



Lancaster
Environment Centre



An assessment of the probability of extreme flood flows from a national perspective: evidence supporting the National Flood Resilience Review

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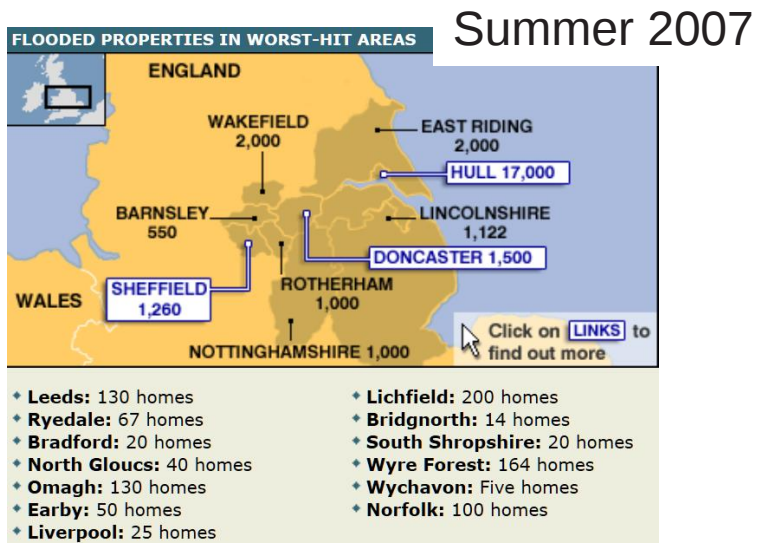
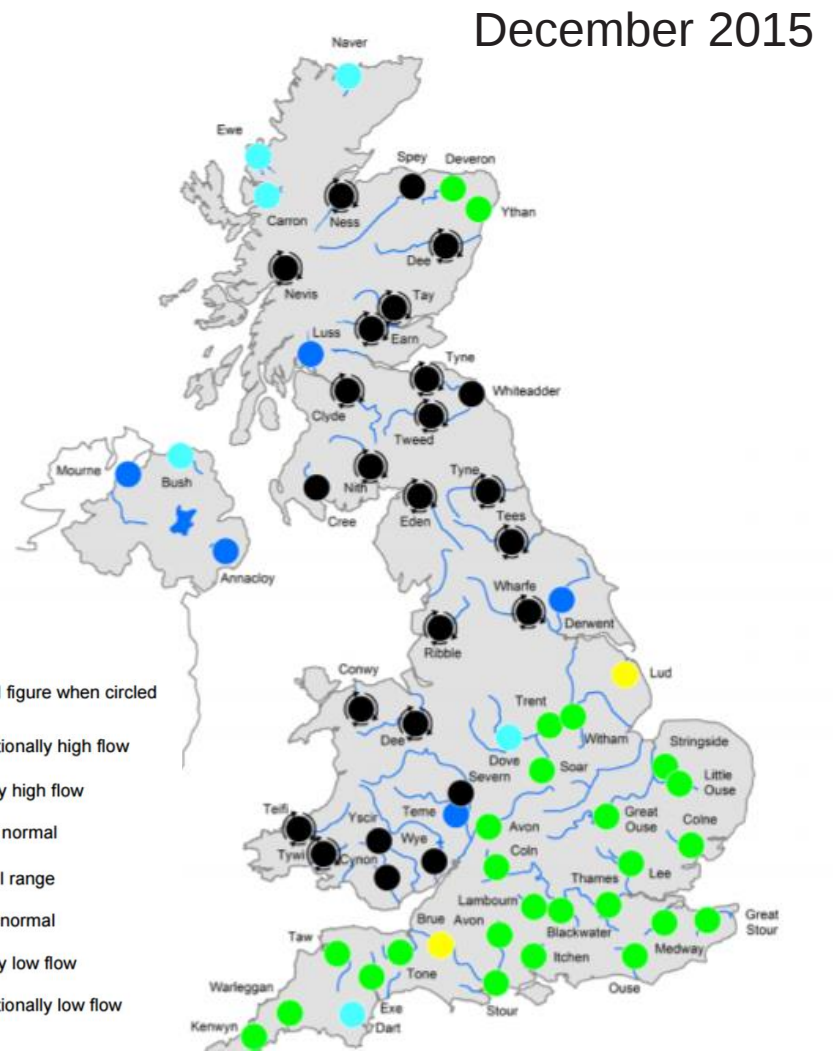
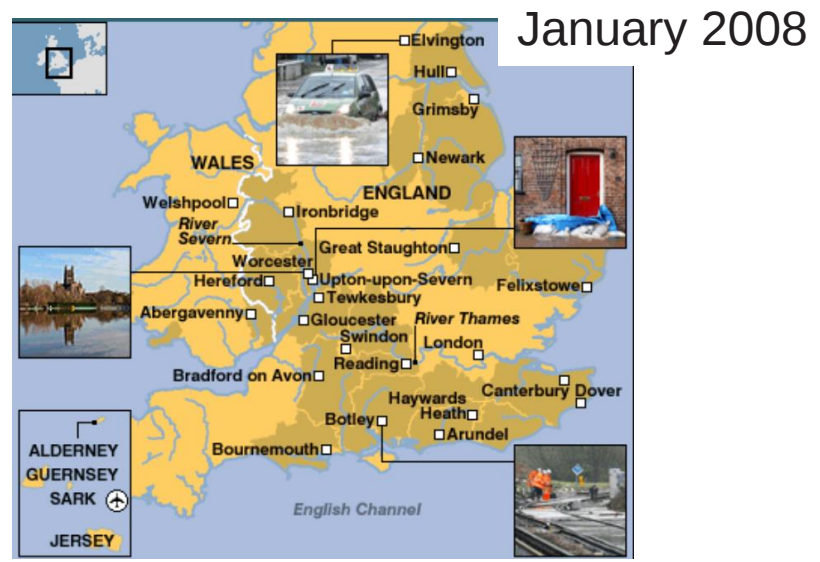
Centre for Ecology and Hydrology

What is the chance of an extreme flood event occurring anywhere in the country in the next 10 years?

National Flood Resilience Review

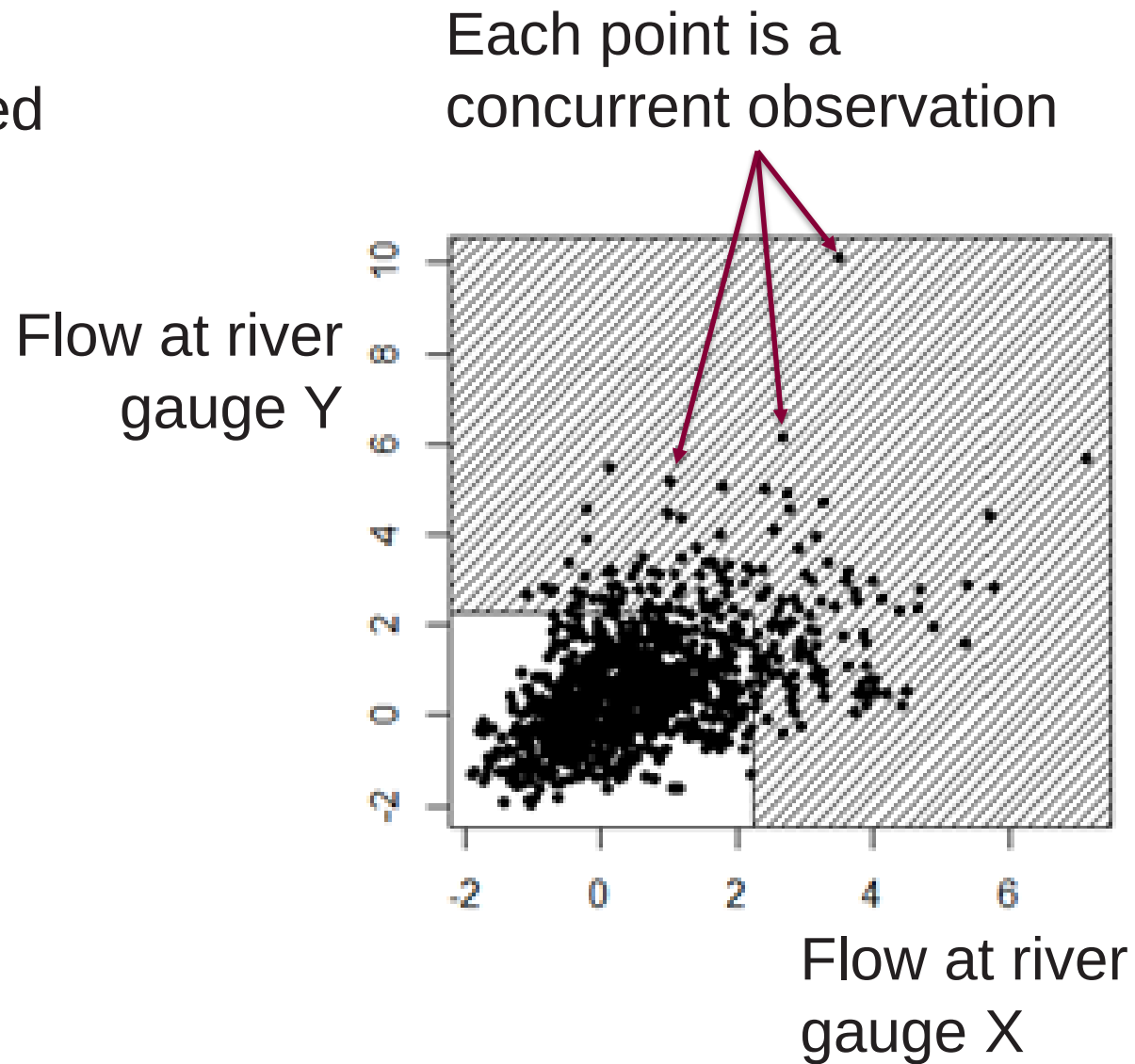


Extreme flood events have distinct, coherent patterns



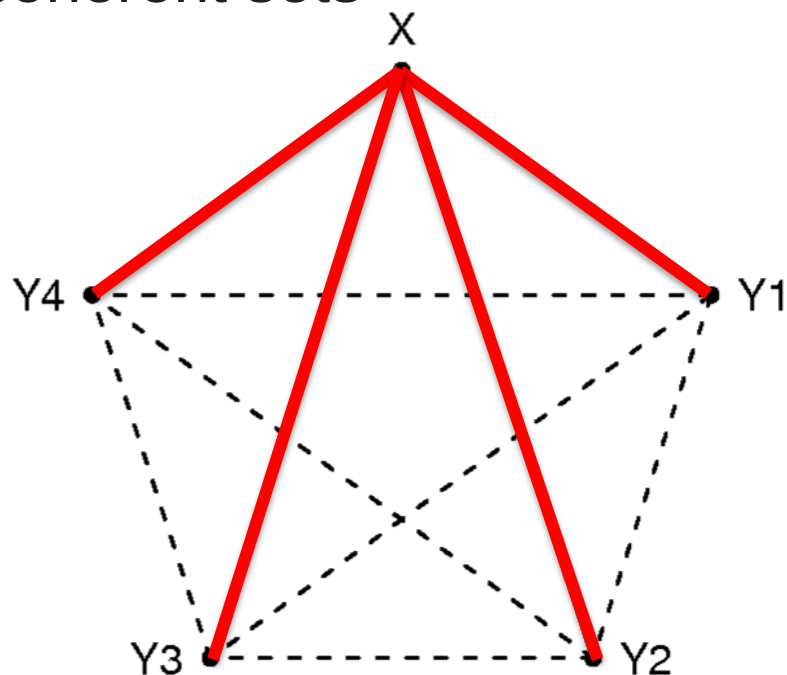
Joint probability model

1. Observed data standardised onto a common scale

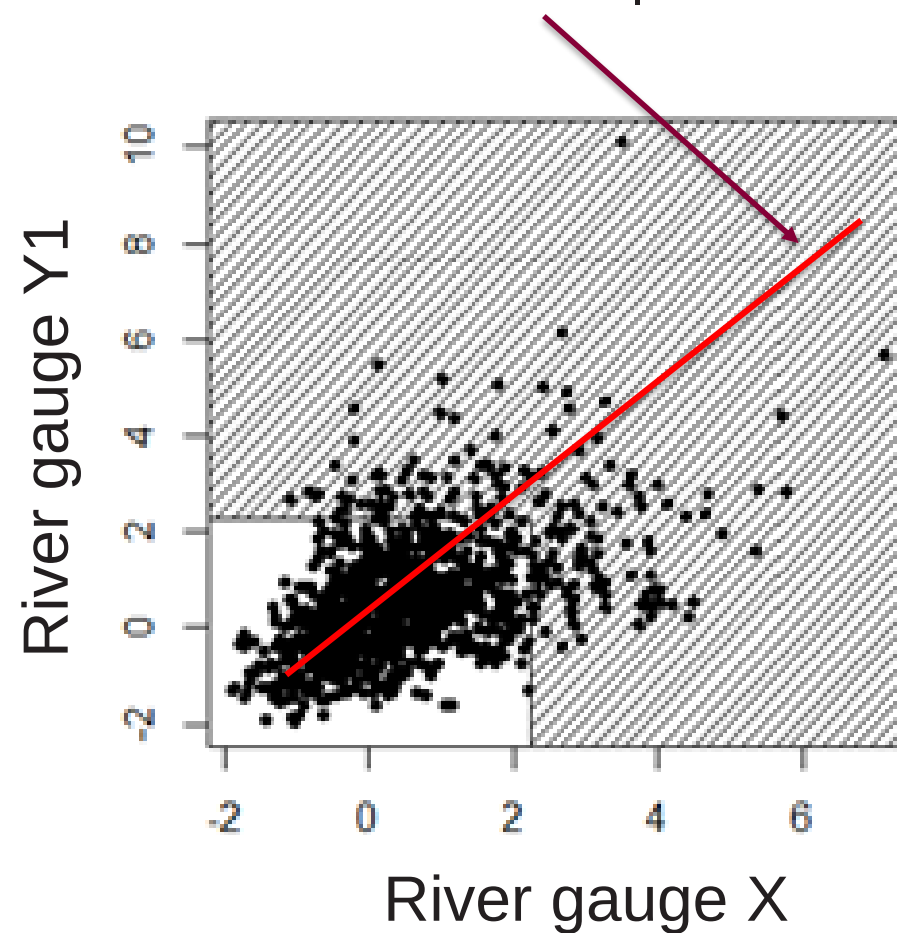


Joint probability model

2. Model the probability that each gauge (Y_n) is extreme when gauge X is extreme, with residuals retained as coherent sets

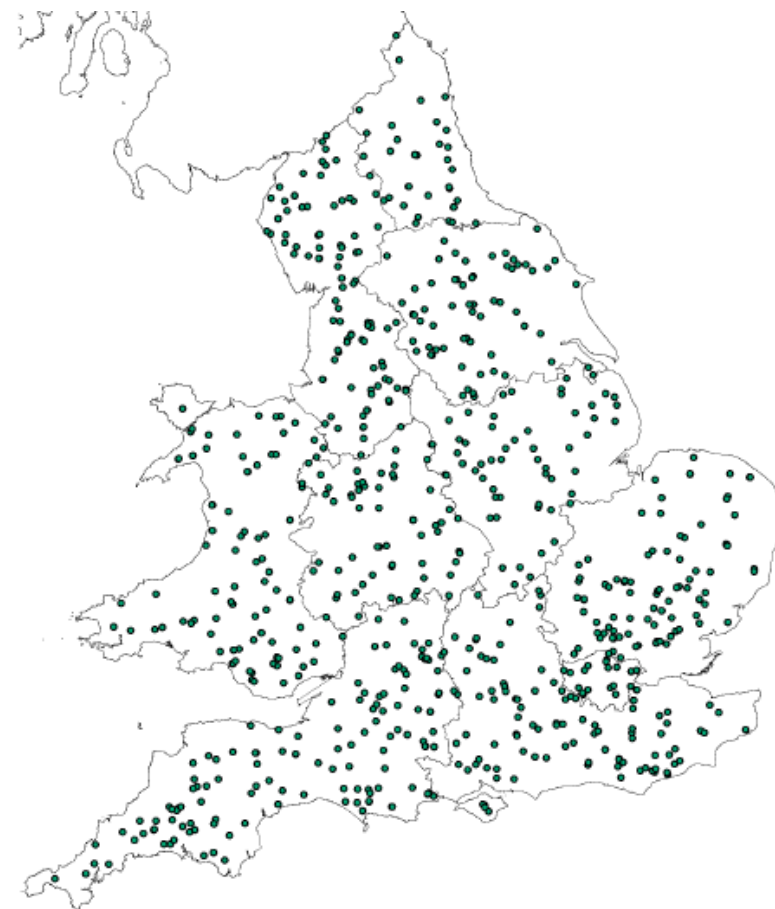
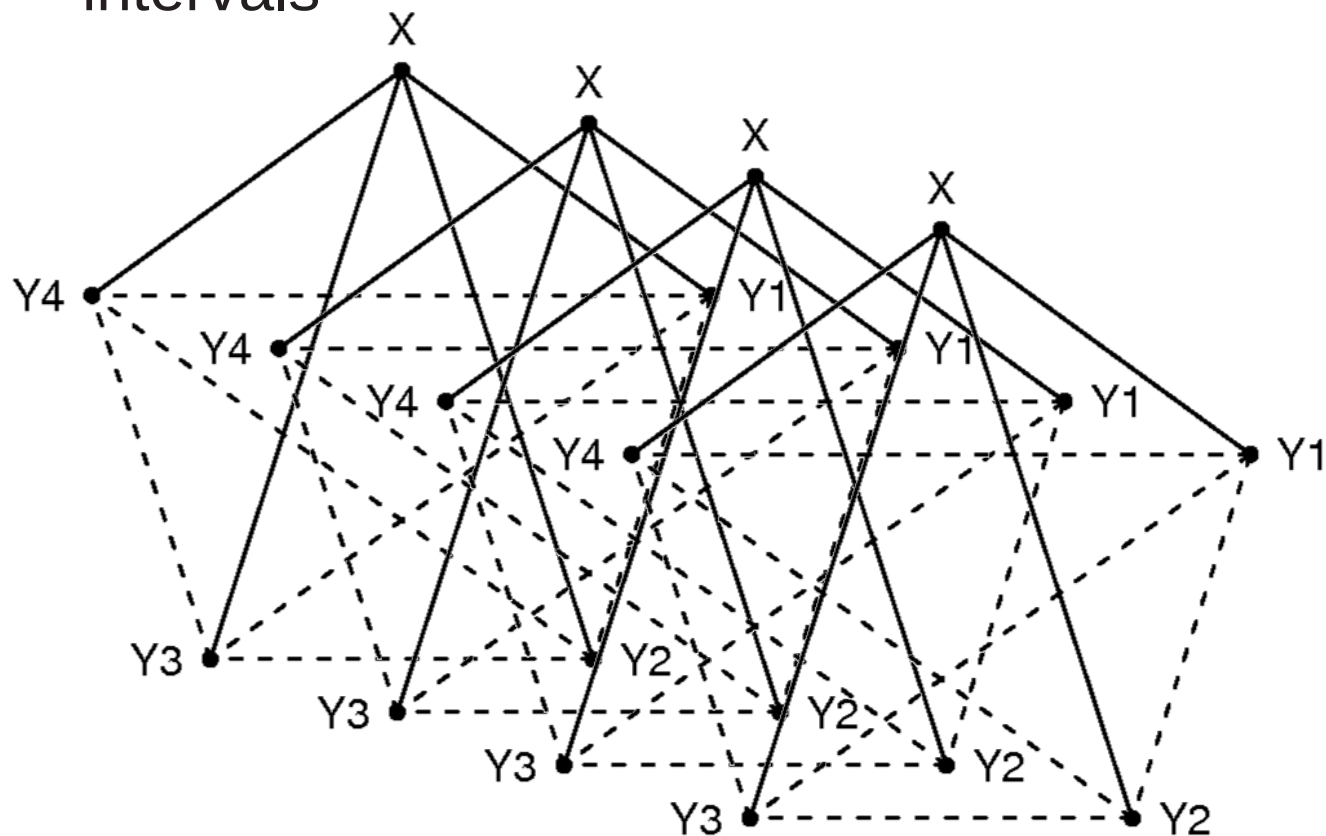


Model for “ Y extreme | X extreme”



Joint probability model

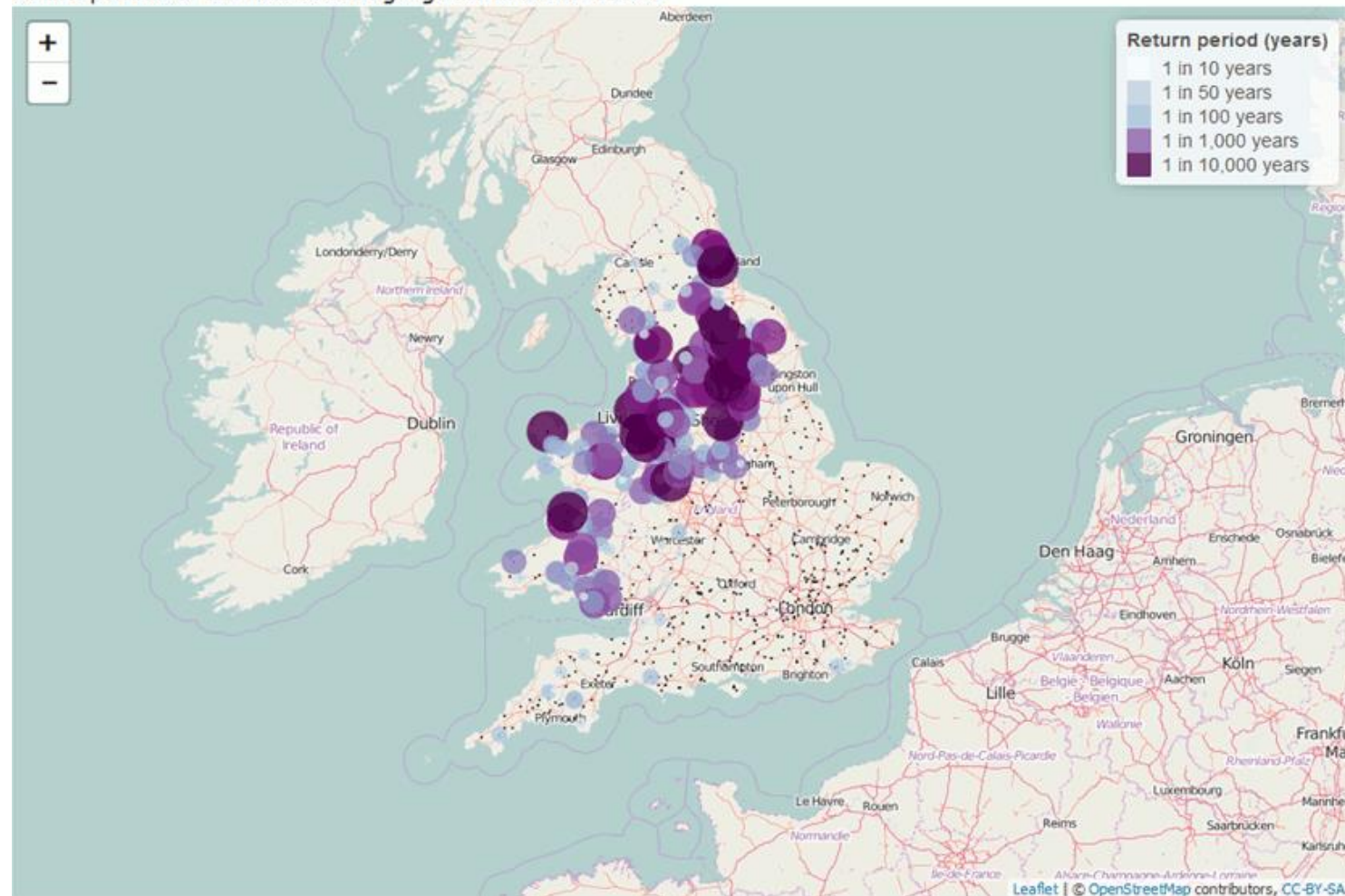
2. Create conditional models for a set of 916 gauges selected for data quality and record length, over 7-day sampling intervals



Joint probability model

3. Monte Carlo simulation to generate many possible, spatially coherent events

Return periods of the flow at each gauge for Event ID 32873

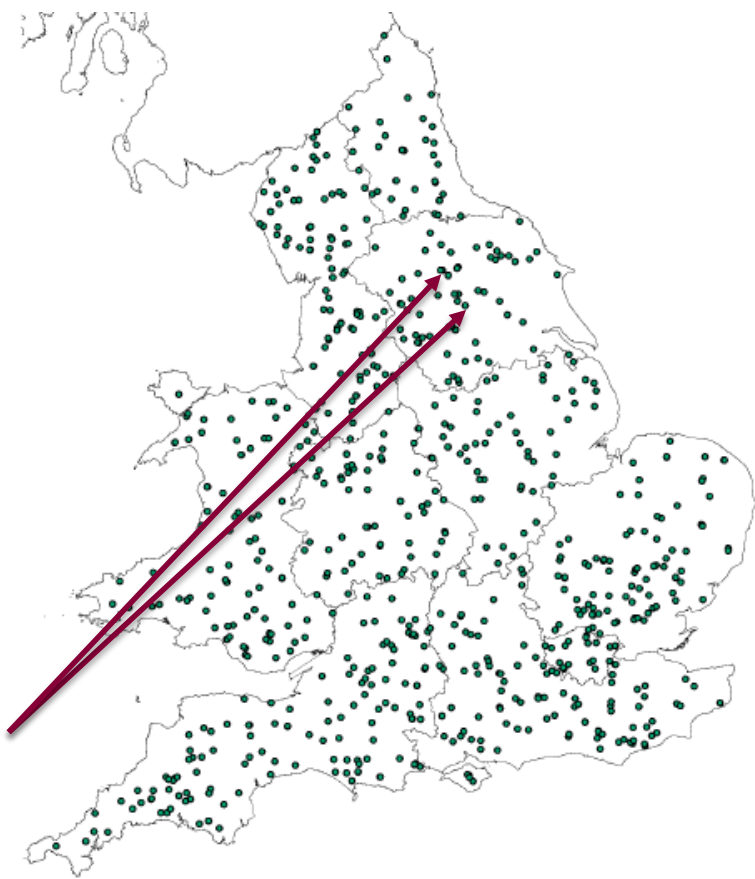
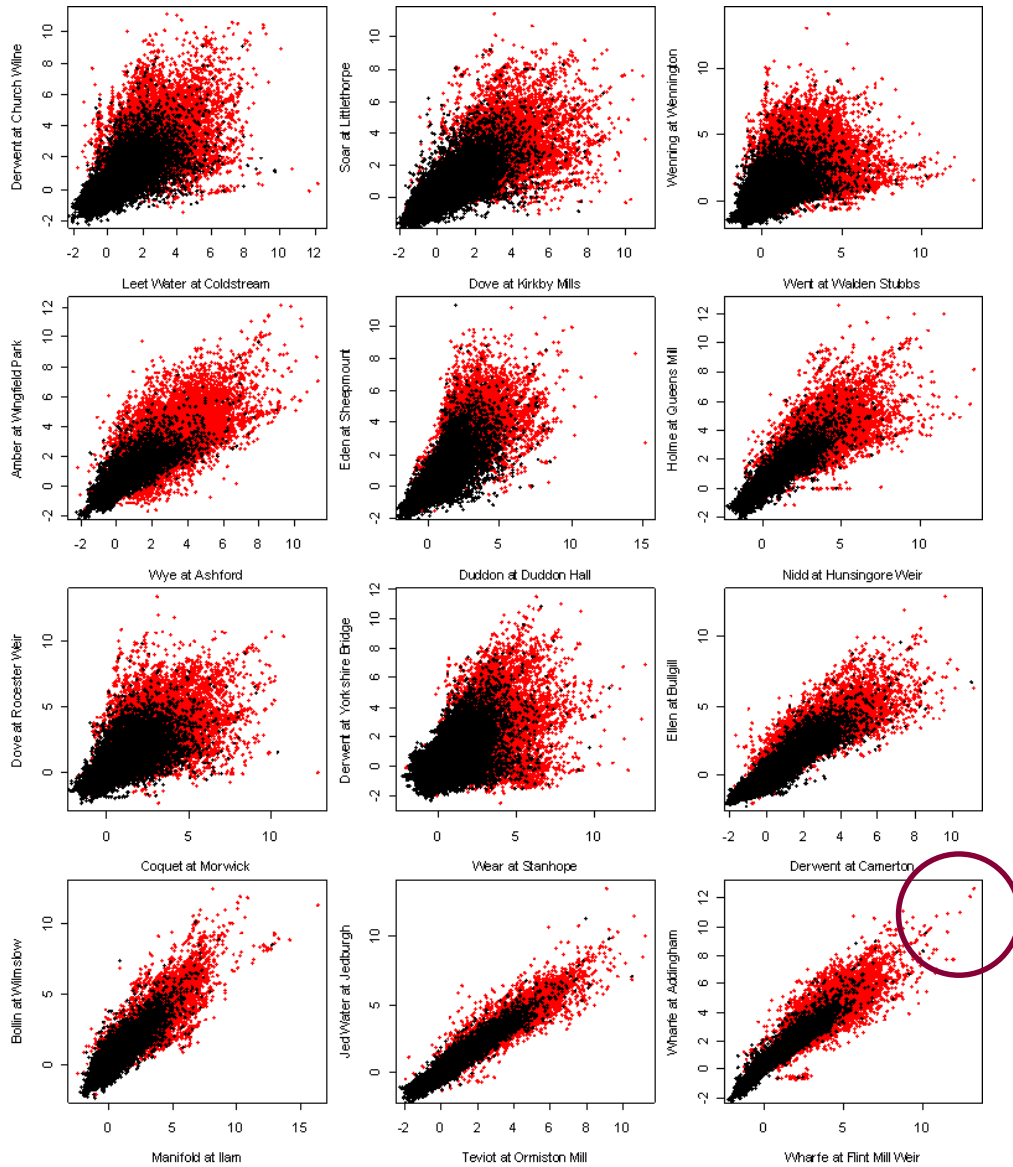


Dependence structure in extreme river flows

Flow data plotted on a standardised scale

Black:
Observations

Red:
Simulated events
representing 10,000 years
of synthetic “observations”

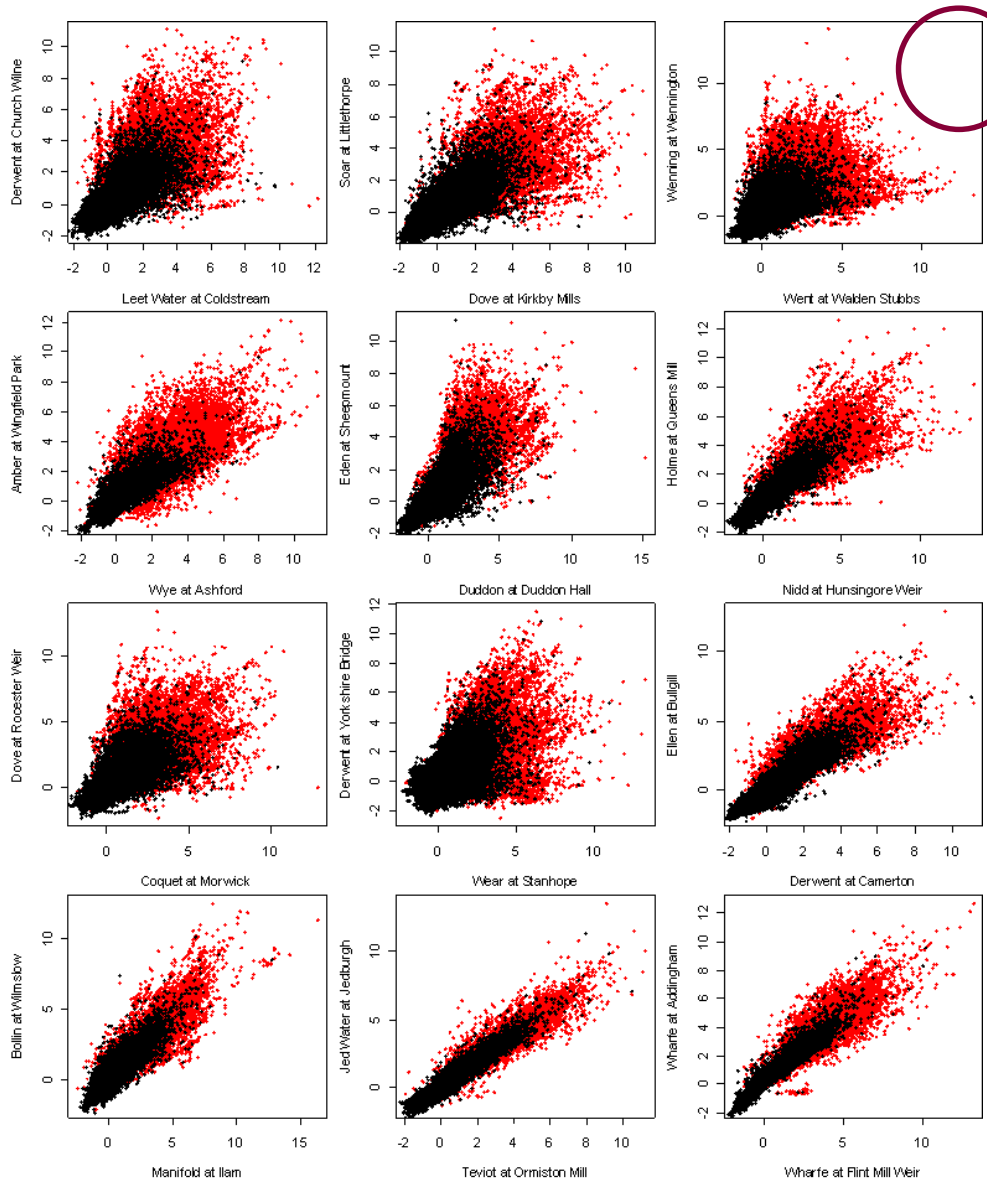


Dependence structure in extreme river flows

Flow data plotted on a standardised scale

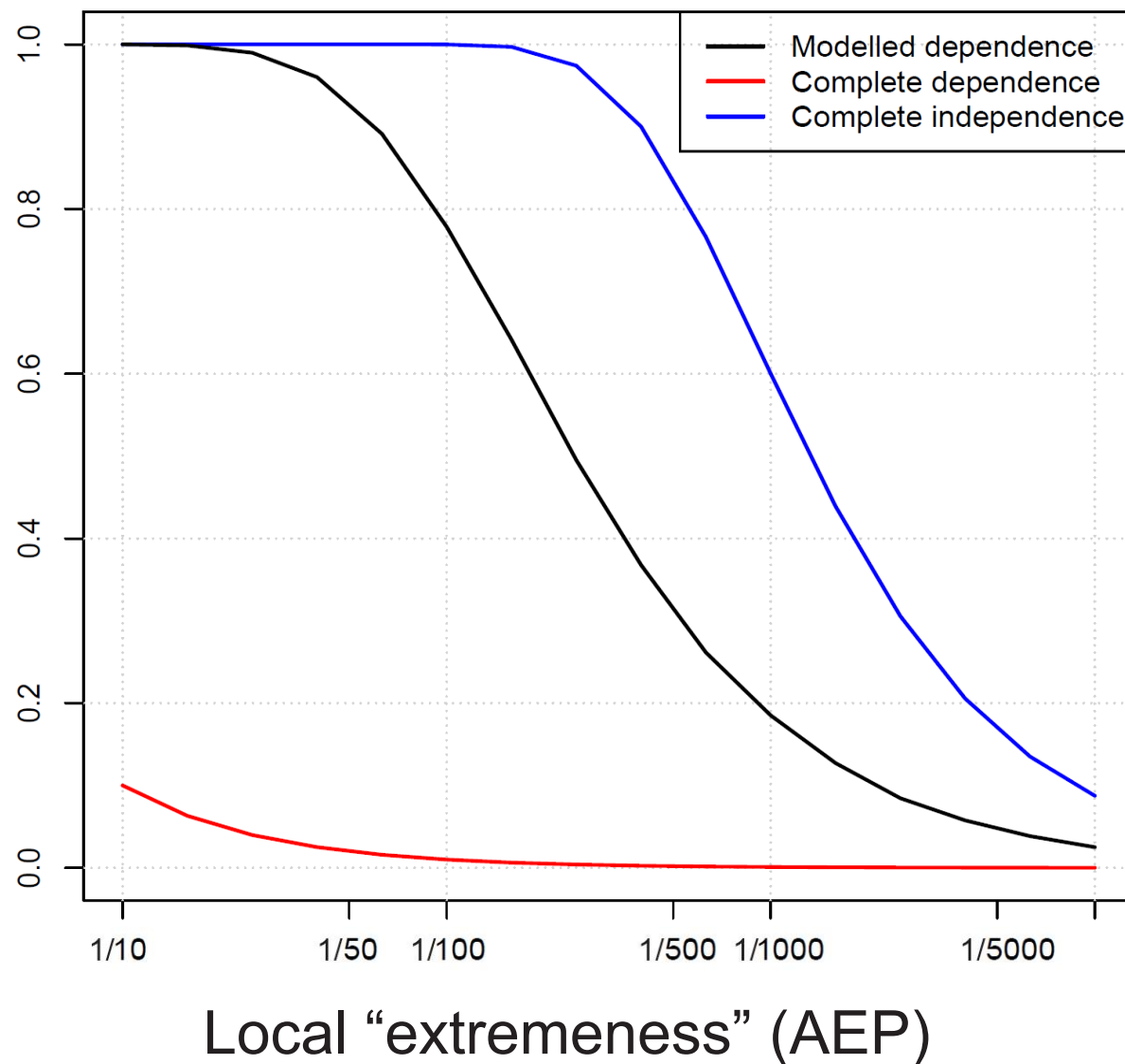
Black:
Observations

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Why the extremal dependence matters

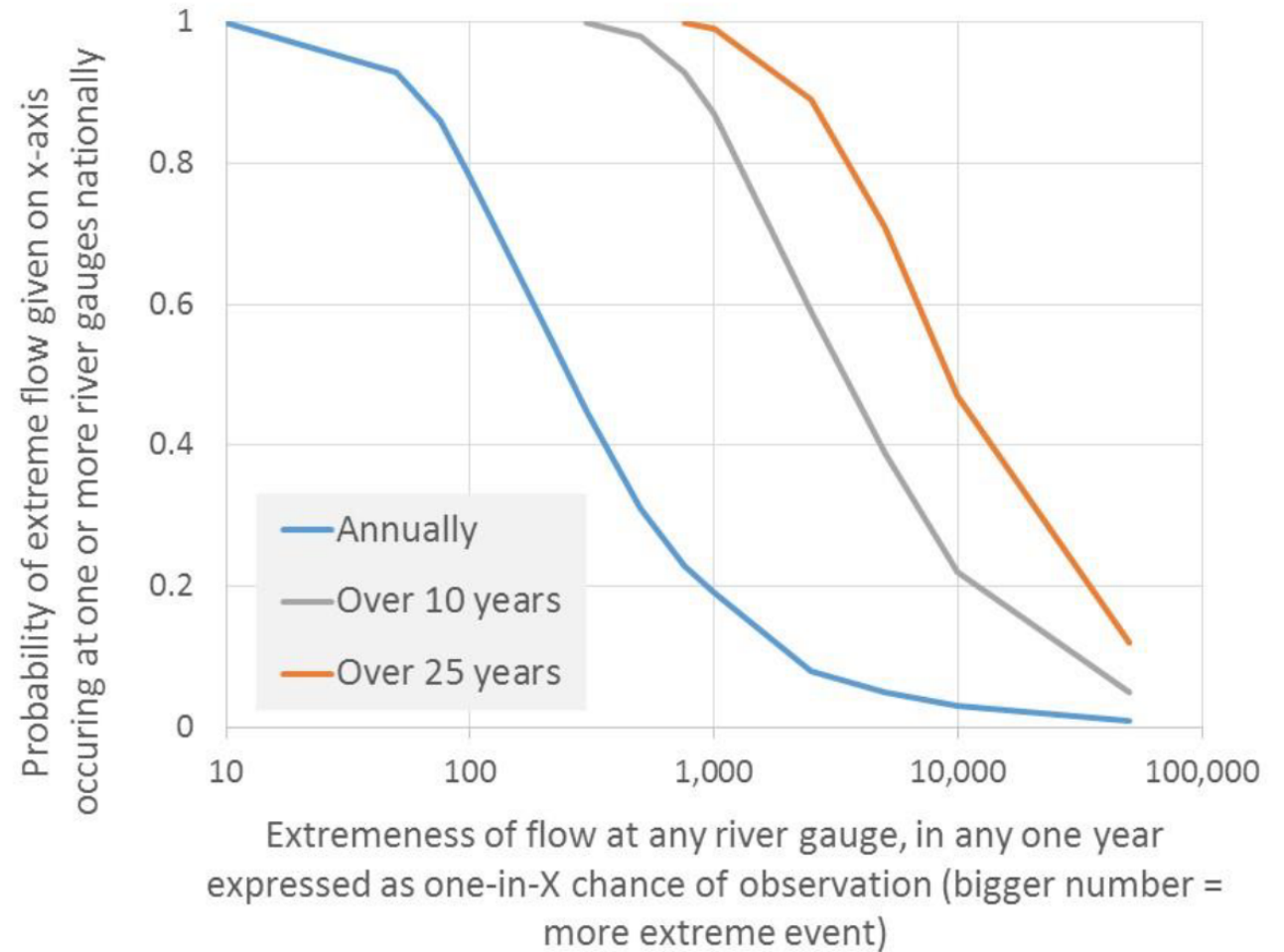
Annual probability of at least one “event” (locally extreme river flow) somewhere in E&W



Results

y-axis

Chance of extreme river flow event occurring at a gauge somewhere in England and Wales in a period of 1, 10 or 25 years



x-axis

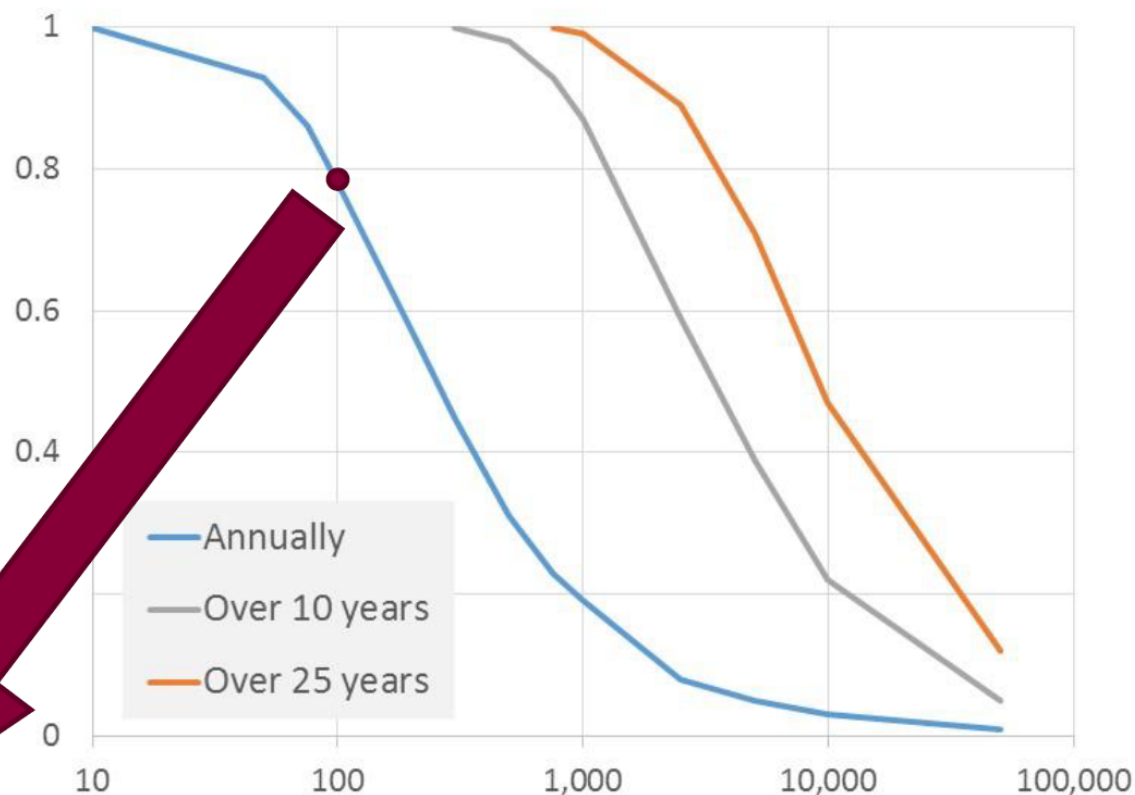
Relative level of extremes that is being used to define “extreme event” at any location

Results

y-axis

Chance of extreme river flow event occurring at a gauge somewhere in England and Wales in a period of 1, 10 or 25 years

Probability of extreme flow given on x-axis occurring at one or more river gauges nationally



There is nearly an 80% probability (0.78) in any one year that at least one river gauge somewhere in E&W will experience an extreme flow, even though the chance of seeing that extreme flow at any one specific location is only 1-in-100 (1%)

Extremeness of flow at any river gauge, in any one year expressed as one-in-X chance of observation (bigger number = more extreme event)

x-axis

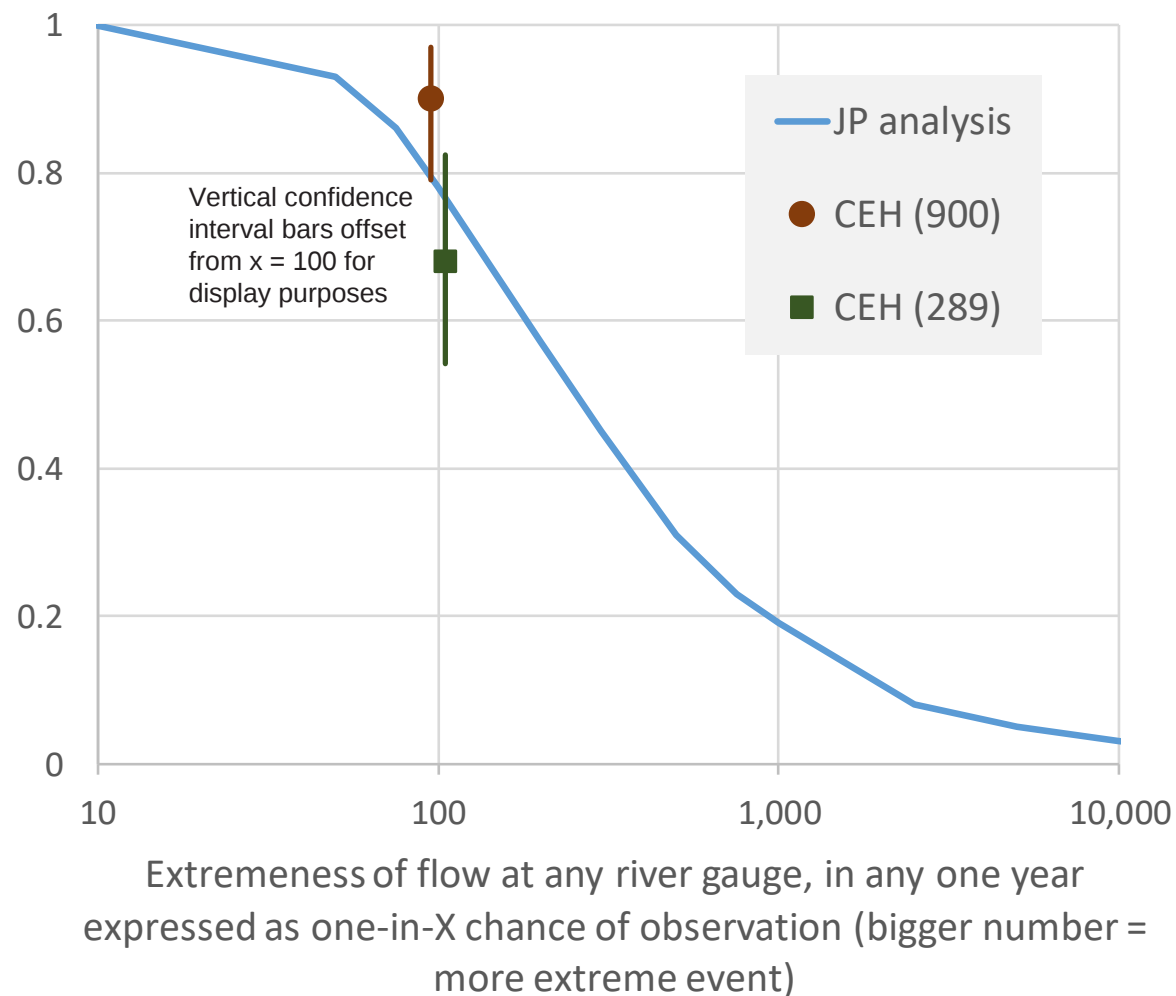
Relative level of extremes that is being used to define "extreme event" at any location

Results

y-axis

Chance of extreme river flow event occurring at a gauge somewhere in England and Wales in a period of 1, 10 or 25 years

Probability of extreme flow given on x-axis occurring at one or more river gauges nationally



CEH calculated the percentage of NRFA stations with data from 1971 to 2012 in which the at-site 1/100 AEP flow was exceeded in **any given year**, first for 900 stations and then for 289 stations with pooled FEH estimates of the 1/100 AEP flows

x-axis

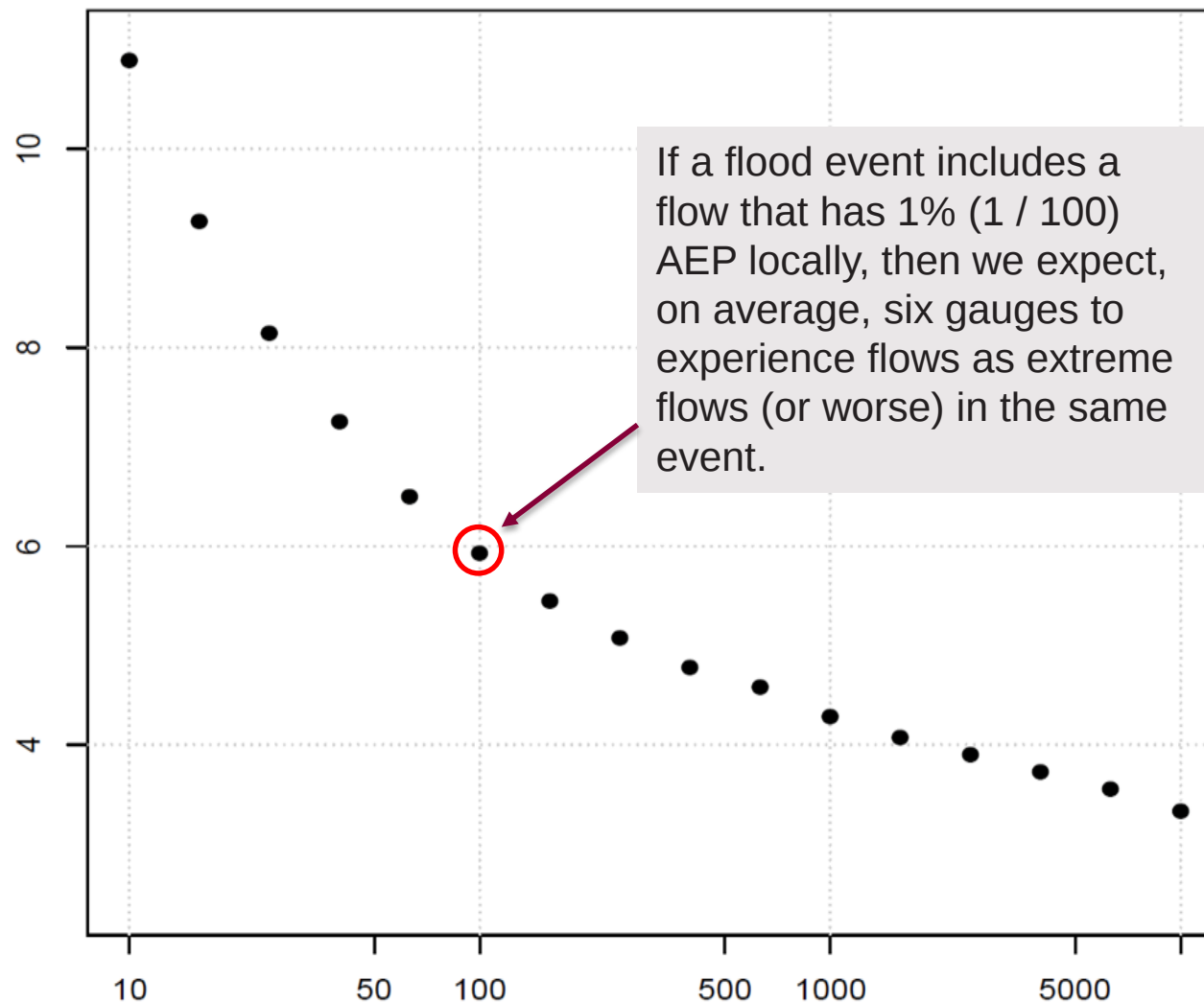
Relative level of extremes that is being used to define “extreme event” at any location

Expected spatial scale

y-axis

Number of river gauges **expected to experience a flow that is at least as extreme as the value defined on the x-axis in any one flood event** (assuming that the flood event affects at least one such gauge)

How many river gauges should we expect to experience extreme flows in **any one event** (up to 7 days apart, here) ?



x-axis

Relative level of extremes that is being used to define “extreme event” at any location (one-in-X chance of observation at any gauge, in any year)

Conclusions

- We quantified the “hydrological risk” of extreme river flows at a national level
- There is a 78% chance in any year that at least one river gauge will experience an extreme flow of 1 – in – 100 annual probability (or worse)
- In most places, flood defences could not contain a peak flow this high
- On-going research is examining the statistical uncertainty and influence of climatic variability on this analysis