



Isotopic biogeochemistry of agricultural nitrate contamination of surface water in the Seine watershed (France)

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In order to get insights into the processes involved at regional scale in nitrate contamination of surface water by agriculture and denitrification in soils and riparian zones, the isotopic composition of nitrates was determined in water samples collected in small streams with differing watershed land use (forests, crops) and pedo-lithological context over the whole Seine catchment.

Invariably, forested watersheds are characterized with low nitrates concentrations and low $\delta^{15}\text{N-NO}_3$ values, consistent with the isotopic composition of the organic nitrogen pool of forest soil which reflects the primary sources from which organic matter (and leached nitrates) are derived (atmospheric N fixation and atmospheric NO_3 deposition).

Groundwater from agricultural watersheds on the other hand, are characterized by high nitrate concentrations, with isotopic composition often much higher than that of forested watersheds, and close to that of the agricultural soil organic nitrogen pool of the respective pedo-lithological regions. As the latter is higher than the $\delta^{15}\text{N}$ of most fertilizers used, it probably results from denitrification processes occurring in agricultural soils.

Surface water from mixed agricultural and forested watershed shows a large range of nitrate concentrations. In some cases, a simple mixing process of agricultural with forest waters explains the corresponding isotopic composition. In many others, the $\delta^{15}\text{N-NO}_3$ value is significantly higher than what could be expected from this simple mixing model. We attribute this increased $\delta^{15}\text{N}$ to a further denitrification of the nitrate pool occurring within riparian zones.