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Land use effect on nitrate storage and transport through unconfined Chalk aquifer

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Chalk aquifer is the main water resource for domestic water supply in many parts in northern France. In this region, groundwater is frequently affected by quality problems concerning nitrates. Often close to or above the drinking water standards, nitrate content in groundwater is mainly due to historical agriculture practices, combined with aquifer recharge through the vadose zone. The complexity of processes occurring into such an environment leads to combine a lot of knowledge in agronomy, geochemistry and hydrogeology in order to understand, model and predict the spatiotemporal evolution of nitrate content and provide a decision support tool for the water producers and stakeholders. To succeed in this challenge, conceptual and numerical models representing accurately the Chalk aquifer specificity will be developed, including a multidisciplinary approach to simulate storage and transport from the ground surface to the underlying groundwater. This involves a new agronomic module "MONICA" (**MO**delling **NI**trates transfert taking into account **C**rops and **A**gricultural practices), a soil-crop model calculating the nitrogen mass balance in arable soil, integrated in the 3D transient groundwater numerical code "MARTHE". This approach integrating existing multi-disciplinary tools is a real challenge. It enables to decrease the number of calibration parameters by selecting the relevant equations and simplifying them without altering the signal. The numerical development is applied on a 2D vertical cross-section in the vadose zone representing experimental nitrate vertical measurements in soil profiles (0-22 m depth) in the Somme region (France). The experiment results highlight the land use management effect on nitrate evolution into the vadose zone (e.g. forest instead of crops). Simulations constrained by climate forcing, land use and nitrogen inputs over several decades reproduce the nitrate spatial and temporal distribution. This approach will be ultimately used to model in 3D the drinking water catchment area. It will be calibrated using nitrate contents time series of nitrate content measured in the domestic water pumping well available since 1995 (field in northern France – Avre Basin region). This numerical tool will help the decision-making in all activities in relation with water uses.