Geophysical Research Abstracts
Vol. 19, EGU2017-13398, 2017
EGU General Assembly 2017

Water vapor increase in the northern hemispheric lower stratosphere by the Asian monsoon anticyclone observed during TACTS campaign in 2012

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Water vapor plays a key role in determining the radiative balance in the upper troposphere and lower stratosphere (UTLS) and thus the climate of the Earth (Forster and Shine, 2002; Riese et al., 2012). Therefore a detailed knowledge about transport pathways and exchange processes between troposphere and stratosphere is required to understand the variability of water vapor in this region.

The Asian monsoon anticyclone caused by deep convection over and India and east Asia is able to transport air masses from the troposphere into the nothern extra-tropical stratosphere (Müller et al. 2016, Vogel et al. 2016). These air masses contain pollution but also higher amounts of water vapor. An increase in water vapor of about 0.5 ppmv in the extra-tropical stratosphere above a potential temperature of 380 K was detected between August and September 2012 by in-situ instrumentation above the European northern hemisphere during the HALO aircraft mission TACTS.

Here, we investigated the origin of this water vapor increase with the help of the 3D Lagrangian chemistry transport model CLaMS (McKenna et al., 2002). We can assign an origin of the moist air masses in the Asian region (North and South India and East China) with the help of model origin tracers. Additionally, back trajectories of these air masses with enriched water vapor are used to differentiate between transport from the Asia monsoon anticyclone and the upwelling of moister air in the tropics particularly from the Pacific and Southeast Asia.