Climate Sensitivity to Volcanic Aerosol Forcing

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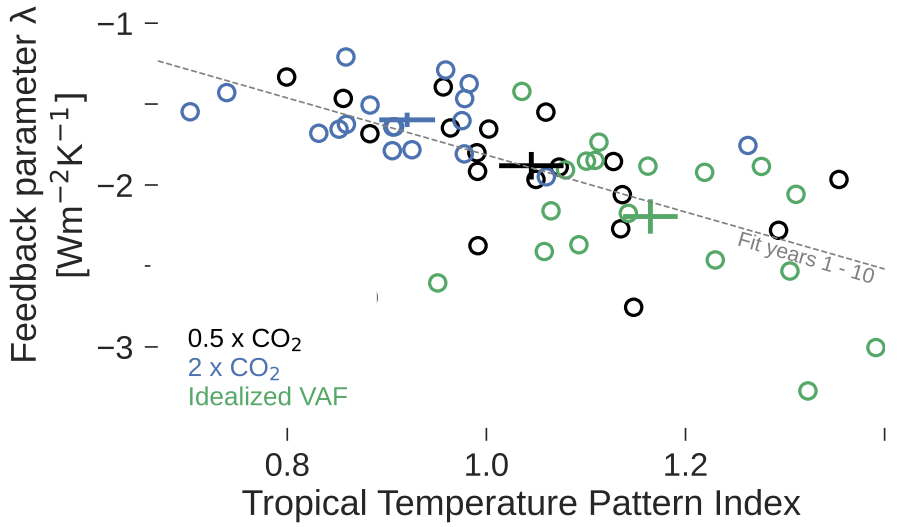
- Volcanic aerosol forcing produces stronger feedback than 2xCO2 forcing
  - Hansen et al. 2005
  - Gregory et al. 2016
  - Gregory et al. 2020
  - Marvel et al. 2016
  - Ceppi et al. 2019
  - Boer et al. 2006
  - Modak et al. 2016
  - Merlis et al. 2014

- Meridional temperature pattern determines feedback



More extratropical → Weak feedback

More tropical → Strong feedback

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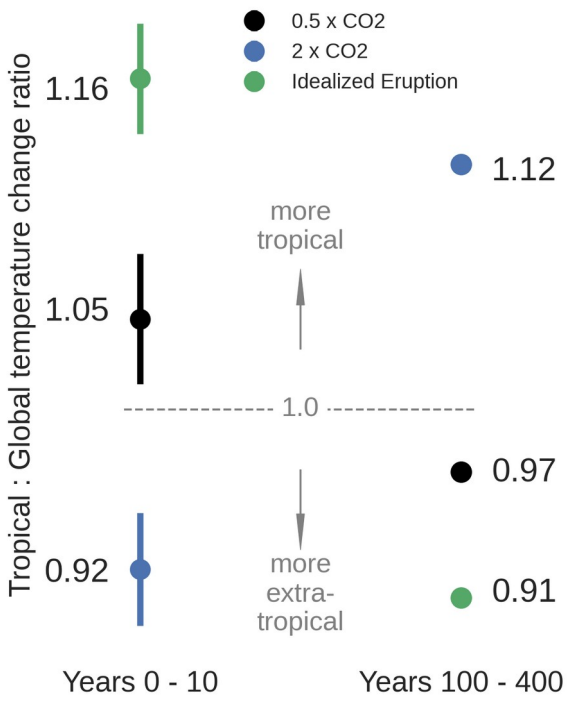
The temperature pattern



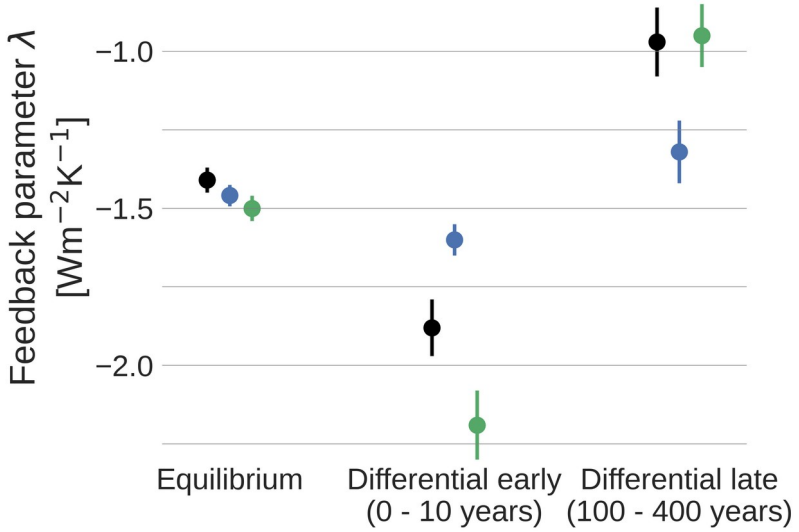
Main reason:
tropical vs. extratropical lapse rate feedback

$$\lambda = \left\langle \lambda(\vec{x}) \frac{\Delta T(\vec{x})}{\langle \Delta T(\vec{x}) \rangle} \right\rangle$$

Temperature pattern

Local feedback

The feedback



Implications

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1. Meridional temperature pattern causes the low efficacy of Volcanic Aerosol Forcing

2. No efficacy differences in equilibrium

3. Constraining ECS from volcanic eruptions is not straightforward

4. The important distinction is cooling vs. warming, not aerosol vs. CO2 forcing

possibly only in MPI-ESM