



## **Direct link paths detection for observed teleconnections in climate networks**

Dong Zhou (1), Avi Gozolchiani (2,3), Yosef Ashkenazy (3), and Shlomo Havlin (1)

(1) Department of Physics, Bar-Ilan University, Ramat-Gan 52900, Israel, (2) Institute of Earth Sciences, The Hebrew University of Jerusalem, Jerusalem 91904, Israel, (3) Department of Solar Energy and Environmental Physics, BIDR, Ben-Gurion University, Midreshet Ben-Gurion 84990, Israel

Climate networks have been used to describe certain kind of relations between the climate time series of each pair of nodes. However, all these observed relations should include both the direct relation between these nodes and the indirect effects through other nodes, and the direct link patterns of climate networks are still unclear. In this work, we use the normalized cross-correlation to define both positive and negative link strengths, and for this definition we develop a method based on partial correlation to remove the indirect effect from the observed global air temperature network and obtain the direct positive and negative links. The strong direct links can illustrate how a certain climatic mechanism is propagating step by step in both time and space. Particularly, for the observed teleconnections, we can find the dominant paths of direct links between two nodes by finding the directed shortest paths in the direct link network. The spatial and temporal properties of these paths can help us better understand the origin of such teleconnections.