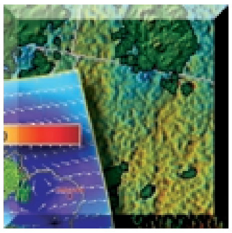

Guest Editors' Introduction

Robert C. Beal and William G. Pichel

Next year (June 2001) will mark the 50th anniversary of the first demonstration of synthetic aperture radar (SAR).[1] For about the first 15 years, SAR technology remained almost exclusively within the domain of military reconnaissance, but by 1965 ocean scientists were already advocating the use of "present day radar technology to give a complete description of the sea state."[2] After several years of SAR applications research in both the United States and Europe, the U.S. National Aeronautics and Space Administration (NASA) launched the first civilian spaceborne SAR in 1978. Even in its unexpectedly brief 98 days, the Seasat SAR revealed marvelous patterns of winds, waves, and current features over the ocean never before seen in such abundance and scope.[3,4]

The Seasat SAR was of great interest to the U.S. National Oceanic and Atmospheric Administration (NOAA) because it offered the possibility of 24-h coastal monitoring of important oceanographic and meteorological parameters. It was also intriguing to APL scientists because the provocative ocean patterns in SAR imagery demanded a new level of understanding if they were to yield quantitative and scientifically useful information. This shared interest continues today, as this dedicated issue of the *Technical Digest* illustrates.

A sequel to the Seasat SAR was a long time in coming. The United States never produced a follow-on, even though NASA, NOAA, and the Navy did continue to develop and demonstrate improved altimeters, scatterometers, and passive radiometers. Except for three brief NASA Shuttle Imaging Radar flights, the SAR research community had to wait until 1991 for the next spaceborne scientific SAR, the European Remote Sensing satellite, ERS-1.

Since 1991, there has been no scarcity of scientific SAR data. Spaceborne SARs have included the European ERS-1 and -2 (1991, 1995), Japanese Earth Resources Satellite JERS-1 (1992), and Canadian Radarsat-1 (1995). For ocean and atmospheric science, ERS-1/-2 and Radarsat have proven most useful; indeed, imagery from these SARs supports nearly every article in this issue. We expect this recent renaissance of scientific and even operational SARs to continue through the next decade with planned launches of the European Envisat (2000), Canadian Radarsat-2 (2002), and Japanese Advanced Land Observing Satellite, ALOS (2002).

Radarsat-1 contained a ScanSAR,[5] an innovative variation of a conventional SAR with a fivefold increase in swath (500 km instead of 100 km) over anything flown previously. This innovation finally transformed the SAR into a practical high-resolution wide swath scatterometer that could measure important geophysical parameters. All three of the planned scientific SARs will also incorporate a ScanSAR mode. Good calibration is the key to success, however, and it is a recurring theme in many of the following articles.

Early in the life of Radarsat-1, during the winter of 1996–1997, ScanSAR imagery over the ocean (see the inside back cover) revealed clearly unique signatures of the marine atmospheric boundary layer. The conversion from backscatter to wind speed had already been demonstrated[6] on the well-calibrated ERS-1/-2 (and to some extent even on Seasat[7]), but it was the wide swath ScanSAR of Radarsat-1 that offered the greatest potential for operational coastal applications.

To take stock of these applications directly related to its charter of environmental forecasting and fisheries management, NOAA asked The Johns Hopkins University Applied Physics Laboratory to organize a symposium. The symposium was held in the Kossiakoff Center on 23–25 March 1999. Nearly 100 participants came from seven countries; 37 presentations were delivered, and 24 of those presentations evolved into the articles published herein. The articles are grouped to follow the symposium structure:

1. Overviews (in which free speculation was encouraged)
2. Wind, storms, and the marine atmospheric boundary layer (where the struggle with calibration is most evident)
3. Ocean features, fisheries, and coastal flooding (where accurate spatial mapping is usually paramount)
4. Future missions and data policy (where science, technology, economics, and politics often intersect)

Each article has survived a rigorous peer review process, with at least three technical reviews, in addition to the usual editorial reviews routinely performed on every *Digest* article. The result, we think, is an accurate synopsis of most of the important issues facing the international SAR marine community today. We hope that these issues are presented clearly enough that even the casual *Digest* reader will sense something of the flavor and excitement of this rapidly evolving field.

The needs of the international SAR marine applications community could be substantially addressed by a constellation of four single-sided (looking to only one side) or two double-sided ScanSARs with 500- to 600-km swaths and 100-m resolution. The resulting coverage would be global, twice a day, and calibrated products could be delivered worldwide over the Web within 3 hours.

The wind field patterns shown on the cover continually evolve, just as the cloud patterns we see on the evening weather continually evolve. These changing wind patterns contain an enormous amount of information important to climatologists, meteorologists, oceanographers, and government agencies responsible for fisheries enforcement and coastal and flood plain monitoring. So far, we have only glimpsed the immense possibilities of SAR to address these problems, because we are just beginning to acquire, understand, and share the proper tools and techniques for the job.

During the symposium, we challenged the agencies planning future SAR satellites to increase cooperation in the scheduling, processing, dissemination, and pricing of wide swath SAR imagery. Such cooperation might permit near–real-time high-resolution (100-m) coastal SAR wind measurements of sufficient temporal and spatial coverage to impact weather forecasting for selected heavily populated coastal regions. Frequent coverage of these regions, either via priority data-takes or background mission scheduling, is the first important step toward this goal. See the article by Beal, this issue, for more details.

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