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High-impact winter compound events and their links to large-scale atmospheric circulation

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Compound events of meteorological variables considerably affect various sectors of human society and natural environment. We focus on winter extreme events since combinations of low temperatures with heavy snowfalls and/or strong winds (e.g., winter storms and blizzards) represent high-impact weather phenomena for transportation, public health sectors, and many other areas of human activity. We aim to expand the understanding of extreme winter weather with respect to its driving mechanisms.
In this study, we analyze frequency of winter compound events and their links to large-scale atmospheric circulation. The study is performed over Central Europe, defined roughly between 48–52°N and 10–20°E. This domain excludes high-altitude mountain ranges (Alps and Carpathians) and therefore has a relatively homogenous climate. Data from the E-OBS database and the ERA5 reanalysis are analyzed over the 1979-2017 period. Winter compound events are characterized as various combinations of anomalous temperatures, heavy snowfalls, strong wind, extreme rain, and sudden temperature changes. The extremes are selected using a modified extremity index proposed by Lhotka and Kyselý (2015) which takes into account spatial extent and severity of winter extremes. Large-scale atmospheric circulation is represented by indices (flow direction, strength and vorticity; Jenkinson and Collison 1977) and classifications derived from circulation patterns produced by the reanalysis. We aim to find useful methods to detect significant synoptic links in observed climate, which could be subsequently used as reference for an evaluation of high-impact winter compound events and their driving mechanisms in historical runs and projections of climate models.

Jenkinson AF, Collison FP (1977) An initial climatology of gales over the North Sea. Meteorological Office, Bracknell, Synoptic Climatology Branch Memorandum No. 62
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