Using causal discovery algorithms to evaluate Arctic-Stratosphere linkages in CMIP5 models

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In what way Arctic Amplification might affect atmospheric dynamics is only poorly understood. Climate models forced with low or missing Arctic sea-ice show no robust mid-latitudinal response, leading to large model spread and contributing to the controversy on the topic. With ongoing Arctic sea ice loss, there is an urgent need to assess its impacts in the current and future climate.

Extracting the physically relevant teleconnection pathways from multi-model ensembles remains challenging. One major issue is to separate the signal from the noise given large internal atmospheric variability. This is compounded by varying dimensions in space and time and competing effects of different processes which likely vary from model to model.

Here, to overcome these current limitations, we apply a novel type of time-series analysis, called causal effect networks (Kretschmer et al. 2016), to compare the representation of teleconnection pathways in observations and CMIP5 data. This allows evaluating these processes with more confidence than using solely correlation analysis. We focus on winter circulation in the North Atlantic/European region and particularly assess the role of Barents and Kara sea ice for stratospheric polar vortex variability. We discuss how this affects future projections of polar vortex strength.

Key words: CMIP5 models, Arctic-stratosphere linkages, causal discovery algorithms, model evaluation

References

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