Event synchrony based complex network analysis of heavy precipitation in different monsoon regions revealing dynamical patterns of extreme event formation and propagation

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Investigating the synchrony and interdependency of heavy rainfall occurrences across and between different tropical regions offers a new perspective on the underlying physical mechanisms. In this context, studies utilizing functional network representations have recently contributed to significant advances in the understanding and prediction of extreme weather events. Here, we systematically contrast previous results on spatiotemporal extreme precipitation patterns in three key monsoon regions (India, South America and East Asia) based on the concept of event synchronization (ES) with corresponding patterns obtained using the closely related event coincidence analysis (ECA) approach. Our findings demonstrate that an additional window size parameter of ECA not involved in ES allows for a more detailed analysis of the formation and propagation processes associated with heavy precipitation events. While the resulting network connectivity patterns based on both approaches closely resemble each other for the case of the South American monsoon system and the Indian summer monsoon, there exist subtle differences that carry climatologically relevant information. We further exploit the advanced potentials provided by ECA for studying in greater detail the spatial organization of East Asian summer monsoon (EASM) related heavy precipitation across the relevant season in a time-dependent fashion. Our results show that the formation of the Baiu front as a main feature of the EASM is accompanied by a double-band of synchronous heavy rainfall with two spatially dislocated centers north and south of the front. Although these bands are closely related to low- and high-level winds which are commonly assumed to be independent of each other, it is rather their mutual interconnectivity that changes during the different phases of the EASM season in a characteristic way. The thus obtained insights could provide relevant information for improving existing forecasting strategies for monsoon onset and strength.

References:


Wolf, R.V. Donner: Spatial organization of connectivity in functional climate networks describing event synchrony of heavy precipitation. European Physical Journal Special Topics (in review)