COHERENT MODEL FOR VHF SCATTERING FROM FORESTS ON MULTILAYER ROUGH GROUND

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In this paper we present a coherent scattering model the for a forest situated on top of a layered ground. The ground layers are separated by rough interfaces of arbitrary depth and dielectric constant. Scattering from forests has been studied extensively by several researchers in the past 20 years, but in all known studies the ground under the vegetation canopy has been assumed to be a single rough surface. With the recent interest and prospects for availability of radar data at the VHF band, the validity of a single rough surface model for the forest floor has to be revisited. Due to the large depth of penetration at VHF, the waves can travel well into the ground surface and scatter from subsurface layers, even for dense forests. Furthermore, realistic forests include a mix of multiple tree species, which is generally not taken into account in previous works. Here, we start from an existing coherent model for a single species forest on a single ground surface, which solves for the scattering coefficients using the distorted Born approximation. The layered ground with rough interfaces is then incorporated using a solution we have developed based on the small perturbation model that takes into account multiple interactions between the interfaces. First we consider a three-layer (two-interface) subsurface, although the solution can be extended to more layers. The first-order interaction of the vegetation, which in the new model consists of several layers of discrete random media, with all rough interfaces is included in the solution. Although multiple interactions between vegetation layers and between vegetation and soil layers are disregarded, the forward scattering matrix for each random layer is used to modify the wave propagation hence the distorted Born approximation. Comprehensive simulation results are presented, and sensitivity of the backscattering coefficients to the vegetation type and density, frequency range, and ground layering properties is evaluated. The results of this study directly impact the analysis of data obtained from low frequency radar systems on tower, airborne, and prospective spaceborne platforms.

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