Geophysical Research Abstracts
Vol. 20, EGU2018-2695, 2018
EGU General Assembly 2018

The year without a summer in 1816: comparing the effects of uncertainties in forcing and initial conditions

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Strong volcanic eruptions are a major natural forcing factor of climate variability. Recent research has revealed that the climate state at the time of an eruption can critically influence how the climate will respond to that eruption. This raises the question of whether, from a paleoclimate perspective, it is more important to constrain forcing estimates or initial conditions to accurately simulate the climate response to a given volcanic eruption.

In this contribution, we compare global, hemispheric and regional-scale climate anomalies in the winter and summer of 1816 in three ensembles of climate simulations that account for different choices of the eruptions' strength. Specifically, the three ensembles span the current estimated range of magnitude of the 1809 and Tambora eruptions and are initialized from different climate states sampled from a preindustrial control simulation. In particular, we use results from a cluster analysis on the difference between simulated and reconstructed European summer temperature anomalies as a basis to discuss the relative role of forcing and initial-condition uncertainties on the "year without a summer".