What do networks have to do with climate?

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This review is a synthesis of work spanning the last 25 years. It is largely based on applying ideas from graph theory to construct climate networks and investigating their underlying topological properties. These studies have ultimately led to the identification of climate subsystems/major modes and to how their collective behavior explains decadal variability. The central point is that a network of coupled nonlinear subsystems may at times begin to synchronize. If during synchronization the coupling between the subsystems increases the synchronous state may, at some coupling strength threshold, be destroyed shifting climate to a new region. This climate shift manifests itself as a change in global temperature trend. This mechanism, which is consistent with the theory of synchronized chaos, appears to be a very robust mechanism of the climate system. It is found in the instrumental records, in forced and unforced climate simulations, as well as in proxy records spanning several centuries.

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