

Appendix 1: Model Implementation Details

All Code used to prepare data, run the simulations, produce figures and run analyses is available for download at: https://github.com/bubalis/VT_pIndex

Parameter	Explanation	Details
Tile Drain	Does the field have pattern tile drainage?	If Soil is drainage class D: True if Corn or Small-Grain is in rotation, else Bernoulli(.5) If Soil is drainage Class C: Bernoulli(.75) if Corn or Small Grain is in Rotation, else Bernoulli(.3)

Table S 1 Details on Simulation of Parameters for All Scenarios

Parameter	Explanation	Details
# manure applications		1 if Current Crop is Corn or Small Grain Random integer between 1 and 3 if Current Crop is Hay 0 if Fallow
Cover Crop	Is there a winter cover crop?	Bernoulli(.25) Current Crop is Corn or Small Grain Else False
Tillage method	What type of tillage, if any, is used on the field?	If crop is corn: If soil is clay: (10% no-till, 45% chisel, 35% disk, 10% moldboard) Else (40% no-till, 30% chisel, 30% disk, 0% moldboard) ----- If crop is Hay and previous year was corn: (20% no-till, 40% chisel, 20% disk, 20% moldboard) ----- If crop is small-grain: (20% no-till, 50% chisel, 20% disk, 10% moldboard)
Manure Incorporation Method	How is manure mixed into soil? Or is it left on surface?	If tillage is No-till: If Crop is Corn or Small-Grain (40% injected, 60% not incorporated) ----- If Crop is Hay: (10% injected 90% not incorporated) Else: Manure Incorporation Method = Tillage Method
Time until manure is incorporated	Days manure is left on soil surface	0 if Incorporation Method = Injected Else: Poisson(4)
Manure Season	Season of Manure Spreading Event	If Crop is Corn: (60% spring, 40% Fall) Otherwise: (30% Spring, 30% Fall, 40% Summer)

Table S 2 Details of Simulation of Parameters for Base Scenario

Parameter	Explanation	Details
Manure Rate	How much manure is spread?	Default: Calculated based on total manure available at the County Level 0 If Soil Test Phosphorus >15 If P-Index > 100: Re-run with no manure spread If P-Index >60: Re-run at 50%
Manure Setback	How close to edge-of-field is manure spread?	If P-Index >60: Re-run with 25-foot setback
Cover Crop	Is there a cover crop?	If P-Index > 100: Re-run with Bernoulli(.9)

Table S 3: Differences in Parameter Simulation for Nutrient Management Planning

Parameter	Explanation	Details
Cover Crop	Is there a winter cover crop?	If crop is Corn or Small Grain Bernoulli(.9) Else False
Tillage method	What type of tillage, if any, is used on the field?	If crop is Corn: If soil is clay: (60% no-till, 30% chisel, 10% disk) Else (80% no-till, 15% chisel, 5% disk, 0% moldboard) -- If crop is Hay and previous year was corn: (40% no-till, 50% chisel, 10% disk) If crop is Small Grain: (50% no-till, 40% chisel, 10% disk)
Manure Incorporation Method	How is manure mixed into soil? Or is it left on surface?	If tillage is No-till: If Crop is Corn or Small-Grain (90% injected, 10% not incorporated) If Crop is Hay: (50% injected 50% not incorporated) Else: Tillage Method is also manure-incorporation method
Time until manure is incorporated	Days manure is left on soil surface	If incorporation is injection, 0 Else: Poisson(1)

Table S 4: Differences in Parameter Simulation for Best Management Practices

Appendix 2: Soil Test Phosphorus Values Validation

We compared our simulated soil test phosphorus data with summary data from the Cornell Nutrient Analysis Laboratory reported by Ketterings and colleagues (2005). Table S5 compares the distribution of our simulated data as compared with results from 38876 samples analyzed from the top 10 dairy-producing counties in NY state. The comparison shows that our simulated data are biased towards moderate values of soil test phosphorus, but for other ranges, it is similar to this dataset. While the extent of farmer error in soil sampling is unknown, we would expect it to make the data more extreme, so the modest moderation of soil test P values in our simulated data may ameliorate this effect.

Figure S1 compares the cumulative distribution functions of the actual soil test phosphorus data from the UVM Soil Lab and the simulated data, showing that the data line up

well, but once again our simulated values are somewhat biased towards more moderate values of soil test phosphorus.

Figures S2 and S3 show the difference between the sorted values of the empirical distribution and the simulated distribution. For each value of soil test phosphorus from the actual data, the chart plots the actual value minus the simulated value at the same percentile. Figure S2 shows that the simulated distribution slightly inflates values for the middle of the distribution. Figure S3 shows that our simulated values trims the highest values from the distribution.

Soil P category	Range of Soil Test P Values	Simulated Data	Top Dairy-Producing Counties in New York		
			Mean	Low	High
Low	0 - 1.5	19%	27%	12%	43%
Medium	1.5 - 4.5	42%	25%	20%	29%
High	4.5 - 20	34%	39%	28%	53%
Very High	> 20	5%	8%	1%	17%

Table S 5 Percent of soil test P values in 4 bins for our Simulated Data and the top 10 dairy-producing counties in New York State. NY Data From (Ketterings et al., 2005)

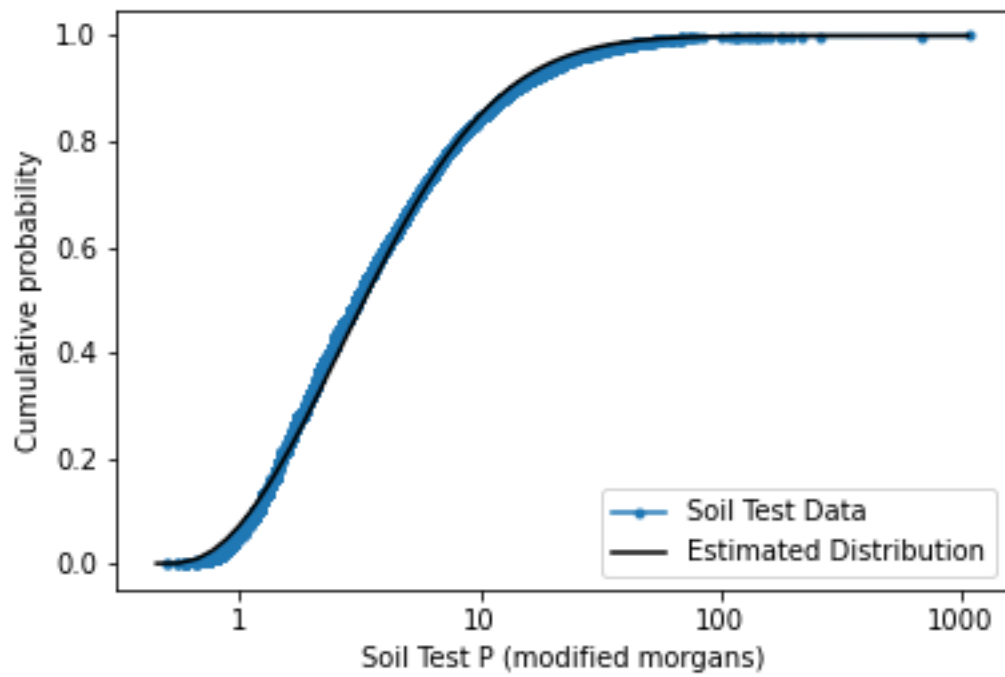


Figure S 1 Cumulative Distribution Functions for Actual and Simulated Soil Test Phosphorus Data

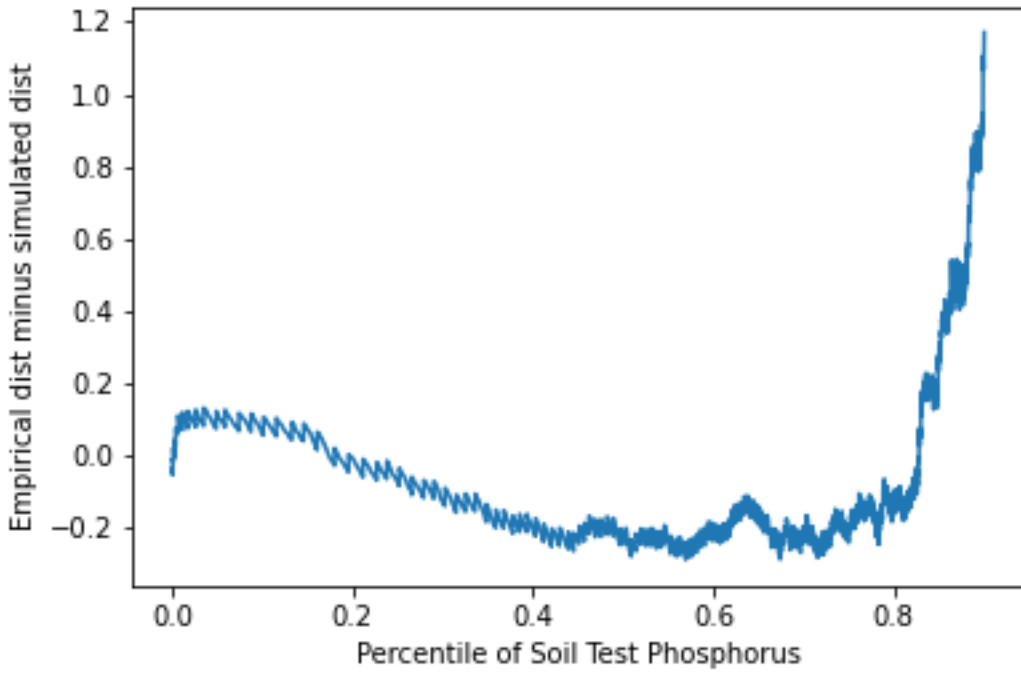


Figure S 2 Differences between values of actual and simulated soil test phosphorus up to the 90th percentile

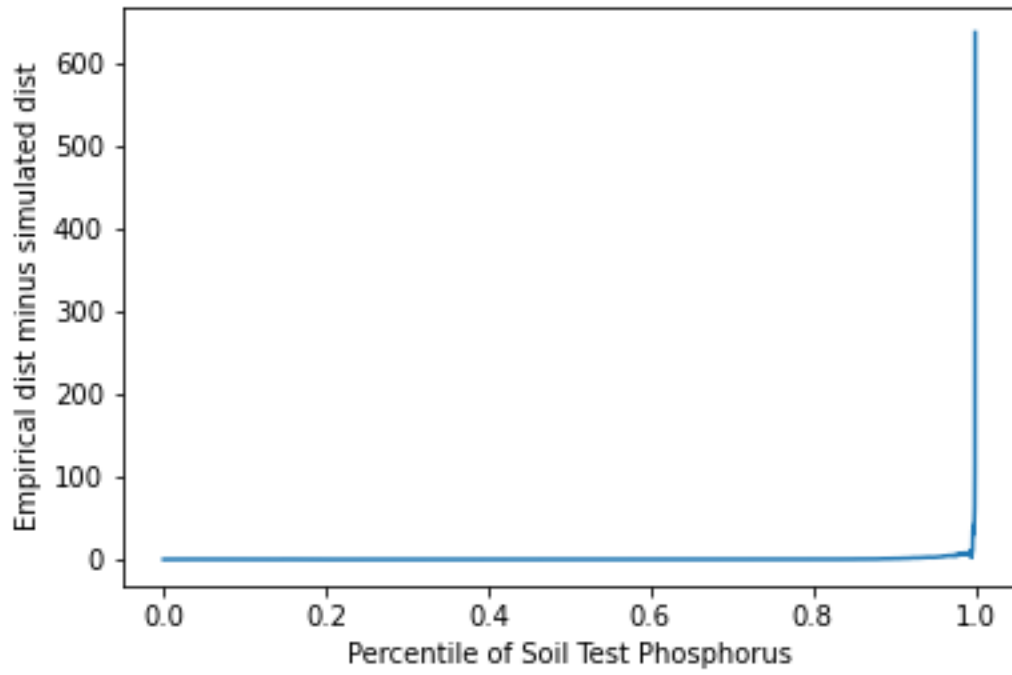


Figure S 3 Differences Between actual and simulated soil test phosphorus for all values

Appendix 3: Supplementary Figures by County

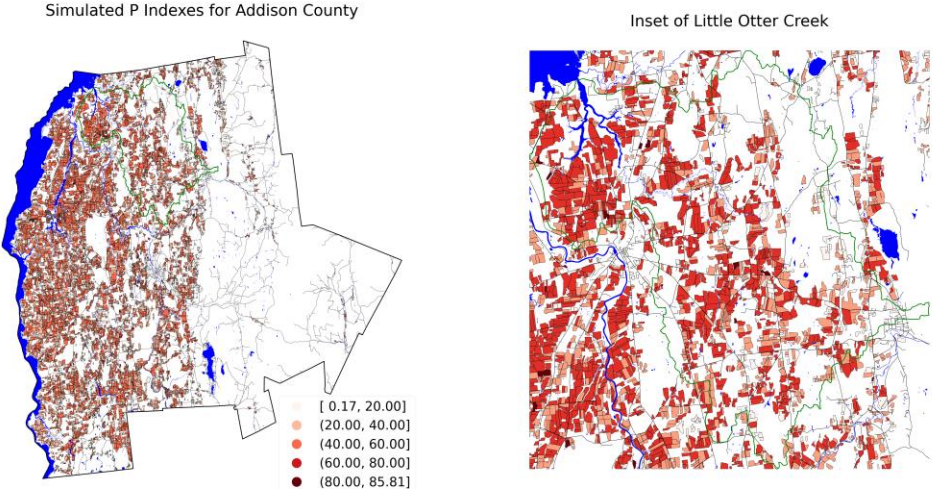
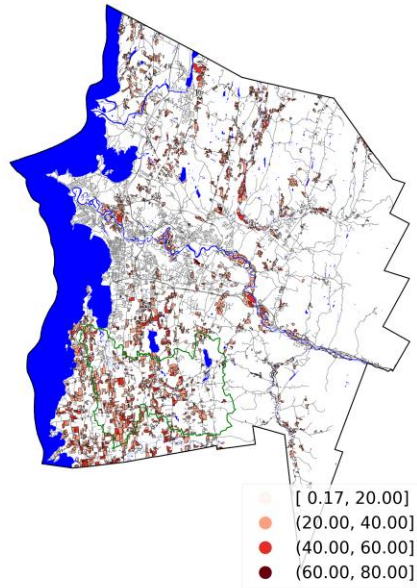


Figure S 4 Simulated P Indices for Addison County in the Base+NMP Scenario

Simulated P Indexes for Chittenden County



Inset of La Platte River

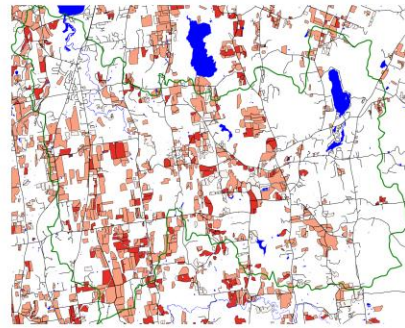
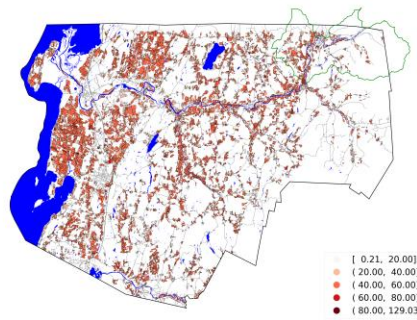


Figure S 5 Simulated P Indices for Chittenden County in the Base+NMP Scenario

Simulated P Indexes for Franklin County



Inset of Lucas Brook

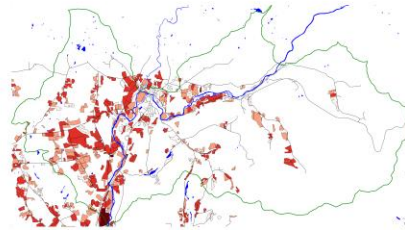


Figure S 6 Simulated P Indices for Franklin County in the Base+NMP Scenario

Simulated P Indexes for Grand Isle County

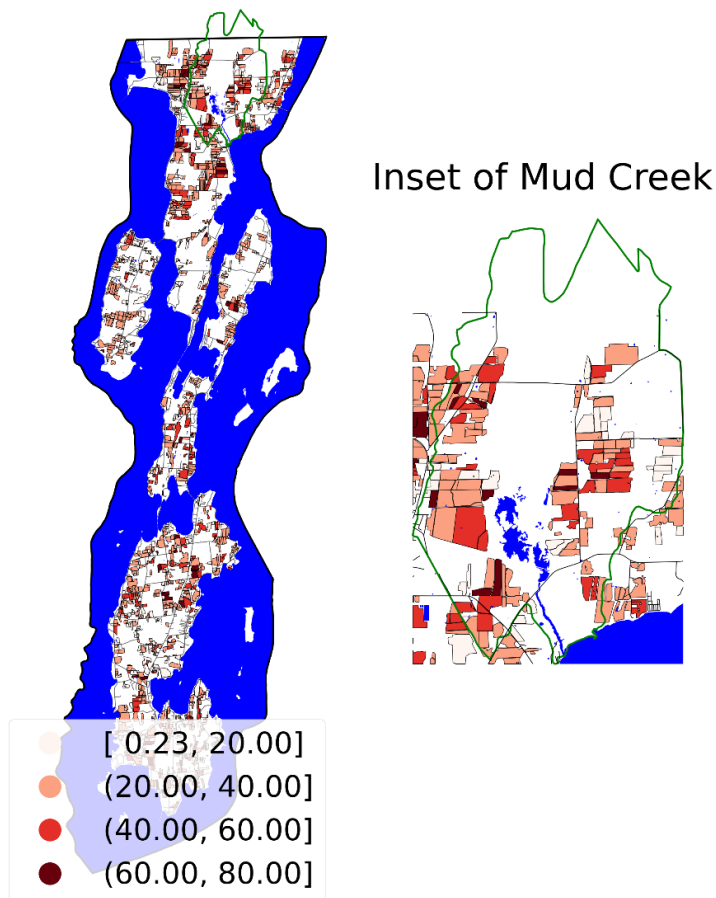


Figure S 7 Simulated P Indices for Grand Isle County in the Base+NMP Scenario

