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Assessment of the performance of Soil Water Assessment Tool (SWAT) model for a small agricultural catchment in Austria

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Aim

Apply, calibrate and validate the SWAT model in a small agricultural catchment with high resolution spatial and climate data, and detailed agricultural management practices.

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Materials and Methods

The study area

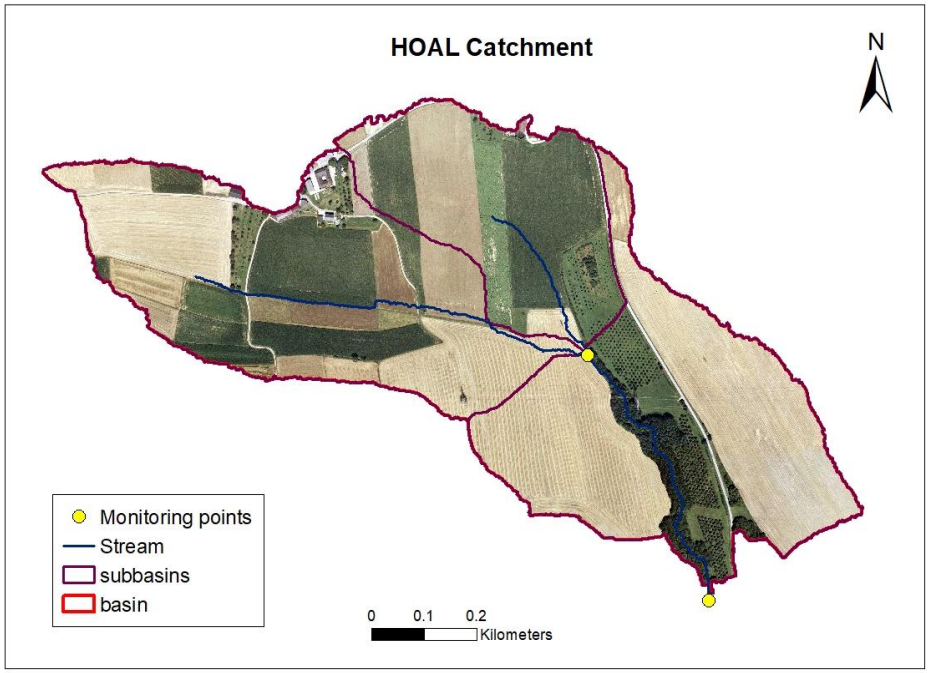

Figure 1. Study area

Location: Petzenkirchen, Austria

Area: 65ha

Crops: Corn,
Winter wheat,
Winter Barley

Mean Annual Prec: 800mm

Mean annual Temp: 10°c

87% agricultural land

Soils: Cambisols and Planosols

37 agricultural fields

Materials and Methods

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The SWAT Model

Water balance eqn:

$$SW_t = SW_0 + \sum_{i=1}^{t} \left(R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw}\right)_i$$

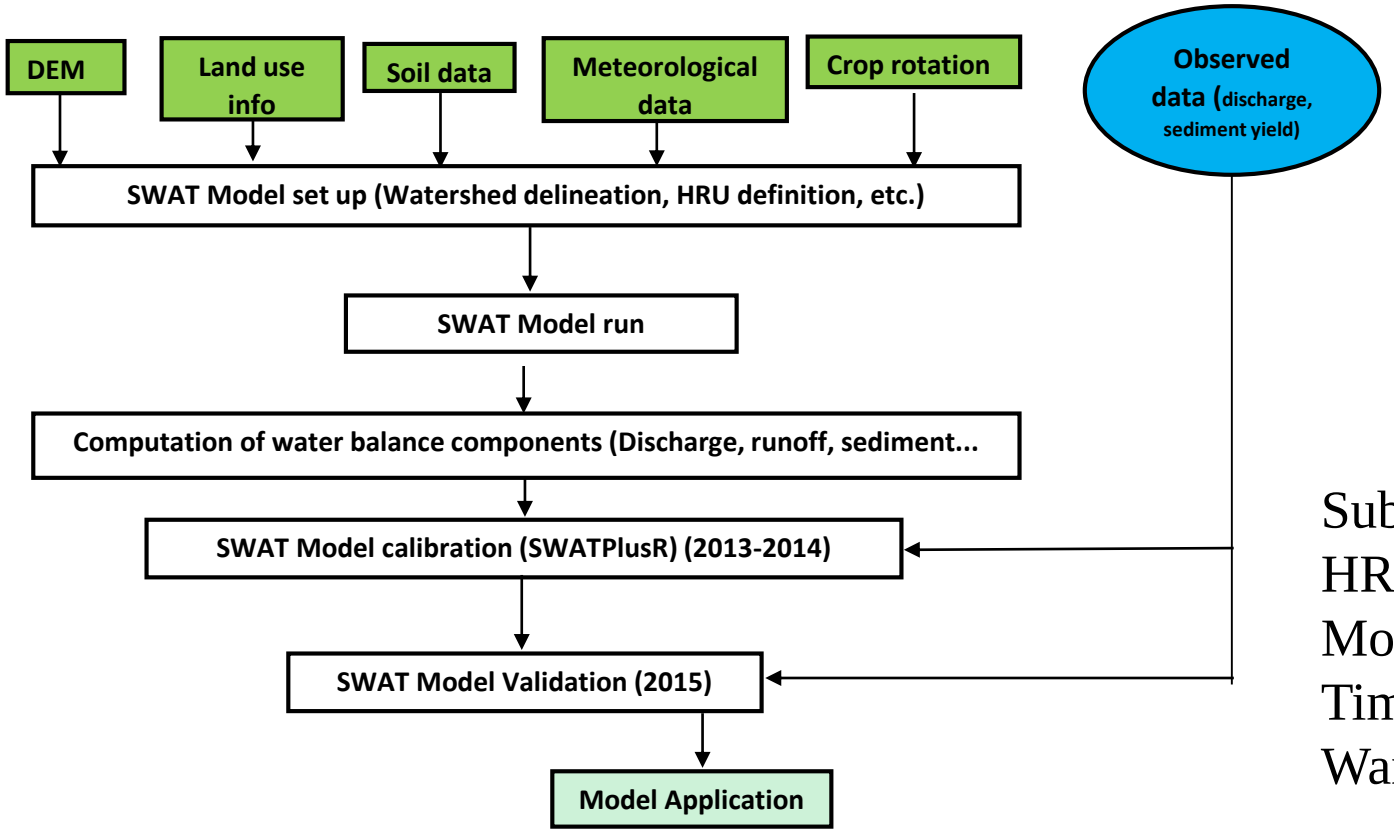

Figure 2. Model set up

- Watershed Scale
- Physically based
- Distrubuted Model

Sub basins: 3
HRUs: 106
Model run: 2008 – 2017
Time-scale: Daily
Warm- up period: 4 years

Results

Initial model output

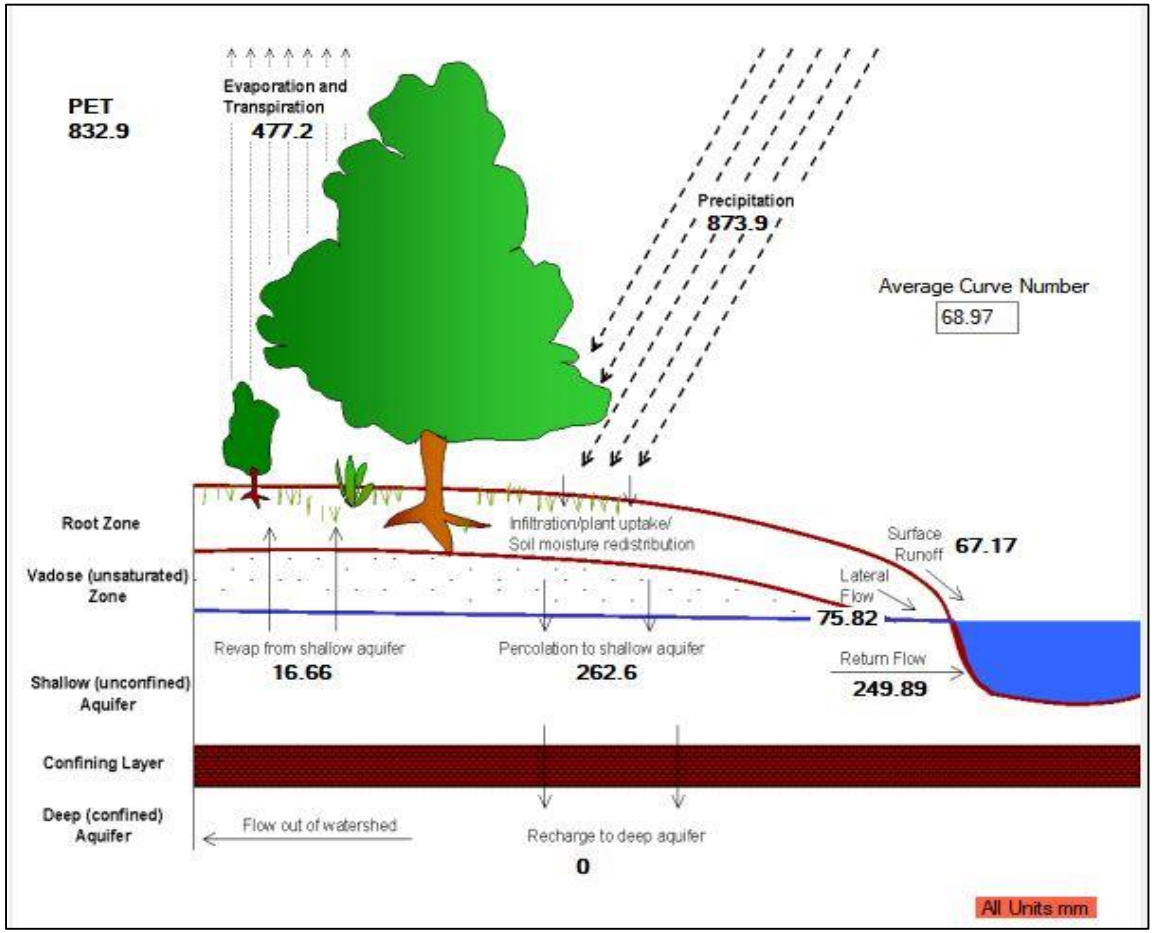

Figure 3. Initial model output

Table 1. Intitial model output and observed annula flow

YEAR	Prec (mm)	Measured flow (mm)	Simulated flow (mm)
2012	839	126	373
2013	1061	339	638
2014	843	124	333
2015	697	133	235
2016	913	148	382

- Flow over-estimated
- ET underestimated
- Calibration based on base flow, ET and soil properties

R^2 and NSE used as model perfomance indicators

Results

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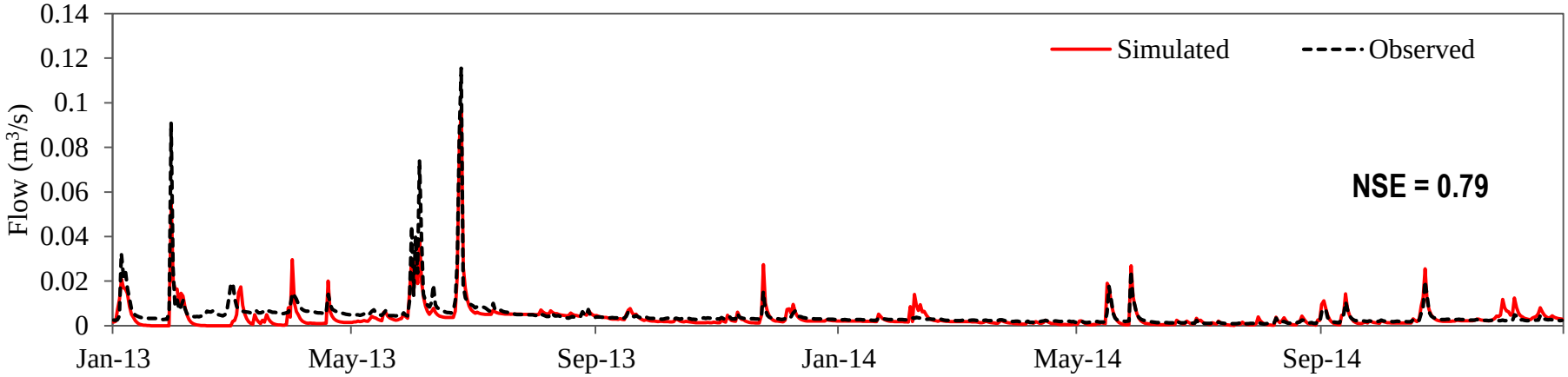
Model Calibration



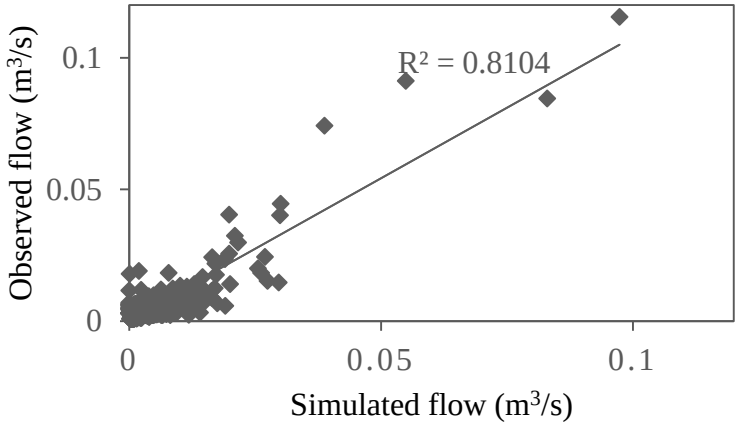


Figure 4. model calibration results

Table 2. Parameter modification

Parameter	Description	Min	Max	Fitted
GWQMN	Threshold depth of water in the shallow aquifer required for return flow to occur (mm)	1200	1800	1520
GW_Revap	Groundwater ‚Revap' coefficient	0.04	0.1	0.07
ESCO	Soil evaporation compesation factor	0.2	0.5	0.28
LAT_TTIME	Lateral flow travel time (days)	0	5	1
SOL_K	Saturated hydraulic conductivity (mm/hr)	-10%	10%	-8%
SOL_AWC	Soil available water content	-10%	10%	3%

Results

Model Validation

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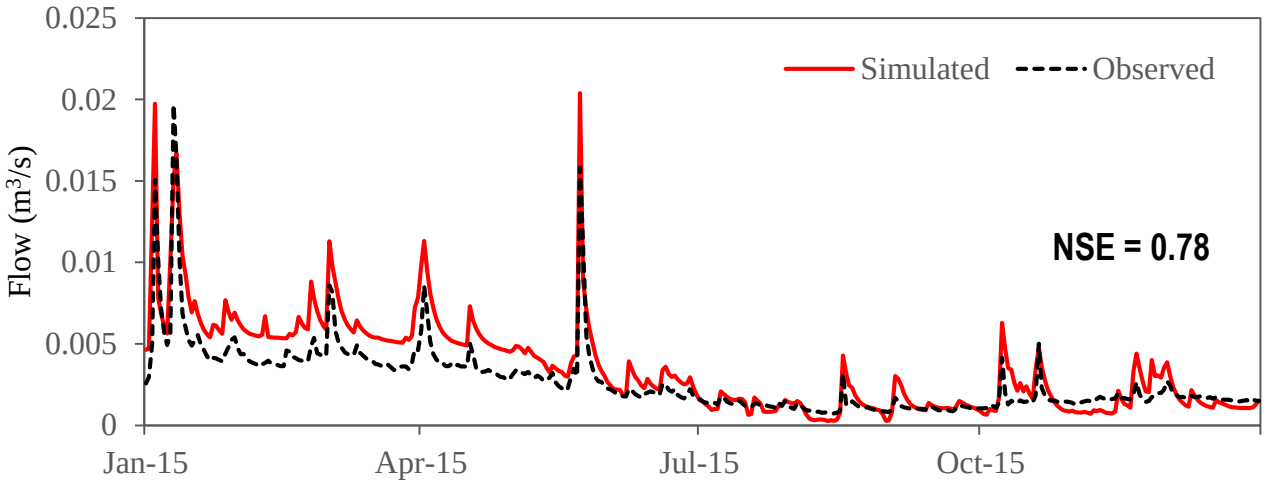

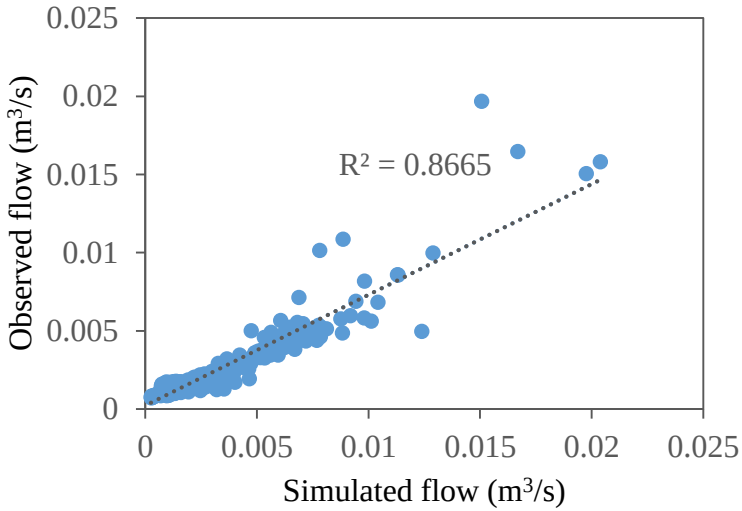

Figure 5. Validation results

Conclusions

- The SWAT model perfomance was satisfactory for both calibration and validation with NSE and $R^2 > 0.7$
- The model underestimated discharge by 19% during calibration, whereas it overestimated discharge by 13% during the validation period
- Further stúdies (erosion, climate change etc) can be carried out using the SWAT model in the catchment area.