Calculation of K_u- and C-band polarimetric azimuthal dependences of radar backscattering from sea surfaces

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Existing airborne and satellite polarimetric radar data at K_u- and C-band show sensitivity of radar signals with various polarizations to anisotropy of the wind-driven ocean waves. The results of such experiments reveal different symmetry properties of the co-polarized backscattering coefficients compared to the correlation coefficients between co-and cross-polarized scattering signals. Usually, comparisons are made with the composite (two-scale) model predictions in order to explain these differences. There is a qualitative agreement between the composite model predictions and the measured polarized backscattering cross sections and corresponding correlations. However, significant quantitative differences remain between the theoretical predictions and experimental data.

We performed calculations using the numerical code based on a small slope approximation of the second order (SSA2). It represents a modified, fully-polarized version of the code from (A. Voronovich and V. Zavorotny, Waves Random Media, 11, 247-269, 2001). Here we present results of the SSA2 calculations for the azimuthal dependence of the VV, HH, and VH normalized radar cross sections and off-diagonal correlators for Ku- and C-band radar signals for fixed incidence and various wind speeds. We pay particular attention to various cross-polarization correlators such as the correlation coefficient which describes the correlation between co- (VV) and cross-polarized (VH) radar returns of ocean waves. These modeling results are compared with both the composite model calculations and the experimental data obtained from airborne polarimetric scatterometers and satellite SAR. Generally, the quantitative agreement between the data and SSA2 calculations is better than for the case of the composite model. Differences between the modeled curves and the experimental data are likely a result of the effect of steep and breaking waves unaccounted for by neither the composite model nor the SSA2.