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Global modelling studies of aerosols linked to the Asian Tropopause Aerosol Layer (ATAL) in the monsoon anticyclone region.

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The Asian Tropopause Aerosol Layer (ATAL), refers to an enhanced aerosol layer associated with the Asian Summer Monsoon Anticyclone (AMA) which was identified at the beginning of this decade using satellite observations and is localized between 13 and 18 km in altitude. The ATAL is controlled by the vertical transport of boundary layer emissions of pollutants (primary aerosols and gaseous precursors of secondary aerosols) through convection and subsequent trapping into the AMA.
To study the impact of the Asian monsoon-related convection on the ATAL composition and properties, we have carried out 3D simulations using the Community Earth System Model (CESM) which embeds the Community Atmosphere Model (CAM5) coupled with the MAM7 (Modal Aerosol Model) aerosol module. Up-to-date anthropogenic and natural emissions inventories of primary aerosols and secondary aerosols precursors have been used to drive our simulation. Particularly, we have merged the regional REAS (Regional Emission inventory in Asia v2.1) and global MaCCity anthropogenic emissions for the principal aerosol species and precursor gases: organic and inorganic carbon (BC and OC), nitrogen oxydes (NO_x), ammonia (NH3), sulfur dioxide (SO_2) and volatile organic compounds. Biogenic carbon monoxide (CO) emissions were added from MEGAN-MACC database, whereas global volcanic SO_2 emissions are taken from the literature. All the simulations are performed using the default chemical mechanism present in CAM5-MAM7 and nudging with MERRA v2 meteorological data at the spatial resolution of 1.9° x 2.5° longitude/latitude and 56 levels of altitude ranging from the ground to approximately 45 km of altitude.
We present the results for long-term simulation, i.e. 10 years (2000-2010), showing that the shape and aerosols average concentration of the ATAL vary inter-annually and its localization could be found around 20-38°N latitude and 65-105°E longitude, with the maximum aerosol number concentration localized between 10-16 km during the summer period (July-September). The ATAL seems to be mainly composed of small particles (mean radius < 0.26 μm) mostly by organics (primary and secondary organic aerosols) $\sim$ 60 %, sulfate (SO4) $\sim$ 28 % and ammonium (NH4) < 10 %.
The model output will be validated through a comparison with the unique EC-FP7 StratoClim aircraft observations, satellite data and the recent BATAL 2018 balloon experiments in India (NASA-ISRO project).