



Event-scale investigations of natural and anthropogenic controls on river recession behaviour and trends

1 Introduction



The [Brutsaert and Nieber, 1977] streamflow recession recession analysis

 $-dQ/dt = aQ^b$

provides a way to link top-down data analysis with bottom-up physical theory.

Mechanism	Slope	Conductivity	B-N-b
Kinematic wave	Steep	Uniform	0
Boussinesq	Steep	Uniform	0
Weir	any		0.5
Linear Reservoir	any		1
Linearized Bouss.	Flat	Uniform	1
Manning	any		1.4
Boussinesq	Flat	Uniform	1.5
Boussinesq	Flat	Power-law	$1.5\ {\rm to}\ 2$
TOPmodel	Steep	Exponential	2

$\mathbf{2}$ **Research** questions

- What are the *patterns* and *trends* in B-N parameters?
- Can the B-N analysis disentangle *natural* and *an*thropogenic factors?
- Can B-N patterns be explained from *physical* mechanisms?

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Results 3

Patterns 3.1



Maps of 'constant' Brutsaert-Nieber parameters a, 1/aand b suggest clear North-South gradients.

3.2 Trends



Distributions of trend magnitude of a and b indicate opposite trend directions.

Summary

The Brutsaert-Nieber recession analysis method has been used to characterize ≈ 200 Swedish rivers. Results suggest that the B-N parameters are strongly linked to the climate-soil-land use complex. Many catchments show a trend towards more nonlinear behaviour, which is not correlated to changes in Q statistics.

4 Interpretation

Natural or anthropogenic? 4.1



Most relevant explanatory variables (to predict a and b), according to a bootstrap-like ensemble multiple regression approach [van der Velde et al., 2013].



Prediction of B-N parameters for standardized catchments, based on maps of explanatory variables.

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Land use clusters in B-N space, with superimposed general trend directions.

Mechanisms 4.2

Land use type	1/a	b range	Mechanism
Agriculture Wetland Natural open Forest	Fast Fast Fast Mixed	1-1.5 1.4-2.0 1.3-2.0 0.8-1.5	Boussinesq k-profile k-profile Mixed
Open water	Slow	0.6 - 1.2	Manning

Conclusions

- Clear spatial *patterns* in B-N parameters - Attributed to climate-soil-landuse association
- Moderate trends in B-N parameters - Towards slower, more nonlinear recession
- No correlation between B-N and Q trends • Strong links with land use
- Mechanistic explanations suggested
- Trends orthogonal on generic land use axis
- Strongest trends in non-agricultural areas