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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Stratospheric O_3 changes during 2001–2010: the small role of solar flux variations in a CTM" *by* S. S. Dhomse et al.

Anonymous Referee #2

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The paper 'Stratospheric O3 changes during 2001 – 2010' investigates the role of spectral solar cycle variations for the variability of stratospheric ozone in the stratosphere and lower mesosphere. A number of specified model simulations are carried out using different models of solar spectral variability for the period 2001 – 2010, and results of these model runs are compared to observations of ozone throughout this period. The main result appears to be that the observed variability of ozone especially at the tropical stratopause, which is commonly attributed to solar spectral variability in the UV range, can be explained by dynamical changes only. This is a very interesting result (and of course raises the question whether the source of the dynamical change is solar or not). The model experiments appear to be generally very well thought out, and the paper is very well written.

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However, there is one point which I find should be addressed: the description of the models used, both the solar models as well as SLIMCAT, is insufficient for the discussion of the results. My main objection here is that the wavelength coverage of the SATIRE and NRL-SSI models are not given, and the treatment of the far-UV (Lyman alpha and Schumann-Runge continuum) regions of the SLIMCAT model, which used to be parameterized to a fixed solar flux, are not discussed. For the discussion of the results, it would be very important to know how the wavelength region 116 – 200 nm, and especially Lyman alpha and the Schumann-Runge continuum, are treated; so please, add this information to the model descriptions.

More specific comments are summarized below.

Specific comments:

Page 12264, lines 15-16: ".. due to changes in stratospheric dynamics". This is a conclusion drawn from the model results, and should be marked as such: ".. which are shown to be due to changes in stratospheric dynamics by the model results."

Page 12267, line 5 – 6: Please give a reference for the vertical resolution of the SABER data.

Page 12267, lines 15-25: What is the wavelength range of the SATIRE-S model?

Page 12267, lines 26 ff: Wavelength range of the NRL-SSI model?

Page 12268, line 10: "32-vertical" → "32 vertical"

Page 12268, lines 15 – 17: as far as I know, the photolysis code of the SLIMCAT model has, or used to have, a special parametized treatment of Lyman alpha photolysis for some species (e.g., O2, H2O, CO2, CH4), as well as a parameterization of the O2 photolysis in the Schumann-Runge continuum. As this affects both the ozone production and the ozone loss rates via HOx production directly, it is important for the discussion of the model results to understand how / if the Lyman alpha and Schumann-Runge parameterizations are varied throughout the solar cycle in the different model runs.

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So, it should be explained in Section 3 how Lyman alpha and Schumann Runge O2 photolysis is treated in your model experiments.

Page 12268, line 16, Figure 1 / page 12269, line 5: In Figure 1, the wavelength range only extends down to 180 nm, while you state that the SLIMCAT range covers wavelength down to 116 nm. Why not show the full wavelength range of the SLIMCAT model in Figure 1, especially as the wavelength range from 116 – 200 nm contains the Schumann-Runge bands, SR continuum, and Lyman-alpha? Should the reason be (as I am led to assume) that the SATIRE-S and NRL-SSI models do not extend to 116 nm, this should be discussed here, as it might lead to an underestimation of the chemical impact of the solar variation in the model experiments.

Page 12268, description of SLIMCAT model: does the chemistry code of the SLIMCAT model still assume an equilibrium approach for families like Ox and HOx? This might affect the comparison of daytime / nighttime values in Figures 5 and 6 in the upper stratosphere and lower mesosphere, as there, Ox and HOx are not in equilibrium during night-time. However, this would probably only affect the upper 1-2 model levels.

Page 12269, line 23-25: does the vertical resolution of the SABER experiment (which, admittedly, is quite good) affect the results of the SABER-model intercomparison? i.e., would it be possible that the comparison of the profile shape improves if the model O3 was reduced to the vertical resolution of SABER?

Page 12274, line 25: due to internal atmospheric variability, or possibly anthropogenic influences?

Figure 2: Would it be possible to give an error range of the observations? This might be helpful to determine whether, or where, the observed differences between observations and model results are significant.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 12263, 2013.