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Measuring Snowfall Using Satellite High Frequency Microwave Observations

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The goal of this study is to retrieve global snowfall from satellite passive microwave observation. First, the scattering of complex snowflakes is studied by discrete dipole approximation. The scattering cross sections and phase function are implemented in our radiative transfer model to develop retrieval algorithm. A snowfall retrieval algorithm based on Bayes' theorem is developed using high frequency microwave satellite data. In this algorithm, observational data from both airborne and surface-based radars are used to construct an *a-priori* database of snowfall profiles. These profiles are then used as input to a forward radiative transfer model to obtain brightness temperatures at high microwave frequencies. In the radiative transfer calculations, two size distributions for snowflakes and ten observed atmospheric sounding profiles are used with snowfall profiles from observations. In addition, the scattering properties of the snowflakes are calculated based on realistic nonspherical shapes using discrete dipole approximation. The algorithm is first verified by airborne microwave and radar observations and then applied to the Advanced Microwave Sounding Unit-B (AMSU-B) satellite data. The retrieved snowfall rates using AMSU-B data from three snowfall cases in the vicinity of Japan show reasonable agreement with surface radar observations with correlation coefficients of about 0.8, 0.6 and 0.96 for the three cases, respectively. The comparison results also suggest the algorithm performs better for dry and heavy snow cases, but is less accurate for wet and weak snow cases.