



# 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 New York, Massachusetts, and Vermont ”**

Edil Sepulveda Carlo, NASA Goddard Space Flight Center

Thursday, March 14, 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
- 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](https://carbon.nasa.gov/multistate_wg)

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

## Contact Information

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Analysis Lab

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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/ORN LDAAC/1320>



# Multi-State Working Group Next Steps

- Multi-State Working Group Webpage Updates
  - Science Information: Links to Data, Metadata
  - Quarterly Meetings: Agenda, Presentations, Recording, Report
  - List of Upcoming Events
    - NASA ARSET Trainings
    - Multi-State WG Quarterly Meetings
    - CMS Science Team Meeting & Applications Workshop
    - Other NASA Carbon-related Meetings
- Next WG Quarterly Meetings – June 2019: NJ, CT, RI & September 2019: NH, ME
- Value of CMS Data Products & Data Needs Survey for NE States – Summer 2019
- Stakeholder Workshop in Fall 2019
  - Venue: Albany or New York City, New York? Boston, MA? Montpelier, VT?...

For Questions or to be included in the WG Mailing List:

Email Contact: [edil.sepulvedacarlo@nasa.gov](mailto:edil.sepulvedacarlo@nasa.gov)





NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

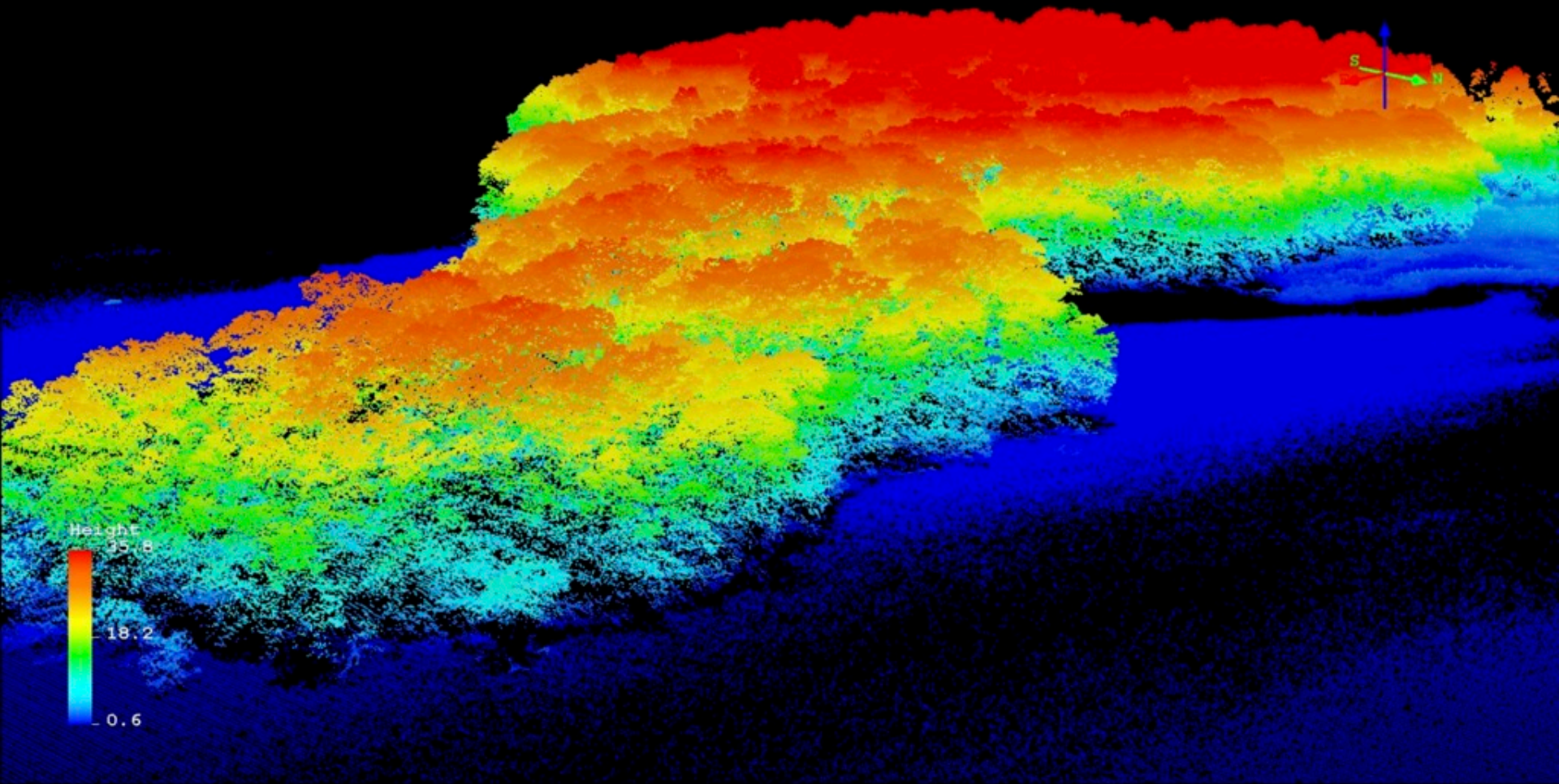
## NASA Carbon Monitoring System

The goal for NASA's CMS project is to prototype the development of capabilities necessary to support stakeholder needs for Monitoring, Reporting, and Verification (MRV) of carbon stocks and fluxes.



High resolution carbon monitoring and modeling prototype

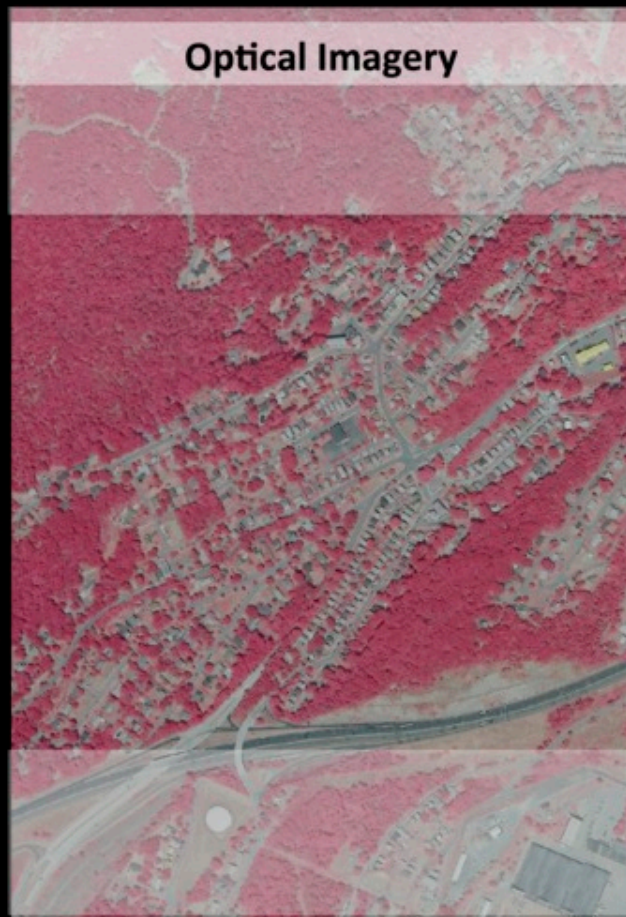
# LiDAR - Light Detection and Ranging



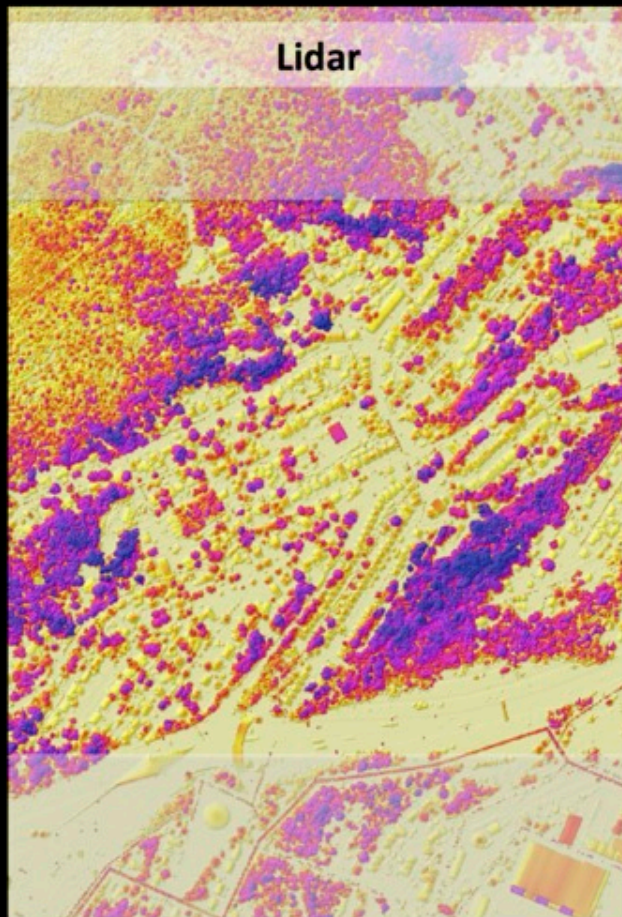


# Canopy Cover Generation

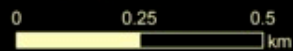
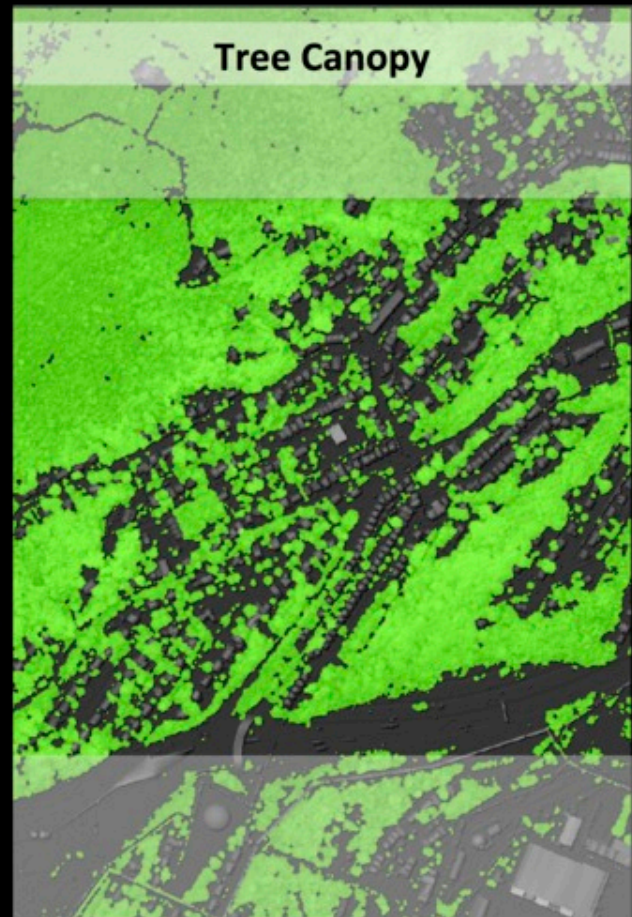
Optical Imagery



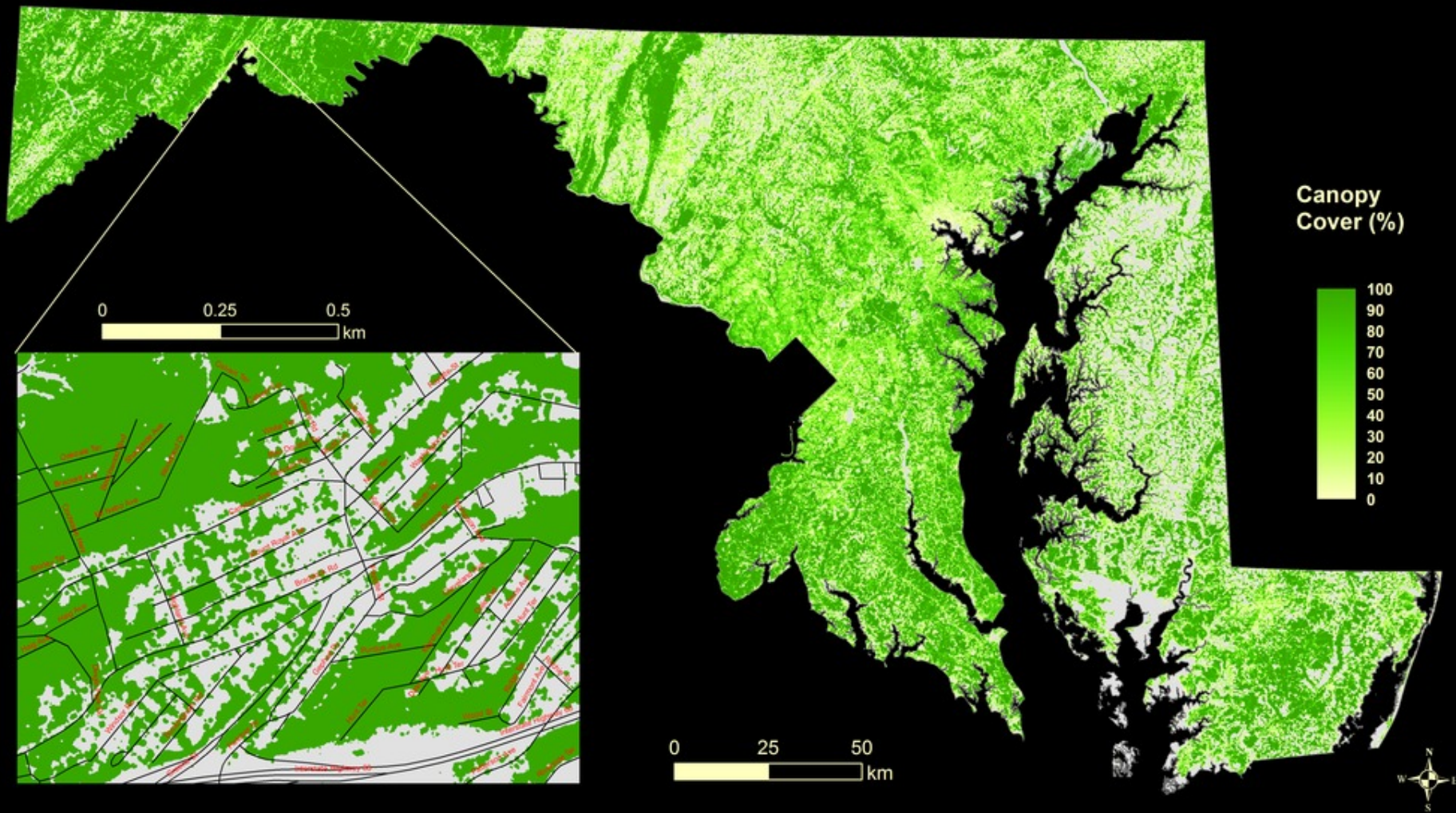
Lidar



Tree Canopy







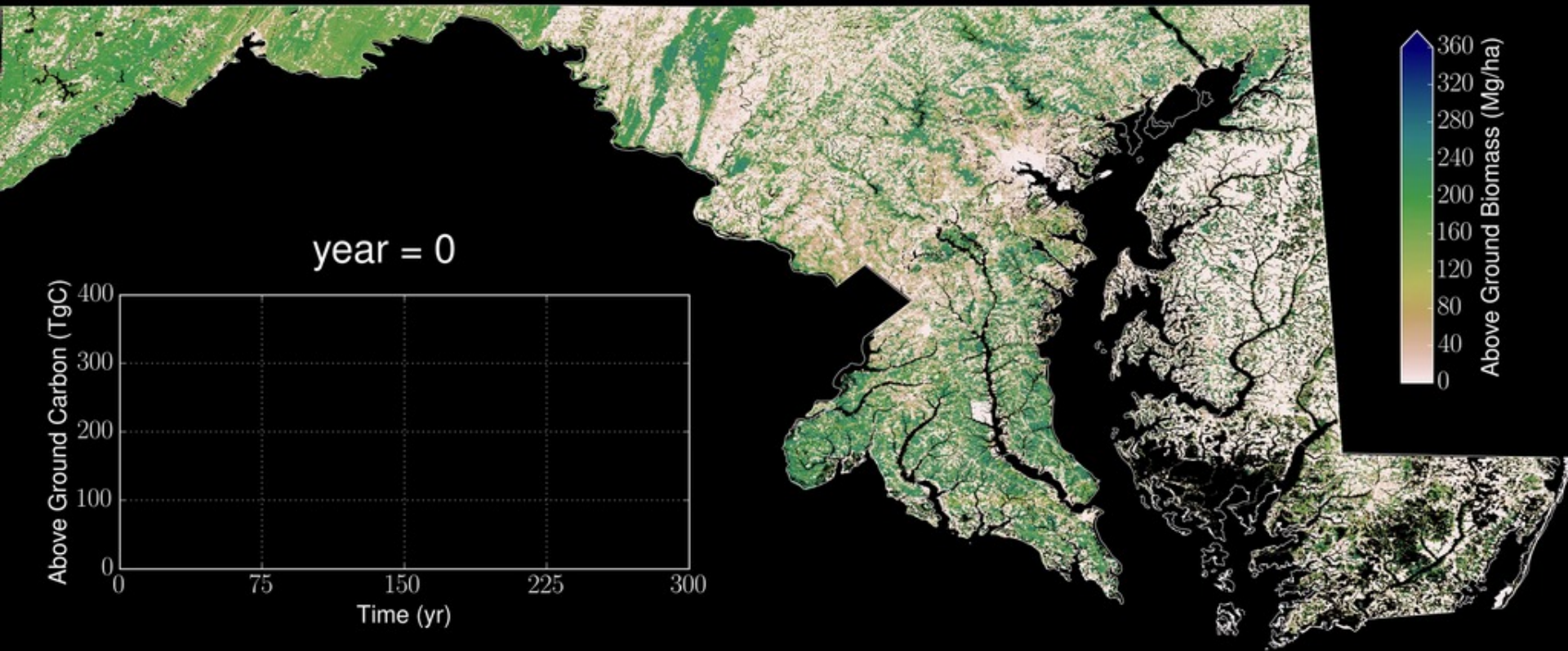


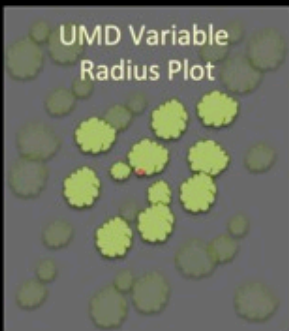
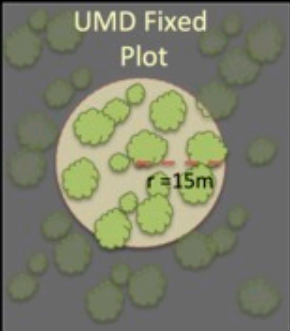
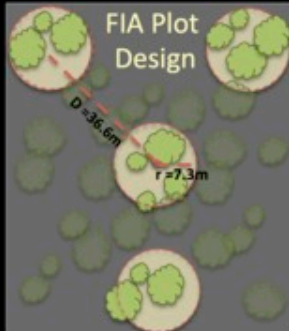
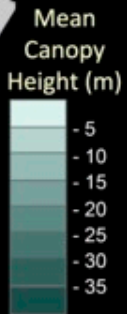
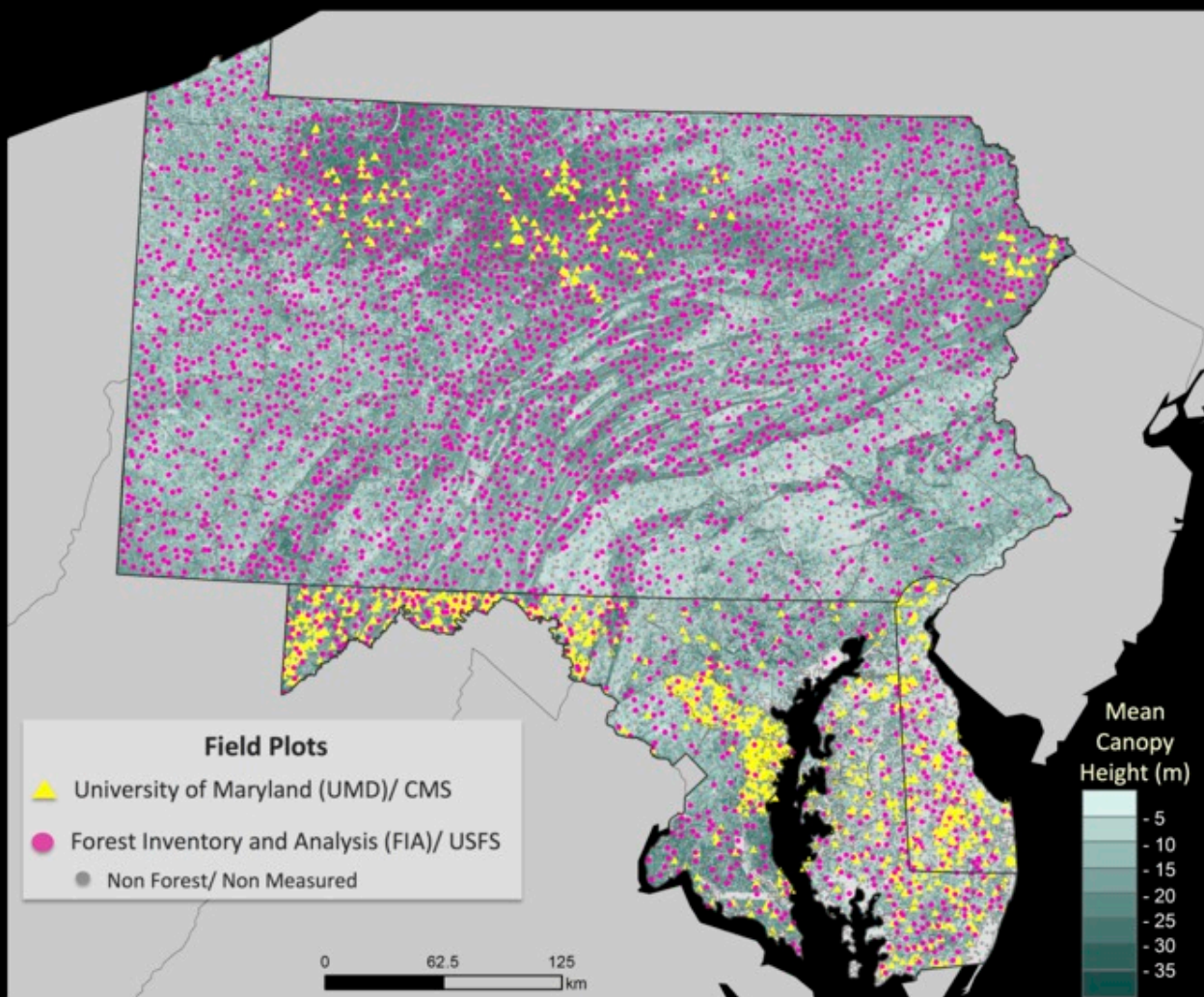




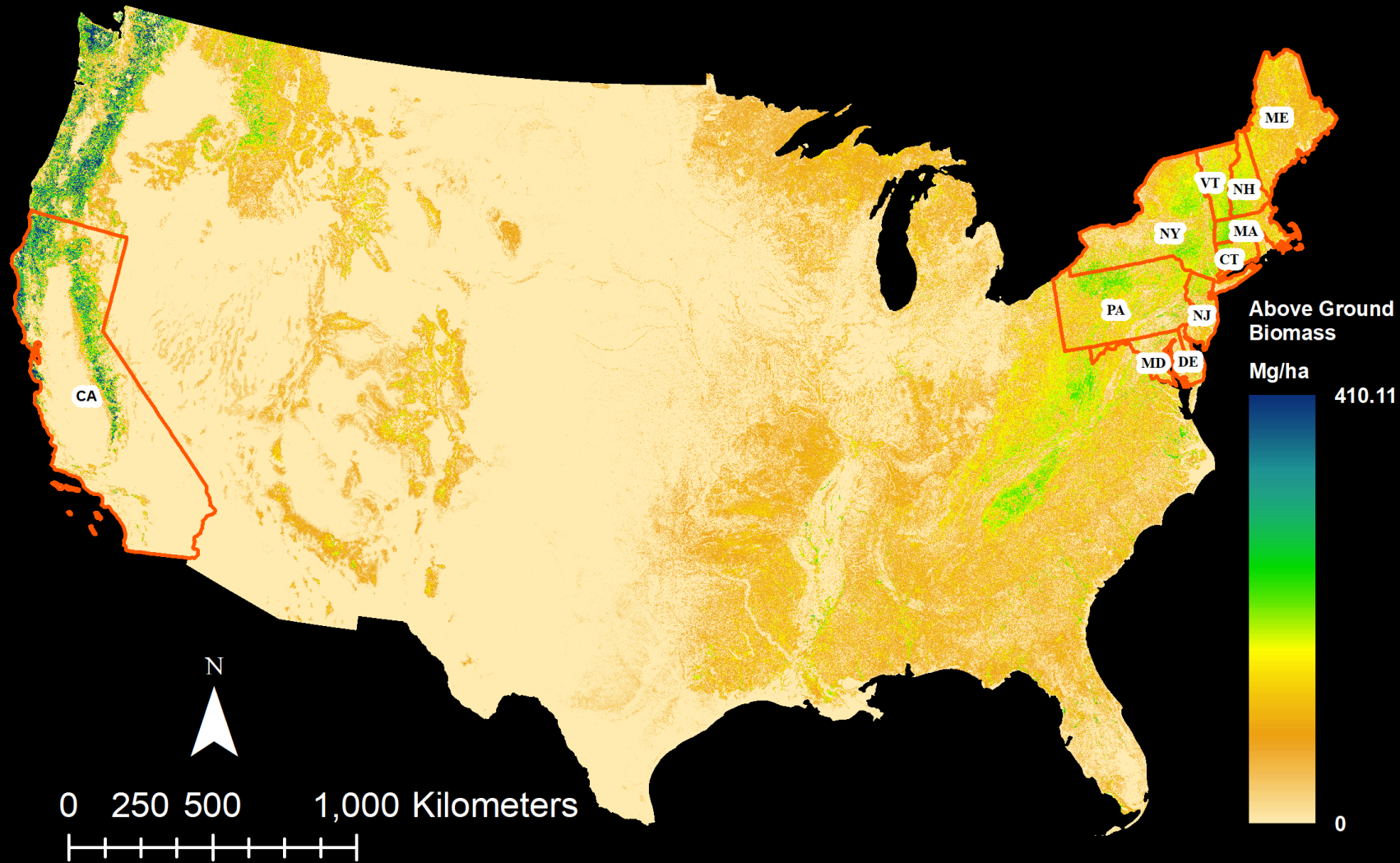












# GLOBAL ECOSYSTEM DYNAMICS INVESTIGATION



## 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<sub>2</sub> 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







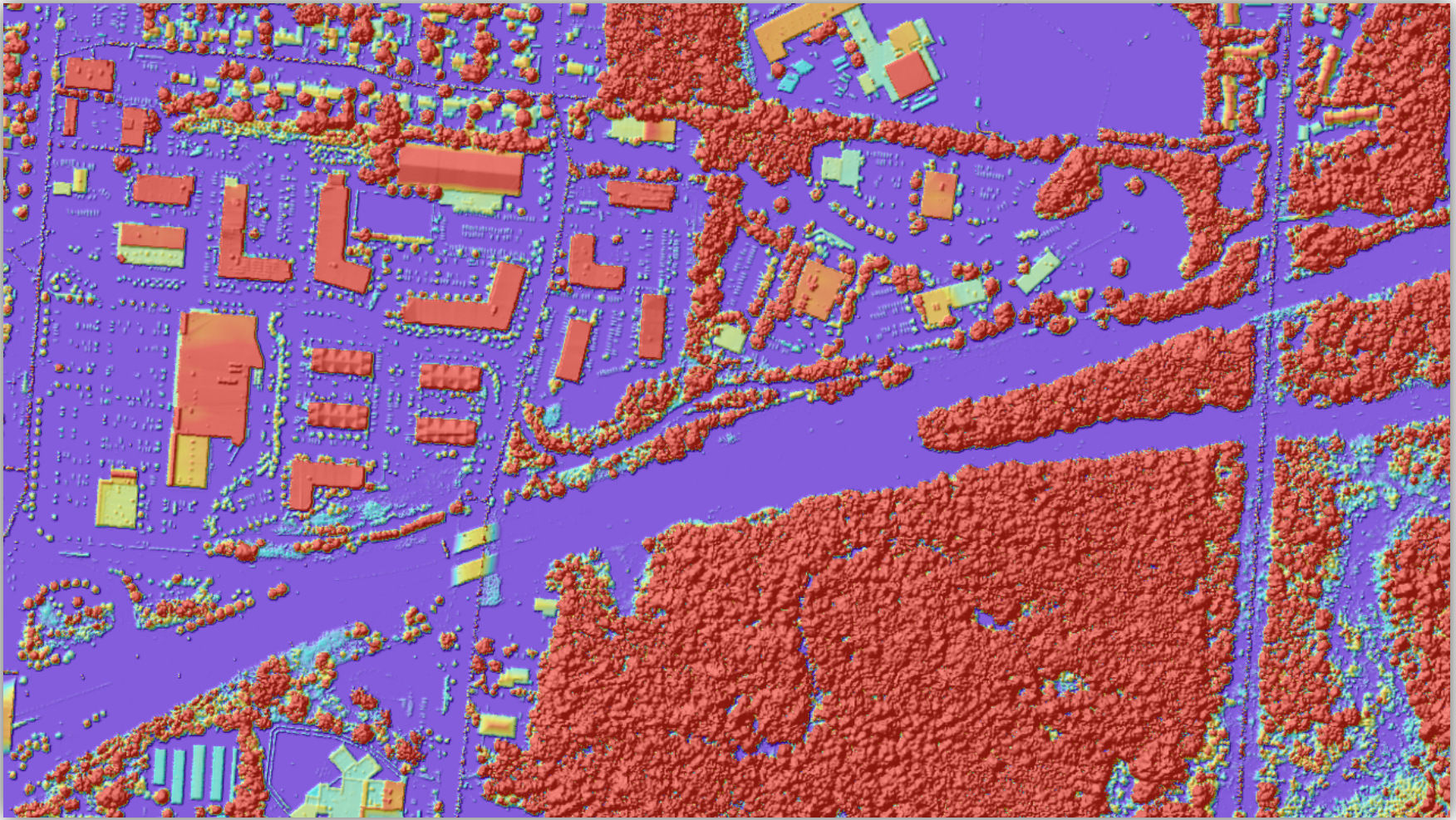
# Imagery







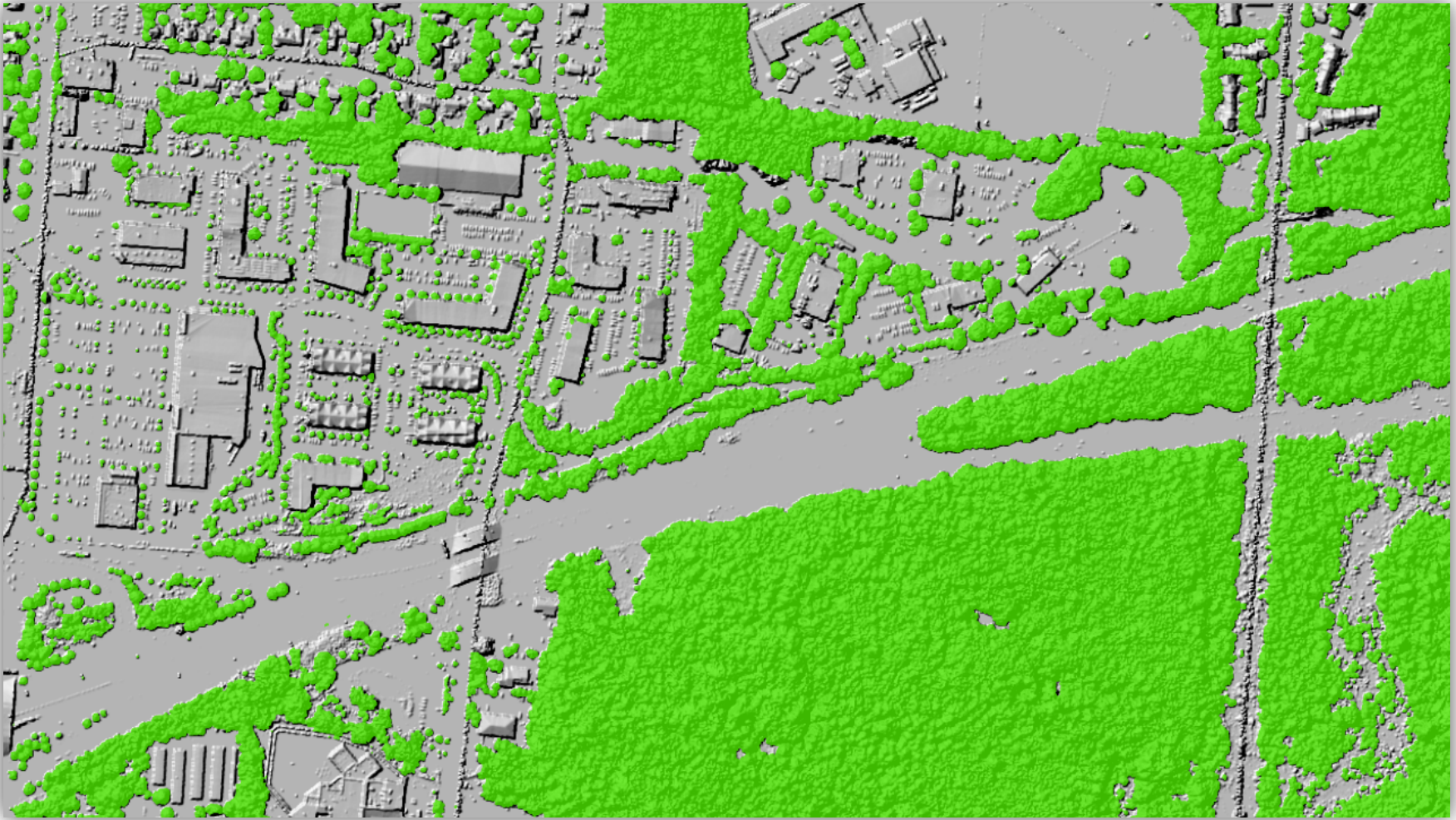
# LiDAR



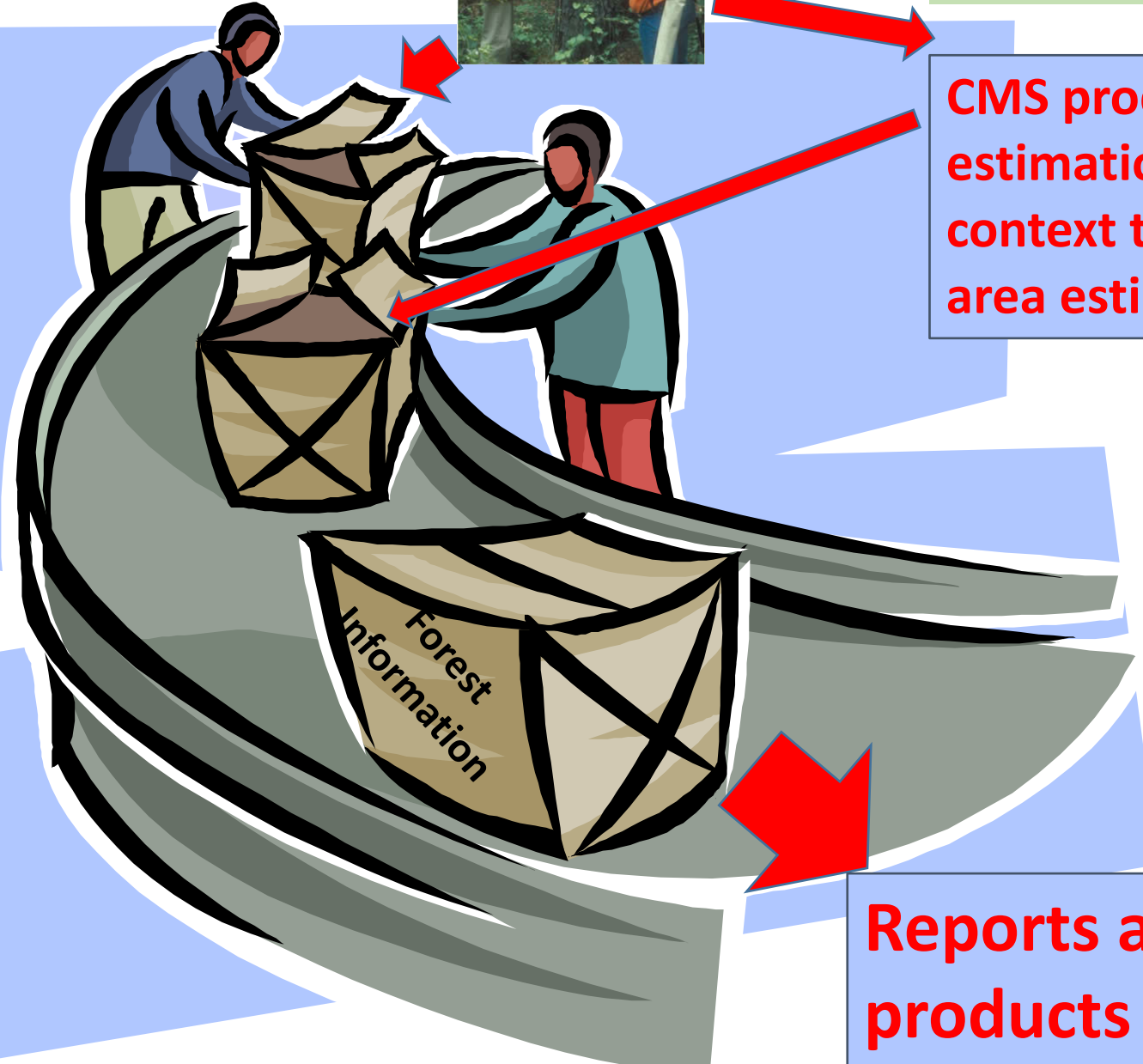




# Tree Canopy

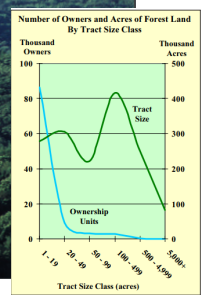
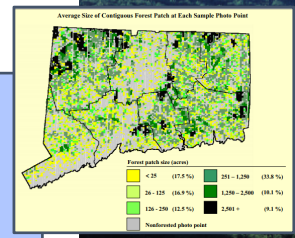
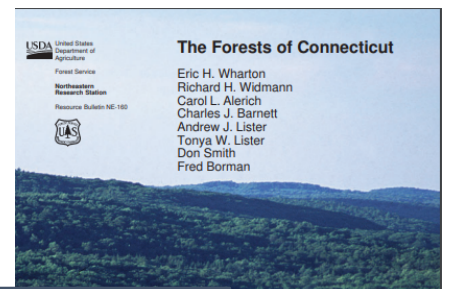


# FIA production line...



**CMS product-assisted estimation, enhanced maps for giving context to plot data, baseline for small area estimation and modelling**

**Reports and other products**







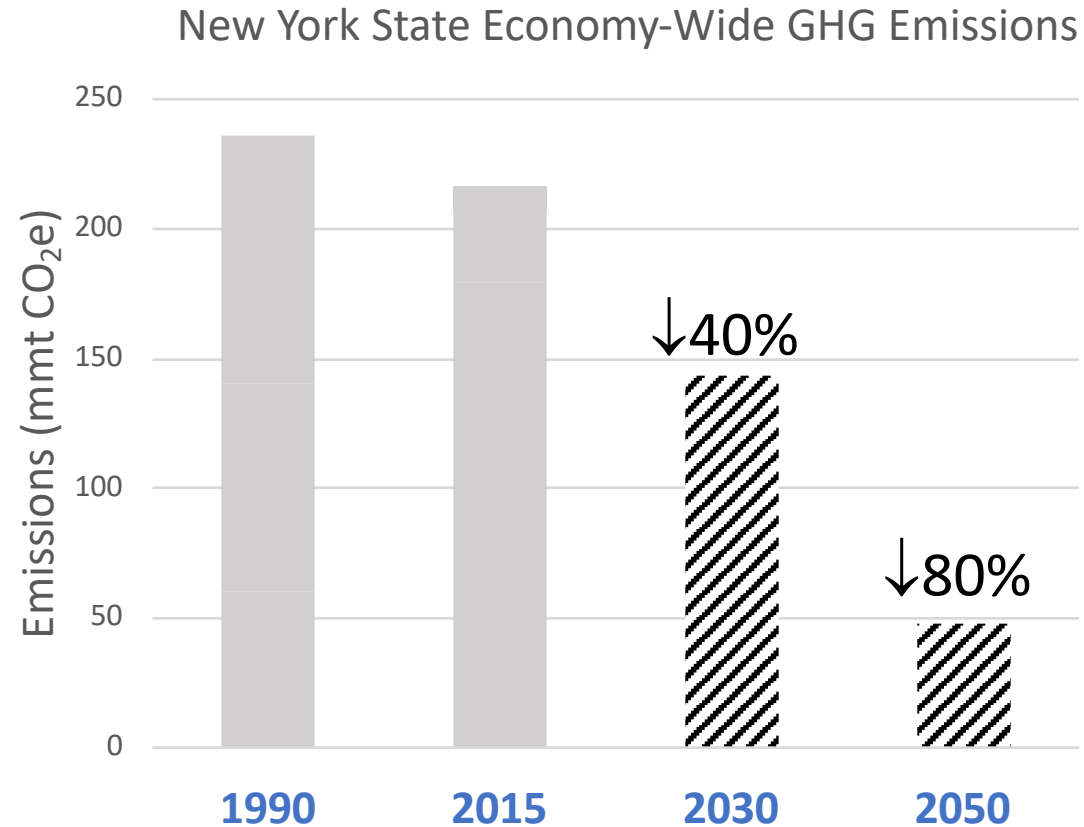
Department of  
Environmental  
Conservation

# New York State's Climate Strategy

## Role of forests and carbon monitoring

Suzanne Hagell  
NYSDEC Office of Climate Change  
March 14, 2019

# New York's Greenhouse Gas Goals



## Long-standing Goal

80% below 1990 by 2050

## 2015 State Energy Plan Goal

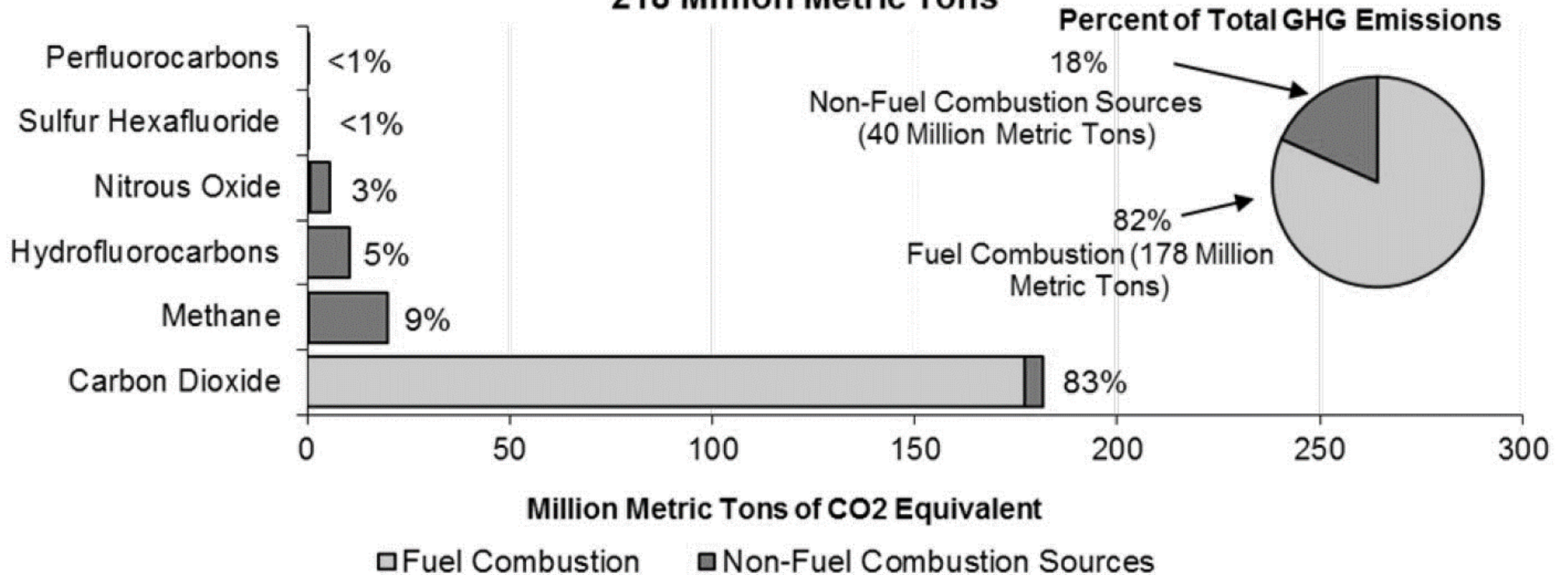
40% below 1990 by 2030

## 2019 Pending Legislative Goal

Carbon neutrality as soon as practical  
Or decadal targets until 100% in 2050



### Total CO2 Equivalent from Greenhouse Gases: 218 Million Metric Tons

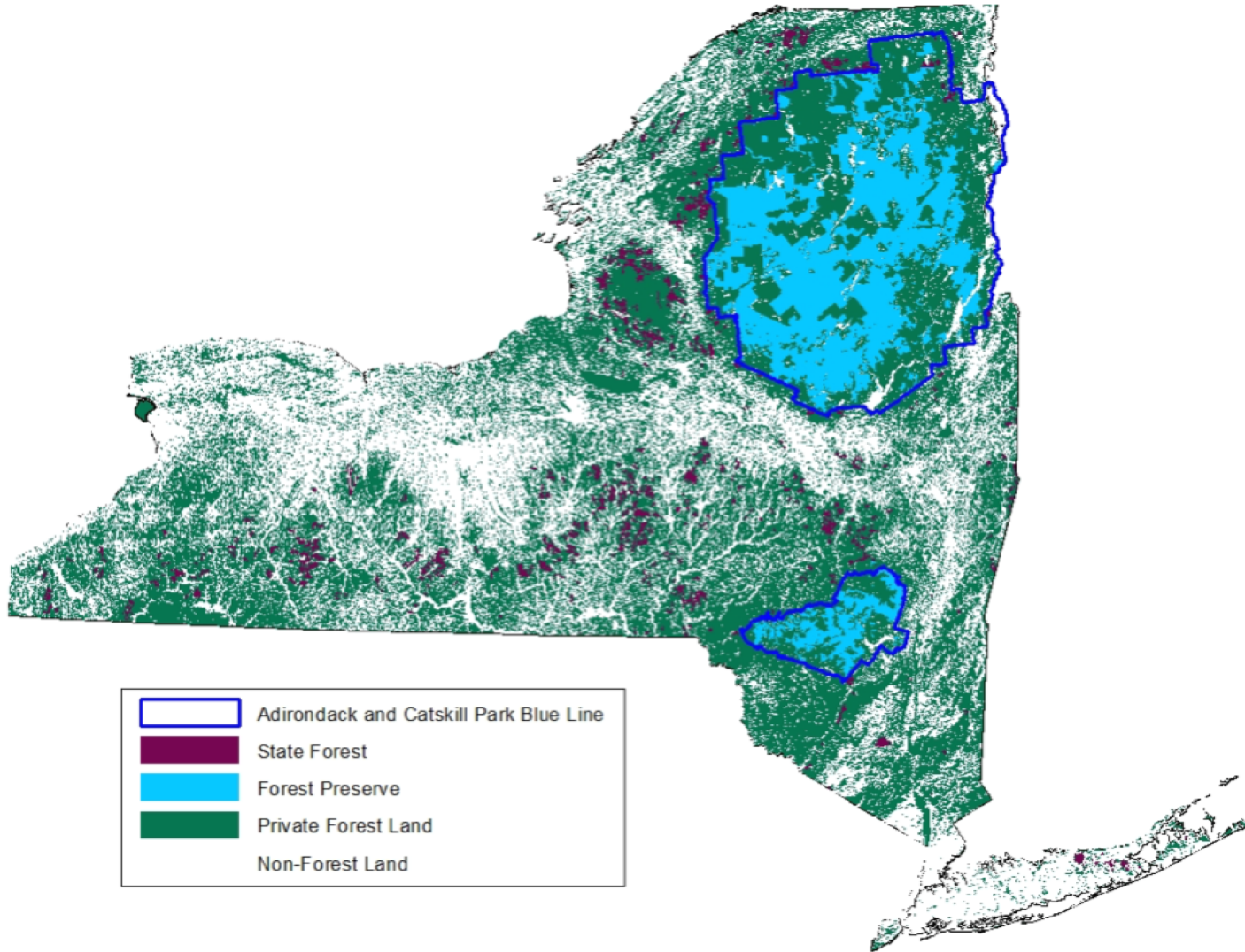


# Carbon Sequestration

- Currently, LULUCF/AFOLU sectors are limited to agricultural emissions
- Sequestration and biogenic emissions are not yet reported
- This is the objective of pending research project with the US Climate Alliance, SUNY-ESF, Cornell, and others







## New York's Forests

~19 million acres or 63% of land area

> 3.7 million acres public

> 14.4 million acres private

- 76% of NY forests are owned by 687,000 land owners
- Few private acres are under deliberate, professional forest management
- Harvest data are not reported



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Conservation

## New York's Forests

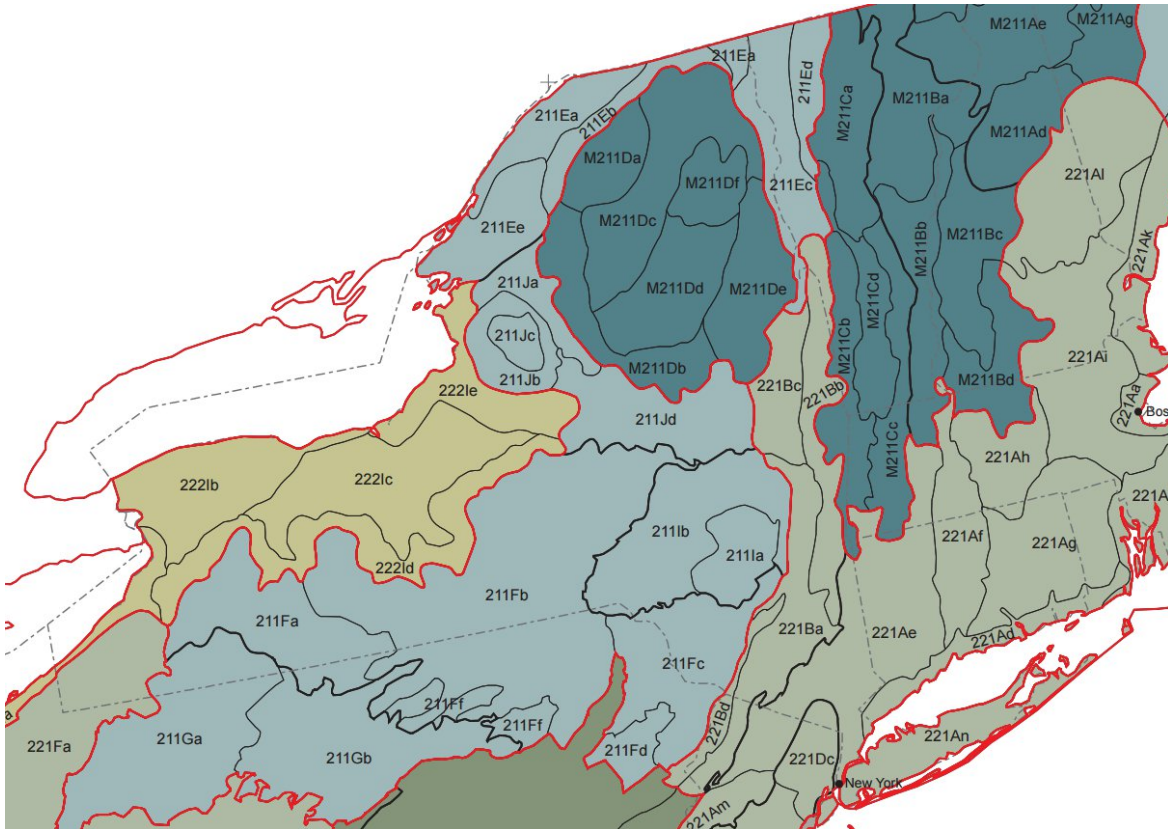
USFS Ecoregions

211: Northeast Mixed Forest

221: Eastern Broadleaf Forest

222: Midwest Broadleaf Forest

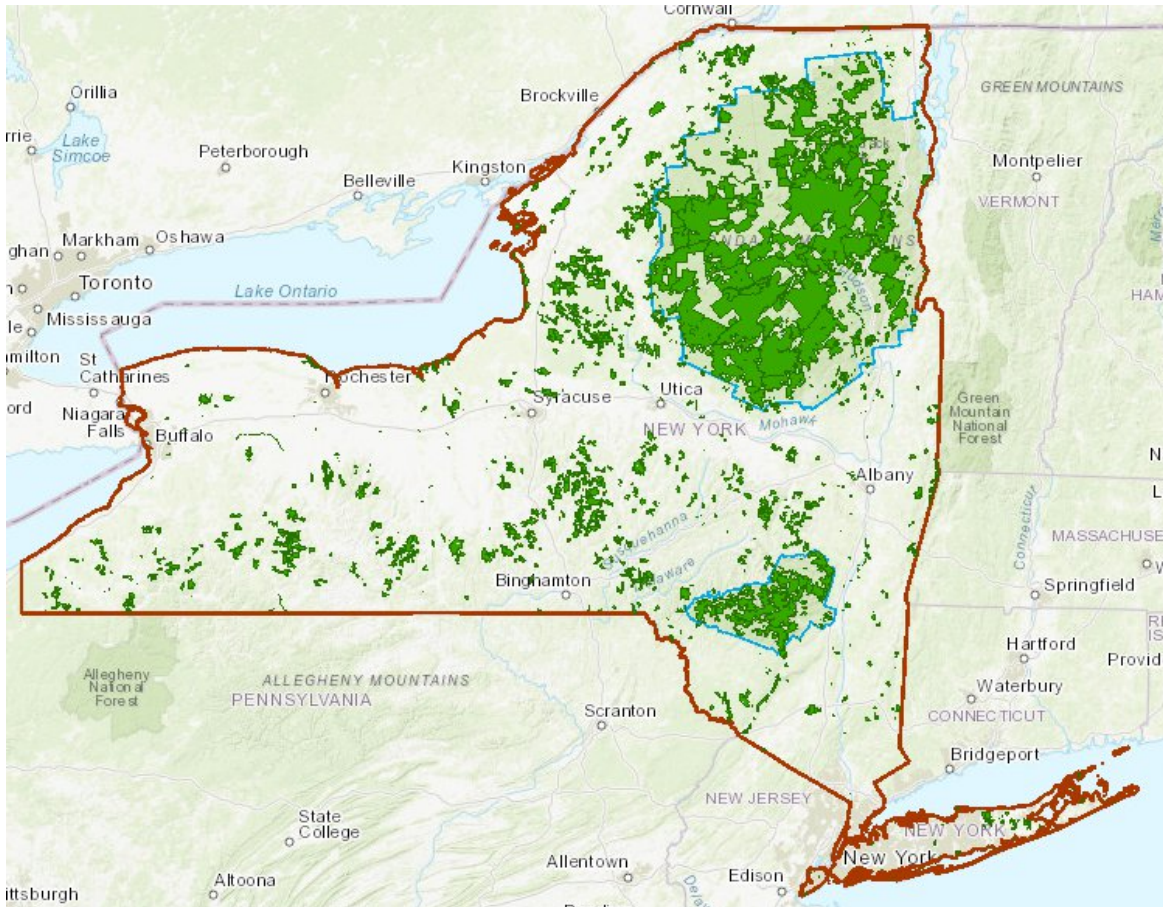
M211: Adirondack New England  
Mixed Forest – Coniferous Forest  
– Alpine Meadow



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# Key issues and needs



1. Integrating forest sector into NYS climate strategy and GHG goals.
  - Recognizing policy needs for public and private lands.
2. Developing NYS capacity to monitor and forecast net emissions.
  - Harvest monitoring
  - Model verification
  - Annual or decadal through 2050

# MASSACHUSETTS CLIMATE LAW & RELATED FOREST PROGRAMS

March 14, 2019

**Massachusetts Executive Office of Energy & Environmental Affairs**

Hong-Hanh Chu, GWSA Implementation Program Manager

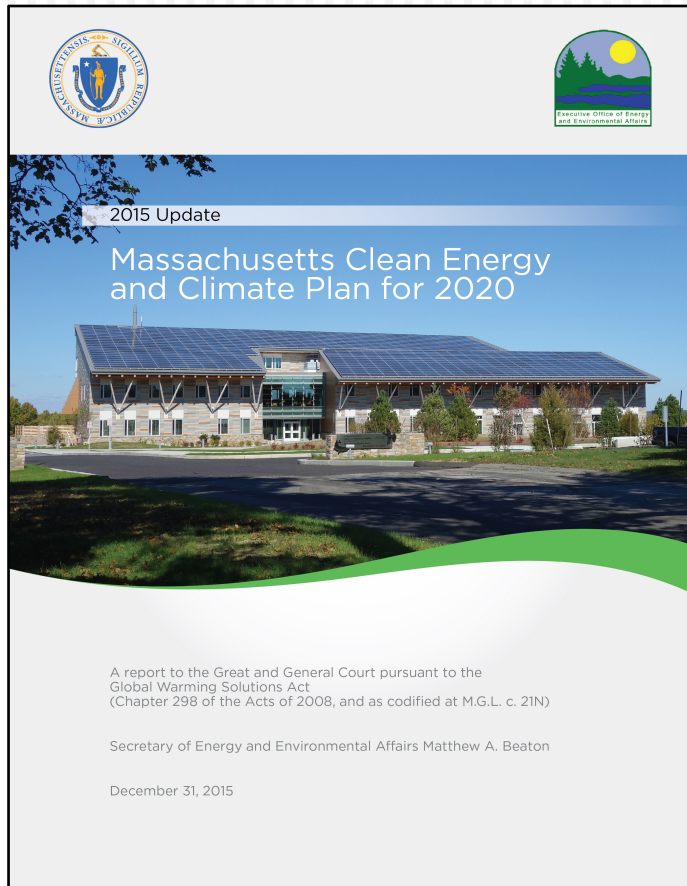
Robert O'Connor, Forests and Land Policy Director



# GLOBAL WARMING SOLUTIONS ACT OF 2008 (GWSA)

- GHG inventory, 1990-2016:
  - Tracks statewide GHG emissions from fossil fuel combustion, natural gas systems (CH<sub>4</sub> leaks), industrial processes, agriculture, and waste
    - Reduction in GHG emissions from these sources are counted toward GWSA compliance
  - Tracks statewide carbon sequestration from forest land and GHG emissions from the loss of forest land
    - Net carbon sink from natural and working lands are not currently counted toward GWSA compliance
- GHG emissions limits and plans to achieve those limits:
  - 25% reduction in statewide GHG emissions below 1990 baseline level by 2020
  - At least 80% reduction in statewide GHG emissions below 1990 baseline level by 2050
  - Interim emissions limits for 2030 and 2040 that maximize the ability of the Commonwealth to meet the 2050 emissions limit

# MA CLEAN ENERGY AND CLIMATE PLAN FOR 2020



- Includes a tree planting and retention policy for reducing heating and cooling loads: **Greening the Gateway Cities program**
  - reduces fossil fuel and electricity consumption in nearby buildings → counts toward GWSA compliance
- Includes the intention to further analyze net carbon sink capacity and potential from natural and working lands for future climate policy development

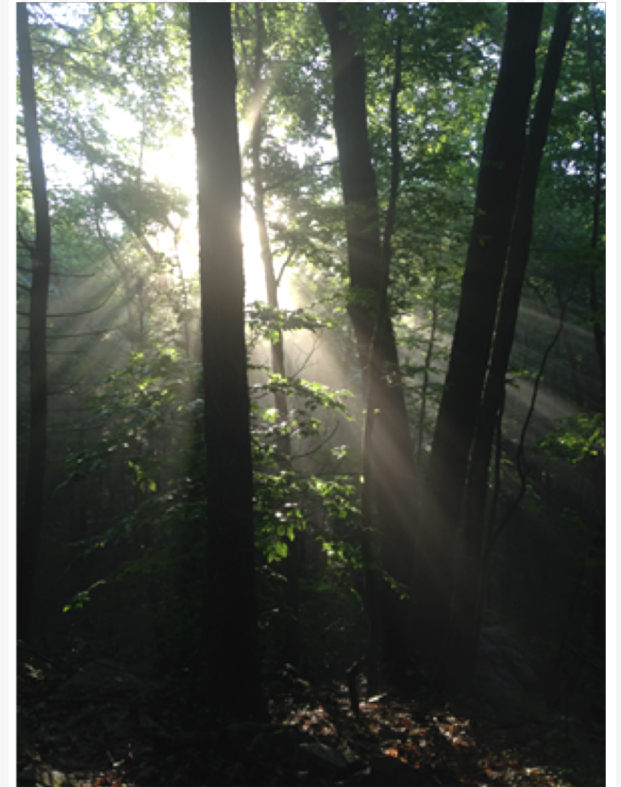


# 80X50 STUDY & MASSACHUSETTS CLEAN ENERGY AND CLIMATE PLAN FOR 2030

- Comprehensive, long-range study of possible pathways and policies for the Commonwealth to strategically, cost-effectively, and equitably meet the GWSA 2050 emissions limit → *Massachusetts Roadmap to 2050* → GHG emissions limit for 2030 and *Massachusetts Clean Energy and Climate Plan for 2030*
  - One goal is to explore how natural and working lands can help the Commonwealth further reduce statewide GHG emissions (beyond the 80% reduction by 2050) by contributing negative emissions.
    - EEA is working to establish a 2016 baseline of net carbon sinks in the Commonwealth
    - EEA is interested in analyzing the potential of existing natural and working lands to serve as net carbon sinks through 2050, factoring in projected population growth and development pressure.

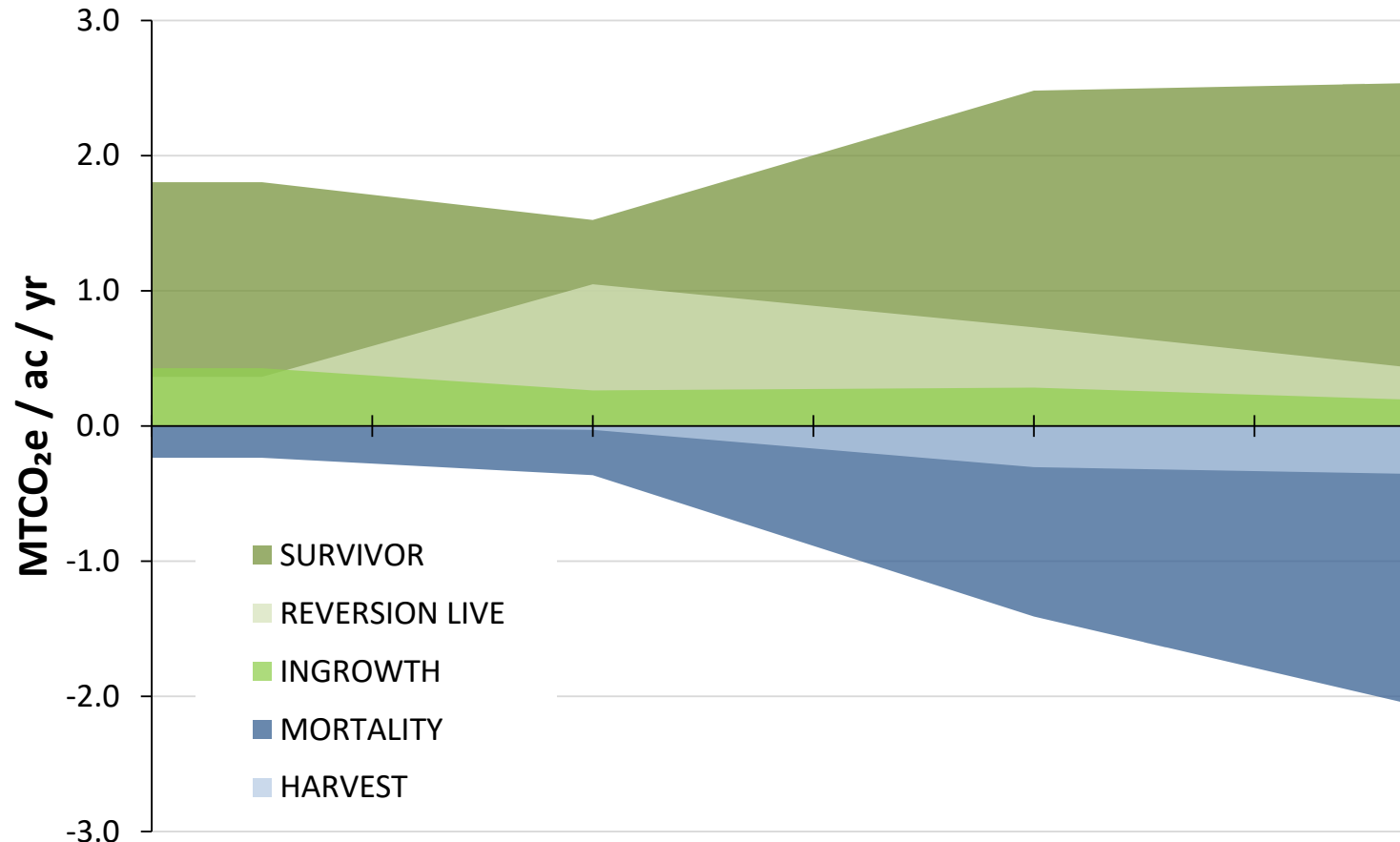
# MA FOREST PROGRAMS AND RESOURCES

- Continuous Forest Inventory plots on state and water supply forests (415,000 acres)
- Working Forest Initiative – Stewardship Plans, “Foresters for the Birds” plans, FSC Group Certification, Estate Planning
- Harvard Forest’s “Changes to the Land” – 2013 analysis of forest, land use carbon storage and climate change scenarios (varied development, conservation, forestry and agriculture practices)
- Urban tree planting program with energy efficiency funding – 20,000 trees planted in 12 cities since 2014
- Statewide land conservation plan (begins this spring)
- Statewide healthy soils plan (begins this spring for forest, farm and lawns land uses)





# CHANGES IN ABOVE GROUND LIVE CARBON STOCKS ON STATE FOREST LAND



↑ = sample year

DSPR system; forested land, 1960 - 2017



# SUMMARY OF CARBON STOCKS ON STATE FOREST LAND

- Historical estimate of net change (Above Ground Live MTCO<sub>2</sub>e/yr):

1960 - 1965	<b>486,235</b>
1965 - 1980	<b>604,700</b>
1980 - 2000	<b>477,919</b>
2000 - 2017	<b>204,112</b>





# DCR WORKING FOREST INITIATIVE

- DCR partners with FLT, MGLCT, MAS and UMass
- 1,596 landowners with 152,073 enroll in Forest Stewardship with plans and 81% also join Chapter 61 (Forest Current Use Law)
- Land trusts, colleges, sportsmen clubs etc. have also received plans
- 87 towns with 44,367 acres have also received forest stewardship plans
- 11 towns have received stewardship grants
- Survey with 450 responses showed that owners spent average of \$2,200 to implement plans and 40% of owners are trying to conserve their woods by contacting land staff





# GRANVILLE ST. BEFORE TREE REMOVAL



After tree  
removal



Commonwealth  
of Massachusetts  
-- Clean Energy  
and Climate Plan  
for 2020: Tree  
Canopy Program



# 4 YEARS AFTER REPLANTING



5-10 TREES PER ACRE...1% IN 8  
YEARS  
5-10% IN 30 YEARS

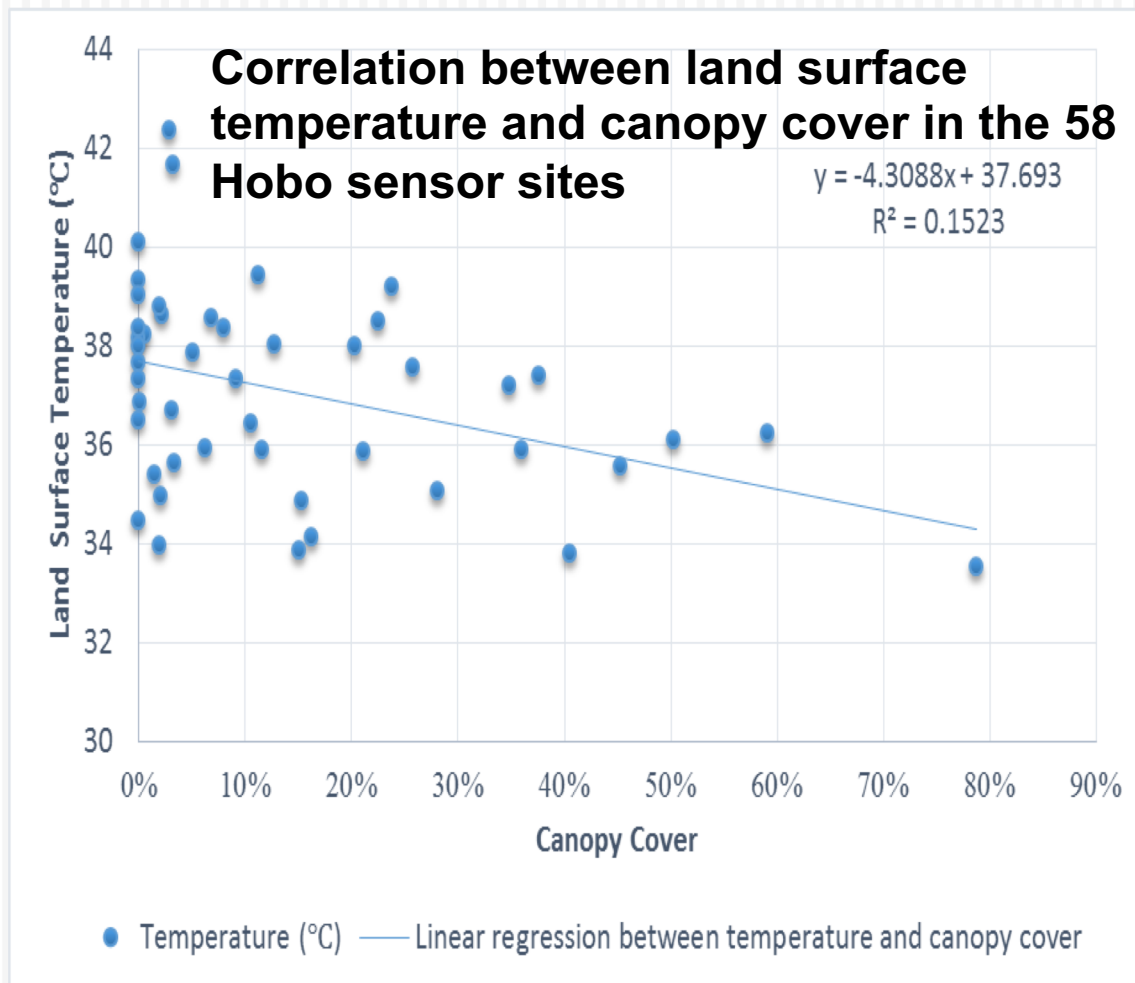


**Greening the Gateway Cities:** Planting new trees in low-income neighborhoods in Gateway Cities. Goal of adding new tree canopy cover to 5- 10% of area of target neighborhoods

Figure 4. Tree Plantings on a Representative Block (approx. 3 acres)



Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
With Canopy Cover	-1.88	-5.86	1.55	10.33	18.62	19.39	24.67	24.43	21.42	12.60	9.49	7.70
Without Canopy Cover	-2.03	-6.02	2.40	10.76	19.53	20.40	25.60	25.33	22.02	12.93	9.66	7.63



Tree cover has evident cooling benefits in Chelsea with an average temperature decrease of 1.7°F in the summer season (June-August) based on the 47 thermal sensor observations

Spatial analysis from Landsat-8 images also shows lower land surface temperatures with increasing tree canopy cover.

# HEALTHY SOILS PLAN

- GIS mapping of land uses and estimates of relative value as carbon storage
- 20 public meetings to educate and collect input into the plan
- Working Group to develop the plan for agriculture, forest and lawns
- Completion in summer, 2020





# Forest Carbon Incentive Program

## For Massachusetts' Private and Community Forests

Forest management choices influence the amount of carbon captured and stored in forests. The following proposal is meant to create a simple yet verifiable program to provide documentation and incentives for owners of our most productive forests who are committed to implementing forest management for a 20 year period that follows the state's "carbon forestry" best practices. Forest Landowners qualifying for the program will be eligible for annual reimbursements from the state with per-acre payments.

**Non-state funding sources** (private businesses, non-profit organizations) invest in stewardship payments to cover specific forest ownerships and receive progress reports in return



**Approved forest stewardship practices** include tree planting, non-commercial forest or habitat improvement, erosion control, estate planning, stream or wetland restoration, invasive species inventory or control, habitat inventory and planning and site restoration

*Reimbursements for approved forest stewardship practices and 20-year plans*

**The state** will deposit an amount equivalent to the annual stewardship payments for the 20-year commitment period of landowners enrolled

## Land under Chapter 61 or Forest Stewardship

- ✓ **FOREST CONDITION**  
Forest has a carbon stock that is or can be managed to be increasing and resilient to climate change impacts (ice, wind, drought, invasive pests, etc.)
- ✓ **FOREST MANAGEMENT**  
Forest land committed to carbon forestry practices approved by EEA to build resilient, high carbon value through management for site-adapted, diverse, native forest stands
- ✓ **SOIL GROWTH POTENTIAL**  
Land containing a majority of highly productive forest soils (MassGIS Data, Prime forest land class 1+2)
- CARBON STORAGE IN FOREST PRODUCTS**  
Commitment of owners to working with foresters to find a use for harvested trees that will result in long-term storage of carbon
- ✓ **COMMITMENT**  
Willingness to commit to implementing the approved forest practices for a 20 year period and agree to sign a contract with the state  
\*enrollment in this program does not exclude you from joining a voluntary or regulatory forest carbon market

# COMMUNITIES FOR A SUSTAINABLE CLIMATE

New incentive program for no net loss of carbon from open lands, encouraging smart growth and climate resilience.



Communities and developers get incentives for new or infill development and projects for land carbon storage.



# COMMUNITIES FOR A SUSTAINABLE CLIMATE

## To qualify, a community needs to meet these criteria:

- Natural Resource Protection Zoning:
  - Local zoning bylaw designed that has “by right” land-saving, compact development so significant areas of important forest and farms are left undeveloped and available for agriculture, forestry, recreation, watershed, or wildlife habitat.
- Commitment to no net loss of carbon from land use changes
  - Communities can charge “climate mitigation development fees”
  - Mitigation for lost farm or forest land with carbon-equivalent conservation projects (e.g. tree planting, land protection, community gardens, etc.)
  - NOAA/MassGIS’s LU/LC mapping product can be used for setting carbon baseline
- Education and incentives for healthy soil farming and climate forestry practices

Conventional Development



Smart Growth Development



# Vermont climate action and carbon monitoring overview

Department of Forests, Parks, and Recreation

- Keith Thompson
- Danielle Fitzko

Department of Environmental Conservation

- Collin Smythe
- Brian Woods
- Bennet Leon

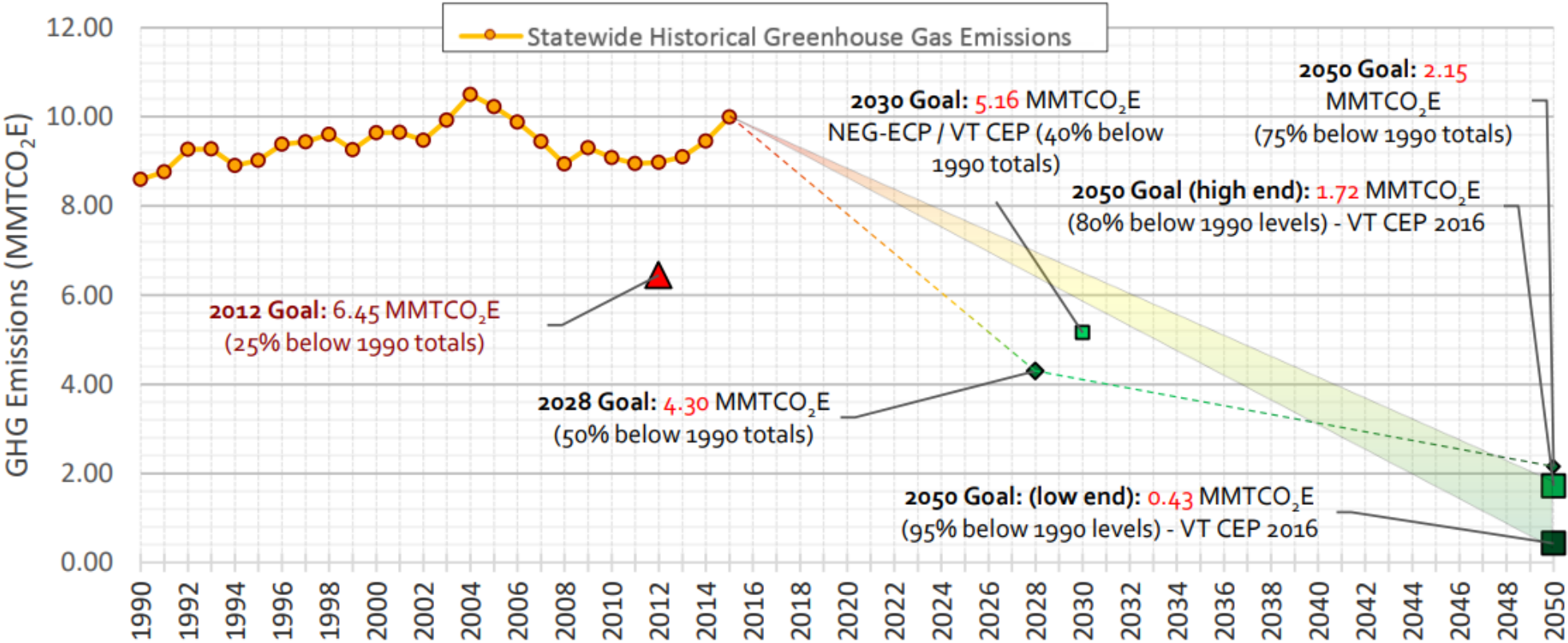


# Forests, Parks, and Recreation

- What we're doing:
  - Helping to keep forests as forests
  - Keeping forests healthy
  - Promoting sustainable forestry
  - Climate adaptation recommendations (landowner outreach, municipal planning, state lands management)
  - Collaborating on Conservation Design
  - Specific mitigation strategies (carbon markets: TNC, Cold Hollow)
- Gaps:
  - Clearly established carbon storage and sequestration goals
  - Information to support prioritization of efforts (where do we invest limited resources)
  - Information to evaluate successes and failures of efforts
  - Lack of a coordinated, collaborative plan
  - Dedicated forest carbon staff

# Environmental Conservation

- GHG emissions reduction goals set in statute
- Comprehensive Energy Plan (CEP)
- NEGECP and Climate Alliance





- Currently no climate action plan - potentially a deep decarbonization study through the Climate Alliance to help inform planning efforts
- Annual GHG emission inventory
  - Includes estimates of forest carbon sequestration and emissions due to decomposition and wood combustion (sequestration is not included in the net emissions totals)
  - Higher resolution, higher confidence estimates of forest carbon sequestration differences across stand types, land cover types, and soil types would better inform GHG sequestration estimates and hopefully inform development decisions for energy and other projects

