Validation of AnnAGNPS model in a watershed of Miyun Reservoir near Beijing, China

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Introduction

Non-point source pollution models, such as AnnAGNPS, use relatively simple mathematical equations to conceptualize complex, spatially distributed, and highly interrelated processes in a watershed. The model parameters often do not represent directly measurable entities and must therefore be estimated using measurements of the system inputs and outputs for model calibration and validation (Vrugt, et al., 2005).

This study evaluated AnnAGNPS model for Chaohe River watershed of Miyun reservoir near Beijing, China by sensitivity analysis of parameters, calibration and validation of model.

Methods

Sensitivity analysis of parameters of AnnAGNPS model was firstly conducted by using Local Sensitivity Analysis to identify sensitive parameters. Split Sample Test was used for calibration and validation of AnnAGNPS model applied in Chaohe River watershed. The data of hydrological and water quality were divided into two periods. The data from 1980 to 1985 were used for calibration while the data from 1986-1990 for validation.

Result and discussion

Table 1 showed that CN (Runoff Curve Number) is the most sensitive parameter, then is FC (Field Capacity), SC (Saturated Conductivity) is the least. So these three parameters were adjusted for calibration of model.

Table 1.1 Sensitivity analysis of parameters of AnnAGNPS model

parameter	range	y	y*	|y*-y|	average
CN	+10%	45.056	69.264	24.208	14.98
	-10%	45.056	30.076	14.98	
FC	+10%	45.056	37.053	8.003	12.472
	-10%	45.056	57.528	12.472	
SC	+10%	45.056	35.188	9.868	5.713
	-10%	45.056	50.769	5.713	

y is the output before adjustment, y* is the output after adjustment.

Annual flows of 1980 and 1981 were used for a rough calibration and monthly flow from 1980 and 1981 were used for fine calibration. Finally, annual flows from 1980 to1985 were used to calibration again until the best set of parameters for satisfactory simulation. After the calibration, annual flows from 1986 to1990 were used for validation.

After the calibration and validation of flow, sediment load was calibrated and validated in the same way.

Figure 1.1 shows the simulated and observed results of Chaohe River for validation.

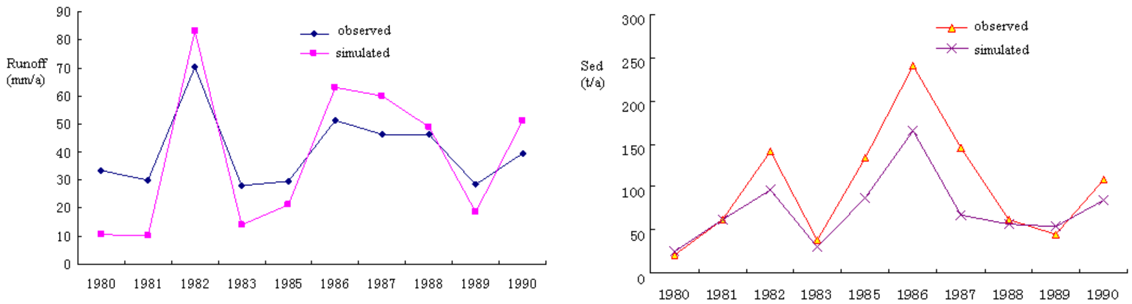

Fig.1.1 Simulated and observed results from 1980 to 1990 (left) mean annual runoff; (right) Mean annual Sediment

It can be seen that the simulated results of flow at high-flow year and normal-flow year are closer to observed ones. There is bigger uncertainty for flow simulation during the low-flow year.

For sediment simulation, there is a better result of normal-flow year, then high-flow year. There is also bigger uncertainty for simulated sediment during the low-flow year.

Non-point source pollution to the river is highest in the rainy season. From 1980 to 1990, the simulated flow amount was about 90% of observed flow and simulated sediment is over 70% of observed sediment in Chaohe River watershed. So AnnAGNPS model is reliable simulation of annual non-point source pollution loads in this study area.

Table 1.2 shows the simulated and observed TN and TP loads of Chaohe River watershed. The error is less than 10%. So the simulated results represent the actual situation well.

Table 1.2 Simulated and observed TN and TP loads of Chaohe River watershed

Year	Observed TN (t/a)	Simulated TN (t/a)	Observed TP (t/a)	Simulated TP (t/a)	Precipitation (mm)
1997	845.07	843.90	6.38	6.03	412.09
1998	2218.31	1991.09	32.27	27.70	634.50
1999	422.54	463.76	2.84	5.27	384.65

Conclusion

The sensitivity analysis confirmed that CN (Runoff Curve Number) is the most sensitive parameter, followed by FC (Field Capacity); SC (Saturated Conductivity) is the least sensitive parameter. So these three parameters were adjusted for calibration.

According the results of calibration and validation, AnnAGNPS model can predict flow well; then sediment and nutrient load, especially during the high-flow year and normal-flow year, the simulated results may present the actual situation better.

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