Uncertainty assessment of climate and land use changes scenarios for the Millbrook catchment - reservoir system simulated by the SWAT-SALMO

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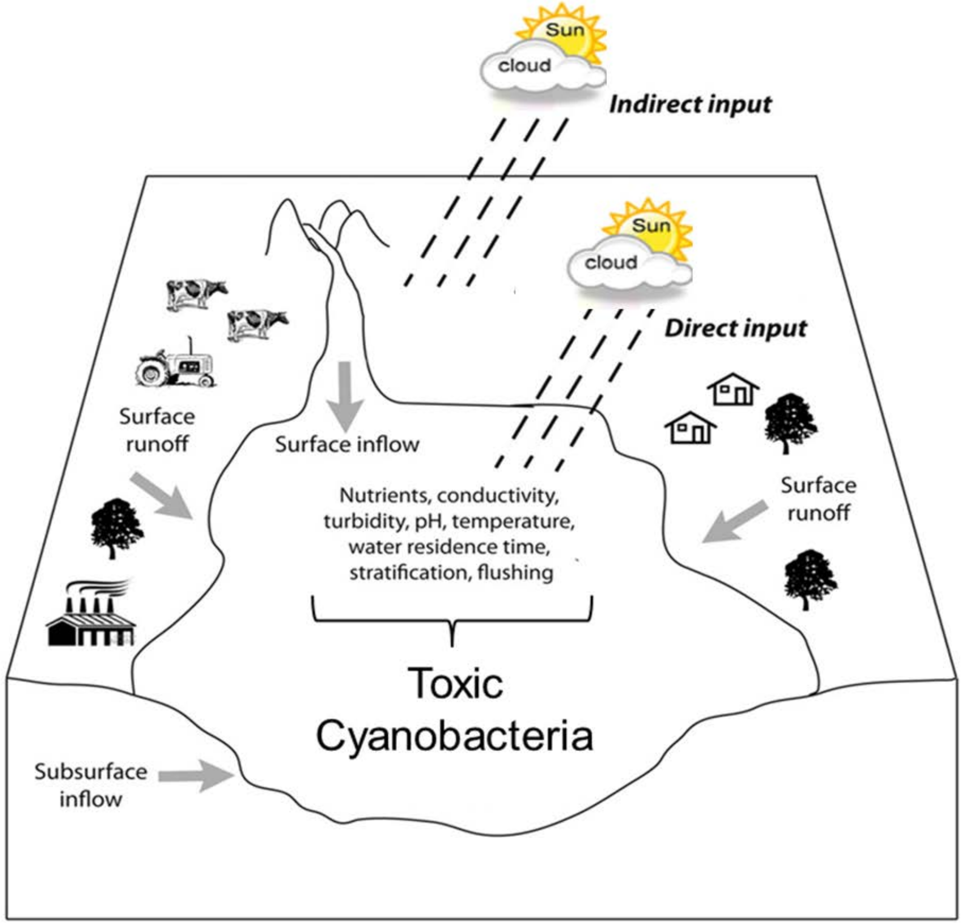
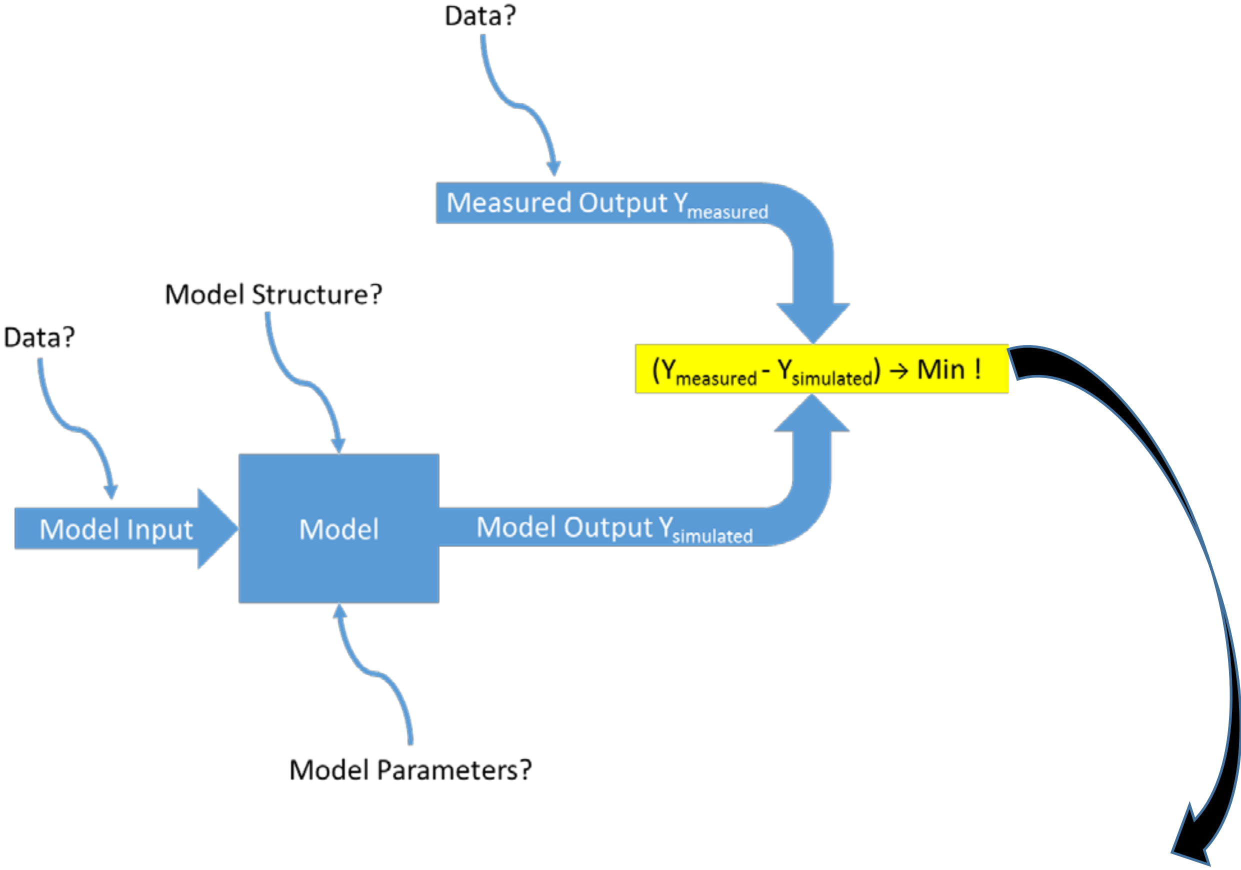
BACKGROUND



Millbrook catchment - reservoir



Model uncertainty is low:

- the more realistic model structures are
- the more accurate measured input and output data
- the more accurate calibrated parameters are.

STUDY DESIGN

Step 1. SWAT model calibration

Step 2. SALMO lake calibration

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ELSEVIER

Research article

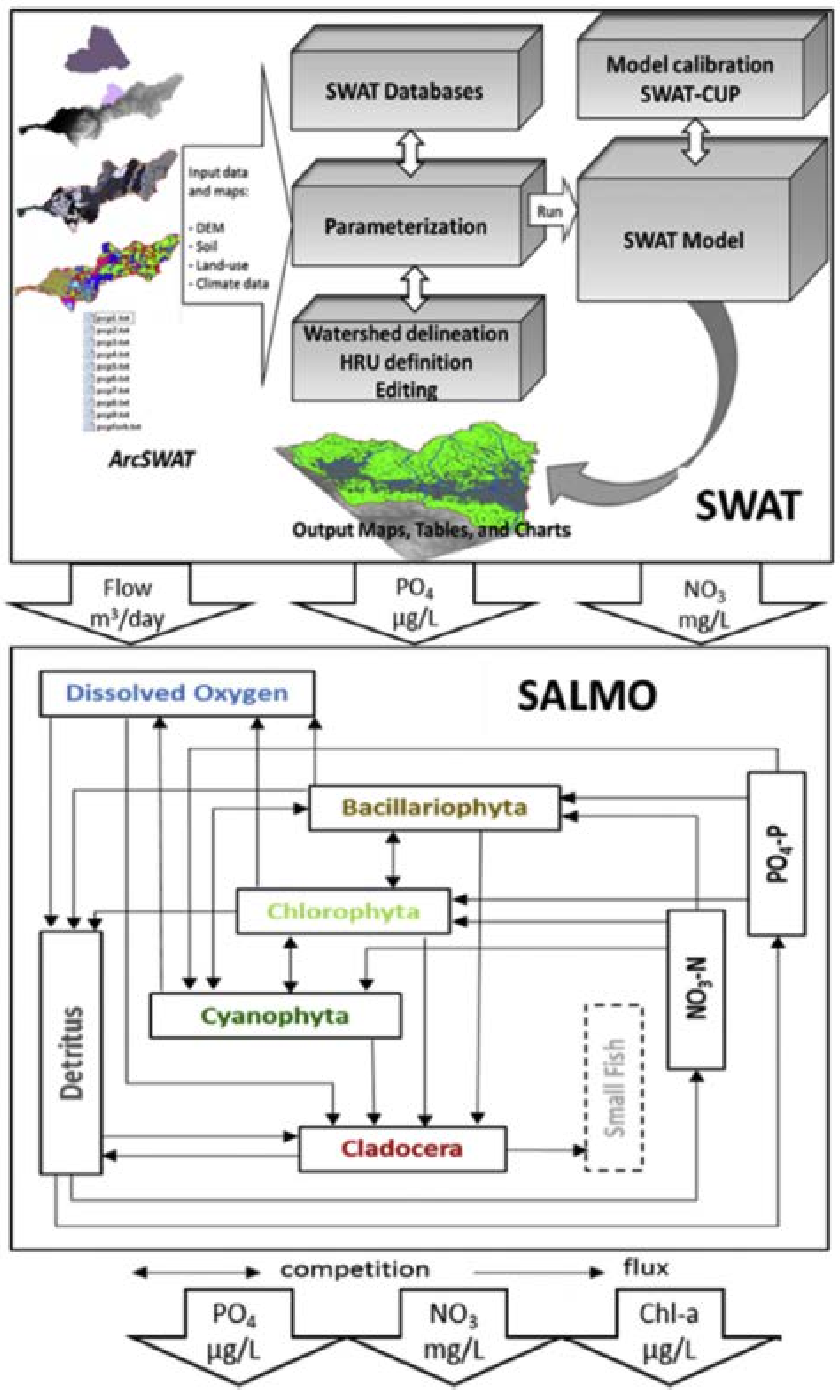
Modelling the impacts of altered management practices, land use and climate changes on the water quality of the Millbrook catchment-reservoir system in South Australia

CrossMark

Step 3. Uncertainty estimation

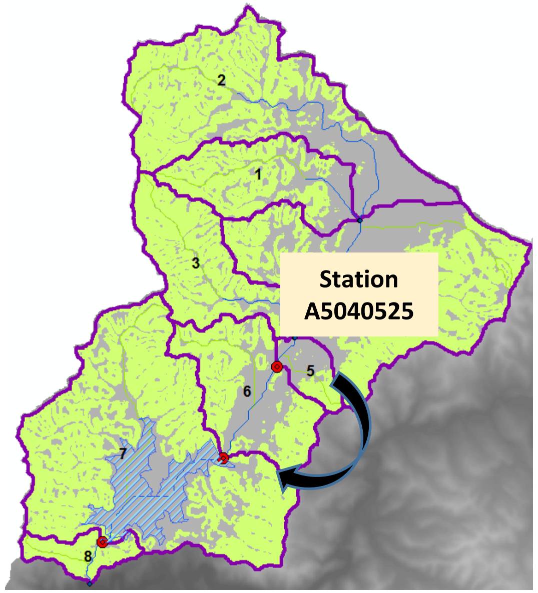
- Uncertainty from catchment model
- Uncertainty from lake model
- Uncertainty from catchment-lake models

Step 4. Scenario analysis

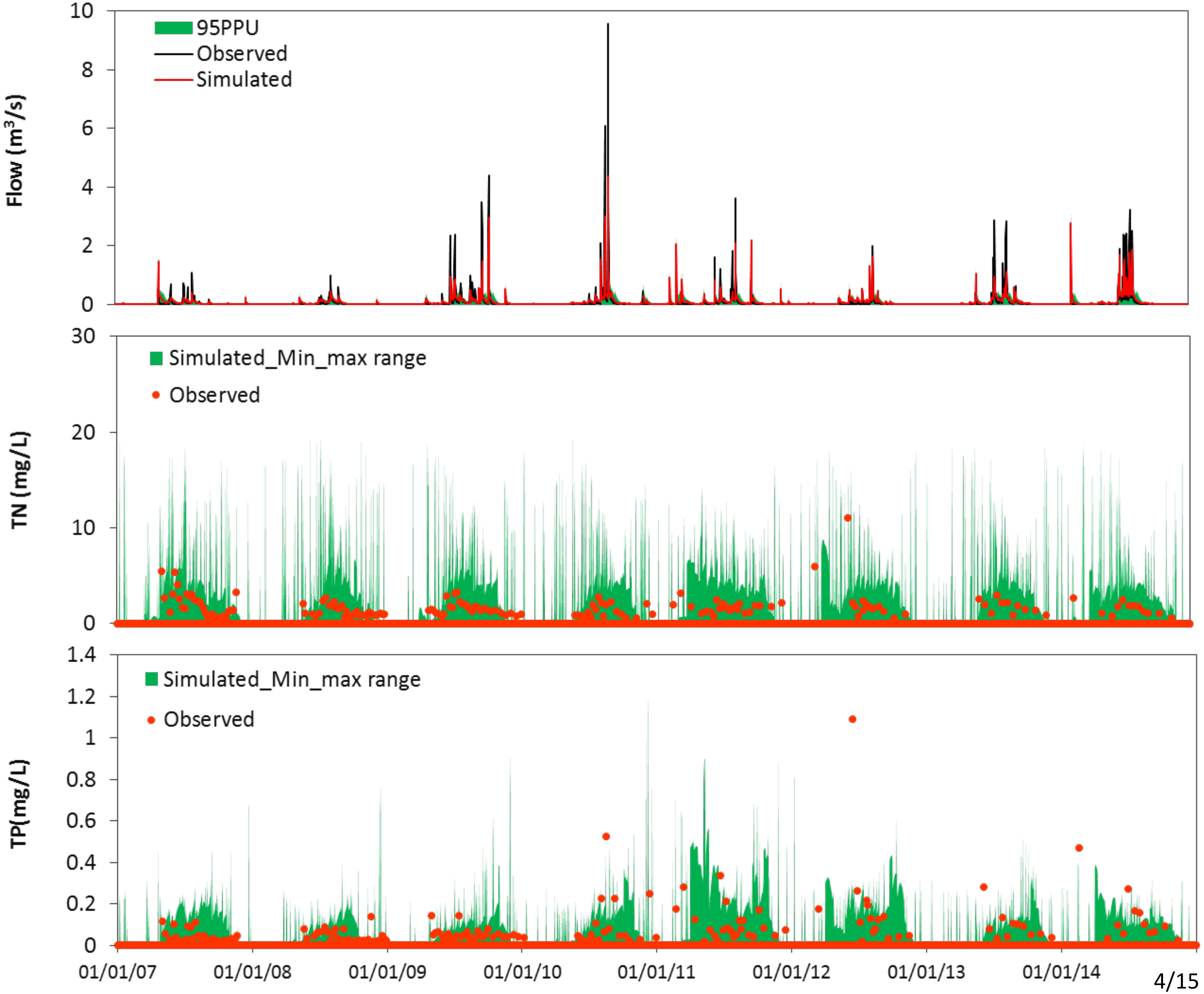


SWAT MODEL CALIBRATION

Near inlet of Millbrook
(Outlet sub-basin 6)

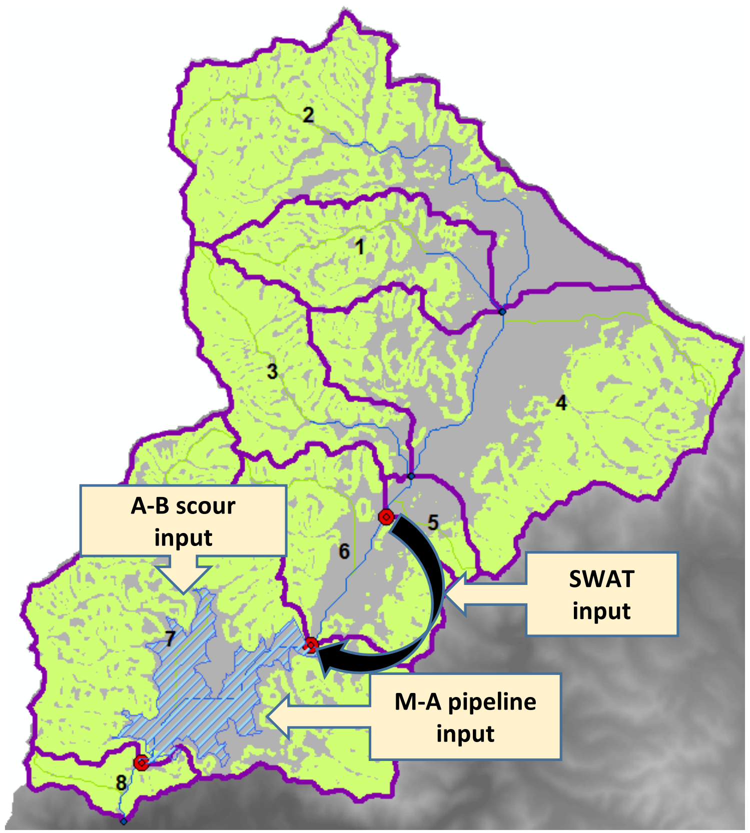


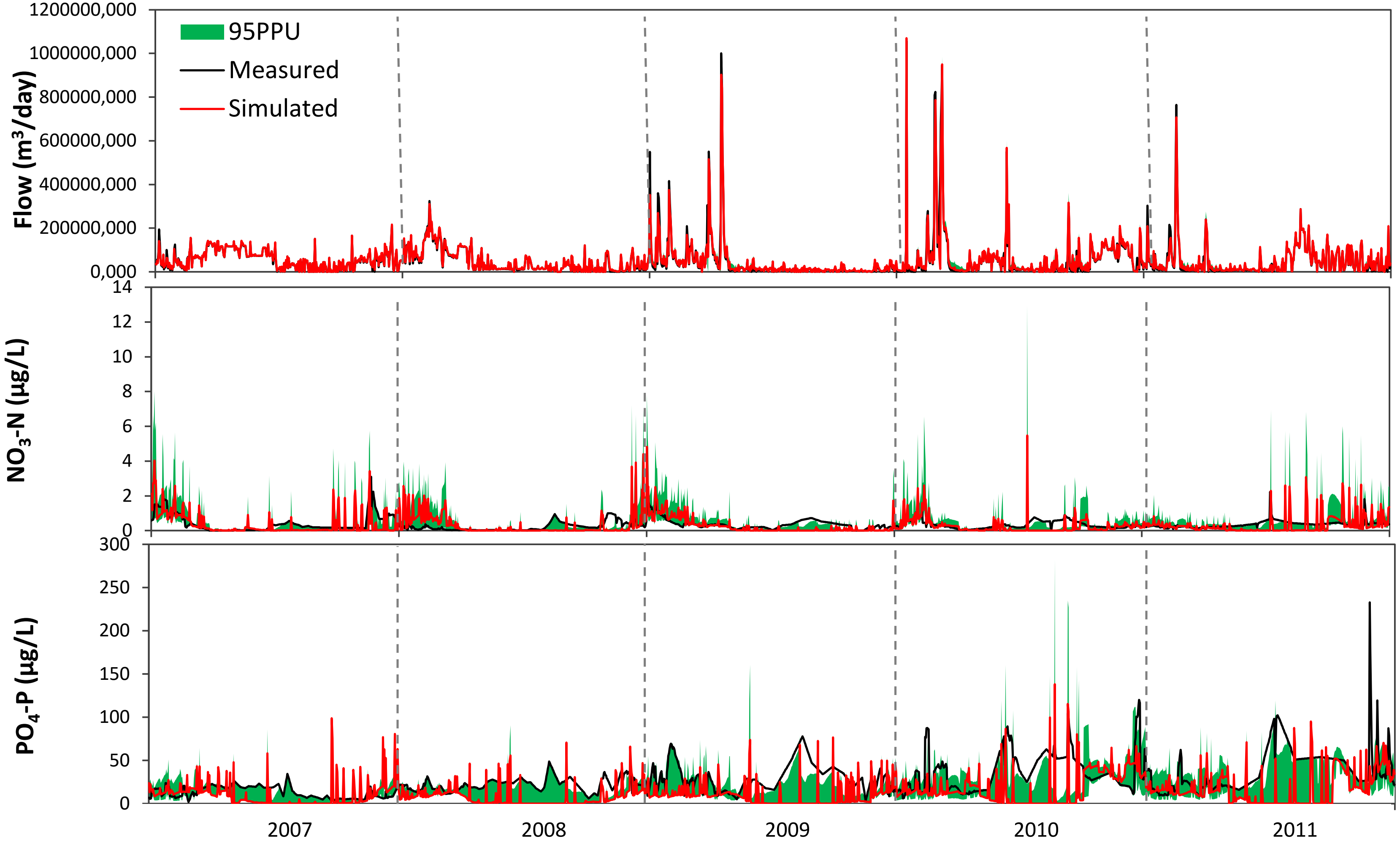
	Flow		TN load		TP load	
	Calibration	Validation	Calibration	Validation	Calibration	Validation
p factor	0.21	0.14	0.22	0.12	0.22	0.16
r factor	0.41	0.53	0.63	0.72	0.19	0.64
R^2	0.63	0.7	0.56	0.62	0.41	0.58
NS	0.61	0.67	0.55	0.61	0.41	0.58
PBIAS	-8.3	-16.0	-19.4	-34.0	10.3	14.6



SALMO INPUT PREPARATION

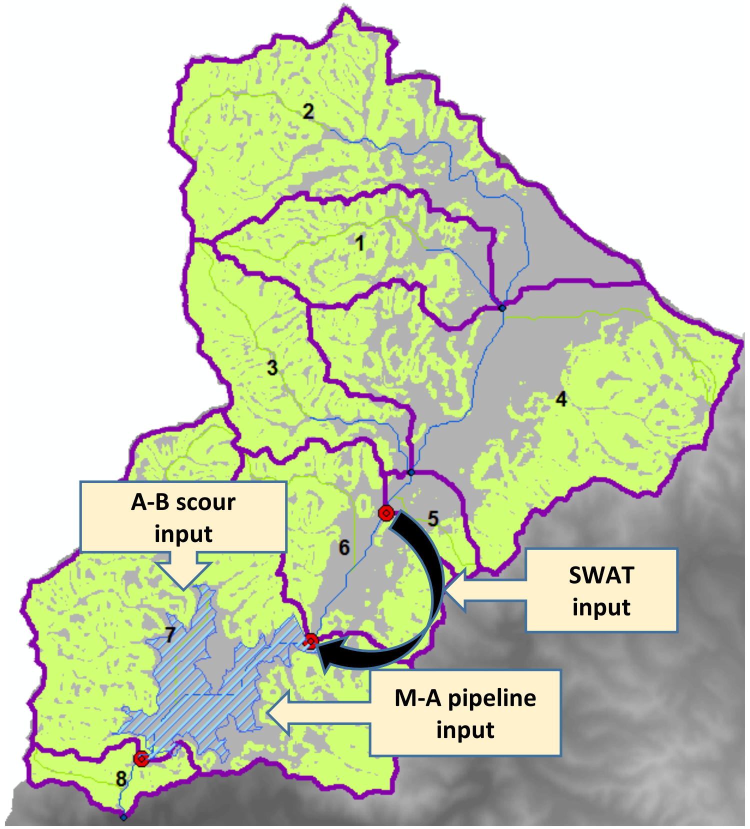
SALMO model inputs





SALMO INPUT PREPARATION

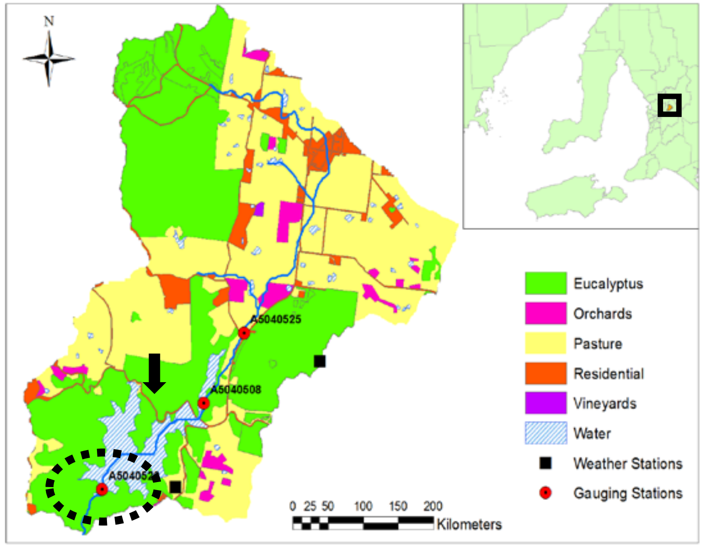
SALMO inputs

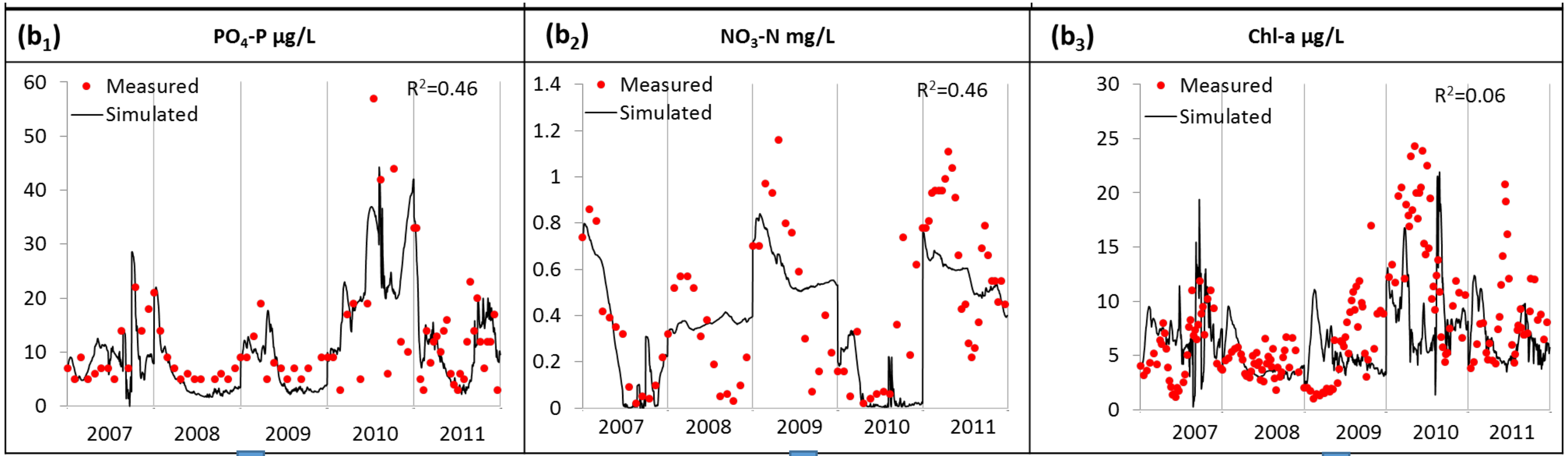


SWAT input	Qin			PO_4-P in			NO_3-N in		
	R^2	NSE	PBIAS	R^2	NSE	PBIAS	R^2	NSE	PBIAS
Model 1	0.95	0.95	-0.90	0.00	-1.20	54.41	0.11	-1.79	12.04
Model 2	0.95	0.95	-3.91	0.35	0.23	21.46	0.50	0.41	20.25
Model 3	0.93	0.93	-4.55	0.33	0.25	16.01	0.50	0.41	23.78
Model 4	0.93	0.93	-2.34	0.42	0.33	21.19	0.47	0.40	17.40
Model 5	0.94	0.94	-1.07	0.36	0.29	16.84	0.51	0.41	24.60
Model 6	0.94	0.94	-1.99	0.20	-0.19	4.26	0.38	-1.40	-26.58
Model 7	0.93	0.92	-4.04	0.34	0.07	36.11	0.43	0.24	18.38
Model 8	0.94	0.94	-4.42	0.00	-1.24	47.29	0.11	-10.49	-91.56
Model 9	0.96	0.95	-3.32	0.41	0.24	28.49	0.32	-4.21	-53.99
Model 10	0.92	0.92	-4.59	0.32	-0.01	39.49	0.28	-4.54	-50.06
Min	0.92	0.92	-4.59	0.00	-1.24	4.26	0.11	-10.49	-91.56
Max	0.96	0.95	-0.90	0.42	0.33	54.41	0.51	0.41	24.60

SALMO MODEL CALIBRATION

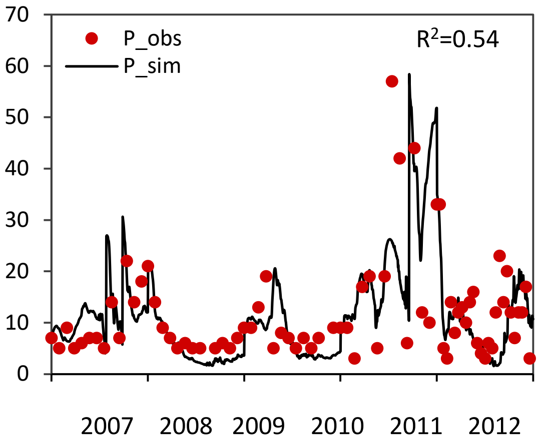
SALMO outputs



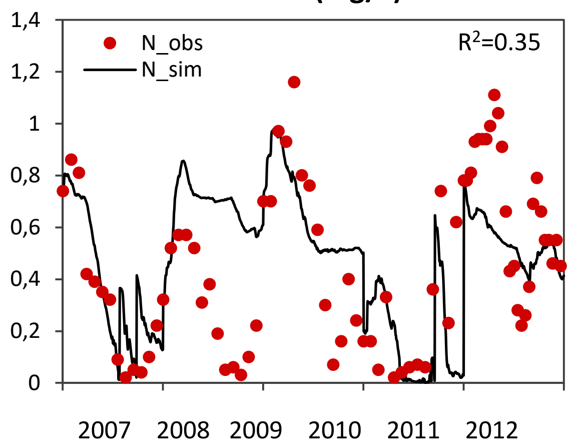


Model 1

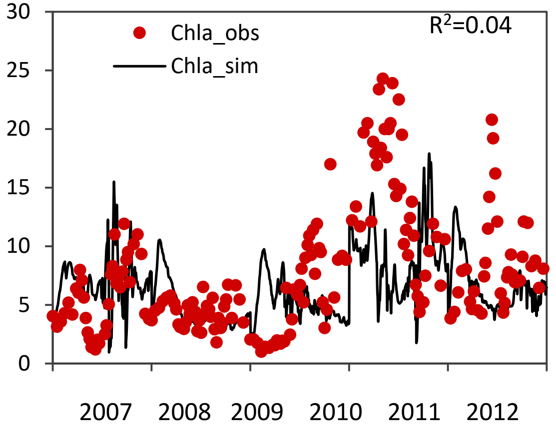
Phosphate (µg/L)



Nitrate (mg/L)



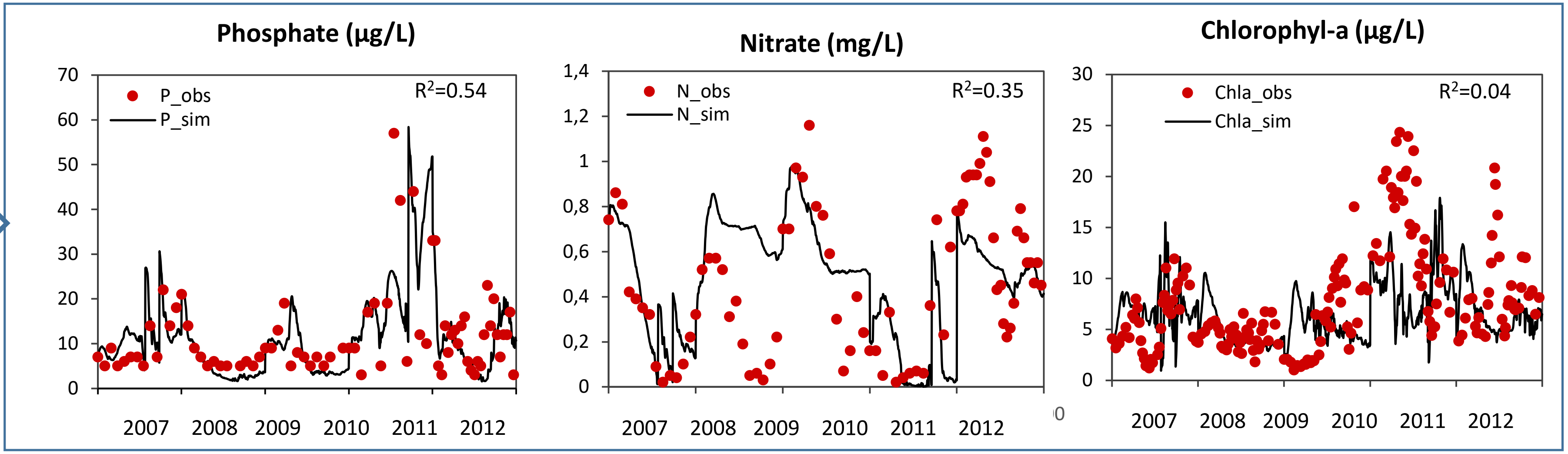
Chlorophyl-a (µg/L)



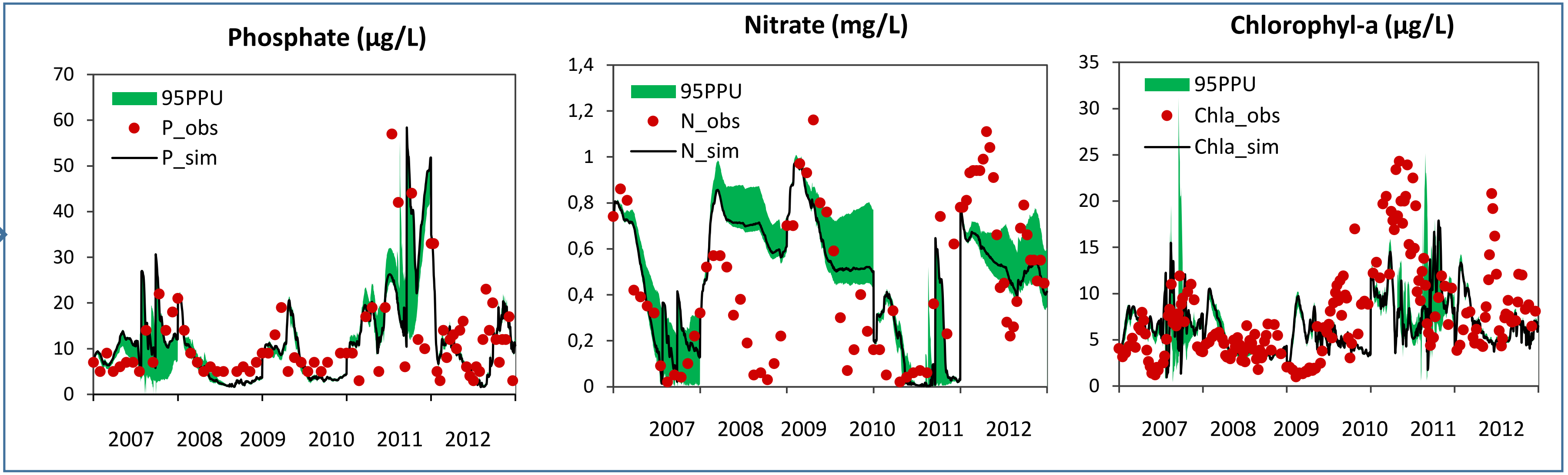
SALMO MODEL CALIBRATION

Model 1

SALMO
(1 best iteration)



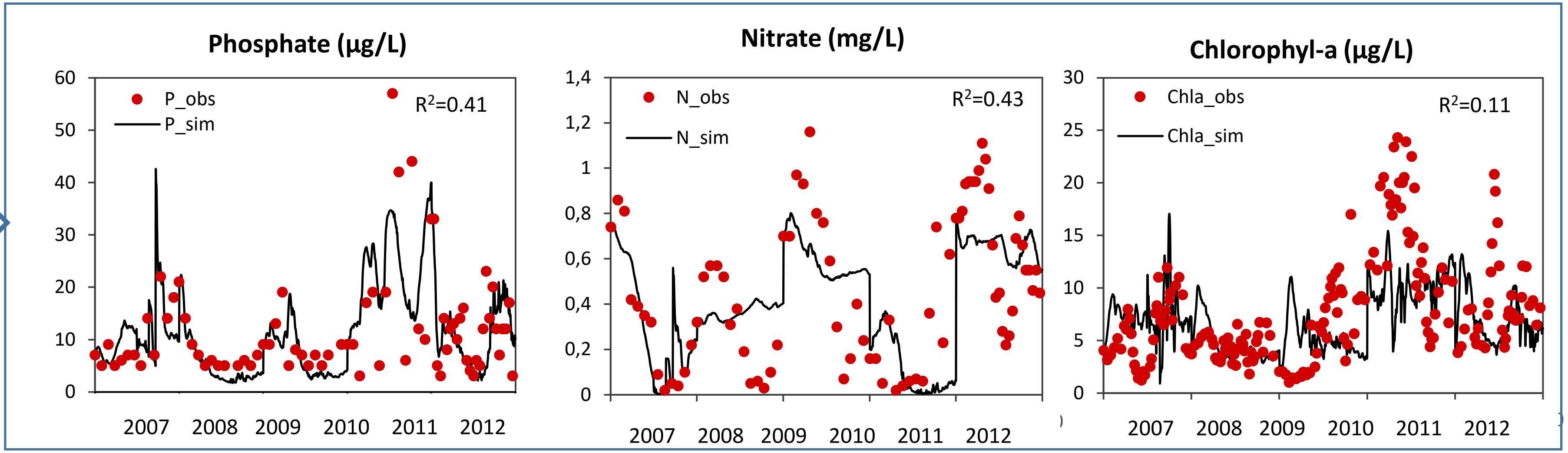
SALMO
(50 iterations)



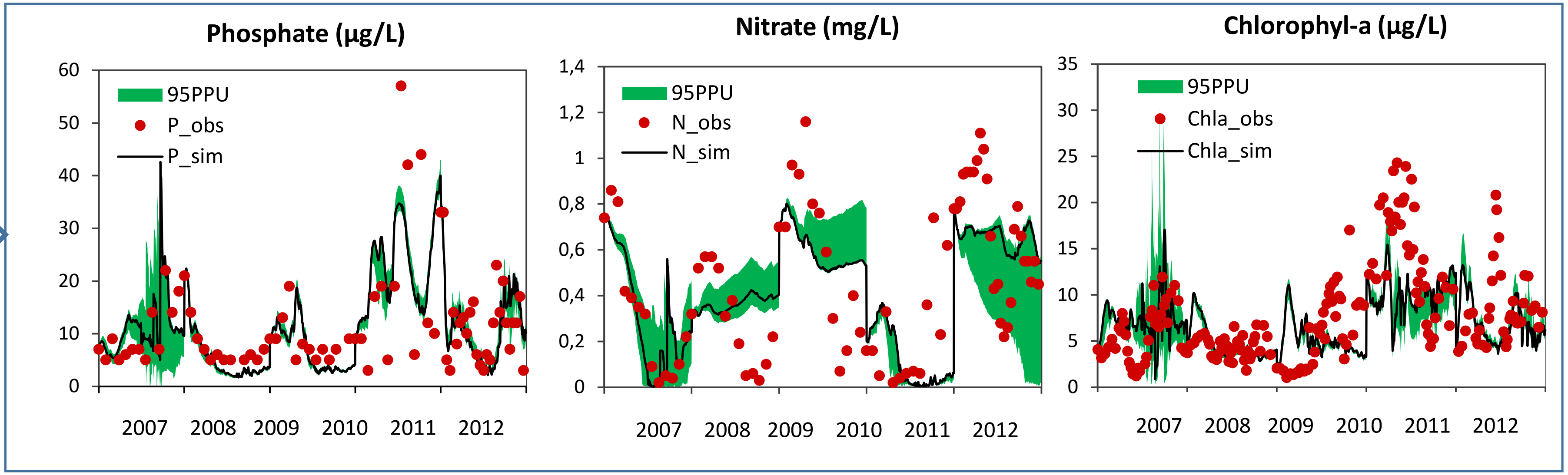
SALMO MODEL CALIBRATION

Model 4

SALMO
(1 best iteration)

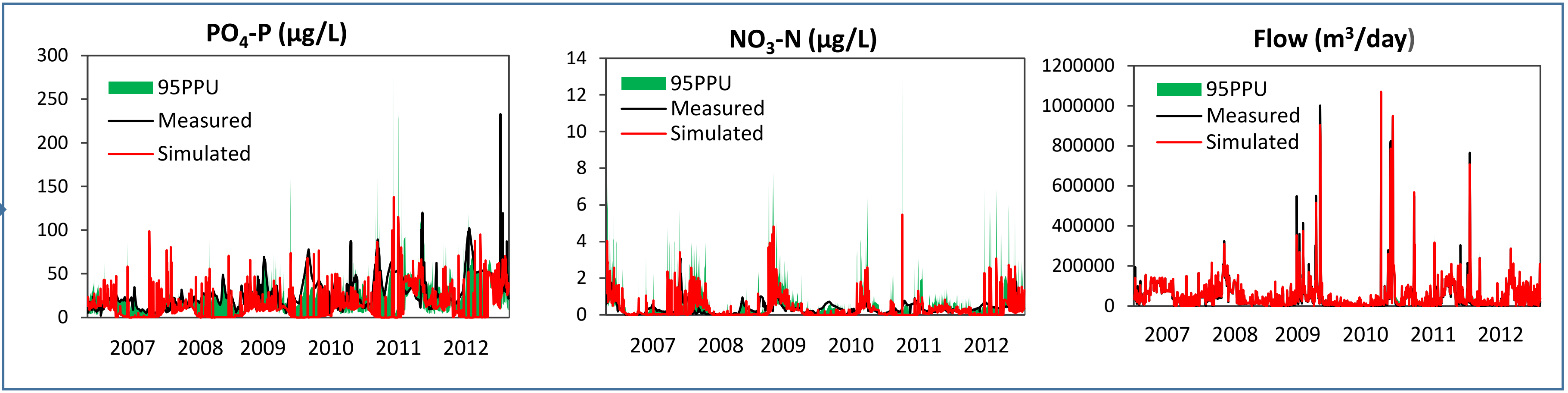


SALMO
(50 iterations)

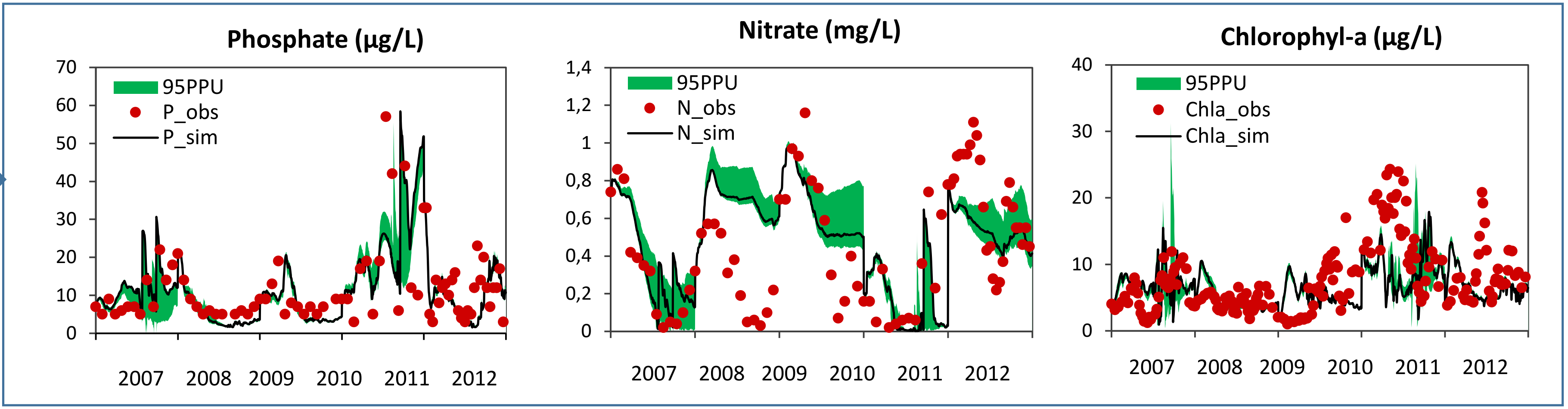


MODEL UNCERTAINTY

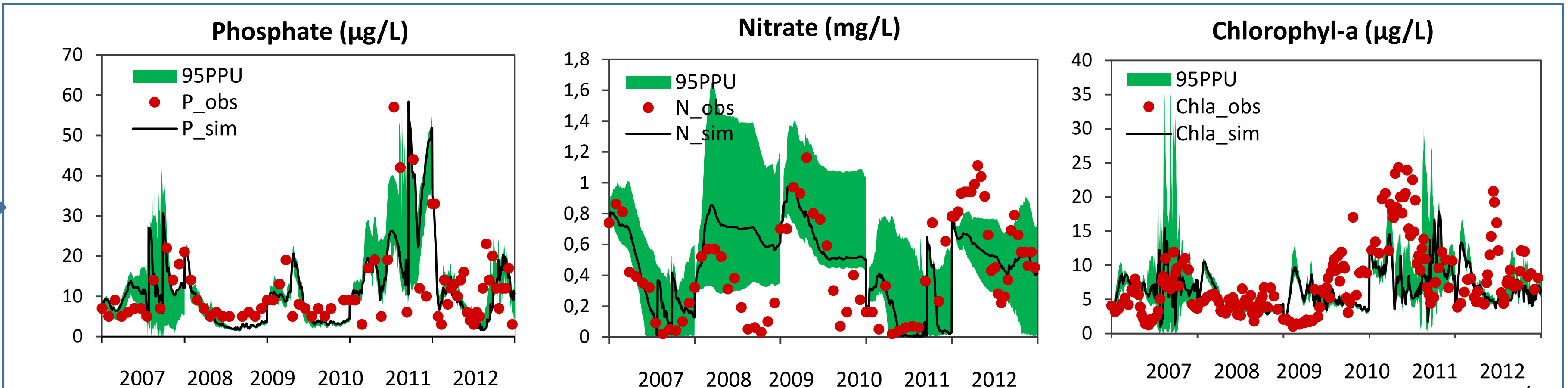
Uncertainty from SWAT (10 best iterations)



Uncertainty from SALMO (50 iterations)

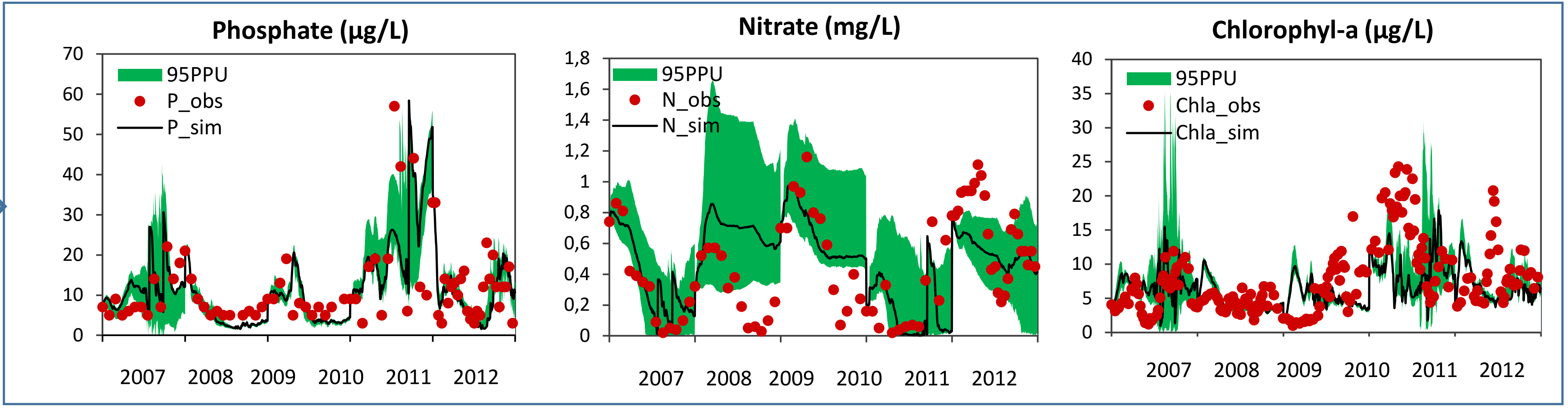


Uncertainties from SWAT (10 best iterations) + SALMO (50 iterations)

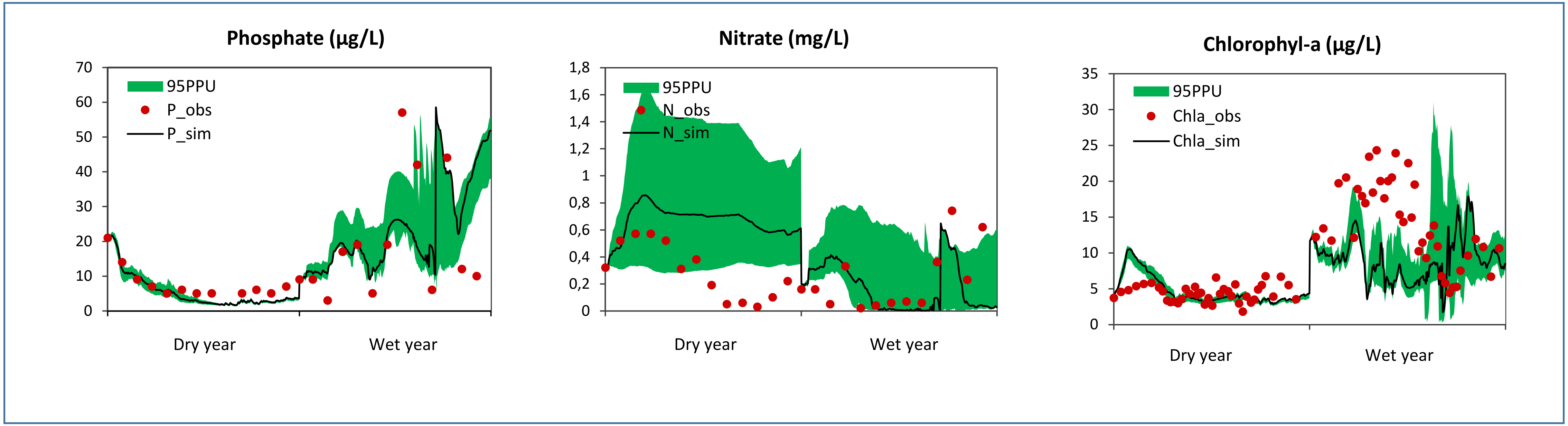


MODEL UNCERTAINTY

Uncertainty from SWAT
(10 best iterations)
+
SALMO
(50 iterations)

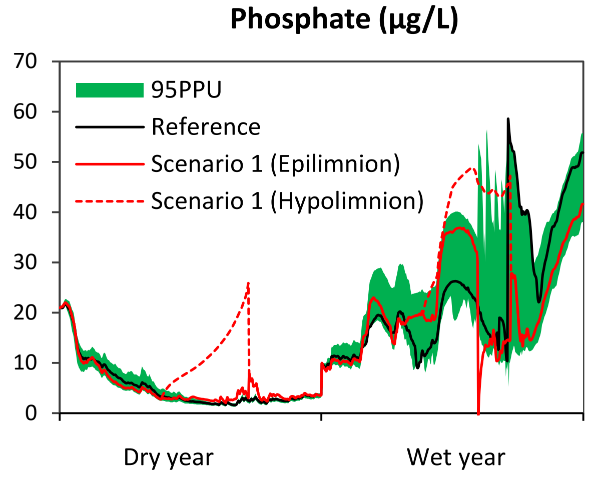


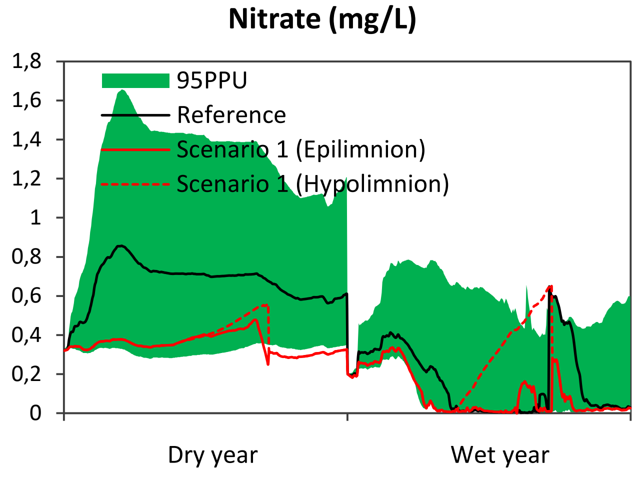
Extract results of two years for scenarios

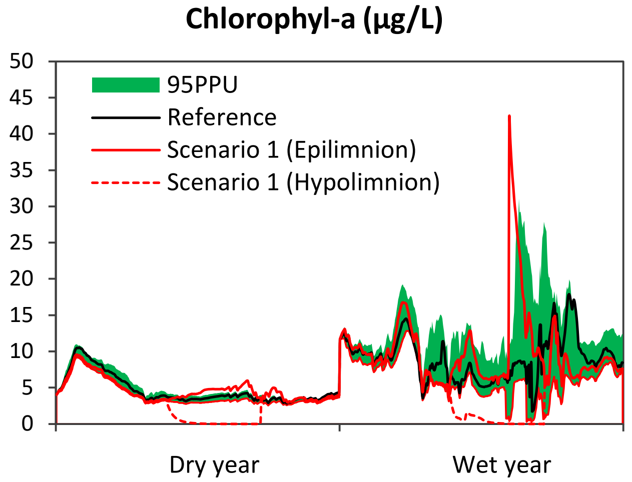


SCENARIO ANALYSIS

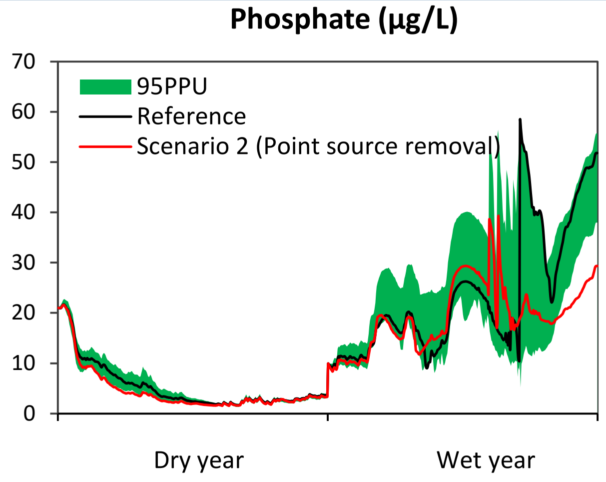
Scenario 1

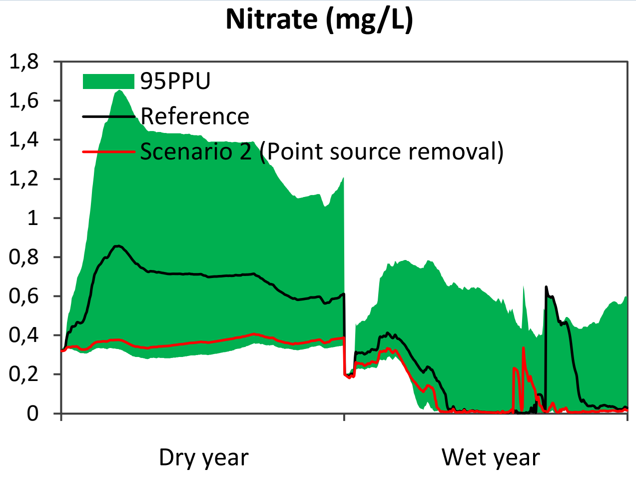


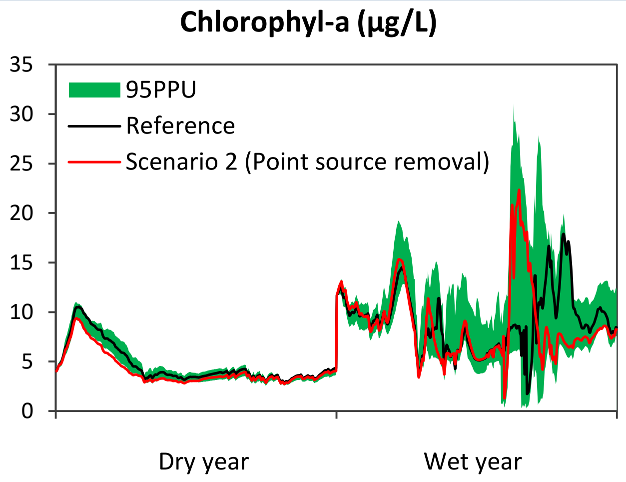




Scenario 2

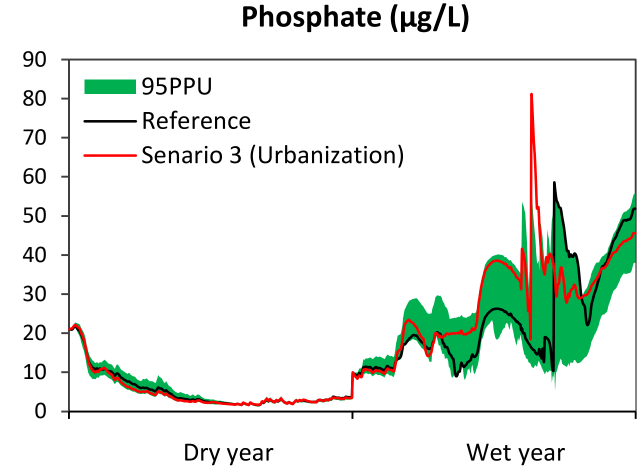


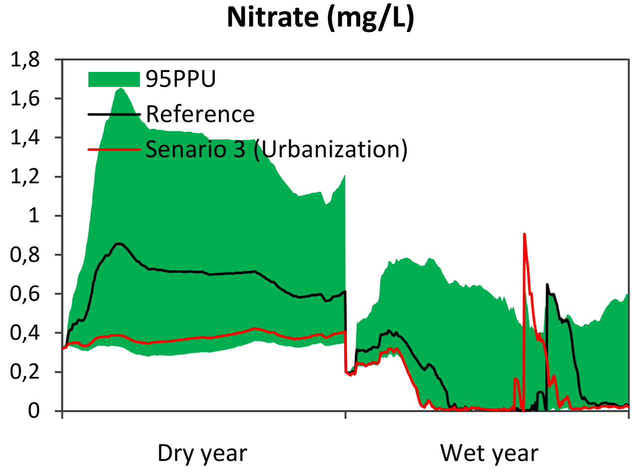


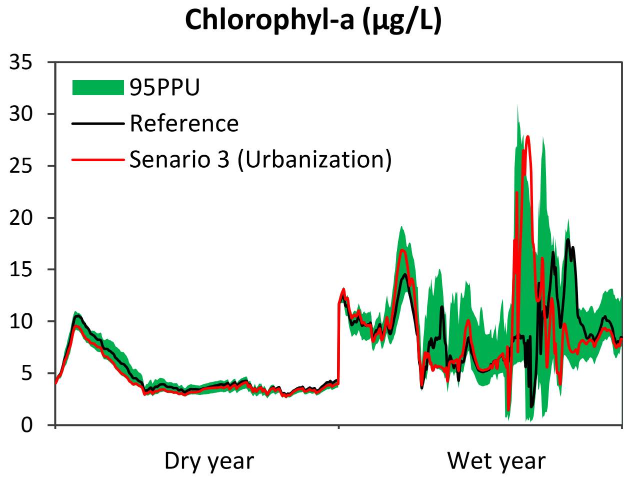


SCENARIO ANALYSIS

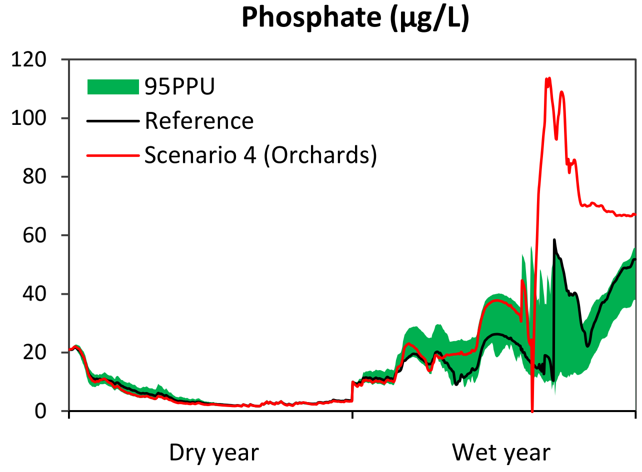
Scenario 3

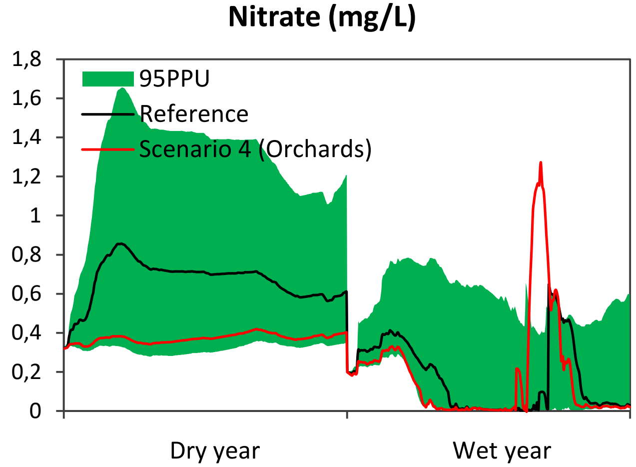


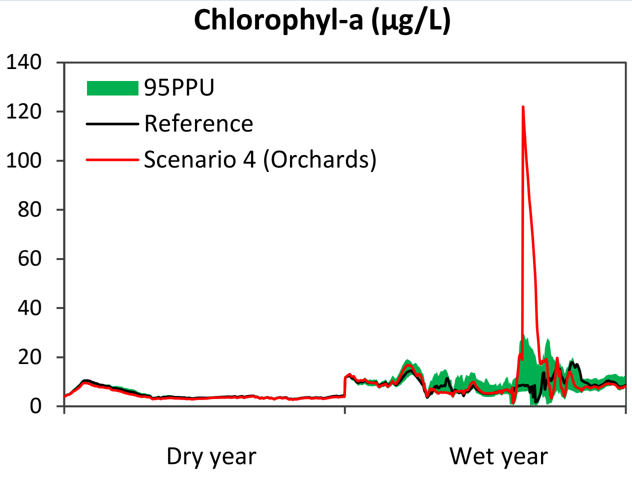




Scenario 4

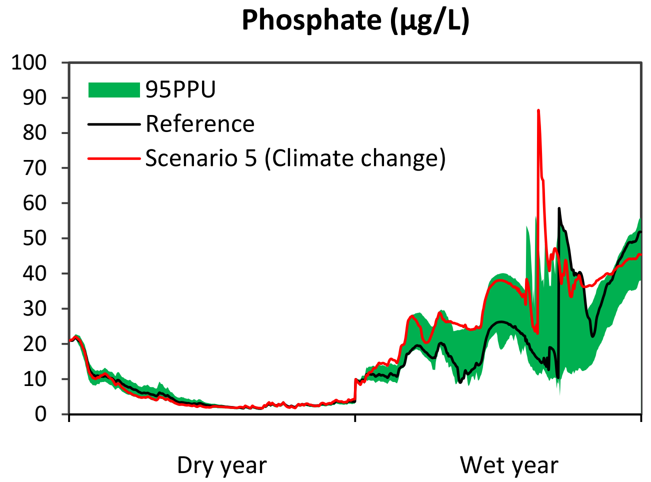


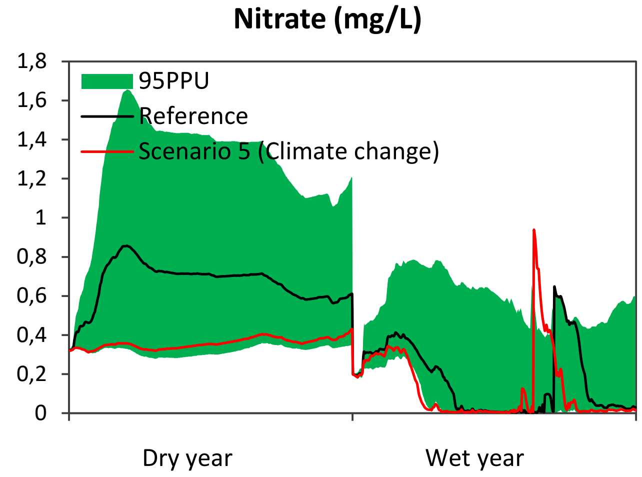


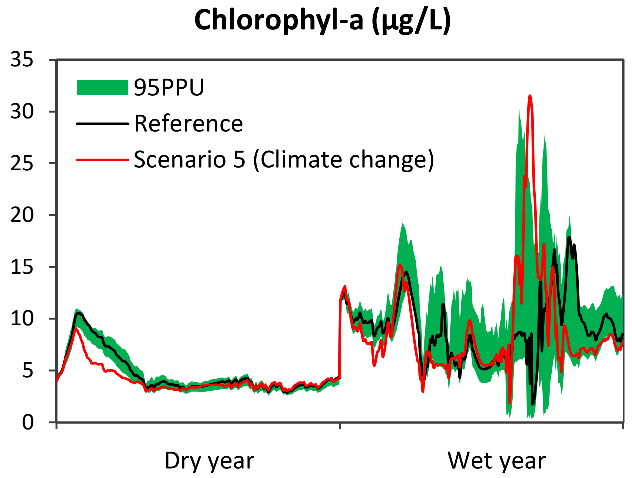


SCENARIO ANALYSIS

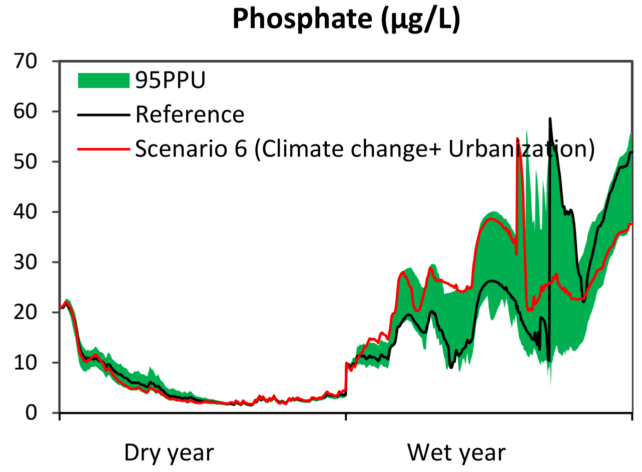
Scenario 5

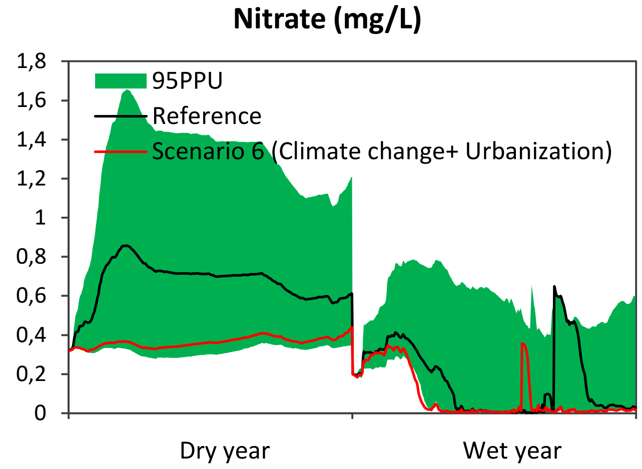


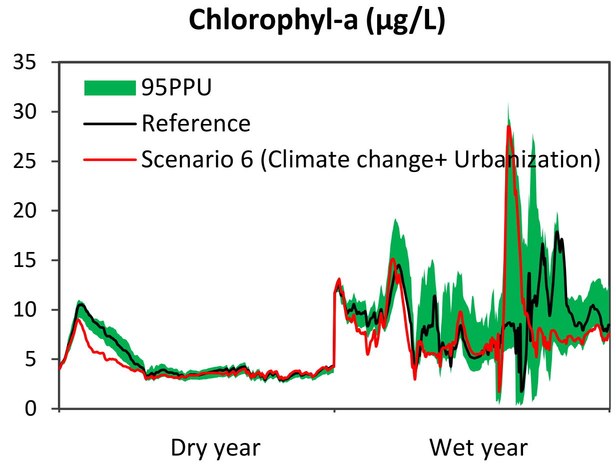




Scenario 6







CONCLUSION

- Combining catchment – reservoir modelling like SWAT-SALMO comprehend more realistically the cascading effects of future scenarios between catchments and reservoirs.
- Uncertainty analyses of both models is vitally important to facilitate the integrated management.

- Future study:

  (1) Analysis of input and parametric uncertainties of coupled catchment – reservoir models

  (2) Apply the approach to a larger scale, natural catchment – reservoir system