NASA CARBON MONITORING SYSTEM (CMS) MULTI-STATE WORKING GROUP QUARTERLY MEETING

Meeting Focus: "Scaling Up the High Resolution Carbon Monitoring and Modeling Products to the Northeast U.S.: Discussion of Climate Action Plans, Current Carbon Monitoring Strategy, and Carbon Monitoring Needs and Interests for Stakeholders in the States of Connecticut, New Jersey, and Rhode Island "

Edil Sepulveda Carlo, NASA Goddard Space Flight Center

Tuesday, July 30, 2019

Meeting Goals & Discussion Topics

- Discuss Science Team progress, plans, and timelines for developing the following products for the NE states:

    - 30m aboveground biomass maps with uncertainty

    - 0.5 and 1m canopy cover maps

    - 1m canopy height maps

    - 90m ecosystem modeling based maps of carbon sequestration potential

- Learn about the uses and applications of CMS data products for state officials in Maryland, and plans in Delaware

- Provide stakeholders with the opportunity to discuss data needs, challenges, and interests, as well as updates of policies, programs, and initiatives that could benefit from CMS carbon data products

- **Understand climate change action plans, mandates, and GHG reduction goals in geographic area of work**

- Discuss further lessons learned on potential applications of carbon products, identify common needs and solutions, and make progress in incorporating science into policy and decision making

- Identify action items and next steps & plan for future meetings

More information: http://carbonmonitoring.umd.edu

Multi State Working Group Webpage: https://carbon.nasa.gov/multistate_wg

To Download MD data: http://dx.doi.org/10.3334/ORNLDAAC/1320

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Stakeholder Feedback – Discussion Questions

- What are the major policy drivers for climate change mitigation at the state level?
  - Policy and decision making timelines that we should be aware of

- What is your current source of data? Spatial resolution?

- What are some data gaps and challenges in your work?

- What scientific advancement(s) could contribute to your work?
  - What data do you need? When? Be as specific as possible.

- How can we help you? Identify next steps.

More information: http://carbonmonitoring.umd.edu

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To Download MD data: http://dx.doi.org/10.3334/ORNLDAAC/1320

Canopy Cover Generation

Optical Imagery | Lidar | Tree Canopy

0   0.25   0.5
km

Canopy Cover (%)

100
90
80
70
60
50
40
30
20
10
0

Max Canopy Height (m)

Above Ground Biomass (Mg/ha)

Field Plots

△ University of Maryland (UMD)/ CMS

● Forest Inventory and Analysis (FIA)/ USFS

● Non Forest/ Non Measured

Mean Canopy Height (m)
- 5
- 10
- 15
- 20
- 25
- 30
- 35

0   62.5   125 km

FIA Plot Design
D =36.6m
r =7.3m

UMD Fixed Plot
r =15m

UMD Variable Radius Plot
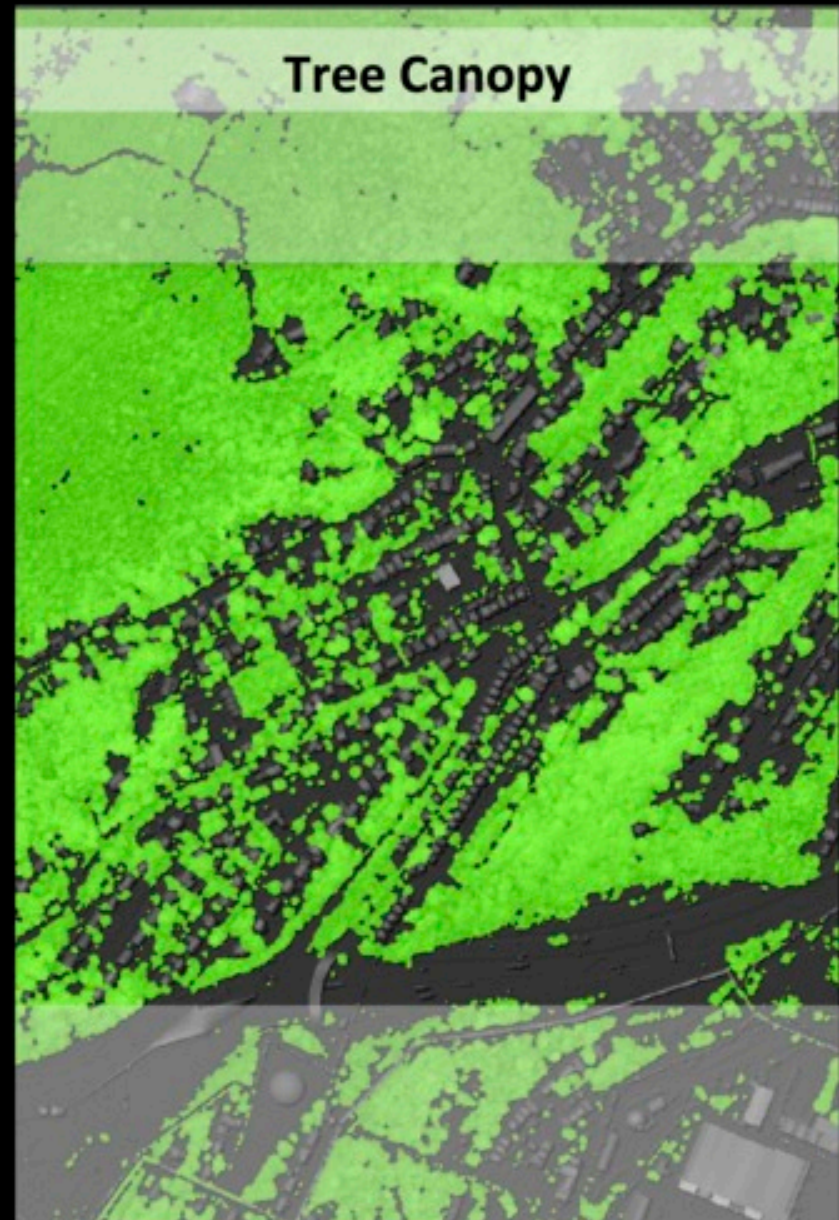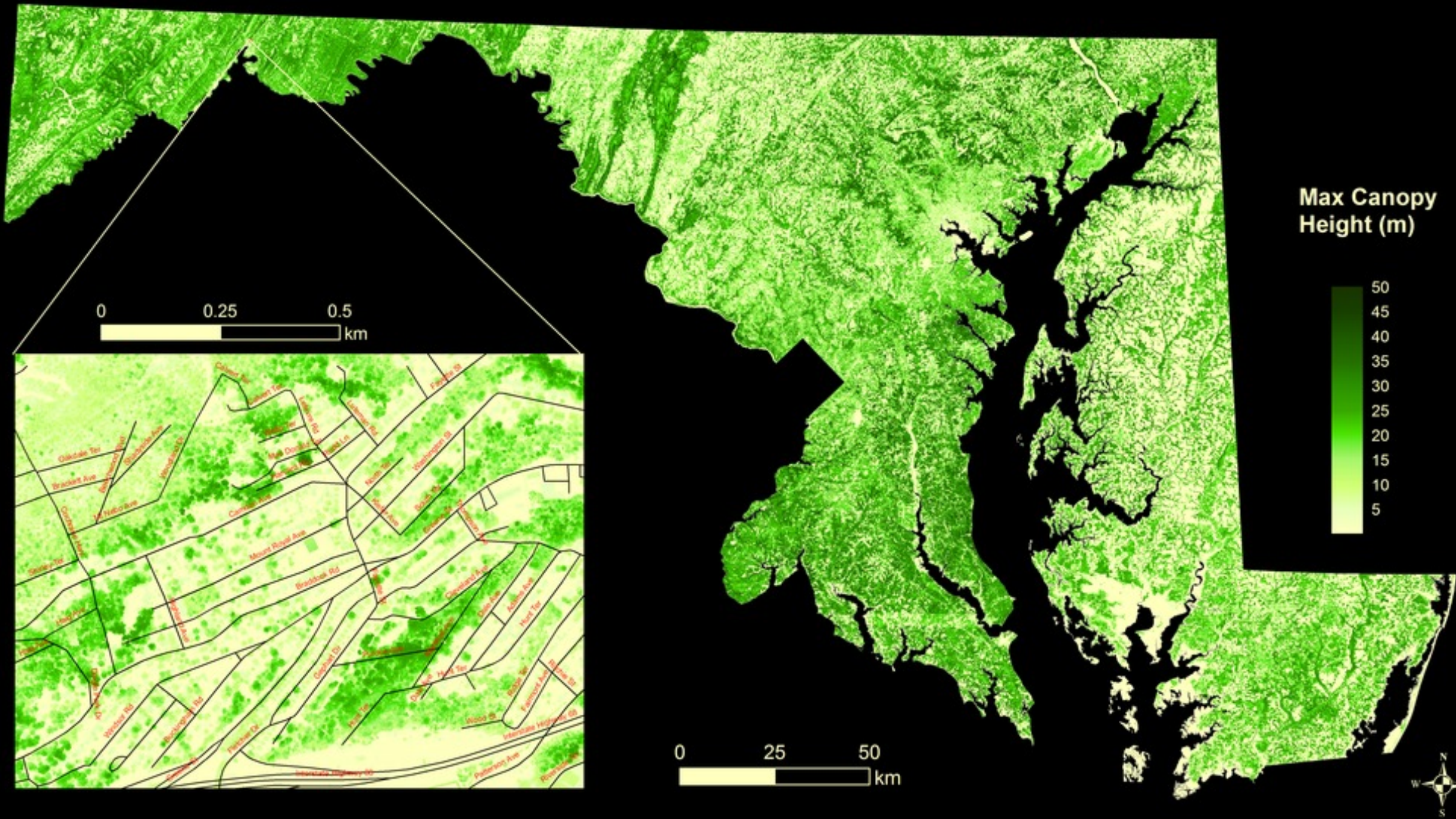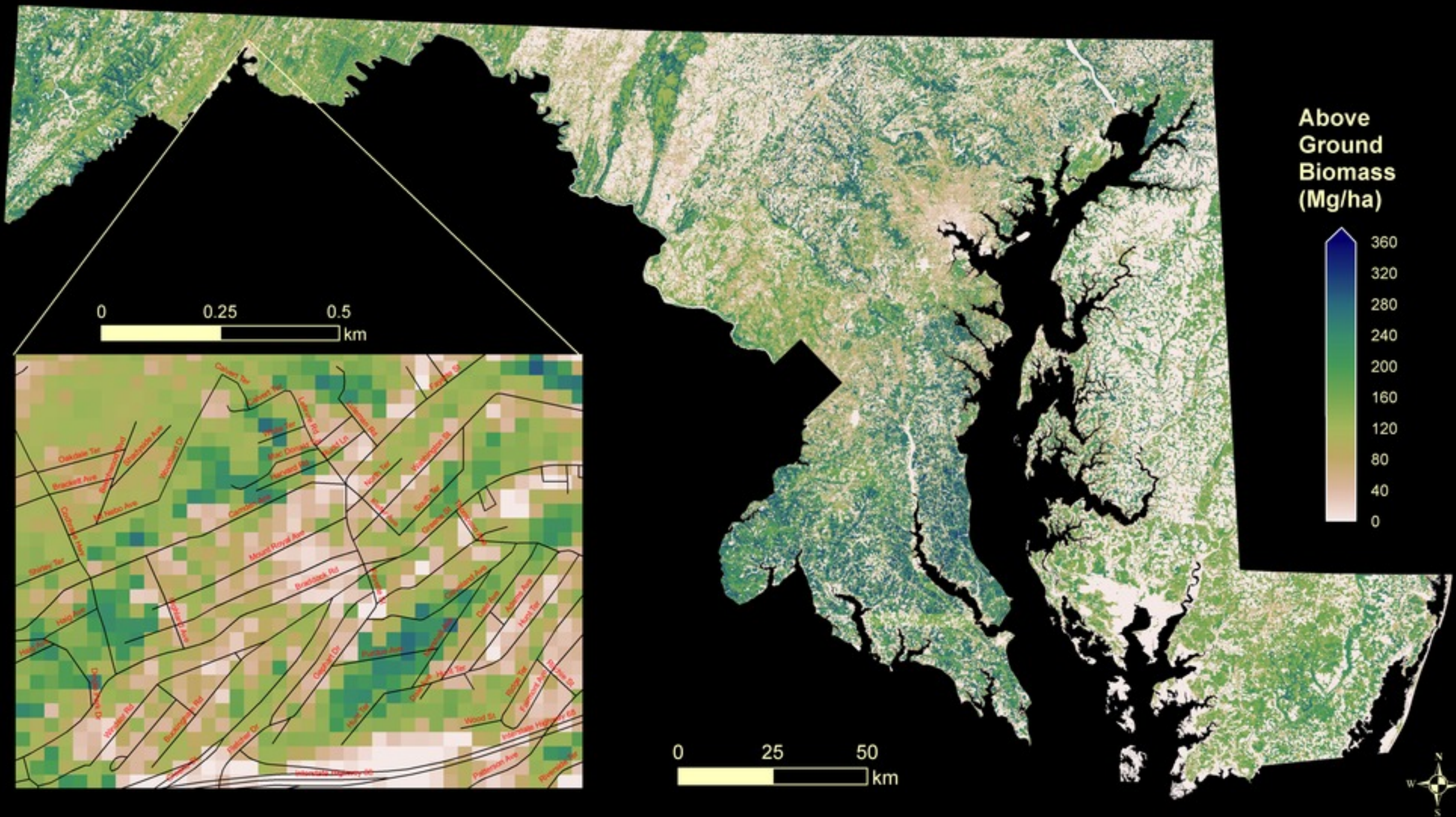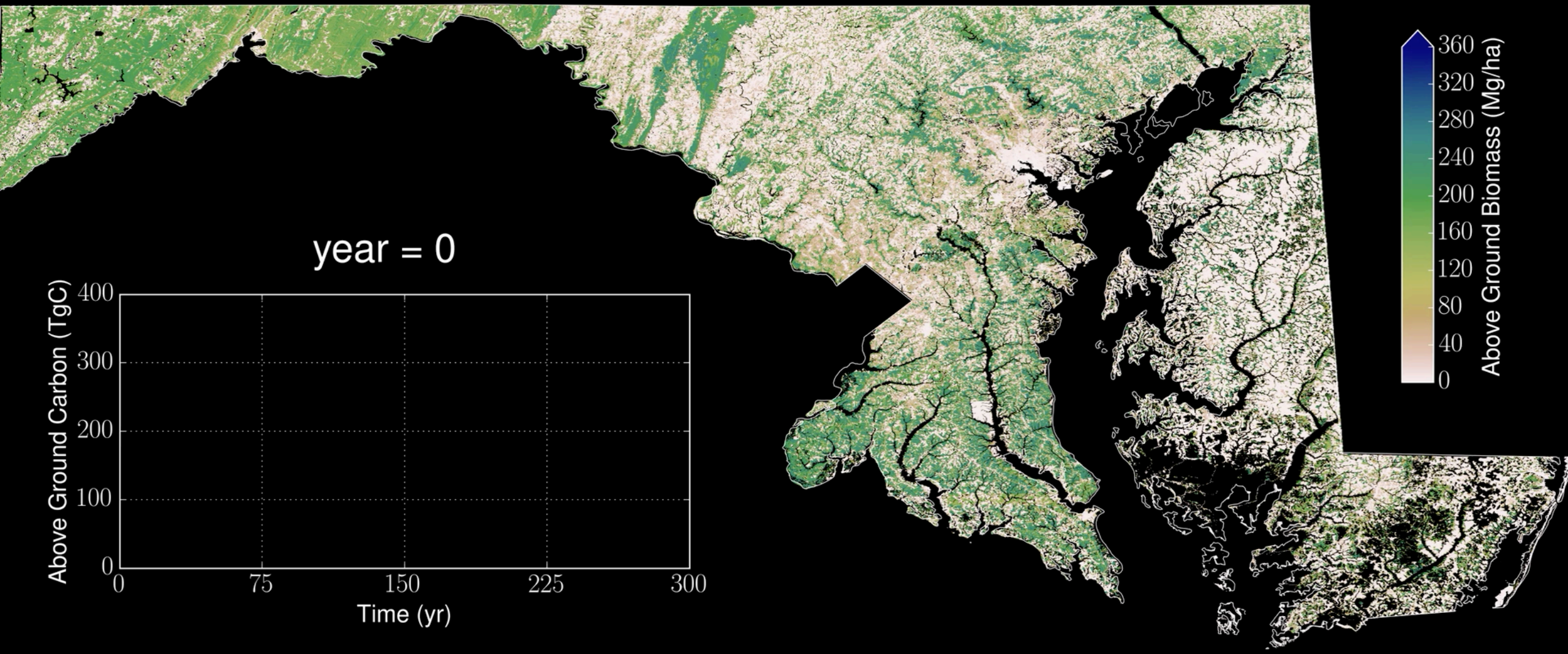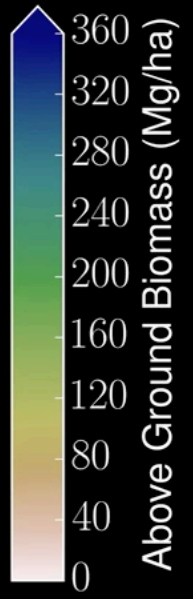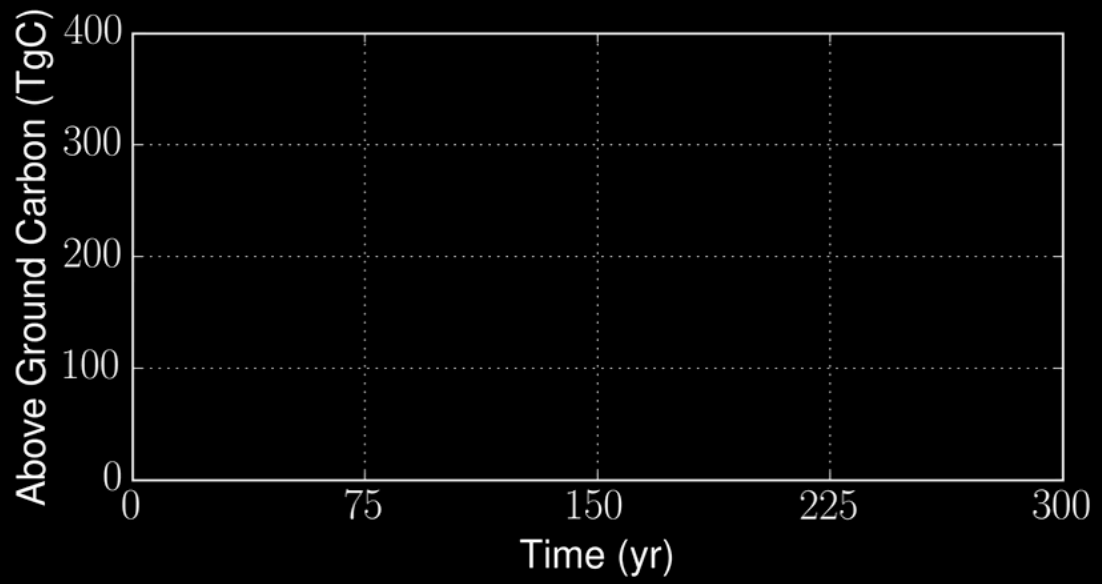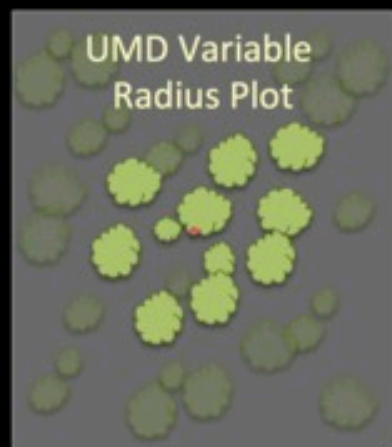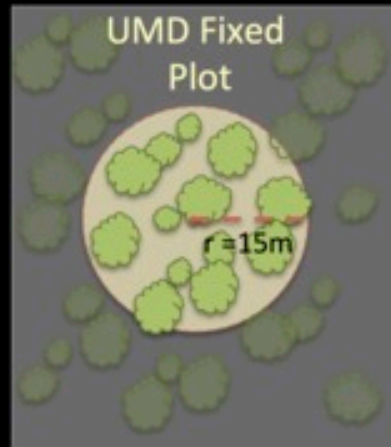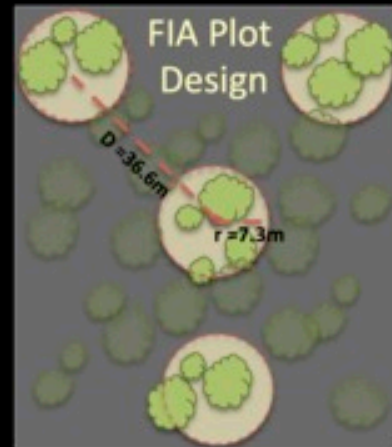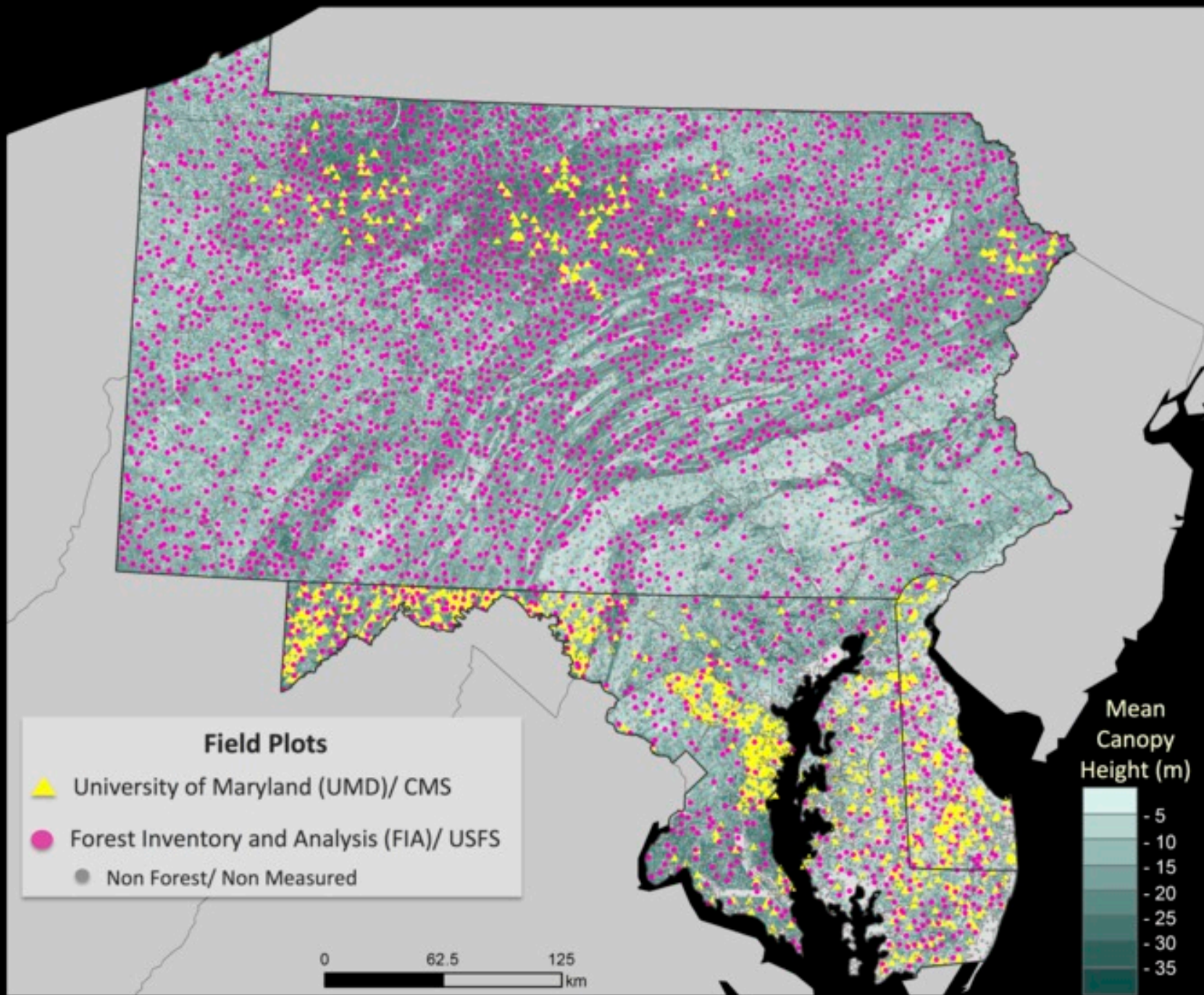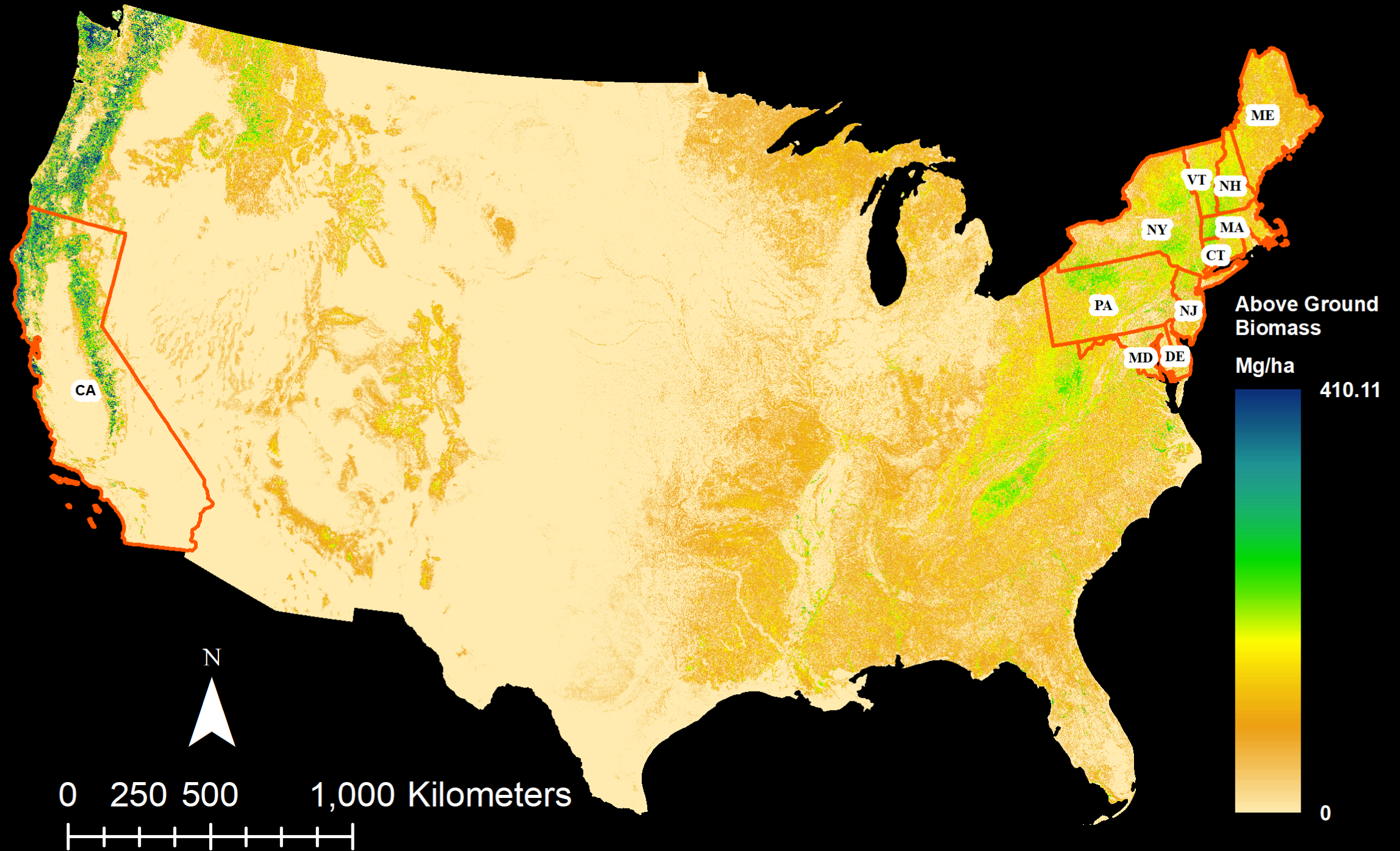
GLOBAL ECOSYSTEM DYNAMICS INVESTIGATION

GEDI LIDAR

Major Science Questions

What is the carbon balance of the Earth's forests?

How does forest structure affect habitat quality and biodiversity?

How will the land surface mitigate atmospheric CO_2 in the future?

- Earth's first comprehensive, high-resolution data set of ecosystem structure

- Selected by NASA Earth Ventures Instrument Competition

- Led by UMD in collaboration with NASA GSFC

Connecticut's Climate Strategy
Carbon Monitoring and LULC Change and Forestry Sectors

Cary Lynch[1] and Christopher Martin[2]

CT Department of Energy and Environmental Protection
July 30, 2019

1 Office of Climate Change
2 Division of Forestry

Connecticut Department of Energy and Environmental Protection

CT Global Warming Solutions Act (PA 08-98) & An Act Concerning Climate Change Planning and Resiliency (PA 18-82).

  GHG Emissions 10% below 1990 levels by 2020

  GHG Emissions 45 and 80% below 2001 levels by 2030 and 2050, respectively.

2016 Statewide GHG emission = 41 MMTCO$_2$e

  Does not include LULC Change & Forestry emissions/sequestration

Connecticut Statewide GHG Emissions 1990-2016

Total GHG Emissions

2020 Target

2030 Target

2050 Target

Y-axis: Million Metric Tons of CO$_2$ equivalent

X-axis years: 1990, 1995, 2000, 2005, 2010, 2015

Connecticut Department of Energy and Environmental Protection
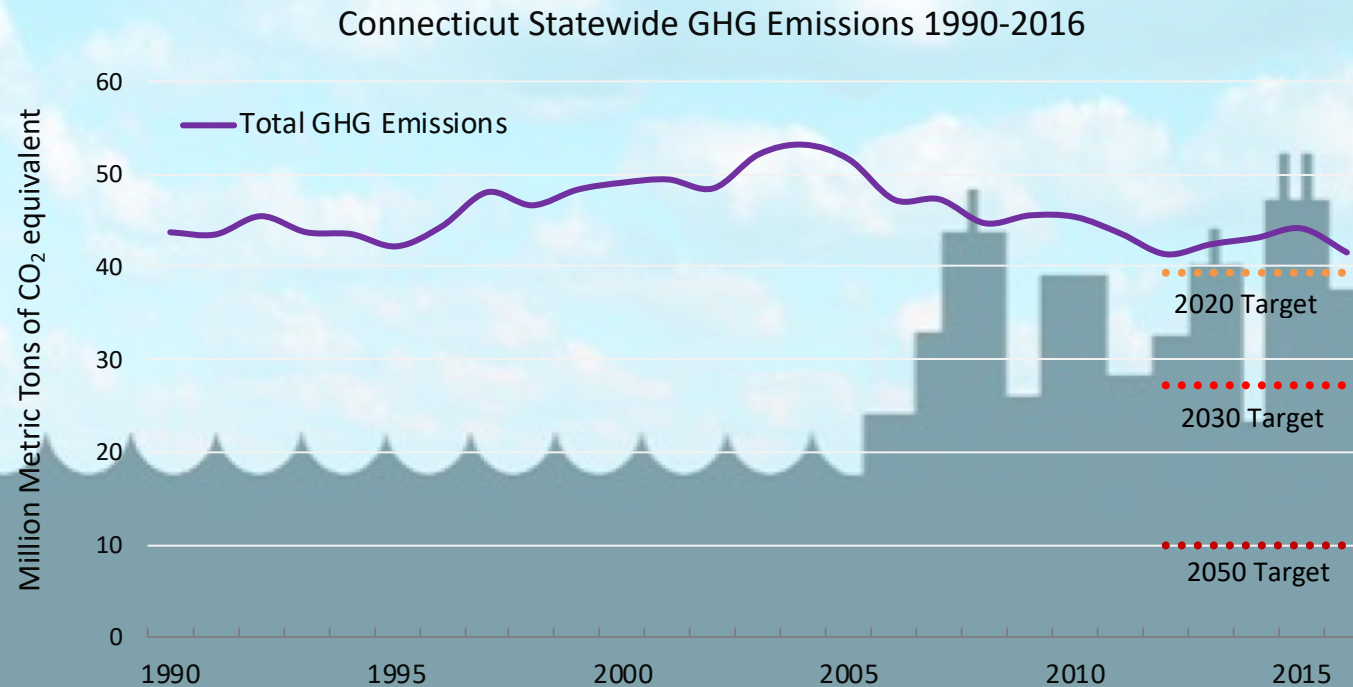
Heavily based on the U.S. Environmental Protection Agency's State Inventory Tool (SIT).

Tool calculates sector-by-sector GHG emissions based on numerous state-level data sets

Default data is used most sectors (transportation, residential, commercial, industrial, waste and agriculture), exceptions are:

Solid-waste data from the DEEP municipal waste program

Natural gas sector data from PHMSA and CT PURA

LULC and forestry default data not used => unreliable, questionable

Consumption based accounting for the electricity sector based on MA DEP SGIT appendix Q-S methodology

National statistics and state data are used when appropriate from EIA and federal sources

Carbon Sequestration

Currently, CT does not account for GHG emissions from LULC Change and Forestry
Agricultural sector emissions are less than 0.6% of overall emissions, and no "sinks" are included

Prior research to assess carbon sequestration in the CT forestry sector
Tomasso and Leighton, 2014; Silver, 2015; Duveneck and Thompson, 2019
Connecticut's Forest Action Plan (2010, 2015)

Pending research with the US Climate Alliance, Natural & Working Lands Challenge
#NWLCHALLENGE

Connecticut Department of Energy and Environmental Protection
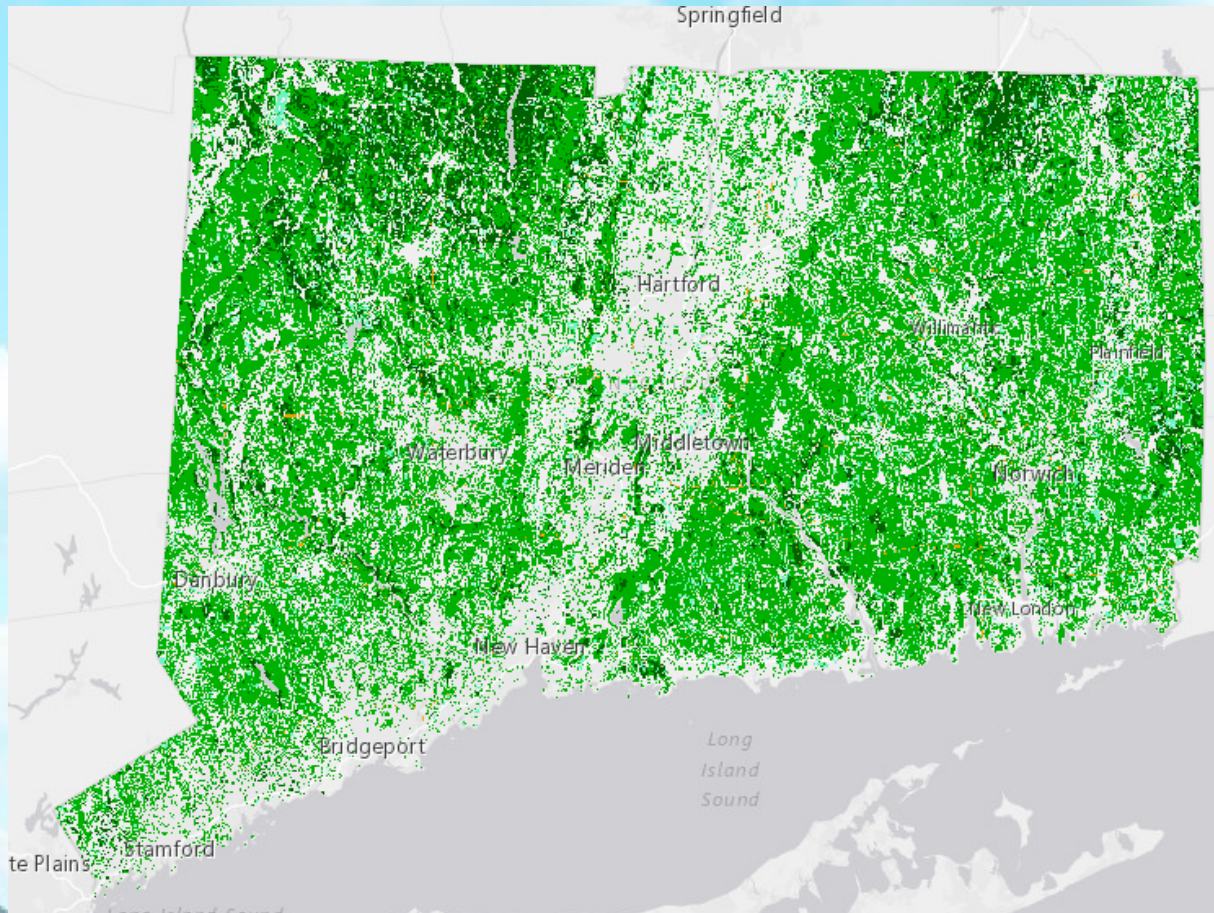
State Forest Coverage in 2010 (CLEAR, Connecticut's Changing Landscape)

58% of land area is forest.

+1.8 million acres
  0.8 billion live trees
  70% of forest type is oak/history

3.1% growth since 2012 (Butler, 2018)
  Ratio of net growth to removals 5:1

71% of forest area is owned by private landowners

Connecticut Department of Energy and Environmental Protection

Forest Conservation/Protection Initiatives

Connecticut Forest Action Plan

Current Use- Property Taxation (PA 490)

Green Plan

Connecticut Department of Energy and Environmental Protection

Forest Action Plan

- US Farm Bill Requirement

- Analyzes the current conditions and trends of forests in Connecticut and lays out strategies and action steps to best plan for the future of the forested landscape.

- Original 2010, Revised 2015, Rewrite 2020

- Addresses 3 national themes:

1. Conserving working forest landscapes;
2. Protecting forests from harm; and
3. Enhancing public benefits from trees and forests.

Connecticut Department of Energy and Environmental Protection

PA 490 Forest Land

Statutory Definition of "Forest Land" (Connecticut General Statutes (CGS) Sec. 12-107b)

. . . any tract or tracts of land aggregating twenty-five acres or more in area bearing tree growth that conforms to the forest stocking, distribution and condition standards established by the State Forester . . .and consisting of . . .

(A) one tract of land of twenty-five or more contiguous acres, which acres may be in contiguous municipalities,

(B) two or more tracts of land aggregating twenty-five acres or more in which no single component tract shall consist of less than ten acres, or

(C) any tract of land which is contiguous to a tract owned by the same owner and has been classified as forest land pursuant to this section.

~500,000 acres

Connecticut Department of Energy and Environmental Protection

Green Plan

- Connecticut's Comprehensive Open Space Acquisition Plan – aka "Green Plan"

- Guides the efforts by DEEP and its land conservation Partners

- Goal of conserving 21% of Connecticut's land base as open space by year 2023, as set by section 23-8 of the general statutes.

Connecticut Department of Energy and Environmental Protection

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Connecticut Department of Energy and Environmental Protection

New Jersey's Energy and Climate Legislation

1999 — Electric Discount & Energy Competition Act
Renewable Portfolio Standard
4.0% Class I + 2.5%
Class I or II = **6.5% by 2012**

2005 — Regional Greenhouse Gas Initiative
Global Warming Response Act

2007

2010 — Offshore Wind Economic Development Act

2011 — Energy Master Plan
New Jersey withdraws from the Regional Greenhouse Gas Initiative

2012 — The Solar Act
Renewable Portfolio Standard
3.470% Solar + 17.88%
Class I + 2.5% Class II = **23.85% by 2021**

2015 — Energy Master Plan Update

2018

January — Executive Order 7
Directs New Jersey to reenter the Regional Greenhouse Gas Initiative
Executive Order 8
Promotes Offshore Wind Energy

February — New Jersey joins the US Climate Alliance
Upholding the Paris Climate Accord

May — Executive Order 28
Advances New Jersey's Clean Energy Economy by establishing a path for 100% clean energy and directs BLU to write the 2019 Energy Master Plan

Clean Energy Act
Renewable Portfolio Standard
35% by 2025 &
50% by 2030

26

NEW JERSEY'S GREENHOUSE GAS REDUCTION TARGETS
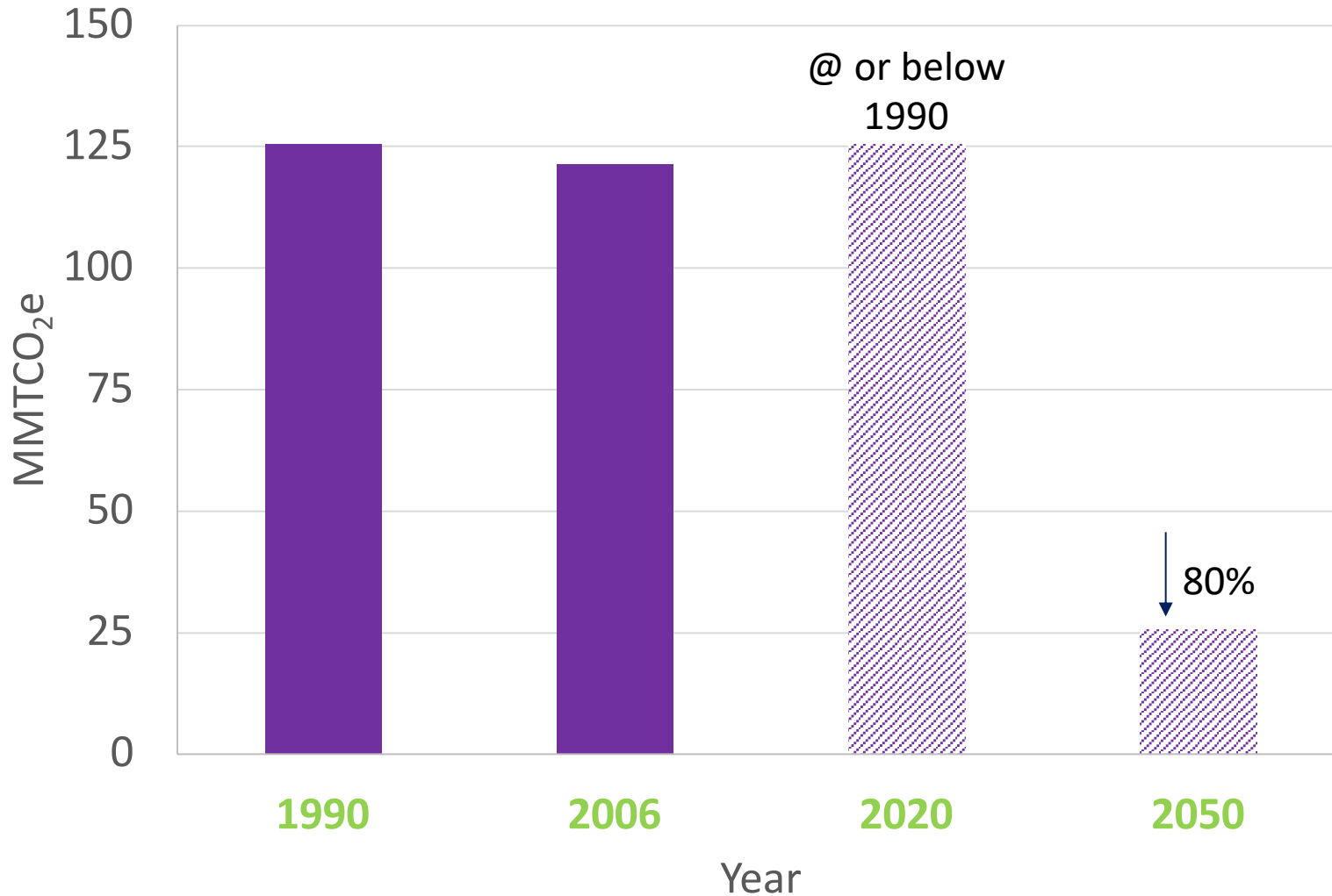
Global Warming Response Act (2007, revised in 2019):
Economy-wide GHG emission limits

2020 Limit
At or below 1990

2050 Limit
80% below 2006

2019 GWRA revision
- Interim benchmarks by 2021
- Annual reporting on SLCPs by 2020

Clean Energy Act (2018):
Electric generation emission limits

100% clean energy in 2050

Greenhouse Gas Reduction Plan

Energy Master Plan (June 2019)
Integrated Energy Plan (December 2019)
Global Warming Response Act 2050
Recommendations Report (July 2020)

Climate Resiliency Plan

- **Climate Change Science Report** (January 2020)

- **Coastal Resiliency Plan** (June 2020)

- **Agency Resiliency Plans** (January 2021)

New Jersey's Natural Resources Legislation and Programs

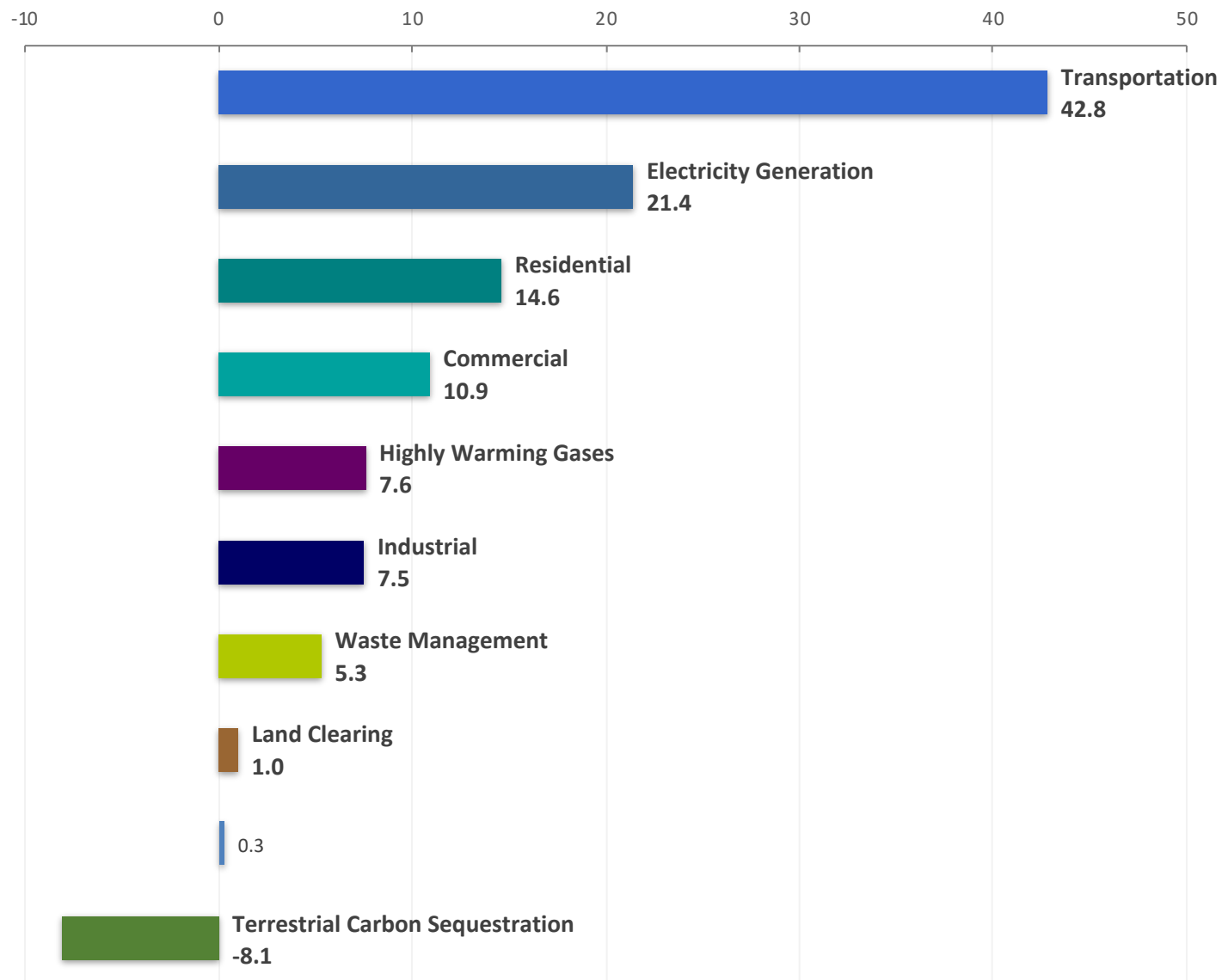| Legislation/Program	Description
Green Acres Program (1961)	purchased and conserved land for public purposes
The Farmland Preservation Program (1981)	preserves farms by purchasing easements to prohibit farmland from being developed for nonagricultural purposes
Garden State Preservation Trust Act (1998)	a constitutional dedication of $98 million annually to create a stable funding source to preserve open space, farmland and historic resources, as well as to provide funds for recreational development.
Green Acres bond referendum (2007 & 2009)	Open space funding for state land, local government, nonprofit, and Blue Acres projects
New Jersey Open Space Preservation Funding Amendment	Beginning in July 2015, 4% of the revenue derived from the Corporate Business Tax Act (CBT), estimated to be $71 million, will be dedicated to Green Acres, Blues Acres, and Farmland Preservation programs as well as historic preservation. In 2019, the CBT will be 6%.
NJ Forest Stewardship Program (P.L. 2009, c. 256)	Provides grants to private property owners with over 5 acres of land to develop forest stewardship plans.
NJ Farmland Assessment Program	The Farmland Assessment Act of 1964, amended in 1986, allows woodland owners to develop and implement a state-approved forest management plan to qualify for reduced property taxation. An existing policy which provides differential (lower) assessment and local property taxes for farmland and woodlands which meet certain requirements.
RGGI Auction Proceeds dedicated to Forest and Tidal Marsh Preservation	Limited new funding, under RGGI carbon auction funds allocated pursuant to the *NJ Global Warming Solutions Fund Act* to conduct stewardship activities, including forestry and tidal marsh projects that conserve and sequester carbon.
Natural Resource Damage settlements	Limited funding available for the restoration of natural resources through Natural Resource Damage settlements (NRD) entered into by NJDEP, which settlement funds were recently constitutionally dedicated to restoration projects.
Wetlands Mitigation Fund	Limited funding available for the restoration of freshwater wetlands, including reforestation activities.
DEP Enforcement Funds	Other potential funding available through DEP-approved Supplemental Environmental Projects (SEPS), penalty settlements, and permit conditions requiring mitigation.
NJ Forest Service's *No Net Loss* program	Compensatory reforestation on public lands.

Federal Programs for Carbon Sequestration through Land Preservation

Legislation/Program	Description
Farm Bill programs	Provide funding for restoration and Stewardship program activities on private lands, including the Environmental Quality Improvement Program (EQIP), and the Wetlands Reserve Program (WRP), as well as UCF, Forest Health, and Fire programs on public lands.
USF&WS Partners for Wildlife Program	Limited federal funding available for stewardship activities, including the planting of trees.
NOAA Coastal Resilience and National Fish & Wildlife Foundation programs	Limited federal funding available for tidal wetlands restoration.
USDA Forest Service – Forest Legacy Program	Forest Legacy Program identifies and protects environmentally important private forestland threatened by conversion to non-forest. A private forest landowner may negotiate the sale of selected interests in their forestland, or the sale of their forestlands, to the U.S. Forest Service. Preferably, the federal government would purchase a private forest landowner's conservation easement. The land would then remain in the possession of the private landowner.

Estimated NJ Greenhouse Gas Emissions, 2016,
(in million metric tons CO_2 equivalent, $MMTCO_2e$)
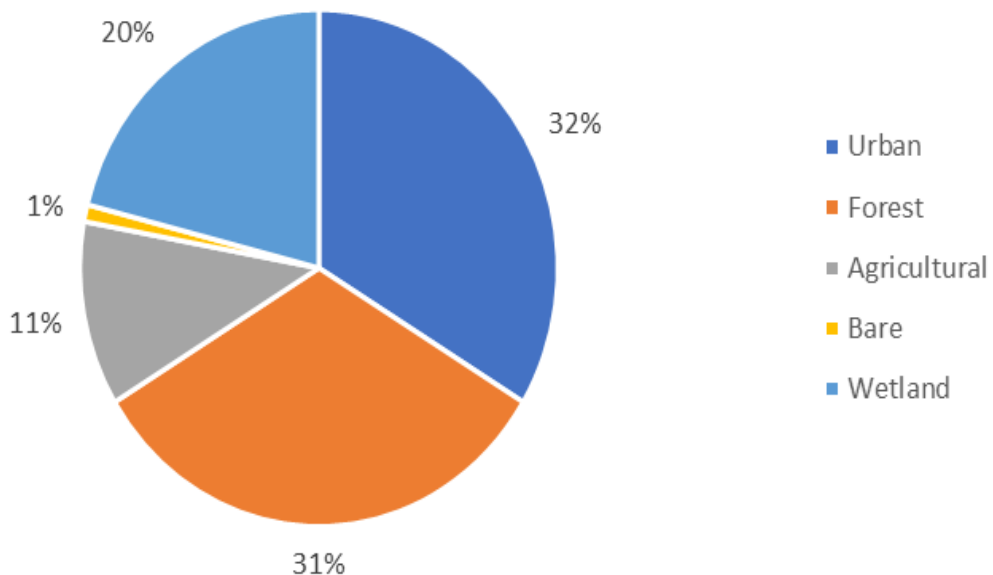Total Net Emissions 103.3 $MMTCO_2e$

Category	Value
Transportation	42.8
Electricity Generation	21.4
Residential	14.6
Commercial	10.9
Highly Warming Gases	7.6
Industrial	7.5
Waste Management	5.3
Land Clearing	1.0
	0.3
Terrestrial Carbon Sequestration	-8.1

Methodology: GHG Inventory

Combination of IPCC tier-1 (default values) and tier 2 (location specific research data) methodologies for land use, land-use change and forestry (LULUCF) sequestration estimation.
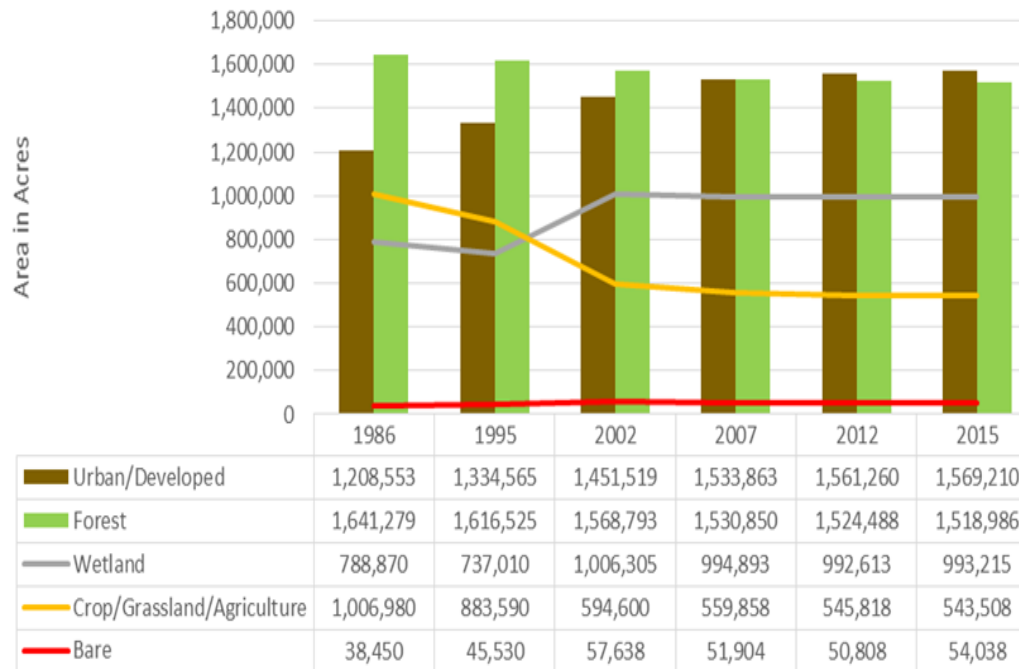Utilizes NJDEP Land Use Land Cover Data (updated every 5 years, latest is 2015).
Estimates carbon sequestration (biomass and soil) based on carbon stock change.

Significance of Terrestrial Carbon Sequestration for NJ

New Jersey Land Use Land Cover Estimates, 2015

- Urban — 32%
- Forest — 31%
- Agricultural — 11%
- Bare — 1%
- Wetland — 20%

NJ Land-Use Trends, 1986-2015

	1986	1995	2002	2007	2012	2015
Urban/Developed	1,208,553	1,334,565	1,451,519	1,533,863	1,561,260	1,569,210
Forest	1,641,279	1,616,525	1,568,793	1,530,850	1,524,488	1,518,986
Wetland	788,870	737,010	1,006,305	994,893	992,613	993,215
Crop/Grassland/Agriculture	1,006,980	883,590	594,600	559,858	545,818	543,508
Bare	38,450	45,530	57,638	51,904	50,808	54,038

Observations and Working Assumptions

Core preservation areas of the State are holding up to development/urbanization pressure. Land clearing declining due to development being concentrated in already developed or built up areas

Urban forestry and urban soils contribute to sequestration.

Risk of reversal of carbon storage (from pests and diseases, wildfires, coastal hazards, etc.) is manageable and/or controlled.

Over the long-term, climate change itself, would work in favor of sustained carbon sequestration. U.S. Forest Service research shows NJ species composition shifting toward carbon-dense tree species (Oak, Hickory, etc.).

Data Needs

Updated New Jersey land-use data.

Methane emissions from wetlands. Blue carbon working group within NJDEP to help address data gaps in this area.

Soil carbon data (such as, forest soil and urban soil carbon).

Improved monitoring, measurement and verification methods.

>Recent legislation (23 July 2019) requires NJDEP to adopt rules and regulations establishing a GHG emissions monitoring and reporting program to monitor and report Statewide GHG emissions starting December 2020.

>Adds "short-lived climate pollutants" to the greenhouse gas sources that need to be identified and included in monitoring and reporting efforts from the Department.

>Requires that the reporting of those emissions (including short-lived climate pollutants) and changes in those emission levels annually, commencing December 2020.

>Adds the requirement to monitor progress towards any interim limits established (see next bullet), in addition to the 2020 and 2050 limits.

RESILIENT RHODY

AN ACTIONABLE VISION FOR ADDRESSING THE IMPACTS OF CLIMATE CHANGE IN RHODE ISLAND
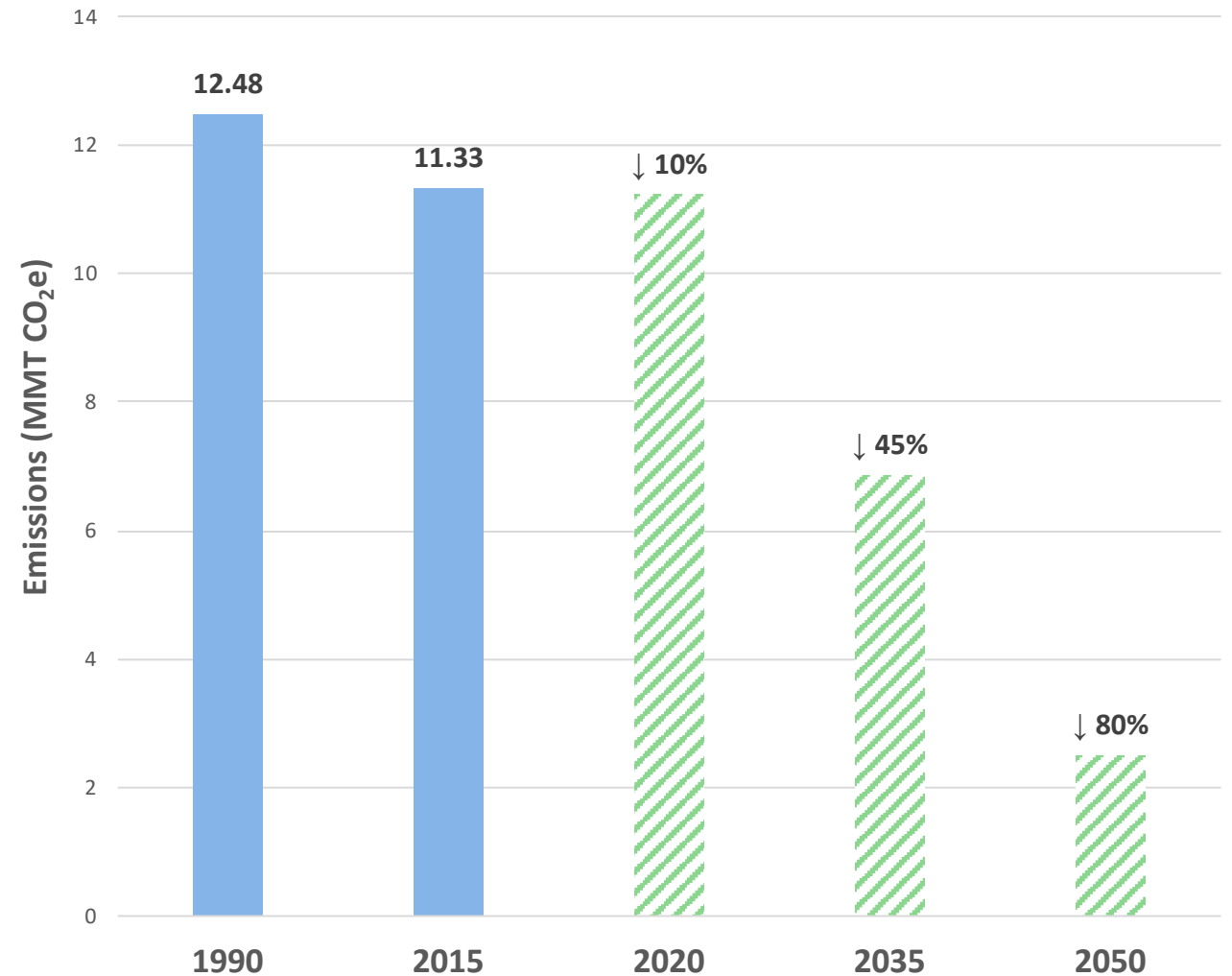
RI Forest Cover

Rhode Island's forests are considered second-growth, established on past agricultural lands.
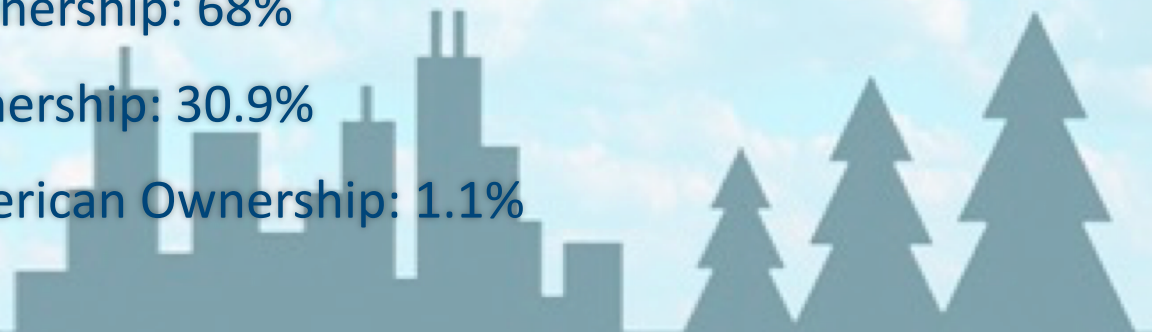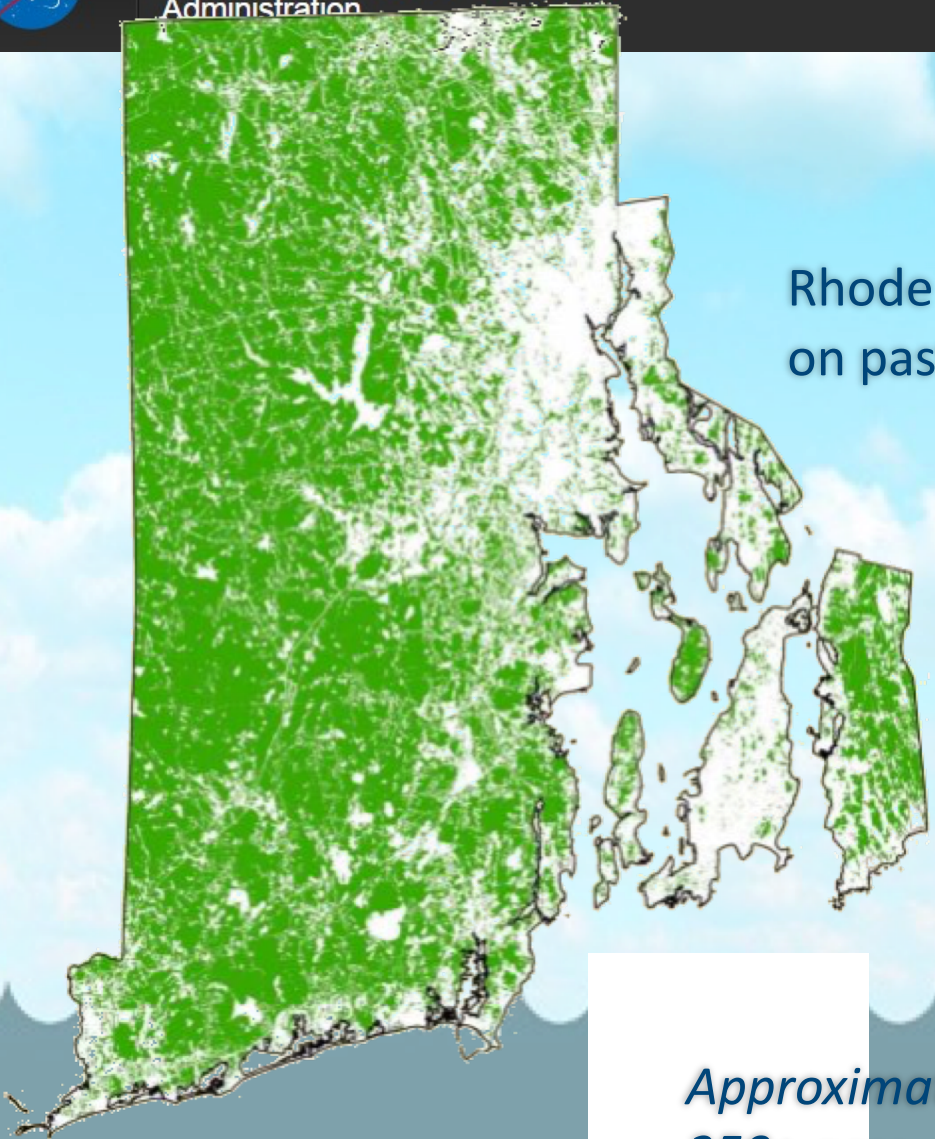
2017 Data

Forestland Acreage: 368,000 (55% of Total Area)
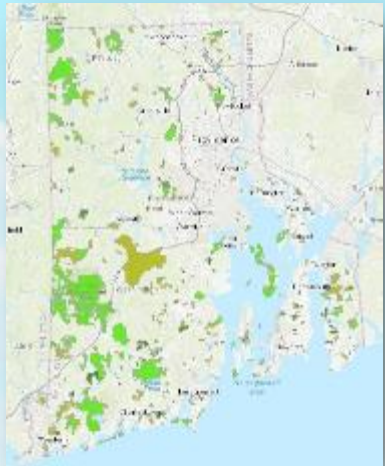
Private Ownership: 68%

Public Ownership: 30.9%

Native American Ownership: 1.1%

Approximately 34% (213,000 acres) of forestland is considered 'core forests' of 250+ acre contiguous blocks
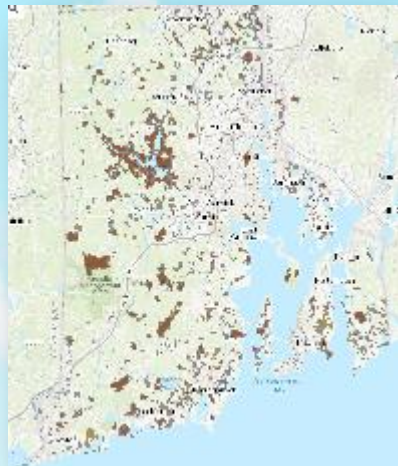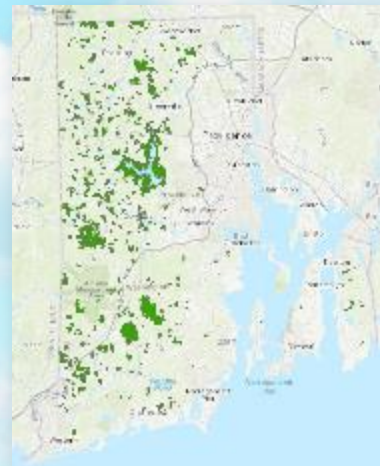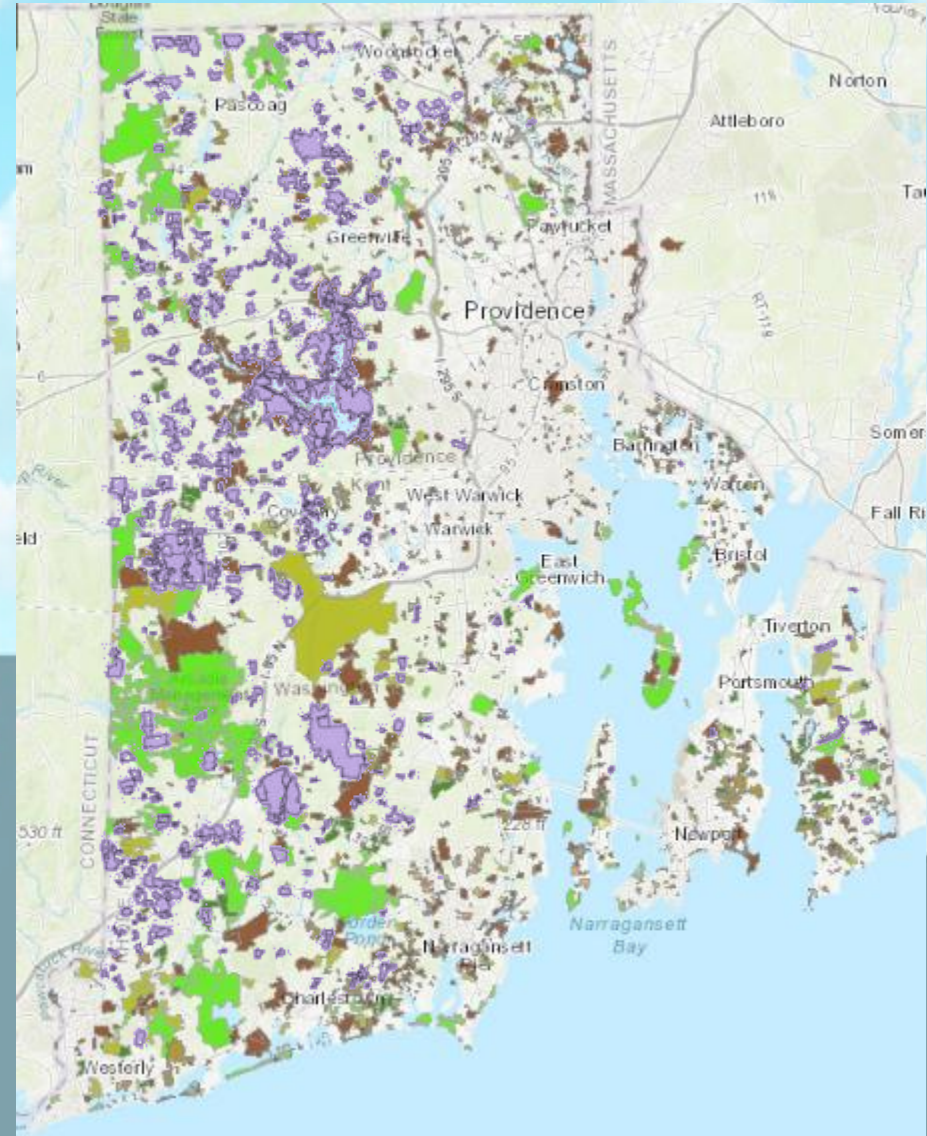
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Collected Conservation Land


state + local + FLC =

FLC = Forest Land Classification

(Current Tax Use Program)

Challenges & Concerns

Rhode Island is on its way to becoming an urban state; suburban spread and development contribute to forest fragmentation and shrinking forest ecosystems.

* Top 5 of all U.S. for urban land (38.7%) and urban/community land (43.2%) as a percent of total land area.

Rhode Island's current-use tax program provides the main impetus for landowners to actively manage their forested lands, but this incentive often can't compete with those offered by commercial and residential developers or alternative energy projects.
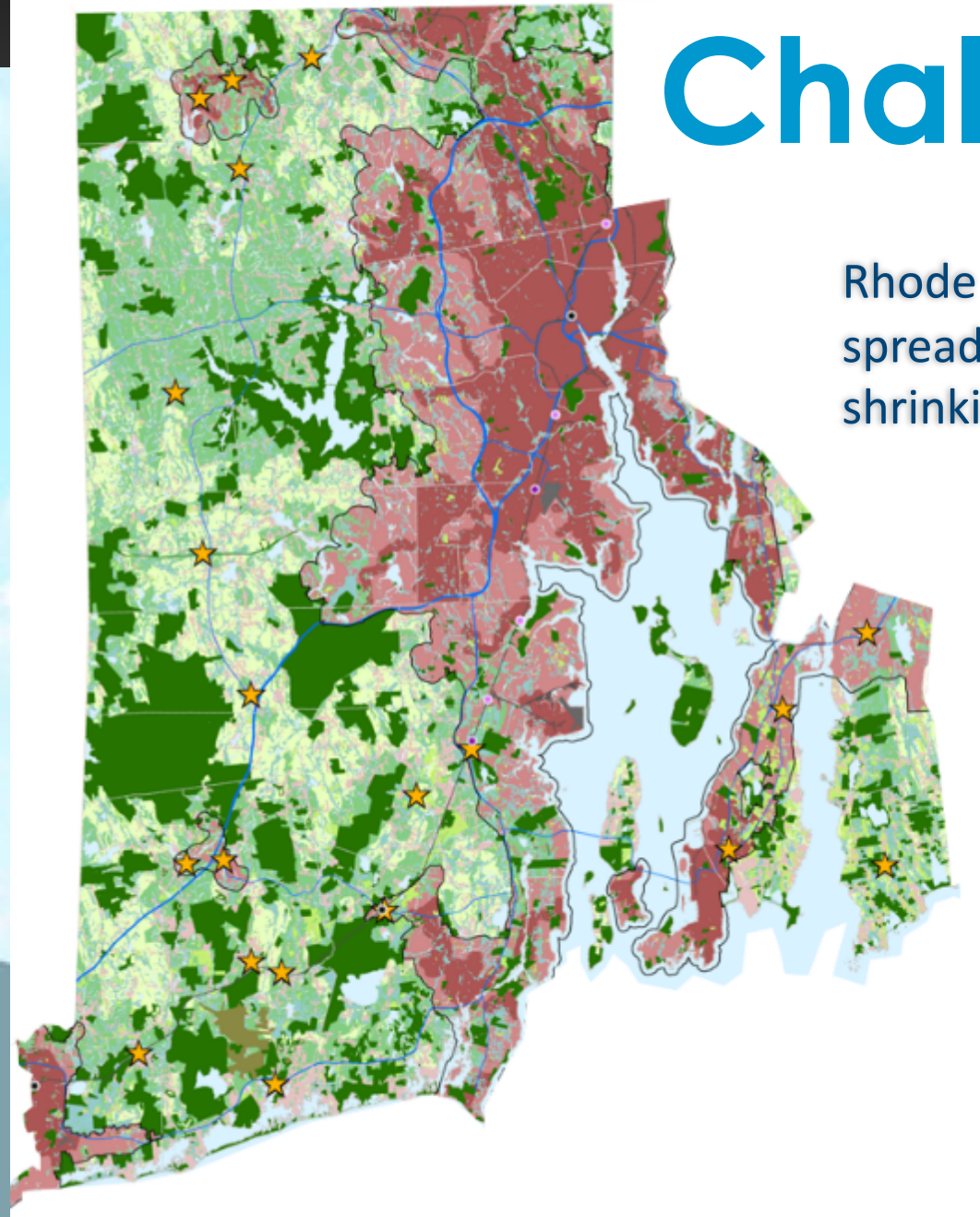
Monetary Forest Values

2017 Stumpage Reports

○ Total acres harvested: 1882

○ Total value: $515,224.50

	NOT SPECIFIED	OAK	WHITE PINE	MIXED OAK	CORDWOOD
VOLUME	338 MBF	1056.1 MBF	2576.4 MBF	159 MBF	6925 CDS
VALUE*	$ 35,490.00	$ 132,012.50	$ 270,522.00	$ 7,950.00	$ 69,250.00

Forest Climate Benefits

Pollutant	Annual Pollutant Removed by Trees (Tons)	Monetary Value of Annual Pollutant Removed by Trees
Carbon Monoxide	98.27	$ 44,670.78
Nitrogen Dioxide	784.15	$ 119,918.23
Ozone	10,525.24	$ 11,513,831.25
Particulate Matter < 2.5 microns	450.65	$ 23,824,109.94
Particulate Matter > 2.5 and < 10 microns	1,581.45	$ 2,989,459.43
Sulfur Dioxide	405.38	$ 21,890.04
TOTAL	***13,845.13***	***$ 38,513,879.67***

Information obtained through a 2104 statewide tree canopy assessment using i-Tree Canopy tool.

www.itreetools.org

Programs and Resources

Forest Stewardship Program

Forestland Classification – Current Tax Use Program

Helps landowners conserve land for future generations

560+ landowner parcels

45,000 certified forestland acres.

Programs and Resources

Urban and Community Forestry Program

Energy-Saving Trees Program

2,000 trees offered to RI homeowners each year to lower energy costs and help combat climate change.
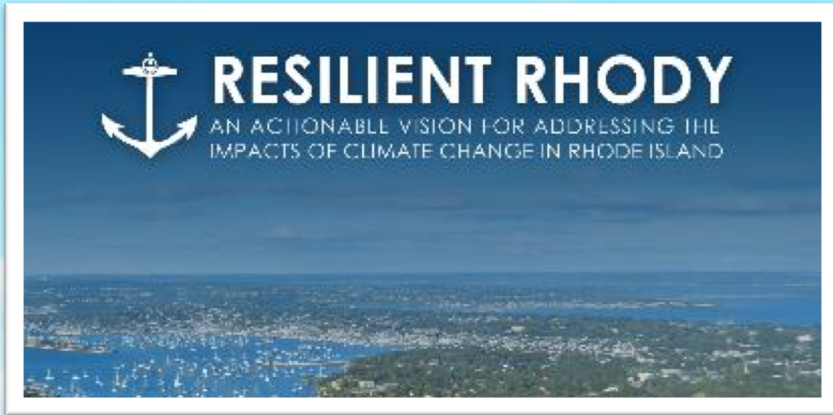
8,000 trees have been planted since the EST program began.

Tree Benefits At Year 20 (*All Campaigns Thus Far*)

kWh – 100,928.56 AVIODED

Carbon (tons) – 3.5 million REMOVED

www.climatechange.ri.gov