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Spatially distributed lateral nitrogen transport at the catchment scale using an object orientated modelling approach

F.B. Hesser and M. Rode

UFZ Centre for Environmental Research, Magdeburg, Germany (fred.hesser@ufz.de / Fax: +49 391 810 9699 / Phone: +49 391 810 9671)

As Carrera pointed out in his Darcy Medal Lecture 2004 the coupled models for reactive groundwater transport are not finally developed yet. Even if they show good results in modelling contaminated landscapes, a tool to model the reactive nutrient nitrate in the natural environment on catchment scale doesn't exist or the needed parameter are missing.

As long as there is no fast and cheap way to gather the aquifer data needed for sophisticated models, we need simple approaches for lateral nitrate transport. This approach has to take into account the irreversible oxidation of the aquifer as the dominant time dependent effect of nitrate transport.

To provide such a tool we started with the hydrological model J2000 and extended it with the capability to simulate nitrate transport. The used model works on hydrological response units and consists of single process components that are embedded in the framework of the Object Modeling System (OMS). This OMS framework provides hierarchic arrangable temporal and spatial contexts allowing to couple different process components at different temporal and spatial scales. Thus OMS enables us to extend the hydrological model with new components for nitrate modelling and to create a model setup that works in three different spatial scales and two different time scales.

In order to proof the concept we modelled a catchment with an area of 100km^2. Because the model takes the irreversible aquifer oxidation into account it shows increasing nitrate load in the river despite there are no changes in nitrate input to the system.

We found that on the long term run nitrate reduction capacity will be reduced in the study catchment. This will increase the share of nitrate loss from the soil that enters the surface waters.

Further OMS extensions for the modelling of lateral phosphorus and sediment transport in a nested approach are intended.