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Volcanic stratospheric aerosol 1991 to 2017: radiative and chemical effects based on the CCM EMAC and limb satellite data

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The chemistry climate model EMAC with interactive modal aerosol scheme nudged to observed tropospheric meteorology (ERA-Interim) is used to simulate stratospheric optical depth (at wavelengths of the instruments), global radiative forcing, ozone changes and other effects by stratospheric aerosol in transient mode from 1991 to 2017. Volcanic SO_2 injections of about 500 explosive events documented in the Smithsonian database were estimated from the limb scanning satellite instruments SAGE-II, MIPAS, GOMOS and OSIRIS and added to the simulated SO_2 as 3D-plumes at the times of the eruptions. We demonstrate that it is of big advantage to use multi-instrument data to detect all relevant eruptions which was unfortunately possible only for the ENVISAT-period 2002 to 2012. For the other periods with mostly only one limb instrument the uncertainty is larger because of much more data gaps. The long timeseries of OSIRIS data identifies periods with low volcanic activity like 2001 to 2004 and 2013. We also try to separate seasonal effects from non-volcanic stratospheric aerosol like mineral dust and organics transported to the lower stratosphere by the Asian summer monsoon and convection as seen in the satellite data, using the model.