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# Hydrological improvements for nutrient and pollutant emission modeling in large scale catchments

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An estimation of emissions and loads of nutrients and pollutants into European water bodies with as much accuracy as possible depends largely on the knowledge about the spatially and temporally distributed hydrological runoff patterns. An improved hydrological water balance model for the pollutant emission model MoRE (Modeling of Regionalized Emissions) (IWG, 2011) has been introduced, that can form an adequate basis to simulate discharge in a hydrologically differentiated, land-use based way to subsequently provide the required distributed discharge components. First of all the hydrological model had to comply both with requirements of space and time in order to calculate sufficiently precise the water balance on the catchment scale spatially distributed in sub-catchments and with a higher temporal resolution. Aiming to reproduce seasonal dynamics and the characteristic hydrological regimes of river catchments a daily (instead of a yearly) time increment was applied allowing for a more process oriented simulation of discharge dynamics, volume and therefore water balance. The enhancement of the hydrological model became also necessary to potentially account for the hydrological functioning of catchments in regard to scenarios of e.g. a changing climate or alterations of land use.

As a deterministic, partly physically based, conceptual hydrological watershed and water balance model the Precipitation Runoff Modeling System (PRMS) (USGS, 2009) was selected to improve the hydrological input for MoRE. In PRMS the spatial discretization is implemented with sub-catchments and so called hydrologic response units (HRUs) which are the hydrotropic, distributed, finite modeling entities each having a homogeneous runoff reaction due to hydro-meteorological events. Spatial structures and heterogeneities in sub-catchments e.g. urbanity, land use and soil types were identified to derive hydrological similarities and classify in different urban and rural HRUs. In this way the hydrological system is simulated spatially differentiated and emissions from urban and rural areas into river courses can be detected separately.

In the Ruhr catchment (4.485 $km^2$) as a right tributary of the Rhine located in the lower mountain range of North Rhine-Westphalia in Germany for the validation period 2002-2006 the hydrological model showed first satisfying results. The feasibility study in the Ruhr shows the suitability of the approach and illustrates the potentials for further developments in terms of an implementation throughout the German and contiguous watersheds.

IWG, Karlsruhe Institute of Technology (KIT). 2011. http://isww.iwg.kit.edu/MoRE.php. [Online] Institute for Water and River Basin Management, Department of Aquatic Environmental Engineering, October 2011.

USGS, U.S. Geological Survey. 2009. PRMS-2009, the Precipitation-Runoff Modeling System. Denver, Colorado : s.n., 2009. Bd. U.S. Geologic Survey Open File Report.