Surface Current Mapping Offshore of North Carolina with High-Frequency Radar

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Sites and History – The Outer Banks (OBX) high-frequency radar system was first established in 2003 with funding from the Office of Naval Research (the SEACOOS project). Two SeaSonde 5 MHz systems were installed that employ a direction-finding technique for determining the radial currents relative to the deployment site. A third site was added in 2013 with funding from the state. The map below (Figure 1) shows the locations of the three sites: DUCK – in Duck, NC at the Field Research Facility operated by the U.S. Army Corp of Engineers; HATY – in Buxton, NC on what is now the Cape Hatteras National Seashore operated by the National Park Service; CORE – at the Great Island fish camp in the Cape Lookout National Seashore operated by the National Park Service.

Since the initial installation the system has run nearly continuously, suffering only one prolonged outage at HATY over fall 2010/winter 2011 associated with a lightning strike. The emphasis since installation has been to maximize uptime and spatial coverage. Steps to harden power and communications were taken early on. Erosion has necessitated moving the HATY system several times, and lightning has proven to be the most persistent cause of downtime. Hurricane damage has also been an issue. Unlike the earlier installations that were positioned near power and communications infrastructure, the CORE site is in a remote location that requires its own power system and wireless communications. A stand-alone power system was installed during summer 2014 that allowed the system to operate over the 2014-2015 winter.

Improvements in coverage have resulted from a better understanding of sources of interference (adjusting transmit frequency) and factors that impact system performance (antenna locations, beam patterns, cable slugs, corrosion prevention). Recent steps taken to improve coverage are given in the table below. The change in coverage due to the addition of CORE can be seen in Figure 3.

Gulf Stream Properties – To provide a simple characterization of the Gulf Stream and its variability we have been developing methods to extract position information. We have chosen to concentrate on analysis of radial velocities along bearings with strongest radial currents due to challenges faced when attempting to analyze the entire domain. Shown below are results from examining 2 months of data (Figure 6). Range-time plots clearly show the Gulf Stream (Figure 7). Time series of the position of the region of most rapid change in current and range of maximum speed (Figure 8) illustrate how the Gulf Stream moves on weekly periods. The average locations compare favorably with frontal locations derived from sea surface temperature (Figure 9).

Acknowledgements: we thank SECOORA and IOOS for ongoing operational support, the NSF Ocean Energy Program for funding the CORE site, and IMS staff T. Whipple and R. Neve for installing the CORE site. The Office of Naval Research funded initial acquisition and operation of the radars.


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