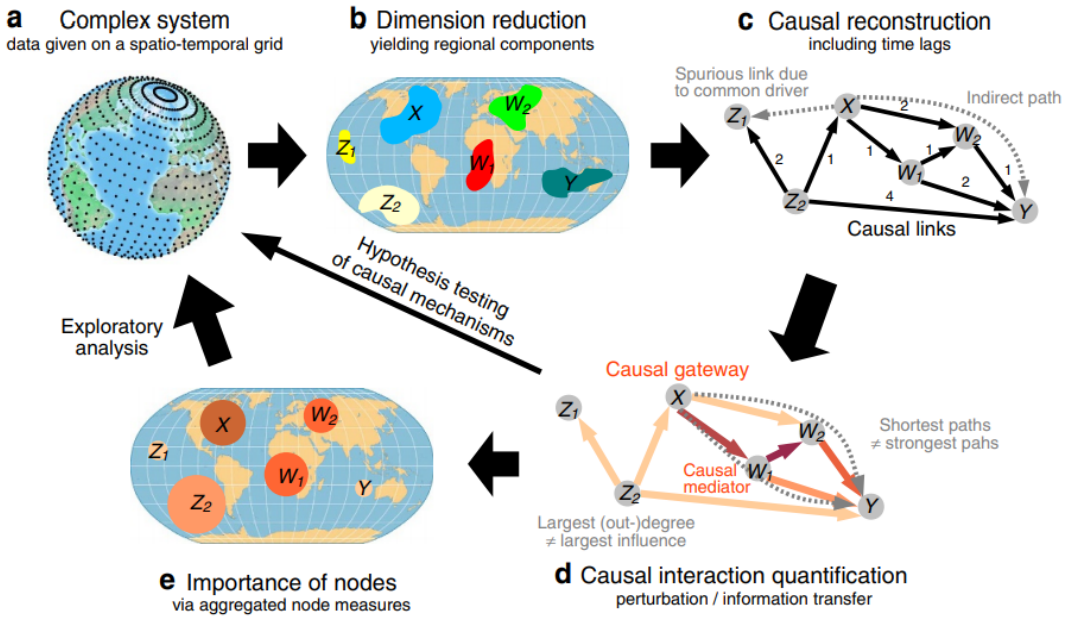
Identifying causal gateways and mediators in complex spatio-temporal systems

https://www.nature.com/articles/ncomms9502.pdf

▼ What did the authors try to accomplish?

Introduce an approach for the analysis of multivariate spatio-temporal data sets, to identify subprocesses in complex systems that are important gateways for spreading and mediating perturbations entering the system in one subprocess

▼ What were the key elements of the approach?



3 steps:

1. Dimension reduction
    - Based on Varimax-rotated principal components
    - Subsequent significance test to eliminate components merely representing noise

2. Causal reconstruction
    - Causal discovery algorithm
    - Based on PC algorithm
3. CE (Causal effect) quantification
    - Directly quantify the causal effect between pairs of components based on the causal network (Tigramite approach: time series graph-based measures of information transfer)
    - Detect through which components and how much the causal effect is mediated.

▼ What can you use yourself?

- Discover causalities
- Quantify the causal effects
- A Python software script by J. Runge to estimate the causal network can be obtained from http://tocsy.pikpotsdam.de/tigramite.php

▼ What other references do you want to follow?

- Runge, J. Quantifying information transfer and mediation along causal pathways in complex systems, Preprint at http://arxiv.org/abs/1508.03808[stat.ME] (2015).
- Runge, J., Petoukhov, V. & Kurths, J. Quantifying the strength and delay of climatic interactions: The ambiguities of cross correlation and a novel measure based on graphical models. J. Climate 27, 720–739 (2014)