AGCHEM Sensitivity Analysis

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UMCES/Bay program

Modeling Quarterly Review Meeting
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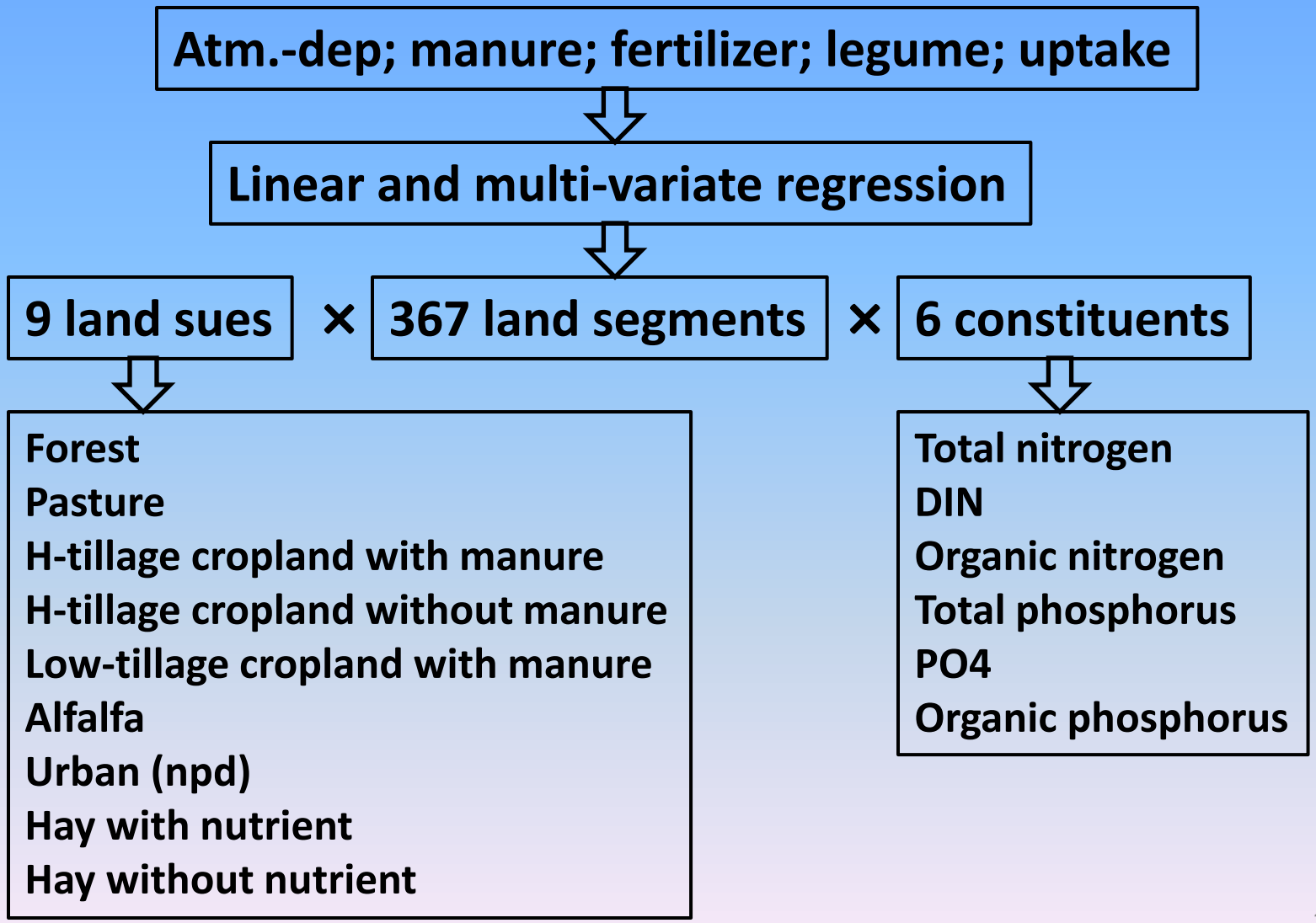
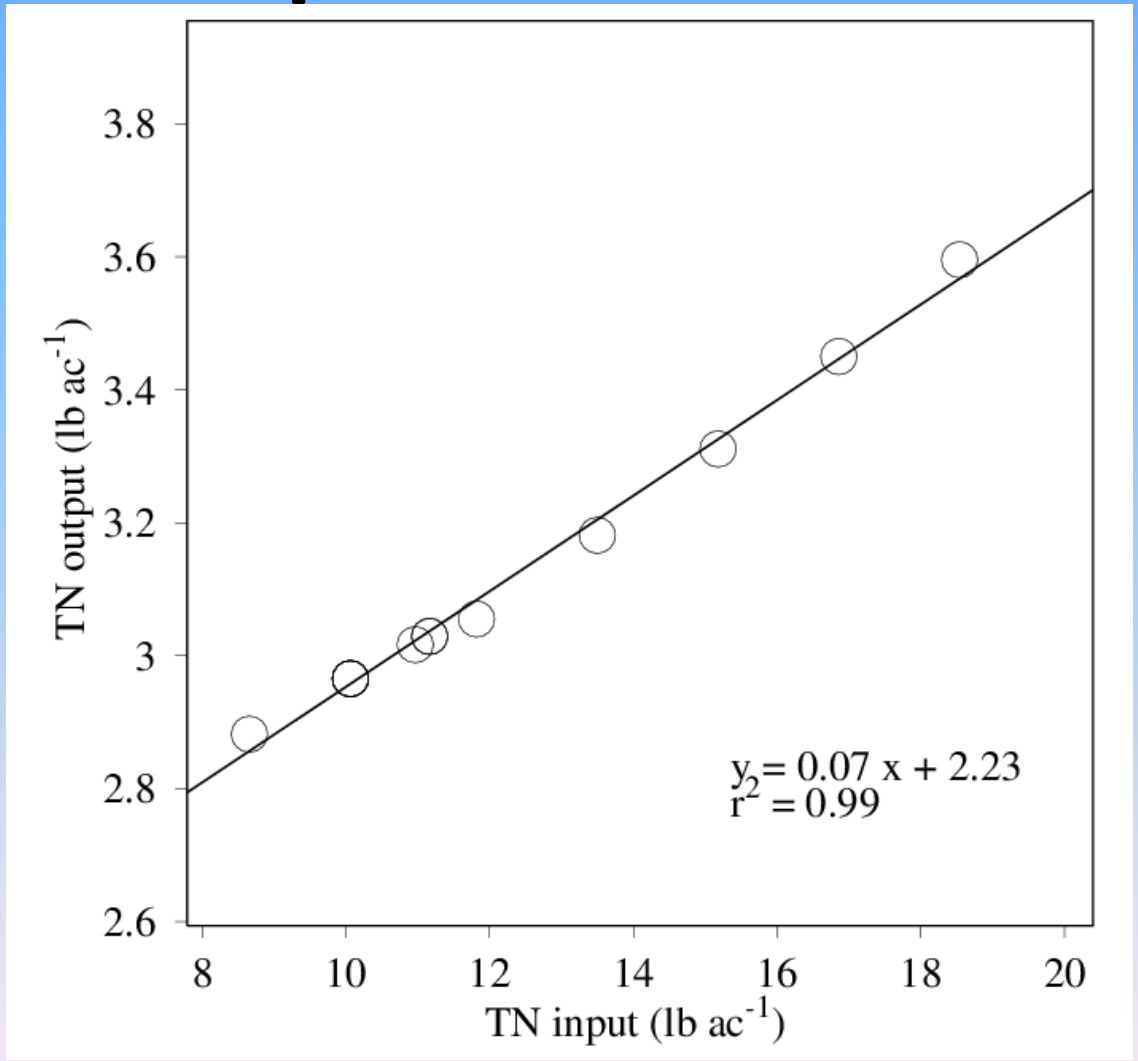
Annapolis

Relationship between input and output

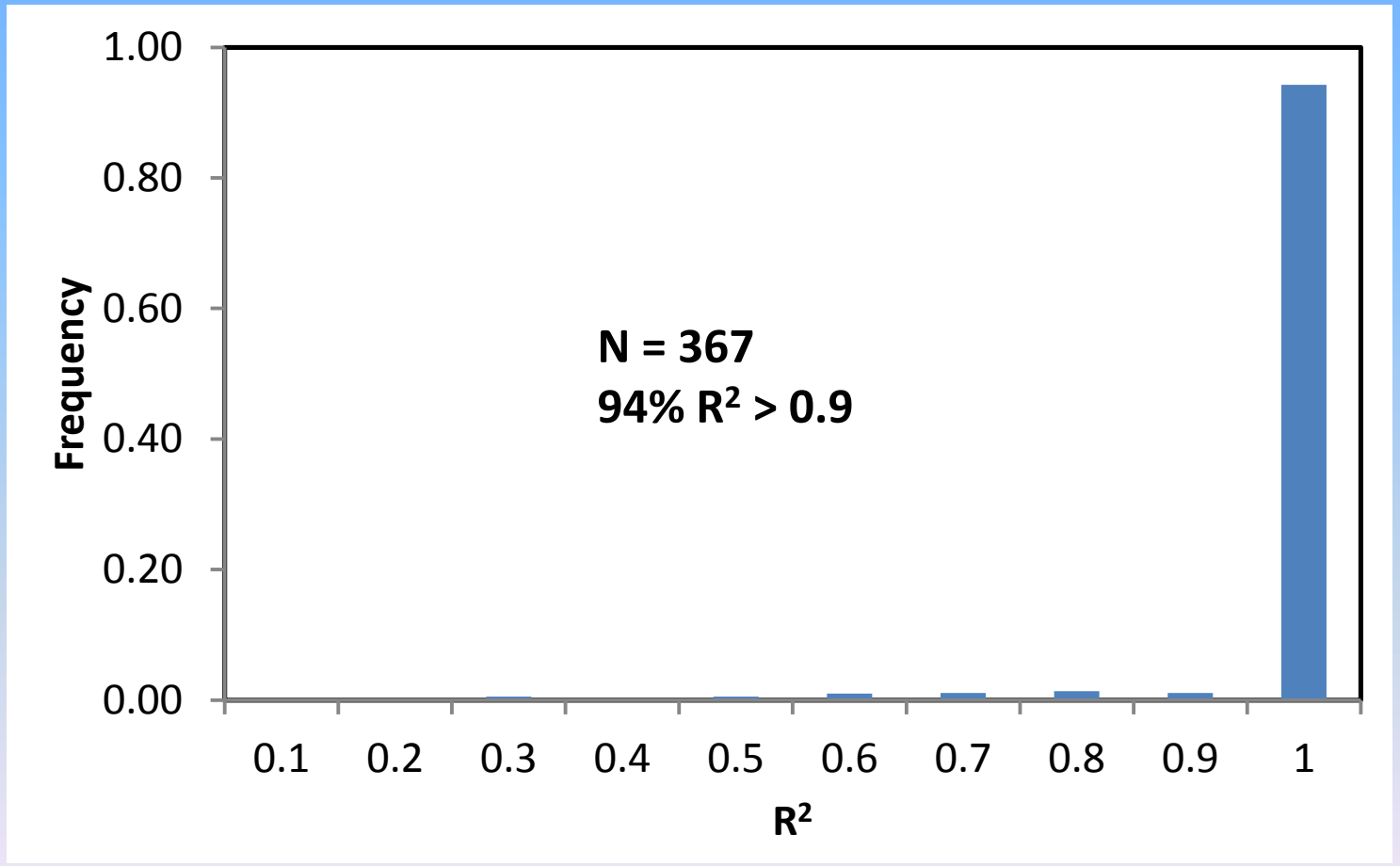


Strong linear relationship between input and output

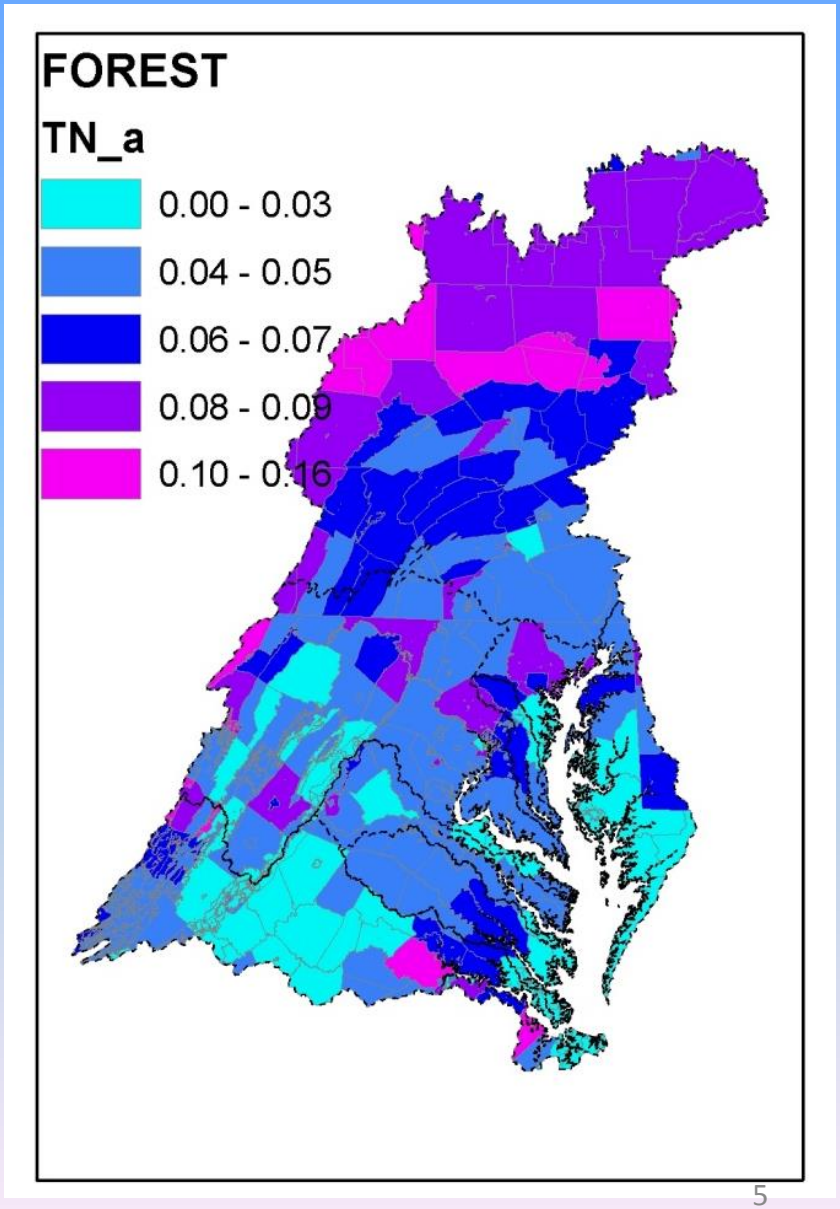
Total nitrogen input and output on forest



R^2 frequency of regression between total N output and inputs on forest

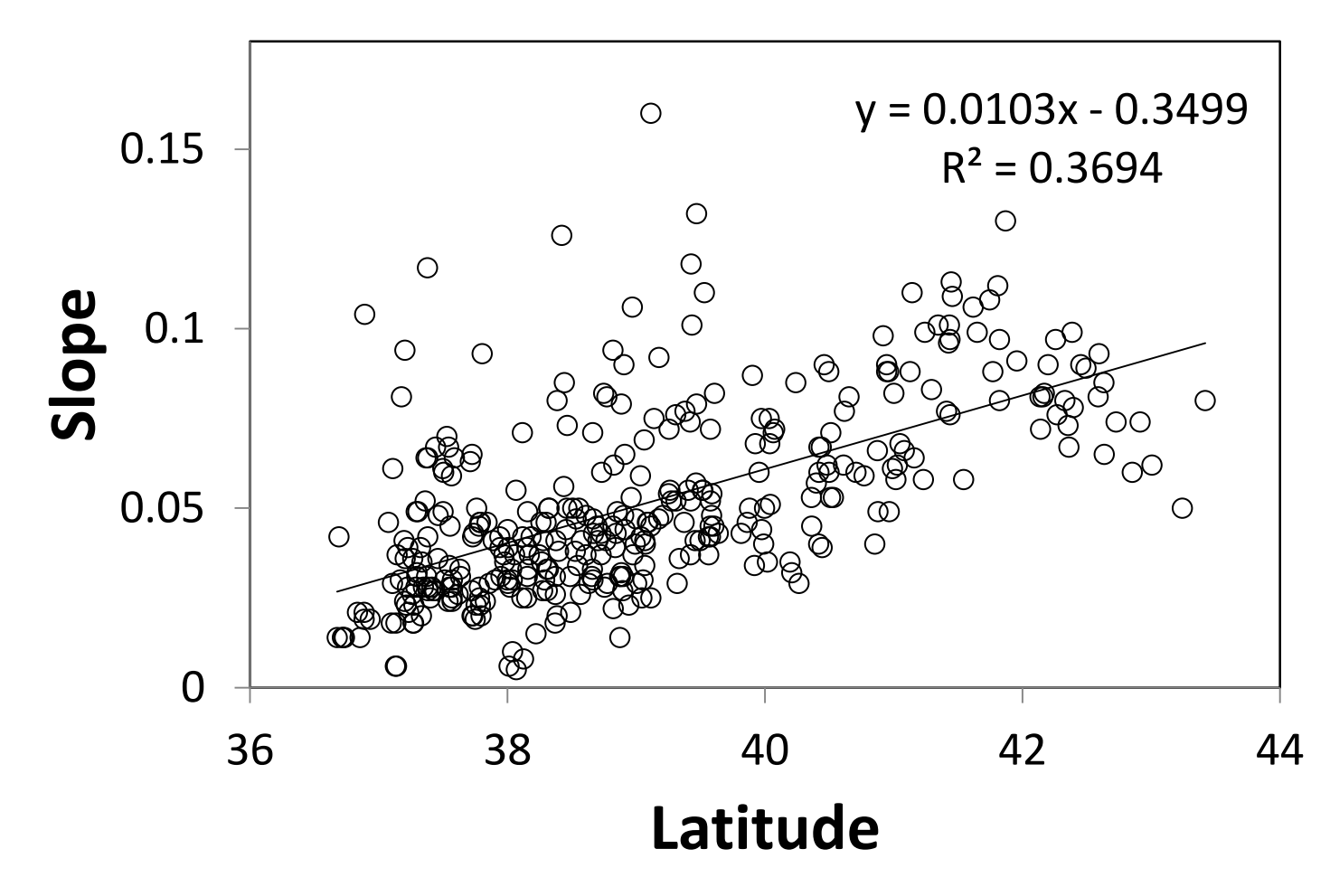


Slope distribution between total nitrogen input and output on forest

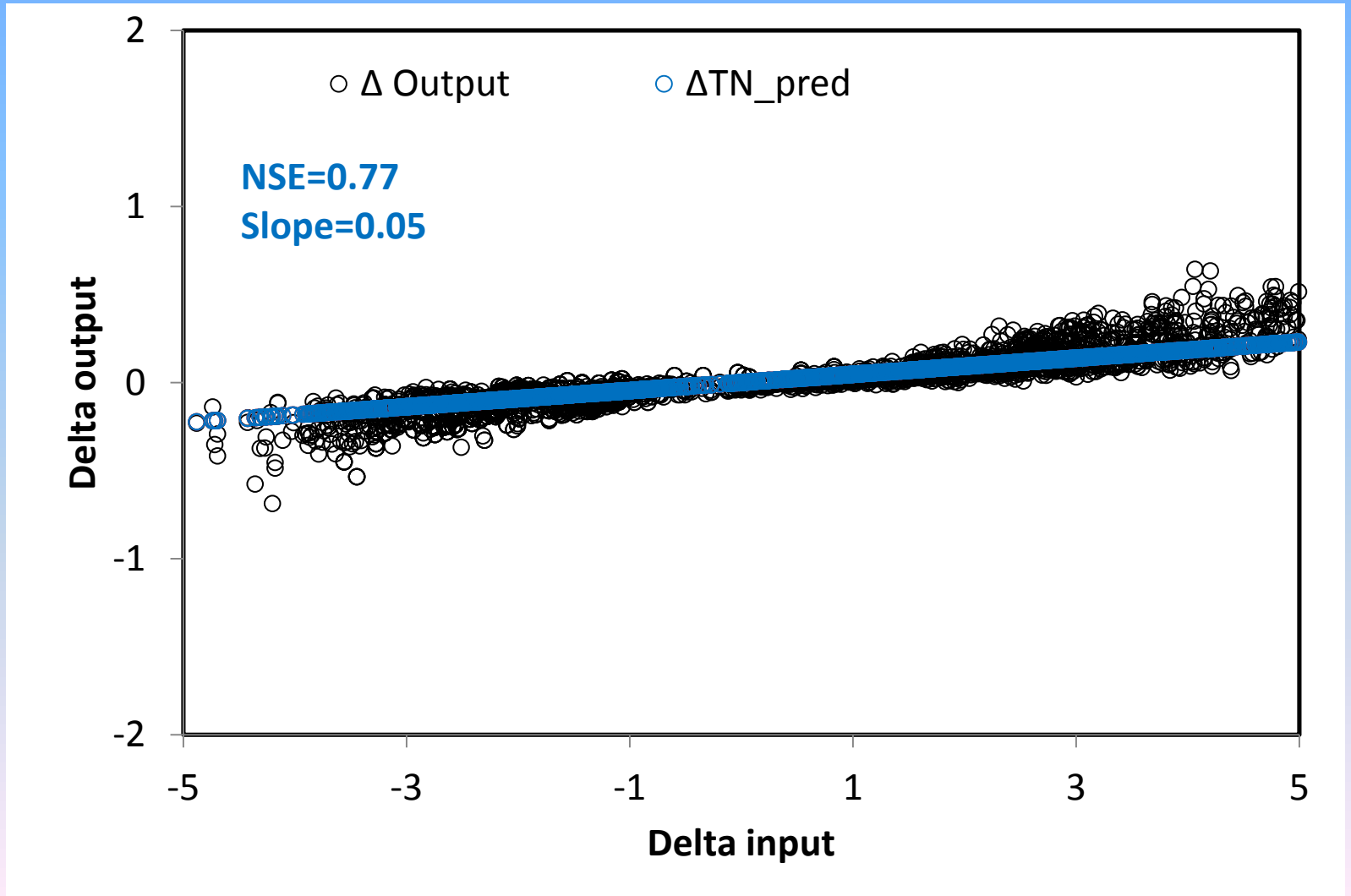


There appears to be a latitudinal pattern

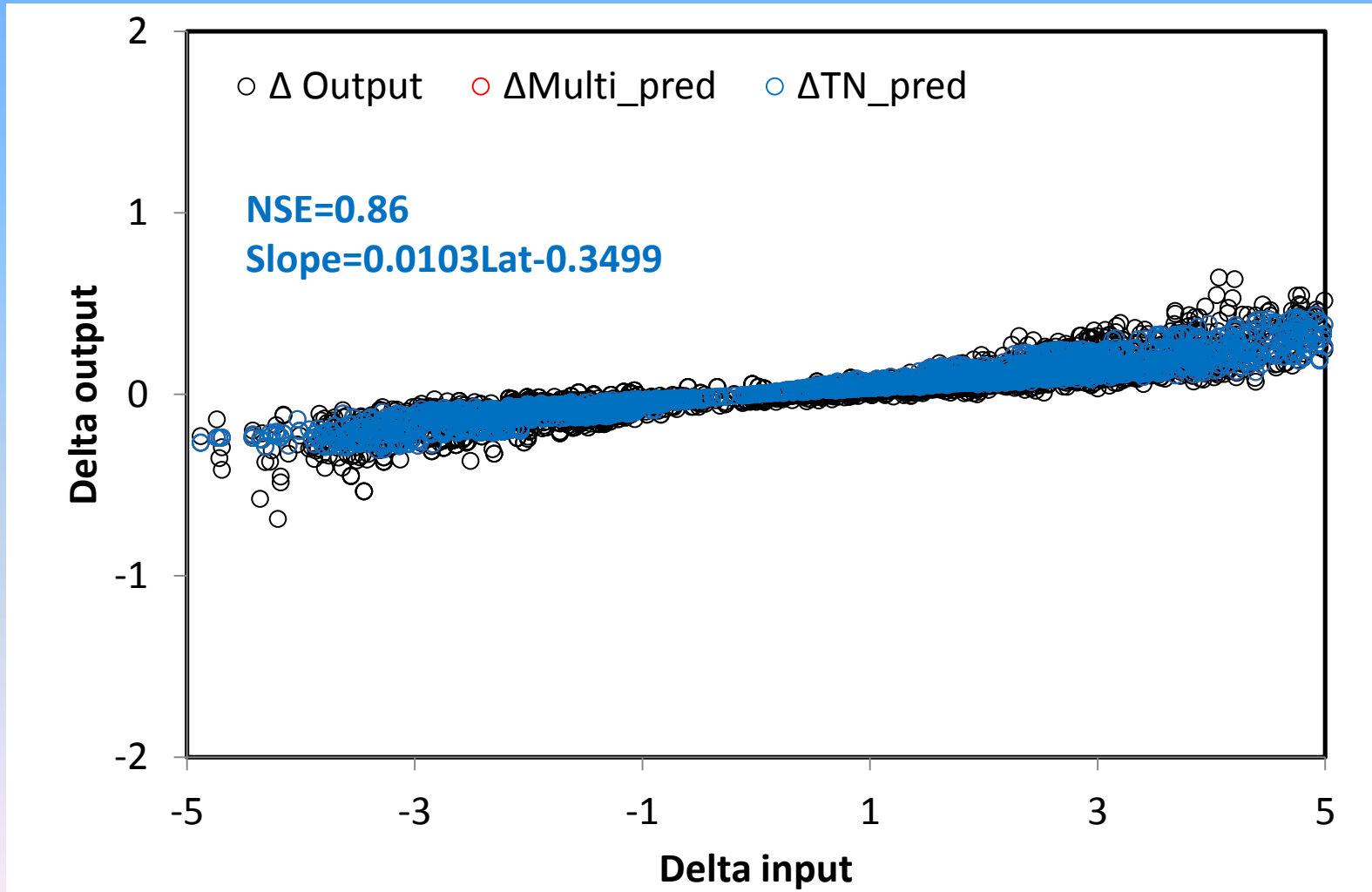
Regression slope versus latitude on forest



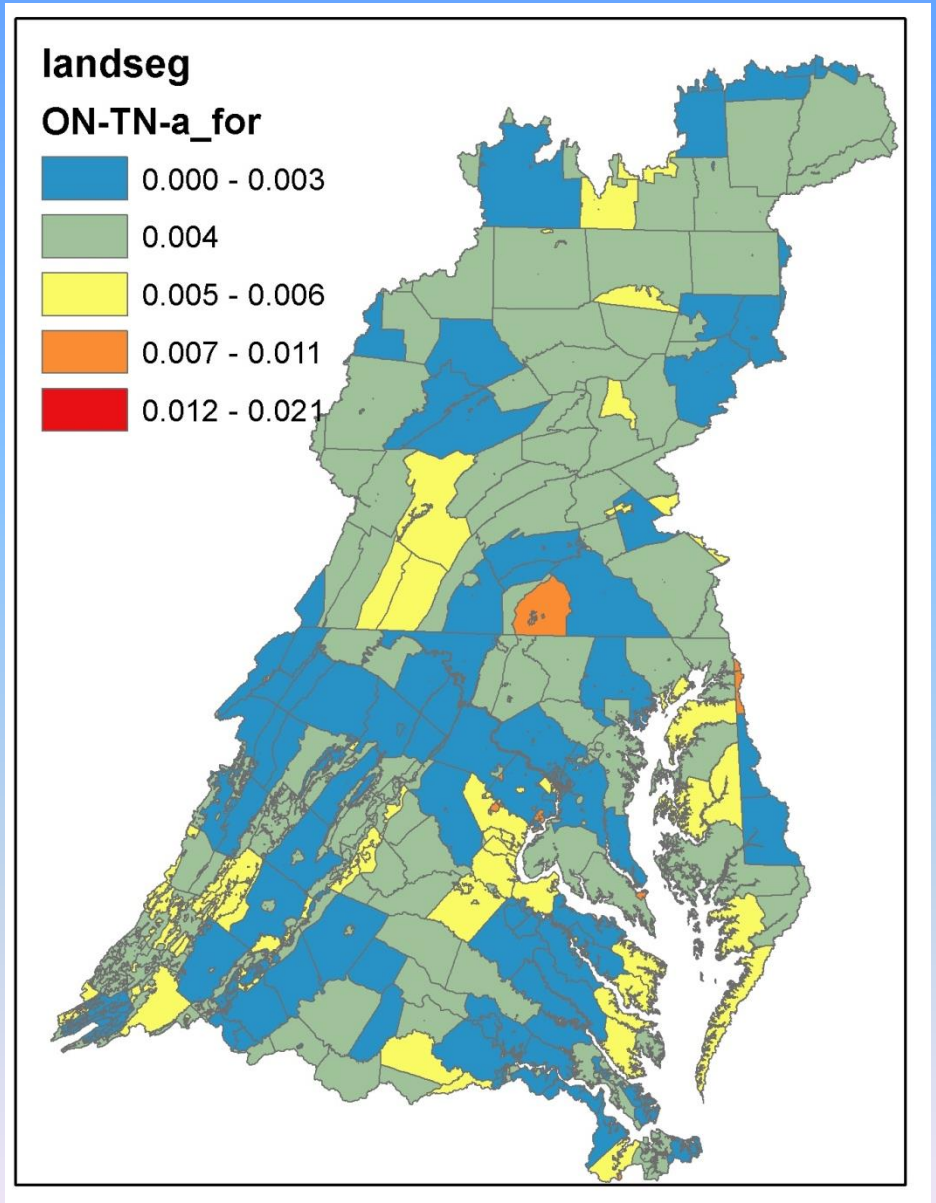
TN output versus regression prediction using median slope and crossing calibration point (forest)



TN output versus regression prediction using latitude-derived slope and crossing calibration point (forest)



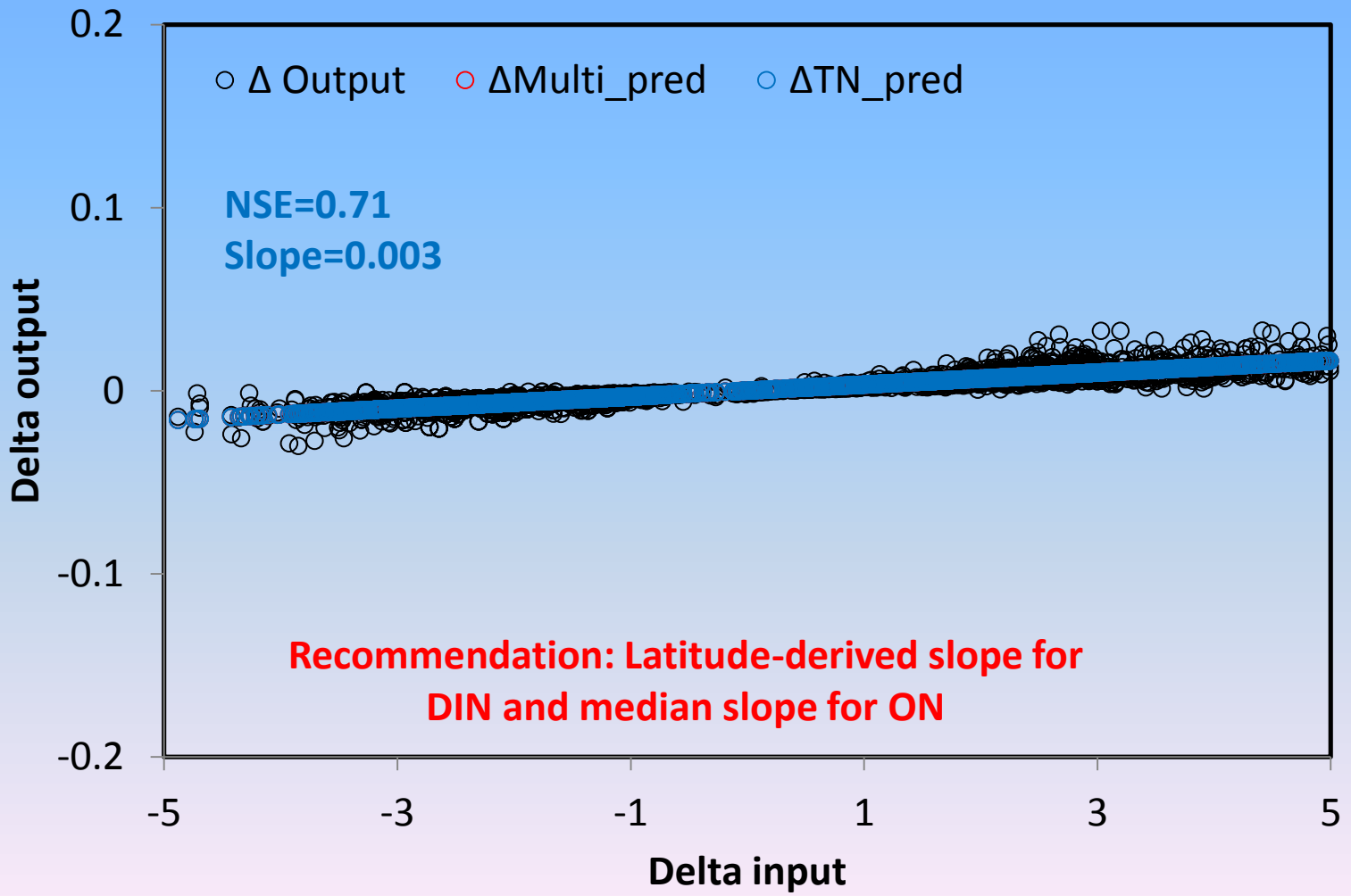
Regression slope of ON output versus total input regression on forest



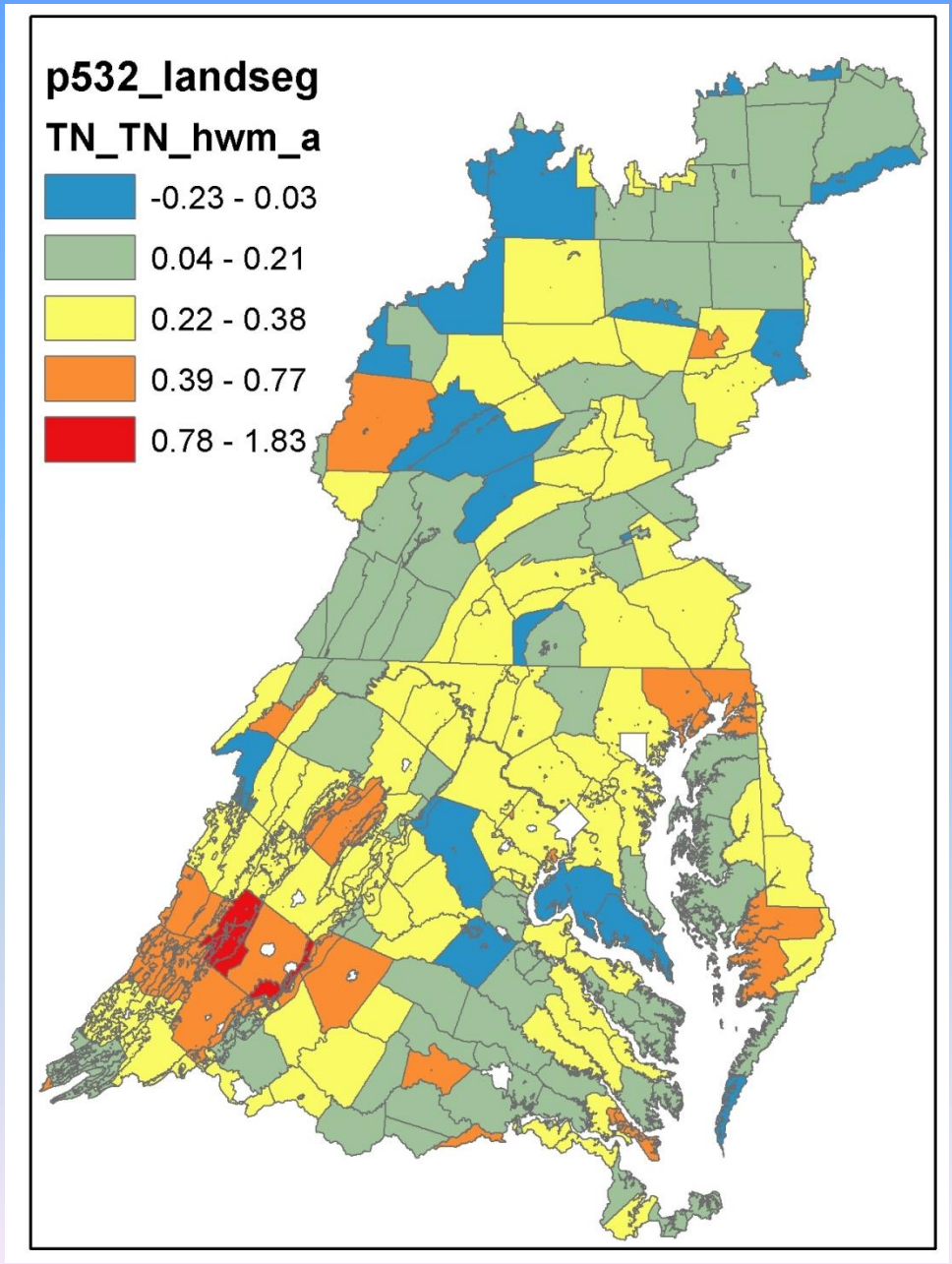
No predictable pattern

Mean=0.004
Median=0.003
std=0.002

Organic nitrogen output versus regression prediction using median slope and crossing calibration point (forest)



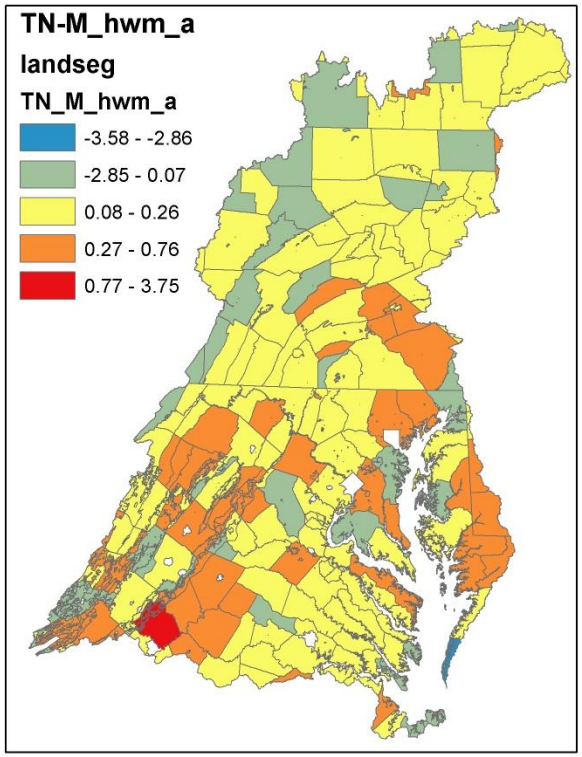
Regression slope on High-tillage cropland with manure (HWM) – Non predictable pattern



Mean=0.24
Median=0.21
std=0.24

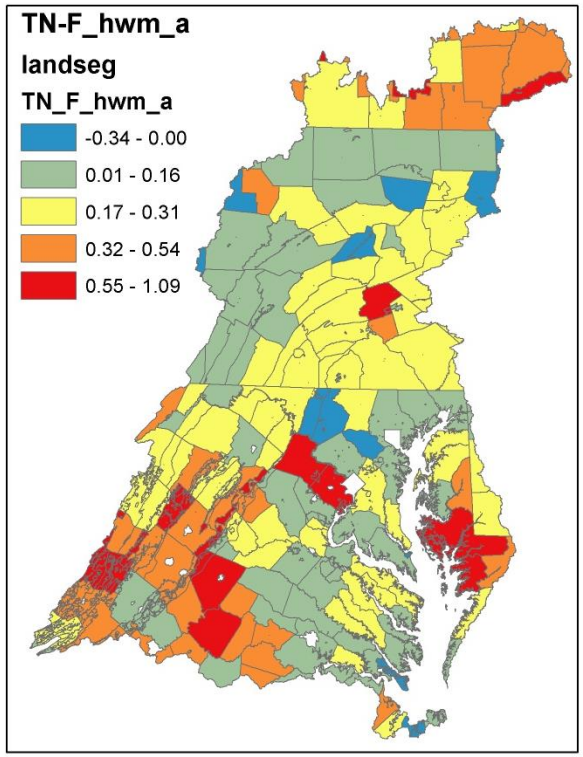
Slope of regression between TN output and multi-variate regression on HWM

Manure



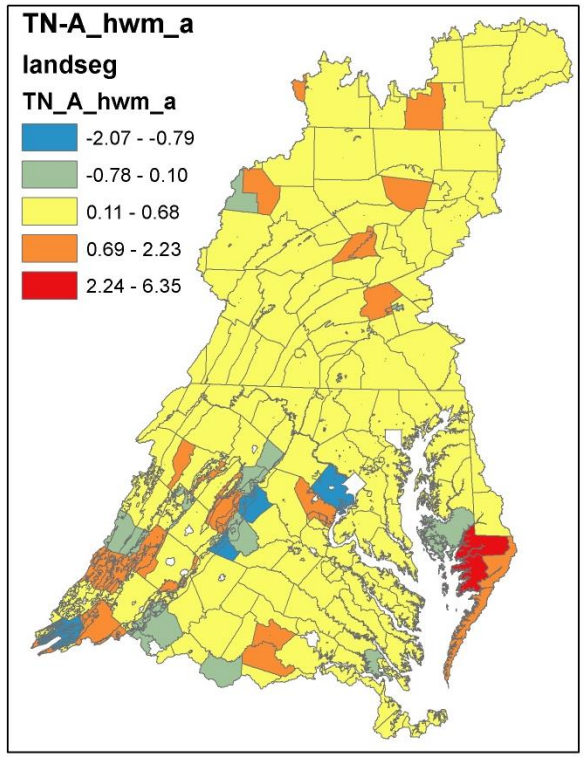
Mean=0.21
Median=0.19
std=0.43

Fertilizer



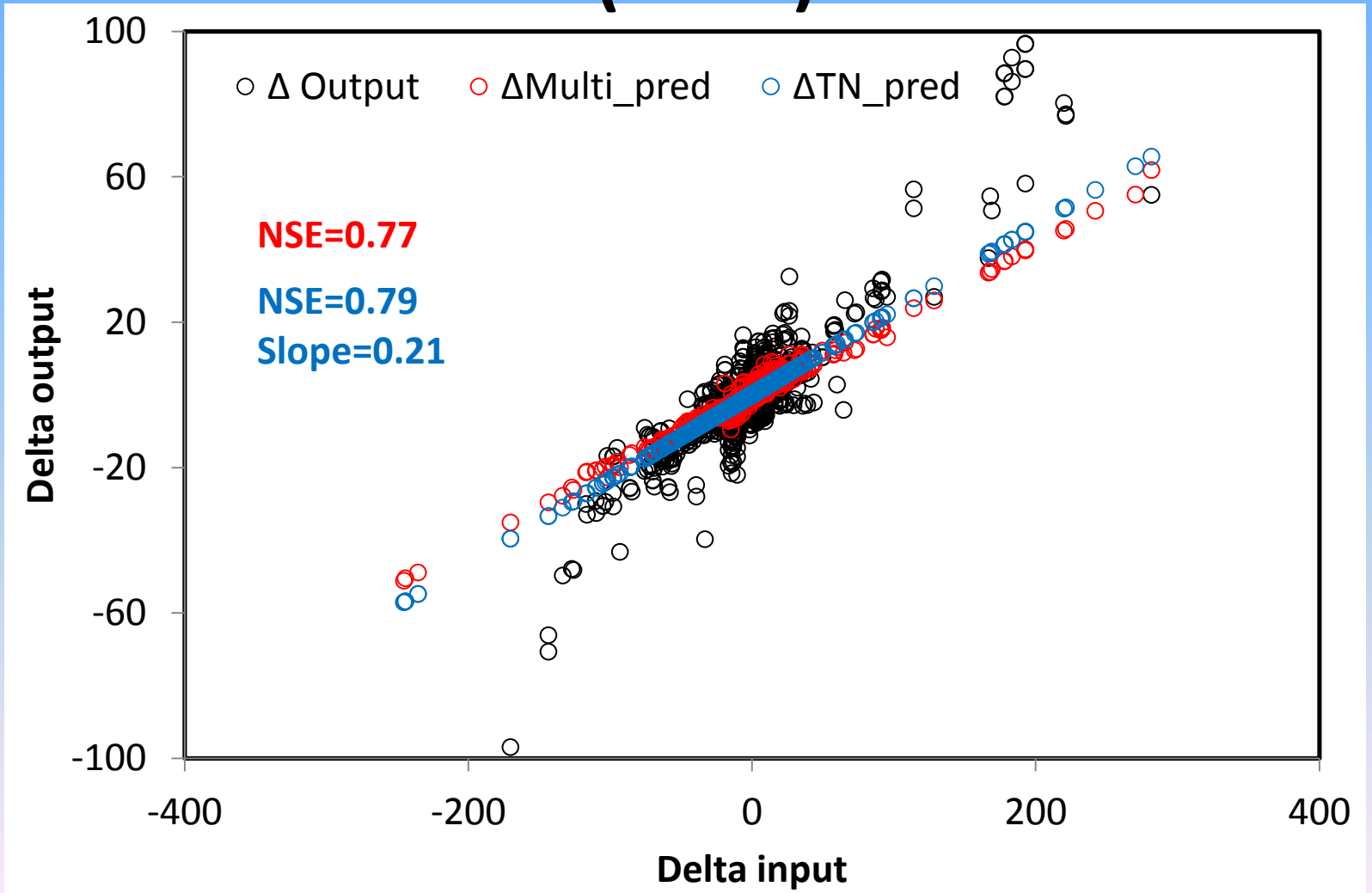
Mean=0.26
Median=0.29
std=0.60

Atmdep

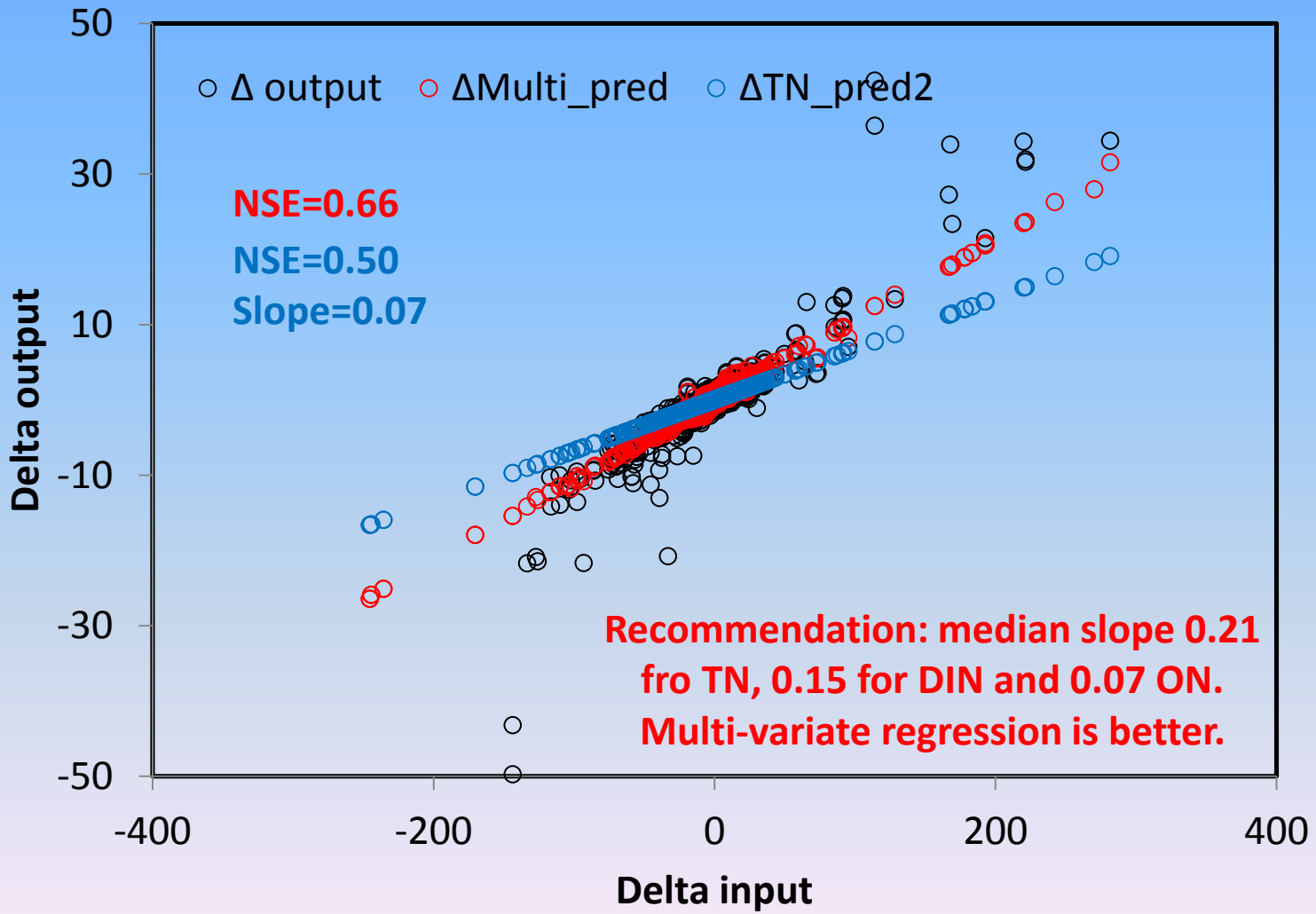


Mean=0.38
Median=0.35
std=0.45

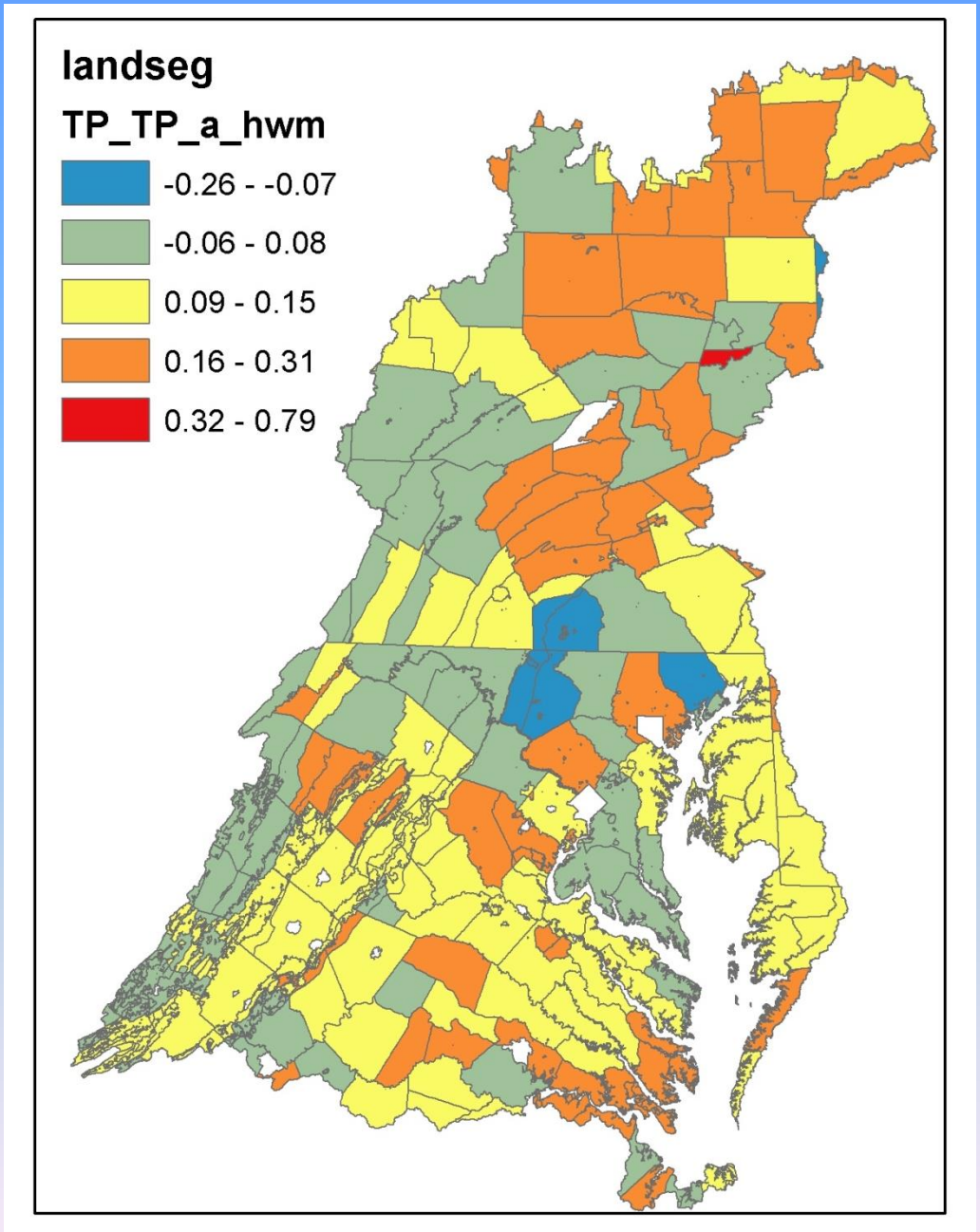
TN output versus regression prediction using median slope and crossing calibration point (hwm)



Demeaned total loading versus model Organic N output and regression prediction on hwm

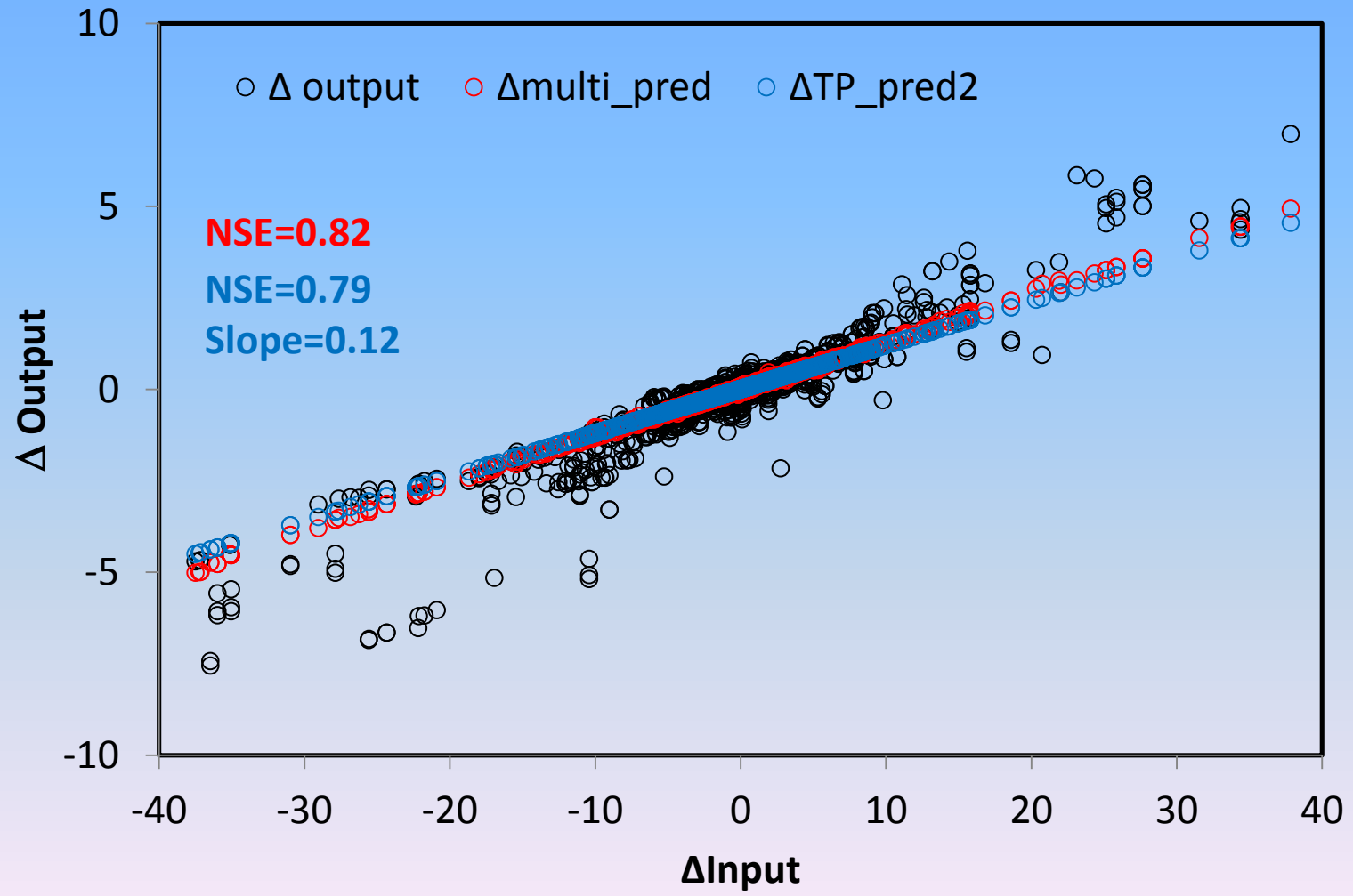


Regression slope between TP input and output on hwm

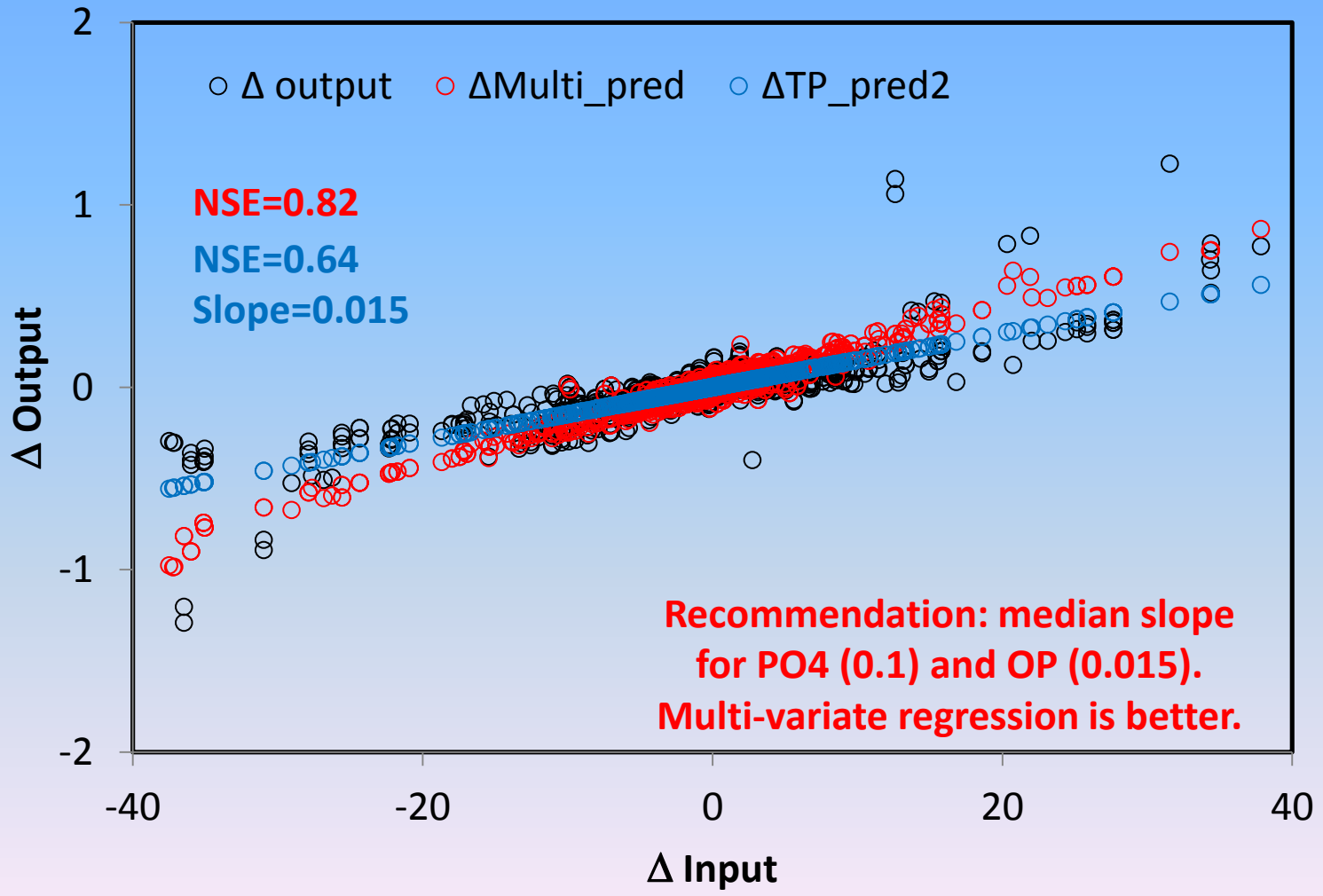


Mean=0.12
Median=0.12
std=0.09

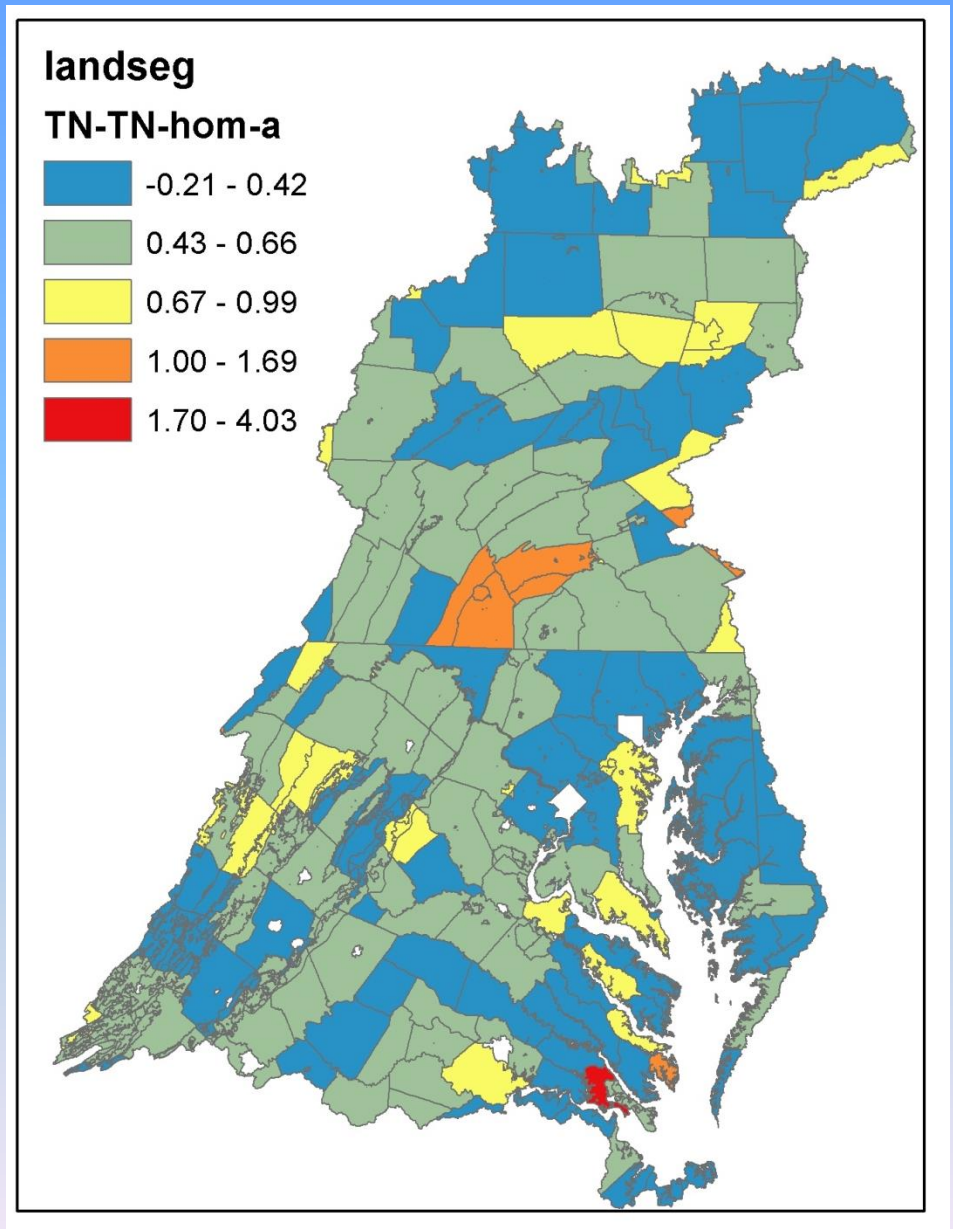
NSE of total phosphorus prediction using median slope for hwm



Demeaned total loading versus model OP output and regression prediction on hwm



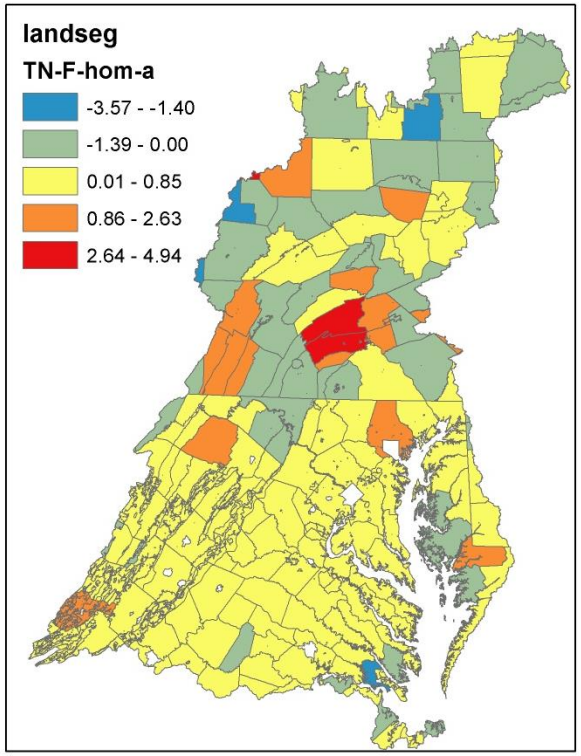
Regression slope: TN output versus total input on high-tillage cropland without manure (hom)



Mean=0.53
Median=0.48
std=0.37

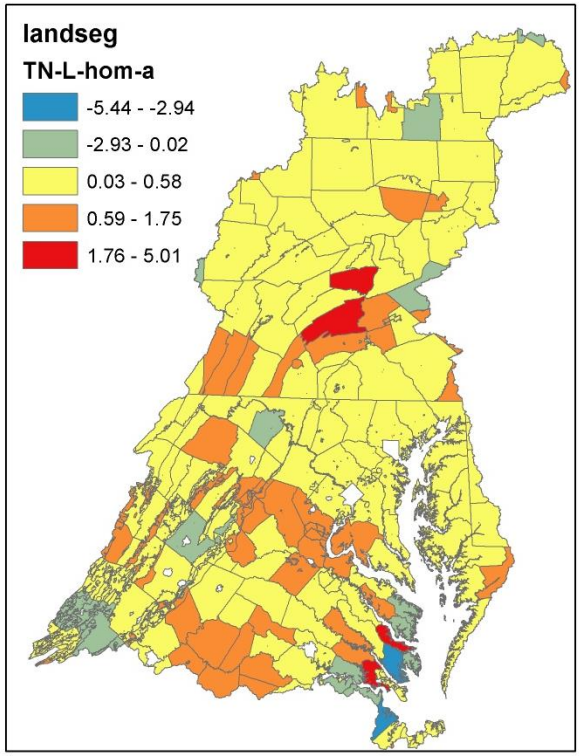
Slopes of multi-variate regression of Total-N output on high-tillage cropland without manure (hom)

Fertilizer



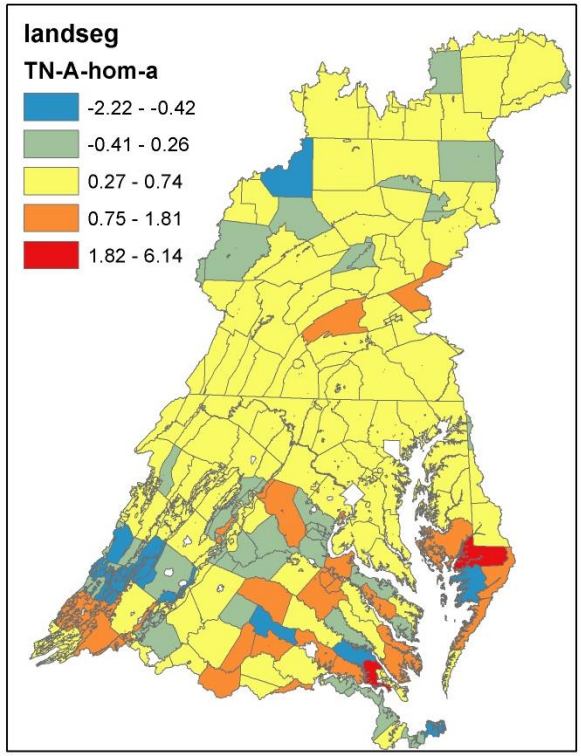
Mean=0.25
Median=0.23
Std=0.72

Legume



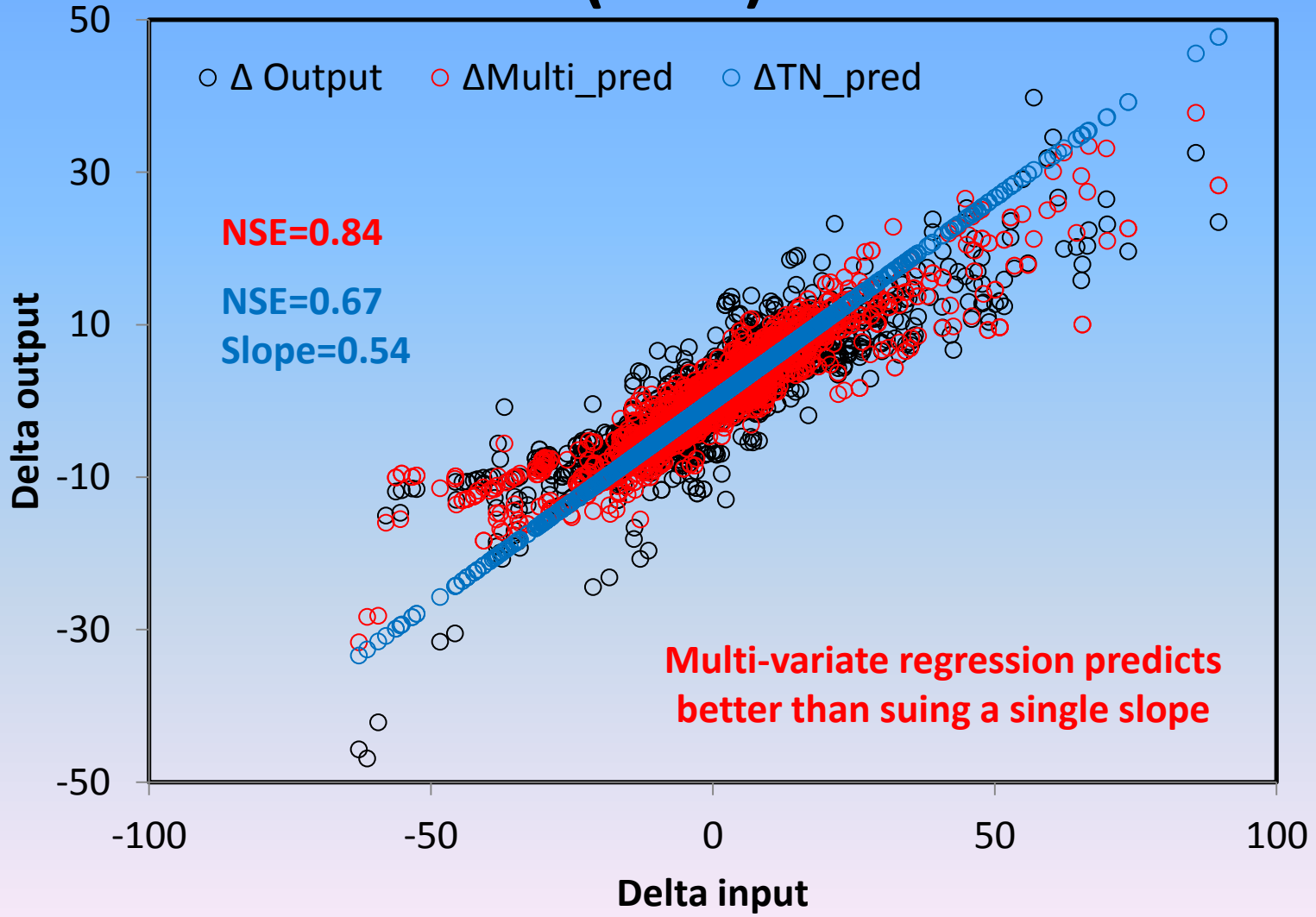
Mean=0.44
Median=0.43
Std=0.62

Atmdep

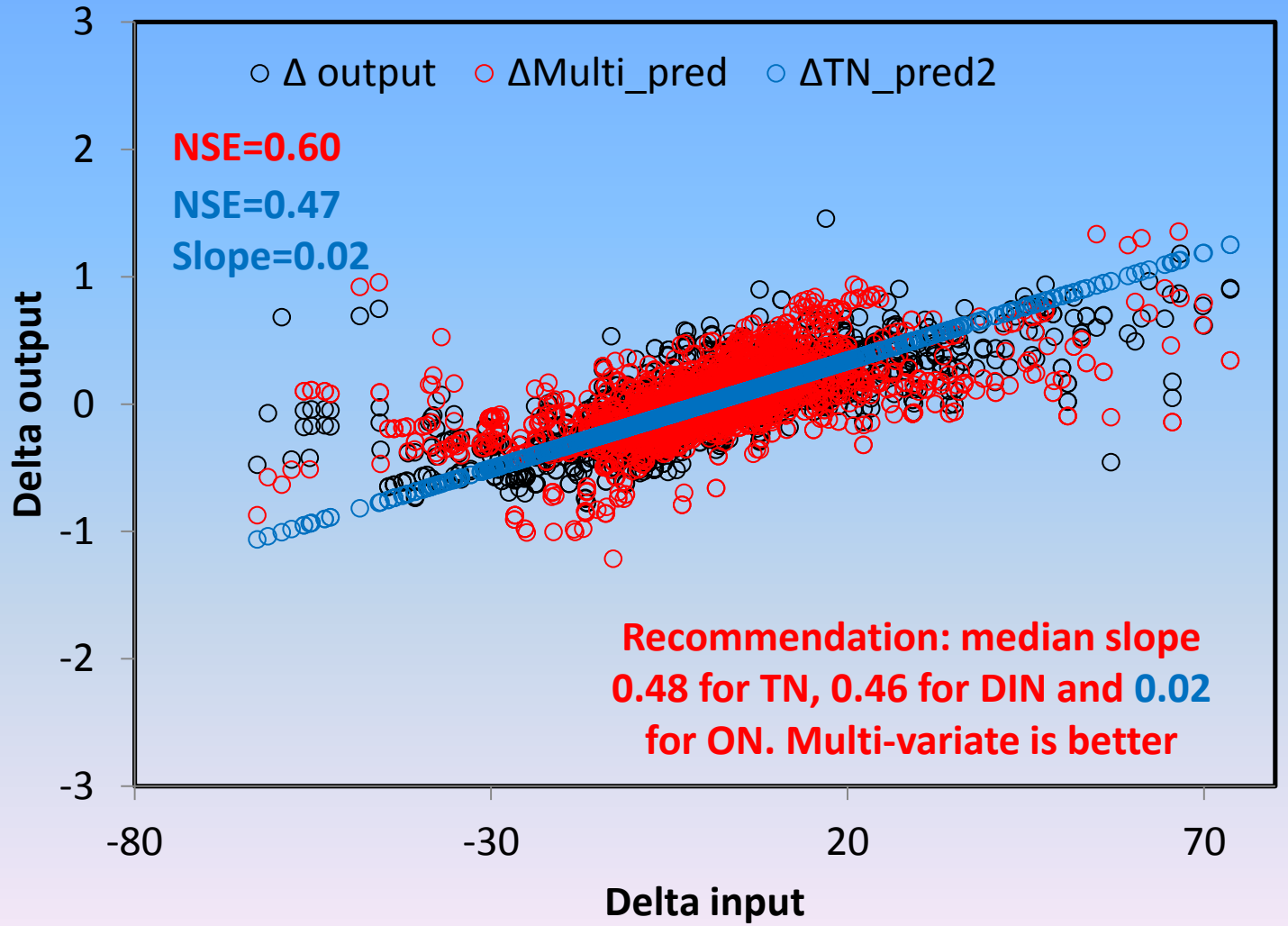


Mean=0.45
Median=0.44
Std=0.56

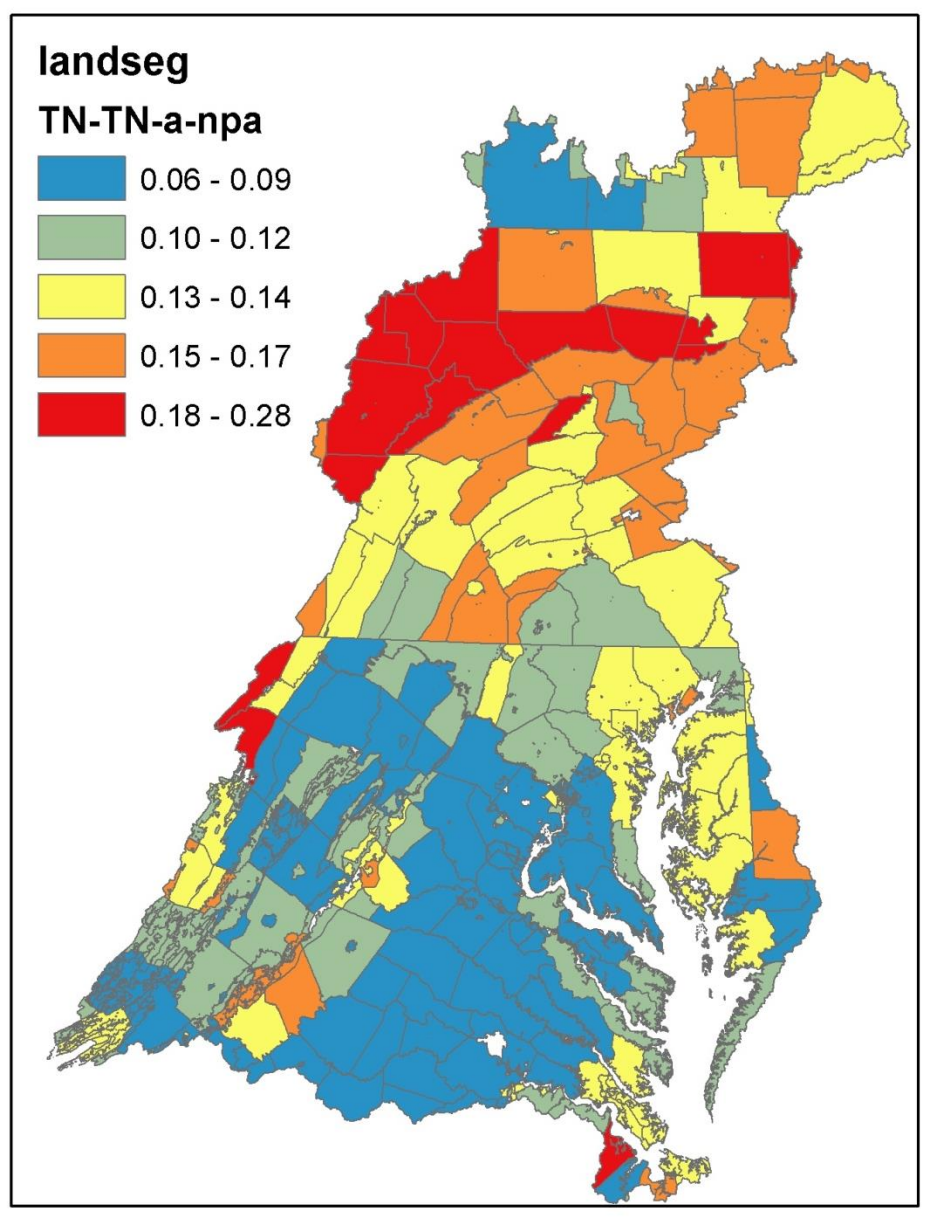
Total nitrogen output versus regression prediction using meadian slope and crossing calibration point (hom)



Demeaned total loading versus model Organic N output and regression prediction (hom)



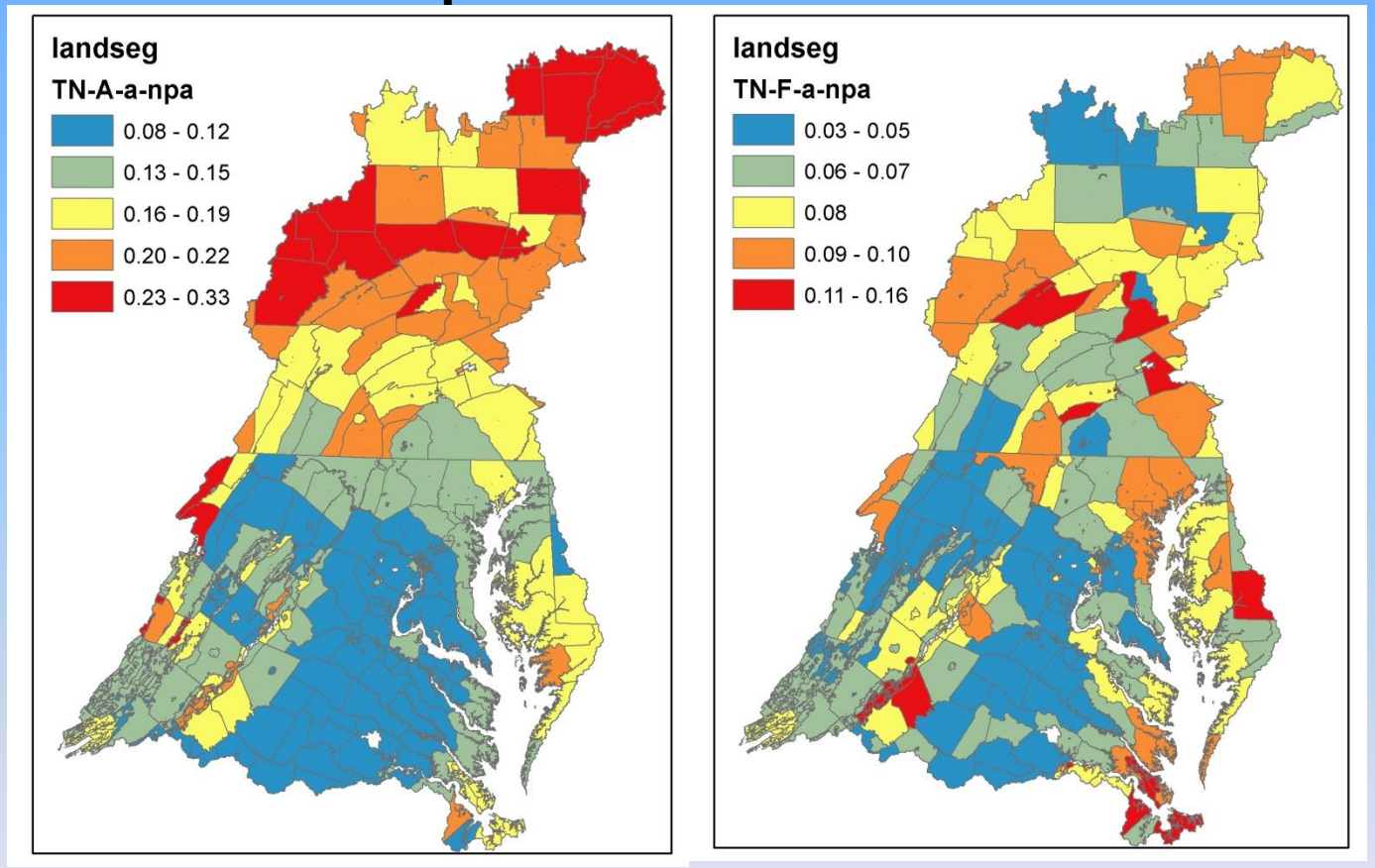
Regression slope of TN output versus total input on urban area (npd)



Mean=0.12
Median=0.12
std=0.035

Slopes of multi-variate regression for TN In urban area (npd)

Atmdep.

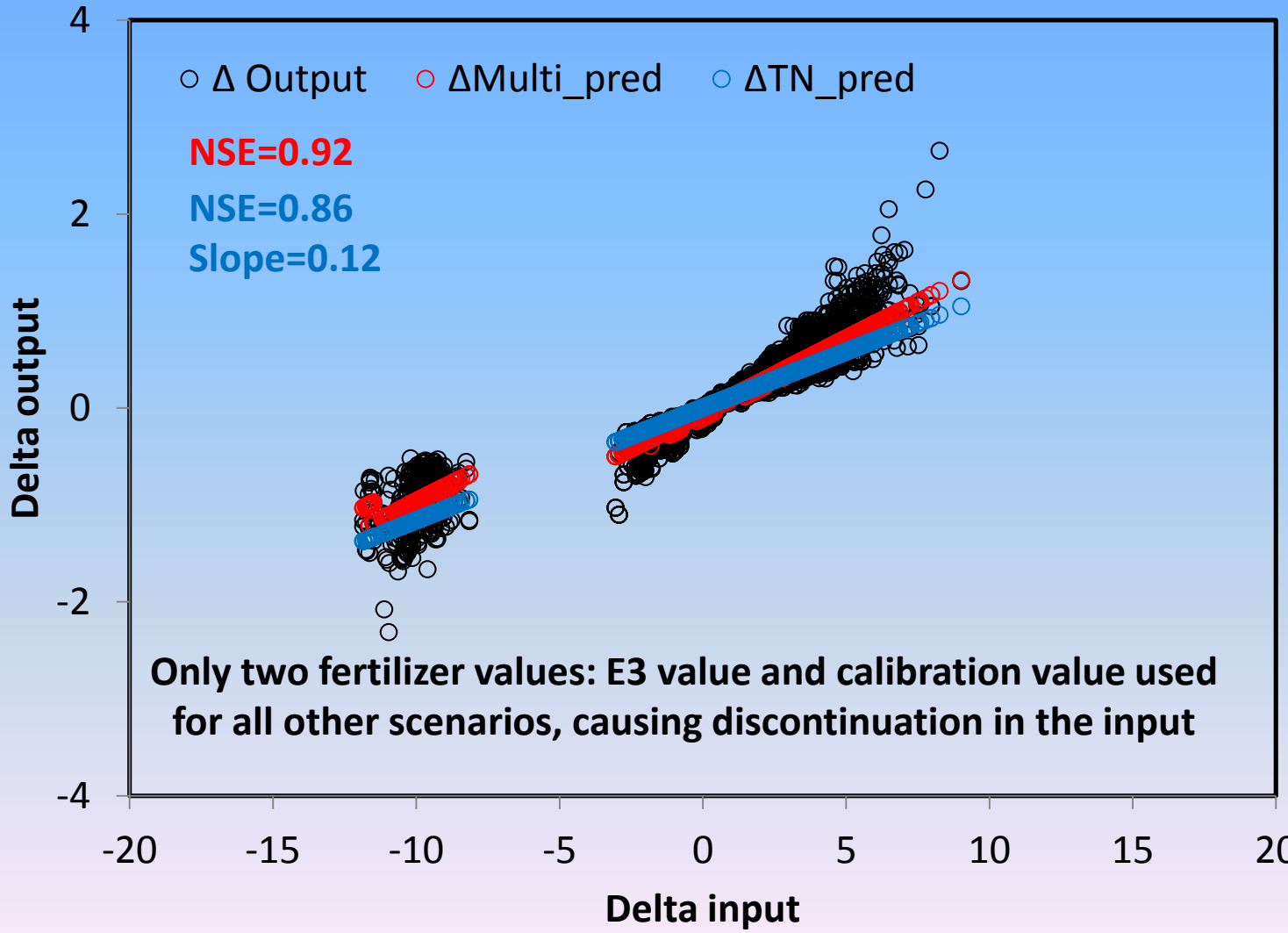


Mean=0.16
Median=0.15
std=0.05

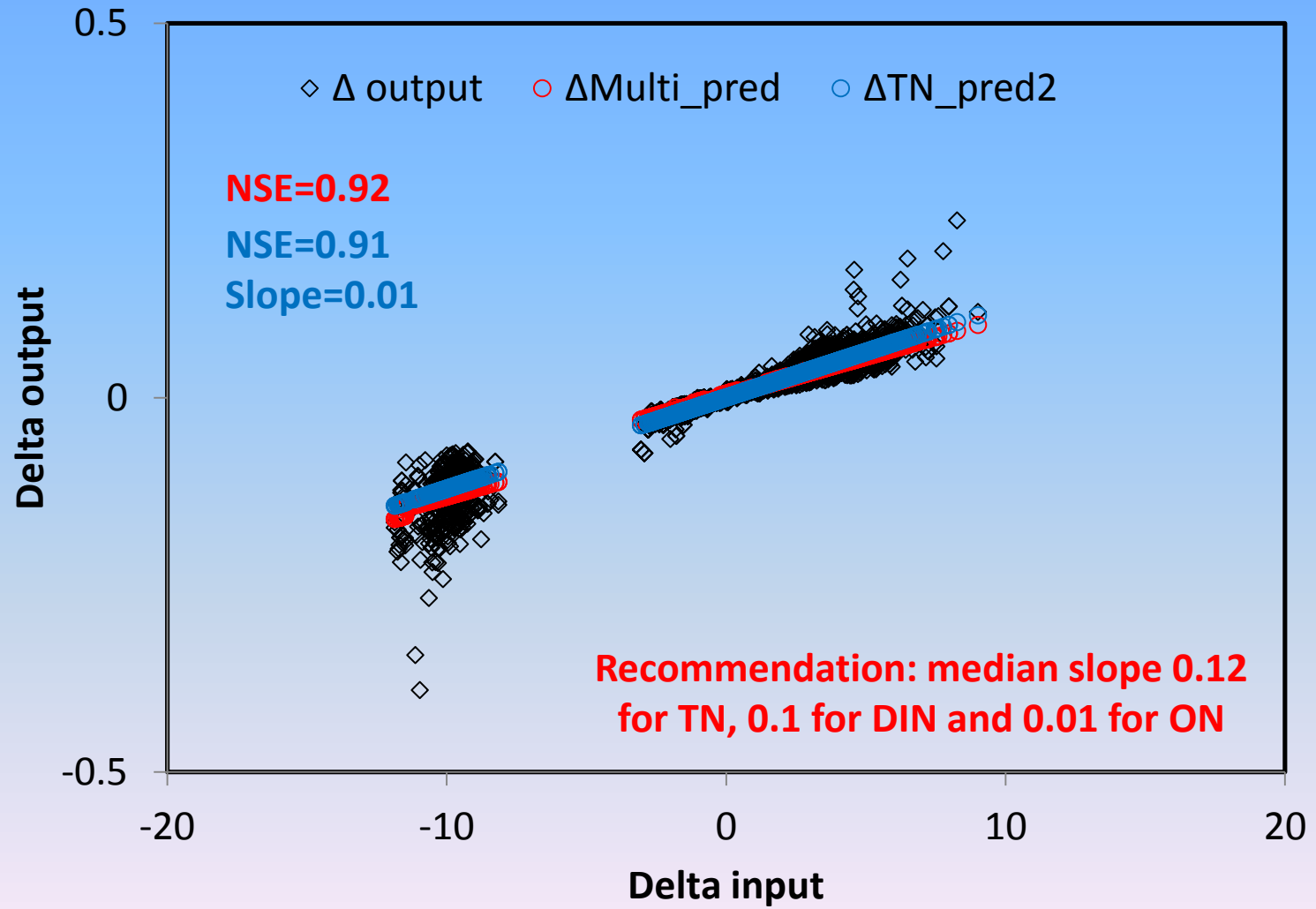
Fertilizer

Mean=0.07
Median=0.07
std=0.02

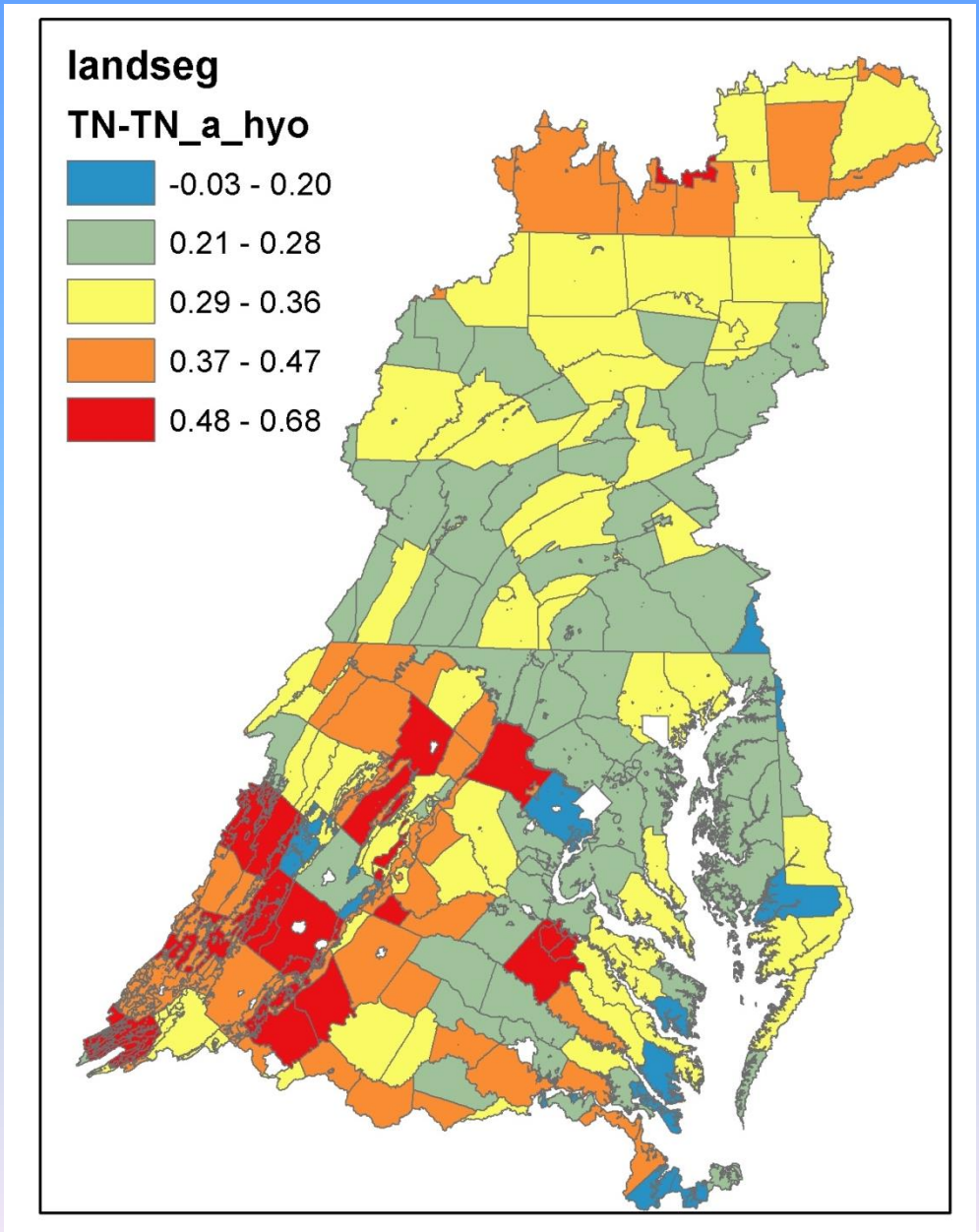
Demeaned total loading versus model TN output and regression prediction (npd)



Demeaned total loading versus model Organic N output and regression prediction (npd)



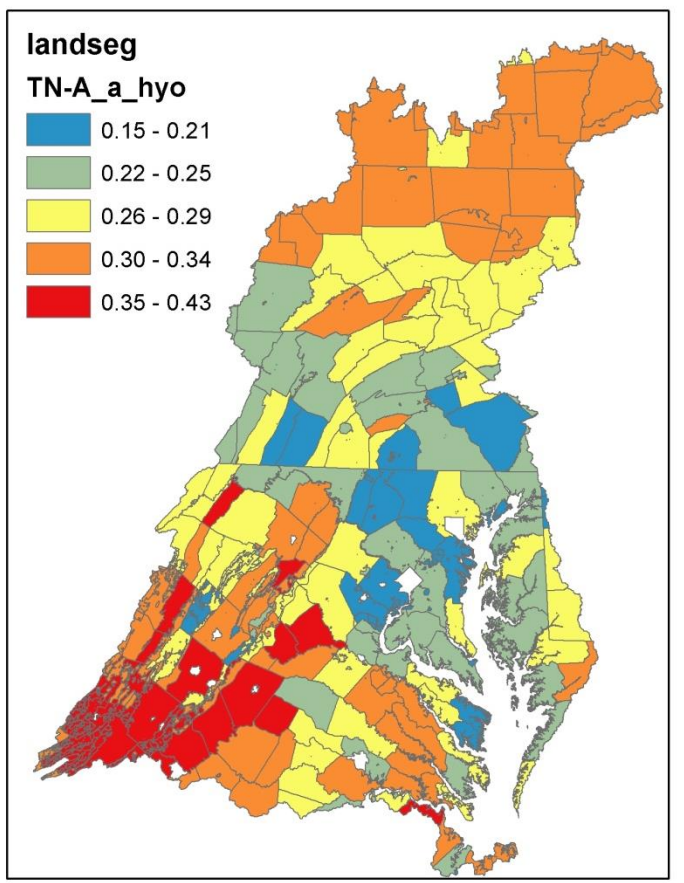
Regression slope of TN output versus input on hay without nutrient (hyo)



Mean=0.32
Median=0.30
std=0.1

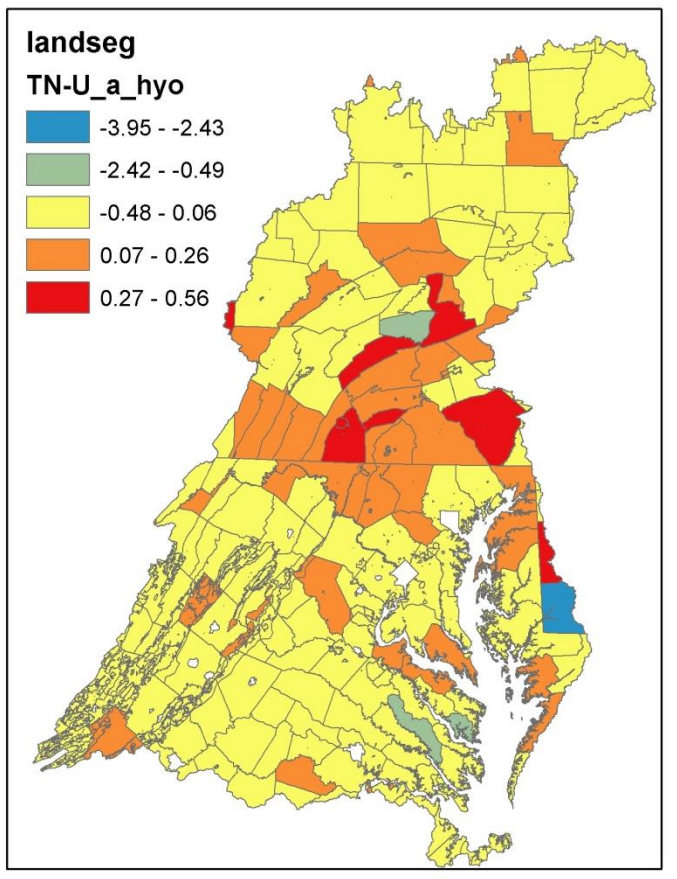
Multi-variate regression slopes for TN output on hay without nutrient (hyo)

Atmdep.



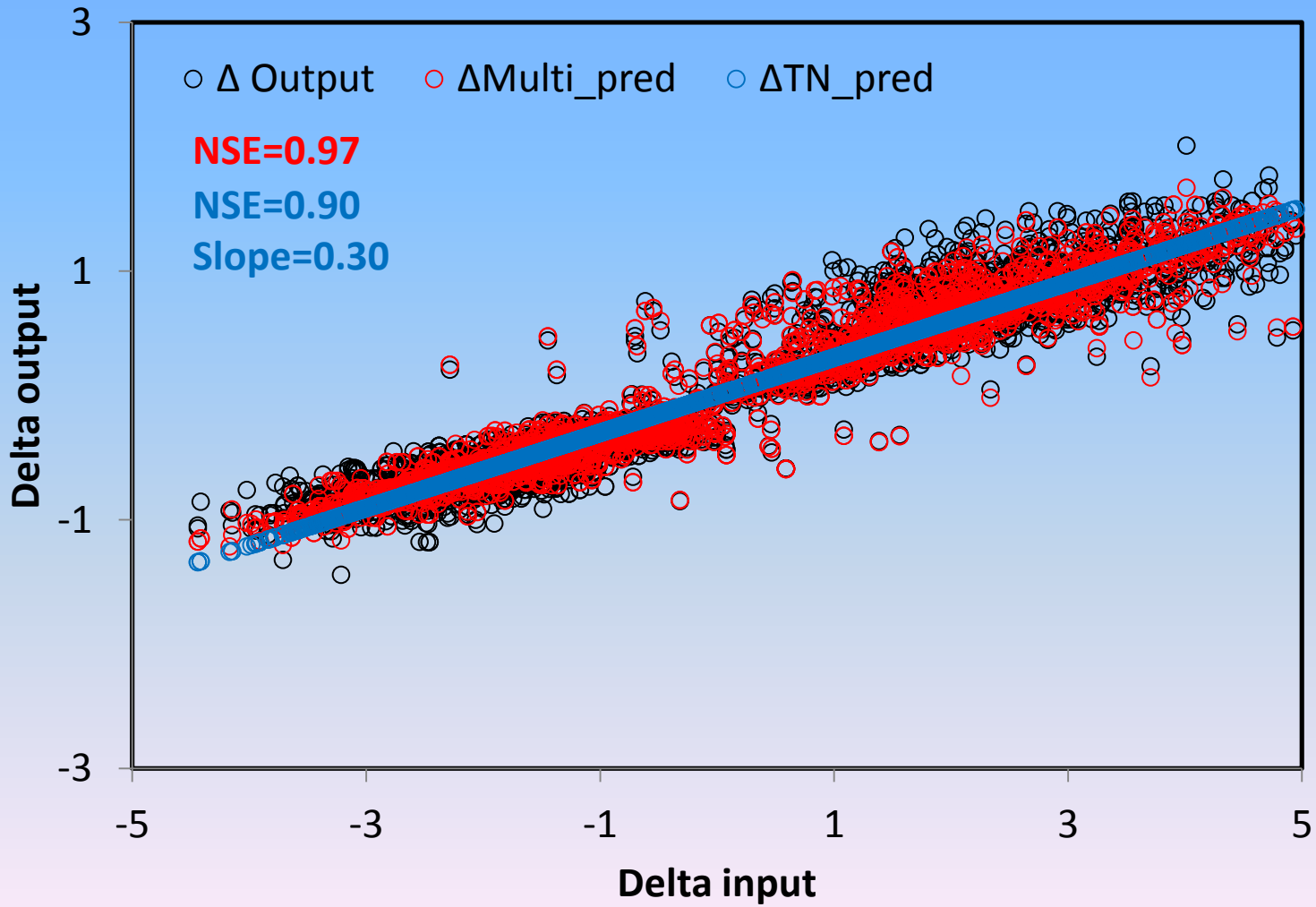
Mean=0.28
Median=0.27
std=0.05

Uptake

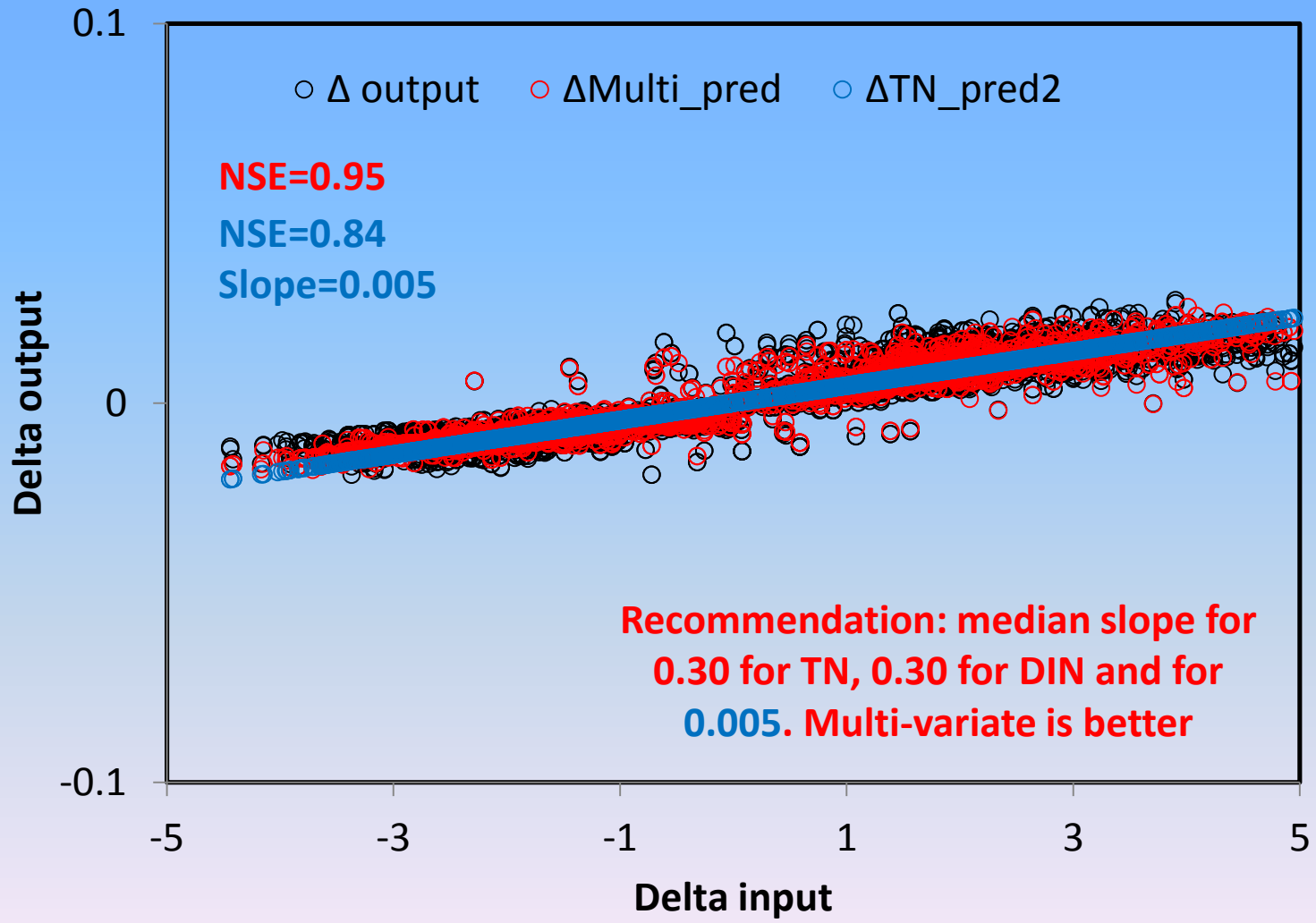


Mean=0.008
Median=0.02
std=0.3

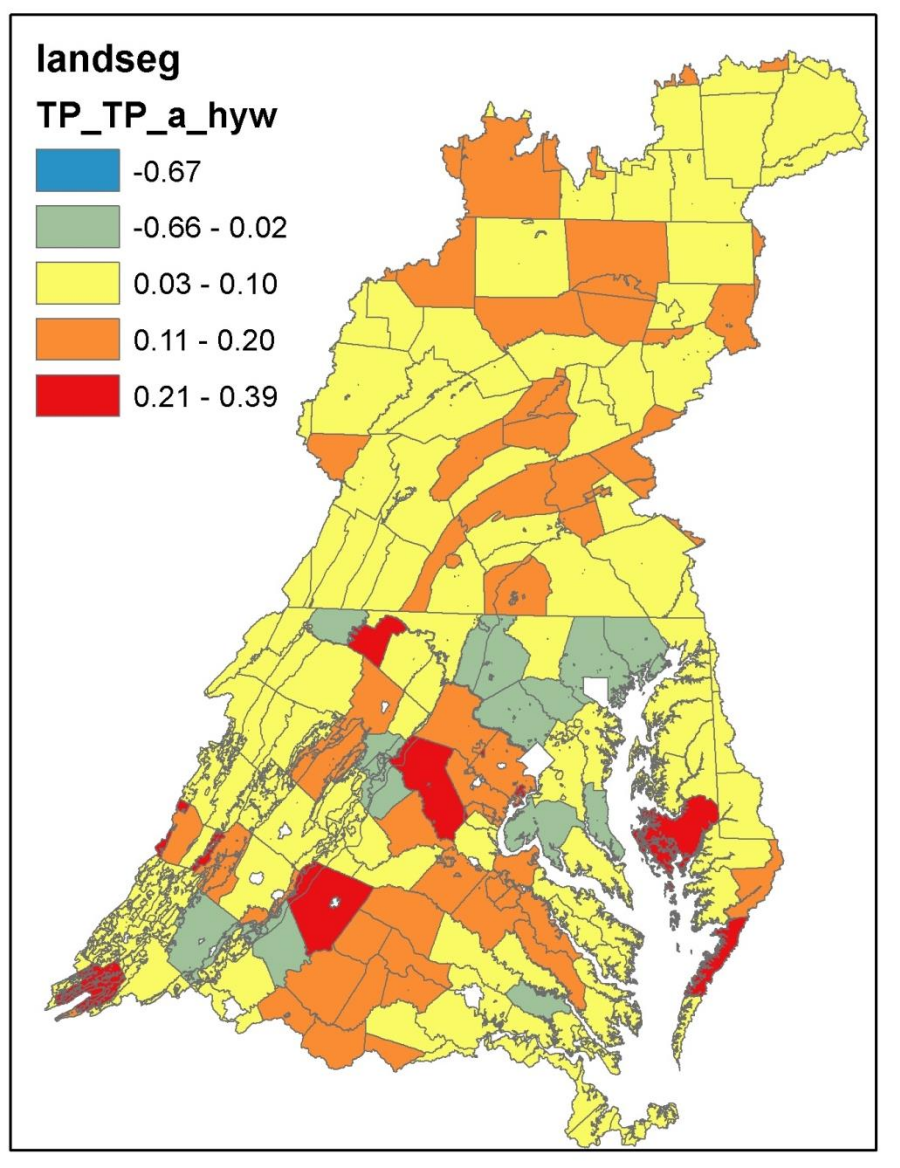
Total nitrogen output versus regression prediction using median slope and crossing calibration point (hyo)



Demeaned total loading versus model Organic N output and regression prediction (hyo)



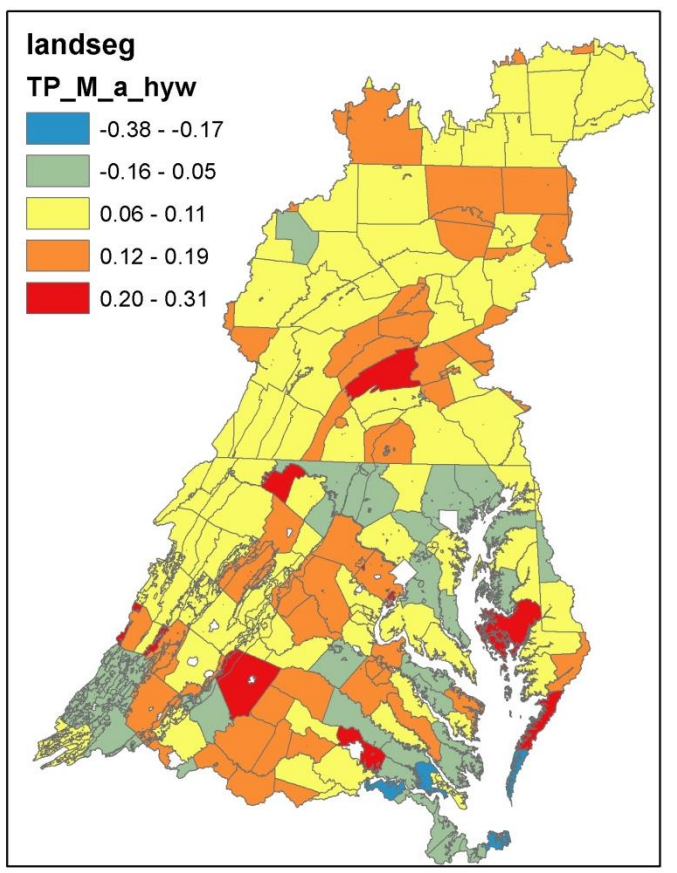
Regression slope for TP output versus total input on hay with nutrient (hyw)



Mean=0.09
Median=0.08
std=0.08

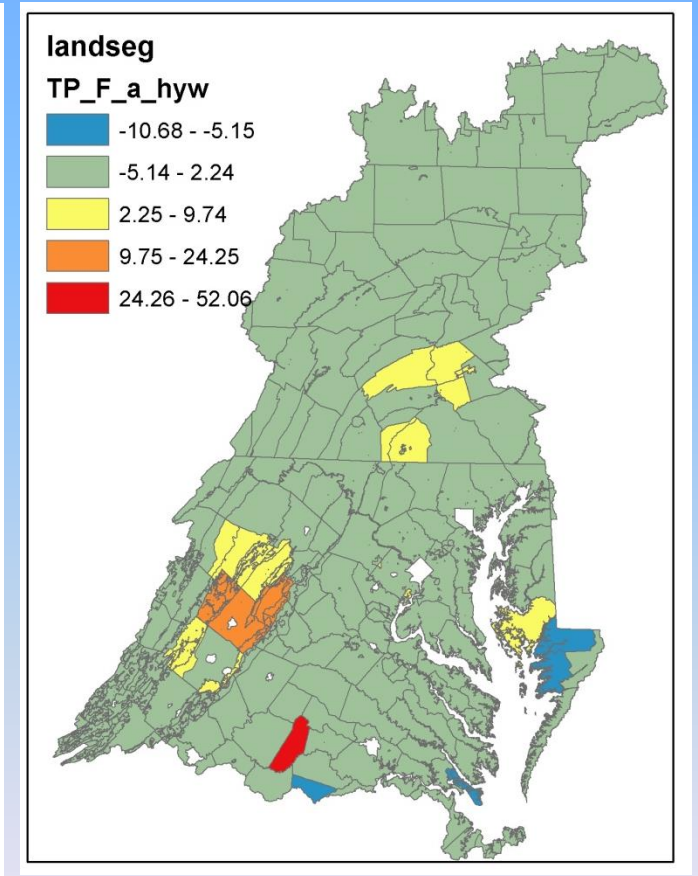
Multi-variate regression slopes for TP output on hay with nutrient (hyw)

Manure



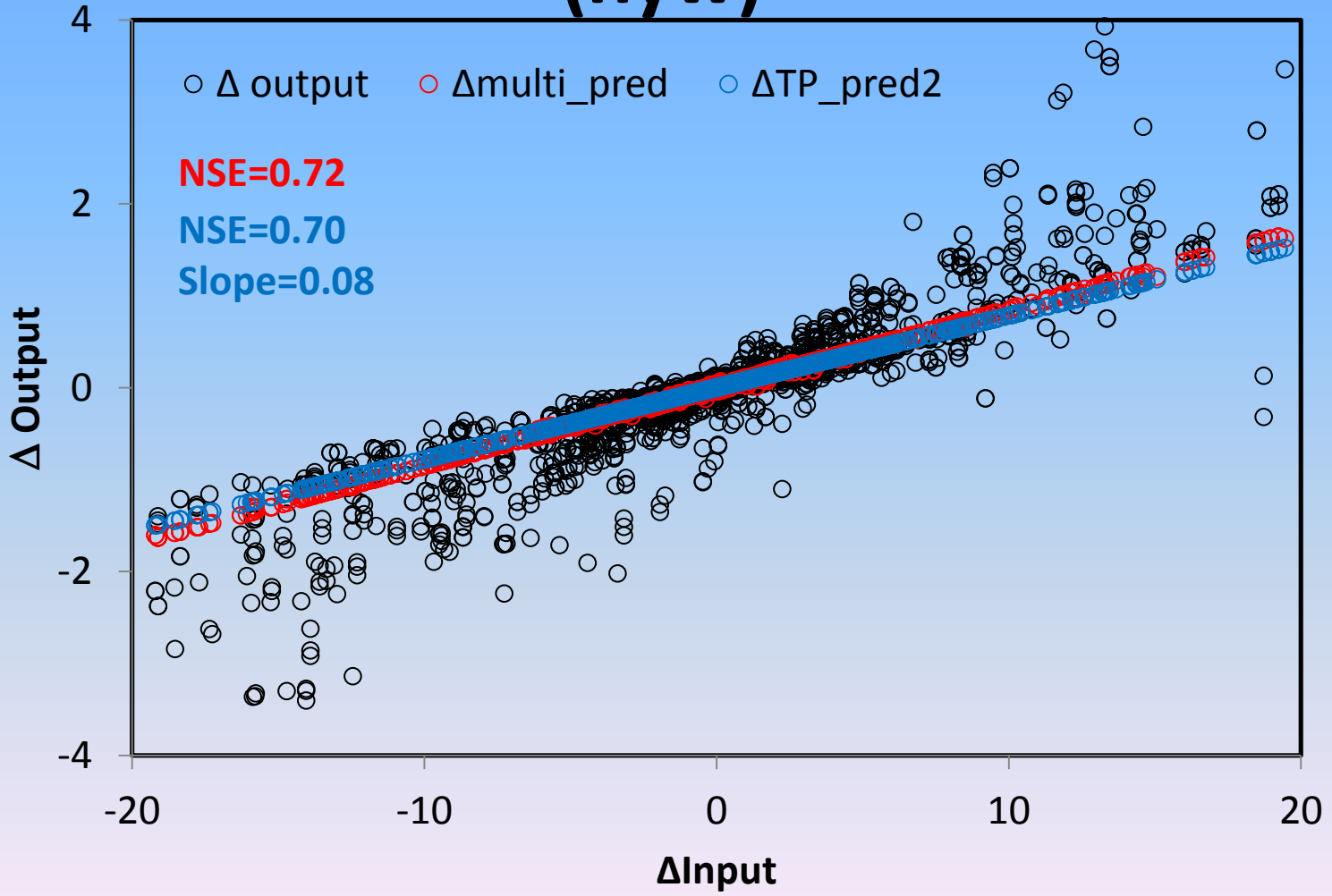
Mean=0.08
Median=0.09
std=0.08

Fertilizer

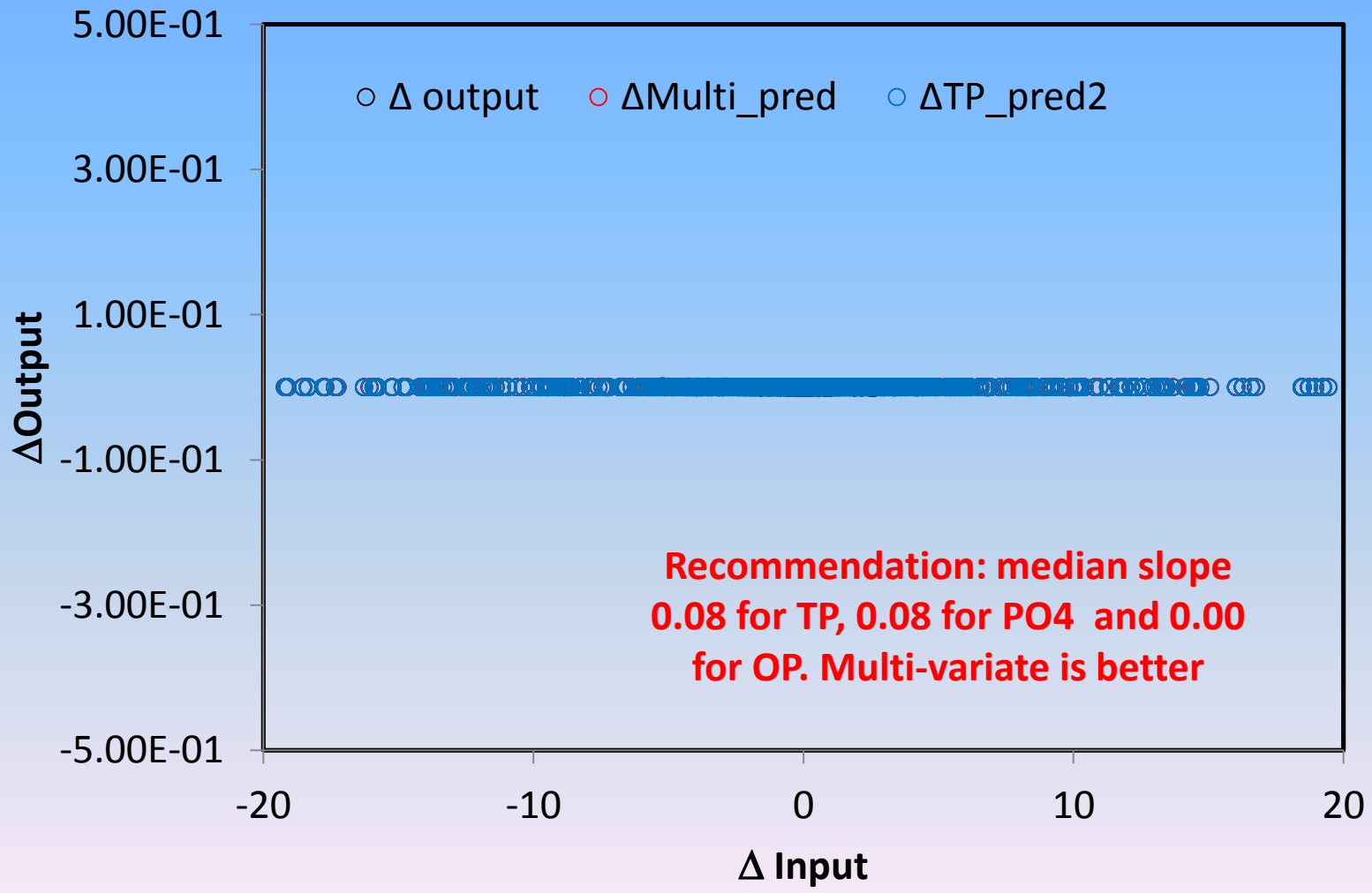


Mean=0.89
Median=0.10
std=4.4

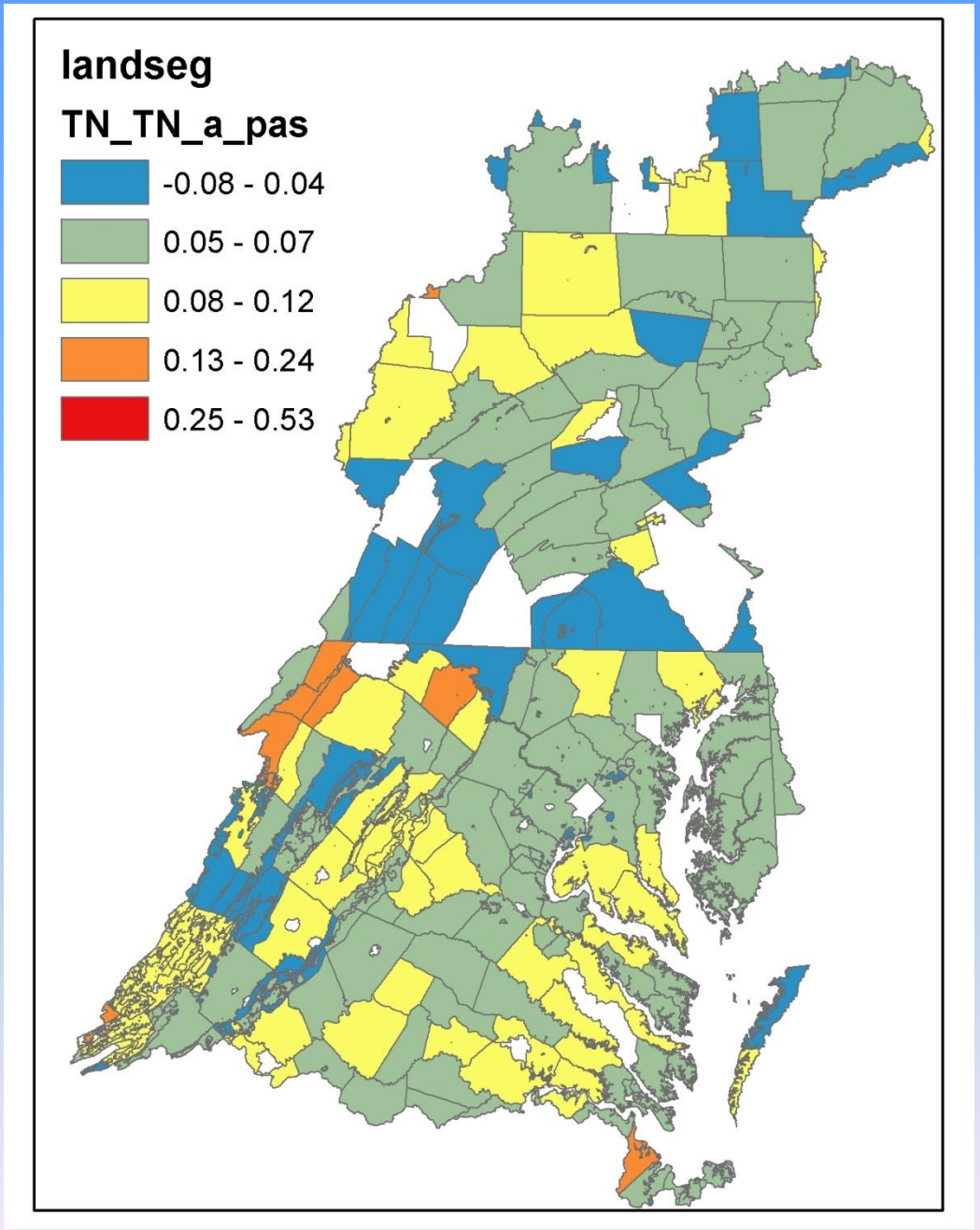
Demeaned TP loading versus model output and regression prediction on hay with nutrient (hyw)



Demeaned total loading versus model OP output and regression prediction (hyw)



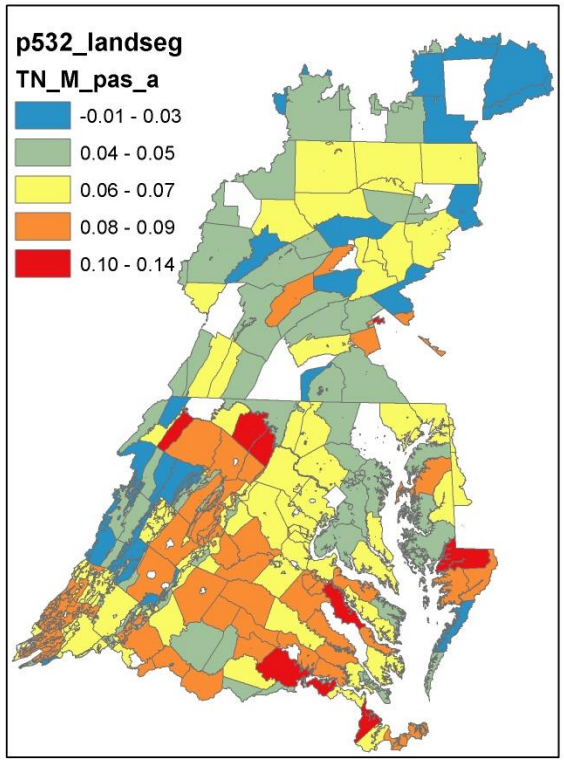
Regression slope for TN output versus input on pasture (pas)



Mean=0.065
Median=0.06
Std=0.05

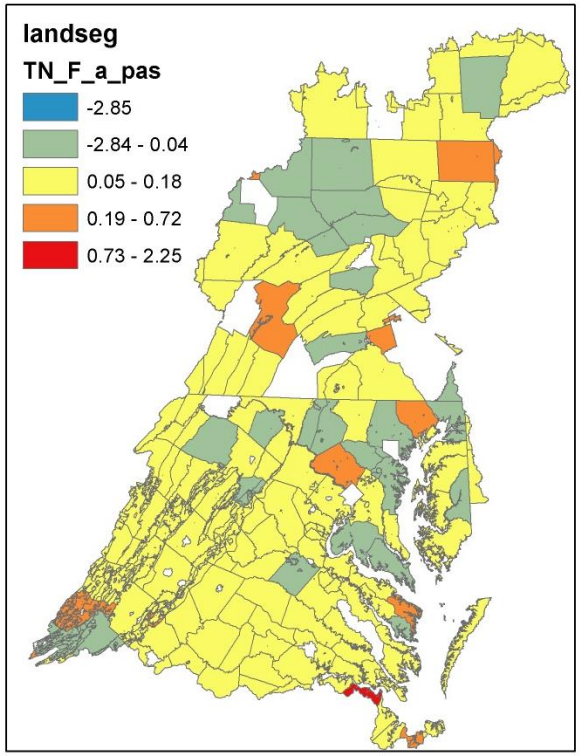
Slopes of multi-variate regression for TN output on pasture (pas)

Manure



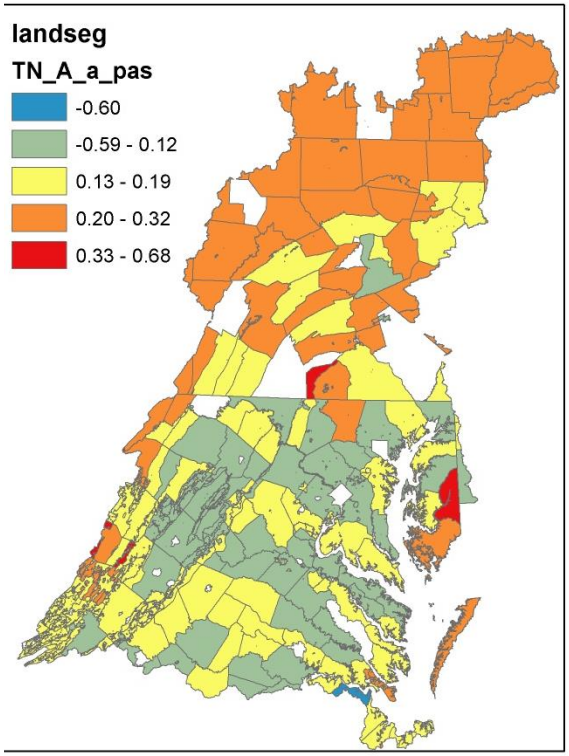
Mean=0.06
Median=0.06
std=0.05

Fertilizer



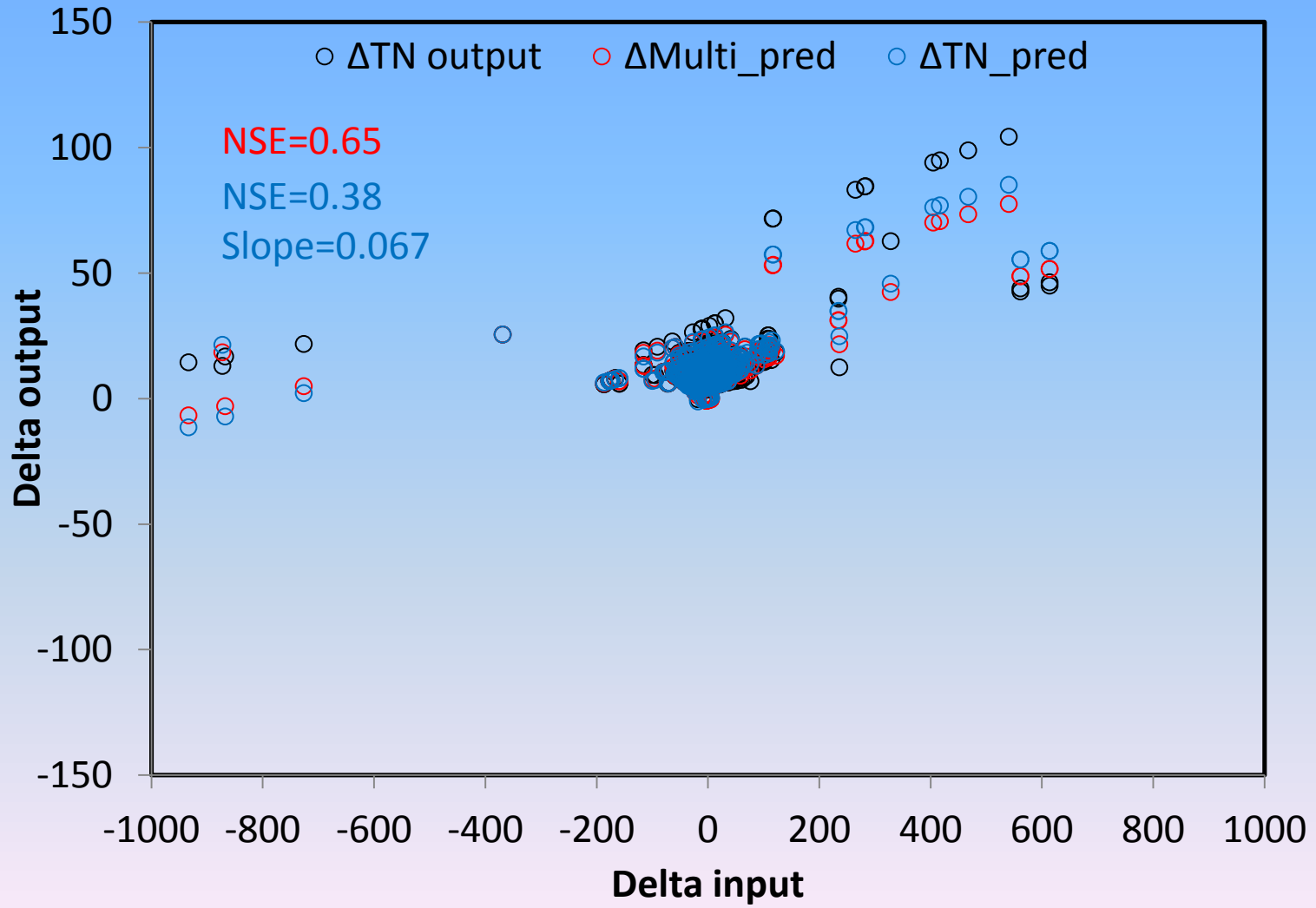
Mean=0.12
Median=0.10
std=0.37

Atdep

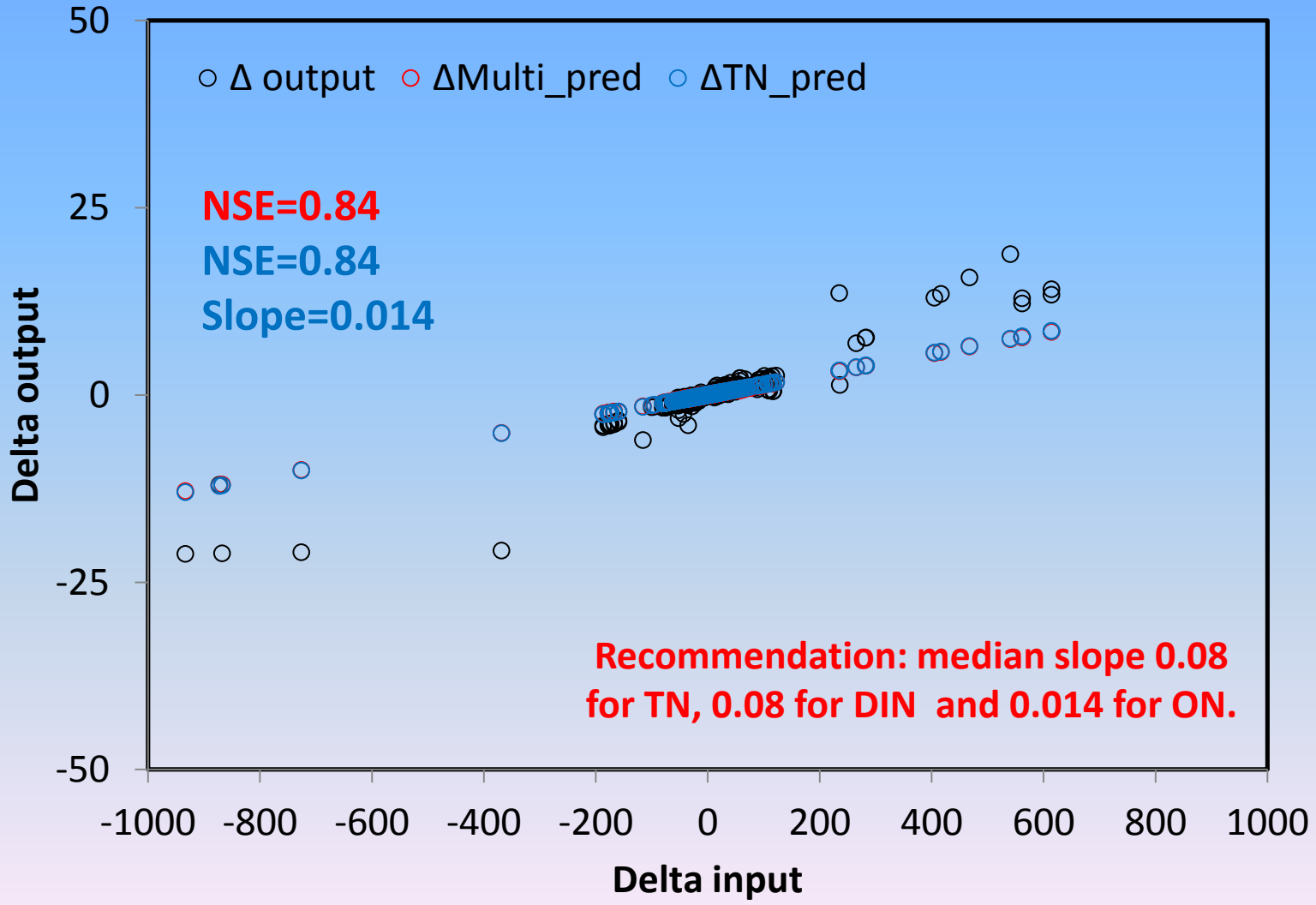


Mean=0.31
Median=0.15
Std=1.8

Demeaned total loading versus model total N output and regression prediction crossing calibration point (pas)



Demeaned total loading versus model ON output and regression prediction using average slope and crossing the calibration point (pas)



NSE of total input prediction

Land use	TN	DIN	ON	TP	PO4	OP
Forest	0.77	0.75	0.71			
Pasture	0.38	-0.9	0.84			
H-tillage w M	0.79	0.75	0.50	0.84	0.75	0.82
H-tillage w/o M	0.67	0.67	0.47	0.87	0.86	0.28
L-tillage w M	0.67	0.30	0.56	0.79	0.75	0.82
Alfalfa	0.48	0.41	0.50	0.60	0.61	0.16
Urban (npd)	0.96	0.91	0.92			
Hay w N (hyw)				0.70	0.70	ND
Hay w/o N (hyo)	0.90	0.90	0.84			

Rule for suggestion: TN is preferred over multi-variates prediction, but inorganic and organic forms are preferred over total output.

NSE of multi-variate prediction

Land use	TN	DIN	ON	TP	PO4	OP
Forest	0.77	0.75	0.71			
Pasture	0.65	0.05	0.84			
H-tillage w M	0.77	0.72	0.66	0.78	0.80	0.64
H-tillage w/o M	0.84	0.83	0.60	0.87	0.86	0.28
L-tillage w M	0.67	0.51	0.69	0.90	0.86	0.64
Alfalfa	0.81	0.78	0.45	0.76	0.74	0.33
Urban (npd)	0.92	0.91	0.92			
Hay w N (hyw)				0.72	0.72	ND
Hay w/o N (hyo)	0.97	0.97	0.95			

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

Slopes of multi-variate regression for TN

Land use	A	M	F	U	L
Forest	0.05				
Pasture	0.15	0.06	0.10		
H-tillage w M	0.38	0.21	0.26	-0.06	0.17
H-tillage w/o M	0.45		0.25	-0.013	0.45
L-tillage w M	0.45	0.21	0.28	-0.19	0.28
Alfalfa	0.22	0.08		0.21	
Urban (npd)	0.15		0.07		
Hay w N (hyw)					
Hay w/o N (hyo)	0.27			0.02	

A: Atmospheric deposition; M: Manure; F: Fertilizer; L: Legume; U: Uptake

TN is shown here to reduce the number of slides

Ratio between total input and output

Land use	TN	DIN	ON	TP	PO4	OP
Forest	0.29	0.13	0.16			
Pasture	0.07	0.05	0.02			
H-tillage w M	0.28	0.17	0.11	0.10	0.08	0.02
H-tillage w/o M	0.23	0.20	0.03	0.10	0.10	0.004
L-tillage w M	0.26	0.16	0.10	0.09	0.08	0.01
Alfalfa	0.73	0.62	0.11	0.09	0.09	0.003
Urban (npd)	0.22	0.07	0.15			
Hay w N (hyw)				0.08	0.08	0.004
Hay w/o N (hyo)	0.37	0.30	0.07			

Legume not included in alfalfa

Conclusions

- **Strong linear relationships were found over all land uses on a segment basis.**
- **A significant relationship was found between latitude and regression slope on forest, but not on other land uses.**
- **Using median slope and the calibration run, linear regression provides robust prediction of nutrient discharges at edge of field.**

Conclusions

- **The ratio between nitrogen output and input ranges from 0.07 on pasture to 0.37 on hay.**
- **DIN discharge is higher than NO discharge on most land uses, except urban area where ON discharge is higher.**
- **Phosphorus ratio between output and input is relatively constant over different land uses, ca. 10%, dominated by PO4.**

Conclusions

- **The regression slope is significantly lower than the ratio, indicating soil storage or buffer effect on nutrient discharge.**
- **In general, high-tillage croplands have higher slope than non-disturbed land uses.**
- **Multi-variate analysis show that atmospheric deposition has higher slope that other input types.**
- **Fertilizer has higher slope than manure for DIN output, but it's the opposite for ON output.**

THE END

Land slope and clay content