Interactive comment on "A global climatology of tropospheric and stratospheric ozone derived from Aura OMI and MLS measurements" by J. R. Ziemke et al.

Anonymous Referee #1 (Received and published: 1 July 2011)

The paper describes a climatology of tropospheric and stratospheric column ozone computed from 6 years of Aura OMI and MLS data and its methodology builds on Ziemke et al (2006). Such a data set can be very useful to scientific community, to modelers in particular. Examples of applications are given in Section 5. The manuscript meets the standards and scope of ACP have a few initial comments and suggestions to kick off a discussion

1) Introduction L10. "it remains to be shown that invoking more sophisticated methods beyond simple interpolation [...]". Agreed. However, and I'm very close to citing some work that I've been involved in, there exist recent studies exploring this topic to some degree (e.g. Doughty et al (2011)). They demonstrate that there are advantages to data assimilation. Simple methods can work very well for coarse-grid climatologies. On the other hand the strength of assimilation is it's ability to provide global fields at synoptic times so those two approaches aim at a bit different goals. I realize that this is a matter of subjective opinions.

Thanks for your comments on the paper. These are important points which we have added to the revision. There are two main issues, one is that there is great promise in data assimilation for generating 3D ozone daily maps (satellite measurements cannot provide profile information in the troposphere other than about 1 to 2 degrees of freedom at best). The *Stajner et al.* [2008] and *Doughty et al*. [2011] studies both used the ASM and have shown very good results in simulating tropospheric ozone. The tropospheric component of the ASM invokes the Harvard GEOS-Chem model which has a legacy of very good results in simulating ozone and other trace gases in the troposphere. A great advantage with the model assimilation is generation of synoptic ozone profile information in the troposphere, but one disadvantage is that applications have generally been limited to short case studies including field campaigns such as INTEX-B. An underlying difficulty is that the GEOS-Chem tropospheric component requires emissions inventories which take substantial time and effort to implement correctly. Developing a long record from ASM for deriving climatology or for studying inter-annual and perhaps even decadal variability would require much more effort. The situation with assimilation and direct satellite retrieval is that these two products currently tend to fill different needs for the science community.

A second issue relates to daily measurements of tropospheric ozone. In regions where the spatial variations of stratospheric column ozone (SCO) are small, all the methods including even the 2D Gaussian-linear interpolation scheme can derive useful daily TCO measurements. Although we are only concerned in this paper with deriving TCO and SCO climatology we have evaluated daily measurements from the 2D interpolation method and others (including GMAO assimilation, GMI model, trajectory-mapped ozone). Daily measurements of TCO in regions away from the subtropical wind jets are comparable for all methods. The Madden-Julian Oscillation (MJO), although of longer time scale than daily (i.e., 1-2 month periods) has a clear and nearly identical geophysical signature in all of these tropospheric ozone products, both signal-to-noise and propagation characteristics derived from the daily data. In our revision we discuss major issues associated with deriving daily maps, profile information, long records, and field campaigns involving the different techniques.

2) Section 3. L25 "The left panel in Fig. 3 represents station latitudes 25S-50N and the right panel is the same but includes stations poleward of 50N." This does not match Figure 3. The title over the right panel and the caption say 25S - 90N not poleward of 50N.

The main text and figure have been revised – the left panel in Figure 3 corresponds to ozonesonde stations in the latitude range 25S-50N while the right panel includes all stations listed in Table 1.

3) Section 3. In addition to the discussion of the climatology minus sondes differences in the final paragraph it would be helpful to have an estimate of errors in sonde ozone. Don't some locations exhibit large differences between ozone derived from sonde and from Dobson and lidar measurements? If such estimates are known this could help explain of some of those very large RMS difference values in Table 1.

A paper by *Smit et al.* [2007, JGR] have done an in-depth analysis of the ECC ozonesonde instruments and measurement errors. There are many contributing factors for sonde errors including mechanical and chemical, from pumping efficiency to KI concentration and general operation of instruments. The study by *Smit et al.* [2007] summarized that with standardized operating procedures the ECC sondes should have an accuracy of 5-10% and precision of 3-5% from ground to 30 km altitude. It is possible that there are sonde error issues involved but also the satellite measurements as well at the higher latitude stations. We discuss these sonde versus satellite measurement issues in the revision.

4) I find Figures 1 and 2 very interesting. They show a nice agreement of the new climatology with ozone sondes. There appear to be some systematic biases though which are not mentioned in the text. Specifically, in the Tropics. the high values are too high compared to the sondes. This is also clearly seen in the scatter plot whose slope appears to be greater than 1 (is that statistically significant?). In the extratropics (Figure 2) the low values seem too low and, consistently, the slope of the scatter plot is slightly less than 1. Are those two biases related? Is it possible to trace them back to their sources (the use of MLS below recommended levels, bias in sonde measurements?). I would like to see a little more discussion here.

These are all useful comments. We have added discussion on these points in the revision.

5) Both, tropospheric and stratospheric ozone exhibit a great deal of interannual variability due to dynamics. For example, stratospheric values were unusually high in the northern high latitudes in 2010 (e.g. Steinbrecht et al. 2011 GRL). The authors state it clearly that their product is specific to years 2005-2010. Would it be possible to include plots of, say standard deviations along with the annual mean (Figures 7 and 9)? This would be helpful to users. Alternatively, could tropospheric ozone for El Nino and La Nina years be shown separatly?

Good points – the previous manuscript only showed one figure (Figure 6) illustrating RMS values relative to measured amplitude amounts. We have added two additional figures (new Figures 8 and 11) in the revision to show relative RMS values for tropospheric and stratospheric column ozone for four seasons each. The figures provide perspective of the inter-annual variability relative to mean background amounts.