Atmospheric Chemistry and Physics Discussions
Special Issue: 6
Atmos. Chem. Phys. Discuss., 11, 33127-33171, 2011
www.atmos-chem-phys-discuss.net/11/33127/2011/
"Analysis of IASI tropospheric O_3 data over Arctic during POLARCAT campaigns in 2008" by M. Pommier et al.

Reply to Anonymous Referee #2

The authors would like to thank the anonymous reviewer for his careful reading of the manuscript and for his helpful comments. We tried to improve the content and to clarify the explanations as recommended. A detailed point by point reply (in blue) is provided hereafter.

The paper by Pommier et al. builds on previous validation work of IASI O3 products with particular reference to the POLARCAT activities during 2008 as part of the International Polar Year. Comparisons with lidar are also shown. Retrieval of gas concentration information over cold surfaces is a particular challenge for nadir-viewing instruments such as IASI and these results give an insight into the quality of tropospheric O3 data in the Arctic. It is suitable for publication after some corrections are made. In many parts of the article, the English writing is not very clear. I make observations for the major corrections, but would urge the paper to be corrected for these technical writing errors by a native English speaker.

The corrections and the manuscript were checked by a native English speaker.

General comments
- the authors produce an ACE-FTS climatology using all data between 2004 and 2009. Is cloud-clearing or cloud filtering applied to the ACE data? If no cloud-filtering applied, this will lead to a bias in the ACE-FTS data, and hence your climatology, affecting your comparisons. Is this accounted for in the sensitivity tests on p 33140, l2-5?

No additional filter was used. The cloudy scenes data were not provided and thus not used in the climatology. The sunlight does not penetrate thick clouds so there are no data. Thin cirrus clouds are possible, however, but because ACE works in transmission, there is no effect on the retrievals (unlike MIPAS).

A sensitivity test was performed to study the impact of this climatology on our results. We decided to use a high value. The 10% value used, was higher to standard deviation observed in the climatology below 70 km, [0.5 3%].
Moreover, only profiles where there was no gap between the aircraft maximum altitude and the ACE-FTS minimum altitude were used in the validation procedure.

- As the tropopause levels only vary by 0.3 km between land and ocean, why does this cause the FORLI retrieval scheme to have “slightly more difficulties in the UTLS over land” (section 5.2)? Is this not a surface/topography effect or another inhomogeneity within the IASI scene?

It is a good point.
The slight difference of the tropopause height is not a good enough hypothesis which could explain the difference in the UTLS between both surfaces.
It is also true that other inhomogeneities could also have an impact. The topography seems to be a less obvious factor affecting sensitivity in the UTLS, but as seen in Fig. 3, the first layers have also an influence around 8-10 km.

We thus modified the sentence:
“These results suggest that the FORLI retrieval has more difficulty in the UTLS over land than over sea witch probably could not be only explained by the slight difference of tropopause heights over land (8.8 km - Fig. 10b) compared to over sea (9.1 km - Fig.10a). It could be due to differences in topography. As shown in Fig. 3, the first layers of the AK also have an impact on the sensitivity around 8-10 km. These differences in topography could affect the information borrowed by the AKs at these altitudes which could be too important compared to the lower troposphere ([0-12 km] DOFS ~ 1.0 over land and ~ 0.85 over sea).”

Specific comments

Title - The title should read “over the Arctic” rather than “over Arctic”. There are several instances throughout the text, and other section titles, lacking the word “the” before “Arctic” which should be corrected.

Agreed. We added the “the” before “Arctic” as well in the title as for the missing parts in the text.

P33129, l6 – unnecessary to define IPY as not used again in the abstract.

The IPY acronym was deleted from the abstract.

P33129, l12 – information content and degrees of freedom for signal (DOFS) are different quantities as defined in Rodgers (2000). Extended use is made of DOFS in the analysis, not information content which is a measure of entropy. Please correct.

The sentence in the abstract was changed (in bold):
“A detailed analysis is provided and the agreement is discussed in terms of **vertical sensitivity** and surface properties at the location of the observations.”

P33134, l10, please insert “of” between “differences” and “less”

The “of” was added. The sentence is now: “Comparison between IASI and ozonesondes within the ozone hole gave differences of less than 30%.”

P33134, l19-26. Why were these specific criteria chosen? Are they related to the IASI noise (which isn’t mentioned) or simply the spectral fit? Also, why was a solar zenith angle of 83o chosen as the threshold for daytime data? Is there a reason the 84o causes data issues? Or is it to allow for an error in determination of SZA?

Criteria: Quality checks have been performed and it has been noticed that the operational cloud filter provided by Eumetsat was not flagging all cloudy scenes perfectly (e.g. the contamination due to low altitude cirrus clouds proved to be difficult).
A detailed description paper for the FORLI code used in this paper is now available and provides more details on the data screening. A reference to the new Hurtmans et al. paper has been added to the manuscript.

SZA: This is a good question. We decided to use the same thresholds that were used in the CO validation study (Pommier et al., 2010) where data between 83deg and 90deg were not used. They were defined as a shady condition.
In spite of different tests, we know that satellite instrument teams are using different thresholds (e.g. 80deg for the CO MOPITT products in NCAR). Thus, we allow an error in the determination of our value.

P33135, l8, the authors should reference Clerbaux et al. 2009 which discusses the challenges of retrieval over cold surfaces with low thermal contrast.

The reference was added at the end of the sentence: “The Arctic is a challenging region for the retrieval of tropospheric concentrations using a nadir-viewing thermal-IR instrument (Clerbaux et al., 2009).”

P33136, l8, please remove the name “Adam” from the reference

We kept Adam because the last name of the author is Adam de Villiers (first name = Raphael).

P33140, l1, please replace than by that

It was replaced.

P33140, l15, please add “s” to RD

When the RD is in plural, we added “s” to RD.

P33143, l19, please insert the word “to” between “according” and “surface”

“to” was added.

P33145, l16, please insert “the” between “by” and “IASI”

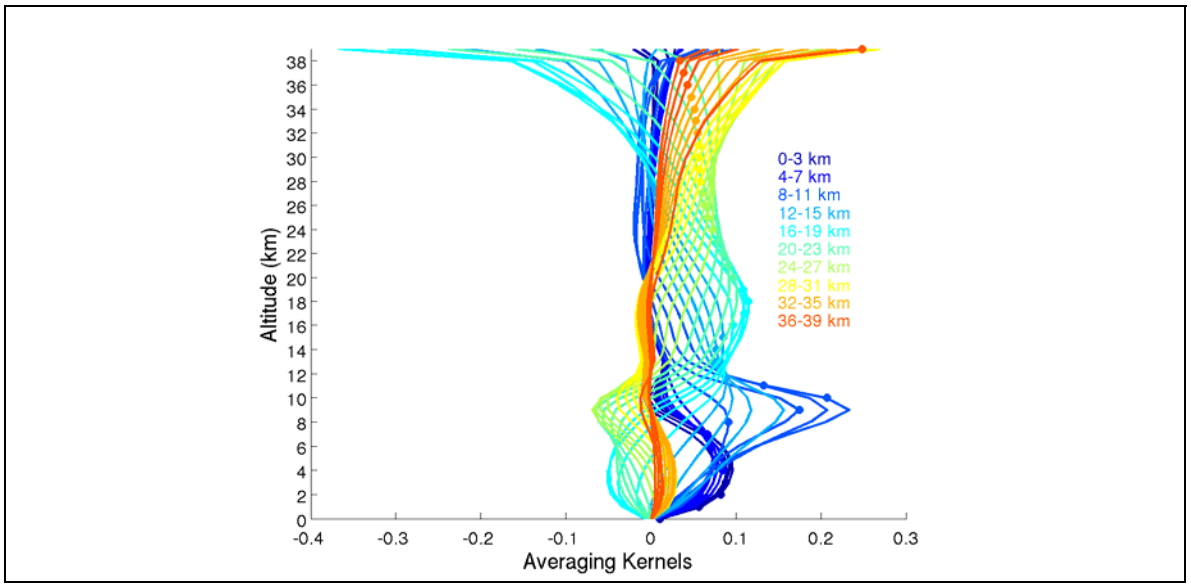
‘the” was inserted.

P33147, l19, please remove “as well” as it does not fit into the sentence

It was corrected. The sentence is now: “These important differences in the UTLS impact the comparison with the IASI [0-12 km] partial columns and the correlations analysis.”

Figure 3. It would be useful if the Altitude range on the y-axis were extended as the 37-40 km averaging kernels are plotted but the y-axis only extends to 34 km.

As you can see, if we plot the last levels of the AK, the plot is less clear.



We thus decided to keep the former plot but we changed the legend because there was a mistake (0-3 km, … instead of 0-4 km). We also added the date in the legend.

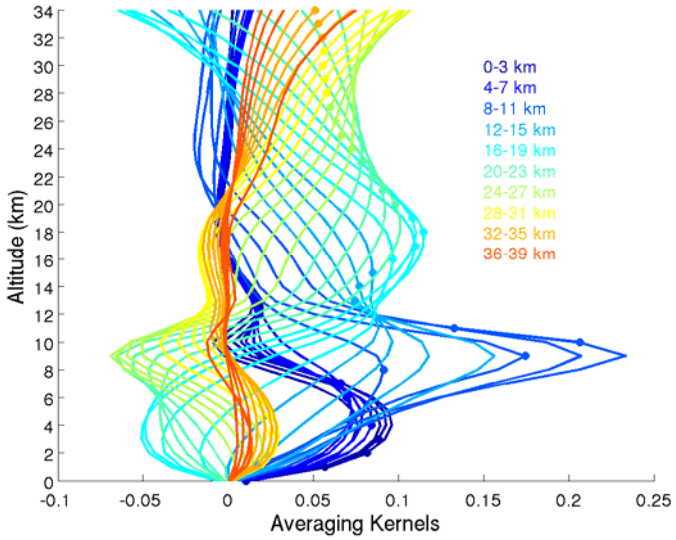


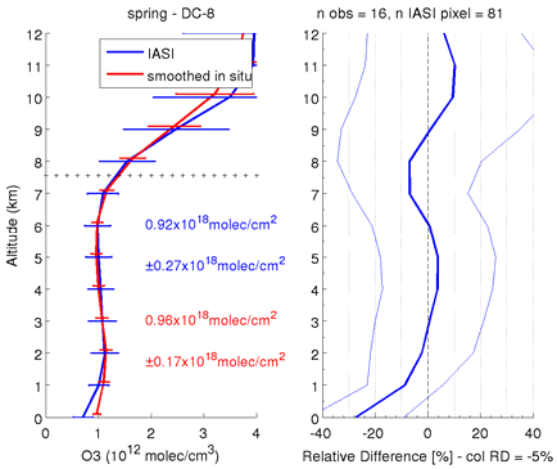
Fig. 3 Averaging kernel functions for different altitudes from FORLI-O_3 retrievals (DOFS=3.3) at 63.7°N, 20.4°W, on 17 July 2008.

Figure 6-10: it is a little difficult to read the text on the plots due to small font, please rectify.

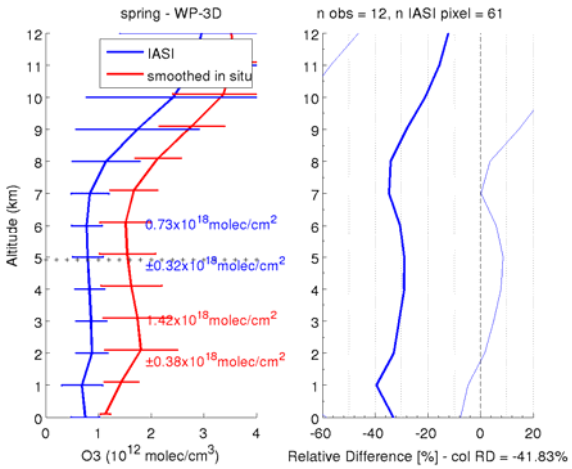
We rectified the text in plots Fig 6 to 10.

I give hereafter the example of the Fig.6:

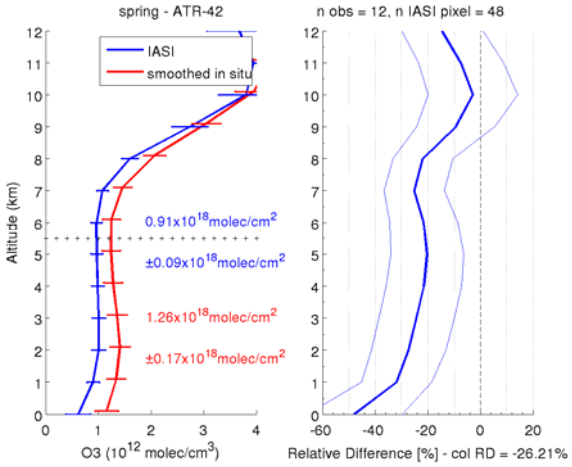
a)


spring - DC-8
n obs = 16, n IASI pixel = 81
IASI
smoothed in situ
0.92x10^18molec/cm^2
±0.27x10^18molec/cm^2
0.96x10^18molec/cm^2
±0.17x10^18molec/cm^2
Altitude (km)
O3 (10^12 molec/cm^3)
Relative Difference [%] - col RD = -5%

b)


spring - WP-3D
n obs = 12, n IASI pixel = 61
IASI
smoothed in situ
0.73x10^18molec/cm^2
±0.32x10^18molec/cm^2
1.42x10^18molec/cm^2
±0.38x10^18molec/cm^2
Altitude (km)
O3 (10^12 molec/cm^3)
Relative Difference [%] - col RD = -41.83%

c)


spring - ATR-42
n obs = 12, n IASI pixel = 48
IASI
smoothed in situ
0.91x10^18molec/cm^2
±0.09x10^18molec/cm^2
1.26x10^18molec/cm^2
±0.17x10^18molec/cm^2
Altitude (km)
O3 (10^12 molec/cm^3)
Relative Difference [%] - col RD = -26.21%