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Boreal Summer Intraseasonal Oscillation extreme rainfall propagation modulated by Pacific sea surface temperatures

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Intraseasonal variability of extreme rainfall events (EREs) during the South Asian Summer Monsoon season is dominated by the Boreal Summer Intraseasonal Oscillation (BSISO). However, deviations from its canonical north-eastward propagation are poorly understood, posing challenges to the prediction of EREs and climate modeling. Here, we combine a climate network-based approach determining regions of synchronously occurring EREs with a clustering analysis of zonal and meridional BSISO propagation patterns which reveals three distinct modes: canonical north-eastward, eastward-blocked, and stationary propagation. We show that Pacific sea surface temperature background states determine the propagation mode. In particular, El Niño (La Niña)-like conditions favor the stationary (eastward-blocked) mode by modifying the zonal and meridional overturning circulation structures and the strength of the BSISO Kelvin wave component. The uncovered mechanism for BSISO diversity has implications for the predictability of large, spatially extensive EREs in South Asia and the development of early warning signals on a time horizon of 3-5 weeks.