Quantifying the influence of natural forcing on oxygen isotope variability in alpine and polar ice core sites

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- We explore the impact of volcanic and solar forcing on simulated $\delta^{18}O$ in an isotope-enabled climate model, HadCM3.
- We compare the impact of eruptions at the Last Glacial Maximum 21kyrs ago and in preindustrial (1850CE).

Testing sensitivity to natural forcing in different climate states

The model:

HadCM3 v.4.5.1 (UK Met Office/ARCHER)

- Resolution: $3.75° \times 2.5°$ (Atm.), $1.25° \times 1.25°$ (Ocean) Gordon et al., 2000
- Isotope-enabled Tindall et al., 2009

The simulations:

- 6 LGM/ 6 PI, 1050a+ each
- 3 equilibrium/ 3 transient (*) *+ more*
- GHG/ice sheets modified Singarayer et al., 2010
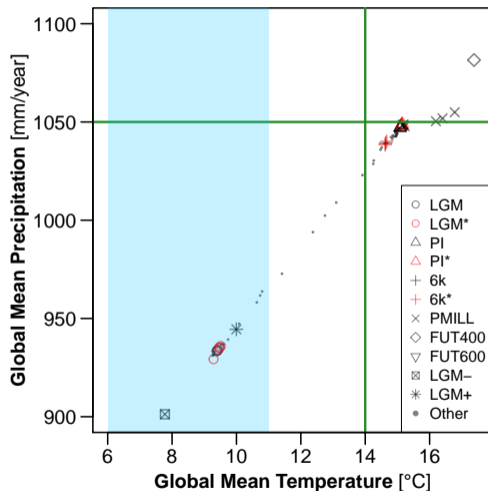- Natural forcing: past millennium

  Crowley et al., 2013 (**A**erosol **O**ptical **D**epth)

  Steinhilber et al., 2009 (**T**otal **S**olar **I**rradiance)


Reference values: WCRP (PI), Shakun & Carlson, 2010 (LGM)

Natural forcing does impact variability of δ^{18}O in precipitation

A Composite δ^{18}O for large eruptions $\Rightarrow$ decline after eruption due to cooling/drying

B Power spectra show higher variability for the 'forced' simulations LGM*, PI*

C/D LGM*/PI* composite anomaly w.r.t. local variability for eruptions with AOD>0.15 *(Dots: significant anomaly at 99% conf., hatched: >50% ann. sea-ice cover)*

E Zonal mean of C/D shows state-dependent response.

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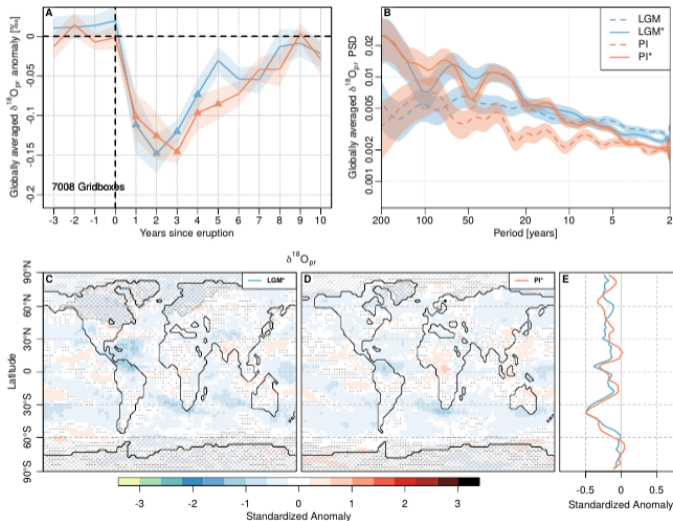
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