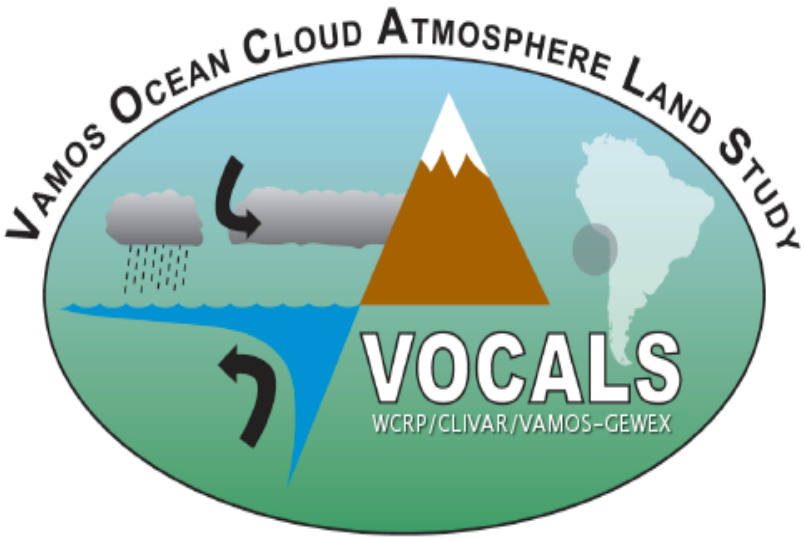
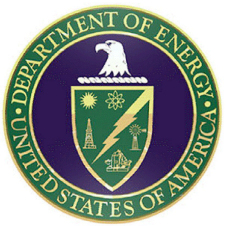
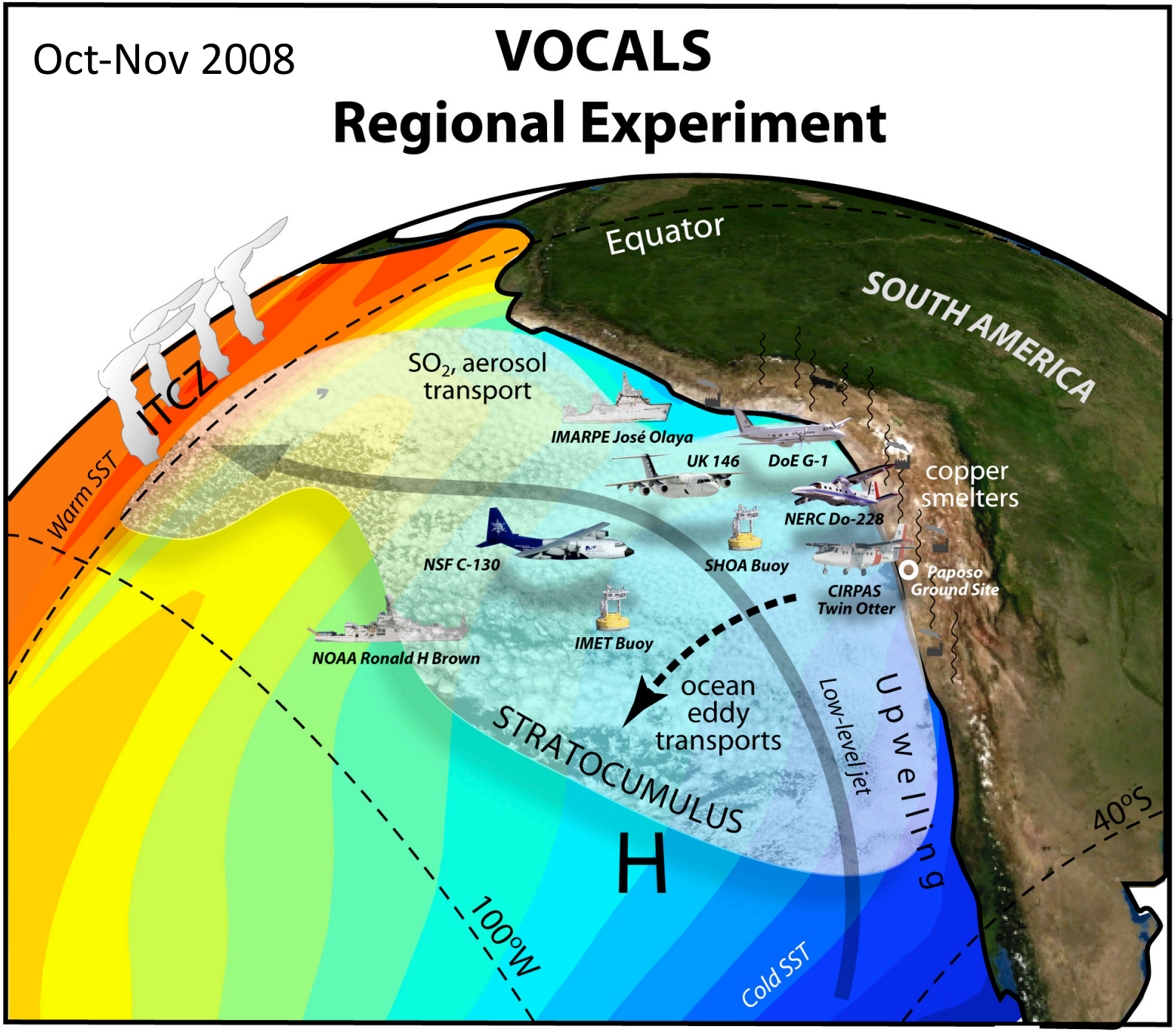


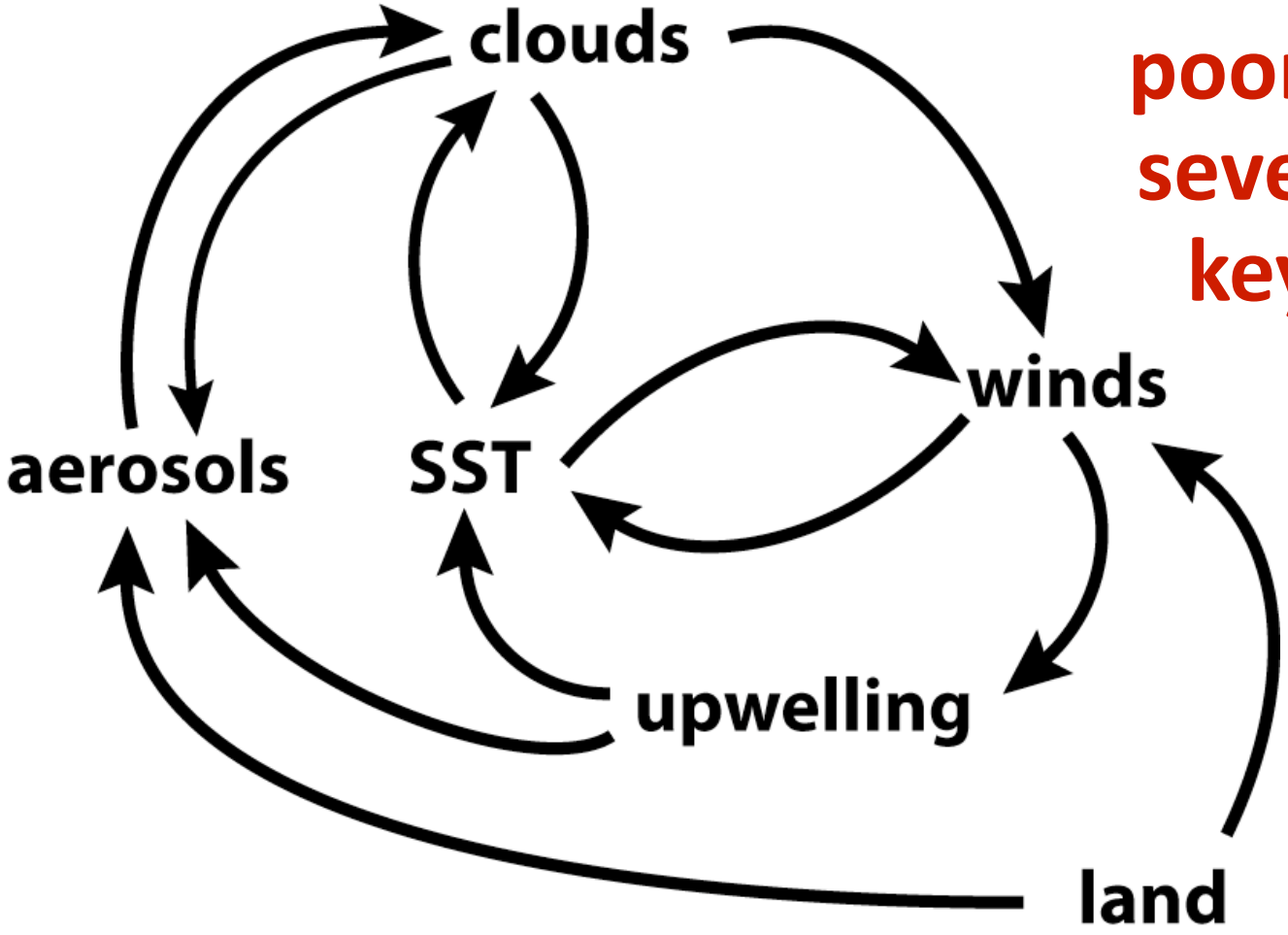
R. Wood (U. Wash., Rex-PI), C. R. Mechoso (UCLA, Chair), C. Bretherton (U. Wash.), R. Weller (WHOI), C. Fairall (NOAA), H. Coe (Manchester U., UK), F. Straneo (WHOI), C. Grados (IMARPE, Peru), B. A. Albrecht (U. Miami), R. Garreaud (U. Chile), P. Daum (BNL), G. Feingold (NOAA), B. Huebert (U. Hawaii), J. L. Brenguier (M. France), S. de Szoeke (NOAA), T. Toniazzo (U. Reading, UK), S. Abel (Met Office) and many others…

www.eol.ucar.edu/projects/vocals



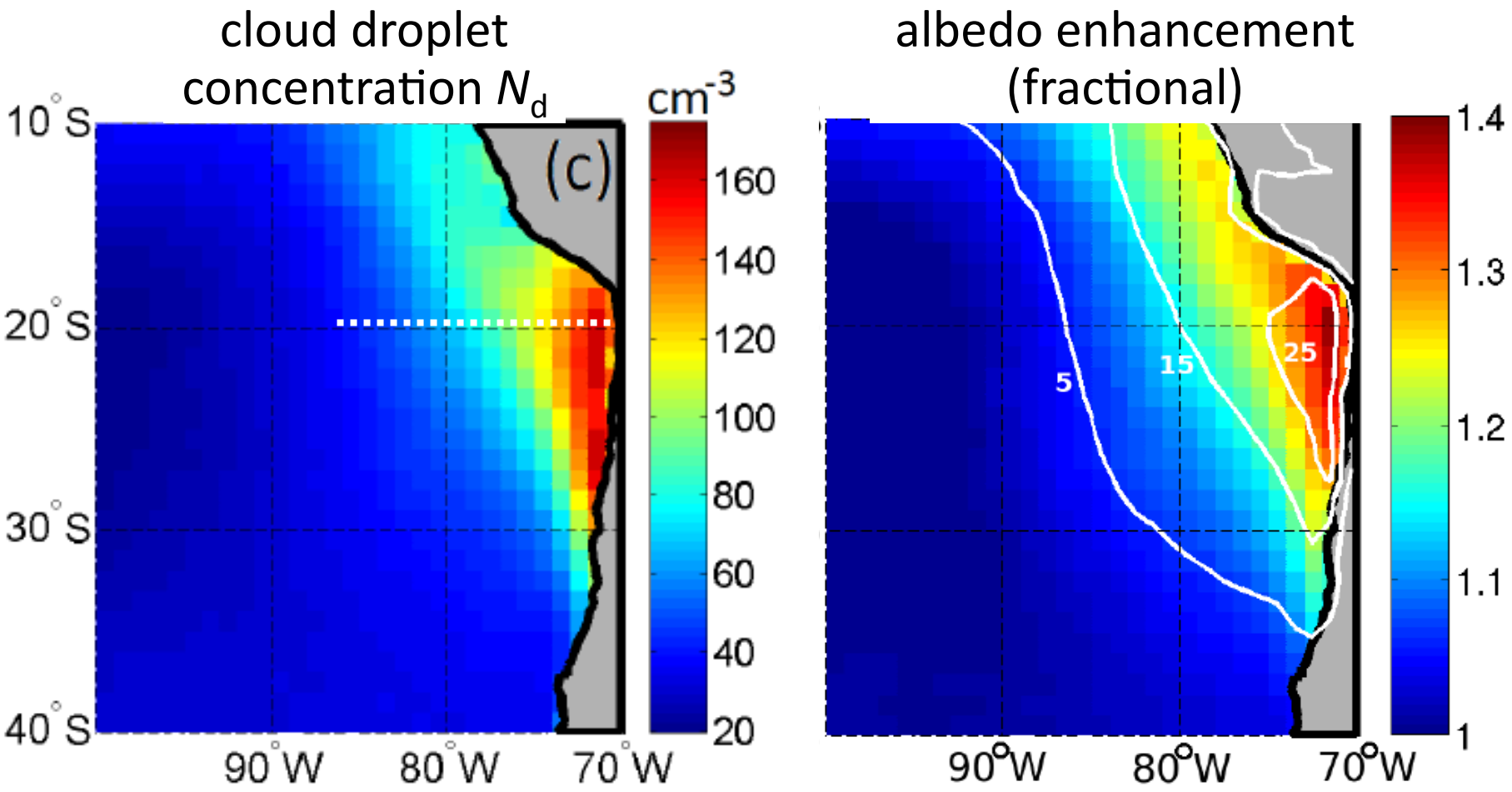

Oct-Nov 2008
VOCALS
Regional Experiment
Equator
SOUTH AMERICA
ITCZ
Warm SST
SO_2, aerosol transport
IMARPE José Olaya
UK 146
DoE G-1
copper smelters
NERC Do-228
NSF C-130
SHOA Buoy
Paposo Ground Site
CIRPAS Twin Otter
IMET Buoy
NOAA Ronald H Brown
ocean eddy transports
STRATOCUMULUS
Low-level jet
Upwelling
H
100°W
40°S
Cold SST

The SEP Coupled System

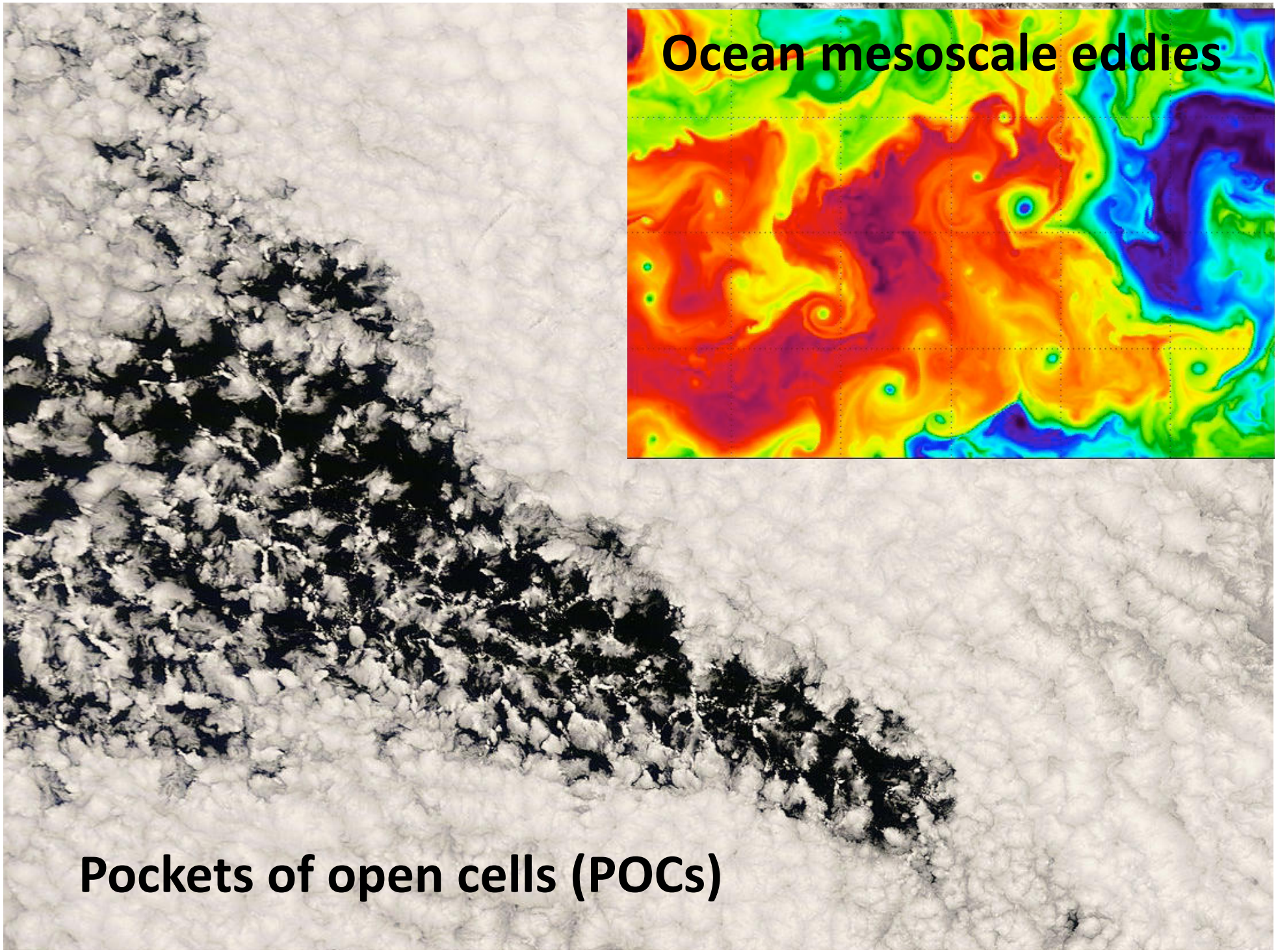


Climate models poorly represent several of these key processes

Radiative impact of cloud droplet concentration variations



George and Wood, *Atmos. Chem. Phys.*, 2010

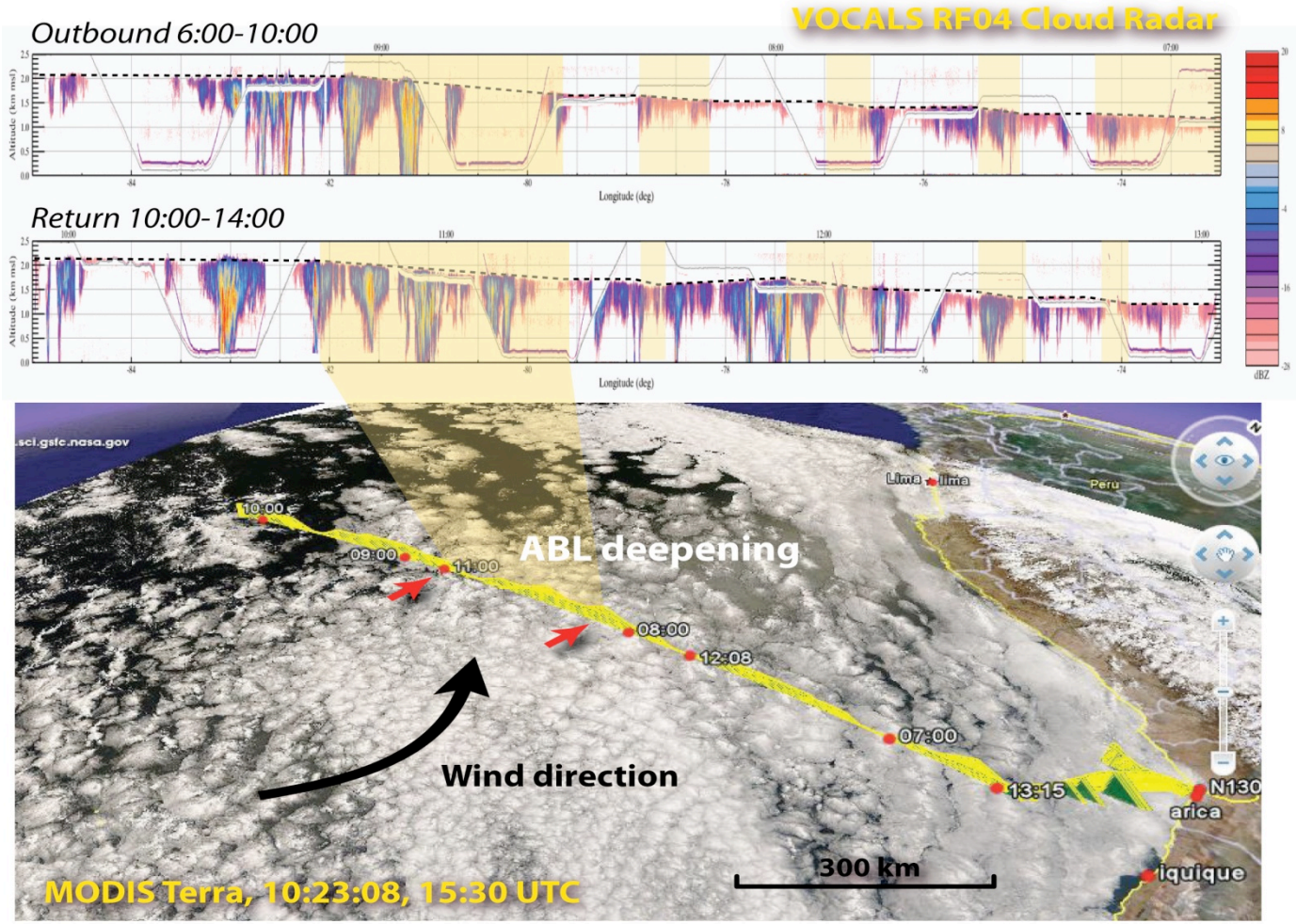

Ocean mesoscale eddies
Pockets of open cells (POCs)

VOCALS Goals

- Elimination of CGCM systematic errors in the Southeastern Pacific, and improved model simulations of the coupled system in the region and global impacts of its variability.
- Improved understanding and regional/global model representation of **aerosol indirect effects** over the region.

Here, focus is on clouds and cloud-aerosol interactions

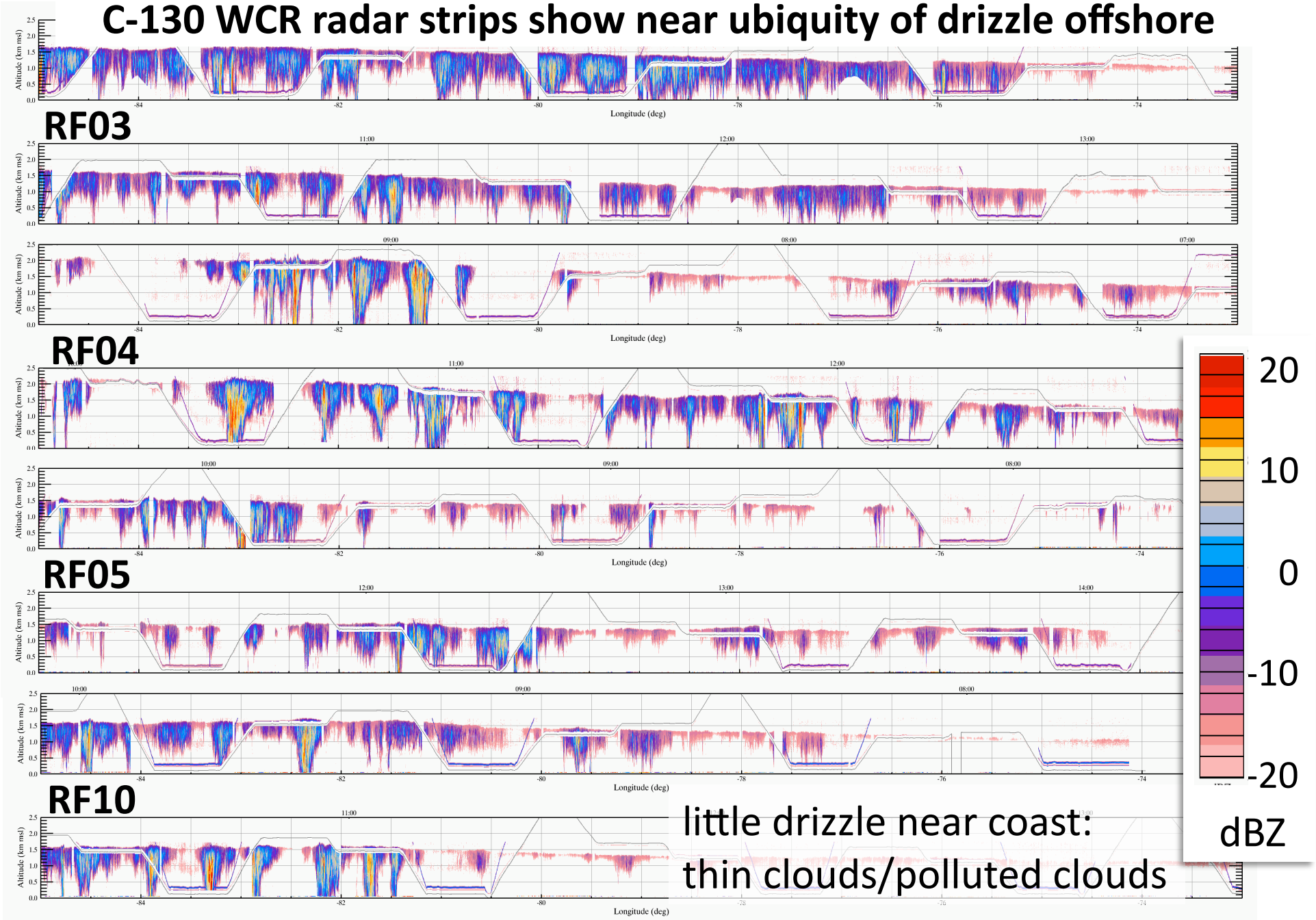
20°S Cross Section (sampled with ships, planes, buoy, satellites)

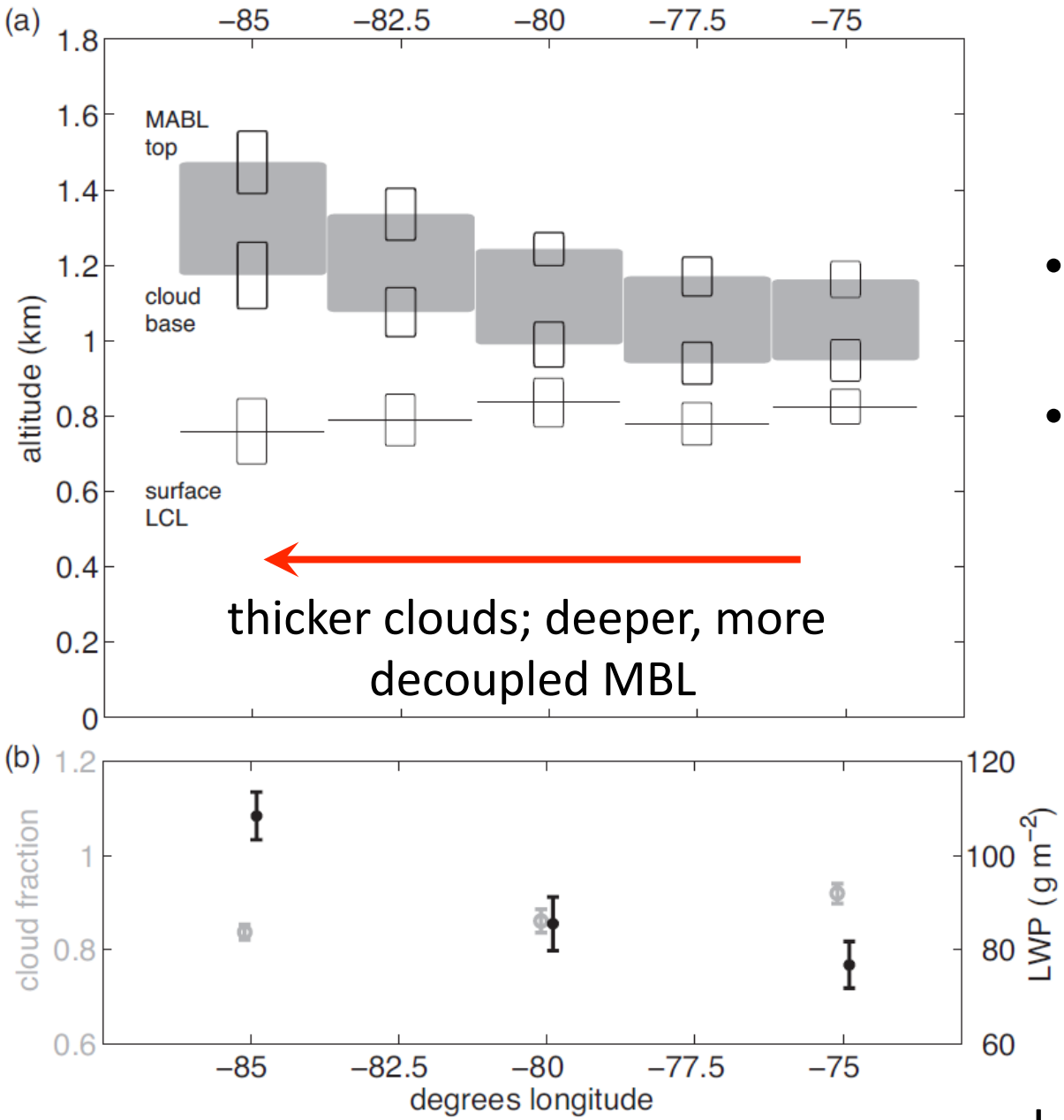


Offshore

Coast

C-130 WCR radar strips show near ubiquity of drizzle offshore





NOAA VOCALS Cruises

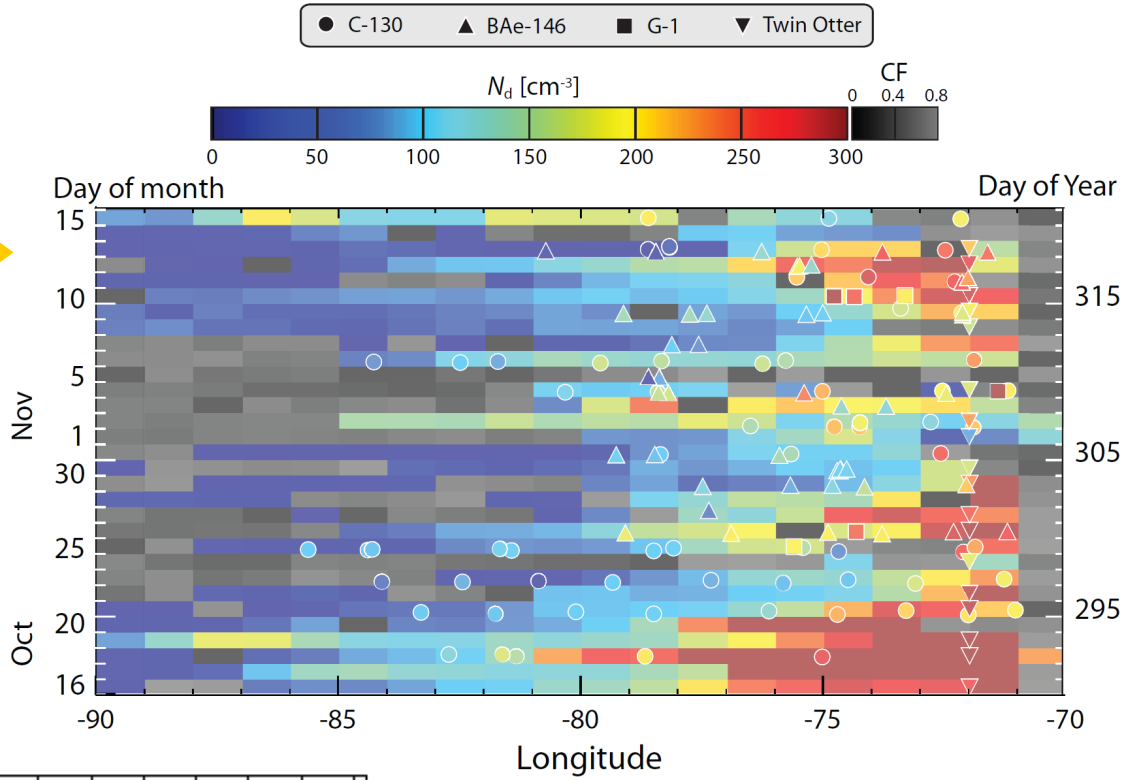
- 2000-2008 during Sept-Dec
- repeated sampling of Sc deck

de Szoeke et al. (2011)

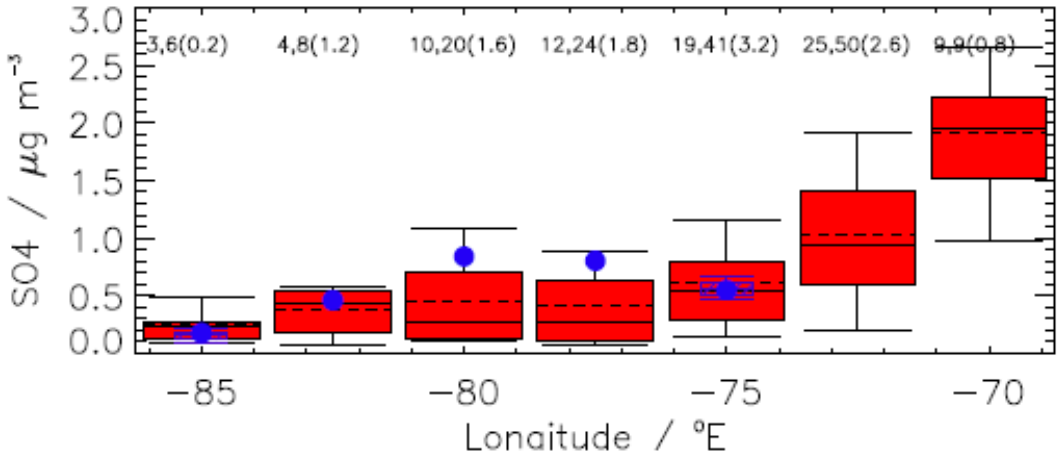
Aerosol-cloud interactions

Strong variability in **cloud droplet concentration** observed during VOCALS-REx. Aerosol transport events observed extending out to beyond 80°W

Bretherton et al., ACP, 2010

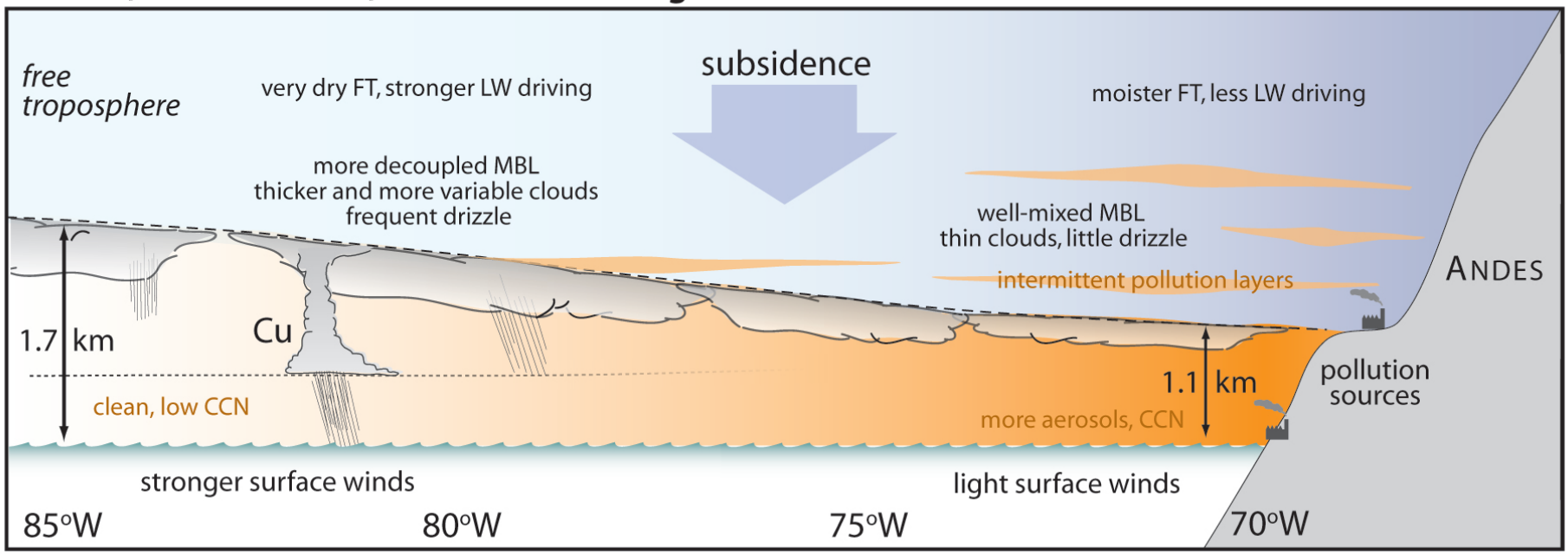


Sulfate aerosol mass loading



Most of the submicron aerosol is sulfate. Both anthropogenic and natural sources, but dominated by the former close to the coast, Allen et al. ACP, 2010

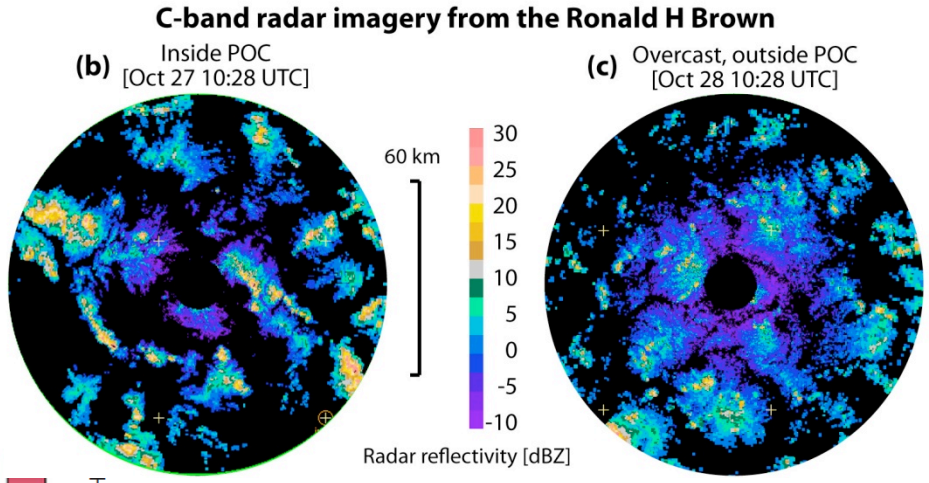
Clouds, MBL structure, and aerosols along 20°S

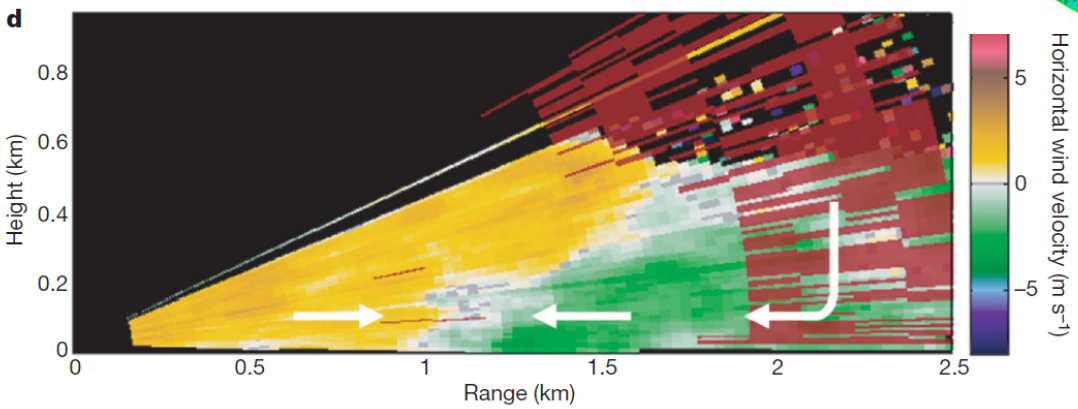


Precipitation and pockets of open cells

Strikingly different precipitation structure in POCs compared with overcast stratocumulus

Sandra Yuter, NCSU



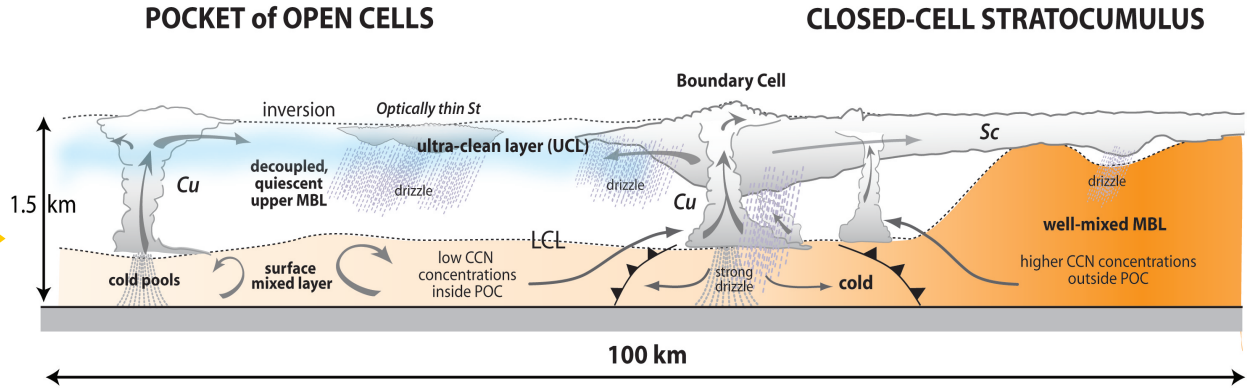


Precipitation generates cold outflows and local convergence that maintains open cell structure

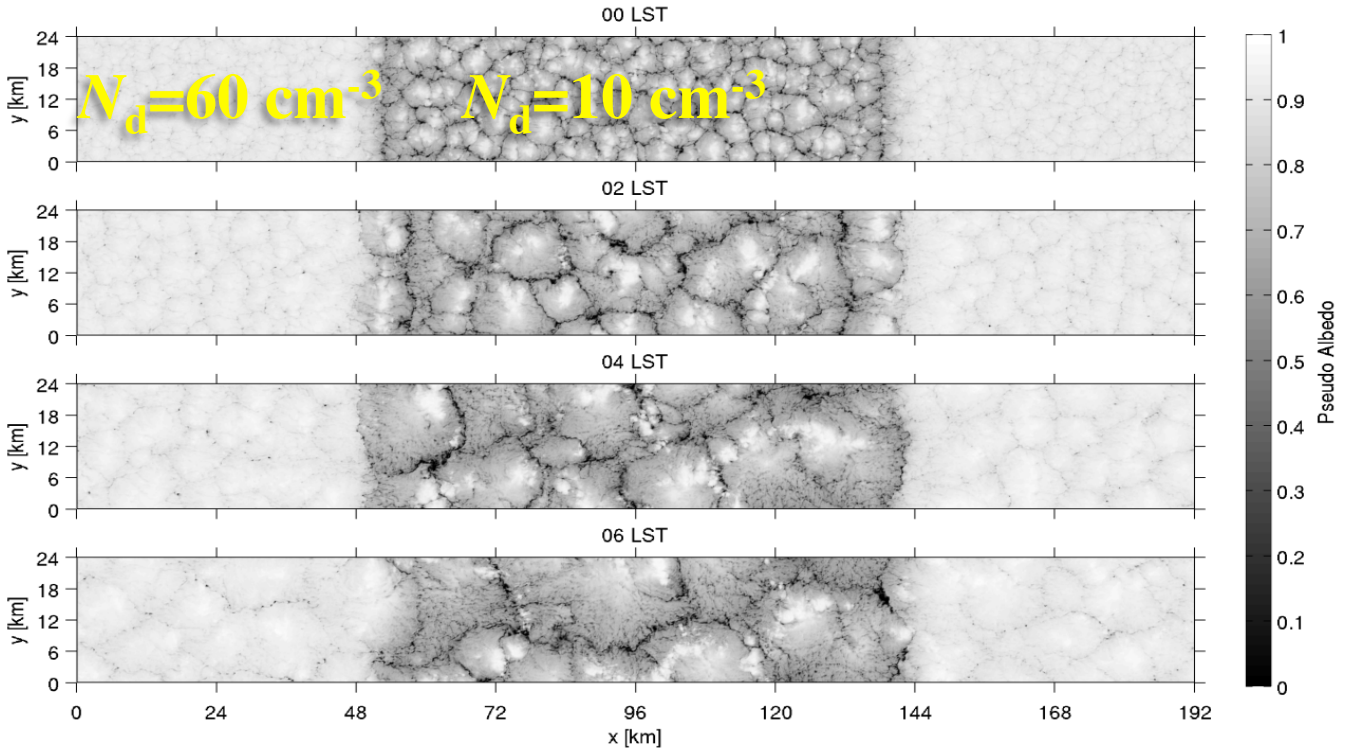
Feingold et al., *Nature*, 2010

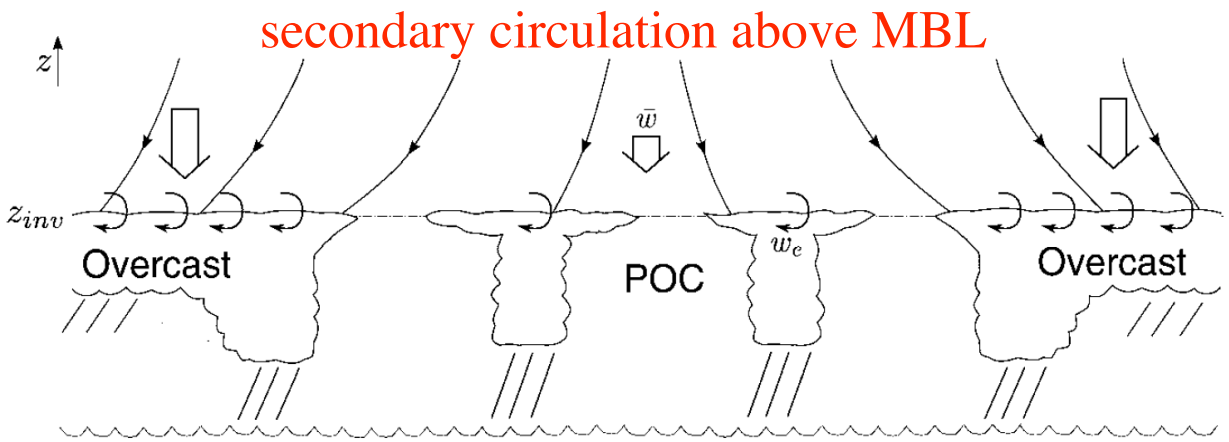
New conceptual models of macrophysical-microphysical interaction across POC boundary

Wood et al. *ACP*, 2010



LES modeling of open-closed cell boundary





inversion rises at same rate in both regions

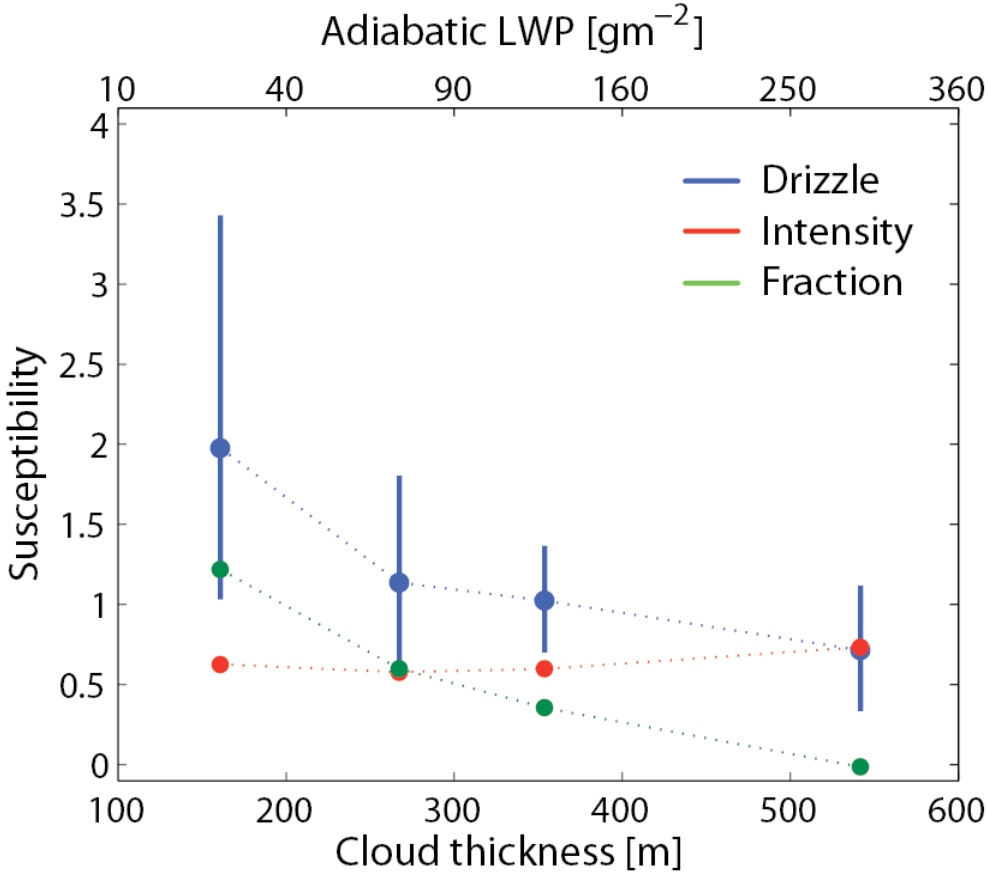
Berner and Bretherton (2011, ACPD), and Bretherton et al. (2010, JAMES)
Wang and Feingold (2009), Wang et al. (2010)

Precipitation susceptibility

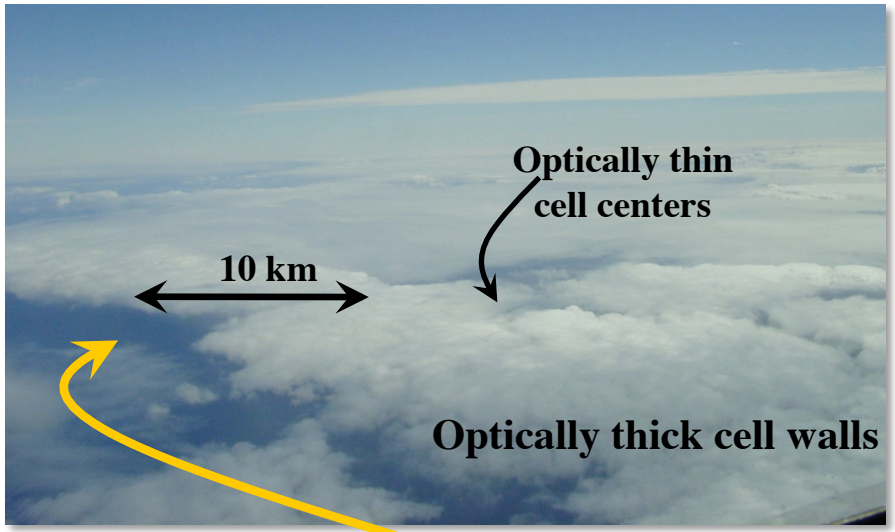
- Construct from Feingold and Siebert (2009) used to examine aerosol influences on precipitation VOCALS-REx data

$$\boldsymbol{S} = -(d\ln R_{CB}/d\ln N_a)_{LWP,h}$$

- *S* decreases strongly with cloud thickness
- Consistent with increasing importance of accretion in thicker clouds
- Consistent with results from A-Train (Kubar et al. 2009, Wood et al. 2009)

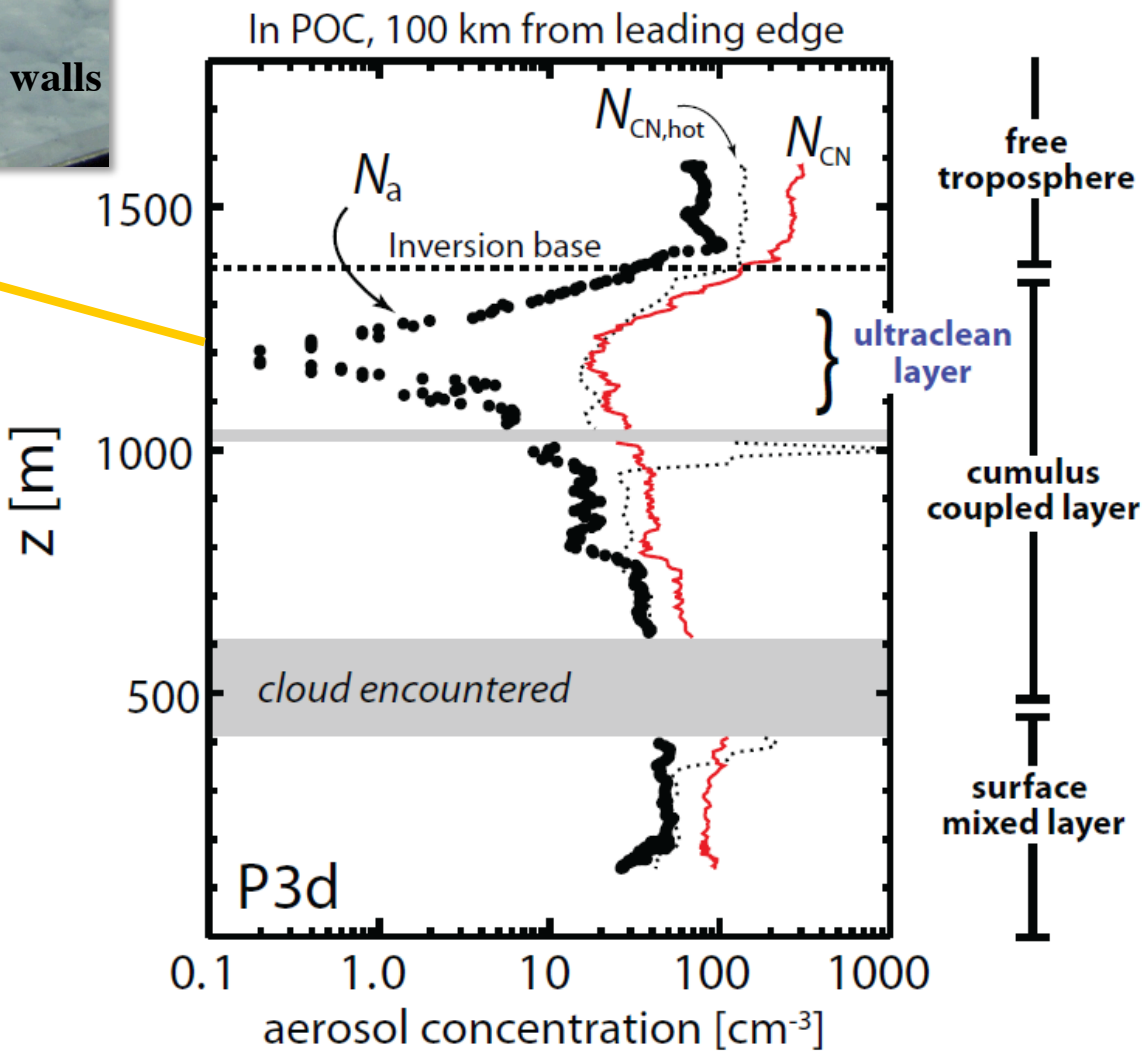


Terai et al. (2011)



Ultra-clean layers

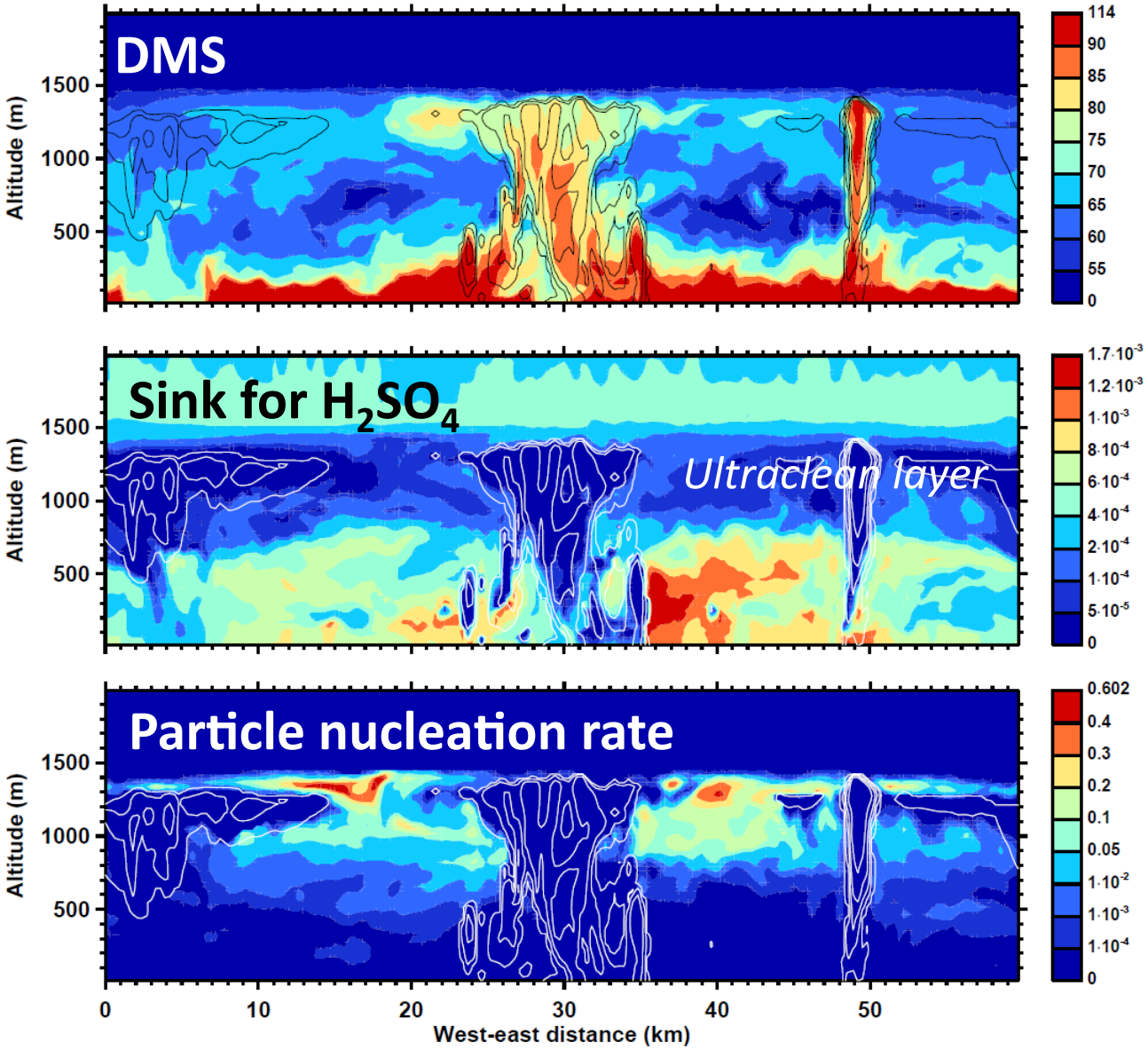
- Ubiquitous layer near top of POC MBL almost completely devoid of CCN
- Driven by coalescence scavenging by efficient precipitation production



See Wood et al. (2010, ACP)
also Petters et al, (2006)

Stratocumuli can create new particles

- WRF-Chem run in LES mode
- New particle formation rate comparable with sources from FT and sea-salt
- Not yet understood how important regionally



Kazil et al. (2011)

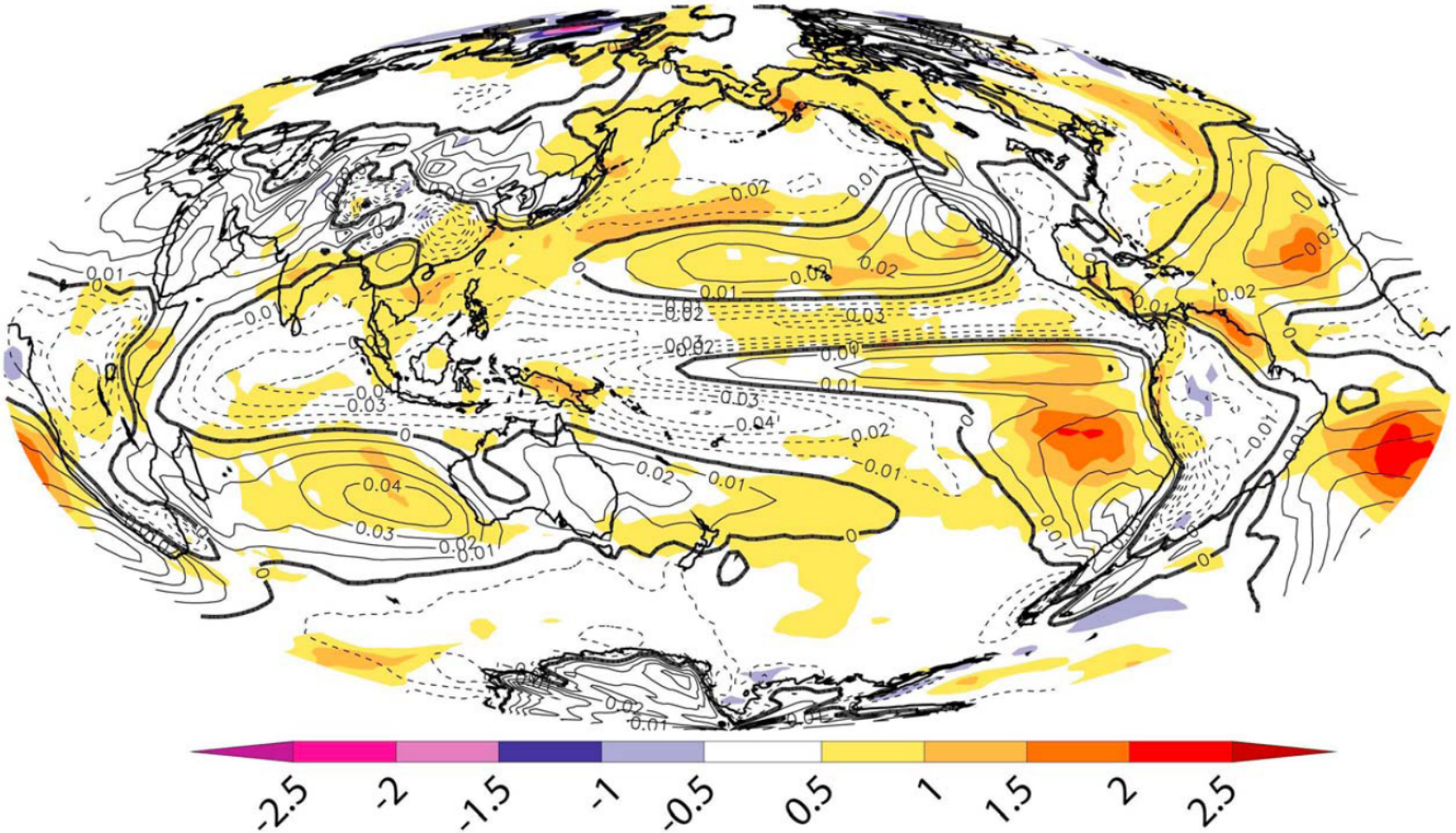
VOCALS Regional Experiment Impact

- Comprehensive, organized, and accessible field datasets from 5 aircraft and 2 ships for the Southeastern Pacific
  - unprecedented data on clouds, aerosols, and marine boundary layer structure; unique sampling strategies
- Strong synergies between field observations and process/ regional/global modeling studies
- Precipitation more prevalent than previously thought
- Aerosols now seen to be far more 'interactive' with stratocumulus than previously imagined
- Demonstration that international community efforts, based on sound scientific hypotheses, can be successful.

VOCALS Special Issue in *Atmospheric Chemistry and Physics*

VOCALS Poster Cluster (Monday 6pm)

- **Katherine Benedict, Taehyoung Lee, Jeffrey L Collett, Jr.** Cloud water composition over the southeastern Pacific (M59A)
- **Simon de Szoeke, Christopher W Fairall**
  VOCALS/Southeast Pacific science confronts coupled models with ship observations (M60A)
- **Jan Kazil, Graham Feingold** Sub-grid scale processes of the marine boundary layer cloud-aerosol system (M56B)
- **David Leon, Jefferson Snider, Paquita Zuidema, Jayson Stemmler, Gökhan Sever**
  The WCR-WCL-GVR Integrated Dataset. Expanding our observational capabilities through a combination of airborne radar, lidar, microwave radiometer, and in situ observations (M55A)
- **David Mechem, Sandra E Yuter, Simon P de Szoeke, Casey D Burleyson**
  Factorial analysis of mechanisms governing the diurnal cycle in southeast Pacific stratocumulus (M57A)
- **Brian Medeiros** Southeast Pacific stratocumulus in two versions of the community atmosphere model (M60B)
- **Jayson Stemmler, David C Leon, Jefferson R Snider, Gökhan Sever**
  Role of drizzle and mesoscale organization in determining cloud characteristics (M56A)
- **Aneesh Subramanian, Arthur J Miller, Bruce D Cornuelle**
  Understanding ocean processes during VOCALS-Rex cruise in the South East Pacific in a data assimilation framework (M55B)
- **Christopher Terai, Robert Wood, David Leon**
  Does precipitation susceptibility change with increasing cloud thickness in marine stratocumulus? (M58A)
- **Thomas Toniazzo, Steven J Abel, Robert Wood, Carlos R Mechoso, Leonard C Shaffrey**
  Large-scale and synoptic meteorology of the VOCALS-REx observations campaign (M41A)
- **Cynthia Twohy, James Anderson, Darin Toohey, Miroslaw Andrejczuk, AnnaRose Adams, Megan Lytle, Paquita Zuidema, David Leon, Rhea George, Robert Wood** Impacts of particles on properties of stratocumulus clouds (M57B)
- **Feiqin Xie, Dong L Wu, Chi O Ao, Anthony J Mannucci, Robert E Kursinski**
  Cloudy atmospheric boundary layer observations over subtropical eastern oceans from COSMIC GPS occultation (M59B)
- **Takanobu Yamaguchi, Alan Brewer, Graham Feingold**
  VOCALS/Southeast Pacific Science: Evaluation of WRF-LES with ship borne data during VOCALS-REx (M58B)



Shade: Regression of Local Cloud Feedback to Global-mean Cloud Feedback ($W \cdot m^{-2} \cdot K^{-1}$)
Contour: Background 500hPa Pressure Velocity ($Pa \cdot s^{-1}$)