Geophysical Research Abstracts
Vol. 14, EGU2012-14274, 2012
EGU General Assembly 2012

Non-linear contributions to interactions in climate networks: sources, relevance, nonstationarity

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Climate data are increasingly analyzed by complex network analysis methods, including graph-theoretical approaches [1]. For such analysis, links between localised nodes of climate network are typically quantified by some statistical measures of dependence (connectivity) between measured variables of interest. Nonlinear connectivity quantification methods, based on information-theoretical concepts, are commonly used for this purpose [2].

In this report, we investigate in detail the consequences of the choice of nonlinear connectivity measures. This is done on several levels, including quantification of the specific non-linear contribution to the interaction information, its effect on global graph topology and localisation of nodes with strongest nonlinear contribution.

Following the latter, we have also been able to identify some of the main sources of observed non-linearity in inter-node couplings. These suggest an important role of nonstationarity of climate data, on top of any genuine nonlinear coupling. We put the analysis results in context of climate network analysis by discussing the (dis)advantages of (non)linear methods, focusing on the inevitable trade-off between measure numerical stability and accuracy, and possibility of data-driven informed choice of connectivity measures [3]. Relevance of nonlinearity for climate network decomposition methods is also considered.

Acknowledgement
This study is supported by the Czech Science Foundation, Project No. P103/11/J068.

References
[1] Boccaletti, S.; Latora, V.; Moreno, Y.; Chavez, M. & Hwang, D. U. Complex networks: Structure and dynamics Physics Reports, 2006, 424, 175-308
[2] Donges, J. F.; Zou, Y.; Marwan, N. & Kurths, J. The backbone of the climate network EPL, 2009, 87, 48007
[3] Hlinka, J.; Palus, M.; Vejmelka, M.; Mantini, D. & Corbetta, M. Functional connectivity in resting-state fMRI: Is linear correlation sufficient? NeuroImage, 2011, 54, 2218-2225