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Survey of environmental cloud controlling factors for the extratropical oceans

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Project summary

Unlike for the tropics and and subtropics, cloud controlling factors in the extratropics are less quantified, notably for low-level clouds. Our project aims to fill this gap by addressing the following questions:

- Are the same factors controlling low level clouds in the more dynamically active extratropics?
- What are the most impactful factors controlling high-level clouds in the extratropics?
- How does the radiative response of clouds change if the environmental cloud controlling factors change in future climate?
- How do all relationships vary across observational platforms, temporal periods and averaging timescales?

Objectives:

- Determine the environmental variables that show strong relationships with low and high-level clouds in the extratropical oceans
- Use TERRA/AQUA, MODIS/AMSR-E/AIRS/VIIRS observations to estimate observational uncertainties in these relationships
- Using collection of same satellites, determine sensitivity and variability of relationships to spatial and temporal averaging domain and instrument platform

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Status/Updates

- Analysis of low-level clouds using daily MODIS and MAC-LWP products undergoing
- Most low-level clouds occur in conditions of subsidence and equatorward winds
- Different regimes identified depending on other metrics, here exploring PBL characteristics: M & EIS (see figure)

Needed Satellite Products

- MODIS L2 and L3 daily, AIRS cloud properties, VIIRS, AMSR-E (processed through MAC-LWP), CERES.

Known Issues or Concerns

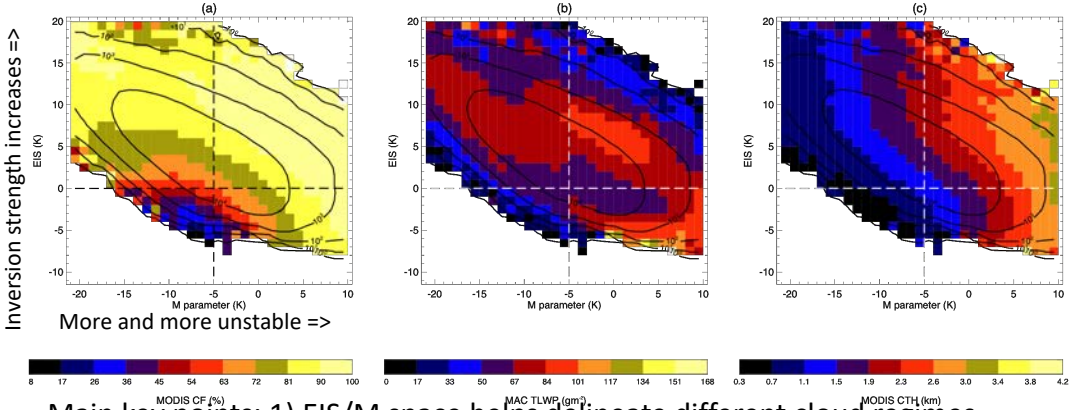
- N/A for now

Recent/Relevant Publications

• Naud et al. JGR 2020/McCoy et al JGR 2017/Wood and Bretherton 2006

5 years, all seasons, daily mean, low level clouds with CTP > 500 hPa, subsidence (at 500 hPa), equatorward winds, both hemispheres: 2D histograms of a) MODIS cloud fraction, b) MAC total liquid water path, and c) MODIS cloud top height (CTH) as a function of

- **M (=θ_{skin}- θ_{800hPa}), a good predictor of CTH (Naud et al. 2020) and**
- **EIS (estimated inversion strength of Wood and Betherton 2006), a good predictor of cloud fraction**



Main key points: 1) EIS/M space helps delineate different cloud regimes, 2) LWP also impacted by both EIS and M