Visualization techniques and tools for large geo-physical networks

Thomas Nocke (1), Stefan Buschmann (2), Jonathan F. Donges (1,3), and Norbert Marwan (1)

(1) Potsdam Institute for Climate Impact Research, Potsdam, Germany ({nocke|donges|marwan}@pik-potsdam.de), (2) Hasso Plattner Institute, Potsdam, Germany (stefan.buschmann@hpi.uni-potsdam.de), (3) Stockholm Resilience Centre, Stockholm, Sweden

Network analysis is an important approach in studying complex phenomena within geophysical observation and simulation data. This field produces increasing numbers of large geo-referenced networks to be analyzed. Particular focus lies on the network analysis of the complex statistical interrelationship structure within climatological fields. The typical procedure for such network analyzes is the extraction of network measures in combination with static standard visualization methods.

To analyze the visualization challenges within this field, we performed a questionnaire with climate and complex system scientists, and identified a strong requirement for solutions visualizing large and very large geo-referenced networks by providing alternative mappings for static plots and allowing for interactive visualization for networks with 100.000 or even millions of edges. In addition, the questionnaire revealed, that existing interactive visualization methods and tools for geo-referenced network exploration are often either not known to the analyst or their potential is not fully exploited.

Within this presentation, we illustrate how interactive visual analytics methods in combination with geo-visualisation can be tailored for visual large climate network investigation (see as well Nocke et al. 2015). Therefore, we present a survey of requirements of network analysts and the related challenges and, as an overview for the interested practitioner, we review the state-of-the-art in climate network visualization techniques and tools, underpinned with concrete examples from climate network research and innovative solutions (e.g. alternative projections, 3D layered networks) implemented within the network visualization system GTX.

References:

Nocke, T., S. Buschmann, J. F. Donges, N. Marwan, H.-J. Schulz, and C. Tominski: Review: Visual analytics of climate networks, Nonlinear Processes in Geophysics, 22, 545-570, doi:10.5194/npg-22-545-2015, 2015