Abstract — A simplified approach is presented for assessing the microwave response to the initial melting of realistically-shaped ice particles. The paper is divided into two parts: (1) a description of the Single Particle Melting Model (SPMM): a heuristic melting simulation for ice precipitation particles of any shape or size. SPMM is applied to a pair of simulated aggregate snow particles, with melt fractions up to 0.15 melt fraction by mass; and (2) the computation of the linearly polarized scattering and extinction properties of microwave radiation, using the discrete dipole approximation, at the following selected frequencies: 13.4, 35.6, 94.0 GHz for radar applications; and 89, 165.0 and 183.31 GHz for radiometer applications. These selected frequencies are consistent with current microwave remote sensing platforms, such as the Global Precipitation Measurement (GPM) mission. Comparisons with conventional variable-density spherical shapes indicate significant deviations in scattering properties throughout the initial range of melting. Integration of the single-particle properties over an exponential particle-size distribution provides additional insight into sensitivity to variation in size/mass, shape, melt fraction, and particle orientation.

A key issue in forward model simulations of precipitation is accurate simulation of the ice and mixed-phase regions of a precipitating cloud. The present research focuses on the following tasks: (1) Development of realistic physical models of ice-phase and melting precipitation particles; (2) Computation of accurate scattering and extinction properties for the wavelengths of interest for these particles; (3) Incorporating these properties into a retrieval algorithm or forward modeling framework.

Relevant Research Goals: (1) Develop a method for simulating the melting of a realistically-shaped ice precipitation particle. (2) Identify parameterizations to simplify the computation of the scattering and extinction properties. (3) Determine whether more simplistic approximations provide adequate radiative properties.

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