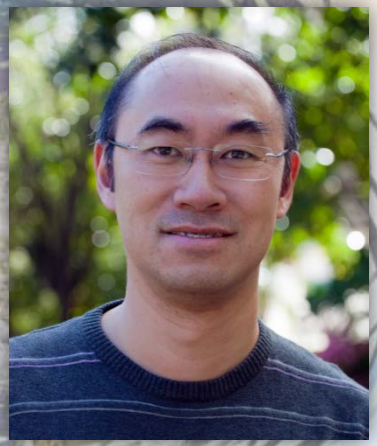
Complex Network Analysis of Extreme Rainfall Events



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Complexity is the new kind of science that is having emerging impacts to almost all aspects of natural and social sciences. Application of such kind of theory to environmental systems is in its early stage. In this talk, an overview of several aspects of complexity theory relevant to the science of weather and climate will first be given. Then a recent study that applied complex network is presented. In this study, tools from complex network theory are employed to compare the spatial features of extreme rainfall over East Asia caused by two atmospheric processes: the Baiu/Meiyu front in June and July, and tropical cyclones mostly from August to November. Networks are inferred from satellite-estimated rainfall data based on a nonlinear correlation measure called event synchronization. We identify the different regions that receive rainfall due to the large spatial-scale activities associated with the Meiyu front and tropical cyclones. It is found that the spatial scales involved in the Meiyu-driven rainfall extremes, including the synoptic processes of frontal development, are longer than those for tropical cyclones although the latter have long storm tracks during their northward and northeastward migration. Some network measures are able to reveal the distinct multiscale nature of the Baiu/Meiyu frontal development. We further delineate regions of coherent rainfall during the two periods based on network communities. At the end of the talk, the recent progress of applying complex network theory to global monsoon research is briefly reviewed, and the issue of whether such theory is applicable to weather and climate prediction will be discussed.

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EARTH SYSTEM SCIENCE PROGRAMME

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