Improving the Efficiency of Rough Surface Normalized Radar Cross Section Computations with the Small Slope Approximation

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Abstract

The small-slope approximation (SSA) is a useful technique for computing the ensemble averaged backscatter normalized radar cross section (NRCS) for scattering from randomly rough surfaces. The SSA computes surface NRCS values as a sum of terms in surface "quasi-slope", with convergence of the series dependent on both parameters of the surface roughness and of the observing scenario (i.e. geometry, polarization, and frequency). The determination of whether to use the first-order SSA (SSA1) or the second-order SSA (SSA2) therefore depends on these parameters. Because SSA2 is computationally expensive as compared to SSA1, computationally efficiency can be improved by avoiding computation of SSA2 when it is unnecessary. It is therefore helpful to know when to use a higher order SSA method for the scenario presented to provide accurate NRCS results efficiently. To investigate when the SSA2 should be used, the terms comprising the SSA2 were analyzed individually to assess their dependence on surface and observing system parameters. The contributions from each term are then compared to determine conditions in which they significantly impact the NRCS. The results reveal that SSA2 terms contribute more for rougher surfaces (higher RMS height, shorter correlation lengths), higher incidence angles, and higher surface permittivities. The presentation will review these results and provide guidelines for when the SSA2 is required. In addition, the behavior of the SSA2 in the high frequency and low frequency limits will be used to provide further information on series convergence properties.