Replies (*in italics*) to the comments of Reviewer 2

General comments

This article presents the results of a validation study for the Nimbus 7 / LIMS HNO3 and NO2 v6 data sets. The study focuses on the Aleutian High region, in January 1979, when occurred a minor stratospheric warming event. An earlier analysis showed that, in the previous version of these data sets, the evolution of NO2 mixing ratios was inconsistent with the evolution of HNO3 mixing ratios, at this particular time and place. The authors have re-investigated this event using the v6 dataset, together with photochemical calculations, and showed that the data quality has improved. This paper presents interesting and novel results, showing that the v6 LIMS observations can be used for scientific studies. This is perfectly suited to the scope of AMT and I recommend publication after consideration of the minor revisions suggested below. Given that the main goal of your study is to show that v6 HNO3 and NO2 LIMS data products are of better quality than v5 data products, why do not you show any direct comparison of these two versions? Rather than comparing them only indirectly by referring to the findings of R93, you could for example add at least one figure and one paragraph addressing the direct comparison of these two datasets in the specific region and time period considered in your study. This is true especially for NO2, that has changed the most. This would add value to your paper.

We regenerated Figure 4 (see attached) showing results for both V5 and V6 at 64°N, since the V5 data are not available at 66°N; V5 profiles are at 4° latitude intervals, rather than every 2° as for V6. The primary changes are for NO2, where the V6 values are about half those of V5. Remsberg et al. (JGR, 1994) describes the effect of improved spectral line data for the retrieval of V6 NO2 and we add that reference to the list.

I think that the general readability of the paper could be improved. Some parts of the text consist of a long description of the figures, but your conclusions are not made clear enough. The presentation quality of the figures could also be improved (see specific comments below).

We have rewritten the conclusions slightly to make them clearer.

Specific comments

L69: It would be clearer if you would change ”or the sum of” to something like ”, which is defined as the sum of...”. Moreover N2O5, which is considered in your study, is also part of the NOy family. You could mention it.

We made changes per your suggestion.

L155: Please give more details about how anomalies are defined in your study. Over which period has the zonal mean used as a reference been calculated? In the next paragraph, when writing about the anomalies for NO2, you mention that you took into account zonal waves also. How have you done exactly? Were the anomalies derived in a different way for different species? Please make that point clearer.

We added more information about the calculation of the zonal anomalies, which are with reference to the daily zonal mean coefficients.

L181: To which pressure level correspond this figure? I guess that it is 31.6 hPa, as in the previous figures. Please mention it, both in the text and in the figure caption.

We now say 31.6 hPa.

L206 and 210: Why do not you represent these uncertainties in the figure? (same comment for Fig. 4)

We added estimates of uncertainty to Figures 4 and 5 and explain them in the text.

L216-224: Please make clearer the link between this discussion on LIMS NO2 L2 products and your figure 5. This paragraph sounds like a general description of the data quality, but it is not clear what is your conclusion and how this affects the interpretation of Fig. 5.

The data in Figure 5 are from the LIMS V6 Level 2 profiles, while the zonal variations in Figure 4 are at grid point longitudes based on the Level 3 Fourier coefficient data.

L236: ”09Z on 28 January” Please explain what is this time format.

Time is 9 am GMT (designated 09Z within most atmospheric datasets) on 28 January.

L258: ”only a modest amount of aerosol surface area is necessary ...” Please quantify this statement.

Aerosol surface area in the model is ~4 x (10-9) per cm at 31 mb and 60N for January. This is equivalent to the value given in Table 1 of Hofmann and Solomon (JGR, 1989) for a background aerosol layer at 25 km, 28N. We’ve added that reference.

L263: ”an updated version of the stratospheric diurnal photochemical model” Could you briefly explain what are the differences between this version of the model and the version described in Natarajan and Callis (1997).

Reaction rates and photochemical rates in the model are now according to Burkholder et al. (2015).

L300 and 304: Maybe you could add the temporal evolution of the air parcel latitude to your plot. It would thus be easier to follow the interpretation. (same comment for Fig. 9)

We elected not to include information about physical location in the Figures 8 and 9.

L454: The highest value of HNO3 is 13 ppbv, according to Fig. 13.

We revised the upper limit value.

L481-500: I am not convinced that it is useful to separate the description of what happened at high and middle equivalent latitudes into two paragraphs. It makes your text a bit repetitive. (For example, what you wrote in lines 498 to 500 sounds redundant with what you wrote in lines 486-487.)

We moved sentences at lines 496-500 to the end of the previous paragraph.

Fig. 4: Please indicate in the caption the concentration unit for each species (ppmv or ppbv), like you have done for Fig. 8.
Fig. 5: Same comment as for Fig. 4.

We made changes to both figure captions.

Fig. 7: It would be good to find a way to better distinguish the trajectories from each other. (As it is now, it is quite difficult to distinguish the trajectory A-a from B-b.) Maybe adding thin black contour lines could help.

We modified Fig. 7, showing A-a with a thin white center line in (a) and a thin black line in (b).

Fig. 8: You could add the names of the species in the beginning of the corresponding lines. This would make the figure clearer (same comment for Fig. 9). You should also define the red solid line in the caption, as it has been done for Fig. 9.

Species names are at the left of each curve, and we describe the red curves in the captions.

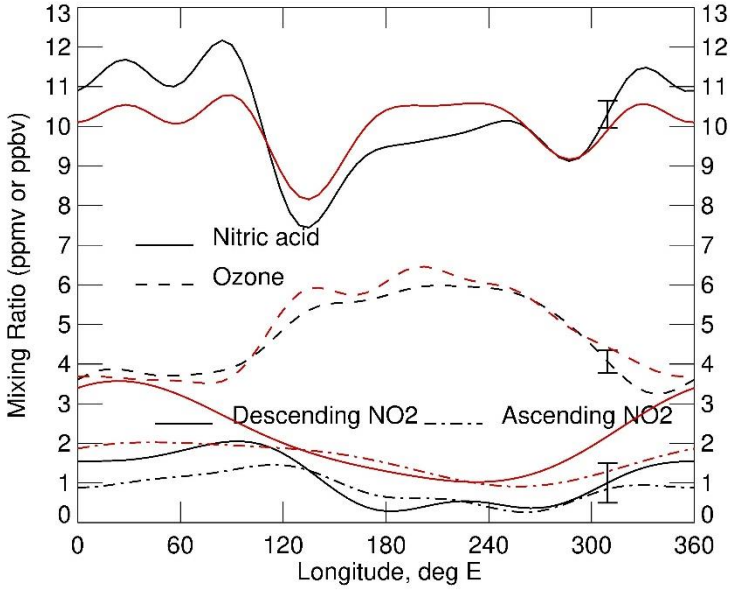
Technical corrections
L29: 27 January (instead of 28).
28 January is correct.

L86: Please remove the second ”unscreened”.
L276: ”that have behavior similar to” Please reword (”that have a similar behavior to...” or ”that behave similarly...” for example).
L401: ”aerosol, surface area” Please remove the comma.
L470: Please change ”during sunlight” to ”under sunlit conditions”.
L711: ”gas phase nitric” The word ”acid” is missing.
L740: Please change ”between 21 and 27 January” to ”on 21 and 27 January”.

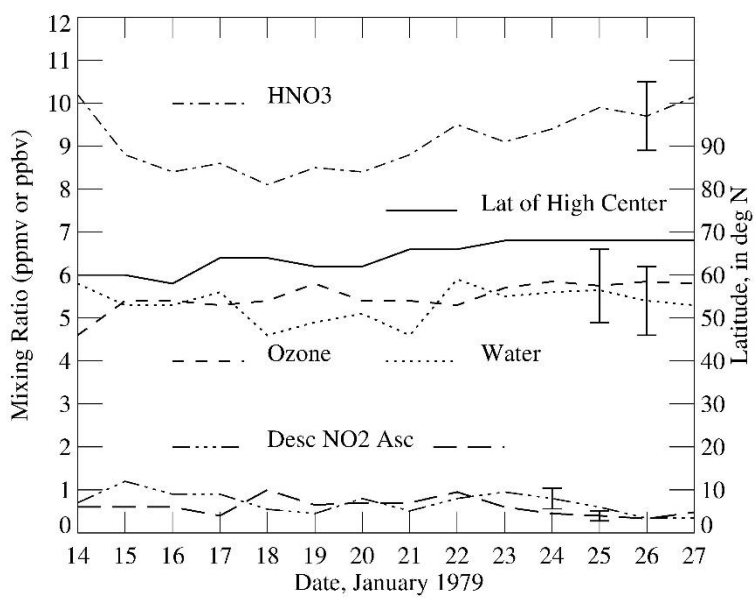
We made corrections, and for L740 we now add, ‘Note that between 21 and 27 January, there is some repetition of the AH center location and the corresponding red squares overlap’.

Fig. 12: Please write the years in white instead of black.

We made that change. At line 444 we now refer to Colucci and Ehrmann (JAS, 2018), as well.



Revised Figure 4 with 2σ error estimates on the V6 curves near 311°E. The data are from the V6 (black) and V5 (red) Level 3 or Fourier coefficient files for January 27, 1979.



Revised Figure 5 that includes ±RSS errors at January 24-26 for variations of V6 species.