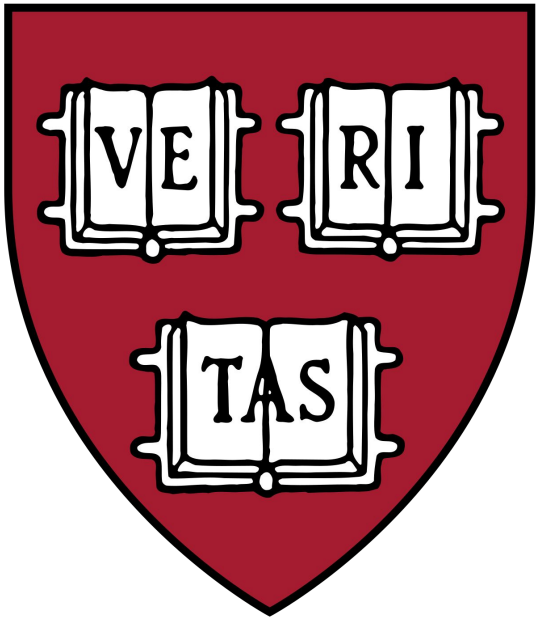

Harvard UFDS 2022

Professor Kelly McConville (Harvard)

Asteria Chilambo (Harvard Math ‘23),
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Julian Schmitt (Harvard Applied Math ‘23),
Maxwell VanLandschoot (Reed Economics ‘22),
Josh Yamamoto (Reed Math-Statistics ‘23)

Project 1: Comparison Study of Survey Sampling Estimators

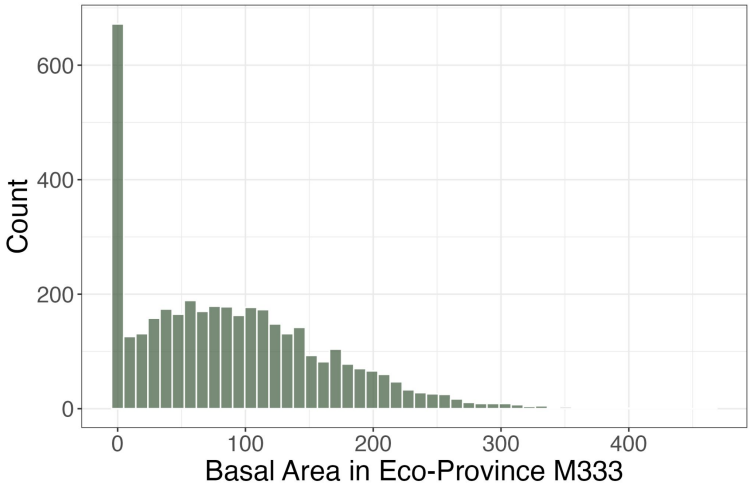
Setting: Combines expensive ground plots (left) that measure variables of interest (basal area) with auxiliary information gathered by satellites (right).

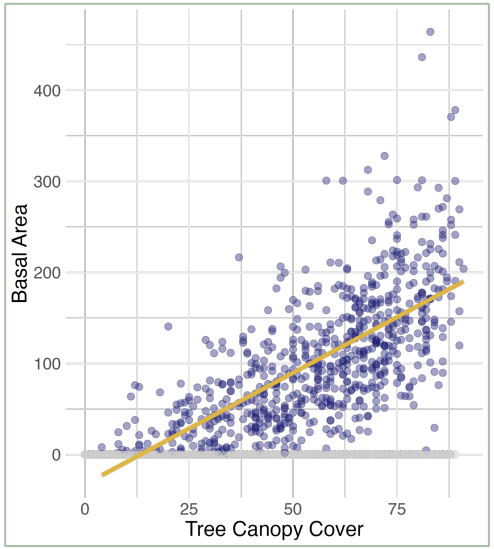
Different Strata

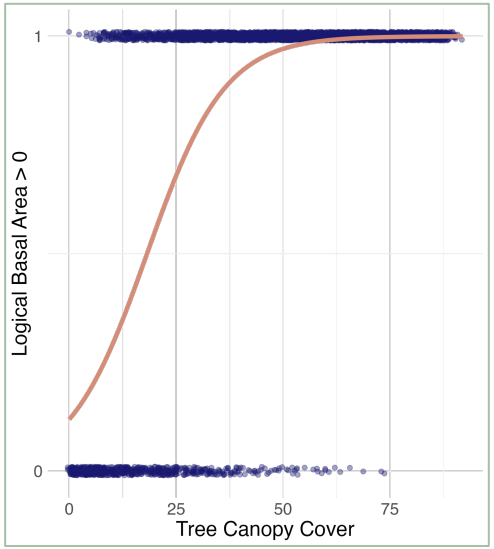
GMDE	GREG	GMDE_Var	GREG_Var
1811.995	1814.122	0.895	0.923
1616.635	1616.157	0.721	0.815
1484.934	1483.678	1.151	1.267
1765.941	1765.211	1.146	1.178
1769.369	1766.972	1.188	1.233

<u>Key Finding:</u> The Generalized Multivariable Difference Estimator (GMDE) should be employed over the Generalized Regression Estimator (GREG) in stratified sampling settings.

Project 2: Zero-inflation models for small area estimation







Setting: Large number of observations are zero! This results in small area estimation models like EBLUP being model mis-specified.

Approach: Use a two-part model to split the problem into a linear part (left) which is well-specified and a logistic part that can capture the zero's in the data. We call this model the zero-inflation small area estimation model.

Project 2: the ZI-SAE model outperforms others in this setting

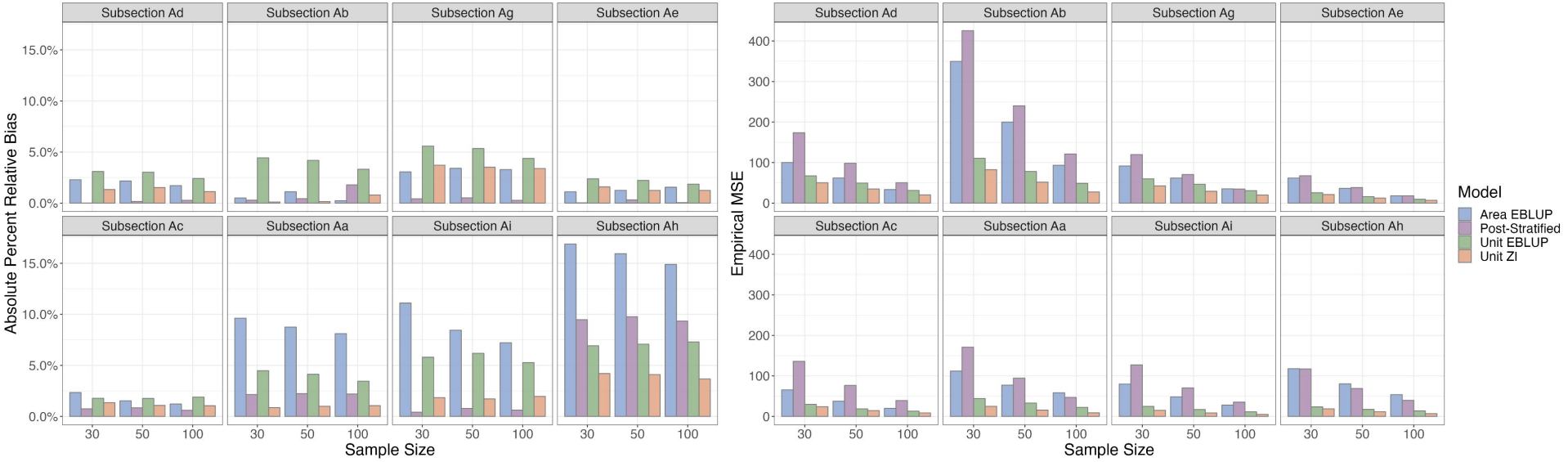
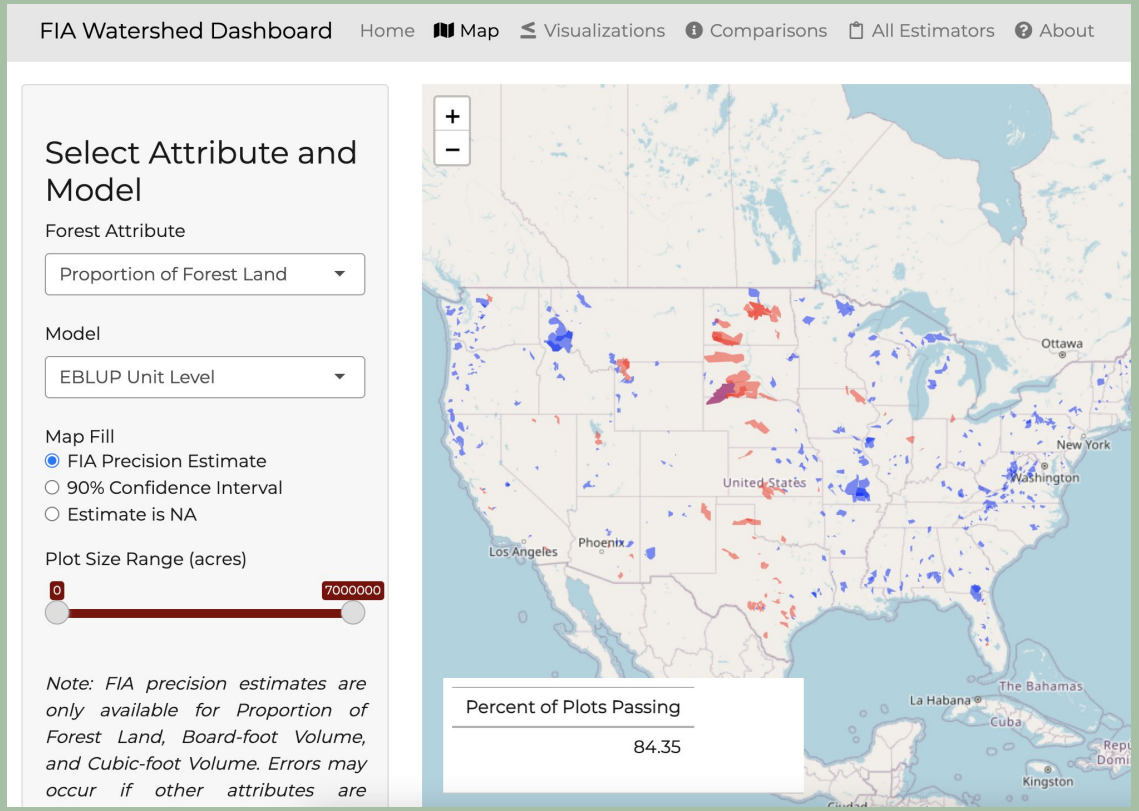


Figure: Absolute percent relative bias in 2000 sample simulation study (left) and empirical mean squared error (right). M333A sections ordered in increasing percentage of zero inflation (Ad - 7%, Ah - 45%). Shading indicates model type.

<u>Key Finding</u>: In the setting where the variable of interest is zero inflated there are benefits (particularly in MSE) to using the two-part ZI-SAE model. The ZI-SAE model had lower MSE across all 24 sample sizes and subsections combinations, and had lower bias on 8/24 (PS had 15/24).

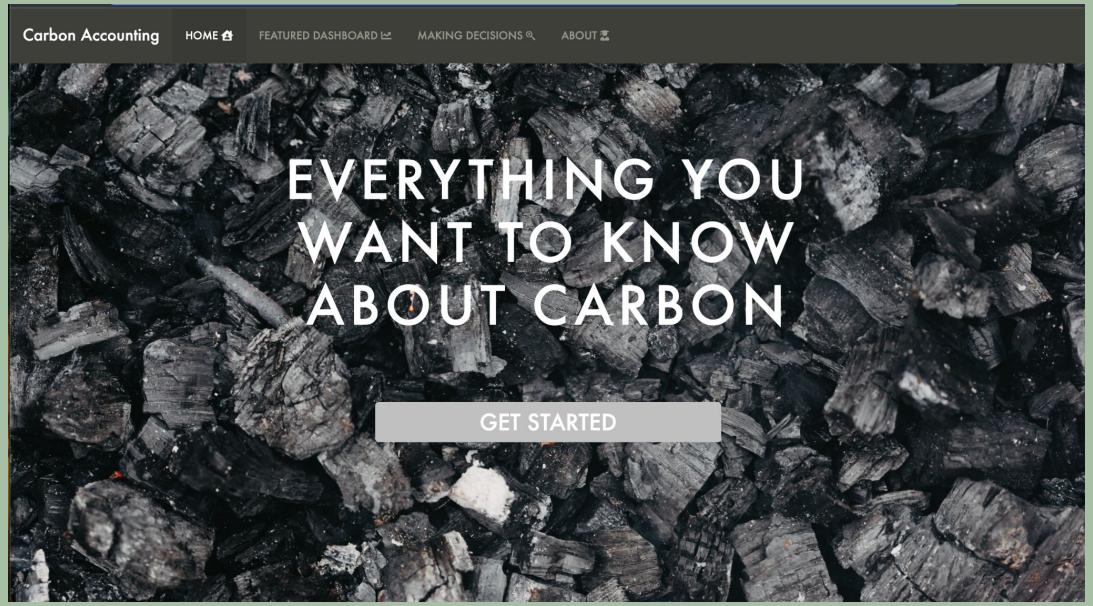
Project 3: Watershed Small Area Estimates



Key Finding:

Unit-level small area estimation models, like the Unit–level Empirical Best Linear Unbiased Prediction, outperforms post stratification. We also recommend that FIA reevaluate its precision metrics for small areas.

Project 5: Carbon Accounting



Project Deliverable:

An interactive website that presents greenhouse gas flux and carbon storage estimates and their uncertainty across a variety of spatial, temporal, and species-specific domains in the continental US.

Project 4: Climate R Shiny Dashboard X NCASI

Our Stakeholders:

Professional foresters, non-statistical audience

Our Research Question:

How do we **best present** climate information and measures of uncertainty to foresters?

Our Project Goals

1) Increase Interactivity

- Interactive graphs
- Plot reactivity
- Smooth, intuitive interface

2) Expand Plot Selection

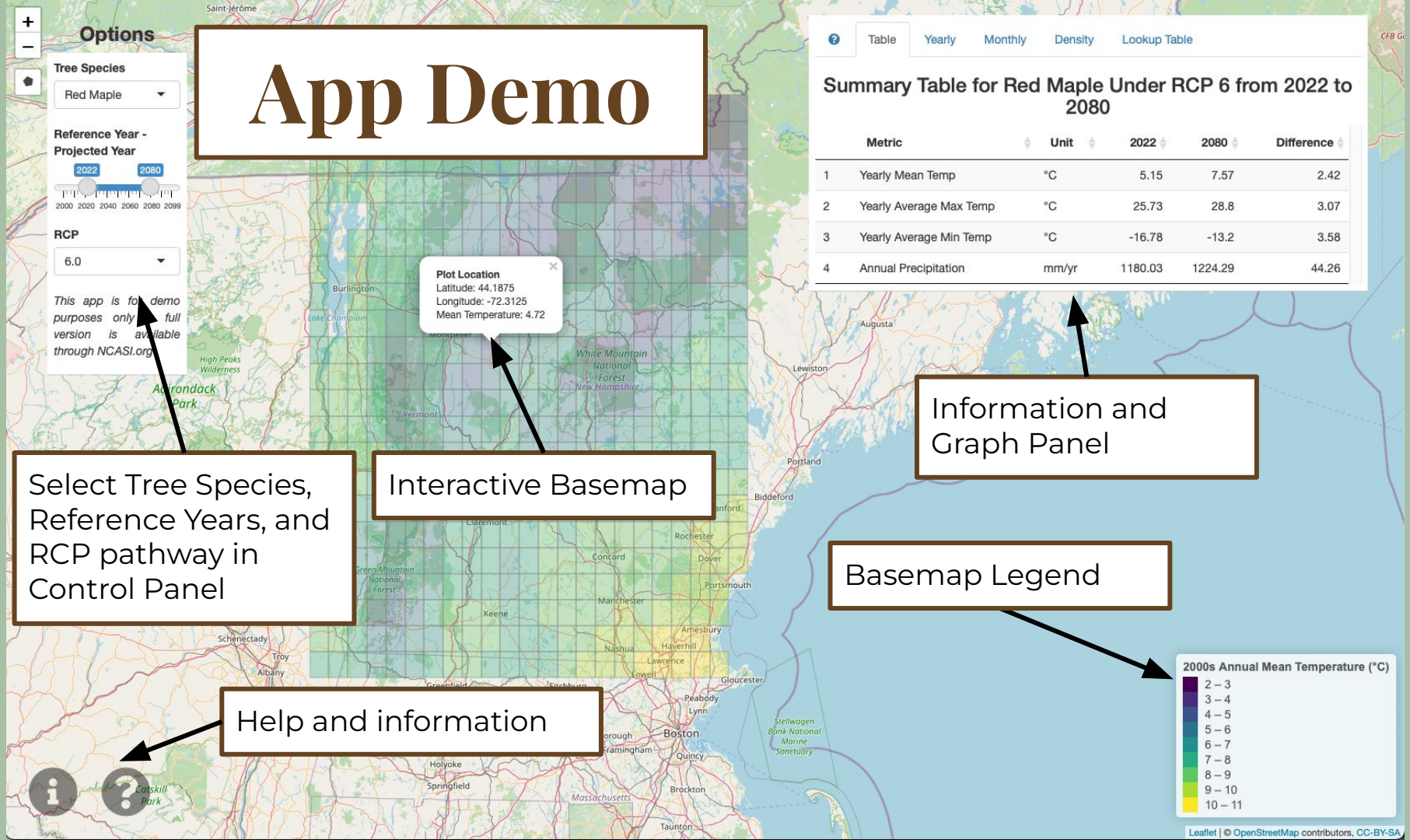
- Point-and-click plot selection
- Draw tool to select polygon region (highly requested)

3) Incorporate Uncertainty

- Conf. intervals on projections
- Heatmap envelopes

4) Improve User Experience

- Streamlined User Interface
- Accessible help features
- Succinct, app information



App Demo

Select Tree Species, Reference Years, and RCP pathway in Control Panel

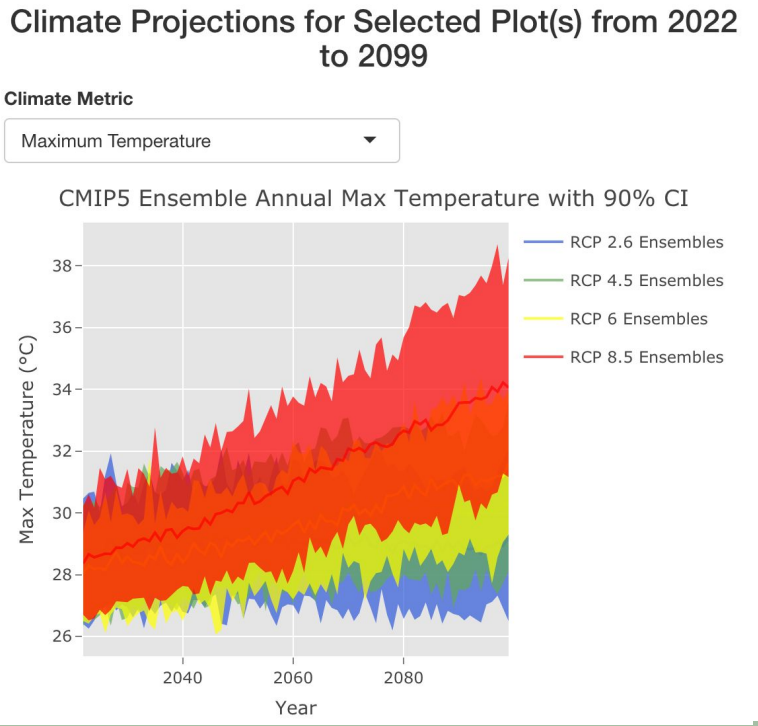
Interactive Basemap

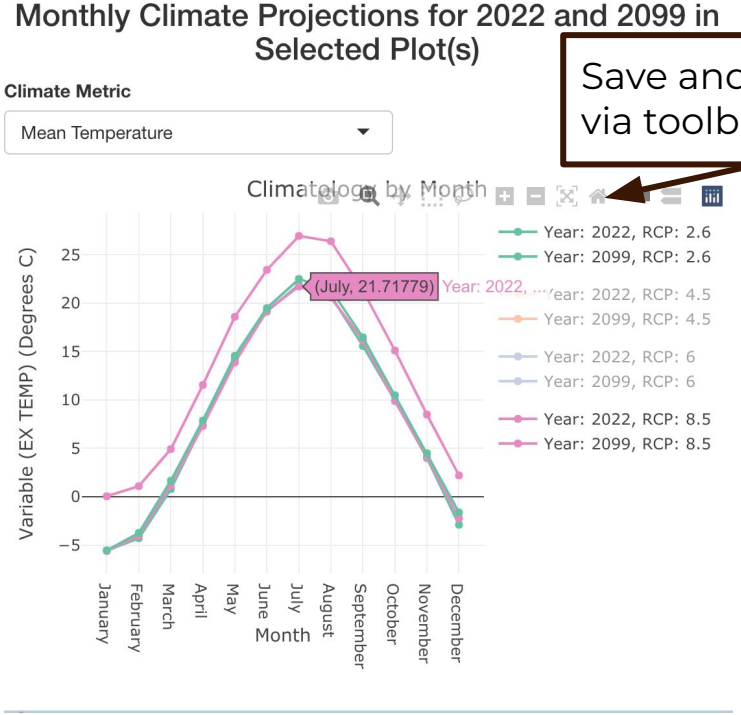
Information and Graph Panel

Basemap Legend

Help and information

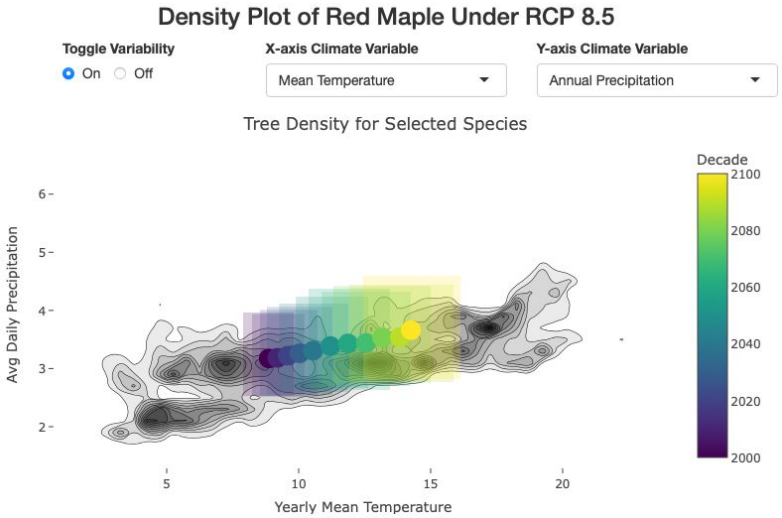
Climate Visualization Features



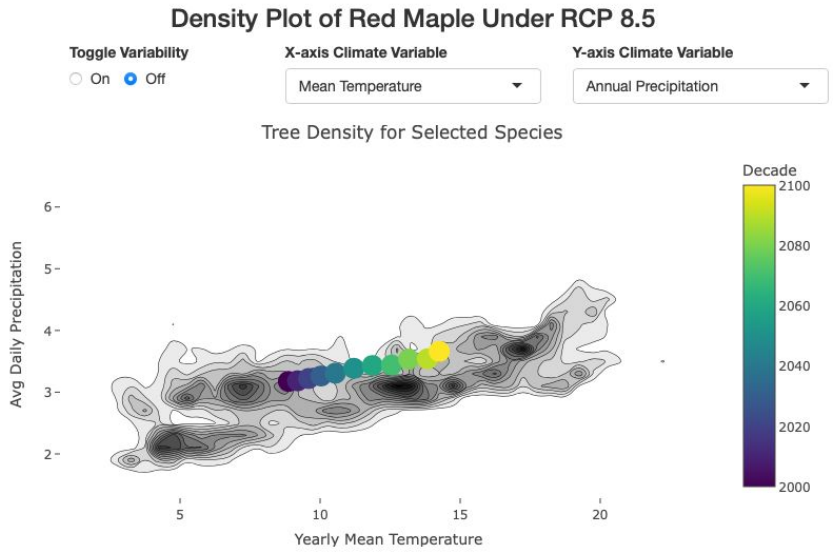


Climate Visualization Features

Visualize with uncertainty...



...and without!



Project Access: Demo Website and GitHub

NCASI

https://ncasi-shiny-tools.shinyapps.io/CPAT_Ver2_Demo/

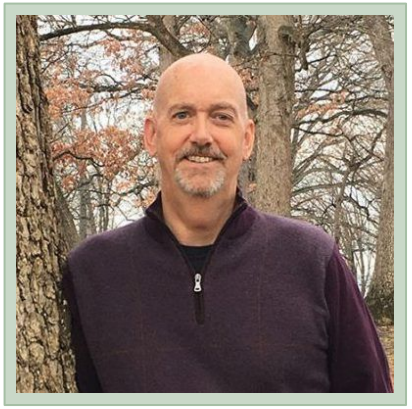
GitHub

https://github.com/harvard-ufds/climate-dashboard

Special Thanks to:

Dr. Kate Hu,
Research Mentor

Dr. Holly L. Munro,
NCASI Stakeholder



Dr. Stephen Prisley,
NCASI Stakeholder