PartnerRe

Enhancing European wind risk models with observational data

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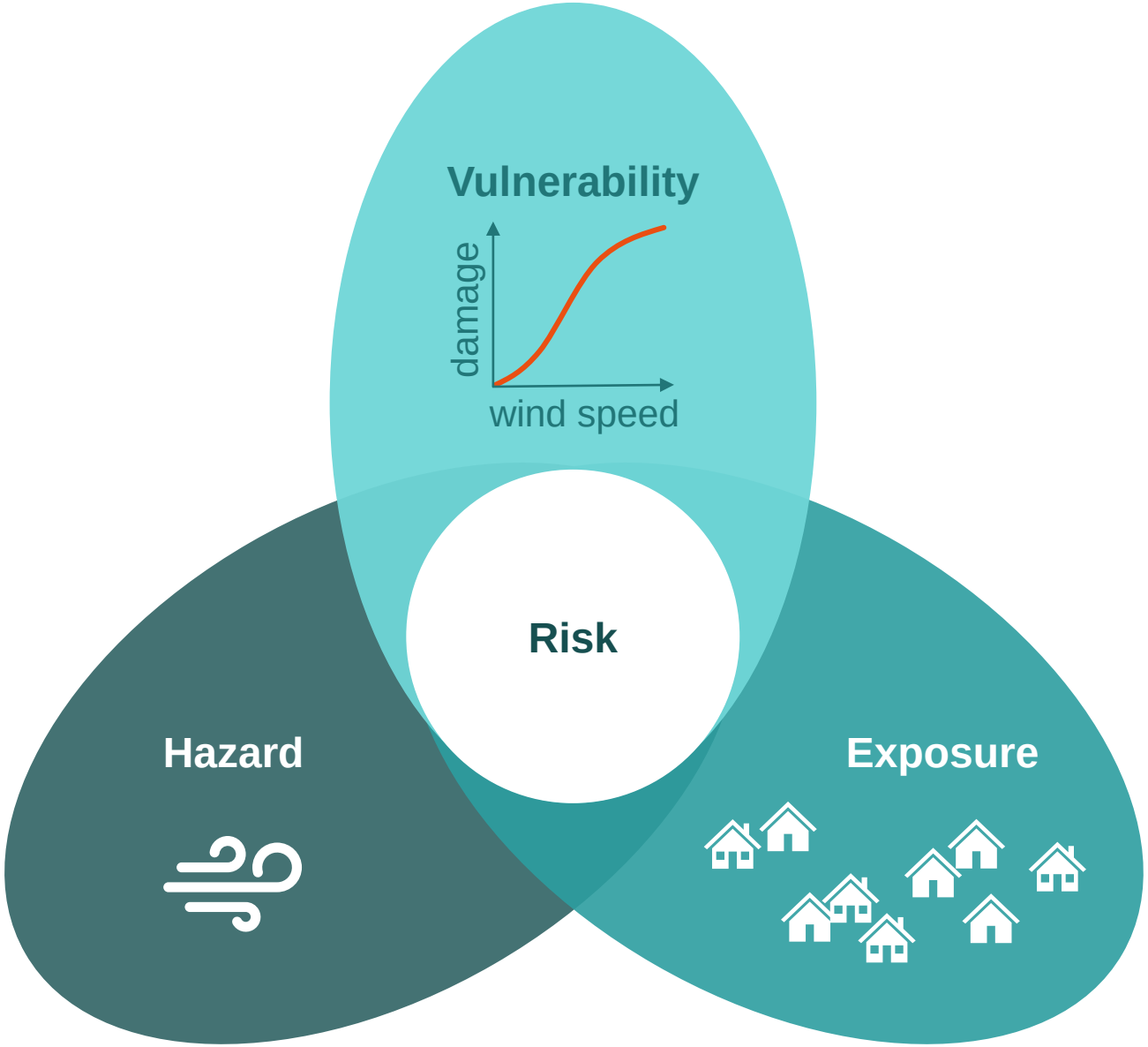
10th Workshop on European Storm

Image created with DALL-E

February 5, 2025

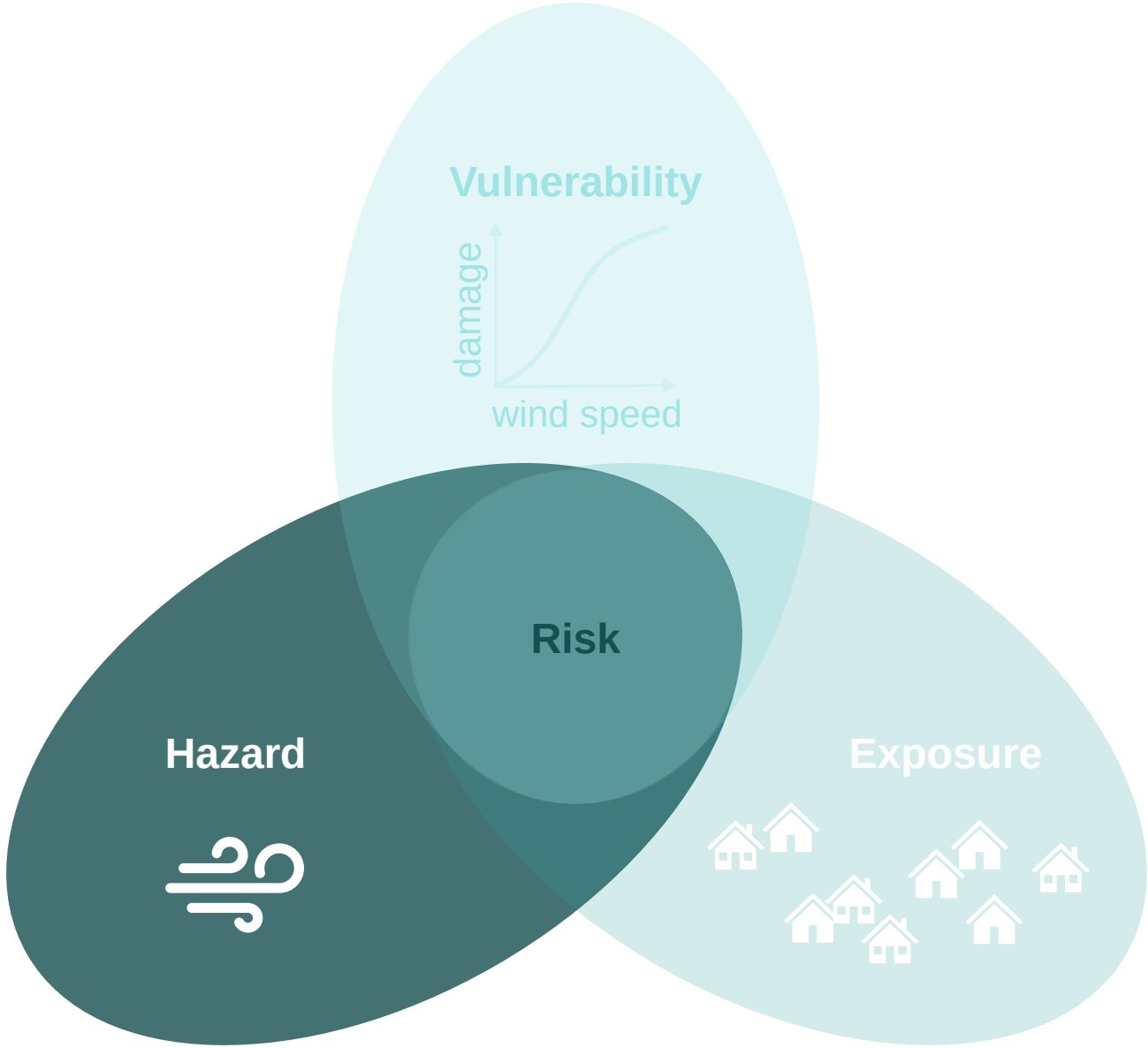
Risk framework

Three components



Risk framework

Today's focus



stochastic event set
(10'000s of synthetic wind storms)

historical event set
(100s of historical wind storms)

vs.

wind gust observations
(bias identification and correction)

PartnerRe's historical event set

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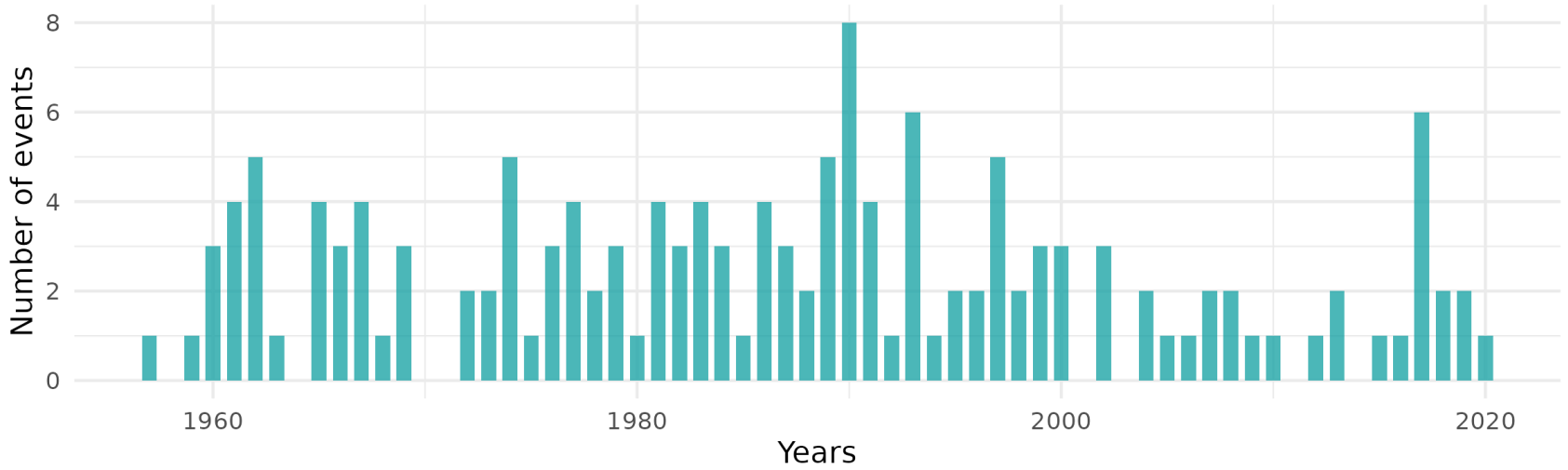
- 148 historical storms between 1957-2020
- Storm footprints defined as max gust over 72h period
- Model set ups:
  - 1957-2002: dynamical downscaling of ERA40 with COSMO (7km, 45 levels)
  - 2003-2020: output from operational COSMO setup @MeteoSchweiz

inconsistencies in wind fields

Details in **Haylock (2011)**
Nat. Hazards Earth Syst. Sci.



Open-access wind gust observations

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Accessed sources providing **global datasets**

Name	Region	Gust data retrieved	Comments (status spring 2024)
ASOS (Automated Surface Observating System)	Global	Yes	https://mesonet.agron.iastate.edu/ASOS/ https://mesonet.agron.iastate.edu/request/download.phtml
DWD (global) (Deutscher Wetterdienst)	Global	Yes	https://opendata.dwd.de/climate_environment/CDC/observations_global/CLIMAT/monthly/raw/
GHCND (Global Historical Climatology Network)	Global	Yes	https://www.ncei.noaa.gov/data/global-historical-climatology-network-daily/archive/daily-summaries-latest.tar.gz
GSOD (Global Summary of the Day)	Global	Yes	https://rdrr.io/cran/GSODR/f/README.md https://www.ncei.noaa.gov/data/global-summary-of-the-day/archive/

Open-access wind gust observations

PartnerRe

Accessed sources providing **national datasets**

Name	Region	Gust data retrieved	Comments (status spring 2024)
CHMI (Czech Hydrometeorlogical Institute)	CZE	No	No open data at time of access. https://www.chmi.cz/historicka-data/pocasi/zakladni-informace?l=en
DMI (Danmarks Meteorologiske Institut)	DNK	Yes	https://opendatadocs.dmi.govcloud.dk/en/APIs/Meteorological_Observation_API
DWD (Deutscher Wetterdienst)	DEU	Yes	https://opendata.dwd.de/climate_environment/CDC/observations_germany/climate/daily/kl/
FMI (Finnish Meteorological Institute)	FIN	No	Gust data available, but slow download due to limited quota. https://github.com/rOpenGov/fmi2
GeoSphere Austria	AUT	No	No open data at time of access. https://www.zamg.ac.at/cms/en/products/climate/data-and-statistics-1
IMGW (Polish Institute of Meteo. and Water Management)	POL	Yes	Gust data available in SYNOP, but not in CLIMATE dataset. https://github.com/bczernecki/imgw
KNMI (Royal Netherlands Meteorological Institute)	NLD	Yes	https://daggegevens.knmi.nl/ # station metadata https://cdn.knmi.nl/knmi/map/page/klimatologie/gegevens/daggegevens/etmgeg_{stationID}.zip
MeteoFrance	FRA	Yes	https://donneespubliques.meteofrance.fr/?fond=produit&id_produit=111&id_rubrique=37 https://www.data.gouv.fr/api/2/datasets/6569b51ae64326786e4e8e1a/
METNO (Norwegian Meteorological Institute)	NOR	Yes	https://api.met.no/
MeteoSchweiz	CHE	No	Open data starting April 1, 2025. https://www.meteoschweiz.admin.ch/service-und-publikationen/service/open-government-data.html
MIDAS (Met Office Integrated Data Archive System)	GBR	Yes	https://data.ceda.ac.uk/badc/ukmo-midas-open/data/uk-mean-wind-obs
RMI (Royal Meteorological Institute of Belgium)	BEL	Yes	Gust data available in SYNOP, few sample data points in AWS dataset. https://opendata.meteo.be/downloadPage.php
SMHI (Swedish Meteorological and Hydrological Institute)	SWE	Yes	https://opendata-download-metobs.smhi.se/api/version/latest/parameter/21.json
SMHU (Slovak Hydrometeorological Institute)	SVK	No	Only daily mean values of wind speed. http://meteo.shmu.sk/customer/home/opendata/

Coverage of collected observations

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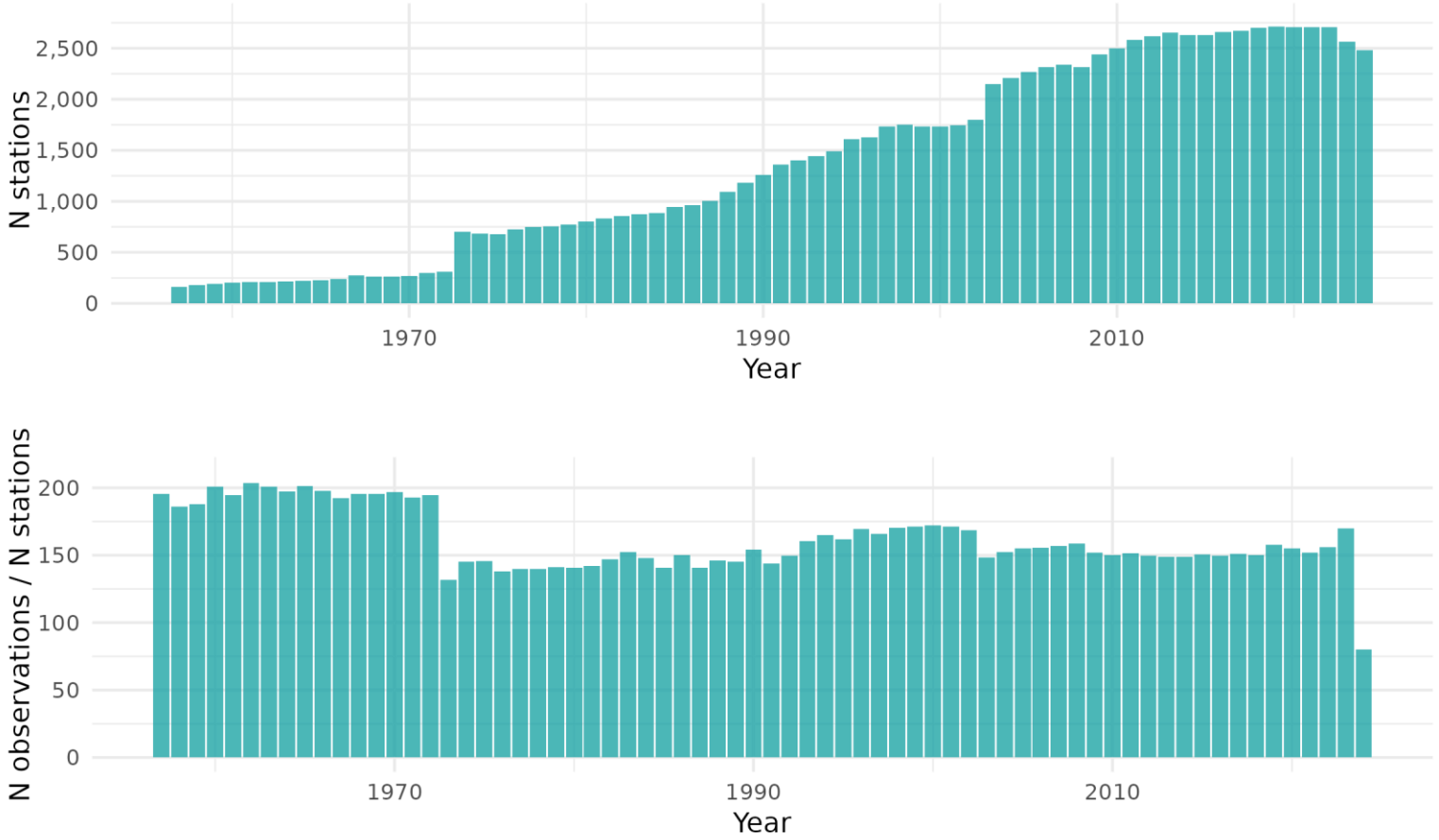
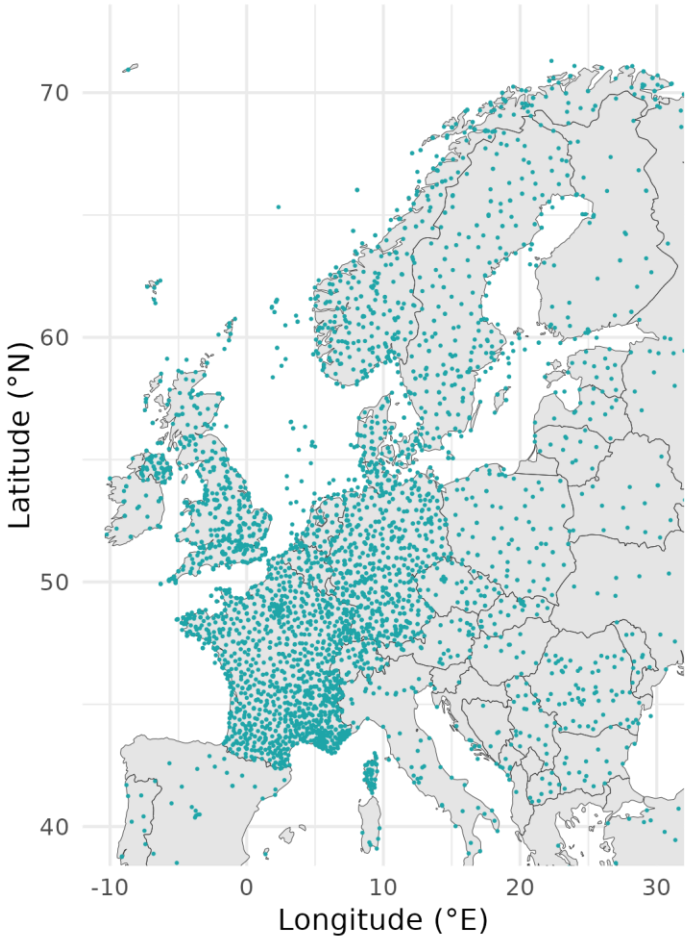
Daily max gusts data points during 1957-2024 (Oct-Apr)





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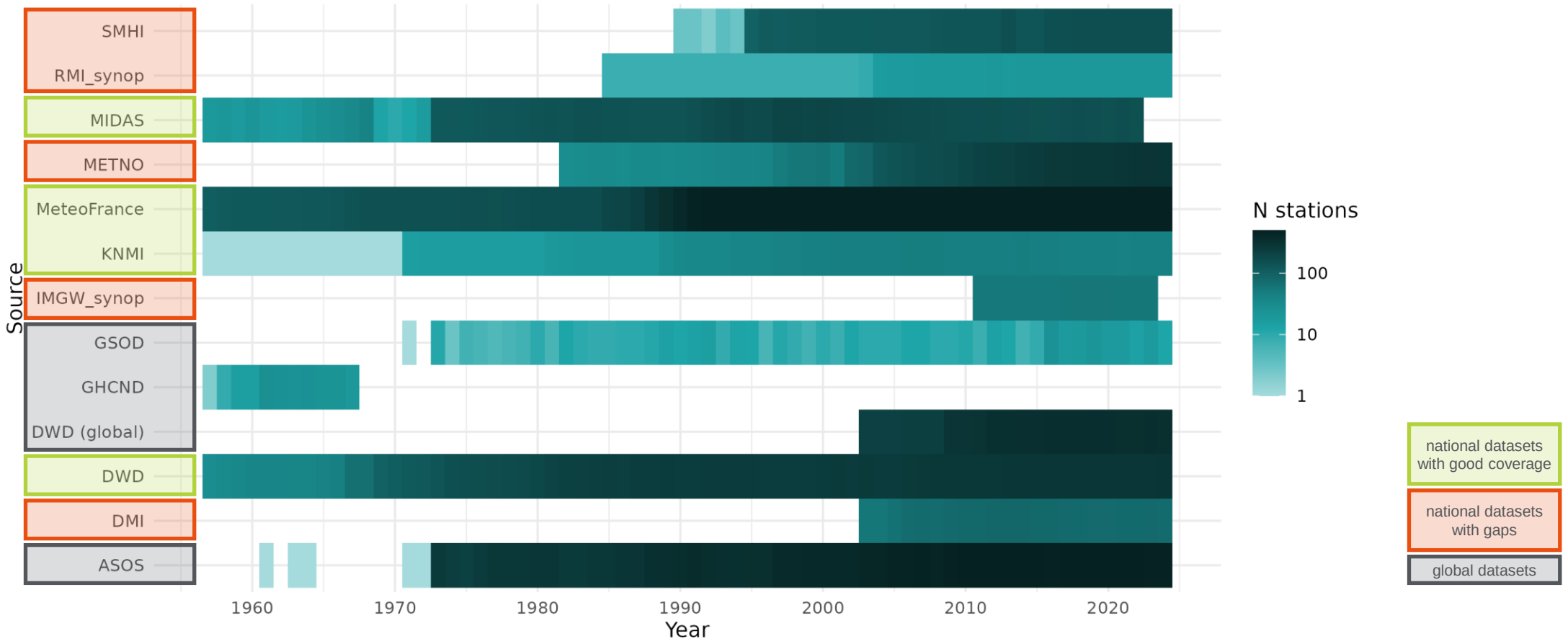


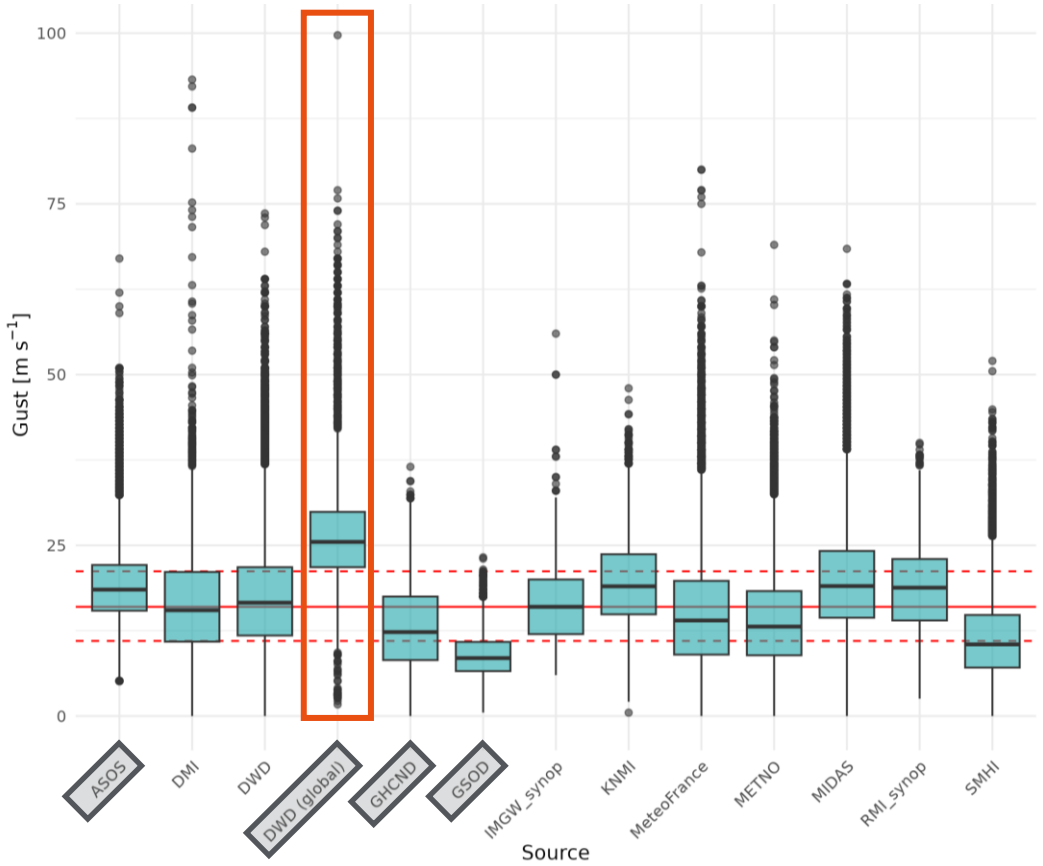
Quality check of collected observations

PartnerRe

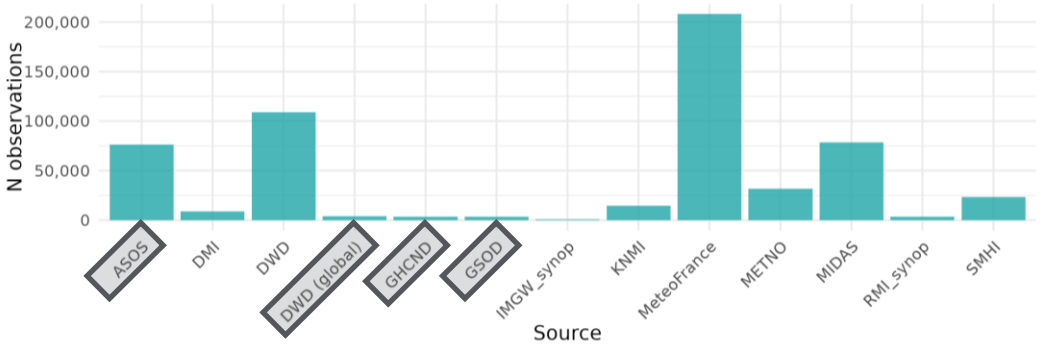
Comparison of daily max gusts

(storm periods only)

- DWD (global) high bias due to values from GBR and NLD → ignore dataset for these countries



global datasets

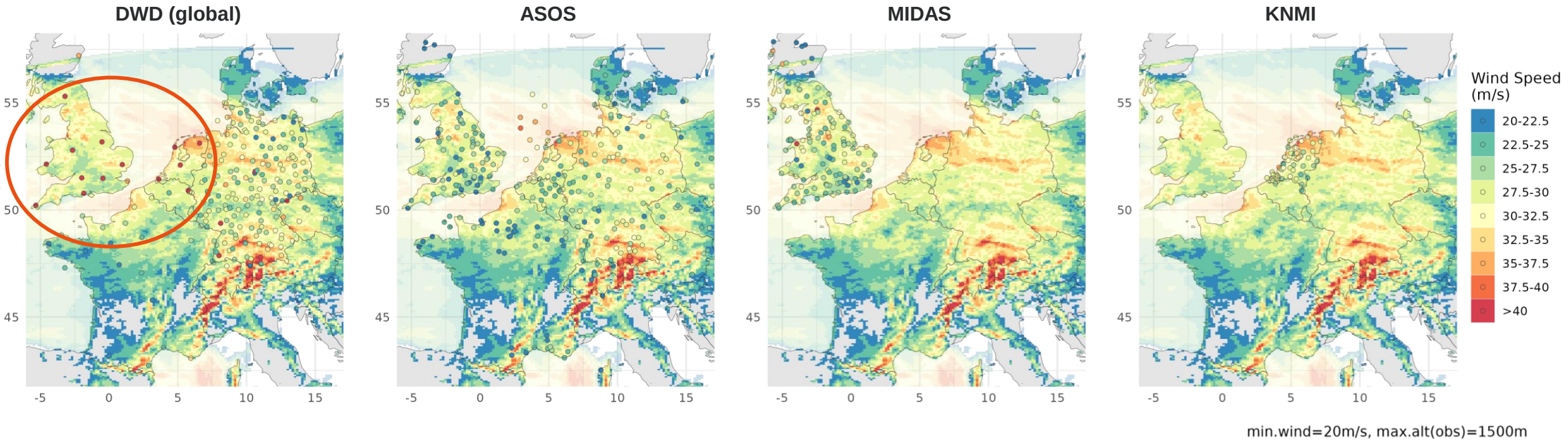


Quality check of collected observations

PartnerRe

DWD (global) data erroneous in some countries

Storm Niklas (29-31 March 2015)



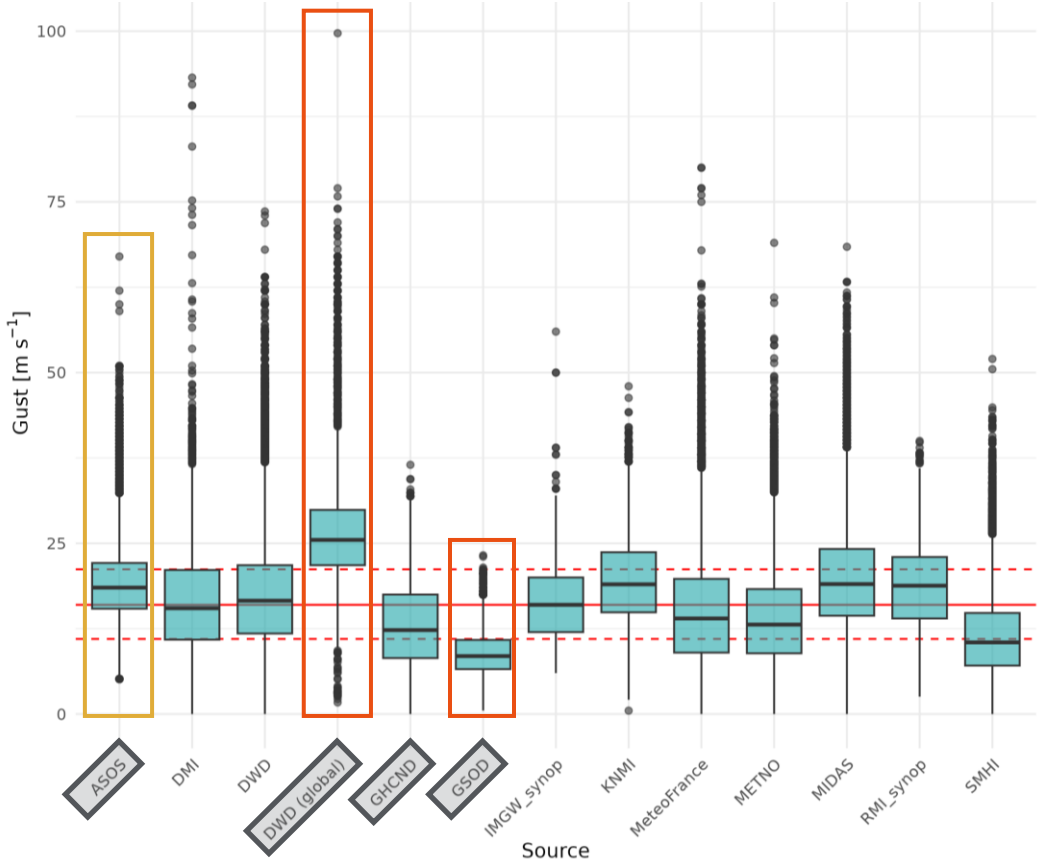
Quality check of collected observations

PartnerRe

Comparison of daily max gusts

(storm periods only)

- DWD (global) high bias due to values from GBR and NLD → ignore dataset for these countries
- GSOD low bias across all European countries → ignore dataset (maybe faulty version downloaded)



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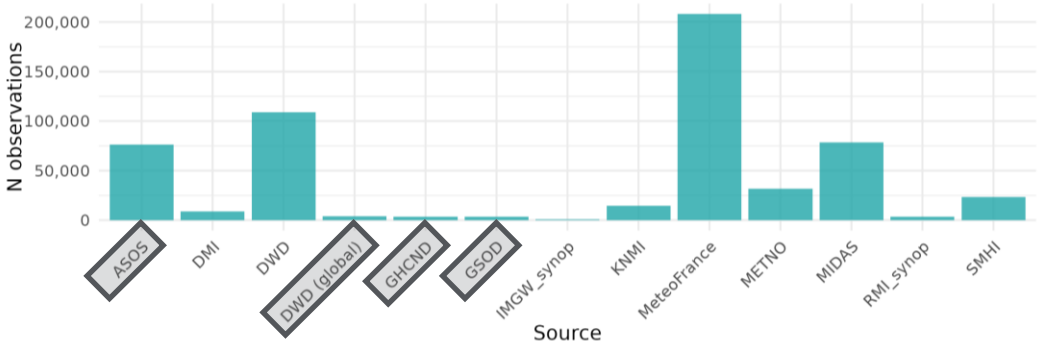
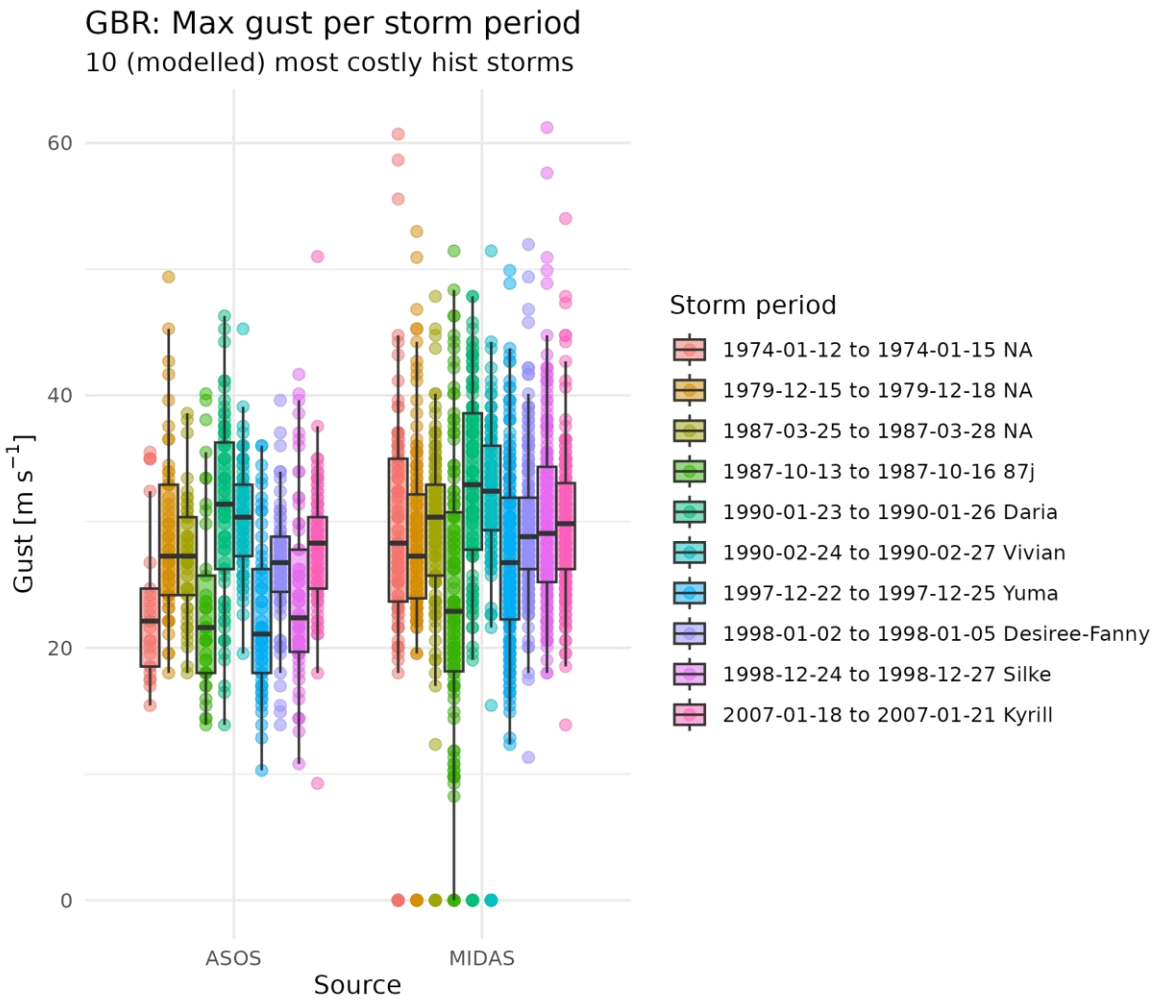


Quality check of collected observations

ASOS within range of national dataset but missing extremes



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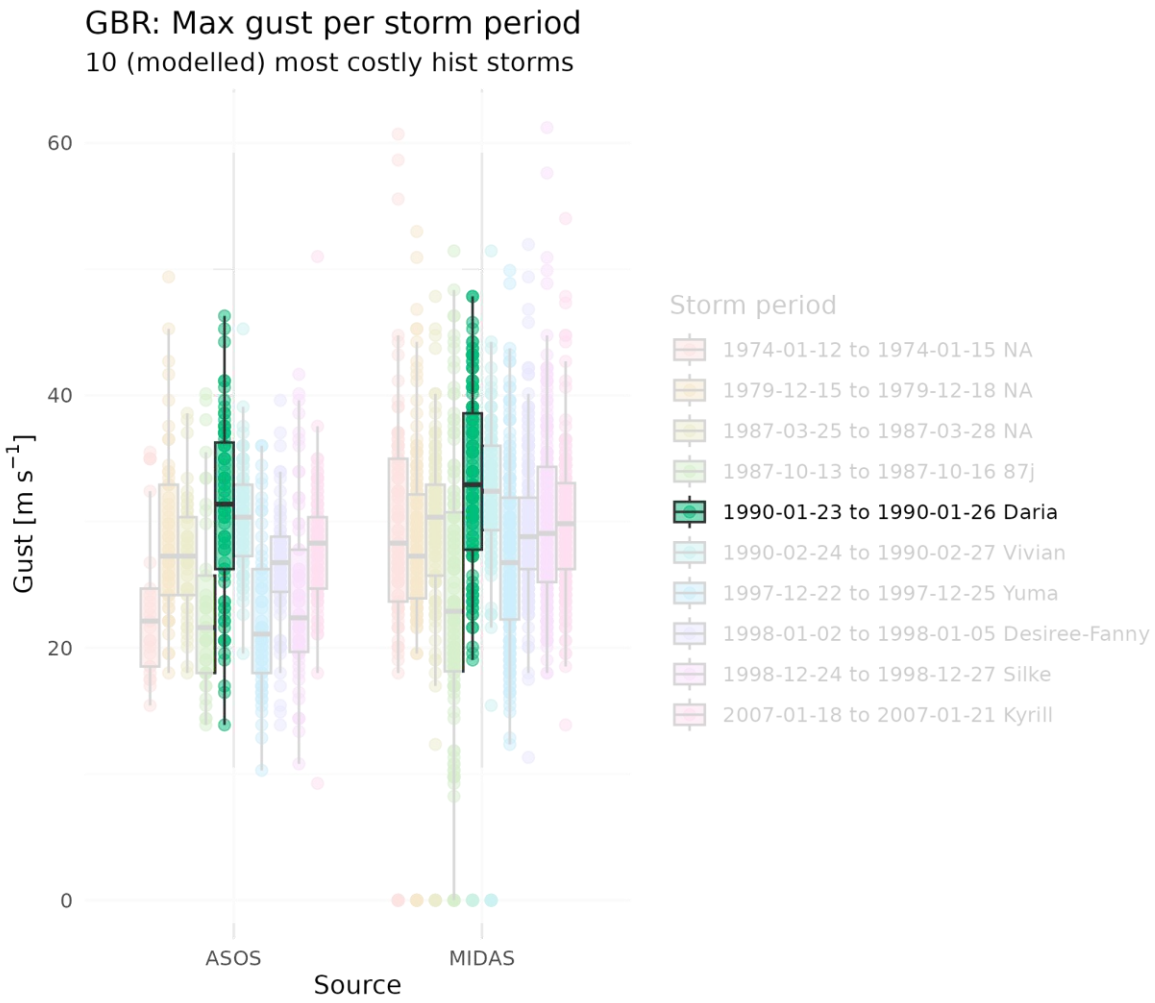
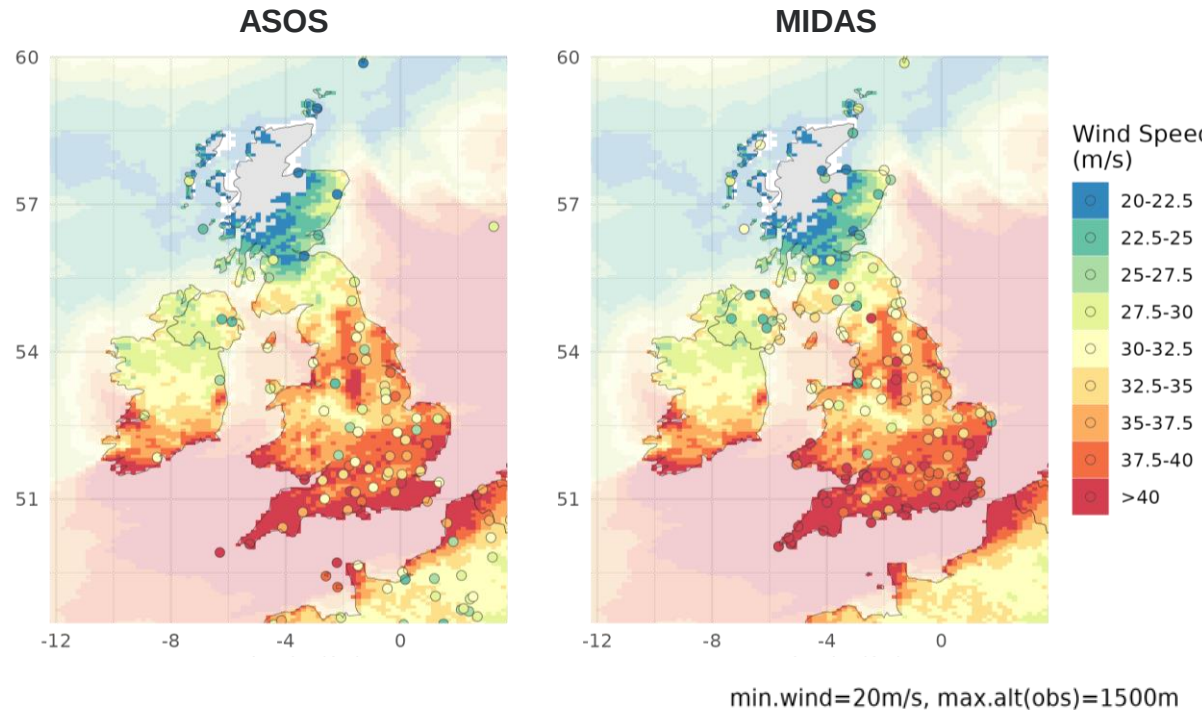
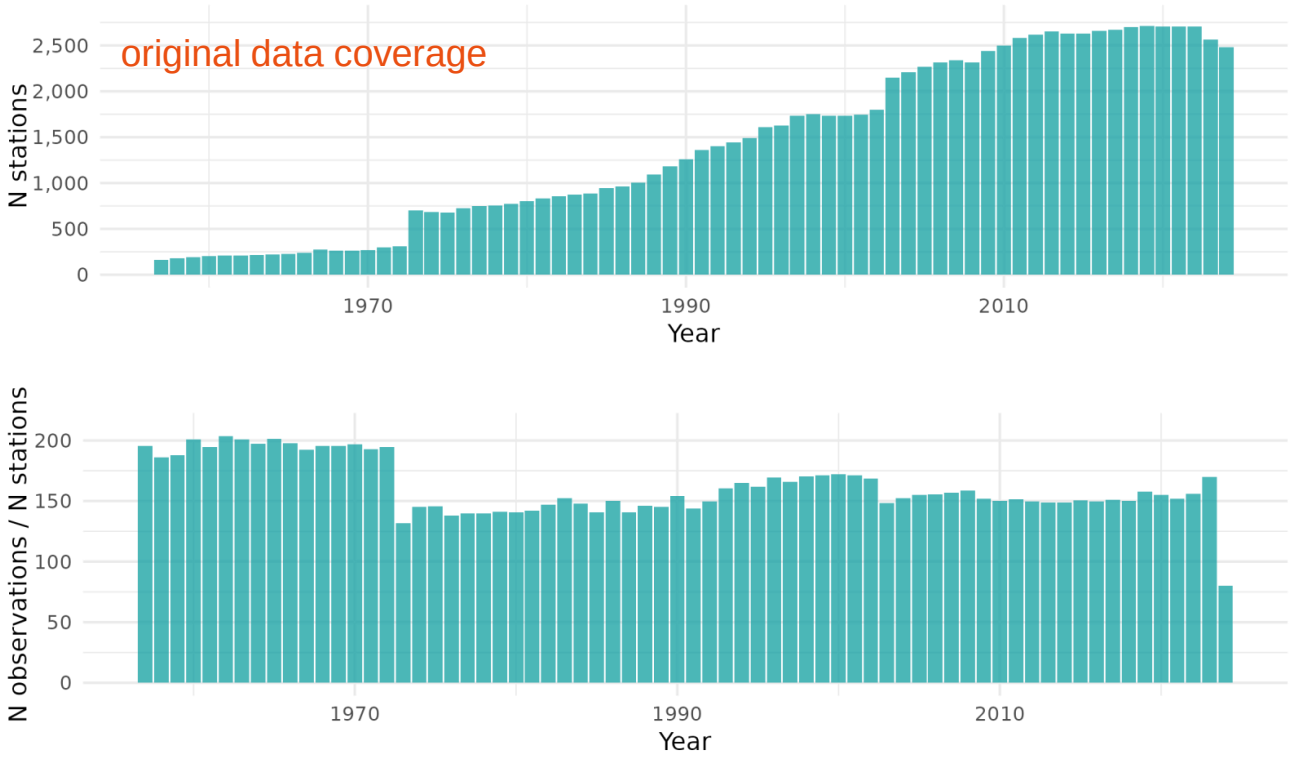


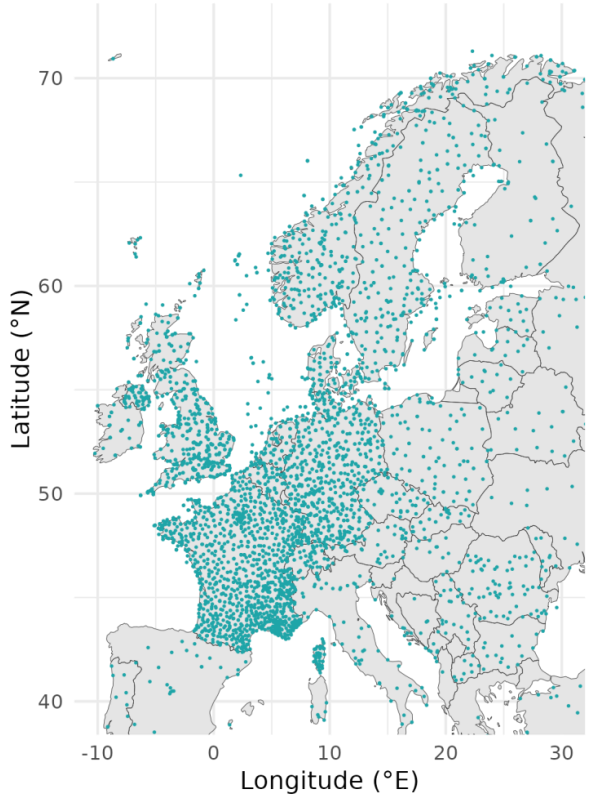


Selection of best data for each country

PartnerRe

- Prefer national over global dataset
- Prefer ASOS over other global dataset (ignore GSOD, and DWD for specified countries)
- Remove outliers (gusts > 80 m/s)





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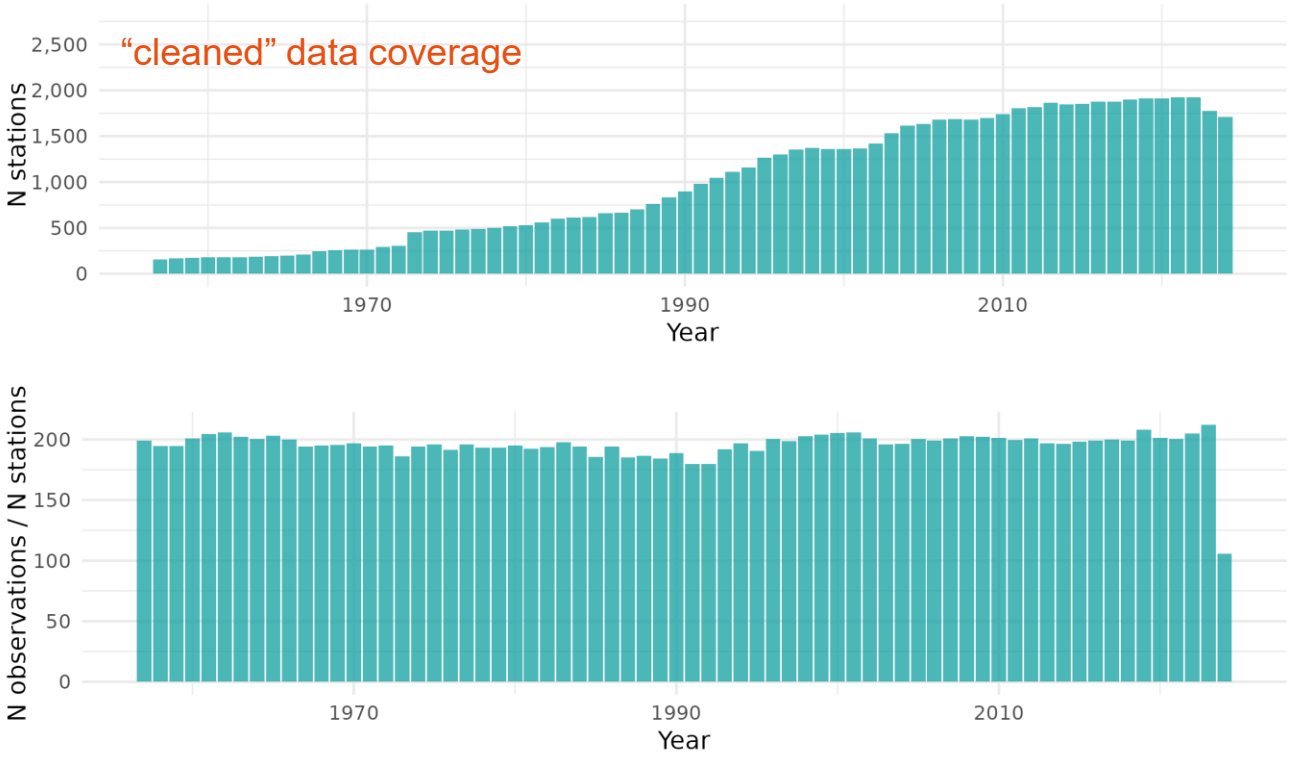

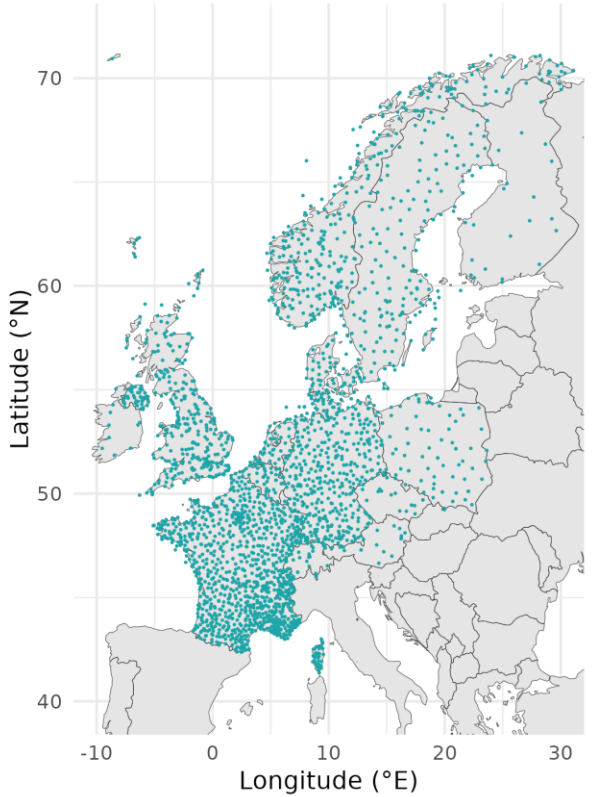

Leveraging wind gust observations

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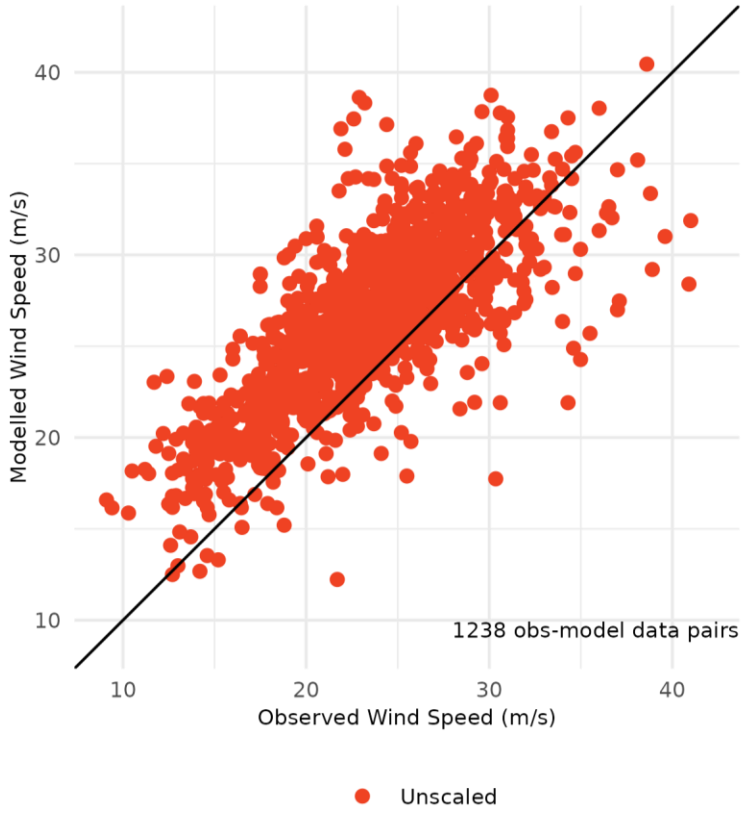
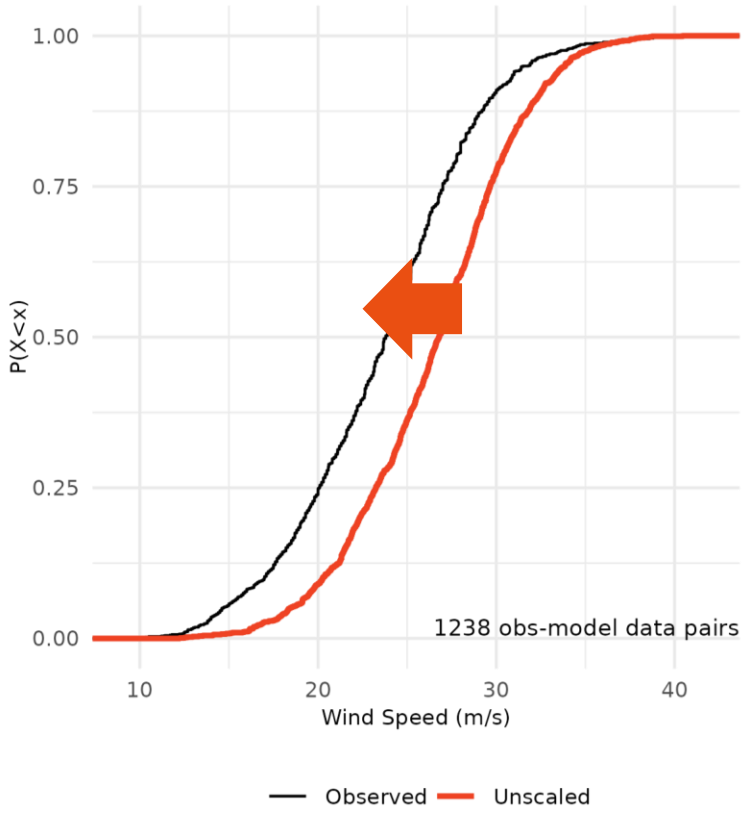
Apply quantile-scaling to align model data with observations

Storm Niklas (29-31 March 2015)

1. Match observation with model data from nearest grid point
2. Derive scaling factor for each probability





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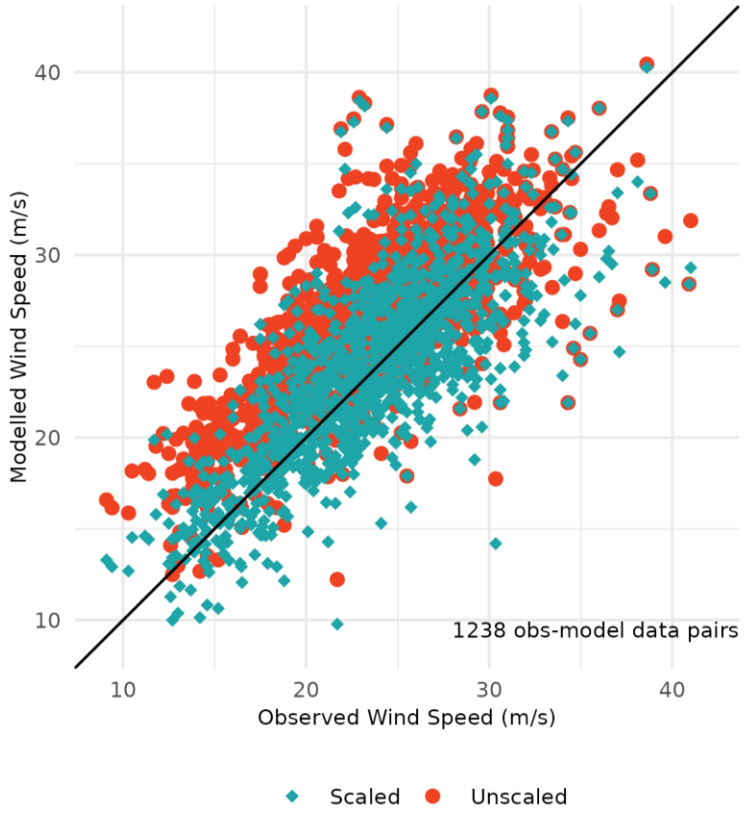
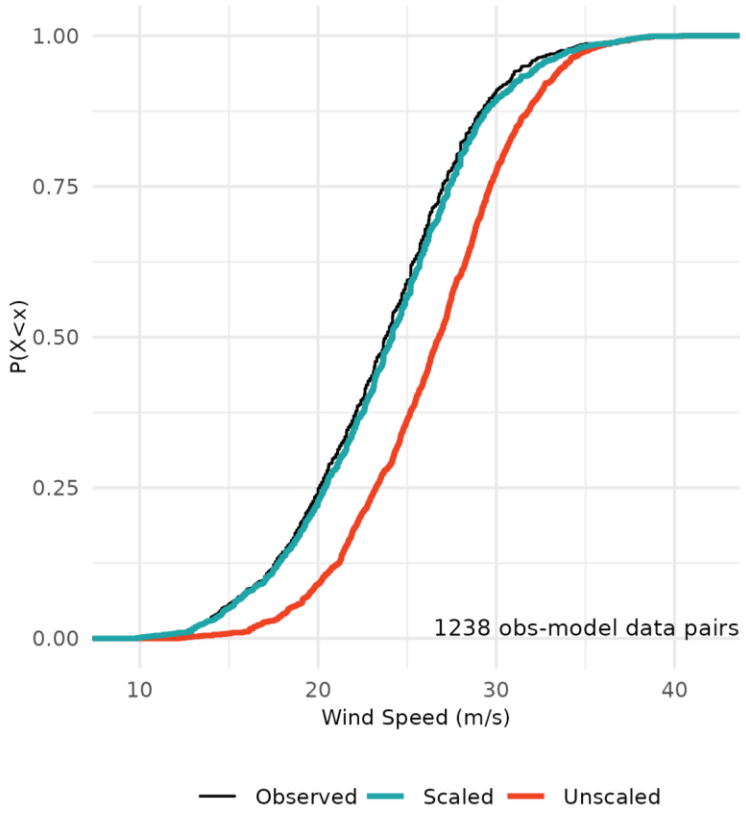




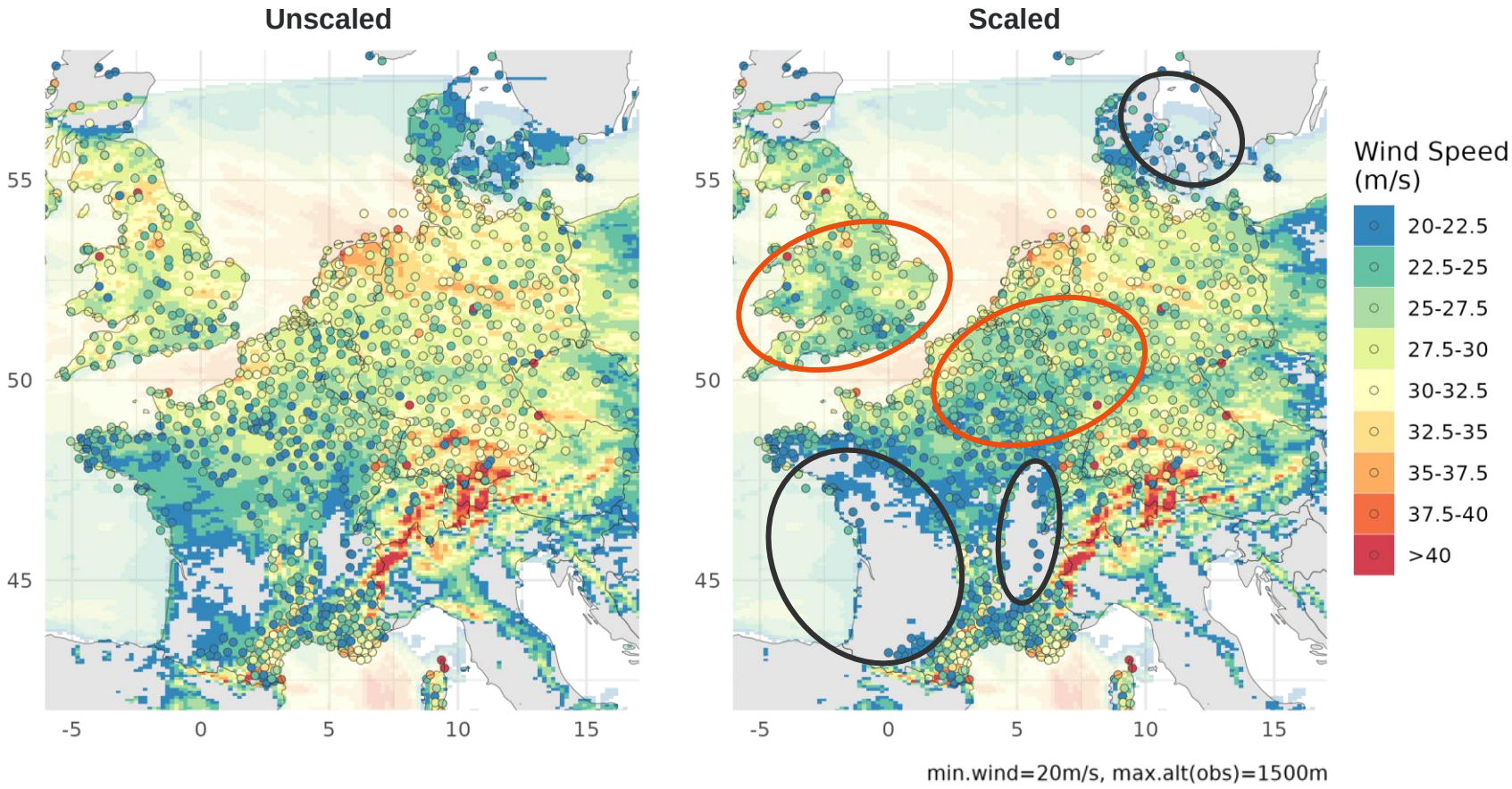
Leveraging wind gust observations

PartnerRe

Apply quantile-scaling to align model data with observations

Storm Niklas (29-31 March 2015)

1. Match observation with model data from nearest grid point
2. Derive scaling factor for each probability
3. Apply scaling to full wind field (only land data points)



Effect of wind field scaling on loss estimates

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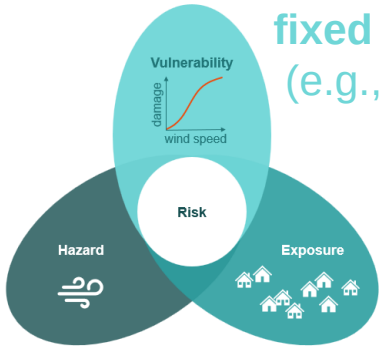
Model Run A



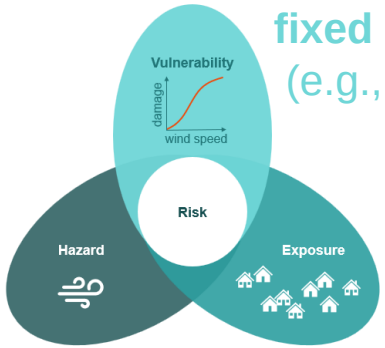
fixed vulnerability curve
(e.g., from old model)

unscaled
historic event set

industry exposure
PERILS (property, commercial, industry)

experimental
loss estimate A
for each storm

Model Run B



fixed vulnerability curve
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experimental
loss estimate B
for each storm

Effect of wind field scaling on loss estimates

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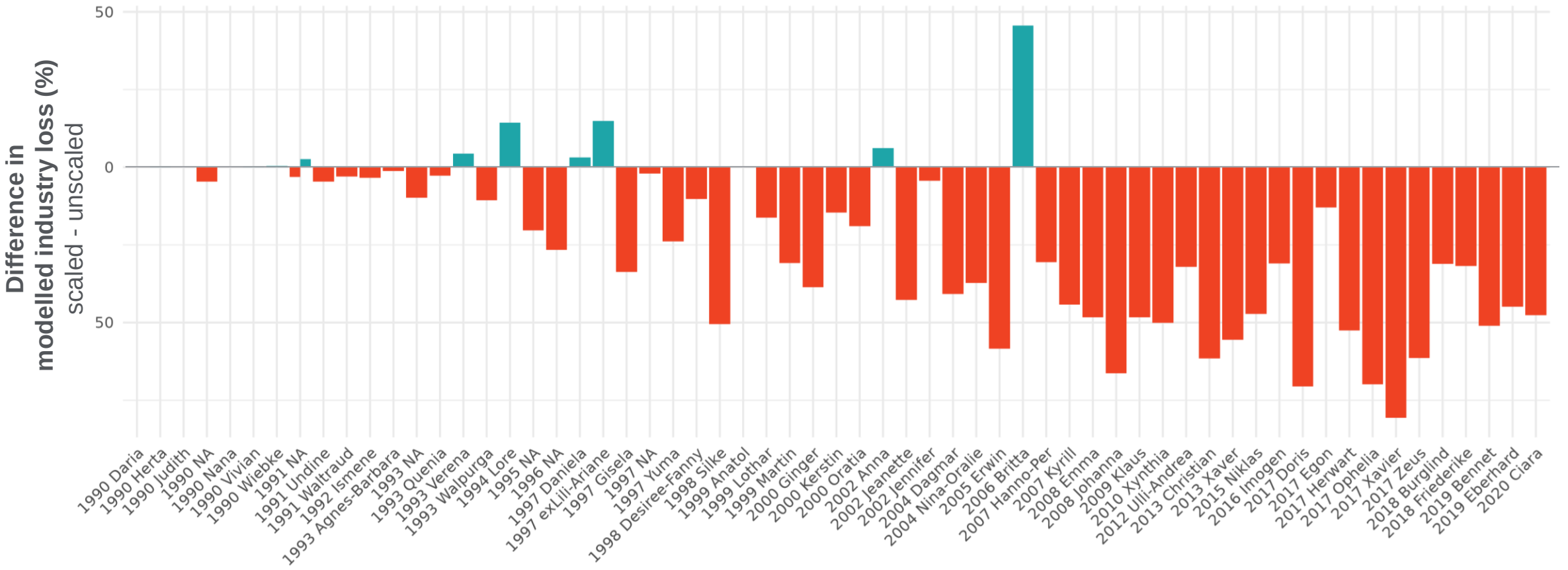
Modelled industry losses 1990-2020



Applied scaling settings

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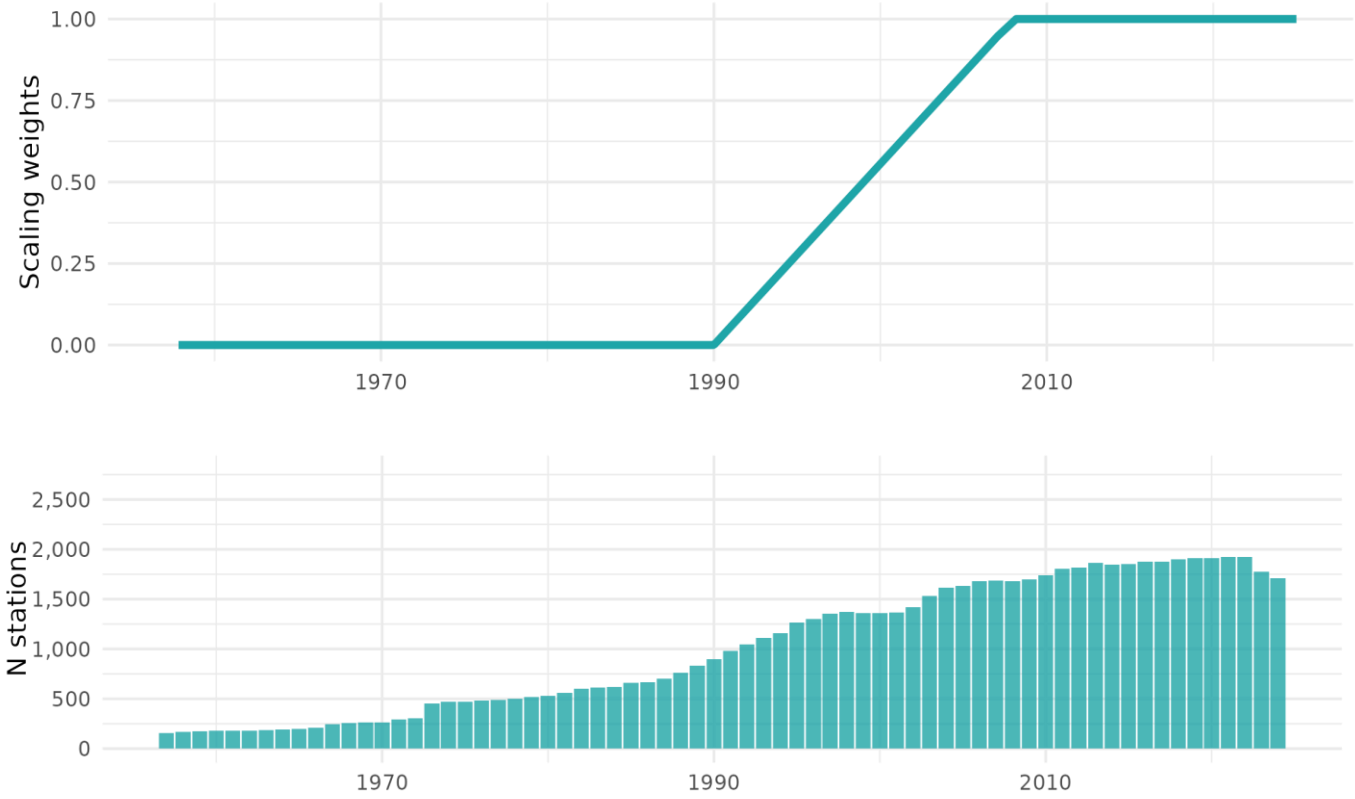
Identified problem

- High bias increasing over time

Chosen approach

- Apply temporal weight (due to number of stations & increasing high bias)
- Scale each storm separately
- Only use observations below 750 m.a.s.l
- Limit scaling to -20% and +5%



Open questions

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- How should we handle inconsistent biases over time and space?
- How should we deal with inhomogeneous observational data?

Breakout groups

1. What are the new challenges in process understanding of the dynamics?
2. Is high resolution (km-scale) modelling the solution?
3. From storms to impacts – what is missing?
4. Will AI-techniques lead to vast improvements in modelling EU WS?
5. Leveraging modelling advancements in building European Windstorm (EU WS) risk models.

Take home message

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- Many national weather services provide open-access observational datasets
- Compared to global datasets, national datasets have advantage of higher station density (capturing local extremes more reliably)
- Scaling wind fields towards observations can have considerable impact on loss estimates (important to recalibrate risk model after adjusting the event set)