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Assessing the origin of the acidity in a humic boreal river draining peatlands and sulfide-bearing soil materials

Jaakko Saukkoriipi[1], Martinmäki, K.[1], Marttila, H.[2], Heikkinen, K.[1], Tammela, S.[2], Tertsunen, J.[3], Tolkkinen, M.[1], Ihme, R.[1] & Klöve, B.[2]

[1]Finnish Environment Institute (SYKE), BO Box 413, 90014 Oulu, Finland

[2]University of Oulu, BO Box 4300, 90014 Oulu, Finland

[3]Centre for Economic Development, Transport and the Environment of North Ostrobothnia, BO Box 86, 90101 Oulu, Finland

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Background

- Total catchment area is ~ 400 km^2 and the proportion of lakes is 2,7 %.
- Catchment area is mainly covered by mires and forests.
  - Intensively drained!

Land use	Coverage [%]
Agricultural land	1,1
Pristine peatlands	10,4
Ditched peatlands	28,7
Peat extraction	1,4
Black schist regions	8,8

- 3/4 of the catchment area is covered by sulfide-bearing soils and black schist regions.
- Temporary acidic peaks detected during spring and autumn high runoff.
  - Fish kills in 2006-2007.

➢ **Assessment of the origin of the acidity!**

- The work was conducted in City and Water – Ecological enhancement and improvement of recreational value of river Sanginjoki project!

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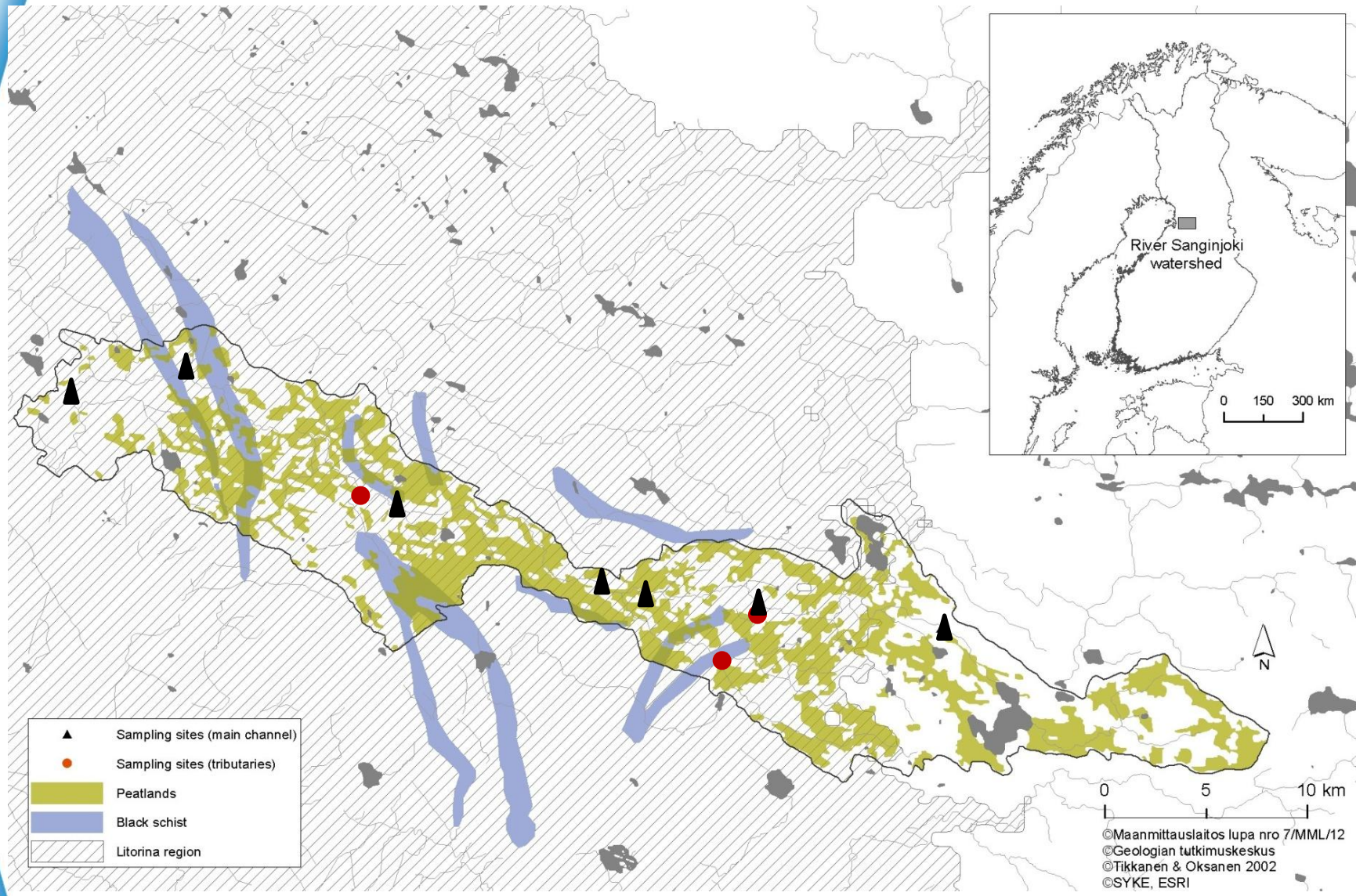
Catchment characteristics



- 1st sampling period: 12 set of samples in 2010 (May - October)
- 2nd period: 2 sets of samples in 2011 (April – May)

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Methods

- Due to the high coverage of peatlands and sulfide-bearing sediments/till in the watershed, the assesment of the origin of the acidity in river Sanginjoki was performed as follows:

1. Comparison of the organic anion [A^-] and non-marine sulphate [$*SO_4^{2-}$] concentrations.
   - Ion balance & model based on titration results of isolated hydrophobic and hydrophilic acids[a].
   - Sea salt corrected sulphate concentration.
2. Statistical analysis of the water quality variables.
3. Comparison of the collected data to a hydro-geochemistry of other streams affected by a.s. soils.

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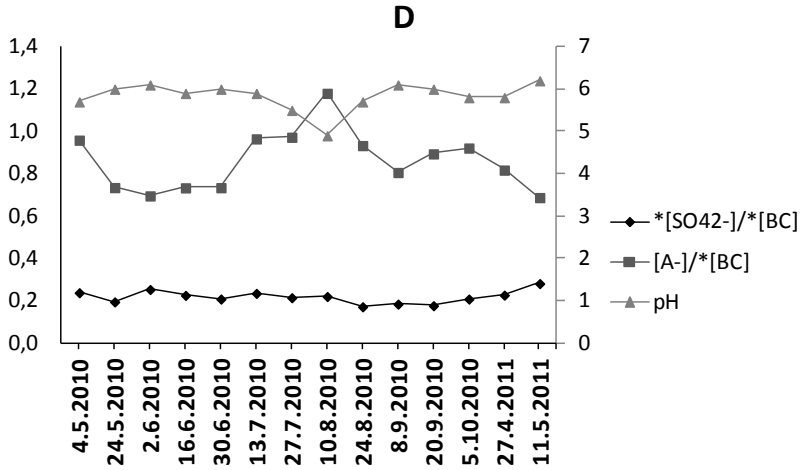
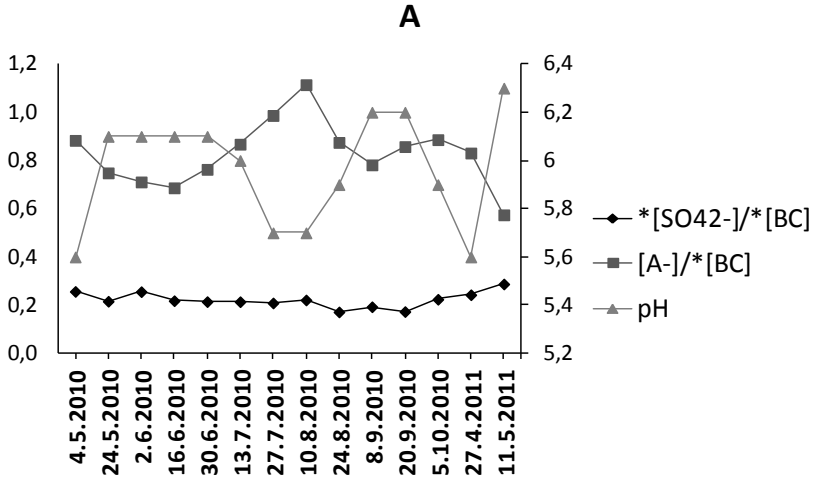
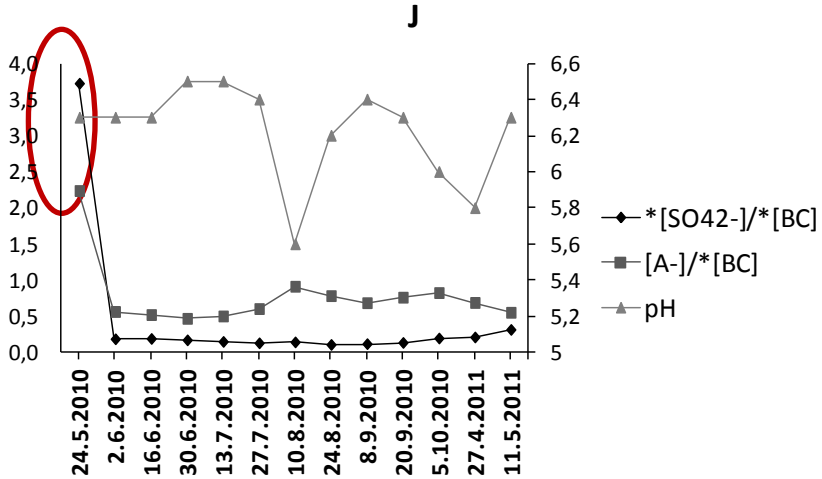
[a] Kortelainen P., Ph.D. Thesis, University of Helsinki, Publications of the Water and Environment Research Institute, no. 13, Helsinki 1993.

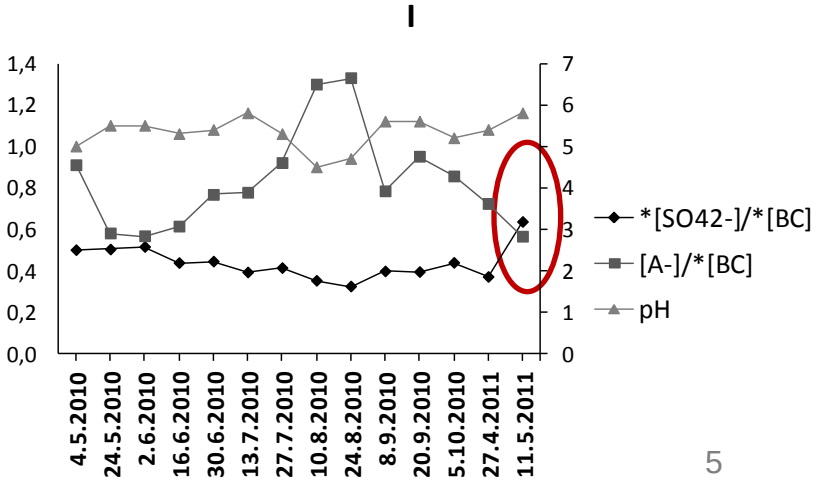
Organic anion vs. non-marine sulphate

- The organic anion concentration exceeded the non-marine sulphate concentration in all main channel sampling sites.









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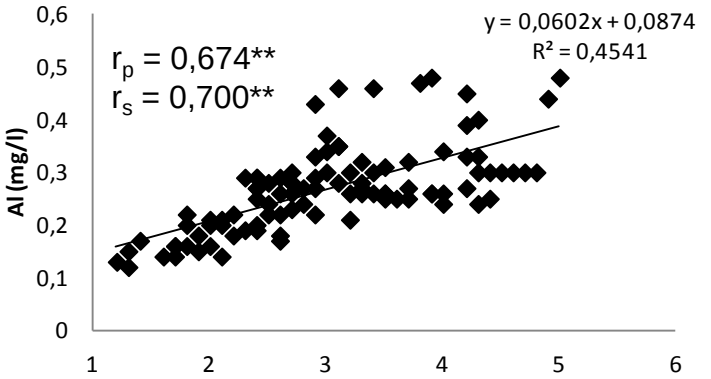
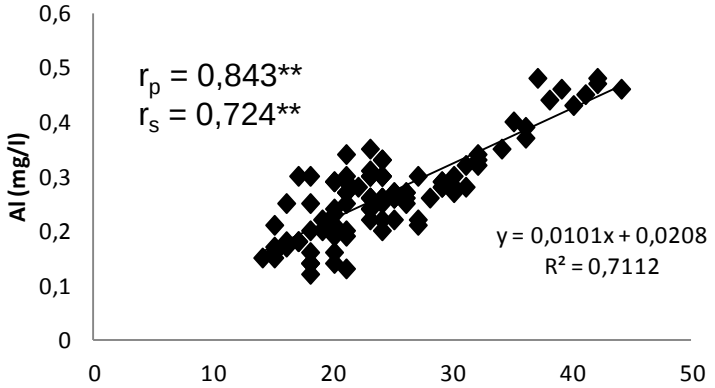
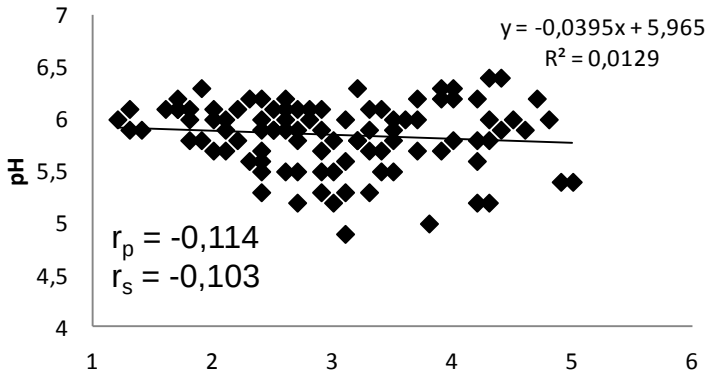
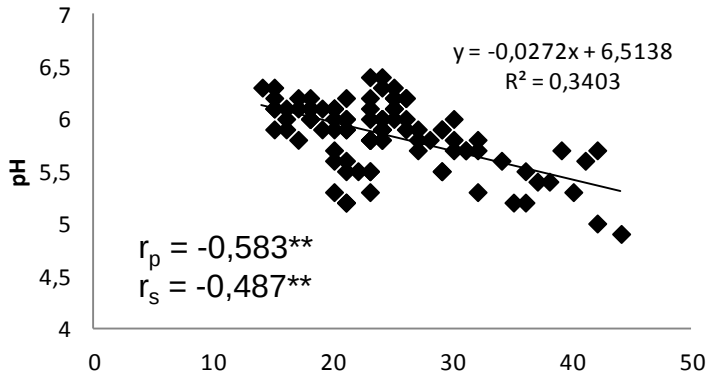
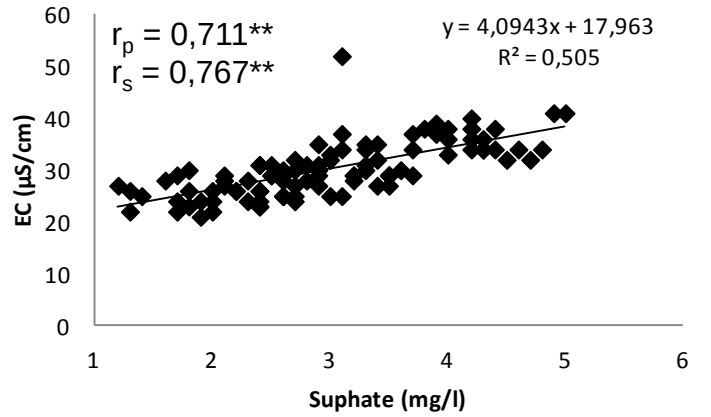
Statistical analysis

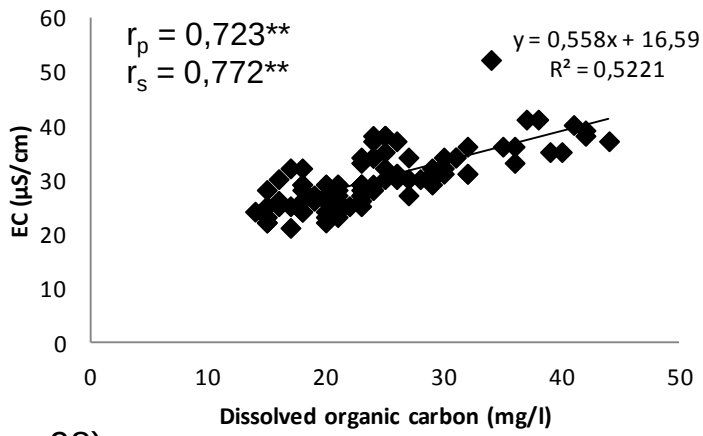












**Correlations significant at the 0,01 level (n = 98)

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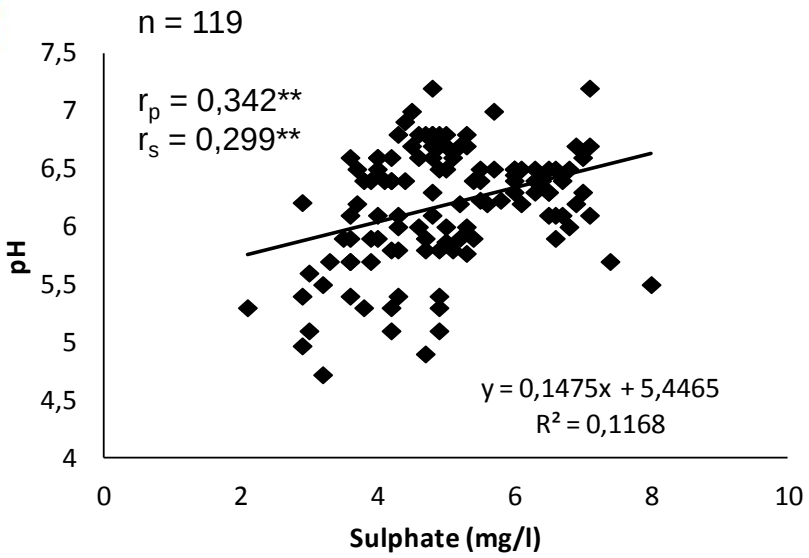
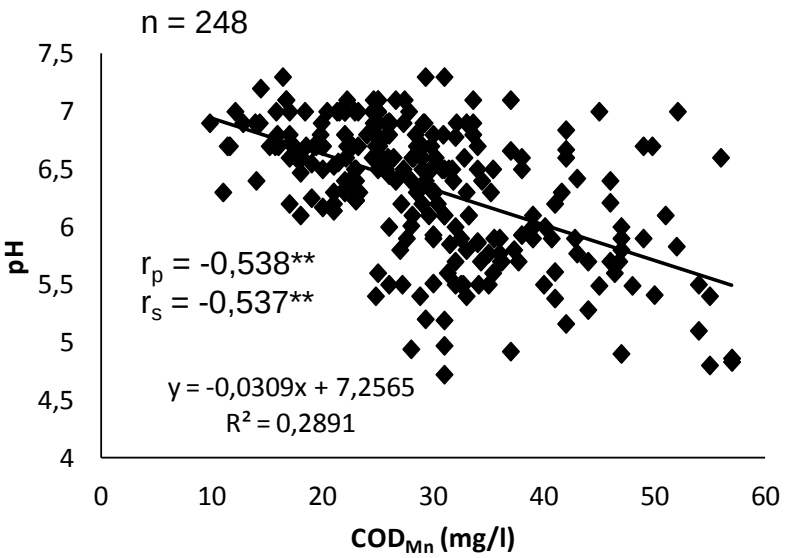
Longer term trends

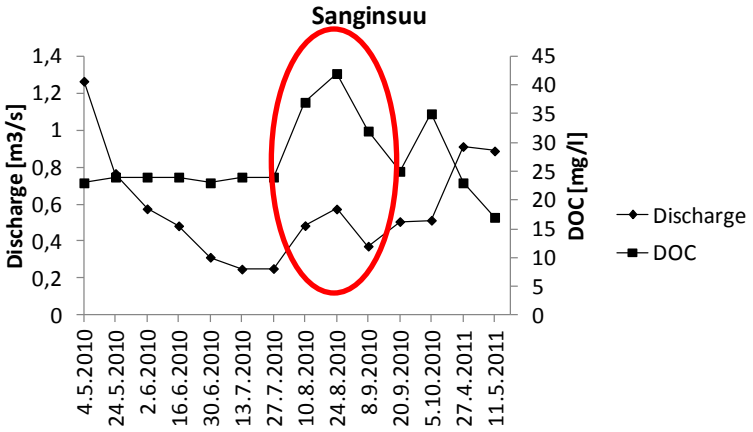


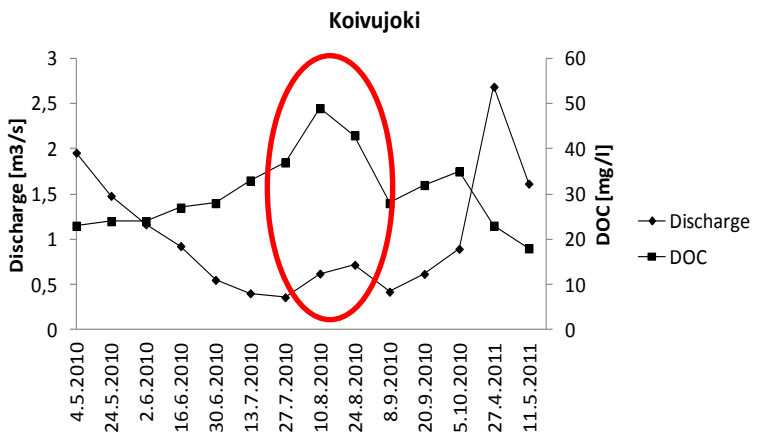


**Correlations significant at the 0,01 level

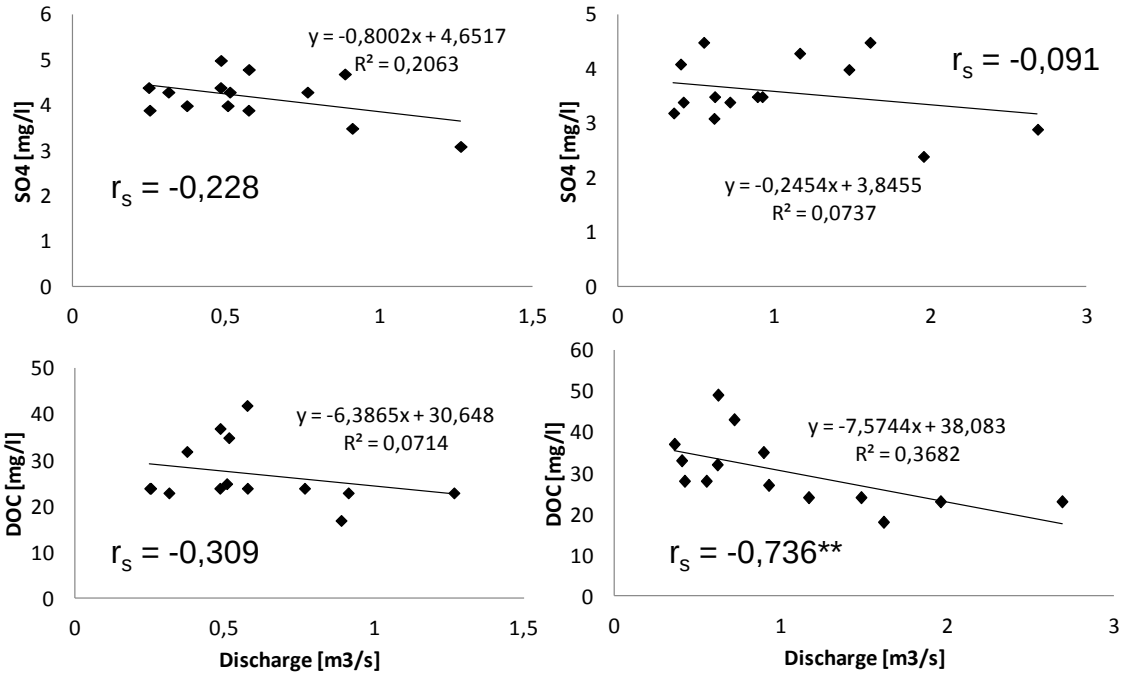
- The low pH values were associated with high DOC or COD_{Mn} concentrations in the drainage basin.
- Longer term data collected from the national Hertta database (1991-2010 for COD_{Mn} and 1998-2001 for SO_4^{2-}).

Discharge vs. DOC/SO_4^{2-}





n = 14



**Correlations significant at the 0,01 level

The hydrochemistry of river Sanginjoki vs. streams affected by a.s. soils

- Detected sulphate and metal concentrations were notably higher in streams that were known to be affected by a.s. soils in the drainage basin.
- Detected EC values were also low in river Sanginjoki compared to the streams in western Finland.

	River Sanginjoki (n=139)			Streams in western Finland[1] (n=74)			Headwater streams in Finland[2] (n=1161)
	MIN	MED	MAX	MIN	MED	MAX	MED
pH	4,5	5,9	6,5	3,1	4,3	6,8	5,9
EC (µS/cm)	21	32	65	41	325	4100	44
SO_4^{2-} (mg/l)	1,2	3,2	18	6,5	85	2000	3,5
Fe (mg/l)	1,2	2,7	10	0,17	3,1	10	0,68
Al (mg/l)	0,12	0,27	0,64	0,55	5,7	267	0,09
Mn (µg/l)	6,8	51	150	BD	820	16000	29
Zn (µg/l)	2	3	9	5,4	102	2500	3,6

[1] Data from Åström et al., 1995
[2] Data from Lahermo et al., 1996.

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Conclusions

- The average organic anion concentration exceeded the non-marine sulfate concetration in all main channel sampling sites and 18 times out of 20 in the tributaries.
- Low pH values were associated with high DOC concentrations in the drainage basin.
- Detected sulfate and aluminum concentrations were low compared to other streams affected by a.s. soils.

➢ The results indicate that the leaching of organic acids from the catchment area, was the primary cause of the acidity in river Sanginjoki during sampling period!

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European Union
European Regional Development Fund
European Social Fund

Thank You!

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Leverage from the EU 2007–2013