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The influence of meteorological parameters on wind speed extreme events: A causal inference approach

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Based on the ERA5 data of hourly meteorological parameters [1], we investigate temporal effects of 12 meteorological parameters on the extreme values occurring in wind speed. We approach the problem by using the Granger causal inference, namely by the heterogeneous graphical Granger model (HGGM) [2]. In contrary to the classical Granger model proposed for causal inference among Gaussian processes, the HGGM detects causal relations among time series with distributions from the exponential family, which includes a wider class of common distributions. In previous synthetic experiments, HGGM combined with the genetic algorithm search based on the minimum message length principle has been shown superior in precision over the baseline causal methods [2]. We investigate various experimental settings of all 12 parameters with respect to the wind extremes in various time intervals. Moreover, we compare the influence of various data preprocessing methods and evaluate the interpretability of the discovered causal connections based on meteorological knowledge.

[1] <https://cds.climate.copernicus.eu/cdsapp#!/dataset/reanalysis-era5-single-levels?tab=overview>

[2] Behzadi, S, Hlaváčková-Schindler, K., Plant, C. (2019) Granger causality for heterogeneous processes, In: Pacific-Asia Conference on Knowledge Discovery and Data Mining. Springer, pp. 463-475.

[3] Hlaváčková-Schindler, K., Plant, C. (2020) Heterogeneous graphical Granger causality by minimum message length, *Entropy*, 22(1400). pp. 1-21 ISSN 1099-4300 MDPI (2020).