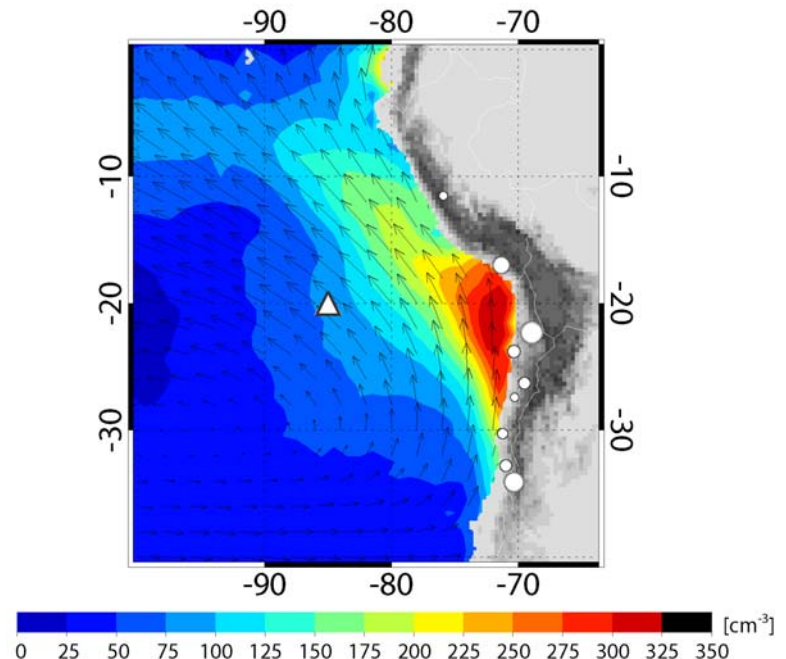


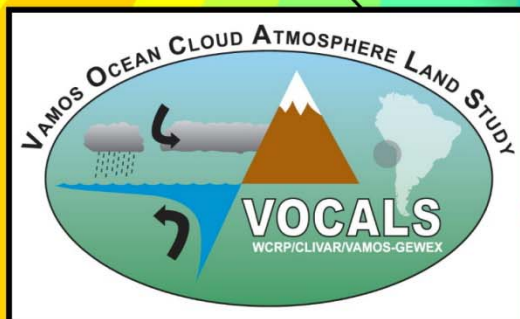
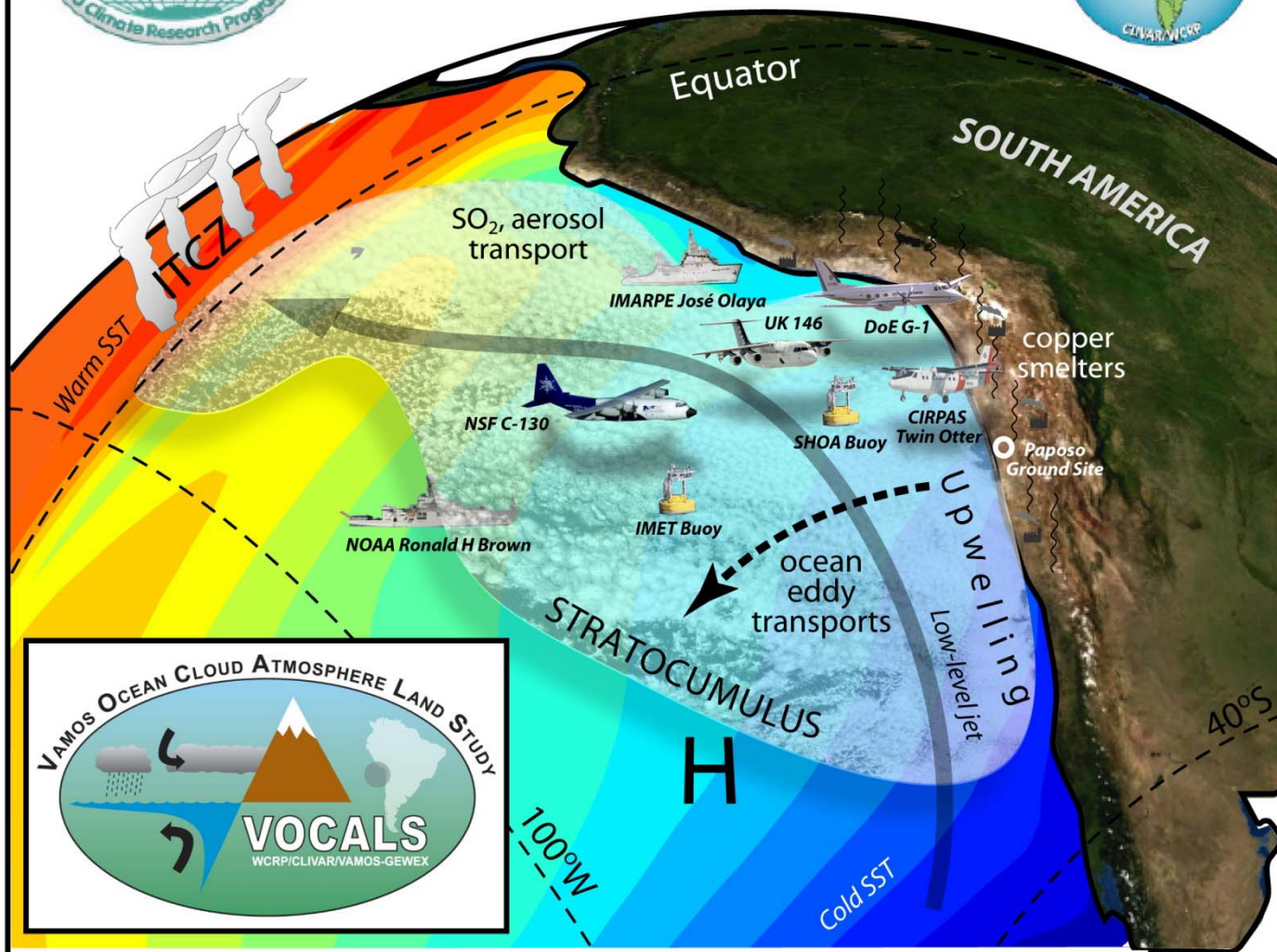
CIRPAS Twin Otter -- Scientific Objectives

- Aerosol-Cloud-Drizzle Interactions
 - Process Studies
 - Gradients and Variability in Clouds and Aerosols
- Coastal Processes
 - Diurnal Cycle
 - Stagnation Effects





VOCALS Regional Experiment



VOCALS -- CIRPAS Twin Otter Iquique

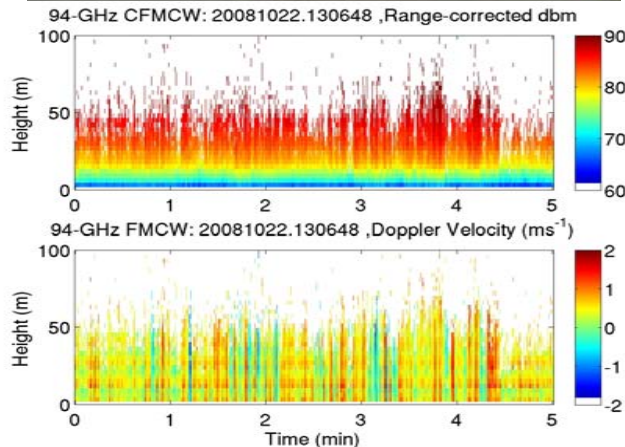


Twin Otter IQQ Science Participants

- **U. Miami**
 - Bruce Albrecht, Shaunna Donaher, Virendra Ghate
- **UC Santa Cruz**
 - Patrick Chuang, Dione Rossiter
- **UC Irvine**
 - Djamal Khelif , Jesus Ruiz-Plancarte
- **UM/NASA Goddard**
 - J. Vanderlei Martins, Roberto Fernandez-Borda, Steven Buczkowski, Eric Wilcox
- **NOAA/ESRL**
 - Graham Feingold
- **CIRPAS**
 - Haf Jonnson



Twin Otter Instrumentation



Instrument	Observations/Purpose
Standard met	Winds, temp, dewpoint, cloud liquid water, sfc temp
Turbulence Probes	High speed wind, temp, and moisture (Djamal Khelif)
94 GHz Doppler FMCW radar	Cloud properties; in-cloud turbulence
Chaff (Dropsonde) Dispenser (with radar)	Track air movements—entrainment, sub-cloud cloud layer coupling, large eddies
CPCs	Ultrafine aerosols
PCASP	Aerosols 0.1-3 μm
FSSP	Clouds 2-40 μm
CIP	Drizzle 25-1500 μm
CCN-200	CCN (fast-2-point; slow-6 points)
Phased Doppler Interferometer (Patrick Chuang)	Cloud-drizzle 2-150 μm
Photo-Acoustic Soot Spectrometer	Bulk soot absorption
SP2-Black Carbon; DMT	BC mass and ratio to total particles;

UC Irvine Turbulence Instrumentation



LI-COR H₂O/CO₂ Analyzer
Closed path (inside nose)



2 Rosemount total
temperature probes

Air intake for LI-COR

Krypton fast Humidity

Research Pitot

5-port radome
wind system



UC Santa Cruz @ VOCALS



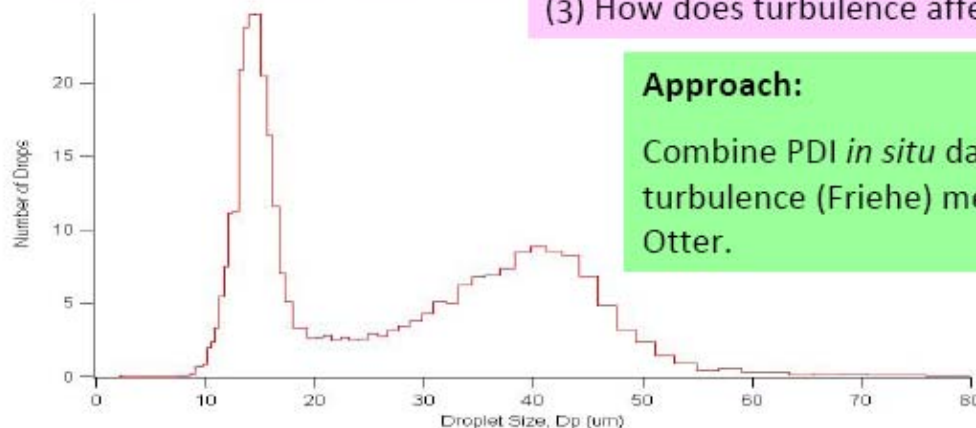
- **Phase-Doppler Interferometer (PDI)** has been developed for airborne measurements (*photo left*).
- Measures cloud drop:
 - *size distribution*
 - *velocity distribution*
 - *inter-drop spacing*
- Size range: 3 to 150 μm

Objectives:

- (1) What is the observed nature of drizzle in the VOCALS region?
- (2) What processes control these observed drizzle properties?
- (3) How does turbulence affect cloud microphysical properties?

Approach:

Combine PDI *in situ* data with airborne radar (Albrecht) and turbulence (Friehe) measurements, all on the CIRPAS Twin Otter.



Left: PDI measurements in stratocumulus near Santa Cruz, CA showing two drop modes.



UC Santa Cruz @ VOCALS



- **Phase-Doppler Interferometer (PDI)** has been developed for airborne measurements (*photo left*).
- Measures cloud drop:
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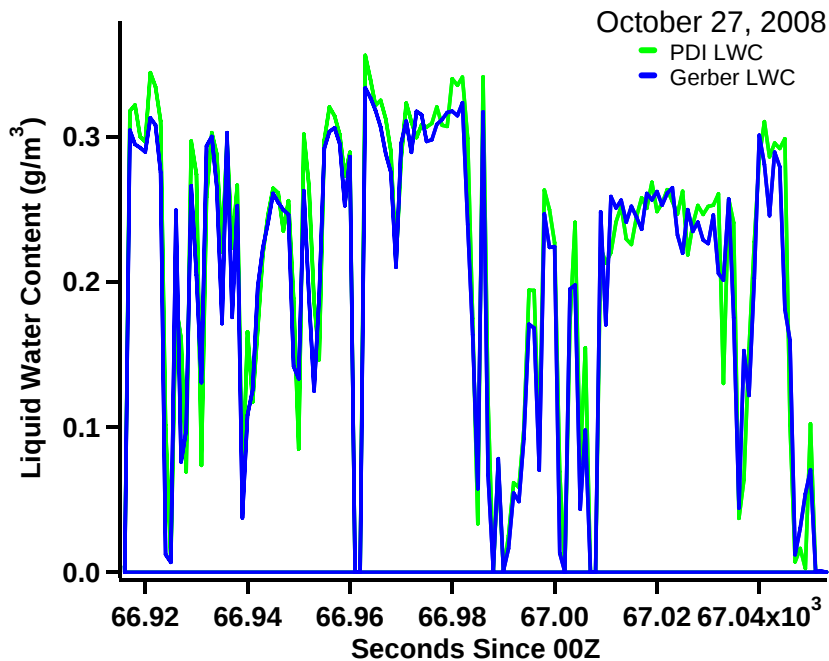
Objectives:

(1) What is the observed nature of drizzle in the VOCALS region?

control these observed drizzle properties?

ence affect cloud microphysical properties?

in situ data with airborne radar (Albrecht) and (Siehe) measurements, all on the CIRPAS Twin

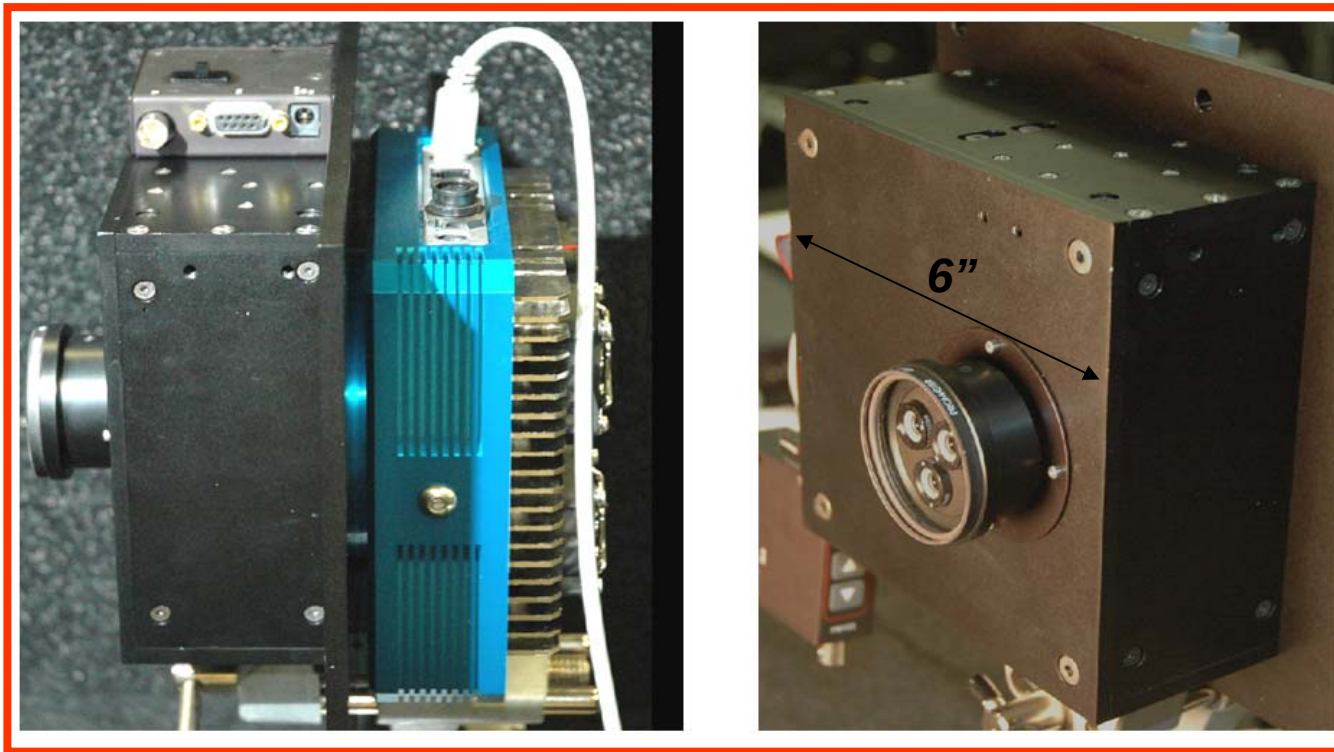


Left: PDI measurements in stratocumulus near Santa Cruz, CA showing two drop modes.

Multi-Angle Rainbow Polarimeter

UMBC¹ and NASA Goddard²:

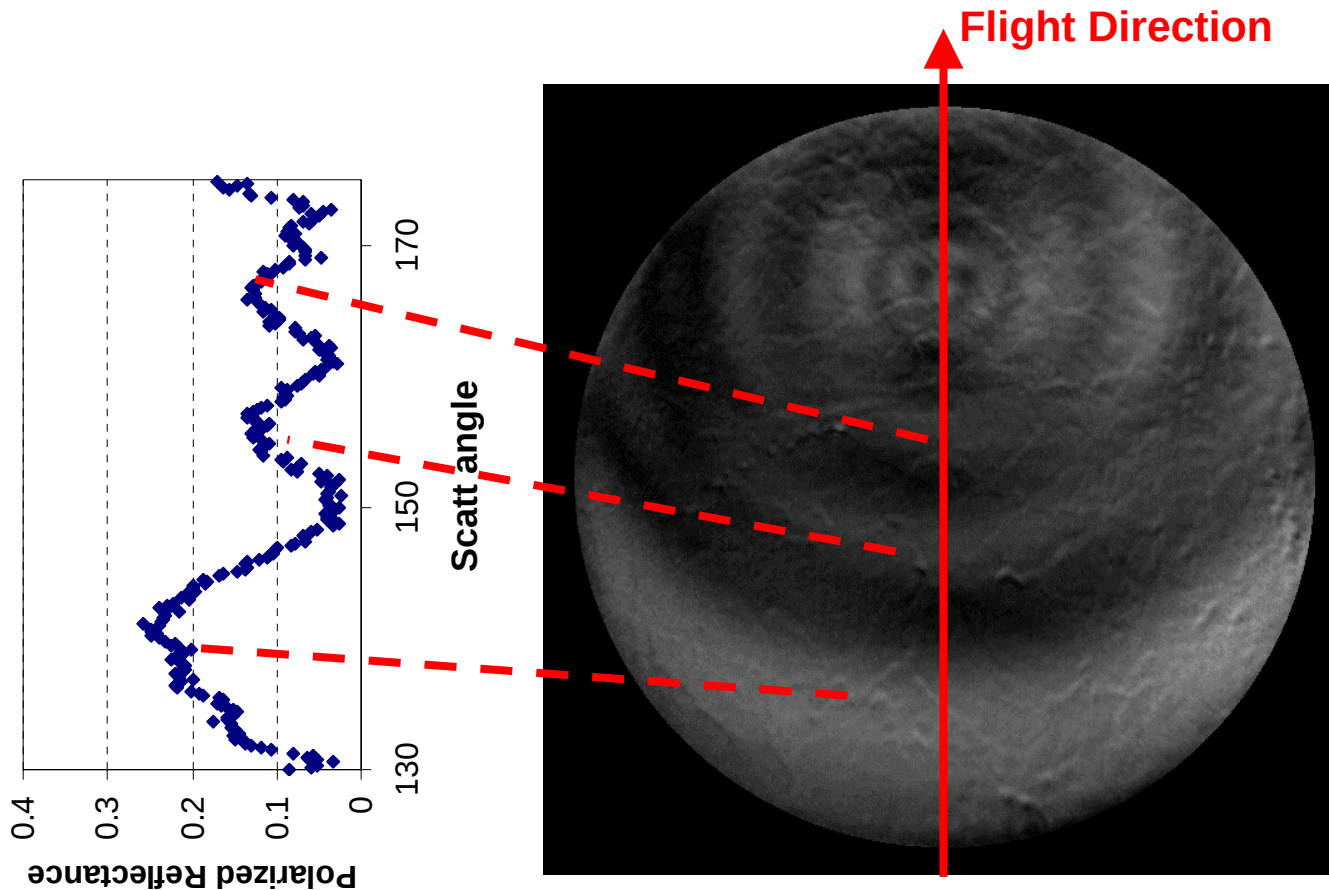
J. Vanderlei Martins^{1,2}, Lorraine Remer², Roberto Fernandez-Borda^{1,2},
Steven Buczkwoski¹, Eric Wilcox², Alexandre Correia²



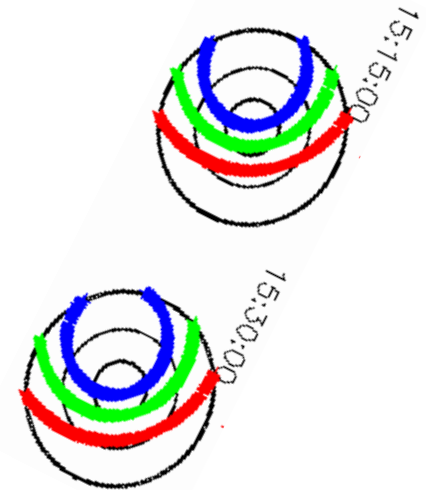
Measurements of water cloud droplet size (effective radius,
and effective variance)

Polarized CloudBow pattern

870nm at 15:17 UTC



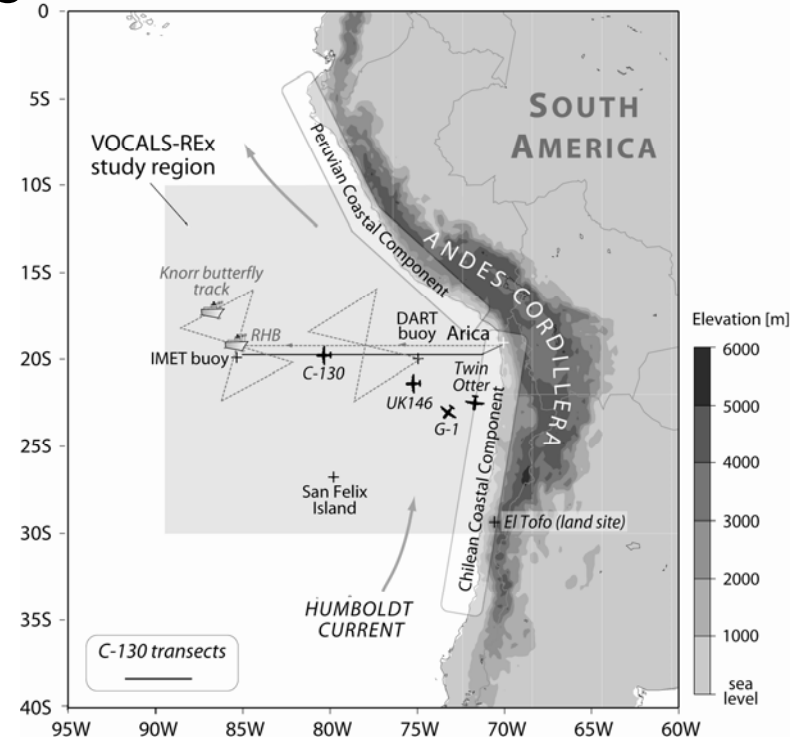
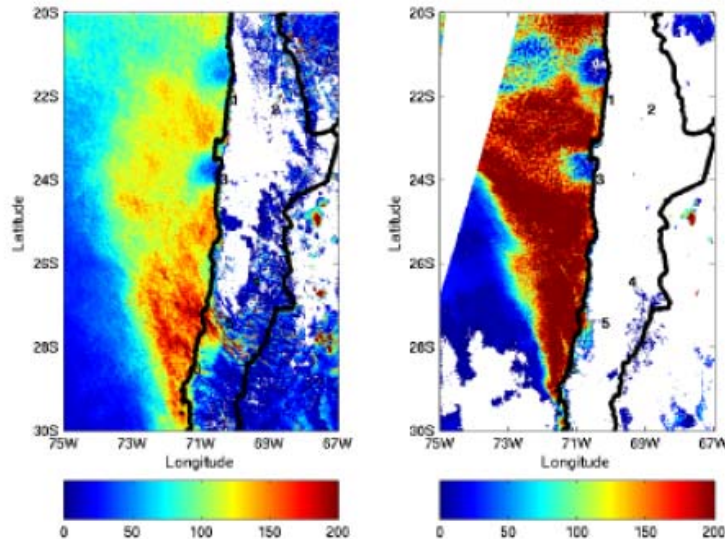
Pre-Flight Simulation



Simulated red line is the central position of the main cloudbow.

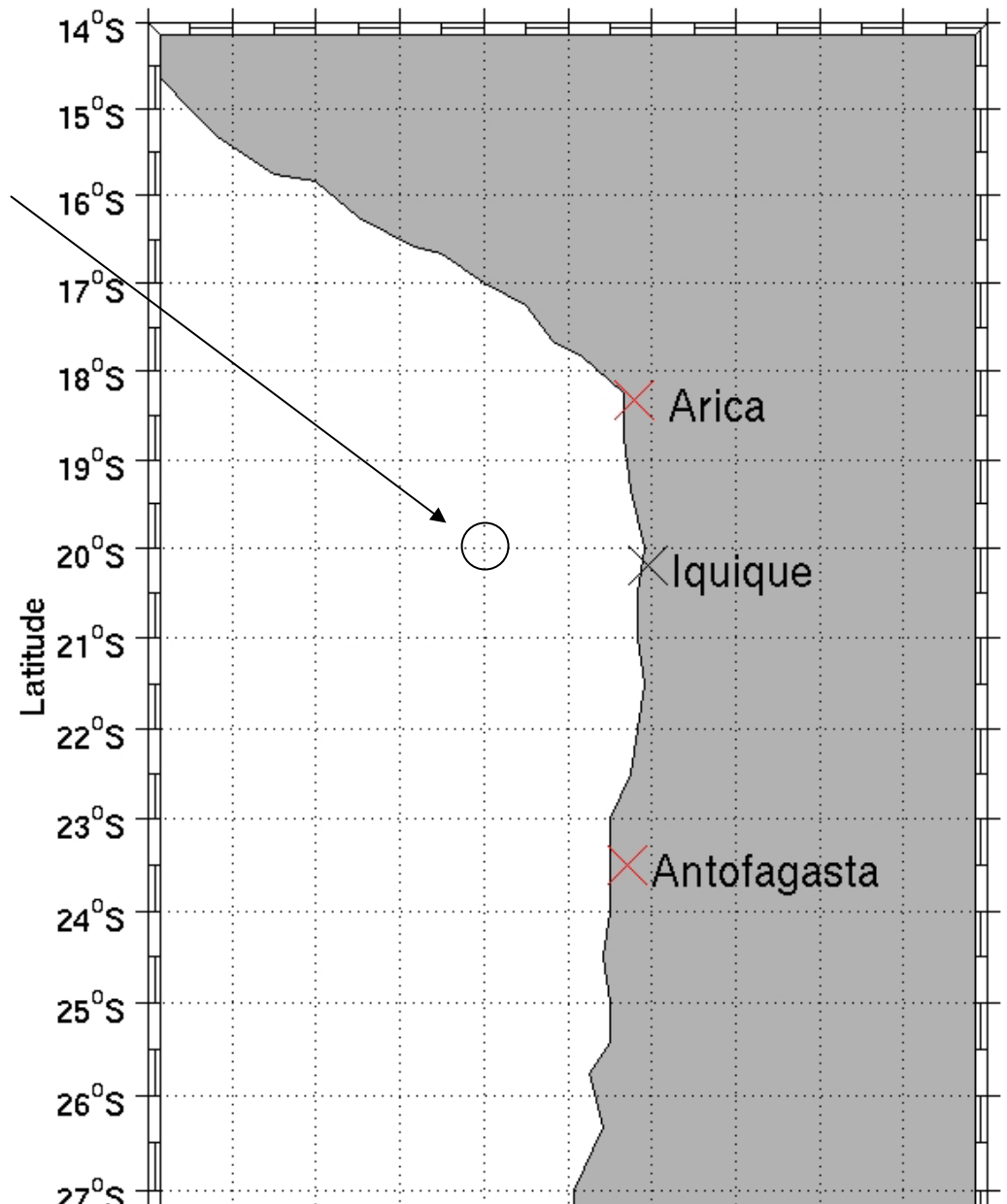
Flight Plans for VOCALS

- Feature/Process Sampling
- Diurnal Cycle
- Coastal Gradient Mapping

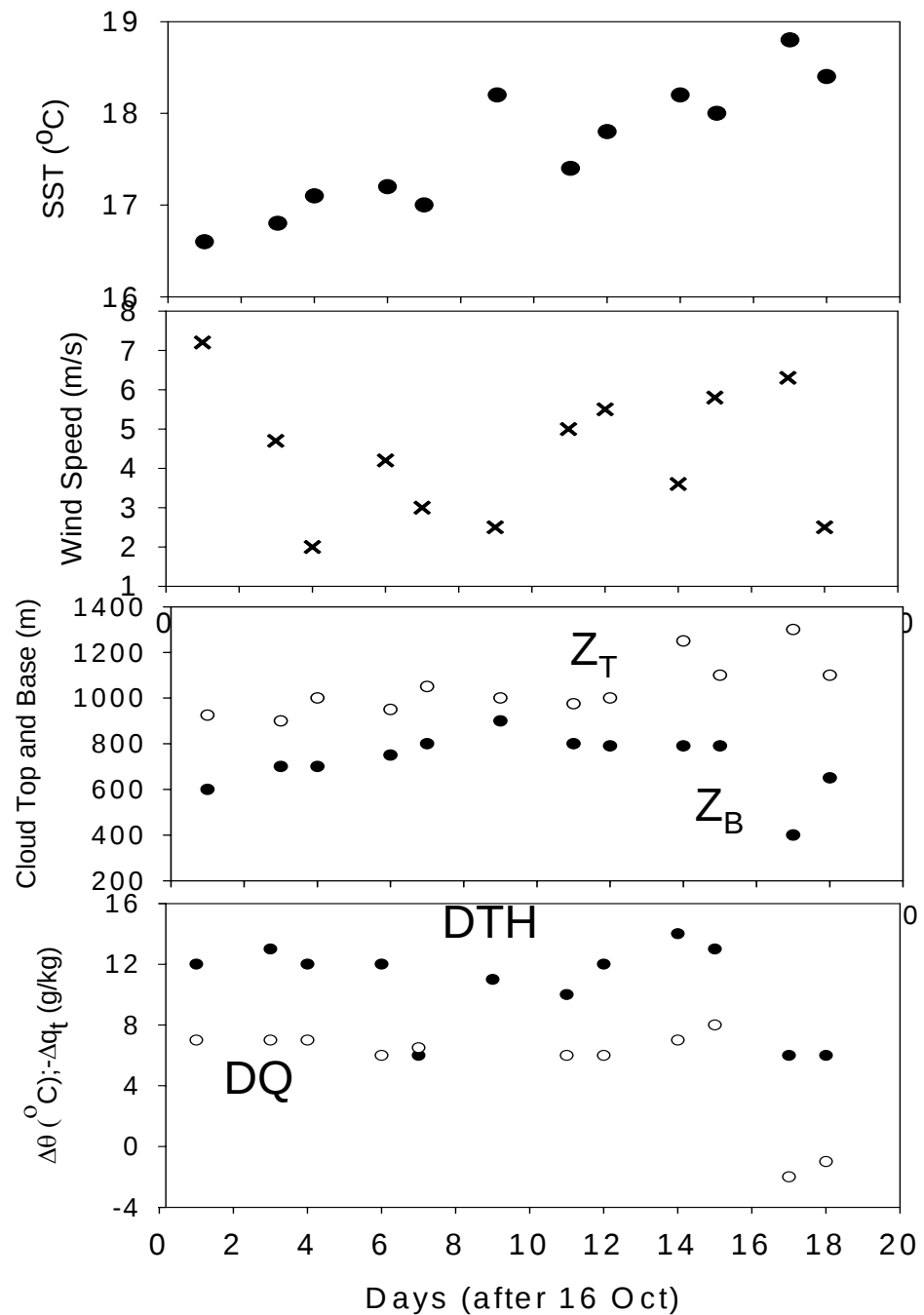
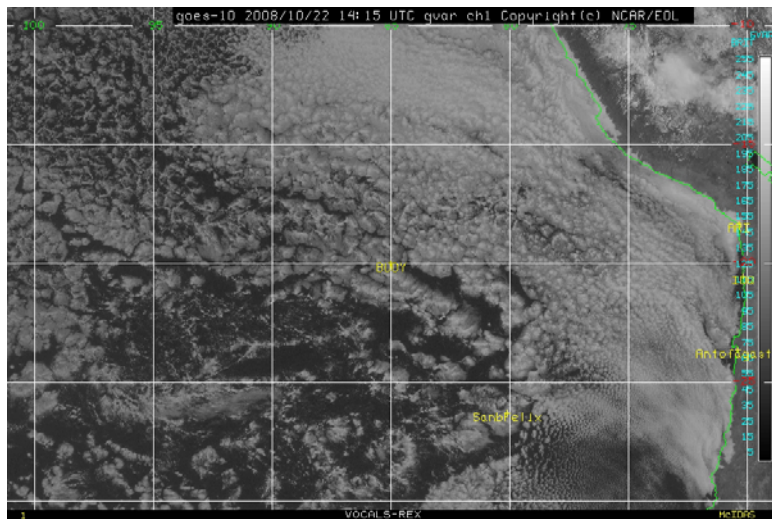


VOCALS
Twin Otter Flights
(13 to date)

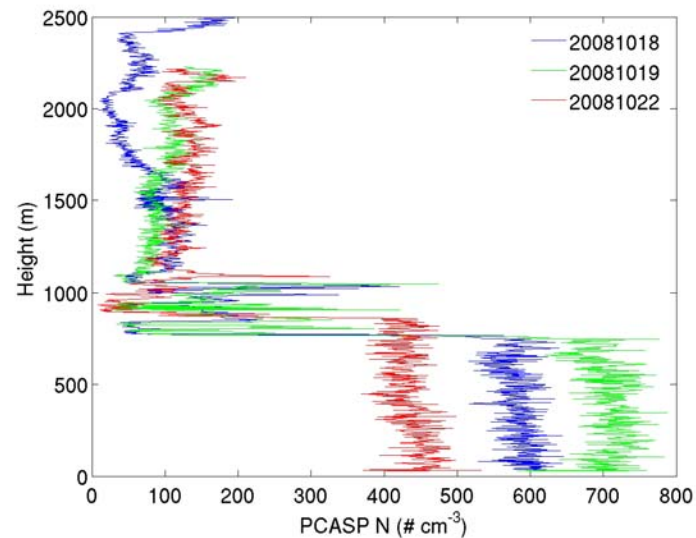
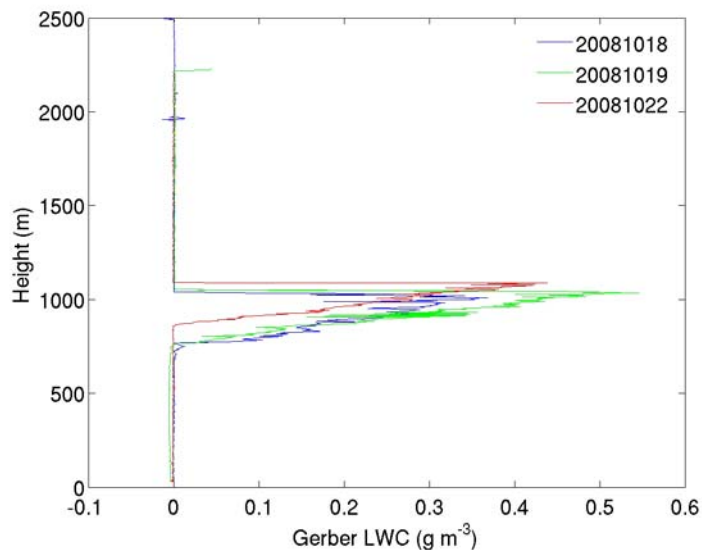
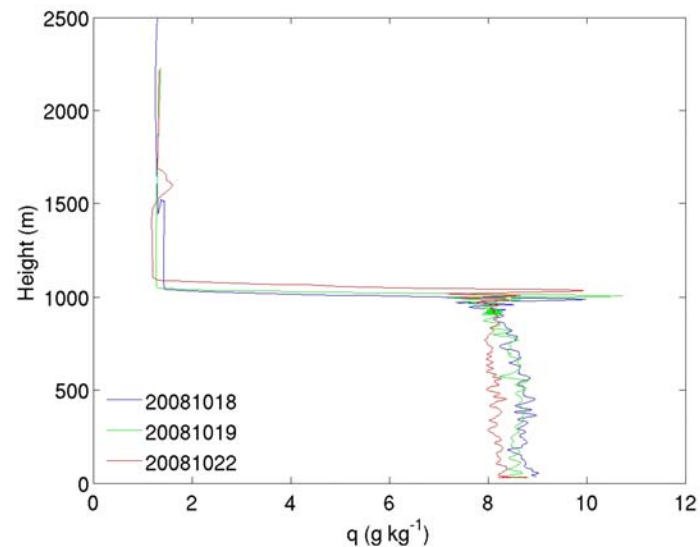
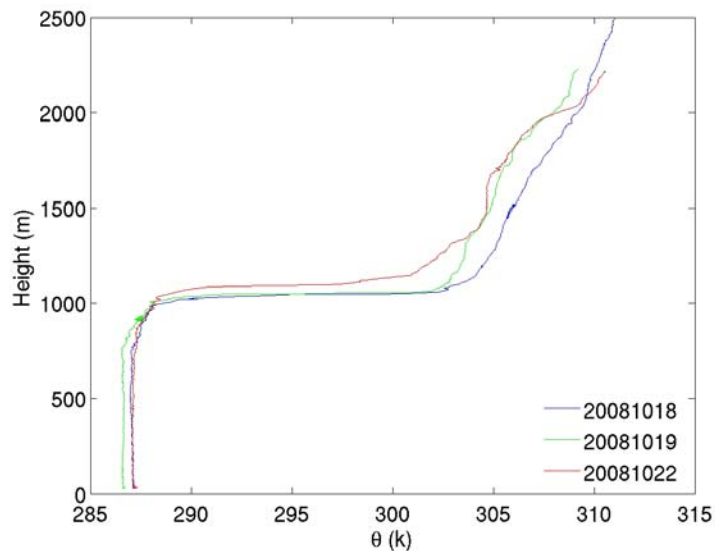
Point Alpha Strategy
(20°S; 72 °W)

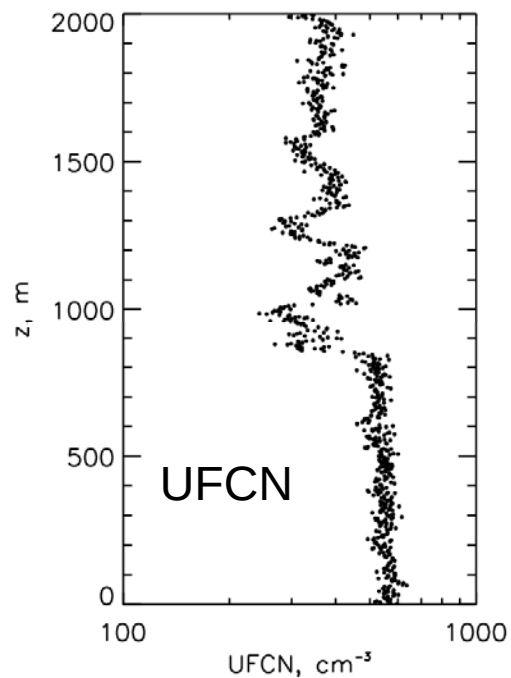
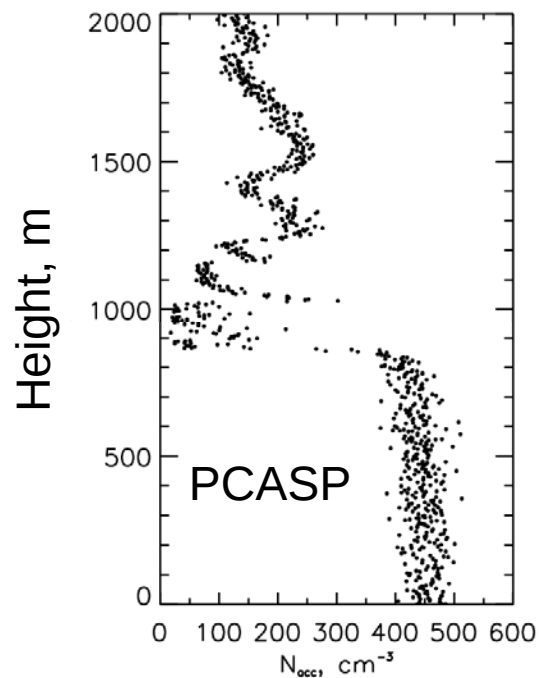
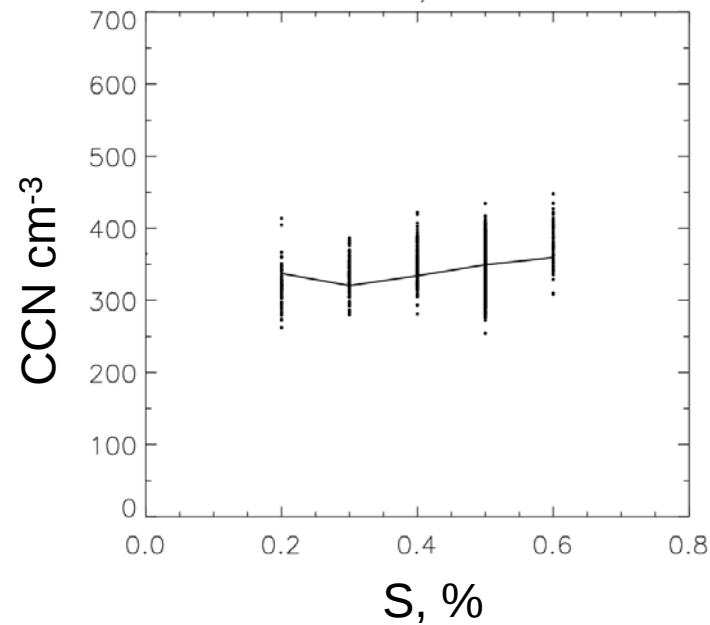
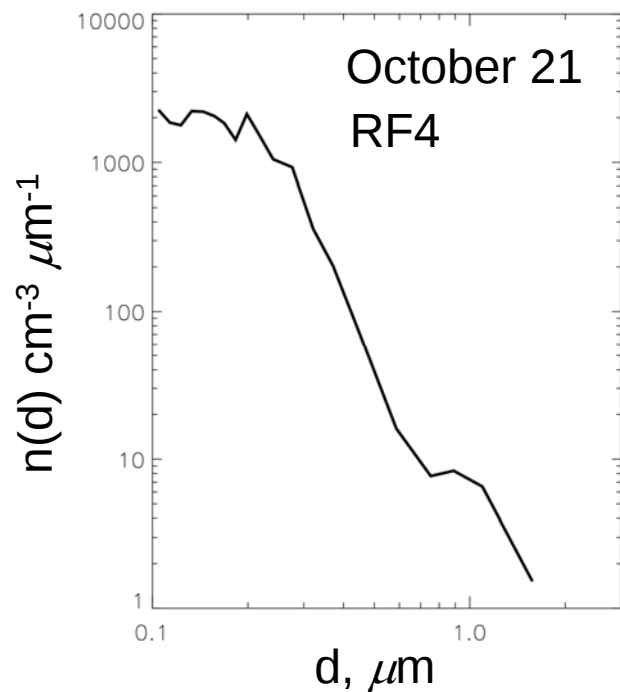


Temporal Variability at ALPHA

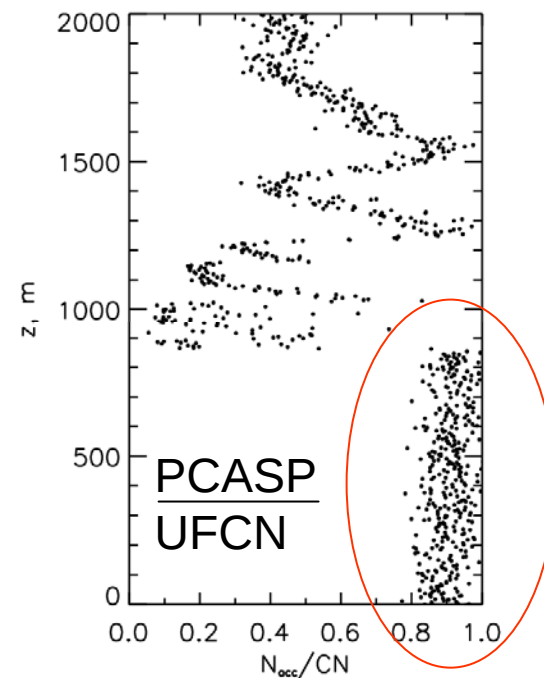


Some Classic Well-Mixed Boundary Layers





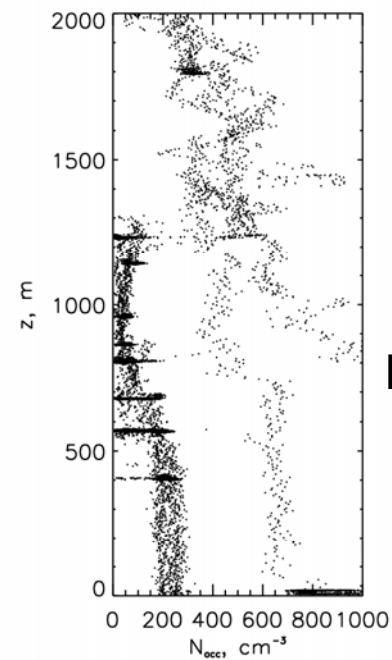
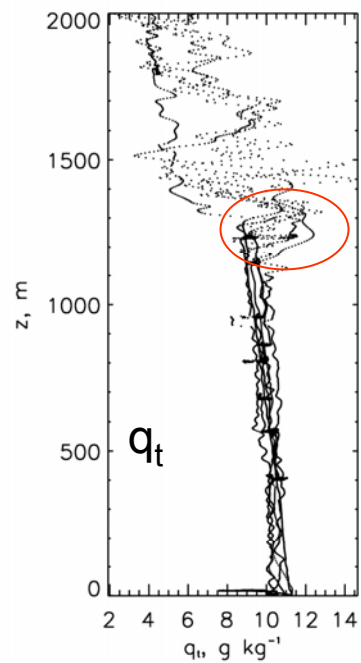
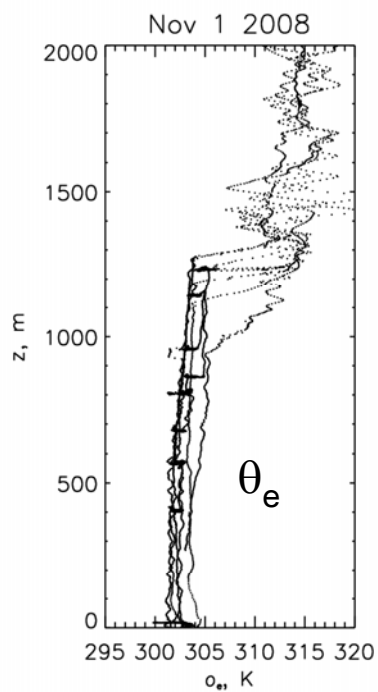
PCASP/UFCN ~ 0.8 - 0.9 in BL!



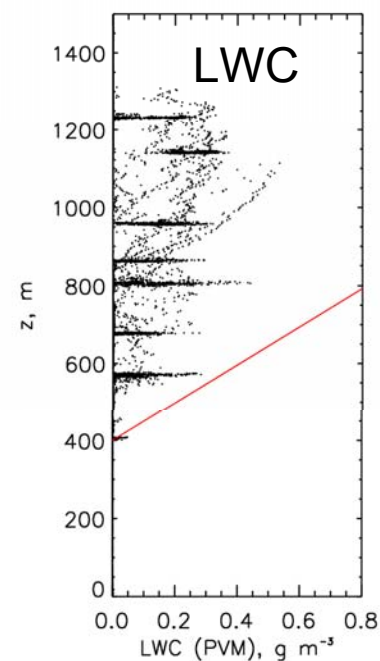
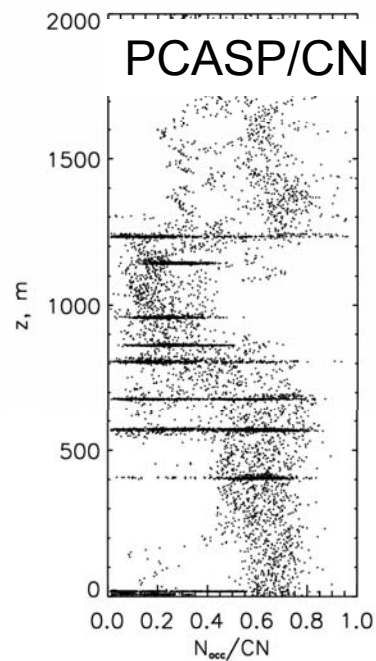
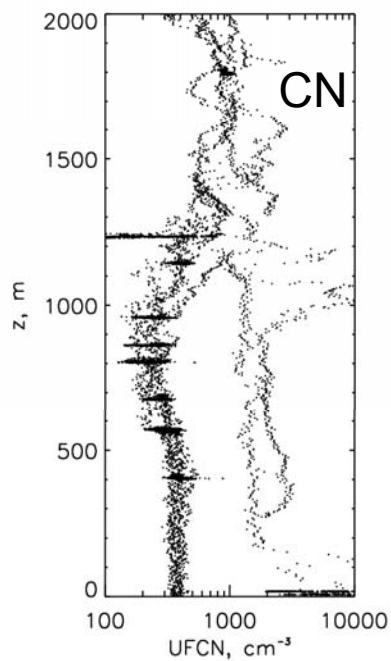
Decoupling-Drizzle Case

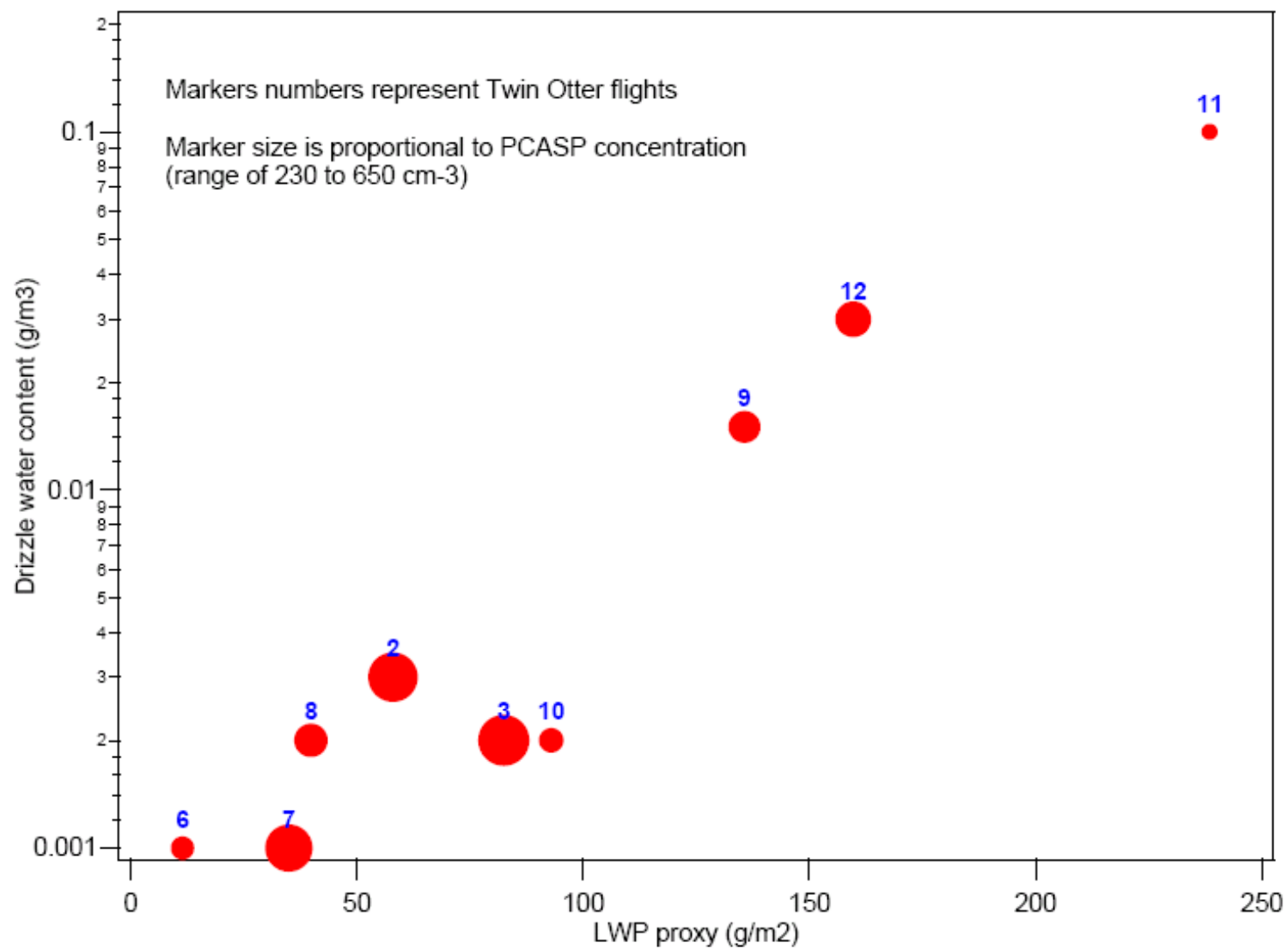


Height, m



PCASP





Inter-comparison Flight Point Alpha



Something new? Mini-sink holes?

Image 655 –14:58 UTC

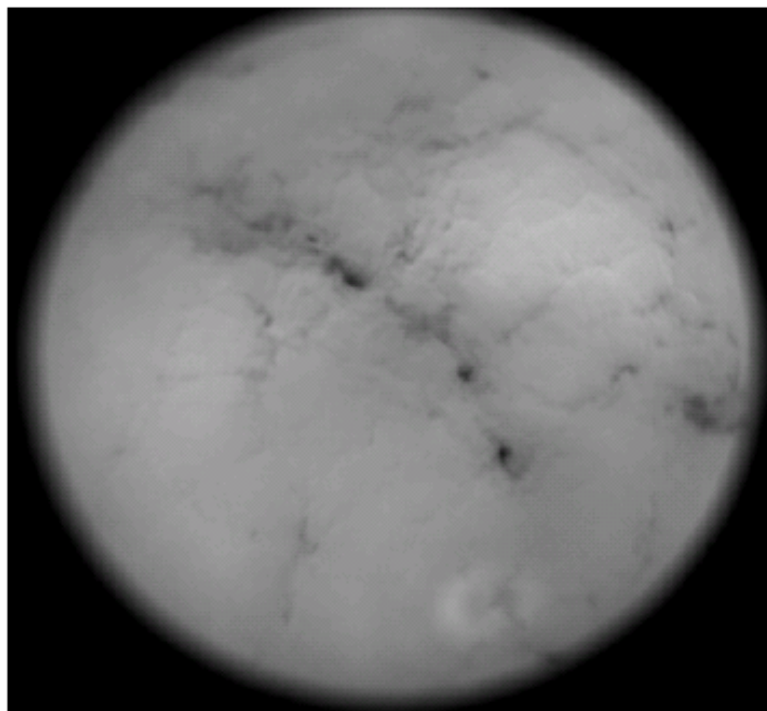


Image 612 –11:46 UTC



VOCALS
Twin Otter Flights
(13 to date)

Point Alpha Strategy
(20°S; 72 °W)

Proposal: Establish
Alpha as a VOCALS
Historical Site

Grid Point Alpha for
Modelers

