LOCALISM: A NEW ENDORSEMENT OF AN OLD PARADIGM FOR FLOOD FREQUENCY ESTIMATION

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- Rationale of using local data
- General uncertainty assessment for FEH
- Constrain uncertainty on QMED using local data

“*You keep saying the FEH methods work reasonably well across the UK, but how come they never work for my catchment?*”

EA-SW hydrologist, 2011

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How reliable are design flood estimates in the UK?

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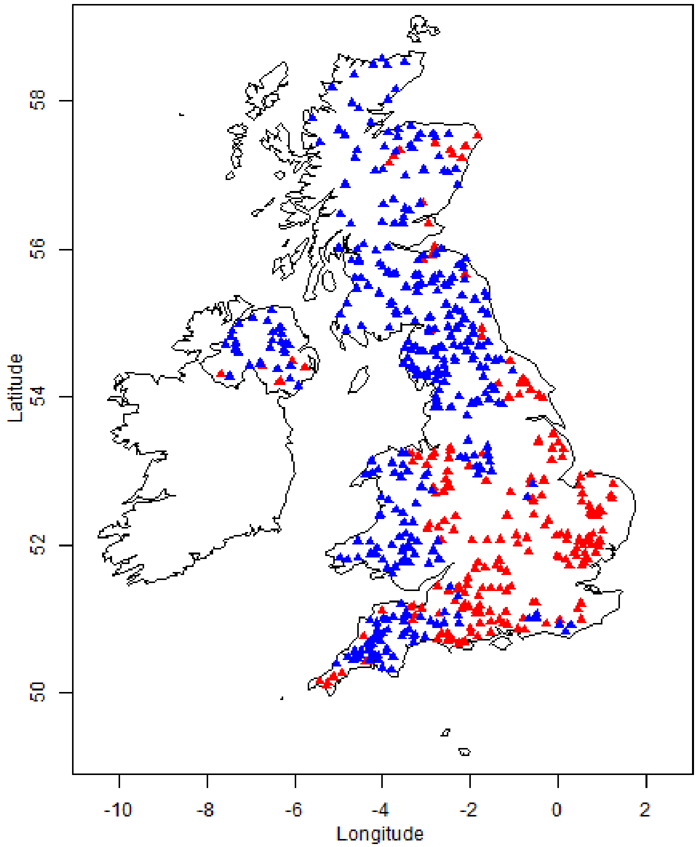
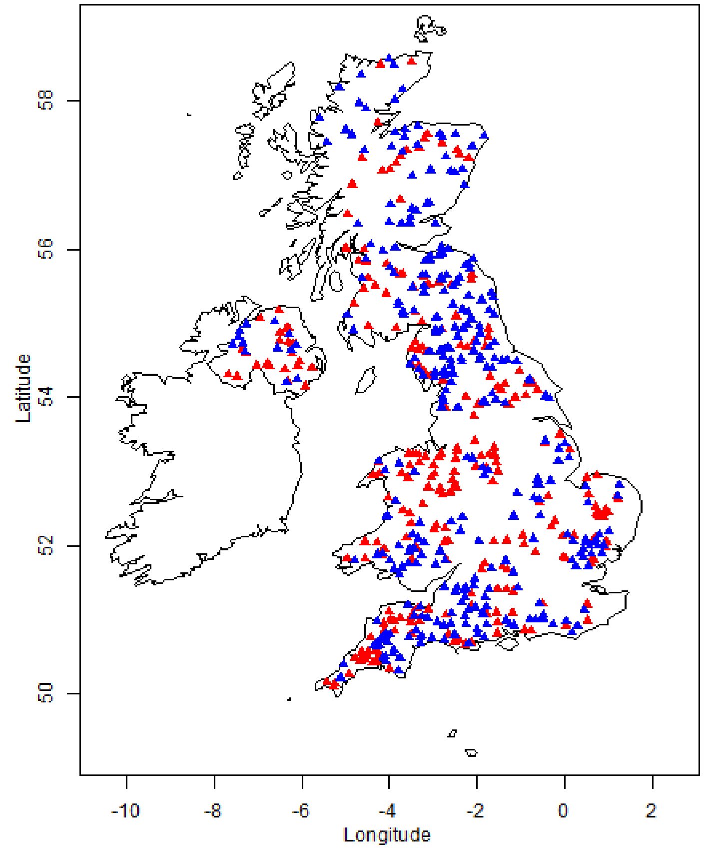
Abstract

Design flood estimates in the UK are routinely obtained by using the improved Flood Estimation Handbook (FEH) statistical procedure. This paper presents a practical framework for assessing the uncertainty associated with estimates of



Regression model using

- AREA



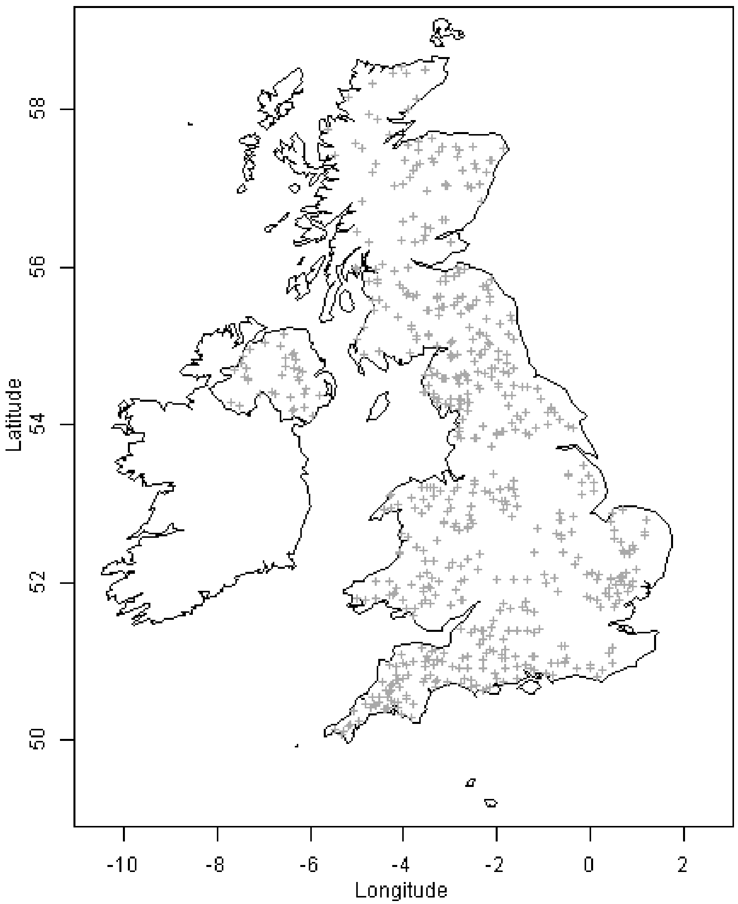
Regression model using

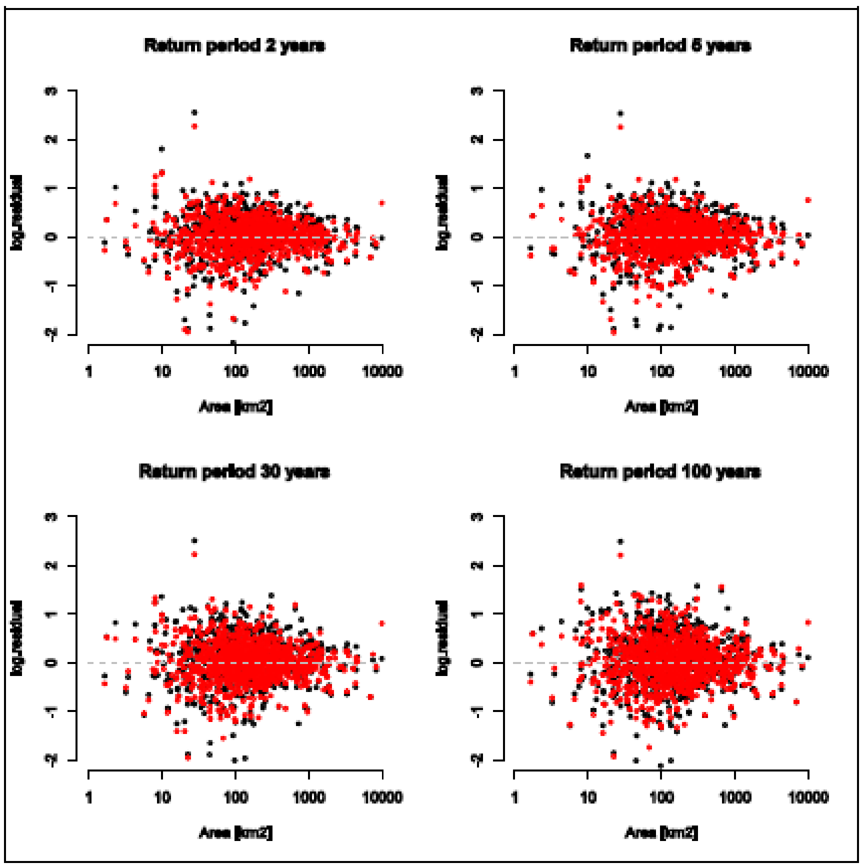
- AREA
- SAAR
- FARL
- BFIHOST

Characterise variability of residuals across many sites

$$e = ln\hat{Q}_T - lnQ_T$$

- Estimate QT – no donor
- Estimate QT – use one donor





$$e = ln\hat{Q}_T - lnQ_T$$

$$fse = exp\left[\sqrt{\frac{1}{m}\sum_{i=1}^{m}\left(ln\hat{Q}_T - lnQ_T\right)^2 - \frac{1}{m}\sum_{i=1}^{m} Var\{lnQ_T\}}\right]$$

Return period	fse (regression only)	fse (regression + donor)
2	1.47	1.42
5	1.48	1.43
30	1.52	1.47
100	1.54	1.50

Return period	fse (regression only)	fse (regression + donor)
2	1.47	1.42
5	1.48	1.43
30	1.52	1.47
100	1.54	1.50

Use FEH to get a design flood: $\mathbf{Q_{100} = 10.0\ m^3/s}$

68% confidence interval: [10/1.50 ; 10*1.50] = **[6.7 ; 15.0] $\mathbf{m^3/s}$**

95% confidence interval: [$10/1.50^2$; $10*1.50^2$] = **[4.4 ; 22.5] $\mathbf{m^3/s}$**

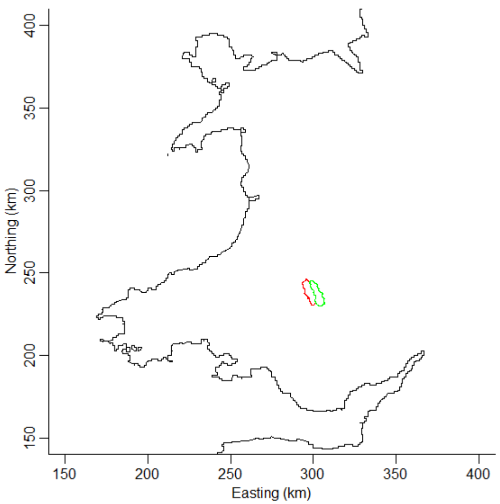
Estimating uncertainty of QMED for a range of scenarios

Data availability	fse formula
Ungauged site	$fse = exp\left(\sqrt{0.1286}\right)$
Ungauged + 1 donor	$fse^{\sqrt{1-a^2}}$
Ungauged + many donors	$fse^{\sqrt{1-\boldsymbol{b}^T\boldsymbol{\Omega}^{-1}\boldsymbol{b}}}$
Gauged, but only just	$fse^{s_x\left(s_x^2+0.1431\right)^{-0.5}}$
Gauged	$exp(2\beta/\sqrt{n})$
Gauged + historical data	???

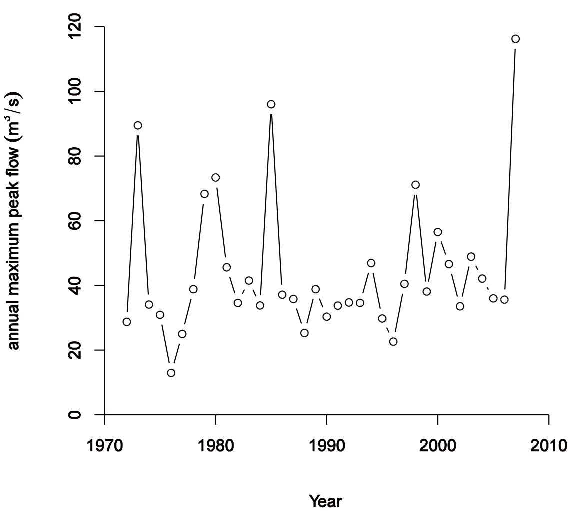
Ungauged (first three rows); Gauged (last three rows)

$$a = 0.4598exp\left(-0.020d_{sg}\right) + (1 - 0.4598)exp\left(-0.4785d_{sg}\right)$$

$$s_x = 2\beta/\sqrt{n}$$



Catchment descriptor	Subject site 56013	Donor site 56003
Easting (cent) [m]	297622	302454
Northing (cent) [m]	238444	237136
AREA [km²]	63.27	62.5
SAAR [mm]	1299	1171
FARL [-]	1	0.999
BFIHOST [-]	0.494	0.528



Method	QMED (m³/s)	fse
Gauged (n = 36)	36.6	1.08
Regression only	31.6	1.43
Regression + donor transfer	31.3	1.37
Sparsely gauged case (n=5 years) + regression	39.4	1.10
Sparely gauged case (n=5) without regression	42.1	1.20

Conclusions

- FEH very helpful where no data are available
- Uncertainty of design floods is very high
- Both FEH and local data can constrain the uncertainty
- Combine FEH with local data should be best practise
- Measures of uncertainty (fse) available for simple cases