Preface

Scatterometers are radars that rely on electromagnetic energy reflected from capillary waves at several different azimuthal angles to estimate vector winds at the ocean surface. The reflected energy from the various radar beams are combined in a (generally empirically derived) geophysical model function to obtain the winds. The first satellite-borne scatterometer was carried on Seasat more than 20 years ago, and, although it collected only 100 days of data, it demonstrated quite clearly the potential of global winds from space for use in oceanographic and meteorological models. With such applications in mind the European Space Agency launched ERS 1 in 1991 and, the second in the series, ERS 2 in 1995. The NASA scatterometer (NSCAT), the subject of the papers in this special section, was launched on the Japanese Advanced Earth Observing System (ADEOS) satellite in 1996, and it gathered 8.5 months of unprecedented (spatially, temporally, and in accuracy) global vector wind fields before failing, owing to the loss of the satellite’s solar panels in June 1997.

ERS scatterometers make vector wind measurements in a single, 500-km-wide swath, while NSCAT acquired data in two, 600-km swaths separated by a 329-km gap at nadir. There are two major differences between the ERS scatterometers and NSCAT. The first relates to their spatial coverage; ERS scatterometers make vector wind measurements in a single, 500-km-wide swath, providing 62% global coverage every 2 days, while NSCAT acquired data in two, 600-km swaths separated by a 329-km gap at nadir, providing 90% coverage in 2 days. The second primary difference between the instruments relates to the frequencies used by the radars, C band (5.3 GHz) for ERS and Ku band (13.995 GHz) for NSCAT. The fact that ERS 2 and NSCAT were operational at the same time enabled careful comparisons on a global scale of the performance of C versus Ku band instruments. Such comparisons are included in this issue from several different perspectives: individual wind retrievals are compared, the impact on numerical models is examined, and a rather intriguing comparison of the ability of these instruments to measure sea ice properties is made.

As with most previous oceanographic satellite missions, the performance of NSCAT exceeded all of its design specifications. Compared with data from ocean buoys, wind speeds are shown to have unity gain, an rms error of \( \sim 1.3 \text{ m s}^{-1} \), and a directional uncertainty of less than 18° for winds in the 3 to 20 m s\(^{-1}\) range. However, of possibly greater interest is that these statistics are for winds obtained at 25-km resolution, while the design specifications exceeded were for winds at 50-km resolution!

There has been a wide range of approaches used to test, improve, and develop new geophysical model functions. These include several approaches based on neural networks. As well as model functions for vector winds, a model function for stress magnitude was developed.

By far the largest group of papers in this section, 7 of the 25, deal with the impact of NSCAT quality winds on the performance of oceanographic and meteorological numerical models. These studies cover a broad range. Several attempts to improve traditional forecasting of El Niños and the examination of precursors to El Niños were made. Other studies have compared the differences in model output when the model was forced with NSCAT winds versus NSCAT stresses. Several of the studies investigated the improvement of ocean models in the areas of convergent zones. Other topics of investigation associated with numerical modeling efforts include Pacific equatorial waves and methods of constructing surface stress fields.

As noted previously, NSCAT studies are not restricted to overwater locations. NSCAT has proven to be extremely effective in observing the evolution of Arctic and Antarctic ice. These studies include locating the ice edge and estimating sea ice drift.

Despite the brevity of the NSCAT mission, the impressive quality of the data collected and the clear demonstration of the impact of these data, especially on oceanographic models as detailed in this issue, encouraged NASA to mount a follow-on mission designed to fill the gap prior to the launch of SeaWinds on ADEOS II in 2000. This mission, SeaWinds on QuikSCAT, is scheduled for launch on May 16, 1999, approximately 18 months after the mission was approved. The SeaWinds instrument is the same as that to be launched on ADEOS II and is quite different in operation from NSCAT, although it also operates in Ku band. The major difference is that SeaWinds uses a rotating dish antenna with two spot beams that sweep in a circular pattern compared with the three stick antennas on each side of NSCAT. Anticipated benefits of SeaWinds are 90% daily ocean coverage and a single, broad (1600–1800 km wide) swath without a nadir gap.

The high quality of NSCAT’s data and the amazingly short time between approval and anticipated launch of QuikSCAT are the result of an exceptional effort on the part of NSCAT project personnel. The NSCAT Science Team, responsible for the papers herein, would like to acknowledge the extraordinary contributions of this group. Additionally, we would like to thank Deborah Hentschell, the JGR-Oceans editorial assistant, for the extra effort that she put into pulling this section together.

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Guest Editor

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