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Generating land-use information to derive diffuse water and nitrate transfer at aquifer scale

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Abstract Modelling diffuse water and nitrate transfer in the unsaturated zone is a state-of-the-art method for determining groundwater recharge and nitrogen leaching at aquifer scale, which can be used to define the upper boundary condition for transient groundwater flow and transport models. Together with soil and weather data, land-use information is an indispensable input parameter for modelling groundwater recharge and nitrogen leaching, but is not available in detail at aquifer scale. In Austria, information concerning cultivated crops is only available as annual crop percentages on the aggregated level of cadastral municipalities. To deal with this problem a stochastic crop rotation tool *StotraPGen* is developed which uses multiple crop rotations and derives optimal percentages of characteristic crop rotations for representing the statistical land-use data. To validate the approach of *StotraPGen* the agricultural research site Wagna (Austria) is treated as a single cadastral municipality. Based on the exact land-use knowledge, annual crop percentages (as it is available at aquifer scale) are computed for the period 1988–2009. In a next step, the time series of groundwater recharge and nitrate leaching are simulated using (a) the actually applied crops and fertilizers, (b) the stochastic land-use approach *StotraPGen* and (c) using just one single crop rotation. The comparison of the results shows that *StotraPGen* very closely resembles the simulated unsaturated zone response due to the real agricultural land-use. Using one single crop rotation does not yield satisfying groundwater recharge and nitrogen leaching results on a daily basis. Future work will focus on upscaling uncertainties due to insufficient soil depth information at aquifer scale, and iterative coupling between saturated and unsaturated water flow and solute transport models to improve the representation of the saturated–unsaturated interface in future model simulations.

Key words vadose/unsaturated zone; diffuse water and nitrate transfer; groundwater recharge; nitrate/nitrogen leaching; land-use; modelling; aquifer/regional scale, multiple crop rotation