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Airmass analysis of the processes driving the progression of the 2016 Indian summer monsoon

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The Indian monsoon is the main source of irrigation in the northern Indian plains and a vital source of water for more than a billion people. Therefore, research investigating the mechanisms driving its onset and progression can be of substantial benefit to society. The INCOMPASS project has been designed to tackle these challenges, through an observational field campaign supplemented by high-resolution convection-permitting numerical simulations for the 2016 season.

These simulations show that the progression of the monsoon over the plains of northern India in June 2016 is a non-steady process, modulated by the interaction between moist south-westerly flow from the Arabian Sea and a north-westerly intrusion of dry air from Central Asia. The location and extent of these two flows is closely linked to synoptic-scale dynamics at higher latitudes, through the southward propagation of PV streamers and the associated formation of mesoscale vortices in the region where the two air masses interact.

Particular focus has been devoted to the use of Lagrangian trajectories to characterise the evolution of the aforementioned airstreams and complement the Eulerian analysis of the monsoon progression in the region. The trajectories confirm that the interaction of the two airstreams is a primary driver of the general moistening of the troposphere associated with the monsoon progression. At the same time, they highlight the importance of diabatic processes occurring along the airstreams, such as the local evaporation from the Arabian Sea in addition to moisture transport from remote sources.

In summary, this combined Eulerian and Lagrangian analysis highlights that the monsoon progression over northern India is a non-steady process driven by the interaction of different air masses, which is influenced by a synergy of factors on different scales, such as higher-latitude dynamics, transient weather systems and local diabatic processes.