

Modification & Application of SWAT to Landscapes with Subsurface Tiles and Enclosed Depressions (Potholes) as Applied to Walnut Creek watershed, IA

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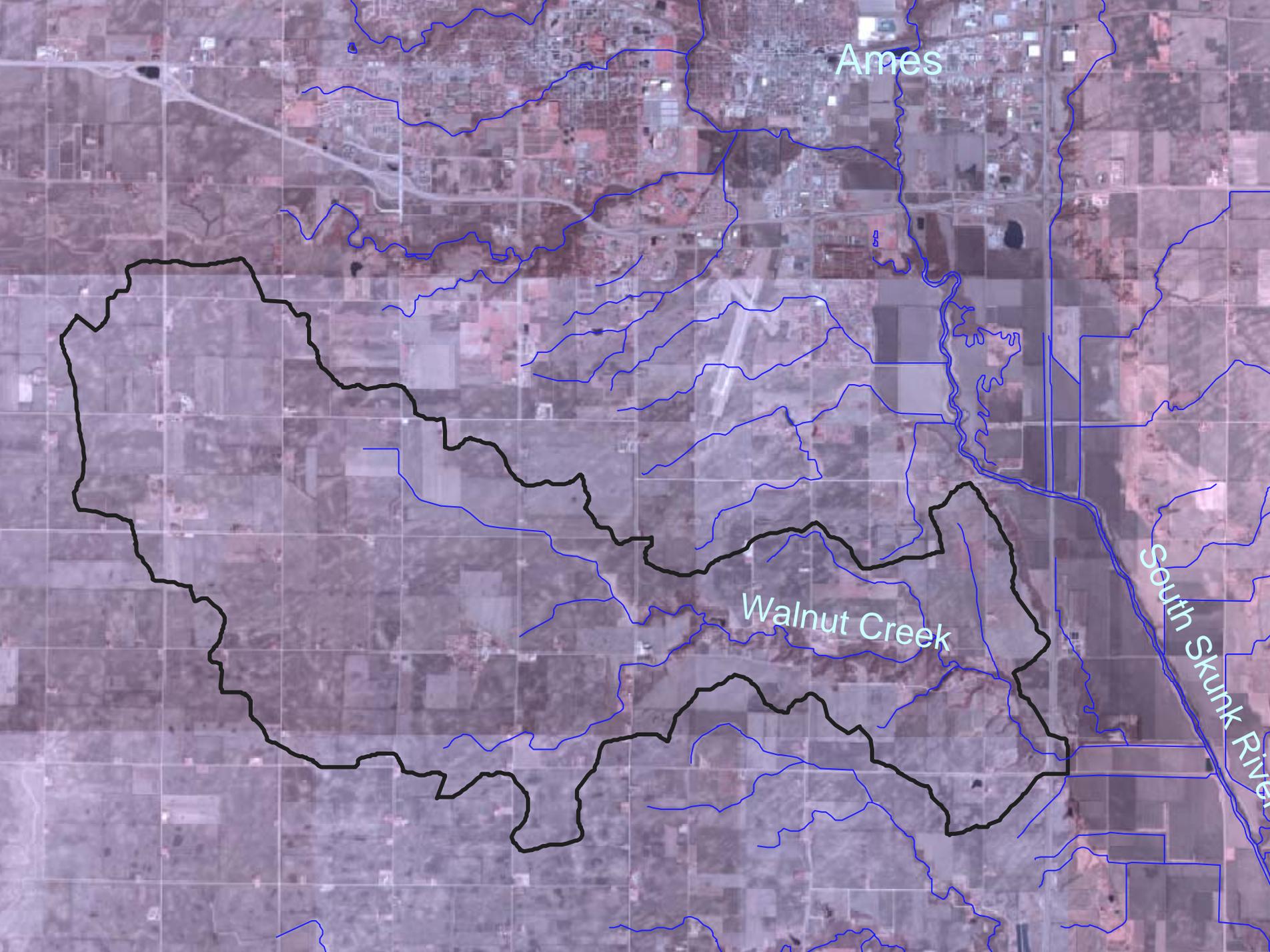
Ali Saleh, TIAER

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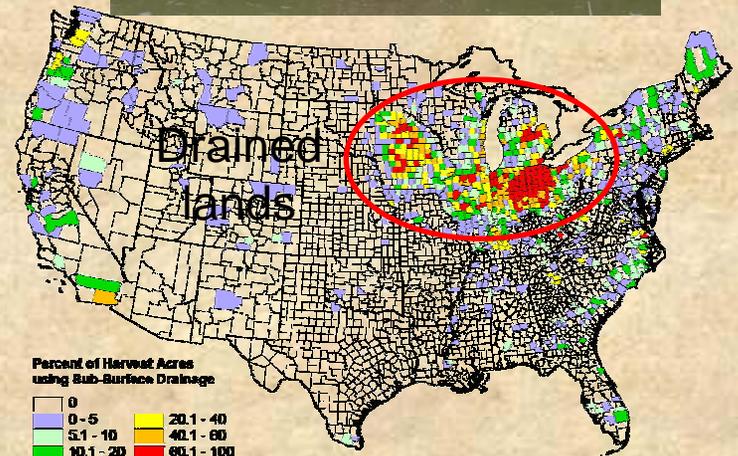
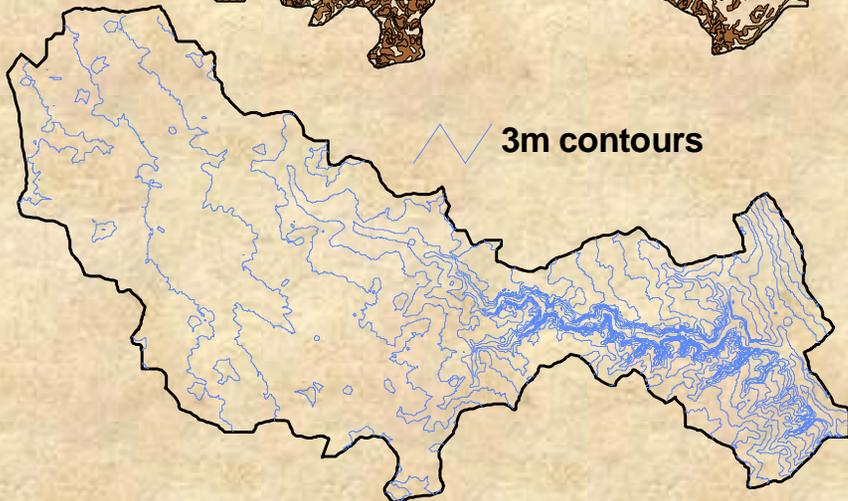
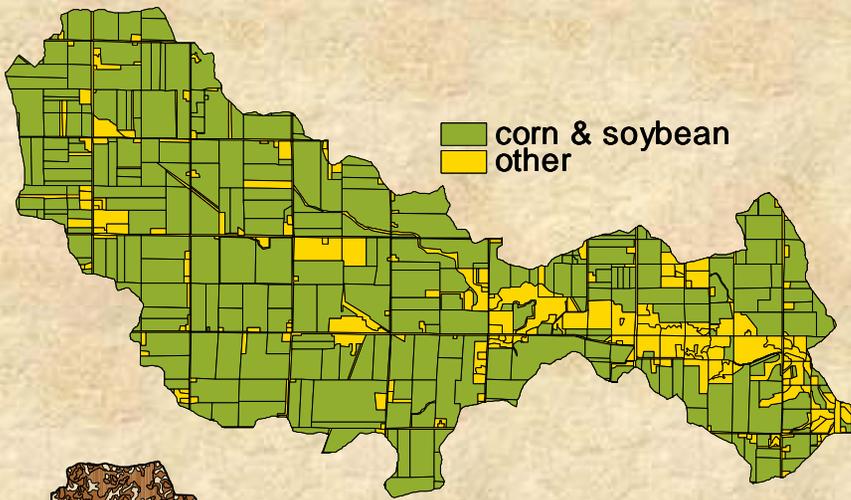




Ames

Walnut Creek

South Skunk River



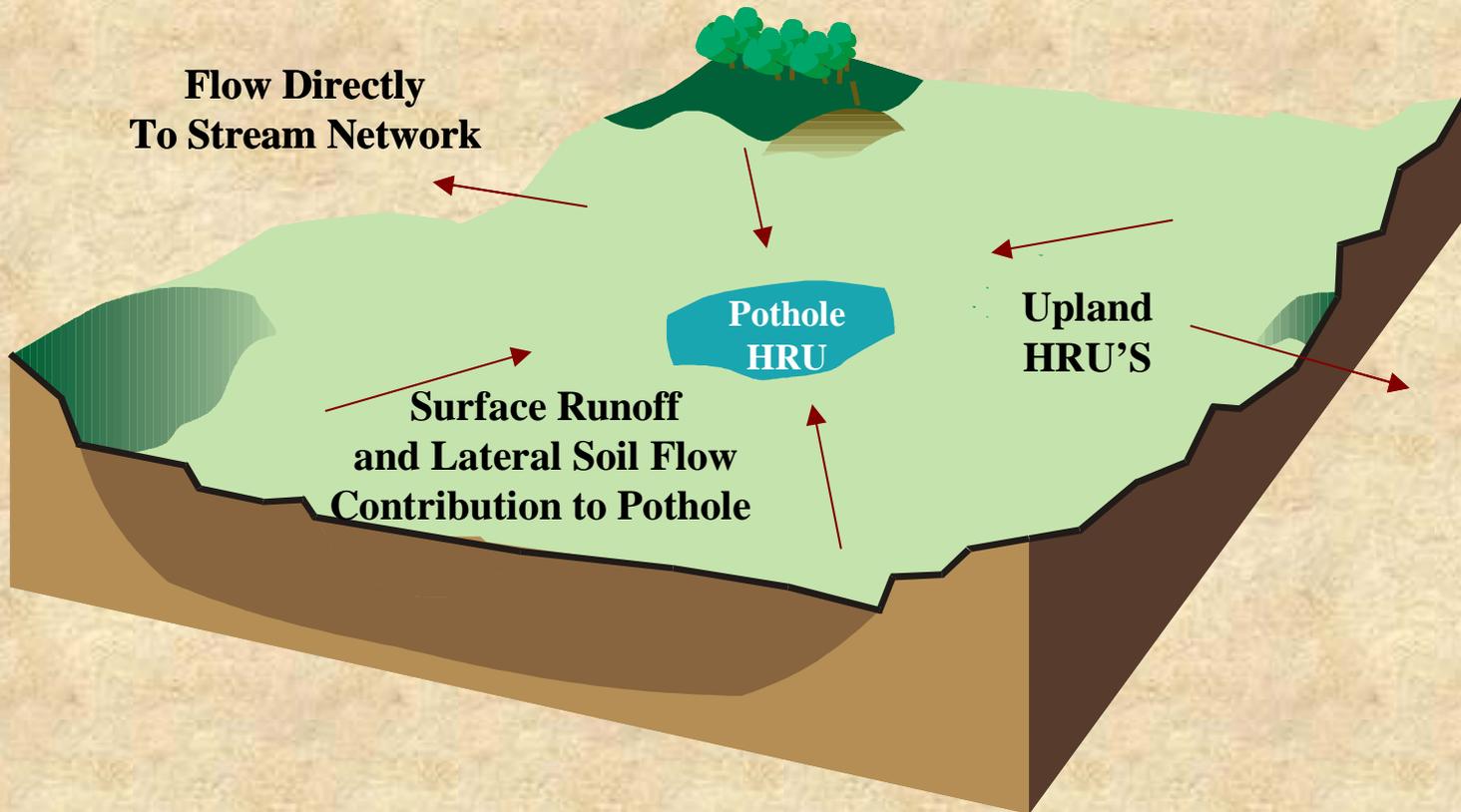
Source: 1992 NRC, 1992 Census of Agriculture

Objectives

- To modify SWAT to better simulate watersheds with tile drains and surface pothole physiography
- To evaluate the modified SWAT (SWAT-M) using 10 yr (1992 to 2001) of measured flow, NO_3 and atrazine data at Walnut Creek watershed, IA
- To use SWAT-M to evaluate selected management practices (MPs) for reducing NO_3 concentrations in WC
- To evaluate the economic impacts of the selected MPs at various adoption levels in WCW

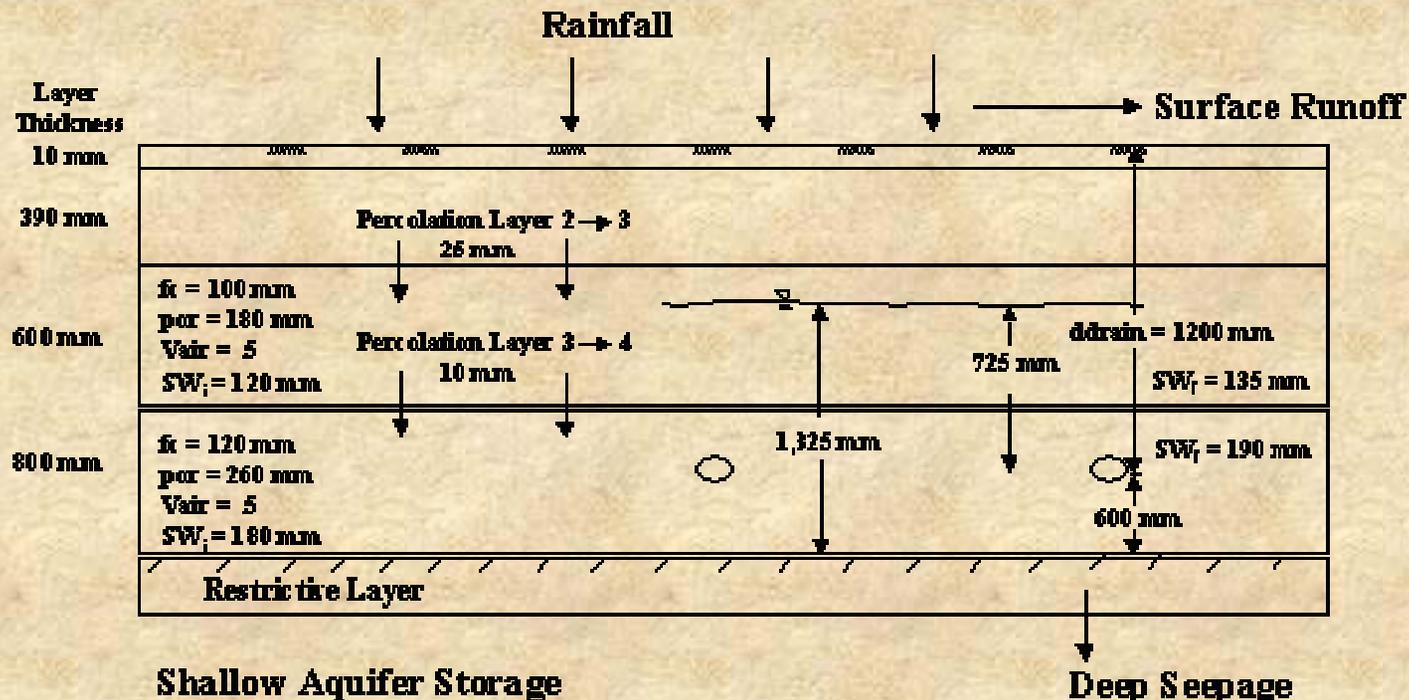
SWAT Modifications

- Depression storage water balance was modified
- Pothole/HRU orientation



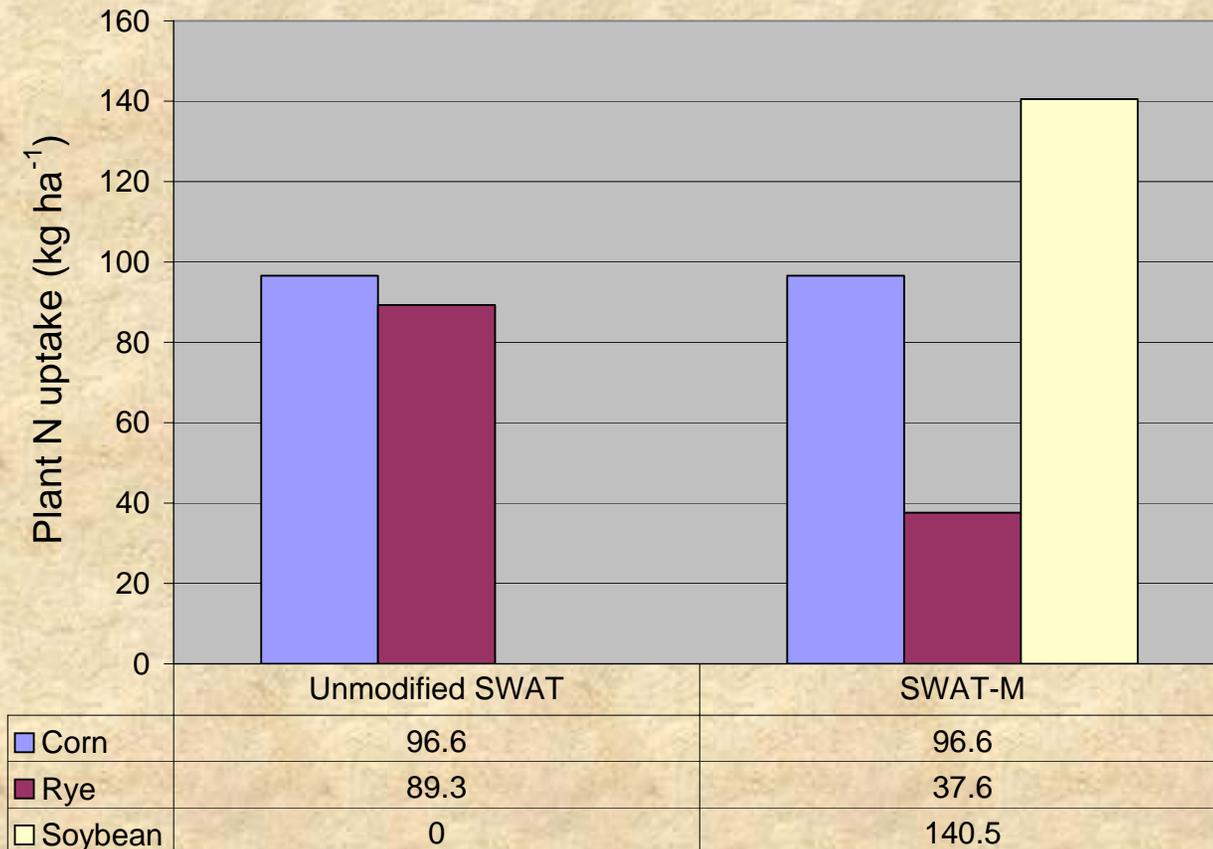
SWAT-M Modifications

- Restrictive soil layer
- Soil profile saturation pattern
- Dynamic water table depth



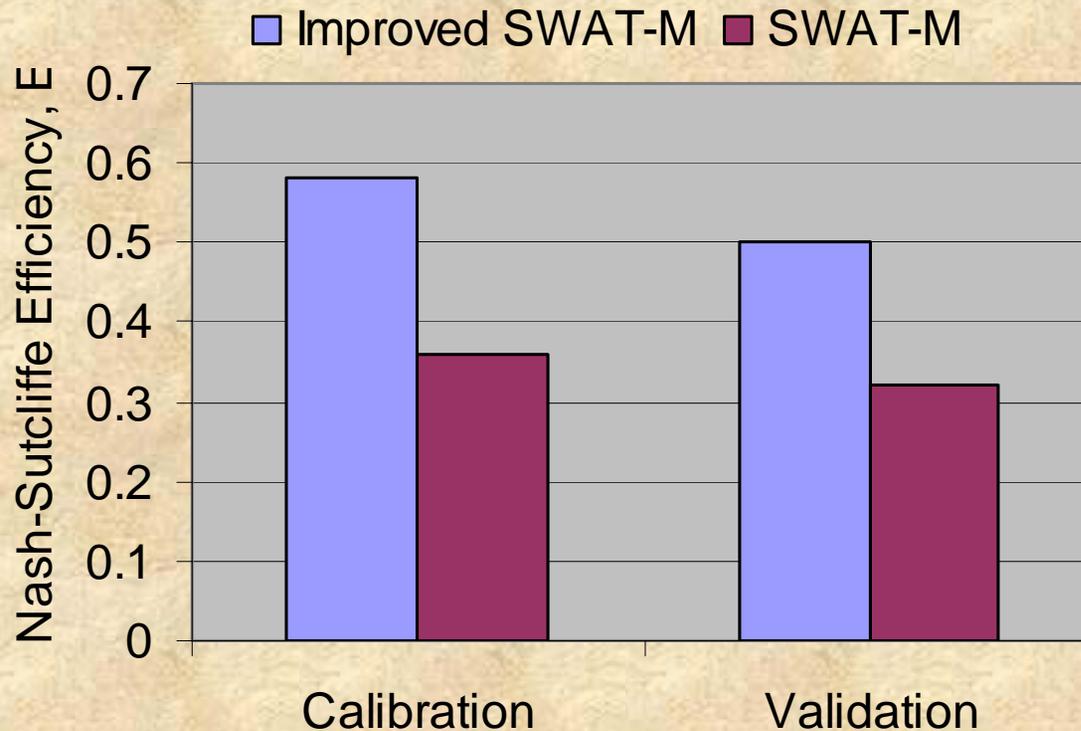
SWAT-M Modifications

- Chemical burn-down of fall cover crop

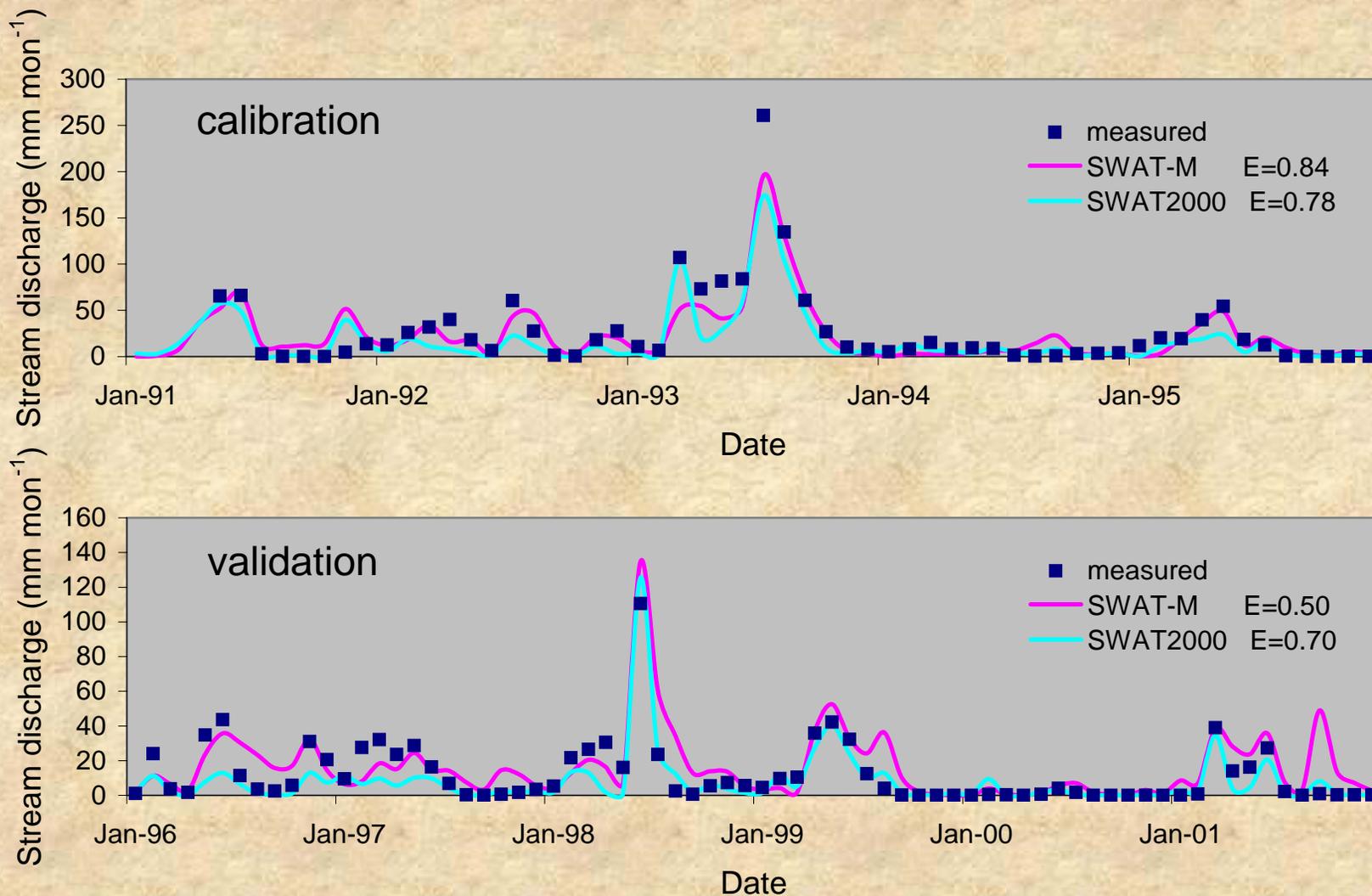


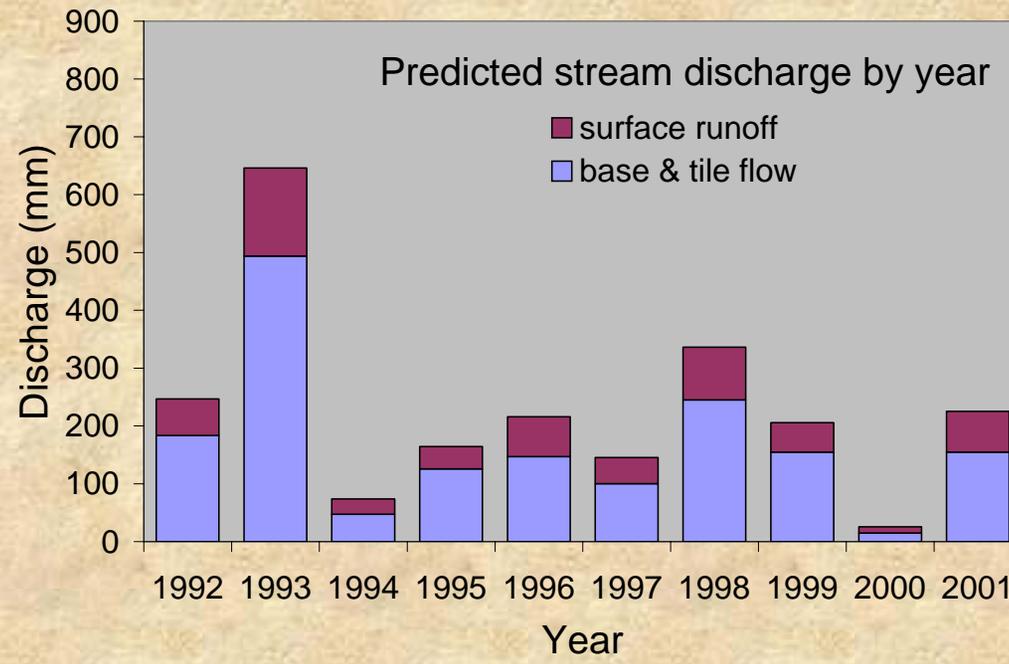
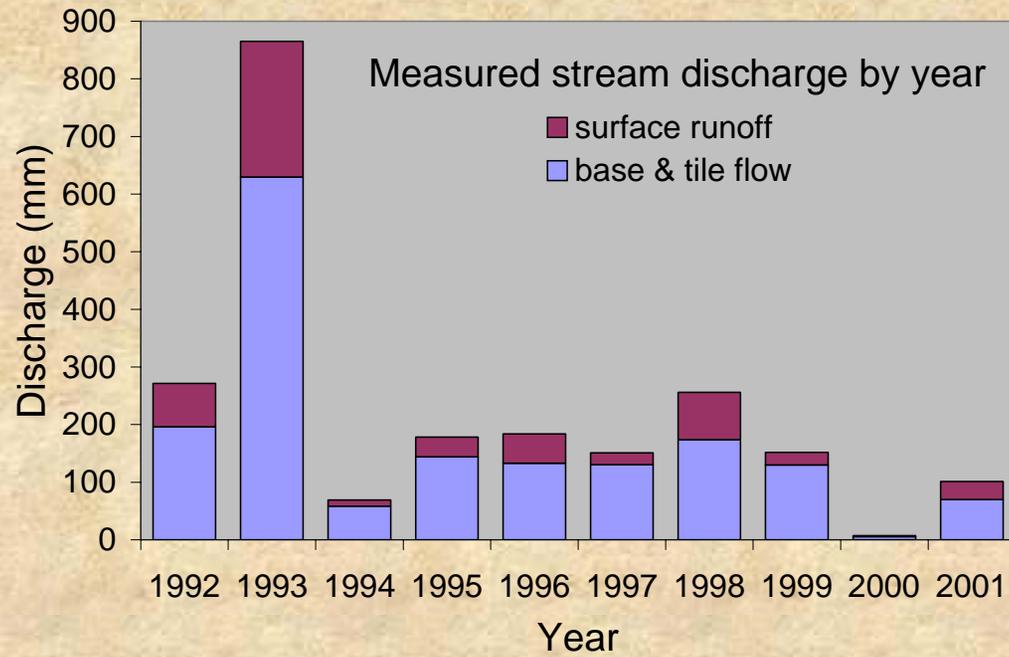
SWAT-M Modifications

- A longer pesticide half-life for subsoil layers

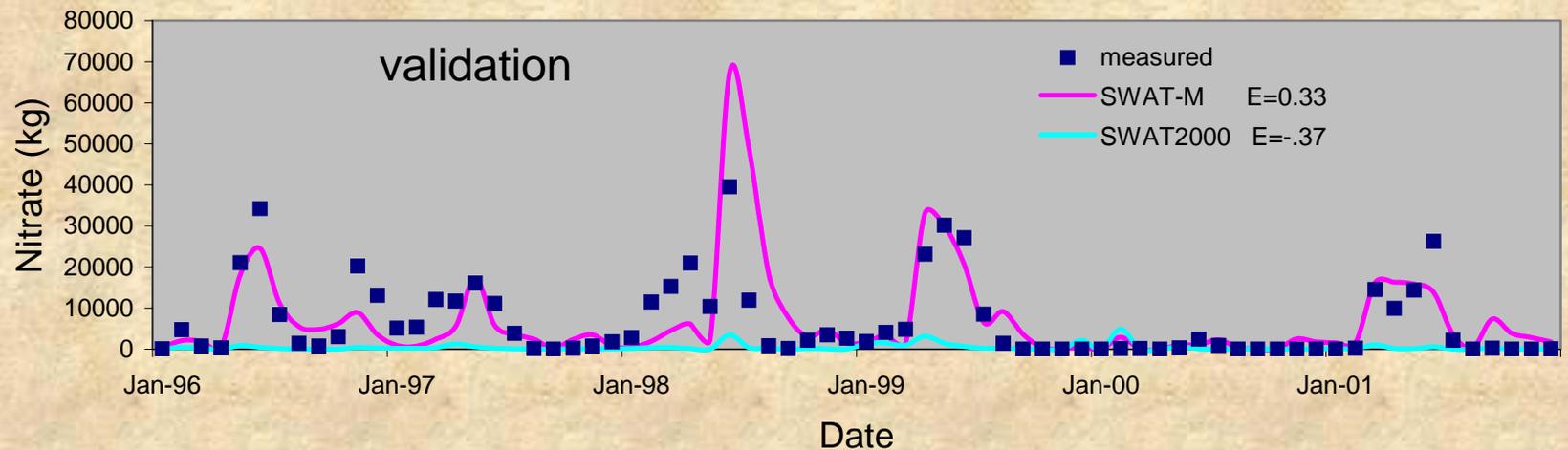
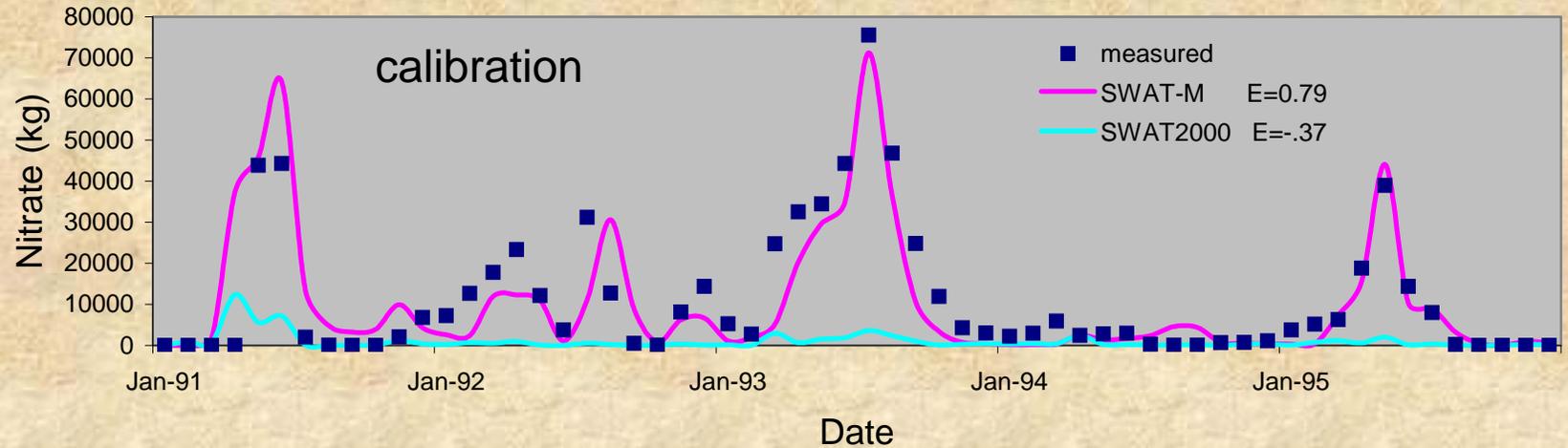


Measured and simulated monthly *flows* during calibration and validation periods at the outlet of WCW

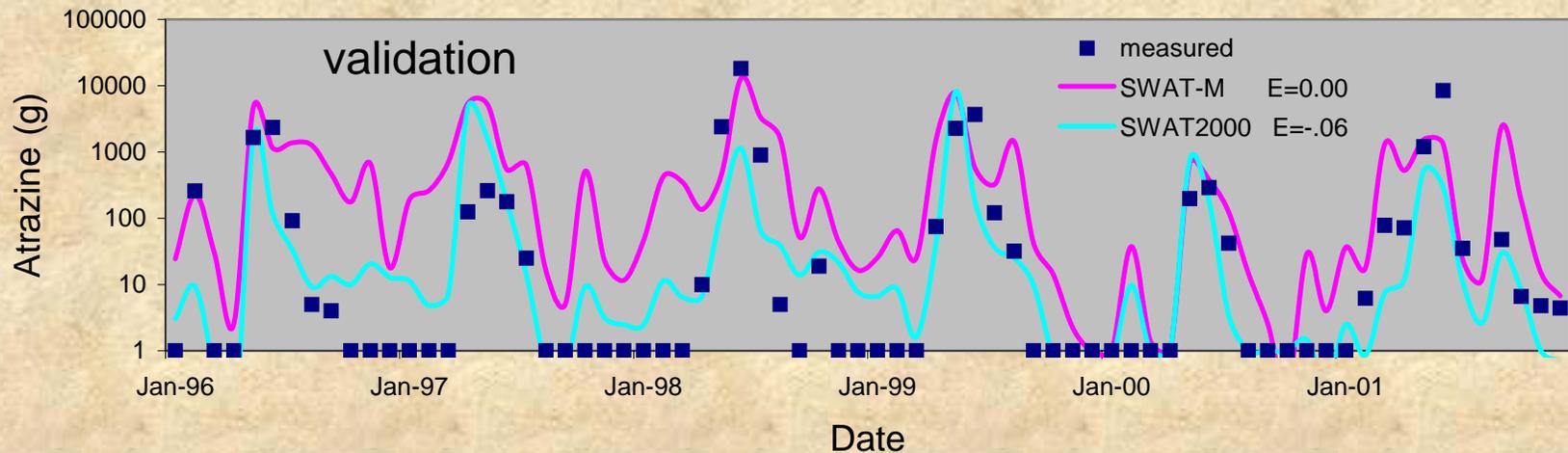
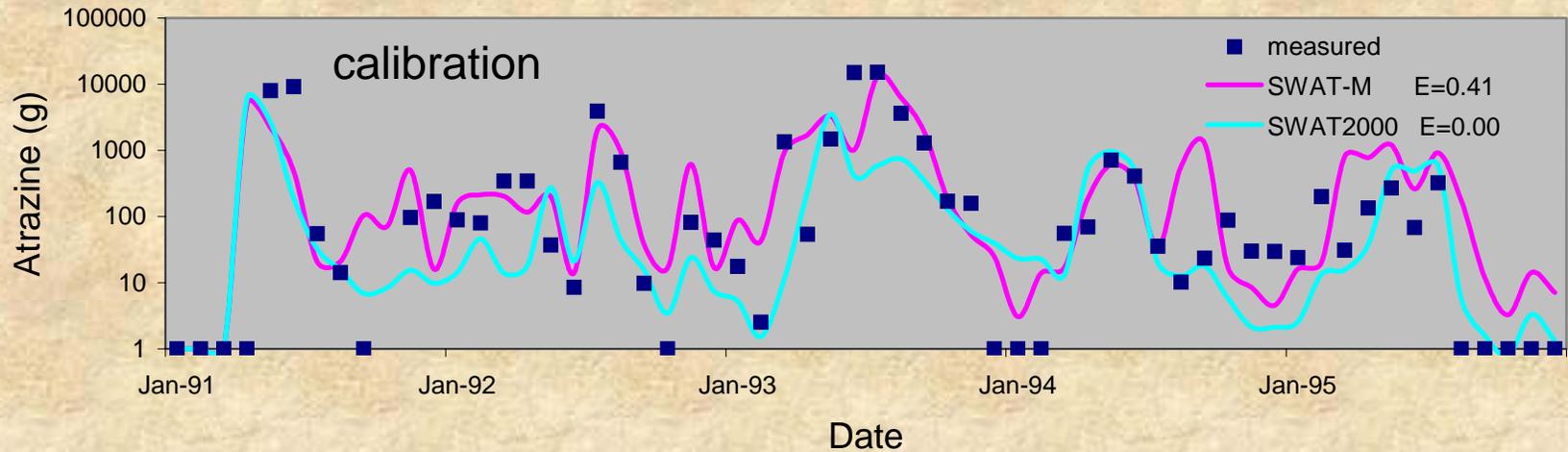




Measured and simulated monthly NO_3-N loads during calibration and validation periods at the outlet of WCW



Measured and simulated monthly *atrazine loads* during calibration and validation periods at the outlet of WCW



Spatial Scale

Drainage District Drain 210

	SWAT-M				SWAT 2000			
	E		%RME		E		%RME	
	Cal.	Val.	Cal.	Val.	Cal.	Val.	Cal.	Val.
Discharge	0.43	0.40	-12	-10	-.78	-.25	-23	-41
NO ₃ load	0.25	0.42	13	-17	-.60	-.16	-95	-96
Atrazine load	0.51	0.09	6	-44	-.47	-.46	-97	-67

Mid-watershed

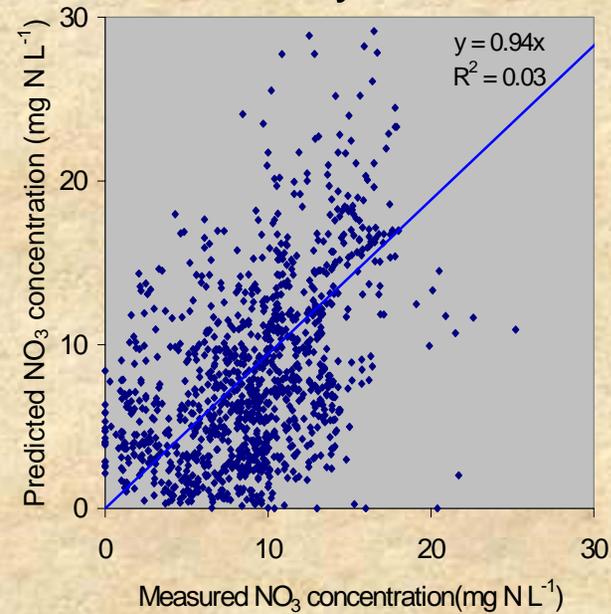
	SWAT-M				SWAT 2000			
	E		%RME		E		%RME	
	Cal.	Val.	Cal.	Val.	Cal.	Val.	Cal.	Val.
Discharge	0.69	0.66	-11	4	0.58	0.59	-38	-47
NO ₃ load	0.61	0.41	-8	0	-.37	-.14	-95	-95
Atrazine load	0.47	0.12	-34	-34	-.05	-.02	-93	-77

Temporal Scale

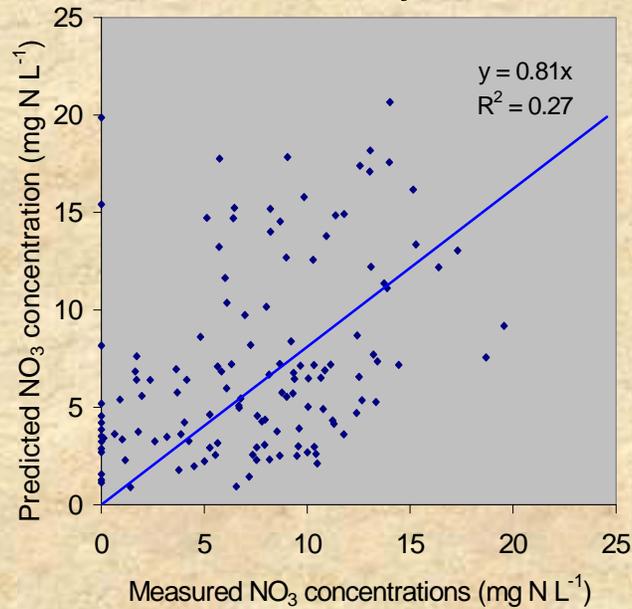
	Daily comparison				Monthly comparison				Yearly comparison			
	E		%RME		E		%RME		E		%RME	
	Cal.	Val.	Cal.	Val.	Cal.	Val.	Cal.	Val.	Cal.	Val.	Cal.	Val.
Discharge	0.63	0.86	-18	-18	0.86	0.50	-18	35	0.87	0.26	17	-35
NO ₃ load	0.53	0.26	-25	8	0.79	0.33	-25	7	0.77	0.62	21	-8
Atrazine load	0.21	0.21	-28	29	0.50	0.49	-13	-53	0.88	0.22	10	-48

Predicted vs. measured daily NO₃ concentration

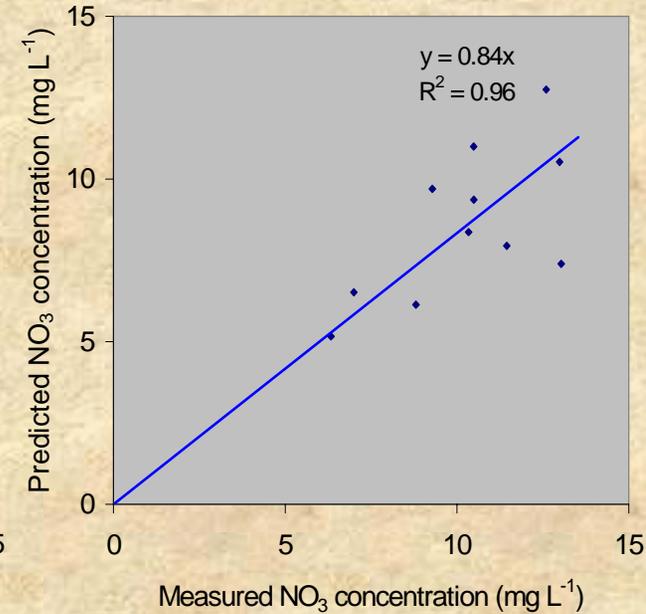
Daily data



Monthly data



Yearly data



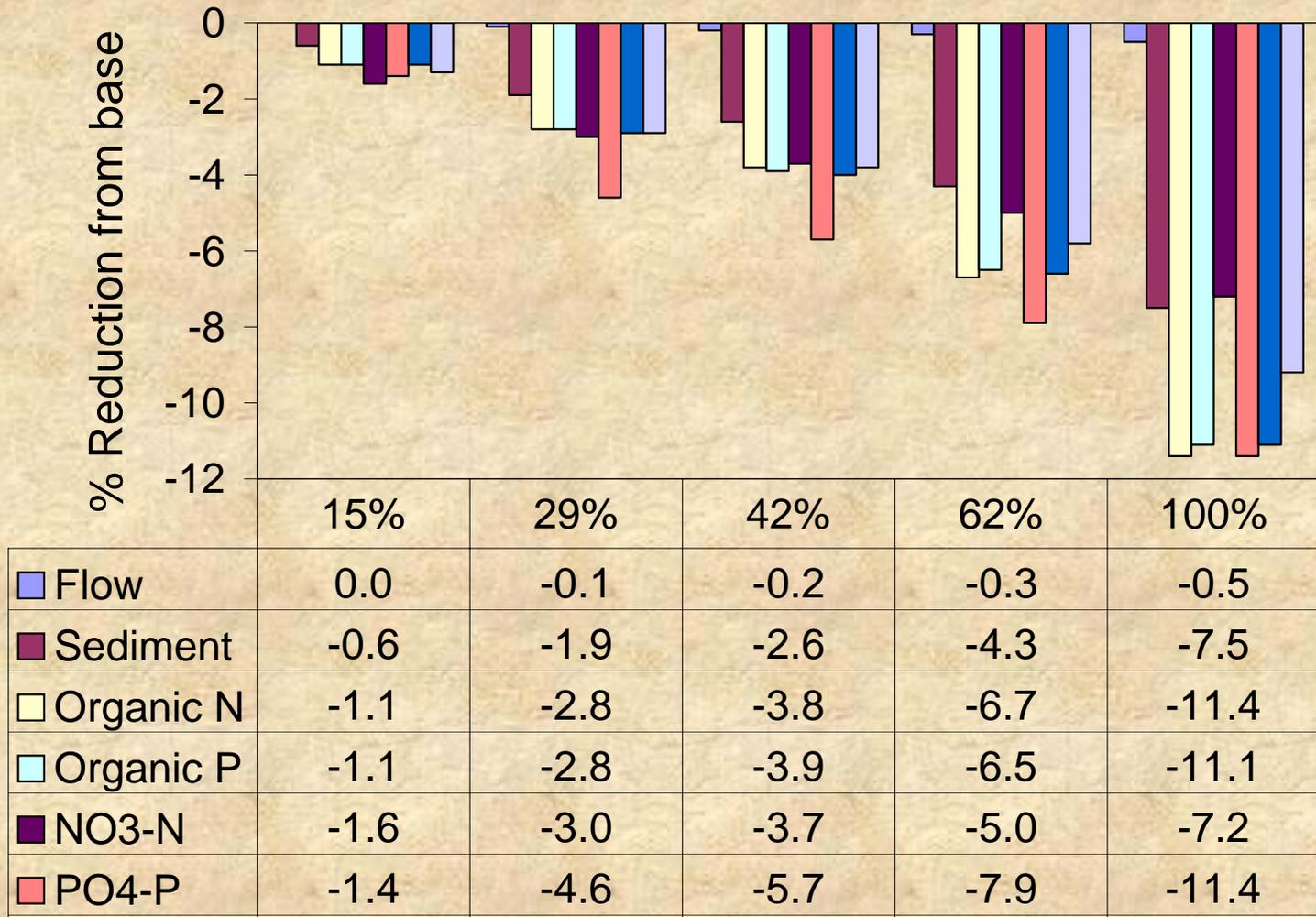
SWAT-M Scenario Simulations

- Spring soil test & sidedress (LSNT) vs. fall NH_3
- Fall rye cover crop after corn and corn/soybean

FEM Scenario Simulations

- Two sets of simulations performed to indicate impact of time horizon:
 - 10-year simulation
 - 30-year simulation

Water quality changes due to variable adoption rates of a winter cover crop (rye) after corn



Economics of rye after corn, \$ ha⁻¹ yr⁻¹

		LSNT	CC after corn	CC every year	LSNT & CC
Farmer Operator	Fixed costs	0.67	12.28	18.54	19.19
	Variable costs	6.08	21.40	33.70	39.73
	Price/kg NO ₃ removed	1.09	23.39	14.04	7.19
Custom Operator	Fixed costs	0.00	0.00	0.00	0.00
	Variable costs	5.01	31.03	50.19	55.20
	Price/kg NO ₃ removed	0.81	21.55	13.49	6.73

Summary (1 of 2)

- Substantial modifications to SWAT were required to simulate an intensively drained watershed
- We were able fit SWAT-M to observed flow, NO_3 , and atrazine loads, especially at monthly and yearly timescales
- Predicted daily NO_3 and atrazine concentrations were not satisfactory
- Further refinements of the model coefficients are needed

Summary (2 of 2)

- We have successfully modeled the impact of a LSNT treatment experiment carried out on one of the subbasins (not presented)
- We are starting to compute the economic and water quality benefits of selected management practices for controlling NO_3 losses in the watershed
- These efforts have been summarized in 3 published journal papers, 2 papers submitted to journals, and 6 conference papers
- Model modifications incorporated into latest version of SWAT