Effect of a volcanic eruption plume height on aerosol formation and distribution based on aerosol microphysics calculations

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Model implementations of aerosol microphysical processes are essential to our prediction of the formation and distribution of sulfate aerosols and climactic forcing. Current models parameterize processes, such as aerosol optical depth (AOD) and aerosol effective radius (r_{eff}), based on data collected during and after the mount Pinatubo eruption in 1991. This study dispensed with the experiential based model from data from the Mt. Pinatubo eruption and calculated chemical reactions and coagulation rates for prognostic evaluations of AOD and r_{eff} for more accurate model calculations of the aerosol radiative forcing for eruptions of various magnitudes. Using this new physical method this study evaluated volcanic eruptions forcings with predetermined SO_2 mass (18Tg), latitude (15°N) and season (summer) for varying injection plume heights using the GISS-E2 model. The model showed that sulfate aerosols had a longer residence time and higher AOD values in plumes that penetrated the stratosphere than plumes that stayed mostly in the troposphere. The initial formation of aerosols formed at the same level of SO_2 emissions but over time converge at around 30mb. Furthermore, stratospheric aerosol lifetimes rarely exceed 5 years. Stratospheric aerosols that are initially concentrated in the tropics later amass at both the southern and northern poles following stratospheric circulation. These results have large implications on climate forcing and can lead to a better quantification of the impact volcanic aerosols have on climate.