# CLOWD Overview

## Andy Vogelmann & Dave Turner
## Jennifer Comstock

### Plus LOTS of PI Contributors

## Outline

1. Introduction
2. Current Activities
3. VAPs
4. CLOWD STM Breakout Report
5. RACORO, an AVP Preproposal

# Who's Doing What?

**CLOWD founded by Dave Turner**

**Organization**
   **Dave Turner, Andy Vogelmann, Jen Comstock**
   **MANY PI efforts**

**VAPS**
   **Comstock, Turner, Vogelmann**

**Programmatic Proposals**
   **Us, plus whoever wants to play (!)**
   **Chief Scientist Team help through Vogelmann**
   - **Has 20% CS support, mostly for CLOWD**
   - **Help front the admin to get ideas moving**
   - **CS Team soundboard**

# FY 07 Activities & Accomplishments

**CLOWD BAMS article published Feb, 2007 !!**
   **A nugget in this year's ARM Annual Report**

**CLOWD Meetings this FY**
   **Fall RP WG (Washington, DC) – Plenary Session**
   **Fall CP WG (Annapolis, MD)  – Break out (Liquid Phase)**
   ➔ **See PI presentations posted at ARM CP & RP WG pgs**

   **STM 2007 – Break out (Just happened! Report follows)**

**Field Studies – Maria Cadeddu**
   • **MWR IOP (SGP)**
   • **GVR (NSA)**

# Programmatic Proposals

## Cloud Microwave Validation Experiment in Support of CLOWD

Andy Vogelmann, Dave Turner, Maria Cadeddu, Christine Chiu, Jen Comstock, Jim Liljegren, Alexander Marshak
Status: Accepted

## TC-RSR Instrument Proposal
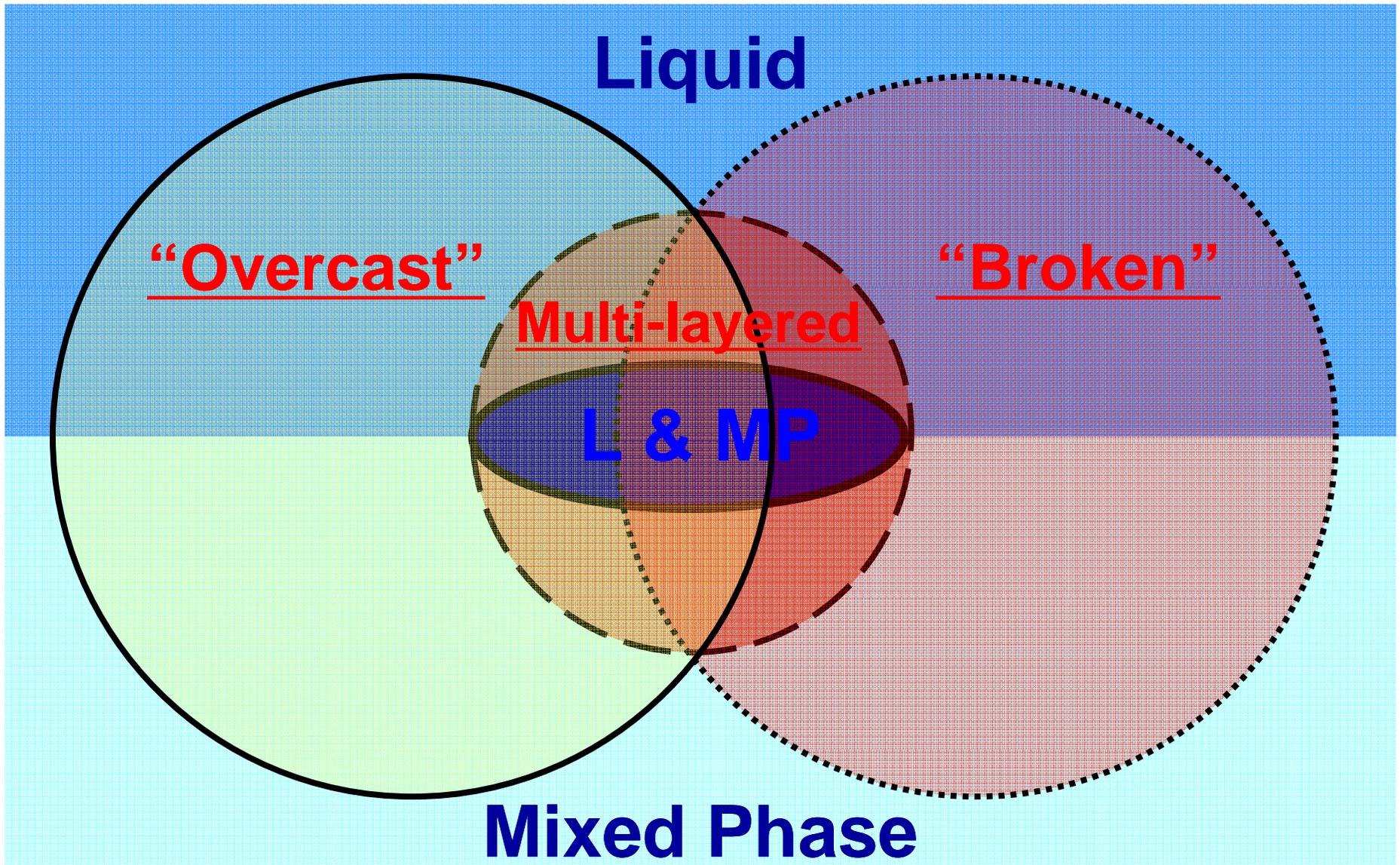
Andy Vogelmann, Qilong Min, Mike, Reynolds
Status: Pending

## RACORO, an AVP Proposal

Andy Vogelmann, Greg McFarquhar, Dave Turner, Jen Comstock, Graham Feingold, Chuck Long & John Ogren
Status: Preproposal submitted

# CLOWD Clouds

# CLOWD VAPs & Plans

| CLOWD Regime |
| --- |
| Liquid water (Only) |
| Overcast |
| Broken (or overcst) |
| Mixed Phs (+/or wat) |
| Broken or overcast |
| Multi-Layered |
| Broken or overcast |

**Cloud Type Classification VAP**

# CLOWD VAPs & Plans

| CLOWD Regime | VAPs | S  L | LWP | Tau | Reff |
|---|---|---|---|---|---|
| **Liquid water (Only)** | | | | | |
| Overcast | | | | | |
| Broken (or overcst) | | | | | |
| **Mixed Phs (+/or wat)** | | | | | |
| Broken or overcast | | | | | |
| **Multi-Layered** | | | | | |
| Broken or overcast | | | | | |

**Cloud Type Classification VAP**

S="Small"; LWP< 25 gm$^{-2}$
L="Large"; LWP > 25 gm$^{-2}$

All methods might not have been tested on true CLOWD type clouds (the real thin stuff)

# CLOWD VAPs & Plans

| CLOWD Regime | VAPs | S | L | LWP | Tau | Reff |
|---|---|---|---|---|---|---|
| **Liquid water (Only)** | | | | | | |
| Overcast | MFRSR Diffuse | | | | | |
| Broken (or overcst) | MWRRET | | | | | |
| **Mixed Phs (+/or wat)** | | | | | | |
| Broken or overcast | MPL | | | | | |
| **Multi-Layered** | | | | | | |
| Broken or overcast | Microbase | | | | | |

**Cloud Type Classification VAP**

S="Small"; LWP< 25 gm$^{-2}$
L="Large"; LWP > 25 gm$^{-2}$

All methods might not have been tested on
true CLOWD type clouds (the real thin stuff)

# CLOWD VAPs & Plans

| CLOWD Regime | VAPs | S | L | LWP | Tau | Reff | Initiatives | S | L | LWP | Tau | Reff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Liquid water (Only)** | | | | | | | | | | | | |
| Overcast | MFRSR Diffuse | | | | | | Long & Barnard | | | | | |
| | | | | | | | MPL Solar Bkgrnd | | | | | |
| | | | | | | | TC-RSR (proposed) | | | | | |
| Broken (or overcst) | MWRRET | | | | | | New 90/150s | | | | | |
| | | | | | | | 2-NFOV (& 3-NFOV) | | | | | |
| **Mixed Phs (+/or wat)** | | | | | | | | | | | | |
| Broken or overcast | MPL | | | | | | D. Turner | | | | | |
| **Multi-Layered** | | | | | | | | | | | | |
| Broken or overcast | Microbase | | | | | | M. Shupe | | | | | |
| | | | | | | | Spectral Radar | | | | | |
| | | | | | | | Z. Wang | | | | | |
| **Cloud Type Classification VAP** | | | | | | | | | | | | |

$S = "Small"; LWP < 25 \ gm^{-2}$
$L = "Large"; LWP > 25 \ gm^{-2}$

All methods might not have been tested on true CLOWD type clouds (the real thin stuff)

# CLOWD Breakout Meeting Report
## Held Monday, 1:30 to 3:00 (Hot off the press!)

**Focus Groups Are not intended to live forever**
- Form on a pressing topic
- Do a few highly visible things
- Disband to make room for new Focus Groups

**Charge**
- Brainstorm CLOWD's "legacy"
- Establish task ownerships

***Why Invitation Only?* It wasn't a normal Breakout Session**



- Navigate Breakout conflicts (1.5 hrs)
- Minimal Introduction (know the issues already)
- Small, dynamic group
  - Facilitates discussion
  - Say the hard things (if needed)

# CLOWD Breakout Meeting Report

## *Things We discussed*

- **RACORO**
- **CLOWD Instruments and VAPs**
- **LES model fields to test retrievals**
- **PI Products**
  - **==> VAPs**
  - **BBHRP vetting?**
    - **NETCDF standard format**
    - **Code to enter output into said format**
- **Direct link to modeling**
  - **WRF Test bed? (Nested → 100 m inner grid)**

# RACORO Overview

**R**outine

**A**erial Vehicle Program (AVP)

**C**louds with Low Optical Water Depths (CLOWD)

**O**ptical

**R**adiative

**O**bservations

*Steering Committee*

Andy Vogelmann, Greg McFarquhar, Dave Turner, Jennifer Comstock, Graham Feingold, Chuck Long and John Ogren

# Overview

- Conduct long-term, routine flights in boundary layer, liquid-water clouds at SGP to measure
  - Microphysical properties
  - Optical properties and radiative fluxes, and
  - Associated aerosol properties & atmospheric state
- Long-term statistics needed because these clouds are thin and/or broken, which make retrievals highly uncertain
  - Help develop & evaluate ARM retrievals
  - Improve our understanding of how boundary layer clouds interact with aerosols & radiative fluxes

# **Relevancy to ACRF**

- Climatology critical for cloud modeling & interpretation
  - 50% of liquid clouds have LWP < 100 g m$^{-2}$
  - Retrieval algorithms differ by 50 to 100% for these clouds

- CLOWD has shown that their cloud radiative effects must be determined with greater accuracy
  - Small uncertainties in their optical properties can affect energy balance & their response to climate forcing

- Clouds with low liquid-water amounts are one of greatest uncertainties in climate models (these clouds are not even resolved in GCMs)
  - these data can help develop & evaluate their improvement in climate models.

**ARM** *Atmospheric Radiation Measurement Program*

# Proposed Experiment

- Fly pre-determined flight tracks over the SGP 2 to 3 times/week for 1 year

- Flight legs envisioned:
  - Focus on low LWP clouds, but sample whatever clouds present to get representative statistics
  - Straight, ~20 km long legs at multiple heights where clouds are present
  - Spirals over central facility

- Times may be planned with satellite overpasses

- Some nighttime flying

- Routine observations must use instrumentation with very high reliability and "easy" processing

**ARM** *Atmospheric Radiation Measurement Program*

# Instrument Suite

- Envision low-level, slow-flying aircraft observing:
  - Cloud microphysics (SDs, bulk LWC, βe)
  - Radiometric quantities (↑ and ↓ SW & LW radiometers, SW spectra to map surface albedo)
  - State parameters (fast response T, water concentration, & turbulence)
  - Aerosol properties (SD [D > 50 nm], CCN and CN)
  - Aircraft telemetry (speed, pitch, roll, video?)

# Our Mascot
# RACORO the Raccoon