ICEPRO: A proposed ASR focus group on ice physical properties and processes that will coordinate individual research activities to address programmatic objectives.

Interested investigators should contact Greg McFarquhar or David Mitchell.

Objectives of IcePro

- Characterize ice properties represented in GCMs & their dependence on cloud/environmental factors (T, w, Na, Ni, composition, etc.) to improve processes depending on properties
- Establish linkage between ice observations & models (variety of scales) needed to investigate how cloud microphysical/radiative properties change with environmental conditions.
- Quantify mean/statistical size-distributions of ice & linkage to process rates, and how PSD uncertainties impact associated process rates and model results.

→ Need observations of ice particles & environment in which they exist

Tools for IcePro

1. Use in-situ observations to derive statistical databases (single ice particles & populations)
2. Utilize new ground-based scanning radar to develop retrieval techniques for crystal habits
3. Conduct spectral radiative closure to constrain ice particle physical & optical properties
4. Conduct model studies to assess sensitivity of modeled cloud processes and properties to representation of ice particle properties

UNCERTAINTY IMPORTANT FOR ALL ACTIVITIES

Other Needs

- Develop framework for determining how well physical properties need to be known
- Develop framework for evaluating degree to which candidate parameterizations fulfill established goals based on analysis of observations and simulation
- Identify gaps that still exist in ice cloud property database and parameterization, and possibly recommend additional field experiments needed to fill these gaps

Performance Metrics

- Deliver a database of single particle properties to ARM archive as PI products
- Deliver m-D and A-D relations, and SD attributes, to ARM archive that will be useful for model & remote retrieval studies
- Develop framework for determining how well physical properties need to be known
- Develop framework for evaluating degree to which candidate parameterizations fulfill established goals based on analysis of observations and simulation

Issues To Consider

- Today, need to identify specific people, funding sources and milestones willing to contribute to group; also need metrics
- Science questions that can be addressed by this focus group?
- Are there specific science gaps that cannot be filled by existing people on team?
- Is there a need for additional data products to be developed and what science questions can these products address?

Available Data on Ice μphysics

- Large databases exist with varying accuracies
  - Not known how properties vary by location, cloud type, formation mechanism, vertical motion, dynamics, meteorology, etc.
  - Such knowledge needed for process-oriented understanding & parameterization development
- Additional data in variety of conditions needed
  - properties of single ice particles & global populations
  - Need uncertainties associated with properties
  - Need to investigate optimal representations in models with variety of scales

ICEPRO Discussion Period

Climate Model Deficiencies	Possible Methods for Addressing Deficiency
m-D, A-D & AR expressions (affects microphys. growth rates, D_e, V_m, ice optics)	Develop or improve instruments that measure ice particle m, A and aspect ratio; improve data processing methods; characterize measurement Uncertainties; Develop databases describing Dependence on aerosols & meteorology
Ice nucleation	Analysis of microphys., w & RHi measurements, MIT CVI instrument
Quantify aerosol impacts on ice cloud microphysics and radiative properties	In situ measurements combined w satellite &/or ground-based remote sensing ➡ design GCM experiments constrained by measurements
Aggregation efficiency	Combine process modeling with in situ observations to improve Ea(T)
Degree of PSD bimodality (i.e. small ice crystals)	In situ measurements possibly combined with ground-based and/or satellite remote sensing

- Observations needed to evaluate models
- Develop a framework for uncertainties in cloud radiative forcing'
- Radiative closure studies in context of isdac; ground based microphysics/radiation and aircraft in situ data
- Establish consistent definitions between models and observations
- Activities needed on coordinating models and observations
- Framework on how uncertainties impact processes & properties
- Develop an ICEPRO website to help coordinate collaboration, databases, modelers, people who are working on same case study or project (e.g. Stormvex, SPARTICUS, etc.)
- Make better use of mountain observatories since cheaper than aircraft but similar measurements over extended periods of time.
- Consider blimps/airships/tether-sondes for cloud measurements; avoids shattering problem'
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