Ordinary Clouds

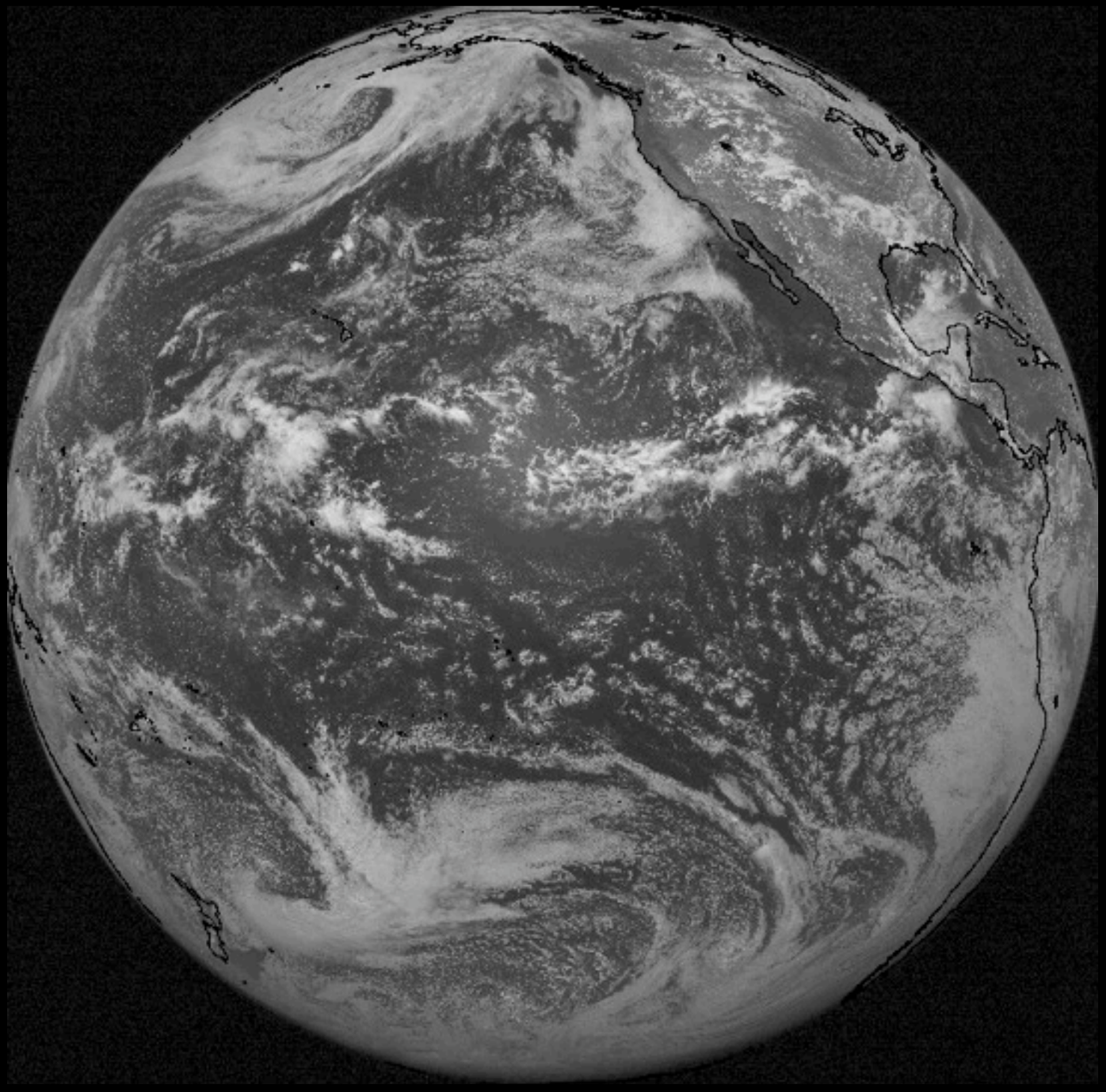
and their extraordinary impacts

Brian Medeiros

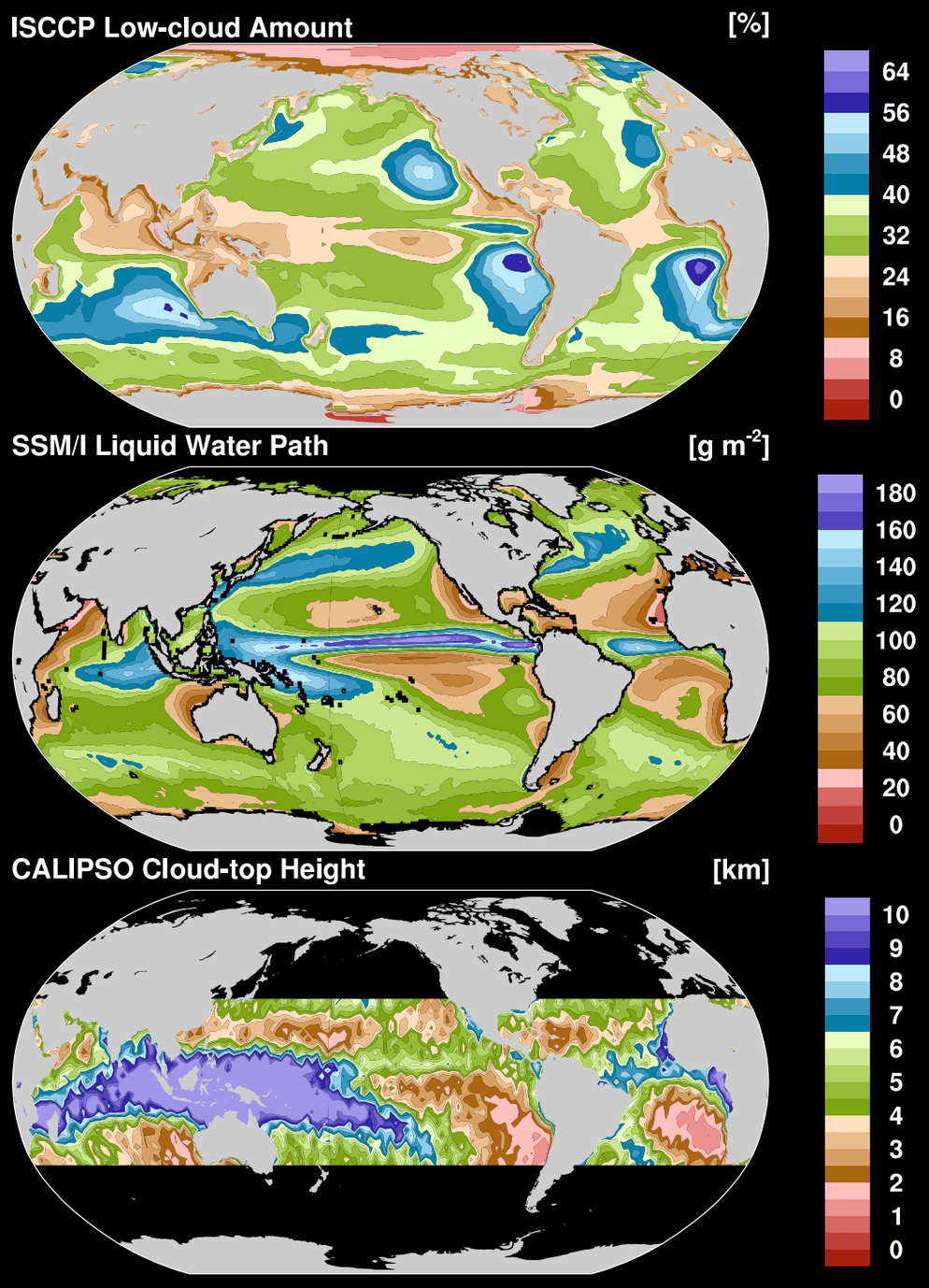
brianpm@ucla.edu

Shallow cumulus

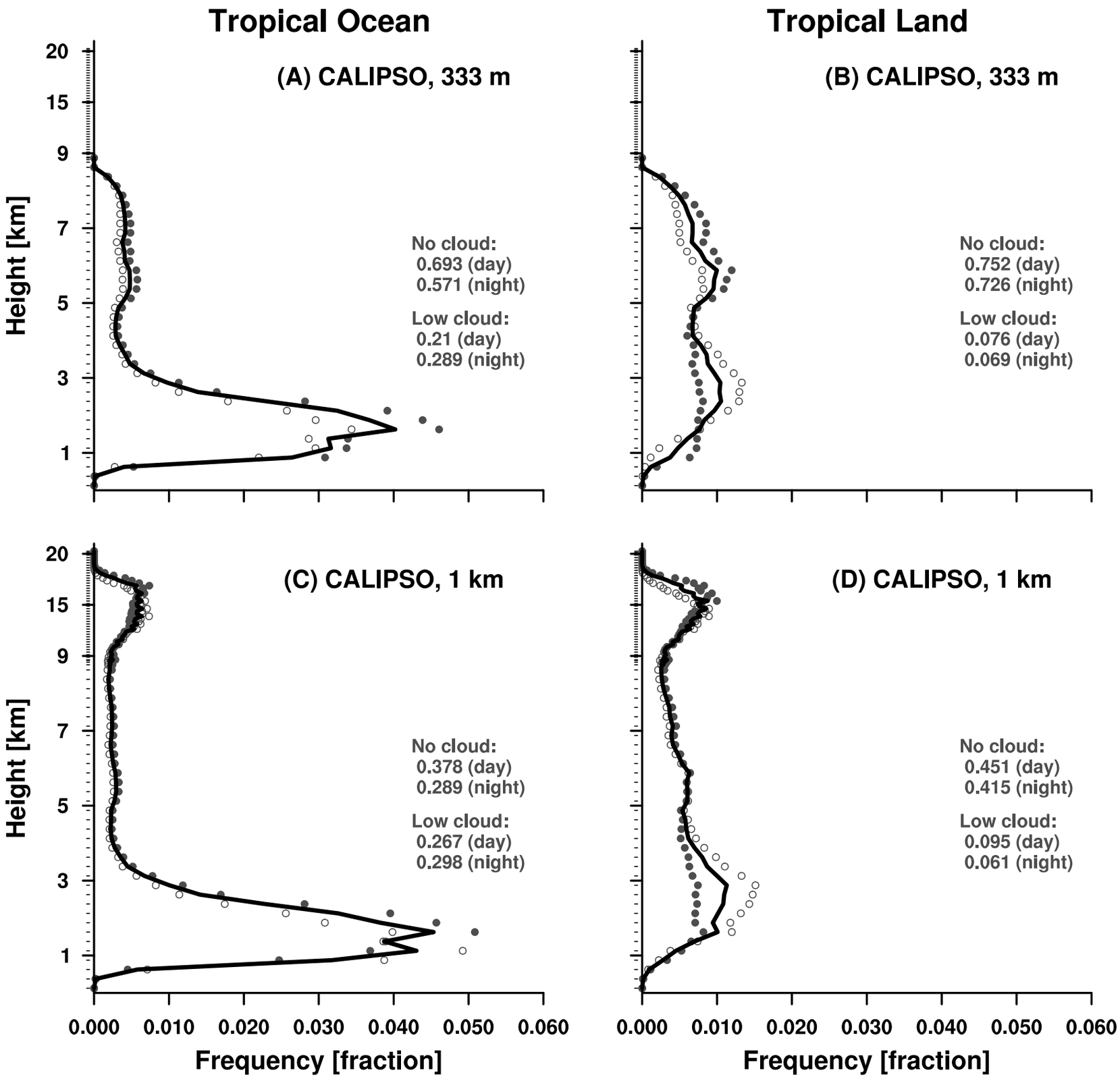
The bigger picture



GOES, 26 July 2009



Counting clouds

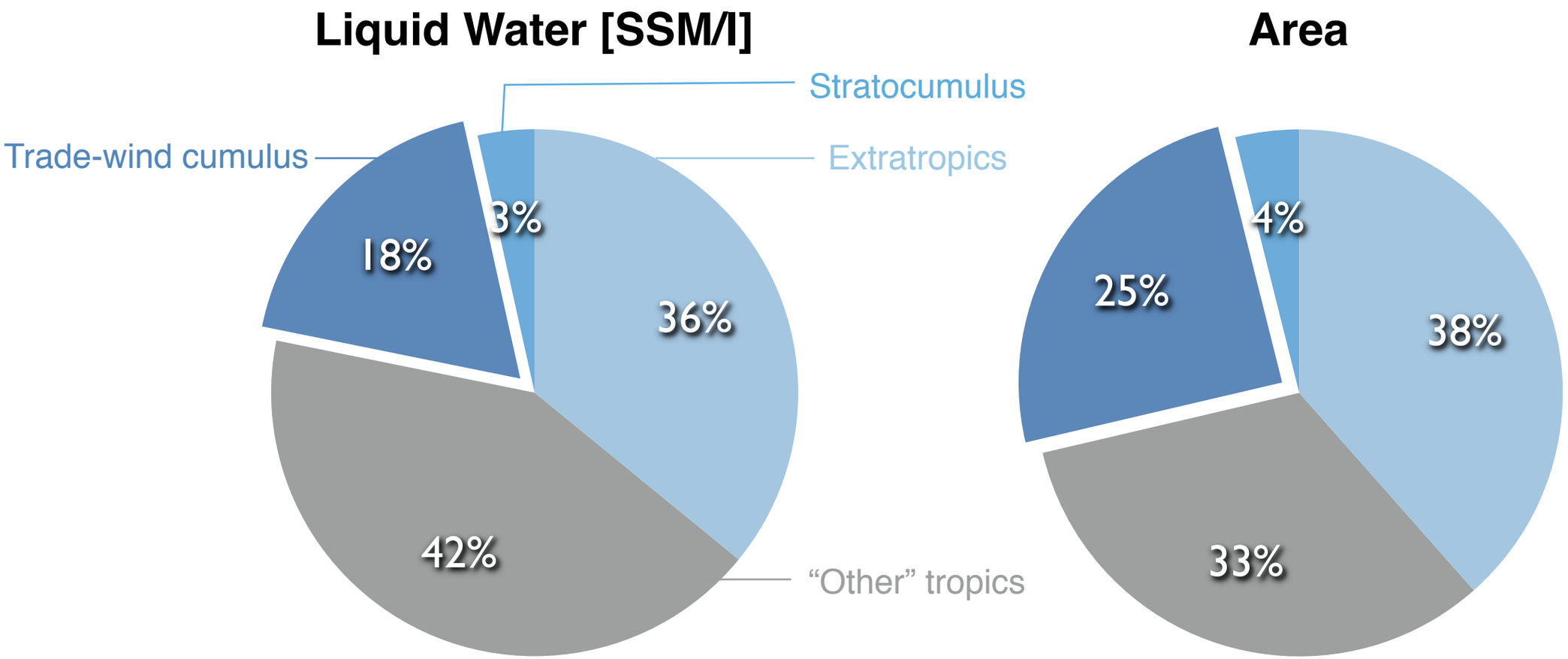


6 months

120×10^6 points at 333m

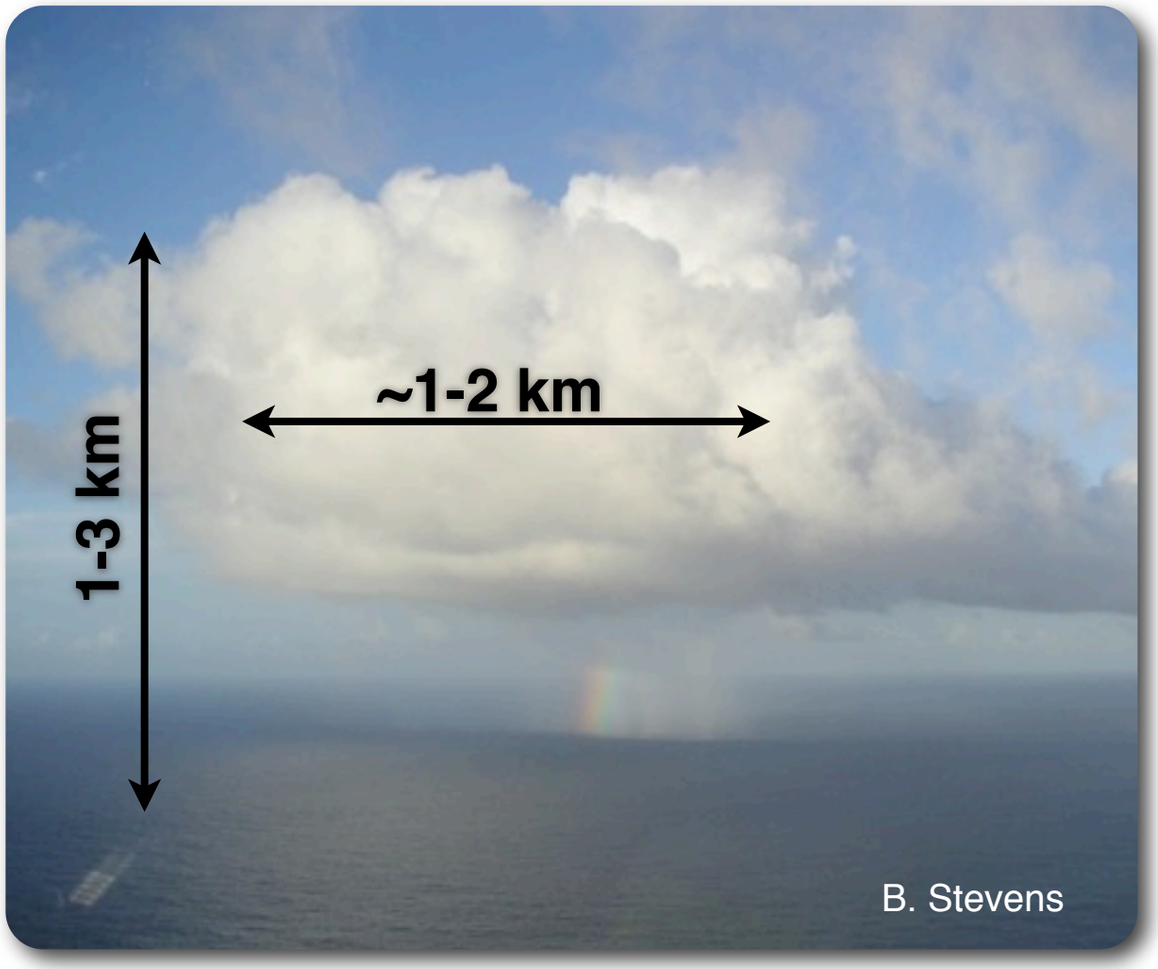
Medeiros, Nuijens, Antoniazzi, & Stevens, *in prep.*

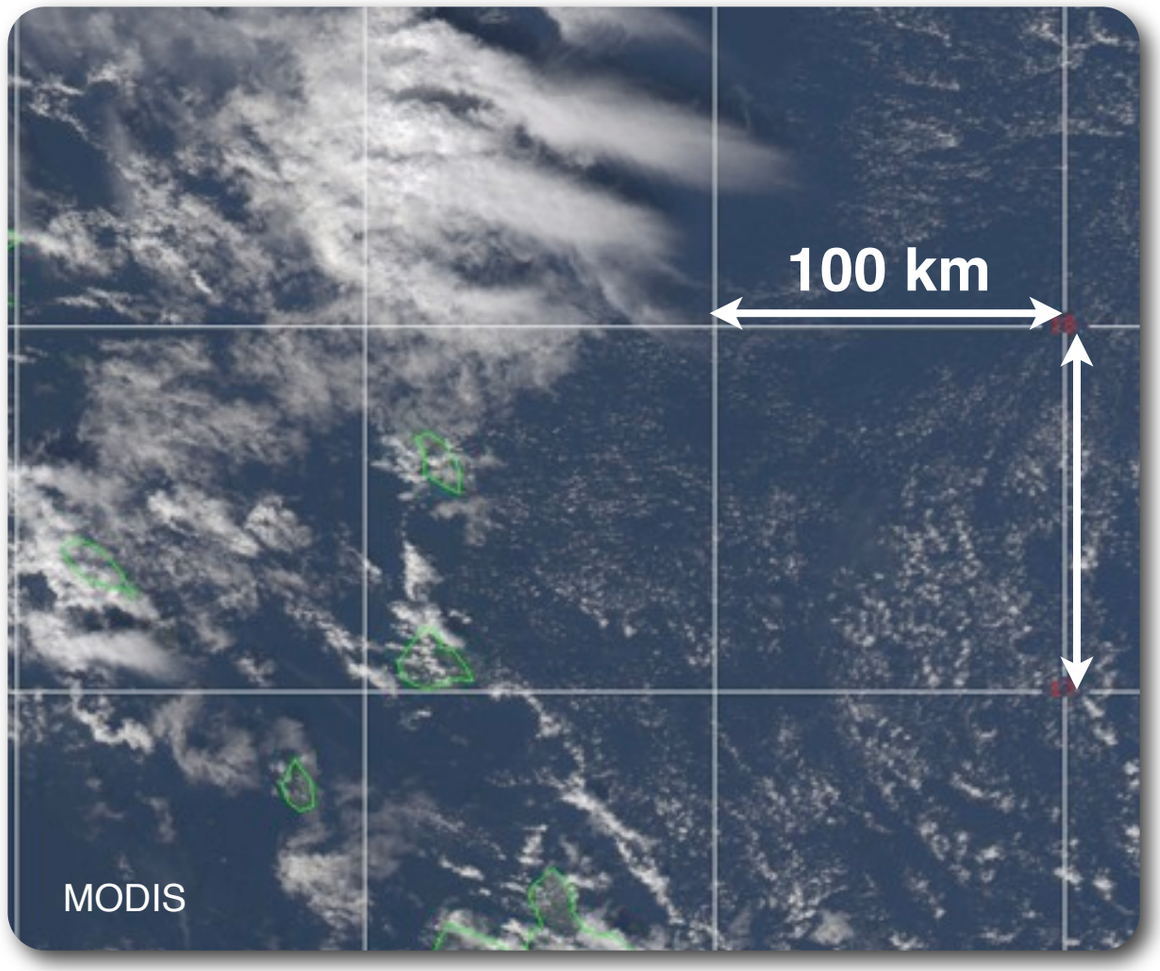
Sure they're common, but do they matter?



100% is global ocean; land excluded

Trade-wind cumulus





Do GCMs properly capture these clouds?

How should we compare with observations?

Distribution of large-scale conditions

ERA-40 v. GCMs

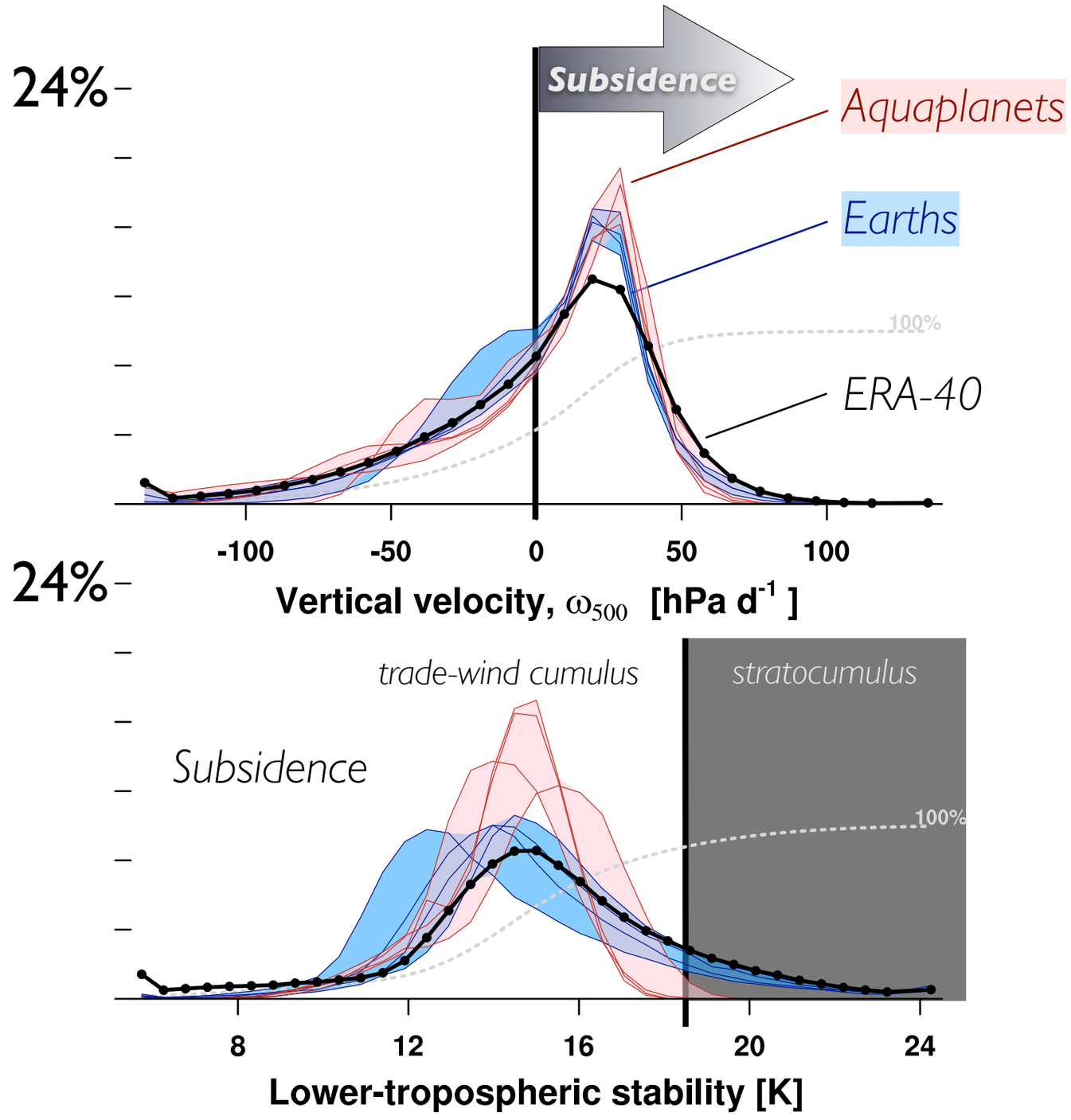
- monthly means
- Earth-like and aquaplanets

Vertical velocity

- subsidence v. convection

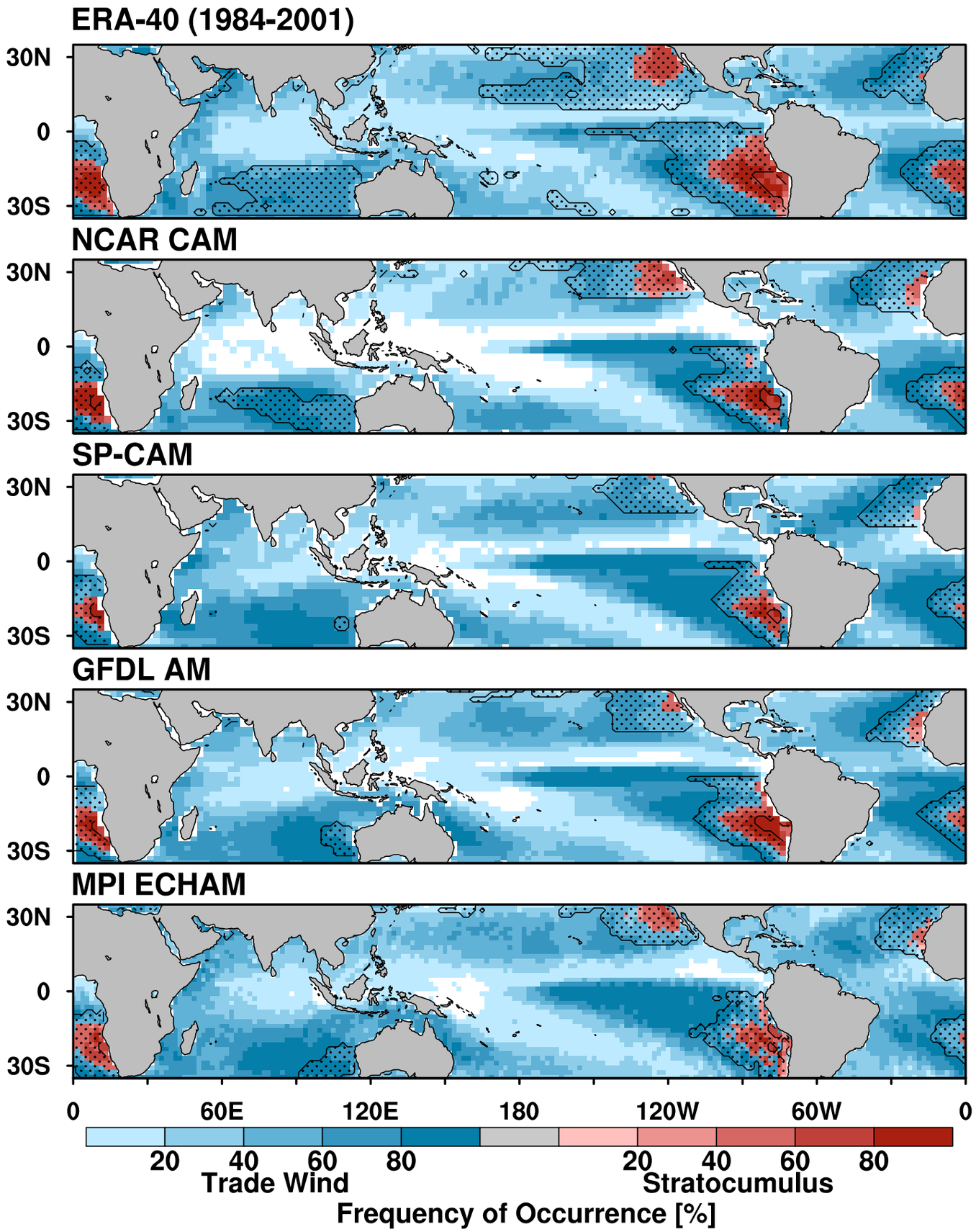
Lower-tropospheric stability

- linked to low-cloud amount

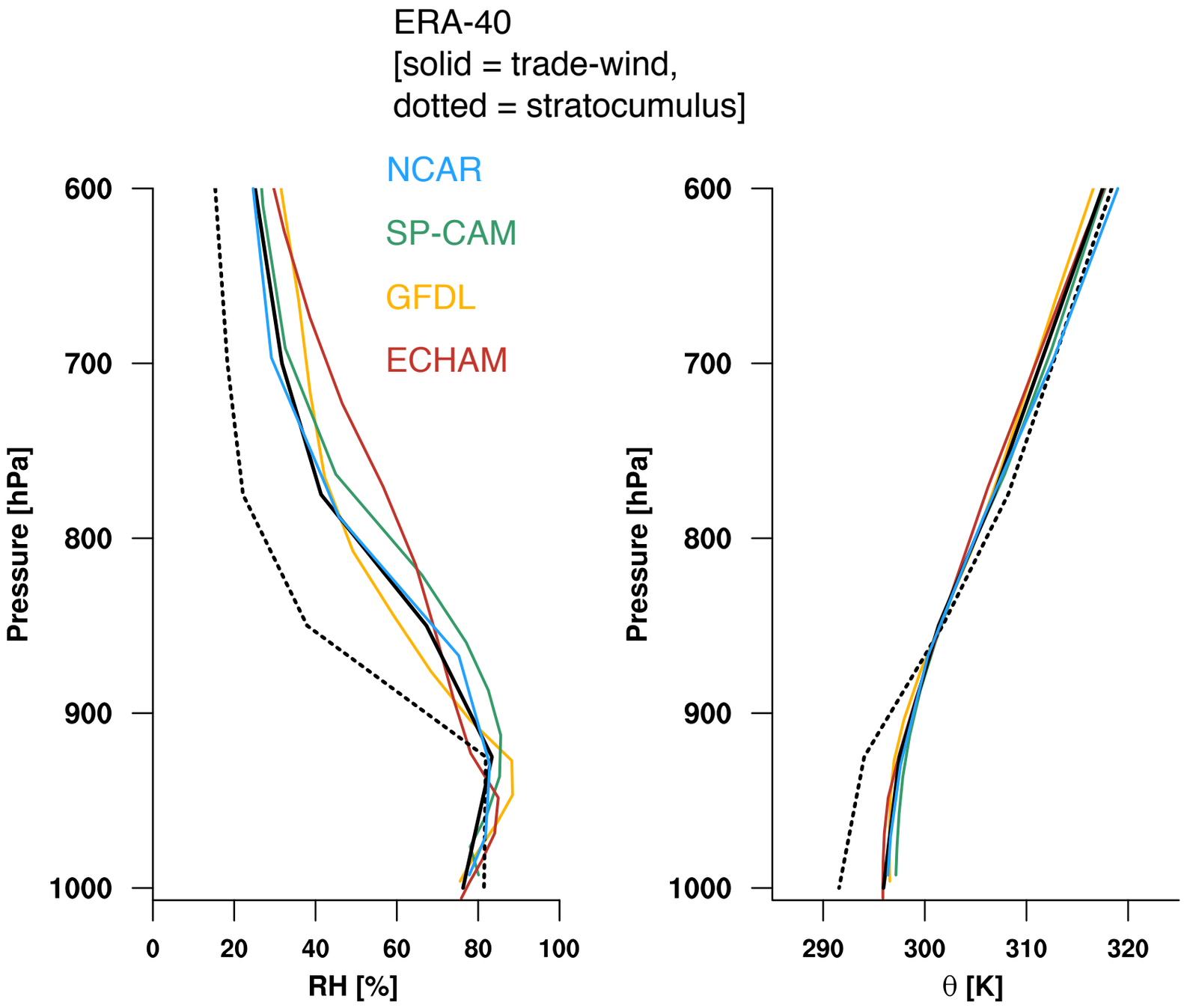


Medeiros & Stevens, *submitted to Climate Dynamics.*

Classification using large-scale conditions



Composite profiles



Composite profiles

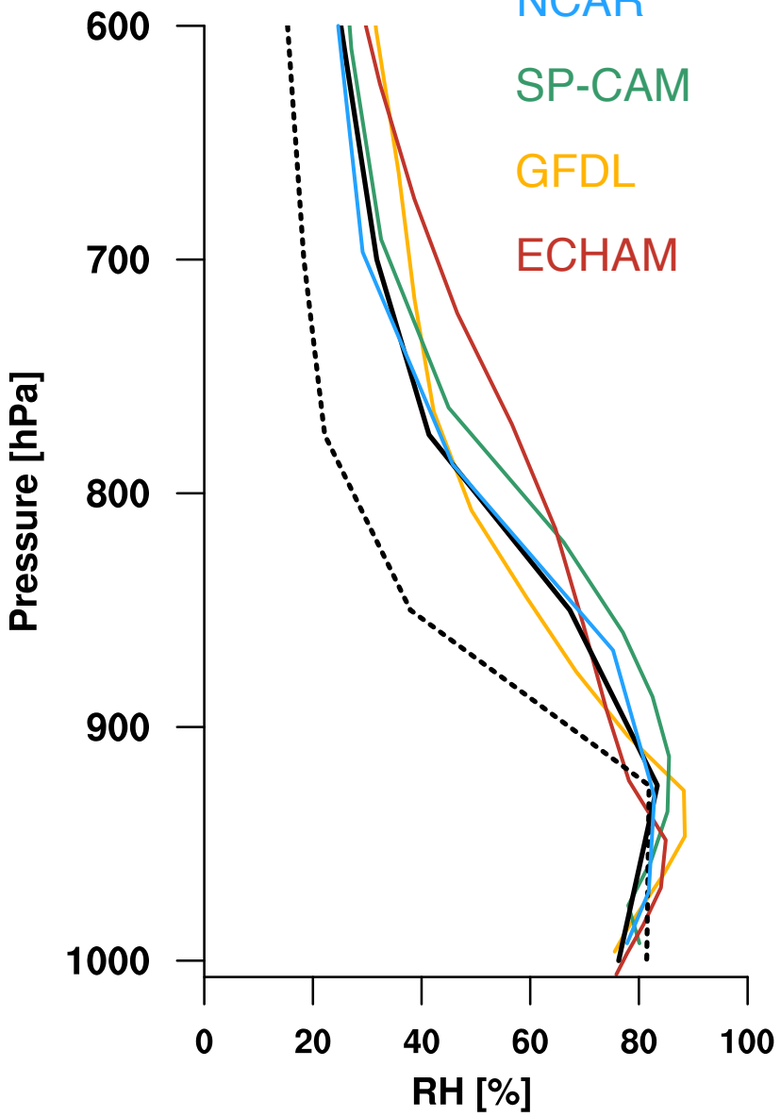
ERA-40
[solid = trade-wind,
dotted = stratocumulus]

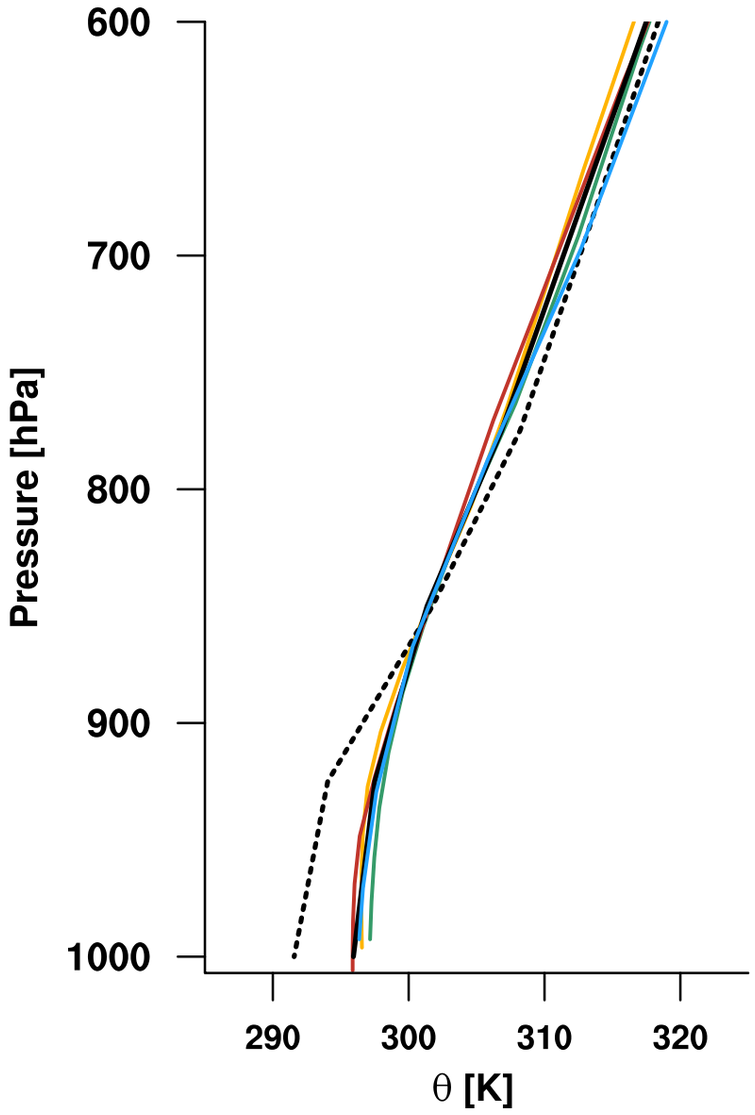
NCAR

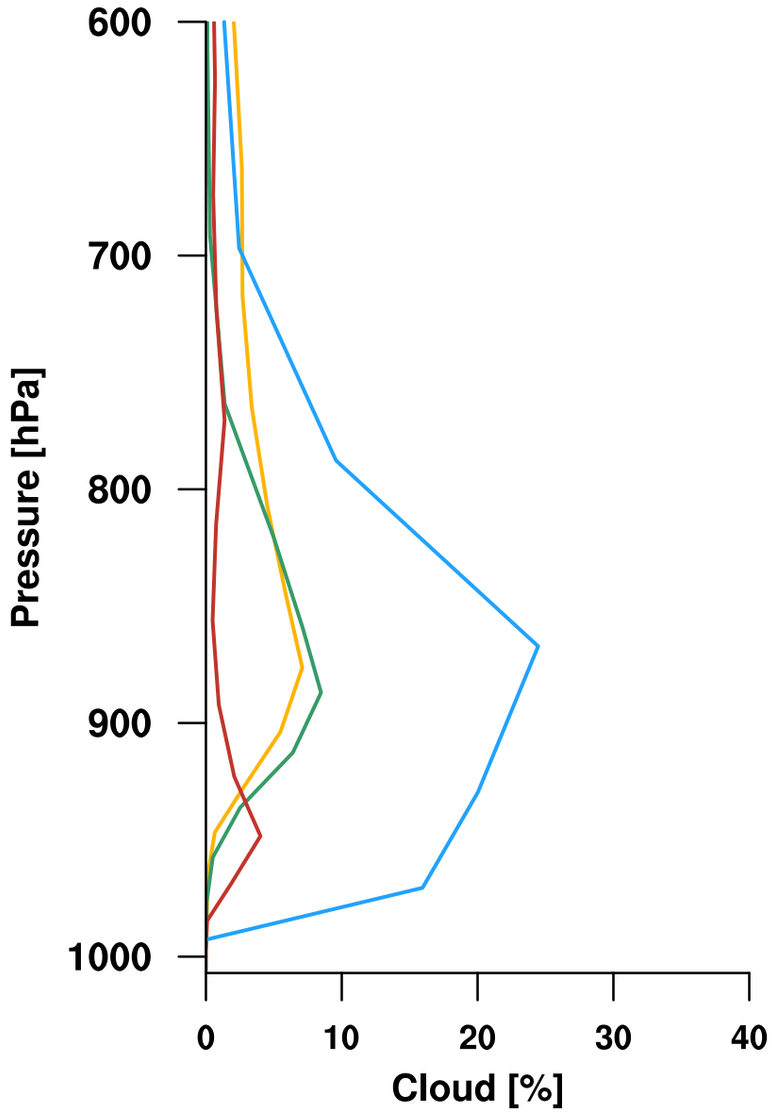
SP-CAM

GFDL

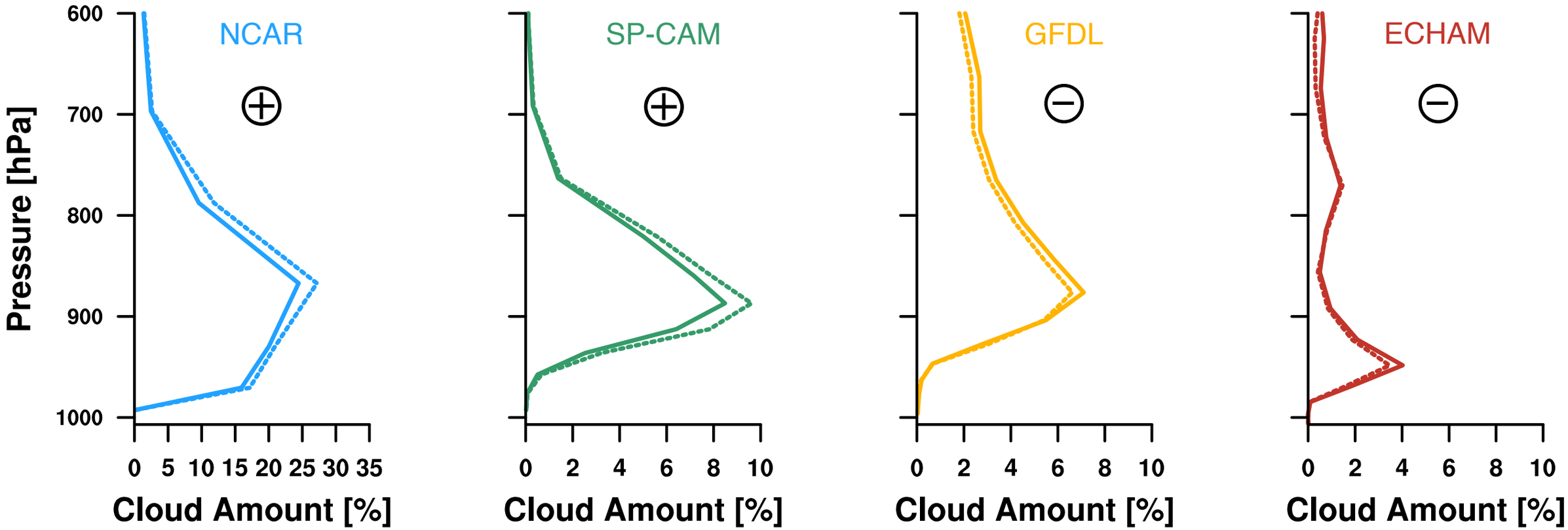
ECHAM



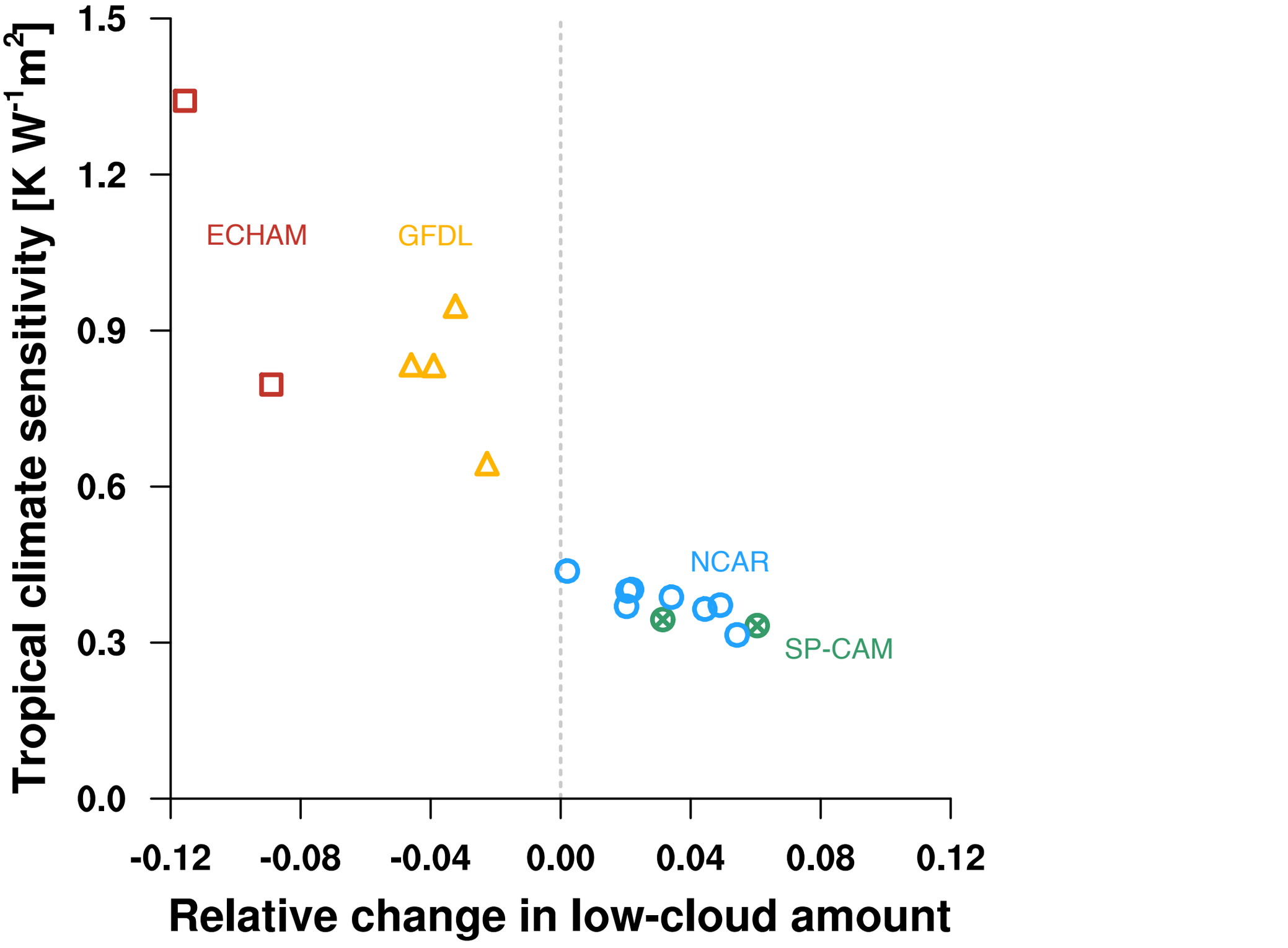




Cloud response to climate change

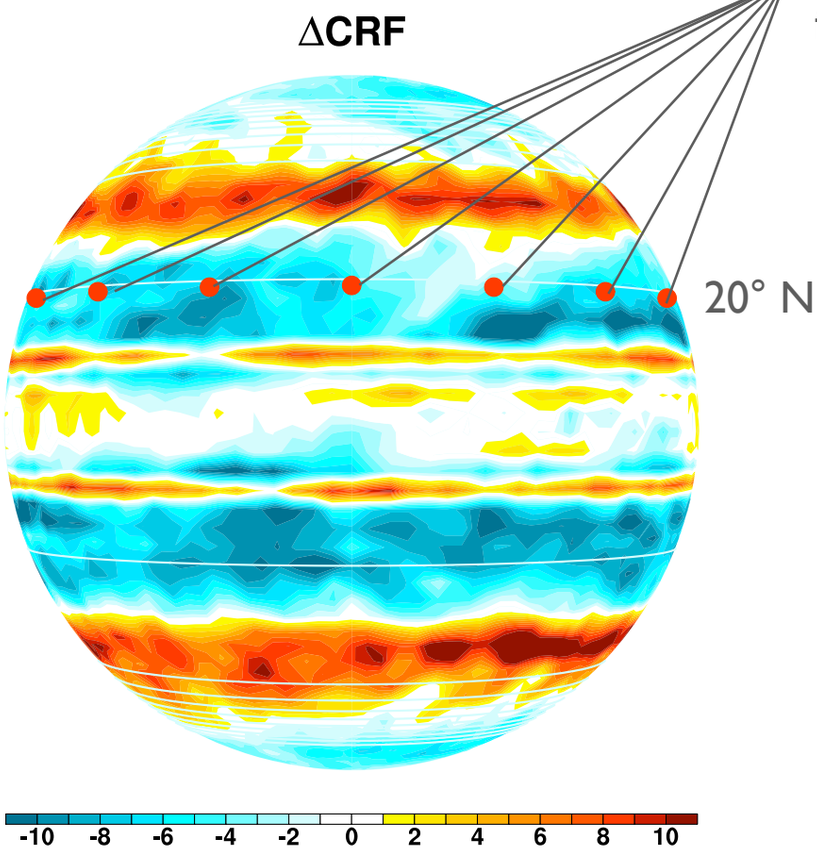


Does it matter?



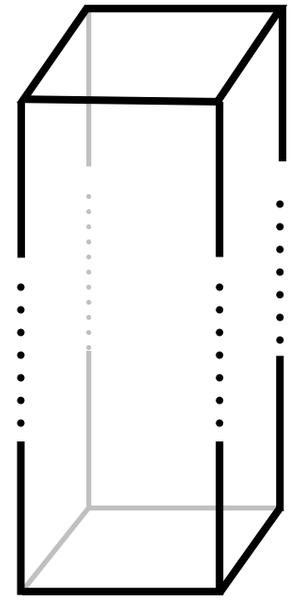
Adapted from Medeiros et al. (2008)

Cloud response in single-columns



CAM (v3.1)

Forcing Locations every 22.5°
from "control" and "plus-2" runs



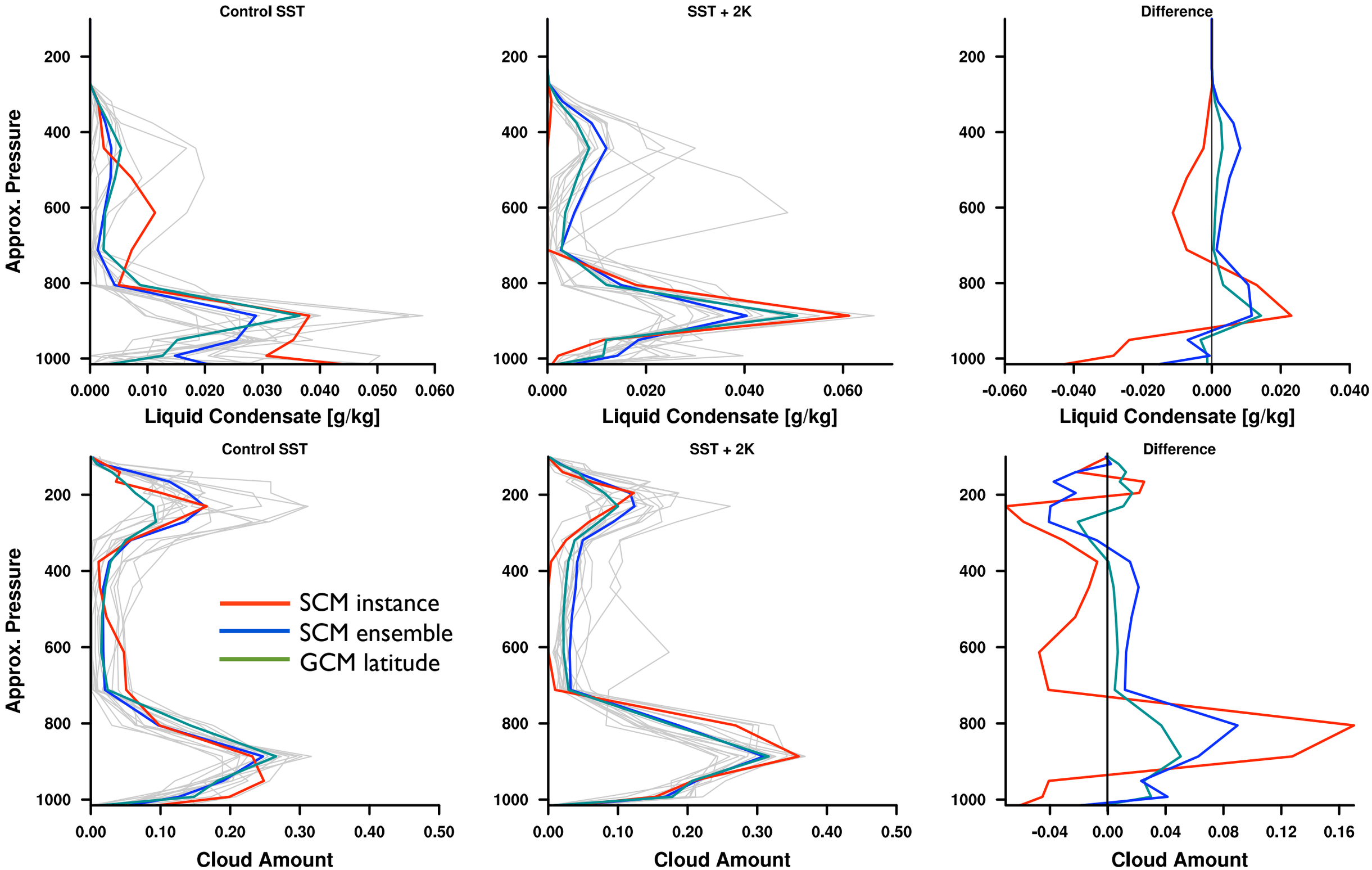
Single-column CAM (v3.1)

Does SCAM reproduce CAM when forced by CAM output?

- Each SCM run should be statistically similar (because of aquaplanet)
- Is result sensitive to details? (Mix up initialization/forcing).

Ongoing work with Cara-Lyn Lappen & Bjorn Stevens

Cloud structure



Wrap it up...

Shallow cumulus are ubiquitous across tropical oceans

- e.g., CALIPSO finds a dominant mode of cloud-top ~2km.
- Sheer numbers mean these clouds are important for energy & water cycles.

Large-scale parameters can be used to separate cloud regimes

- LTS & vertical velocity separate shallow cumulus and stratocumulus.

Within similar environments, GCMs get different clouds

- Reinforces notion that parameterized physics is key weakness.

Differences in response have strong influence on climate sensitivity

Need to understand the processes involved

- Useful frameworks include aquaplanets & single-column models.