

Analysis of parameters for distributed modelling of hydrologic regime in three subcatchments of Kopaninský tok catchment

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The Frame

**part of Czech Ministry of Agriculture R&D
project (2008-2012)**

**The impact of land use in particular
catchment on runoff and some substances
loss**

measurement + modelling

sign NAZV QH 82095

**coordinator: Research Institute for Soil and Water
Conservation, Prague)**

continuation of projects on hydrology nad water quality

Analysis of parameters for distributed modelling

The Aim

current point:

**To use distributed deterministic
mathematical modelling for sensitivity
analysis of rainfall/runoff response of
small subcatchments**

Kopaninský tok exp. catchment

Operated by RISWC since 80's

Basic data:

467 - 578 m a. s. l. , hilly area

area 6.99 km²

arable land 45 %

grassland 13 % forest 36 %.

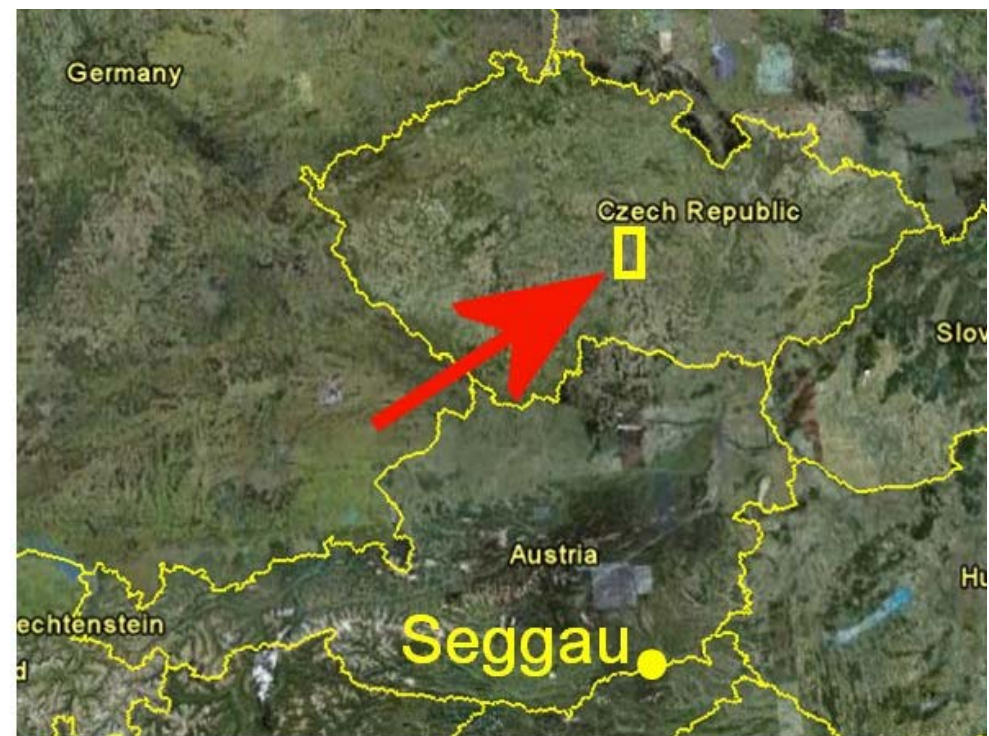
tile drainage 10 %

P: 665 mm

T: 7.0 °C

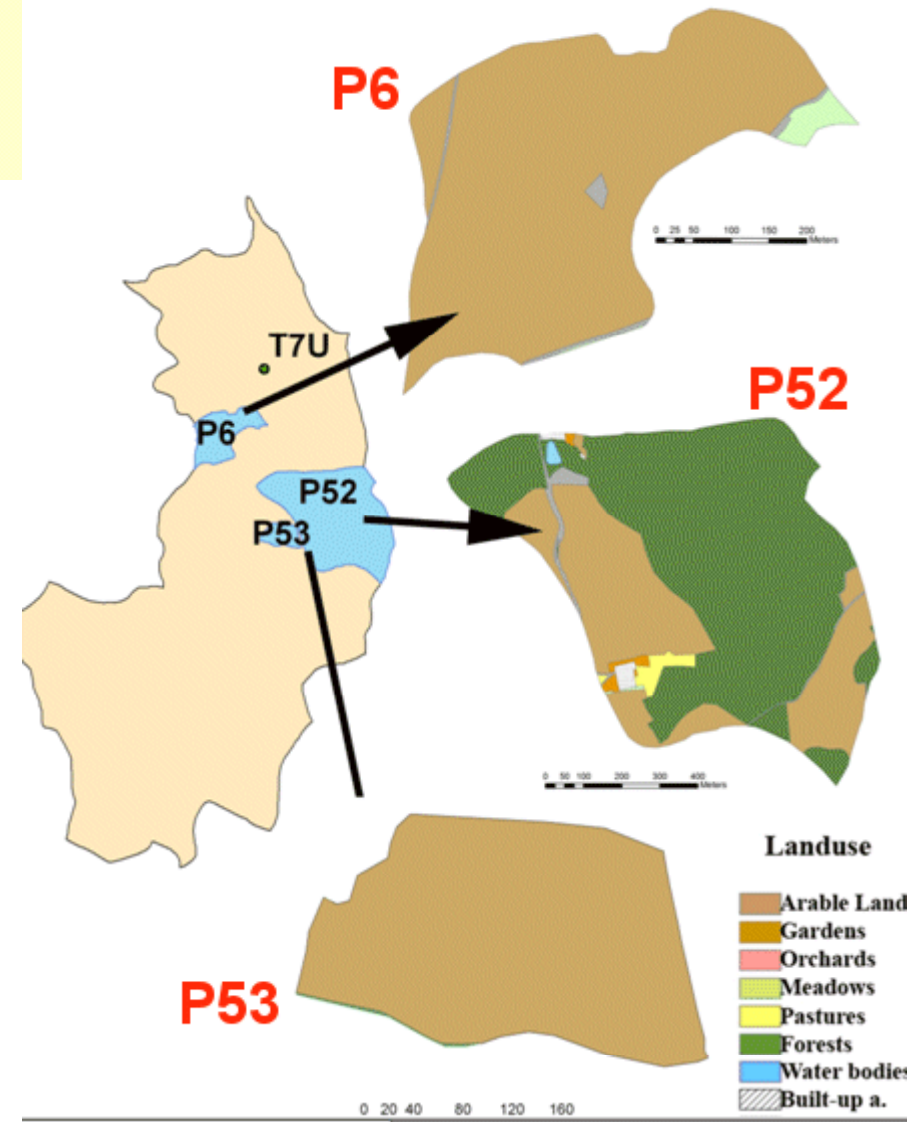
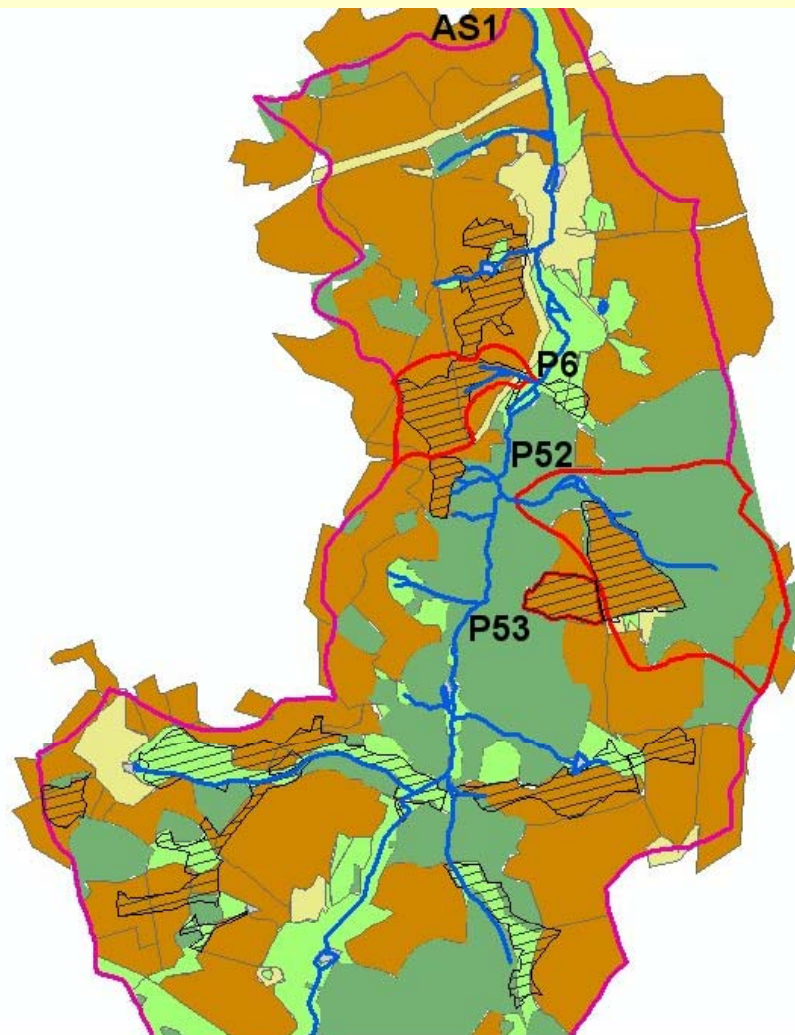
bedrock: paragneiss,

soil cover : Dystric Cambisol, 100 cm.



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Kopaninský tok exp. catchment



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Subcatchments

	Area km ²	Arable	forest	drainage
P6	0.157	96	0	100
P52	0.649	31	62	16
P53	0.049	98		100

measured:

discharge, temperature (10 min)

sampled: WQ, isotopes

available: meteorological data

GW levels (1 piezometer)



Data used

1. Maps (Arc GIS layers)

Contour lines – DEM of surface

Land use map (1982 – 2002)

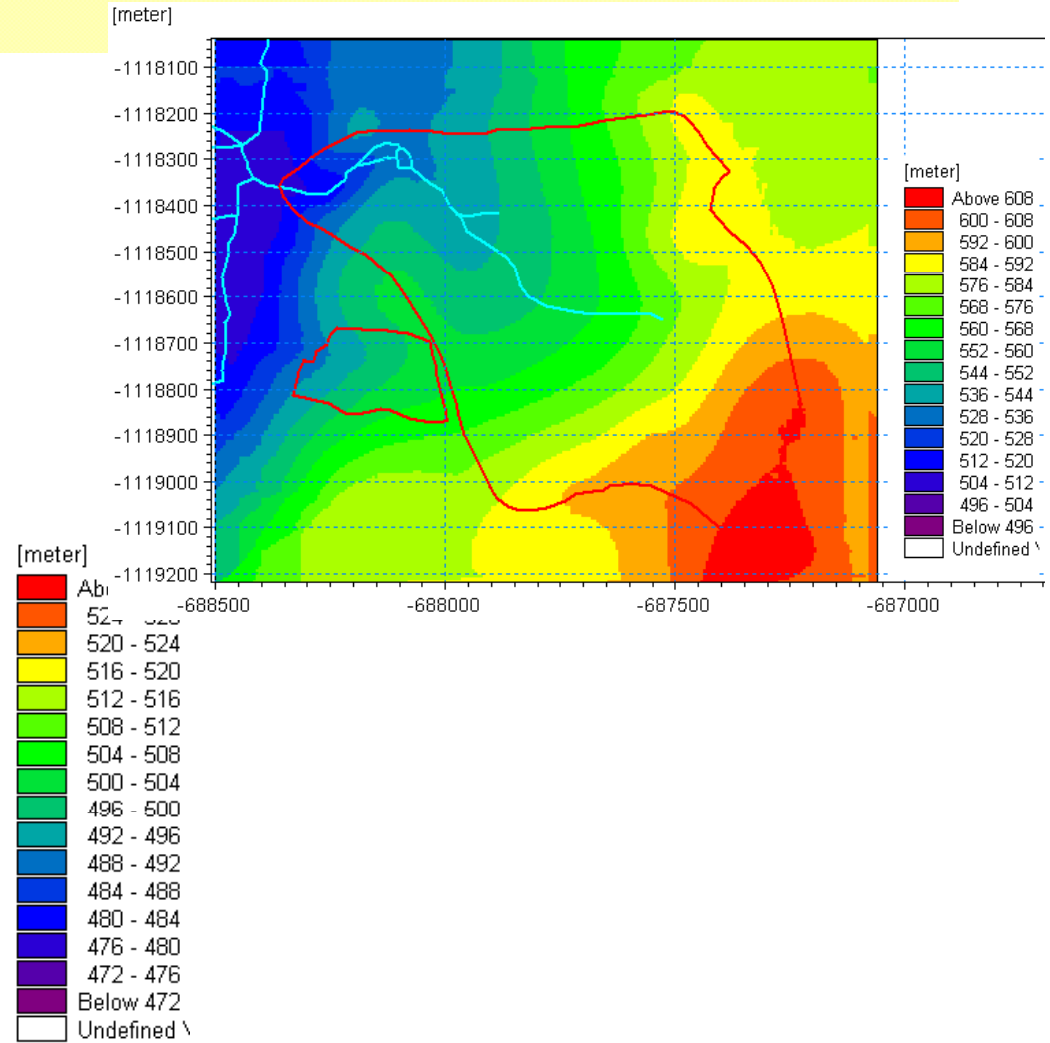
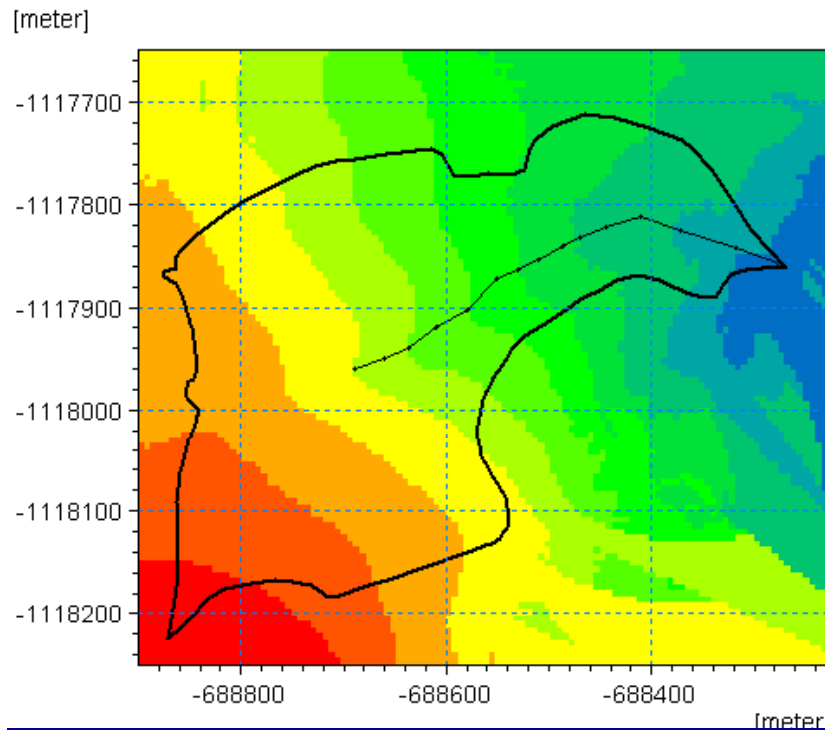
Soil types map (aggregated)

Soil substrates map (4 types) + depth map

Drainage map

Data used

Topography - DEM



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Data used

2. Time series (2004 – 2009)

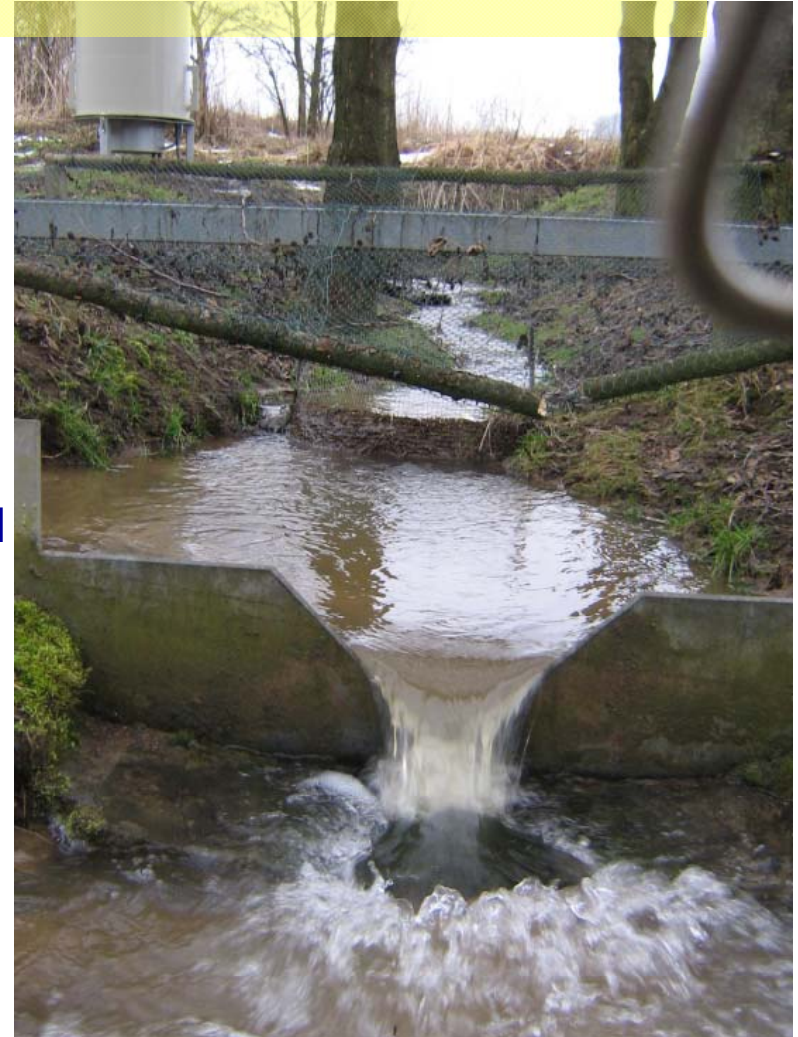
**Precipitation – 10 min meteostation
combined with daily data**

Air temperature: hourly averages (AS1)

**Ref. Evapotranspiration: computed (P-M
eq.) daily from AS1 data**

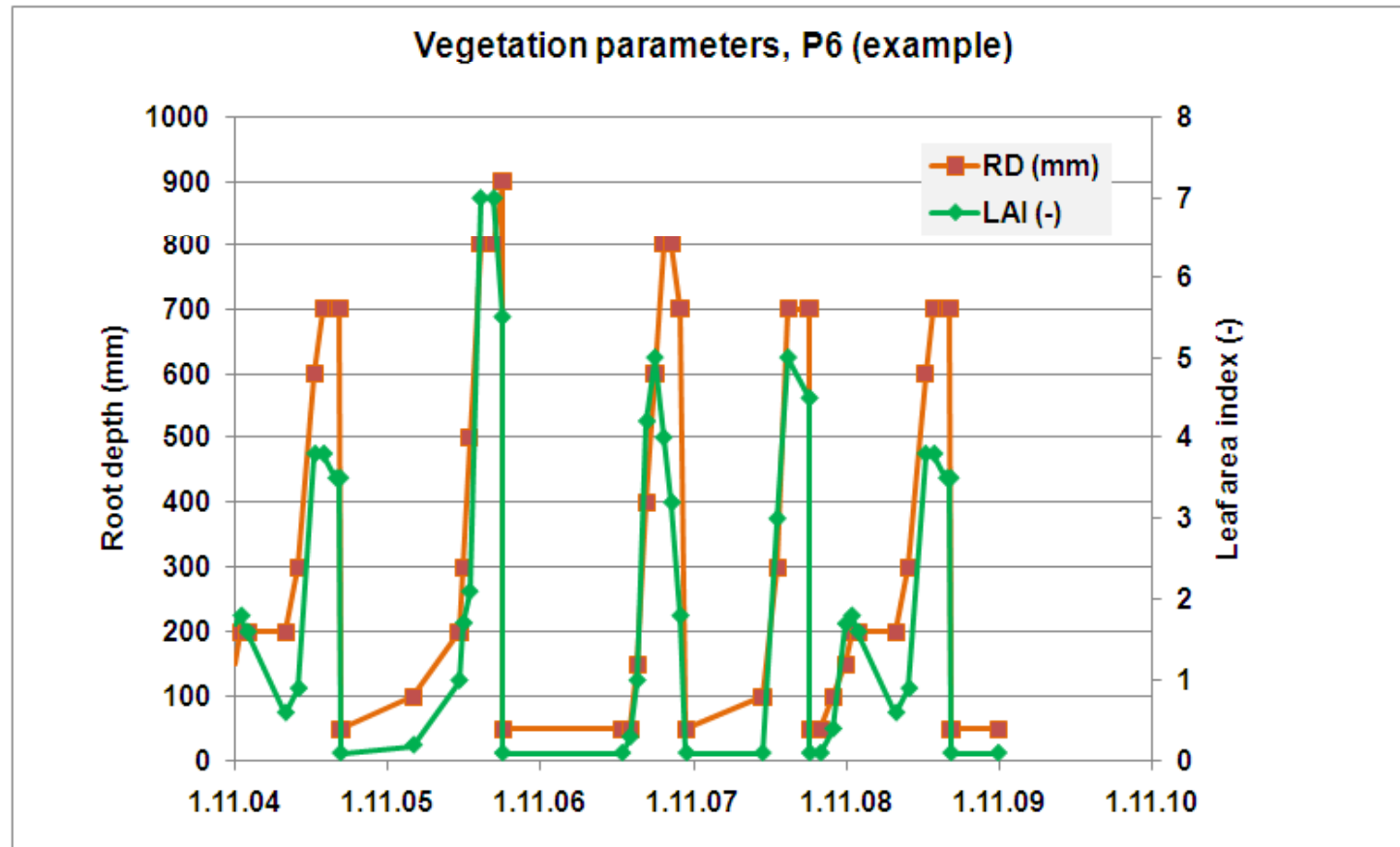
Discharge: 10 min data

**Vegetation: LAI, root depth assessed
according to type of crop**



Data used

Vegetation parameters time series



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Kopaninský tok exp. catchment

Data – 3. Parameters

Soil hydraulic characteristics:

SZ hydraulic characteristics: previous studies, calibrated

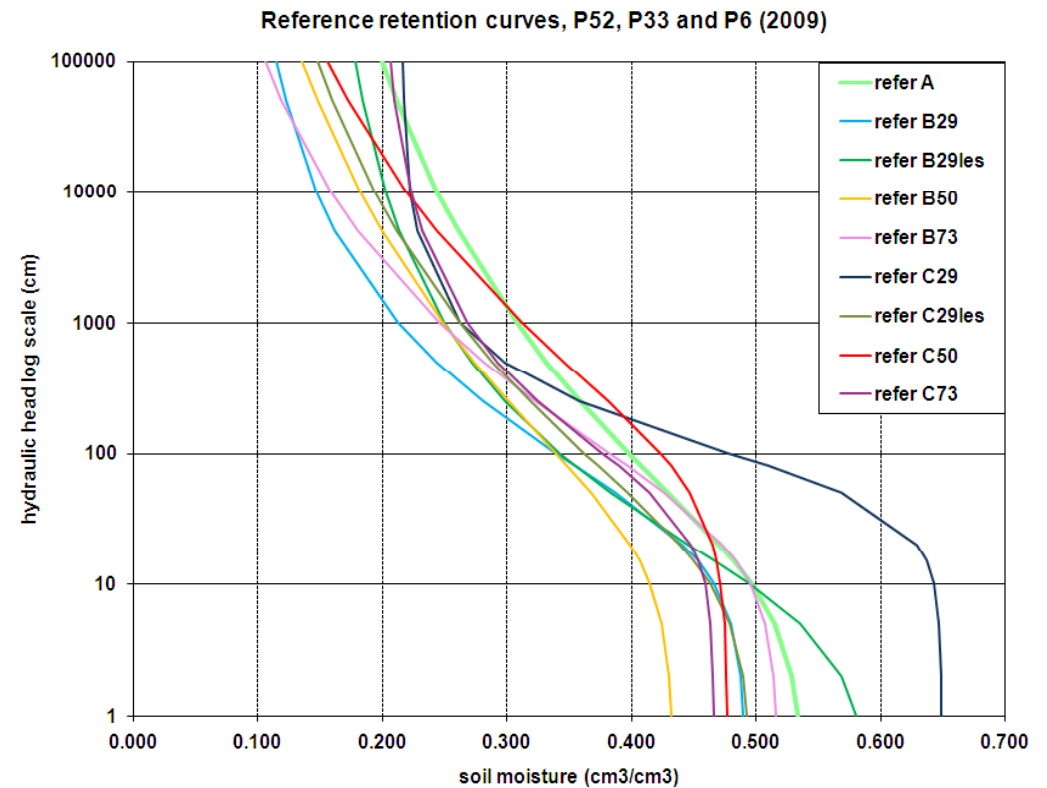
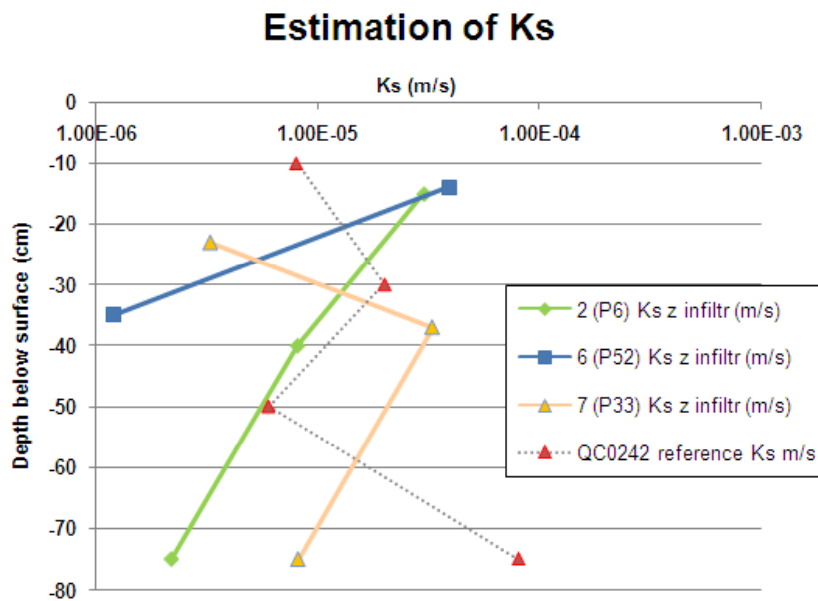
Drainage parameters: calibrated

Snow melt model: calibrated

Interception and vegetation parameters: measurement + literature

Data used

Soil hydraulic parameters: (Ks + retention curve) based on 81+10 core samples and infiltration measurement

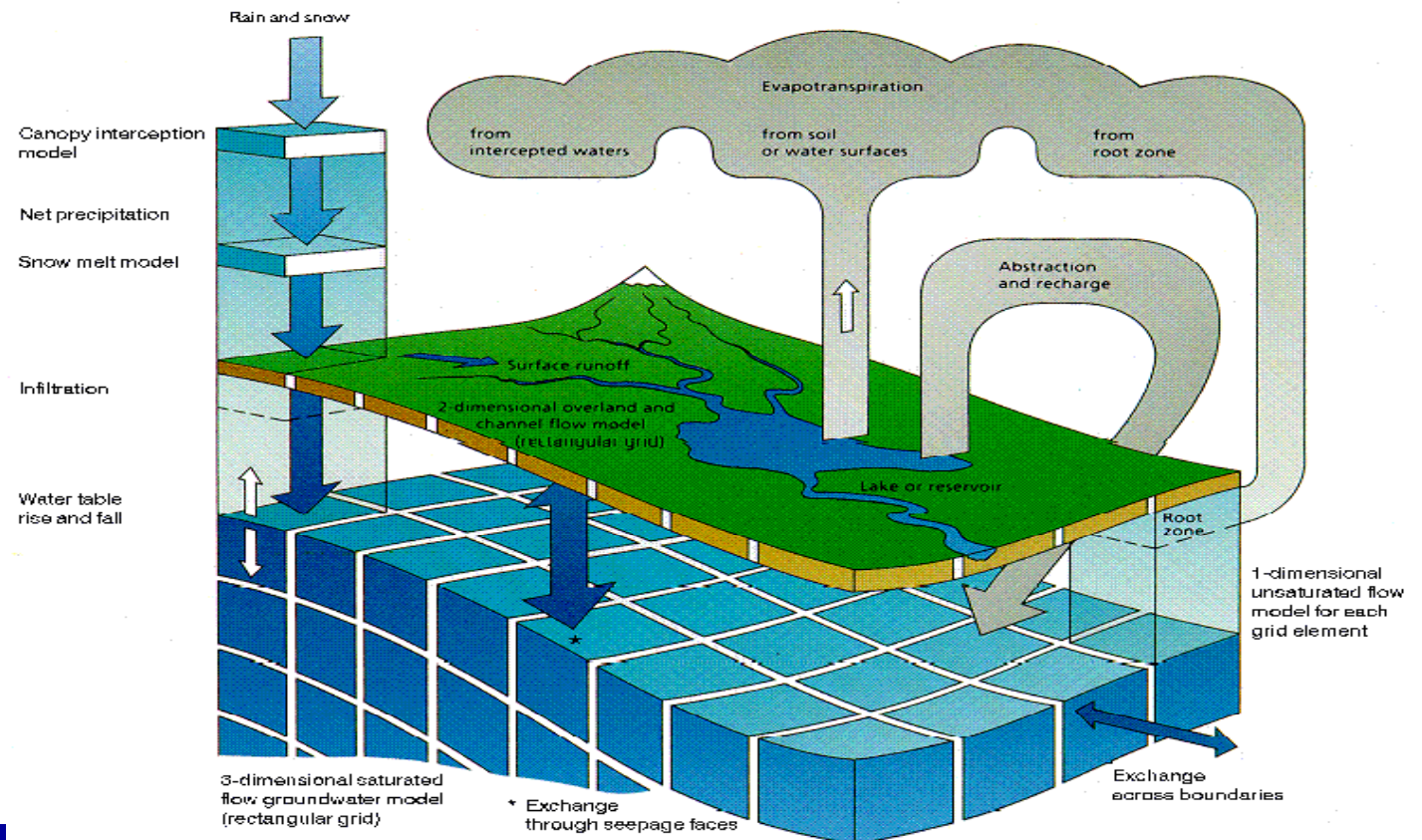


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Modelling system used

MIKE SHE 2009 WM (DHI software)

an Integrated Hydrological Modelling System



Model setup overview

- **Channel Flow**
 - ⇒ **1 -D kinematic wave**
- **Overland Flow**
 - ⇒ **2-D diffusive wave**
- **Evapotranspiration**
 - ⇒ **Kristensen & Jensen method for ETa calculation**
- **Unsaturated Zone**
 - ⇒ **Richards Equation 1D vertical in all grid cells**
- **Saturated Zone Flow**
 - ⇒ **2D finite difference approx. of Boussinesq eq.**

Model setup overview

- **Time step: 1h / 10 min**
- **Grid cells: 6-10 m**
- **Simplified river channel schematisation**
- **3 soil types and land use distribution**
- **Soil profile: 3 horizons**
- **2 layers (constant) of saturated zone**
- **Drainage schematised (distributed)**
- **Initial conditions estimated according to previous simulations**

Model setup overview

UZ Soil Profile Definition

Profile ID: Polygon:

Soil Profile:

	From depth	To depth	Soil name	UZ Soil property file		
1	0	0.25	A29	C:\MyFiles\...\db\pudy1209_1.uzs	...	Edit...
2	0.25	0.55	B29	C:\MyFiles\...\db\pudy1209_1.uzs	...	Edit...
3	0.55	5.95	C29	C:\MyFiles\...\db\pudy1209_1.uzs	...	Edit...

Vertical Discretization:

	From depth	To depth	Cell height	No of cells
1	0	0.25	0.05	5
2	0.25	0.55	0.1	3
3	0.55	1.95	0.2	7
4	1.95	5.95	0.25	16

Bypass constants

Maximum bypass fraction

Water content for reduced bypass flow

Min water content for bypass flow

[meter] **Untitled**

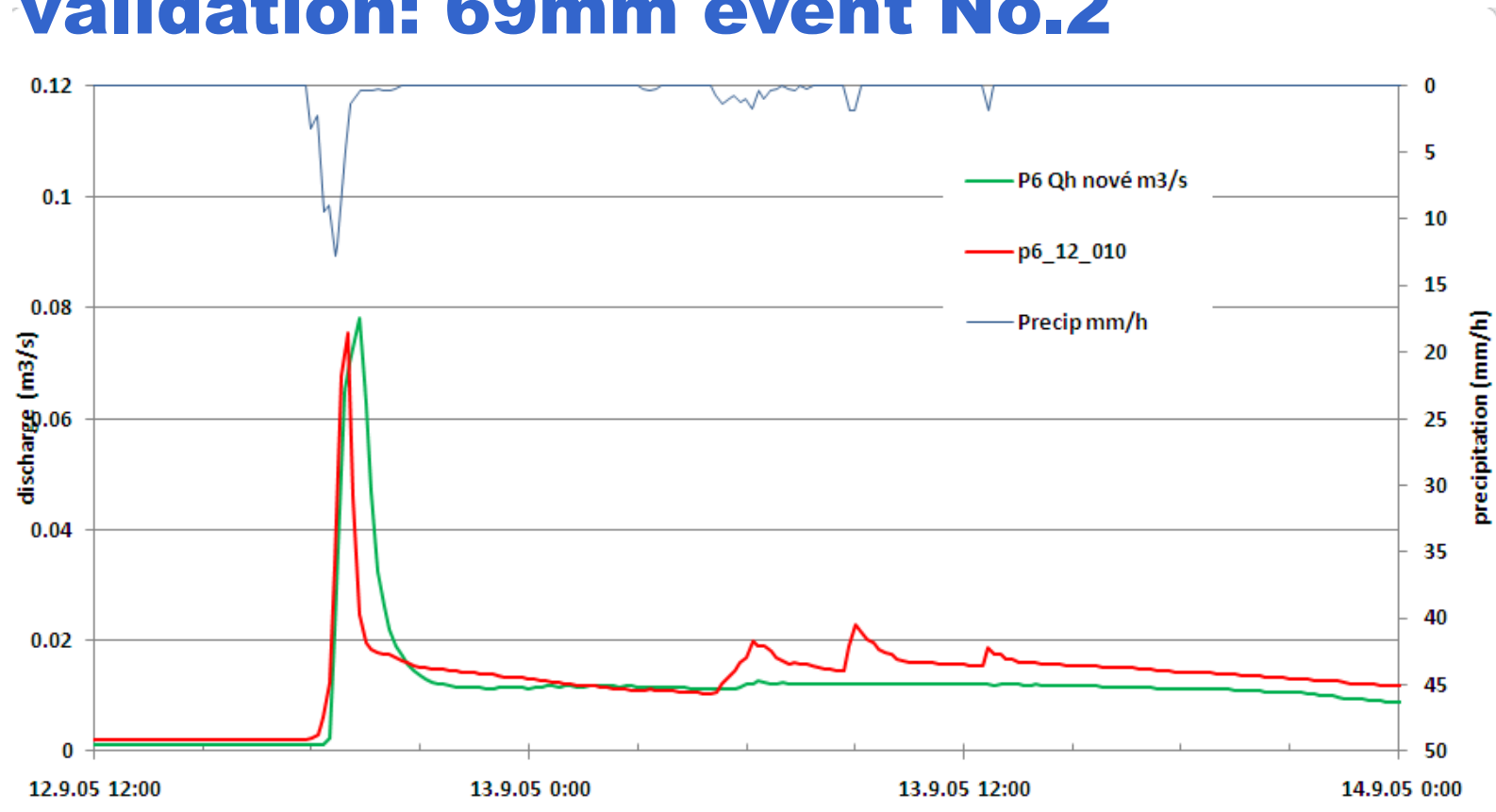
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Modelling steps

- **Calibration:** on 1h (10min) discharge data (summer periods of 2007-2009) manual/automated (Shuffled Complex Evolution method, Weighted sum of squares + RMSE as Objective functions)
- **Validation:** against 1h (10min) discharge data (summer periods of 2005-2006) correlation and effectivity coeff. used
- **Sensitivity analysis** (local for selected parameters, backward, pertubation fract.)

Results

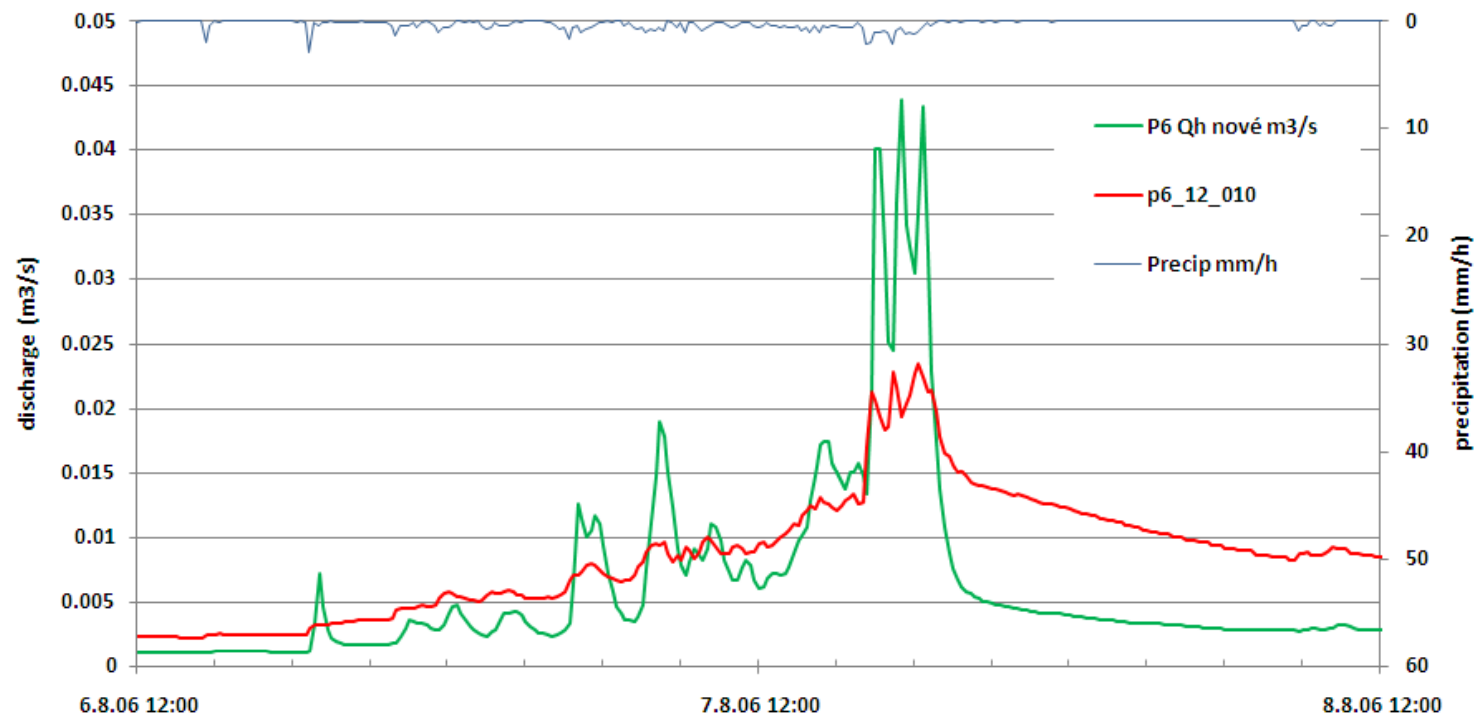
- validation: 69mm event No.2



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Results

- validation: 28mm low intensity event



Analysis of parameters for distributed modelling

Conclusions (P6)

- **the most important parameters were ranked:**
 - 1. Bypass ratio of macropores in unsaturated zone,**
 - 2. Horizontal and vertical saturated hydraulic conductivity of saturated zone**

Conclusions (P6)

- **Optimum values of parameters differ according to different grid cell size of model**
- **The influence of initial conditions is crucial at least for first simulated year**



Thank you for your attention

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