Water Balance Simulations for Major German River Basins

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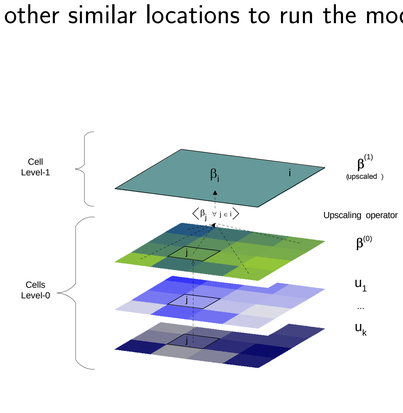
1. Abstract

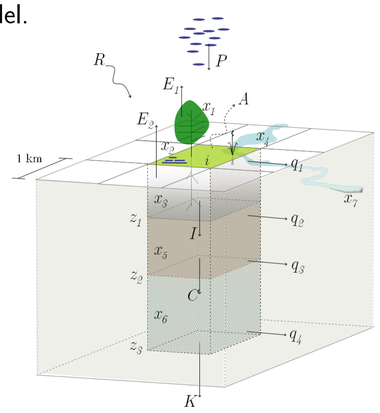
Accurate and reliable predictions of water fluxes and state variables such as soil moisture or evapotranspiration in large river basins are required for flood forecasting, drought mitigation, climate change impact assessment, water resource management, among others. The objective of this study is to simulate the water balance of the largest river basins within Germany: Danube, Elbe, Rhine, Weser and Ems. To achieve this goal, the recently developed, process based spatial distributed hydrological model mHM was set up in these basins.

2. The Model mHM

mHM uses a multiscale parameter regionalization scheme (MPR) [3], which relates model parameters to catchment characteristics through a set of transfer functions and few global parameters. The latter could be estimated via calibration at locations where discharge information is available. At ungauged locations, MPR offers a possibility to use the global parameters obtained at other similar locations to run the model.



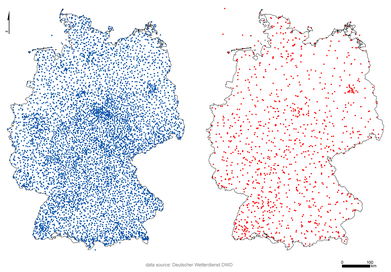
Multiscale Parameter Regionalization



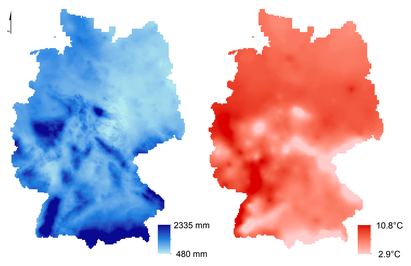
Model Structure

3. Input Data

- **Period**: 1950-2009
- **Meteorological Observations**
  - Source: German Meteorological Service [2]
  - 5600 precipitation and 1100 temperature measuring stations
  - Interpolated with External Drift Kriging EDK (4x4 km)



Precipitation and Temperature Measuring Stations

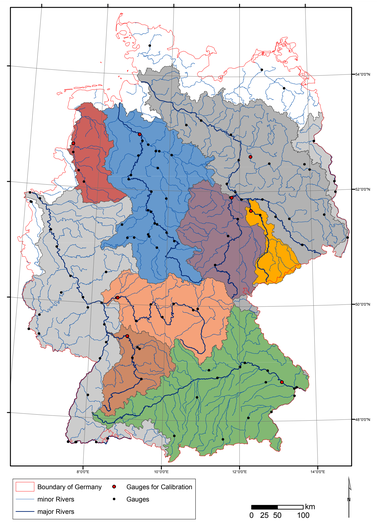


Mean of Annual Precipitation and Temperature (1950-2009)

4. Study Area

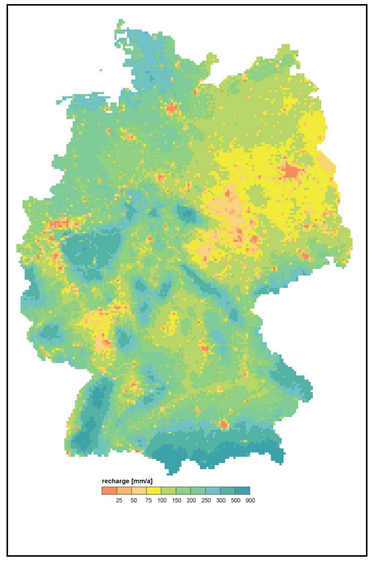
- **Domain**: Germany, 357 000 km^2
- **Catchments**:

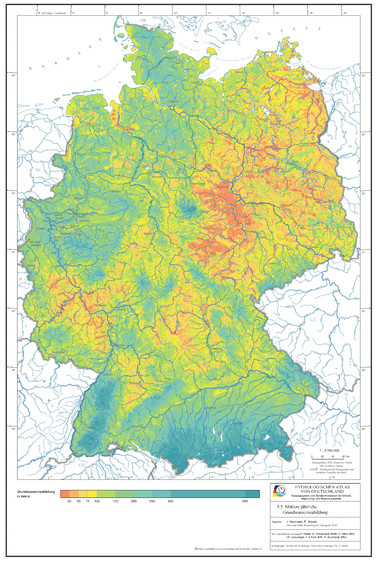
	area	NSE
Danube	47 500 km^2	0.81
Weser	37 700 km^2	0.93
Main	24 800 km^2	0.92
Saale	23 700 km^2	0.74
Neckar	12 700 km^2	0.92
Ems	8 400 km^2	0.86
Mulde	6 200 km^2	0.84



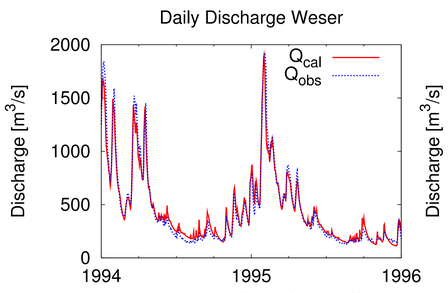
Major German River Basins

5. Validation and Plausibility of the Results

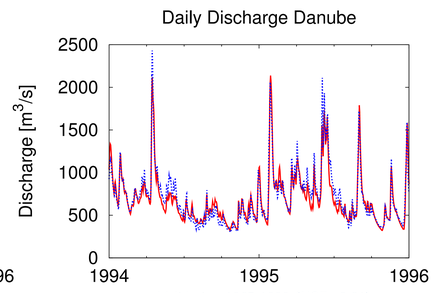




Simulation (left) and HAD-Illustration (right) [1] of groundwater recharge



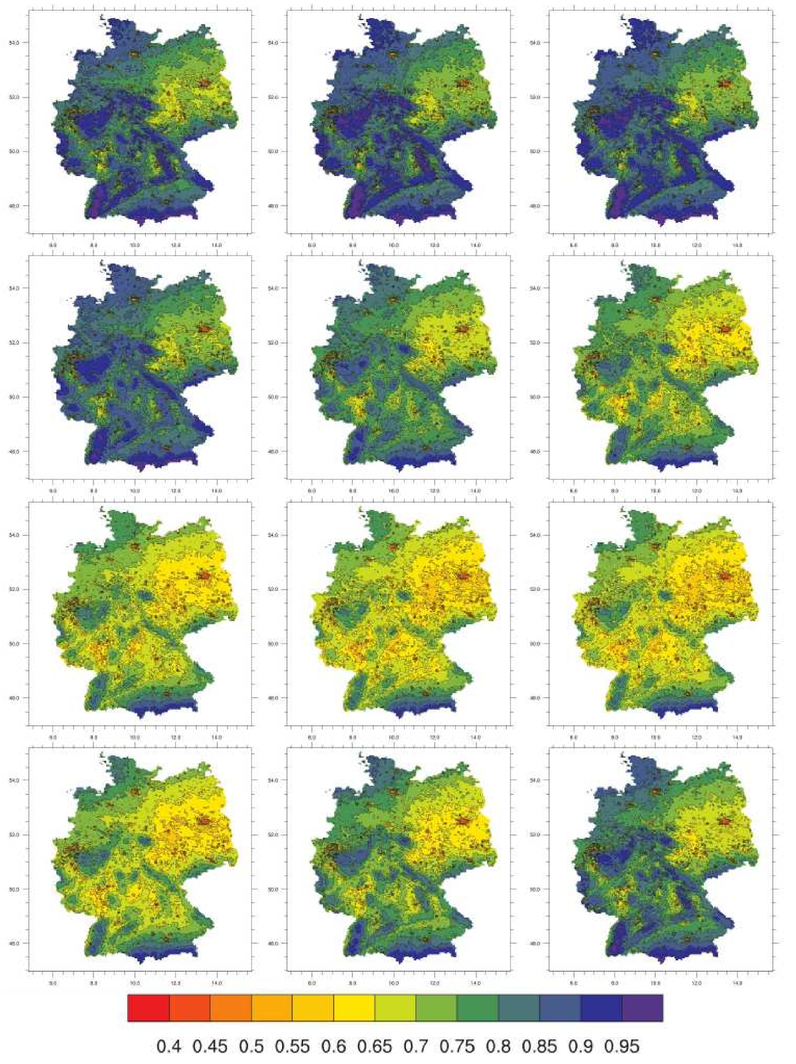
Validation 1965-1999 (NSE=0.93)



Validation 1965-1999 (NSE=0.81)

6. Results

Mean, monthly soil moisture (θ/θ_s) patterns (Jan bis Dec 1955-2009)



7. Outlook

- Determination of model parameters for every grid cell (4x4 km).
- Validation of soil moisture simulations with satellite data (e.g. MODIS).
- Usage of satellite data as input data (precipitation, evapotranspiration).

References

[1] *Hydrologischer Atlas von Deutschland*. Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU), 2003.

[2] DWD, http://www.dwd.de/.

[3] L. Samaniego, R. Kumar, and S. Attinger, "Multiscale parameter regionalization of a grid-based hydrologic model at the mesoscale," *Water Resources Research*, 2010.

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