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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying uncertainties of climate signals related to the 11–year solar cycle. Part I: Annual mean response in heating rates,temperature and ozone" *by* Markus Kunze et al.

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We thank Paul Pukite for his comment, that we try to answer below.

For a climate signal such as QBO, the observed 28-month cycle is directly related to the interaction between the semiannual solar nodal crossing with the 27.21 day lunar draconic (or nodical) cycle. Above the altitude of the QBO, the semi-annual SAO occurs, suggesting a transition from tidal forcing to a primarily solar semi-annual

radiative forcing cycle. This set of forcing factors is certainly more important than the rather weak 11-year cycle in sunspot activity, and the asymptotic agreement with a tidal forcing pattern only gets more apparent as more data is accumulated over the years. This agreement is shown in Fig. 1 shown below. The only question is what causes the fluctuation over the years and perhaps this is in some way related to disturbances such as SSW, ENSO, or 2nd-order solar variations such as sunspot levels. (p.s. thank you for maintaining the QBO data at fu-berlin.de)

Your question concerning the influence of the 11-year solar cycle on the period of the QBO cannot be answered with the simulations performed for our study. The simulations are performed with a setup where the QBO is included by the relaxation of the zonal mean zonal wind to an observed (EMAC) or idealized (WACCM) QBO. Due to this setup there are no differences in the QBO phases between the time slice simulations for solar maximum and solar minimum. To simulate the influence of the 11-year solar cycle on the length of the QBO period, a setup with a higher vertical resolution of EMAC and WACCM has to be used.

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