Cloud and Precipitation Measurements and Science Group (CPMSG)

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Goal and approach

To provide recommendations for improving the performance and science impact of ARM's measurements of clouds and precipitation

By

- Identifying **science needs** from the broader research community, and **measurements gaps** in instrumentations, products, and retrieval techniques
- Helping setting **the priorities**
- Providing ARM with **clear pathways** to address those needs and gaps

CPMSG members


Christine


Minghui


Kara


Mike


Christopher


Matt


Po-Lun


Jennifer


Ya-Chien

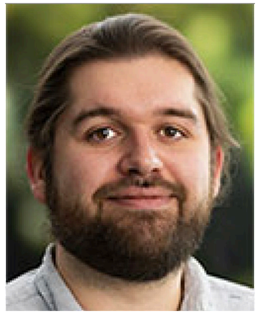

Paytsar


Alyssa


Nicki


Scott G


Adam


Joe


Rob


Ann


Scott C

Past Focuses of CPMSG

- Collect input and **we will continue collecting input!!**

- Input and discussions are documented using the science traceability matrix, showing a pathway from roadblocks to improved understanding and modeling.

- **Science traceability matrices can be found via the QR code.**

- These matrices will serve as an important document for the future strategic planning workshop.

Aim to address the following sub-topics

- **Study microphysical cloud properties at ENA** – Christine Chiu
- Study microphysical cloud properties at NSA and frozen precipitation processes – Minghui Diao and Matt Kumjian
- Study coupled dynamical and microphysical processes in convection – Mike Jensen
- Evaluate and refine radar measurement strategy – Adam Theisen
- **Develop in-cloud vertical velocity data products** – Christopher Williams
- Develop boundary layer structure best estimate products – Rob Newsom
- Develop precipitation best estimate products – Christine Chiu and Scott Giangrande

CPMSG Breakout Session

Today 4:15 – 6:15 pm White Flint

We need your input and feedback!

well as for precipitation. ARM will pursue advancing measurement capabilities in these areas and will continue to engage the science community to identify measurement priorities and new technologies that improve the characterization of these and other cloud- and precipitation-related parameters.

- *Cloud droplet number concentration:* ARM has implemented data products that provide droplet number concentrations through in situ measurements as well as through remote-sensing retrievals; however, work is needed to improve the accuracy of remotely sensed values.
- *Liquid water path in the presence of precipitation:* There has been much work on providing high-quality liquid water path measurements, primarily using microwave radiometers. In recent years, this work has included improved measurements for low liquid water paths; however, providing this measurement in the presence of precipitation remains a significant challenge and calls for development of modified measurements that minimize the collection of water on the radiometer and possibly modified retrievals.
- *Cloud hydrometeor phase and ice properties:* There has been a great deal of progress in this area using multi-frequency radars, radar spectra, and combinations of active and passive remote sensors, but there remains significant work to do, particularly with regard to deriving detailed properties of ice.
- *Frozen precipitation properties:* ARM has recently deployed several instrument systems on the North Slope of Alaska that provide measurements of ice particle shape, snowfall rate and snow depth, and auxiliary measurements that help distinguish falling snow from blowing snow. However, work is required to fully apply these measurements to obtaining a quantitative snowfall rate and spatial variability, especially near the coast, is an issue that is beginning to be explored.
- *Vertical air motion: Measurements of vertical air motion are critical for studying cloud processes.* A variety of instruments and techniques are being used to obtain vertical air motion in various domains (e.g., below cloud base and within clouds); however, significant challenges remain, including measurement of vertical motion above clouds and developing an integrated view of vertical motion.

Example of science traceability matrix

Science Question	How do coupled dynamical and microphysical processes drive convective lifecycle, and radiative and precipitation properties?				
Problems & Roadblocks	**Impact**	**Research Elements**	**Maturity/ Readiness**	**Solution/ Recommendation**	**Roadmap to modelling**
Uncertainties in retrievals of velocity and microphysical properties.	Accurate observational estimates of convective velocity and microphysics are needed to improve understanding of underlying convective processes, model validation and parameterization development. This is a significant shortcoming for interpreting convective simulations.	Multi-wavelength radar observations (VPT, scanning, polarimetric, spectral).	Research platforms are mature, but continuous operation remains a challenge. **(Medium)**	Focus on fewer, high quality radar platforms. **(3 months)** Calibration needed for quantitative data and products. **(6 months)**	High-quality, quantitative retrievals are necessary for process study analysis and model evaluation.
		Retrievals of vertical velocity	Historical methods are mature but may have uncertainties that are too large for target process studies. Validation difficult. **(Medium)**	Prioritize VAPS and follow-on analysis of existing retrieval algorithms. **(6 months)** Data assimilation approaches, e.g., through LASSO may be required. Doppler lidars can play a role for sub-cloud motions. **(6 months)**	Long-term datasets (statistics) of convective vertical velocity is an important target for large-scale models. Accurate retrievals are needed for evaluation of high-resolution models. Need regime-based evaluation.