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Role of atmospheric chemistry in the climate impacts of stratospheric volcanic injections

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The climate impact of a volcanic eruption is known to be dependent on the size, location and timing of the eruption. However, the chemistry and composition of the volcanic plume also control its impact on climate. It is not just sulfur dioxide gas, but also the coincident emissions of water, halogens and ash that influence the radiative and climate forcing of an eruption. Improvements in the capability of models to capture aerosol microphysics, and the inclusion of chemistry and aerosol microphysics modules in Earth system models, allow us to evaluate the interaction of composition and chemistry within volcanic plumes in a new way. These modeling efforts also illustrate the role of water vapor in controlling the chemical evolution - and hence climate impacts - of the plume. A growing realization of the importance of the chemical composition of volcanic plumes is leading to a more sophisticated and realistic representation of volcanic forcing in climate simulations, which in turn aids in reconciling simulations and proxy reconstructions of the climate impacts of past volcanic eruptions. More sophisticated simulations are expected to help, eventually, with predictions of the impact on the Earth system of any future large volcanic eruptions. Such simulations will be presented, and the role of water in accelerating sulfate aerosol formation in the stratosphere will be demonstrated.