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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Impact of prescribed SSTs on climatologies and long-term trends in CCM simulations" *by* H. Garny et al.

Anonymous Referee #2

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Garny et al. investigate how prescribing different sea surface temperatures (SSTs) in Chemistry-Climate models (CCMs) leads to different temperature and ozone climatologies throughout the atmosphere.

Figure 3a demonstrates that colder SSTs lead to colder climatological temperatures throughout the troposphere, and warmer climatological temperatures throughout the stratosphere. It is interesting to see this result on the climatological time scale. However, the idea that colder SSTs lead to colder tropospheric temperatures is well known, for example:

E. Yulaeva and J. M. Wallace, 1994: The Signature of ENSO in Global Temperature and Precipitation Fields Derived from the Microwave Sounding Unit. Journal of Climate,

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Discussion Paper

7(11), 1719-1736.

and the authors might like to include this or other relevant references. In fact there are also a few papers that show colder SSTs lead to warmer temperatures in the stratosphere, for example:

Figure 3 of A. J. Clarke and K-Y. Kim, 2005: On Weak Zonally Symmetric ENSO Atmospheric Heating and the Strong Zonally Symmetric ENSO Air Temperature Response. J. Atmos. Sci., 62(6), 2012–2022.

Figure 4 of R. García-Herrera, N. Calvo, R. R. Garcia, and M. A. Giorgetta 2006: Propagation of ENSO temperature signals into the middle atmosphere: A comparison of two general circulation models and ERA-40 reanalysis data. J. Geophys. Res., 111, D06101, doi:10.1029/2005JD006061

Figure 2 of S. C. Hardiman, N. Butchart, P. H. Haynes, and S. H. E. Hare, 2007: A note on forced versus internal variability of the stratosphere. Geophys. Res. Lett., 34, L12803, doi:10.1029/2007GL029726

and this fact should also be made clearer.

The paper goes on to consider the impact of SSTs on the ozone climatology, making the point that the Brewer Dobson Circulation is key to the redistribution of ozone throughout the stratosphere, and touching briefly on other mechanisms affecting stratospheric ozone. However, no mention is made of the positive ozone anomaly found in the Southern Hemisphere polar stratosphere (Figure 3b). I think it likely that this is due to the positive temperature anomaly there (Figure 3a) leading to fewer polar stratospheric clouds and thus less heterogeneous ozone destruction, especially since the positive anomaly is largest in September/October (Figure 4a). A comment to this effect would be illuminating, if the authors can compute a time series of polar stratospheric cloud area (from daily September temperatures, for example) to confirm this is the case. Figure 6 is also consistent with this idea, showing a greater negative tempera-

ACPD

9, S1194–S1197, 2009

Interactive Comment

ture trend in the Southern Hemisphere polar stratosphere in REF1 than SCN2 and a corresponding greater trend in ozone loss there in REF1 than SCN2. Again, confirmation that the model is near the threshold temperature for PSC formation around this region would be very interesting.

Section 4.3 goes into a fair amount of detail about the structure of the EP flux anomalies shown in Figure 5. Whilst it has been shown in various publications that colder SSTs lead to less planetary wave propagation into the stratosphere, it would be nice if the authors could say something about the robustness of the more detailed features of the EP flux anomaly to changing SSTs that they discuss (perhaps by means of an ensemble of integrations, or a proposed mechanism for these more detailed features).

In section 6 the authors state that "the question of how SSTs can affect the excitation of planetary waves is poorly understood". Perhaps, however, there also ought to be reference to the paper:

S. Ineson and A. A. Scaife, 2009: The role of the stratosphere in the European climate response to El Niño. Nature Geoscience 2, 32-36, doi:10.1038/ngeo381.

which states that:

"In the Pacific, the middle-latitude surface response to El Niño is a persistent signal through winter consisting of a deeper Aleutian low shifted towards the west coast of North America. This signal is well known from observations and models and has an equivalent barotropic structure. Its large horizontal scale projects strongly onto the first zonal harmonic or wave 1 ... in winter, it interferes positively and strengthens the stationary waves above their climatological amplitude"

Overall, Garny et al. is a good paper, giving a detailed study of how SSTs affect temperatures and ozone concentrations through their impact on the wave driven circulation. The conclusion that these effects are secondary to those of GHGs and ozone depleting substances is an important one for communities modelling 21st century stratospheric

ACPD

9, S1194–S1197, 2009

Interactive Comment

climate change and ozone recovery.

Typographical errors:

Global replace: except of → except for

Line 19 of page 4498: "However, due the relatively" → "However, due to the relatively"

Line 21 of page 4499: "month" → "months"

Line 14 of page 4501: "divergences" → "convergences" ?

Line 27 of page 4506: "descend" → "descent"

Line 2 of page 4507: "hypotheses" → "hypothesis"

Line 14 of page 4509: "de detectable" → "be detectable"

Line 7 of page 4510: "in theses" → "in these"

Line 16 of page 4510: "Holton, D." → "Holton, J."

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 4489, 2009.

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9, S1194–S1197, 2009

Interactive Comment