Cloud and Precipitation Measurement and Science Group (CPMSG) Considerations for Convective Processes Working Group
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The CPMSG was assembled in 2019 to "improve the performance and science impact of ARM measurements of clouds and precipitation."

Discussions within the CPMSG and with the community have resolved into two general categories:
- Measurement or data product gaps that inhibit science advancement
- Processes, tools, etc. that could enhance the impact of ARM measurements

Current CPMSG membership and timeline

ARM's Cloud and Precipitation Measurements and Science Group

- Christine Chiu, Colorado State University
- Scott Collis, Argonne National Laboratory
- Jennifer Comstock, Pacific Northwest National Laboratory
- Ann Fridlind, NASA Goddard Institute for Space Studies (chair)
- Scott Giangrande, Brookhaven National Laboratory
- Nicki Hickmon, Argonne National Laboratory
- Michael Jensen, Brookhaven National Laboratory
- Matthew Kumjian, Pennsylvania State University
- Paytsar Muradyan, Argonne National Laboratory
- Rob Newsom, Pacific Northwest National Laboratory
- Alyssa Sockol, University of Oklahoma
- Matthew Sturm, University of Alaska, Fairbanks
- Adam Theisen, Argonne National Laboratory

CPMSG Initial Meeting   21 March 2020
(approx. quarterly meetings)

CPMSG Breakout   12 June 2020

CPMSG Virtual Workshop   23-24 March 2020 (included workshop chairs)

Plan to deliver workshop report this summer

Convective Processes – Measurement or Data Product Gaps

Evolving matrix focused on 2 convective processes science questions:

- How do coupled dynamical and microphysical processes drive convective lifecycle, and radiative and precipitation properties?
- How do convective processes and properties and their relationships/feedbacks with the environment vary in different regimes?

Based on input from CPMSG members, working group chairs, and breakout session participants defined elements of matrix:

Problems and Roadblocks

Scientific Impact

Research Elements (i.e. instruments, measurements, retrievals)

Maturity and/or Readiness for implementation

Solution or Recommendation

Roadmap to modeling

Processes, tools, etc. that could enhance the impact of ARM measurements

Short-term measurement strategies (i.e., in between IOP and long-term continuous)
- e.g., varying configurable measurement systems for specific science objectives
- Scanning radar systems, Doppler lidar, radiosondes
- Operational and science benefits
- Trade-offs with long-term continuous measurements

Maintain list of infrequently used measurements/products
- Identify measurements or products that may be discontinued or repurposed

Solutions to reduce size of high-volume datasets
- Is continuous collection of radar Doppler spectra necessary?
- Are there unique solutions for storing data and information content?

Regime classifications
- Climate, Synoptic, Cloud, Data Availability and Quality (Virtual IOPs)
- Need to define regimes that would be of most use to community (beyond a single PI)

Processes, tools, etc. that could enhance the impact of ARM measurements

Open-source and community code paradigm for data products
- Sharing of code among program and contributors
- Opportunities for tailoring data products for specific needs

Frameworks across modeling and observation teams for limited joint exercises
- Towards model intercomparison and evaluation case studies
- Parameterization and process model development
- Bringing together observationalists and modelers

Matrices for recording problems and roadblocks to scientific progress
- Convection example just presented
- Working document with continuing input from science users

Convective Processes – Problems and Roadblocks

Roadblock: Uncertainties in retrievals of velocity and microphysical properties
- **Measurements:** Multi-wavelength radar observations (VPT, scanning, polarimetric, spectral)
- **Readiness:** Platforms and many retrievals are mature but continuous radar operation, calibration, and retrieval validation and uncertainty quantification remain challenging
- **Recommendations**
  - Focus on fewer radar platforms, some of which operate over shorter periods
  - Ensure radar calibrations and corrections are done and prioritized before retrievals
  - Acquire more in situ data for retrieval validation
  - Explore integration with LES modeling and/or machine learning

Roadblock: Rapid evolution of convection requires specialized observational approaches
- **Measurements:** Scanning or phased array radar and aircraft in situ
- **Readiness:** Currently no phased array radar; Agile scanning is possible with operator; Automated tracking algorithms do not yet exist
- **Recommendations**
  - Develop automated tracking algorithms for scanning radar
  - Utilize LASSO for algorithm development and integration
  - Investigate phased array options

Convective Processes – Problems and Roadblocks

Roadblock: Poorly observed, localized, 4D environment has significant impacts on dynamics and microphysics

- **Measurements:** Frequent radiosondes, remote sensing retrievals, in situ aerosols and meteorology
- **Readiness:** Instrumentation is mature but remote sensing retrievals have limitations, in situ measurements aloft are expensive, and sampling is spatiotemporally limited
- **Recommendations**
  - Need more distributed thermodynamic/wind sampling
  - Explore integration with modeling through data assimilation and/or LASSO
  - Target better CCN profile retrievals

Roadblock: More, detailed observations of convection in varying environments are needed

- **Measurements:** Comprehensive cloud, precipitation, and environmental observations
- **Readiness:** See other roadblocks; logistical difficulty of some locations
- **Recommendations**
  - More oceanic measurements are needed
  - Revisiting past locations with latest observational techniques and lesson learned

Some links

ARM CPMSG Webpage
https://www.arm.gov/about/constituent-groups/cpmsg-group

ARM CPMSG Charter
https://www.arm.gov/publications/programdocs/doe-sc-arm-19-001.pdf

ARM News and Events Feature on CPMSG Workshop
https://www.arm.gov/news/facility/post/61545