

Unveiling the role of soil water: Identifying primary sources of dissolved organic matter in surface waters

Livia V. C. Charamba¹, Tobias Houska^{1,2}, Klaus Kaiser³, Klaus-Holger Knorr⁴, Tobias Krause¹, Karsten Kalbitz¹

¹ Institute of Soil Science and Site Ecology, Technische Universität Dresden, Tharandt, Germany (livia.charamba@tu-dresden.de)

² Department of Landscape Ecology and Resource Management, University of Gießen, Gießen, Germany

³ Institute of Agricultural and Food Sciences, Martin Luther University Halle-Wittenberg, Halle (Saale), Germany

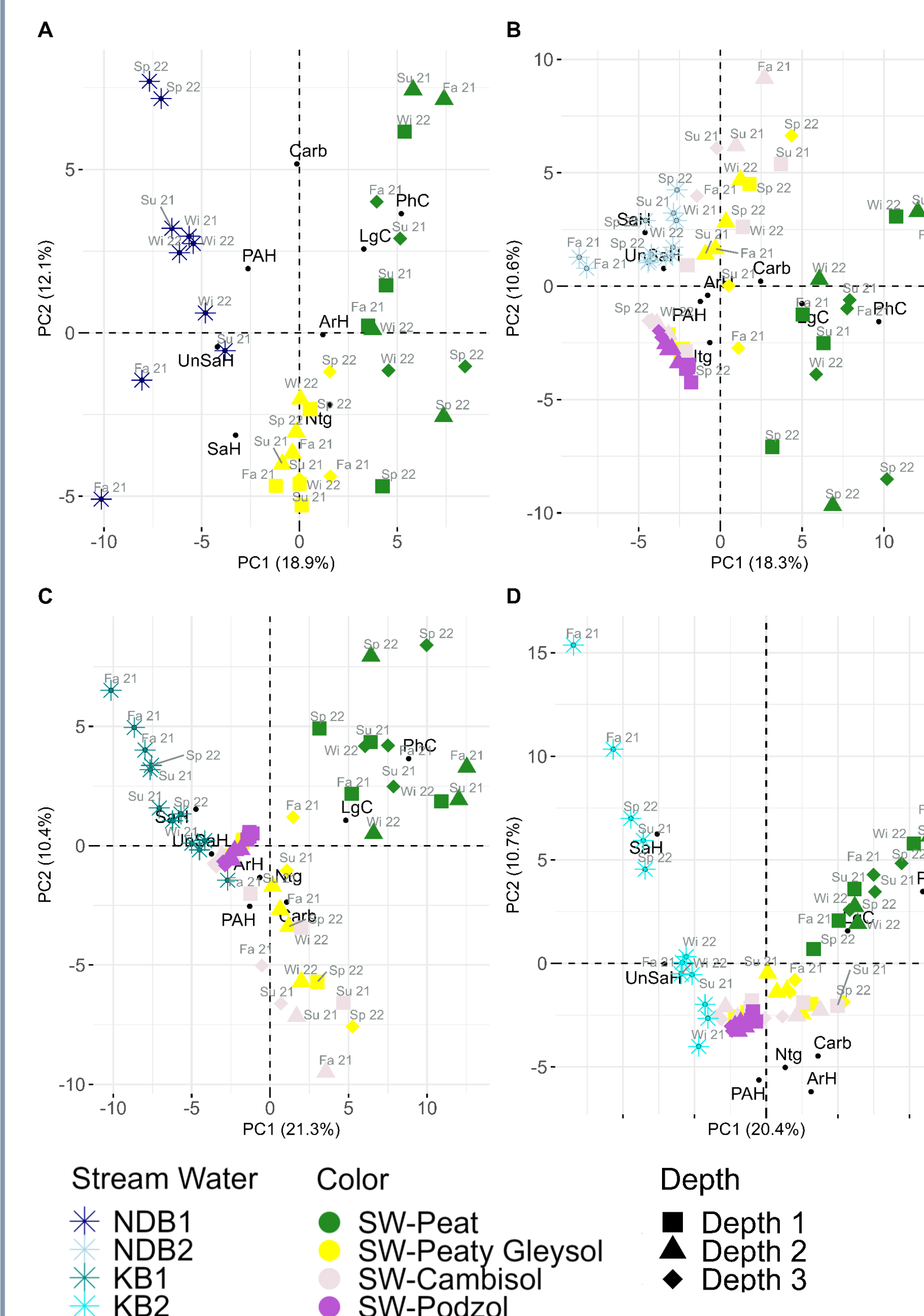
⁴ Institute for Landscape Ecology, Ecohydrology and Biogeochemistry Group, University of Münster, Germany

Introduction

Dissolved organic matter (DOM) is crucial for various ecological processes, playing essential roles in carbon and nutrient cycling. The transition of DOM from soil organic matter to a dissolved state significantly impacts ecological balance, highlighting specific soil horizons' roles in stream water. DOM fingerprints, reflecting variations and similarities, act as valuable indicators for identifying primary DOM sources. The increasing trend in dissolved organic carbon (DOC) concentrations in surface waters underscores the urgency to understand contributing sources comprehensively. This study aims to characterize DOM along the terrestrial-aquatic continuum, identifying sources in stream water.

Results

Main DOM sources for the four stream sampling sites (A-D) are illustrated in the PCA below:



1. Chemical composition

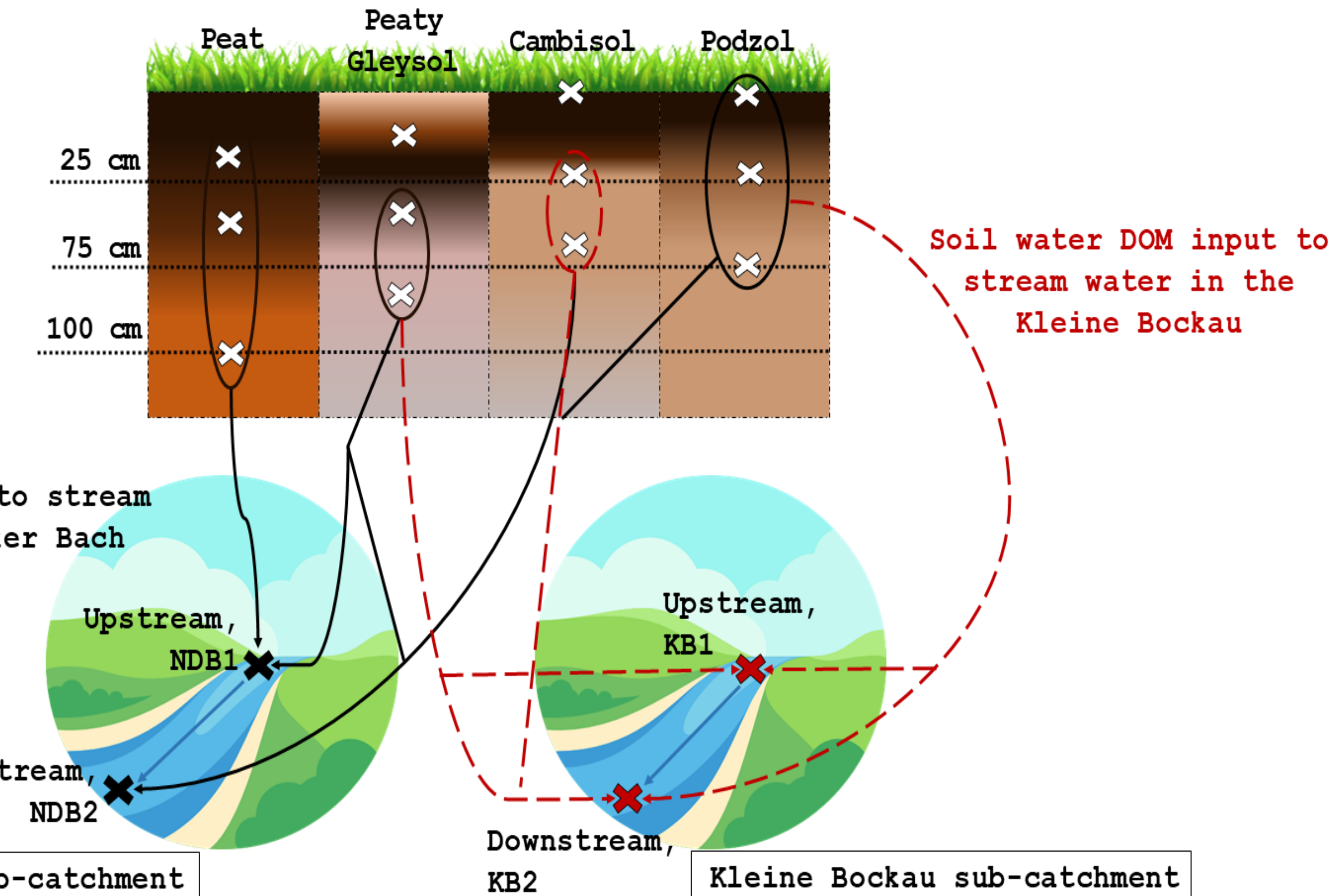
- Lignin-derived compounds were not suitable indicators of DOM source: ↑ in organic soil horizons
- Phenolic and Nitrogen containing compounds prevalent in peaty environments: stream and soil water
- Saturated and unsaturated compounds: main compounds in stream water

2. DOC concentration and DOC:DON ratio

- Higher DOC concentrations and DOC:DON ratios in stream water of peat predominant sub-catchment: NDB1 > NDB2 ≈ KB2 > KB1
- DOC concentration and DOC:DON ratio decrease along the soil depth

3. Role of soil water DOM for stream waters

- **NDB1:** SW-Peat Gleysol > SW-Peat
- **NDB2:** decreasing influence of SW-peat Gleysol and increasing influence of SW-Cambisol and some impact of SW-Podzol
- **KB1 and KB2:** increasing influence of SW-Cambisol and SW-Podzol and some impact of SW-peaty Gleysol



Input from the deeper mineral horizons of the surrounding soils was the main DOM source in stream water

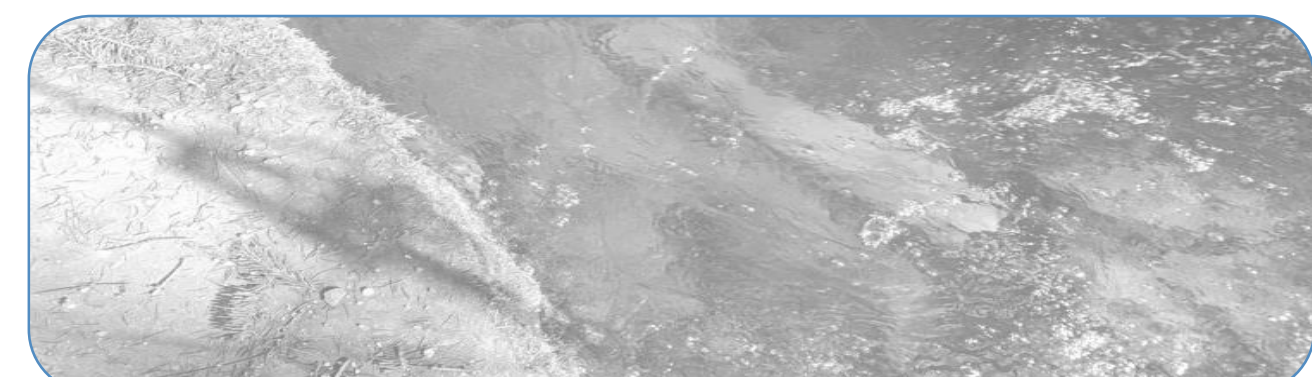
Conclusion

1. **DOM of stream water** closely resembled DOM of soil water with no direct influence from the solid samples of organic soil horizons. Thus, sampling of soil water was essential for accurate DOM identification of stream water.
2. **Soil waters from the different soil types** influenced the DOM composition of stream water according to the land cover of each soil to the sub-catchment and its closeness to the stream.
3. **Immediate vicinity of the streams was crucial for DOM export** of the surrounding soil water into stream water.

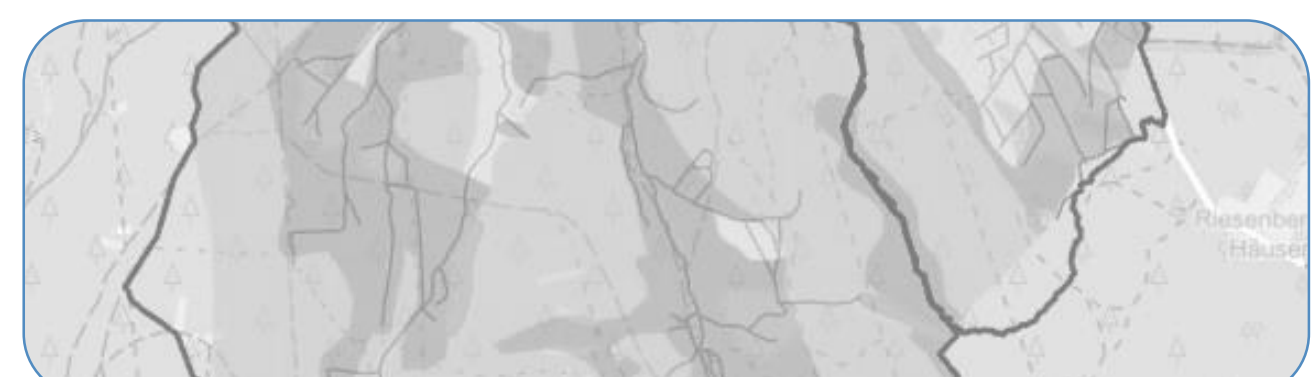
References

¹Huan Chen, et al. (2018). Integration of an automated identification-quantification pipeline and statistical techniques for pyrolysis GC/MS tracking of the molecular fingerprints of natural organic matter. Journal of Analytical and Applied Pyrolysis, 371-380.

Methodology



Samples were taken for roughly a year in the catchment area of Sosa drinking water reservoir in Saxony, Germany



Two sub-catchments (different contribution of organic soils (4 sampling points) were analyzed: NDB1, NDB2, KB1 and KB2



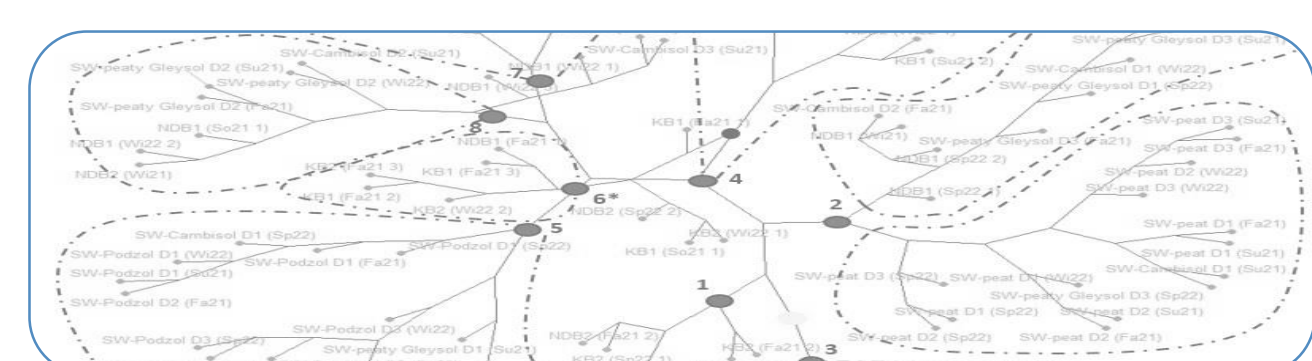
Aqueous and soil samples were analyzed by pyrolysis chromatography mass spectrometry (Py-GC-MS)

```

R> library("Rpy")
R> library("Rshiny")
R> library("Rcpp")
R> library("RcppEigen")
R> library("RcppArmadillo")
R> library("RcppMath")
R> library("RcppEigen")
R> library("RcppArmadillo")
R> library("RcppMath")
R> library("RcppEigen")
R> library("RcppArmadillo")
R> library("RcppMath")

```

The Py-GC-MS data was further processed in an automated pipeline in Rstudio¹.



A principal component analysis and cluster were applied to the results from Rstudio.

