



The interaction of Indian monsoon depressions with northwesterly dry intrusions

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Monsoon depressions (MDs) bring substantial monsoon rainfall to northern and central India. These events usually form over the Bay of Bengal and travel across northern India toward Pakistan. Using European Centre for Medium-Range Weather Forecasting Interim Reanalysis, an MD tracking algorithm, and an objective identification method, we find that 30-40% of MDs interact with northerly intrusions of dry desert air masses as the MDs traverse the subcontinent. Dry intrusions nearly halve the precipitation rate in the southwest quadrant of MDs, where they rain the most. However, dry intrusions increase the rainfall rate near the MD centre. Both of these changes occur because dry intrusions change the structure of radial pressure gradients west of MD centres, increasing the pressure gradient near the centre and decreasing it further out. Dry intrusions reduce MDs' propagation speed and distance. Dry intrusions bring air with low potential vorticity (PV) to within 200 km of the centre of the monsoon depression. This causes a substantial negative PV anomaly near and to the west of the MD centre compared to MDs that do not encounter dry intrusions. This reduces the MDs' ability to propagate via potential vorticity advection.