

HIGH-FREQUENCY RADAR REMOTE SENSING: THE NEW REVOLUTION IN COASTAL OCEANOGRAPHY

THE LITTORAL OCEAN with its complicated coastline and complex bathymetry poses great challenges to oceanographers, coastal managers, and naval forces that have an ever increasing need to understand and predict its behavior. However, the prediction of coastal environmental parameters is particularly difficult because winds, waves, and currents interact with the boundaries on much smaller space and time scales than in the open "deep blue" ocean. As a result, the dynamics of coastal waters and the resulting circulation are dependent on many physical mechanisms and interactions that are not well understood and have not been measured extensively with the necessary spatial and temporal resolution. Conventional measurement techniques are limited to single-point, temporal observations (e.g., current or wave measurements from a mooring) or to poorly resolving spatial snapshots (e.g., ship surveys or drifting buoy arrays). The broad spectrum of societal and environmental issues that arise from our increasing interest in, and dependence on, the coastal ocean (e.g., coastal pollution, fisheries recruitment, search and rescue, beach erosion, and sediment transport) demands that we improve our ability to monitor coastal processes and to fine-tune models to more accurately predict impending changes.

This improved measurement capability is important for the Navy in its tactical decision making. For example, Naval operations in the littoral ocean encounter numerous challenges in mine countermeasures and also during amphibious landings, whereas detailed information on meteorological conditions is critical during takeoff and landing operations on aircraft carriers. Additionally, improved knowledge of the local sea state is crucial for the detection and defense of surface-skimming missiles. The Army's need to observe the coastal ocean stems from its dual function in our society. On the military side, logistics over the shore (LOTS) are critical to disembarkation of equipment and the temporary maintenance of harbors. On the civilian side, the Army Corps of Engineers has responsibilities for the health and maintenance of our shorelines and beaches. Huge sums of money are expended in the dredging of harbors and shipping lanes to maintain the safety and viability of our waterways, whereas it is the near-shore circulation patterns and relentless impact of shoaling waves that force these expensive actions through sediment transport and shoreline erosion.

With the beginning of operation of high-frequency (HF) radars in coastal zones some forty years ago and the application of near-shore current mapping some twenty years ago, it became feasible to simultaneously observe large regions of the coastal ocean and construct maps of surface currents, waves, and wind direction. Depending on the system configuration, horizontal resolutions can be from hundreds of meters to tens of kilometers whereas offshore ranges are from tens to hundreds of kilometers. The shore-based, noninvasive nature of this remote sensing technology means that, in principle, these two-dimensional observations can be collected continuously for relatively low costs compared with at-sea measurements. The potential of HF radars to advance our understanding of coastal oceanography by providing much of the necessary space-time observations is truly incredible. This special issue of *Oceanography* is dedicated to the presentation of a diverse set of examples in which HF radars were used to observe the coastal ocean. The Office of Naval Research and the U.S. Army Engineer Waterways Experiment Station are pleased to sponsor this publication. We would like to thank the authors and the editors, Hans Graber and Jeff Paduan, for the efforts in putting this special issue together. We hope it will both introduce you to this revolutionary tool and also foster your interest in coastal oceanography research, but with a somewhat different perspective than before this encounter.

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