

Interactive comment on “Global distributions of nitric acid from IASI/MetOP measurements” by C. Wespes et al.

Anonymous Referee #2

Received and published: 22 May 2009

Review of the manuscript “Global distributions of nitric acid from IASI/MetOP measurements” by C. Wespes, D. Hurtmans, C. Clerbaux, and P. F. Coheur

General comment:

The paper presents the first global distribution of HNO₃ as derived from IASI nadir infrared observations in terms of total columns with main weight on the stratosphere. The analysis of the global distributions focusses on polar winter observations. The observed atmospheric distributions do not really contribute new insight into the chemical and dynamical processes related to polar winter stratospheric chemistry, instead they are discussed in terms of confirmation of the currently accepted understanding. In this sense, the paper would potentially be better suited for ACP's sister journal AMT(D), however I appreciate that it is intended to be part of ACP's special section on IASI. The

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new HNO₃ dataset from IASI could be very valuable for validation of models, provided the characterization of the data with respect to precision and accuracy is improved. After the related revisions, I consider the paper suitable for publication in ACP.

Specific comments:

Abstract:

It should be stated in the abstract that the product is a total (stratospheric) column. Any information on precision or accuracy of the data product is missing, and related numbers should be added.

I15: The term “local trend” should not be used if seasonal variation is meant. A trend is a long-term (over many years) variation.

Introduction:

p8038, I1-2: Orsolini et al. 2008 and von Clarmann et al., 2009 are further references to be considered when citing global satellite observations of HNO₃.

Section 2:

p8040, I25: a step width of 10 for the relative humidity seems to be rather coarse given the dryness of the stratosphere.

Section 2.4, p8043, I6-11: From the text I conclude that retrievals have been discarded if the rms of the residual was above a certain threshold (however, the threshold is not given). This is described as removal of noisy spectra. However, the residual might be large due to other reasons as well, for example because a spectral fit has not been achieved (the convergence criteria as described on page 8042, lines 3-5, does not guarantee that the minimum of the penalty function has been reached). Removal of noisy spectra should be based on the estimate of the noise of the spectra. In this sense, the authors should improve their description of what they have really done. Further (in lines 8-10) some emissivity features are mentioned. The authors should state clearly if the spectra/retrievals have been removed based on the identification of

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these emissivity features, or based on unreasonable HNO₃ values which are thought to be related to the emissivity features. The latter would be no satisfactory criterion, since a filter criterion should not depend on the values of the quantity to be filtered itself.

Section 3:

Section 3.1: It is not clear why the authors refer to retrieval tests with the Atmosphit code: the FORLI-HNO₃ code seems to provide all the necessary retrieval diagnostics as well. As already stated by referee#1, some minimum requirements to convince the reader of the validity of these tests for the FORLI-HNO₃ retrievals as well are: - the consistency of the Atmosphit and FORLI-HNO₃ code in terms of spectral simulation and retrieval results has to be demonstrated, or a reference to a respective paper has to be made; - a good reason has to be given why the Sa matrix used within the FORLI-HNO₃ approach is different to the one used within the Atmosphit retrievals and a quantitative assessment on the impact of different Sa matrices on the retrieval has to be provided; - does the Atmosphit approach retrieve in the log space as well? If not, the differences in the retrievals due to log(column) space versus column space have to be quantified.

page 8044, line 5: does "full covariance matrix" mean that non-diagonal elements are also considered? How does this affect the retrieval compared to the diagonal covariance matrix used within the FORLI-HNO₃ retrieval?

page 8044, lines 9-14: I understand that the spectral fit shown in Fig 2a belongs to the Atmosphit 9-layer retrieval. How do the residuals look like for the FORLI-HNO₃ log(column) retrieval?

Section 3.2:

p8046, l22-24: I don't right understand the conclusion here: It was stated in the introduction that the tropospheric amount of HNO₃ is about 5% of the total amount (in terms of partial column, I guess); further an assessment of the contribution of the tropospheric part to the total column can be made from the a priori profile. Is this sentence meant as a confirmation that the tropospheric column indeed is as low as

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assumed in the a priori profile? A study on the impact of the shape of the a priori profile on the retrieved column would help to assess this point. I suggest either to provide this study or just to remove this sentence.

p8048, l16: The authors suggest that the large scatter in the data is due to "daily variability" which I understand is meant as natural variability. I doubt, similar to referee#1, that the natural variability indeed is that large. The error threshold of 32% (1sigma, I guess) applied in the a posteriori filtering is compatible with a 3sigma "variability" of maximum 100% as seen in Fig. 6. This points towards the precision of the data as source for the high scatter, and not the natural variability.

Conclusion:

p8051, l 4 and 6: Again, the term "trend" should not be used for a seasonal variation.

Technical comments:

p8038, l2 and l9: "Fisher" should be "Fischer"

p8046,l11: typo in "contrast"

References:

Orsolini, Y. J., Urban, J., and Murtagh, D. P.: Nitric acid in the stratosphere based on Odin observations from 2001 to 2007 – Part 2: High-altitude polar enhancements, *Atmos. Chem. Phys. Discuss.*, 8, 9591-9605, 2008.

von Clarmann, T., Höpfner, M., Kellmann, S., Linden, A., Chauhan, S., Funke, B., Grabowski, U., Glatthor, N., Kiefer, M., Schieferdecker, T., Stiller, G. P., and Versick, S.: Retrieval of temperature, H₂O, O₃, HNO₃, CH₄, N₂O, ClONO₂ and ClO from MIPAS reduced resolution nominal mode limb emission measurements, *Atmos. Meas. Tech.*, 2, 159-175, 2009.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 9, 8035, 2009.

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