Understanding the Risk from Correlated Windstorms and Floods in the UK

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A Thought Experiment

References

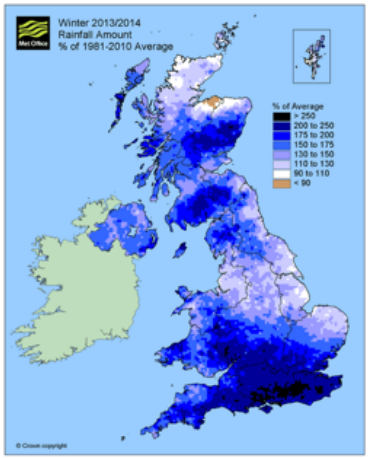
1. The Great Storm of 1987, RMS Special Report.
2. U.K. Environment Agency

Great Storm of 1987

£2bn [1]
(£5.526bn today)

+

Floods of winter 2013/14



£1.3bn [2]

= ?

Could extreme wind and flood events occur in tandem?

Are the two physically linked?

What are the implications for the insurance industry?

Presentation Outline

1. Project Overview
2. Methods
3. Spatial patterns in correlations between windstorm and high river flow
4. Large scale atmospheric drivers of compound events
5. When do compound events occur?
6. Summary

Project Overview

- **Collaborative** 2-year project venture between **Reading University** and insurers at **Lloyds Banking Group**
- Will use a combination of observations/reanalysis/climate simulations to understand the **risk in correlated flood and windstorms** in order to **prepare** for an **extreme compound event**
- Very little literature on this subject

  (Hillier et al. 2015, De Luca et al. 2017**, and not much else!**)
- Big problem for the Insurance industry, who currently do not know what to do. Any correlation will effect capital requirements.

Correlations in River Flow and Wind: Method

Data:

- ERA5 10m wind speed
- NRFA river gauge data
- 1979-2015

Method:

1. Choose a sample of locations
2. Filter river peak over threshold (POT)
3. Choose max wind and max flow during POT.
4. Extra filters (e.g. event proximity)

Example plot

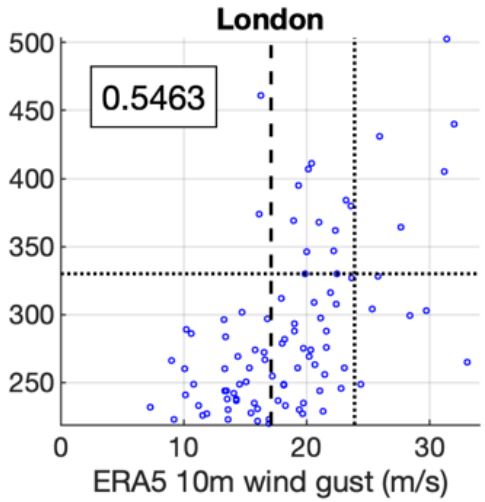
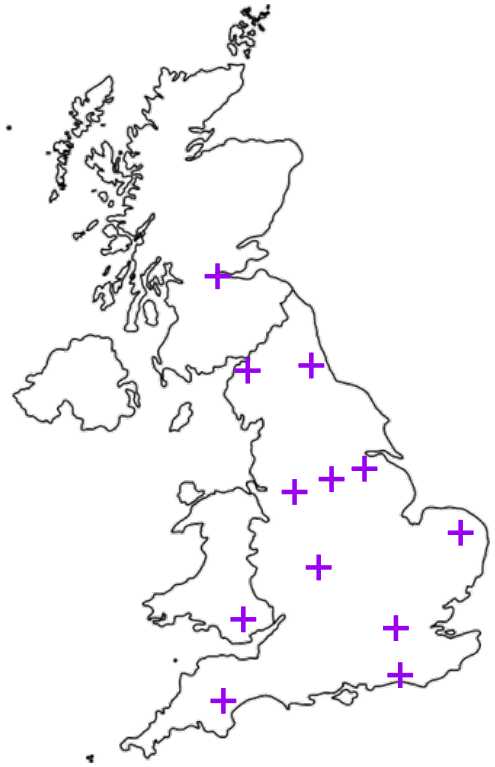
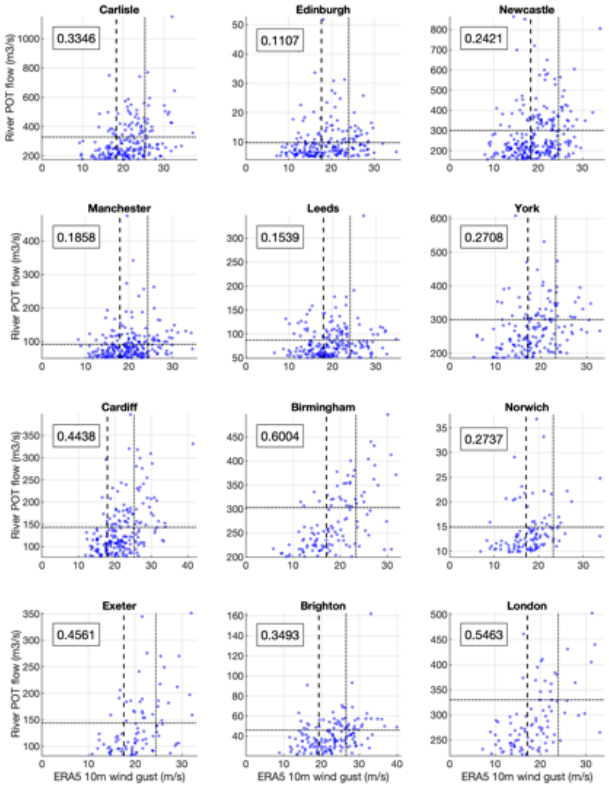


Figure:
Scatter plot of NFRA maximum POT flow and ERA5 **maximum 10m wind gusts** for London (Kingston), 1979-2015.
Dashed lines show 99th percentile. Spearman correlation coefficient is printed in the top left.

Correlations in River Flow and Wind





Compound events (high river flow, high windspeed) appear in top right of each panel.

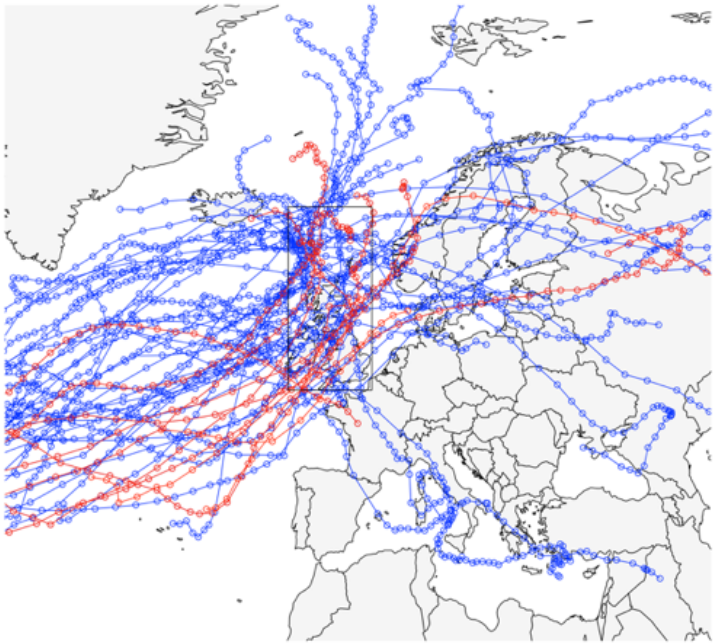
Larger correlations in South West.

Large scale atmospheric drivers of compound events

Extract all compound events, plot associated storm tracks (all storms which hit the UK during high river flow period)

Example Figure: Oct-Mar UK Storm tracks for winter 13/14 a particularly wet winter which resulted in flooding in the South East.
Blue lines = "normal" storms
Red lines = storms which led to compound events

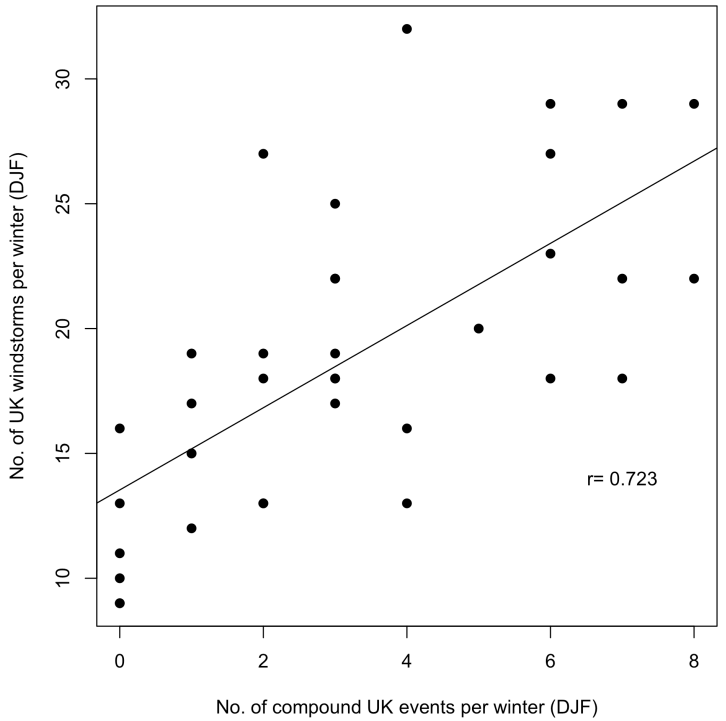
Repeat for all years in timeseries.
Find no real pattern in compound event storm tracks.



When do compound events occur?

Figure: Scatter plot of the number of DJF all storms and compound storms by year (1979-2015)

Generally, it is more likely that a compound event will occur during a stormy season.



The seasonal variation in compound events

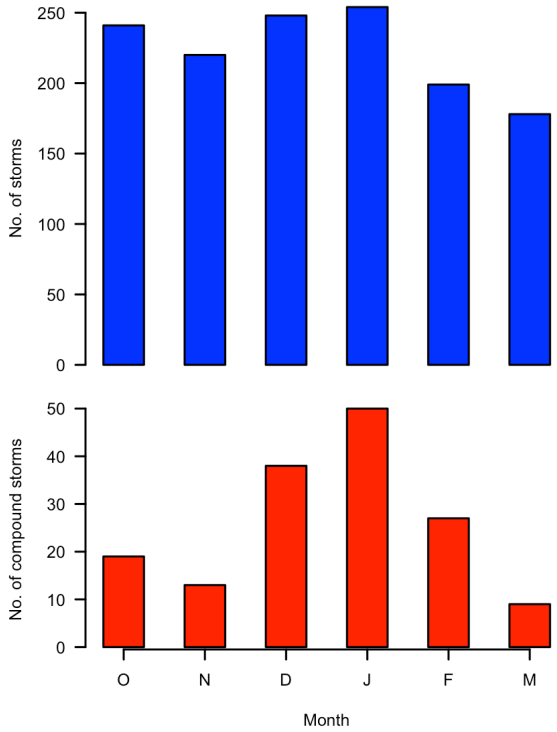


Figure: The seasonal variation in the number of UK storms and UK storms which lead to compound events .

Blue = "normal" storms

Red = storms which led to compound events

Compound events tend to occur in December and January - the height of windstorm season (as seen in the blue bars) and long enough into winter for considerable rainfall accumulations

Summary

1. We have undertaken a research project with insurers at Lloyds Banking Group to asses the **risk of compound windstorm and flood**.

2. We have investigated **correlations in wind and stationed river flow** and found modest correlations in the South and West UK.

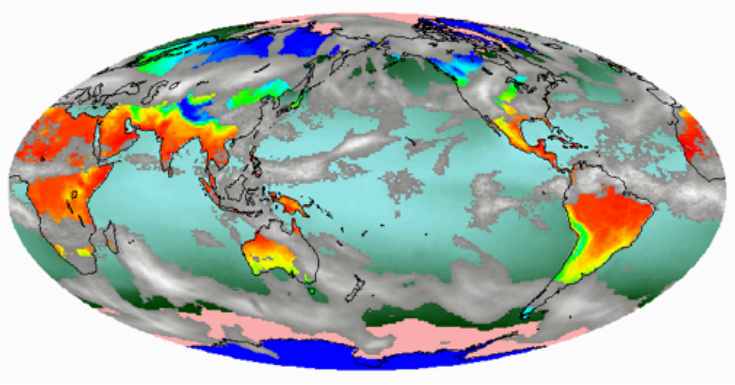
3. Analysis of UK storm tracks allows permits analysis of the large-scale atmospheric drivers of compound events. No particular preferred path for the storms associated with compound wind and flood events is found.

4. However, compound events appear to be moderated by the storminess of any given winter.

Future Work

1. Find the physical mechanism that leads to extreme compound events

2. Use a very long timeseries (~1000 years) of precipitation from a climate model (HiGEM) to examine the correlation in very extreme events.



University of Reading

LLOYDS BANKING GROUP

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

Thanks!

Get in touch:
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