

Projected Climate Change Impacts to Floodplain Forests in the Twin Cities Metro

Leslie Brandt

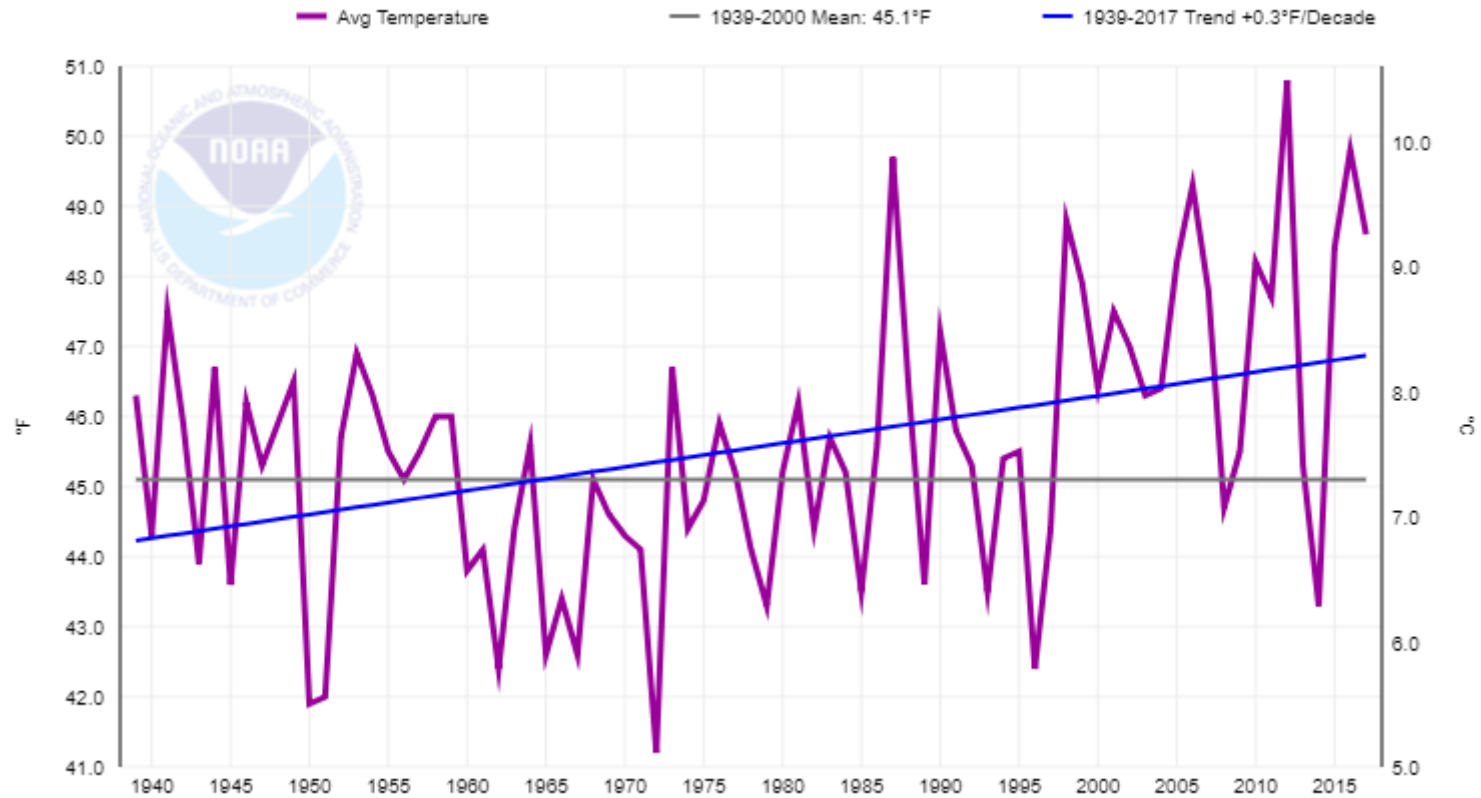
Northern Institute of Applied Climate
Science

US Forest Service

Current Trends

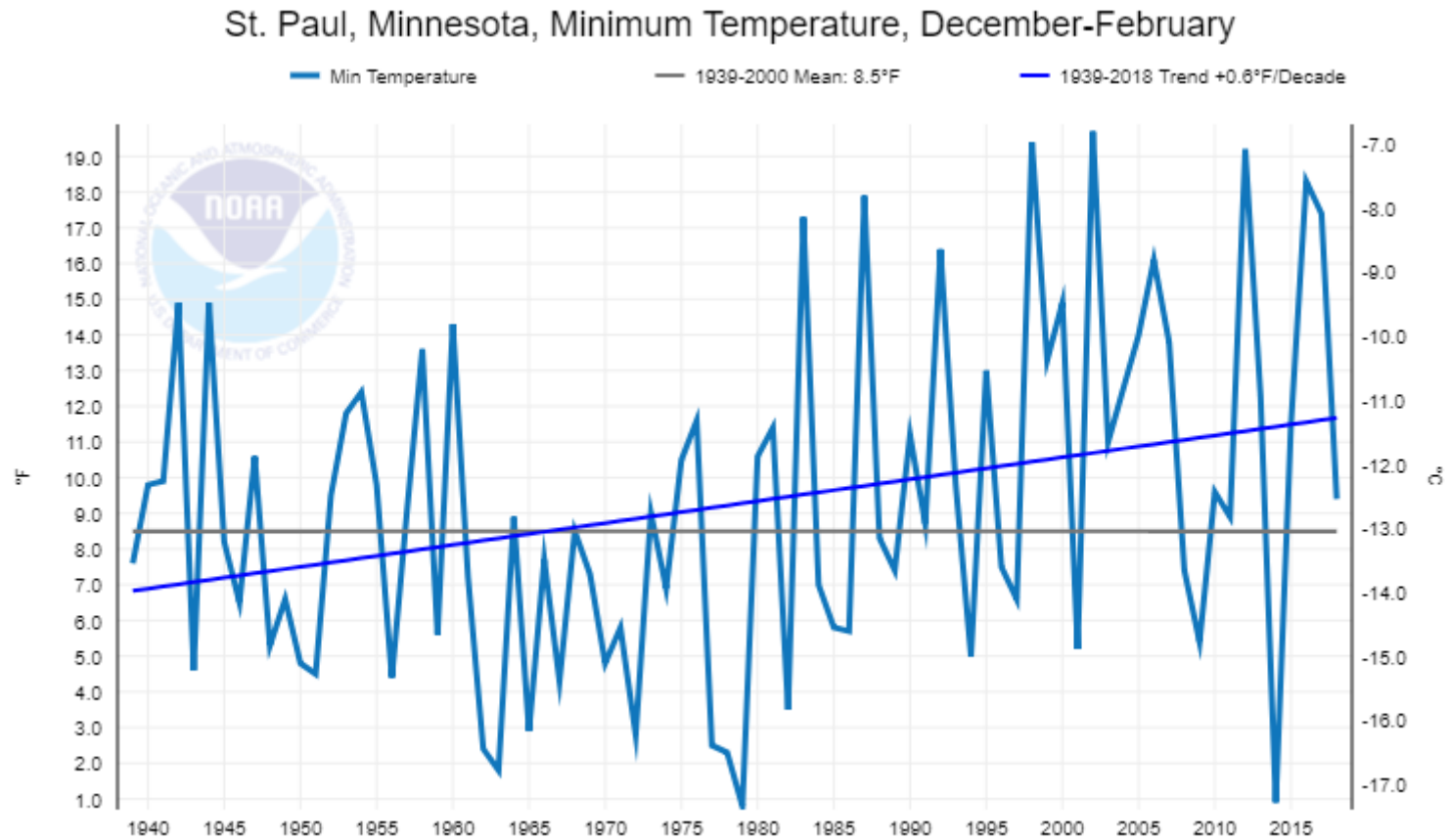
Temperatures are rising

St. Paul, Minnesota, Average Temperature, January-December



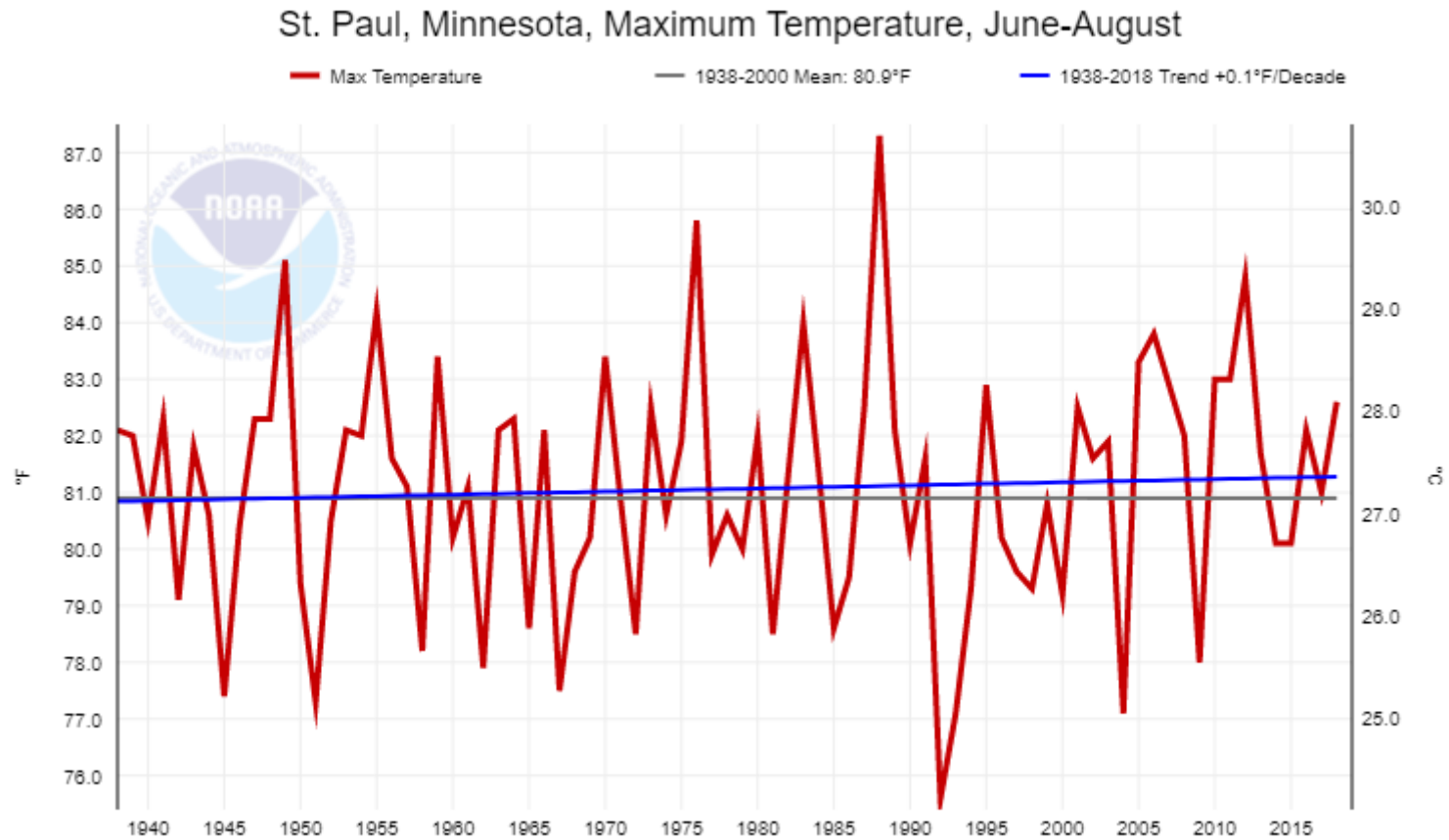
Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

Winter lows are increasing most



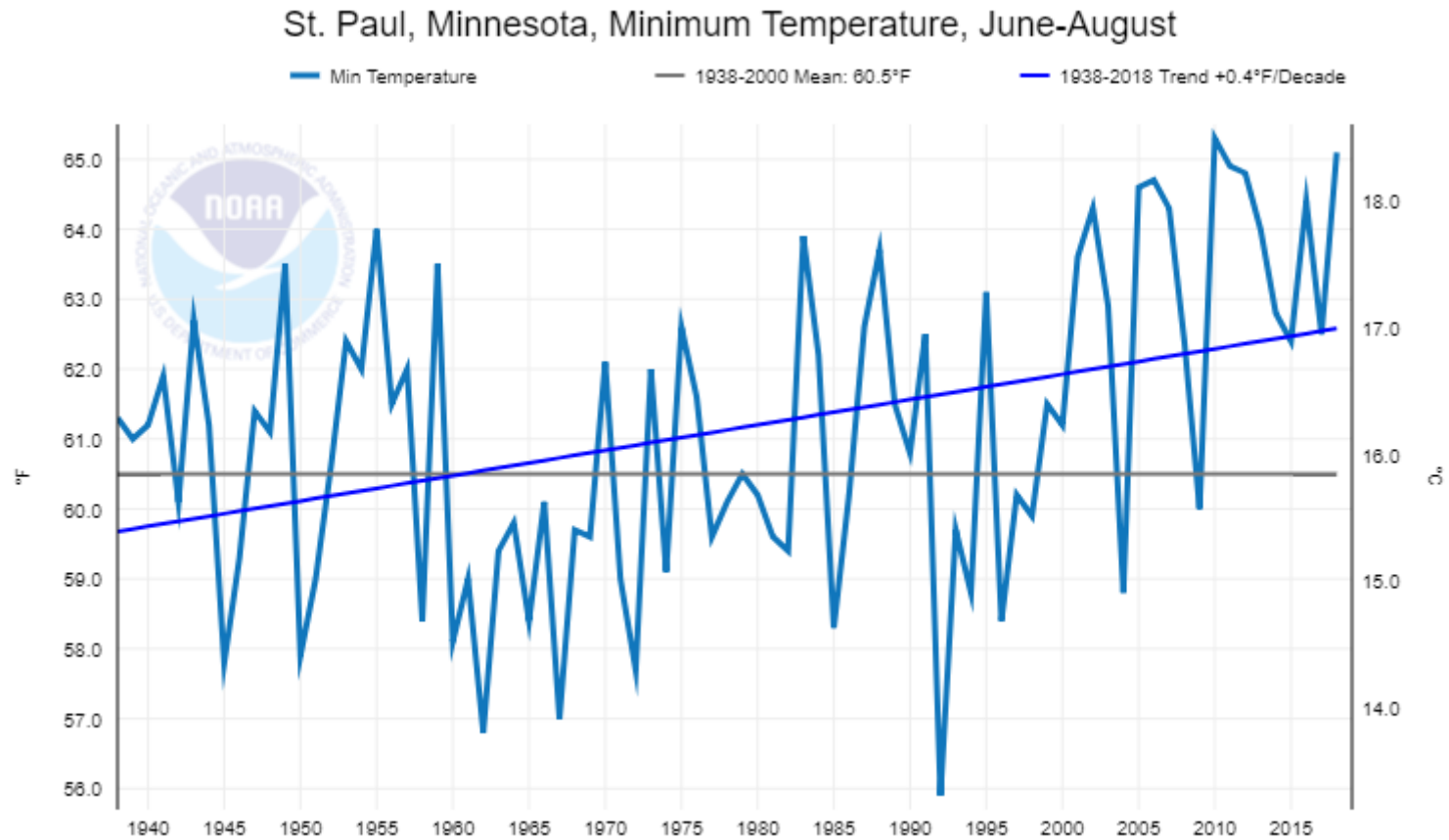
Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

Summer highs are not changing much



Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

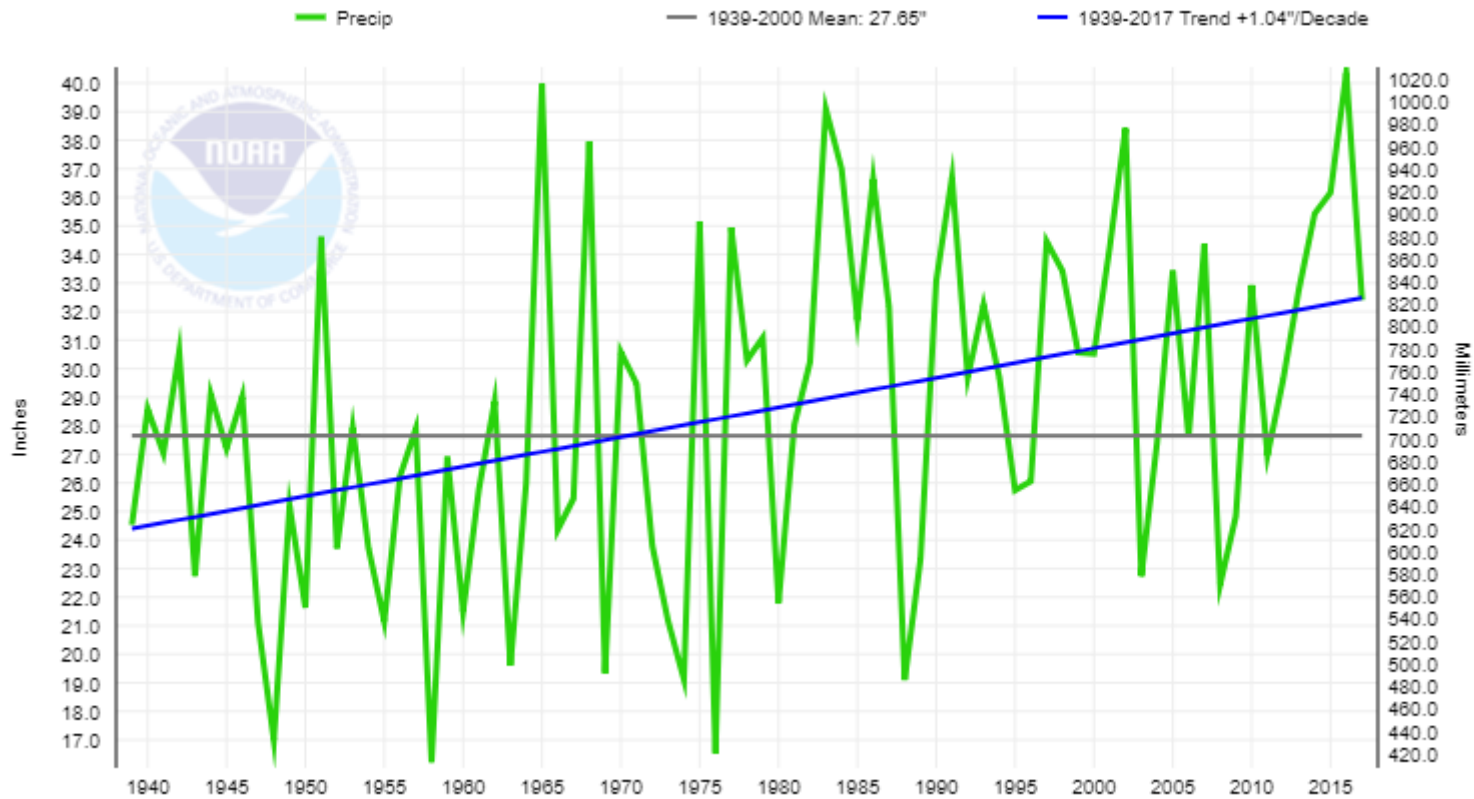
Summer lows are increasing



Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

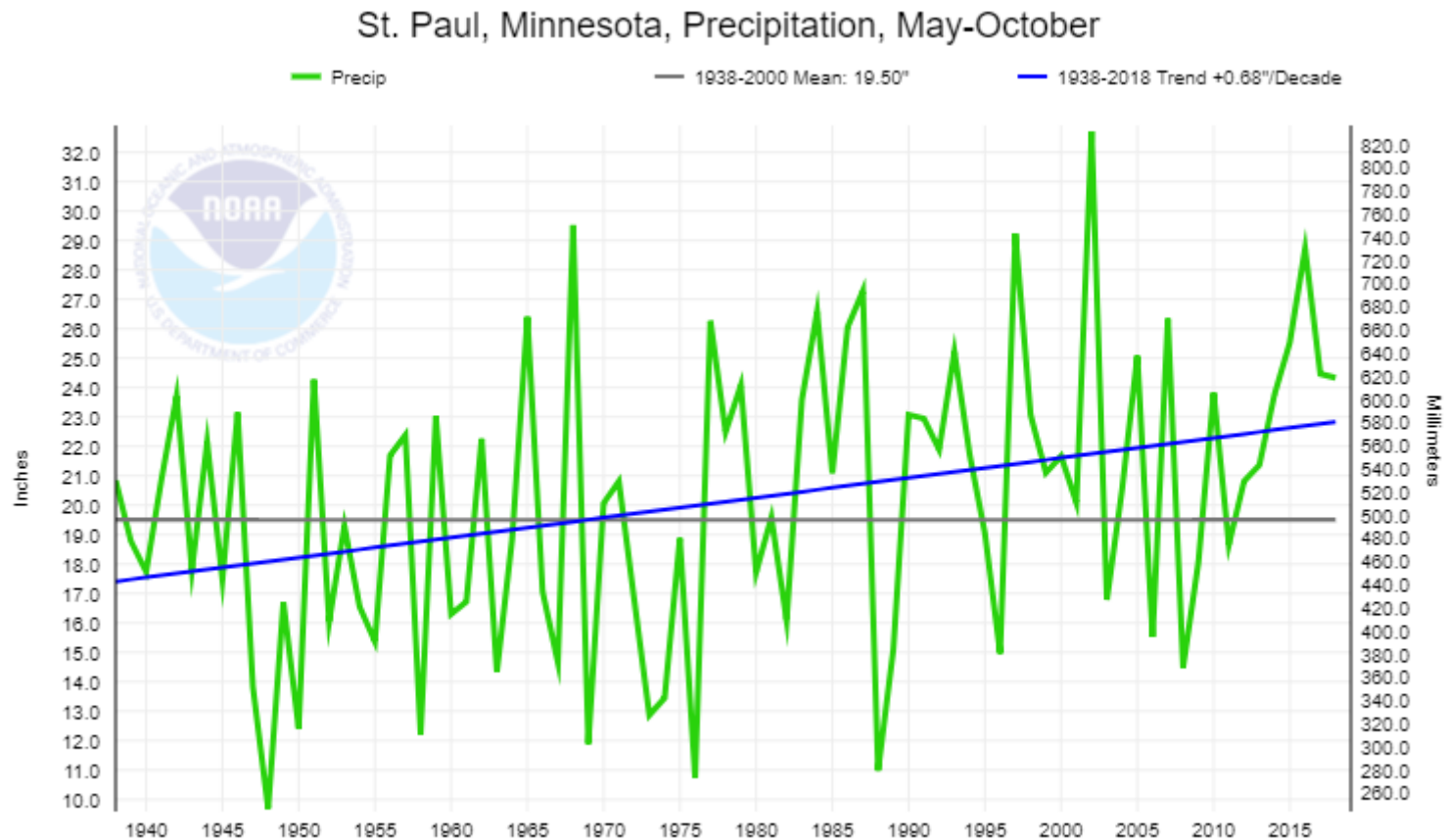
It's getting wetter!

St. Paul, Minnesota, Precipitation, January-December



Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

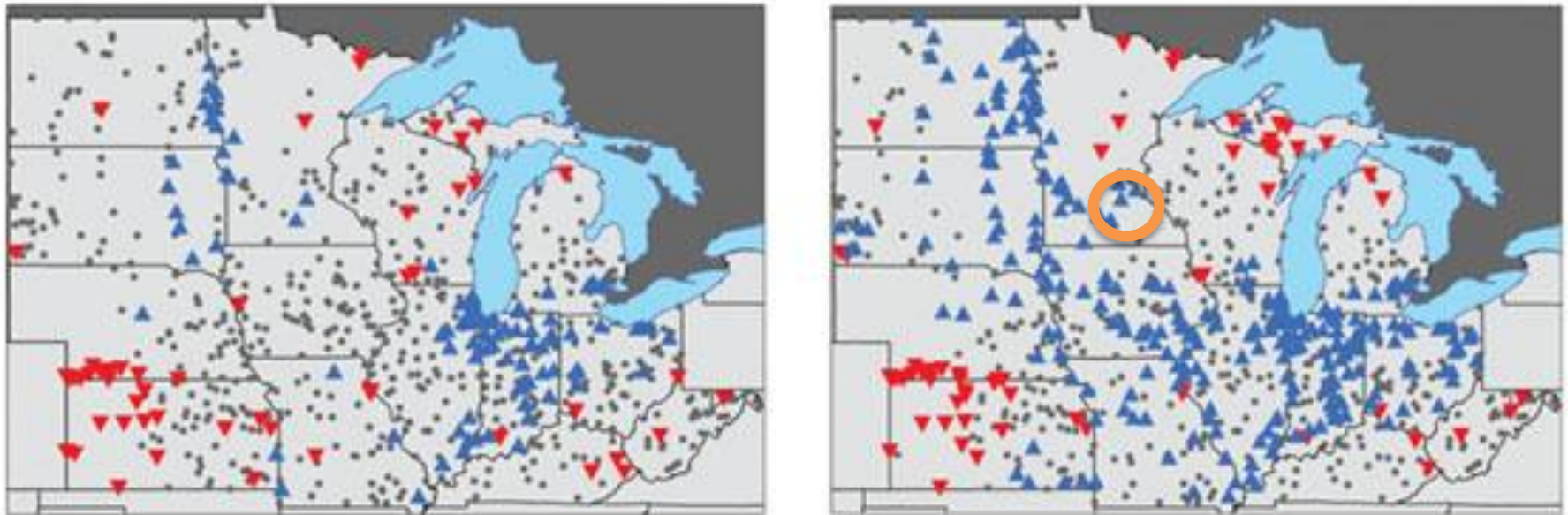
...Including During the Growing Season



Source: <https://www.ncdc.noaa.gov/cag/global/time-series>

Floods are more frequent

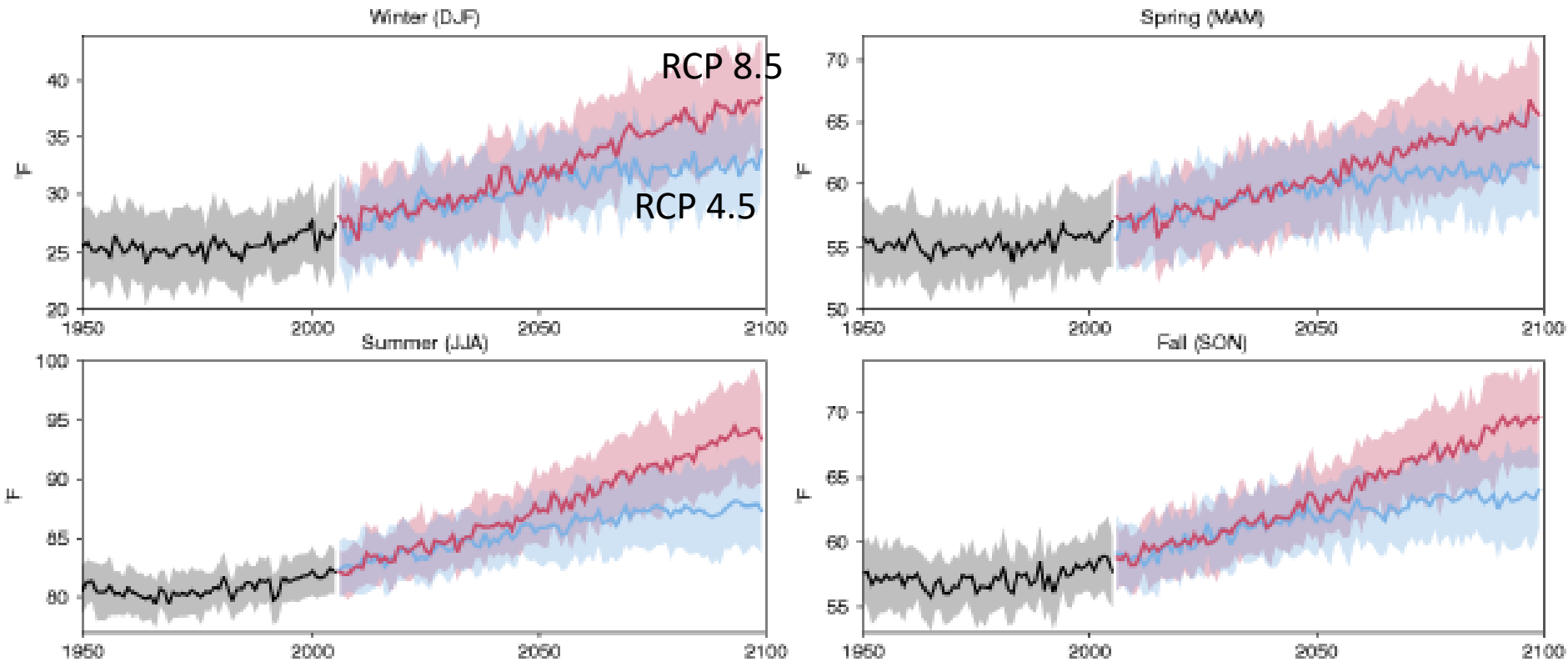
Flood magnitude and frequency in the central U.S., 1962-2011



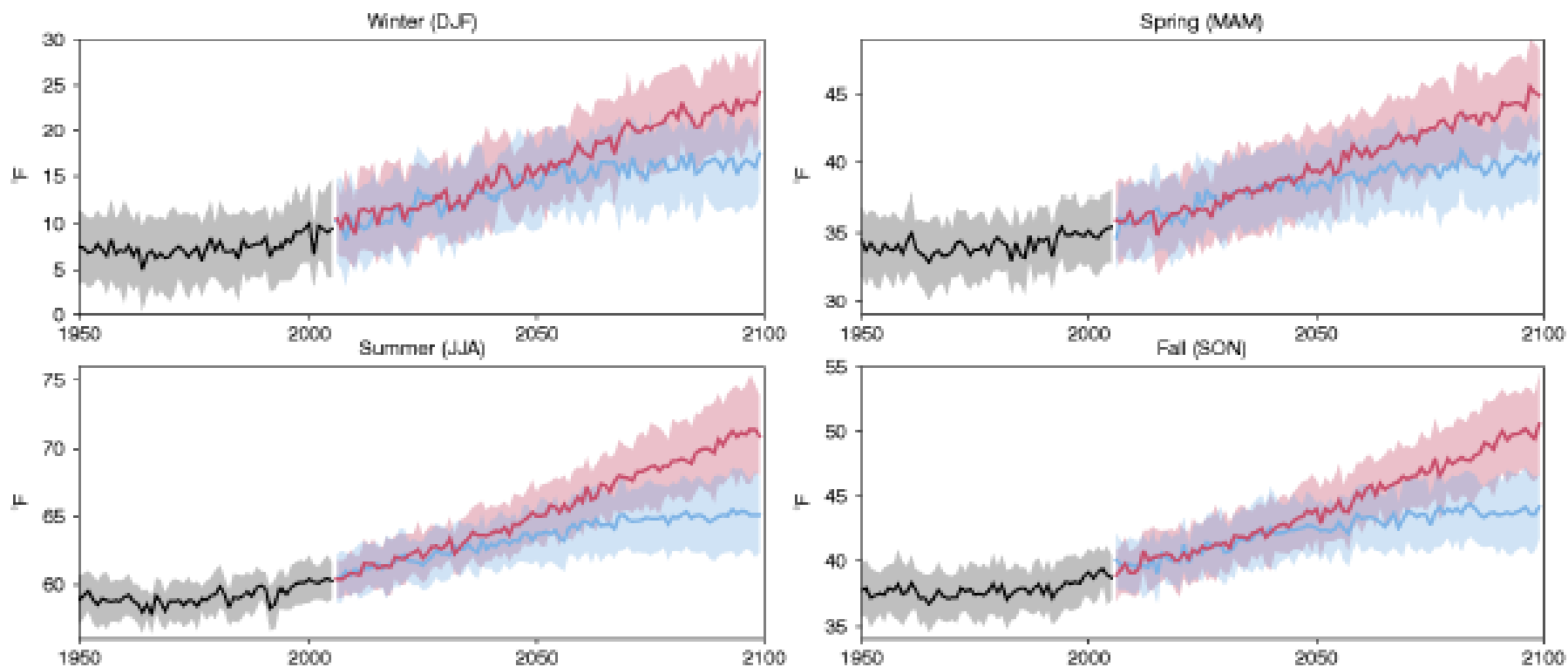
Changes in flood magnitude (left) and frequency (right). Blue indicates increasing frequency and red shows decreasing frequency. Credit: *Nature Climate Change*, 2015.

Looking Forward

Daily Maximum Temperatures Expected to Increase Across All Seasons

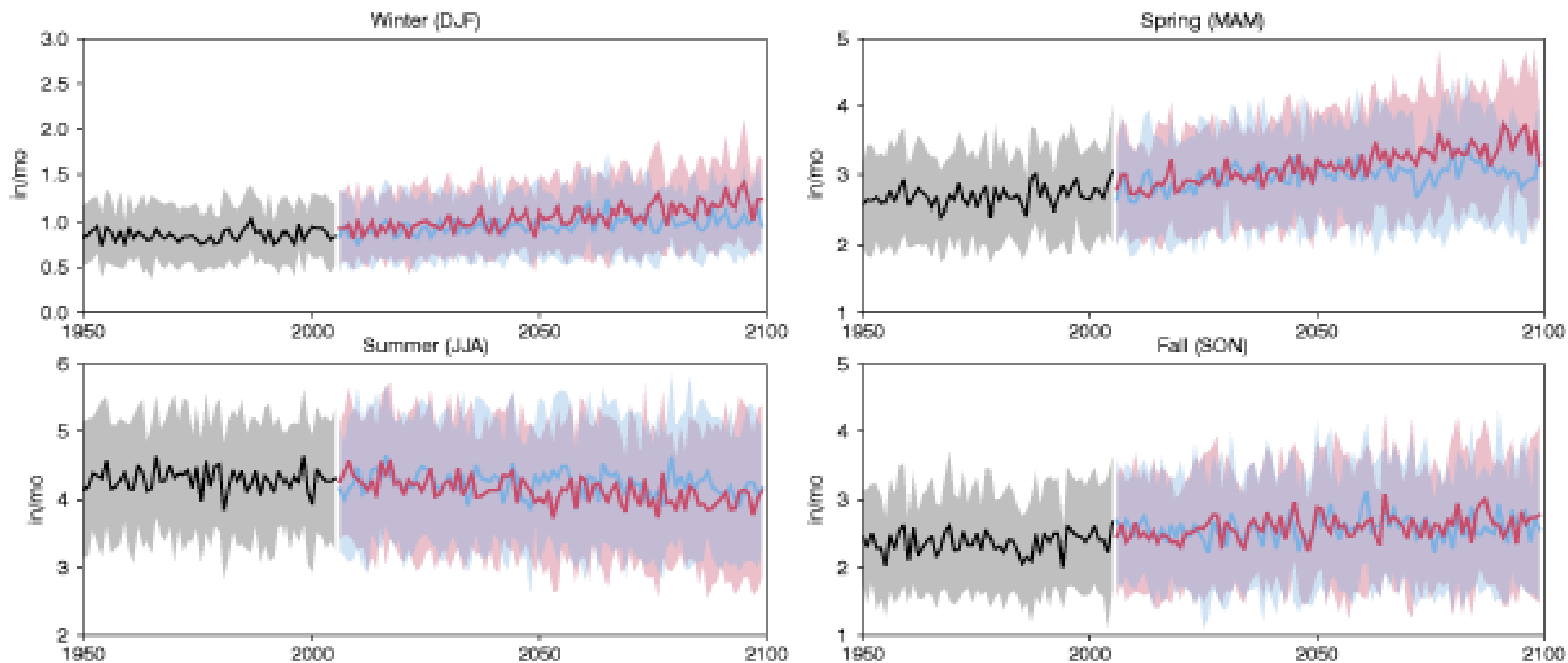


Minimum Temperatures will increase across all seasons



Source: https://www2.usgs.gov/climate_landuse/CLU_rd/nccv/viewer.asp

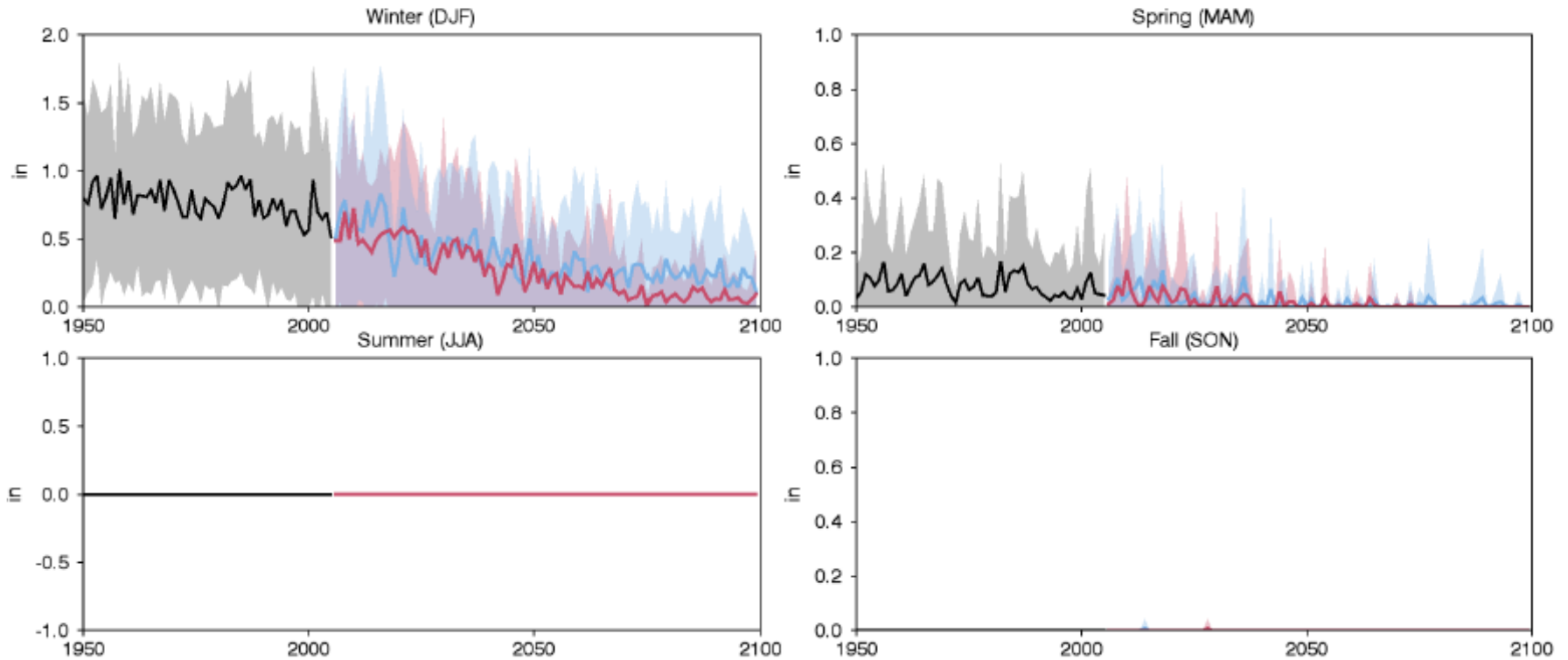
Uncertainty in Precipitation Projections



Source: https://www2.usgs.gov/climate_landuse/CLU_rd/nccv/viewer.asp

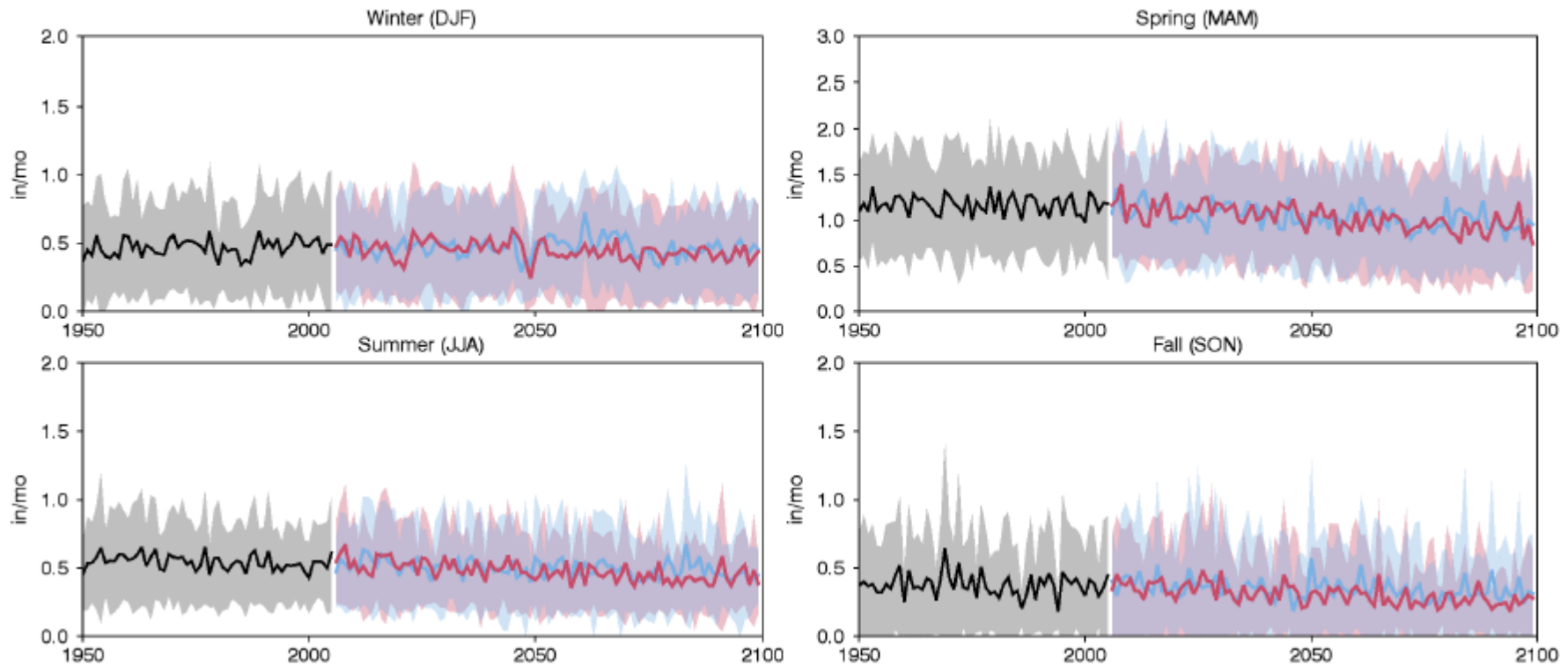
Less precipitation will fall as snow

Snow Water Equivalent



No clear trends in runoff

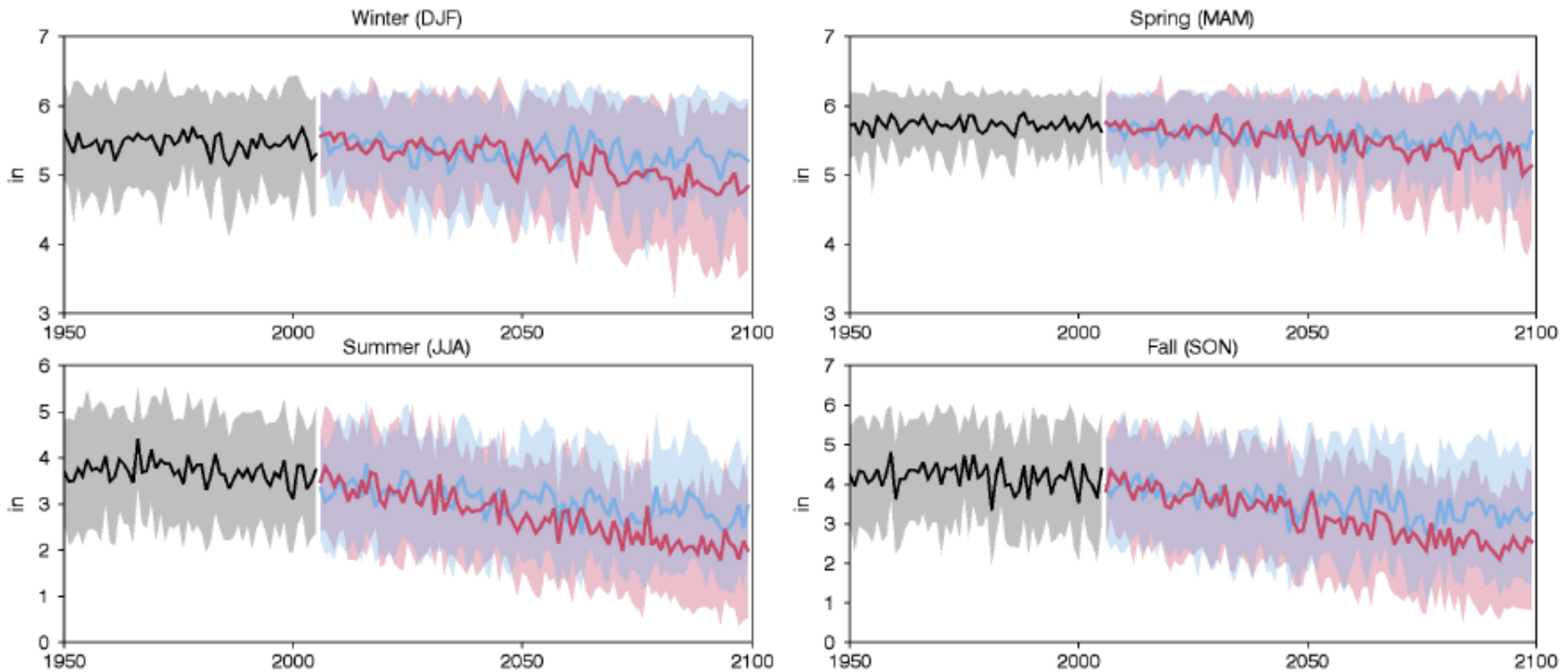
5 Runoff



Source: https://www2.usgs.gov/climate_landuse/CLU_rd/nccv/viewer.asp

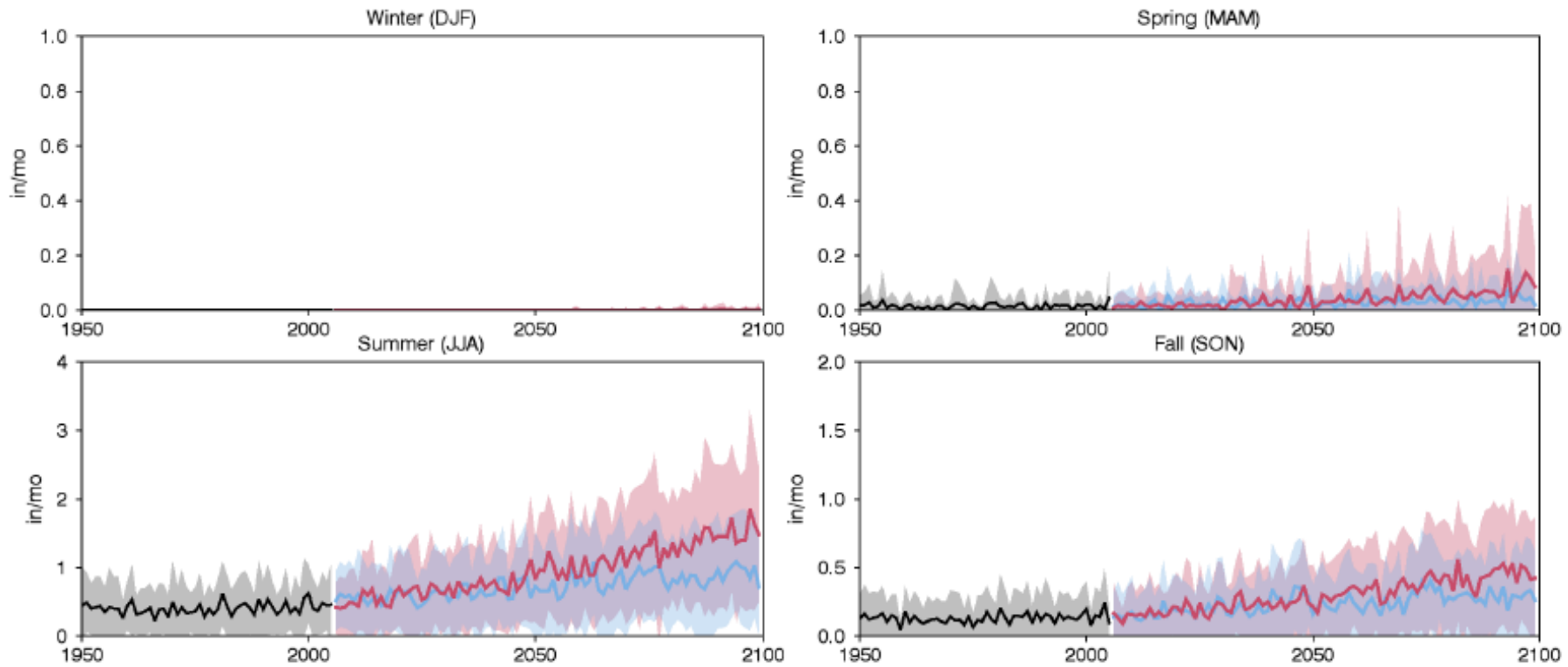
Reduced soil water storage (especially in summer)

Soil Water Storage



More evaporative deficit in summer/fall

7 Evaporative Deficit



Source: https://www2.usgs.gov/climate_landuse/CLU_rd/nccv/viewer.asp

Future Climate Analogs?

Seedlot Selection Tool

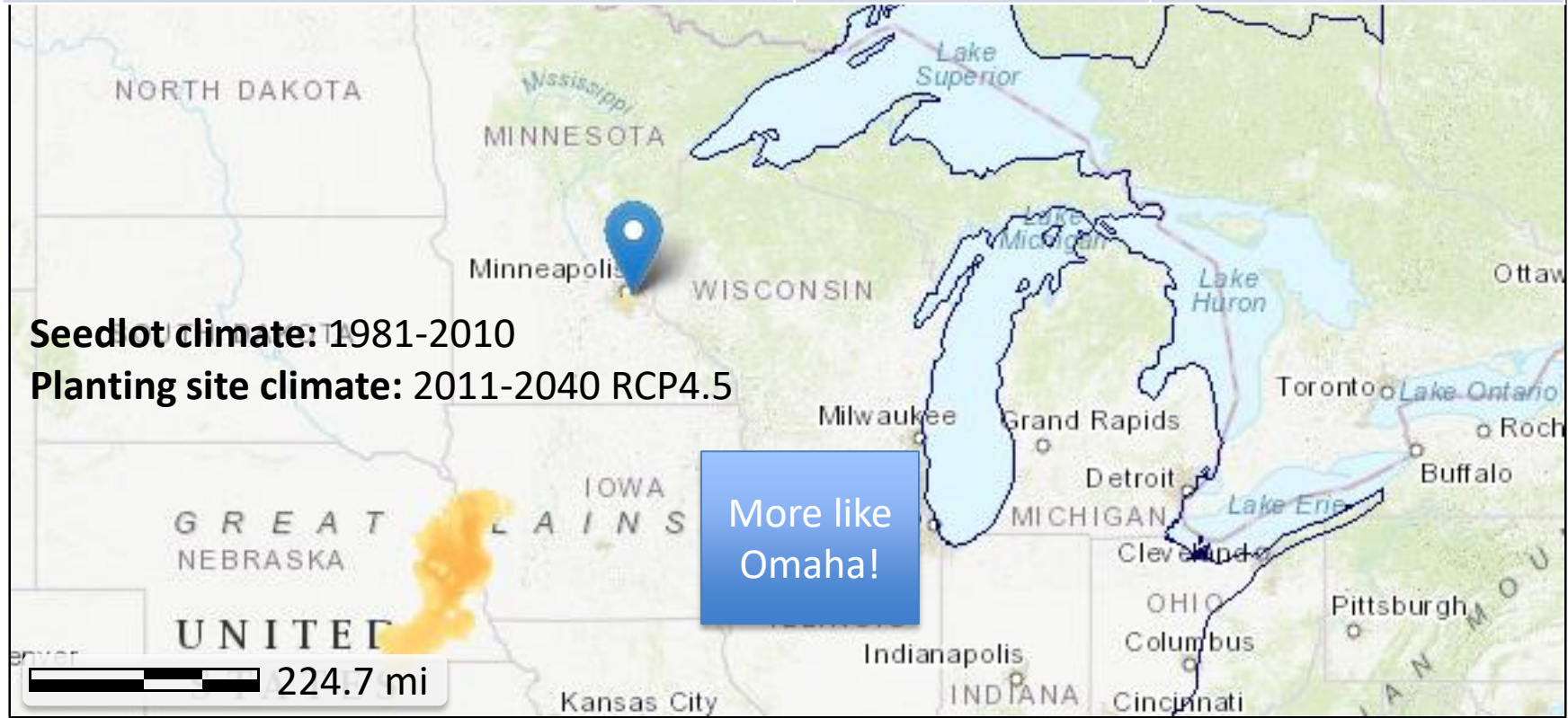
- Web-based mapping application
- Defines the center of the climatic space to be mapped, and then maps all areas that fall within a specified climatic distance
- Within the mapped area, the degree of climatic similarity is shown using different colors.
- By choosing a future climate, the SST can be used to examine how assisted migration might be used to respond to climate change.

52.32° N

104.48° W



Variable	Center	Transfer limit (+/-)
EMT: Extreme minimum temperature over 30 years	-34.5 °C	5.00 °C (modified)
FFP: Frost-free period	171 days	14 days (modified)
MAP: Mean annual precipitation	779.0 mm	50.0 mm (modified)



Seedlot climate: 1981-2010
Planting site climate: 2011-2040 RCP4.5

More like Omaha!

224.7 mi



Match

39.23° N

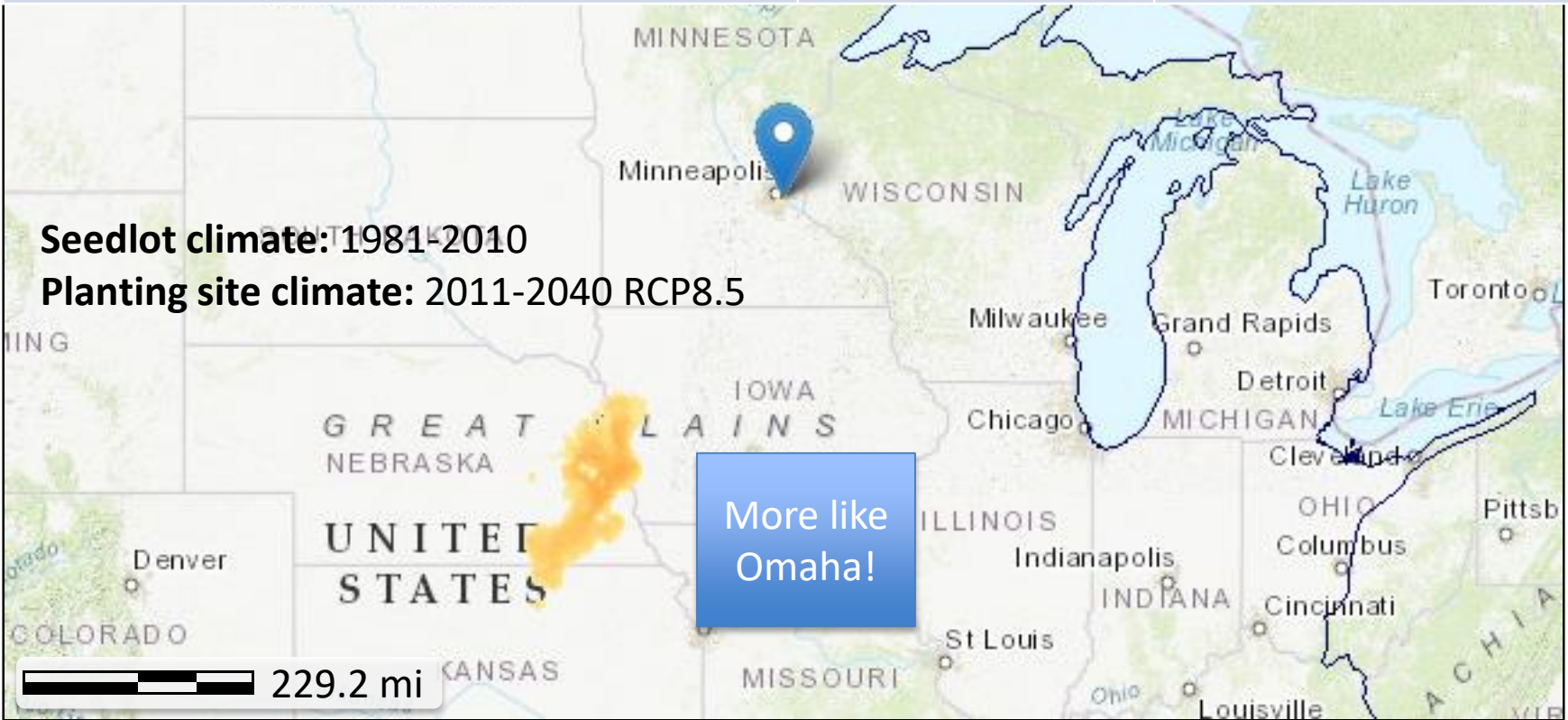
76.14° W

51.21° N

107.29° W



Variable	Center	Transfer limit (+/-)
EMT: Extreme minimum temperature over 30 years	-34.2 °C	5.00 °C (modified)
FFP: Frost-free period	172 days	14 days (modified)
MAP: Mean annual precipitation	774.0 mm	50.0 mm (modified)



Match

37.82° N

78.95° W

Climate Change Tree Atlas

USDA United States Department of Agriculture Forest Service Northern Research Station

Forest Service Home About the Agency Contact the National Office

You are here: Northern Research Station Home / Tools & Applications / Climate Change Atlas

Climate Change Atlas

Explore the Climate Change Tree Atlas

Explore the potential habitat shifts for 134 tree species

Search for Trees & Birds:
Enter a common or scientific name
[List of Trees](#) | [List of Birds](#)

About the Climate Change Atlas

The Climate Change Atlas documents the current and possible future distribution of **134 tree species** and **147 bird species** in the Eastern United States and gives detailed information on environmental characteristics defining these distributions. Please be sure to read the **warnings, cautions and questions**.
You can also **browse and view the previous version of the Tree Atlas**.

Featured Research

Ecosystem vulnerability assessment and synthesis: a report from the Climate Change Response Framework Project in northern Wisconsin

Combined Species Outputs

Potential Changes by Region, State, Forest Type or National Forest and Parks

Climate Change Atlas Videos

- Quick Start Guide
- An Introduction to the Climate Change Atlas: How does it work?
- An Overview of the Climate Change Atlas Components
- Exploring Current Species Information
- Modeled Future Habitats
- Combined Species Outputs

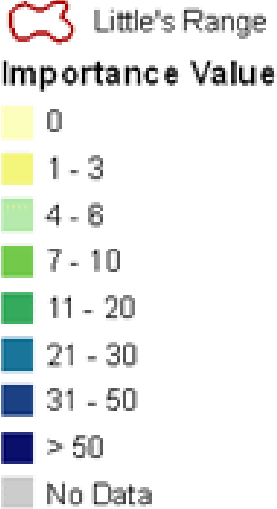
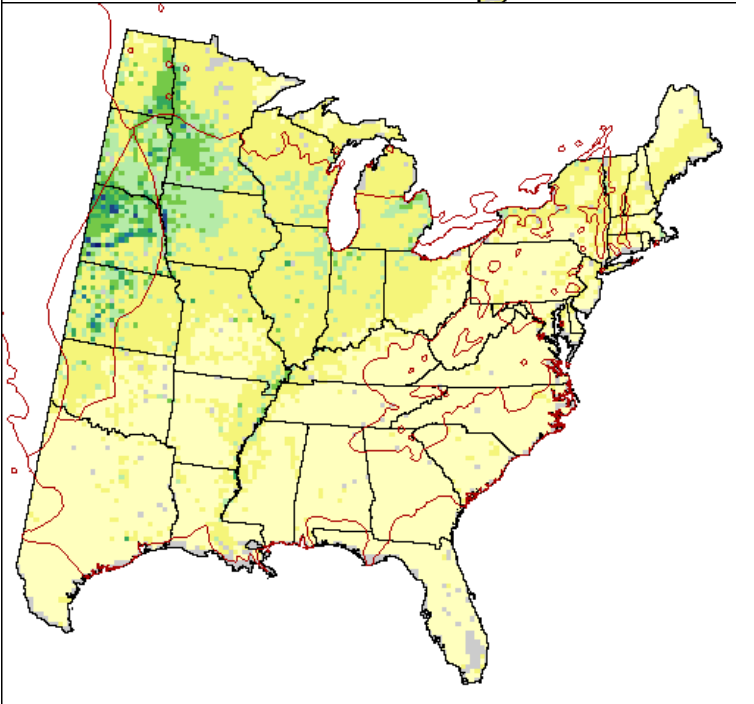
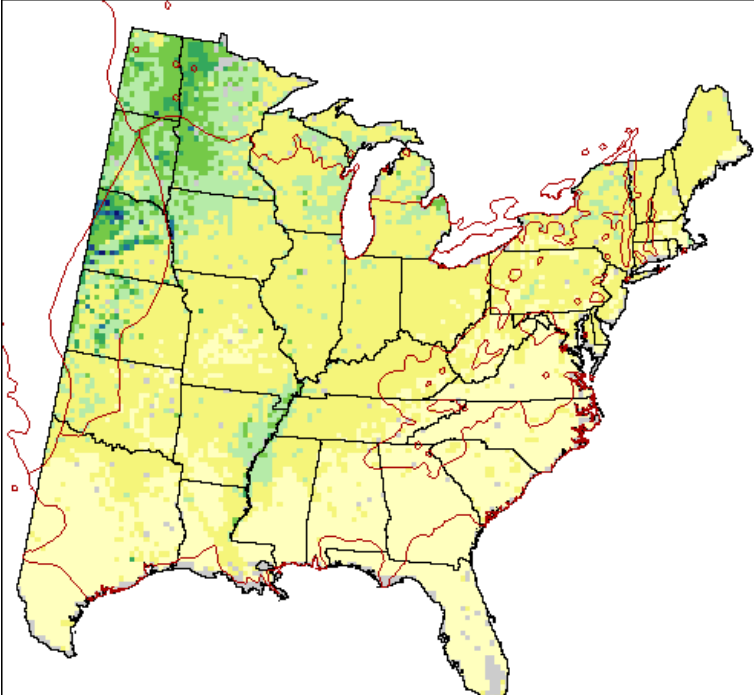
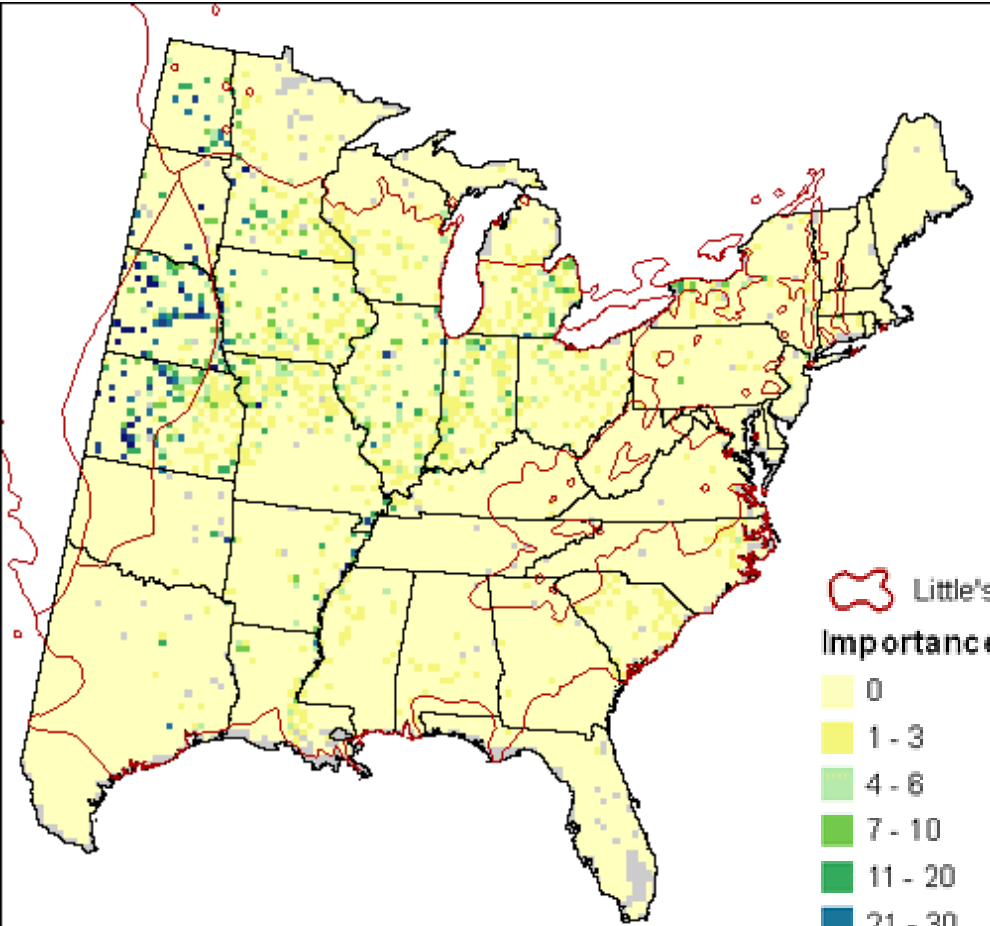
[Climate Change Atlas](#) [Learn About the Models](#) [Products](#) [Get Help](#)

<http://www.fs.fed.us/nrs/atlas/>

Losing Habitat

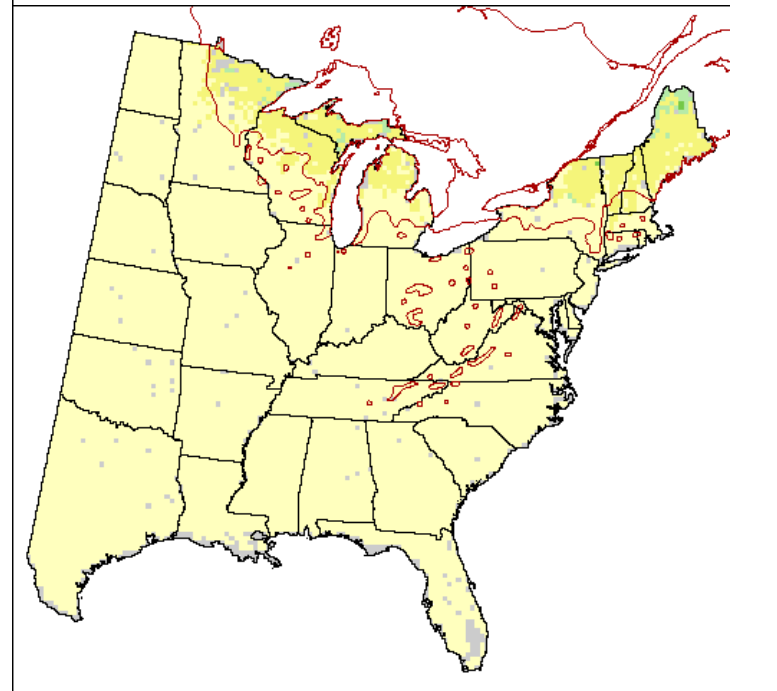
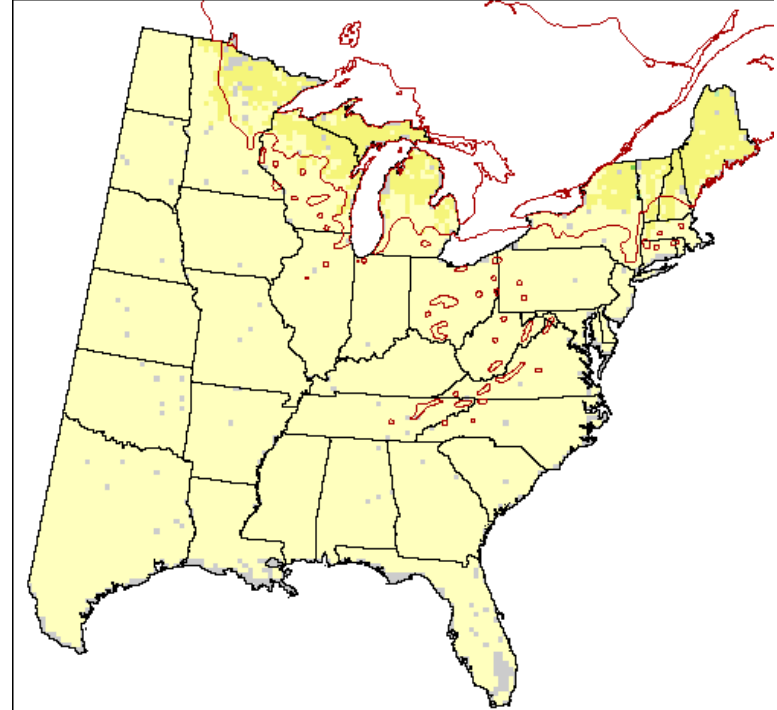
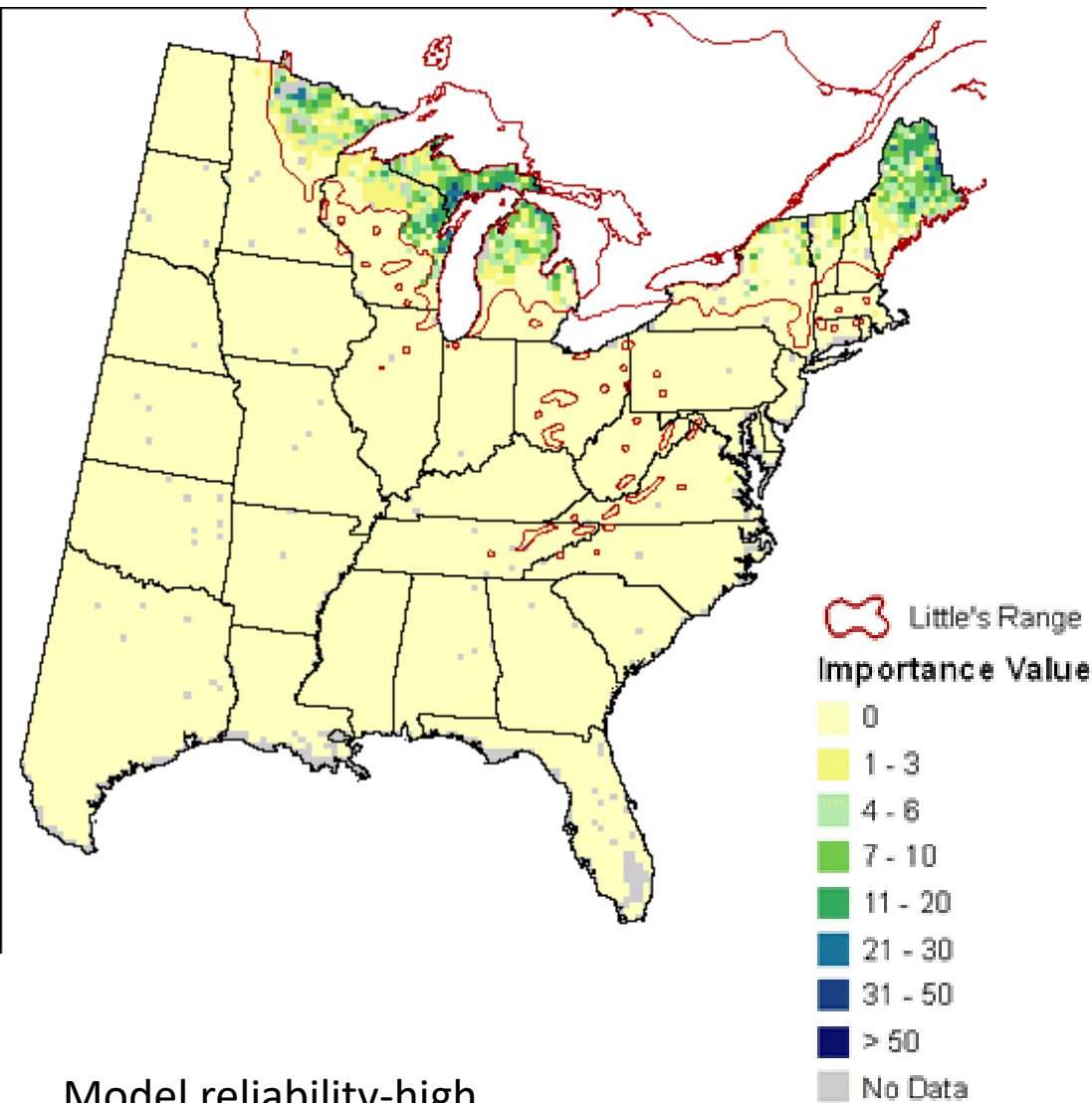
- Cottonwood?
- Northern white cedar
- Black willow?
- Silver Maple?
- Boxelder?

Cottonwood

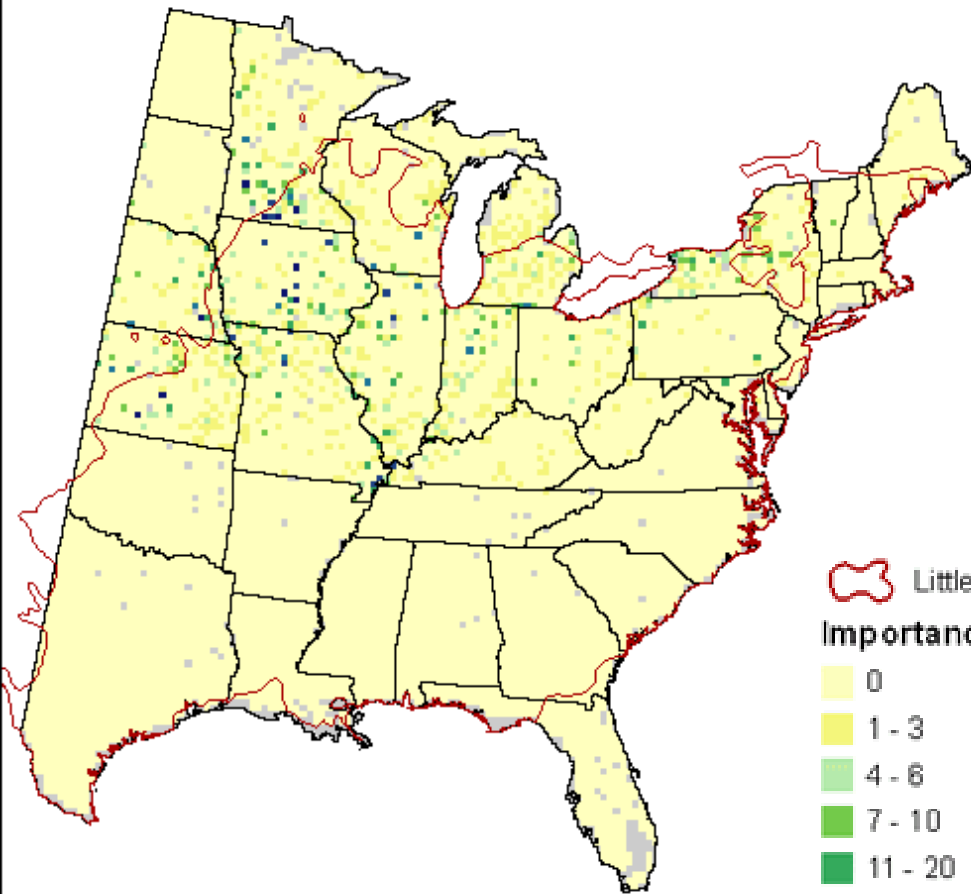


Low model reliability

Northern White Cedar

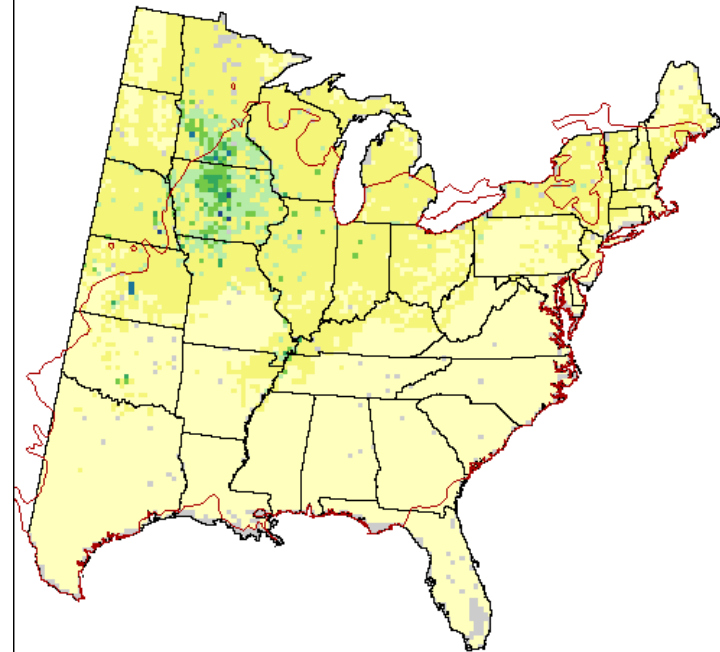
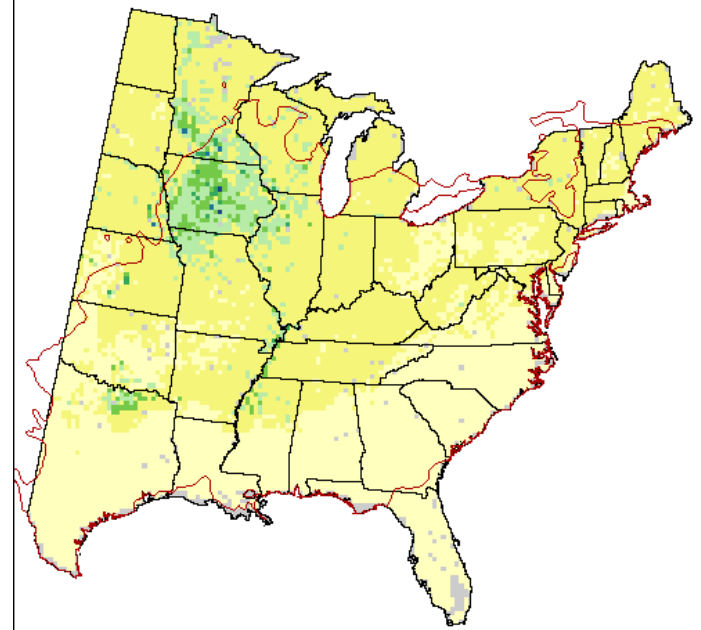
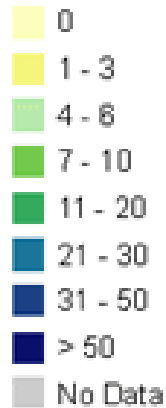


Black Willow

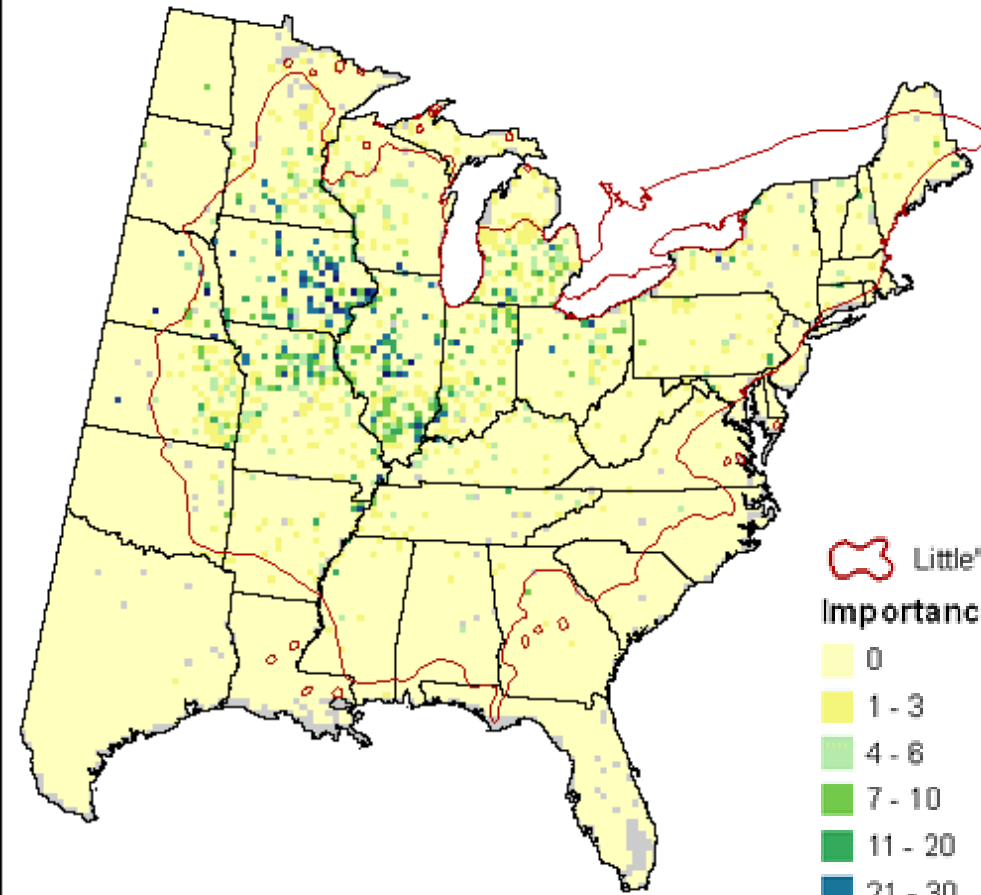


 Little's Range

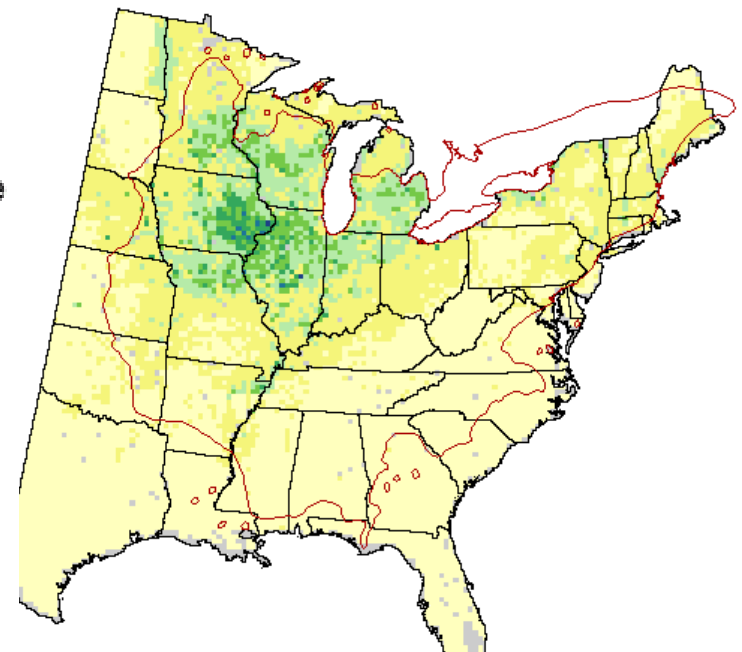
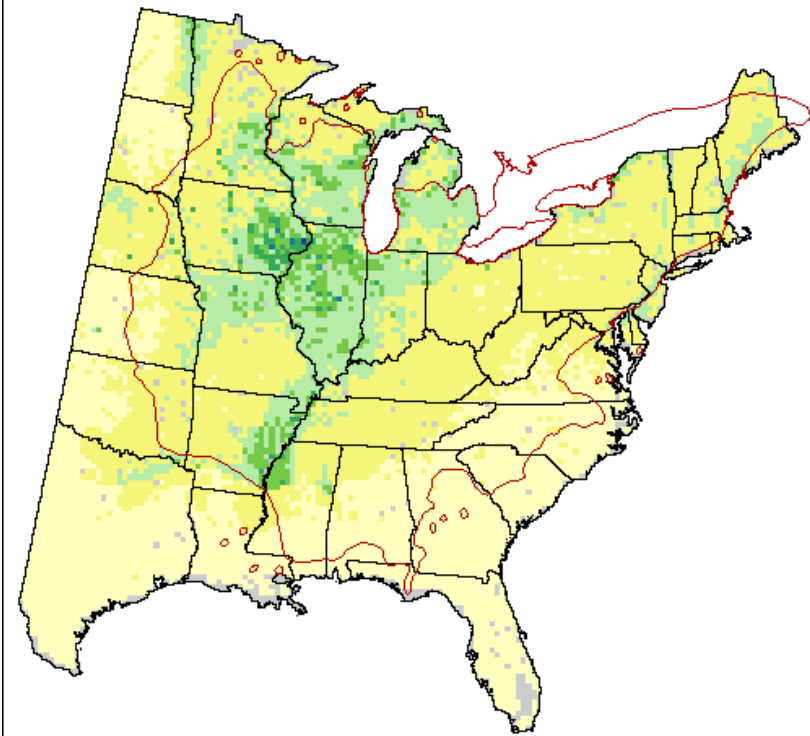
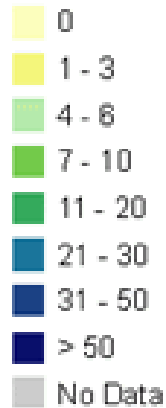
Importance Value



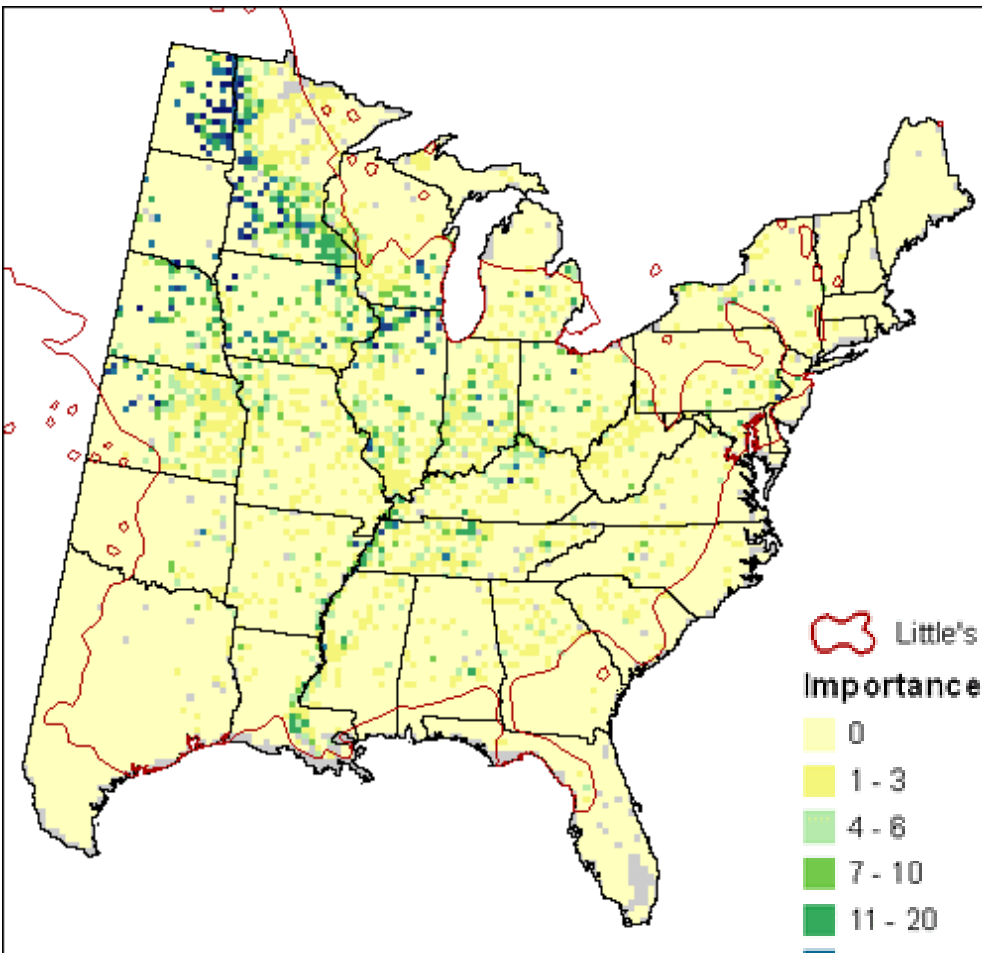
Silver Maple



 Little's Range
Importance Value

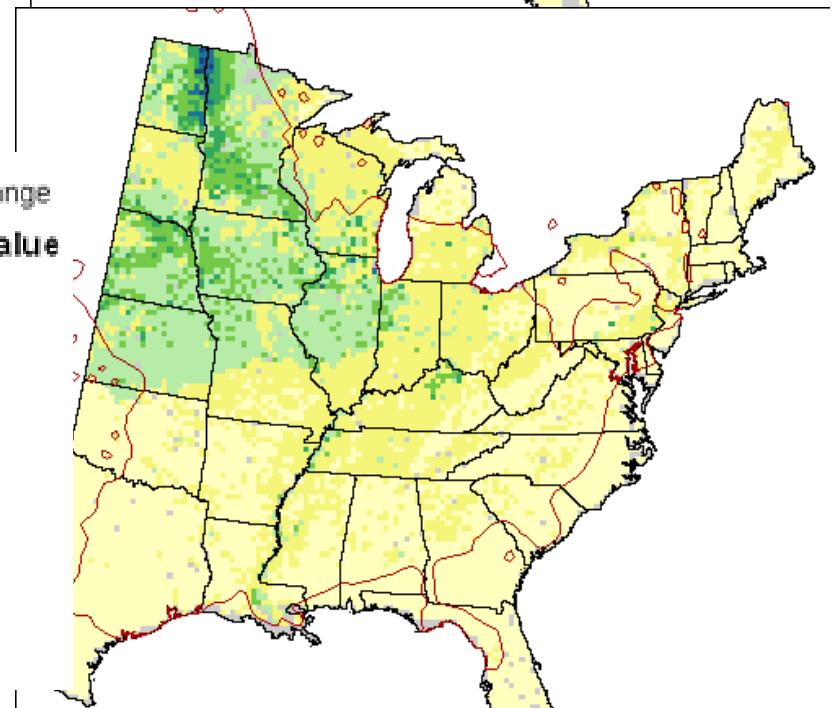
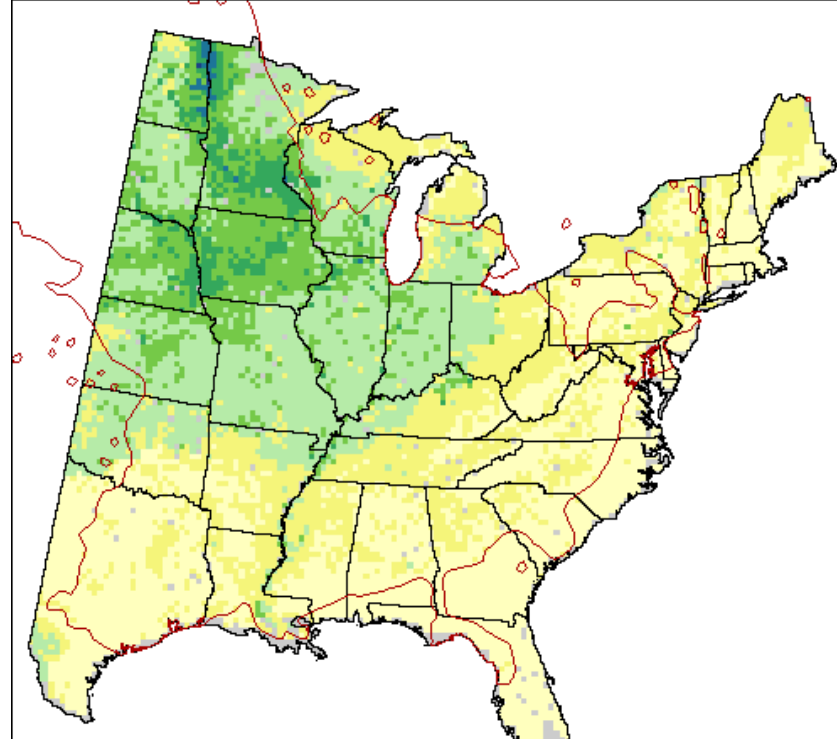
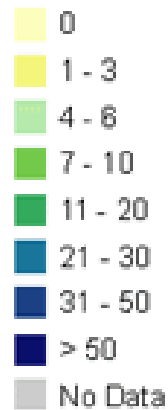


Boxelder



 Little's Range

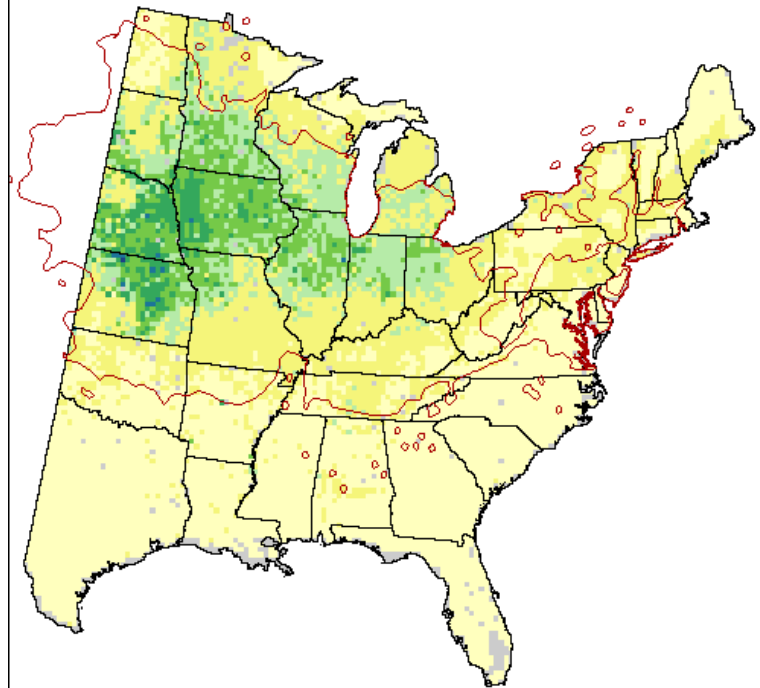
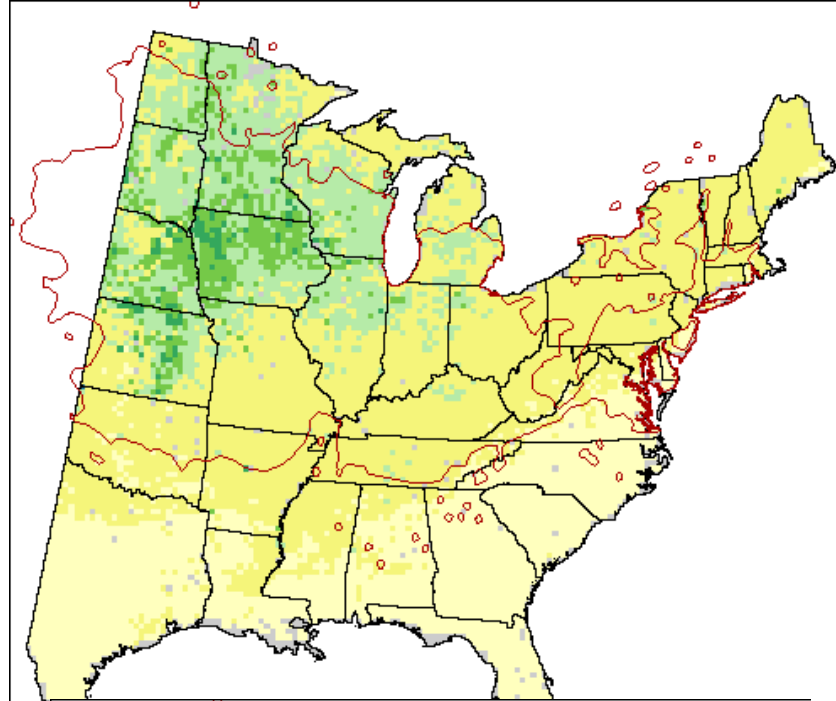
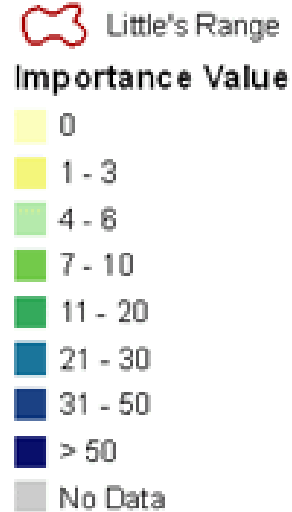
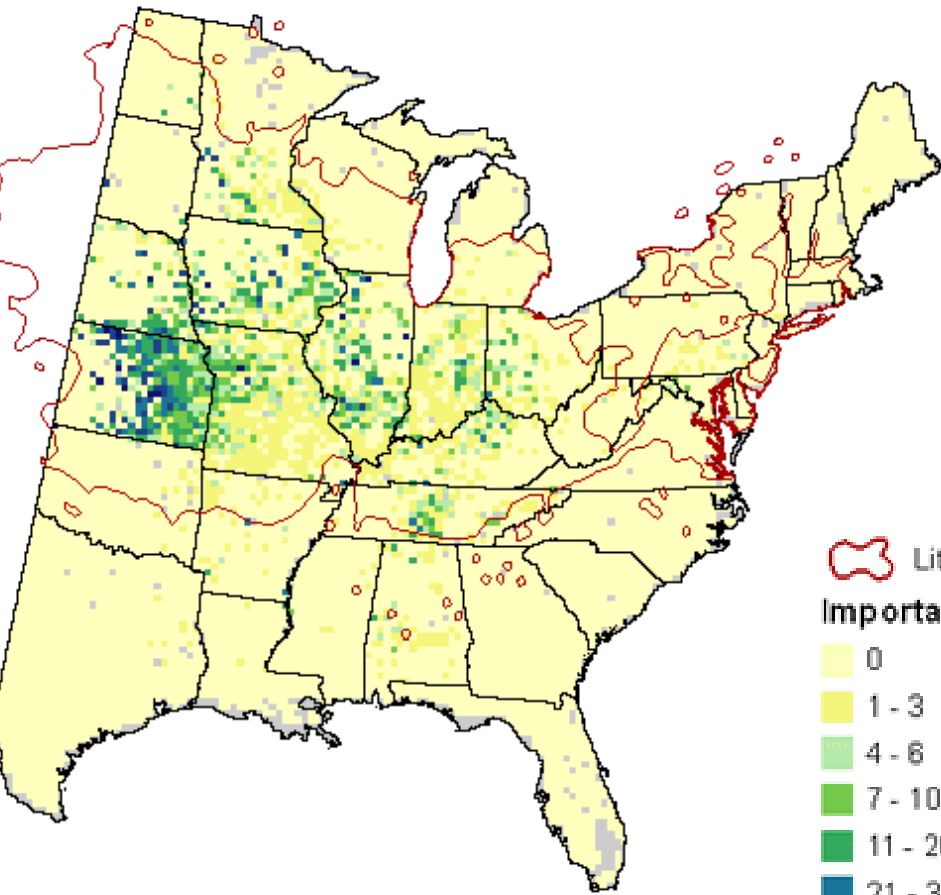
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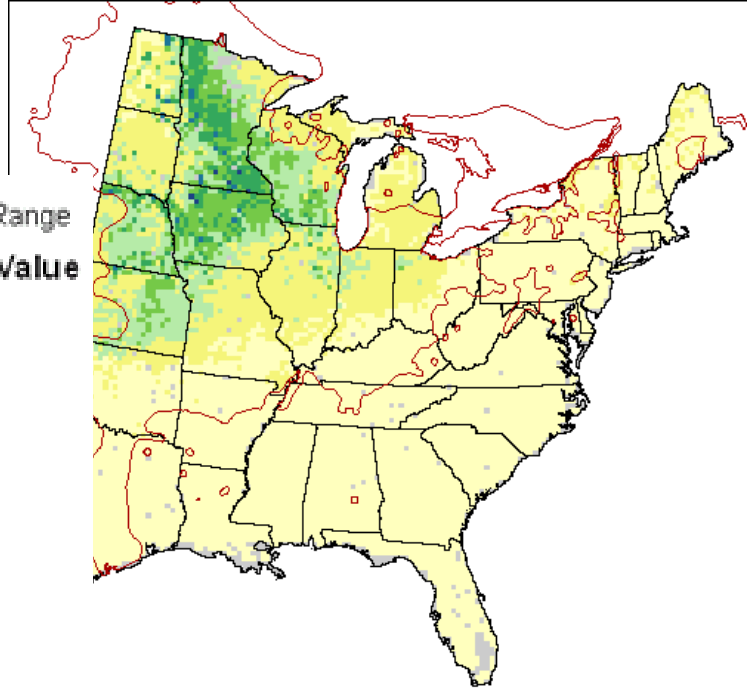
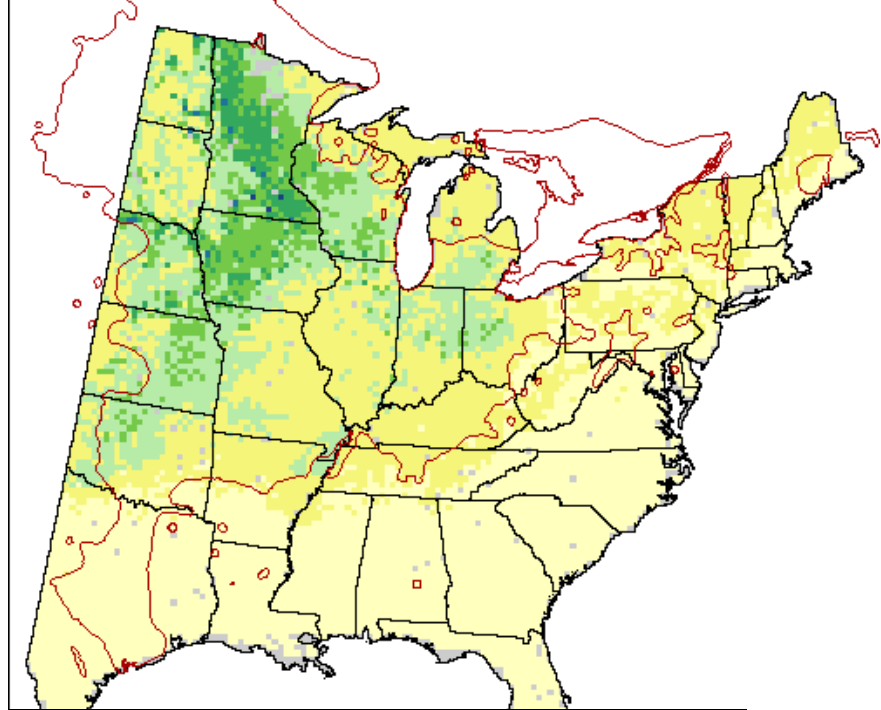
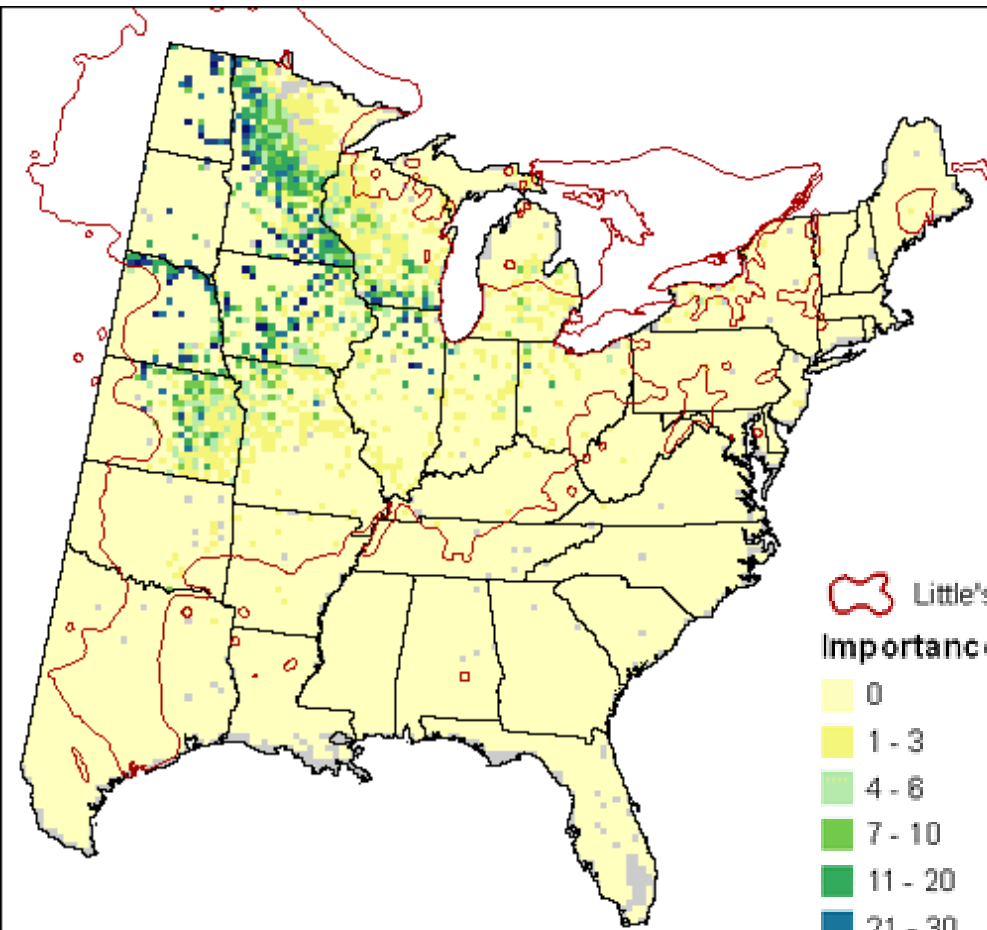
Retaining/Gaining Suitable Habitat

- Hackberry
- Bur Oak
- American elm
- Red mulberry

Hackberry

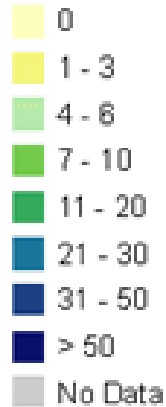


Bur Oak

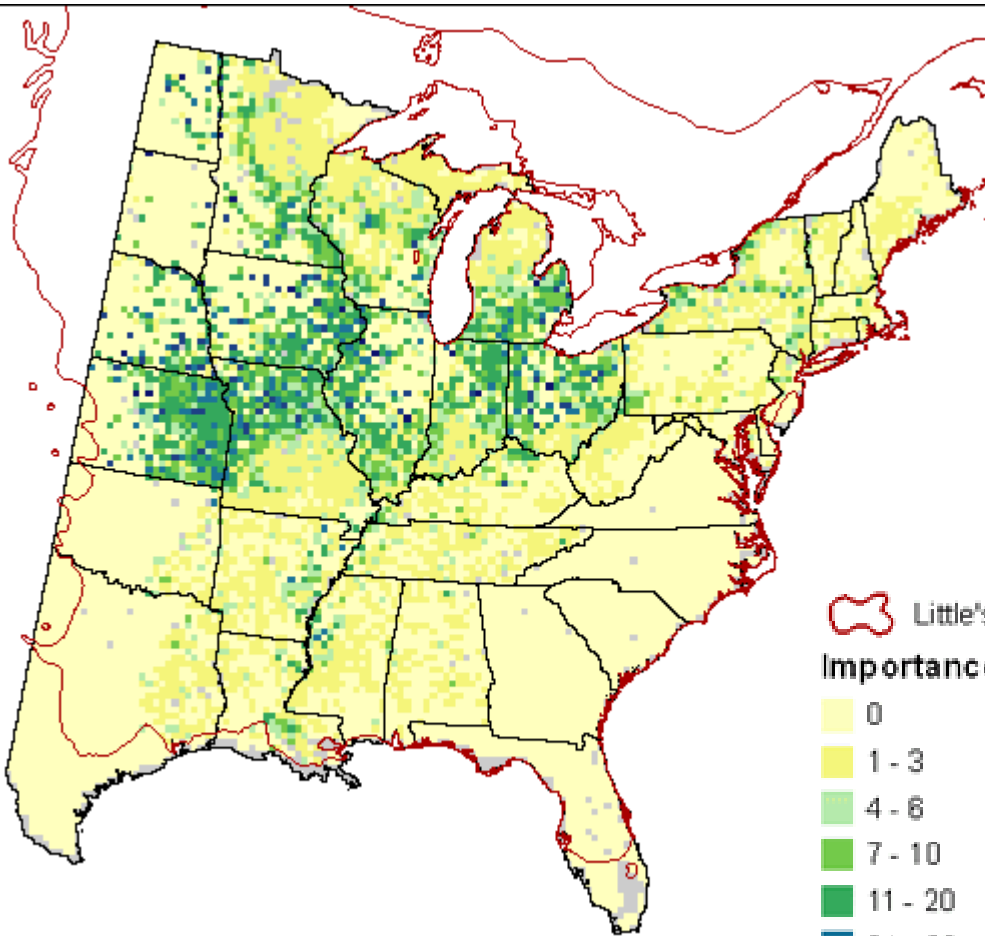


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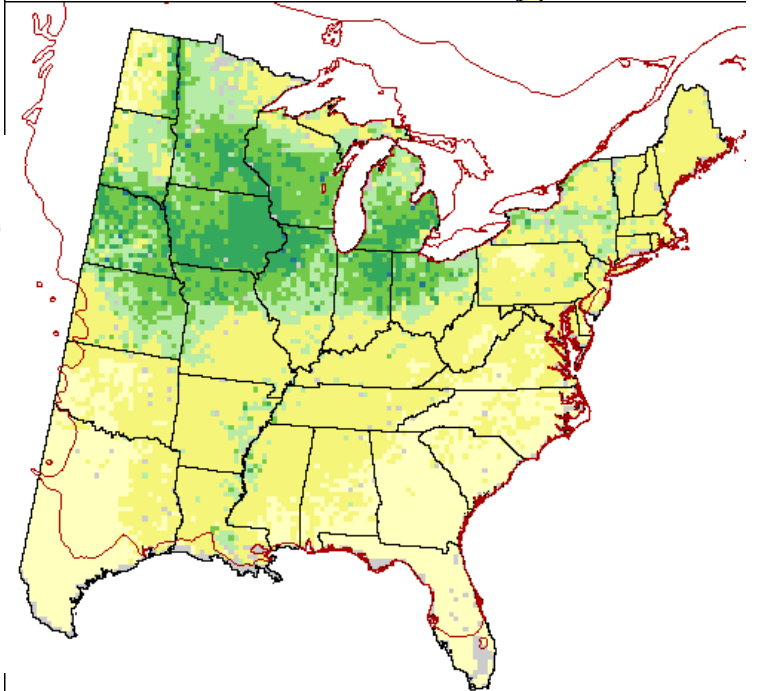
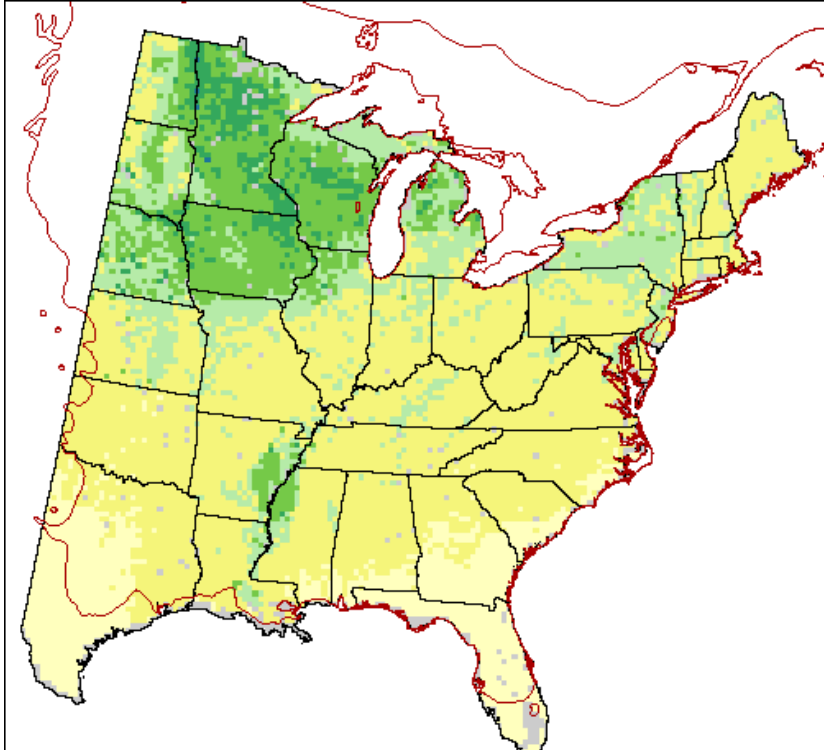
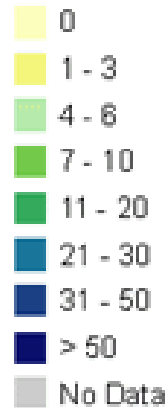
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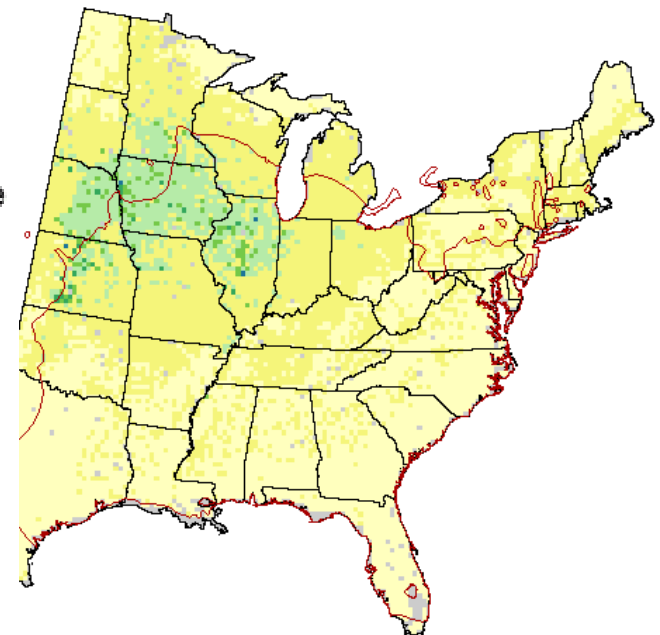
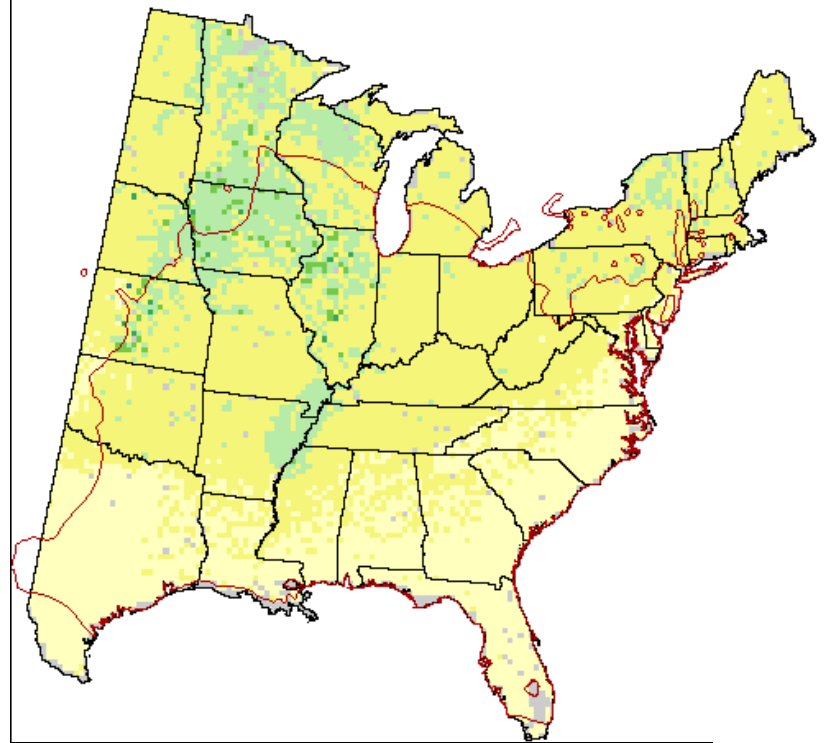
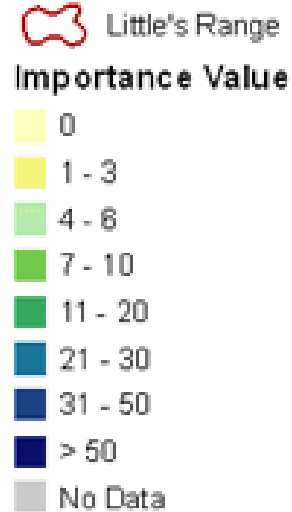
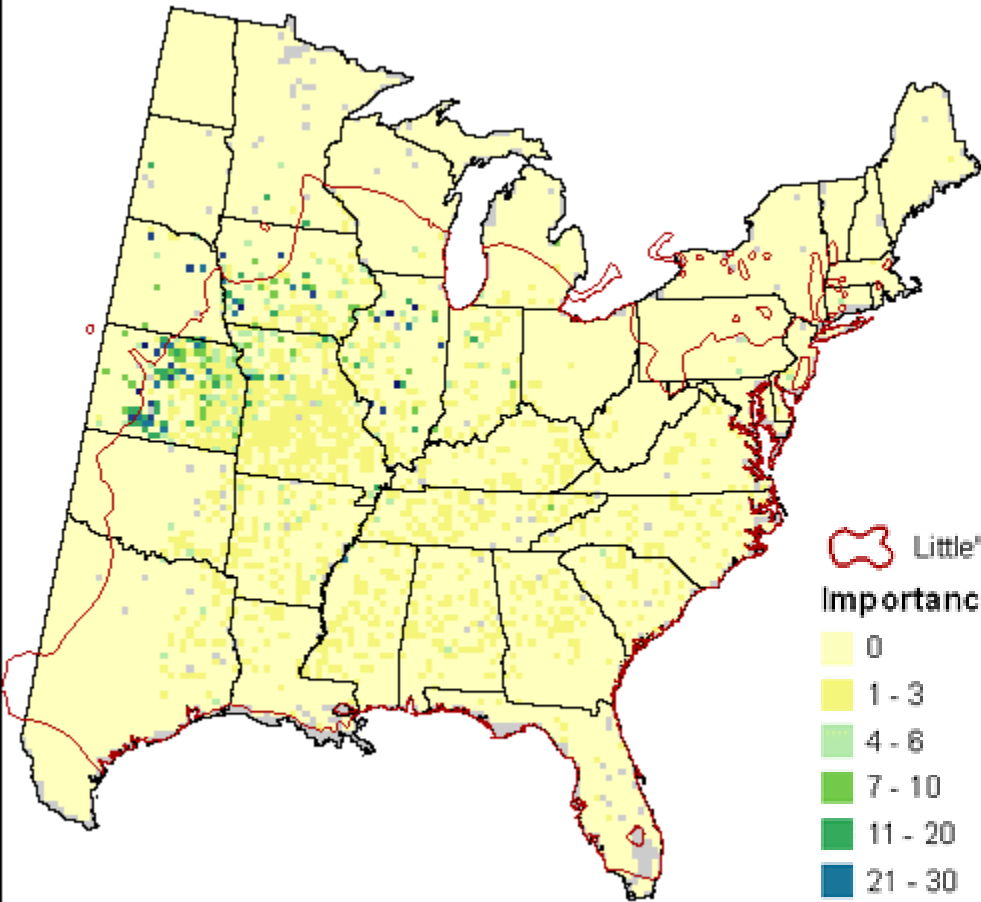
American Elm



 Little's Range
Importance Value



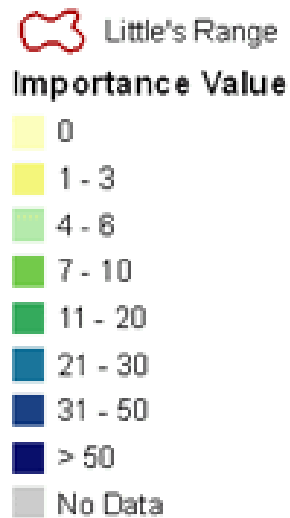
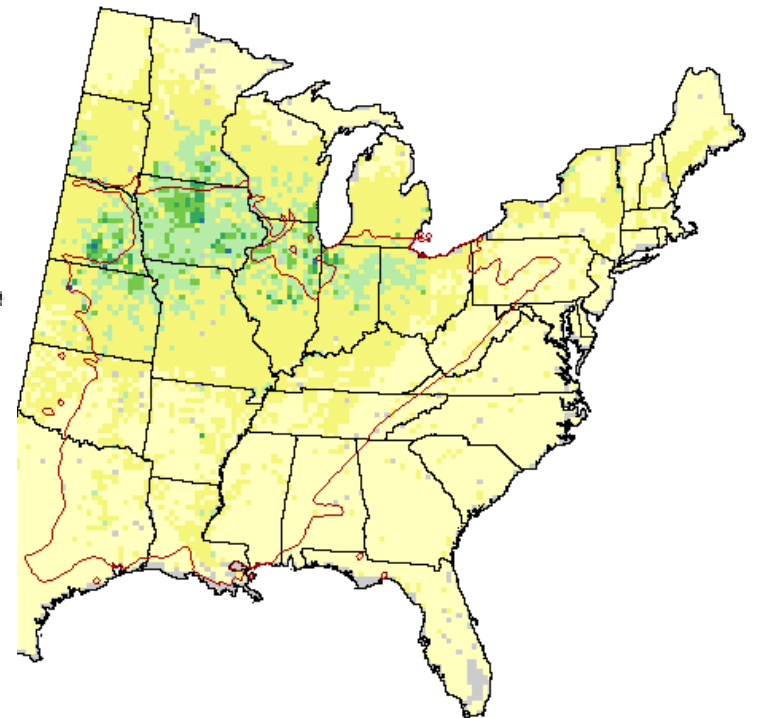
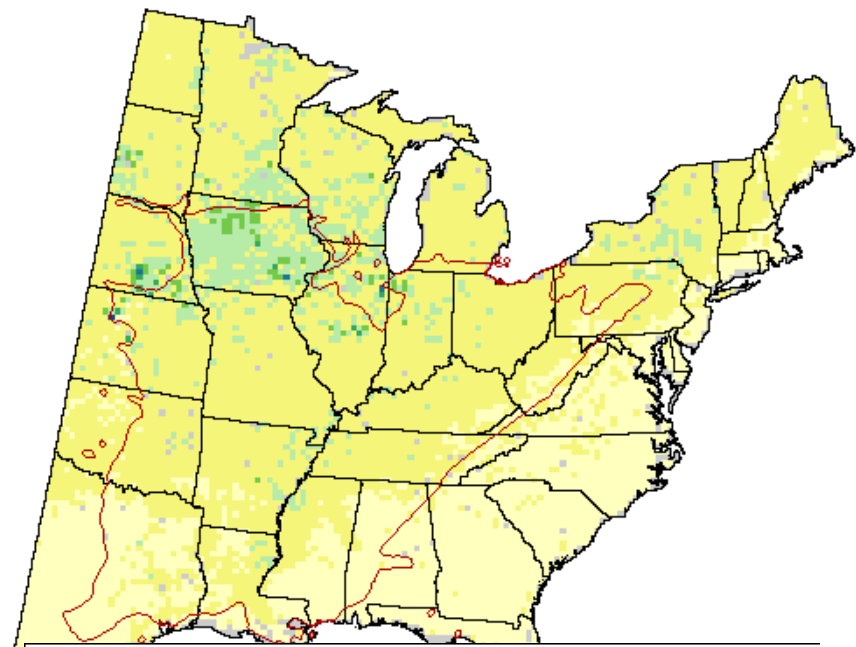
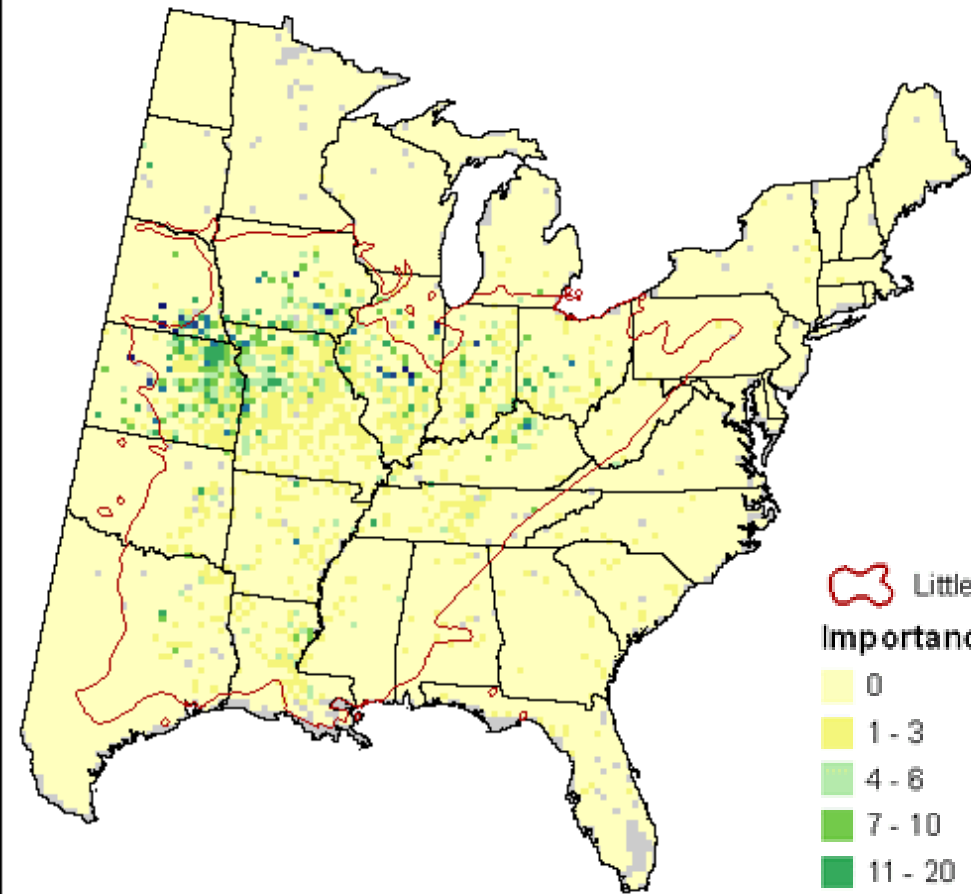
Red Mulberry



New Habitat

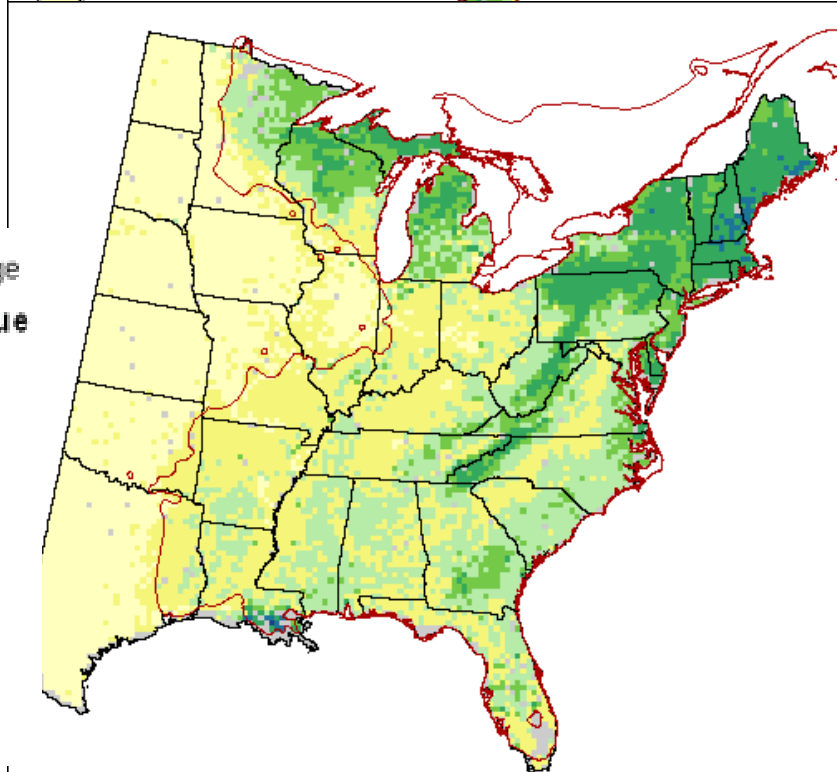
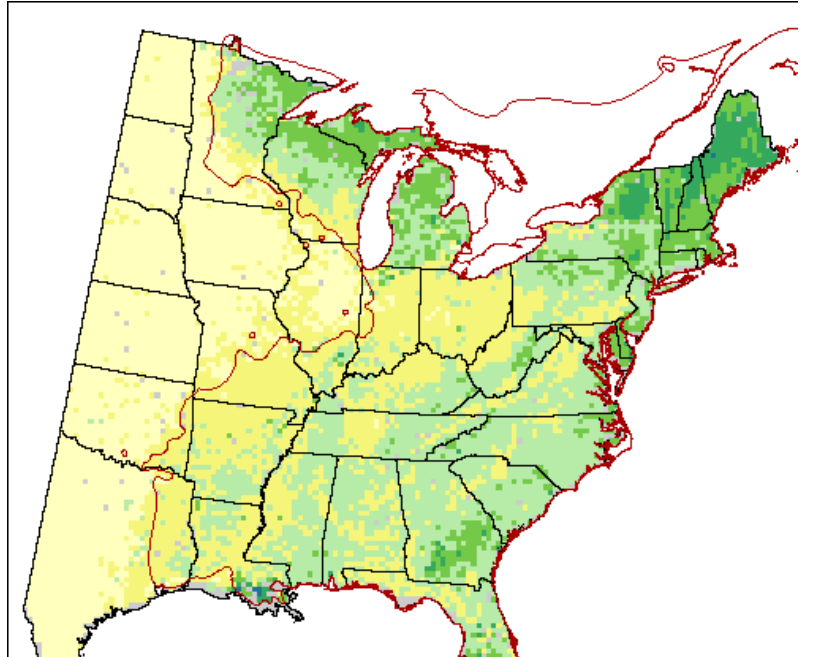
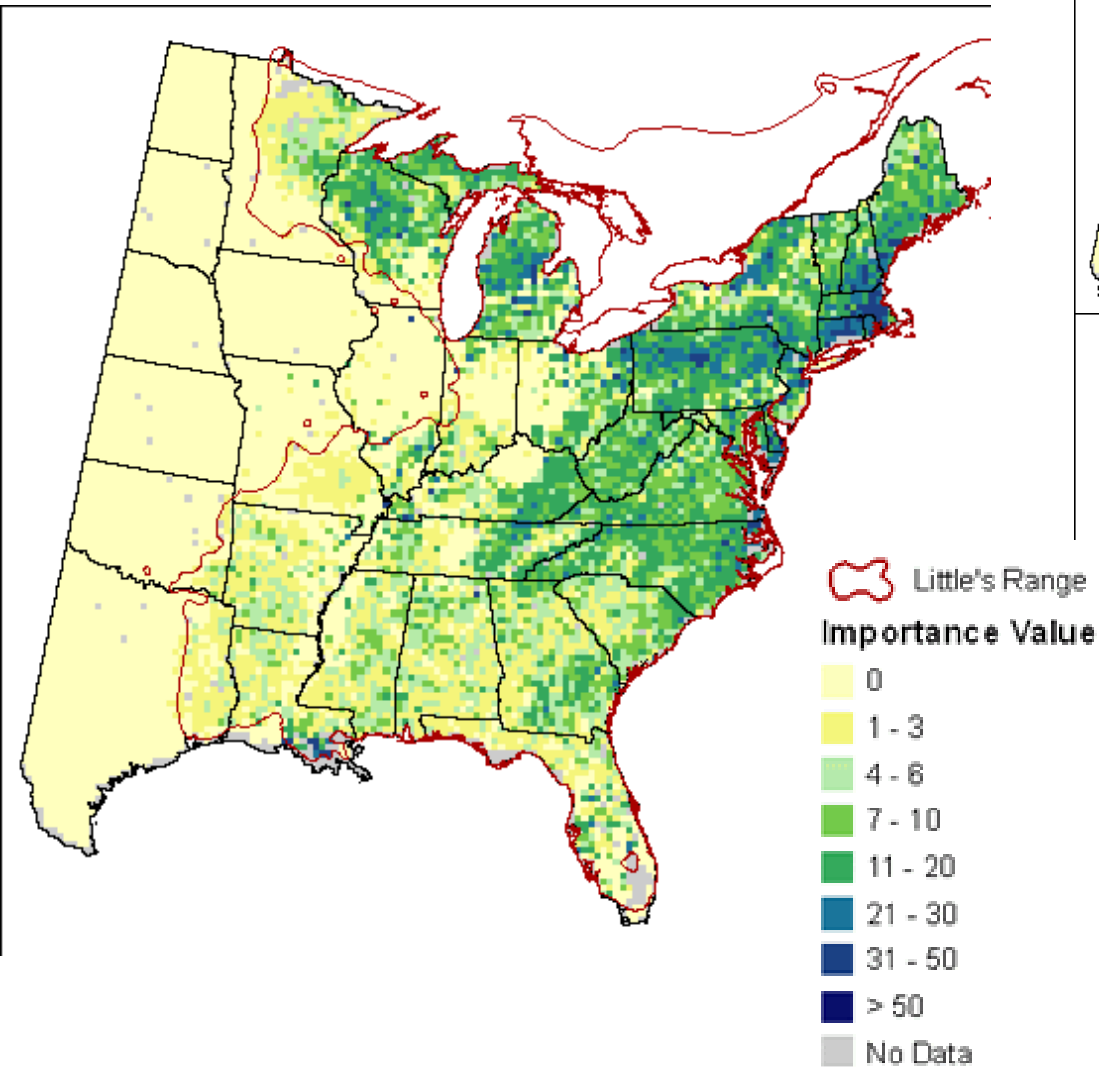
- Honeylocust
- Red Maple
- Sycamore
- Swamp white oak

Honeylocust

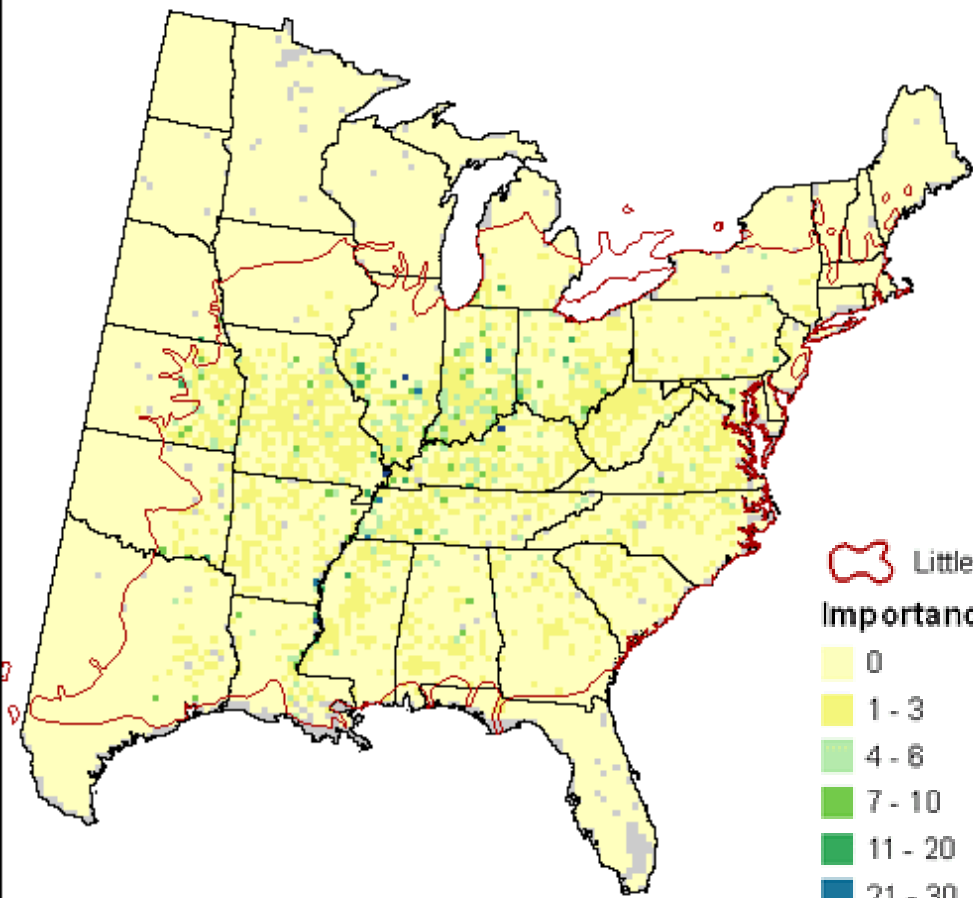


Low model reliability

Red Maple

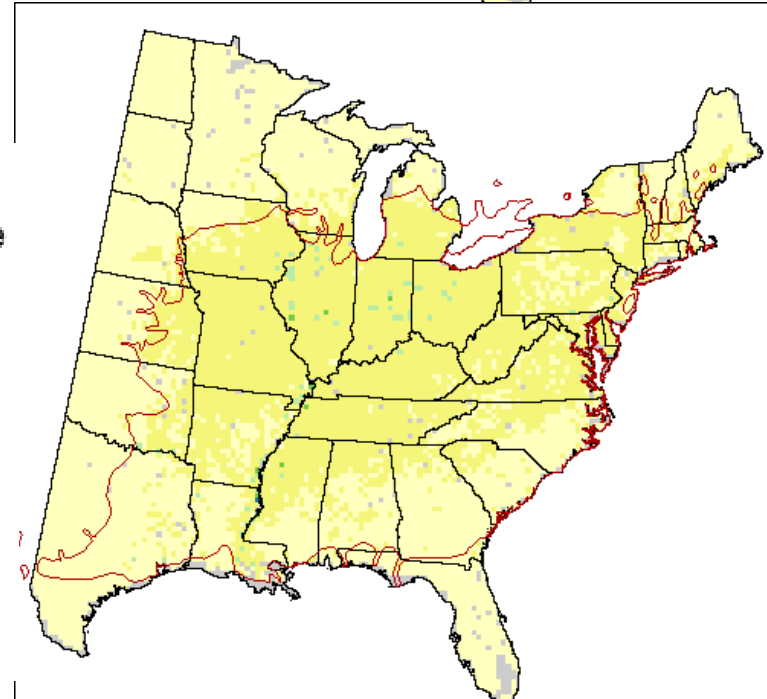
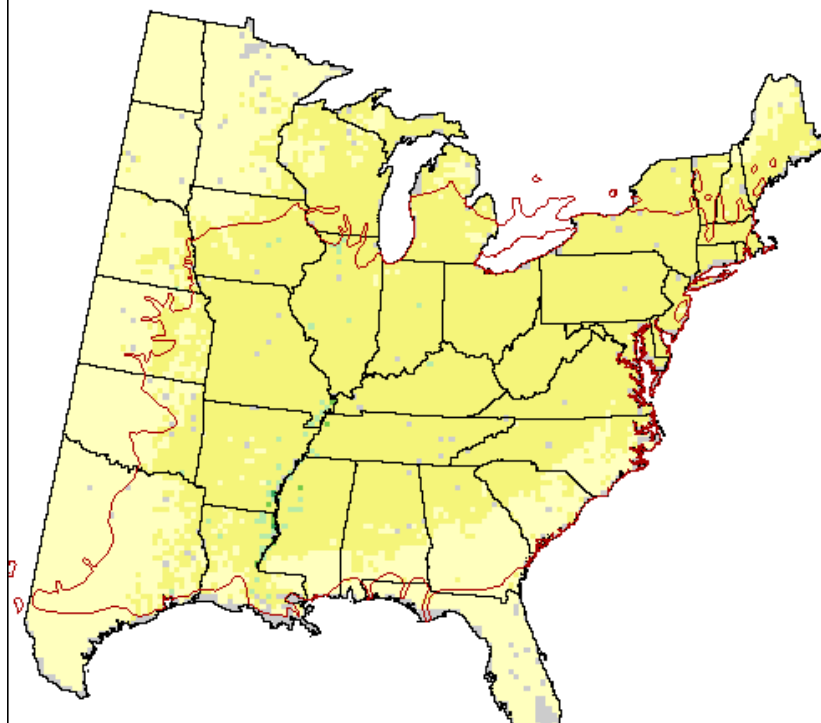
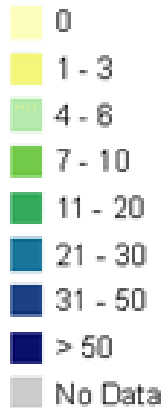


American Sycamore

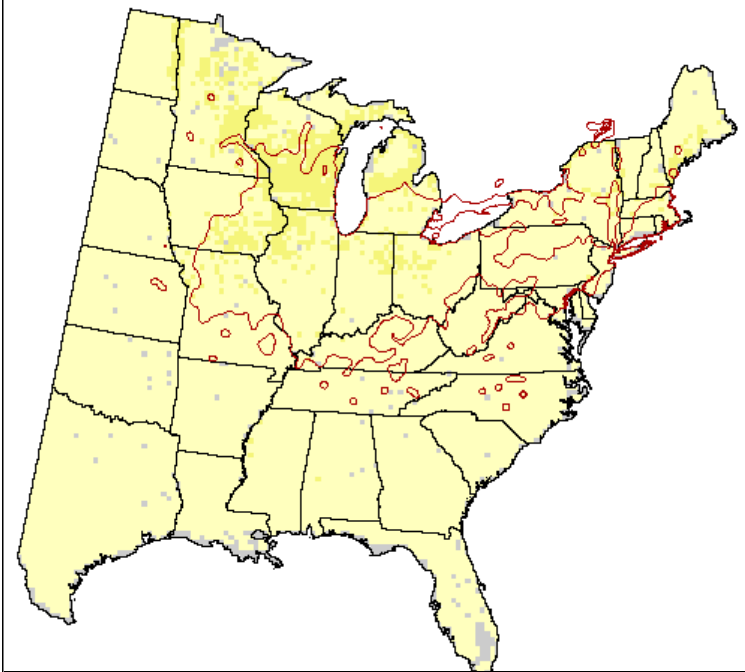
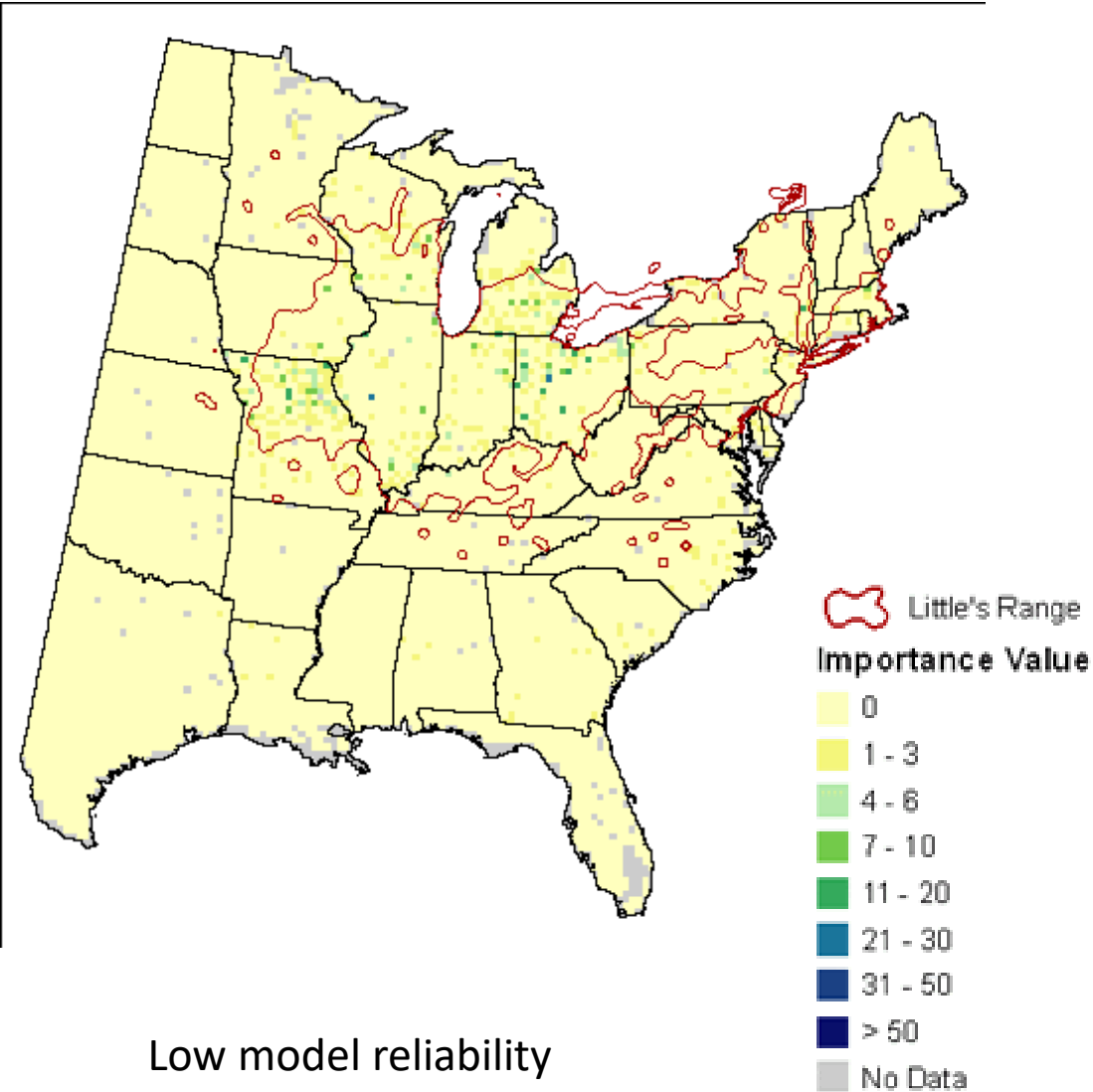


 Little's Range

Importance Value



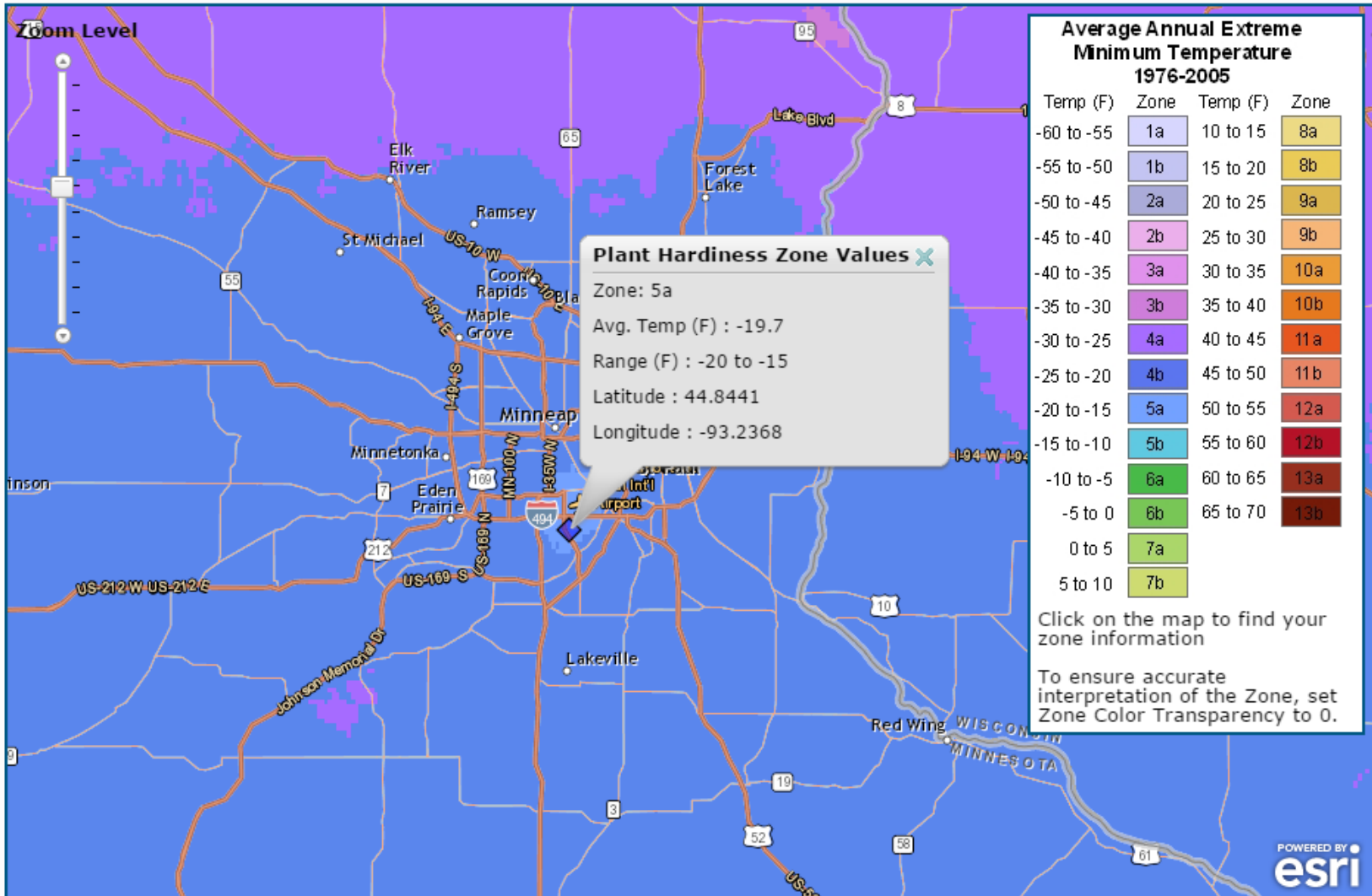
Swamp White Oak



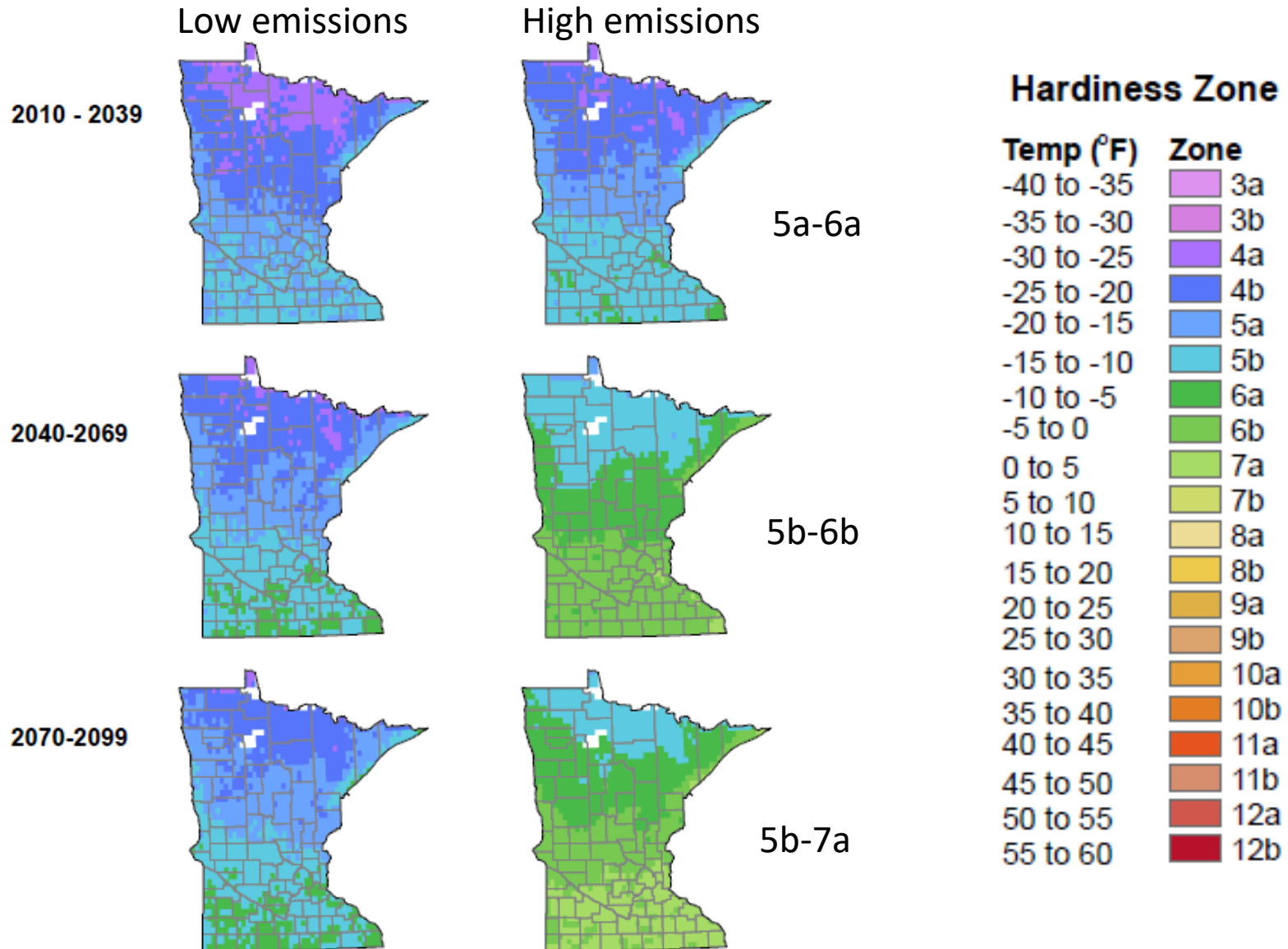
Floodplain species not modeled or out of range

	Hardiness Zone
Bald cypress	4-9
Southern Pin Oak	4-8
River Birch	4-9
Shellbark Hickory	5-8
Sweetgum	5-9
Swamp Chestnut Oak	5-9
Cherrybark Oak	6-9
Pecan	6-9

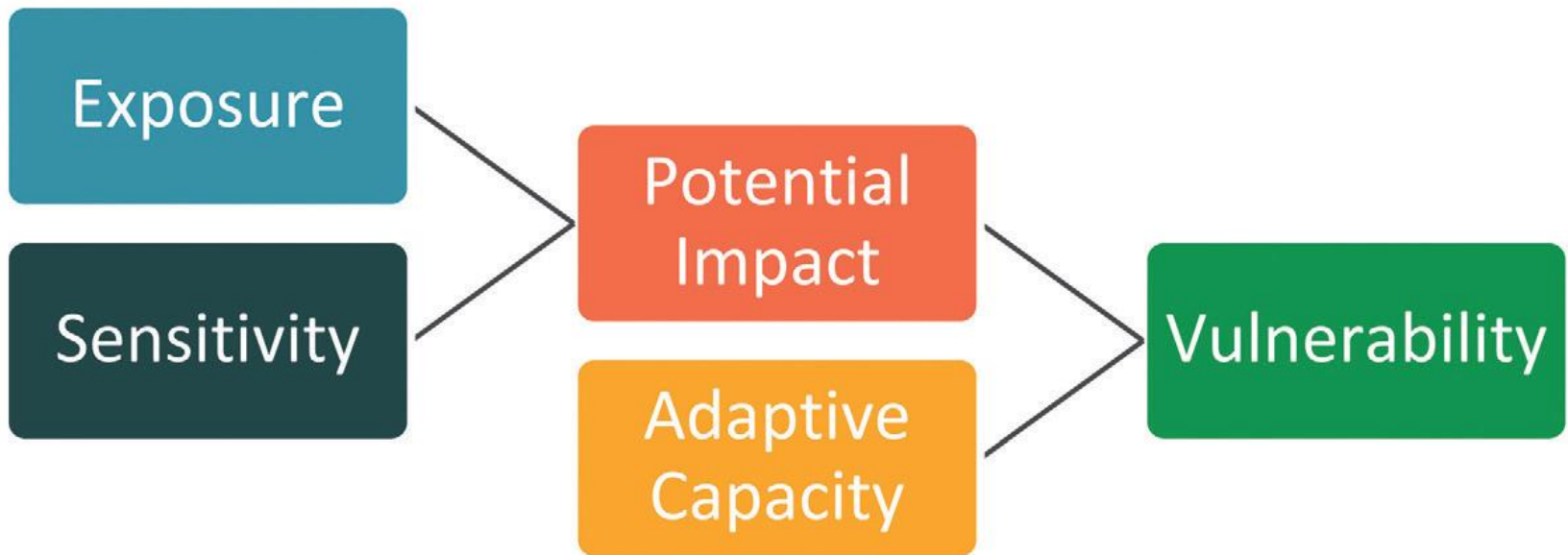
Current USDA Hardiness Zones



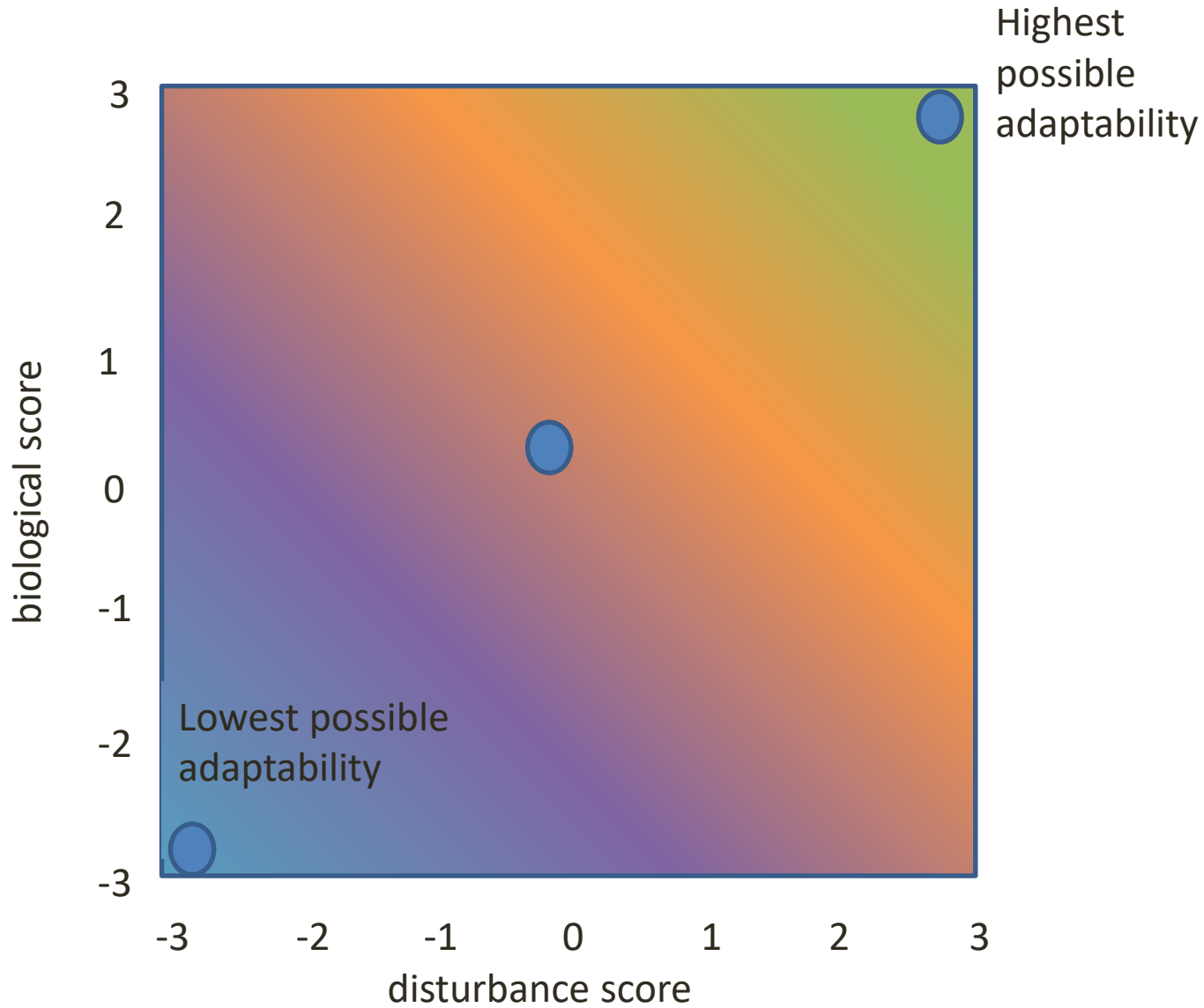
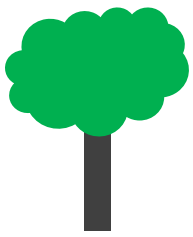
Hardiness Zone Projections



Vulnerability



ADAPTIVE CAPACITY SCORE



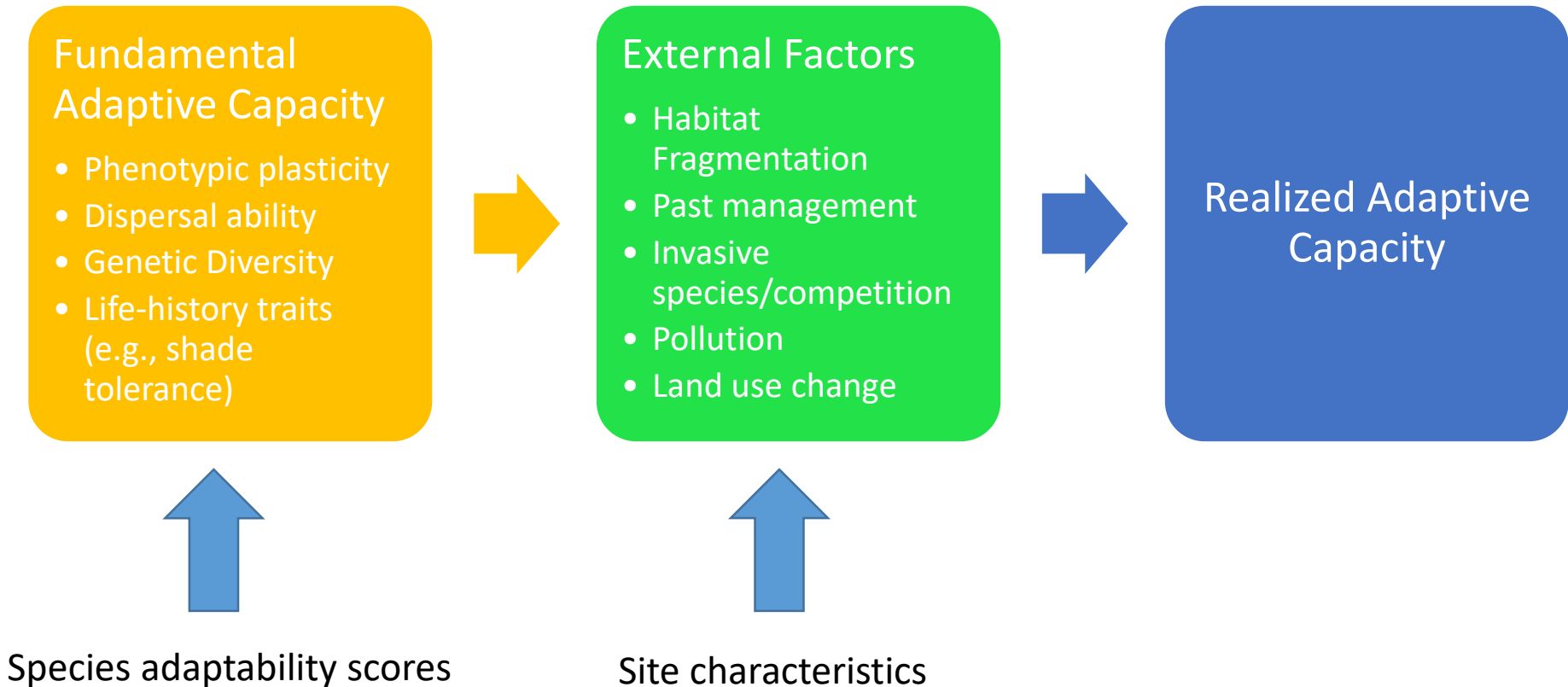
Species with High Adaptive Capacity

- boxelder
- bur oak
- hackberry
- honeylocust
- red mulberry
- silver maple
- swamp white oak
- sycamore

Species with Lower Adaptive Capacity

- black willow
- American elm
- eastern cottonwood
- green ash
- northern white-cedar
- peachleaf willow
- river birch

Fundamental vs. Realized Adaptive Capacity



Key Vulnerability Factors: Floodplain Forests (from Handler et al. 2014)

Impacts:

- more variability in flood regimes
- more flooding may expand the width of the floodplain
- earlier and larger spring flood pulses
- lower summer flows
- flashier hydrological systems
- increase in erosion during heavy precipitation events

Adaptive Capacity:

- low species diversity
- dispersal-mainly downstream/south?
- dams currently in place to control flood dynamics

Key Points

- The Twin Cities are getting warmer (especially at night) and wetter (with more heavy rain events and flooding)
- Temperatures will increase even more in the future, and we may experience more drought stress in the summer.
- The climate may be more similar Omaha, Nebraska and we may shift up to a zone 5 or 6!
- Tree species that are more vulnerable:
 - Northern white cedar, black willow, ashes, non-DED resistant elms, cottonwood.
- Tree species that are less vulnerable:
 - Bur oak, honeylocust, swamp white oak, hackberry, silver maple