



Example for the importance of interface biogeochemistry for C and N fluxes from terrestrial to open aquatic ecosystems

S. Fiedler (1) and H. Jungkunst (2)

(1) University of Hohenheim, Institute of Soil Science, Stuttgart, Germany (fiedler@uni-hohenheim.de, +49 711 459 23633),

(2) University of Göttingen, Landscape Ecology Institute of Geography

Boundaries between terrestrial and aquatic ecosystems play a critical role in regulating terrestrial export. Understanding of biogeochemical cycling within this zone is urgently needed to unravel controls of matter transfer between terrestrial and aquatic ecosystems. This knowledge is needed to support decisions for optimizing mitigation options of water loading of “pollutants”.

Our investigation focused on the fate of carbon (C) and nitrogen (N) species at the interface between soil and spring, known as critical transition zone (CTZ).

We present long-term monitoring data from a temperate spruce forest ecosystem (‘Wildmooswald’) in Southwest Germany (MAP 1,600 mm, MAT 6°C). The investigated catena which is little more than 200 m long, includes common forest soils (n = 4) of three redox categories: Soils are represented by anaerobic Histosol, oxic Cambisols, Histosol with degraded peatlayers and Stagnosols having intermediate redox state.

Measured C and N species were DOC, dissolved CO₂, CH₄, dissolved N₂O, NH₄⁺, and NO₃⁻ in soil solutions along a hydrological pathway and in the adjacent aquatic system.

Our results demonstrated that DOC dominance in soil solution throughout a catena can instantaneously shift to DIC (dissolved CO₂) dominance when this soil water leaves the system at a spring outlet. This can be interpreted as a result of adsorption or oxidative turnover. At the presence of O₂ extremely rapid shifts in N species (NH₄⁺ → NO₃⁻) can be observed. This was found at the spring. This rapid nitrification process apparently produced N₂O: The N₂O concentrations at the spring were three times higher than the N₂O concentrations in the soil solutions. Oxidative turnover is also an important process for dissolved CH₄. Although soil solutions were highly CH₄-oversaturated, low concentrations in the aquatic system were found. Dissolved gases were discharged to the atmosphere, when the soil solution crossed the CTZ, whereas direct degassing at the spring was inferior.

Furthermore, our study demonstrated significant temporal variability of matter export in concert with (1) spatial redox patches along hydraulic pathway, and (2) stream flow rate. Therefore, measurements of matter fluxes at short intervals at the critical transition zone over a longer time period is needed for credible estimations of matter fluxes.

Our results suggest that the control of C and N loading of aquatic systems is mainly the result of transformation processes within the CTZ. We concluded that interface biogeochemistry is a highly important tool towards a better scientific understanding of biogeochemical C- and N-fluxes at the landscape scale.