

COMPARISON OF COMPUTER MODELS FOR ESTIMATING HYDROLOGY AND WATER QUALITY IN AN AGRICULTURAL WATERSHED

Yaoze Liu, Sisi Li, Carlington W. Wallace, Indrajeet Chaubey,
Dennis C. Flanagan, Lawrence O. Theller, Bernard A. Engel

Department of Agricultural and Biological Engineering, Purdue University

Email: liu754@purdue.edu



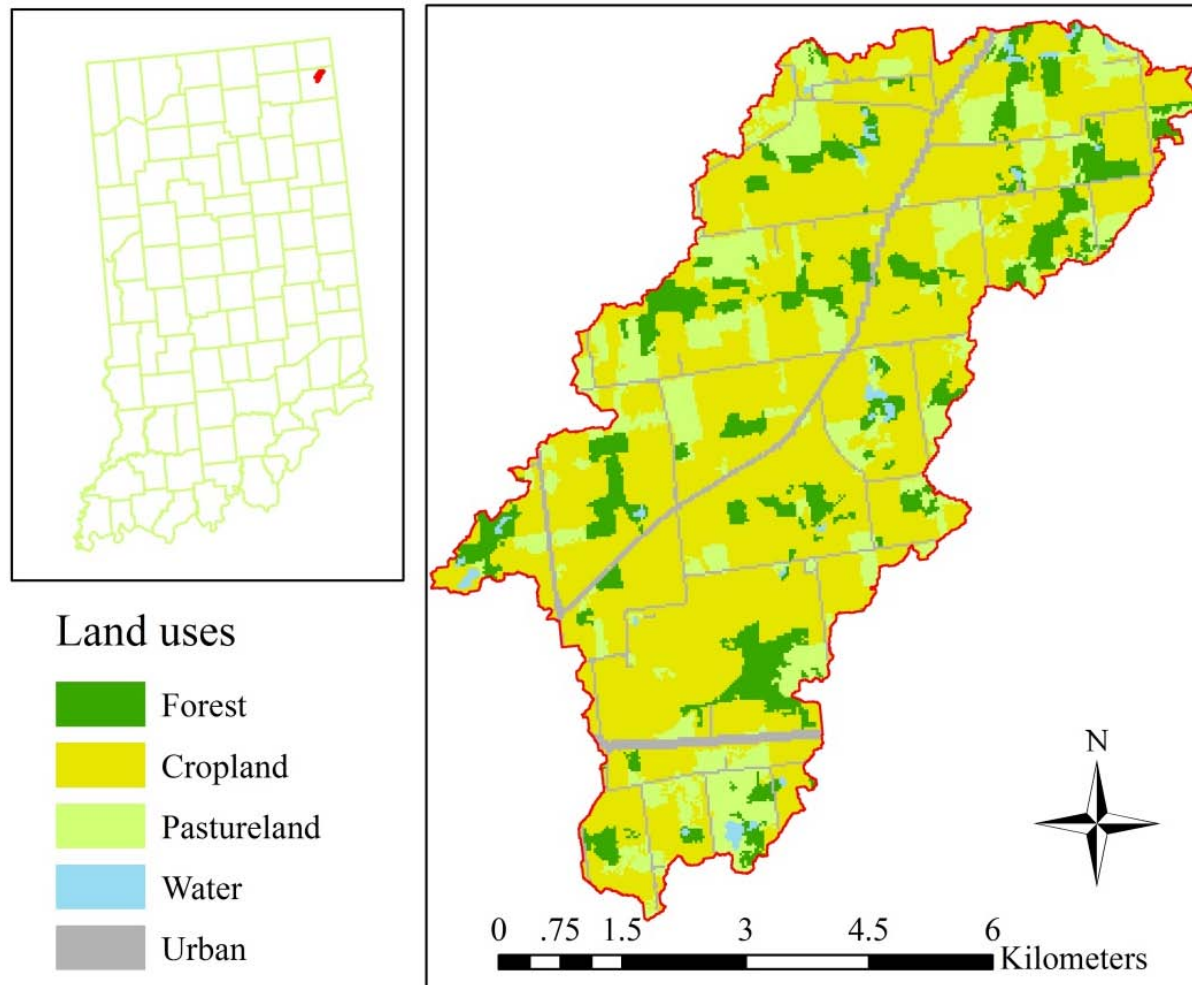
1. Introduction

- ❑ Computer models estimate hydrology and water quality at field to watershed scales.
- ❑ Users are uncertain about which model(s) to choose.
- ❑ Model comparison is needed.
- ❑ Computer models:
 - Spreadsheet Tool for the Estimation of Pollutant Load (STEPL)-Purdue
 - Soil and Water Assessment Tool (SWAT)
 - High Impact Targeting (HIT)
 - Long-Term Hydrologic Impact Assessment (L-THIA)
 - Pollutant Load (PLOAD)
 - Spatially and Temporally Distributed Model for Phosphorus Management (STEM-P)
 - Region 5

2. Objectives

- ❑ Explore uncalibrated, calibrated, and validated outputs of STEPL-Purdue, SWAT, HIT, L-THIA, PLOAD, STEM-P, Region 5, and uncalibrated ensemble modeling in estimating water quantity and quality for an agricultural watershed.
- ❑ Compare models and provide suggestions on selection and use.

3. Study area



Location and land uses of AXL watershed in northeast, Indiana.

4. Methods

❑ Uncalibrated (2006-2013)

- Single models (except Region 5) and ensemble modeling
- Region 5 model not included—field level model
- Ensemble modeling: STEPL-Purdue, SWAT, L-THIA, PLOAD, and STEM-P

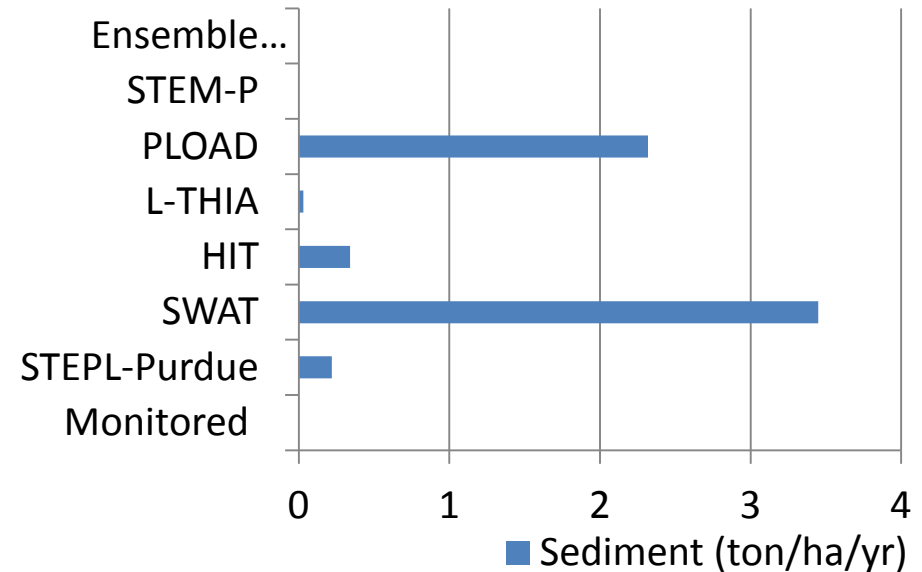
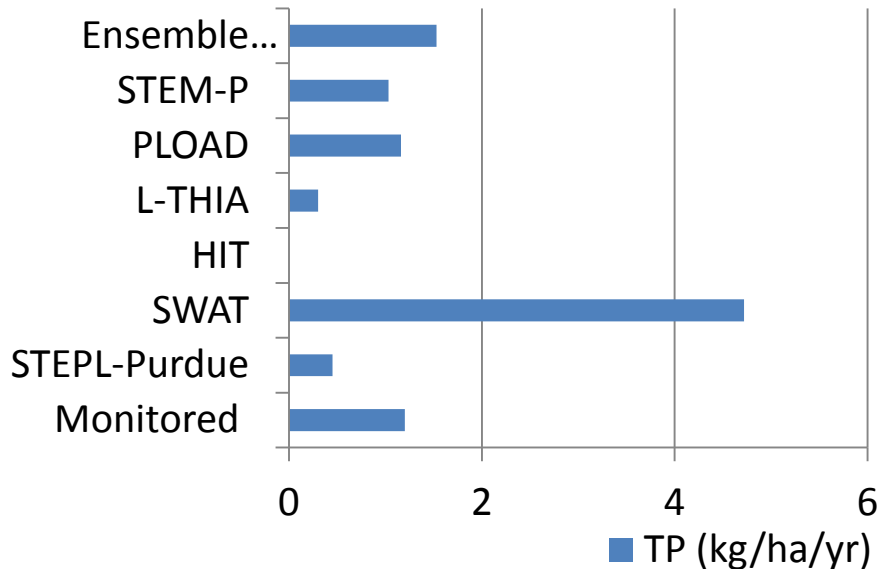
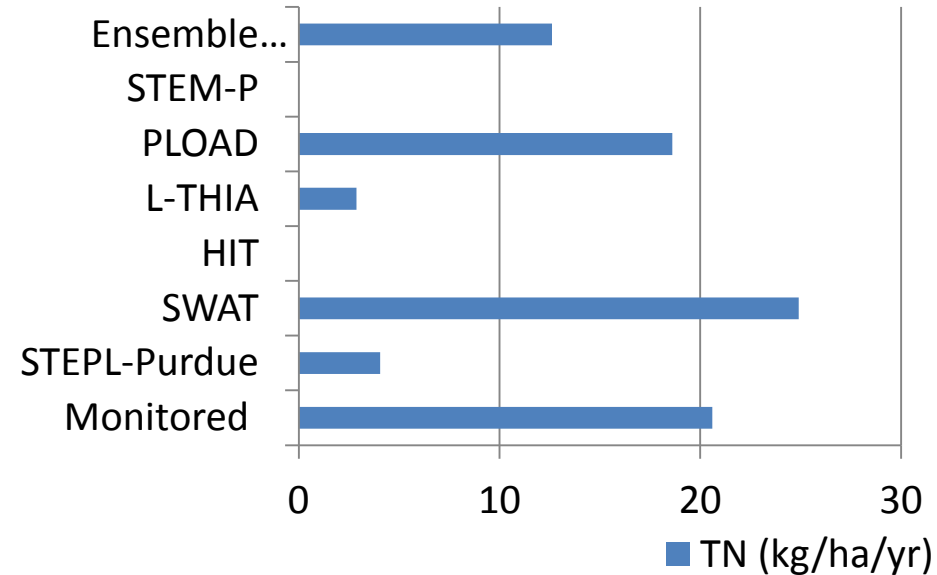
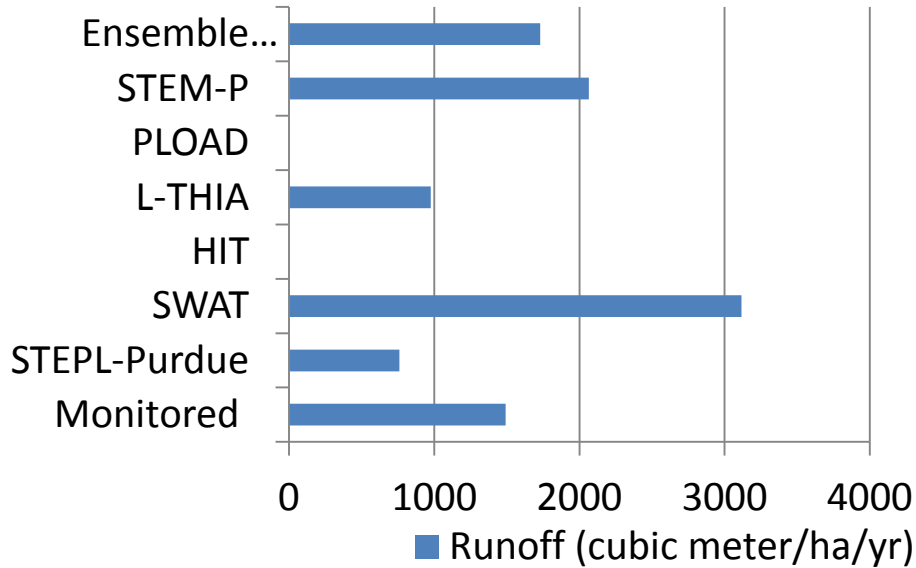
❑ Calibrated (2006-2009) and Validated (2010-2013)

- STEPL-Purdue, SWAT, L-THIA, STEM-P

❑ Simulated results compared with observed data

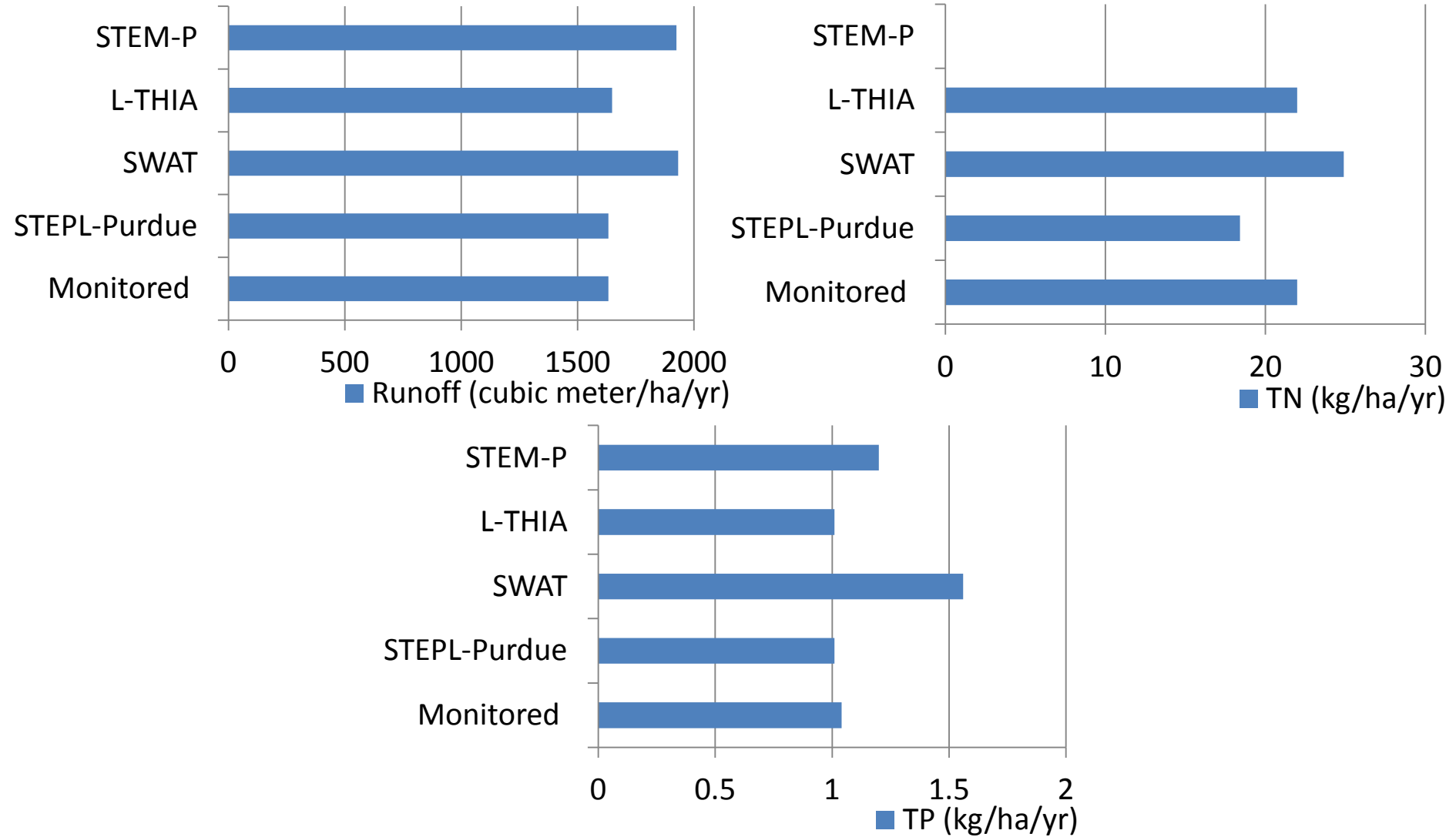
❑ Average annual runoff, TN, TP, sediment

5. Uncalibrated results comparison



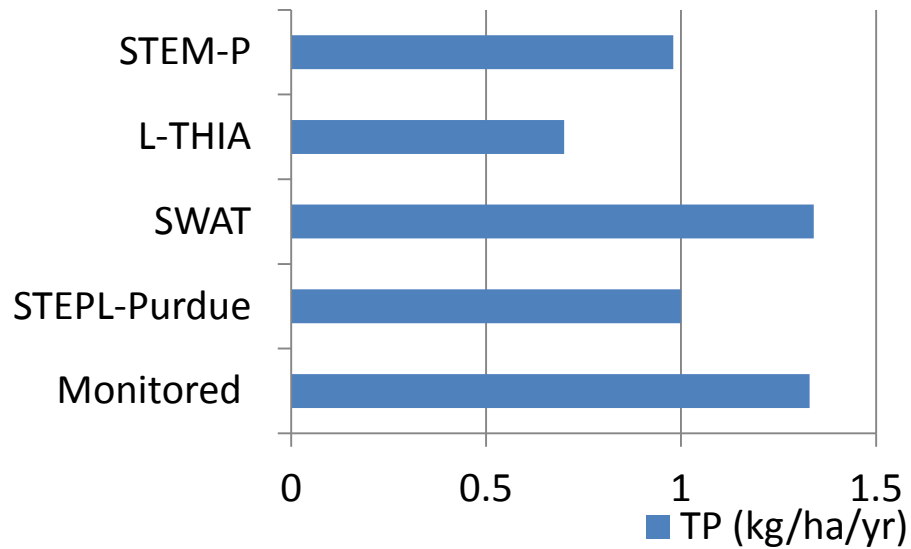
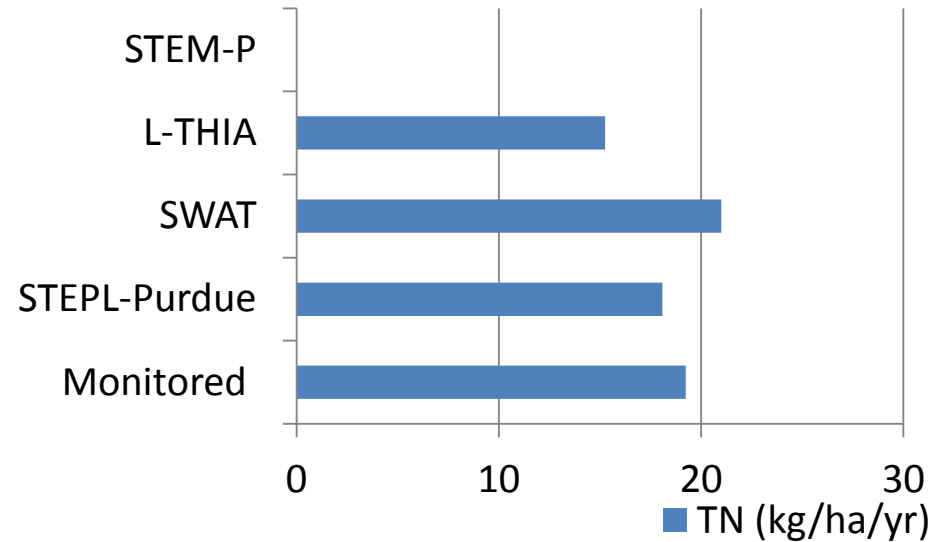
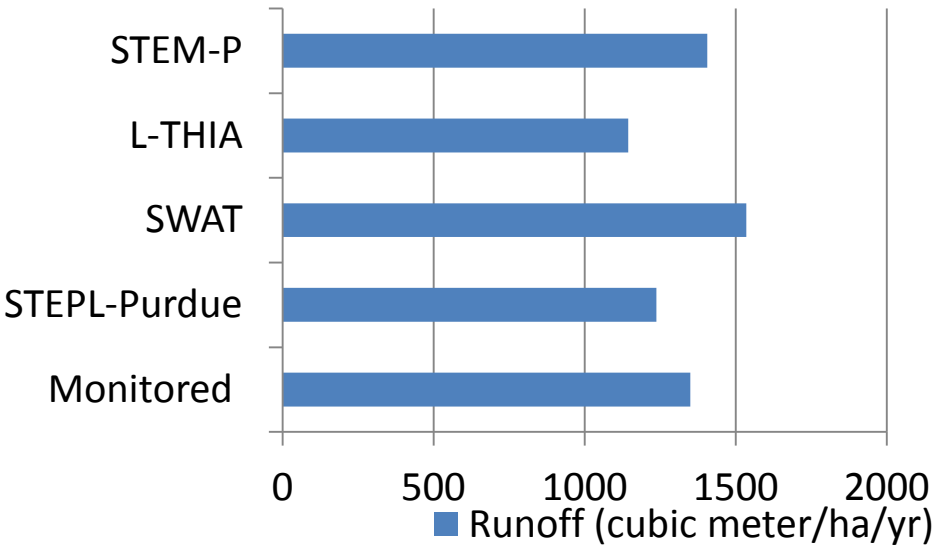
Uncalibrated results of models in simulating average annual runoff, nutrients, and sediment (2006-2013)

6. Calibrated results comparison



Calibrated results of models in simulating average annual runoff and nutrients (2006-2009)

7. Validated results comparison



Validated results of models in simulating average annual runoff and nutrients (2010-2013)

8. Model comparison and suggestions

Model capabilities

	STEPL-Purdue	SWAT	HIT	L-THIA	PLOAD	STEM-P	Region 5		
Land use	All	All	Agricultural	All	All	All	Agricultural, feedlots, urban		
Scale	Watershed-scale						Field-scale		
Streamflow	Average annual	Daily, monthly, yearly	No	No	No	Daily, monthly, yearly	No		
Baseflow				Annual				Average annual	No
Runoff									
TP									
TN									
Sediment			Average annual						
BOD									
Other Pollutants	No	No	No	No	No	Average annual			
BMP effectiveness	Yes	Yes	Yes	Yes	Yes	No	Yes		
BMP cost	Yes	No	Yes	Yes	No	No	No		

8. Model comparison and suggestions

❑ SWAT

- ✓ More comprehensively simulates watershed processes
- ✗ Complex model
- ✗ Requires extensive input data
- ✗ Time consuming and relatively more difficult to use

❑ STEPL-Purdue, HIT, L-THIA, PLOAD, STEM-P, and Region 5

- ✓ Simple models
- ✓ Minimum input data
- ✓ Less time consuming and easier to set up
- ✗ May misrepresent watershed processes and provide inaccurate results
- ✗ Default values of parameters may or may not match local reality

8. Model comparison and suggestions

- ❑ Uncalibrated PLOAD had good performance in AXL watershed - should be used with caution.
- ❑ Ensemble modeling—increase reliability of predictions when no monitored data are available.
- ❑ Models need to be selected carefully
 - Simulation purposes
 - Data availability
 - Model characteristics
 - Time constraints
 - Project budgets