Replies (*in italics*) to comments of Reviewer 3:

The paper "On the consistency of HNO3 and NO2 in the Aleutian High Region from Nimbus 7 LIMS Version 6 dataset" uses data from the LIMS instrument in January 1979 together with results from a photochemical trajectory model to investigate an event of HNO3 increase in the warm part of a dominant wave-2 structure in the lower stratosphere (30 hPa). Two aspects of this investigation are of interest: 1) The study demonstrates that LIMS v6 observations of HNO3, NO2, temperature and ozone can be used for scientific studies. Though the measurement period of LIMS was relatively short (October 1978 to May 1979), to my knowledge no other global observations of HNO3, or NO2/ozone during night, were available at that time. 2) A dedicated photochemical model study of the role of heterogeneous chemistry in a relatively warm winter stratosphere is carried out, an area certainly not as well investigated as the cold stratospheric vortex; it is found that even in the warm winter stratosphere, heterogeneous chemistry on the background aerosol plays a significant role in re-distributing NOy during night. The paper is reasonably well written, and I recommend publication with a few minor revisions. Some suggestions, mostly related to readability of the text and figures, are listed below.

line 69: ... that includes the chemistry of reactive nitrogen (NOy), the sum of HNO3 and odd nitrogen (NOx) (comma instead of or?)

Line 69: We added a comma.

line 73: here as well as in other places where a zonal wave-2 signature in HNO3 is discussed: I would rather call this a "quasi-wave 2 signature", because it is likely not related to a real planetary (Rossby) wave structure, as you indeed show in the paper. You could also say that it shows a quadrupolar structure. E.g., line 76; line 171; line 382.

Line 73: We changed the terminology, where appropriate.

line 76: "independent of dynamics" but heterogeneous reactions are temperature dependent, and transport plays a role as well here. Maybe it would be better to characterize the behavior of HNO3 as driven by a combination of chemistry and dynamics.

Line 76: We agree that your description is better so we made a change.

line 86: two "unscreened" in this sentence, one of them is unnecessary.

Line 86: We made a correction.

line 137, figure: observed HNO3 is highest in the polar vortex, and particularly in the presence of PSCs. However, as HNO3 is taken up into PSCs, a decrease of gas-phase HNO3 might also be expected in the presence of (large) PSCs (von Koenig et al., JGR, 2002; Lambert et al., Atmos Chem Phys, 2008)

Line 137: We agree with your assessment that it is likely that there was a decrease of gas-phase HNO3 directly downwind of the observed PSCs. We have modified this sentence, accordingly, and have included your two references. However, we believe that Lambert et al. has a publication year of 2012.

line 172-173: Please provide more detail about the derivation of the anomalies. Did you fit zonal planetary wave signatures as well as subtract the zonal mean? How? Why?

Lines 172-173: The zonal anomalies in Figures 2 and 3 are a result of merely subtracting the zonal mean coefficients (or mixing ratio) from the total value at each latitude/longitude grid point. However, the so-called "zonal anomalies" for NO2 represent the result of subtracting the average of the descending or "11 pm" value at a latitude from the total values of NO2 at each longitude. In other words, the separate analyses of the ascending or descending NO2 in the LIMS Level 3 product do not account for likely diurnal variations in the NO2.

line 177: "... while HNO3 and NO2 have anomaly patterns of the same sign" on January 19, but not on January 27 in the Ah region.

Line 177: We agree that the HNO3/NO2 anomalies are of the same sign across the AH region on 17 January but not on 27 January, and we now make that distinction in the revised text.

lines 181-196, figure 4: it would be good to provide error bars in the figure, and discuss the error range of the observations in the text, to assess whether the observed zonal variation is significant. This is especially true for NO2, where variations are small. Error ranges are provided in the discussion of figure 5, but should be provided here as well.
line 188: are "observed? seen?"

Lines 181-196 and Figure 4: The zonal variations in revised Figure 4 (see below) are species values at 64°N, as obtained from the Level 3 Fourier coefficients for both V6 and V5 and calculated at grid points spaced every 5.625° of longitude. The LIMS Fourier coefficients for each of the species are the result of applying a sequential estimation algorithm to their Level 2 or profile data, as limited by the estimated data precisions. As a result, the species variations in Figure 4 are relatively accurate and significant, at least to the scale of zonal wave 6 (or to wave 4 for NO2). The error bars in revised Figure 4 are the $2\sigma_n$ values from the error covariance matrix of the vector of the V6 Fourier coefficients (Remsberg and Lingenfelser, 2010).

Line 188 will say that the "differences for NO2 are seen mainly in the longitude sector from 320 to 120 E."

figure 5: it would be good to provide error bars in figures 4 and 5. I admit figure 5 is quite busy already; however, lines could also be highlighted by color, or you could provide one error range for every species at the edge of the figure. As is it at the

moment, it is difficult to asses whether the temporal evolutions of ozone, water vapor and NO2 are significant.

Figure 5: The species variations with time shown in Figure 5 are taken from the orbital or Level 2 profiles nearest to the center of the AH on each day, and we now include estimates of their single profile error. Vertical bars based on those root-sum-squared (RSS) data errors are on each curve near the right hand side of revised Figure 5 (see below).

lines 263-264: please specify in which way the model is updated - reaction rates, heterogeneous chemistry?

Lines 263-264: We use an updated version of the stratospheric diurnal photochemical model (Natarajan and Callis, 1997) that incorporates the chemical kinetics and photochemical data from the recent JPL evaluation (Burkholder et al., 2015) to calculate the changes in the composition of the air parcels until they reach the AH region on 27 January.

line 276: "have behavior" –> "behave"

Line 276: We made the change.

line 458: "when further chemical changes are inefficient" however, there should be uptake into PSCs if cold enough.

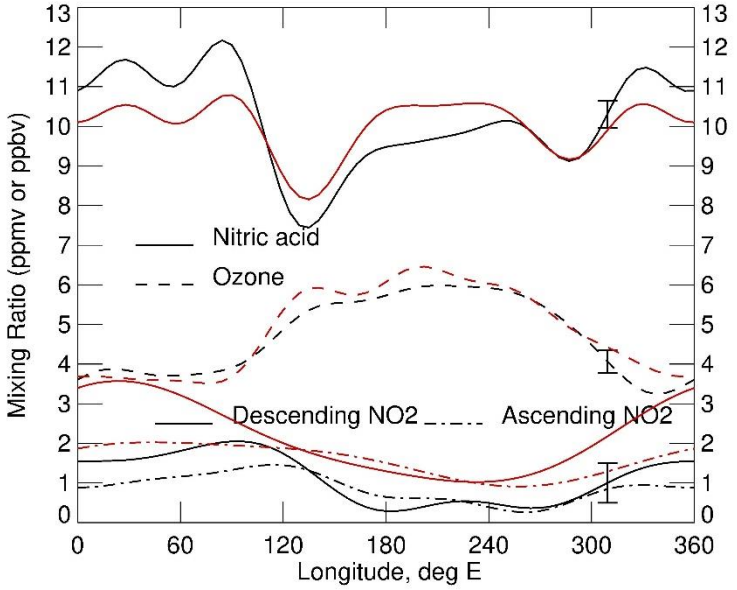
Line 458: We are adding your modifying statement.

line 476: "values_7ppm" –> "values of _7 ppm"

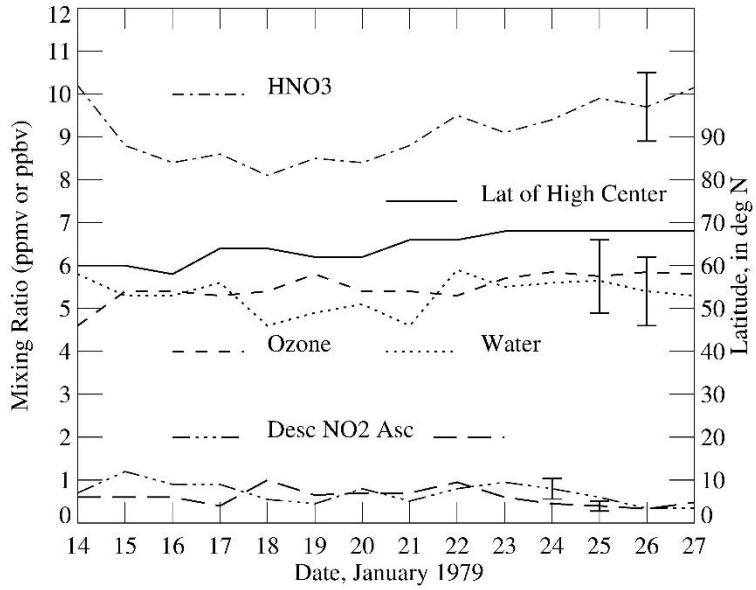
Line 476: We made the change.

figure 11: is the scatter within the single profile error of LIMS?

Figure 11: The RSS error estimates for HNO_3 and NO_2 are 0.8 ppbv and 0.24 ppmv, respectively.



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.