Cloud-Field Radiative Properties from RACORO

RACORO

R outine
A RM Aerial Facility (AAF)
C louds with Low Optical Water Depths (CLOWD)
O ptical
R adiative
O bservations

Steering Committee

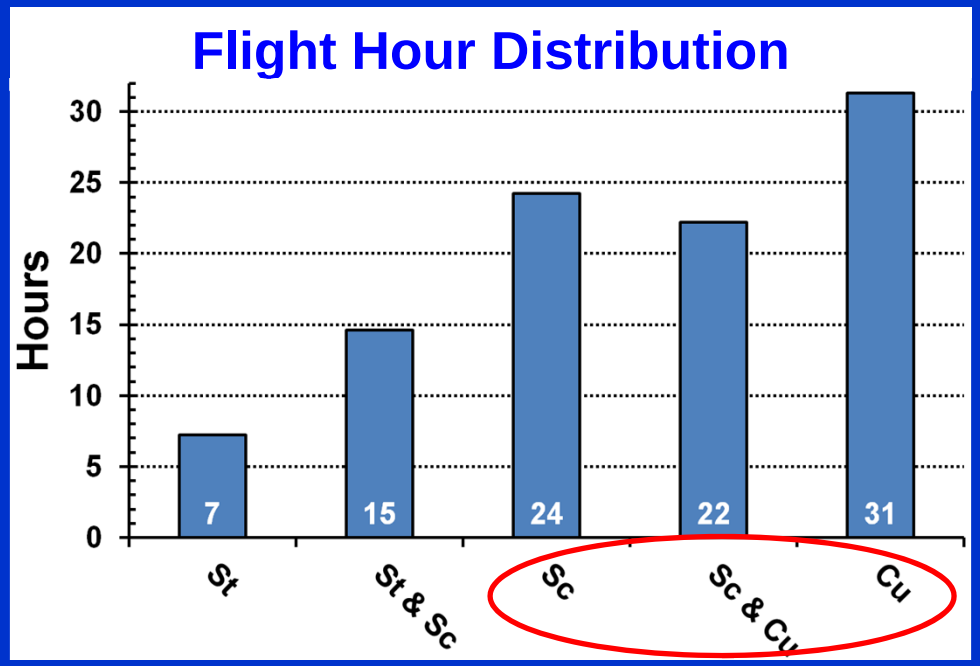
Andy Vogelmann, Jennifer Comstock, Graham Feingold, Chuck Long, Greg McFarquhar, John Ogren, Dave Turner

RACORO *BAMS* (submitted)

Can CLOWD cloud-field aircraft observations be used to obtain radiative closure?

- CLOWDs
- Cloud vs. aerosol ambiguity

RACORO Cloud-Field Sampling



24 January to 29 June 2009

260 hrs in 59 Research flights

31 Cloud flights

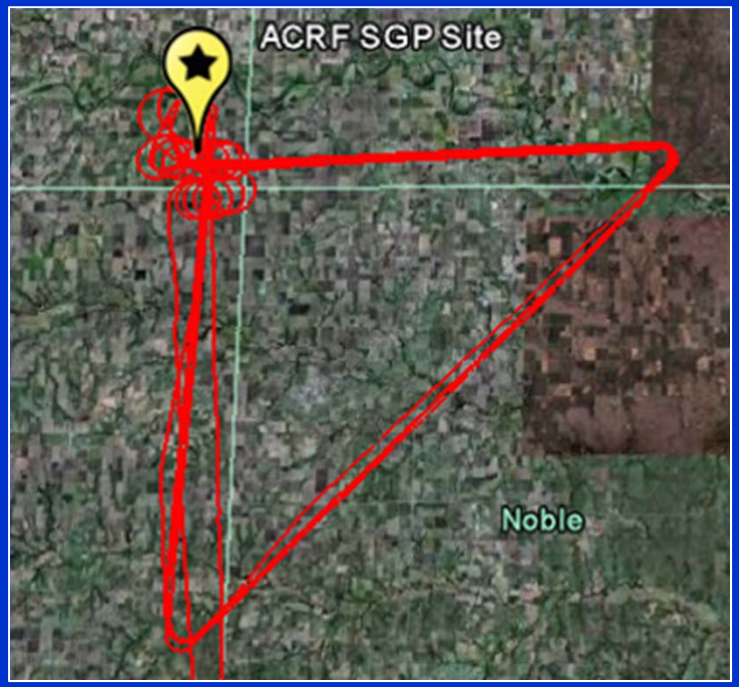
> 75% in Sc & Cu

30-40 km Legs

Along wind

Perpendicular

Hypotenuse



Radiometric Observations

Broadband Irradiances

- ↑↓ Shortwave Kipp & Zonen (a modified CM22)
- ↑ Sunshine Pyranometer (SPN1)
- ↑↓ Longwave Kipp & Zonen (a modified CG4)

Spectral Irradiances

- ↑↓ Multi-filter Radiometer (MFR, incl. 1.6 µm)
- ↑↓ HydroRad-3 Hyperspectral Radiometer

Spectral Radiances

- ↑↓ Infrared Thermometer (IRT)
- ↑ or ↓ HydroRad-3 Hyperspectral Radiometer

Hydrorad Hyperspectral Radiometer

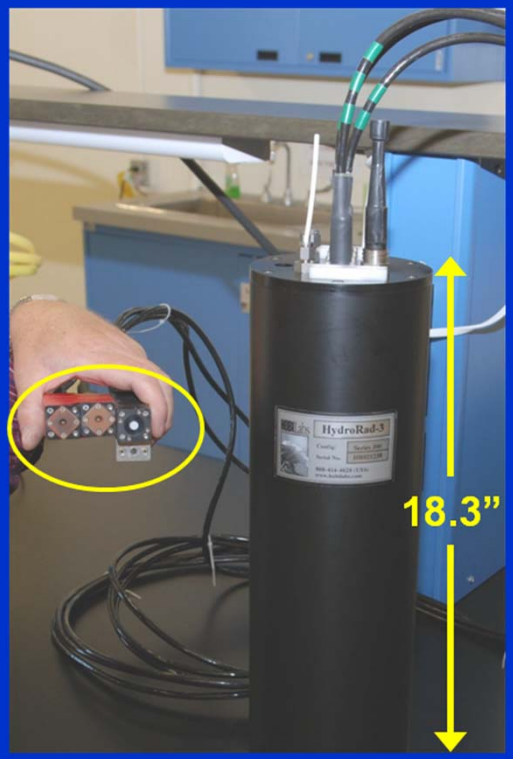
HOBI Labs (http://www.hobilabs.com)

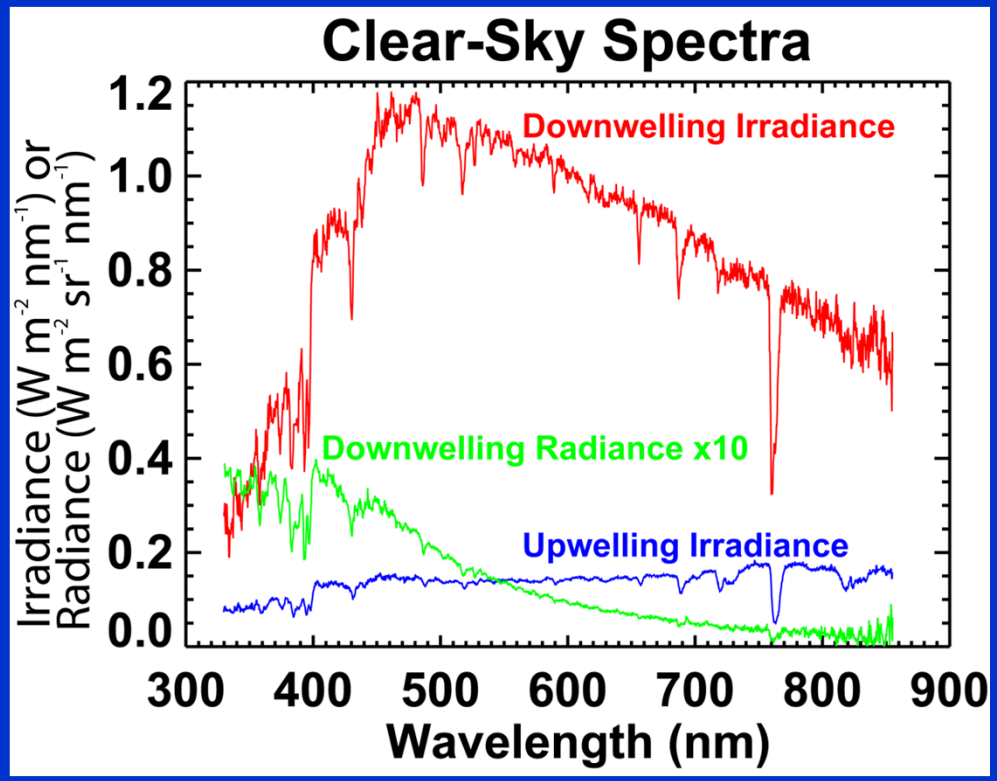
Wavelength range 350-850 nm at down to 0.3 nm resolution

- **↑↓ Irradiances**
- **↑ or ↓ Radiance (3º field-of-view)**

Fast response: dwell time between 20 and 200 ms

Report time 1-5 sec

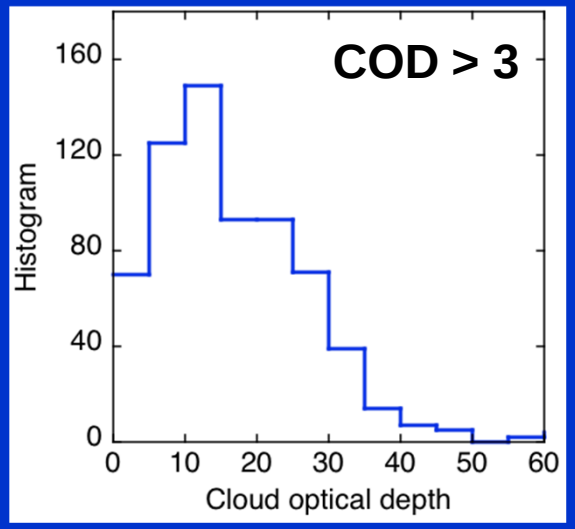


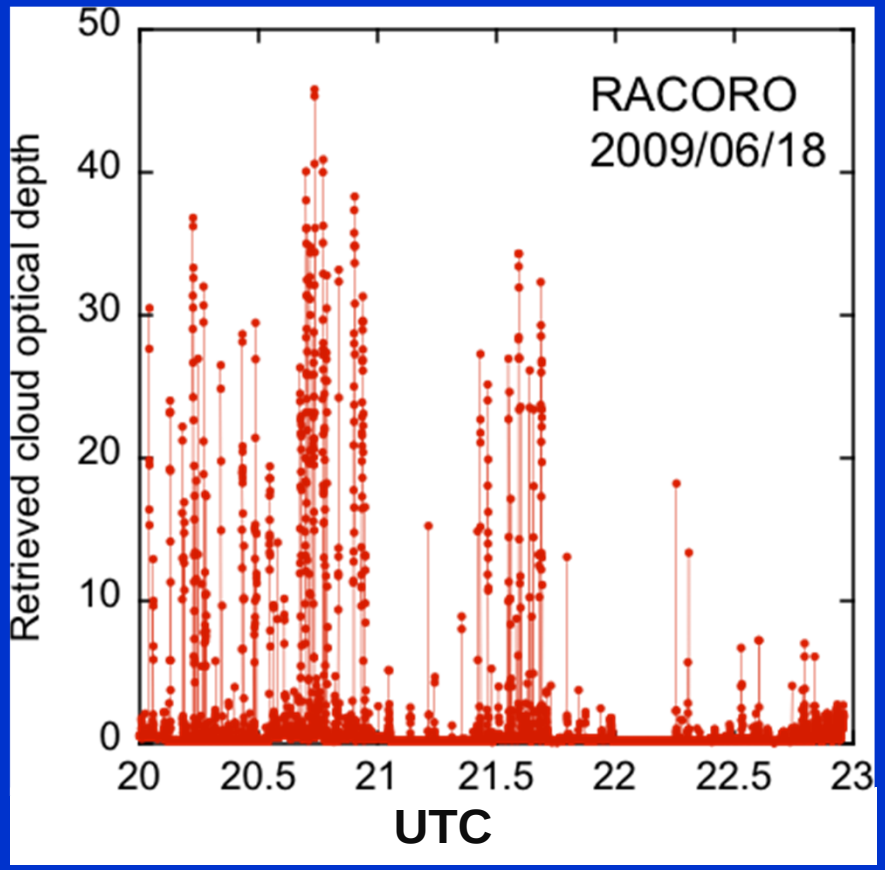


Sample Retrievals

Radiance retrievals (440 and 780 nm)

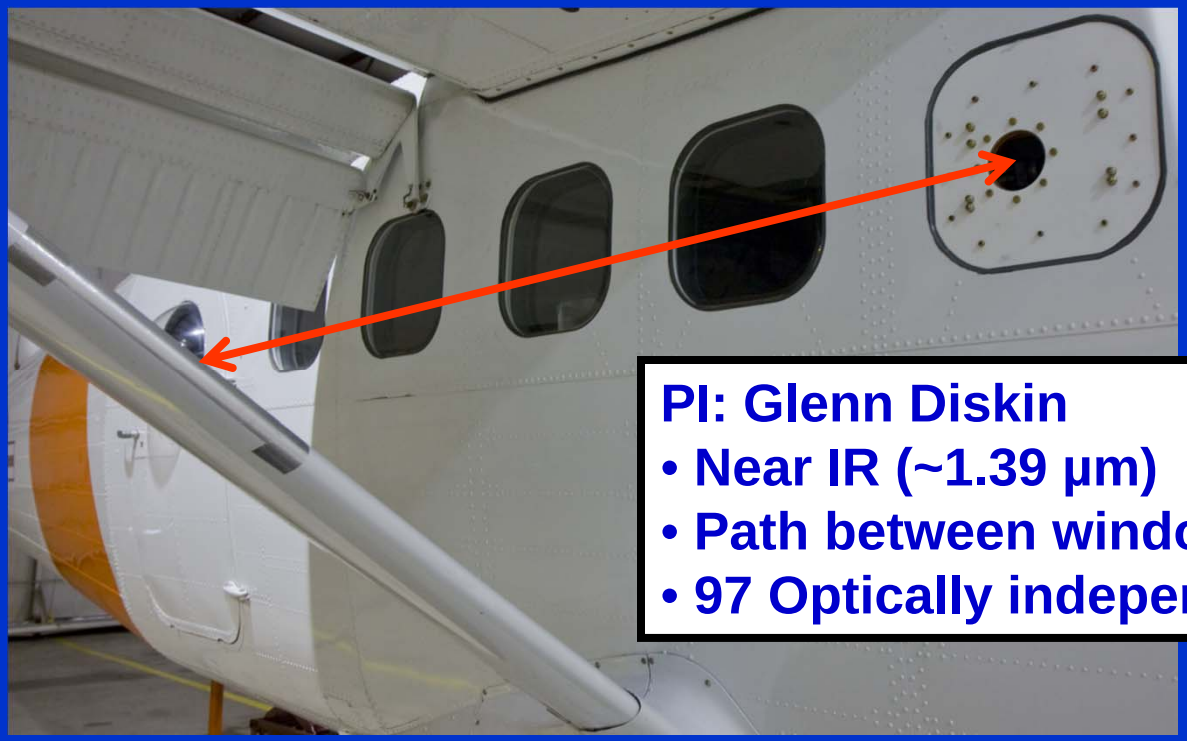
Marshak et al. (2004); Chiu et al. (2006, 2010)





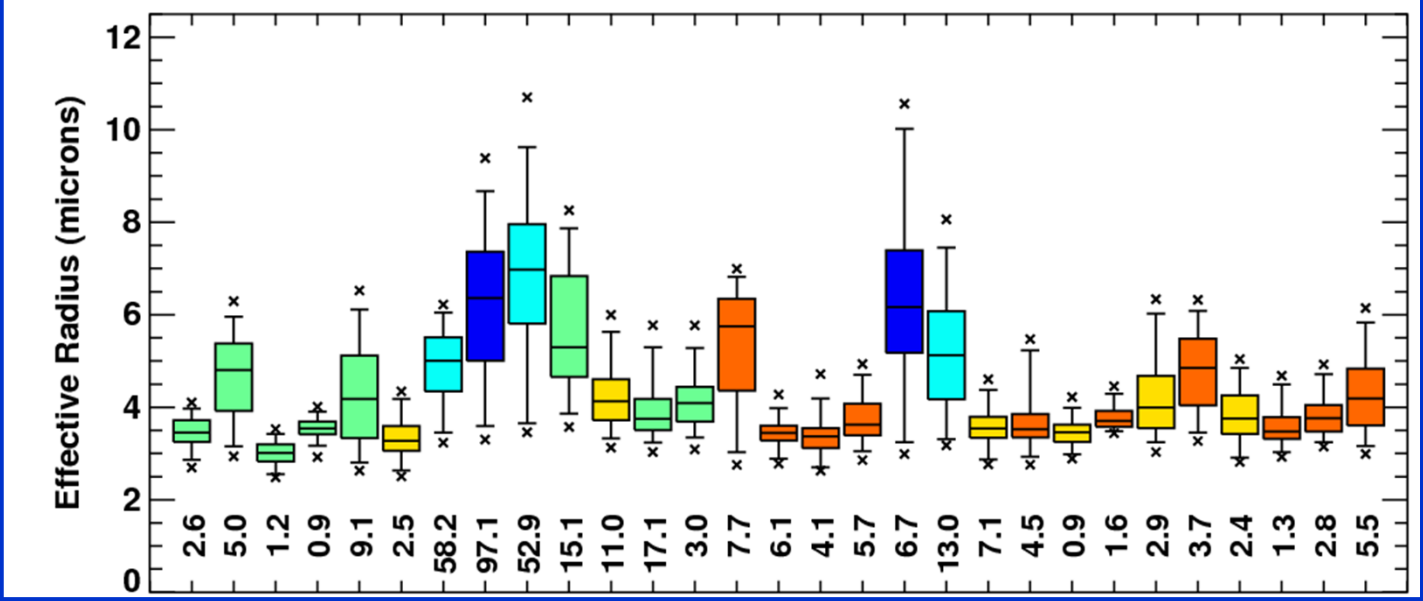
Cloud In-Situ Measurements

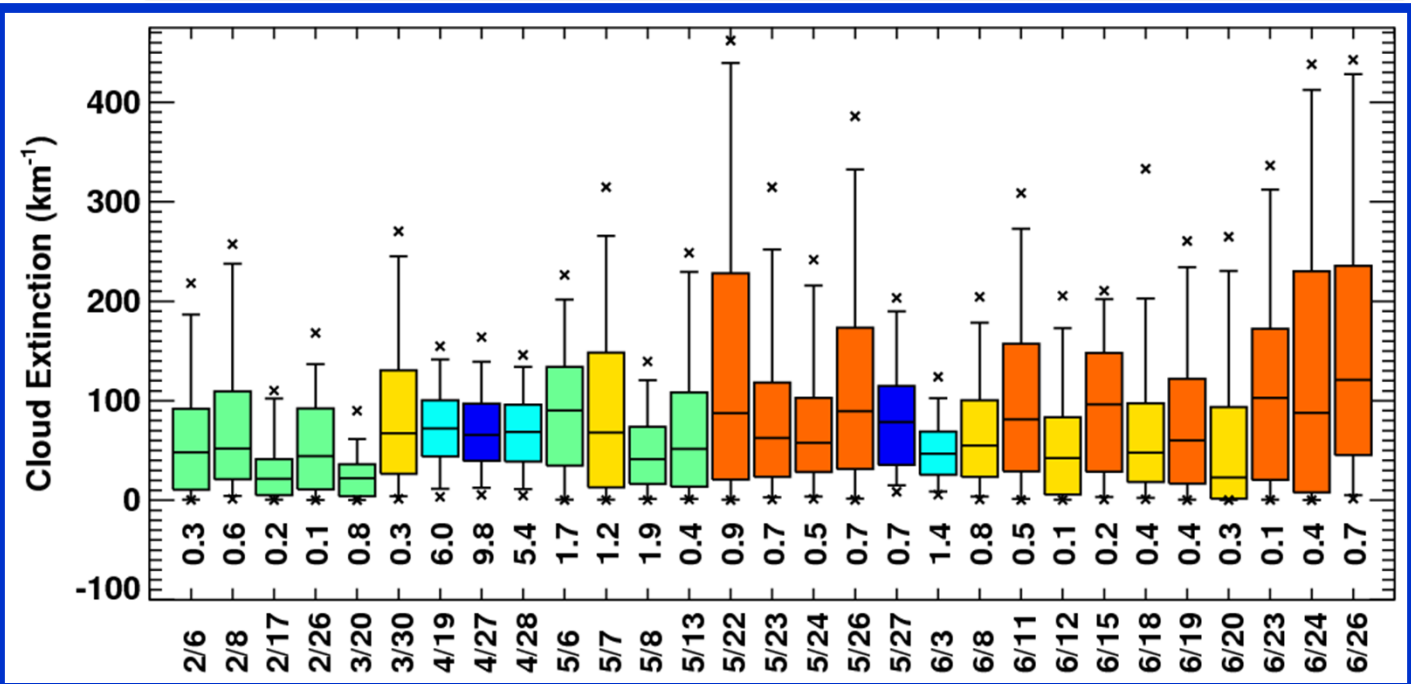
- **Microphysical properties**
  LWC, Drop size distribution
- **Cloud Extinction**
  Cloud Integrating Nephelometer (CIN), β_{ext} > 4 km^{-1}
  Diode Laser Hygrometer (DLH)



PI: Glenn Diskin
- **Near IR (~1.39 µm)**
- **Path between window and strut ~2.2m RT**
- **97 Optically independent samples / sec**

What They Look Like





Yet More Observations & Activities

- **Aerosol scattering properties (Ogren & Andrews)**
  Computed from size distributions
- **King Air Over Flights (June)**
  HSRL (Ferrare, Hostetler)
  RSP (Cairns)
- **Cloud Tomography IOP (Dong Huang)**
- **EOS Overpasses**

- **FASTER IOP (Yangang Liu)**