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Chemical composition and processing of aerosol particles in the Asian Tropopause Aerosol Layer inferred from airborne measurements during the ACCLIP campaign

Oliver Eppers[1], Franziska Köllner[2], Oliver Appel[2], Philipp Brauner[1], Fatih Ekinci[2], Sergej Molleker[1], Antonis Dragoneas[1], Andreas Hünig[1], Warren Smith[3], Rei Ueyama[4], Johannes Schneider[1], and Stephan Borrmann[1,2]
[1]Max Planck Institute for Chemistry, Mainz, Particle Chemistry Department, Mainz, Germany (o.eppers@mpic.de)
[2]Institute for Atmospheric Physics, University of Mainz, Mainz, Germany
[3]National Center for Atmospheric Research, Boulder, Colorado, USA
[4]NASA Ames Research Center, Moffett Field, CA, USA

The presence of aerosol particles in the upper troposphere/lower stratosphere (UTLS) region plays an important role for the Earth's radiative balance and the formation of cirrus clouds. In recent years, a substantial amount of organic matter and ammonium nitrate have been found in the Asian upper troposphere (UT) associated with the Asian summer monsoon anticyclone (ASMA; Appel et al., 2022; Höpfner et al., 2019). These particles were observed at altitudes between 11 and 19 km (corresponding to potential temperatures between 355 and 420 K), known as the Asian Tropopause Aerosol Layer (ATAL). However, the formation and aging processes of these particles remain unclear. In particular, the fate of aerosol particles in eastward eddy shedding events is poorly understood.

Here, we present the results of aircraft-based measurements in the eddy shedding region above the Western Pacific during the ACCLIP campaign in July/August 2022. Using the hybrid mass spectrometer ERICA (ERC instrument for chemical composition of aerosols; Hünig et al., 2022), the chemical composition of aerosol particles in the Asian UT was measured via a combination of two complementary aerosol mass spectrometry techniques: the desorption ionization technique (ERICA-LAMS) and the thermal desorption with subsequent electron impact ionization technique (ERICA-AMS). The detectable size range of ERICA extends from ~120 nm up to 3.5 µm.

Our ERICA-AMS measurements indicate that the ATAL above 360 K potential temperature exhibited enhanced concentrations of ammonium nitrate and organics with a growing fraction of sulfate towards higher altitudes. Additionally, measurements in aged ASMA air masses during eddy shedding events enabled the investigation of photochemical aging of particles originating from the ATAL. For this purpose, the degree of oxidation will be evaluated by the ratio of organic signals at m/z 43 and 44 from the ERICA-AMS. We will further combine the dataset from these observations with model results of the location and timing of recent convective influence. The determination of recent convective influence is based on kinematic backward trajectories and a

satellite-derived database of convective cloud top altitudes to distinguish different source regions.

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