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Atmospheric Measurement Techniques Discussions

Interactive comment on "Evaluation of ozone profile and tropospheric ozone retrievals from GEMS and OMI spectra" *by* J. Bak et al.

Anonymous Referee #1

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General Comments: The manuscript "Evaluation of ozone profile and tropospheric ozone retrievals from GEMS and OMI spectra" by Bak et al simulates measurements for the proposed Geostationary Environment Monitoring Satellite instrument from OMI level 1b measurements in order to analyse ozone retrieved from them. GEMS is expected to measure earthshine radiance from 300-500nm, whereas OMI currently measures between 270-500nm. The manuscript assesses the impact of this shorter wavelength range (and other sub-ranges) on the retrieval of ozone in the troposphere and stratosphere.

It would be expected from first principles that without the spectral information from the Hartley Bands <300nm information about stratospheric ozone would be reduced.

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Interactive Discussion
Discussion Paper

The authors use properties of the averaging kernels (AKs), a measure of information content and retrieval error to demonstrate how the retrieval is affected. They then evaluate the retrievals against MLS ozone profiles in the stratosphere.

The impact of the restricted wavelength range of GEMS on ozone profile retrieval is very important to establish, both for satisfying the mission requirements and for future reference. It is anticipated that there will be extensive comparison to other satellite products that are scheduled to be operational at the same time as GEMS (not least those from MetOp and Sentinel 5 Precursor/Tropomi).

Overall the manuscript satisfies its objectives, and the study of how a change in wavelength range affects the retrieved ozone profile for this type of instrument is a useful one beyond just GEMS.

As a general comment, it is important to clearly distinguish whether 'tropospheric ozone retrievals' (used frequently) are tropospheric column retrievals or tropospheric profile retrievals, i.e. what is the final product that is compared. Based on the AKs shown in Figure 2 it is apparent that a profile is retrieved in the troposphere, and yet a tropospheric column or just tropospheric ozone is referred to in the text. More clarity is needed so that conclusions drawn in the manuscript about comparative tropospheric ozone for GEMS and OMI are more meaningful.

It is stated that tropospheric retrievals are no worse than OMI for the curtailed wavelength range, but it would be an improvement to give an indication to the reader of what OMI is capable of in terms of retrieval of ozone in the troposphere. This would entail at the very least a reference to a paper that evaluates tropospheric ozone derived from OMI measurements. For example, the last line of section 3 (ending in 'OMI experience') does not indicate whether fitting to 3% is good or bad. For example, is it larger or smaller than the standard deviation of the fit residuals? In general I would not think it sufficient to state that something is as good as OMI in some way but not even indicate how good OMI is.

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Specific Comments: It would have been clearer to indicate in the title the fact that GEMS is a mission in preparation or that these retrievals do not represent a final or real product from GEMS and some assumptions or approximations have been used to simulate them. It is a minor editorial point though, as it is soon evident from the abstract that this is the case, and may be superseded by the need for brevity.

Page 6742 line 13 it is stated that the errors increase by 1-2% for most of the stratosphere and 3-4% above ∼40km, compared to OMI. This is an ambiguous statement, as it implies that this percentage change is the change based on the OMI retrieved error. Figure 2 shows that in absolute terms the retrieved error actually doubles above ∼3hPa compared to OMI.

In the abstract (page 6734 line 16) and section 4 (page 6740 line 18), the information content is defined as the degrees of freedom for signal, derived from summing along the diagonal of the averaging kernel (although this is not the only measure of information content). In addition to the measurement vector, the DFS is also heavily dependent on the prior covariance (and the state itself), and while these are accepted as being the same for the OMI and GEMS retrievals for this simulation it would be fairer to mention that it is both an estimate and that it is dependent upon more than just the spectral range of the measurement, particularly when the measurement noise for the proposed instrument has only been estimated. As such it is a little strong to state that should the diagonal value of the AK be 1 the measurements have 'perfect' information for ozone at that layer. Even to have something like perfect information this might not necessarily imply you have perfect retrieval knowledge, or that you can know the ozone in that layer with perfect accuracy or precision. The terms 'appropriate' or 'sufficient' would be better.

Title of Section 5.2 (page 6744) should be 'Comparison of stratospheric profiles' to avoid ambiguity.

Section 4 (page 6740 line 30) it is worth considering that if the sub-column prior con-

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straint for both the OMI and GEMS profiles in the stratosphere is relatively small, then the sub-column retrieval errors will also remain very small irrespective of spectral range has been used and other than the reduction in DFS it would reveal little about how the retrieval has been affected on its own.

Page 6747 line 2. While it is clear that there is 'little difference for tropospheric ozone retrievals' using the proposed GEMS wavelength range compared to OMI, elsewhere it is stated that the bias in the UTLS is affected. Unless your tropospheric ozone column is retrieved via a different scheme it follows that any impact on the UTLS potentially impacts the tropospheric column and the stratospheric column, so there is a minor inconsistency here.

Page 6747 line 22. Another way to interpret the statement that GEMS profiles above 3hPa would be improved if a better prior were used, is that it would just be returning a better prior (particularly when compared to MLS which also comprises the prior). In that case the retrieval itself is not necessarily improved. It might be more appropriate to retrieve fewer, deeper layers above this, but it is a good result to establish the useful vertical limit of the retrieved profile.

Figure 2. It is hoped that this would appear bigger in the final PDF. At present it is far too small to read all of the information on the panels without some difficulty.

Typographical Corrections: Page 6741, line 10, 'erros' should be 'errors'.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 6733, 2012.