SPartICus: Small Particles In Cirrus

ARM Aerial Facility Field Campaign

Science Steering Committee

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SPartlCus Science Objectives

- What is the nature and variability of the particle size distribution in cirrus?
- How do cloud-scale dynamical processes control the evolution of cirrus properties through nucleation, particle growth, and sublimation?
- What degree of complexity is required in cloud property retrieval algorithms, and what minimal set of algorithms can be used to rigorously describe cirrus microphysical properties using ground-based ACRF data?
SPartIcUs Summary

- Routine aircraft in situ measurements in cirrus over SGP
- Total Hours: 200 hr (190 research / 10 test flight)
- 47 Flight Days (1-3 flights per day)
  - 23 SGP Flights
  - 21 CALIPSO/CloudSat Flights (9 combined with SGP flights)
  - 3 TERRA
  - 8 Orographic, wave clouds, or other cirrus not associated with remote sensors
Platform: SPEC, Inc. Learjet 25

Instruments

- FSSP, CDP, 2D-S, 2D-P, CPI
- Deep Cone Nevzorov (CSI for 7 flights)
- Rosemount, AIMMS-20
- Water Vapor: DLH (PI Glenn Diskin)
Flight Domain and Objectives

1) Focused flights over ARM SGP site
2) CloudSat/CALIPSO underpass along satellite orbital track
3) Cirrus within the flight domain
<table>
<thead>
<tr>
<th>Measurement</th>
<th>Responsible Party</th>
<th>Status</th>
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<tbody>
<tr>
<td>Aircraft Parameters (position, attitude, etc)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<tr>
<td>State Variables (T, P, etc)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<tr>
<td>Water Vapor (DLH)</td>
<td>Diskin</td>
<td>Prelim. Data available. Final due 4/7</td>
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<tr>
<td>AIMMS-20 (T, P, Winds)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<td>2DS (PSD &amp; Images)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<tr>
<td>CDP (PSD)</td>
<td>Lawson</td>
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<td>FSSP (PSD)</td>
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<td>CPI (Images)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<td>Nevzorov (Total Water)</td>
<td>Lawson</td>
<td>Final Data in IOPshare (by 3/31)</td>
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<td>Raman Lidar Extinction</td>
<td>Comstock</td>
<td>Jan-Jun Data will be archived with Sparticus dataset (4/30)</td>
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<tr>
<td>CSI (Total Water)</td>
<td>Comstock</td>
<td>Calibration Needed (target 4/30)</td>
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<tr>
<td>Data Quicklooks and Calipso Images</td>
<td>Comstock</td>
<td>Final versions will be produced and archived after final data submitted</td>
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Science Objectives

- Nature and variability of Cirrus Properties?
  - Lawson, Diskin

- Coupling between cloud and larger scale dynamics and cirrus evolution?
  - Xiaohong Liu

- Remote Sensing?
  - Mace, Cooper, Schwartz, Mitchell, Mishra
2010/02/03 Nebraska
Homogeneous Thin Cirrus
2010/02/19 Western Oklahoma
Heterogeneous Thin Cirrus
2010/04/17 Just East of SGP
Anvil
2010/03/17 SW Wyoming and NE Colorado
Cloudsat-Calipso Retrieval
Cloud Property Retrievals from Doppler Spectra over SGP
2010/02/27 at 0214 UTC
Cloud Property Retrievals from Doppler Spectra over SGP
2010/02/27 at 0223 UTC
Preliminary CSI Data Compared with Nevzorov and FSSP

Closure Studies with Cloud Probe data will be used to assess total water measurements.
How are the properties of cirrus clouds affected by nucleation mechanisms and sub-grid-scale variability of water vapor and vertical velocity?

Using Measurements (Comstock):
- Examine nucleation zone characteristics ($T$, $RH$, Vert. Vel., $N_{ice}$, etc.)
- Characterize sub-grid variability of WV and Vert. Vel. and their correlation to microphysical properties

Using Models (Wang and Liu):
- Improve statistical cirrus cloud scheme in CAM5 (Wang and Penner 2010) using sub-grid scale analysis of SPartlCus aircraft and SGP data.