DUAL-POLARIZATION RADAR MEASUREMENTS OVER THE SEA SURFACE: TOWARD A BETTER UNDERSTANDING OF THE INTERACTIONS BETWEEN THE SEA SURFACE AND THE ELECTROMAGNETIC WAVES AT C-BAND

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In the context of the increasing capabilities of the spaceborne sensors (as the ASAR from ENVISAT or the forthcoming RADARSAT-2) for measuring the radar cross-section in dual-polarized mode, a study has been conducted to investigate the interest of the dual polarization in order to better understand the interactions between the electromagnetic waves and the sea surface. We present an analysis of coincident measurements of the Normalized Radar Cross-Section (NRCS) in VV and HH polarization over the ocean obtained from the C-band airborne radar STORM during the VALPARESO experiment. We propose a method to analyze separately the polarized and the non polarized contributions to the NRCS using appropriate combinations of the two polarizations. These data are compared with a physical model, which describes the polarized and non-polarized contributions. The polarized part is represented by a 2-scale Bragg model coupled with a wave spectrum model. The non polarized part is described through a quasi-specular reflection model for the lower incidence angles and a model to consider the contribution of the wave breaking events parameterized with the same wave spectrum model. Comparisons between data and model reveals that the ratio of the NRCS in up- to cross-wind directions in both HH and VV polarizations are not well reproduced versus incidence angle and wind speed. The comparisons between data and model for the polarized and the non polarized parts of the model show that both of them need to be improved. This study reveals that the contribution of the non polarized part of the NRCS is bi-modal function of the azimuth angle with respect to the wind direction (as the NRCS). A new physical model breaking wave effect is proposed to take into account this fact. The impact of such a new model is shown to provide better results for the non-polarized part. Then, concerning the polarized part, it appears that the azimuth description of the wave spectrum can be improved. A modification of the azimuth behavior of the growth rate parameter of our wave spectrum model is presented. It leads to significant improvements for the polarized part of the NRCS in both VV and HH polarization. Using these two modifications, we present comparisons between the new model and the data. A good agreement is found for the total NRCS versus incidence angle or versus wind speed in both HH and VV polarizations. The ratio of NRCS in up- to down-wind and in up- to cross-wind directions versus incidence angle and versus wind speed predicted by the new proposed model are also shown and are also consistent with the data. Finally, satisfying comparisons with the new empirical CMOD-5 model in VV polarization are presented.