National Aeronautics and Space Administration

Poster #16

Front Delineation and Tracking with Multiple Underwater Vehicles

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Project Summary:

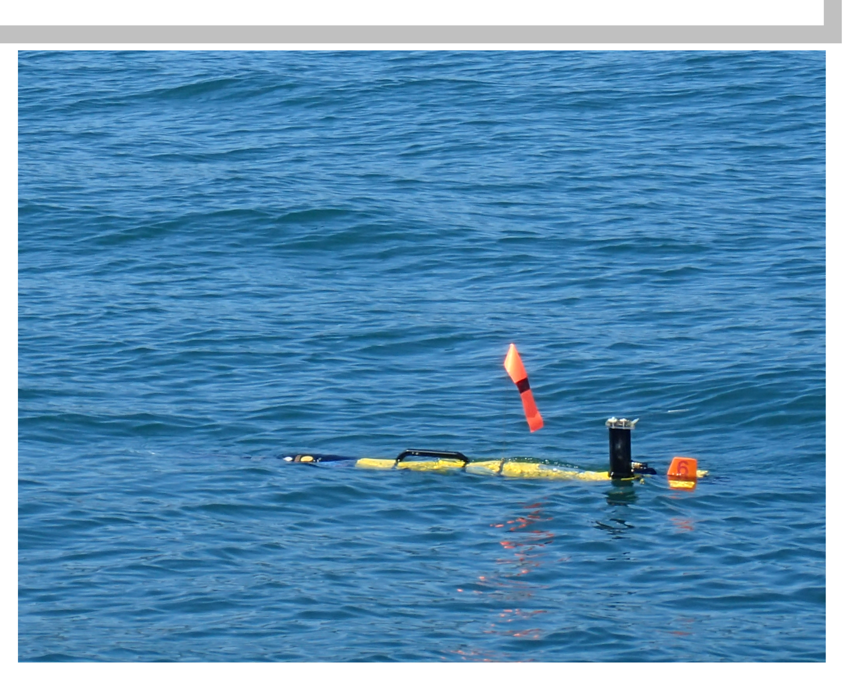
Space based remote sensing provides great information about ocean dynamics. However, remote sensing information is generally limited to measuring the ocean surface or the upper layer of the ocean. Ocean models can further augment this information. However, in order to probe the immense volume of the ocean most accurately generally requires marine vehicles such as autonomous underwater vehicles (AUVs), Seagliders, profiling buoys, and surface vehicles sampling in-situ. Deploying and operating these assets is very expensive. This means there is a very limited number of marine vehicles compared to the massive size of the ocean. Knowing where the assets should be deployed and operated is very difficult.

One strategy is to deploy in-situ assets to study specific scientific features such as fronts, eddies, upwellings, harmful algal blooms, or other features of interest. A typical strategy would be to deploy marine assets to measure transects across the feature of interest at a scale that covers the feature, as well as a baseline signal around the feature. However, asset capabilities (e.g. mobility, endurance) and prevailing ocean currents may render these science goals unachievable. Our project targets automatic detection and tracking of these features and generation of mission plans for assets to follow these science derived templates relative to projected feature motion.

From 22 October to 30 October 2016 the project team deployed an underwater glider executing feature prediction using a predictive ocean model and adaptive sampling near Monterey Bay, CA. The glider was commanded along a given transect, at each surfacing features were extracted from the model based on the vehicles expected path. The vehicle was then commanded along the path that resulted in the observation of the most interesting science features.

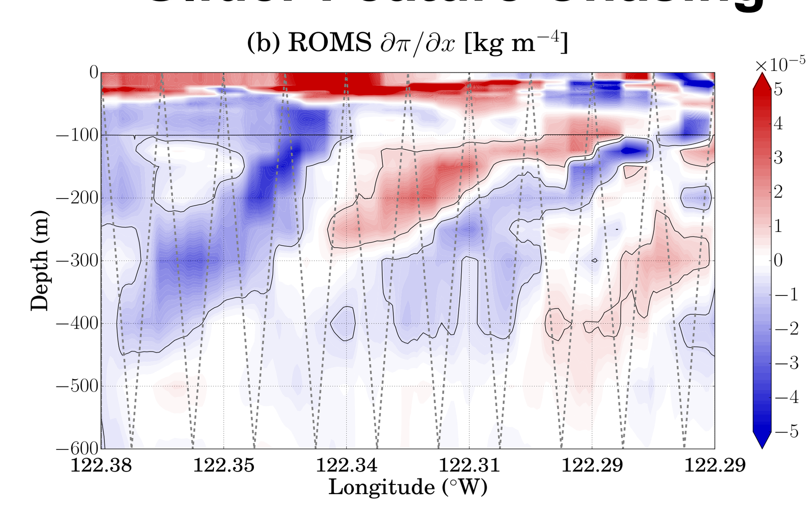
From 27 April to 11 May 2017 the project team, along with MBARI, deployed a heterogeneous fleet of marine vehicles including Tethys and Iver AUV's and gliders executing linear front detection and retasking near Monterey Bay, CA. Multiple vehicles were used performing parallel transects to autonomously detect an ocean front, fit a linear estimate to those detections, and re-command the vehicles to repeatedly cross the front.

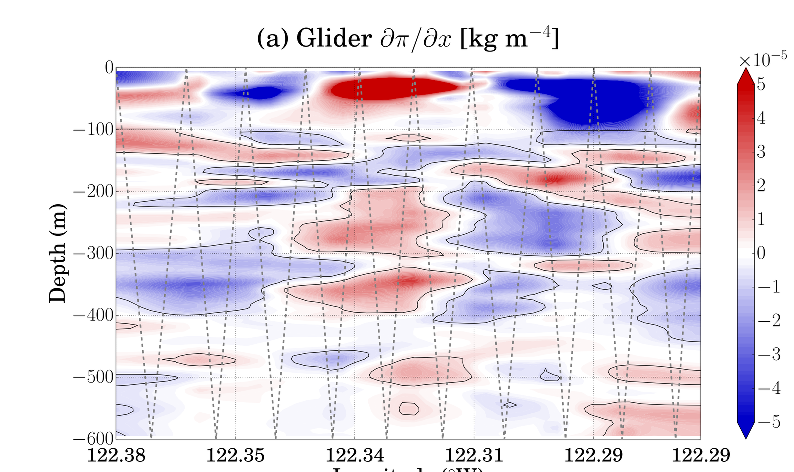
Iver AUV on deck

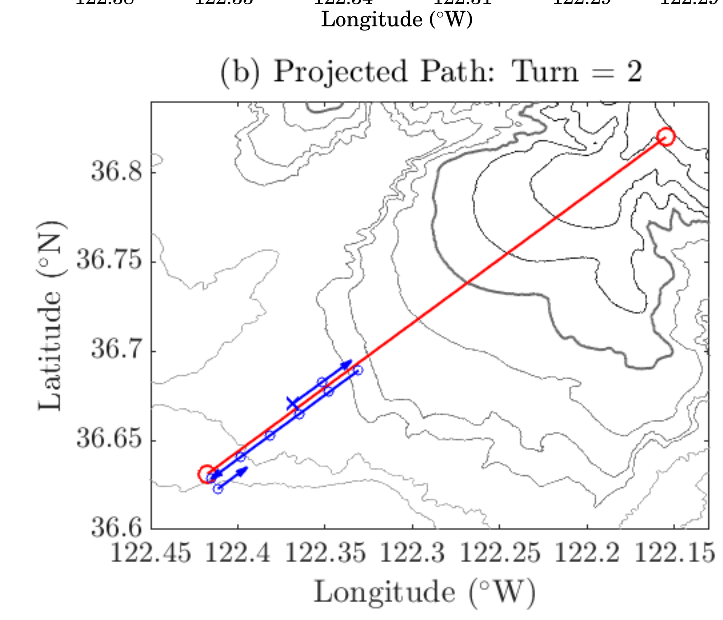


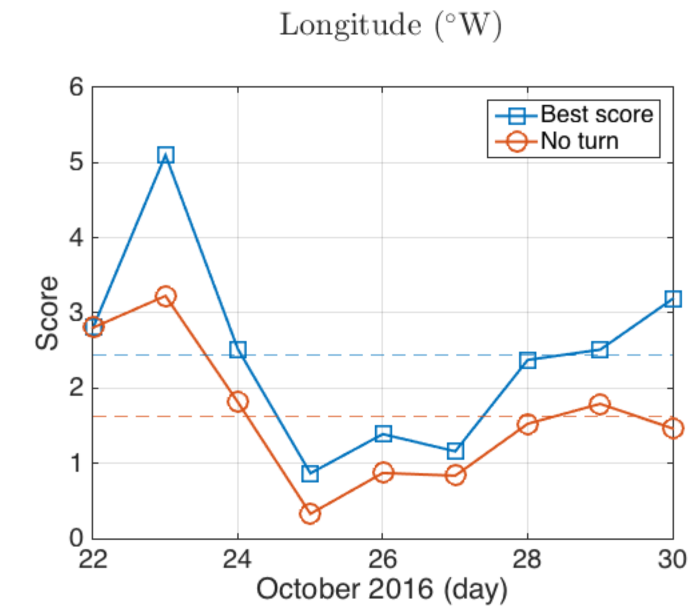
Deployed Iver AUV

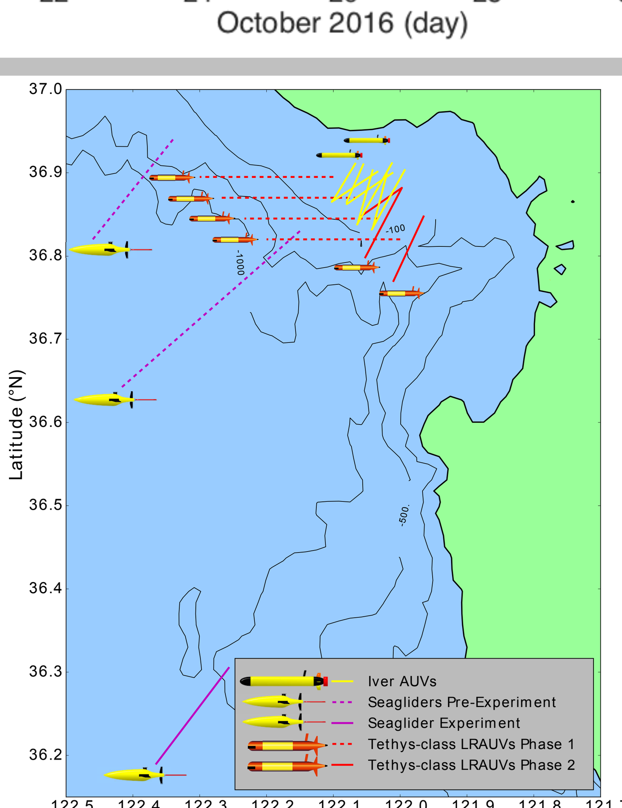
Glider Feature Chasing





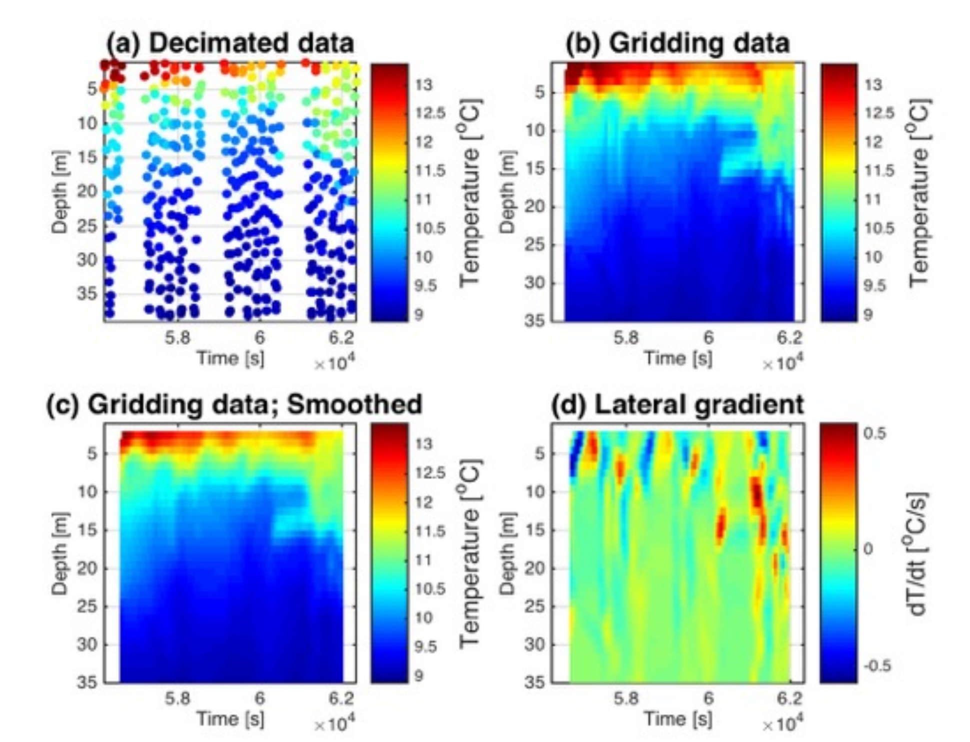


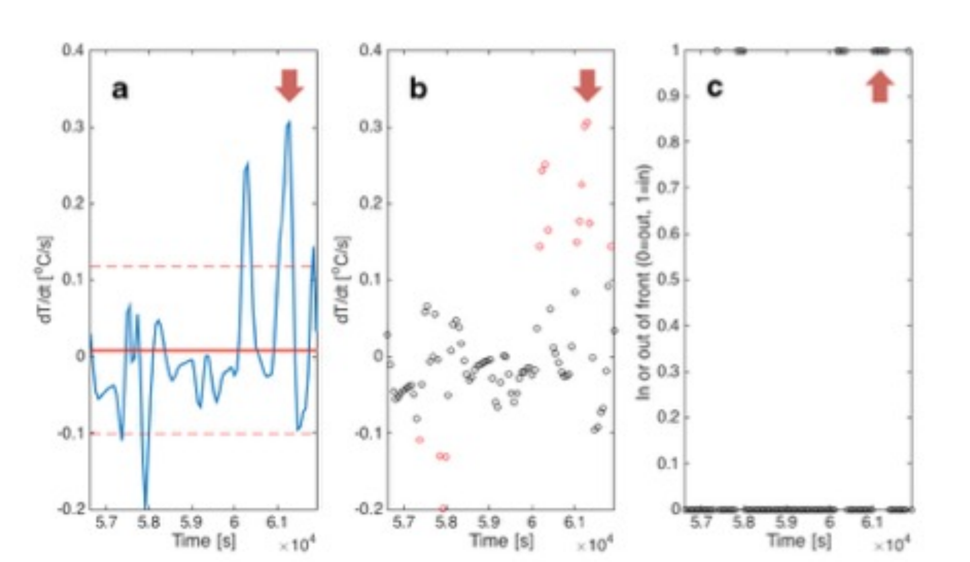


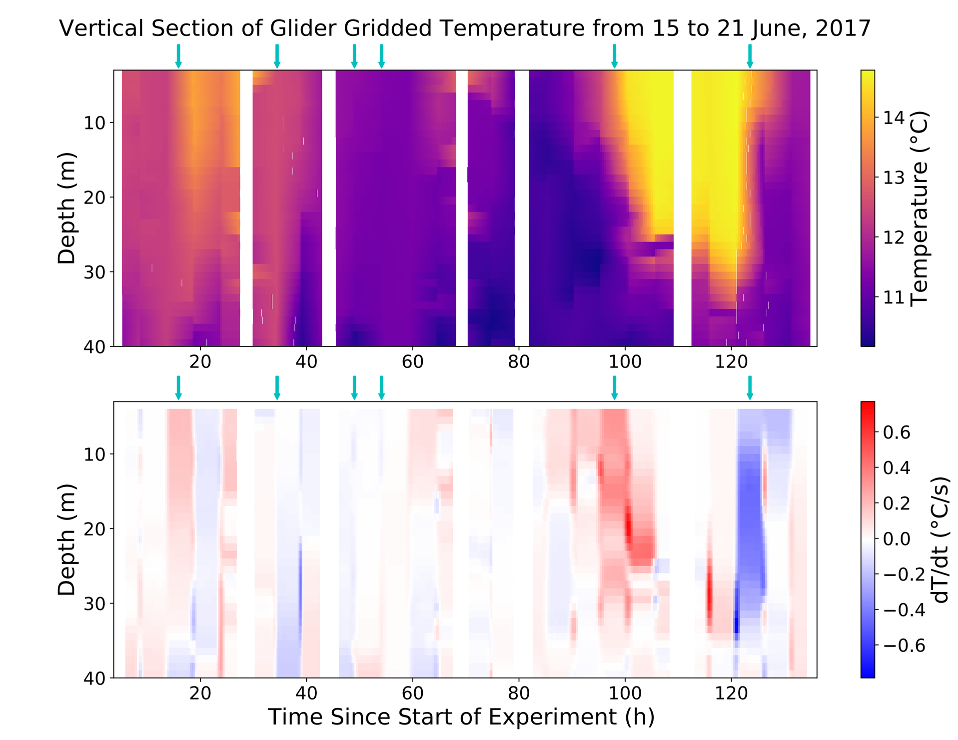


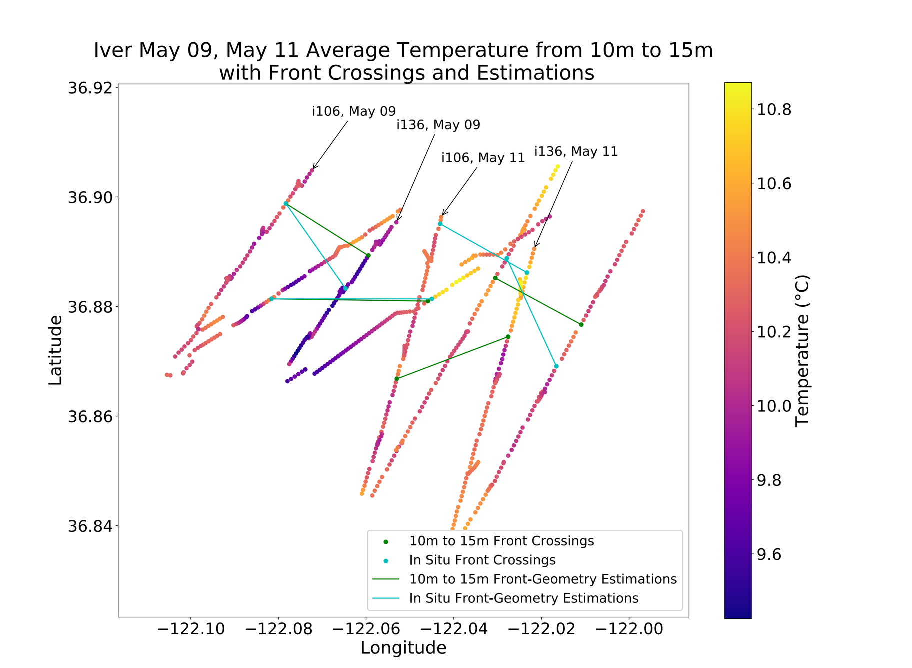
2017 Deployment Map

Linear Front Detection and Tracking









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Publications:

A. Branch, E. Clark, S. Chien, M. Flexas, A. Thompson, B. Claus, J. Kinsey, D. Fratantoni, Y. Zhang, B. Hobson, B. Kieft, and F. Chavez, Front Delineation and Tracking with Multiple Underwater Vehicles. *Journal of Field Robotics (JFR)*, 0(0). December 2018.

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