Geophysical Research Abstracts
Vol. 18, EGU2016-7452, 2016
EGU General Assembly 2016


# Discriminating different El Niño and La Niña phases from evolving climate networks

Marc Wiedermann (1,2), Alexander Radebach (3,4), Jonathan F. Donges (1,5), Jürgen Kurths (1,2,6), and Reik V. Donner (1)

(1) Potsdam Institute for Climate Impact Research, Research Domain IV, Potsdam, Germany, (2) Department of Physics, Humboldt University, Berlin, Germany, (3) Mercator Research Institute on Global Commons and Climate Change, Berlin, Germany, (4) Economics of Climate Change, Technical University, Berlin, Germany, (5) Stockholm Resilience Centre, Stockholm University, Stockholm, Sweden, (6) Institute for Complex Systems and Mathematical Biology, University of Aberdeen, Aberdeen, UK,

The variability of the El Niño Southern Oscillation (ENSO) can roughly be categorized into El Niño (anomalously warm), La Niña (anomalously cold) and normal periods. Additionally, at least the El Niño exhibits into two different types (Eastern Pacific (EP) and central Pacific (CP)), which may be distinguished from each other by different signatures in the Pacific sea surface temperature field. However, up to now no generally applicable criterion to distinguish these different phases has been introduced.

We present here a method based on complex network analysis to distinguish these EP and CP events by utilizing a simple scalar-valued measure (the so-called climate network transitivity) related to the third power of the cross-correlation matrix between grid points in a daily global surface air temperature field. From a one-year running window analysis we obtain the time-evolution of this measure and show that during EP events it displays a strong peak, whereas its value during CP events is close to the baseline formed by normal periods. This behavior is easily understood from the different impacts on the global climate system displayed by the two different El Niño flavors as well as the high synchronization of Pacific sea-surface temperatures during El Niño events.

We compare our results with recent works on El Niño classifications and find that for the years 1970-2000 (the main time interval covered by most past studies) our method distinguishes correctly all existing events. By performing a network-based dimensionality reduction of the correlation matrix, we show that our findings also display high consistency with works that applied EOF analysis as a tool to discriminate between both El Niño flavors. Ultimately, we apply our framework to La Niña events and show that a similar discrimination into two types is not only possible but again in good accordance with the few existing previous works regarding this problem.

Our framework provides a powerful formalism to systematically detect and categorize different types of ENSO periods. With our tools we derive generally applicable criteria for discriminating EP and CP events purely based on the structural properties of the underlying global cross-correlation matrix and thus complement existing tools from statistical climatology.