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The Measurements of HNO_3 in the Upper Troposphere and Lower Stratosphere during the Asian Summer Monsoon in 2017

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In situ measurements of HNO_3 in the Upper Troposphere and Lower Stratosphere (UTLS) were conducted in the region of 20-30 N°, 80-100 E°, during the Asian Summer Monsoon (ASM) season in 2017. Ambient gas was sampled and analyzed by a Chemical Ionization Time-of-Flight Mass Spectrometer (FunMass) on board a high -flying research aircraft – Geophysica M55, at the altitude range of 12-20 km.

FunMass is an innovative and versatile airborne instrument. It is equipped with a Dielectric Barrier Discharge (DBD) ion source to produce reagent ions, an Ion Funnel to enforce ion transfer efficiency and an online calibration system. HNO_3 was detected employing the CO_3^- chemical reaction scheme during the flights. The HNO_3 vertical profile shows that the HNO_3 mixing ratio below the tropopause layer was as low as tens of parts per trillion volume (pptv) and was rather constant with the increasing altitude. The upper tropopause layer saw a dramatic increase of HNO_3 concentration and the HNO_3 concentration rose rapidly with the increasing altitude in the lower stratosphere, peaking at 19.3 km at around 1.3 parts per billion volume (ppbv). On a short quasi-horizontal ascent to 19.4 km, a dip by 350 pptv of HNO_3 was observed, indicating a filament of air with more tropospheric characteristics. Overall, the in situ measurements of HNO_3 distribution can be used as a case study on the dynamical transport processes in the UTLS during the ASM season. Model simulation results of the Chemical Lagrangian Model of the Stratosphere (CLaMS) will be presented.