Carbon fluxes in an acid rain impacted boreal headwater catchment (Jizera Mountains, Czech Republic)

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Introduction

Terrestrial carbon export via inland aquatic systems is a key process in the budget of the global carbon cycle. This includes loss of carbon to the atmosphere via gas evasion as well as carbon fixation in sediments. Headwater streams are important as the first endmembers of the transition of carbon between soils, ground- and surface water and the atmosphere. Here a small stream in the Uhlirska Catchement was studied.

Fig 1: Gauging station Cerna Nisa stream and peatland in Uhlirska catchment.

Measurements

- Groundwater, soil water and stream water sampling campaigns were carried out between 2014 and 2015
- DIC, DOC, POC concentration and isotope analyses (Dissolved inorganic, dissolved and particulate organic carbon)
- CO_2 degassing was calculated via isotope modelling approach (Venkiteswaran et al. 2014)

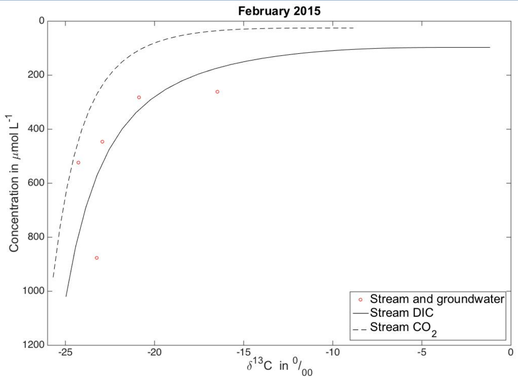

Fig. 2: Modelled DIC and CO_2 degassing trajectories (Venkiteswaran et al. 2014).

Basin characteristics

Location	15°09'E, 50°49'N
Altitude	776-886 m a.s.l.
Drainage area	1.78 km² (subcatchment: 1.18 km²)
Annual average temperature	4.7°C (1961-1997)
Annual average precipitation	> 1400 mm (1966-1997)
Dominant tree species	95 % Norway spruce, 5 % grassland
Average age of spruce forest	Up to 80 yrs (15 % of spruce), 15 yrs (85 % of spruce)
Dominant soil type	Dystric and Podzolic Cambisols, Histosols, Gleysols
Bedrock	Granite, deluviofluvial sediments, glacial tills

Map of experimental Uhlirska catchment

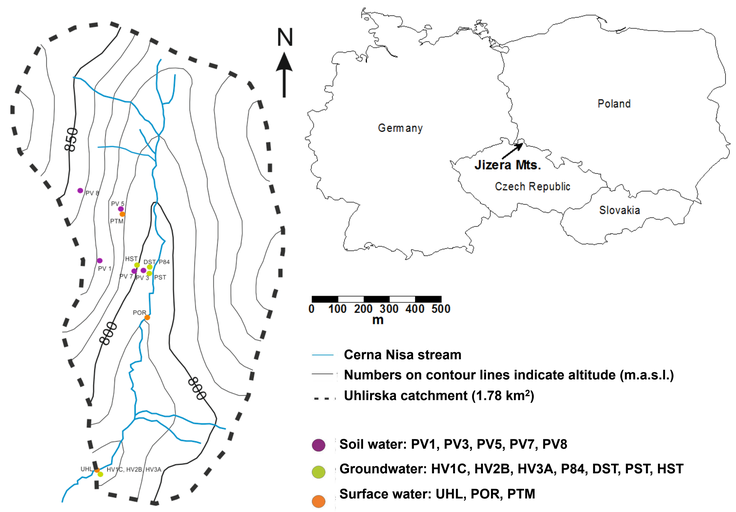

Fig 3: Location of Uhlirska catchment and sampling sites.

Carbon export and isotopes Uhlirska catchment

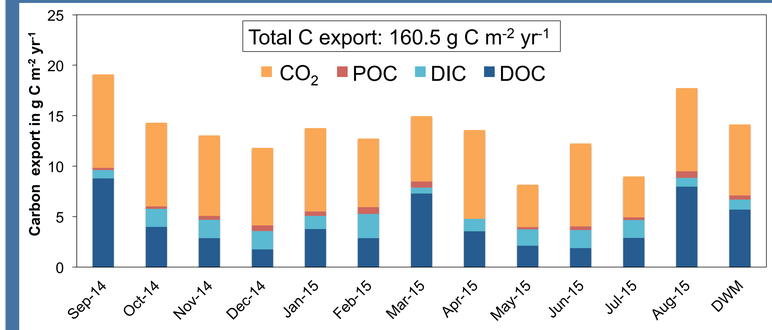

Fig 4: Monthly and discharge-weighted mean (DWM) carbon export rate.

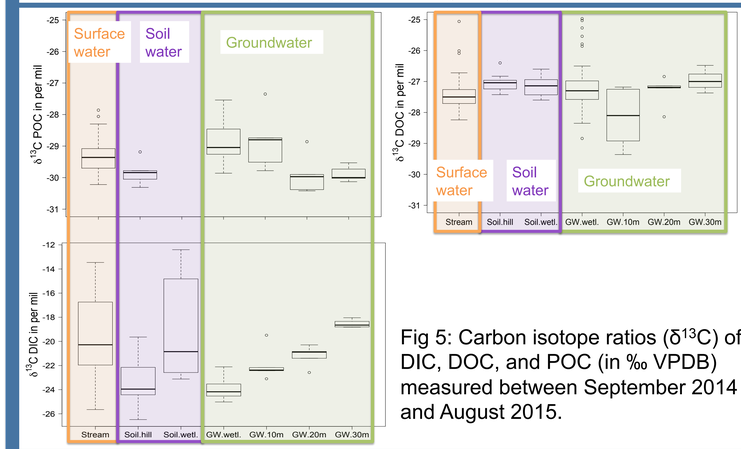

Fig 5: Carbon isotope ratios ($\delta^{13}C$) of DIC, DOC, and POC (in ‰ VPDB) measured between September 2014 and August 2015.

Conclusions

- Carbon export via aquatic system is dominated by CO_2 degassing 55 % CO_2 >> 31 % DOC > 11 % DIC > 3 % POC
- Isotope ranges indicate predominant silicate weathering and little turnover of organic material
- No $\delta^{13}C$-DOC variation from upland to wetland domain due to permeable bedrock
- CO_2 degassing caused an enrichment of the $\delta^{13}C$-DIC values of up to 6.8 ‰ between a catchment gauge and the catchment outlet (~865 m distance)

REFERENCE
Venkiteswaran, J.J., Schiff, S.L. and Wallin, M.B., 2014. Large Carbon Dioxide Fluxes from Headwater Boreal and Sub-Boreal Streams. Plos One, 9(7).

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