Integration and Calibration of a conceptual Rainfall-Runoff-Model in the framework of a Decision Support System for River Basin Management

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Abstract
In this approach the hydrological model HBV was adapted to allow for a spatially highly discretized simulation of daily groundwater recharge that is transferred to the groundwater model which returns modeled base flow to the flood-routing module of the rainfall-runoff-model. Regionalisation and optimization methods lead to an objective and efficient calibration in spite of the large number of parameters. The representation of model parameters by transfer functions of catchment characteristics enables a consistent parameter estimation. By establishing such relationships, the model was calibrated for the parameters of the transfer function instead of the model parameters themselves. Simulated annealing using weighted Nash-Sutcliffe-coefficients of variable temporal aggregation assists in an efficient parameterisation.

Model concept HBV
- Grid-based (1 km²)
- Fully distributed process description
- Parameter estimation by transfer functions of catchment characteristics
- Calibration of the parameters of the transfer functions instead of the model parameters

\[ Q_t = k_1 \cdot S_1 \quad Q_{perc} = k_{perc} \cdot S_1 \quad Q_g = k_2 \cdot S_2 \]

\[ p = G (\text{flowtime}, \text{landuse}, \text{soiltype}) \]

Input:
- statistical downscaling and External Drift Kriging
- regional soil and landuse database information system

Output:
- spatially distributed groundwater recharge = boundary condition for the groundwater model returning base flow
- discharge at river network nodes

Regionalized parameters and basis for regionalization

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Regionalized by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper reservoir, non-linear recession constant</td>
<td>Flow time, land use</td>
</tr>
<tr>
<td>Upper reservoir, non-linear recession exponent</td>
<td>Land use</td>
</tr>
<tr>
<td>Upper reservoir, linear percolation constant</td>
<td>Field capacity, wilting point</td>
</tr>
<tr>
<td>Upper reservoir starting water level</td>
<td>Soil class</td>
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</tbody>
</table>

Results
- Discharge in similar, uncalibrated catchments can be simulated using a priori defined transfer functions of readily available catchment characteristics (Regionalisation)
- Model performance suited well for river basin management, water availability, water quality and habitat ecology simulations
- Areal groundwater recharge simulations reproduce model results of Armbruster (2002)

References