
Simulating Potential Production Capacity of Corn and Potatoes in New England using a Geospatial Crop Model

Jonathan P. Resop

D. H. Fleisher, D. J. Timlin, V. R. Reddy

2012 ASABE Annual International Meeting

Dallas, Texas, August 1st, 2012



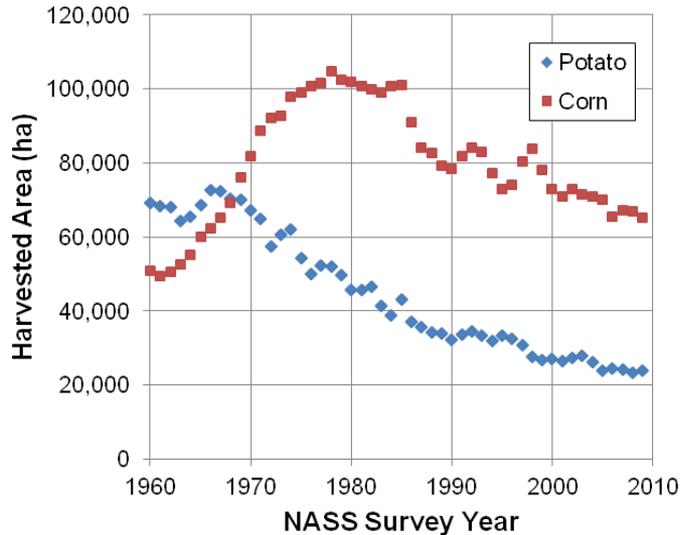
Objectives

1. Evaluate the potential production capacity for the region of New England
 - A. Determine the land available for production under various land use scenarios
 - B. Simulate crop yield under both water-limited and unlimited water use scenarios
 - C. Calculate the natural resource requirements (land, water, nutrients) for production

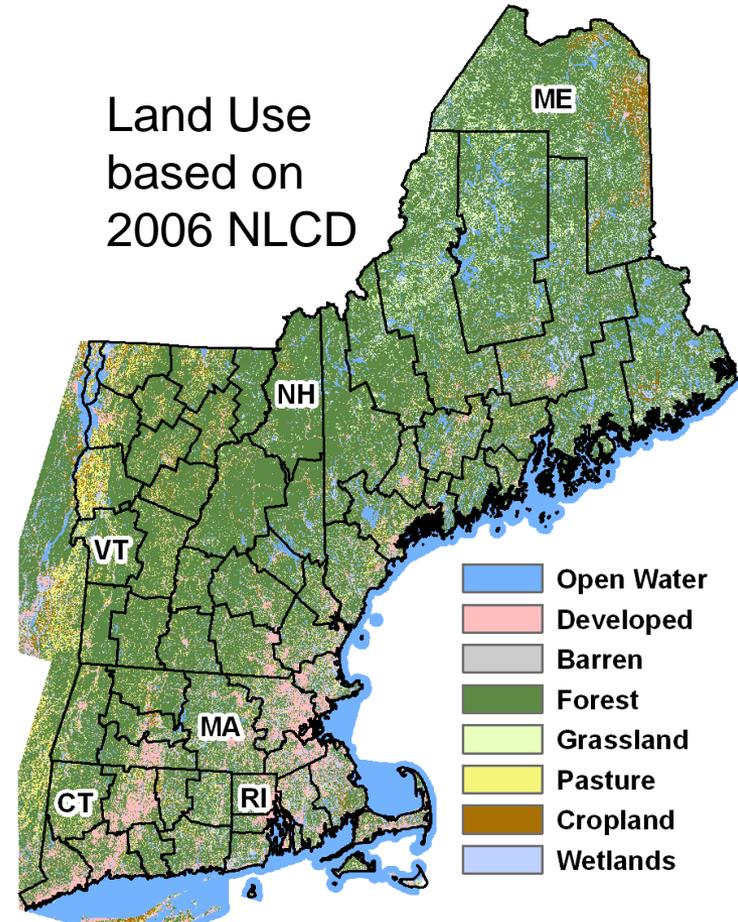
Potential Production Capacity

- What is the capacity of a region for food production?
 - Can I grow X crop in Y location?
 - What are the natural resource constraints?
 - What is the sensitivity of production?
 - What is the potential under various scenarios?
 - Can we support a growing population with locally grown food?
- Land Use Change Scenarios
 - Current Production
(Crops currently grown in the region)
 - Potential Production (Areas not currently being used)
- Water Use Availability Scenarios
 - Water-limited, Rain-fed, No Irrigation
 - Not Water-limited, Irrigated to Full Potential

Study Area



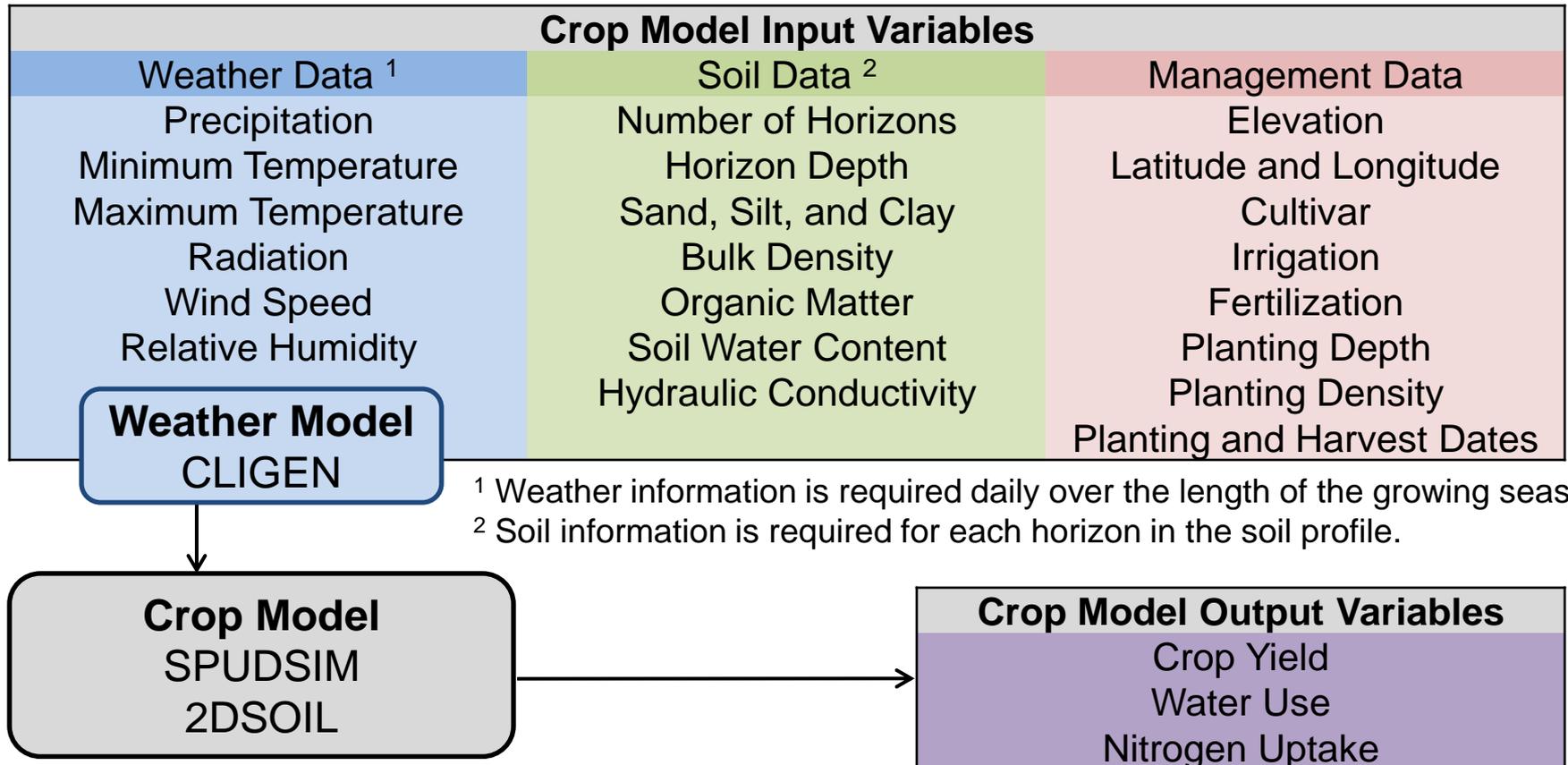
Land Use
based on
2006 NLCD



- Loss of local production due to the loss of the agricultural land:
 - Soil erosion
 - Urbanization
- More food will need to be imported to support the growing population!

Crop Modeling

- Explanatory, Process-based Crop Models



Geospatial Crop Modeling

ArcGIS

1) Organize Data Layers

Weather
NOAA

Land Use
CLU, NLCD, CDL

Management
Various Sources

Soil
SSURGO

Region of Interest



Modeling Units

Georeference

Intersection

2) Create Modeling Units

Modeling Units (MUs)
Weather (WID), Soil (SID),
Management (MID), Land Use

5) Aggregate Results

Aggregation

MUs
Yield, Water,
Nitrogen

4) Simulate Production

SPUDSIM

CLIGEN
30 Gen. Years

3) Select Modeling Units

Land Use Classifier

Min Area Threshold

Apply Variability
Land Use Change
Soil or Climate Change
Management Scenarios

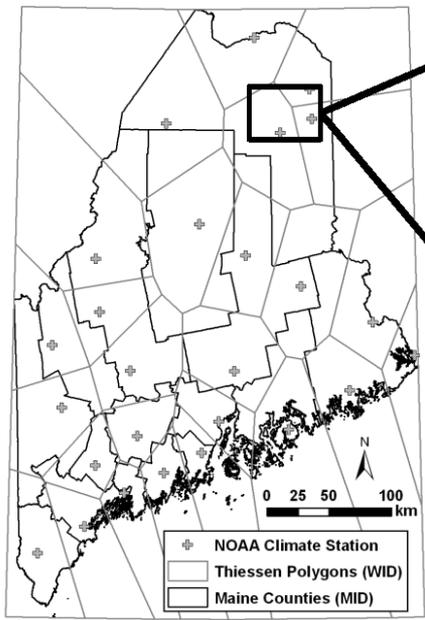
List of Unique Combinations of Parameters (PID)
WID SID MID

1)
2)
n)

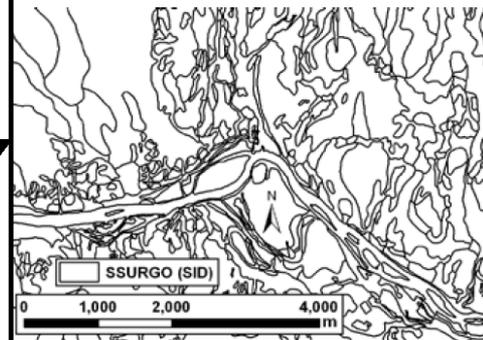
Field-scale Modeling Units

Region of Interest

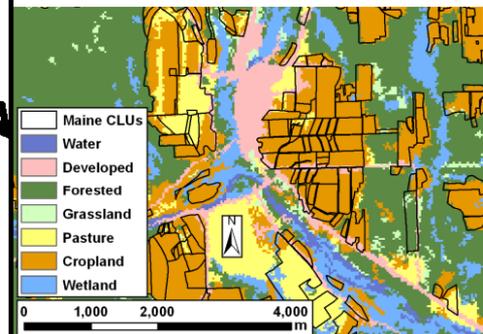
Weather ID (WID)
Management ID (MID)



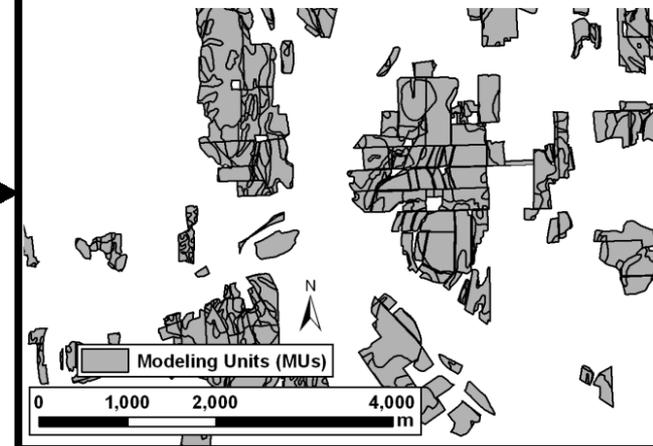
Soil ID (SID)



Land Use



Modeling Units (MUs)



Potential Production Scenarios

Land Use Classifications

Current Production

1) Potato / Corn Cropland

Potential Production

2) All Cropland

3) Pasture

4) Grassland / Scrub

Decreasing
Productivity?

Increasing
Conversion

Likelihood?

Not Considered for Production

5) Forested

6) Developed / Barren

Off Limits to Production

7) Open Water / Wetlands



If we were to increase production

How much land is available?

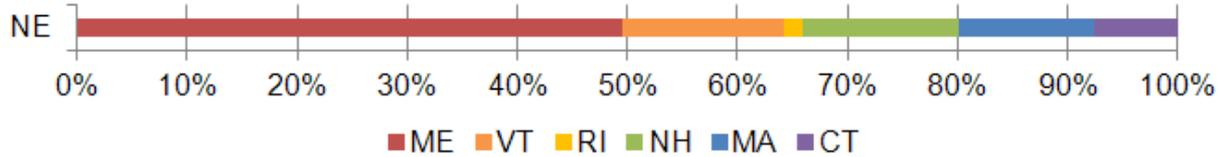
Where is the potential yield greatest?

What is the potential production range?

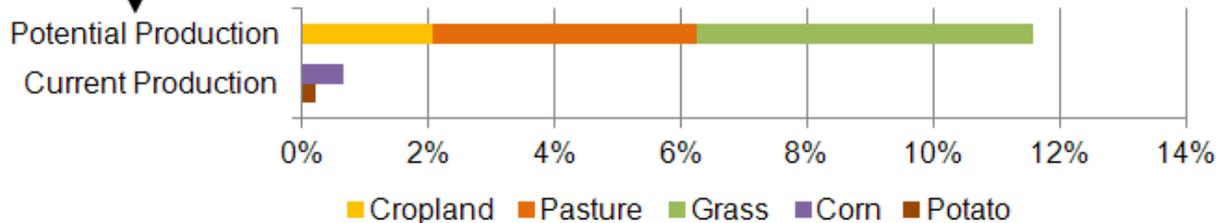
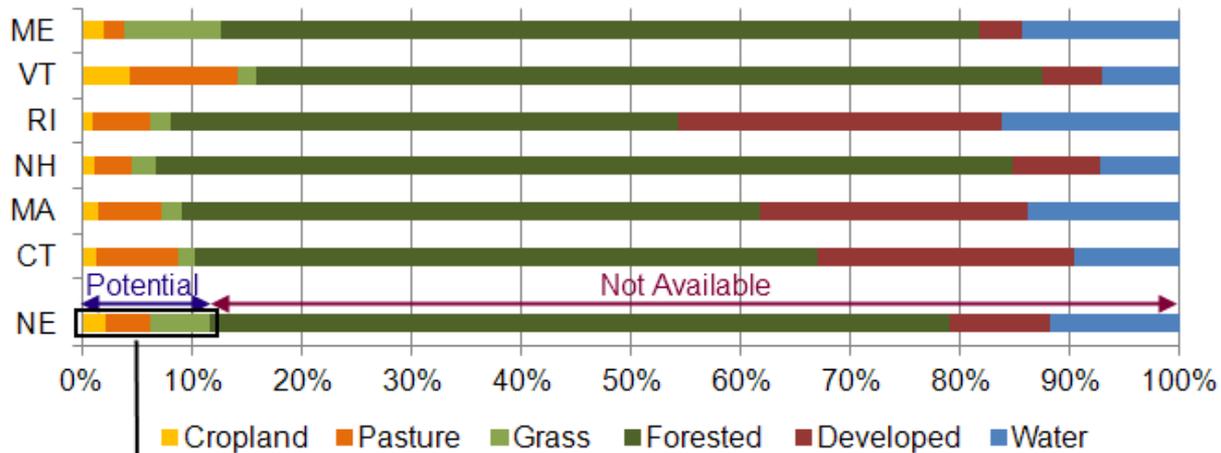
What are the resource requirements?

Land Use Availability

Percent of Total Area by State



Percent of Total Area by Land Use

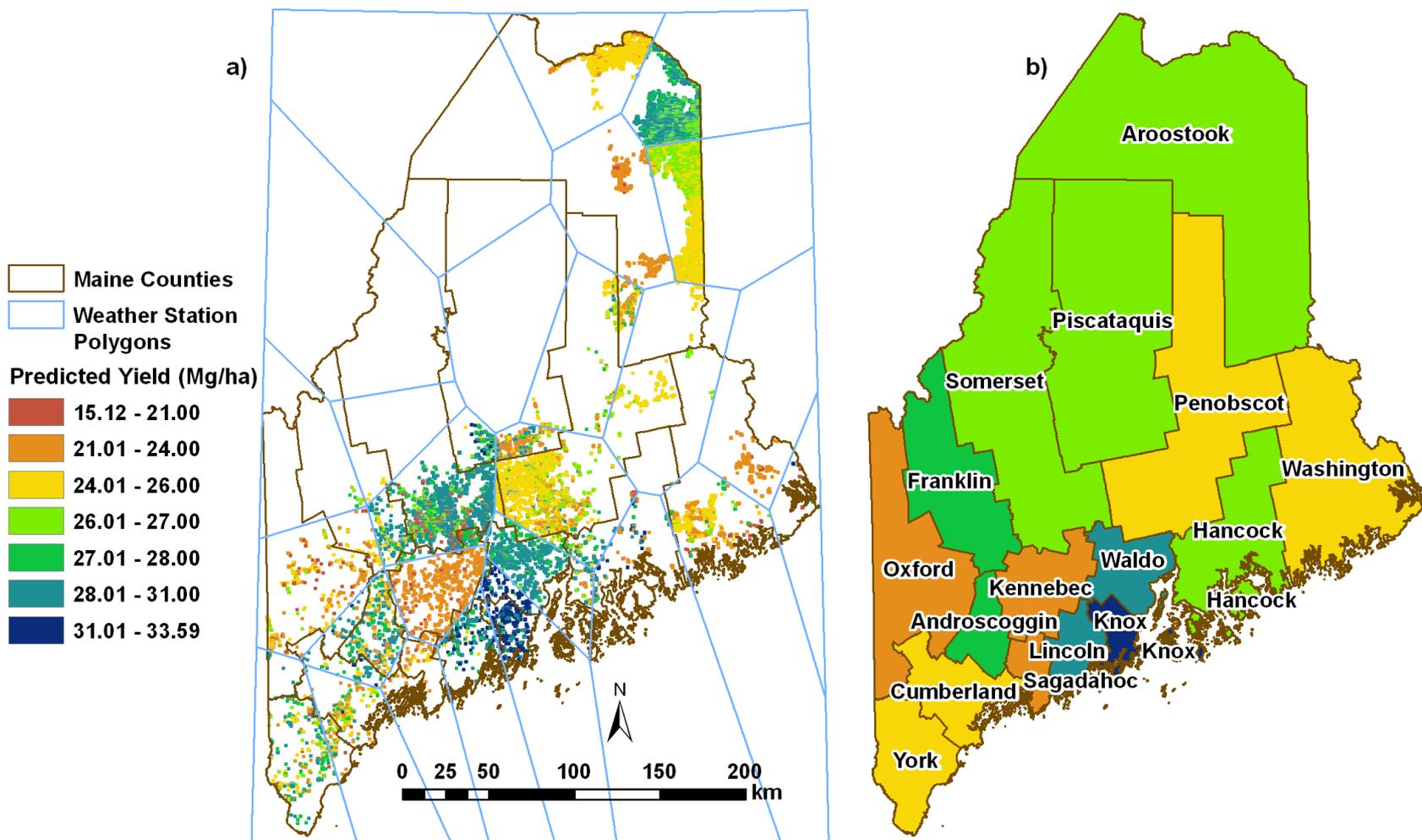


Current Land Use - Potato

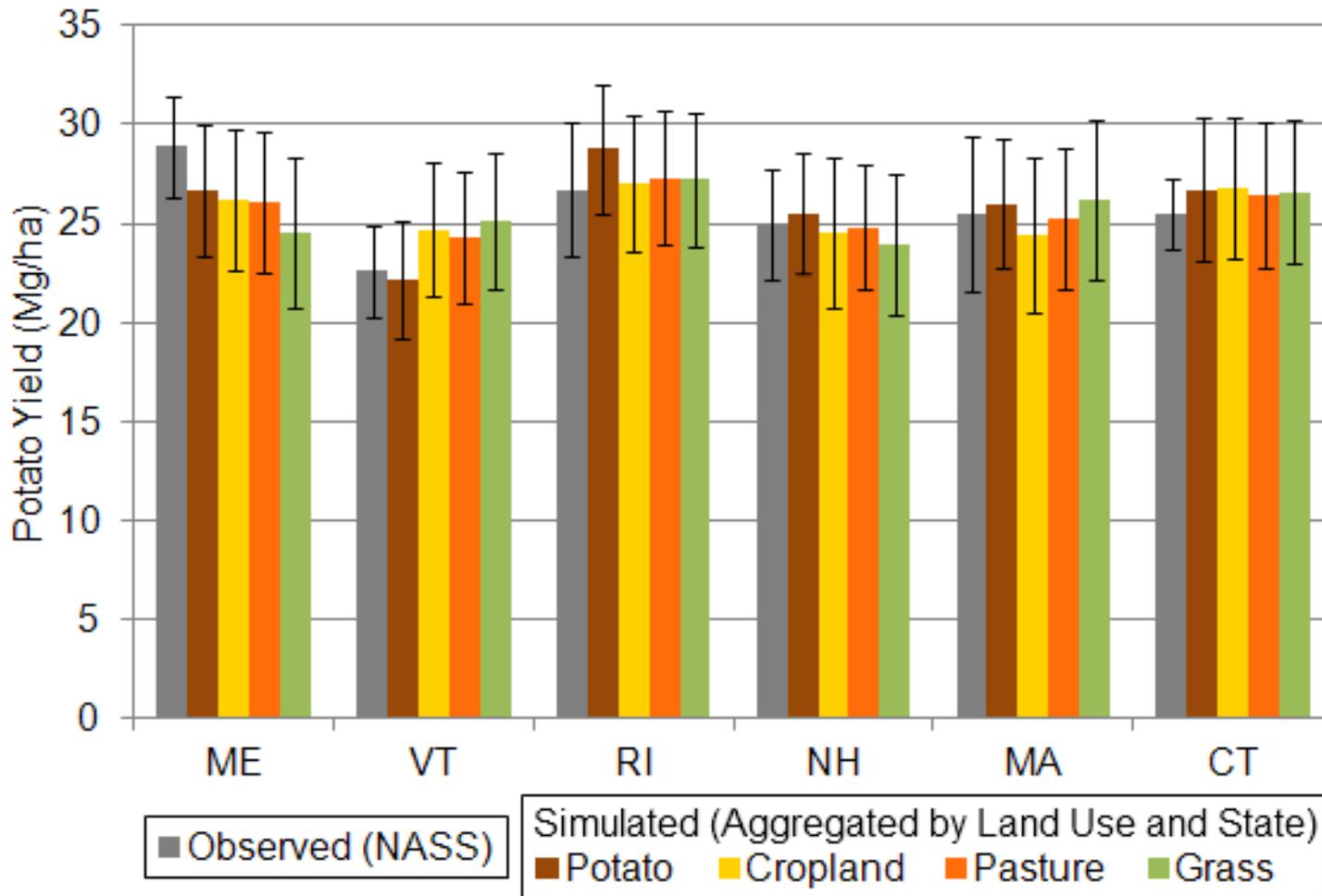
State	County	Observed (NASS)		Simulated (SPUDSIM)			
		Ave.	Std.	Water-limited		Non-limited	
				Ave.	Std.	Ave.	Std.
Maine	Aroostook	30.73	1.07	26.80	3.37	35.73	3.56
	Penobscot	27.13	1.70	25.38	3.03	38.85	0.98
	Oxford	32.39	0.85	24.64	3.30	37.09	0.88
	Piscataquis	25.11	1.77	25.31	4.09	38.92	0.97
	Androscoggin	29.15	2.49	27.90	3.88	39.33	1.70
Massachusetts	Hampshire	27.88	2.27	26.09	3.22		
	Franklin	29.05	3.52	N/A	N/A	N/A	N/A
Rhode Island	Newport	26.76	5.26	29.77	3.02		

Potential Land Use - Potato

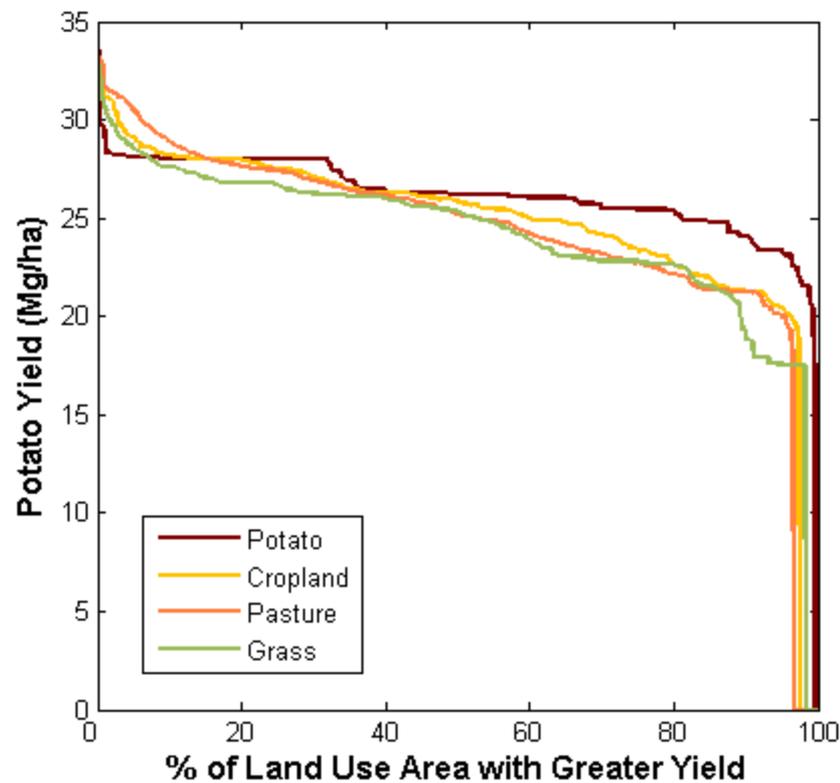
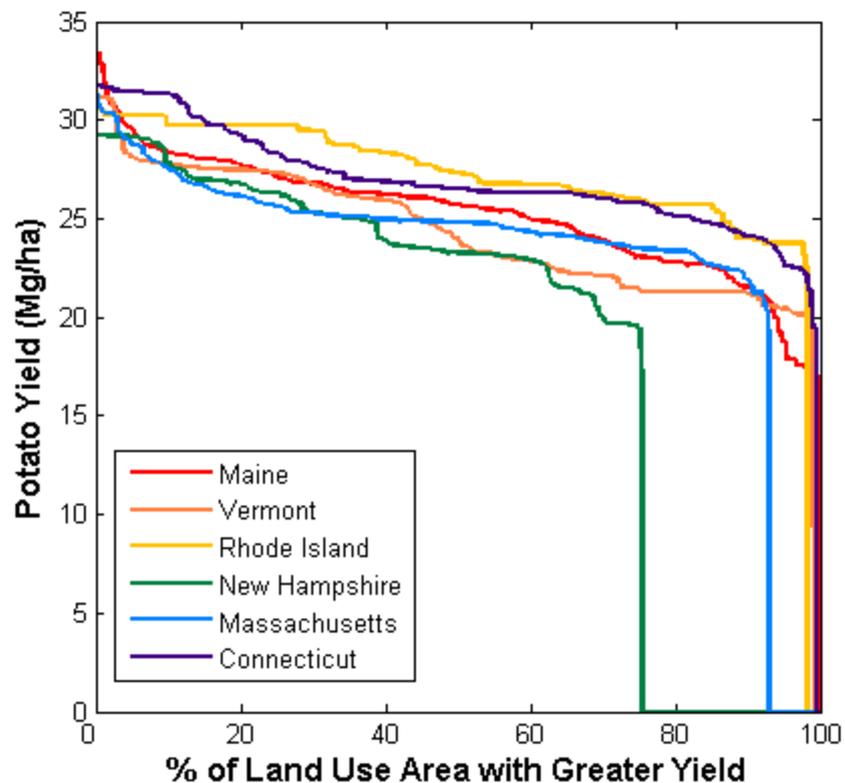
(Simulated Over All Cropland)



Land Use Comparison

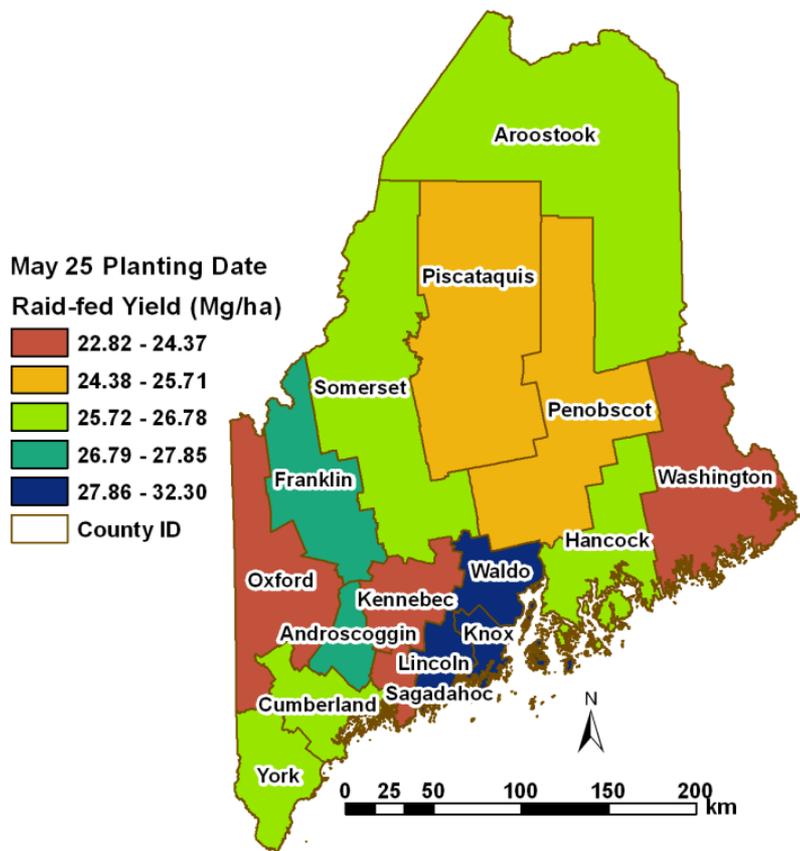


Potential Land Use - Potato

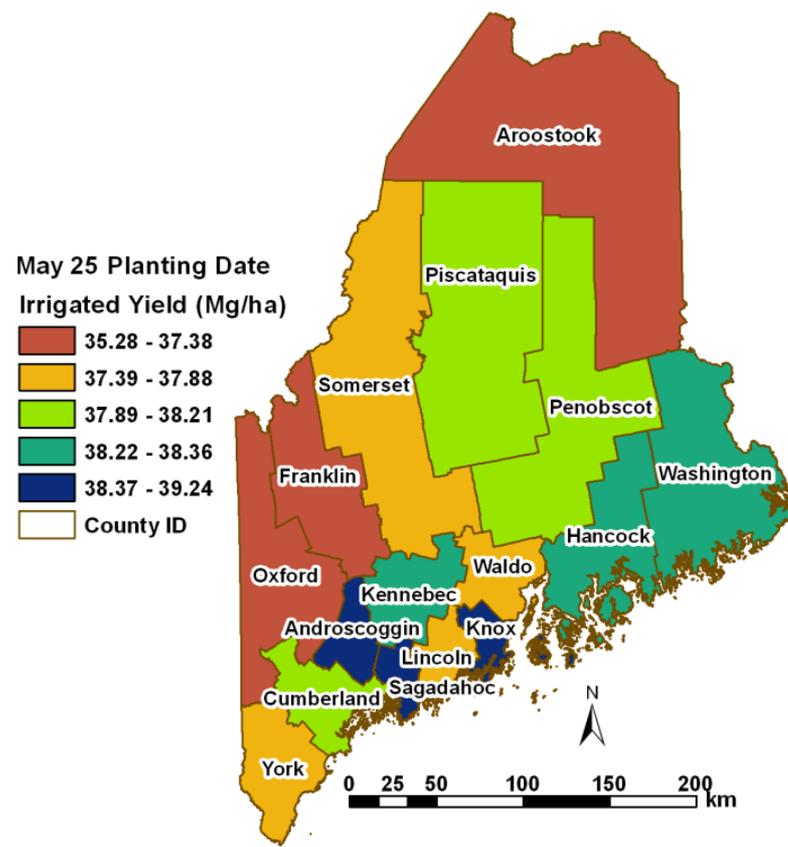


Water-limited vs. Potential Yield

(Preliminary Results - Potato - Simulated Over All Cropland)



Average Simulated = 26.20 Mg/ha

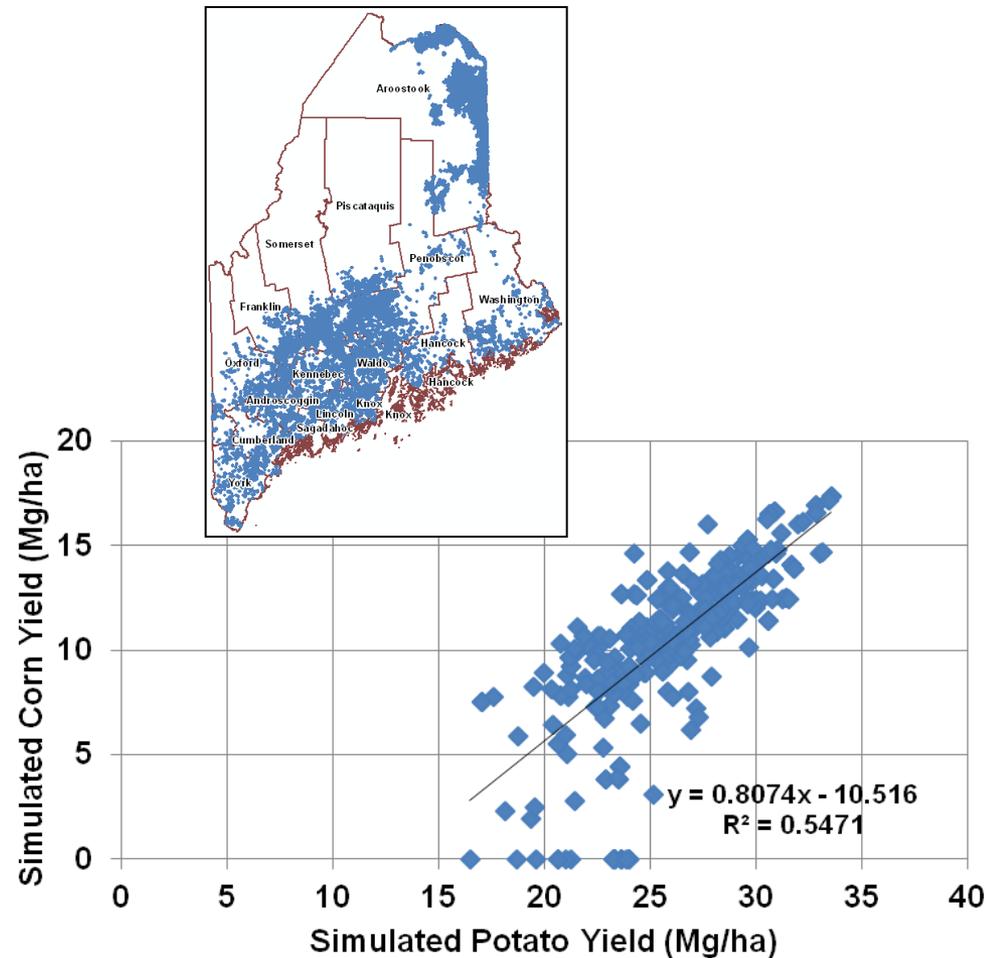
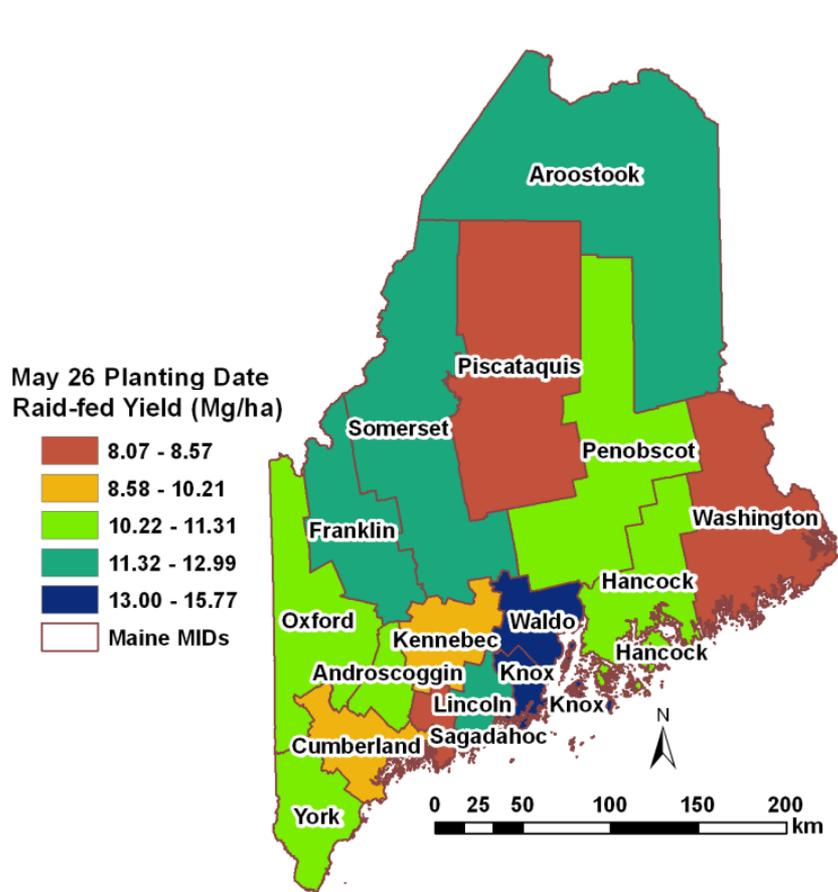


Average Simulated = 36.80 Mg/ha

Average Observed (NASS) = 28.88 Mg/ha

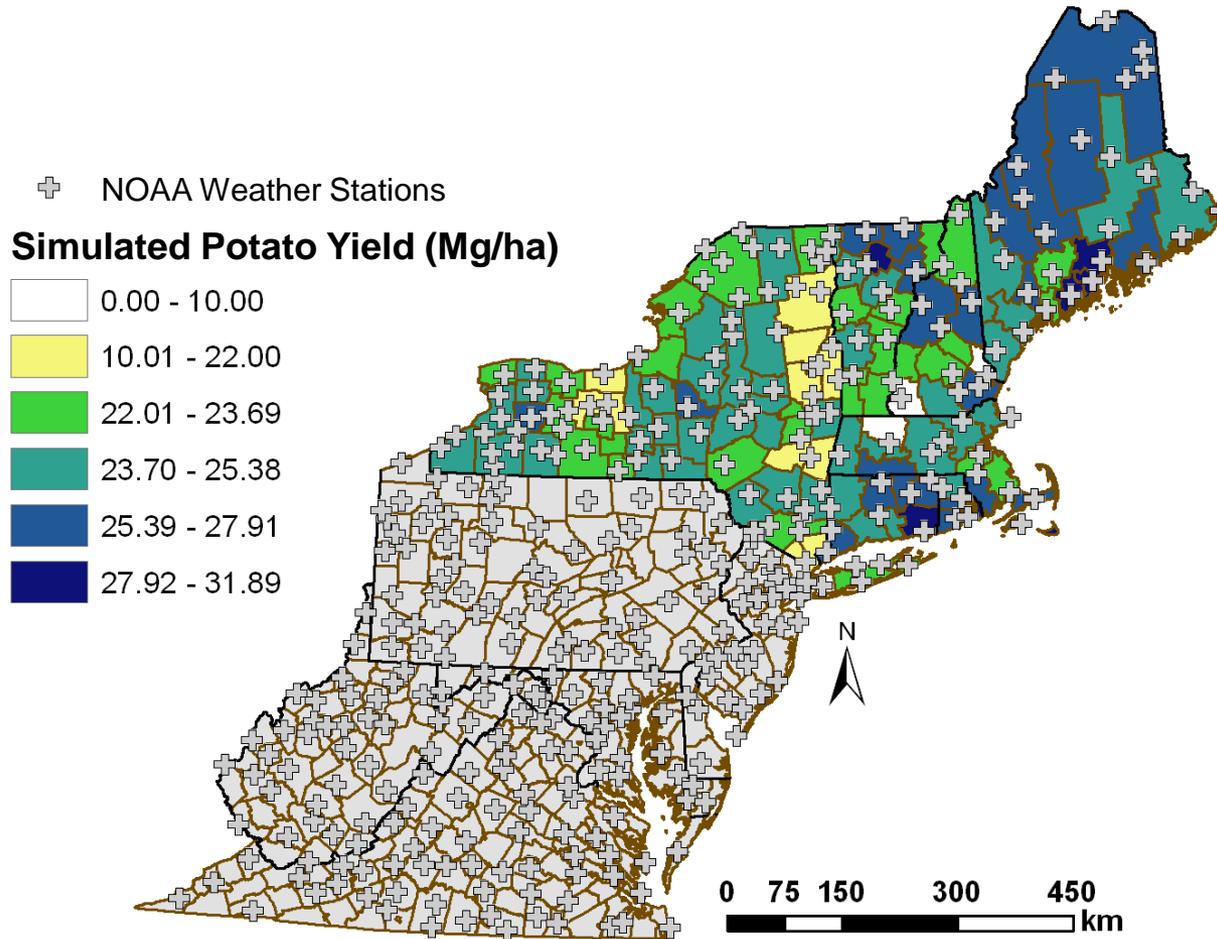
New England Corn Yield

(Preliminary Results - Simulated Over All Cropland)



Regional Production Capacity

(Preliminary Results - Potato - Simulated Over All Cropland)



Conclusions

- More research is needed to evaluate the availability of specific land areas, but this initial analysis shows potential for crop production growth in the region
- The field-scale geospatial crop model generates high-resolution results to allow analyses into the regional infrastructure
- The results demonstrate highly productive areas to focus on over more marginal land

Future Work

- Perform further validation / ground-truthing
- Explore uncertainties in the model
 - Parameter variability (e.g. planting date)
 - Weather data interpolation
- Expand land availability to other variables:
 - Rockiness of the soil
 - Soil Slope
- Evaluate other scenarios e.g. climate change