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Complex networks identify spatial patterns of extreme rainfall of the South American monsoon system

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In this study, we investigate the spatial characteristics of extreme rainfall synchronicity of the South American Monsoon System (SAMS) by means of Complex Networks. We first show how this approach leads to the identification of linkages between large-scale atmospheric conditions and natural hazards occurring at the earth's surface. Thereafter, we exemplify how our methodology can be used to compare different datasets and to test the performance of climate models.

In recent years, complex networks have attracted great attention for analyzing the spatial characteristics of interrelations of various time series. Outstanding examples in this context are functional brain networks as well as so-called climate networks. In most approaches, the basic idea is to represent time series at different locations by network nodes, which will be connected by network links if the corresponding time series behave similar. Information on the spatial characteristics of these similarities can be inferred by network measures quantifying different aspects of the networks' topology.

By combining several network measures and interpreting them in a climatic context, we investigate climatic linkages and classify the spatial characteristics of extreme rainfall synchronicity. Although our approach is based on only one variable (high spatiotemporal resolution rainfall), it reveals the most important features of the SAMS, such as the main moisture pathways, areas with frequent development of Mesoscale Convective Systems, and the major convergence zones. We will show that these features are only partially reproduced by reanalysis and (regional and global) climate model data.