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Single-Particle Aerosol Composition in the Asian Tropopause Aerosol Layer and in the North American Upper Troposphere/Lower Stratosphere during ACCLIP

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The Asian Summer Monsoon Anticyclone (AMA) is known to bring ground-level pollutants up to the stratosphere. Aerosols in the AMA often form what is known as the Asian Tropopause Aerosol Layer (ATAL), with modelling studies suggesting that the ATAL can provide up to 15 % of the stratospheric aerosol in the Northern Hemisphere. In this work, we present single-particle mass spectrometry measurements of aerosol composition in the AMA outflow and in the North American upper troposphere/lower stratosphere (UTLS) during the same season. Measurements were taken by the Particle Analysis by Laser Mass Spectrometry (PALMS) instrument and made during the Asian Summer Monsoon Chemical & CLimate Impact Project (ACCLIP). We find that the dominant aerosol type found in the ATAL and those found in the UTLS over North America are chemically different. Despite high concentrations of ground-level gas phase pollutants, particles in the ATAL are dominated by secondary nitrate particles. The organic content of these particles is low, which precludes them from being organic-nitrate aerosol; thus, we believe that these particles are either nitric/sulfuric acid solutions, or they are mixtures of partially neutralized ammonium nitrate/sulfate. Finally, we present the mass concentrations of nitrate particles, dust, and sulfate-organic particles in the ATAL, and estimate each particle type's influence on the aerosol composition over the North American continent.