SENSITIVITY ANALYSIS OF INCOHERENT EFFECTS ON MICROWAVE RADAR OBSERVATIONS OF PRECIPITATION MEDIA

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Precipitation media are characterized by hydrometeor distribution in a liquid, melting or ice phase. Their absorption and scattering properties can give rise to incoherent effects on the radar echo, mainly due to the angular scattering recovery. An approach to model the radar response in these conditions is to resort to the generalized radar equation, including coherent effects. The generalized radar equation can be derived from the radiative transfer theory and its solution is not straightforward as it takes an integro-differential form. Within this context, we propose a fast, fairly accurate analytical algorithm to simulate the radar response in presence of a stratified slab of rainfall or hail, characterized by a given precipitation rate. The solution is based on the expansion of the specific intensity in terms of Legendre polynomials, truncated to the first order. Accuracy of the analytical solution is evaluated against available numerical methods. Numerical results are compared to those obtained by using the classical radar equation, including the effects of the antenna pattern. Examples for ground-based and space-based radars at frequency from C to Ka band are discussed in terms of radar echo sensitivity. Incoherent effects are shown to apparently increase the received power and to be sensitive to the observation frequency, volumetric albedo and antenna beamwidth.