HOMOGENIZATION OF NEAR-SURFACE WIND SPEED AND GUST SERIES ACROSS SWEDEN

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Abstract

Studies which evaluate the impact of wind-related hazards need to have access to reliable and homogeneous measurements. Unfortunately, observed wind series can be affected by several non-climatic artifacts, which may introduce inhomogeneities that mislead the study of climate trends and multi-decadal variability.
This study compares different homogenization approaches using the R-package CLIMATOL to identify the best technique for homogenizing near-surface mean wind speed (WS) and daily peak wind gust (DPWG, i.e. the highest near-surface wind gust speed recorded in 24 hours) across Sweden.

Observed WS and DPWG

Observed WS and DPWG from available anemometer measurements (Table 1)

Variable	# of series	Country	Time period covered	Time resolution
WS	29	Sweden	1979-2016	Daily and monthly
DPWG	90		1996-2016	

Table 1. List and info of WS and DPWG measuring stations adopted for this study

Homogenization + Reference series

Tested automatic homogenization in R-package CLIMATOL (http://www.climatol.eu/) using as **reference**:

1. **Nearby** — 4 nearby stations (standard approach in CLIMATOL)
2. **Geowind** — Geostrophic wind speed series (mean for WS and max for DPWG) calculated from sea level pressure (SLP) measurements
3. **ERAINT** — Closest ERA-Interim grid point
4. **Nearby + ERAINT** — 4 nearby stations and/or closest ERAINT grid point

Table 2. Possible pro and cons of tested reference series

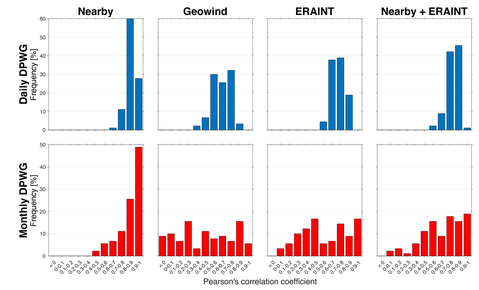
	Advantages	*Disadvantages*
Nearby	Same climate signal of the candidate series	Can be affected by same inhomogeneities of the candidate series
Geowind	Large-scale synoptic system signal included	○ Can be affected by inhomogeneities in SLP measurements ○ Geostrophic wind values much higher compared to observed surface wind
ERAINT	○ Do not assimilate wind observations ○ More homogeneous	Uncertainties in the climate signal carried
Nearby + ERAINT	Lower distance to candidate series	Discrepancies between climate signal of nearby and ERAINT references

Results

Comparison reference series

Different reference series bring advantages and disadvantages (Table 2) which need to tested against the selected WS and DPWG datasets.

Figure 1. Relative frequency for the correlation between observed DPWG and reference series

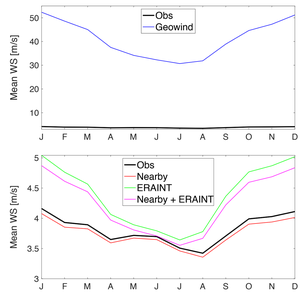


⟶ Nearby references show higher correlation and same climate signals (as seasonal cycle) with respect to the candidate series for DPWG and WS

⟶ Nearby + ERAINT and ERAINT references performs okay for WS

⟶ Geowind do not appear to be suitable references

Figure 2. Seasonal cycle WS *Candidate vs Reference series*



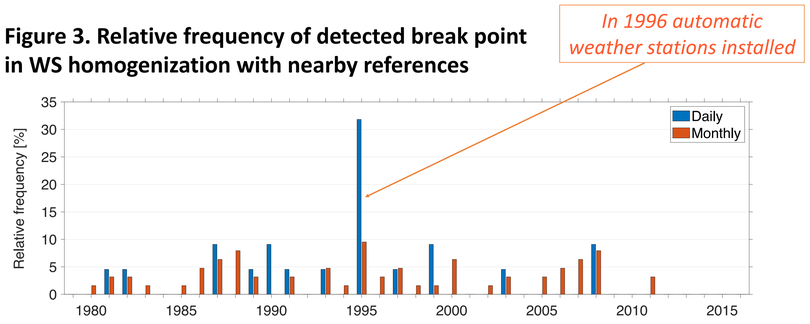
Daily vs monthly homogenization

	WS homogenization	*DPWG homogenization*
Nearby	27.3% (6/22)	38.9% (7/18)
Geowind	21.7% (5/23)	5.7% (5/88)
ERAINT	40.0% (10/27)	1.1% (1/90)
Nearby + ERAINT	48.1% (13/27)	12.8% (5/39)

Table 3. Percentage (number/total number) of breakpoints detected in daily homogenization which occur in the same month when breakpoints in monthly homogenization are identified

Major breakpoints (as the ones due to change of measuring instrumentation in 1996) detected in both daily and monthly homogenization.

Figure 3. Relative frequency of detected break point in WS homogenization with nearby references



Trends and climate statistics

Homogenization using different references can affect climate statistics (Fig. 4) for a single station but consistent statistics and trends (Fig. 5) for the whole dataset

Figure 4. Boxplot of annual WS trends 1979-2016

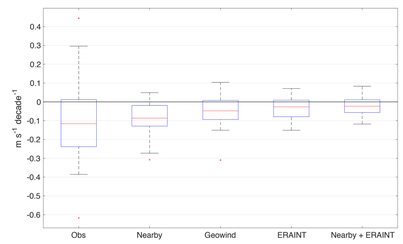
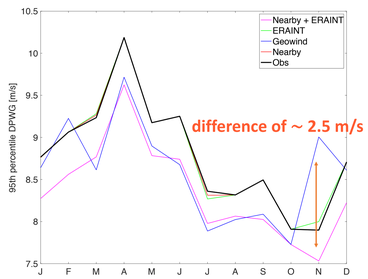


Figure 5. Seasonal cycle of DPWG extremes (95th percentile) – Arvika A



Conclusion

- Homogenization carried at daily time-scale is able to identify the major breakpoints detected in monthly homogenization.
- The homogenization approach that adopts as reference series nearby stations performs better compared to the other tested techniques.
- By having a large enough dataset, climate statistics and trends do not differ according to the homogenization approach adopted although differences arise for the homogenization of single measured series.

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Photography encouraged