

Estimating agroforestry biomass carbon stock changes in the US National GHG Inventory

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Background

- Agroforestry is recognized as a promising nature-based solution for its potential to store carbon in croplands and grasslands and enhance other ecosystem services.
- Knowledge of historical and current carbon status and extent of agroforestry adoption in the US is missing, which makes it a gap in the US National Greenhouse Gas (GHG) Inventory.

Objectives:

- Evaluate available agroforestry data based on suitability for the Inventory (coverage, latency, operational status, data quality).
- Develop activity data and emission factors to estimate changes in aboveground biomass carbon in US agroforestry systems.

Next Steps

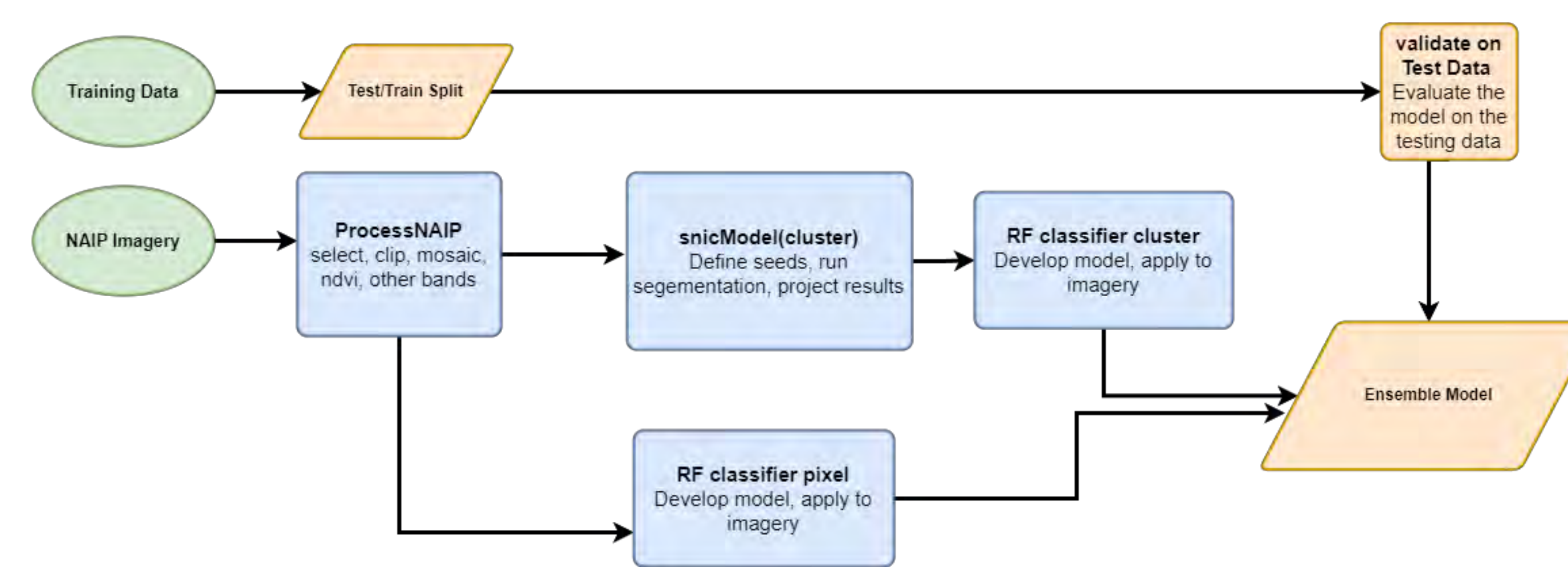
- Iteratively test the model parameters for the image segmentation and pixel-based approaches to determine what components influence most model results.
- Add more texture-based indicators into the predictor variable set.
- Assess model accuracy across Nebraska state-wide precipitation gradient.
- Evaluate best models and different predictors (agroforestry system, age, climate, species, and tree stocking density).
- Conduct a pilot study to account for aboveground biomass carbon changes in agroforestry systems in the state of Nebraska to assess method applicability.

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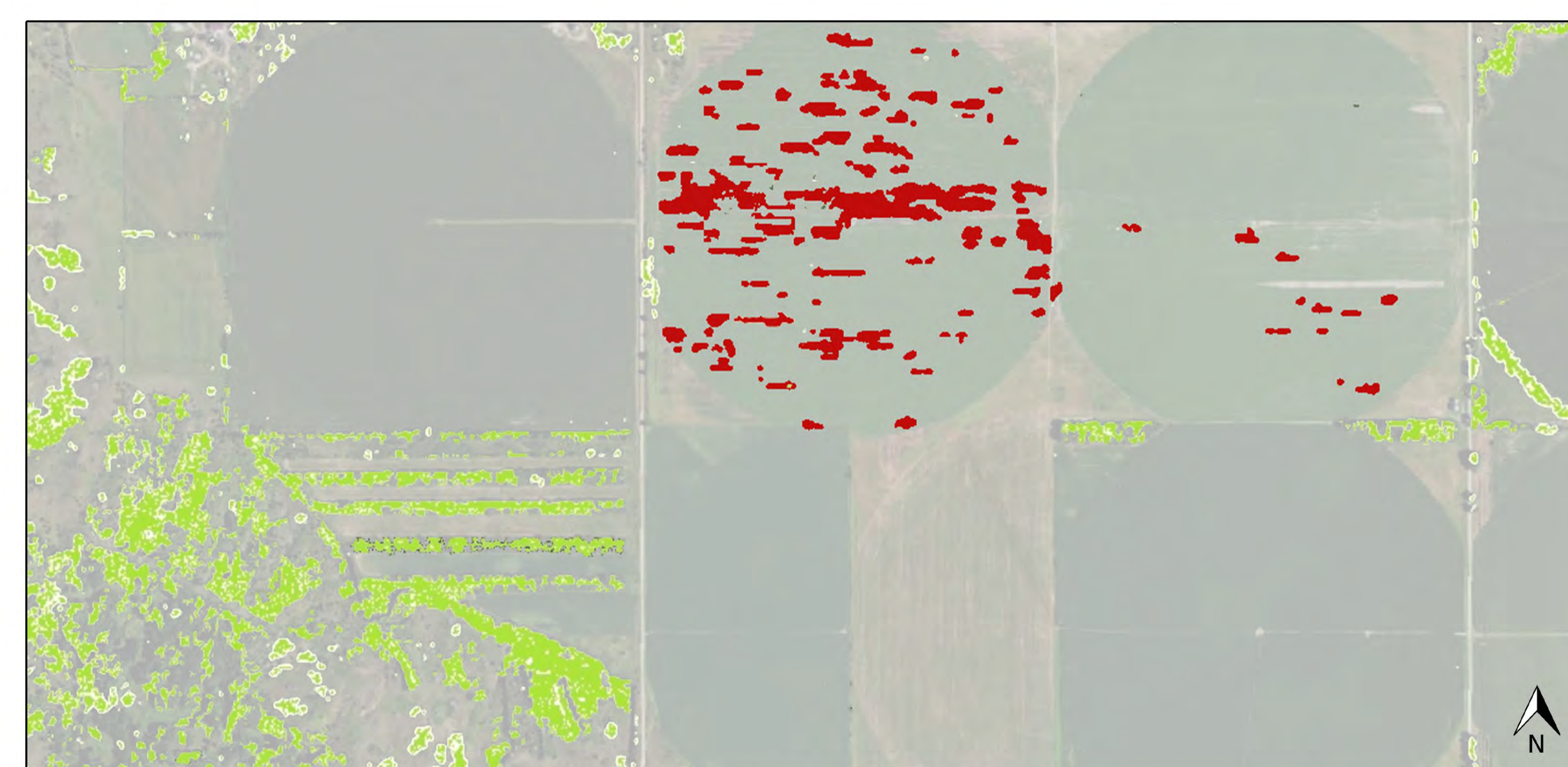
Activity Data/Agroforestry area

Methods

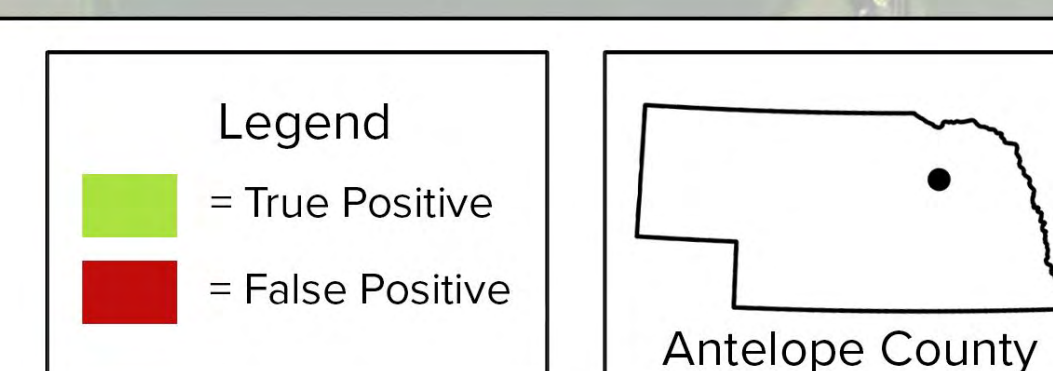


- Use of NAIP imagery from 2010, 2016, and 2020 to develop a predictive map of trees outside of forests within Nebraska at three time periods.
- Ocular sampling of trees outside of forest provides a training and validation set for the modeling process.
- An ensemble model is generated by combining a pixel base classification and image segmentation of NAIP imagery within Google Earth Engine.

Main Findings



Tree Presence/Absence Sampling in Antelope County, NE
This figure shows the areas reported as trees (presence) and the areas not reported as trees (absence) used to train the model. The presence areas are visualized in green and red, while the absence areas are in gray. Note: There are some regions, visible in the lower left corner, where trees have not been classified by the current methodology.



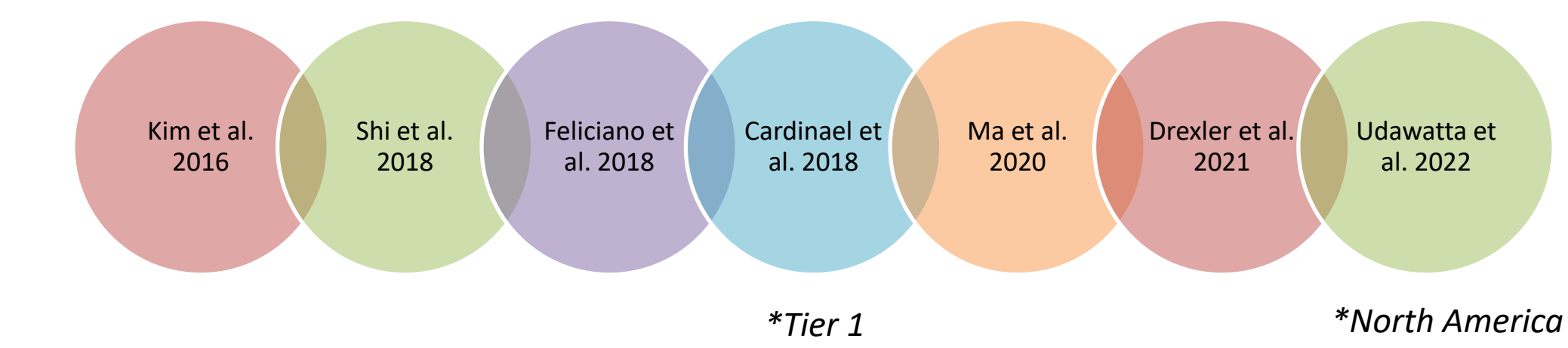
- Model shows promise to identifying trees outside of forest and agroforestry shapes, and scalability.
- The model is overpredicting forest cover in some center pivot agricultural areas.
- Riparian Forests display the highest variability between model runs.

GitHub project link: <https://github.com/GeospatialCentroid/Agroforestry>

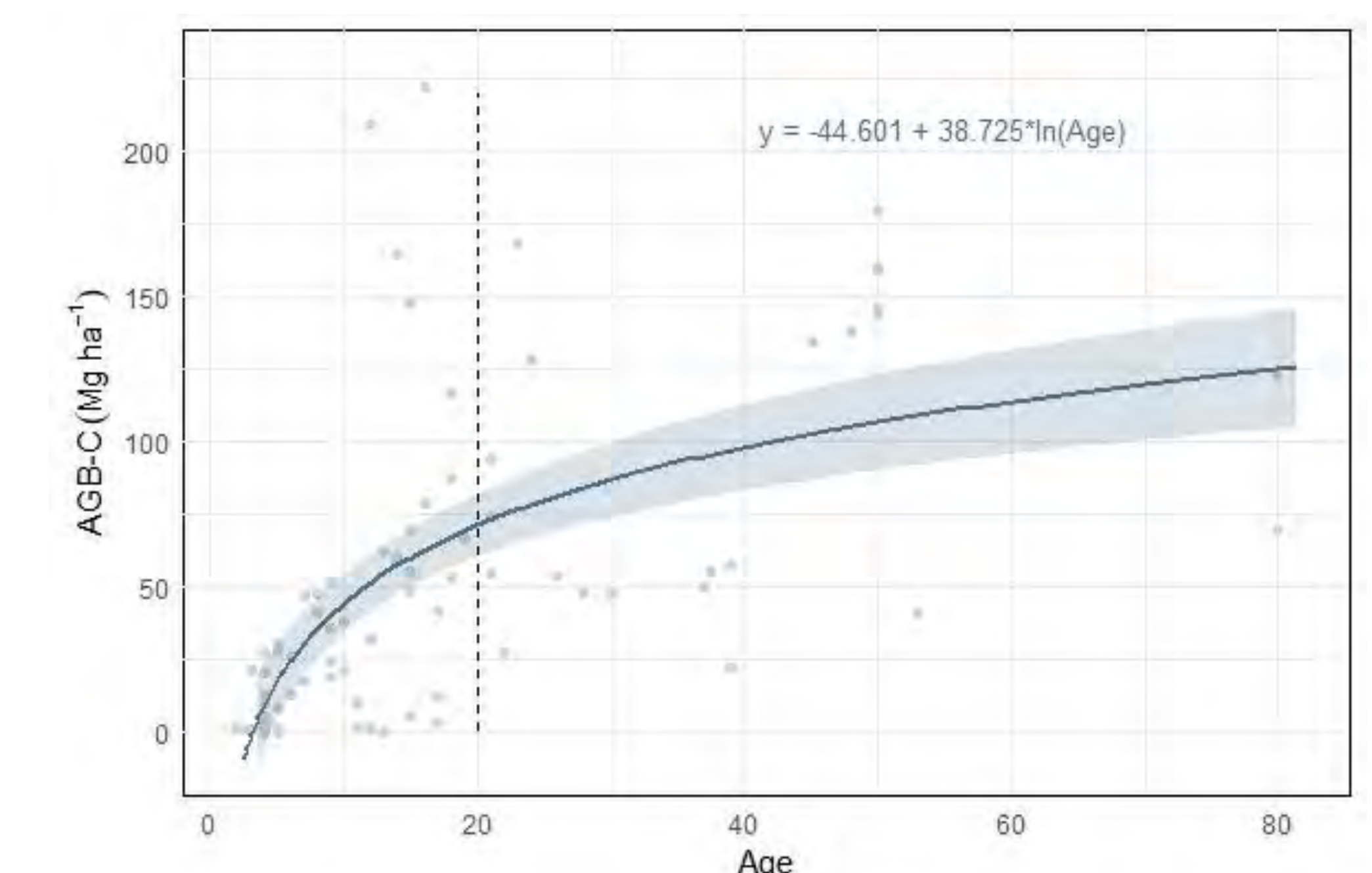
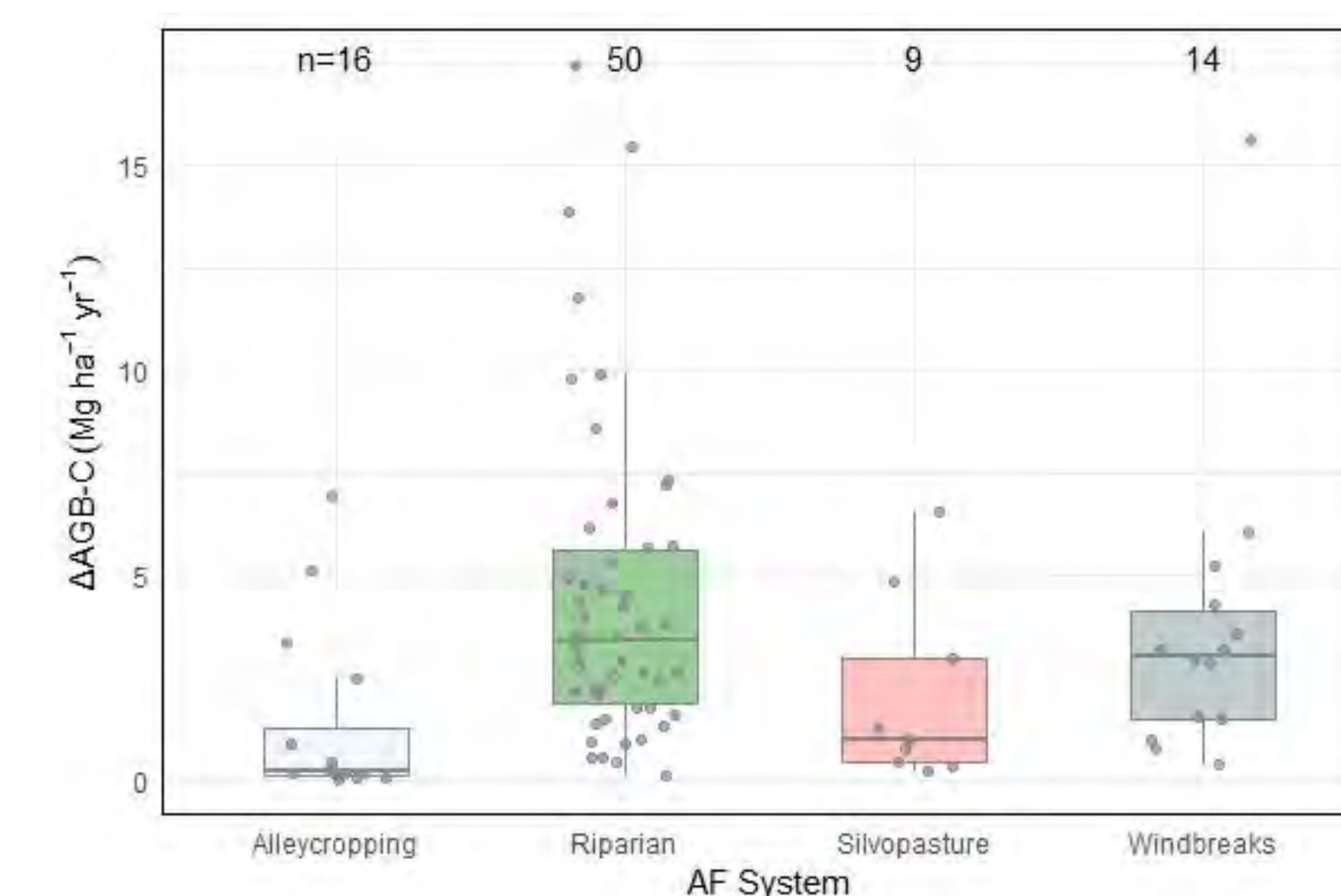
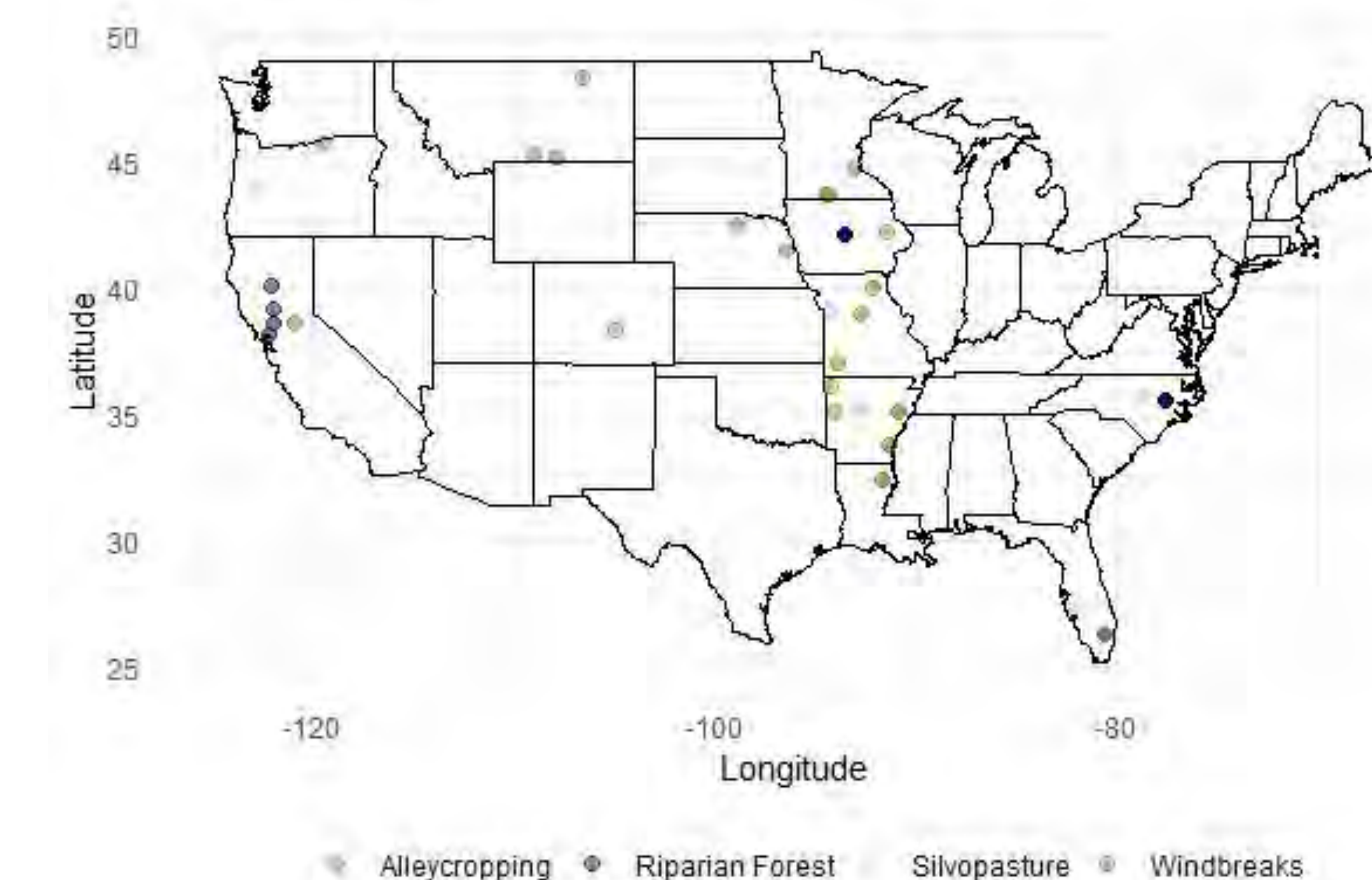
Emission Factors/ Biomass carbon changes

Methods

- Data compilation (Web of Science, accompanying references of selected studies, and review of reviews and meta-analyses).



Main Findings



- Comprehensive data compilation encompassing US agroforestry systems from 2 to 80 years with multiple tree species across different climate zones.
- Model is able to represent the nonlinear increase in aboveground biomass carbon as stands age.
- High variability across systems, species, and climate zones, and as stands age.