

RADAR BACKSCATTERING ANALYSIS OF SNOW AND SEA ICE AS MULTI-LAYER ELECTRICALLY DENSE MEDIA IN ROSS ISLAND ANTARCTICA

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Researchers have done previous works to understand the interaction of snow and sea ice with electromagnetic wave in Antarctica. However, there are many terrain types in Antarctica that requires more complex microwave remote sensing models to represent, such as snow covered sea ice above the ocean water. In addition, previous works mostly model the sea ice and snow as sparse media with the assumption of independent scattering from the scatterers (air bubbles, brine inclusions) without considering the close spacing effect of these scatterers. In this paper, a multi-layer theoretical model based on Radiative Transfer Theory is developed, by considering snow and sea ice as electrically dense random discrete medium. The Dense Medium Phase and Amplitude Correction Theory (DMPACT), which takes into account of the close spacing effect among the scatterers (air bubbles and brine inclusions), is applied to the sea ice and snow media. The air-snow interface and snow-sea ice interface are modeled using the Integral Equation Method (IEM) with the consideration of multiple surface scattering effects. The Radiative Transfer Equation is solved iteratively to include up to second order solutions so that the contributions of major scattering mechanisms are obtained and analyzed. The predictions from the model are verified with the radar returns recorded by Radarsat satellite SAR (Synthetic Aperture Radar) images using input parameters derived from ground truth measurement in Ross Island in Antarctica that were done from Years 2001-2005. Detailed backscattering components, such as surface scattering, volume-surface scattering and volume scattering contribution, from each layer are calculated and analyzed. The matching of theoretical results with satellite radar returns will be presented and the analysis of the trends of radar returns with respective to observation angle, frequency, polarization and changes in physical parameters of sea ice and snow will also be provided for better interpretation of satellite SAR images for applications in monitoring Antarctica terrains.