Expected to run: TBD
University: TBD

Charting Coastal Waters: A Challenge in Prolonged Ocean Health Diagnosis

SPONSORING ORGANIZATION
Monterey Bay Aquarium Research Institute (MBARI)

CHALLENGE
Marine Scientists need a cost-effective and scalable way to quantify ocean health globally to better understand the Earth's changing climate and better inform policymakers to develop science-based policies that effectively mitigate the harmful consequences of these changes.

RELEVANT CONTEXT

- There are a variety of current global scientific needs for new observing systems that can acquire and provide the data required to help understand the health of our oceans.
- Examples of current, critical needs to quantify ocean health include the following.
    - Measurement, reporting and validation (MRV) observing systems that can be used to quantify the effect of marine carbon dioxide removal (mCDR) systems being proposed to mitigate the problem of ocean acidification.
    - Observing systems that can be used by local and government fishery management organizations in order to develop science-based policy.
    - Observing systems that can be used effectively in the Arctic and Antarctic to quantify the impact of climate change.
    - Observing systems targeting current marine threats including oxygen dead zones and marine heat waves.
- Current ocean observing technologies include ship-based measurements, fixed moorings and autonomous vehicles. However, these technologies have not been able to scale up to meet the needs of a global observing system.
- The Argo system (https://argo.ucsd.edu/) of profiling floats is currently the only system that has scaled up to meet the needs of a global observing system. The Argo system has been providing orders of magnitude more data and at a significantly lower cost per data point than other observing technologies for over a decade. However, the Argo system was originally optimized to quantify ocean heat content and climate change in the deep ocean.
- The SOCCOM and Argo-BGC projects (https://soccom.princeton.edu/ and https://www.go-bgc.org/) have extended the capability of the original Argo profiling floats to make a suite of biogeochemical measurements that are being used to begin understanding the health of the ocean. However, this new generation of floats is still optimized for deep water applications.
- This new generation of biogeochemical profiling floats can measure temperature, salinity, oxygen, pH, nitrate (a critical marine nutrient), chlorophyll, optical radiation, phytoplankton and particulate carbon. Measurements are made through the entire water column and the results are telemetered to shore in near real time. These floats are autonomous and can work for as long as 7 years completely unattended.
- MBARI researchers have developed a coastal profiling float (CPF) designed to mitigate the challenges of working in coastal environments while making the full suite of biogeochemical

measurements (MBARI, 2020). In addition to the profiling float itself, the CPF system includes tools for data processing, quality control and visualization.

- In order to move the CPF from the MBARI research environment to the wider community the following issues (and many others) need to addressed
    - Is the CPF system capable of scaling to meet stakeholder requirements including functionality and cost? Is it the best choice?
    - Can the cost of the CPF system be reduced? If so, how?
    - Can the current CPF data system be operated by non-expert users? If not, what changes need to be made?
    - How can the CPF technology be made generally available? Commercial partners, government agencies, philanthropic organizations, open source or ?
    - What is an appropriate way to demonstrate the utility of a CPF based observing system? Pilot project(s), workshops, advertising or ?

IMPACT

Solving this problem would enable scientists to better track and predict climate change, monitor fish populations and determine ecosystem health.

POTENTIAL BENEFICIARIES

- NOAA Fisheries (https://www.fisheries.noaa.gov/)
- Alaska Marine Conservation Council (https://www.akmarine.org/).
- NOAA Future Seas (https://www.integratedecosystemassessment.noaa.gov/regions/california-current/future-seas)
- ARPA-e SEA-CO2 program (https://arpa-e.energy.gov/technologies/programs/sea-co2)

TEAM RECOMMENDED SKILLSETS

- Marine Biology and Environmental Science
- Oceanography and Remote Sensing
- Robotics, Mechanical, Computer, Electrical, Industrial, Manufacturing and System Engineering
- Embedded computer programming
- Fisheries Science and Policy
- Data Science and GIS (Geographic Information Systems)
- Navigation and Maritime Knowledge
- Environmental Engineering
- Project Management and Logistics
- Stakeholder Engagement and Policy
- UX/UI Design
- Communication and Outreach
- Financial and Business Acumen
- Legal and Policy Analysis

RESOURCES (OPTIONAL)

MBARI New Coastal Profiling Floats
NOAA Ocean Data Uses
Argo Floats

PROBLEM SPONSOR

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