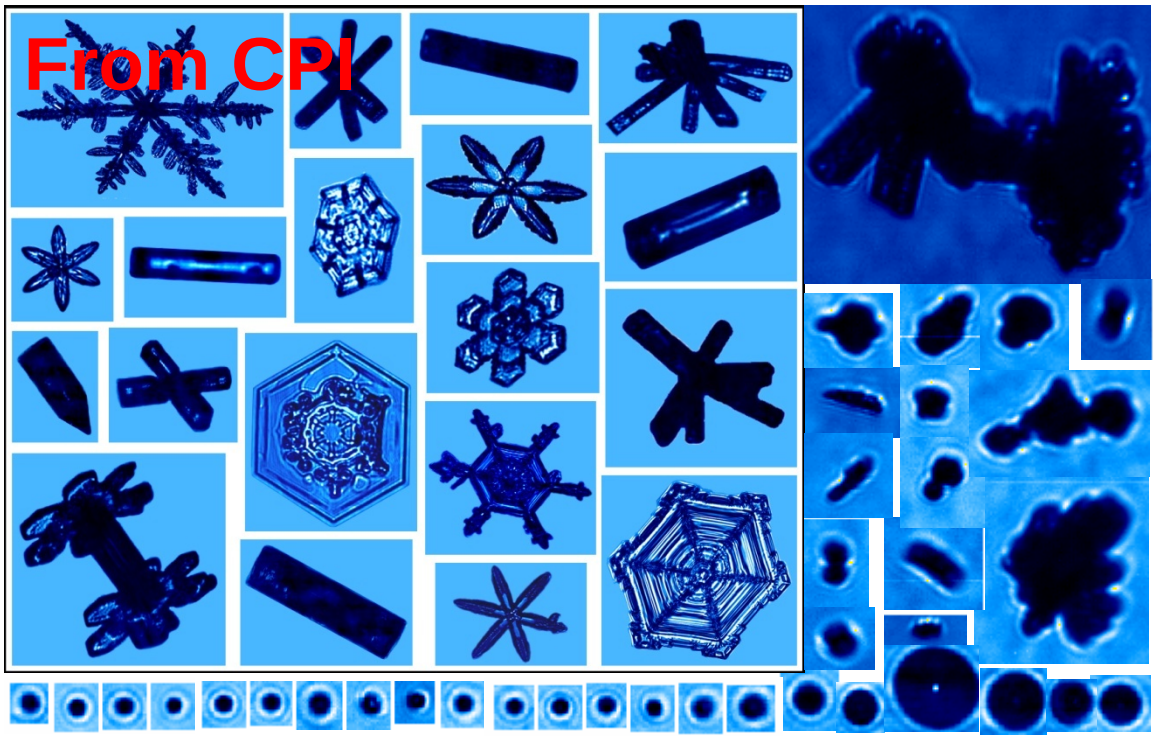
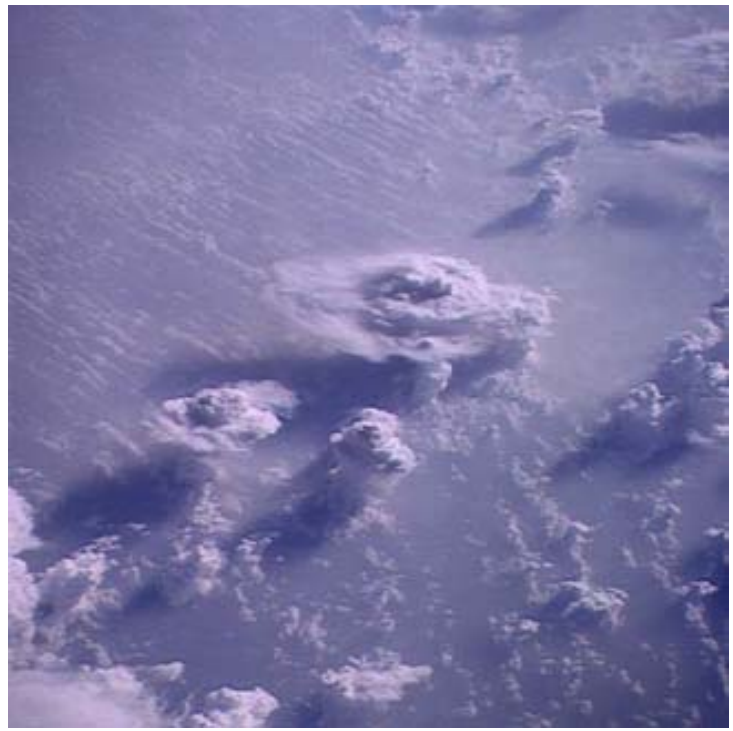
A Focus on Advancing our Understanding of

Cloud Microphysical Processes

Initializations, diffusion growths, and hydrometer interactions





Cloud Microphysical Processes –couple aerosol, dynamics, and the water and energy cycles in the atmosphere

There are large knowledge gaps in cloud microphysical processes, especially related ice.

- Very large differences between observed IN number concentration and ice concentration in a given clouds.
- Many ice nucleation modes are poorly understood or still unknown.
  - Heterogeneous freezing —two opposing views: **stochastic** versus **singular** behavior; Most of models use **Bigg (1953)** formulation.
- Turbulence impacts on hydrometer interactions are not fully quantified.
- …

Cloud microphysical processes represented in current models are far from “accurate” !

The intercomparisons of observations and model simulations are important, but not an effective way to improve cloud microphysical parameterization in models

- Complex cloud microphysical processes are included in models – hard to identify any issue related to a given process.
- Model simulations are also impacted by the other processes.

Understand cloud microphysical processes, then represent them in models!

The ARM Program is in position to make a significant contribution in the future

- Laboratory studies are not enough.
  - Not capture all nature processes
  - Do can contribute to some processes study
- ARCF long-term ground-base observations and extensive airborne observations (AVP) are more suitable for process-oriented study compared with satellite observations and other field experiments.
- Time is right too.

Where will we be in 30 years?

- Progress in computation
  - Moore's Law will give us a factor of about 10^6, we hope.
  - Global cloud-resolving models will be used in true climate simulations.
- Progress in understanding: Future parameterizations
  - A new focus on microphysical processes
  - How many clouds?

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