Directed network of global temperature drivers

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We present a recurrence-based approach to quantify an interacting, directed network of various global climatic factors that influence global mean temperature. Extending the notion of an earlier measure based on joint recurrences, we present a new approach to capture directed influences among structurally different systems such as the El Niño Southern Oscillation, volcanic activity, and solar irradiance. We find that the various climatic phenomena interact and influence each other at multiple delays with feedbacks. All measures estimated in the analysis are tested for significance using twin surrogates. We stress the need to incorporate multiple, delayed interactions involving feedback in analyses focussed on understanding and predicting global mean temperature.