Measuring Forest Carbon and Emissions with the Land Emissions and Removals Navigator Tool (LEARN)

Susan Minnemeyer, Chesapeake Conservancy
Tom Herrod, ICLEI USA
Erin Glen, WRI
Richard Birdsey, Woodwell Climate Research Center
Eric Ashcroft, Blue Raster

ICLEI Local Governments for Sustainability

WORLD RESOURCES INSTITUTE

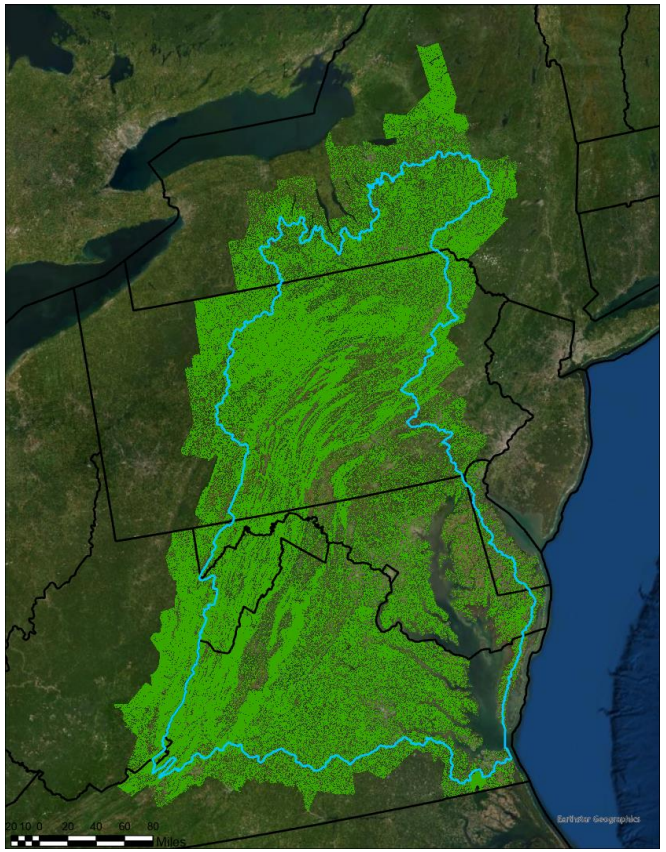
Woodwell Climate Research Center

BLUE RASTER

Chesapeake Conservancy
EXPLORE. CONNECT. CONSERVE.

High Resolution Tree Canopy Data

Planning at the Parcel Scale



Chesapeake 1m Land Cover
Tree Canopy Class

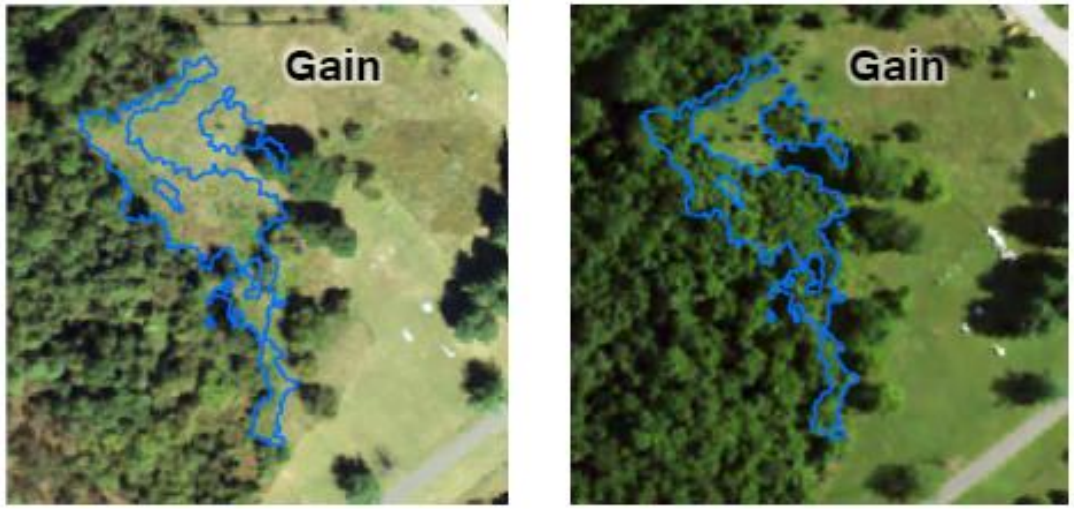
2013-2014

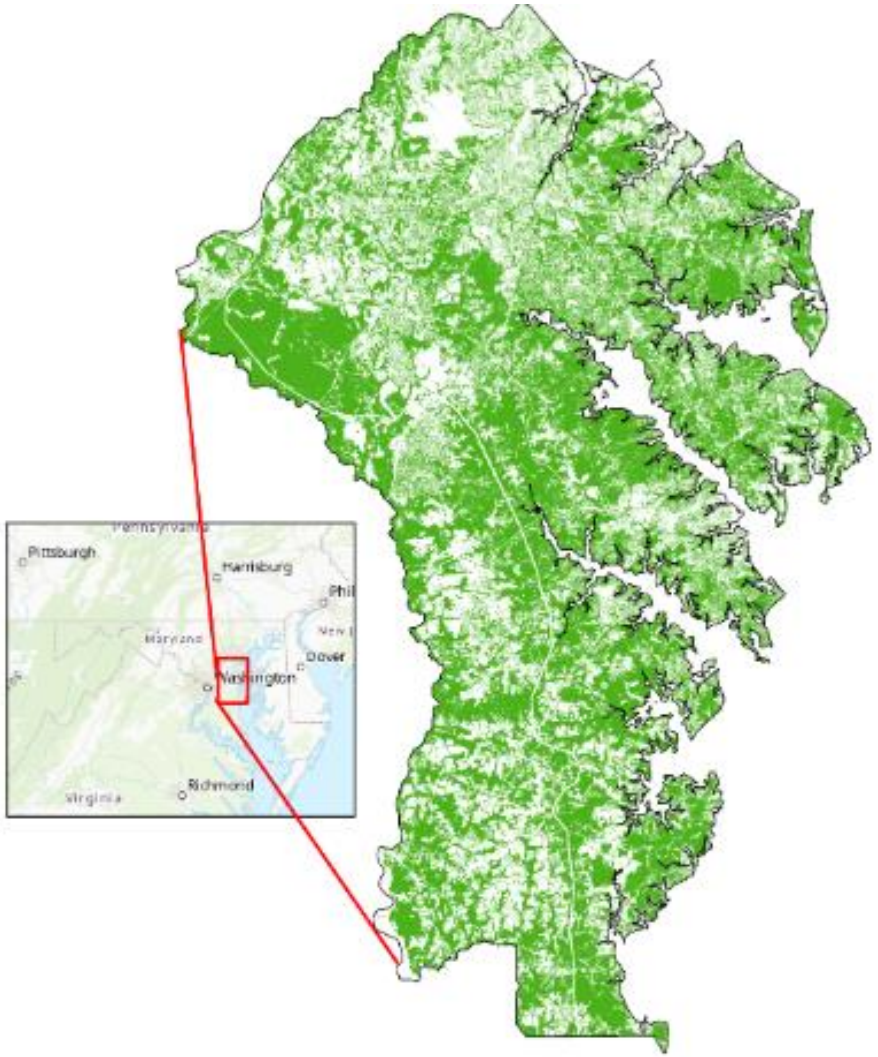
2017-2018

High Resolution Tree Canopy Change Detection

Anne Arundel County, Maryland

2013 → 2017

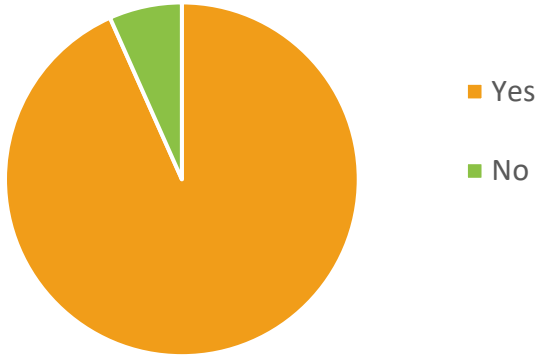




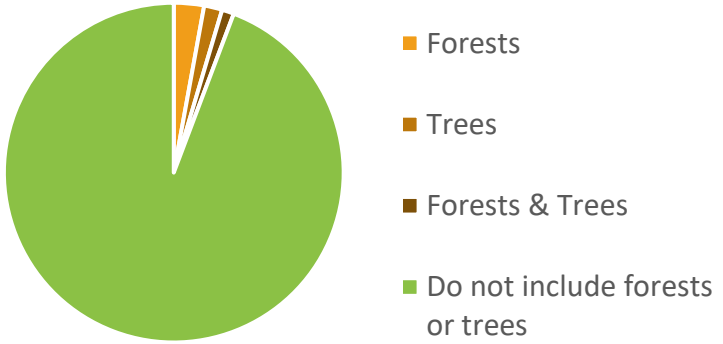
Anne Arundel County 2017 Tree Canopy

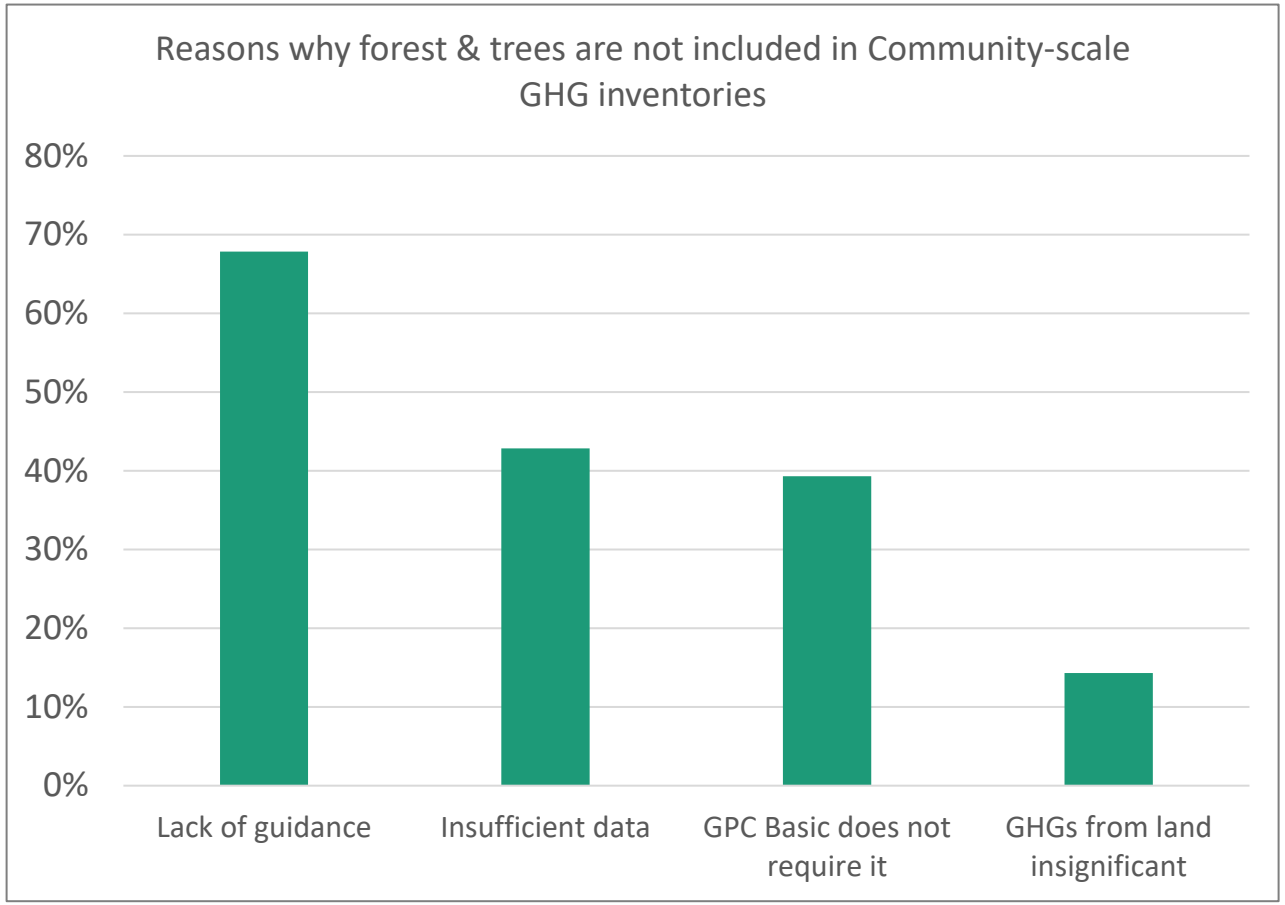
Hundreds of US communities are setting climate targets, but few include forests & trees

Do you want to include forests & trees?



Actual inclusion of forests & trees in GHGIs





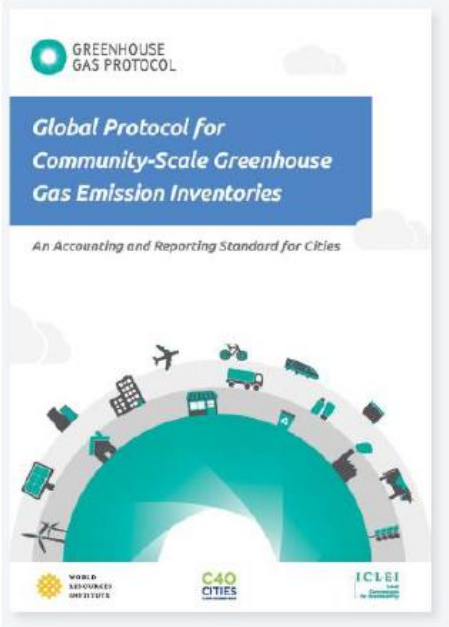
Community Climate Action & GHG inventories

U.S. Community Protocol

Provides more detailed methodologies tailored to US communities, including sector guidance in Appendices:

Appendix C: Built Environment
Appendix D: Transportation
Appendix E: Solid Waste
Appendix F: Wastewater
Appendix G: Agriculture Livestock
…
Appendix J: Forests & Trees

Global Protocol for Community-Scale Emissions (GPC)



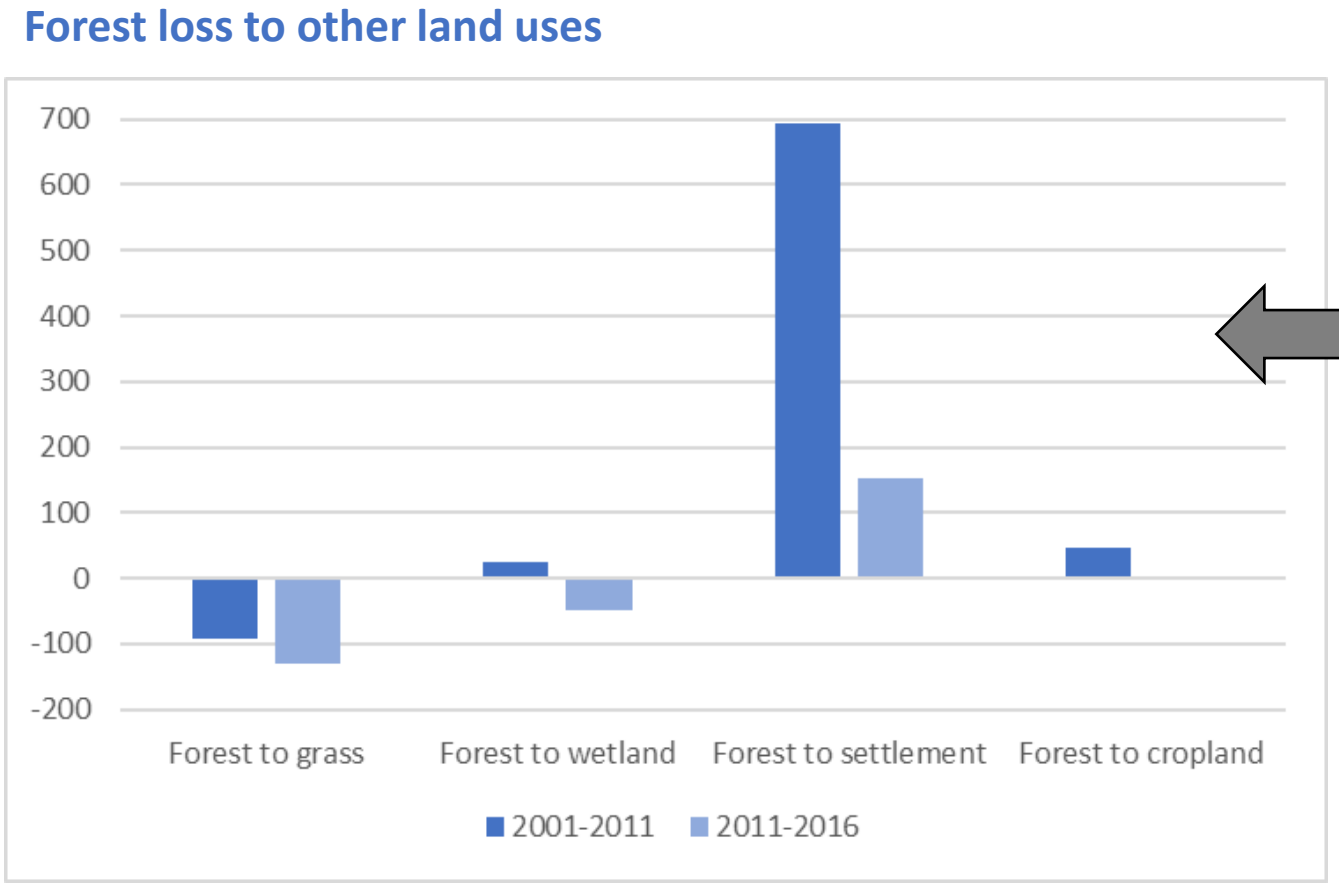
…Update from March 2022 includes Forestry and Trees, based on Appendix J

NEW!

ICLEI's US Community-scale Protocol: New Appendix on Forests & "Trees Outside Forests"

Application of the protocol…	…but does not:
• Provides a community with estimates to understand the magnitude and direction of GHGs from forests & trees. • Provides information that can be used to inform climate friendly policies • Supports the development of a GHG inventory consistent with IPCC and US GHG inventory methods.	• Provide estimates that can be used for selling carbon credits. • Provide a methodology to estimate the GHG impacts of specific mitigation activities • Provide a way to measure the indirect or non-GHG benefits of forests/trees • Estimate E/R from non-forests or non-trees outside forests e.g. agriculture.

Other data useful for policymaking…



Why is forest loss happening?
In this case, forest loss is due to urban expansion (i.e. forest to settlement)

Integrating Forests & Trees into the GHG inventory reporting

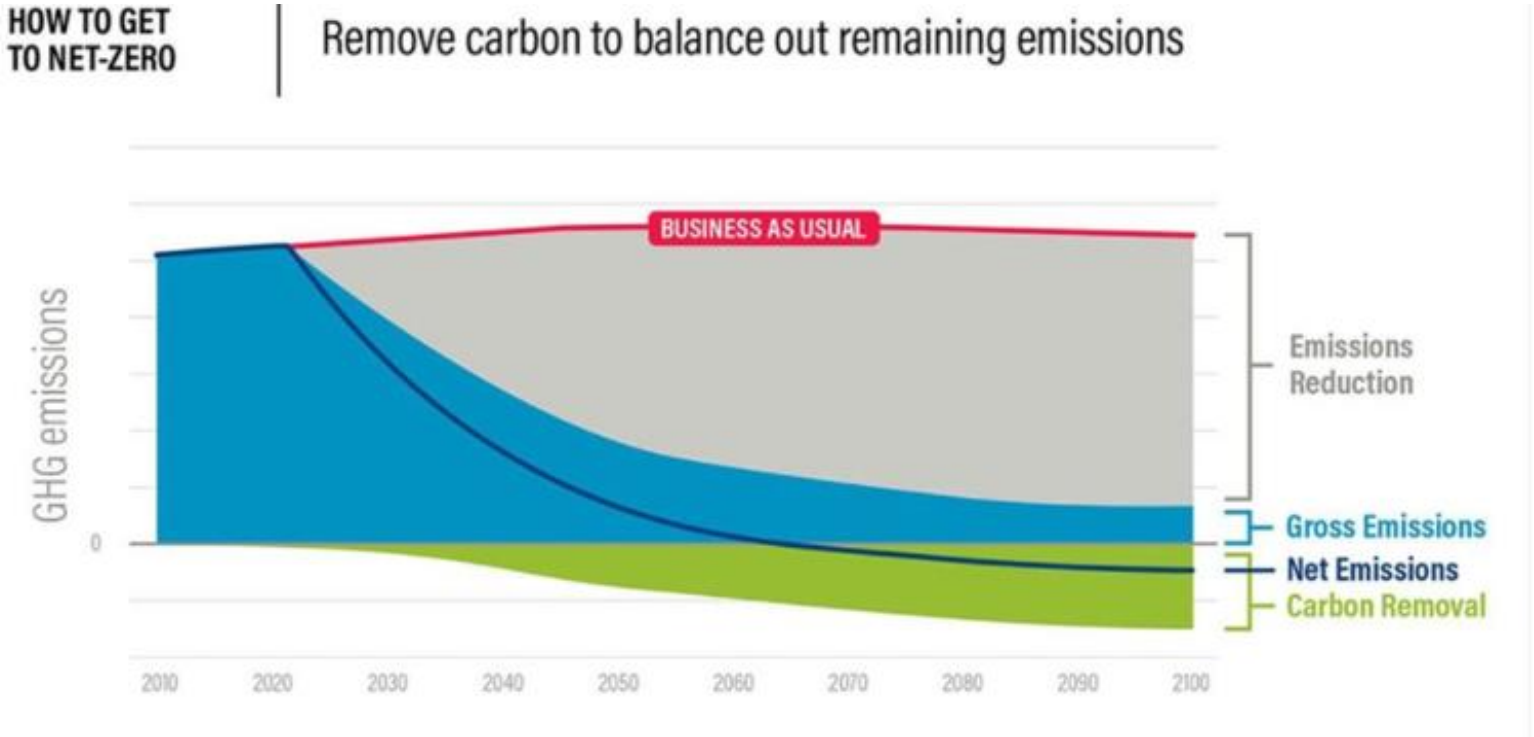
Emissions Type (Main ClearPath Tab)	Emissions ($MTCO_2e$)			
	2005	2012	2015	% Change, 2005-2015
Residential Energy	3,521,192	2,424,184	2,739,447	-22%
Commercial Energy	3,949,381	2,884,333	3,001,394	-24%
Transportation and Mobile Emissions	4,972,108	4,890,664	4,687,981	-6%
Water and Wastewater	11,993	11,376	10,979	-8%
Agriculture	52,190	48,440	41,914	-20%
Solid Waste	268,533	264,005	266,617	-1%
Process and Fugitive Emissions	369,260	519,885	596,167	61%
Total (Gross) GHG Emissions	**13,144,657**	**11,042,886**	**11,344,499**	**-14%**
LAND USE				
Forests remaining forests	(289,344)		(278,491)	4%
Forests converted to other lands	52,071		29,221	-44%
Other lands converted to forests	(4,328)		(3,635)	16%
Sequestration from trees	(313,176)		(382,643)	-22%
Emissions from tree loss	346,292		135,790	-61%
Total (Net) GHG Removals	**(208,485)**		**(499,758)**	**-140%**
Total (Net) GHG Emissions	**12,936,172**		**10,844,741**	**-16%**

Reduction of 14% of **gross** emissions…

…refined to reduction of 16% of **net** emissions…

Forest and Trees in Climate Targets

- Alongside robust emission reductions, carbon sequestration in natural and working lands can remove significant carbon from the atmosphere



2022 Forestry Cohort and Opportunity

Guided Sessions for Running Specific Analysis

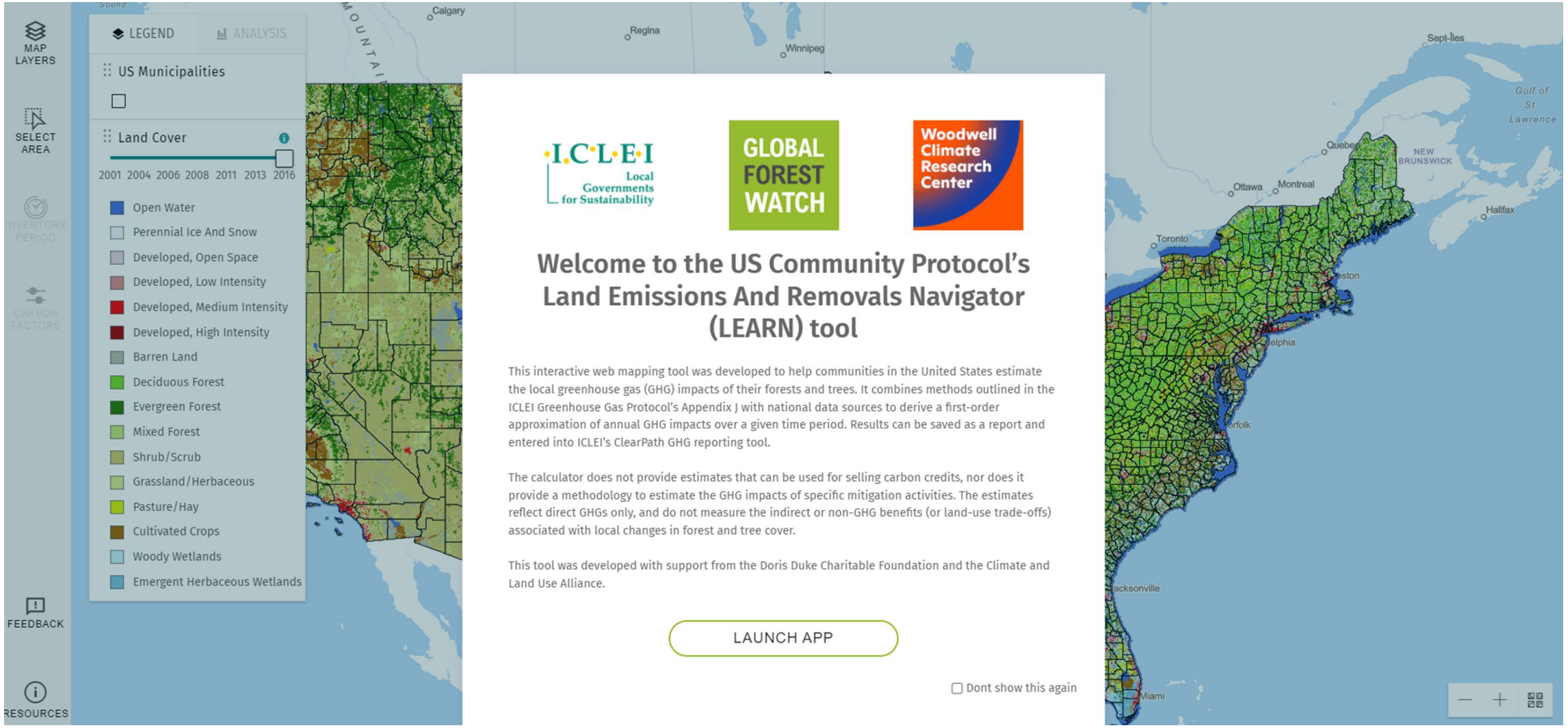
- **Flexibility in community type**
- **Stratification of Analysis**

Guidance interpreting results

- **Utilization in Policy**
- **Utilization in Planning**

Network and Peer Opportunities

LEARN Forest carbon accounting



Key Definitions

Emissions:

Carbon emitted as a result of forest or tree canopy loss or disturbance

Removals:

Carbon removed or sequestered from the atmosphere by forests or trees remaining forests and forest or tree gain

Current Data Inputs

Land Cover

Data Type	*Data Source*
Land Cover	USGS National Land Cover Database (NLCD)
Tree Canopy	USGS NLCD Tree Canopy Cover*

Forest Disturbance

Insect Damage	USFS Aerial Surveys
Burned Areas	Monitoring Trends in Burned Severity (MTBS)
Harvest / Other	Hansen Tree Cover Loss

Forest Characteristics

Forest Stand Age	USFS / FIA Forest Age
Forest Group Type	USFS / FIA Forest Age
Forest Region	FIA Forest Regions
Forest Stand Origin	WRI Spatial Database of Planted Trees*

Data Updates

Land Cover	
Data Type	*Data Source*
Land Cover	USGS National Land Cover Database (NLCD) – Updated through 2019
Tree Canopy	USGS NLCD Tree Canopy Cover – Updated with high-res data for Chesapeake Bay

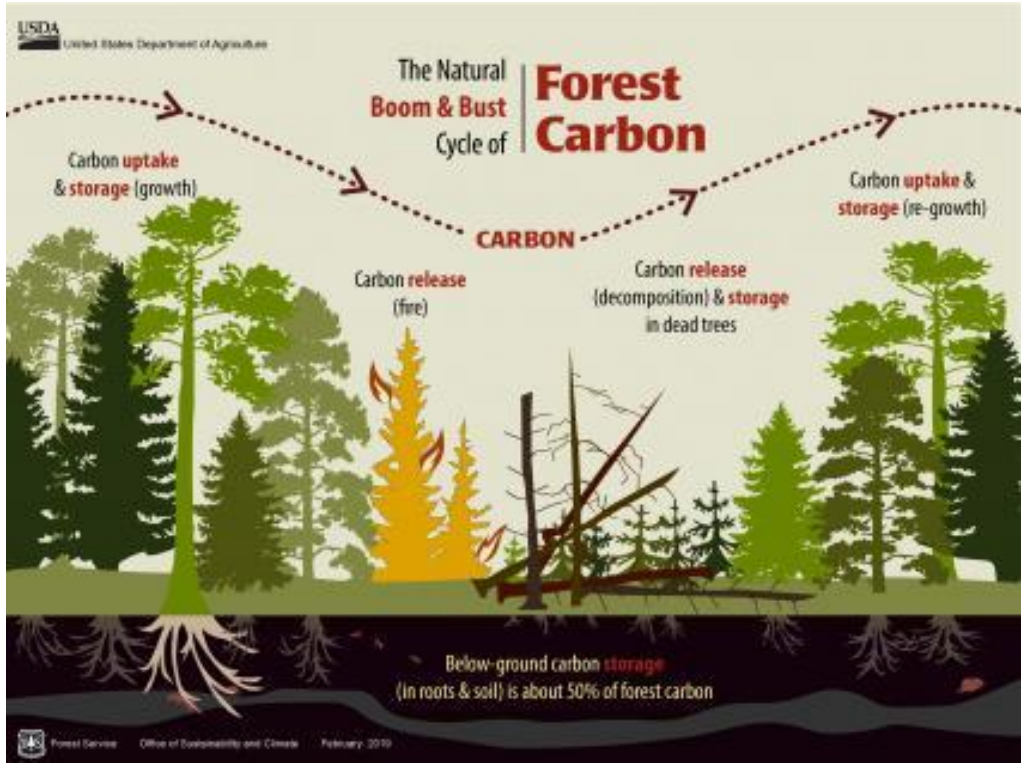
Forest Disturbance	
Insect Damage	USFS Aerial Surveys – Updated through 2019
Burned Areas	Monitoring Trends in Burned Severity (MTBS) – Updated through 2019
Harvest / Other	Hansen Tree Cover Loss – Updated through 2019

Forest Characteristics	
Forest Stand Age	USFS / FIA Forest Age
Forest Group Type	USFS / FIA Forest Age
Forest Region	FIA Forest Regions
Forest Stand Origin	WRI Spatial Database of Planted Trees* – Updated with FIA / USFS Data for plantations

Removal and emission factors

"Removal" means taking CO_2 out of the atmosphere

"Emission" means releasing CO_2 to the atmosphere



	Emission Factor (t C/ha)	Removal Factor (t C/ha/yr)
Forest Change		
Deforestation		
To Cropland	22.93	
To Grassland	26.16	
To Settlement	56.11	
To Wetland	45.07	
To Other	89.31	
Reforestation (Non-Forest to Forest)		-1.95
Forest Remaining Forest		
Undisturbed		-1.73
Disturbed		
Fire	0	
Insect/Disease		
Harvest/Other	77.40	
Trees Outside Forest		
Tree canopy loss	103.00	
Canopy maintained/gained		-3.53

Calculations and results

- GHG removals = activity data x removal factor (negative number)
- GHG emissions = activity data x emission factor (positive number)
- Net GHG balance = GHG removals + GHG emissions

Reporting category	2001-2011	2011-2016
Emissions of CO_2 (Mt) per year		
Forest → Settlement[1]	35,742	16,371
Forest → Other Land[1]	5,158	1,402
Forest → Grassland[1]	11,171	11,448
TOTAL FORESTS	52,071	29,221
Trees outside forest[2]	346,292	135,790
TOTAL ALL LANDS	398,362	165,011
Removals of CO_2 (Mt) per year		
Forest → Forest[3]	-289,344	-278,491
Non-forest → Forest[4]	-4,328	-3,635
TOTAL FORESTS	-293,672	-282,126
Trees outside forest[5]	-313,176	-382,643
TOTAL ALL LANDS	-606,848	-664,769
Net change in CO_2 Emissions (Mt) per year		
TOTAL ALL LANDS	**-208,486**	**-499,759**

LEARN Tool Demonstration

- Key features
- High resolution tree canopy data update
- Run analysis
- Generate report