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Atmospheric Measurement Techniques Discussions

Interactive comment on "Consistency and quality assessment of the Metop-A/IASI and Metop-B/IASI operational trace gas products (O₃, CO, N₂O, CH₄ and CO₂) in the Subtropical North Atlantic" *by* O. E. García et al.

Anonymous Referee #2

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The manuscript "Consistency and quality assessment of the Metop-A/IASI and Metop-B/IASI operational trace gas products (O3, CO, N2O, CH4 and CO2) in the Subtropical North Atlantic" by Garcia O.E. et al. presents a validation study for total columns of five trace gases retrieved by IASI sensors against ground-based FTS observations at Izana Atmospheric observatory. In this study author limited their analysis by the time period between 2010-2014, when the version 5 of the IASI L2 is available. This manuscript fits to the scope of problems discussed in the AMT, and the manuscript is recommended

for the publication after corrections. Specific comments are listed below.

Major comments:

The methodology of the validation is not well described in the manuscript. Authors refer readers to another manuscript for the details [Sepúlveda et al. (2014)]. However, in order to apprehend results presented in this manuscript it is crucial to understand the methods used for the analysis. The methodology should be carefully described in Section 4 "Comparison strategy". Below I listed some specific comments related to that:

p. 13740, line 7: Please, explain your motivation for using a logarithmic scale versus linear (e.g. anomalies as % from the mean);

p. 13740, lines10-11: Please, include the equation for the statistical fit model used to remove "the trend and the intra-annual variations";

p. 13745, lines 1-5 (also Figure 7): In the text authors talk about "long-term trends" and correlations, but the method to compute these trends and correlations has never been explained. Did you compute those long-term time series by fitting linear trends in weekly averaged, de-trended, de-seasonalised residuals? Please, carefully describe your approach in Section 4.

Figure 5: The bottom panel shows median biases in %. How were the median biases computed? Do these biases account for differences in annual cycles between the sensors and overpasses? Please, explain your approach in Section 4.

Another major comment is related to the analysis of the theoretical errors for the FTS retrievals presented in Appendix A. Authors followed Rodgers formalism to estimate these errors. Authors defined a covariance matrix Sa (see p. 13750, line 10), used to estimate the smoothing error, as "the assumed a priori covariance matrix". However, according to Rodgers (see p. 49 in his book, [Rodgers, 2000]) in order "to estimate the smoothing error, the covariance matrix of a real ensemble of states must be known".

He further emphasizes: "To estimate it correctly, the actual statistics of the fine structure must be known. It is not enough to simply use some ad hoc matrix that has been constructed as a reasonable a priori constraint in the retrieval. If the real covariance is not available, it may be better to abandon the estimation of the smoothing error...". First of all, authors have to change a definition for the covariance matrix Sa and use Rodgers definition. Secondly, authors need to justify the use of WACCM model outputs for constructing the covariance matrices for considered atmospheric species. It is not clear for the referee how well the WACCM simulations represent the real atmospheric states: fine vertical structures, inter-level correlations. It would be nice if authors can provide references on works that show ability of the WACCM model to reasonably simulate vertical distribution of gases in comparison with sonde, lidar or any other high-resolution measurements. At the very least, authors have to clearly identify in the text that they use "assumed" covariance matrices due to lack of real observations. In this case obtained error estimates should be also considered and treated as "assumed" smoothing errors. Finally, authors stated that the smoothing error have only statistical component, which is incorrect. The smoothing error represents the error caused by a limited vertical resolution of the observing system, thus it has very pronounced features defined by the instrumental averaging kernels and natural variability of the considered atmospheric gas. Moreover, any purely statistical errors will be cancelled out by averaging a large number of observations, which is not a case for the smoothing error.

Minor comments:

p. 13732, line 13: It would be nice to specify in numbers (km) what is "excellent horizontal resolution".

p. 13736, lines 7-14: Please, explain what does "a global a priori" and "single unique covariance matrix" mean. Does it mean that a priori information is independent of season? Do the a priori depend on latitude?

p. 13741, line 20: It might be better to replace "the position of the spectrometer relative

to the atmosphere" with, for example, "the geometry of observations".

p. 13743, lines 14-15: Please, consider to rephrase the sentence "Figure 3 shows ..."

p. 13743, line 23: Do you see significant differences for the O3 distributions between evening and morning overpasses? If so, please specify that in the text.

p. 13746, lines 9-13: Authors stated here that "IASI-FTS comparison also confirms the results observed for the consistency study of IASI-A and IASI-B sensors". It would be nice if you can be more specific and list similarities. In the following sentence it is stated that inter-comparison of IASI sensors could replace a validation against ground-based instruments. Two IASI sensors have similar systematic errors (instrumental, smoothing error etc.), and inter-comparisons will never reveal these types of errors. Only validation against independent observations can help to asses all type of errors. I would suggest to re-write this text.

p. 13754, line 11: What does "Gr" mean here? Please, define it.

p. 13765, Table 1: Does "Daily" mean +/- 12 hours or 24 hours?

Figure 3, upper panel: Please, consider to change colors. It is difficult to see differences between light grey and dark grey symbols.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 13729, 2015.