

Spatial distribution of HBV-ETH model

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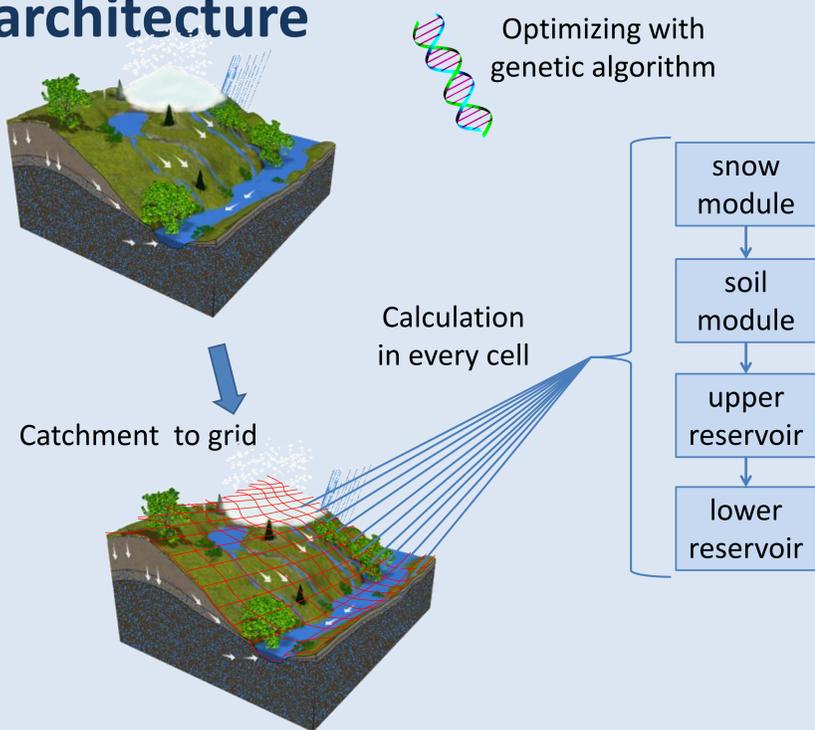
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Introduction

Based on the HBV-ETH model, three new models (**Dis**, **Dis+**, **Energy**) were created.

All of them employ spatial distribution of parameters of the whole calculation and automatic optimization. They use different methods of simulating the development of snow cover and potential evapotranspiration.

Common principles of models architecture



Differences between models

HBV-ETH Dis

- only a distributed adaptation of the original HBV-ETH model, does not involve any modifications in the calculation

HBV-ETH Dis+

- calculates snowmelt development with respect to geomorphology, consider the distinction between forest/forest-free area, potential evapotranspiration is established using daily air temperature data

HBV-ETH Energy

- compared to Dis+ calculates this version snowmelt using simplified Energy-balance method

Model	Snowmelt module			Potential evapotrans.	Input Data enlargement	Eliminated calibration parameters
	Method	LandUse	Rain on snow			
HBV-ETH Dis	Temperature Index	no	no	sinusoid	-	-
HBV-ETH Dis+	Temperature Index	yes	yes	function of daily air temperature	LandUse	REXP, ETMAX
HBV-ETH Energy	Energy balance	yes	yes	function of daily air temperature	LandUse, min & max airtemperature, windspeed	CMIN, CMAX, REXP, CWH, CRFR, ETMAX

Acknowledgements:

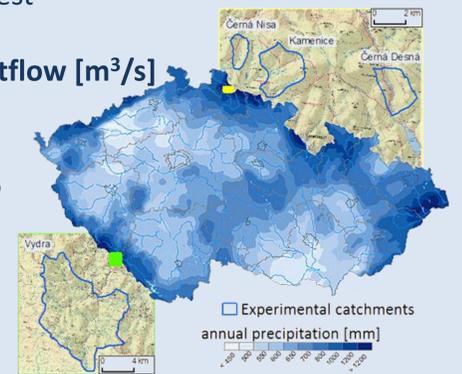
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Test catchments and methods

CATCHMENTS

Catchments, where is the runoff significantly influenced by snow cover - basins of Cerna Nisa, Kamenice and Cerna Desna in Jizera Mountains and basin of Vydra in Bohemian Forest

Catchment	Area [km ²]	Avg. Outflow [m ³ /s]
Cerna Nisa	1,87	0,055
Kamenice	6,62	0,252
Cerna Desna	4,75	0,196
Vydra	90,17	3,01

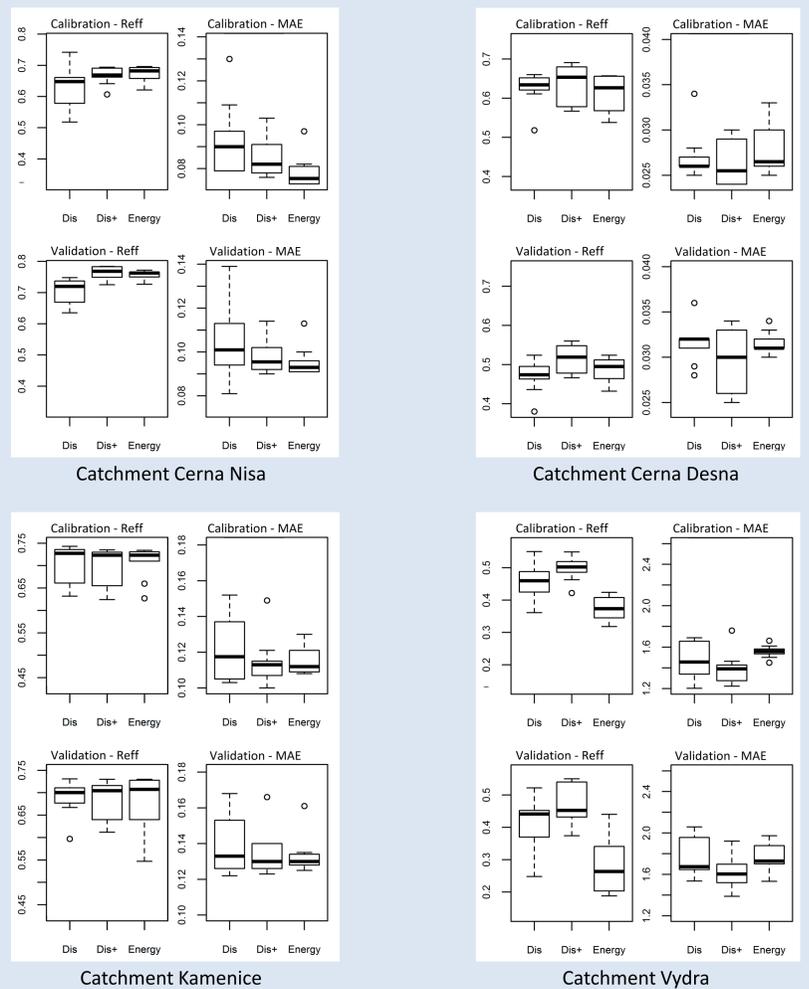


Location of tested catchments in Czech Rep.

CALIBRATION

- each model 10x calibrated on all catchments
- identical starting values and settings of genetic algorithm
- optimization: measured and simulated runoff - Nash-Sutcliffe efficiency coefficient

Results - objective functions distribution



Conclusion

- implementing of actual LandUse leads to more accurate results
- the Energy version, which brings a reduction of the parameters in the Snow module, provides reliable results
- Created models are able to simulate snow cover development and distribution on the catchment where only the rainfall-runoff and temperature data are observed