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Interactive comment on “Nitric acid in the stratosphere based on Odin observations from 2001 to 2007 – Part 1: A global climatology” by J. Urban et al.

J. Urban et al.

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Reply to anonymous referee 1

The paper report in a climatology for HNO₃ built using Odin observations. It is a subject of strong interest particularly for atmospheric chemistry-climate model assessments and validation but also for devising new instruments for measuring atmospheric composition. The material is well presented and the results are properly discussed. We therefore recommend the paper to be published after some revision. One point we notice is that the authors did not make any attempt to combine the Odin dataset with other existent climatology for HNO₃ neither in try to address the discussion on possible trends in HNO₃ concentration. Maybe

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the authors could still do some work along those lines since this would be really useful for the scientific community.

A section on the temporal variability in the tropical stratosphere has been added, including two new figures. A discussion on possible trends in HNO₃ is done within this section, however a quantitative trend analysis is beyond the scope of this work.

Section 1

In the introduction, the authors could focus the discussion on the objectives of the paper being more descriptive on what exists in terms of climatology/measurements of nitric acid in the literature. Moreover, the authors should better introduce the originality and innovation of their results. In particular:

- (9571, 5-11): "The molecule ... Stiller et al., 2005)" is a rather dense sentence. The reader tends to get confused in the content that not really contribute to build along the paper objectives.

Reformulated.

- (9571, 20-24). "Stratospheric nitric acid has". Could be valuable here to expand more on why this climatology is interesting; how does it compares with what exists in the literature and why the authors are building another one.

One objective of the paper is precisely to compare the new Odin climatology with the older climatology from UARS in order to derive new insights of the climatological characteristics of nitric acid in the stratosphere. Other published global nitric acid data sets are to our knowledge based on shorter measurement periods and are therefore not discussed explicitly. The introduction was slightly modified to point out our objectives more clearly.

Section 2

The authors could change the subtitles in this section so that they could better

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represent their content. We would suggest something along the line: 2.1 Measurements and build of an Odin HNO₃ climatology 2.2 Global features 2.3 HNO₃ characteristics at high latitudes

Our sub-section titles are already very similar to what the reviewer suggests, and short titles are preferable. HNO₃ is already mentioned in the section title.

The authors keep changing units between potential temperature (K), height (km) and pressure (hPa). While it could be useful for specific purposes, it makes the reading of the paper rather difficult. Using consistently the same units in the text and the figures would avoid confusion and make the paper easier to read and understand.

The text has been revised in this sense. Concerning Figures 1-3, we continue to use potential temperature as the vertical coordinate as it is the relevant variable for isentropic transport in the stratosphere, but indicate now altitudes (instead of pressures) for the sake of readability.

The use of equivalent latitude has been properly justified. However, it is not clear the value of introducing the potential temperature as a scale, which is a derived rather than a measured quantity. In order to improve the clarity of the paper we would recommend the authors to avoid potential temperature.

Potential temperature was chosen for two reasons: First, since stratospheric air masses move to a first order (adiabatically) on isentropes, potential temperature is a natural choice for a stratospheric climatology. Second, choice of potential temperature allows us to directly compare to the UARS/MLS climatology published by Santee et al. in JGR (2004). Besides, also pressure and altitude are not directly measured but are in fact derived quantities (from ECMWF assimilation model zpt relationship, spacecraft pointing geometry etc.). Usage of ECMWF potential temperature is therefore a relatively straightforward approach.

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Specific points:

S5167

-(9572, 11-19): In the paragraph HNO₃ volume mixing ratios... please better explain the significance of the sentence ...limitations of the spectrometer read-out data rate... on line 15.

Comment added.

-(9573, 1): On line 1 please define Chalmers version-2.0 retrievals.

Changed to Odin/SMR version-2.0 retrievals.

-(9574, 5-25): The authors need to match the order of discussion with the order in which the Figure is presented, i.e. present the results in increasing altitude.

In order to separate the effects, it is more illustrative to describe the panels in the Figures the way it was done: lower level, upper level, intermediate case.

-(9575, 3-8): Is the section of the paragraph starting with At the middle and low .." a general comment on HNO₃ field? If so, it should be written in a different paragraph. If it is not a general comment, the authors should add a short paragraph to summarize the section. In addition, the authors could elaborate on the role of the different oscillations on HNO₃ field.

Slightly reformulated and clarified.

-(6575, 10-28): A lot of information is presented in this paragraph, which makes it hard for the reader to follow. Furthermore, we hardly see the connection of the paragraph with the objectives of the paper. Just as one example the authors mention reversed tape-recorder effect without elaborating.

Since one of the objectives of the paper is to present climatological characteristics of the global nitric acid field, this description of the high-latitude characteristics is es-

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sential. The presentation of the material has been simplified by focusing on potential temperatures and altitudes (instead of pressure levels). Figures 2 and 3 have been modified to show altitude contours (instead of pressures) and some explanations have been added.

Section 3

The authors compare Odin climatology with UARS/MLS without a clear discussion on how each one was build. Would the only difference between the two be the time frame? In anyhow, we believe this paper would be improved by adding more detail on the building of the climatology in itself, a discussion that should actually be placed in the previous section.

Whilst the building of the Odin climatology is described in details in section 2.1, the UARS climatology has been described extensively in Santee et al. (JGR 2004) and we give a short summary in section 3 for the convenience of the reader. This includes already all relevant information, for example concerning precision, altitude range and resolution, global coverage and temporal sampling.

-(9576, 25): Excellent is not a quantitative term and without a definition of what excellent means in the context it should be avoid in describing measurements. From Figure 4 one can see that the agreement between the datasets for 40-50 deg is not exactly perfect; there are differences. Therefore, it is difficult to understand why the authors used excellent .

Slightly reformulated.

S5168

-(9577, 21): We guessed that the paragraph describes Figure 5. However, the authors never refer specifically to this figure in the text.

Additional reference to Fig. 5 added.

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-(9578, 3-4): It is not clear what is the latitude coverage as per the number of measurements used in building the climatology. For example, would high latitudes climatologic values be based on several measurements that span over the entire dataset or would it be based on only few measurements?

Comment added in section 2.2.

-(9578, 23): Once again we notice the word **excellent** . Please define what **excellent** means in this context.

Changed.

Section 4

The authors should emphasize more the value of the work presented in this paper. This section could also include some discussions about future work in the field of HNO₃ measurements: what aspects of the HNO₃ global distribution are not clear and should be further explored, what are the recommendation in terms of future missions regarding HNO₃ measurements,... Another aspect it could mention is if this climatology would be made accessible to the scientific community and how.

The summary and conclusions section has been expanded along these lines.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 9569, 2008.

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