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Regional and inter–regional effects in evolving climate network

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Real-world systems composed of many interacting subsystems are frequently studied as complex networks. Studied systems are thus represented by graphs composed of nodes standing for the subsystems and edges denoting interactions present among the nodes; the characteristic properties of the graph are subsequently studied and related to the system's behavior. Potential time-dependency of edges is conveniently captured in so-called evolving networks. There is a growing interest in the application of complex network analysis approach to climate data. Use of evolving networks is a promising technique in this research area due to non-stationarity of the climate dynamics. Recently, it has been shown that an evolving climate network can be used to disentangle different types of El-Nino episodes described in the literature. In particular, an evolving network was constructed as thresholded correlation matrix of a year-long daily surface air temperature data from the NCEP/NCAR reanalysis dataset remapped onto a 10242-point equidistant geodesic grid. The time evolution of several graph characteristics, including density, clustering coefficient or average path length, has been compared with the intervals of El Niño and La Niña episodes. In the current study we identify the sources of the evolving network characteristics by considering a reduced-dimensionality description of the climate system. First, we have used low density geodesic grid remapping as well as rotated principal component analysis to define the network nodes. In a more detailed analysis, the uncovered components were used to segment the whole globe surface into 68 regions. The time evolution of temperature correlation structures in local intra-component networks was studied and compared to evolving inter-component connectivity. This detailed analysis showed that the evolution of graph properties of the global network can be mostly attributed to the evolution of the intra-regional connectivity of the ENSO area and adjacent tropical regions and of the inter-regional connectivity between those.