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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Spatial regression analysis on 32 years total column ozone data" *by* J. S. Knibbe et al.

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This reply is a continuation of the general reply posted by Knibbe et al.

Authors Reply on Specific Comments by Reviewer #2

- Reviewer: "One of the most puzzling results has to do with the differences noted (see lines 522 and 523) for the EESC versus the PWLT results and the ozone recovery rates in the ozone hole region."

The differences in obtained PWLT and EESC based ozone recovery rate estimates are due to the different breakpoints in the linear segments and the shape of the EESC curve respectively. Breakpoints situated later in time will increase the slope of the linear



segment in the recovery period to fit the nominal ozone values in this timeframe. For the EESC based estimates the complete EESC curve is fitted to the ozone timeseries. For larger age of air parameters the slope of this curve is less steep in the recovery period, which results in smaller recovery rate estimates. The fundamental difference is that the PWLT estimates are based on 2 individually fitted linear segments, whereas the EESC based estimates are based on fitting the complete curve. The large range in the obtained estimates and their standard deviation is something to worry about. It shows that quantification of ozone recovery rates is extremely sensitive to the applied trend estimation method and on model assumptions. Based on the location, however, it still can be argued which model is more appropriate. For example, the age of stratospheric air increases by increasing latitudes. This is accompanied with an increasing range of possible recovery rates, because the breakpoint at high latitudes is considered to have occurred later in time than around the tropics.

At the end of section 2.4 we added "The piecewise linear trend (PWLT) characterization for long term ozone variation has the advantage that the slope in ozone recovery and ozone depletion periods can be estimated separately, whereas these slopes are proportionally fixed in the EESC curves. On the other hand the EESC parameterization yields a smooth curves instead of the ad-hoc turn around point in the PWLT characterization.". Additionally, we now elaborate on these results in the discussion section.

- Reviewer: "The results in Table 7 for the SH region are also puzzling in the same way."

For table 7, we found that the numbers got mixed up. Figures 11 and 12 show the trends on this matter correctly. This is adjusted in the revised paper, and the description 'maximum' will be changed to 'average' since the numbers are averages.

-Reviewer: "Line 149 (in MSR ozone section), is the "standard errors" really what you want to mention here, rather than the "standard deviations"."

We have changed 'standard errors' to 'standard deviations' in the revised manuscript.

- Reviewer: “could you clarify why plots do not specify equivalent latitude or was this coordinate system used as a partial analysis which was then redone on geographic latitudes?”

We have used geographical coordinates for the seasonal analysis. We have changed ‘equivalent’ to ‘geographical’ in the first line of section 2.3 in the revised manuscript.

- Reviewer: “L486, why did you not consider a piecewise linear model with two adjacent time periods (such as 1979 to 1997 and 1997-2010)?”

We have applied a piecewise linear function in these analyses. So we have modelled the decreasing trend in ozone prior to the breakpoint, but we focussed on presenting the recovery rates because these are currently more interesting.

Technical Corrections

- We have corrected all textual comments.

- L381, Reviewer: “it would be good to find and cite past references (if any) that may have looked at interhemispheric differences for the solar influence.”.

we have looked for publications that report hemispheric asymmetry in solar cycle response on ozone, and now found references with similar results (e.g. Hood and Soukharev, 2006). We will put our results in perspective with these papers.

-L387, Reviewer: “do you mean that for both pressures, the correlation for total column is positive?”.

essentially we mean that including the QBO of both pressure levels in these regressions with positive regression coefficient yields the best fit. This indeed is due to positive correlation with ozone along the equator, especially at 30 hPa.

- L416/417, Reviewer: “the statement is not very convincing if not backed up by the reference cited (is it?) or by this manuscript’s work.”.



In the revised manuscript we backup this statement with references (Harris et al., (2008); Kiesewetter et al., (2010) and Rieder et al., (2010))

- L426, Reviewer: “I strongly suggest that the definition of R squared be provided here, to ensure that this is clear to all readers.”.

Although we believe the definition of Rˆ2 is basic statistical knowledge, we provide a proper definition in the revised version.

- Reviewer: “I can understand the motivation for studying a site over Antarctica, but if you have a motivation for the other two sites, please indicate this (one in the tropics and one at high northern latitudes, is it as simple as that?).”.

The sites are selected almost as easy as you have stated, with the note that Bogota is chosen to properly show the effect of ENSO at the equator. We will include a line about this in the revised version.

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 5323, 2014.