

## Modeling, Data Assimilation, Dealing with Sparse Data (Session V) Plenary Discussion

These presentations discussed how cloud and aerosol uncertainties can dominate radiative transfer, general circulation and climate models. Cloud both reflect shortwave radiation and absorb/emit longwave radiation to different degrees depending on their altitude and optical depth, and microphysics can have a big effect on modeling, but is sub-grid scale and thus parameterized in a global model. The uncertainties can be accounted for to some extent by using a single GCM and perturbing all parameters within their allowable limits, comparing multiple GCMs, trying a super-parameterized GCM with a fine-scale cloud-resolving model in each gridbox (computationally intensive), and in the end, going back to first principles to check assumptions and validity of the model. “Snowball Earth” models show that the feedback of clouds can be very important in determining the fate of an atmosphere and habitability for tidally-locked planets. In addition, aerosols have been poorly represented in many models and may be the cause for why climate prediction models have overestimated anticipated heating. These are very poorly constrained, even for Earth – some contribute to cooling, some to heating, and there is a need for frequent (monthly) global monitoring, with information about particle size, shape, single scattering albedo to adequately account for their effects.

The plenary session included discussion about when is good, good enough? Detailed climate modeling and prediction is needed for Earth, but probably not solar system bodies, and certainly not exoplanets. Another topic of debate was the limitations of datasets. Should models strive to perfectly match imperfect data? This pointed to the need to understand observational systematic errors, and for observing a body more than once, even for the most basic parameters.