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Importance of lateral nitrogen transport at the catchment scale

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Existing modelling tools commonly simulate nitrate transport on catchment scale either in a lumped approach or, if spatially distributed, not with a time dependent decrease in nitrate reduction capacity. The latter are suited to identify distinct areas that currently lead to high nitrate loads in rivers.

We present a new approach for nitrate load calculations at the catchment scale that considers lateral flow paths and transformation processes.

The framework for this approach is the Object Modeling System (OMS). An OMS Model consists of lean single process components which are held in an open library of alternate science. Currently a starting set of methods is implemented to model hydrological processes on basis of hydrological response units. We chose the implementation of nitrate transport components in OMS that uses the already calculated groundwater runoff from an upper and a lower storage and its routing through a cascade of storages to the receiving surface water. Segmenting the lower groundwater storage into an amount of small storages leads to a discrete streamtube for each hydrological response unit to the river. Nitrate losses from the unsaturated soil are calculated separately. The groundwater storages can be associated with an initial amount of nitrate reduction capacity depending on the local rock material. Therefore irreversible oxidation process within the aquifers can be taken into account. In addition to the base flow we model a more rapid discharge component through the upper groundwater storages that represents the weathered zone of hard rock areas.

This approach takes into account that nitrate cause successive oxidation of the aquifers and that a breakthrough of an oxidation front may result in increasing nitrate input to the river. The developed approach calculates nitrate load at the catchment outlet as

well as the contribution of each hydrological response unit in the model.

The presented approach provides a flexible way to fit the availability of geological and geochemical information. Thus, its results strongly depend on the quality and quantity of data.