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On the Structure and Dynamics of Indian Monsoon Depressions

Kieran Hunt (1), Andrew Turner (1), Peter Inness (1), David Parker (2), and Richard Levine (2)

(1) University of Reading, NCAS-Climate/Department of Meteorology, Reading, United Kingdom (a.g.turner@reading.ac.uk), (2) Met Office Hadley Centre, FitzRoy Road, Exeter, Devon, United Kingdom

ERA-Interim reanalysis data from the past 35 years have been used with a newly-developed feature tracking algorithm to identify Indian monsoon depressions originating in or near the Bay of Bengal. These were then rotated, centralised and combined to give a fully three-dimensional 106-depression composite structure – a considerably larger sample than any previous detailed study on monsoon depressions and their structure. Many known features of depression structure are confirmed, particularly the existence of a maximum to the southwest of the centre in rainfall and other fields, and a westward axial tilt in others. Additionally, the depressions are found to have significant asymmetry due to the presence of the Himalayas; a bimodal mid-tropospheric potential vorticity core; a separation into thermally cold- (-1.5K) and neutral- ($\sim$0K) cores near the surface with distinct properties; and that the centre has very large CAPE and very small CIN. Variability as a function of background state has also been explored, with land/coast/sea, diurnal, ENSO, active/break and Indian Ocean Dipole contrasts considered. Depressions are found to be markedly stronger during the active phase of the monsoon, as well as during La Nina. Depressions on land are shown to be more intense and more tightly constrained to the central axis. A detailed schematic diagram of a vertical cross-section through a composite depression is also presented, showing its inherent asymmetric structure.