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TO: MONTEREY BAY AQUARIUM RESEARCH INST (MB)
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PURCHASE ORDER

NO. **P516972A**

DATE: 10/24/17

THIS NUMBER MUST BE SHOWN ON ALL INVOICES, PACKAGES, CORRESPONDENCE, ETC.

Procurement Officer

Date

PURCHASE AUTHORIZED ONLY WHEN SIGNED ABOVE BY THE AUTHORIZED AGENT.

"Unless otherwise superseded, vendor shall comply with University of Alaska Terms and Conditions of Purchase Order, located at www.alaska.edu/swproc/downloads/terms.pdf"

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DELIVERY DATE 06/30/18		BUYER NAME Carson Davis		TIN #92-6000147 Tax Exempt No A-125217	
ITEM NO.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	EXTENDED PRICE
	This order issued to extend closed Purchase Order P0516972, for Amendment No.1 to Research Subaward Agreement No. P0516972.				
	Change Order 1: Subaward P0516972 (P516972A) Amendment No. 2. The period of performance is extended through June 30, 2019. The subaward is increased by \$19,999.00 for ADAC year 5 funding. CRD, 9/17/2018.				
1	Research Subaward Agreement: Amendment No. 1	150,182.00	EA	1.0000	150,182.00
2	Research Subaward Agreement: Amendment No. 2	19,999.00	EA	1.0000	19,999.00
	This order issued in accordance with the following documents: *Research Subaward Agreement P0516972 for Project Title: "Centers for Homeland Security" *Research Subaward Agreement Amendment No. 1 *Research Subaward Agreement Amendment No. 2 (attached). Amendment No. 2 Period of Performance August 08, 2018 - June 30, 2019 UAA Department: ADAC Research Primary Contact: Heather Paulsen Phone Number: 907-786-1663				
TOTAL					170,181.00

**FDP Research Subaward Agreement
Amendment (Number 2)**

Pass-Through Entity (PTE)

Subrecipient

University of Alaska Anchorage (UAA)

Entity Name Monterey Bay Aquarium Research Institute (MBARI)

UAA_Postaward@alaska.edu

Email Address danielle@mbari.org

Dr. Douglas Causey

Principal Investigator Mr. Brett Hobson

Project Title: Centers for Homeland Security

PTE Federal Award No:

formerly 2014ST061ML0002 new: 1&STADA00001-02-00

Federal Awarding Agency:

Department of Homeland Security

Revised Subaward Period of Performance:

Start Date: August 8, 2018

End Date: Jun 30, 2019

Amount Funded This Action:

\$ 19,999.00

Subaward No:

P516972A

Effective Date of Amendment:

Aug 8, 2018

Total Amount of Federal Funds Obligated to Date:

\$ 210,181.00

Subject to FFATA:

☐ Yes ☒ No

Automatic Carryover:

☐ Yes ☒ No

Amendment(s) to Original Terms and Conditions

This Amendment revises the above-referenced Research Subaward Agreement as follows:

This subaward is hereby revised to include any and all of the applicable changes as mandated by the Year 5 Notice of Award received from the Department of Homeland Security (DHS) for the Center of Excellence-Arctic Domain Awareness Center (ADAC) project.

Carryforward was not requested and therefore not approved by the Department of Homeland Security. Year 5 funding is approved with a new budget period of 8/8/2018-6/30/2019. Total funding for Year 5 is \$19,999.

Included in this amendment are the following attachments:

- * Notice of Award
- * Updated Terms and Conditions from the Department of Homeland Security
- * Special Terms and Conditions (not updated, only for reminder)
- * Year 5 Work Plan as Approved by the Department of Homeland Security
- * Information Protection Plan (not updated, just reapproved by UAA and DHS)
- * Safety Plan (not updated, just reapproved by both by UAA and DHS)

When executing this agreement, please return Single Audit for your most recent fiscal year for our files.

For clarity: all amounts stated in this amendment are in United States Dollars.

All other terms and conditions of this Subaward Agreement remain in full force and effect.

By an Authorized Official of PTE:

Elizabeth
Dickinson

Digitally signed by Elizabeth Dickinson,
DN: cn=Elizabeth Dickinson, o=
our Sponsored Programs,
email=evdickinson@alaska.edu, ou=US
Date: 2018.08.13 13:11:41 -0800

Sep 13, 2018

Name: Elizabeth Dickinson

Date

Title: Acting Director, Office of Sponsored Programs

By an Authorized Official of Subrecipient:

Basilio Martinez

9-17-18

Name:

Date

Title: CFO

Beck
Procurement Services

9/19/18
Date



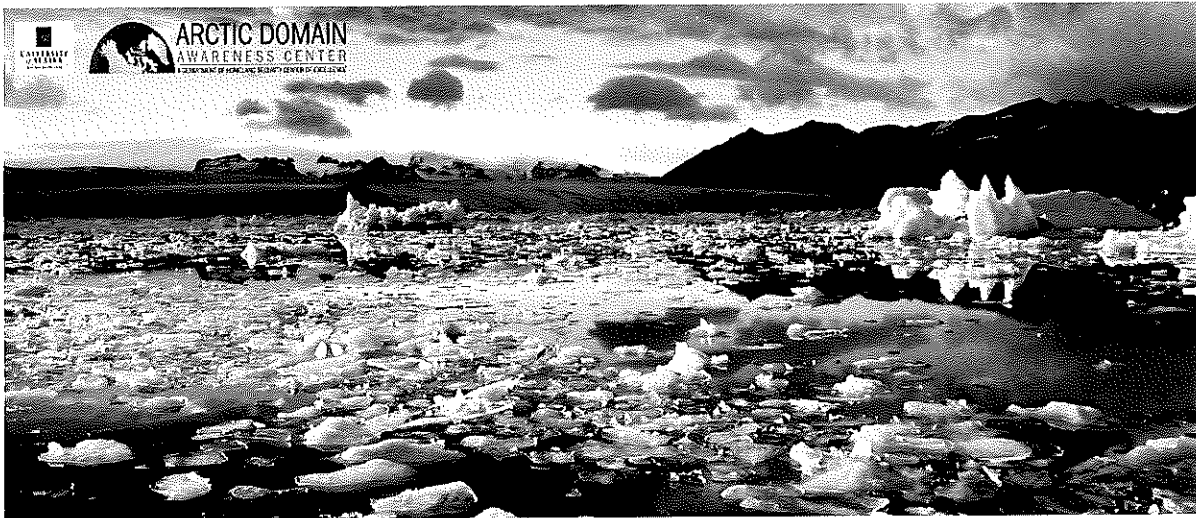
**ARCTIC DOMAIN
AWARENESS CENTER**
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

Arctic Domain Awareness Center (ADAC)

***A DHS Science and Technology Office of University Programs,
Center for Maritime Research***

ADAC Work plan for Program Year 5:

***1 July 2018 - 30 June 2019
Version 2.5***



Submitted by ADAC leadership team to DHS S&T OUP

1 August 2018

Douglas Causey, PhD, Principal Investigator, University of Alaska, Anchorage (UAA)
Larry Hinzman, PhD, Research Director, University of Alaska Fairbanks (UAF)
Randy Kee, Maj Gen (Ret.) USAF, MS, Executive Director, UAA
Heather Paulsen, MBA, Finance Director, UAA
LuAnn Piccard, MSE, PMP, Project Management Director, UAA
Malla Kukkonen, MSS, Education and Administration Manager, UAA

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I. Arctic Domain Awareness Center (ADAC) Year 5 Work Plan Executive Summary

The Arctic Domain Awareness Center (ADAC) is a U.S. Department of Homeland Security (DHS) Science and Technology (S&T) Office of University Programs (OUP) Center of Excellence in Maritime Research (CMR).

ADAC supports the U.S. Coast Guard (USCG) and other DHS maritime missions in order to improve capability for Arctic search and rescue, humanitarian assistance, disaster response, and security. This includes efforts to “enable the decision maker” across those mission sets.

Accordingly, ADAC looks to the coming program year to complete and transition existing research, rapidly advance research initiated in Year 4 to effect suitable transition, continue to innovate education activities, add new research derived from Year 4 workshops and publish conducted research. The ADAC Year 5 Work Plan introduces new ADAC research teams and institutions to the Center’s research network. Outside of the workplan, University of Alaska personnel associated with ADAC will seek sponsor diversification to take effect beyond Year 5.

A core part of the ADAC mission is to foster the next generation of scientists and engineers devoted to the discovery, development, and improvement of technologies and applications for Arctic Maritime Domain Awareness, Response and Resilience. During Program Year 5, ADAC will continue to work and mentor our student fellows that presently are at different stages in their studies to ensure their successful transition to the Homeland Security Enterprise workforce once they graduate. ADAC Center leadership will support student transition efforts with enrichment efforts that will enable their success.

ADAC’s Year 5 Work Plan management and administrative processes (Section II) highlights the Center’s strategy and overarching management plan. This includes ADAC’s organization and plans for: 1) engagement and strategic communications, 2) research investigation and development (including research calls and operator-driven workshops), 3) current project assessment, evaluation and management, 4) research transition and/or commercialization, and 5) summary of education management and fiscal accountability.

ADAC’s Year 5 Work Plan project descriptions, located in Section III of the document, are the heart of the Center’s mission. This section also describes ADAC’s efforts in education and workforce development.

As introduced in ADAC’s Year 4 workplan, ADAC’s Year 5 Work Plan format aligns research projects to the DHS Funding Opportunity Announcement’s (FOA) six overarching themes. These are:

- Maritime Risk, Threat Analysis and Resilience Research;
- Maritime Domain Awareness (MDA) Research;
- Maritime Technology Research;
- Integration of Science and Engineering with Maritime;
- End to End (E2E);
- Integrated Education.

ADAC plans to conduct, complete and transition the following projects for Program Year 5:

- Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response.
- High Resolution Modeling of Arctic Sea Ice and Currents.
- Arctic Oil Spill Modeling.
- Ice Condition Index (ICECON) for the Great Lakes.
- Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic
- Development of Propeller Driven Long Range Autonomous Underwater Vehicle (LRAUV) for Under-Ice Mapping of Oil Spills and Environmental Hazards.
- Arctic related incidents of National Significance (Arctic IoNs) & Arctic focused Medium and Long Term Environment (MaLTE) workshops collaborated with U.S. Coast Guard.
- Integrated education and workforce development workshops, research interning, for specific project investigators, and a summer internship program that provides Arctic research opportunities for students from under represented categories.

In Program Year 5, ADAC will transition legacy projects as the priority of effort. Additionally, the Center will advance new projects from the fall 2017 Request for Proposal (RFP) "Seeking solutions to advance Maritime spatial understanding, resilience, and awareness to achieve safety and security in the maritime domain." Further, ADAC will finalize workplans and conduct projects from the March 2018 RFP associated with the "Coping with the Unthinkable, an Arctic Maritime Oil Spill" Arctic IoNs workshop.

II. Center Management Processes

Arctic Domain Awareness Center (ADAC) Objective and Purpose.

The U.S. Department of Homeland Security, Science and Technology's Office of University Programs (DHS S&T OUP) established the Arctic Domain Awareness Center (ADAC) in summer 2014 to research and provide a scientific basis to address the challenges faced by USCG and other DHS maritime missions in the Arctic region.

ADAC's principal customer is the USCG. ADAC investigates capability shortfalls and gaps, and orients research activity to support the USCG mission needs. The particular areas that ADAC seeks to assist the USCG are related to missions in support of Arctic search and rescue, humanitarian assistance, disaster response and security matters. While principally oriented to the USCG, ADAC also seeks to support other DHS maritime mission needs in the Arctic.

As a university-hosted research venue, ADAC supports student education. Through the Center's Fellows Program, ADAC provisions student research, internships, and entry into the Homeland Security Enterprise.

ADAC's approach is to align the Center's research agenda with U.S. national, DHS, and USCG Arctic strategies and strategy implementation plans. ADAC notes existing strategies may change, and DHS strategy for the Arctic remains in development. As the U.S. national, DHS, and USCG Arctic strategies adapt and develop over time, ADAC will seek to conform Center research endeavors appropriately.

As in prior year work plans, research and development conducted by ADAC will not only serve USCG and other DHS maritime missions, but also benefit an array of ADAC partners and collaborators and support the public good.

ADAC's vision, mission and strategy:

Vision: The DHS Center of Excellence provides networked and mission-focused support to the USCG Operator in the High North. ADAC strives to become a National Center of Arctic maritime research.

Mission: ADAC's mission is to develop and transition technology solutions, innovative products and educational programs to improve situational awareness and crisis response capabilities related to maritime challenges posed by the dynamic Arctic environment. ADAC seeks to accomplish this mission through an inclusive approach.

Strategy: The Center's overall strategy is as follows: ADAC will conduct a parallel effort over five lines of major activity collaboratively with DHS S&T OUP and USCG in order to:

- Investigate, develop, resource, and initiate new research.
- Execute approved research work plans that are appropriately detailed and resourced.
- Successfully integrate university student fellows into the Homeland Security Enterprise workforce.
- Transition sufficiently mature research to meet customer acquisition needs, and commercialize as appropriate.
- Adapt Center activities, management, and communications to continue to learn and collaborate with an array of Center partners, and continue to suitably expand the reach of ADAC across U.S. and Canada to include Arctic government, military and security operators, researchers, and industry partners.

Implementation: In order to implement the Year 5 strategy, ADAC will improve established management processes, continue existing communications practices, execute approved workplans, seek commercialization opportunities, and continue to innovate in education and workforce development.

Organization and Leadership: DHS S&T OUP awarded ADAC's cooperative grant to University of Alaska, Anchorage. ADAC has created a unified approach to leading the Center for the University of Alaska through close partnership with the University of Alaska Fairbanks. ADAC reports to the DHS S&T OUP program manager in accordance with protocols established via the DHS S&T OUP cooperative grant. ADAC's Principal Investigator and Executive Director jointly report through the UAA Provost and Executive Vice Chancellor, the UAA Chancellor, and the University of Alaska System President for academic institutional support requirements.

ADAC leadership consists of the Principal Investigator, Executive Director, and Directors of Research and Finance. Rounding out the leadership team is the Project Manager and Education & Administration Manager. ADAC will gain communications support from UAA resources.

ADAC has established an extensive research partner and collaborative network across Arctic-minded universities and industries throughout the U.S. and Canada. ADAC also gains multi-faceted counsel through an external advisory board, and has established an effective student fellows program. ADAC maintains committed collaboration with fellow DHS S&T OUP Centers of Excellence. ADAC comprehensively engages with U.S. Federal, State of Alaska, and local Arctic authorities on Arctic research matters. Internationally, ADAC principally engages with Canada as well as other Arctic partners, including Denmark, Finland, and Norway.

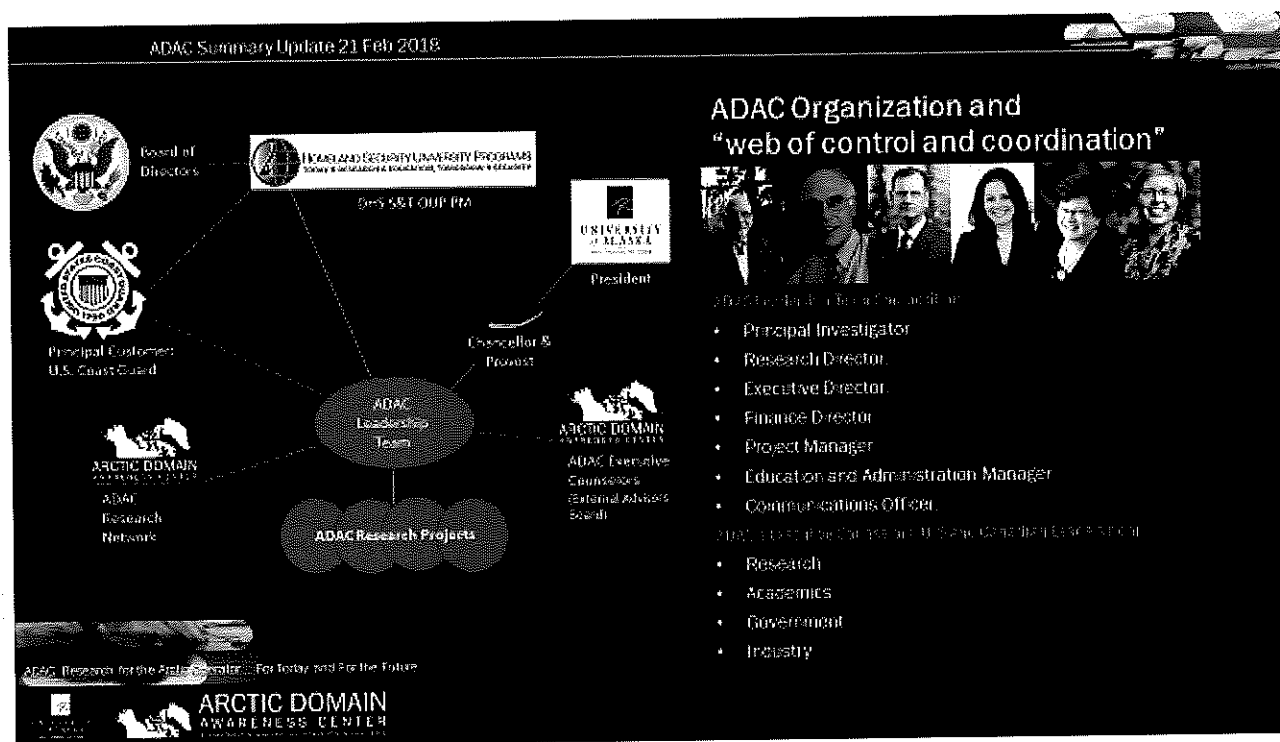


Figure 1: ADAC Organizational Construct (see <http://adac.uaa.alaska.edu/home/newabout>)

In accordance with the DHS award, the University of Alaska Anchorage hosts the Principal Investigator and Executive Director. The ADAC Research Director is located at the University of Alaska Fairbanks campus, while also serving as the Vice Chancellor for Research at the University of Alaska Fairbanks.

In sum, the ADAC team comprises a diverse blend of Arctic science and technology academics, Arctic-related strategy and policy expertise, and strong organizational and fiscal leadership credentials. The following is the leadership lineup for ADAC:

Principal Investigator (PI), Douglas Causey, PhD, University of Alaska. The ADAC PI is responsible to closely collaborate with the Executive Director and the Research Director to achieve ADAC mission goals. The ADAC PI will seek to connect ADAC with partners and opportunities. In coordination with the Executive Director, the ADAC PI is responsible for reporting to the University of Alaska System Leadership and DHS

program sponsors on a regular basis. Ultimately, the ADAC PI is responsible for program execution and accomplishment to DHS.

Executive Director (ED), Randy Kee, Maj Gen, USAF (Ret), MS, University of Alaska. The ADAC ED provides day-to-day direction of all Center activities to meet COE goals, achieve milestones, develop technology, communicate with customers and engage the broader Arctic community across the U.S. and Canada. The ED will organize site visits for demonstrations, interface with the end users, and will work with ADAC leadership to ensure the Center complies with federal regulations and reporting. Together with the ADAC PI, the ED will regularly meet with DHS staff at DHS headquarters and represent the program at meetings required to support the needs of DHS management and the greater DHS enterprise. The ADAC ED works closely with U.S. Coast Guard (USCG) stakeholders to ensure the Center meets USCG expectations. Finally, the ED will ensure ADAC appropriately conducts internal processes, in particular assessment meetings, engagement forums, and DHS sponsored workshops.

Research Director (RD), Larry Hinzman, PhD, University of Alaska Fairbanks. The ADAC RD provides leadership for the center in establishing research concepts and follow-on proposals. The RD also provides leadership to support research concept generation, individual project leaders, and research teams. ADAC's RD is responsible for addressing and guiding scientific quality for the individual projects and the overall program. The ADAC RD, where suitable, interacts with DHS and stakeholders and interfaces with other DHS COEs and research centers to identify and formulate additional research projects. The ADAC RD is a key leader for the Center to identify when research projects are ready to transition to the next TRL and whether they are suitable for transition from research to development.

Finance Director, (FD), Heather Paulsen, MBA, University of Alaska Anchorage. The ADAC FD is responsible for management and oversight of administrative operations of the Center of Excellence (COE) and its group of associated subcontracts. The ADAC FD will provide program/project planning, budgeting, and implement operational policies and processes to support the COE. Further, the FD will work in close collaboration with the ED and the Project Management Director to develop budgets aligned to program and project planning objectives and to manage expenditures as aligned with the research mission of the Center.

Project Management Director (PMD), LuAnn Piccard, MSE, PMP, University of Alaska Anchorage. In partnership with ADAC ED, Finance Director, and Project PIs the PMD will lead efforts to integrate project plans into a cohesive program with phased solution and technology deliverables aligned with ADAC's strategic mission and ADAC's research-to-development process. This includes managing and documenting the progress of projects relative to established ADAC program execution guidelines. The Center PMD efforts include coordinating and documenting regular team meetings, and facilitating project communication within the Center team and with partners and external stakeholders.

Education and Administration Manager (EAM), Malla Kukkonen, MSS, University of Alaska Anchorage. ADAC's Education and Administration Manager oversees ADAC's student development program. This includes DHS Career Development Grant Scholarships and student research interns. ADAC's EAM will oversee and support the Center's student, summer internship program for ADAC Fellows and under-represented students from Minority Serving Institutions (MSI), Federal Tribal Designations (FTD), and Significant Minority Enrollment (SME) universities or colleges. ADAC's EAM will lead efforts to recruit, enroll, and monitor student performance and to graduate entry into the Homeland Security Enterprise. The ADAC EAM leads administrative management functions and supports communications outreach.

ADAC Executive Counselors. The Executive Counselors (EC) are ADAC's external advisory board and are highly qualified senior leaders and/or research professionals. The EC provide counsel pro-bono. The EC principally provide strategic advice on Center management focus, critical commentary on current project work, and insights to future opportunities. In Program Year 5, ADAC will continue to meet individually with these Executive Counselors periodically, while also conducting three Strategic meetings with the Counselors via a dedicated forum (one associated an ADAC Program Quarterly Review).

ADAC's Executive Counselors are:

Tom Barrett, VADM (Ret), USCG, President, Alyeska Corporation, Anchorage Alaska. Admiral Barrett is a former USCG Vice Commandant and District 17 Commander.

Paul Hubbard, PhD, Canada Department of National Defense, Ottawa Canada.

John Farrell, PhD, Executive Director, U.S. Arctic Research Commission, Washington D.C.

Ruth Lane, CDR, USN, Director, National Ice Center, Suitland Maryland.

Mike Faust, (Ret), Former Vice President of Exploration, Conoco-Phillips Corporation, Anchorage Alaska.

Tom Case, Chancellor Emeritus, University of Alaska Anchorage, and Lt. Gen, USAF (Ret).

Roberta Quintavell, President and CEO of Sitnasuak Native Corporation.

ADAC Overall Management Approach and Allocation of Effort

The USCG and other DHS maritime Arctic operators are the key end users driving research for ADAC. The Center will conduct fundamental and applied research in maritime domain awareness and maritime technology. Strategically, ADAC will:

- Advance Arctic domain awareness research areas by increasing the science of knowledge and understanding in order to improve USCG Arctic operator coordination, control, and decision-making.
- Conduct research in maritime technology to provide needed capability to support and effect increased domain awareness.
- Comprehensively investigate new research.
- Transition sufficiently mature or completed research. Transition outcomes are project specific.
- Pursue commercialization options as suitable for concluding or completed research.
- Initiate patents, trademarks and other measures to protect developed intellectual property.

ADAC will continue to advance Center student research programs, including student fellow participation within research projects and their participation in cross-center activities.

ADAC's leadership apportions the execution of the Program Year 5 Work Plan accordingly:

- Direct and manage the research of established projects, which includes extensive research transition coordination between Project teams, USCG Project Champions, HQ USCG Acquisition and DHS S&T OUP. This entails 60% of the ADAC management focus. Specific tasks and associated measurements include:

Task	Associated Metric
Conduct weekly teleconferences with ADAC Project leads and research teams.	Informed ADAC leadership and research team.
Participate in weekly teleconference with DHS S&T OUP Program Manager.	Informed DHS S&T OUP Program Manager.
Conduct monthly project invoice review.	Fiscal understanding of each project performance on monthly basis.
Conduct a Quarterly Review with ADAC Project Leads and research teams for DHS S&T OUP Approved workplans that includes specific project transition planning.	Comprehensive review of project performance by ADAC leadership team, enabling oversight on a scheduled basis.
Conduct one Quarterly Review with ADAC Project Leads and research teams, with the Executive Counselors.	Comprehensive review as with regular reviews, with added recommendations from ADAC's Executive Counselors.
Prepare Center and project Work plan for any approved research activities that extend beyond Year 5 (30 June 2019).	Approved plans and activities by DHS S&T OUP PM.
Establish new projects from Fall 2017 Arctic IoNS workshop. This includes concluding proposal reviews, notification, development of workplans and establishing HQ USCG Project Champions.	Projects approved by DHS S&T OUP PM.
Subrecipient monitoring via ADAC leadership in-person visits at each subrecipient of the DHS S&T OUP Cooperative Grant location (university or business).	Successfully concluded subrecipient monitoring. ADAC leadership plans to conduct a minimum of one subrecipient monitoring visit at each location at least once per two-year program period.
Prepare Annual Report reporting on Center activities and Project Research	Approved report by DHS S&T OUP PM.
Participate in detailed effort for project transition, including collaboration with HQ USCG CG-9 ADAC point of contact and USCG Project Champions.	Established transition pathway for ADAC research to meet USCG acquisition needs.
Investigate commercial opportunities for research transition, including patent and licensing.	Approved patents and/or licensing from submitted proposals.

- Continue research development Initiative started in Program Year 4. This entails 10% of ADAC leadership focus. This effort entails collaborating with DHS S&T OUP and USCG for workshops that

generate research questions, conducting and processing calls for research. Specific tasks and associated measurements include:

Task	Associated Metric
Plan and conduct Arctic IoNS workshop, with topic determined by USCG (in particular, USCG D17 Commander).	Successfully concluded workshop that provides workshop Rapporteurs report and USCG approved research questions. Research questions will not result in ADAC funded solicitation, simply intended for mission agencies to consider sponsoring research, which addresses priority shortfalls identified at the workshop.
Coordinate and conduct Arctic Medium and Long-Term Environment (Arctic MaLTE) workshop on Canada-U.S. (CANUS) Arctic Regional Security. Workshop planned in conjunction with Trent University, Peterborough, Ontario, Canada.	Conducted workshop at University of Alaska Anchorage addressing CANUS Arctic Regional Security Needs. Workshop to produce a report suitable for peer review and publishing highlighting concerns and discussions from the workshop. Hosting workshop in Anchorage affords attendance from a diverse array of U.S. Federal security mission agencies.

- Conduct outreach, engagement and communications with customers, partners and collaborators, including potential new partners, to inform of center initiatives and research project details, while advancing ADAC's research networks. This encompasses 10% of ADAC leadership focus. Specific tasks and associated measurements include:

Task	Associated Metric
Prepare and conduct Annual meeting in Washington D.C. (preferably at HQ USCG).	Successfully presented meeting, informing DHS, USCG and invited participants of ADAC research and transition planning.
Conduct approximately quarterly Customers and Partners Roundtables via teleconference/webinar.	Successful completion of roundtables, and publishing of associated minutes.
Conduct semi-annual USCG focused ADAC "Principal Customer's" research project teleconference.	Successful completion of teleconference.
Participate in Alaska Marine Science Symposium (January 2019).	ADAC completing a planned presentation.
Conduct a UAA Arctic Research Day, highlighting ADAC activities and research (in partnership with fellow UAA researchers).	ADAC participates, presents and contributes to UAA Arctic Research day.
Develop center and project motion graphics presentations in support of outreach.	Completed and posted motion graphics that describe ADAC efforts.

Prepare and release quarterly newsletters.	Published newsletters to established ADAC mailing list and posted to Center website.
Prepare brief noteworthy activities and project vignettes for DHS S&T OUP communications staff.	Providing DHS S&T OUP, communications needed information of ADAC activities and project research.
Update ADAC website, Facebook and Twitter of Center activities and noteworthy events.	Informing public of ADAC activities and research.
Publish specific ADAC events and activities to Interagency Arctic Research Policy Committee (IARPC).	Informing community of Arctic researchers about ADAC activities.

- Continue conducting education, outreach and workforce development efforts consisting of a variety of activities that include both ADAC Fellows and minority students. ADAC anticipates this effort requires 10% of Center leadership focus.

Task	Associated Metric
Recruit student interns (ADAC Fellows) for available research.	Achieve 100% fill for ADAC Fellow available slots.
Assign projects and develop workplans to ADAC Fellows.	Students fully assigned to projects with associated workplans.
Conduct monthly ADAC Fellows meetings.	Accomplish planned meeting schedule.
Conduct an ADAC Student research Symposium.	Completed symposium highlighting student research efforts.
Support ADAC fellows entry into suitable 10-week summer internship;	All ADAC fellows conclude a 10-week summer internship.
Support post-graduate student placement with Homeland Security Enterprise (HSE).	All graduated ADAC fellows complete one year minimum service in a HSE related position or alternatives as described in the DHS OUP Terms and Conditions.
Recruit and conduct an abbreviated Minority Serving Institute (MSI) Arctic Summer Intern Project (ASIP) for June 2019.	Successful completion of an Abbreviated MSI ASIP in June 2019.

ADAC Information Protection Plan.

ADAC has reviewed the Center's Information Protection Plan established in Program Year 1. ADAC will continue to execute this plan.

ADAC Research Safety Plan.

ADAC has carefully reviewed Center's Research Safety Plan established in Program Year 1. ADAC will continue to execute this plan.

ADAC Review Group and Project Evaluation Process.

ADAC Review Group. Central to ADAC's evaluation plan is establishing a comprehensive review of the Center's work on a quarterly basis. Therefore, ADAC will schedule the convening of the ADAC Review Group to govern ADAC Quarterly Reviews. The ADAC Review Group will also review ADAC's comprehensive approach to investigate and develop new research for DHS S&T OUP and USCG consideration.

ADAC's Principal Investigator, Research Director, and Executive Director will Co-Chair the ADAC Review Group at Center Quarterly Reviews. The remaining ADAC Center leadership (Finance Director, Education and Administration Manager, and Project Management, will complete the ADAC Review Group. Co-chairs will consider inviting additional subject matter experts to assist the ADAC Review Group in executing an overall "end to end" approach for the Center and for project examination. Co-chairs will consult with the ADAC Executive Counselors Board for appropriate participation to provide their assessments of program and project utility and performance.

ADAC Project Evaluation process to assess program activity. ADAC will use the following process to evaluate Center projects during Center quarterly reviews by the ADAC Review Group. As needed, ADAC leadership will conduct specific reviews on research projects outside of the quarterly review cycle.

1. Evaluate the science and technology advances. The ADAC Review Group will assess the progress made by each individual project compared to the utility of the research for ADAC's goals and objectives and make onward recommendations for proposed action.
2. Assess project resourcing versus project execution. The ADAC Review Group will determine the appropriate alignment between project plans and resources. If a project's importance, priority, and performance measures warrant additional resourcing during "in-year execution," ADAC's leadership will seek to address or mitigate the need by coordinating cross-funding from projects that are under-executing (according to project planned schedule and milestones) in resource expenditure. Any movement of resources between projects will comply with the terms and conditions of the DHS S&T - ADAC cooperative agreement protocols.
3. Assess each project's ability to communicate current findings and projected research trajectory. The ADAC Review Group will determine if project discoveries or developments warrant the pursuit of publication in the appropriate media, particularly scientific journals. The ADAC Review Group stresses the importance of publishing ADAC funded research.
4. Assess project Technology Readiness Levels (TRLs). The ADAC Review Group will determine if the actual TRLs versus the planned TRLs at given milestones for each project indicate that research is progressing as planned. Additionally, assessment will seek to determine if research indicates planned TRLs are on a trajectory to produce a useful capability for the Arctic operator.
5. Review Project Transition Plan. The ADAC Review Group will review and consult with the project team and project champion for discoveries in new intellectual property, commercialization opportunities, and alignment that meet end-user acquisition needs.

6. Determine actual program execution versus planned in terms of schedules, milestones, and metrics. The ADAC Review Group will assess how well each project is progressing according to their workplan submitted by ADAC to DHS OUP for the project year. If the project is substantially off schedule, the project team will develop a "Get-Well-Plan" to re-establish adherence to the prior approved Project schedule, milestones, and metrics.
7. Assess project team overall performance. For projects that are significantly under-performing, the ADAC Review Group will determine if the project lead is able to present an acceptable approach to Center leadership. If necessary, ADAC leadership will consult with the DHS S&T OUP Program Manager to restructure the project's leadership, team, and/or project plan in accordance with DHS S&T OUP - ADAC grant terms and conditions. If a project is unable to proceed accordingly, ADAC leadership will consult with DHS S&T OUP PM to discontinue the project. Following such a decision, ADAC leadership will conduct documentation and provide reprogramming recommendations.
8. Specific process for Education Program Management: ADAC's Education and Administration Manager will present assessments of the education program during quarterly reviews or during periods between quarterly reviews as needed. Following each quarterly education assessment, the ADAC Review Group will:
 - a. Examine the effectiveness of student participation in individual projects.
 - b. Evaluate Center performance for recruitment of under-represented students in both the ADAC Fellows program and for the summer internship program.
 - c. Assess individual ADAC Fellow performance in meeting their work plan objectives.
 - d. Evaluate the Education Outreach and Workforce Development Program by assessing schedules, milestones, and planned metrics for the overall program.
 - e. Assess recommendations by the Education and Administration Manager to address any deficient areas of performance.
9. Subrecipient monitoring visits by ADAC leadership. Independent of the ADAC quarterly review cycle but instrumental in the overall management of project work for the Center, ADAC leadership will conduct subrecipient monitoring visits. ADAC leadership has developed a subrecipient checklist to guide awardees in preparing and presenting their project's compliance with the cooperative grant terms and conditions. ADAC's Executive Director and Finance Director normally conduct these subrecipient monitoring visits.

ADAC Research Transition Process.

As a DHS S&T OUP Center of Maritime Research, ADAC's priority is to transition research that is sufficiently mature to DHS acquisition processes. In pursuit of acquisition, ADAC seeks to connect sufficiently mature research to industry, HQ USCG CG-7 (Assistant Commandant for Capabilities), and HQ USCG CG-9 (Assistant Commandant for Acquisitions). In addition to working with HQ USCG CG-7 and CG-9, ADAC will conduct appropriate coordination with USCG Research and Development Center for operational testing of research in advance of formal USCG acquisition of ADAC maturing research. While principally oriented to the USCG, ADAC also seeks to support other DHS maritime mission needs in the Arctic.

Research transition is principal focus of ADAC Year 5. All ADAC's projects included in Year 5 plan include

transition as an integral part of their work plans. Center leadership evaluates project transition planning during quarterly reviews via the ADAC Review Group. This review is one way to discern the pathway of transition planning needed to support end user mission needs, and that an acquisition opportunity is feasible, acceptable, and supportable. ADAC's USCG Project Champions are integral to research transition. Consulting USCG Project Champions normally occur during ADAC's Annual Meeting, through direct dialogue with Project teams, and at the ADAC Customers and Partners Roundtable.

Attributes of research transition readiness. Research projects that are suitable for transition need a higher Technology Readiness Level (TRL). Project leads are responsible for identifying the TRL. Transitioning research needs a confirmed pathway to become an acquisition. Accordingly, the established USCG Project Champions are encouraged to confirm the TRL and to provide advocacy to establish transition planning with HQ USCG CG-9, and by appropriate coordination with DHS S&T OUP, HQ USCG CG-7, and USCG Research Development Center (RDC).

ADAC's "Research-to-Capability Process" (RTCP). ADAC's RTCP is the Center's approach for finalizing the transition of research to end users. In Program Year 5, ADAC plans to add an industry-provided transition advisor to work with the ADAC Executive Director and Project Management Director to transition concluding research to DHS and USCG acquisition professionals. ADAC will recruit the support of the University of Alaska Business Enterprise Institute and UAA Office of Sponsored Programs to support transition activities.

This task team approach includes careful handling of transfer for appropriate documentation and patent initiation.

ADAC's Principal Investigator, Research Director, and Executive Director will determine the task organization needed to migrate research to receiving development and acquisition professionals. ADAC's Executive Director will lead with Center's Project Management Director in serving as deputy lead for the task-organized team. This team will include project PI(s), center support personnel, and supporting institutions.

The task-organized team will prepare the transfer of research materials, associated physical hardware, software, and intellectual property. Transfer preparation will include a review of financial documentation, DHS S&T OUP-ADAC grant terms and conditions, onward disclosure notifications to DHS S&T OUP Program Manager, and appropriate public announcements.

The Project PI(s) will complete documentation. This will include fully describing the research, completed milestones, objectives, and project research conclusions while also initiating science review and preparing journal submissions. The Project PI(s) team, in coordination with ADAC leadership, will initiate patent application with University of Alaska as appropriate.

Following internal center preparations, ADAC's Executive Director and Project Management Director will lead the task-organized team in correspondence and meetings with the receiving agency or organization to

conclude transfer.

If a research project is not able to discern a pathway to DHS and USCG acquisition, ADAC's secondary approach is to determine an *alternative pathway* to the research plan to realize an achievable acquisition for DHS and USCG.

If either primary or alternative pathway efforts for acquisition prove infeasible, ADAC's next approach is to seek transition for commercial application. ADAC believes the following categories are the most feasible for commercial application of ADAC research:

- *Oil and mineral extraction;*
- *Coastal and port security;*
- *Destination adventure cruises;*
- *Arctic region maritime shipping;*
- *Education materials.*

Lastly, if research does not prove to be feasible for commercial applications, ADAC will seek to connect completed research with those in the community of Arctic maritime research who will benefit the most. In all cases, ADAC will continue to strive to ensure research outcomes benefit the public good.

ADAC Strategic Communications Plan.

Effective communications is essential for ADAC research success. This communication plan is both a chance to publicize center and project activities and accomplishments, and to receive input from stakeholders. The below reflects both mediums and audiences targeted for communications.

ADAC's plan will communicate progress on research projects and center activities as well as announcements of workshops and research opportunities. The center will engage with the community of Arctic researchers (particularly in the U.S. and Canada) to inform and be informed of S&T advances and research associated with Arctic Domain Awareness. ADAC plans to continue a comprehensive approach in various mediums to communicate to customers, partners, and collaborators. Therefore, ADAC plans to utilize the internet, social media, workshops, roundtables, and direct engagement with USCG entities and other key stakeholders to remain informed.

Correspondingly, in Program Year 5, ADAC will accomplish the following tasks to advance Strategic Communications:

- As part of ADAC's Quarterly Review process, ADAC leadership will review communications activities. This includes review of ADAC's internet website, quarterly newsletters, and proposed project journal articles. During the Quarterly Review, Center leadership will benchmark ADAC communications products based on a summary review of other DHS CoEs and U.S. university research centers. Following the review, ADAC communications team will implement changes.

- ADAC will maintain Center website synchronization with the DHS S&T OUP website, www.hsuniversityprograms.org.
- Center newsletters will include focused project reviews and ADAC Fellow's written contributions.
- Continue to use Facebook, LinkedIn, and Twitter social media when suitable.
- Continue ADAC outreach through utilizing the resources and venues of the University of Alaska, the Arctic Research Consortium of the U.S., the Interagency Arctic Research Policy Committee, and the U.S. Arctic Research Commission communications media.
- Engage fellow DHS S&T OUP Centers of Excellence for collaboration opportunities.
- Collaborate with fellow University of Alaska research entities.
- Continue to improve engagement activities as discussed under USCG and Key Stakeholder Engagement. This includes providing a survey via Customers and Partners Roundtables to solicit feedback of all ADAC engagement. ADAC leadership will address surveys at ADAC Quarterly Reviews.

USCG and Key Stakeholder Engagement.

In Program Year 5, ADAC will build upon successful prior engagement with USCG. ADAC will also advance efforts with other U.S. Federal departments and agencies, particularly those agencies that also seek to support USCG missions in the Arctic. Current or planned collaborations with U.S. Federal agencies include National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), U.S. National Ice Center (USNIC) and National Maritime Intelligence-Integration Office (NMIO). ADAC will work to advance partnerships, and investigate potential for joint or sponsored research with these and other Federal agencies that are oriented toward USCG mission needs in the Arctic. ADAC's leadership will conduct teleconferences and webinars with these key agencies, participate in their workshops and conferences when invited, and provide invitations for these agencies to participate in ADAC or University of Alaska hosted venues. Further, ADAC plans to travel to USCG District 17 to meet with the incoming Commander and senior command staff early in Year 5 to review all current and new research. ADAC plans quarterly teleconferences with USCG R&D Center, and will initiate new reach-out with USCG Pacific Area leadership, as the new command team transitions in the summer of 2018.

ADAC's "Customers and Partner's Roundtable" will continue to be an important research synchronization forum, that will be conducted on a quarterly basis in Program Year 5. This forum has proven itself as a useful venue to inform research and provide customers and partners alike, the opportunity to ask specific questions, and stay connected to ADAC's research projects and Center activities.

As a focused supplement to the open nature of Customer's and Partner's Roundtable, there will be a semi-annual USCG "Principal Customer's" teleconference, which include HQ USCG Project Champions. This focused venue will be off-set from ADAC's fall Annual meeting. The Project Champion's

teleconference provides a chance for ADAC's principal customers in the USCG, the chance for extended conversations on Center activities and research, within a USCG oriented format.

Due to their reach across the network of Arctic research, additional key partners for engagement include the U.S. Arctic Research Commission, Arctic Research Consortium of the U.S., the Alaska Arctic Policy Commission (a State of Alaska agency), and the U.S. Interagency Arctic Research Policy Committee.

ADAC leadership and project leads will continue to routinely interact with HQ USCG Project Champions and key HQ USCG staff leadership, and engage with USCG Pacific Area, USCG Districts 9 and 17, and USCG R&D Center.

ADAC will also continue routine interaction with DHS S&T Homeland Security Advanced Research Projects Agency (HSARPA).

In addition to routine engagement with USCG Project Champions and project advocates, ADAC will conduct the following calendar driven engagement approach for program Year 5 as previously described.

III. ADAC Project Descriptions Aligned to DHS CMR FOA Themes:

THEME 1: Maritime Risk, Threat Analysis and Resilience Research Projects:

1. Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response in the Arctic;
2. High resolution Modeling of Arctic Sea Ice and Currents (HIOMAS).
3. TBD: Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "*Coping with the Unthinkable...an Arctic Maritime Oil Spill.*"

1. PROJECT: Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response in the Arctic.

Project PI: Dr. Nathan Kettle

Lead Institution: University of Alaska Fairbanks

Supporting Team: Dr.'s Hajo Eicken, Andy Mahoney, and Lawson Brigham (UAF)

Project Description:

Abstract: This research project aims to improve USCG and other DHS Arctic maritime operator situational awareness. The forecasting tools developed from this project will improve crisis response by enhancing the support for planning an emergency response to meteorological and environmental marine hazards in the Arctic. Researchers will develop a decision support tool, grounded in stakeholder interactions, to support

weather and sea ice-sensitive decision making. This includes facilitated and deliberate interactions among University of Alaska researchers, USCG emergency responders, NOAA forecasters, and marine operators in the Arctic. Researchers will focus investigation on the waters surrounding Utqiagvik (Barrow), Alaska; a sub region of the North Slope located on the north coast of Alaska between the Chukchi and Beaufort Seas. The research project involves three phases:

1. Preliminary tool development;
2. Stakeholder feedback and tool optimization and;
3. Outreach, dissemination, and evaluation.

Phase 1: Prototype tool development involves three steps. First, researchers assess the decision contexts of marine operators in the Arctic including: weather and sea ice-sensitive decisions, use of weather and climate information, factors influencing information use, thresholds, and uncertainties via a series of literature reviews and interviews. Second, the team identifies coastal hazards from historical gridded ice velocity data from the UAF Coastal Sea Ice Radar system (CSIRS). Third, researchers will collaborate with the National Weather Service (NWS) and Arctic Environmental Response Management Application (ERMA) to identify procedures for generating event notifications and formats suitable for communicating information.

Phase 2: Findings help to develop a prototype-forecasting module. Researchers leverage feedback obtained from marine stakeholders via an interactive webinar to improve the project-forecasting tool.

Phase 3: Researchers share project findings with a broader audience across Alaska and the Arctic via outreach and project evaluation.

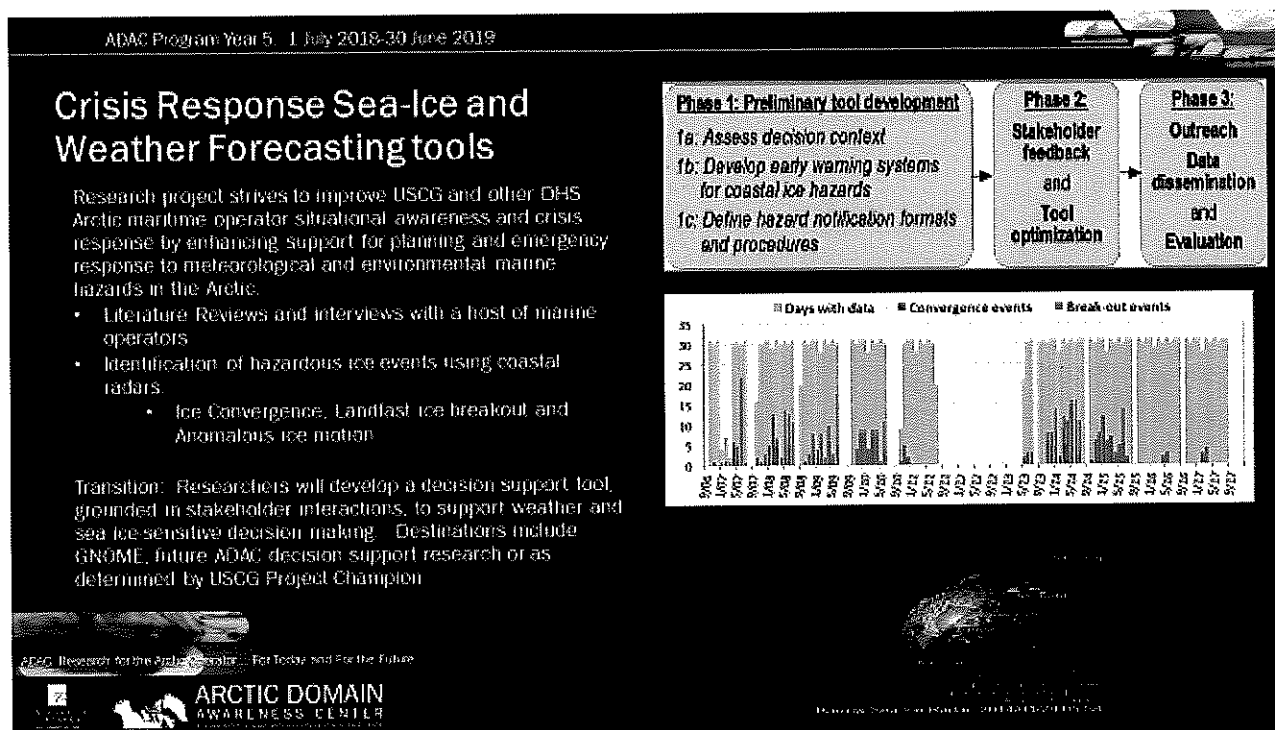


Figure 2: Developing Sea-Ice and Weather Forecasting Tools Overview

Objective/Purpose: The proposed research will address the following goals and objectives:

- (1) Assess the decision contexts for marine operators in the Arctic, including weather and sea ice-sensitive decisions, use of weather/climate information, factors influencing information use, thresholds, and uncertainties.
- (2) Enhance the usability of weather and sea ice forecasting tools to predict and respond to environmental hazards threatening vessels and marine activities via the development of a prototype forecasting module.
- (3) Identify lessons learned and best practices for supporting knowledge co-production of decision support tools in the Arctic.

Baseline: ADAC and other research endeavors investigate approaches to support key decision makers involved in Arctic operations. Some tools provide information on existing environmental conditions in the Arctic, which are useful in decision-making. However, there is a need to improve decision support tools in a manner that directly serves operators. The proposed enhancement of the operator support tools includes the following: (1) understanding the tactical scales of data flow needed for planning and response to sea ice and other marine hazards, (2) developing methods to automate emergency responses from observations based on potentially hazardous conditions, (3) understanding perceived uncertainties, and (4) identifying decision thresholds for tools. There is also a need to understand the best methods for sharing summaries of lessons learned from past rescue and response efforts. Improving the opportunities for implementation and long-term cost-effectiveness will require leveraging existing infrastructure, observations, and partnerships.

Research Method: Using a model of action-oriented science, researchers will continue work established in Program Year 4 by consulting with key stakeholders to develop and evaluate a sea ice-forecasting tool for Arctic operators. The team seeks a forecast tool, which will have a direct bearing on stakeholder needs with regard to hazards, planning, and operations.

The research method is accomplished via a phased process, which includes multiple iterations of stakeholder engagement in the development, testing, implementation, and evaluation of the research product (forecasting tool). This approach is within a total hazards framework, and builds on the premise that comprehensively accounting for different classes of hazards is far preferable to considering these hazards in isolation. Details of the research plan, including what work will be completed by the close of ADAC Program Year 5, are as follows:

Phase 1: The team develops a prototype weather and Sea Ice Hazard Tool. This includes an assessment of decision contexts among marine operators by conducting a literature review and interviews with key stakeholders (Phase 1a). This step focuses on understanding the following: (1) weather and sea ice sensitive decisions related to mitigating Arctic shipping hazards, (2) operator use and awareness of forecasting tools, (3) information needs and decision thresholds, (4) key uncertainties, (5) what planners and managers desire to learn about past emergency response efforts, and (6) previous rescue and recovery efforts in the Arctic. Interviews will target key decision makers involved in shipping management

decisions across Arctic Alaska (e.g., managers, operators, responders across several agencies and organizations). We anticipate these steps for phase 1a will be completed in the initial weeks of Year 5.

Findings from the literature review and interviews will inform the development of the prototype hazard-forecasting tool, which provides early warning capability for three classes of hazards (phase 1b). The team begins by identifying coastal hazards from historical gridded ice velocity data from the UAF CSIRS. The focus is on three classes of coastal ice hazards observed by the CSIRS and for developing early warning systems (EWS). We anticipate phase 1b will be completed very soon following the start of Program Year 5.

For each EWS, the team will develop working prototypes using archived data and knowledge of previous events. They will then prepare a series of demonstrations for each EWS under different ice conditions and thresholds to present to project partners and stakeholders for evaluation and refinement in later phases of the project. In parallel with phases 1a and 1b, they will collaborate with project partners at NWS and Arctic ERMA to identify procedures for generating event notifications detected by EWS's and formats suitable for communicating information (phase 1c). Phase 1c will begin in Program Year 5.

Phase 2: The team presents a prototype-forecasting tool to the marine stakeholders to obtain feedback for tool refinement. The research team will elicit feedback via an interactive webinar, which specifically targets the interviewees, project partners, and additional stakeholders. The research team will then optimize the prototype-forecasting tool based on the feedback obtained during the webinar and presentation. Optimizing the tool will require iterations with project partners to revise hazard notification formats and procedures discussed in Phase 1c. Phase 2 will begin in Program Year 5.

Phase 3: During the final phase of the project, the team will share project findings with a broader range of stakeholders across Alaska and the Arctic to evaluate the tool. This includes presenting the tool to a broader audience via the following: a webinar, developing a summary FAQ sheet for distribution to stakeholders (made available online), and presenting the findings at peer review forums attended by both scientists and stakeholders to provide additional opportunities for dialog and engagement. Phase 3 will begin in Program Year 5.

The research team will evaluate the action-oriented approach to creating useable forecasting tools based on feedback obtained from a web-based questionnaire (following the webinar) to understand how project outcomes met user needs. They will also discuss lessons learned about knowledge co-production with project partners, including barriers and enabling factors, to identify lessons learned that might advise future collaborations.

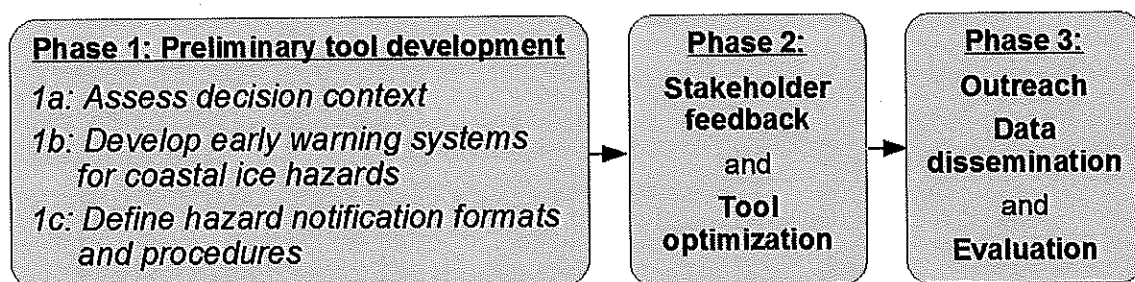


Figure 3: Developing Sea-Ice and Weather Forecasting Tools Research Methodology Phases

Student Participation: ADAC Fellow Dina Abdel Fatah will continue as a project student researcher. Ms. Fatah will work closely with the Principal Investigator to conclude interviews and work with the technology development members of the project to assist realizing information gained from the interviews into the applied tools. This research will further her PhD program and prepare her to enter the HSE uniquely qualified as a social science researcher who can visualize technology solutions.

Key Milestones:

1. Assessment of decision context. The research team provides a summary of the context in which decisions relating to weather and sea ice hazards from different stakeholders based upon a review of existing literature and interviews with decision makers (30 Jun 2018, with follow-on assessment, 15 Jul 2018).
2. EWS demonstrations for sea ice hazards detected using a CSIRS development of demonstration products for identifying historical sea ice hazard events developed using archived data (30 Jun 2018 with follow-on assessment, 15 Jul 2018).
3. Identify procedures for generating notification events detected by EWS and formats suitable for communicating information (30 Oct 2018).
4. Present prototypes of EWS to project partners and stakeholders for evaluation and refinement
5. Refine EWS based on partner and stakeholder feedback (15 Jan 2019).
6. Present findings to a broader audience of stakeholders across Alaska and the arctic via a webinar tool, which includes obtaining evaluation data (30 Mar 2019).
7. Develop outreach material, including FAQ sheets (30 Apr 2019).
8. Transition EWS to Arctic ERMA (15 Jun 2019).

Performance Metrics: Metrics for assessing how the project team is meeting the stated milestones include:

- Number of stakeholders interviewed. The team anticipates interviewing up to 15 participants from five different groups: response managers (USCG, local search and rescue), agency data analysts (NOAA ERMA/NWS), first responders, commercial marine operators, and subsistence hunters.
- Assessing the quality of the decision tool.
- Number of EWS prototypes developed. The team anticipates developing EWS prototypes for three different classes of coastal ice hazard. Each will be evaluated using data from prior incidents identified through the course of the project or any that arise during the period of performance. Currently no EWS exist. The target for each EWS is the successful identification of at least one incident with <50% false alarm rate.
- Number of authors on peer-reviewed publication. In addition to the project team, our target is to include authors from NOAA ORR, the NWS ASIP and at least 1 other stakeholder group.
- Number of stakeholders and stakeholder groups represented during the project webinar.

Outcomes/output: Overall, the project's key outcomes are improved situational awareness and crisis response in the Arctic and enhanced Arctic marine safety and environmental protection. Additional

outcomes include the following: (1) an understanding of decision contexts for marine operators in the Arctic, (2) enhanced usability of weather and sea ice forecasting tools to predict and respond to environmental hazards, threatening vessels, and marine activities, and (3) identification of best practices for supporting knowledge co-production of decision support tools in the Arctic. As this project is a two-year research endeavor, the following established both the first and second year planned outcomes (ADAC Program Year 4 and Year 5). Accordingly, the project plans to deliver the following capabilities:

- Provide improved situational awareness and crisis response in the Arctic and enhanced Arctic marine safety and environmental protection; via integrating the information tools and products directly into the operations of the NWS ASIP information and advisory dissemination process and Arctic ERMA's response management portal and advisory framework (overall outcome). This outcome will be achieved in Program Year 5;
- Provide enhanced usability of weather and sea ice forecasting tools to predict and respond to environmental hazards threatening vessels and marine activities (overall outcome). This outcome will be achieved in Program Year 5;
- Identify best practices for supporting knowledge co-production of decision support tools in the Arctic (overall outcome). This outcome was achieved in Program Year 4;
- Develop and transition sea ice and weather hazard forecasting tool (overall outcome). This outcome will be achieved in Program Year 5;
- Conduct two interactive webinars (Program Year 5 specific outcome);
- Provide Frequently Asked Questions (FAQ) sheets; Author manuscripts submitted for peer-review (Program Year 5 specific outcome).

Stakeholder Engagement: Integrated stakeholder engagement continues in each phase of the project. ADAC and Project investigator conduct routine calls with HQ USCG Project Champion. Project is featured during quarterly ADAC Customer's and Partner's Roundtable. In Year 5, researchers continue with an examination of decision contexts and information needs via interviews and literature reviews, which will inform the design of a forecasting tool. This includes engagement with UAF researchers involved in sustained Arctic observations, marine operators involved in sea ice hazard-related sensitive decisions, and agencies involved with issuing early warnings (such as National Weather Service) or providing interactive interfaces with data relevant in a hazard mitigation and response context (such as Arctic ERMA). The project team will continue to participate in the planned ADAC "Customers and Partners" Roundtable in order to inform and receive feedback on project progress and usefulness to USCG mariners and ADAC collaborators. The research team will provide opportunities for stakeholder feedback via an interactive webinar. This feedback will enable the team to optimize tools and evaluate the process as well as outcomes with an interdisciplinary approach. Researchers will engage a wider audience via a FAQ sheet and a second webinar.

Project Champion: Dr. Jon Berkson, HQ USCG CG-WWM. Project support is provided by CAPT Tom Meyer, HQ USCG CG-761. Project advocates include: USCG HQ CG-926, USCG R&D Center, USCG D17. Due to association with Arctic ERMA, ADAC acknowledges NOAA Office of Response and Restoration (ORR) as a project advocate.

Transition Plan. The research team disseminates project outcomes to stakeholders through the project-specific presentations and webinars described above as well as through regular customers and partners

meetings and annual reports coordinated by ADAC leadership. The team will also publish findings in peer-reviewed journals. Destination of applications of the research is principally focused on NWS ASIP and Arctic ERMA. Accordingly, transition of the research to NWS ASIP and Arctic ERMA provides USCG, and other Arctic mariners access to mission planning software, and a relatively uncomplicated transition pathway. The research team designed the workflow and partnerships underlying this research in a manner that sets the stage for integrating the information tools and products directly into the operations of the NWS ASIP information and advisory dissemination process and Arctic ERMA's response management portal and advisory framework. Both of these elements are tied directly into the formal response frameworks, such as under an incident command, as well as for routine hazard monitoring and mitigation operations by USCG and other DHS Arctic operators. Researchers expect to achieve TRL 7 for project-developed information products and software applications.

2. PROJECT: High-Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS)

Project PI: Dr. Jinlun Zhang

Lead Institution: University of Washington

Project Description:

Abstract: This ADAC project is completing an accurate High-resolution Ice-Ocean Modeling and Assimilation System (HIOMAS) to simulate and predict sea ice and currents in the Arctic Ocean. This system is calibrated and validated using a range of available sea ice and ocean observations. Once validated, the system is used for near real-time hindcasting and daily to seasonal forecasting of the Arctic Ocean currents, sea ice, and other environmental changes. The research pays particular attention to: (1) the prediction of spatial distribution of ice motion and thickness, (2) the fraction of thick-ridged or multi-year ice, and (3) the retreat and advance of ice edges. These are the sea ice factors that are most relevant to Arctic operators.

Accurate high-resolution prediction of ocean currents and sea ice conditions will enhance the Coast Guard's ability to prepare for and respond to oil spills in the Arctic Ocean. The prediction data will aim to improve Coast Guard safety and consistency when conducting search and rescue missions. The prediction data may also be useful for assisting other stakeholders in planning and management of economic activities. In addition, the data may be useful for other modeling efforts, such as oil spill and wave modeling. An inherent strength of HIOMAS is the ability to generate high precision models of sea ice thickness, the movement of ice, and ocean currents across the Arctic Ocean. When focused on a particular region of concern, HIOMAS is able to achieve even greater data precision. Through prior ADAC investigation, pan-Arctic resolution has reached the limits of the existing computing ability. Research is now focused on integrating HIOMAS into USCG operations in order to aid in predicting Arctic sea ice and currents on daily to seasonal time scales. Complementing research prediction for Arctic sea ice and ocean currents is assessing the HIOMAS model predictability through skilled evaluation and uncertainty analysis as well as identifying areas for further model improvement. ADAC currently seeks the model destination for HIOMAS within a NOAA/National Weather Service organization or affiliate. Throughout transition with NOAA, ADAC will continue to publish HIOMAS to Arctic ERMA and provide modelled data to operational users and operationally oriented institutions, such as the U.S. National Ice Center.

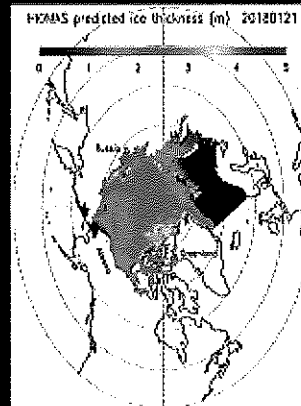
High resolution Modeling of Arctic Sea Ice and Currents

HIOMAS (High-resolution Ice-Ocean Modeling and Assimilation System)

- A forecast system that can distribute the forecast data to the Coast Guard and other Arctic stakeholders
- Developed 3 versions of HIOMAS with 6, 4 and 2 km horizontal resolutions
- Assimilate satellite sea ice concentration in HIOMAS hindcast to improve initial conditions for forecast
- Calibrated and validated HIOMAS hindcast using sea ice observations, no excessive ice thickness buildup in areas such as the Beaufort Sea.
- Conducted (near) real time hindcast and daily to seasonal forecast of Arctic sea ice and currents.
- Creating new 1 KM resolution for US Arctic EEZ

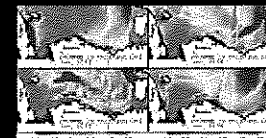
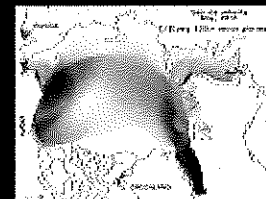
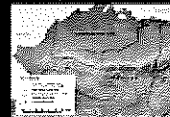
Transition: Underway in planning with NOAA, National Weather Service and NOAA Affiliate

- Note: Still publishing to Arctic ERMA



Current 4 km resolution HIOMAS

Just created a 1 KM resolution version for the US EEZ for Bering, Chukchi and Beaufort Seas



ADAC Research for the Arctic: For Today, and For the Future



ARCTIC DOMAIN
AWARENESS CENTER

Figure 4: High Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS) Overview

Objective/Purpose: This ADAC project is aims to develop a robust numerical tool that can be used to conduct high-resolution hindcast and forecast of Arctic sea ice and ocean currents. Our goal is to provide accurate, high-resolution hindcast and forecast data to help enhance the USCG ability to conduct search and rescue missions more safely and reliably. We also want to use the data to assist NOAA and other Arctic stakeholders to prepare and respond to potential oil spills or to plan and manage economic activities.

Baseline: Through prior research, the ADAC research team has developed three versions of HIOMAS with 6 km, 4 km, and 2 km horizontal resolution. These investigators note that none of these three versions creates any false ice thickness buildup data associated with other modeling approaches. With a 2 km pan-Arctic resolution, HIOMAS is too data intensive to run on University of Washington's existing computer cluster. However, for most applications investigators have discovered that a 4 km resolution HIOMAS is appropriately useful. Nevertheless, once a more powerful computer is available it will be straightforward to run the 2 km resolution HIOMAS.

In Program Year 5 research, we plan to experiment, refine and test, a new version of HIOMAS developed in Program Year 4, focusing on the U.S. Arctic EEZ, i.e., the Alaska waters in the Beaufort and Chukchi Seas. Focusing on such a subset region of the Arctic may allow HIOMAS to achieve even higher horizontal resolution, useful for tactical-level operations. We plan to target on 1 km resolution for this smaller regional model depiction.

ADAC notes that (to the researcher's knowledge), no high resolution (≤ 4 km) models have previously been used for daily to seasonal forecast of Arctic sea ice and currents. Daily to seasonal Arctic sea-ice and ocean current forecasts correspond to USCG direct operational needs. Therefore, orienting HIOMAS research will fill this operational gap. ADAC leadership, HIOMAS investigation, and other project investigators (in particular, Arctic Oil Spill Modeling) will work comprehensively to ensure that HIOMAS is available via NOAA programs such as: Arctic ERMA, along with HIOMAS program execution a targeted destination within NOAA or a NOAA affiliate. Further ADAC will continue to pursue any DHS or USCG application as desired by the HIOMAS HQ USCG project champion.

Research Method: The research involves expert mathematical modeling of the Arctic Ocean to obtain sea ice thickness and sea ice and ocean current movement using atmospheric forcing data and satellite provided data. The Program Year 5 research project will continue to advance HIOMAS application to benefit operational community needs, factoring appropriate Arctic meteorological conditions. Accordingly, for Program Year 5, ADAC plans to investigate the following scientific/technical questions, (focusing on the challenging modeling of the subset region of the Arctic Ocean at very high horizontal resolution (targeting 1 km) that would be most useful to specific Arctic mariner needs within the U.S. Arctic maritime EEZ). Specific research investigations include:

- Is it possible to construct a version of HIOMAS for a very small model domain with very high horizontal resolution (targeting 1 km resolution) which is able to generate stable numerical solution?
- Can such a HIOMAS realistically simulate and predict Arctic sea ice (thickness and velocity) and corresponding ocean (current) velocity?
- How does HIOMAS behave along the lateral open boundaries? Would the very small model domain cause spurious sea-ice and ocean properties along the open boundaries?
- Can the 1 km resolution HIOMAS capture more ice cracks and ridges seen in reality that is relevant to Arctic operators?

Research project developed HIOMAS from the Pan-arctic Ice–Ocean Modeling and Assimilation System (PIOMAS, Zhang and Rothrock, 2003). PIOMAS is a well-established modeling and assimilation system with advanced sea ice and ocean model components and is capable of assimilating satellite derived sea ice concentration. Its realistic sea ice output is widely disseminated worldwide by scientists, sea ice enthusiasts, interested bloggers, media organizations, and government officials.

Developed based on PIOMAS, HIOMAS has a high probability of advancing operationally useful Arctic Ocean current and sea ice modeling. In addition, HIOMAS has a much higher horizontal resolution than PIOMAS, with 2–4 km resolution for the entire Arctic Ocean, depending on computing resources. Research team plans to further enhance model resolution by refining, testing and conducting experiments on a 1 km resolution HIOMAS for the Alaska waters (the U.S. Arctic EEZ) in for Program Year 5. Such high resolution is essential to improving the prediction of sea ice concentration, thickness, motion, and ocean circulation. Due to the increased resolution, many of the model parameters may need adjustment in areas such as ice strength and ocean viscosities.

A key adaptation for Program Year 5 research is integrating forecast atmospheric forcing from the NOAA National Center for Environmental Prediction (NCEP) Climate Forecast System (CFS) into HIOMAS.

NOAA's CFS consists of coupled atmosphere, sea ice, and ocean model components with data assimilation. The CFS forecast ranges from hours to months: there are a total of 16 CFS forecast runs every day, of which four runs go out to nine months, three runs go out to one season, and nine runs go out to 45 days. These runs all create 6-hourly forecasts of atmospheric data that are widely accessible in real time, and thus ideal for forcing the HIOMAS forecast. Using the CFS forecast forcing, the researchers will conduct daily to seasonal forecast experiments on a monthly basis and more frequently if emergencies occur in the Arctic that need a rapid response. Forecast results will help the researcher investigate and potentially answer previously stated science questions.

The science review for this project is extensive. U.S. National Ice Center (USNIC) provides short-term numerical forecasts of sea ice extent and concentration using the Polar Ice Prediction System (PIPS), combined with satellite observations (Cheng and Preller, 1999). PIPS uses forecast forcing from an atmospheric forecast model to drive a coupled ice-ocean model to predict the future state of the ice cover days in advance.

PIPS was later replaced by the Arctic Cap Nowcast/Forecast System (ACNFS). Most recently, ACNFS was replaced by the Navy's Global Ocean Forecast System (GOFS), developed at the Naval Research Laboratory at the Stennis Space Center (NRL-SSC). Like the PIPS and ACNFS models, GOFS also consists of a coupled ice-ocean model driven by forecast forcing from an atmospheric forecast model. Scientists at the NRL-SSC have been conducting hindcasts and short-term and seasonal forecasts of Arctic sea ice using GOFS3.1. In addition, the Canadian Ice Service is also providing short-term forecasts of sea ice in Canada's navigable waters.

After the dramatic retreat of Arctic sea ice during the summer of 2007, the U.S. SEARCH and the European DAMOCLES programs recommended a community-wide prediction effort – the September Arctic Sea Ice Outlook. The focus of the Outlook is on the area of the overall Arctic sea ice extent and hence different from the focus of HIOMAS forecast. This effort has been ongoing since 2008 with increasing participation (Stroeve et al., 2014; <http://www.arcus.org/search/seaiceoutlook/> and now <http://www.arcus.org/sipn/sea-ice-outlook>).

For the September 2014 Arctic Sea Ice Outlook, 23 research groups worldwide participated, employing various methods that combined observations, statistical and numerical models, and empirical analyses. Among the 23 contributions are 10 predictions from numerical models, including coupled ice-ocean models.

Community involvement in the Outlook (as discussed in the previous paragraph) has shed considerable light on the predictability of the area of September Arctic sea ice extent. Most of the numerical models participating in the Outlook have a coarse horizontal resolution (> 10 km). These numerical models focus on the predictions of total September Arctic sea ice extent, and few predict ice thickness and ice edge locations; which is not particularly useful for assisting the planning and management of economic activities and USCG operational missions in the Arctic Ocean. Among these numerical models, only ACNFS (later GOFS) has a high horizontal resolution (4 km) comparable to the 4 km resolution HIOMAS.

However, unlike HIOMAS, GOFS is primarily for hindcasts and short-term forecasts. Its seasonal forecasts are mainly for scientific exercises, focusing on September Arctic ice extent. In addition, the sea ice model in GOFS is different from that in HIOMAS. The HIOMAS sea ice model is adapted from PIOMAS, which has

proven to simulate ice thickness with low mean bias and high model-observation correlation (e.g., Schweiger et al., 2011). This is why PIOMAS sea ice output is used extensively. ADAC leadership and the research team believe the high-resolution HIOMAS results will be even more Arctic operator-friendly and more broadly utilized. In addition, it is our belief the experiment on 1 km resolution HIOMAS on a subset region covering the U.S. Arctic EEZ will prove operationally useful, and particularly useful to USCG Arctic operations in the Bering, Chukchi and Beaufort Sea regions.

Student Participation: No student participation is planned at this point in the project.

Key Milestones:

1. Create a sustainable fine resolution (≤ 1 km) HIOMAS for U.S. Arctic maritime EEZ (Chukchi and Beaufort Sea Regions), 30 Aug 2018.
2. Confirm a suitable HIOMAS transition pathway with NOAA/NWS and or NOAA Affiliate 15 Sep 2018.
3. Establish and test sequential 6, 4 and 2 KM resolution prototypes for pan-Arctic transitions of HIOMAS at NOAA/NWS and or NOAA 15 Nov 2018.
4. Refine and test fine resolution (≤ 1 km) U.S. Arctic EEZ HIOMAS in support of Arctic operations, 15 Jan 2019.
5. Provide HIOMAS transition documentation to NOAA/NWS and or NOAA Affiliate, 15 Feb 2019.
6. Finalize feeds from HIOMAS (operating in NOAA/NWS and or NOAA Affiliate and Arctic ERMA in support of Arctic Oil Spill Modeling (AOSM). Explore the possibility of including the fine resolution (≤ 1 km) version into the HIOMAS portfolio. 15 Mar 2019.
7. Determine supportable refreshment of HIOMAS from University of Washington Applied Physics Laboratory to NOAA systems (and any "on-demand" support aspects), 1 May 2019.
8. Conduct testing, refine documentation, finalize journal submissions and conclude transition, 30 Jun 2019.

Performance Metrics: The key output of HIOMAS forecast includes sea ice thickness, concentration, and velocity; fraction of thick ridged or multi-year ice; ice edge locations; snow depth; and ocean velocity. The researcher will improve prediction accuracy through extensive model calibration and validation using corresponding observations, such as NASA Ice Bridge observations of ice thickness and snow depth, satellite observations of ice concentration, and buoy observed ice drift (ice motion).

The researcher will use statistical quantities such as model-data correlation, root mean squared error, and mean model bias to quantify and subsequently reduce model misfits through calibration and validation. In particular, the researcher will strive to limit the mean model bias to under 20% for ice concentration, 0.4 m for ice thickness, and 0.02 meters per second (m/s) for ice drift velocity and surface ocean velocity.

Range of mean prediction error in ice concentration percent): 0% to 30%; range of mean prediction error in ice (thickness (m): 0 m to 0.4 m, range of mean error in ice drift estimates (m/s): 0 m/s to 0.02 m/s.

Collaborate with ADAC Leadership and other ADAC researchers to determine improved approaches to disseminate HIOMAS to USCG and other DHS maritime operators. NOAA's Arctic ERMA is currently a key platform for distributing HIOMAS forecast as the USCG, NOAA and Arctic stakeholders. USNIC is a center useful to distribute HIOMAS as part of their product portfolio. In Program Year 5, ADAC leadership will finalize transition destination for HIOMAS model operations, in order to publish modeled data to USNIC and USCG operational command centers (to include USCG D17). Further, ADAC will

publish research results through journal publications and scientific peer-review forums.

Outcomes/Outputs:

1. HIOMAS Models in 6, 4, 2 KM resolution via hindcast and forecast of sea ice thickness, concentration, and velocity; fraction of thick ridged or multi-year ice; ice edge locations; snow depth; and ocean velocity for pan-Arctic display.
2. HIOMAS Model in fine resolution (at or less than 1 KM scale) for U.S. Arctic maritime EEZ for direct benefit to USCG Arctic operations in Bering, Chukchi and Beaufort Sea regions.
3. Establishment of HIOMAS with an operationally focused model within NOAA/NWS and or NOAA Affiliate.

Stakeholder Engagement: ADAC and Project investigator conduct routine calls with HQ USCG Project Champion. This project continues to publish to NOAA's Arctic ERMA in support of USCG D17 request. Project is featured during quarterly ADAC Customer's and Partner's Roundtable. ADAC is collaborating with NOAA to provide HIOMAS support to ADAC's Arctic Oil Spill Modeling (which is currently in transition to GNOME). ADAC will also investigate utility of HIOMAS providing direct feeds to support U.S. Coast Guard Search and Rescue Operations (SAROPS) software application. Integral to Project Transition, ADAC is engaging NOAA and NWS to determine final transition destination. Such a destination is needed in order to operate the model, providing modeled data to NOAA/NWS and U.S. National Ice Center and USCG operational users.

Project Champion: Dr. Jon Berkson, HQ USCG CG-WWM. Project advocates include: USCG HQ CG-926, USCG R&D Center, USCG D17. U.S. National Ice Center advocates for the program's modeled data. Due to association with Arctic ERMA, ADAC acknowledges NOAA Office of Response and Restoration (ORR) as a project advocate.

Transition Plan: As discussed in schedules and milestones, ADAC's transition focuses in establishing HIOMAS as an operationally supported model. At the close of ADAC Year 4, ADAC is in coordination for the most suitable model operational destination with NOAA/NWS and or NOAA Affiliate and/or Pacific Northwest National Laboratory (PNNL). As part of that transition, continuing to have HIOMAS modeled data feed AOSM for ocean current, sea ice presence, thickness (including ridging, and other fine scale characteristics) via NOAA's GNOME is planned (while recognizing that AOSM can also use non-HIOMAS data as needed by GNOME). Meanwhile, HIOMAS provides Arctic maritime operators via NOAA/NWS and or NOAA and potentially PNNL a pan Arctic capable of 2 KM resolution pan-Arctic, plus a fine scale at or less than 1KM resolution model of U.S. Arctic maritime EEZ. Transition planning consists of confirming transition pathway with NOAA and/or potentially PNNL, establishing working prototypes (at increasingly fine scale, based on host equipment capability), establishing feeds to GNOME (in order to support AOSM) and publishing HIOMAS modeled data from NOAA/NWS and or NOAA Affiliate and potentially PNNL to other NOAA systems (such as Arctic ERMA). On a separate line of effort, ADAC will investigate if there is any suitability of HIOMAS to support USCG SAR-OPS (either pan Arctic or U.S. EEZ versions). Transition of HIOMAS from ADAC and University of Washington, will be conducted in accordance with ADAC management plan as previously discussed.

Researchers expect to achieve TRL 7/8 for project-developed information products and software applications.

3. PLACEHOLDER TBD: Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

THEME 2: Maritime Domain Awareness (MDA) Research

1. Arctic Oil Spill Modeling (AOSM)
2. Ice Conditions Index for the Great Lakes Region (ICECON)
3. Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic
4. The Arctic All-Hazards GIS Platform, University of Maryland.
5. Arctic Vessel Monitoring Geofencing/Alert Awareness, Alaska Marine Prevention and Response Network and UAA College of Engineering
6. TBD: Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

1. PROJECT: Arctic Oil Spill Modeling

Project Pls: Dr. Tom Ravens and Dr. Scott Socolofsky

Lead Institution: University of Alaska Anchorage (UAA) and Texas A&M University (TAMU)

Supporting Team: Dana Brunswick (UAA), Caixia Wang (UAA), Tristan A. Goers (graduate student UAA) and a Postdoctoral researcher (TAMU) (TBD).

Project Description:

Abstract: In support of the USCG marine oil spill response mission the research team is developing an analytical model to estimate the spread of oil released in an ocean environment under ice due to a well blowout, ruptured pipeline, or ship grounding. The approach for under ice oil release from an offshore well blowout or pipeline rupture will involve coupling output from the ocean oil plume model developed by TAMU with the UAA derived analytical density current models to forecast oil spreading. These tools have in turn been included in the NOAA's oil spill forecasting model, the General NOAA Operational Modeling Environment (GNOME). For oil released near the ocean surface, the project team has adopted approaches derived from the research literature compatible with NOAA's GNOME model, and worked to have these algorithms included in GNOME.

The research goal is to develop a tool to forecast the spread of oil in an Arctic marine environment in the immediate aftermath of an oil spill event (i.e., within 24 or 48 hours of the spill). Modeling will account for the character of the oil spill (e.g., well blowout or pipe rupture), the release rate or amount, the environmental conditions (ice concentration, water depth, water velocity (drift), and salinity). Researchers will prioritize near-surface releases of oil (e.g., vessel source) as there is a greater risk of oil spills from a vessel source.

Specific research seeks to transition the Arctic-capable oil spill-forecasting tool to appropriate stakeholders by incorporating the tool into NOAA's oil spill model (the GNOME Suite, including both WebGNOME and PyGNOME). This approach improves NOAA modeling environment used by USCG decision makers in oil spill

response. The team further advances the tool by incorporating improved environmental data on Arctic conditions, and through increased amounts of pre-formatted input data for Arctic applications.

Planned research includes:

1. Developing a user interface for the new elements of GNOME developed by ADAC; coding will be accomplished by TAMU who has experience with JavaScript programming.
2. Validation of the dissolution algorithms used by GNOME incorporating those in the Texas A&M model;
3. Couple GNOME with available ice data, and;
4. Complete the transition of all ADAC algorithms to the GNOME environment.

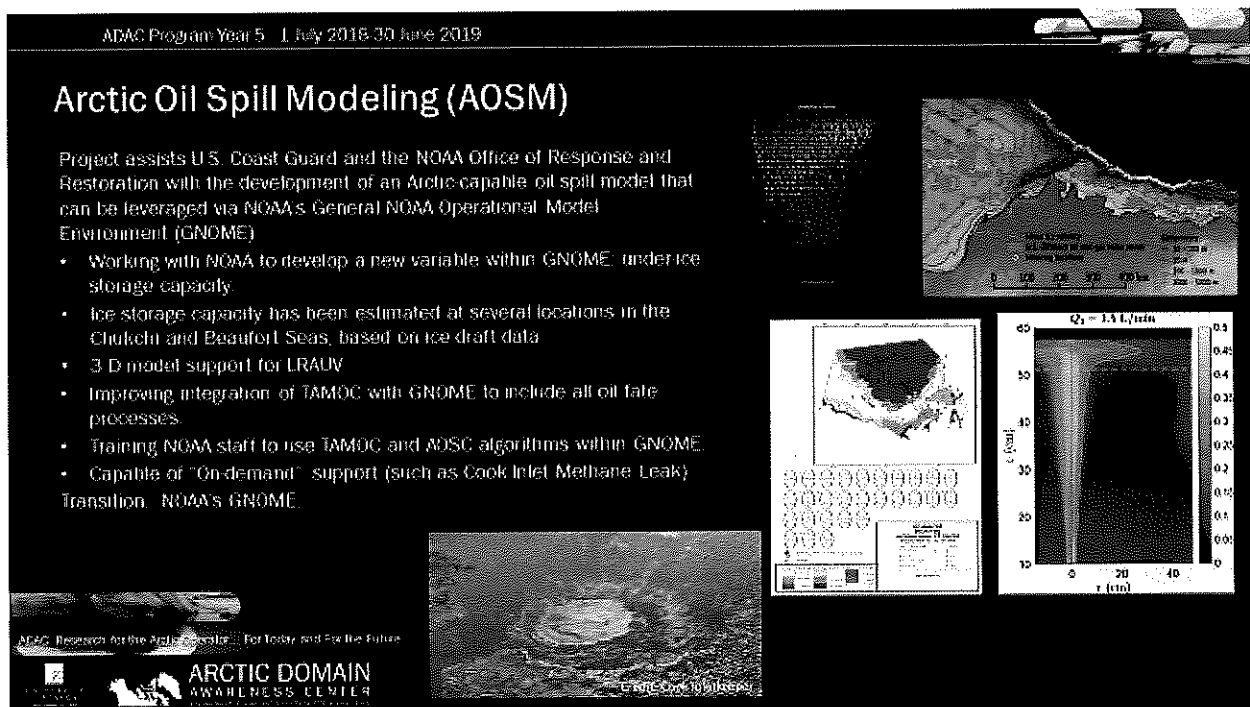


Figure 5: Arctic Oil Spill Modeling Overview

Objective/Purpose: The research objects of the Arctic Oil Spill Modeling (AOSM) project is to develop new algorithms for oil fate and transport in the Arctic environment, including the effects of temperature, salinity, ocean currents, and ice cover. These new methods are designed to fit an oil spill response paradigm, meaning that they would be efficient calculations that can be run in a forecasting mode during a spill. In order to make the new methods widely available and useful to the U.S. Coast Guard, AOSM is working with the National Oceanic and Atmospheric Administration (NOAA) to implement these algorithms in their oil spill-forecasting tool, GNOME.

Baseline: The USCG relies on the General NOAA Operational Modeling Environment (GNOME) oil spill model and NOAA for expert guidance when responding to an oil spill. At the start of this project, NOAA's existing GNOME oil spill model was not Arctic-capable (e.g., it did not account for sea ice). The existing GNOME oil spill model also did not yet include an oil plume module so it could not readily address sub-

surface well blowouts and sub-surface pipeline ruptures. A new NOAA GNOME model, under development, deals with ice by assuming if the coverage is 20% or less, the oil moves with winds and currents. If the coverage is 80% or more, then it moves entirely with the ice. For concentrations between 20% and 80%, it interpolates linearly.

ADAC oil spill researchers have engaged with NOAA's leading oil spill modelers to provide expert advice to incorporate ice into GNOME. As a result, ADAC oil spill research has provided a GNOME compatible model that will forecast the movement of surface and under-ice releases of oil and gas. This model takes into account the under ice roughness that affects the oil spread within the first 24 – 48 hours of an oil spill. Recent ADAC research has created an Arctic oil spill calculator to serve as an in-house platform for the development and testing of Arctic-capable oil spill algorithms. Recently, these algorithms were incorporated to GNOME.

One of the key and unique features of this project is the realistic accounting of Arctic under ice roughness. As a part of prior Beaufort Sea oil exploration, Shell Corporation provided initial estimates of Arctic under-ice roughness. ADAC oil spill researchers have advanced this analysis and added further collaboration from ADAC's Integrated Sea Ice Hazards PI, Dr. Andy Mahoney from the University of Alaska Fairbanks.

Oil and gas plume modeling expertise developed by Texas A&M University (co-PI Scott Socolofsky) also constitutes significant baseline data. Over the last five years, Dr. Socolofsky has developed the Texas A&M Oil Spill Calculator (TAMOC), a comprehensive model for predicting the nearfield behavior of subsea oil spills (Socolofsky et al., 2015), through funding from an array of sources. Contributors to this prior work include the U.S. National Science Foundation, the Gulf of Mexico Research Initiative (GoMRI), the Bureau of Safety and Environmental Enforcement (BSEE), Chevron Energy Technology Company, and Shell Corporation.

When an oil and gas release occurs below the ocean surface, the chemicals rise and entrain ambient seawater to form a plume. The nearfield region of a spill then extends until the buoyancies of the oil, gas, and seawater mixture are in equilibrium. For the Deepwater Horizon accident, the nearfield dynamics were responsible for effecting the intrusion layer that formed at a depth of 1100 m in the Gulf of Mexico (Socolofsky, et al., 2011). These factors not only effected the intrusion layer, but also were responsible for the transport of oil to the surface and close to the response zone (Ryerson, et al., 2011). In shallow ice-capped regions, such as the Chukchi and most of the U.S. regions of the Beaufort Sea, the nearfield plume will extend from the spill to the bottom of the ice surface. The plume model will predict the mixture density of oil, gas, and seawater that will intrude laterally under the ice. It will also predict the mass flow rate of oil and gas.

ADAC has successfully integrated algorithms developed and tested within the in-house ADAC Arctic Oil Spill Calculator into the GNOME Suite. NOAA's GNOME model is a next-generation oil spill model that is designed to incorporate a number of oil spill modeling updates, including the Arctic-oriented updates produced by ADAC. It remains to test these algorithms carefully, continue training of NOAA staff on their use, and to enhance the user interface to access these new capabilities within the GNOME model.

Research Method: Through an integrated and sequential task driven method, the research team is conducting advanced mathematical modeling to understand and characterize an Arctic region oil spill that is emanating from a sea floor-based well, a ruptured marine transport pipeline, or a leak from a transport

marine vessel. The research team continues to advance the prior year's investigation, and iterates with NOAA's oil spill modelers to produce an advanced Arctic-capable oil spill response forecast tool. The research method includes: (1) testing of the completed GNOME modeling suite for Arctic conditions, (2) development of a user interface to access new capabilities created by ADAC within GNOME, (3) on-going training of NOAA staff on Arctic GNOME, and (4) better integration of GNOME with available ice, shoreline, and current data for the Arctic.

Accordingly, the research program investigates four specific outcomes:

- Validate and improve the fate processes in GNOME using the algorithms in the Texas A&M Oil spill Calculator (TAMOC) as reference;
- Develop a user interface within the Web front-end to GNOME that allows access to all of the Arctic-capable elements that ADAC has added to GNOME;
- Couple GNOME to available predictions for ice and currents in the Arctic;
- Complete the transition of all ADAC Arctic capability to GNOME so that the final GNOME product is fully operational within NOAA.

The following paragraphs describe the planned investigation in detail.

Advance prior research and transitioning of the Arctic-capable oil spill-modeling tool to stakeholders.

ADAC's Arctic-capable oil spill forecasting tool provides short-term (24 and 48 hour) forecasts of the movement and spreading of oil whether it is released under ice or near the surface. The tools are being integrated into NOAA's GNOME model so that they can be used operationally in the event of an oil spill in the Arctic.

Validate and improve fate processes in GNOME.

When oil is released into the ocean water column, whether from a blow, pipeline leak, or leaking vessel it begins to change its composition as it interacts with the surrounding environment. Within the ocean water column (below the air/water interface), the main fate process within the first 48 hours of an oil release is dissolution. Once the oil reaches the air/water interface, evaporation (though potentially limited) generally dominates dissolution, but in ice-covered waters, dissolution may remain the dominant fate mechanism for oil. The dissolution algorithms in GNOME are simplified to allow for efficient computation in a large domain, and these algorithms have not been carefully tested to evaluate their accuracy.

Due to the fact dissolution may be the most important process affecting the fate of oil in an Arctic environment, we propose to test the GNOME dissolution predictions against those in the Texas A&M Oil spill Calculator (TAMOC) as a reference. The dissolution in TAMOC has been validated to numerous laboratory studies, and to available field data collected during the Deepwater Horizon accident (Gros et al. 2016, 2017).

Dissolution has two important effects on spilled oil itself. First, it moves some of the released oil mass from the liquid oil phase to the dissolved phase. Dissolved oil is much more available to biodegradation, and does not pose the same fouling hazard as liquid oil. Second, as the more water-soluble components

of the oil dissolve, the density of the remaining liquid oil increases. This change in the oil density controls the oil buoyancy and rise rate, ultimately affecting the trajectory of the liquid oil in the ocean water column.

We propose to test both the dissolution algorithms, and to enhance the capability of GNOME to predict the evolving oil density in two different ways. First, we will make direct comparison between predictions for solubility and oil density computed from GNOME algorithms with those predicted by TAMOC. This will serve to find any inconsistencies in the GNOME assumptions and to evaluate the level of accuracy of the GNOME approximations. Second, we will test the importance of these GNOME approximations for predicting where oil will go in the Arctic environment. The main purpose of GNOME is to direct response operations; hence, predicting the trajectory and occurrence of oil is particularly important. We will enhance and adapt the GNOME algorithms for dissolution and density until an acceptable match is made between trajectories predicted in GNOME with those that would be predicted using TAMOC algorithms. This work is necessary to ensure the accuracy of GNOME predictions in the Arctic environment where dissolution may be the dominant mechanism changing the properties of spill oil as it is transported.

Develop a user interface for Arctic capabilities in the Web front-end of GNOME.

The new generation of the GNOME model is a collection of methods written as a Python programming module. NOAA uses this next generation GNOME (hereafter, simply GNOME) via a user interface programmed in Java to run in a web browser. During Year 4, ADAC successfully transitioned each of their new Arctic capability algorithms into the GNOME modeling suite. For these new capabilities to be utilized, the web user interface must be updated to provide access to this new functionality.

During Year 5, ADAC will design an updated user interface that allows efficient usage of all of the ADAC Arctic Oil Spill Modeling capabilities within GNOME, and will facilitate creation of this user interface design within the web front-end of GNOME. This is a necessary step to complete technology transfer of the ADAC algorithms to the NOAA end users. Texas A&M has expertise in JavaScript programming, and they will design and code the user interface.

Couple GNOME to available predictions for ice and currents in the Arctic.

In Program Year 4, and continuing into Program Year 5, ADAC is bringing available operational sources of data on sea ice and ocean currents into GNOME. For example, ADAC is working to ensure that the Arctic version of HYCOM (the Arctic Cap Nowcast/Forecast System, ACNFS), and sea ice nowcasts/forecasts from the National Weather Service (NWS) Alaska Sea Ice Program are available to drive the GNOME model. This includes the use of ice velocity to drive the movement of oil in the event of surface spills as well as the use of ice stage data to serve as a proxy for under-ice storage capacity in the event of an under ice spill.

Complete technology transfer of ADAC Arctic Oil Spill capabilities to GNOME.

During Program Year 5 of the Arctic Oil Spill Modeling project, we will complete all elements of technology transfer from ADAC to the NOAA GNOME model, where our work will be used operationally to provide oil spill forecasts to the USCG in the event of an oil spill in the Arctic. Through Year 4, we have created Arctic-capable algorithms for oil transport in the Arctic Ocean environment, and have facilitated including these algorithms in GNOME. During Year 5, we will complete training of NOAA staff on usage of these algorithms, and will make all final changes to GNOME necessary to make these capabilities available operationally.

Hence, at the end of Program Year 5, technology transfer for this project will be complete and operationally available to USCG.

Student Participation: ADAC Fellow Ms. Kelsey Frazier, undergraduate Mechanical Engineering research assistant at UAA is detailed to support AOSM. Ms. Kelsey is supporting the development of *Under-Ice Storage Capacity*, which is a new variable within the GNOME model. Specifically, she is examining ice draft data (originally collected for Shell) relative to the ice stage – as determined by the Alaska Sea Ice Program (under the NOAA National Weather Service). The final product of her work will be recommending “low”, “medium”, and “high” levels of *Under-Ice Storage Capacity* for the Chukchi and Beaufort Seas.

Key Milestones:

1. Validate and improve the fate processes in GNOME using the algorithms in the Texas A&M Oil spill Calculator (TAMOC) as reference, 28 Feb 2019.
2. Develop a user interface within the Web front-end to GNOME that allows access to all of the Arctic-capable elements that ADAC has added to GNOME, 31 Mar 2019.
3. Couple GNOME to available predictions for ice and currents in the Arctic, 15 Jan 2019. Note: AOSM is capable and suitable to ingest HIOMAS provided ocean current, sea ice presence, thickness and movement. In Year 3 of the AOSM project, we demonstrated that HIOMAS output can be used to drive GNOME.
4. Conduct AOSM testing in GNOME, coordinate training on AOSM model performance parameters and provide initial documentation for NOAA use, 30 Apr 2019
5. Refine documentation, finalize journal submissions and conclude transition of all ADAC Arctic capability to GNOME so that the final GNOME product is operational within NOAA, 30 Jun 2019.

Performance Metrics: Researchers will evaluate their investigations according to the following metrics:

- Trajectories predicted in GNOME for oil location in the environment at the end of the first 48 hours of transport will agree in range to within 20% and in bearing to within 15 degrees of predictions using dissolution and density calculations from TAMOC. It is expected that this goal will be achieved in 4 out of 5 of the baseline sample Arctic spills that were already created during Years 3 and 4 of the project.

GNOME will be modified to offer three ranges of *Under-Ice Storage Capacity* (“low”, “medium”, and “high”) – for the Chukchi and Beaufort Seas - that users can select based on sea ice stage, as provided by the NWS Alaska Sea Ice Program. The UA team will develop code to ingest the analysis provided by the NWS Alaska Sea Ice Program and to generate an Ice Storage Capacity grid that will be used to model spreading under ice.

Outcomes/Outputs: All of ADAC’s Arctic Oil Spill modeling algorithms are operational within GNOME.

Stakeholder Engagement: AOSM is a project underway with transition. ADAC and Project investigator conduct routine calls with HQ USCG Project Champion. Project is featured during quarterly ADAC Customer’s and Partner’s Roundtable. The ADAC AOSM team is in frequent contact with Mr. Chris Barker (NOAA, Office

of Response and Restoration), who directs the development of the GNOME model for NOAA, and is the key facilitator of AOSM into GNOME.

Project Champion: Ms. Kirsten Trego, HQ USCG-MER. Project advocates include: USCG HQ CG-926, USCG R&D Center, USCG D17, NOAA and Interagency Coordinating Committee on Oil Pollution Research (ICCOPR).

Transition Plan: ADAC Program Year 5 plan for AOSM continues and concludes on the established pathway started in ADAC Program Year 3 and refined in Year 4. NOAA's GNOME system provides NOAA ORR responders the modelling framework to inform USCG Federal On-Scene Coordinators of maritime oil spill characteristics. AOSM provides GNOME a uniquely suited Arctic oil spill model in order to characterize an Arctic maritime oil spill (with a high degree of fidelity). The implementation of all of ADAC's Arctic oil spill algorithms within NOAA's operational GNOME oil spill model is at the heart of the transition plan. The training of NOAA staff in the use of the GNOME user interface and algorithms contributed by ADAC is a second aspect of the transition plan. Both these aspects will be concluded by 30 Jun 2019. Researchers expect to achieve TRL 7/8 for project-developed information products and software applications.

2. PROJECT: Ice Condition Index (ICECON) for the Great Lakes

Project Pls: Dr. Tom Ravens and Dr. Andy Mahoney

Lead Institution: University of Alaska Anchorage (UAA) and University of Alaska Fairbanks (UAF)

Supporting Team: Professor Shawn Butler (UAA), Graduate student (UAA) (TBA)

Project Description:

Abstract: In collaboration with USCG and others, the project team is developing an ice condition index (ICECON) for the Canada-U.S. Great Lakes. ICECON is a USCG decision support tool combining vessel class with nowcast and forecast, lake ice conditions. Researchers plan ICECON forecasts up to 120 hours into the future, make use of the circulation and ice models developed by NOAA's Great Lakes Environmental Research Laboratory (GLERL). Researchers will account for icebreaker activity and its impact on ICECON nowcasts and forecasts. In parallel with the development of ICECON, ADAC will identify and adopt a vessel classification system to define a number of vessel classes and the ice-capability of ships in those classes (in terms of ICECON). The ICECON system will help the USCG provide guidance and appropriate decision support to Great Lakes marine vessels (for a given class) planning a given transit.

ICECON's workplan consists of six tasks. Collectively these tasks combine marine vessel size, gross tonnage and hull strength to contrast against current and forecast ice of the planned route of sail, to provide USCG and shipmasters improved safe passage insight. In order to achieve effectiveness, ICECON for the Great Lakes needs to be an inclusive and iterative process principally with meteorological, marine traffic, and safety experts. Accordingly, project researchers plan several workshops and seminars (using distant technologies as appropriate) in coordination with USCG D9 to collaborate with ice and maritime transportation experts. These experts are from a range of organizations including (but not exclusive to): NOAA, the U.S. National Ice Center, the US Army Corps of Engineers Cold Regions Research and

Engineering Laboratory (CRREL), USCG RDC, USCG D9, Transport Canada, the Canadian Ice Service, the Finnish Meteorological Institute, and the University of Alaska.

Objective/Purpose: Create an ice conditions index for the Great Lakes region as a planning and decision support tool for mariners operating during winter season, to reduce the risk of vessel entrapment in ice conditions. This is accomplished by combining marine vessel size, gross tonnage and hull strength to contrast against current and forecast ice of the planned route of sail, to provide USCG and shipmasters improved safe passage insight. Accordingly, ICECON for the Great Lakes will aide safer waterways management for USCG District 9 and Great Lakes mariners. In parallel with the Great Lakes ICECON, project team plans to provide an initial framework of an ICECON for the Bering, Chukchi and Beaufort Seas.

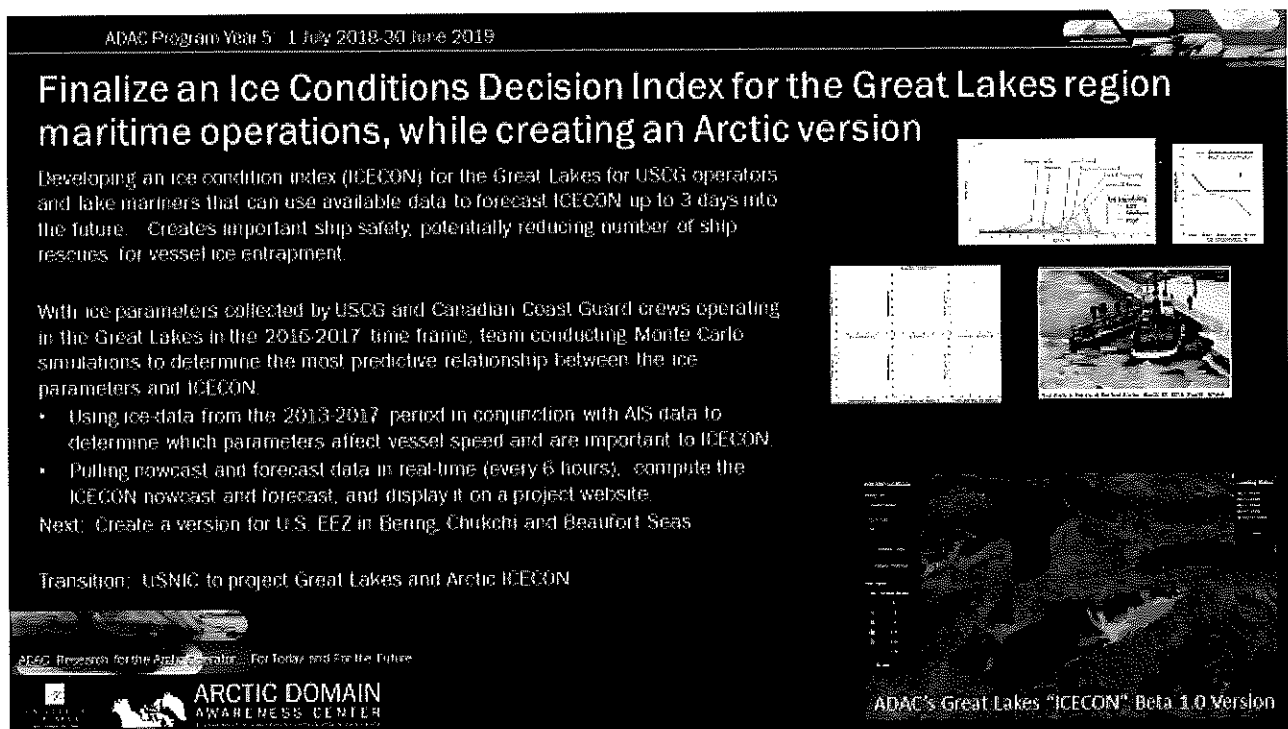


Figure 6: Ice Condition Index (ICECON) for the Great Lakes Overview

Baseline: Approximately fifteen years ago, Transport Canada developed the "Arctic Ice Regime Shipping System" (AIRSS, Transport Canada 2003) in order to guide decisions on whether a ship (of a given class) should travel in ice (of a given condition). The system integrates information on Vessel Class (specifically the ice-capacity of ships) and ice condition (referred to as "Ice Regime" by Transport Canada). AIRSS is a basis for ICECON. ADAC examined AIRSS in detail in a 2015 document entitled: "AIRSS as basis for ICECON." Briefly, application of AIRSS follows a 4-step process:

Step 1: Define the ice regime based on ice conditions (in particular, ice thickness and stage of development).

Step 2: Define vessel classes and ice multipliers (to define a set of vessel classes and a set of class-dependent ice multipliers). Accordingly, positive ice multipliers indicate the vessel class is sufficient to handle the ice condition and negative multipliers indicate that the vessel class is insufficient.

Step 3: Calculate the ice numeral IN, which integrates information about the ice regime, the vessel class, accounts for the concentration of each type of ice in the region of interest as well as the ice multiplier for the range of ice types for a particular vessel class. A positive ice numeral indicates that the ship transit is safe for the ship class in question and considering the ice condition.

Step 4: Decide whether to proceed or to take an alternative route based on the Ice Numeral (IN).

A close examination of the AIRSS system reveals that the system determines whether a ship (of a specific class) can safely navigate for the ice present or not. AIRSS fails to take into account ocean/lake surface temperature (which would affect ice hardness and strength), ice pressure (whether ice is diverging or converging), and the effect of ship traffic on ice condition. Further, AIRSS does not explicitly include heat transfer calculations, which are useful in an ice-condition forecasting system.

Fortunately, NOAA's GLERL forecasts Great Lakes surface temperature and the surface wind vector from which ice pressure can be determined. High resolution meteorological and limnology forecasts for the Great Lakes provide the basis for heat transfer calculations. Additionally, AIS data is available and is useful; to determine the frequency of ship passage in constricted areas. Hence, for the Great Lakes, data for building a more sophisticated decision support system for ship transit in ice is available.

Both USNIC and USCG District 9 developed ICECON proposals that merit consideration. Transport Canada is reportedly working on an update to the AIRSS system. Prior research team efforts established an ICECON Council of Experts, conducted corresponding workshops, and provided detailed assessment of the accuracy of a prototype ICECON algorithm developed by USNIC, providing improvement recommendations.

Research Method: The ICECON project in Program Year 5 will primarily involve the completion of six tasks. The tasks and the methodology used in the tasks is described below.

Task 1: *Use of Monte Carlo optimization procedures for optimizing the ICECON algorithms.* Monte Carlo optimization procedures will be used to determine the best relationship between the available ice-related environmental parameters and the ice condition index (ICECON). Ice-related environmental parameters available for forecasting ICECON include ice thickness, ice concentration, lake surface temperature, ice type, and wind condition. The ice condition index used in the Monte Carlo optimizations are observations of ICECON made by the crews of the US and Canadian ice-breaking fleet. The environmental variables for the optimization is obtained from observations from the crews of the icebreaker fleets, and based on output from GLERL models.

Task 2: *Accounting for impact of vessel transit frequency on ICECON in constricted waterways.* USCG operators (e.g., CDR Maffia) and researchers (Ettema and Huang 1990) have observed that ice is thicker in ship channels in accordance with the frequency of traffic. Hence, when operating the ICECON forecasting system (described below), we will adjust the ice thickness (and ICECON) to reflect the frequency of ship traffic following Ettema and Huang (1990). AIS data will be used to estimate the

frequency of ship traffic in selected channels at different times of the year. If possible, real-time AIS data will be used to inform the calculation of ice thickness in these ship canals.

Task 3: *Develop an ICECON forecasting system.* An ICECON forecasting system will developed in steps: (a) Environmental data (netCDF format) from GLERL's "thredd" server is automatically downloaded, (b) the data is automatically written to a database, (c) the data is then queried and the ICECON algorithm is used to calculate the actual ICECON, and (d) the computed ICECON data is then displayed for operator reference.

Task 4: *Develop a vessel classification system in terms of ICECON.* The system is based on available data like ship horsepower, length, and type.

Task 5: *Assessment of the relationship between ship performance and ICECON.* AIS data in conjunction with "hindcasted" environmental data and inferred ice condition index is examined to determine how the speed of a ship (with a given ICECON classification) is affected the ice condition (measured with ICECON) in which it operates. It is noted that there are multiple reasons for why ship speed may slow besides ice condition.

Task 6: Investigate and provide an initial report in the development of an Arctic version of ICECON (focused on the U.S. Arctic Maritime EEZ—Bering, Chukchi and Beaufort Sea regions). In this task, researchers will explore the development of an Arctic version of ICECON, focused on those Arctic regions that most relevant to USCG mission and waterways management concerns: the Bering, Chukchi and Beaufort Sea areas within the U.S. EEZ. The initial report will describe feasibility of constructing an Arctic ICECON, based on available science and information gained from the Great Lakes ICECON project. Consideration will be given to the vessel classification system as well as the environmental data upon which ICECON is built. Importantly, Task 6 is aided by the project team leveraging AIS data of the Bering, Chukchi and Beaufort Seas collected from the ADAC project "*Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic.*" Since observations of ICECON may not be available in the Arctic, researchers will explore whether AIS data is sufficient to develop the index.

Student Participation: A graduate student from UAA will contribute to the ICECON project in ADAC Program Year 5. The graduate student will assist with the continued development of the ICECON algorithms. This student researcher will consider possible improvements to the existing algorithm and test them by examining their predictive capability.

Key Milestones:

1. Monte Carlo simulations are performed using the ICECON observations and environmental data from the 2017-2018 winter as well as earlier winters, 30 Sep 2018.
2. An approach for using vessel transit frequency to inform the calculation of ice thickness and ICECON is developed using data from at least two Great Lakes canals, 30 Sep 2018.
3. A vessel classification system in terms of ICECON is defined and validated with the Council of Experts, 15 Dec 2018.
4. Determine the impact of ice condition (quantified in terms of ICECON) on ship velocity for ships with a range of ICECON classifications, 15 Dec 2018.
5. Provide the completed and operational ICECON forecasting system to the National Ice Center, 15 Jan 2019.

6. Develop an initial feasibility analysis report and associated proposal for the development of an Arctic ICECON for the U.S. Arctic EEZ areas of the Bering, Chukchi and Beaufort Seas, 15 March 2019.

Performance Metrics: Researchers will evaluate their investigations according to the following metrics:

- The ICECON algorithms enable accurate ICECON predictions 70% of the time.
- Use of vessel transit frequency in the ICECON algorithm reduces non-concurrences between observed and calculated ICECON by 50%.
- The relationship between ship velocity (for ships of a given ICECON class) and ICECON is established for at least five ships in at least three different vessel classes.

Outcomes/Outputs:

- A finalized set of ICECON algorithms for the Great Lakes Region.
- A finalized vessel classification system for the Great Lakes Region.
- A determination of the effect of ICECON on ship speed (for ships of various classes) for the Great Lakes Region.
- A feasibility analysis report and associated proposal for the development of an Arctic ICECON for the U.S. Arctic EEZ region of the Bering, Chukchi and Beaufort Seas.
- USNIC operates ICECON for the Great Lakes region.

Stakeholder Engagement: The ADAC team is in frequent contact with the project champion (CDR William Woityra (CG-WWM)) or his substitute, Jason Radcliffe. Project is featured during quarterly ADAC Customer's and Partner's Roundtable. There have been two "Council of Experts" meetings and numerous conference calls. Continued engagement with stakeholders is planned in year 5.

Project Champion: CDR William Woityra (CG-WWM)/substitute Jason Radcliffe. Project advocates include HQ CG-926, Mr. Mark VanHaverbeke, USCG RDC, the U.S. National Ice Center, the Great Lakes Environmental Research Lab, USCG D9 and USCG D17.

Transition Plan: Overall, transition planning for ICECON from research to an operationally relevant tool for USNIC has been via an ADAC to USNIC Plan of Action and Milestone (POAM). In ADAC Program Year 4, project investigators provided USNIC an initial Beta version of ICECON, (as a working prototype) in order to identify shortfalls and provide recommendations for improvement. ADAC starts Program Year 5 refining improvements in the Beta version. Mid-way through Program Year 5, investigators conclude research and development, transferring an updated, final version of ICECON (following adapting needed changes from the Beta edition and final review by the Council of Experts) providing an operationally useful ICECON to USNIC. Transition planning includes ADAC researchers providing USNIC all associated training and ICECON

maintenance information. Researchers devote the remaining of Program Year 5 is creating a feasibility report and associated proposal of an Arctic ICECON for review by USCG Project Champion.

3. PROJECT: Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic.

Project PI: Dr. Carol Janzen

Lead Institution: Seward Association for the Advancement of Marine Science (a 501c3) on behalf of the Alaska Ocean Observing System (AOOS)

Supporting Team: Axiom Data Science LLC and the Marine Exchange of Alaska

Project Description:

Abstract: The Arctic Domain Awareness Center's Arctic-related Incidents of National Significance (Arctic IoNS) workshop in June 2016 highlighted the need to improve awareness and understanding of nearshore bathymetry across the Arctic and, in particular, the North American Arctic. Accordingly, this research project supplies critical data related to vessel tracking and bathymetry that is useful for existing and developing USCG mission databases.

The project team is creating products to support decision-making concerning vessel traffic and vessel safety in a rapidly changing Arctic environment. The research effort will develop the capability to reduce execution time required for handling and analyzing exceptionally large collections of Automated Information System (AIS) vessel tracking data. This capability will enable the investigating team to produce AIS-derived data products to identify marine vessel risk areas, such as those with outdated bathymetry or insufficient coastal detail for safe passage of vessel traffic. Using and optimizing a high capacity, parallel compute workflow will solve current data volume processing challenges by streamlining the workflow to deliver valuable summaries of vessel density patterns from massive quantities of data across multiple vessel types, environments, and locations.

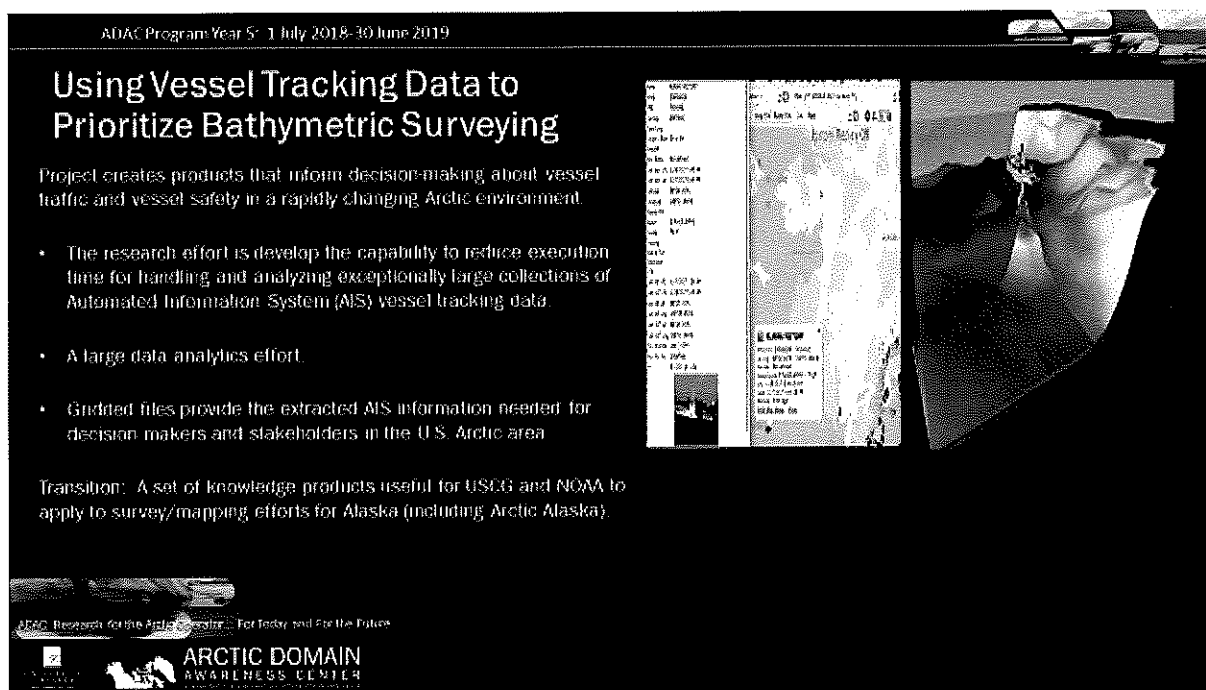


Figure 7: Using Vessel Tracking Data to Prioritize Bathymetric Surveying Overview

Objective/Purpose: The primary goal of this research and application project is to assist the U.S. Coast Guard and NOAA with promoting safe transit and maritime operations in a rapidly changing Arctic environment. The project team aims to accomplish this goal by providing useable, customizable summaries of extremely large-volume AIS vessel traffic data to better inform the prioritization of areas in the U.S. Exclusive Economic Zone (EEZ) for bathymetric surveying. The research process for this project will include the following objectives:

1. Acquire and quality review U.S. Arctic historical AIS vessel data using high-performance computing infrastructure, and make the data available in an intuitive web-based tool.
2. Modify a proof-of-concept workflow from an existing NOAA OCS- funded pilot effort (NOAA OCS: AIS Big Data Project) to scale up to the U.S. Arctic EEZ and deliver the AIS data in an application-ready format for prioritizing bathymetric surveys using the NOAA-OCS Hydrographic Health Model.
3. Engage decision-makers and maritime domain experts throughout the life of the project to provide guidance and feedback and ensure the products and outcomes of this project meet their needs.

Baseline: The U.S. Arctic is experiencing significant changes widely recognized by both Alaska coastal communities and regulatory agencies across the region, including the USCG. Arctic Sea-ice coverage has decreased to the point that existing northern shipping lanes around the world are open for longer periods and are projected to experience a continued increase in marine vessel traffic. Recent ship groundings in the U.S. Arctic have occurred in areas with outdated bathymetry that falsely reflected adequate water depth for safe passage, which demonstrates the importance of identifying areas where vessels are currently operating. It is also of interest to identify what type of vessels are frequenting these areas to

ensure the availability of critical navigational charts and bathymetric survey information that meet current and emerging standards.

This project continues to build on previous NOAA OCS investments, including the Integrated Ocean Observing System (IOOS)-funded special project the NOAA OCS: AIS Big Data Project. The outcomes from that effort rapidly transformed 2015 AIS data for U.S. Exclusive Economic Zone (EEZ) waters into “vessel density heat maps,” or raster images (geotiffs), that allow visual and computational means for identifying high concentrations of ship traffic in the areas summarized. The benefits of leveraging the pilot cloud-based cluster workflow developed during the NOAA OCS effort are portability and scalability to larger datasets on larger compute clusters, and the adaptability to summarize other high-volume datasets, such as the 5-year and spatially extensive historical dataset being examined for this project. The expected products developed on this project will collectively benefit agencies, communities, and industries in the US Arctic waters. This is accomplished by applying proven technologies to establish bathymetric survey priorities for planning and improving vessel traffic safety in a rapidly changing environment.

Research Method: Automatic Identification System (AIS) is an internationally adopted tracking system required by most commercial vessels to aid maritime safety, security and environmental protection. Vessels equipped with AIS transponders transmit position reports, speed, and type of vessel, size, cargo, and destination several times a minute. With funding from the State of Alaska, USCG, marine industry and non-Governmental Organizations (NGOs), the non-profit Marine Exchange of Alaska (MXAK) has built and operates an extensive AIS receiving network of over 120 terrestrial receiving stations throughout Alaska, including the Arctic waters. Risk assessments, emergency response, and other maritime applications leverage MXAK real-time information on marine vessel operations.

The research method used for this project utilizes MXAK AIS information that will be used in the NOAA Office of Coast Survey (OCS) Hydrographic Health Model to prioritize areas of the North American Arctic (the U.S. Arctic, in particular) for new or improved hydrographic surveys. During initial investigations in Program Year 4, project team successfully processed and analyzed a very large dataset, which exceeded traditional database management tools.

For the 48 terrestrial AIS receivers located in the Arctic, there are more than 3 million vessel messages received and processed per day. Therefore, AIS datasets contain tens of billions of records for a single year. This immense volume of data vastly exceeds the handling capabilities of traditional databases (such as PostgreSQL or Oracle Database) in a useful timeframe.

In order to overcome the limitations of traditional data storage and processing infrastructure, the project team developed a cluster-computing stack using Apache Spark as the computing engine (see below figure) to rapidly and cost-effectively process the AIS vessel data. Apache Spark allows for parallel processing of data. This stack is horizontally scalable, has high-availability, and is built upon a suite of high-performance open-source technologies that store, process, and provide access to data.

In order to produce vessel traffic summaries for use in the NOAA OCS Hydrographic Health Model, researchers are ingesting raw AIS messages into the scalable network file system. Upon ingesting the data, the research team processes the information via a series of data cleanup and analysis stages on the computing cluster, which are completed in addition to the manual quality control checks already performed on the raw data. Raw AIS messages are then parsed, filtering out any remaining invalid data, and these messages are then joined with the Vessel Identification System (VIS) catalog to link additional

ship metadata. The result of completing this stage is a set of CSV files available on the GlusterFS file system.

The second stage (which initiates late in ADAC Program Year 4 and concludes in Program Year 5) will take these CSV files and use GeoTrellis, an open-source library for performing very large raster operations in a distributed way, to generate “vessel density heat map” raster files. These files will then be ready for input into the Hydrographic Health Model.

By the end of the two-year project, in addition to these static products, users will also have the option of running queries on the computing cluster via interactive Python or Scala shells, or a Jupyter notebook, allowing ad-hoc querying of the vessel traffic dataset to allow end users to work with the vessel density data to draw their own conclusions.

Throughout this approach, the team will produce data analysis products hundreds of times faster than with a traditional database, while also providing users the ability to run ad-hoc queries and apply decision-making for intermediate results.

Upon completion of the project, all project data products are available for USCG and other DHS maritime mission use as well as public use. The investigative team will interact with USCG Project Champions to determine appropriate USCG data destinations for most appropriate operator use. In support of public safety, the project team will provide a dedicated interactive project data portal/website within the Alaska Ocean Observing System (AOOS) Arctic Data Portal. Public access to the underlying data for each product is aggregated and anonymized as appropriate, and is available along with the associated metadata describing the dataset and the processes used in its aggregation or generation.

Throughout the remainder of the project, the research team, in coordination with ADAC leadership will engage with decision-makers and maritime domain experts to gain user guidance and feedback and ensure the products and outcomes of this project meet their needs (the stakeholder steering committee).

Throughout ADAC Program Year 5, the research team will provide updates to the USCG project champion, project advocates and other key ADAC stakeholders, principally through ADAC’s *“Customers and Partners” Roundtable*. In Program Year 5, researchers also plan special webinar demonstrations that will include: live demonstrations of the interactive data products, hands-on exercises, and discussion sessions to gauge the efficacy of the platform.

A critical aspect of the method is soliciting expert opinion from a select steering committee. As initiated in Program Year 4, project team will continue to convene the Project’s *Stakeholder steering committee*. This steering committee of nine members is actively working with the project team to help guide the following project initiatives:

- Determine an appropriate initial scope for the U.S. Arctic Hydrographic Health model to best assign survey priorities in the Arctic;
- Inform the specific input configurations of AIS vessel data attributes relative to the defined scope;
- Evaluate the feasibility of various platforms for a user-driven, web-based tool developed to sort and display user-chosen data queries in the AIS data archive. The tool will not only support bathymetric survey prioritization but management decisions around increasing vessel traffic in the US Arctic;
- Decide on key features and reporting metrics for the data products and web-based tool;

- Inform on the communication and outreach strategy for the life of the project.

The stakeholder steering committee meets quarterly throughout remaining year of project research and are presented with prototype products to promote timely input and feedback as the products are being developed. These meetings illustrate prototype web-based tools that are being developed as well as provide demonstrations using interactive hands-on exercises and discussion sessions to gauge the performance of the web-based tool's chosen platform. Links to product revisions will be provided on the project website and subsequently emailed to stakeholder steering committee members in order to ensure the feedback is efficiently and properly captured in the revisions throughout the remainder of the project. All meetings, demonstrations and workshops will be summarized with a meeting report and minutes to document feedback and recommendations. These reports are posted on the project website to facilitate information exchange, and project tracking by ADAC and the HQ USCG Project Champion.

Project Data Plan: The web-based applications of the vessel density data will be implemented, maintained, and stored through the A00S Data System, which is managed through its technical partnership with Axiom Data Science. The A00S Data System is the backbone of the cyberinfrastructure that is leveraged for this project to acquire, archive, and share marine data and information products. This infrastructure has been developed to meet the guidelines and specifications recommended by the NOAA-funded Integrated Ocean Observing System (IOOS), and endorsed by the federal Interagency Ocean Observation Committee and Global Earth Observation Program.

Communications and Outreach: The project team, with input from the stakeholder steering committee, will have a communications and outreach plan for coordinating additional potential end users who will be interested in fully vetted AIS data and products developed during this project. The project team will continue to participate in the planned ADAC "Customers and Partners" Roundtable, quarterly and annual meetings, and weekly calls in order to inform and receive feedback on project progress. Project information and summaries will also be included in A00S outreach activities, including newsletters, social media posts, and annual reports.

Final Product Demonstration Workshops: Near the end of the project, the project team will convene at least two final webinar capable workshops in Anchorage and Juneau, principally focused on HQ USCG, USCG D17 and the project stakeholder committee. These final workshops will offer introductory training on data product(s) functionality and application, and a demonstration presentation on the user-driven web-based tool. Demonstrations of the web-based tool and its potential scalable approach will also be offered by the project team to interested parties at outside venues, stakeholder meetings, and professional conferences.

Student Participation: ADAC plans at least one ADAC Fellow participant to participate in Program Year 5. ADAC Fellow will continue to assist investigators ingesting AIS source data into the Axiom Spark cluster while also assisting in performing project spatial temporal analysis.

Key Milestones:

1. Convene steering committee meetings (quarterly or more often as needed), Sep and Dec 2018;

2. Prepare and quality review AIS data, to fix any unresolved issues in data from Program Year 4, Sep 2018;
3. Transfer AIS data and optimize high-computer cluster workflow; ingest remaining data by Sep 2018;
4. Implement cluster parallelization of U.S. Arctic EEZ AIS data to assess vessel density pattern, ongoing throughout project, Sept and Dec 2018;
5. Demonstration of vessel density outputs/products to Steering Committee; conduct modifications based on feedback, quarterly meetings, with final review, Sep and Dec 2018;
6. Develop interactive web-based tool to communicate vessel patterns to end users, review quarterly and conduct modifications based on feedback, with final review and presentation, Dec 2018;
7. Demonstrate interactive web-based tool to Steering Committee and other stakeholders; review quarterly and conduct modifications based on feedback, generate training guidance for product training workshops, Dec 2018;
8. Deliver final data products to NOAA OCS for use in the Hydrographic Health Model, 31 Dec 2018. Final products include delivery of processed, quality controlled, and formatted data to NOAA OCS office for use in the Hydrographic Health model. Success is 100% data processed and ingested into the Hydrographic Health model;
9. Provide data available to public on the AOOS and ADAC websites, sharing links to data on the project website, and provide links to the tool made available to DHS S&T HSUP and USCG websites; 31 Dec 2018.
10. Host webinar capable workshops to train and share tool functionality to end users: Based in Anchorage, Juneau AK, NLT Dec 2018.

Performance Metrics: There are two principle goals of the project. The first is to develop summaries of AIS data that can be used directly in the NOAA OCS Hydrographic Health Model used by NOAA to prioritize areas for new or improved hydrographic surveys. This is an effort in quality checking and validating five years of AIS data for the Arctic, and then processing and formatting this quality controlled, extensive dataset so NOAA can use it as direct input to their Hydrographic Health model. This reformatted data product is what will be transferred to NOAA as part of this project, and it is through this model which NOAA prioritizes where they need to initiate or revise bathymetry information. The actual implementation of the NOAA-OCS model is not in the scope of this project, but is an expected outcome of this project.

The second principle goal is to derive additional AIS data products that can be made publically available through a value-added, intuitive and user-driven web-based tool. This tool will take advantage of the large AIS, curated data set(s) hosted by the AOOS data system as well as incoming new data beyond the life of this project, also hosted by AOOS. The tool itself will be made available through the AOOS website, which hosts and maintains and updates the large AIS Data streams and manages the computational infrastructure required to generate these products (e.g., the data product tool engine).

Researchers will evaluate success of their investigations according to the following metrics:

- Delivery of processed, quality controlled, and formatted data to NOAA OCS office for use in the Hydrographic Health model. Success is 100% data processed and ingested into the Hydrographic Health model. The success of the effective transfer of quality controlled and formatted AIS data to

NOAA will be evaluated by continued interaction with the NOAA OCS group applying the data during and beyond the project. This will occur beyond the project as part of the AOOS, IOOS (Integrated Ocean Observing System) and Axiom ongoing partnerships with NOAA OCS. A report will be requested from NOAA OCS near the end of the project to describe their success with applying the data products generated during this project in the Hydrographic Health Model. The project team will share this report with ADAC.

- Quarterly product stakeholder solicitation of data products and increase use-competency of the developing tool. Success of this metric is defined by user-surveys to the steering committee at the various stages in the product development, which will allow assessment of competency in understanding the product, the outputs, tool functionality, while asking for input on other attributes and features the tool should offer. This information will also contribute to the development of a training protocol for stakeholder user groups and final training workshops to be given at the end of the project.
- Public access to the curated AIS data and the user-tool, made possible through the AOOS data system and websites/data portal. Success is defined as the ability of users to create vessel density maps corresponding to U.S. Arctic regions in the Bering, Chukchi and Beaufort Sea areas within the U.S. EEZ using these data and the tool will be evaluated using website tracking (e.g., how many people are accessing this tool via AOOS website), and soliciting voluntary feedback from users on ease of use, purpose of use including organization, and future use needs. The questionnaire will also be available over other websites hosting the links to the tool and data (such as DHS S&T HSUP, ADAC and USCG websites).
- Create and present vessel traffic data products to 50 or more decision-makers and make these products available in a web-based platform for public access. Success of this key outreach metric will be evaluated by the number of outreach opportunities completed, and the publication of the final ship traffic data and associated products on the AOOS Website and associated linked websites (DHS S&T HSUP, ADAC and USCG).
- Document and curate AIS metadata. Success is 100% curated AIS metadata
- Develop technical documentation of data ingestion and prioritization processes utilized on the project to facilitate re-use and workflow scaling for other big-data analysis projects. Success is measured through publication of this technical documentation.

Outcomes/Outputs: This project will produce vessel density grids of 5-years of documented traffic activity across several types of vessels and metrics. This information will be used by NOAA to prioritize the allocation of limited surveying capabilities to improve navigational charting in the U.S. Arctic. Highest priority for surveying and charting will likely be for the routes historically sailed by deeper draft vessels that present the greatest consequences if they ground in Arctic waters. These vessels are large passenger vessels and tankers.

After NOAA conducts the soundings of these waters as per current day standards, the USC, who is responsible for issuing Marine Safety Information Bulletins, will recommend vessels transit advice in these surveyed waters. This was done by the USCG for the Bering Strait region after NOAA surveyed a portion of

these waters where AIS data indicated a majority of vessels were transiting and later went to IMO to establish Routing Measures in the region.

AIS datasets were instrumental in the current PARS for Bering Strait, and will be equally important in the Arctic PARS. USCG's routing measures principally focus on areas where there is high confidence that the soundings of the waters reflect the adequate depth of water, as well as accommodate traditional routes of vessels when the traditional routes are verified to be in well-charted waters and do not present environmental threats. Once these routing measures are established, an outcome will be the USCG watchstanders increased capacity to advance "Arctic Marine Domain Management."

Secondary outcomes include:

- Improved efficiency in vetting, processing and analyzing AIS data that can be used for new research and AIS data applications.
- Use lessons learned from vetted data corrections to improve automated processes for future QC efforts.
- Improved access to the types of AIS data most useful to stakeholders, and the capability to make this information public and visually accessible to those who need or would like access to it.
 - Currently, the AIS data are not available in useful formats to most end-users and the public. This project optimizes a process to take these large datasets and provide outputs in a consistent, application-ready format, regardless of the source.
 - Data will be made available to the public through the public AOOS website and via links on primary stakeholder websites.
- Expanded capacity nationwide for AIS data handling for similar projects.
- Feedback for the USCG where the AIS system needs improvement, which could be used to guide USCG efforts at implementation processes and requirements.

Stakeholder Engagement: The primary customers for these products are USCG (in particular, USCG D17) and the NOAA's Office of Coast Survey. The ADAC team is in frequent contact with the project champion. Project is featured during quarterly ADAC Customer's and Partner's Roundtable. Other primary stakeholders who will also benefit from this project include NOAA's Arctic ERMA, regional vessel operators, state and federal agencies working on maritime, environmental and resource management issues in the region, and the communities across the region who benefit from the decreased risk of vessel groundings, oil spills, and risks to subsistence (food security) activities. Specific project engagement is conducted via multiple agency (including USCG D17) steering committee.

Project Champion: Dr. Jon Berkson, CG-WWM. Project Advocates include: NOAA, Bureau of Ocean Energy Management (BOEM), HQ USCG CG-926, USCG RDC and USCG D17.

Transition Plan: The NOAA-OCS Hydrographic Health Model is currently used to prioritize bathymetric surveying. In Program Year 4, project stakeholders were convened to form a product steering committee and to determine the appropriate scope of this model necessary to achieve survey priorities in the Arctic. The project team also worked directly with the NOAA-OCS on data issues and formatting using trial data

outputs. The relevant quality reviewed AIS vessel datasets are being configured accordingly for final delivery for this application.

Application-ready geotiffs describing AIS vessel densities for use in the NOAA-OCS Hydrographic Health Model were in development in the second half of Program Year 4, and will be completed by the second half of Program Year 5. This step is important for the prioritization of areas for bathymetric surveying, with the geotiffs providing valuable information for decision makers and stakeholders in the U.S. Arctic area by affording insight into vessel traffic patterns. The approach for developing the geotiffs utilizes the high-performance compute stack and job parallelization workflow developed in Program Year 4 to overcome the inability of traditional data systems to reliably and time-effectively handle the large volumes of AIS vessel data. The result from this effort in Program Year 5 will provide improved inputs to the Hydrographic Health Model whilst making those inputs readily accessible for other applications, including a web-based data portal tool that is being developed as part of this project.

By the end of the project in Program Year 5, the project team will transfer final data products in the form of geo-spatial density files to NOAA-OCS for application in their Hydrographic Health Model and to any other applications as discovered through interactions with assigned USCG Project Champion(s) and project advocates, including the project stakeholder steering committee.

The Alaska Ocean Observing System (AOOS) being a regional association of the NOAA funded Integrated Ocean Observing System (IOOS) will act as the transition target for the raw data. AOOS has the processing capacity required to operate on the large data set and implement the HPC methodology by way of an AOOS web-based visualization and plotting tool. The AOOS mission, existing cyberinfrastructure capacity and the organization's strong relationship with major stakeholders to this project establish AOOS as an ideal NOAA partner for transitioning and housing this capability and makes them a valuable partner on this project. By project end, all data and data products generated as part of this effort, namely the 5-year vetted AIS data and the web-based user tool, will be made available to the public on the AOOS data system portal. The tool will also be accessible and made available through links on the DHS S&T HSUP and USCG websites and other interested party websites.

The scale of the computational capacity required to process these AIS data using the methodology developed here and the ongoing AIS data updates makes this tool best served and hosted by the AOOS data system going forward. That said, the methodology used by the AOOS web-based user tool, which processes raw AIS data within an HPC (high-performance computing) environment, can be transitioned to any facility with the necessary compute capacity to support the analysis workload.

All software components produced by this project are built from open source software and thus are portable to other data processing facilities. As such, the source code developed during this project can also be provided as a deliverable or mechanism for technology transfer. The methodology that drives the tool is a series of processing scripts that go from one stage of the process to the next, and these scripts can be run against an Apache Spark cluster, which is an open source, big analysis framework that can be stood-up by an organization with the appropriate resources (human and infrastructure). If there is an interest for the methodology developed as part of this project to be implemented in another facility aside from AOOS, it is recommended that an organizational determination be made as to whether the proposed facility has the appropriate compute infrastructure and personnel with the necessary skills on how to use the HPC resources. Personnel must also understand the open source code and how to implement it.

The outreach strategy and transition plan will guide recommendations and actions for building added utility going forward, such as new visualization options, added features, and data analytics.

Researchers expect to achieve TRL 7/8 for project-developed information products and software applications.

4. PROJECT: The Arctic All-Hazards GIS Platform

Project PI: Dr. Marcus A. Boyd

Lead Institution: University of Maryland

Supporting Team:

Researcher, Joshua House

Researcher, Brady Woods

Project Description

Abstract: The National Oceanic and Atmospheric Administration (NOAA) Arctic Environmental Response Management Application (ERMA) serves an important function for improving U.S. Coast Guard (USCG) Arctic domain awareness. However, increased activity in the Arctic (particularly the U.S. Arctic Extended Economic Zone (EEZ)) demonstrates the need for an all-hazards approach centered on a next-generation geospatial platform capable of displaying, informing, and disseminating data to users from various communities (e.g., the public, non-governmental, state, local, tribal, and federal). This project seeks to provide a web application that matches the state-of-the-art in commercial geovisualization. The project team will work with stakeholders to design, develop, and implement a web-based geospatial tool in an ArcGIS Online format. The research goal is to minimize redundancy by providing an accessible application that meets stakeholder needs. The project team will test presently available options (e.g., ERMA) for user experience, interface, and design. Through creating Alpha and Beta versions, and testing with project stakeholders, the research team will discover areas of needed improvement in coding, display, and usability. The project will result in an Arctic web GIS application and that is driven by HQ and operational level USCG mission needs and requirements. This project blends basic research into cartographic design with the applied research of implementing a webGIS application that uses state-of-the-art technologies and methods and will be compliant with the DHS S&T prototype Integrated Maritime Domain Enterprise (IMDE). The application will be built within the Geospatial Information Infrastructure (GII) under the Geospatial Management Office (GMO) and the Homeland Security Information Network (HSIN) infrastructure and that it will align with existing requirements within HSIN and the GMO. A HSIN Community of Interest will be overseen by the project champion.

Arctic Domain All-Hazards WebGIS

Project assists U.S. Coast Guard with the development of an Arctic all-hazards webGIS built within the DHS Geospatial Information Infrastructure and the Homeland Security Information Network.

- Basic research into U/X and U/I for all-hazards web mapping.
- Coordinating with USCG to include data and views that will quickly assist Arctic Stakeholders.
- Working with the DHS Geospatial Management Office to improve how USCG interfaces with web maps.
- Improving integration of Arctic data sources and spatial layers.
- Serves as a testbed for further development of localized webGIS protals for USCG

Transition: The Arctic All-Hazards WebGIS housed within the GII/HSIN.

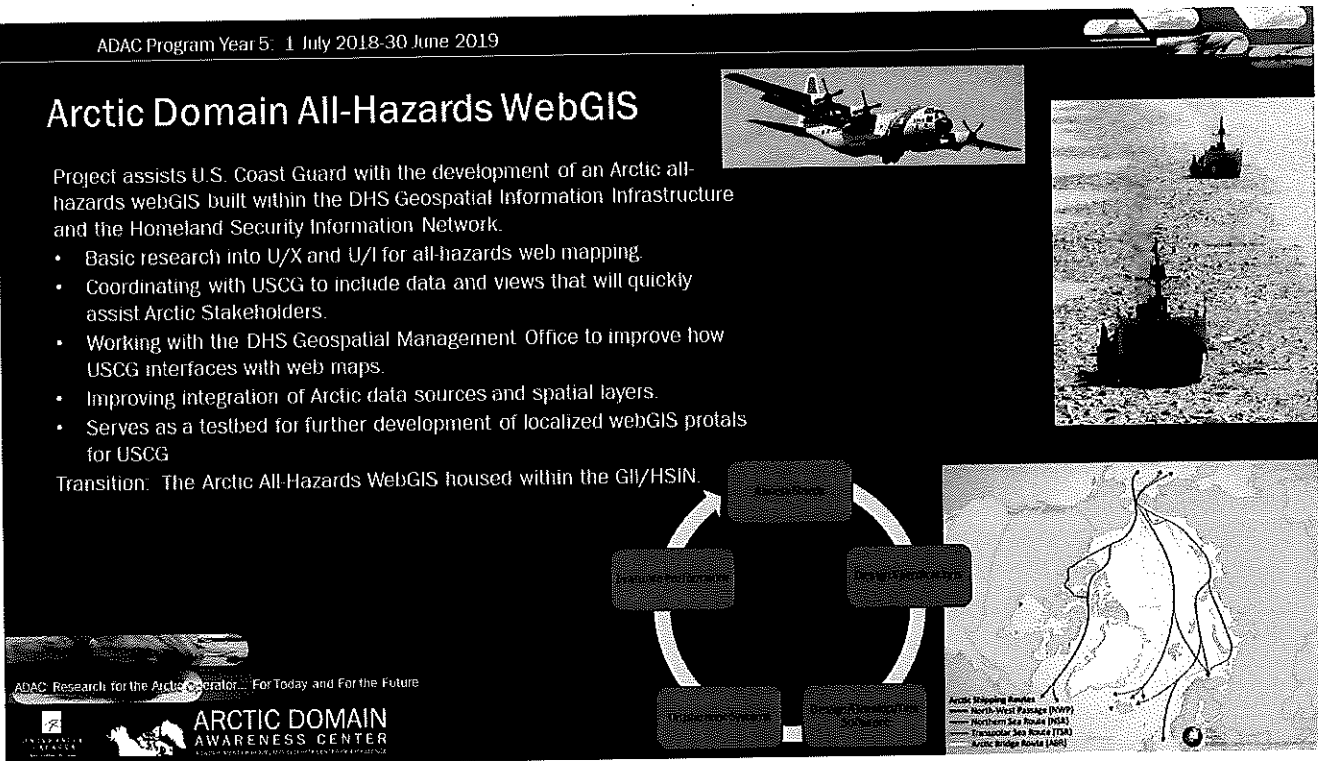


Figure 8: The Arctic All-Hazards GIS Platform Overview

Objective/Purpose: The research goal of this project is to create and transition a web-hosted Geographic Information System (GIS) application for USCG decision makers, oriented to Arctic operations. Accordingly, this webGIS application will improve Arctic Domain Awareness for USCG operational and tactical centers, useful for USCG Watchstanders at Pacific Area (USCG Pac Area), USCG District 17 and District 17's Sector Juneau and Anchorage. Our purpose is to work hand-in-hand with Arctic stakeholders to provide recommendations for a geospatial web application that accommodates an all-hazards approach and to better inform the various communities of interest. We will conduct a review of present web GIS tools and capabilities, and then provide recommendations for a full-scale approach that we will design and implement. The final product will provide a geospatial web platform flexible enough to meet the needs of various types of users with differing degrees of skill level.

Baseline: The advent of Geographic Information Systems and Geographic Information Sciences has led geography to become a more diverse field of study incorporating aspects of traditional geography, computer science, cartography, and information science. MacEachren and Kraak (2001) claim that 80% of generated digital data include geospatial referencing. This figure has only increased in the ensuing years. The ready availability of georeferenced data has led to an increased demand for geovisualization. For MacEachren and Kraak (2001, 3) this leads to a challenge: "how to transform these data into information, and subsequently into knowledge."

Data are becoming more diverse and plentiful and the outcome is an expectation that geographers will visualize more data. This is an issue Geographic Information Scientists share with statisticians like Tufte (2001) who provides an outline for "graphical excellence" that parallels much of the language from Tyner.

Amongst other things, Tufte (2001, 13) calls for statistical graphics to be “communicated with clarity, precision, and efficiency.” He continues by urging that “the viewer” should not become preoccupied with “methodology, graphic design, the technology of graphic production, or something else.” In other words, Tufte calls on statisticians to visualize their data in a way that makes the analysis clear, approachable, but not overly visualized to the point where the visualization moves from an aid to understanding results to an object of study in and of itself. For Tufte (2001, 13), “graphics reveal data.”

Web-based cartography faces persistent challenges (Çöltekin et al. 2017). One significant issue is the shift in how maps are being used. Roth et al. (2017, 61) suggest that map *readers* have become map *users* (emphasis theirs). Centuries of knowledge and theory relating to cartographic design has affected how people use maps. In short, users and the technology shifted, but the techniques and methods have lagged. Static maps are easily understood because centuries of usability testing and socialization has gone into our collective understanding of them (Tyner 2005).

However, the added complexity of a user interface requires that cartographers consider usability in entirely different ways (Field and Demaj 2012). Typically, web-based mapping applications have placed too much attention on traditional methods of cartographic design or simply disregarded cartographic design completely. However, Fuhrmann et al. (2005, 554) argue for user-centered design modeled after human-computer interaction studies.

The present interpretation is that web mapping applications are a new and unique method for displaying data (Montello 2009; Virrantaus 2009; Roth 2017). As such, the goal with this project is to elucidate the “perceptual, cognitive, cultural, and practical considerations” (Roth 2017, 61) required to successfully design and implement a web-GIS applications for Arctic Domain users.

NOAA’s Arctic ERMA is a web GIS tool designed to aid in emergency response and restoring habitat. The goal of Arctic ERMA “was to improve access to critical information on the location of resources needed to respond to oil spills in the Arctic and to develop electronic response infrastructure for use in the Arctic” (Arctic ERMA Final Report). However, there is a need to improve the interoperability, usability, and function of a platform critical to the Arctic and maritime domains.

Arctic ERMA provides some of the capabilities required for an all-hazards approach to changing natural and geopolitical issues in the Arctic, but ERMA lacks the ability to serve as an easy-to-use hub for users from multiple agencies, civilians, and non-profit organizations. ADAC’s prior Arctic Information Fusion Capability (AIFC) project cataloged data sources useful to Arctic operators and developed use cases oriented to Arctic operators, now contained in Arctic ERMA. AIFC also made further Arctic environmental information enhancements to Arctic ERMA to support USCG D17 watch stander requests.

The USCG’s Search and Rescue Optimal Planning System (SAROPS) is a desktop-based ArcGIS application for modeling maritime search areas. Using a Monte Carlo simulation, the tool outputs probable search areas. As this is a desktop tool, it requires users to use a traditional desktop – or laptop – computer. The results from the model runs could, however, be displayed on a WebGIS application and these data could be stored and compared with locations of actual findings to aid in evaluating error rates, but more

importantly, to increase the dissemination of search areas if needed. The variables needed for SAROPS can also be displayed and housed in a webGIS system allowing for a single repository.

The Arctic Spatial Data Infrastructure (Arctic SDI) is a cooperative agreement between the government agencies of Canada, Finland, Iceland, Norway, Russia, Sweden, USA, and Denmark. Their webGIS application provides general information and data layers for the Arctic, but it lacks the ability to assist in all-hazards risk mitigation and response. Arctic SDI does have a strong ontology of the data they do possess and this project will seek to build on Arctic SDI and ERMA.

In many respects, NOAA and NGA have been leaders in the development of webGIS portals to support hazard response. NOAA and the National Weather Service consistently push data to the public, other government agencies, and non-profits via an ESRI ArcGIS Online platform. NGA's response to the Ebola Crisis in 2014 included the public release of 495 of their data layers, various applications, products, and other data via an ESRI ArcGIS Online platform. This information aided the international efforts and provided information to aid in the response. Presently, NGA hosts the Combating Wildlife Trafficking (Community of Interest) ArcGIS Online portal. It provides data layers, map products, reports, and reference materials to whomever is interested and includes a login and password for sensitive data. Building out an application that will foster wider dissemination of data sources, reports, and analysis will aid the USCG and other stakeholders. In times of crisis, the tool can be used to disseminate information to the public and non-profits and serve as a primary repository for geospatial data relating to the Arctic.

Arctic ERMA serves an important function; however, the increased activity in the Arctic demonstrates the need for an all-hazards approach centered on a next-generation geospatial platform capable of displaying, informing, and disseminating data to users from various communities (e.g., the public, non-governmental, state, local, tribal, and federal). Accordingly, this project seeks to provide a web application that matches the state-of-the-art in commercial geovisualization.

The Geospatial Management Office (GMO) within the DHS Office of the Chief Information Officer oversees the DHS NOC Common Operating Picture, the Homeland Security Enterprise Geospatial Concept of Operations and works with others to construct and maintain the Homeland Security Infrastructure-Level Data (HIFLD). The GMO also maintains the DHS Geospatial Information Infrastructure which can be accessed through the Homeland Security Information Network (HSIN). Within HSIN, there are numerous web GIS common operating pictures and other web GIS standalone products.

Methodology: Project method is a comprehensive geospatial web GIS, based technology research and development, which integrates project research into an existing government, sponsored and supported data and geo-spatial knowledge platform. The goal of this project is to create a web tool, via specific research that advances user interface and associated capabilities of an existing system architecture to better meet the needs and requirements of the Arctic Domain stakeholder community. In order to achieve this goal, research team has planned for project methodology to proceed in six phases:

- Phase 1 will outline a functionality and feasibility of Arctic ERMA.
- Phase 2 is the building of the web application.
- Phase 3 and phase 4 are the alpha and beta releases.
- Phase 5 will transition the application to government stakeholders.

- Phase 6 will serve as verification and validation of the new web application.

Phase 1: Benefits, Limitations and Usability: In order to better understand the benefits and limitations of ERMA, Research Team will assess ERMA's capabilities with a focus on usability and functionality in comparison with other available options in use by the U.S. government. This project will include surveying undergraduate and graduate students about the usability of two web applications. The research team will adhere to all requirements set forth by the University of Maryland's Institutional Review Board (IRB) and the PI of the project will be personally responsible for overseeing the cognitive interviewing and in maintaining the confidentiality of those interviewed and surveyed as a part of this project. We believe there is an exceptionally low probability of any lasting effects on those surveyed and/or interviewed for this project.

1.1: Eye Tracking: We will begin by conducting usability testing with the platform by engaging in eye tracking methodology. We will use Qualtrics, a robust online data capture platform for the first round of usability testing. Qualtrics includes hot spot data capture, wherein an image is presented to the user, and the user is instructed to find certain functionality in the platform. For example, we may ask respondents – all of whom are in residence at START - to the eye tracking survey to find the search functionality, and then record how many are able to locate the search bar in the image, and record the length of time it took for the respondent to find the search bar. In this way, we will be able to identify the functionality that is intuitive to the user, and also capture those tools that are less obvious to users. We will work with key stakeholders to determine which functionality to test using hot spot methodology.

Following, the research team will engage in a second round of usability testing using heat map data collection. Heat mapping is similar to hot spot capture in that users are presented with an image and asked a series of questions about that image. However, in heat mapping, there are no "right" or "wrong" answers – instead, users are asked to perform more open-ended tasks, like "click on the first thing your eye saw when looking at this image." We can use the data from heat mapping to better understand what on the page is holding users' attention, what is going unnoticed, and how users are interfacing with the platform.

Project team plans to invite approximately 50 undergraduate and graduate students who will all be at the University of Maryland for START's summer program to participate in a survey during the early stages of the research. The sample size for eye tracking and hot spot analysis vary greatly and is focused on reaching a convergent understanding of the usability of a website. For example, Russell (2005) had a sample size of 36 to review three websites. Hornof and Cavender (2005) piloted their study with ten participants and in the final evaluation study, the research team selected four participants. On the other extreme, Djasasbi et al. (2010) used a sample of 98 participants. The main difference in the methodology of the three studies is that in both Hornof and Cavender (2005) and Russell (2005) the studies had a very narrow focus whereas Djasasbi et al. (2010) had participants review fifty randomly selected websites. The increase in response burden caused Djasasbi to need a larger sample size. As the focus of this project is a singular website, it is assessed that a sample of roughly 50 will provide robust results. These students come from a wide array of disciplines, demographic characteristics, and levels of content knowledge to participate in the usability testing. The survey participants will have at least an introductory-level.

understanding of emergency management/preparedness, terrorism studies, geography, and/or GIS.

Project team will include a series of questions in the methodology to ascertain participants' level of familiarity with each of these topics as well as other key demographic characteristics. This approach will allow researchers to determine differences in preferences for casual and power users:

- Casual users: students with little knowledge or in allied fields that may only use these kinds of data sporadically.
- Power users: those students with more advanced knowledge, in a field of study directly related to the project, or who have ambitions that may put them in contact with data like these regularly.

Project team plans in using students for two reasons: first, University of Maryland's START Center produces the next generation of thought leaders in emergency preparedness and terrorism studies, who may have insights that bring innovation to the research. Second, project team seeks to find cost efficiencies as good stewards of these research resources.

Using the results from the hot spot and heat mapping data capture, project team will refine the layout, tools, and structure of the new platform to respond to issues uncovered during analysis. Those tools not seen as "intuitive" will be redesigned or reformatted to make them more accessible. Those tools and graphics that are clearly helpful will be retained and refined in order to minimize user error and maximize usability.

During usability testing, project team will capture data on Qualtrics' survey platform. Qualtrics is Federal Information Security Management Act (FISMA) compliant, uses Transport Layer Security (TLS) encryption, and data are stored in a single secure data center (not a cloud-based system). While we will collect pertinent background information on respondents, all usability data collection will be done anonymously; researchers will not collect any personally identifiable information (PII). Project team will deploy the survey using Qualtrics' secure email client, sending a unique URL to all identified graduate and undergraduate respondents.

1.2: Cognitive Interviewing:

Concurrent with usability testing, researchers will engage in cognitive interviewing at University of Maryland's START center. Cognitive interviewing is a method of pre-testing products that involves in-depth interviewing, paying particular attention to the mental processes respondents use to navigate the platform (Campanelli 2007, 54). Cognitive interviewing uses a framework dependent on evaluating products against their outcome objectives, including the research questions the platform is designed to answer, and to what level of accuracy respondents can provide data in response. It is dependent on a "think aloud" technique that encourages respondents to "verbalize thoughts while engaged in a cognitive activity with little interjection by the interviewer other than" to keep the respondent thinking out loud (Willis and Lessler 1999: 135). In engaging respondents in this exercise, their cognition is slowed while not impacting their task performance; that is, the act of asking respondents to think aloud while using the platform does not necessarily change their interactions with the platform, even though it causes them to move through the survey more slowly (Ericsson and Simon 1984).

The Research Team will begin by developing a cognitive interviewing protocol. This guide will include question probes and prompts to keep respondents thinking aloud. It may include probes asking respondents to summarize the task at hand:

- For example, “in your own words, what are we trying to accomplish here?”), to rate the task (for example, “how easy or difficult was it to find this answer?”), and to define specific words, phrases, or symbols on the page (for example, “what do we mean by the word “reset”? or “what does this small dot represent here?”).

Once the protocol is established, researchers will recruit a set of approximately five undergraduate and graduate students to participate in cognitive interviewing. Blair and Conrad (2011, 637) state that “one of the few explicit discussions [within cognitive interviewing methodology] of sample size largely supports small samples.” Willis (2005, 226-28) notes that statistical estimation is not the purpose of cognitive interviewing: “...we do not evaluate the [item being tested] simply by counting the number of interviews in which a problem occurs.” Lastly, Blair and Conrad (2011) state that careful selection of interview subjects counteracts issues that could occur with small sample sizes. The interview subjects have been carefully selected from a larger sample and were selected based on the variety of their skills and experience with geographic information systems and demographic characteristics. The purpose of cognitive interviewing is to understand the prevalence of an issue. Blair et al. (2006) found that five interviews will help the project team to identify the major issues with the platform; while adding more interviews may increase the likelihood of finding additional minor issues, it does not necessarily lead to the discovery of additional major issues. Likewise, because we are conducting usability testing in the form of eye tracking and hot spot analysis, the results of the cognitive interviewing will augment findings from these other forms of testing; the combination of methods will produce the most robust results, identifying issues in the platform (Houle 2009). The interviews will last 60 to 90 minutes, will be audio recorded and have screen capture, and be conducted by methodologists trained in cognitive interviewing practices.

Project researchers will use the results of the cognitive interviewing lab to identify the strengths and challenges of the platform. The team will retain the low burden elements of the platform, and engage in refinement and redesign of those elements identified as having high cognitive burden.

For the cognitive interviewing lab, researchers will ask all respondents to sign a consent to participate form outlining the risks and benefits of participation. Project team will store these forms in accordance with University of Maryland records retention protocols. Project team will audio record the interviews, however, researcher will not ask the respondents to provide personally identifiable information during the interview so that the data are de-identified. Project team will store the resultant audio and capture files on START’s secure internal server, maintained in accordance with University of Maryland’s information protocols and in accordance with ADAC’s Information Protection Plan (ADAC’s IPP).

1.3: Research Brief: Research team will deliver a research brief to detail the findings of the cognitive interviewing and the eye tracking/hotspot survey. It will include recommendations for improvement to ERMA and recommendations for an all-hazards Arctic GIS platform. The research brief will be a publically releasable document detailing the findings from the cognitive interviewing and from the eye tracking survey. The goal of this research brief will be to detail our findings for the

general community of scholars and to provide further insight in to best practices for visualizing spatial data that will inform our web-based GIS platform.

Phase 2: Build a Web GIS Platform:

2.1: Selecting a Web GIS Platform: Currently, there are numerous off-the-shelf solutions for building a web GIS platform. Project team believes the Environmental Systems Research Institute's (ESRI) ArcGIS Online platform is the most flexible and parsimonious platform. It has been approved for use by various government agencies and is now the platform used on the Homeland Security Information Network (HSIN) and the Geospatial Information Infrastructure (GII), for many of NOAA's online mapping projects, and is how the National Geospatial-Intelligence Agency shares public use data. Research team has been given a community of interest within HSIN and server space in the GII to leverage ESRI's platform as the basis for the new Arctic all-hazards GIS platform.

2.2: Data Acquisition: This project will require third-party data. The third-party data to be used is all public-use data provided freely by the U.S. government. Like Arctic ERMA, our project seeks to bring together the relevant data and APIs in one location for Arctic community stakeholders. We plan to pull data from NOAA, NWS, USCG, NGA, etc. These data are all public-use and available for anyone who wants to use them. These data provide demographic, economic, political, social, and security indicators and estimates. These data will be used to display information to users of the Arctic All-Hazards Web GIS Portal and all of these data sources are available on open websites for public consumption. If the stakeholders and/or project champion suggests inclusion of data that are not currently publically available, we will ensure that the data are not classified. The ship tracking (i.e., AIS, S-AIS, and VMS) will be incorporated as a requirement from USCG. The team will work with points of contact at HQ USCG and the USCG research and Development Center to link these feeds to the Arctic Web GIS. The web application will be housed in HSIN/GII which will allow the owner of the application (USCG) to define and manage authorized user levels. The research team will also link the GMO's existing, applicable, data streams to the new application.

All data will be stored within enterprise servers maintained by the GMO, HSIN, and the Office of the Chief Information Officer (OCIO) of the Department of Homeland Security. Data feeds for this project are supported by the GMO. The research team expects no data to be maintained or stored on University of Maryland Servers. In the event that any data is stored or created at the University of Maryland, it will be stored on EMC Isilon storage arrays housed at the University of Maryland, College Park in accordance with ADAC IPP. EMC Isilon is a leading provider of highly redundant and ultra-scalable data storage. Storage utilization is managed by quotas that can be adjusted within a day. Snapshots, replication, and backups for the data stored through the Networked Storage Service address various levels of data protection requirements. Opting for the SAN solution, researchers can choose from different tiers of storage with varying performance and capacity characteristics to meet their needs. All data on these disk storage arrays are backed up. The EMC Isilon storage used for this project will only be accessible by University of Maryland's START's head of Information Technology (IT) and the Geospatial Research Unit. It is important to emphasize: no sensitive information will be stored or collected at the University of Maryland and the GMO's

ArcGIS infrastructure is rated at FISMA Low. Representatives from HSIN and the GMO will be consulted if there are any questions about sensitivity of a data source.

During ADAC Program Year 3, as the Center's AIFC project, team developed a catalog of data sources and feeds. They uncovered roughly 1,800 data feeds relevant to the Arctic. Our research team will use these data sources as a baseline and work with the stakeholders and project champion to incorporate sources that they deem as suitably useful for the overall project. In addition, our student interns will assist with discovery of new and potentially useful data sources.

A major thrust in geospatial analysis is data discovery and aggregations. By incorporating students in this process, it provides hands-on experience with discovering data, identifying useful data, and how to structure geodatabases. Given the numerous sources of potentially relevant Arctic data, the project team will provide informed recommendations and the stakeholders and project champion will have final purview on which data sources should be included and which should not.

During Phase 3 and 4 of the project, the research team will collect feedback from the Alpha and Beta testers. These data will be aggregated into use cases and will not be identifiable to individual respondents.

2.3: Developing the Display: Research team will build a splash page identifying the tool as a U.S Government website and will provide full information relating to monitoring.

Phase 3: Alpha Release: Research team will publish the web application Alpha release and conduct a structured, Alpha testing of the application to collect feedback from Research Team staff and government stakeholders. Research Team will open the Alpha Release to the project's intern cohort and the project champion (USCG). The purpose of the Alpha test is to ensure that obvious errors and issues are discovered before wider release. A comment period will aid in refining the web application based on comments and feedback. Comments and suggestions will be coded and refined into use cases that we can use to better understand user needs and requirements. This information will be compared with previous discussions to ensure that development continues at the appropriate pace and with the correct set of users in mind. The PI and research team plans to discuss the Alpha release with stakeholders and ingest comments and suggestions that can then be fixed, modified, or added into the web application. The goal for the Alpha release will be to identify user issues and allow for guidance from the user community.

Phase 4: Beta Release and User Guide:

4.1: Beta Release: Research team will publish the web application Beta release and conduct a structured, Beta testing of the application to collect feedback from Research Team staff and government stakeholders. Research Team will schedule a comment period and will refine the web application based on user comments and feedback. The Beta test will be opened to the Alpha testers and any additional testers identified by the stakeholders and Project Champion. The comments and suggestions will be compared to the use cases developed during the Alpha release to ensure that the most vital issues and concerns are being met and that the usability of the tool remains consistent. The Beta release will serve as the final testing period and will incorporate the agreed-upon comments and suggestions gained from the Alpha release. The Beta release will also coincide with detailed discussions with USCG, the Geospatial Management Office, and HSIN, as we solidify the transition from our test server to HSIN. The project team has already been in

communication with HSIN within DHS OCIO and will maintain contact with him and/or other representatives at HSIN and the OCIO as the project progresses. The goal of the Beta test will be to show stakeholders and the Project Champion that major issues discovered during the Alpha test have been rectified, to show that the application is stable, and to allow for further comments and recommendations.

4.2: Data User Guide: Research team will develop an interactive step-by-step user guide to orient new users to the Web Application. The Guide will be available as a menu in the web application.

Phase 5: Prep for final delivery (Go Live): (December 30, 2019).

1. Consultation with USCG, GMO, and HSIN to discuss final steps for handing off the application including guidance on final requirements and needs for application to Go Live.
2. Application onboarding documents (User manual, technical manual) review and approval by Arctic Stakeholders.
3. Platform Testing to include Browser and Device support levels (operating system and browser combinations), connection speed, Content Audit, Crawl errors (missing pages/links after Go Live), and Security.

After comments are incorporated from the Beta release, Research Team will prepare the application for integration by the government taking into consideration technical requirements and the availability of resources, which the Research Team and project champion will address during the life of the project.

Phase 6: Usability Study:

The Research team will conduct an additional round of usability testing and cognitive interviewing on the new platform. Wherever possible, we will use the same protocols as were used to test the ERMA platform in Phase 1. That way, we can compare the high burden and poor usability issues of the ERMA platform to our efforts to mitigate these issues in the newly developed platform. As previously discussed, research team will deploy a Qualtrics-based hot spot and heat mapping questionnaire to approximately 50 undergraduate and graduate students. Research team will cognitively test the new platform with a new set of 9 students. We will incorporate the results of this testing into a research report outlining the value-added components of the new tool (as compared to the current ERMA tool) as well as recommendations for future refinements or additions to the new platform. Research team expects that the new tool will outperform the current platform, and by comparing usability and cognitive testing, we can highlight these differences in performance.

Student Participation: Throughout the project, project team will include four to six undergraduate- and/or graduate-level interns to assist in gathering data and testing the web GIS platform. The geospatial research unit has a longstanding history of recruiting highly qualified interns from the University of Maryland and other universities around the world to learn and grow as geospatial analysts and geographers. The research team plans to work with students to further develop their technical skills as geospatial analyst and provide a unique opportunity for young scholars to contribute to research projects. Project PI will supervise student participants on open-source data collection, raster and vector analysis, automating geo-processes, and various geospatial methods for modeling environmental systems to curate data for publication to the web application. In addition, interns will also make significant contributions to

the development of associated metadata and data standardization between common data layers. The students will be introduced to qualitative and quantitative methods of analyzing and visualizing geospatial data and will take part in data discovery efforts and in testing the application. The students will be mentored throughout the project and will gain solid, practical geospatial experience that can be directly applied to the field.

The students planned to participate beginning in summer 2018 are as follows:

<i>Name</i>	<i>University</i>	<i>Year</i>	<i>Duties</i>	<i>Benefit</i>
<i>Katarina Jerman</i>	Penn State University	MA	Open-source data collection; Assist drafting the user guide; application testing	Will gain experience with data collection and handling. Will gain experience with professional writing and will gain experience with web mapping best practices.
<i>Brett Kulka</i>	University of Maryland	Senior	Open-source data collection; data aggregation and validation; application testing	Will gain experience with data collection and handling. Will learn how to aggregate and validate data sources and will gain experience with web mapping best practices.
<i>Peter Lay</i>	University of Maryland	Junior	Open-source data collection; application testing	Will gain experience with data collection and handling. Will gain experience with web mapping best practices.
<i>Alejandro Pugh</i>	University of Maryland	Senior	Open-source data collection; data aggregation and validation; application testing	Will gain experience with data collection and handling. Will learn how to aggregate and validate data sources and will gain experience with web mapping best practices.
<i>Hilary Sandborn</i>	University of Maryland	Sophomore	Open-source data collection; application testing	Will gain experience with data collection and handling. Will gain experience with web mapping best practices.

Key Milestones: The following “waterfall” graph illustrates the 6-phase research project planned schedule. Details describing each phase is provided below the graph. The schedule was originally planned with a start date of 1 May 2018. Project team will adjust the schedule to coincide with the actual approved start date, when that date is determined.

		2018					2019												2020		
Task ID		Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan		
	Start																			End	
1	8/1/2018					Phase 1														11/31/2018	
1.1	8/1/2018																			8/31/2018	
1.1	9/1/2018					Usability Testing														9/30/2015	
1.2	10/1/2018					Cognitive interviewing														11/30/2018	
1.3	11/1/2018					Research Brief														11/30/2018	
2	12/1/2018												Phase 2							4/30/2019	
2.2	12/1/2018												Data Acquisition							4/30/2019	
2.3	12/1/2018												Develop ArcGIS Online Platform							4/30/2019	
3	5/1/2019												Phase 3							6/30/2019	
3.1	5/1/2019												Alpha Release							6/30/2019	
4	7/1/2019													Phase 4						9/30/2019	
4.1	7/1/2019													Beta Release						8/31/2019	
4.2	7/1/2019														User Guide					9/30/2019	
5	10/1/2019																	Phase 5		1/31/2020	
5.1	10/1/2019																	Final delivery		1/31/2020	
6	12/1/2019																	Phase 6		1/31/2020	
6.1	12/1/2019																	Usability Study Re		1/31/2020	

Phase 1: Meeting Notes. The kick-off meeting with Arctic stakeholders will identify the direction of the project and the ideal outcomes of the project (August 30, 2018).

Milestones:

1. The Principal Investigator (PI), with the assistance of the Project Team, will consult with Arctic stakeholders to organize the project kick-off meeting.
2. The PI, with the assistance of the research team will compile the detailed stakeholder feedback.
3. Research team will submit the meeting notes report with outcome of the meetings and onward steps.

1.3: Research Brief. Research team will develop the research brief detailing the findings of the usability study on Arctic ERMA (November 30, 2018).

Milestones:

1. The Principal Investigator (PI), has already submitted the cognitive interviewing protocol and the survey to the University of Maryland Institutional Review Board (IRB) (May 18, 2018).
2. The Principal Investigator (PI), with the assistance of the Project Team will organize/conduct cognitive user interviewing (October 1, 2018).
3. The Principal Investigator (PI), with the assistance of the Project Team will organize/conduct the Eye tracking exercise (September 1, 2018).
4. The Principal Investigator (PI), with the assistance of the Project Team will draft a report and recommendation of the analysis of the eye tracking and cognitive interviews (November 30, 2018).

Phase 2

2.2: Data Acquisition: Research team will compile all the public-use data needed for the all-hazards web GIS application (April 30, 2019).

Milestones:

1. The Principal Investigator (PI), with the assistance of the Project Team will compile all recommended stakeholder recommended data and ready for inclusion into the web GIS platform. (April 30, 2019)
2. A feature list will be created based on meetings with stakeholders.

2.3: Develop ArcGIS Online Platform: Research team will design and develop the ArcGIS Online Portal internally (development platform), (April 30, 2019).

Milestones:

1. The Principal Investigator (PI), with the assistance of the GIS Researchers and Web Developer will develop and build in the internal development platform the web GIS portal.
2. Research Team will commence internal testing of the web application.

Phase 3: Alpha Release: Research team will publish the web application Alpha release for stakeholder testing (June 30, 2019).

Milestones:

1. The Web developer, with the assistance of the GIS Researcher will publish the alpha web application.
2. Research team will schedule a web application testing comment period
3. Research team will compile and prioritize received comments and suggestions for improvements for beta release
4. Progress will be defined based on USCG list of requested and/or required features at the alpha stage.

Phase 4

4.1: Beta Release: Research team will publish the web application Beta release for stakeholder testing (August 31, 2019).

Milestones:

1. The research team and web developer will incorporate changes from the Alpha release in coordination with stakeholders and the project champion.
2. The Web developer, with the assistance of the GIS Researcher will publish the beta web application.
3. Research Team will schedule a web application testing comment period.
4. Research Team will compile and prioritize received comments and suggestions for improvements for beta release.
5. Progress will be defined by the incorporation of user feedback from the alpha release.

4.2: User Guide: Research team will develop the web application user guide (September 30, 2019).

Milestones:

1. Research Team will develop an interactive user guide that will be incorporated into the Web application.

Phase 5: Prep for final delivery (Go Live): Research Team will prep for final delivery enabling Government sustainment of the web application (January 31, 2020).

Milestones:

1. Research Team will incorporate comments from Beta testing (October 31, 2019).
2. Research team will continue weekly discussions with GMO and USCG on handing off the application. (NLT November 30, 2019).
3. The Project Team, under the supervision of the Project PI will work with representative from GMO and USCG to facilitate USCG maintenance of the application. (NLT December 31, 2019).
4. Arctic stakeholders will provide comments, guidance, and approval of the government sustainment plan to USCG, the Research Team, HSIN, and the GMO (NLT December 31, 2019).
5. Research Team will transition (Go Live) completed web application (NLT January 31, 2020).

Phase 6: Usability Study Report. Research Team will author publishable academic research detailing our findings relating to usability with suggestions for best practices (January 31, 2019).

Milestones:

1. The Project PI with the assistance of the research team will draft a report detailing the findings of the project for ADAC Leadership quality review (NLT December 31, 2019).
2. Research Team's Research Director will provide comments and guidance to the PI and the research team (NLT January 10, 2020).
3. The Project PI will submit the revised final (draft) report to ADAC Leadership for comments and guidance (NLT January 20, 2020).
4. Arctic stakeholders provide any comments and guidance to the PI (NLT January 25, 2020).
5. The Project PI will submit the final report to ADAC (NLT January 31, 2020).

Key Stakeholder Engagement Plan: The PI and the team will work with the USCG, (in close coordination with ADAC leadership and the HQ USCG Project Champion), HSIN, the GMO, and other stakeholders throughout the project to ensure that we build a platform that is useful to USCG needs and requirements. Principally, we seek to understand, at an unclassified level, what types of data are available for inclusion into the new web application. We will also discuss with the relevant stakeholders across the whole of government and industry what types of functionalities they are interested in or will find useful.

Project Champion: Hank Blaney, CAPT (Ret), USCG. Project advocates (who are planned to join the steering committee): Personnel (as coordinated with Project Champion from HQ USCG CG926, USCG PAC Area, D17 and R&D Center. The primary operational customer for this product is the 17th U.S. Coast Guard District, and the tactical customer is U.S. Coast Guard District 17 Sector Anchorage. Lew Summers and Marigny Boyd will serve as points of contact from the GMO and HSIN, respectively.

The PI will engage Capt (Ret) Hank Blaney, the project champion on a frequency basis as determined by the CAPT (Ret) Blaney, but as a minimum twice a month. Critical coordination is planned with Mr. Robb Wright of NOAA's Office of Response and Restoration and Ms. Lorna Schmidt of the U.S. Geologic Survey, who serves as the U.S. point of contact for the Arctic Spatial Data Infrastructure (SDI). The PI will reach out to the National Geospatial-Intelligence Agency to determine their interest in serving as a project advocate and collaborators.

Throughout the research, the project team will remain in close coordination with ADAC leadership and USCG mission users. The project team plans to meet with the project champion, other USCG personnel as defined by the project champion and personnel other government agencies at the discretion of the project champion (as decided in advance/at the kick-off meeting). We then plan for bi-weekly calls during Phases 1 and 2 of the project. The purpose of these bi-weekly calls will be to discuss the survey roll-out, survey results and findings, and to detail the cognitive interviewing. We plan for weekly phone conferences during Phases 3 through 6. We are planning for monthly face-to-face meetings with the project champion and other stakeholders as their schedule permits throughout the life of the project, seeking to meet on a quarterly basis. The project team requests ADAC leadership participation in all of these meetings throughout the life of the project.

The PI and select members of the project team will participate in the quarterly Customers and Partners Roundtable and the ADAC Annual Meeting in Washington, DC.

Performance Metrics:

- Number of stakeholders engaged and generation of requirements.
- Formation and number of members on Steering Committee.
- Number of stakeholders that accept requirements specifications.
- Design and documentation of system architecture, use cases, and test cases.
- Number of successful customer acceptance tests.
- Number and impact of peer-reviewed publications/presentations.
- Develop ArcGIS Online Platform. Suitable parameters consist of the following:
 - Complete initial data identification and collection.
 - Complete data processing and standardization procedure for inclusion in WebGIS application.
 - Complete developer testing for Alpha release.
 - Provide the Alpha Release. Suitable parameters consist of the following:
 - Users will provide comments and feedback regarding the user experience and overall usefulness of the application.
 - The research team will evaluate user feedback for inclusion in the Beta release. Feedback will be evaluated and prioritized based on relevance to the application and feasibility of implementation prior to Beta release.
 - Provide the Beta Release. Suitable parameters consist of the following:
 - The research team will incorporate user comments and feedback generated from the Beta release prior to the delivery of the final application.
 - The research team will develop the web application user manual based on the final version of the application.
- Prep for final delivery (Go Live): Suitable parameters consist of the following:
 - Technology transfer: The research team will coordinate with HSIN/OCIO to transfer the application to DHS-controlled server(s).

Outcomes/Output: The outcomes of the project will result primarily in developing a new capability for the USCG as they do not presently have an Arctic Web GIS product and have been relying on NOAA's Arctic ERMA as a dissemination tool. This new tool will meet USCG decision support needs via enhanced data feeds, user interface, and will be owned and controlled by the USCG. The research team plans the web application to be suitable for USCG decision makers at regional level use, in context of Arctic mission needs.

Other items produced by this project will include: a research brief, usability study, and user guide. The GIS application is intended to serve as the USCG Arctic web GIS interface and is highly useful to serve as a pilot for other all-hazards web GIS applications. The research brief will present initial findings from the research project's eye tracking and hotspot survey. The brief will detail general usability issues. The usability study will present the overall usability findings from the project and will serve as the basis for multiple academic publications. The user guide will serve as a means by which users can navigate the web application.

Transition Plan: Concluded research will result in the creation and refined Arctic web GIS application for USCG operations. Transitioning the research will be coordinated with Project Team, ADAC leadership, the HQ USCG Project Champion, HSIN, and the GMO. Coordination will involve Commandant USCG CG-926, USCG Pac Area and USCG D17 personnel as well as USCG R&D Center, and DHS OCIO Geospatial Management Office. ADAC's Research to Capability Process (as described in ADAC Annual Year workplan) will be utilized. While USCG Project Champion and key USCG stakeholders will be involved via the steering committee from beginning through transition, the key milestone transition phase starts once research reaches "Phase 5" Prep for final delivery (Go Live).

Transition destination will be within the DHS HSIN Geospatial Information Infrastructure (GII). The research team has held initial discussions with an OCIO HSIN representative who confirms planned research and the resulting application is feasible and suitable to be housed within GII. Subsequent meetings with government POCs from HSIN and the GMO have confirmed that the GII will host and house the application. HSIN and GMO representatives have provided the project team with access within HSIN and the GII to develop the application. The Project Champion will assist in granting any person with a HSIN account access to the community of interest.

Accordingly, coordination meetings with HSIN and GMO staff will continue monthly throughout the project with weekly or bi-weekly (depending on HSIN and GMO staff availability) occurring after the alpha stage. The project team will work with HSIN and GMO staff to ensure that the project build occurs smoothly. At the outset of the project, HSIN and the GMO will discuss sustainment and maintenance challenges with USCG directly in hopes of overcoming them by the close of the project. As USCG is the champion of this project, when the application is completed, the USCG will influence determining which HSIN/GII accounts are allowed access to the application.

The research brief will provide an overview of the findings from the initial usability studies (cognitive interviewing and web survey). The results will focus on what users liked, did not like, what they found useful, and what they did not find useful. The brief will differentiate between findings from casual users and those who have experience and expertise in geographic information systems in order to better understand differences in how those with training versus those without training view web-mapping applications. This research brief will serve as a baseline for the recommendations the project team will make to the USCG and NOAA stakeholders.

Requirements for fine scale research development in the research will be driven by the project champion at HQ USCG and will be coordinated with, HSIN staff who support the USCG.

The research team will prepare a user guide for the Arctic web GIS application that details the changes made to the application, location of data sources, and will detail the functions of the web application. Consistent with prior aspects of the research project, the user guide will be approved by USCG stakeholders.

The project research reports will be provided to all stakeholders, and we plan to publish the results of the usability study to aid future research in the visual display and dissemination of information. This report will allow for a pre-test/post-test examination of usability prior to the beginning of the research project and after the research project. The analysis of our results from the eye tracking, cognitive interviewing, and overall usability studies will add new insights into human-computer interaction, how people use web mapping applications, and what trends, if any, exist in user experiences. These results will be of specific interest to the academic communities surrounding the Journal of Public Opinion Research, Applied Geography, and Cartographic Perspectives among others..

5. PROJECT: Arctic Vessel Monitoring Geofencing/Alert Awareness

Project Pls: Dr. Kenrick Mock and Buddy Custard

Lead Institutions: University of Alaska Anchorage (UAA) and Alaska Maritime Prevention & Response Network (AMPRN – a 501c6 organization)

Supporting Team: Aaron Poe (Alaska Conservation Foundation – ACF, a 501c3 organization), Ed Page (Marine Exchange of Alaska – MXAK, a 501c6 organization)

Project Champion: Hank Blaney, HQ USCG CG-255

Project Description:

Abstract: This project seeks to advance Arctic Maritime Domain Awareness & Management (MDA&M) by developing protocols and software for the Automatic Identification System (AIS) technology. Capitalizing on existing satellite and terrestrial AIS technology and the terrestrial AIS infrastructure in the U.S. Arctic region, the project aims to boost the development and implementation of automated geofencing alerts by applying the emerging software development of M2M (Machine to Machine) and IoT (Internet of Things) for vessel monitoring and notification. By providing improved “watch-dog” alerts to the Coast Guard, other agencies and maritime stakeholders (i.e., Alaska Native coastal communities) the project’s overall objective will enhance maritime security and safety, environmental protection, and vessel regulatory compliance in U.S. Arctic waters. This project will aid Coast Guard decision-makers to rapidly distill, analyze, and prioritize potential threats to allocate precious resources, energies, and partnerships using triggered “watch-dog” alarms by using geofencing technology based on specified criteria and parameters. The project is directed at Arctic maritime operations. Once the Arctic portion is successfully established, project team will seek to apply to all Alaska waters.

The workplan consists of three primary tasks: 1. Validating end-user geofencing and notification requirements; 2. Developing enhanced AIS geofencing and notification software; and 3. Evaluating the software against stakeholder requirements.

The team will focus on software programming, coding, Geographic Information System (GIS) overlays, agency protocols, and IT guidance throughout the project to ensure that each aspect of the process is engineered with the Coast Guard's and other stakeholders' necessities in mind. The team will develop the process and software by:

- 1) Developing technology for tailor-specific geofences and AIS-triggered alarms that can be customized by the end-user and exportable to other users for tracking and monitoring vessels throughout the U.S. Arctic; and,
- 2) Automatically disseminating the alert information to decision makers across multiple platform devices to ensure it reaches them in a timely fashion to better discern if a threat exists to mariners and/or to the marine environment.

ADAC Program Year 5: 1 July 2018-30 June 2019

Arctic Vessel Monitoring Geofencing/Alert Awareness

Advance Arctic Maritime Domain Awareness and Management by boosting the development and implementation of automated geofencing alerts to the U.S. Coast Guard to enhance maritime safety, security, environmental protection, and vessel regulatory compliance in U.S. Arctic Waters.

- Geofences can be customized by the end-user to meet agencies requirements.
- Have multiple filters and GIS overlays to better discriminate vessel type and activities.
- GIS files will be importable and exportable by end-users.
- Alerts and notifications can be received on multiple unclassified platform devices by government agencies.
- Geofence/alert notifications sent to Social Media/email platforms for other Federal/State agencies and Arctic stakeholders.
- Coastal Communities can receive tailored notification and alerts.

Transition: Software will transitioned to the U.S. Coast Guard, State of Alaska, and the maritime industry within the U.S. Arctic Exclusive Economic Zone.



ADAC: Research for the Arctic Operator... For Today and For the Future

ARCTIC DOMAIN AWARENESS CENTER
A U.S. COAST GUARD AND U.S. NAVY JOINT VENTURE

Figure 8: Arctic Vessel Monitoring and Geofencing/Alert Awareness

Objective/Purpose: The objective is to develop customized vessel geofencing alerts for the USCG and other Arctic stakeholders. More specifically:

- Geofences can be customized by the end-user to meet agencies requirements.
- Geofences will have multiple filters and GIS overlays to better discriminate vessel type and activities.
- Geofence GIS files will be importable and exportable by end-users.
- Alerts and notifications can be received on multiple unclassified platform devices by government agencies.
- Geofence/alert notifications sent to Social Media/email platforms for other Federal/State agencies and Arctic stakeholders.
- Coastal Communities can receive tailored notification and alerts.

Baseline: AIS is an internationally adopted tracking system required by most commercial vessels to aid maritime safety, security, and environmental protection. Vessels equipped with AIS transponders transmit position reports, speed, type of vessel, size, cargo, navigation status, and destination several times a minute. This information is received by AIS and disseminated to the Coast Guard, state agencies, vessel operators, and numerous other stakeholders to aid safe and sound maritime operations.

Using the AIS data of vessel movements, there are approximately 10,000 vessel transits annually in the U.S. Arctic region as defined under section 112 of the Arctic Research and Policy Act of 1984 (15 U.S.C. 4111). On any given day, there are 100 to 500 vessels operating within the U.S. Arctic region depending on the season. The sheer volume in the number of vessels to keep continuous situational awareness in detecting vessel movement anomalies that could cause harm to people, property, and the marine ecosystem in this U.S. strategic region is overwhelming. This is especially true when the Coast Guard Arctic regional command centers and staffs are simultaneously managing multiple cases ranging from search and rescue, maritime law enforcement, homeland security, oil spill response and salvage, waterways management, and fisheries enforcement, as well as managing its mandated missions throughout the other portions of the Western Alaska Captain of the Port Zone. The enormous challenge of trying to manage this volume of information requires enhanced tools that leverage M2M and IoT software technologies to help sift through the hundreds of vessel movements during any given hour to detect a potential incident(s).

Arctic communities have also voiced concern of commercial vessels entering and interfering with their subsistence activities with no notice of impending transit through the waters their communities rely on for their way of life. There is also no active monitoring of all AIS equipped vessels in the Arctic to determine if vessels are entering marine protected areas or proceeding at a high speed that increases the risk of striking whales, disrupting protected species rookeries and walrus haul-out areas, and endangered bird nesting areas.

Presently, the AIS network in Alaska can generate rudimentary automated geographic prescribed alerts with current fundamental geofencing software. However, the AIS software interface to import /export customized geofences and automatically push alerts and notifications across multiple platform devices and software applications are not developed. Additionally, the tools to receive alerts used by agencies is different than mobile devices and apps used by Arctic communities. The alert information needs to be automatically pushed to agency personnel and interested Arctic communities across multiple platforms and devices in an unclassified fashion to aid in rapid and proper MDA&M and decision making. Presently, geofence software and alert notifications are not able to:

- Share filters, zones, buffers, and customized alarms to other users;

- Adjust filters/alarms sensitives seasonally for vessel traffic and sea ice;
- Import GIS layers that can be used for alarms and notifications;
- Allow for enhanced geofencing customization to develop alerts and notifications that meet stakeholder requirements across many mission sets; and
- Produce alerts and notifications on various mobile platform devices and applications.

Development of the enhanced geofence/alert software will use the existing AIS data network and system developed in Alaska used by the Coast Guard, State of Alaska, and the maritime industry. As a result, no additional replication of AIS data or new computational or data storage clusters are necessary. However, new software components (e.g., codes) will need to be developed to interface with existing AIS data in a manner that can establish geofencing based on additional criteria and push notification alerts ascertained from stakeholders' requirements and desired input modalities.

This project concentrates on increasing existing vessel tracking systems features, focusing on the implementation of geofences and AIS-triggered notifications to remain on the leading edge of MDA&M.

Methodology: The research team will build upon existing and emerging geofencing techniques to develop enhanced processes, protocols, and software AIS geofencing development. The project team will develop software changes to existing vessel tracking and monitoring unclassified system used at U.S. Coast Guard and commercial marine monitoring centers within the U.S. Arctic EEZ, leveraging prior investments in AIS geofencing technology and software. The research team employs task-oriented objectives to develop its software geofencing and push notification enhancements. The overall methodology is to leverage M2M and IoT software engineering, while understanding the mechanical and electrical AIS limitations to refine the trigger alerts across multiple platform devices.

The methodology includes:

- Requirements elicitation from stakeholders regarding geofencing feature set and development of use cases and design specifications.
- Workflow diagrams to model vessel management and notifications as stipulated by the stakeholders.
- Agile development with stakeholder input.
- Software development that builds upon existing AIS datasets and geofencing technology. A majority of the software development will be server-based and accessible through a web browser or widely-available technology (e.g. email, social media).
- Synthetic test cases and test cases utilizing actual vessels.
- Acceptance testing and customer training.
- Peer-reviewed publication/presentation for validation and improvement.

A stakeholder will require a user profile to store desired alert parameters along with an appropriate way for the user to edit, manage, and import/export the geofence parameters. For example, the new software codes may trigger the dissemination of vessel notification information via smartphone application, social media platforms, email, and text messages to the various agencies and communities, depending on user preferences.

Student Participation:

The project will seek the participation of two undergraduate student researchers. The students will be ADAC fellows. Students with a computer science background will assist with AIS trigger-alert software development. They will develop and test possible improvements to existing algorithms that trigger alert notifications, and how to push the notifications to multiple user-interface mobile platform devices. This will provide a practicum that complements the theory presented in the computer science curriculum. Students outside of computing will assist with stakeholder requirements and engagement. Students of both backgrounds will learn principles of project management and team-based communication.

Research Objectives:

- Identify vessel alerting and management workflow and the decision-making processes through stakeholder engagement.
- Design and implement a software architecture capable of efficiently managing geofences/alerts.
- Provide the Coast Guard, resource trustees, and Arctic coastal communities with accessible, AIS-triggered information technology tools necessary to increase their MDA&M of vessel traffic in the U.S. Arctic.
- Ensure the effectiveness of geofences/alerts in the unclassified Common Operating Picture system used by the USCG.
- Provide MDA&M and notice of hazards to vessel operators via an AIS alerting system.

To accomplish the research objectives, the team will develop:

- Geofencing/alert files that can be shared among users of vessel tracking display systems;
- Software interface that will push notification information based on filters requested by the end user;
- New codes to give the end user choices to tailor notification to meet their specific requirements;
- Filters, zones, buffers and customized alarms that can be adjusted for vessel traffic and sea ice; and
- The ability to create GIS layers that can be used for alarms and notifications;
- Customization for U.S. Coast Guard mission needs, (such as alarms customized by individual users):
 - Included in customization are stakeholder specified U.S. Coast Guard Reports, such as: ability to compile past history & tracks – (with some limitations on time scale and scope) and history of zone violations (e.g., how many times fence has been crossed in the past "X" hours/days/weeks, etc.)
- Achievable Cyber characteristics (for a non-classified science and technology research project):
 - Research team plans to support USCG D17's non-secure PACTRACS vessel tracking display developed and operated by the Marine Exchange of Alaska.
 - USCG user import or export of GIS type files with customizable permissions levels;
 - Import/export file types need to be common enough to use on other applications (i.e. GoogleEarth, CG1V).

The project will work in partnership with the HQ U.S. Coast Guard Project Champion, U.S. Coast Guard D17, U.S. Coast Guard R&D Center, other federal and state agencies, the marine industry, and Arctic coastal communities to identify and develop methods by which relevant stakeholders can employ AIS geofences/alerts tailored to their information needs to make operational decisions. This will be accomplished by:

1. Identifying the maritime areas of concern of each stakeholder, such as:¹

- a. U.S. Coast Guard: Areas to be Avoided (ATBA), presence of commercial vessels in vicinity of whaling operations, responding to agencies' requests for the service to prevent vessels from entering dynamic marine protected areas, communicating sea ice and other hazards to mariners. This includes U.S. Coast Guard Safety and Security Zones, Maritime Boundary Lines. This also includes U.S. Coast Guard specified Arctic Waterways and Bering Strait focus areas.
- b. U.S. Fish and Wildlife Service: Aleutian Islands ATBA and walrus haul out areas.
- c. NOAA: Weather alerts to mariners where VHF radio coverage does not exist (most of U.S. Arctic), whale migration and feeding areas, Bogoslov Island Marine Sanctuary, and other marine mammal concentration areas.
- d. State of Alaska State Fish and Game: Walrus Islands State Game Sanctuary, other marine mammal concentration areas, and fish habitat areas.
- e. Alaska Arctic Coastal Communities: Areas of subsistence activities, including whaling, as well as presence of cruise ships and other commercial vessels approaching their ports or near their shores.

2. Identify the geofencing/alerting criteria, such as:

- a. Authorized party to establish an alert (Agency representative or vetted stakeholder);
- b. Time frame of alert: start and ending period;
- c. Vessel parameters for alerts: size (length, draft or tonnage), type of vessel (tanker, cruise ship, tug, fishing, cargo vessel), and activity;
- d. Speed of vessel: i.e. more than 14 knots or below 3 knots for certain vessel types;
- e. Geographic parameters: area where alerts are provided (e.g., warning area, incursion area, customize areas); and
- f. Notifications: e.g., agency e-mail address, phone call to operations center, text message to decision maker, computer screen alerts, data base entry, and/or notifications made to specific vessel(s) or vessels operating in a designated area.

In a parallel process to identifying the geofencing/alerting criteria, the project team will develop the work flow and decision-making processes as end-user requirements are identified. This will allow the project software engineers to commence software development to allow sufficient time to test and evaluate the geofencing and notification output products. During the final phase of the project, the team will share project findings with the stakeholders to further evaluate the tool before making final improvements.

Key Milestones:

- Identify vessel alerting and management workflow and the decision-making processes based on consultation with relevant stakeholders, 31 Oct 2018.
- Geofencing software development, 31 Mar 2019.
- Alert and notification software development, 31 May 2019.

¹ These are examples of the types perspectives we expect to hear from stakeholders.

- Test of AIS Transmission of Dynamic Marine Protected Area to a vessel, 30 Jun 2019.
- Test notification and alerts with agencies and coastal communities, 31 Aug 2019.
- Finalize tools and complete transition plan, 31 Oct 2019.

Performance Metrics:

- Number of stakeholders engaged and generation of requirements.
- Formation and number of members on Steering Committee.
- Number of stakeholders that accept requirements specifications.
- Design and documentation of system architecture, use cases, and test cases.
- Percentage completion/project velocity of features and use cases.
- Percentage of successful synthetic test cases (simulated vessel movements or other automated tests)
- Percentage of successful manual tests (e.g. interfacing with social media, user interface)
- Percentage of successful field tests (e.g. AIS transmission of dynamic marine protected area)
- Number of successful customer acceptance tests.
- Number and impact of peer-reviewed publications/presentations.

Outcomes/Outputs: The project's outcomes are:

- 1) Documentation of geofencing workflow for stakeholders in the form of diagrams and text.
- 2) Document that identifies a collaborative process that will engage regulatory agencies, industry and Alaska Native communities regarding issues related to geofencing.
- 3) Software requirements specification document.
- 4) Use/test case document.
- 5) Systems architecture design document.
- 6) Development and publication of a geofencing file format based on existing standards (e.g. CSV, shape file, etc.)
- 7) Software system to create and manage geofences with alert preferences.
- 8) Software system to generate customized geofence alerts integrated with existing AIS database.
- 9) System documentation.

Key Stakeholder Engagement Plan: The research team plans a comprehensive series of engagements on a calendar basis throughout the life of the research project with U.S. Coast Guard at strategic, operational, and tactical levels. The research team will include stakeholder engagements via focus groups, again on a scheduled calendar basis for the life of the project.

The strategic customer is HQ U.S. Coast Guard Project Champion. The primary operational customer for this product is the 17th U.S. Coast Guard District, and the tactical customer is U.S. Coast Guard District 17 Sector Anchorage. A key collaborator is the U.S. Coast Guard R&D Center. Other stakeholders who will also benefit from this project include federal and Alaska state stakeholders (e.g., NOAA Fisheries, U.S. Fish & Wildlife Service, Alaska Department of Environmental Conservation, and Alaska Department of Fish & Game), and the communities across the U.S. Arctic coastal region who benefit from the decreased risk of vessel groundings, oil spills, collisions, and disruption of subsistence activities. Priority of engagement for research team is HQ USCG Project Champion, and the direct USCG end-users: USCG D17 and USCG D17 Sector Anchorage.

Examples of the secondary beneficiaries of the outcomes of this project are as follows.

Resource Trustees: NOAA Fisheries, U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, and Alaska Department of Environmental Conservation all have responsibilities to protect the marine environment but have limited resources to do so effectively. Due to environmental changes in the Arctic, the designated “Marine Protected Areas” are ever changing. The locations of walrus haul out areas, presence of whales, and sea lion rookeries are dynamic. In most cases agencies are not aware of maritime operations in these areas that have the potential to adversely impact the environment or resources they are charged with protecting. The agencies also do not have an effective way of notifying vessels when they are approaching or entering protected areas. This project will provide them the software notification tools to automatically monitor, detect, and notify 7x24.

Coastal Communities. Periodically vessels appear on the horizon without notice of coastal communities and enter areas where Alaska Native hunters are actively engaged in subsistence activities, hazarding the mariners, and preventing a successful hunt. This project can send alerts to mobile devices, social media, and other means to communities regarding approaching vessels. It can also provide them the means to notify approaching vessels of areas “off limits” due to the presence of whales, other marine mammals, and local mariners.

Mariners. The safe and environmentally sound transit and operation of vessels in arctic waters requires the effective dissemination of weather, ice, hazards, marine life, restricted areas, and dynamic marine protected areas to mariners. This project will develop the protocols and software that can identify when a vessel is entering a prescribed region and transmit relevant safety and environmental information to vessel operators to minimize negative impacts of their operation.

Stakeholder engagement will be central to the success of this project. Deliberate investments in the collection of information required to develop the work flow diagrams and identify the end-user requirements of the tools and in how recipients can receive this information will be critical.

The Alaska Conservation Foundation (ACF) will convene stakeholder focus group discussions to gather the end-user requirements. ACF has a history of collaborating across stakeholder groups on vessel traffic issues through the Aleutian and Bering Sea Islands Landscape Conservation Cooperative. They will conduct four group meetings at the beginning of the project:

- Primary stakeholder. Coast Guard personnel from HQ, D17, and Sector Anchorage who are the primary users of the project.
- Other Federal and State Stakeholders. Federal and state agencies involved in the management of resources in coastal and marine areas including: NOAA, BOEM, the U.S. Fish and Wildlife Service, Alaska Department of Environmental Conservation, and Alaska Department of Fish and Game.
- Coastal Communities. Leaders/decision makers from coastal villages and larger coastal hub communities. These individuals will include staff and leadership from Alaska Native tribes/organizations, as well as city officials who are working on or concerned about issues related to vessel traffic and MDA&M.
- Maritime Industry. Those companies that conduct operations in Arctic waters, including but not limited to ports and facilities in the Arctic (e.g., Nome, Kotzebue, Red Dog Mine) and vessel operators (e.g., tugs, offshore supply vessels, landing craft, research vessels, and tankers).

The Alaska Conservation Foundation will also seek to obtain coastal community end-user requirements at the Alaska Tribal Conference of Environmental Managers in November 2018 and similarly at the Alaska Forum on the Environment (AFE) in February 2019. Both conferences attract Alaska Native leaders and tribal staff to Anchorage annually and provide the opportunity to engage many of the Alaska Native stakeholders regarding the project to receive feedback on the functionality and use of the tools developed. Natural resource managers from industry and government agencies from around the state also attend AFE, providing another opportunity to engage with these stakeholders.

In addition, two key existing bodies representing Arctic stakeholders include the Arctic Waterways Safety Committee and the Aleutian Islands Waterways Safety Committee. The research team will work with these groups at the outset of the project, outlining the potential uses of the deliverables to help them meet their missions of safe and environmentally sound vessel traffic in the Bering, Chukchi and Beaufort Seas.

After the initial series of focus groups has been conducted, individuals will be invited to participate in a monthly steering committee. The committee's meetings will primarily be conducted using online collaboration tools for both discussion and to demonstrate the geofences and alert notification products. The research team will present progress to date including the evaluation and validation of solutions under development, efficacy of the products, progress toward objectives, and solicit and address feedback from committee members.

Transition Plan: The transition plan will be conducted under the direction of the steering committee. The primary output of the project is new software. The research team will incorporate the new software into the existing unclassified AIS tracking and monitoring system used by the Coast Guard, State of Alaska, and the maritime industry for MDA&M within the U.S. Arctic EEZ at the end of the project.

The new software will be hosted on the cloud or execute on Marine Exchange servers rather than require installation on end-user or client computers. While development and test servers will be used in ADAC Program Year 5. Following the conclusion of the research beyond Program Year 5, research team will transition the software to run on the production servers hosted by the Alaska Marine Exchange, or other suitable and feasible destination as determined by the USCG Project Champion. By hosting the software on the Marine Exchange servers and making it web/Internet accessible, the technology transition for stakeholders is simplified by removing the need for stakeholders to set up and install their own servers or software systems. Additionally, by hosting the new software on the Marine Exchange servers, data transport and access to vessel data stored on the same servers is more efficient than if the new software were hosted elsewhere. However, upon request the project team can provide the software source code that could run in a different computing facility with sufficient computing and network capabilities.

MXAK servers and computers have been used to receive, process and display AIS information used by the Coast Guard for over 10 years. All Arctic terrestrial AIS data accessed by the Coast Guard is provided by MXAK AIS receivers, servers and software, therefore, the cost to develop this geo-fence system is based on the ability to utilize the existing software and hardware owned and operated by the MXAK as well as accessing MXAK AIS data from the 130 AIS sites the organization established and operates in Alaska. The AIS data provided to the Coast Guard by MXAK servers can ultimately reside on Coast Guard servers (as directed by HQ USCG Project Champion).

Product will be delivered with robust training/instruction and documentation elements. The project team plans a comprehensive engagement investment principally focused on HQ USCG, and USCG End users.

This engagement will result in co-development of a system that is user-friendly. Project team will provide a streamlined user's guide and directions and supporting how-to video/webinar, with additional focused training support to USCG end users.

The interface between the system and social media access will also be server-based. Scripts that run on the server or cloud will provide requested data via social media channels. End-users will be responsible for managing social media or email software on their endpoint device. Any separate client-side tools (e.g. custom apps) will be made available from the server or from an appropriate application repository.

The project team will provide comprehensive training to stakeholders on how to use the new software. As the initial and primary stakeholder, we will engage with the USCG first across the development and deployment lifecycle and expect significant input from the USCG through the steering committee.

The final software application will reach TRL 7, demonstration under an operational environment. TRL 8, actual system completion and qualification will be partially achieved but require additional testing under a more complete set of operating conditions. TRL 9 will require successful operation over an extended period of time.

4. PLACEHOLDER TBD: Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

THEME 3 – Maritime Technology Research:

1. Propeller Driven Long Range Autonomous Underwater Vehicle (LRAUV) for Under-Ice Mapping of Oil Spills and Environmental Hazards (Continuation Project);
2. Arctic IoNS and MaLTE workshops.
3. TBD: Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

1. PROJECT: Development of Propeller Driven Long Range Autonomous Underwater Vehicle (LRAUV) for Under-Ice Mapping of Oil Spills and Environmental Hazards

Project PIs: Dr. James Bellingham (WHOI), Amy Kukulya (WHOI) and Brett Hobson (MBARI)

Lead Institutions: Woods Hole Oceanographic Institution (WHOI) and Monterey Bay Aquarium Research Institution (MBARI)

Supporting Team: Dr. Chris Reddy (WHOI), Amanda Besaw (WHOI), Sean Whelan (WHOI), Daniel Gomez-Ibanez (WHOI), Mike Jakuba (WHOI)

Project Description:

Abstract: Increasing level of commercial marine activity in high latitudes creates an ever-growing risk of oil spills. Characterizing oil spills in remote and austere Arctic locations is a daunting challenge to the U.S. Coast Guard. Led by the LRAUV project PI, Dr. Bellingham, the laboratories at Monterey Bay Aquarium Research Institute (MBARI) developed a small long-range system called the Tethys Autonomous

Underwater Vehicle (AUV). The Tethys AUV is a helicopter-portable system that functions as a rapid response solution to incidents

occurring in the maritime environment, and aims to increase the situational awareness of first responders. Outcomes of this project will be: (1) construction of a small long-range AUV (LRAUV) based on a modified Tethys platform equipped with oil sensors and navigation systems, (2) a demonstration of the LRAUV survey capability, and (3) the creation of a simulator for establishing Standard Operating Procedures (SOP) related to AUV oil spill deployments. Gaining an autonomous underwater capability to survey oil spills at long range, high latitudes, and under ice answers an unmet need for DHS and the USCG, (4) conduct review of a reduced cost design for USCG and broader ADAC use.

ADAC Program Year 5: 1 July 2018-30 June 2019

Propeller Driven Long Range Autonomous Underwater Vehicle

LRAUV is helicopter portable, carrying an environmental mapping payload, allowing rapid response to provide situational awareness and damage mitigation for first responders/USCG.

Initial Capabilities (expandable):

- Ability to map in 3D
- Extended unattended deployment (days to weeks)
- 500 KM range, under ice
- Detection and quantification of dissolved particles and fluorescent material (with current sensor package)
- Environmental characterization

Transition: Planning for USCG R&D Center, USCG-led National Strike Force, with options to commercialize

Tethys testing deployment: January 2018 being operated from a cell phone in Monterey Bay California

Image of LRAUV, which is currently in construction at MBARI, California. completion date: 15th April 2019

First mapping with detection and 3D mapping proof of concept mission: San Francisco Bay, November 2018

ADAC: Research for the Arctic, for Today and for the Future

ARCTIC DOMAIN AWARENESS CENTER

Vehicle cost and Maintenance

Transportability

Operative Safety Security

Figure 9: Propeller Driven Long Range Autonomous Underwater Vehicle Overview

Objective/Purpose: Our objective is to develop an Autonomous Underwater Vehicle (AUV) based capability to observe and sampling dynamic processes in the Ocean in order to characterize oil spills and other environmental hazards under ice.

Baseline: PI Dr. Bellingham's prior laboratories at MBARI originally created the Tethys platform specifically to carry biological and chemical payloads for long distances and extended durations. The vehicle is small, about 30 cm (12 inches) in diameter, and requires no special handling equipment. Prior deployments ranged from a few days to over three weeks, and were conducted without the direct supervision of surface escort vehicles. The longest-range mission to date was over 1,800 km at a speed of 1 meter/second (m/s) off the coast of Moss Landing, California. The vehicle operated as far as 500 km from shore independent of any escort. However, achieving ranges two to three times greater is possible. Maximizing the vehicle

range is achievable by operating at a speed of 0.5 m/s, using the buoyancy engine, shifting internal weight, trimming the vehicle to neutral buoyancy, and drifting at zero propeller speed while using minimal sensors.

The vehicle is typically shore-launched and recovered. A small boat is used to tow the vehicle between the harbor entrance and a boat launch ramp. The Tethys is also helicopter transportable to remote areas.

The Tethys system occupies the design space intermediate between underwater ocean gliders and the current generation of propeller-driven AUVs. Existing ocean gliders such as the Teledyne Webb Slocum, the Scripps Spray, and Kongsberg Seaglider have a sufficient operational range to achieve the desired range goals needed by USCG. However, they do not have the payload capacity or power to carry the chemical and biological sensors that are required, and cannot operate at higher speeds without redesign. Typical gliders operate at speeds of about 0.3 m/s, and utilize a power source equivalent to 1W of energy with minimal power consumption.

In contrast, existing propeller-driven AUVs such as those manufactured by Hydroid, Bluefin, OceanServer, and Teledyne Gavia consume more power, resulting in a shorter endurance. These commercial propeller-driven systems can operate for a period typically up to 24 hours at speed of 1.5 m/s, and providing ranges of less than 130 km. As a result, Tethys is uniquely capable in its combination of payload capacity, range, and endurance for remote under-ice oil detection.

Mission-level control of the Tethys is achieved by using an architecture called 'state-configured layered-control'. This is an improved variant of the layered control architecture developed by Dr. Bellingham (1991) and implemented on vehicles ranging from Webb gliders to the Dorado AUVs. State-configured layered control supports autonomous adaptive operations for long periods. The software building blocks of the system are behaviors, or control laws, that can be combined to accomplish tasks. These control laws are conditionally connected to the AUV to complete missions that are more complex or respond to certain contingencies. For example, vehicle software is able to detect faults in critical components and respond appropriately, greatly improving the reliability of the AUV. In some cases, through configuration changes, the Tethys may continue a mission after a component failure. For example, depth control of the submersible is a redundant system. If the elevator actuator fails, the vehicle can continue to control depth by shifting internal weight.

Operators interact with the vehicle via an Iridium satellite link by recovering data snippets in near real-time and sending new mission commands to the vehicle as desired. Communication with the vehicle is possible when it surfaces, and interpreted at operator-determined intervals.

Over several years of operation a web-based operator portal for the Tethys has been developed², which includes a display of science and engineering data. On a secure portion of the site³ users can access a command interface and a variety of utilities, such as an alert page that operators can configure to send mission data via email or mobile phones based upon certain criteria. Prior research has established a design, created operating and navigation software, investigated the range of capabilities associated with

² <http://aosn.mbari.org/TethysDash/>

³ <http://aosn.mbari.org/TethysDash/data/daphne/realtime/sbdlogs/2012/201211/20121127T053258/>

critical components, implemented a systems integration plan, and conducted successful field-tests to validate research. Further research has developed an advanced LRAUV design package with first article fabrication to allow subsequent full platform fabrication. Completed research to date provides a design for platform fabricators to construct an LRAUV platform to meet stated parameters in navigation, mission performance, and operator ease of use.

Research Method: Research team employ a task-oriented team of expert marine mechanical and electrical engineers to conclude the creation of a readily deployable, easily handled, variable speed, and long range AUV capable of detecting and mapping oil spills under ice. The team leverages prior investments in AUV research and oil sensor technology, and under-ice operations. The overall objective is to leverage mechanical and electrical engineering to fine-tune the Tethys vehicle with sensors, navigation, and chemical mapping to operate under ice.

The LRAUV re-design of Tethys will observe and sample dynamic processes in the Arctic marine environments in order to characterize oil spills and other environmental hazards under ice. Sensor focus is to detect and acquire mapping of dissolved hydrocarbons and oil drops. Developed technology is useable in other regions (such as the Canada-U.S. Great Lakes). LRAUV research team will investigate sensing and mapping information relay needs to get data quickly from the platform to on-scene operators.

Research team will integrate prior ADAC sponsored investigations in systems software, AUV simulator, chemical detection sensors, navigation, and mapping to design changes of the Tethys platform. Priority for specific Year 5 project work is documentation of the redesigned vehicle, and subsequent testing in increasingly difficult marine environments. Testing the fabricated platform will leverage a prior developed oil-spill survey simulator using currents obtained from coastal models to simulate the advection of oil, and allows testing of different survey strategies. Additionally, researchers will initiate investigating accompanying research in data relay as previously discussed.

The research team will design and fabricate an Arctic buoy system that will allow the LRAUV to precisely navigate via Long-BaseLine (LBL) and Ultra-Short BaseLine (USBL) navigation methods. LBL allows for long range (up to 10 Km per buoy), while USBL allows for short range (<100 meters) homing and docking for recovery under ice or in open water. The buoy system will also allow for data transfer from the LRAUV back to Command Control Center via Iridium. In order to transfer data in a format that can be visualized by the receiving party, a software compression will be included in the buoy development.

AUV navigation is a particularly challenging aspect of the project. Building on prior LRAUV project work, research will aim to improve on this by exploring multiple modes of navigation to mitigate complex environmental conditions and changing scenarios. We will use several levels of navigation for the AUV:

1. A GPS system built into the Tethys antenna will routinely obtain GPS fixes when the vehicle surfaces;
2. The vehicle will dead-reckon using a Doppler sonar to measure velocity relative to the bottom, and a compass for heading;
3. An UltraShort BaseLine (USBL) acoustic system will measure range and direction to a transponder and allow acoustically marking interesting sites for revisit by the vehicle.
4. LBL navigation with two or more buoy transponder systems.

Test Plan for LRAUV:

- WHOI will extensively test LRAUV in open water either in Woods Hole with a surrogate dye in order to test vehicle open water navigation systems, dye surrogate detection and adaptive mission behaviors similar to the experiments conducted with REMUS-100 in 2016. We will then work out of site MC20 in the Northern Gulf of Mexico, in conjunction with NOAA and EPA (for science verification, calibration and overall science expertise). We can work for 5-6 days out of MC20 and work in oiled and non-oiled areas in order to test detection, mapping and fouling questions. With a shortened test at MC20, we could perform a second (short) test in high latitudes to exercise LRAUV navigation accuracy. Please note, that the Arctic buoys may not be ready for a high latitude test, therefore, WHOI transponders will be used in place if necessary. While at Woods Hole and the MC20 site, the vehicle will be deployed and be commanded to find and follow a signature spike from the SeaOWL sensor.
- The SeaOWL will be calibrated in the lab and baseline signals will be determined allowed for anomaly spikes to trigger an 'autonomy mapping' mission. Different mission scenarios will be outlined and tested including: a.) finding the source, b.) mapping out the extent of the plume and, c.) finding out where there is no signal of oil in the entire water column for 0 to 300 meters (or max depth of operating area up to 300 meters).
- Once testing missions are complete, mission macros will be created so the operator can quickly decide the type of mission to run prior to launch. The vehicle simulator will be a valuable tool for running planned missions with simulated currents, etc. based on available environmental data from the test area.

Test Plan for Arctic Buoy System:

- Once the buoy system is complete, it will be deployed in local Cape Cod waters and a dye tracking mission will be conducted. The buoys (at least a quantity of 2) will be deployed in a pattern to maximize vehicle navigation, vehicle docking and vehicle communication back to command control. We will test acoustic communication range, data transfer success and percentage of vehicle docking tries via USBL. We expect to receive navigation fixes from each buoy back to the LRAUV up to 10 Km away (environmental conditions fluctuate and can impact sound range).

Reduced Cost Vehicle Outline: Using WHOI's maker space known as Dunk Works, the WHOI LRAUV team along with designated student interns associated with the project will do the following in order to reduce vehicle costs:

- Evaluate LRAUV BOMs and identify machined parts that can be 3D printed with less people labor and less expensive materials.
- Produce drawings and prototypes of vehicle components, such as chassis, end comes, end caps, vehicle shells, etc.
- Evaluate third party licensing of the LRAUV with MBARI approval.

Detection and mapping of chemicals is the mission focus of the research. Project team will integrate associated software designed in prior LRAUV project years into fabrication. Follow-on testing requirements plan to validate observation requirements for the AUV system. Validation metrics specifically include the following:

- Ability to map in 3D;
- Detection and quantification of dissolved particles;
- Determine the physical ocean environment (and determine acute/critical variables, such as assessing hypoxia of the water column in/near spill area);
- Take CTD measurements.

Student Participation: Project has established an "ADAC-WHOI Research Intern" from Massachusetts Maritime Academy (MMA).

Key Milestones: For Program Year 5, the goals for LRAUV are threefold:

1. The first is to test and demonstrate the LRAUV in the Arctic. Project team outlines a series of steps that arrive at this goal.
2. The second is develop and test an Arctic buoy system.
3. The third is to establish a reduced cost design capable of being reproduced for USCG and broader use within the HSE. Currently this is represented by one milestone; exploratory activities underway in Program Year 4 will allow this to be broken into smaller elements in the coming months. An additional and valuable enhancement for the LRAUV would be development of a swappable payload nose with multi-beam sonar for 3D bathymetric mapping for multi-mission scenarios.

Specific schedule and milestones are as follows:

1. Collect navigation performance data, Buzzards Bay, MA, 30 Aug 2018;
2. Complete water testing and documentation of LRAUV vehicle and systems, 30 Nov 2018;
3. Process the data and tune navigation algorithms from the testing missions, 30 Dec 2018;
4. Plan for observation mission under-ice, 30 Apr 2019;
5. Plan adaptive mapping of oil surrogate for high latitudes; 15 Feb 2019;
6. Complete fabrication of 3 Arctic buoys for LRAUV navigation and data transmission, 1 Jun 2019;
7. Complete software development and compression of LRAUV data for near real-time visualization 15 Jun 2019;
8. Perform the planned high-latitude mission, open water; 15 Jun 2019;
9. Evaluate Data, make software and hardware adjustments. Perform training to USCG; 30 Jun 2019.
10. Conduct testing of LRAUV with Arctic buoy system in local waters, 30 June 2019;
11. Research and Review of low cost vehicle production, 30 June 30, 2019;

Performance Metrics: Fabricate LRAUV and water test platform to achieve the following parameters in navigation, performance, and operator ease of use with aided navigation from the LBL Arctic Buoy system:

- Navigation performance:
 - Conduct design improvements for Tethys platform to achieve the following drift rate: percentage of distance traveled. Target: < 0.5% with LBL aided navigation.

- Conduct design improvements for Tethys platform to achieve the following error bounding of navigation drift by ranging from a fixed beacon.
- Performance-specific measures:
 - Modification of Tethys platform in mechanical and electrical engineering to integrate separate oil sensor package to accomplish detection level of oil: measured in terms of minimum sensitivity Target: < 80 ppb.
 - Modification and design improvements for Tethys platform to meet specified AUV range and endurance: Target: 300 km on secondary batteries, twice that on primary.
 - Modification and design improvements for Tethys platform to integrate mapping algorithm for adaptive sampling performance- mapping of spill extent: Target: Area coverage 1000 km² per vehicle deployment.
 - Each Arctic buoy will be able to communicate position data via acoustics up ≤ 5 Km distance per buoy to undersea vehicle (please note two buoys navigation solutions are needed for a valid fix).
 - Position updates from the LRAUV will be pushed to the Arctic buoys and then relayed back to command control (topside laptop anywhere in the world).
 - LRAUV will be able to line capture or dock to a fixed beacon with its USBL and capture nose assembly. Target=50% success.
- Operator ease of use:
 - Logistical footprint: number of operators required on site, number of kilograms to transport. Target: 2-3 adult operators and < 600kg.
 - Ease of mission configuration: design time to specify grid survey: Target: < 1 hr.
 - Ease of remote interaction: design modifications to allow training time required for operators: Training: < 1 week.
- Metrics for reduced cost design: We understand what makes the current design expensive to build, and what parts introduce long lead times. Consequently we are exploring additive manufacturing technologies to realize improvements in the following dimensions, with the LRAUV as a reference:
 - End bell of PV complex and long lead: Can additive manufacturing be used to build integrated end bells rapidly?
 - Wet volume for sensors: This space is inefficiently used. Can additive manufacturing allow more efficient integration of actuators/propulsion system/sensors?
 - BoM = 1000 parts for LRAUV: How much does 3d printing allow us to reduce this?
 - Wiring harness: How much can the wiring harness complexity (wire number, connector count) be reduced?
 - Connectors: Can connector count be reduced?
 - Customization: Can 3d printing be used to enable faster turnaround on custom sensor suites?
 - Software reliability: Can integration of mechanical/electrical/software system engineering documentation be used to enable auto-configuration of I/O software?
 - Cumulatively how much cost can be extracted from the build, and how much lead-time is removed? In addition, does this enable smaller, low cost vehicles (e.g. could they be expendable)?

Outcomes/Outputs: The goal of this project is to create an operational system that the USCG can use for characterizing spills in ice-covered ocean environments. A DAC-WHOI and MBARI focus on creating LRAUV to provide and demonstrate a prototype system that is feasible and suitable for production. During Program Year 5, the project team plans the following outcomes/output:

- The research team will collect navigation performance data from Buzzards Bay, MA. Following the data collection, there will be a complete water testing of the LRAUV vehicle and systems. The data will be processed and the navigation algorithms will be tuned from the testing mission at WHOI. The LRAUV vehicle and systems will be documented after the testing.
- The team will plan for observation mission, and then will perform the high-latitude mission in open water. The research team will perform adaptive mapping of oil surrogate in high latitudes. Compass performance in high-latitudes will be evaluated.
- WHOI conducts video documentation (to facilitate transition) during marine testing. During marine testing, Research team will conduct training for DHS S&T OUP and USCG champions and advocates, to observe and operate the system.
- The team will fabricate three Arctic buoys for LRAUV navigation and data transmission.
- Project team will research and review options for a low cost vehicle production in the future.
- After vigorous testing of the system, WHOI and MBARI will adapt software and hardware as necessary based on lessons learned and recommendations from potential users in anticipation of upcoming test missions in low and high latitudes.

Stakeholder Engagement: Project team will continue to participate and be featured in the planned ADAC "Customers and Partners" Roundtable, in order to inform and receive feedback on project progress. Project team will also participate in maritime oil-spill peer venues as much as practical, while also ensuring close collaboration with USCG Interagency Coordinating Committee on Oil Pollution (ICOPR) leadership and members, as well as the USCG R&D Center.

Project Champion: Ms. Kirsten Trego, HQ USCG-MER, with project support provided by Mr. Jeff Wheeler, CG-731 and CAPT Tom Meyer, CG-761. Project Advocates include USCG leadership of ICOPR, HQ USCG-255, USCG Districts 9, USCG HQ CG-926, USCG R&D Center, USCG D17, NOAA Office of Response and Restoration, US Department of the Interior, Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement, U.S. Environmental Protection Agency, Oil industry (Exxon Mobil, Shell Oil and American Petroleum Institute).

Transition Plan: ADAC and LRAUV project team seek an integrated approach with USCG RDC and HQ USCG to acquire and develop additional LRAUVs commensurate with USCG mission needs. In accordance with DHS S&T OUP-ADAC Grant Terms and Conditions, LRAUV Intellectual Property (IP) rights developed under this project remain jointly held between ADAC, WHOI and MBARI. According to the DHS S&T Terms and Conditions, DHS and USCG may leverage this IP royalty free to acquire and construct additional LRAUVs to USCG and other DHS maritime mission needs. During LRAUV testing, ADAC, WHOI and MBARI recommend HQ USCG Project Champion, HQ USCG CG5R, CG7, CG9 as well as USCG RDC participation. Project team notes that NOAA is interested in LRAUV capabilities.

ADAC proposes a research transition specifically focused with HQ USCG CG-7 and CG-9 at the Flag Officer level at the onset of Program Year 5 to determine suitable destination for LRAUV. One possible destination

for USCG operational use, is the USCG led "National Strike Force" (with subordinate Strike Teams) a purpose built and equipped set of responders who support oil-spill response for the United States maritime regions. Transition could also include retaining ADAC supported, WHOI and WHOI's Center for Marine Robotics led indefinite delivery/indefinite quantity contract, where WHOI's CMR would provide owner operated technical LRAUV operations in response to USCG mission tasks.

Following the LRAUV's testing plan, and completion of data relay devices, the overall system will be TRL 7/8 and ready for production. Depending on DHS and USCG acquisition desires, project team relays WHOI and MBARI have around-the clock technical expertise available if any such need arises. This technical support covers hardware, software, design, fabrication, specialty application, and operations expertise.

The platform used for the LRAUV initial year 3 demonstration, a REMUS-100, is commercially available. The research team used commercially available sensors to create a customized payload design developed for the project year 3 demonstration. Operating and navigation software design provided an additional new element to the demo prototype. As with all of the IP created under this effort, the designs are available for government systems on a royalty free basis. Consequently, USCG can readily replicate the LRAUV year 3-demonstration vehicle.

The Tethys completing fabrication in Program Year 4 is a modification of a proven vehicle developed by Research PI during previous investigation at MBARI. The Tethys vehicle has performance far beyond commercially available systems, and thus transition of that capability to the USCG requires some planning. WHOI has a history transitioning technology to operational use, especially with the US Navy. WHOI uses a variety of transition methods tailored to the nature of the challenges associated with the transition. Factors influencing the nature of transition include technological maturity, complexity of operations, availability of investment for 'hardening' of systems, market prospects, and more. Transition methods include the following factors:

- Facilities: WHOI operates facilities for high complexity platforms such as at the ALVIN Human Occupied Vehicle, the JASON Remotely Operated Vehicle, and the Sentry Autonomous Underwater Vehicle. These systems operate as part of the National Deep Submergence Facility (NDSF) under the sponsorship of the National Science Foundation, the Department of the Navy, and NOAA. Facility selection preference is for systems operated in small numbers, which requires a highly specialized team. The WHOI facility uses protocols, allows costs sharing across the user base, and frees users from the need to keep operators on staff.
- Service for-Hire: Some platforms, such as the REMUS vehicles, are operated on a for hire basis. Examples of for-hire operations include the location of the El Faro data recorder by a Deep Submergence Laboratory WHOI team funded by U.S. Department of Transportation, and location of Air France Flight 447 by the WHOI Ocean Systems Laboratory. Like the facility model, the "for-hire" model frees the user from the need of creating and maintaining a staff of expert operators. Unlike the facility model, where scheduling is driven by the sponsors, "for-hire" operations may be precluded if vehicles have prior commitments.
- Hardware Builds: When an organization wants to replicate a WHOI system, WHOI has in the past built small numbers of devices for a customer. For example, WHOI inventors built many of the early REMUS 100 platforms for scientists and other users. Since the user takes delivery of and owns their own platform, scheduling is completely under the user's control. However, the user does

need to build their own operational team, and that team will need training and support from key WHOI staff. For example, Amy Kukulya (the Project Manager for LRAUV), trains Navy sailors in the operation of REMUS platforms.

- Commercialization: When there is sufficient demand for a system, commercial production is the logical solution. A healthy commercial enterprise will make investments to improve manufacturing and reliability, and provide operator support. Commercialization may occur by licensing of the technology to a commercial entity, or by a spin-off company. Examples of the former include recent WHOI developments of REMUS 600 technology by WHOI for the U.S. Navy, now produced as Kongsberg Hydroid products. Examples include the original “spin-out” of Hydroid from WHOI, and Bluefin Robotics from Massachusetts Institute of Technology, (J. Bellingham was a cofounder of the later).

Accordingly, LRAUV transition plan for the capabilities should occur in three stages, first by building one or more systems for the USCG, commercialize the resulting platform, and work with DHS and USCG acquisition process to field needed systems to meet USCG mission requirements.

- Stage one: “set conditions for production.” A key stage in Year 5, this effort would initiate after a successful demonstration; in accordance with DHS S&T OUP Approved LRAUV workplan. Investigation team would fabricate one or more vehicles for the USCG (in partnership with USCG RDC).
 - As part of the project funding for that build funds will be allocated for WHOI training of USCG operators, and for WHOI support of USCG operations.
 - Given the nature of Tethys LRAUV operations (operated via a satellite link) WHOI operators are able to participate in USCG operations remotely.
 - Lesson learned in transitioning a system to USCG operation would be invaluable in preparing the system for commercialization. WHOI would work with one of its many partners to commercialize the resulting system.
 - Selecting the company is premature at this point. However, marine robotics research is evolving rapidly, and we are likely to have more options available in the near future.
 - However, we do note that WHOI has a well-trodden path to commercialization of AUVs with Hydroid, and the PI of this effort has designs that are the foundation for the General Dynamics Knifefish (the root of that vehicle’s family tree is the ALTEX AUV).
- Stage two: “investigate manufacturing efficiencies to create low cost production.” In parallel with ADAC funded efforts in building the Tethys design, WHOI plans to devote resources to creating a more cost-efficient manufacturing process for LRAUV.
 - As a scientific platform, the research team has not designed the Tethys with efficiency of manufacturing as a consideration. However, now with much of the critical investigation work realized the Project PI will work with ADAC leadership to create plans to revisit the long-range AUV design with efficiency of manufacturing as a central goal.
 - This effort would leverage the nearly \$1M investment made by the state of Massachusetts in the Center for Marine Robotics “Dunk Works” manufacturing space. Dunk Works opened officially on July 20 2017. Equipped with the latest in design tools, 3D printers, circuit board printers, and the like, the space is ideally set up for the initiative. Additionally, the

prospect of low-cost, high-reliability, and long-range AUVs is attracting other sponsors. This is producing the prospect of a multiple sources in supporting cost efficiency in manufacturing LRAUV.

- *Stage three:* "Establish working group with DHS and USCG to support acquisition process and requirement demand." Informed by progress and conclusions of Stage 1 & 2, ADAC, WHOI and MBARI the team will consult with DHS S&T OUP, Borders and Maritime Division, USCG Project Champion, HQ USCG CG-7 and CG-9 and USCG RDC to present results of transition efforts. Additionally, the team will strive to understand and meet USCG LRAUV acquisition mission requirements, through cost effective production processes.

Transition plan conclusions: The above planning considerations will be reviewed and updated accordingly during the ADAC Program Year 5 during Center quarterly reviews and in accordance with DHS S&T OUP approved ADAC management plan. These forums and management processes will inform and improve LRAUV ability to transition efficiently and effectively from research to acquisition.

2. PROJECT: Arctic-related Incidents of National Significance (Arctic IoNS) and Arctic Medium and Long Term Environment (Arctic MaLTE) Workshops.

Project PI: ADAC Executive Director Randy Kee

Lead Institution: University of Alaska Anchorage

Partnered team: USCG District 17 Staff officers for Arctic IoNS and HQ USCG DCO-X staff officers for Arctic MaLTE workshop. Note: ADAC Fellows provide preparation and administrative support.

Project Description:

Abstract: ADAC plans to conduct one Arctic-related Incidents of National Significance (IoNS) workshop for the upcoming program year. ADAC plans the Arctic IoNS workshop in close coordination with USCG District 17. Based on identified operator concerns, Arctic IoNS assembles assemble expert academic and industry research professionals to work with select Canada and U.S. Coast Guard Arctic operators, along with U.S. and Canada government security officials in a structured workshop to understand gaps and shortfalls in science and technology and to provide corresponding research questions to address. ADAC publishes a corresponding workshop Rapporteurs report addressing research questions. If approved, ADAC is prepared to conduct a funded call for proposals, while noting new research projects would extend beyond Program Year 5.

ADAC plans to conduct one Arctic focused Medium and Long Term Environment (MaLTE) workshop to understand and address the medium and long-term research needs specific to the Arctic. ADAC plans Arctic MaLTE in close coordination with HQ USCG Future Concepts Division (HQ USCG DCO-X, "Evergreen"). Arctic MaLTE is a structured workshop involving select academics, industry researchers, and government officials, who explore longer, range challenges comprehensively, from policy, governance, and science & technology.

Objective/Purpose: Arctic IoNS: Conduct focused workshops with select researchers/paired with USCG and other suitable operators to discern USCG shortfalls in a Commander, USCG D17 mission area. Arctic MaLTE: Conduct focused workshops to meet medium and long-term strategy, planning and policy problems as determined by HQ USCG (specifically, HQ USCG Arctic advisor to the Commandant and HQ USCG DCO-X).

Baseline: During a national incident, the public (including academia) offers technology solutions to the incident commanders to assist in the response. ADAC believes such an approach, while ultimately may assist in a successful outcome, often generates ad hoc solutions that prove to be sub optimal to capabilities developed by well-planned and researched processes.

The proposed workshops for the upcoming year will pull lessons learned from ADAC's Arctic IoNS workshops conducted June 2016 and October 2017. The planned Arctic IoNS workshop will identify research and development gaps and research questions aimed at closing the gaps with relevant research to support the USCG mission before an actual Arctic IoNS occurs. ADAC plans the next Arctic IoNS for February 2019 framed as a humanitarian response scenario, in close collaboration with USCG District 17.

In order to complement near term operator-driven research, the MaLTE workshop will look towards the 10-20-year time horizon to investigate potential mission needs based on projected technology gaps driven by the anticipated Arctic operational environment. Building from lessons learned in the MaLTE workshops from May 2017 and March 2018, ADAC is collaborating with Trent University, Peterborough Ontario, Canada to conduct a Regional Security North...Future Challenges Workshop in late August 2018 at the University of Alaska, Anchorage.

Research Method: These two Arctic-focused workshops will exercise a similar development methodology. Each workshop seeks to identify research gaps and define research questions.

ADAC plans Arctic IoNS, February 2019. The workshop initially plans the scenario of an Arctic region, Humanitarian Assistance scenario. Final scenario determination will be made by USCG D17 Commander.

Arctic IoNS method is expert research, operator and government official structured seminar oriented to provide follow-on research to address discovered shortfalls. Arctic IoNS development begins with the Arctic operators providing specified areas of concern to investigate. ADAC will seek to conduct a scenario-based seminar early in Program Year 5 with USCG D17 and USCG Canadian counterparts to identify areas of under researched concern in an Arctic humanitarian assistance response.

ADAC will conduct a comprehensive literature review through Center Fellows to establish a baseline of published experts. ADAC solicits and assembles an appropriate panel of select researchers from the baseline to present to invited operators and government officials in Canada and the U.S. their research findings a comprehensive plenary session. After the plenary, ADAC divides participants across facilitated breakout workshops to discover real.

Through this structured plenary and breakout workshop, participants gain understanding of knowledge gaps and shortfalls in science and technology. Equipped with this understanding, participants will develop research questions to address shortfalls. ADAC will create a Rapporteurs report, with prioritized research questions and prepare an open RFP to address research approaches (if/as approved by DHS S&T OUP).

Workplan Annex B describes the planned ADAC open call process. The output of each workshop will be workshop proceedings, relevant research questions, and request for proposals (RFPs) solicitation addressing specific research relevant to USCG mission needs leading to solutions related to gaps and shortfalls.

ADAC plans Arctic MaLTE for August 2018. ADAC proposes to work with collaborate with HQ USCG DCO-X in a new venue that directly links to Canadian counterparts in Security concerns. This new workshop builds from a prior workshop sponsored by Trent University at Whitehorse Yukon Territory, in June 2017. Scenario based literature review will present a baseline of understanding by futurist researchers in terms of economic, security and physical environment of the future Arctic.

Guided by the Literature Review, expert opinion of selected and polled researchers, and the strategy documents, this late 2018 Arctic MaLTE workshop will establish areas of concern in accomplishing planned strategy and strategic goals. An invited team of researchers, operators and government officials assemble to analyze the preparatory materials to investigate alternative scenarios to determine needed policy, governance, and science & technology to realize DHS and USCG strategic goals and objectives. ADAC will then publish the findings of the research in a comprehensive report.

Student Participation: Center leadership plans that ADAC Fellows will aide preparation and administrative support as part of professional development and opportunity for networking. ADAC plans no laboratory or fieldwork.

Key Milestones:

1. Work closely with DHS, USCG and Canadian counterparts on the workshop scenario.
2. Conduct research to identify the universe of SMEs (international, domestic, in/out government, etc.); conduct research to determine what research is underway to address the likely challenges posed by the scenario and those challenges most relevant to USCG.
3. Organize workshop (via securing facility, inviting participants, developing agenda etc.).
 - Completed workshop participants' selection;
 - Completed workshop participants' invitations;
 - Completed logistics arrangements;
 - Completed workshop announcement;
 - Completed workshop program.
4. Make a determination to identify appropriate SME speakers to discuss relevant research activities across disciplines that likely address USCG challenges relevant to the scenario.
5. Complete panel selection and invitations.
6. Execute workshop – Research Questions developed and provided to DHS.
7. Complete report/proceedings and slides deck representing the workshop discussions and submitted to DHS for review
8. Publish rapporteurs report/proceedings, including list of participants, and slides deck will be publically posted (website) with the ADAC RFP.
9. Prepare RFP (for Arctic IoNS...if/as desired by DHS S&T OUP).

Performance Metrics:

- Arctic IoNS: Planned and conducted workshops that meets USCG D17 Commander expectations.
- Arctic MaLTE: Planned and conducted workshops that meets HQ USCG Arctic advisor to the Commandant and HQ USCG DCO-X expectations.

Outcomes/Outputs: The output of each workshop will be prioritized research questions that will lead to a request for proposals (RFPs) addressing specific USCG operational challenges and leading to solutions of the identified gaps. A collateral outcome is to provide USCG with a directory of subject-matter experts (SMEs) likely to understand the scope of challenges posed by Arctic IoNS and Arctic MaLTE. In addition, it will provide a directory of current ongoing research and expertise to help develop support plans in the future that can draw upon state-of-the-art technology and knowledge.

Workshop format:

Day 1:

- Meeting Product / Agenda / Logistics / Introductions
- Presentation and discussion of the IoNS or MaLTE scenario.
- Presentations by SMEs on current research underway related to the challenges posed by the scenario including description and analysis of the state-of-the-art. Based on the above presentations, the workshop participants will identify and discuss research gaps related to the scenario
- The day will conclude with the formation of break out groups of experts for each research theme gap related to the scenario and discussions.

Day 2:

- During the morning period, break out groups will discuss the gaps and formulate research questions to close those gaps. During the afternoon, breakout groups will convene as a general plenary session to discuss each group's findings.
- Formalize research questions and provide to appropriate USCG colleagues along with DHS S&T OUP PM for final review. Upon review by DHS, research questions will form the basis for an RFP issued by ADAC (only if desired by DHS S&T OUP).

Stakeholder Engagement: Through a series of prior research and coordinating meetings, establish a network of Canada and U.S. operators, researchers and government official tailored to address each individual workshop.

Project Champions: Arctic IoNS: USCG D17, Arctic MaLTE: HQ USCG DCO-X. Project Advocates include the following: HQ USCG-5PW, HQ USCG-CPE, USCG HQ CG-926, and USCG R&D Center.

Transition plans: ADAC's goal of each workshop is to ultimately transition discovered science and technology gaps and shortfalls into relevant research questions, elicit response via an open call for proposal, and place the most qualified responses into research to deliver needed products to address the identified need. The shorter-range focus of Arctic IoNS workshops is well suited to accomplish deliverables

in 2-3 year timeline. The longer-range focus of Arctic MaLTE advances long lead research, requiring greater community of interest patience in awaiting relevant outcomes.

3. **PLACEHOLDER TBD:** Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

THEME 4: Integration of Science and Engineering with Maritime Security Governance and Policy Research

1. **TBD:** Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

THEME 5: End-to-End (E2E)

1. **TBD:** Projects awarded and established responding to the fall 2017 Arctic Incidents of National Significance Workshop: "Coping with the Unthinkable...an Arctic Maritime Oil Spill."

THEME 6: Integrated Education

1. Education Outreach and Workforce Development Overview;
2. PROJECT: Career Development Grant Scholarships;
3. PROJECT: Minority Summer Intern (MSI) Program;
4. PROJECT: Arctic Summer Internship Program (ASIP). ASIP is an integrated project with Minority Summer Intern (MSI) Program.

1. Integrated Education Overview

Education outreach and workforce development is a core mission for ADAC. The intent of ADAC's education program is to contribute to the next generation of Science, Technology, Engineering, and Mathematics (STEM) professionals for the Homeland Security Enterprise (HSE). ADAC's geographic focus on the Arctic is unique in the DHS S&T OUP portfolio. The Arctic focused research led by ADAC offers ADAC fellows a variety of unique research and development opportunities to engage with research aimed specifically to respond to the challenges faced by the USCG and other DHS maritime missions operating in the High North. Upon graduation, ADAC fellows will be well suited to provide needed Arctic expertise as future members of the HSE.

The ADAC Fellows program is integral to the Center and associated research projects. During the academic year, ADAC fellows will participate in research and Center led activities providing students with both technical and professional developmental experiences. ADAC Fellows participate in student research either in individual research projects, or in Center activities during the academic year. Additionally, ADAC fellows participate in two 10-weeks long summer internships while associated with the program.

In accordance with the DHS S&T OUP Cooperative Grant, the terms and conditions for applying and maintaining, "good standing" while associated with ADAC are rigorous and demanding. The reward for meeting these conditions are fiscal support for studies, professional and technical development through activities conducted as part of the ADAC Fellows program, and mentoring and improved access for graduates seeking a career within the HSE.

The ADAC Fellows program is open to undergraduate, graduate, and advanced graduate students. Currently, the ADAC Fellows program is comprised of two Career Development Grant (CDG) fellows and a larger number of student research interns engaged in ADAC projects as Workforce Development fellows (WFD). The CDG fellows are funded via a DHS S&T OUP Supplemental Award while the WFD fellows receive their support from the overall DHS S&T OUP Cooperative Grant to the Center. Once the associated DHS CDG Supplemental Award is exhausted at the end of ADAC's Program Year 4, ADAC will continue to provide awarded grant funding to new student fellows via the overall ADAC cooperative grant by enrolling new students into the WFD program. Additionally, ADAC will continue to seek appropriate institutional support funding to support the Center's education activities in Year 5.

ADAC currently has established fellows at the University of Alaska Anchorage (UAA), University of Alaska Fairbanks (UAF), University of Texas El Paso (UTEP), and Massachusetts Maritime Academy (MMA). In Program Year 5, ADAC will investigate possibilities to enroll additional students into the ADAC Fellows program from other institutions associated with the Center. ADAC's student recruitment efforts will continue to seek to develop the ADAC Fellows programs into an ethnically diverse group of student fellows.

Complementing the Fellows program, ADAC plans to host five minority students in Program Year 5 to take part in a summer internship during the early summer of 2019. Funding permitting, ADAC will integrate these five minority students with participating Center fellows for the Arctic Summer Intern Program, which is discussed in more detail below.

Overall ADAC Fellows Program Schedule and Objectives In this coming program year, ADAC seeks to continue advancing the Fellows program. Accordingly, the following are the key attributes for ADAC Fellows in Program Year 5. In sum, ADAC Fellows will:

- Participate in professional exchanges with USCG, in particular via the Arctic IoNS and MaLTE workshops, and any corresponding tabletop seminars.
- Accompany ADAC leadership to forums with U.S. Federal enterprises in the greater Anchorage area.
- Attend monthly Fellows meetings with Center leadership. These meetings will include professional mentoring, updates on the HSE and discussion about research efforts conducted by ADAC fellows in their respective ADAC projects and beyond. ADAC will continue to host meetings at UAA and use webinar technologies for students participating remotely. ADAC will invite speakers to provide leadership and career development perspectives oriented to science and technology careers and/or careers across HSE to these monthly meetings.
- In collaboration with Project PIs/lead(s) and ADAC Education and Administrative Manager, develop individual student research workplans to map out their expected participation and contribution to ADAC's research projects, or Center led activities.

- Participate in significant maritime focused forums hosted in Anchorage Alaska. This includes the Alaska Marine Science Symposium planned for January 2019, and Anchorage Arctic Research Day as part of the Anchorage North by North Festival in April 2019.
- Participate in a compact 6 week ADAC Summer Internship Program as an option to satisfy one of two required summer research internships. Included in the Summer Internship Program are visits to an array of Anchorage based federal, state and local agencies associated with the HSE and supporting activities. Also included is a planned Arctic research program at Utqiagvik (formally known as Barrow), Alaska.
- Integrate five Minority Summer Interns from Minority Serving or Significant Minority Enrollment Institutions to ADAC's Summer Internship Program.
- Participate, (as a program graduate) as desired, in post student mentoring and networking by Center leadership seeking entry into the HSE.

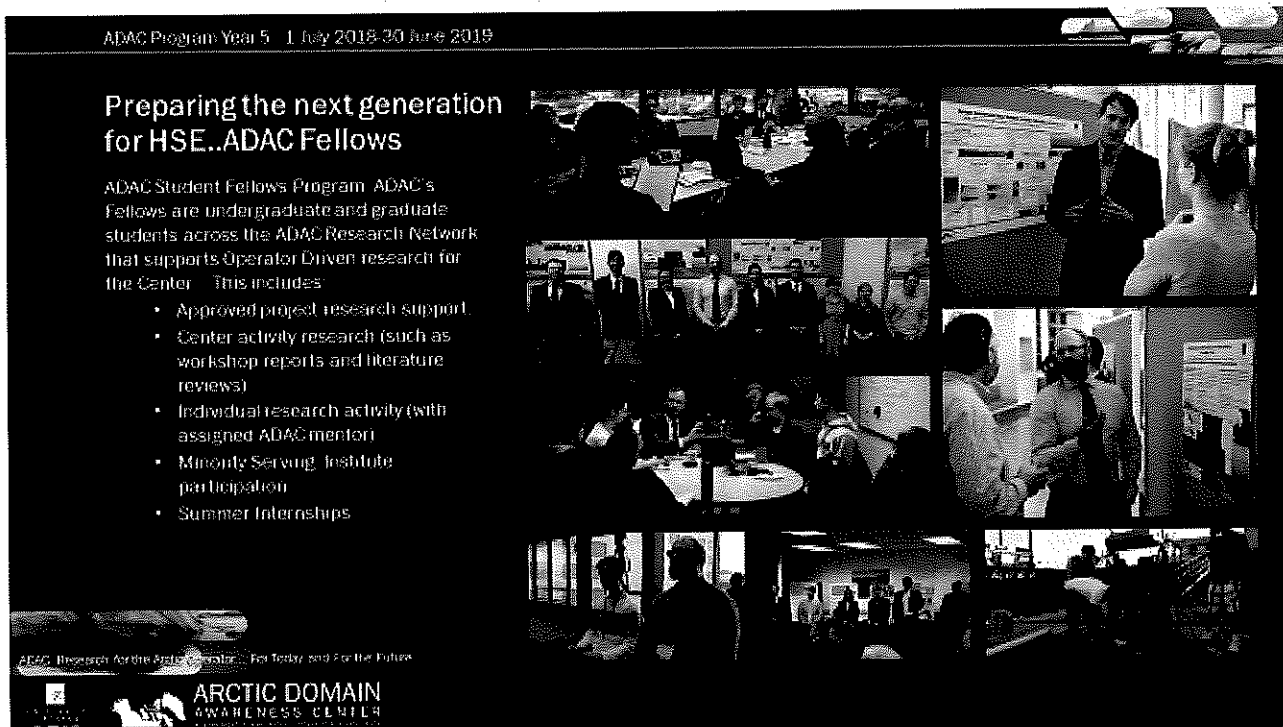


Figure 10: ADAC Fellows Program Overview

Quarterly coordination with DHS S&T OUP. ADAC will conduct a program quarterly review with DHS S&T OUP ADAC Program Manager and DHS S&T OUP Education Outreach and Workforce Development Program Manager. As discussed in Module 1, ADAC leadership will assess the Education Program in detail during ADAC Quarterly Reviews.

Compliance with DHS S&T OUP Workforce development criteria. ADAC leadership (principally through the Center's Education and Administration Manager) will ensure ADAC complies with the Homeland Security Act of 2002 to provide U.S. citizens training in homeland security-related science and engineering disciplines to maintain U.S. leadership in science and technology.

2. PROJECT: DHS Career Development Grant (CDG) program (DHS Supplemental)

Project PI: ADAC Education and Administration Manager, Malla Kukkonen.

Lead Institution: University of Alaska Anchorage.

Supporting Team: ADAC Industry Partners.

Project Description:

Abstract: ADAC CDG fellows are part of the next generation of scientists and engineers devoted to the discovery, development and improvement of technologies and applications for Arctic Maritime Domain Awareness, Response, and Resilience.

Funded via a DHS S&T OUP Supplemental Award, ADAC established CDG fellows as the initial element of the overall ADAC Fellows Program in February 2016. The DHS Supplemental Award provides ADAC's CDG fellows a scholarship to support students' studies, independent of the main Cooperative Agreement. Participation in the ADAC Fellows program provides CDG fellows research and professional development opportunities, including access to DHS and USCG professional forums and networks. DHS S&T OUP Supplemental Award terms and conditions established eligibility, minimum grade average, and student service obligation requirements after graduation. ADAC leadership manages these requirements to ensure compliance. Due to no additional DHS S&T OUP CDG Supplemental Awards, the Center plans to add two new participants to the project in Program Year 5. Center leadership manages CDG fellows as part of the overall ADAC Fellows Program. Continuing prior efforts, ADAC plans to mentor and develop CDG fellows to be capable of competing for future opportunities in DHS and/or Homeland Security Enterprise careers.

Objective/Purpose: Provide a scholarship and workforce development project to prepare undergraduate and graduate level students for entry into the Homeland Security Enterprise, specifically aligned to the CDG supplemental award. The specifications in expectations for the project are included in the DHS - ADAC Terms and Conditions for Workforce Development Plan.

Baseline: ADAC established CDG fellows in February 2016. DHS S&T OUP Supplemental Award provides CDG fellows student stipends. ADAC currently has two CDG Fellows that are continuing their fellowship in Program Year 5. Center leadership will continue to place a particular focus in connecting CDG fellows in applied areas of science and technology most relevant to DHS and USCG.

In accordance with DHS S&T OUP Terms and Conditions, ADAC tracks CDG graduated fellows until successfully placed into a DHS careers for a minimum of 1 year of service. CDG fellows present their ADAC related/supported research at the ADAC Student Research Symposium, and contribute to ADAC's annual

meeting conducted in Washington, D.C. At the close of the academic year, ADAC hosts an awards event for CDG fellows and other ADAC fellows. University of Alaska supports the administration of CDG fellows and the overall ADAC Fellows program via institutional support resourcing.

Methodology: ADAC's CDG fellows receive comprehensive educational support and professional development to serve in the HSE after graduation. Project methodology is based on guiding students through professional opportunities associated with DHS and USCG research needs in the Arctic all while monitoring students' academic development in their studies. Center leadership, along with Project leads, directs, monitors, and supports CDG fellows in their fellowship. ADAC's Education and Administration Manager tracks fulfillment of scholarship requirements, academic progress, and accomplishments for individual CDG fellows. Core to CDG fellows' success is direct coaching and mentoring by ADAC leadership. This coaching and mentoring includes actively advising CDG fellows while they accomplish work in their research projects and engaging them in Center led activities.

In summary, ADAC CDG Fellows program provides:

- A monthly student stipend and semester based tuition support while enrolled in the program.
- Research opportunities in ADAC projects.
- Mentoring and professional development.
- Participation in Center led activities (ADAC hosted/conducted workshops and the Center's Annual meeting, DHS and USCG activities, and open forums such as conferences).
- Contributions to Annual Student Symposium.
- Two summer internship programs, one per year for two years. Each summer internship is a minimum of 10-weeks in duration.

Note: Individual workplans developed collaboratively by project PIs/Leads, ADAC Education and Administrative Manager and the student guide the planned activities for all ADAC fellows and may vary in their content according to the students' goals and academic requirements.

Center led activities provide CDG fellows exposure to a variety of professional networks within DHS and USCG, U.S. federal, state and local agencies associated with ADAC, and internationally. Most importantly, gaining access to DHS and USCG networks provides CDG fellows potential avenues to employment within the HSE upon graduation.

ADAC's CDG fellows are STEM majors. ADAC monitors students' grade activity and other DHS S&T Supplemental Award Terms and Conditions outlined requirements to ensure each students' appropriate progress. A CDG fellow who fails to meet the rigorous requirements are allowed a maximum of two probationary semesters of continued participation in the program on an unpaid volunteer basis. If the probationary semester results in satisfactory progress, ADAC leadership returns the CDG fellow to good standing and restarts their financial support.

ADAC CDG fellows will comply with DHS Approved Safety plan as coordinated with the University of Alaska Anchorage procedures. ADAC applies the DHS approved safety procedures to all ADAC sponsored academic, government, and industry institutions. Compliance with the Safety plan is required for both field and laboratory conditions.

In coordination with assigned mentor, ADAC leadership conducts an annual performance evaluation of CDG fellows and the CDG fellows program at the conclusion of the program year. This evaluation will be part of the Center's final Quarterly Review for the program year in question.

Student Involvement: Program is 100% focused on participating ADAC fellows and students from under-represented classifications.

Key Milestones: For Program Year 5, ADAC conducts the following schedules and milestones for CDG Fellows:

1. Fellows will conduct tailored research work during the academic year with schedules mutually determined by CDG fellow and assigned mentor with appropriate Center leadership oversight (normally conducted by Education and Administration Manager).
2. CDG fellows will participate in two, ten-week summer internships with ADAC or industry hosted research (one per summer).
3. CDG fellows will join ADAC Customers and Partners Roundtables in order to gain insights to operator driven research requirements.
4. CDG fellows will participate in coaching and mentoring sessions hosted by ADAC Education and Administration Manager.
5. CDG fellows will participate in planning, execution and follow-up administration of ADAC sponsored research Arctic IoNS and MaLTE workshops.
6. Two CDG fellows, who have not previously participated, will join the ADAC Annual meeting in Washington, D.C.
7. CDG fellows will participate in ADAC planned outreach activities (in particular Alaska Marine Science Symposium in 2019 January 2019, and Anchorage Arctic Research Day as part of the Anchorage North by North Festival in April 2019).
8. CDG fellows will participate in ADAC Annual Student Research Symposium.
9. In coordination with assigned mentor, ADAC leadership conducts an annual performance evaluation of CDG fellows and the CDG program at conclusion of the program year. ADAC conducts this evaluation during the final ADAC Quarterly Review for the program year.
10. CDG fellows will participate in end of academic year recognition event.

Performance Metrics: The following are CDG program metrics used to evaluate individual and overall program success:

- Comparing student's grade point average (GPA) with DHS required minimum (3.3 on a 4.0 scale). Program is considered as "Success" when 100% of students are above the required 3.3 GPA. "Caution" is noted for the program when two students are performing below expectation. The program will received a "Failure" mark, if three or more students are not being able to maintain the required GPA;

- *Note: ADAC uses a two semester probationary period allowing CDG fellows to continue take part in program activities on an unpaid voluntary basis. Failure to return grades to the required GPA level after the probationary semesters will result in fellow's dismissal from the CDG program. In such an event, ADAC leadership will and follow with subsequent efforts to achieve recoupment of awarded funds*
- Comparing CDG Fellows completion of required 10-week summer internships with DHS required minimum of two summer internships prior to graduation. Program is considered "Success" when 100% of students are completing two internships prior to graduation. "Caution" is noted for the program when two students are completing only one internships before graduation. The program will receive a "Failure" mark if three students complete only one internships, or if two students fail to complete at least one summer internship prior to graduation.
- Comparing CDG Fellows assignments with participating in ADAC Annual Student Research Symposium. Program is considered "Success" when 100% of students participate at the Annual ADAC Student Research Symposium. "Caution" is noted for the program when two students fail to participate in one Annual Student Research Symposium. The program will receive a "Failure" mark if three or more CDG fellows fail to participate in one or more Annual Student Research Symposium while in the program.
- Comparing graduated CDG fellows accredited to DHS enterprise careers with program graduates who are unable to gain employment in HSE. Program is considered "Success" when all graduates (or more) year(s) of service within the HSE. "Caution" is noted for the program when two CDG graduates are unable to complete a minimum of one year of HSE service. The program will receive a "Failure" mark if three or more CDG graduates are unable to obtain employment for a minimum of one year of in the HSE.

Outcomes/Outputs Coached, mentored, and professionally developed CDG fellows enter HSE workforce.

Stakeholder Engagement: ADAC's Customers and Partners' Roundtable meetings are a mentoring and professional development opportunity for both CDG and WFD fellows. In addition, the CDG fellows will continue to play a vital role in ADAC's Arctic IoNS and Arctic MaLTE workshops. Depending on their availability, CDG fellows will participate in outreach forums, such as the Alaska Marine Science Symposium 2019 conference, and the Anchorage North by North/Arctic Research Conference and ADAC's Annual meeting in Washington, D.C.

Project Champion: While not designated as Project Champion, DHS S&T OUP Education POC reviews the progress of ADAC's education program on an approximately quarterly basis. MSI summer internship program progress will be included in ADAC's quarterly reviews of the Center's efforts in Education Outreach and Workforce Development with DHS S&T OUP Education Outreach and Workforce Development program management.

The CDG Fellows program progress will be included in ADAC's quarterly reviews of the Center's efforts in Education Outreach and Workforce Development with DHS S&T OUP Education Outreach and Workforce Development program management.

Transition Plan: As students prepare to graduate, ADAC Education and Administrative Manager supports student career placement into the positions aligned to HSE. Transition plans will continue past lifecycle of grant for tracking and job initiatives.

3. PROJECT: Minority Serving Institution (MSI) and Significant Minority Enrollment (SME) Summer Internship (MSI). Note: For Program Year 5 MSI will be integrated with ADAC Arctic Summer Intern Program.

Project PI: ADAC Education and Administration Manager, Malla Kukkonen

Lead Institution: University of Alaska Anchorage

Supporting Team:

- **MSI Institutions:** University of Texas El Paso (Hispanic)

SME Institutions:

- Texas A&M (Hispanic)
- University of Alaska Anchorage (Native American Indian)
- University of Alaska Fairbanks (Native American Indian)

Project Description:

Abstract: In Program Year 5, ADAC will recruit five student summer interns from under-represented classifications seeking to leverage established partnerships with designated MSI and SME institutions. The ADAC Minority Summer Internship will integrate these five summer interns along with additional participating ADAC fellows for a new 2019 ADAC Arctic Summer Intern Program.

ADAC's Arctic Summer Intern Program (ASIP) is a comprehensive 6-week internship conducted at the University of Alaska Anchorage. ADAC's ASIP will provide students opportunity to visit across multiple U.S. federal agencies with offices in Anchorage, participate in ADAC research conducted at UAA, and take part in an Arctic fieldwork experience conducted in Utqiagvik (formerly Barrow) Alaska.

Objective/Purpose: Provide an Arctic focused summer internship program as part of the overall ADAC Fellows program oriented for Minority Serving Institutions, under-represented classifications students and other ADAC Fellows as part of the student program's overall workforce development to prepare undergraduate and graduate level students for entry into the Homeland Security Enterprise. The specifications in expectations for the project are included in the DHS - ADAC Terms and Conditions for Workforce Development Plan.

Baseline: As part of the ADAC student focus presented under the ADAC Fellows Program, the Center seeks to recruit student summer interns from under-represented classifications. ADAC will advertise the Minority Summer Internship opportunity across ADAC research network (in particular through existing networks with MSI or SMEs), DHS S&T OUP communications, U.S. Arctic Research Commission (USARC), Arctic Research Consortium of the U.S. (ARCUS), and Interagency Arctic Research Policy Committee (IARPC).

Funding permitting, the selected summer research interns will travel to UAA. ASIP will focus on providing students workforce development opportunities in operational capacities that will directly benefit the Department of Homeland Security and its components.

Relevance to DHS: Professionally developing students from under-represented classifications conforms to DHS diversity goals. Integrating visiting interns with ADAC fellows provides synergy and networking opportunities for all students. Visiting students may then seek to apply for a fellowship with ADAC, or seek similar opportunities with other DHS S&T OUP Center of Excellence due to their ASIP experience.

Research Method: Students from under-represented minorities who focus in science, technology, engineering and mathematics (STEM) fields are the most likely candidates to be interested in connecting with many of the projects the Center is pursuing and may be interested in seeking a career associated with the HSE.

Through an Arctic-focused, financially supported summer internship program, ADAC will recruit and connect with students from under-represented minorities. As described in project baseline, ADAC will recruit students via a comprehensive approach.

Visiting students from under-represented minorities participating in the MSI summer program will comply with DHS Approved Safety Plan as coordinated with the University of Alaska Anchorage procedures. In all cases, compliance with DHS approved safety procedures is mandatory for ADAC sponsored academic, government and industry institutions and will be applied in both field and laboratory conditions.

As described in the Education and Workforce Development segment, coaching and mentoring of students from under-represented minorities (and other ADAC fellows) is conducted to provide an overview and to orient these students to careers in government service across the DHS Enterprise .

The University of Alaska Anchorage plans to support the administration of the overall ADAC Fellows program, including the MSI summer internship program, and the overall ADAC Fellows program via institutional support resourcing.

Student Involvement: Program is 100% focused on students from under-represented minorities.

Key Milestones: For Program Year 5, ADAC will conduct the following steps to reach intended goals of the Minority Summer Internships:

1. Recruit five students from under-represented minorities to participate in ADAC's Arctic Summer Intern Program and integrate the MSI students with participating ADAC fellows.
2. Outline expectations and opportunities for recruited students by providing advance preparation information and associated materials.
3. Recruited students will travel to Anchorage and participate in ADAC's ASIP. Details of ASIP are available in the associated project segment.

Performance Metrics: Measures of meaningful performance for program success are as follows:

- Recruiting five students from under-represented minorities: Program is considered "Success" when full recruitment goal is achieved. , "Caution" is noted for the program when four students have

been successfully recruited. The program will receive a "Failure" mark if only three or less students are successfully recruited.

- Visiting minority students who then decide to compete for a DHS CoE student intern program, because of participating in the ADAC MSI: Program is considered "Success" when one student considers pursuing a follow-on intern with either ADAC or another DHS CoE.
- Visiting minority students who follow-on through a student relationship to a DHS CoE who then successfully graduate and enters into employment with the HSE. Program is considered "Success" when one student takes this path over the duration of the ADAC MSI program.

Outcomes/output: Coached, mentored and professionally developed students from under-represented minorities enter DHS enterprise workforce.

Key Stakeholder Engagement Plan: Students from under-represented minorities will be invited to join other ADAC fellows taking part in the summer internship program in a scheduled summer ADAC "Customer's and Partner's" Roundtable as a mentoring and professional development opportunity.

Project Champion: While not designated as Project Champion, DHS S&T OUP Education POC reviews the progress of ADAC's education program on an approximately quarterly basis. MSI summer internship program progress will be included in ADAC's quarterly reviews of the Center's efforts in Education Outreach and Workforce Development with DHS S&T OUP Education Outreach and Workforce Development program management.

Transition Plan: As students prepare to graduate, ADAC Education and Administrative Manager supports student career placement into the positions aligned to HSE. Transition plans will continue past lifecycle of grant for tracking and job initiatives.

4. PROJECT: ADAC Arctic Summer Intern Program (ASIP). An ADAC Fellow & Minority Student Integrated Summer Intern Program.

Project PI: ADAC Education and Administration Manager, Malla Kukkonen

Lead Institution: University of Alaska Anchorage

Supporting Team: Dr. Craig Tweedie, UTEP, Dr. Andrew Mahoney, UAF Utqiagvik (formerly Barrow) Field team and ADAC Executive Director, Randy Kee, (Exercise lead).

Project Description:

Abstract: In Program Year 5, ADAC will conduct a second Arctic Summer Intern Program (ASIP). ADAC's ASIP will integrate visiting Minority Summer Interns with participating ADAC fellows in a comprehensive orientation and mission focused education experience. ASIP includes visits to U.S. federal agencies based in Anchorage that are concerned with Arctic issues, a maritime disaster response table-top exercise, focused time with ADAC researchers at UAA, individual research concept development to generate new

approaches to addressing Science and Technology solutions to USCG Arctic mission needs, and a 2-week Arctic Field work experience at Utqiagvik, Alaska.

The summer internship is focused on recruitment of students from underrepresented minorities. Project specifications of the Minority Student Internship are described in the associated, preceding project segment and included in the DHS - ADAC Terms and Conditions for Workforce Development Plan.

Objective/Purpose: Provide an Arctic focused summer internship program as part of the overall ADAC Fellows program oriented for Minority Serving Institutions, under-represented classifications students and other ADAC Fellows as part of the student program's overall workforce development to prepare undergraduate and graduate level students for entry into the Homeland Security Enterprise. The specifications in expectations for the project are included in the DHS - ADAC Terms and Conditions for Workforce Development Plan.

Baseline: DHS S&T OUP Cooperative Grant Terms and Conditions require ADAC to develop and conduct two 10-week summer internships for all Center student fellows during their tenure of association with ADAC. Accordingly, ADAC proposes to create an innovative Summer Internship program for ADAC fellows and students from underrepresented minorities.

Additionally, the Center seeks to integrate minority students who are awarded paid internships from ADAC's Minority Summer Intern program to ASIP. Specifically, ADAC has established a project to provide scholarships opportunity for five Minority interns recruited to gain an introduction to Arctic research and the Homeland Security Enterprise (HSE).

Anchorage Alaska is home to a myriad of U.S. federal field offices focused on Alaska and Arctic Alaska. These field offices are staffed with federal professionals that are either directly or indirectly associated with the Homeland Security Enterprise. Anchorage is also home to many State of Alaska department offices and a number of Arctic-focused Native Alaskan Foundations and Arctic focused commercial enterprises, and a critical seaport, which offer opportunistic education and outreach experiences for ASIP interns. Anchorage's Joint Base Elmendorf Richardson (JBER) is home to a U.S. Northern Command sub-Unified Command (Alaskan Command) and an array of U.S military forces oriented for the defense of Alaska and power projection into the Pacific region. JBER also hosts U.S. Coast Guard District 17, Sector Anchorage, Alaska's Department of Military and Veterans Affairs (and the Alaska National Guard) and the Alaska District U.S. Army Corps of Engineers.

ADAC's leadership team includes a retired USAF General Officer with extensive operational experience, including disaster response and humanitarian assistance missions, plus prior service as a Joint Exercise Director at a U.S. Unified Command.

University of Alaska Fairbanks (UAF) and University of Texas El Paso (UTEP) conduct considerable field research near Utqiagvik, (formerly Barrow) Alaska. Both universities support student activities in this field research. The two proposed field leads (Dr. Mahoney and Dr. Tweedie) provide complimentary and extensive experience in Arctic research. Based on existing logistics, the field teams are well suited to handling up to 8-10 ASIP interns in ADAC Year 5.

ADAC's ASIP will leverage the attributes of the Anchorage area in a comprehensive introduction to the Arctic challenges faced by government agencies and commercial enterprises. ADAC will leverage the expertise of its staff based in Anchorage to conduct a meaningful guided seminar to facilitate student understandings of the challenges faced by USCG Arctic operators. ADAC will leverage the skills of UAA based researchers to guide students in understanding research oriented to support the Arctic operator. Lastly, ADAC will tap the unique experiences of expert field researchers and established locations at a critical Arctic location to provide students a safe developmental field research experience.

Research Method: ADAC leads 6 weeks- of planned activity guided by ADAC's Education Manager that is overseen by the ADAC Executive Director for the Anchorage based portion of the internship program. UTEP and UAF Supporting leaders will co-lead the field portion of the internship program and will contribute to an orientation of students at UAA prior to students departing for Utqiagvik (Barrow). ADAC will screen and select a student leadership team to support detailed planning and execution of the program. ADAC will process visiting minority students and participating ADAC fellows into ASIP, and conduct and conclude the program as detailed in schedule and milestones.

Student Involvement: Program is focused on participating ADAC fellows and students from underrepresented minorities.

Key Milestones: For Program Year 5, ADAC will conduct the following for ASIP:

1. Recruit five students from underrepresented minorities to participate in the Arctic Summer Intern Program that will also include the participation of other ADAC fellows.
2. Outline expectations and opportunities for recruited students, providing advance preparation information and associated materials.
3. Funding permitting, support student travel to Anchorage and participation in ADAC's ASIP.
4. Orient students in ADAC's overall mission, the internship experience, expectations of the program, safety briefs including both Anchorage and Utqiagvik (Barrow) portions. Include professional mentoring of government careers in HSE and careers in Arctic-oriented science and technology.
 - a. The orientation is expected to incorporate 2 days of student activity.
5. Engage University researchers associated with ADAC to participate and relay the breadth of Center research efforts and association with other university research enterprises.
 - a. ADAC Project leads/their designated representatives will present.
 - b. ADAC will gain overviews from other UAA research entities such as UAA Institute of Social and Economic Research, the Applied Environmental Research Center and business ventures such as UAA's Business Enterprise Institute.
 - c. The above activities should take approximately 3 days of student activities.
6. Depart for ASIP Utqiagvik (Barrow) trip for field research. Team proceeds to Utqiagvik (Barrow) for a ~12-day of field-based research and returns to Anchorage.
 - a. Upon arrival, team participates in overview, safety briefings and orientation, supporting logistics and training on research tasks at hosted site.
 - b. Team participates in field-based research co-led by UTEP and UAF researchers.
 - c. Where possible, students will participate in field-based research that supports other ADAC projects. For example, field based testing of LRAUV, and affiliated research being conducted near Utqiagvik by ADAC researchers, including Dr. Tweedie's storm surge monitoring and modeling project.

- d. Students will also conduct their own independent research projects that will be designed to align with both ADAC's mission and the students' expertise and future career interests. Project deliverables from this effort will take the form of a draft research poster suitable for presentation at a conference.
- e. Total time allotted is 14 days (~2 days for travel and ~12 in the field).
7. ADAC UAA team conducts Anchorage area Arctic focused HSE and associated government visits.
 - a. This activity is 7 days of student activity.
8. ASIP Intern Research White Paper development.
 - a. This activity is 9 days of student research and paper development.
 - b. Goal is to generate 2-3 Arctic research focused White Papers.
9. Interns participate in ADAC Customer's and Partner's Roundtable.
10. Complete out-process, obtain survey feedback and conclude Internship.

Logistics: ADAC provides funded support to students, and houses students from outside the Anchorage area at UAA student facilities. UTEP and UAF Co-research leads will work with ADAC leadership to establish the field-based logistics required for the success of the field-based component of the program. Student workspace is located at ADAC's office at 1901 Bragaw Street, Anchorage. ADAC does not provide transportation for students for personal matters, but will seek UAA transportation assets for local area visits.

Performance Metrics: Measures of meaningful performance for program success are as follows:

- Recruiting MSI metrics as previously described.
- Executing Outdoor leadership and Field research program 100% safely.
- Collecting feedback from ASIP participants accomplished at end of course survey.

Outcomes/Outputs: Coached, mentored and professionally developed students from both under-represented minorities and other enrolment categories participating in the ADAC Fellows Program enter DHS enterprise workforce enriched with their expertise gained by working through the ASIP experience.

Stakeholder Engagement: Students from under-represented minorities will be invited to join other ADAC fellows taking part in the summer internship program in a scheduled summer ADAC "Customer's and Partner's" Roundtable as a mentoring and professional development opportunity. ASIP progress will be included in ADAC's quarterly reviews of the Center's efforts in Education Outreach and Workforce Development with DHS S&T OUP Education Outreach and Workforce Development program management.

Transition Plan: As students prepare to graduate, ADAC Education and Administrative Manager supports student career placement into the positions aligned to HSE. Transition plans will continue past lifecycle of grant for tracking and job initiatives.

IV. Appendix A: Acronyms

ACNFS	Arctic Cap Nowcast/Forecast System
ADAC	Arctic Domain Awareness Center
ADCIRC51	Advanced Circulation Model
AESC	Arctic Executive Steering Committee
AFP	ADAC Fellows Program
AI	Artificial Intelligence
AIA	Aleut International Association
AIS	Automatic Identification System
AOOS	Alaska Ocean and Observation System
AOSC	Arctic Oil Spill Calculator
ARN	ADAC Research Network
ASRC FS	Arctic Slope Regional Corporation Federal Systems
BOEM	Bureau of Ocean Energy Management
BSSN	Bering Sea Sub-Network
CAFF	Conservation of Arctic Flora and Fauna
CDG	Career Development Grant
CBP	Customs and Border Protection
C&ES AD	Communications and Educational Support Associate Director
CIMES	Center for Island Maritime and Extreme Environment
CIS	Critical Indicators System
CFS	Climate Forecast System
CMR	Center for Maritime Research
COE	Center of Excellence
CONAS	Community Observing Network for Adaptation and Security
COTS	Commercial Off-the-Shelf
CFS	Climate Forecast System
DGPS	Differential Global Positioning System
DHS	Department of Homeland Security
DHSEM	Division of Homeland Security and Emergency Management (State of Alaska)
DHS S&T OUP	Department of Homeland Security Science & Technology's Office of University Prgm
DIPP	Data Information Protection Plan
DR	Disaster Response
E2E	End to End
ED	Executive Director
EO&WFDD	Education Outreach and Workforce Development Director
ERAU	Embry Riddle Aeronautical University (ERAU)
EO&WFDD	Education Outreach and Workforce Development Director
ERMA	Environmental Response Management Application
ET-Storm Surge	Extra Tropical Storm Surge
FEMA	Federal Emergency Management Agency

FMI	Finnish Meteorological Institute
FIST	Field Information Support Tool
FTD	Federal Tribal Designation
FTIR	Fourier Transform Infrared Spectroscopy
GoMRI	Gulf of Mexico Research Initiative
GNOME	General NOAA Operational Modeling Environment
HA	Humanitarian Assistance
HFO	High Fidelity Observer
HIOMAS	High-resolution Ice-Ocean Modeling and Assimilation System
HIPPA	Health Insurance Portability and Accountability Act
HYCOM	Hybrid Coordinate Ocean Model
IANA	Indian and Northern Affairs
IARPC	Interagency Arctic Research Policy Committee
ICECON	Ice Conditions Index
IICWG	International Ice Charting Working Group
IMO	International Maritime Organization
InSAR	Interferometric Synthetic Aperture Radar
IONS	Incidents of National Significance
JTFN	Joint Task Force North (Canada)
KTG	Kestrel Technology Group
LIDAR	Light Detection and Ranging
LPBK	Local Placed Based Knowledge
LRAUV	Long Range Autonomous Underwater Vehicle
LWIR	Longwave Infrared
MBARI	Monterey Bay Aquarium Research Institute
MIZMAS	Marginal Ice Zone Modeling and Assimilation System
MMA	Maine Maritime Academy
MDA	Maritime Domain Awareness
MN	Member Node
MOTR	Maritime Operational Threat Response
MSI	Minority Serving Institutions
MXAK	Marine Exchange of Alaska
NAIS	North American Ice Service
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCEI	National Centers for Environmental Information
NCEP	National Center for Environmental Prediction
ND	Nova Dine
NIC	National Ice Center
NOAA	National Oceanic and Atmospheric Administration
NSC	National Security Cutter
NSF	National Science Foundation
NWS	National Weather Service
OODA	Observe, Orient, Decide and Act
OGCWS	Open Geospatial Consortium Web Service
OSA	Open Systems Architecture

OUP	Office of University Programs
ORR	Office of Response and Restoration
ONR	Office of Naval Research
PI	Principal Investigator
PII	Personally Identifiable Information
PIOMAS	Pan-arctic Ice–Ocean Modeling and Assimilation System
PM	Program Manager
PMD	Project Management Director
POA	Port of Anchorage
PoISAR	Polarimetric Synthetic Aperture Radar
RD	Research Director
RPA	Remotely Piloted Aircraft
SAR	Search and Rescue
S&T	Science and Technology
SETS	Social-Ecological-Technological Systems
SDI	Spatial Data Infrastructure
SME	Significant Minority Enrollment
STCW	Standards of Training, Certification, and Watchkeeping
SWAN	Simulating Waves Near Shore
TAMOC	Texas A&M Oil Spill Calculator
TAMU	Texas A&M University
TRL	Technology Readiness Level
UAA	University of Alaska Anchorage
UAF	University of Alaska Fairbanks
UAV	Unmanned Aircraft Vehicle
UDOP	User-defined Operating Picture
UNM	University of New Mexico
UGV	Unmanned Ground Vehicle
USCG	United States Coast Guard
USCG RDC	United States Coast Guard Research and Development Center
USGCRP	U.S. Global Change Research Program
US MDA	United States Maritime Domain Awareness
USN	United States Navy
USNORTHCOM	United States Northern Command
USV	Unmanned Surface Vehicle
UTEP	University of Texas El Paso
UUV	Unmanned Underwater Vehicle
UW	University of Washington
WHOI	Woods Hole Oceanographic Institution

V. Appendix B. Budgetary Information.

Year Five Arctic Domain Awareness Center (ADAC) Financial Summary

Summary for Center:

Management and Central Administration Costs: \$343,030 total costs borne by the award; other costs are from the University of Alaska Anchorage in direct funding or returned Indirect costs back specifically for the project.

By Themes/Projects/Partner:

- Theme 1: Maritime Risk, Threat Analysis, and Resilience Research
(Total Theme Costs: \$348,359)
 - Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response in the Arctic (Total Project Costs: \$258,301)
 - University of Alaska Anchorage: \$47,619
 - University of Alaska Fairbanks: \$210,682 (carry forward funding)
 - High Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS) (Total Project Costs: \$90,058)
 - University of Washington: \$90,058
- Theme 2: Maritime Domain Awareness (MDA) Research (Total Theme Costs: \$2,402,660.24)
 - Arctic Oil Spill Modeling (AOSM) (Total Project Costs: \$199,999)
 - Texas A&M—College Station: \$100,000
 - University of Alaska Anchorage: \$99,999
 - Ice Condition Index (ICECON) for the Great Lakes (Total Project Costs: \$246,062.45)
 - University of Alaska Anchorage: \$133,316.45 (\$7,947 carry forward funding)
 - University of Alaska Fairbanks: \$112,746
 - Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic (Total Project Costs: \$91,444.79)
 - Alaska Sea Life Center: \$15,000 (carry forward funding)
 - University of Alaska Anchorage: \$76,444.79 (\$56,644 carry forward funding)
 - The Arctic All-Hazards GIS Platform (Total Project Costs: \$351,519)
 - University of Alaska Anchorage: \$12,800 (Funding from IoNS 2016 RFP, carry forward funding)
 - University of Maryland: \$338,719 (Funding from IoNS 2016 RFP, carry forward funding)
 - Arctic Vessel Monitoring Geofencing/Alert Awareness (Total Project Costs: \$302,582)
 - Alaska Maritime Prevention & Response Network: \$98,283 (Funding from Yr 4 Issues 2017 RFP, carry forward funding)

- University of Alaska Anchorage: \$204,299 (Funding from Yr 4 Issues 2017 RFP, carry forward funding)
- Issues (2017) RFP Reserve Funding (Total Project Costs: \$1,211,053)
- Theme 3: Maritime Technology Research (Total Theme Costs: \$2,125,491.17)
 - Propeller-driven Long-Range Autonomous Underwater Vehicle (LRAUV) for Under-Ice Mapping of Oil Spills and Environmental Hazards (Total Project Costs: \$996,973)
 - Monterey Bay Aquarium Research Institute: \$19,999
 - Woods Hole Oceanographic Institute: \$996,973 (\$22,000 carry forward funding)
 - Arctic Incidents of National Significance (IoNS) and MaLTE workshops and RFP (FY18-19) Oil Spill Focus (Total Project Costs: \$989,548.17)
 - Arctic Incidents of National Significance (IoNS) and MaLTE workshops and (Total Project Costs: \$138,970)
- Theme 4: Integration of Science and Engineering with Maritime Security Governance and Policy Research (Total Theme Costs: \$0)
- Theme 5 End-to-End (E2E) (Total Theme Costs: \$0)
- Theme 6 Integrated Education (Total Theme Costs: \$513,799.56)
 - Education Outreach and Workforce Development (Total Project Costs: \$314,513)
 - Career Development Grant Scholarships (Total Project Costs: \$24,871.56)
 - Arctic Summer Research Internship (integrated project with Minority Servicing Institution) (Total Project Costs: \$174,595)
 - University of Alaska Anchorage: \$124,595
 - University of Texas—El Paso: \$50,000

**Year 5 Breakdown of Costs and Sources of Funding:
Budget by Theme/Project and Source of Funding:**

Theme	Project Name	Source of Funding					Total Costs
		DHS Year Five Base	Year Four CF	CDG CF	IoNS (2016) RFP CF	Institutional Support	
1-Maritime Risk, Threat Analysis, and Resilience Research	Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response in the Arctic	\$ 47,619.00	\$ -	\$ -	\$ 210,681.26	\$ -	\$ 258,300.26
1-Maritime Risk, Threat Analysis, and Resilience Research	High resolution Modeling of Arctic Sea Ice and Currents	\$ 90,058.00	\$ -	\$ -	\$ -	\$ -	\$ 90,058.00
	Theme 1: Subtotal	\$ 137,677.00	\$ -	\$ -	\$ 210,681.26	\$ -	\$ 348,358.26
2-Maritime Domain Awareness	Arctic Oil Spill Modeling	\$ 199,999.00	\$ -	\$ -	\$ -	\$ -	\$ 199,999.00
2-Maritime Domain Awareness Research	Ice Conditions Index for the Great Lakes Region	\$ 238,115.45	\$ 7,947.00	\$ -	\$ -	\$ -	\$ 246,062.45
2-Maritime Domain Awareness Research	Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic	\$ 7,098.00	\$ -	\$ -	\$ 84,346.79	\$ -	\$ 91,444.79
2-Maritime Domain Awareness Research	The Arctic All-Hazards GIS Platform	\$ -	\$ 57,119.00	\$ -	\$ 294,400.00	\$ -	\$ 351,519.00
2-Maritime Domain Awareness Research	Arctic Vessel Monitoring Geofencing/Alert Awareness	\$ -	\$ 302,582.00	\$ -	\$ -	\$ -	\$ 302,582.00
2-Maritime Domain Awareness Research	Issues (2017) RFP	\$ 1,010,754.00	\$ 200,299.00	\$ -	\$ -	\$ -	\$ 1,211,053.00
	Theme 2: Subtotal	\$ 1,455,966.45	\$ 567,947.00	\$ -	\$ 378,746.79	\$ -	\$ 2,402,660.24
3-Maritime Technology Research	Propeller Driven Long Range Autonomous Underwater Vehicle for Under-Ice Mapping of Oil Spills and Environmental Hazards	\$ 974,973.00	\$ 22,000.00	\$ -	\$ -	\$ -	\$ 996,973.00
3-Maritime Technology Research	Arctic IoNS (2017) Oil Spill Focus RFP	\$ -	\$ 989,548.17	\$ -	\$ -	\$ -	\$ 989,548.17
3-Maritime Technology Research	Arctic IoNS and MaLTE workshops (2019)	\$ 138,970.00	\$ -	\$ -	\$ -	\$ -	\$ 138,970.00
	Theme 3: Subtotal	\$ 1,113,943.00	\$ 1,011,548.17	\$ -	\$ -	\$ -	\$ 2,125,491.17
4-Integration of Science and Engineering with Maritime Security Governance and Policy Research		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Theme 4: Subtotal	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
5-End to End		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
	Theme 5: Subtotal	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
6-Integrated Education	Education and Outreach and Workforce Development	\$ 274,788.00	\$ 39,725.00	\$ -	\$ -	\$ -	\$ 314,513.00
6-Integrated Education	Career Development Grant Fellowships	\$ -	\$ -	\$ 24,871.56	\$ -	\$ -	\$ 24,871.56
6-Integrated Education	Arctic Summer Research Internship	\$ 174,595.00	\$ -	\$ -	\$ -	\$ -	\$ 174,595.00
	Theme 6: Subtotal	\$ 449,383.00	\$ 39,725.00	\$ 24,871.56	\$ -	\$ -	\$ 513,979.56
	Management and Center Administration Costs	\$ 343,030.55	\$ -	\$ -	\$ -	\$ 444,268.00	\$ 787,298.55
Total		\$ 3,500,000.00	\$ 1,619,220.17	\$ 24,871.56	\$ 589,428.05	\$ 444,268.00	\$ 6,177,787.78

Year 5 Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$619,066.00	\$139,683.27	\$758,749.27
Travel	\$97,974.00	\$5,121.21	\$103,095.21
Contractual	\$1,210,032.00	\$246,937.82	\$1,456,969.82
Commodities	\$36,000.00	\$1,500.00	\$37,500.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Participant Support)	\$108,000.00	\$0.00	\$108,000.00
Other (Reserve Money RFP	\$1,010,754.00	\$1,729,071.56	\$2,739,825.56
Other Tuition)	\$25,461.00	\$0.00	\$25,461.00
Indirect	\$392,713.00	\$111,005.92	\$503,718.92
Total	\$3,500,000.00	\$2,233,319.78	\$5,733,319.78

Budget Notes:

- Projects' Funding have been rolled up in this summary. Most detailed justifications regarding requested budget and expenditures can be found in the individual project analysis.
- Projects that are a subaward are listed as contractual in the composite as they are a procurement action on the part of University of Alaska System.
- Indirect and Facilities and Administrative (F&A) costs are used interchangeably.
- Costs follow 2CFR200 to determine allowability, allocability, and reasonableness. These regulations also determine which costs are allowed indirect and which are not.
- Due to rounding composites might be off +/- \$2; however exact costs without rounding are \$3.5M.
- Some institutional support is in higher than the normal distribution of returned indirect costs back to ADAC; indirect costs at the University of Fairbanks are returned based on their model and are not subject to returning funds for institutional support.

Management and Central Administration Costs:

Total Management and Central Administration Budget Request: \$343,002 (see budget object class and justification below for management composite)

Management and Central Administration Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$117,853.00	\$0.00	\$117,853.00
Travel	\$85,000.00	\$0.00	\$85,000.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$24,000.00	\$0.00	\$24,000.00
Equipment	\$0.00	\$0.00	\$0.00
Other	\$0.00	\$0.00	\$0.00
Indirect	\$116,149.00	\$0.00	\$116,149.00
Total	\$343,002.00	\$0.00	\$343,002.00

Management Budget Justification:

Senior Personnel Salaries:

PI, Dr. Douglas Causey is requesting five percent effort (104 hours) for scientific leadership of the project as a direct cost on the award. Other effort is being covered via institutional support. Per the University of Alaska Board of Regent's Policy Manual, PIs must charge a minimum effort of five percent to sponsored research and is associated with appropriate projects that Dr. Causey's expertise will be needed. Dr. Causey is responsible for all associated PI duties of the award to include but not limited to:

- management of the ADAC team,
- obtaining institutional support, and
- reporting required to DHS as per the Terms and Conditions.

Support is also requested for Executive Director, Randy (Church) Kee for approximately three months' effort (510 hours). The Executive Director is responsible for the day-to-day operations of the Center as well as project oversight. All other effort not directly attributed to a project is provided by institutional support.

Other Personnel Salaries:

Support is also requested for the Communications and Media Broadcast team for two individuals for a total of 1280 hours (approximately four months of time between the two individuals) to assist with all the report writing, perform technical editing, website development, content development, videos, Twitter and Facebook accounts, and all Center activities related to Communications unless specified direct time for a specific project.

Fringe Benefits:

Benefits are applied according to the University of Alaska Anchorage's approved federally negotiated fringe benefit rates.

Total request for salary and fringe benefits for personnel: \$117,853

Travel:

Travel funding is requested for 20 ADAC team members to travel to the annual meeting. In Washington DC. Costs are estimated at \$2,000 per person; however, based on where the individual team member is located, costs may be higher or lower. Costs assume roundtrip airfare, per diem for four days, transportation, and miscellaneous costs in keeping with the approved GSA rates and allowability.

Funding is also requested for the Executive team in the amount of \$30,000 for various necessary trips to include subrecipient monitoring of those sites that have not yet been monitored and have been involved in the project going into their second year, various workshops and conferences that request ADAC participation and may not be able to cover all the costs and any other DHS required travel.

Funding is also requested for six ADAC team members to travel to a host Center of Excellence in support of a DHS Summit. Costs are estimated at \$2,500 per person; however based on where the individual team member is located, costs may be higher or lower. Costs assume roundtrip airfare, per diem for four days, transportation, and miscellaneous costs in keeping with the approved GSA rates and allowability.

Total request for travel: \$85,000

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request.

Total request for indirect costs: \$116,149

Management Budget Notes:

- Additional salary for members of the Executive team is covered by the University of Alaska Anchorage and Fairbanks Institutional Support commitments.

Budget and Justification by Theme by Project:

Theme 1: Maritime Risk, Threat Analysis and Resilience Research

PROJECT: Developing Sea-Ice and Weather Forecasting Tools to Improve Situational Awareness and Crisis Response in the Arctic

Project PI: Dr. Nathan Kettle, University of Alaska Fairbanks

Total Project Budget Request: \$258,300.26 (see budget object class and justification below for project composite).

Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$28,720.00	\$127,813.51	\$156,533.51
Travel	\$0.00	\$5,121.21	\$5,121.21
Contractual	\$0.00	\$5,420.65	\$5,420.65
Commodities	\$0.00	\$1,500.00	\$1,500.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Tuition)	\$4,194.00	\$0.00	\$4,194.00
Indirect	\$14,705.00	\$70,825.89	\$85,530.89
Total	\$47,619.00	\$210,681.26	\$258,300.26

University of Alaska Anchorage

Total Budget Request for University of Alaska Anchorage: \$47,619

Budget Request by Object Class for University of Alaska Anchorage:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$28,720.00	\$0.00	\$28,720.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Tuition)	\$4,194.00	\$0.00	\$4,194.00
Indirect	\$14,705.00	\$0.00	\$14,705.00
Total	\$47,619.00	\$0.00	\$47,619.00

Project Budget Justification and Narrative for the University of Alaska Anchorage:

Other Personnel:

Support is requested for a graduate student researcher, Dina Abdul-Fattah for 12 months' effort in support (760 hours during academic year and 560 hours during summer) to assist Dr. Kettle and will collaborate on publications as appropriate stemming from the ADAC project.

Benefits are applied according to the University of Alaska Anchorage—approved federally negotiated fringe benefit rates. This also includes health insurance as required for graduate students.

Total request for salary and fringe benefits: \$28,720

Other Costs (Student Support):

Graduate student tuition costs are included for the graduate student (academic year only). 18 hours of tuition (9 fall, 9 spring) @ \$466/credit hour at half of the tuition costs as per the DHS terms and conditions.

Total request for other costs: \$4,194

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request.

Total request for indirect costs: \$14,705

University of Alaska Fairbanks

Total Budget Request for University of Alaska Fairbanks: \$210,681.26

Budget Request by Object Class for University of Alaska Fairbanks:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$127,813.51	\$127,813.51
Travel	\$0.00	\$5,121.21	\$5,121.21
Contractual	\$0.00	\$5,420.65	\$5,420.65
Commodities	\$0.00	\$1,500.00	\$1,500.00
Equipment	\$0.00	\$0.00	\$0.00
Other	\$0.00	\$0.00	\$0.00
Indirect	\$0.00	\$70,825.89	\$70,825.89
Total	\$0.00	\$210,681.26	\$210,681.26

Project Budget Justification for the University of Alaska Fairbanks (original budget was for a two-year project, year two funding of this project was justified via carryforward process):

Carryforward Justification:

Research PI, Dr. Nathan Kettle is requesting carry forward in the amount of \$210,681.26 to meet Year 2 (ADAC Year 5) tasks, milestones and deliverables as outline in the approved project Work Plan. The specific tasks that the funding is being requested for in year two of the project is as follows:

1. Presentation of prototype hazard forecasting tool;
2. Dissemination of finding and recommendations.

This project funding was held in reserve from the original IoNS RFP (2016) and all projects funded from this source were built as two-year projects. Tasks are on schedule to be completed within the two-year period. This funding is NOT part of the Year 5 base funding. See below original justification for remaining funding as approved for this project.

Senior Personnel Salaries:

Funds are requested for 522 hours (3.0 mos.) are requested for Research PI Kettle (at \$39.10/hour) to oversee coordination with project partners, conduct research on the decision making context (Phase 1a), lead stakeholder engagement and feedback efforts (Phase 2), and lead outreach, data dissemination and evaluation (Phase 3).

Support is also requested for 174 hours (1.0 mo.) per year are requested for Research Co-PI Mahoney (at \$44.36/hour) to lead efforts on the identification of coastal hazards from radar data (Phase 1b), communicate hazard notification formats with partners (Phase 1c),

and optimize tool based on stakeholder feedback (Phase 2), and oversee Research Technician Josh Jones.

Funds are requested for 80 hours (0.5 mo.) per year are requested for Research Co-PI Eicken (at \$79.23/hour) to facilitate coordination among project partners and collaborate with Mahoney on phases 1b and 1c.

Other Personnel Costs:

Support is requested for 348 hours (2.0 mos.) per year are requested for Josh Jones (at \$23.84/hour) to lead computer programming for the analysis sea ice and weather hazard-forecasting tool.

Funding at 174 hours (1.0 mo.) per year are requested for Lawson Brigham (at \$50.51/hour) to facilitate transitioning of research findings into operations. Support is requested for 90 hours (0.5 mo.) in year 1 and 45 hours (0.3 mo.) in year 2 is requested for Lindsey Heaney (placeholder; at \$16.15/hour) to help transcribe interview data (phase 1a) and summarize workshop and webinar discussion notes.

Salaries include a leave reserve of 12.7% for faculty, 20.0% for executive management, and 22.4% for support (classified) staff. Salaries are listed at the current FY17 rate and include an annual inflation increase of 2.0% for faculty and 2.5% for professionals and staff each year. Anticipatory increases have been included for Year 1 of the proposal.

Staff benefits are applied according to University of Alaska Fairbanks' Fixed FY17 fringe benefit rates. Rates are 30.5% for faculty salaries, 28.8% for executive management, 54.4% for support (classified) staff, 9.7% for adjunct faculty and 9.5% for temporary staff. Anticipatory increases have been included for Year 1 of the proposal.

Total request for salary and fringe benefits for personnel: \$127,813.51

Travel:

Domestic: 2 trips in year 2 for 1 individual, are requested for travel to Barrow (at \$500/person/trip for airfare) to collaborate with subsistence marine operators in Barrow. Per Diem for Barrow is \$301/day. \$50/person/trip has been included for ground transportation.

Funding is requested for 1 trip in year 1 and 2 trips in year 2 are requested for 1 individual to travel from Barrow to Fairbanks (at \$550/trip for airfare) for a local consultant/coordinator from Barrow collaborate on tool development, optimization, and validation. Per Diem (meals/lodging/incidentals) for Fairbanks is \$214/day. \$50/trip has been included for ground transportation.

An inflation rate of 10% per year has been included for all transportation costs. Anticipatory increases have been included for Year 1 of the proposal. All airfare cost data is based on Internet research from www.kayak.com. All Per Diem is in accordance with GSA/JTR Regulations.

Total request for travel: \$5,121.21

Contractual Services:

Budget requested is \$1,220.65 per year is requested for interviewing services, \$200 in year 2 is requested for Webinars to receive feedback from stakeholders on tool optimization and validation, and \$4,000 per year is requested for contractor services – local coordinator.

Total Contractual Services costs requested: \$5,420.65

Materials and Supplies:

Funds (\$750 per year) are requested for supplies such as hard drives, workshop supplies, etc.

Total materials and supplies requested: \$1,500

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the Office of Naval Research. The predetermined rate for sponsored research at UAF is calculated at 50.5% (FY17 –FY18 predetermined agreement) of Modified Total Direct Costs (MTDC). MTDC includes Total Direct Costs minus tuition and associated fees, scholarships, participant support costs, subaward amounts over \$25,000, and equipment. A copy of the rate agreement is available at: <http://www.alaska.edu/cost-analysis/negotiation-agreements/>.

Total request for indirect costs: \$70,825.89

PROJECT: High Resolution Modeling of Arctic Sea Ice and Currents (HIOMAS)

Project PI: Dr. Jinlun Zhang, University of Washington

Total Project Budget Request: \$90,058 (see budget object class and justification below for project composite)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$53,811.00	\$0.00	\$53,811.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$2,000.00	\$0.00	\$2,000.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (UW-APL Prorated)	\$19,868.00	\$0.00	\$19,868.00
Indirect	\$14,379.00	\$0.00	\$14,379.00
Total	\$90,058.00	\$0.00	\$90,058.00

Project Budget Justification and Narrative:

Senior Personnel Salaries:

Research PI, Dr. Jinlun Zhang is requesting 2.0 months' effort for scientific leadership of the project and continuation of development and refinement of the coupled High-resolution Ice/Ocean Modeling and Assimilation System (HIOMAS) with even higher horizontal resolution, focusing on the newly developed 1 km resolution version for the US Arctic sea ice and ocean currents and examine HIOMAS hindcast and forecast skills. He will also work for transition of HIOMAS. As the University of Washington (UW) PI, Dr. Zhang will ensure that the University of Washington is meeting all subcontract requirements. Dr. Zhang will be responsible assisting with project evaluation and bringing research to capability process.

Other Personnel Salaries:

Programmer Kay Runciman is requesting $\frac{3}{4}$ of one months' effort to assist Dr. Zhang and continue model development, refinement, calibration/validation and analytics.

Fringe Benefits:

The APL benefits and leave rates are applied according to the University of Washington's approved federally negotiated fringe benefit rates with the Department of Health and Human Services (DHHS). The APL-UW rate for professional staff is 29.9% of salaries. The APL leave rate for professional staff is 29.9% of salaries. The total benefit rate is 54.7%.

Total request for salary and APL fringe benefits and leave rate for personnel: \$53,811

Contractual/Services:

Publication Costs: one publication cost is requested. The estimated cost is based on the American Geophysical Union (AGU) published open access APC costs. Amount requested is \$2,000.

Total request for contractual/services: \$2,000

Other Direct Costs:

APL Prorated Direct Costs: APL-UW's purpose is Research and it is solely funded through grant and contract revenue. APL-UW's operating expenses meet the definition of Direct Costs as defined by 2CFR200.413 and are directly charged to grants and contracts through the application of the Prorated Direct Costs rate (PDC). The PDC rate of 35.6% MTDC was approved by the Office of Naval Research. PDC is included within the MTDC cost base for F&A recovery.

Total request for other direct costs: \$19,868

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Washington's cognizant federal authority (DHHS) and on sponsored research are calculated at 17.0% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current F&A Rate Agreement dated 23 April 2015.

Total request for indirect costs: \$14,379

Project Budget Notes:

- F&A costs on the subaward to the University of Washington was satisfied in keeping with Uniform Guidance in year one and therefore no F&A are applied to this subaward at the University of Alaska Anchorage.

Theme 2: Maritime Domain Awareness Projects

PROJECT: Arctic Oil Spill Modeling

Project PIs: Dr. Scott Socolofsky, Texas A&M University—College Station and Dr. Thomas Ravens, University of Alaska Anchorage

Total Project Request: \$199,999 (see budget object class and justification below for project composite)
Texas A&M University—College Station: \$100,000
University of Alaska Anchorage: \$99,999

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$63,363.00	\$0.00	\$63,363.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Subaward to Texas A	\$100,000.00	\$0.00	\$100,000.00
Other (Student Support)	\$4,194.00	\$0.00	\$4,194.00
Indirect	\$32,442.00	\$0.00	\$32,442.00
Total	\$199,999.00	\$0.00	\$199,999.00

Project Budget Notes:

- F&A costs on the subaward to the University of Washington was satisfied in keeping with Uniform Guidance in year one and therefore no F&A are applied to this subaward at the University of Alaska Anchorage.

Individual Project Budget Components:

Texas A&M University—College Station

Total Budget Request for Texas A&M: \$100,000 (see budget object class and justification below for project composite)

Budget Request by Object Class for Texas A&M:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$67,340.00	\$0.00	\$67,340.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (GERG Facilities Fees)	\$0.00	\$0.00	\$0.00
Indirect	\$32,660.00	\$0.00	\$32,660.00
Total	\$100,000.00	\$0.00	\$100,000.00

Budget Justification and Narrative for Texas A&M:

Senior Personnel Salaries:

Research PI, Dr. Scott Socolofsky is requesting 1.0 month's effort for scientific leadership of the project, supervision of assistant research scientist, attend weekly project conference calls, and conduct all required project reporting, and collaboration with ADAC team. Dr. Socolofsky will be responsible assisting with project evaluation and bringing research to capability process.

Other Personnel Salaries:

Support is also requested for to be named (TBN) Post Doctoral Researcher for 9 months' effort, who will perform all laboratory experiments, analyze the data, run numerical simulations, integrate the blowout model with GNOME, and update the model to reflect new knowledge from the laboratory experiments, and will collaborate on publications as appropriate stemming from the ADAC project.

Fringe Benefits:

Benefits are applied according to the Texas A&M—College Station's approved federally negotiated fringe benefit rates. The current rate is 16.8% plus \$746 per month for insurance.

Total request for salary and fringe benefits for personnel: \$67,340

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the Texas A&M University's cognizant federal authority and on sponsored research are calculated at 48.5% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request.

Total request for indirect costs: \$32,660

University of Alaska Anchorage

Total Budget Request for the University of Alaska Anchorage: \$99,999 (see budget object class and justification below for project composite)

Budget Request for the University of Alaska Anchorage by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$63,363.00	\$0.00	\$63,363.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$4,194.00	\$0.00	\$4,194.00
Indirect	\$32,442.00	\$0.00	\$32,442.00
Total	\$99,999.00	\$0.00	\$99,999.00

Budget Justification for the University of Alaska Anchorage:

Senior Personnel Salaries:

Research PI, Dr. Thomas Ravens is requesting almost one month's effort (147.3 hours) for scientific leadership of the project, supervision of graduate student researchers, and collaboration with the Texas A&M team. Dr. Ravens will be responsible assisting with project evaluation and bringing research to capability process. Dr. Ravens will also be responsible for providing workforce development mentoring.

Support is also requested for Dr. Caixia Wang for one month's effort (173.3 hours) to conduct additional arctic modeling and programming. Dr. Wang was selected for extensive research in modeling.

Other Personnel Salaries:

Support is also requested for Dana Brunswick for approximately two months' effort (294.0 hours) to assist Dr. Ravens and continue model development of the arctic-capable oil spill model, validate the model, and collaborate on publications as appropriate.

Support is also requested for a TBN graduate student to perform hands on comparisons of the models, validation, and coding as appropriate. Support is for 12 months' effort (760 hours during academic year and 560 hours during summer) to assist Dr. Ravens.

Fringe Benefits:

Benefits are applied according to the University of Alaska Anchorage's approved federally negotiated fringe benefit rates. Fringe benefits also includes health insurance for graduate students at \$2,437 annually.

Total request for salary and fringe benefits for personnel: \$63,363

Other Costs (Student Support):

Graduate student tuition costs are included for the graduate student (academic year only). 18 hours of tuition (9 fall, 9 spring) @ \$466/credit hour at half of the tuition costs as per the DHS terms and conditions.

Total request for other costs: \$4,194

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$32,442

Budget Notes for the University of Alaska Anchorage:

- F&A costs on the subaward to Texas A&M-College Station was satisfied in keeping with Uniform Guidance in year one and therefore no F&A are applied to this subaward at the University of Alaska Anchorage.

PROJECT: Ice Condition Index (ICECON) for the Great Lakes

Project PI: Drs. Thomas Ravens, University of Alaska Anchorage and Andrew Mahoney, University of Alaska Fairbanks

Total Project Budget Request: \$246,062.45

University of Alaska Anchorage: \$133,316.45 (\$7,947 carryforward funding)

University of Alaska Fairbanks: \$112,746

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$134,386.00	\$5,256.00	\$139,642.00
Travel	\$6,974.00	\$0.00	\$6,974.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$1,000.00	\$0.00	\$1,000.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$23,391.00	\$0.00	\$23,391.00
Indirect	\$72,364.45	\$2,691.00	\$75,055.45
Total	\$238,115.45	\$7,947.00	\$246,062.45

Individual Project Budget Components:

University of Alaska Anchorage:

Total Budget Request for University of Alaska Anchorage: \$129,228 (see budget object class and justification below for project composite)

Budget Request by Object Class for University of Alaska Anchorage:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$64,742.00	\$5,256.00	\$69,998.00
Travel	\$2,704.00	\$0.00	\$2,704.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$23,391.00	\$0.00	\$23,391.00
Indirect	\$34,532.45	\$2,691.00	\$37,223.45
Total	\$125,369.45	\$7,947.00	\$133,316.45

Budget Justification and Narrative for University of Alaska Anchorage:

Senior Personnel Salaries:

Research PI, Dr. Thomas Ravens is requesting 1.2 month's effort (208 hours) for scientific leadership of the project, supervision of graduate students, and collaboration with ADAC team at UAF. Dr. Ravens will be responsible assisting with project evaluation and bringing research to capability process.

Other Personnel Salaries:

Support is requested for Assistant Professor, Shawn Butler for approximately two months' effort (393.5 hours) to assist Dr. Ravens with the modeling, validation, and collaboration with the USCG D-9 and ADAC team.

Support is also requested for graduate student researcher, Kelsey Frazier for 4.5 months' effort in support of ICECon (380 hours during academic year) to assist Dr. Ravens and continue model development, validate the model with available data, coordinate with the ADAC and USCG D-9, and will collaborate on publications as appropriate stemming from the ADAC project.

Fringe Benefits:

Benefits are applied according to the University of Alaska Anchorage—approved federally negotiated fringe benefit rates. This also includes health insurance as required for graduate students.

Total request for salary and fringe benefits: \$64,742

Travel:

Domestic: Dr. Ravens is requesting one trip to Great Lakes region for the annual meeting with Coast Guard District 9 for project meeting and model validations. The request includes a budget to accommodate economy air travel, governmental subsistence allowance (GSA) rate lodging, federal per diem for trips.

Total request for travel: \$2,704

Other Costs (Student Support):

Graduate student tuition costs are included for the graduate student (academic year only). 18 hours of tuition (9 spring) @ \$466/credit hour at half of the tuition costs as per the DHS terms and conditions. Support is also requested for undergraduate Kelsey Frazier (December graduation) to continue to assist Drs. Ravens and Mahoney with validation of the model at \$1,000 per month for six months. Support is requested for a TBN undergraduate student for 12 months' effort at \$1,000 per month. Tuition costs are \$2,196 per year per undergraduate student.

Total request for other costs: \$23,391.

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage University's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$34,532.45

University of Alaska Fairbanks

Total Budget Request for the University of Alaska Fairbanks: \$112,746 (see budget object class and justification below for project composite)

Budget Request for the University of Alaska Fairbanks by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$69,644.00	\$0.00	\$69,644.00
Travel	\$4,270.00	\$0.00	\$4,270.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$1,000.00	\$0.00	\$1,000.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Tuition)	\$0.00	\$0.00	\$0.00
Indirect	\$37,832.00	\$0.00	\$37,832.00
Total	\$112,746.00	\$0.00	\$112,746.00

Budget Justification for the University of Alaska Fairbanks:

Senior Personnel Salaries:

Research PI, Dr. Andrew Mahoney is requesting two months' effort (374.0 hours) for scientific leadership of the project, supervision of research staff, and collaboration with the University of Alaska Anchorage team. Dr. Mahoney will be responsible assisting with project evaluation and bringing research to capability process.

Other Personnel Salaries:

Research Assistant, Josh Jones is requesting 522 hours' effort to assist Dr. Mahoney and continue model development, validate the model, coordinate with UAA and U.S. Coast Guard, and will collaborate on publications as appropriate stemming from the ADAC project.

Fringe Benefits:

Benefits are applied according to the University of Alaska Anchorage's approved federally negotiated fringe benefit rates.

Total request for salary and fringe benefits for personnel: \$69,644

Travel:

Domestic: Dr. Mahoney is requesting one trip to Great Lakes region for the annual meeting with Coast Guard District 9 for project meeting and model validations. The request includes a budget to accommodate economy air travel, governmental subsistence allowance (GSA) rate lodging, federal per diem for trips.

International: Dr. Mahoney is requesting one trip to Canada for the International Charting Ice Workshop. The request includes a budget to accommodate economy air travel, governmental subsistence allowance (GSA) rate lodging, and federal per diem for the trip. Appropriate export controls will be vetted and submitted to DHS for approval.

Total request for travel: \$4,270

Materials and Supplies:

Request for computing supplies to include hard drive for model validation and archiving is budgeted at \$1000.

Total request for materials and supplies: \$1,000

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Fairbanks's cognizant federal authority and on sponsored research are calculated at 50.5% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$37,832

PROJECT: Using Vessel Tracking Data to Prioritize Bathymetric Surveying in a Rapidly Changing Arctic

Project PI: Dr. Carol Janzen, Alaska Ocean Observing System

Total Project Budget Request: \$91,444.79 (\$7,098 year 5 base funding and \$91,444.79 in carry forward funding)

Alaska Sea Life Center: \$15,000 (Note: this is carry forward funding and F&A will be charged on the first \$25k and is included in the University of Alaska Anchorage individual budget and the project rollup)

University of Alaska Anchorage: \$76,444.79

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$41,644.00	\$41,644.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Subaward)	\$0.00	\$15,000.00	\$15,000.00
Other (Student Support)	\$7,098.00	\$0.00	\$7,098.00
Indirect	\$0.00	\$27,702.79	\$27,702.79
Total	\$7,098.00	\$84,346.79	\$91,444.79

Project Budget Notes:

- F&A costs on the subaward to the Alaska Sea Life Center will be applied in keeping with Uniform Guidance on the first \$25,000 of the subaward issued the Alaska Sea Life Center.
- UAA is treating Axiom Data Science and Marine Exchange in Alaska as a vendor as they have done throughout the life of this cooperative agreement. Contractor's relationship has been reviewed to see if it meets definition of subaward and it fails; therefore, vendor has been classified as contractor.
- Because this is a vendor relationship, per 2CFR200, UAA will charge full research indirect costs on the contract.

Individual Project Budget Components:

Alaska Sea Life Center:

Total Budget Request for Alaska Sea Life Center: \$15,000 (see budget object class and justification below for project composite)

Budget Request by Object Class for Alaska Sea Life Center:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$15,000.00	\$15,000.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Tuition)	\$0.00	\$0.00	\$0.00
Indirect	\$0.00	\$0.00	\$0.00
Total	\$0.00	\$15,000.00	\$15,000.00

Budget Justification and Narrative for Alaska Sea Life Center:

Carryforward Justification:

Research PI, Dr. Carol Janzen, Alaska Ocean Observing System Director of Administration and Outreach is requesting 5% effort for each year of the project. Dr. Janzen is responsible for the overall programmatic delivery of tasks and deliverables and reporting requirements. She will oversee the work performed by project partners Axiom and the Marine Exchange of Alaska and will serve as the liaison between the University of Alaska Anchorage and the project team as needed on tasks and deliverables. She will review all project reports and will ensure that all tasks and deliverables are completed on time and within budget. She will also participate in Steering Committee activities and demonstration workshop webinars held throughout the project and will participate in ADAC team meetings.

Support is requested for Ms. Holly Kent, the AOOS Director of Administration and Outreach, whom will be largely responsible for supporting AOOS hosted activities involving the project steering committee and their functions, and implementing the planned outreach activities in Years 1 and 2. Ms. Kent will also work with the project partners on submission of regular status reports and technical documentation used to inform the steering committee of the project's progress. These reports will be made available on the dedicated project data portal/website. Ms. Kent will help coordinate the final workshop webinars planned for Anchorage and Juneau, and potentially others near the end of the project. About 3.5 weeks in Year 2 are budgeted for Ms. Kent to administer these functions.

Fringe Benefits:

Benefits are calculated at 28% of the salary costs for personnel.

Total request for salary and fringe benefits: \$15,000

University of Alaska Anchorage

Total Budget Request for the University of Alaska Anchorage: \$347,832 (see budget object class and justification below for project composite)

Budget Request for the University of Alaska Anchorage by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$41,644.00	\$41,644.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$7,098.00	\$0.00	\$7,098.00
Indirect	\$0.00	\$27,702.79	\$27,702.79
Total	\$7,098.00	\$69,346.79	\$76,444.79

Budget Justification for the University of Alaska Anchorage:

Participant Support:

Support is requested for undergraduate Lonnie Young to continue to assist Axiom Data Science with development and validation of the model. Support is requested for 6 months' effort at \$1,000 per month and \$1,098 in tuition costs for Fall semester. Lonnie Young is out of support under DHS terms and conditions after December 31, 2018.

Total request for participant support: \$7,098

Carryforward Justification:

Contractual:

Funding is requested for Axiom Data Science in the amount of 30,000 for:

- 20 hours of the Project Manager, Rob Bochenek to attend ADAC meetings, provide coordination and project oversight for Axiom.
- 100 hours of various staff Software Engineers to apply high-compute cluster workflow to transform vessel data into application-ready format for bathymetric prioritization in the US Arctic Economic Exclusion Zone. Software Engineers will adapt the Apache Spark cluster to index and analyze the Automated Information System data sets and produce analytical heat maps of various vessel activity characteristics. Additionally, the team will assist with the integration of data through analytical workflows in addition to supporting the core cyberinfrastructure systems and parallelization for this project.
- 5 hours of a physical scientist to assist with the development and deliver an application-ready data format for prioritization of bathymetric surveys in the US Arctic Economic Exclusion Zone.

Funding is also requested for Marine Exchange of Alaska in the amount of \$11,644 for:

- 28 hours of project team to help establish and lead project steering committee of maritime domain experts to define explicit AIS data configurations to the US Arctic Hydrographic Health model.
- 92 hours of project team is requested to the team to analyze data from 48 terrestrial AIS receivers amounting to over 3 million received and processed messages per day in the US Arctic and evaluate them.

Total request for contractual: \$41,644

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$27,702.79

PROJECT: The Arctic All-Hazards GIS Platform

Project PIs: Dr. Marcus Boyd, University of Maryland

Total Project Budget Request: \$351,519 (\$351,519 in carry forward funding)

University of Alaska Anchorage: \$12,800

University of Maryland: \$338,719

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (subaward)	\$0.00	\$338,719.00	\$338,719.00
Indirect	\$0.00	\$12,800.00	\$12,800.00
Total	\$0.00	\$351,519.00	\$351,519.00

Project Budget Notes:

- F&A costs on the subaward to the University of Maryland will be applied in keeping with Uniform Guidance on the first \$25,000 of the subaward issued.
- No further UAA charges to this project.

Individual Project Budget Components:

University of Alaska Anchorage:

Total Budget Request for University of Alaska Anchorage: \$12,800 (see budget object class and justification below for project composite)

Budget Request by Object Class for University of Alaska Anchorage:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$0.00	\$0.00	\$0.00
Indirect	\$0.00	\$12,800.00	\$12,800.00
Total	\$0.00	\$12,800.00	\$12,800.00

Budget Justification for the University of Alaska Anchorage:

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$12,800

University of Maryland

Total Budget Request for the University of Maryland: \$338,719 (see budget object class and justification below for project composite)

Budget Request for the University of Maryland by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$192,841.00	\$192,841.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$30,000.00	\$30,000.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$0.00	\$0.00	\$0.00
Indirect	\$0.00	\$115,878.00	\$115,878.00
Total	\$0.00	\$338,719.00	\$338,719.00

Budget Justification for the University of Maryland:

Senior Personnel Salaries:

Dr. Marcus Boyd is the Principal Investigator for the project and a Senior Researcher in START's GIS unit. He has a Ph.D. in geography. He will be responsible for overseeing the project, the eye tracking, and cognitive interviewing, and acting as the main point of contact for project stakeholders (including the HQ USCG Project Champion and ADAC central leadership). Dr. Boyd will provide project updates at weekly ADAC call and monthly

HQ USCG Project Champion steering meetings. Dr. Boyd will ensure the project meets methodological standards and deadlines. He will also provide mentorship to student interns on the project. He will contribute 7.2 calendar months over the period of performance with a base salary of \$87,567.

Joshua House is a senior faculty specialist and will oversee data collection. He has a master's degree in geography. He will assist in the maintenance of IRB paperwork for the project, help recruit research participants for eye tracking and cognitive interviewing, assist in intern recruitment and selection, assist in collecting inputs for reporting for Dr. Boyd's review and approval, transcribe interview results, and contribute to the drafting of technical manuals and reports. He will contribute 6.3 calendar months over the period of performance with a base salary of \$60,030.

Brady Woods is a faculty specialist who will work with the web application developer to build the back-end of the data model and will build any tools necessary for the project. Woods is currently a doctoral student in geography. He will also assist with drafting reports. He will contribute 10.8 calendar months over the period of performance with a base salary of \$60,000.

Fringe Benefits:

The fringe benefit rate for full-time employees is averaged at 30% of salaries. This includes retirement benefits, health insurance, Social Security, Medicare, and unemployment taxes. Hourly employees' average fringe rate is 10% for Social Security, Medicare, and unemployment taxes, and health benefits.

Total request for salaries and fringe benefits: \$192,841

Consultants:

University of Maryland requests \$30,000 for Mr. Buboyma Kagniniwa, who is a U.S. person. Mr. Kagniniwa is an expert geospatial applications developer with experience using open source and ESRI proprietary platforms for development. He has direct expertise in using a variety of APIs, JavaScript, Flex, and HTML 5. Mr. Kagniniwa is a subject matter expert for GIS Web application implementation. He presently serves as a GIS Consultant with USAID. He holds a Master's degree in Geography of Commerce from Universite de Lomé and a Masters in Geographic Information Systems from University of Maryland, College Park. Mr. Kagniniwa has twelve years of direct experience related to geographic information systems and web application development. Mr. Kagniniwa will work closely with the University of Maryland GIS team on the review, design, and development of the ArcGIS online web application implementation. The Arctic All-Hazards GIS Platform will require additional development and enhancement to the ArcGIS Online Web application based on the needs identified by the sponsoring agency. The further development is dependent upon a qualified and SME developer with exceptional skills related to GIS, database design and management, and web mapping. Mr. Kagniniwa will use his knowledge and expertise to code a more appealing web application with advanced functionality. His contribution will include working with GIS staff to create a sustainable and robust GIS web application.

Total request for contractual: \$30,000

Indirect Costs:

The on-campus indirect cost rate (F&A) for the University of Maryland is 52% of the Modified Total Direct Costs (MTDC) of \$222,841. The MTDC excludes tuition remission, equipment over \$5,000, participant support costs, and the portion of individual subcontracts over \$25,000. This charge has been approved by the cognizant government agency, Department of Health and Human Services. This rate was agreed to June 28, 2012 and has been in effect since July 1, 2012.

Total request for indirect costs: \$115,877

Budget Notes:

Salaries are budgeted with a projected 4% cost of living and merit increase at the beginning of each fiscal year (July 1), subject to approval by the University.

All staff working on the project are U.S. persons.

PROJECT: Arctic Vessel Monitoring Geofencing/Alert Awareness

Project PIs: Buddy Custard, CAPT, USCG (Ret), Alaska Maritime Prevention & Response Network and Dr. Kenrick Mock, University of Alaska Anchorage

Total Project Budget Request: \$302,582 (\$302,582 in carry forward funding)

Alaska Maritime Prevention & Response Network: \$98,283

University of Alaska Anchorage: \$204,299

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$13,726.00	\$0.00	\$13,726.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$94,280.00	\$0.00	\$94,280.00
Commodities	\$0.00	\$0.00	\$0.00
Other (Subaward)	\$98,283.00	\$0.00	\$98,283.00
Other (Student Support)	\$28,194.00	\$0.00	\$28,194.00
Indirect	\$68,099.00	\$0.00	\$68,099.00
Total	\$302,582.00	\$0.00	\$302,582.00

Project Budget Notes:

- F&A costs on the subaward to the Alaska Maritime Prevention & Response will be applied in keeping with Uniform Guidance on the first \$25,000 of the subaward issued.
- UAA already has a prior existing relationship with Marine Exchange Network of Alaska; therefore costs for Marine Exchange are treated consistently and as a vendor with UAA.

Individual Project Budget Components:

Alaska Maritime Prevention & Response Network

Total Budget Request for the Alaska Maritime Prevention & Response Network: \$98,283 (see budget object class and justification below for project composite)

Budget Request for the Alaska Maritime Prevention & Response by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$65,846.00	\$0.00	\$65,846.00
Travel	\$2,000.00	\$0.00	\$2,000.00
Contractual	\$23,652.00	\$0.00	\$23,652.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$0.00	\$0.00	\$0.00
Indirect	\$6,785.00	\$0.00	\$6,785.00
Total	\$98,283.00	\$0.00	\$98,283.00

Budget Justification for the Alaska Maritime Prevention & Response Network:

Senior Personnel Salaries:

Co-PI, Buddy Custard is requesting 40 days of effort for co-scientific leadership of the project, conducting iterative engagement with USCG stakeholders and supporting integration of stakeholder interactions in the user application. This also includes support to user analysis of producing final deliverables. Mr. Custard will be responsible assisting with project evaluation and conducting project level ADAC "research to capability process."

Other Personnel Salaries:

Mr. Steven Gabelien is requesting 80 days of effort to direct interaction of fielding stakeholder engagement and conduct comparative analysis of end-user needs to product development, and work with tech development in order to insure consistency of stakeholder tactical needs vs developing product. Mr. Gabelien's experience from operating in Alaska Arctic coastal and marine environments, directly contributes user experience to the development of the application. He will also support training product development and contribute to project publication for review.

Fringe Benefits:

The benefits are applied according to the Alaska Maritime Prevention & Response Network fringe rates: Mr. Custard's rate is 33.7% of salaries and Mr. Gabelien's rate is 31.3% of salaries.

Total request for salaries and fringe benefits: \$65,846

Travel:

Domestic: Research Co-PI is requesting one trip for a project meeting in Anchorage, AK with UA and the Alaska Conservation Foundation personnel. If it is more useful planning meeting may be conducted at D-17. The request includes economy air travel, governmental subsistence allowance (GSA) rate lodging, federal per diem for trip, car rental when necessary, and miscellaneous expenses and ground transportation. Trip is budgeted at \$2,000.

Total request for travel: \$2,000

Contractual:

Alaska Maritime Prevention & Response Network is requests \$23,652 for consulting work to be done by the Alaska Conservation Foundation. This request includes:

Alaska Maritime Prevention & Response Network is requests \$23,652 for consulting work to be done by the Alaska Conservation Foundation. This request includes:

- Salary and fringe benefits for Mr. Aaron Poe for 20 days effort to lead stakeholder engagement in/across Arctic Alaska to clarify and specify tactical level details for vessel alert end-user requirements.
- Salary and fringe benefits for Ms. Carley O'Donnell for 20 days effort to team with Mr. Poe to co-develop collaboration tactical level details for vessel alert end-user requirements. Ms. O'Donnell's participation with Mr. Poe will reduce overall timeline in developing tactical level details for vessel alert end-user requirements.
- Both Mr. Poe and Ms. O'Donnell will co-develop stakeholder inputs to project documentation, as well as support writing and development of training products.
- Domestic travel for three trips to outlining Arctic communities (Nome, Kotzebue, and Utqiagvik) for face-to-face outreach to Alaska Native coastal communities and collaboration. These three trips will seek to coordinate developing application that could be potentially useful for local mariners and local/regional Search & Rescue (SAR), as these local marine operators intersect with USCG Arctic operations. The request includes economy air travel, economy rate lodging, car rental when necessary and standard federal-rate per diem. Each trip is budgeted at \$3,000. Prior to taking these trips, an assessment will be made based on telecom interaction with Arctic communities to determine value, viability and likelihood of including local/regional information into application. ADAC will provide this information to OUP PM prior approval for travel.

Total request for contractual: \$23,652

Indirect Costs:

The on-campus indirect cost rate (F&A) for the Alaska Maritime Prevention & Response Network has never been codified. Therefore, under 2cfr200, the Alaska Maritime Prevention & Response Network will be utilizing the allowable de minimums rate of 10% of the Modified Total Direct Costs (MTDC). The MTDC excludes tuition remission, equipment over \$5,000, participant support costs, and the portion of individual subcontracts over \$25,000.

Total request for indirect costs: \$6,785

University of Alaska Anchorage:

Total Budget Request for University of Alaska Anchorage: \$204,299 (see budget object class and justification below for project composite)

Budget Request by Object Class for University of Alaska Anchorage:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$13,726.00	\$0.00	\$13,726.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$94,280.00	\$0.00	\$94,280.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$28,194.00	\$0.00	\$28,194.00
Indirect	\$68,099.00	\$0.00	\$68,099.00
Total	\$204,299.00	\$0.00	\$204,299.00

Budget Justification for the University of Alaska Anchorage:

Senior Personnel Salaries:

Dr. Kenrick Mock is requesting 120 hours of effort for co-scientific leadership of the project. He will serve as overall lead in the product development, integrating user requirements with technical application as described in the associated project workplan. This includes integration of stakeholder interactions in producing the vessel alert user application. Dr. Mock will conduct specified analytics to ensure product conforms to U.S. Coast Guard (USCG) Project Champion and other key USCG and non-USCG stakeholders specified needs. Dr. Mock will work with Mr. Custard to execute conducting project level ADAC "research to capability process," and ensure training documentation and co-produce peer journal article at project's conclusion. Dr. Mock will also be responsible for supervision of the ADAC undergraduate student fellows detailed to the project.

Fringe Benefits:

Benefits are applied according to the University of Alaska's fixed fringe benefit rates for FY18. Rates are 30.50% for faculty. A copy of the rate agreement is available at: <http://www.alaska.edu/cost-analysis/negotiation-agreements/>

Contractual:

The University of Alaska Anchorage is requesting \$94,280 for a contract with Marine Exchange of Alaska. This request includes:

- Salary and fringe benefits for Mr. Ed Page for 30 days for support scientific leadership of the project, integration of user requirements and developed technology into mission systems directly accessible to USCG end-users and other marine operators. Mr. Page will be support project evaluation and ADAC "research to capability process in transitioning from research to fielded mission systems.
- Salary and fringe benefits for Mr. Bill Benning for 15 days effort to assess the technological challenges of implementing the deliverables of this project, including AIS receiver locations and range, AIS transmitters and range, and collaboration on publications as appropriate stemming from the project.
- Salary and fringe benefits for Mr. Shawn Mauldin is requested for 30 days to integrate vessel and other USCG specified decision alerts into web application. Mr. Mauldin will contribute specific technical skills and marine operations knowledge to coordinate user experience with USCG mission operators at USCG D17 and USCG D17 Sector Anchorage.

- Salary and fringe benefits for Mr. Ed Mayer is requested for 20 days to develop Automated Safety Messages (ASM) that can be transmitted over AIS that can be triggered by alerts based on user-defined categories.
- Salary and fringe benefits is requested for Ms. Jennifer Karnik for 20 days effort to compile and compare AIS data.
- Domestic travel is requested for Mr. Page to attend one trip in Anchorage for its programmer to meet with UAA team lead and staff in developing the programming elements of the project. The request includes economy air travel, economy rate lodging, car rental when necessary and standard federal-rate per diem. Trip is budgeted at \$2,000.
- Materials and supplies are requested to purchase multiple platform devices and software and application licensing fees to research and develop modifications needed to complete project objectives in the amount of \$4,000.
- Marine Exchange of Alaska intends to utilize the software engineering services of Resource Data Inc. to contribute additional technology development in producing web interface for USCG end-users and other marine operators. Resource Data Inc. will provide information needed to program an AIS generated alert and the transmission of reports and notifications desired including the platform in which support vessel and other alert notifications (e-mail, text, website, app, etc.). The request is for \$26,000.

Total request for contractual costs: \$94,280

Other (Student Support Costs):

The University of Alaska Anchorage is requesting to support two undergraduate students at \$1,000 per month stipend for a year. Additionally, UAA is requesting in keeping with the other ADAC Fellows and previous DHS Terms and Conditions half the tuition costs for each student for a year (\$2,097) to assist Dr. Mock with the project. These undergraduate students will continue development of the project as appropriately directed.

Total request for other (Student Support) costs: \$28,194

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$68,099

Budget Notes:

All staff working on the project are U.S. persons.

PROJECT: Issues (2017) RFP Projects

Project Pls: TBN

Total Project Budget Request: \$1,865,154 (\$854,400 carryforward funding)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Participant Travel Stipends)	\$0.00	\$0.00	\$0.00
Other (Reserve Funding for RFP)	\$1,010,754.00	\$854,400.00	\$1,865,154.00
Other (Tuition)	\$0.00	\$0.00	\$0.00
Indirect	\$0.00	\$0.00	\$0.00
Total	\$1,010,754.00	\$854,400.00	\$1,865,154.00

Funding is being held in reserve for project budgets to be finalized.

Theme 3: Maritime Technology Research

PROJECT: Propeller-driven Long-Range AUV for Under Ice Mapping of Oil Spills and Environmental Hazards

Project Pls: Dr. James Bellingham, Woods Hole Oceanographic Institute and Mr. Brett W. Hobson, Monterey Bay Aquarium Research Institute

Total Project Budget Request: \$974,973

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Subawards)	\$974,973.00	\$22,000.00	\$996,973.00
Indirect	\$0.00	\$0.00	\$0.00
Total	\$974,973.00	\$22,000.00	\$996,973.00

Individual Project Budget Components:

Monterey Bay Aquarium Research Institute (MBARI)

Total Budget Request for Monterey Bay Aquarium Research Institute: \$19,999 (see budget object class and justification below for project composite)

Budget Request by Object Class for Monterey Bay Aquarium Research:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$13,114.00	\$0.00	\$13,114.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Symposium)	\$0.00	\$0.00	\$0.00
Indirect	\$6,885.00	\$0.00	\$6,885.00
Total	\$19,999.00	\$0.00	\$19,999.00

Budget Justification and Narrative for Monterey Bay Aquarium:

Senior Personnel Salaries:

Research PI, Mr. Brett Hobson is requesting 89.7 hours' effort for scientific leadership of the project, supervision of the MRARI team, and assisting with the assembly of the buoyancy system, assembly of the actuators, thruster motor, batter pack and assisting WHOI personnel with the AUV sea tests, and support the test and validation of the Whisker Box and DUSBL.

Other Personnel Salaries:

Support is requested for a research specialist for 16.77 hours to help with quality control, test and assembly the LRAUV, assembly and testing of the RF antenna system, assembly of the buoyancy system, assembly of the actuators, thruster motor, batter pack and assisting WHOI personnel with the AUV sea tests and design bracketry to mount the WHOI Whisker Box and BUSBL into the nose of the LRAUV .

Fringe Benefits:

Benefits are applied according to the Monterey Bay Aquarium Research Institute set annually. The base is labor dollars and the pool costs consist of payroll taxes, health benefits, retirement benefits, workers' compensation and leave. The rate for full and part-time regular employees is 58.5%.

Total request for salary and fringe benefits: \$13,114

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the Monterey Bay Aquarium Research Institute's cognizant federal authority and on sponsored research are calculated at 54% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$6,885

Woods Hole Oceanographic Institute (WHOI)

Total Budget Request for the Woods Hole Oceanographic Institute: \$976,974 (\$) (see budget object class and justification below for project composite)

Budget Request for the Woods Hole Oceanographic Institute by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$336,610.00	\$22,000.00	\$358,610.00
Travel	\$18,947.00	\$0.00	\$18,947.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$109,436.00	\$0.00	\$109,436.00
Equipment	\$0.00	\$0.00	\$0.00
Other	\$156,735.00	\$0.00	\$156,735.00
Indirect	\$333,246.00	\$0.00	\$333,246.00
Total	\$954,974.00	\$22,000.00	\$976,974.00

Budget Justification for the Woods Hole Oceanographic Institute:

Senior Personnel Salaries:

J. Bellingham, PI, (0.85 mos) will be responsible for overall coordination of the project. Funding for a portion of his effort will be provided through the Center for Marine Robotics at WHOI. He is responsible for the low-cost vehicle exploratory activity, which will use the WHOI DunkWorks facility to experiment with additive manufacturing approaches to making low cost AUVs. Bellingham will also participate in development of the LRAUV transition plan and the annual meeting, which includes two trips to The Coast Guard Research and Development Center in New London, CT.

Kukulya, co-PI, (5.70 mos) will be responsible for overall operations and coordination. She will participate in the build and testing of the Arctic buoys, and manage the LRAUV payload testing, which includes a trip to MBARI in order to complete water testing and accept delivery of the LRAUV. She will also participate in the low latitude expedition in Louisiana, which also includes planning the logistics for the mission, as well as time for mobilization and demobilization. Post mission, she will be involved with data analysis reporting. Her time is also requested for planning the high latitude ice mission. Kukulya will also participate in the LRAUV transition plan, including 2 trips to The Coast Guard Research and Development Center in New London, CT.

Other Personnel Salaries:

M. Jakuba, Research Engineer, (4.66 mos) will be involved with processing data and fine tuning algorithms on the LRAUV payload. Jakuba will also participate in the trip to MBARI to complete water testing and accept delivery of the LRAUV. He will also participate in the low latitude expedition in Louisiana, which includes post mission data analysis, as well as mobilization and demobilization. His time is also requested for planning the high latitude ice mission. Jakuba will also collaborate with Mike Godin at IntuAware, for software development, compression and visualization.

S. Whelan, Senior Engineering Assistant II, (3.85 mos) will participate in the build and testing of the Arctic buoys, and assist with the LRAUV payload testing, which includes a trip to MBARI to complete water testing and accept delivery of the LRAUV, and receive operator training. Whelan will also participate in the low latitude expedition in Louisiana, which also includes planning the logistics for the mission, as well as mobilization and demobilization. His time is also requested for planning the high latitude ice mission, under-ice.

D. Gomez-Ibanez, Research Engineer, (2.09 mos) will participate in the build and testing of the Arctic buoys and assist with the LRAUV payload testing. He will also participate in the low latitude expedition in Louisiana, as well as mobilization and demobilization. Gomez-Ibanez will also be involved with planning the high latitude ice mission.

K. Ball, Senior Engineer, (0.66 mos) will be responsible for building the 2 Arctic buoys and overseeing all umodem functionality of the LRAUV and auxiliary gear.

Research Engineer A, TBD, (4.70 mos) will design, construct, and test vehicle components ranging from pressure hulls, actuators, fairings, propulsion systems, internal mounting structures, and signal/power pass-throughs. The goal is to reduce lead time and cost for an AUV system by a range of strategies including reducing parts counts and eliminating long-lead items. The Research Engineer A will work with PI, J. Bellingham on this task.

Graduate Student, TBD, (9.0 mos) will support preparation of design documentation and drawings, work with machine shops and additive manufacturing facility to have new parts created, and help run open-water test missions. Student will also investigate and correct problems in current vehicle design, testing and integration. Student is to start in Fall of 2018.

A. Besaw, Senior Admin Assistant II, (0.39 mos) A small amount of support for administrative assistance is requested to assist with reporting, budget tracking, making travel arrangements and processing reimbursements, purchasing, and other administrative tasks that are related to the project and are not supported by overhead.

Total request for salary and fringe benefits: \$336,610

Travel:

Funds are requested to cover the cost of domestic travel for 3 people to go to MBARI in Monterey, CA. Funds are also requested to cover domestic travel for 3 people to participate in the low latitude expedition in Louisiana. Funds for two daytrips have also been requested so the 2 project PIs can collaborate with the United States Coast Guard Research and Development Center in New London, CT. Estimates for airfare are based on rates currently available on Expedia for non-refundable tickets. Ground transportation costs include rental car(s) and transportation to/from the airports, as well as mileage @ \$2.89/mile. Estimates for ground transportation to/from airports are based on previous trips. Rental car estimates are based on rates currently available at Expedia. Per diem expenses are based on rates currently available via the GSA website (<http://www.gsa.gov/portal/category/21287>). Lodging is also based on the rates currently available via the GSA website.

Total request for travel: \$18,947

Materials and Supplies(Commodities):

Supplies have been budgeted in the amount of \$100,936 for building 2 Arctic buoys. This includes the thermister, circuit boards, buoys, antennas, Sim cards, transducers, cables, coils and batteries. This is necessary for navigation and communication of the LRAUV. Data drives, tools, tape and cradles has been budgeted in the amount of \$5,000, which will all be used during field testing locally and in the low latitude expedition. Drone survey gear @ \$3,500 has been budgeted for the expedition for ground-truthing oil and oil-surrogates for data visualization and presentation materials.

Total request for materials and supplies: \$109,436

Other Direct Costs:

WHOI DunkWorks is a rapid-prototyping facility that includes additive and subtractive 3D-scanning, modelling and printing machines which is used for development of new components. 2 one-year memberships have been budgeted at \$200/month each for the ADAC student and mentor. This is necessary for developing 3D printed parts. An additional 6-month membership has been budgeted @ \$200/month for the Research Assistant A, to ensure access to the facility while using the multi-durometer plastic printer.

OSL Hurricane is operated as a WHOI cost center with an established day rate calculated by dividing the operating costs by the days of anticipated operation. The Hurricane costs \$525 per half day of use and will be used to support testing of the Arctic buoys for 2 half-days. The Hurricane will also be used for system water testing of the LRAUV for 8 half-days.

R/V Tioga is operated as a WHOI cost center with an established day rate calculated by dividing the operating costs by the days of anticipated operation.

The Tioga full day rate is \$3,850, and will be used for system water testing for 6 days.

R/V Discovery has a day rate of \$2,750/day for 11 days. 7 days are for the expedition itself, while 4 days have been included for transit to and from Louisiana. Fuel is not included. This is the main boat to be used for field testing on the low latitude expedition in Louisiana.

Ship Fuel for the OSL Hurricane has been budgeted as 17.3 gallons per half-day @ \$2.89/gallon for 2 half-days. This is for the testing of the Arctic buoys outside of Woods Hole. Ship Fuel for the OSL Hurricane has also been budgeted as 4.3 gallons per half-day @ \$2.89/gallon for 8 half-days. This is for the system water testing, which will take place in local waters in Woods Hole. In addition, ship fuel was also budgeted for the R/V Discovery for 7 days @ 59 gallons/day (for the expedition), and 4 days @ 100 gallons/day (for transit to and from Louisiana), @ \$2.89/gallon.

Mike Godin from IntuAware will assist with processing data and fine tuning algorithms @ \$18,000 (150 hours). He will also assist with software development, compression and visualization @ \$10,000 (83 hours). Godin's rate is \$120/hour.

Wings of Care Flights @ \$1500/day for 5 days. This is necessary for the Louisiana expedition for the oil survey in order to find specific oil targets and for on the water guiding to find correct survey locations.

Satellite Imaging @ \$4,999 needed for ground truthing data.

Port Eads Boat Transfers @ \$1,500 needed for moving gear and people down to survey lodging location.

Sensor Calibration @ \$1,000 needed for calibrating the CTD, fluorometer and optode probes pre expedition.

Shipping & Postage: Shipping @ \$5,000 is needed to send the LRAUV vehicle back to WHOI from MBARI. Shipping @ \$6,000 is needed to ship the LRAUV vehicle and equipment to Louisiana for the expedition. Estimates based on previous trips.

Over the side insurance @ \$4,000 is needed to insure the LRAUV vehicle for the Louisiana expedition.

Misc.: Boat slip at Louisiana Port Eads Marina for R/V Discovery has a rate of \$5/foot per night. The R/V Discovery is 65ft, and the slip is needed for 10 nights. Tuition (JPS) @ \$28,336 covers 9 months of tuition for the ADAC-WHOI Graduate Student. Graduate student stipends are included in the total direct salary costs.
Total request for other direct costs: \$156,735

Indirect Costs:

MTDC (62%). Indirect costs include expenses associated with conducting scientific research, operating the institution, and maintaining buildings. MTDC is applied to all direct salaries and wages, applicable fringe benefits, materials and supplies, services, and travel.
Total request for indirect costs: \$333,246

Budget Notes:

The Woods Hole Oceanographic Institution (WHOI) is a non-profit [501(c)(3)] research and education organization subject to the cost principles of 2 CFR 200. WHOI Principal Investigators are responsible for conceiving, funding and carrying out their research programs. Senior Personnel are expected to raise 12 months of support per calendar year for themselves and their staff by writing proposals and obtaining sponsored research grants and contracts from a variety of sources. Some teach voluntarily in WHOI's Joint Program, but support for this is limited. NSF has confirmed to WHOI that salary support from grants beyond 2 months per calendar year can be justifiable for these Principal Investigators.

The rates included in the proposal are negotiated with our cognizant government agency.

WHOI has a negotiated rate agreement with the Office of Naval Research and uses the method of allocation of indirect costs to Modified Total Direct Costs (MTDC). The normal exclusions contained in 2 CFR 200.68 (MTDC) apply, as well as the following cost categories; ship use, submersible use, vessel charters and ship fuel.

A proposed labor month is equal to 152 hours or 1824 hours annually versus 2080 hours (40 hours/week for 52 weeks). The difference is for vacations, holidays, sick time, and other paid absences, which are included in the Paid Absences calculation. WHOI cannot "waive" or reduce overhead rates on any sponsored research project due to the structure of our negotiated rates with our cognizant government agency (Office of Naval Research). When a program sets limits on overhead, WHOI must use Institution unrestricted funds to pay the unfunded portion of the overhead costs.

PROJECT: Arctic Incidents of National Significance (IoNS) 2017 Oil Spill Focus RFP

Project PI: TBN

Total Project Budget Request: \$989,548.17 (carryforward funding)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$0.00	\$0.00	\$0.00
Other (Reserve Funding for RFP)	\$0.00	\$989,548.17	\$989,548.17
Indirect	\$0.00	\$0.00	\$0.00
Total	\$0.00	\$989,548.17	\$989,548.17

Funding being held in reserve for RFP selection and awarding.

PROJECT: Arctic Incidents of National Significance (IoNS) and Medium and Long Term Environment (MaLTE) workshops

Project PI: Randy (Church) Kee

Total Project Budget Request: \$138,970 (see budget object class and justification below for project composite)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$60,684.00	\$0.00	\$60,684.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$15,000.00	\$0.00	\$15,000.00
Commodities	\$3,000.00	\$0.00	\$3,000.00
Other (Participant Support)	\$20,000.00	\$0.00	\$20,000.00
Other (Reserve Funding for RFP)	\$0.00	\$0.00	\$0.00
Indirect	\$40,286.00	\$0.00	\$40,286.00
Total	\$138,970.00	\$0.00	\$138,970.00

Project Budget Justification and Narrative:

Senior Personnel Salaries:

Funding is requested for Executive Director, Randy (Church) Kee for two month of support to oversee students working on the literature review, administer approved workplan to include assisting with logistics, invitees, hosting, request for proposal, and oversight of selected projects being funded.

Other Personnel Salaries:

Support is requested for the Media Broadcast and Communications team for two months' effort for two individuals to assist with building web content, videos focusing on this workshop, writing report and request for proposal, webinar and other duties as needed to support the communications logistics.

Fringe Benefits:

Benefits are applied according to the University of Alaska's fixed fringe benefit rates for FY17. Rates are 30.50% for faculty, 46.40% for exempt staff and 9.5% for summer portion of the graduate student. Graduate student health insurance is also budgeted @ \$2,326 for each student in each year of the project. A copy of the rate agreement is available at:

<http://www.alaska.edu/cost-analysis/negotiation-agreements/>

Total request for salary and fringe benefits for personnel: \$60,684

Contractual/Services:

Funds are requested for approximately 50 individuals (non-federal) at the GSA rate of \$75/day for 2.5 days for receptions/catering for breaks, continental breakfasts, lunch, and dinner for a total of \$9,375. Funds are requested for room rental, AV needs to host a webinar, rental of tables and equipment as needed; estimated costs are \$5,625.

Total request for contractual/services: \$15,000

Materials and Supplies:

Funds are requested for printed materials for the workshop. The workshop assumes the same level of participants as previous IoNS workshop (approximately 100 participants). Printed materials include name badges, signage, binders, workshop agendas and materials.

Total request for materials and supplies: \$3,000

Participant Support:

As with the previous conference, support is requested to provide non-federal support to participants for travel. Travel support is budgeted at \$2,000 for 10 participants; however, this could be adjusted to provide \$1,000 in support for 20 participants if the need to defray participant costs is greater.

Total request for participant support: \$20,000

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the Office of Naval Research and for sponsored research are calculated at 51.2% of the Modified Total Direct Costs (MTDC). MTDC includes Total Direct Costs minus tuition, scholarships, subaward amounts over \$25,000, participant support costs, and equipment. A copy of the rate agreement for FY17-FY18 is available at:

<http://www.alaska.edu/cost-analysis/negotiation-agreements/FY17-FY18-FA-Rate-Agreement.pdf>

Total request for indirect costs: \$40,286

Theme 4: Integration of Science and Engineering with Maritime Security Governance and Policy Research

No projects currently awarded align to this Theme; therefore, no funding is dedicated to this theme.

Theme 5: End to End (E2E)

No projects currently awarded align to this Theme; therefore, no funding is dedicated to this theme.

Theme 6: Integrated Education

PROJECT: Education Outreach and Workforce Development

Project PI: Ms. Malla Kukkonen, Education and Administration Manager, University of Alaska Anchorage

Total Project Budget Request: \$314,513 (\$39,725 carryforward funding)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$153,413.00	\$6,613.76	\$160,026.76
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$23,325.00	\$23,325.00
Commodities	\$4,000.00	\$0.00	\$4,000.00
Other (Student Support)	\$36,780.00	\$0.00	\$36,780.00
Other (Student Travel)	\$0.00	\$0.00	\$0.00
Indirect	\$80,595.00	\$9,786.24	\$90,381.24
Total	\$274,788.00	\$39,725.00	\$314,513.00

Project Budget Justification:

Senior Personnel Salaries:

Education and Administration Manager, Ms. Malla Kukkonen is requesting 1340 hours effort for leadership, development, and management of the ADAC and CDG Fellows program. Ms. Kukkonen will oversee the activities of the students along with ADAC faculty mentors and ensure compliance for workplans. Ms. Kukkonen will arrange the Research Day Symposium in Anchorage where students will present their research and also be assisting with project evaluation and bringing recruitment efforts to workforce development capacity and opportunities for DHS and ADAC.

Other Personnel Salaries:

Support is requested for the Media Broadcast and Communications team for four months' effort (987.50 hours) for two individuals to assist with building student web content, videos focusing student spotlights and workplans, maintaining student ADAC Facebook and Twitter accounts, and webinars and other duties as needed to support the communications logistics for the student workplan.

Support is requested for two graduate students to work on individual projects. Jessica Faust will be working on curriculum for the ASIP project, assisting with the Arctic IoNS Oil Spill RFP, and online version of the Arctic Security Class. A TBN graduate student will be assisting with one of the new projects that will be coming online. Both graduate students will have 760 hours during the academic year and 560 during the summer months.

Fringe Benefits:

Benefits are applied according to the University of Alaska's System approved federally negotiated fringe benefit rates for both Anchorage. Health insurance is also included for graduate students. A copy can be provided upon request.

Total request for salary and fringe benefits for personnel: \$153,413

Contractual Services:

Funds are requested for printing poster presentations for the student research symposium and for recruitment materials.

Total request for contractual services: \$4,000

Other Costs (Student Support):

Support is requested to continue two undergraduate students to complete the program through summer 2019. Costs also include tuition for the students both graduate and undergraduate.
Total request for other costs (student support): \$36,780

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.
Total request for indirect costs: \$80,595

PROJECT: Career Development Grant (CDG) Fellowships

Project PI: Ms. Malla Kukkonen, Education and Administration Manager, University of Alaska Anchorage

Total Project Budget Request: \$24,671.56 (carryforward funding)

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Equipment	\$0.00	\$0.00	\$0.00
Other (Student Support)	\$0.00	\$24,671.56	\$24,671.56
Indirect	\$0.00	\$0.00	\$0.00
Total	\$0.00	\$24,671.56	\$24,671.56

Carryforward Justification:

Other (Student Support):

Funds are requested to utilize carryforward funding to recruit two new undergraduate students for the CDG Fellowship program. All four CDG students graduated this past December (2017) leaving a void and when they declared graduation there was not enough time to recruit for Spring semester 2018. Funding is requested for two undergraduate students for two years at \$1,000 per month per participant for ten months. Additional funding is requested for tuition.
Total request for other: \$24,671.56

PROJECT: Arctic Summer Research Internship

Project PI: Ms. Malla Kukkonen, University of Alaska Anchorage and Dr. Craig Tweedie, University of Texas-El Paso

Total Project Budget Request: \$174,595

Project Budget Request by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$45,949.00	\$0.00	\$45,949.00
Travel	\$6,000.00	\$0.00	\$6,000.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$4,000.00	\$0.00	\$4,000.00
Other (Subaward)	\$50,000.00	\$0.00	\$50,000.00
Other (Participant Support)	\$40,000.00	\$0.00	\$40,000.00
Indirect	\$28,646.00	\$0.00	\$28,646.00
Total	\$174,595.00	\$0.00	\$174,595.00

University of Alaska Anchorage Budget Justification

Total Budget Request for the University of Alaska Anchorage: \$124,595 (see budget object class and justification below for project composite)

Budget Request for the University of Alaska Anchorage by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$45,949.00	\$0.00	\$45,949.00
Travel	\$6,000.00	\$0.00	\$6,000.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$4,000.00	\$0.00	\$4,000.00
Other (Tuition)	\$0.00	\$0.00	\$0.00
Other (Participant Support)	\$40,000.00	\$0.00	\$40,000.00
Indirect	\$28,646.00	\$0.00	\$28,646.00
Total	\$124,595.00	\$0.00	\$124,595.00

Budget Justification for the University of Alaska Anchorage:

Senior Personnel Salaries:

Executive Director, Randy "Church" Kee is requesting 160 hours' effort for leadership, development and mentorship of the ASIP base camp activities. Director Kee will oversee the safety and ensure compliance at the base camp.

Education and Administration Manager, Ms. Malla Kukkonen is requesting 320 hours effort for leadership, development, and management of the ADAC and CDG Fellows program. Ms. Kukkonen will oversee the activities of the students along with ADAC faculty mentors and ensure compliance for workplans. Ms. Kukkonen will arrange the Research

Day Symposium in Anchorage where students will present their research and also be assisting with project evaluation and bringing recruitment efforts to workforce development capacity and opportunities for DHS and ADAC.

Other Personnel Salaries:

Support is requested for the Media Broadcast and Communications team for one months' effort for two individuals to assist with building student web content, videos focusing student spotlights and workplans, maintaining student ADAC Facebook and Twitter accounts, and webinars and other duties as needed to support the communications logistics for the student workplan.

Fringe Benefits:

Benefits are applied according to the University of Alaska's System approved federally negotiated fringe benefit rates. A copy can be provided upon request.

Total request for salary and fringe benefits for personnel: \$45,949

Travel:

Funding is requested for \$6,000 (\$3,000 each) for both the ADAC Executive Director or the Education and Administrative Manager travel to setup the base camp and assist with the logistics for the Barrow summer internship. The request includes a budget to accommodate economy air travel, governmental subsistence allowance (GSA) rate lodging, federal per diem for trips at base camp rates.

Total request for travel: \$6,000

Materials and Supplies Costs:

Funding is requested for \$4,000 for field supplies and poster printing to present at the student symposium upon completion of the ASIP.

Total request for materials and supplies: \$4,000

Participant Support Costs:

Funding is requested at \$8,000 per student for five ADAC fellows to travel to Barrow and perform research for 12 days plus have an additional week in Anchorage and another seven week internship with remote participation. This participant support cost includes airfare, GSA lodging and per diem at base camp rates, and also includes associated research fees to conduct experiments.

Total request for participant support: \$40,000

Indirect Costs:

Facilities and Administrative (F&A) Costs are negotiated with the University of Alaska Anchorage's cognizant federal authority and on sponsored research are calculated at 51.2% of the modified total direct costs (MTDC). MTDC includes total direct costs (TDC) minus tuition, scholarships/fellowships, subaward amounts over \$25,000, participant support costs, and equipment over \$5,000. A copy of the rate agreement is available upon request. The indirect rate applied for this request is based on the current approved F&A Rate Agreement.

Total request for indirect costs: \$28,646

University of Texas-El Paso Budget Justification

Total Budget Request for the University of Texas-El Paso: \$50,000(see budget object class and justification below for project composite)

Budget Request for the University of Texas-El Paso by Object Class:

Object Class	Year Five Proposed	Carry Forward	Total Funding
Salary and Fringe Benefits	\$0.00	\$0.00	\$0.00
Travel	\$0.00	\$0.00	\$0.00
Contractual	\$0.00	\$0.00	\$0.00
Commodities	\$0.00	\$0.00	\$0.00
Other (Tuition)	\$0.00	\$0.00	\$0.00
Other (Participant Support)	\$50,000.00	\$0.00	\$50,000.00
Indirect	\$0.00	\$0.00	\$0.00
Total	\$50,000.00	\$0.00	\$50,000.00

Budget Justification for the University of Texas-El Paso:

Participant Support Costs:

Funding is requested at \$1,000 per student per month for 12 months for two MSI UTEP ADAC fellows. \$8,000 per student intern is allocated to travel to Barrow and perform research for 12 days and be present the week prior to the internship in Anchorage. This participant support cost includes airfare, GSA lodging and per diem at base camp rates, and also includes associated research fees to conduct experiments. Additionally, participants will receive \$5,000 each for tuition during the academic year.

Total request for participant support: \$50,000

Project Budget Notes:

- Projects that are a subaward are listed as contractual in the composite as they are a procurement action on the part of ADAC.
- This project is assuming that carryforward request for the University of Texas-El Paso will be allowed to be repurposed from AIFC (project is being restarted with an RFP) and utilized for this education initiative.
- F&A costs on the subaward to the University of Texas-El Paso was satisfied in keeping with Uniform Guidance in year one and therefore no F&A are applied to this subaward at the University of Alaska Anchorage.

1. DATE ISSUED MM/DD/YYYY 08/08/2018
2. CFDA NO. 97.061
3. ASSISTANCE TYPE Cooperative Agreement

Department of Homeland Security

DHS Grants and Financial Assistance Division (GFAD)

245 Murray Lane, SW
Mail Stop 0115
Washington, DC 20528

NOTICE OF AWARD

AUTHORIZATION (Legislation/Regulations)
Homeland Security Act of 2002, Public Law 107-296, 6 U.S.C 188

1a. SUPERSEDES AWARD NOTICE dated
except that any additions or restrictions previously imposed remain
in effect unless specifically rescinded

4. GRANT NO. 17STADA00001-02-00
Formerly 2014ST061ML0002
5. ACTION TYPE Non-Competing Continuation

6. PROJECT PERIOD MM/DD/YYYY
From 09/01/2017 Through 06/30/2019

7. BUDGET PERIOD MM/DD/YYYY
From 07/01/2018 Through 06/30/2019

8. TITLE OF PROJECT (OR PROGRAM)

Centers for Homeland Security

9a. GRANTEE NAME AND ADDRESS
University Of Alaska Anchorage
3211 Providence Dr
Anchorage, AK 99508-4614

9b. GRANTEE PROJECT DIRECTOR
Mr. Douglas Causey
3211 PROVIDENCE DR
ANCHORAGE, AK 99508-4645
Phone: 907-786-1021

10a. GRANTEE AUTHORIZING OFFICIAL

Ms. Tana Myrstol
3211 PROVIDENCE DR
ANCHORAGE, AK 99508-4645
Phone: 907-786-1065

10b. FEDERAL PROJECT OFFICER

Mr. Theo Gemelas
7th and D Street, SW
Washington, DC 20407
Phone: 202-254-6108

ALL AMOUNTS ARE SHOWN IN USD

11. APPROVED BUDGET (Excludes Direct Assistance)

I Financial Assistance from the Federal Awarding Agency Only

II Total project costs including grant funds and all other financial participation

II

a. Salaries and Wages	598,472.27
b. Fringe Benefits	160,277.00
c. Total Personnel Costs	758,749.27
d. Equipment	0.00
e. Supplies	37,500.00
f. Travel	103,095.21
g. Construction	0.00
h. Other	2,873,286.56
i. Contractual	1,456,969.82
j. TOTAL DIRECT COSTS	5,229,600.86
k. INDIRECT COSTS	503,718.92

l. TOTAL APPROVED BUDGET 5,733,319.78

m. Federal Share 5,733,319.78

n. Non-Federal Share 0.00

12. AWARD COMPUTATION

a. Amount of Federal Financial Assistance (from item 11m)	5,733,319.78
b. Less Unobligated Balance From Prior Budget Periods	2,233,319.78
c. Less Cumulative Prior Award(s) This Budget Period	0.00
d. AMOUNT OF FINANCIAL ASSISTANCE THIS ACTION	3,500,000.00
13. Total Federal Funds Awarded to Date for Project Period	13,432,081.00

14. RECOMMENDED FUTURE SUPPORT

(Subject to the availability of funds and satisfactory progress of the project):

YEAR	TOTAL DIRECT COSTS	YEAR	TOTAL DIRECT COSTS
a. 3		d. 6	
b. 4		e. 7	
c. 5		f. 8	

15. PROGRAM INCOME SHALL BE USED IN ACCORD WITH ONE OF THE FOLLOWING ALTERNATIVES:

- a. DEDUCTION
b. ADDITIONAL COSTS
c. MATCHING
d. OTHER RESEARCH (Add / Deduct Option)
e. OTHER (See REMARKS)

b

16. THIS AWARD IS BASED ON AN APPLICATION SUBMITTED TO, AND AS APPROVED BY, THE FEDERAL AWARING AGENCY ON THE ABOVE TITLED PROJECT AND IS SUBJECT TO THE TERMS AND CONDITIONS INCORPORATED EITHER DIRECTLY OR BY REFERENCE IN THE FOLLOWING:

- a. The grant program legislation
b. The grant program regulations.
c. This award notice including terms and conditions, if any, noted below under REMARKS.
d. Federal administrative requirements, cost principles and audit requirements applicable to this grant.

In the event there are conflicting or otherwise inconsistent policies applicable to the grant, the above order of precedence shall prevail. Acceptance of the grant terms and conditions is acknowledged by the grantee when funds are drawn or otherwise obtained from the grant payment system.

REMARKS (Other Terms and Conditions Attached -

☒ Yes

☐ No

See next page

GRANTS MANAGEMENT OFFICIAL: Jacqueline Greely, Grants Officer

17. OBJ CLASS 4102	18a. VENDOR CODE 92600047	18b. EIN 926000147	19. DUNS 076664986	20. CONG. DIST. 00
FY-ACCOUNT NO.	DOCUMENT NO.	ADMINISTRATIVE CODE	AMT ACTION FIN ASST	APPROPRIATION
21. a. U80B70800803	b. STADA00001A	c. ADA1	d. \$3,500,000.00	e.
22. a. 779A70790803	b. STADA00001A	c. ADA1	d. \$0.00	e. 70790803
23. a.	b.	c.	d.	e.

NOTICE OF AWARD (Continuation Sheet)

PAGE 2 of 2	DATE ISSUED 08/08/2018
GRANT NO. 17STADA00001-02-00	

REMARKS:

The workplan approval of 29 June 2018 approves the following projects; project details as outlined in the workplan.

Theme 1: Maritime Risk, Threat Analysis, and Resilience

Theme 2: Maritime Domain Awareness Research

Theme 3: Maritime Technology Research

Theme 6: Integrated Education

Themes 4 & 5: No funding approved

AWARD ATTACHMENTS

UNIVERSITY OF ALASKA ANCHORAGE

17STADA00001-02-00

1. NCC Terms and Conditions

CENTER OF EXCELLENCE (COE)
COOPERATIVE AGREEMENT TERMS AND CONDITIONS
GRANTS AND FINANCIAL ASSISTANCE DIVISION (GFAD)

In addition to the **DHS Standard Terms and Conditions** as outlined here: <http://www.dhs.gov/publication/fy15-dhs-standard-terms-and-conditions> , the following Terms and Conditions apply specifically to this award as administered by the Grants and Financial Assistance Division (GFAD):

ARTICLE I. ADMINISTRATIVE TERMS AND CONDITIONS

A. RESEARCH PROJECT AND MANAGEMENT AWARD SPECIFIC TERMS AND CONDITIONS AND/OR RESTRICTIONS

1. Recipient shall submit all projects and programs funded under this Award to DHS for review and approval.
2. Recipient shall compete fully and fairly, to the maximum extent practicable, all projects funded under this Award unless DHS has provided written approval otherwise.
3. Recipient shall submit annual work plans for the activities for this Award to DHS for review and approval ahead of the next budget period, including individual recipient activities or projects. Modifications to any project or program funded under this award should be submitted to DHS for review and approval before initiating new work.
 - a. Annual work plans must provide information on the overall activities of the Center. The work plan shall include:
 - i. Summary of the Center's strategic vision and activities;
 - ii. Summary of Center communication and transition activities;
 - iii. Summary of Center management efforts including management decision making apparatus;
 - iv. Detailed descriptions on each Center project (including sub-recipient projects) to include:
 - o Methodology
 - o Project milestones
 - o Performance metrics used to evaluate progress & assessments of current concept of operations and baselines/state of the art in use
 - o Transition plans to include development steps, intellectual property management plans, & market specific considerations
 - o Stakeholder engagement
 - o Potential programmatic risks to completion; and,
 - o Project outcomes and outputs, including information on how project outcomes will advance or impact current policies, procedures, technologies or capabilities.

v. Budget information categorized by both object class and project, including budget justification. DHS requires Centers to submit a budget that maps to the key competencies and activities necessary for a Center to deliver useful technologies and knowledge products to the Department. The competency areas also align to the criteria DHS utilizes to evaluate its Centers of Excellence Program. Centers should allocate resources in the following categories: Administration & Execution, Research & Development, Education & Training, Customer Outreach & Communication, and Transition. The following categories should be included in the budget request. Centers should work with PM's to identify minimum expenditures in each category necessary to address Biennial Evaluation Criteria:

1. Administration and Execution (labor)

- a. Director
- b. Executive Director
- c. Professional Project Management Staff & Financial Staff
- d. Travel to sub-contractor sites

2. Research and Development

- a. Principal Investigator & supporting investigators (labor)
- b. Data acquisition (licenses, fees, etc.)
- c. Materials
- d. Supplies
- e. Equipment
- f. Facilities
- g. Project travel (consistent with iv. Customer outreach)

3. Education and Training

- a. Staff (labor)
- b. Scholarships
- c. Fellowships
- d. Internships
- e. Workforce development classes/webinars/seminars
- f. Course & curriculum development (labor)
- g. Summer workshops (labor, facilities, materials)
- h. MSI program support (labor)

4. Customer Outreach and Communication

- a. Professional Strategic Communications Expert (labor)
- b. Communications support staff (labor)
- c. Travel for all Center functions to DHS customers including project level travel
- d. Communication services, products, materials
- e. Annual meeting and outreach events – not including travel (technical and customer engagements)

5. Transition

- a. Technology development professional (labor)
- b. IP due diligence costs (labor legal)
- c. Business planning evaluations – financial modeling to support stage gate decisions (labor business)
- d. IP submission costs e.g. trademark, copyright expenses
- e. Market assessments (labor)
- f. Licensing costs for background IP
- g. Initial operations and maintenance costs (vendor services)
- h. Unit testing and evaluation – (labor , facilities, supplies/equipment/materials)
- i. Concept or technology integration costs (in customer environments or to meet final customer requirements, e.g. FISMA accreditation)

4. Recipient shall organize and participate in technical review of the research and education efforts funded under this Award annually, at a minimum, or as determined by the DHS Program Officer.

5. Recipient shall participate in a DHS managed, biennial review of the Center's progress against milestones, scientific quality, and commitment from the end user for the activities funded under this Award. The DHS Program Officer will select a review panel of subject matter experts representing government, industry and academia, to the extent practicable.

6. Recipient shall participate in at least two DHS Science and Technology (S&T) outreach events per year for the purposes of sharing information on the research, development, and education efforts funded under this Award.

7. Recipient agrees to work with the technology transfer office of recipient's institution to engage in technology transfer and commercialization activities, as appropriate.

8. DHS has an interest in publications generated from DHS-funded research for program awareness. Recipient shall forward publications generated under this Award to the DHS Program Officer as follows:

- a. On a quarterly basis one electronic and one hard copy of all publications; and
- b. Prior to publication, one electronic copy of any near-final pre-publication draft

9. Co-Authoring of Reports and Articles. Papers, presentations, or other documents co-authored by a DHS employee and a COE researcher will be subject to DHS's publications approval process prior to dissemination of the publication by the authors. Recipient shall submit these publications to the DHS author for DHS clearance at least sixty (60) days prior to dissemination of the publication. Recipient agrees to submit all required DHS clearances with the publication materials to the DHS Program Officer of Record.

10. Data Acquisition and Management Plan

a. Within thirty (30) days of initiating work on any research project that requires access to third party data, including data provided by DHS Component agencies, the Recipient must provide a plan for acquiring data as described in (b) below. The Recipient shall coordinate review of the plan with the University Privacy Officer prior to submission to DHS. The Recipient shall submit its plan to the DHS Program Officer for review and comment within thirty (30) days of initiating research. DHS will review the plan and notify the Recipient of any concerns that may be identified. The Recipient shall review the Data Acquisition and Management Plans at least annually and identify or update, as necessary, any new areas of research that require access to third party data.

b. The plan must include the following information for each project (See 11d for data definitions):

i. The purpose for collecting the data and characteristics of the data. If the data is deemed privacy sensitive, the Recipient must comply with the applicable federal, state, and local privacy laws, as well as DHS and university/research institute policies regarding the collection and use of personally identifiable information (PII).

ii. The uses of the data.

iii. A written commitment from the data's owner(s) to provide the Recipient the required data and the conditions under which the data will be provided.

iv. A plan for the disposal or retention of the data after the research ends.

c. Flowdown Requirements: The Recipient shall include the substance of this section in all sub-awards/contracts at any tier where the sub-Recipient may use, generate or have access to government facilities and sensitive or classified information.

11. Information Protection Plan: The Parties agree that all research conducted under this Award is intended to have publicly releasable results. Accordingly, no research under this Award should involve, use, or generate sensitive information, which includes PII, and/or classified information (see Item d of this section for Definitions). As a condition of access to this Center of Excellence, DHS agrees not to provide the Recipient any data or information that is sensitive or classified, i.e., information or data that would not be released completely in response to a request under the Freedom of Information Act, 5 U.S.C. § 552. Should the Recipient receive any data or information from DHS that the Recipient has reason to believe may be sensitive or classified, within 24 hours, the Recipient shall (1) notify the DHS Grants Management Specialist named in the award documents; (2) shall send such data or information to the Grants Management Specialist, unless otherwise directed by DHS; (3) shall erase or otherwise destroy any vestige of such data or information in its records and computer systems; and (4) shall notify the Grants Management Specialist of the means and time of such destruction.

In order to ensure research under this Award does not involve, use, or generate sensitive or classified information, intentionally or accidentally, Recipient shall develop an Information Protection Plan that incorporates policies and procedures that properly define, recognize, and protect such sensitive or classified information. Recipient will submit its plan to the DHS Program Officer for review and comment within thirty (30) days of award. The Recipient will be notified of any concerns that may be identified once the plan is reviewed by DHS. The recipient will review the Information Protection Plan at least annually and update as necessary for new or existing areas of research that may involve sensitive information. Recipient will submit any updates to the Information Protection Plans along with annual reports to the DHS Program Officer for review and comment.

a. Recipient further understands and agrees that despite the best efforts of the Parties to avoid research under this Award that involves, uses, or generates sensitive or classified information, the possibility exists that such information could nonetheless be involved, used or generated and be subject to protection by law, executive order, regulation or applicable DHS policies. The Recipient is, therefore, responsible for compliance with all applicable laws, regulations and policies. Nothing in this Award shall be construed to permit any public disclosure of sensitive and/or classified information in violation of these restrictions.

b. The Information Protection Plan will ensure the Recipient identifies, secures, and prohibits public disclosure of “sensitive or classified information.” Recipient maintains responsibility for their due diligence in identifying and properly marking any information governed by U.S. export controls regulations. For further information on applicable export controls, please see **Article II, Section H** of this award.

c. Required Notifications to DHS:

i. If Recipient determines that research under this Award involved, used, or generated sensitive or classified information, it agrees to secure the information in accordance with its Information Protection Plan and notify the DHS Program Officer immediately.

ii. The Recipient shall inform the DHS Program Officer in writing within 24 hours of the Recipient becoming aware of any potential security lapses involving either: the handling requirements for sensitive or classified information; or material failure of individuals to follow the Information Protection Plan.

d. Flowdown Requirements: The Recipient shall include the substance of this section in all sub-awards/contracts at any tier where the sub-Recipient may use, generate or have access to government facilities and sensitive or classified information.

e. Definitions: For purposes of this section.

i. Sensitive Information. General Definition. Any information, the loss, misuse, disclosure, or unauthorized access to or modification of which could adversely affect the national or homeland security interest, or the conduct of federal programs, or the privacy to which individuals are entitled under Section 552a of title 5, United States Code (the Privacy Act), but which has not been specifically authorized under criteria established by an Executive Order or an Act of Congress to be kept secret in the interest of national defense, homeland security or foreign policy. This definition includes the following categories of information:

o Protected Critical Infrastructure Information (PCII) as set out in the Critical Infrastructure Information Act of 2002 (Title II, Subtitle B, of the Homeland Security Act, Public Law 107-296, 196 Stat. 2135), as amended, the implementing regulations thereto (Title 6, Code of Federal Regulations, Part 29) as amended, and any supplementary guidance officially communicated in writing by an authorized official of the Department of Homeland Security (including the PCII Program Officer or his/her designee);

o Information designated as “For Official Use Only,” which is unclassified information of a sensitive nature and the unauthorized disclosure of which could adversely impact a person’s privacy or welfare, the conduct of federal programs, or other programs or operations essential to the national or homeland security interest; and

o Personally Identifiable Information (PII). Any information that permits the identity of an individual to be directly or indirectly inferred, including any information that is linked or linkable to that individual, regardless of whether the individual is a U.S. citizen, legal permanent resident, visitor to the U.S., or employee or contractor to the Department.

o Sensitive PII is PII which if lost, compromised, or disclosed without authorization, could result in substantial harm, embarrassment, inconvenience, or unfairness to an individual.

ii. Classified Information. Defined as information designated in accordance with Executive Order 12958.

12. Information Technology Security

a. As a condition of access to this Center of Excellence, DHS agrees not to provide the Recipient any data or information that is sensitive or i.e., information or data that would not be released completely in response to a request under the Freedom of Information Act, 5 U.S.C. § 552. Should the Recipient receive any data or information from DHS that the Recipient has reason to believe may be sensitive or classified, within 24 hours, the Recipient shall (1) notify the DHS Grants Management Specialist named in the award documents; (2) shall send such data or information to the Grants Management Specialist, unless otherwise directed by DHS; (3) shall erase or otherwise destroy any vestige of such data or information in its records and computer systems; and (4) shall notify the Grants Management Specialist of the means and time of such destruction.

13. Intellectual Property Management

- a. It is vitally important that both Parties understand their respective intellectual property rights and applicable obligations under this Award.
- b. Recipients should refer to both 2 C.F.R. § 215 “Uniform Administrative Requirement for Grants and Agreements with Institutions for Higher Education, Hospitals” and 37 C.F.R. § 401 “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements” for a complete summary of their rights and responsibilities.
- c. Flowdown Requirements: The Recipient shall include the substance of this section in all sub-awards/contracts at any tier where the sub-Recipient may use, generate or have access to government facilities and sensitive or classified information.
- d. Definitions: Please refer to Article II. Section J.

14. Research Safety Plan

- a. DHS COE research addresses issues of importance to intelligence and counter-terrorism agencies, law enforcement, or emergency responders, all of which involve inherent risks. To ensure that researchers and research facilities funded through this Award meet the highest safety standards possible, DHS requires every Recipient of a COE award to develop a Research Safety Plan. The Recipient shall review the Research Safety Plan at least annually and identify or update, as necessary, any new areas of research or sub-recipients conducting research activities under this plan. This review will also ensure that all sub-recipients conducting research covered by this plan have developed and implemented appropriate safety plans and periodic safety training in accordance with their institutional policies and procedures. Recipient will submit any updates to the Research Safety Plan to the DHS Program Officer for review and comment.
- b. The Research Safety Plan must include, at a minimum, the following:
 - i. Identification of possible research hazards associated with the types of research to be conducted under this Award;
 - ii. Research protocols or practices that conform to generally accepted safety principles applicable to the nature of the research;
 - iii. The Recipient’s processes and procedures to ensure compliance with the applicable protocols and standards;
 - iv. The Recipient’s processes and procedures to ensure the prevention of unauthorized activities conducted in association with this Award;
 - v. Faculty oversight of student researchers;
 - vi. Research safety education and training to develop a culture of safety;
 - vii. Access control, where applicable;
 - viii. Independent review by subject matter experts of the safety protocols and practices; and
 - ix. Demonstrated adherence to all safety-related terms and conditions contained elsewhere in this Award.
- c. Flowdown Requirements: The Recipient shall include the substance of this section in all sub-awards/contracts at any tier where the sub-Recipient may conduct research where safety protocols are necessary to conduct safe research.

15. Public Communication: The Recipient shall input and update all required project information into relevant webpage(s) hosted on the www.hsuniversityprograms.org. Posting and updating Center and project level information is a condition for receiving further annual funding increments. This website is one of the primary mechanisms used to communicate COE information to the public. Project updates follow pre-determined categories of information that must be populated at least annually. The DHS Office of University Programs maintains the right to edit and post submissions to www.hsuniversityprograms.org, as needed.

16. COE Science and Engineering Workforce Development:

Should the COE work with DHS through this initiative, the recipient shall follow the below terms and conditions:

a. DHS must ensure that U.S. citizens are trained in homeland security-related science and engineering disciplines in order to maintain U.S. leadership in science and technology, as required by the Homeland Security Act of 2002. Only U.S. citizens can work with federal, state and local agencies in the agencies' secure offices and operating environments, and can obtain security clearances and access to sensitive information needed to conduct research into homeland security issues.

b. Under this initiative, each COE may use COE Science and Engineering Workforce Development tuition assistance and stipends to support U.S. students studying the topics of, and working on homeland security research projects of their COEs.

Ninety-two percent (92%) of funds must go directly to support undergraduates, graduates, or a combination of undergraduate and graduate, students who are U.S. citizens working in the recipient COE's research area.

c. All students supported by COE Workforce Development funds shall report directly to COE faculty or staff, and shall work primarily on COE projects. Student participation in COE activities must take precedence to other research or employment for students to be eligible for COE support. COE activities include but are not limited to the following: supporting COE management activities, working on COE research projects, teaching, and experiential learning related to COE research topics.

d. Grants may be used to complement existing funding sources for students that are selected as participants, but may not supplant or be used in lieu of other COE funds. DHS expects a net increase in the number of students supported in COE programs funded through this section. These funds must be awarded only to newly supported students.

e. All COEs working with DHS on this initiative must develop and submit a Workforce Development work plan to DHS Program Manager for review and approval ahead of the next budget period, including individual recipient activities or projects. Modifications to any project or program funded under this award should be submitted to DHS for review and approval before initiating new work.

The work plan shall include:

i. A description of the COE's established or proposed science and engineering research and coursework including how research experiences will be incorporated in to the program.

ii. Details of an application and award process for selecting recipients. This process must include input from external subject matter experts (SMEs). Qualified students must meet the following minimum standards:

1. Must be U.S. citizens.
2. Must achieve and maintain a cumulative GPA of 3.30 or higher on a 4.00 scale, averaged over all academic terms.
3. Must major in priority science and engineering-related discipline associated with the COE research areas. These funds may not be used to support the completion of professional degrees (law school, medical school, etc.)
4. NOTE: Many positions in the homeland security field require a background check. Therefore, the student selection process and program experiences should include plans to address these requirements.
5. A commitment to facilitate student attendance at a professional conference within a science and engineering-related field of study.
6. A description of how the COE will assign qualified academic mentors for each recipient from the student's field of study.
7. A plan to make awards within one year of receipt of funds. Recipient institutions must award tuition assistance and stipends to students attending COE-affiliated institutions and working on COE research, development or technology transition projects. The students must be supported for up to 2 years for undergraduates and 3 years for graduate students or for the duration of their studies whichever is less. COEs may adjust this amount to account for other monetary awards to individual students.
8. For undergraduates, awards shall cover up to 100% but not less than 50% of tuition and mandatory fees (or equivalent), plus a stipend of no more than \$1,200 per month for twelve months. Stipends can be less than \$1,200 per month if appropriate for the geographic region or if paid summer internships can be secured.
9. For graduate students, awards shall cover up to 100% but not less than 50% of tuition and mandatory fees (or equivalent), plus a stipend of no more than \$2,700 per month for twelve months. Stipends can be less than \$2,700 per month if appropriate for the geographic region or if paid internships can be secured.

iii. A plan for identifying and placing students in the two required ten week internships that complement DHS COE approved research or are operational venues that work in the COE field of study. Internships should take place away from the student's home institution. Students must receive a stipend and travel/lodging support to an internship location during summer months for 2 summers if paid internships cannot be secured. Funds budgeted for stipends during summer months may be re-budgeted if paid internships are secured.

iv. Details of a strategy to ensure supported students proactively seek and obtain paid employment within the Homeland Security Enterprise (DHS, federal/state/local government, etc.) for at least one year after graduation.

1. Employment requirement will be waived for those entering the military /military school, or with a commitment to teach Science and Engineering at the elementary or secondary level.
2. Undergraduate students will be allowed a deferment of the one year service requirement if they have been accepted into a Science and Engineering related graduate program. Include a plan for managing and tracking this type of deferment.

v. An approach to evaluating student success

vi. A plan to monitor the activity of individual students to assure compliance with program requirements; develop a mitigation strategy; and establish procedures to ensure funds are used appropriately.

vii. A plan to monitor student's homeland security employment placement for up to six years after graduation from the program.

B. DHS PROGRAMMATIC INVOLVEMENT

In addition to the usual monitoring and technical assistance, the following identifies DHS responsibilities under this Award:

1. DHS shall determine if a kickoff meeting is required for proposed projects or proposed continuations of existing projects. DHS shall coordinate with appropriate DHS staff, Center staff and Center researchers prior to project initiation.
2. DHS shall approve or disapprove annual work plans and any modifications to the work plans for this Award (See Article 1. A.).
3. DHS shall conduct ongoing monitoring of the activities of Recipient's workplan and activities funded through this Award through face-to-face and/or telephone meetings and review of progress reports.
4. DHS shall coordinate biennial reviews in cooperation with the Recipient during the Project Period to provide guidance on how the research and education programs need to evolve to align with the needs of the Homeland Security Enterprise consistent with the COE mission. The biennial review evaluates the Center's long-term strategy, relevance of the research and education to DHS mission needs and technology gaps, stakeholder engagement, research quality, outreach efforts and management of the activities funded under this Award. The DHS Program Officer will select a review panel of subject matter experts representing government, industry and academia for the biennial review.
5. DHS coordination with the Recipient will include, but is not limited to:
 - a. Providing strategic input as necessary on an ongoing basis;
 - b. Coordinating research and development activities that support the national research agenda; and
 - c. Creating awareness and visibility for this program.

6. DHS may modify this Award to support additional research projects funded by DHS or other sources provided that these projects meet three conditions:

- a. Are research for a public purpose that addresses homeland security research priorities;
- b. Fall within scope of the grant or cooperative agreement; and
- c. Conform to federal assistance agreements (grant and cooperative agreement) guidelines.

7. DHS employees may co-author publications with COE researchers. Any publication co-authored by DHS staff will be subject to DHS's publications approval process prior to dissemination of the publication as required under Item 9, in Section A.

8. DHS shall review and provide comments on the Recipient's Information Protection Plan as required under Item 11 in Section A.

9. DHS shall review and provide comments on the Recipient's Research Safety Plan as required under Item 14 in Section A.

10. DHS may create a Board of Directors that provides guidance and direction to the DHS Program Officer regarding the Recipient's research plan.

11. DHS may invite subject matter experts, end users, or stakeholders to assist in evaluating the Center's annual workplan, annual meetings, or other events for the purpose of reviewing project quality and/or providing relevant operational perspectives.

12. DHS shall facilitate initial engagement with Homeland Security Enterprise stakeholders, but recipient is expected to maintain ongoing engagement for research areas of interest to the stakeholders.

C. AMENDMENTS AND REVISIONS

1. Budget Revisions.

- a. The Recipient shall obtain prior written approval from the DHS Grants Officer for transfers of funds between direct cost categories in the approved budget, when such cumulative transfers among those direct cost categories exceed ten percent of the total approved budget.
- b. The Recipient shall obtain prior written approval from the DHS Grants Officer for any budget revision that would result in the need for additional resources/funds.
- c. The Recipient is not authorized at any time to transfer amounts budgeted for direct costs to the indirect costs line item or vice versa, without prior written approval of the DHS Grants Officer.

2. Extension Request.

- a. Extensions to the Period of Performance can only be authorized in writing by the DHS Grants Officer.
- b. The extension request shall be submitted to the DHS Grants Officer sixty (60) days prior to the expiration date of the performance period.

c. Requests for time extensions to the Period of Performance will be considered, but will not be granted automatically, and must be supported by adequate justification to be processed. The justification is a written explanation of the reason or reasons for the delay; an outline of remaining resources/funds available to support the extended Period of Performance; and a description of performance measures necessary to complete the project. Without performance and financial status reports current and justification submitted, extension requests shall not be processed.

d. DHS has no obligation to provide additional resources/funding as a result of an extension.

D. EQUIPMENT

1. Prior to the purchase of Equipment in the amount of \$5,000 or more per unit cost, the recipient must obtain the written approval from DHS.
2. For equipment purchased with Award funds having a \$5,000 or more per unit cost, the Recipient shall submit an inventory that will include a description of the property; manufacturer model number, serial number or other identification number; the source of property; name on title; acquisition date; and cost of the unit; the address of use; operational condition of the property; and, disposition data, if applicable. This report will be due with the Final Progress Report 90 days after the expiration of the project period, and emailed to DHS-GrantReports@hq.dhs.gov.

E. FINANCIAL REPORTS

1. Annual Federal Financial Reports. The Recipient shall submit a Federal Financial Report (SF-425) to the DHS Grants Officer no later than thirty (30) days after the end of the budget period end date. The report shall be submitted via GrantSolutions using the FFR submission guidance found here: <https://www.grantsolutions.gov/support/granteeUsers.html>.
2. Final Federal Financial Report. The Recipient shall submit the final Federal Financial Report (SF-425) to the DHS Grants Officer no later than ninety (90) days after the end of the reporting period end date. The report shall be submitted via GrantSolutions using the FFR submission guidance found here: <https://www.grantsolutions.gov/support/granteeUsers.html>.
3. Quarterly Federal Financial Reports (Cash Transaction). The Recipient shall submit the Federal Financial Report (SF-425) Cash Transaction Report to the Department of Health and Human Services, Payment Management System. Quarterly Cash Transaction reports shall be submitted no later than 1/30, 4/30, 7/30, and 10/30.

F. PAYMENT

The Recipient shall be paid in advance using the U.S. Department of Health and Human Services/Payment Management System, provided it maintains or demonstrates the willingness and ability to maintain written procedures to minimize the time elapsing between the transfer of the funds from the DHS and expenditure disbursement by the Recipient. When these requirements are not met, the Recipient will be required to be on a reimbursement for costs incurred method.

Any overpayment of funds must be coordinated with the U.S. Department of Health and Human Services/Payment Management System.

G. PERFORMANCE REPORTS

1. Annual Performance Reports. The Recipient shall submit semi-annual performance reports to the DHS Grants Officer for review and acceptance by DHS as a condition for receiving further annual funding increments. Semi-Annual performance reports are due six (6) months after the start of each budget year and no later than sixty (60) days after the end of the Center's budget period of each year. Annual reports must provide a summary of the activities conducted during the prior budget year. The report shall be submitted via www.GrantSolutions.gov using the Grant Note submission guidance found here: <https://www.grantsolutions.gov/support/granteeUsers.html>

a. Performance reports must provide information on the overall progress of the Center based on the activities discussed in the corresponding work plan. These reports should map work plan activities (activities planned) to those activities performed during the year to include:

- i. Summary reports on the Center's strategic vision and support justification
- ii. Summary of Center communication and transition activities;
- iii. Summary of Center management efforts including decision making apparatus;
- iv. Performance reports on each Center Project should include:
 - o Explanation of any changes from the initially approved workplan
 - o Methodology
 - o Project milestones
 - o Performance metrics used to evaluate progress & assessments of current concept of operations and baselines/state of the art in use
 - o Progress against each milestone, outcomes and outputs and explanation of why any items were not reached
 - o Transition plans to include development steps, intellectual property management plans, & market specific considerations
 - o Stakeholder engagement
 - o Potential programmatic risks to completion; and,
 - o Progress against each milestone outcomes and outputs and explanation of why any items were not reached
 - o Unanticipated problems and plans for addressing them; and
 - o Information supported by data on how project outcomes will advance or impact current technologies or capabilities.

- v. Budget information (narrative and figures) categorized by both object class and project as described in Article I, A, item 3.v.
- vi. If applicable, include a certification that no patentable inventions were created during the budget period.
- vii. Updates to the Center's Information Protection Plan and Researcher Safety Plan as needed.

b. If the performance report contains any information that is deemed proprietary, the Recipient will denote the beginning and ending of such information with the following heading:

*****PROPRIETARY INFORMATION*****

2. Annual COE Science and Engineering Workforce Development Report. COEs working with DHS through the COE science and engineering workforce development initiative will submit a separate Science and Engineering Workforce Development Annual Performance Report to the DHS Grants Officer.

a. The report shall compare actual accomplishments to the approved project objectives and shall include:

- i. A program overview section on the goals, objectives and accomplishments to date; total number of students supported; total number of students graduated; total number of students still enrolled; number of graduate students supported; number of undergraduate students supported; total number of students currently employed full time in a Homeland Security related position
- ii. A student report for each supported student including: student name; current status of student (graduated/enrolled); degree (masters, bachelors, PhD); major; dates of funding; total funding amount; description of complete internship/research experiences; workshops/conference attended; publications, presentations, poster sessions; other relevant accomplishments/success stories; copy of student resume.

3. Final Performance Report. The Recipient shall submit the Final COE Performance Report to the DHS Grants Officer and DHS Program Officer no later than ninety (90) days after the expiration of the Project Period (See Section H). The report shall be emailed to DHS-GrantReports@hq.dhs.gov and include the grant program name and number in the subject line.

a. The Final COE Performance Report shall include:

- i. An executive summary and final summary abstracts for each sub-project across all years of the period of performance.
- ii. Address the areas identified above in the annual report section.

4. The Final COE Science and Engineering Workforce Development Performance Report. COEs working with DHS through the COE science and engineering workforce development initiative will submit final reports within ninety (90) days after the expiration date of the performance period of this initiative to the DHS Grants Officer.

a. The Final COE Science and Engineering Workforce Development Performance Report shall include:

- i. Post completion employment plans for each student scholar/fellow or an explanation for student leaving the program.

- ii. Summary of research accomplishments and contributions, post-award activity and post-graduation placement, new skills or knowledge acquired

H. PERIOD OF PERFORMANCE

The Period of Performance is the Project Period approved for the supported activity and is comprised of one or more Budget Periods as reflected on the Notice of Award cover page.

1. Project Period. The Project Period shall be for up to 10 years, unless extensions are approved. All COEs' annual performance periods shall run from July 1 to June 30 of the following year. An exception is made for the first performance period, which will run from the date of award to June 30 of the following year. Subsequent years' funding is contingent on acceptable performance, as determined by the Department of Homeland Security's (DHS's), acceptance and approval of each non-competing continuation application, and the availability of the next year's annual DHS appropriations. The Recipient shall only incur costs or obligate funds within the Project Period for approved activities.

2. Budget Period. The Budget Period shall be for a period of 12 months, from July 1, through June 30 of the following year.

a. Additional funding will be provided for subsequent Budget Periods of the project, contingent on all of the following:

- i. Acceptable performance of the project as determined by the DHS under this Award;
- ii. Acceptance and approval by the DHS of each noncompeting continuation application;
- iii. Acceptance and approval by the DHS of each previous Annual Performance Report and
- iv. Subject to the availability of appropriated funds.

3. Non-Competing Continuation Requirements.

a. Ninety (90) days prior to the expiration date of each budget period, the Grants Officer will request submission of the annual incremental funding request details via www.GrantSolutions.gov. The Recipient shall submit a non-competing continuation application to request the next Budget Period's incremental funding and a separate request for any possible carryover of prior year funds.

The non-competing continuation application shall include:

- i. An annual project work plan as described in Article A, Item 3

ii. Carryover of Funds. Recipients are required to submit a separate Carryover Application for the unobligated balances remaining from funds awarded in one budget period to be carried over to the next succeeding budget period. This submission is due to the DHS Grants Officer and DHS Program Manager 90 days prior to budget period expiration (e.g., March 31) and is a best estimate at the budget period expiration from the recipient (lead university and all sub-recipients). The Program Officer will review the Carryover justification, in consultation with the DHS Grants Officer, and provide input to the Grants Officer that the justification is reasonable and the carryover funds should be used to complete any objectives which remain unmet from the prior budget period. Requests for carryover of funds from one Budget Period to the next Budget Period shall be submitted separately via email to the DHS Grants Officer with an SF 424 (R&R) face page and shall include:

1. A brief description of the projects or activities and milestones to be carried forward,
2. The amount of funds to be carried over,
3. The reason the projects or activities were not completed in accordance with the project time line, and
4. The impact on any future funding for the projects or activities.

iii. The DHS Program Officer will review the continuation application submission and provide input to the Grants Officer as to whether the Continuation Application is consistent with the approved work plan.

iv. COE Science and Engineering Workforce Development annual workplan and budget justification: COEs retain the ability to balance financial support as appropriate if students have or will receive other sources of funding. Should the COE work with DHS through this initiative, the recipient will submit an annual workplan described in Article 1, A, Item 16.

I. PRIOR APPROVAL REQUIRED

The Recipient shall not, without the prior written approval of the DHS, request reimbursement, incur costs or obligate funds for any purpose pertaining to the operation of the project, program, or activities prior to the approved Budget Period.

ARTICLE II. GENERAL TERMS AND CONDITIONS

A. ACCESS AND RETENTION TO RECORDS

The Recipient shall retain financial records, supporting documents, statistical records, and all other records pertinent to this Award for a period of three (3) years from the date of submission of the final expenditure report. The only exceptions to the aforementioned record retention requirements are the following:

1. If any litigation, dispute, or audit is started before the expiration of the 3-year period, the records shall be retained until all litigation, dispute or audit findings involving the records have been resolved and final action taken.

2. Records for real property and equipment acquired with federal funds shall be retained for 3-years after final disposition.

3. The DHS Grants Officer may direct the Recipient to transfer certain records to DHS custody when he or she determines that the records possess long term retention value. However, in order to avoid duplicate recordkeeping, the DHS Grants Officer may make arrangements for the Recipient to retain any records that are continuously needed for joint use.

DHS, the Inspector General, Comptroller General of the United States, or any of their duly authorized representatives, have the right of timely and unrestricted access to any books, documents, papers, or other records of the Recipient that are pertinent to this Award, in order to make audits, examinations, excerpts, transcripts and copies of such documents. This right also includes timely and reasonable access to Recipient's personnel for the purpose of interview and discussion related to such documents. The rights of access in this award term are not limited to the required retention period, but shall last as long as records are retained.

With respect to sub-recipients, DHS shall retain the right to conduct a financial review, require an audit, or otherwise ensure adequate accountability of organizations expending DHS funds. Recipient agrees to include in any sub-award made under this Agreement the requirements of this award term (Access to Records).

B. COMPLIANCE ASSURANCE PROGRAM OFFICE TERMS AND CONDITIONS

The Compliance Assurance Program Office (CAPO) is comprised of the DHS Treaty Compliance Office (TCO), Export Control Group (ECG), and the DHS Regulatory Compliance Office (RCO). The Compliance Assurance Program Manager (CAPM) is the DHS official responsible for overseeing CAPO and implementing procedures to ensure that the Recipient and any Recipient institutions/collaborators under this Award comply with international treaties, federal regulations, and DHS policies for Arms Control Agreements, Biosafety, Select Agent and Toxin Security, Animal Care and Use, the Protection of Human Subjects, Life Sciences Dual Use Research of Concern, and Export Controls.

CAPO collects and reviews relevant documentation pertaining to this Award on behalf of the CAPM. Additional guidance regarding the review process is provided in the following sections, along with contact information. This guidance applies to the Recipient and any/all Recipient institutions involved in the performance of work under this Award. The Recipient is responsible for ensuring that any/all Recipient institutions and collaborators comply with all requirements and submit relevant documentation, as outlined in sections C – G below, for work being performed under this Award.

C. TREATY COMPLIANCE FOR BIOLOGICAL AND CHEMICAL DEFENSE EFFORTS

The Recipient and any Recipient institution shall conduct all biological and chemical defense research, development, testing, evaluation, and acquisition projects in compliance with all arms control agreements of the U.S., including the Chemical Weapons Convention (CWC) and the Biological Weapons Convention (BWC). DHS Directive 041-01, Compliance With, and Implementation of, Arms Control Agreements, requires review of all such projects, including classified projects; projects involving biological and/or chemical agents, surrogates, or simulants; and non-laboratory activities related to biological and/or chemical agents (e.g., literature reviews, simulations, and/or modeling activities) to be systematically evaluated for compliance at inception, prior to funding approval, whenever there are any project changes, and whenever in the course of project execution an issue potentially raises a compliance concern.

1. Requirements for Initial Treaty Compliance Review. To ensure compliance with DHS Directive 041-01, for each biological and/or chemical defense-related effort (including non-laboratory activities related to biological and/or chemical agents) to be conducted under this Award, **the Recipient must submit the following documentation for compliance review and certification prior to funding approval:** a completed Treaty Compliance Form (TCF) and a Statement of Work.

2. Requirements for Ongoing Treaty Compliance Review. To ensure ongoing treaty compliance for approved biological and/or chemical defense-related efforts funded through this Award, **the Recipient must submit the following documentation for review and approval prior to any project modification and/or whenever in the course of project execution an issue potentially raises a compliance concern:** an updated Treaty Compliance Form and an updated Statement of Work detailing the proposed modification. The proposed project modification must receive written approval from CAPO prior to initiation. Examples of project modifications include – but are not limited to—the addition of agents, a change in performer, modifications to the scope of work, and changes to the technical approach.

The Recipient should contact the CAPO regarding treaty compliance issues at treatycompliance@hq.dhs.gov to: obtain the TCF, submit the completed Form, and/or request additional guidance regarding treaty compliance documentation and review requirements, as applicable to (1) new biological and/or chemical defense-related efforts, or (2) modifications to previously approved efforts. The CAPO will review all submitted materials and provide written confirmation of approval to the Recipient once the treaty compliance certification process is complete. **The Recipient and any Recipient institution shall not initiate any new activities, or execute modifications to approved activities, prior to receipt of this written confirmation.**

D. REGULATORY COMPLIANCE FOR BIOLOGICAL LABORATORY WORK

The Recipient and any Recipient institution shall conduct all biological laboratory work in compliance with applicable federal regulations; the latest edition of the CDC/NIH Biosafety in Microbiological and Biomedical Laboratories; DHS Directive 066-02, Rev 01, Biosafety; DHS Instruction 066-02-001, Biosafety; ; and any local institutional policies that may apply for Recipient institution facilities performing work under this Award. The CAPO will review the submitted Treaty Compliance Form (TCF) for planned work under this Award to determine the applicability of the requirements outlined in this section. **The Recipient must contact the CAPO at STregulatorycompliance@hq.dhs.gov for guidance on the requirements, and then submit all required documentation based on CAPO guidance, prior to the initiation of any biological laboratory work under this Award.**

1. Requirements for All Biological Laboratory Work. Biological laboratory work includes laboratory activities involving: (1) recombinant or synthetic nucleic acid molecules; (2) Biological Select Agents and Toxins or 'BSAT'; or (3) biological agents, toxins, or other biological materials that are not recombinant, synthetic, or BSAT. Each Recipient and any Recipient institution to be conducting biological laboratory work under this Award must submit copies of the following documentation, as required by the CAPO after review of the TCF(s), for review prior to the initiation of such work:

- a. Research protocol(s), research or project plan(s), or other detailed description of the biological laboratory work to be conducted;
- b. Documentation of project-specific biosafety review for biological laboratory work subject to such review in accordance with institutional policy;
- c. Institutional or laboratory biosafety manual (may be a related plan or program manual) for each facility/laboratory to be involved in the biological laboratory work;
- d. Biosafety training program description (should be provided as available in existing policies, plans, and/or manuals for all relevant facilities/laboratories where work is conducted;
- e. Documentation of the most recent safety/biosafety inspection(s) for each facility/laboratory where the biological laboratory work will be conducted;
- f. Exposure Control Plan, as applicable;
- g. Documentation from the most recent Occupational Safety and Health Administration (OSHA) or State Occupational Safety and Health Agency inspection report; a copy of the OSHA Form 300 *Summary of Work Related Injuries and Illnesses* or equivalent, for the most recent calendar year; and documentation of any OSHA citations or notices of violation received in the past five years; and
- h. Documentation from the most recent U.S. Department of Transportation (DOT) inspection report; and documentation of any DOT citations or notices of violation received in the past five (5) years.

2. Requirements for Research Involving Recombinant or Synthetic Nucleic Acid Molecules. Laboratory activities involving recombinant or synthetic nucleic acid molecules research are defined by the *NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules, "NIH Guidelines"*. Each Recipient and any Recipient institution shall conduct all such work in compliance with the NIH Guidelines. In addition to the documentation referenced in Section B.1 above, **each facility conducting research activities involving recombinant or synthetic nucleic acid molecules under this Award must submit copies of the following documentation to the CAPO for review prior to the initiation of such activities:**

- a. Institutional Biosafety Committee (IBC) Charter, and/or other available documentation of IBC policies and procedures;
- b. Most recent Office of Biotechnology Activities (OBA) acknowledgement letter of the annual IBC Report;
- c. IBC-approved recombinant or synthetic nucleic acid molecules research protocol(s); and
- d. Documentation of final IBC approval for each recombinant or synthetic nucleic acid molecules research protocol and all subsequent renewals and amendments as they occur

3. Requirements for Activities Involving Biological Select Agents and Toxins (BSAT). **Planned activities involving the possession transfer, and/or use of BSAT must be reviewed by the CAPO prior to initiation.**

This requirement also applies to activities involving select toxins that fall below the Permissible Toxin Limits, both at facilities registered with the National Select Agent Program and at unregistered facilities. Each Recipient and any Recipient institution shall conduct all BSAT work in compliance with all applicable regulations, including 42 C.F.R. § 73, 7 C.F.R. § 331, and 9 C.F.R. § 121, related entity- and laboratory-specific policies and procedures, and DHS Directive 026-03, Rev 01, Safeguarding Select Agents and Toxins; and DHS Instruction 026-03-001, Safeguarding Select Agents and Toxins. **In addition to the documentation referenced in Section B.1 above, each facility conducting activities involving BSAT under this Award must submit copies of the following documentation to the CAPO for review prior to the initiation of such activities:**

- a. Current APHIS/CDC Certificate of Registration;
- b. Current versions of the Biosafety, Security, and Incident Response Plans required and reviewed under the Select Agent Regulations; and
- c. Documentation of the most recent annual BSAT facility inspection, as required of the Responsible Official under the Select Agent Regulations.

The Recipient should contact the CAPO at STregulatorycompliance@hq.dhs.gov to obtain the CAPO Documentation Request Checklist, submit documentation, or request more information regarding the DHS CAPO documentation and compliance review requirements. The CAPO will provide written confirmation of receipt of all required documentation to the designated Point(s) of Contact. The CAPO will evaluate the submitted materials, along with available documentation from any previous reviews for related work at the Recipient and Recipient institution. Additional documentation may be required in some cases and must be submitted upon request. The CAPO will review all submitted materials and provide written confirmation to the Recipient once all requirements have been met.

CAPO review of submitted materials may determine the need for further compliance review requirements, which may include documentation-based and on-site components. The Recipient, and any Recipient institutions conducting biological laboratory work under this Award, must also comply with ongoing CAPO compliance assurance and review requirements, which may include but are not limited to initial and periodic documentation requests, program reviews, site visits, and facility inspections.

The Recipient must promptly report the following to the CAPO, along with any corrective actions taken: (1) any serious or continuing biosafety or BSAT program issues as identified by the APHIS/CDC National Select Agent Program, other compliance oversight authorities, or institutional-level reviews (e.g., IBC or equivalent, laboratory safety/biosafety inspections); (2) any suspension or revocation of the APHIS/CDC Certificate of Registration; and (3) any for-cause suspension or termination of biological, rDNA, or BSAT activities at the laboratories/facilities where DHS-sponsored work is conducted.

Foreign Contractors/Collaborators and U.S. Institutions with Foreign Subcomponents. Foreign organizations (including direct Contractors, Subcontractors, Grant Recipients, Sub-recipients, and subcomponents or collaborating partners to U.S. Recipients) are subject to applicable DHS requirements for biological laboratory activities. All entities involved in activities under this Award must comply with applicable national and regional/local regulations, and standards and guidelines equivalent to those described for U.S. institutions (e.g., BMBL and NIH Guidelines). The Recipient must provide CAPO documentation sufficient to illustrate this compliance. The CAPO will evaluate compliance measures for these institutions on a case-by-case basis. The Recipient must not initiate work nor provide funds for the conduct of biological laboratory work under this Award without CAPO's formal written approval.

E. REGULATORY REQUIREMENTS FOR RESEARCH INVOLVING ANIMALS

The Recipient and any Recipient institution shall conduct all research involving animals under this Award in compliance with the requirements set forth in the Animal Welfare Act of 1966 (P.L. 89-544), as amended, and the associated regulations in 9 C.F.R., Chapter 1, Subchapter A; the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals (which adopts the "U.S. Government Principles for the Utilization and Care of Vertebrate Animals used in Testing, Research, and Training", 50 FR 20864, May 20, 1985); the National Research Council (NRC) Guide for the Care and Use of Laboratory Animals; the Federation of Animal Science Societies (FASS) Guide for the Care and Use of Agricultural Animals in Agricultural Research and Teaching; any additional requirements set forth in the DHS Directive 026-01, Rev 01, Care, Use, and Transportation of Animals in Research; and DHS Instruction 026-01-001, Care, Use, and Transportation of Animals in Research. **Each Recipient and any Recipient institution planning to perform research involving animals under this Award must comply with the requirements and submit the documentation outlined in this section.**

1. Requirements for Initial Review of Research Involving Animals. Research Involving Animals includes any research, experimentation, biological testing, and other related activities involving live, vertebrate animals, including any training for such activities. Each facility conducting research involving animals under this Award must submit copies of the following documentation to the CAPO for review **prior to the initiation of such research:**

- a. Institutional Animal Care and Use Committee (IACUC)-approved animal research protocol(s), including documentation of IACUC approval, any protocol amendments, and related approval notifications;

b. Public Health Service (PHS) Animal Welfare Assurance, including any programmatic amendments, and the most recent NIH Office of Laboratory Animal Welfare (OLAW) approval letter for each Recipient and Recipient institution; OR DHS Animal Welfare Assurance, if the Recipient is not funded by the PHS and does not have a PHS Assurance on file with OLAW. Any affiliated IACUCs must be established under the same requirements as set forth in the PHS Policy;

c. Most recent IACUC semiannual program review and facility inspection reports covering all relevant facilities/laboratories involved in DHS-funded work; and

d. Most recent Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) inspection report(s) for AAALAC-accredited institution(s) housing and/or performing work involving animals under this Award.

All documentation, as well as any questions or concerns regarding the requirements referenced above, should be submitted to the CAPO at STregulatorycompliance@hq.dhs.gov. Additional documentation may be required in some cases and must be submitted upon request. The CAPO will review all submitted materials and provide written confirmation to the Recipient once all documentation requirements have been met. Upon receipt of this written confirmation, the Recipient may initiate approved animal research projects under this Award, but must address any potential compliance issues or concerns identified by the CAPO. **Research involving the use of nonhuman primates or international collaborations involving animal research will require more extensive review prior to approval, and must not begin under this Award without first obtaining a formal certification letter from the CAPO.**

The Recipient, as well as any Recipient institution and partner institutions conducting animal research under this Award, shall also comply with ongoing CAPO compliance assurance functions, which may include but are not limited to periodic site visits, program reviews, and facility inspections.

2. Requirements for Ongoing Review of Research Involving Animals. For ongoing animal research activities, each Recipient and any Recipient institutions must submit updates to the CAPO regarding any amendments or changes to (including expiration, renewal, or completion of) ongoing animal protocols as they occur, and may be required to submit annual updates regarding the ACU program at Recipient and Recipient institutions. Annual updates may include, but are not limited to, the IACUC semiannual (program review and facility inspection) reports, the USDA inspection report, and the most recent AAALAC inspection report, as applicable.

The Recipient must promptly report the following to the CAPO, along with any corrective actions taken: (1) any serious or continuing noncompliance with animal care and use regulations and policies adopted by DHS (as referenced above); (2) any change in AAALAC accreditation status; (3) any USDA Notice of Violation; and (4) IACUC suspension of any animal research activity conducted under this Award.

3. Foreign Contractors/Collaborators and U.S. Institutions with Foreign Subcomponents. Foreign organizations (including direct Contractors, Subcontractors, Grant Recipients, Sub-recipients, and subcomponents or collaborating partners to U.S. Recipients) are subject to DHS approval for work involving animals. All entities involved in activities under this Award must comply with their own applicable national and regional/local regulations, standards and guidelines. The Recipient must provide CAPO documentation sufficient to illustrate this compliance. The CAPO will evaluate compliance measures for these institutions on a case-by-case basis to determine their sufficiency. The Recipient must not initiate nor provide funds for the conduct of work involving animals at foreign institutions under this Award without formal written approval from the CAPO.

F. REGULATORY REQUIREMENTS FOR LIFE SCIENCES DUAL USE RESEARCH OF CONCERN (DURC)

The Recipient and any Recipient institutions shall conduct all research involving agents and toxins identified in sections III.1 and 6.2.1 of the *USG Policy for Oversight of Dual Use Research of Concern* and *USG Policy for the Institutional Oversight of Dual Use Research of Concern*, respectively, in accordance with both policies referenced above and in accordance with any additional requirements set forth in related DHS policies and instructions. Each Recipient and any Recipient institutions planning to perform research involving agents and toxins identified in sections III.1 and 6.2.1 of the USG DURC policies under this award must submit the following documentation outlined in this section for CAPO review. Institutions were required to implement the policy on or by September 24, 2015.

1. Requirements for Research Using DURC Agents and Toxins. To ensure compliance with the USG DURC Policies, each facility conducting research involving the agents and toxins identified in sections III.1 and 6.2.1 of the USG DURC Policies under this Award must submit the following documentation for compliance review by CAPO prior to the initiation of such activities.

- a. Institutional Review Entity (IRE) charter, and/or other available documentation of IRE policies and procedures, to include the contact information for the Institutional Contact for DURC (ICDUR);
- b. Institution's project-specific risk mitigation plan, as applicable;
- c. DURC training or education program description;
- d. Formal annual assurance of compliance with the USG Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern;
- e. A completed iDURC form and a Statement of Work.

2. Required Notifications to DHS:

- a. Within thirty (30) calendar days of initial and periodic reviews of institutional review of research with DURC potential, notify CAPO of the results, including whether the research does or does not meet the DURC definition.
- b. Report, in writing, any instances of noncompliance and mitigation measures to correct and prevent future instances of noncompliance within thirty (30) calendar days to CAPO.

3. Flowdown Requirements: The Recipient shall include the substance of this section in all sub-awards/contracts at any tier where the sub-Recipient is performing work with agents or toxins identified in sections III.1 of the *USG Policy for Oversight of Dual Use Research of Concern* and 6.2.1 of the *USG Policy for the Institutional Oversight of Dual Use Research of Concern*.

The Recipient should contact CAPO at STregulatorycompliance@hq.dhs.gov to submit documentation or to request more information regarding the DHS regulatory documentation and compliance review requirements. CAPO will provide written confirmation of receipt of all required documentation to the designated Points of Contact. CAPO will evaluate the submitted materials. Additional documentation may be required in some cases and must be submitted upon request. CAPO will review all submitted materials and provide written confirmation to the Recipient once all requirements have been met. Upon receipt of this written confirmation, the Recipient may initiate approved projects under this award.

In order to meet the reporting requirements set forth in section IV.2 of the 2012 USG Policy for Oversight of Life Sciences Dual Use Research of Concern (the biannual DURC Data Call), the Recipient and any Recipient institution shall submit documentation regarding all active, planned or recently completed (within twelve months of the submission) unclassified intramural or extramural activities on Federally-funded or conducted life science research projects biannually on the first Monday in May and November. The Recipient should contact CAPO at STregulatorycompliance@hq.dhs.gov to submit documentation. Documentation should include an update on all listed activities, including status, all agents or toxins incorporated by strain or surrogate name, performers, contract information, and sites of activities. Documentation should also include any changes to existing or completed projects since the most recent submission, including—but not limited to—the addition of agents, a change in performer, modifications to the scope of work, and/or changes to the technical approach. A supplemental report detailing all work involving low pathogenic avian influenza virus H7N9 (LPAI H7N9) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV).

4. Foreign Contractors/Collaborators and U.S. Institutions with Foreign Subcomponents. Foreign organizations (including direct Contractors, Subcontractors, Grant Recipients, Sub-recipients, and subcomponents or collaborating partners to U.S. Recipients) are subject to the iDURC policy. The Recipient must provide CAPO documentation sufficient to illustrate this compliance. CAPO will evaluate compliance measures for these institutions on a case-by-case basis. The Recipient must not initiate work nor provide funds for the conduct of biological laboratory work under this Award without CAPO's formal written approval.

G. REGULATORY REQUIREMENTS FOR RESEARCH INVOLVING HUMAN SUBJECTS

The Recipient and any Recipient institutions shall conduct all Research Involving Human Subjects in compliance with the requirements set forth in 6 CFR. § 46, Subparts A, and 45 CFR. § 46, Subparts B-D, DHS Directive 026-04, Rev 01, Protection of Human Subjects, and DHS Instruction 026-04-001, Ensuring Human Subjects Research Compliance, prior to initiating any work with human subjects under this Award. Each Recipient and any Recipient institutions planning to perform research involving human subjects under this Award must submit the documentation outlined in this section for CAPO review.

1. Requirements for Research Involving Human Subjects. Each facility conducting work involving human subjects under this Award is required to have a project-specific Certification of Compliance letter issued by the CAPO. Each Recipient must submit the following documentation to the CAPO for compliance review and certification **prior to initiating research involving human subjects under this Award**:

- a. Research protocol, as approved by an Institutional Review Board (IRB), for any human subjects research work to be conducted under this Award;
- b. IRB approval letter or notification of exemption (see additional information below on exemption determinations), for any human subjects research work to be conducted under this Award;
- c. IRB-approved informed consent document(s) (templates) or IRB waiver of informed consent for projects involving human subjects research under this Award; and
- d. Federal-wide Assurance (FWA) number from the HHS Office for Human Research Protections (OHRP), or documentation of other relevant assurance, for all Recipient institutions (including Sub-recipients) involved in human subjects research under this Award.

2. **Exemptions for Research Involving Human Subjects.** Exemption determinations for human subject research to be conducted under this Award should only be made by authorized representatives of (1) an OHRP-registered IRB, or equivalent, or (2) the CAPO. Exemption determinations made by an OHRP-registered IRB, or equivalent, should be submitted to the CAPO for review and record-keeping. Program Officers, principal investigators, research staff, and other DHS or institutional personnel should not independently make exemption determinations in the absence of an IRB or CAPO review. DHS Program Officers (or institutions conducting human subjects' research under this Award) seeking an exemption determination from the CAPO should submit a request to STregulatorycompliance@hq.dhs.gov that includes the following:

- a. Research protocol or detailed description of planned activities to be conducted under this Award.
- b. Identification of the exemption category that applies to the project(s) to be conducted under this Award and explanation of why the proposed research meets the requirements for that category of exemption.

All documentation, as well as any questions or concerns regarding the requirements referenced above, should be submitted to the CAPO at STregulatorycompliance@hq.dhs.gov. The submitted documentation will be retained by the CAPO and used to conduct a regulatory compliance assessment. Additional documentation may be required in some cases to complete this assessment. The Recipient must provide this documentation upon request, and address in writing any compliance issues or concerns raised by the CAPO before a certification letter is issued and participant enrollment can begin under this Award. The CAPO will review all submitted materials and provide written confirmation to the Recipient once all documentation requirements have been met.

The Recipient and any Recipient institution shall submit updated documentation regarding ongoing research involving human subjects, as available and **prior to the expiration of previous approvals**. Such documentation includes protocol modifications, IRB renewals for ongoing research protocols (“Continuing Reviews”), and notifications of study completion.

The Recipient must promptly report the following to the CAPO, along with any corrective actions taken: (1) any serious or continuing noncompliance with human subjects research regulations and policies adopted by DHS (as referenced above); and (2) suspension, termination, or revocation of IRB approval of any human subjects research activities conducted under this Award.

Foreign Contractors/Collaborators and U.S. Institutions with Foreign Subcomponents. Foreign organizations (including direct Contractors, Subcontractors, Grant Recipients, Sub-recipients, and subcomponents or collaborating partners to U.S. Recipients) are subject to all DHS and CAPO requirements for research involving human subjects. All entities involved in activities under this Award must comply with applicable national and regional/local regulations, and standards and guidelines equivalent to those described for U.S. institutions (e.g., 45 CFR. § 46, including all Subparts, as relevant). The CAPO will evaluate compliance measures for these institutions on a case-by-case basis to determine their sufficiency. The Recipient must not initiate nor provide funds for the conduct of work involving human subjects at foreign institutions under this Contract without formal written approval from the CAPO.

H. COMPLIANCE WITH U.S. EXPORT CONTROLS

Activities performed by the Recipient and any Recipient institution under this Award may or may not be subject to U.S. export control regulations. The Recipient and any Recipient institution shall conduct all such activities, to include any and all DHS-funded research and development, acquisitions, and collaborations in full compliance with U.S. export controls—to include the Export Administration Regulations (EAR), the International Traffic in Arms Regulations (ITAR), and the Office of Foreign Assets Control (OFAC) Regulations. The Recipient and any Recipient institution will ensure that all legal requirements for compliance with U.S. export controls are met prior to transferring commodities, technologies, technical data, or other controlled information to a non-U.S. person or entity. Upon DHS request, the Recipient and any Recipient institution must provide to CAPO documentation and any other information necessary to determine satisfaction of this requirement.

All documentation, as well as any questions or concerns regarding export controls, should be submitted to the CAPO at exportcontrols@hq.dhs.gov.

I. CONTROLLED UNCLASSIFIED INFORMATION

The parties understand that information and materials provided pursuant to or resulting from this Award may be export controlled, sensitive, for official use only, or otherwise protected by law, executive order or regulation. The Recipient is responsible for compliance with all applicable laws and regulations. Nothing in this Award shall be construed to permit any disclosure in violation of those restrictions.

J. INTELLECTUAL PROPERTY, PATENT, AND DATA RIGHTS

Patent rights.

The Recipient is subject to applicable regulations governing patents and inventions, including government-wide regulations issued by the Department of Commerce at 37 CFR Part 401, “Rights to Inventions Made by Nonprofit Organizations and Small Business Firms Under Government Grants, Contracts and Cooperative Agreements.” The clause at 37 CFR 401.14 is incorporated by reference herein. All reports of subject inventions made under this Award should be submitted to DHS using the Interagency Edison system website at <http://www.iedison.gov>.

Data rights.

1. General Requirements. The Recipient grants the Government a royalty free, nonexclusive and irrevocable license to reproduce, display, distribute copies, perform, disseminate, or prepare derivative works, and to authorize others to do so, for Government purposes in:

- a. Any data that is first produced under this Award and provided to the Government;
- b. Any data owned by third parties that contributed in the data provided to the Government under this Award; or
- c. Any data requested in paragraph 2 below, if incorporated in the Award.

“Data” means recorded information, regardless of form or the media on which it may be recorded.

2. Additional requirement for this Award.

a. Requirement: If the Government believes that it needs additional research data that was produced under this Award, the Government may request the research data and the Recipient agrees to provide the research data within a reasonable time.

b. Applicability: The requirement in paragraph 2.a of this section applies to any research data that are:

i. Produced under this Award, either as a Recipient or sub-recipient;

ii. Used by the Government in developing an agency action that has the force and effect of law;
and

iii. Published, which occurs either when:

1) The research data is published in a peer-reviewed scientific or technical journal; or

2) DHS publicly and officially cites the research data in support of an agency action that has the force and effect of law

c. Definition of “research data:” For the purposes of this section, “research data:”

i. Means the recorded factual material (excluding physical objects, such as laboratory samples) commonly accepted in the scientific community as necessary to validate research findings.

ii. Excludes:

1) Preliminary analyses;

2) Drafts of scientific papers;

3) Plans for future research;

4) Peer reviews;

5) Communications with colleagues;

6) Trade secrets;

7) Commercial information;

8) Materials necessary that a researcher must hold confidential until they are published, or similar information which is protected under law; and

9) Personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study.

d. Requirements for sub-awards: The Recipient agrees to include in any sub-award made under this Agreement the requirements of this award term (Patent Rights and Data Rights) and **DHS Standard Terms and Conditions award term (Copyright)**.

K. PROGRAM INCOME

Post-award program income:

In the event program income becomes available to the recipient post-award, it is the recipient's responsibility to notify the DHS Grants Officer to explain how that development occurred, as part of their request for guidance and/or approval. The Grants Officer will review approval requests for program income on a case-by-case basis; approval is not automatic. Consistent with the policy and processes outlined in 2 CFR Part 200, pertinent guidance and options, as determined by the type of recipient and circumstances involved, may be approved by the Grant Officer.

If approval is granted, an award modification will be issued with an explanatory note in the remarks section of the face page, concerning guidance and/or options pertaining to the recipient's approved request. All instances of program income shall be listed in the progress and financial reports.

L. PUBLICATIONS.

1. Publications. All publications produced as a result of this funding which are submitted for publication in any magazine, journal, or trade paper shall carry the following:

a. Acknowledgement. "This material is based upon work supported by the U.S. Department of Homeland Security under Grant Award Number 2014-ST-061-ML0002."

b. Disclaimer. "The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security."

Recipient agrees to include in any sub-award made under this Agreement the requirements of this award term (Publications).

2. Use of DHS Seal and DHS S&T Logo.

The Recipient shall not use the DHS seal. The Recipient shall acquire DHS's approval prior to using the DHS S&T logo.

3. Enhancing Public Access to Publications. DHS requires that investigators submit their final, peer-reviewed, pre-publication manuscript upon acceptance for publication, to the DHS Program Officer, to be made publically available no later than 12 months after the official date of publication. Final, peer-reviewed manuscripts should be emailed to the DHS Program Officer in pdf format and will be publically posted to www.hsuniversityprograms.org in a manner consistent with copyright law. DHS Policy explicitly recognizes and upholds the principles of copyright. Authors and journals can continue to assert copyright in publications that include research findings from DHS-funded activities, in accordance with current practice. While individual copyright arrangements can take many forms, DHS encourages investigators to sign agreements that specifically allow the manuscript or software to be deposited with DHS for U.S. Government use after journal publication. Institutions and investigators may wish to develop particular contract terms in consultation with their own legal counsel, as appropriate. But, as an example, the kind of language that an author or institution might add to a copyright agreement includes the following: "Journal (or Software recipient) acknowledges that the Author retains the right to provide a final copy of the final manuscript or software application to DHS upon acceptance for Journal publication or thereafter, for public access purposes through DHS's websites or for public archiving purposes."

M. SITE VISITS

The DHS, through authorized representatives, has the right, at all reasonable times, to make site visits to review project accomplishments and management control systems and to provide such technical assistance as may be required. If any site visit is made by the DHS on the premises of the Recipient, or a contractor under this Award, the Recipient shall provide and shall require its contractors to provide all reasonable facilities and assistance for the safety and convenience of the Government representatives in the performance of their duties. All site visits and evaluations shall be performed in such a manner that will not unduly delay the work.

N. TERMINATION

Either the Recipient or the DHS may terminate this Award by giving written notice to the other party at least thirty (30) calendar days prior to the effective date of the termination. Failure to adhere to the terms and conditions may result in award termination. All notices are to be transmitted to the DHS Grants Officer via registered or certified mail, return receipt requested. The Recipient's authority to incur new costs will be terminated upon arrival of the date of receipt of the letter or the date set forth in the notice. Any costs incurred up to the earlier of the date of the receipt of the notice or the date of termination set forth in the notice will be negotiated for final payment. Closeout of this Award will be commenced and processed pursuant to 2 CFR §200.339.

O. TRAVEL

Travel required in the performance of the duties approved in this Award must comply with 2 CFR Part 200.474.

Foreign travel must be approved by DHS in advance and in writing. Requests for foreign travel identifying the traveler, the purpose, the destination, and the estimated travel costs must be submitted to the DHS Grants Officer sixty (60) days prior to the commencement of travel.

P. GOVERNING PROVISIONS

The following are incorporated into this Award by this reference:

31 CFR 205	Rules and Procedures for Funds Transfers
2 C.F.R. Part 200	Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards
Application	Grant Application and Assurances dated 6/29/2018 as revised, .

Q. ORDER OF PRECEDENCE

1. 2 C.F.R. Part 200, "Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards."
2. The terms and conditions of this Award
3. The Funding Opportunity, DHS-17-061-COE-NC001 , DHS COE Continuation
4. Application and Assurances dated 6/29/2018 ,

ADAC Special Terms and Conditions

By signing this Research Subaward Agreement, subrecipient makes the certifications and assurances specified in the Research Terms and Conditions of the Department of Homeland Security Cooperative Agreement. In addition to the terms and conditions, the following also apply effective as of the fully executed Research Subaward Agreement:

1. Subrecipient must adhere to the Information Protection Plan approved by the Department of Homeland Security.
2. Subrecipient must adhere to the Research Safety Plan approved by the Department of Homeland Security.
3. Expanded authority is extended to the subrecipients; any budget deviations within 5% of total approved budget can be moved between categories is allowed following normal federal regulations and rules; budget is to not exceed the approved budget listed on the cover page. Any budget deviations above 5% require prior approval from the University of Alaska Anchorage and requests need to be routed to the Administrative and PI contacts as listed in Attachment 3a.
4. If approved by the University of Alaska Anchorage and subsequently the Department of Homeland Security, a second-tier subaward agreement may be issued. If a second-tier subaward agreement is issued all terms and conditions of the Department of Homeland Security as well as the following special terms and conditions (#1, 2, 6, 11, and 14) found in this subaward agreement.
5. As requested by the Department of Homeland Security, all requests regarding programmatic and budgetary questions and concerns should be routed to the University of Alaska Anchorage Administrative and PI contacts as listed in Attachment 3a and not directly to the Department of Homeland Security.
6. The Department of Homeland Security expects funds to be expended in the appropriate budgetary period; therefore, requests for no cost extensions will not be granted.
7. While the expectation from the Department of Homeland Security is that all funds will be expended, if carryforward of prior year funding is needed, all requests must be submitted to the University of Alaska Anchorage Administrative and PI contacts as listed in Attachment 3a no later than February 28th prior to subsequent incremental funding.
8. The Department of Homeland Security discourages foreign travel unless the trip is critical to the research. To ensure appropriate approvals, requests for foreign travel must comply with ITAR policies and need to be requested to the University of Alaska Anchorage Administrative and PI as shown in Attachment 3a no later than 90 days prior to the travel.
9. The Department of Homeland Security typically does not allow equipment purchases; however if equipment is necessary please submit a written request to the University of Alaska Anchorage Administrative and PI as shown in Attachment 3a for approval. The University of Alaska Anchorage will seek appropriate approval on your behalf from the Department of Homeland Security.
10. If the research involves Human Subjects or Animals, please submit approved protocols with the executed Research Subaward Agreement.

11. The Department of Homeland Security requires that all publications are reviewed prior to print; therefore, all publications related to this grant are to be submitted 90 days in advance of the publication. Subrecipient grants to the University of Alaska Anchorage an irrevocable, royalty-free, non-transferable, non-exclusive right and license to use, reproduce, make derivative works, display, and perform publicly any copyrights or copyrighted material (including any computer software and its documentation and/or databases) first developed and delivered under this Subaward Agreement solely for the purpose of and only to the extent to meet the obligations to the Federal Government under this award.
12. Subrecipient grants to the University of Alaska Anchorage the right to use data created in the performance of this Subaward Agreement solely for the purpose of and only to the extent required to meet obligations to the Federal Government under its Prime Award.
13. Subrecipient shall report any financial conflict of interest to the University of Alaska Anchorage's Administrative and PI contacts as designated in Attachment 3a. Any financial conflicts of interest identified shall subsequently be reported to the Department of Homeland Security. Such report shall be made before expenditure of funds authorized in this Research Subaward Agreement and within 45 days of any subsequent identified financial conflict of interest.
14. Subrecipient must have a financial conflict of interest policy which by execution of this Subaward Agreement complies with 42 CFR 50. If subrecipient does not have a financial conflict of interest policy that complies with 42 CFR 50 then subrecipient will adhere to the University of Alaska Anchorage Conflict of Interest policy.
15. The parties agree there will be no classified research performed under this Subaward Agreement.
16. Work plans for subsequent funding need to be submitted to the University of Alaska Anchorage no later than January 31st.
17. The University of Alaska Anchorage may issue non-substantive changes to the Period of Performance and Budget bilaterally. Except as expressly set forth in this section, no subsequent amendment, modification or addition to this Subcontract will be binding upon the parties hereto unless reduced to writing and signed by the respective Authorized Official Representatives of each party.
18. Subsequent yearly funding is based on the availability of funds and satisfactory progress as approved by the Department of Homeland Security and the University of Alaska Anchorage. No additional funding is guaranteed.

Reporting Requirements:

Annual Progress Reports. Subrecipient shall submit annual progress reports to the University of Alaska Anchorage Administrative and PI contacts listed in Attachment 3a no later than August 10th of each year of funding. Final Progress report is due no later than thirty (30) days from the end date of the Cooperative Agreement. The Progress report should describe accomplishments and significant research findings derived from the work conducted under this agreement.

Property Reports. If property is acquired under this Agreement and property reports are a requirement of the prime award, Subrecipient shall submit a report of equipment purchased to the University of Alaska Anchorage Administrative and PI contacts listed in Attachment 3a within thirty (30) days of the Cooperative Agreement end date.

Invention Reports. If any inventions or discovery is made in connection with this Agreement, Subrecipient shall submit a report of inventions to the University of Alaska Anchorage PI as listed in Attachment 3a stating the nature of the invention and the names of the inventors within thirty (30) days of the Cooperative Agreement end date.



**ARCTIC DOMAIN
AWARENESS CENTER**
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

Information Protection Plan

Authored by:

George I Kamberov
Associate Vice Provost for Research
University of Alaska Anchorage

Adopted by:

Douglas Causey, PhD, Principal Investigator, University of Alaska Anchorage
Larry Hinzman, PhD, Research Director, University of Alaska Fairbanks
Randy Kee, Maj Gen (Ret) USAF, Executive Director, University of Alaska Anchorage
Heather Paulsen, MBA, Finance Director, University of Alaska Anchorage
LuAnn Piccard, MSE, PMP, Project Management Director, University of Alaska Anchorage
Elyce Hackley, ADAC Associate Director, University of Alaska Anchorage

All research conducted under this Award is intended to have publicly releasable results. No research under this Award should involve, use, or generate sensitive information, which includes export control information or classified information. This plan incorporates policies and procedures that properly define, recognize, and protect such sensitive or classified information.

University of Alaska Anchorage

INFORMATION PROTECTION PLAN

11/20/2014

I. OBJECTIVE:

The objective of the University of Alaska Anchorage in the development and implementation of this information protection program (IPP), is to create effective administrative, policies and procedures that properly define, recognize, and protect sensitive or classified information (SCI), in order to comply with the award DHS CMR Center lead requirements and our obligations under UA and Alaska policies and procedures (the "regulations"). The IPP sets forth our procedure for evaluating and addressing our electronic and physical methods of defining, recognizing, and protecting sensitive or classified information.

For purposes of this IPP, "sensitive or classified information" includes "any information or material that has been determined by the United States Government pursuant to an Executive order, statute, or regulation, to require protection against unauthorized disclosure for reasons of national security and any restricted data, as defined in paragraph r. of section 11 of the Atomic Energy Act of 1954 (42 U.S.C. 2014(y))", and any Personally Identifiable Information (PII), as defined by HIPPA/HITECH, and PCI. In addition, projects may require protection of other data sets for a variety of reasons specific to the project.

However, "sensitive or classified information" shall not include information that is lawfully obtained from publicly available information, or from federal, state, or local government records lawfully made available to the general public.

II. PURPOSE:

The purpose of the IPP is to better: (a) ensure the that sensitive and classified information is properly defined and recognized; (b) protect against any reasonably anticipated threats or hazards to the security or integrity of such information; and (c) protect against unauthorized access to or use of such information.

III. SCOPE:

In formulating and implementing the IPP, University of Alaska Anchorage has addressed and incorporated the following protocols:

- (1) identified reasonably foreseeable internal and external risks to the security, confidentiality, and/or integrity of any electronic, paper or other records containing sensitive or classified information;
- (2) accessed the likelihood and potential damage of these threats, taking into consideration the SCI;
- (3) evaluated the sufficiency of existing policies, procedures, customer information systems, and other safeguards in place to control risks;
- (4) designed and implemented a IPP that puts safeguards in place to minimize those risks, consistent with the requirements the regulations; and
- (5) implemented regular monitoring of the effectiveness of those safeguards.

IV. DATA SECURITY COORDINATOR:

The University of Alaska Anchorage has designated [INSERT EMPLOYEE NAME] to implement, supervise and maintain the IPP. This designated employee (the "Data Security Coordinator") will be responsible for the following:

- a. Implementation of the IPP including all provisions outlined in Section VII: Daily Operational Protocol;
- b. Training of all employees;
- c. Regular testing of the IPP's safeguards;
- d. Evaluating the ability of any of our third party service providers to implement and maintain appropriate security measures for the SCP to which they might have gained access as part of their work with the DHS CMR, and requiring such third party service providers by contract to implement and maintain appropriate security measures;

e. Reviewing the scope of the security measures in the IPP at least annually, or whenever there is a material change in our business practices that may implicate the security or integrity of SCI:

f. Conducting an annual training session for all researchers, students, employees and independent contractors, including temporary and contract employees who have access to personal information on the elements of the IPP. All attendees at such training sessions are required to certify their attendance at the training, and their familiarity with our requirements for ensuring the protection of SCI.

V. INTERNAL RISK MITIGATION POLICIES:

To guard against internal risks to the security, confidentiality, and/or integrity of any electronic, paper or other records containing SCI, and evaluating and improving, where necessary, the effectiveness of the current safeguards for limiting such risks, the following measures are mandatory and are effective immediately:

The DHS CMR research under this Award should not involve, use, or generate sensitive information, which includes export control information or classified information.

Written and electronic records containing accidentally acquired SCI shall be securely destroyed or deleted at the earliest opportunity consistent with legal retention requirements.

A copy of the IPP is to be distributed to each current participant in the DHS CMR projects and to each new participant on the beginning date of their work on the DHS CMR projects. It shall be the participant's responsibility for acknowledging in writing, by signing the attached sheet, that he/she has received a copy of the IPP and will abide by its provisions. Project participants are encouraged and invited to advise the IPP Data Security Coordinator of any activities or operations which appear to pose risks to the security of SCI. If the Data Security Coordinator is involved with these risks, participants are encouraged and invited to advise any other manager or supervisor in the DHS CMR.

A training session for all current employees will be held on [INSERT DATE] to detail the provisions of the IPP.

All employment contracts, where applicable, will be amended to require all employees to comply with the provisions of the IPP and to prohibit any use SCI as defined by the IPP as part of their work with the DHS CMR.

Terminated employees must return all records containing SCI, in any form, in their possession at the time of termination. This includes all data stored on any portable device and any device owned directly by the terminated employee.

A terminated employees' physical and electronic access to records containing SCI shall be restricted at the time of termination. This shall include remote electronic access to SCI, voicemail, internet, and email access. All keys, keycards, access devices, badges, company IDs, business cards, and the like shall be surrendered at the time of termination.

Disciplinary action will be applicable to violations of the IPP, irrespective of whether SCI was actually accessed or used without authorization.

All security measures including the SCI shall be reviewed at least annually beginning July 1, 2015 to ensure that the policies contained in the SCI are adequate meet all applicable federal and state regulations.

Should the DHS CMR practices change in a way that impacts the collection, storage, and/or transportation of records containing SCI the IPP will be reviewed to ensure that all the policies contained in the IPP are adequate meet all applicable federal and state regulations.

The Data Security Coordinator or his/her designee shall be responsible for all review and modifications of the IPP and shall have fully consult and apprise management of all reviews including any recommendations for improves security apprising from the review.

The Data Security Coordinator shall maintain a secured and confidential master list of all lock combinations, passwords, and keys. The list will identify which employee possess keys, keycards, or other access devices and that only approved employee have been provided access credentials.

Current project participants and employees' user ID's and passwords shall conform to accepted security standards. All passwords shall be changed at least annually, more often as needed (e.g. seasonally).

Project participants and employees are required to report suspicious or unauthorized use of SCI to a supervisor or the Data Security Coordinator.

Whenever there is an incident that requires notification pursuant to the procedures established by the UA Computer Incident Response Team (<http://www.alaska.edu/cirt/>), the Data Security Coordinator shall host a mandatory post-incident review of events and actions taken, if any, in order to determine how to alter security practices to better safeguard personal information.

VI. EXTERNAL RISK MITIGATION POLICIES:

Firewall protection, operating system security patches, and all software products shall be reasonably up-to-date and installed on any computer that stores or processes all project information

SCI shall not be removed from the business premises in electronic or written form

All system security software including, anti-virus, anti-malware, and internet security shall be reasonably up-to-date and installed on any computer that stores or processes personal information.

There shall be a secure user authentication protocols in place that:

- a) Control user ID and other identifiers;
- b) Assigns passwords in a manner that conforms to accepted security standards, or applies use of unique identifier technologies;
- c) Control passwords to ensure that password information is secure.

VII. DAILY OPERATIONAL PROTOCOL

This section of our IPP outlines our daily efforts to minimize security risks to any computer system that may inadvertently access, processes or stores SCI. It develops daily employee practices designed to minimize access and security risks to SCI.

The Daily Operational Protocol is effective September 1, 2014 and shall be reviewed and modified as deemed necessary at a meeting of the Data Security Coordinator and personnel responsible and/or authorized for the security SCI. The review meeting shall take place on or before July 1, 2015. Any modifications to the Daily Operational Protocol shall be published in an updated version of the IPP. At the time of publication, a copy of the IPP shall be distributed to all current employees and to new hires on their date of employment.

A. Recordkeeping Protocol:

Within 30 days of the publication of the IPP or any update the Data Security Coordinator or his/her designee shall perform an audit of all relevant DHS CMR UAA records to determine which records may contain SCI, notify UAA legal counsel and the relevant Federal and State agencies for advice how to dispose or

assign to a secured storage location, and to redact, expunge or otherwise eliminate all SCI in a manner consistent with the IPP.

Any SCI stored shall be disposed of when no longer by required the relevant Federal or State agency for investigative purposed or required by law for storage. Disposal methods must be consistent with those prescribed by the IPP.

Paper files containing SCI may be stored only in a locked filing cabinet only if required by the appropriate Federal or State agency for investigative purposes. Only the Data Security Coordinator will be assigned keys to such filing cabinets.

All project participants' employees are prohibited from keeping SCI in their work area.

Paper or electronically stored records SCI shall be disposed of in a manner that complies with UA Standards for disposal of records containing SCI and as follows:

(a) paper documents SCI information shall be either redacted, burned, pulverized or shredded so that SCI cannot practicably be read or reconstructed;

(b) electronic media and other non-paper media containing SCI shall be destroyed or erased so that SCI cannot practicably be read or reconstructed.

Only the Data Security Coordinator is authorized to assist the Federal/State agencies to assess SCI accessed inadvertently by project participants.

Electronic records containing SCI shall not be stored or transported on any portable electronic device, sent or transmitted electronically to any portable device, or sent or transported electronically to any computer, portable or not, without being encrypted.

B. Access Control Protocol:

All DHS CMR UAA computers shall restrict user access to those employees having unauthorized and unique log-in ID assigned by the Data Security Coordinator

All computers that have been inactive for 5 or more minutes shall require log-in

After 5 unsuccessful log-in attempts by any user ID will be blocked from accessing any computer or file stored on any computer until access privileges are reestablished by the Data Security Coordinator or his/her designee

Access to electronically stored records containing SCI shall be electronically limited to those employees having an authorized and unique log-in ID assigned by the Data Security Coordinator

Where practical, all visitors are restricted from areas where files containing SCI are stored. Alternatively, visitors must be escorted or accompanied by an approved employee in any area where files containing SCI are stored

Cleaning personnel (or others on site after normal business hours and not also authorized to have access to personal information) are not to have access to areas where files containing SCI are stored

All computers with an internet connections or any computer that stores SCI must have a reasonably up-to-date version of software providing virus, anti-spyware and anti-malware protection installed and active at all times.

An inventory of all company computers and handhelds authorized for SCI storage is contained in Attachment C: Computer and Handheld Inventory, which shall be made known only to Data Security Coordinator and other managers on a "need to know" basis.

C. Third Party Service Provider Protocol:

Any service provider or individual that receives, stores, maintains, processes, or otherwise is permitted access to any file from the DHS CMR ("Third Party Service Provider"). Examples of Third Party Service Providers include third parties who provide off-site backup storage copies of all our electronic data; paper record copying or storage service providers; contractors or vendors having authorized access to our records.

It shall be the responsibility of the Data Security Coordinator to obtain reasonable confirmation that any Third Party Service Provider is capable of meeting security standards consistent with the IPP and Federal/State requirements.

A list of currently known third party service providers is contained in Attachment
B: Third Party Service Providers

VIII. BREACH OF DATA SECURITY PROTOCOL:

Should any employee know of a security breach at any of our facilities, or that any SCI has been lost or stolen or accessed without authorization, the following protocol is to be followed:

Employees are to notify the Data Security Coordinator or the CMR/COE Executive Director in the event of a known or suspected security breach or unauthorized use of SCI.

The Data Security Coordinator shall be responsible for drafting a security breach notification to be provided to the relevant Federal/Agency, the FBI, the DHS OUP. The security breach notification shall include the following:

- a) A detailed description of the nature and circumstances of the security breach or unauthorized acquisition or use of SCI;
- b) The steps already taken relative to the incident;
- c) Any steps intended to be taken relative to the incident subsequent to the filing of the notification; and
- d) Information regarding whether law enforcement officials are engaged in investigating the incident

Attachment A:

Common Business Records Needs/Associated Retention and Secure Destruction Periods

Record	Time Retained	Destroyed On/Destroyed By

Appendix B:
Third Party Service Providers

Company Name	Contact Information	Services Provided	Contract Date

Attachment C – TO BE KEPT CONFIDENTIAL EXCEPT NEED TO KNOW BASIS:

Computer and Handheld Inventory

<u>Computer Make/Model</u>	<u>Location</u>	<u>Employee Assignment</u>



ARCTIC DOMAIN
AWARENESS CENTER
A DEPARTMENT OF HOMELAND SECURITY CENTER OF EXCELLENCE

*Arctic Domain Awareness Center (ADAC)
A DHS Science and Technology Office of University Programs,
Center for Maritime Research*

ADAC Safety Plan

Originally Authored by: Dr. Helena Wisniewski, 5 Nov 2014
Edited by: ADAC Executive Director and Project Management Director
15 Apr 2016 and 10 Feb 2017

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All research conducted under this Award is intended to have publicly releasable results. No research under this Award should involve, use, or generate sensitive information, which includes export control information or classified information.

COOPERATIVE AGREEMENT NUMBER: 2014-ST-061-ML0002

COOPERATIVE AGREEMENT TITLE: Arctic Domain Awareness Center (ADAC)
DHS Center of Excellence: DHS Science and Technology Office of University Programs
Center for Maritime Research
Document: ADAC Safety Plan

DHS COE in Maritime Research
3211 Providence Drive
Anchorage, AK 99508-4614

November 5, 2014

Updated: April 15, 2016

Updated: February 10, 2017

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Background Information

Contractor Name

University of Alaska Anchorage

Award number

2014-ST-061-ML0002

Project Name

Arctic Domain Awareness Center (ADAC). A DHS Center of Excellence: DHS Science and Technology Office of University Programs Center for Maritime Research

Description of Work to be Performed

The planned work as detailed in this document addresses the DHS mission as detailed in the National Strategy for Maritime Security, in particular, the mission to Maximize Domain Awareness (pages 16 and 17.) This COE will produce systems to aid in accomplishing two of the objectives of this mission. They are

1) Sensor Technology developing sensor packages for airborne, underwater, shore-based, and offshore platforms and 2) Automated fusion and real-time simulation and modeling systems for decision support and planning. An integral part of our efforts will be to develop new methods for sharing of data between platforms, sensors, people, and communities.

Statement of Safety and Health Policy

University of Alaska Board of Regents' Policy on Risk Management and Environmental Health and Safety

PART V – FINANCE AND BUSINESS MANAGEMENT Chapter 05.09 - Risk Management and Environmental Health and Safety

P05.09.010. Introduction and Purpose.

A. Although all risks and exposures cannot be foreseen or eliminated, through this policy the ADAC leadership team seeks to establish a framework across the ADAC Research Network, in coordination with ADAC's Grant Administration at the University of Alaska Anchorage within which the university administration can effectively and efficiently establish and maintain a risk management and environmental health and safety program.

B. ADAC leadership establish the following **"safety strategic approach"** for all research associated across the Center's network of researchers:

- ADAC conducts risk management from a **"Go-No-go"** vantage, and in simplest terms urges all members to exercise a **"Red-Yellow-Green"** (Stop, Caution and Go) approach for any activity that can potentially cause injury to people or damage to property.
- Due to the need to maintain a very low risk environment, **ADAC does not wish any function or activity of the center to proceed at any color other than "Green."**
- As comprehensively as possible, ADAC charges Project and Team Leads conducting activities in a laboratory or in the field, to assess conditions prior to initiating actions each and every time.
- Prior to start of laboratory or in the field work, Team Leads, will challenge themselves and the people conducting activity that needed:
 - Understanding of task to be accomplished is discussed and clear to all members associated with the activity.
 - Personnel wellness factors are assessed and acceptable (i.e., proper prior rest, lack of illness, proper nutrition, mobility, etc.).
 - Personal protection gear is serviceable and in-place for all members
 - Proper training in using any laboratory or field equipment is conducted by skilled and competent personnel, to ensure unskilled personnel achieve needed competency prior to use. Personnel who are learning to operate the equipment, must demonstrate acceptable use parameters prior to unsupervised operations.
 - Ensuring laboratory and field equipment is properly serviced and functioning according to standards associated with equipment manuals.
 - Suitable standoff distances are established for non-participants
 - Emergency and first-aid kits are serviceable and at the ready.

- If any factor (personal wellness, competency for the task, equipment issues, inappropriate weather, etc.) is not “in the green” (i.e. Yellow or Red condition) then ADAC research and associated team members will stop...as a “no-go,” without fail. This includes stepping away from completing a task, once underway, if a factor that started “Green” transitions to Yellow or Red, then “no-go”/activity stop procedures must commence.
- **“Knock-it off.”** If any member associated with laboratory or field work observes or believes any activity has entered an unsafe condition, that member is charged with announcing “knock-it-off” to everyone in the vicinity of the activity. Upon hearing a “knock-it-off” announcement, all ADAC personnel associated with the activity will stop work, safely place shut-down and place the equipment in a resting state, step away, and meet with the entire team to address the concern. If conditions can be resolved to a “Green” level of risk, then activity can safely recommence. If any condition remains in “Yellow or Red” then activity will remain “No-Go” until resolved.

C. The risk management and environmental health and safety program shall include general, occupational, and environmental health and safety, environmental protection, general risk management, loss prevention, insurance, and claims administration. The RM/EHS program will be established and maintained under an enterprise-wide philosophy, whereby safety and risk control are incorporated into all facets of the organization and its programs; i.e. Enterprise Risk Management. The president is charged with the responsibility to provide for and require sound and proactive business, operations, and program practices in order to safeguard human, property, financial, and other resources of the university. The goal of the RM/EHS program will be to facilitate the accomplishment of the university’s primary missions of instruction, research, and public service at a reasonable cost with minimal disruptions and adverse events.

P05.09.090. Definitions.

In this chapter:

- A. “RM/EHS” means risk management and environmental health and safety; and
- B. “SWORM” means statewide office of risk management.

Responsibilities and Lines of Authorities

Employer's ultimate responsibility for Safety and corporate and project level

The University of Alaska Anchorage, including the project managers and site directors, take ultimate responsibility for implementing the health and safety program on this project. All project personnel are responsible for reporting hazards and preventing accidents. Everybody associated with the fieldwork plays a role in ensuring a safe and healthy work environment. The specific roles and responsibilities are described below.

Identification and accountability of personnel responsible for safety at both corporate and project level.

ADAC Leadership as described below are responsible for the overall execution of ADAC's Safety Plan. The ADAC leadership team will work to ensure safety prevention and response measures as described in this plan are appropriately executed.

Principal Investigator (PI), Douglas Causey, PhD, University of Alaska. The ADAC PI is responsible to guide the Executive Director and the Research Director to achieve ADAC mission goals. ADAC PI will seek to connect ADAC with partners and opportunities. The ADAC PI is responsible to report to the University of Alaska System Leadership and DHS program sponsors on a regular basis. Ultimately, the ADAC PI is responsible for program execution and accomplishment to DHS.

Executive Director (ED), Randy Kee, Maj Gen, USAF (Ret), University of Alaska. The ADAC ED provides day-to-day direction of all Center activities and ensure COE goals are met, milestones achieved, technology development is proceeding, and the end users are appropriately satisfied with the results. The ED will organize site visits for demonstrations, interface with the end users, and will work with ADAC leadership to ensure the Center is in compliance with federal regulations and reporting. In concert with the ADAC PI, the ED will regularly meet with DHS staff at DHS headquarters and represent the program at meetings required to support the needs of DHS management and the greater DHS enterprise. The ADAC ED will work closely with U.S. Coast Guard (USCG) stakeholders, to include USCG District 17 and the USCG Research and Development Center (RDC) to ensure that the USCG expectations of the center are being met. Finally, the ED will ensure ADAC internal processes, in particular assessment meetings, engagement forums and DHS sponsored workshops, are appropriately conducted.

Research Director (RD), Larry Hinzman, PhD, University of Alaska, Fairbanks. The ADAC RD provides leadership for the center in establishing research concepts and follow-on proposals. The RD also provides leadership to support research theme leads, and individual project leaders and researchers. ADAC's RD is responsible to address and guide scientific quality for the individual projects and the overall program. The ADAC RD where appropriate, will interact with DHS and stakeholders and will interface with other DHS COEs and research centers to identify and formulate additional research projects. The ADAC RD will be a key leader for the Center to identify when research projects are ready to transition to the next TRL and suitable for transition from research to

development.

Finance Director, (FD), Heather Paulsen, MBA, University of Alaska, Anchorage. The ADAC FD is responsible for management and oversight of administrative operations of the Center of Excellence (COE) and group of associated subcontracts. The ADAC FD will provide program/project planning, budgeting, and implement operational policies and processes to support the COE. Further, the FD will work in close collaboration with the ED and the Project Management Director to develop budgets aligned to program and project planning objectives and to manage expenditures as aligned with the research mission of the Center.

Education Outreach and Workforce Development Director (EO&WFDD), Clarice Conley, MFA, CRA, University of Alaska, Anchorage. The new EO&WF Director will work in partnership with the ADAC ED in creating an “ADAC Fellows program” from DHS Career Development Grant Scholarships, and student research interns, (including students from under-represented classifications) connected with the ADAC Research Network. This reconstituted position proposes to advance education outreach and workforce development by further developing the ADAC Fellows Program and managing outreach to ADAC connected Minority Serving Institutions (MSI), or which have Federal Tribal Designation (FTD) or have Significant Minority Enrollment (SME). Accordingly, the EO&WFDD will manage under-represented student recruitment at MSI, FTD and SME to connect with ADAC programs. The EO&WFDD will lead developmental mentoring and professional networking among all ADAC Fellows, including CDG Scholarship students and student research interns. Lastly, the EO&WFDD serves to collaborate with the ADAC’s Administration and Communications Officer to develop the communications and information plans and actions for the center.

Project Management Director (PMD), LuAnn Piccard, MSE, PMP, University of Alaska, Anchorage. In partnership with ADAC ED, Finance Director and Project PIs, PMD will lead effort to integrate project plans into a cohesive program with phased solution and technology deliverables aligned with ADAC strategic mission and outlined in ADAC research-to- development process. This includes managing document progress of projects relative to established ADAC program execution. The Center PMD efforts include coordinating and documenting regular team meetings and facilitate project communication within the Center team and with partners and external stakeholders.

Malla Kukkonen, MS, University of Alaska, Anchorage. In collaboration with the ADAC EO&WFDD, ADAC’s Administration and Communications Officer works with the leadership team to conduct needed administration functions of the center as well as primary responsibility for strategic messaging, via communications, information plans and associated actions. This will include ensuring that ADAC on-line materials remain current and focused on providing relevant communications of center activities and preparing Fact Sheets. These include highlighting research success stories of ADAC Fellows, as well as supporting quarterly newsletters to the ADAC community of interest.

Through coordination, and consistent with ADAC's leadership and management plan, ADAC leadership team will ensure:

- Procure permits and other documents required to conduct the work are in place
- Ensure the project is in compliance with state and federal laws as they relate to cultural resources
- Ensure there are an adequate number of competent people to conduct the work
- Provide CMR researchers, and their teams (including students, contractors, and consultants) with the appropriate training, education, equipment, and materials to conduct the work
- Ensure that CMR researchers and their teams and program managers performing field work:
 - Have safe and adequate housing and food given the field conditions
 - Comply with the policies and procedures required to work within the areas selected for the field work
- Monitor all field work as it is conducted
- Ensure the necessary field reports are completed and ensure that all project- required reports are completed and meet project deadlines.
- Ensure that the research members are documenting their activities adequately.
- Ensure that standards and documentation are maintained as described in the research design.
- Ensure the crew comply with the policies and procedures required to work within the various university, state or federal Training Areas.
- Appropriately review protocols for the site safety and health officer for the field crew and ensure that safety protocols, and basic safety standards are observed. When necessary, they will conduct safety briefings.
- When necessary they have the authority to stop work when conditions warrant.

Project researchers and research teams' members

They will:

- Follow the instructions of the TPIs in work related matters, record field observations as directed, and participate in training and education as required
- Turn over field notes, records, photographs generated during the field project (this does not include private diaries or journals and personal photographs)
- Return project equipment and supplies at the end of the field season
- Stop work and contact ADAC leadership if they feel their work, or the work of a co-worker is unsafe, or poses an unreasonable risk of injury
- Contact the ADAC leadership if they feel they or their co-workers are being subject to gender-based and sexual misconduct by other crew members, or by supervisors.
- Participate in safety meetings and trainings.

Competent Persons

This project does not require Competent and/or Qualified Persons to meet specific OSHA Competent/Qualified Person requirements. The Principal Investigator, Dr. Helena Wisniewski, is responsible for identifying health and safety related issues.

Designated Competent Person Oversight

No work requiring oversight from specially trained health and safety professionals will be conducted and there is no requirement for a designated competent person on the job site. Should these tasks become necessary, then this Accident Prevention Plan and Site Safety and Health Plan will be amended to include the names and qualifications of individuals who are competent to provide health and safety oversight for these tasks.

Pre-Task Safety and Health Analysis

Before the fieldwork start, site hazards will be reviewed and corrective measures discussed with the field crew. Any deficiencies noted during the initial review will be addressed before work begins.

Lines of Authority

ADAC Research Project Leads will report to the ADAC Principal Investigator and Executive Director, who will collaborate with the remaining ADAC Leadership Team for onward reporting to UAA and DHS S&T OUP Leadership.

Non-Compliance with Safety requirements

All researchers and research teams' members are expected to comply with safety and health requirements. The first identification of a problem will result in a discussion of the problem and how it can be corrected with the individual or individuals involved. A record of the discussion and suggested solutions will be recorded in the field notebook by the field director. If the individual(s) do not correct the problem, the worker will be removed from the project area. Non-compliance is subject to immediate dismissal from the project.

Management Accountability

The Principal Investigator will evaluate all incidents occurring on the project and the adequacy of the approach to managing field safety and health risks. The Principal Investigator and the TPIs are accountable for field safety and will participate in safety meetings at the job site, and offer insights on lessons learned during the project, and suggestions for better approaches for correcting deficiencies.

Subcontractors and Supplies

Safety Responsibilities of Subcontractors

Subcontractors will be responsible for ensuring their work is conducted in a safe manner in accordance with the other field workers' responsibilities and safety requirements. They will be expected to participate in safety briefings and trainings and they must report unsafe or hazardous conditions to the TPIs or to the Principal Investigator. Problems with compliance will be reported to

their supervisor for resolution.

TRAINING REQUIREMENTS

New Hire Safety and Health Orientation training

All researchers and research teams' members will receive pre-field and on-site training before being allowed to conduct field work that will cover the following topics:

- Content of the Accident Prevention Plan and the Site Safety and Health Plan
- Site hazards including physical and environmental, and the means to reduce or eliminate hazards
- Emergency response procedures
- Blood-borne pathogen briefing
- Supervisor and crew member responsibilities for reporting all accidents, and procedures for reporting accidents, unsafe conditions, or unsafe practices
- General health and safety procedures

Mandatory Training and Certifications Applicable to this Project

Mandatory tail-gate safety trainings covering environmental and physical risks will be conducted at the beginning of the project. The greatest risks are trips, slips, and falls, and environmental hazards. The TPIs and research teams' leads will have current first aid/CPR/blood borne pathogen training. Persons trained in first aid and CPR will have training as required in 29 CFR 1910.1030.

No other training is required, but additional safety insights to quantify and mitigate safety risk is encouraged.

Procedures for periodic safety and health training for supervisors and employees

First aid training will be renewed every three years and CPR training will be renewed every two years. All field crew members will receive pre-field and on-site training before field work begins. Training will be repeated as needed, or if deficiencies are noted and need to be corrected during tail-gate safety trainings.

Requirements for emergency response training

Employee emergency response training will consist of

- Employee alarm system, including radio protocols and emergency contacts
- Evacuation procedures, routes, and meeting places
- First aid, CPR, Blood borne pathogens, particularly for the appointed research teams leads for each project/task involving field work.

SAFETY AND HEALTH INSPECTIONS

Responsibilities for Job Safety and Health Inspection

The Principal Investigator or TPIs will conduct informal daily inspections of the job site for field work. The results will be reported in the field notes for the project. Monthly inspections will be performed for field projects that last no more than 6 weeks. Deficiencies will be corrected as described in 4g and recorded in the TPIs field notebooks.

6b. External Inspections/Certifications that may be Required

No external inspections of the jobsite are required, nor are they anticipated.

ACCIDENT REPORTING

Exposure data (labor-hours worked);

The University of Alaska Anchorage documents their recordable rates at the end of each fiscal year. Copies of the recordable rates can be made available to the DHS S&T OUP, upon request.

Accident investigations, reports, and logs

When an incident occurs, the Project Lead/Principal Investigator or TPI will perform an initial accident investigation that will be documented as a report. Corrective actions will be specified and implemented to prevent similar incidents from occurring. The DHS S&T OUP will be notified immediately by telephone of any serious mishaps that occur during the field work, and will be sent a Contractor Significant Incident Report within 24 hours of the event by e-mail or fax. A serious mishap is an injury resulting in the death of a field crew member, permanent total or partial disability, three or more worker hospitalizations, property damage greater than \$200,000. All reportable injuries resulting in a fatality, or three or more hospitalizations, will result in the appropriate federal or state OSHA agencies being notified within 8 hours of the accident.

Reportable injuries, near miss incidents, high loss potential incidents, property damage incidents greater than \$5,000, First Aid cases, will be reported to the University of Alaska Anchorage Risk Management and Environmental Health and Safety program as an incident report within 48 hours of the incident.

PLANS (PROGRAMS, PROCEDURES) REQUIRED BY THE SAFETY MANUAL

The following list of plans is provided in Appendix A of EM 385-1-1 as a guide. Those plans applicable to this project are included in the Accident Prevention Plan. Those plans that do not apply are labeled N/A or Not Applicable.

Listing of Plans

- A. Site Layout Plans: N/A
- B. Emergency response
 - a. Procedures and tests: See Section B below
 - b. Spill plans: N/A
 - c. Firefighting plan: N/A
 - d. Posting of emergency telephone numbers: See Section B below
 - e. Man overboard/abandon ship: N/A
 - f. Medical Support: See Section B below
- C. Plan for prevention of alcohol and drug abuse: See Section C below
- D. Site sanitation plan: See Section D below
- E. Access and haul road plan: N/A
- F. Respiratory protection plan: N/A
- G. Health hazard control program: N/A
- H. Hazard communication program: N/A
- I. Process Safety Management Plan: N/A
- J. Lead Abatement plan: N/A
- K. Asbestos abatement plan: N/A
- L. Radiation Safety Program: N/A
- M. Abrasive blasting: N/A
- N. Heat/Cold Stress Monitoring Plan: See Section N below
- O. Crystalline Silica Monitoring Plan: N/A
- P. Night operations lighting plan: N/A
- Q. Fire Prevention Plan: N/A
- R. Wild Land Fire Management Plan: N/A
- S. Hazardous energy control plan: N/A
- T. Critical lift Plan: N/A
- U. Contingency plan for severe weather: See Section U below
- V. Float Plan: N/A
- W. Site-Specific Fall Protection & Prevention Plan: N/A
- X. Demolition plan: N/A
- Y. Excavation/trenching plan: N/A

- Z. Emergency rescue: N/A
- AA. Underground construction fire prevention and protection plan: N/A
- BB. Compressed air plan: N/A
- CC. Formwork and shoring erection and removal plans: N/A
- DD. PreCast Concrete Plan: N/A
- EE. Lift slab plans: N/A
- FF. Steel erection plan: N/A
- GG. Site Safety and Health Plan for HTRW work: N/A
- HH. Blasting Safety Plan: N/A
- II. Diving plan: N/A
- JJ. Confined space Program: N/A

Section B: Emergency Response Procedures

Field work and the work specified by the scope of work provide the opportunity for a medical emergency. The Emergency Response Plan included in this section, and the map to the emergency medical facility will be kept at the work site and in the vehicles at all times. During the initial safety tailgate meeting, repeated as needed, the team will review the emergency route to the clinic from that day's work site.

The Emergency Response Plan will also be provided to each crew member during the New Hire Safety and Health Orientation training before field work begins. The Emergency Response Plan will be modified as needed.

For each project and where appropriate specific project task medical care will be sought at the nearest medical center. The local Fire Department is responsible for emergency medical services, search and rescue, and responding to hazardous materials releases.

Emergency Contact Numbers (Table B-1)

Table B-1 Emergency Response Contact Numbers

Organization/Agency/Individual	Telephone Number
Anchorage Fire Department	(907) 267-4936
Emergency Police/Fire/Ambulance	911
Gambell Volunteer Fire Department	(907) 985-5042
Gambell Police – non Emergency telephone	(907) 985-5333
National Poison Control Hotline	(800) 222-1222
USCG District 17 Emergency Contact number	(907) 463-2367
ADAC Principal Investigator	(907) 786-1310
ADAC Research Director	(907) 474-6000
ADAC Executive Director	(907) 786-0708
ADAC Finance Director	(907) 786-1663
ADAC Education and Workforce Director	(907) 786-0425

ADAC Administration and Communications Officer	(907) 786-7279
Director UAA Risk Management and Environmental Health and Safety	(907) 786-1335

Site Emergency Coordinator

The Site Emergency Coordinator role is the responsibility of the appointed team lead for each project/task performing work in the field. They are responsible for evacuations, emergency treatment, emergency transport of the field crew, and notifying emergency response units, the Director and the Principal Investigator at the CMR/COE at UAA.

The Site Emergency Coordinator will inspect First Aid equipment and supplies before fieldwork begins. Emergency equipment will be stored in each site vehicle, and will carry individual first aid supplies during the fieldwork.

Should an incident described below occur, any member of the field crew may halt field-work. The Site Emergency Coordinator may order the evacuation of the site and notify emergency services as appropriate. Communication of evacuation routes, assembly points, and hospital routes will be discussed during the tailgate safety briefing. Emergency telephone numbers and maps to the hospital will be kept in the vehicle.

In the event of an evacuation, the crew will evacuate to a predetermined assembly area and remain there until everybody is accounted for and the Field Director provides further instructions.

Fires and Explosion

In the event of a fire or explosion the Site emergency coordinator will:

- Determine the extent of the fire,
- Attempt to suppress the fire only if the fire is in the initial stage and if it is safe to do so
- Coordinate the evacuation of injured and non-essential personnel from the site
- Notify local fire and medical services if appropriate
- Provide emergency first aid if required.
- Assist emergency response personnel when requested
- No person will fight a fire beyond the stage where it can be put out with a portable extinguisher

Personal Injury

In the event of a serious personal injury (fatality, patient is unconscious, possible broken bones, severe bleeding, burns, blood loss, shock or trauma), the first responder will immediately

- Administer first aid if qualified, or seek out a person qualified to administer first aid
- Notify the Site Emergency Coordinator of the name of the individual, their location, and the nature of the injury.

On notification of an injury, the Site Emergency Coordinator shall immediately

- Assist the injured person as appropriate

- Notify emergency response (911) and give the appropriate patient information and their location to responding medical personnel
- Designate someone to accompany the injured party to the hospital
- Notify the Director and the Principal Investigator at CMR/COE at UAA.
- Complete the UAA Incident Report and Investigation form

In case of extreme emergency, personnel may require airlift support from the site. Airlifting activities are coordinate through the medical center specified in the field project plan for each specific field project.

Earthquakes or Volcanic Activity

In the event of a strong earthquake,

- If indoors, drop down to the floor. Take cover under a desk, table or other furniture and hold onto it. Hold the position until the ground stops shaking and it is safe to move. Stay clear of windows and heavy furniture, or items that may fall. Stay inside to avoid being injured by falling glass or building parts. Do not stand in a doorway because this is no longer the strongest part in modern buildings.
- If outdoors, stay away from buildings or power lines
- If driving, pull to the side and stop, but stay inside the vehicle. Avoid stopping under light posts, power lines, or signs. Do not stop on bridges.
- If in a mountainous area, near unstable slopes of cliffs, be alert for falling rock, slides or other loosened debris.

Eruptions leading to ash fallout and earthquakes are possible. If there is ash fallout, the Site Emergency Coordinator may choose to halt outdoor activities. In the event of an eruption, the Site Emergency Coordinator will assemble all personnel and evacuate the worksite until the risk can be assessed.

Section C: Drug and Alcohol Abuse Prevention Plan

University of Alaska Board of Regents' Policy and Regulations, P04.02.040 and P04.02.050, and R04.02.040 and R04.02.050, provide for a University Drug-Free Workplace; and Employee Alcohol and Controlled Substance Testing for certain, defined safety sensitive employees.

P04.02.040. Drug-Free Workplace.

1. The unlawful manufacture, distribution, dispensing, possession, or use by an employee of a controlled substance as defined in Schedules I through V of Section 202 of the Controlled Substances Act (21 USC 812), and as further defined by regulation at 21 C.F.R. 1308.11 - 1308.15 is prohibited in any workplace of the university.
2. All employees will abide by the terms of this policy as a condition of their employment and will notify the university of any criminal drug statute conviction for a violation occurring in the workplace

no later than 5 working days after the conviction. Within 30 days of receiving the notice of conviction, the university will take appropriate personnel action against the employee as prescribed by university regulation, up to and including termination, or require the employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement, or other appropriate agency.

3. The university regulation implementing this section must provide for publishing a statement to notify employees of this policy and to establish a drug-free awareness program to inform employees about: the dangers of drug abuse in the workplace; the university's policy of maintaining a drug-free workplace; any available drug counseling, rehabilitation, and employee assistance programs and the penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

4. Each employee will be provided a copy of this policy and accompanying university regulation.

(06-20-97)

P04.02.050. Employee Alcohol and Controlled Substances Testing.

1. The university regulation implementing P04.02.040 and this section will at a minimum provide for the establishment of alcohol and controlled substances testing programs as required by law; the imposition of penalties on employees when tests exceed allowable levels; compliance with reporting and record keeping requirements; dissemination to affected employees of educational materials explaining the legal requirements, this policy and university regulation; and provide for appropriate staff training and employee assistance programs. Collective bargaining units representing affected university employees will be given written notice concerning the availability of this information.

2. All employees subject to laws mandating alcohol and controlled substances testing will comply with such laws, this regents' policy and university regulation as a condition of their employment.

Should the Site Emergency Coordinator have reasonable suspicion (i.e. observation of use or possession or physical symptoms of being under the influence of drugs or alcohol during work hours) that project personnel are in possession, or under the influence, of alcohol or controlled substances, they will take the following actions:

- Immediately stop the work being conducted by the suspected individual
- Question the suspected individual as to whether they are in possession of and/or under the influence of alcohol, controlled substances, or other medications
- Immediately notify the Principal Investigator and the Director of details of the situation
- Do not resume work until notification is made to the Principal Investigator and the Director.
- If in the judgment of the Site Emergency Coordinator, the situation poses a significant or imminent risk of property damage and/or injury to the suspected individual or other project members at the site, the Site Emergency Coordinator will dial emergency 911 and request assistance.
- Follow-up actions after the situation is under control including providing the Principal Investigator and the Director with written details of the situation.

Section D: Site Sanitation Plan

The researchers and their teams performing field work will use existing sanitation facilities at the field work site or conform to the standard operation procedures of the specific field work site.

Section N: Cold Stress Monitoring Plan

Symptoms of Cold Stress and Hypothermia will be discussed during each Tail-gate safety meeting and the field crew will monitor each other for symptoms. If Heat/Cold Stress symptoms are observed, the field crew will follow the treatment procedures described below. Hypothermia can affect people at temperatures of 60°F.

Hypothermia

Hypothermia can occur even when temperatures are not particularly cold during prolonged heat loss, or from being chilled in wet clothing, or some medical conditions as diabetes or hypothyroidism may make someone more susceptible to hypothermia.

- Symptoms of mild hypothermia likely to be observed in the field are shivering, dizziness, nausea, numbness in the extremities, confusion, trouble speaking, uncoordinated and increased heart rate.
- Symptoms of moderate and severe hypothermia are shivering and in extreme cases the shivering stops, slurred speech, poor decision making, removing clothing, drowsiness, weak pulse, and slow shallow breathing.
- Severely hypothermic individuals will have dilated pupils and may be unconscious.

Treatment

For mild hypothermia:

- Provide more layers of clothing,
- If the clothing is wet, remove it and provide dry clothing
- Increase physical activity
- Move to a sheltered area
- Give them warm liquids
- Give them something to eat and drink

For severe cases

- Warm the trunk area first not the extremities. If you are using hot packs (“Hot hands”) wrap them in cloth and do not apply them directly to the skin. Do not immerse them in warm water – it may cause heart arrhythmia. Slowly warm the individual. Apply body to body contact in a

sleeping bag.

- If the heart has stopped, administer CPR at half the normal rate. It is unnecessary if there is a faint pulse and they are taking an occasional breath.

Avoiding Hypothermia

- Stay well hydrated – you are less likely to become hypothermic if you are not dehydrated
- Wear layers of clothing that you can add or remove depending on your physical activity. A windproof outer layer is particularly important
- Eat regularly.

Section R: Wild Land Fire Management Plan

The ADAC CMR/COE researches and teams performing field work will follow the specific Wildfire Standard Operating Procedure appropriate for the field work site. Field crew members will use electric lights and cook on a camp stove within an approved camping area.

Section U: Contingency plan for severe weather

In the event of severe weather, the appointed team lead (TL) will cancel work. High temperatures are the greatest problem in the summer, with associated heat stress. In the winter, snow and cold temperatures may create conditions that lead to hypothermia. When there is severe or inclement weather, the TL will determine whether the health and the safety of the crew will be adversely affected by the conditions.

RISK MANAGEMENT PROCESSES

Cold weather hazards

1. Layer clothing
2. Cover exposed skin
3. Keep moving
4. Drink fluids
5. Avoid alcoholic beverages
6. Use blankets and portable seat/cushion
7. Know the signs of frostbite
8. Know the signs of hypothermia
9. Winter driving safety
 - i. Have vehicle survival gear
 - ii. Warm-up vehicle, clear off all ice and snow
 - iii. Wear your seatbelt
 - iv. Ensure someone knows your travel plans

Slips, Trips, and Falls

The most likely source for injuries are slips, trips, and falls that can be caused by ice, missteps, loose items on the ground surface, protruding objects. To prevent these injuries

1. Be aware of your footing
2. Observe obstacles
3. Remove tripping hazards in frequently traveled areas
4. Wear appropriate footwear for each season. Consider traction devices
5. When walking on slippery surfaces
 - a. Don't take large steps, shuffle your feet
 - b. Keep arms close to the body
 - c. If carrying something, carry in front at waist height, close to the body
6. Be cautious when getting in and out of vehicles:
 - a. Never jump out of, or down from, your vehicle.
 - b. Be sure you have good footing as you exit the vehicle

Wildlife hazards

1. Avoid areas with known wildlife; take alternative routes
2. Warn others as you leave the area where wildlife is present
3. Moose safety
 - a. Recognize signs of an aggressive moose: The moose stops eating and stares at you. The moose lays its ears back and raises the hair on its hump. The moose licks its lips or clicks its teeth. The moose lowers its head and walks towards you.
 - b. Observe moose only from a safe distance
 - c. If attacked by moose: Run and place a strong barrier between you and the moose. If you get knocked to the ground, curl up in the fetal position. Protect your head with your arms.
Do not move until the moose is a safe distance from you. Use any means you can to protect yourself from an aggressive moose.

Bear safety

- i. To avoid dangerous situations in bear country:
 1. Make your presence known while you are traveling by creating noise and traveling in groups.
 2. Avoid traveling through thick brush with restricted visibility. If you have to hike through brush, keep the wind at your back so your scent will carry ahead of you.
 3. Avoid, and never get between, a bear and her cubs.
 4. Don't camp near a salmon stream or near a trail that might be used by bears.
 5. Avoid a bear's food cache. Take a detour if you see or smell carcasses or see scavengers.
 6. Don't leave food or dirty dishes lie around your campsite. Cook and store all food at least 100 feet away and downwind from camp.
 7. Avoid bringing along smelly foods.
 8. If you don't have a bear-resistant food container, hang food out of reach of bears, if possible. Try to get food up 30 feet as bears can launch themselves vertically a significant distance.
 1. Your campsite should be in an open area visible to wildlife.

2. Don't sleep in clothes with food or food smells on them.
 3. Keep food, cooking equipment, lotions, cosmetics, and garbage out of your tent
 4. Burn garbage completely and pack out the remains
- ii. When you find yourself too close to a bear, do the following.
 1. Make noise and wave your arms to let it know you are a human. If the bear stands on hind legs and swings its head back and forth, that's to find out what you are. Bears may make a "whoosh" or "woof" sound as they turn to run - that's okay.
 2. Face the bear with your body. You want to look as large as possible as this may persuade the bear to run away. If you have a jacket on, keep your arms in the sleeves but bring the jacket (unzipped) up around behind your body with your hands raised above your head (like a kid flying) to create an even larger appearance.
 3. Bears may make a series of woofs, pop their teeth together, or both. That's not okay and is an indication of aggressiveness.
 4. Don't imitate the bear's sounds or positions.
 5. Don't turn and run from a bear; that may invite pursuit.
 6. If a bear actually gets very close or gets hold of you, lie still in the fetal position.
 7. Protect your head as much as possible, and don't move; play dead. This technique has been reported to be somewhat successful for brown bear encounters. However, it has not been reported as being very effective for aggressive black bears.
 8. If a bear is stalking you, is approaching your campsite, or an attack is continuing long after you have ceased struggling, fight back! Predatory bears are often young bears that can be successfully intimidated or chased away. Use a stick, rocks, your hands, teeth and feet to fight back.
 9. Attacks at night are a hunting behavior, fight for your life immediately if attacked at night.
 10. Other large animals: large animals will attack to protect themselves or their young, to defend their mates, or even to guard a food supply. Stay away from large animals and do not give them a reason to attack you. Do not make sudden moves either toward or away from them, as this may be interpreted as aggressive or territorial.

Exertion

The TL will establish a work/rest regimen appropriate for the project site conditions. Members of the research teams are to adhere to this regimen to prevent health issues from over exertion.

Poisonous Insects

Persons with allergies to insect stings or spider bites are at risk of anaphylactic shock. Individuals that are allergic to insects must:

- Keep their prescribed medication with them at all times
- Advise the TL and trusted individuals of the allergy and the location of the medicine.

To treat minor stings apply a cold pack to the area and apply lotions such as calamine lotion. For severe reactions to stings or bites:

- Use an EpiPen or similar medication immediately
- Give artificial respiration if breathing stops
- Apply a loosely constricting band above the sting site between sting site and the heart. Remove the band after 30 minutes
- Keep the area with the sting below the level of the heart
- Apply ice wrapped in a towel, plastic bag, or clod cloths to the bite or sting
- If it is a bee sting, removing the “stinger” with its venom sac using a credit card to scrape it away. Do not use your fingers.

Appendix

University of Alaska Incident Report

System Office of Risk Services

Anchorage – (907) 786-1140
Fairbanks- (907) 450-8150

University of Alaska Anchorage

(907) 786-1351



UNIVERSITY
of ALASKA
Many Traditions One Alaska

University of Alaska Fairbanks

(907) 474-5413 phone
(907) 474-5489 fax

University of Alaska Southeast

(907) 796-6077

INCIDENT REPORT

Print and complete this form to report an incident resulting in potential bodily injury, property damage, and/or loss or theft of University property. **Send the completed form within 48 hours of the incident to Campus Risk Services either by Email, facsimile, Campus or U.S. Mail.** Do NOT use this form to report auto or employee injury related incidents. Please contact your campus Risk Services representative if you have questions.

Name (Last) _____ (First) _____ (MI) _____

Address _____

City _____ State _____ Zip Code _____

Status: ☐ Employee / If employee, please identify department: _____

☐ Student ☐ Visitor ☐ Other _____

Work Phone _____ Home Phone _____ Email _____

Date of Incident _____ Time of Incident _____

Location _____

Describe Incident

Was anyone injured or anything damaged? If yes, please describe

Witnesses (Include name, address, phone and relationship)

Did police, security, fire or other emergency agencies respond? If yes, please explain.

Other Comments

Your Signature _____

Date _____

SORS 5/9/2018

University of Alaska, Supervisor's Investigation Report for Employee Injuries

**UNIVERSITY OF ALASKA
SUPERVISOR'S INVESTIGATION REPORT FOR EMPLOYEE INJURIES
INSTRUCTIONS FOR FORM COMPLETION**

**DO NOT COMPLETE THIS FORM IF SERIOUS INJURY, HOSPITALIZATION, OR
FATALITY HAS OCCURRED
CALL SW RISK MANAGEMENT AT
450-8150 (Fairbanks) or 786-1140 (Anchorage)**

A. INVESTIGATE each accident immediately after it occurs.

B. REPORT DISTRIBUTION: (To be completed within 72 hours.)

1. Your Department
2. Your Campus Risk Management Office
3. Statewide Office of Risk Management
P.O. Box 755240
Fairbanks, AK 99775-5240

1. WHAT HAPPENED?

- GET ALL THE FACTS by studying the job and conditions where the accident occurred.
- TELL WHAT THE EMPLOYEE WAS DOING when injured. (BE SPECIFIC. If employee was using tools or equipment or handling material, name them and tell what employee was doing with them.)
- TELL HOW THE ACCIDENT OCCURRED. (Describe fully the events, which resulted in injury. Tell what happened and how it happened. Name any objects or substances involved and tell how they were involved. Give full details on all factors, which led or contributed to the accident.)
- TELL WHAT THING DIRECTLY INJURED THE EMPLOYEE. (Name object struck against or struck by. If strain or hernia, name the object lifted, pulled, etc. If injury resulted solely from bodily motion, state the stretching, twisting, etc., which caused the injury.)

2. WHY DID IT HAPPEN?

Describe in detail the CONDITION RESPONSIBLE for the accident. It will always involve one or more of the 12 OPERATION FACTORS listed. Be specific in identifying the equipment, material and people involved and how they contributed to the accident.

3. WHAT SHOULD BE DONE?

Determine what CORRECTIVE ACTION IS NEEDED TO PREVENT A SIMILAR ACCIDENT IN THE FUTURE. The OPERATION FACTORS used in No. 2 should help you determine what should be done.

4. WHAT HAVE YOU DONE THUS FAR?

State what CORRECTIVE ACTION you have taken or recommended to your supervisor, depending on your authority.

5. HOW WILL THIS IMPROVE OPERATIONS?

State what CORRECTIVE ACTION you have taken, or have recommended, that will help to prevent future accidents.

6. WHAT IS YOUR ROUGH ESTIMATED COST OF THIS ACCIDENT?

In most cases, actual accident costs are not available for some period of time. Please use your BEST JUDGEMENT IN MAKING A DETERMINATION of lost wages, medical expenses, and damage to University property and/or equipment.

University of Alaska Supervisor's Accident Investigation Report For Employee Injuries

Your Name _____ Phone: _____

Department: _____ MAU: _____

Name of Injured/Equipment/Property _____

Job or Activity at Time of Accident _____

Date of Accident _____ Time of Accident _____

Exact Location _____

1. What Happened? _____	Tell what the employee was doing, how the accident occurred, and what thing directly injured the employee												
2. Why Did it Happen? _____	Get all the facts by studying the job and situation involved. Use the following factors to help you identify the condition responsible <i>Operating Factors to Be Considered:</i> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 33%;">Proper Equipment Selection</td> <td style="text-align: center; width: 33%;">Proper Material Selection</td> <td style="text-align: center; width: 33%;">People Selection</td> </tr> <tr> <td style="text-align: center;">Arrangement</td> <td style="text-align: center;">Placement</td> <td style="text-align: center;">Placement</td> </tr> <tr> <td style="text-align: center;">Use</td> <td style="text-align: center;">Handling</td> <td style="text-align: center;">Training</td> </tr> <tr> <td style="text-align: center;">Maintenance</td> <td style="text-align: center;">Use</td> <td style="text-align: center;">Supervision</td> </tr> </table>	Proper Equipment Selection	Proper Material Selection	People Selection	Arrangement	Placement	Placement	Use	Handling	Training	Maintenance	Use	Supervision
Proper Equipment Selection	Proper Material Selection	People Selection											
Arrangement	Placement	Placement											
Use	Handling	Training											
Maintenance	Use	Supervision											
3. What Should be Done? _____	What action(s) will prevent similar accidents in the future?												
4. What have you done thus far? _____	Take or recommend action, depending on your authority												
5. How will this improve operations? _____	How will this help us meet our objective: Accident Prevention?												
6. What is your rough estimated cost of this accident? <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Cost of lost wages and medical expenses?</td> <td style="width: 50%; border-bottom: 1px solid black;"></td> </tr> <tr> <td>Damage to UA property or equipment?</td> <td style="border-bottom: 1px solid black;"></td> </tr> <tr> <td>Damage to third parties (property and people)?</td> <td style="border-bottom: 1px solid black;"></td> </tr> <tr> <td style="text-align: right;">Total</td> <td style="border-bottom: 1px solid black;"></td> </tr> </table>		Cost of lost wages and medical expenses?		Damage to UA property or equipment?		Damage to third parties (property and people)?		Total					
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Signature: _____	Date: _____												