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Multi-Scale Phase Synchronization Analysis of Regional Temperature Networks via Symbolic Dynamics and Wavelet Filtering

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Concepts from complex systems sciences like phase synchronization and network theory have already been suggested by various authors for describing different sub-components of the system Earth on a conceptual level.

Following recent results suggesting that the phase coherence of complex signals from natural systems may crucially depend on the reference time-scale [1,2], in this work we study the corresponding dependence of spatio-temporal correlations and coherence of irregular oscillatory components of air temperatures distributed over a certain spatial area. For selecting a time-scale, different approaches are compared: moving-average filtering, wavelet decomposition [1,2], and symbolic discretisation by means of static thresholds and dynamic order patterns [3]. To test the capability of the different methods to give interpretable results, we firstly study their performance for different chaotic model systems before applying them to observations and reanalysis data from Japan and Western Europe. In particular, we investigate the importance of appropriate deseasonalisation of temperature records as well as changes in the topology of the resulting temperature networks in dependence on the reference time-scale.

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