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Robustness of large-scale causal network discovery in CMIP5 models

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Causal network discovery in the geosciences aims at reconstructing the causal interdependency structure between subprocesses from large-scale time series datasets. In a typical workflow [1] a spatio-temporal dataset such as gridded sea-level pressure is dimensionally reduced to component time series representing relevant regional subprocesses such as ENSO or the NAO. Then the time-lagged causal interdependency structure among these components is reconstructed using causal discovery algorithms such as PCMCI [2,3] or multivariate Granger causality. But how reliable are such methods on typical observational records covering few decades? Climatic processes act on vastly different time scales from days to decades: What minimum sample size do we need to reconstruct a particular link? Here we analyze the robustness of causal network discovery methods utilizing CMIP5 pre-industrial control runs that provide long stationary time series. We evaluate network reconstruction reliability of different causal methods with respect to time series length and other characteristics and investigate how well causal links emanating from important climatic subprocesses such as ENSO can be reconstructed. These results enable a better evaluation of the applicability of modern causal discovery techniques for climatic time series datasets.

References:

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