Importance of including small-scale drain discharge data in the calibration of a catchment scale nitrate model

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ABSTRACT BODY: Nitrate leaching from agricultural areas and the resulting pollution of groundwater and surface waters is one of the largest challenges in water resources management in Denmark. Nitrate can however be naturally degraded under anaerobic conditions and several studies have shown that degradation in the saturated zone removes more than 50% of the nitrate leaching in Danish catchments. For degradation of nitrate to occur in the saturated zone, nitrate must be transported under the redox interface and a correct simulation of the small-scale flow patterns within a catchment is therefore important in nitrate models. The general findings in Danish nitrate modeling studies are that the models perform well at catchment scale, but the predictability of the models decreases at smaller scale. Thus the model predictions are highly uncertain at small scale and the models cannot at present predict areas within a catchment, where the majority of the nitrate is brought under the interface and thus degraded, and areas, where nitrate is transported directly to streams and lakes without any significant reduction. The objective of this study is to test if the small scale performance of a catchment scale nitrate model can be improved by including small scale observation data in the calibration procedure. The study area is the clayey catchment to Lillebæk stream (4.7 km²), located on the island of Funen in Denmark. Due to the presence of clayey top soils subsurface drains are installed and in consequence the stream discharge is highly dominated by drain flow. An integrated transient hydrological model based on the MIKE SHE code has been developed for the study area. The model has been calibrated against hydraulic head measurements and stream discharge measurements from two stations, one covering most of the catchment and the other station approximately half, using the parameter estimator code PEST. Acceptable model performance has been achieved at catchment scale calibrating the model against head and stream discharge data, but not at smaller scale, as also found in other similar studies. However, in the Lillebæk catchment measurements of drain discharge from five small-scale (2-4 ha) drain areas have also been made. In this study these drain discharge data are included in the calibration procedure, to test if this results in an improved model performance and thus in a more correct description of the water flow within the catchment.

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