CIRPAS Twin Otter -- Scientific Objectives

• Aerosol-Cloud-Drizzle Interactions
  – Process Studies
  – Gradients in Clouds and Aerosols

• Coastal Processes
  – Diurnal Cycle
  – Stagnation Effects
# Twin Otter Instrumentation

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Observations/Purpose</th>
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</thead>
<tbody>
<tr>
<td>Standard met</td>
<td>Winds, temp, dewpoint, cloud liquid water, sfc temp, turbulence (Carl Friehe)</td>
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<tr>
<td>Towed-Platform (optional)</td>
<td>Turbulence near surface</td>
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<tr>
<td>94 GHz Doppler FMCW radar</td>
<td>Cloud properties; in-cloud turbulence</td>
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<tr>
<td>Chaff (Dropsonde) Dispenser (with radar)</td>
<td>Track air movements — entrainment, sub-cloud cloud layer coupling, large eddies</td>
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<tr>
<td>CPCs</td>
<td>Ultrafine aerosols</td>
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<tr>
<td>PCASP</td>
<td>Aerosols 0.1-3 μm</td>
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<tr>
<td>FSSP</td>
<td>Clouds 2-40 μm</td>
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<tr>
<td>CIP</td>
<td>Drizzle 25-1500 μm</td>
</tr>
<tr>
<td>DMA/TDMA (Don Collins)</td>
<td>Aerosol size/hygroscopicity</td>
</tr>
<tr>
<td>N-Mass</td>
<td>5 channel CN, fast response</td>
</tr>
<tr>
<td>CCN-200</td>
<td>CCN (fast 2-point; slow 6 points)</td>
</tr>
<tr>
<td>Phased Doppler Interferometer (Patrick Chuang)</td>
<td>Cloud-drizzle 2-600 μm</td>
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<tr>
<td>SP2-Black Carbon</td>
<td>BC mass and ratio to total particles</td>
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</table>
VOCALS
CIRPAS Twin Otter

Aircraft Specs:
• Airspeed: ~ 130 knots
• Duration: 4 hours
• Range: 200-400 km

VOCALS Deployment:
80 hours: 20 hours/week
Flight Plans for VOCALS

- Feature/Process Sampling
- Diurnal Cycle and Coastal Gradient Mapping
Feature Sampling – Soundings and Horizontal Legs at Different Levels
CCN Number Concentration for Level Legs during flight 990716

Drizzle Rate for Level Legs during flight 990716

Ultrafine Particle Concentration for Clear Air Rift during flight 990716

Sharon et al, (2006, JAS)
Diurnal Cycle and Near Coast Sampling

- Levels at 50, 500, 1000, 1500m; soundings at end of legs
- 05-06 AM and 04-05 PM
Missions (20 total)

- Features and Process Studies (#?)
- Diurnal (#?)
- Coastal Mapping (#?)
- Coordination with other aircraft (?)
Proactive Probing—Cloud Seeding

Purpose: Study response of cloud microphysics to artificial introduction of giant CCN – cause and effect (Hypothesis 1A and 1B)
Cloud Response

[Graphs and diagrams showing data distributions and wind directions related to flare experiments and PCASP event break-up.]
VOCALS Seeding – Artificial Introduction of GN and UGN in Stratocumulus

Role of GM and UGN in Precipitation Enhancement
(Hypothesis 1A and 1B)

• Seeding Techniques
  – Flares
  – Salt (CaCl$_2$) – Grind and dispense
  – Water – Spray

• Targets
  – Near-shore polluted marine
  – Clean marine (POCS environment)
VOCALS Seeding? – Artificial Introduction of GN and UGN in Stratocumulus

Hypothesis 1 A and 1B

• Flares
• Salt (CaCl$_2$) – Grind and dispense
• Water – Spray
Cloud Seeding as a Technique for Studying Aerosol-Cloud Interactions in Marine Stratocumulus

• Feasibility demonstrated
  – Marine stratocumulus provide stable background
  – Small (cloud-inactive) aerosols produced by flares make useful tracers
  – Clear evidence of broadening of the cloud droplet distribution by condensational growth and collision and coalescence processes

• Potential for future studies
  – Model evaluations of microphysical responses to aerosol forcing
  – Seeding possibilities
    • Aerosol size and composition variations
    • Background effects on response
    • Transports