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Tracking frontal system rainfall during Baiu season using complex climate networks

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Tools from complex network theory can effectively extract spatio-temporal variability patterns from climate data. Such climate networks are often set up utilizing non-linear synchronicity metrics, i.e. event synchronization. In previous studies, event synchronization based precipitation networks did not only reveal the driving mechanisms of extreme precipitation events, but also contributed to predicting these (Boers et al., 2014). Accordingly, we aim here to investigate the annual migration of the Baiu front, as a part of the Asian Monsoon System, between May and July using precipitation networks based on event synchronization and the recently introduced event coincidence analysis.

The Baiu front forms around 30°N in May as the Okinawa Baiu, a latitudinally extending rain band, and gradually moves northward during June and July until its withdrawal due to an abrupt northward shift of the subtropical jet and a northward movement of the North Pacific subtropical high. We employ the three-hourly Tropical Rainfall Measuring Mission (TRMM) precipitation estimates (1998-2015) with a spatial resolution of 0.25° to study the migration of the Baiu system. We observe substantial quasi-stationary precipitation during the Baiu season, which are caused by mesoscale convective systems providing up to 50% of the annual precipitation in East Asia. We construct temporally distinct (sliding window approach) network representations of extreme precipitation based on the spatial synchronicity to access the temporal evolution of the Baiu front. Furthermore, we explore different topological and spatial network characteristics to identify key regions and driving factors of the propagation mechanism of the front. By conducting this study, we contribute to a better understanding and prediction of extreme precipitation events during the Baiu season.