Using classification trees with Landsat imagery, ancillary variables, and FIA data to map tree species in Massachusetts, USA

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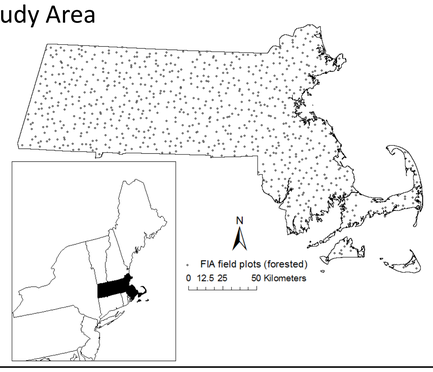
1 Introduction

Spatially explicit maps of the current distributions of tree species that comprise mixed temperate forests are necessary tools for practical biodiversity assessments, conservation efforts, forest health monitoring, and modeling future pest-risk and climate change scenarios. Though in recent years spatial data for modeling purposes have become abundant, there is a lack of species-level models of forested regions in the northeastern United States.

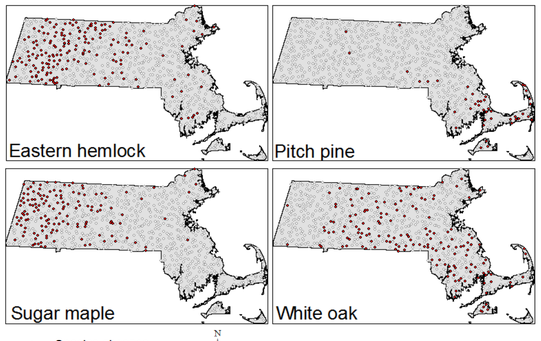
This study the See5 software to execute classification tree analysis (CTA) to model current distributions of four Massachusetts, USA tree species by relating point-based species presence or abundance data to explanatory variables in order to predict species' distributions based on biophysically meaningful relationships.

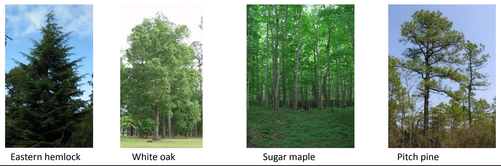
This study uses Forest Inventory and Analysis (FIA) data, multitemporal Landsat Enhanced Thematic Mapper-plus imagery, land use, and topographic and climatic variables to model the distribution of Eastern hemlock (*Tsuga canadensis*), Pitch pine (*Pinus rigida*), Sugar maple (*Acer saccharum*), and White oak (*Quercus alba*).

2 Study Area

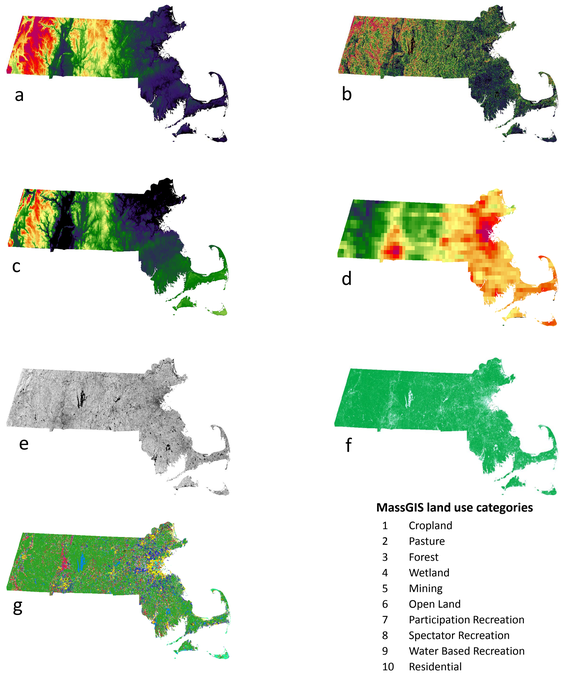


3 Forest and Inventory and Analysis Data





4 Environmental and Remotely Sensed Data



MassGIS land use categories

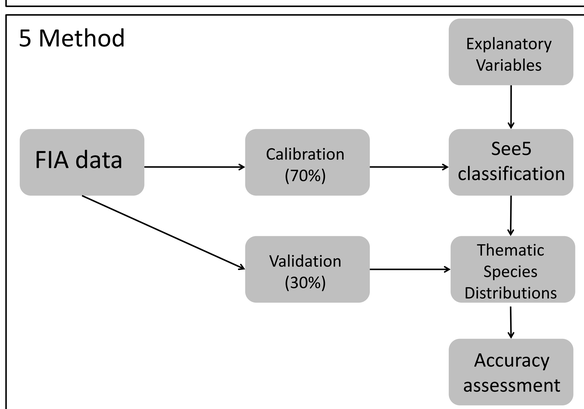
1	Cropland
2	Pasture
3	Forest
4	Wetland
5	Mining
6	Open Land
7	Participation Recreation
8	Spectator Recreation
9	Water Based Recreation
10	Residential
11	Residential
12	Residential
13	Residential
14	Salt Wetland
15	Commercial
16	Industrial
17	Urban Open
18	Transportation
19	Waste Disposal
20	Water
21	Woody Perennial

(a) Digital elevation model (DEM); (b) slope; (SLOPE) (c) precipitation (PRECIP); (d) mean annual temperature (TEMP); (e) September and October Landsat ETM+ 2000 band 7 (SeptB7 and OctB7); (f) September and October NDVI derived from Landsat ETM+ 2000 imagery (SeptNDVI and OctNDVI); (g) Mass GIS 1999 land use (LU99)

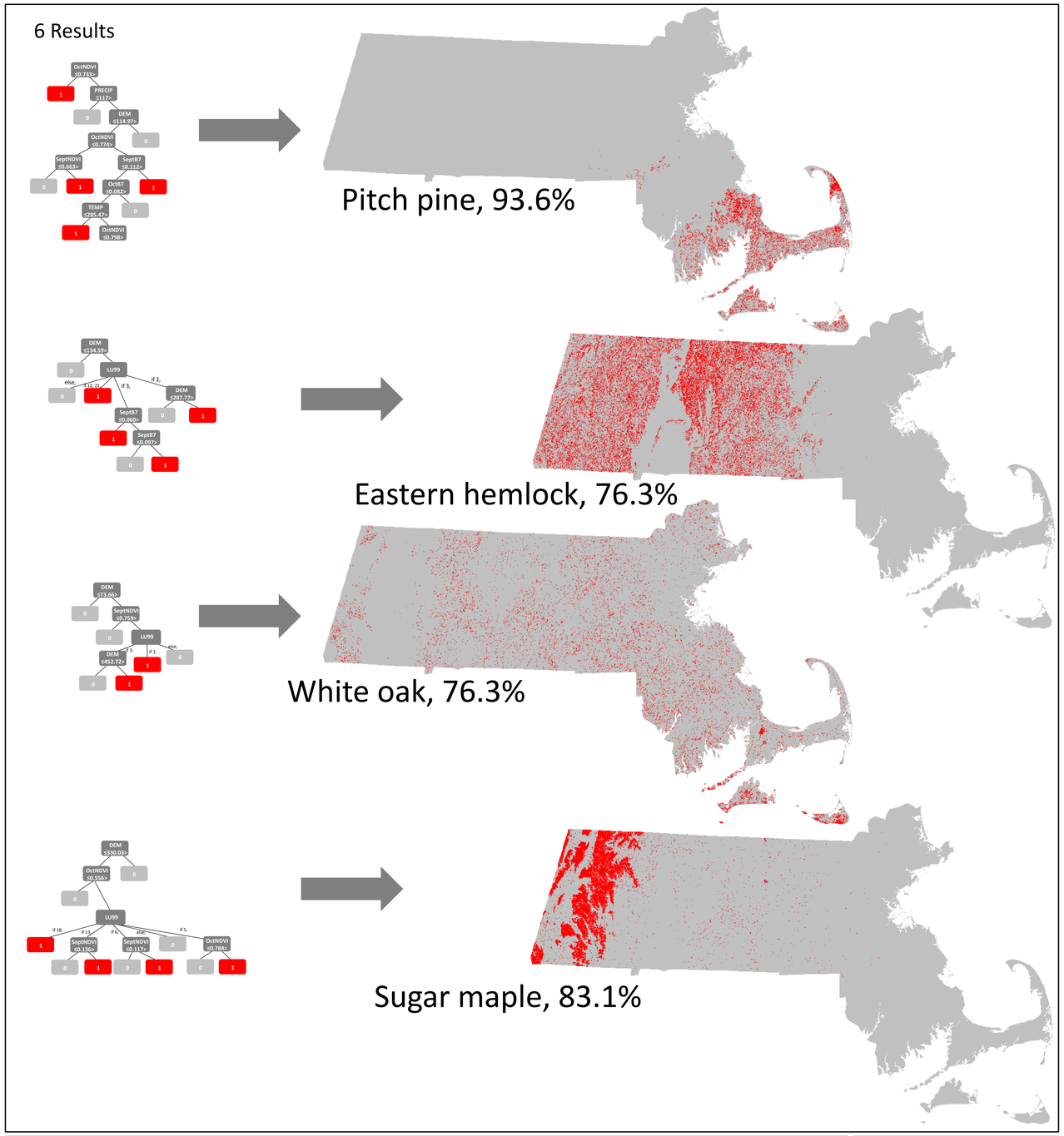
	SLOPE	DEM	OctB7	SeptB7	OctNDVI	SeptNDVI	PRECIP
SLOPE	1.0000	0.2002	0.0437	0.0161	0.0008	0.0534	0.0396
DEM		1.0000	0.0907	0.0154	0.0002	0.0688	0.3275
OctB7			1.0000	0.1279	0.0001	0.0144	0.0133
SeptB7				1.0000	0.0767	0.1447	0.0118
OctNDVI					1.0000	0.2160	0.0032
SeptNDVI						1.0000	0.0314
PRECIP							1.0000

R-squared values for relationships between non-categorical variables used in analysis. The strongest relationships are between DEM and PRECIP (0.3275) and SeptNDVI and OctNDVI (0.2160).

5 Method



6 Results



7 Main Findings

Pitch pine has the highest accuracy of the four species considered, likely because it is a very localized species. Found predominantly along the coast of Cape Cod, few locations in Massachusetts suit the ecological needs of Pitch pine. Conversely, in this study area, Eastern hemlock and White oak are relatively generalist species whose distributions are more widespread and less site driven. The root note for both Sugar maple and Eastern hemlock is DEM, which indicates that both distributions rely heavily upon elevation, which greatly restricts their modeled distributions. Eastern hemlock and Sugar maple are two dominant tree species in western Massachusetts, the portion of the state with the greatest topographic variation. Future research should attempt to include soils information, as well as generate continuous surface depicting the probability of species presence.

When land use is selected as a variable, the classes 'forest', 'woody perennial', 'residential', 'open land', 'pasture', and 'cropland' tend to indicate species presence. In the tree diagram for White oak, the class 'transportation' is used to explain presence, which for all other tree diagrams indicates absence.

Acknowledgements

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