On air pressure and past storm activity—an assessment of the informational value of proxies for past storm activity

Oliver Krueger[1]* and Hans von Storch[1]**

[1]Institute for Coastal Research, Helmholtz-Zentrum Geesthacht *oliver.krueger@hzg.de **hvonstorch@web.de

Motivation

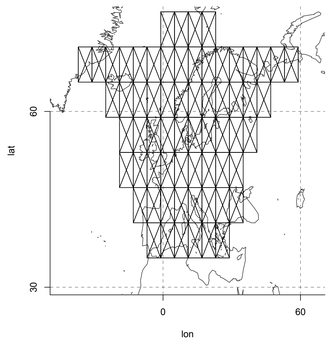
- *Wind time series are often **inhomogeneous** and **too short.***
- *Air pressure readings are usually homogeneous.*
- *Making use of air pressure is a possible solution to derive proxies for past storm activity.*
- *It is commonly believed, however unproven, that the variation of the statistics of air pressure-based proxies describes the variation of statistics of ground level wind speeds. Or in other words: **Are air pressure-based proxies appropriate to describe past storm activity?***

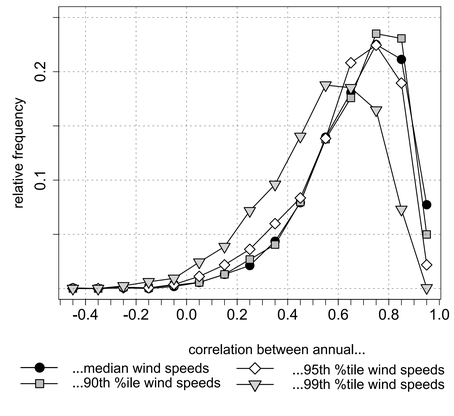
This study evaluates and measures the informational value of several air pressure-based proxies by examining the correlation between pressure-based proxies and high percentiles of atmospheric wind speed.

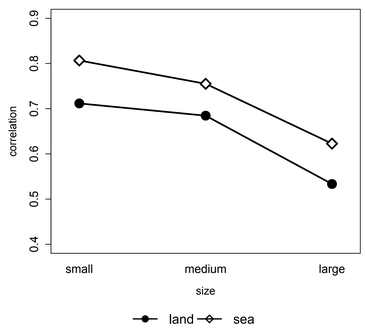
Multiple-station based proxies

Percentiles of geostrophic wind speeds

- Pressure is bilinearly interpolated over triangles in a local coordinate system
- Geostrophic wind speeds via pressure gradient
- Annual and seasonal frequency distributions derived
- Specific annual and seasonal quantiles examined to determine linear link between high percentiles of geostrophic wind speeds and of ground level wind speed (repeated for multiple triangles)

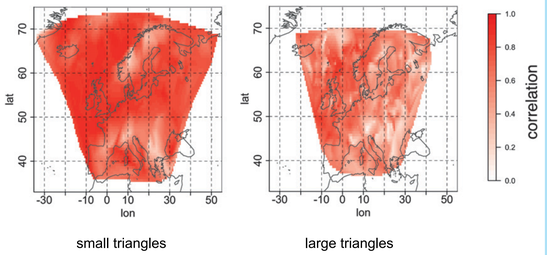






➡ Geostrophic wind from sea triangles reflects storm activity better than geostrophic wind from land triangles.

➡ Smaller triangles lead to a better description of storminess than bigger triangles.

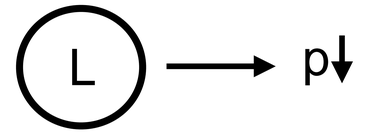


Dataset

- Diagnostic 10m wind and surface air pressure fields from the spectrally nudged and NCEP driven REMO (Weisse et al., 2009), known as coastDat, are made use of. The dataset covers Europe and the North Atlantic.
- The period 1959-2005 is analysed.

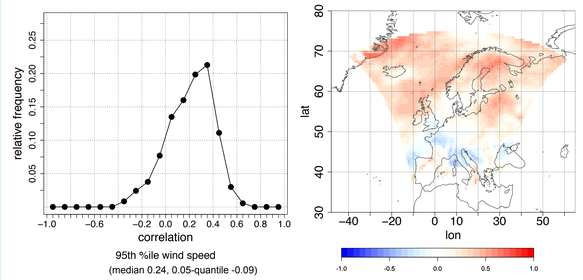
Single-station based proxies

1. Number of deep low pressure readings
2. Low percentiles of pressure readings
3. High percentiles of absolute local pressure changes over a certain time (|Δp/Δt|)
- Frequency of absolute local pressure changes exceeding a threshold over a certain time (|Δp/Δt|)



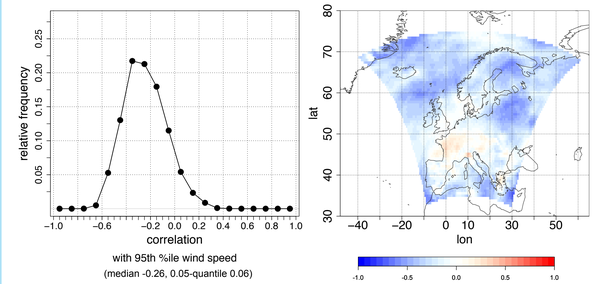
based on synoptic experience

1. Number of low pressure readings



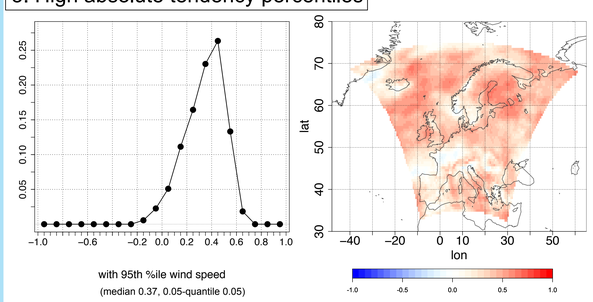
Correlation between annual 95th percentiles of ground level wind speed and annual **number of pressure observations below 980 hPa.**

2. Low pressure percentiles



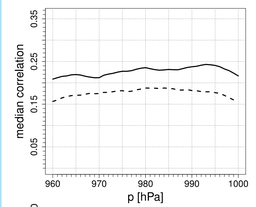
Correlation between annual 95th percentiles of ground level wind speed and annual **first percentile of air pressure.**

3. High absolute tendency percentiles

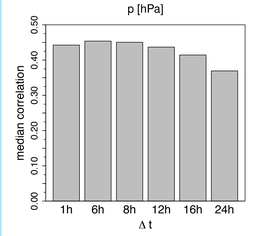


Correlation between annual 95th percentiles of ground level wind speed and annual **99th percentile of absolute pressure tendencies in 24 h.**

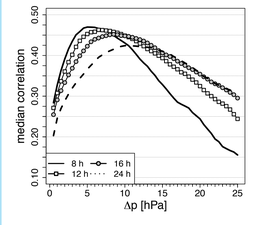
Influence of proxy configuration



(a) Median correlation between the annual number of pressure readings below a certain threshold p and annual 95th (solid line) and 99th percentiles (dashed line) of surface wind speeds.



(b) Median correlation between annual 95th percentiles of ground level wind speed and annual 99th percentile of absolute pressure tendencies over Δt.



(c) Median correlation between annual 95th percentiles of ground level wind speed and annual number of absolute local pressure changes exceeding a threshold Δp over a certain time Δt.

References

Krueger, O. and H. von Storch, 2011: Evaluation of an air pressure–based proxy for storm activity. Journal of Climate, 24 (10), 2612–2619.
H. Alexandersson, T. Schmith, K. Iden, and H. Tuomenvirta. Long-term variations of the storm climate over NW Europe. The Global Atmosphere and Ocean System, 6(2):97–120, 1998.
H. Schmidt and H. von Storch. German Bight storms analysed. Nature, 365 (6449):791–791, 1993.
X.L. Wang, F.W. Zwiers, V.R. Swail, and Y. Feng. Trends and variability of storminess in the Northeast Atlantic region, 1874–2007. Climate Dynamics, 33(7):1179–1195, 2009.
R. Weisse, H. von Storch, U. Callies, A. Chrastansky, F. Feser, I. Grabemann, H. Guenther, A. Pluess, T. Stoye, J. Tellkamp, et al. Regional meteo-marine reanalyses and climate change projections: Results for Northern Europe and potentials for coastal and offshore applications. Bulletin of the American Meteorological Society, 2009.
Bärring, L. and K. Fortuniak, 2009: Multi-indices analysis of southern Scandinavian storminess 1780-2005 and links to interdecadal variations in the NW Europe-North Sea region. International Journal of Climatology, 29 (3), 373–384.
Bärring, L. and H. von Storch, 2004: Scandinavian storminess since about 1800. Geophys. Res. Lett, 31, 1790–1820.

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Conclusion

➡ **Pressure-based proxies and storm activity are linearly related.**

➡ **The informational value of single-station proxies is weak.**

➡ **The informational value of geostrophic wind speed statistics is superior to the informational value of single-station proxies.**