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CALIBRATION OF SWAT MODEL FOR SMALL AGRICULTURAL CATCHMENT IN POLAND – PROBLEMS AND RESULTS

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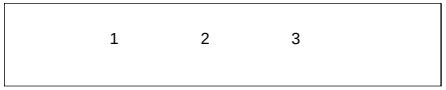
CONTENT:

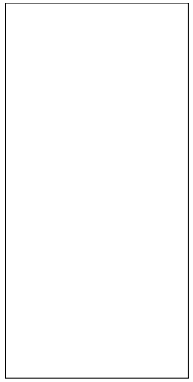
- Brief description of the research area
- Problems with SWAT calibration
- Sensitivity analysis as a first step of calibration process
- Results of SWAT calibration
- Conclusions
- Future research plans

Upper Zgłowiączka river catchment – 129.6 km^2

Research area - 78 km^2

- precipitation – **500 mm**,
- mean discharge **2dm^{3}s^{-1}km^2**
- water stress during vegetation period





Rather flat area

Land use

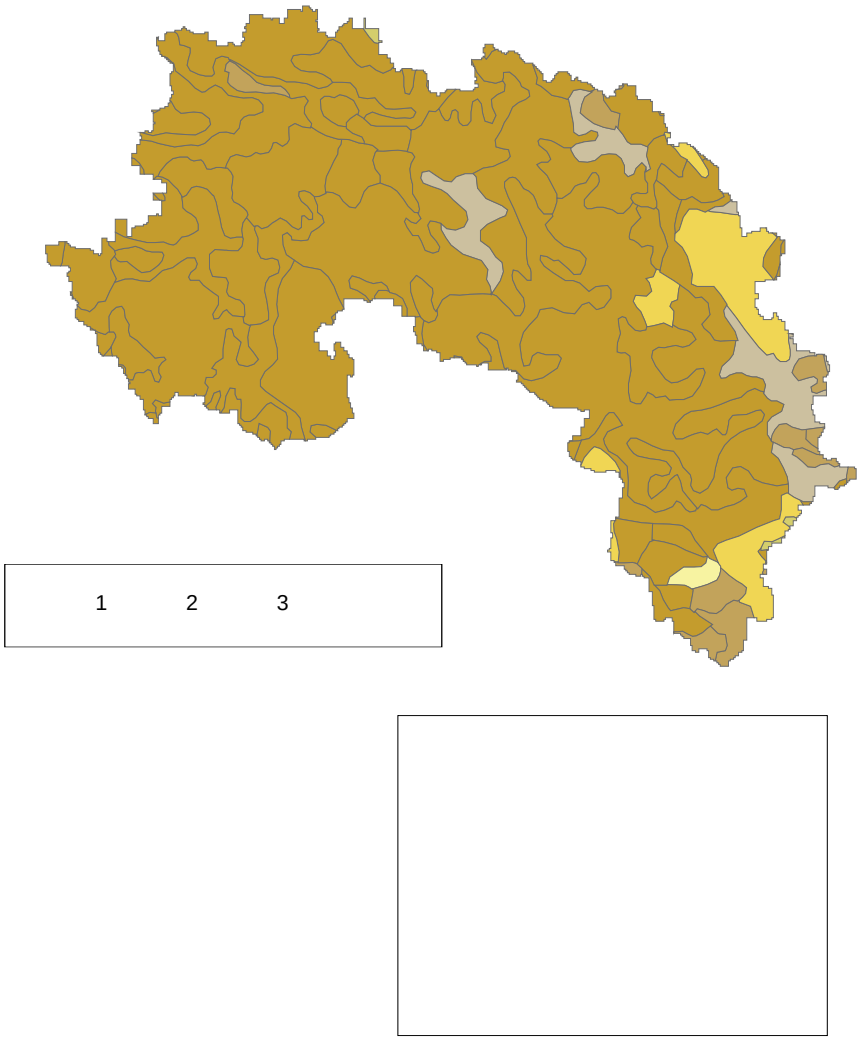
- arable land – around 90%
- forest – around 4 %
- urban areas – 2 % (low density)

Arable land:

- grasslands – around 1 %
- cereals – 50 %
- corn – 16 %
- rape – 14%
- sugarbeets – 10%

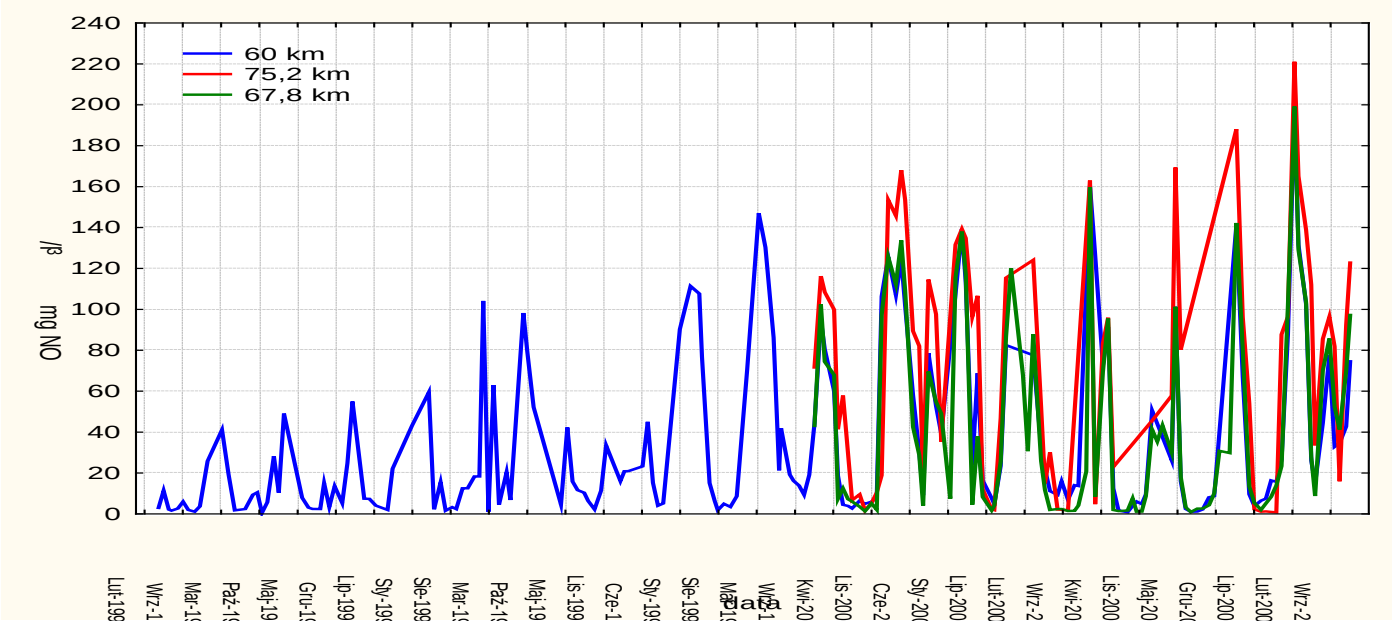
17 subbasins
561 HRU

Soils



Domination of one soil type
85% Phaeozems

2 main problems within the upper Zgłowiączka river catchment: quantity and quality of water resources



- very high nitrate concentrations in surfacewater
- and increasing still
- area designated as a NVZ according to the Nitrate Directive of UE

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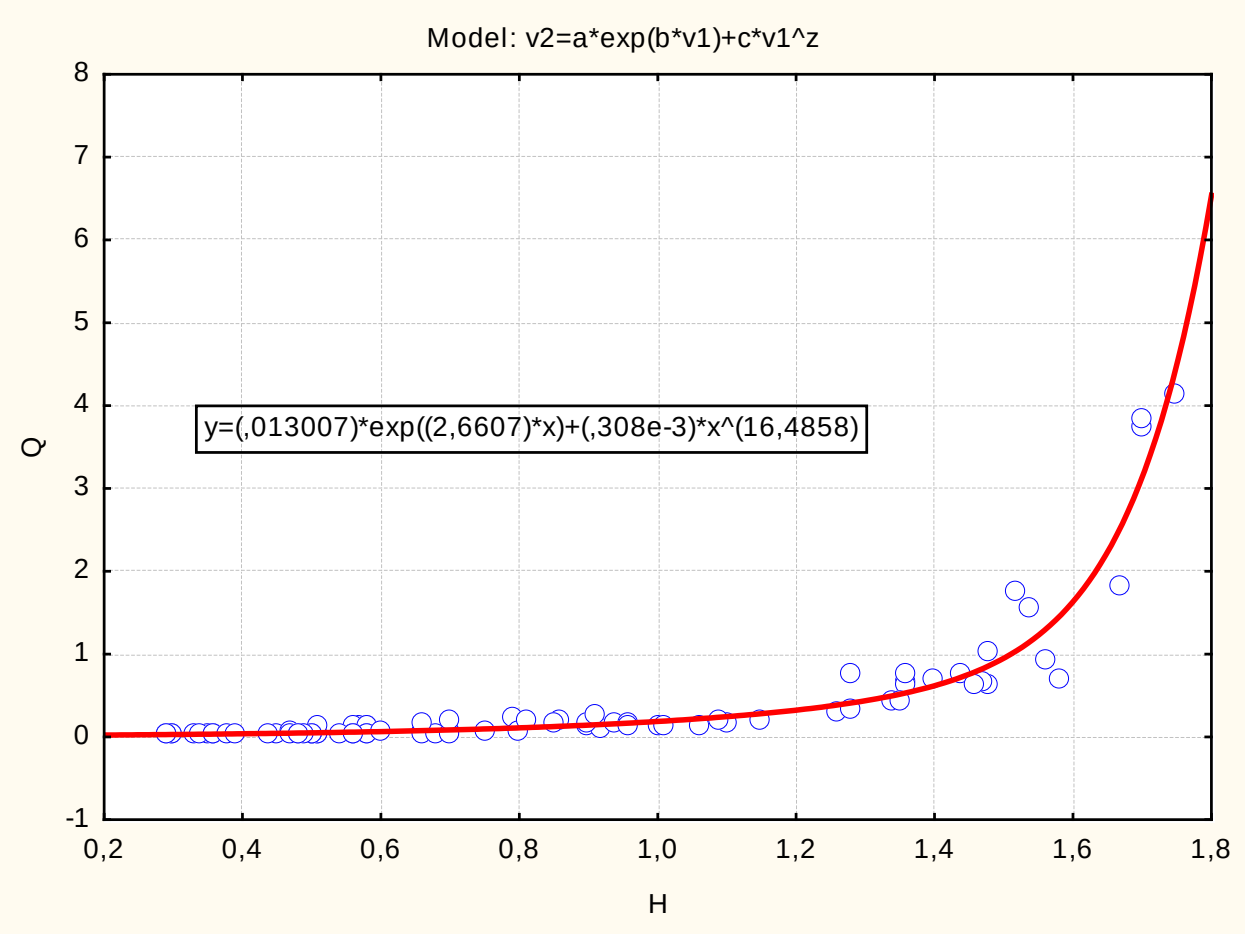
SWAT CALIBRATION PART I - PROBLEMS

Problems:

- No monitoring data for small agricultural catchments in Poland,
- Luck of historic observed discharge data, no data for calibration,
- The only available data – hourly water level at outlet from October 2006
- First discharge measurements taken at the outlet in 2008 – twice a month,

Stage-discharge relationship at watershed outlet



24.05.2010

18.01.2011

First results

- precipitation– **547** mm
- PET– **665** mm
- actual ET – **377** mm ≈ **70%**
- water yield – **140** mm

- around **4** days with water stress

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SWAT CALIBRATION PART II - RESULTS

Results of the sensitivity analysis for flow parameters

Parameter	Ranking
Sol_Z	1
Esco	2
Alpha_Bf	3
Sol_Awc	4
Blai	5
Canmx	6
Epco	7
Timp	8
Gwqmn	9
Cn2	10
Ch_K2	11
Biomix	12
Sol_Alb	13
Slope	14
Surlag	15
Ch_N2	16
Sol_K	17
Revapmn	18
Gw_Revap	19
Gw_Delay	20
Slsubbsn	21
Sftmp	27
Smfmn	27
Smfmx	27
Smtmp	27
Tlaps	27

The analysis was done using the Sensitivity Analysis procedure available in SWAT 2005

Additional parameters:
SOL_BD
SOL_ZMX
ALPHA_BNK

Average water balance of the research area according to SWAT results (1997-2010)

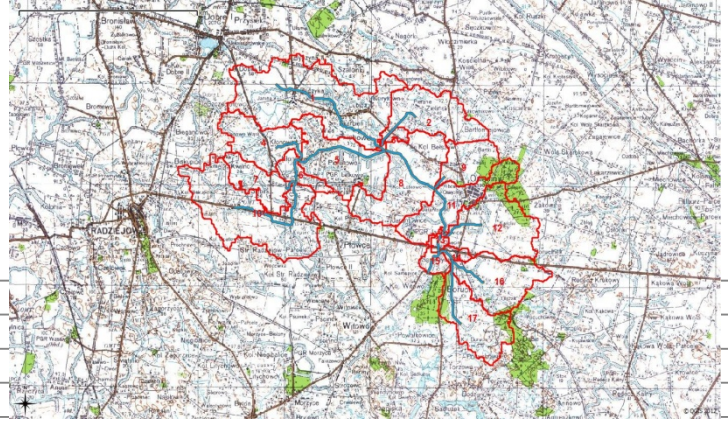
- precipitation– **547** mm
- PET– **662** mm
- actual ET – **480** mm ≈ **90%**
- water yield – **53** mm

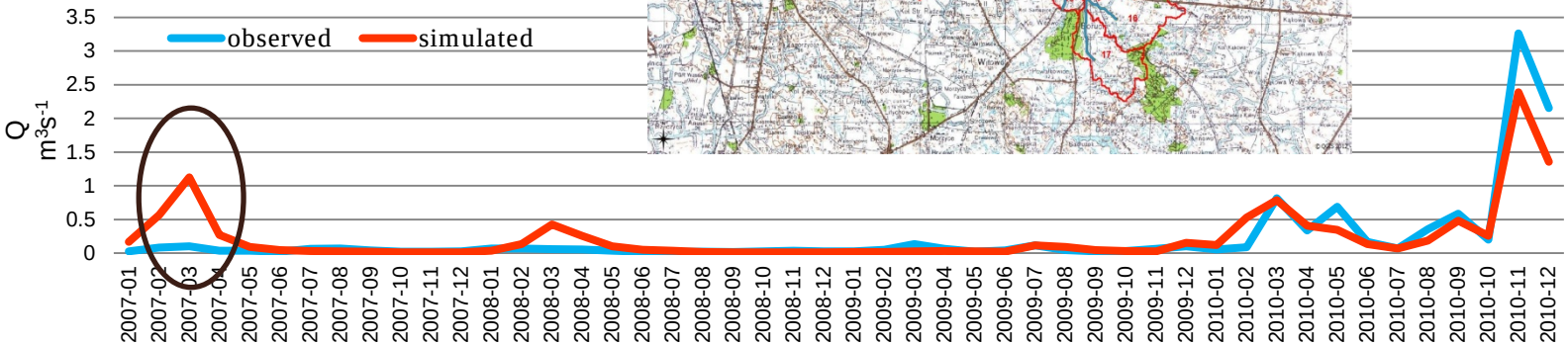
- around **30** days with water stress

Average water yield components:

- Tile Q – 30 mm ≈ 60 %,
- Surface runoff Q – 13 mm,
- Lateral soil Q – 7 mm,
- Groundwater Q – 3 mm

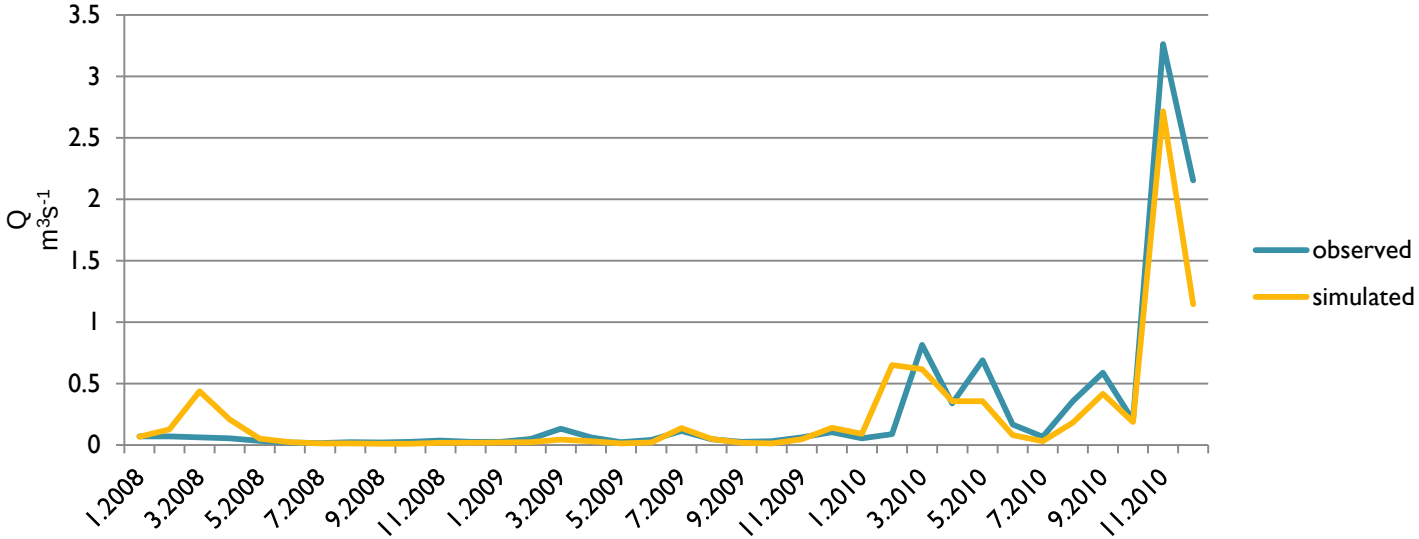
Results for monthly discharge for 4 years





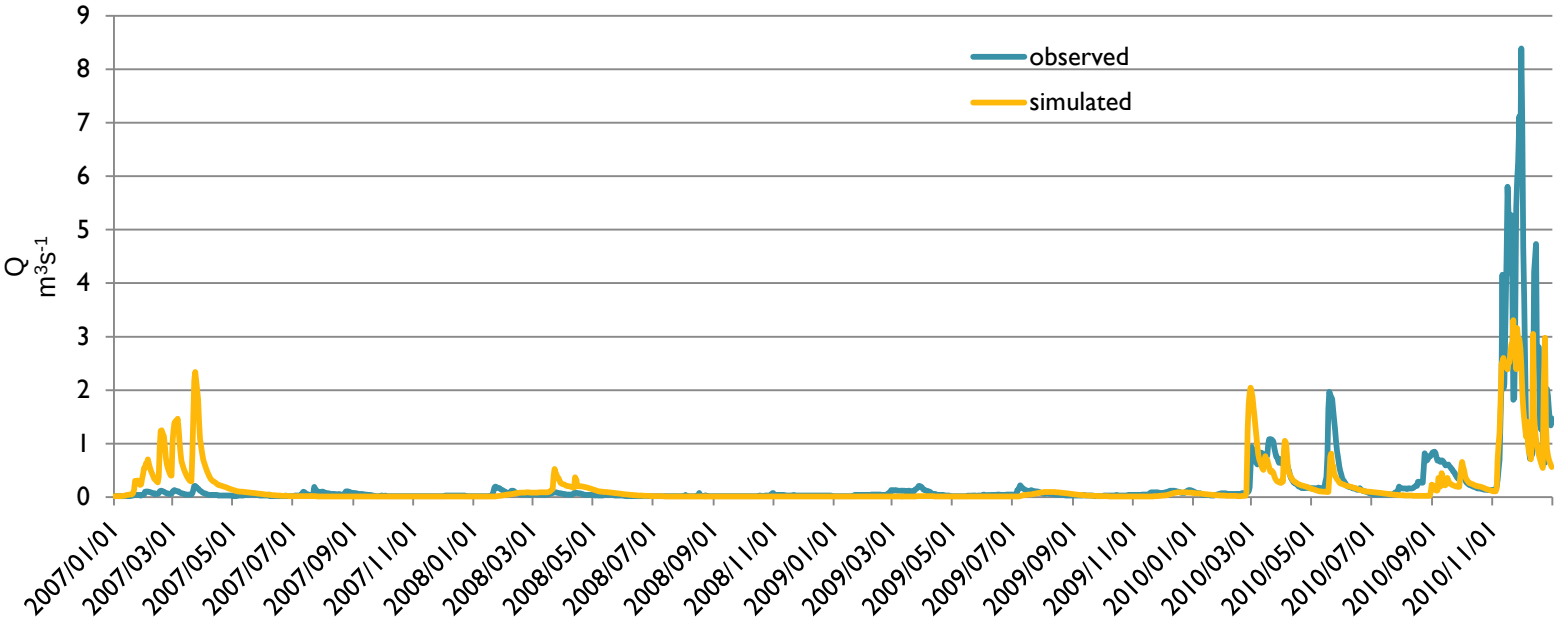
NSE = 0.78
R^2 = 0.79

Results for monthly discharge for 3 years – problematic year was excluded



NSE = 0.86
R^2 = 0.90

Results for daily discharge for 4 years – problems with observed high flow at the end of 2010



NSE = 0.53 R^2 = 0.55

Conclusions:

- The most important for discharge simulation are parameters used in evapotranspiration calculations according to results of sensitivity analysis
- Calibration of SWAT model for small catchments is a real challenge,
- But finally correct water balance and its components,
- Maybe calibration based on monthly discharge is enough?
- If not, there is still some effort (and time) needed for better „daily" calibration.

Future work:

- SWAT calibration for NO_3 loads,
- SWAT validation,
- scenarios of alternative management practices to reduce nitrate loads outflowing from the catchment area

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THANK YOU FOR YOUR ATTENTION

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