1. RACORO*-FASTER: Case Study Generation

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**RACORO=Routine Atmospheric Radiation Measurement (ARM) Aerial Facility (AAF) Clouds with Low Optical Water Depths (CLOWD) Optical Radiative Observations*

Summary

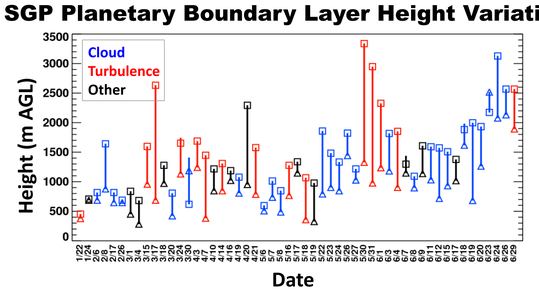
- As part of the FAst-physics System TEstbed and Research (FASTER) project, RACORO aircraft data are being synthesized with SGP data to construct case studies to assess and improve models of continental boundary layer clouds and their fast-physics processes.
- The variation in these continental case studies offer a physical contrast to the Global Cloud System Study boundary layer case studies (GCSS, now GASS) that have focused primarily on steady-state, marine boundary layer clouds.

1. What's RACORO & What New Does it Contribute?

RACORO was a 5-month cloud aircraft campaign conducted over the SGP to obtain an in-situ characterization of boundary layer clouds and their environment (Vogelmann et al., BAMS, 2012).

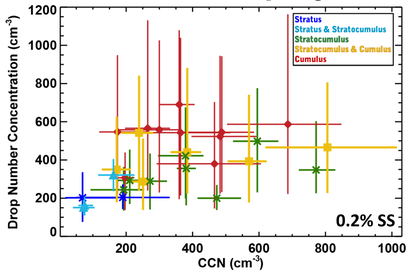
- Diversity
  - Boundary layer cloud types (Cu, St, drizzling St)
  - Time variation/transitions (multiple days/timing)
- Extensive data synthesis (in progress)
  - Aircraft (Aerosol*, Cloud, Radiation, Atmospheric State)
  - SGP observations
  - Entrainment analyses [Lu et al., 2012a,b]
- Structured approach for high-resolution models to inform:
  - Single column models
  - High-resolution model parameterizations (inter-HRM assessments)
  - Observational needs

SGP Planetary Boundary Layer Height Variation



The PBL variation over the SGP is given during flight times, showing a large variation of conditions. The PBL heights were derived using Raman Lidar+AERI potential temperature profiles (data courtesy of Rich Ferrare).

Cloud and Aerosol Property Variation



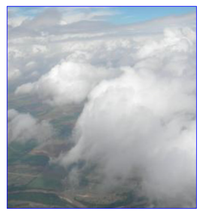
A somewhat systematic change in cloud type is seen across this *CCN–N_d* phase space, where the lower N_d and *CCN* values coincide with the stratus cases and the upper range coincides with the cumulus.

2. FASTER Case Study Selection/Development

Data-to-model progression takes a team!

Tandem Multi-Pronged Approach

1. Observations (This poster)
   - Chose aircraft flights that sampled different cloud states/mixtures
   - Multi-day periods with minimal advection effects
2. Single-Column Models (Lead: Wuyin Lin)
   - Examined the full RACORO period
   - Tendency to over trigger in the different models
   - **See Wuyin Lin's poster! →**
3. High-resolution modeling (Lead: Ann Fridlind and Satoshi Endo)
   - Examined selected periods
   - Test runs verified quality of variational analysis (!)
   - **See Satoshi Endo's poster! →**



Many viable periods were found; three 3-day periods were selected as a starting point.

Also see related posters:

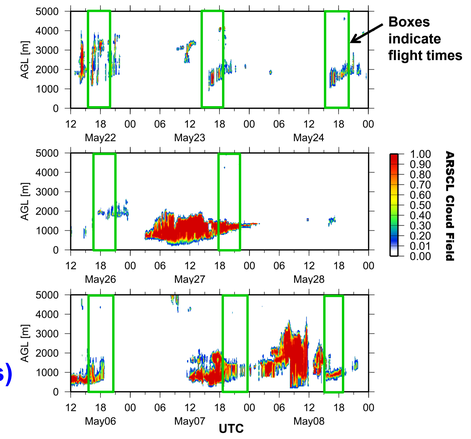
Yangang Liu's poster: An Integrative LES-CRM-SCM-NWP Evaluation Framework →
Zhijin Li's poster on Multiscale Aerosol Data Assimilation →
Sha Feng's poster on Improved Hydrometeor Simulations using Data Assimilation →

3. Three 3-day Case Study Periods

Case 1: Cumulus with Variable Aerosol
- May 22-24
- CCN drops 600 → 350 cm^{-3}
- Median updrafts ~1 m/s

Case 2: Cumulus and Drizzling Stratus
- May 26-28
- CCN low (170, 280 cm^{-3})
- Median updrafts change 10x (0.9 → 0.1 m/s)

Case 3: Variable Cloud Types
- May 6-8 (St → Sc, St & Cu, Sc)
- CCN variable (200, 580, 210 cm^{-3})
- Median updrafts low and varied (0.4, 0.8, 0.4 m/s)

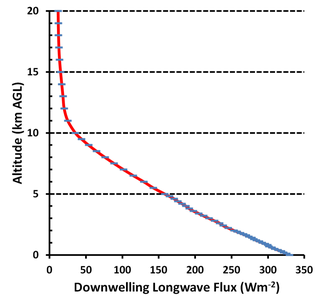


The Plan:
- Generate integrated realistic cases for FASTER
- Later simplify to observationally constrained "idealized/hybrid" cases (for ease of use)

4. Observational Constraints: Aerosol & LW Fluxes

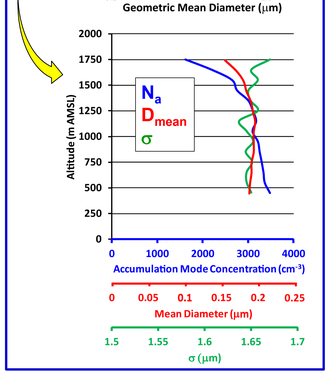
RACORO aerosol profile observations
- CCN (multiple supersaturations)
- Aerosol number concentrations
- Size-resolved number concentrations

Longwave Flux Calculations

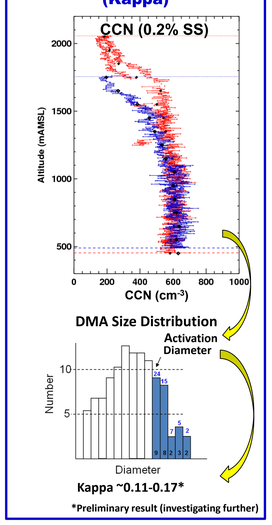


Downwelling longwave fluxes computed from sondes using Modtran, providing the model-top boundary condition for LES simulations.

Aerosol Accumulation Mode Fits



Aerosol Hygroscopicity (Kappa)



Kappa ~0.11-0.17*

*Preliminary result (investigating further)

Acknowledgements & References

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Reference and for more information on RACORO see:

RACORO ACRF Website: http://acrf-campaign.arm.gov/racoro/

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