Simulation of the aerosols produced by Mt. Pinatubo eruption and its impact to stratosphere

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We simulated the aerosols produced by the volcanic eruptions of Mount Pinatubo (15N, 120E) in June 1991, and investigated its impact to the dynamics and chemistry of stratosphere using a global climate model which is interactively coupled with aerosol and chemistry models. Stratospheric aerosol has various effects on stratospheric and tropospheric climate through radiative impacts and changing chemical composition by providing surfaces for heterogeneous reactions. Simulation of the volcanic eruptions of Mt. Pinatubo in 1991 is a suitable event because it had significant impacts on stratospheric and tropospheric climate and dynamics, and is the best observed volcanic eruption to date. The MRI ESM is a global climate model, which consists of an atmosphere-ocean coupled general circulation model (MRI-CGCM3), an aerosol model (MASINGAR), and the atmospheric chemistry model (MRI-CCM). The model components are interactively coupled using a coupler library called Simple Coupler (SCUP). In the aerosol model, the volcanic aerosols are assumed to be in the form of sulfuric acid produced from oxidation of the released sulfur dioxide. The reactions of sulfur dioxide is calculated with hydroxyl radical, ozone, O(^3P), O(^1D) and hydrogen peroxide, which are calculated by the MRI-CCM. The calculated surface area density of sulfate aerosol by MASINGAR is coupled to the heterogeneous reactions in MRI-CCM. The calculated aerosols and ozone are interactively coupled with the radiative transfer process in the atmospheric circulation model (MRI-CGCM3). The simulated distribution of the aerosol from Mt. Pinatubo is sensitive to the radiative effect of aerosols. The volcanic aerosols injected in the stratosphere are heated by absorption of short and long wave radiation, and transported upward. The lifted aerosols are transported by the meridional flow from north to south in the middle and upper stratosphere. In order to reproduce the observed globally distributed volcanic aerosol cloud, inclusion of the radiative effect of aerosol is necessary. Another important factor for reproducing the observed behavior of the volcanic aerosol cloud is the gravitational settling, which controls its lifetime in stratosphere. The stratospheric volcanic aerosols also affect the chemistry of ozone. After injection of volcanic sulfur, column total ozone decreases. It is suggested that correctly predicting the size distribution of aerosols will be essential to achieve better agreement with the observations.