MuDak-WRM

FONA Research for Sustainable Development BMBF

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LARSIM water balance model for the Passaúna catchment and reservoir

Context

The water balance of a catchment is one of the most relevant factors in the management of reservoirs. Water balance models can deliver valuable information on all components of the water balance of the reservoir and can thereby contribute to sustainable reservoir management.

Water balance model LARSIM

LARSIM simulates the terrestrial water balance of catchments spatially distributed and temporally continuously in a process-oriented way. Its setup for a given catchment is based on data on the river network, topology, soil hydraulic properties and land use. Forcing data for the model consist of meteorological data, most notably precipitation. The most common data basis for calibration and validation is measured discharge at gauges.

Outputs of LARSIM

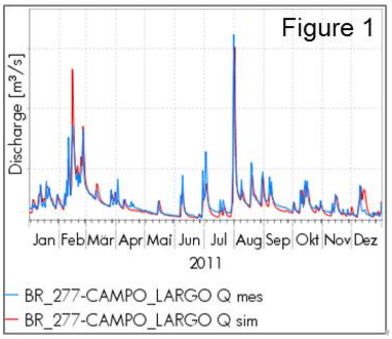
Water balance models deliver results for different parameters on various spatial and temporal scales. The minimum spatial and temporal scale depends on the resolution of input data.

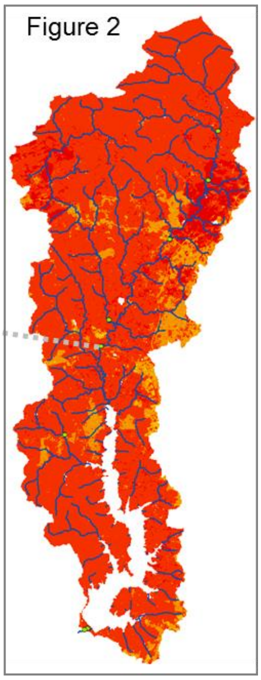
The most obvious output is simulated discharge along the represented river network, e.g. at hydrological gauges (Figure 1), but also at other points of interest (e.g. ungauged inflows into the reservoir). In LARSIM, this often-used outcome is based on spatially distributed computation of discharge generation. Therefore, it is also possible to obtain spatially distributed results on runoff. This kind of result is also available for other components of the water balance, e.g. evapotranspiration (Figure 2). Both kind of results can additionally be differentiated by their flow paths into different runoff components, such as groundwater recharge or surface runoff (Figure 3). For some parameters, even further differentiation is possible, e.g. spatially distributed runoff components differentiated by the underlying land use (e.g. surface runoff from sealed areas or agricultural land).

The model can also simulate the temporal evolution of water level and water volume in the reservoir, which is essential for the assessment of the availability of drinking water and different management scenarios.

This type of results for Passaúna reservoir is in more detail presented on the extra flyer "*Using hydrological models to plan and manage reservoirs with respect to water quantity*".

Moreover, the LARSIM model for the Passaúna catchment simulates water temperature. Therefore, it is possible to obtain water temperature results along the river network at points of interest (not for standing water bodies; Figure 4 and 5).





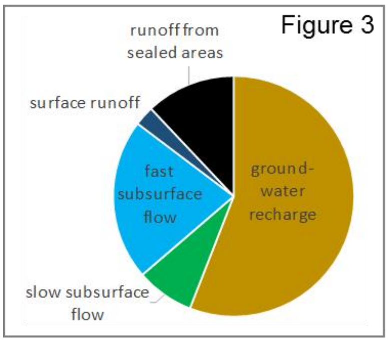


Figure 1: Comparison of simulated (red) and measured (blue) daily discharge time series [m³/s] at gauge BR277/Passaúna.

Figure 2: Simulated spatial distribution of average annual evapotranspiration [mm/a] for the catchment of Passaúna reservoir.

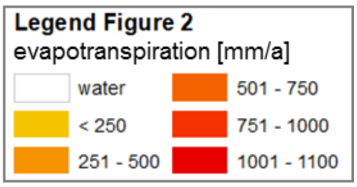
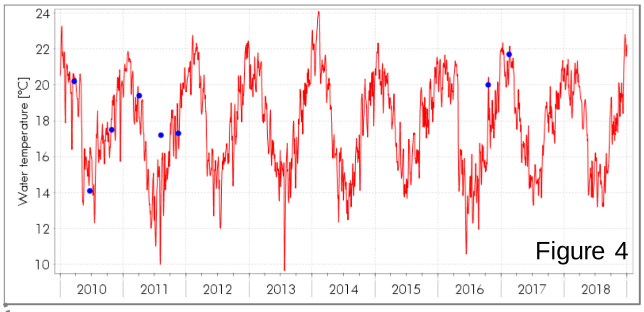


Figure 3: Simulated long-term percentage shares of different runoff components for Passaúna catchment.



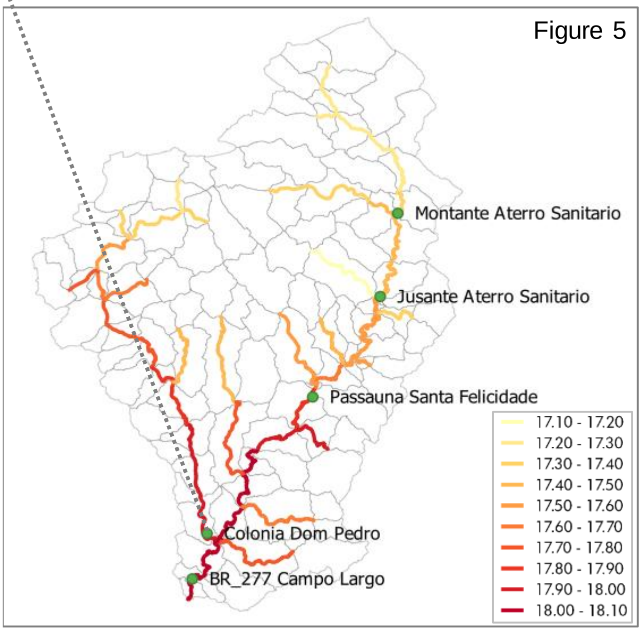


Figure 4: Comparison of simulated (red) and measured (blue) daily water temperature at station Colonia Dom Pedro/Rio Cachoeirinha.

Figure 5: Spatial distribution of simulated average annual water temperature [°C] for the Passaúna river network.

Applications of water balance models

As water balance models run temporally continuously and spatially differentiated, they can supplement information on parameters, which are difficult, laborious or expensive to measure. Once a model has been setup and calibrated, it can be run for all periods, for which meteorological forcing data is available.

Therefore, the models allow not only the simulation of forecasts (such as for flood warning), but also the assessment of effects of hypothetical changes in the catchment (e.g. land use alterations or climate change) on the hydrology.

Applications within MuDak-WRM

Within MuDak-WRM the LARSIM water balance model set up for the Passaúna catchment serves two primary goals: Spatially differentiated, land use specific runoff components are used as input for the emission model MoRE. Discharge and water temperature results for all inflows (including not monitored inflows) to the reservoir are used as boundary conditions for the hydraulic and water quality modelling of the reservoir itself. Furthermore, the model has been applied to check the available information on the water balance of the reservoir (inflows, outflows, drinking water intake and water level variations) for consistency.

Potential future applications

The existing model can be used for all further purposes, for which the necessary driving data is available. This includes the calculation of scenarios (e.g. climate change or land use scenarios). Impacts on both discharge and water temperature in the rivers can be assessed under scenario conditions. Also, the impact of such scenarios (and operation scenarios) on the water volume in the reservoir and the availability of drinking water can be assessed (see example results for Passaúna reservoir on the extra flyer "*Using hydrological models to plan and manage reservoirs with respect to water quantity*"). If coupled with MoRE, the model results also allow drawing conclusions on the water quality in the reservoir. Thus, the model cannot only help to understand the present water balance, water temperature and water quality conditions, but can also help supporting decisions, which might influence future conditions.

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