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Incorporation of stable nitrogen and oxygen isotope fractionation into a regional-scale runoff modelling framework for assessing denitrification in distributed riparian and hyporheic zones.

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Isotope techniques applicable to tracing and quantifying groundwater - surface water interaction with rivers fall broadly into two categories: those focussed on understanding flow system geometry, flow dynamics, and rates of flow and those that, via fractionation processes during biogeochemical transformations such as denitrification, identify processes of interest in contaminant degradation and transformation. There is increasing evidence from field observations of nitrate in rivers that $\delta^{15}N_{NO3}$ alone, but particularly in conjunction with $\delta^{18}O_{NO3}$, can be successful in demonstrating systematic and observable isotope effects during nitrate denitrification in riparian zones. These observations open up scope to consider novel ways in which isotopic indicators could be incorporated into conceptual, analytic or numerical models of flow, transport and denitrification in riparian zones in ways that take advantage of i) the up-scaling" properties of isotope effects – from micro to diffuse scales and ii) development of a modelling framework whereby the regional-scale status of diffuse denitrification could be determined by monitoring the $\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$ in streamflow to determine the catchment-scale status and dynamics of denitrification.

The basis of our analysis of N and O isotope analysis is the Riparian Nitrate Model (RNM) (Rassam *et al.*, 2005) which operates as a filter (plug-in) module within E2, the latter being a node-link catchment scale model capable of simulating the hydrologic behaviour of catchments. The RNM-E2 modelling framework has been augmented with Rayleigh fractionation algorithms at each node within the model domain to track the isotope shifts due to denitrification. This paper will present preliminary results on

the N & O isotopic behaviour of nitrate in streamflow as distributed within an idealised RNM-E2 model framework

Such model outputs could be used to improve assessments of the function of riparian zones as denitrifying reactors and hence their capacity to reduce or eliminate nitrate discharge into streams and rivers from diffuse sources at the catchment scale. Further, they can be used to design synoptic or temporally based field-based experimental designs based on $\delta^{15}\mathrm{N}_{NO3}$ and $\delta^{18}\mathrm{O}_{NO3}$ in streamflow nitrate that may be used for long-term assessment of diffuse denitrification in regional scale catchments.