

ECOSTAT nutrient meeting (18.-19.11.2015)

Session 2: Analysis of pressure-response relationships and application of nutrient boundaries

**Part 2: Results for rivers
Sebastian Birk**

Data

Seven Member States provided monitoring data:

Austria, Denmark, Germany, Luxembourg, Netherlands, Poland, United Kingdom

Main river types covered:

Low alkalinity lowland (incl. R-C1)

Low alkalinity upland (incl. R-C3)

High alkalinity lowland (incl. R-C4)

Data

BQEs:

Macrophytes

Phytobenthos

Minimum of Macrophytes & Phytobenthos

Determinants:

Soluble phosphorus

Total nitrogen

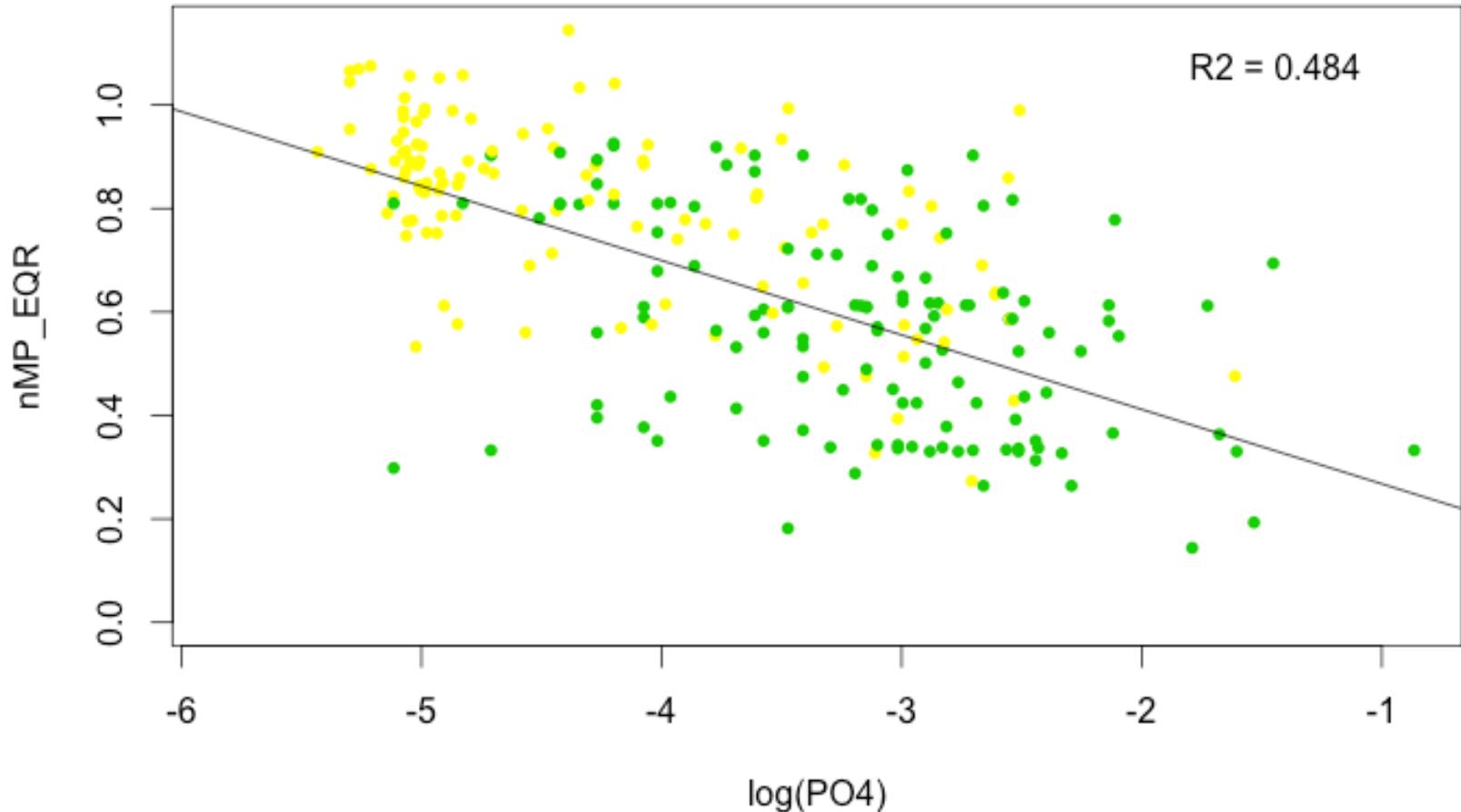
Total Phosphorus

Ammonium

Nitrate

Nitrite

Exemplary relationship



Macrophyte EQR versus soluble phosphorus at low alkalinity
lowland rivers (incl. R-C1) including data from UK and DK
(n=119)

Results

Low alkalinity lowland (incl. R-C1) – Total Nitrogen

IC Type	BQE used		GM TN mg l ⁻¹			HG TN mg l ⁻¹		
			Pred	range		Pred	range	
LAL	Macrophytes	most likely boundary		1.36	2.57		0.22	1.01
		best model R ² 0.38	1.47	0.59	3.49	0.38	0.15	0.91
		possible range		0.47	4.94		0.07	2.25
LAL	Phytobenthos	most likely boundary		1.93	4.72		0.62	1.03
		best model R ² 0.48	3.54	1.55	7.77	0.65	0.28	1.43
		possible range		0.90	12.56		0.22	1.56
LAL	Combined	most likely boundary		1.01	1.88		0.17	0.58
		best model R ² 0.51	1.13	0.56	2.54	0.36	0.20	0.89
		possible range		0.43	3.46		0.08	1.01

Results

Low alkalinity lowland (incl. R-C1) – Total Nitrogen

Outlying countries

- Macrophytes: *Poland*
- Phytobenthos: *none*
- Macrophytes & Phytobenthos: *Belgium (Flanders), Poland*

Results



Low alkalinity lowland (incl. R-C1) – Soluble Phosphorus

IC Type	BQE used		GM sol-P μgl^{-1}		HG sol-P μgl^{-1}			
			Pred	range	Pred	range		
LAL	Macrophytes	most likely boundary		32	45		11	22
		best model R^2 0.48	45	25	80	13	7	23
		possible range		18	98		5	30
LAL	Phytobenthos	most likely boundary		27	62		10	17
		best model R^2 0.49	40	26	55	16	11	23
		possible range		16	126		7	36
LAL	Combined	most likely boundary		21	36		8	12
		best model R^2 0.50	28	19	43	10	7	15
		possible range		13	72		5	18

Results

UPDATED

Low alkalinity lowland (incl. R-C1) – Soluble Phosphorus

Outlying countries

- Macrophytes: *Belgium (Flanders), Croatia, Poland*
- Phytobenthos: *Belgium (Flanders), Croatia, Poland*
- Macrophytes & Phytobenthos: *Germany, France, Netherlands, Belgium (Flanders), Croatia, Poland*

Results

Low alkalinity upland (incl. R-C3) – Total Nitrogen

IC Type	BQE used		GM TN mg l ⁻¹		HG TN mg l ⁻¹			
			Pred	range	Pred	range		
LAU	Mac	most likely boundary		1.31	3.20		0.50	0.69
		best model R ² 0.49	2.44	1.18	5.10	0.50	0.24	1.05
		possible range		0.82	7.18		0.23	1.12
LAU	Phytobenthos	most likely boundary		1.29	4.40		0.63	0.92
		best model R ² 0.40	2.52	1.27	5.61	0.80	0.40	1.78
		possible range		0.83	12.61		0.29	2.63
LAU	Combined	most likely boundary		0.78	2.80		0.35	0.43
		best model R ² 0.34	1.87	1.02	4.59	0.36	0.20	0.89
		possible range		0.55	7.24		0.15	0.91

Results

Low alkalinity upland (incl. R-C3) – Total Nitrogen

Outlying countries

- Macrophytes: *Poland*
- Phytobenthos: *none*
- Macrophytes & Phytobenthos: *Poland*

Results

Low alkalinity upland (incl. R-C3) – Soluble Phosphorus

IC Type	BQE used		GM sol-P $\mu\text{g l}^{-1}$			HG sol-P $\mu\text{g l}^{-1}$		
			Pred	range		Pred	range	
LAU	Macrophytes	most likely boundary		48	128		10	17
		best model R^2 0.40	91	39	215	12	5	29
		possible range		25	372		4	50
LAU	Phytobenthos	most likely boundary		51	86		17	28
		best model R^2 0.43	64	33	124	21	11	41
		possible range		28	186		7	50
LAU	Combined	most likely boundary		32	57		6	13
		best model R^2 0.47	40	19	78	8	4	16
		possible range		17	93		2	27

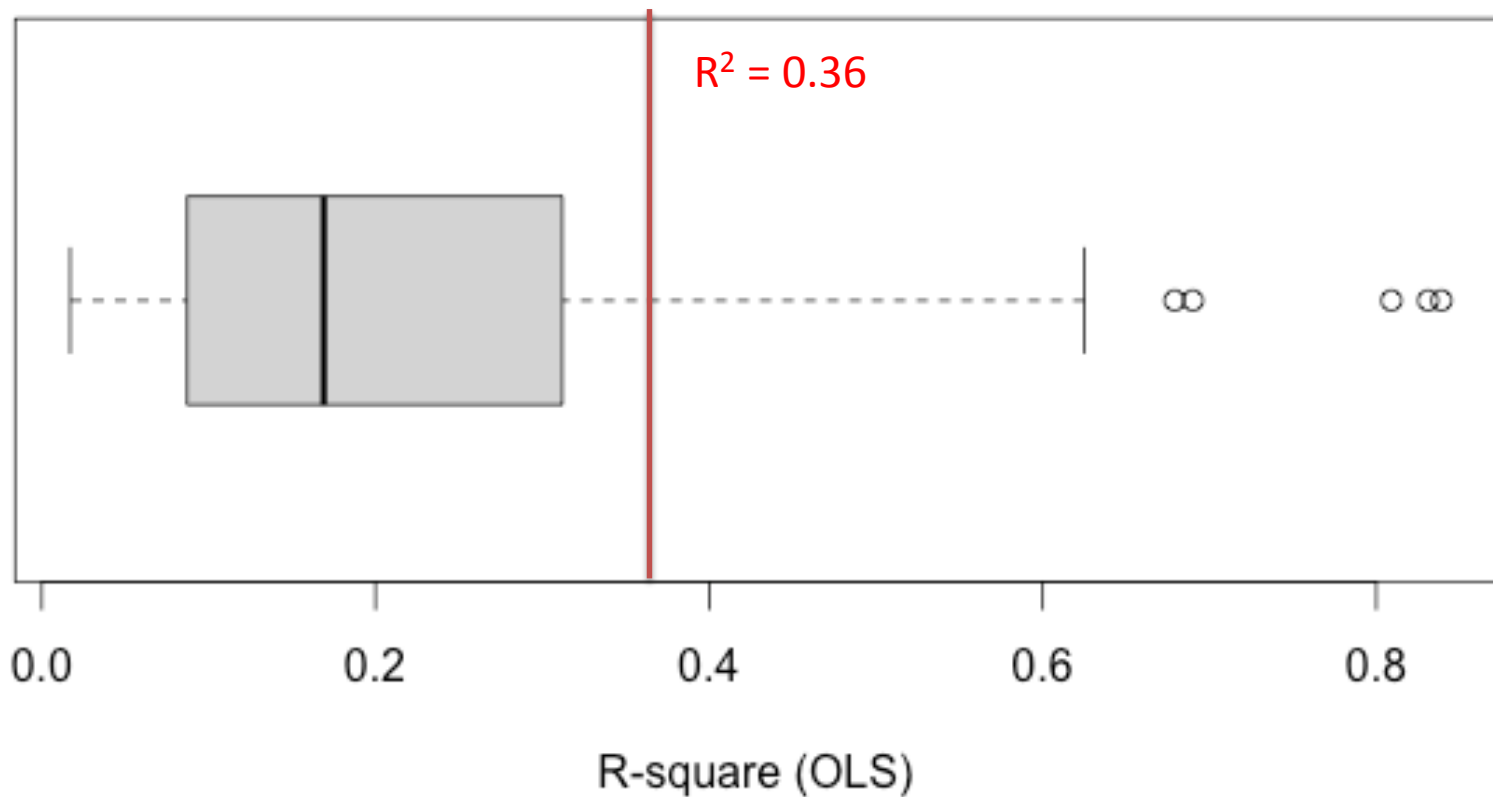
Results

Low alkalinity upland (incl. R-C3) – Soluble Phosphorus

Outlying countries

- Macrophytes: *Poland*
- Phytobenthos: *Poland*
- Macrophytes & Phytobenthos: *Hungary, Poland*

Poor pressure-response relationships



*R^2 -value range of significant pressure-response relationships
($n=159$ relationships analysed in total)*

Poor pressure-response relationships

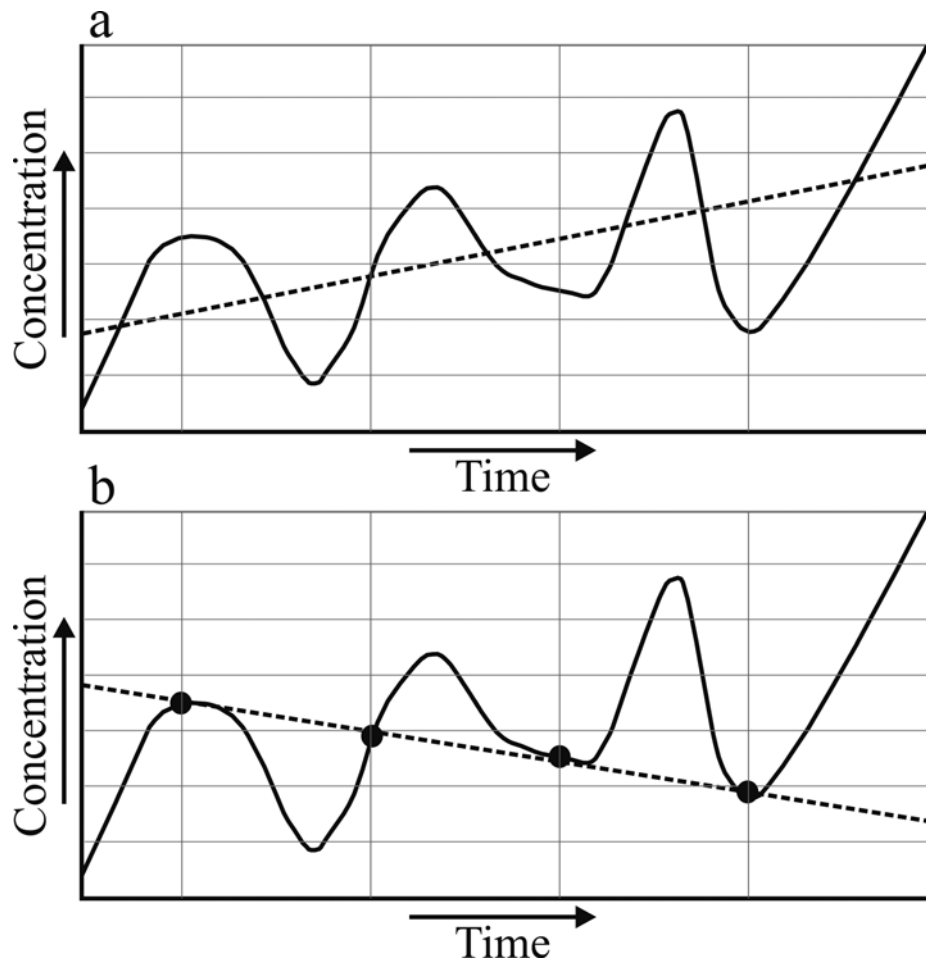
Reasons

Methodological (sampling-related)

- Inadequate temporal resolution
- Unsuitable medium (sediments in case of macrophytes)

Ecological (ecosystem-related)

- Rivers are highly variable, multi-stress environments with nutrients being less influential (low retention time).



Hypothetical example of an upward trend in solute concentrations **(a)**, which is misinterpreted as a downward trend due to the uncertainty which is involved in low-frequency measurements **(b)**.

(Rozemeijer & van der Velde 2014)

Final remarks

- Statistical approach devised by Geoff is considered very reasonable.
- Rivers provide settings fundamentally different from lakes. However, approach is sensible also for rivers.
- Availability of suitable national datasets covering most of the broad types is most crucial.