

THE ROLE OF OCEAN IN MODIFYING SST PATTERN FORMATION AND TIME-EVOLVING RADIATIVE FEEDBACK

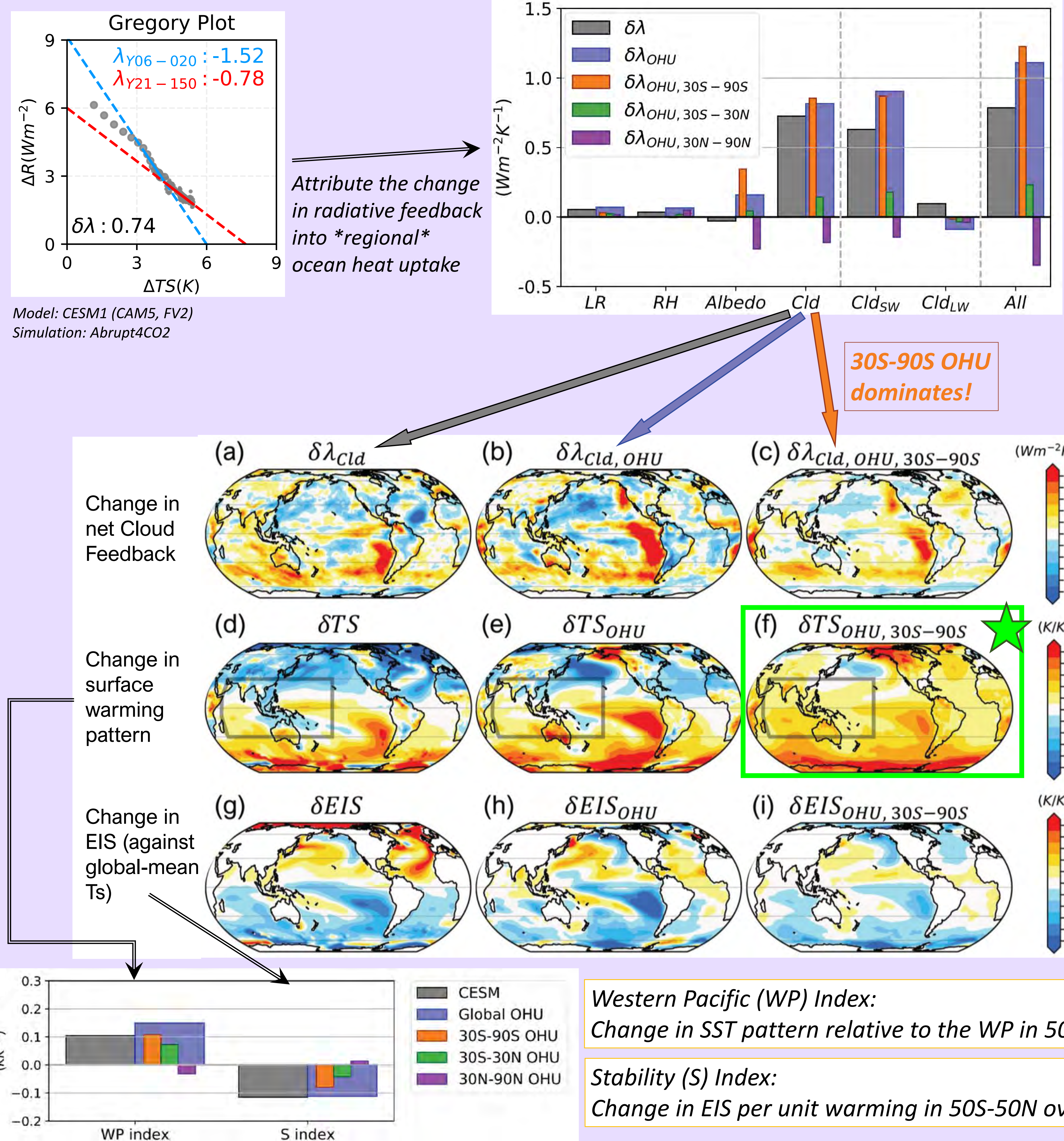
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1. What causes the time-evolving radiative feedback? The q-flux Green's Function approach

(a) The dominant contribution of Southern Ocean heat uptake in CESM1



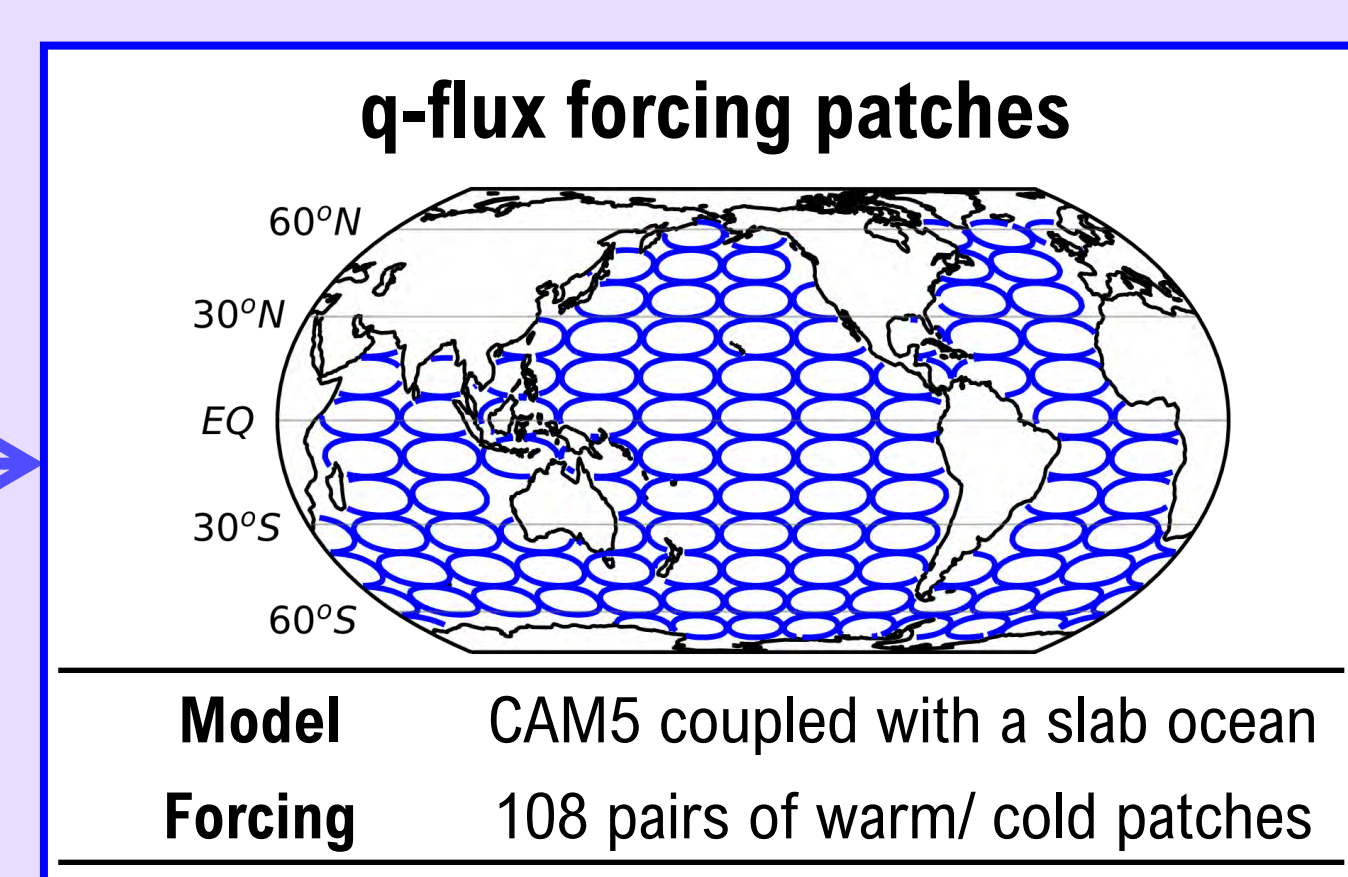
(b) Method

$$\Delta X_i(t) = \Delta X_{i,CO2} + \Delta X_{i,OHU}(t) + \varepsilon(t)$$

X : TOA radiative fluxes, air or surface temperature, etc.
 $\varepsilon(t)$: residual term

$$\Delta X_{i,OHU}(t) = \sum_{j=1}^n \frac{\partial X_i}{\partial OHU_j} OHU_j(t)$$

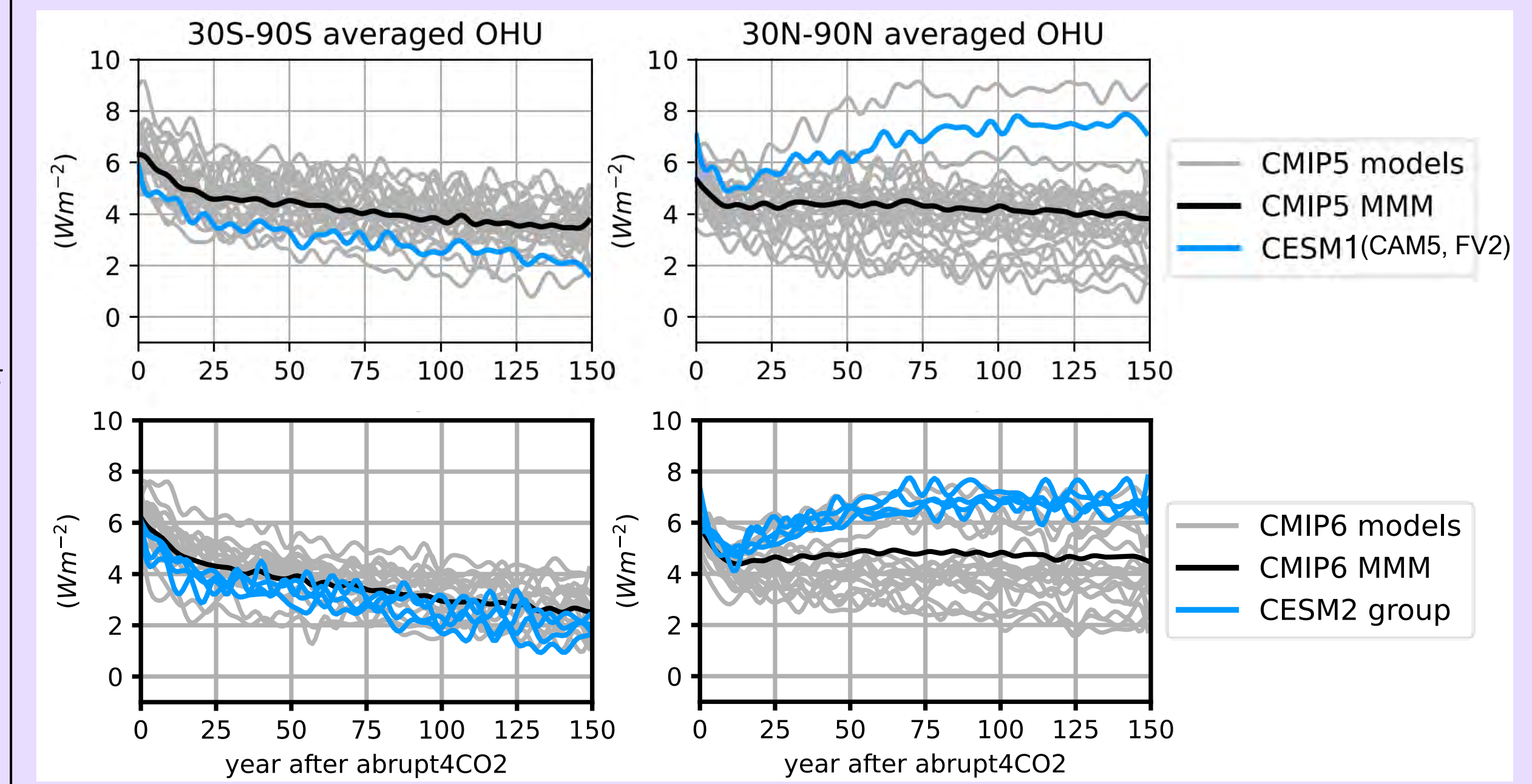
Diagnosed from the coupled model



(c) Summary

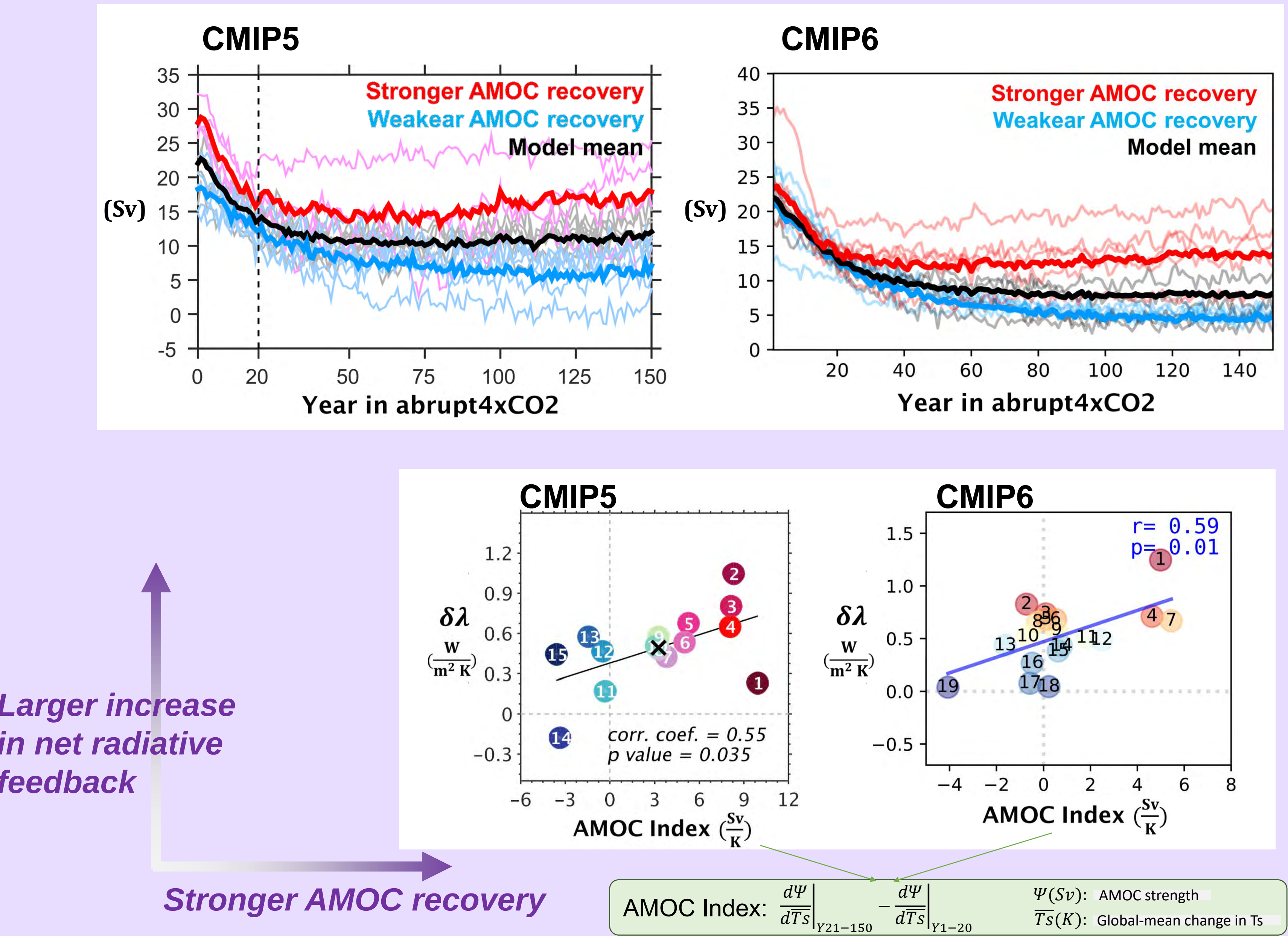
- The increase in cloud feedback in CESM can be mostly attributed to the ocean heat uptake evolution in the Southern Ocean.
- The increasing weakening of ocean heat uptake in the Southern Ocean leads to increasingly enhanced warming locally and remotely.
- The remote impact from Southern Ocean heat uptake on the tropical surface temperature pattern leads to an increase in cloud feedback by decreasing tropospheric stability.

(d) What about other CMIP5/6 models?

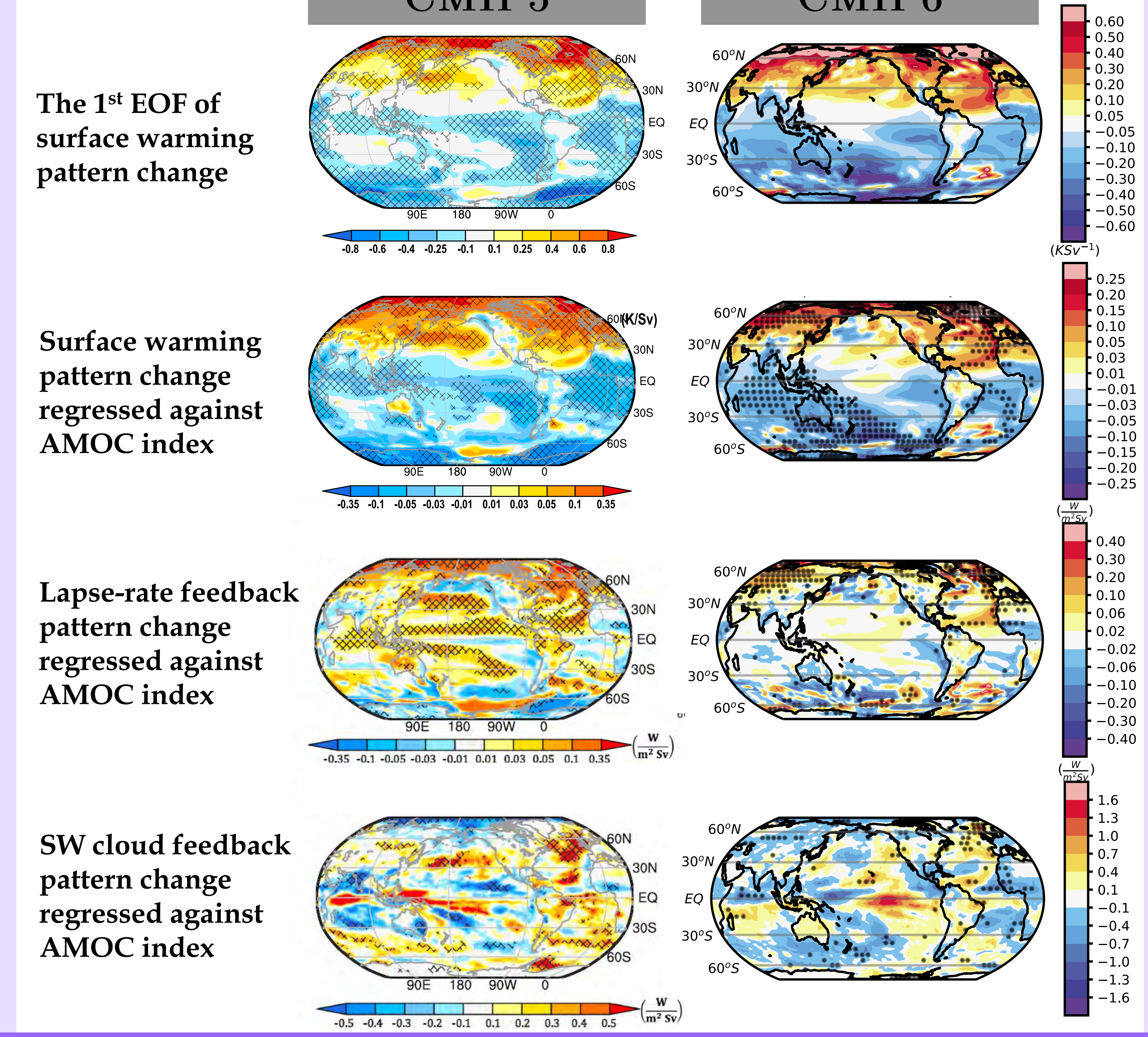


2. What causes the CMIP5/6 inter-model spread of time-evolving radiative feedback?

(a) Models with stronger AMOC recovery tend to project larger increase in λ (relatively more amplifying climate)



(b) Explanation



(c) Summary

- Models with stronger recovery in Atlantic Meridional Overturning Circulation tend to project a larger increase in net climate feedback.
- Warming in Northern Hemisphere extratropics tends to be surface trapped, leading to more positive lapse-rate and cloud feedbacks.

Reference

Lin, Y.-J., Hwang, Y.-T., Cepi, P., & Gregory, J. M. (2019). Uncertainty in the Evolution of Climate Feedback Traced to the Strength of the Atlantic Meridional Overturning Circulation. *Geophysical Research Letters*, 46, 12331–12339.

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