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Downward propagation of the solar cycle signal in the HAMMONIA chemistry climate model

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The variability of the solar UV radiative output influences chemistry and dynamics of the Earth's atmosphere over a wide altitude range. While the response is in general stronger in higher atmospheric layers signals may propagate downward via the transport of chemical constituents or dynamical coupling. A number of observational and numerical studies have provided evidence for the influence of 11-year solar cycle variability on the atmosphere. However, discrepancies between observed and simulated features of the atmospheric response still exist. It is attempted to improve numerical simulations by using complex models coupling atmospheric dynamics and chemistry and extending over a large altitude range. In this paper, we present simulations with the HAMMONIA chemistry climate model that is particularly suited for studying the stratospheric solar cycle response as it internally produces a realistic quasi-biennial oscillation (QBO) of equatorial winds that is believed to interact with the 11-year solar signal. In different studies mechanisms have been suggested for a downward propagation of the solar signal from the stratopause region to the lower stratosphere and even the troposphere. We will present model results confirming such mechanisms of downward signal propagation: a) via a reduction of equatorial stratospheric upwelling that is leading to a positive temperature anomaly in the lowermost stratosphere and a change of horizontal momentum flux in the upper troposphere, and b) via a modification of the stratospheric polar night jet that is propagating downward, and leading to a modification of the tropospheric high latitude wintertime circulation that can be identified in particular in the NAO structure. We will analyse the role of the QBO in the downward propagation of the signals and compare results for northern and southern

hemisphere winter.