Willis Research Network

European Wind Risk

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22 September 2016
European Windstorm Risk

- (1) What are some of the main challenges in modelling European Windstorms?

- (2) How do we bring this WRN research into our Model Evaluation work?
  How can our clients benefit from these efforts?
Challenges in Modelling European Windstorms

Model the Wind Associated with Windstorms
Challenges in Modelling European Windstorms

Tropical Cyclones

Extra-Tropical Cyclones

Symmetric

Comma shape

Isabel 2003

Desmond 2015
Challenges in Modelling European Windstorms

Tropical Cyclones

Symmetric
Strong Winds
Size of 100s of km

Extra-Tropical Cyclones

Comma shape
Reduced Winds
Size > 1000 km

Isabel 2003
Desmond 2015
Challenges in Modelling European Windstorms

**Tropical Cyclones**
- Symmetric
- Strong Winds
- Size of 100s of km
- Non-frontal

**Extra-Tropical Cyclones**
- Comma shape
- Reduced Winds
- Size > 1000 km
- Frontal
Challenges in Modelling European Windstorms

**Tropical Cyclones**
- Symmetric
- Strong Winds
- Size of 100s of km
- Non-frontal
- Simplistic vertical structure

**Extra-Tropical Cyclones**
- Comma shape
- Reduced Winds
- Size > 1000 km
- Frontal
- Complex vertical structure
Challenges in Modelling European Windstorms

Tropical Cyclones

=> Parametric Modelling is sufficient

=> Small number of equations and parameters

Extra-Tropical Cyclones

=> Numerical Modelling is needed

=> Very complex, millions of equations and parameters

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Challenges in Modelling European Windstorms

Determine Frequency of Windstorms
Challenges in Modelling European Windstorms

Tropical Cyclones

Storm Definition:
Wind (>= 39 or 74 mph)

Extra-Tropical Cyclones

Storm Definition:
Surface Pressure,
Rel Vorticity, Wind, Loss,
+ Diff Thresholds

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Challenges in Modelling European Windstorms

Tropical Cyclones

Landfall:

Center of storm crosses boundary

Extra-Tropical Cyclones

Landfall:

No clear definition
Challenges in Modelling European Windstorms

Tropical Cyclones

Extra-Tropical Cyclones

Naming:

National Hurricane Center

Naming:

Free University of Berlin + UKMO, DMI, SMHI, NMI…
Challenges in Modelling European Windstorms

Was Friederike a 3-day (72h) or a 5-day (120h) event?
Challenges in Modelling European Windstorms

⇒ European Windstorms represent a very complex peril, difficult to model

⇒ There is a lot of uncertainty in the risk associated with these storms
Bringing WRN Research into Cat-Model Evaluation Work

Annual Rates
Frequency of Storms
Tail Estimates

What is the annual frequency of storms in Europe?
What is the annual frequency of storms in UK?

What is the RP period of observed wind estimates at location X?
Which model’s hazard validates best?
If provided, **modeled annual rates** of storms, over Europe or any given country; vary by model vendor, data used and tracking technique employed.

**WRN** research can provide a third-party *educated* opinion regarding a **realistic annual rate of storms** - by choosing a specific threshold in the Generalized Pareto Distribution used to model extreme values in region of interest.
Bringing WRN Research into Cat-Model Evaluation Work

WRN research also provides an educated opinion regarding return periods and tail hazard in a given region - based on objective data and peer-reviewed methodology.
Bringing WRN Research into Cat-Model Evaluation Work

WRN research also provides an educated opinion regarding return periods and tail hazard in a given region - based on objective data and peer-reviewed methodology.
Bringing WRN Research into Cat-Model Evaluation Work

- Case of an European country where model LOSS estimates are VERY different from each other
- If HAZARD is main driver behind these loss curves, one can make an *educated* choice on the model tail that better reflects risk in the country
Bringing WRN Research into Cat-Model Evaluation Work

Scenario Testing

What is the loss range from events similar to a certain historical storm?
Bringing WRN Research into Cat-Model Evaluation Work

Need to test how a client portfolio responds to events similar to a historical storm that has produced significant loss in the past.

WRN research provides a set of events with statistically similar hazard:
- applying a calibrated vulnerability curve to hazard from each event, results in a range of loss estimates.
Bringing WRN Research into Cat-Model Evaluation Work

Correlation

What is a reference correlation between events affecting different countries?
Bringing WRN Research into Cat-Model Evaluation Work

Need to assess model vendor simulations in terms of correlation of events between different countries

WRN model uses geostatistics in developing stochastic events, which directly considers correlation between locations (correlation is relative to the distance between the two locations)

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Conditional Probability ....

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Bringing WRN Research into Cat-Model Evaluation Work

Clustering

Can we validate clustering of events?
Validation of Clustering is difficult to carry out due to very limited data, so how can we evaluate models on this aspect?

The **WRN statistical catalogue** of events will be conditioned on particular atmospheric indices, like **NAO**, which are known to encourage clustering in Europe.

**NAO** = difference in surface sea level pressure between
- Subtropical High (Bermuda-Azores) and
- Subpolar Low

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[Diagram showing the positive and negative phases of the North Atlantic Oscillation (NAO)]
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- **North Atlantic Oscillation (NAO)**
  - **NAO-** (or blocked) leads to cold winters
  - **NAO+** gives more intense and faster moving storms and mild wet winters
  - Tendency for more clustering during NAO+

![NAO Negative Mode](image1.png) ![NAO Positive Mode](image2.png)

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- Currently there is development work taking place at Willis to create a new generation of **Willis Clustering**
- Among other improvements, geographic variations in degree of clustering will now be explicitly incorporated => more complete view on winterstorm overdispersion
- Need to maintain transparency and flexibility
Key Summary Points

- European windstorms represent a **very complex peril**, which makes it difficult to model, both in terms of WIND and in terms of FREQUENCY.
- **WRN Research** can shed light on particular aspects of European Wind Risk.
- Better evaluation and validation of cat-models can help our clients make more informed decisions regarding realistic risk in a specific country and the choice of model.
Thank You!