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EUROPEAN WINDSTORM

Using seasonal forecasts to enhance our understanding of extreme windstorms

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1. Motivation
2. Methodology and Validation
3. Implications for Risk
4. Takeaways

Agenda

Motivation

1

Collaborative Research

European Windstorm

Guy Carpenter industry applications and evaluation capabilities

Research Collaboration

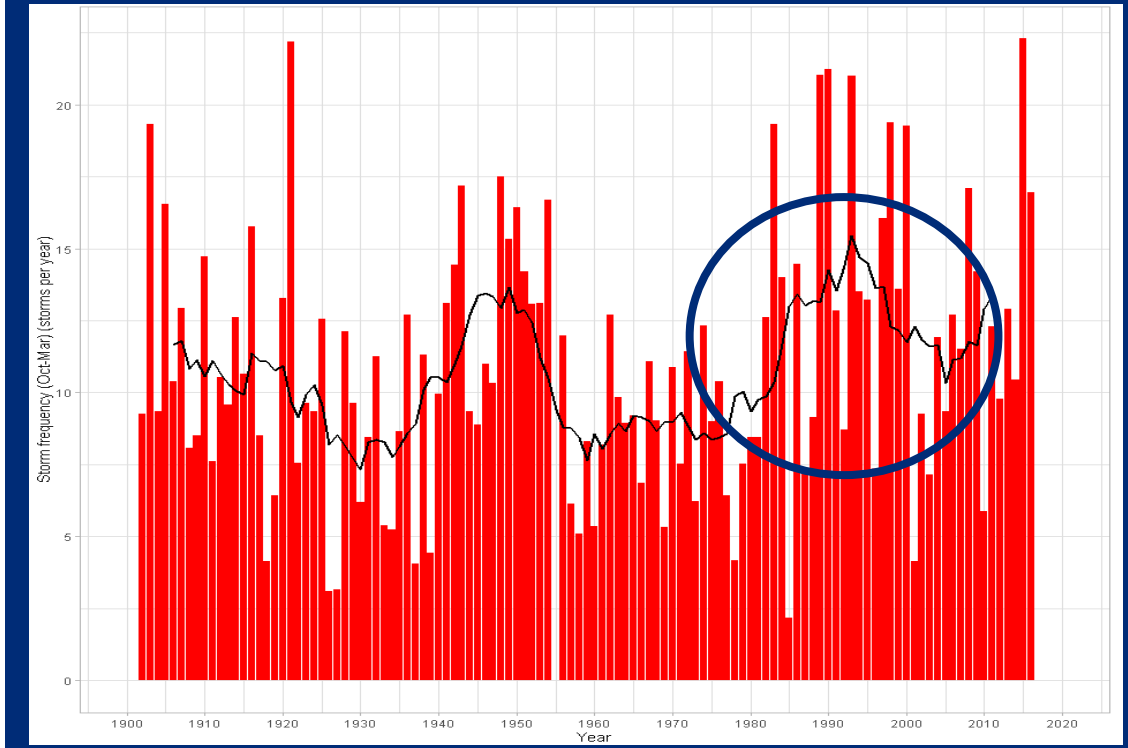
University of Exeter scientific expertise

Problems we face in understanding risk:

Short Observational Records
Good quality observational / reanalysis gust data is only available for a relatively short period; not sufficient to understand tail risk. Climate models suffer from coarse resolution.

Choice of Calibration Period
The choice of calibration period affects the storm frequency and intensity distribution, due to natural variability.

Storm Metrics
Different studies use different measures of storm severity; difficult to compare directly with catastrophe models



Methodology and Validation

2

Methodology

Met Office (GloSea6) seasonal forecast model:
- 1993-2016 (24 years)
- 4 hindcast initiation dates
- 7 perturbed ensemble members

Storm Severity Index (SSI) calculation using catastrophe model definition

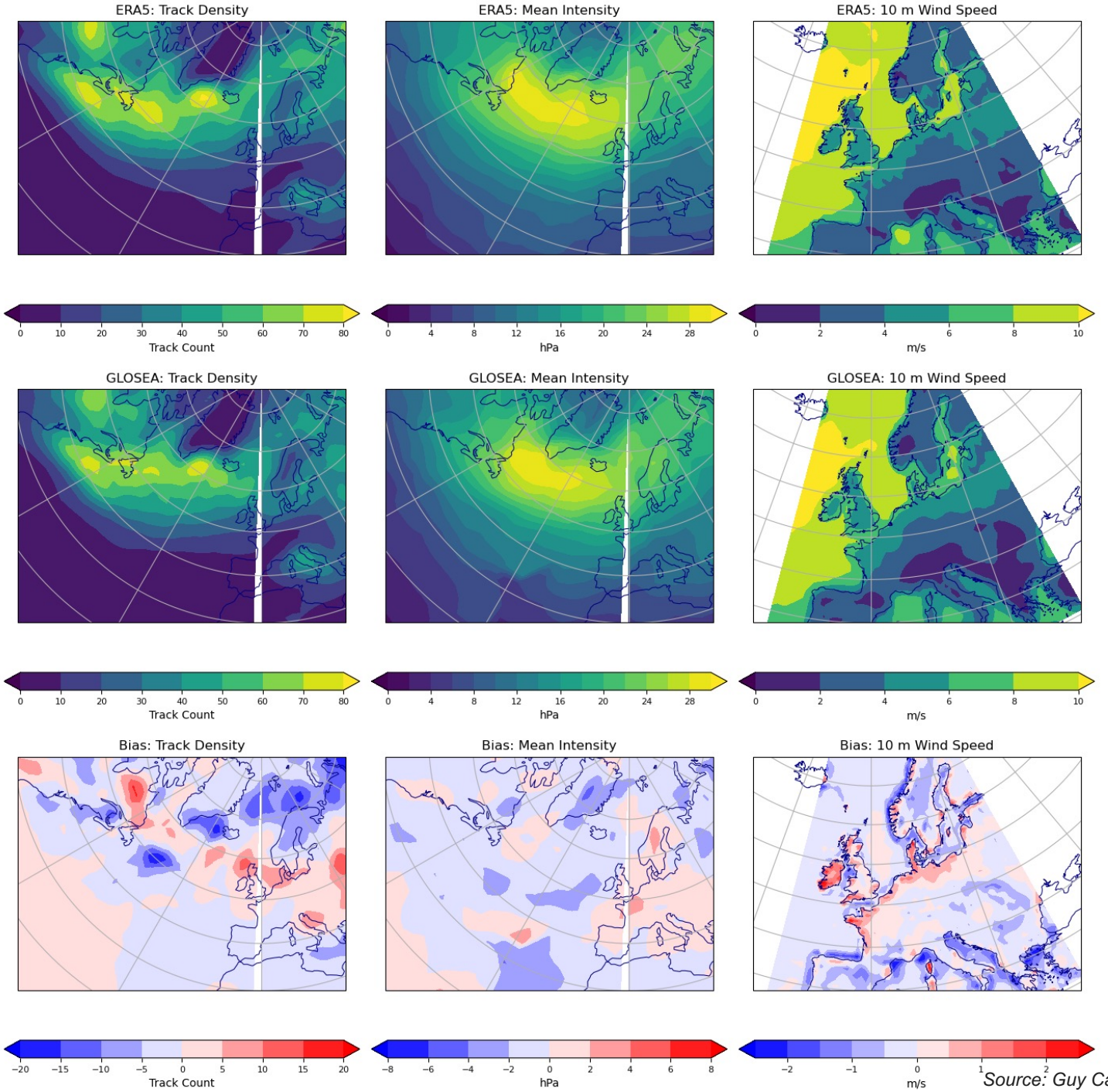
Resulting **672 year event set (tracks, footprints, SSIs)**

Storm tracking with Hodges algorithm (1994, 1995, 1999) using mean sea level pressure field

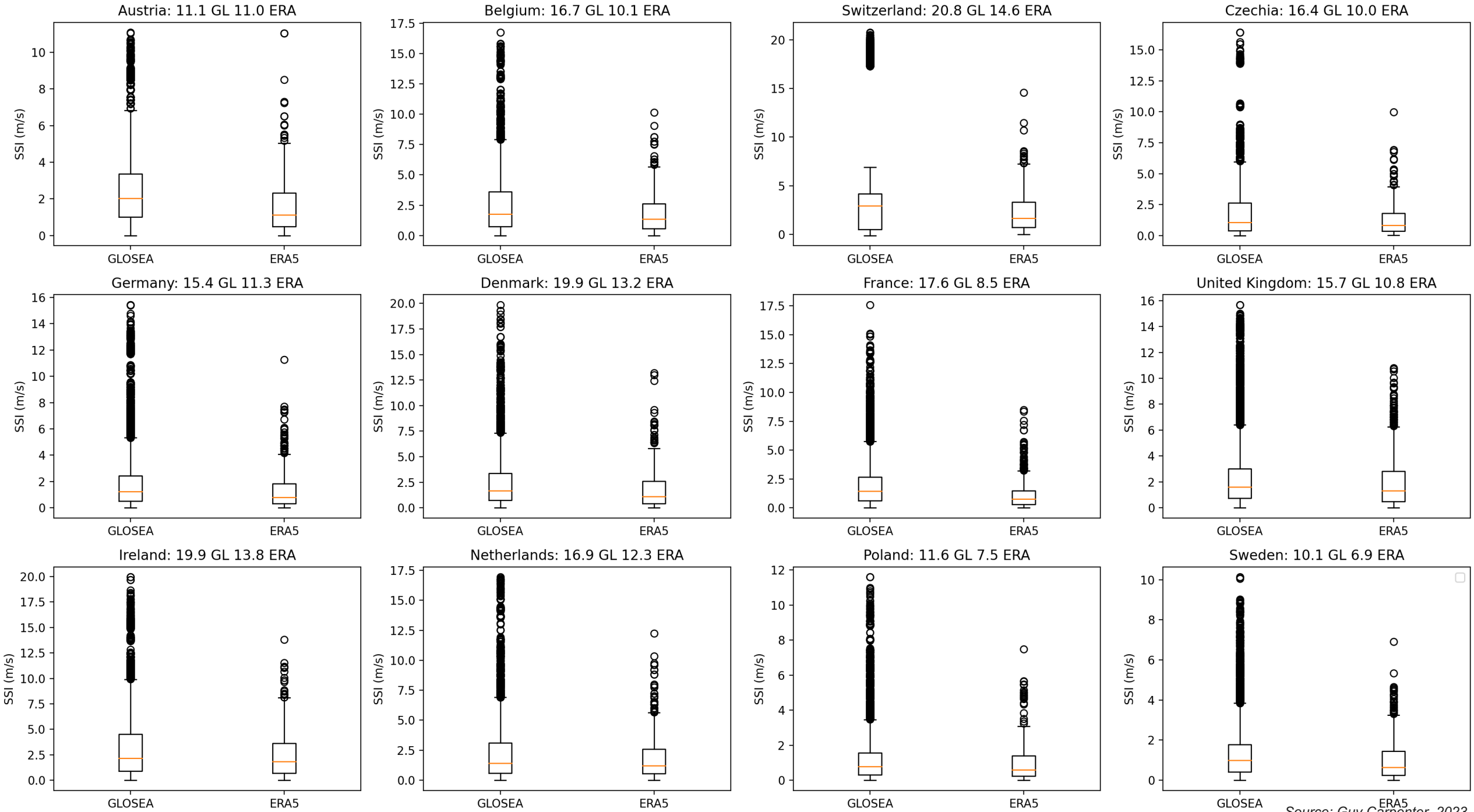
Bias correction and conversion from mean wind speed to gust using ERA5

Model Fidelity

- **North Atlantic storm track is reasonably well represented** in GloSea6 model
- Slight **overestimation of near surface wind speeds** for some countries



Source: Guy Carpenter, 2023



Source: Guy Carpenter, 2023

Implications for Risk

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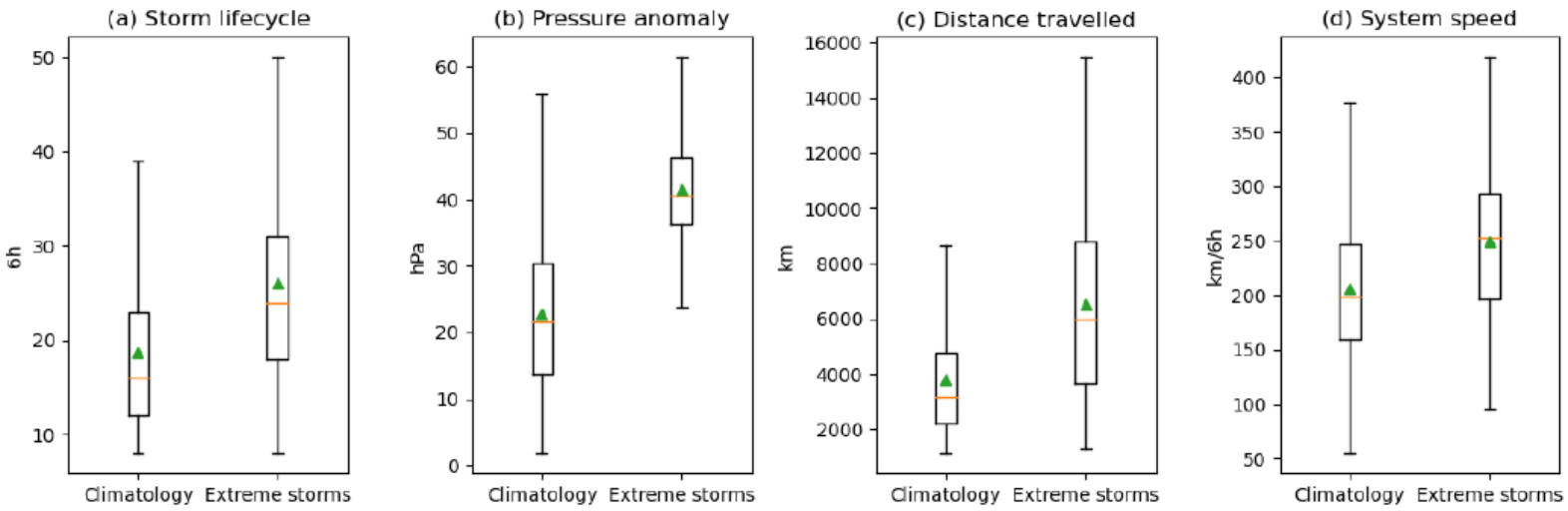
Extreme Storm Characteristics



Distributions of (a) the number of points constituting each storm's track, (b) the pressure anomalies of the cyclones at each of these points, (c) the total distance travelled by the cyclone during their lifetimes, and (d) the average speed at which they move. Distributions are shown for unprecendented storm and non-extreme storms within the European domain. Orange lines and green triangles denote the medians and means of the data, respectively.

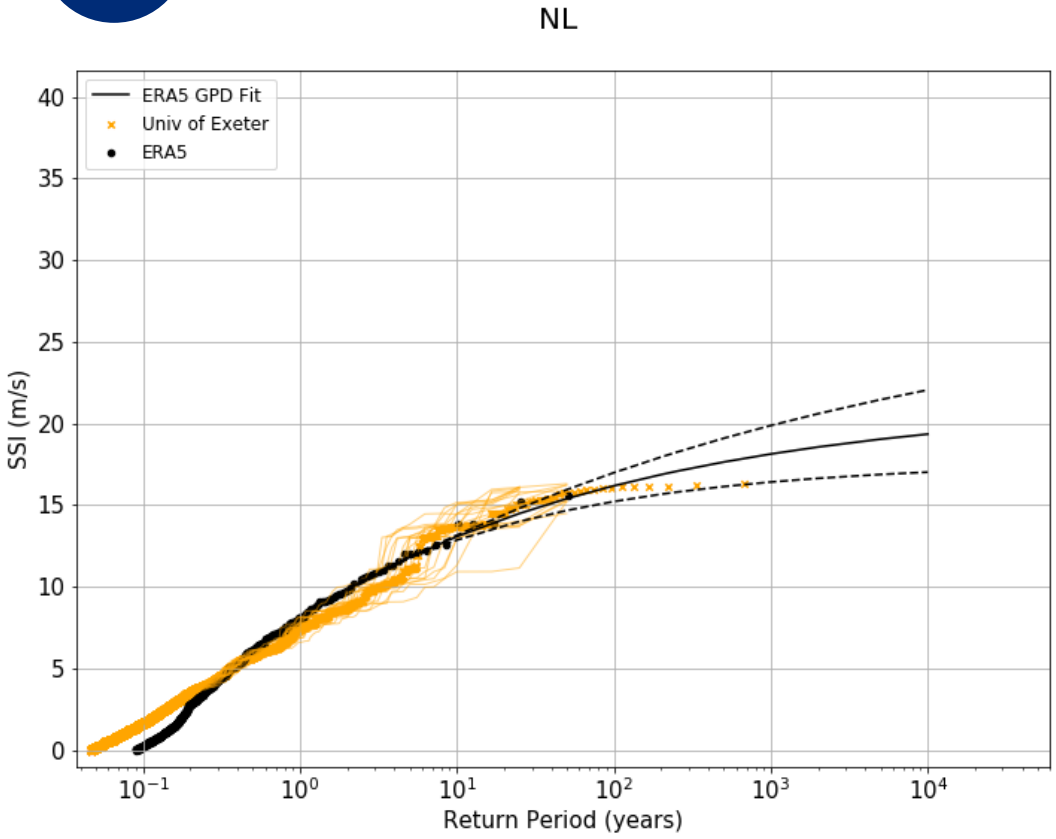
Extreme storms (SSI > ERA5 max):

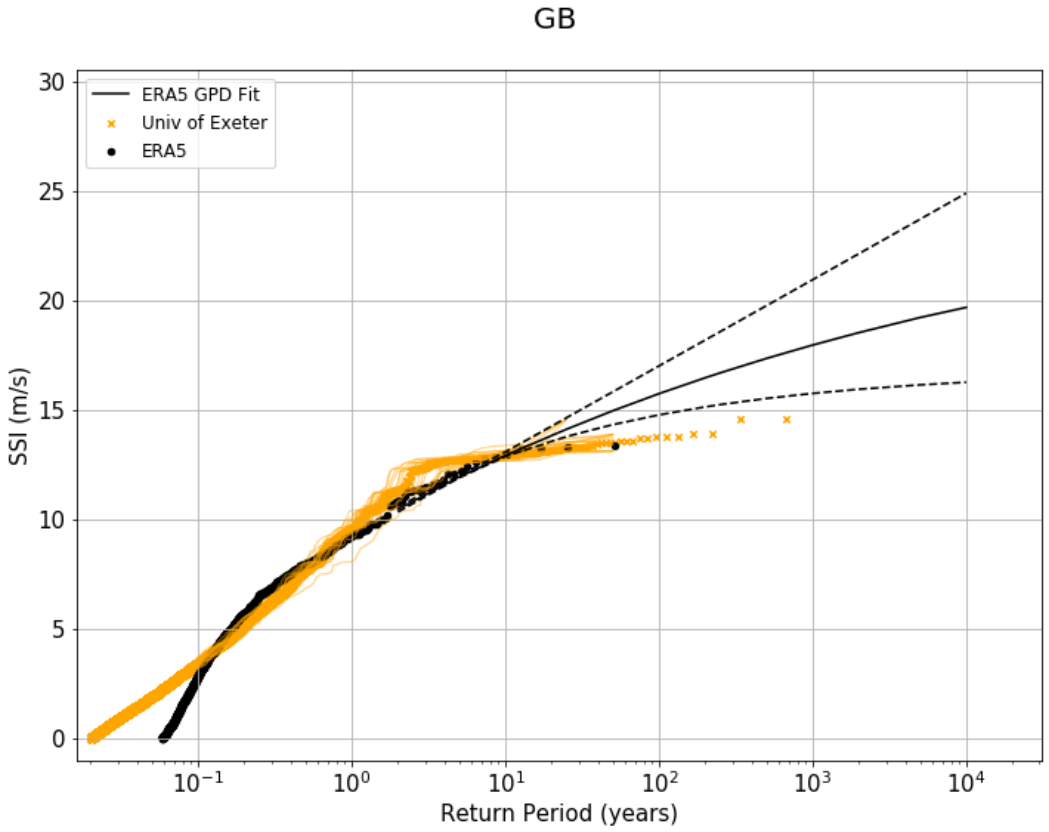
- Longer lasting (+36 hrs longer)
- Greater pressure anomaly
- Travel further (+2000km)
- Travel at greater speeds (+8km/h)

More potential for damage

Frequency/Intensity Distribution

GloSea6 extended event set allows us to evaluate the frequency/intensity distribution in the models and improve our understanding of tail risk

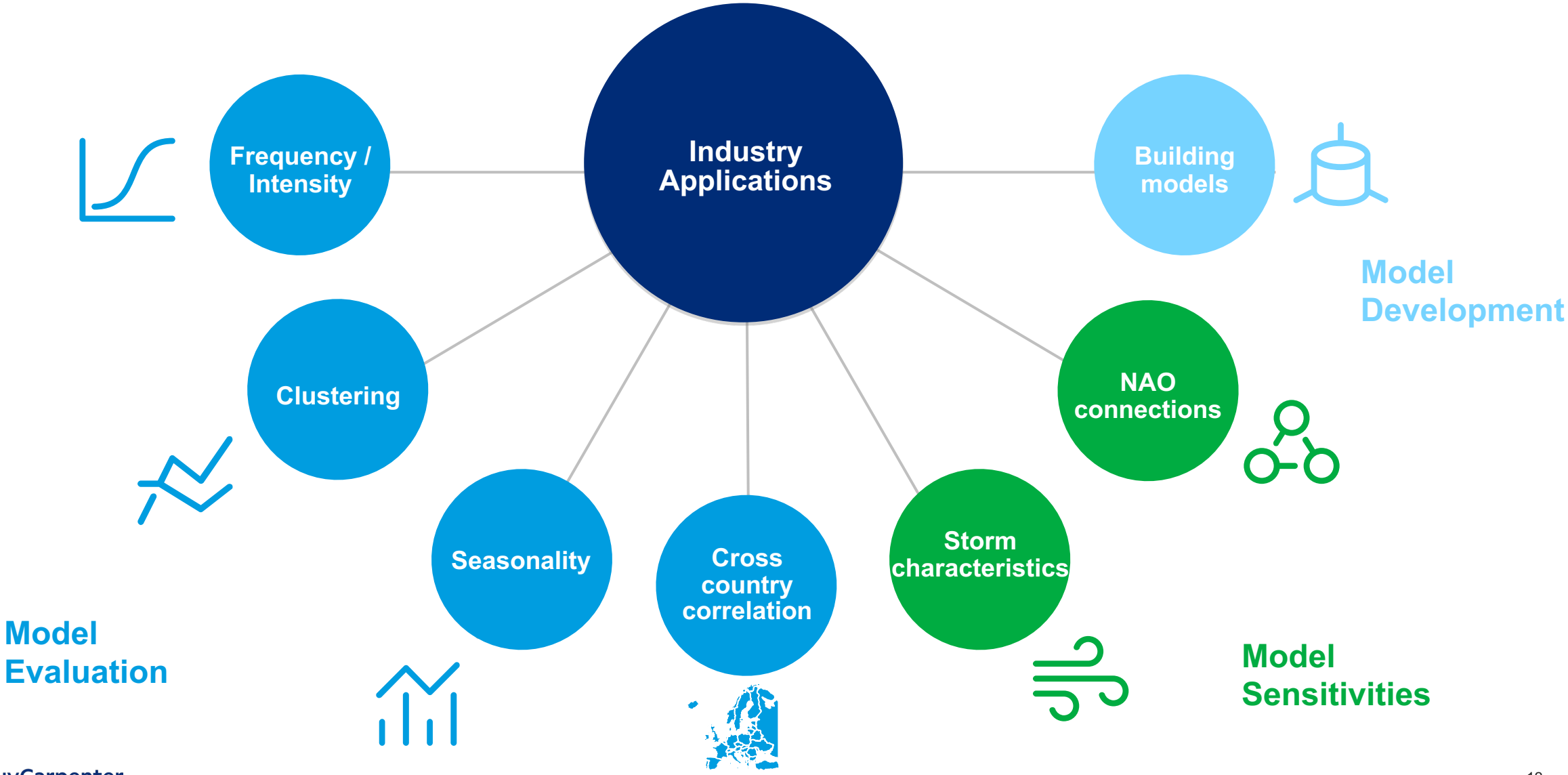




ERA5 reanalysis: Hourly data on single levels, 10m wind gust since previous post-processing, 0:25x0:25 resolution, 3-second peak gusts. Event dates in the reference event catalogue are extracted from available historical model catalogues, for storms between 1972-2022. Max gust above 20m/s in 900km radius from centre at each time step, 5 day window. A Generalized Pareto Distribution (GPD) is fitted to the reference catalogue following the Peaks Over Threshold (POT) method. The median fit and its corresponding uncertainty are shown. The thresholds for POT method are selected based on the 85-95th percentiles of SSI values. University of Exeter event set is sampled for 50 years 20 times. Source: Guy Carpenter, 2023

Industry Applications

Examples



Takeaways

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Summary

We need reference datasets for **scientific benchmarking to evaluate catastrophe models**

Typical references cover a short historical period and do not use consistent measures of Storm Severity Index (SSI), making it **difficult to evaluate tail risk in the models**

Through a collaboration project we created an **extended event set of 672 years (100,000s tracks) derived from seasonal forecasts**

The event set is **useful for a number of model evaluation and development purposes**

More extreme storms than have occurred on record are identified in GloSea6 and can be used to estimate tail risk

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