MICROWAVE RADAR OCEANOGRAPHIC INVESTIGATIONS

by

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The main thrust of this activity has been, and continues to be, the development and demonstration of the Radar Ocean Wave Spectrometer (ROWS) technique for measuring ocean wave directional spectra from air and space platforms. The measurement technique has been well-demonstrated with data collected in a number of flight experiments involving wave spectral comparisons with wave buoys and the Surface Contour Radar (SCR); recent missions include the SIR-B underflight experiment (1984), FASINEX (1986), and LEWEX (1987). ROWS-related activity is presently concentrating on (1) using the aircraft instrument for wave-processes investigations and (2) obtaining the necessary support (consensus) for a satellite instrument development program. Prospective platforms include Eos and the Canadian RADARSAT.

Allied work conducted under this RTOP task includes studies of near-nadir, quasi-specular scatter using the ROWS instrument in a broad-beam altimeter mode configuration and theoretical and empirical studies of the altimeter EM bias. ROWS altimeter mode measurements of the surface Mean Square Slope (MSS) parameter (i.e., the Ku-band frequency effective MSS) in MASEX and FASINEX have been shown to be consistent with a wind speed dependent equilibrium range slope spectrum model. On properly accounting

for diffraction effects using a two scale scattering model, the model spectrum produced MSS in agreement with a consensus of Ku-band data and with the classical optical data of Cox and Munk. A two scale model of the EM bias has been developed for swell dominated conditions that gives a bias in accord with in-orbit estimates (Jackson, 1988).

All LEWEX data have been processed and communicated to the Applied Physics Laboratory. Preliminary comparisons with the SCR, Canadian SAR, buoys and wave hindcasts are favorable according the results of a recent workshop held at APL. The wave/current interaction work with A. K. Liu has been reported at the AMS meeting in Anaheim, CA in February (Jackson and Liu, 1988). The refraction of a long (215 m) swell system computed for a simulated flow field in FASINEX (see Liu's figure) was shown to be consistent with both the ROWS (see accompanying figure) and SCR observed spectra on both sides of the oceanic front.

Elements of a new data system for the aircraft ROWS, including a new streaming tape drive and waveform sampler have been checked out. The new data system should be ready for the planned EM bias flights in January-February, 1989. The system is, however, presently limited by the power of the small PC; a better computer is needed to handle the data stream plus the radar housekeeping and aircraft data, and to afford a real time data processing and display capability. It is hoped to have such a capability for

the upcoming Surface Wave Dynamics Experiment (SWADE) in the winter-spring of 1990-91. For this experiment, we plan to transfer the ROWS to the small T-39 Sabreliner aircraft at WFF. Operating on the T-39 at twice the altitude at about 1/10 the cost per spectral degree of freedom relative to the P-3 operation with a turn-key data system will make the flight costs trivial; use of the aircraft ROWS in a "service" capacity also becomes a possibility.

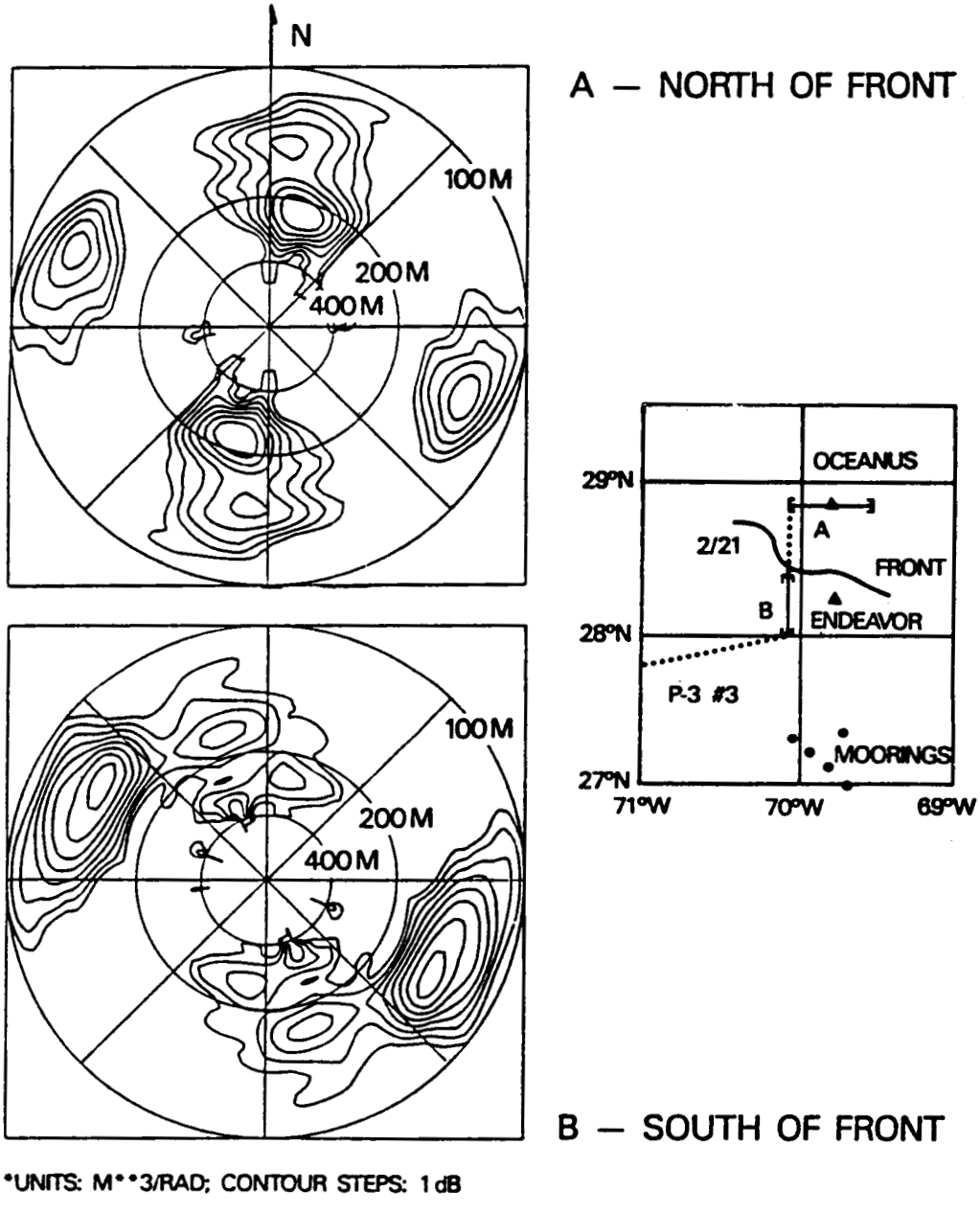

Figure 1. ROWS directional wave-height spectra (DWS) observed north and south of the subtropical front in FASINEX February 21, 1986. Two nearly equal energetic swell systems are evident in the (symmetrical) wavenumber spectrum of the surface waves on the north side of the front, while on the south side of the front the north-south swell is greatly diminished in amplitude. Because the front has meandered into a north-south orientation in the region of the observations, the north-south swell system, which originated in a storm off New England, strikes the front at near grazing incidence and hence experiences strong refraction. A ray trace using an idealized model of the frontal currents by A. K. Liu shows a strong wave, shadow, zone south of the front that is consistent with these observations (see figure 1. in A. K. Liu's activity report).