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Interannual-to-decadal Variability of Stratospheric Chemistry and Climate during the 20th Century

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Stratospheric interannual-to-decadal variability is dominated to a large degree by external forcings, such as variability of the sun, volcanic eruptions, as well as by internal factors of El Niño Southern Oscillation (ENSO) variability and the quasi-biennial oscillation (QBO). The current data records as well as model simulations addressing stratospheric chemical climate variability mostly cover the past few decades only, which often is not sufficient to address interannual-to-decadal variability.

Here we present results of transient simulations with the chemistry-climate model (CCM) SOCOL, spanning the whole 20th century. SOCOL is a combination of the middle atmosphere version of ECHAM4 (MPI, Hamburg) and the chemistry-transport model MEZON (PMOD/WRC, Davos). The simulations are carried out in ensemble-mode (9 members) prescribing sea surface temperature, sea ice distribution, volcanic aerosols, solar variability, greenhouse gases, ozone depleting substances, land surface changes, and QBO.

Low frequency variability and long-term trends of the stratospheric wave driving in the Northern Hemisphere and its impact upon variables closely related to are analyzed in depth. Moreover, we will address the relation of stratospheric ozone and the strength of the polar vortex upon tropospheric variability modes on different time scales. The analysis is accompanied by an extensive model validation against various observational and (prior to 1957) reconstructed upper-air datasets.