Development of the Mid Atlantic Regional HF Radar Network: Applications to Search And Rescue, Fisheries Management, Hurricane Forecasting and Oil Spill Response

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Abstract: The Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) currently operates 36 CODAR High Frequency Radars along a 1000 kilometer segment of the United States coast. The multi-static multi-layered network supports the five MARACOOS user themes. Here we first describe the operational network, discuss its validation, and provide examples of its application to Search And Rescue, Fisheries Management and Hurricane Forecasting. We further describe how techniques developed through MARACOOS were used to coordinate the response to the Gulf of Mexico oil spill in 2010.

1. Introduction

The Mid Atlantic Regional Association Coastal Ocean Observing System (MARACOOS) is one of eleven Regional Associations comprising the regional component of the United States Integrated Ocean Observing System (U.S. IOOS). MARACOOS operates an observation, data management and forecast system to support the five user-defined themes of Maritime Safety, Ecosystem Management, Water Quality, Coastal Inundation, and Offshore Energy. The Observing Subsystem includes spatial data acquired from satellites, a multi-static CODAR High Frequency Radar network, a fleet of autonomous underwater gliders, and drifters deployed by the U.S. Coast Guard. Forecast models include an ensemble of weather

models used to force an ensemble of data assimilative ocean models. The ocean models are coupled to biological, sediment transport and water quality models (Glenn & Schofield, 2009).

2. Methods

The Mid-Atlantic High Frequency Radar network was established in 2007. It currently consists of a triple-nested network of 14 Long-Range (5 MHz), 7 Medium Range (13 MHz) and 15 Short Range (25 MHz) CODAR HF Radars. The Long-Range CODARs provide broad spatial coverage of the wide continental shelf. The Medium Range CODARS provide coastal coverage off beaches. The Short-Range CODARS provide high-resolution coverage inside major ports. Each frequency range is operated in Multi-static mode, allowing the each receiver to listen in on multiple transmitters within range, increasing both the coverage area and the quality of the data. The network is operated by three BA-level technicians located in northern, central and southern locations, and is administered by a Ph.D.-level Regional Coordinator (Roarty et al., 2010).

The network was validated in a series of collaborative studies with the U.S. Coast Guard. Arrays of bottom-mounted ADCPs and drifters were used to compare to the HF Radar derived surface currents. Two methods, UnWeighted Least Squares (UWLS) and the Optimal Interpolation (OI) for calculating the total vector currents from the radial data from each site, were tested. Comparisons with drifters indicated the value of the weighting provided by the OI method (Kohut et al., 2012).

3. Results

A test of the ability of the Mid-Atlantic CODAR systems to forecast the trajectory of a U.S. Coast Guard drifter compared to the available forecast models was tested in 2008-2009. In each case, 5000 virtual drifters, each with random flight standard deviations and time constants determined from previous comparisons were released into the current fields observed by the CODAR and forecast by the model. The evolving particle clouds where compared to actual drifters deployed in the ocean. Compared to the models, it was found that the particle clouds derived from the CODAR fields were more likely to contain the actual drifter even though their size of the cloud was reduced by a factor of 3. The result lead the Coast Guard to declare the Mid-Atlantic's CODAR HF Radar network operational in their Search And Rescue Optimal Planning System (SAROPS) on May 4, 2009.

Fisheries applications are also use products derived from the CODAR current fields such as areas of convergence and divergence. Fisheries sampling cruises are used to relate fish distributions to physical habitat parameters such as satellite sea surface temperatures, CODAR convergence and divergence zones, water column structure from gliders, and bottom

type. The correlations are used to predict fish distributions, in particular how it relates to by-catch. Areas favorable to the target species and unfavorable to the by-catch species are indentified and checked with dedicated fishing vessels.

A third application is storm response. In 2011, Hurricane Irene traveled up the U.S. east coast, causing billions of dollars of damage. The CODAR network provided current maps throughout the storm, including the initial onshore coastal flooding response, followed by the long-enduring inertial tail offshore where mixing to the bottom was not complete.

4. Conclusions and Discussion

The lessons learned in the Mid-Atlantic were applied to the Gulf of Mexico oil spill in 2010. A network of existing HF Radars and a fleet of gliders was deployed to validate the numerous models and decide which models were best to predict the distribution of oil over the next few days.

References

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