Session 6B Synthesis

Aerosol-Cloud-Drizzle Interactions

Patrick Chuang

Presentations:

Peter Daum: Overview of G-1 measurements
Bruce Albrecht: Aerosol-cloud Interactions in coastal marine Sc - Overview of Twin Otter observations
Xue Zheng: Aerosol, cloud, drizzle data from Twin Otter flights.
Dione Rossiter: Cloud microphysics and drizzle fluxes
Patrick Chuang: What controls stratocumulus drizzle and entrainment
Frederic Burnet: Fast FSSP measurements
Larry Kleinmann: Aerosol size distributions and activation
Gunnar Senum: High speed cloud microphysics
Peter Cook (M): Examining cloud-scale processes using LEM, comparison with aircraft measurements
Jefferson Snider: CCN, Aerosol and Cloud Droplets
Jorgen Jensen: Impact of giant aerosols on drizzle formation
Aerosol-Cloud

- Strong gradient in sub-cloud aerosol from coast to open ocean, mainly in number and not in composition.
- Fairly low increases in [CCN] at supersaturation > 0.1 ~ 0.2%.
- In some cases, activated fractions are very high, even in near-shore environment.
- Sub-cloud aerosol correlates well with cloud drop concentration; above-cloud aerosol correlates poorly with cloud drop conc.
- Hoppel minimum (associated with cloud processing of aerosol) is observed in many cases.
- There was wide variability at Pt. Alpha in BL structure, which should be considered in looking at aerosol-cloud interactions.
Cloud

- BAe-146 and C-130 cloud microphysical probes are exhibiting good agreement
- A possible homogeneous mixing event was observed (none was seen during DYCOMS-II)
- Large fluctuations in cloud properties over short length-scales (order 1 to 10 m) can be seen
Cloud-Drizzle

- Evidence of threshold behavior of auto-conversion (G-1)
- At Pt. Alpha, drizzle is:
  - generally not well-developed, and very light
  - is usually maximum at cloud top, with a few cases with significant cloud base flux
- Cloud top sedimentation-entrainment feedback may be an aerosol indirect effect independent of cloud base drizzle flux
Aerosol-Cloud-Drizzle

- LWP is well-correlated with drizzle @ Point Alpha
- Some initial hints that drizzle may be anti-correlated with aerosol @ Point Alpha
- Initial evidence that giant (sea-salt) aerosol may affect drizzle production (but likely not in POC regions)
- Model predicts differences in cloud microphysical and radiative properties between 72W and 79W. These properties are predicted to be sensitive to drizzle, surface energy fluxes and aerosol.
Looking forward...

- Must move from qualitative to **quantitative** description
- Macrophysical vs microphysical variable controls of drizzle
- Teasing this apart requires:
  - that meteorology and aerosol be uncorrelated
  - (hopefully) a wide dynamic range in these variables. Best achieved by combining data from all platforms
  - it is crucial to evaluate both of these factors
- Integration of snapshots to help build a time-continuous story (movie from photos). This requires:
  - integration of aircraft data (pre-requisite is self-consistent measurements)
  - closely working with models at multiple scales