Regional circulation and cloud droplet number concentration variability

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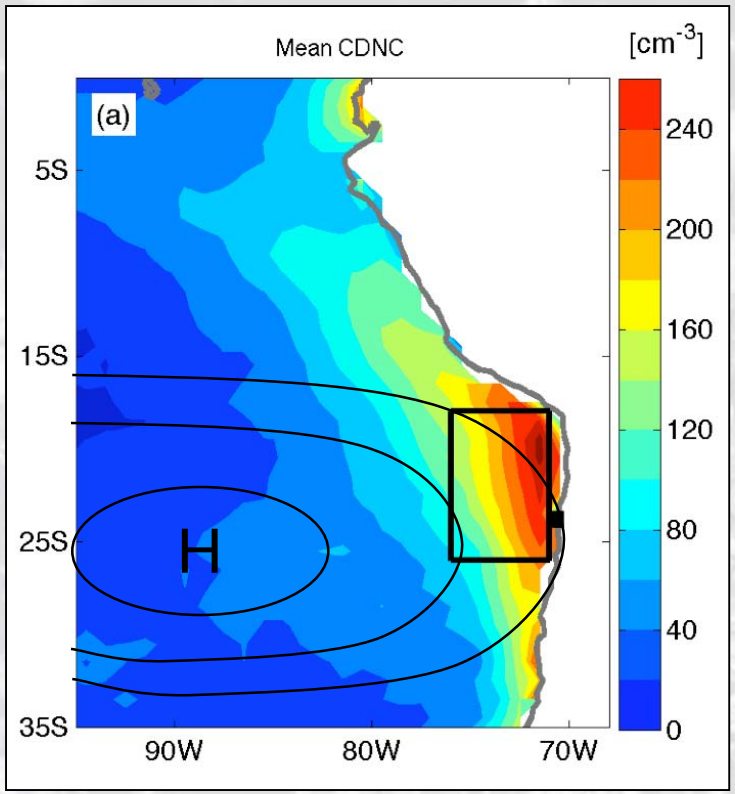
Motivation



- Understand the regional circulation associated with changes in CDNC along the coast.
- Determine the net radiative effect driven by both microphysics and meteorology.

Outline

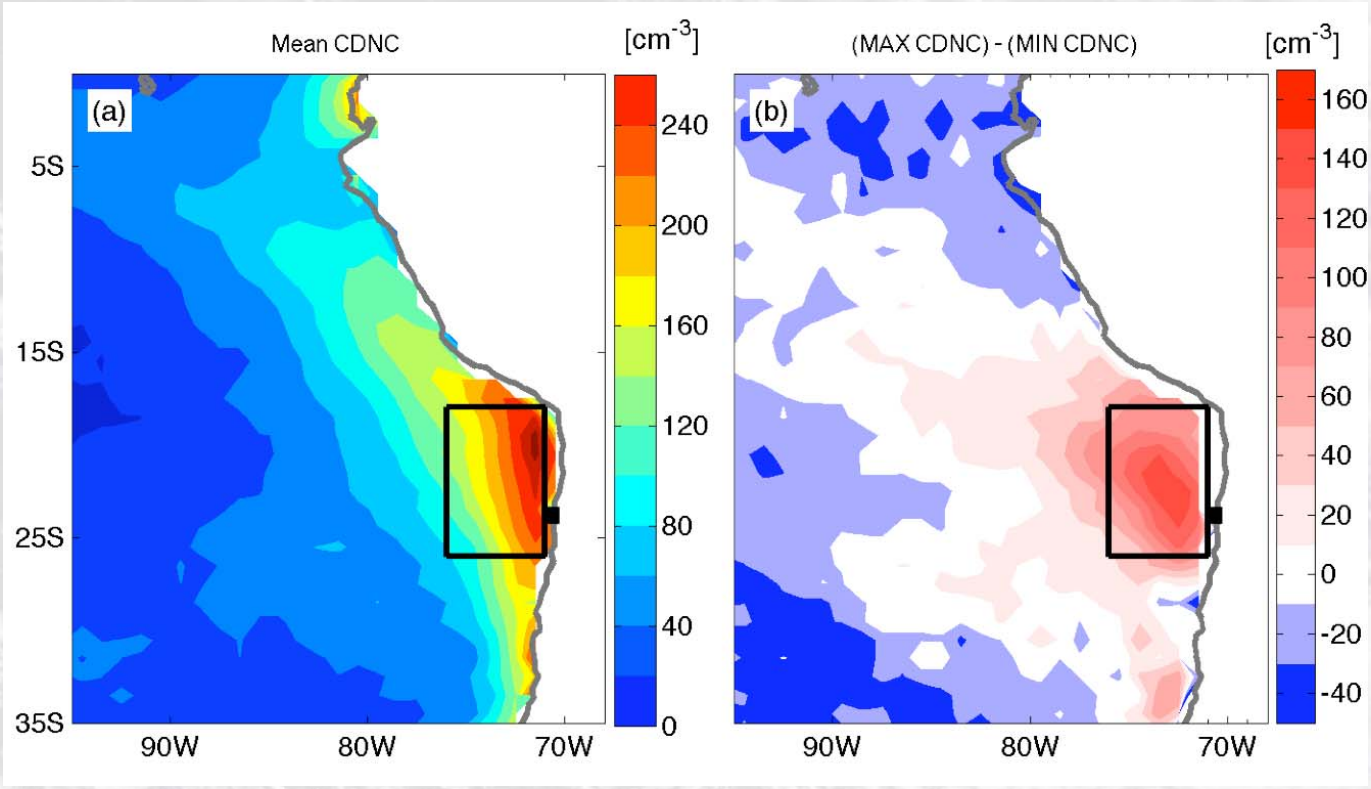
- Data and Methods:
  - Basic microphysical relationships
  - Composite analysis.
- Results
  - Synoptic conditions.
  - Radiative changes
- Summary and conclusions

Dataset and Methods

- **NCEP/NCAR reanalysis** (Kalnay et al 1996): 2.5˚x 2.5˚
- **QuickSCAT surface winds** (daily values) 25kmx25km
- **MODIS retrievals** (daily values) 1˚x1˚
  - Cloud effective radius (r_{eff})
  - Cloud optical thickness (τ)
  - Combined under assumption of adiabatic approximation:
    - CDNC $\propto \Gamma^{1/2} \cdot \tau^{1/2} / r_{eff}^{5/2}$ (Szczodrak et al 2001)
  - Cloud top temperature
    - Estimate of cloud top height using radiosonde-derived lapse rate (Zuidema et al., 2009)
- **CERES** shortwave radiation at TOA

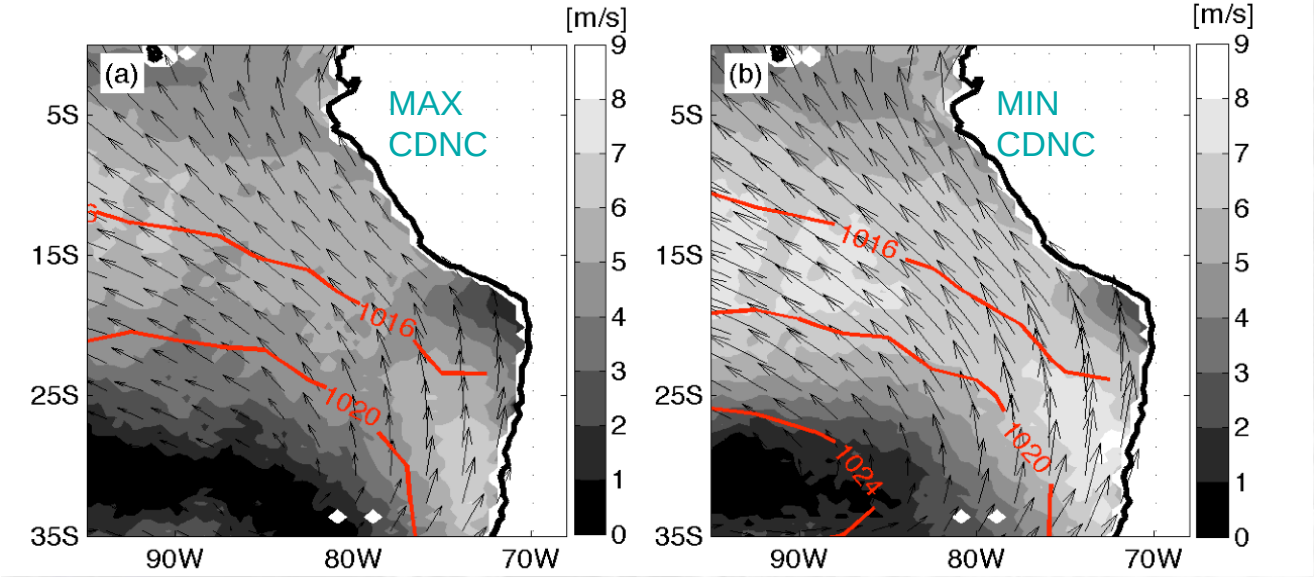
- **Period of study: October (2001-2005-2006-2007-2008)**

Dataset and Methods



- Maximum CDNC (MAX CDNC) (41 days)
  - Events with: CDNC>216 =$Mean_{CDNC}$+std_{CDNC}/2
- Minimum CDNC (MIN CDNC) (43 days)
  - Events with CDNC<161.5 = $Mean_{CDNC}$-std_{CDNC}/2

Results



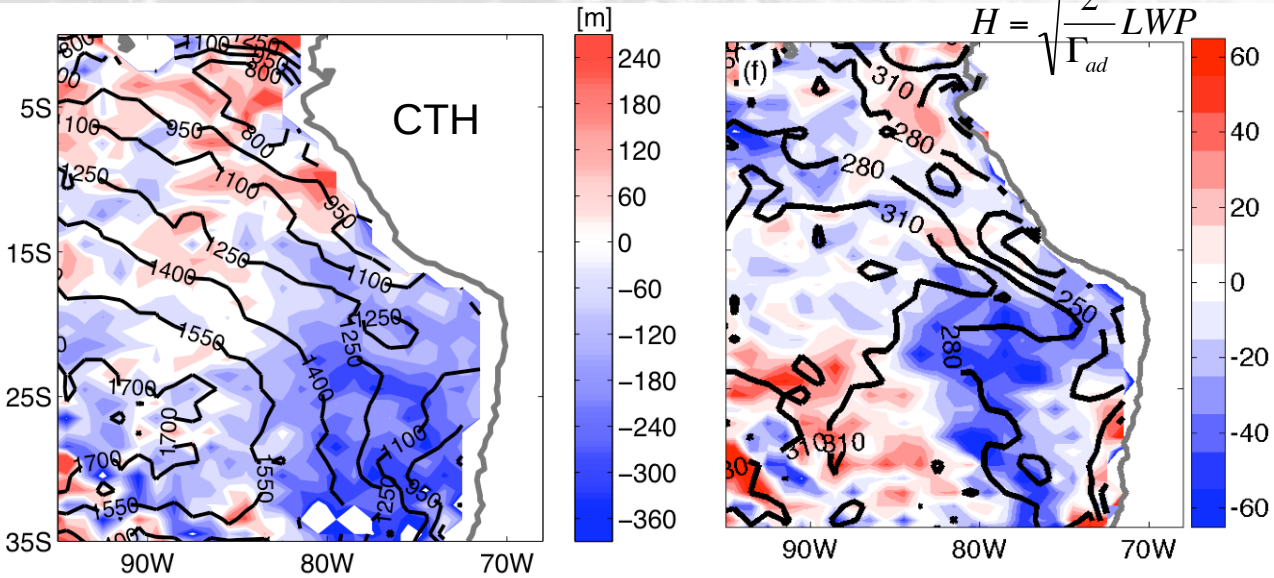
QSCAT winds and SLP (red contours)

- MIN case
  - Reinforced SLP
  - Stronger winds

MAX-MIN differences

Schüller et al. 2003

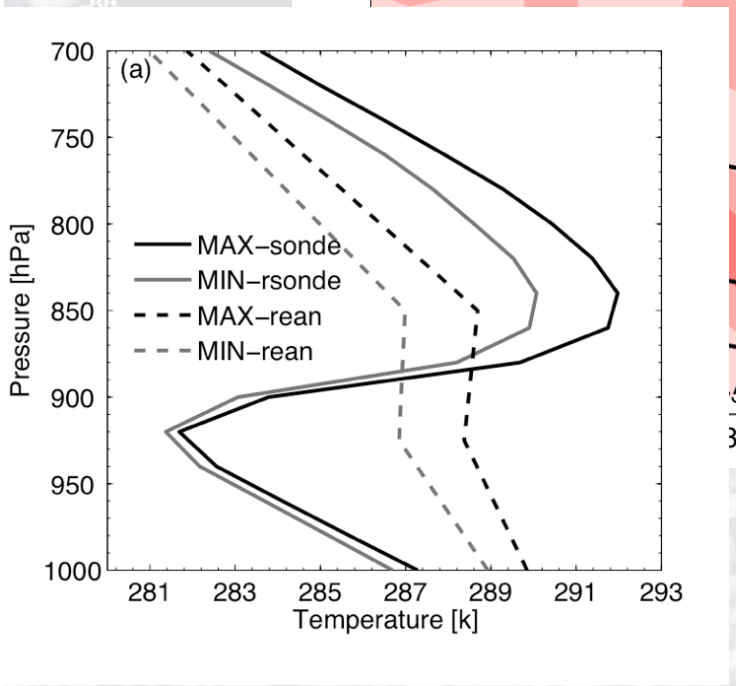
$$H = \sqrt{\frac{2}{\Gamma_{ad}} LWP}$$

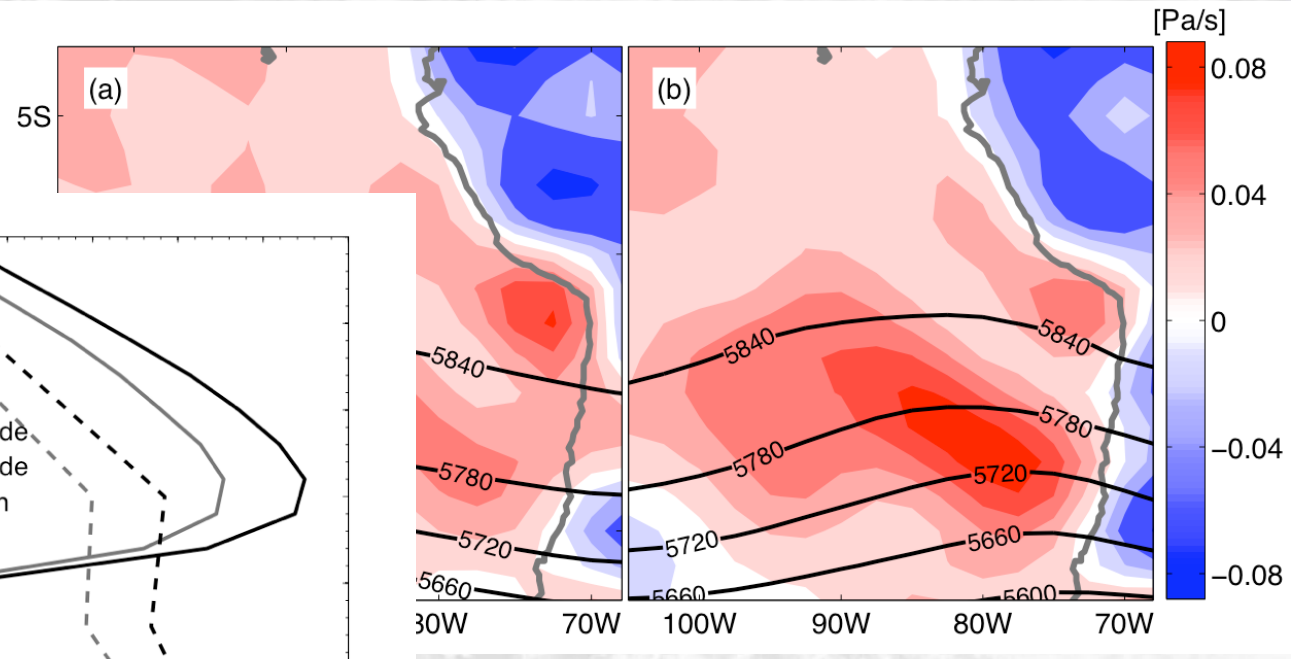


- MAX case
  - lower CTH
  - Thinner clouds

Subsidence (700 mb) and geopotential height

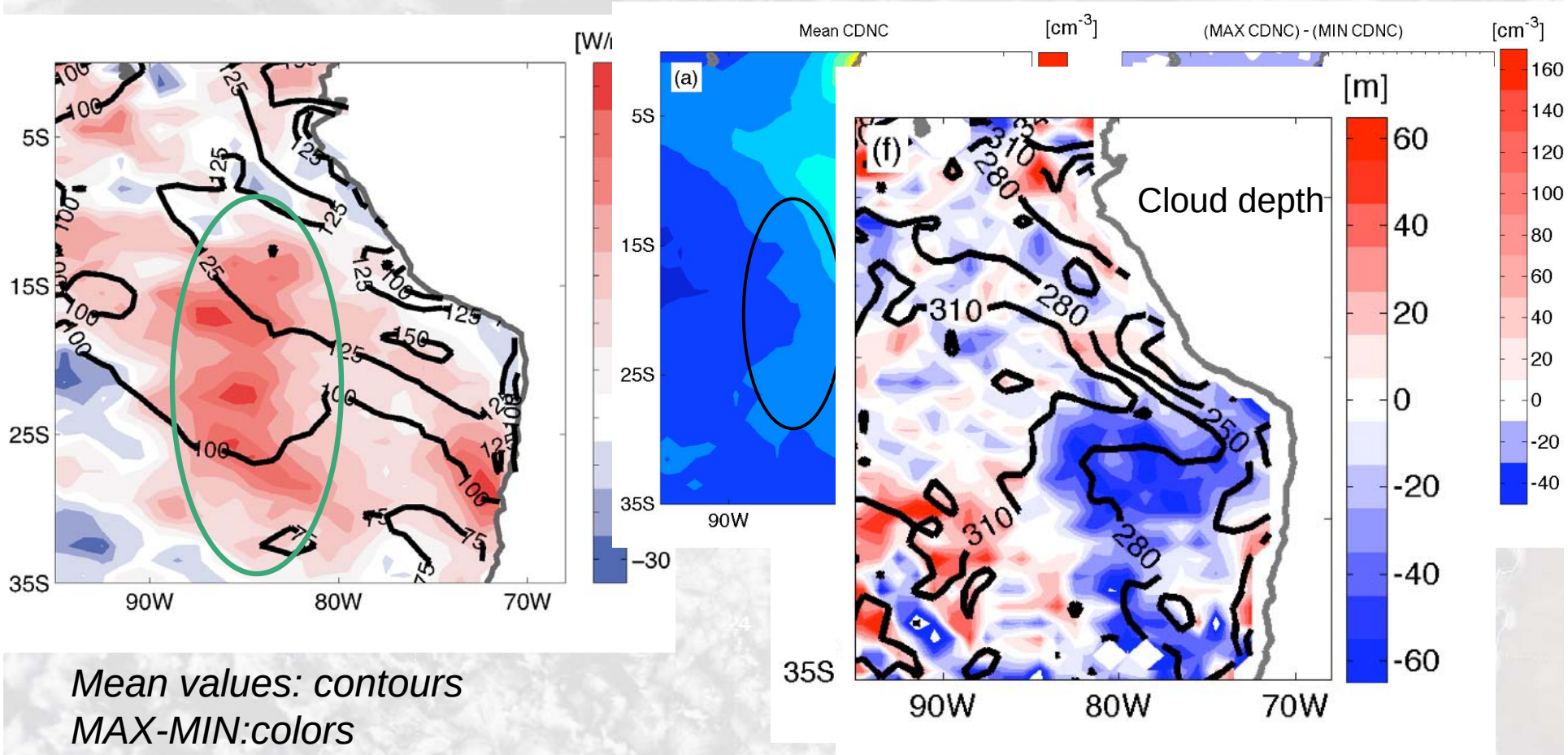
MAX CDNC





MIN CDNC

Radiative impact

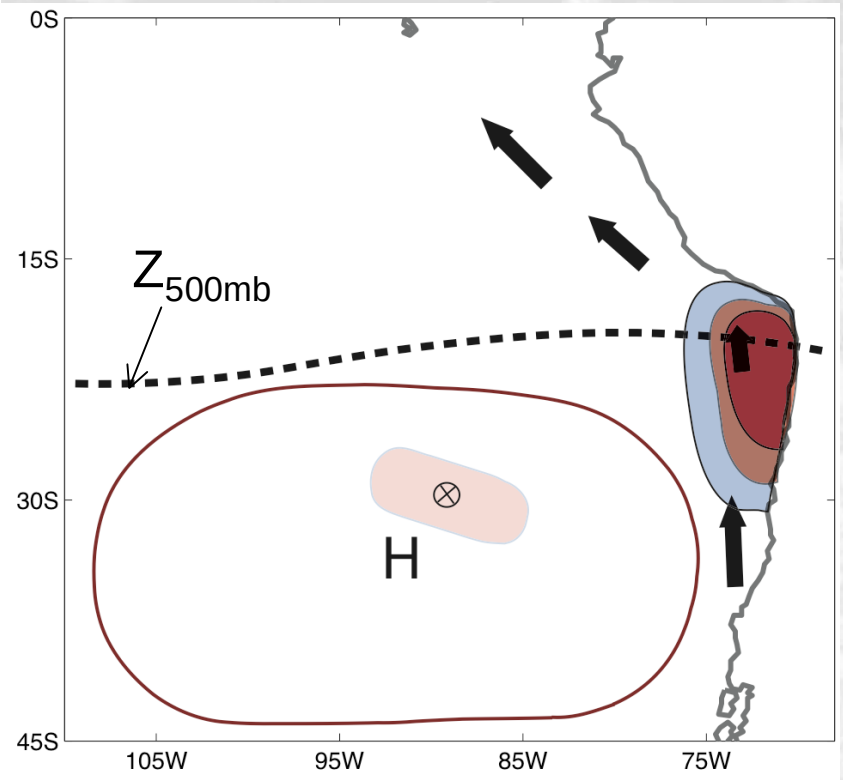


Mean values: contours
MAX-MIN:colors

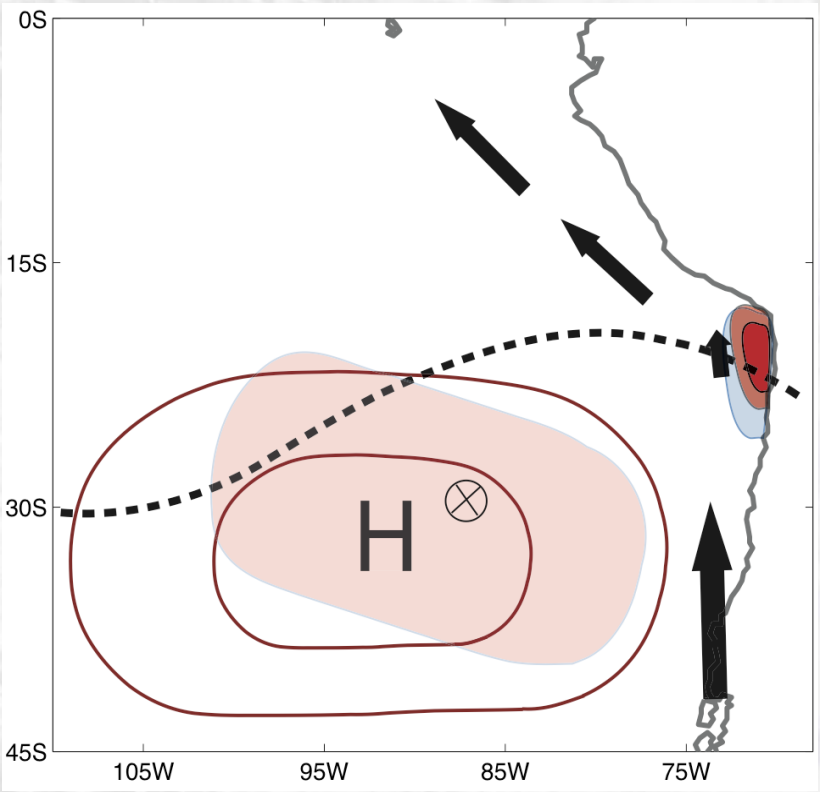
- Radiative changes are not related to the region with larger CDNC.
- Albedo effect is counteracted by the cloud thinning and reduced CF

Summary: Regional circulation

MAX CDNC

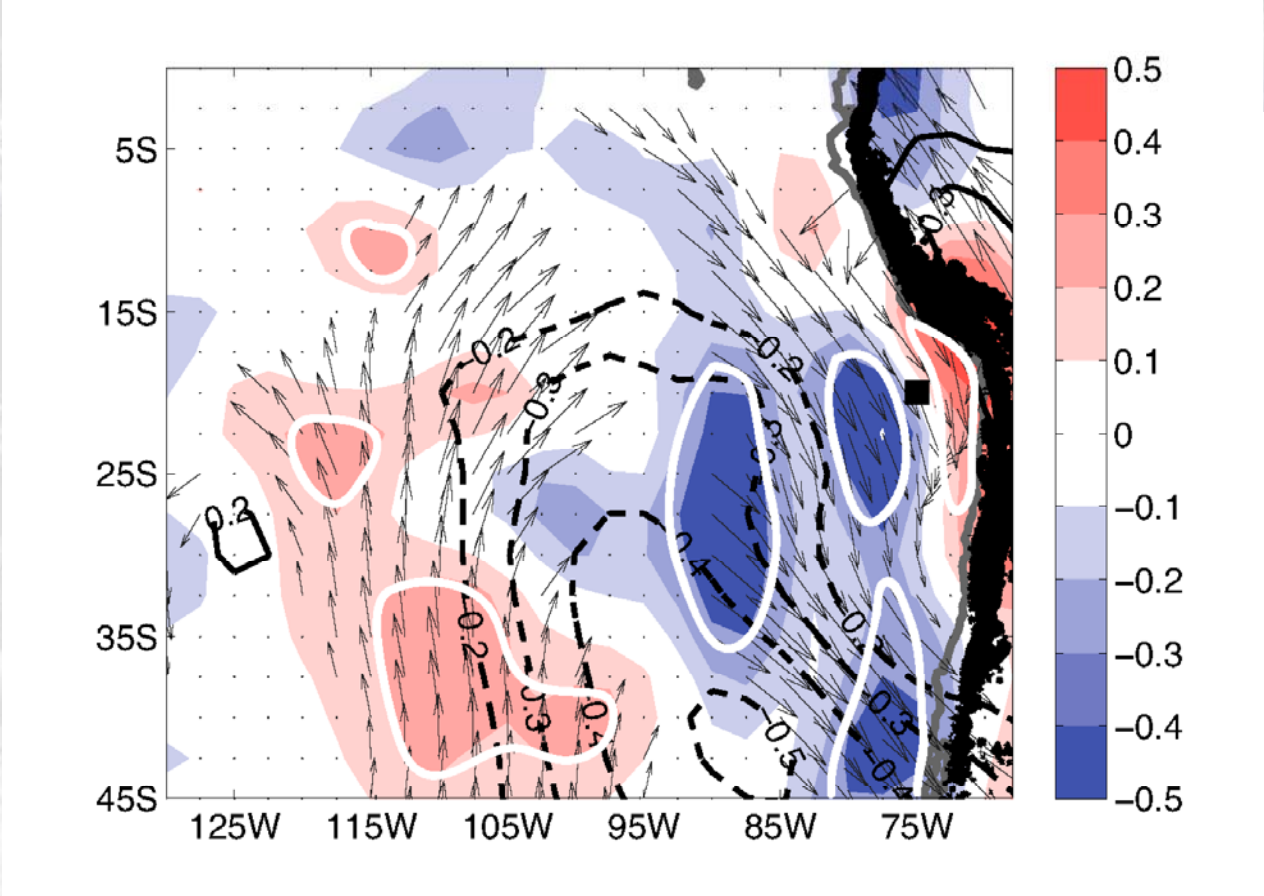


MIN CDNC



- MAX-CDNC: weaker anticyclone, and subsidence, weaker winds
- MIN-CDNC: opposite pattern

One point correlation: T_{850mb} vs: subsidence (colors),Z_{850mb} and winds (arrows)



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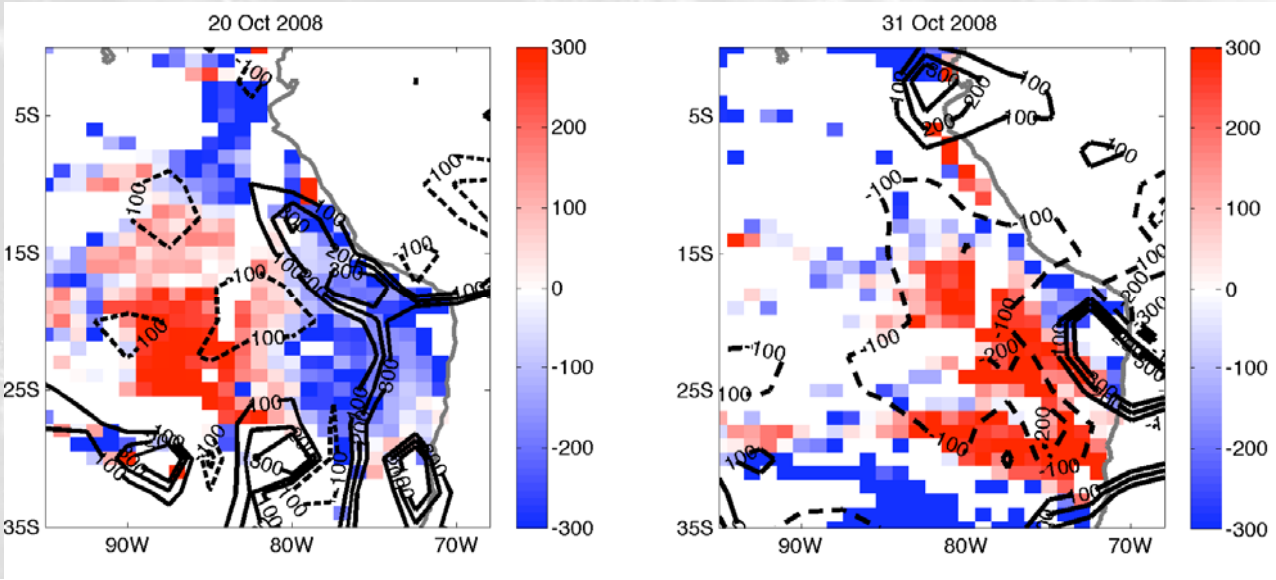
MAX CDNC



MIN CDNC