Transport of aerosols and trace gases into the upper troposphere during the peak Asian monsoon period in summer 2017

T. ONISHI[1], K.S. LAW[1], J.-C. RAUT[1], F. FIERLI[2], F. CAIRO[2], F. RAVEGNANI[3], A. ULANOVSKY[4], S. VICIANI[5], F. D'AMATO[5], and S. BORRMANN[6]

[1] *Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS/CNRS/UPMC/UVSQ), Paris, France*

[2] *Institute for Atmospheric Sciences and Climate (ISAC-CNR), Rome, Italy*

[3] *Institute for Atmospheric Sciences and Climate (ISAC-CNR), Bologna, Italy*

[4] *Central Aerological Observatory (CAO), Moscow, Russia*

[5] *National Institute of Optics (INO-CNR), Florence, Italy*

[6] *Max Planck Institute for Chemistry (MPIC)/U. Mainz, Mainz, Germany*

Deep convection associated with the Asian summer monsoon transports trace gases and aerosols into the upper troposphere and lower stratosphere (UTLS) and contributes to the Asian Tropopause Aerosol Layer (ATAL), a region important for the Earth's climate. This includes transport of anthropogenic emissions from Himalayan-Gangetic Plain and China as well as dust emissions from desert regions. As part of the EU StratoClim project, a high altitude aircraft campaign was carried out in summer 2017 using the Russian research aircraft M55-Geophysica making measurements of chemical and aerosol composition over Nepal, northern India and the Bay of Bengal in the UTLS up to 20km. In this study, we examine the relative contributions of different anthropogenic emission regions to the composition of the UT during the peak monsoon period in July-August 2017. The WRF-Chem model, ver. 3.8, was run at 25km horizontal resolution, nudged with meteorological analyses from GFS and using anthropogenic emissions from ECLIPSE and REAS v2.1 (Regional Emissions in Asia) inventories. Natural emissions are also included (e.g. dust). To investigate the role of convective uplift in enhancing pollutant levels in the Asian Monsoon Anticyclone (AMA) during the campaign period the model was run with CO/black carbon tracers from different sub-regions over south-east Asia and different cumulus convection parameterization schemes (Grell 3D, Betts-Miller-Janjic and Kain-Fritsch-Cumulus Potential (KF-CuP)). The model was also run with detailed gas phase and aerosol treatments (SAPRC99 coupled with VBS and MOSAIC). Simulated spatial and vertical distributions of clouds as well as the convective available potential energy (CAPE) are examined and results compared carbon monoxide and ozone data measured onboard the M55. We also investigate the impact of convective uplift from different emission regions on the vertical distribution of aerosols in the ATAL through comparison with available observations (ERICA aerosol composition, aerosol backscatter and lidar).

Key words: Asian Monsoon Anticyclone, convection, aerosols, aircraft data, regional modelling