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Idealized solar cycles forcing experiments using coupled ocean-troposphere-stratosphere-GCM

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The goal of this study is to gain a better understanding of the role of solar variations on different timescales for climate. This examination focuses on the Schwabe and Gleisberg cycle. Idealized experiments are performed to get a clearer response to the forcing and to provide a basis for a systematic investigation of different mechanisms including ocean interactions. The solar effect on stratosphere-troposphere coupling and the variability of the polar vortex is investigated.

The EGMAM model is used to assess the role of solar variation in climate. EGMAM is a middle atmosphere version of ECHO-G with 39 vertical levels (top level 0.01 hPa) and a better representation of the middle atmosphere dynamics. Three idealized runs are performed. Two transient simulations with a 11 year sinusoidal variation of the total solar irradiation are used to detect the signal of the Schwabe-cycle. One simulation with a solar cycle period of 76 years mimicking the Gleisberg-cycle is performed to represent longer solar variations. In one 11-year-cycle-experiment fixed climatological ozone concentrations are used. In the other two experiments we prescribe ozone variations in dependence of the solar irradiation.

40 Schwabe-cycles (440 years) and 10 Gleisberg-cycles (760 years) are analysed with focus on the Northern Hemisphere during winter. Sudden stratospheric warmings are identified and counted using an objective algorithm. This algorithm is based on the zonal mean temperature and the zonal mean zonal wind and distinguishes between minor and major warmings. Whereas no clear solar signal is found for the occurrence of major warmings, the inclusion of the ozone leads to an improvement in the intra

seasonal distribution of the warmings when compared to observations. The role of the underlying troposphere for the variability of the polar stratospheric vortex is discussed by means of Eliassen-Palm-Flux diagnostics.