Atmos. Meas. Tech. Discuss., 6, C2432–C2436, 2013
www.atmos-meas-tech-discuss.net/6/C2432/2013/

Atmospheric Measurement Techniques Discussions
Open Access

AMTD

6, C2432–C2436, 2013

Interactive Comment

Interactive comment on "Monitoring the lowermost tropospheric ozone with thermal infrared observations from a geostationary platform: performance analyses for a future dedicated instrument" *by* P. Sellitto et al.

Anonymous Referee #2

Received and published: 6 September 2013

General

The paper presents a sensitivity study for the observations of the MAGEAQ-TIR observing system. It is a Thermal InfraRed (TIR) spectrometer proposed as part of a project for Monitoring the Atmosphere from Geostationary orbit for European Air Quality (MAGEAQ). The subject of the paper is very interesting and appropriate for the AMT journal. The presented results, however, would be much more convincing and useful if

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

complemented and modified to address the following major points.

- **Equations.** No equations are reported in the paper. It is difficult to establish whether the authors have used the correct formalism to characterize the information contained in the MAGEAQ-TIR measurements. In particular, the description of the formulas used for the inversion and for the diagnostics is demanded to the papers describing the KOPRAfit algorithm. This algorithm usually retrieves vertical Volume Mixing Ratio (VMR) profiles on a 1km-fine vertical grid. It seems that the authors use the sum of the diagonal elements of the ozone VMR averaging kernels from 0 to 6 km (or from 0 to 3 km) as a proxy for the information contained in their synthetic measurements regarding ozone columns. Columns, however, are also connected with pressure and temperature distributions. It would be appropriate to show how this dependence is accounted for in the presented results.
- **DOFs.** On average the number of DOFs in the retrieved profiles from 0 to 6 km is around 1. This number seems very small to justify the retrieval of a "profile" with (as far as I understand) 1km vertical grid. It would be much more physically sound to retrieve directly the ozone column in the 0-3 or 0-6 km range, this approach would allow to limit the contribution of the a-priori information. Presently, with such a large contribution of the a-priori in the results, the discussion on biases seems quite speculative: the bias depends on the accuracy of the model used for the estimation of the a-priori profile, not on the actual measurements.
- **Contribution of a-priori.** The (I expect "very large", but how much?) contribution of the a-priori information on the presented results could be adequately quantified with the so called "information gain" introduced in Rodgers (2000).

AMTD

6, C2432–C2436, 2013

Specific comments

Pages and line numbers refer to the PDF file published in AMTD:

www.atmos-meas-tech-discuss.net/6/6445/2013/amtd-6-6445-2013.pdf

Page 6453, lines 10, 11: stopping the model at 35 km may seem a quite rough approximation. Can you include a statement supporting this choice ?

Page 6454, first paragraph of Sect. 3: as mentioned above, including some formulas here would help to understand if the used diagnostics is appropriate.

From page 6455, line 20 to page 6466, line 26: the discussion of the two small Tables 2 and 3 is very lengthy and sometimes redundant. I would suggest to condense everything in a few lines.

Pages 6457-6458, Sect.4: see the general comment above. Can you demonstrate that the accuracy you are showing originates from the features of the measurements and does not depend on the a-priori information used to constrain the inversion ? Did-you try a test run with different a-priori and/or initial guess for the retrieval ?

Page 6459, line 22 and ff: note that the daily cycle in the DOFs could be avoided using a self-adapting constraint in the retrieval. See e.g. Steck (2002) who shows how to set up a Tikhonov constraint with the requirement of keeping constant the trace of the averaging kernel.

Page 6460: see again the general comment above, regarding the use of a-priori information. What happens if a different a-priori profile is used for the Tikhonov constraint ? Will the observed biases change ?

Page 6461, 6462: Fig. 8 shows exactly the effect of having only 1 DOF, I feel that, also

AMTD

6, C2432–C2436, 2013

Interactive Comment

here, the description of the findings could be significantly shortened.

Pages 6462 to 6464: again, I argue that a very detail discussion of the observed biases is not very useful. My impression is that the observed biases may easily change in sign and/or shape if a different a-priori is used for the Tikhonov regularization. Only the orders of magnitude should be taken seriously from this analysis. The key point is that the MAGEAQ-TIR observations do not contain much information on the lowermost ozone. Since this is not a limb instrument, the information on the vertical distribution comes from the accurate measurement of the shape of the spectral lines. Can we improve the sensitivity by using a broader spectral interval for the inversion ? What could we get if the instrument had a finer spectral resolution and/or better S/N ratio ?

Page 6465, line 27: for the above mentioned reasons I am rather skeptical on this conclusion regarding the biases observed.

Page 6467, lines 21, 26: a synergistic use of both TIR and VIS observations is a good idea. For the future developments I would suggest also to adapt the inversion code to retrieve only a few (1 or 2, max 3) ozone columns in pre-defined layers and avoid, as much as possible, the use of a-priori constraints. If these cannot be avoided, I would suggest to use at least Tikhonov with adaptive strength.

Minor comments

Page 6452, lines 20, 21: data missing from a synthetic set ? Why the calculations lost in the failure of the data processing system were not repeated ? Please explain or don't even mention the problem...

Page 6455, line 25: 0.61 or 0.71 as in Table 2 ?

Labels and legendae are really tiny in Fig.s 3, 4, 5, 6, 7 and 9.

AMTD

6, C2432–C2436, 2013

Interactive Comment

References

Rodgers, C.D.: Inverse Methods for Atmospheric Sounding: Theory and Practice, Vol. 2 of Series on Atmospheric, Oceanic and Planetary Physics (World Scientific, Singapore, 2000).

Steck, T.: Methods for determining regularization for atmospheric retrieval problems, Appl. Opt., 41(9), 1788–1797, 2002.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 6445, 2013.