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Influence of Dynamic Hydraulic Conditions on Nitrogen Cycling in Column Experiments

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In order to improve management strategies of agricultural nitrogen input, it is of major importance to further understand which factors influence turnover processes within the nitrogen cycle. Many studies have focused on the fate of nitrate in hydrological systems, but up to date only little is known about the influence of dynamic hydraulic conditions on the fate of nitrate at the soil-groundwater interface. We conducted column experiments with natural sediment and compared a system with a fluctuating water table to systems with different water content and static conditions under the constant input of ammonia into the system. We used hydrochemical methods in order to trace nitrogen species, ^{15}N isotope methods to get information about dominating turnover processes and microbial community analysis in order to connect hydrochemical and microbial information.

We found that added ammonia was removed more effectively under dynamic hydraulic conditions than under static conditions. Furthermore, denitrification is the dominant process under saturated, static conditions, while nitrification is more important under unsaturated, static conditions. We conclude that a fluctuating water table creates hot spots where both nitrification and denitrification processes can occur spatially close to each other and therefore remove nitrogen more effectively from the system. Furthermore, the fluctuating water table enhances the exchange of solutes and triggers hot moments of solute turnover. Therefore we conclude that a fluctuating water table can amplify hot spots and trigger hot moments of nitrogen cycling.