Flood Estimation

Reducing uncertainty for the estimation of hydropower potential – the use of local data

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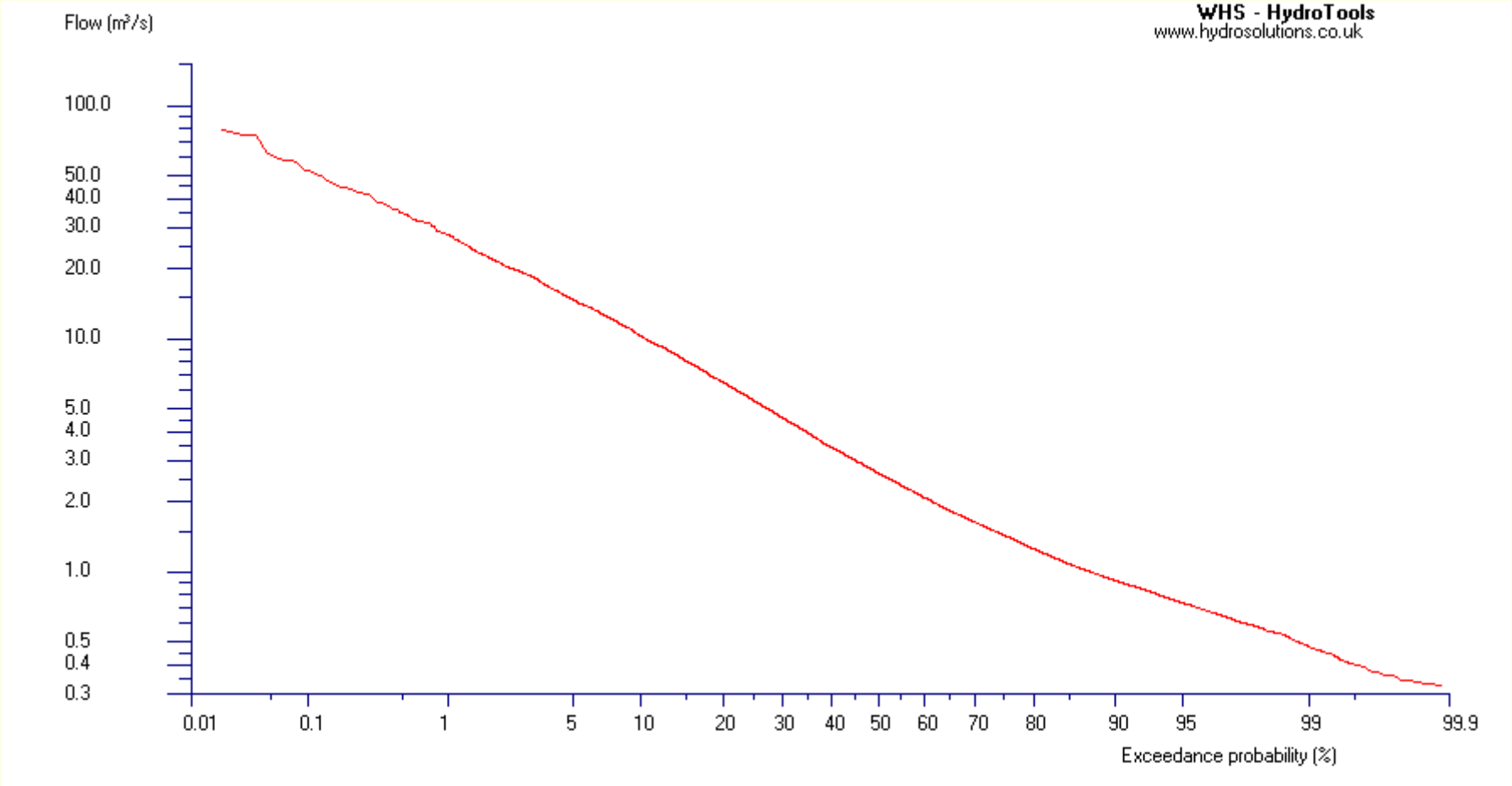
Joule Programme Project: North West Hydro Model – Joule Centre, George Aggiddis (Lancaster University) & David Howard (CEH)

Joule Centre: North West Hydro Model

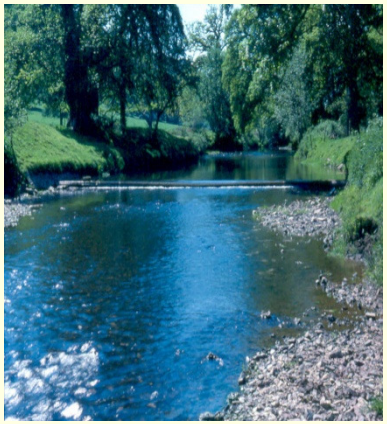
- Reducing barriers to hydropower development in the North West: a multi-disciplinary approach
- The Hydrology work package:
  - Development of a formal framework for acquisition and incorporation of local data within the Low flows estimation framework
  - Improving FDC information that can be extracted from short record at-site data:
    - Guidance for best use of analogue gauges
    - Development of regional linking equations


Flow (m³/s)
WHS - HydroTools
www.hydrosolutions.co.uk
100.0
50.0
40.0
30.0
20.0
10.0
5.0
4.0
3.0
2.0
1.0
0.5
0.4
0.3
0.01
0.1
1
5
10
20
30
40
50
60
70
80
90
95
99
99.9
Exceedance probability (%)

The Problem

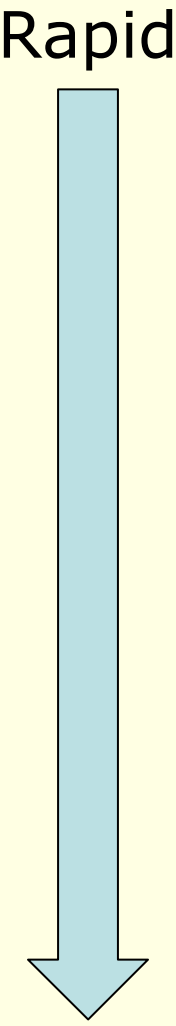
- The Ideal
  - Long record measurement
  - Of good hydrometric quality
  - Known artificial component of river flow

- The Reality
  - No at site measurement
  - Short record data?
  - Suitable gauged analogue?

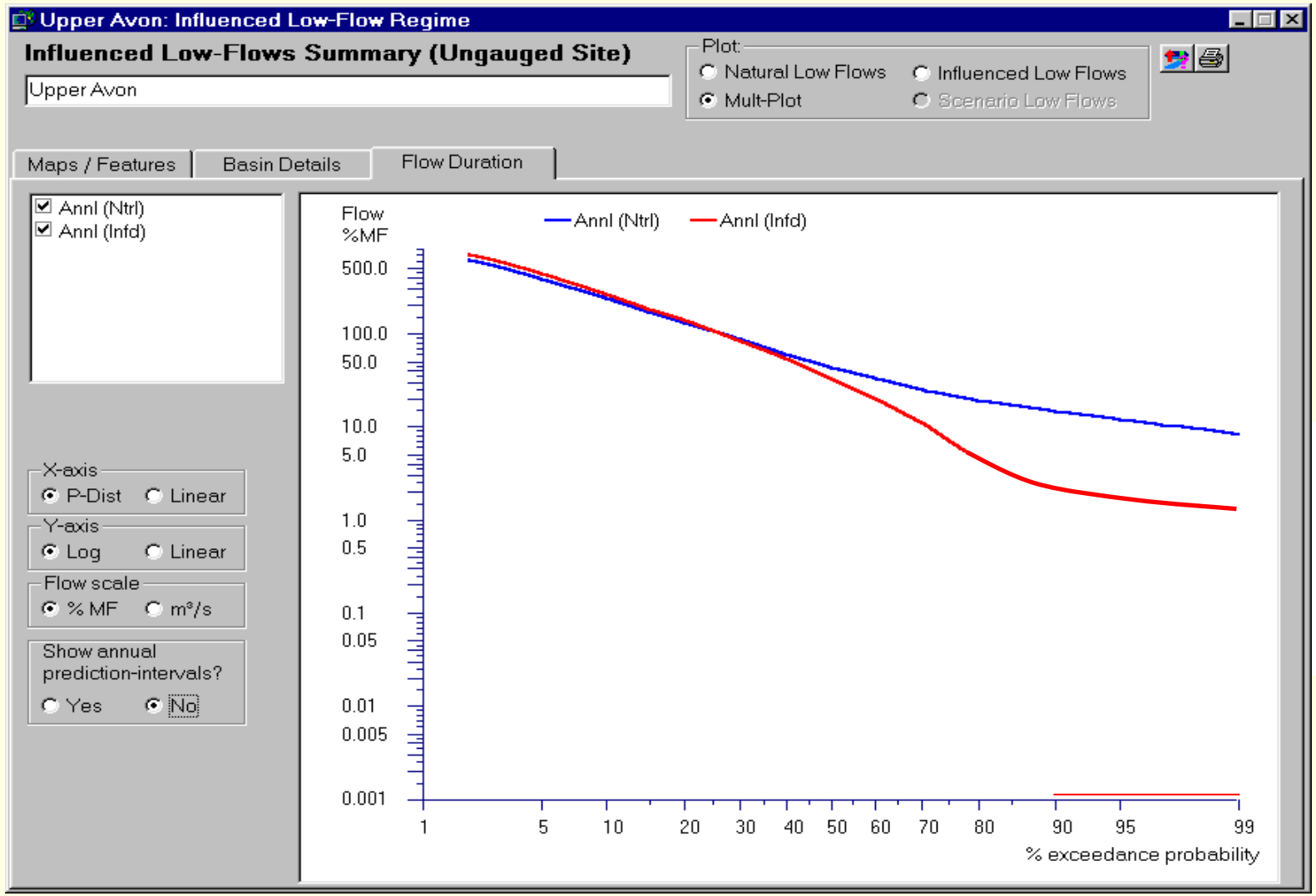


Sources of Flow Information

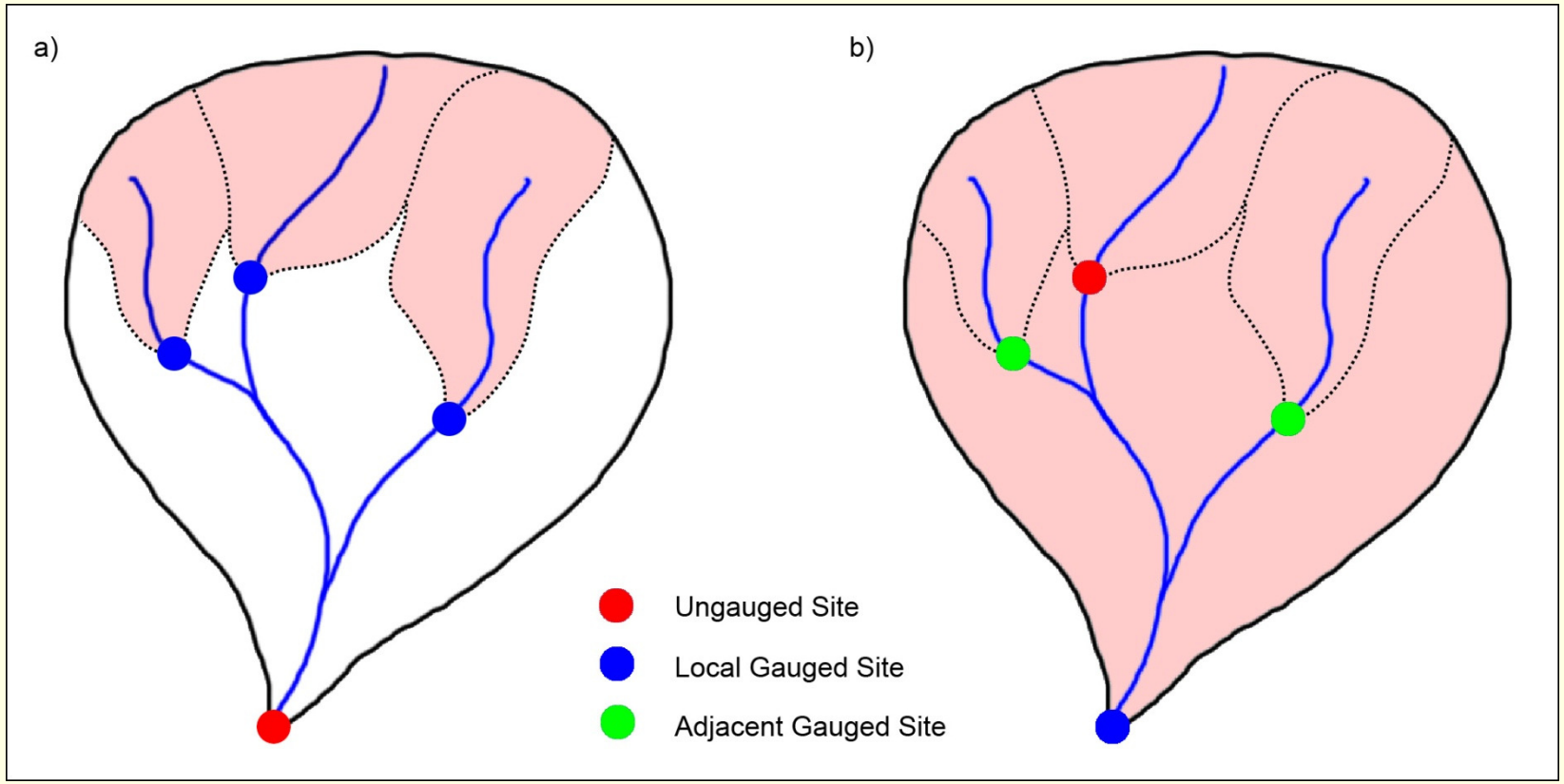
- LowFlows Software– FDC estimation within ungauged catchments
- Local data to corroborate/improve the flow estimates
  - Formal incorporation of Local Data in ungauged flow estimation.
  - Transposing flow data
  - Use of at site measurements
- Long Term Good Quality Gauging Station Data



The LowFlows Software



Analogue catchments



What makes a good analogue?

- Close in proximity (less than 50km)
- Similar climatology
- Similar catchment area (<factor 2)
- Hydrogeologically similar (HOSTBFI <0.1)
- Nested with site (common component of flow)

Transposition of flow data

adjacent Analogues

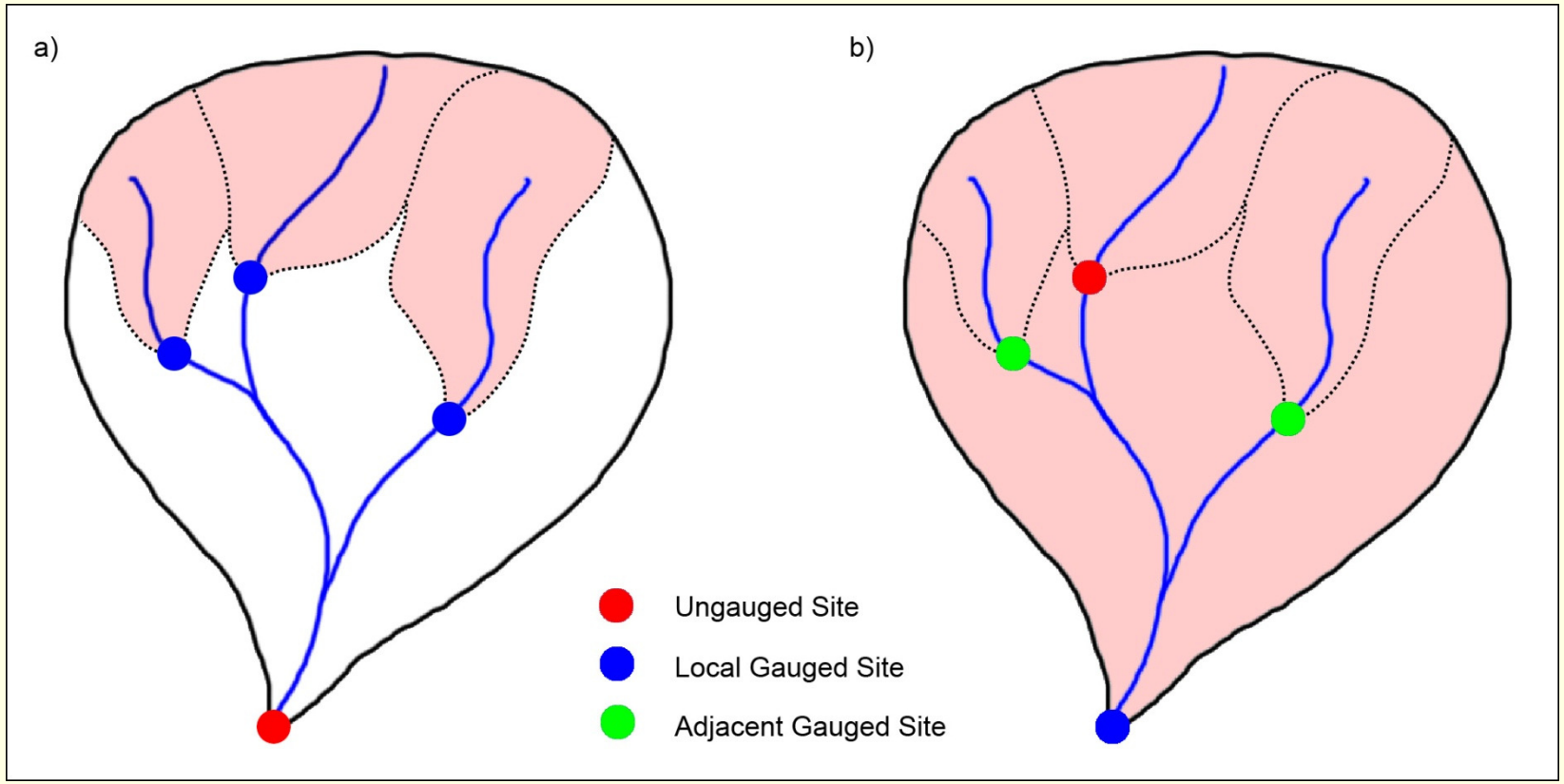
Estimation method	Flow statistic (m^3s^{-1})	Percentage prediction uncertainty (at 68% confidence level)
Transpose by catchment Area and AAR	MF	±28
	Q95	±98
Estimated using Low Flows 2000	MF	±11
	Q95	±45

Nested Analogues

Estimation method	Flow statistic (m^3s^{-1})	Percentage prediction uncertainty (at 68% confidence level)
Transpose by catchment Area and AAR	MF	±16
	Q95	±38
Estimated using Low Flows 2000	MF	±11
	Q95	±45

Choose your analogue wisely!

Incorporation of Local Data: Catchment configurations

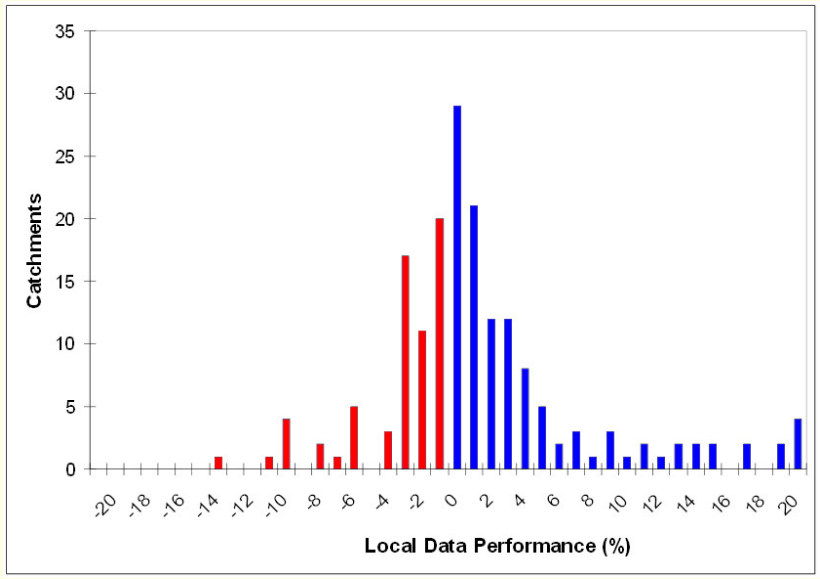


Incorporation of local data: approach

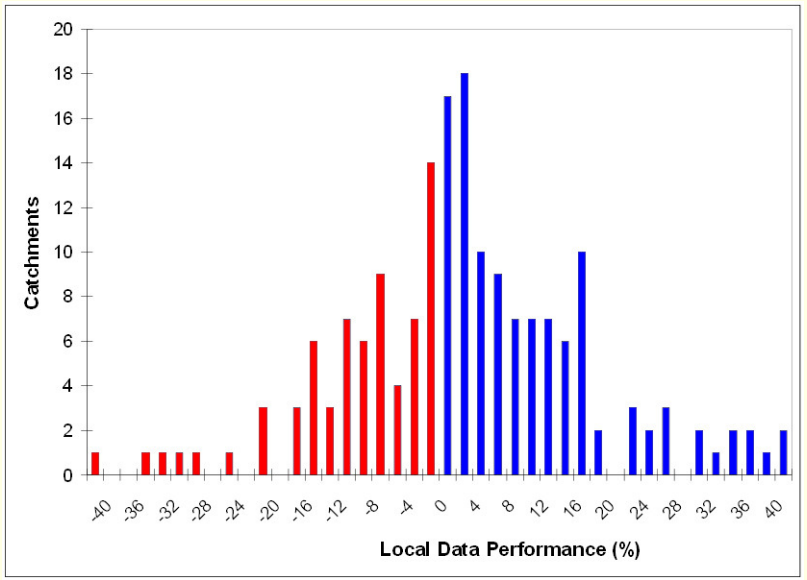
- Upstream local data
  - Identify non-nested upstream gauges.
  - Estimate flow statistics for incremental catchment area.
  - Combine upstream gauged flows and flows from the incremental catchment area to give flows at site.
- Downstream local data
  - Indentify non-nested parallel gauged catchments
  - Estimate flows by “subtracting” the incremental catchment flows and parallel gauged flows from the downstream site.

Local data: preliminary results

Mean Flow



Q95 m^3s^{-1}

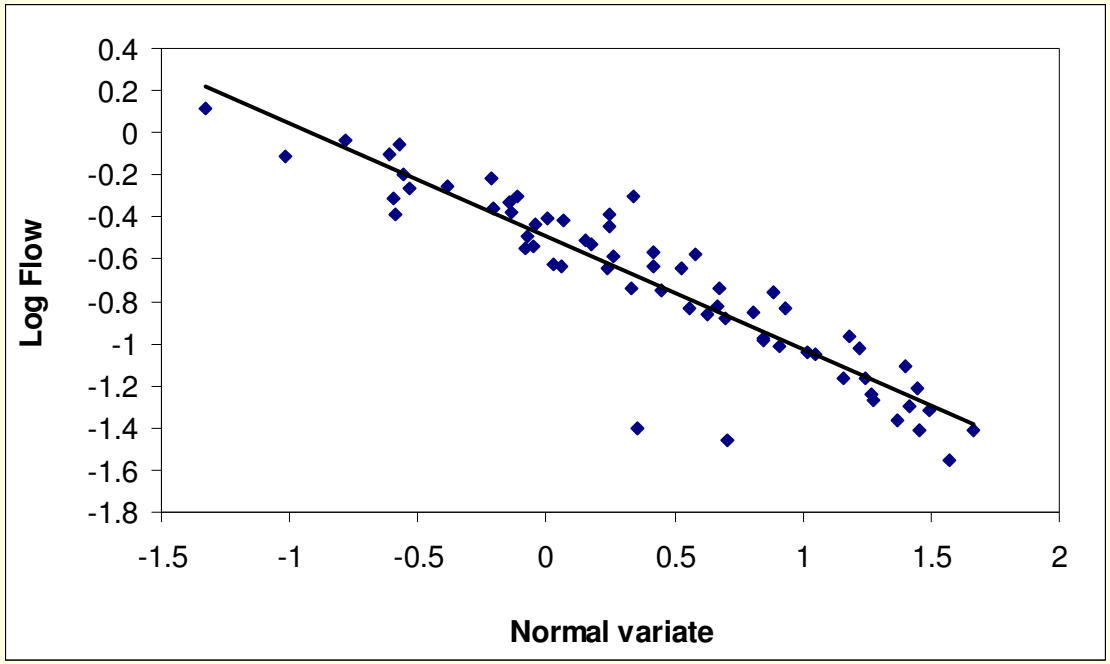


At site measurement: continuous measurement

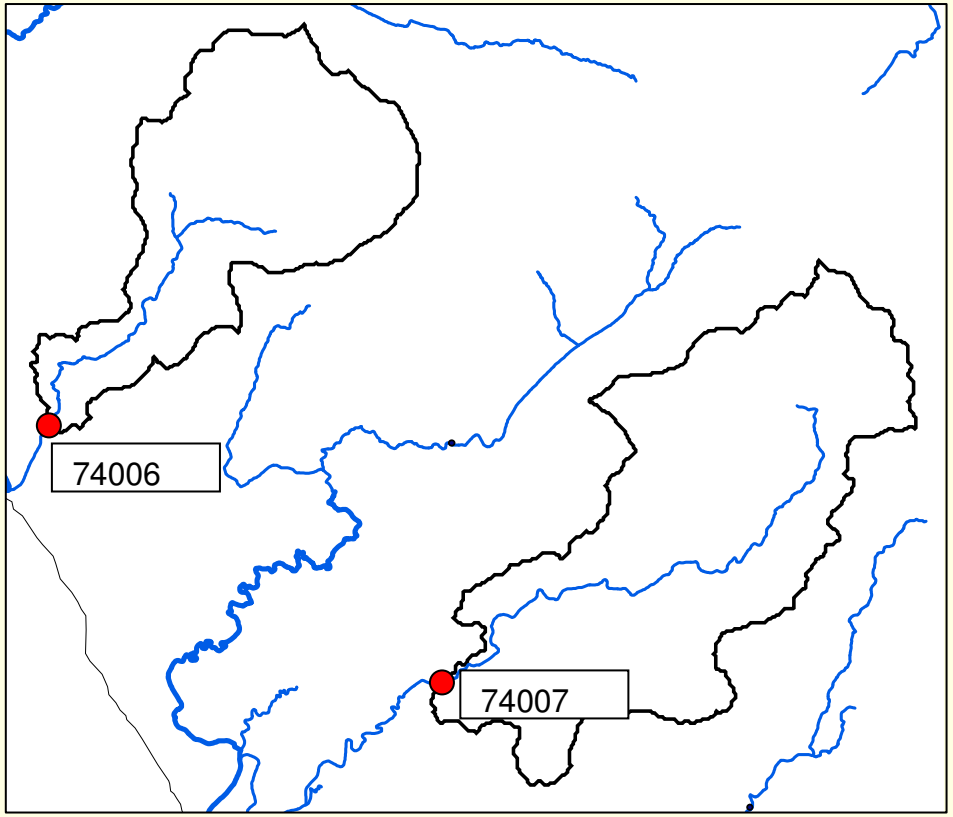
- Continuous measurement of flows over a 6-12mth period
  - Provides a lot of information
  - BUT prone to sampling error (*and measurement error*!)
  - 6 months commonly used…….we would recommend a year of data.

Assigning percentiles to days from a short record

- Selected flows on falling limb of the hydrograph
- Each days flow treated as a spot gauging
- Log normality assumed for flow distribution
- Fitted relationship
- Relationship used to predict FDC



An example from the North West of England



	74006	74007
Area	43.87km^2	70.03 km^2
BFIHOST	0.42	0.42
Mean Flow	1.84m^3/s	4.43m^3/s
Q95	0.32m^3/s	0.37m^3/s

Treat 74006 as ungauged and estimate from 74007

Results

		MF (m^3/s)	Difference (m^3/s)	Q95 (m^3/s)	Difference (m^3/s)
	Long record gauged values at site	1.84		0.32	
1	LowFlows software	2.11	**-0.27**	0.25	***0.07***
2	1 Year of Data and record extension	1.73	***0.11***	0.12	0.20
3	Transposing by SAAR and Area	2.18	-0.34	0.18	0.14
4a	Estimation with 1 Spot Gauge values at Q95			0.43	-0.11
4b	Estimation with an average of 5 Spot Gauge values at Q95			0.38	**-0.06**

The choice of method & analogue strongly influences the answer! Whilst we advocate the use of local data, hydrological expertise is required to minimise the chance of getting a worse result!

Thank You!