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Solar cycle variations of stratospheric ozone and temperature in simulations of a coupled chemistry-climate model

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Abstract. The results from three 45-year simulations of a coupled chemistry climate model are analysed for solar cycle influences on ozone and temperature. The simulations include UV forcing at the top of the atmosphere, which includes a generic 27-day solar rotation effect as well as the observed monthly values of the solar fluxes. The results are analysed for the 27-day and 11-year cycles in temperature and ozone. In accordance with previous results, the 27-day cycle results are in good qualitative agreement with observations, particularly for ozone. However, the results show significant variations, typically a factor of two or more in sensitivity to solar flux, depending on the solar cycle.

In the lower and middle stratosphere we show good agreement also between the modelled and observed 11-year cycle results for the ozone vertical profile averaged over low latitudes. In particular, the minimum in solar response near 20 hPa is well simulated. In comparison, experiments of the model with fixed solar phase (solar maximum/solar mean) and climatological sea surface temperatures lead to a poorer simulation of the solar response in the ozone vertical profile, indicating the need for variable phase simulations in solar sensitivity experiments. The role of sea surface temperatures and tropical upwelling in simulating the ozone minimum response are also discussed.

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