Scattering of Electromagnetic Waves by Ocean Surfaces at L Band Based on Numerical 3D Solutions of Maxwell Equations

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The interaction of ocean surfaces with electromagnetic waves has long been studied due to its broad applications in remote sensing. The ocean wavefields are mostly influenced by sea wind, gravity and is considered to be a complex hydrodynamic process. Ocean spectrum is used to denote the power distribution along with different spectral components and azimuthal angles. Ocean waves consist of many scales of waves of which the gravity waves of meter scales and capillary waves can be as small as millimeters. Taking advantage of the fact that the small scale roughness is riding on the large roughness, the two scales model (TSM) has been used to interpret radar backscattering from ocean surfaces. In the model, a dividing line is selected in the ocean spectrum between the small roughness and the large roughness. Full wave numerical simulations have been used to model ocean backscattering. Because of the large permittivity of sea water, the ocean surfaces have been modelled as a perfect electric conductor. The approximation of impedance boundary condition has also been used. In this paper, we perform 3D solutions of Maxwell equations using the PMCHWT formulation and the Method of Moment. The RWG basis functions are used and matrix column vector multiplication is accelerated by using SMCG. In stochastically generating the ocean surface, the isotropic Durden-Vesecky spectrum is used and truncated between upper limit k_u and lower limit k_l. Unlike the TSM, there is no need to set a dividing line in the ocean spectrum. When physical models are used for scattering problems, it always involves in a process which parameters are modified in order to better match the data or get more stable results. While as a rigorous approach to Maxwell equation, the accuracy of numerical method is mainly determined by the correctness of the geometry of the object itself. We studied scattering from ocean surfaces at L band under the winds ranging from 5m/s to 10 m/s and the incidence angles from 29 degree to 46 degree. An objective of the NMM3D simulations is to assess the accuracy of the TSM model.