

Dear authors,

After adding the new Table 3, Figure 12 and the related text, the revised manuscript presents a clearer picture about the mechanism that leads to the accumulation of nitrate in the UTLS over TP/SASM. It is, however, not clear enough. I am not questioning your conclusion about the importance of upward transport and the gas-to-aerosol conversion of HNO_3 , but I want to know the source of HNO_3 that is converted to aerosol nitrate. You calculated the net-chemical production of HNO_3 by subtracting the losses in reactions R24-R25 from the total production of HNO_3 in reactions R1-R23. In the range 100-400 hPa, the calculated net-chemical production looks much smaller than the production of nitrate from gas-to-aerosol conversion (Fig. 12). Moreover, you did not include the loss of HNO_3 in reaction with NH_3 in your calculation of the net-chemical production of HNO_3 . If the HNO_3+NH_3 reaction is included, as required for a chemical budget, the net-chemical production of HNO_3 should be even much smaller than shown in Fig. 12, and negative around 200-300 hPa. So, what is the origin of HNO_3 converted to nitrate? From transport of air masses outside the range 100-400 hPa? If so, you are suggested to plot this source on Fig. 12. In addition, I suggest to display the vertical profile of the mixing ratio of HNO_3 on Fig. 12 and discuss the major chemical sources of HNO_3 and their vertical distributions.

Other points:

Figures 4 and 5: the performance of GEOS-Chem model seems to be bad in high latitudes (40-50N). Please explain this.

Figure 7: while I can see the high value zones of nitrate, ammonium, OC, BC, and $\text{PM}_{2.5}$ in the UTLS over TP/SASM, I can hardly see that of sulfate. Fadnavis et al. (2013) reported a very clear high value zone of sulfate in their Fig. 1 (c). Why is there such a large difference? What could be the problem in your or their simulations?

Figure 9: you show in Fig. 7(c) two high $\text{PM}_{2.5}$ zones, but there is only one zone of high aerosol extinction coefficient in Fig. 9(a). Why?

Lines 705-713: they are many many percent values in Table 4, but the percent values you mention here are actually not shown in Table 4. Please give values, from which you calculated the percent values, e.g., "46.8% (from $0.94 \mu\text{g m}^{-3}$ to $0.50 \mu\text{g m}^{-3}$)" .

Sincerely,

Xiaobin Xu