Uncertainty analysis of the FyrisNP model for source apportionment of phosphorous and nitrogen in catchments

Mats Wallin and Elin Widén-Nilsson

Swedish University of Agricultural Sciences, Department of Aquatic Sciences and Assessment, Uppsala, Sweden
Mats.Wallin@vatten.slu.se

In catchment management, models are usually used to interpolate between measurements of environmental variables, apportionment of pollution sources and scenario simulations. It is now generally accepted that such models have to undergo some uncertainty analysis to demonstrate the reliability of the model. These analyses are commonly performed for a single catchment. As each catchment is unique in its composition of landuse, nutrient load and climate there is, however, a need to perform uncertainty analysis for several catchments of varying types. In this study uncertainty analysis has been performed for several Swedish catchments with the semi distributed nitrogen and phosphorous source apportionment model FyrisNP. The FyrisNP model is a relatively simple model that works with weekly or monthly time steps and uses a tree structure of interconnected sub-catchments. It uses time series on runoff, water temperature and nutrient concentration as input data. Information on landuse percentages and lake and stream area is also required. The diffuse nutrient load from land is calculated from type specific concentrations for each land use type and, in the case of agriculture, for each sub-catchment, accounting for differences in crops, soil type and for phosphorus also slope and P-content in the soil. Data on atmospheric deposition as well as major and minor point sources, e.g. sewage treatment plants and rural households, is also needed. The main model outputs are retention, source apportionment and gross and net transportation of nutrients. Calculated nutrient concentrations are compared with measured concentrations to calibrate and evaluate the model. The two calibration parameters are both used in the equation for retention calculation. The first results show that the type specific concentration in runoff from arable land is the most sensitive model parameter. Model results are usually sensitive to the calibration parameters. Equifinality occurs for type specific concentrations for most landuse types, except for arable land. Arable land has much higher type specific concentrations than the other land use types. The model calculates the source apportionment of nitrogen and phosphorous in separate runs. Nitrogen simulations have fewer parameters with equifinality than phosphorous and so exhibit less model uncertainty. This is explained by the higher type specific concentrations for nitrogen leakage than phosphorous leakage. The land use percentage is sometimes important for the sensitivity of the corresponding type specific concentration while the amount of calibration data apparently has no effect on number of parameters with equifinality or the absolute values of the model efficiency. Other factors with possible influence on the model uncertainty will be further studied, as well as the effect of the parameters on the source apportionment.