Geophysical Research Abstracts
Vol. 12, EGU2010-11005-2, 2010
EGU General Assembly 2010

Denitrification capacity and greenhouse gas emissions of soils in channelized and restored reaches along an Alpine river corridor

Juna Shrestha (1), Pascal Niklaus (2), Emanuela Samaritani (3), Emmanuel Frossard (4), Klement Tockner (5), and Jörg Luster (1)

(1) Swiss Federal Institute for Forest, Snow, and Landscape Research, Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland, juna.shrestha@wsl.ch, joerg.luster@wsl.ch, (2) Institute of Grassland Sciences, Swiss Federal Institute of Technology, Switzerland, pascal.niklaus@ethz.ch , (3) Swiss Federal Institute for Forest, Snow, and Landscape Research, CH-1015 Lausanne, Switzerland, (4) Institute of Plant Sciences, Swiss Federal Institute of Technology, Eschikon 33, CH-8315 Lindau, Switzerland, emmanuel.frossard@ipw.agrl.ethz.ch , (5) Leibnitz-Institute of Freshwater Ecology and Inland Fisheries, Mueggelseedamm 310, D-12587 Berlin, Germany, tockner@igb-berlin.de

In order to assess the effects of river restoration on water and air quality, the biogeochemical functions of channelized and restored river reaches have to be quantified. The objective of this study was to compare denitrification potential and greenhouse gas emissions of functional processing zones (FPZ) in a channelized and a recently restored reach of the alpine river Thur in north-eastern Switzerland. The study was part of the project cluster RECORD of the ETH domain, Switzerland, which was initiated to increase the mechanistic understanding of coupled hydrological and ecological processes in river corridors. The denitrification potential represents an important aspect of the soil filter function related to water quality. Besides, it also contributes to the emission of greenhouse gases.

Extensively used pasture growing on a sandy loam is the characteristic FPZ of the channelized section. The restored section encompasses five FPZ: (i) bare gravel bars sparsely colonized by plants, (ii) gravel bars densely colonized by grass (mainly canary reed grass with up to 80 cm sandy deposits), (iii) mixed forest dominated by ash and maple, (iv) riparian forest dominated by willow (Salix alba), (v) older overbank sediments stabilized during restoration with young willows separating the forests from the river-gravel bar system (willow bush).

The FPZ were sampled in January, April, August and October 2009. In addition, in June and July 2009 two flood events were monitored in the restored section with more frequent samplings. At each date, topsoil samples were collected in each FPZ (four replicates per samples) and analyzed for denitrifier enzyme activity (DEA). In addition, gas samples were taken in-situ using the closed chamber technique to measure soil respiration as well as N2O and CH4 fluxes.

In all FPZ, the denitrification potential was mainly governed by soil moisture. It was highest in the willow forest exhibiting low spatial variability. The DEA in pasture, grass zone, willow bush and mixed forest exhibited intermediate levels. Spatial variability was higher in the grass zone compared to other FPZs especially during the flooding events when denitrification hot spots occurred in this zone. In the gravel zone DEA was high when saturated slowly – as during a minor flood -, while it was low under dry conditions as well as during saturation following a major flood. The N2O emission rate was low in all FPZ throughout the year, except during few hot moments (i.e. in grass FPZ two weeks after major summer flood events and in grass and willow bush zone during winter.

In conclusion, replacing a rather homogeneous floodplain by a spatially complex and temporally dynamic mosaic of FPZ of different succession stages (gravel bars with a varying degree of plant colonization and cover by fresh overbank sediments) has not led to fundamental changes in denitrification potential of the river floodplain. It is rather the shift from a homogeneously distributed filter function to a filter function mainly located in spatially and temporally defined hot spots. However, this change appears to be coupled to increased trace greenhouse gas emissions (methane and nitrous oxide) from certain hot spots. In addition, the study confirms the high denitrification potential of advanced stable wetlands as represented by the willow forest.