Addressing gaps in nearshore salinity measurements – White Paper submitted by NOS/CO-OPS October 2015

Per the recent request for Line/Program Offices to produce a few White Papers that provide the Decadal Study committee and panels NOAA's perspectives on the following questions, the following is a discussion of a potential topic area of interest to NOS.

1) What are the key challenges or questions for Earth System Science across the spectrum of basic research, applied research, applications, and/or operations in the coming decade?

Salinity is one of the fundamental properties of seawater and fluctuates greatly in the nearshore environment. Knowing, understanding and being able to predict surface salinity is critical to understanding sea water density, currents, and circulation patterns. For example, in the coastal ocean, changes in salinity and temperature patterns are important to understanding terrestrial and marine mixing zones. Relating the variability in salinity and nutrients nearshore to larval and juvenile fishes is key to ecosystem studies.

There is an acknowledged data gap in the spatial and temporal measurement of salinity in the global ocean and particularly in estuarine and coastal regions (Geiger et al., 2013). *In Situ* measurement systems are difficult and expensive to maintain and offer limited spatial resolution. Airborne microwave radiometers offer an alternative data source but the missions are expensive and the missions have limited temporal and spatial coverage.

The lack of salinity measurements with the required spatial and temporal resolution is a serious constraint to modeling accuracy and effectiveness and severely limits model forecast capability (Wei et al., 2015).
For instance, the skill of the salinity forecasts of NOAA operational forecast are not satisfactory for mangers to make decisions on freight loading of commercial vessels or beach closures due to the potential proximity of sea nettles.

2) Why are these challenge/questions timely to address now especially with respect to readiness?

In NOAA, the benefits of an improved measurement capability would most directly affect operational hydrodynamic modeling and ecological forecasting. The NOAA/NOS Ocean Forecast Systems do not adequately forecast salinity (and subsequently density) and the outputs cannot be applied operationally without improved skill. Success of the NOAA Ecological Forecast Roadmap requires the implementation of nearshore forecast models for HABS, hypoxia, pathogens and habitat (Allen, 2015). Without improved skill in validating and forecasting salinity, the ability to forecast water quality and density will remain a significant challenge.

3) Why are space-based observations fundamental to addressing these challenges/questions?

Significant strides have been made recently with satellite systems equipped with microwave radiometer sensors (Klemas, 2011), but their optimal temporal and spatial footprint is focused on the global oceans and not nearshore areas. Satellite systems offer longer time series information on a regularly recurring basis and provide products with the resolution needed to improve open ocean, coastal ocean, and estuarine models.

References:

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