Geophysical Research Abstracts
Vol. 16, EGU2014-11105, 2014
EGU General Assembly 2014


# An analysis of global climate-vegetation interactions over arid and semi-arid regions via causal statistics

Iyasu Eibedingil (1,2), Erik Casagrande (1,2), Annalisa Molini (1,2)

(1) iWATER, Institute Centre for Water Advanced Technology & Environmental Research, Masdar Institute of Science and Technology, PO Box 54224, Abu Dhabi, United Arab Emirates, (2) Department of Chemical and Environmental Engineering, Masdar Institute of Science and Technology, PO Box 54224, Abu Dhabi, United Arab Emirates (amolini@masdar.ac.ae).

Precipitation and Temperature are two of the major drivers of ecosystem dynamics. Their control is the result of complex dynamical interactions, often non-linear, and is exerted over a wide range of space and temporal scales. Rainfall intermittency, as an example, is known to be among the main drivers of plants production, with a consequent influence on carbon and nitrogen cycles. However, a clear understanding of the complete pathway of such a forcing remains still unclear. Traditional time series analysis bases the study of these inter-connections on linear correlation statistics. However, the possible presence of causal dynamical connections, as well as non-linear couplings and non-stationarity can affect the performance of these tools. Additionally, dynamical drivers can act simultaneously over different space and time scales.

Given this premise, this talk explores different approaches to the estimation of global causal relationships between two main climatic variables (temperature and precipitation) and vegetation over arid and transitional (semi-arid) regions. By using monthly globally gridded precipitation and temperature data (University of Delaware, NOAA/ESRL/PSD) and remotely sensed normalized difference vegetation index (NDVI, Global Inventory Modeling and Mapping Studies-GIMMS) as a proxy of vegetation dynamics we explore possible direct and conditional causal relationships between climate and vegetation. Pairwise Granger causality (GC) test is applied in order to assess bi-directional causal influences between each couple of variables due to their direct interaction and instantaneous causality deriving from exogenous variables. In addition to this, conditional Granger causality tests were performed on the three variables system. Conditional GC has the ability to resolve whether the interaction between two variables is direct or is mediated by a third variable, and whether the causal influence is simply due to differential time delays in their respective driving inputs.

Several examples, from different arid and semi-arid regimes, are also discussed with the goal of highlighting strengths and weaknesses of these statistics.