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Interactive comment on “The GOME-2 instrument on the Metop series of satellites: instrument design, calibration, and level 1 data processing - an overview” by R. Munro et al.

Anonymous Referee #1

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The manuscript provides a very good compilation of the state of the knowledge on the GOME-2 instruments' design and performance. The results are well-structured and well-referenced and use good statistical analysis methods. There are good references to detailed reports for interested readers. The paper is generally well-written. Some questions and suggestions to handle them, some ideas to improve the flow and clarify some of the content in the tables and figures, and some minor editing notes are discussed below.

The Journal choice to place all of the tables and figures at the end of the document instead of near their descriptions in the text is inconvenient.

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Page 10, Line 10. Are the SLS measurements able to give the relative changes (wavelength dependent ones) in the solar path throughput even without overall signal stability? That is, even though the lamp output is not stable, are the output variations sufficiently well correlated across the different lines?

Table 2. It is not clear in Table 2 that the last row of values is for both PMDs.

Table 3. This table has designations for two footnotes “**” and “1” but only one footnote is present.

Page 6 Line 19. There should be some clarification here. Maybe “For Earthshine measurements, subsets of the 256 detector pixels of both PMD devices (for details we refer to EUMETSAT, 2014b) are selected and co-added spectrally on board to create 15 broader PMD spectral bands to send to the ground. The numbers and spectral locations of the pixels are provided in Tables 4, 5 & 6.”

Page 6, Line 14. Minor edits. “A sub-set of the calibration key data is a required input to the GOME-2 level 0 to 1 processor, e.g., the radiance, irradiance and polarization responses of the instrument.” Note: “e.g.” is an abbreviation for “for example” in Latin. As such it should be italicized. If it is used to start a clause, then it should be offset with at least one comma from the main part of a sentence.

Introduce Etalon. The term “Etalon” is first used on Page 5, line 27 and then three more times through Page 13 without any discussion or promise of further illumination on the phenomenon. This is okay for an instrument effect like stray light but the novice GOME-2 reader needs some guidance or at least the assurance the all will be explained in Section 3.5 .

Page 14, Line 5. Add the following notice: “Cloud parameters are also determined and added to the output. The methods to determine these parameters are described in Section 3.9.”

Page 15, Line 3 and following. While it is certainly important for users to be aware of the

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spatial aliasing and how to calculate adjustments, this material breaks up the overall discussion and seems to have too much detail relative to the surrounding content. I recommend that the detailed description of the calculations and the equations be moved to an appendix.

Page 19, Section 3.4. The instrument bandpasses will be differentially impacted by wavelength-dependent throughput gradients in any dichroic or other reflective/transmissive discriminating element. Consider a grating/detector system that produces a balanced symmetric Gaussian bandpass convolved with a decreasing throughput dropping by 10% across the nominal bandpass FWHM, say from 22% to 20% transmission. This will produce a skewed bandpass resulting in shifts in the bandpass-weighted average wavelengths. Further, the gradients have opposite signs for two channels around their overlap point. Are these bandpass shape/skewing variations observed for GOME-2? The relative variations become largest for wavelengths with the largest relative changes in the throughput. This usually occurs where the dichroic is delivering 50% or less of the signal.

Figures 8 and 9. The information in the legends for Figures 8 & 9 could be repeated in the figure titles since the fonts are very small.

Page 22, Section 3.6. To me, a full calibration would mean removing the effects of instrument throughput degradation. Since the solar and earth spectra are left with a shared component, we are given an in-between quantity – the radiance at the space-craft adjusted for the ground-based characterization of throughput but not all of the ensuing known changes in orbit. I am not sure what term to use in place of “full”. This would be proper usage for the reprocessed Level 1 data.

Figures 9 and 10. Perhaps a scaled “minus T” curve from the average for Figure 10 could be superimposed on one of the Figure 9 plots to good effect for displaying the correlation between the temperature evolution and the wavelength scale variations.

Figure 11. The surface plots should be stretched in the Z direction as that is the main

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result. Consider removing the internal titles and the top figure's solar azimuth angle axis label. A simple (A) and (B) in the plots with references in the title can identify the two cases.

Figure 14 and Page 31, line 14. Were solar cycle activity features (27-day variations) removed from the data for the 250 nm to 290 nm region? Are there any theories on the causes of the vertical striping for 300 to 400 nm range most apparent in the PMD-S figure but also present in Band 2 near 350 nm?

Page 32, Lines 1 to 3 and Lines 26 to 27. Where and when will this quantitative analysis appear? What locations are used to monitor the year-to-year changes? How do these adjustments compare to the information from Level 2 product developers?

Section 4, Level 2 feedback. It would be nice to have more information (or at least citations) on the feedback on calibration provided by Level 2 product developers. Possible topics/references for Section 4 would include: Trends in trace gas retrieval uncertainty from decreased throughput; Trends and cross-track changes in UV Absorbing Aerosol Index values (or the adjustments made to remove them); trends in adjustments applied by GOME-2 ozone profile retrieval product creators; and sizes of intra-orbital wavelength scale shifts estimated from DOAS retrievals, and, perhaps, their relationship to intra-orbit thermal changes and Figure 9 & 10 long-term results.

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