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Stratosphere-troposphere coupling investigated by climate model simulations with a prescribed stratosphere

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Stratospheric impact on surface climate is investigated by climate model simulations with prescribed stratospheric conditions. We have used the ECHAM5-MESSy (EMAC) model with stratospheric temperatures and wind fields (vorticity and divergence) nudged towards ECMWF ERA-Interim reanalyses over the period 1979-2014. Sea surface temperatures in these simulations are prescribed from a climatology (repeating annual cycle) to suppress tropospheric variability. One model simulation uses an ozone climatology, while a second simulation applies stratospheric ozone changes consistent with the stratospheric meteorology from an offline chemistry simulation with EMAC. In northern hemisphere winter, the simulations show clear Arctic Oscillation (AO) like features in surface temperature and pressure in response to the strength of the stratospheric polar vortex. Similarly, in the southern hemisphere surface temperature and pressure in our simulations respond to stratospheric changes due to the imposed development of the Antarctic ozone hole. We analyse and discuss the model simulations with respect to the role of stratospheric changes for inter-annual variability and long-term trends of surface climate.