CARBON DATA AND TOOLS:
A BREIFING FOR THE FIELD

February 27, 2024

The Nature Conservancy
Protecting nature. Preserving life.

OPEN SPACE INSTITUTE

Land Trust Alliance
Together, conserving the places you love

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

CLARK UNIVERSITY FIAT LUX MDCCCLXXXVII

TRUST FOR PUBLIC LAND

Program

Welcome
Open Space Institute

Updated Forest Carbon Data
Clark University

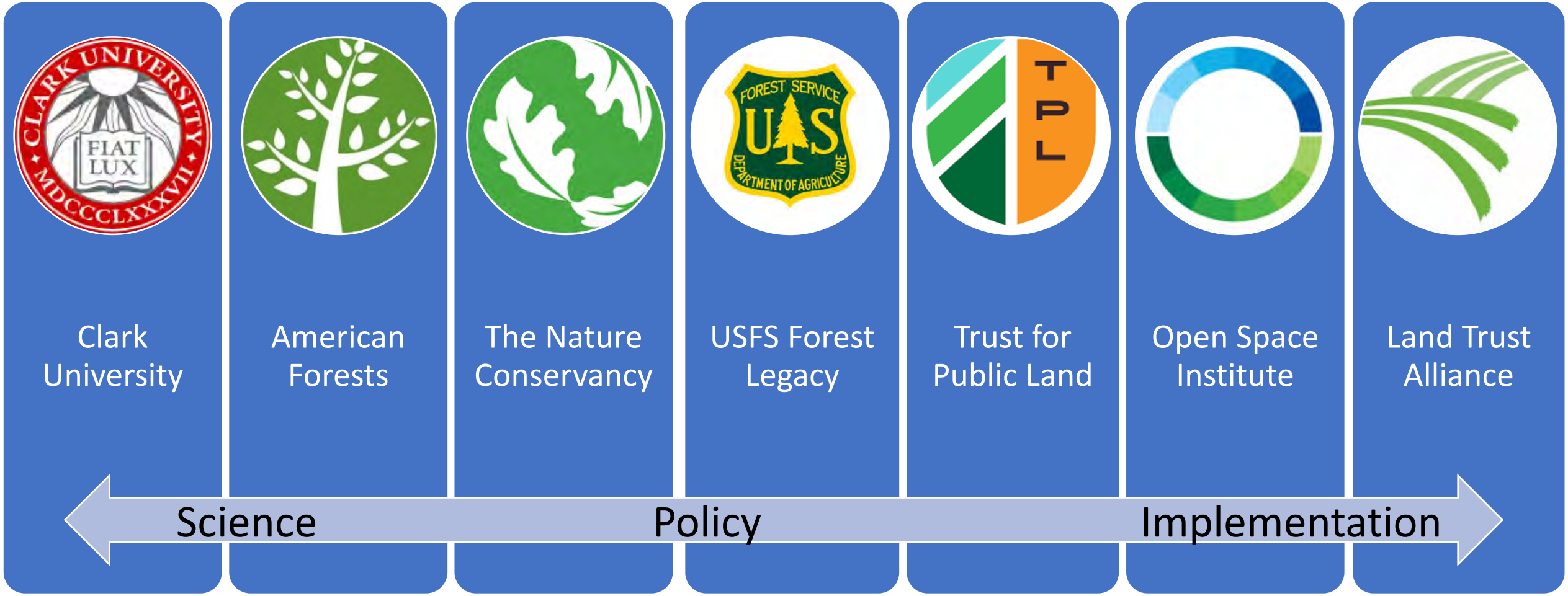
New Tools
The Nature Conservancy

Next Steps and Support for the Field
Trust for Public Land & Land Trust Alliance

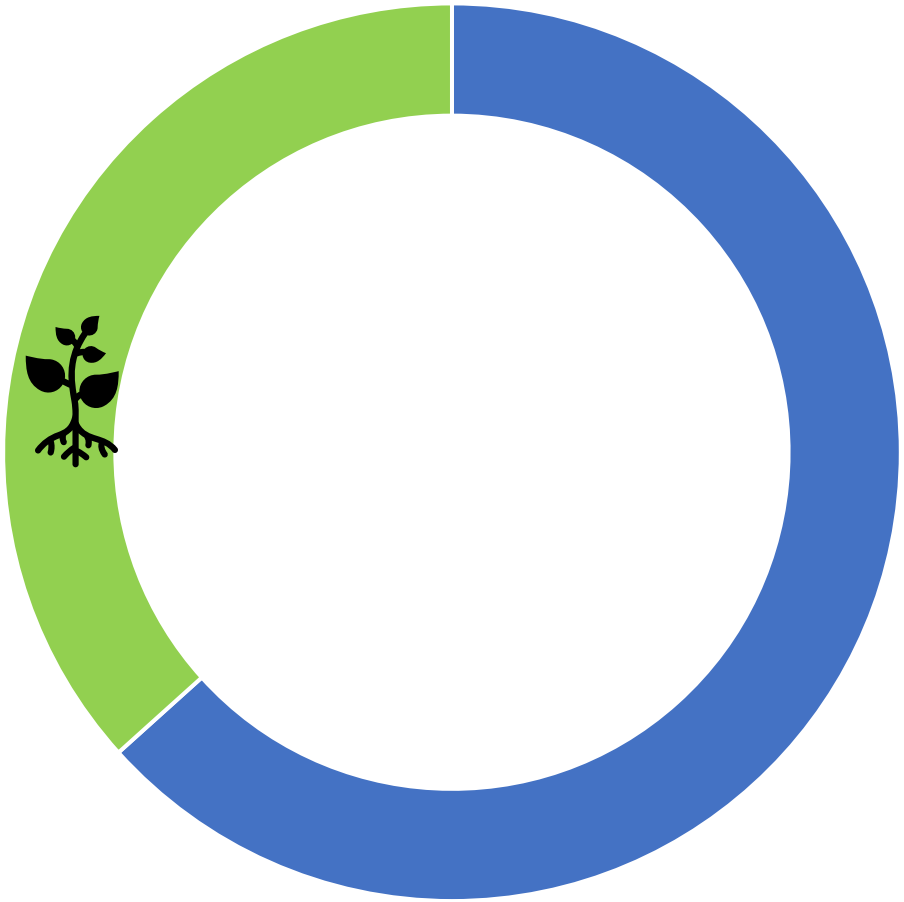
Closing
Open Space Institute

OPEN SPACE INSTITUTE

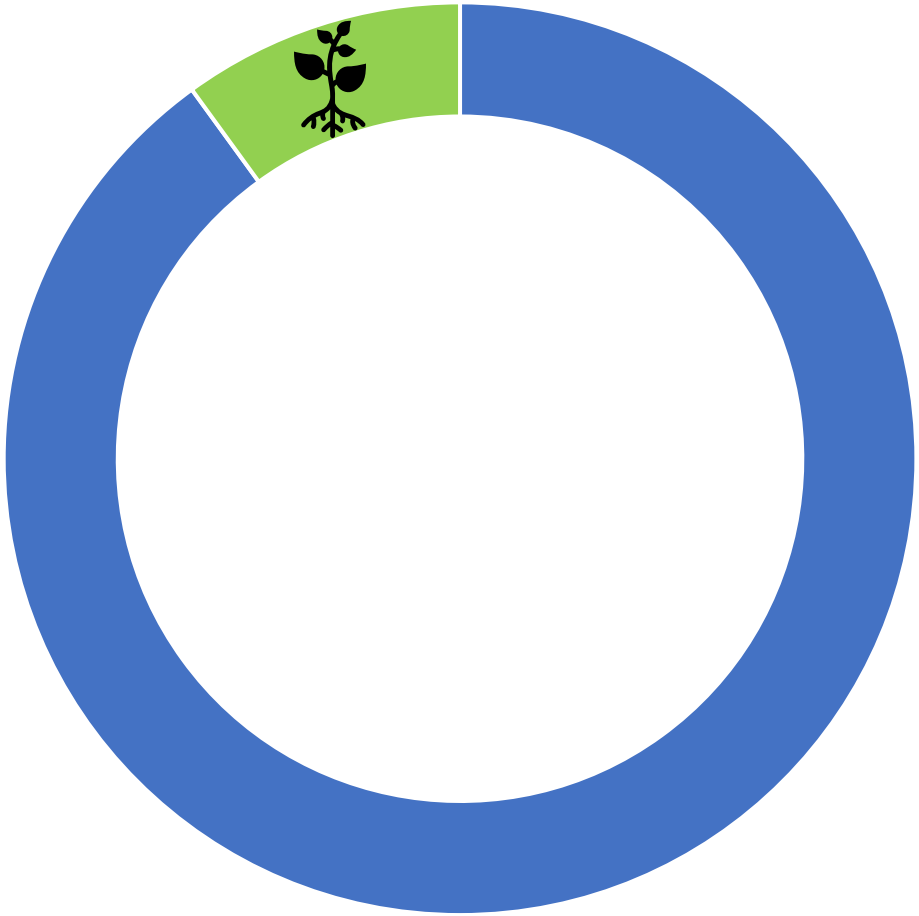
Mobilizing conservation partners to move climate science into conservation practice



Natural Climate Solutions can contribute one third of emissions reductions

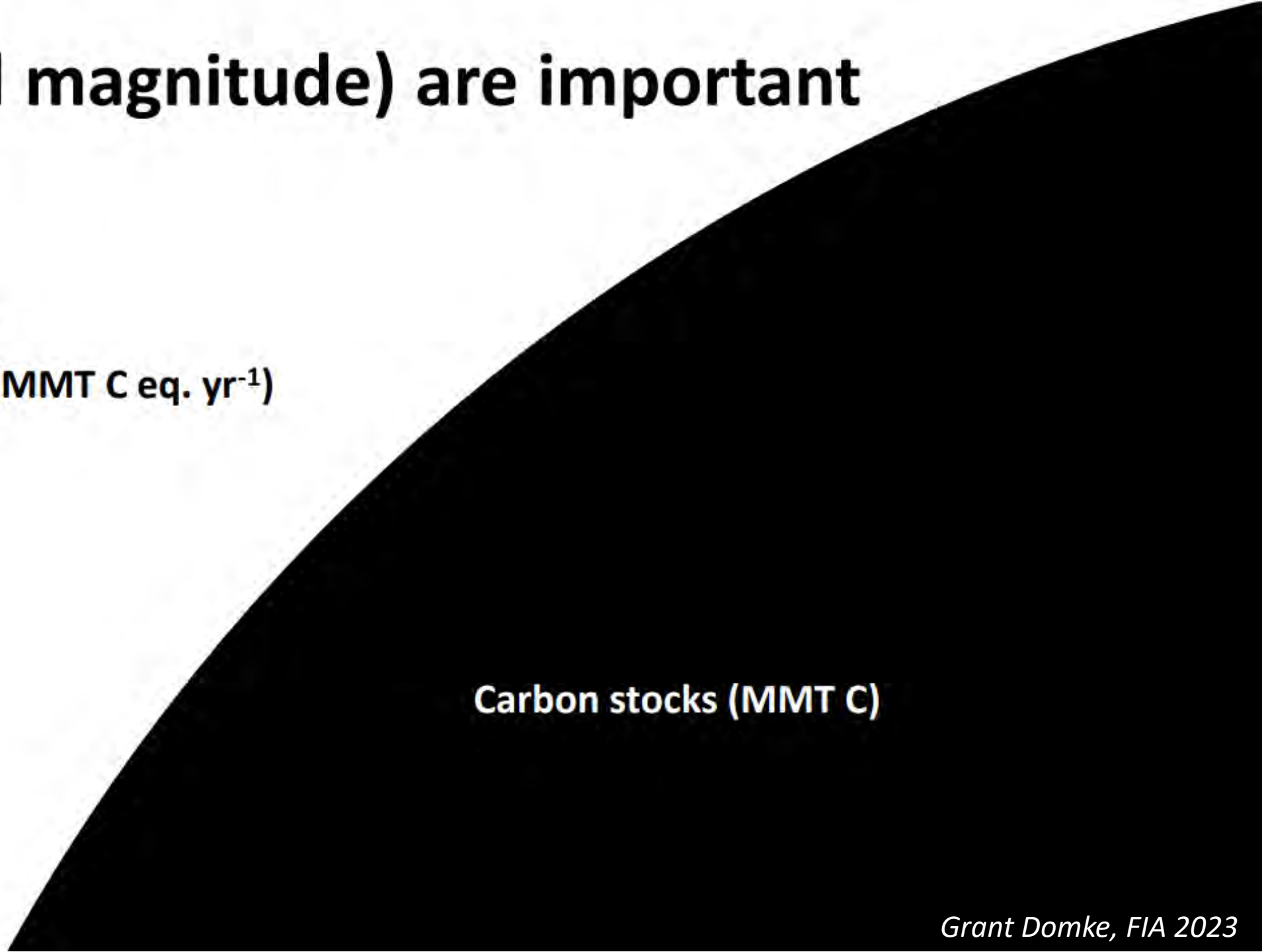


And yet receive about 10% of the investment



Data source: World Economic Forum

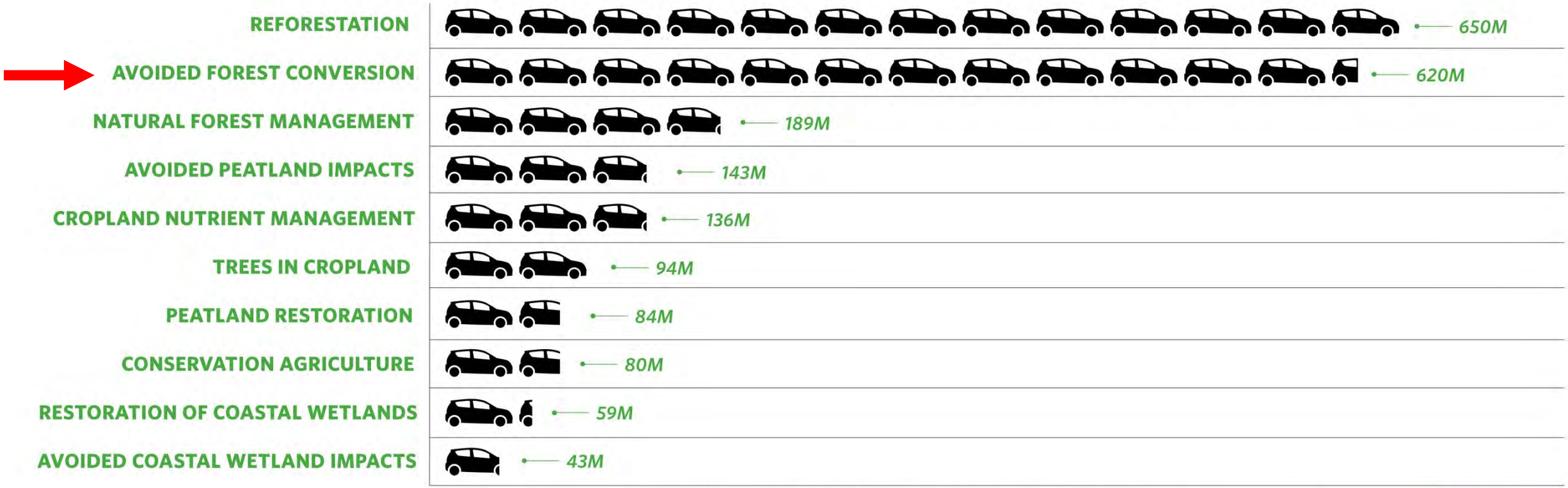
Context (and magnitude) are important



Grant Domke, FIA 2023

NATURAL CLIMATE SOLUTIONS

The Nature Conservancy



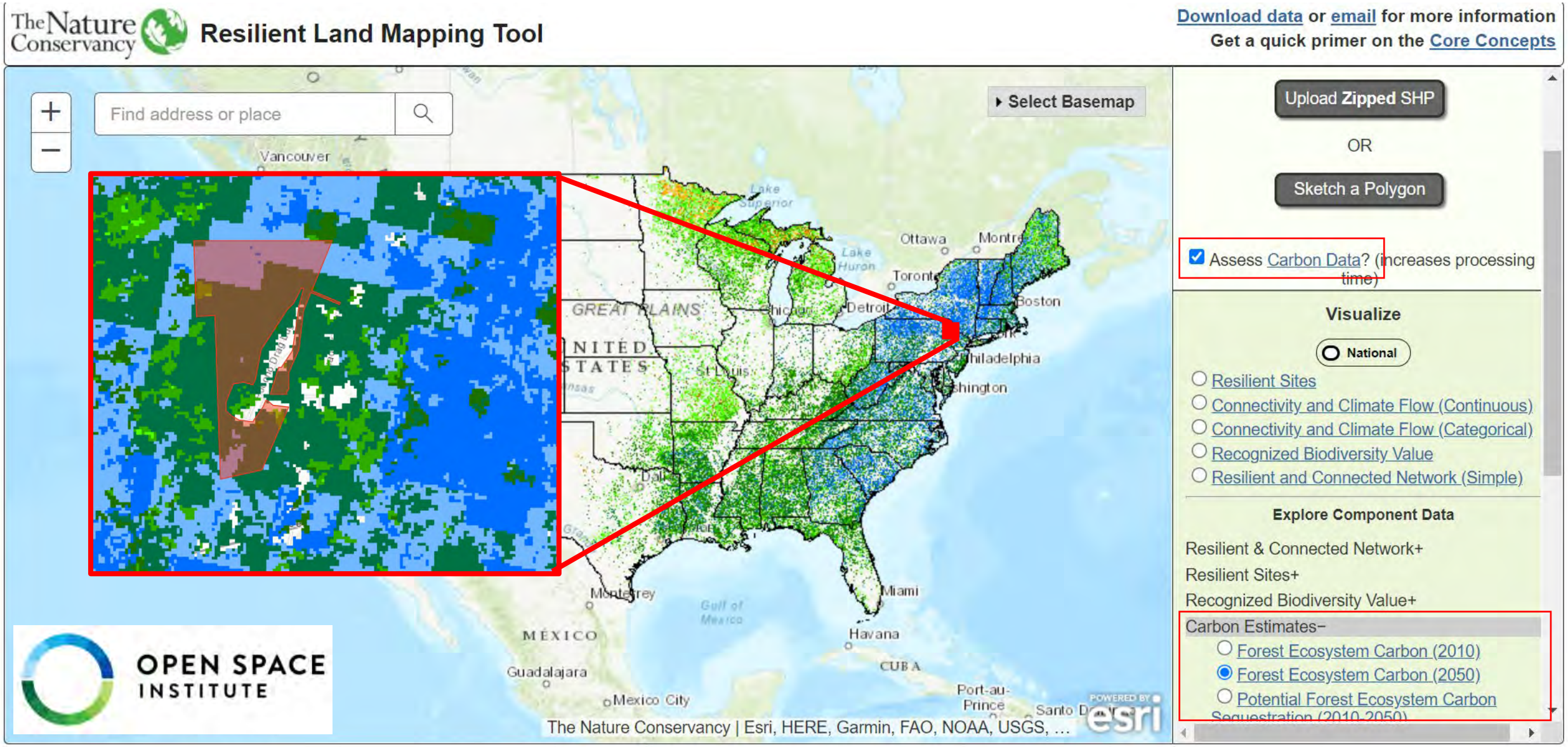
Global Mitigation Potential: *Approximate Number of Cars Removed Each Year in Millions*

= 50M cars

[1]Cost-Effective

Credit: Nathalie DuPre

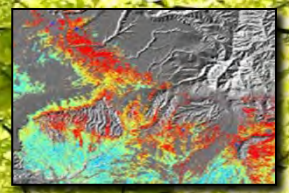
Project Evaluation



Credit: Nathalie DuPre







Forest Carbon & Climate Protection:
Data and Tools for Applications

Christopher A. Williams, Ph.D.
cwilliams@clarku.edu, 508-793-7323

Forest Carbon Data & Tools Webinar

Graduate School of Geography, Clark University
February 2024

Australian Government

Australia's forest industries

n to

Millions of trees to be planted in China and UK in ambitious plans

News

China to plant forest the size of Ireland

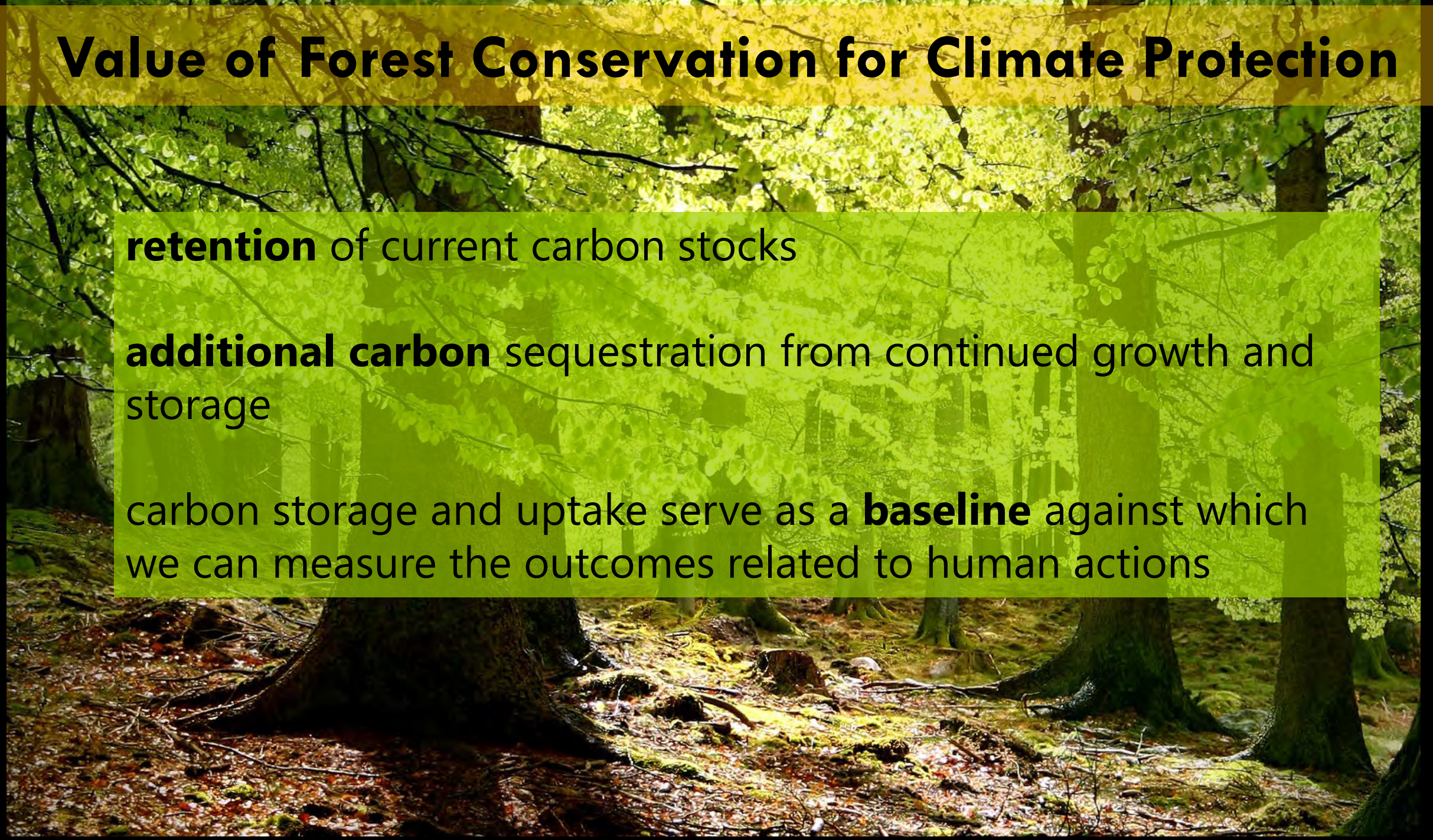
Northern Forest: Plan to plant 'ribbon of woodland' across England

By Roger Harrabin
BBC environment analyst

Trees

lia closer to

Value of Forest Conservation for Climate Protection



retention of current carbon stocks

additional carbon sequestration from continued growth and storage

carbon storage and uptake serve as a **baseline** against which we can measure the outcomes related to human actions

Available National Data layers (30m resolution)

Forest Carbon

- Forest extent in 2010
- Standing carbon in 2010
- Expected sequestration with limited disturbance to 2050

Climate Impacts of Forest Loss

- Carbon emission risk and foregone sequestration from 2010

Soon to be Available National Data layers

Forest Carbon

- Forest extent in 2021 removing areas of recent loss
- Standing carbon in 2021 updating to near-present
- Expected sequestration with limited disturbance to 2050 or later

Climate Impacts of Forest Loss

- Carbon emission risk and foregone sequestration from 2021
- Albedo correction factor for forest loss areas
- Conversion risk from recent forest losses

How much carbon is out there?

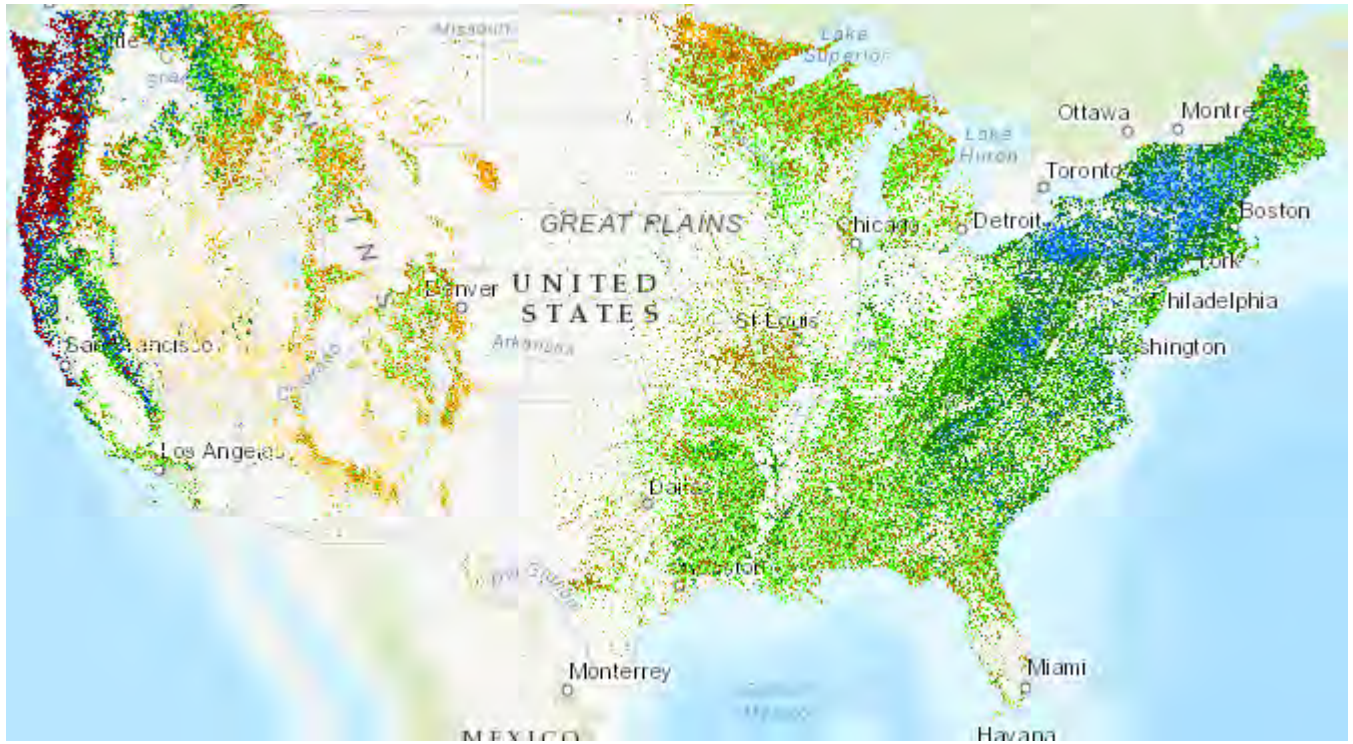
Baseline Biomass and Carbon Stocks

National Coverage (lower 48 states)

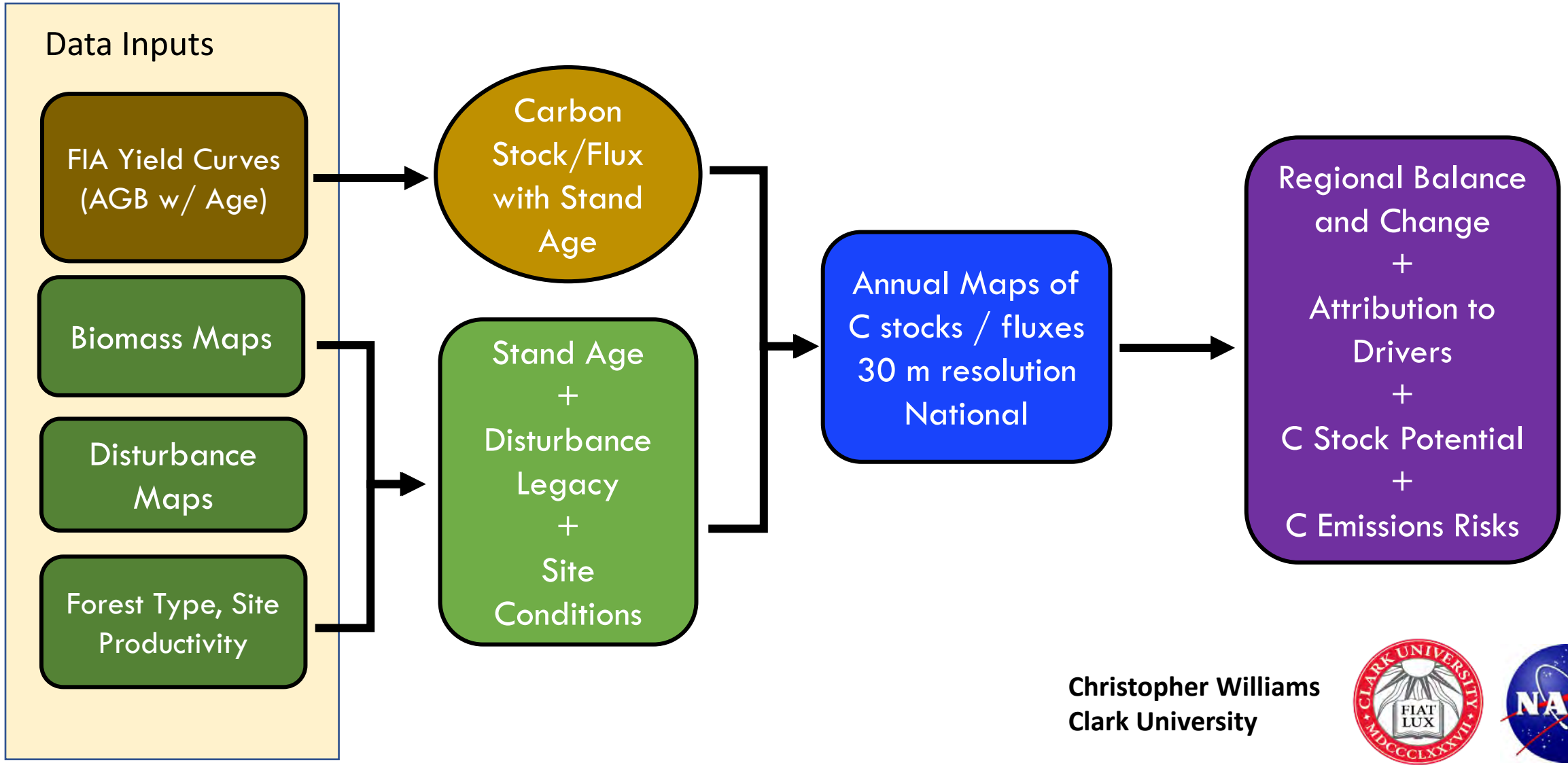
Derived from NBCD (Kellndorfer):
- 30 m resolution
- radar and optical fusion mapping
- trained with FIA data
- complemented by carbon modeling

Biomass, Soil C, Litter, and Woody Debris

Forest Ecosystem Carbon in 2010



National Forest Carbon Monitoring and Reporting System

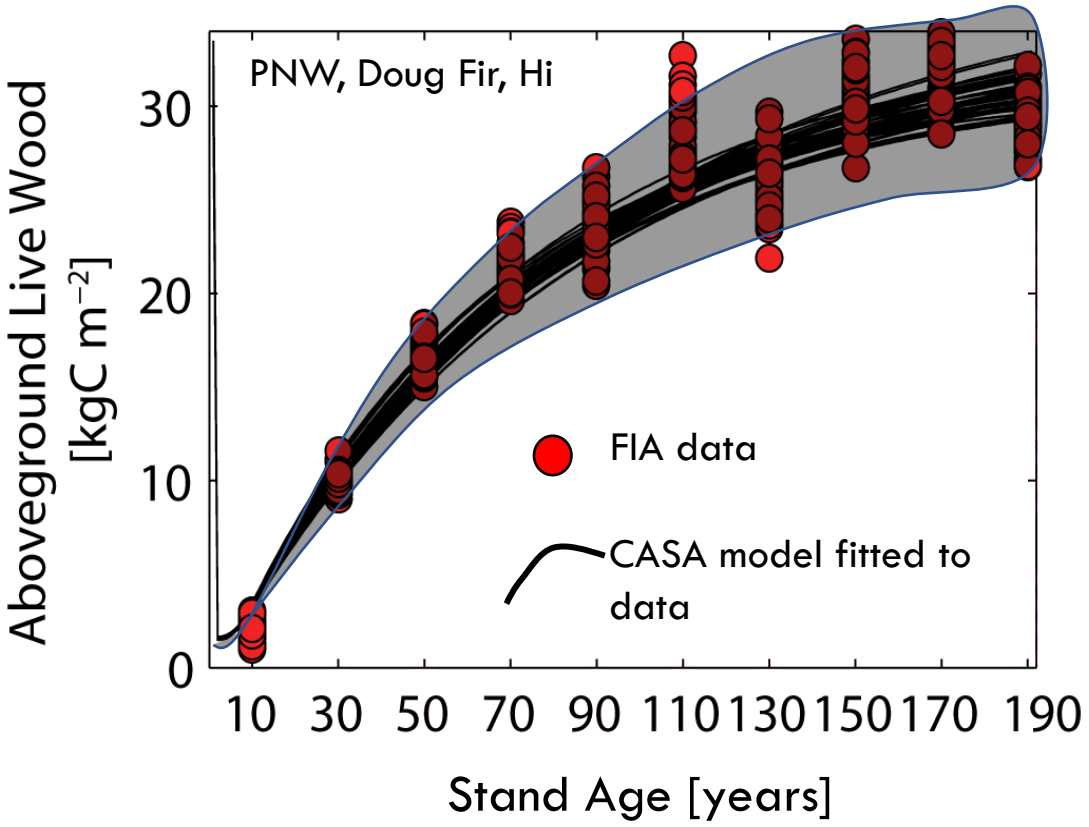


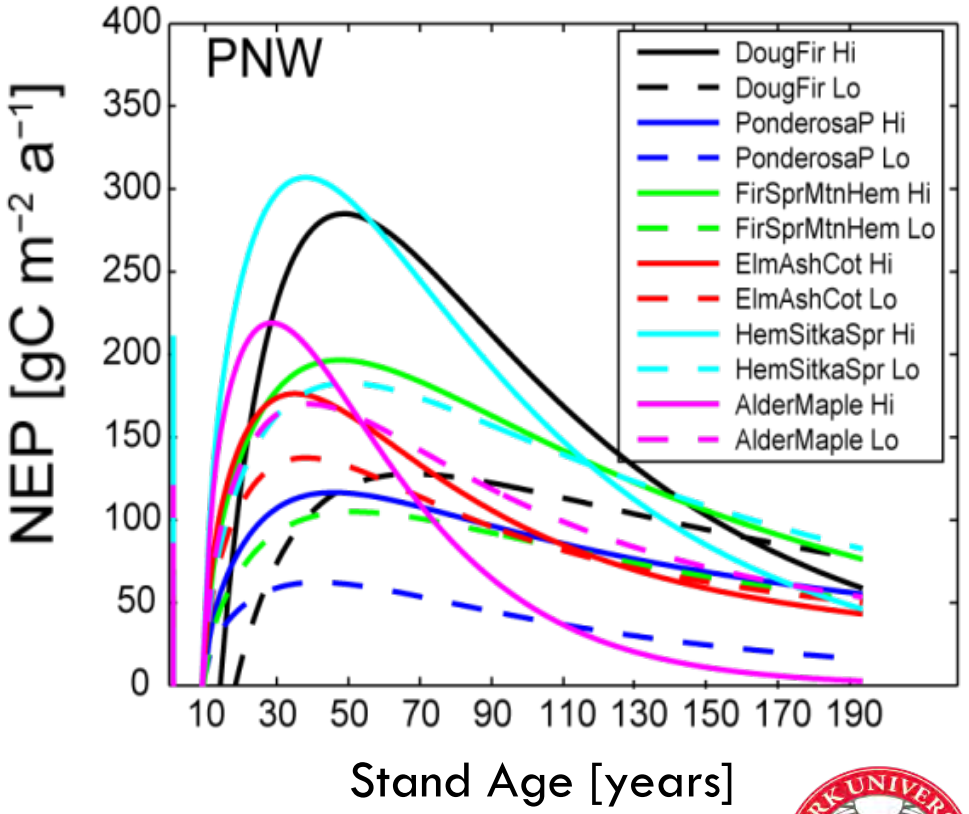
Christopher Williams
Clark University

Carbon Storage from FIA Yield Curves + Process Modelling

Accounts for Forest Type, Climate Setting, Site Fertility, Disturbance and Regrowth

Based on **FIA Yield Curves** to Constrain **C-Cycle Modeling**





Williams et al. (2012, 2014)

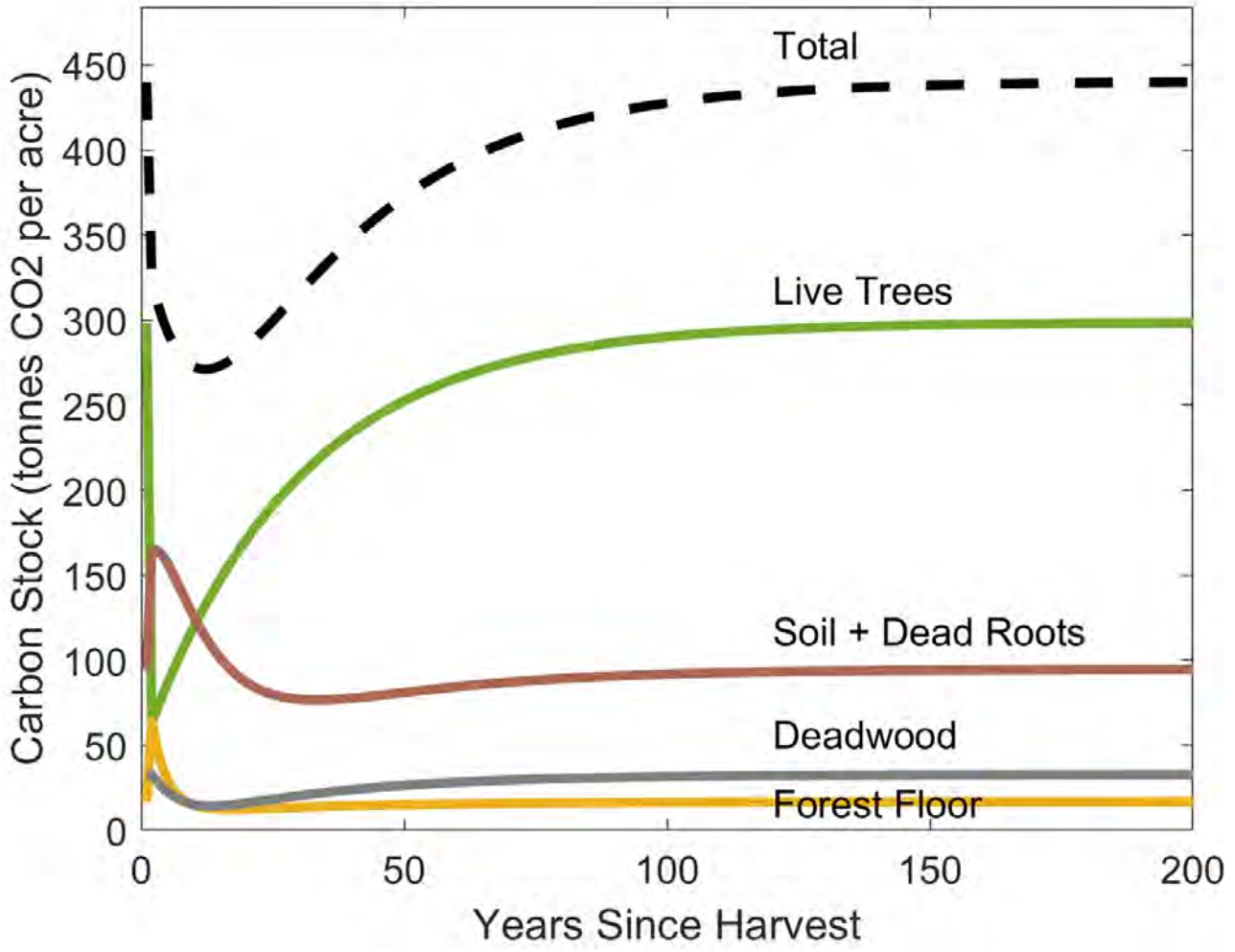
Tracking Forest Carbon Dynamics after Disturbance

Forests free of major disturbance **accumulate carbon stocks over time** during *secondary succession*.

Carbon accumulation **slows down as forests mature and develop** (at *stand-level*).

The **largest increases are in live biomass** with some in dead wood and litter as well.

Example: Post-Harvest

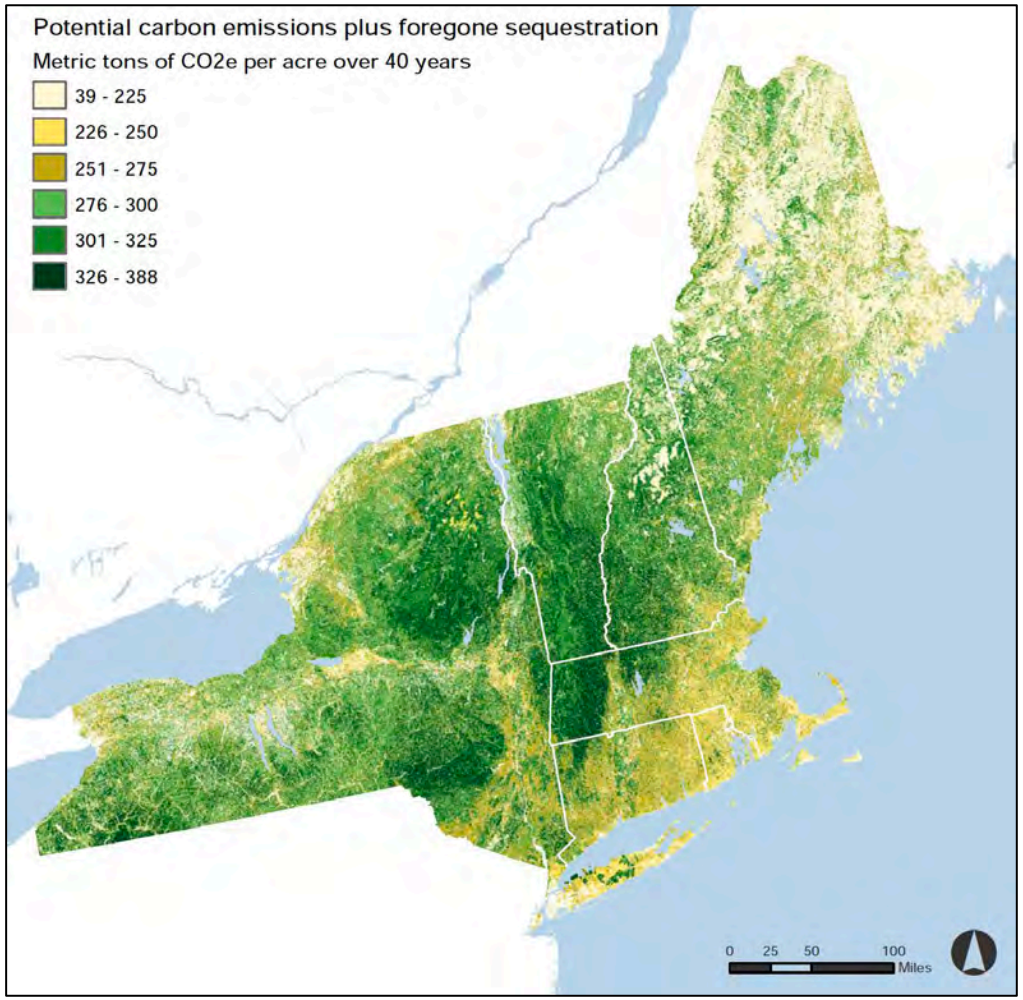


When we lose forests to other land uses, we emit stored carbon and lose out on future carbon sequestration

Carbon loss varies geographically depending on:

- initial biomass of the converted forest
- potential future biomass

We need to **keep track of emissions and foregone removals** (and more … albedo)

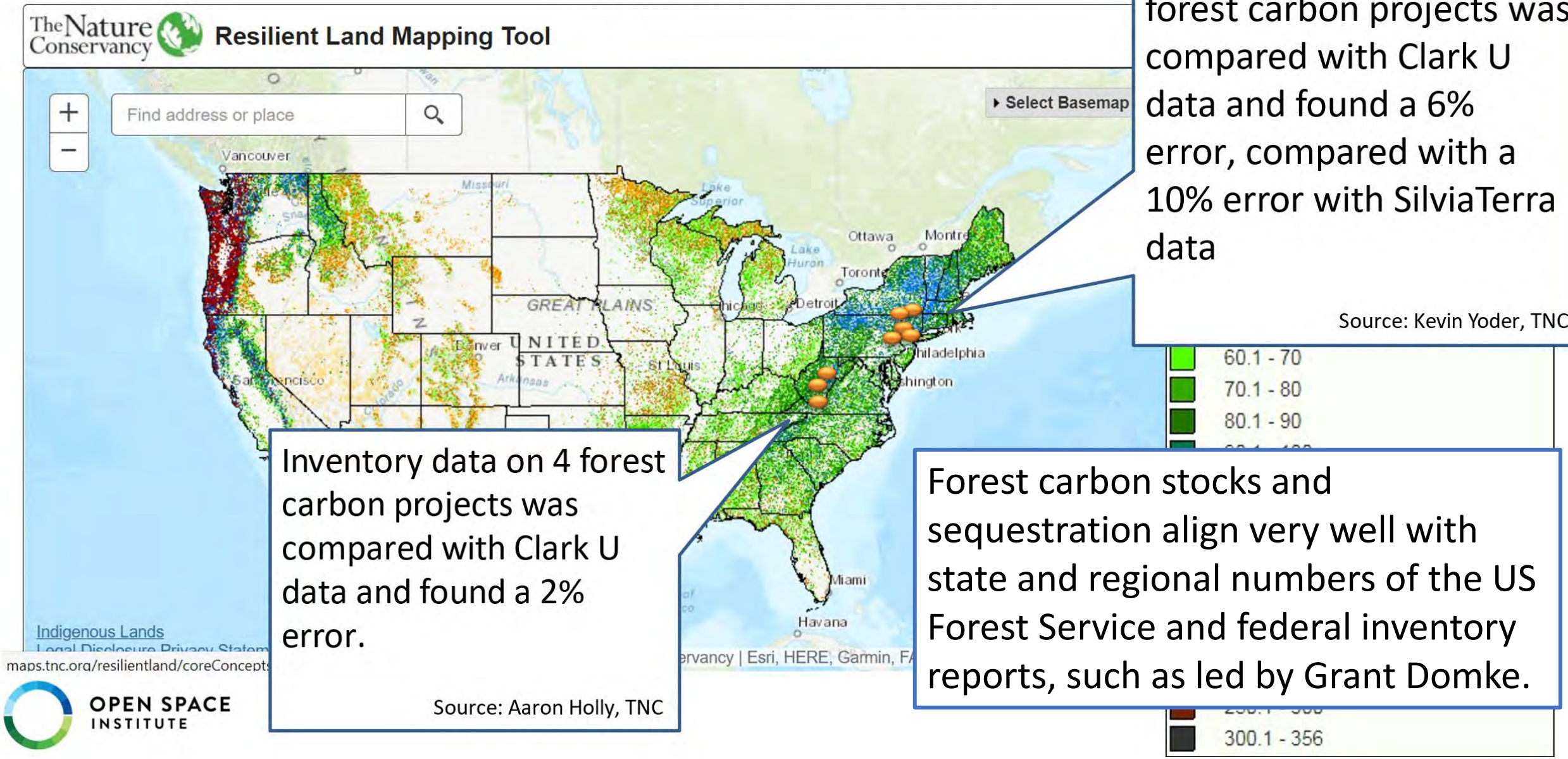


Source: Williams et al. (2021)

Application of Clark University Data

Forest Ecosystem Carbon 2010

Metric tons of carbon per acre



Inventory data on 12 forest carbon projects was compared with Clark U data and found a 6% error, compared with a 10% error with SilviaTerra data

Source: Kevin Yoder, TNC

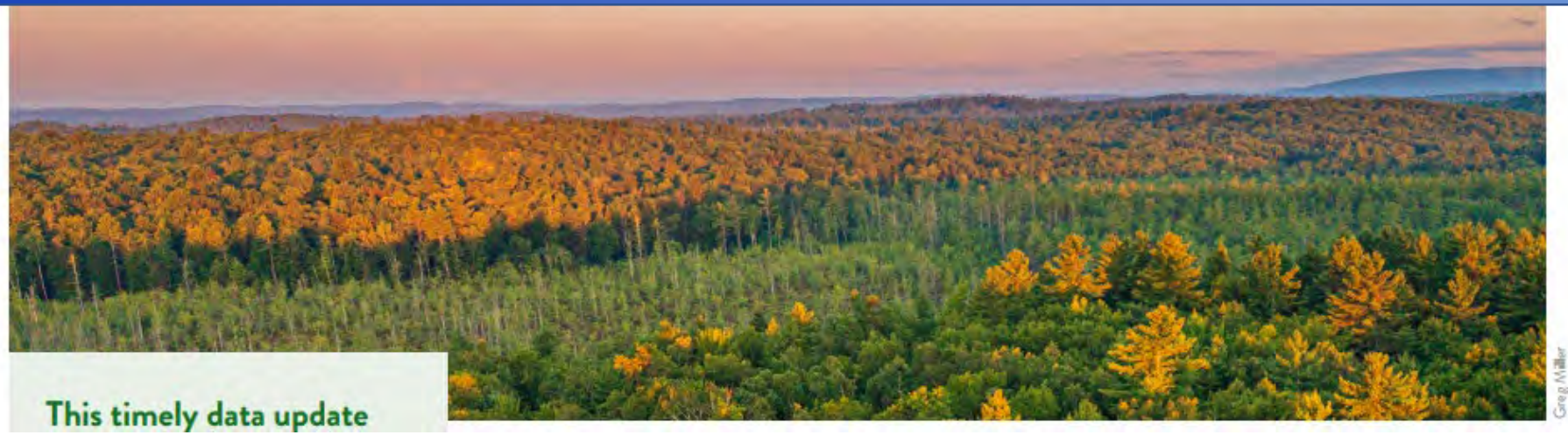
Inventory data on 4 forest carbon projects was compared with Clark U data and found a 2% error.

Source: Aaron Holly, TNC

Forest carbon stocks and sequestration align very well with state and regional numbers of the US Forest Service and federal inventory reports, such as led by Grant Domke.

OPEN SPACE INSTITUTE

Updates to support Climate Smart Conservation



This timely data update

- Collect end-user input to maximize utility to the field.
- Update forest carbon data from 2010 to recently released 2020 to accurately depict forest cover.
- Revise forest carbon projections for 2050.
- Develop tools that display this data and support effective decision making.
- Provide guidance and technical assistance for land conservation organizations to utilize the data.

How this is different from existing national tools

EXISTING

- Standing carbon from 2010 data
- No ongoing sequestration
- No albedo correction
- No ability to target places at the greatest risk of conversion
- No ability to compare CO_2 benefit per dollar spent on protection

PROPOSED

- Standing carbon from 2021 data
- Ongoing sequestration
- Albedo correction
- Estimate future risk of conversion, mapping losses, modeling land use change
- Find places with most CO_2 benefit per dollar spent

Advantages over other national datasets

Higher Resolution, Better Spatial Detail, Relevant for Parcels

- 30 m resolution is 1,000 times greater than 1 km x 1km
- 30 m resolution is 11 times greater than 1 ha

Includes Ongoing Sequestration

- Not just current, also future carbon stocks
- Limited disturbance scenario

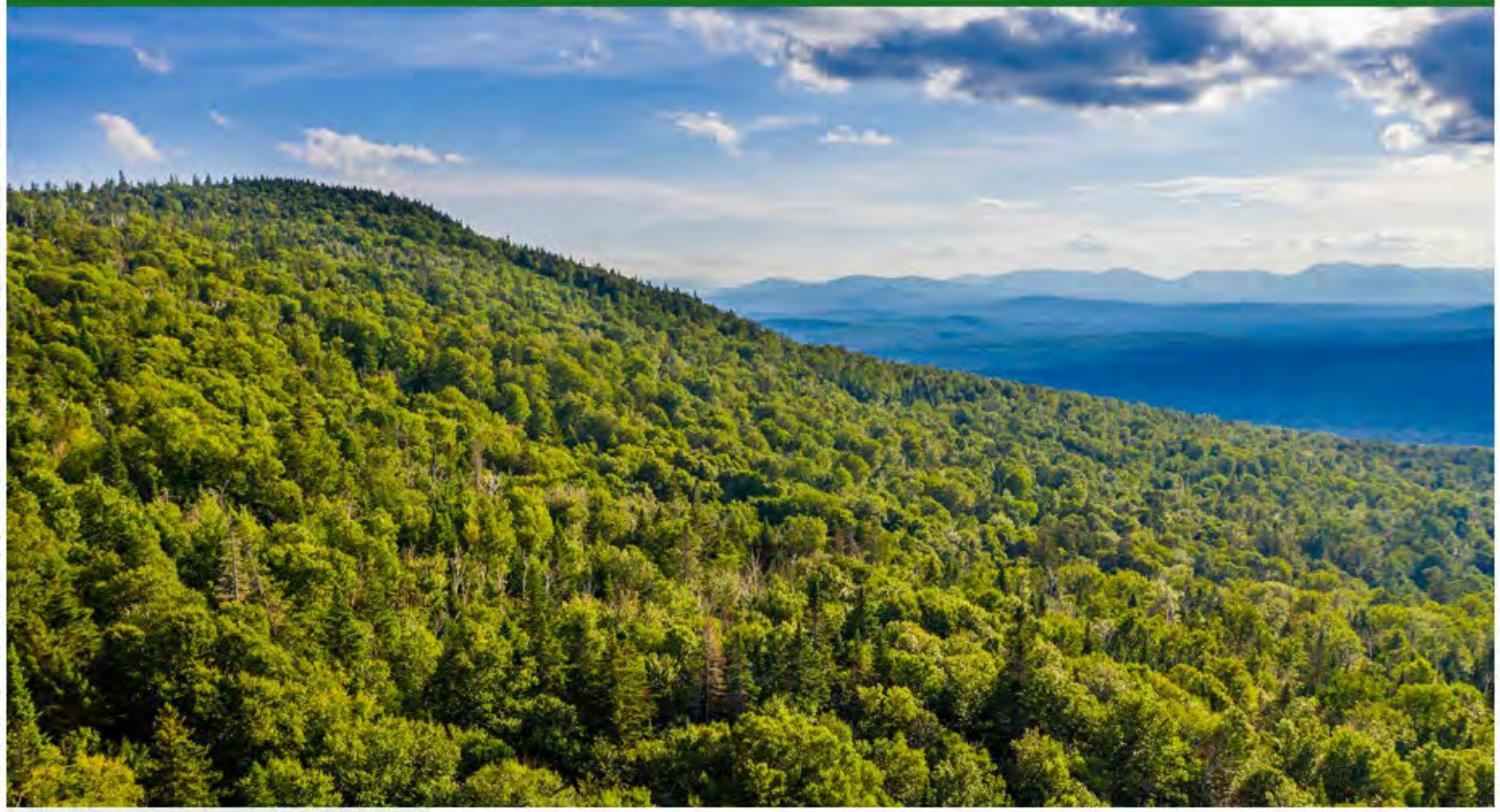
Freely Available and Served in Web-Mapping Tools

- Fly through the data, or point and click to get an analysis
- Upload parcel boundaries and get a report
- Request national or regional domains (large)

Our Findings in Use by Land Trusts and Conservation Orgs

OPEN SPACE INSTITUTE | The Nature Conservancy | TRUST FOR PUBLIC LAND | Land Trust Alliance — Together, conserving the places you love | American Forests

Targeting Conservation to Maximize Forest Carbon



Jerry Monkman

- A focus on forest carbon can simultaneously address the biodiversity crisis and support human communities.
- Land trusts and state and federal agencies are adopting climate science to guide land protection efforts, yet lack the resources to put this work into action.
- Coalition partners are advancing updates to and use of the National Forest Carbon Monitoring System (NFCMS) to ensure groups have the knowledge and tools for action at this critical moment.

Our Findings in Use by States

Our display of spatial patterns for carbon stocks and ongoing sequestration are elevating understanding

Assisting states with methods of forest carbon accounting in GHG inventories

Supporting estimates of the carbon opportunity for tree planting and forest expansion

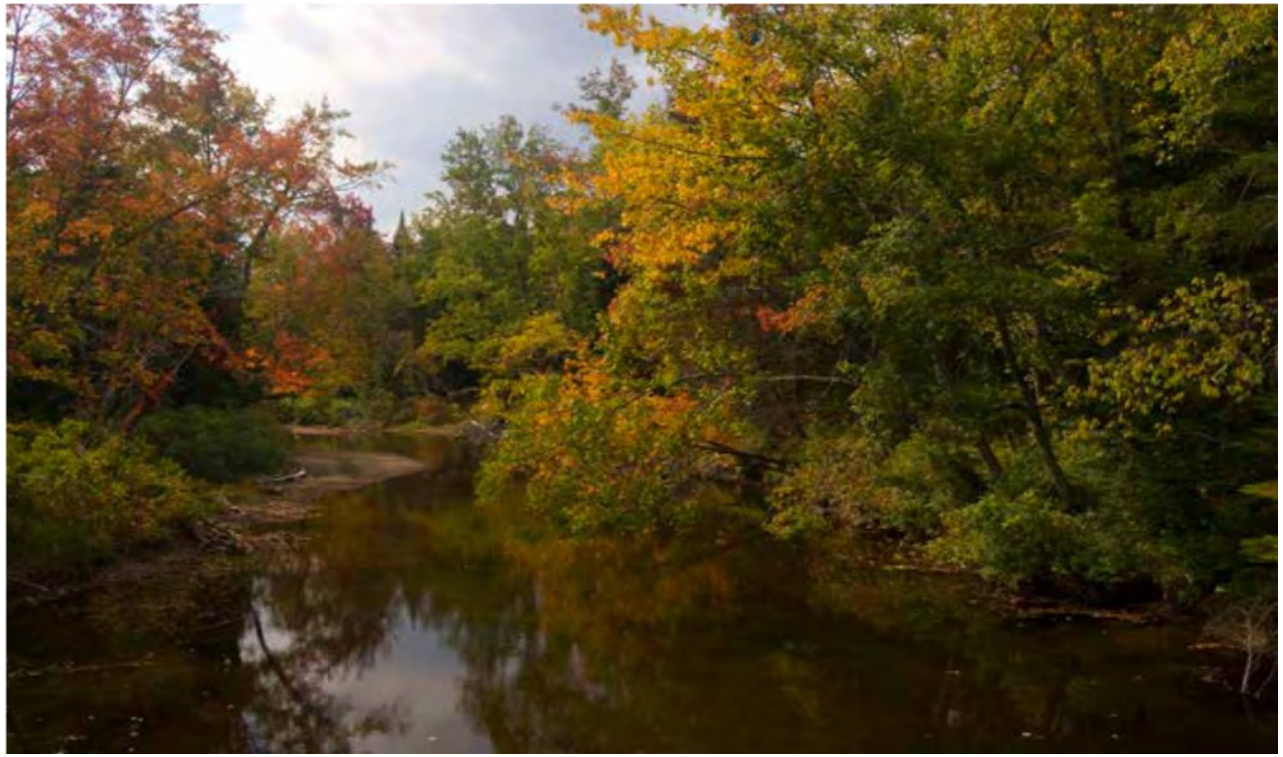


Photo Credit: © Mark Godfrey, TNC

Verifying state GHG reporting

Advising on the role forestlands might play in a roadmap to get to net zero

Scope for Decision Support

WELL-SUITED

- Current C stock assessment
- Future C stock with limited management & disturbance
- Climate mitigation value of forest conservation
- High carbon forests, referenced
- Parcel-level and regional looks
- Conversion risk

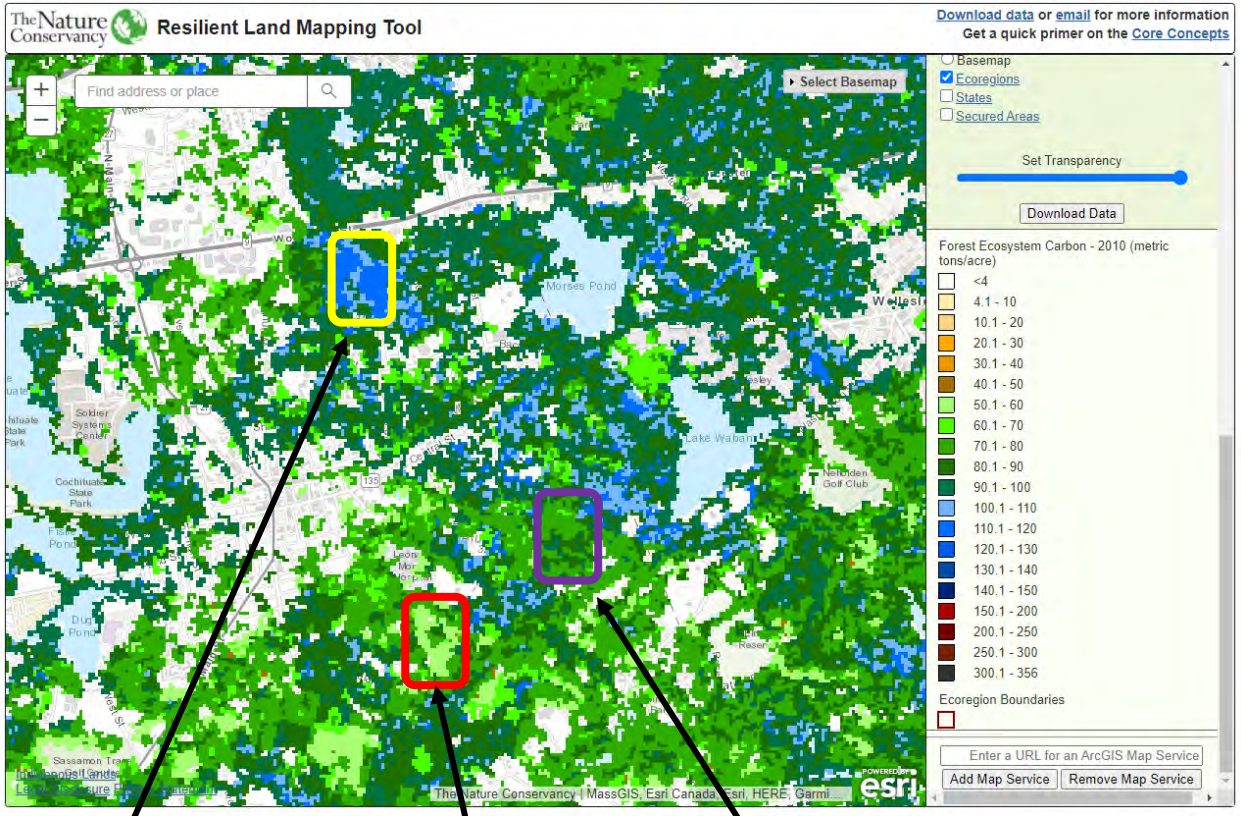
LESS WELL-SUITED

- Disturbance prone areas (partially in progress)
- Management scenarios (eager to build)

Forest Carbon Data on the TNC Resilient Land Mapping Tool

https://maps.tnc.org/resilientland/

Forest Ecosystem Carbon in 2010

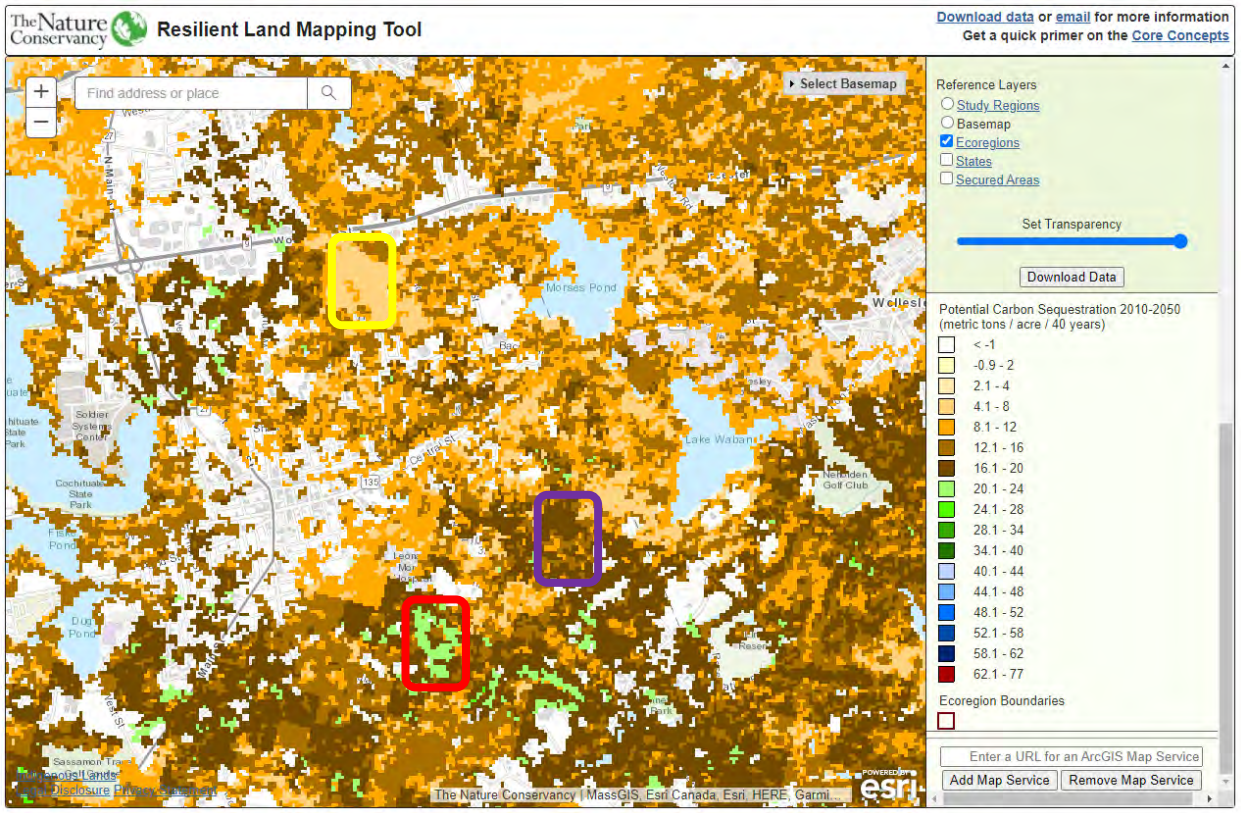


high carbon, mature stand

very low carbon likely non-forest

low carbon, young stand

Forest Carbon Sequestration Expected Over 40 Years from 2010 to 2050



Natick, MA

Forest Carbon Data on the TPL Conservation Carbon Map Tool

TRUST FOR PUBLIC LAND™

Conservation Carbon Map

Developed by the *Land and People Lab* at the Trust for Public Land, the Conservation Carbon Map helps pinpoint and then quantify at the state, county, watershed, and parcel scale where conservation is needed to protect carbon-rich forested landscapes. This tool is publicly available and free to use: https://web.tplgis.org/carbonmap/.

Answering three key questions:

The Conservation Carbon Map helps users answer three key questions:

1. Where are existing forest carbon stocks and areas with high annual carbon sequestration rates?
2. What and where are the threats to these carbon-rich landscapes from development, insects and disease, and wildfire risk?
3. Where can climate conservation also provide multiple co-benefits by protecting drinking water supplies, rare ecosystems, and important habitat cores?

Datasets and Reports are Freely Available

- **NFCMS** – National Forest Carbon Monitoring System: https://doi.org/10.3334/ORNLDAAC/1829
- **Forest Carbon Data** on the TNC Resilient Land Mapping Tool: https://maps.tnc.org/resilientland/
- **Report on Avoided Deforestation**: https://tnc.app.box.com/s/apncszy7yrsknlk0hix9n2bt7n6n3f9k

Web Tool: Carbon Benefits of Avoided Deforestation

The Nature Conservancy

Joe Fargione, Director of Science, North America Region

February 27, 2024

The new data allows us to:

- **For conterminous US, map and quantify effect of protection on:**
  - **Storing additional carbon per acre**
  - **Storing additional carbon per dollar spent on protection**

What’s new?

- More up-to-date data
- Future sequestration (not just what carbon is already there)
- Which places most need protection (because of risk of conversion)
- Albedo correction (at high resolution)
- Cost effectiveness (considering land cost)

Why a new tool?

- New elements can be used to target protection to the places that have the most climate benefit

(just looking at standing carbon without ongoing sequestration, risk of loss, or albedo correction won’t maximize climate benefit)

Users

- Land Trusts and other NGOs targeting protection efforts
- Agency staff, e.g., those working with forest legacy funds

Use cases

1. Quantify climate benefit of protection of specific parcels
2. Identify areas with higher climate benefit
3. Identify areas with cost-effective climate benefit
4. Identify areas of both high biodiversity and high climate benefit

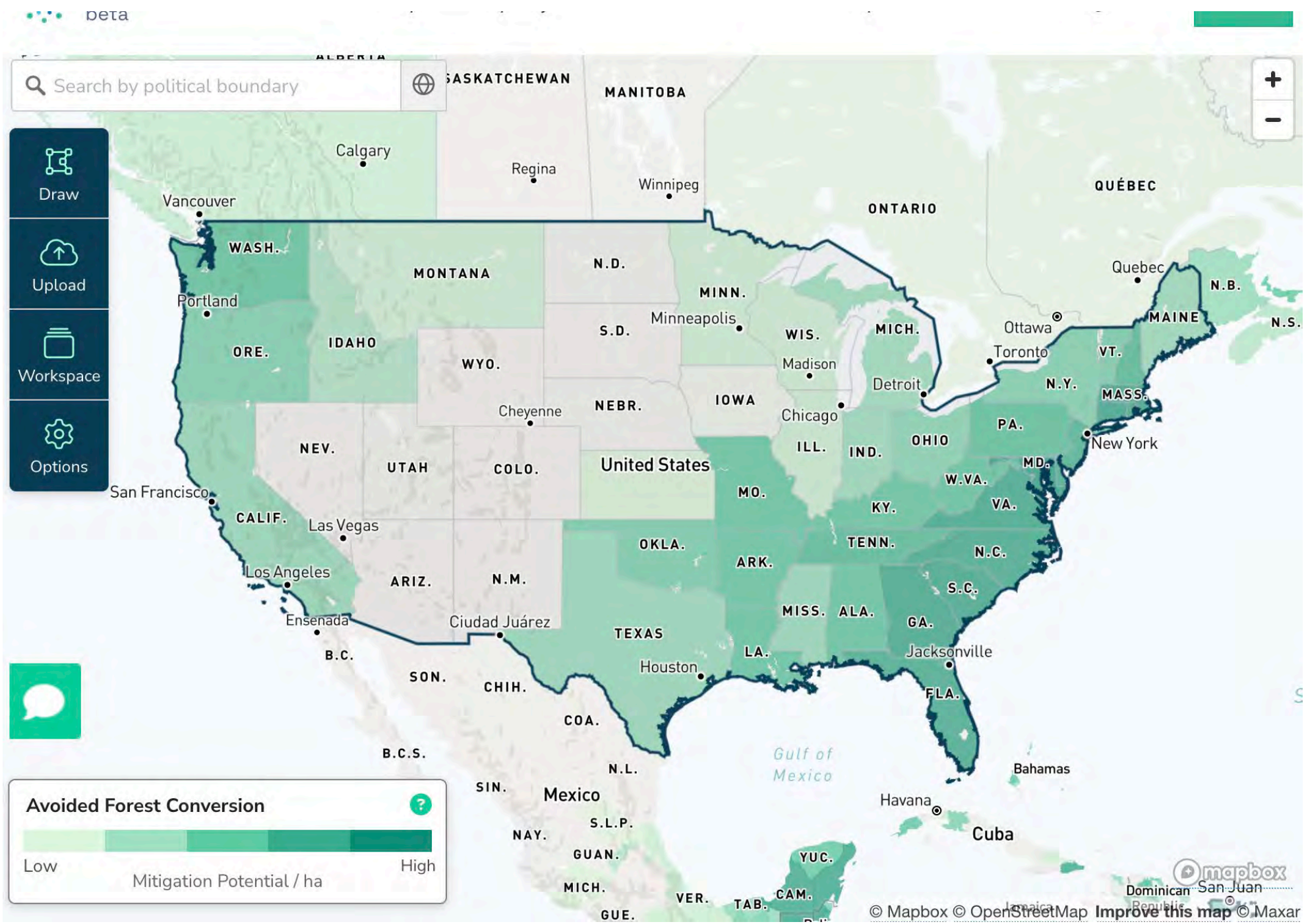
Use cases

1. Quantify climate benefit of protection of specific parcels
2. Identify areas with higher climate benefit
3. Identify areas with cost-effective climate benefit
4. Identify areas of both high biodiversity and high climate benefit

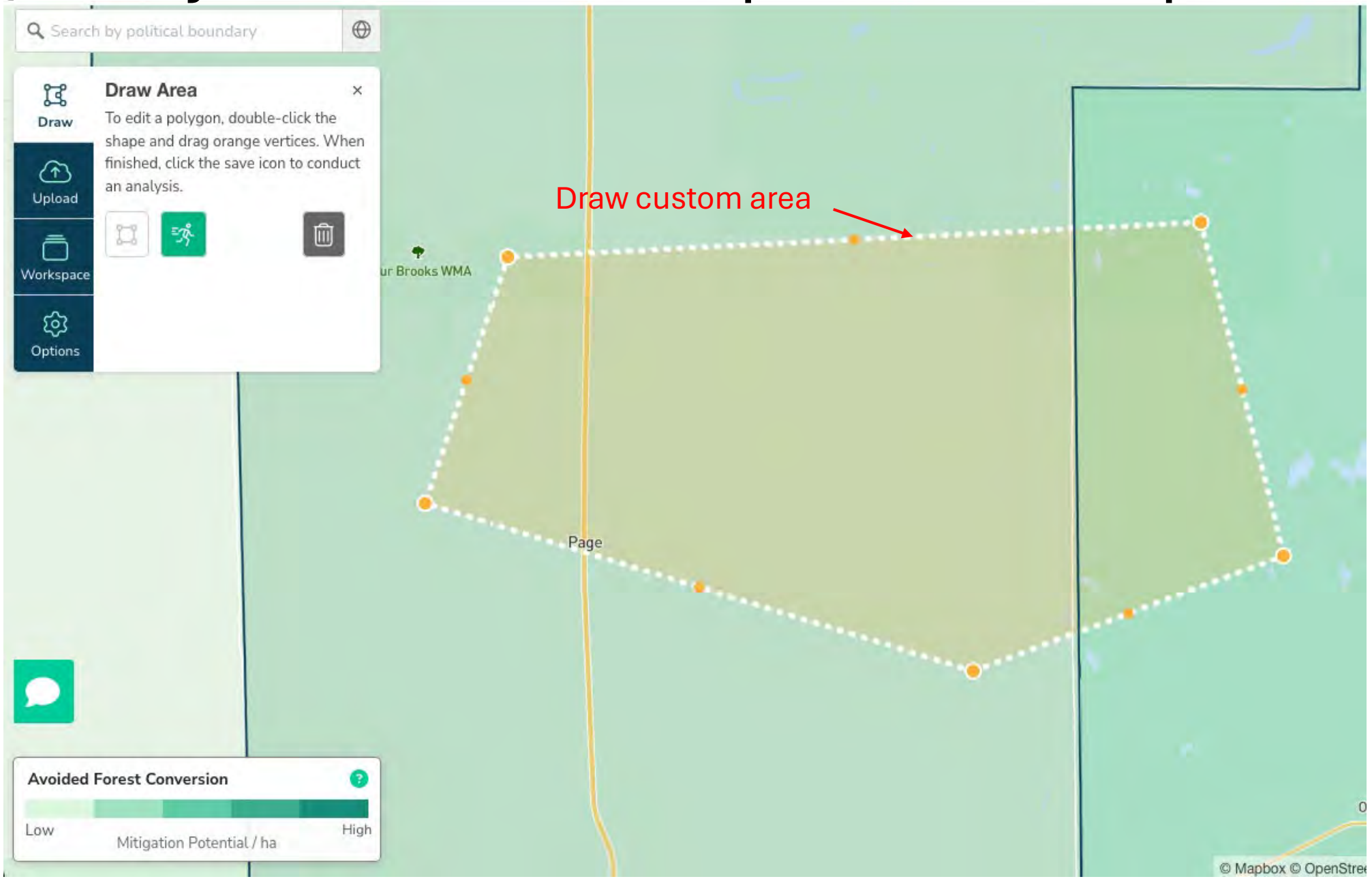
Satisfy donors!

Use cases

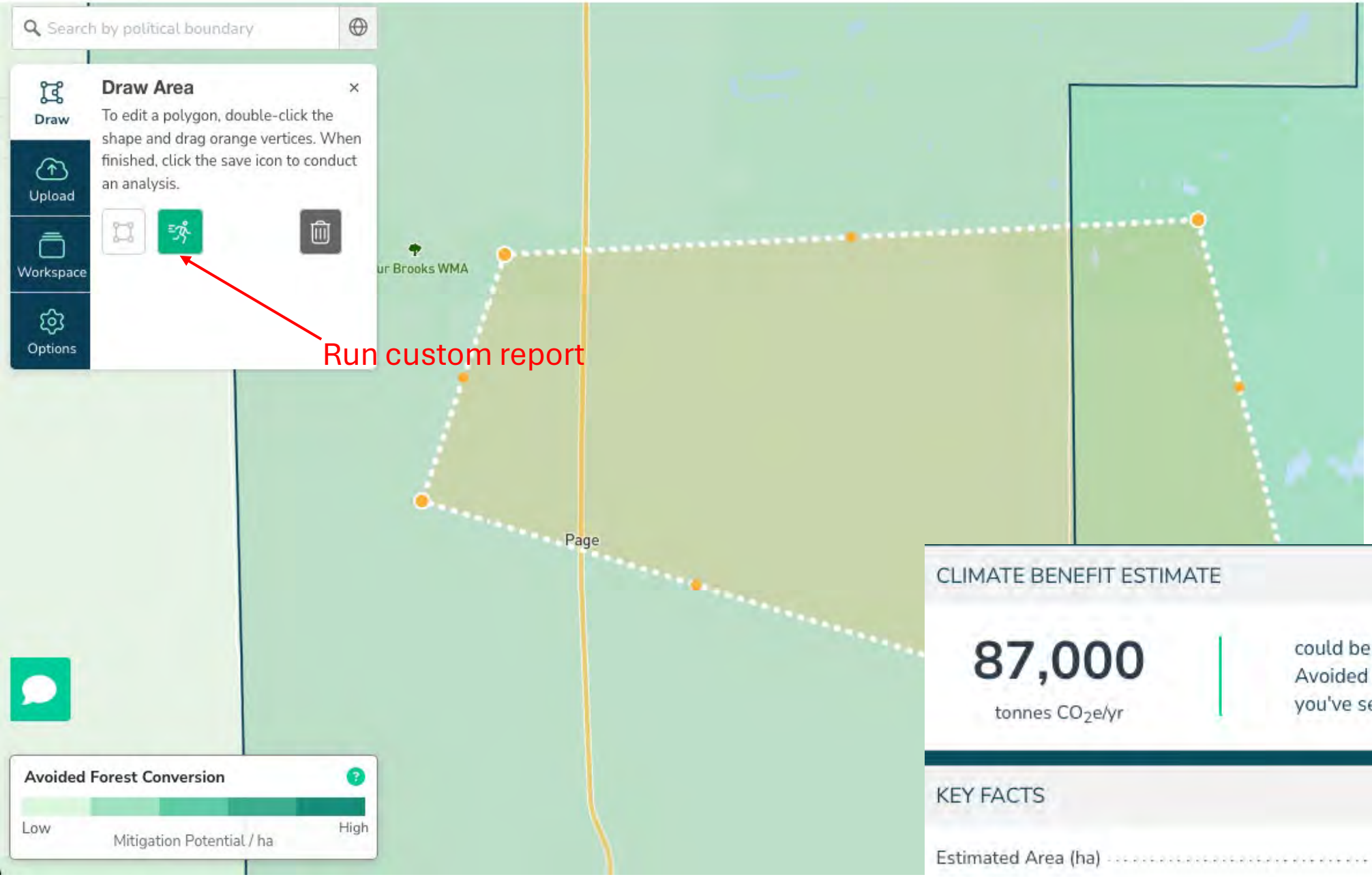
1. Quantify climate benefit of protection of specific parcels
2. Identify areas with higher climate benefit
3. Identify areas with cost-effective climate benefit
4. Identify areas of both high biodiversity and high climate benefit
5. Others? (tell us your ideas for how you would use this!)


beta
Search by political boundary
Draw
Upload
Workspace
Options
Avoided Forest Conversion
Low
High
Mitigation Potential / ha
Calgary
Regina
Winnipeg
Vancouver
Portland
Minneapolis
Quebec
Ottawa
Toronto
Madison
Detroit
Chicago
Cheyenne
New York
San Francisco
Las Vegas
Los Angeles
Ensenada
Ciudad Juárez
Houston
Jacksonville
Gulf of Mexico
Bahamas
Havana
Cuba
Mexico
United States
WASH.
ORE.
CALIF.
NEV.
IDAHO
MONTANA
WYO.
UTAH
COLO.
ARIZ.
N.M.
N.D.
S.D.
NEBR.
KANS.
OKLA.
TEXAS
MINN.
IOWA
MO.
ARK.
LA.
WIS.
ILL.
MICH.
IND.
OHIO
KY.
TENN.
MISS.
ALA.
GA.
FLA.
S.C.
N.C.
VA.
W.VA.
PA.
N.Y.
MD.
MASS.
VT.
MAINE
N.B.
N.S.
ONTARIO
QUÉBEC
MANITOBA
SASKATCHEWAN
ALBERTA
B.C.
B.C.S.
SON.
CHIH.
COA.
N.L.
SIN.
NAY.
S.L.P.
GUAN.
MICH.
GUE.
VER.
TAB.
CAM.
YUC.
© Mapbox © OpenStreetMap Improve this map © Maxar

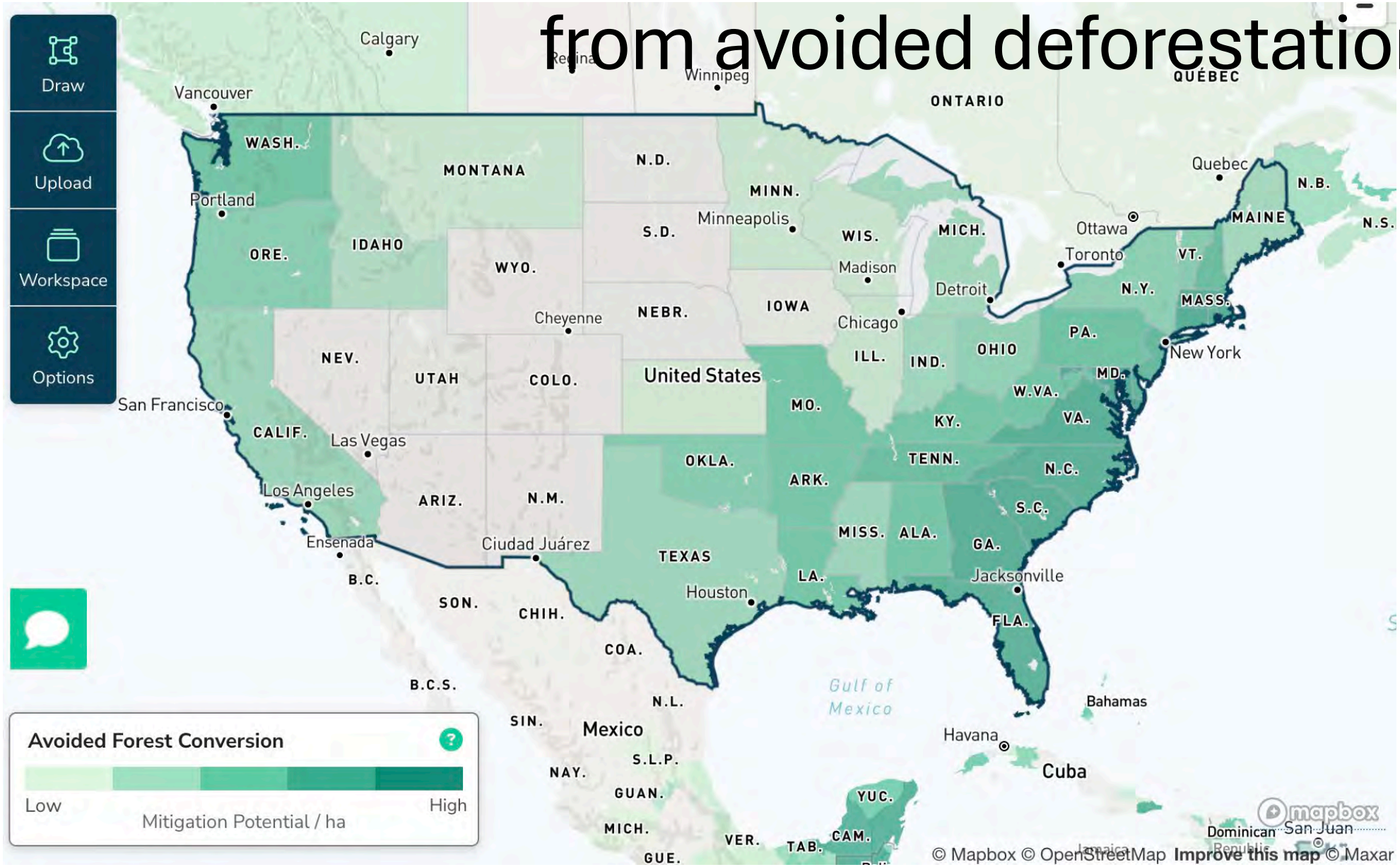
1. Quantify carbon benefit of protection of specific parcels

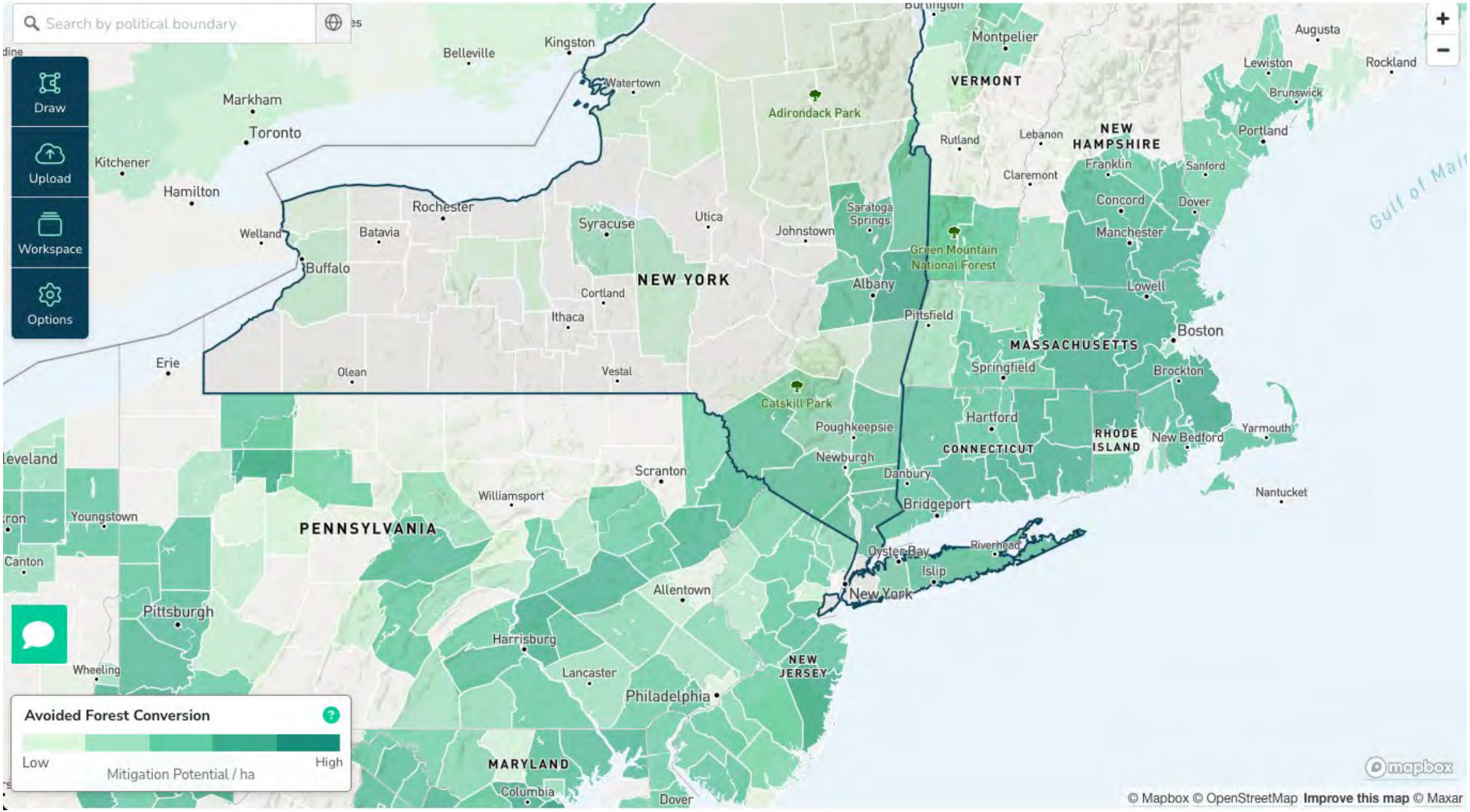


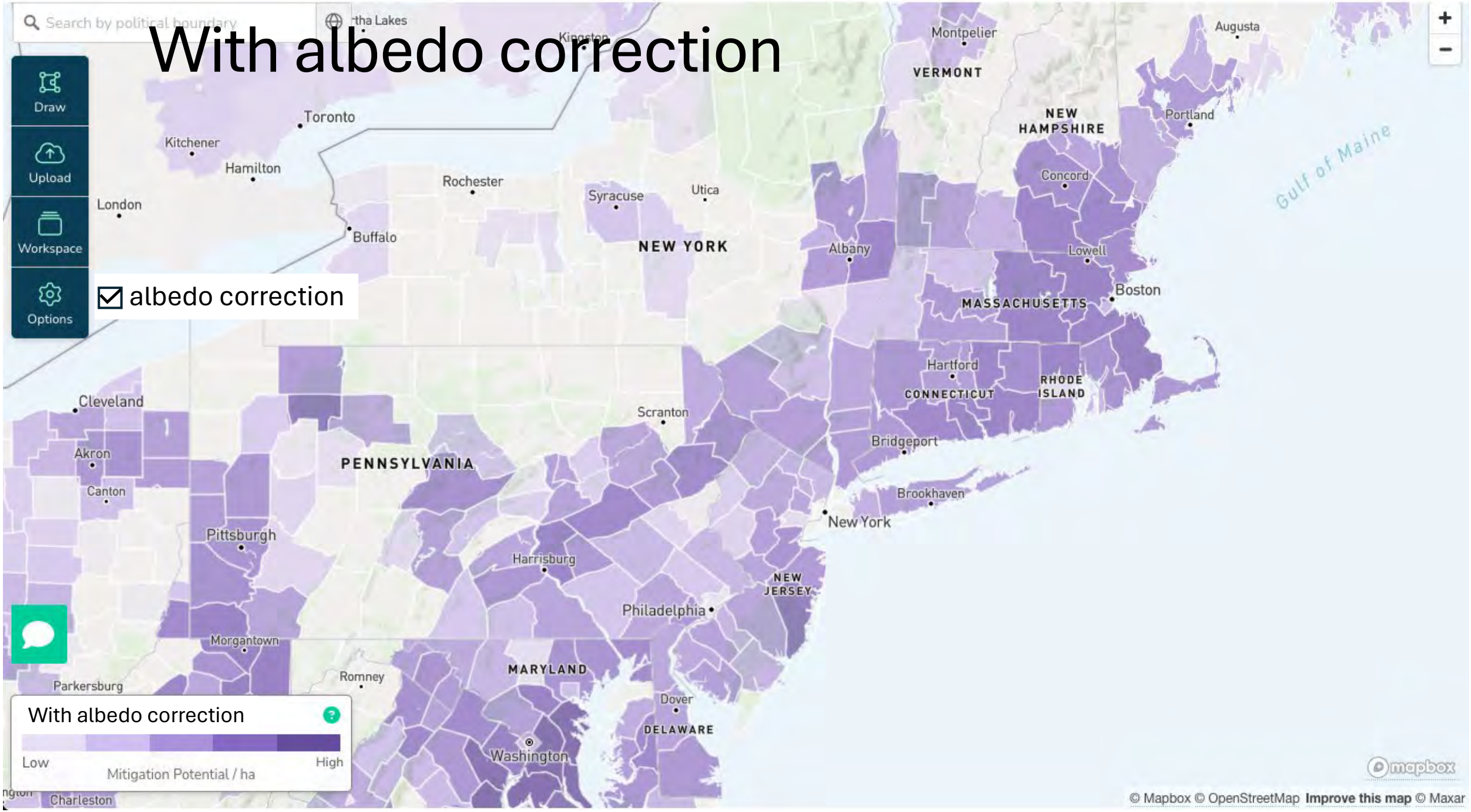
1. Quantify carbon benefit of protection of specific parcels



2. Identify areas with higher carbon benefit from avoided deforestation

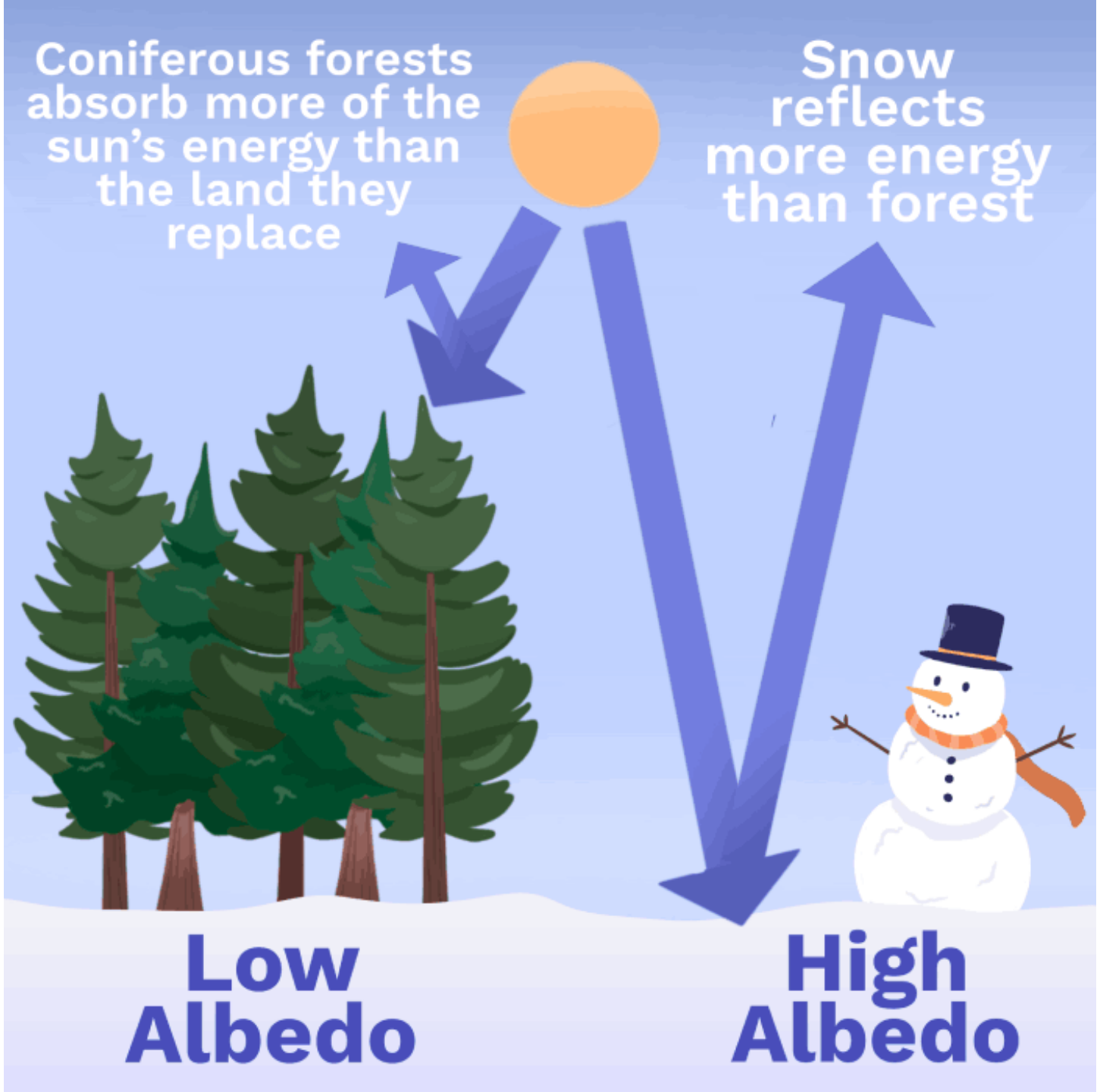



Search by political boundary
Draw
Upload
Workspace
Options
Avoided Forest Conversion
Low
High
Mitigation Potential / ha
Montpelier
VERMONT
Augusta
Lewiston
Rockland
Brunswick
Portland
Adirondack Park
Rutland
Lebanon
NEW HAMPSHIRE
Franklin
Sanford
Claremont
Concord
Dover
Manchester
Saratoga Springs
Green Mountain National Forest
Johnstown
Albany
Lowell
Pittsfield
Boston
MASSACHUSETTS
Springfield
Brockton
Hartford
RHODE ISLAND
New Bedford
Yarmouth
CONNECTICUT
Nantucket
Newburgh
Danbury
Bridgeport
Poughkeepsie
Catskill Park
Oyster Bay
Riverhead
Islip
New York
Kingston
Belleville
Watertown
Markham
Toronto
Kitchener
Hamilton
Rochester
Welland
Batavia
Buffalo
Syracuse
Utica
NEW YORK
Cortland
Ithaca
Olean
Vestal
Erie
Scranton
Williamsport
PENNSYLVANIA
Youngstown
Canton
Pittsburgh
Wheeling
Allentown
Harrisburg
Lancaster
Philadelphia
NEW JERSEY
MARYLAND
Columbia
Dover
Gulf of Maine
© Mapbox © OpenStreetMap Improve this map © Maxar


With albedo correction
Search by political boundary
Draw
Upload
Workspace
Options
albedo correction
Toronto
Kitchener
Hamilton
London
Buffalo
Rochester
Syracuse
Utica
NEW YORK
Montpelier
VERMONT
Augusta
NEW HAMPSHIRE
Portland
Concord
Gulf of Maine
Albany
Lowell
Boston
MASSACHUSETTS
Hartford
CONNECTICUT
RHODE ISLAND
Cleveland
Akron
Canton
Scranton
PENNSYLVANIA
Bridgeport
Brookhaven
New York
Pittsburgh
Harrisburg
NEW JERSEY
Philadelphia
Morgantown
Parkersburg
Romney
MARYLAND
Dover
DELAWARE
Washington
Charleston
With albedo correction
Low
High
Mitigation Potential / ha
mapbox
© Mapbox © OpenStreetMap Improve this map © Maxar

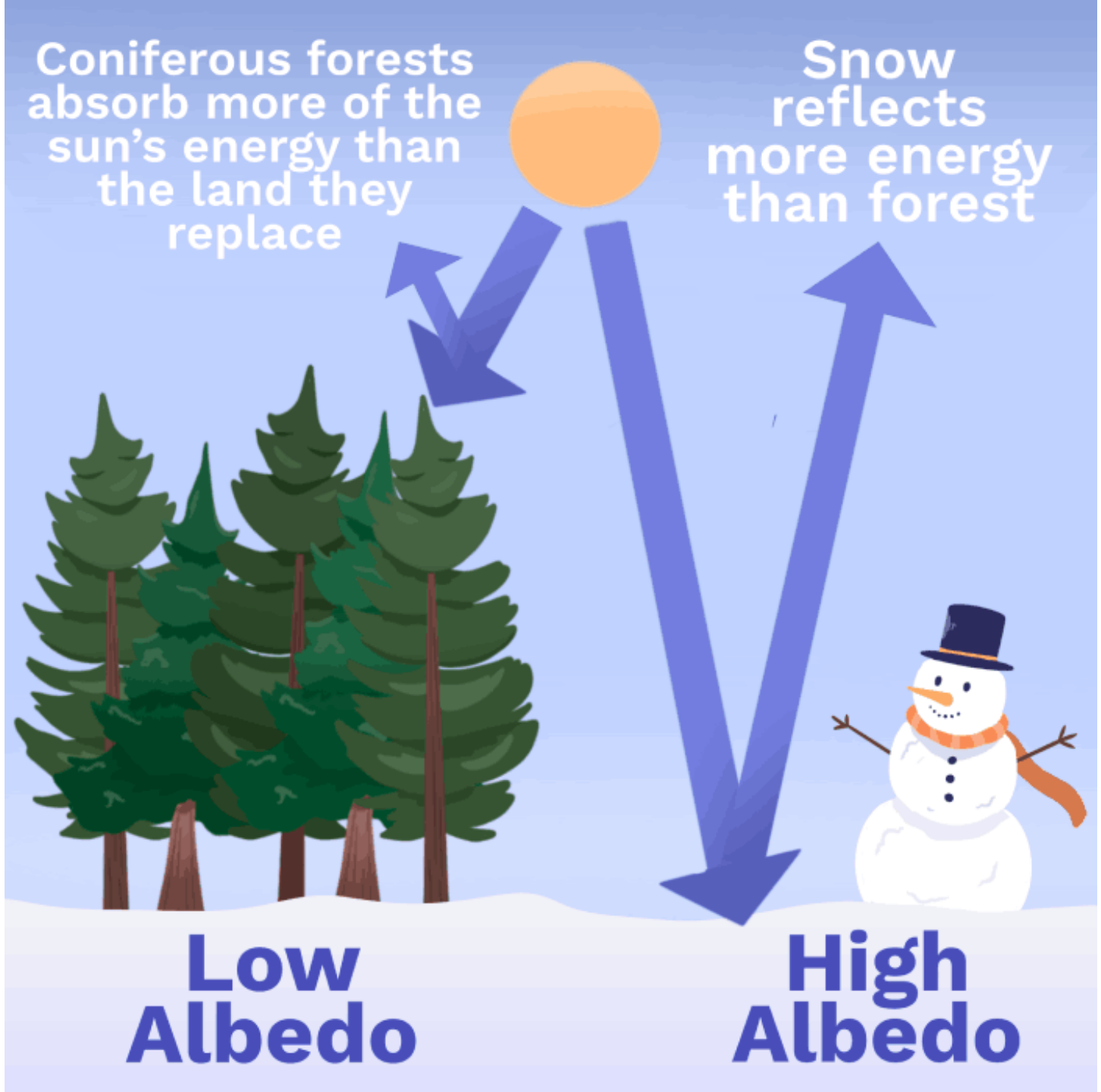
albedo explained

Albedo explained



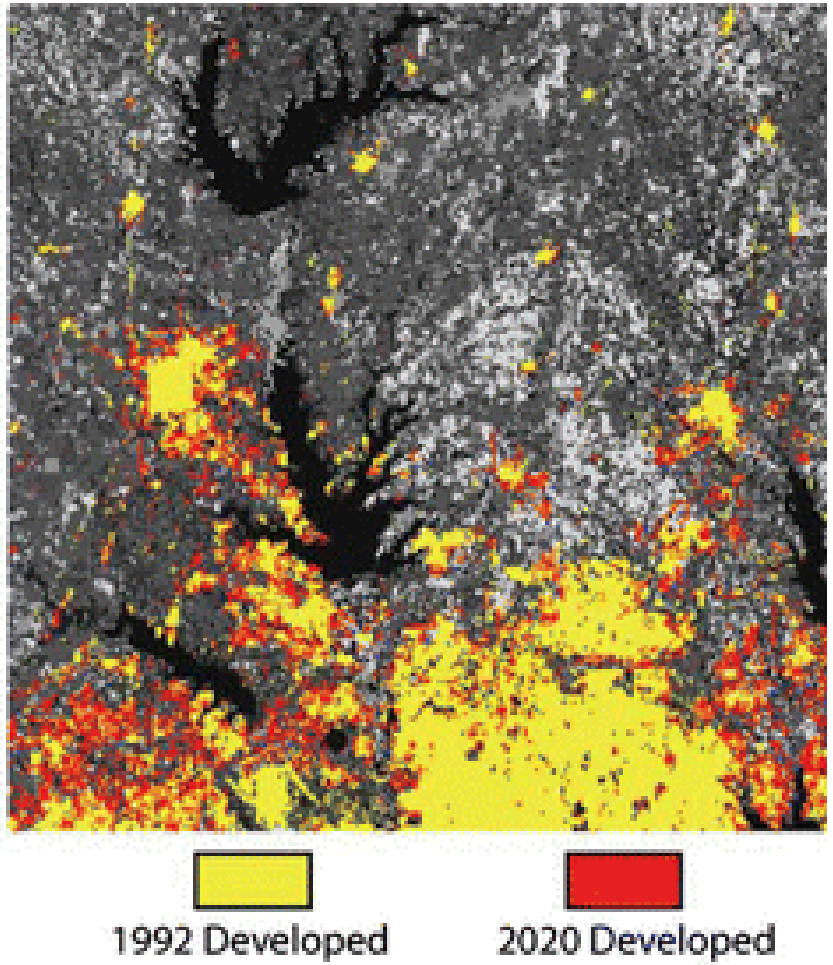
Albedo explained

Lower net climate benefit of forest protection in places with snow cover much of the year, especially if the forest is coniferous



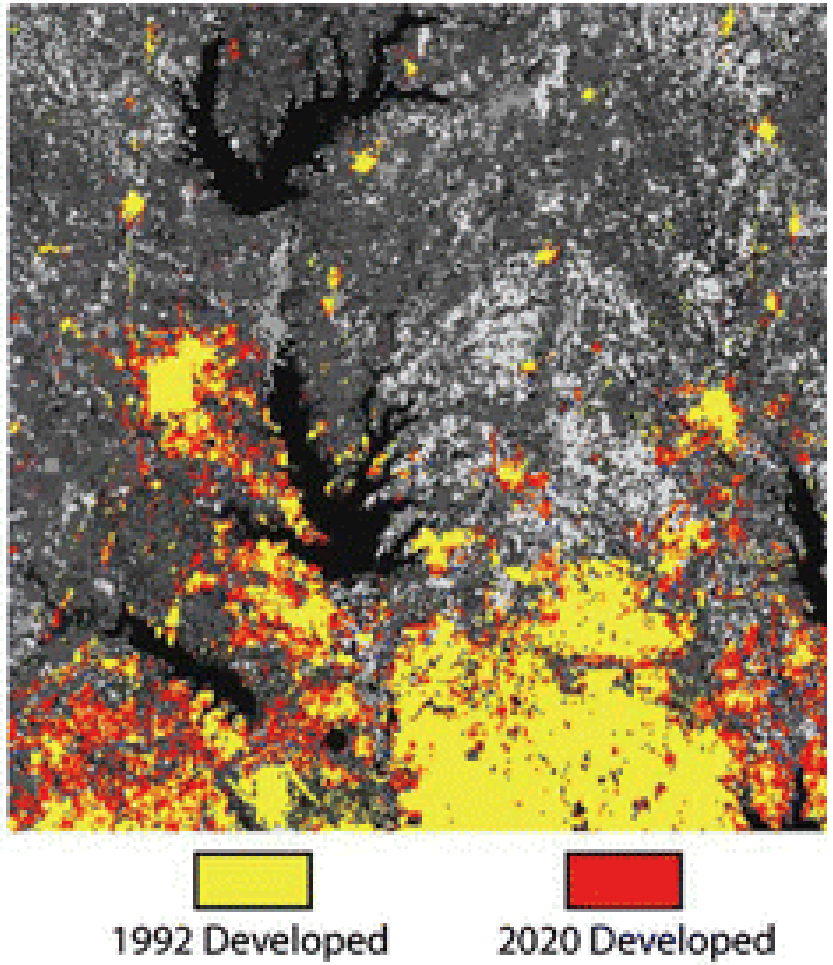
Risk of conversion

Historic observations

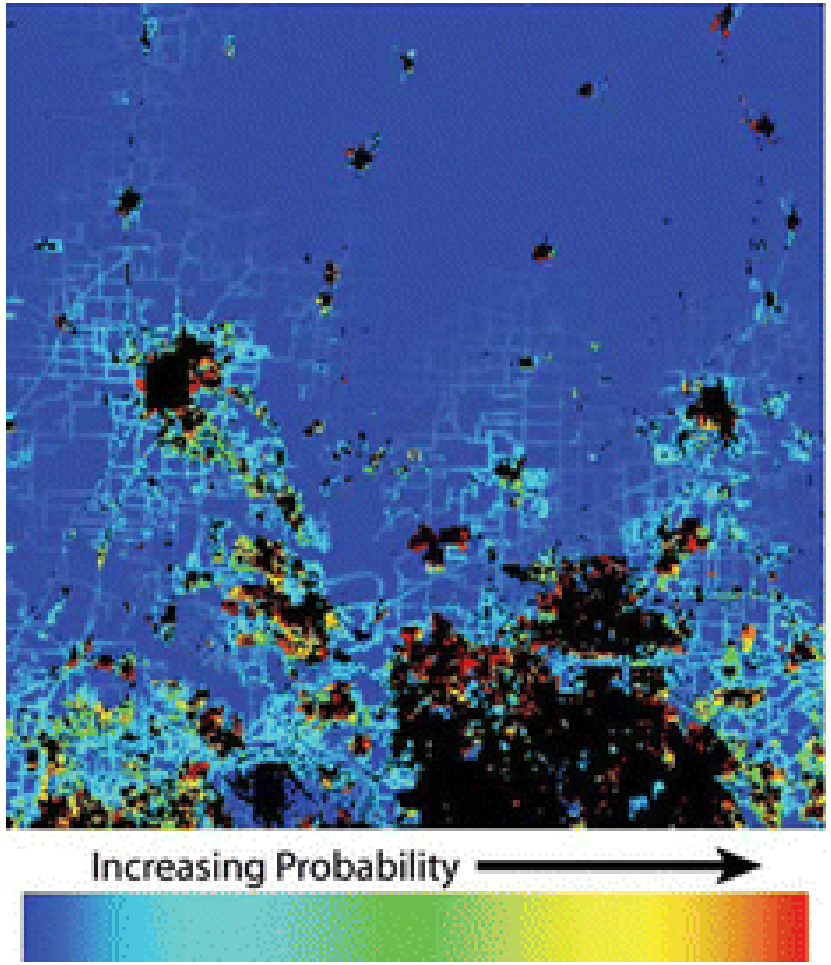


Risk of conversion

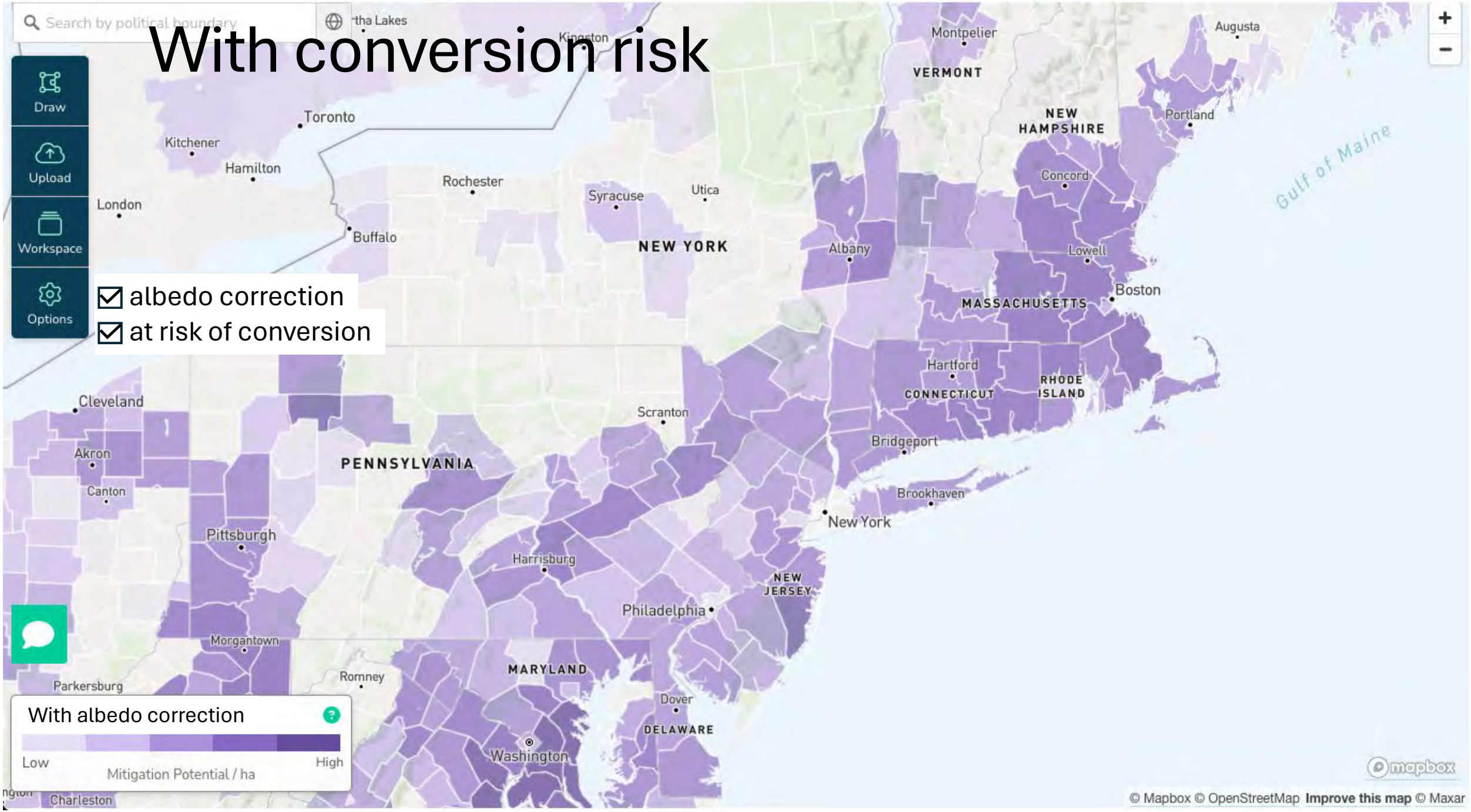
Historic observations



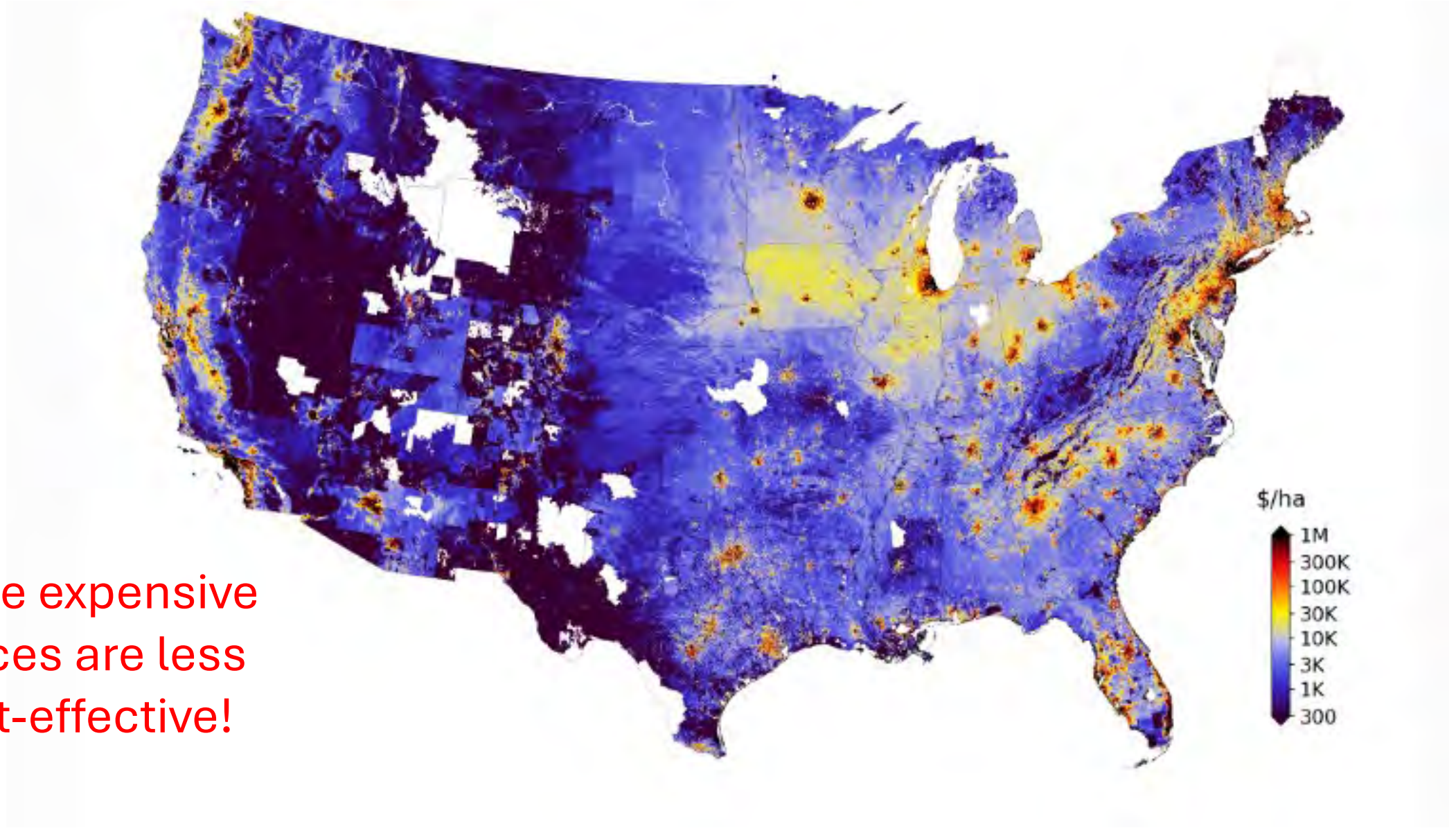
Modeled future risk



With conversion risk

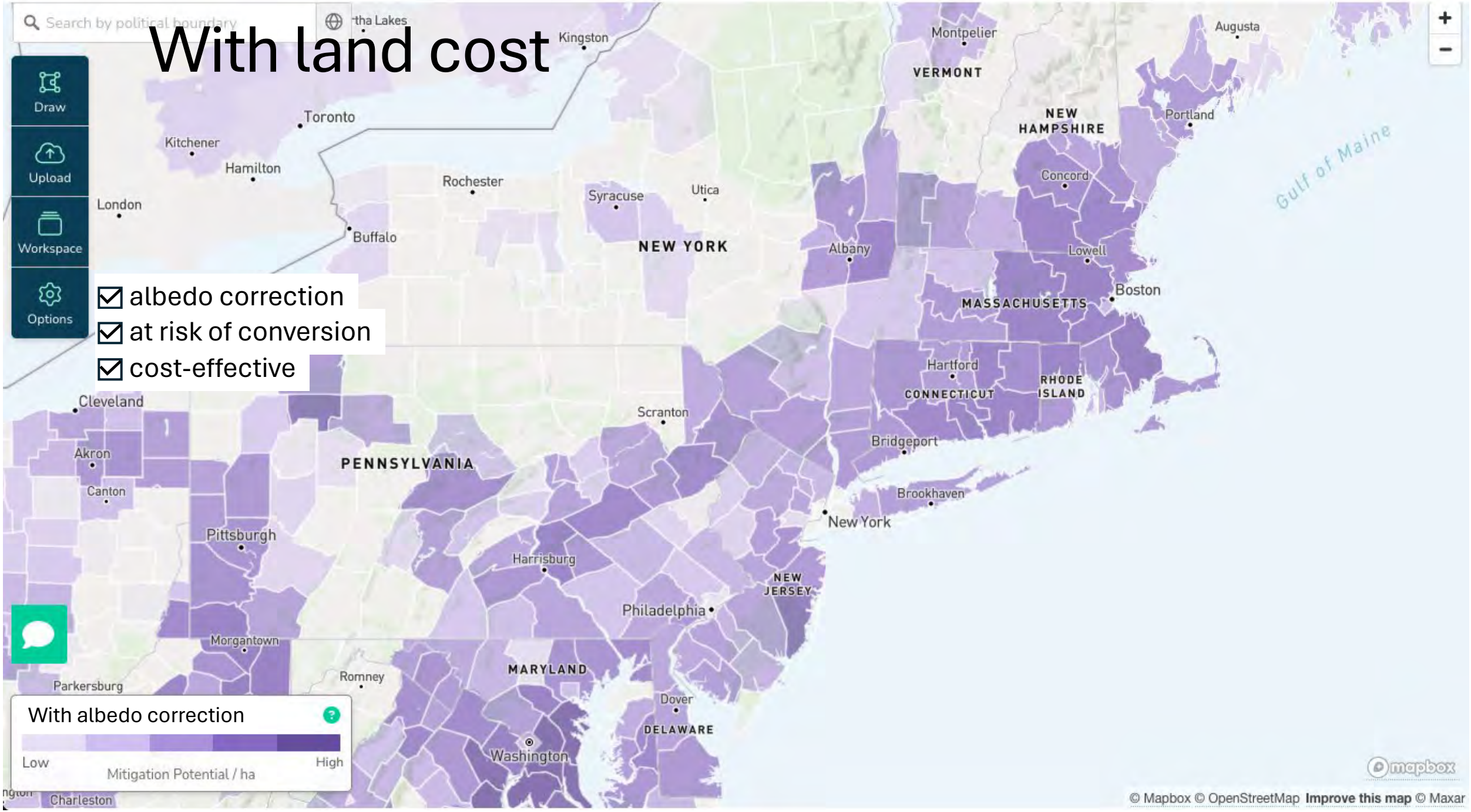


3. Identify areas with cost-effective climate benefit

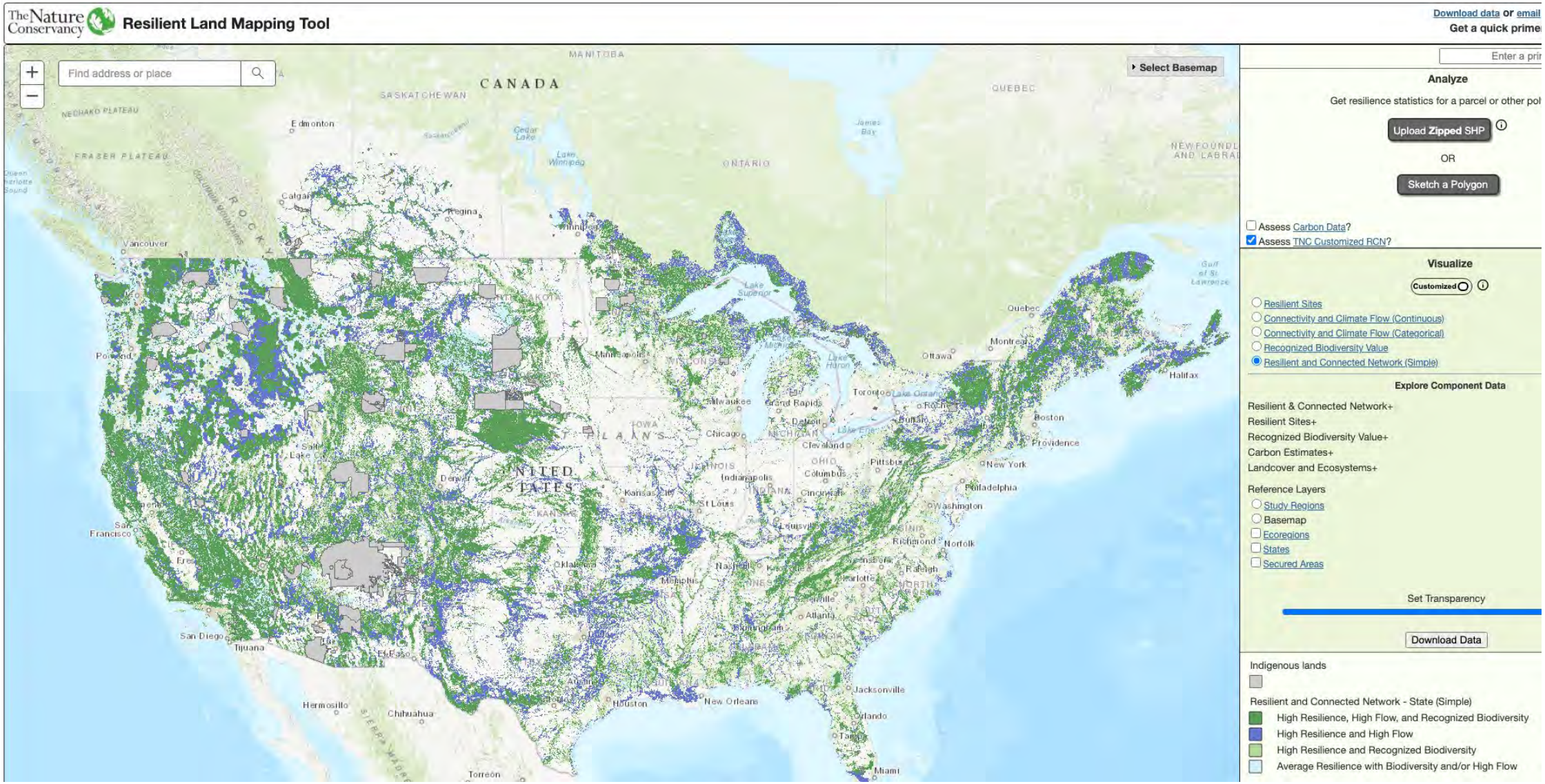


More expensive places are less cost-effective!

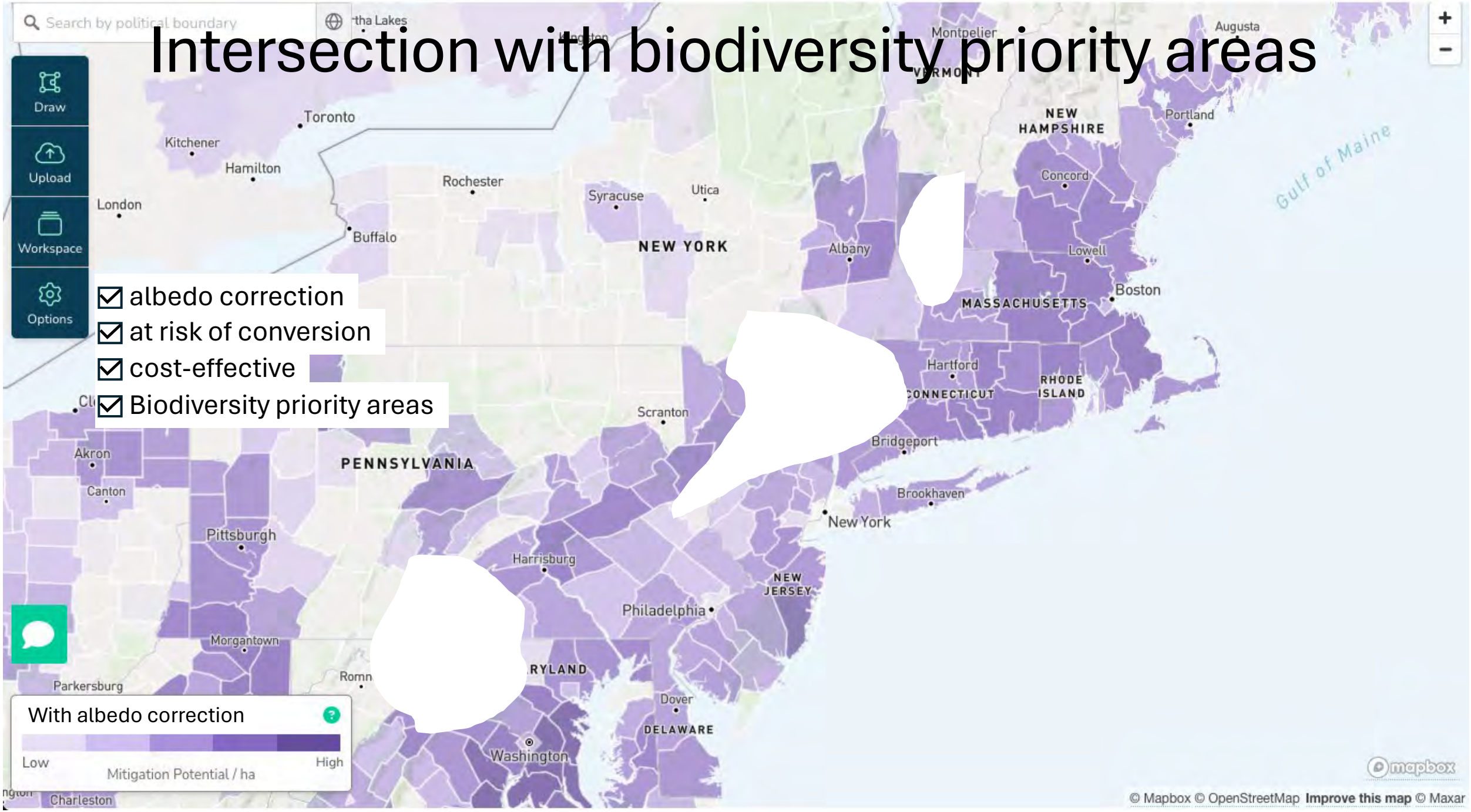
With land cost



4. Identify areas of both high biodiversity and high climate benefit



Intersection with biodiversity priority areas

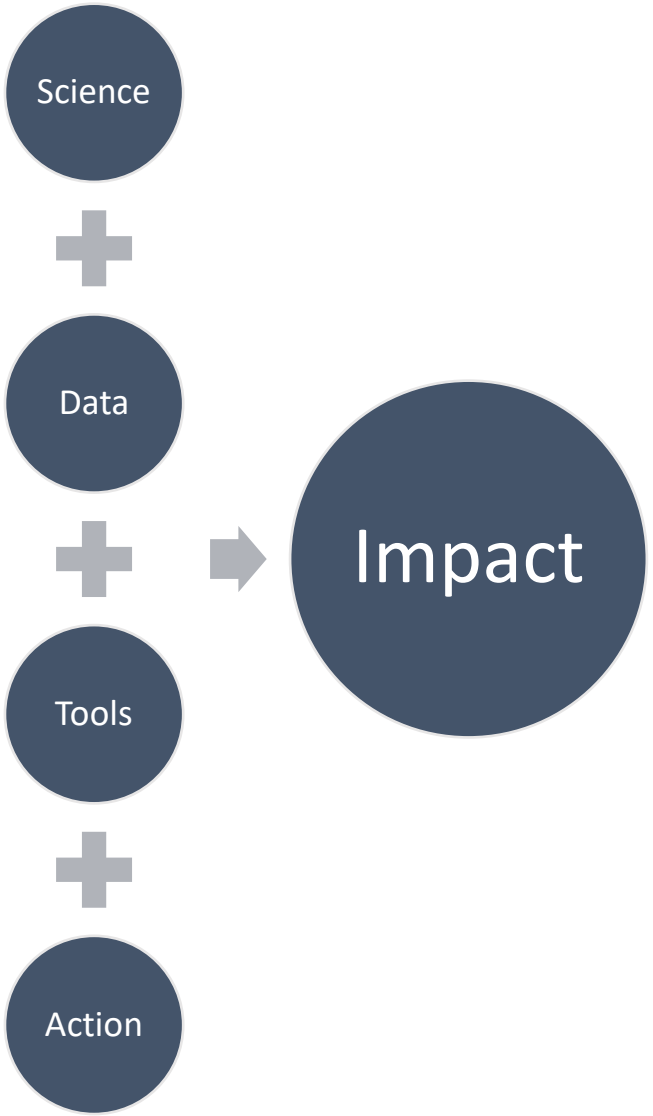


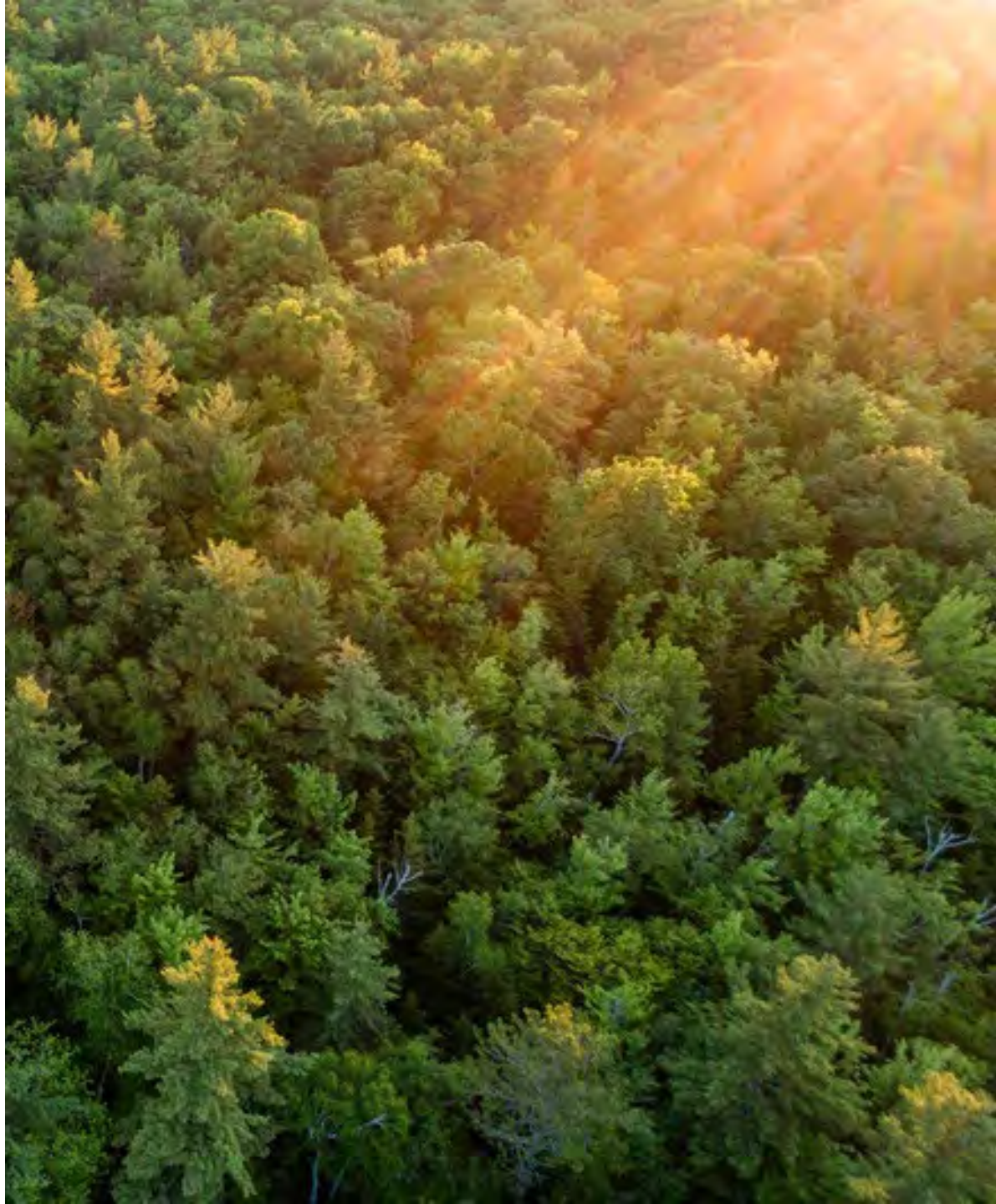
Use cases

1. Quantify climate benefit of protection of specific parcels
2. Identify areas with higher climate benefit
3. Identify areas with cost-effective climate benefit
4. Identify areas of both high biodiversity and high climate benefit

Q and A

Putting it all together…






I SUPPOSE IT WILL ALL MAKE SENSE WHEN WE GROW UP.
NO DOUBT.

Now

- 2010 forest carbon data
- 2050 storage potential
- Available through:
  - TNC Tool
  - TPL Tool

Spring 2024

- 2020 forest carbon data
- 2050 & 2070 storage potential
- Updated in:
  - TNC Tool
  - TPL Tool

Summer 2024

- Emissions avoided
- Cost effectiveness

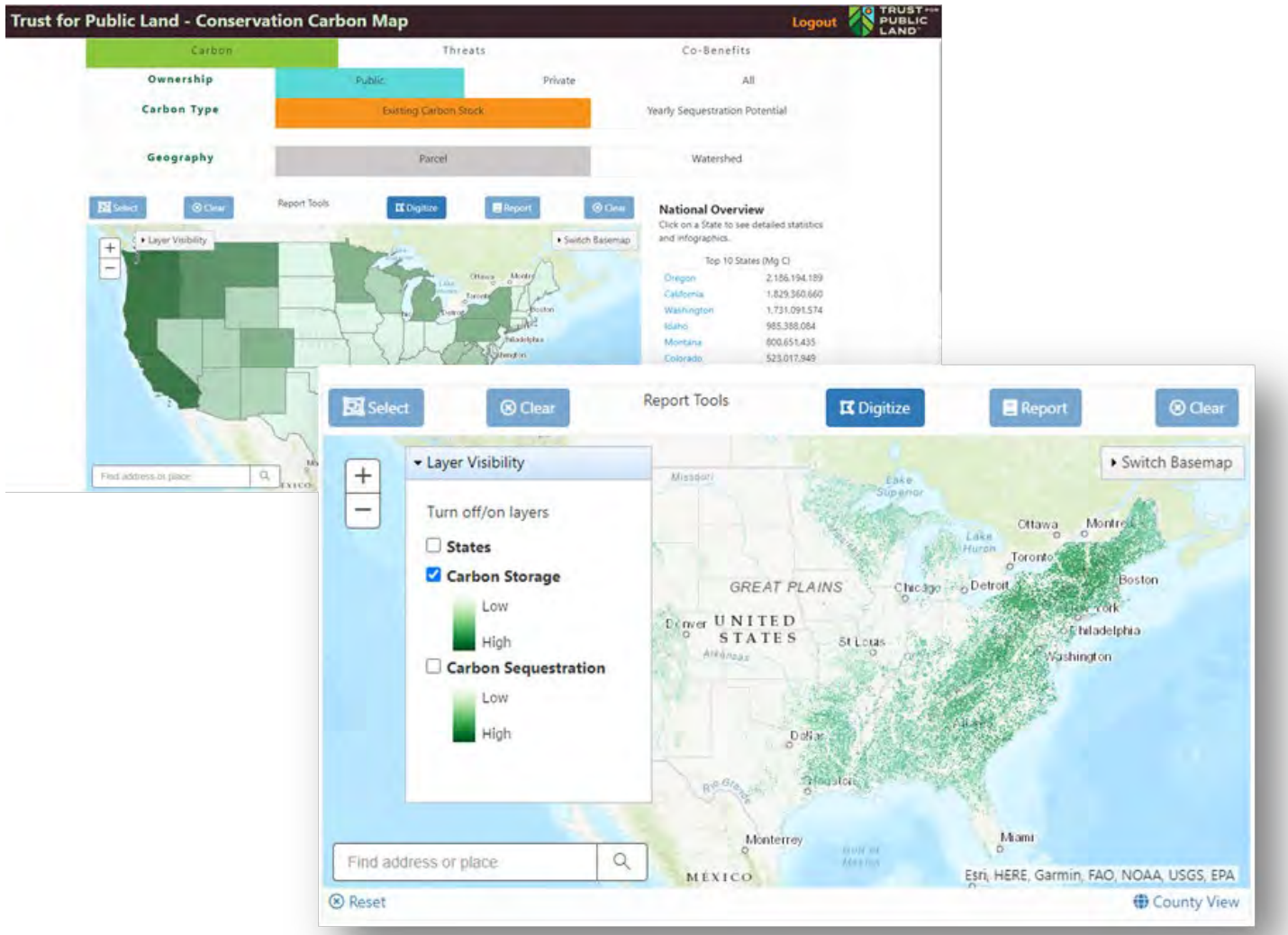
Conservation Carbon Map

Designed to answer 3 key questions:

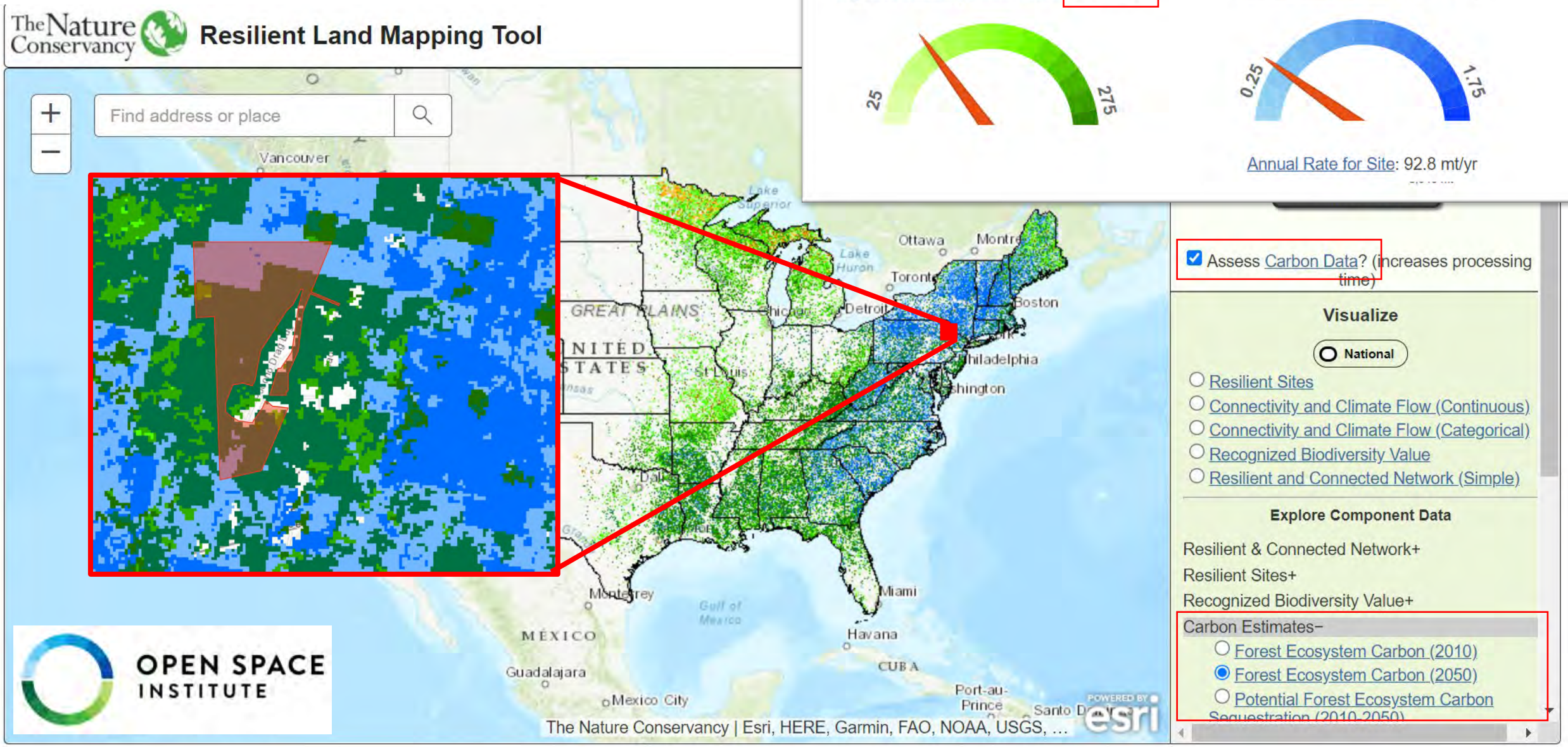
1. Where are existing forest carbon stocks?

2. What and where are the threats to those carbon stocks?

3. Where can conservation provide multiple benefits?

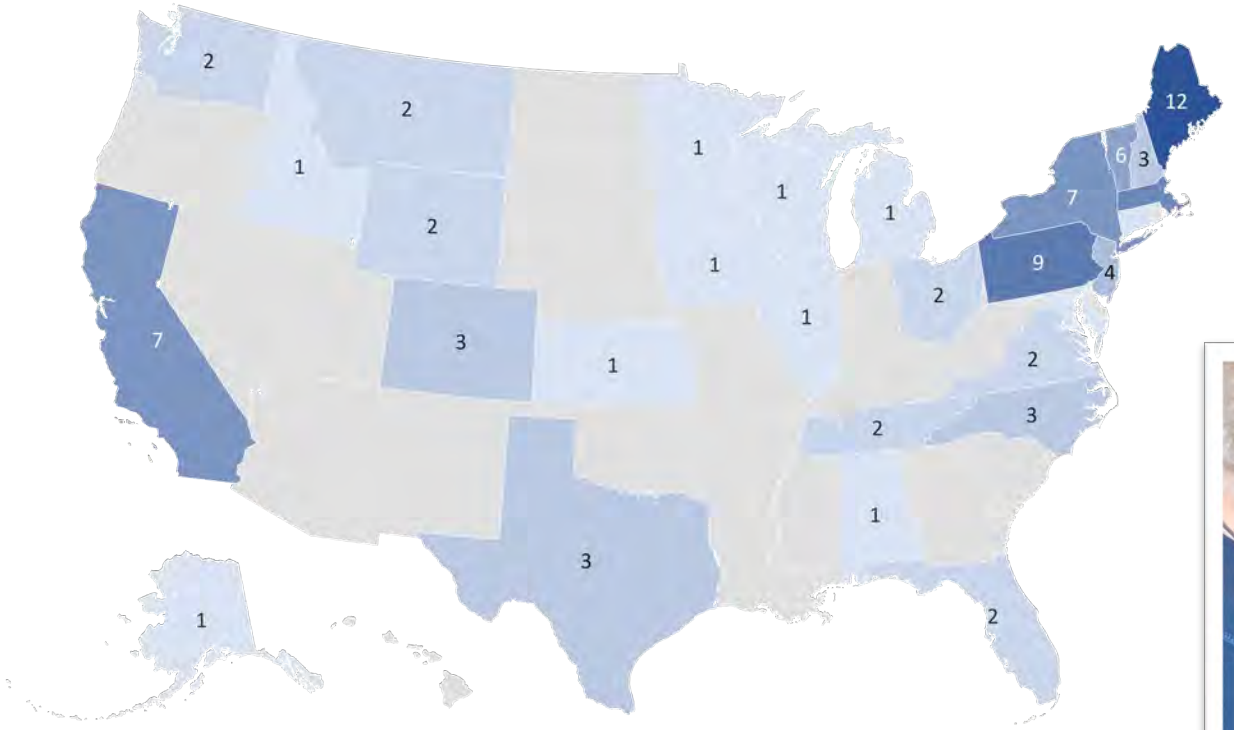


Project Evaluation



Land and Climate Planning Grants and Technical Assistance

2021-2023



- 93 awards
- More than $1.2 M in support

Land Trust Alliance
Together, conserving the places you love

OPEN SPACE INSTITUTE

Changing the way conservation happens on the ground.

Available Resources

- Capital grants for climate-driven land protection
- Conservation planning grants
- Online tools
- One-on-one technical assistance

Potential Resources

- Training series
- Written guidance
- Recorded demos
- Online Hub - a single go-to resource

Supporting all members of the conservation community in picking up an oar to pull towards critical climate goals

OPEN SPACE INSTITUTE

Aweinberg@osiny.org

THANK YOU

- USFS Forest Legacy Program
- Jane's Trust Foundation
- RBC Tech for Nature
- Individual Donors