July 3, 2105

Re: Revision for "**Observation of ozone enhancement in the lower troposphere over East Asia from a space-borne ultraviolet spectrometer**" by S. Hayashida et al.

Dear Editor van Roozendael:

We would like to thank the reviewer for his additional constructive comment. We have addressed his comment as detailed below and in the updated manuscript.

Thanks a lot for your consideration.
Sincerely

Sachiko Hayashida

Reply to the comments

Here is the new comment from the reviewer:
"The authors have largely answered to the points raised by the referee. However the difference in Fig. 5b and Fig. Ab (in the reply) remains significant and requires additional discussion in the text. This difference implies that the correlations shown in Fig. 5b are to a significant extent related to the variability in the upper layers that are common for x and y in this plot. The authors should give a fair evaluation of this term in the main text, to avoid any mis-interpretation of Figure 5b."

For reference, we also include the initial related comment from the same reviewer:
"*Same profile as OMI is assumed for the 21th and above layers in the derivation of MOZAIC-based values convolved with the AKs. The common contribution from these high altitude layers could be the source of correlation in Figure 5 and therefore the authors need to test if such contribution is small, in order to retain the conclusion*"

Response: Although the OMI-retrieved data do not represent the real ozone profile, it is the best estimate of real measurements that we have. OMI ozone profiles have been shown to agree very well with collocated Microwave Limb Sounder (MLS) stratospheric O_3 data (Liu et al., 2010b). Testing with ozonesonde data at latitudes 30°N-50°N shows that using OMI retrievals above layer 22 provides good and much better approximation of the real measurements to account for smoothing from upper layers to lower layers than using a priori values (as shown in Figures A, B, C). The above sentences have been added to the revised manuscript except that the figures are not shown.

In addition, we added some discussion about the impact of using OMI retrievals on the comparison: "The correlation of $X' - X_a$ with ΔO_3 shown in Fig. 5b was evaluated to be sufficiently close to unity with R^2 values of ~0.75. According to the testing with ozonesonde data, the use of OMI retrievals above layers 22 rather than real MOZAIC data will slightly overestimate the correlation from R^2 values of ~0.60. The slopes are also much closer to unity when compared to Fig. 3, although with slight overestimation by the OMI in the 23rd and 24th layers (1.25 and 1.41, respectively), which can be partly

due to the use of OMI retrievals above layer 22."

The purpose of Figure 5 is to show the consistency between OMI retrievals and the OMI retrieval scheme as approximated by eq. (1) and the retrieval averaging kernels. That is why we need to add ozone above MOZAIC data to account for smoothing from upper layers to layers 22-24 in a way similar to the OMI retrievals even if the good correlation is due to smoothing from upper layers. "As seen from the difference between Fig. 3 and Fig. 5, it is obvious that OMI-retrieved values in 22^{nd} and 23^{rd} layer in Fig. 3 (b1 and b2) are not correlated to MOZAIC data at all (R^2 is almost zero). It means the OMI-retrieved ozone value at a certain layer does not necessarily represent the actual ozone value at the corresponding layer, but it is affected by the ozone values at different layers as mentioned for Fig. 4. In Fig. 5 we find much better correlation than in Fig. 3 after smoothing by AKs, which assures the OMI retrieval process is functioning self-consistently." We have the quoted sentences at the end of section 3.1.

All the changes in the revised manuscript including minor changes not mentioned here are also shown in red in the revised manuscript.

Liu, X., Bhartia, P. K., Chance, K., Froidevaux, L., Spurr, R. J. D., and Kurosu, T. P., Validation of Ozone Monitoring Instrument (OMI) ozone profiles and stratospheric ozone columns with Microwave Limb Sounder (MLS) measurements, Atmos. Chem. Phys., 10, 2539–2549, doi:10.5194/acp-10-2539-2010, 2010b.

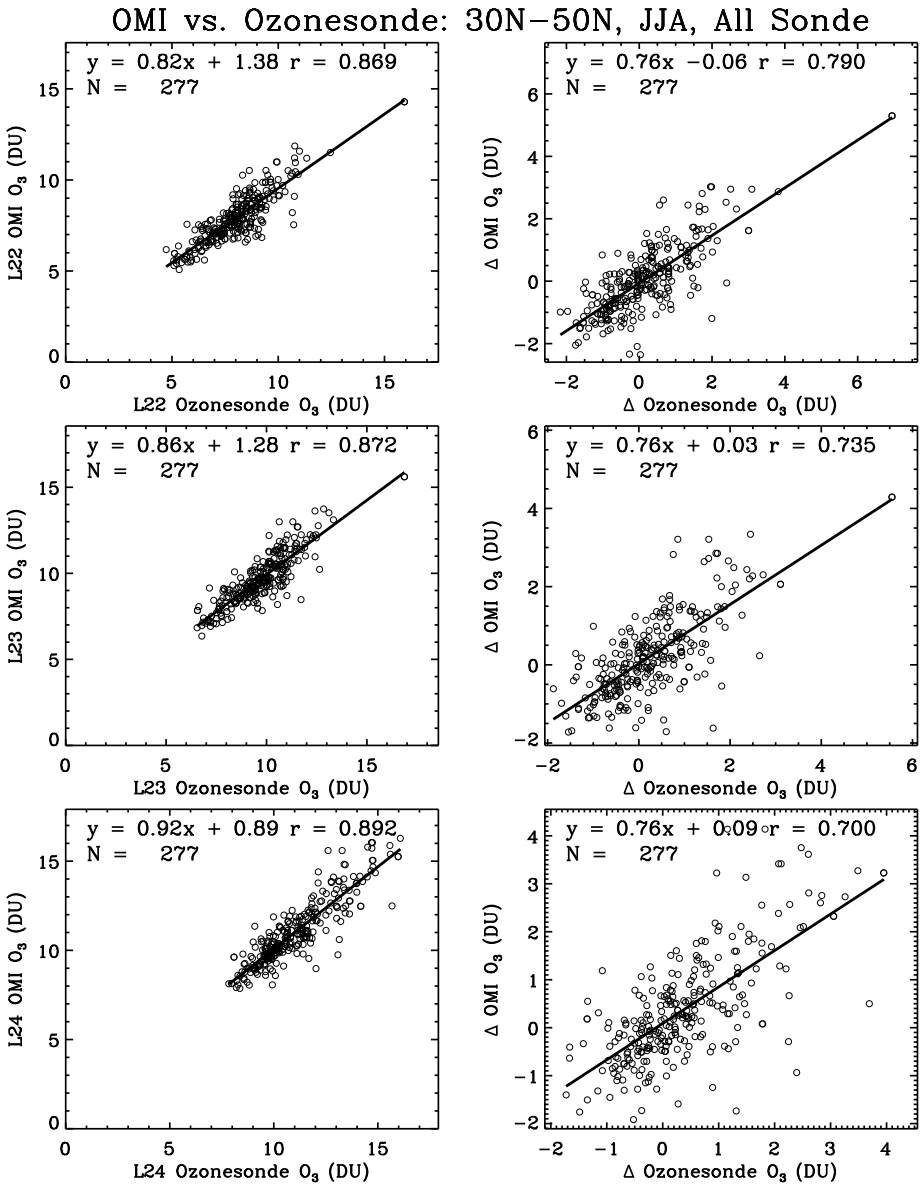

Figure A. Same as Figure 5 except with ozonesonde data at latitudes 30N-50N during the summer of 2004-2008. X_t above ozonesonde burst pressure (<10 hPa) is also assumed as OMI retrievals, but the use of either OMI retrievals or a priori have little effects on the comparison at layers 22-24.

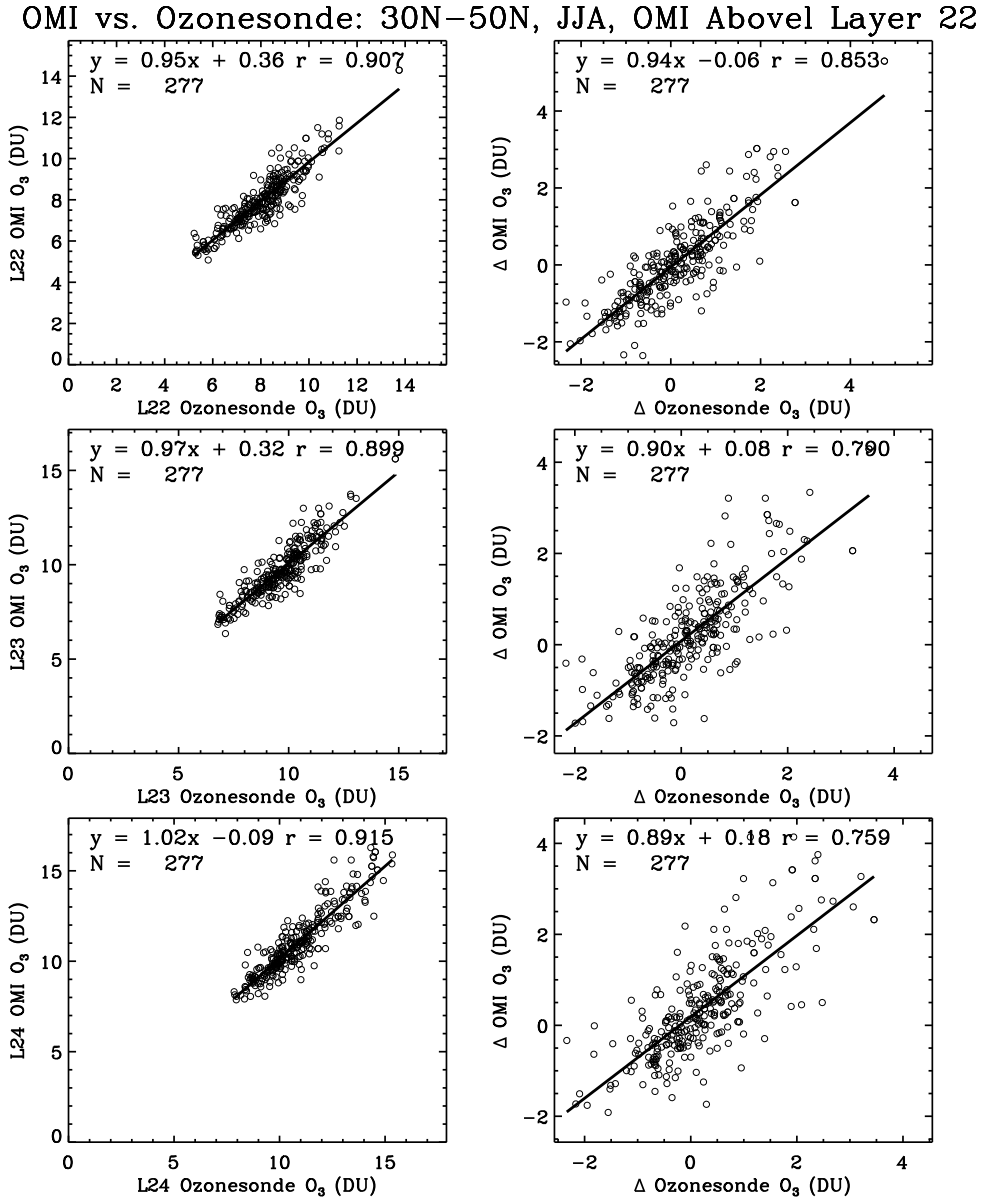

Figure B. Same as Figure A. except that X_t above layers 22 is assumed as OMI retrievals.

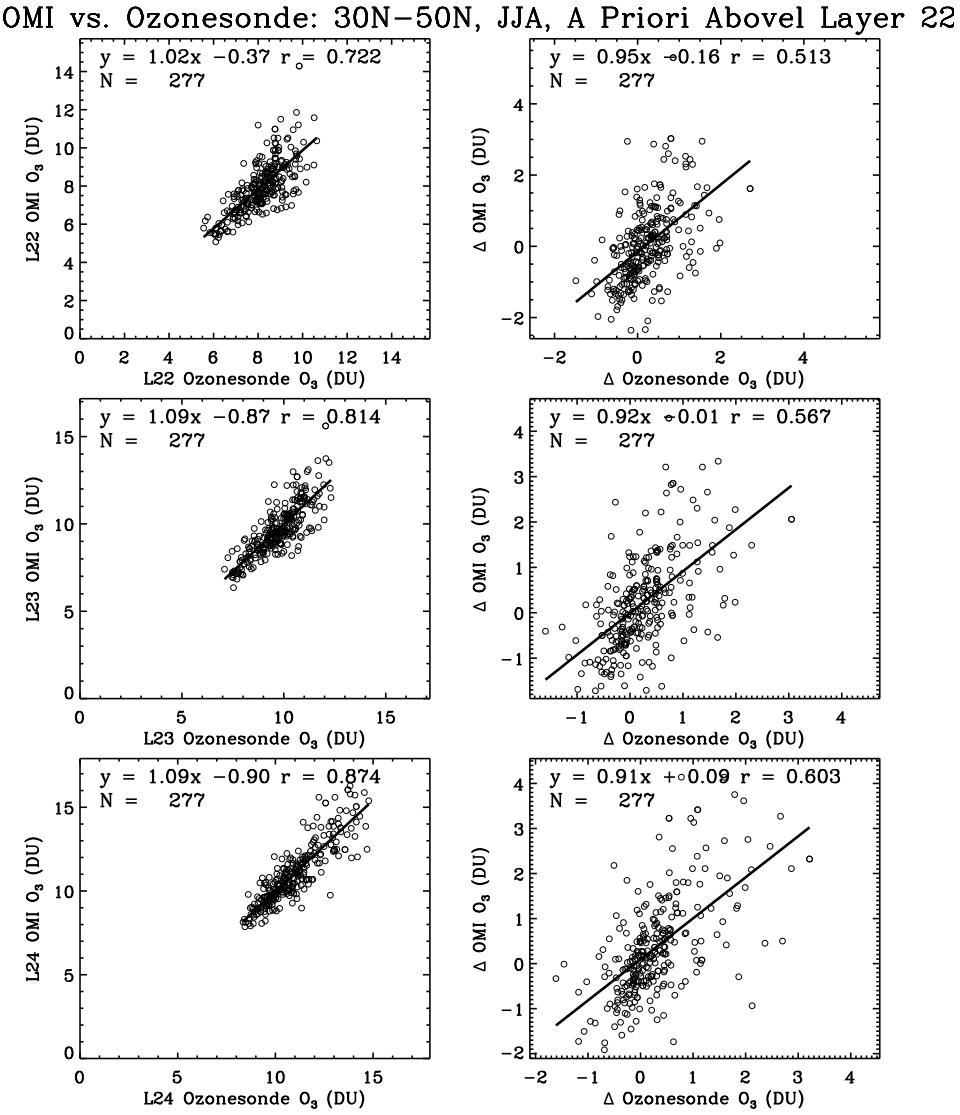

Figure C. Same as Figure B except X_t above layers 22 is assumed as OMI a priori.