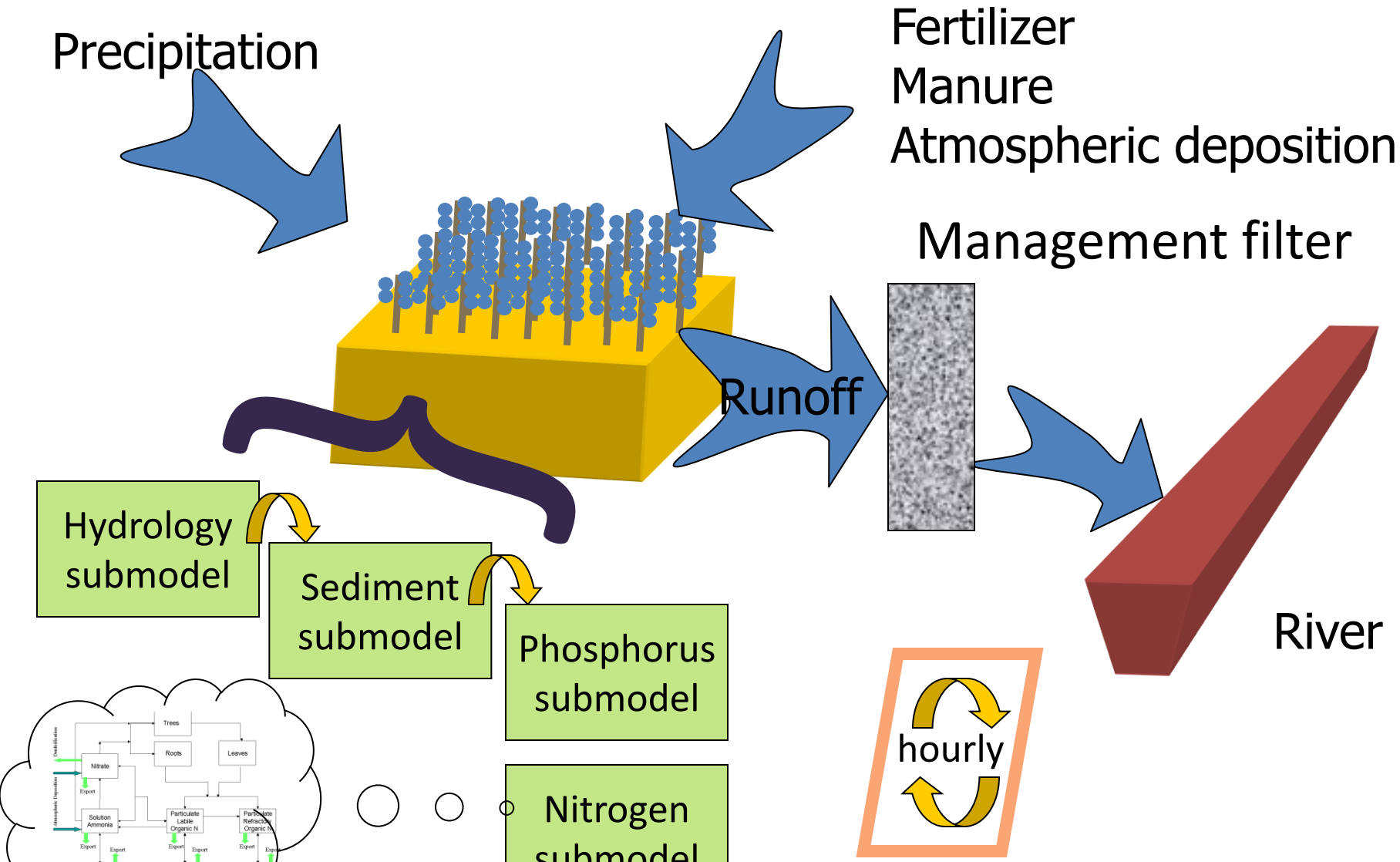
Phase 6 Sensitivity

Gary Shenk EPA/CBPO

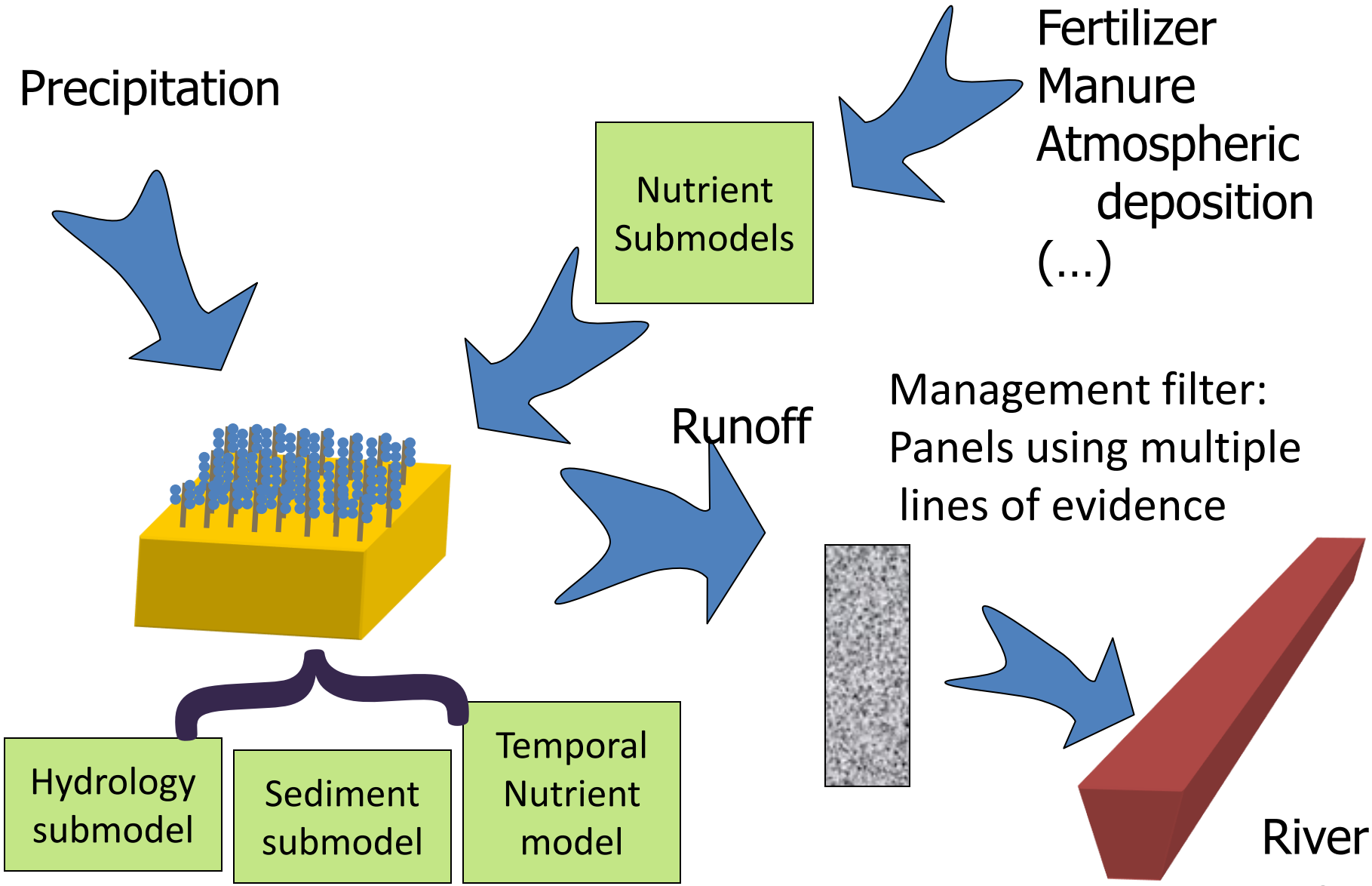
Presentation to Modeling WG

12/11/13

Phase 5


Precipitation
Fertilizer
Manure
Atmospheric deposition
Management filter
Runoff
River
Hydrology submodel
Sediment submodel
Phosphorus submodel
Nitrogen submodel
hourly
Trees
Roots
Leaves
Nitrate
Solution Ammonia
Particulate Labile Organic N
Particulate Refractory Organic N
Adsorbed Ammonia
Solution Labile Organic N
Solution Refractory Organic N
Export
Denitrification
Atmospheric Deposition

Phase 6


Precipitation
Fertilizer
Manure
Atmospheric deposition
(…)
Nutrient Submodels
Runoff
Management filter:
Panels using multiple lines of evidence
Hydrology submodel
Sediment submodel
Temporal Nutrient model
River

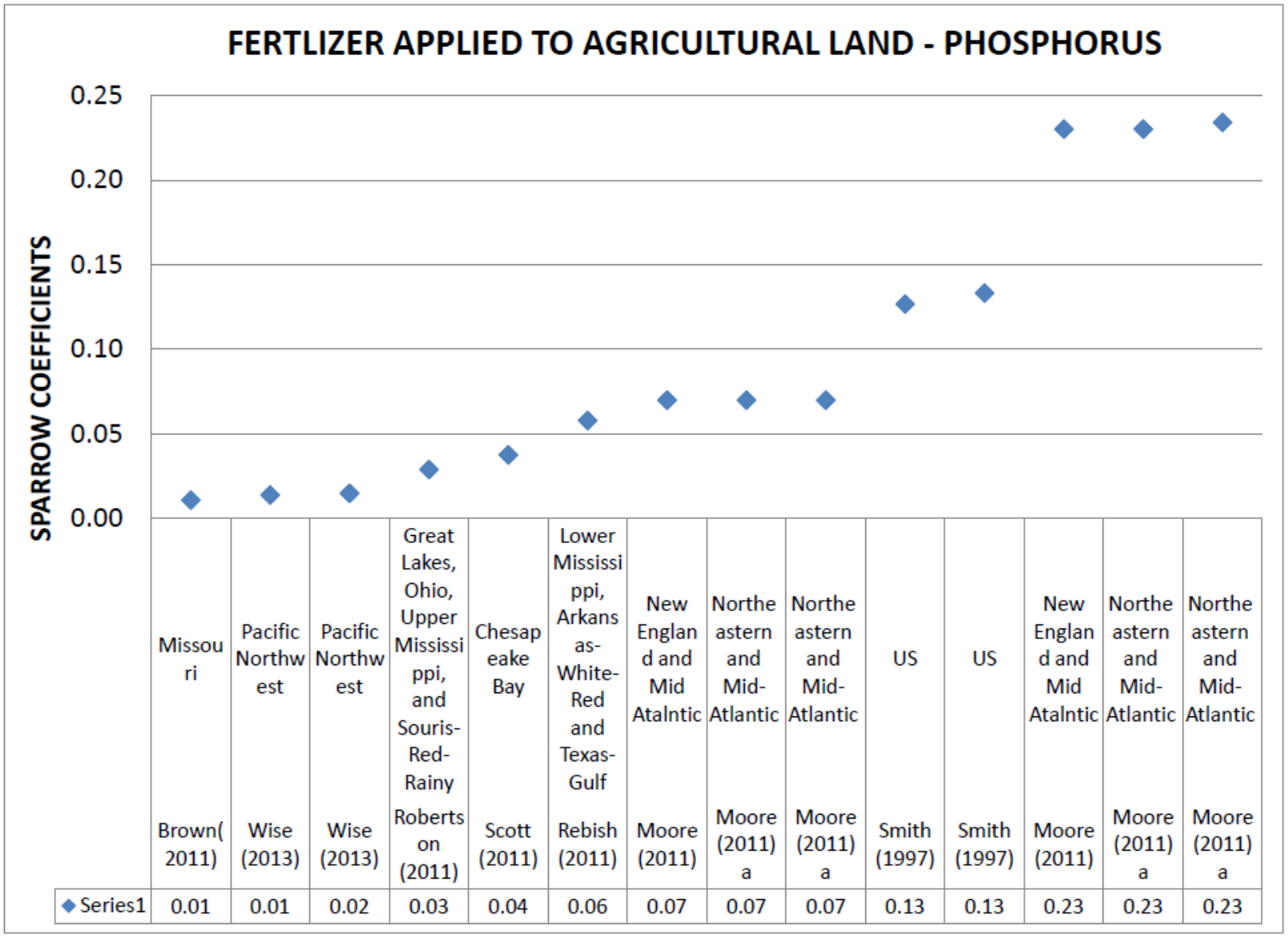
What could submodels look like?

Slope between output and total input

Land use	TN	DIN	ON	TP	PO4	OP
Forest	0.05	0.05	0.004			
Pasture	0.06	0.05	0.013			
H-tillage w M	0.24	0.14	0.07	0.12	0.1	0.015
H-tillage w/o M	0.53	0.52	0.02	0.1	0.1	0.002
L-tillage w M	0.20	0.15	0.06	0.1	0.08	0.015
Alfalfa	0.03	0.03	-0.002	0.1	0.1	0.001
Urban (npd)	0.15	0.14	0.011			
Hay w N (hyw)				0.08	0.08	0.0
Hay w/o N (hyo)	0.30	0.30	0.005			

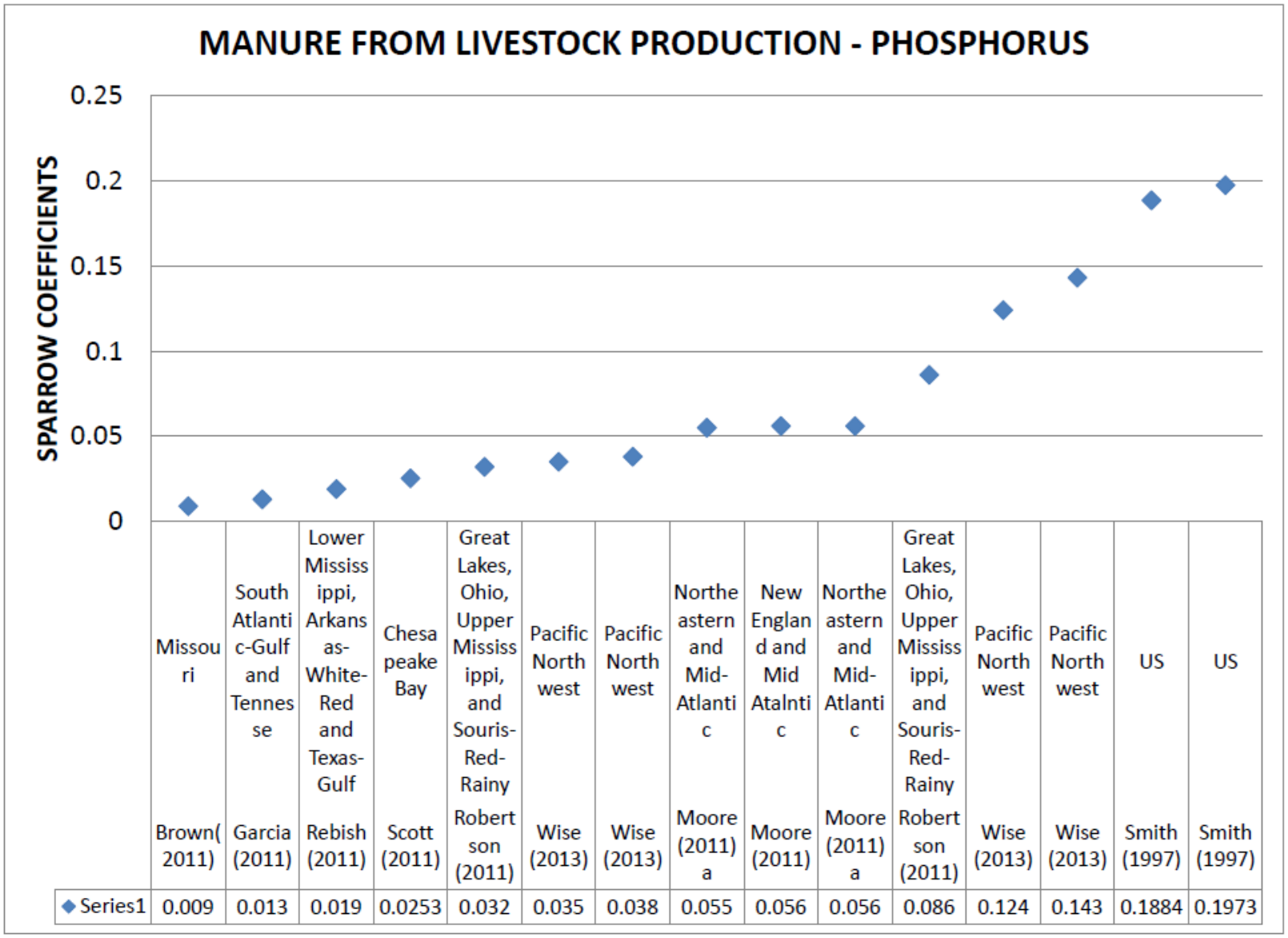
Caveat: N Uptake substracted from total input for croplands, but not for forest and pasture; Tillage croplands have higher slopes than non-disturbed land uses

What could submodels look like?



	Missouri Brown(2011)	Pacific Northwest Wise (2013)	Pacific Northwest Wise (2013)	Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy Robertson (2011)	Chesapeake Bay Scott (2011)	Lower Mississippi, Arkansas-White-Red and Texas-Gulf Rebish (2011)	New England and Mid Atalntic Moore (2011)	Northeastern and Mid-Atlantic Moore (2011) a	Northeastern and Mid-Atlantic Moore (2011) a	US Smith (1997)	US Smith (1997)	New England and Mid Atalntic Moore (2011)	Northeastern and Mid-Atlantic Moore (2011) a	Northeastern and Mid-Atlantic Moore (2011) a
Series1	0.01	0.01	0.02	0.03	0.04	0.06	0.07	0.07	0.07	0.13	0.13	0.23	0.23	0.23

What could submodels look like?



	Missouri Brown(2011)	South Atlantic-Gulf and Tennesse Garcia (2011)	Lower Mississippi, Arkansas-White-Red and Texas-Gulf Rebish (2011)	Chesapeake Bay Scott (2011)	Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy Robertson (2011)	Pacific Northwest Wise (2013)	Pacific Northwest Wise (2013)	Northeastern and Mid-Atlantic Moore (2011) a	New England and Mid Atalntic Moore (2011)	Northeastern and Mid-Atlantic Moore (2011) a	Great Lakes, Ohio, Upper Mississippi, and Souris-Red-Rainy Robertson (2011)	Pacific Northwest Wise (2013)	Pacific Northwest Wise (2013)	US Smith (1997)	US Smith (1997)
Series1	0.009	0.013	0.019	0.0253	0.032	0.035	0.038	0.055	0.056	0.056	0.086	0.124	0.143	0.1884	0.1973

What could submodels look like?

Export Load =

Storage * Coeff (soil, slope, location, tillage)

+

Annual application * Coeff (parameters)

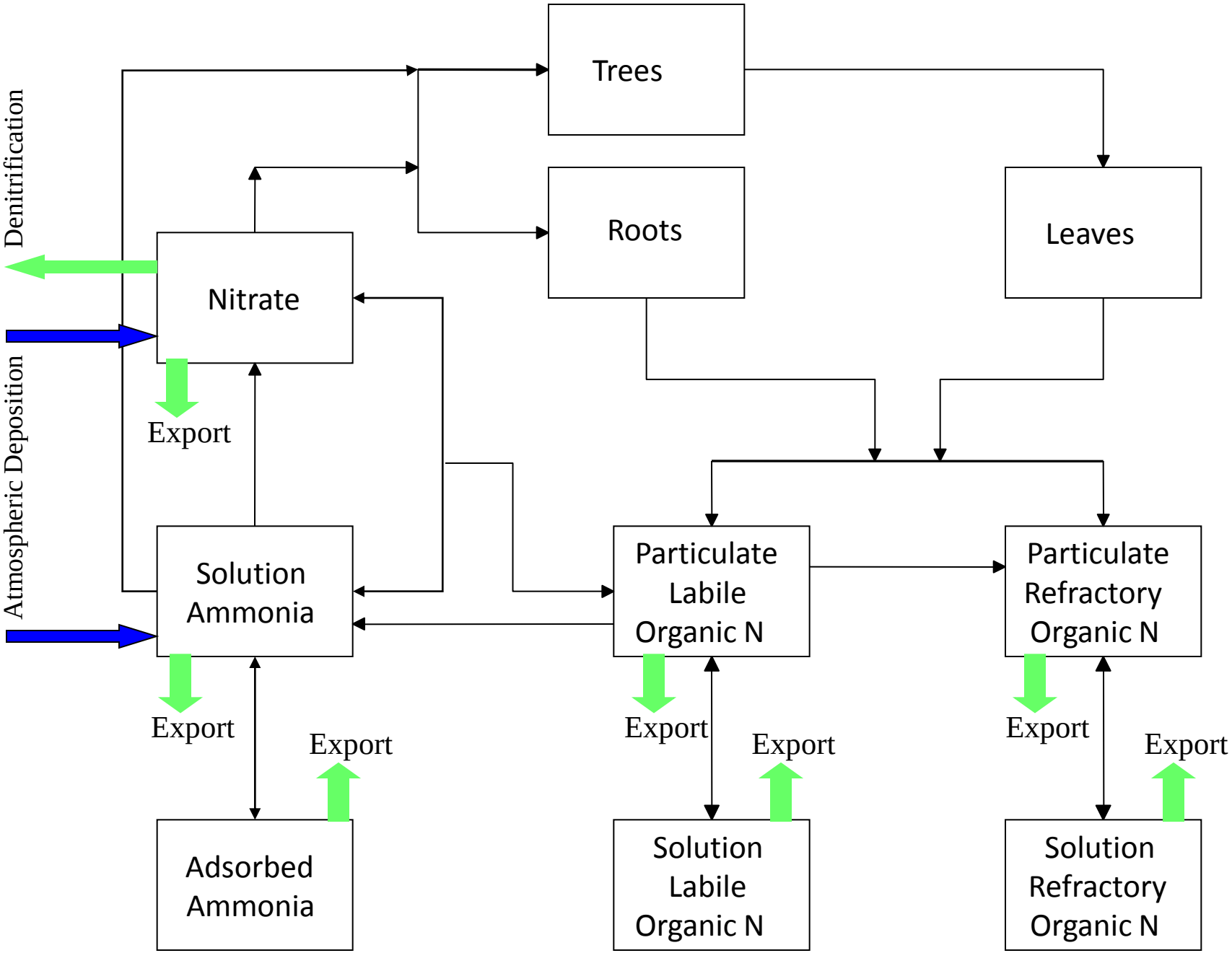
Alisha Mulkey and Frank Coale are working on a model like this

A STAC recommendation in this format could be readily implemented

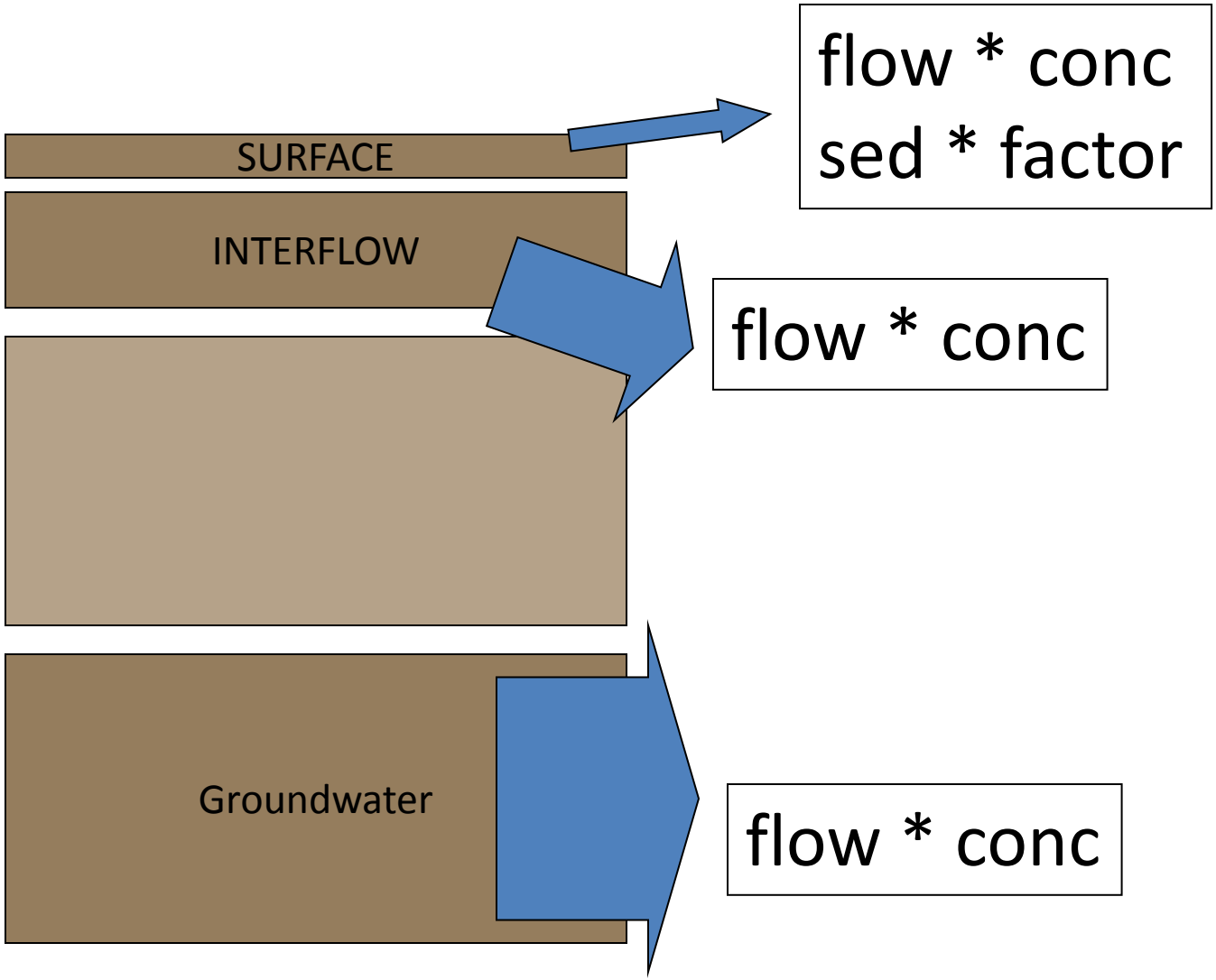
Phase 6 Sensitivities and Targets

- Gather Information
  - AGCHEM - CBPO
  - Sparrow - CBPO
  - CEAP - BARC
  - Forest Disturbance model – Gutierrez-Magness, et al
  - APLE – Coale and Mulkey
  - Other Coefficient Models - TetraTech
  - Literature - TetraTech
- Synthesize and Discuss with Workgroup
- Next Step – Incorporate Sensitivity into PQUAL

AGCHEM Nitrogen Cycle



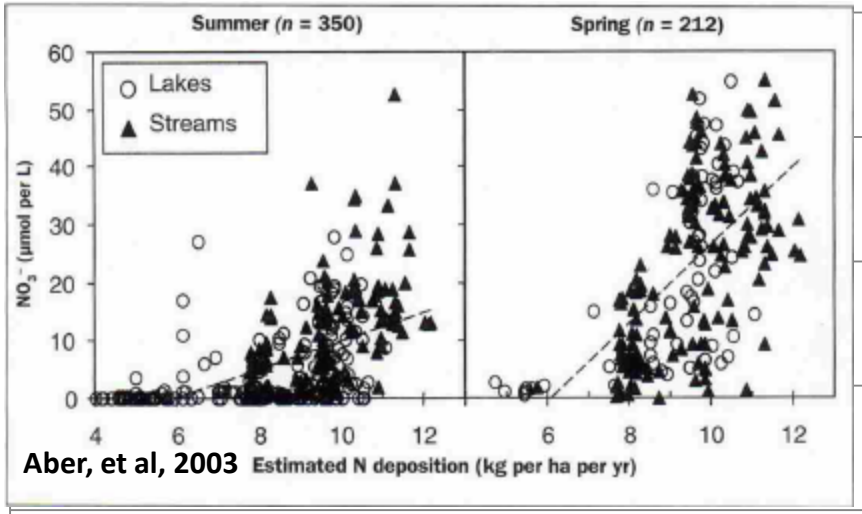
PQUAL loading model



Complex *vs* Simple

Complex	Simple
• Calibration is complex and time consuming	• Calibration is relatively simple and fast
• Calibration is imprecise	• Calibration is precise
• Longer run time	• Shorter run time
• Simulated sensitivity to inputs	• Sensitivity to inputs must be specified (by multiple research models and methods)

Reduction in forest loads from 1985 to CAIR

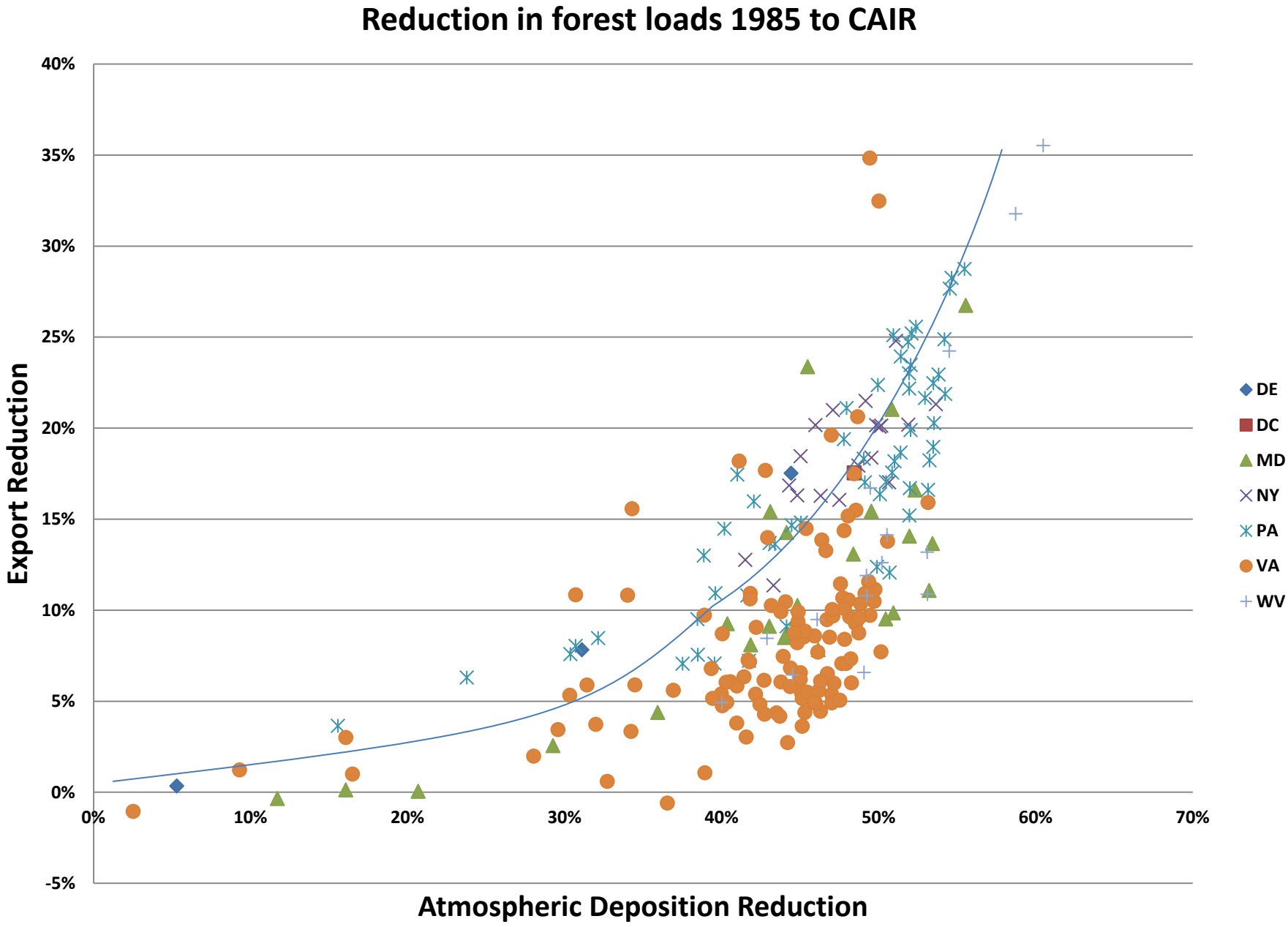


Export Reduction

40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%

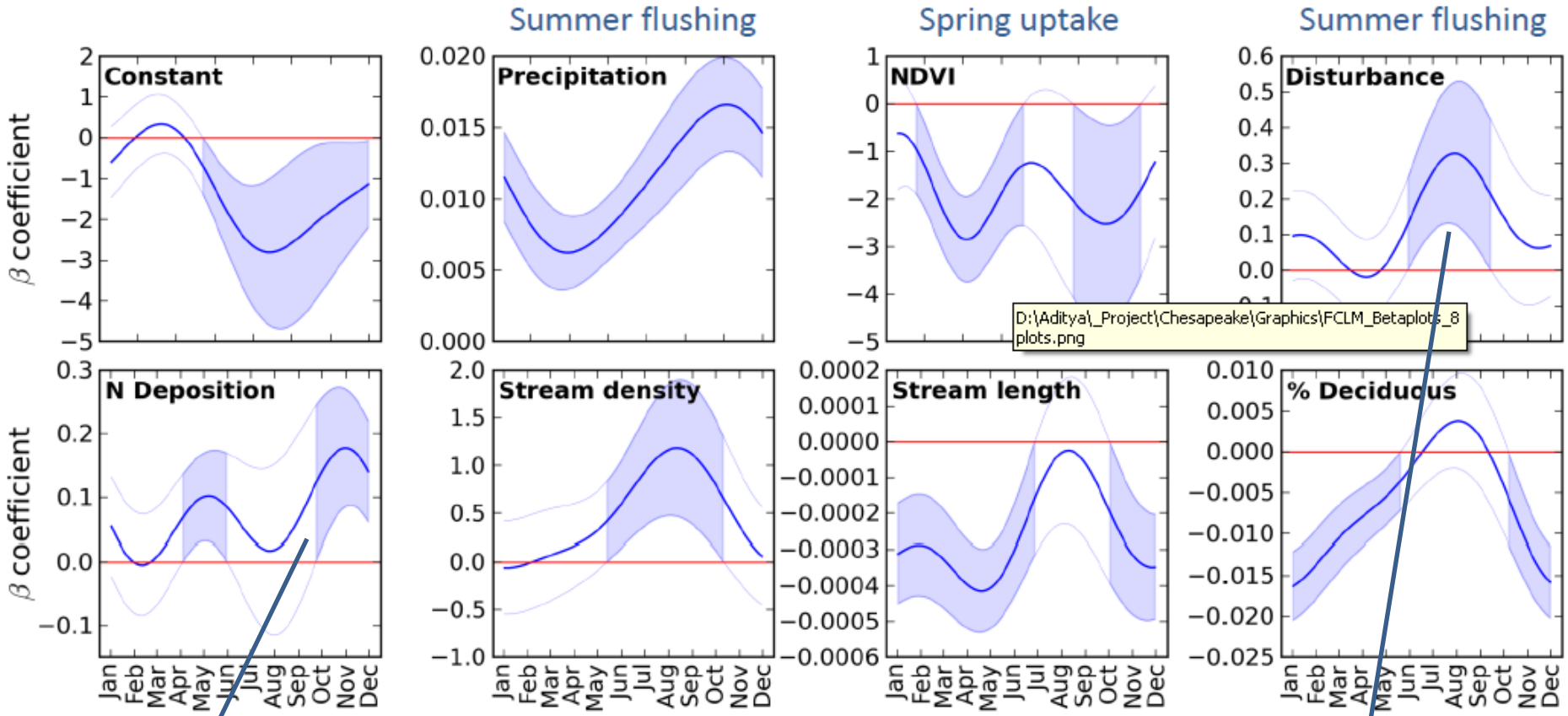
0%
10%
20%
30%
40%
50%
60%
70%

Atmospheric Deposition Reduction


Reduction in forest loads 1985 to CAIR
Export Reduction
Atmospheric Deposition Reduction
40%
35%
30%
25%
20%
15%
10%
5%
0%
-5%
0%
10%
20%
30%
40%
50%
60%
70%
DE
DC
MD
NY
PA
VA
WV

Results:

Regression of monthly nitrate yield – Preliminary Results



Estimating nitrate export from Chesapeake Bay watersheds using MODIS and climate data

Aditya Singh and Phil Townsend

Angélica Gutiérrez-Magness

Keith Eshleman

Brenden McNeil

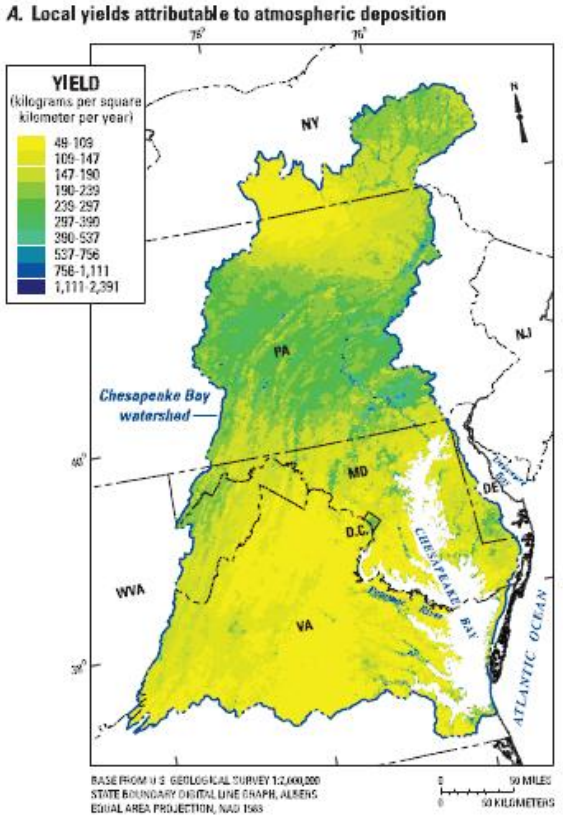
Deposition is Important in the spring and fall

Disturbance is Important in the summer

USGS
science for a changing world

SPARROW Surface Water-Quality Modeling

NAWQA Home | Model Description | Fact Sheet | Decision Support System | FAQs



Total Nitrogen, 2002
(n = 181, MSE = 0.0836, RMSE = 0.289, flux R^2 = 0.978, yield R^2 = 0.858

Explanatory variables	Estimate	Units	90-percent confidence interval	Standard error	p[1]
Sources					
Point sources (kg yr^{-1})	0.774		0.375 – 1.17	0.242	0.0008
Crop fertilizer and fixation (kg yr^{-1})	0.237		0.177 – 0.297	0.0363	< 0.0001
Manure (kg yr^{-1})	0.0582		0.0138 – 0.103	0.0269	0.0157
Atmospheric deposition (kg yr^{-1})	0.267		0.179 – 0.355	0.0533	< 0.0001
Urban[2] (km^2)	1,090	kg km^{-2} yr^{-1}	707 – 1,480	234	< 0.0001
Land-to-water delivery					
ln[Mean EVI for WY02 (dimensionless)]	-1.70		-2.65 – -0.737	0.580	0.0039
ln[Mean soil AWC (fraction)]	-0.829		-1.26 – -0.401	0.260	0.0016
ln[Groundwater recharge (mm)]	0.707	mm^{-1}	0.499 – 0.916	0.126	< 0.0001
ln[Piedmont carbonate (percent of area)]	0.158		0.0755 – 0.241	0.0500	0.0018