Confinement of air in the Asian monsoon anticyclone and pathways of convective air to the stratosphere during Summer season

Bernard Legras[1], Silvia Bucci[1], and Soheil Salimi[1]

[1] *Laboratoire de Météorologie Dynamique/IPSL, CNRS/PSL-Univ./Sorbonne-Univ./Ecole Polytechnique, Paris, France*

High resolution backward and forward trajectory calculations are used to study the transport of convective air in and around the Asian Monsoon Anticyclone (AMA). We focuse on the 2017 summer season which is the first one during which MSG data and products are available over the Asian Monsoon region and during which the StratoClim campaign data are available. The transport is performed using ERA-Interim and ERA5 with both diabatic and kinematic vertical transport at 3- hourly and hourly time resolution. The cloud top properties are estimated from geostationary satellite products and from ERA5 detrainment rates.

This study corroborates the results of Tissier and Legras (2016) and brings new important highlights. We show that the trajectories reconstruct a layer of concentrated convective parcels within the AMA up to 16 km which is also the altitude of the observed Asian Tropopause Aerosol Layer. The main sources to the high altitude core of the anticyclone concentrate in preferred continental regions in Northen India, China and the Tibetan Plateau, which are for the first two highly polluted. The age of air with respect to convection is however minimal and not maximal in the core of the AMA indicating that the concentration is not due to trapping but to the localization of sources and the favourable conditions of vertical transport in the TTL. We also emphasize that the main troposphere to stratosphere flux from Asian Monsoon convection is from maritime origin and circulate along

the southern jet of the AMA without penetrating inside. Both kinematic and diabatic trajectories generate confinement but there are also significant differences: for instance, the radiative diabatic transport rapidly washes out the levels below 14 km in the AMA. There are also differences between ERA-Interim and ERA5 diabatic transport due to differences in the cloud distribution in these two reanalysis. The ERA-Interim vertical diabatic transport is excessive while the ERA5 diabatic transport is slightly lower than the kinematic transport. On the overall, the ERA5 diabatic and kinematic transport properties are much closer than the ERA5 and also more consistent with the StratoClim tracer observations.

This study confirms that the main feeders of the Tropical Tropopause layer are the clouds that reach above the all sky level of zero radiative heating rates with contributions up to the tropopause level. These clouds are rare and our results are sensitive to the retrieval of their properties from satellite observations and their representations in models. We identify the Tibetan plateau as the region where discrepancies between satellite and model based methods are the largest.

Key words: transport, TTL, convection, ATAL

References

Tissier, A.-S. and B. Legras, 2016: *Atmos. Chem. Phys.*, **16**, 3383-3398, doi:10.5194/acp-l6-3383-2016