**“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

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

### Software implementation

- 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.

### Physical processes - mathematical representation of the model

**Surface processes**
- \( E_D = \min (\varepsilon P_t, E_P) \)
- \( Q_D = \kappa (P_t - E_D) \)
- \( S_m = S_m(t-1) + \xi (E_m - H_2) \)
- \( S_m = S_m(t-1) - Q_b \)
- \( Q_{OUT} = \phi S_m(t) \)

**Physical processes - mathematical representation of the model**

**Potential evaporation**
- \( E_P = P_t - E_D \)

**Actual evaporation**
- \( E_A = \min (E_P, E_D) \)

**Direct evaporation**
- \( E_D = \min (\varepsilon P_t, E_P) \)

**Direct runoff**
- \( Q_D = \kappa (P_t - E_D) \)

**Soil moisture evaporation**
- \( E_m = \max (0, S_m - K_\infty) \)

**Lagged flow**
- \( Q_I = \max (0, \lambda (S_m - H_1)) \)

**Base flow**
- \( Q_B = \max (0, \xi (S_m - H_2)) \)

**Percolation**
- \( Q_{PERC} = \max (0, \mu S_m(t)) \)

**Outflow**
- \( Q_{OUT} = Q_B - Q_{PERC} \)

**Ground processes**
- \( Q_{OUT} = Q_B - Q_{PERC} - PUMP \)
- \( Q_b = \max (0, \xi (T_m - H)) \)
- \( Q_B = T_m - Q_b \)
- \( Q_{OUT} = Q_B - Q_{PERC} \)
- \( T_m = T_m(t-1) \)

**Graphical interface to control model calibration.**

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

**Model outline window**