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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Attribution of stratospheric ozone trends to chemistry and transport: a modelling study" *by* G. Kiesewetter et al.

Anonymous Referee #1

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Kiesewetter at al. use a stratospheric chemistry transport model driven by ERA-40 and ERA-Interim meteorological analyses to investigate the role and magnitude of chemical and meteorological processes important for the long-term evolution of ozone over the last 3 decades. The model results are compared very well with available satellite observations. Although the paper does not provide any major new insights, I found this a very well written manuscript. The underlying analysis seems well done and is made very plausible. I thoroughly enjoyed reading it.

The paper is well organized. The Figures are good and well selected. I have only minor comments, and fully support publication of this paper in ACP.

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1 Minor Comments

One small thing that I feel is missing, is a statement on the magnitude of chlorine/ EESC changes over the two considered periods (1979 to 1999, and 2000 to 2009). Depending on which EESC data you use (or which part of the stratosphere you look at), the magnitude of the 2000 to 2009 EESC decline is only 5 to 30% of the 1979 to 1999 increase. So even without any model calculations, I would expect only very small "chemical" ozone recovery for 2000 to 2009. Of course your paper / model also shows that, but the underlying fundamental thing is the smallness of the EESC decrease since 2000. I think that this needs to be stated in several places in the paper, including abstract (maybe), introduction, main-part, and conclusions.

Page 17492, line 6: maybe better : driven by

Page 17492, line 19: typo: significantly. Also: Can you give a percentage value for this fraction?

Page 17492, line 20: You might want to say that the ODS changes themselves are much smaller than over the 1979 to 1999 period. The ozone sensitivity to ODS is probably the same.

Page 17493, line 7: Delete the awkward "to be observed in within the present years". Also: what about Newchurch et al., JGR, 2003?

Page 17493, line 15: "(mostly NH)" → "NH"

Page 17493, lines 18 and 23: I think you also have to mention the Mt. Pinatubo eruption here. It has resulted in the very low ozone levels observed between 1992 and 1995, and has a major impact on trend estimates until the late 1990s.

Page 17494, line 3: Don't you mean EESC-varying? Isn't your chemistry always depending on EESC/ chlorine?

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Page 17494, line 6: temperature and transport

Page 17496, line 10: Can you be more specific here? How unrealistic do the T-trends have to be, to throw the ozone trends off significantly? Are we talking 1 K per decade off, or 10 K per decade off?

Page 17497, lines 10, 11: I am not sure what you mean by toggled and time dependent. Do you mean: "in these, all possible combinations of time dependent ODS and year 2000 constant ODS were tested for Linoz and polarchem, respectively."

Page 17497, line 25: Delete "presented below"?

Page 17498, line 4: To be consistent with the GSG data set, the website for the TOMS/SBUV dataset should be given as well.

Page 17498, line 13: You might want to make this a new subsection "Solar cycle effects".

Page 17498, line 18: It would probably be good to add an observation-based reference for the magnitude of the 11-year solar cycle in total ozone as well, e.g. WMO 2007, or one of Lon Hood's papers.

Page 17500, lines 11 to 13: I would drop this last sentence here. When I look at Fig. 4, I don't see an underestimation of trends. The agreement is almost perfect, especially if I consider that the shift between curves is somewhat arbitrary anyways (and Pinatubo aerosol and solar cycle are missing in the model).

Page 17504, lines 1 to 11: I think it would be important to give some numbers for the difference in T-trends in the E4 and EI analyses. How big is the E4 trend in K/decade, how big is the EI trend. How do they compare to e.g. Ramaswamy et al., Rev. Geophys., 2001 and/or Randel et al., JGR, 2009?

page 17505 line 19: maybe add "and the same E4 or EI meteorology"?

Fig. 10: Maybe this would get a bit cluttered, but: Would it not make sense to also

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plot the tt trends in Fig. 10? And to compare them with the sum of cc, gas-phase, and polar chemistry trends? To me the most interesting question is, what fraction of the total trend comes from what. Right now, Fig. 10 does not answer that easily, because the full trend is missing.

Also: To me it would be quite helpful to add in the legend "polar" after "ct-cc", "gas-phase" after "tt- ct", and "meteorology" after "cc".

Fig. 11: Same as for Fig. 10.

page 17507, line 24: You might want to also quote Hood , McCormack and Labitzke, JGR, 1997, or Steinbrecht et al., JGR, 1998, some of the first papers to mention large meteorological contributions to decadal ozone trends.

page 17508, line 2: Certainly the large ozone declines in the lower stratosphere are also a big contributor to the temperature trend in the lower stratosphere. This needs to be mentioned.

page 17509, line 24: delete "overly".

Good paper, enjoyed reading it!

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 17491, 2010.