RACORO

Routine
Aerial Vehicle Program (AVP)
Clouds with Low Optical Water Depths (CLOWD)
Optical
Radiative
Observations

CLOWD Session Briefing
RPWG Meeting

RACORO Objectives

- Conduct long-term, routine flights in boundary layer, liquid-water clouds at SGP measuring:
  - **Microphysical properties**
  - **Optical properties and radiative fluxes**
  - **Aerosol properties & Atmospheric state**
- Statistics needed – these clouds are thin and/or broken, making retrievals uncertain
  - **Help develop & evaluate ARM retrievals**
  - **Improve our understanding of boundary layer clouds and their interactions with aerosols & radiative fluxes**

The RACORO Steering Committee

Andy Vogelmann	**Science coordinator, CLOWD co-chair**
Greg McFarquhar	**AVP Chief Scientist, *In situ* cloud obs**
Dave Turner	**CLOWD Co-chair, Surface retrievals**
Jennifer Comstock	**CLOWD Translator, Lidar FG, BBHRP**
Graham Feingold	**Cloud-aerosol interactions**
Chuck Long	**Radiometer mentor, flux analyses**
John Ogren	***In situ* aerosol & cloud obs (7 yrs, 2x wk)**

Operations

CIRPAS Twin Otter

Speed: 55 m/s
Flight ceiling: 12,000 ft (no O_2)
Research Capacity: 1,500 lbs
Has needed AC & DC power

Schedule

Field period: 22 January to 30 June 2009
Frequency : 2-3 times a week (4-5 hrs each)
QC'd data in archive: 1 January 2010

Science & Operations Plan

In progress
Full draft by Thanksgiving (feedback), final by early December

Systematic Operations

Seasonal flight time partitioning

- **Time split evenly within the Jan-June period**

Flight timing

- **Sample diurnal cycle, including some nighttime flights**
- **Timing prefers satellite overpasses**
- **Fly Saturday, Monday, and Wednesday, roll to next day if no-go**

Flight patterns

- **Preset matrix of spirals & level legs**
- **Some pilot discretion for slightly modifying location of legs**

Chain of Command

RSC rotation schedule

One week as 2nd in command, followed by one week as PI

Go/no-go telecon briefing participants

RSC PI

RSC 2nd in command

Surface meteorologist (cloud spotter)

Pilot (aviation conditions)

AVP representative

Final decision made by AVP rep based on recommendations

- **Science recommendation (RSC-ers)**
- **Flight operations recommendation**

RACORO Instrumentation

- Instrumentation must be
  - **Robust/reliable**
  - **Low maintenance**
  - **Simple/routine processing**
  - **Low weight & power**

  Prefer:
  - **Fast response**
  - **Large sampling volumes**
- Approach
  - **Pair a slow, accurate measurement with a fast, precise measurement**

Cloud Microphysics

LWC

- **Gerber Probe (LWC & Reff)**
- **SEA LWC Probe**

Drop Size Distribution

- **FSSP-100 0.3 – 47 µm**
- **CAPS 0.5 – 1,550 µm**
  - **CAS 0.5 – 50 µm**
  - **1D & 2D CIP 25 – 1,550 µm**
- **2DS 10 – 1,280 µm**

Extinction

- **Cloud Integrating Nephelometer (CIN)**

Aerosol

CCN

Dual-Column CCN Spectrometer (DMT, Inc.)

Size Distribution

Sample at 1 Hz

Ultrafine Particle Counter — **D > 3 nm**

2 Condensation Particle Counters — **D > 7 or 10 nm**, **D > 12 nm**

Scanning DMA (10 – 750 nm) **~0.01 Hz (60-90 secs)**

PCASP (100 – 3,000 nm) **1 Hz**

Atmospheric & Flight State

Atmospheric State

- Temperature (Rosemount)
- Water vapor
  - Chilled mirror (CR2) 1 Hz for T > -40°C
  - Diode Laser Hygrometer (DLH)
- Pressure, Updraft velocity & Turbulence (Gust probe)

Flight State 10 Hz

- Lat/lon, Altitude, Altitude over ground,
- Heading, Pitch & Roll angles
- Ground speed, Ground Track,
- E-velocity, N-Velocity, Up/Down Velocity
- Video
- (NovAtel, TANS Vector, C-MIGITS-III, Video)