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Disentangling the ambiguity of the lagged correlation function - analysis of the Walker circulation mechanism

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A first step towards the investigation of tropical climate variability and teleconnections is the analysis of observations. Lagged correlation analysis is commonly used to gain insights into interaction mechanisms between climatological processes, in particular to determine the time delay and strength of a mechanism.
In this talk, such an analysis is discussed on the mechanism of the Walker circulation. The influence of serial correlation on lagged correlation functions and regressions is investigated and it is demonstrated how this influence can lead to ambiguous and misleading conclusions about the time delay and strength of an interaction mechanism. To overcome the issues arising in interpreting the lag and strength of a correlation, we propose to use graphical models that encode the lag-specific causality between multiple processes. In this framework a certain partial correlation measure is derived that allows to very specifically measure the time delay and strength of a coupling mechanism.
This approach is then shown to yield a more precise picture of the interaction mechanism of the Walker circulation. The talk is intended to serve as a guideline to interpret lagged correlations and regressions and introduces a more powerful approach to analyze time delays and strengths of interaction mechanisms.