Volcanic aerosol strongly cools the warm pool, and therefore **produces strong feedback** (following tropical eruptions)

Climate feedback to stratospheric aerosol forcing explained by pattern effect

MOTIVATION

Stratospheric sulfate aerosol forcing from volcanic eruptions seems to produce little temperature change per unit forcing, i.e. strong feedback.

Hansen et al. 2005; Boer et al. 2006; Gregory and Andrews 2016; Gregory et al. 2016, 2020; Marvel et al. 2016; Modak et al. 2016; Ceppi and Gregory 2019; Zhao et al. 2021

Why?

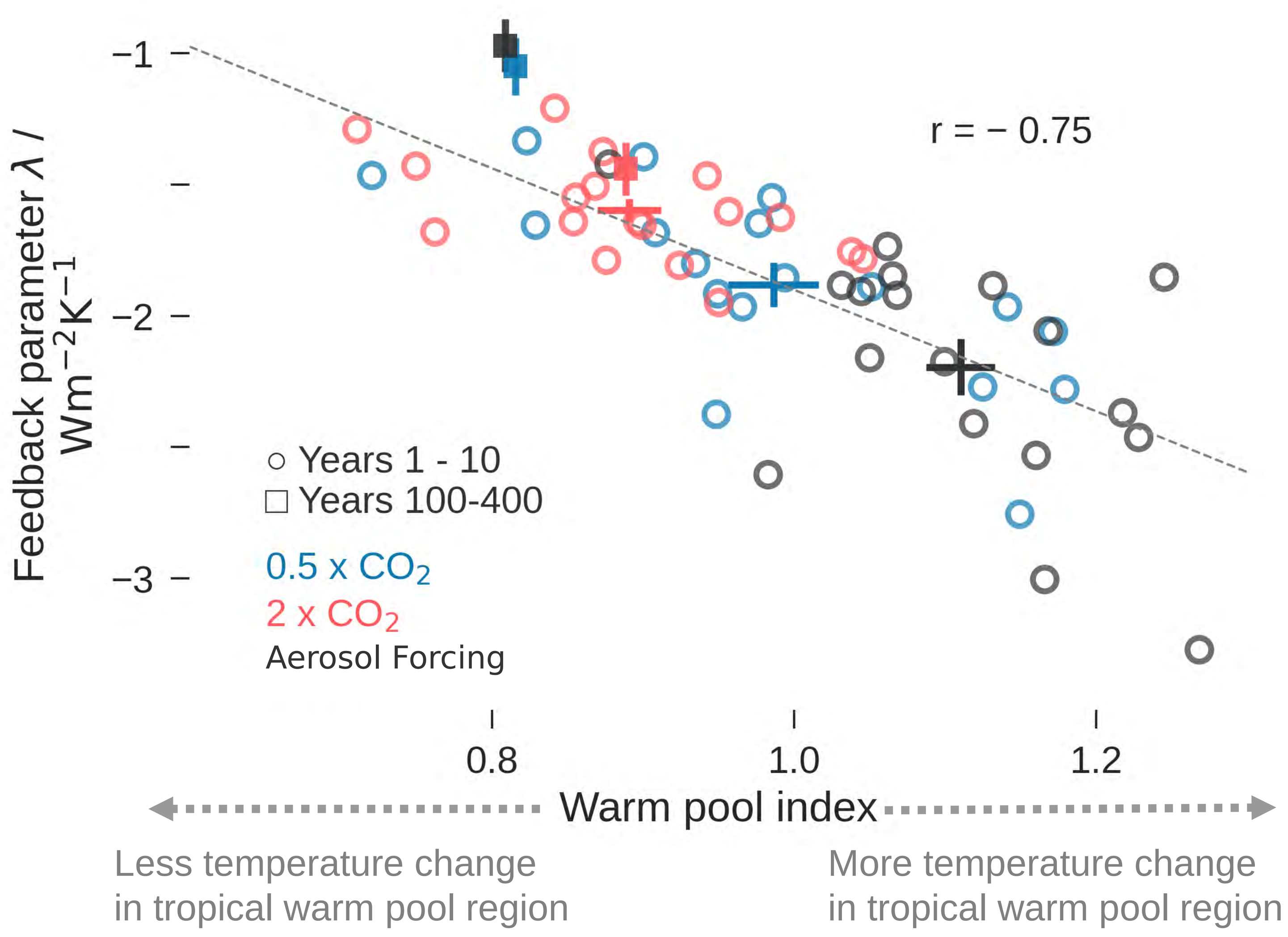
METHODS

3 types of step-like forcing simulation in MPI-ESM (fully coupled):

- 2 x CO_2
- 0.5 x CO_2
- Idealized Stratospheric Aerosol Forcing (time-invariant, equatorial injection)

RESULTS

Strong feedback from stratosoheric aerosol forcing in the first decade originates from the temperature pattern. CO_2 cooling also produces stronger feedback than CO_2 warming in the first decade.

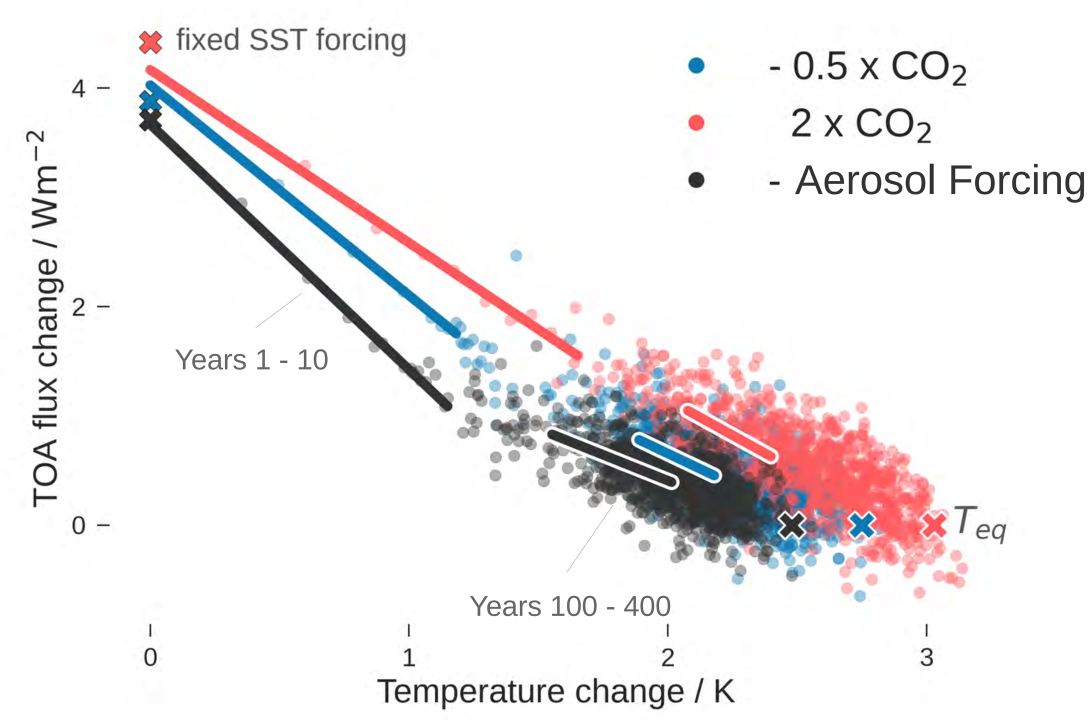


Warm Pool Index = regression slope of temperature change in Indo-Pacific warm pool region (30°S - 30°N, 50°E – 160°W) Dong et al. 2019; 2020 vs. global mean temperature change

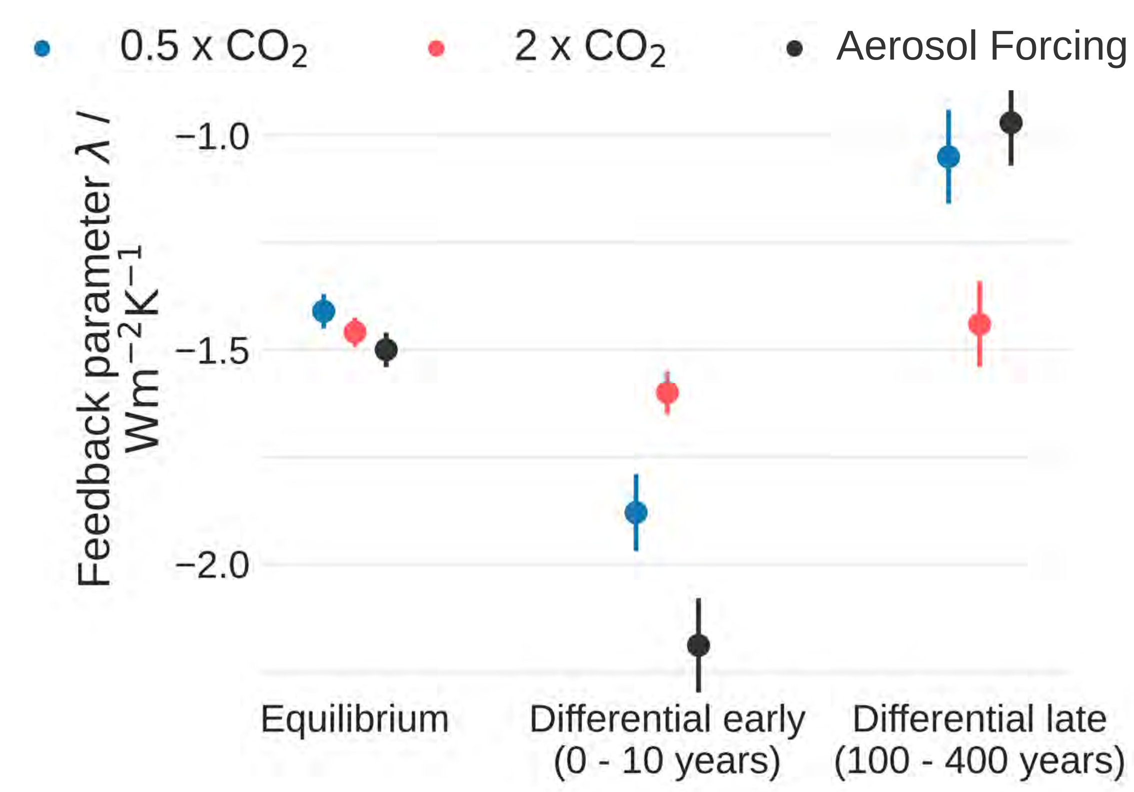
DISCUSSION

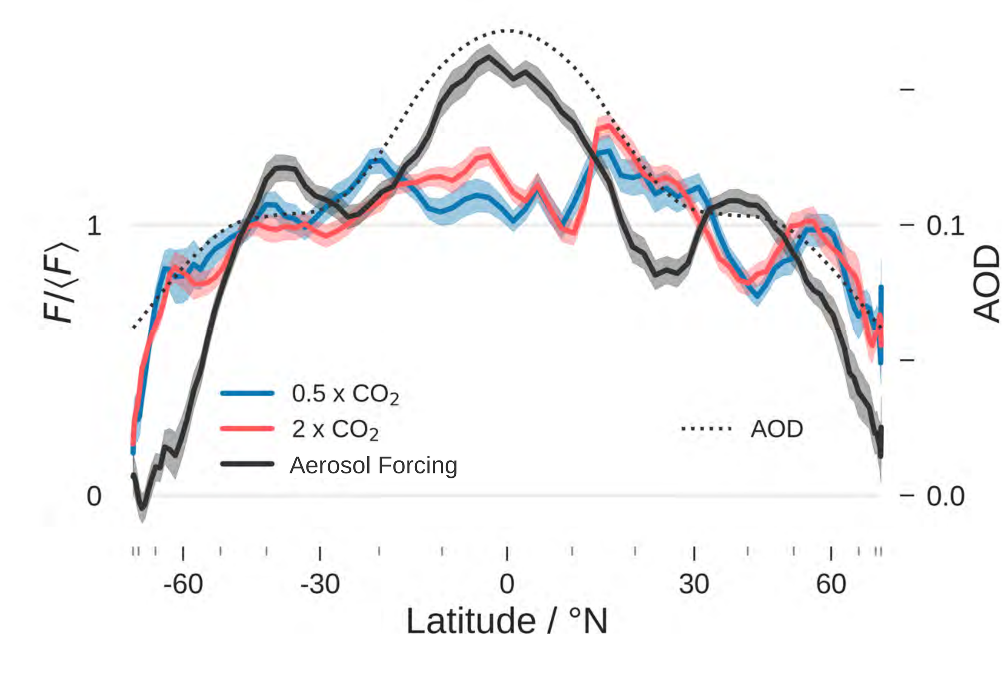
Temperature change in the tropical warm pool region, relative to the global mean, determines feedback to stratospheric aerosol forcing.
Reason: Strong negative feedbacks in the tropical warm pool Dong et al. 2019; 2020 (mainly LR)
Open questions remain about the origin of the temperature change pattern differences. They can only partly be explained by the radiative forcing pattern.

MORE RESULTS



Cooling simulations: strong early, weak late feedback (compare blue/black to red slope changes); can partly also be related to changes in Warm Pool Index (see main Figure to the left)





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