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A straightforward approach to estimating the spatial distribution of nitrate retention potential for groundwater bodies in Germany

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Meeting the requirements of the EU Water Framework Directive due to nitrate pollution in water systems is challenging the European countries. In most river basins with intensive agricultural land use, extensive mitigation measures are required to reduce nitrogen inputs in order to reduce nitrate concentrations in our water resources. Relevant areas must be identified for the planning of measures. For this, key factors such as nitrogen balance, nitrate leaching and nitrate concentration in groundwater as well as the natural retention potential have to be determined. It is precisely these factors that are difficult to assess at large scales, since the transfer of nitrate from soil to groundwater underlies complex hydro-biogeochemical processes. Despite this complexity, simplified approaches are needed to support national decision-making processes in view of nitrogen abatement measures.
Here we show a possibility how this apparent contradiction between model complexity and simplicity can be realized. We trained a Random Forest (RF) model to estimate the spatial distribution of groundwater nitrate concentration for Germany using a comprehensive data set of groundwater concentration measurements (n∼10,000) and spatial geo data. As one of the predictors we calculate a potential leachate concentration from the nitrogen surplus and the seepage water rate. We ultimately use this to estimate a nitrate retention rate for groundwater bodies from the ratio to the determined groundwater concentration.
We show preliminary results and discuss whether this straightforward approach is a practicable and useful method for the identification of nitrate-polluted areas. We further assess how this can help in planning mitigation measures to restore the “good chemical status” of relevant groundwater bodies, required by the European Water Framework Directive.