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Comparison of tropical and frontal storms using complex networks

Ugur Öztürk (1,2), Nishant Malik (3), Norbert Marwan (1), Jürgen Kurths (1,4)

(1) Potsdam Institute for Climate Impact Research, Potsdam, Germany, (2) Institute of Earth and Environmental Science, University of Potsdam, Potsdam, Germany, (3) Department of Mathematics, Dartmouth College, Hanover, NH-03755, USA., (4) Department of Physics, Humboldt University, Berlin, Germany

Complex network analysis supports exploring spatiotemporal dynamics of significant climate phenomena, such as heavy precipitation. Complex networks are able to capture the spreading and concentration of extreme rainfall by using event-synchronization, such as rainfall propagation patterns of the Indian Summer Monsoon by parameterizing the delay from precipitation time-series. Despite much advancement in monitoring extreme rainfall, capturing spatiotemporal dynamics of the fast-evolving atmospheric events (e.g., tropical storms) is still a challenge. Quantifying spatial scales of extreme rainfall will aid mitigating concomitant flood and landslide hazards.
We use network analysis to compare spatial features of extreme rainfall over Japan using satellite-derived rainfall data (TRMM-3B42V7). We first divide the time series into two subsets: June to July (JJ) and August to November (ASON) to concentrate on the Baiu front season (JJ) and the tropical storms season (ASON). We assess the spatial scales involved in the two distinct mechanisms and define regions of coherent rainfall during the two seasons. We additionally propose using radial statistics to trace the network flux over long distances, which allows us to observe the general pattern of extreme rainfall tracks. Extreme rainfall associated with tropical storms show smaller spatial scales (in the range of 100 km) compared to Baiu linked extremes. We also discovered a consistent deviation of the extreme rainfall from the eye of the tropical storm tracks.