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 ($\tau$)
  - Combined under assumption of adiabatic approximation:
    - CDNC $\propto \Gamma^{1/2} \tau^{1/2} r_{eff}^{-5/2}$ (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

- Maximum CDNC (MAX CDNC) (41 days)
  - Events with: \( CDNC > 216 = \text{Mean}_{CDNC} + \frac{\text{std}_{CDNC}}{2} \)
- Minimum CDNC (MIN CDNC) (43 days)
  - Events with \( CDNC < 161.5 = \text{Mean}_{CDNC} - \frac{\text{std}_{CDNC}}{2} \)
Results

QSCAT winds and SLP (red contours)

- **MIN case**
  - Reinforced SLP
  - Stronger winds

- **MAX case**
  - lower CTH
  - Thinner clouds

\[ H = \sqrt{\frac{2}{LWP}} \]

Schüller et al. 2003
Subsidence (700 mb) and geopotential height

MAX CDNC

MIN CDNC
Radiative impact

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

*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**: weaker anticyclone, and subsidence, weaker winds
- **MIN-CDNC**: opposite pattern
One point correlation: $T_{850\text{mb}}$ vs: subsidence (colors), $Z_{850\text{mb}}$ and winds (arrows)
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MAX CDNC

MIN CDNC