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Temporal trends and relationships between groundwater and surface water nitrate concentrations in headwater agricultural catchments: what can we learn from a monitoring over 20 years?

O. Fovet (1), C. Gascuel (1), M. Faucheux (1), L. Ruiz (1), L. Aquilina (2), and J. Molenat (3)

(1) INRA, UMR SAS, Rennes, France (ophelie.fovet@rennes.inra.fr), (2) Universite Rennes 1, UMR Geosciences, Rennes, France, (3) INRA, UMR LISAH, Montpellier, France

The intensification of agriculture during the 20th century led to strong issues on water quality related to nutrients enrichments in groundwater and surface water. In this context, Western France is an extreme case regarding to the high nitrate concentrations observed in rivers (around 7 mg $N\text{-}NO_3$/l1 in average). In the early 90ies, an Environmental Research Observatory AgrHys has been created and instrumented to investigate the response time of hydro-chemical fluxes to landuse changes in agrohydrosystems. This observatory is part of a French Catchments Network (Critical Zone Observatory), and composed of two sites. Kervidy-Naizin monitoring has been recently analyzed to identify the effect of climatic factors on water quality, while we focus here on Kerbernez site. This site is composed of 5 first-order and adjacent catchments, less than 1 km2, where land use agricultural practices have been recorded with precision.

Hydrological, hydrochemical and climatic data were recorded over the last 20 years. Since 2001, the monitoring was extended to groundwater using piezometric measurements and chemical analyses. Previous studies [1] suggested that nitrate transport was essentially a transport limited process on this site. The long-term and extensive monitoring programs can help us understanding the effect of agricultural practices on nitrate concentration in streams. We reconsider this hypothesis 10 years later by analyzing if the streams nitrate concentrations reacted to the changes in agricultural practices.

Different protocols of monitoring (manual vs. automatic measurements) are compared though the annual water fluxes at the outlet in order to estimate the incertitude on water discharge for such small streams. All the water balances computed were not equilibrated suggesting important subsurface flows. The high contribution of the shallow groundwater is confirmed by the hydrochemical data. Mean annual nitrate concentration in the drainage water is computed using two methods leading to consistent results. There is no correlation between this mean annual concentration in drainage water and the nitrate stream concentration. This supports the hypothesis of a mixing process of different types of water with widely various transit times [2]. The transfer in the unsaturated zone or in the groundwater seems to induce a strong buffering effect which could explain the absence of response on nitrates river concentrations to changes in agricultural practices during the last 20 years.

References

1. Martin, C., et al., Seasonal and interannual variations of nitrate and chloride in stream waters related to spatial and temporal patterns of groundwater concentrations in agricultural catchments. Hydrological Processes, 2004. 18(7): p. 1237-1254.

2. Rouxel, M., et al., Seasonal and spatial variation in groundwater quality along the hillslope of an agricultural research catchment (Western France). Hydrological Processes, 2011. 25(6): p. 831-841.