

Interactive comment on “Stratospheric ozone in the post-CFC era” by F. Li et al.

F. Li et al.

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Reply to Referee #1

Comment: The only minor problem with the paper is the stark confidence expressed in the model results. E.g. the strengthening of the BDC is mentioned numerous times, but without mentioning the caveat that this is a model only result so far and that recent observations (Engel et al., 2009, Nature Geoscience) cannot find a strengthening of the BDC for the recent past (obviously with the caveat of sparse sampling). The paper should be published with minor revisions, including a slightly more critical assessment of the models ability to simulate future change.

Reply: Strengthening of the Brewer-Dobson circulation (BDC) is a robust response to greenhouse gas increase in model results. As pointed out by the referee, despite a consensus among different models, there are no direct observational evidences to support the acceleration of the BDC in the past 3 or 4 decades. However, indirect evidences

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based on observations do exist to support a strengthened BDC (e.g., Thompson and Solomon, 2005, 2008). As far as we know, Engel et al. (2009) is the first to provide long-term measurements that shows no obvious acceleration of the BDC in the Northern Hemisphere middle stratosphere. Results of Engel et al. (2009) are derived from very limited samples and do not exclude a strengthening of the BDC in the lower stratosphere, but they cast some doubt on the model's ability to simulate future changes of the BDC. As illustrated in this study, resolving the discrepancy between simulated and observed BDC change is very important to understand model projections of ozone recovery. This is a challenging issue for both the modeling and observation community. We have added a paragraph in Section 4 to discuss model's ability to simulate changes of the BDC.

Minor points:

Comment: The Perlwitz et al. (2008) citation is missing.

Reply: The reference is added.

Comment: I am not quite sure I understand the statement: "SST data for the late 20th century are from observations". Does this imply a discontinuity of SSTs in Cl60? Are the past SSTs merged with the modelled future SSTs (but for Cl60 only)? Please clarify!

Reply: There is a discontinuity of SSTs in Cl60 when SSTs are switched from observations to NCAR Community Climate System Model (CCSM) outputs in January 2001. The CCSM SSTs merge well with the observed past SSTs in the tropics, but there are differences in the extratropics. The switch of SSTs, however, does not cause a significant discontinuity in the ozone simulations. Evolution of ozone in different regions in Cl60 shows that ozone merges well when the SSTs switch in 2001 (see Fig. 2 of Waugh et al. 2009 in which Cl60 is referred as climate-only simulation).

Comment: In the discussion on page 20231 (starting line 11) it might help to briefly

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mention if and how Cl60 differs from FREF for the 1975-1984 period.

Reply: A brief description of differences between cl60 and FREF for 1975-1984 is added.

Reference:

Engel, A., Mobius, T., Bonisch, H., and co-authors (2009), Age of stratospheric air unchanged within uncertainties over the past 30 years, *Nature Geoscience*, 2, 28-31.

Thompson, D. W. J., and S. Solomon, S. (2005), Recent stratospheric climate trends: Global structure and tropospheric linkages. *J. Climate*, 18, 4785-4795.

Thompson, D. W. J., and Solomon, S. (2008), Understanding recent stratospheric climate change, *J. Climate*, doi:10.1175/2008JCLI2482.1, in press.

Waugh, D. W., Oman, L., Kawa, S. R., Stolarski, R. S., Pawson S., Douglass, A. R., Newman, P. A., and Nielsen, J. E. (2009), Impacts of climate change on stratospheric ozone recovery, *Geophys. Res. Lett.*, 36, L03805, doi:10.1029/2008GL036223.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 8, 20223, 2008.

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