Swiss Re

European winter storm modelling: Challenges, solutions, open issues

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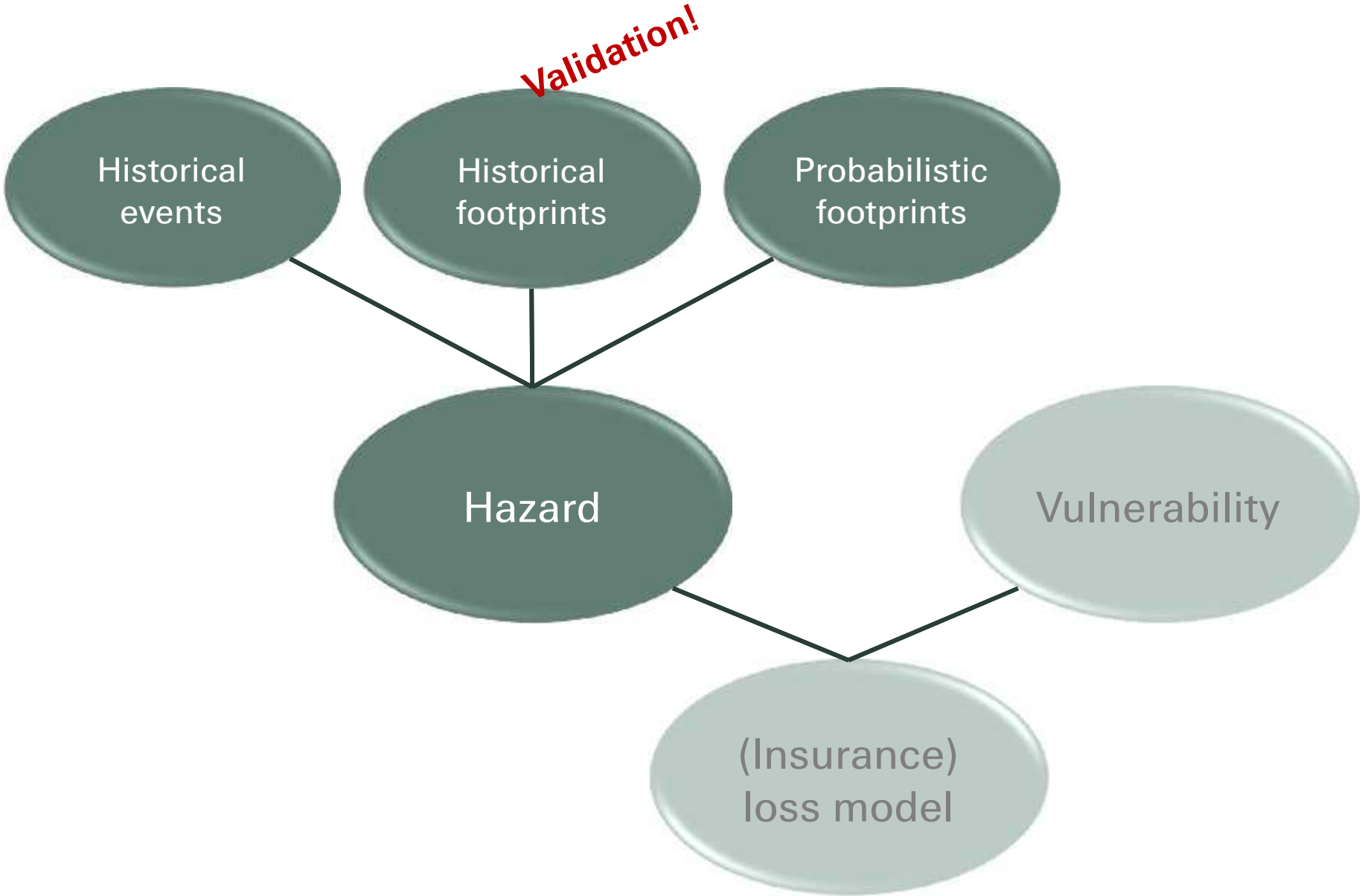
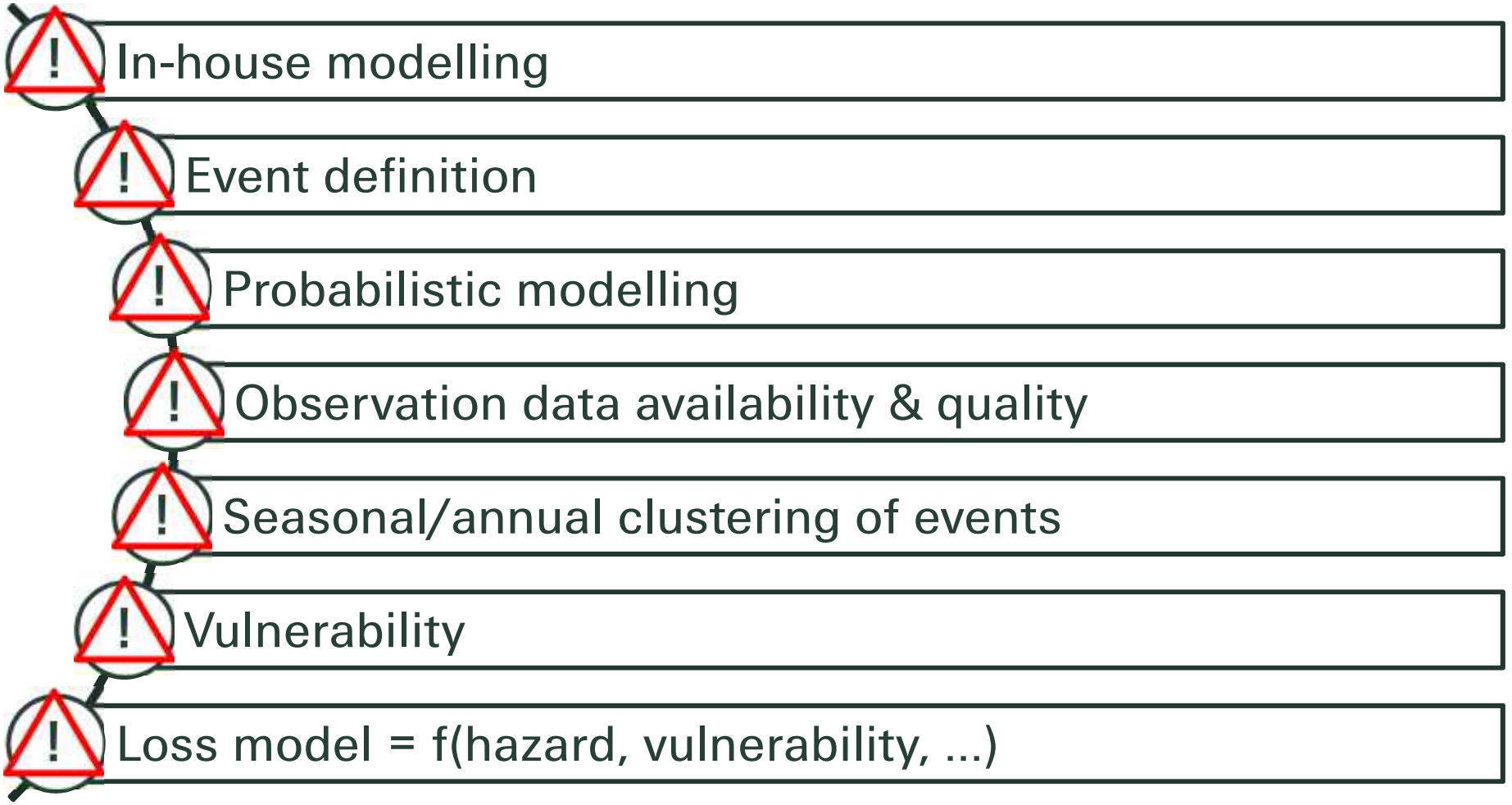
Components of a natural perils risk assessment model



Challenges


In-house modelling
Event definition
Probabilistic modelling
Observation data availability & quality
Seasonal/annual clustering of events
Vulnerability
Loss model = f(hazard, vulnerability, ...)

Challenge 0:
In-house modelling: Keep control anytime!

Fast

Economically

Lean 

Challenge 1:
Event definition

No accepted meteorological definition

No (consistent/complete) historical catalogue

No European weather agency

Windstorm tracking following Leckebusch et al. (2008)

Cyclone tracking following Wernli & Schwierz (2006)

Applied to reanalysis data (20th Century Reanalysis in our case)

Allows defining events in time and space

Prepares ground for probabilistic modelling

Challenge 2: Probabilistic modelling

The history is not enough!

Simulation of thousands of physically consistent events

Parameterisation hardly possible (in contrast to Tropical Cyclones)

GCMs (long runs or specific events):

- Very resource demanding
- Availability? Spatial resolution? Systematic biases? Consistency with history?

Seasonal/decadal hindcast ensembles

- Availability? Spatial resolution? Systematic biases? Consistency with history?

Perturb (observed) historical footprints

- Physically consistent?

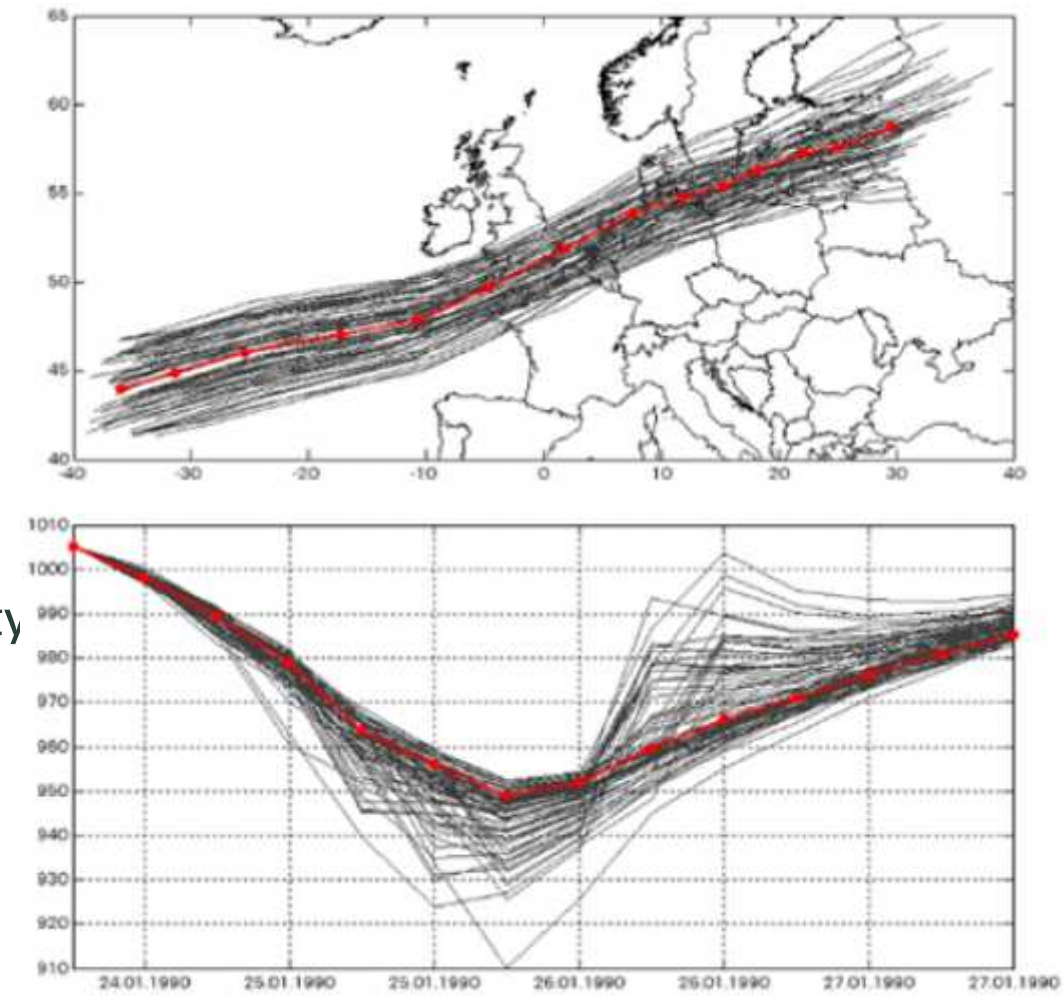
Challenge 2:
Probabilistic modelling: History is not enough!

Identification of historical events in 20th Century Reanalysis (Daria 1990 as example in red)

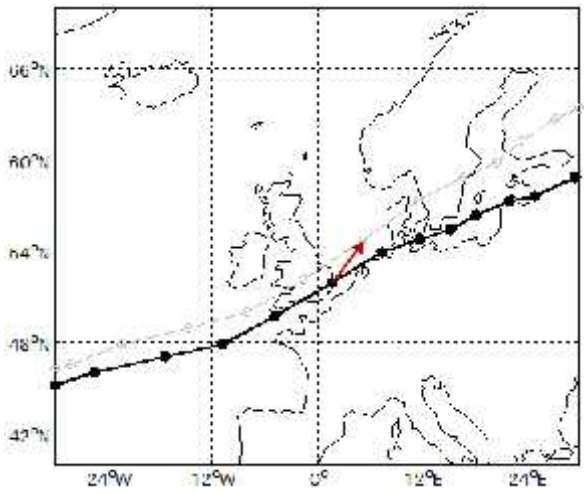
Perturbation of both track (top) and intensity (bottom) to produce probabilistic “sibling” events (grey)

Perturbation takes local historical climatology into account!

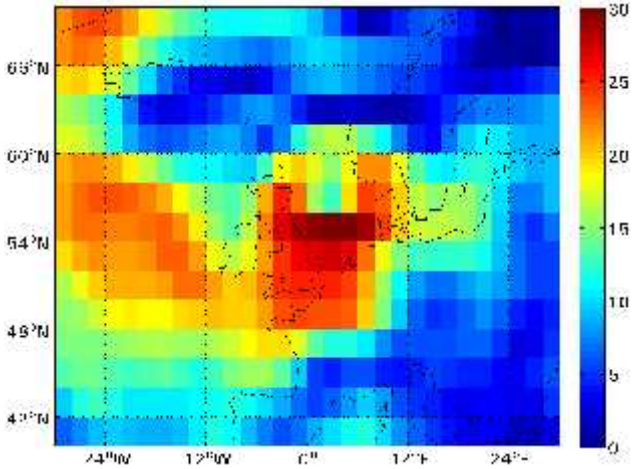
Relative shift of position and intensity defines properties of probabilistic “sibling” (next slide)



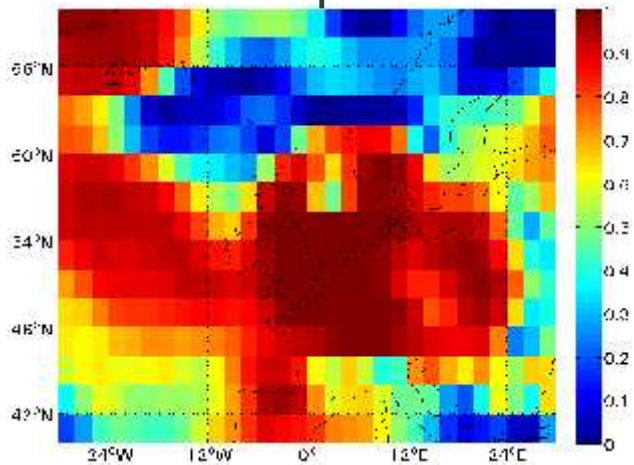
Challenge 2:
Probabilistic modelling: History is not enough!



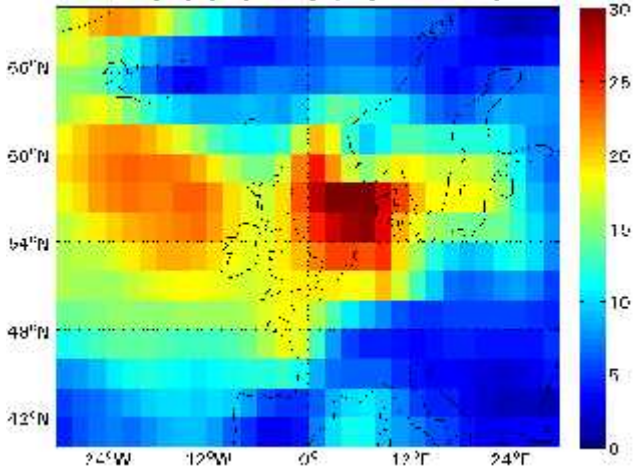
Historical wind



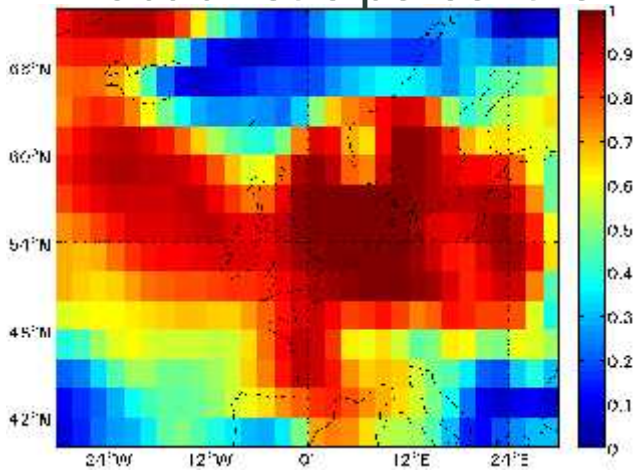
Historical percentile



Probabilistic wind

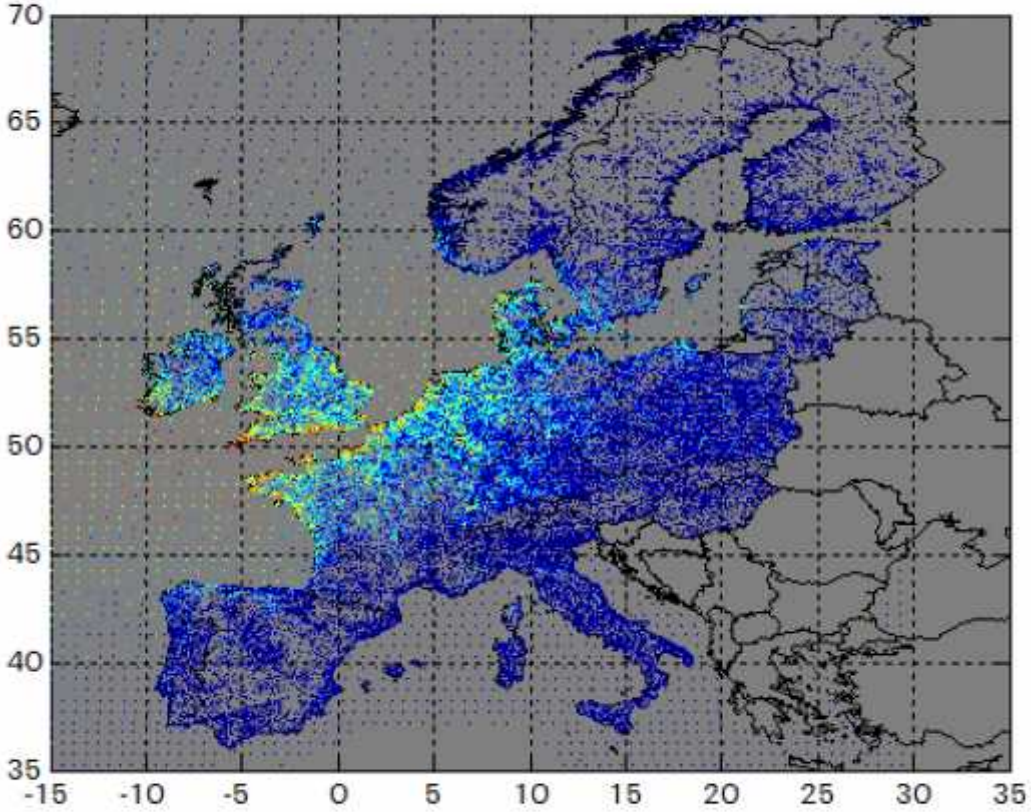


Probabilistic percentile

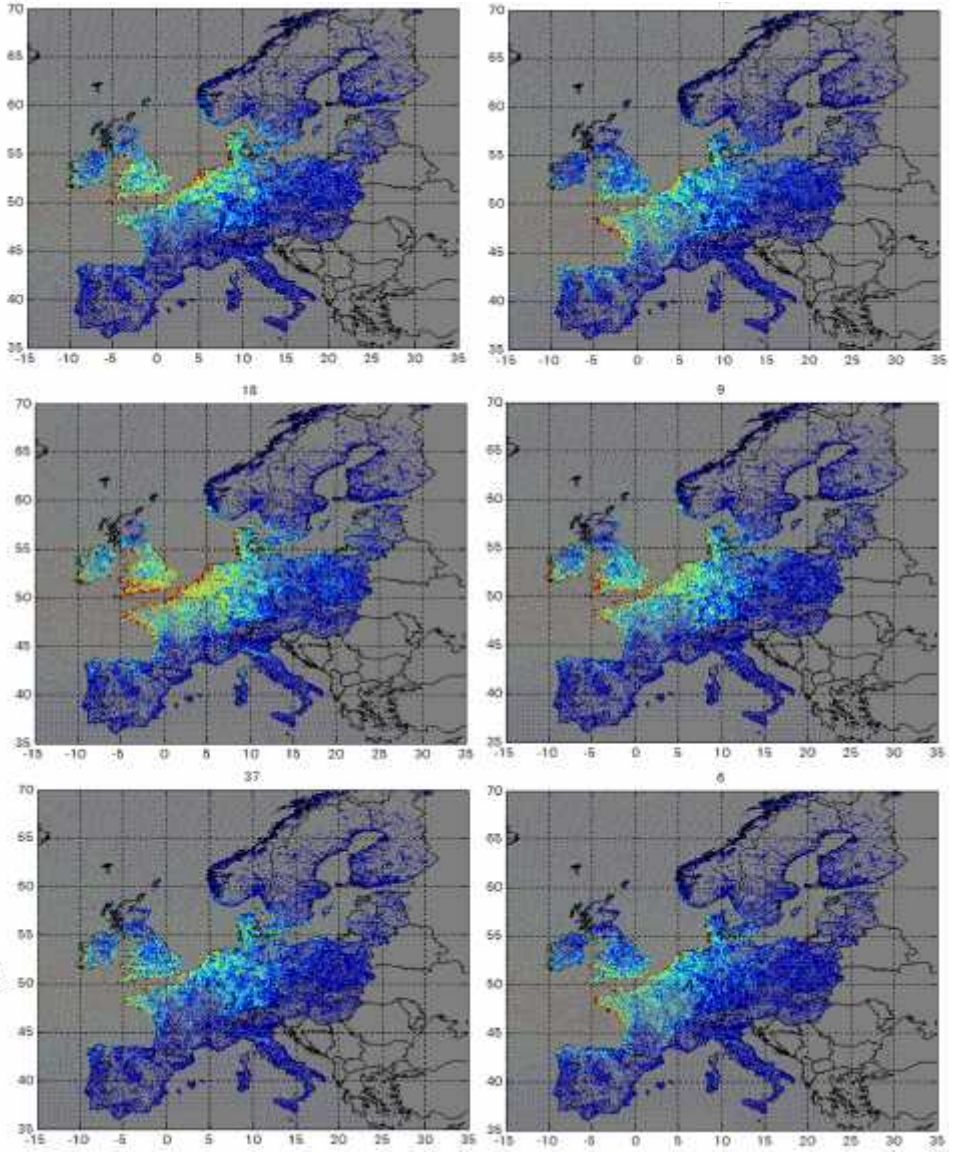


Challenge 2: Probabilistic modelling

Historical WS Daria 1990



Probabilistic siblings of Daria



Challenge 3:
Availability & quality of peak gust observations

Generally only until ~1970s

Prone to inconsistencies (obs devices and practice, changes of surroundings, ...)

Low density of measurement network

Restricted access and use (e.g. NOAA's Global Summary of the Day, ECA&D)

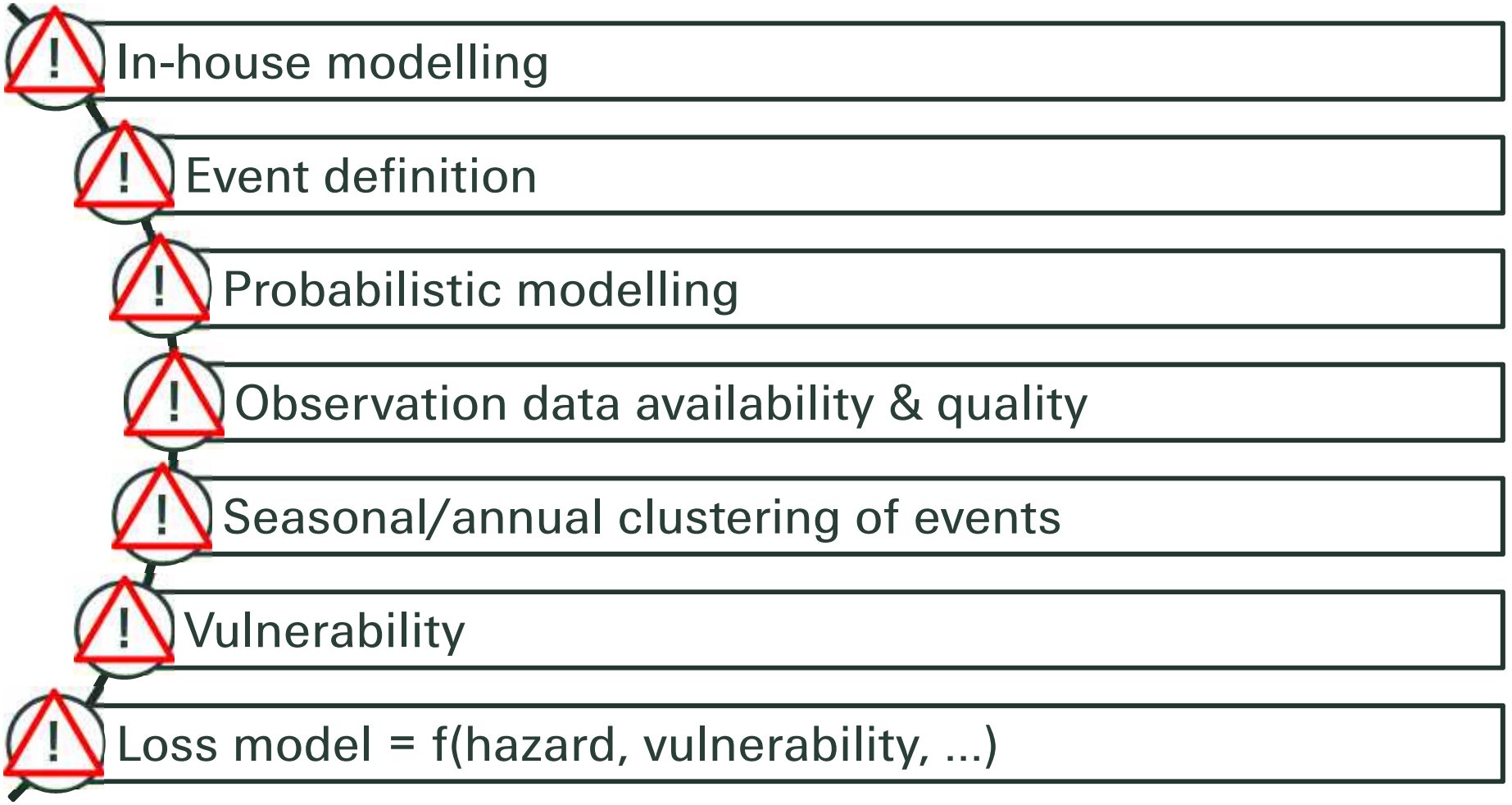
Purchase sometimes very expensive and very cumbersome

Open access policies: e.g. DWD, KNMI, Norwegian weather service

Using climate models allows generalisation of validation findings

Use any other validation data (e.g. gust return period maps)

Challenges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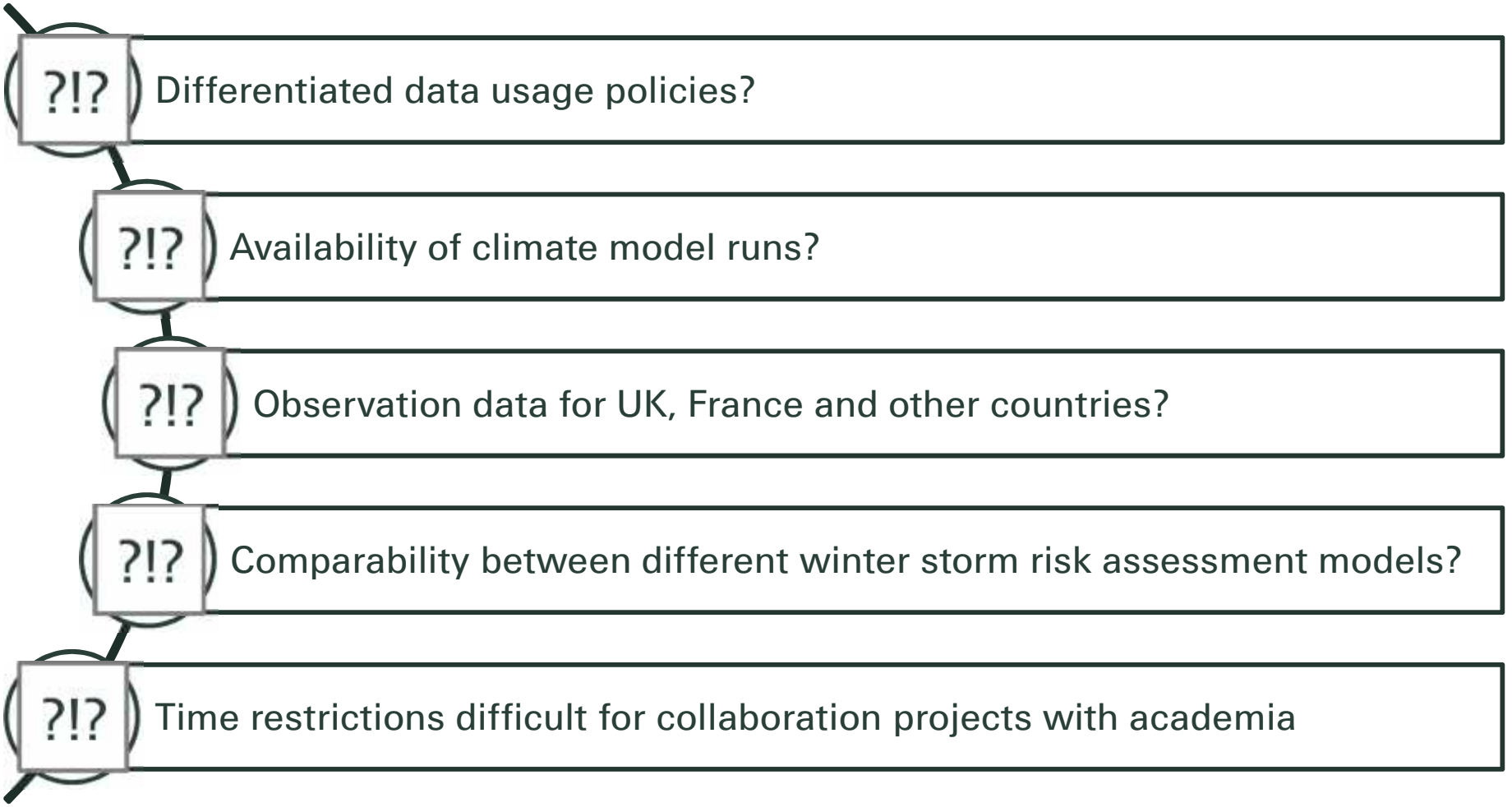
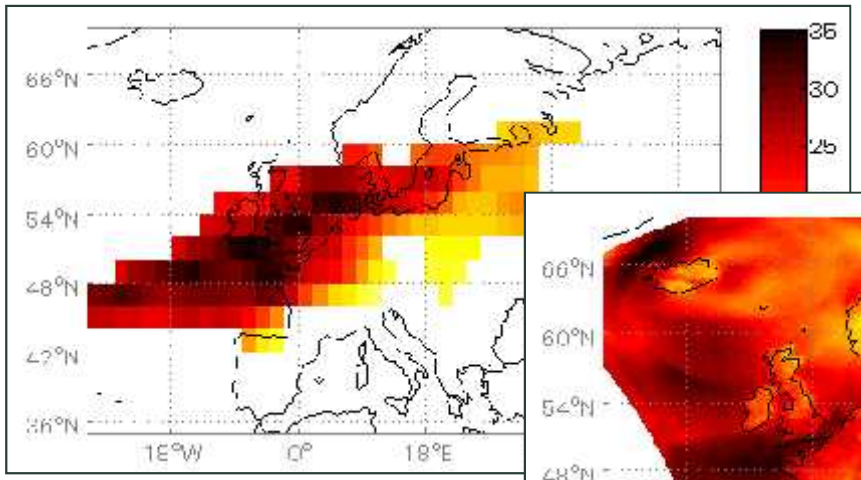
Open issues


?!?
Differentiated data usage policies?
?!?
Availability of climate model runs?
?!?
Observation data for UK, France and other countries?
?!?
Comparability between different winter storm risk assessment models?
?!?
Time restrictions difficult for collaboration projects with academia

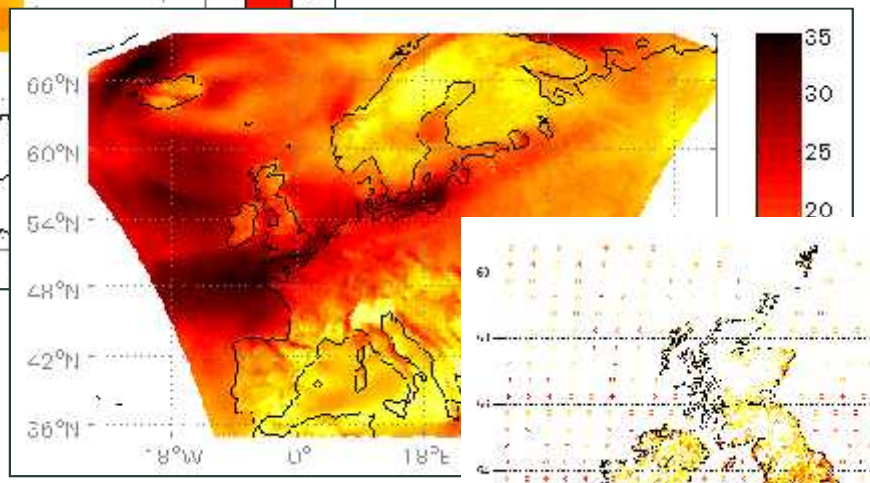
Reproduce footprints of historical events
Downscaling: From continental to local scale

Multiple-linear regression (Haas et al. 2012)

20CR footprint (2x2°)



RCM footprint (25 km)



Distance-weighted average

CalculationUnits (~10 km)