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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Satellite observation of lowermost tropospheric ozone by multispectral synergism of IASI thermal infrared and GOME-2 ultraviolet measurements" *by* J. Cuesta et al.

Anonymous Referee #1

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General comment:

The paper "Satellite observation of lowermost tropospheric ozone by multispectral synergism of IASI thermal infrared and GOME-2 ultraviolet measurements" by J. Cuesta et al. deals with improvements of Ozone retrievals from the Metop plateform using both infrared (IASI) and UV (GOME2) channels. The paper does not discuss geophysical processes related to tropospheric Ozone. It would therefore have been better suited for publication in AMT than in ACP. This work represents a real improvement to ozone observations from the Metop palteform. The paper is well written and the innovative retrieval method is correctly described. The main claim of the authors is that their multi-

spectral retrieval enables them to capture “lowermost tropospheric ozone” variations. This claim is not sufficiently supported by the evidences they give in their study and it is therefore an overstatement. Given the importance of the innovation presented, this study is suitable for publication. Nevertheless, the way the results will be presented will depend on the evidence the authors will provide to support their claim which is required in the present review. If the evidence we require does not support the claim of the paper regarding the observation of lowermost tropospheric ozone, the authors will have to change the title and the conclusions of their paper.

Theoretical characterisation:

The claim of the authors to capture lowermost tropospheric Ozone is mostly based on theoretical characterisation of the retrievals with information content analysis: AVKs and DOFs and altitude of highest sensitivity for instance (The two latest products being directly derived from the AVKs). These parameters give interesting information about the retrievals but are based on tuning parameters that regularize the retrievals and cannot be taken as the “truth”. The only way to claim that the retrieved quantities are “good” or “better” is to compare them to independent observations.

Validation with ozonesondes:

This is the most important part of the paper to support the claim of the authors, but it is too weak to be convincing.

-Validation sample: 119 ozonesondes, 3 months and Europe only is not much to support the strong claim of the authors considering the 6 years of operation of Metop and the availability of thousands of sondes all over the world. Furthermore if the authors keep the European focus, it should appear starting in the title: “Satellite observation of lower(most?) tropospheric ozone OVER EUROPE”. Indeed, the behaviour of the retrievals in other parts of the world is not discussed and is not straightforward at all.

-IASI versus IASI+GOME-2: one of the most important point of the paper is that the

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multi-spectral retrieval improves O3 retrievals in the LMT versus IASI only retrievals. But, the only real evidence that could support this claim is a joined comparison of IASI and IASI+GOME-2 versus ozonesondes. The authors only refer to previous IASI validation papers. This is not sufficient because the sonde sample is different and the comparison methodology is not the same. Furthermore, no LMT columns comparisons of IASI and O3 sondes are provided in the previous IASI validation papers. As this is the central point of this study, the reader should be able to clearly see the improvement without searching elsewhere. Therefore, we ABSOLUTELY need to have the same statistics for IASI and IASI+GOME2 versus ozonesondes in this paper.

- Comparison methodology: the authors present basic validation statistics: biases, rms of the differences and correlation coefficients. Important information is lacking: is the variability captured by the retrieval close to the variability observed by the sondes? There is a much better and more synthetic way to present the ability of an observing system or of a model to capture the variability of a parameter: the Taylor diagram used among others for the evaluation of climate models. Based on their simple relationship, it allows seeing at one glance the 3 important statistical parameters (rms of the differences, correlation coefficients and variability) of many datasets relative to a reference dataset. It is therefore more convenient for the reader who does not have to search for this information in many tables. A single diagram would allow the reader to see immediately the improvements brought by the multi-spectral retrieval versus IASI for LT, LMT, TROPO and UPTO30 (that is 8 datasets on a single plot). For clarity two diagrams could be plotted, one for raw and one for smoothed sonde data. The biases would still have to be presented in tables.

- Scatter plots: as they are, these plots do not bring much information (RMS, biases and correlation coefficients are already in the tables and Taylor diagrams would be more efficient and informative). The only added value of a scatter plot would be to see the line representing the linear fit between the sonde and satellite data and the corresponding parameters (slope...). Furthermore, if the authors want to present scatter plots, they

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have to show IASI and IASI+GOME2.

Comparison between IASI+GOME2 and CHIMERE:

This part is interesting to qualitatively document a particular event of high O3 concentrations in the lower troposphere over Europe and the ability of the satellite observations to capture this event. But it has to be clearer in the text that the model is not used to validate the observations. I would like to draw the attention of the authors to some weaknesses of those comparisons:

- they are based on colour maps visualisation and no quantitative statistics are presented.

- in order to clearly characterise the difference or improvement of IASI+GOME2 versus IASI figure 8 should also present the LMT columns of IASI and of CHIMERE*AVK for IASI.

- the authors do not discuss an important feature of the LT and LMT O3 distributions which is rather unclear: enhanced columns from IASI+GOME2 over north eastern Europe (north of 45N and east of 20E) (fig. 7 a and b). These enhanced O3 columns are not observed with IASI (fig. 7c and d) but are clearly detected by GOME2 (fig. 7e and f). As GOME2 is more sensitive to the UTLS than to the LT this indicates that these enhanced LMT columns are POSSIBLY coming from a CONTAMINATION FROM UTLS O3. Furthermore CHIMERE do not simulate this feature (both from surface to 3km (fig. 9c) and from 3 to 6km (fig. 9d)) except partly just north of the Black Sea but high LMT columns appear when the IASI+GOME2 AVK are applied to the CHIMERE data (fig. 9b). This corroborates the hypothesis of an UTLS contamination of the LMT column by the AVKs. In order to confirm or to rule out an UTLS contamination, the authors have to look at UTLS properties over Europe during the studied period. Is there an intrusion of polar LS air over north eastern Europe? The answer will come from UTLS O3, PV/geopotential heights from CHIMERE and from other sources. In case such a contamination is confirmed, this has to be discussed in the paper as a weakness of the

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