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Nonlinear Spatio-Temporal Characteristics of the Japanese Air Temperature Network

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Climate variations are known to be the result of non-linear processes. In this work, we study and compare the statistical as well as dynamic properties of complex networks derived from the daily air temperature time series of various Japanese stations using different linear as well as nonlinear threshold criteria. Whereas recent investigations were mainly based on the consideration of linear cross-correlations between sets of stations, we extend these approaches by considering the applicability of other types of statistical dependence, including monotonic (rank-order correlations), oscillatory (phase synchronisation), topologic (recurrence quantification analysis (RQA)) and information-theoretic (redundancies, transfer entropies) approaches.

In order to achive a better qualitative understanding of which types of processes may be responsible for the observed similarities and differences between the derived network structures, different nonlinear dynamic characteristics (fractal dimensions, entropies, RQA measures) are estimated for the individual time series using sliding windows in time. Our results suggest certain systematic relationships between the spatial and temporal variations in the local complexity of atmospheric dynamics and the resulting networks.