Purdue University Agricultural & Biological Engineering

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Comparison of the tile drainage routine performance in SWAT 2009 and 2012 in the Little Vermillion River Watershed (LVRW)

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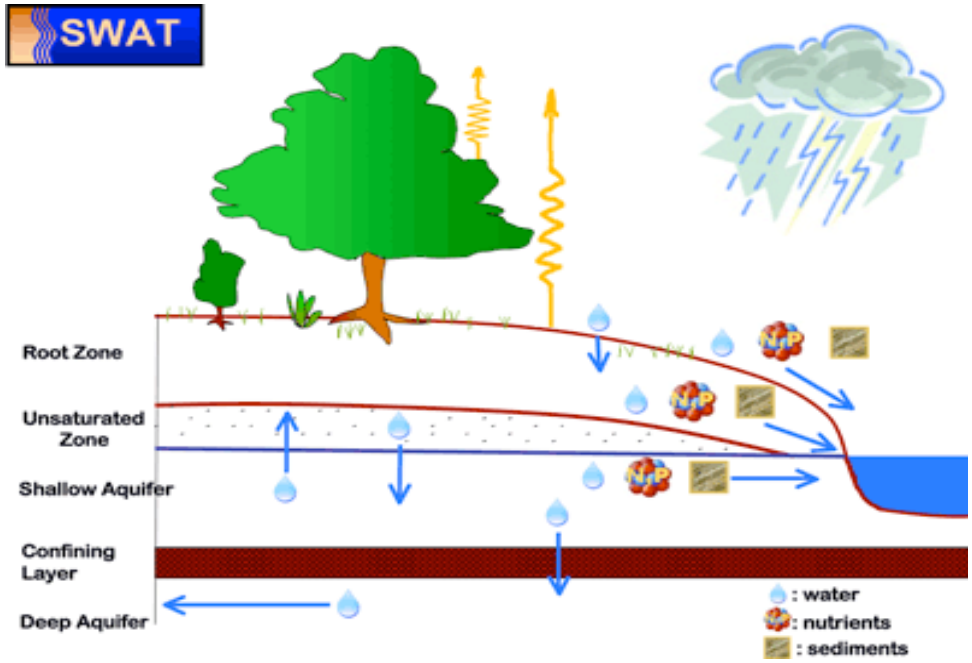
Background

Soil and Water Assessment Tool

- watershed management decisions on hydrology and water quality responses;
- Improvements in new tile drainage routine in SWAT2012 to simulate tile drains at a watershed scale;

Rev.645

$$S = S_{max}\left(1 - \frac{SW}{\left[SW + \exp(w_1 - w_2 SW)\right]}\right)$$



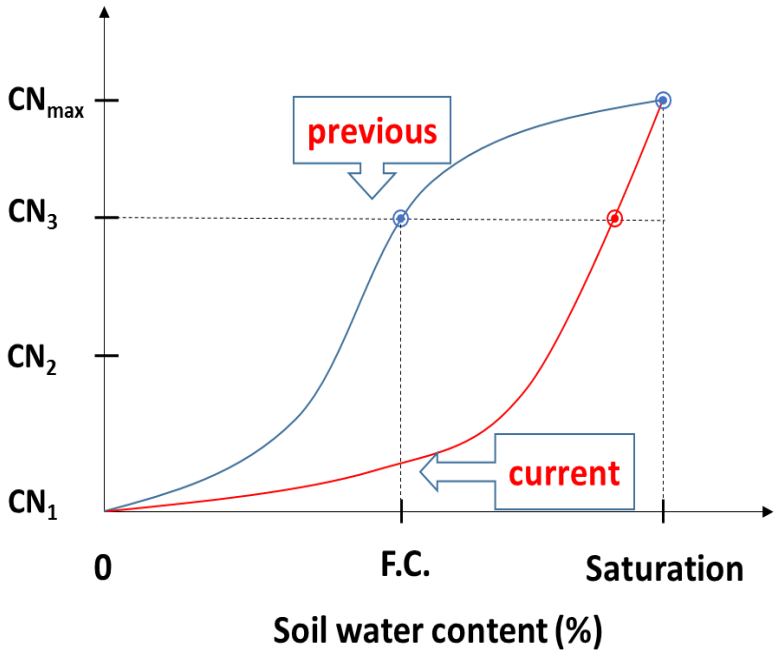


Fig. 1 The scenario simulated by SWAT

http://ches.communitymodeling.org/CCMP-Newsletter-February-2009.html#item1

Motivation

Importance of tile drainage routine comparison

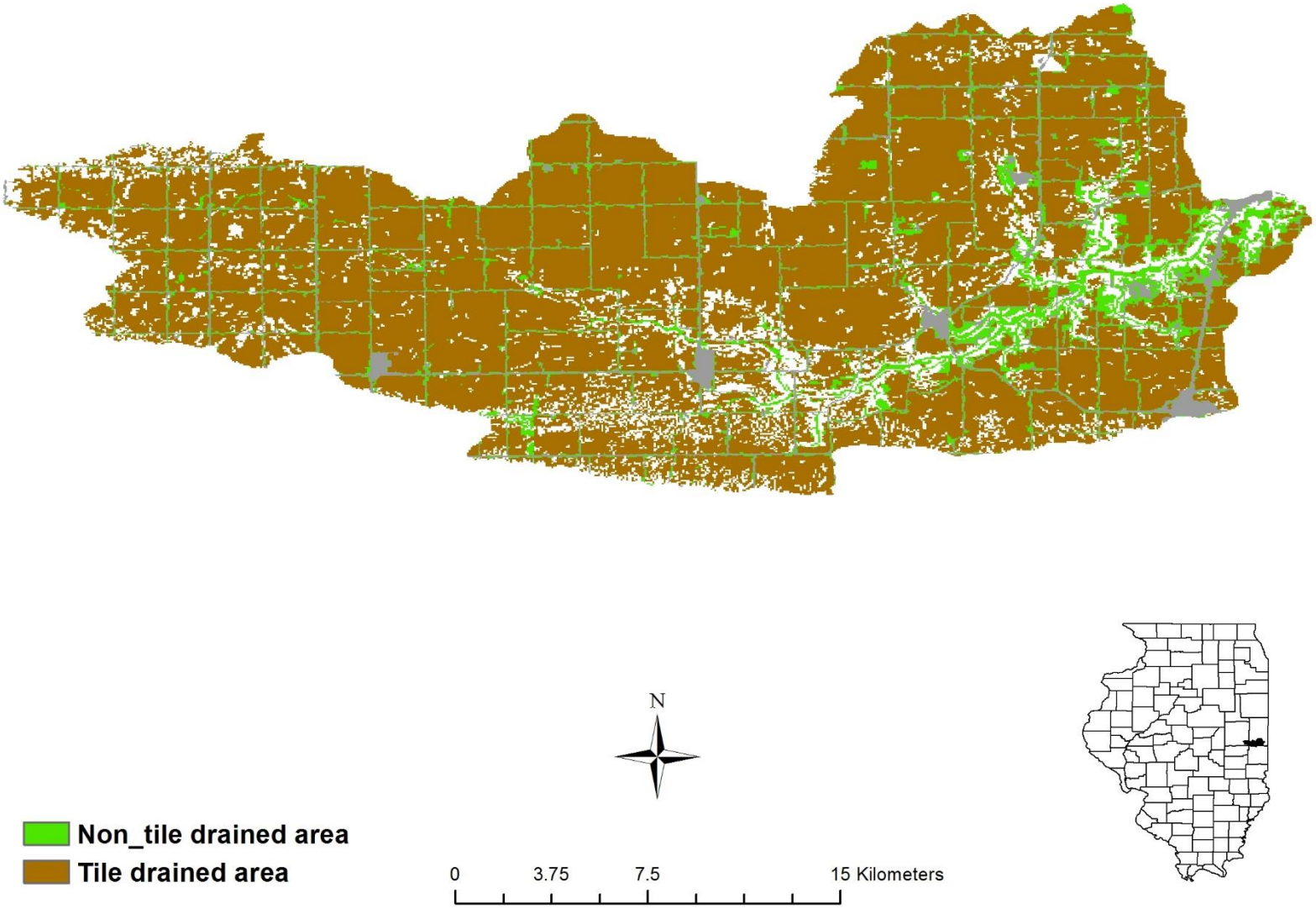
- Few studies with tile drain simulations at watershed scale using SWAT2012; New parameter-R2ADJ.

- SWAT2009 (rev.528)-constant water table depth, tile drain depth, size, and spacing; SWAT2012 (rev. 645)-Hooghoudt steady state equation, Kirkham equation.

- Constant water table depth VS. dynamic water table depth;

- Importance of testing routine before simulation in LVRW.

Study area



Tile drainage area: 303.23 km^2, 73.7% of total watershed

Monitored sites

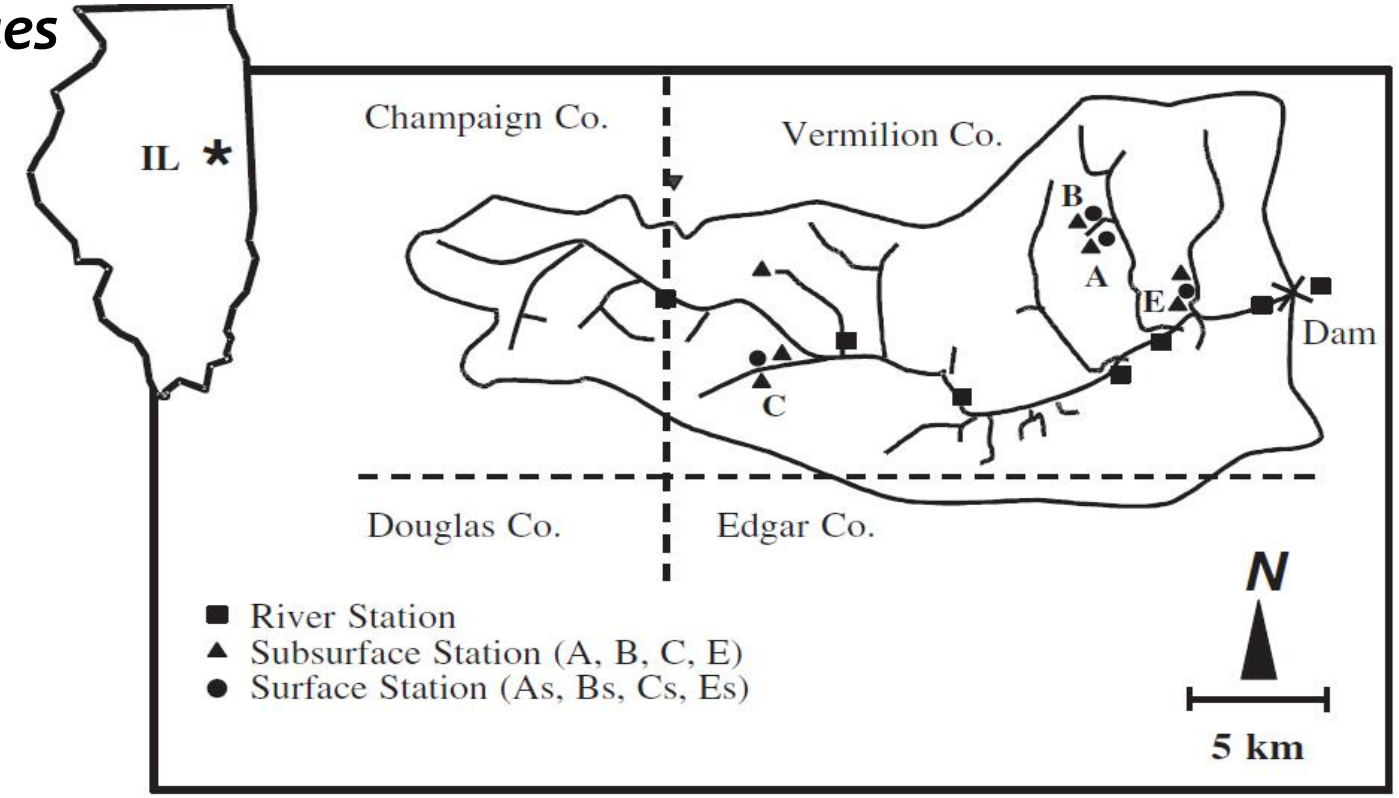
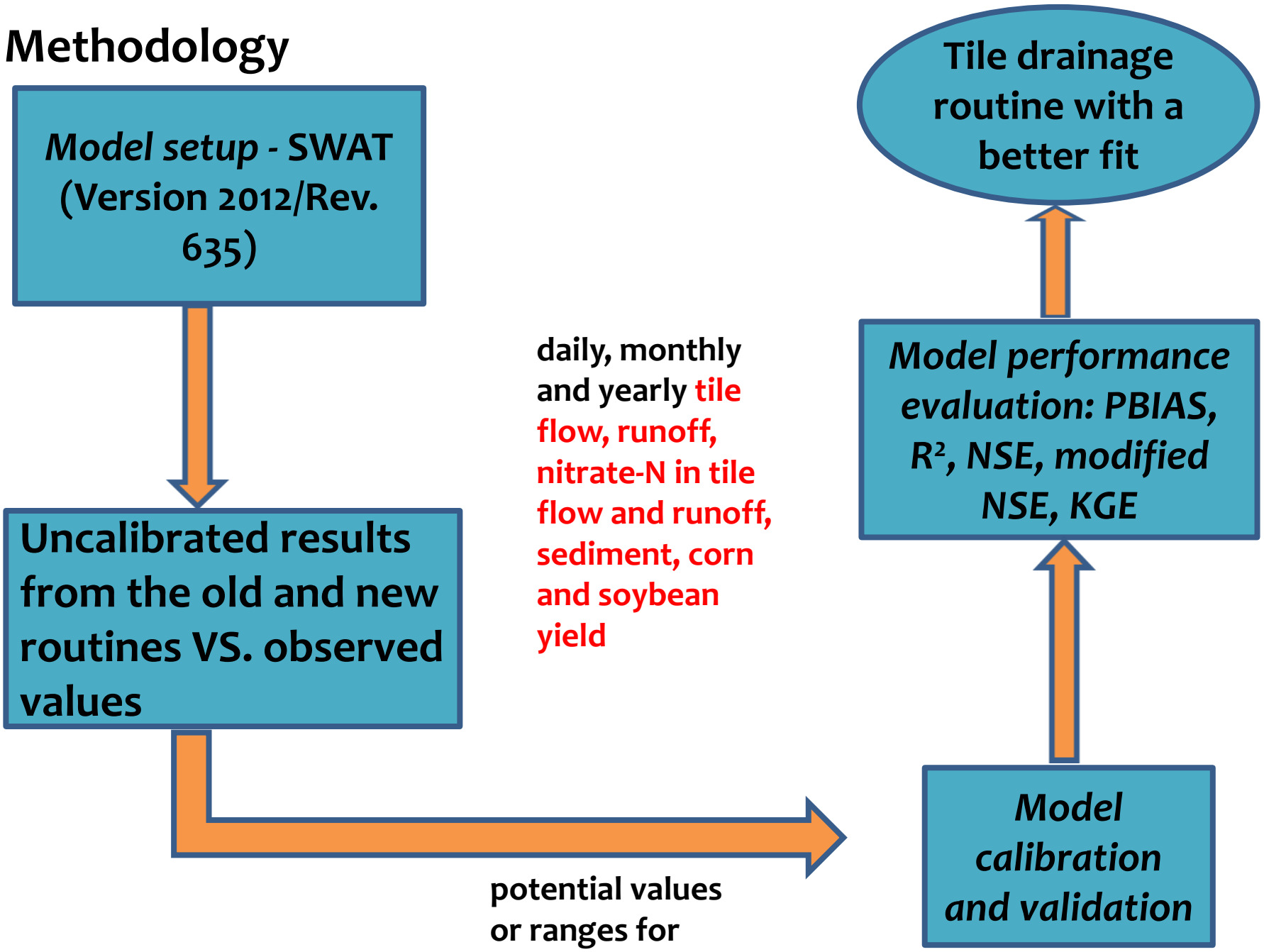


Fig. 6 Stations in LVRW

Table 1 Monitored Area Characteristics and Data Collection

Site	Soils	Station	Drainage system	Cropping
B	Drummer silt clay loam	Subsurface	Random tile drainage tubing systems in depressional areas	Reduced-Tillage Beans-Corn
	Flanagan silt loam	Surface		
E	Sabina silt loam	Subsurface	Complete tile drainage system at 28-m spacing	No-Tillage Corn-Beans
	Xenia silt loam	Surface		

Methodology



Methodology

Table 2 Initial values of parameters about tile drainage routines

Parameter	Definition	2009 (Rev.528)	Initial value (2009)	2012 (Rev.645)	Initial value (2012)
DRAIN_CO.sdr	Daily DC (mm/day)			ITDRN = 1	50
TDRAIN.mgt	Time to drain soil to field capacity (hr)	ITDRN = 0	48		
GDRAIN.mgt	Drain tile lag time (hr)	ITDRN = 0	48		
DDRAIN.mgt	Depth from soil surface to tile drain (mm)				1075
DEP_IMP.hru	Depth to impervious layer (mm)		2000		2000
SDRAIN.sdr	Tile spacing (mm)			ITDRN = 1	40000 (B) 28000 (E)

Preliminary results

Site B

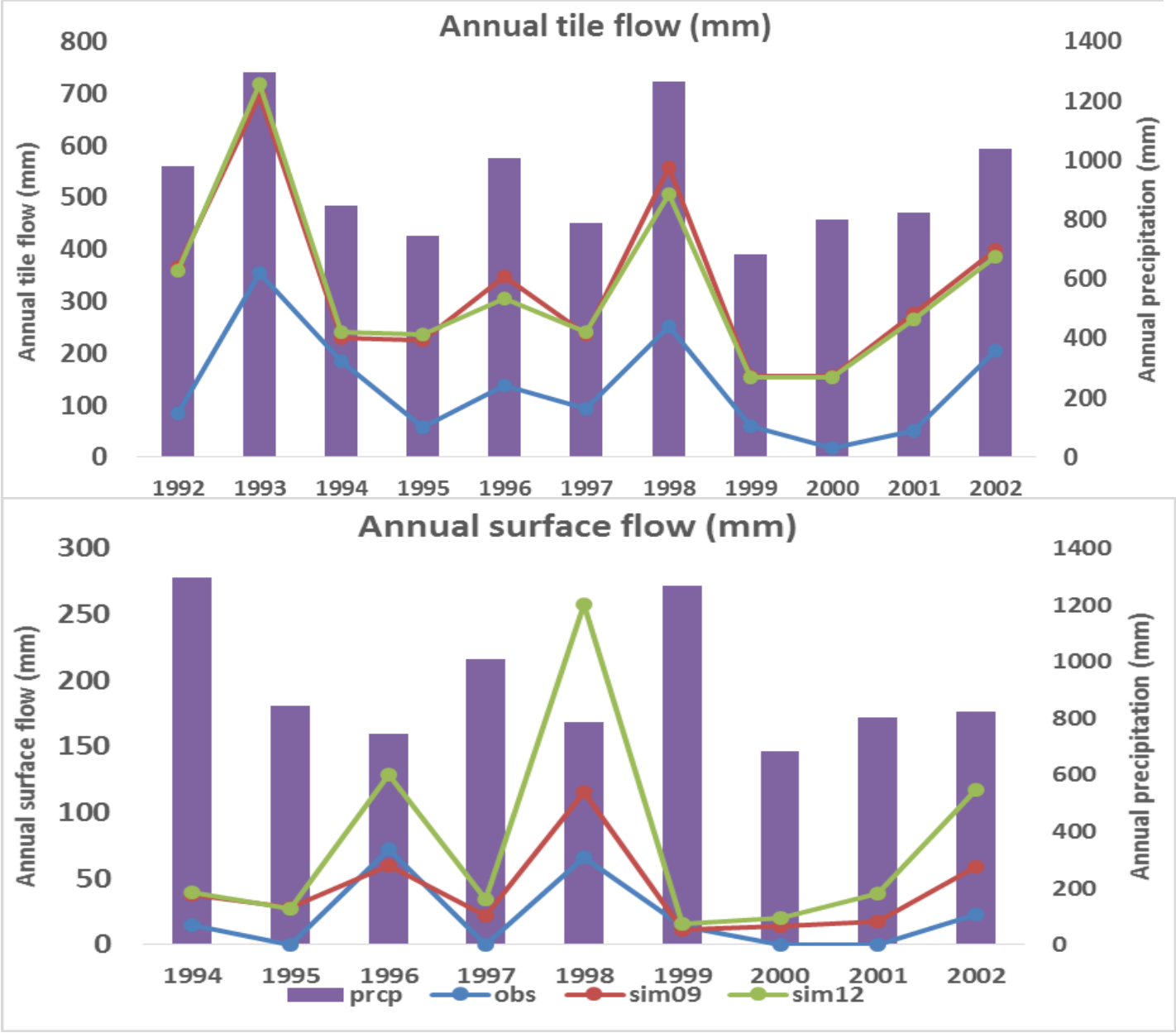


Fig. 7 Uncalibrated tile and surface flow at site B

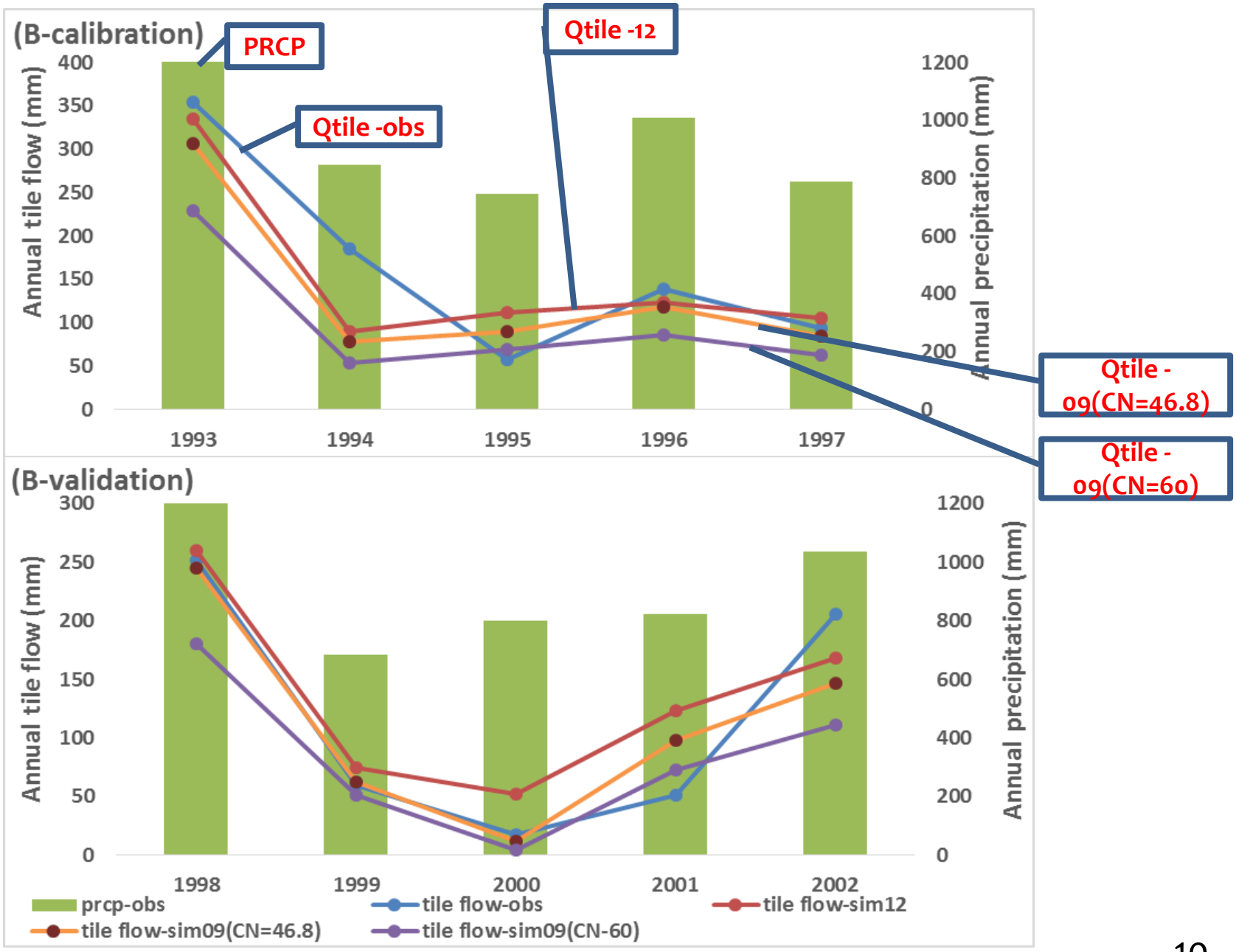
Preliminary results

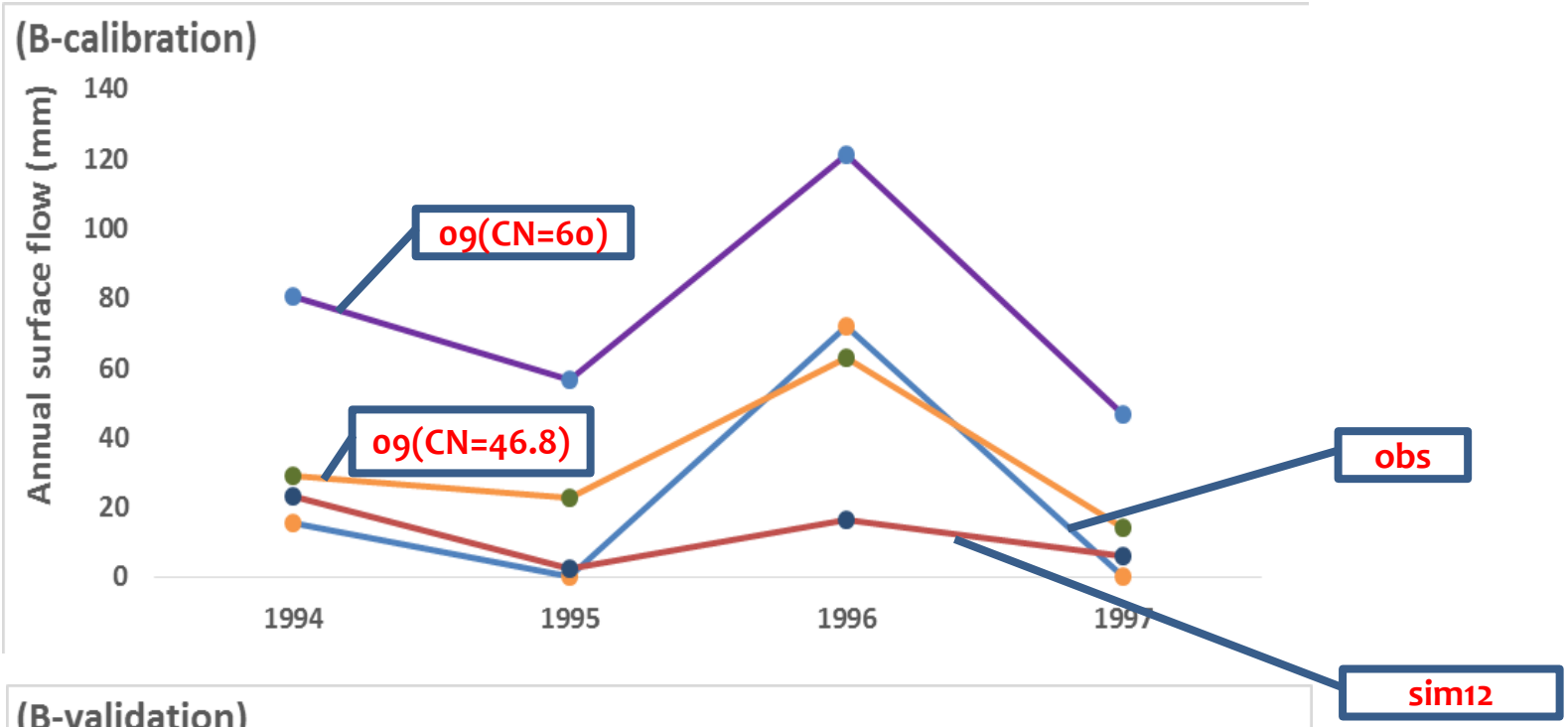
Table 3 Statistics for uncalibrated results

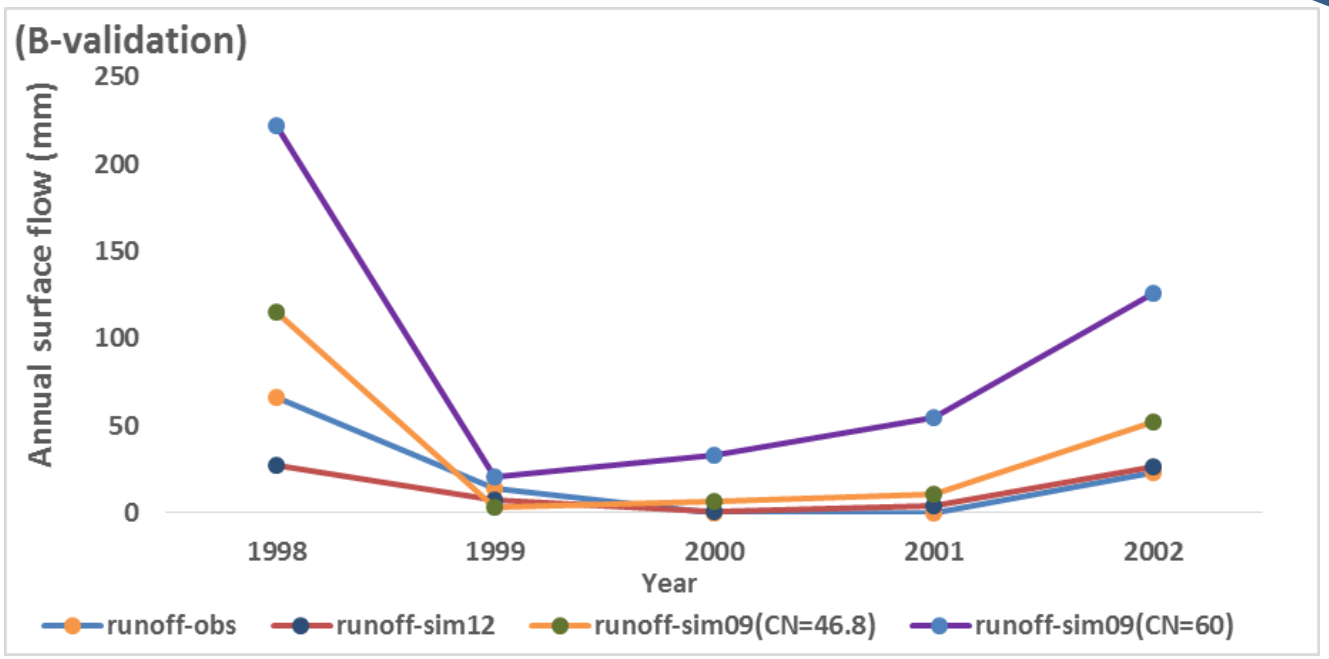
Site B		P_{BIAS} (%)		NSE		KGE	
		Rev.528	Rev.645	Rev.528	Rev.645	Rev.528	Rev.645
Annual	Tile flow	-143.1	-137.5	-3.72	-3.36	-0.57	-0.51
	runoff	-90.6	-255.5	0.05	-7.27	0.06	-2.14
	Corn yield	33.2	22.9	-28.65	-14	0.07	-0.03
	Soybean yield	18.3	18.3	-2.35	-2.35	0.13	0.13

Preliminary results

Site B

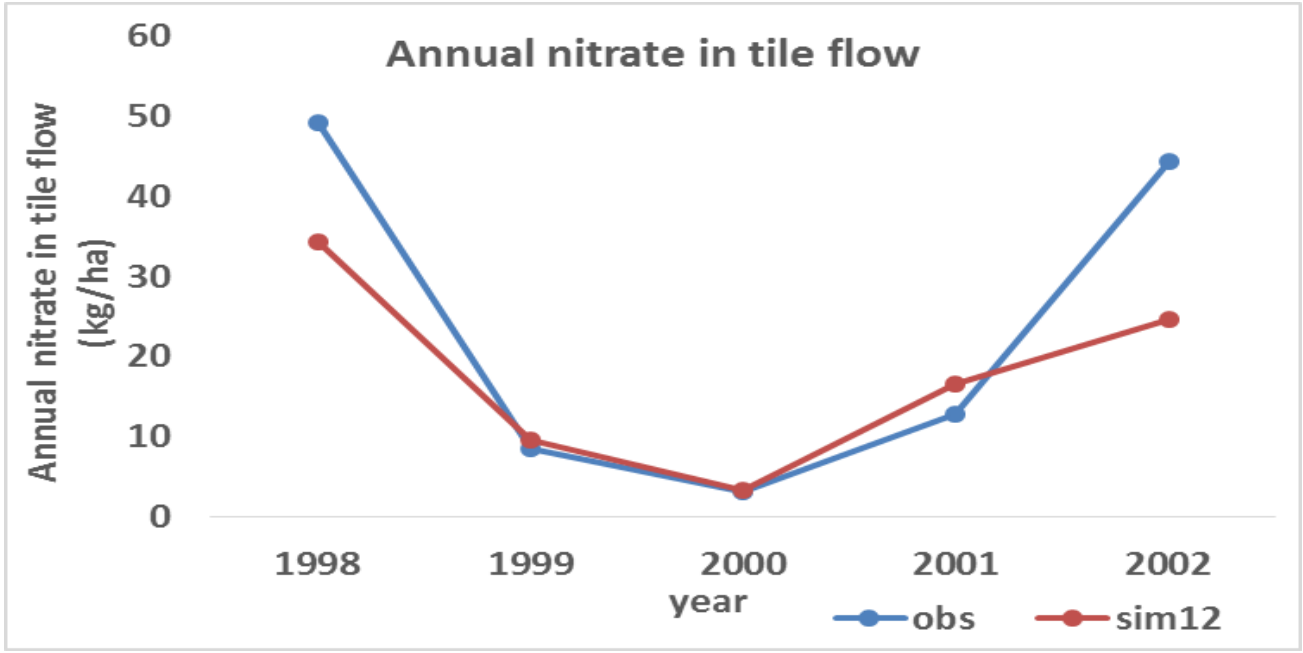


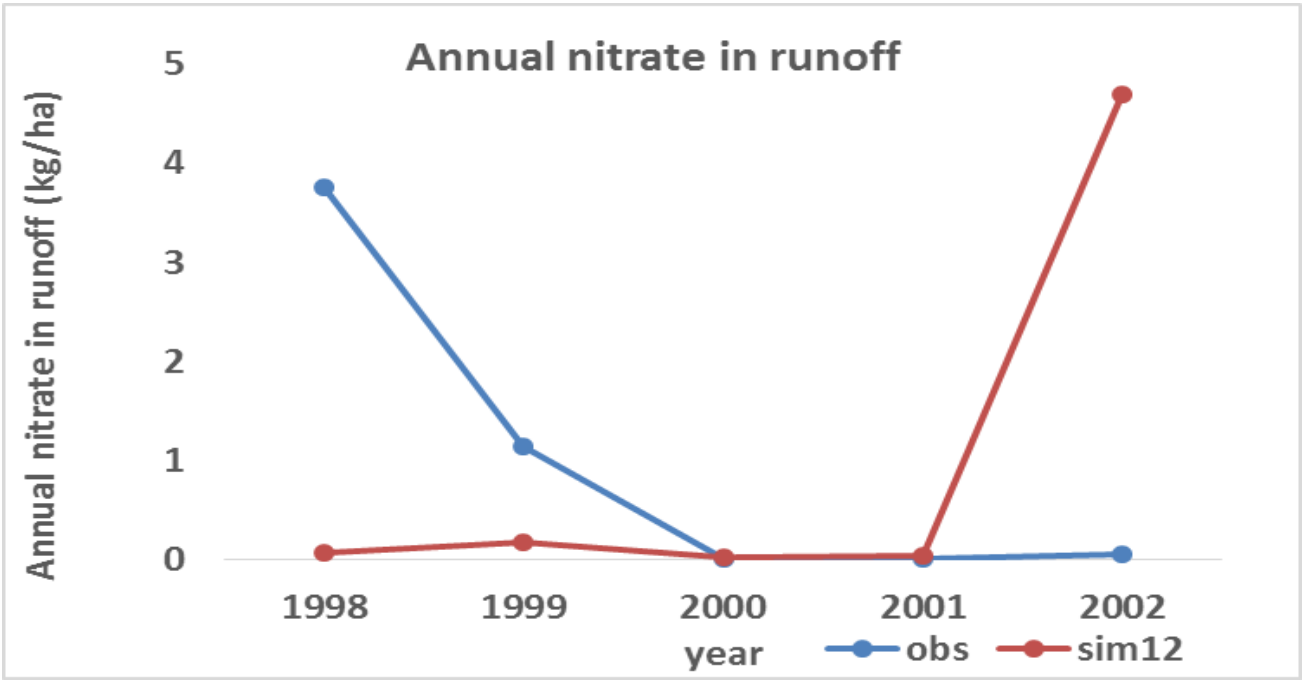

(B-calibration)
Annual surface flow (mm)
140
120
100
80
60
40
20
0
1994
1995
1996
1997
09(CN=60)
09(CN=46.8)
obs
sim12


(B-validation)
Annual surface flow (mm)
250
200
150
100
50
0
1998
1999
2000
2001
2002
Year
runoff-obs
runoff-sim12
runoff-sim09(CN=46.8)
runoff-sim09(CN=60)

B-validation

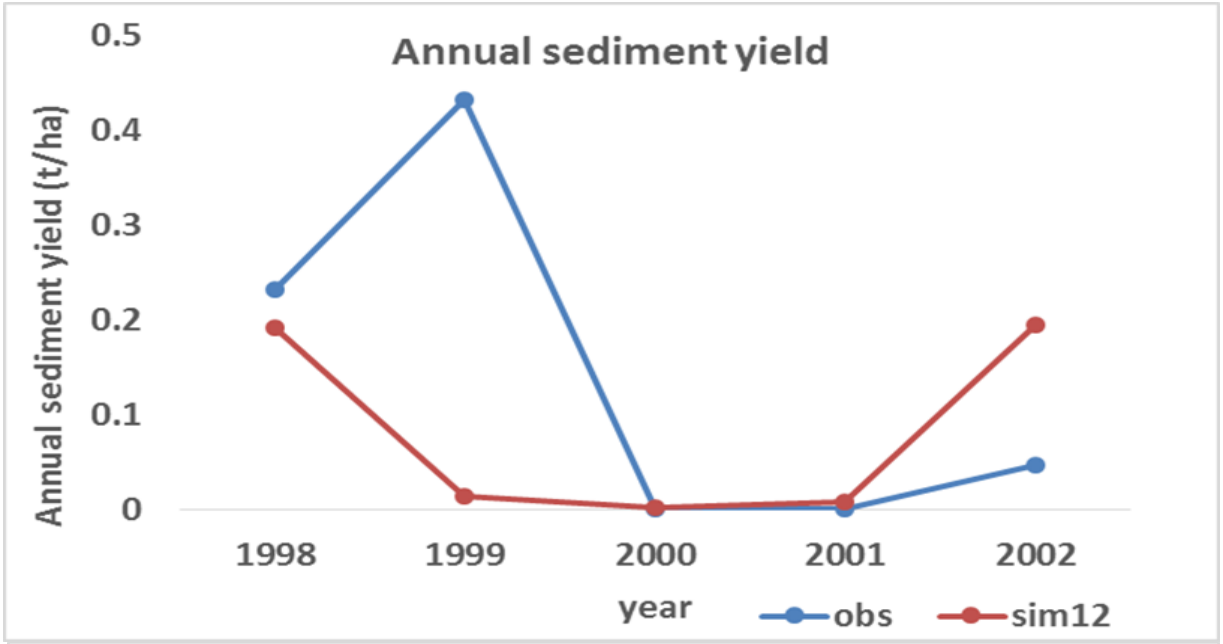
Rev. 645





B-validation

Rev. 645



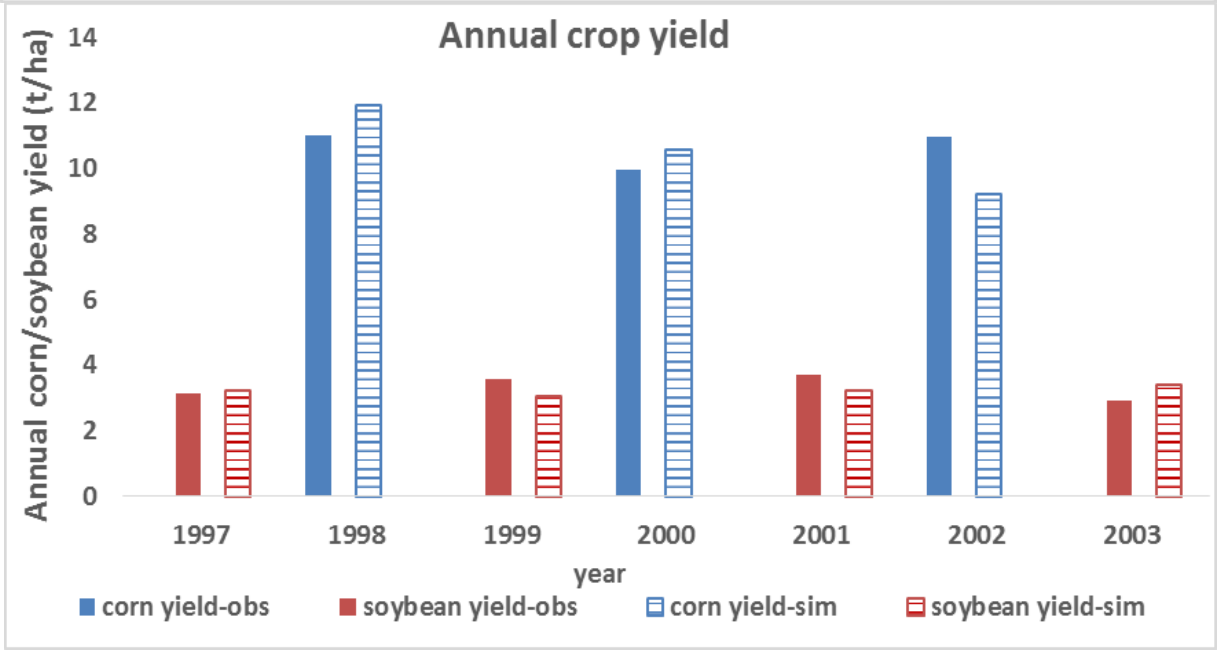
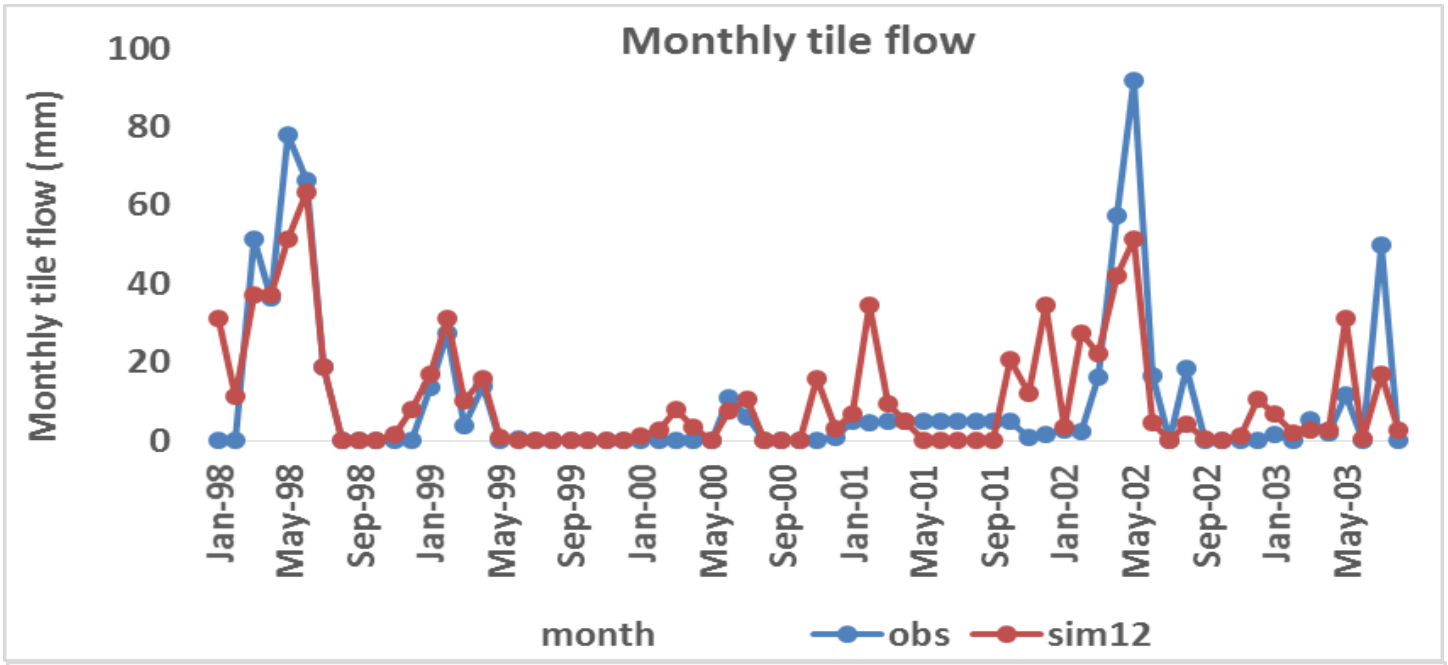


Fig. 7 Annual calibrated results of site B during validation

B-validation

Rev. 645



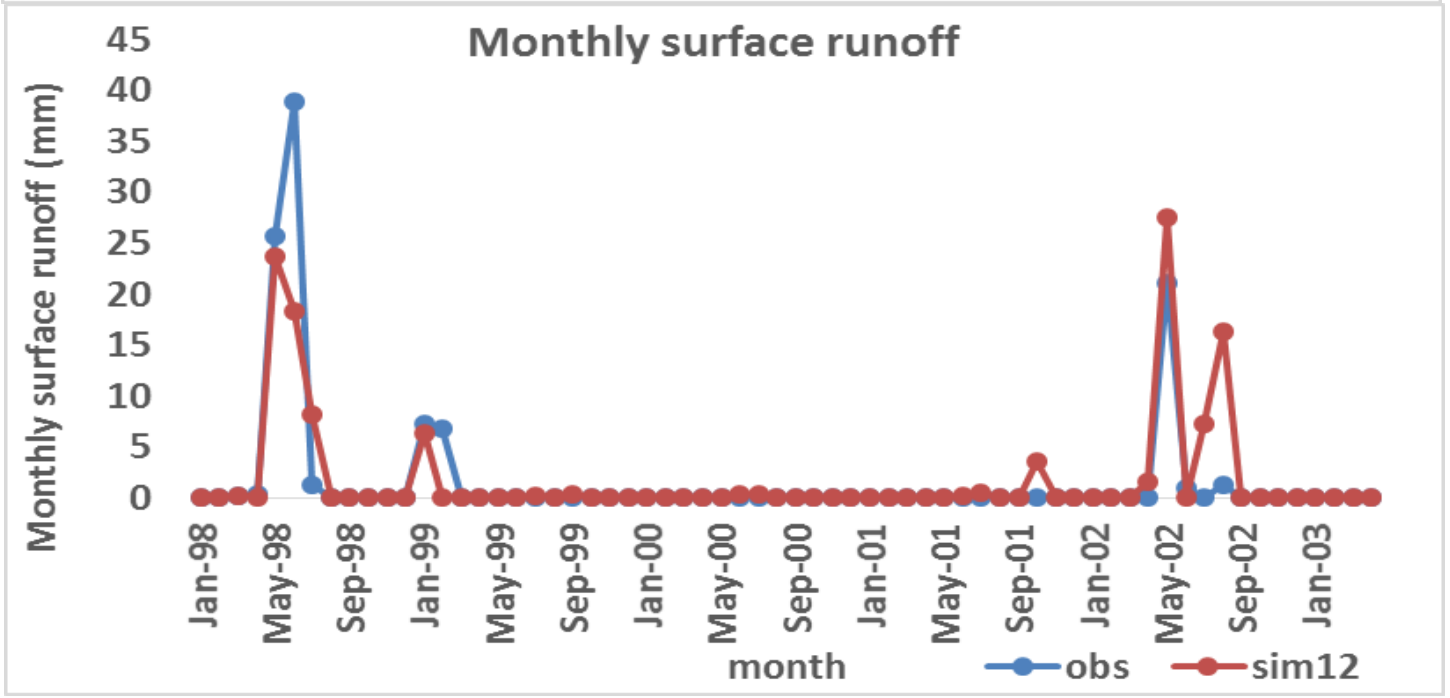


Table 5 Statistics for calibrated results for model validation

Station B (validation)		Tile drainage routine in Rev.645 (Rev.528)		
		Pbias (%)	NSE	KGE
Annual	Tile flow	26.15 (-92.09)	0.75 (-0.59)	0.69 (0.02)
	Surface flow	37.42 (-203.51)	0.44 (-4.63)	0.31 (-1.59)
	NO3-N in tile	37.98	0.68	0.52
	NO3-N in runoff	-0.28	-2.43	0.27
	Sediment yield	42.58	-0.40	-0.16
	Crop yield	1.37	0.94	0.97

Conclusions

- Uncalibrated results from the old and new tile drainage routines were poor;
- Uncalibrated results from SWAT2012 (Rev.645) were slightly poorer than SWAT2009 (Rev.528);
- Calibrated results from SWAT2012 were better than SWAT2009;
- New tile drainage routine with reasonable parameter sets.

Further work

- **Model calibration and validation at river station**