MODELLINGOF WINI) DIRECTIONSIGNALS IN POLARIMETRIC SEA SURFACE BRIGHTNESS TEMPERATURES

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There has been an increasing interest in the applications of polarimetric microwave radiometers for ocean wind remote sensing. Aircraft and spaceborne radiometers have found significant wind direction signals in sea surface brightness temperatures, in addition to their sensitivities on wind speeds. However, it is not yet, understood what physical scattering mechanisms produce the observed wind direction dependence. '1'0 understand the relative contributions of capillary waves, long waves, and sea foam, polarimetric microwave emissions from wind-generated sea surfaces arc investigated with a two-scale scattering model of sea surfaces, which relates the directional willd-wave spectruin to passive microwave signatures of sea Sill'races. Theoretical azimuthal modulations are found to agree well with experimental observations for all Stokes parameters from near nadir to 65° incidence angles. The up/downwind asymmetries of brightness temperatures are interpreted using the hydrodynamic modulation. The contributions of Bragg scattering by short waves, geometric optics scattering by long waves and sea foam arc examined. The geometric optics scattering mechanism underestimates the directional signals in the first three Stokes parameters and predicts no signals in the fourth Stokes parameter (V), in disagreement with experimental data. In Contrast, the Bragg scattering mechanism dominates the wind direction signals from the two-scale model and correctly predicts the phase changes of the up/crosswind asymmetries in T_v and U. The accuracy of the Bragg scattering theory for radiometric emission from water ripples is corroborated by the numerical Monte Carlo simulation of rough surface scattering. This theoretical interpretation indicates the potential use of polarimetric brightness temperatures for retrieving the directional wave spectrum of ocean waves.