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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulation of solar-cycle response in tropical total column ozone using SORCE irradiance" *by* K.-F. Li et al.

Anonymous Referee #2

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General Comments:

This paper contains a lot of interesting and timely information. It compares the atmospheric response in total column ozone in the WACCM model using the 11-year solar cycles in solar spectral irradiance (SSI) according to (a) the Naval Research Laboratory (NRL) reconstruction and (b) the SORCE mission. It has a good discussion of the recent literature and issues. I cannot recommend publication in its current form, however.

A major conclusion of this paper, as I read it, is that the total column ozone simulated with the WACCM model using the SORCE SSI agrees better with TOMS/SBUV than when the NRL SSI is used, so therefore SORCE must be correct. Insufficient evidence

for this conclusion is provided. Figure 2 summarizes the results: WACCM/SORCE agrees better with TOMS/SBUV; WACCM/NRL agrees better with ground-based observations. I suspect if the uncertainty in the solar cycle inferred from the ground-based measurements were included in Fig. 2 that we would see that the satellite and ground-based data are actually in statistical agreement. Further, quoting Randal and Wu, "Overall, given the uncertainties between results from the three column ozone data sets [ground-based, SBUV, and TOMS/SBUV], it is difficult to critically evaluate the solar cycle derived from the integrated SAGE results" (Randal and Wu, 2007). I think the logic applied to SAGE in their paper could be applied to the WACCM results in the present paper. Li et al. reject the ground-based measurements on the grounds that they are "probably [less] reliable because there are few ground stations in the tropics (Fioletov et al., 2002; Randel and Wu, 2007)" (see present paper p. 1870, lines 7–10). This is not an obvious conclusion of the two papers cited, so if the verdict concerning NRL vs. SORCE hinges on this tenuous decision to throw out the ground-based observations, then it needs to be argued convincingly. (And in any event, using a CCM is a very indirect way to resolve the NRL–SORCE discrepancy.)

Specific Comments:

[Abstract] *The solar-cycle response obtained using SORCE SSI implies a maximum change in lower stratospheric temperature of* $\sim$*0.8 K.*
This is not shown in this paper and not even mentioned until the last paragraph of the entire paper, in the Summary and discussions. Please remove from Abstract and final section unless the details are added to the body of the paper.

[Sect. 1–Introduction] *. . . enhanced during a solar-cycle maximum through the absorption of anomalously high UV radiation . . .*
This is solar maximum, not anomalous.

[Sect. 2–Model setup] SORCE SSI description: As noted by Reviewer #1, both the SSI and extrapolation to solar maximum conditions must be described/shown. The Wang et al. PNAS reference is apparently still not available, as of today. Also, what is the source of the SORCE/SIM data? Only wavelengths $>$310 nm are publicly available on-line.

[Sect. 2–Model setup] The authors say that WACCM uses $F_{10.7}$ as a proxy of the solar cycle, along with sunspot number, etc. What does this mean in the context of specified SSI (extrapolated using the Mg II index in the case of SORCE)? What is the model actually using for SSI as a function of time?

[Sect. 2–Model setup] *. . . the realistic SST/ice also includes a tiny solar-cycle variability of* $\sim$*0.1 K peak-to-trough (Zhou and Tung, 2010).*
Ironically, the solar cycle variability embedded in the SSTs is in phase with TSI, whereas the SORCE mission claims that visible wavelengths are out of phase. This is probably not a significant inconsistency, however, as this study finds that the effect from the SST solar cycle is not statistically significant.

[Sect. 4.1–Topical averages . . .] *This is because of an enhanced production of stratospheric* O_3 *at wavelengths below 240 nm as revealed in the SORCE SSI.*
This quite possibly is the case, but it is not shown in this paper. In fact, the SSI is not even revealed (see comment, above).

[Sect. 4.2–Latitudinal patterns . . .] *This should also highlight the use of the latest SORCE SSI data since the larger UV variability would lead to a stronger signal . . .*
Would like to, but the SORCE/SIM data are not publicly available below 310 nm.

[Sect. 4.3–Tropical spatial patterns . . .] *For comparison, we apply the same regression analysis to the monthly-averaged TOMS/SBUV data (Randel and Wu, 2007; Stolarski et al., 2006).*
Note that Stolarski et al. did, in fact, include volcanic eruptions in their regression analysis. Why is it all right to exclude them in this case?

[Sect. 5–Summary and discussions] *. . . using spectral solar variability in UV derived from a conventional model developed in NRL and that from the SORCE measurements.*
One could infer from this statement that the NRL SSI is pure model and the SORCE SSI is pure measurement. This is most definitely not the case. The NRL SSI is a reconstruction that includes many years of pre-SORCE satellite observations. And the SORCE solar cycle in SSI has to be inferred assuming instrument degradation and other factors.

[Sect. 5–Summary and discussions] *The reason is an enhanced production of stratospheric* O_3 *at wavelengths below 240 nm as revealed in the SORCE SSI.*
Please see comment on enhanced O_3 production, above.

[Sect. 5–Summary and discussions] Final paragraph, starting *The above results may lead to . . . .*
This discussion, largely on solar cycle heating, should either be shown/explained in greater detail in the body of the paper or removed.

Technical Corrections:

[p. 1872, line 13] *In other to isolate the effects due . . .*
"other" should be "order."

[p. 1876, line 13] *Fig. 6 of Randal and Wu (2007).*
Should be Fig. 12. Same for caption of the present paper's Fig. 2.

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