



The Measurements of HNO₃ in the Upper Troposphere and Lower Stratosphere during the Asian Summer Monsoon in 2017

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In situ measurements of HNO₃ 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. HNO₃ was detected employing the CO₃⁻ chemical reaction scheme during the flights. The HNO₃ vertical profile shows that the HNO₃ 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 HNO₃ concentration and the HNO₃ 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 HNO₃ was observed, indicating a filament of air with more tropospheric characteristics. Overall, the in situ measurements of HNO₃ 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.