



Amplification of the ENSO Effects on Indian Summer Monsoon Rainfall by Absorbing Aerosols

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In this study, we present observational evidence of the elevated heat pump (EHP) effect and modulation of the ENSO effect on Indian summer monsoon rainfall by absorbing aerosols based on a composite analysis of satellite measurements and MERRA reanalysis data for the period 1979-2011. Results show that in the pre-monsoon season (April to May) rainfall during a La Nina is reduced over the expansive desert region from western Asia, including the Middle East, to northern India and thereby the La Nina effect provides abundant aerosols that are necessary to work the EHP effect in the northern India. Thus, the EHP effect due to abundant absorbing aerosols during a La Nina phase is strongly associated with atmospheric warming, increased moisture transport from the Indian Ocean to the Bay of Bengal, and enhanced pre-monsoon (May-June) rainfall over northern India. As a result, precipitation in May to June in northern India (20-30°N) increases by approximately 20% and 25% due to the pure ENSO (PENSO) and EHP effects, respectively, while precipitation in May and June increased by approximately 30% due to the combined effect. This finding suggests that the EHP effect plays an important role in amplifying the La Nina effect on Indian summer monsoon.