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Clustering of wind-precipitation relation over the southwest coast India: A new perspective on monsoon intraseasonal oscillations

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This study attempts to understand the non-linearity observed between wind and precipitation during the Indian summer monsoon over the west coast of India. We used an unsupervised machine learning algorithm (K-means clustering) to explore the possible wind-precipitation clusters. The Monsoon Low-Level Jet core speed observed by 205 MHz wind profiler radar placed over Cochin (10.04N; 76.33E) and rainfall averaged over the west coast of India is given as input to the K-means algorithm. Five distinct wind-precipitation regimes are identified, and their large-scale dynamics, which lead to these clusterings, are investigated. Two clusters are placed in the low wind regimes, whereas three clusters are in the high wind regimes. Different modes of monsoon intraseasonal oscillation seem to contribute to different clusters. The low-wind low-precipitation (LWLP) and low-wind high-precipitation (LWHP) clusters are signatures of monsoon break over the central India, while high-wind high-precipitation (HWHP) and high-wind low-precipitation (HWLP) clusters lie in the strong and weak modes of northward propagating monsoon intraseasonal oscillation (MISO). The high-wind extreme precipitation cluster (HWEP) is also in the strong mode of MISO over the west coast, and the northwestward propagating monsoon depressions lead to extreme precipitation in this cluster.

Lagrangian back trajectories are used in this study to find the moisture sources at 500 hPa. We found that the dry mid-troposphere due to dry air intrusion from adjacent regions suppresses the precipitation regardless of the wind regime. On the other hand, the enhanced boundary layer convergence owing to the ascent of moisture into the 500 hPa level can trigger heavy rainfall over the west coast of India.