“Zygos”: A basin processes simulation model

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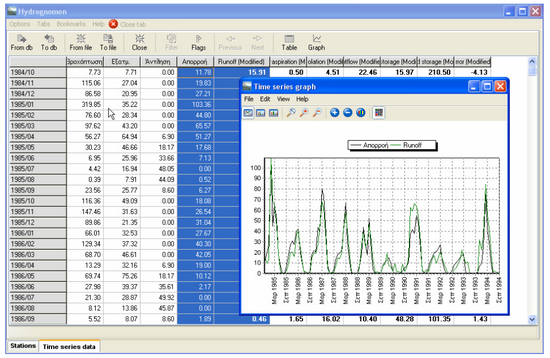
ZYGOS models the main hydrological processes of a watershed, using a lumped approach. It implements a conceptual soil moisture accounting scheme, based on a generalisation of the standard Thornthwaite model, extended with a groundwater tank.

A visual representation of modeling components helps the implementation of different configurations.

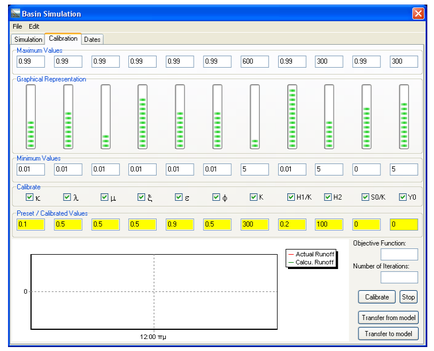
A global optimization procedure, implementing the evolutionary annealing-simplex algorithm, is included for the automatic estimation of model parameters.

Hydrological processes included and simulated:

- Rainfall
- Potential and actual evapotranspiration
- Ground and soil moisture water storage
- Surface (direct) flow
- Lagged flow (interflow)
- Percolation
- Base flow
- Outflow to basins or to the sea

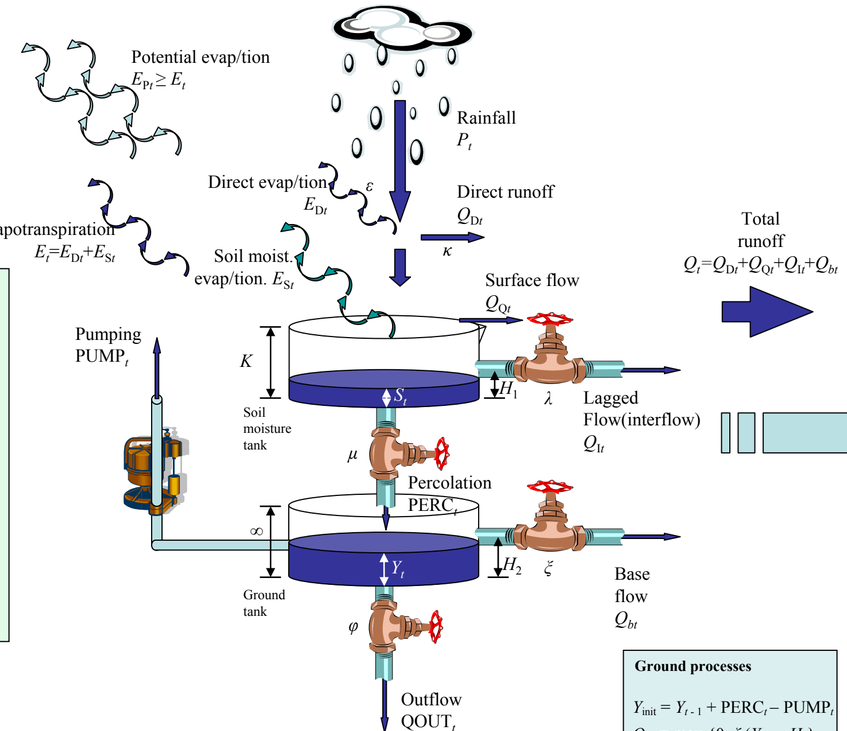


Model integration within Hydrognomon software. Representation of input and output data.



Graphical interface to control model calibration.

Physical processes - mathematical representation of the model



Surface processes

$E_{Dt} = \min(\varepsilon P_t, E_{Pt})$

$Q_{Dt} = \kappa (P_t - E_{Dt})$

$S_{init} = S_{t-1} + P_t - E_{Dt} - Q_{Dt}$

$Q_{Qt} = \max(0, S_{init} - K)$

$S_{init} = S_{init} - Q_{Qt}$

$D = E_{Pt} - E_{Dt}$

$E_{St} = S_{init}(1 - e^{-D/K})$

$S_{init} = S_{init} - E_{St}$

$Q_{It} = \max\{0, \lambda (S_{init} - H_1)\}$

$S_{init} = S_{init} - Q_{It}$

$PERC_t = \max(0, \mu S_{init})$

$S_{init} = S_{init} - PERC_t$

Ground processes

$Y_{init} = Y_{t-1} + PERC_t - PUMP_t$

$Q_{Bt} = \max\{0, \xi (Y_{nit} - H_2)\}$

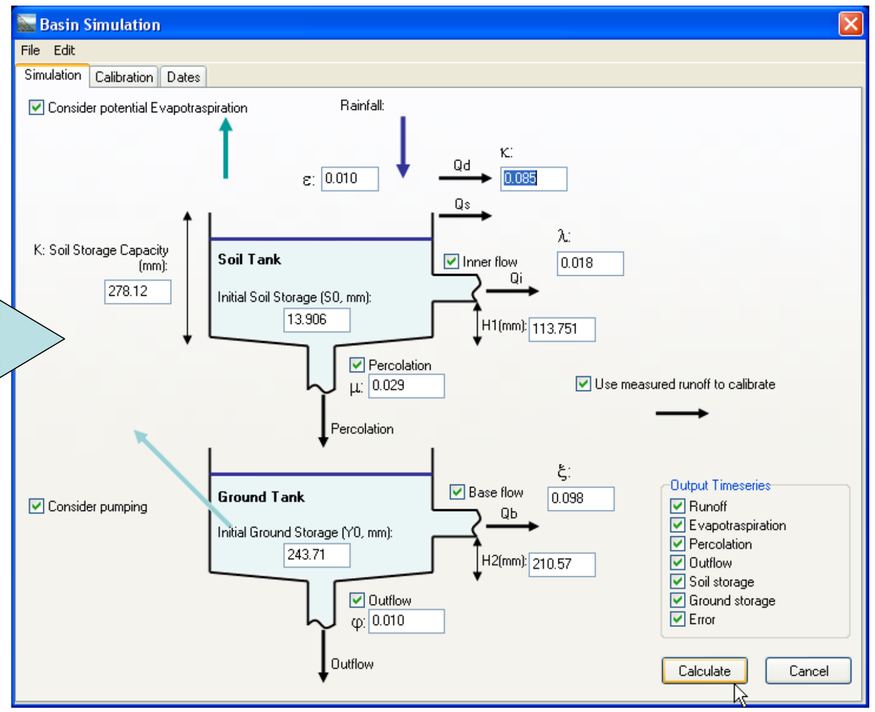
$Y_{init} = Y_{init} - Q_{Bt}$

$QOUT_t = \varphi Y_{init}$

$Y_{init} = Y_{init} - QOUT_t$

Software implementation

Input data as well as results, all in form of time series, are assessed through *Hydrognomon* giving additional capabilities such as statistical analysis though “*Pythia*” and synthetic time series generation through “*Castalia*” models.



Model outline window

- User defines the configuration of the model by opening or closing the appropriate vanes
- The complexity of the model scales from a simple model with two parameters to a full model of up to 11 parameters, adapted on the availability of data and physical behaviour of the basin.
- User can select the parameters to be calibrated by the optimization process.