

Interactive comment on “Equatorial total column of nitrous oxide as measured by IASI on MetOp-A: implications for transport processes” by P. Ricaud et al.

Anonymous Referee #2

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The manuscript of Ricaud et al. covers an important scientific topic, namely the interpretation of satellite-derived pattern of the greenhouse gas N₂O. The topic is well-suited for ACP. The manuscript is well-written and I recommend its publication after the comments listed below have been carefully considered by the authors.

General

The retrieval of tropospheric N₂O from space and the interpretation of the results is a relatively new area. Previous papers, which are cited by the authors (mainly Chedin et al., 2002, and, Lubrano et al., 2004), basically show some first results exhibiting significant differences with reference data used for comparisons without any detailed

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interpretation on what may cause the discrepancies. The results discussed in Lubrano et al., 2004, which are based on high spectral resolution satellite data, are limited to only five real IMG spectra. It is therefore early days for N₂O retrieval from space. The topic covered by this manuscript is therefore relatively new. Because of this, this paper is potentially quite important. On the other hand care is needed with the interpretation of the results. The authors aim at giving a clear interpretation of what the retrieved pattern mean in terms of, for example, transport processes. Based on the results shown, I have strong doubts that at this stage it is possible to draw the conclusions, which have been drawn by the authors. In the following I will give more details about this aspect.

Abstract

Based on Fig. 4, which shows large differences between IASI and MOCAGE N₂O, I think one cannot say that "very good agreement" exists between the two data sets. I recommend to replace "very good" by "reasonable" (at best).

"N₂O measured by IASI": IASI measures interferograms, which are converted to spectra. N₂O is retrieved from the spectra. N₂O is therefore, strictly speaking, not measured, but obtained from an interpretation of the spectra (which implies many subjective choices how to do this). I recommend to replace "NO₂ measured by IASI" with "N₂O retrieved from IASI".

Last sentence: Based on the results shown (Fig. 4) this statement is too strong. I recommend to replace "we provide measurement evidence ..." with something like "our results are consistent with ..." or equivalent.

Section 2.1, page 3248:

As this is (one of) the first papers on IASI N₂O more details about the retrieval algorithm are needed as part of this paper. Please add a more detailed description of the retrieval algorithm and the assumptions and input data the algorithm is based on. It needs to

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be explained how the algorithm works, but also how sensitive the retrieval is to errors of the temperature profile and how exactly the temperature profile has been obtained. Has the temperature profile been obtained assuming that CO₂ is known? If yes what is the impact of this for N₂O retrieval? N₂O is due to its long lifetime (potentially) even less variable (more constant) than CO₂ implying that the N₂O results may depend critically on the assumptions made about CO₂. How are varying surface properties dealt with (e.g., surface pressure / altitude variations, emissivity)?

Of critical importance for this manuscript is also if averaging kernels are available from the retrieval algorithm? As IASI's N₂O altitude sensitivity is far from constant, IASI cannot provide "true vertical columns". It is therefore mandatory to apply averaging kernels (which depend on the instrument and on the retrieval algorithm) to the model profiles before any reasonable comparison can be made. Has this been considered?

The numbers given for the estimated accuracy and precision are much larger than the approx. 1 percent variations shown in the top panel of Fig. 5 on which most of the conclusions of this paper are based on. Important for this paper would be the relative accuracy (systematic differences between different regions and time periods). If I understand correctly, the accuracy (4 percent) is mainly supposed to be a general bias (offset). But what about the relative accuracy? Is the relative accuracy (e.g., between regions) supposed to be better than 1 percent? Or is it possible that the longitudinal variations shown in Fig 5., which are only about 1 percent, are on the same order as the estimated relative accuracy?

Section 2.1, page 3249:

As good spectral fit does not necessarily imply a high accuracy of the state vector parameters.

Section 3.2, page 3263:

The main conclusions of the paper are drawn from the top panel of Fig. 5, showing

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good agreement between IASI and the model. The curves have been obtained by averaging the results shown in Fig. 4, where large differences are visible. The results shown in Fig. 5 are likely not very stable. I recommend to add two additional figures analog to Fig. 5 but for latitude intervals shifted by 10 degrees. They would probably show large differences. I dont think that strong conclusions can be drawn from Fig. 5 if good agreement is only present in one latitude band but large (unexplained ?) differences exist if neighbouring latitude bands are used.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3243, 2009.

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