Multiscale complex network analysis: An approach to study spatiotemporal rainfall pattern in south Germany

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Understanding of the climate sytems has been of tremendous importance to different branches such as agriculture, flood, drought and water resources management etc. In this regard, complex networks analysis and time series analysis attracted considerable attention, owing to their potential role in understanding the climate system through characteristic properties. One of the basic requirements in studying climate network dynamics is to identify connections in space or time or space-time, depending upon the purpose. Although a wide variety of approaches have been developed and applied to identify and analyse spatio-temporal relationships by climate networks, there is still further need for improvements in particular when considering precipitation time series or interactions on different scales. In this regard, recent developments in the area of network theory, especially complex networks, offer new avenues, both for their generality about systems and for their holistic perspective about spatio-temporal relationships.

The present study has made an attempt to apply the ideas developed in the field of complex networks to examine connections in regional climate networks with particular focus on multiscale spatiotemporal connections. This paper proposes a novel multiscale understanding of regional climate networks using wavelets. The proposed approach is applied to daily precipitation records observed at 543 selected stations from south Germany for a period of 110 years (1901-2010). Further, multiscale community mining is performed on the same study region to shed more light on the underlying processes at different time scales.

Various network measure and tools so far employed provide micro-level (individual station) and macro-level (community structure) information of the network. It is interesting to investigate how the result of this study can be useful for future climate predictions and for evaluating climate models on their implementation regarding heavy precipitation.

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