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Is it possible to draw conclusions from mean wind statistics on extreme wind statistics?: A wind direction analysis for the Baltic Sea region.

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We investigate whether direction-related statistics of extreme wind events follow statistics of mean wind and thus whether changes in mean wind statistics can be used to approximate extreme wind changes. This study shows that this hypothesis is not valid over the Baltic Sea region. Furthermore, the predominant extreme wind direction and its temporal changes are analyzed.

Differences between both mean and extreme wind direction distributions are detected. Main direction for extremes is wind from South-West (SW) whereas for the mean wind all directions can be found. The distribution of extreme wind directions shows a limited spread around SW.
These distributions are not just different for annual statistics for mean and extreme, but additionally across seasons. The main direction remains SW but deviations from this mean winds in springtime occur as often from SW as from NE. Extreme winds are clearly focused from W, with a stronger influence of SW. Easterly wind seems to play a minor role in extreme wind statistics.
The spatially covariance of wind statistics is further investigated by an EOF- analysis, which shows seasonally independent patterns of wind direction variability. Extreme winds are mainly westerlies, thus their variability is limited to north-south directions. These variability patterns show no trends in time and are quite homogeneous over the whole region.
The results show that mean wind is not a good indicator for the main direction of extreme wind.

As these first results showed a limited distribution for extreme wind directions for SW we continued analyzing changes of wind extremes from W and SW in the Baltic Sea region during winter (DJF) based on regional reanalysis data (coastdat2) over the period from 1948 to 2012. Extreme winds occur mostly and are strongest in winter season. Although on average all wind directions are quite frequent over the Baltic Sea, extremes are very focused on W and SW directions.
Trends in the frequencies of extremes from SW can be detected, namely an increasing trend from 1970 to 1990 and a decreasing trend since then. A correlation between the sum of W (SW) frequencies and the corresponding intensities shows a statistical significant value of 0.54 (0.25). For the other directions there is no such high correlation ($r<0.08$). A similar correlation as it was described for wind directions is also visible in a similar but weaker trend for SW wind intensity. This means that years with more (less) W/SW winds show higher (lower) wind velocities. After identifying eight circulation types by cluster analysis, type 4 (type 2) can be related to W (SW) winds and it shows a similar temporal evolution as W (SW) wind frequencies. Type 4 is dominated by low pressure located east of Sweden and for type 2 it lies west of Norway.