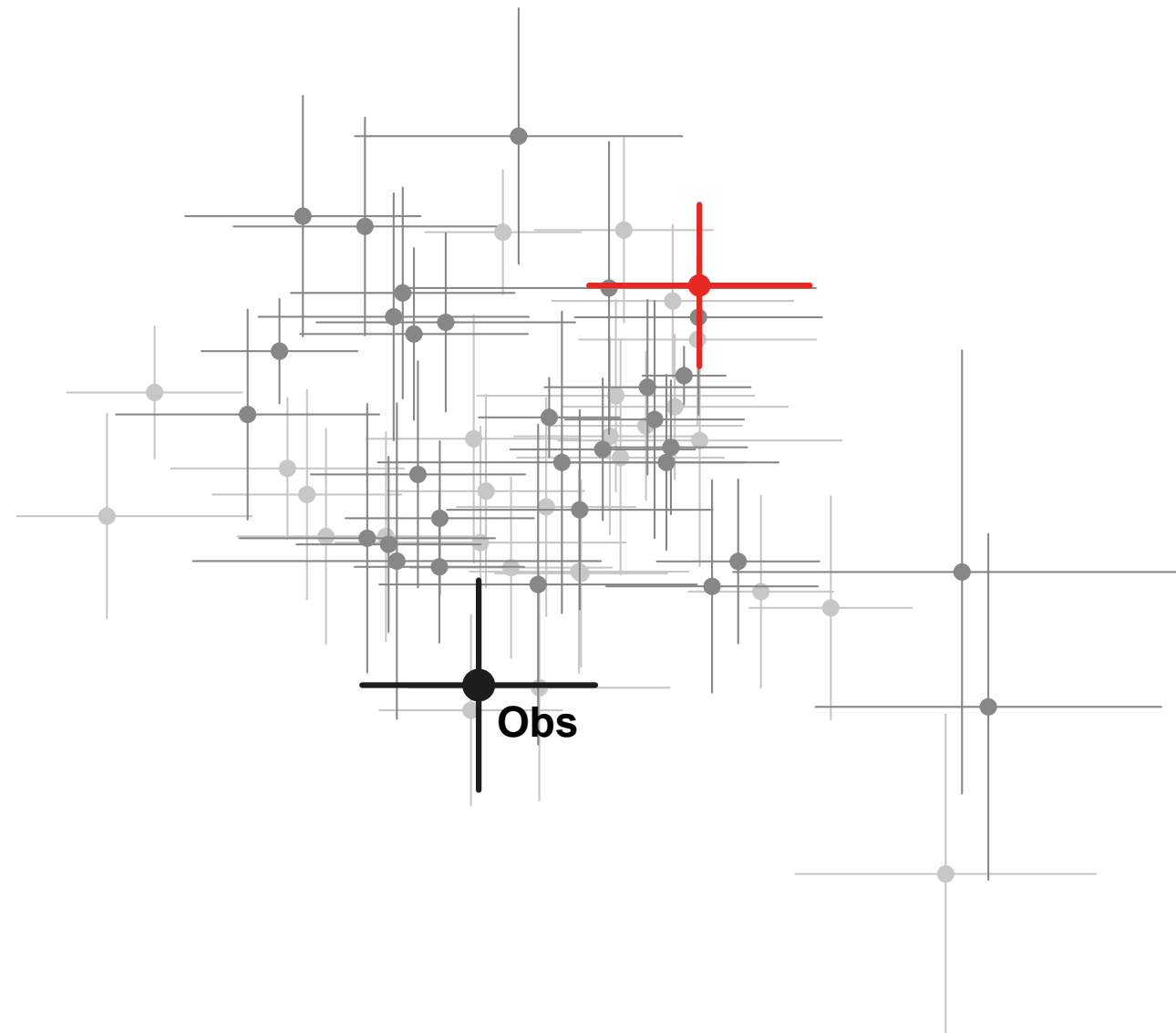
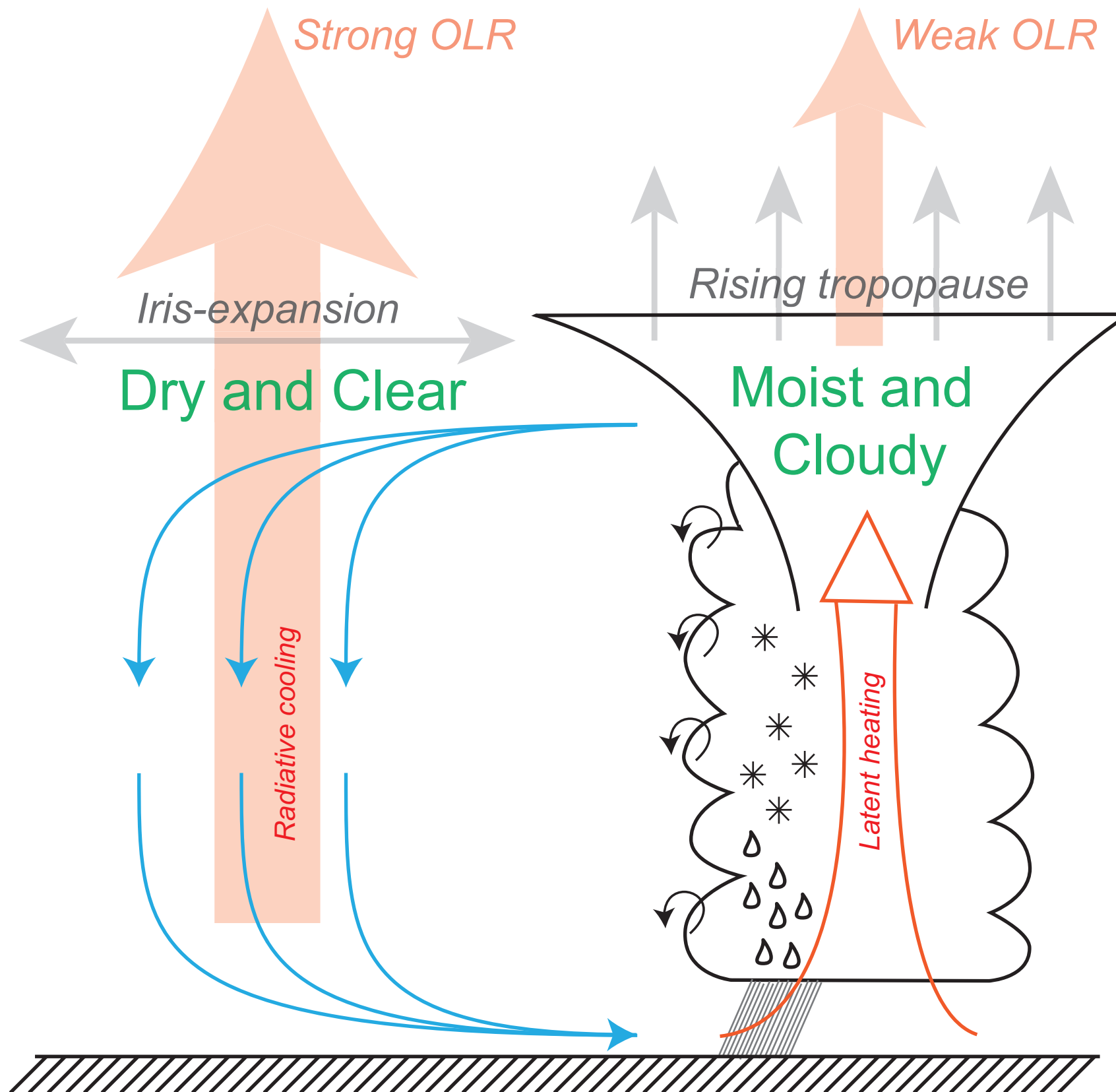


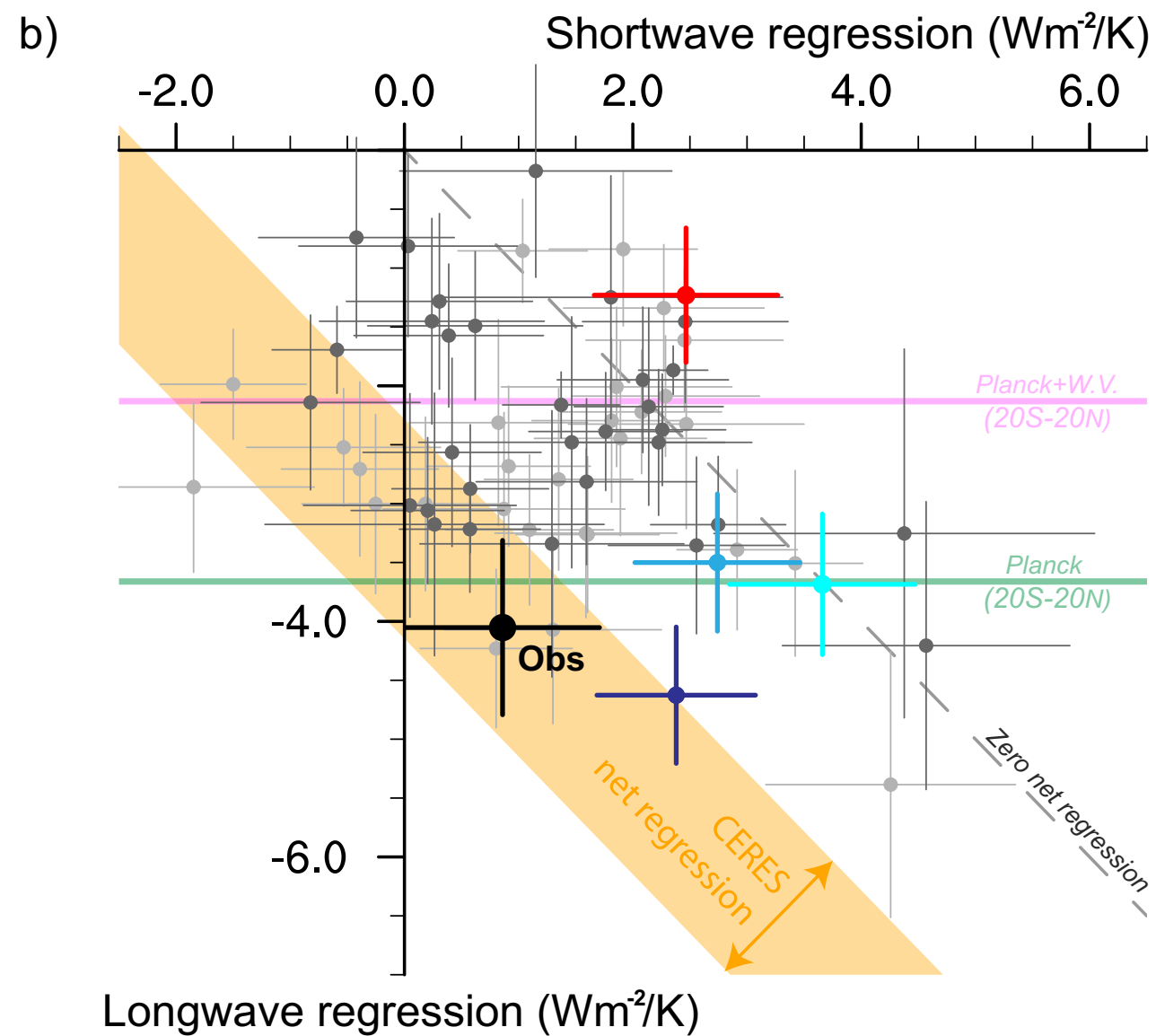
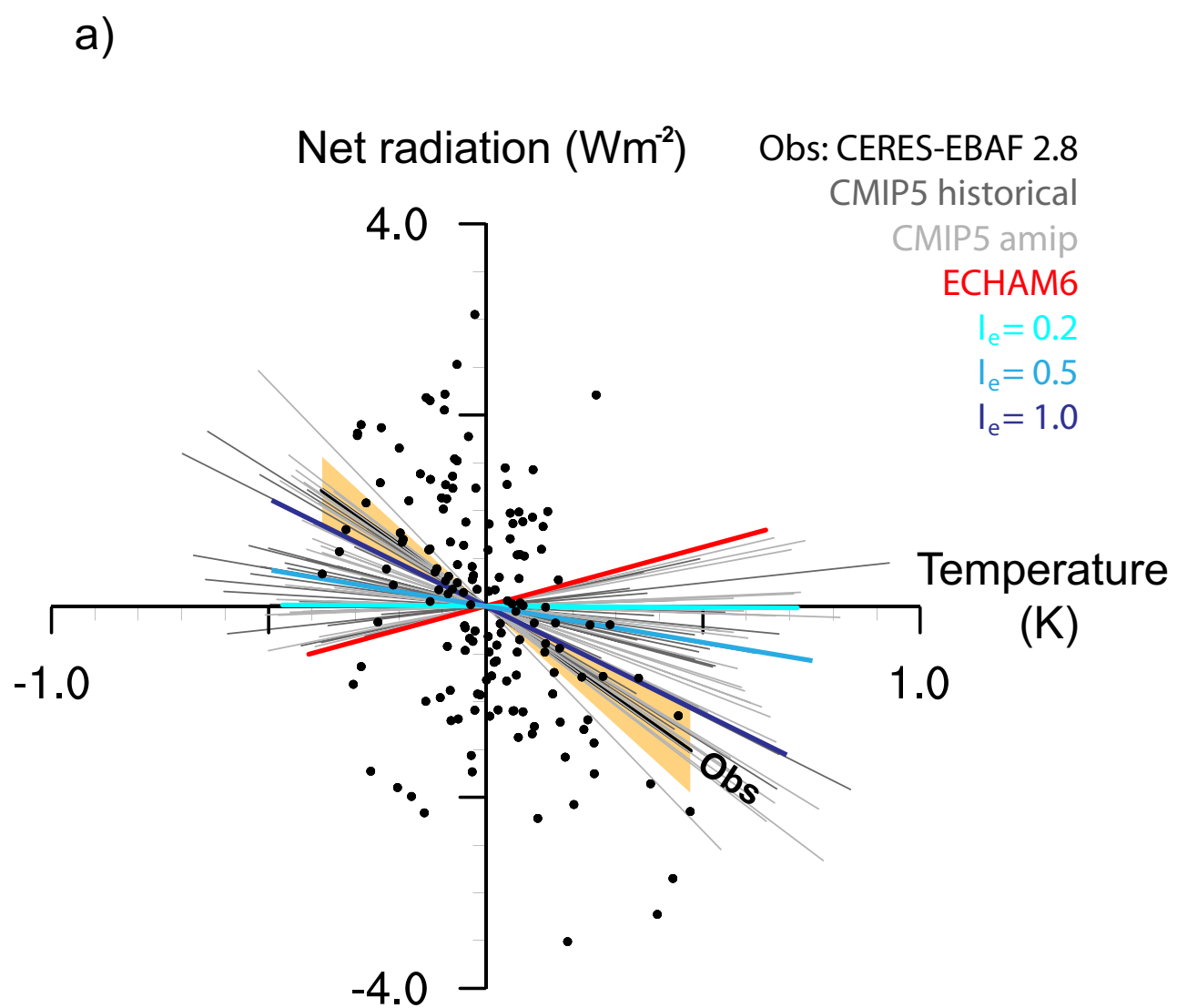
Missing iris-effect as a possible cause of:

- muted hydrological change and
 - high climate sensitivity
- in models

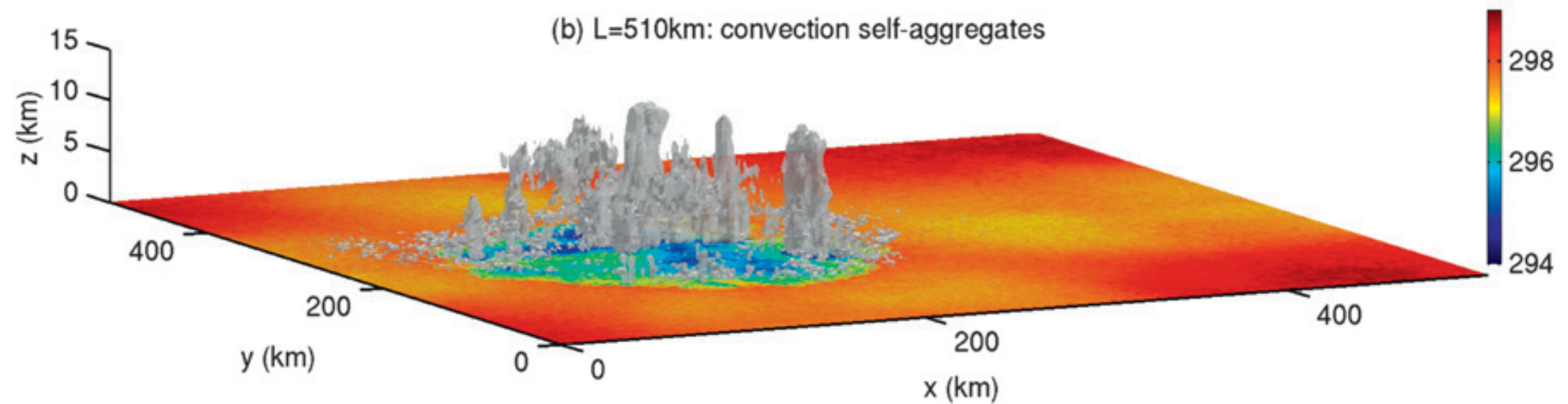
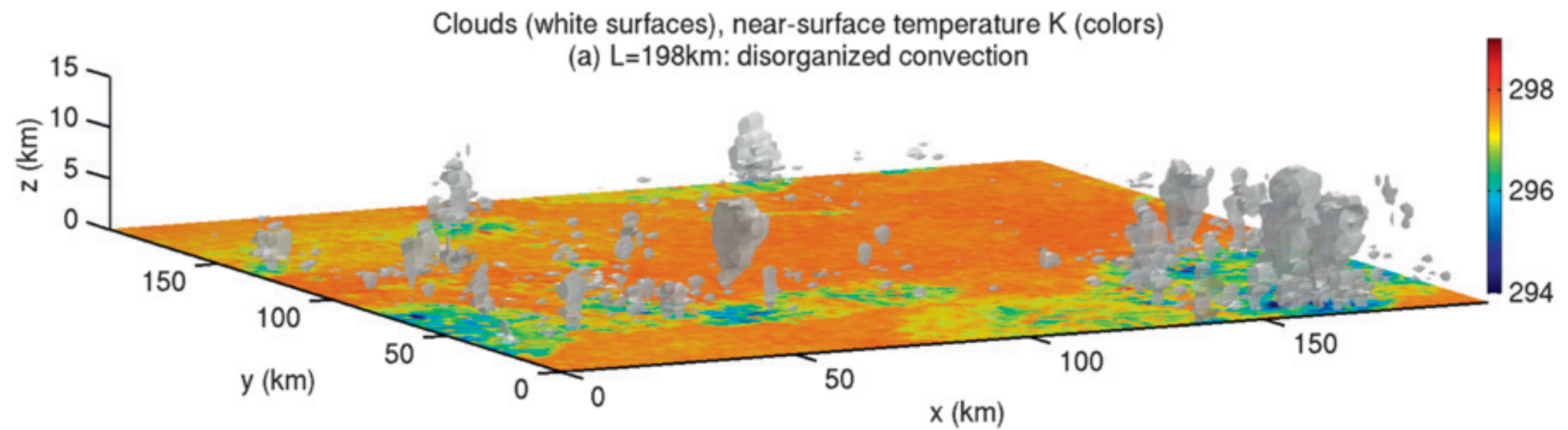


T. Mauritsen and B. Stevens
Max Planck Institute for Meteorology, Hamburg



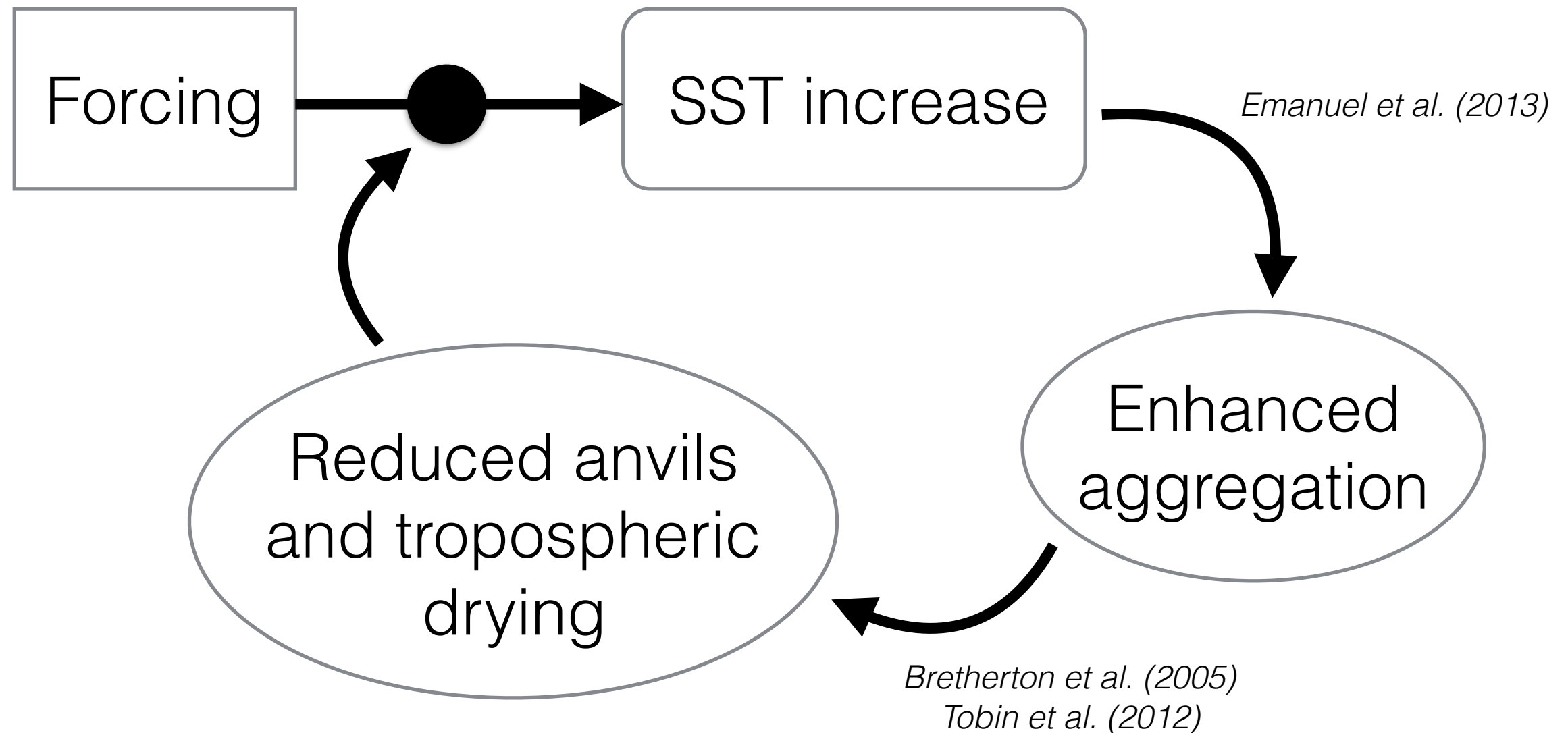


20S-20N, monthly anomalies, 90 percent confidence, 10-month auto-correlation



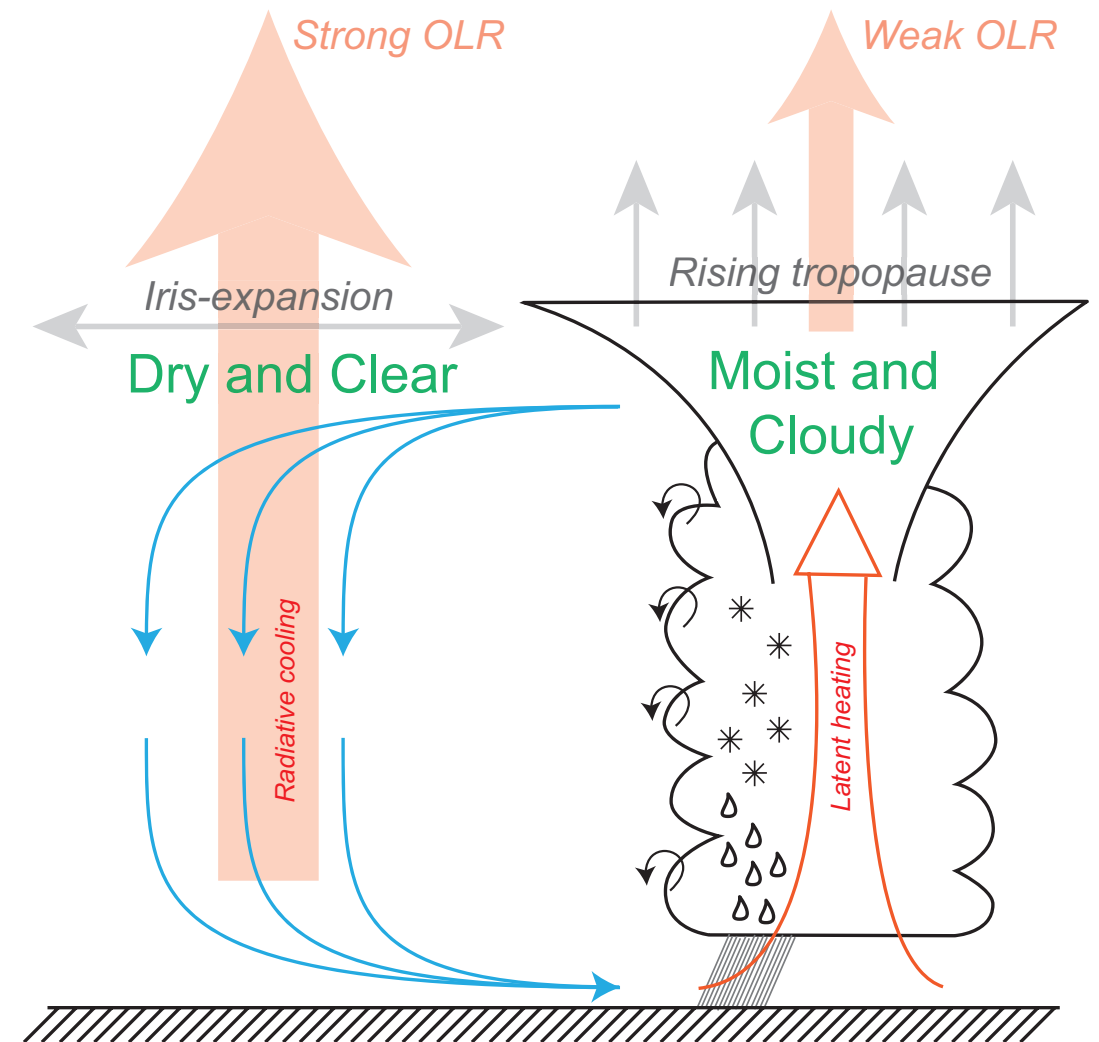
Muller and Held (2012)

Hypothesized negative feedback loop (longwave)



An Iris-effect:

$$C_p(T_s) = C_o \cdot (1 + I_e)^{T_s - T_o}$$



ECHAM6, T63L47

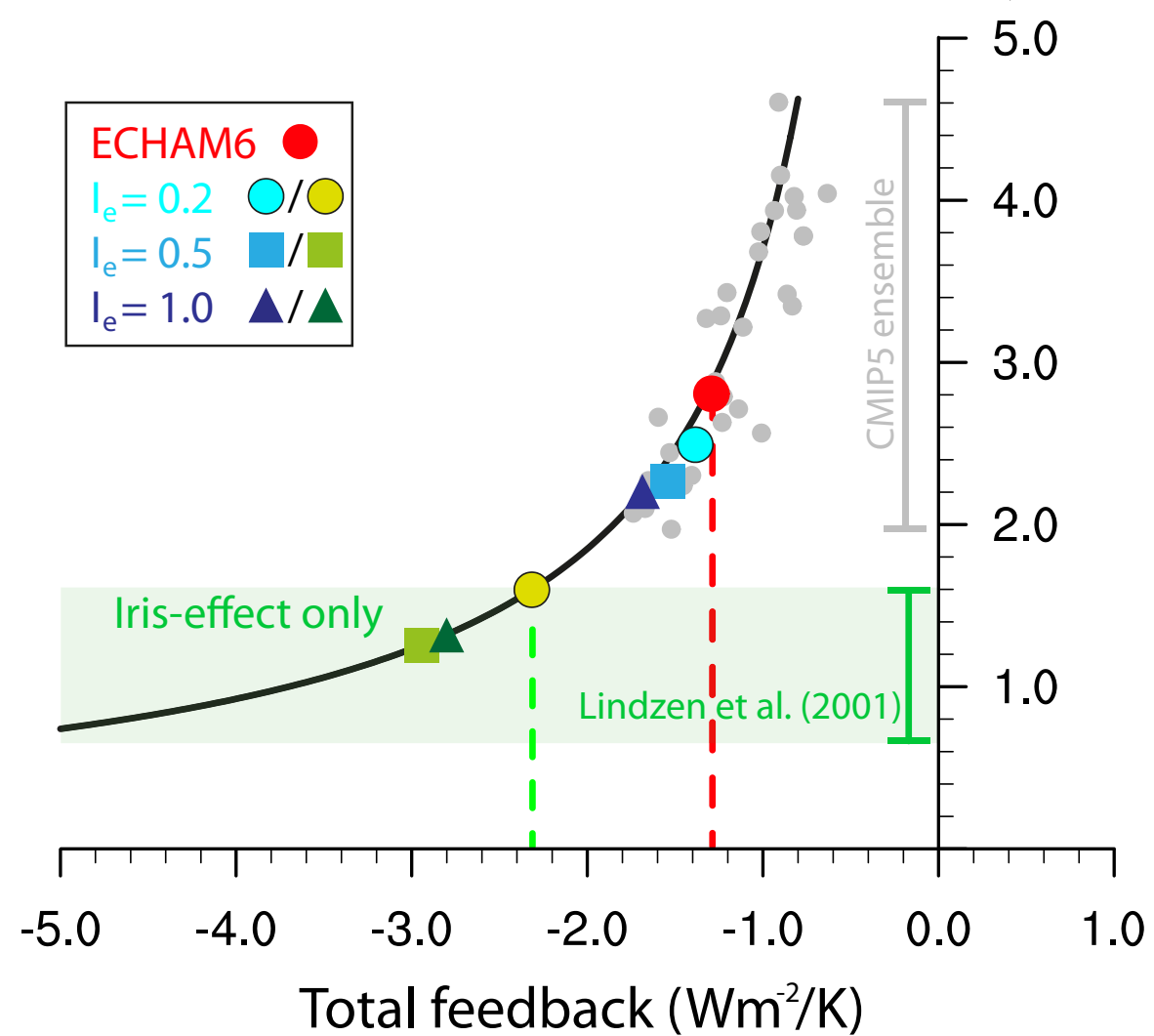
Coupled to mixed-layer ocean

2xCO₂ forcing

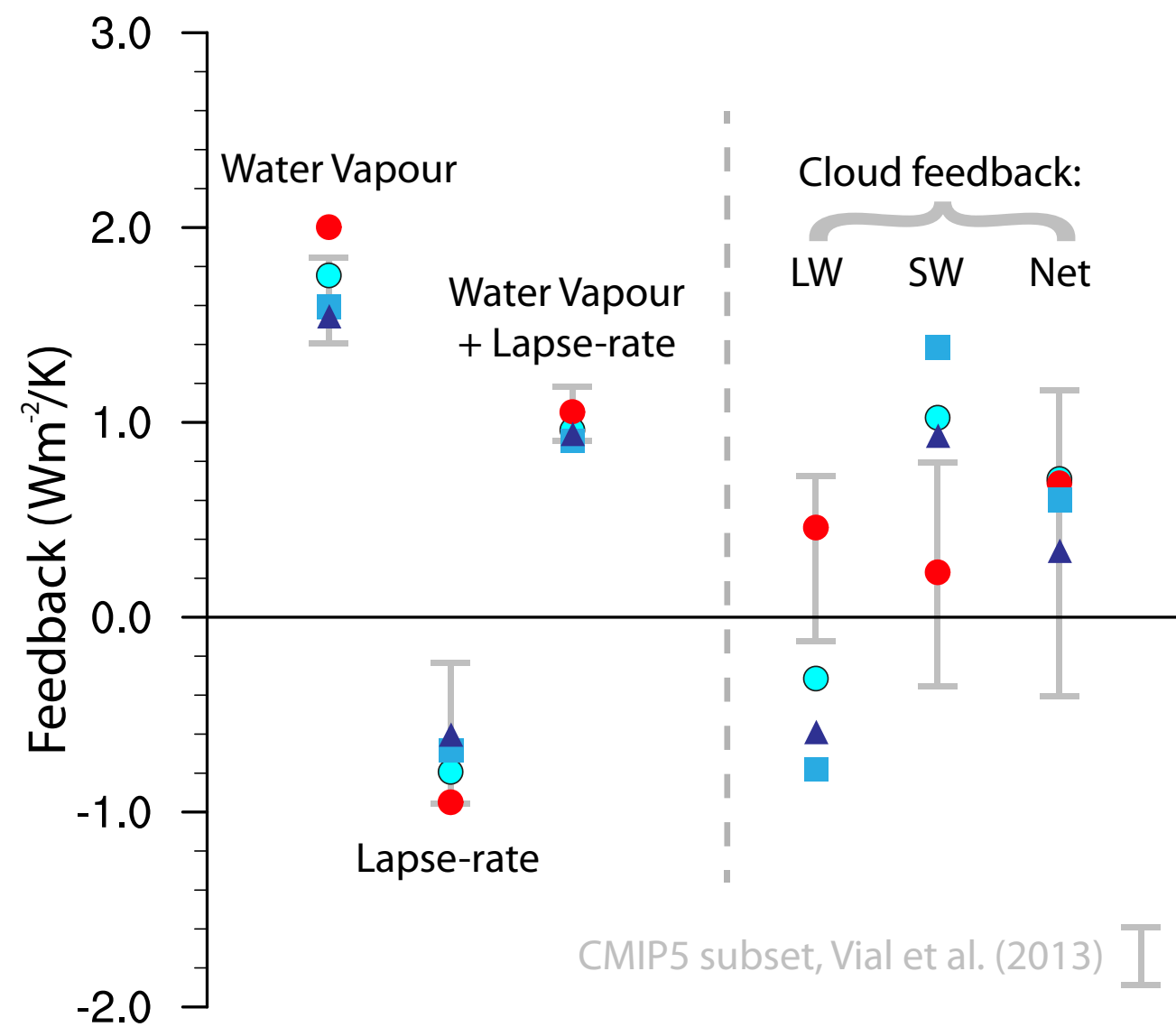
Partial radiative perturbations (PRP) feedback analysis

a)

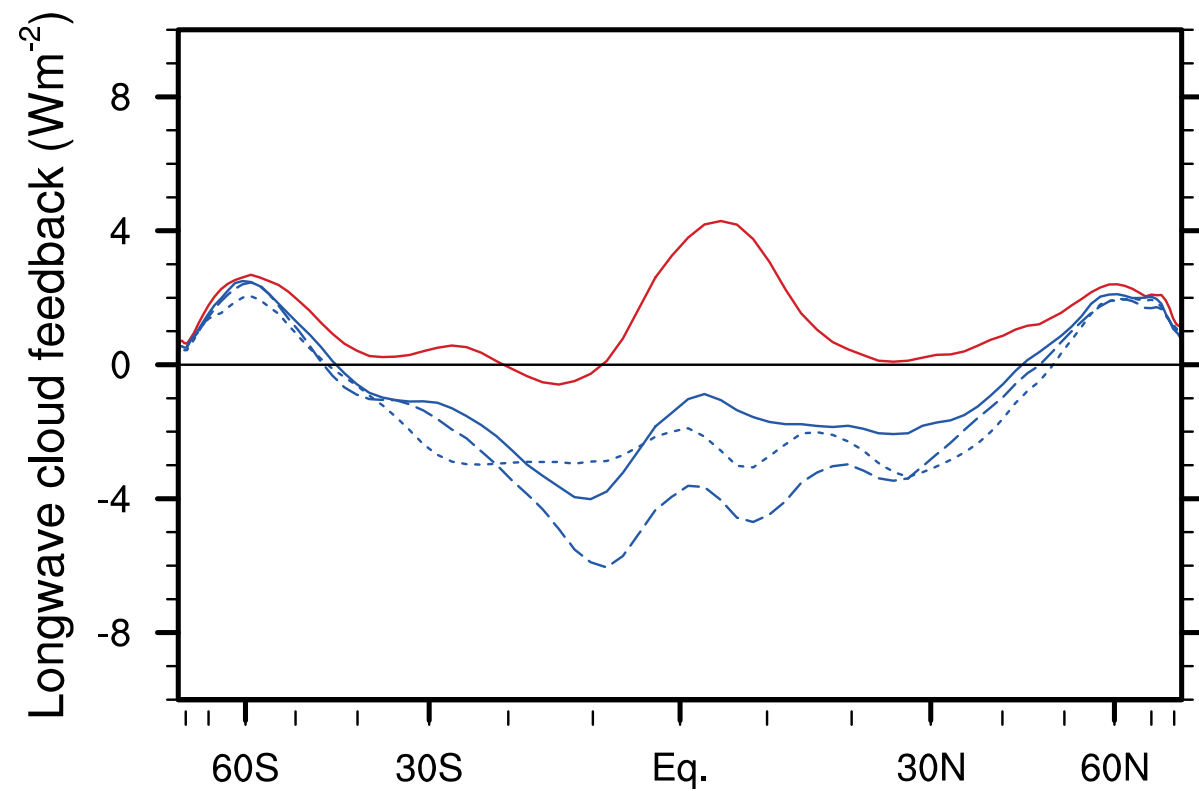
Equilibrium climate sensitivity (K)



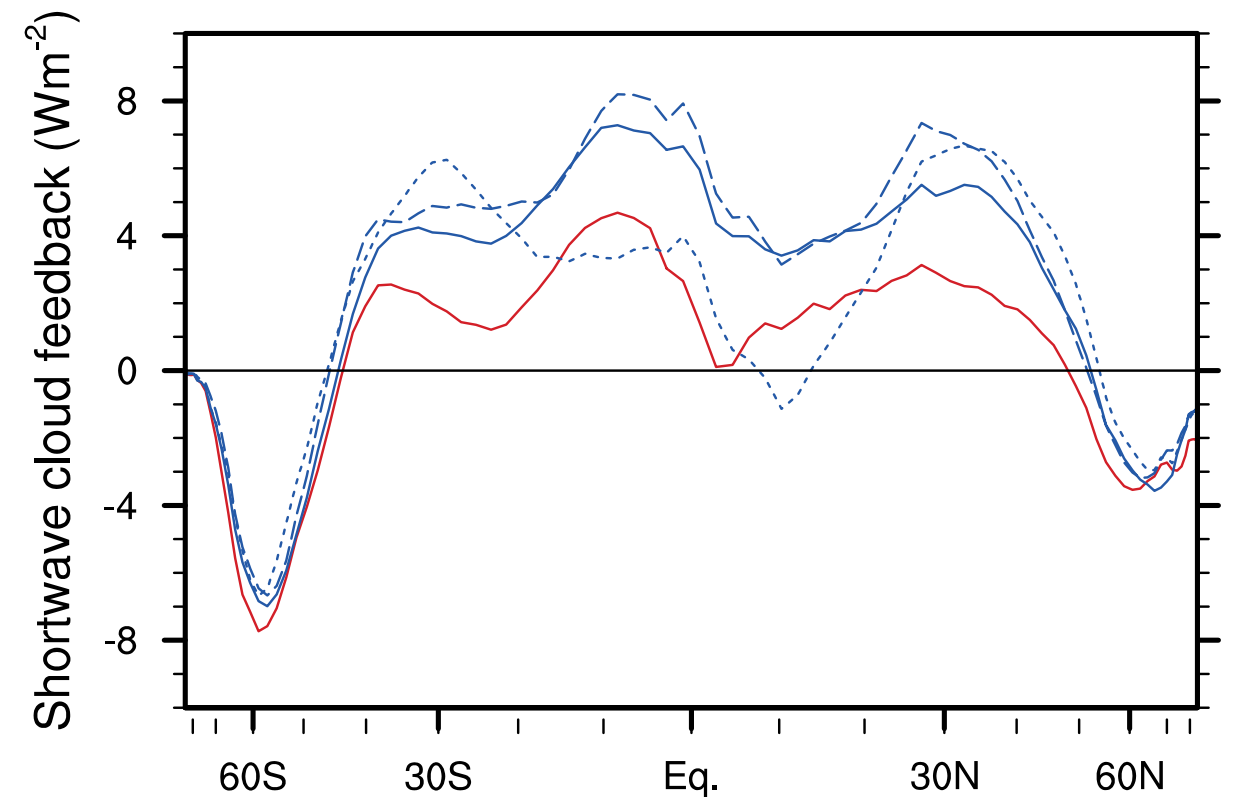
b)



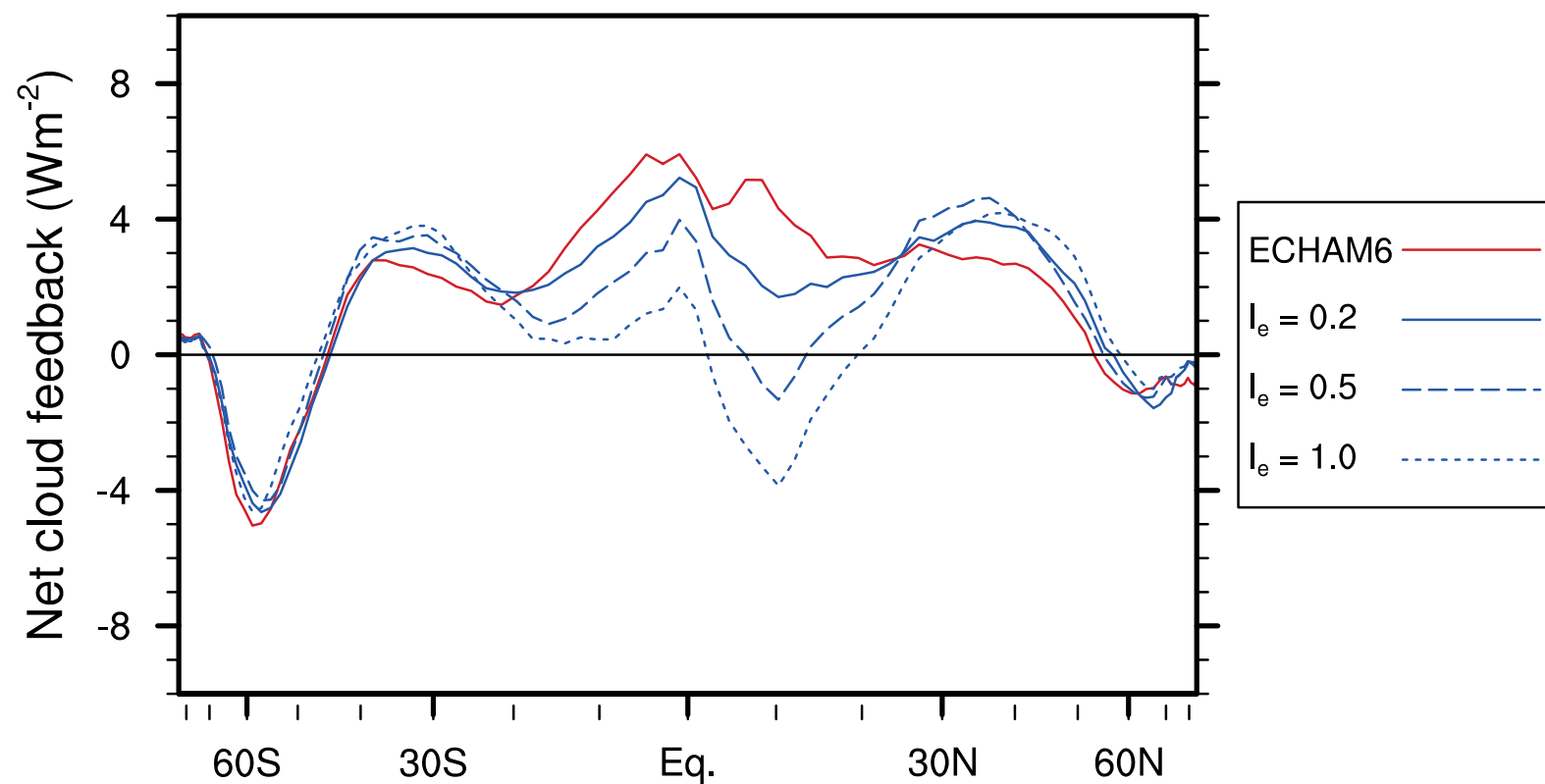
Longwave cloud feedback:

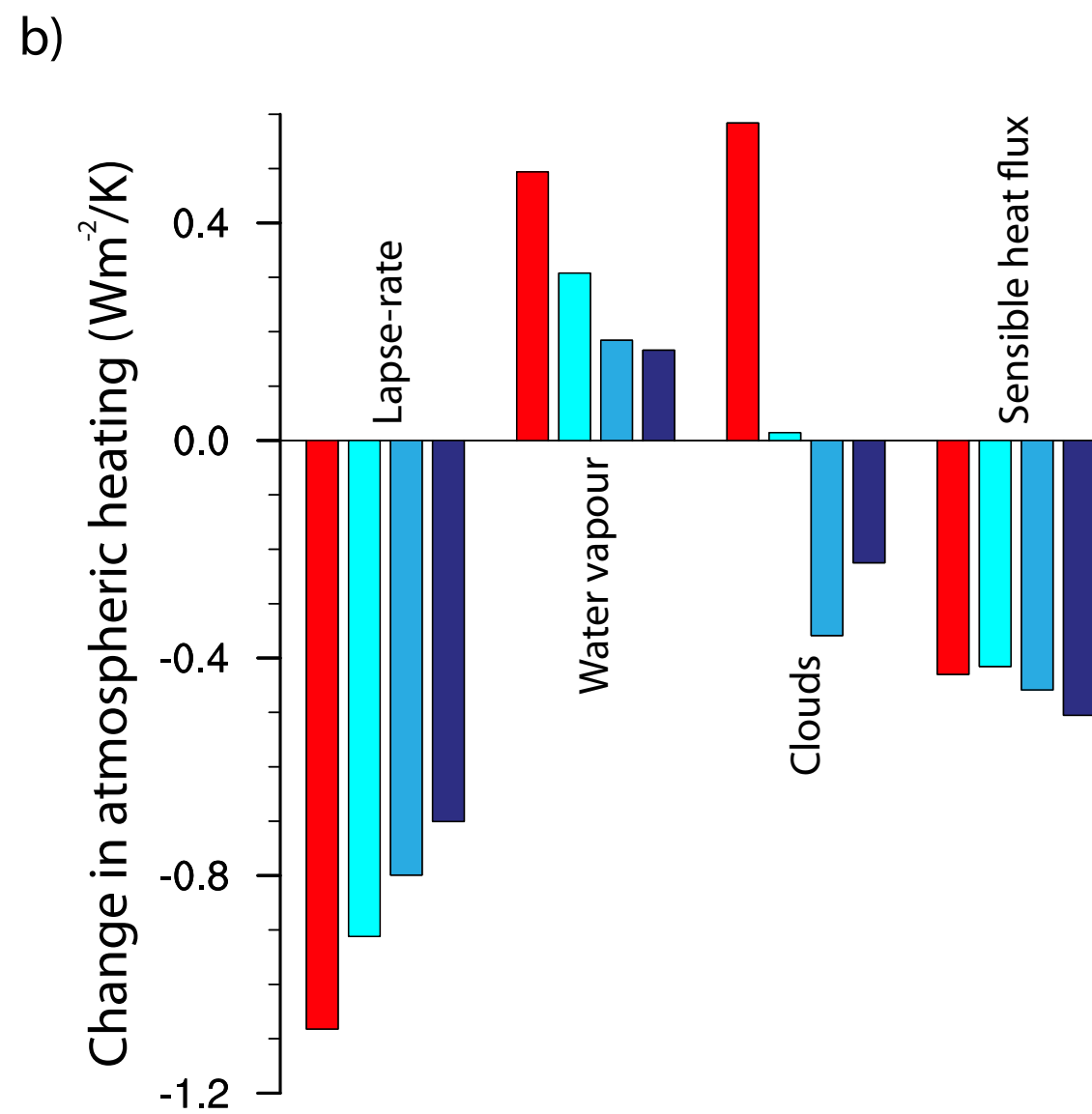
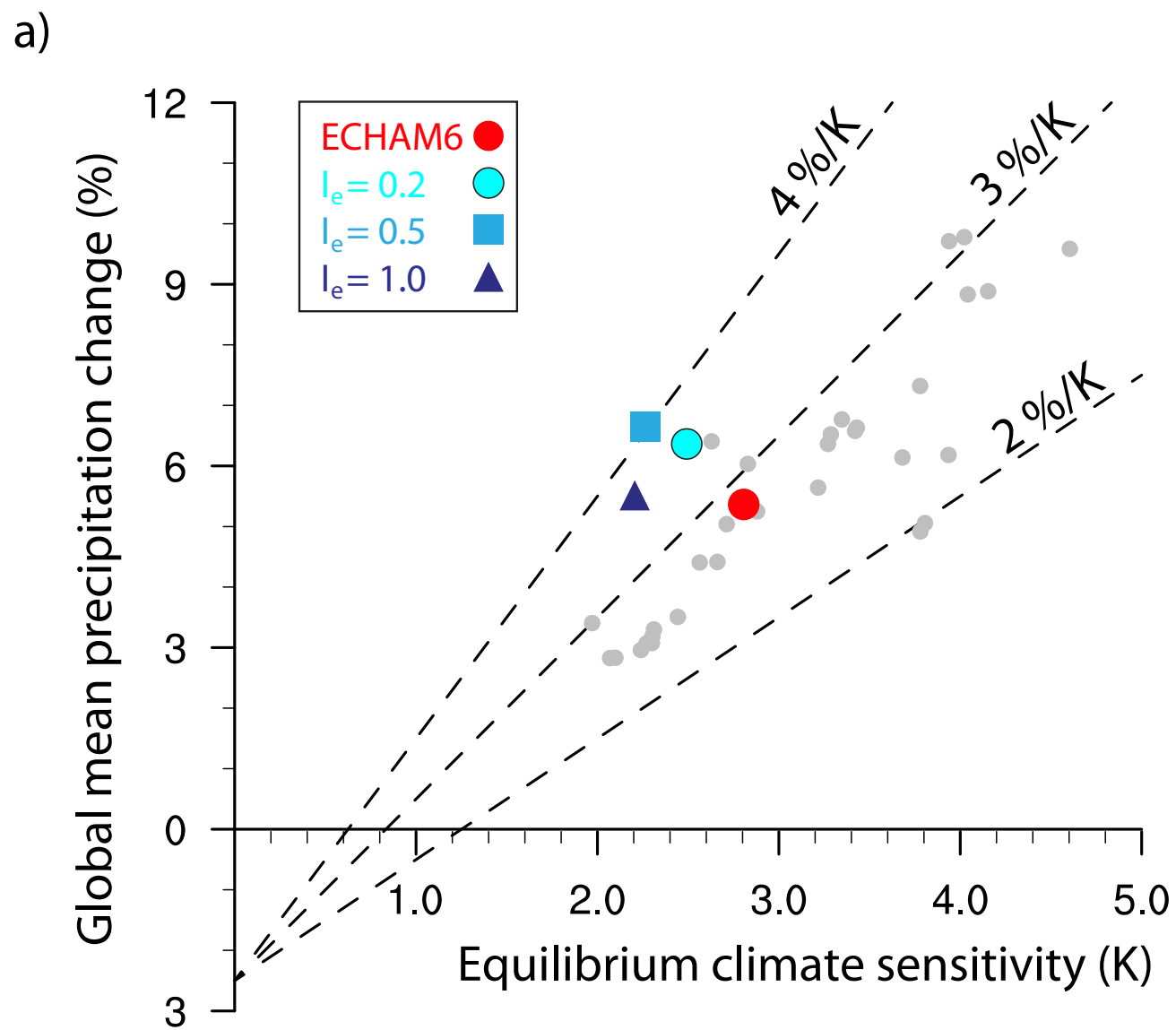


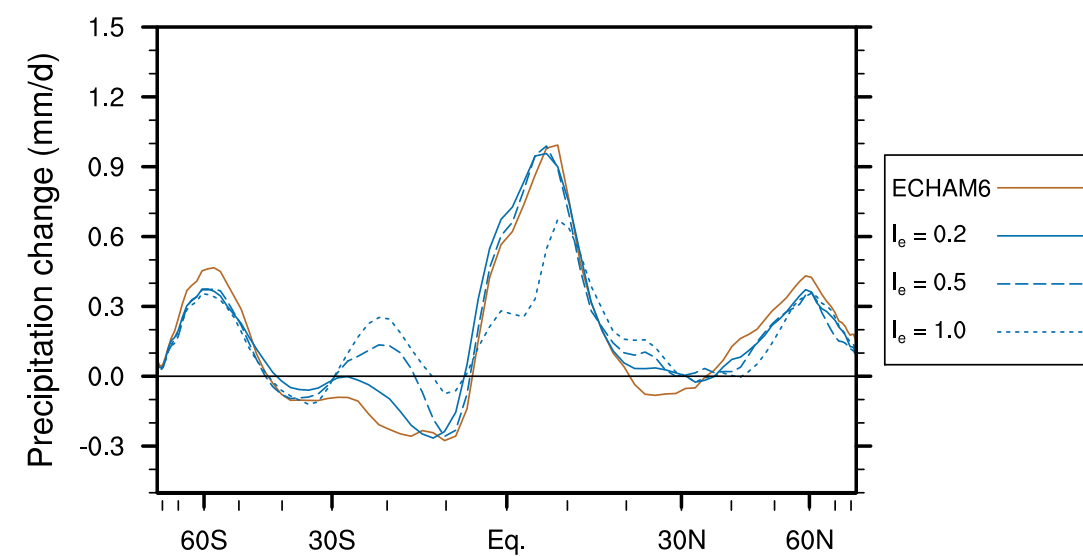
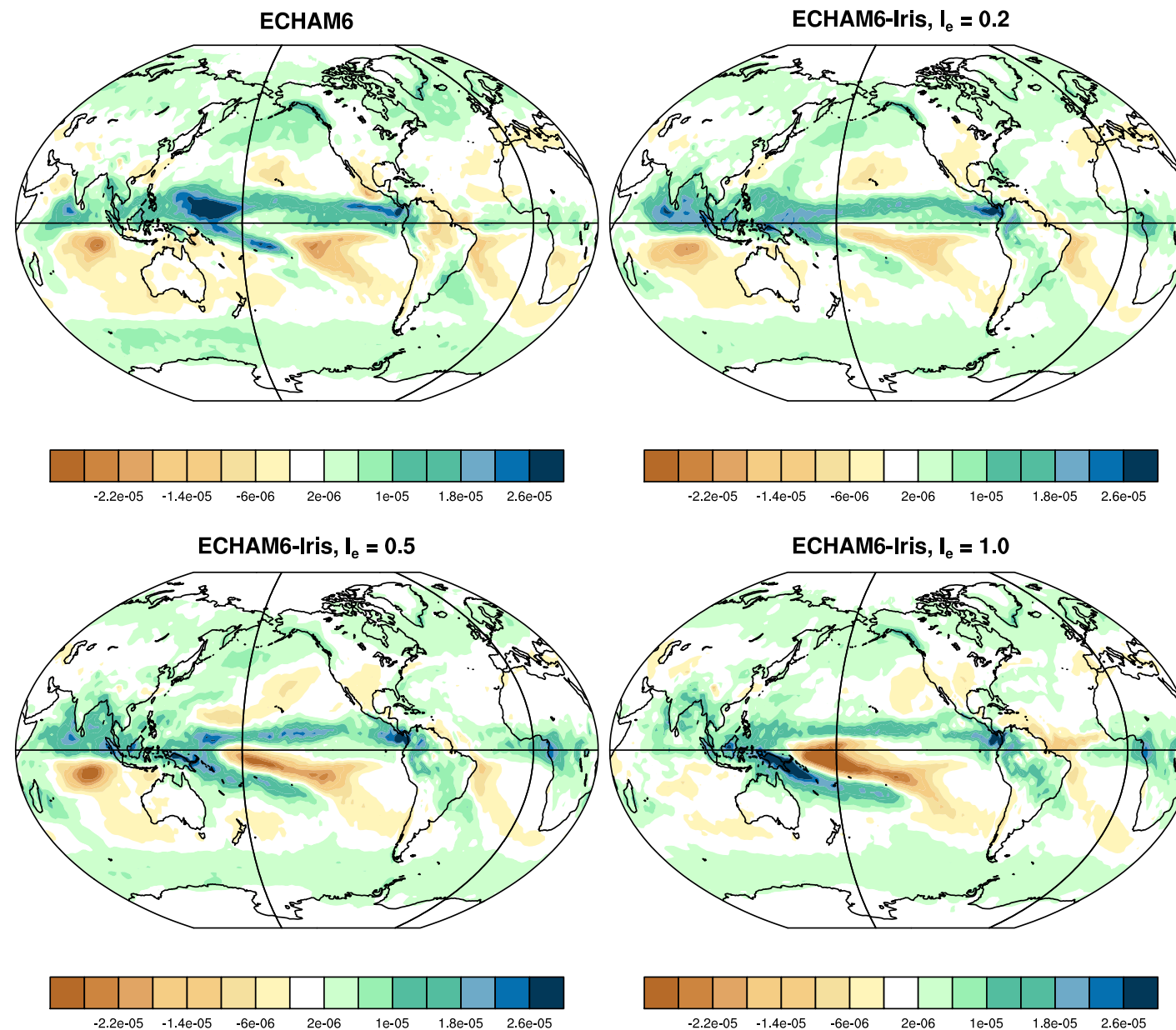
Shortwave cloud feedback:



Net cloud feedback:







Summary

The iris-hypothesis predicts a response which in certain respects could help reconcile modelling with recent constraints and observations:

1. Lower-end ECS is possible, even with positive shortwave cloud feedback (✓)
2. Hydrological sensitivity is enhanced (✓)

However, the model implementation leads to less organized resolved precipitation (✗)

Summary

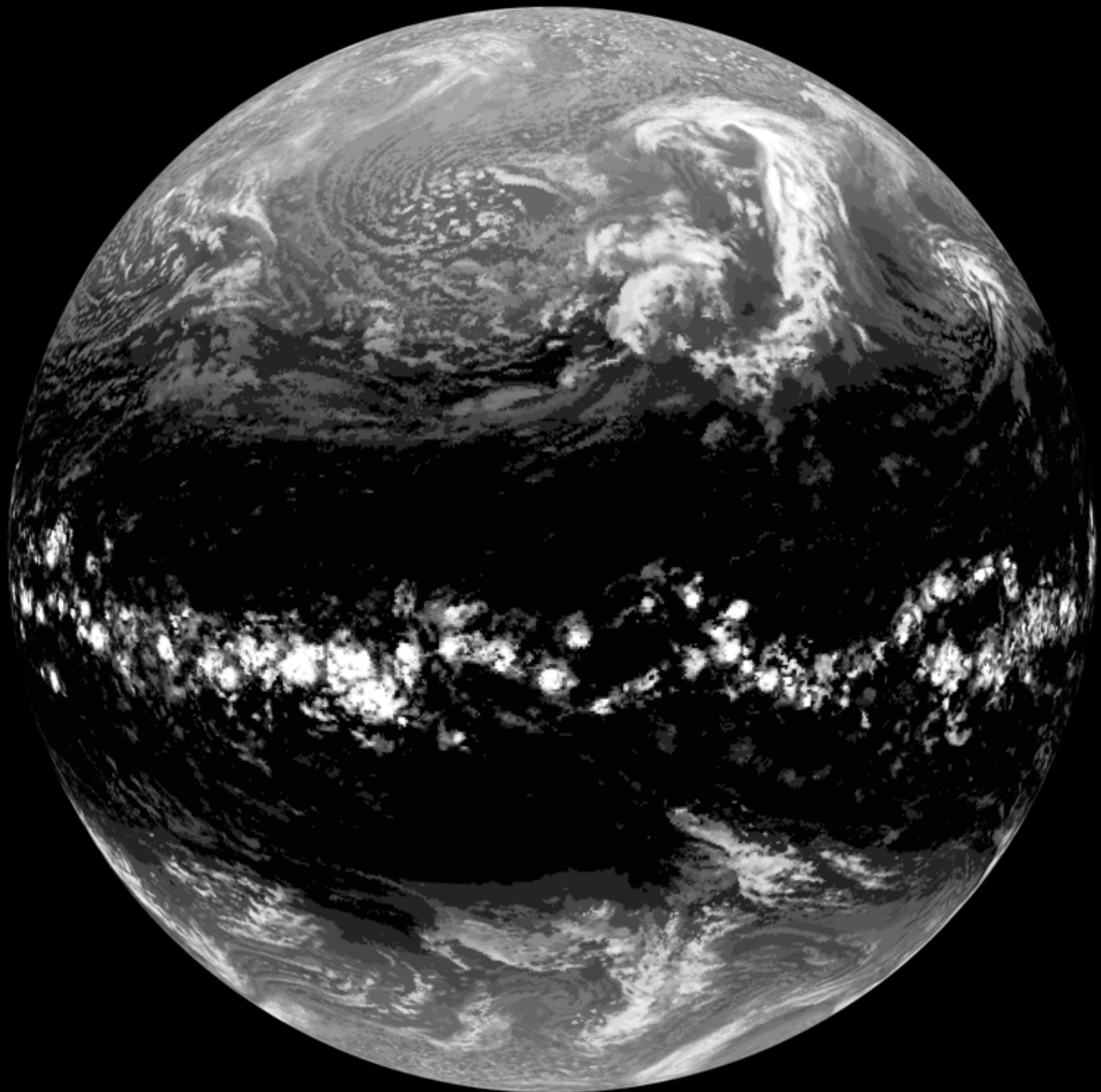
The iris-hypothesis predicts a response which in certain respects could help reconcile modelling with recent constraints and observations:

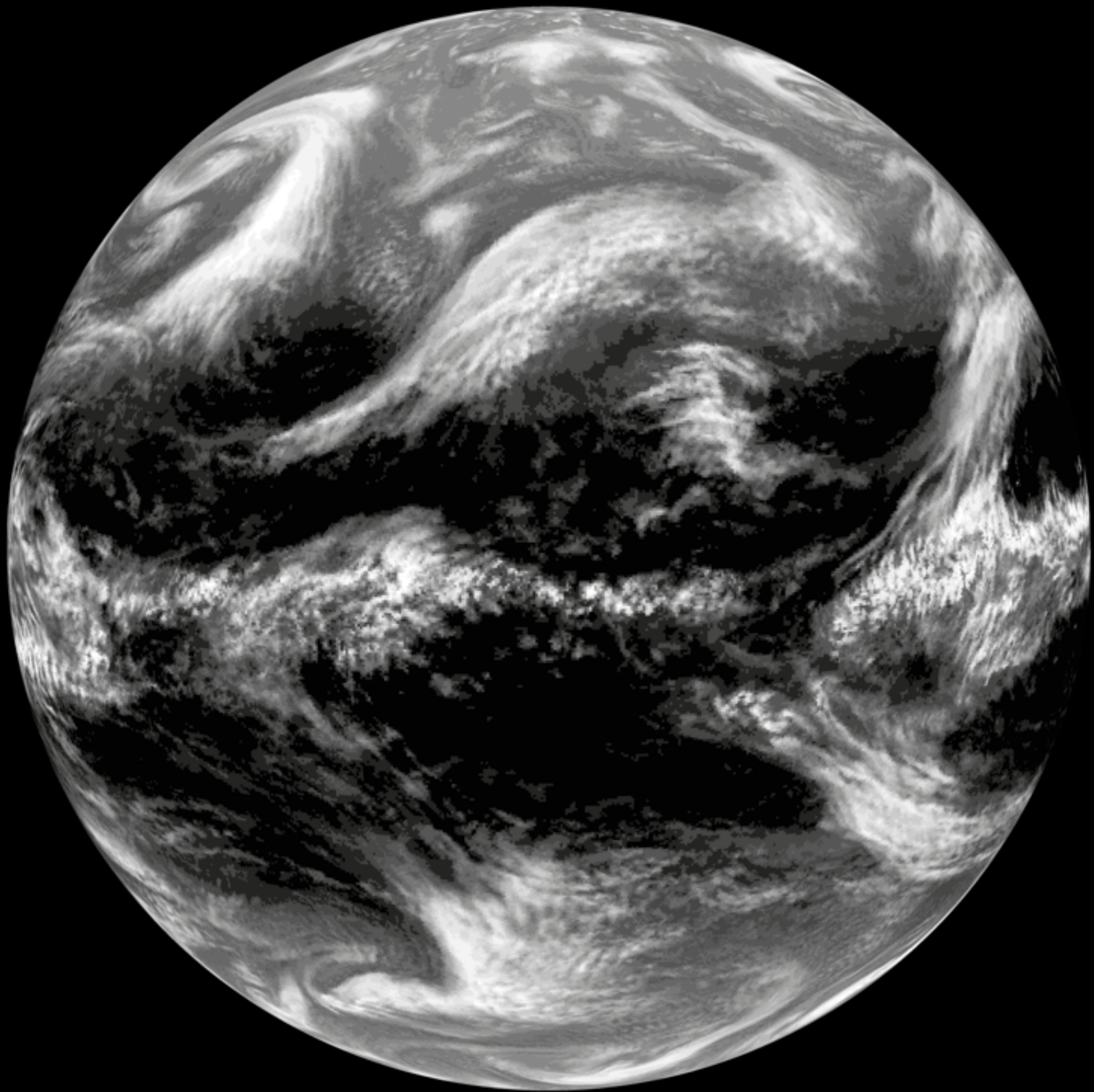
1. Lower-end ECS is possible, even with positive shortwave cloud feedback (✓)
2. Hydrological sensitivity is enhanced (✓)

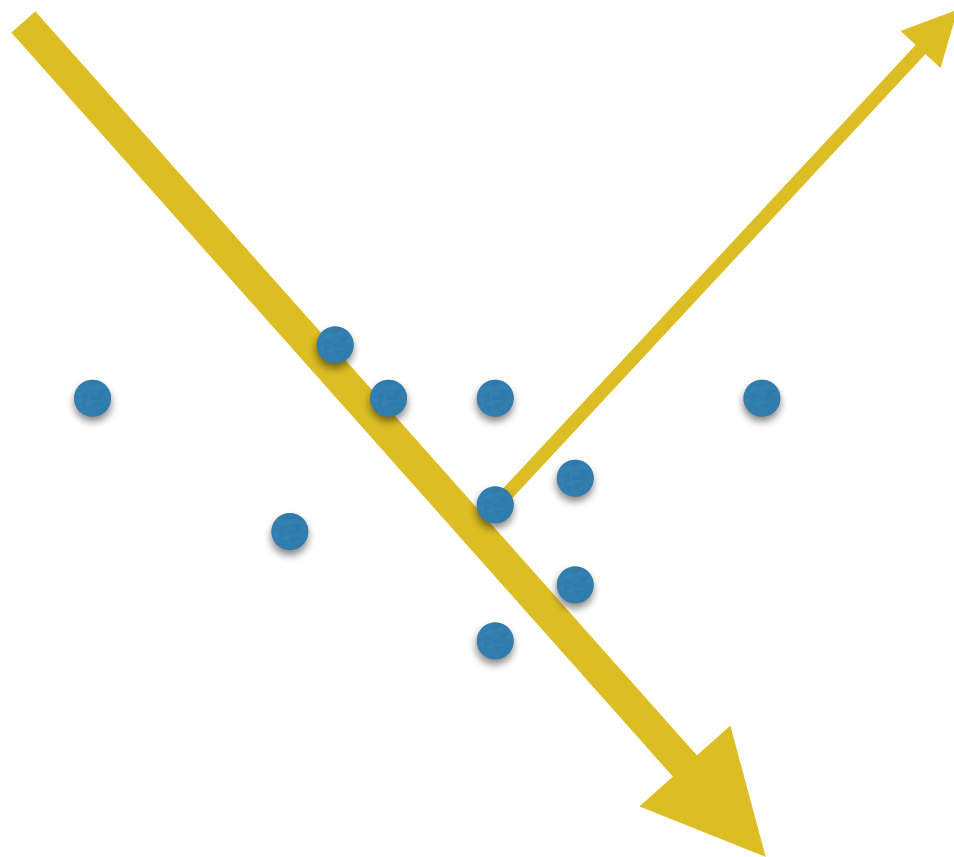
However, the model implementation leads to less organized resolved precipitation (✗)

Moving forward:

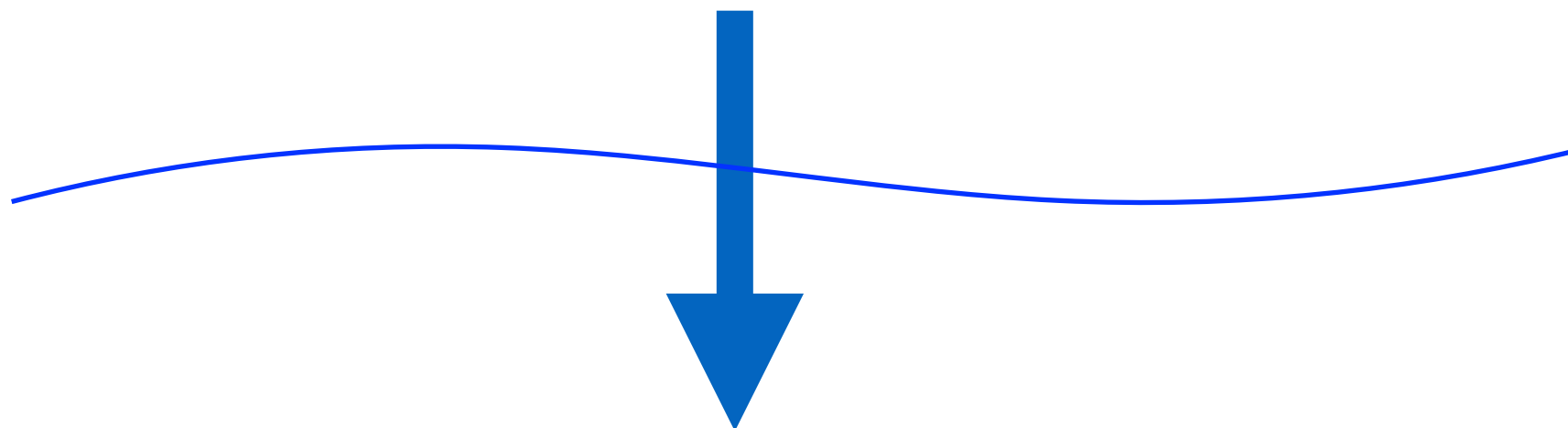
- Long-term calibrated observations in space of Earth's radiation budget
- Top-down climate modeling (in CMIP6)
- High-resolution studies

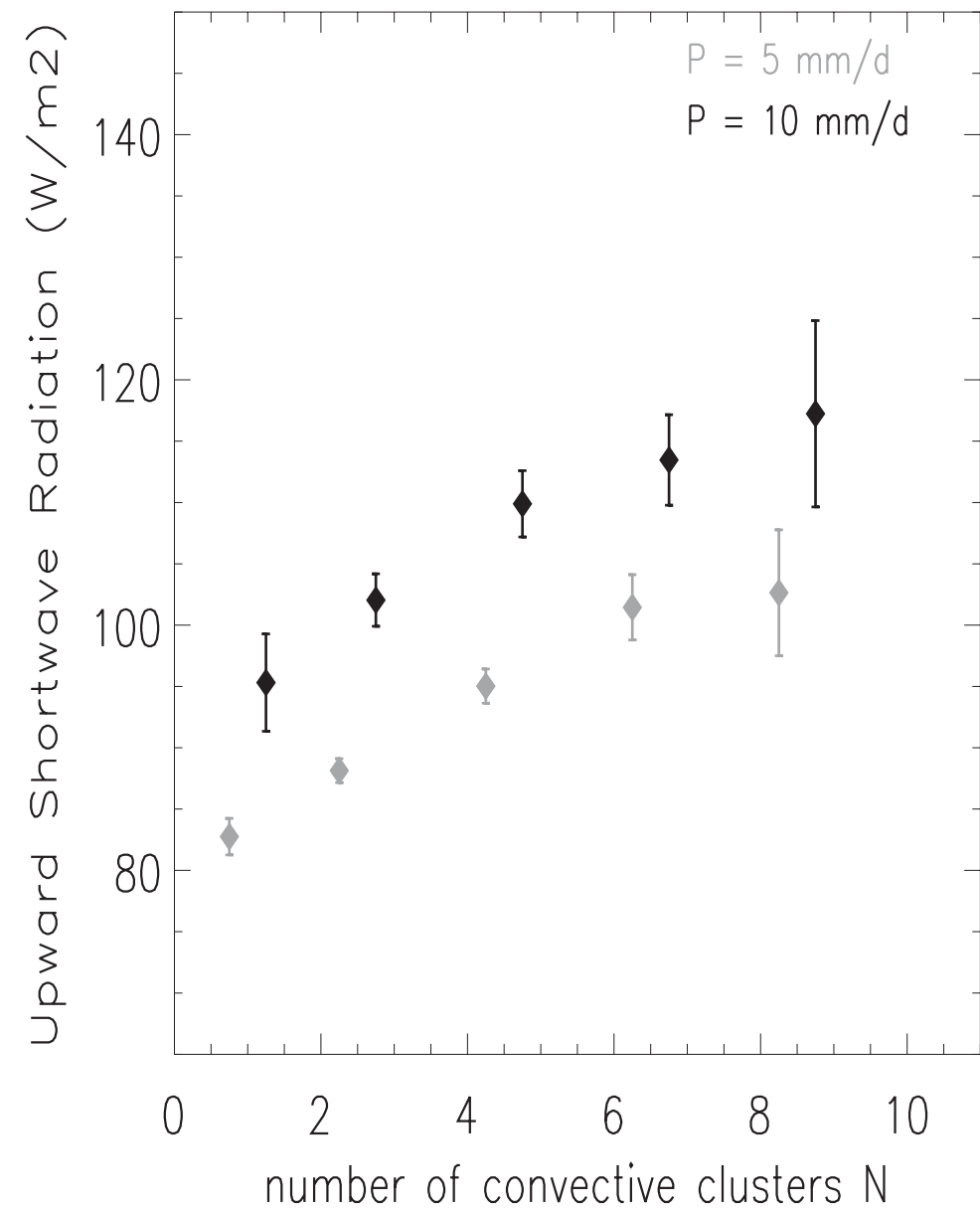
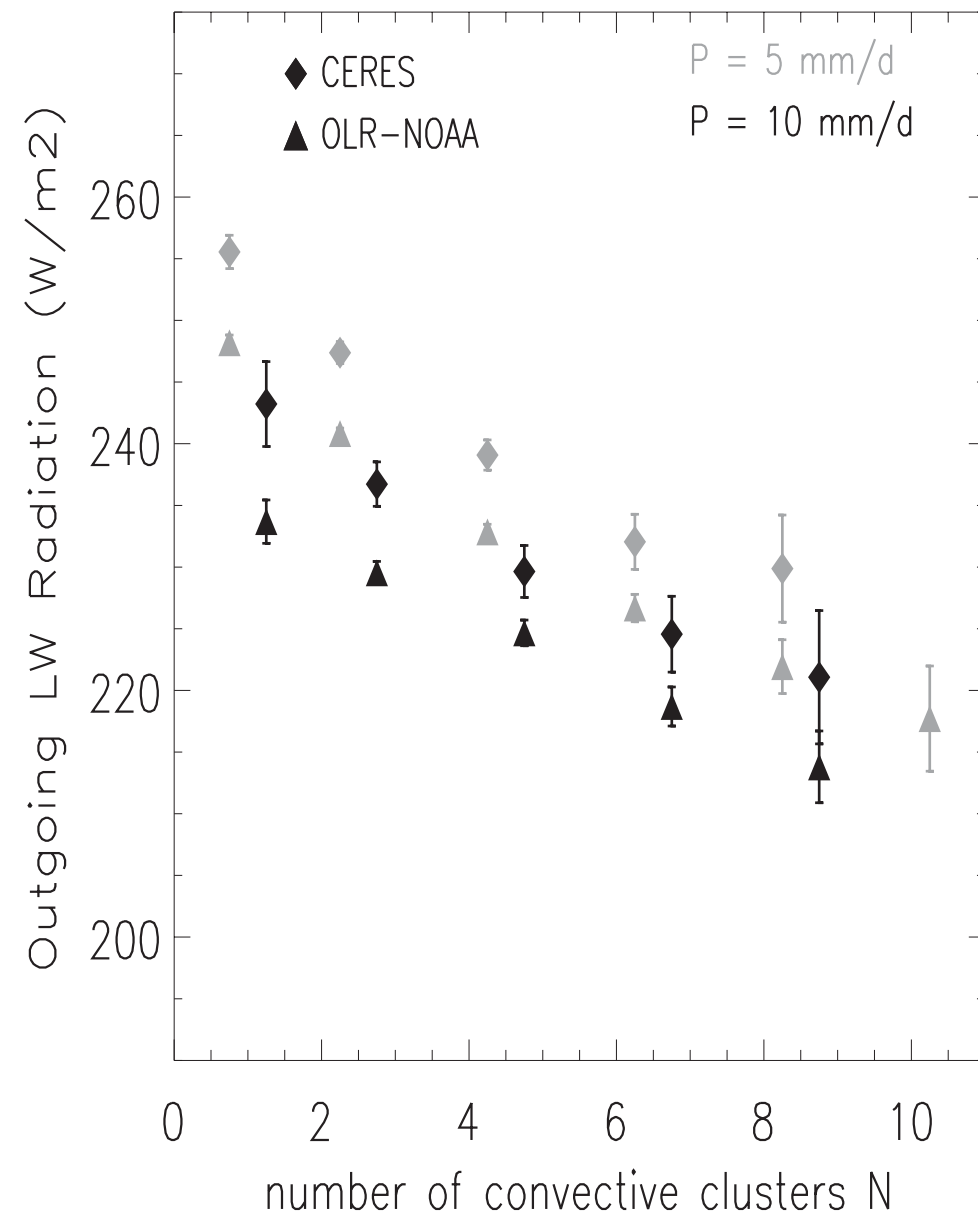






Challenging alternatives

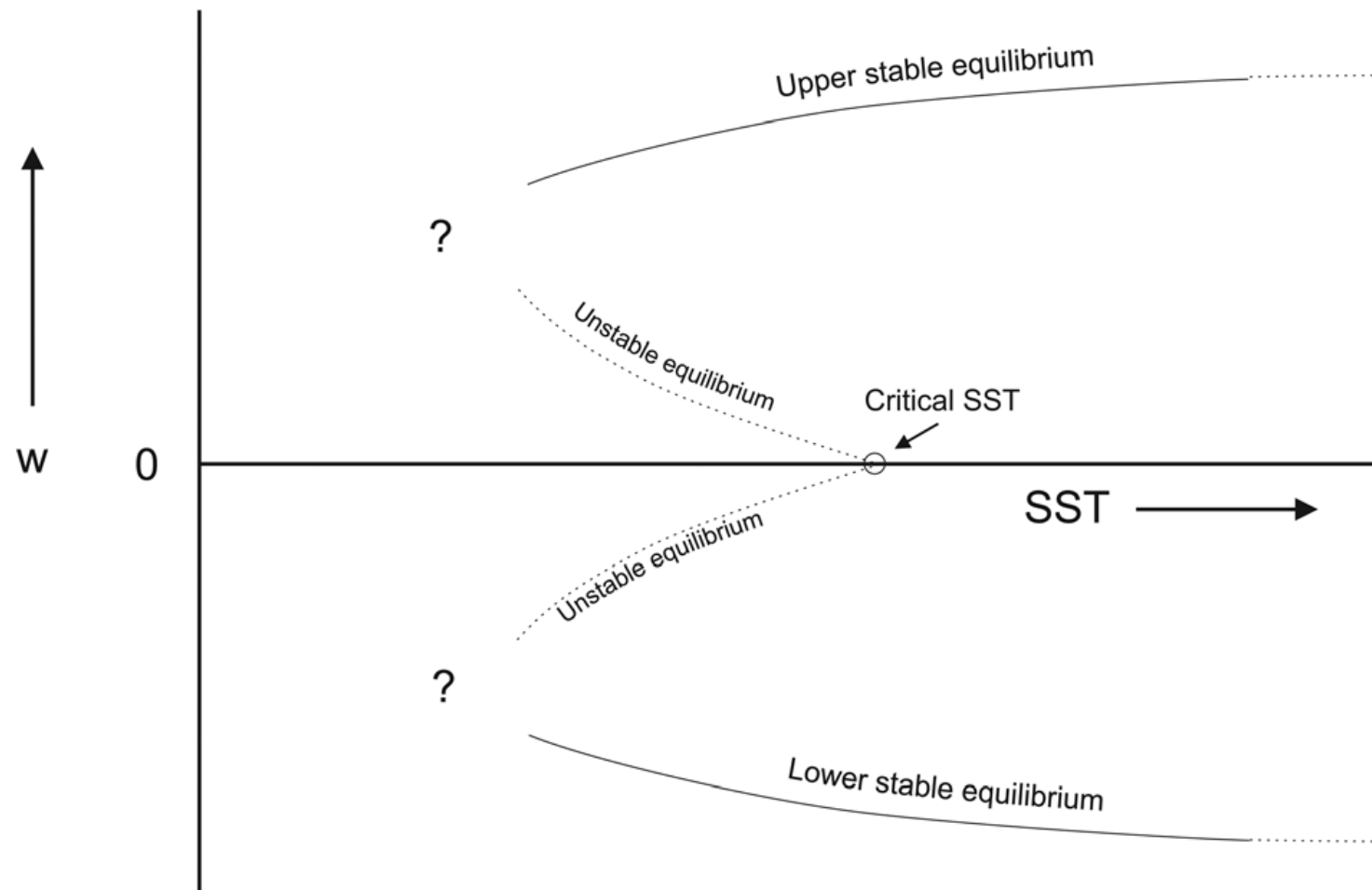




More aggregated



Warmer atmosphere is more prone to aggregate



Climate sensitivity:

Recent warming (~2K)

(e.g. Otto et al. 2013, Skeie et al. 2014,
Lewis and Curry 2014)

vs.

Model-based (3-5K)

(Clement et al. 2009, Fasullo and Trenberth 2012,
Rieck et al. 2012, Sherwood et al. 2014)

Hydrological sensitivity:

Models underestimate
by about a factor 2

(Zhang et al. 2007, Lambert et al. 2008,
Durack et al. 2012, Ren et al. 2013)