Breakout Session Report
ARM/ASR User and PI Meeting
March 16-20, 2015

Session Title: Drizzle Retrieval
Session Date: Monday, March 16, 2015
Session Time: 7:00-9:00pm
Summary Authors: Laura Riihimaki, Steve Ghan (and presentations by David Mechem, David Turner, Ed Eloranta, Ed Luke, Christine Chiu, Pavlos Kollias)

Main Discussion

Framing of relevant science:

- Outstanding scientific challenges related to drizzle:
    - cause and effect for drizzle rate,
    - representativeness of cloud breakup mechanisms,
    - role of solar forcing,
    - boundary layer collapse.
- Impact of turbulence has not previously been evaluated very well in model simulations. New measurements from Doppler lidar could help.
- Observation needs to move science forward:
    - better sampling of cloud properties over the diurnal cycle
    - precipitation rate with uncertainty
    - joint pdfs of cloud and CCN variables.

Measuring liquid water path (LWP) in raining conditions:

- New 3-channel microwave radiometer (MWR) systems much better with better geometry and stronger blower, but still have problems keeping radome dry in precipitation.
- Two major challenges with MWR retrievals:
    - Must correct for water on radome (currently, this is the harder problem)
    - Need to adjust retrieval algorithms to deal with non-Rayleigh scattering (this is achievable, though would take some work).
- A possible path forward would be a research project to be able to correct for the impact of water on top of the radome by matching rain rates and adjusted signal; alternatively could develop mechanical means of removing liquid.

New multi-instrument retrievals presented of simultaneous drizzle/cloud properties and statistical uncertainties:

- Christine Chiu's ENCORE retrieval reported good agreement with a liquid water content (LWC) retrieval using spectral zenith radiance and radar measurements compared to MWR measurements, but for accuracy needs 1.6 micron channel.

- Ed Luke's Doppler spectra retrieval (plus ceilometer, Doppler lidar, MWR, sondes) calculates air velocity, eddy dissipation rate, cloud LWC, and drizzle microphysics.
- Additional advances with high spectral resolution lidar below cloud-drizzle rates presented by Ed Eloranta.

X-band scanning ARM precipitation radar 2 (X-SAPR2) plans and relevance for drizzle-science questions:

- Will likely have some sample X-SAPR2 data by the fall meeting, after early fall testing.
- X-band calibration and attenuation correction will both be very important for usable rain rates; in the absence of in situ data, vertically pointing radar retrievals could be used as "truth."
- Some discussion of scanning strategies; may need a "wide net" scanning strategy at first to help understand what science questions can be answered.

Discussion of how to understand which retrievals give most accurate picture:

- Ground, in situ validation needed: traditional rain gauges are not sufficiently sensitive
- Dedicated intensive operational period (IOP) to sort out? Retrieval intercomparison?
- Retrieval intercomparison can tell us something without ground truth.

Key Findings

- Retrieving drizzle would provide an important constraint on modeling
- Drizzle retrieval is difficult with microwave because (a) Rayleigh conditions do not apply for microwave, (b) contamination by water on the microwave radome.
- Active methods show great promise, but need validation and intercomparison.

Decisions

- Compare methods for the same conditions.
- An IOP is needed to gather in situ or ground validation data.

Needs

- A way to characterize water on MWR radome
- In situ measurements for validation
- 1.6 micron radiance measurements improve ability to retrieve drizzle/cloud properties without MWR, so could be very useful for consistency.

Future Plans

Need to intercompare retrievals.

Action Items

Develop proposal for an IOP.