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Atmospheric circulation feedback on west Asian dust and Indian monsoon rainfall

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Classification of the atmospheric circulation patterns associated with high aerosol loading events over the Ganges valley, via the synergy of Factor and Cluster analysis techniques, has indicated six different synoptic weather patterns, two of which mostly occur during late pre-monsoon and monsoon seasons (May to September). The current study focuses on examining these two specific clusters that are associated with different mean sea level pressure (MSLP), geopotential height at 700 hPa (Z700) and wind fields that seem to affect the aerosol (mostly dust) emissions and precipitation distribution over the Indian sub-continent. Furthermore, the study reveals that enhanced aerosol presence over the Arabian Sea is positively associated with increased rainfall over the Indian landmass. The increased dust over the Arabian Sea and rainfall over India are associated with deepening of the northwestern Indian and Arabian lows that increase thermal convection and convergence of humid air masses into Indian landmass, resulting in larger monsoon precipitation. For this cluster, negative MSLP and Z700 anomalies are observed over the Arabian Peninsula that enhance the dust outflow from Arabia and, concurrently, the southwesterly air flow resulting in increase in monsoon precipitation over India. The daily precipitation over India is found to be positively correlated with the aerosol loading over the Arabian Sea for both weather clusters, thus verifying recent results from satellite observations and model simulations concerning the modulation of the Indian summer monsoon rainfall by the Arabian dust. The present work reveals that in addition to the radiative impacts of dust on modulating the monsoon rainfall, differing weather patterns favor changes in dust emissions, accumulation as well as rainfall distribution over south Asia.