

European Geosciences Union General Assembly 2011

SESSION HS2.11/NH1.14

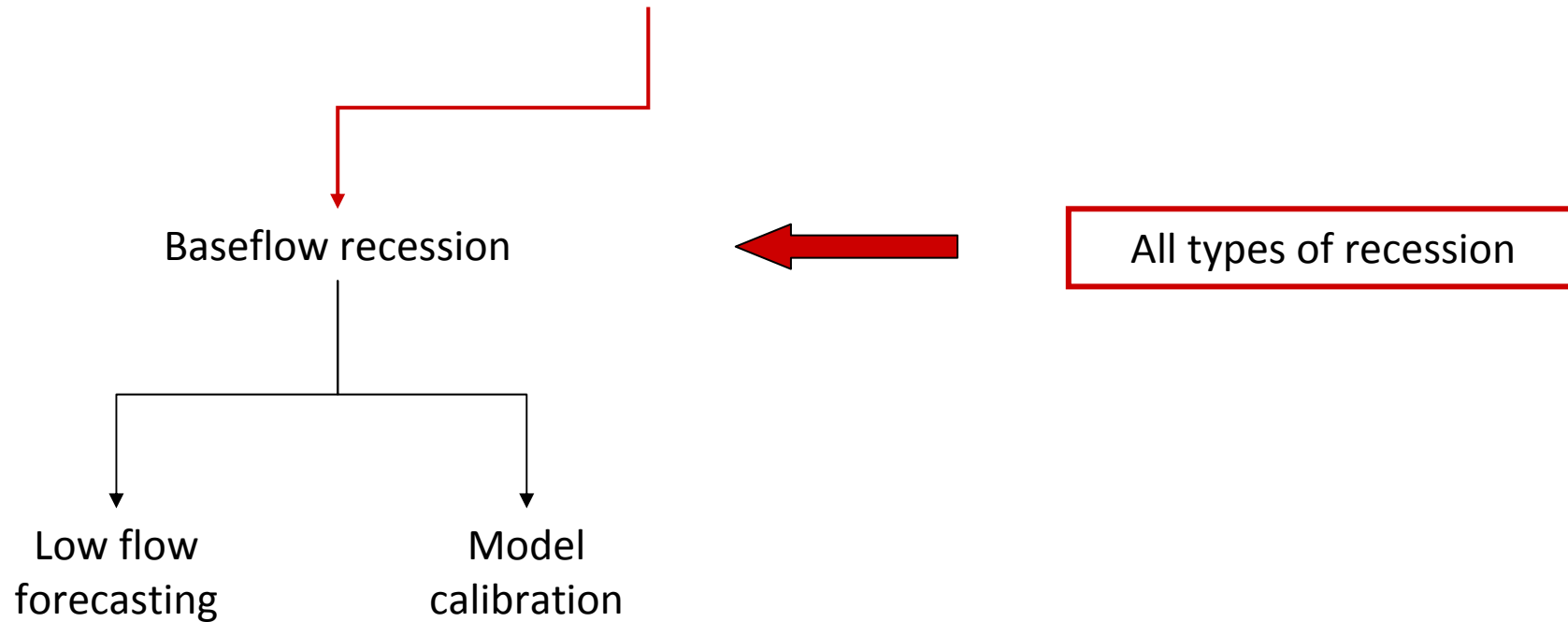
Hydrological extremes: from droughts to floods

From flood to low flow: analysis of recession processes

Claire LANG & Didier FRANÇOIS

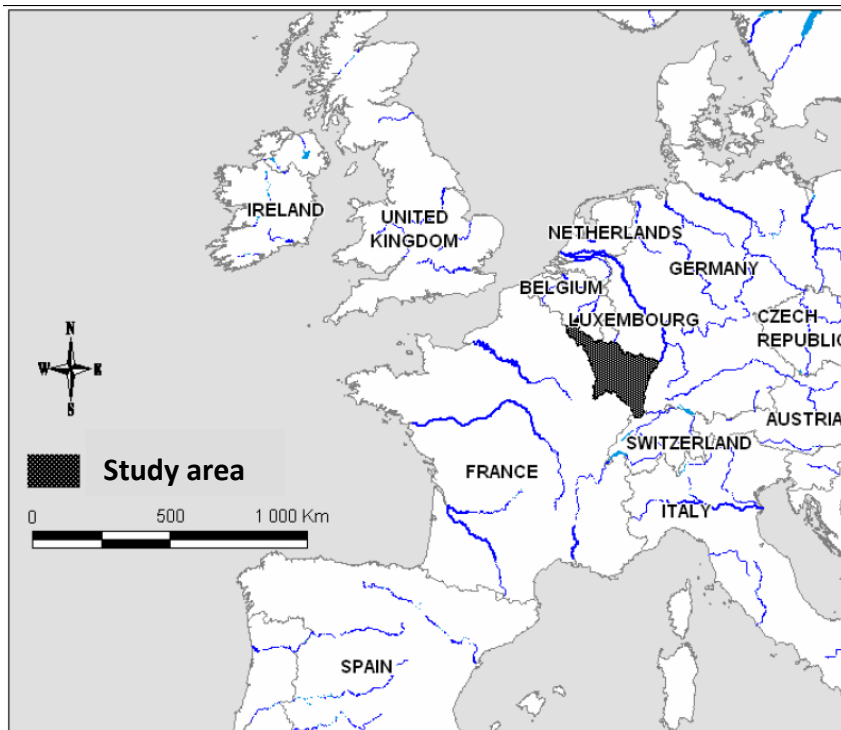
From flood to low flow: analysis of recession processes

- A good knowledge of recession processes is useful in many hydrological applications -

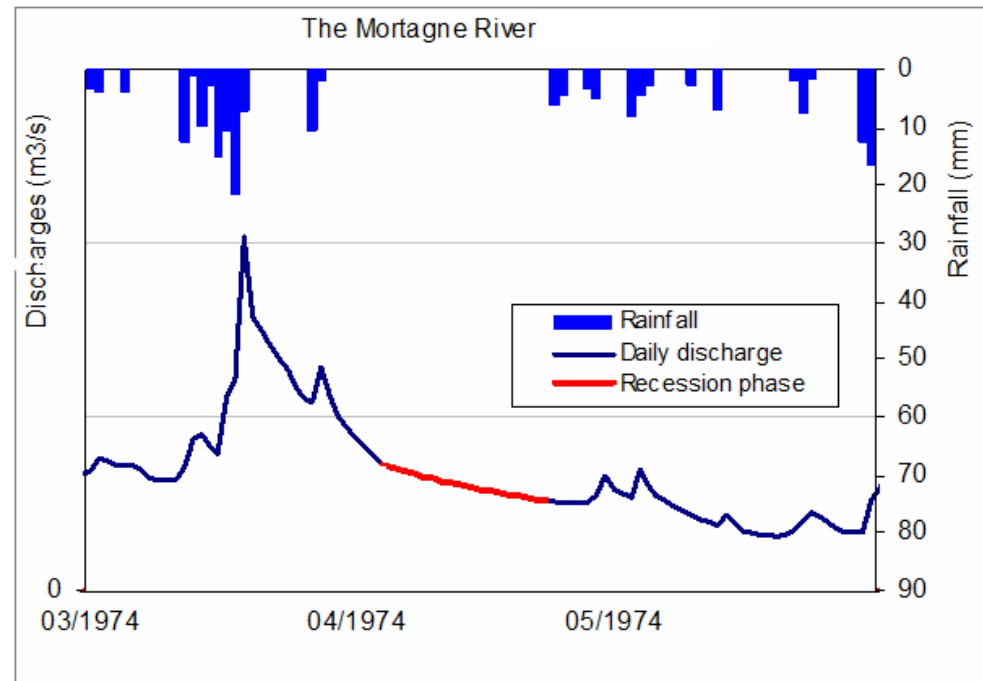


I. Main difficulties encountered in the analysis of baseflow recession processes

Data set of 60 catchments



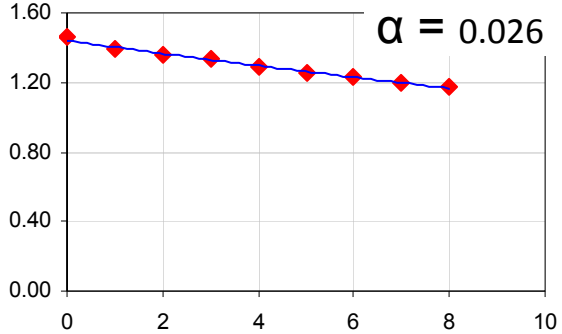
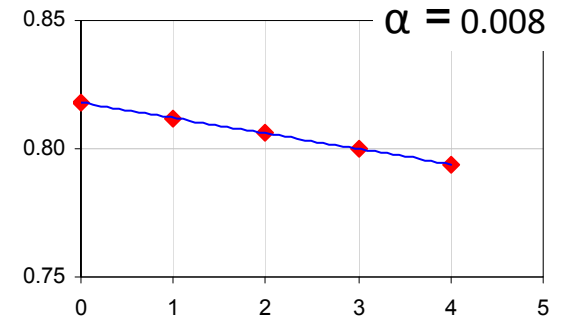
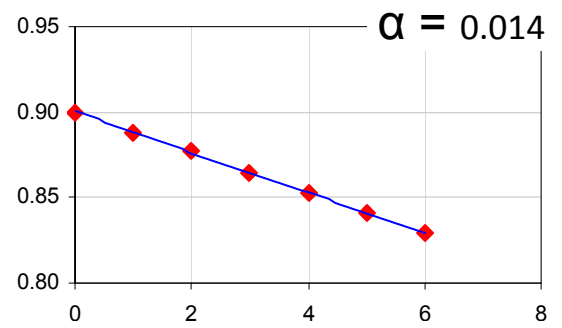
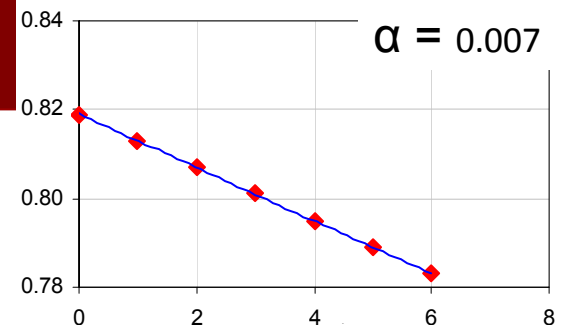
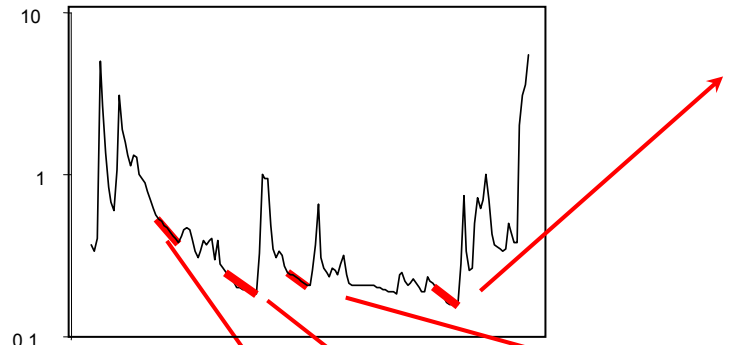
Baseflow recession: Gradual depletion of discharges during no precipitation periods



River	Station	Number of segments
Bar	Cheveuges	135
Bruche	Russ	113
Bruche	Holtzheim	126
Chiers	Chauvency	47
Chiers	Carignan	88
Doller	Reiningue	54
Esch	Jezainville	89
Fecht	Wintzenheim	74
Fecht	Ostheim	78
Giessen	Sélestat amont	135
Ill	Didenheim	80
Largue	Dannemarie	108
Loison	Han-lès-Juvigny	134
Madon	Mirecourt	140
Madon	Pulligny	133
Meurthe	Saint-Dié	130
Meurthe	Raon l'Etape	96
Meurthe	Damelevières	58
Meurthe	Malzéville2	43
Meuse	Goncourt	127
Meuse	Domremy la Pucelle	55
Meuse	Vaucouleurs	83
Meuse	Saint Mihiel	64
Meuse	Stenay	34
Meuse	Chooz	16
Moder	Schweighouse	44
Mortagne	Autrey-Ste-Hélène	109
Mortagne	Gerbéville	93
Moselle	Rupt-sur-Moselle	126
Moselle	Saint-Nabord	172
Moselle	Epinal	128
Moselle	Tonnoy	67
Moselle	Toul	41
Moselle	Custines	31
Moselle	Hauconcourt	39
Moselle	Uckange	29
Moselotte	Vagney	95
Mouzon	Circourt-sur-M.	129
Nied All	Varize	109
Nied Fcse	Pontigny	108
Rau Trey	Vandières	47
Rupt de Mad	Orville	77
Sarre	Keskastel	38
Sarre	Sarreinsming	51
Sauer	Beinheim	43
Scance	Verdun	27
Seille	Nomeny	146
Seille	Metz	123
Seltzbach	Niederroedern	41
Semoy	Haulmé	61
Sormone	Belval	47
Thur	Staffelfelden	50
Vair	Soulosse	118
Vezouze	Lunéville	138
Vezouze	Frémonville	23
Vologne	Chénimenil	73
Weiss	Kaysersberg	100
Zorn	Waltenheim	41



109 precipitation-free recession segments



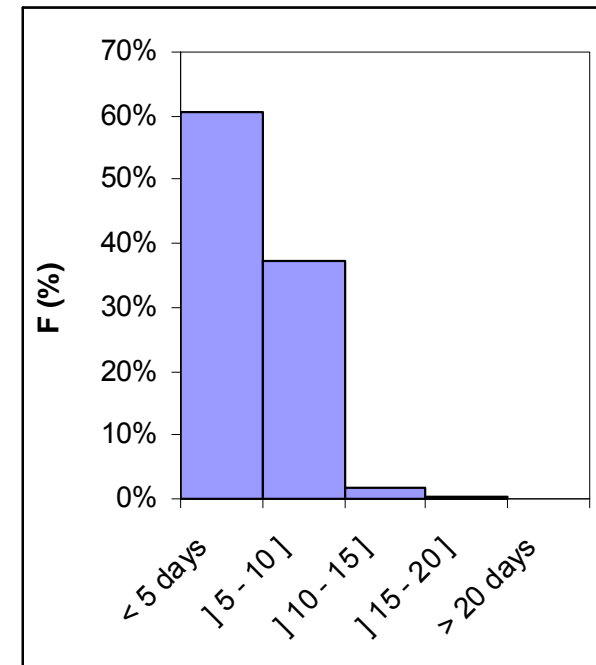
These recession segments can be described by an exponential curve:
 → The recession coefficients of each individual segments are calculated.

I. Main difficulties encountered in the analysis of baseflow recession processes

- Two main difficulties -

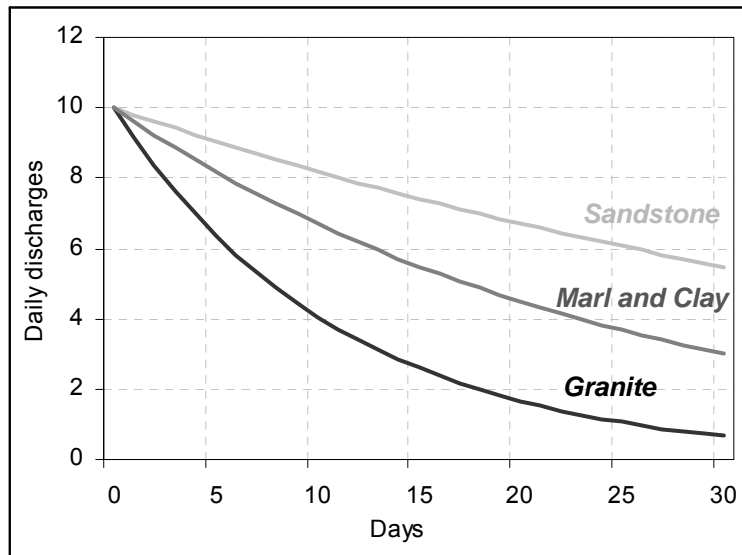
- The segments are very short (recession processes are frequently interrupted by rainfall)
- A high variability in recession behaviors

Statistics of the duration of the baseflow recession segments for the data set of 60 basins

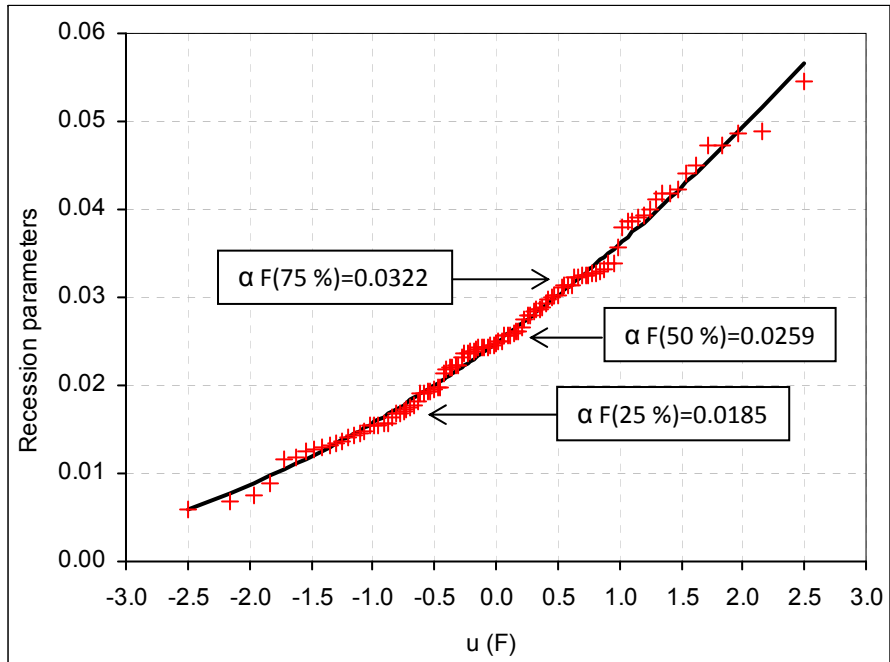


I. Main difficulties encountered in the analysis of baseflow recession processes

Master Recession Curve

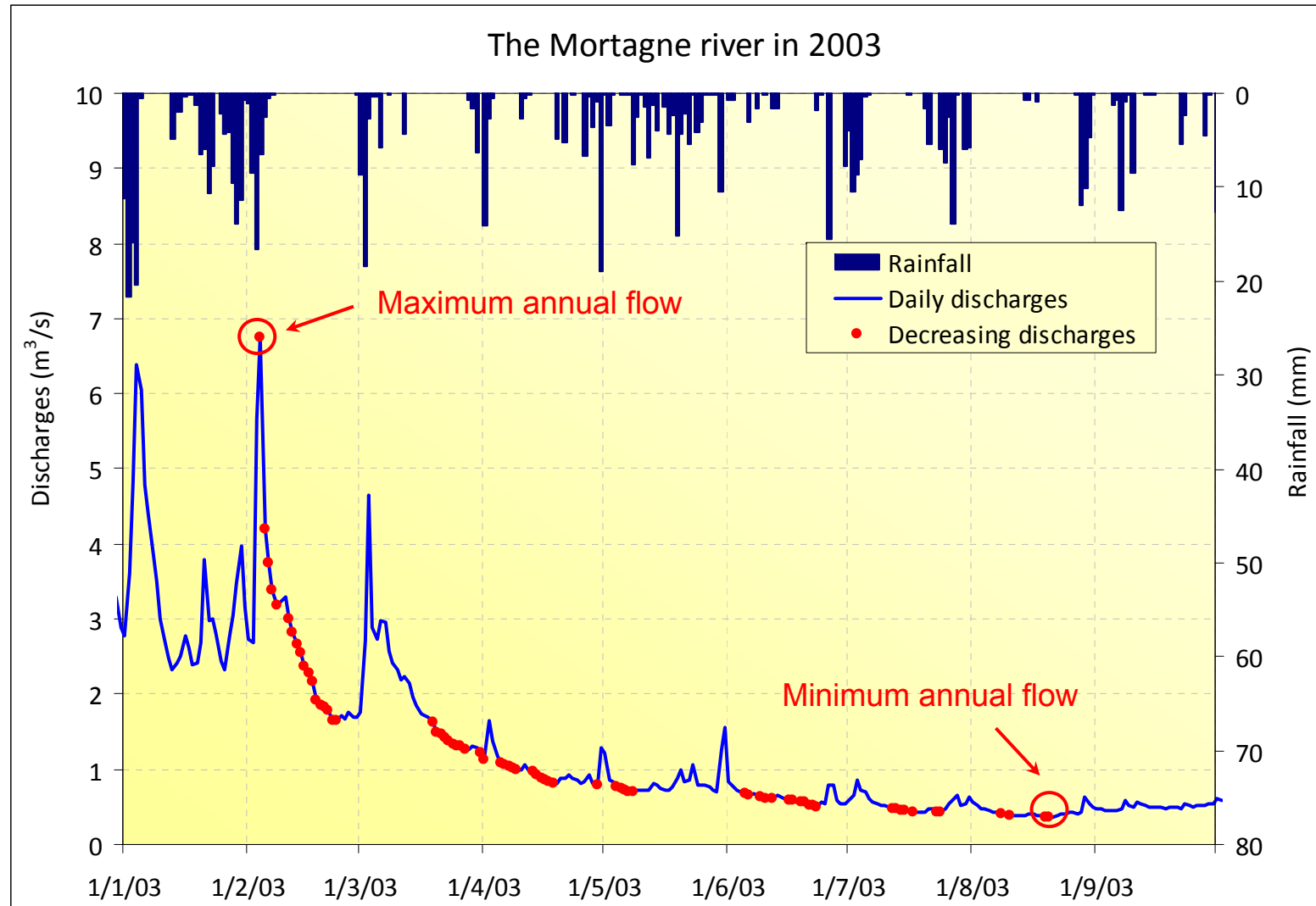


Statistical analysis

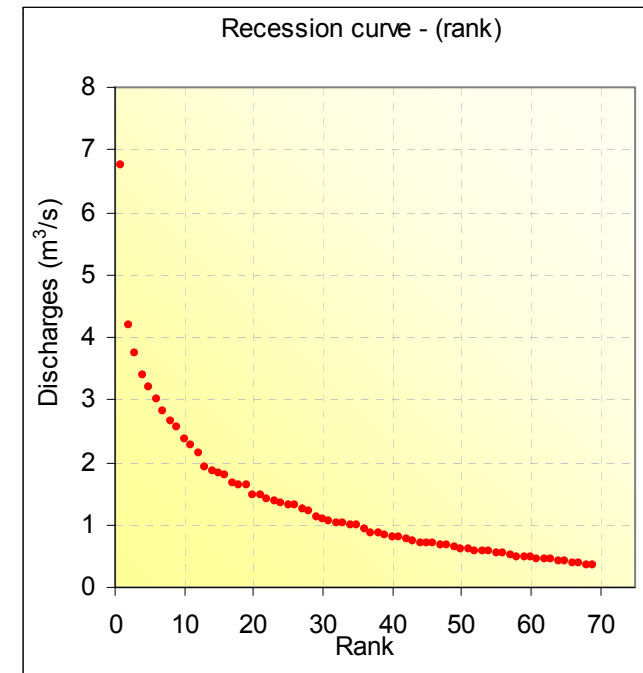
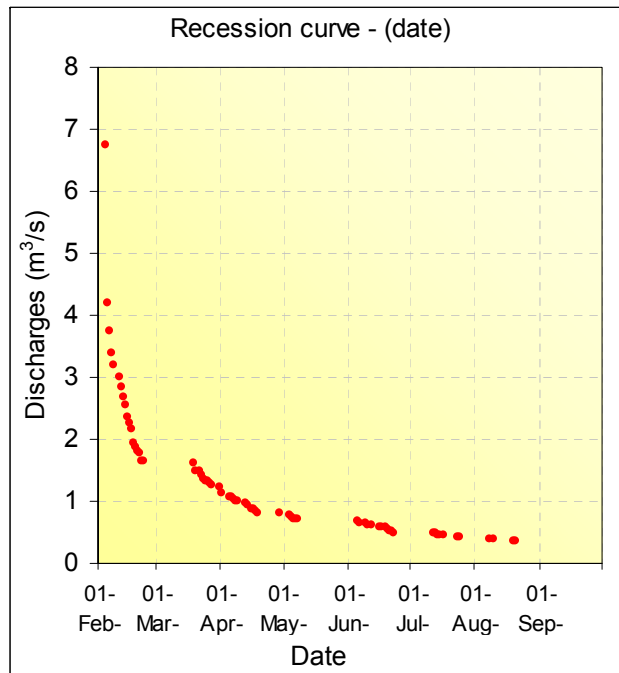
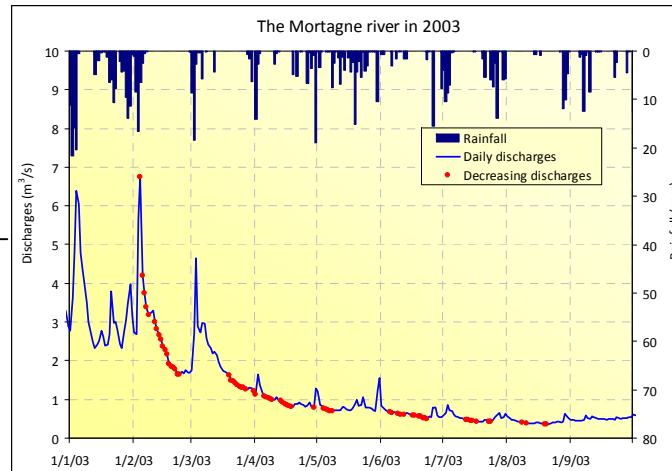


- High variability both between and within catchments -

II. Method - Construction of an “annual recession curve” of decreasing discharges

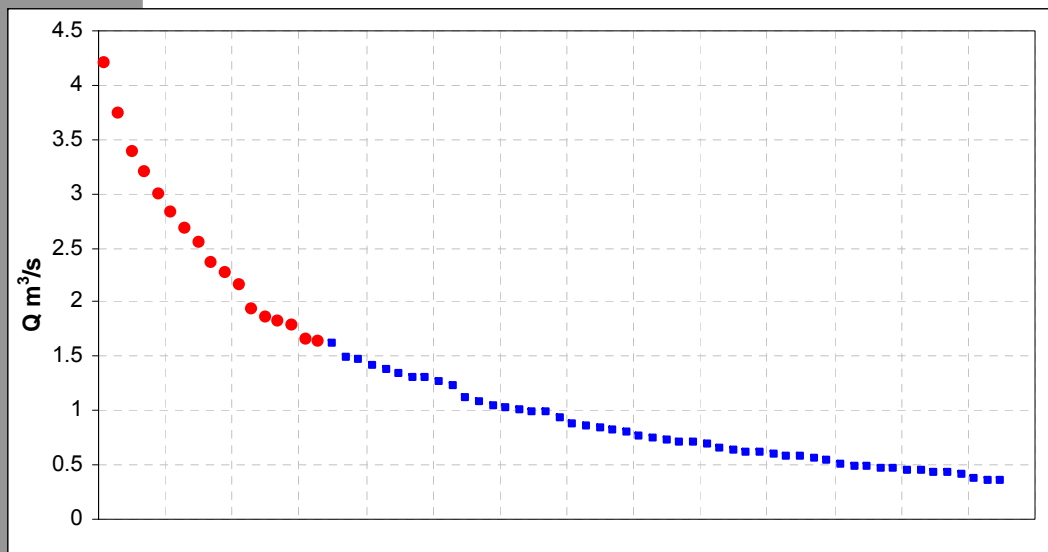
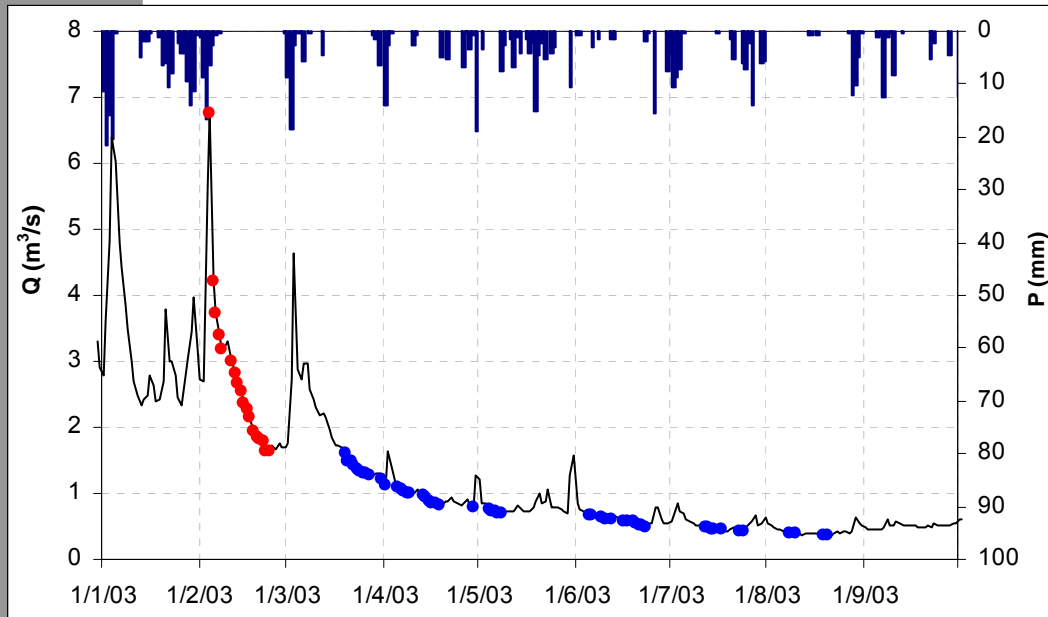


II. Method - Construction of an “annual recession curve” of decreasing discharges

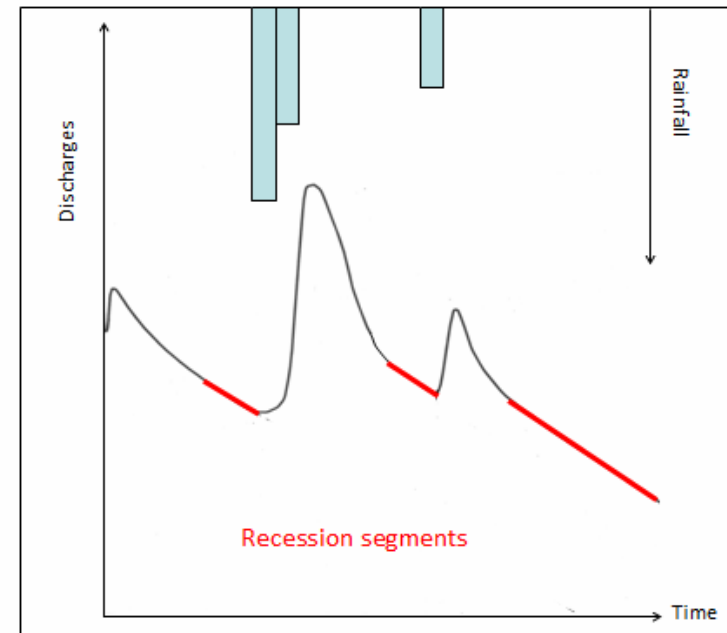


III. Results - Interpretation of the recession curve

Example of an “annual recession curve”
The River Mortagne in 2003



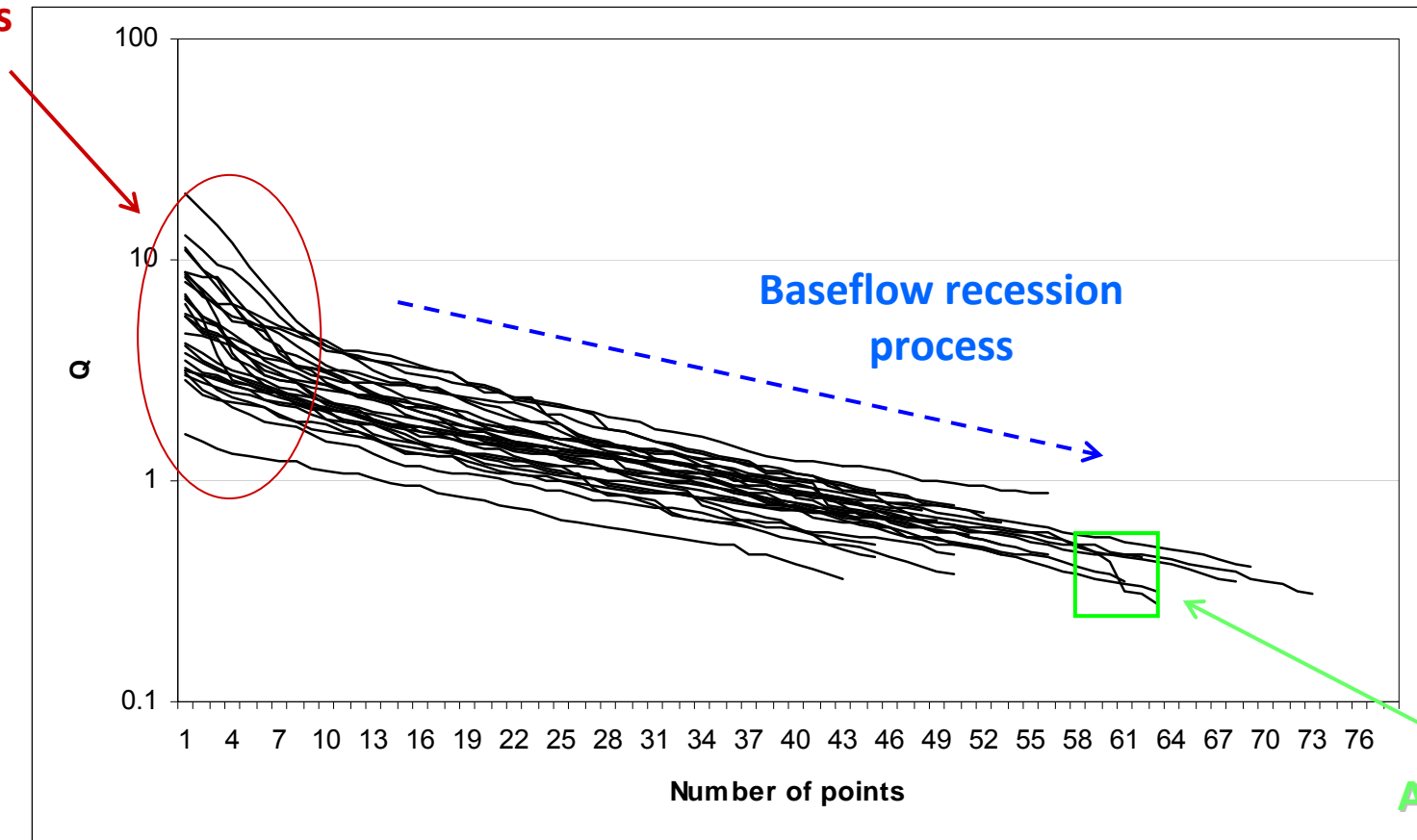
Comparison with the selection of baseflow
recession segments



III. Results - Graphical interpretations

Annual recession curves - The River Mortagne (1971-2003)

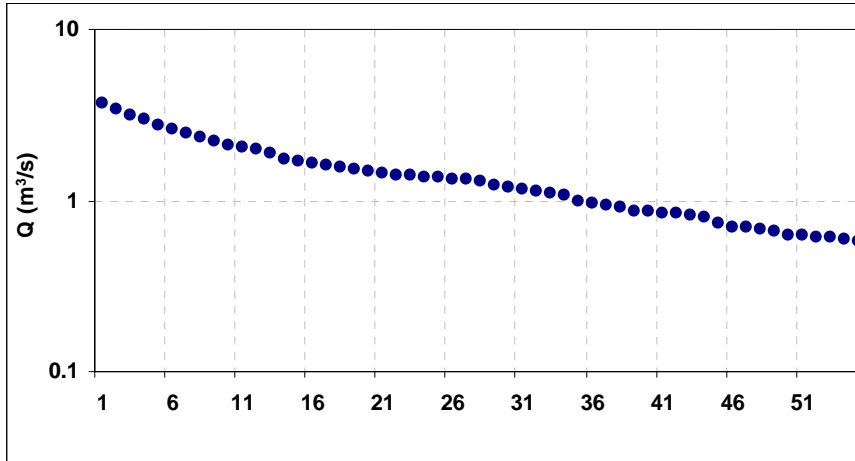
**Flood recession
process**



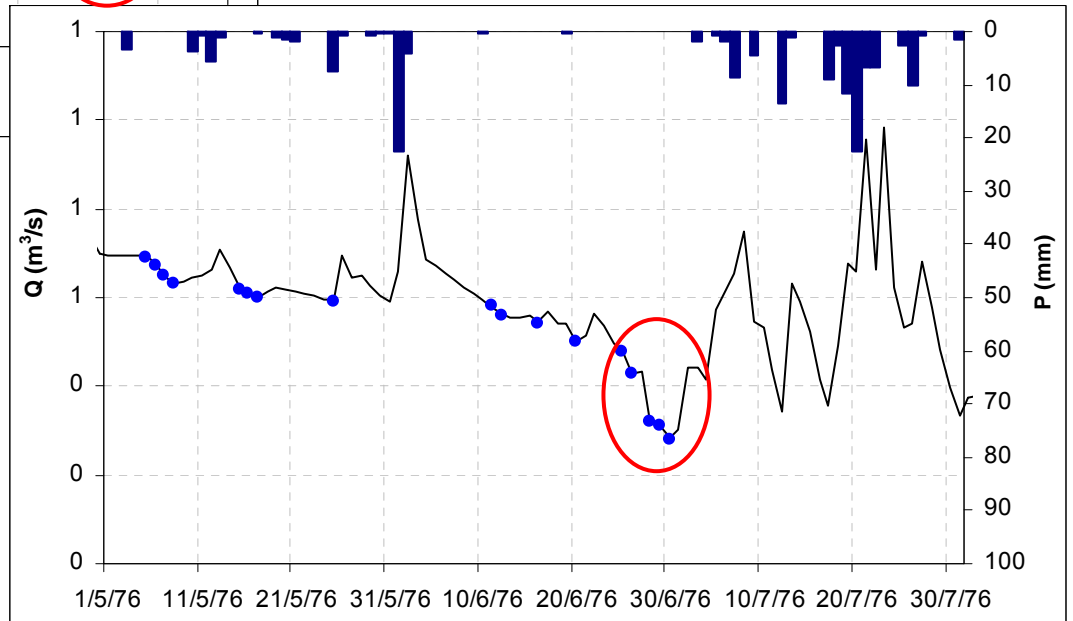
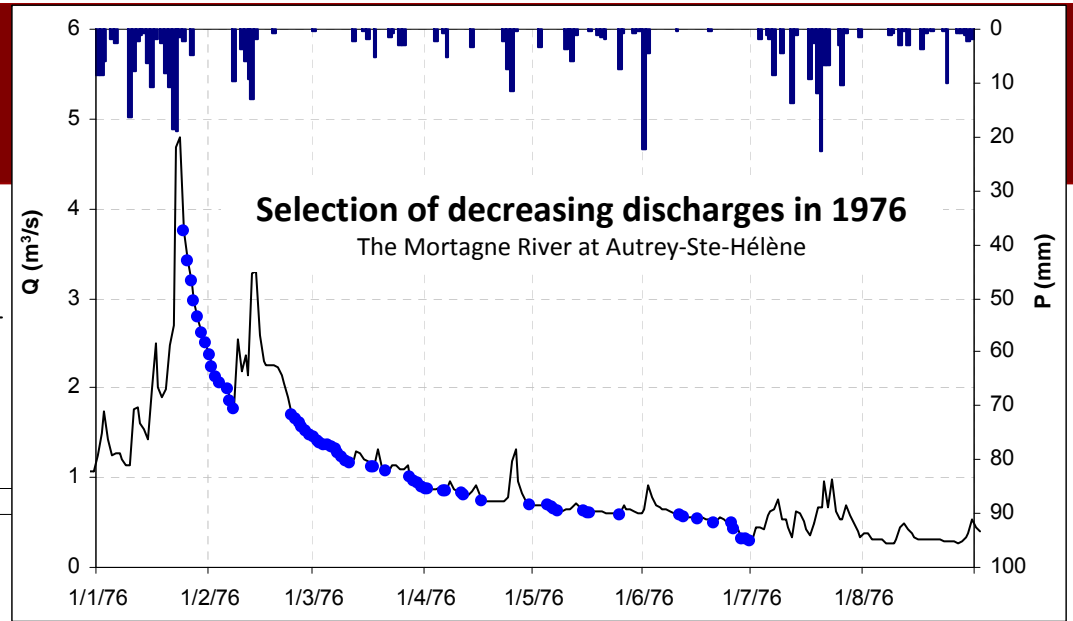
Anomalies

Detection of anomalies in the hydrograph

Recession curve in 1976



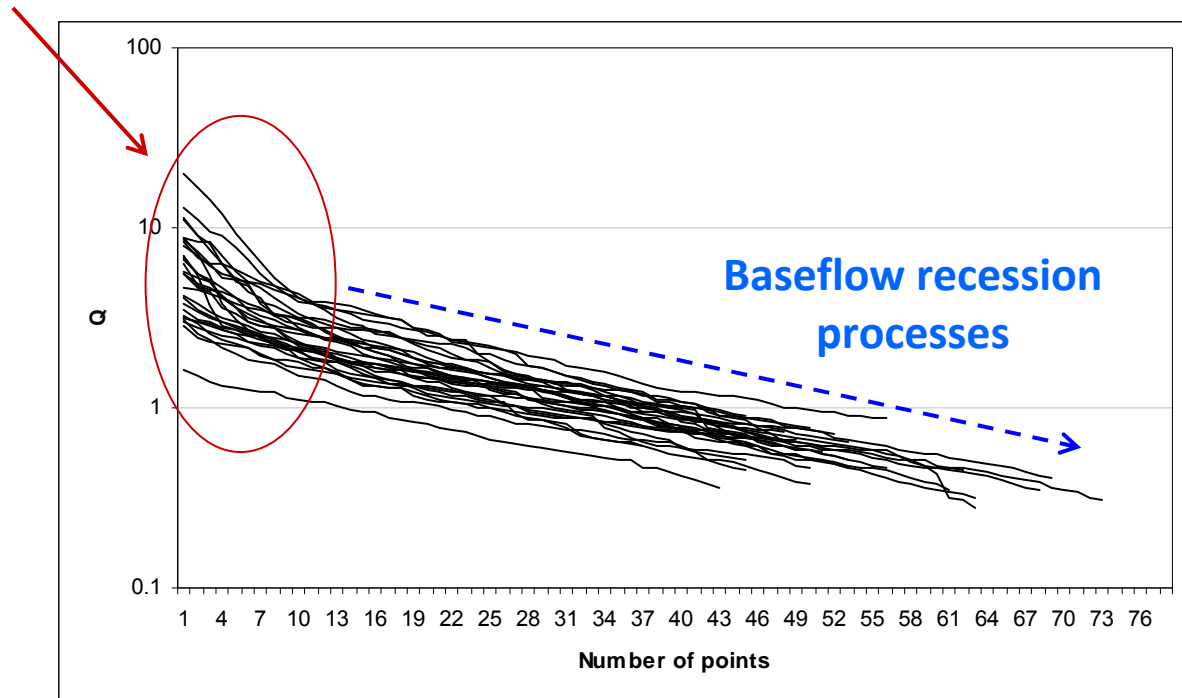
Anomalies probably due to the rating equation



III. Results - Interpretation of the recession curve

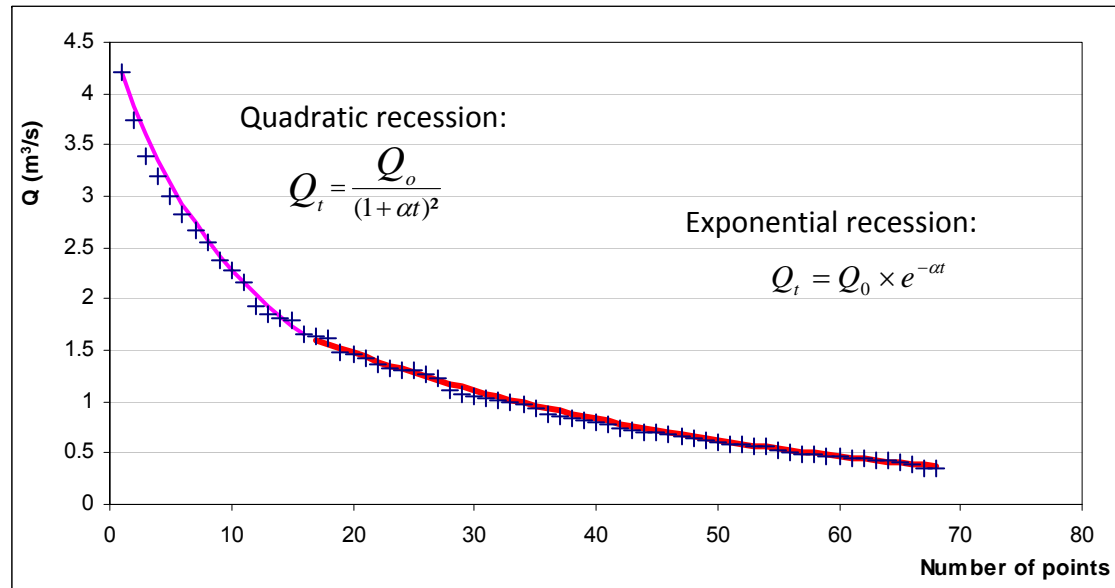
Surface recession processes

Annual recession curves
The River Mortagne (1971-2003)

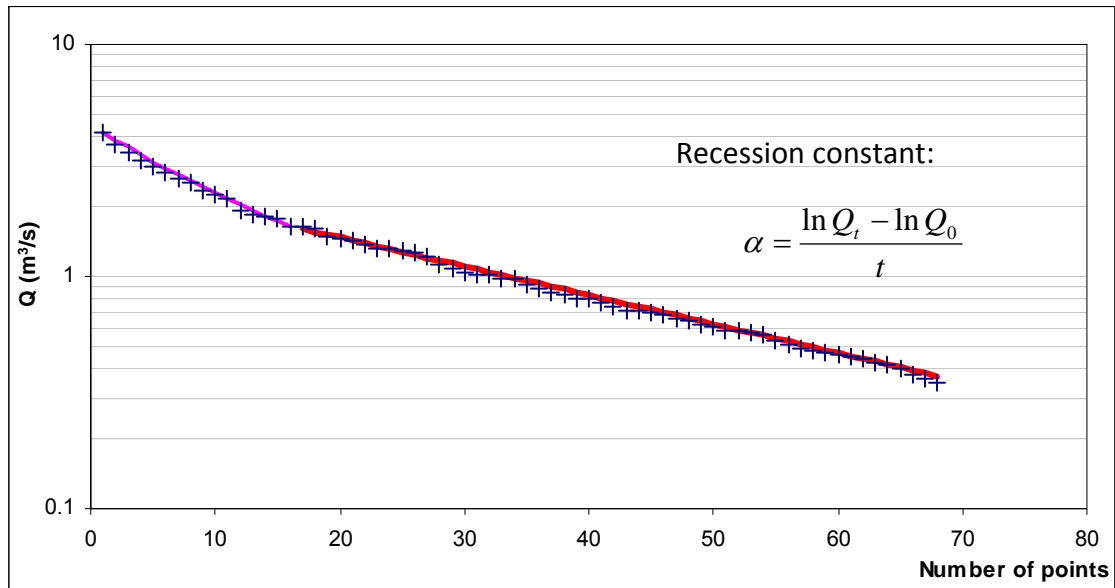


III. Results - Interpretation of the recession curve

Example of an “annual recession curve”
The River Mortagne in 2003



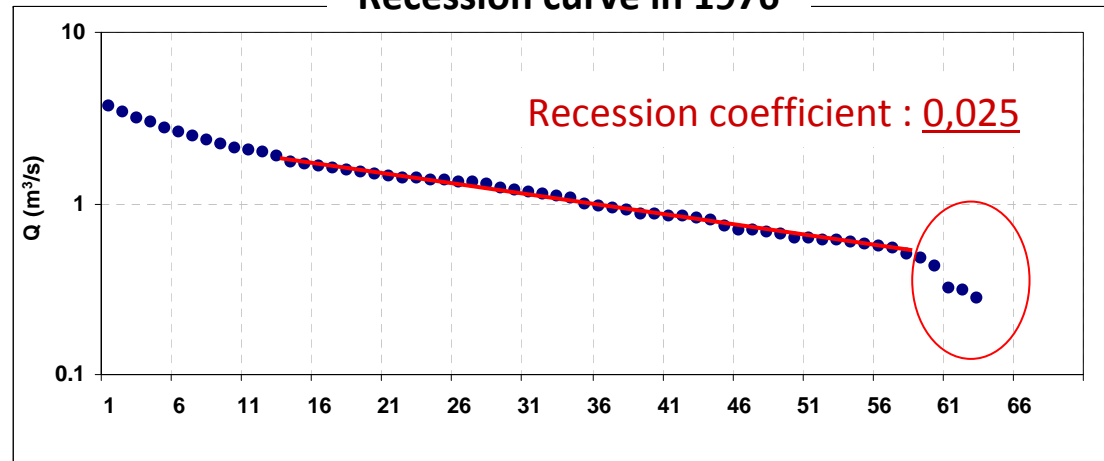
Semi-logarithmic scale:



III. Results - Comparison with the master recession curve

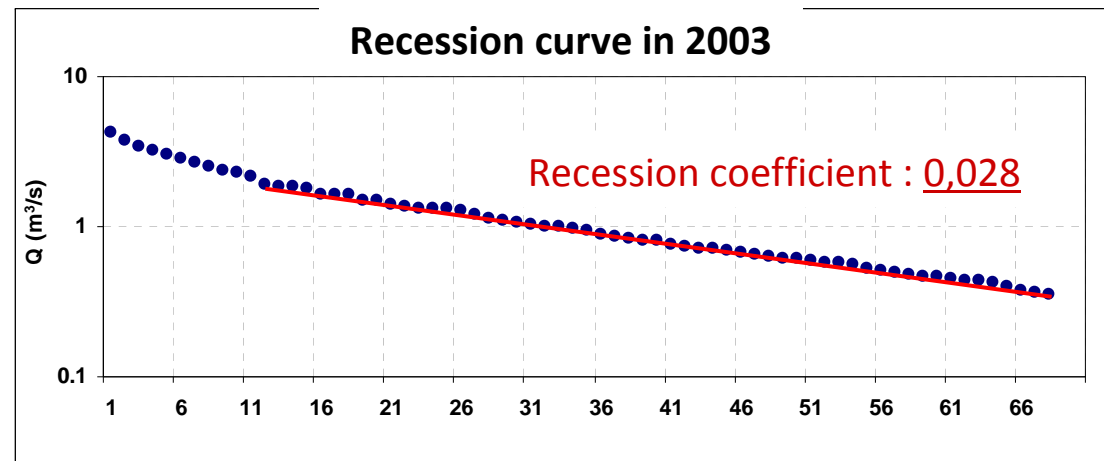
The Mortagne River at Autrey-Ste-Hélène

Recession curve in 1976



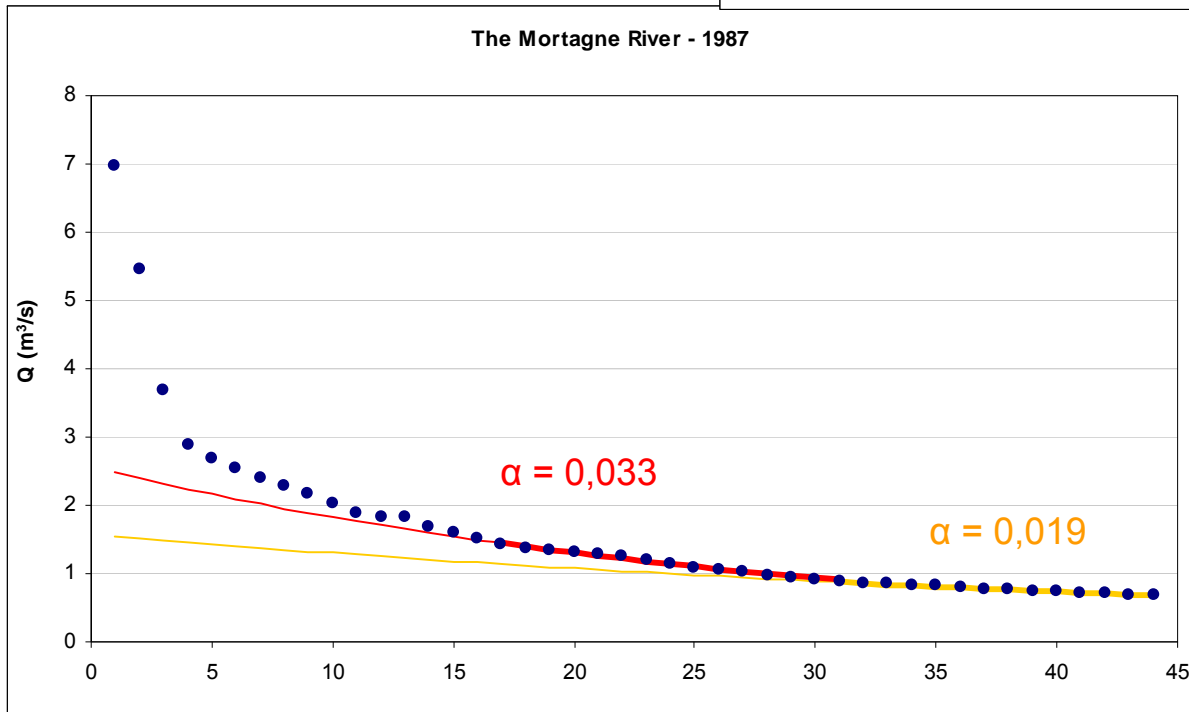
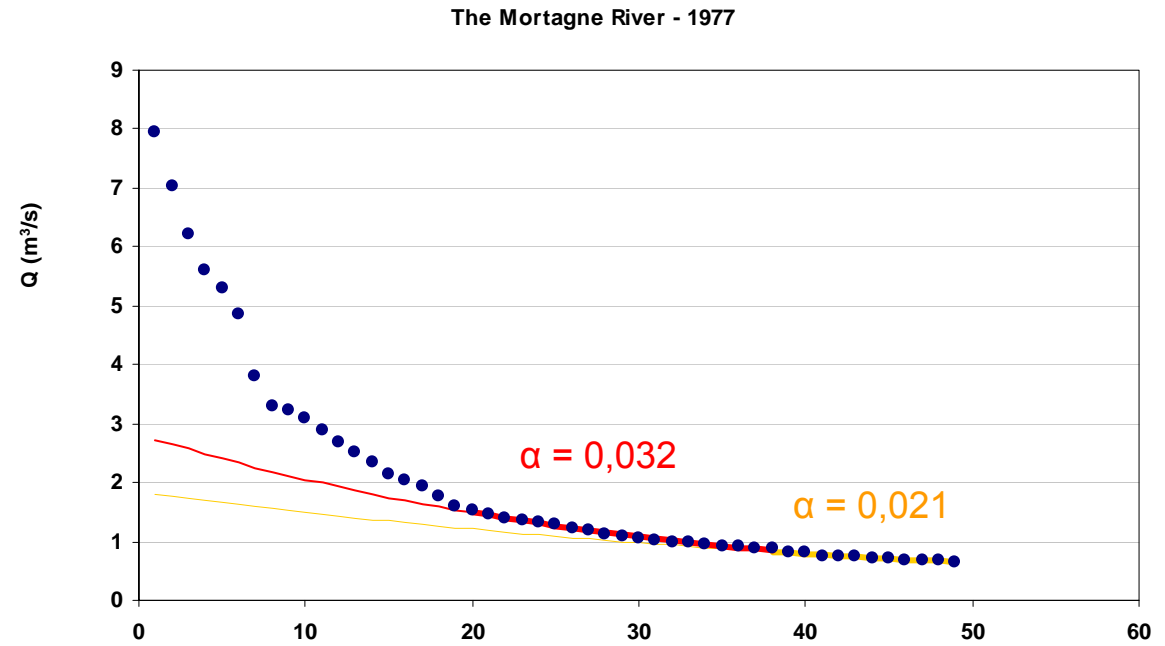
Recession coefficient
derived from the MRC:
 $\alpha = \underline{0,023}$

Recession curve in 2003



III. Results

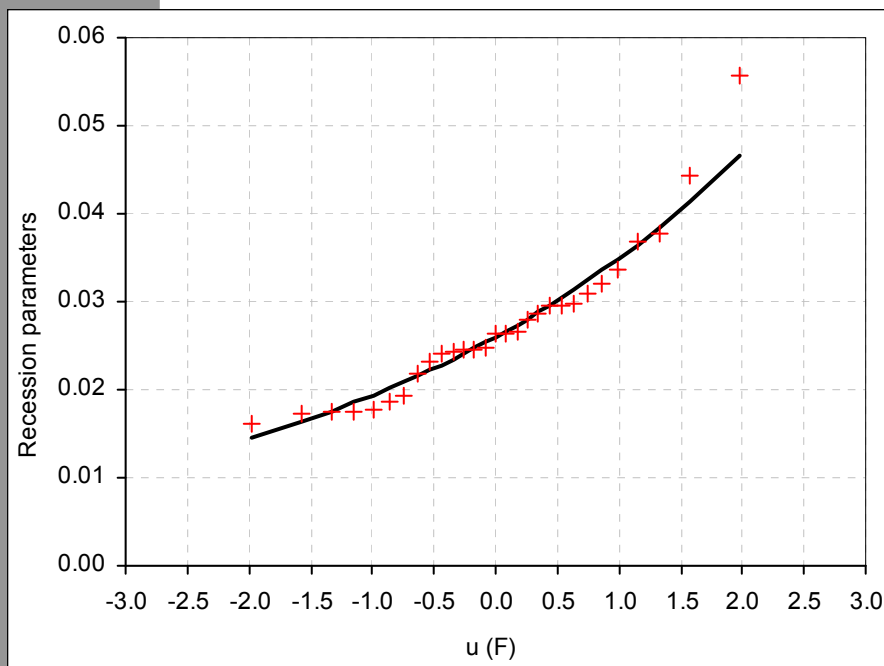
The recession rates decrease gradually and could represent different stages in the groundwater outflow process.



III. Results

Statistical analysis to compare the similarities with the coefficients calculated from the baseflow recession analysis.

Frequency	“Annual recession curve”	Baseflow recession analysis
F 25%	0.021	0.023
F 50%	0.026	0.029
F 75%	0.032	0.035



Conclusion

- ❑ The recession segments can be sorted according to their rates and behaviours.
- ❑ The last part of the curve can be related to the baseflow recession process. We can observe a variability in the recession rates but this variability is organized: the rates decrease gradually during the year.
- ❑ Similar patterns are observed for small catchments located in an homogeneous area with important groundwater storage.
- ❑ These results are used to improve the rainfall-runoff model.