



## **Node-weighted measures for complex networks with directed and weighted edges for studying atmospheric moisture recycling**

Delphine Zemp (1), Marc Wiedermann (1,2), Jonathan Donges (1,3), Carl-Friedrich Schuessner (1), and Anja Rammig (1)

(1) Potsdam Institute for Climate Impact Research, Earth system analysis, Potsdam, Germany, (2) Department of Physics, Humboldt University, Berlin, Germany, (3) Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden

In many real-world networks, nodes represent agents of different sizes or importance. However, the sizes of the nodes are rarely taken into account in network analysis, inducing bias in network measures and confusion in their interpretation. Recently, a new axiomatic scheme of node-weighted network measures has been suggested for networks with undirected and unweighted edges. However, many real-world systems are best represented by complex networks which have directed and/or weighted edges. Here, we extend this approach and suggest node-centrality measures for the networks with directed and/or weighted edges and weighted nodes. We apply these measures on an artificial spatially embedded network and a real-world moisture recycling network. We show that these measures improve the representation of the underlying physical systems and can be used for any types of complex networks.