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Structured teleconnections reveal the South American monsoon onset: A network approach

Catrin Ciemer (1,2), Nikoo Ekhtiari (1,2), Henrique Barbosa (3), Niklas Boers (1,4), Reik Donner (1), Jürgen Kurths (1,2), Anja Rammig (5), Ricarda Winkelmann (1,6)

(1) Potsdam Institute for Climate Impact Research, Germany (ciemer@pik-potsdam.de), (2) Humboldt University Berlin, Germany, (3) University of São Paulo, Brazil , (4) Ecole Normale Supérieure de Paris, France, (5) Technical University of Munich, Germany, (6) Potsdam University, Germany

The regional onset dates of the global monsoon systems are, to first order, determined by the seasonal shift of the intertropical convergence zone. However, precise onset dates vary substantially from year to year due to the complexity of the involved mechanisms.
In this study, we investigate processes determining the onset of the South American monsoon system (SAMS).
In recent years, a trend towards later onset dates of the SAMS has been observed. A later onset of the monsoon can have severe impacts on agriculture and infrastructure such as farming, water transport routes, and the stability of the Amazon rainforest in the long term.
Possible reasons for this shift involve a multitude of climatic phenomena and variables relevant for the SAMS. To account for the highly interactive nature of the SAMS, we here investigate it with the help of complex networks.
By studying the temporal changes of the correlation structure in spatial rainfall networks, we are able to determine coherent areas of similar precipitation patterns, spot teleconnections in terms of strongly correlated areas, detect key regions for precipitation correlations, and finally reveal the monsoon onset by an abrupt shift from an unordered to an ordered correlation structure of the network.
To further evaluate the shift in the monsoon onset, we couple our rainfall network to a network of climate networks using sea surface temperature as a second variable. We are thereby able to emphasize oceanic regions that are particularly important for the SAMS and anticipate the influence of future changes of sea-surface temperature on the SAMS.