

Summary of “ice properties” working group session and future plans

Updates on the progress made on the 12 deliverables and 3 metrics originally defined in the ICEPRO white paper were first given. The remainder of the session was devoted to discussion centered around 4 questions. Tangible developments from this and subsequent discussions are as follows:

1) **Model/measurement intercomparison studies** To address needs for modeling studies of Fridlind (NASA GISS) and others, measurements on the size dependence and distance from cloud top dependence of ice particle aggregation is needed. Chandra (UC Boulder) volunteered radar measurements showing the dependence of aggregation on distance from cloud top and other factors. This complements ongoing efforts by McFarquhar (UI) and Dong (UND) who are deriving fractional contributions of aggregates from MC3E and other data bases. Combined this would integrate retrievals from radar, in-situ data and modeling studies, and contribute to better understanding aggregation.

2) **Closure studies:** We discussed whether anything new or different should be done, including whether future campaigns should be done differently to make them more relevant. There was discussion on the ongoing collaborations at SGP (led by Mlawer, AER) and NSA (led by Lubin NSA). In addition, it was emphasized that cases were needed from a variety of climates, not necessarily including all ice clouds.

3) **Ice processes:** We discussed what processes we should focus upon for improving the representation (e.g., fall speeds, single-scattering properties, etc.). It was emphasized that the shape parameter for a gamma distribution, denoted as μ , was sorely needed in order to relate measurements to the size distribution moments. However, those estimating μ from in situ data noted that μ is poorly constrained, and that measurements from different probes using different size ranges can give very different values, especially given that μ is very sensitive to the concentrations of small ice crystals. Further, examination of in-situ data by McFarquhar (UI) has shown that adequate treatment of uncertainties means that volumes of equally realizable solutions in (N_0, λ, μ) phase space rather than point values is required to adequately represent gamma distributions.

4) ***m-D/A-D relations:*** Mitchell (DRI) presented a means of treating the process of ice particle riming in terms of *A-D* and *m-D* power laws for dendrites, and a means of generalizing this approach to other ice crystal habits was offered by Harrington (PSU). This may be useful in modeling the life cycle of Arctic stratus clouds. Since the meeting, another approach of improving *m-D/A-D* relations, especially for problematic small ice crystals, has been proposed using high-resolution ice crystal images (Lance of SPEC, and Mitchell of DRI); this will be implemented in CAM5 and is critical for determining optical properties of thin cirrus near the tropopause. Alternate approaches of using single particle databases to constrain models predicting the ice particle properties were also discussed.

5) **New field studies?** We discussed whether we were missing any high priority observations, and whether there were any other groups we should team up with for future measurement campaigns. Different ideas were raised here, including a campaign over the NSA to look at aerosols and ice nucleation at various temperatures (including $T < -40^\circ\text{C}$ where in situ measurements are absent), field campaigns trying to better constrain *m-D* relations, and a field campaign over the Southern Oceans.