Ocean Surface Currents from SST: Derived Motion and Model Data Assimilation

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The goal of this R3 project is to learn how satellite SST can be utilized with statistical and dynamical models of ocean circulation to improve prediction and forecasting of near-surface ocean currents. Two approaches have been under investigation: motion derived directly from a sequence of SST images using feature tracking algorithms and assimilation of SST in a coastal ocean circulation model. We have run feature tracking and assimilation tests off Oregon, where ocean dynamics in summer are dominated by upwelling and separation of cold coastal currents toward the interior ocean, resulting in a strong SST contrast. Feature-tracking offers the best hope for rapid deployments, in situations where there are no operating numerical models but sequences of SST fields available. A number of feature tracking methods have been proposed over the past several decades and these are being evaluated, using SST fields from high-resolution computer models and real SST images from the Pacific Northwest. The goal is to develop a better understanding of the expected error fields associated with these estimated surface current fields. In situations where time is less critical, assimilation of SST fields into numerical circulation models is the preferred method. Assimilation using sets of hourly SST images in a series of 3-day time windows, in particular combined with other observations (satellite altimetry, HF radar surface currents), yields more accurate gap-free maps of surface currents and SST. Assimilation of SST affects location of the fronts and has a dynamical effect of the currents in the area. The system developed has produced daily updates of 3-day forecasts, which are delivered to the public via the regional ocean observing system visualization portal (www.nanoos.org). These have been used by Oregon fishermen to help plan their trips. We have also set-up an Opendap server to deliver current forecasts to the NOAA Office of Response and Restoration lab in Seattle, where the currents are integrated with their oil spill prediction software. By the end of the 2nd year we plan to improve the assimilation system by including the Columbia River, which affects a vast area off the Oregon and Washington coasts. New user groups (e.g., sardine fishermen) are also interested in the location of the river plume. In the 3rd year, we would plan to extend the model farther north, to the Washington coast. New user products will be developed, including the probability of the Columbia River plume location, indexes for retrieving crab pots based on the forecasts of currents, and interactive Lagrangian particle simulators. Future directions for the modeling research include predictions of hypoxia and ocean acidity. To do this correctly, ecosystem and bio-physical model components need to be further developed. However, statistical relationships between temperature and salinity (from the model) and oxygen or acidity

(from field measurements presently collected by gliders, mooring and ships) will be tested and used in experimental predictions, based on the circulation model.