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# Bi- and multivariate recurrence network analysis for identifying and characterizing coupled geophysical systems

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Recently, it has been suggested to reinterpret the recurrence plot obtained from a time series of an arbitrary dynamical system as the connectivity matrix of an associated complex network. Statistical measures characterizing the topology of such recurrence networks on both local and global scale have already demonstrated their great potentials for detecting changes in the underlying dynamics as reflected in the geometry of the corresponding attractor in phase space.

Here, we introduce two possible extensions of the recurrence network approach for studying two or more potentially coupled dynamical systems. Specifically, the established concepts of cross- and joint recurrence plots, as well as the recently introduced graph-theoretic framework for describing the properties of interacting networks are utilized for deriving a corresponding complex network representation.

We discuss the interpretation of both approaches in terms of the associated phase space properties and provide some examples highlighting their performance for studying interacting complex systems with respect to identifying their coupling direction and investigating complex synchronization processes. Finally, we present an application to recent observational as well as palaeoclimate data from the Asian monsoon system which illustrates some of the potentials and practical limitations of the two proposed methods.