

Interactive comment on “Results from the validation campaign of the ozone radiometer GROMOS-C at the NDACC station of La Réunion Island” by Susana Fernandez et al.

Anonymous Referee #3

Received and published: 17 April 2016

General Comments

This manuscript describes mostly validation results for a new groundbased microwave radiometer (GROMOS-C) aimed at continuous measurements of stratospheric and lower mesospheric ozone from a remote location such as Reunion Island. The observations from GROMOS-C are compared to satellite results for ozone profiles near this low latitude site from June 2014 to January 2015, as well as to ozonesonde and lidar data from Reunion Island, and ECMWF ozone results. In addition, wind retrievals from GROMOS-C (viewing in several different directions) are compared to wind data from another microwave radiometer (WIRA) used for the validation campaign. Very few results are provided regarding atmospheric process studies or phenomena; there

C1

is a minor discussion regarding ozone change from possible updrafts and also a wind reversal period or periods.

The last comment could imply that this manuscript is really most suitable for the Atmospheric Measurement Technique branch of the ACP/AMT group of journals, although this is probably mostly an editorial decision (but based also on reviewer comments). This does seem to be the intent of the manuscript types for ACP and AMT (with the former requesting "general implications for atmospheric science" and the latter requesting "new developments, significant advances, or novel aspects of remote sensing"). Traditionally, most validation-type papers have indeed appeared in AMT. Having said this, I just leave such comments for the editor(s) to ponder and decide upon; in the end, I think that this manuscript is worth publishing after a few revisions, so my more specific comments follow. While many comments are minor or simply English-related suggestions, there are enough "small comments" to view this as slightly more than minor changes in order to improve the manuscript towards publication.

Specific Comments

It is nice to see Reunion Island used as a site for additional continuous ozone profile data (except during the wetter/warmer periods), given the lack of such low latitude operational sites. Some suggestions from the authors regarding other potential uses of this microwave radiometer would be useful as well (any campaigns elsewhere?) - or is the primary plan to try to keep this instrument operational at Reunion Island for many years?

Abstract:

Page 1

- Line 1 (L1), this first sentence seems a bit vague and too general; I think that "of primary interest" and "key role" are similar enough in meaning that, without more explanation here, one could just say "Ozone performs a key role ...". The Introduction

C2

emphasizes the details more, which seems appropriate.

- L9, "installed at" sounds better than "installed in".
- L10, "ozone spectra were recorded continuously for 7 months."
- L12, change "is done" to "is obtained".
- L13, "located at the observatory".
- L15, probably best if you spell out the acronyms (WIRA might be OK, but also ECMWF), as you have done for other acronyms in the abstract.
- L16, "shows very good agreement at all levels. The agreement with MLS is better than 10% for pressure ...". However, I would note that the conclusion section states 5% rather than 10%, so the authors should be consistent... (make a change here or in the Conclusions, page 11, line 13).

Page 2

- In general, I find that there are too many line breaks or small paragraphs. The text should be cleaned up in order to reduce this number of breaks, which is a bit distracting, and also a waste of space. Maybe this is just a simple editing or formatting issue.
- L1, "it is well known that the ozone abundance..."
- L15, New Zealand [spelling]. I would delete the next sentence (repetitive). Then, "Continuous ground-based measurements are needed in other regions, particularly in the southern hemisphere."
- L19, define MIAWARA with the full name.
- L20, These 3 instruments recorded measurements together in a campaign...
- L21, "It was inaugurated..."
- L26, I suggest "Recent work has shown that a significant negative trend exists in the

C3

tropical stratosphere and this is likely related to...circulation (Randel and Thompson, 2011).

Page 3

- L3, "campaign at the Maito..."
- L4, "pressure-broadened"
- L5, "can be found in Fernandez et al. (2015)."
- L9, "and can observe different emission lines:..."
- L11, One of the GROMOS-C main features..."
- L13, a sealed thermally insulated aluminum housing.
- L28/29, drier atmosphere which ensures lower tropospheric attenuation. [you have already stated it is high altitude]

Page 4

- L2, recorded continuously for 7 months.
- L12, "and was found to be between 0.1..."
- L22, onboard the Aura satellite
- L24, with two overpasses per day (at fixed local times) near Reunion Island.
- L25, "Atmospheric" [spelling].

Page 5

- L2, was installed at the Maito..."
- L21, below the 10 hPa pressure level

Page 6

C4

- L11, Before the spectra are fed...
- L15, The spectral baseline
- L18, integration in time, with a minimum time interval of 1 hour.
- L24, are the squares of the noise
- L30, Fig. 3a, where the a priori profile...

Page 7

- L4, kernel widths (Fig. 3c) are about 7 km in the lower stratosphere and increase up to 17 km in the middle mesosphere.
- L30, since we use MLS climatology as a priori profile.

Page 8

- L9, calibration techniques
- L17, change "(above)" to "(top)" or "(top panel)". [same in general for Figures, use top and bottom]
- L19, parts per million by volume is usually abbreviated as ppmv.
- L21, period where → period when. Also, "The regions below the white lines show where the measurement range ..."
- L27, humid period with high opacity.
- L30, are discussed in section 6.

Page 9

- L4, all measurements are within 10%.
- L5, middle and upper stratosphere

C5

- L12, stands for the O3 profile and xa is the a priori...
- L15, Results show agreement ...within 5%...
- It would be good to state what the a priori is for the winds, assuming there is one here also...(for section 5).
- L25, add a comma before "zonal".

Page 10

- L3, altitude resolution better (less) than 20 km...
- L14, Fig. 6 shows...
- L19, change "correspondent" to "corresponding"
- L23, (Fig. 10, bottom)
- Section 6: There could also be some impact from horizontal transport (can one really rule this out - not clear at least)?
- L26, change "till" to "to".
- L27, We validated the GROMOS-C capability ...
- L29, We have confirmed that different calibration... the spectra are baseline-free.

Page 11

- L14, Radiosonde data show ... The bias in the GROMOS-C ozone...
- Could you not estimate / provide error bars for the wind measurements (or also ozone)?
- L24, it would be interesting to investigate...

Figures

C6

- Regarding Fig. 2 and the tipping curves, and opacity calculation (for example), it would be good if the authors include a more specific analysis discussion or at the very least a reference in the paragraph where this Figure is mentioned, so that readers can follow this (or track this down) better, as long as the longer discussion has been published elsewhere; otherwise, it seems like this is a bit too succinct.

- Similarly for Fig. 3, why is panel (b) labeled with $AVK * 4 / MR$? You need to define this better for someone to follow exactly what is plotted. Is this expanded scale mainly so that this is more easily read? Presumably the black curve is not on the same scale and is actually close to 1? Also, panel (c) or the text could be more specific regarding the width of the averaging kernels (which is typically defined as full width at half-maximum, but just to be clear on the definition).

- In Fig. 4 and also Fig. 8, a better drawing of the vertical line (in black) at zero (at least) would help readability. A solid line could possibly work well or better for this. Also, change the caption for Fig. 4 to "relative differences with respect to the East profile." I also think that error bars or a mention of error bars would help the interpretation (otherwise measurements do not mean much). Is the green line systematically different enough from the others (or even for the differences between blue and red), given the number of profiles and the errors in the mean here? The authors mention a possible or likely explanation for the South-pointing data (a difference in elevation angle) although not much quantitative analysis is given in the manuscript regarding this explanation. The broader conclusions of the manuscript are not significantly affected by this detail, but in general, not enough discussion is really provided regarding estimates of systematic uncertainties for the ozone measurements and one has to rely more on comparisons to other sensors. This is acceptable to first-order for this paper, but it does leave some room for improvements overall for the GROMOS-C measurement itself; if more information has been provided elsewhere, the authors should certainly point to that, or plan for more analyses in the future (such as sensitivity tests and exploration of forward model errors).

C7

- Fig. 8; please indicate specifically in the Figure caption how the difference is calculated (instrument minus GROMOS-C), as the sentence may not be completely unambiguous.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-117, 2016.

C8