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Danubs – nutrient management in the Danube basin and its impact on the Black Sea - The role of the water balance calculations

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In estimating the nutrient balance of river basins the diffuse pollution and the transport, retention and losses of nutrients play an important role and therefore knowledge about the water pathways is important. The objective of the water balance analyses within the daNUbs-project (nutrient management in the Danube basin and its impact on the Black Sea) was to understand the key processes in terms of water path ways that lead to regional nutrient turnover. These results were also used to identify potential weaknesses of the MONERIS model which was applied to the whole Danube Basin in WP 5 of the daNUbs project. The main emphasis of this project part was on

SWAT 2000 model	DIFGA 2000	MONERIS
- conceptual continuous time model - lumped model (HRU's) - daily timestep	- hydrograph separation technique - linear storages - daily measurements	- empirical model for large river basins - net-catchments for calculation - 5-year average values

- A better understanding of the nutrient cycling at the surface water-groundwater transition zone and the retention in the groundwater,
- The identification of runoff components,

- A comparison of different estimation methods for a number of case study catchments

Groundwater – surface water interaction

The characteristics and the rates of nutrient cycle processes strongly depend on hydrological, chemical and biological interactions. Knowledge about hydrologic conditions, groundwater flow direction and velocity is crucial for process understanding and for estimating nutrient loads. Two study sites (the relatively dry Wulka catchment and the wet Ybbs catchment) were chosen, on the basis of availability of groundwater data. A detailed groundwater observational network and detailed geohydraulic information from former studies provided the basis for the investigations. In addition to the existing groundwater observational network, multilevel wells were installed in the riparian zone near the Wulka and Ybbs rivers (filter depth: 0.2m, 0.5m and 1.0m). From stream and groundwater level measurements a rough groundwater isoline plan was developed for an extended region showing the groundwater table and groundwater flow directions.

Retention in the groundwater

Using interpolated groundwater table measurements, geological maps and the river network, distributions of groundwater residence time in the Ybbs and the Wulka catchments were estimated. These were then used to estimate the retention (denitrification) of nitrogen (nitrate) in the groundwater by a half-life time approach assuming a constant nitrogen surplus at the top of the groundwater. As a result, the relative contribution of catchment areas to the total nitrogen load as a function of groundwater residence times was obtained.

Runoff components and comparison of different estimation methods

As a fist step, a conceptual model based on physical equations was used. The SWAT 2000 model was chosen as it is widely used internationally and is freely available. As input data, average daily values of a 7 year time series were used, including precipitation, air temperature, solar radiation, relative humidity and wind speed. Application of the SWAT 2000 model revealed that an immense effort for data preparation and for specifying model parameter is needed to obtain acceptable model performance. Furthermore, it was noted that with the multitude of partly uncertain model parameters it is possible for the model to match the observed data with different, equally likely model parameter sets.

An alternative method for estimating the runoff components based on a hydrograph separation technique was hence used to address these problems. The DIFGA 2000

model was applied to the case study regions. The plausibility of the estimated distributions of the runoff components was checked against other runoff separation methods and literature values. The runoff component distribution was then one of the main pieces of information for calibrating the SWAT 2000 model. In addition, the water balance for the four case study regions was estimated using the MONERIS model.

The main characteristics of the case study regions and the results of the water balance calculations using the different methods are discussed in this presentation.

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