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Using the N2/Ar-Method to check modelled diffuse NO_3^- emissions from soils into the groundwater of Lower Saxony (Germany)

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Diffuse NO_3^- emissions derived from agricultural N surpluses are the main cause of NO_3^- pollution of aquifers and open water bodies. Denitrification is the key process for the attenuation of these anthropogenic NO_3^- concentrations in soils and groundwater. Since the greenhouse gas N2O is an obligate intermediate of denitrification this process is also a major regulator of N2O emissions from soils and indirect N2O fluxes from aquifers and open water bodies which result from NO_3^--leaching. Up to now the denitrification potential of soils and the potential NO_3^- concentration in the groundwater recharge are modelled from agricultural N-surpluses, water balances (GROWA) and soil properties (DENUZ) (Wendland et al. 2009) (LBEG 2008).
In this study we compare modelled NO_3^- emissions (pot-NO_3^-) (DENUZ) to the groundwater recharge with the calculated initial NO_3^- concentrations in the groundwater at time of groundwater recharge (NO_3^-t0) (N2/Ar-method (Weymann et al. 2008)). NO_3^-t0 can be calculated from the measurement of dissolved gases N2, N2O, Ar and NO_3^- concentrations in groundwater samples.
We analysed groundwater samples from 534 groundwater monitoring wells throughout Lower-Saxony (Germany). Median NO_3^- and NO_3^-t0 concentrations were 0,4 and 29 mg NO_3^- l^{-1} respectively, showing that considerable proportions of the anthropogenic N-surplus is denitrified within the saturated zone.
First results showed a good agreement between measure and modelled NO_3^- emissions for areas of coastal marshes in the North of Lower-Saxony (predominantly Fluvisols). Medians of measured and modelled NO_3^- emissions are 12,5 mg NO_3^-t0 l^{-1} and 0,3 mg pot-NO_3^- l^{-1} (mean values 20 mg l^{-1} NO_3^- pot and 9,3 mg l^{-1} NO_3^-t0), respectively. Compared to the coastal marshes and in accordance with modelled pot-NO_3^- concentrations our measurements show small-scale spatial heterogeneities of NO_3^-t0 concentrations in soil regions where the dominant parent material of soils are glacio fluviatile and moraine deposits (predominantly Podzols, Cambisols and Gleysols) in Lower-Saxony. In these regions the median of measured NO_3^-t0 concentrations was between 29 and 38 mg NO_3^- l^{-1} and on average 25 to 30 mg NO_3^- l^{-1} below the modelled NO_3^- l^{-1} concentrations. To further compare the modelled NO_3^- emissions (pot-NO_3^-) with results of the N2/Ar-method (NO_3^-t0 values) we select groundwater monitoring wells with more homogenous soil properties, soil water residence times in their catchment areas.
We expect that further analysis will help to validate existing denitrification models. NO_3^-t0 values might then be used as a lower boundary condition if denitrification in soils is modelled.

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