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20th century ensemble simulations with a chemistry climate model

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Through dynamical and radiative mechanisms and its coupling to the troposphere, the stratosphere plays an important role in affecting the Earth's climate, particularly in context with climate forcings such as solar variability, volcanic eruptions, or ozone depletion. Conversely, tropospheric climate variability can affect stratospheric chemical and dynamical variability. It is therefore important to understand interannual-to-decadal variability of this two-way interaction between stratosphere and troposphere. For this purpose, model-based studies by means of a middle atmosphere chemistry-climate model (CCM) over several decades are needed. To date, no century-long transient simulations have ever been performed with a CCM.

Here we present first results of simulations with the CCM SOCOL, spanning the whole 20th century. SOCOL is a combination of middle atmosphere version of ECHAM4 (MPI, Hamburg) and the chemistry-transport model MEZON (PMOD/WRC, Davos). The simulations are carried out in ensemble-mode prescribing sea surface temperature, sea ice distribution, volcanic aerosols, variability of the spectral solar irradiance, greenhouse gases, ozone depleting substances, land surface changes, and the quasi-biennial oscillation.

We will describe the compilation of the boundary data and will present a first validation of the simulations against ground-based measurements and reconstructed upper-level fields. Analyses are presented with respect to the chemical-climate response to the eruptions of St. Maria 1902 and the high-latitude volcano Mt. Katmai 1912 as well as the response to strong El Niño and La Niña events.