Aquaplanet sensitivity in CAM 4&5

Brian Medeiros
brianpm@ucar.edu

with help from: **D. Coleman, R. Neale, D. Williamson**

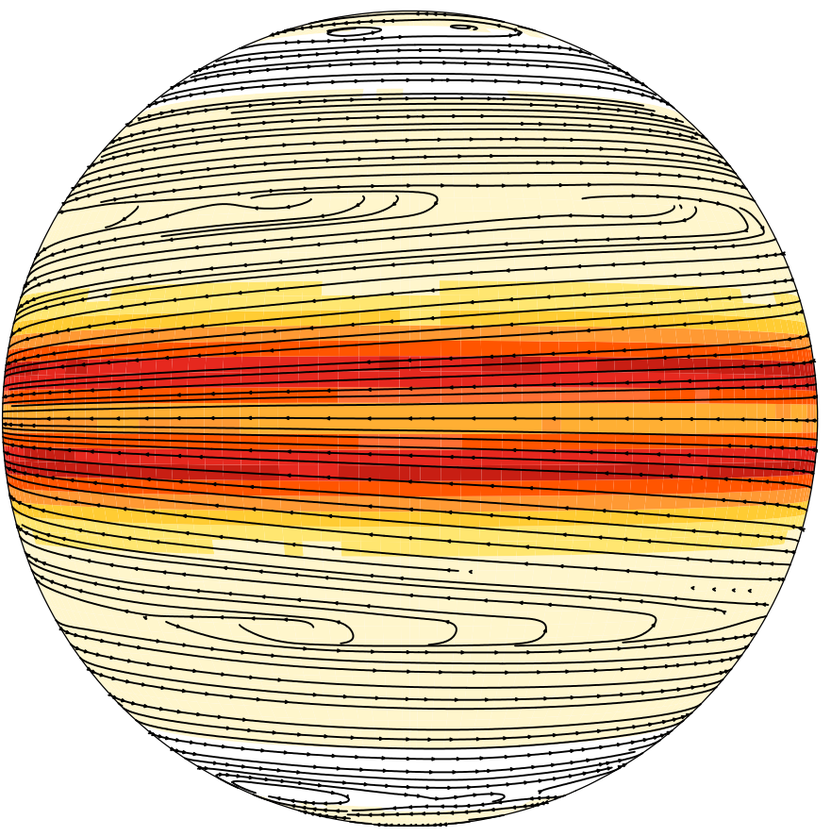
The Point

Extend previous efforts

Examine CAM4/CAM5 cloud response

Develop strategies/expectations for upcoming CMIP/CFMIP experiments

The Review (I)



CAM5 Aquaplanet

APE SST profiles and conventions

"Cess-type" experiments.

Compare Earth v. Aquaplanet results

The Review (2)

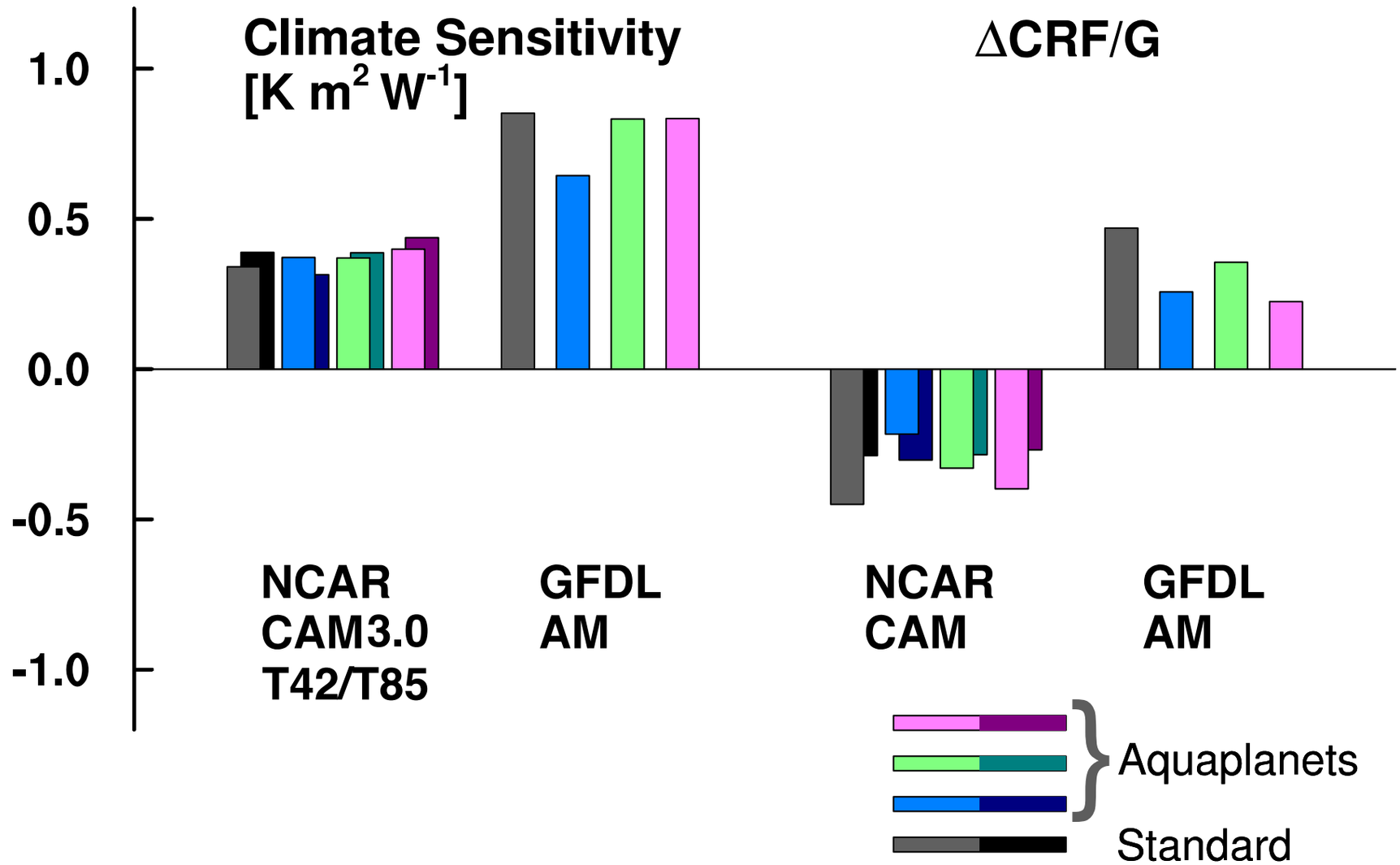
climate sensitivity:

- $\lambda = \Delta T/G$

cloud effect:

- $\lambda/\lambda_{clr} - 1 = \Delta CRF/G$

Response tied to low-cloud response in subsiding regimes.



Medeiros et al. 2008 J. Climate

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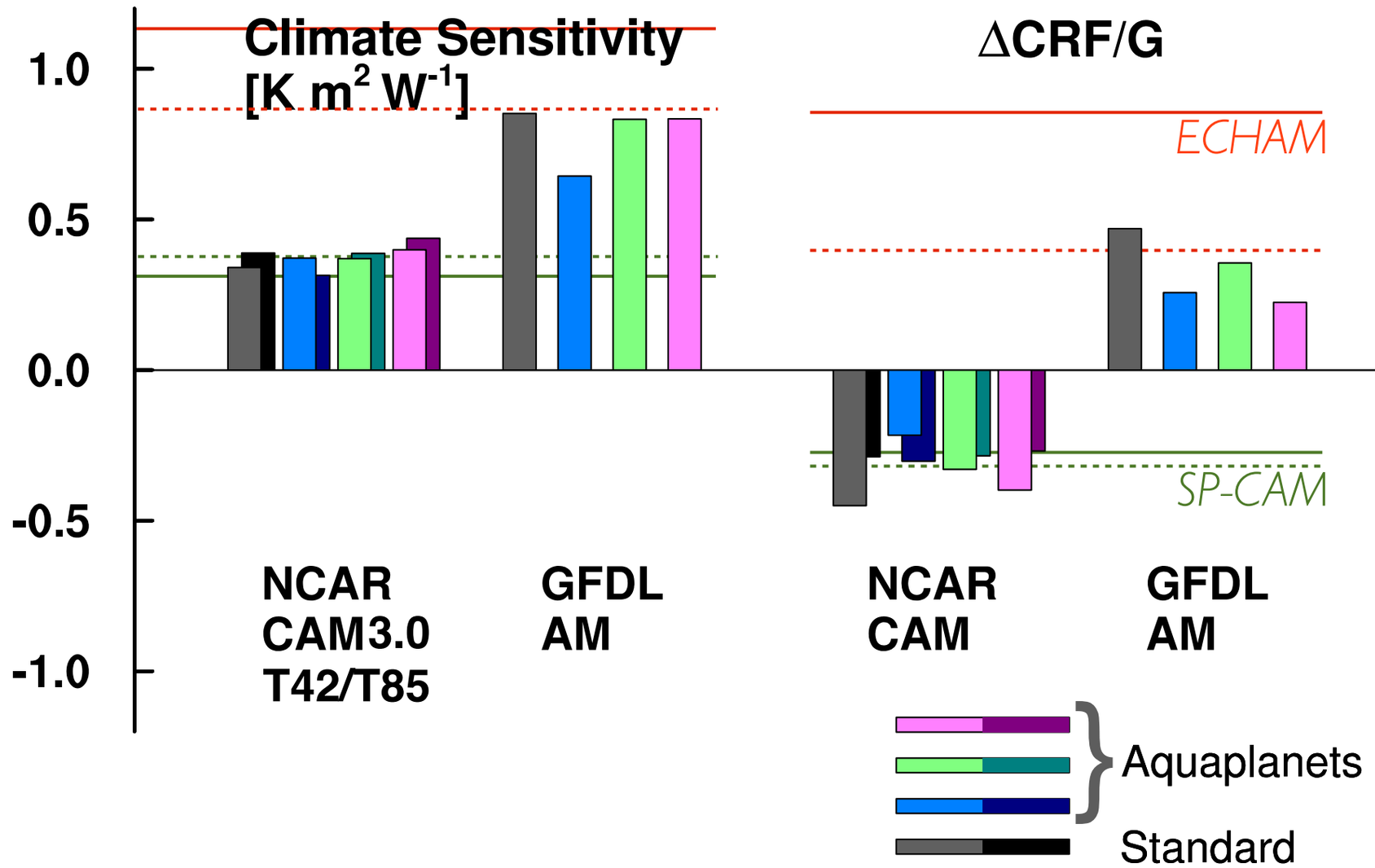

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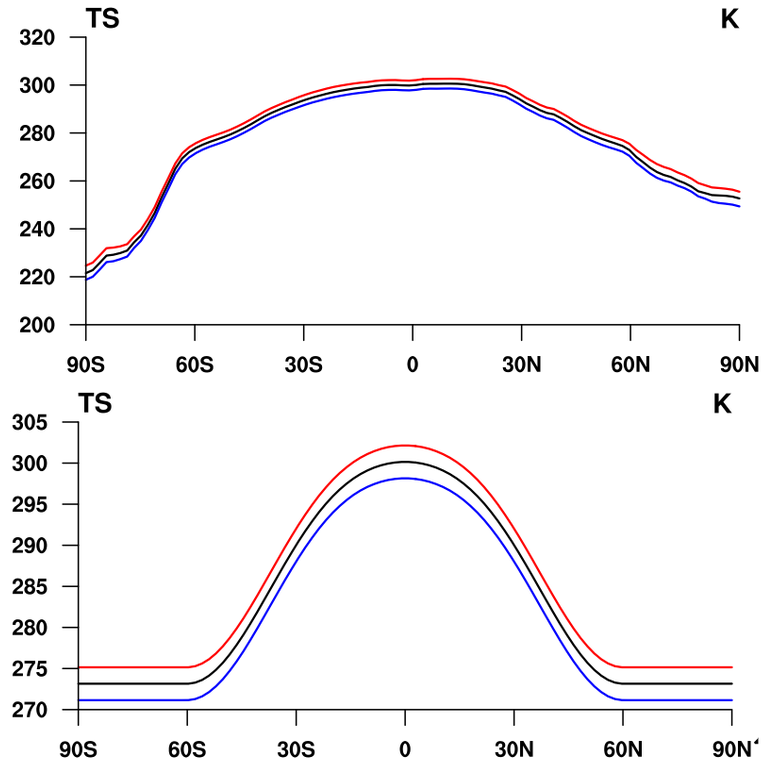
The Experiments

Do newer versions of CAM (i.e., "v4" & "v5") show the same pattern of response?

- Use CAM4 & CAM5, SST±2K experiments
- Both Earth-like and one Aquaplanet ("qobs")

CAM5: how to deal with the aerosol model?

- Try the most naive thing first: prescribe zonal average emissions



The Results

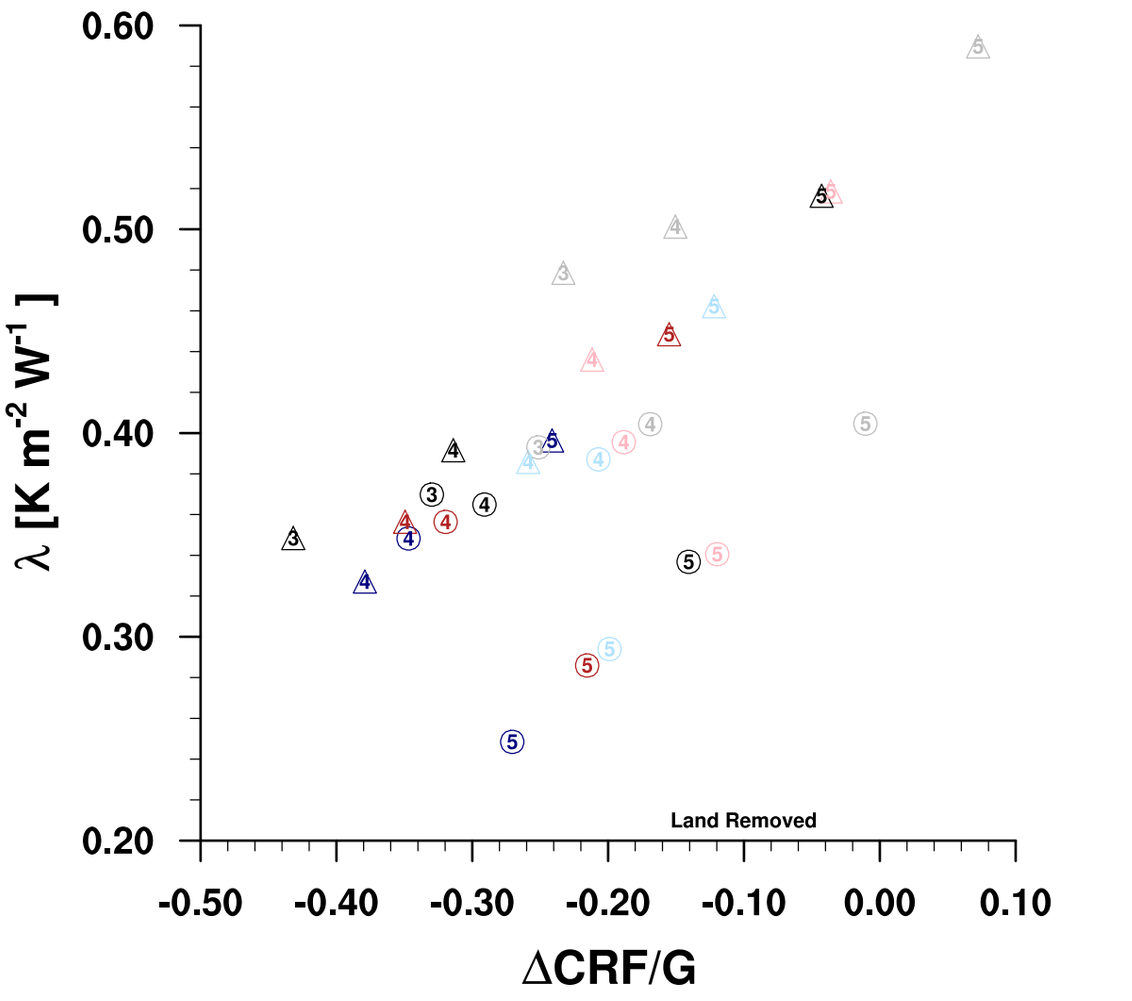
CAM 4 similar to CAM 3 in λ and ΔCRF/G

- Global & Tropics
- Earth & Aquaplanet

CAM 5 Earth more sensitive, weaker cloud effect

CAM 5 Aquaplanet is the outlier...

- stronger cloud response than Earth-config
- lower sensitivity



Tropics Global

Earth Config

Aquaplanet

SST+2 - BASELINE

BASELINE - SST-2

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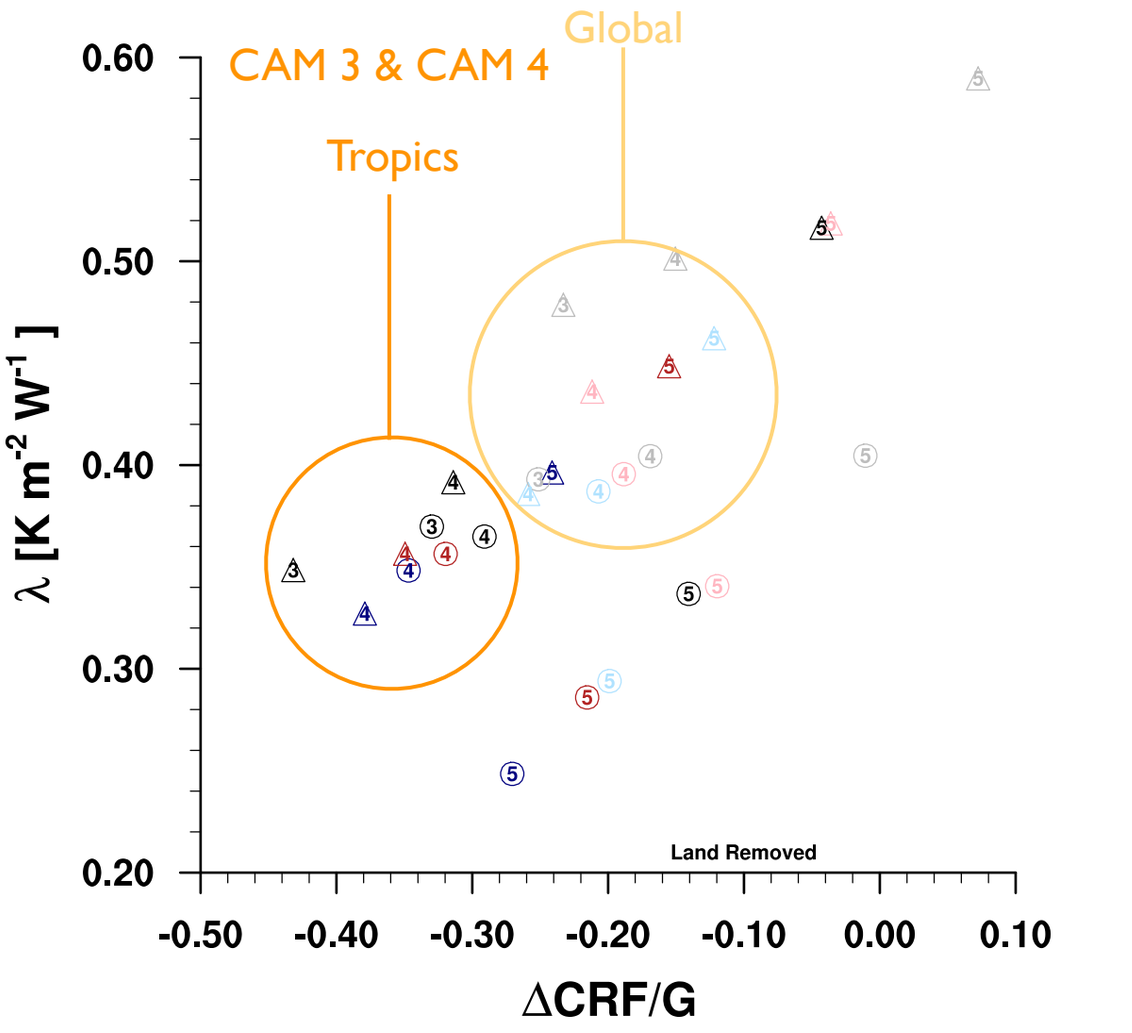

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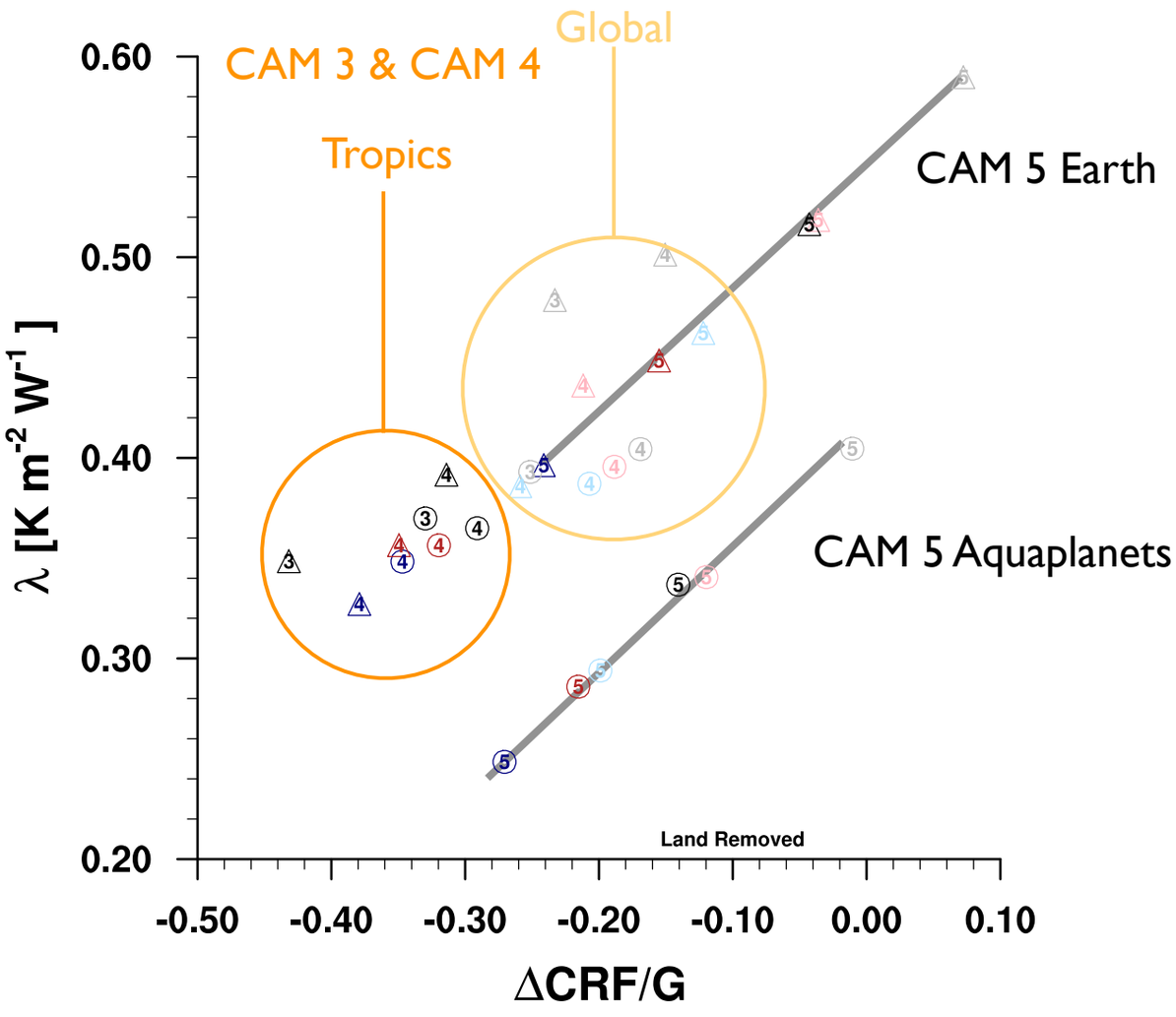
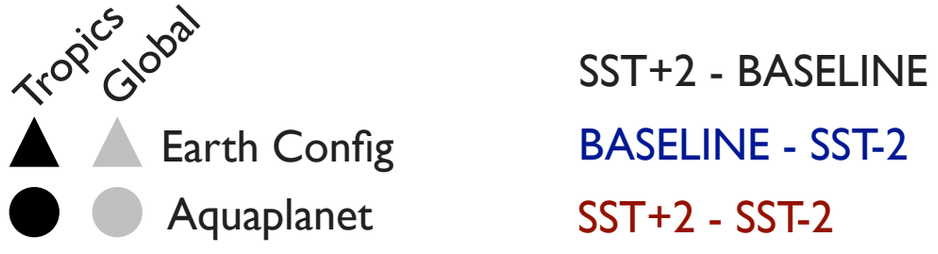
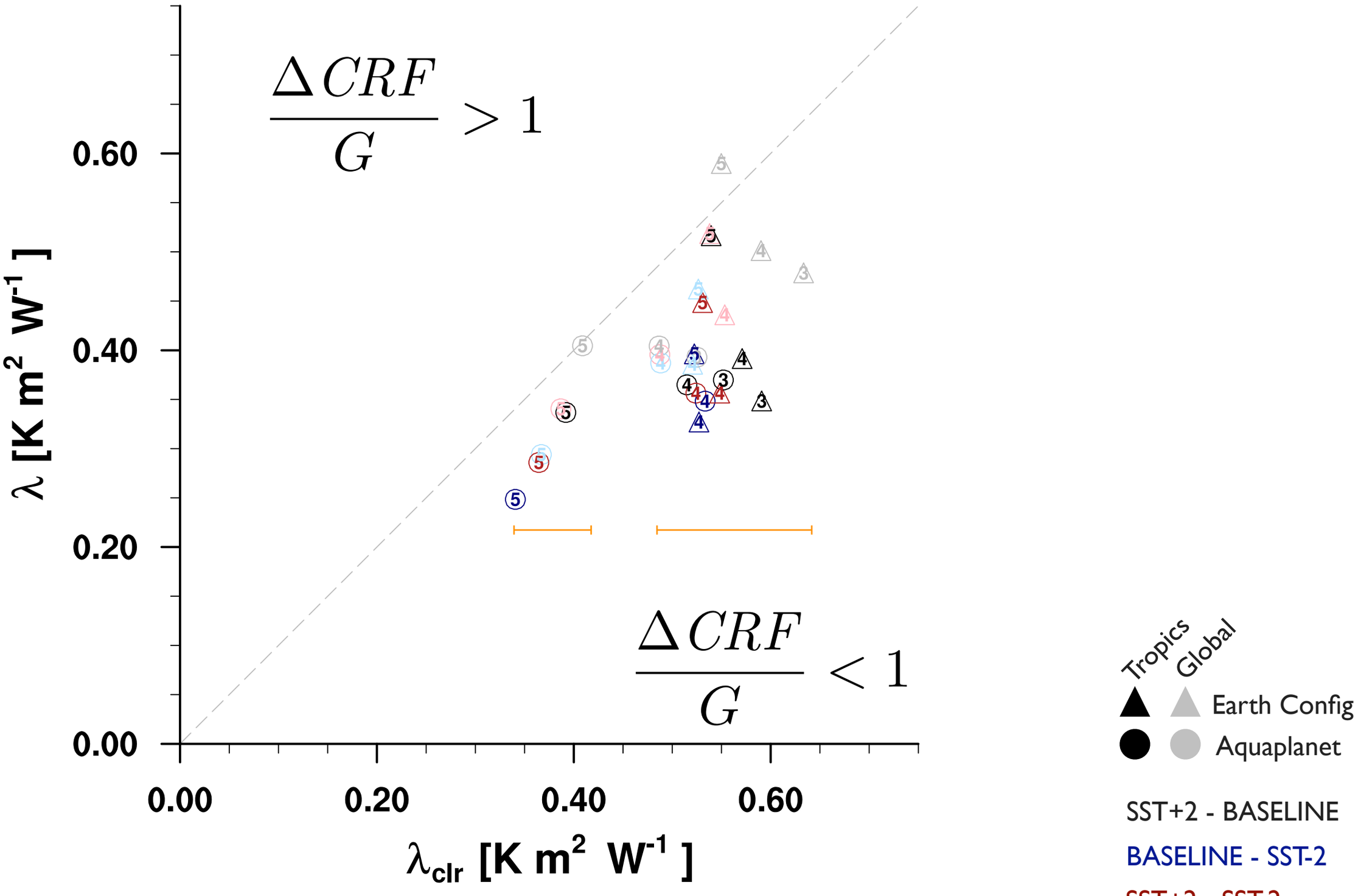
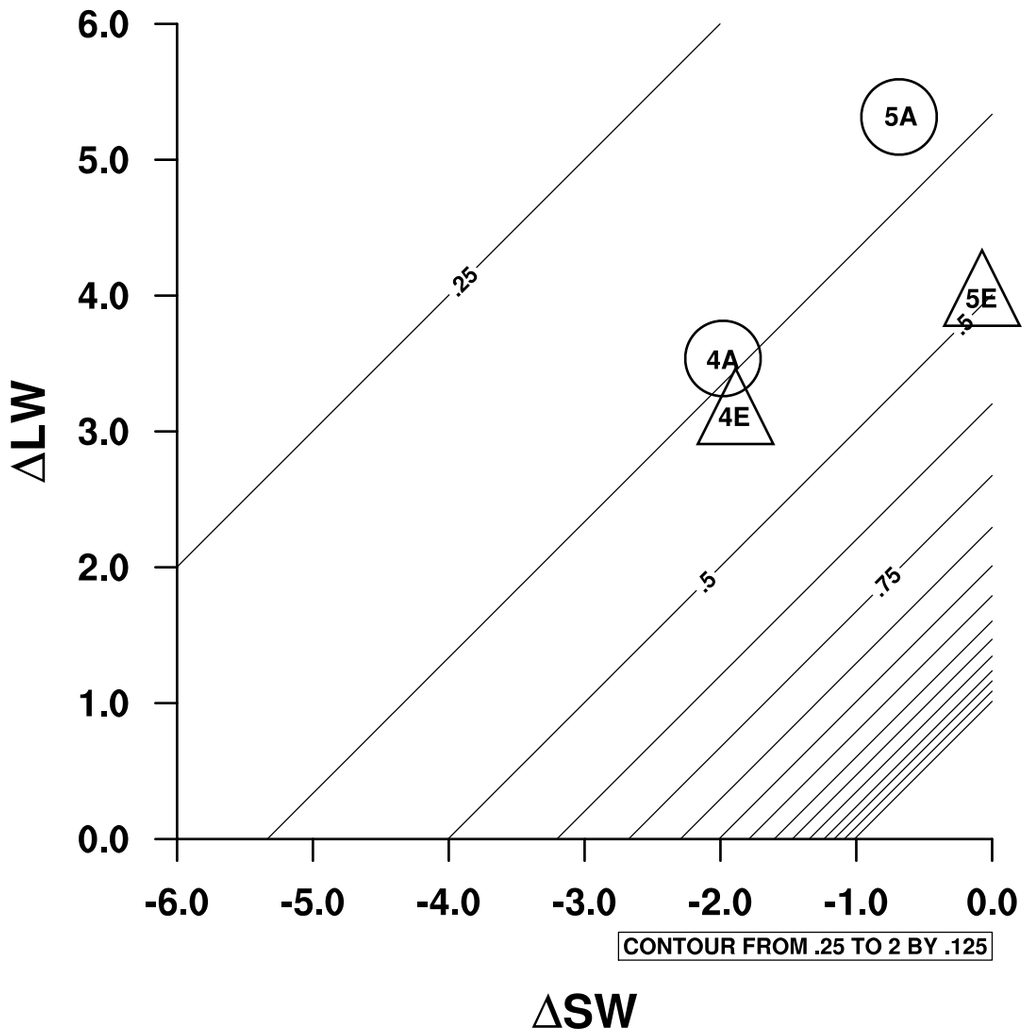


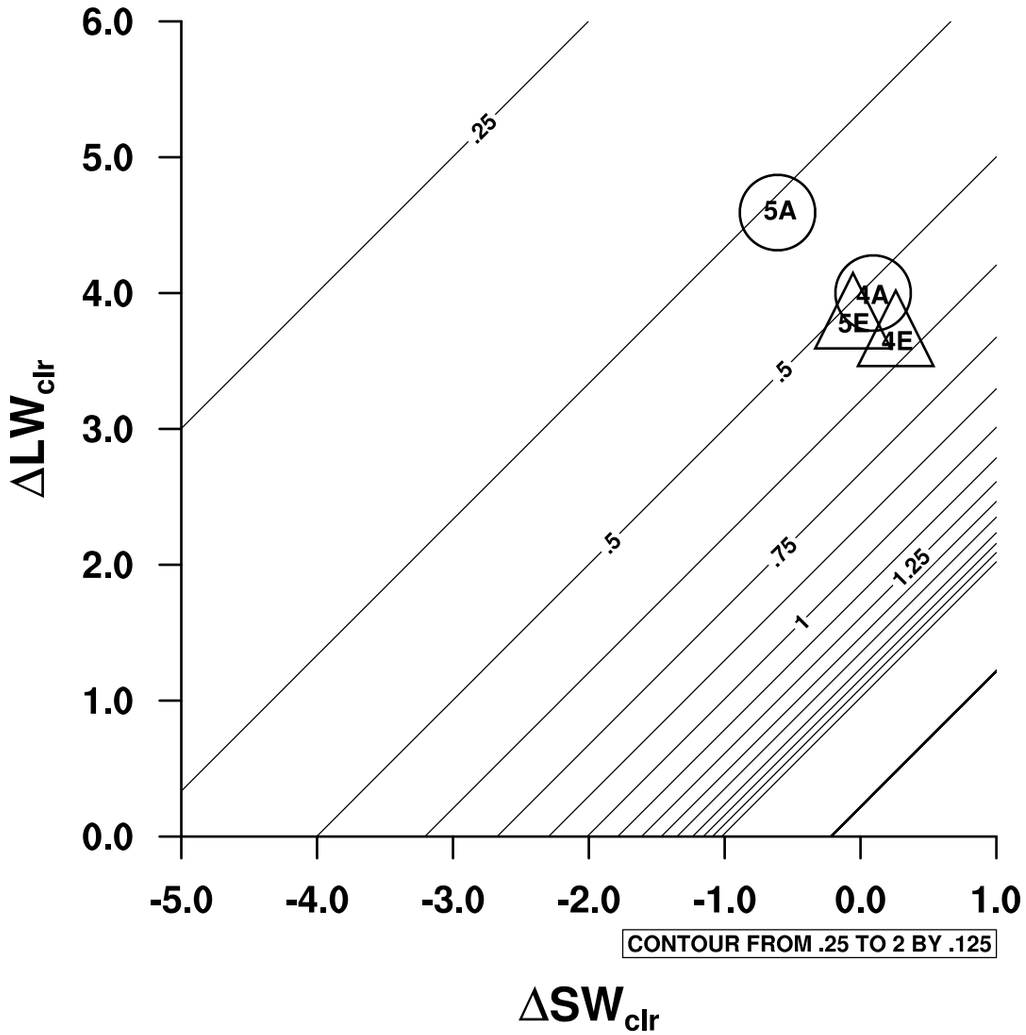


Clear-sky effects



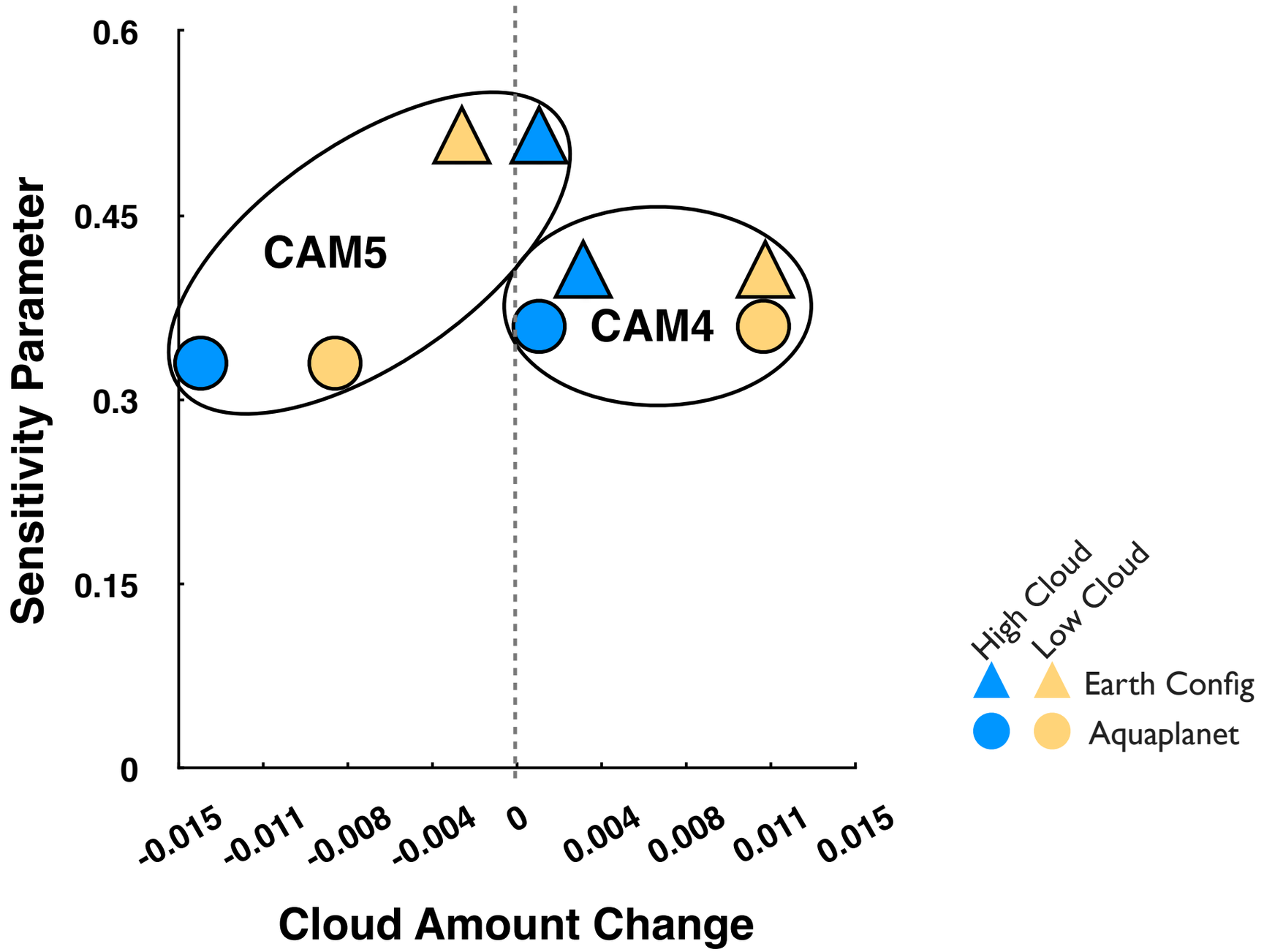
TOA Components



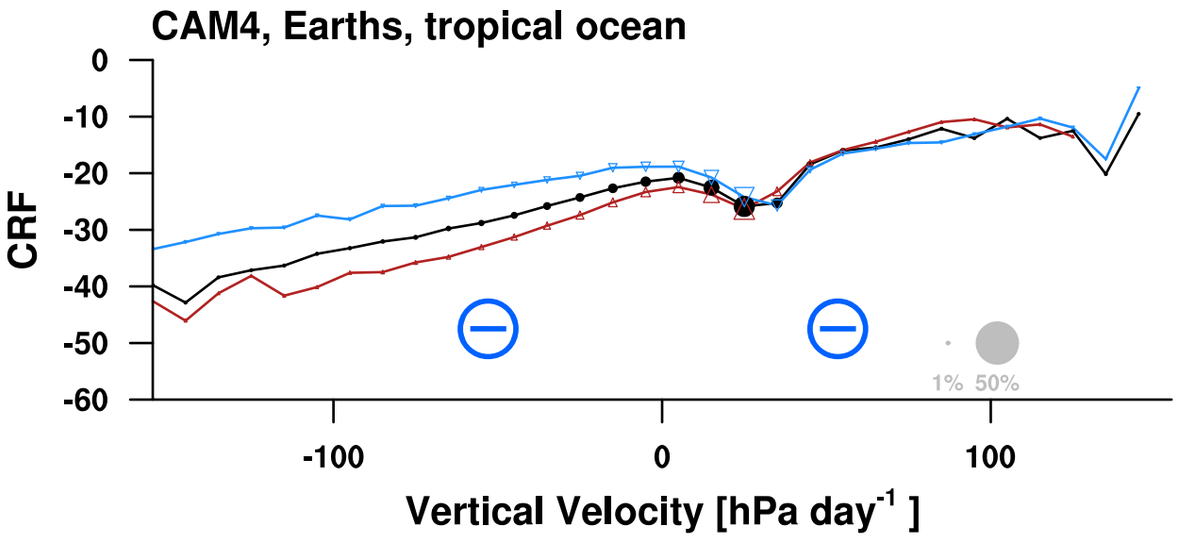


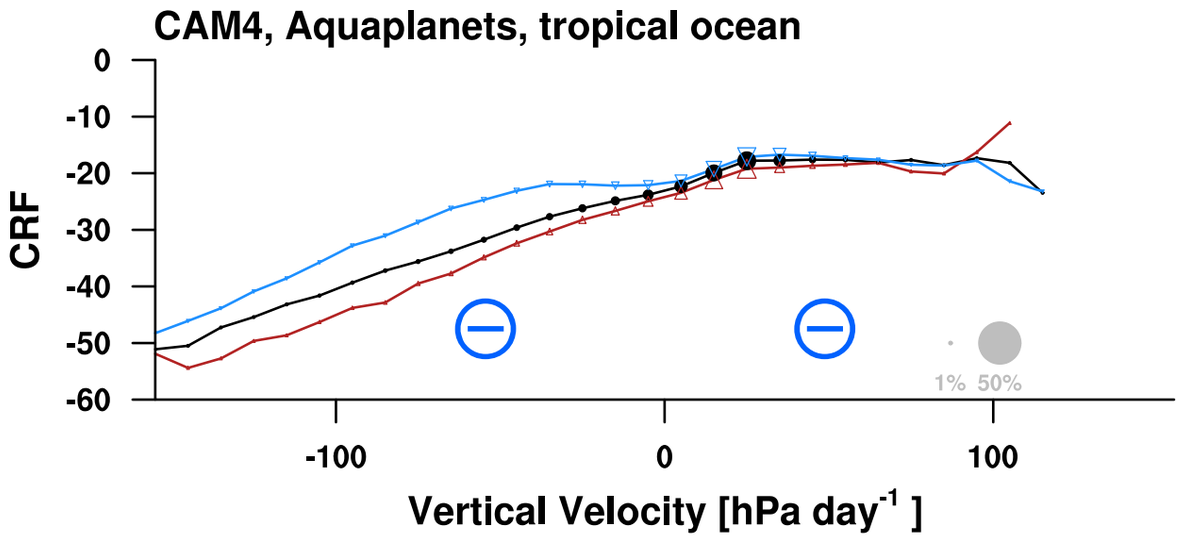
Contour lines show λ and λ_{clr}

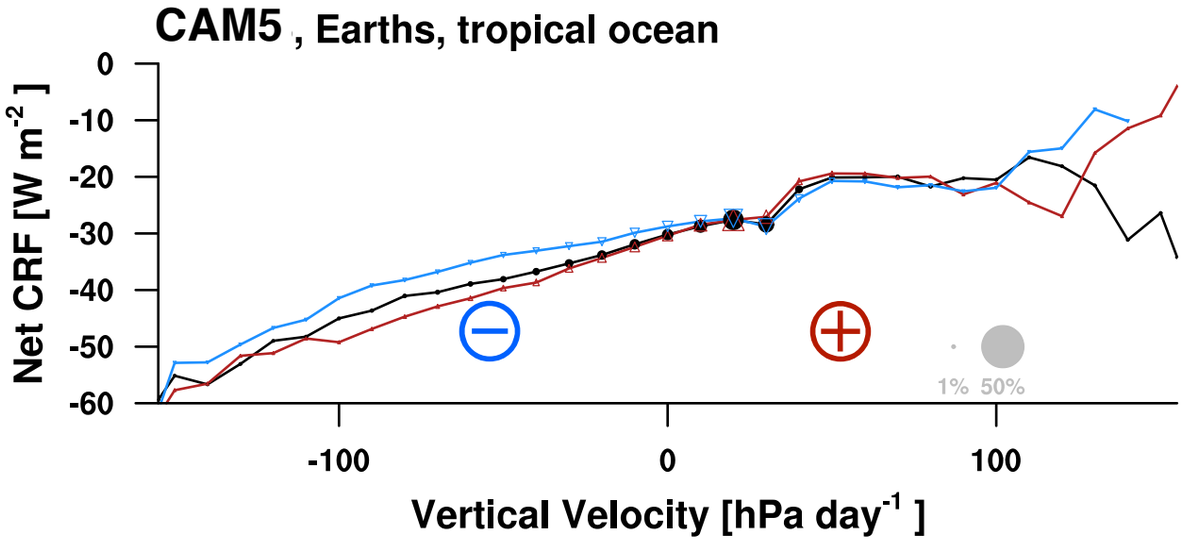
Tropical Cloud Response

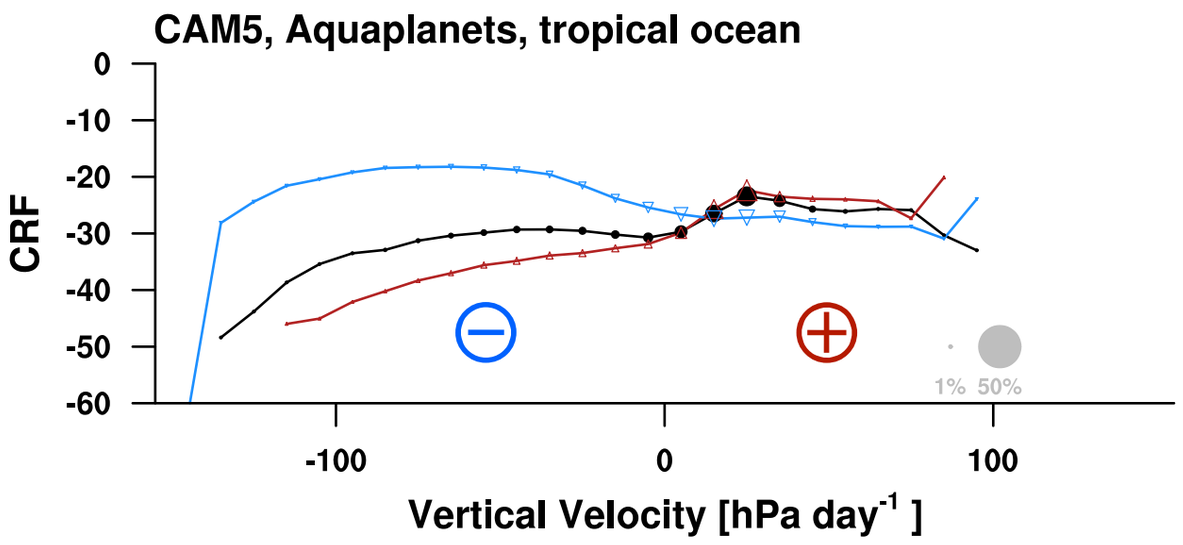


ω_{500} Regimes, Net Cloud Forcing









Size of markers is frequency of occurrence (i.e., statistical weight).

Conclusions?

CAM4 sensitivity and cloud response largely like CAM3

CAM5 aquaplanet has smaller λ, λ_{clr} than Earth-like configuration

Appears to be influenced by clear-sky fluxes

- affects clear-sky sensitivity AND cloud radiative forcing, by construction
- Not all bad news: change in CRF is partitioned similarly by circulation regimes

Some possible directions:

- Investigate role of aerosol in this result (i.e., our naive experiment is probably naive)
- Turn off the aerosol model (in the works, and is probably the right way to do this)