EGU23-1966, updated on 24 Apr 2024
https://doi.org/10.5194/egusphere-egu23-1966
EGU General Assembly 2023

Understanding the climate impacts of the Asian Summer Monsoon with in-situ observations of aerosol microphysical properties in the upper troposphere and lower stratosphere

Christina Williamson[1,2], Dylan Simone[3], Charles Brock[4], Ming Lyu[4,5], Matthew Brown[6], Luke Ziemba[6], Joowan Kim[7], Teresa Campos[8], Kirk Ullmann[8], and Laura Pan[8]

[1]Atmospheric Composition Unit, Finnish Meteorological Institute, Helsinki, Finland
[2]Institute for Atmospheric and Earth System Research, University of Helsinki, Helsinki, Finland
[3]University of Colorado, Boulder, Colorado, USA
[4]Chemical Sciences Laboratory, National Oceanic and Atmospheric Administration, Boulder, Colorado, USA
[5]Cooperative Institute for Research in Environmental Science, University of Colorado, Boulder, Colorado, USA
[6]NASA Langley Research Center, Hampton, Virginia, USA
[7]Department of Atmospheric Science, Kongju National University, Gongju, South Korea
[8]Atmospheric Chemistry Observations and Modeling Lab, National Center for Atmospheric Research, Boulder, CO, USA

The Asian monsoon anticyclone transports aerosol and gas phase pollutants from the boundary layer to the upper troposphere and lower stratosphere, from whence they are transported out over the Western Pacific by eddy shedding. This significantly increases aerosol loading in the upper troposphere and maintains a layer of aerosol in the lowermost stratosphere with important implications for climate and stratospheric chemistry. Models show large spread in the spatial distribution and microphysical properties of aerosols transported by the Asian monsoon, and the chemical and radiative effects remain uncertain.

In August 2022 we measured aerosol size distributions in Asian summer monsoon outflow from two aircraft, the NCAR GV and NASA WB57, as part of the Asian Summer Monsoon Chemical Climate Impacts Project (ACCLIP). On both aircraft we operated a Nucleation Mode Aerosol Size Spectrometer (NMASS, a custom battery of 5 condensation particle counters) and a modified Ultra-High Sensitivity Aerosol Spectrometer (an optical particle counter from Droplet Measurement Technologies) to measure size distributions from 3 to 1500 nm at 1 Hz time resolution.

Here we use these data together with concurrently measured trace gases and reactive gases, and cloud properties, to quantify the transport of primary aerosol by the monsoon system, and the formation of secondary aerosol in the monsoon outflow. We show that new particle formation occurs in the upper troposphere in monsoon outflow and investigate its relation to lofting of condensable vapours and wet scavenging of larger aerosols by deep convection. We use data taken in the upper troposphere and lower stratosphere of the NASA Atmospheric Tomography Mission (ATom) to compare aerosol microphysical properties in the summer monsoon outflow with those in less anthropogenically influence air.