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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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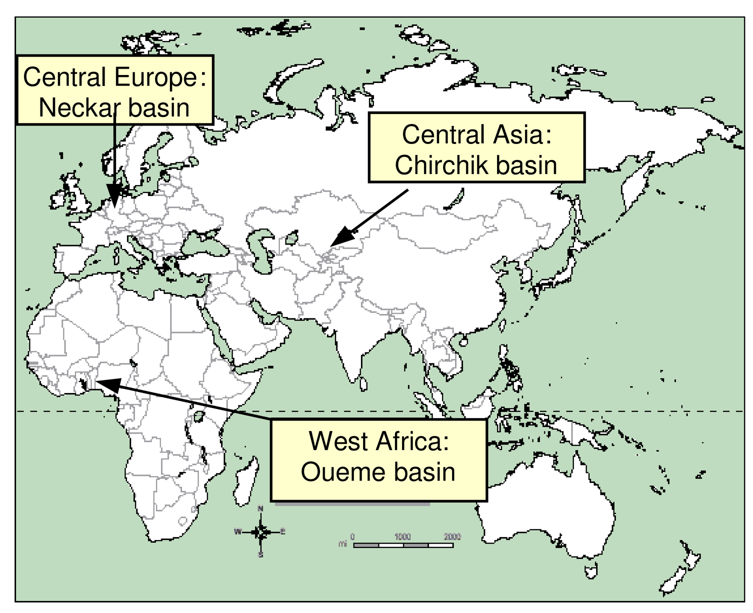
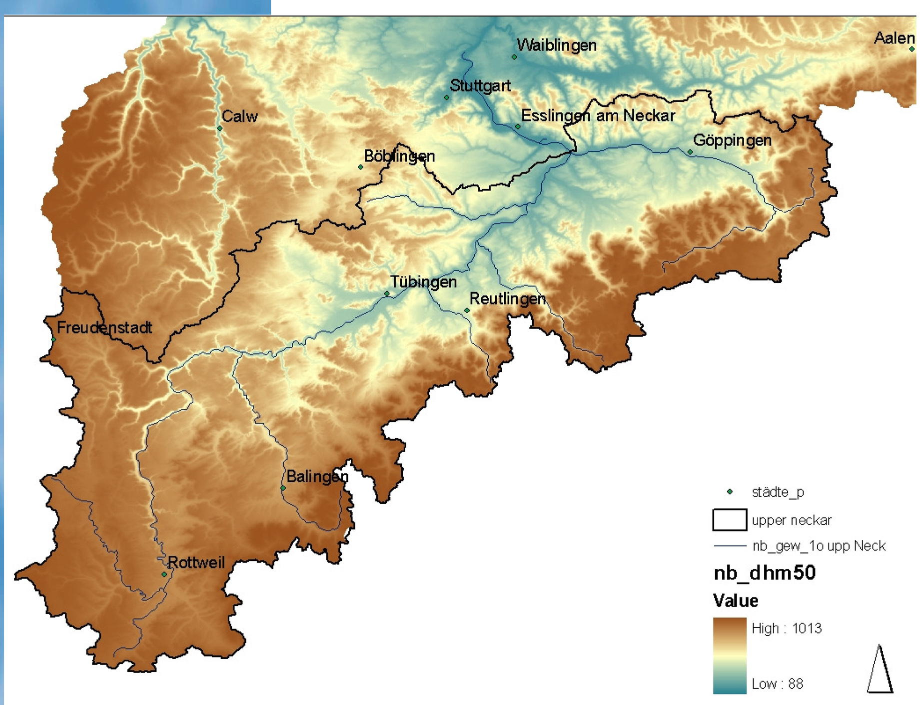


Location of project basins

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. ww.rivertwin.org



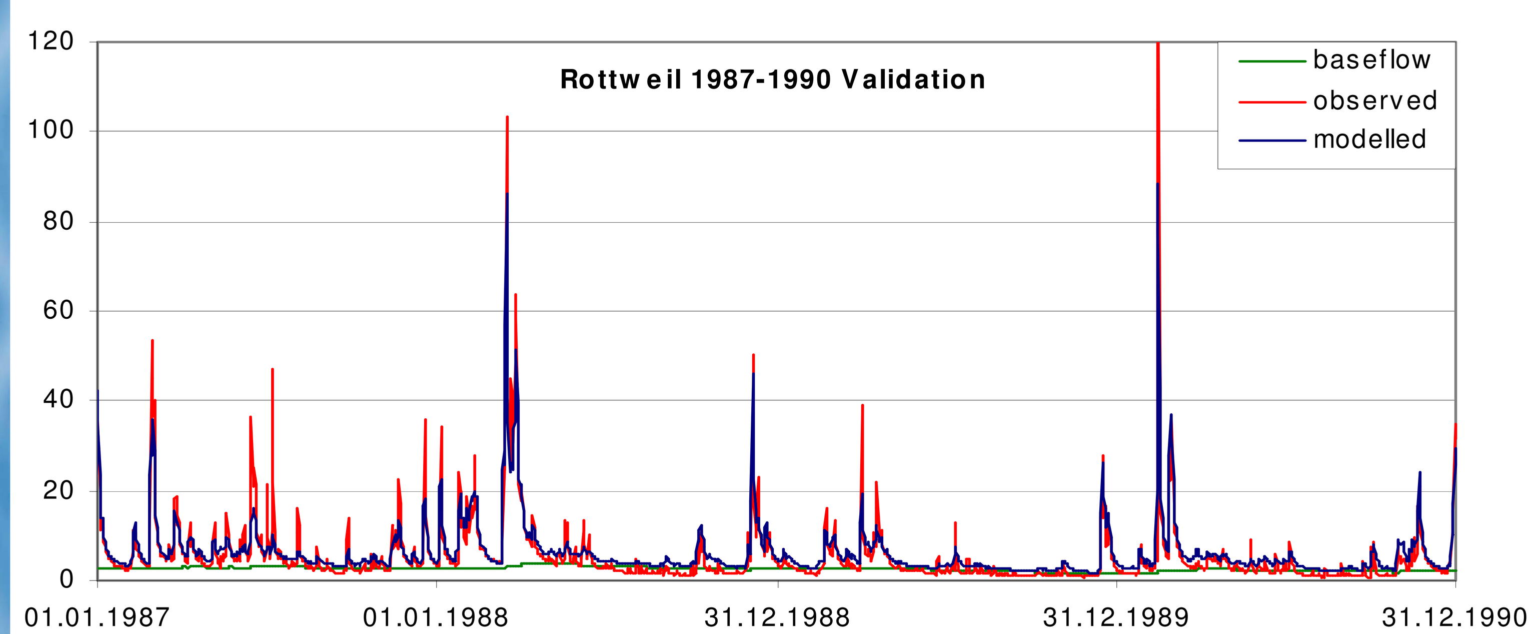
Topography of upper Neckar catchment (3211 km²)

Model concept HBV

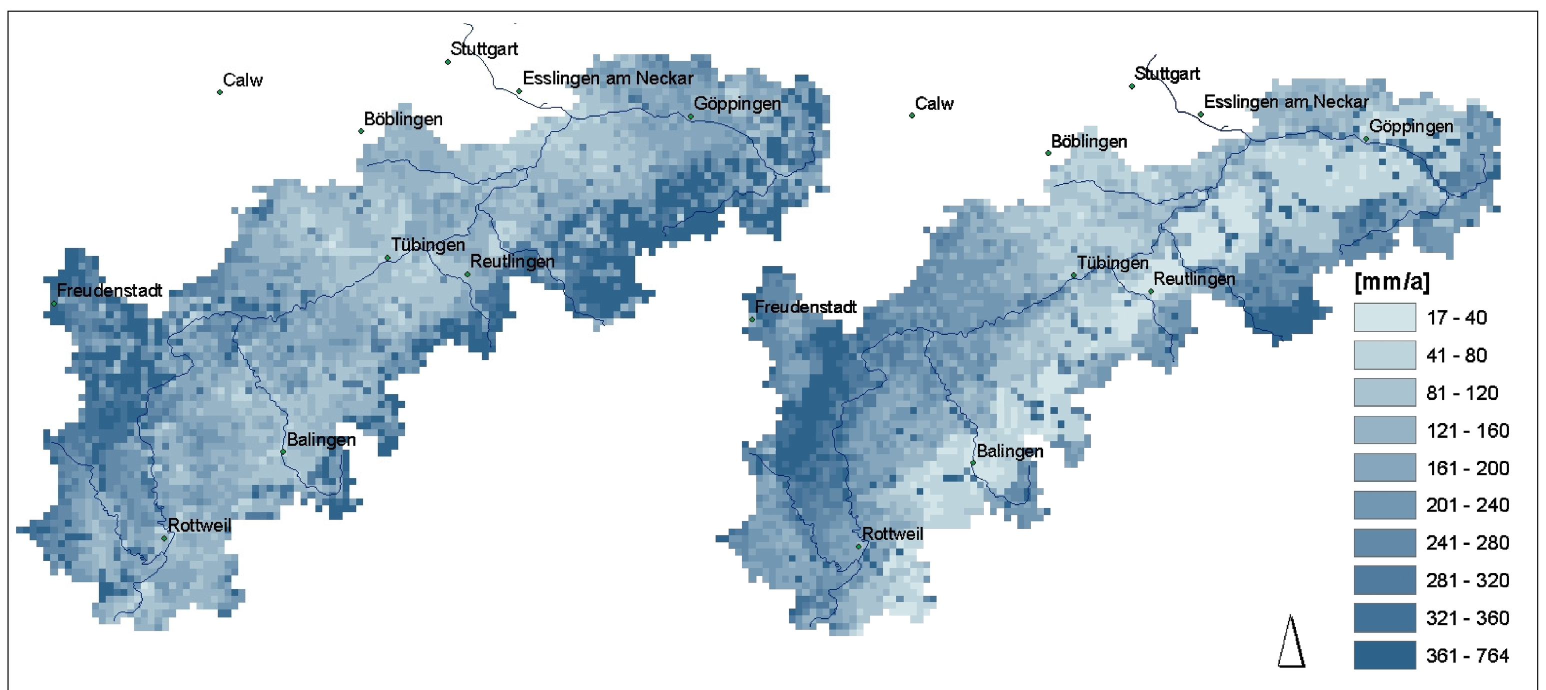
- Grid-based (1 km²)
- Fully distributed process description
- Parameter estimation by transfer functions of catchment characteristics
- Calibration of the parameters of the transfer functions instead of the model parameters

$$Q_1 = k_1 \cdot S_1^{1+\alpha} \qquad Q_{perc} = k_{perc} \cdot S_1 \qquad Q_2 = k_2 \cdot S_2$$

$$\boxed{p = G(\, flowtime \,,\, landuse \,,\, soiltype \,)}$$



Simulated discharge and baseflow (m³/s) at calibration station



Annual groundwater recharge HBV (left) and Armbruster (right)

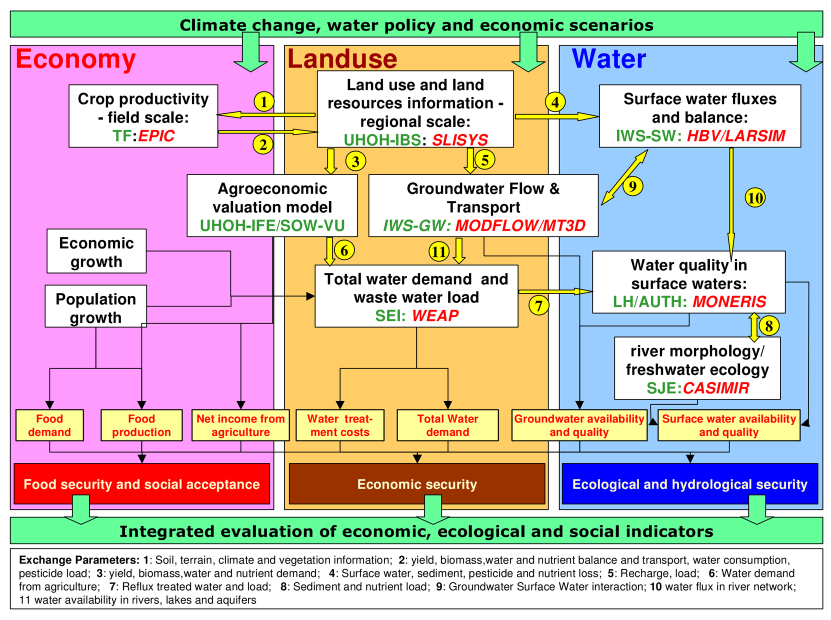
Mean	175 mm	207 mm
Standard deviation	107 mm	108 mm

- Local variations through different model approaches (1 km²: r=0,44)
- Large-scale pattern matches well (25 km²: r=0,7)

MOSDEW

(Model for Sustainable Development of Watersheds)

- GIS-based user interface, database and external submodels
- coupled submodels are started in case of a scenario run, e.g.: hydrological model HBV



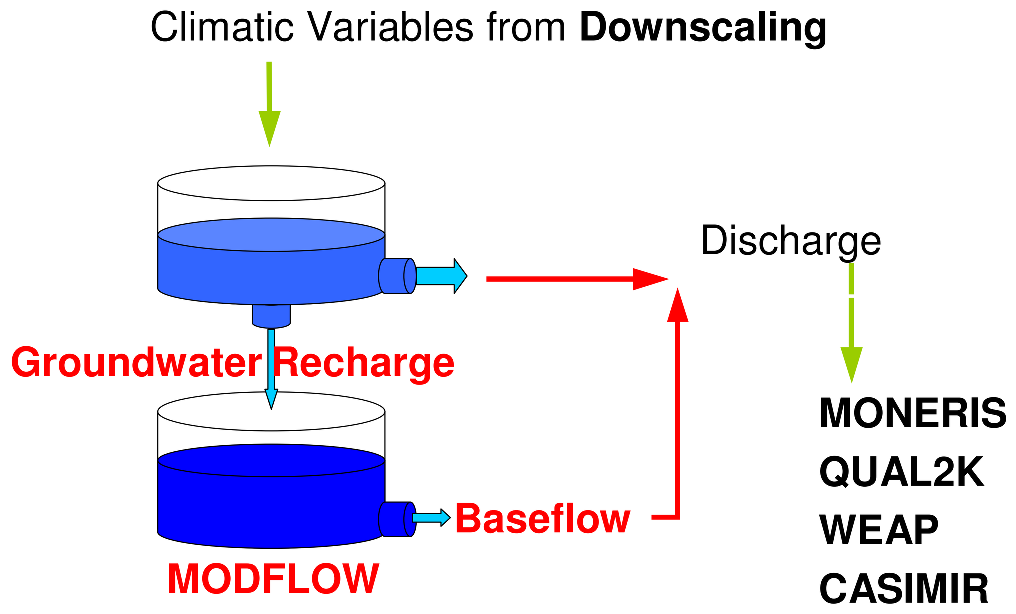
Submodel interfaces in MOSDEW

Input:

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

Output:

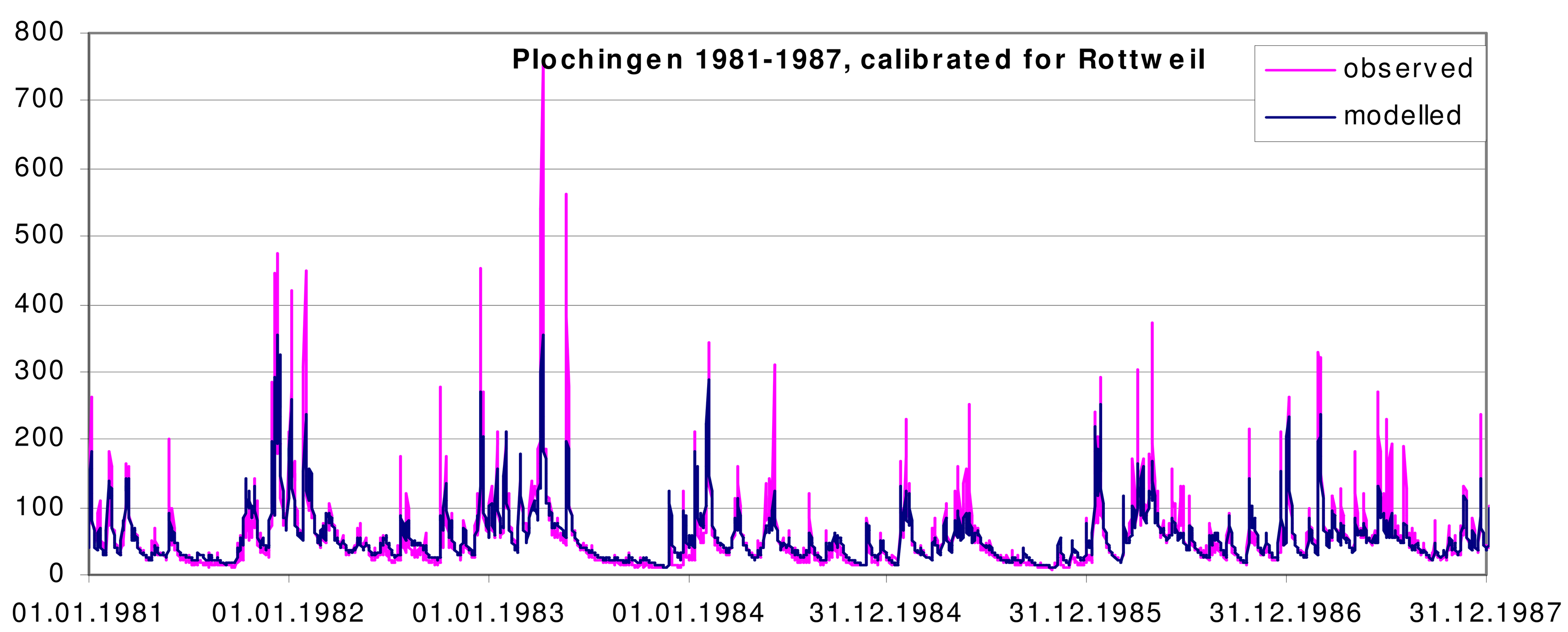
- spatially distributed groundwater recharge = boundary condition for the groundwater model returning baseflow
- discharge at river network nodes



Coupling of the water balance model

Regionalized parameters and basis for regionalization

Parameter	Regionalized by
Upper reservoir, non-linear recession constant	Flow time, land use
Upper reservoir, non-linear recession exponent	Land use
Upper reservoir, linear percolation constant	Field capacity, wilting point
Upper reservoir starting water level	Soil class



Simulated discharge (m³/s) using regionalised parameters

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:

Armbruster, V.: Grundwasserneubildung in Baden- Württemberg, Freiburger Schriften zur Hydrologie (17), Institut für Hydrologie, Freiburg, 2002.

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