Reconstructing the East Asian Monsoon Response to the 1815 Tambora Eruption; a Test of Model Simulations with Paleoclimate Data

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Abstract
Episodic volcanic eruptions inject into the stratosphere huge quantities of sulfuric gases, which gradually convert to sulfate aerosols and cause heterogeneous perturbations of the earth's radiative balance and significant global- and regional-scale climatic effects for up to 3 years following individual events. Regional-scale climate modeling skill is tested by evaluating the response of the East Asian monsoon system to major volcanic eruptions. In particular, the 1815 AD Tambora eruption is used as a case study by comparing historical paleoclimate records from China with ensemble simulation results from both global and regional climate modeling experiments.

Diagnostic analyses focus on direct radiative effects as well as the dynamical response of the climate system to volcanic forcing. Key findings from coupled global climate model simulations include a 10% reduction in the strength of tropical Hadley Cell circulation and significantly decreased precipitation over East Asia under Tambora-like volcanic forcing conditions. Objective indices for pre-instrumental, early 19th century Hadley Cell strength are obviously unavailable but historical climate reconstructions from eastern China suggest that precipitation conditions following major eruptions over the past millennium typically lead to a relatively wet north and a dry south. Not surprisingly, both historical records and modeling experiments suggest that regional temperatures were cooler during periods with high volcanic forcing. The regional cooling contributed by direct radiative forcing vs. that caused by dynamical atmospheric circulation effects is under investigation through regional climate modeling experiments.

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