

Reply to Referee #1, about the article "Intercomparison of polar ozone profiles by IASI/MetOp sounder with 2010 Concordiasi ozonesonde observations" by Gazeaux et al.

Thank you for the time you took to review this paper, and for the constructive comments that helped to improve the paper.

Each correction is given in the same order as the review. Comments from the referee are highlighted in green, and texts added to the article are printed in italic. We also provide a pdf-file of the article with the main corrections highlighted in yellow.

- [This manuscript suffers a bit from the little effort undertaken by the authors to discuss the effect of varying collocation criteria for satellite-sonde match on the validation results and interpretation.]

A comment was added in the conclusion about how the collocation criteria were used depending if there is available GPS data: *Some of the launched balloons were equipped with GPS receivers. When available, the GPS data are used to select IASI profiles along the sonde path, which makes the comparisons more accurate as the closest IASI profiles are selected. The study shows that the smaller the collocation criteria, the better the match between the IASI profiles and the smoothed ozonesonde profiles.*

- [I also would like that the authors elaborated more on the data retrieval]

More information is now provided for the ozone retrievals in the 2nd paragraph of part 2.1.

- [... and on how they handle the little thermal contrast between surface and atmosphere inevitable affecting the measured radiance and the accuracy of the ozone retrieval. Or stated otherwise, how are the authors dealing with the reduced sensitivity of the retrieval at high latitudes?]

As for the thermal contrast, its role is important only in the lowest layers of the atmosphere (i.e low troposphere), and the study shows that the comparisons between IASI and the sondes are good in the low troposphere. In polar region, the noisy aspect of the spectra do not comes from the thermal contrast at the surface but from the very low temperatures in every layers of the atmosphere. The article shows that, despite temperature issues, sensitivity at high latitudes is better than expected, a comment was added in the conclusion in order to make this point clearer: *A good agreement is found between the two datasets even with the reduced sensitivity associated with high latitude (low temperature) and ice surface (emissivity issues).*

- [P7924L3: use "vertical sensitivity" instead of "height sensitivity";]

Correction done

- [P7924L4: omit "the" before ozone; Also in other parts of the manuscript the word "the" is redundant and hampers readability of the text.]

Correction done

- [P7924L7-8: The sentence "This campaign was ... " needs to be rewritten (splitting in two parts?);]

Correction done

- [P7924L11: replace "altitude" by "vertical";]

Correction done

- [P7924L12: suggest to replace "differ" by "varying" or similar word;]

Correction done

- [P7924L15: should be "considered vertical range";]

Correction done

- [P7924L20-21: should be "This study allows a better characterization of IASI retrieved ozone over the polar region during ozone depletion/recovery processes."]

Correction done

- [P7924L23: should be "Surveying ozone distribution over ... is an important task in order to quantify/ for quantifying ozone depletion "]

Correction done

- [P7925L2: include ", " after decades;]

Correction done

- [P7925L4: "Spring" should be "spring" and a referenced should be added;]

Correction done, we used (WMO, 2011) as a overall reference for this paragraph.

- [P7925L6: should be "United States" without "the";]

Correction done

- [P7925L9: aimed to or aimed at?]

Correction done

- [P7925L11-15: rephrase sentence; I prefer low thermal contrast rather than low temperatures]

Correction was not done as low temperatures and low thermal contrast are not similar. Over the Poles, the signal to noise is worsened due to lower temperatures, not to the thermal contrast.

- [P7925L23: should be "Ozone is one ... and IS the focus of this paper";]

Correction done

- [P7925L24: remove "the" before ozone products;]

Correction done

- [P7925L26: should be "... both for accuracy as well as for characterizing the profile data";]

Correction done

- [P7925L28: Insert blank space after campaign. Change to "This paper is organized "; Section should be fully written (see also next page) and without a capital letter. etc Section 2.2. Split sentence in two parts, remove commas;]

Correction done

- [Section 2.1. IS the optimal estimation approach of FORLI similar to for instance the TES retrieval methodology? (Rodgers ...);]

Yes it is very similar for the general method, both are based on optimal estimation as described in Rodgers et al 2000. The a priori assumptions differ though, eg we use a single a priori variance-covariance matrix for the whole globe, whereas TES uses several a priori depending on latitude and season.

- [P7927L20: should be "... the readers are referred to";]

Correction done

- [P7927L28: should be "... IASI profiles which are at the smallest distance of the balloon ";]

Correction done

- [P7928L14: "reducing the risk of a poor comparison": Do the authors not mean "reducing the risk of a poor sampling"?]

Corrected as suggested.

- [P7928L15-16: "The fact that McMurdo is inside the vortex guarantees stability to ozone profiles and makes the comparisons more useful"; Should it not be "The fact that the balloon launches at McMurdo all occur inside the vortex guarantees stability to ozone profiles and makes the comparisons more useful"?;]

Correction done

- [P7928L20: It should be "one cannot directly compare"; Equation 1: I am not in favor of the annotation of the terms in the equation. It is much more convenient for the reader if "low" and "high" are substituted with "IASI" and "sonde";]

Corrected as suggested.

- [Equation 3: is there any evidence that the data are Normally distributed? Did the authors check that? Why not using a Student t distribution? I am not sure that 1.96 is the appropriate choice;]

Good point in fact, the mistake was in the text. The number 1.96 is commonly used as the value of the 97.5 percentile point of the normal distribution. Here we did not use a normal distribution but a Student's t-distribution which suits for the description of the mean of normal distributed sample with unknown variance. We made the point clear in the text by adding the following sentence: "*The number 1.6, in Eq. (3) depends on the Student's t-distribution, commonly used to describe the mean of a normal distributed sample with variance to be estimated (See Frontier)*" In the text, the number 1.96 should have been 1.6 (Figure 6 was originally made using 1.6). We also initially checked that the distribution can be described by the Student's t-distribution, and made some Figures to illustrate this point. However we did not believe that it is worth showing these figures in the article. plots not shown in the paper, but now provided here :

- [P7930L5: remove "that have been carried out ";]

Correction done

- [P7930L11: "own" should not be used. Rephrase:]

Correction done

- [P7930L15: superscripts needed for 2nd and 3rd;]

Correction done

- [P7930L27: should be "equals"; remove "to"; - How can you explain that the confidence interval is vertically nearly constant?]

Correction done

Note that the confidence interval is not completely constant, it tends to slightly increase with altitude, but not significantly. The confidence interval is not meant to increase anyway, as it represents the variance of the comparisons between IASI and the sondes. This comparison is not similar to the observation error which indeed generally increases with altitude. The fact that the length of the interval is constant explains that the variance of the difference between IASI profiles and sondes profiles are only slightly altitude dependent.

- [P7931L17: Define, quantify what you mean with a large gradient.]

Rephrased by: *A large ozone loss ($\approx 0.3-0.5$ ppm ozone loss for each altitude) can be seen on the ozonesonde profiles (blue lines) measured between 10 km and 20 km from 19th September (Figure 5).*

- [P7931L18-23: this is not a proper sentence; Rephrase and split. Three times the word "observe" is too much. Moreover, it is hard to understand;]

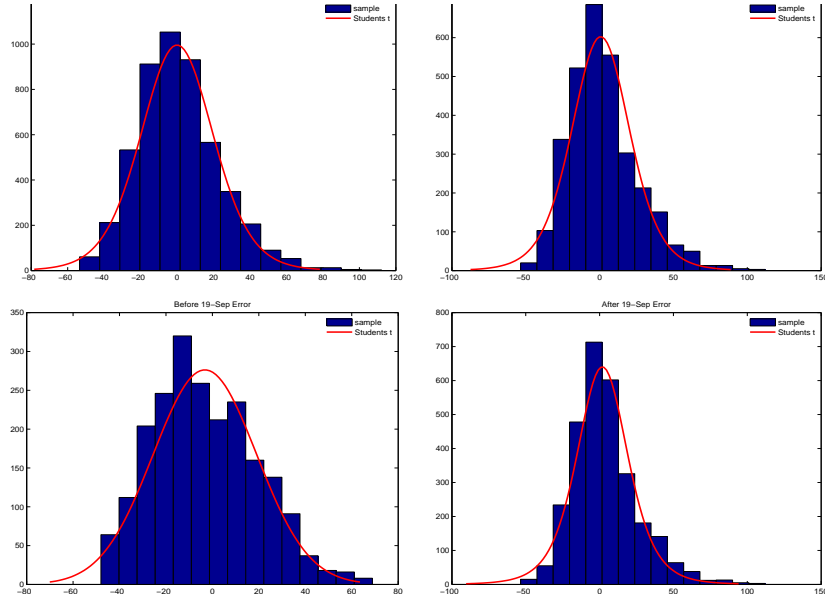


Figure 1: On each plot, the blue histogram represents the sample of the error, and the red line represents the Student's T distribution fitted to the sample. Top left: overall error (black lines from Figure 6). Top right: error GPS-only (red line from Figure 6). Bottom left: Error before 19 September (blue line from Figure 6). Bottom right: error after 19 September.(Purple line from Figure 6).

Rephrased by: *To verify whether the overestimation is induced by this gradient, Figure 6b compares the profiles measured before and after 19 September. This corresponds to the time when ozone depletion is observed in IASI ozone mixing ratio profiles, soon after it is measured at McMurdo during the first week of september (Figure 5). The figure illustrates that the overestimation of IASI between 10km and 25km is not due to ozone depletion as it is observed both before and during the depletion process.*

- [P7932L7: add "TES" after Trop. Emiss. Spectrom.]

Correction done

- [P7932L15: I prefer to use months instead of season names (spring: NH MAM, SH SON);]

Correction done.

- [P7932L23-25: How can you drawn this conclusion from figure 5? Can the author clarify that?;]

This conclusion is drawn from Figure 6. This point has been clarified in the conclusion.

- [P7933L1-4: Rephrase. What the authors mean is that the IASI overestimation occurs independent from the ozone depletion process?]

Rephrased by: *The overestimation of ozone in the 10–25km range has already been highlighted in previous studies and with other instruments (e.g. TES as described in (Boxe2010)). The positive bias was found to occur both for ozone depleting and standard conditions.*

- [Fig. 1.: Should be "The black box indicates the longitude/latitude span in which ";]

Correction done

- [Fig. 4.: Should be "retrieved"; Should be "missing values"; these values are given in grey?]

Explanation is now given in the legend.

- [Fig. 5.: Enlarge figure. Now hard to read. "Collocation criteria ARE given ";]

Figure was enlarge at its maximum.

- [Fig. 6.: Clearly different vertical structures occur before and after 19 Sep. Can the authors comment on that?]

In Figure 6, the vertical structures of each comparison profile show a difference. This difference was not explained in the article by the coauthors who first highlighted the general shape of both lines. The positive bias is clearly visible in both lines, however, after 19 September, the mean error is slightly more impor-

tant above 15km ($\approx +10\%$). This is explained by the increasing variance of the signal due to the ozone loss process which effect is mainly visible between 15 km and 20 km (Figure 5). The following text is added in the article: *The different vertical structures of both lines are explained by the increasing variability of the signal between 15 km and 20 km due to ozone loss process (Figure 5).*

Best regards,
The coauthors.