

Effects of climate change on the radial growth of shelterbelts across the Brown, Dark Brown, and Black soil zones of Saskatchewan

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Why Shelterbelts?

Many benefits

Soil conservation

Wind protection

The problem...how will climate
change effect shelterbelts?



Objectives

- Make a model to forecast the growth of four shelterbelt species under future climate models and scenarios.
- Determine if there is a pattern of forecasted growth across the Brown, Dark brown, and Black soil zones of Saskatchewan.



Agriculture and Greenhouse Gases Program

Phase 1: 2011–2016

- Useful for dendrochronology
- Shelterbelt inventory
- Lots of samples

Phase 2: 2017–2021

- Create management toolbox
- Use samples from phase 1
- Economics and dendrochronology

Shelterbelt Species

- White spruce (*Picea glauca*)
- Scots pine (*Pinus sylvestris*)
- Green ash (*Fraxinus pennsylvanica*)
- Hybrid poplar (*Populus* hybrids)



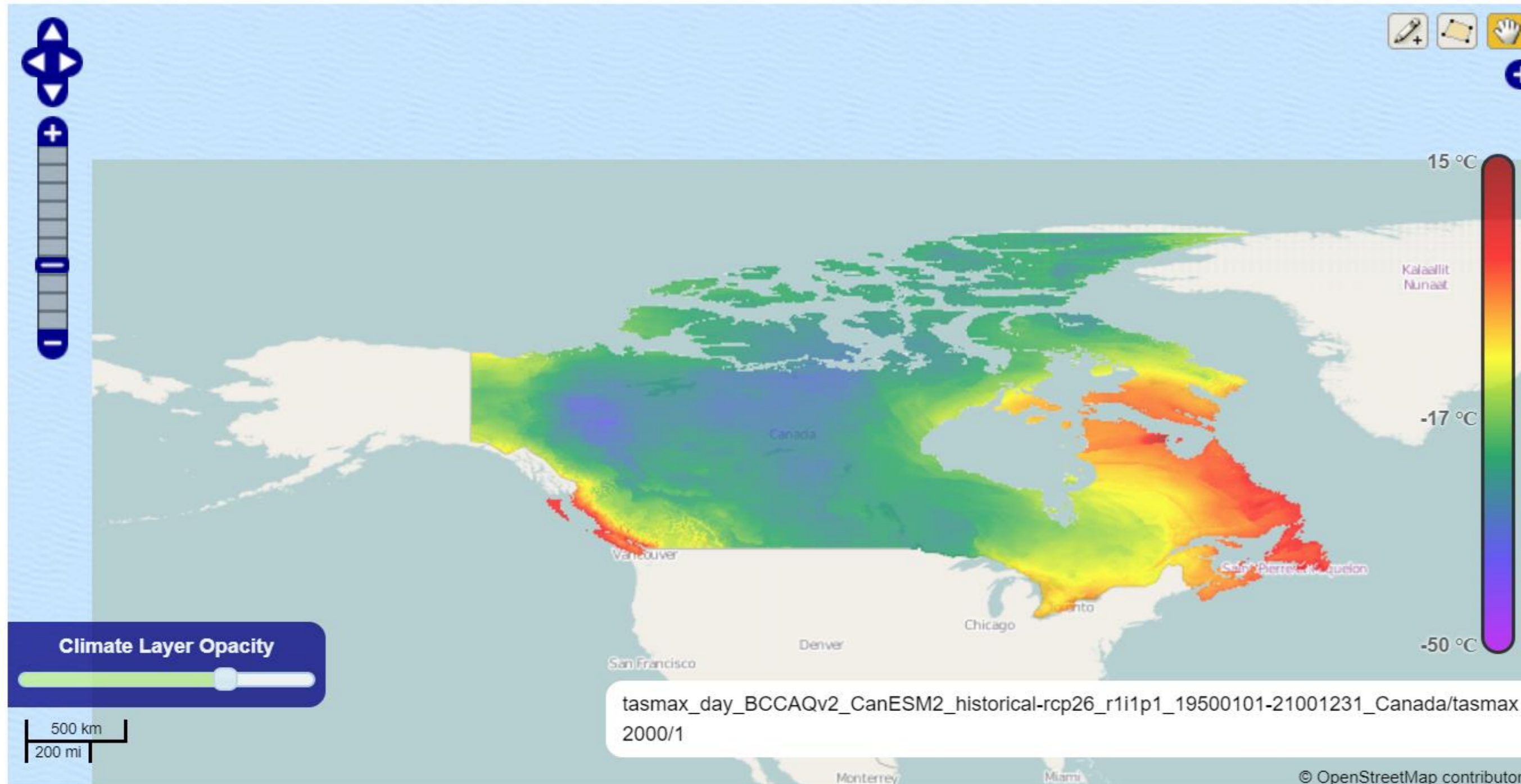
Historical Climate Data

- Climate stations
- Environment Canada Website
- Current and previous year monthly max temperature and precipitation

Future Climate Data



Statistically Downscaled GCM Scenarios - BCCAQv2



Dataset Selection

historical,rcp26	[+]
historical,rcp45	[+]
historical,rcp85	[+]

Download Data

Date Range
1950/01/01 to 2101/01/01

Download Full Timeseries

Output Format
NetCDF [?]

[Download](#) [Metadata](#)

Future Climate Data

2 Representative Concentration Pathways

- RCP 45: 650 ppm
- RCP 85: 1,370 ppm

4 Climate Models

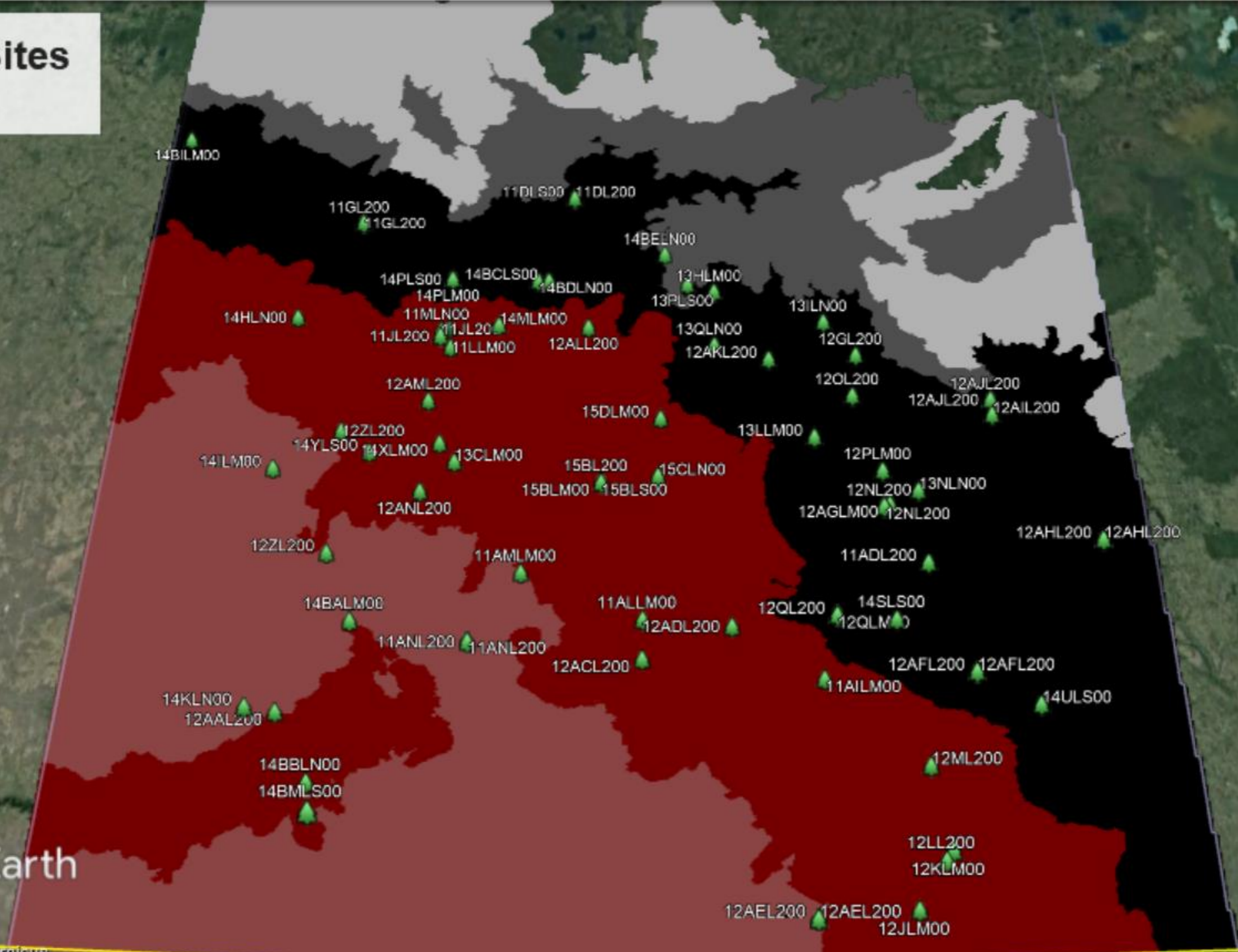
- ACCESS1-0-r1
- CanESM2-r1
- CNRM-CM5-r1
- Inmcm4-r1

Study Sites

AGGP1

Legend

- BLACK
- BROWN
- DARK BROWN
- DARK GRAY
- GRAY



Google Earth

© 2018 Google

Image Landsat / Copernicus

Lake Ma



100 mi

Experimental Design

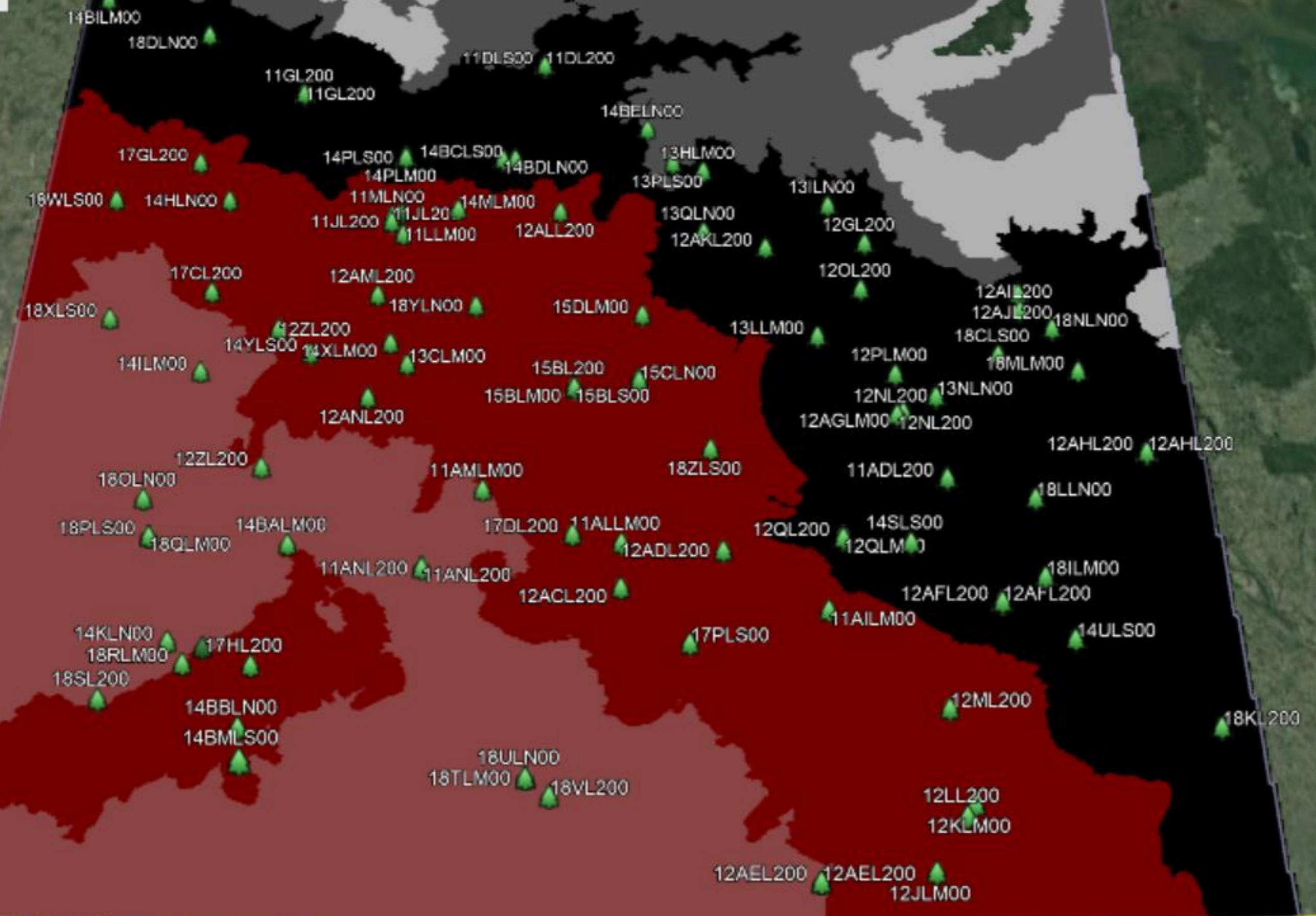
- PFRA database trees =>50 years
- Randomized list
- Called landowners

Study Sites

AGGP2: 2017-2018

Legend

- BLACK
- BROWN
- DARK BROWN
- DARK GRAY
- GRAY



Google Earth

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Lake Ma



100 mi



Sample Preparation

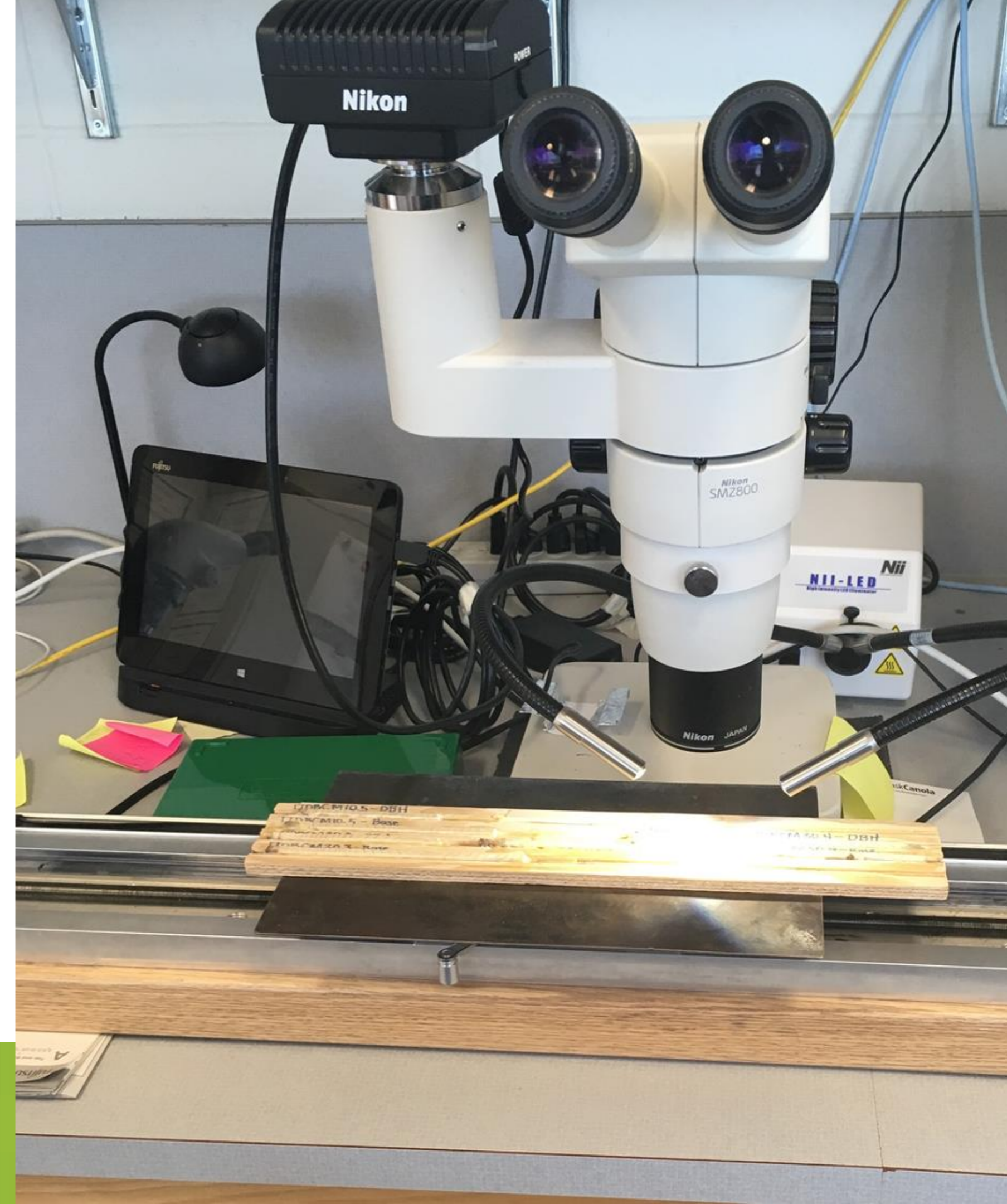
- Glued
- Labelled
- Sanded



Measuring tree rings

➤ Velmex stage system

➤ 0.001 mm

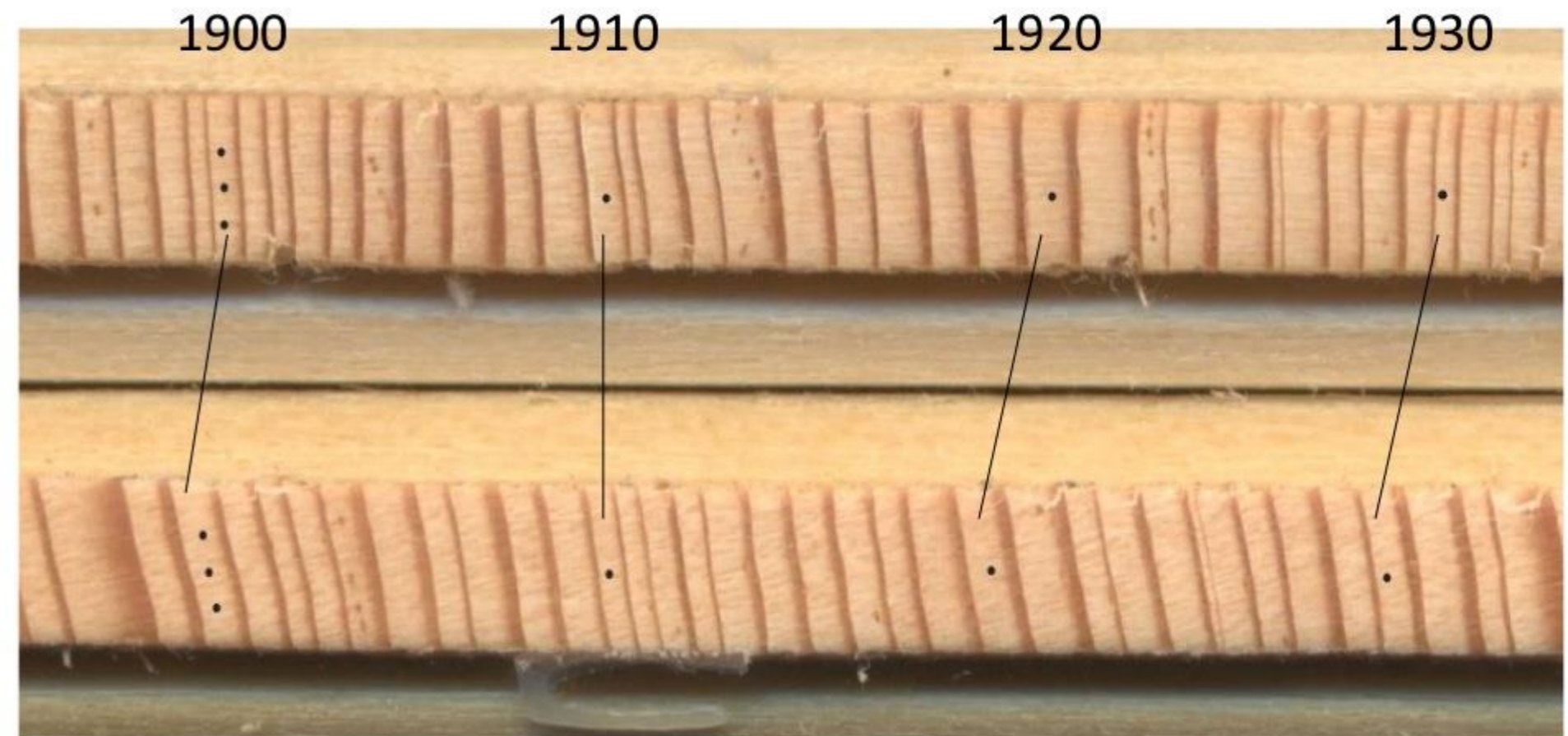


Cross-dating and standardizing

➤ COFECHA

➤ ARSTAN

Same climate influences the growth of all trees at a site = **cross-dating**



Two Douglas-fir trees near Eldorado Springs, CO

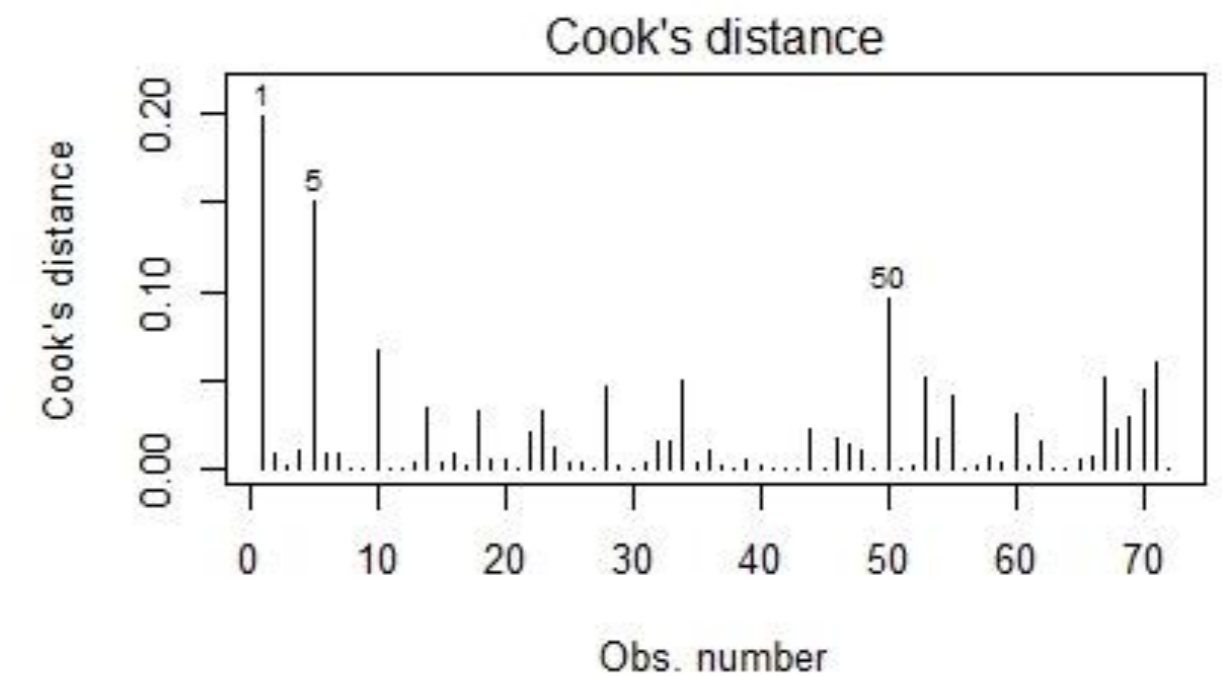
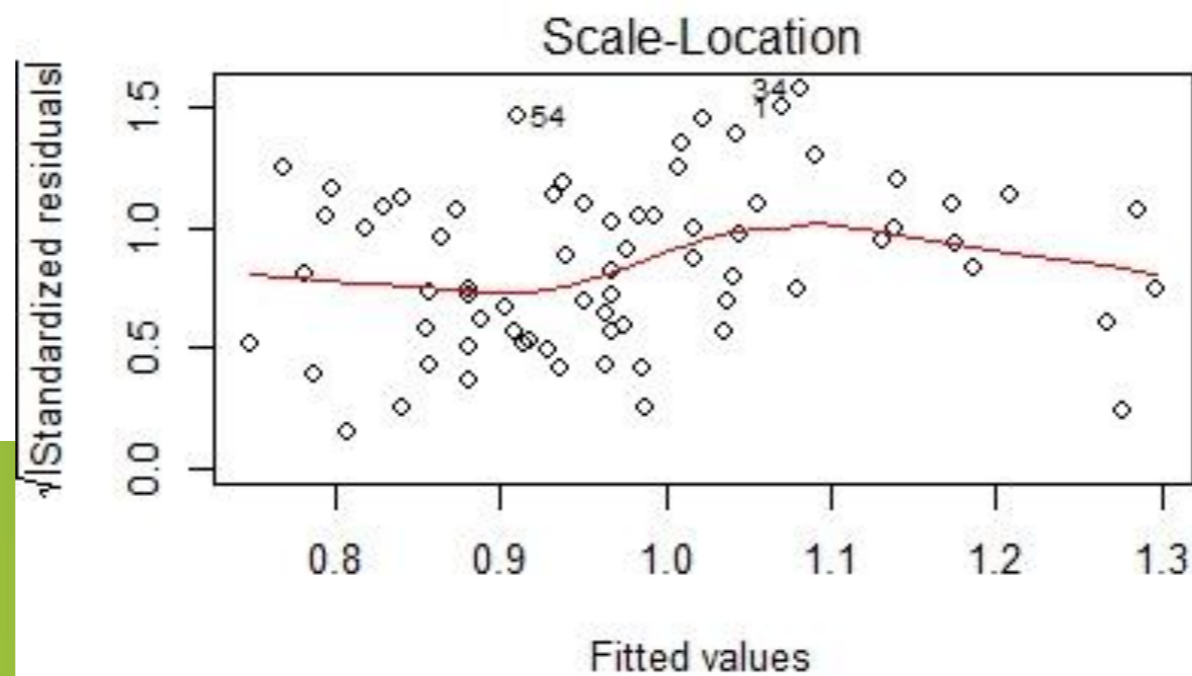
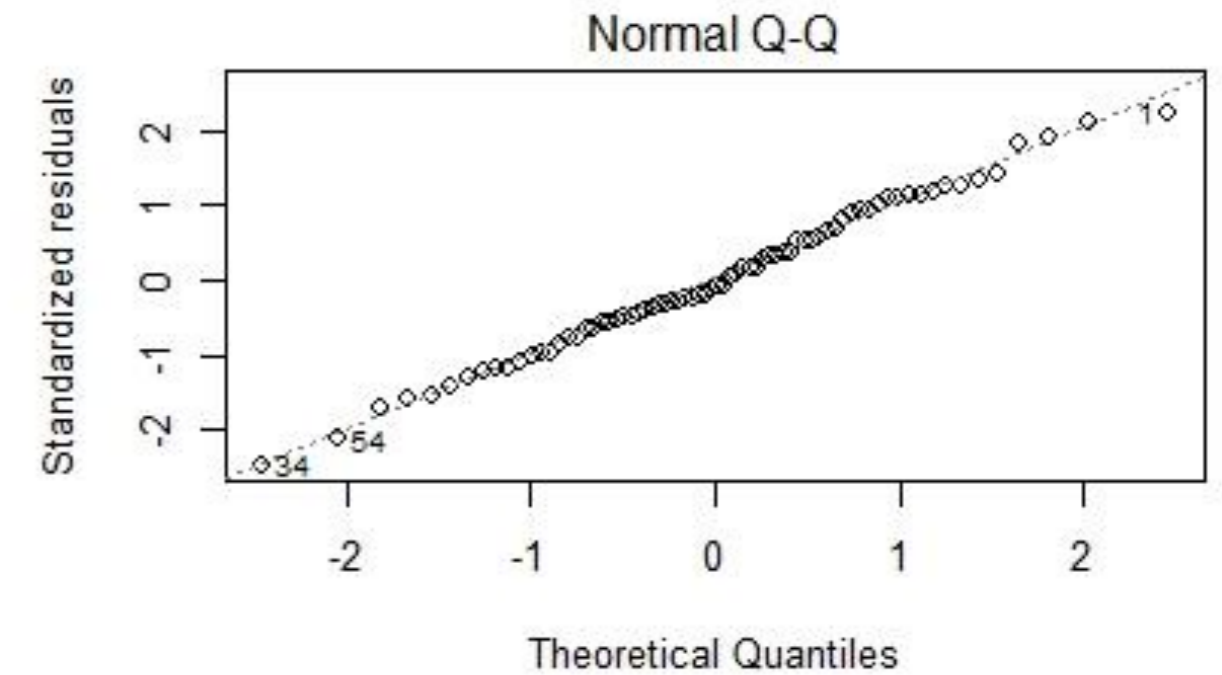
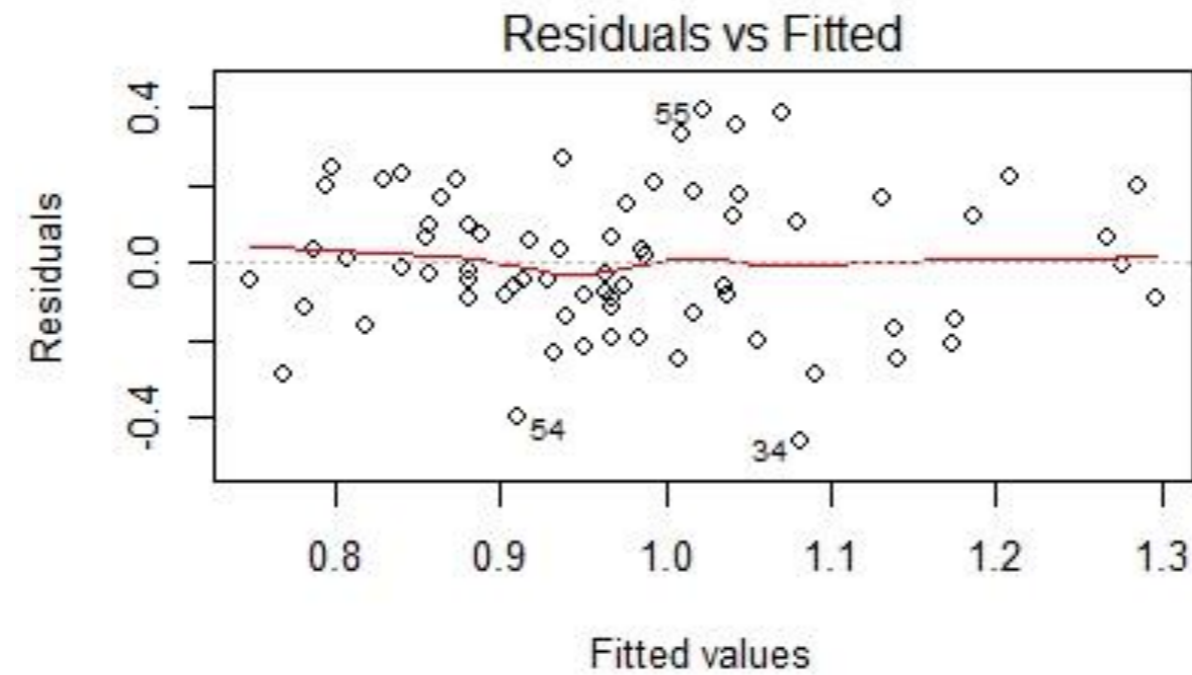
Forecasting Growth

- Linear regression model
- Ring-width
- Historical climate data

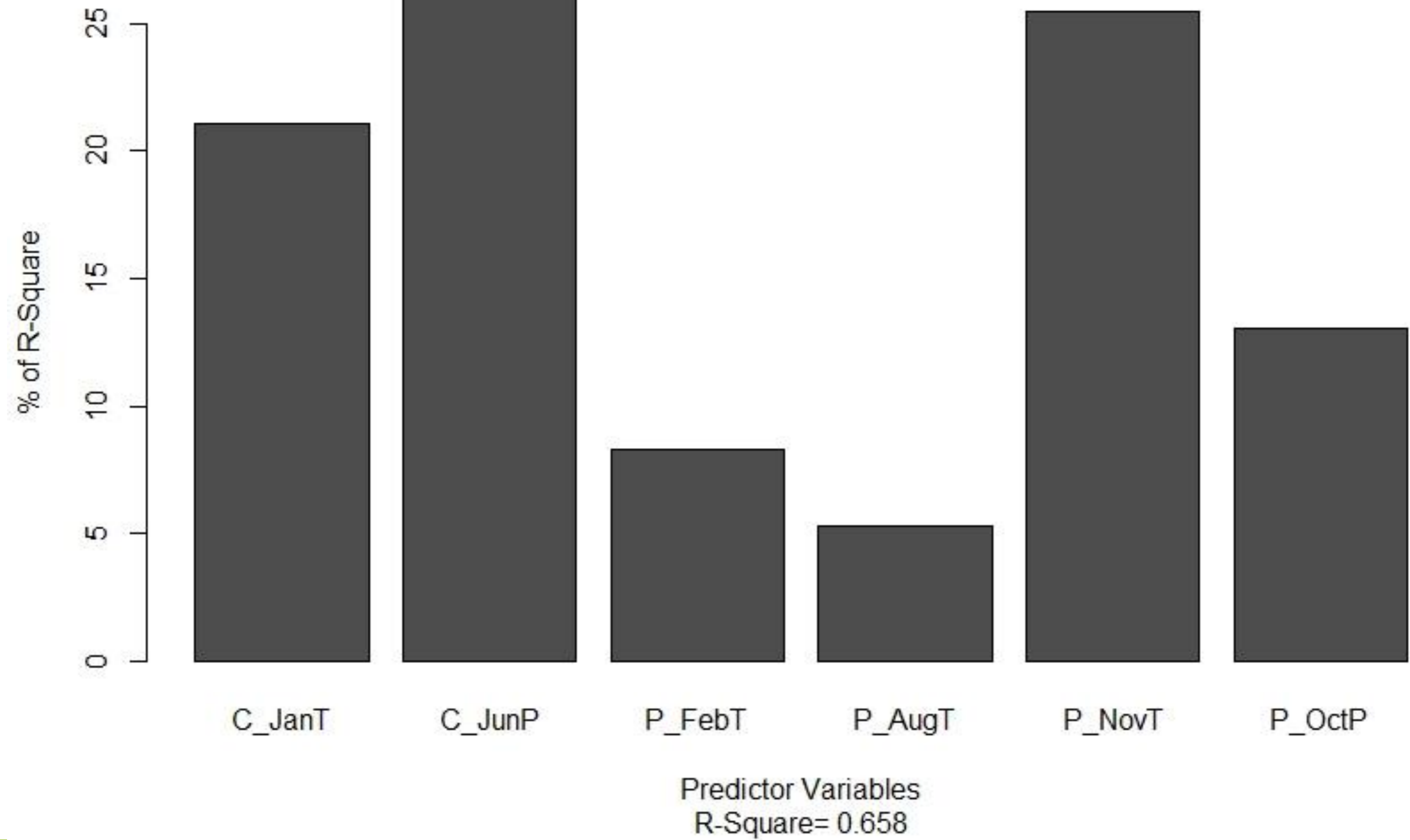


Model Optimization

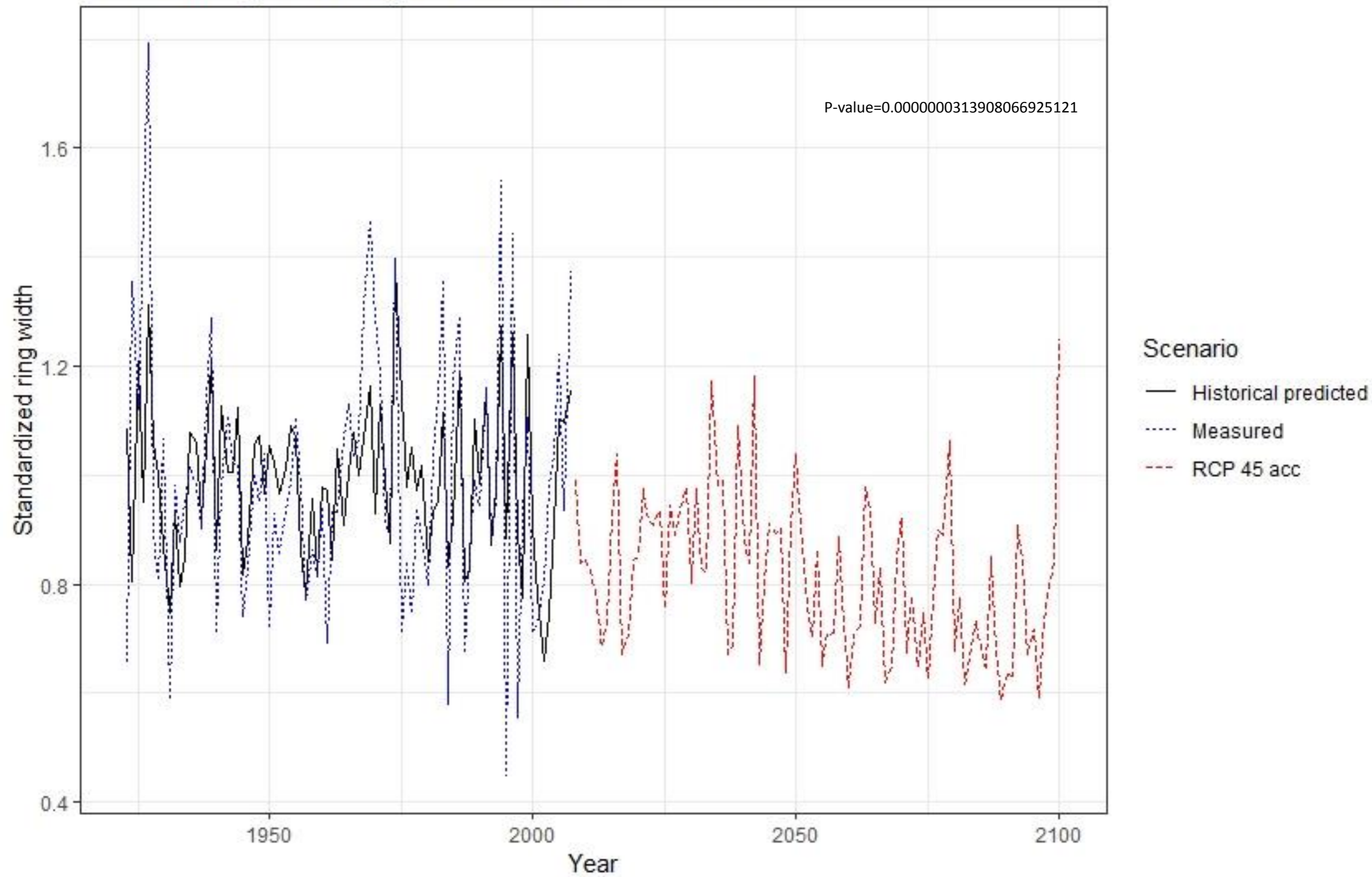
- Model fit
- K-fold cross validation

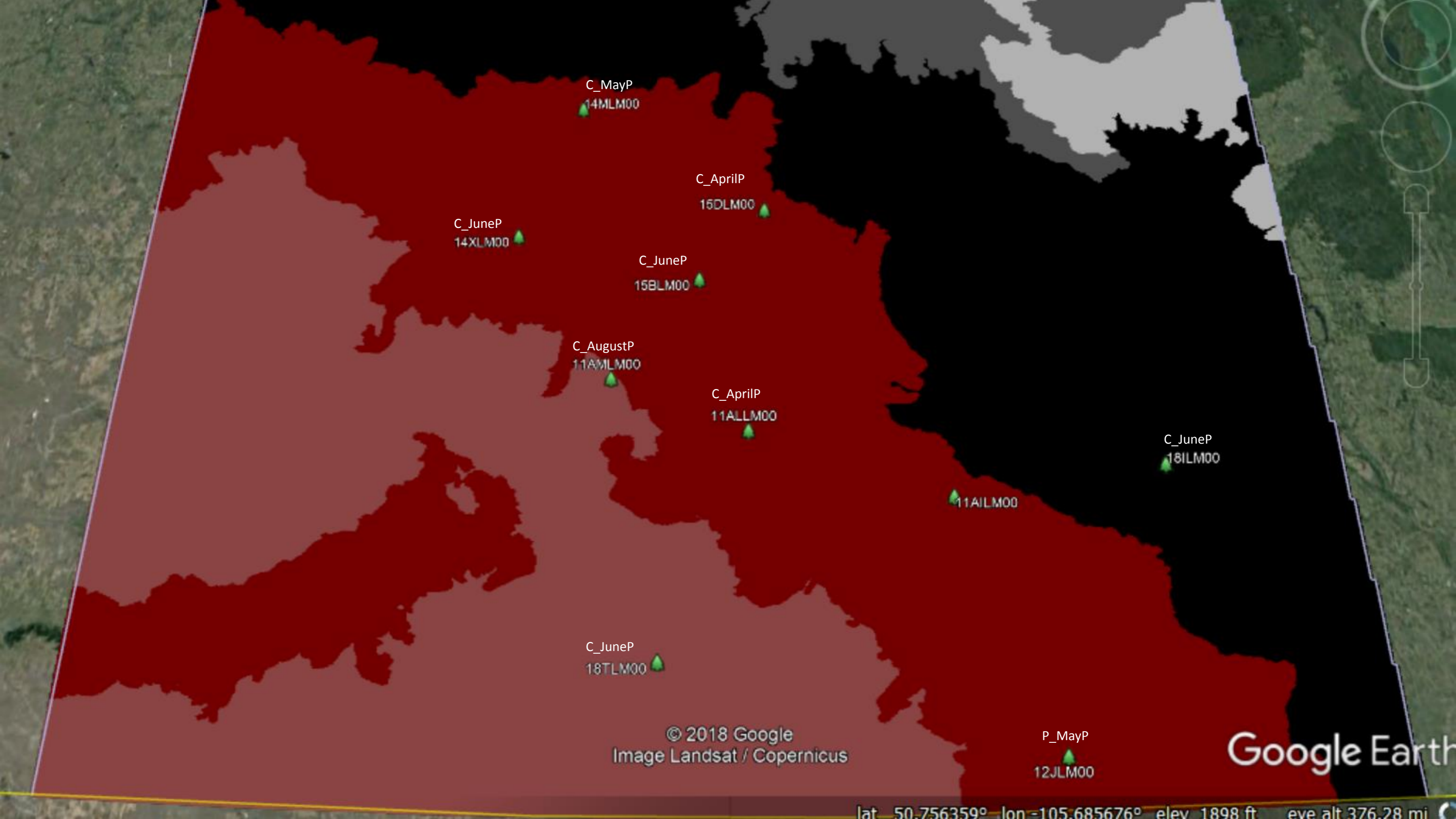


Relative Importance of Predictor Variables



Saskatoon - green ash growth for RCP 45 ACCESS





C_MayP
14MLM00

C_AprilP
15DLM00

C_JuneP
14XLM00

C_JuneP
15BLM00

C_AugustP
11AML00

C_AprilP
11ALLM00

C_JuneP
18BILM00

11AILM00

C_JuneP
18TLM00

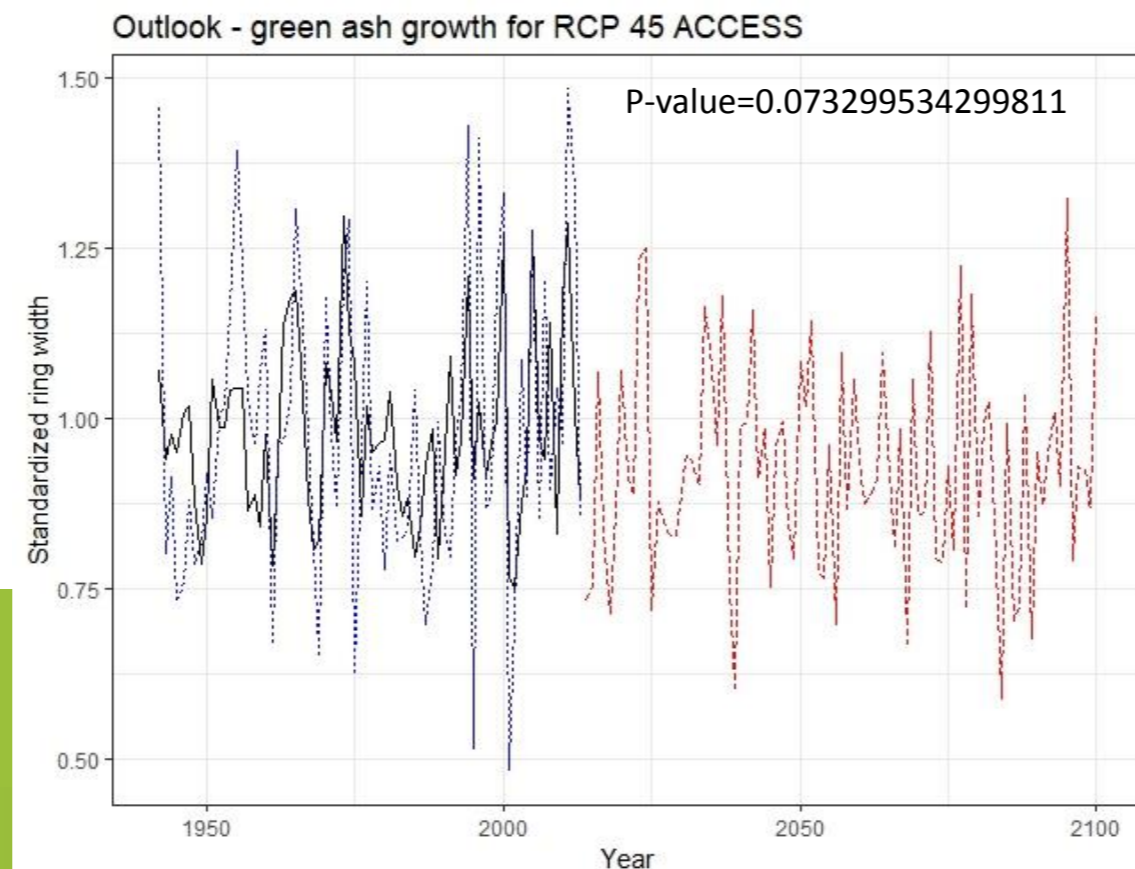
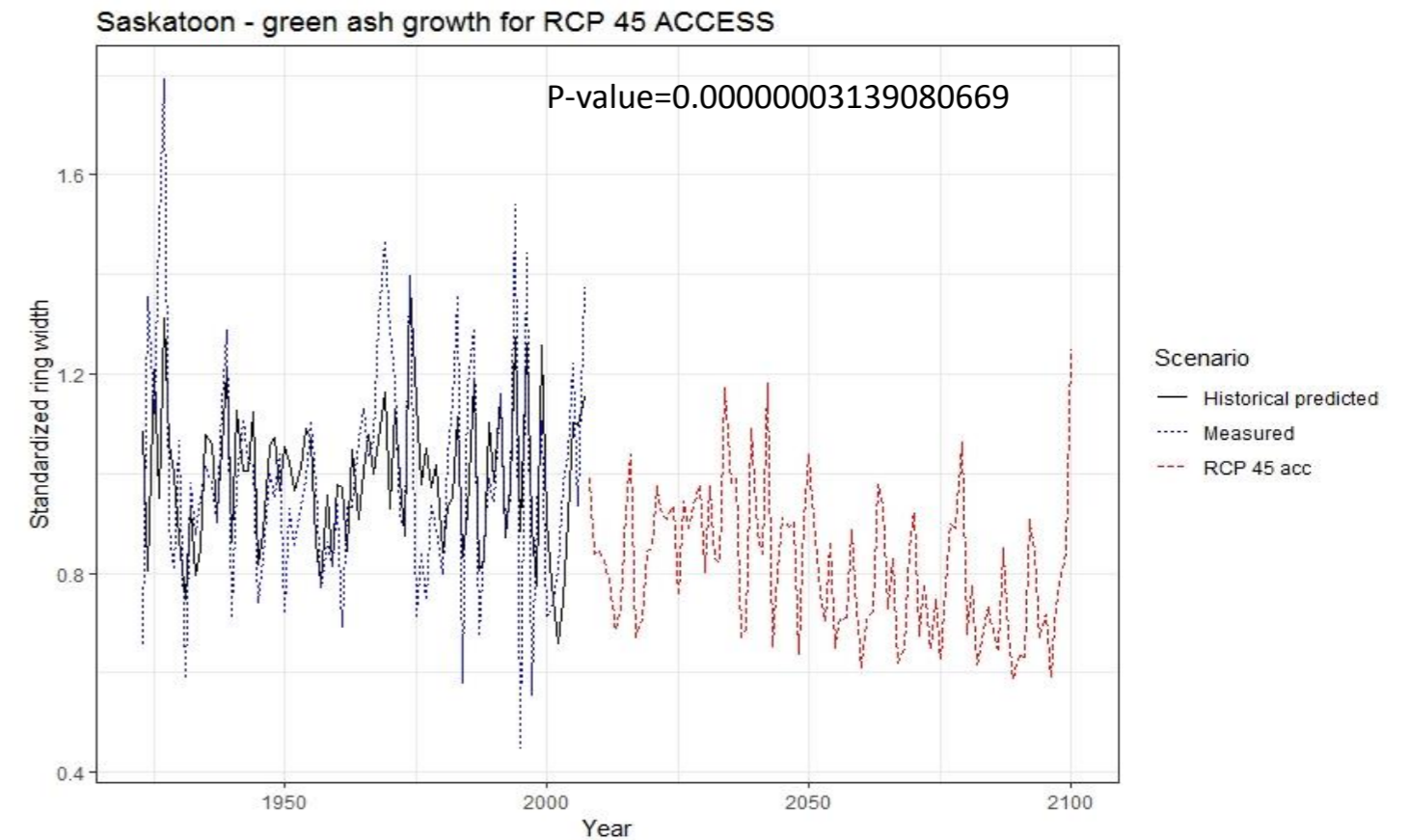
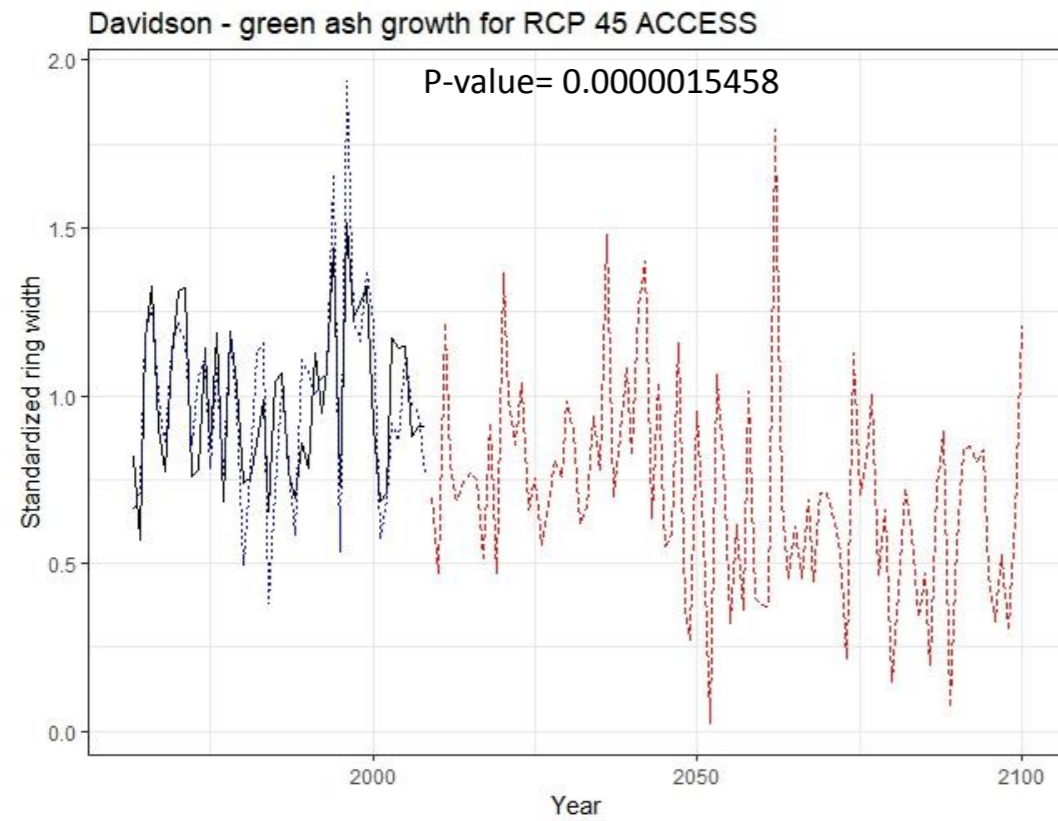
P_MayP
12JLM00

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Image Landsat / Copernicus

Google Earth

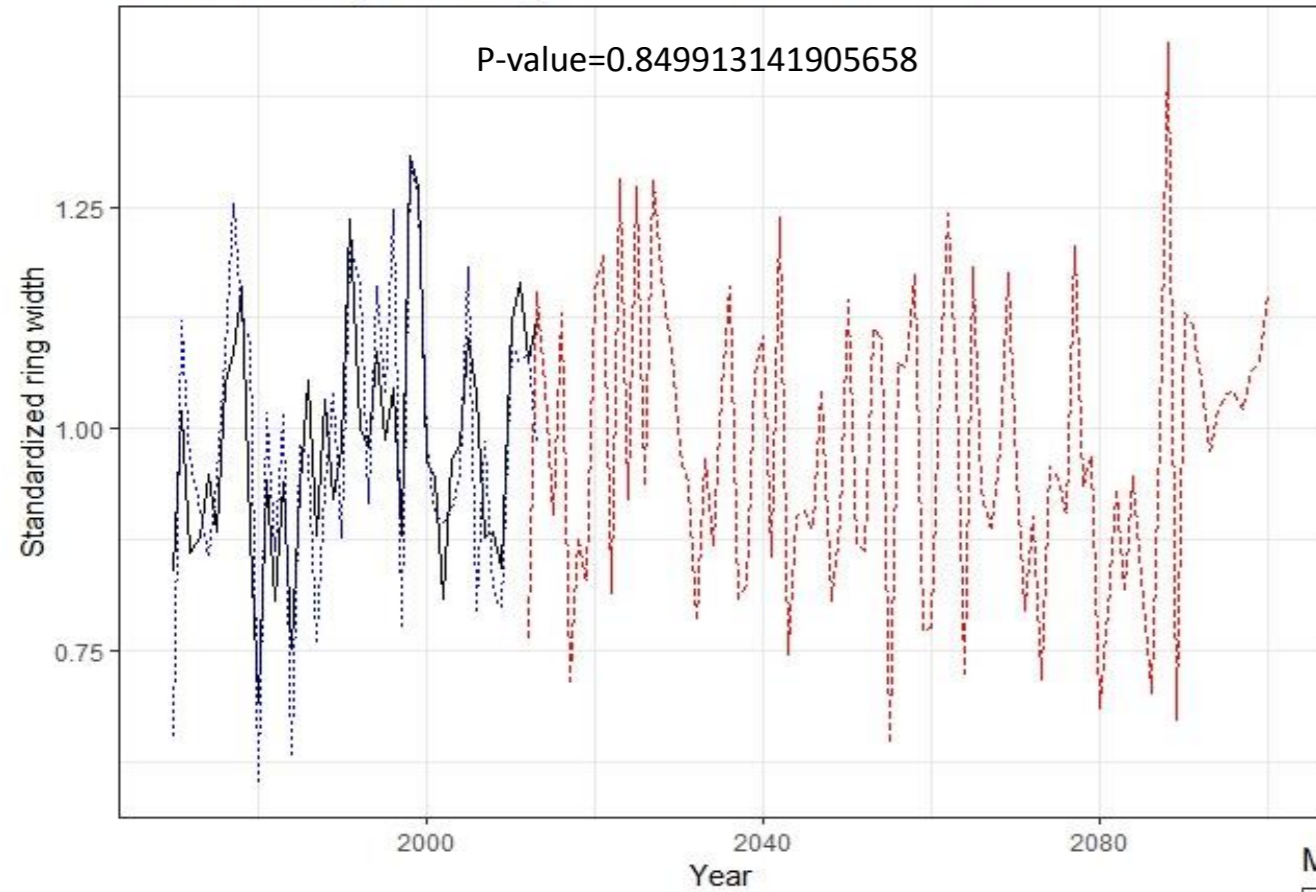
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Central Saskatchewan RCP 45 ACCESS1

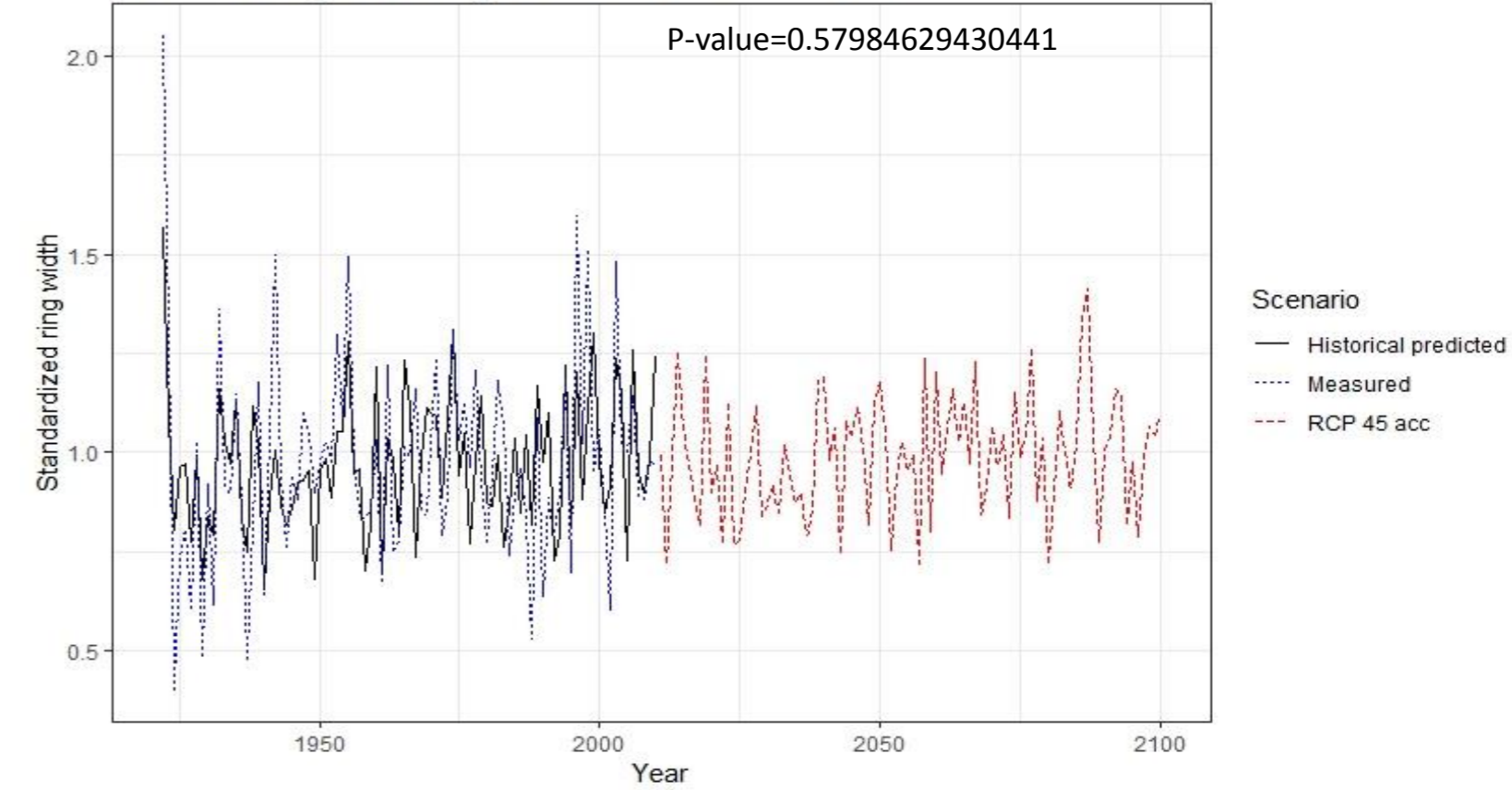


South-Central Saskatchewan RCP 45 ACCESS1

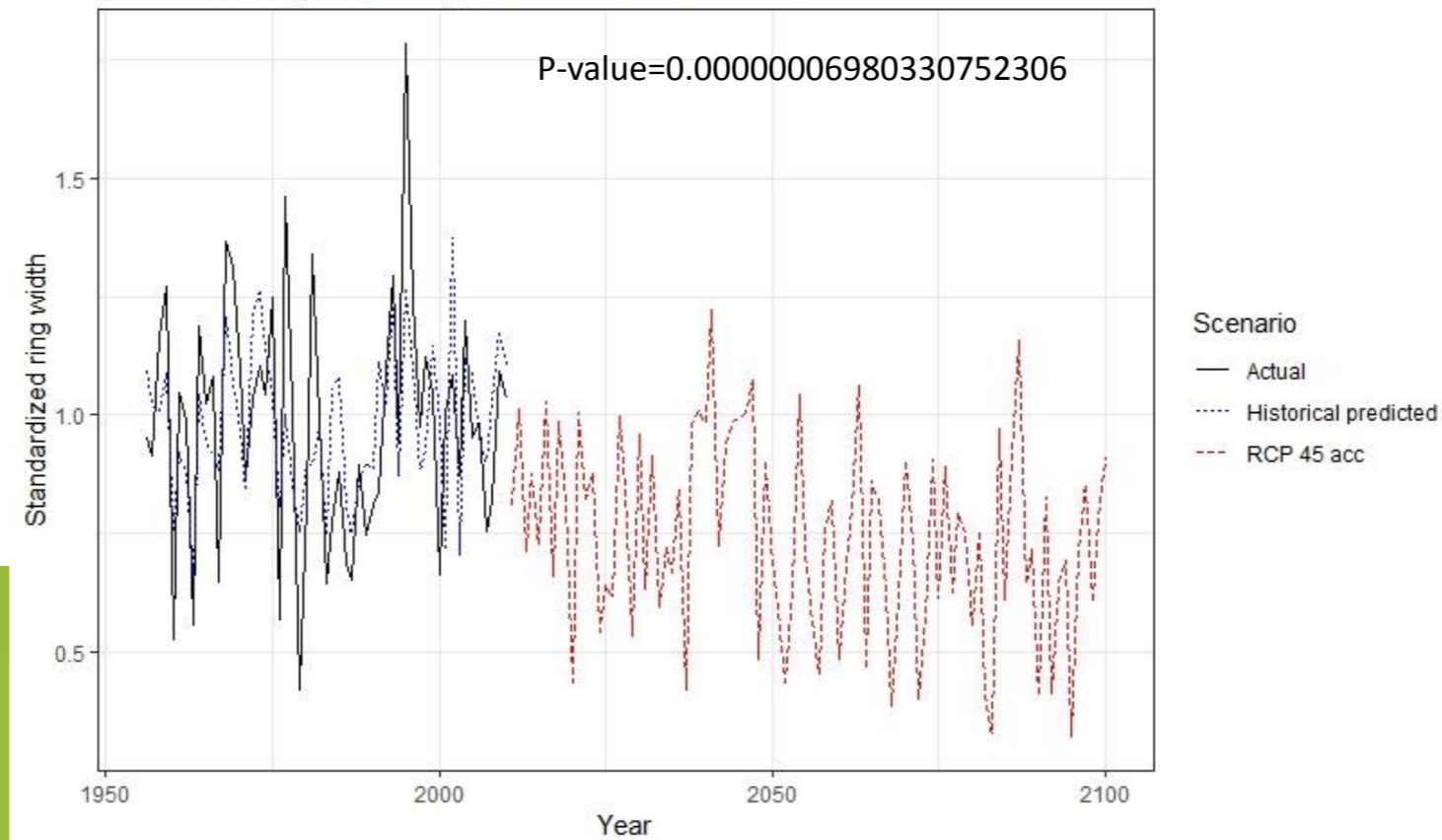
Indian Head - green ash growth for RCP 45 ACCESS



Moose Jaw - green ash growth for RCP 45 ACCESS

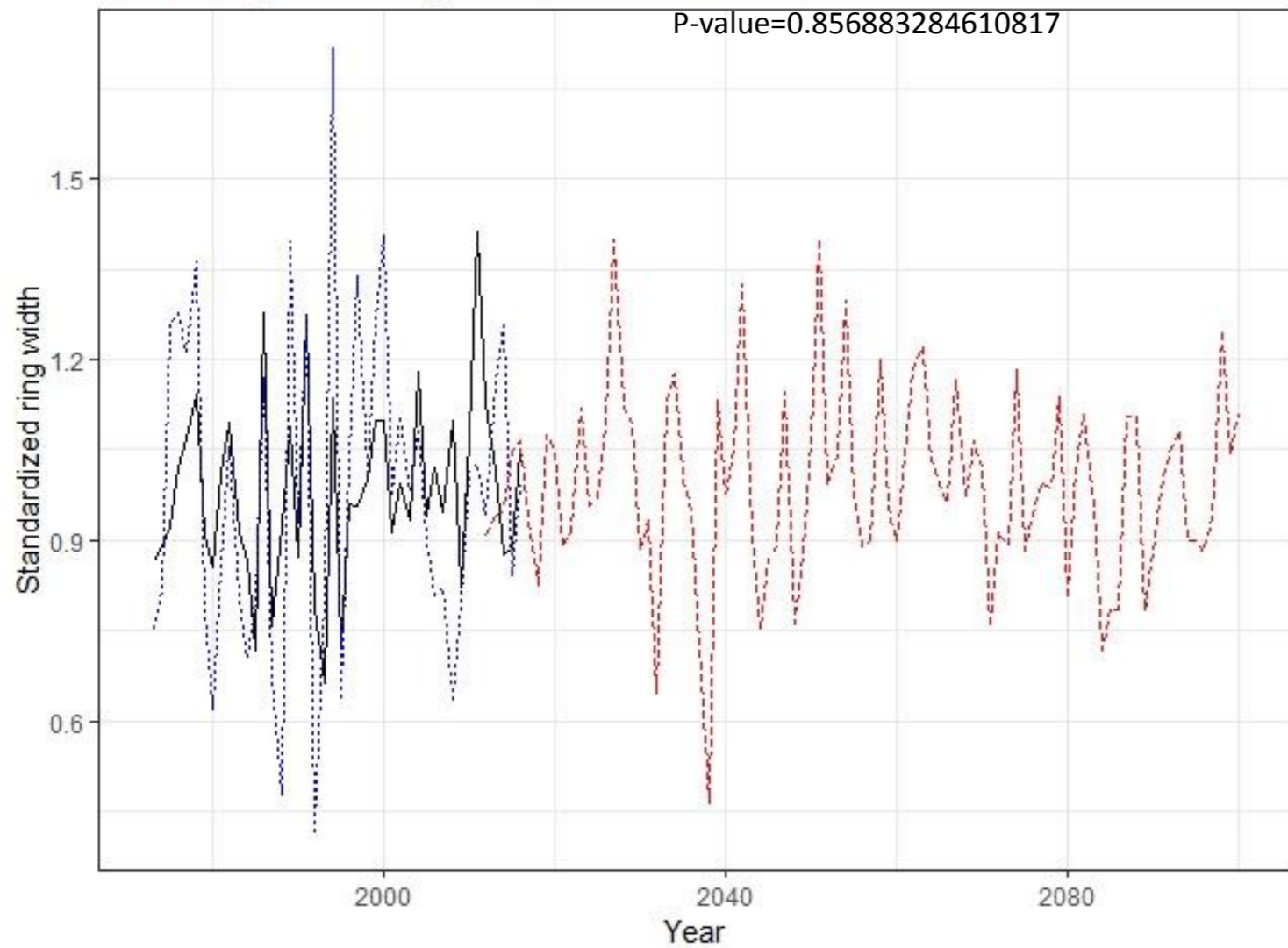


Moose Jaw - green ash growth for RCP 45 ACCESS

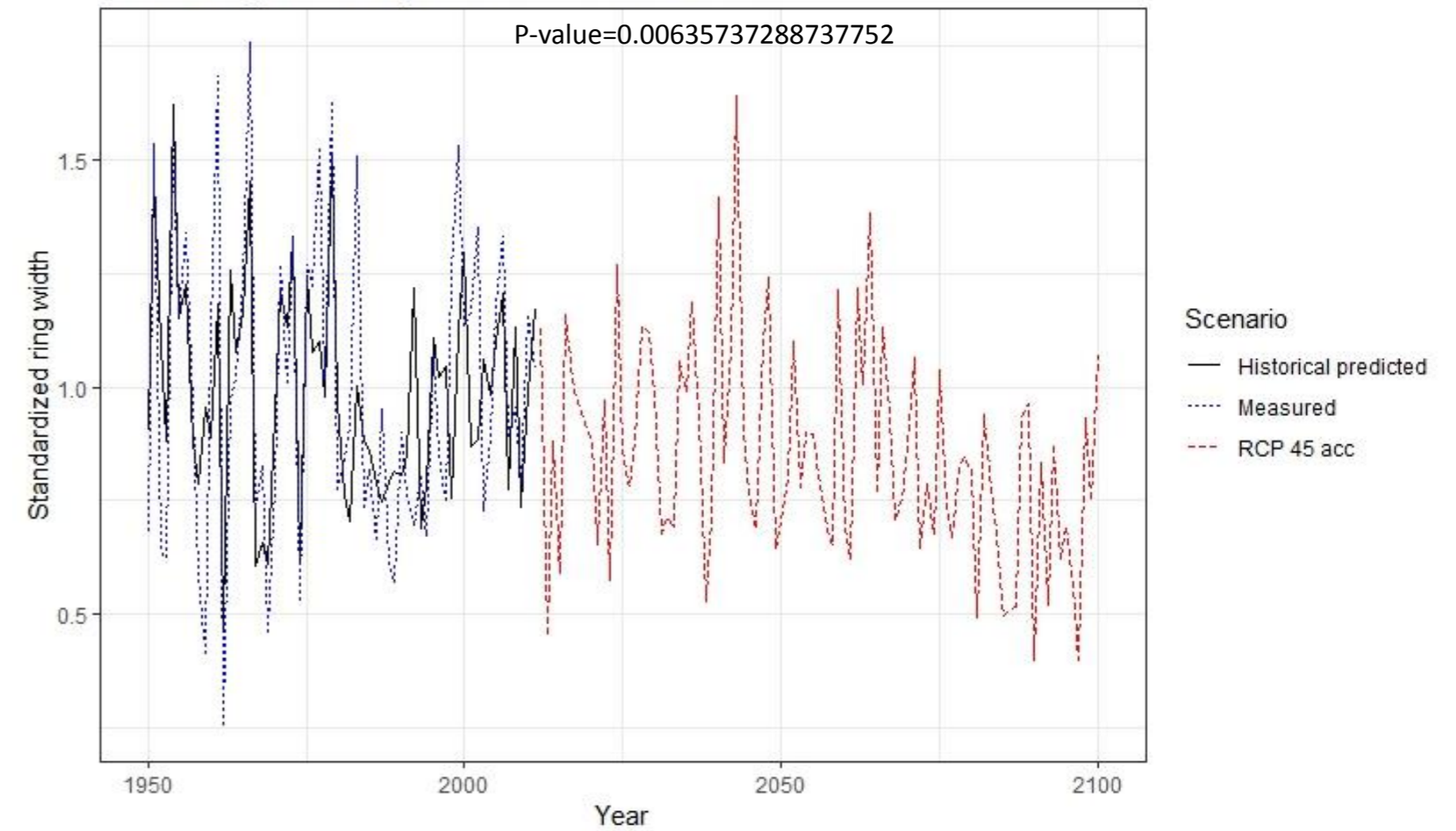


Southern Saskatchewan RCP 45 ACCESS1

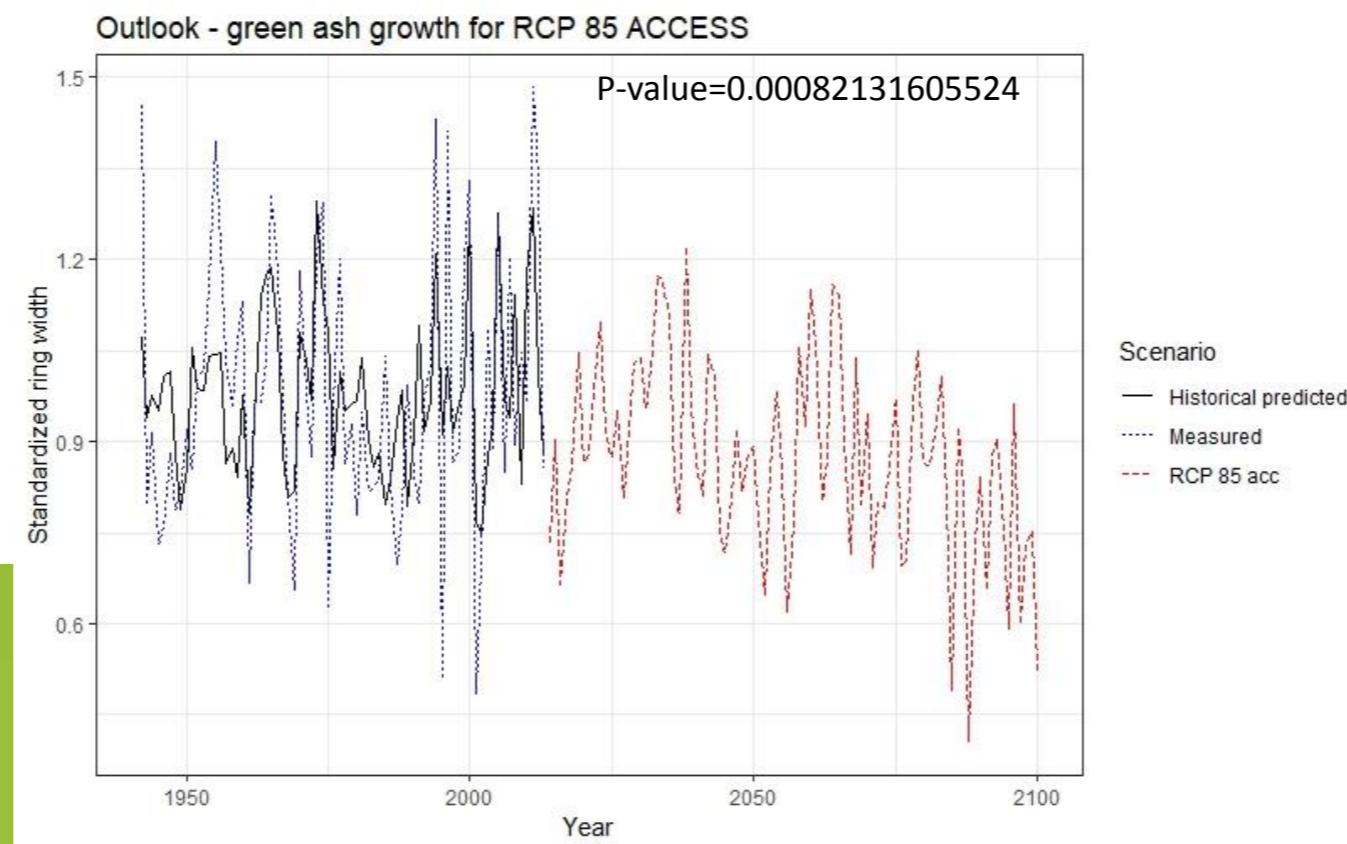
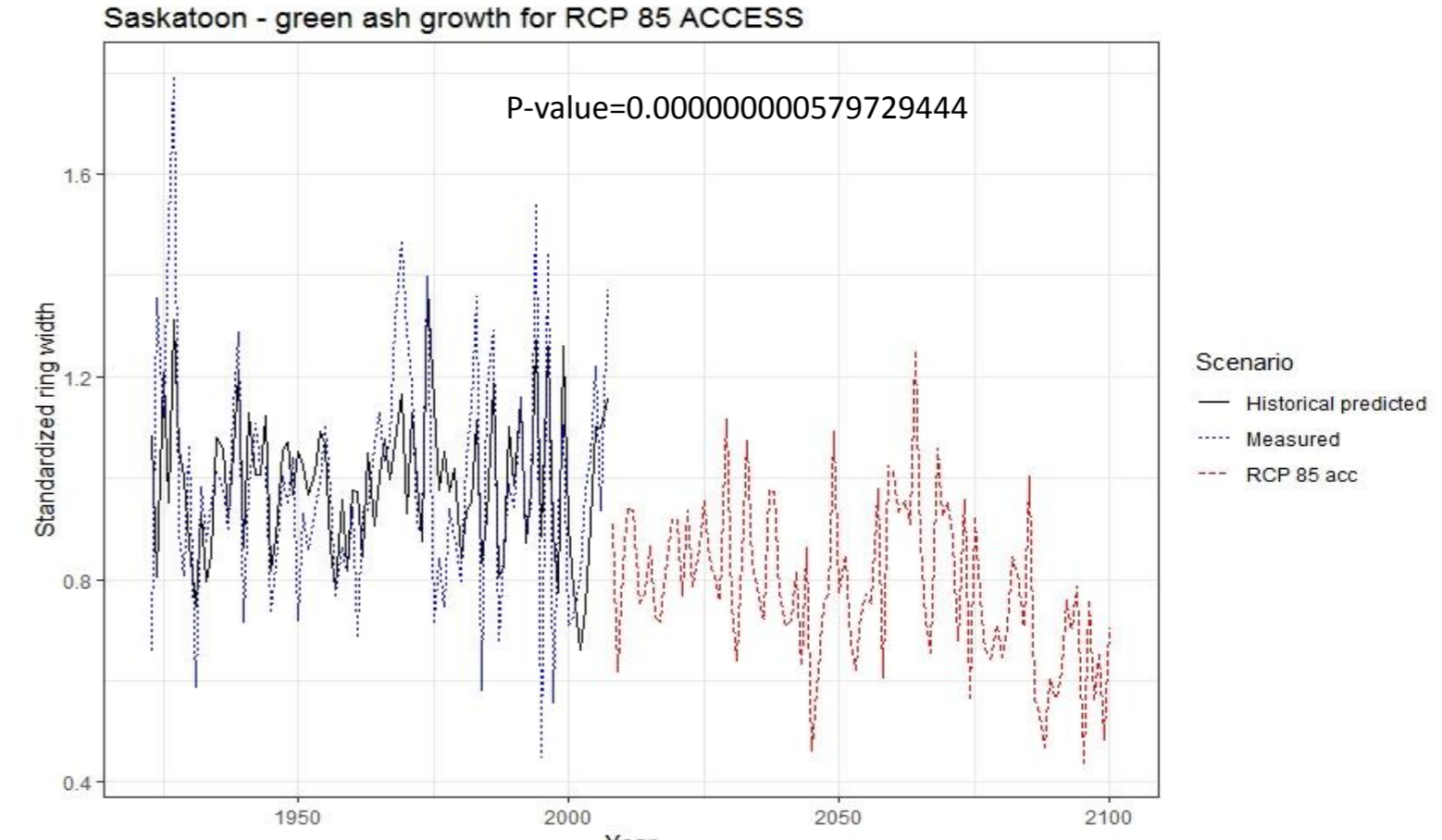
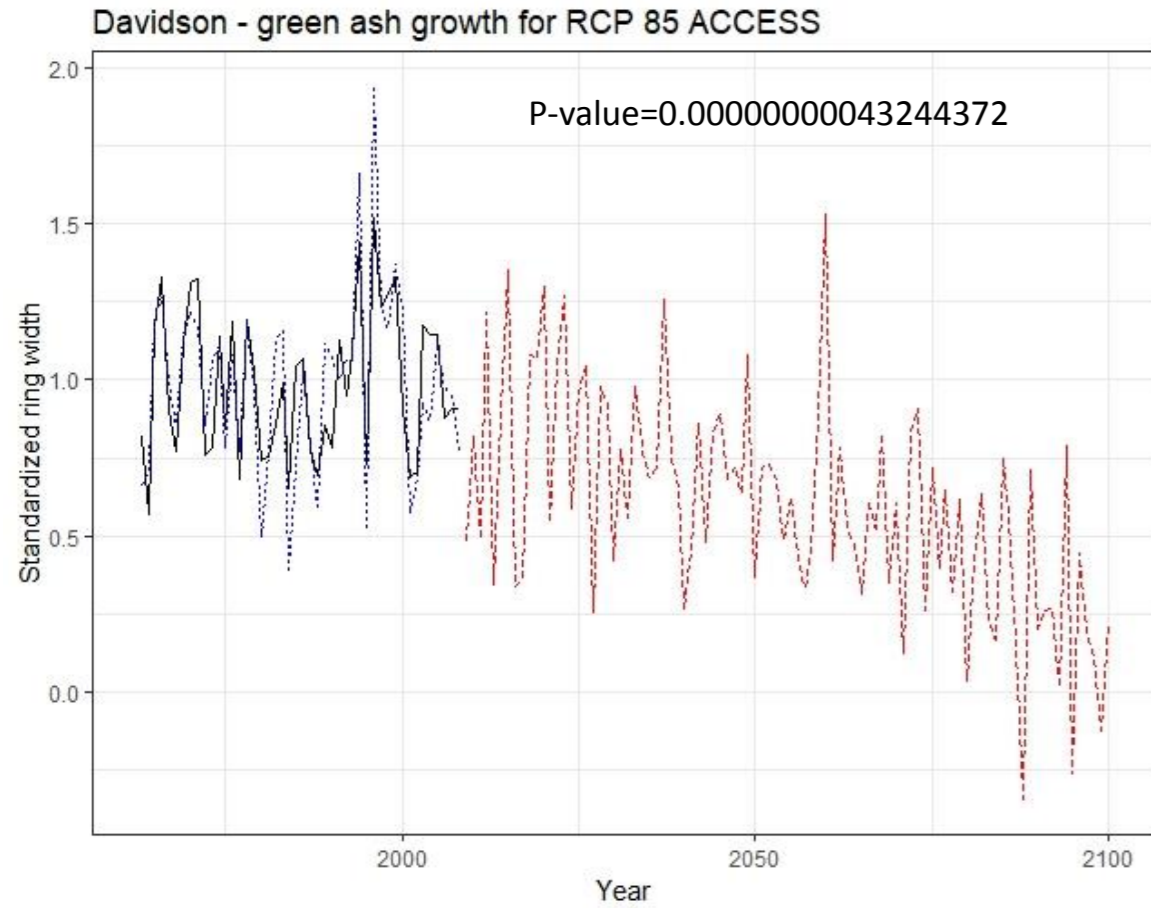
Aneroid - green ash growth for RCP 45 ACCESS



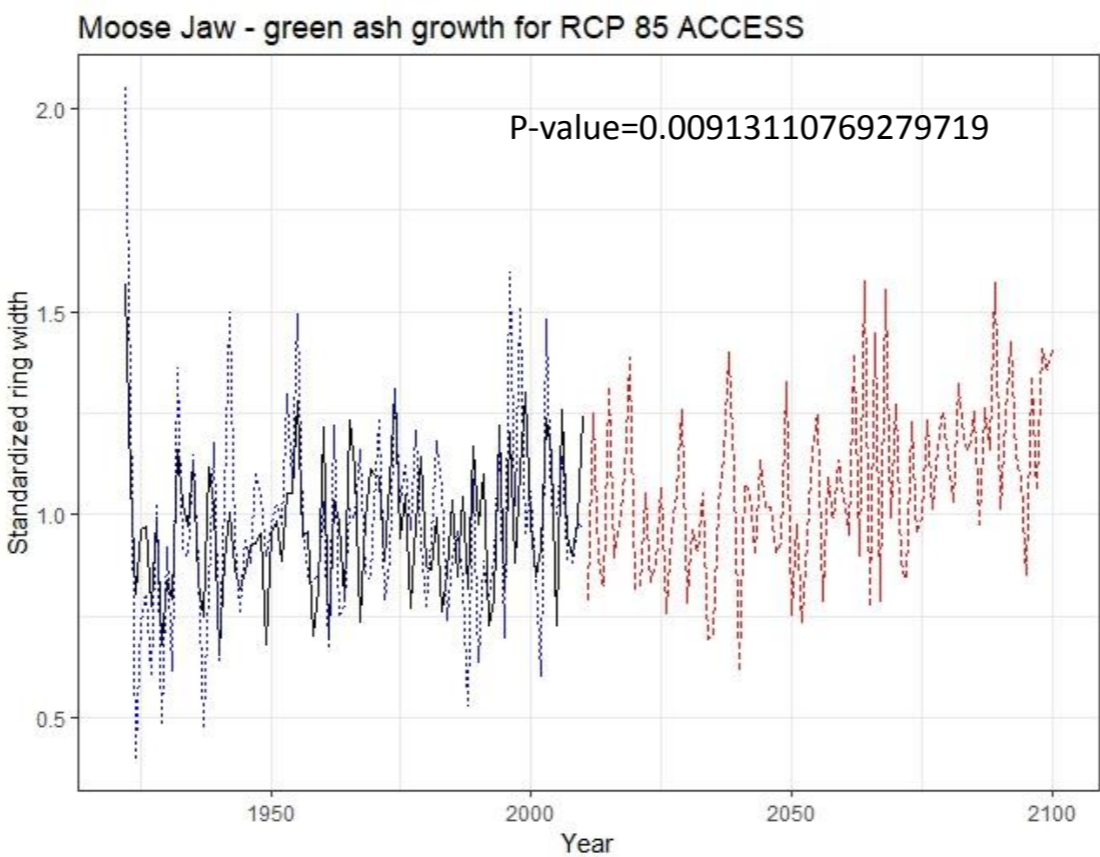
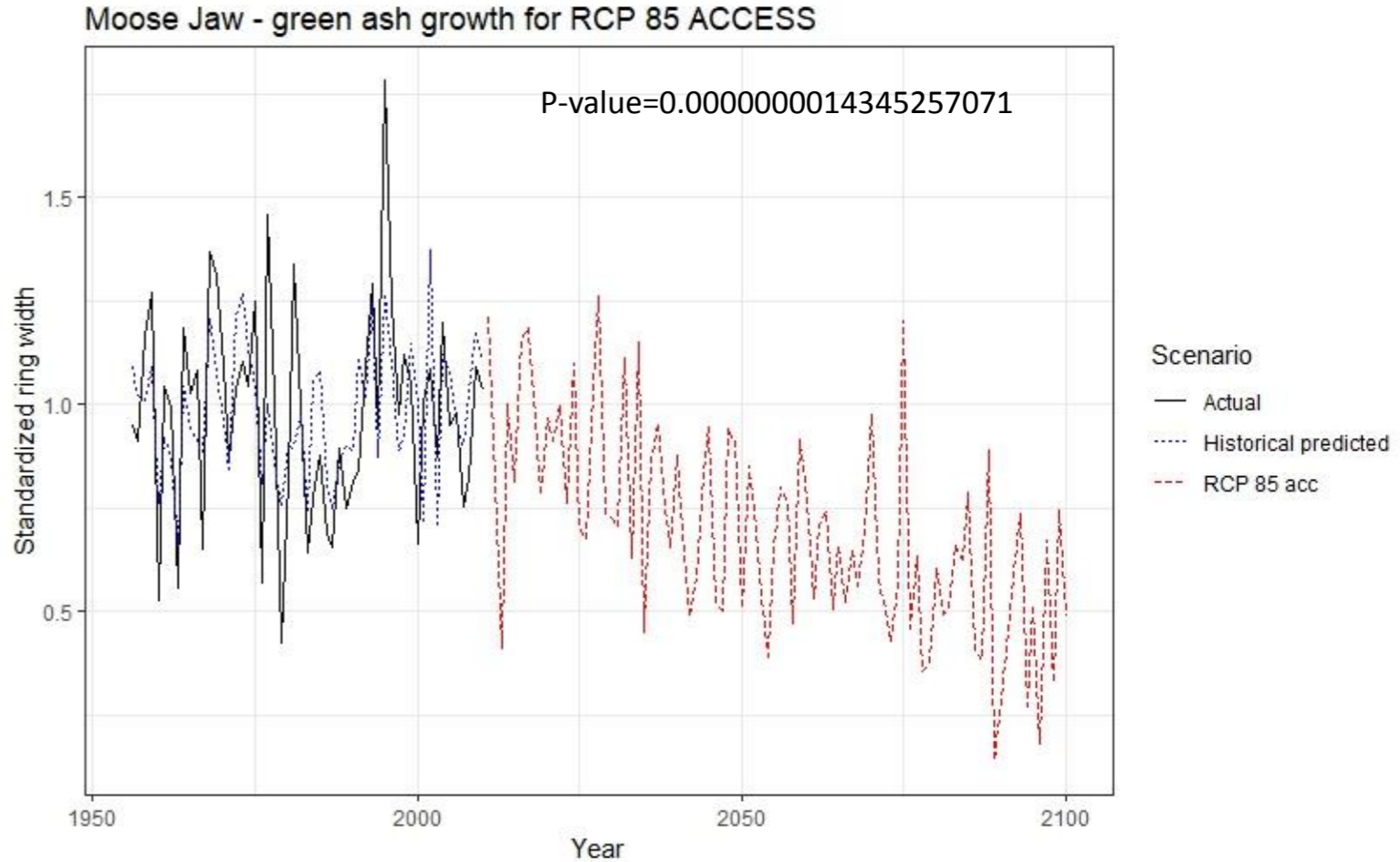
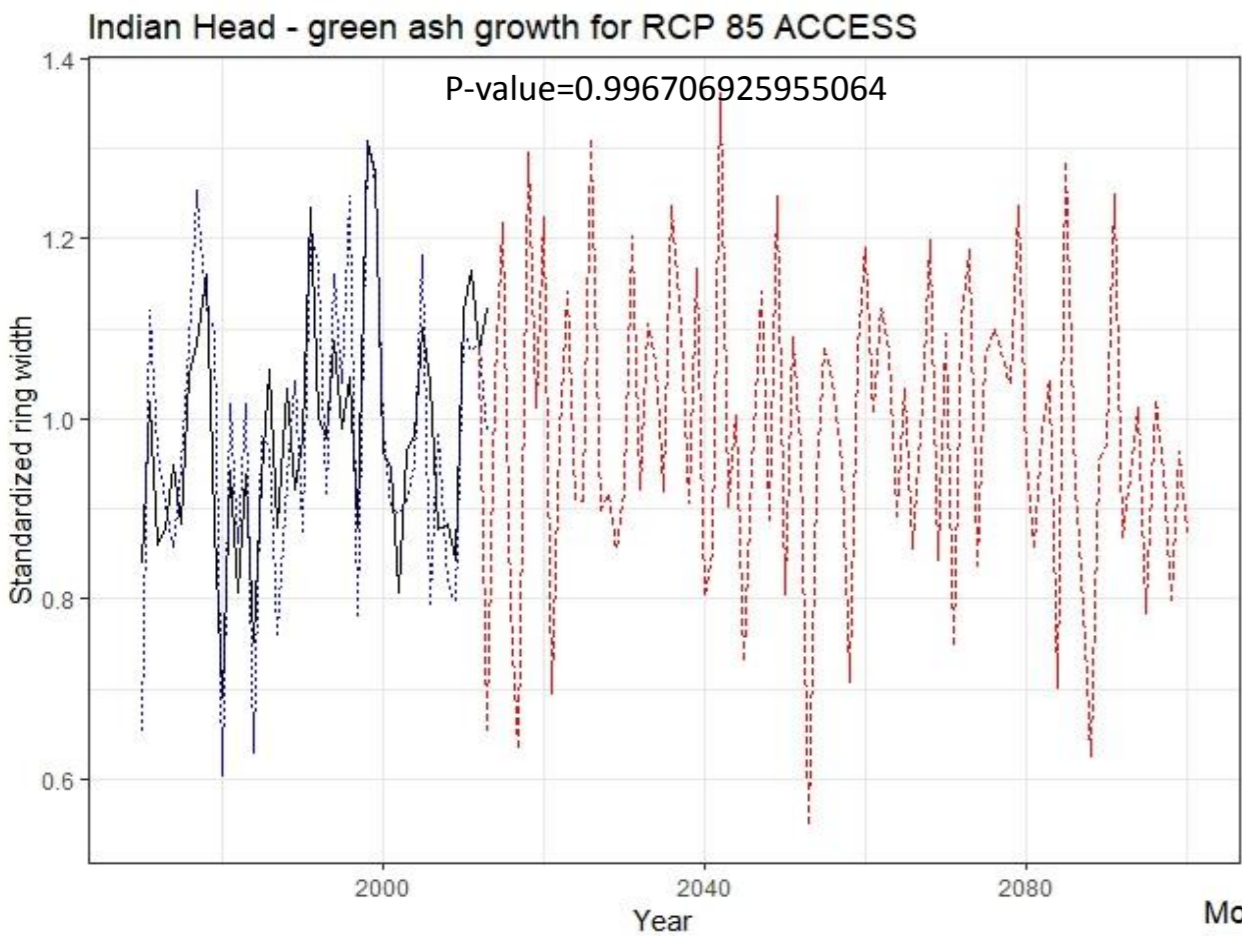
Estevan - green ash growth for RCP 45 ACCESS



Central Saskatchewan RCP 85 ACCESS1

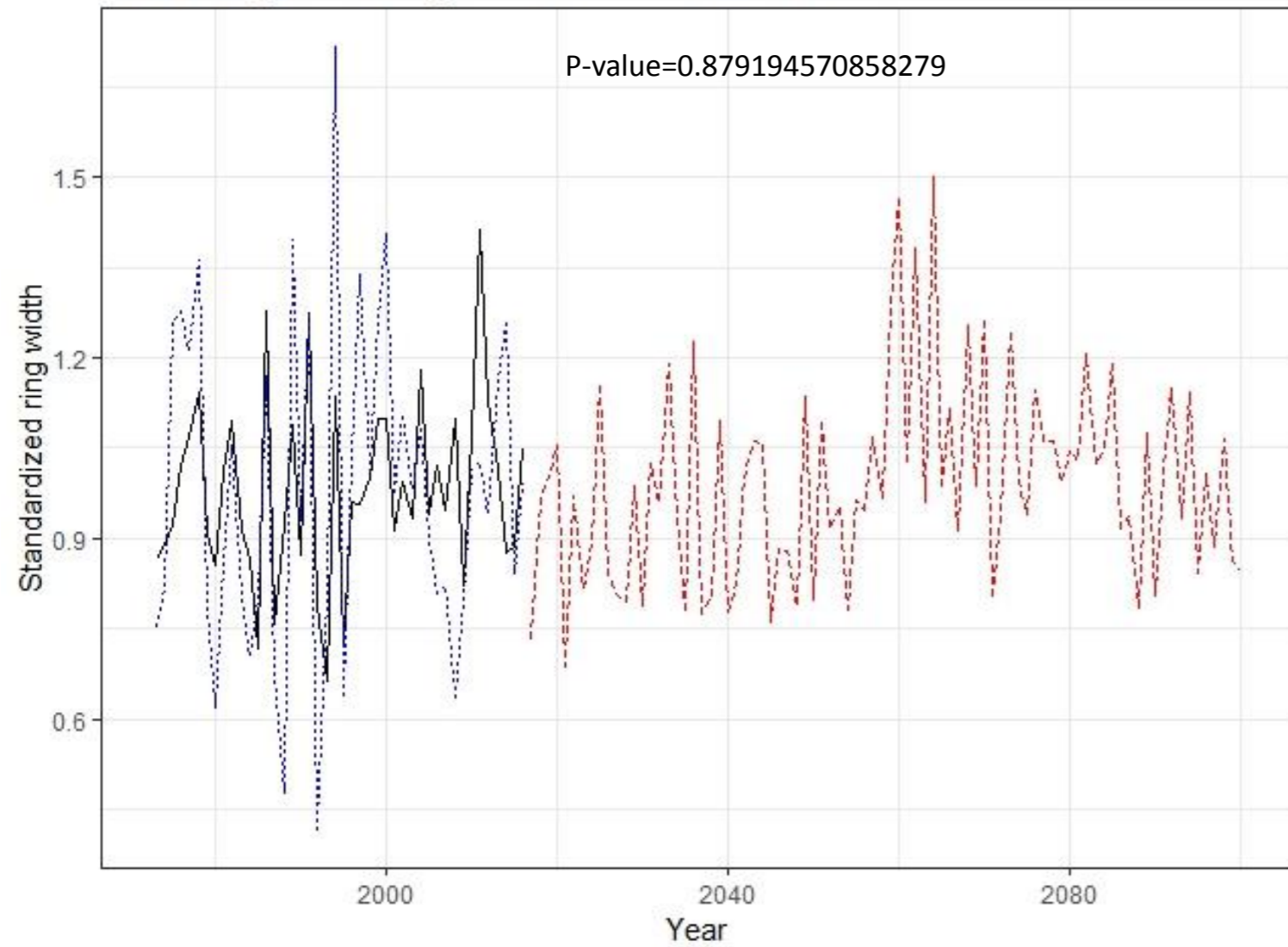


South-Central Saskatchewan RCP 85 Access 1

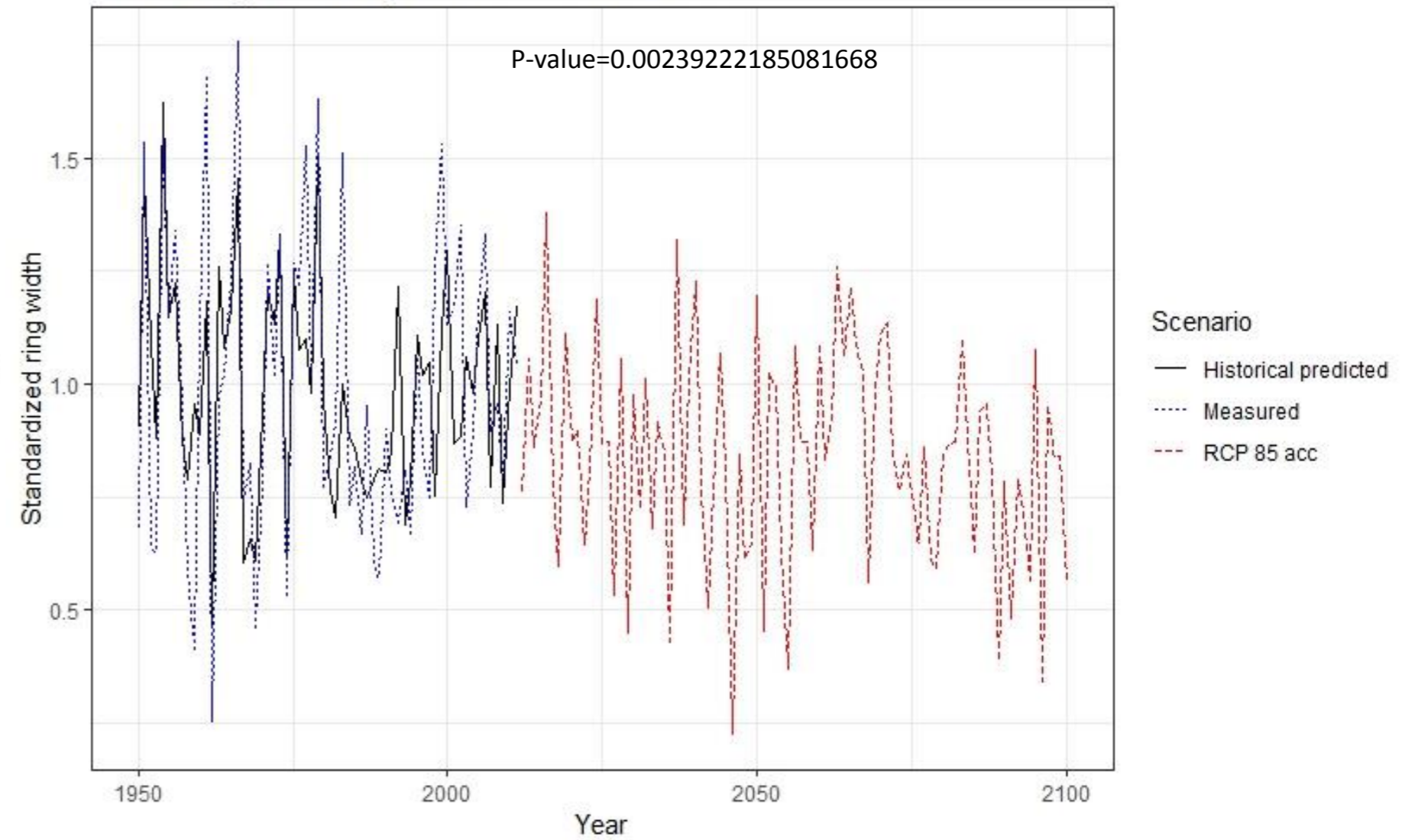


Southern Saskatchewan RCP 85 ACCESS1

Aneroid - green ash growth for RCP 85 ACCESS



Estevan - green ash growth for RCP 85 ACCESS



Summary of Results

- Current spring precipitation most influence on radial growth of green ash
- May be a trend of decreasing green ash growth northward



Acknowledgments

- Supervisor: Colin Laroque
- Committee members: Katherine Stewart and Ken Van Rees
- Ian McConkey
- Beyhan Amichev
- Murray Bentham and Paul Krug
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- Mad Lab Crew



Questions??

