Projected effects of biofuel production on landscapes in North Carolina

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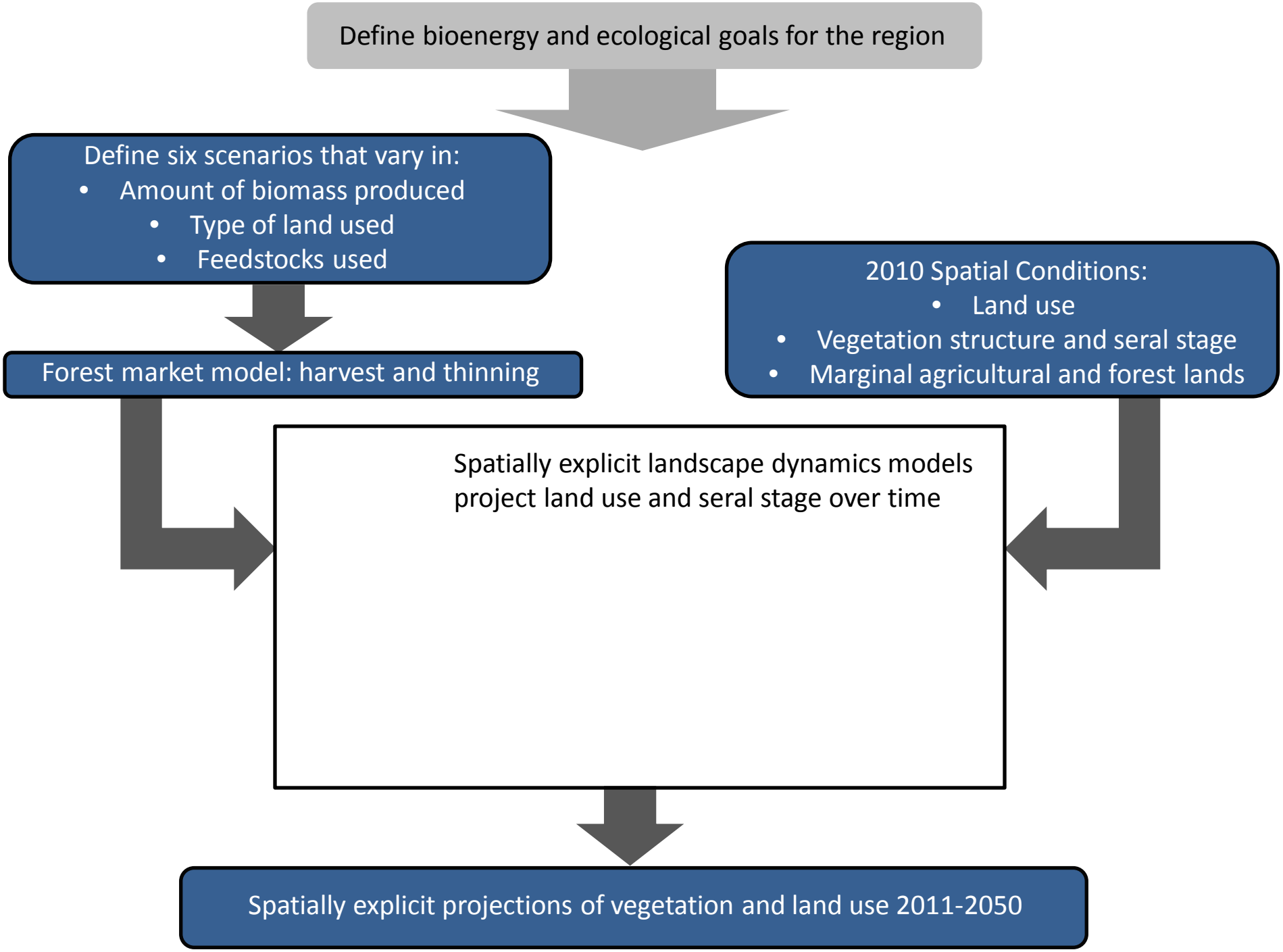
Overview

How will potential biomass production scenarios affect landscapes in North Carolina?

1. **Define likely scenarios** of biomass production that vary in:
   - Feedstocks used
   - Types of land used
   - Amount of biomass produced
2. **Simulate** spatial and temporal landscape effects

See case study in Dale et al. paper


Define bioenergy and ecological goals for the region
Define six scenarios that vary in:
• Amount of biomass produced
• Type of land used
• Feedstocks used
2010 Spatial Conditions:
• Land use
• Vegetation structure and seral stage
• Marginal agricultural and forest lands
Forest market model: harvest and thinning
Spatially explicit landscape dynamics models project land use and seral stage over time
Spatially explicit projections of vegetation and land use 2011-2050

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Scenarios in NC: Amount of biomass produced

Initial work:

10% of North Carolina's liquid transportation fuel from locally-produced biofuels

Biofuels Center of North Carolina

Scenarios in NC: feedstocks and land types

Conventional forests and residues

Purpose-grown crops on marginal lands

- **Sweet sorghum**
- **Switchgrass**
- **Short-rotation loblolly pine**

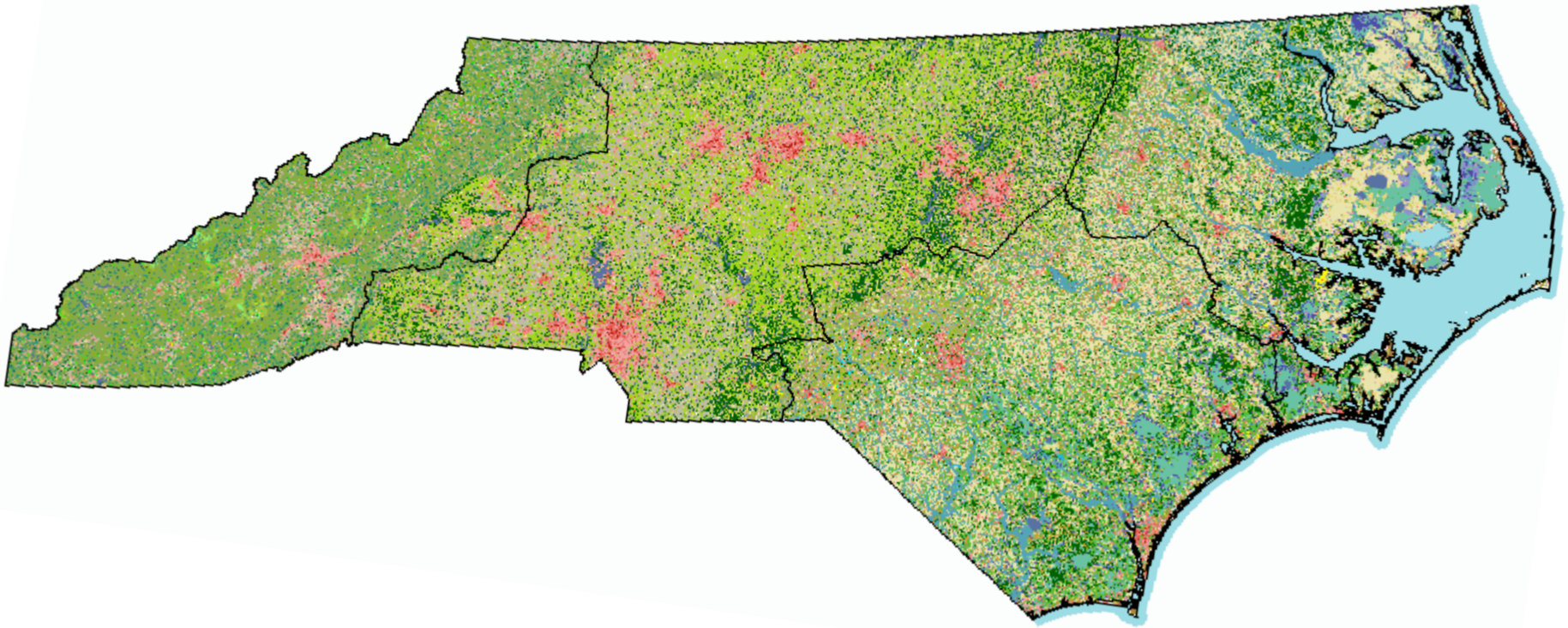
based on supply chain (Gonzalez et al. 2011, 2012)

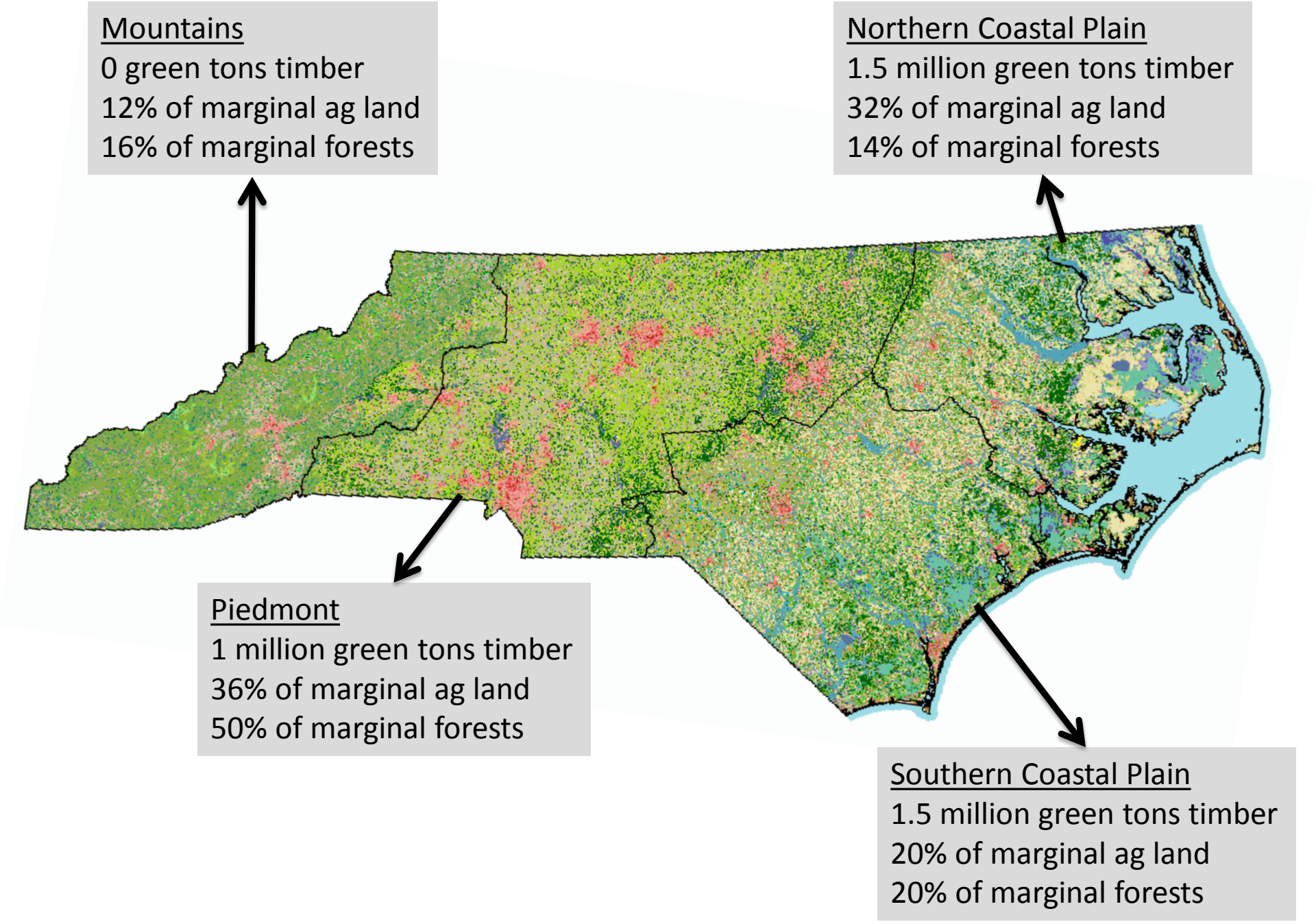
Feedstock production scenarios for NC

Scenario	Conv. forests (mill. green tons)	Other forest products	Marg. ag to purpose grown (ha)	Marg. forest to purpose grown (ha)	Portion of goal
Baseline	None	BAU	None	None	0%
1.	4	Reduced	None	None	15-29%
2.	4	Reduced	425,000	None	100-148%
3.	4	Reduced	212,500	212,500	100-148%
4.	None	BAU	504,000	None	100-140%
5.	None	BAU	252,000	252,000	100-140%

Conventional biomass: harvest, thinning, residues, based on SRTS (*Abt et al.*)
Purpose-grown: supply chain analysis (*Gonzalez et al. 2011, 2012* and new analysis)
Portion of goal: based on thermochemical or biochemical conversion pathway

Simulation regions




Mountains
0 green tons timber
12% of marginal ag land
16% of marginal forests
Northern Coastal Plain
1.5 million green tons timber
32% of marginal ag land
14% of marginal forests
Piedmont
1 million green tons timber
36% of marginal ag land
50% of marginal forests
Southern Coastal Plain
1.5 million green tons timber
20% of marginal ag land
20% of marginal forests

Simulating forest change through time

SRTS timber supply model (Abt et al. 2009 *For. Prod. J.*)

Regional projections

Future thinning, harvest, land use change

Estimates timber supply based on

- Inventory: how much timber exists? (FIA data)
- Demand:
  - Empirical harvests (FIA data)
  - Annual demand increases to 4 million green tons biomass by 2018

***Not all demand is met by increased harvest

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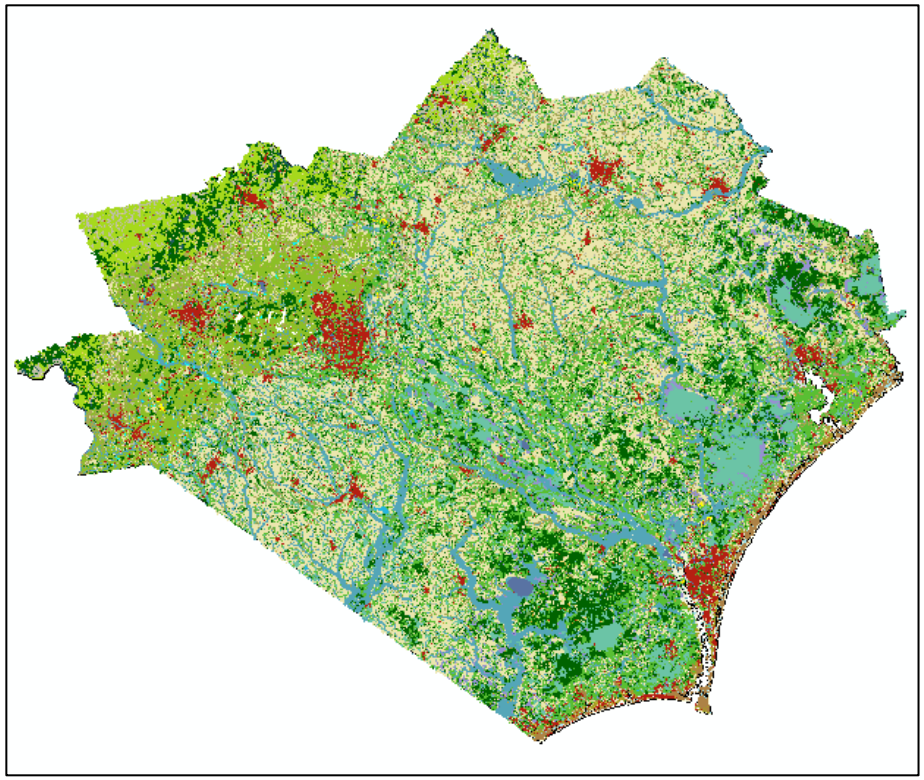
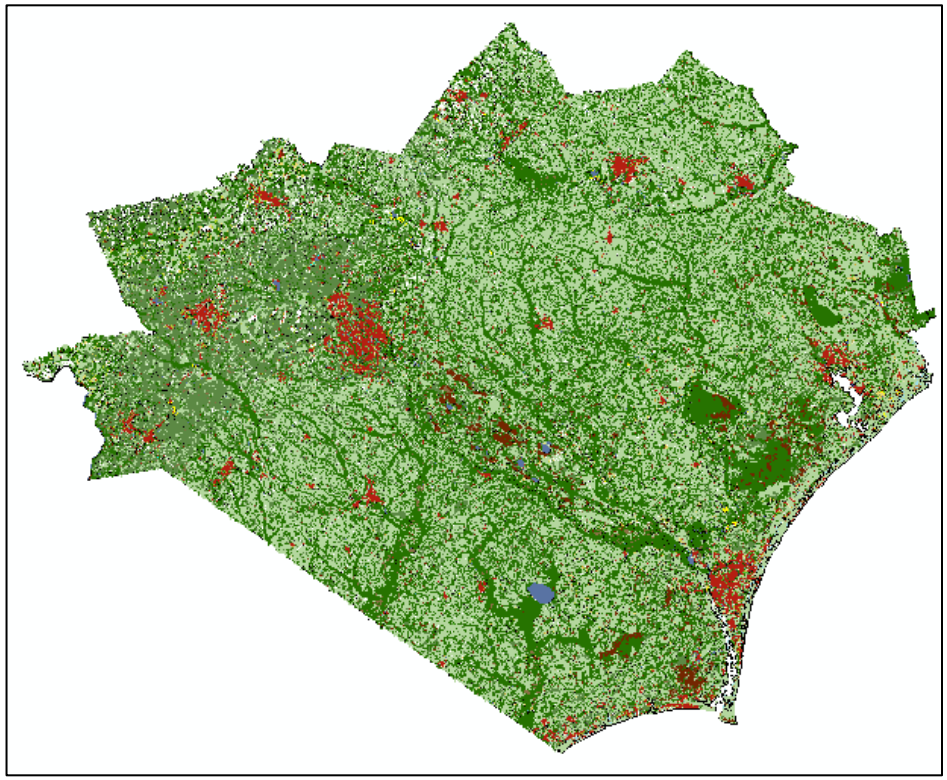
Spatial inputs

Land use & vegetation types

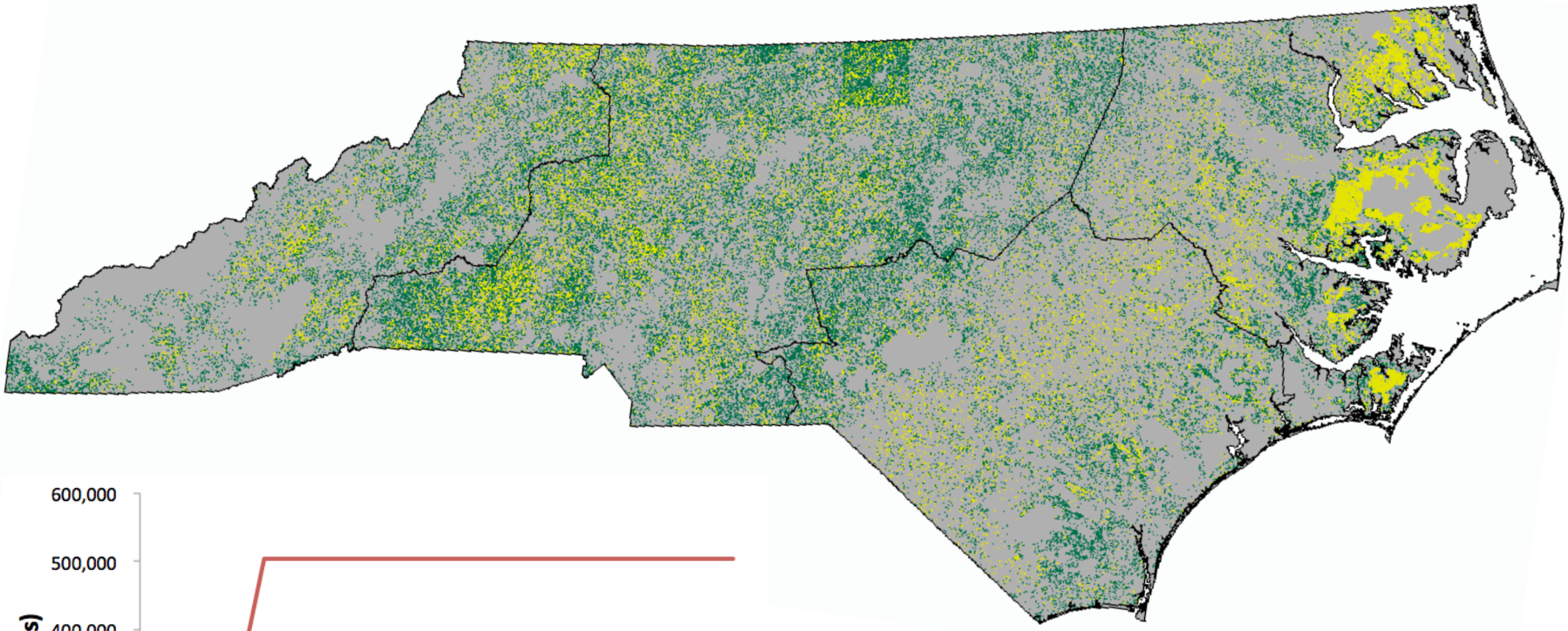


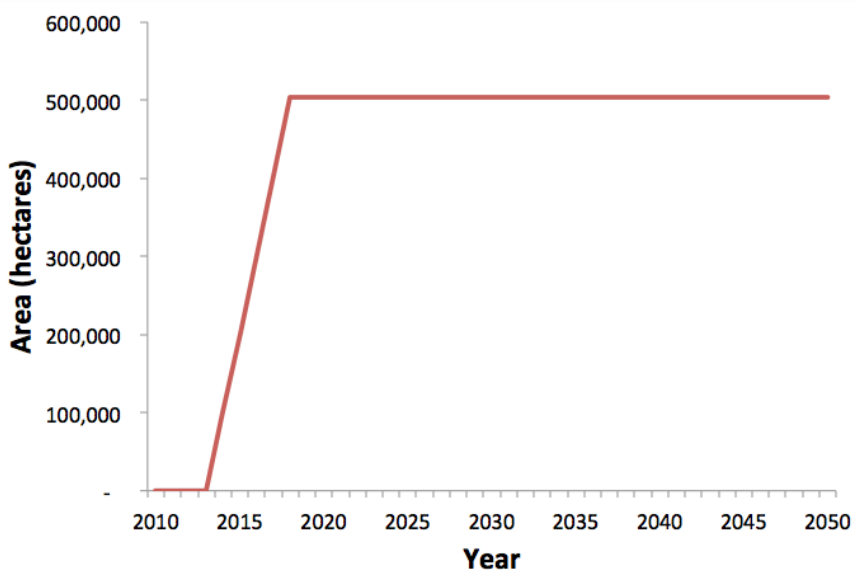
State classes



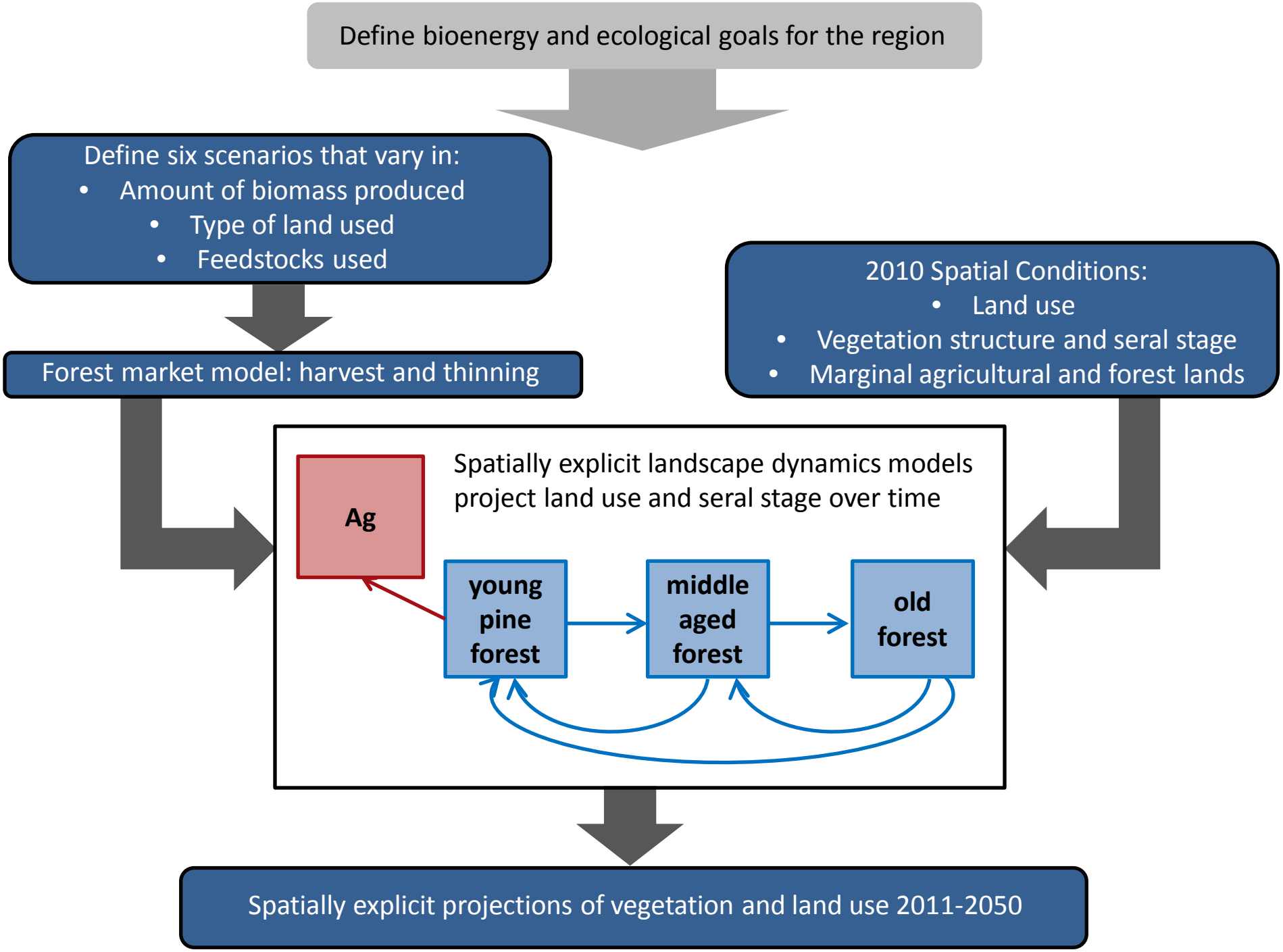
- Early succession
- Late succession, closed
- Late succession, open
- Mid-succession, closed
- Mid-succession, open

Spatial inputs: Marginal agricultural and forest land





Based on soil and land use
Marginal ag: 10% of NC
Marginal forest: 20% of NC
Exclude protected areas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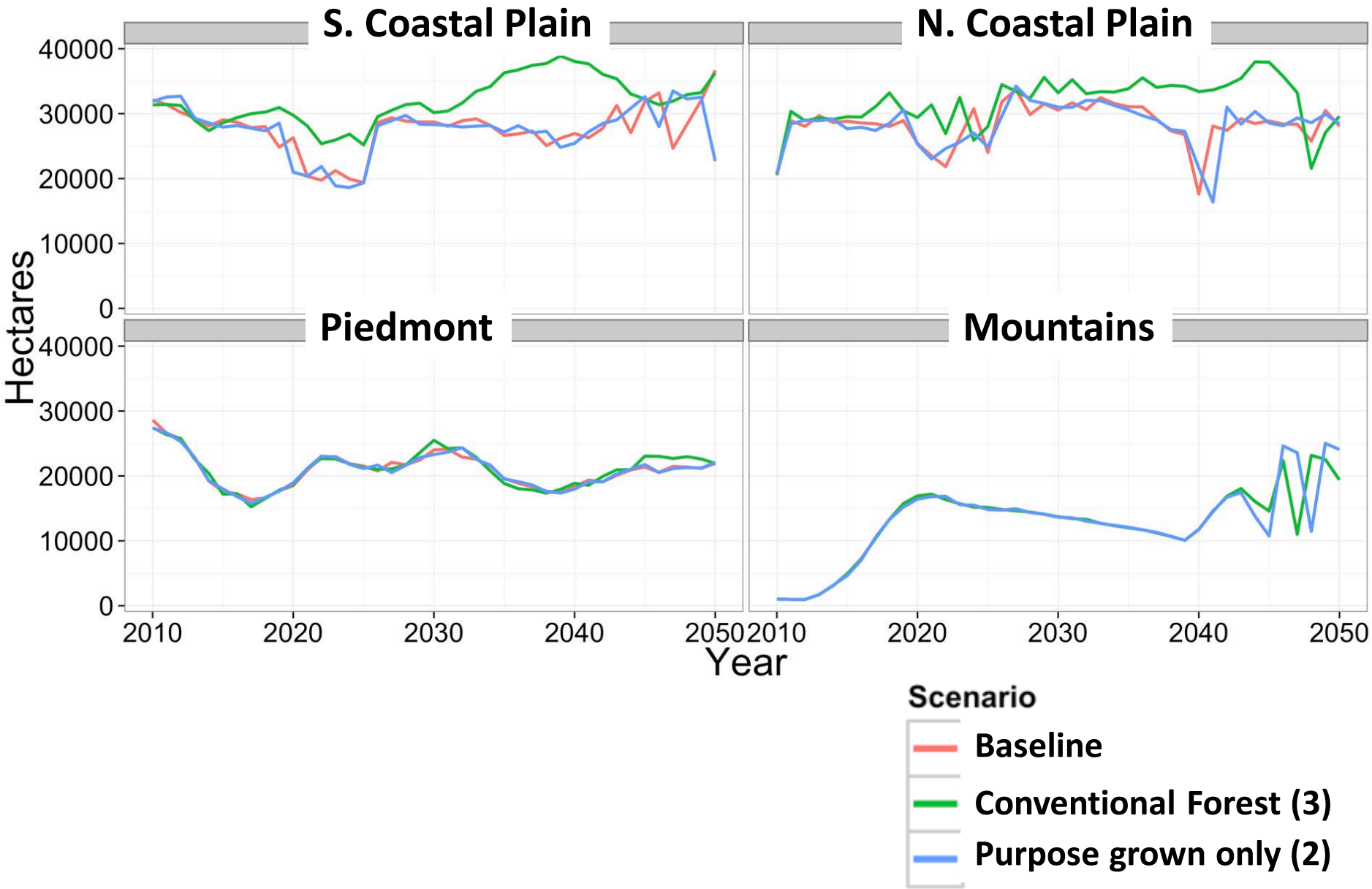
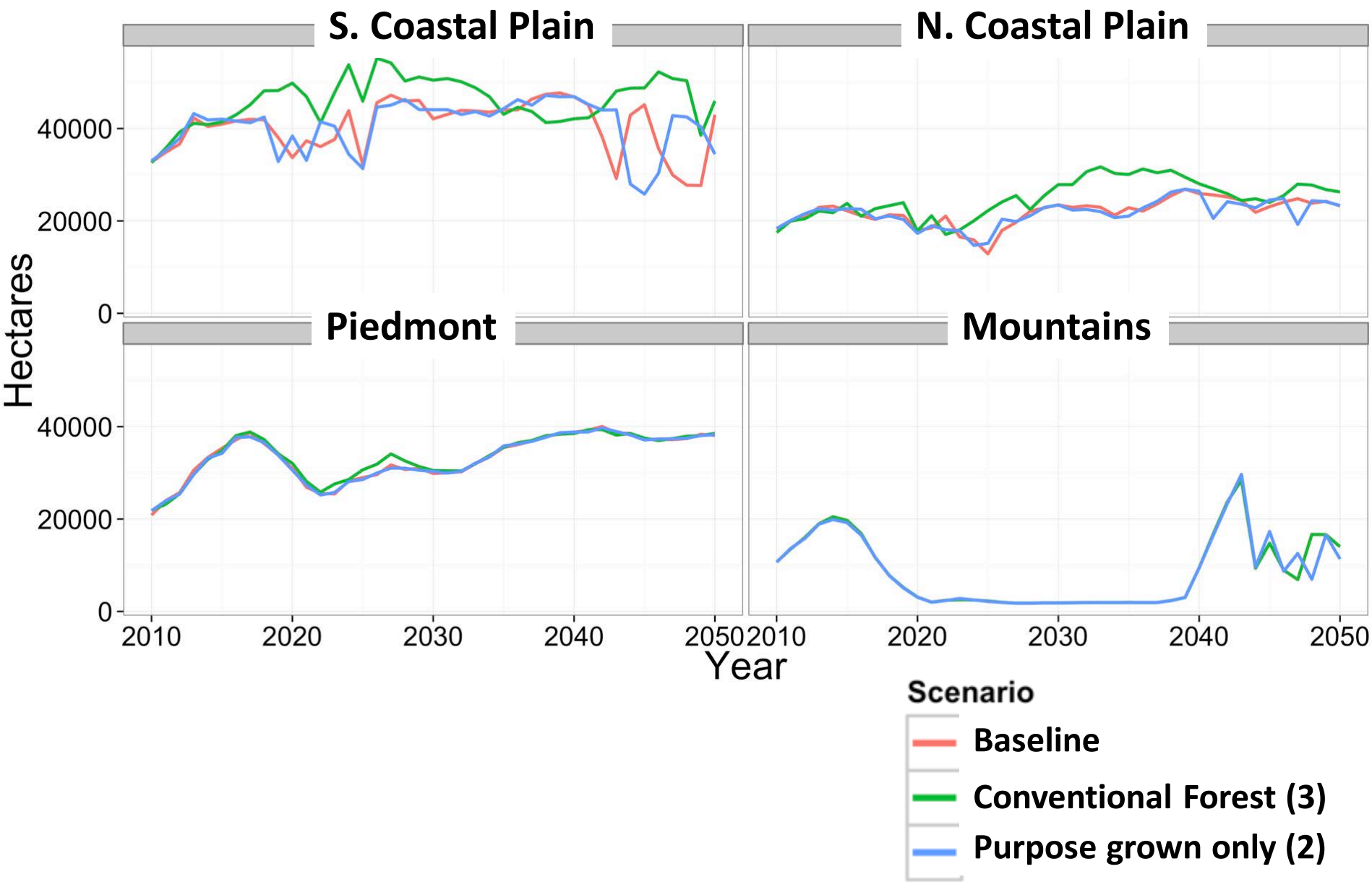
Ag
young pine forest
middle aged forest
old forest
Spatially explicit projections of vegetation and land use 2011-2050

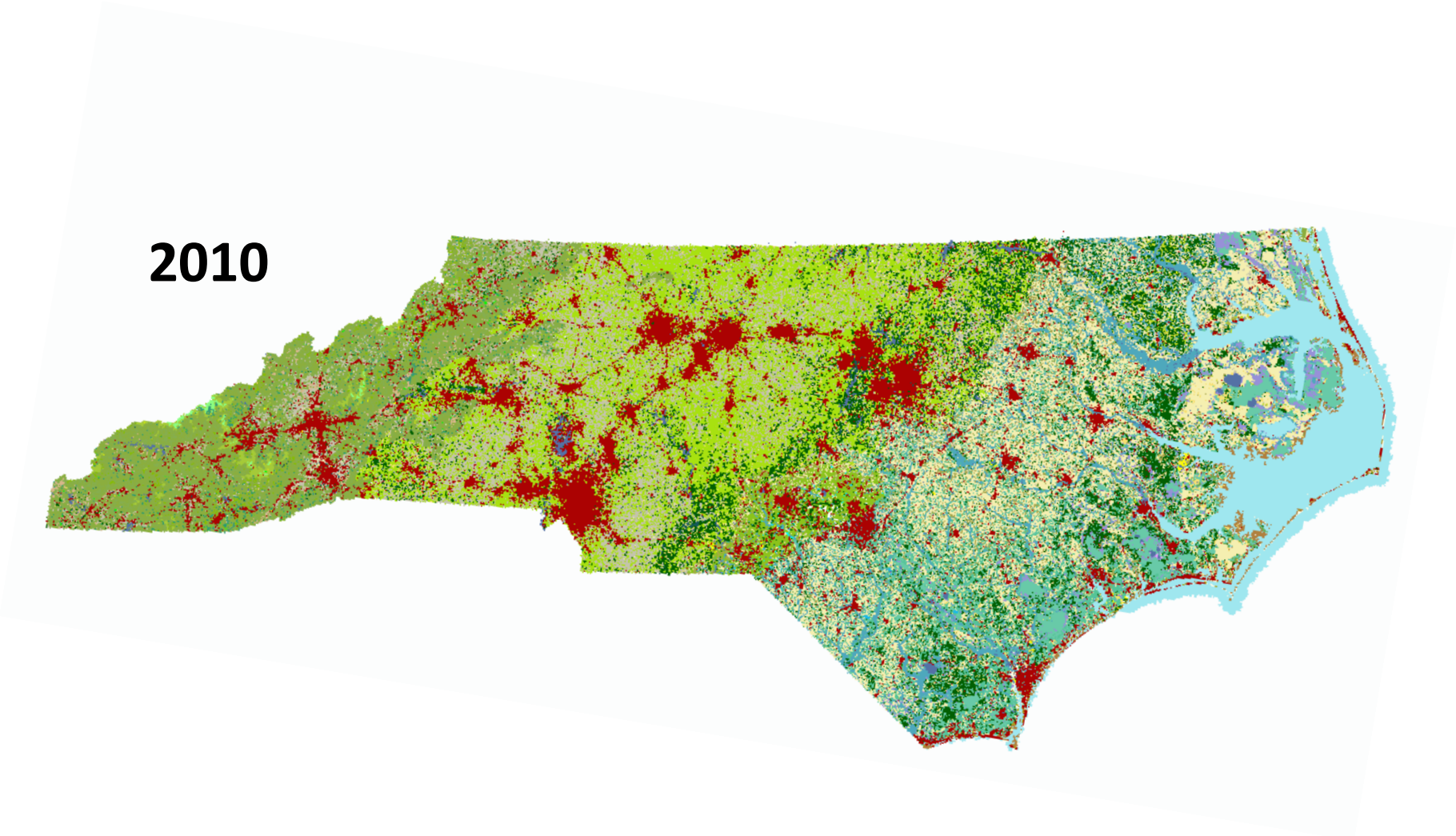
Results: Harvest by region



Results: Thinning by region



Results: Simulated land use and vegetation



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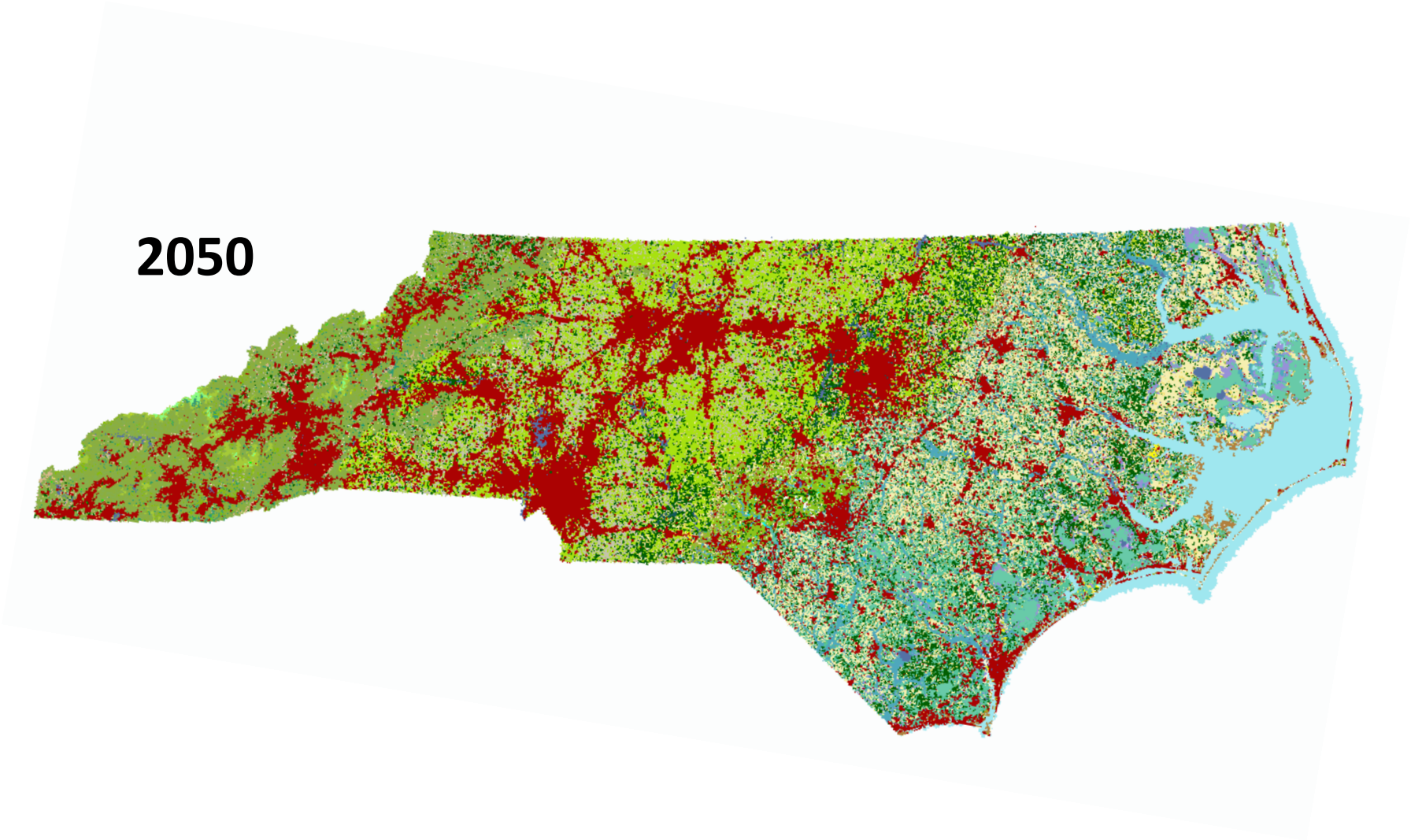
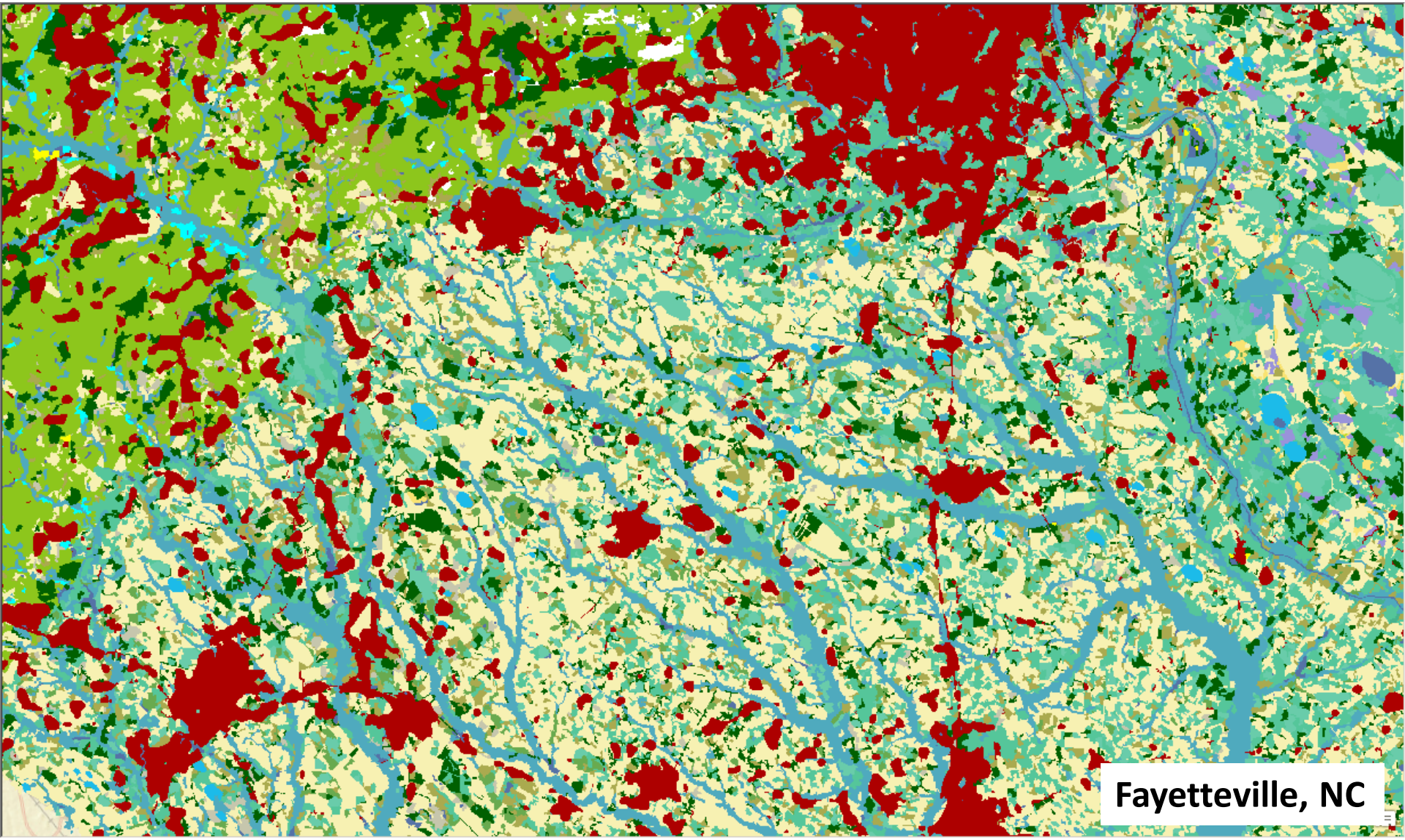
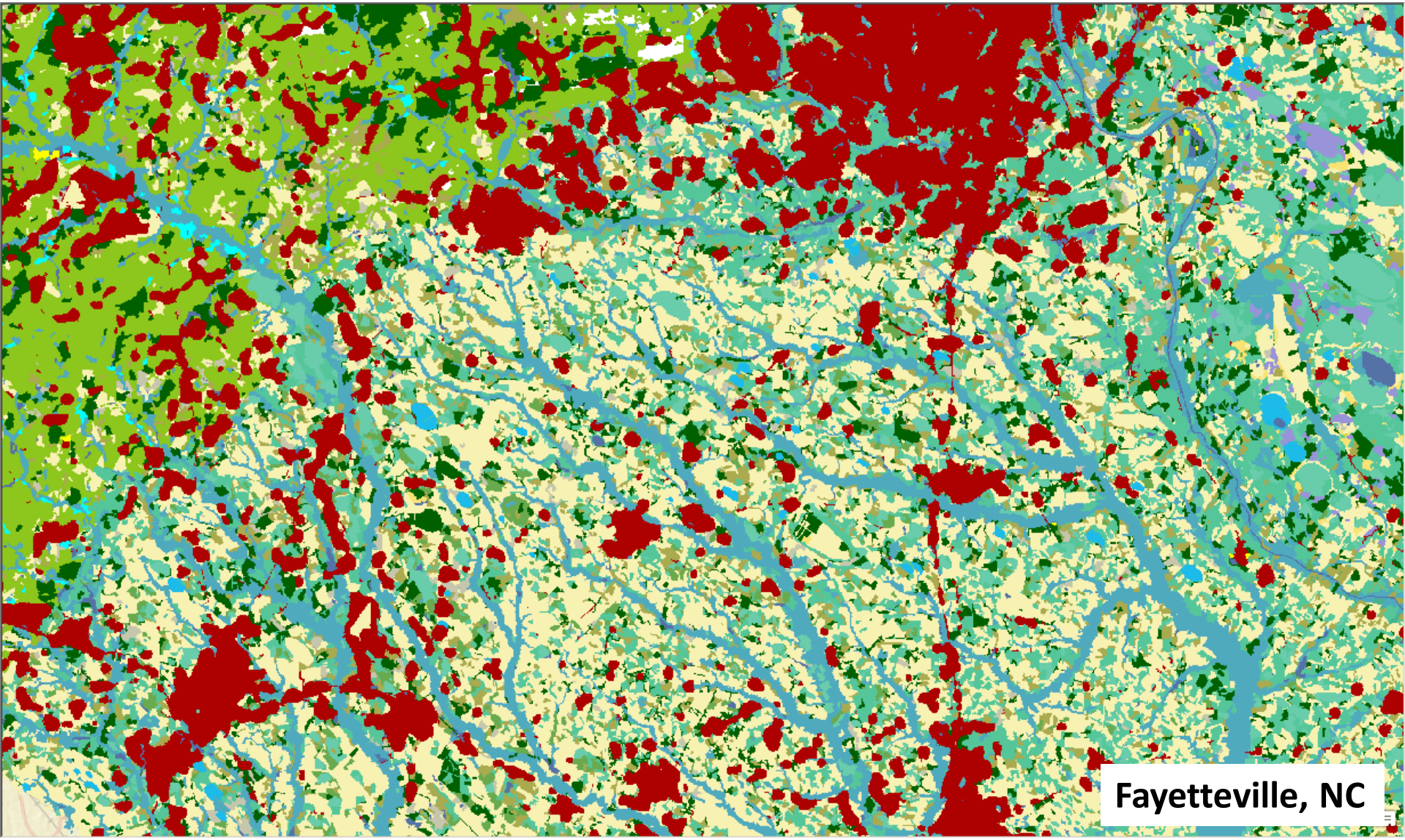


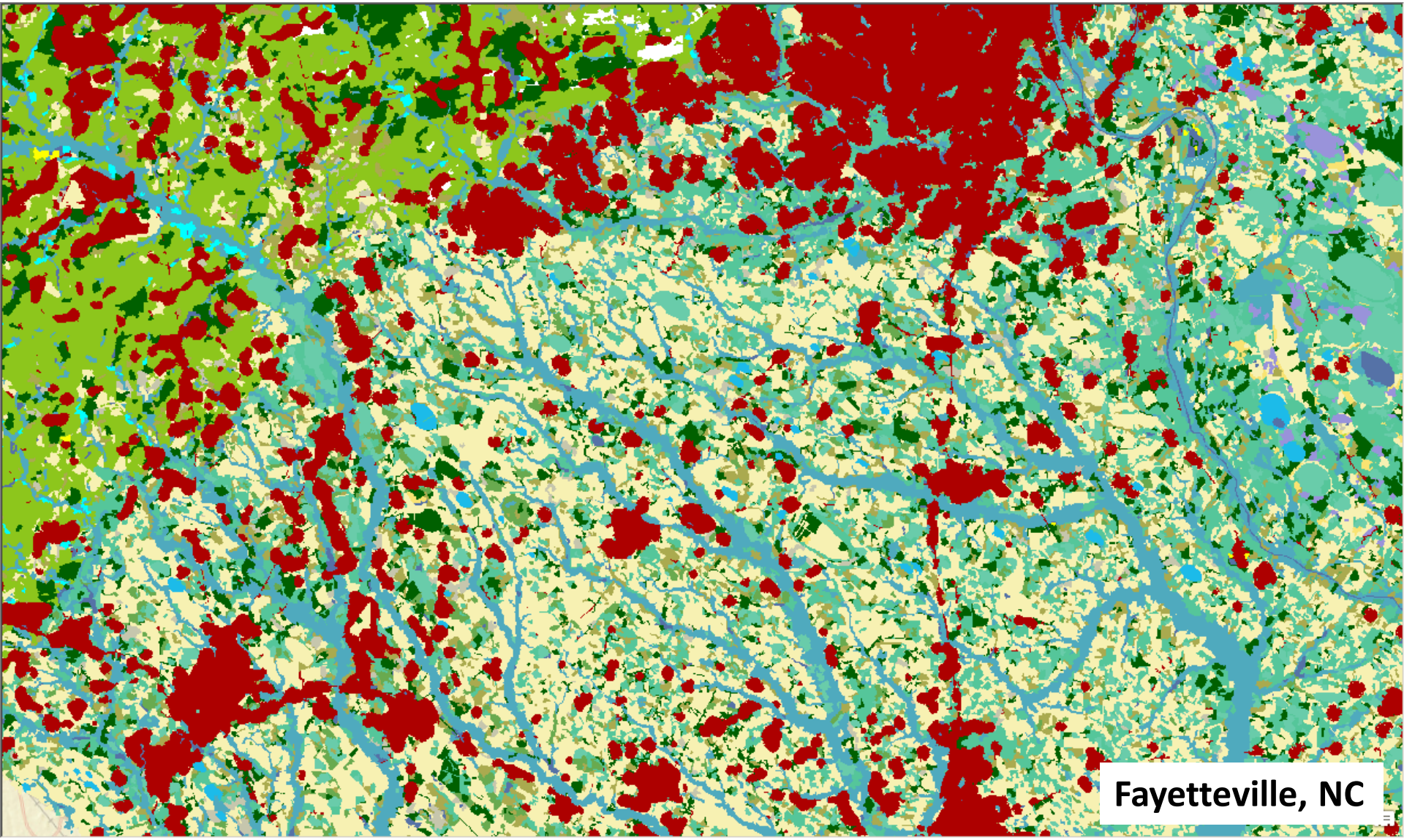
2010 Spatial results: Conventional biomass scenario



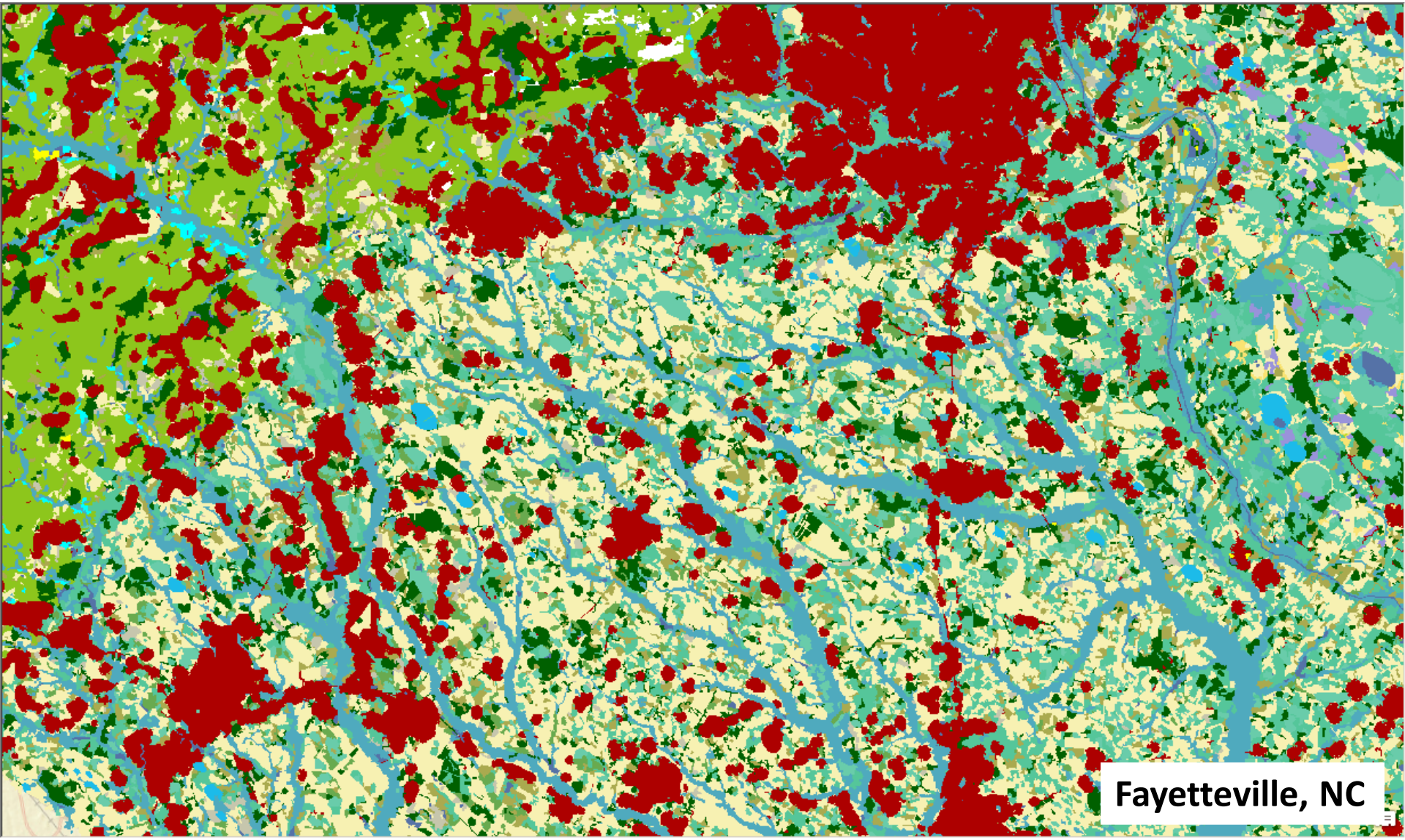
2020 Spatial results: Conventional biomass scenario



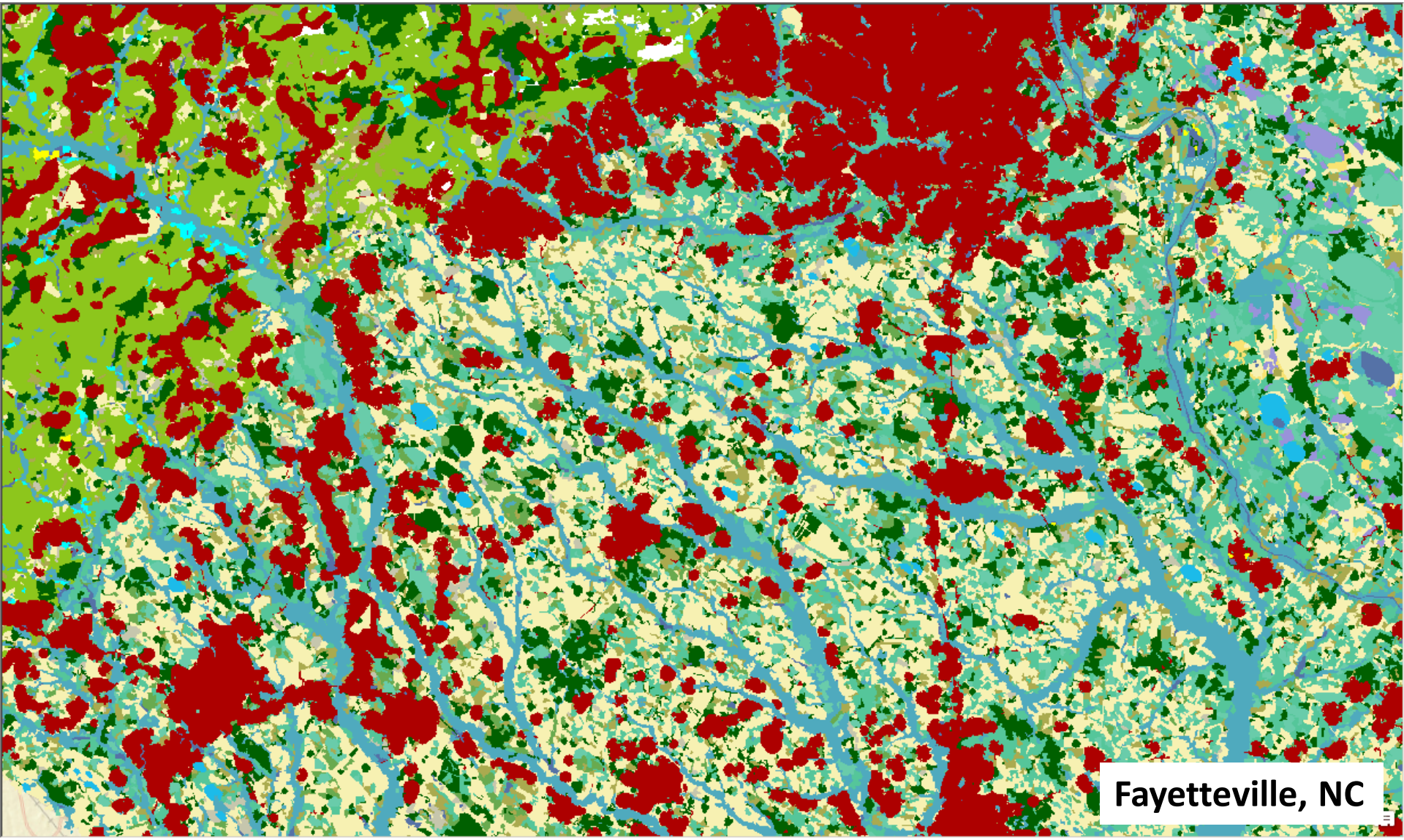
2030 Spatial results: Conventional biomass scenario



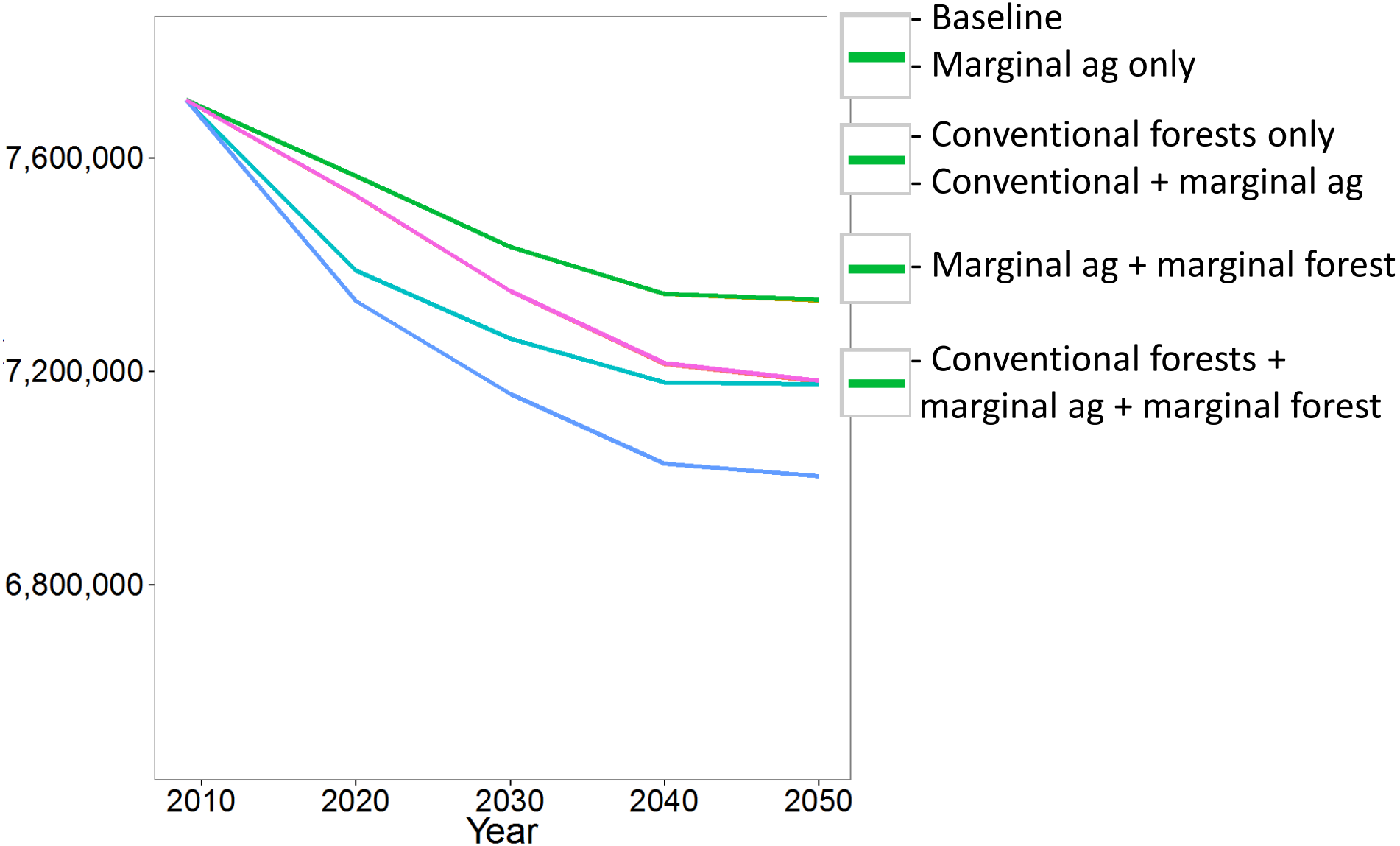
2040 Spatial results: Conventional biomass scenario



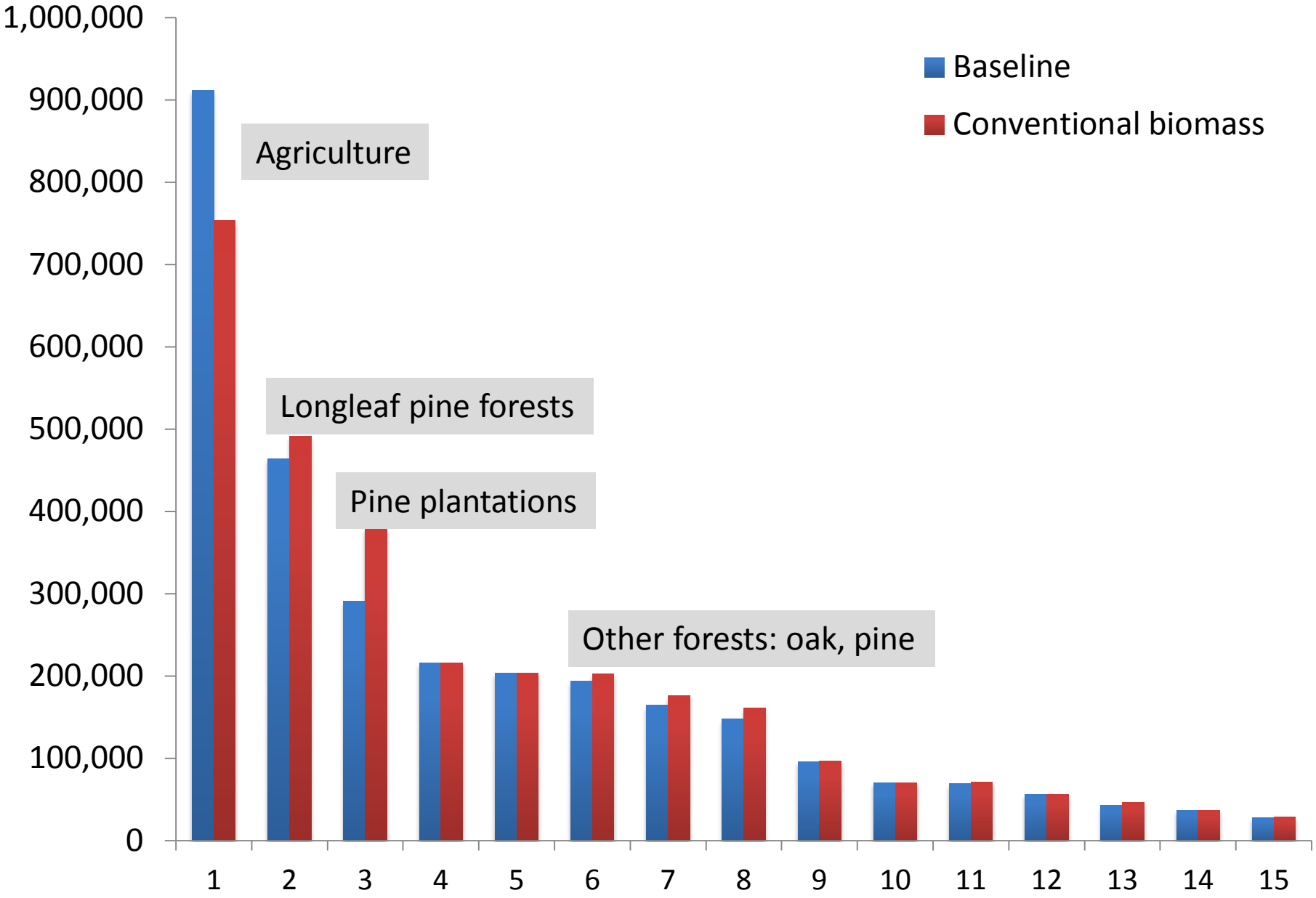
2050 Spatial results: Conventional biomass scenario



Results: forests over time (ha)



Results: 2050 landscape conditions - Coastal Plain



Summary for NC

- More biomass demand in conventional forests may help keep forests on the landscape
- Conventional forests can't meet the goal
- Conversion of marginal land to purpose-grown crops can meet the state's goal; impacts depend on which land is converted

- Future work will relate our outputs to wildlife habitat availability over time based on forest type, structure, successional stage

Summary: framework

- Advantages for assessing tradeoffs:
  - Spatial and temporal simulations
  - Vegetation structure and successional stage
- Additional work needed for full landscape design
  - Richer set of spatial inputs to guide feedstock production
  - Include full supply chain in tradeoffs
- Can relate outputs to ecological indicators
- Flexible framework for additional scenarios, including wood pellet demand, and focus on individual production plants

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USGS science for a changing world

gap KEEPING COMMON SPECIES COMMON

NORTH CAROLINA Cooperative Fish & Wildlife Research Unit

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