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# Simulating Ice Particle Melting using Smooth Particle Hydrodynamics

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To measure precipitation from space requires an accurate estimation of the collective scattering properties of particles suspended in a precipitating column. It is well known that the complicated and typically unknowable shapes of the solid precipitation particles cause much uncertainty in the retrievals involving such particles. This remote-sensing problem becomes even more difficult with the “melting layer” containing partially melted ice particles, where both the geometric shape and liquid-solid fraction of the hydrometeors are variables.. For the scattering properties of these particles depend not only on their shapes, but also their melt-water fraction,and the spatial distribution of liquid and ice within. To obtain an accurate estimation thus requires a set of “realistic” particle geometries and a method to determine the melt-water distribution at various stages in the melting process. Once this is achieved, a suitable method can be used to compute the scattering properties.

In previous work, the growth of a set of astoundingly realistic ice particles has been simulated using the “Snowfake” algorithm of Gravner and Griffeath. To simulate the melting process of these particles, the method of Smooth Particle Hydrodynamics (SPH) is used. SPH is a mesh-less particle-based approach where kinematic and thermal dynamics is controlled entirely through two-body interactions between neighboring SPH particles. An important property of SPH is that the interaction at boundaries between air/ice/water is implicitly taken care of. This is crucial for this work since those boundaries are complex and vary throughout the melting process. We present the SPH implementation and a simulation, using highly parallel Graphic Processing Units (GPUs), with ∼1 million SPH particles to represent one of the generated ice particle geometries. We plan to use this method, especially its parallelized version, to simulate the melting of all the "Snowfake" particles (∼10,000 of them) in our collection, to form the basis for the construction of an extensive scattering database of the melting particles. Such a database will be invaluable to the characterization of uncertainty for precipitation retrievals.