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DEPARTMENT OF GEOGRAPHICAL SCIENCES

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Including Forest Carbon into UMD's GHG Inventory and CAP 3.0

Maddy Albee, Camille Hoffman Delett, Jarrett James, Amelia Patterson & Marie Panday

utilizing previous contributions from Rieley Auger, Janna Chapman, Jordan Nicolette, & Hilary Sandborn

NASA

UNITED STATES CLIMATE ALLIANCE

March 11, 2022

with support from Dr. Rachel Lamb, Dr. George Hurtt, Sally DeLeon, & the UMD Office of Sustainability

Who We Are

Undergraduate Team:

Maddy Albee: Senior ENSP Student (Fall 2020)

Marie Panday: Senior ENSP Student (Jan 2021)

Amelia Patterson: Senior ENSP Student (Fall 2021)

Jarrett James: Junior ENSP Student (Spring 2022)

Graduate Advisor:

Camille Hoffman Delett: M.S. Geographical Sciences Student (Spring 2020)

Previous Team Members:

Rieley Auger: Environmental Impact Program Manager at Eden Reforestation Projects

Jordan Nicolette: GIS Analyst and Biologist at USDA Animal and Plant Health Inspection Service (APHIS)

Hilary Sandborn: PhD Student UNC Chapel Hill

Janna Chapman: Junior ENST student

Faculty Advisors:

Dr. Rachel Lamb: Maryland Sea Grant State Science Policy Fellow at Maryland Department of the Environment

Dr. George Hurtt: Associate Chair and Professor Department of Geographical Sciences

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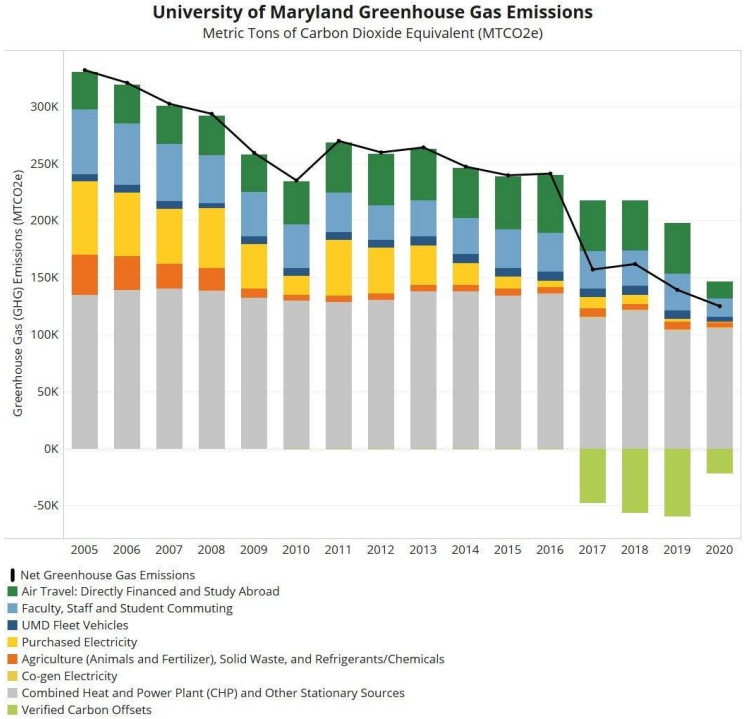
Outline

1. UMD context + project goals
2. Forest carbon science background
3. NASA science advances
4. Applications to UMD (monitoring, planning, offsets)
5. Next steps

University of Maryland Climate Goals

- Signatory of the Presidents Climate Commitment
- UMD CAP 2.0: Quantify forest carbon sequestration
- **UMD CAP 3.0: Inclusion of land-based carbon into campus GHG inventory**



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UMD's History of Including Forest Carbon

- UMD initially used the **Campus Carbon Calculator** which is no longer available
- UMD has also supported the **Urban Forest Effects (UFORE)** assessment in 2008 (Keen et al. 2008)
- UMD currently uses **The Sustainability Indicator Management & Analysis Platform (SIMAP) = *does not debit*** forest carbon sequestration in its calculation **unless it can be entered as an offset with credible, consistent measurement and verification against a baseline calculation**

SIMAP
SUSTAINABILITY INDICATOR MANAGEMENT & ANALYSIS PLATFORM

Campus Forest Carbon Project Goals

1. Complete historical analysis of forest carbon dynamics
2. Update carbon budget annually for campus GHG inventory
3. Quantify carbon impact from future land use change
4. Build support for approach across Climate Commitment Members
5. Develop new forest offset protocol for scope 3 emissions

Forest Carbon Science and Climate Change

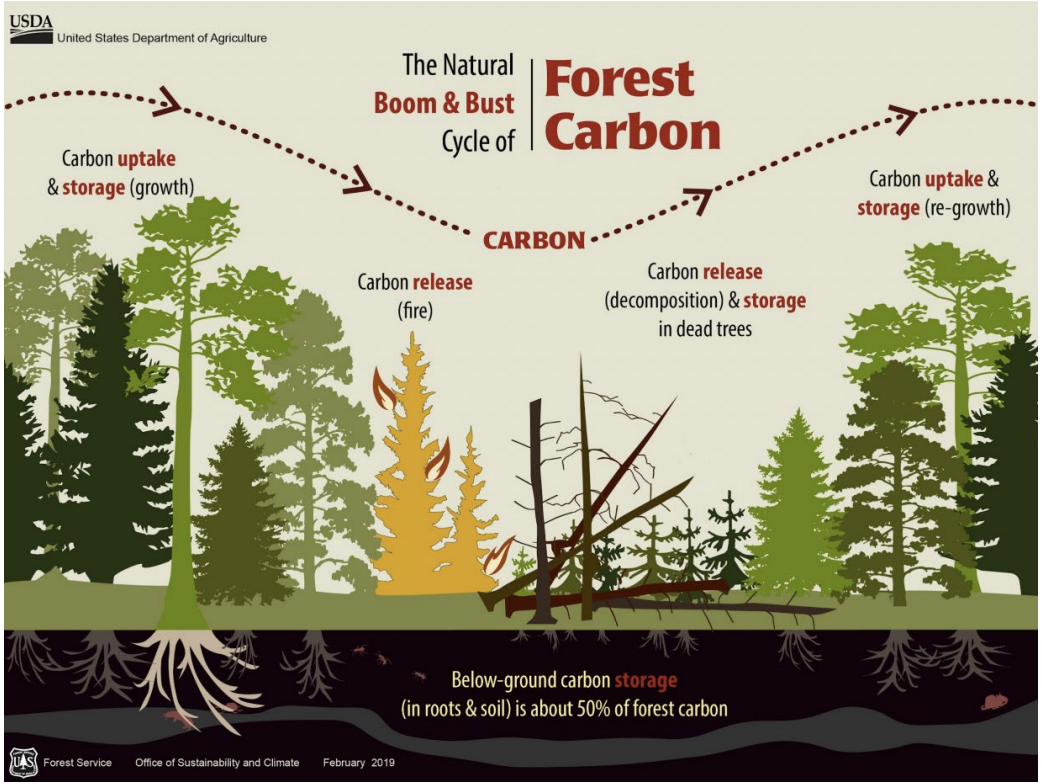
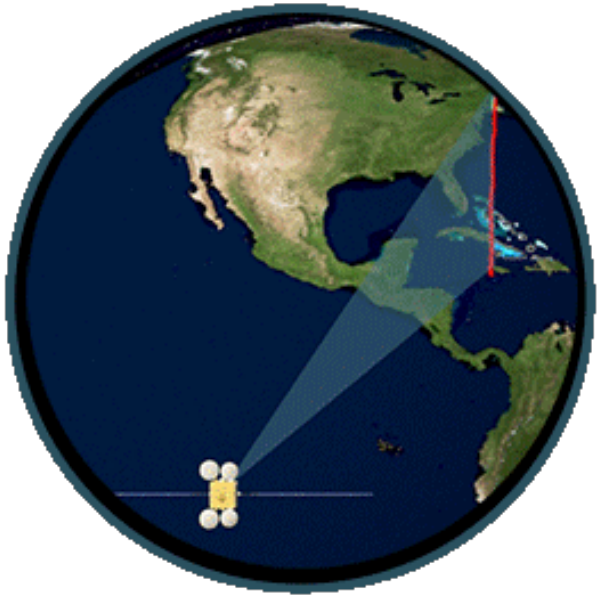


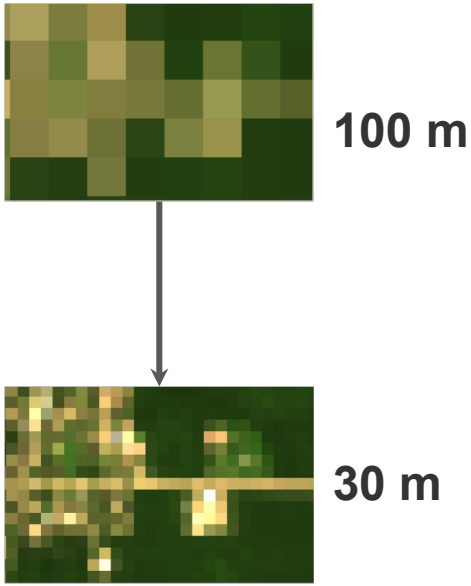
Image: USFS

Key Definitions and Terms

- **Aboveground Biomass (AGB):** the total amount of living plant matter that sits above the soil where ~50% of this value is carbon (tonnes per unit area)
- **Carbon Sequestration Potential (CSP):** the maximum amount of forest carbon that could be captured and stored in a given area
- **Carbon Sequestration Potential Gap (CSPG):** the remaining amount of carbon that could potentially be stored from current AGB
- **Carbon Flux:** the amount of carbon gained or lost between carbon reservoirs
- **LiDAR:** a form of remote sensing data that measures ranges in elevation

Role of High-Resolution Remote Sensing and Modeling





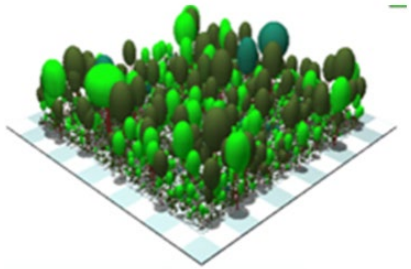
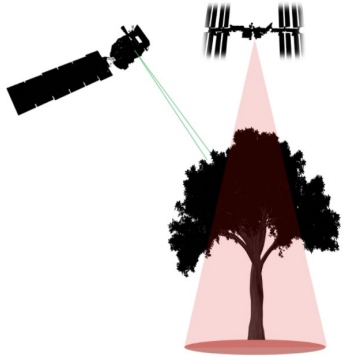


Image: NASA

Advances offered by NASA Carbon Monitoring System

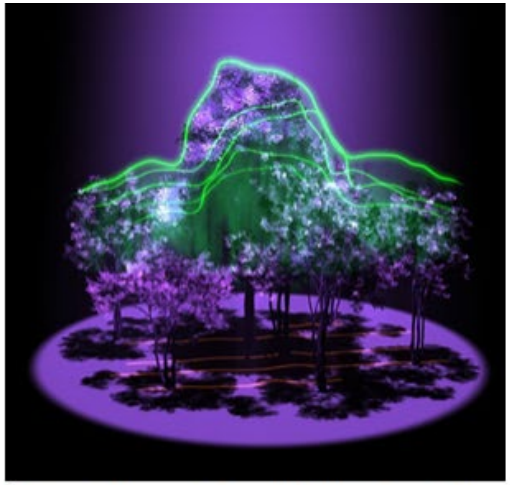
Inputs: High resolution optical imagery (NAIP) + LiDAR to measure existing canopy height and generate contemporary AGB



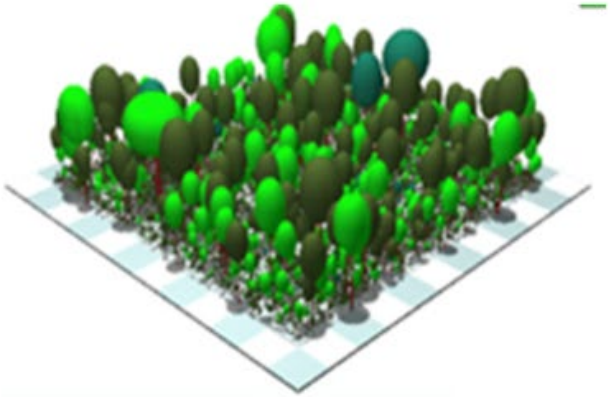
- **Advanced** forest ecosystem modeling
  - **High accuracy** *(USFS Forest Inventory & Analysis Data to validate)*
  - **High resolution** *(1m lidar, 30m disturbance, 90m carbon)*
  - **Large spatial domains** (*state → regional → national*)

Output: **NASA Carbon Monitoring System (CMS)** provides annual **carbon stock** and **flux estimates** of any given region = monitoring of carbon dynamics over time

Key Science Applications



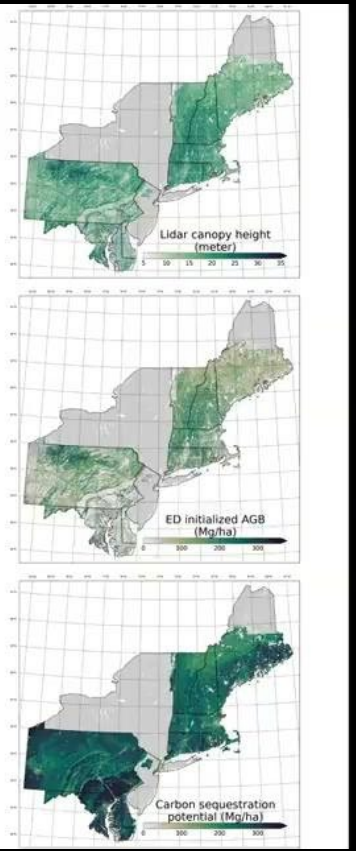
Mapping to Establish Baseline

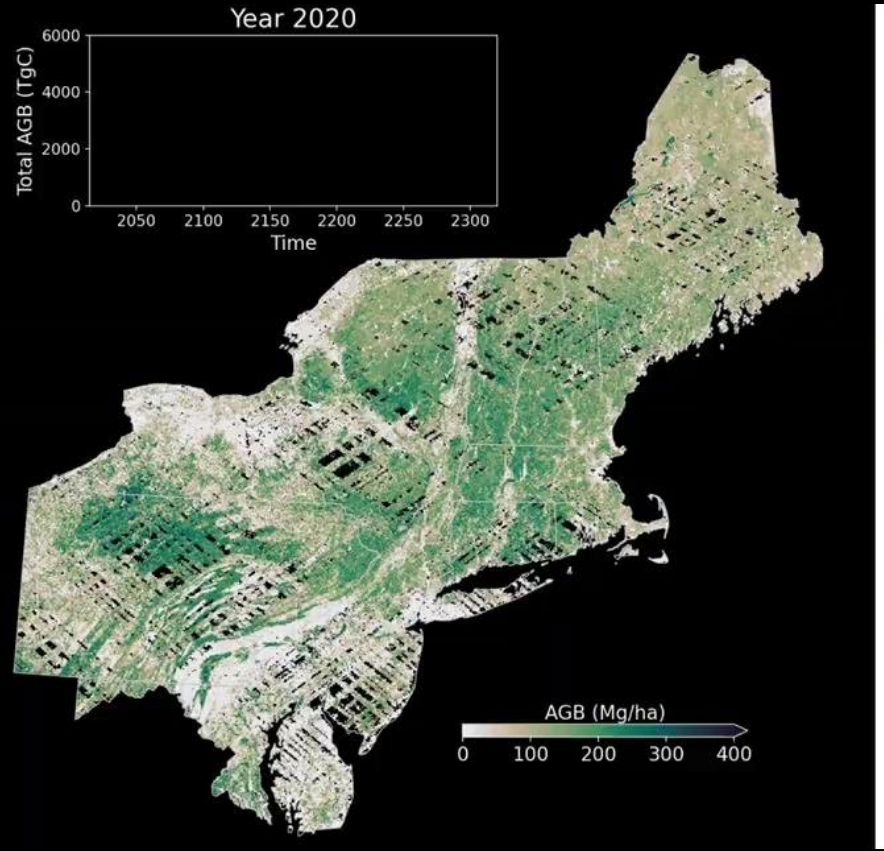


Modeling to Facilitate Planning

Monitoring to Provide Assessment

Key Science Applications

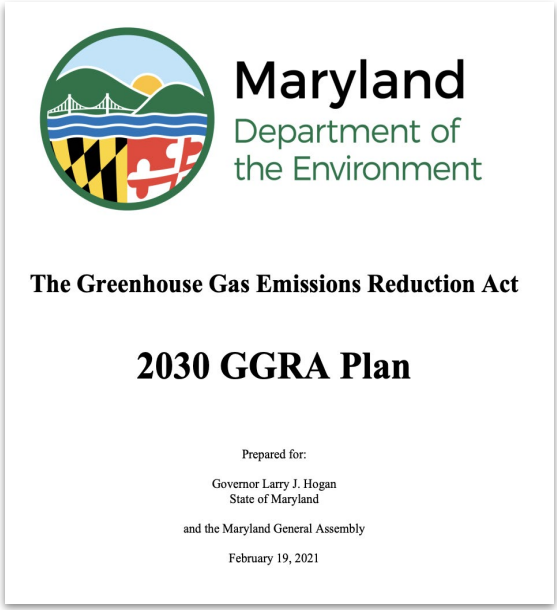




Regional Greenhouse Gas Initiative Domain

NASA CMS Use in Maryland and Beyond

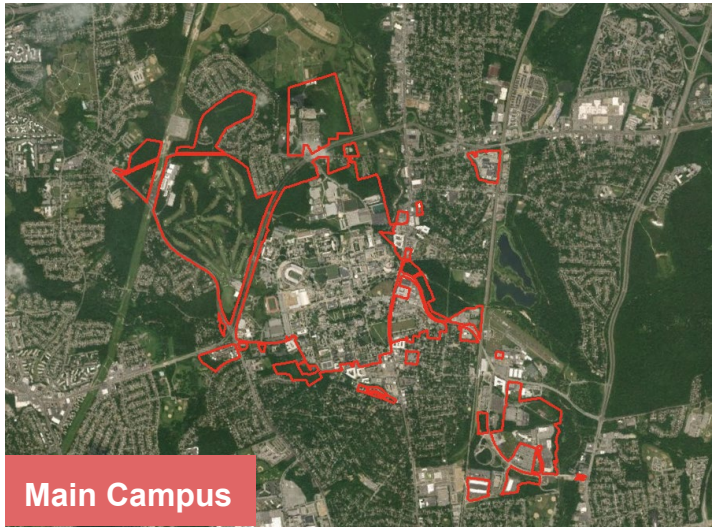
- The **State of Maryland announced at COP26** in early Nov 2021 that it is **incorporating NASA CMS science** into GHG inventory to monitor GGRA Plan progress
- Underlying data available across the eastern US with interest from other states
- Prototyping national and global products

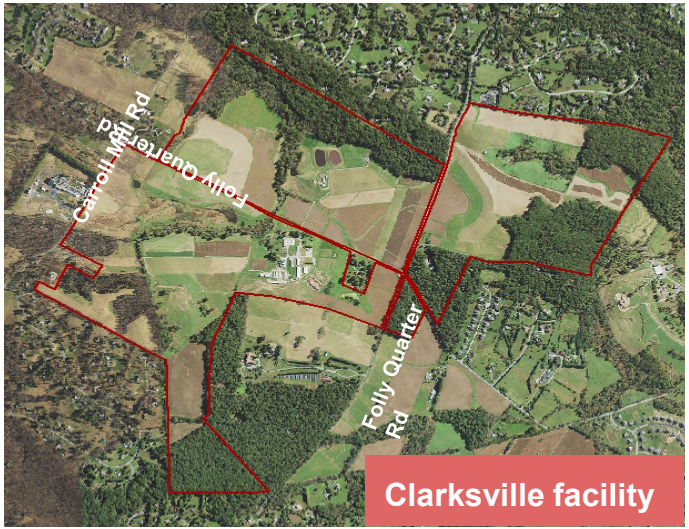


Project Scope

Analysis is made up of forest carbon change over land that the University of Maryland College Park owns and operates:

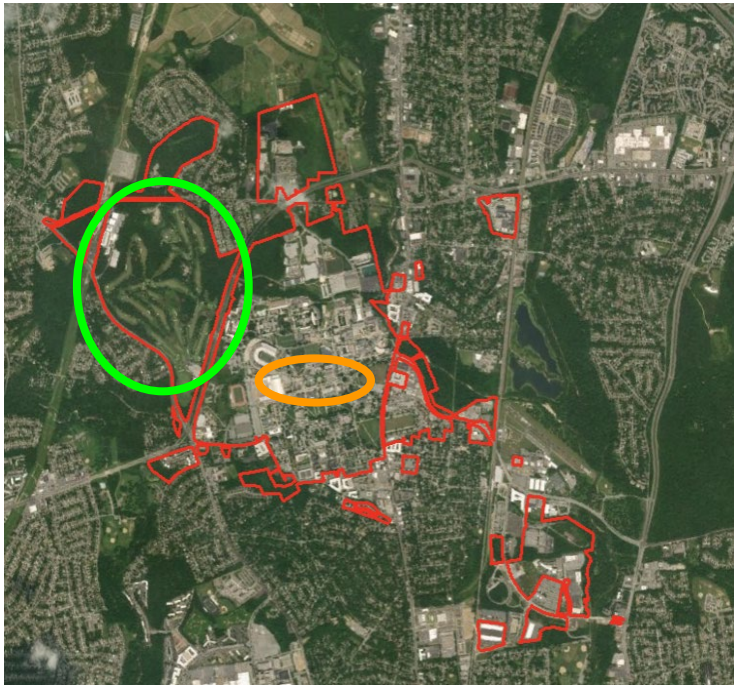
- Main Campus
- Satellite properties located throughout Maryland

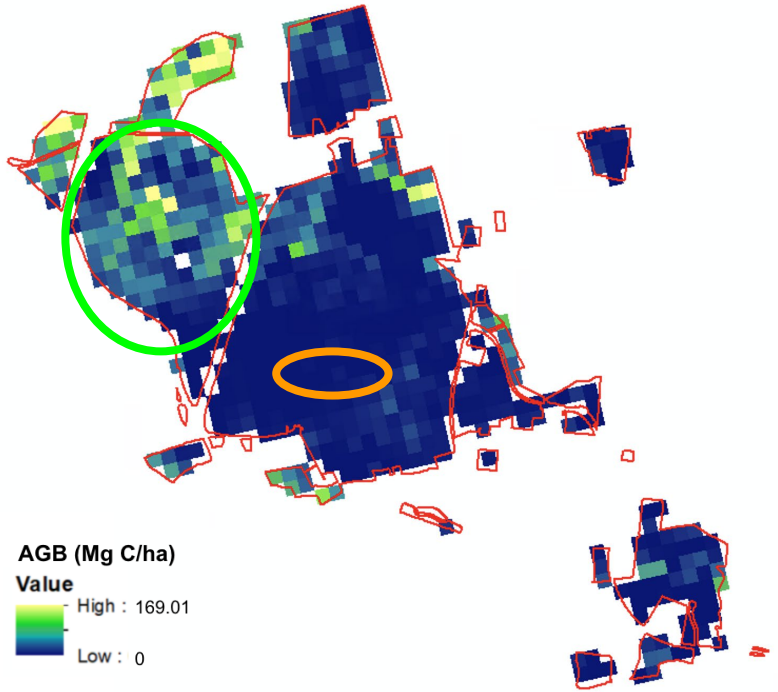




Baseline Mapping

Aboveground Biomass (AGB)





Aboveground Biomass (AGB): the total amount of living plant matter that sits above the soil (tones per unit area)

Monitoring

FUNDAMENTAL EQUATIONS

Annual Net Carbon Flux = Carbon **Gains** - Carbon **Losses**

Gains = growth over forested fraction of a pixel

Losses = amount of carbon in disturbed or deforested area

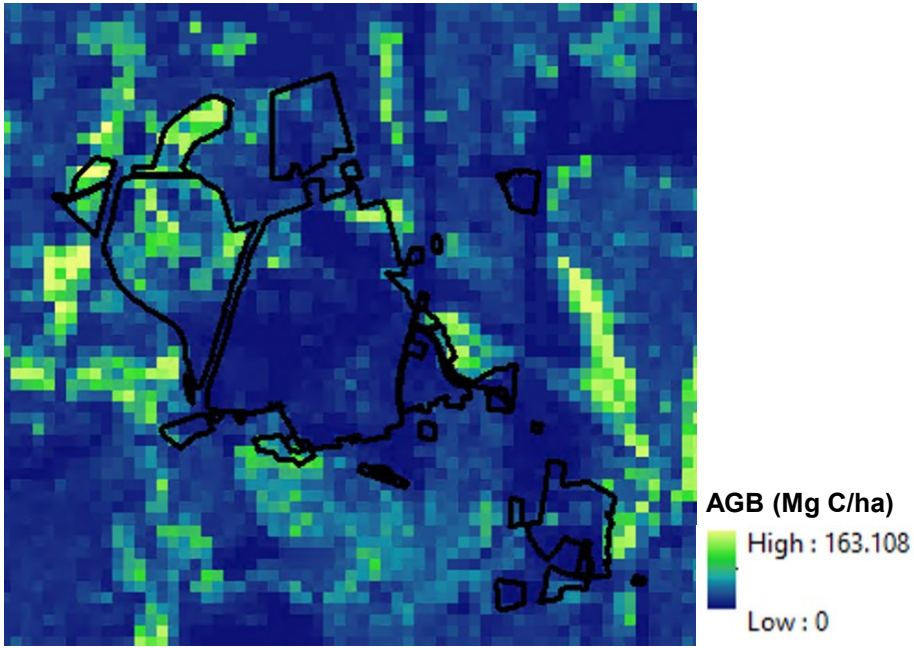
+ flux = **carbon sink**

- flux = **carbon source**

Key Data Inputs

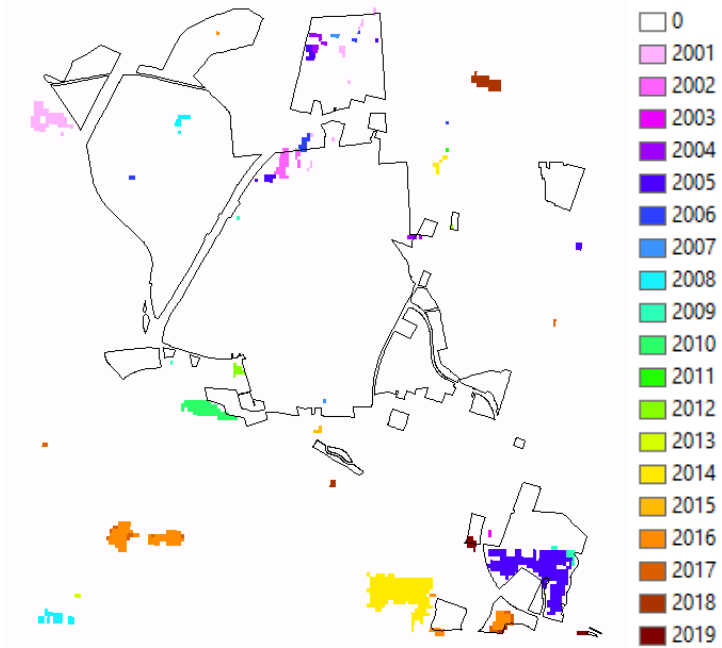
GAIN

Aboveground Biomass (AGB) Trajectories from ED Model
(90m resolution) (Ma et al., 2021)



LOSS

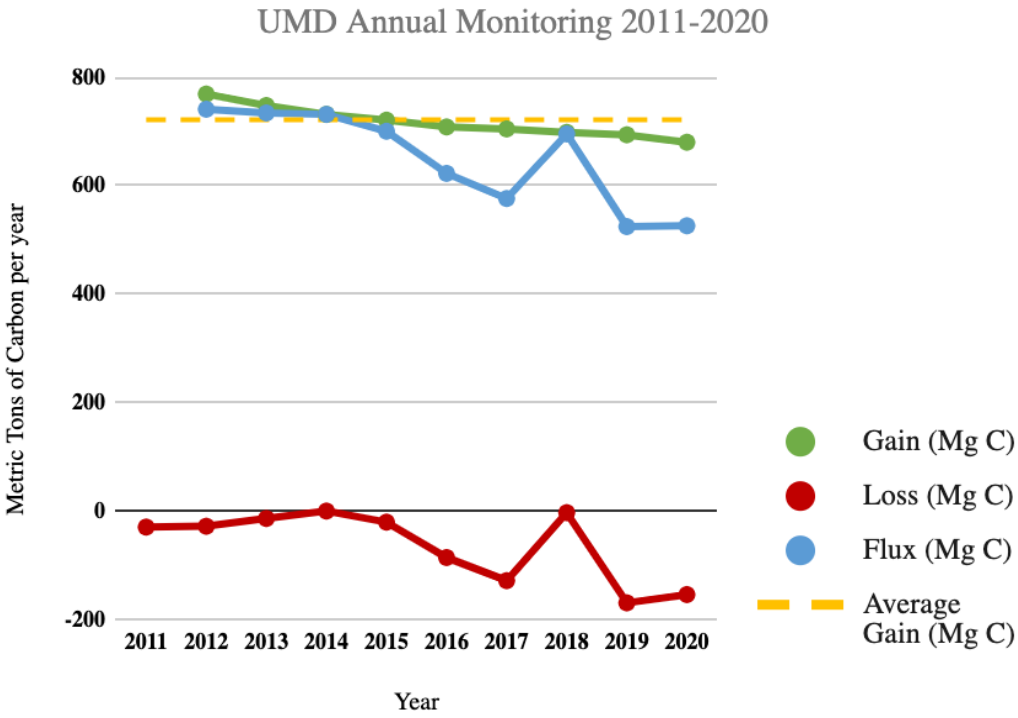
Observed Forest Loss by Year
(2000-2020, 30m resolution) (Hansen et al. 2013)



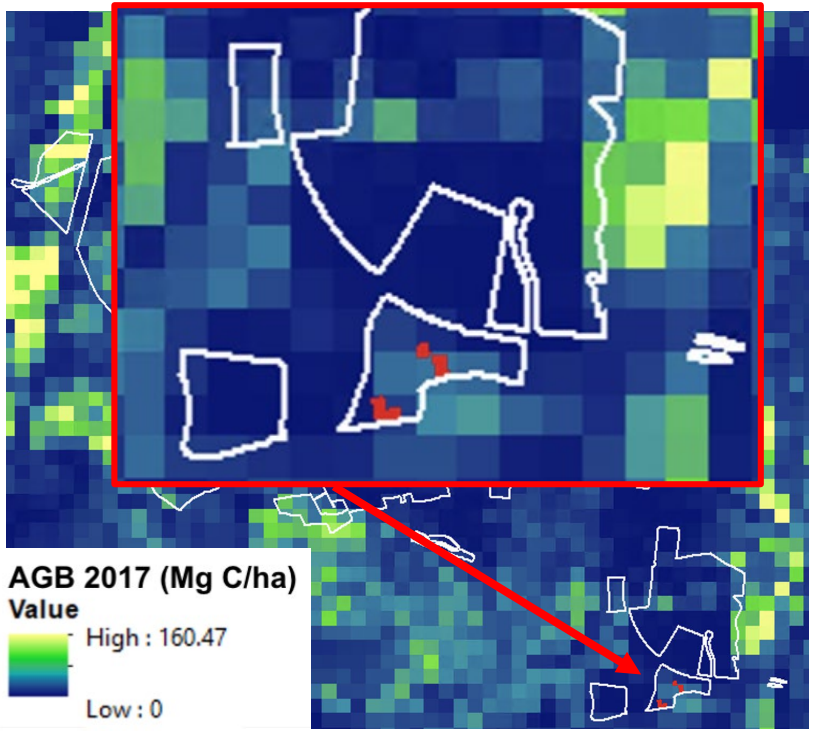
Aboveground Biomass (AGB): the total amount of living plant matter that sits above the soil (tones per unit area)

Monitoring Results

Net Carbon Fluxes

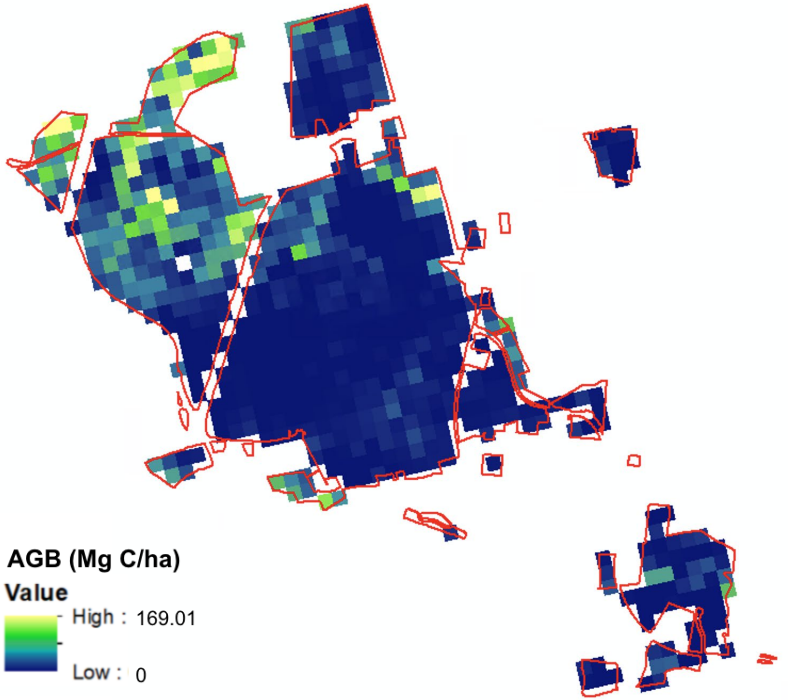


Example Map - 2017

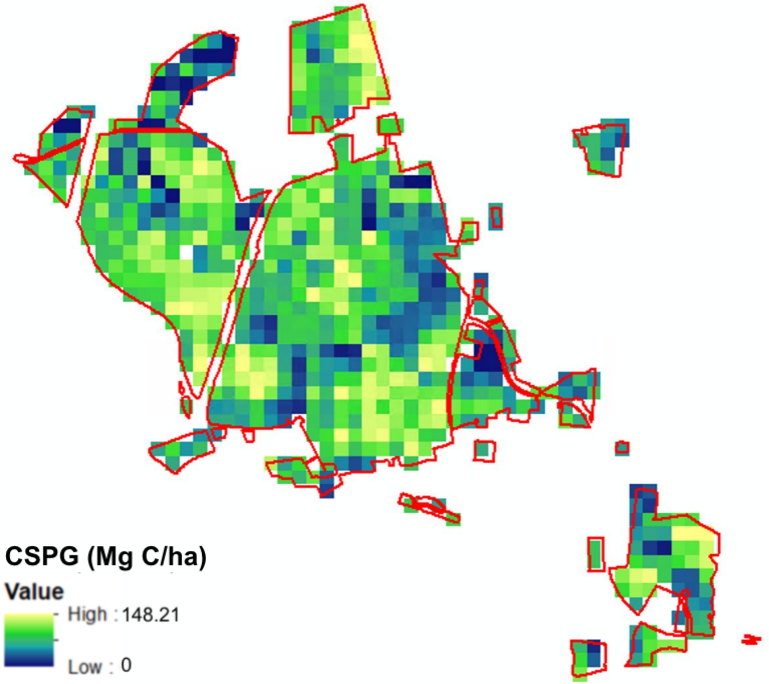


Potential for Scaling Impact

Aboveground Biomass (AGB)



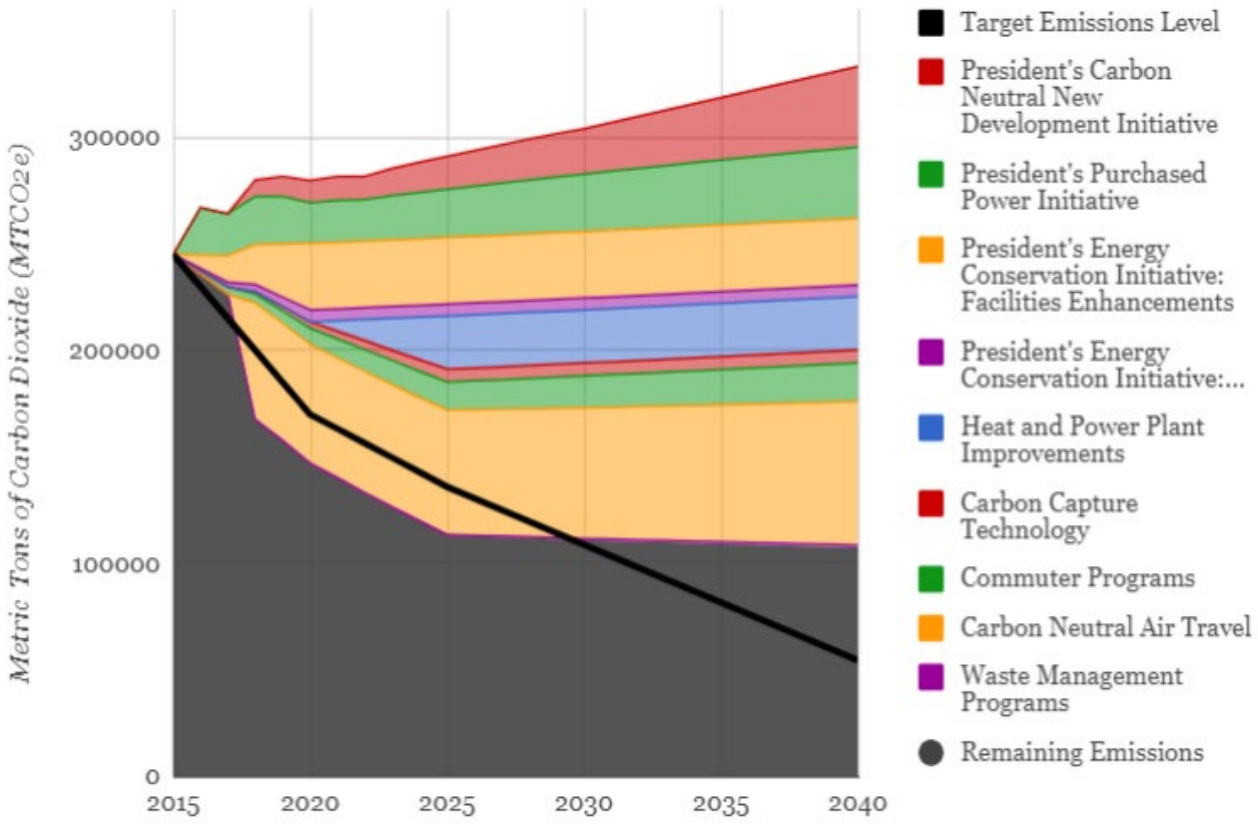
Carbon Sequestration Potential Gap (CSPG)



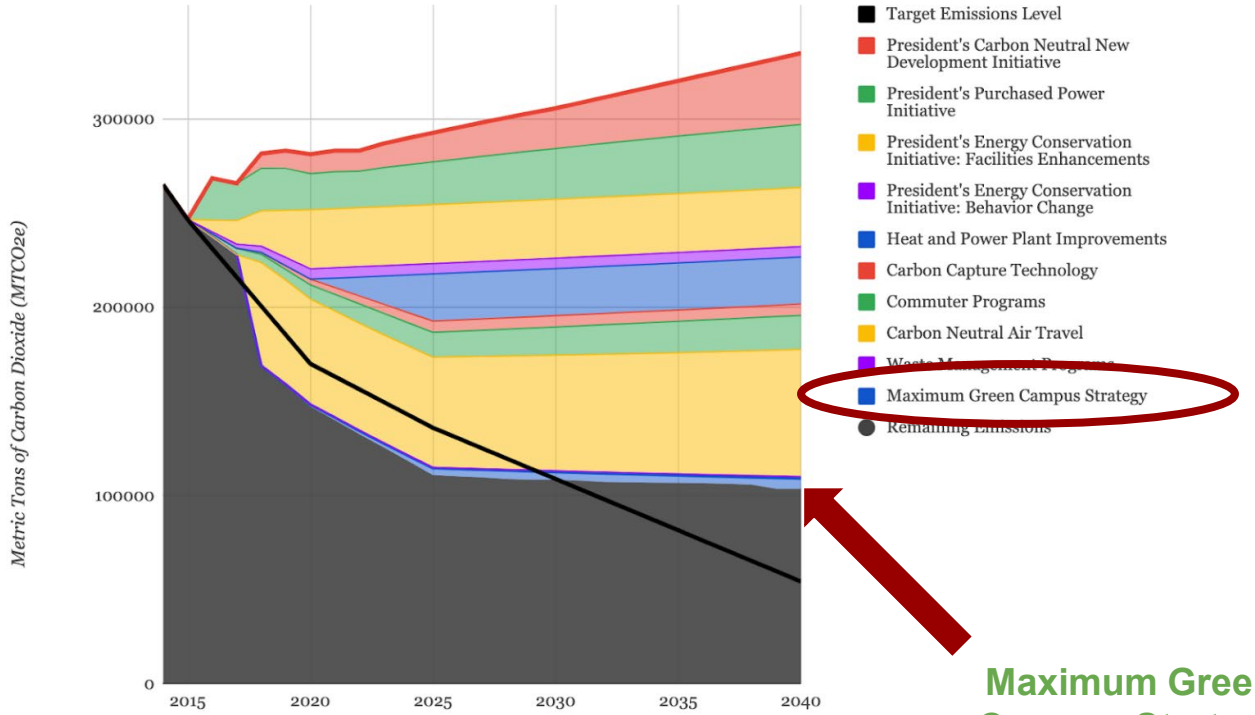
Aboveground Biomass (AGB): the total amount of living plant matter that sits above the soil (tones per unit area)
Carbon Sequestration Potential Gap (CSPG): the maximum amount of carbon that could be stored minus current AGB

Modeling to Facilitate Planning

Current CAP emissions goals

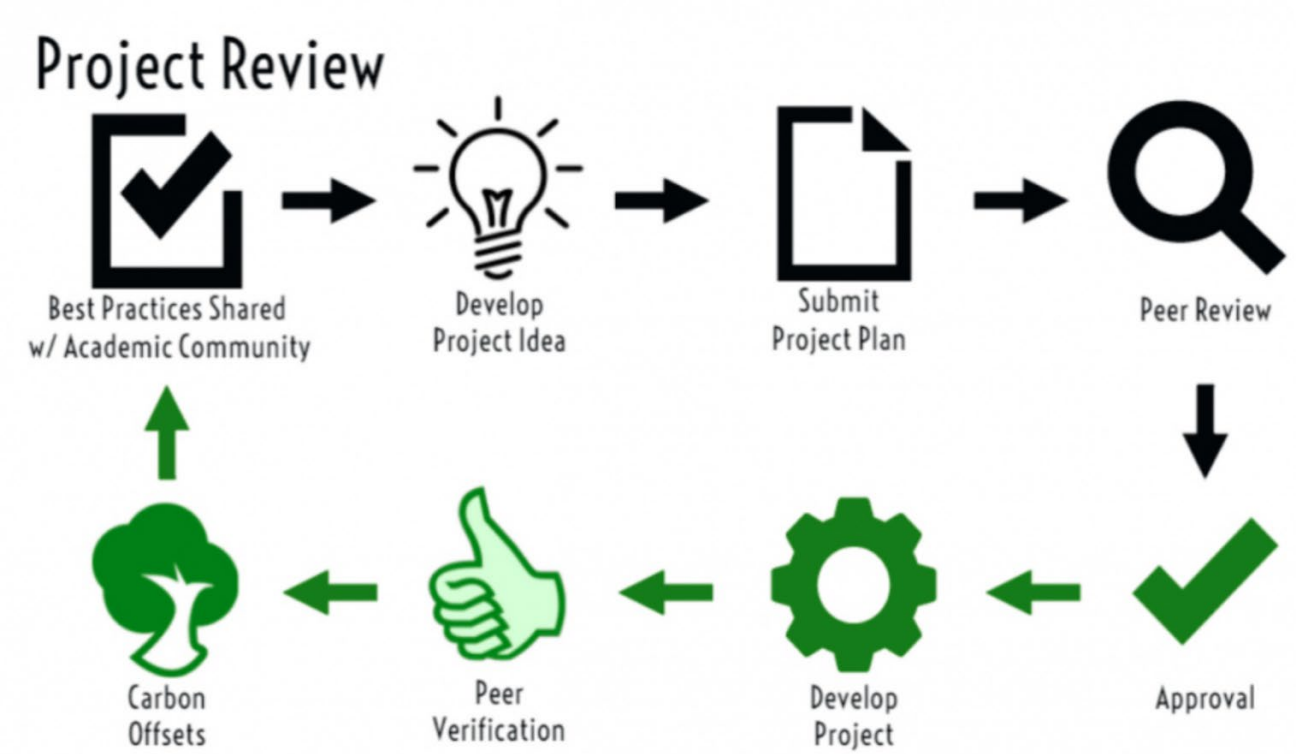


Reforestation Scenarios on UMD Main Campus



Maximum Green Campus Strategy

Re-Tooling Science for Scope 3 Peer-Reviewed Offset Protocol



Next Steps

1. Include current estimates into 2021 Campus GHG Inventory
2. Incorporate forest carbon into CAP 3.0
    - Develop reforestation scenarios with facilities management and other campus partners to support strategic planning
    - Expand planning scenarios to AGNR Research and Education Centers across the state
3. Chart path for UMD to offset a portion of Scope 3 emissions through new Peer-Reviewed Reforestation Offset Protocol

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Learn more at **https://geog.umd.edu/project/campus-forest-carbon-project**