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Stratospheric ozone response to natural and anthropogenic forcings during 1975-2000 simulated with a global climate-chemistry model

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The results of the CCM SOCOL transient runs for 1975-2000 are used to study the influence of different natural and anthropogenic forcing mechanisms (greenhouse gases (GHG), ozone destroying substances (ODS), volcanic aerosols and solar variability) to the climate. SOCOL is a stratosphere-mesosphere version of ECHAM 4 (MPI, Hamburg), which is coupled to the stratospheric chemistry model MEZON (PMOD/WRC, Davos). For simulation I, constant GHG and ODS concentrations of 1975 and a mean solar constant are prescribed, for simulation II, GHG are increased, for III, ODS are varied, for IV, both GHG and ODS are varied, for V, volcanoes are additionally included, and for simulation VI, solar variability is taken into account. Simulations III-VI show a significant negative trend of total ozone because of increasing ODS. The formation of the ozone hole at high latitudes is successfully reproduced by the model for these simulations. For the runs with volcanic aerosols, the tropics clearly show an enhanced ozone depletion in the years after El Chichon (1982) and Mt. Pinatubo (1991) eruptions. The simulated tropical and middle latitude total ozone time series is in very good qualitative and quantitative agreement with TOMS satellite observations for simulations V and VI.