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Volcanic aerosol control on reactive nitrogen species in the post-Pinatubo era

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Decreases in stratospheric NO_x associated with enhanced aerosol have been observed after large volcanic eruptions, e.g., after the eruption of Pinatubo in 1991. While the 1991 Pinatubo eruption was the last large explosive eruption, recent studies have shed light on the importance of moderate-sized eruptions since 2000 on the global stratospheric aerosol budget.

We use an ensemble of simulations from a coupled climate-chemistry model to quantify and analyze changes in NO, NO_2, N2O5, and HNO_3, and their impacts on O_3 changes in the stratosphere during periods of increased volcanic aerosol since 2000. By using an ensemble approach, we are able to distinguish forced responses from internal variability.

We also compare the model ensemble results to satellite measurements of these changes in atmospheric composition, including measurements from the Optical Spectrograph and Infrared Imaging Spectrometer on the Odin satellite and the Aura Microwave Limb Sounder. We find significant decreases in stratospheric NO_x concentrations and increases in stratospheric HNO_3 concentrations associated with periods of increased volcanic aerosol. We also demonstrate the efficacy of a new method of fitting out circulation-induced anomalies of these and other stratospheric trace gases by regression with N2O.