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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A global historical ozone data set and signatures of El Niño and the 11-yr solar cycle" *by* S. Brönnimann et al.

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Reply to Reviewer 2

"This paper introduces a new approach for setting up a long-term ozone data set via assimilating various available ozone observations. The paper also presents some preliminary analysis on ENSO and 11yr solar cycle signals in this ozone data set. Overall, the efforts of this work are worthwhile and the new long-term ozone data is somewhat useful for scientific community. The main merit of this data set is extending the ozone time series backward to 1900. However, the robustness of the assimilated ozone time series from 1900-1970 is lack of verification."

The results shown in Figure 8 and 9 are a way to validate at least the methodology

used for the 1900-1970 period, i.e., by applying it to scattered ground based total ozone series during the satellite period and comparing the result to zonally averaged satellite data. The actual product cannot be validated as we have no zonal mean ozone data set prior to 1979. The revised manuscript will be more specific with respect to these limitations.

"Ozone observations in the time period 1900-1970 are very rare and the ozone time series for this period is set up mainly via regression method based on meteorological fields which are also not reliable."

Meteorological series are used for the adjustment process. We think that these reconstructed meteorological data are relatively reliable. Previous works has shown that month-to-month variations in these reconstructed 200 hPa heights are very highly correlated with total ozone data, even in the very early years. We will provide references for this (e.g., Vogler, C., et al. J. Geophys. Res., 112 (2008), D20116).

"For the assimilation approach, the results show that the approach can not significantly improve the data quality relative to the model background at the full temporal and spatial resolution. A question arise here as what is the advancement of this data relative to previous longer-term ozone time series."

The data set does provide significant skill for total ozone, hence one potential use of the data set is to analyse total ozone. It is true that the vertical structure does not have additional skill on the full resolution of the data set. This means that one might as well use the bias-adjusted SOCOL model output. It should be noted, however, that the skill score is based on variability. "Smoothed" data are likely to yield a better skill, but would be deficient in variability. Note that the product does show skill even in the vertical when compared to the climatology of the bias-adjusted SOCOL model output. So in this sense HISTOZ is better than a climatology. In the revised manuscript we will incorporate a little more information on the skill measures and their interpretation.

"The following are some specific comments:

1. Figure 4 indicates that the original SOCOL ozone time series at the latitude band 30oN-90oN is out of phase with the debiased SOCOL time series and BDBP. Does this imply SOCOL simulations have serious problems?"

The SOCOL simulations indeed have problems in some stratospheric levels. A possible reason for this behaviour could be problems in the representation of QBO effects in the extratropics. We will add mote information in the revised manuscript.

"2. Figure 5 indicates that the raw and zonally adjusted TOMS total column ozone data have large differences and some small scale details disappear in the spatial distributions of the adjusted TOMS ozone compared with the raw data. One may wonder whether those fine details in the raw data are true signals or are smoothed out after the adjustment."

The goal of the adjustment is to exclude zonal variability. So anything that disappears must have been a true signal. However, there are many potential reasons why a feature might not disappear. For instance, it may not be related to tropopause-level flow changes, or these may not be adequately captured in 200 hPa height. Or the TOMS data have uncertainties, or 200 hPa heights have uncertainties. The paper will be a bit more specific on this, but the entire section will be moved to the supplement.

"3. It is concluded in the paper that there is a more pronounced effect of ENSO and slightly weaker effect of the 11 yr solar cycle in the earlier period. It is interesting to discuss whether the weaker effect of the11 yr solar cycle in the earlier period is caused by the stronger ENSO effect or by the solar activity changes."

This is an interesting question. We will add more analyses of ENSO and solar activity changes.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 7767, 2013.