Global characteristics of marine stratocumulus clouds and drizzle

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May 2011

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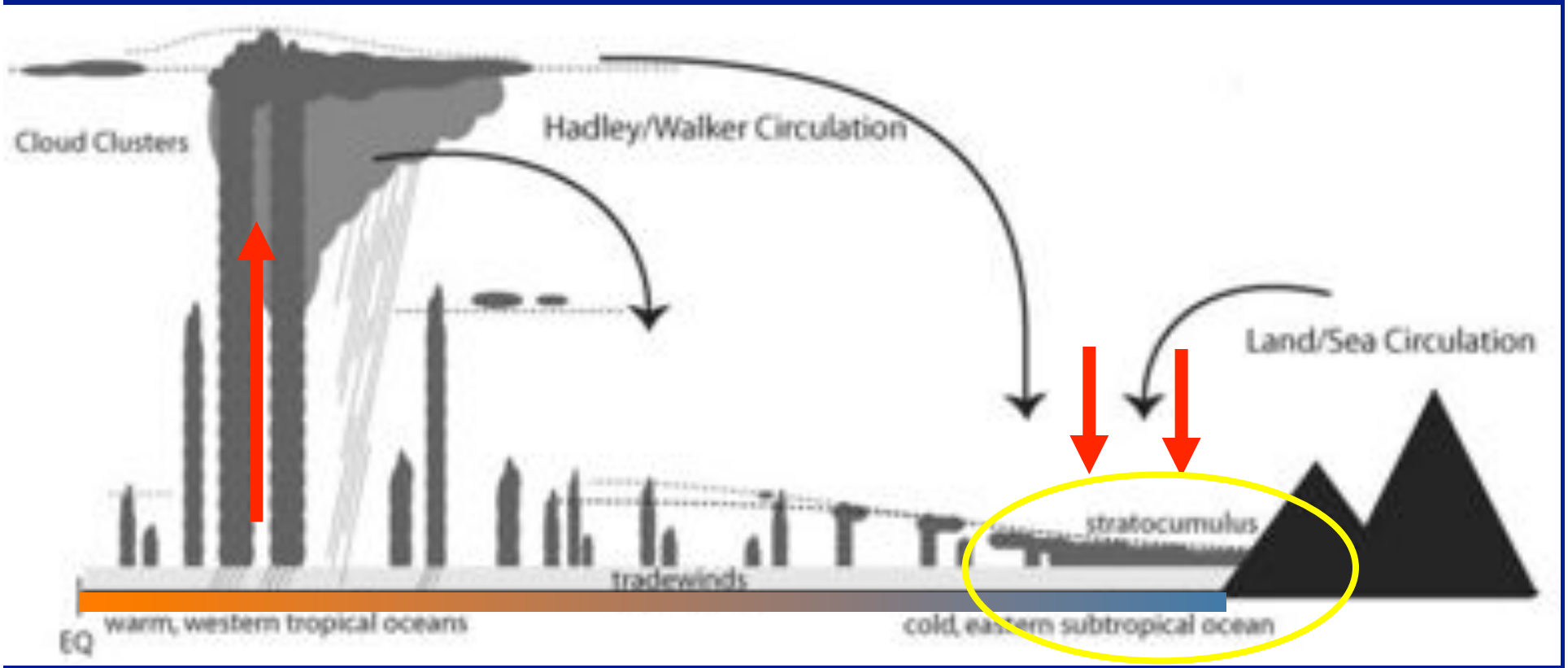
Stratocumulus formation

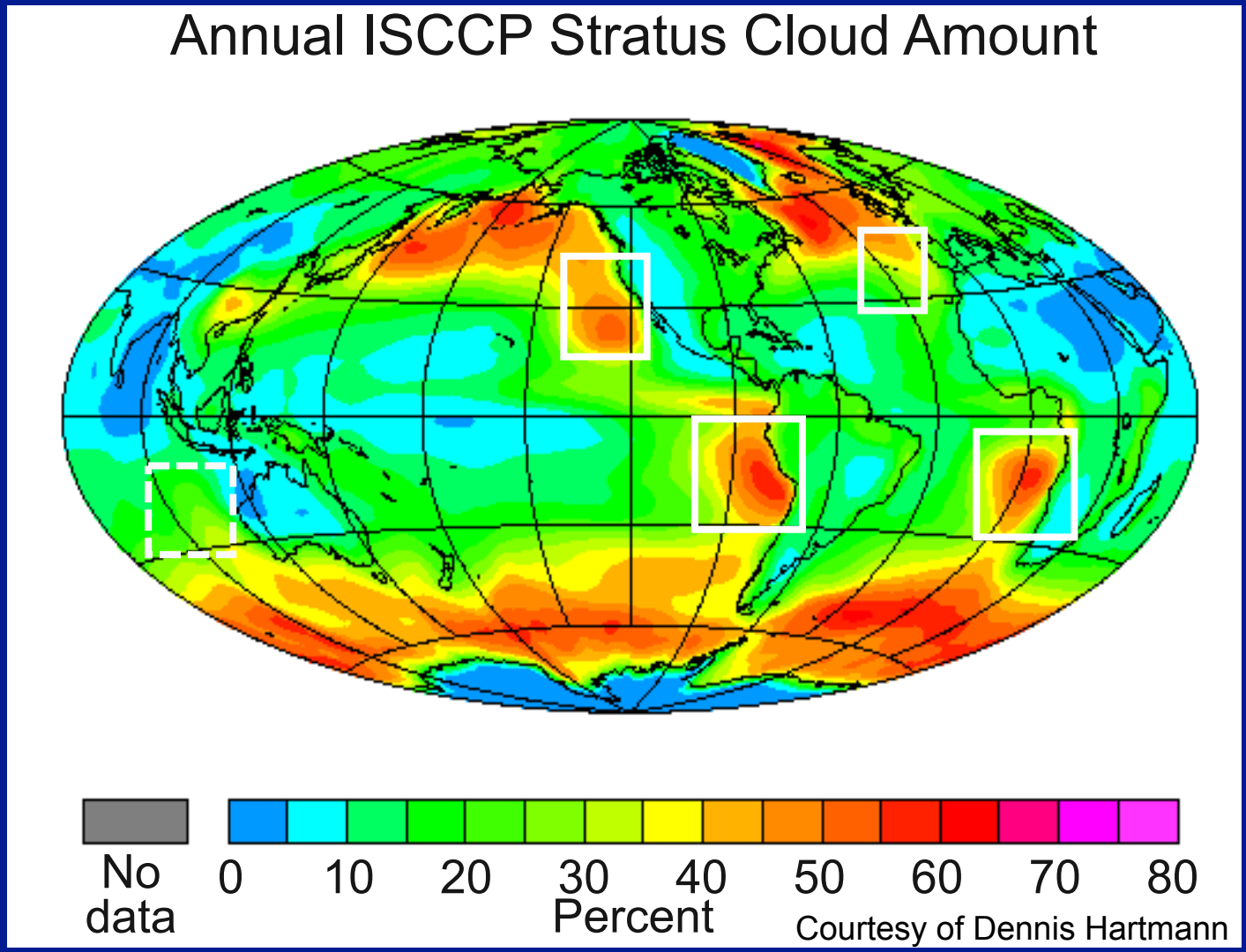


← Equator

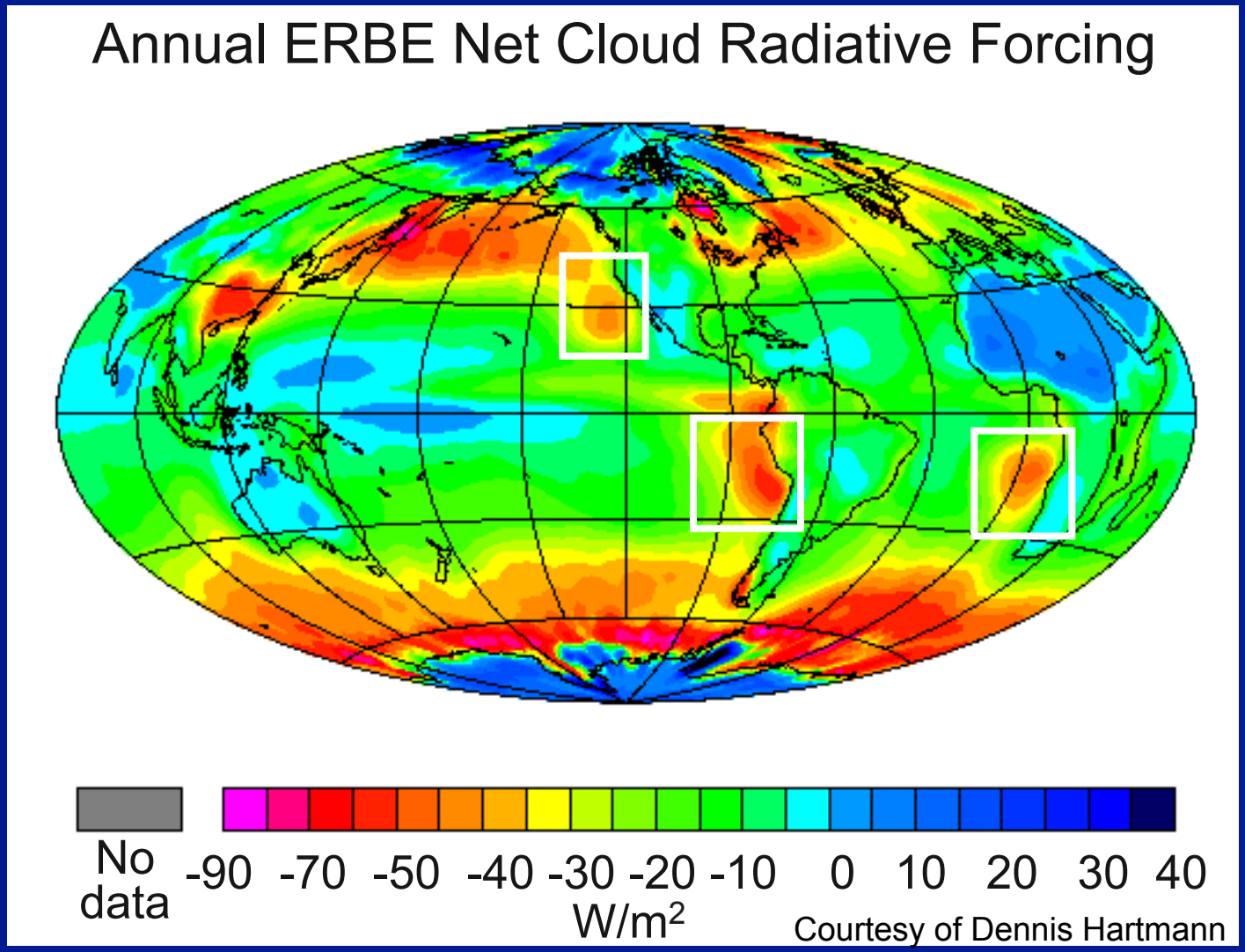
Poleward →

Stevens 2005, from Arakawa 1975

Why study marine stratocumulus?



Why study stratocumulus?- radiative forcing



cloud forcing

=

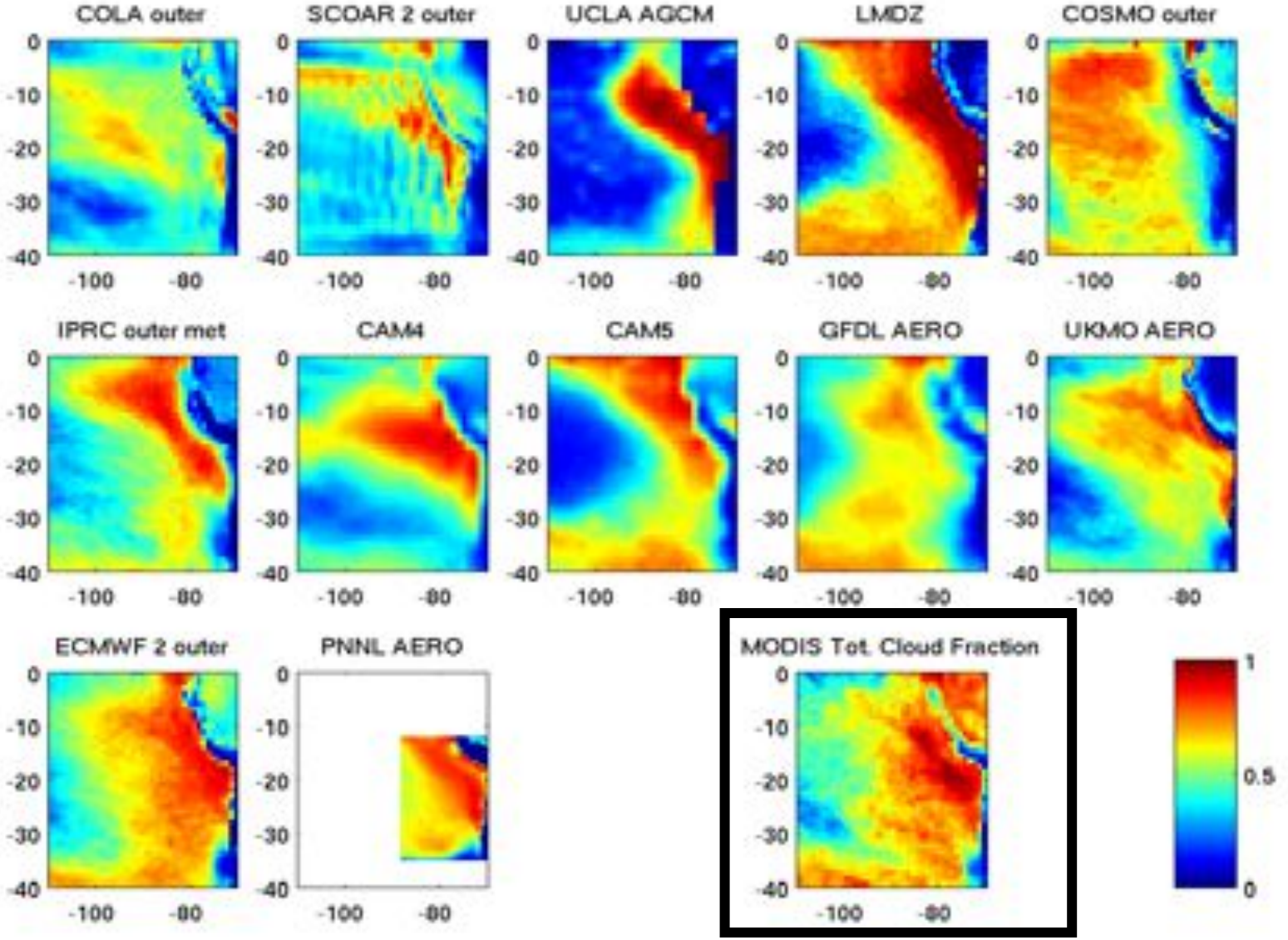
cloudy TOA rad. flux

–

clear sky TOA rad. flux

Monthly-mean results (16 Oct – 15 Nov 2008)

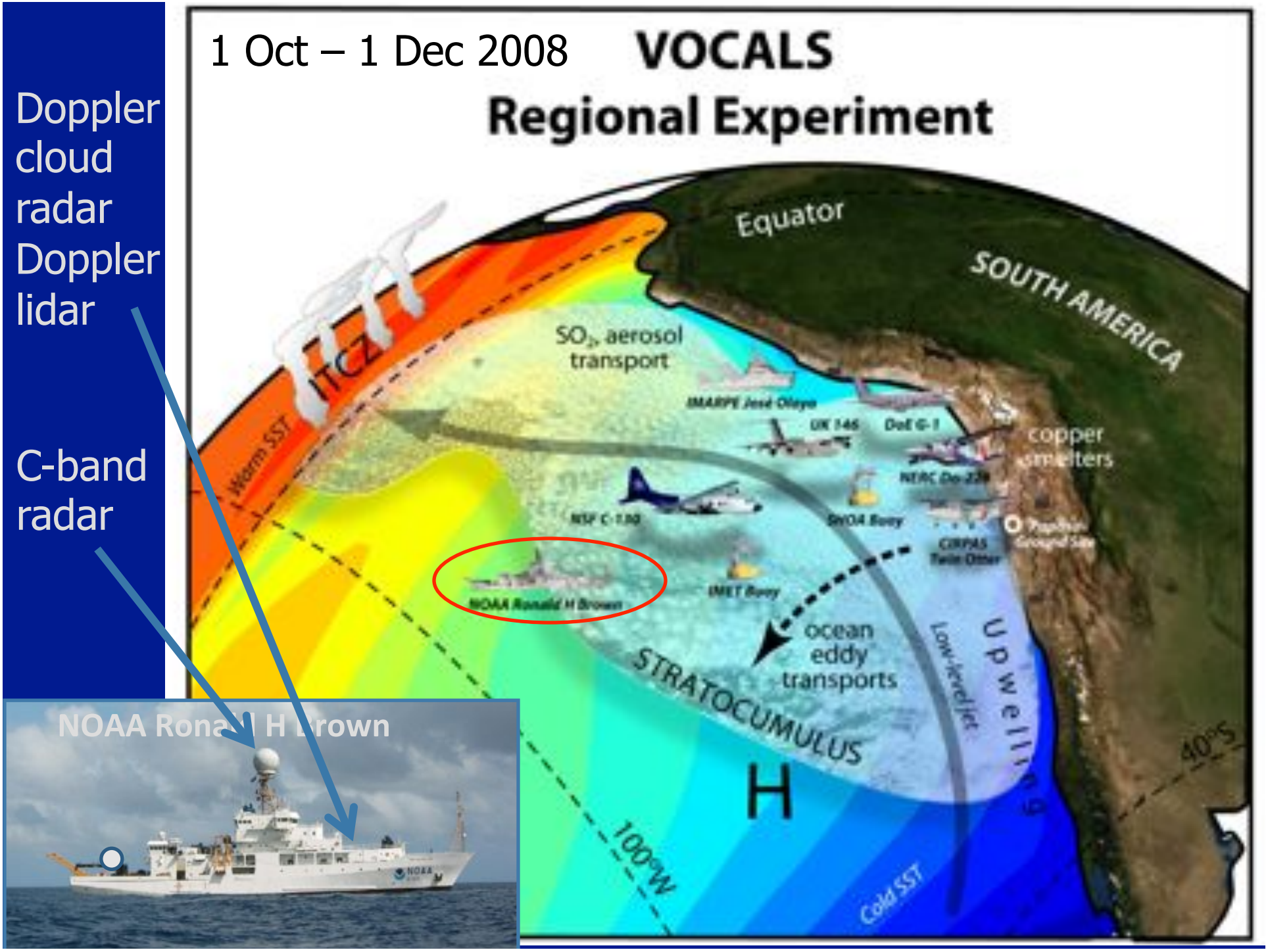
Modeled low cloud fraction for SE Pacific



M. Wyant, U. Washington

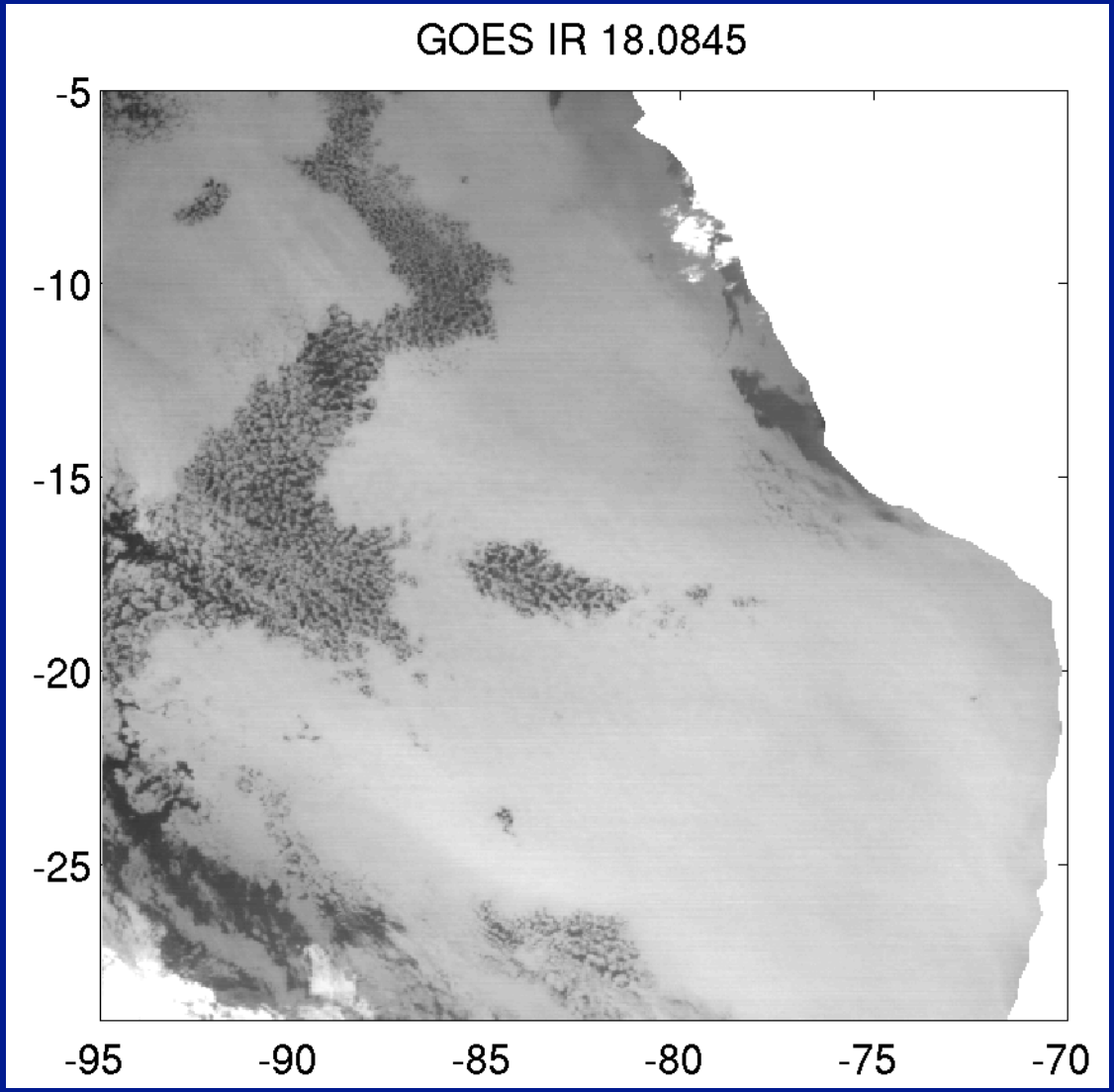
Doppler cloud radar
Doppler lidar

C-band radar

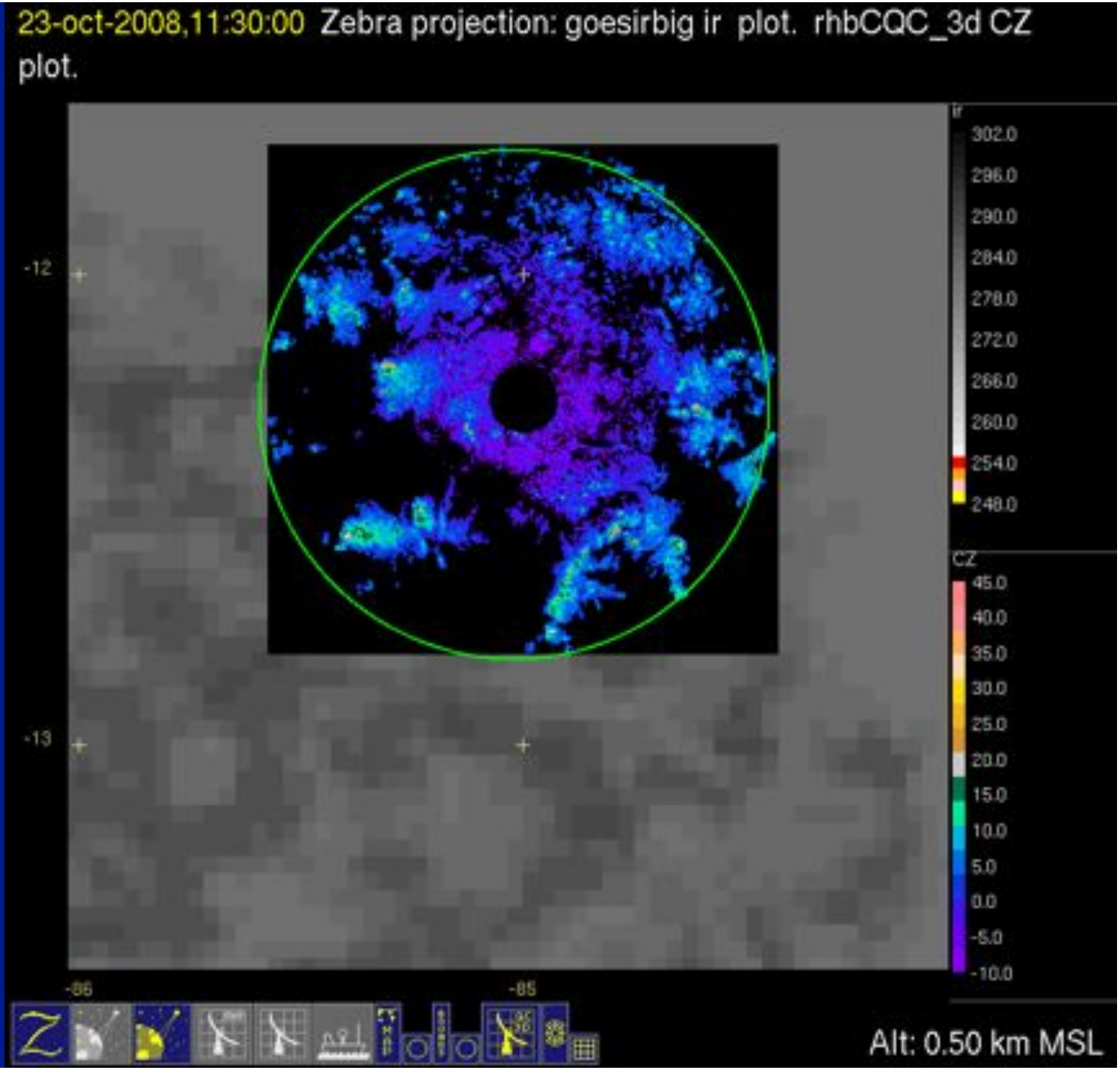


Focus on stratocumulus mesoscale organization and albedo variations

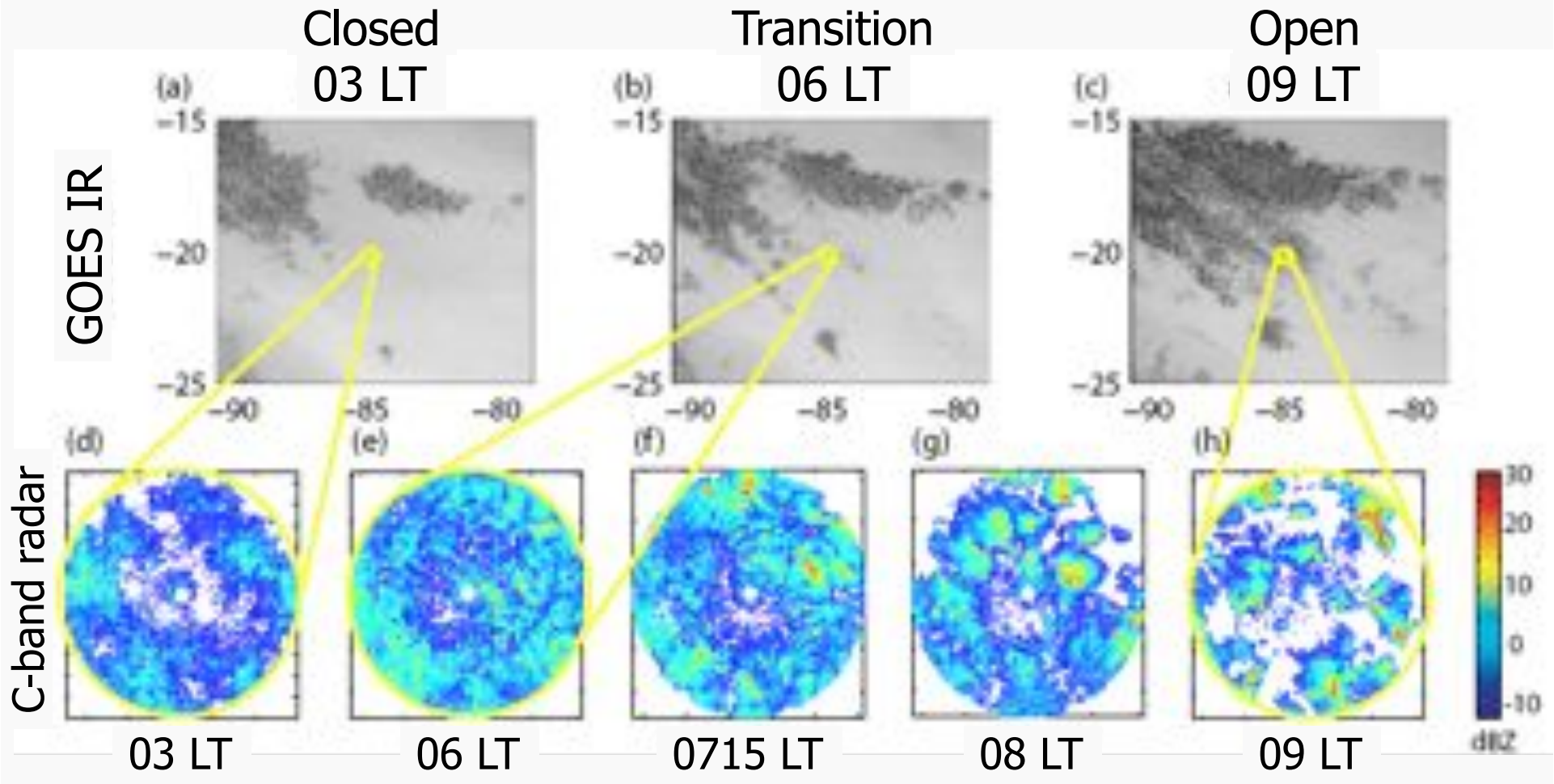
Pockets of open cells



1130-1430 UTC
23 Oct 2008



Field project data sets (and modeling studies) show that drizzle is implicated in the transition from closed to open-cellular

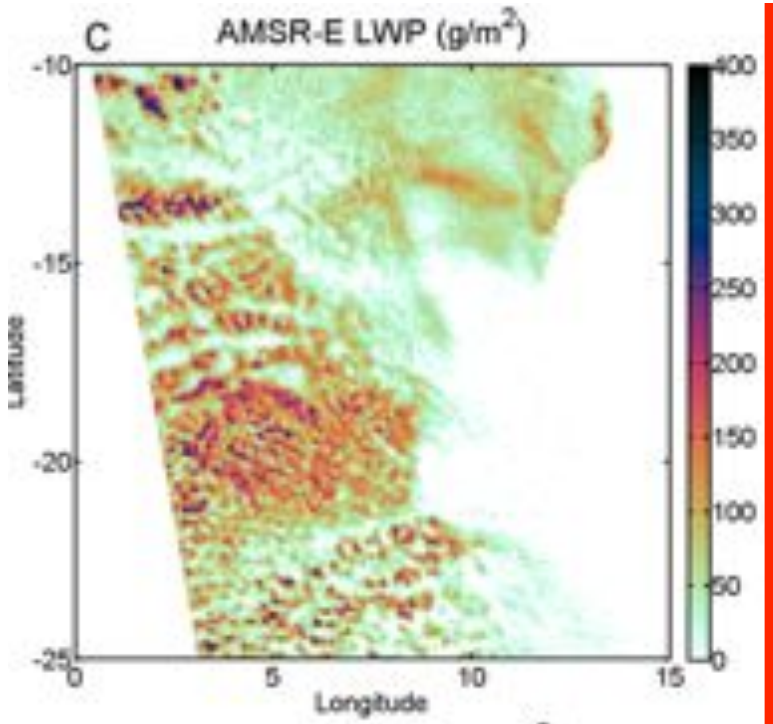


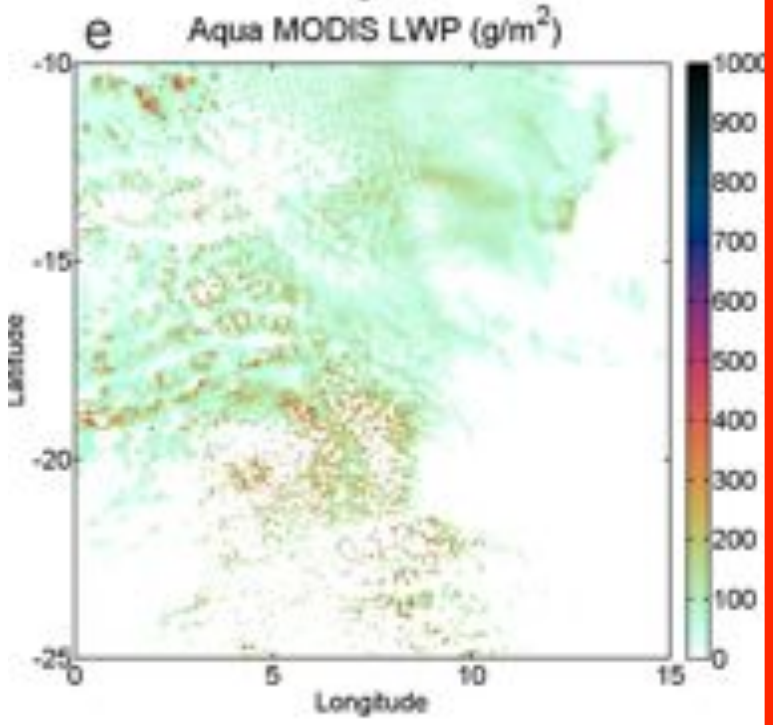
EPIC Sc cruise Oct 2001

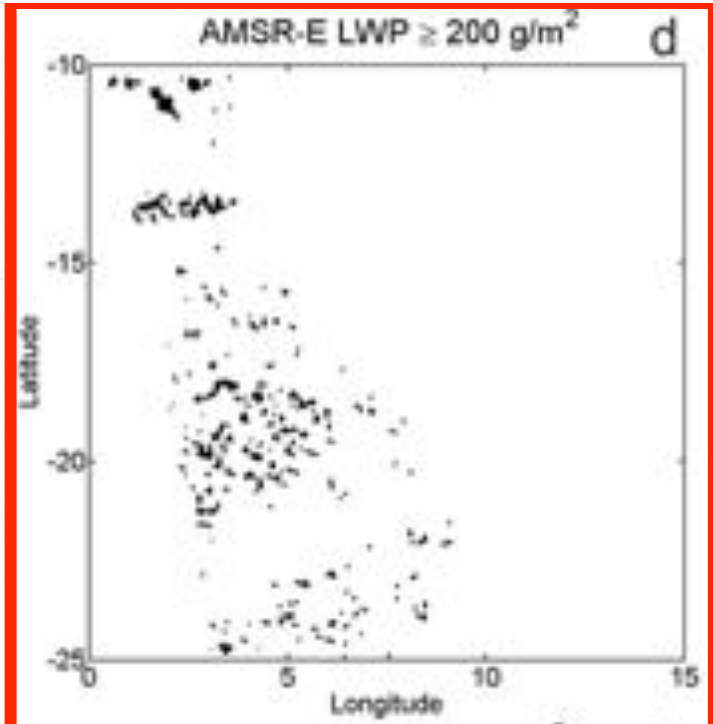
Comstock et al. 2007

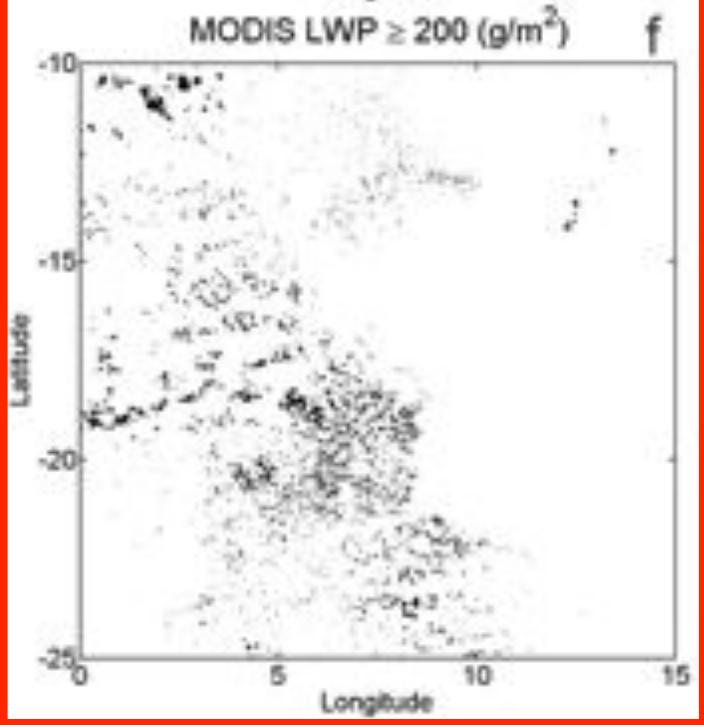
Field project data sets contain detailed data from multiple sensors but are limited in time and spatial coverage….

…In order to understand these clouds globally and over multiple years, we need to use satellite data sets





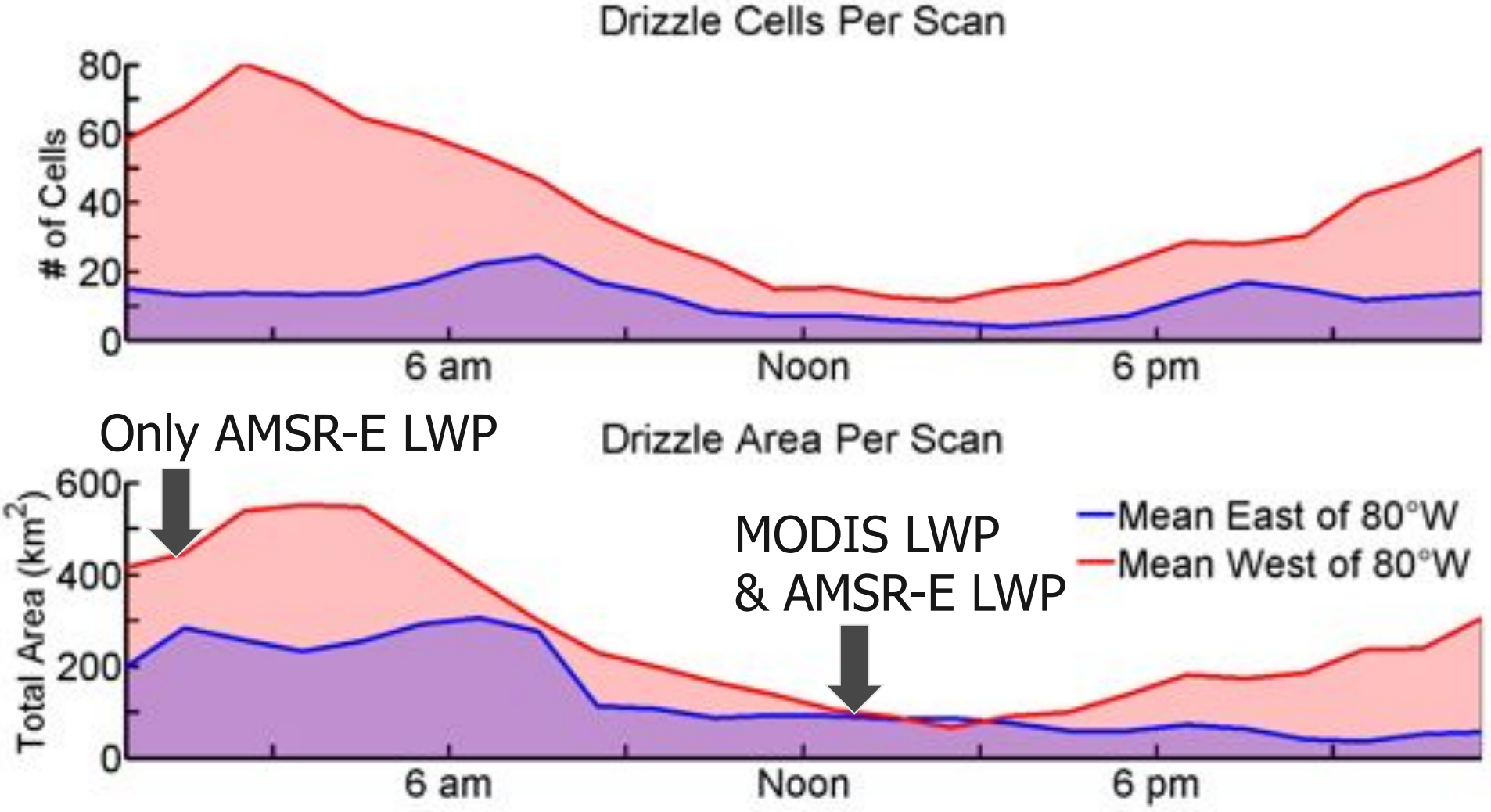




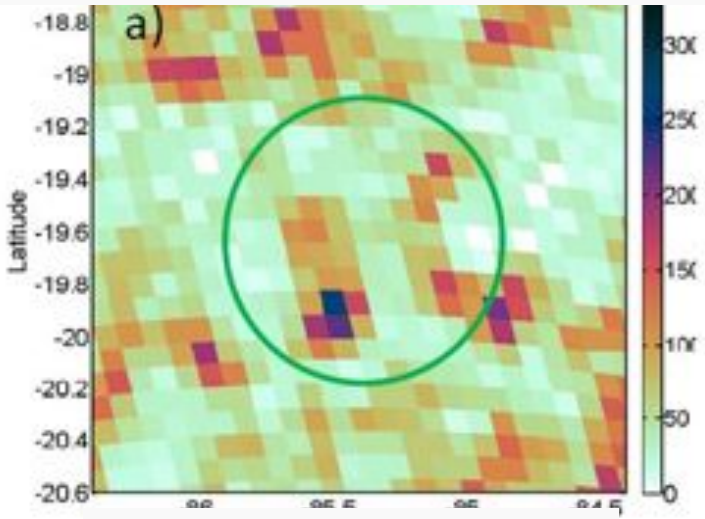
Current satellite methods to identify drizzling stratocumulus are either lacking in resolution (AMSR-E LWP; 12 km x 12 km) or diurnal coverage (MODIS LWP daylight only; 1 km^2).

Most drizzle occurs at night

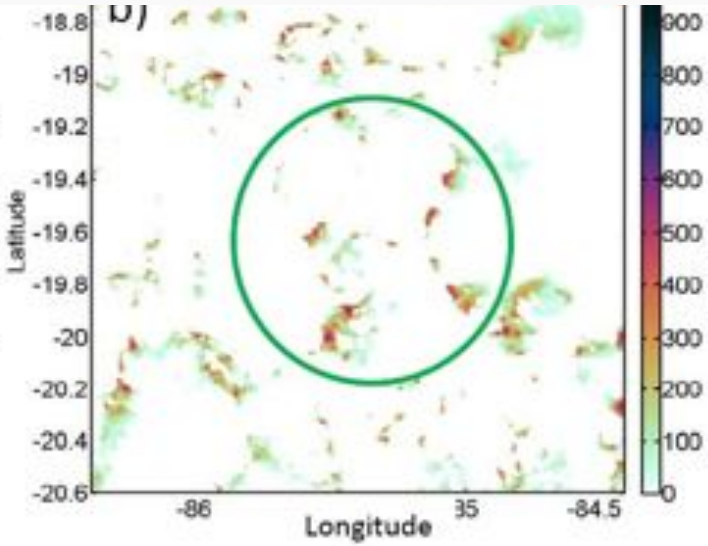
C-Band Radar Observed Drizzle: SE Pacific



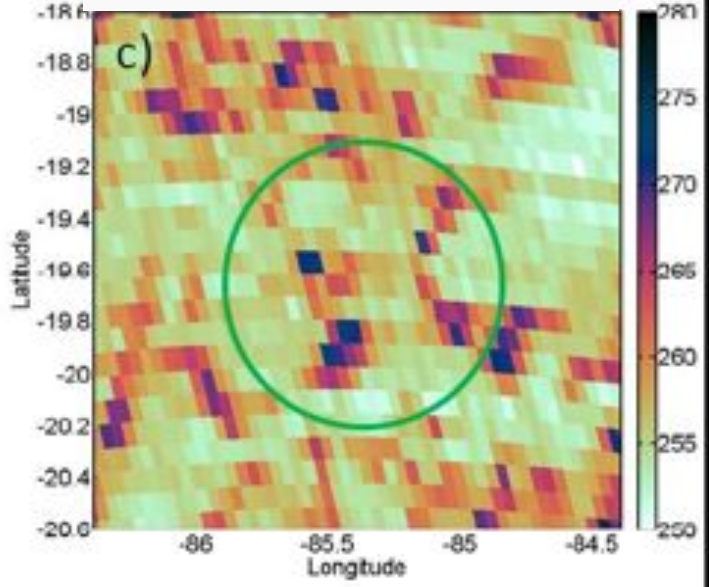
Level II AMSR-E Cloud LWP

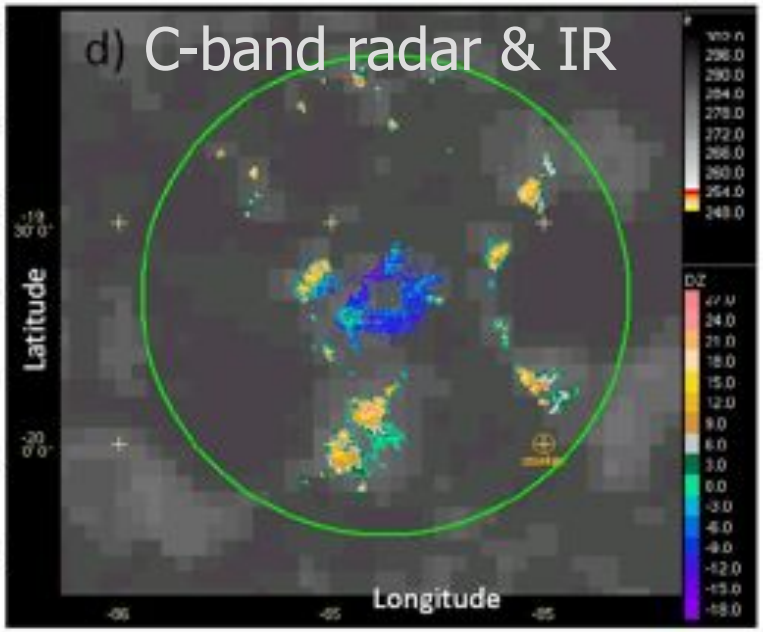


Level II MODIS Cloud LWP

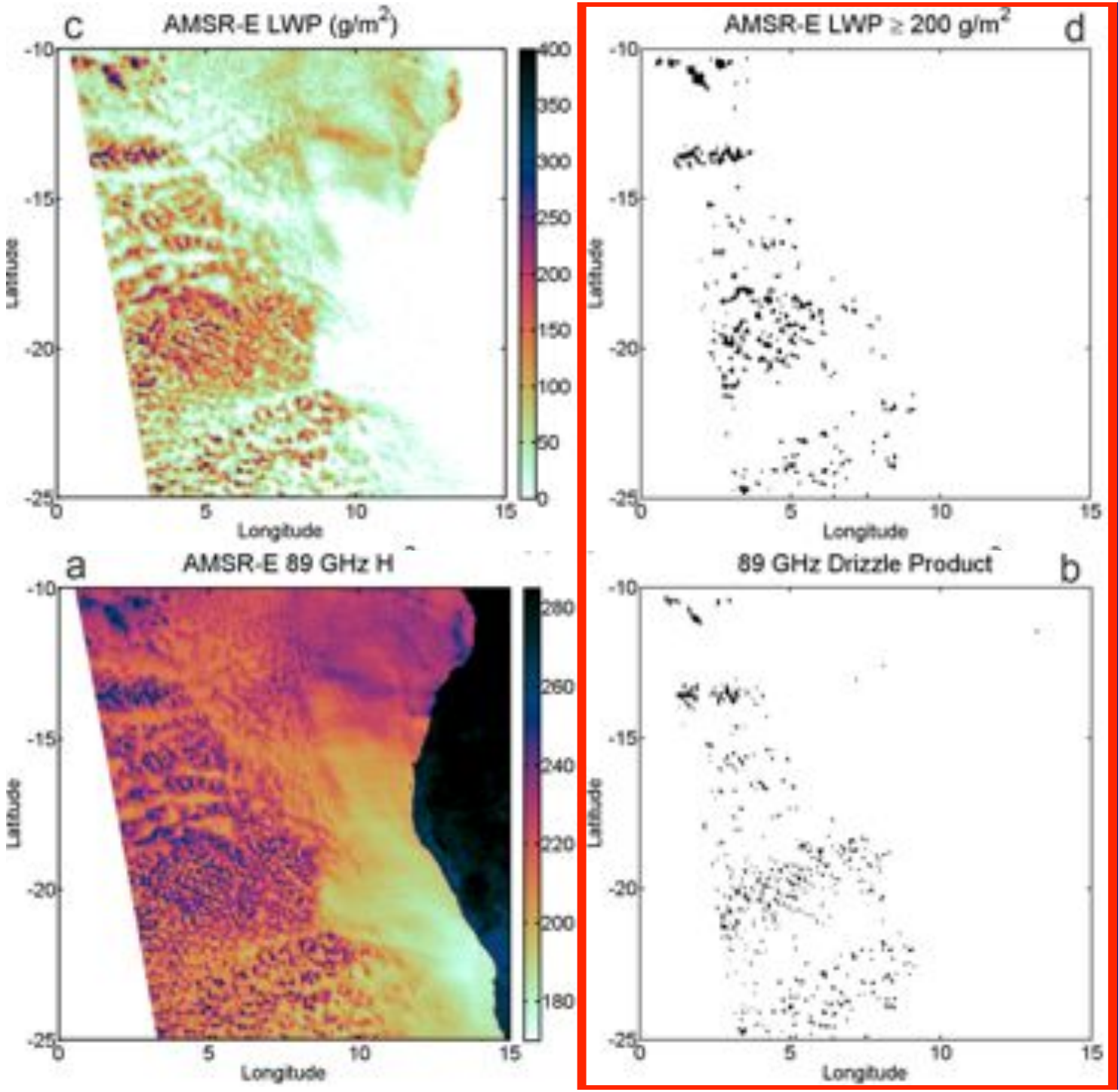


AMSR-E 89 GHz Tb



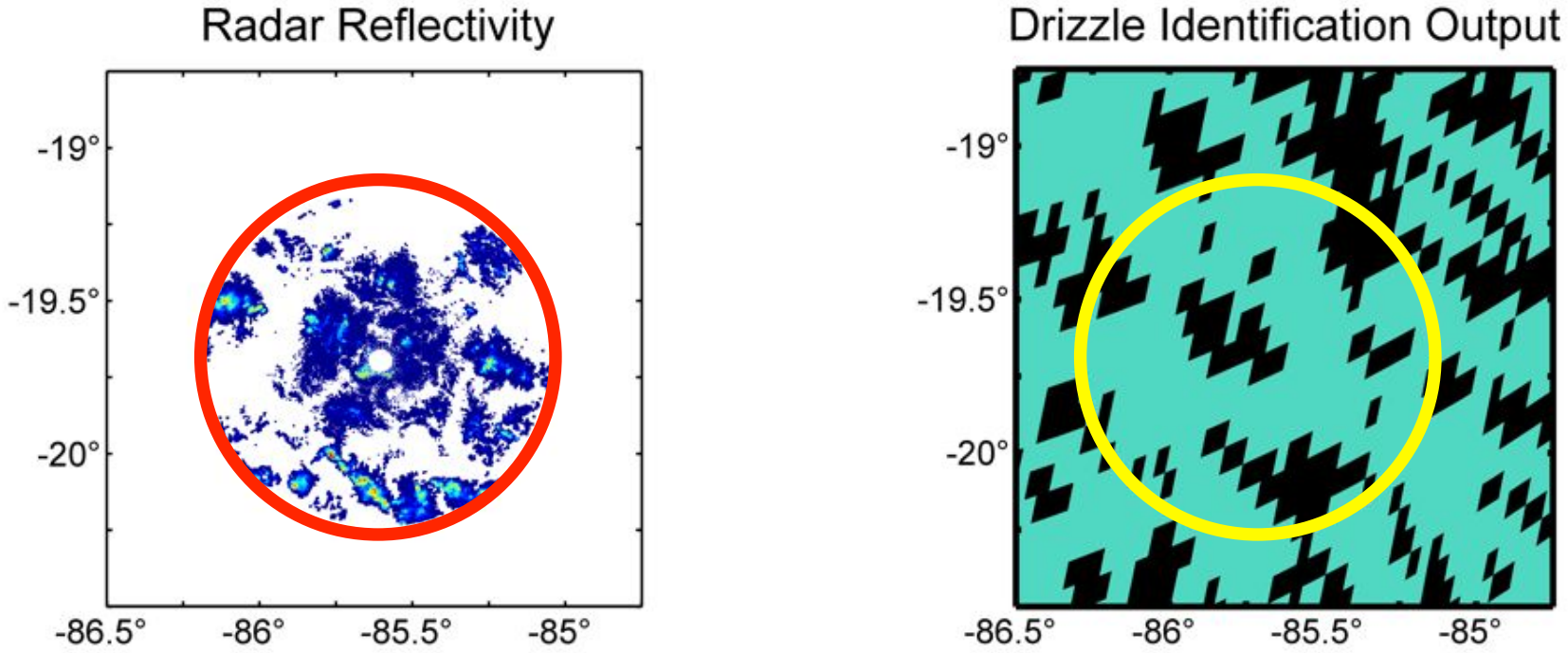


In the absence of ice, AMSR-E 89 GHz Tbs (6 km x 4 km) contain liquid water emission information



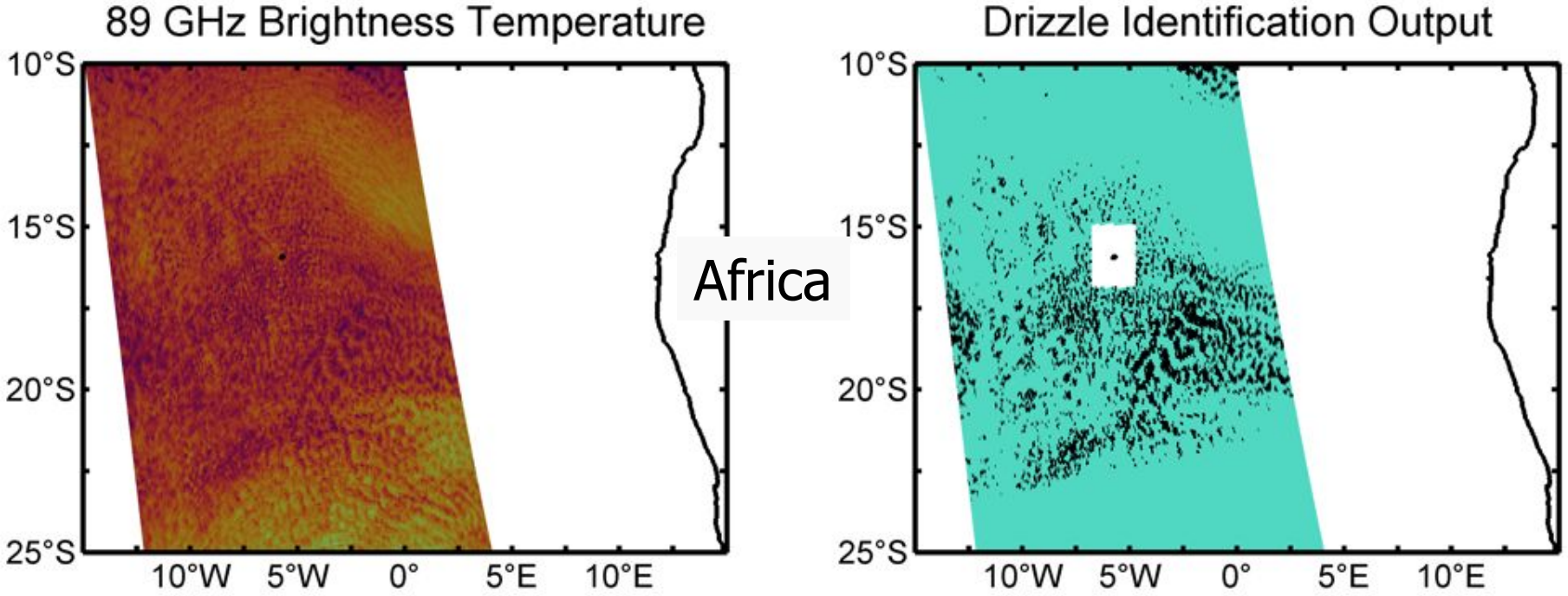
We can improve upon AMSR-E LWP in regions where clouds contain no ice

Oct 27 2008 06:55 UTC (Night)

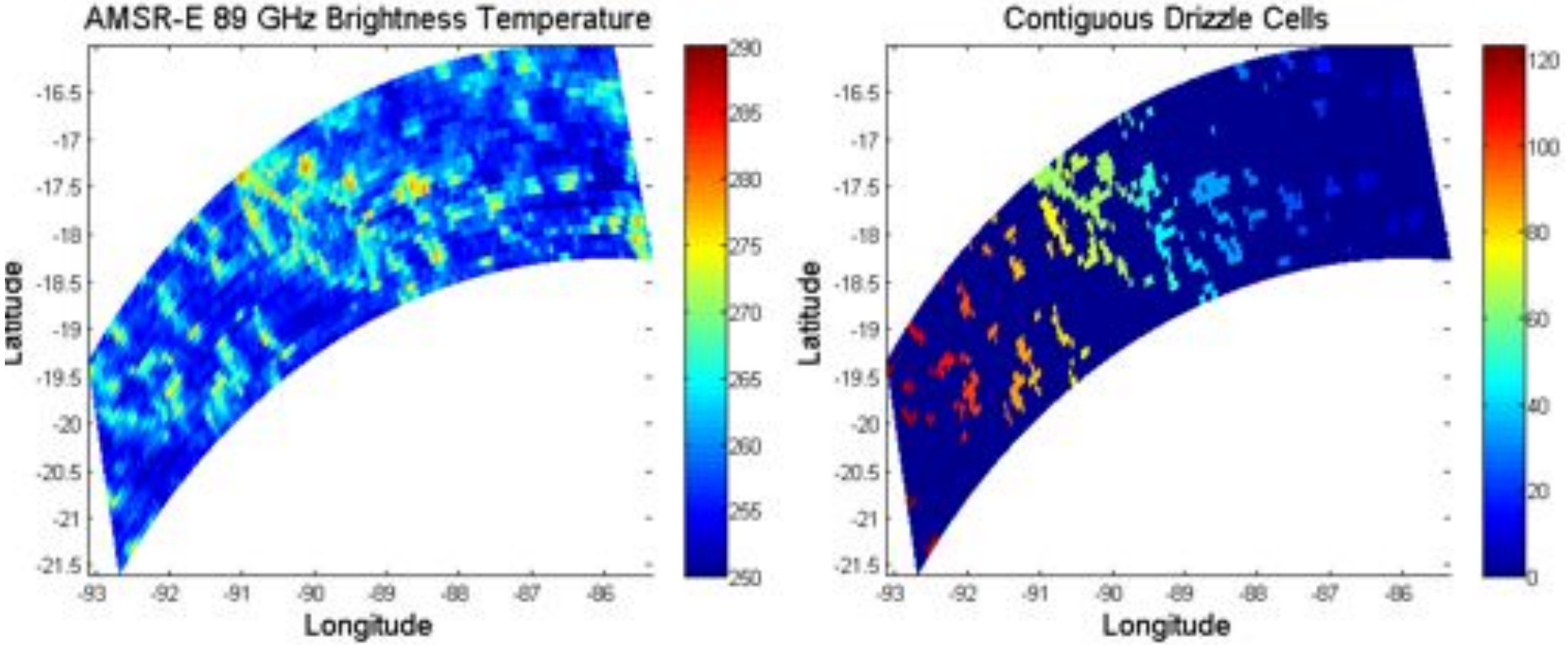


C-Band Radar Reflectivity (left), 89 GHz Drizzle Cell ID (right)

SE Atlantic Oct 8 2008 13:49 UTC (Day)



Feature analysis tools



Identified drizzle cell features are color-coded by feature number

Goals

- Refine drizzle proxy product based on combination of AQUA MODIS and AMSR-E data using ship-based VOCALS Rex data sets
- Extend drizzle proxy product to work based on TRMM TMI 85 GHz data
- Use drizzle proxy product to address:
  - How do the characteristics of drizzle cells and their mesoscale organization compare among the different marine stratocumulus cloud decks?
  - Variability in regional drizzle occurrence since 2002