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# Simulation of stratospheric aerosol changes after the Pinatubo eruption

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An explosive volcanic eruption can inject a large amount of $SO_2$ into the stratosphere, which is oxidized to form sulfate aerosol. Such aerosol has an impact on the Earth's radiative budget by enhancing back-scattering of the solar radiation, and causes stratospheric ozone depletion through heterogeneous chemical reactions. This study investigates spatiotemporal changes in the volcanic aerosol after the 1991 Pinatubo eruption. We particularly focus on impacts of (1) heating due to volcanic ash, (2) injection height, and (3) temporal evolution of the aerosol radius, on transport and distribution of the volcanic aerosol. We conducted a control simulation and three sensitivity simulations using the MIROC-ESM-CHEM chemistry — climate model. In the control simulation, 20 Mt of the $SO_2$ and 30 Mt of the ash were injected into the altitudes between 16 km and 18 km over the Mt. Pinatubo on June 15th 1991. The radius of stratospheric sulfate aerosol is prescribed by the data estimated from SAGE II in the control simulation. The first sensitivity simulation injected only the $SO_2$ into the altitudes between 16 km and 18 km. The second sensitivity simulation injected the $SO_2$ into the altitudes between 17 km and 26 km. In the third sensitivity simulation, the radius of the sulfate aerosol was fixed to 0.08 $\mu$m. The control simulation reproduced a general feature of the observed aerosol optical depth (AOD) derived from SAGE II and AVHRR, although the simulated residence time of the aerosol is longer than the observed one. The sensitivity simulations show the following: (1) heating due to the ash causes an anomalous upward and equatorward transport of the volcanic aerosol during 4 — 5 days after the eruption, (2) the $SO_2$ injection into the altitudes of 17 — 26 km does not represent the anomalous transport due to the heating which is caused by long-wave absorption of the ash , (3) the temporal evolution of the aerosol radius slightly facilitates the removal of the aerosol from the stratosphere.

Keywords: stratospheric aerosol, volcanic eruption, chemistry-climate model