Langley Aerosol Research Group Experiment (LARGE)

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  - Aerosol Optical and Microphysical Properties from the DC-8

- High-level of collaboration with other research groups
  - University of New Hampshire (Chemical Composition)
  - Georgia Tech. (Cloud Condensation Nuclei)
  - Georgia Tech. (Aerosol Biological Analyses)
  - Clarkson University (Aerosol Inlet Development)

- Collaboration with other experiments
  - LASE (LaRC), CALIPSO (LaRC), Heymsfield (NCAR)

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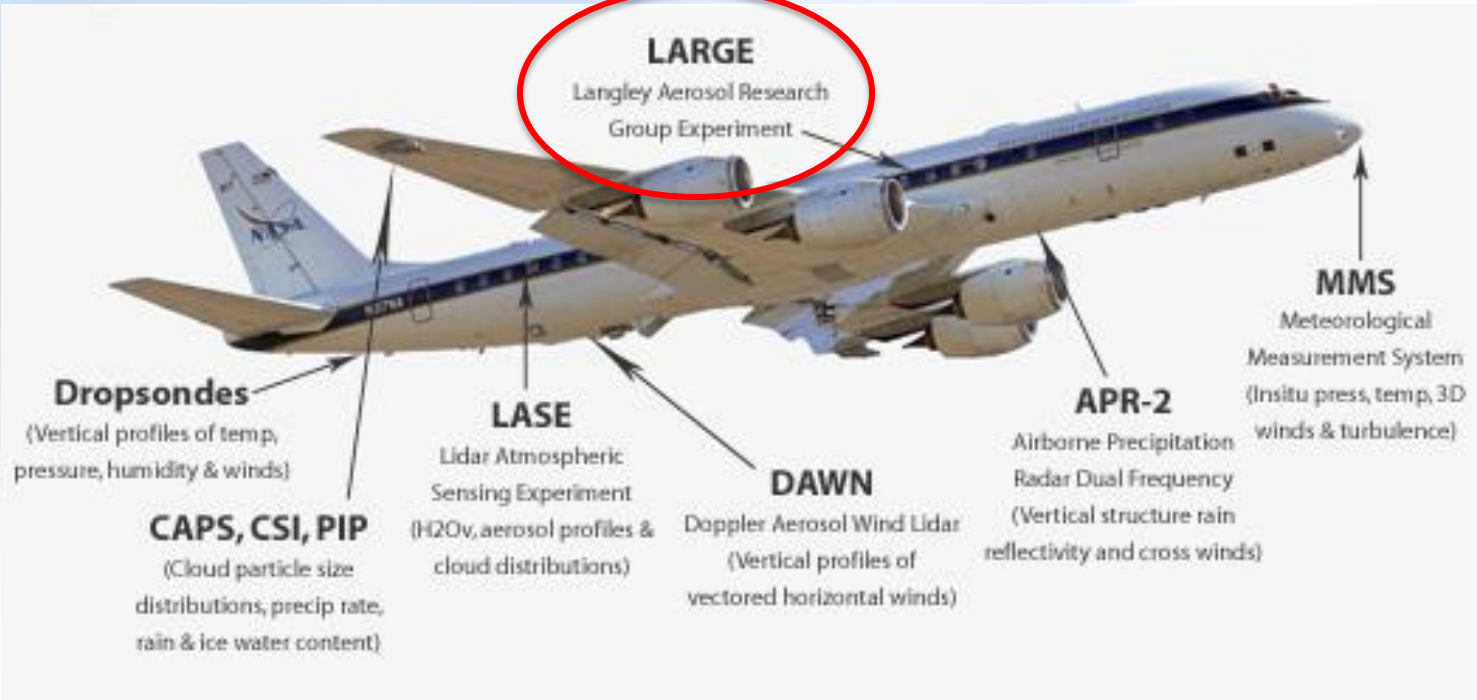


LARGE Instrumentation

- Aerosol Concentrations:
  - Total and Non-Volatile Particles
  - CCN spectra (activation efficiency)
- Aerosol Sizes (10 nm - 5 µm):
  - Primary indication of dust
- Optical Properties:
  - Scattering & Absorption Coefficients (Extinction)
  - Single Scattering Albedo
  - Scat. Angstrom Exponent (aerosol size)
- Black Carbon Mass (SP2)

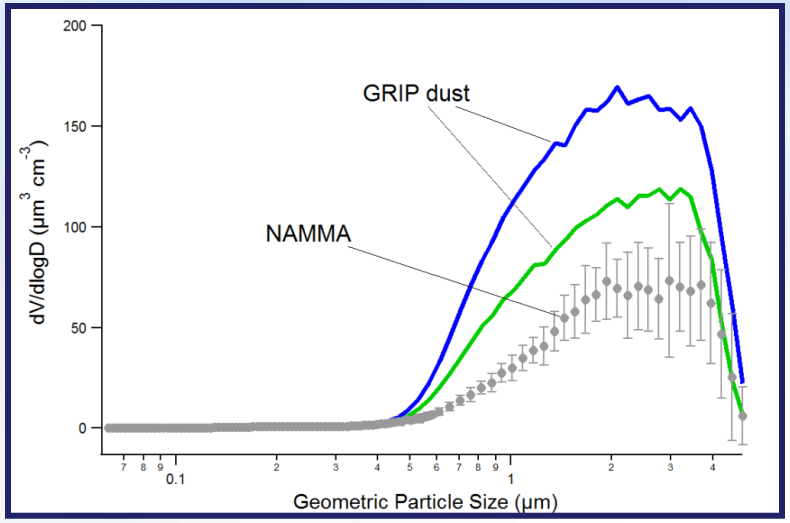
LARGE Areas of Interest

Preliminary results are presented here:

Lathem et al. (poster)
Ziemba et al. (poster)

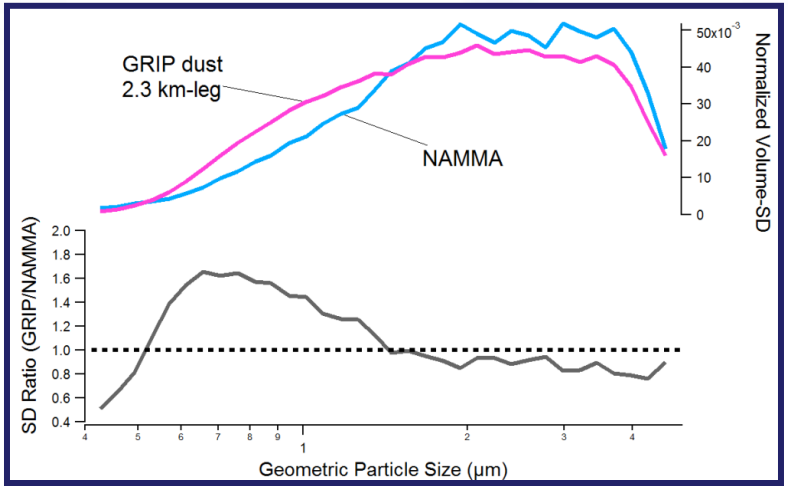
1. Comparison with NAMMA
2. New particle formation in the eye of hurricane Earl
3. Evaluation of aerosol products from remote sensors (CALIPSO)
   - Upper troposphere/lower stratosphere black carbon concentrations and distributions
   - Characterization of aerosols in storm region for improved model constraint

Comparisons to NAMMA



- GRIP size distributions qualitatively similar to NAMMA

- Comparison shows a shift towards smaller dust/pollution particles during GRIP



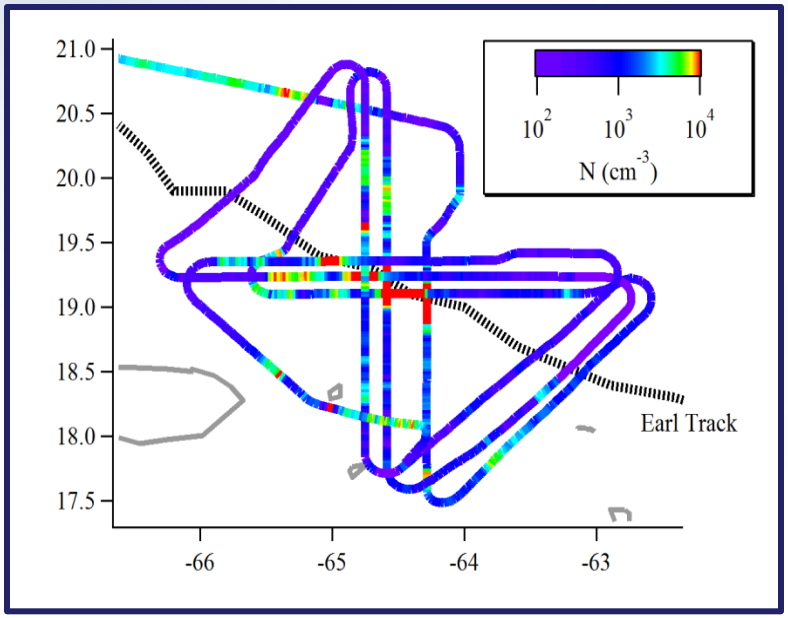
NAMMA

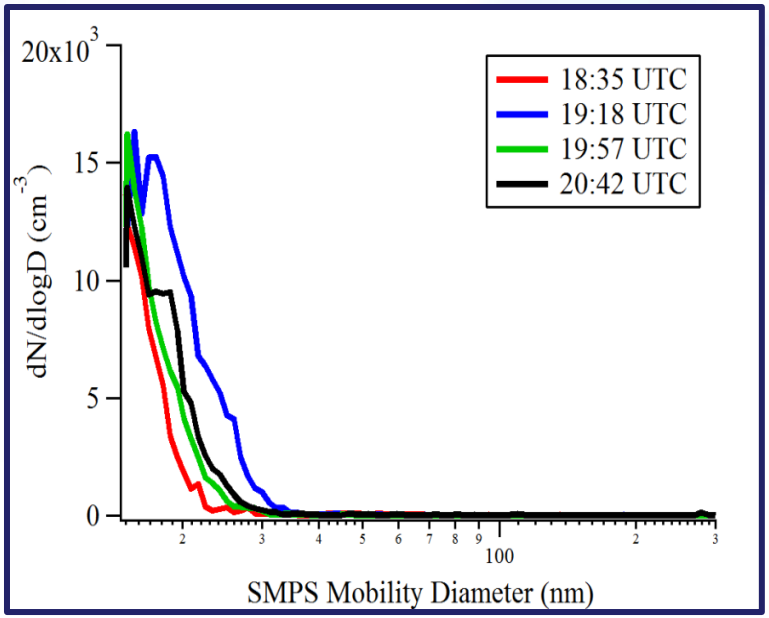
- 62 Dust layers studied
- Size distributions and optical properties uniform over study area
- Integrated AODs agree with LASE, CALIPSO and MODIS; varied from 0.3 to 0.7
- Mass extinction coeff. = 1.09 m^2 g^{-1}
- SSA = 0.97 ± 0.02
- n = 1.53 + 0.0022*i*

Chen et al. [2011], ACP

New Particle Formation during Earl

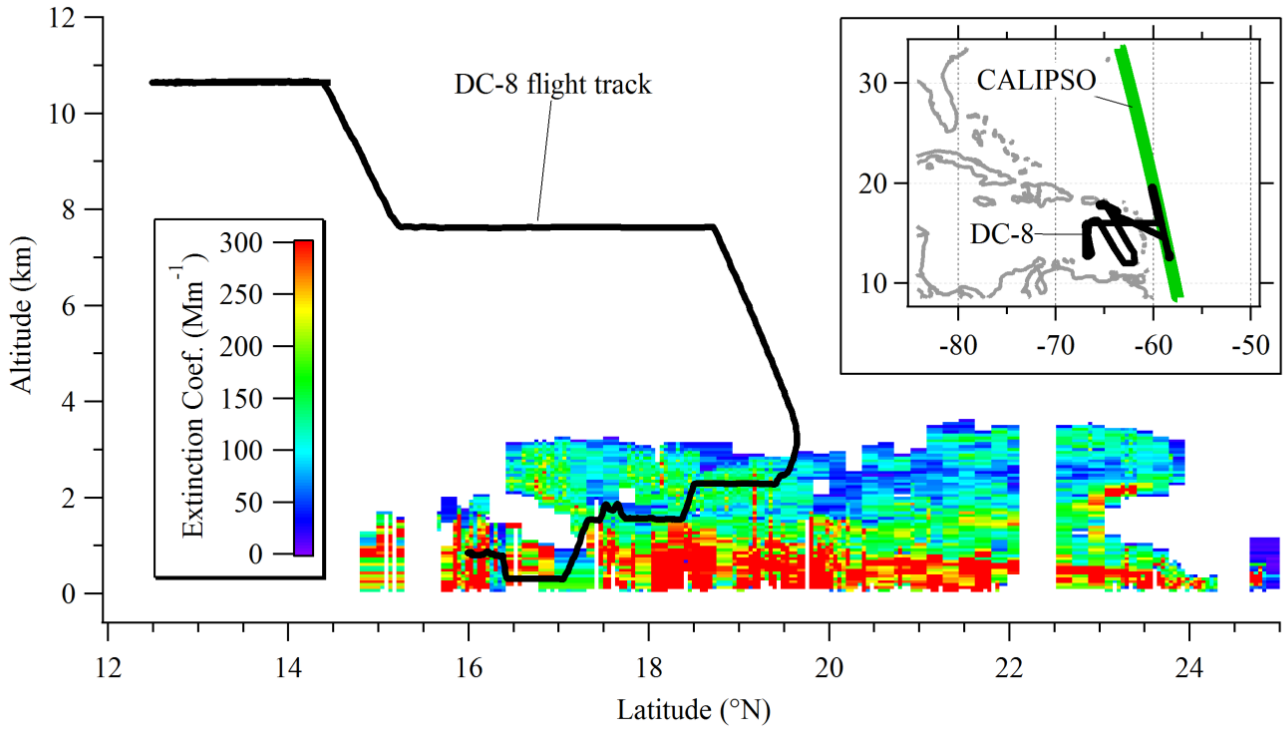
- Evidence for particle nucleation during GRIP seems associated with the Hurricane eye penetration
- This was only distinctly observed during one flight, were conditions unique during Cat-3/Cat-4 transition?
  (low pre-existing aerosol, sunlight, condensable gases)





Flight 10, 8/30/11

Comparison with CALIPSO



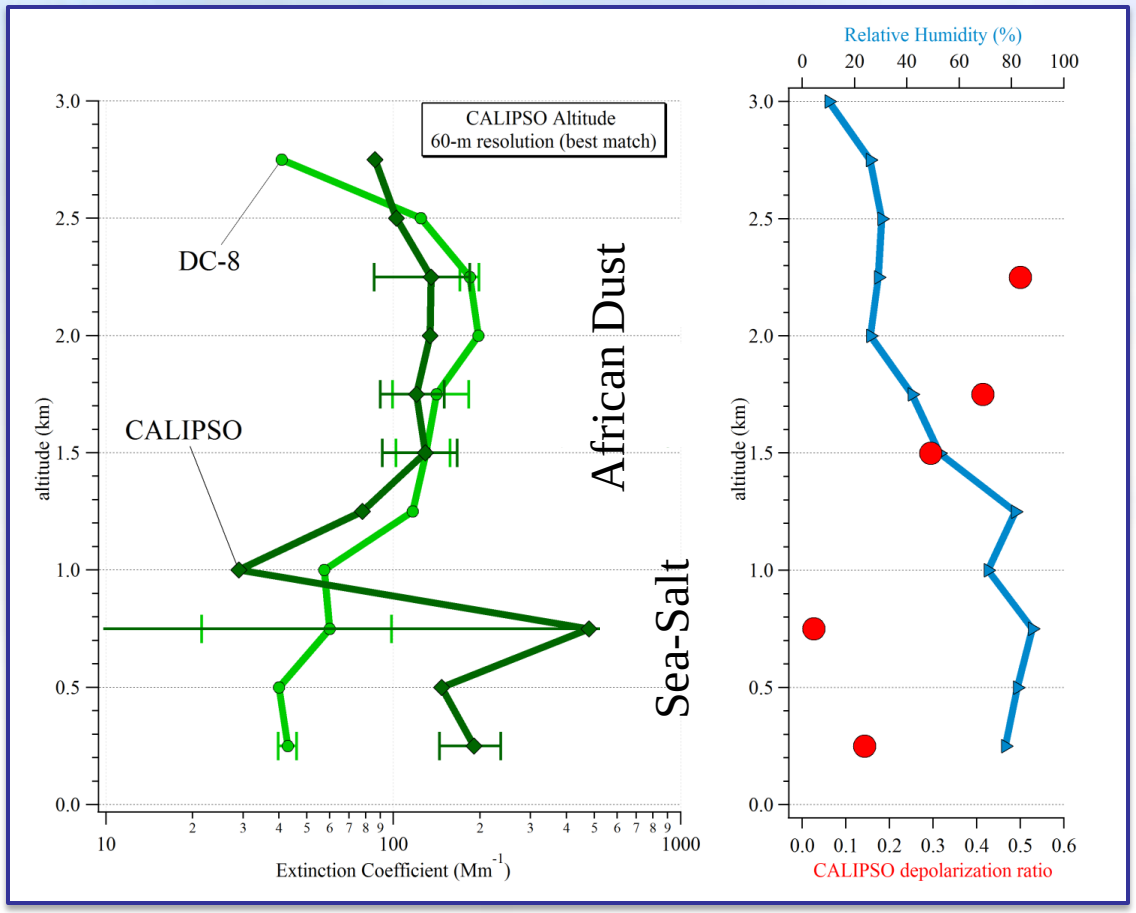
- 4 level legs in 3-km layer

Statistics !

Composition !

Flight 23, 9/21/11

Comparison with CALIPSO



- Dust and sea-salt layers identified by chemical composition
- In Situ and CALIPSO-derived extinction coefficients agree well for dust layer, deviate for sea-salt

Flight 23, 9/21/11

Cloud Condensation Nuclei (CCN) Measurements

- CCN Instruments integrated onto NASA DC-8 and NOAA P-3
- Instruments operated in new method of "Scanning Flow", ***providing the first measurement of fast CCN spectra within hurricanes and dust layers.***
- Complete CCN spectra (CCN at 0.2 - 1.0% Supersaturation) every 30 seconds!

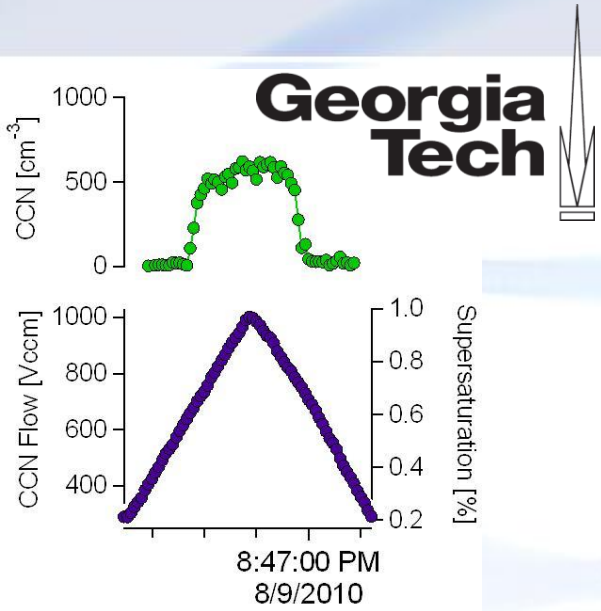
CCN Data Goals: (See Lathem Poster)

1) Build Observations: categorize concentrations, gradients, and profiles of CCN in developing storms.

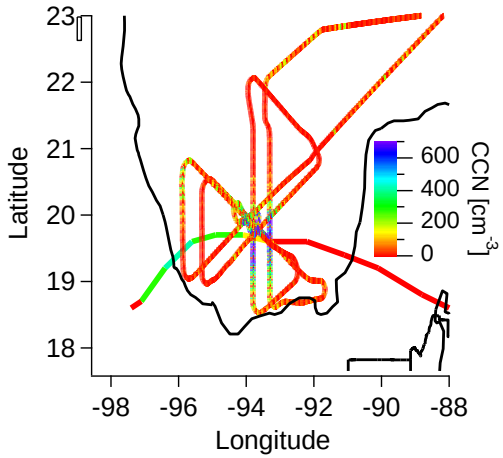
2) Improve Models: Are these observations consistent with tropical cyclone (TC) microphysical model inputs?

3) Impact: Sources of aerosol and CCN? Do they impact TC development?

4) Impact: Influence of cloud nucleating dust from the Saharan Air Layer (SAL) on TC development.



Representative Scanning Flow CCN data



CCN distributions for Hurricane Karl

Analyses for Biologic Material

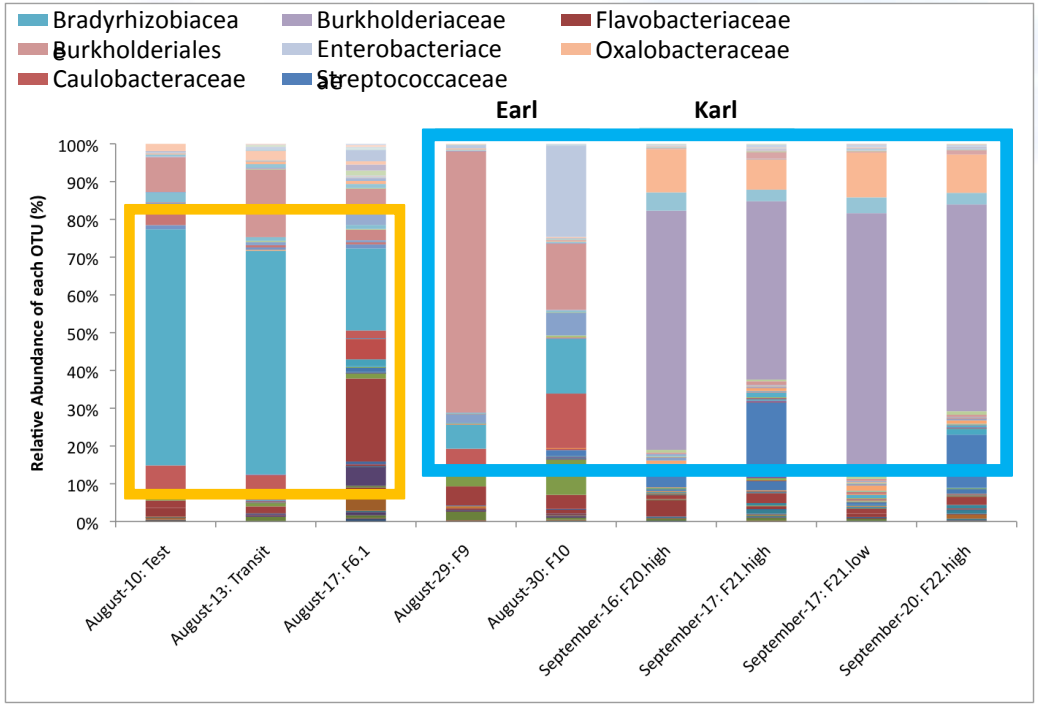
DNA extraction

Bacterial Quantification (quantitative PCR and microscopy) + **Bacterial Identification (Phylogenetic analysis of 16S rRNA)** + **Functional Characterization (Community DNA Analysis, i.e. metagenome)**

To study the microbial community in the atmosphere we use an integrated approach involving molecular tools, microscopy imaging, and isolation of bacteria.

- Preliminary results show a shift in bacterial community composition before and after major hurricanes pass.

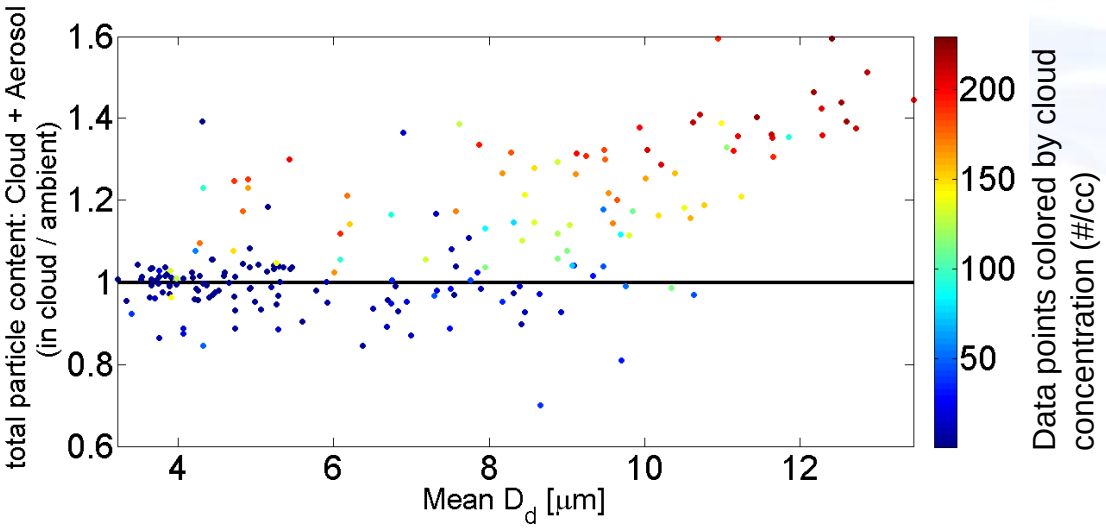
- Our data suggests that the bacterial community change from organisms commonly found in **soil environments** to organisms that are very abundant in **marine and freshwater ecosystems**.



Clarkson University Aerosol Inlet

- Inlet designed to sample only sub-micron aerosol
- Allows accurate in-cloud sampling of aerosols

- Inlet performed well with low concentrations of small cloud particles
- Aerosols enhanced at cloud drop diameter > 8 µm



Current Status and Future Work

- Data in archive (ftp://grip.nsstc.nasa.gov)
- Further evaluation of CALIPSO/CloudSat products for dust/sea-salt case study
- Assess the consistency between model inputs and in situ observations
  - Size distributions
  - CCN, total particle number concentration
  - Vertical distribution
- Investigate the impact/extent of hurricane eye new particle formation

- Thanks -