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Reading

A century-long European windstorm catalogue as a tool for model benchmarking in reinsurance

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SCOR The Art & Science of Risk | P&C

PhD with Météo France on European windstorms

- 3.5 years project, started in April 2014
- Building an historic catalogue of European Winter Storms from the beginning of the 20th century from ECMWF.
- Most vendor models cover only since 1970s
- Based on long term reanalysis ERA-20C

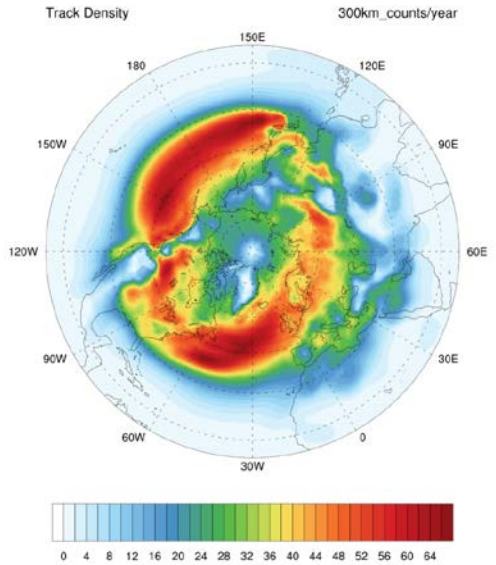
- The tracking algorithm follows the maximum vorticity (125x125 km resolution)
- Only keep tracks larger than 600 kms and 12 hours

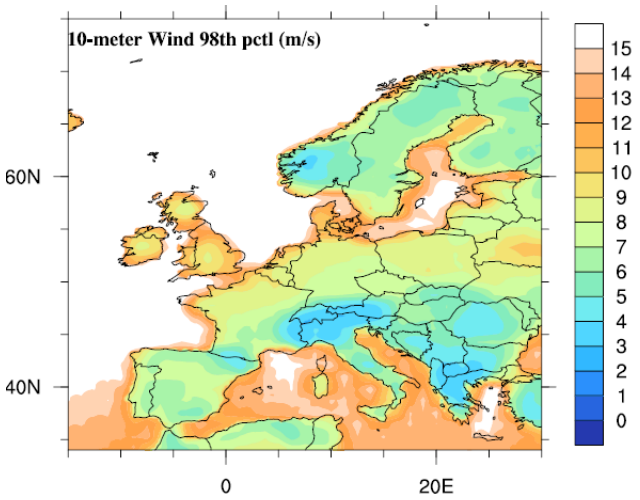
- To convert it to a economic loss we scale the wind speed at 10m (25x25 km resolution) with the population and only keep the top 2% of vorticity.

Pinto et al. 2012

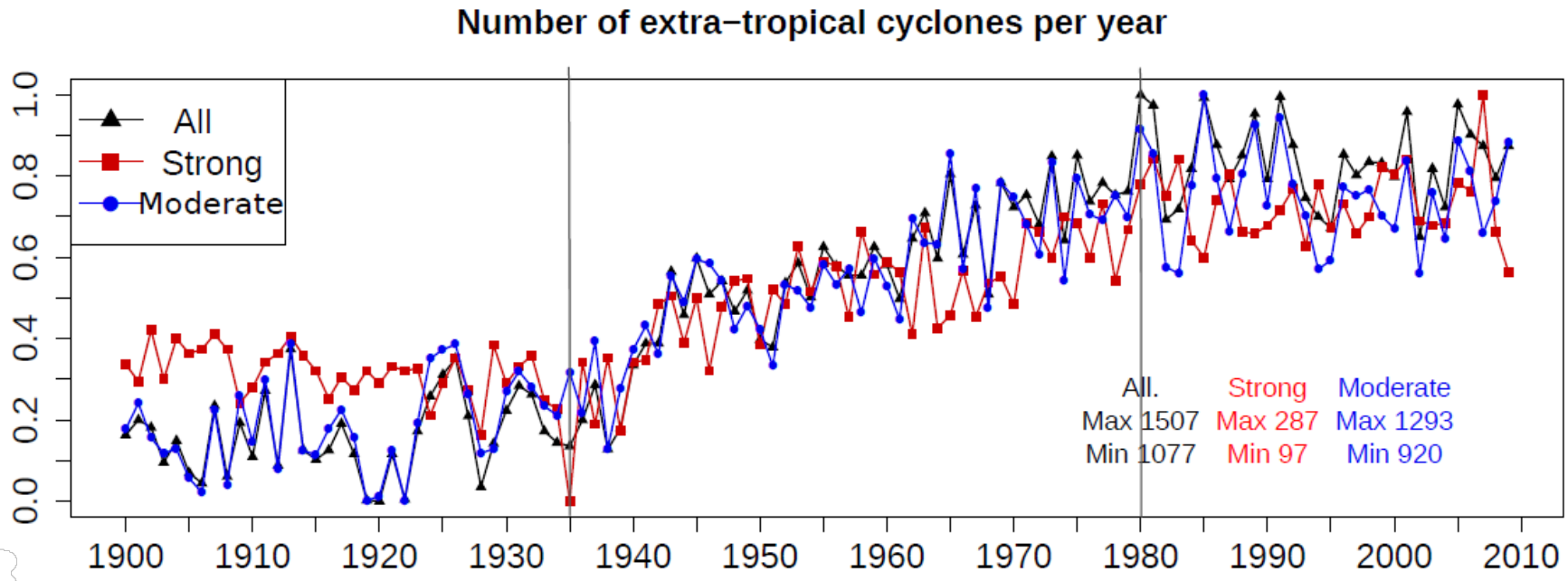
$$LI\_1(i,j,t) = \left(\frac{V_{ij}(t)}{V_{98_{ij}}}\right)^3 I_{(V_{ij}(t),V_{98_{ij}})} P_{ij}\ L_{ij} \qquad (1)$$

- We obtain a catalogue to benchmark vendor model results and assumptions including clustering and cross-country correlation





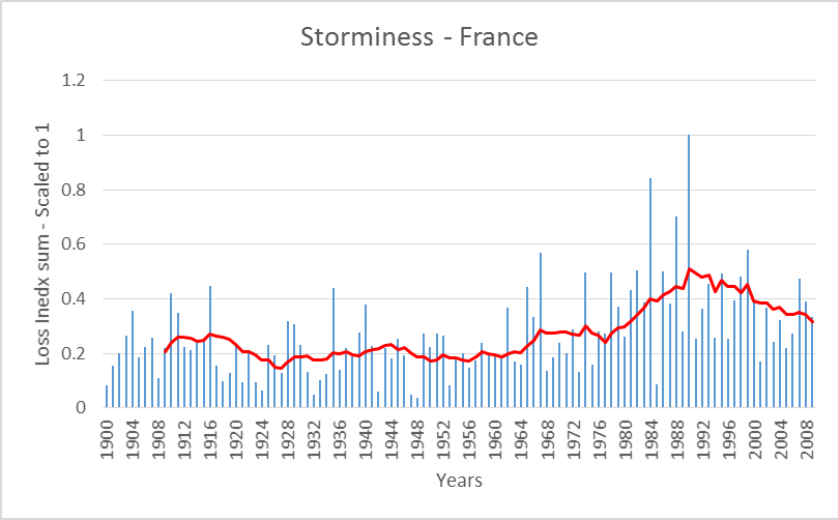
PhD with Météo France: number of storms per year (worldwide)

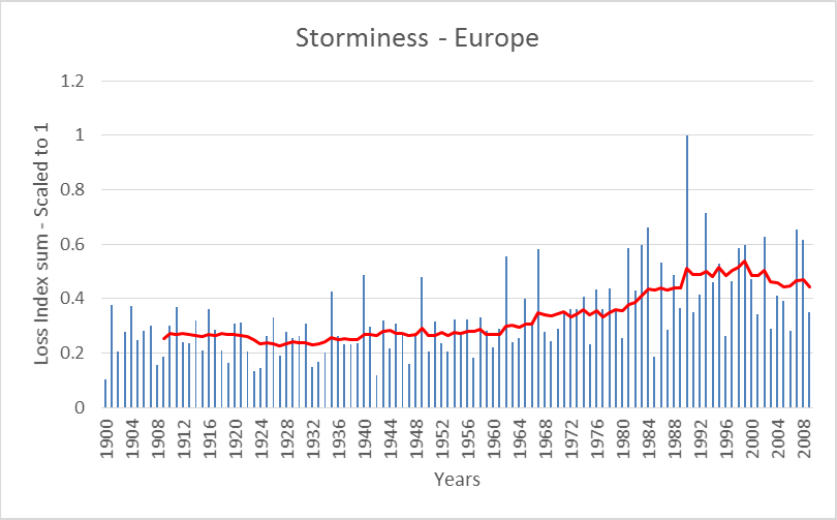


- 3 distinct trends :
  - 1900 – 1935: overall stability
  - 1935 – 1980: worldwide increase
  - 1980 – 2010: back to stability
- The observed trends are in agreement with trends in baroclinicity and large scale variability.
- Article submitted to Climate Dynamics, currently under revision

PhD with Météo France: challenging climate variability

- Measurement of storminess in terms of Lisum (integrated LI over France mainland when a storm is at less than 500km from France)
- The storminess is on a decreasing trend in the last 25 years, but the trend is weaker in Europe than in France, and overall the mean of the last 42 years



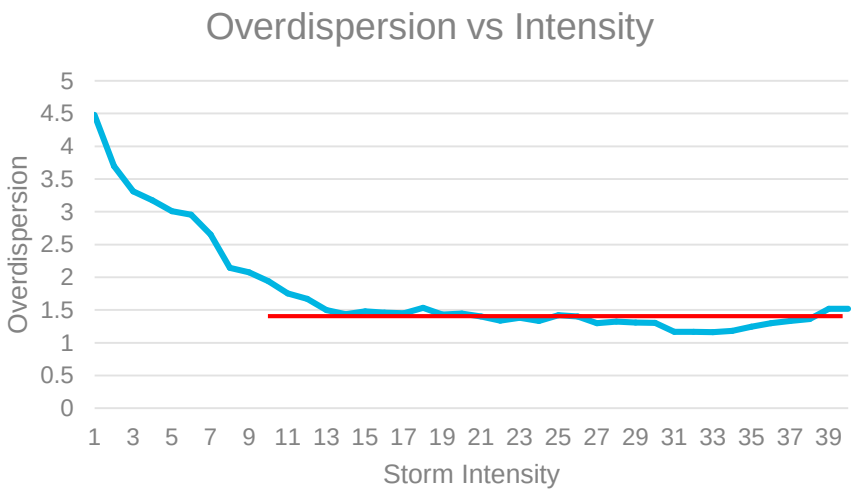


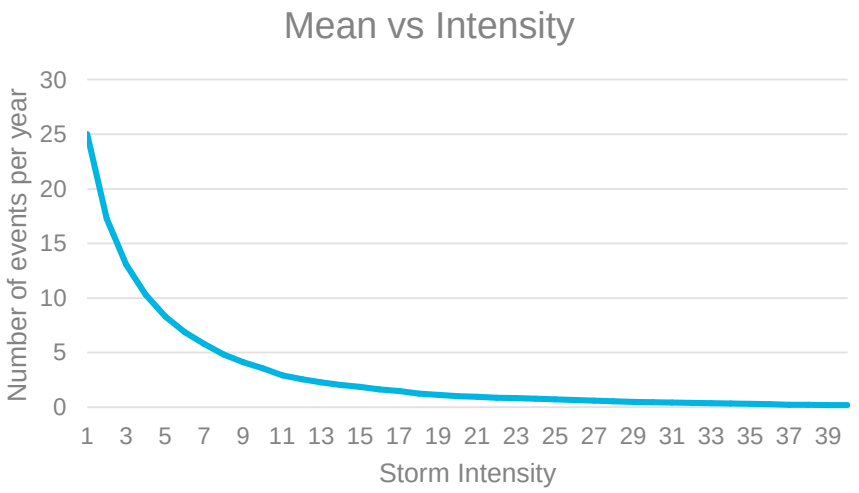
- In disagreement with some vendor models, which assume the last 25 years less damaging than the last 40 years.

PhD with Météo France: challenging Overdispersion parameter

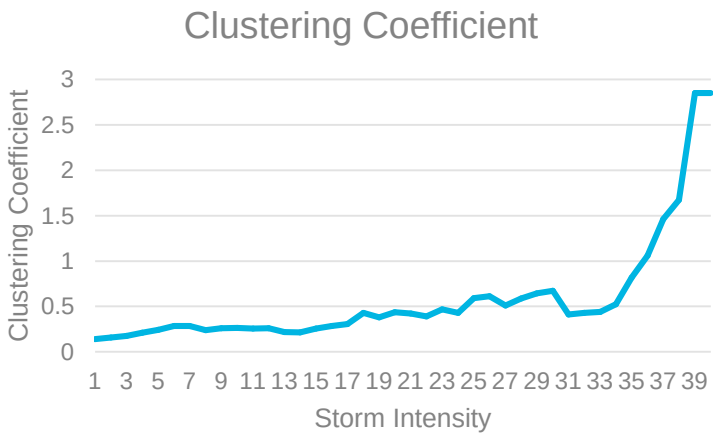
- Overdispersion as a metric for clustering is highly influenced by the intensity threshold
- We still see an asymptote for extreme events around 1.5

$$Overdispersion = {Variance}/{Mean}$$

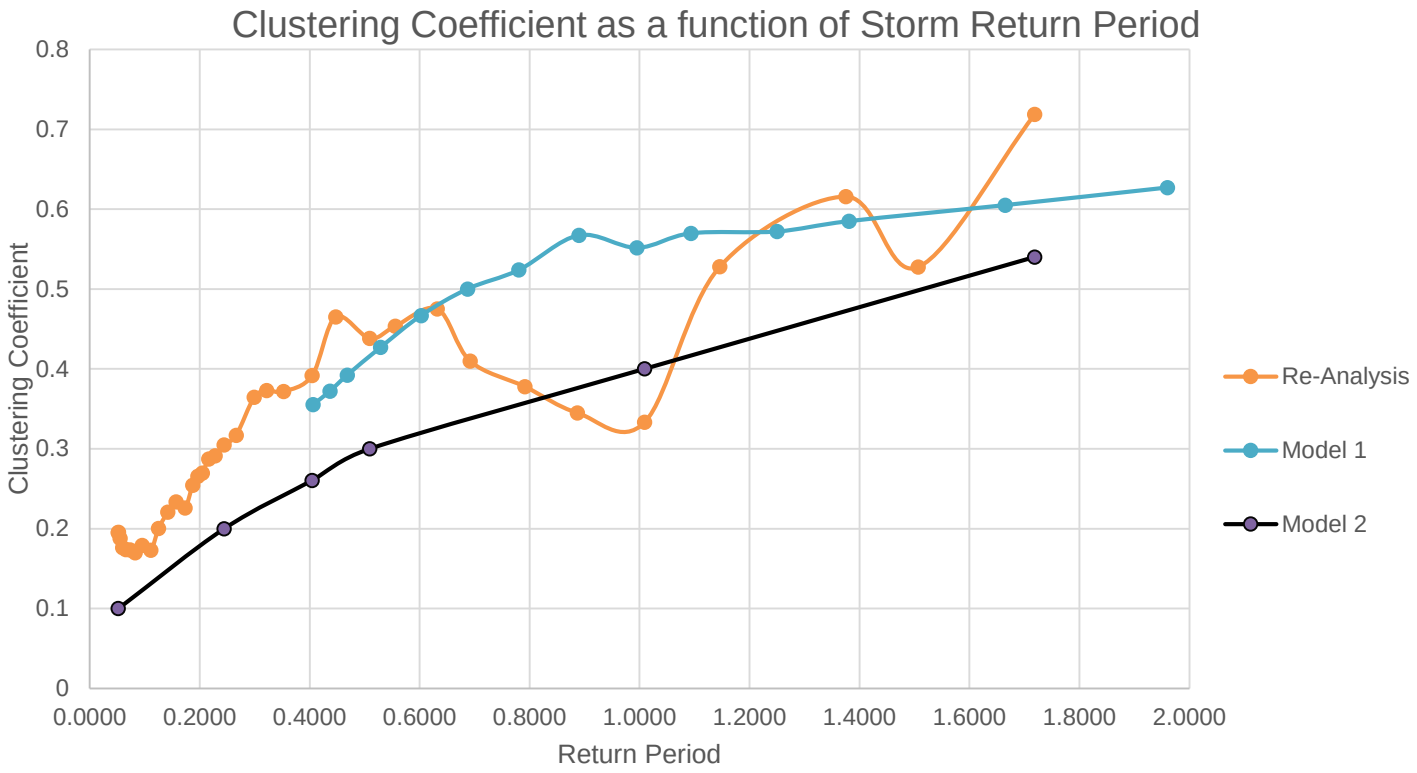




- Clustering coefficient to remove dependence on Mean
- $CC = \frac{Overdispersion - 1}{Mean}$
- When using this metric, clustering increases with intensity



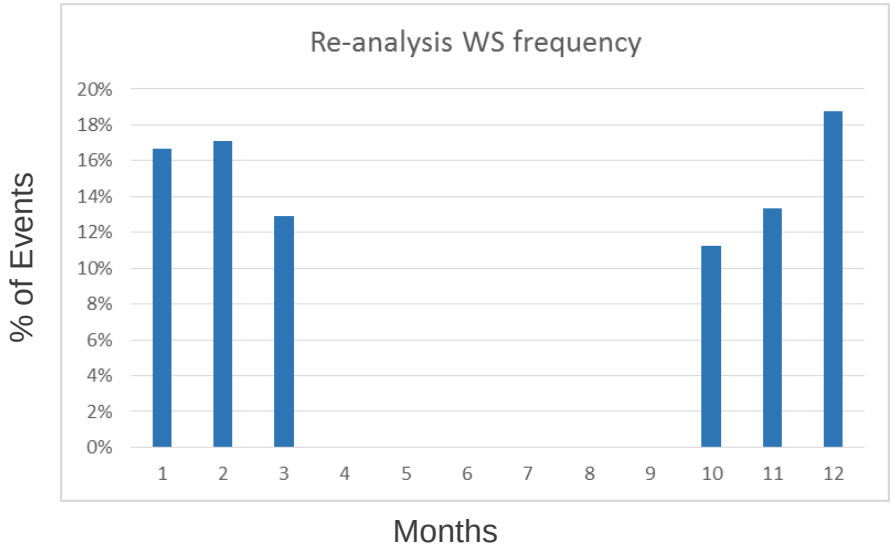
PhD with Météo France: challenging clustering assumption

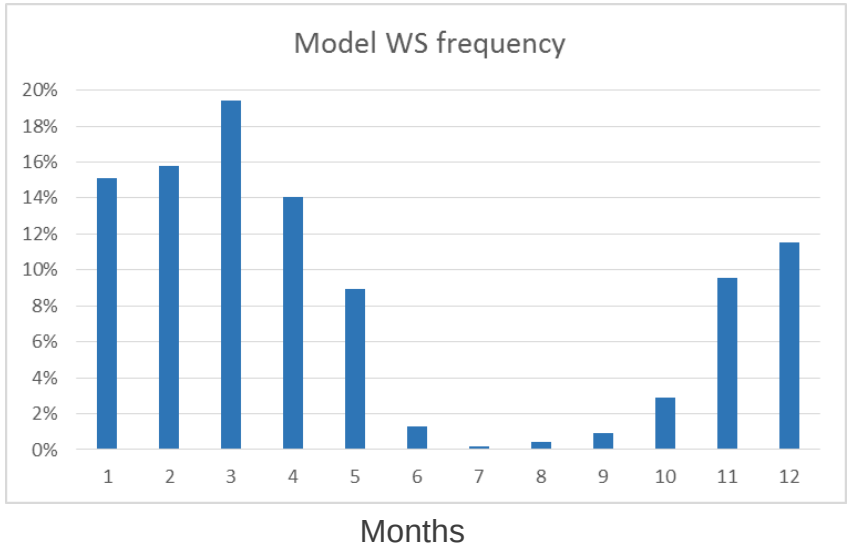


- Return Period: threshold above which we keep the storms to compute the clustering coefficient
- At low RP where we have observations, vendor models seem adequatly calibrated with regard to clustering

PhD with Météo France: challenging seasonality

- Strong hypothesis of seasonality for windstorms in models.
- We can challenge those with the frequency derived from historical data
- We find a strong discrepancy in March, April and May are not in the scope of the catalogue, but the model frequency seems too high in those months





- This is of importance when pricing less than one year contract

PhD with Météo France: challenging cross-country correlation

- Germany has the highest correlation with Europe, followed by Benelux, France and the UK

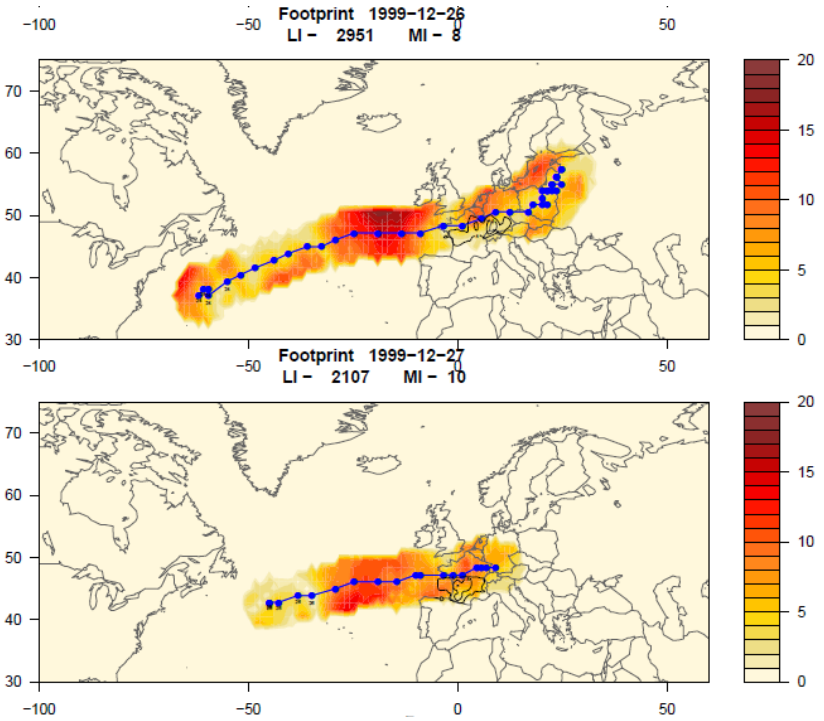
Model Cove	Europe	Austria	Belgium	Denmark	France	Germany	Ireland	Luxembourg	Netherlands	Norway	Sweden	Switzerland	UnitedKingd	Poland
Europe														
Austria	29%													
Belgium	68%	12%												
Denmark	22%	6%	5%											
France	65%	12%	23%	1%										
Germany	86%	35%	73%	12%	33%									
Ireland	38%	4%	14%	5%	9%	20%								
Luxembourg	49%	12%	44%	2%	39%	51%	4%							
Netherlands	72%	14%	60%	8%	15%	73%	34%	21%						
Norway	5%	-2%	0%	23%	-2%	1%	1%	-1%	2%					
Sweden	12%	2%	1%	60%	0%	4%	0%	0%	2%	36%				
Switzerland	38%	22%	14%	1%	45%	26%	3%	17%	9%	-2%	-1%			
UnitedKingd	64%	8%	36%	11%	19%	41%	71%	14%	58%	3%	2%	8%		
Poland	34%	28%	16%	20%	5%	43%	11%	10%	27%	2%	15%	3%	16%	
Czech Repu	45%	54%	24%	8%	14%	58%	8%	22%	31%	-1%	3%	11%	16%	55%

PhD Study	Europe	Austria	Belgium	Denmark	France	Germany	Ireland	Luxembourg	Netherlands	Norway	Sweden	Switzerland	UnitedKingd	Poland
Europe														
Austria	41%													
Belgium	76%	12%												
Denmark	50%	9%	31%											
France	72%	17%	71%	17%										
Germany	87%	33%	71%	45%	53%									
Ireland	39%	15%	33%	20%	25%	24%								
Luxembourg	72%	14%	82%	24%	75%	73%	25%							
Netherlands	77%	12%	87%	42%	55%	77%	34%	68%						
Norway	22%	3%	9%	40%	4%	13%	12%	6%	13%					
Sweden	32%	4%	15%	59%	6%	23%	12%	12%	22%	68%				
Switzerland	61%	39%	42%	11%	64%	55%	12%	52%	36%	0%	0%			
UnitedKingd	67%	5%	62%	38%	46%	49%	66%	47%	65%	18%	21%	24%		
Poland	55%	35%	22%	45%	10%	54%	7%	22%	29%	19%	32%	16%	17%	
CzechRepul	59%	61%	27%	29%	17%	65%	7%	29%	32%	9%	16%	31%	17%	75%

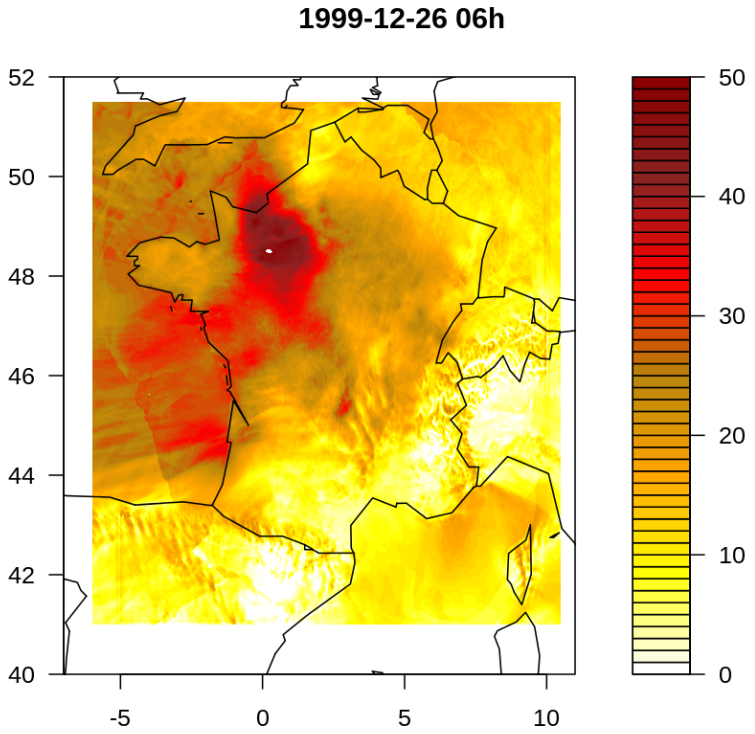
- Model and ERA-20C are mostly in agreement

PhD with Météo France: historical footprints

ERA-20C 10-meter maximum windspeed:



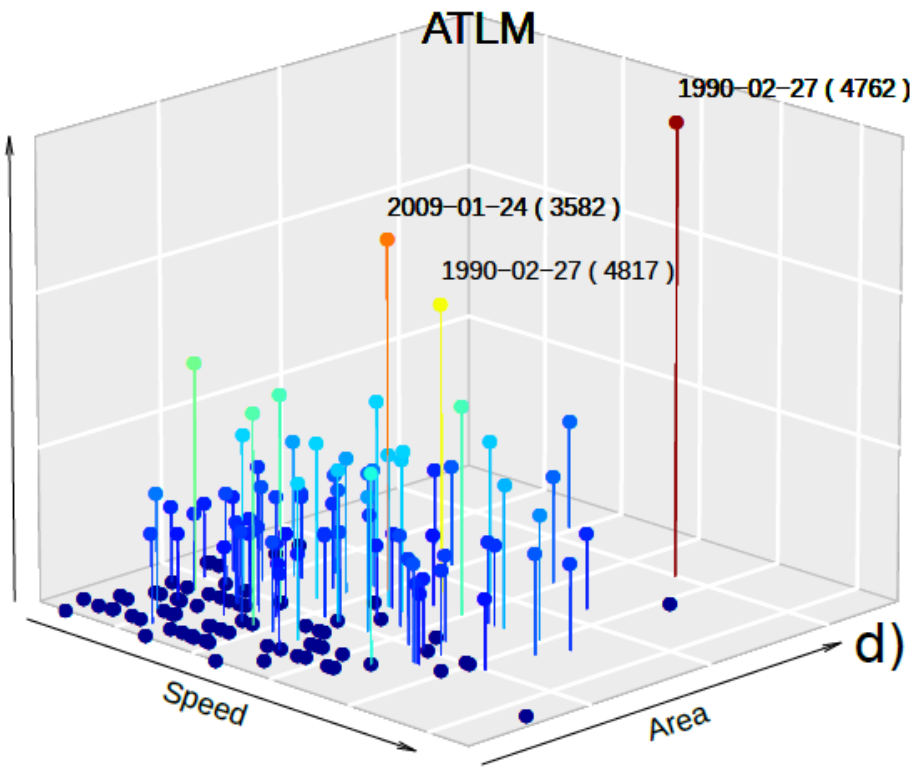
Observed gust from observations+AROME model



- Clear underestimation of Lothar in the reanalysis

PhD with Météo France: analysis of historical storms

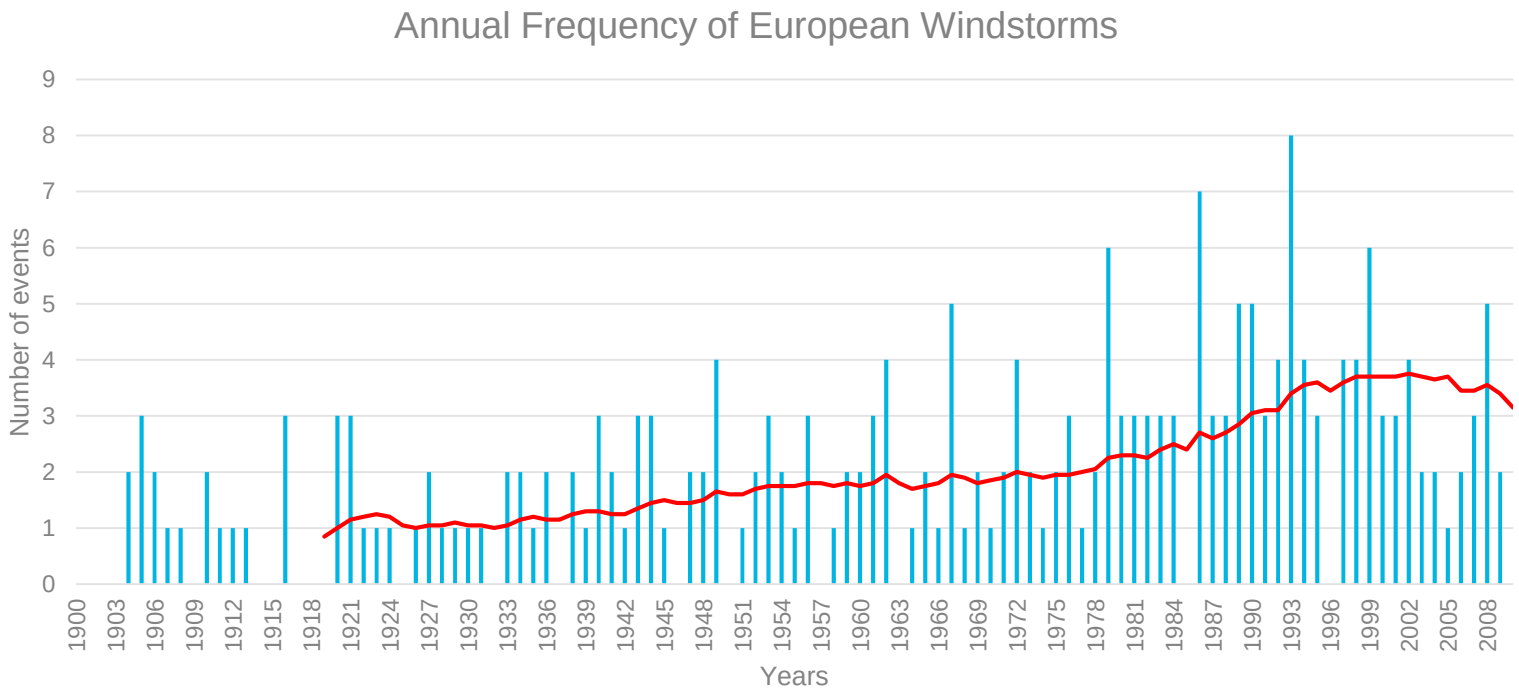
- Lothar underestimated in the reanalysis: spatial and temporal resolution of the reanalysis incapable of representing the strength of the storm, particulary over very exposed regions
- 1990s windstorms seems to be among the largest of the century



Area: number of France mainland grid points with LI>0

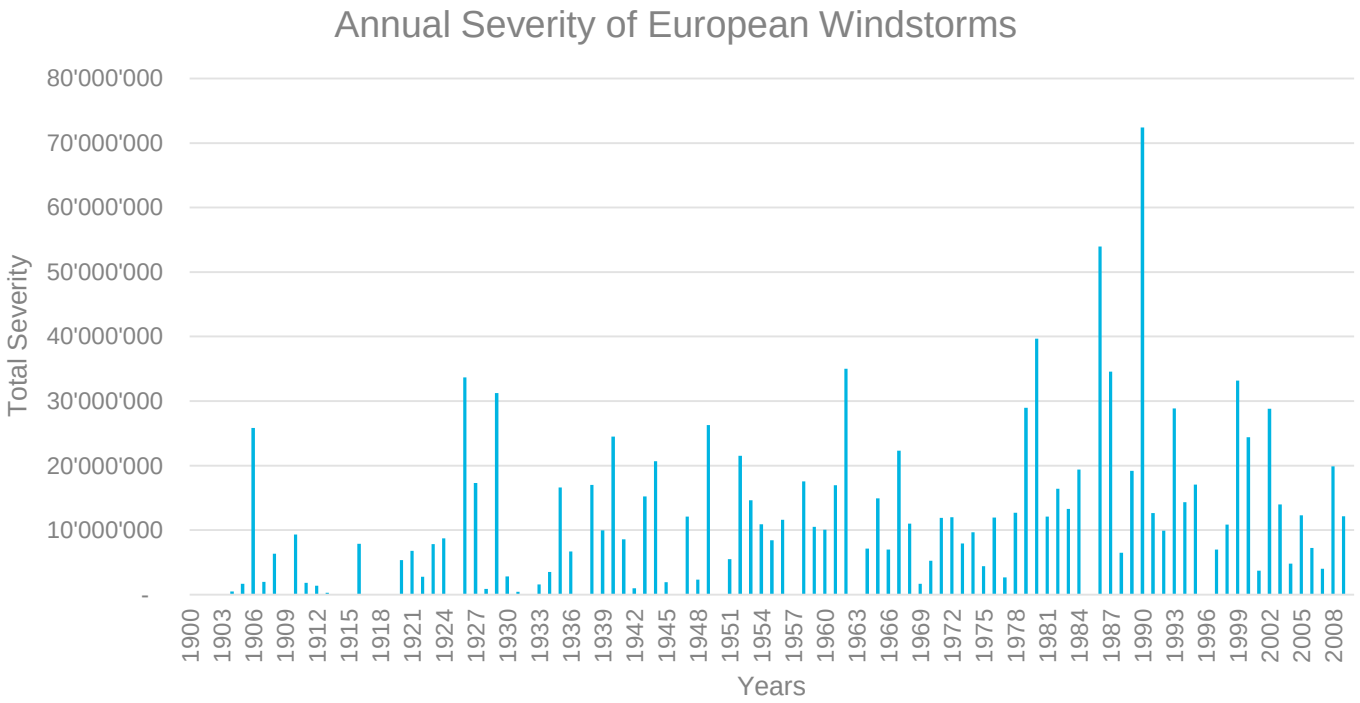
Speed: mean displacement speed of a storm when at less than 500km from France

Frequency analysis at European level



- Up to 8 windstorms per year of medium to high intensity
- Some vendor models generate up to 50 high intensity storms in a year!

Severity analysis at European level



- 1990 highest damaging year of the century ?
- Underestimation of 1999, overestimation of 1986 (with regards to economic losses)
- Calibration needed to correlate insurance losses and reanalysis proxy losses

Conclusion and perspectives

- Wind is the first damaging peril in Europe for the reinsurance sector
- A joint PhD between Scor and Meteo France to investigate the topic deeper
- First study with ERA-20C, which covers the whole century
- Increasing trend in number of windstorms for the period 1935-1980
- Loss index defined as a proxy for losses
- Independent dataset used to benchmark vendor models on various criteria:
  - Seasonality
  - Clustering
  - Country Correlation
- Help SCOR to infer view of the risk
- Some bias in our data which requires further calibration
- Perspectives of this work include :
  - Extension to 18 countries over Europe
  - Classification of winter storms based on trajectories and position relative to the jet stream