Parameters optimization with field observed data and application in freeze-thaw area

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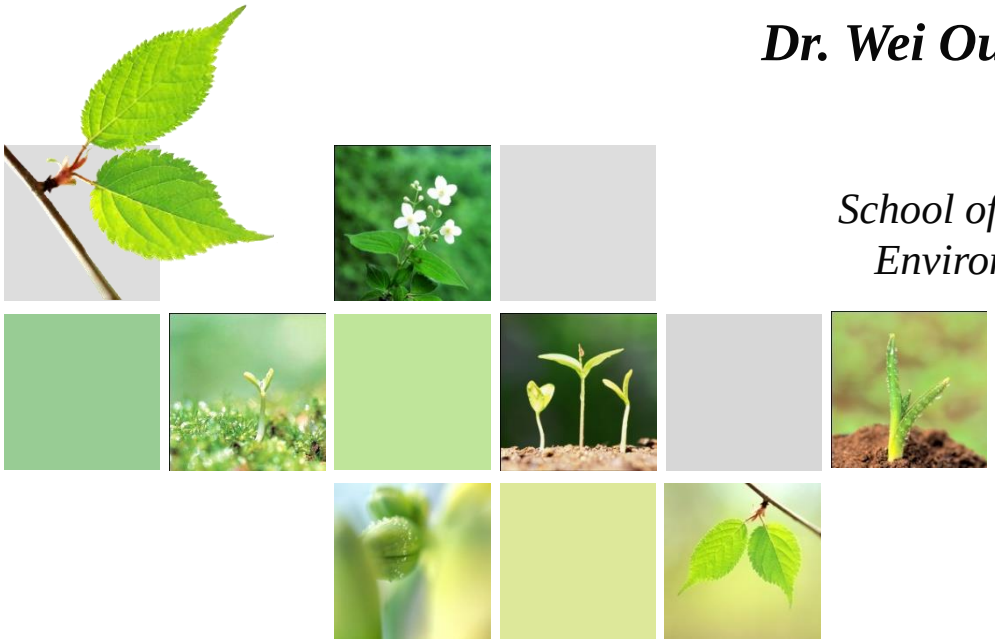


Main contents of report

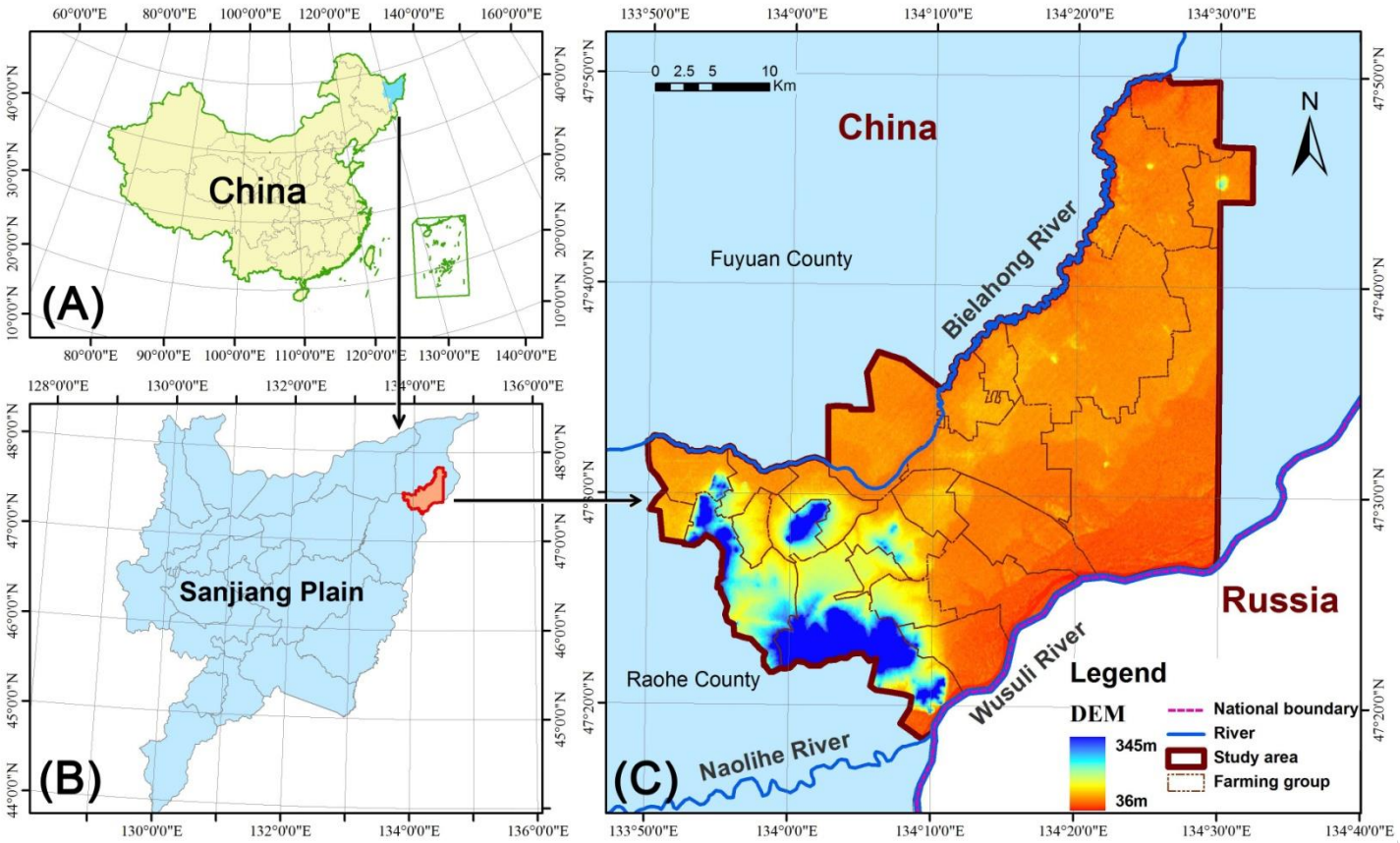
- Background and significance
- Contents and methods
- Results and discussion
- Conclusions and prospect

Background and significance

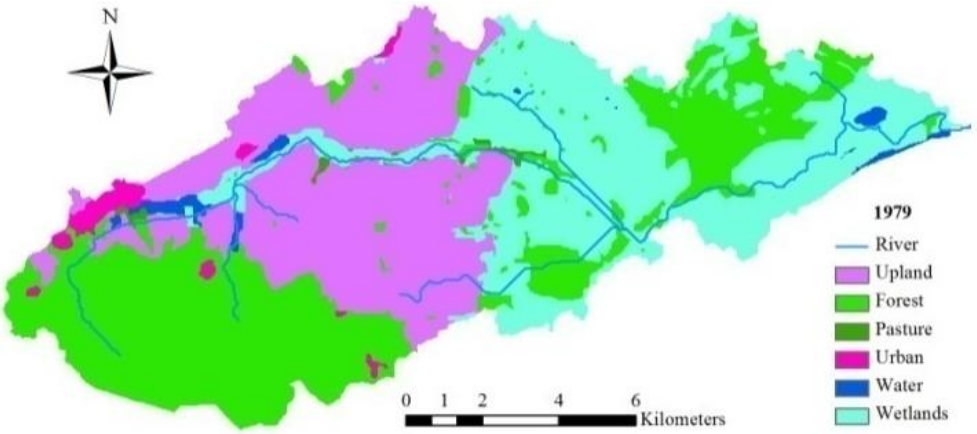
- How to apply model to the area without enough data for validation.
- The Chinese national soil database was constructed in 1970’s.
- The land use suffered intensive impact.

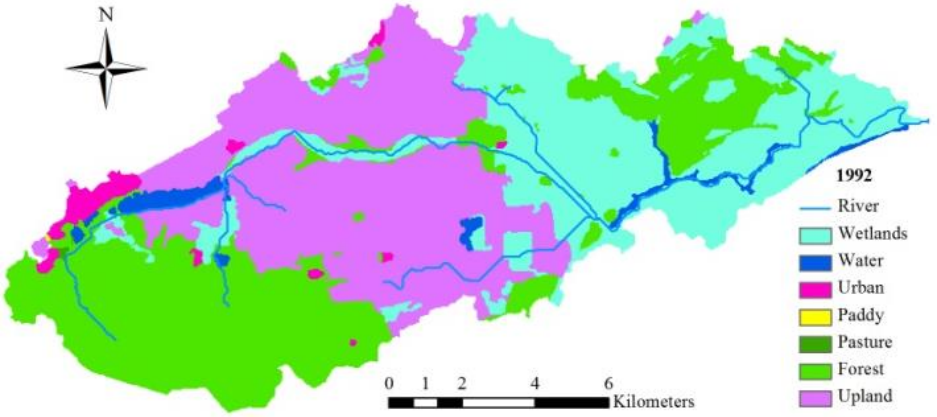
Study area

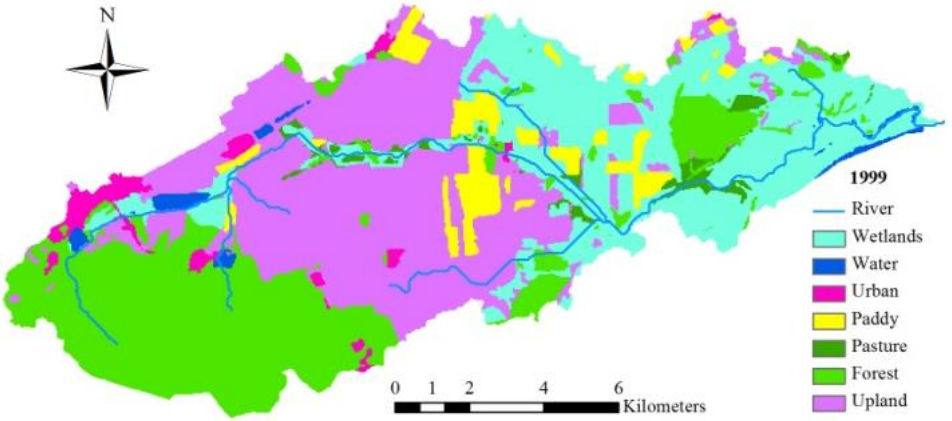
The selected Abujiao river watershed (47.25N, 134.02 E) with an area of 141.5 km^2 is located in the Northeast of China.

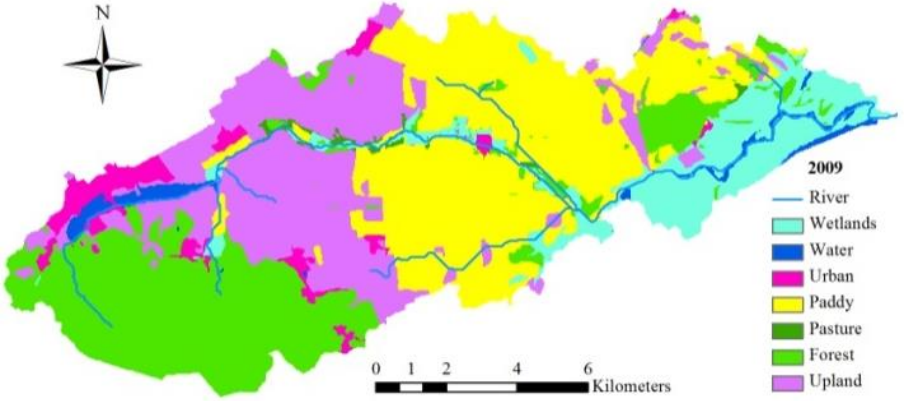


Regional land use variation from 1979-2009

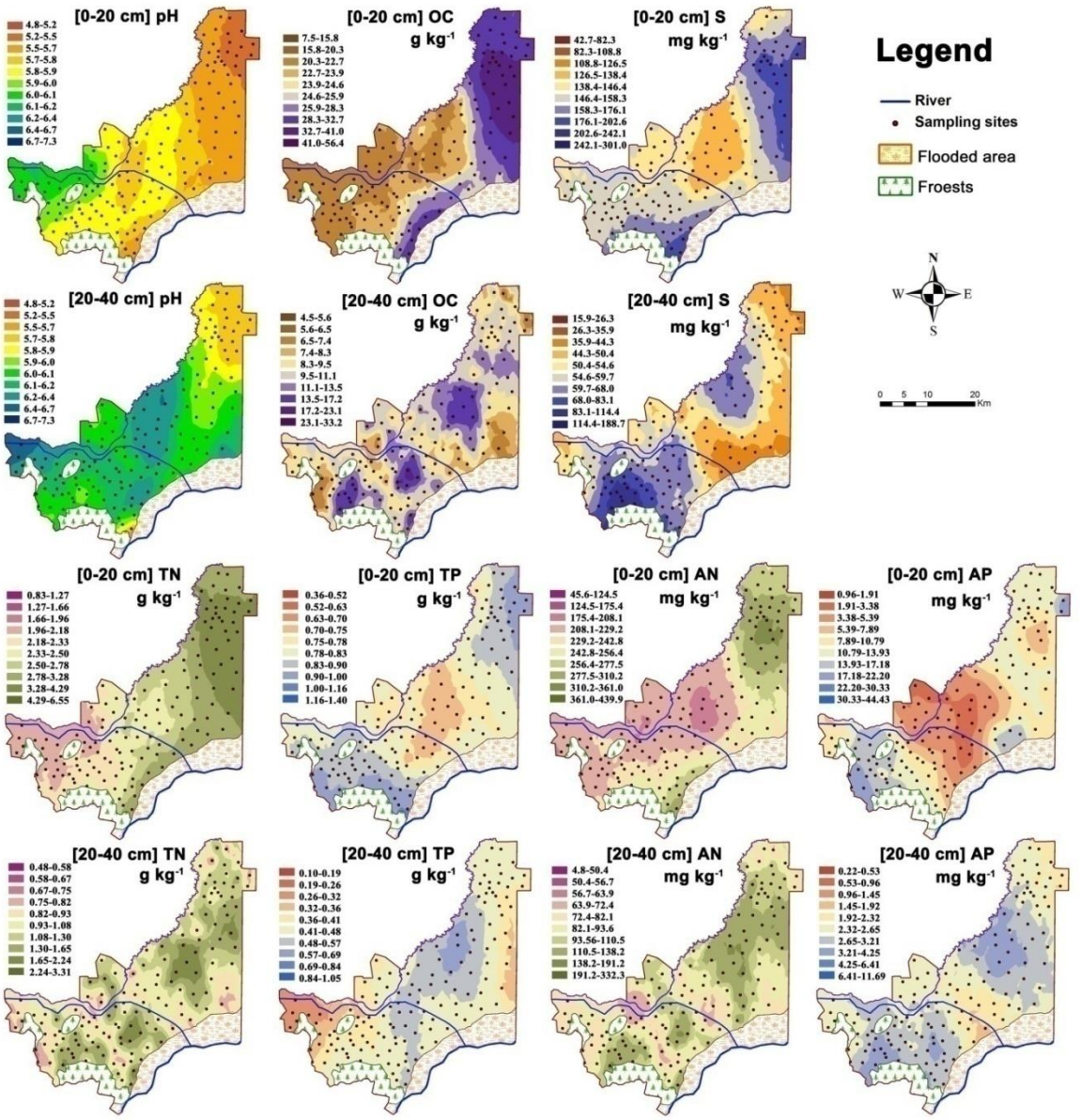








Soil property response during land use variation



Ouyang W., Soil & Tillage Research, 2013

Parameters comparisons

- **Screening for the key parameter**

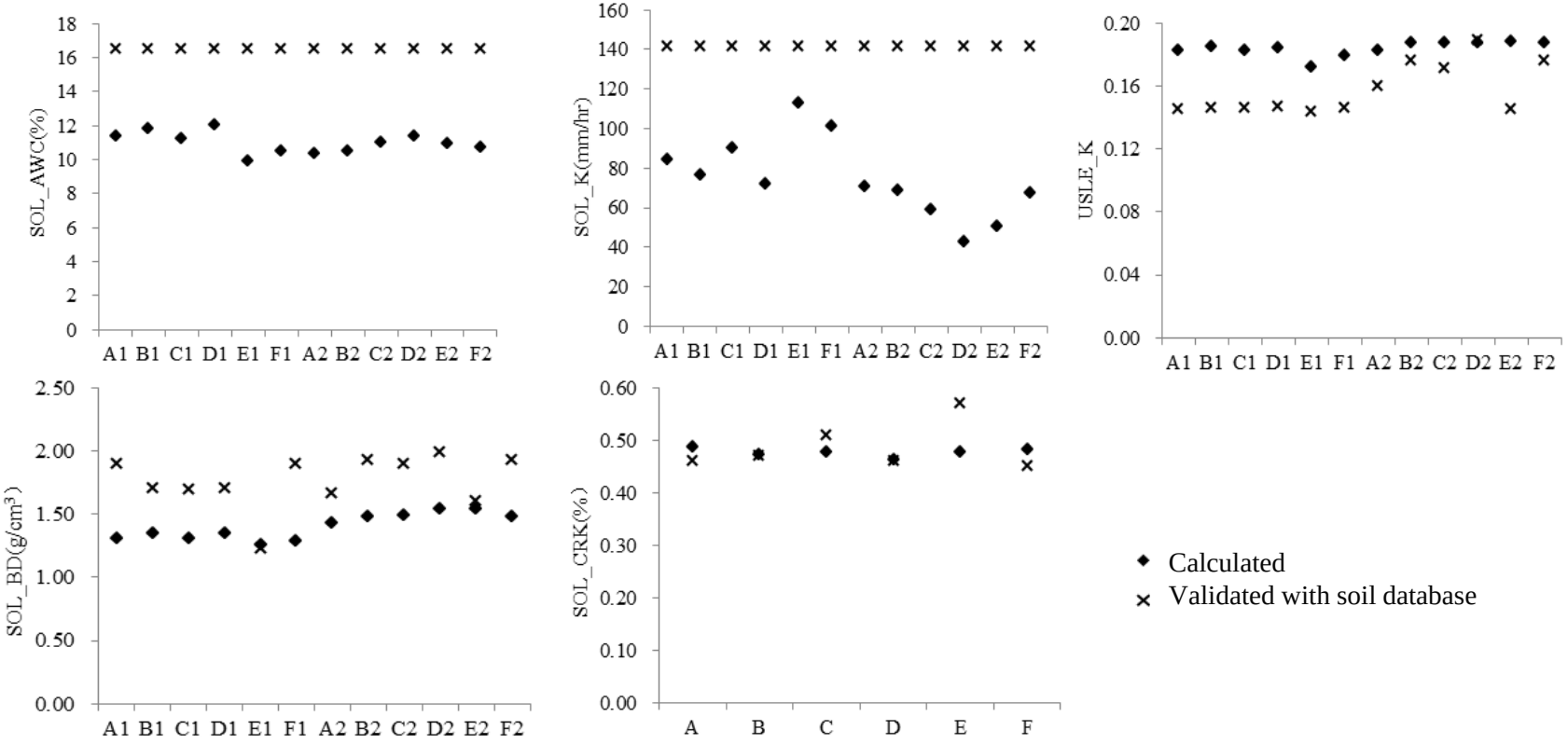
  LH-OAT sensitivity analysis method in the SWAT2009 model.

- **Parameter calculation based on field observed data**

Parameter	Calculation methods
SOL-ORGN、SOL-ORGP、OM、USLE-K	Hypothesis and formula in the SWAT2009 theoretical documentation
SOL_AWC 、 SOL-BD 、 SOL_K	SPAW（Soil - Plant – Atmosphere – Water System）model
SOL_CRK	Empirical formula

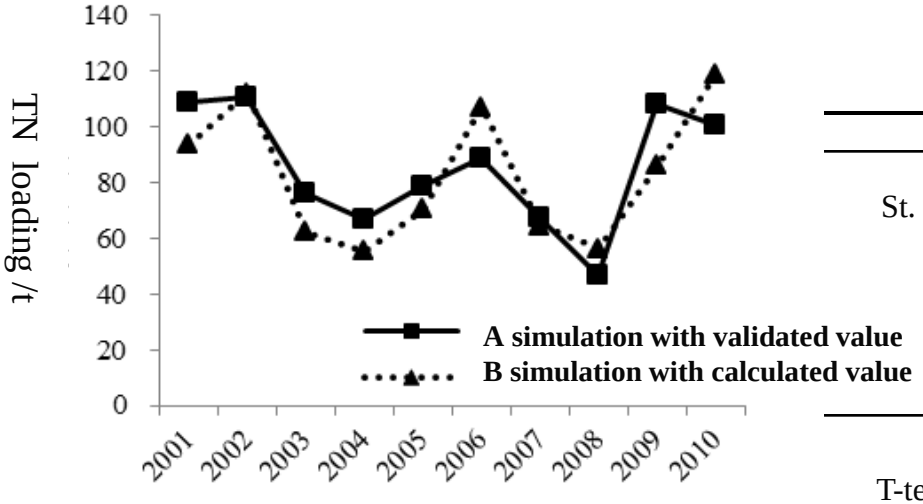
Results

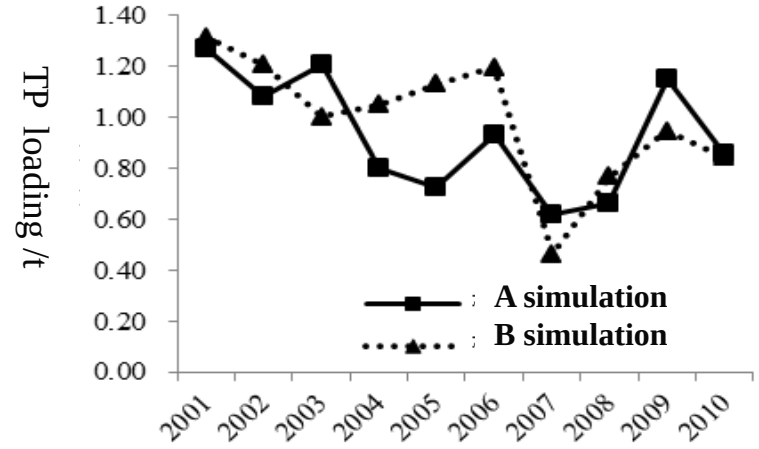
- **Comparison of calculated parameter value based on the observed data and the calibrated parameter value**



Temporal variation on NPS loading of two simulations

➢ Interannual variation



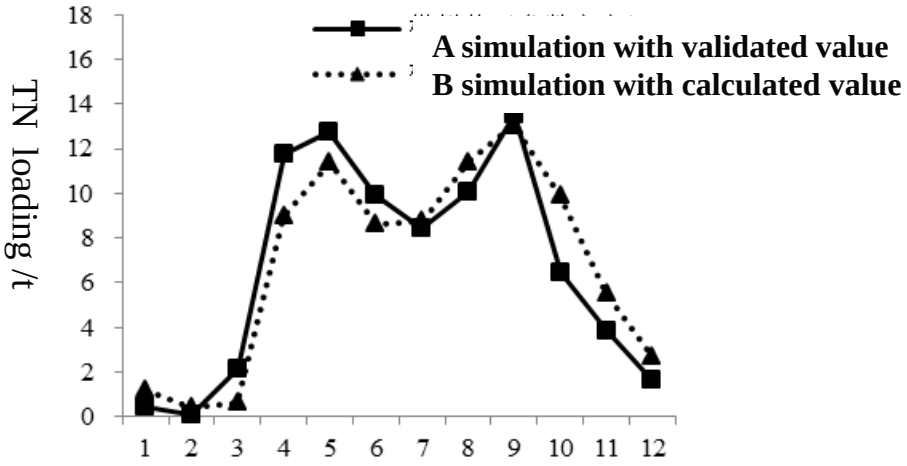


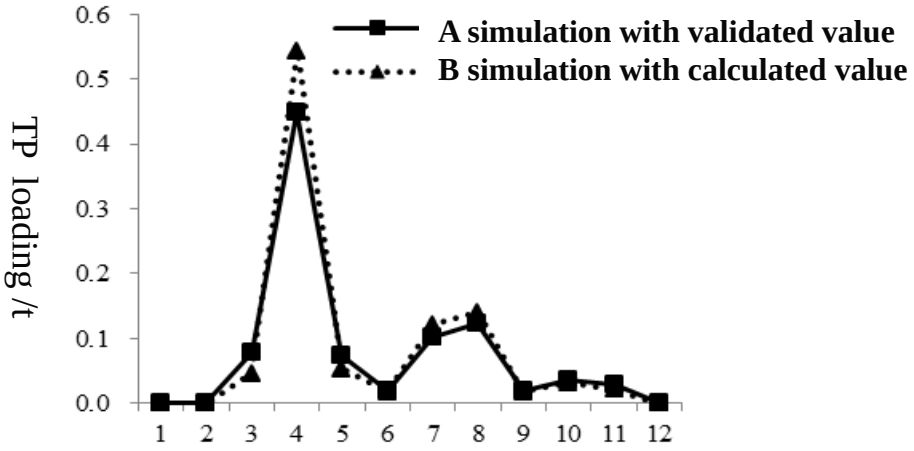
Index	TN in A	TN in B	TP in A	TP in B
Mean	85.26	82.61	0.93	0.99
St. Error. Of Mean	6.87	7.64	0.07	0.08
St. Error.	21.72	24.17	0.23	0.25
Variance	471.91	584.07	0.06	0.06
Range	63.94	63.63	0.65	0.85
Min	46.49	55.28	0.62	0.46
Max	110.42	118.90	1.27	1.31
R2		0.809		0.630
T-test t		0.583		-0.933
T-test P		0.574		0.375

- ✓ There was a considerable numerical difference on yearly non-point source (NPS) loading between two simulations.
- ✓ TP loading of two simulations shared the same variation regularity on interannual variation.

Temporal variation on NPS loading of two simulations

➢ Inter-monthly variation



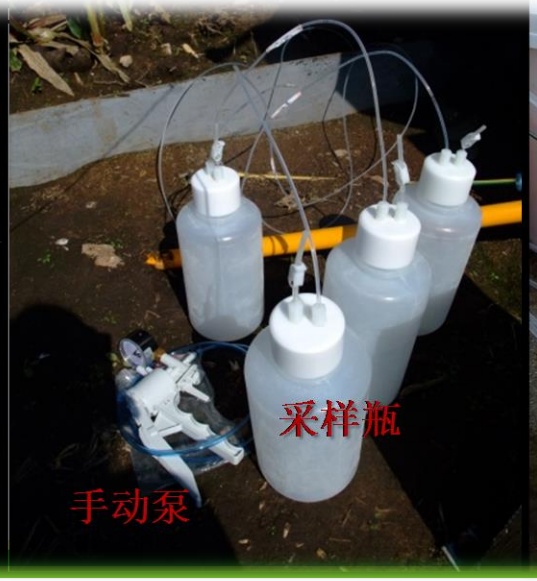


Index	TN in A	TN in B	TP in A	TP in B
Mean	6.75	6.88	0.08	0.08
St. Error. Of Mean	1.43	1.32	0.04	0.04
St. Error.	4.96	4.59	0.12	0.15
Variance	24.63	21.05	0.02	0.02
Range	13.43	12.63	0.45	0.54
Min	0.09	0.42	0	0
Max	13.51	13.04	0.45	0.54
R2	0.940		0.995	
T-test t	-0.267		-0.569	
T-test P	0.794		0.581	

Soil water monitoring

Paddy rice

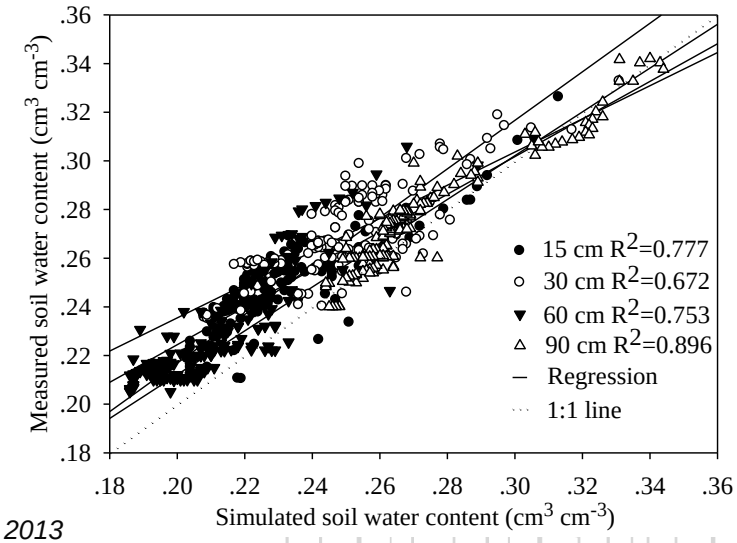

Dryland



Soil water

Main crops parameters for the crop growth module of SWAP

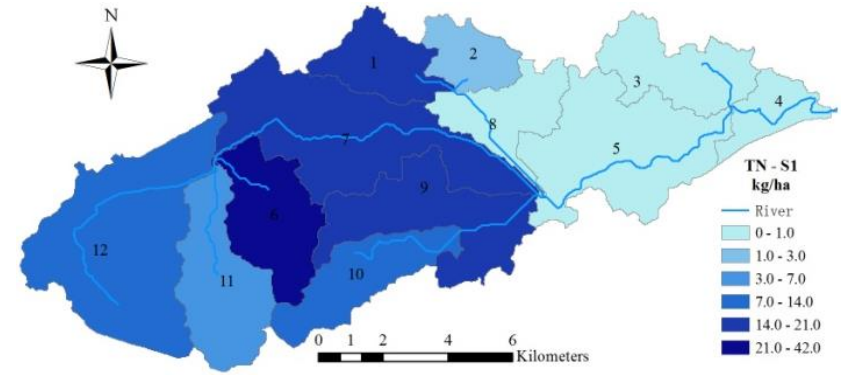
Parameter	Maize
Temperature sum from emergence to anthesis, TSUMEA (◦C)	697
Temperature sum from anthesis to maturity, TSUMAM (◦C)	1821
Light extinction coefficient, KDIR	0.75
No water extraction at higher pressure heads, HLIM1(cm)	-15
h below which optimum water extr. starts for top layer, HLIM2U (cm)	-30
h below which optimum water extr. starts for sub layer, HLIM2L (cm)	-30
h below which water uptake red. starts at high Tpot, HLIM3H (cm)	-325
h below which water uptake red. starts at low Tpot, HLIM3L (cm)	-600
No water extraction at lower pressure heads, HLIM4 (cm)	-8000
Minimum canopy resistance, RSC (s m^{-1})	70

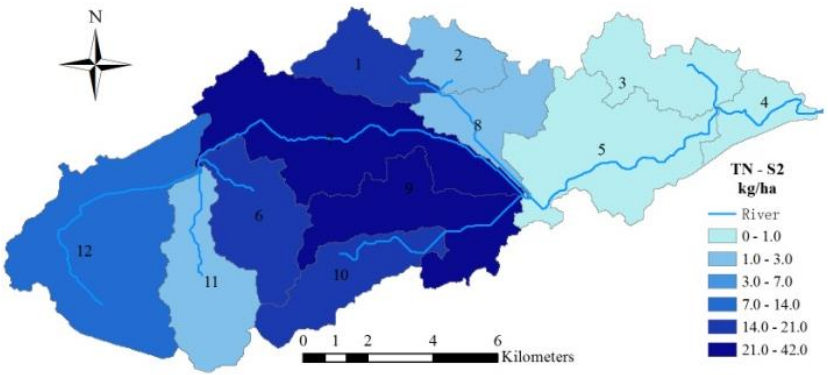


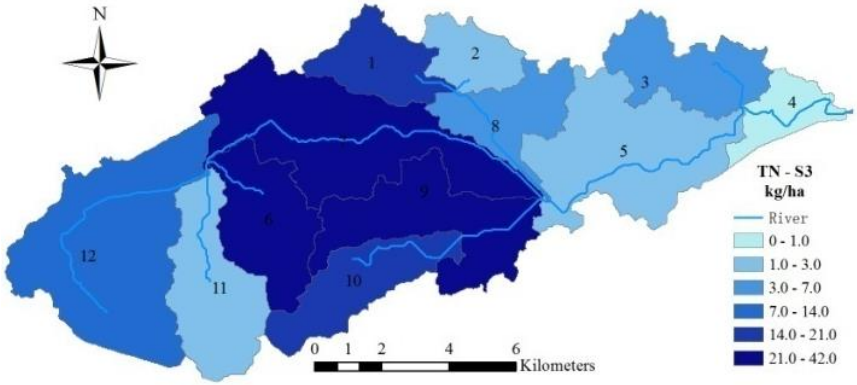
Hao F.H., et al., Journal of Hydrology, 2013

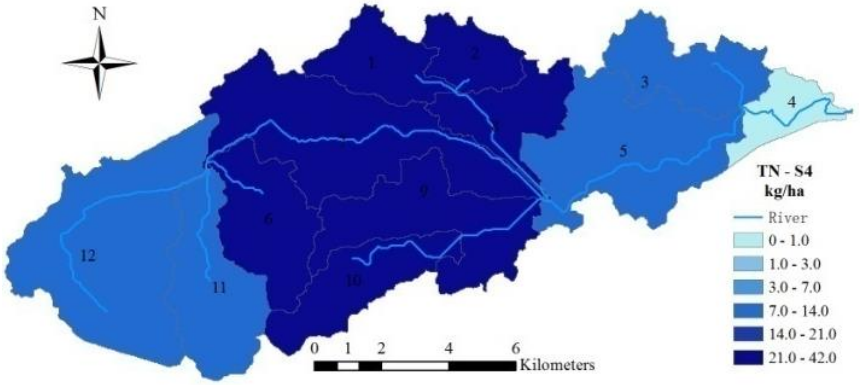
Synergistic impacts of land-use change and soil property variation on non-point source nitrogen pollution in a freeze-thaw area

• Spatial distribution of average annual NPS total nitrogen load for four sequential land-use changes



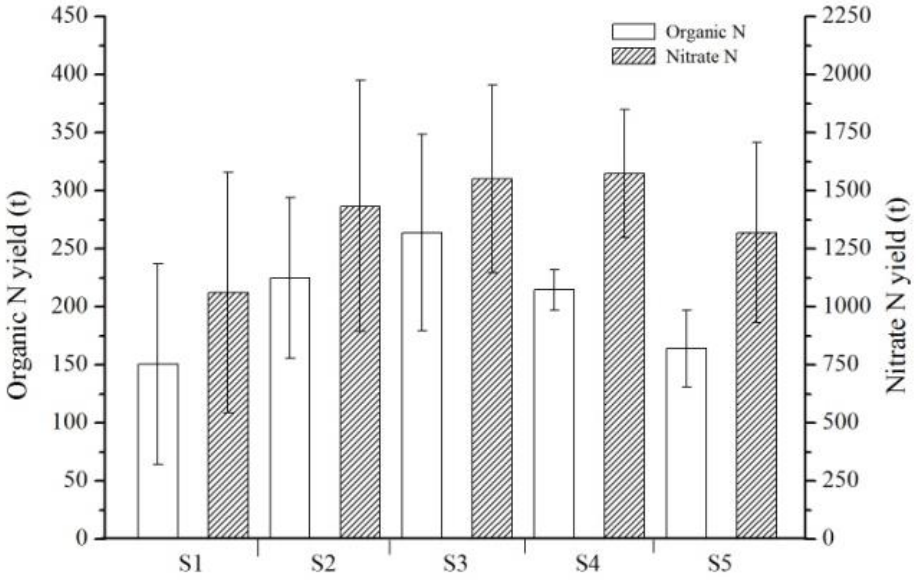




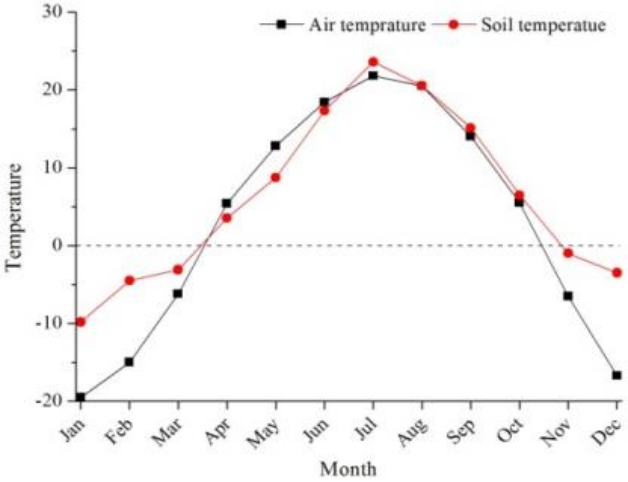


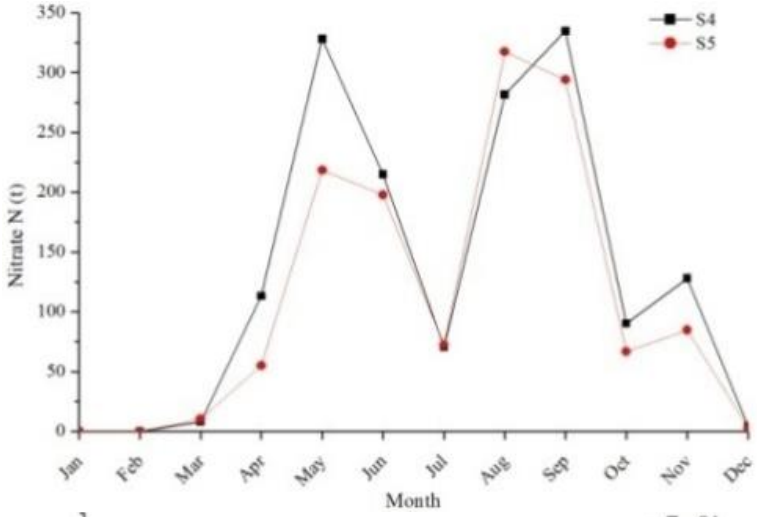
Ouyang W. et al., Journal of Hydrology, 2013

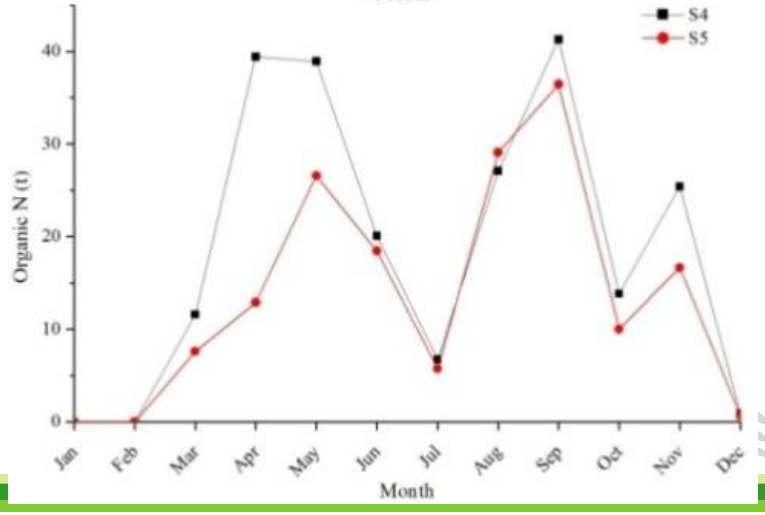
- Averages and standard error bars of yearly simulated of NPS organic N and nitrate N in each simulation



Monthly air, soil temperature, and NPS nitrogen load with unvaried land use and varied soil properties



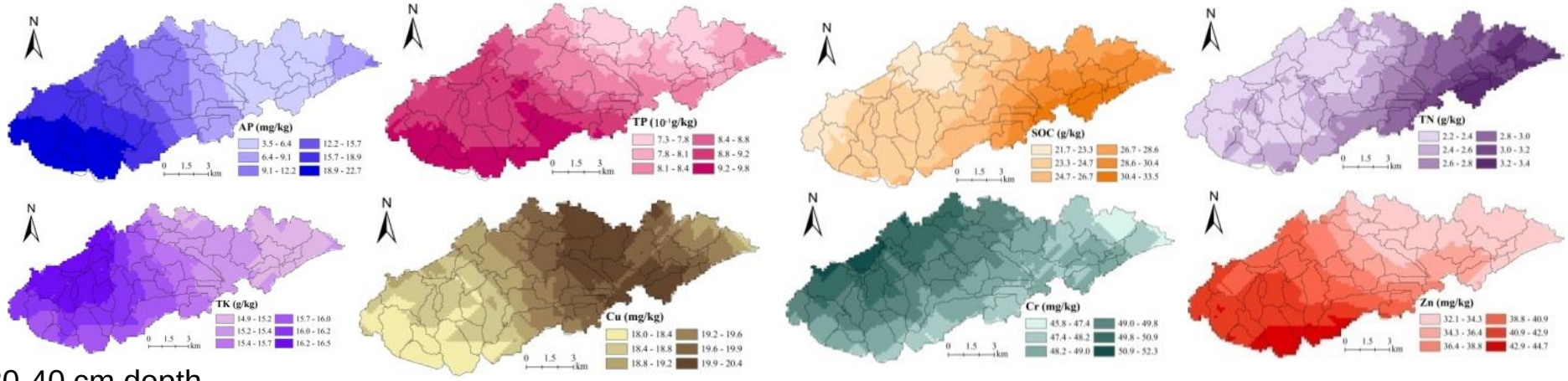




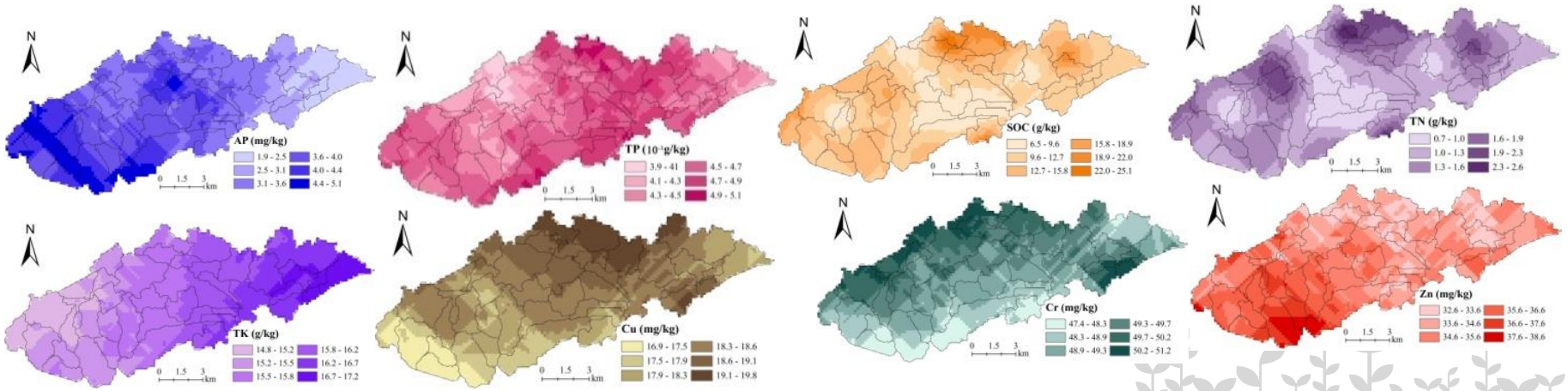
Spatial interaction of soil property with NPS pollution at watershed scale: the phosphorus indicator

Spatial distributions of eight soil properties indexes

top 20 cm surface

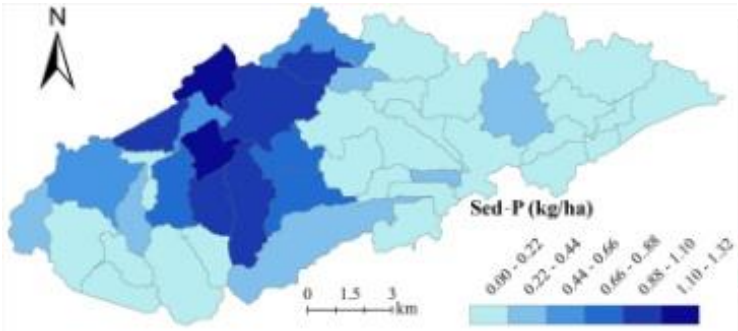


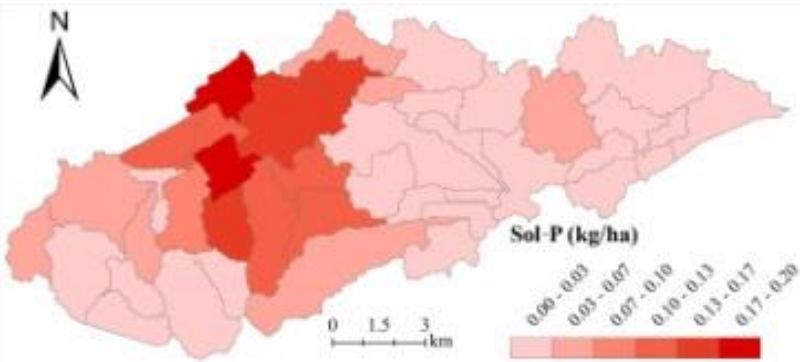
20-40 cm depth

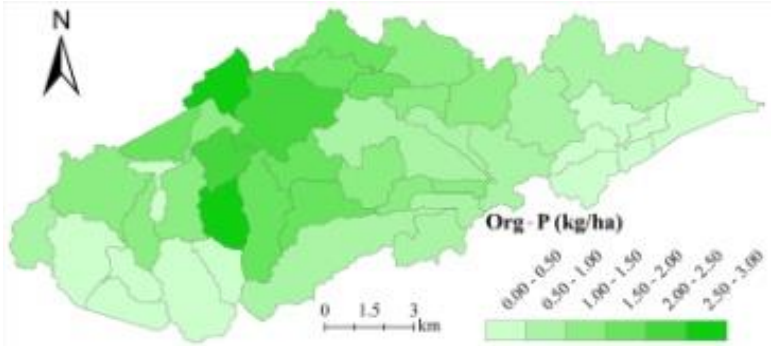


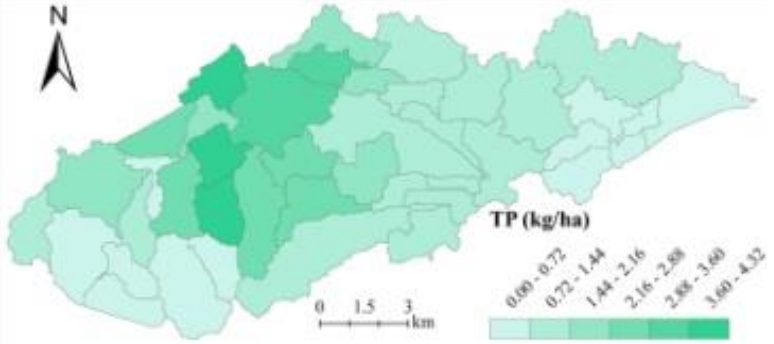
Ouyang W. et al., Science of the Total Environment, 2012

Spatial distribution of mean yearly NPS phosphorus loading

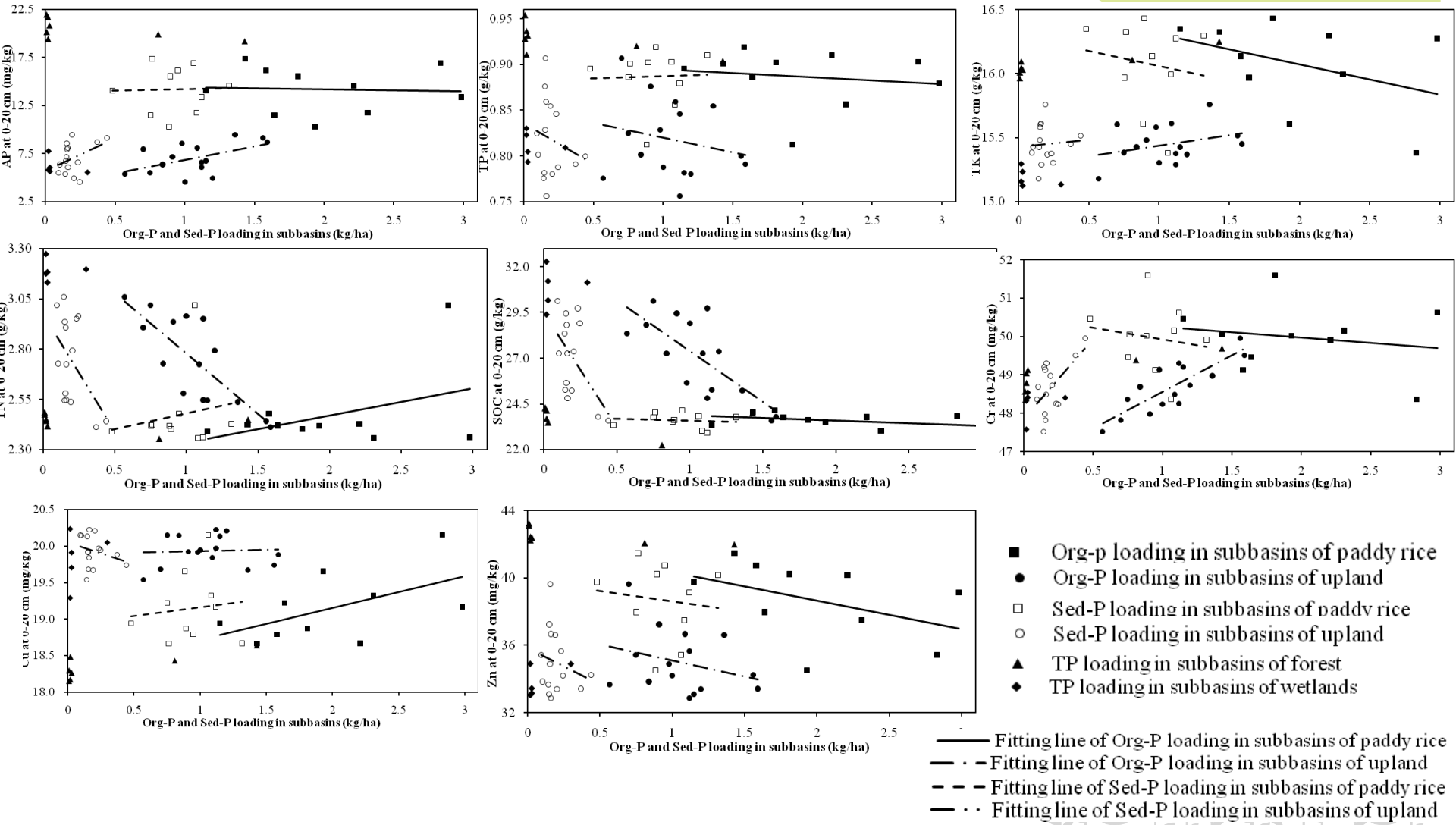




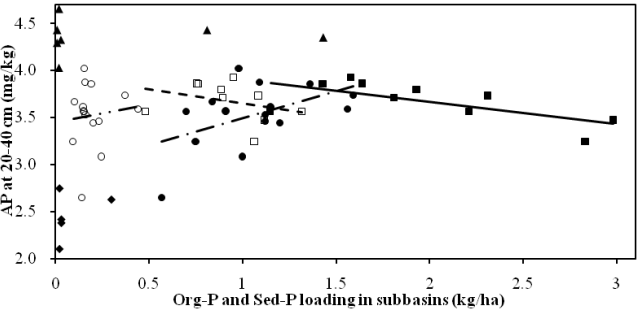


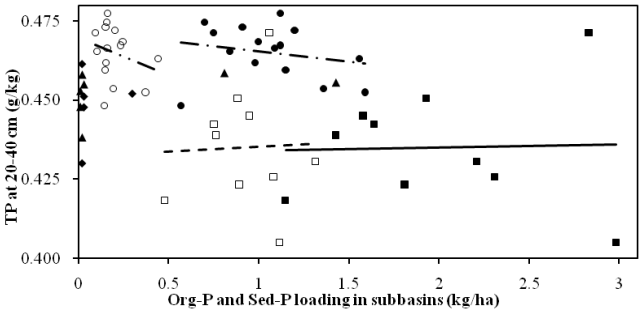


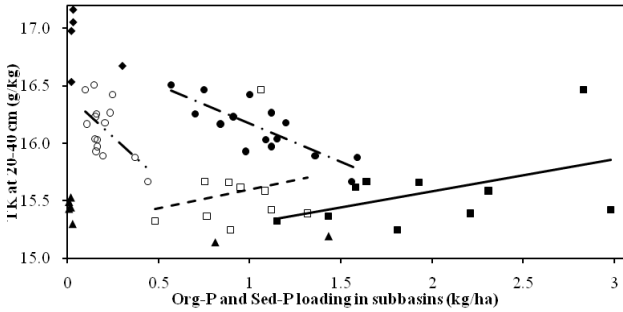
Spatial interactions of NPS sediment P (Sed-P) and organic P (Org-P) with soil parameters of 0-20 cm surface at subbasins with four kinds of landuses

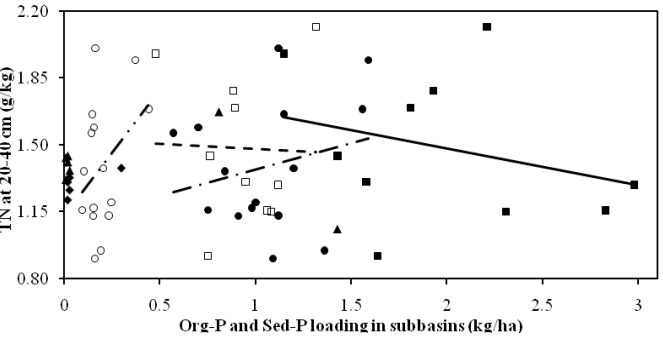


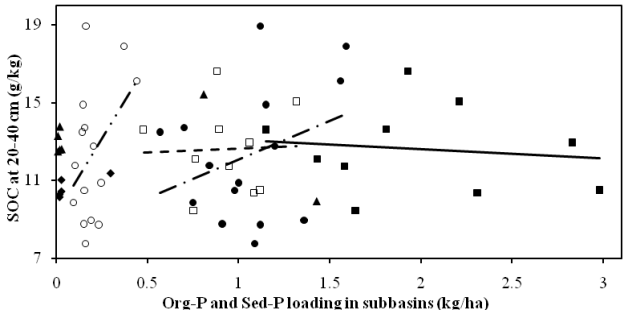
Spatial interactions of NPS sediment P (Sed-P) and organic P (Org-P) with soil parameters of 20-40 cm depth at subbasins with four kinds of landuses

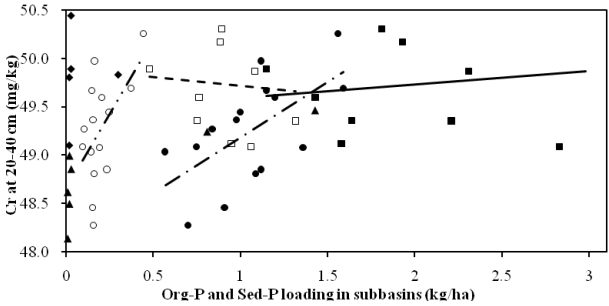


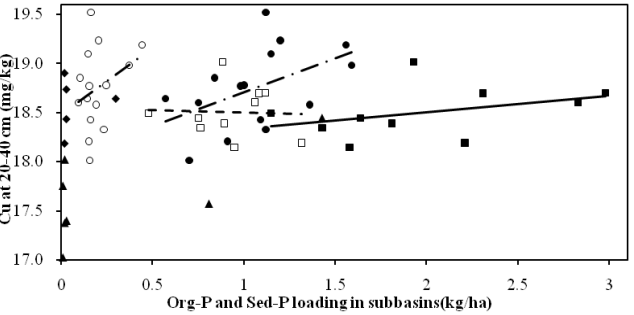


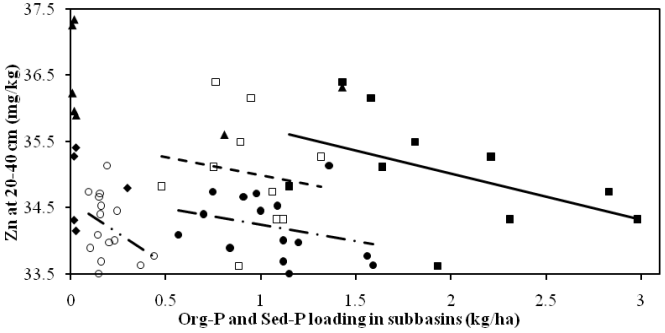


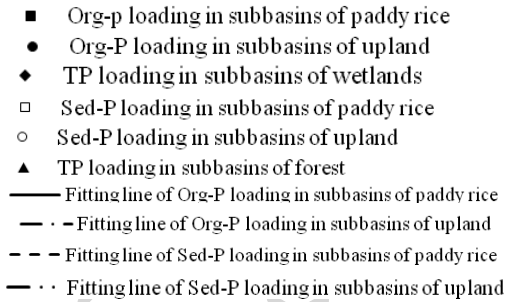




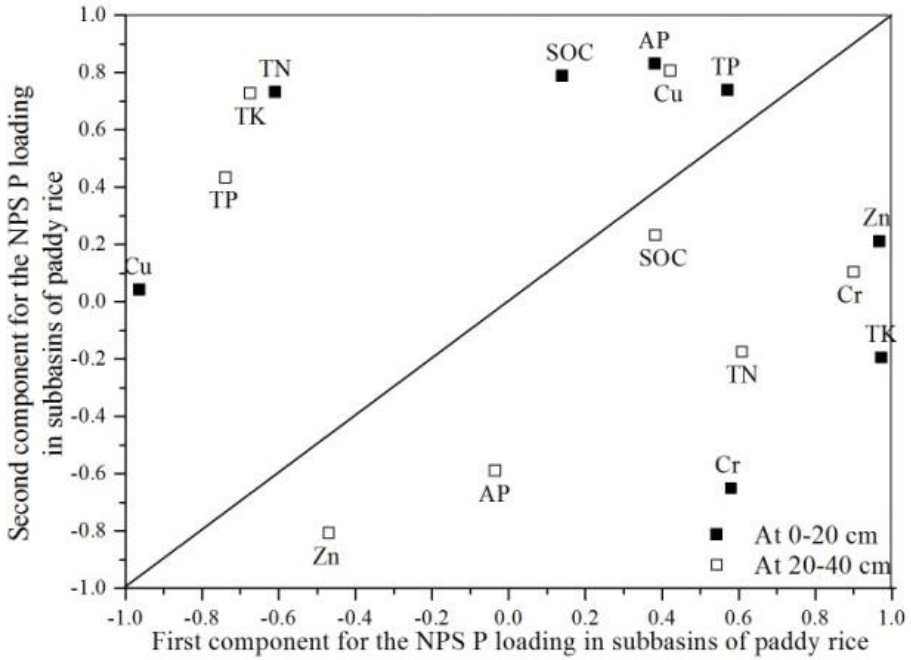


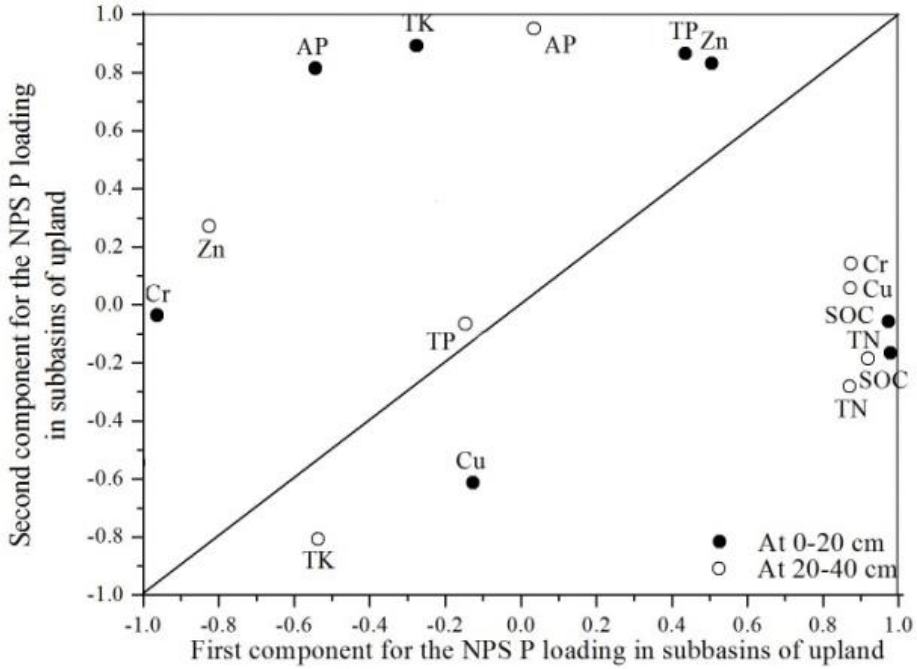






Contribution of soil indexes to NPS phosphorus loading assessment from the subbasins of upland and paddy rice





Conclusions

- By comparing two simulations based on calibrated parameter values and based on calculated ones respectively, it was identified that there was some difference on the NPS loading between them.
- The comparison also indicated the validated parameters value from similar watershed was a reliable solution for the area without regular monitoring data.
- With the field monitoring, SWAT had diverse applications on watershed management.

Thank You !