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GUEST EDITOR'S INTRODUCTION

This issue of the *Johns Hopkins APL Technical Digest* is the second of two consecutive issues devoted to the theme of ocean science at APL. The first contained several papers selected to represent our work regarding in situ physical oceanography. In this issue we concentrate on the derivation of information about the ocean environment through the use of remote electromagnetic probes. These experimental techniques, and the theoretical developments necessary for their proper application and interpretation, are relatively recent but rapidly maturing additions to the set of tools employed by the oceanographic community. As such, they are perhaps less familiar to the general technical reader of this journal. Therefore, space has been set aside to provide overviews of these increasingly important techniques and developments.

In the first article, Gilreath provides a historical perspective on the field of oceanography, discusses some of the issues being addressed in ongoing research, and outlines the related initiatives taken by APL under its Independent Research and Development program. In the second article, McGoldrick broadly reviews the field of oceanography from space, with emphasis on the strong potential for much improved temporal and spatial sampling of relevant ocean parameters. Three different topics are addressed in some detail: the measurement of wind stress at the ocean surface and its effect on circulation patterns; measurement of sea surface elevation (altimetry), in particular, the dynamic topography field, and subsequent determination of the large-scale surface current field; and finally, the measurement of ocean color in order to provide global and selected regional assessments of living marine resources. The third and last overview (Beal) addresses the subject of synthetic aperture radar (SAR). A thorough physical description of the processes involved in synthesizing a radar aperture in space is followed by a brief history of APL's involvement in SAR oceanography and an outline of some possibilities for future activities.

As Beal makes abundantly clear, the transformation of raw SAR data into useful images is a challenging technical problem in and of itself. The first processors applied to the problem were optical systems working on SAR data recorded on film. Although these are still the fastest and least costly systems to use, they are also relatively inflexible and offer the highest resolution only in special circumstances. Digital techniques, on the other hand, are highly flexible and can provide resolution at the theoretical system limit across an entire data set, albeit more slowly and at higher cost. McDonough et al. describe in considerable detail a digital signal processor recently developed at APL that has been successfully applied to SAR data from Seasat, SIR-A, SIR-B, and the Canadian CV-580 aircraft.

Most of the ocean processes that can be measured by remote electromagnetic techniques are accessible only through their effects on surface wave properties. Irvine provides a brief tutorial on surface gravity waves as an introduction to a description of a recent experiment using data from a particular pass of the 1978 flight of the NASA Seasat satellite. This successful experiment was designed to determine the degree to which such measurements, when combined with complex computer models, can relate ocean storm activity and the resultant long-wavelength surface waves

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(swell). The same data set is used in another experiment reported by Gerling, where the issue is whether SAR can provide useful estimates of wind speed and direction at higher resolution than other remote sensors (e.g., scatterometers). Of particular interest is the possibility of providing such estimates near land, fronts, squall lines, rain cells, and other regions with high wind-speed gradients.

Emphasis in the next three articles shifts away from the determination of surface wave and wind field properties to an examination of the surface manifestation of ocean internal waves. The measurement of such waves with SAR from space is a complex process whose complete description requires models for the internal wave current field, for the interaction of that field with the existing surface wave field, and for the scattering of electromagnetic energy from the modulated surface waves. Considerable progress in modeling these processes has been made in the last few years. Apel et al. report the results of an investigation of large-amplitude internal waves in the Andaman Sea. This investigation uses historical density data from the region in conjunction with known nonlinear properties of internal solitons and theories for the radar backscatter modulation that would be produced by such solitons to compare with SAR measurements from the first Shuttle Imaging Radar experiment (SIR-A) in 1981. The ability to reproduce quantitatively the observed L-band radar signatures is remarkably good, due in part to three related activities: earlier development of a soliton hydrodynamic model, a subsequent experiment with substantial coincident in situ observations to characterize the internal wave properties and the surface wave conditions, and corresponding improvements in the theoretical models for the internal wave-surface wave interaction processes and radar backscatter therefrom. The subsequent experiment, the SAR Internal Wave Signature Experiment, conducted in the New York Bight off the coast of Long Island in late summer and early fall 1984, is described in the article by Gasparovic et al. The primary SAR in this experiment was deployed by the Environmental Research Institute of Michigan on the Canadian CV-580 aircraft; additional SAR images were obtained during the SIR-B experiment. A theoretical description of the process by which internal wave surface currents interact with surface waves to modulate the SAR backscattered energy is presented in the Thompson article.

In the years since the Seasat flight, considerable progress has been made in the development of instruments to measure various properties of ocean surface waves. Some of these instruments were deployed on aircraft to gather supporting data during the Extreme Waves Experiment in the Southern Hemisphere, aspects of which are described in the tenth article, by Monaldo. That experiment, based on the second Shuttle Imaging Radar experiment (SIR-B), was an attempt to explore the capability of SAR ocean wave imaging to update global wave forecast models.

Two successive issues of the *Technical Digest* have been devoted to the theme of ocean science in order to recount more completely APL's efforts in this increasingly important area. In retrospect, I believe we have reached that goal. However, our efforts are evolving and growing, and even this extensive collection of articles provides only a snapshot—a valid picture for the moment but quickly to be overtaken by new insights. When we devote space to the theme again, a somewhat different picture will no doubt emerge.