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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Growth of upper tropospheric aerosols due to uptake of HNO_3" *by* S. Romakkaniemi et al.

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1. By quantification of the effect of HNO3 on hygroscopic growth we mean putting precise numbers on how much HNO3 enhances aerosol growth as a function of relative humidity. Kärcher and Solomon (1999) and Lin and Tabazadeh (2002) are both excellent papers but do not provide all of the information that our paper gives. Lin and Tabazadeh considered the effect of HNO3 on the deliquescence RH of letovicite particles, but not how much HNO3 enhances hygroscopic growth. Karcher and Solomon calculated the effect of HNO3 on sulfuric acid aerosol extinction coefficients as a function of temperature reduced by the local frost point. This is undoubtedly also a way of quantifying the effect of HNO3 on hygroscopic growth; however, it certainly would not be straightforward to deduce particle diameter growth as a function of RH or the enhancement of haze mode number concentration from their calculations. Further, they do not give quantitative numbers on the effect of HNO3 on the growth of ammoniated

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aerosols. In fact, they conclude their paper by noting that their work highlights the need for detailed microphysical and chemical modeling of [UT] aerosols and that "A better understanding of the role of ammonia in particle formation and growth ... is required...".

We would also like to point out that neither Kärcher and Solomon nor Lin and Tabazadeh (nor anyone else) have shown that the UT aerosol growth due to uptake of HNO3 is strongly dependent on particle size (see figs. 1 and 2). This is contrary to the statement of Referee 1 that "insofar this paper does not reveal any new aspect".

2. We will add to the paper a figure (which cannot be shown here for technical reasons) and the following text: Trajectories were analysed for the encountered air masses. Measured data were sorted according to the related ozone level for separating tropospheric and stratospheric air masses. To obtain a similar separation for trajectory data, the potential vorticity scaled by atmospheric pressure was used. The analysed data suggest a clear separation of mainly tropospheric from mainly stratospheric air at a value of 300 - 400 scaled PV units. For all mission flights when haze mode events were observed, the trajectories indicate a lifting of tropospheric air parcels during the past 10 to 12 days prior to the measurement. The origin of these tropospheric air masses varies between 14 and 37 deg. N and 85 to 118 deg. E, i.e., from the Eurasian continent. Figure 7 shows an example for mission flight 1. Blue symbols indicate PV < 300 a.u. while black symbols indicate PV > 300 a.u.. Summarising, the trajectory data analysis supports the assumption that air masses close to the polar tropopause can be influenced by boundary layer air masses from lower latitudes and can thus carry chemical species of continental origin.

3. Fig. 1 of Krämer et al. (2003) shows HNO3 mixing ratios between 0.2 and 0.9 ppb measured during flight M3 of POLSTAR II (green stars in our Figs. 5 and 6). We will formulate the sentence referring to the paper of Krämer et al. (2003) accordingly.

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Interactive Comment

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