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COMPARISON OF RADAR BACKSCATTER MEASUREMENTS AND AREA EXTENDED WAVE SLOPE MEASUREMENTS OF WIND GENERATED WAVES IN A LARGE WIND/WAVE TANK WITH TWO-SCALE MODEL PREDICTIONS.

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In February 1988, combined measurements of microwave backscatter, wind, waves and gas exchange have been carried out in the large indoor, well equipped wind/wave facility (100x8x0.8 m^3) of Delft Hydraulics in Delft. This experiment was performed in the framework of the VIERS-1 project. In this project a number of Dutch and German institutes cooperate. Main objective is to increase the knowledge about the physics involved in the interaction of microwaves and the ocean surface and, from that point, to an improvement of the algorithms used for determination of wind speed and direction from satelliteborne microwave scatterometers. A second objective is to study the relation between the gas exchange at the water surface and the microwave backscatter.
The improve the understanding of the interaction between microwaves and water waves the VIERS-1 (Dutch acronym for "Preparation and Interpretation of ERS-1 data") project started in 1986 with the preparation of two wind/wave tank experiments and an ocean tower experiment, while airborne scatterometer data became available through the participation in different ESA windscatterometer campaigns.
The Delft facility is excellently suited for detail studies of microwave backscattering from waves in the capillary region. This tank was mainly used for studying wind-generated waves.
In the Delft experiment measurements of the microwave backscatter have been performed, together and simultaneously with wave slope measurements as a function of azimuth angle, incidence angle, polarization and wind velocity. A number of wave measurement devices have been employed in the Delft wind/wave tank. The most important for the microwave measurements were the so-called imaging slope gauge (ISG) and the laser slope gauge (LSG).
The ISG was used to derive the short wave spectral density function, with the wavelength between 3 mm and 15 cm, while the slope distribution of the larger waves was calculated using the LSG measurements. The cross-over frequency between the two scales was chosen in the order of 4 Hz after a sensitivity analyses. Using these waveparameters as a input the two scale backscatter theory (G.R. Valenzuela, Boundary Layer Meteorol., 13, 61-85, 1978) with some modifications (M.A. Donelan and W.J. Pierson, Journal of Geophysical Research, 92, 4971-5029, 1987) was applied to derive the normalized radar cross section.
The radar measurements are compared with the model predictions. In general a difference of 1 dB for HH and 2 dB for VV polarization is found. Detailed analyses using a windspeed of 11.2 m/s (U_{10}) shows differences in the measured and predicted polarization ratio between 1 and 2 dB, where the larger difference is found at the larger incidence angles.
The model seems to be non-stable for small incidence angles leading to a large discrepancy with the measurements. Applying a cutoff in the model at a local incidence angle of 18° shows a much better agreement with the measurements.

SIGNATURE PROBLEMS IN MICROWAVE REMOTE SENSING OF THE SURFACE OF THE EARTH

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