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Interactive comment on "Validation of Aura-OMI QA4ECV NO$_2$ Climate Data Records with ground-based DOAS networks: role of measurement and comparison uncertainties" *by* Steven Compernolle et al.

Anonymous Referee #1

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General comments:

The manuscript by Compernolle et al. presents an important validation work for a satellite-based NO2 climate data records. The validation process is accurate and comprehensive. The findings, especially the ex-ante uncertainty vs. RMSD budget, in this work are important for end users. The manuscript should be published after addressing the following minor comments.

Specific comments:

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Page 10, lines 1 to 8. Any comments on the difference caused by AOD inputs (i.e., QA4ECV uses AERONET, whereas bePRO uses OE results)? What if bePRO uses AERONET AOD?

Page 17, Figure 5. The model adjusted SAOZ AM and PM data have a larger discrepancy in winter at OHP (Fig. 5 right panel, green and cyan dash lines). This effect is not observed at Kerguelen, i.e., its July data. Is this due to the heavy local tropospheric NO2 signal at OHP (in winter)? Any comments?

Page 20, Figure 7. It is very difficult to see if there is or isn't any seasonal variation. The symbols are jammed. One needs to find better methods to show this, e.g., sub-panels by seasons.

Page 24, Figure 8. Taking the fact the size of superpixels from OMI and TROPOMI are similar, why Uccle and Thessaloniki show very large changes in the smoothing difference error (OMI vs. TROPOMI). Is this indicate these sites have more fine-scale variation than others? Note that for Mainz, the smoothing difference error in Fig. 8a and 8b are not very different.

Figure 8. Any comments on the positive mean difference for Xianghe and Cabauw in Fig 8b, at JFM? This figure is fascinating and revelled many important aspects of these two generations of satellite data products. Although this is a bit out of the scope for this paper, I would still suggest the author give more comments on their difference.

Page 31, lines 28-29. For the Xianghe site, why smoothing can increase the seasonal variance this much (baseline vs. GB smoothed, var (seasonal) increased by about a factor of two)? Can the author confirm this is simply due to the non-harmonized a priori? Why "GB harmonized" has less seasonal variance than "GB harm + smoothed". The figure leaves the impression that the averaging kernel smoothing caused this increase of seasonal variance, no matter one harmonizes a priori or not. Please provide some comments and explanations.

Technical corrections:

Page 3, line 8. Define OMI here.

Page 3, line 9. Define DOAS here.

Fig. 4. Use consistent abbreviations for stratospheric and tropospheric, i.e., "strat" or "strato", "trop" or "tropo".

Page 8, line 26. Modify "by Irie et al. (e.g., 2011, Fig. 17)" to "by e.g., Fig. 17 in Irie et al. 2011."

Page 10, line 2. AOD has been defined twice in this line, remove the 2nd one.

Page 11, line 21. Change 'MAXDOAS' to 'MAX-DOAS'.

Page 15, Figure 3. Please define "MXD" in the caption.

Page 38, line 7. Change "n/a-n/a" to proper page numbers. There are several other "n/a-n/a" in the references.