We appreciate the efforts of the Referee #2 and want to express our gratitude.

Referee #2 Anonymous

Review of the manuscript "Overview of the O3M SAF GOME-2 operational atmospheric composition and UV radiation data products and data availability", by Hassinen et al. This manuscript provides an overview of the GOME-2 O3M SAF products. After an introduction all the products are described with varying information content. The ground segment and potential new products are described.

General comments

Overall I find this a very hard paper to review. Partly this is because it is an overview paper, which generally do not provide a whole lot of new scientific information. However, I think this paper must be improved in a various ways, because currently it reads like a cut-and-paste work. I think that the audience for which the paper is intended has not been properly defined. Different audiences could for example be: 1. users that are new to GOME-2 products and need a starting point; 2. policy makers that have funded the mission and need a concise overview; 3. scientific data users that need information on data products they use; 4. scientists that need a paper to refer to. I think that the manuscript has the potential to serve the audiences 1 and 2.

Once the authors have defined the audience, they should revise the entire paper to ensure that it serves that audience. This includes improving the consistency between different parts of the paper.

Answer:
We thank you for you comments and appreciate your suggestions for improvements. We did go through the manuscript keeping in mind the target audience (groups 1 and 2).

Question:
The number of acronyms in the paper is way too large. For each acronym that is used it should be checked if it adds anything to the paper (for example acronyms that used only once are not too useful), and if the acronyms is used consistently throughout the paper. Given the large number of acronyms, I propose to make a separate section at the end of the paper where they are all described.

Answer:
Yes indeed, there exist a lot of acronyms. This is normal when mentioning several instruments and products. Fortunately, most of those are quite well known in general.

We did go through the acronyms. We spelled out the acronyms in the first sections and left only those that are mostly used or that are generally known. However,

specific acronyms mentioned in sections of individual products were left mostly intact because they are used only inside those sections and thus, also the meaning is well defined and explained. Thus, we didn't see it very useful to add a specific section for acronyms.

Question:
In some parts of the paper there are reference to the MACC II project. I propose to update these to point to CAMS. Also, GMES should be updated to EU Copernicus I think the manuscript could be improved with the corrections a native English speaker. (For example "quarantined" in line 15 on page 6995.)

Answer:
GMES replaced with Copernicus
MACC II replaced with CAMS
Typos corrected

Manuscript organization

Question:
I propose to modify the organization of the paper as follows: Include section 7 into section 4. Rationale: section 4 describes the ground segment; it is logical that it also covers data dissemination.

Answer:
This was done. Furthermore, we added the proposed section on data usage. Please see the updated manuscript

Question:
I strongly advice to place the ozone profile product description (section 5.2) directly after the total ozone description (5.1.1).

Answer:
This was done. This change caused also that the order of figures has changed from the previous version.

Question:
I advice to write a new section on data users. This is now covered in the introduction, but deserves to be described in more detail. Maybe statistics on the data use can be added.

Answer:
We investigated this approach, in fact, already adopted it. But, we realized that the usage of certain data product is better to have together with the product introduction. However, we added a paragraph about product usage in a general level into the Section 4 which describes Level 2 processing and archiving and thus, is a natural place for this information.

Question:
A section shall be added that describes where the Level 2 requirements for GOME-2 can be traced to.

Answer:
We see that a complete section for this may be too much. However, we have added a paragraph into the Section 5 regarding product requirements, where they originate and how they are updated. In brief:

The original accuracies were defined in the EPS End User Document (EUM.EPS.MIS.REQ.93.001). The requirements specified in this document have been established in coordination with User representatives nominated by the National Meteorological Services of EUMETSAT Member States and endorsed by the relevant EUMETSAT bodies.

However, each product is subject to Requirements Review before the product can be implemented and declared operational. The review board consists of EUMETSAT representatives as well as external reviewers who represent the user community. Thus, the accuracy requirements for operational products reflect the evolving user needs as well as improved retrievals with the new algorithms. The existing product requirements are available from the Serve Specifications document.

Question:
I propose to organize section 5 differently by simply using one subsection per product. Now there is a very long section 5.1 with many shorter subsection for the column trace gas products, followed by section 5.2 – 5.5 for the other products.

Answer:
We adopted this approach. Thus, the numbering of sections as well as figures has changed.

Specific comments

Section 1.
The first sentence should be revised. While I understand what the message is, I don't think it is properly worded.

Answer:
The sentence was revised.

Question:
Page 6996 lines 1-9. Here several reference need to be added to high-level requirement documents, e.g. Copernicus, IGACO, GCOS, etc.

Answer:
References to IGACO, GCOS and , CAMS and C3S were added. IGACO and GCOS references are to latest reports whereas Copernicus, C3S and CAMS references are to WWW sites.

Question:
Page 6996 lines 10-23. The introduction heritage missions is far too limited. The introduction should also include a description of and references to the TOMS and SBUV missions, the OMI/Aura mission and the Copernicus Sentinel 4/5/5p missions. This puts the GOME-2 missions into perspective.

Answer:
This part was extended by including BUV/SBUV/TOMS, OMI, OMPS, Envisat instruments, SAGE, SABER, OSIRIS as well as coming S5p, S4 and S5.

Question:
Page 6997. I propose to remove the description on the data dissemination because it is described in a separate section.

Answer:
Dissemination removed from the section 1

Question:
Page 6998. Delete the detailed information on who develops the IASI product. The point here is that IASI products will be add, not who makes them.

Answer:
Developer information was removed as proposed by the Referee

Section 2.

Question:
Page 6998. I find a reference back to the old science objectives papers of GOME very weird. These papers are 20 years old. In the mean time our insights have changed. Moreover measuring a set of trace gases is not a scientific objective (page 6998, line 25); these are observation requirements that follow from the science objectives. In addition there is a big difference between the GOME and GOME-2: a scientific

mission versus and operational mission. I don't even know if the operational GOME-2's have a set of science requirements. Thus, this section is really confusing to me and needs strong revision. Maybe the whole part on scientific objectives should be deleted.

Answer:
These references were added to show the historical development started with GOME and continued with GOME-2. However, we understand that this may look quite strange and indeed, there has been a lot of changes during these years. Therefore, we deleted the scientific and general objectives as proposed by the Refee but we leave the first part of the paragraph.

Question:
Page 6999 line 3-8. This is introduction. If the authors want to keep it, it should be moved to the introduction.

Answer:
This was moved to the Introduction as proposed by the Referee

Question:
Page 6999 line 9-15. References shall be added to papers or technical reports that provide technical details on the instrument.

Answer:
The technical details are given in the paper by Munro et. al. 2015 which is under discussion in AMT. A reference into that paper was added at the end of the paragraph indicated by the Referee.

Section 3

Question:
Section 3 in its present form is too short to keep as a separate section. However, I think it should cover more information (see below).

Answer:
Due to changes, this is now much longer and more detailed section. Please, see below.

Question:
Page 7000 line 9. Here a reference is made to a paper that is not yet published. This shall be replaced by a traceable reference.

Answer:
A proper reference was added.

Question:
In section 3 description shall be added that describes the Level 1B data quality of GOME2A and B. In section, for several products instrument degradation is mentioned to have a large impact on data quality. This could be a short summary of the Munro (2015) paper.

Answer:
We invited a L1 expert to participate. Thus, this section has been rewritten completely with proper references to Munro et. al. 2015 and relevant technical notes.

Question:
In section 3 the current Level 1B version should be given.

Answer:
The current version is 6.1.0. This was added into the text as proposed.

Section 4

Question:
This section starts with a description of the ground segment. I propose to include here also the data dissemination section (now section 7).

Answer:
This was done. Furthermore, as separate User section was added. Thus, the section numbers were updated too.

Question:
Although I understand the text on page 7000 line 11 to 24, figure 1 confused me a lot. This seems to be a flow chart, but without further description it is not clear to me. The entities described in the text are not shown in this figure. I propose to delete this figure, because for me it has no added value.

Answer:
The figure was deleted

Question:
Also the validation methods are very briefly described. Given the importance that such processes are for an operational mission, I think the authors could describe this in more detail. I checked the website that is given, and was only to find recent comparisons with ground stations for a few products. Most the validation reports are several years old. What is the strategy for validation and quality control? How often

are analysis made
and reports issued?

Answer:
The complete validation is done in the review process before the product comes operational and available for the users. Furthermore, the validation is repeated whenever there is a major upgrade of the algorithms that have an effect to product quality/accuracy. Thus, the validation reports may be quite old. However, the product stability and quality is monitored continuously by the processing centers as well as the validation teams. Online monitoring services in NRT or within couple of weeks against external data and/or trends are available for many products and we will improve this kind of services in future. Furthermore, the product quality is checked in Operations Reviews by the review board once per year. This board has members from our user community too.

We added a short sentence on this at the beginning of current Section 5.

Question:
Page 7001 lines 9-11. I don't understand this sentence. Without context I can only guess what "user services of climatological proxies" are, and similarly for BEAT. I think this sentence can be deleted and otherwise it should be expanded and references added.

Answer:
These sentences have been deleted. The BEAT interface is explained together with data dissemination in section 4, which is a proper place for it.

Section 5

Question:
Table 1 provides key information for this paper and should be expanded. I propose to rotate it 90 degrees such that it can hold more columns. Information to be added:
-The current version of the processor to which the validation examples apply.
–The spectral ranges used for the retrieval
-Application area (e.g. climate change, air quality, ozone monitoring, aviation safety, etc.)
-Main reference
-Internal products, e.g. cloud products.
-In separate the rows the planned products fro CDOP 3.

Answer:
Unfortunately, if adding CDOP-3 products as well as internal products, the table becomes so long that it cannot fit on the rotated page either. Thus, other kind of solution was investigated for AMTD. We decided to split the table into two parts, the second table focusing on geometry and more general aspects whereas the first focus on more scientific/physical issues. The aspect may be reconsidered for the final AMT paper when the paper dimensions are different.

We added the proposed new columns except the main reference because the references are mentioned in the text. Furthermore, it's quite impossible to select just one or two main references because the possible targets focus on different aspects. The added columns are:

- Processor version
- Spectral ranges
- Main application area(s)

Question:
It is not clear that "High res. Ozone" and "Low res. Ozone" refers to ozone profile products. From the product name it should be clear that this is about ozone profiles.

Answer:
We clarified the names of those products.

Question:
Some product names contain information on the dissemination, e.g. "Off-line UV index", "NRT UVI Clear". Why put this information in the product name when there is a separate column for this information?

Answer:
We removed this separation

Question:
On one row "Absorbing Aerosol Index" is used and in the next "AAI". Please make the table consistent.

Answer:
Done, we use only AAI

Question:
Footnote 1: the resolution is not well described. This table is for the entire data record and not for the current situation. The baseline resolution is 80x40 km2 for GOME-2. Since recent years GOME2A measures at 40x40 km2.

Answer:
We improved the wording here by indicating the nominal resolution for both instruments and the special case for GOME-2A.

Question:

The background of the target accuracy is not discussed in the manuscripts. What are the references to the observational requirements? How is target accuracy defined and how is it verified? Is it applicable to single measurements or to an ensemble? This should be discussed in a lot more detail in section 5.

Answer:
The original accuracies were defined in the EPS End User Document (EUM.EPS.MIS.REQ.93.001). The requirements specified in this document have been established in coordination with User representatives nominated by the National Meteorological Services of EUMETSAT Member States and endorsed by the relevant EUMETSAT bodies.

However, each product is subject to Requirements Review before the product can be implemented and declared operational. The review board consists of EUMETSAT representatives as well as external reviewers who represent the user community. Thus, the accuracy requirements for operational products reflect the evolving user needs as well as improved retrievals with the new algorithms.

We have added a paragraph into the Section 5.

Question:
Note that only for a few data products described in section 5 the validation results are compared to these accuracies.

Answer:
Text adapted in section 5

Question:
Some of the target accuracies seems strange to me. For example the combination of an accuracy for a total NO2 column of 3-5 10ˆ14 and a total column of 20% seems an impossible when the trop column is several times 10ˆ16.

Answer:
We agree, the accuracy estimates for NO_2 needs to be described in some more detail. As indicated by the reviewer, the accuracy in the total and tropospheric NO_2 columns depends strongly on the pollution level and on the measurement conditions (e.g. impact of clouds and aerosols). The reported target accuracy for the total NO_2 column of $3\text{-}5 \cdot 10^{14}$ molec cm^{-2} (8-15% annual mean) applies to unpolluted conditions. The target accuracy of 30% for the trop. NO_2 columns (the 20% mentioned in Table 1 was a typo; this is now corrected) is for polluted conditions. We have added a footnote to Table 1 on the NO_2 accuracy estimates.

Question:
A target accuracy for the LER of 0.04 seems way too relaxed. For most surfaces this

is an error of more than 100%.

Answer:
This is true, for certain surfaces and wavelengths the error in the retrieval is larger than the value of the LER itself.

Unfortunately, that is just how it is. Relatively small errors in the Earth reflectance lead to quite large errors in the surface LER, especially for the shorter wavelengths. This is due to the fact that the atmospheric correction is very large compared to the Earth reflectance itself for the shorter wavelengths (Koelemeijer et al., 2003, section 5.1.1).

In the Kleipool et al. (2008) paper the following accuracy of the OMI surface LER product is reported:

"The overall accuracy of the OMI LER climatology is approximately 0.01 to 0.02 for the longer wavelengths and increasing toward the shorter ultraviolet wavelengths."

So 0.01 to 0.02. But only up to 499 nm. In the Koelemeijer et al. (2003) paper errors of 0.02 are reported, as well as an accuracy of 0.02.

Therefore, we do not think that the 0.04 is way too relaxed value. Perhaps a target value of 0.02 would be feasible as well, but anything less than that is just impossible to achieve.

By the way, in the GOME-2 surface LER product we have included an accuracy field. This is to report to the users the accuracy of the surface LER for the actual grid cell that they are using, for the actual wavelength that they need. This is useful for certain retrievals. Additionally, it makes it quite easy to analyse the overall accuracy of the database.

Question:
Why is the target accuracy for low res ozone different from low res ozone?

Answer:
The target accuracies are indeed the same. This was corrected.

Section 5.1

Question:
I propose to include the information of table 2 in table 1 and delete table 2.

Answer:
This was done. However, due to several new columns that Referee proposed, the table 1 is split into two parts. Otherwise the table is too large.

Question:
The sentence that the new version will be implemented this fall doesn't add anything to the manuscript, so I propose to delete it. Furthermore, information on processor versions can be included in table 1.

Answer:
The processor version was added into the table 1. However, we propose to keep the information regarding the next implementation because the work for this is ongoing and the new versions include clear improvements. Thus, the reader should be aware of coming improvements when using the products.

Section 5.1.1 (Currently 5.1)

Question:
I have my doubts if the part on ENSO/NAO is suitable for this paper (page 7003 and 7004). First of all there is no introduction on what these are, even the acronyms are not explained. Thus, a lot knowledge is required to understand this paragraph. Furthermore, thelack of correlation with the NAO index is not discussed. The authors should either expand this part a lot, or decide to leave it out. I am in favor of the latter.

Answer:
The ENSO/NAO paragraph has been removed as well as the corresponding Figure.

Question:
The last part of this section describes the users. As described above, my advice is to describe the data users in a separate section for al the data products. The text provide here already contains a good basis to do that.

Answer:
A separate user section was added. (Section 5)

Section 5.1.2 (Currently 5.3)

Question:
Why is the MOZART-2 model used for NO2 AMFs and the IMAGES model for formaldehyde?

Answer:
That the MOZART-2 model is used for NO_2 AMFs while IMAGES model is used for HCHO is mostly for historical reasons. The development of the operational NO_2 column algorithm was carried out in cooperation with the University of Bremen and

has started well before the development of the operational formaldehyde algorithm, (which is based on the BIRA algorithm, De Smedt et al.). The use of an updated NO_2 profile climatology (e.g. from the IMAGES model) in the operational NOS processor is foreseen for the next algorithm version (GDP 4.9).

Question:
Figure 5 shows an average tropospheric NO2 column. I don't like the use of the nonlinear color scale for this figure. The text focuses on the high values in China, but due to the choice of the color scale this is one red blob without any variability. Also, depending on the target audience (see general comments), one should be very careful in the use of non-linear scales.

Answer:

Note: Fig 5 is now Fig 7 due to structural changes.

The main purpose of Fig 5 is to illustrate various different NO_2 features, e.g. the extreme pollution over Eastern China, the individual cities in South East Asia, as well as the shipping tracks in the Bay of Bengal and the South China Sea (see comment below). Because these features cover very different NO_2 levels (from $5 \cdot 10^{14}$ molec cm^{-2} to $2 \cdot 10^{16}$ molec cm^{-2}), a map with linear color scale does not properly illustrate these features (see Fig. 1 below). In the manuscript, we have improved Fig. 5 by adjusting the values range. In the figure caption, we mention the logarithmic scale used for the NO_2 map.

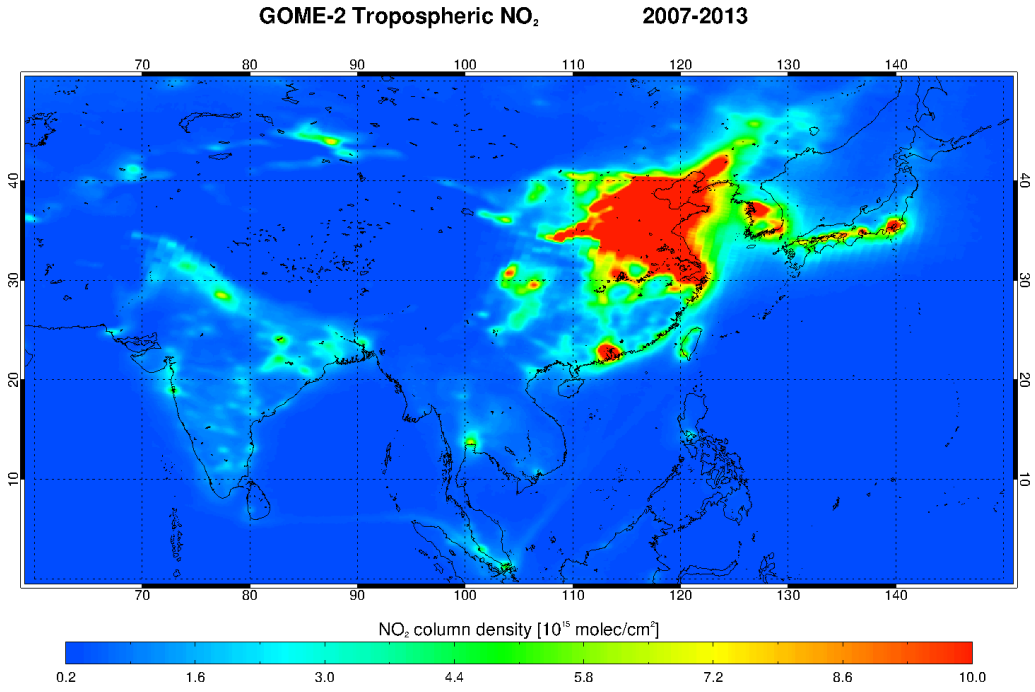


Fig. 7 Average tropospheric NO2 columns over East Asia measured by GOME-2 for 2007-2013 (linear color scale)

Question:
In many cases there are strong NO2 variations over land-sea crossings (e.g. India), also in regions with far less emissions. What is the reason for these?

Answer:
Note: Fig 5 is now Fig 7 due to structural changes.

In figure 5, the strong NO_2 variations over land-sea crossings (e.g. India, Bay of Bengal and the South China Sea) are emissions along shipping lanes. See e.g. Richter et al. (2011).

Question:
Page 7005, lines 5-10. This is about data users. I advice to move this to a separate section.

Answer:
A separate section (Section 5) on users was created and this information was moved there.

Question:
Page 7005, line 21. On the validation website I could only find validation data up to the beginning of 2014. This is not very recent for an operational mission.

Answer:
Figures in the BIRA validation pages are updated after new validation reports. We are currently in the process of evaluating reports for version GDP 4.8, and figures will be updated once this report is official. In parallel, we are working on quality assessment pages that will be updated automatically, but they probably won't be ready before the paper publication.

Question:
Figure 6. What do the error bars represent? This figure could be further improved by using box-whisker plots.

Answer:
Note: Fig 6 is now Fig 8 due to structural changes

The error bars represent the 1 sigma spread (68% of the points) around the median value, ie, plus and minus (Interq84-Interq16)/2.
We agree with the reviewer that this figure could be improved by using box-whisker plots, but our approach in the current figure 6 is quite similar, and the

goal in this paper is to show examples of validation results (performed in details in the validation reports themselves) for both GOME-2A and GOME-2B, and we thus prefer to keep the look of the reports themselves.

Question:
Figure 6 doesn't compare the same period for GOME-2A and GOME-2B. Given these different periods, can the conclusions on the bias be drawn?

Answer:
Note: Fig 6 is now Fig 8 due to structural changes

The goal of figure 6 is not to compare GOME-2A and GOME-2B one to the other (in this case the illustration would be biased because showing only data above stations with available ground-based data), but to compare the 2 satellites with the reference ground-based data. By selecting only common time-period, we would lose the relation to other parameters, such as the difference in age of the 2 satellites.

Question:
Page 7007, line 2. The term "urban effect" is misleading. This effect is due to a representation error and should be referred to in that way.

Answer:
This term has been removed and the term "representation error" has been used instead and the following sentence has been added in the text:
"This effect is due to a representation error for stations in urban locations, affected by local pollution episodes, not seen in the averaged GOME-2 pixel. "

Question:
Figure 7. Panel a is way to small. Panel b: why are the symbols in red? I would opt for a more neutral color for these plots. Panel 7 c: the last part of the plot is very hard to read (when there are 4 datasets instead of 2). I propose make a zoom of this period in another panel.

Answer:
Note: Fig 7 is now Fig 9 due to structural changes .

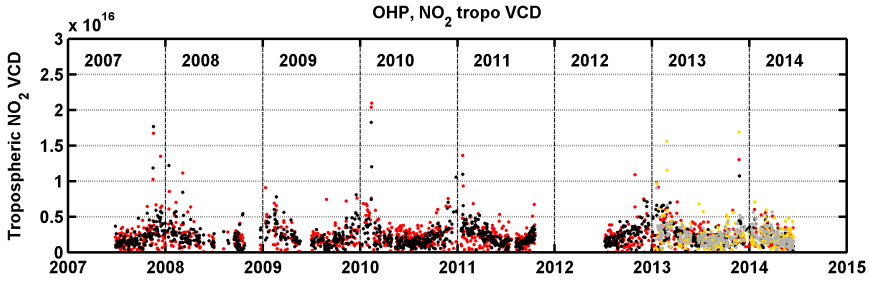
This figure has been improved, as suggested by the reviewer, by increasing panel a), adding panel (d) with a zoom of panel (c) and changing colors of panel (b).

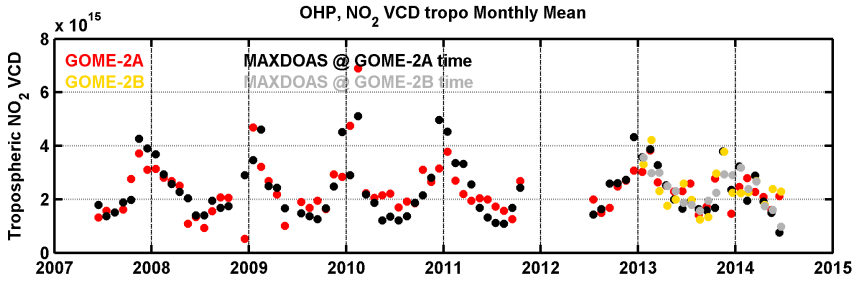
Question:
Figure 7c: this plot contains monthly means. There are several months with larger

differences between GOME2A and MAXDOAS. For example December 2009, February 2010. In these cases GOME2A seems to be way off. Describe in the text the reason for these discrepancies and how the use of these data by users can be avoided.

Answer:
Note: Fig 7 is now Fig 9 due to structural changes .

The specific discussion about the differences of every months is not the focus of this paper. Figure 7(c) is an example of validation results, showing only monthly means. When looking to the daily points comparisons (not shown in the paper, but reported below for the reviewer), it can be seen that most of the months where the difference are larger (December 2008, December 2009 to February 2010, …) are due either to a small number of daily points for the monthly average, either to 2 or 3 values where the differences are larger.





Median values could be used instead of monthly means or a more specific selection of pixels close to the ground-based station. Part of these differences could also be due to differences in sensitivity between the satellite and the MAXDOAS, and if the MAXDOAS is recording profiles (which is not the case for figure 7c), the averaging kernels could be used to reduce the influence. See the new NO2 validation report which will be available in December 2015.

Section 5.1.3 (Currently 6.4)

Question:
The chemical formula of formaldehyde that is most commonly used is CH2O. Sometimes HCHO is used. Why do the authors use H2CO? I think this is confusing for potential users to see all these different chemical formula's used for the same species. I advice not to use H2CO and change to either CH2O or HCHO throughout

the manuscript.

Answer:
H2CO replaced with HCHO

Question:
Page 7007, page 25. As before I advice to describe the main data users in a separate section and to delete it form the product description.

Answer:
A separate user section was added and this sentence was moved there. 5. Data usage

Section 5.1.4 (Currently 5.5)

Question:
Page 7009, lines 5-10. This is an introduction on the role of SO2 and needs a few references. In addition, the role of sulfate aerosols in human health is not mentioned.

Answer:
We have modified this part accordingly

Question:
Page 7009, lines 10, Fig 10. The text mentions that the Figure 10 shows global SO2 missions. However, what is shown are regions where GOME-2 has detected SO2 concentrations above a certain threshold. There are certainly more SO2 sources than shown in the figure. I find figure 10 not clear. There are color used, but a color scale is missing. For example over the Beijing area I see blue colors, but the anthropogenic emissions are yellow according to the caption. Also, both in print and on-screen the black background doesn't work. In addition from the caption and the text it remains unclear what is presented (variable, mean/median/max value, time period, etc.).

Answer:
Note: Fig 10 is now Fig 12 due to structural changes
We have updated the figure by using white background. We have exchanged this figure with a yearly average plot of SO2 data detected by GOME-2A and GOME-2B clearly showing volcanic and anthropogenic SO2 sources that are explained in the text. The color scale show only column density, not the origin.

Question:
Page 7010, line 11. Add a version number to the OMI/Aura SO2 data product.

Answer:
The OMI/Aura SO2 PBL product is the version described by Li et al., 2013, and is

distributed as v003 by NASA via http://disc.sci.gsfc.nasa.gov/Aura/data-holdings/OMI/omso2_v003.shtml.

Li, C., J. Joiner, N. A. Krotkov, and P. K. Bhartia (2013), A fast and sensitive new satellite SO2 retrieval algorithm based on principal component analysis: Application to the ozone monitoring instrument, Geophys. Res. Lett., 40, doi:10.1002/2013GL058134.

We have added the version number and a reference for this.

Section 5.1.5 (Currently 5.7**)**

Question:
Fig 13. This figure is way too small. Fig 13a. Add error bars in the plot indicating the variability (i.e. standard deviation of the mean). Fig 13b. The difference between the light and dark green is not very cleat. Why not use the same colors in the left and right panels? Also, I am in favor of adding error bars showing to indicate the uncertainty of the individual data points.

Answer:
Note: Fig 13 is now Fig 15 due to structural changes
This figure has been enlarged by putting the 2 panels horizontally. Error bars have been added in the revised version of the figure and the same color has been used in Fig 13b for GOME-2A and GOME-2B. In panel (a), the error bars have been added as: err(%)=sqrt(err_scia(%)^2+err_gome2(%)^2) where the error on each satellite dataset is given by sigma(VCD)/mean(VCD) (in %). For the sake of clarity, error bars on panel (b) have been only plotted on ground-based and GOME-2 A and B (total AMF) data.

Section 5.1.6 (Currently 5.8**)**

Question:
Section 5.1.6 Page 7012, line 5-9. This introduction on water vapor contains some strange claims: water vapor contributes to the energy balance? I think what is meant is that water vapor is an important greenhouse gas (as stated later-on). Also the growth of aerosol particles is a function of the relative humidity, where temperature also plays a crucial role, as for cloud formation. These lines should be rephrased carefully and references need to be added.

Answer:
Yes, Referee is right. We replaced the first sentence with the following:
"Atmospheric water vapour plays a major role for both meteorology as well as for climate because it's an important greenhouse gas (Solomon2010) and via its influence on the formation of clouds and precipitation and the growth of aerosols (Hegg2009)."

Question:
Page 7013 line 1-2. Using the O2 or O4 as a proxy for the light path, does this mean that the same vertical profile is assumed in calculating the AMFs? This seems a very crude assumption.

Answer:
The water vapour Vertical Column Density is retrieved by dividing the water vapour column density (corrected for non-linearity effects) by the AMF computed for O2, which is defined as the ratio between the simultaneously retrieved O2 Slant Column Density and the known VCD of O2 for a standard atmosphere. This simple approach has the advantage that it corrects in first order for the effect of varying albedo, aerosol load and cloud cover without the use of additional independent information. However, as correctly stated by the anonymous referee, it also introduces some discrepancies because the vertical profile of water vapour is much more peaked in the troposphere with respect to that of O2. These effects are minimized by introducing an additional multiplicative correction factor look-up table in the VCD computation, which accounts for differences between the AMF of H2O and the AMF of O2. These correction factors were derived from radiative transfer computations and depend on the solar zenith angle, on surface albedo and to a lesser extend on line of sight and relative azimuth angles (see Grossi at al., 2015).

Suggested update in the manuscript:
In the updated version of the paper we explicitly address this point (7013, 2):
"... measured O2 absorption. Finally, a correction factor depending on solar geometry, line of sight geometry and solar albedo is applied to minimize the effects deriving from the different profile shapes of H2O and O2."

Question:
The product and intended use is not very clear for this product. It is claimed that it is especially useful for long time series, but it is not explained why. Also, there are many water vapor products from different wavelengths regions. What makes this product unique? From the references that are cited I get the impression that these are mostly connected to the data product producers, hence the user community of this product seems to be very small compared to those of other water vapor products. Since this is an EUMETSAT mission, how is this product appreciated within EUMETSAT?

Answer:
The GOME-2 water vapour product targets different user communities. In contrast to most other algorithms, the GOME-2 water vapour product does not rely on external input data, except for the use of an albedo database to compute the AMF correction mentioned before. This unique characteristic, together with the ability to retrieve H2O data over ocean and land, makes this product especially valuable for the long-term series and climatological studies. Nevertheless, the product can also be useful for the NWP community.

Alternative water vapour data are available from a large number of satellites; each product has its own advantages and disadvantages. Long time series derived from

microwave data, such as SSM/I are limited over ocean surfaces and are usually calibrated on radiosonde data. Hyperspectral imagers such as MERIS and MODIS, on the other hand, only provide data over land. High quality data may be derived from GPS satellites, but with a limited number of atmospheric paths. Satellite infrared observations can distinguish different tropospheric layers, but have the disadvantage of being less sensitive to the surface emission from the lowest layers, where most of the atmospheric water vapour is present. They also need extensive model input or a-priori assumptions for their retrievals and, therefore, cannot provide an independent data set for climatological studies.

EUMETSAT hasn't provided any negative signs. In contrary, water vapor is mentioned for the next generation instrument (S5 on EPS-SG) as Day 1 product in the EPS-SG End User Requirements Document.

Section 5.2 (Current 5.8)

Question:
Page 7014, line 12. The authors mention only the vertical sampling, however also the vertical resolution of the product shall be described, because I suspect that this is not the same as the sampling.

Answer:
The vertical resolution is not the same as vertical sampling. The resolution is defined by the width of the averaging kernel for a particular layer. However, remembering the target audience, we are not adding the averaging kernel information into the text. Users may look the ATBD document if they are interested for such a details.

Question:
Figure 16. The units in this figure shall be changed to either VMRs or number densities. DU per layer is a bad unit because it depends on the thickness of the layers and should not be used. Also, the horizontal axis should run from the south pole to the north pole, so please reverse it.

Answer:
Note: Fig 16 is now Fig 3 due to structural changes
The plot has been updated by adopting number density for the units as well as by reversing the direction of the latitude axis.

Question:
Caption Figure 17: ozone sondes are not ground-based measurements. What are the two red vertical lines? Please refer to GOME2A and GOME2B instead of METOP A and METOP B, to be consistent with other figures. Add a second vertical scale to indicate the pressures.

Answer:
Note: Fig 17 is now Fig 4 due to structural changes.
We changed the captions removing "ground based" (....corresponding ozone sonde, lidar and microwave measurements) and adding the meaning of the vertical red lines (+/-sigma range of deviations). Pressure scale was added.

Question:
For Figure 17 The GOME2A and GOME2B comparisons are very different, what is the reason for this? Also GOME 2B seems to be worse than GOME2A, while GOME2A has a lot more degradation?

Answer:
Note: Fig 17 is now Fig 4 due to structural changes.

Degradation of the GOME-2A instrument is clearly visible in the ozone profile products as a decrease in retrieved ozone concentrations over the years of the mission (Fig. 18, in the updated paper as Fig 5). This decrease occurs at all altitudes except for the range of the ozone maximum.

Question:
Figure 18. I advice to use different vertical scales for each of the subplots, or to increase the figure size.

Answer:
Note: Fig 18 is now Fig 5 due to structural changes.
All subplots should have the same scale for better comparability. We changed the length/width ratio of the figure a little bit to enlarge the vertical axis.

Section 5.3. (Current 5.9)

Question:
This section is very short. It would be good to add a discussion on the performance of GOME2A and GOME2B in the overlap period.

Answer:
We have extended this section in the following way:
- A new paragraph briefly describes the correction for instrument degradation that is applied.
- The closing paragraph of the section has been extended and now mentions the results from comparisons between the GOME-2A and GOME-2B AAI that were performed in the context of validation.

Section 5.4. (Current 5.10)

Question:
References need to be added to the mentioned GOME and OMI heritage products. The described method has a strong heritage to the OMI method, please mention this.

Answer:
References to the GOME-1 and OMI surface LER papers are now added to the paper. Also, the strong heritage from the GOME-1 and OMI surface LER databases is now mentioned explicitly.

Section 5.5 (Current 5.10)

Question:
Page 7018, line 20. There is a forward reference. This is not acceptable, please delete.

Answer:
Deleted

Question:
Page 7019, line 7. Add a reference to the most recent validation paper.

Answer:
There doesn't exist published validation paper but a validation report that is available via the project web pages. A reference to that report was added (Jonch-Sorensen 2012)

Section 6.

Question:
Page 7020, line 4-11. The discussion on definition of the tropopause is far to detailed and also incomplete. I think this part should be deleted.

Answer:
Text updated. The section on the tropopause has been removed.

Question:
Add new products to the Table 1.

Answer:
Mostly done. We didn't add L3 products to save some space in the table. The L3 products are based on L2 products and thus, this sacrifice is feasible.

Section 7

Question:
Section 7 should be shortened an included in section 4. Preferable there should be a pointer to one website where all the technical details can be found. All these details do not belong in a scientific paper, because they will not be sustainable in the future. Table 2 should be deleted because (1) it contains very little info and (2) this technical info doesn't belong in a scientific paper. Please take my general comments on the target audience into account when doing the rework on this part.

Answer:
The content of this section was moved to Section 4 as proposed by the Referee.

All other web addresses have been removed but a link to the main site.

We suppose that the Referee means table 3 which was mentioned in the Section 7, and indeed, contains very little information. We deleted this table.

Section 8

Question:
The discussion section starts with a series of very general statements, which are not backed up by references. Please rewrite this section with a clear objective in mind. What are the messages that I should read here? What are the conclusions and what are the recommendations?

Answer:
This is current section 7 as proposed by the Referee.

We rewrote this section by adding a reference to WMO statement about ozone recovery as well as clarifying the message to the readers.