

Transforming USGS's Ecosystems Observing Capacity with Long-range Autonomous Underwater Vehicles

Project Narrative

The goal of the collaborative research with USGS Great Lakes Science Center is to demonstrate the transformative capacity of long-range autonomous underwater vehicles (LRAUVs) in conjunction with satellite- and vessel-based monitoring to describe regional patterns in plankton abundances and their contributions to carbon fixation and food web spatial structure. There are three specific research objectives:

1. Compare spatial patterns in surface and deep chlorophyll and primary production to satellite-derived chlorophyll and primary production across a transect through Lake Michigan. The exact length of the transect will be determined, but will be on the order of a 1000 km.
2. Measure zooplankton abundances and the degree of spatial correspondence to phytoplankton across Lake Michigan
3. Demonstrate the science and management benefits of LRAUV characterization of plankton communities "at scale"

The research will take place during July of 2016 and MBARI's primary contribution will be to deploy and operate their LRAUV in Lake Michigan for about 26 day. Over the deployment the LRAUV will traverse the entire lake collecting data on water temperature, depth, photosynthetically active radiation, chlorophyll fluorescence, dissolved oxygen and acoustic backscatter.

To support this experiment MBARI pack and ship one of their LRAUVs and support equipment to USGS' operating base in Cheboygan, MI or another more appropriate location prior to the start of the experiment. Two engineers will unpack and prepare the AUV for deployment and likely perform a short test mission to ensure everything is working well. At this point, one of the engineers will return to MBARI, leaving one engineer on site for the duration of the experiment.

The MBARI engineer standing by in Michigan will be the primary operator of the LRAUV and will be the point of contact to coordinate all operations. We expect the LRAUV will need its battery recharged at least once during the experiment so the LRAUV will have to be recovered and attached to its charging console which in turn must be connected to 110 VAC power for about 20 hours. Data packets will be recovered from the LRAUV either over satellite or cellular based communications. Data summaries will be posted on a web page available to all collaborators. In addition, when the LRAUV is recharged, full resolution data will be uploaded. Mission parameters like navigation waypoints, maximum/minimum depth of AUV vertical reference points ("YoYos") and vehicle speed can be updated while the LRAUV is deployed.

At the end of the experiment, the LRAUV will be recovered and all data will be downloaded and shared with all collaborators. The vehicle and all support equipment will be packed up and shipped back to MBARI. MBARI engineers will work with their collaborators to review the data set, draw conclusions and help review resultant publications.

Budget Justification:

Labor

Kieft is PI and will oversee the project and 0.2 months of his time are devoted to this task. Kieft will be the primary AUV operator be onsite during the experiment and will ready the vehicle for operations and perform battery recharge, 0.986 months of his time are devoted the activity. Hobson is Co-PI and a mechanical engineer and will assist with vehicle preparation, checkout and assist with remote operation of the AUV. Stanway is a software engineer and will assist with vehicle preparation and operation.

Travel

Travel funds are requested for Brian Kieft and Brett Hobson to go to Michigan for vehicle preparations and operations. The budget includes airfare and hotel & perdiem costs for a 26-30 day stay for Kieft and a three to four day stay for Hobson.

Shipping

We estimate that 3 pallets worth of equipment, including the vehicle, will have to be shipped to and from Michigan to support the operations. Cost per round-trip is \$2000 per pallet.

Indirect Cost

The institutional IDC rate is 51% MTDC. The base excludes capital items, participant support costs, and subcontract costs exceeding the first 25K of each subcontract.