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Lecture: ***Methods for Causality Analysis in Climate Science***

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Abstract:

Knowledge of cause-effect relationships is central to the field of climate science, supporting mechanistic understanding, observational sampling strategies, experimental design, model development and model prediction. While the major causal connections in our planet's climate system are already known, there is still potential for new discoveries in some areas. The purpose of this talk is to make this community familiar with a variety of available tools to discover potential cause-effect relationships from observed or simulation data. Some of these tools are already in use in climate science, others are just emerging in recent years. None of them are miracle solutions, but many can provide important pieces of information to climate scientists. An important way to use such methods is to generate *cause-effect hypotheses* that climate experts can then study further. In this talk we will (1) introduce key concepts important for causal analysis; (2) discuss some methods based on the concepts of *Granger* causality and *Pearl* causality; (3) point out some strengths and limitations of these approaches; and (4) illustrate such methods using a few real-world examples from climate science.