Geophysical Research Abstracts,
Vol. 11, EGU2009-4347, 2009
EGU General Assembly 2009

Assessing the nitrate buffering efficiency in riparian wetlands and streams within agricultural catchments at different scales

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In a context of water quality degradation induced by agricultural intensification, assessing the role of landscape structures as buffers represents a scientific objective as well as a necessary prerequisite for the sustainable management of water resources. Because water resources are managed at a large basin scale, we need to understand how the processes change and integrate through time and space scales.
The objective of this study is to assess the buffer role of the riparian wetlands and stream system in controlling nitrate fluxes and concentrations at the outlet of an agricultural catchment of 377 km ^{2} and analyze the influence of the seasons and the stream order on the this buffer role. Initially, we identify the physical and anthropic characteristics of the landscape that regulate nitrate fluxes in a catchment area, by investigating the role of the wetlands and streams. We then evaluate the impact of hydrological seasonal variation on the nitrate concentrations and their relationship to these landscape features. Lastly, we determine the changes of landscape structure according to the modifications of stream order, so we can evaluate the impact of the scaling of catchments on the fluxes and seasonal variation of nitrate concentrations at their outlets.
This assessment is based on the monitoring of nitrate concentrations during interstorm periods, at the outlet of 16 sub-catchments of different orders within the catchment .and involves characterizing stream network, wetlands, agricultural practices and land cover. A statistical analysis allows us to identify the relations between these characteristics and the nitrate fluxes and concentrations. Two main factors control annual nitrate fluxes: 1) the nitrogen surplus, and 2) the system comprising the wetland zone and adjoining watercourses. This latter factor exhibits a depletion of nitrate fluxes proportional to the surface-area of the riparian wetland and the flowpath distance of these fluxes in the stream network. 53% of the annual nitrate flux during interstorm periods is removed during transfer via the wetland and the river, which corresponds to 10.6 kg N ha-1 y-1. Moreover, the influence of this riparian wetland zone/watercourse system increases during periods of low water level, accounting for up to 64% of the spatial variations in nitrate concentration. In addition, this role also becomes more important at high stream orders. This dependence on stream order is more apparent at low water level, when we observe a 47.3% reduction of nitrate concentrations from order 2-3 to order 6.