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On the use of probabilistic network models to assess spatially compound events in a warmer world

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Probabilistic network models (PNMs) have established themselves as a data-driven modeling and machine learning prediction technique utilized across various disciplines, including climate analysis. Learning algorithms efficiently extract the underlying spatial dependency structure in a *graph* and a consistent *probabilistic model* from data (e.g. gridded reanalysis or climate model outputs for particular variables). The graph and probabilistic model together constitute a truly probabilistic backbone of the system underlying the data. The complex dependency structure between the variables in the dataset is encoded using both pairwise and conditional dependencies and can be explored and characterized using network and probabilistic metrics. When applied to climate data, PNMs have been demonstrated to faithfully uncover the various long range teleconnections relevant in temperature datasets, in particular those emerging in El Niño periods (Graafland, 2020).

The combination of multiple climate drivers and/or hazards that contribute to societal or environmental risk are the so-called compound weather and climate events. These compound events can be the result of a combination of factors over different dimensions: temporal, spatial, multi-variable, etc. (Zscheischler et al. 2020). In particular, spatially compound events take place when hazards in multiple connected locations cause an aggregated impact. In this work we apply PNMs to extract and characterize most essential spatial dependencies of compound events resulting from concurrent temperature and precipitation hazards, either in the same location or spatially connected, which can be relevant for agriculture. Furthermore, PNMs are used to propagate evidence of different levels of observed and projected global warming to assess the possible evolution of compound events in a changing climate.

References

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