

ONLINE COURSE

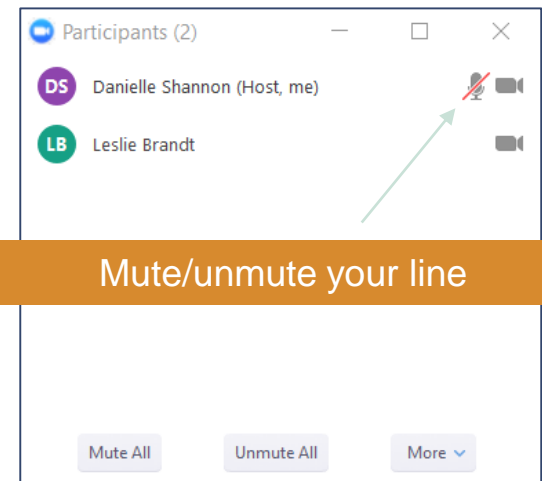
URBAN FORESTED WATERSHEDS ADAPTATION PLANNING AND PRACTICES

Session 2: Understanding and Evaluating Climate Change Vulnerabilities

Tuesday, November 13, 2018 @ 11 am ET

Web session etiquette. Please:

- If you are using a phone, turn off your computer speakers to avoid feedback and terrible noises.
- Mute your line unless you are speaking to the group.

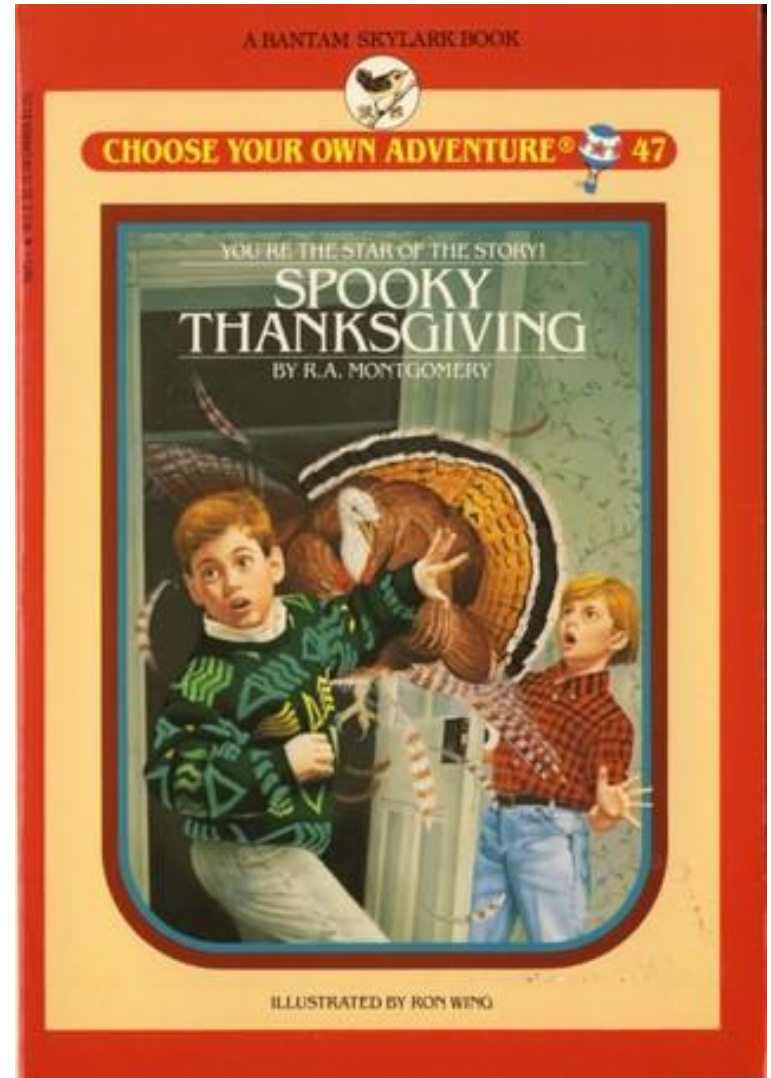


Welcome Back!

Please turn on your webcams if you have them.

Today's Agenda

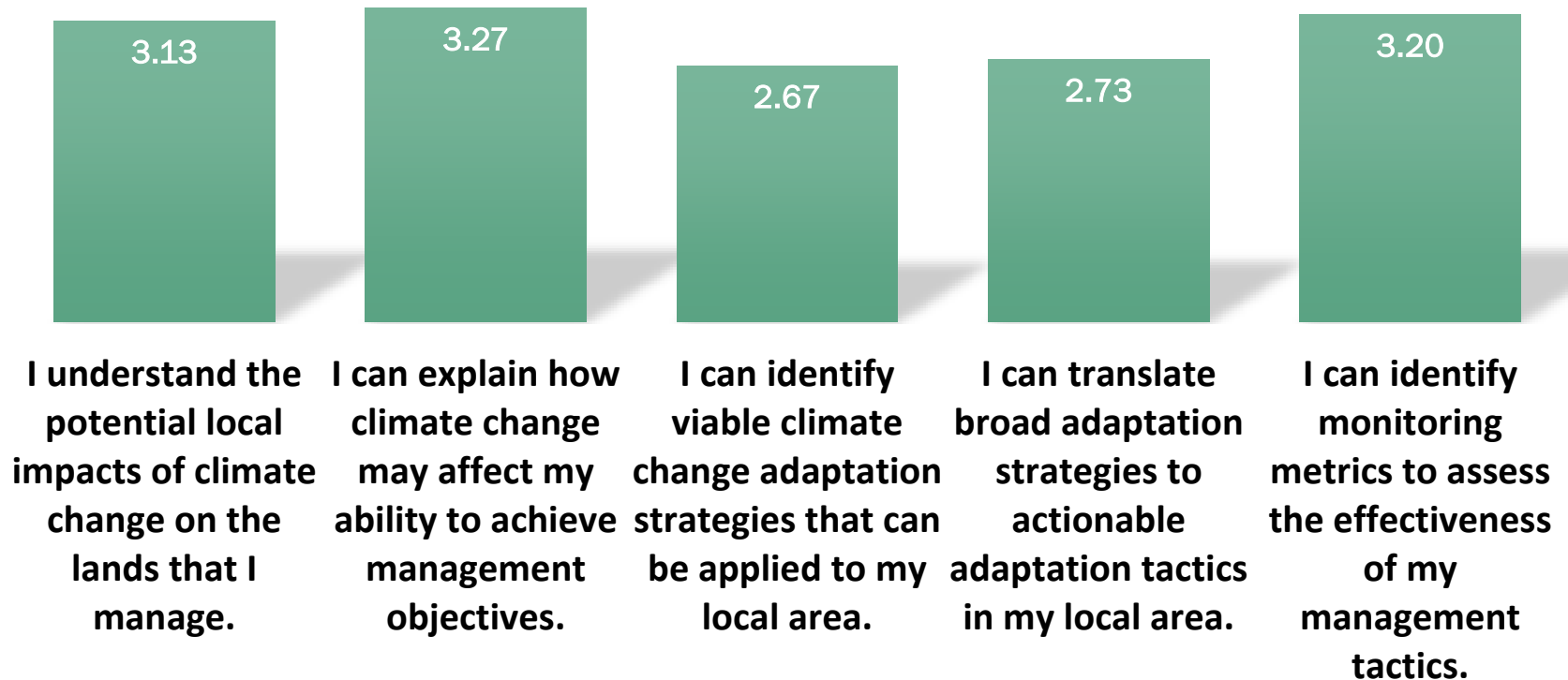
- Homework Review
- Breakout Groups
 - introduce your project
 - Step 1 discussion
- Step 2 introduction
- Overview of key resources and concepts
- This week's assignment!



Where are we now?

Average response

Respondents: 15
Rating: Disagree 1 to Agree (5)



Topics you are interested in:

Topic	When we'll cover it
Improving my skills in practice as an arborist	Throughout course
Local impacts of climate change	Step 2
Adaptable trees to plant	Step 2, 4
Climate change effects in Michigan and what we can do about them	Throughout course
Ecosystem and species vulnerability	Step 2
A better understanding of forest adaptation	Throughout course
Adaptive management, climate impacts on current plantings, planning to mitigate future impacts	Throughout course
Identifying climate change adaptation strategies that can be applied to conservation practices in the real-world	Step 4
How climate change can be incorporated into current watershed management strategies.	Throughout course
Vulnerabilities and adaptation strategies for coastal/shoreline areas	Step 4 (let's chat more)

Getting to know your classmates



<https://flipgrid.com/cdc8cd>

Password: NIACS2018

Breakout rooms

Danielle-Room 1

- Abby Kleinheksel
- Amanda Studor Bond
- Daniel Goldfarb
- Jamie Vaughn
- John Scott
- Kirsten Lyons
- Melissa Evans
- Nick Sanchez
- Paul Harris
- Paul Kogelschatz
- Rhiannon Ulatowski
- Ryan Colliton
- Sheela Johnson
- Susan Rusinowski

Leslie –Room 2

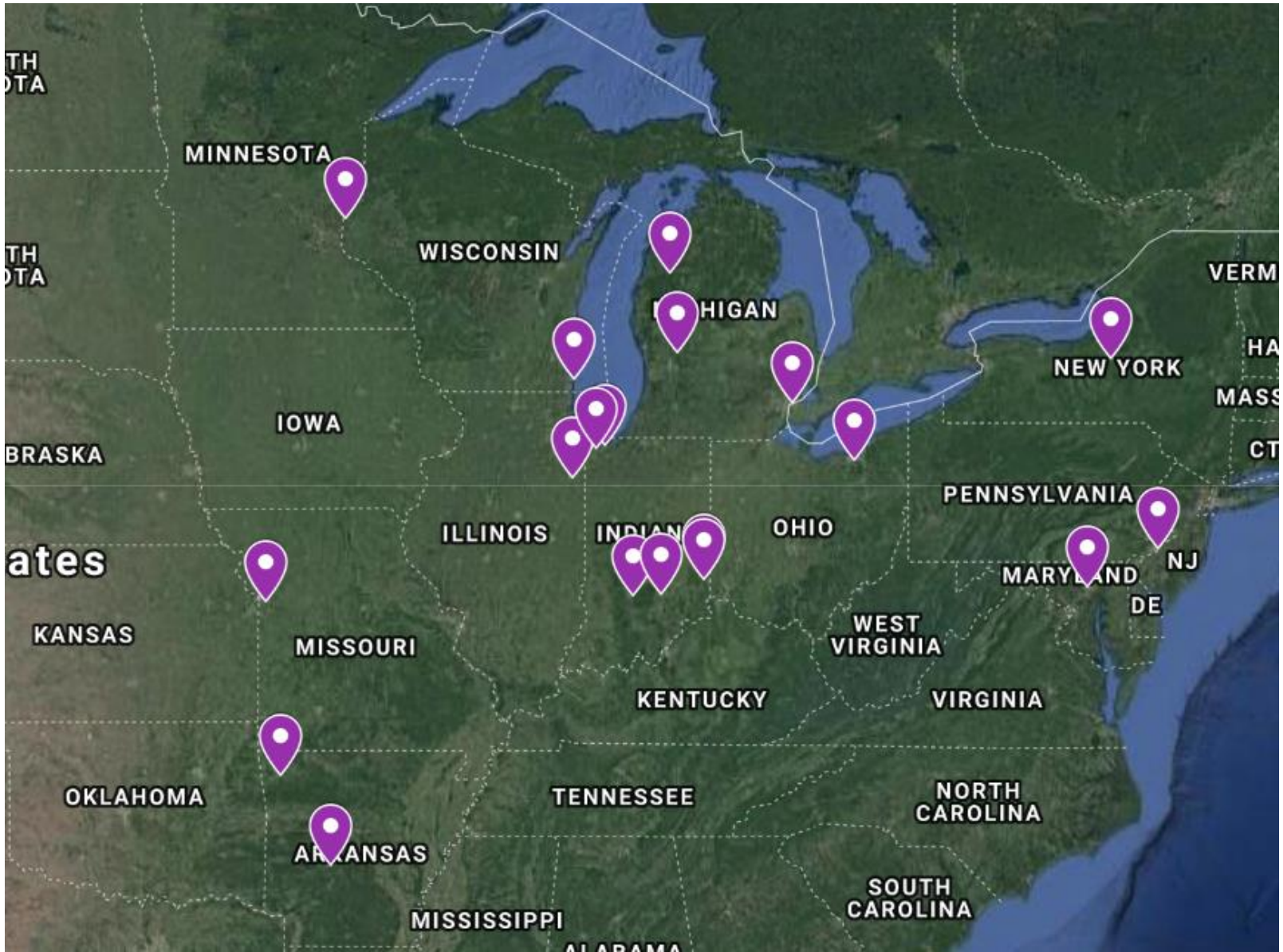
- Andrea McCullough
- Burney Fischer
- Daiva Gylys
- David Lein
- Genevieve Mortenson
- Jack Braunstein
- Jennifer Hrlec
- John Goodfellow
- Julia E Jones
- Kris Medic
- Michael Santel
- Regine Skelton
- Stephanie Freeman-Day
- Stephen Van Rhein
- Todd Jackson
- Wendy Sangster

Introduce your project

- Name
- Organization
- Project location
- What are your key goals and objectives?



Project Locations

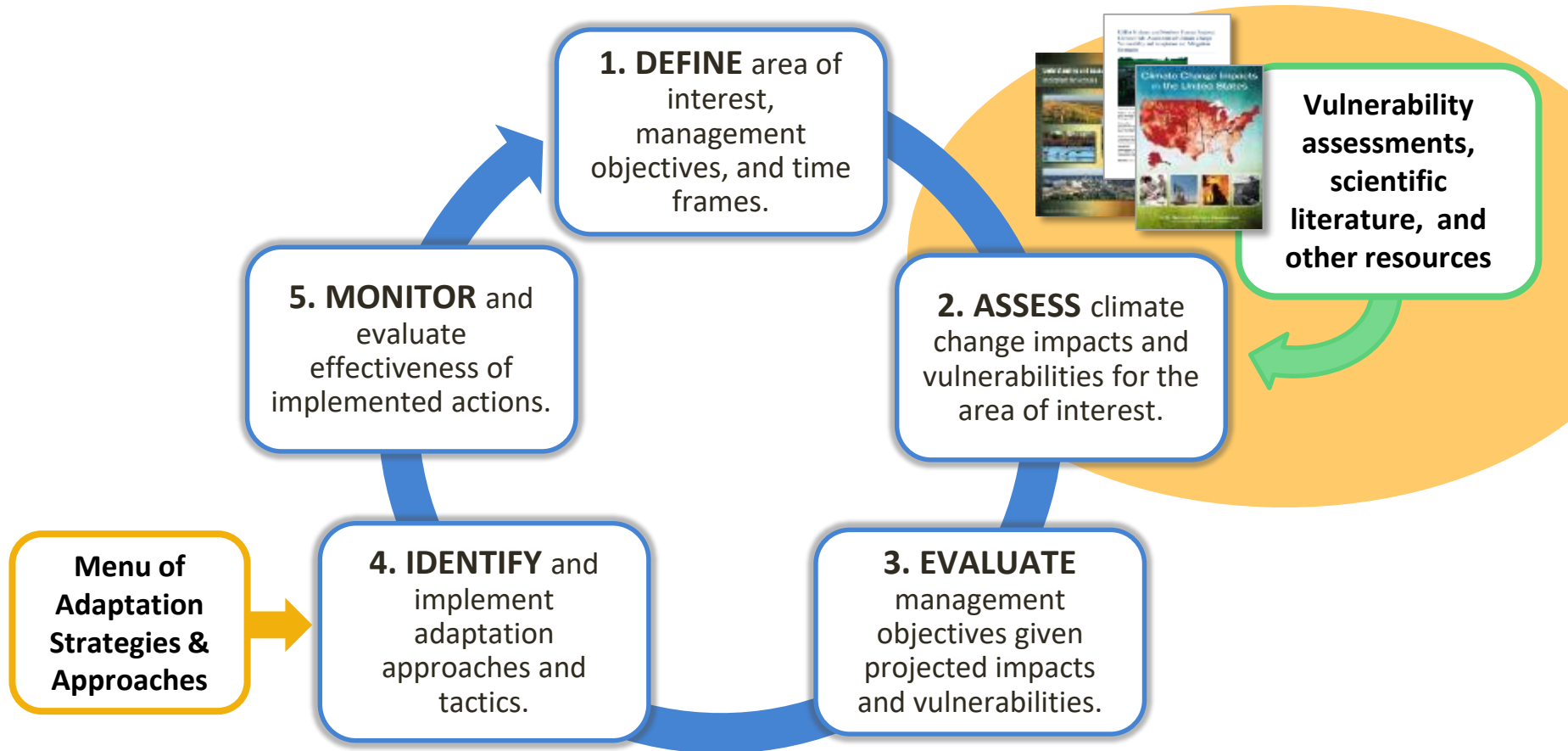


Questions

- What questions do you have for us about step 1?
- What additional tools or resources would have helped you complete this step?
- Are there any issues you had with the online tool that we can address?

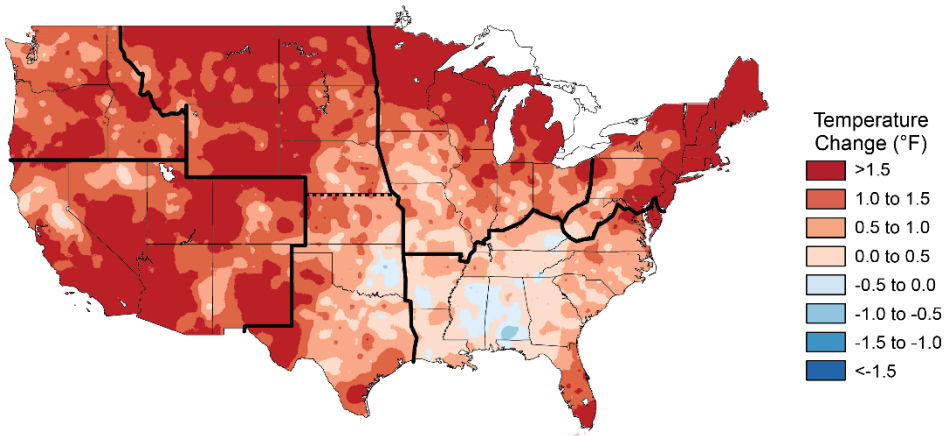
**WELCOME BACK TO THE MAIN
ROOM!**

This week– Step 2!

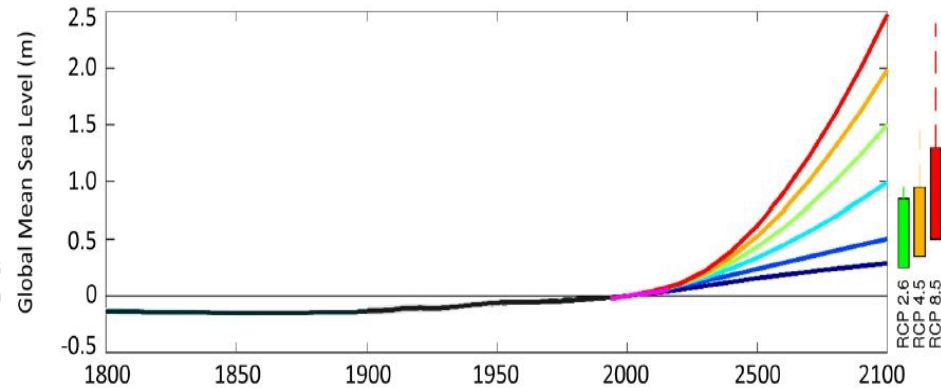


Step 2: Considering Climate Change

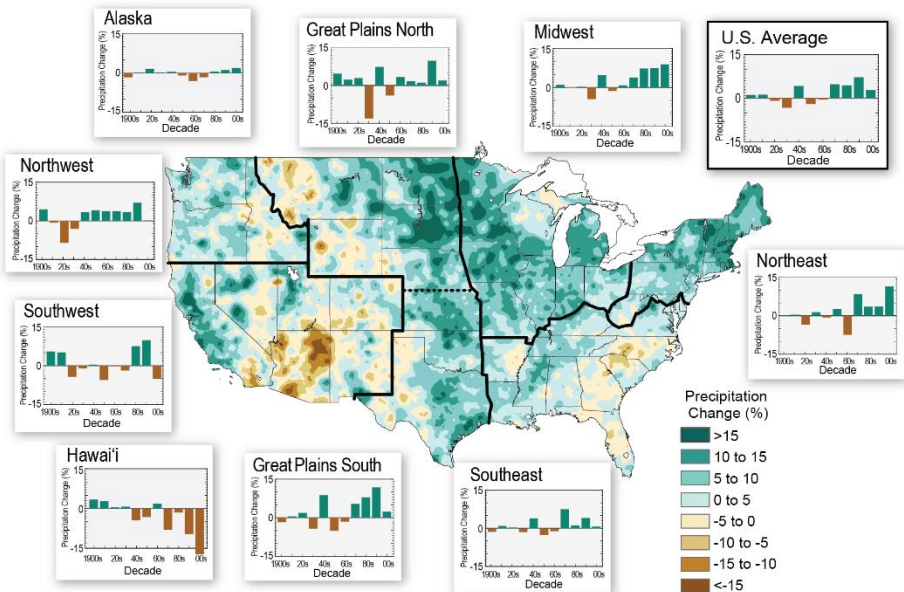
Observed U.S. Temperature Change



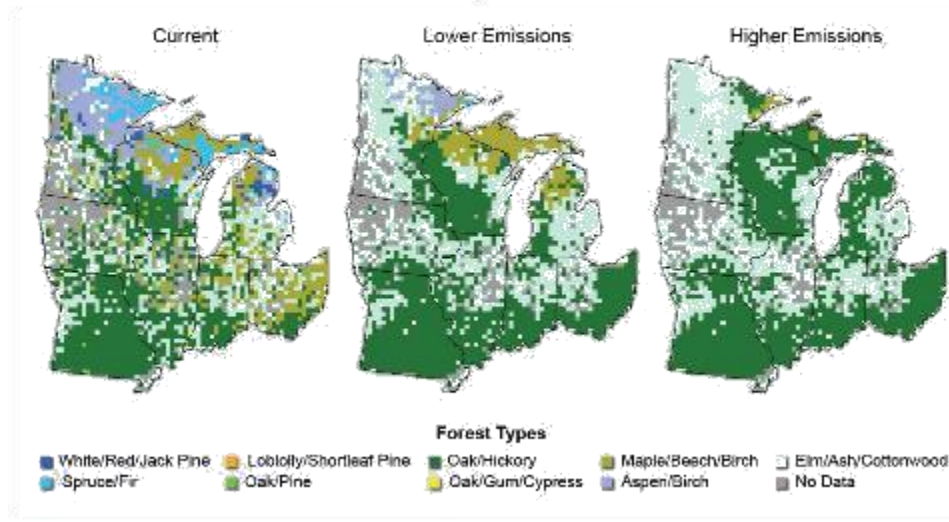
NOAA Global Mean Sea Level (GMSL) Scenarios for 2100



Observed U.S. Precipitation Change



Forest Composition Shifts



Step 2: ASSESS site-specific climate change impacts and vulnerabilities.

Key Question:

- How might the area be uniquely affected by climatic change and subsequent impacts?
- How might regional impacts be different in the project area?

Step 2.1: Climate impacts

Regional Impacts:

Warmer temperatures

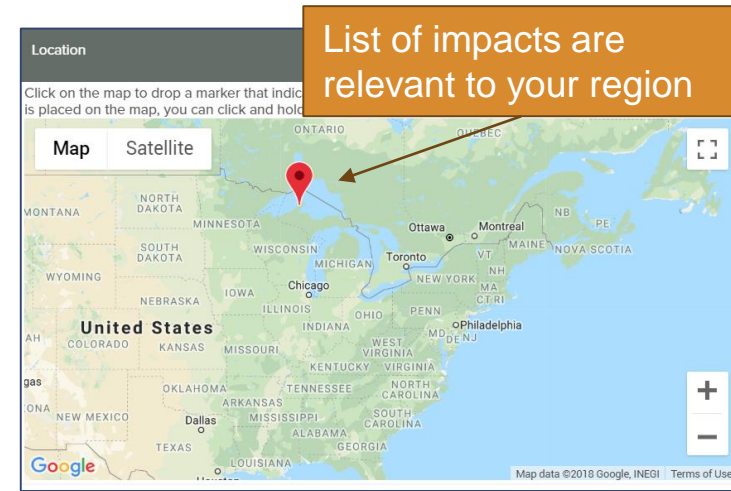
Altered precipitation

Longer growing seasons

Rising sea levels

More extreme events

Altered forest habitat



Step 2: ASSESS site-specific climate change impacts and vulnerabilities

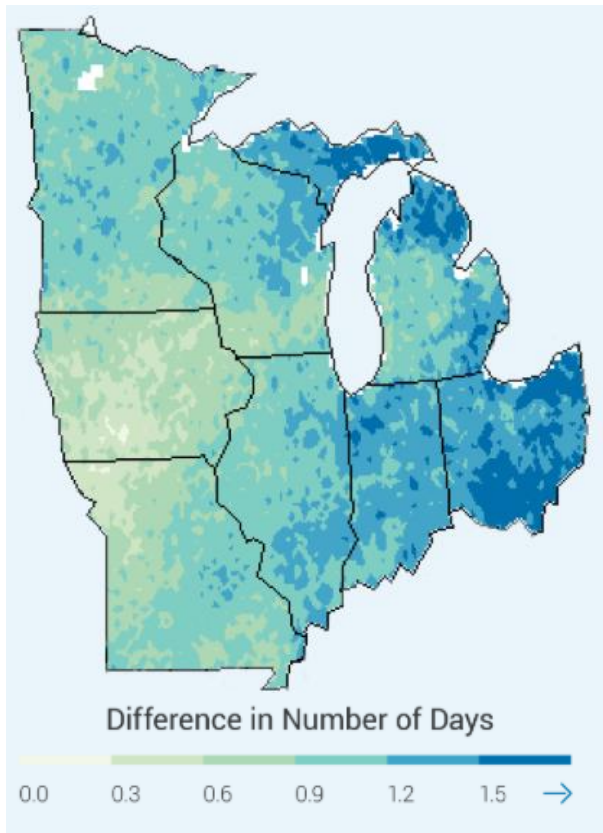
Regional Climate Impacts

- Based on regional info



Site-specific Impacts

- Based on your expertise



Midwest and Northeast:

The frequency of days with very heavy precipitation (the wettest 2% of days) is also projected to increase, raising the risk of floods and nutrient pollution.

National Climate Assessment (2014)
2041-2070 compared to 1971-2000 (High emissions A2 scenario).
NOAA NCDC / CICS-NC



Source: KQED

Step 2: ASSESS site-specific climate change impacts and vulnerabilities

Regional Climate Impacts

- Based on regional info



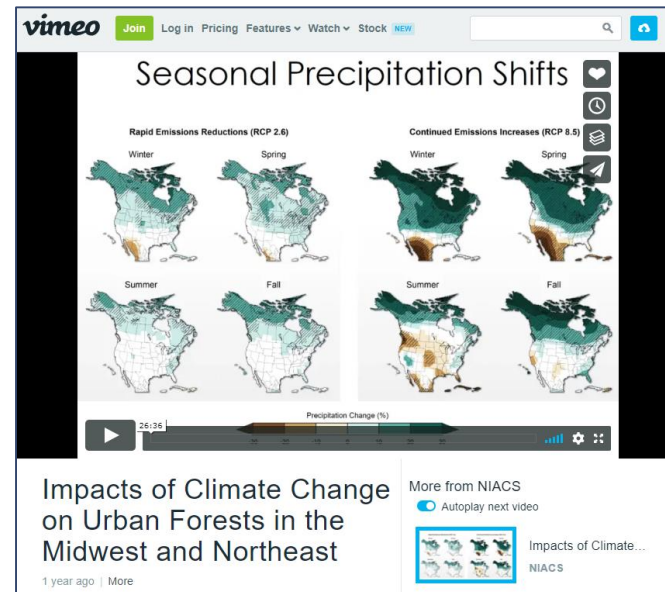
Site-specific Impacts

- Based on your expertise

Mgmt. Unit/ Topic	Climate Change Impacts and Vulnerabilities	
	Regional From vulnerability assessments	For the Property or Project Area Based on your knowledge of the site
Forest in Lot C	More extreme precipitation events	Slope on east side of property may deliver nutrients from neighboring ag fields
Riparian forest	Boreal species will face increasing stress	Hemlock riparian trees are projected to decline, a decrease in July/Aug shade may contribute to increased water temperatures

Before you begin this step

1. Watch the video **“Impacts of Climate Change on Urban Forests”** (about ½ hour)
2. Assemble information about your project location, such as:
 - Tree species lists/inventories.
 - Landcover, and flood maps
 - Soil maps
 - Digital elevation/topographic maps
 - Facilities, road & culvert
3. Review information specific to your project area as listed in the course materials.



Watch the video:
<https://vimeo.com/240862566>

Step 2 landing page

Adaptation Workbook

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Climate Impacts and Vulnerability instructions

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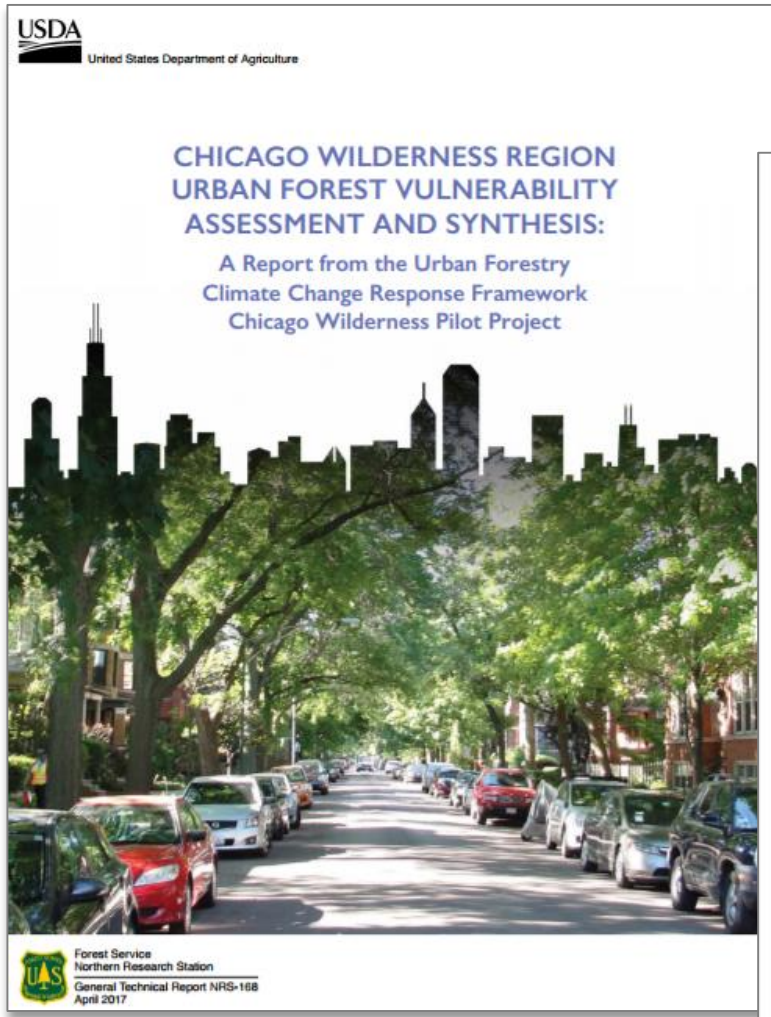
Review Session 2 slides.

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NIACS Regional Vulnerability Assessments

Region: Chicago Wilderness

Addresses vulnerabilities of individual tree species and forest or natural community types within the region



128 APPENDIX 7—Tree Species Vulnerability

Table 23.—Overall vulnerability, and associated information, for tree species in the Chicago Wilderness region

Common name	Origin	Estimated number of trees	Planted Adapt Class	Natural Adapt Class ¹	Projected change: Tree Atlas	Heat/Hardness zone effect	Overall vulnerability	Confidence
Accolack® elm	cultivar	0	high	n/a	not modeled	positive	low	medium
Accolack® flowering cherry	cultivar	0	medium	n/a	not modeled	positive	low-moderate	low-medium
Allegheny serviceberry	native	0	high	high	not modeled	no effect	low	low-medium
American basswood (American linden)	native	822,780	medium	medium	no change	not evaluated	low-moderate	medium
American beech	native	0	medium	medium	mixed results	not evaluated	moderate	medium
American elm	native	5,363,030	medium	high	increase	not evaluated	low-moderate	medium-high
American hornbeam	native	26,130	high	high	increase	not evaluated	low	high
American plum	native	150,100	medium	medium	mixed results	not evaluated	moderate	low-medium
American sycamore	native	7,970	medium	medium	increase	not evaluated	low-moderate	medium
American witchhazel	native	206,360	medium	high	not modeled	no effect	low-moderate	low
Amur cherry	nonnative	0	high	n/a	not modeled	*	low	low
Amur corktree	invasive	7,970	medium	high	not modeled	no effect	low-moderate	low
Amur honeysuckle	invasive	3,370,400	high	high	not modeled	no effect	low	low
Amur maackia	nonnative	744,480	high	n/a	not modeled	negative	moderate	low
Amur maple	invasive	36	medium	n/a	not modeled	negative	moderate-high	low
Agave senn-foeberry	nonnative	0	high	n/a	not modeled	negative	moderate	low
Agave/forabapple species	cultivar	1,724,980	medium	n/a	not modeled	no effect	moderate	low
Austrian pine	nonnative	963,160	medium	n/a	not modeled	positive	low-moderate	low
Autumn-olive	invasive	226,040	medium	high	not modeled	no effect	low-moderate	low
Baldcypress	native	26,030	high	n/a	not modeled	positive	low	medium
Balsam fir	native	206,390	medium	n/a	not modeled	negative	high	medium
Bigtooth aspen	native	0	low	high	decrease	not evaluated	high	medium-high
Bitternut hickory	native	186,540	medium	medium	increase	not evaluated	low-moderate	medium-high
Black cherry	native	7,737,030	low	medium	decrease	not evaluated	high	medium-high
Black gum	native	0	high	high	increase	not evaluated	low	high
Blackhaw	native	68,650	high	high	not modeled	no effect	low	low
Black Hills spruce	native	0	medium	n/a	not modeled	negative	moderate-high	low
Black locust	native	2,972,000	medium	high	increase	not evaluated	low	high
Black maple	native	69,910	medium	high	not modeled	no effect	moderate	low
Black oak	native	53,670	medium	high	no change	not evaluated	low	medium
Black walnut	native	2,469,240	medium	medium	increase	not evaluated	moderate	medium
Black willow	native	44,830	low	low	increase	not evaluated	moderate	medium
Blue spruce	native	1,107,240	medium	n/a	not modeled	no effect	moderate	low
Boxelder	native	8,597,890	medium	high	increase	not evaluated	low	high
Bur oak	native	1,603,410	high	high	no change	not evaluated	low	medium-high
Callery pear	invasive	257,690	medium	n/a	not modeled	positive	low-moderate	low
Chestnut oak	native	0	high	high	not modeled	no effect	low	low
Chinese catalpa	nonnative	0	medium	n/a	not modeled	*	moderate	low
Chinese chestnut	nonnative	11,090	medium	n/a	not modeled	no effect	moderate	low
Chinese lingstro	nonnative	0	high	n/a	not modeled	positive	low	low
Chinese juniper	nonnative	0	high	n/a	not modeled	no effect	low	low
Chinquapin oak	native	79,770	medium	medium	new habitat	not evaluated	moderate	medium
Cockspur hawthorn	native	320,200	high	n/a	not modeled	negative	moderate	low
Common chokecherry	native	114,910	medium	medium	decrease	not evaluated	moderate-high	low-medium
Common skunkberry	native	197,340	medium	high	not modeled	no effect	low-moderate	low
Common hackberry	native	1,020,060	high	high	increase	not evaluated	low	high

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NOAA State Summaries

  NOAA National Centers for Environmental Information | State Summaries 149-MO


MISSOURI

KEY MESSAGES

Average annual temperature has increased about 0.5°F since the early 20th Century. Winter warming has been characterized by a below average occurrence of extremely cold days since 1990. Under a higher emissions pathway, historically unprecedented future warming is projected.

Missouri has experienced an increase in heavy rain events, a trend which is projected to continue. Future increases in winter precipitation will pose a continued risk of spring planting delays and increased flooding along rivers and streams.

Severe drought, a natural part of Missouri's climate, is a risk to this agriculture-dependent state. Future increases in evaporation rates due to higher temperatures may increase the intensity of naturally-occurring droughts.



Missouri's location in the interior of the North American continent exposes it to a climate with large ranges in temperature with hot, humid summers and cold winters. The lack of mountain barriers both to the north and to the south, and the state's inland location away from the moderating effects of the oceans, allow it to be influenced by both cold Arctic air masses and warm, moist air masses from the Gulf of Mexico. Average annual temperatures across the state vary over a range of about 10°F from north to south. The year 2012 was the hottest on record, with an average annual temperature of 58.6°F, 4.1°F higher than the long-term average.

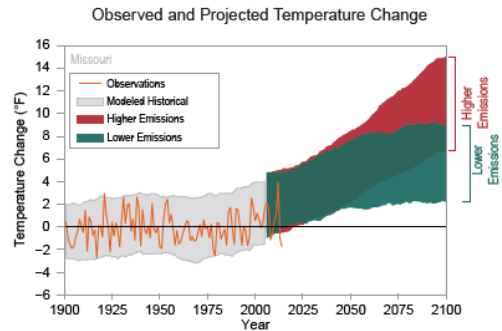


Figure 1: Observed and projected changes (compared to the 1901–1980 average) in near-surface air temperature for Missouri. Observed data are for 1900–2014. Projected changes for 2006–2100 are from global climate models for two possible futures: one in which greenhouse gas emissions continue to increase (higher emissions) and another in which greenhouse gas emissions increase at a slower rate (lower emissions)¹. Temperatures in Missouri (orange line) have risen about 0.5°F since the beginning of the 20th century. Shading indicates the range of annual temperatures from the set of models. Observed temperatures are generally within the envelope of model simulations of the historical period (gray shading). Historically unprecedented warming is projected during the 21st century. Less warming is expected under a lower emissions future (the coldest years being about as warm as the hottest year in the historical record; green shading) and more warming under a higher emissions future (the hottest years being about 11°F warmer than the hottest year in the historical record; red shading). Source: CICS-NC and NOAA NCEI.

¹Technical details on models and projections are provided in an appendix, available online at: <https://statesummaries.ncei.noaa.gov/mo>.

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Tree Vulnerability information

Location-specific Vulnerability Information

Climate Change Response Framework

Home Our Approach Projects Demos Products Partners Resources Contact

Central
Appalachians

Central
Hardwoods

Mid-Atlantic

New England

Northwoods

Urban

Urban Forestry Climate Change Resources for Columbia Missouri

List of Tree Atlas model results for the Central Dissected Till Plain ecological section. This area includes Columbia, Missouri. Hardiness and heat zone maps for the state of Missouri are also Provided.

-  [heatzoneszones_MO.PDF](#)
-  [hardinesszones_MO.PDF](#)
-  [TreeAtlasCentralTillPlain.xlsx](#)

Impacts: Heat, Hardiness, Growing degree days

Climate Change Pressures in the 21st Century

Office of Sustainability Climate



Growing Degree Days

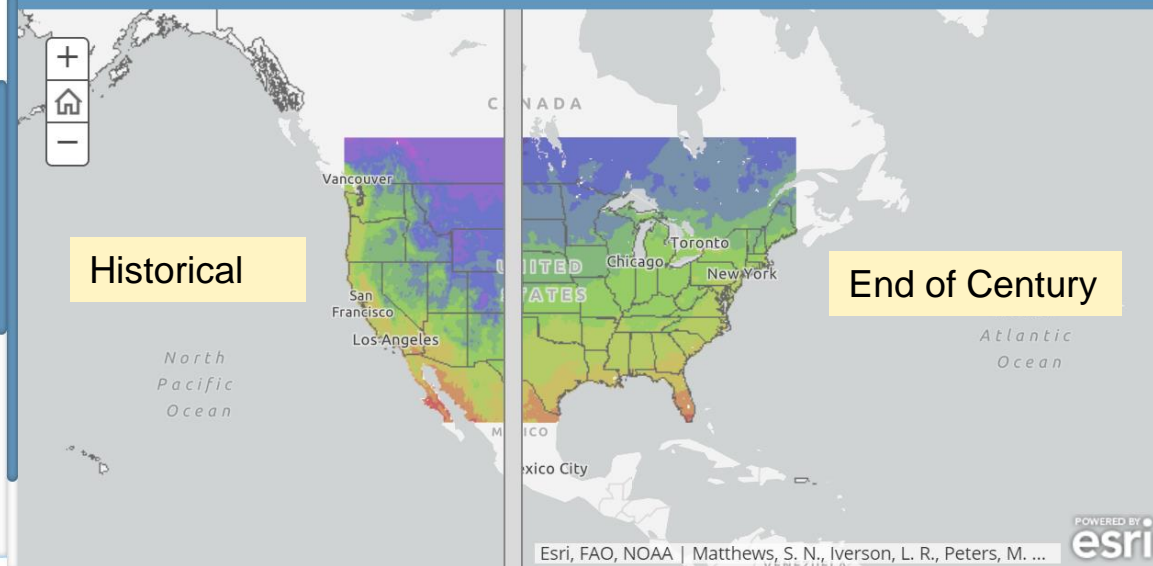
Plant Hardiness Zones

Plant hardiness zones (PHZs) can indicate the extent of winter stress that plants experience due to cold temperatures. These zones are based on the average annual extreme minimum temperatures (extreme winter lows). Horticulturists use this information to evaluate the cold hardiness of plants. The zones displayed here are based on the 30-year average of the absolute minimum temperature achieved in each year, which are then categorized into 2.8 °C (5 °F) increments.

Winter temperatures have been rising dramatically across much of the country, and this trend is expected to continue into the future. For example, minimum winter temperature could rise at least 8–9 °C (14.4–16.2 °F) across much of the Northeast and Midwest under a high emissions scenario.

Plant Hardiness Zones

Historical (1980-2010) [Left] ↔ Future (2070-2099) [Right]



<https://goo.gl/iPpZCw>

Explore “current” and projected end of century (high emissions: RCP 8.5):

- growing degree days
- plant hardiness zones
- heat zones

Step 2 landing page

The screenshot shows a web interface for the 'Adaptation Workbook'. On the left is a navigation sidebar with the following items: 'My dashboard', 'Log out', 'Resources', 'Chicago 2018', 'Progress Summary', 'Step 1' (with sub-items: 'Define Management Topics', 'Management Goals and Objectives', 'Homework 1'), 'Step 2' (with sub-items: 'Climate Impacts and Vulnerability', 'Vulnerability Determination', 'Homework 2'), 'Step 3' (with sub-items: 'Evaluate Objectives', 'Homework 3'), 'Step 4' (with sub-item: 'Adaptation Actions'), 'Tactic Recommendations', 'Homework 4', and 'Step 5'. The 'Climate Impacts and Vulnerability' item is highlighted with a right-pointing arrow. A large orange arrow points from this sidebar item to the main content area.

The main content area is titled 'Climate Impacts and Vulnerability instructions' and contains the following text and list:

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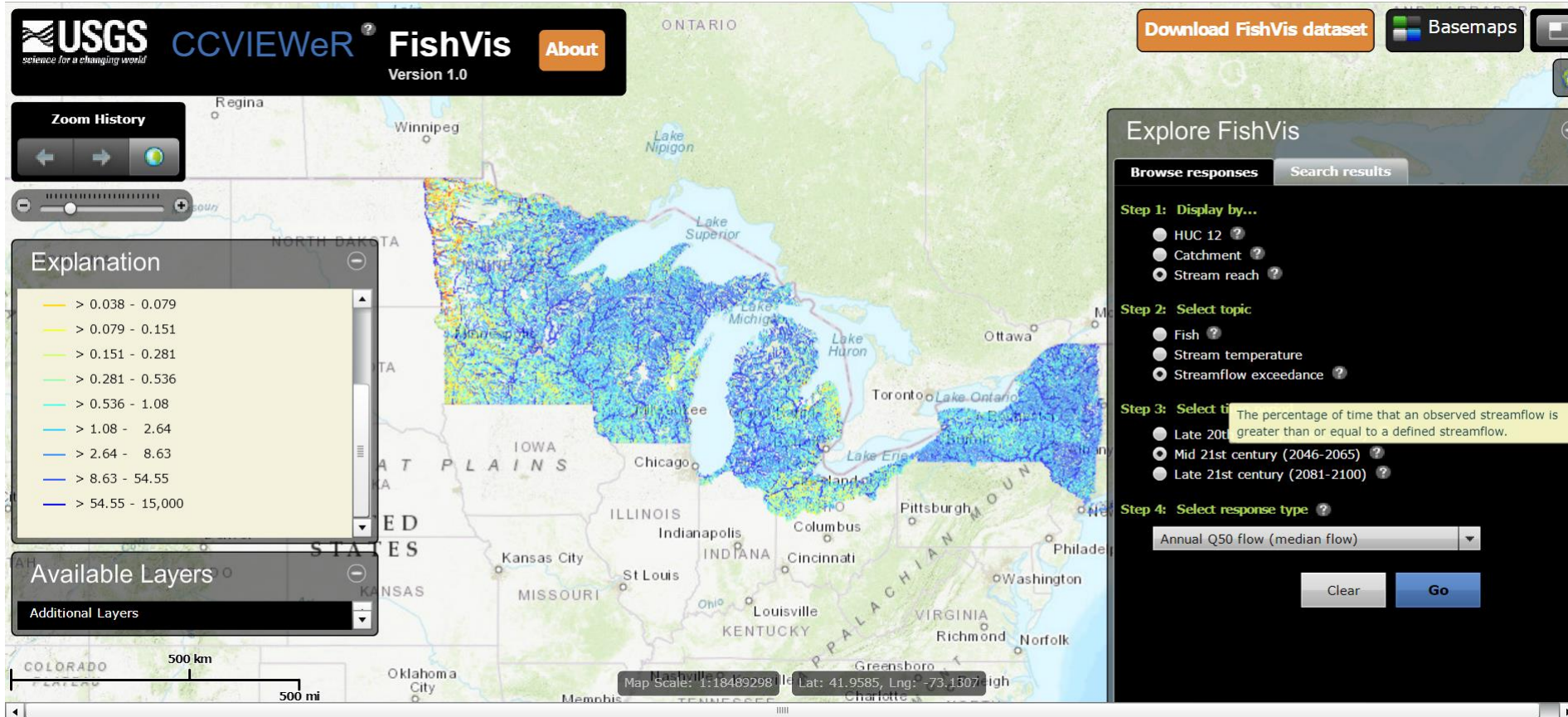
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 - The [Mid-Atlantic Assessment](#) covers Pennsylvania, Maryland, Delaware, and southern New York (link will be provided in early November when published)
 - The [Minnesota Assessment](#) covers northern Minnesota
 - The [New England and Northern New York assessment](#) covers Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and northern New York.
 - The [Wisconsin Assessment](#) covers northern Wisconsin and the western upper peninsula of Michigan
- **State-wide Climate Summaries for all 50 states and US Territories** from NOAA.
- Additional information on **tree species vulnerability (including urban trees)**, and shifts in **heat and hardiness zones**, found here:
 - Find tree species habitat suitability information for the entire Midwest, Northeast and Southeast at the [USFS Tree Atlas tool](#)
 - [Use this interactive story map to discover expected shifts in heat and hardiness zones](#) (maps display for the contiguous USA)
 - Location-specific information is available for these areas:
 - [California Climate-ready trees](#)
 - [Climate Change Projections for Tree Species in the Driftless Area \(IA, MN WI\)](#)
 - [Climate Change Projections for Individual Tree Species in the Northwoods \(MI, WI, MN\)](#)
 - [Urban Forestry Climate Change Resources for the Boston Area](#)
 - [Urban Forestry Climate Change Resources for the Cleveland Area](#)
 - [Urban Forestry Climate Change Resources for the Detroit Region](#)
 - [Urban Forestry Climate Change Resources for Indiana](#)
 - [Urban Forestry Climate Change Resources for New York City](#)
 - [Urban Forestry Climate Change Resources for Philadelphia](#)
 - [Urban Forestry Climate Change Resources for the Twin Cities](#)
- General information on climate impacts to **water resources** (*choose whatever is of interest*)
 - [Climate Change, Forests, and Water](#) (USDA FS Climate Change Resource Center)
 - [Water, climate change, and forests: Watershed stewardship for a changing climate](#)
 - Explore the potential changes to stream temperature and streamflow in the Upper Midwest at USGS FishVis (<https://ccviewer.wim.usgs.gov/fis>)
 - [Vulnerability of US Water supply](#) (12pgs); or the [technical report](#) (160pgs) (2011)

Review Session 2 slides.

If you encounter technical issues with the Workbook or have suggestions for improvements, send us an email using [this link](#).

A yellow callout box on the right side of the page, with a bracket pointing to the 'water resources' section of the list, contains the text: 'Water Resources info and tools'.

Impacts: Fish habitat, water temperature



<https://ccviewer.wim.usgs.gov/fishvis/>

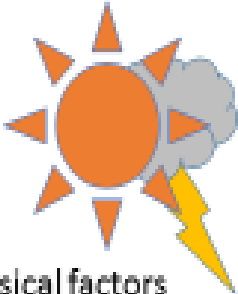
**We will send a pdf tutorial to help you use this tool*

**Explore future projected:
fish, stream temperature, streamflow
exceedance, and climate data.**

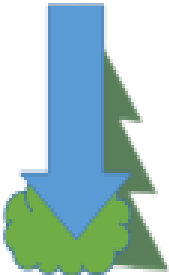
- **By stream reach, catchment, HUC**
- **By state**

Vulnerability=Impacts +Adaptive Capacity

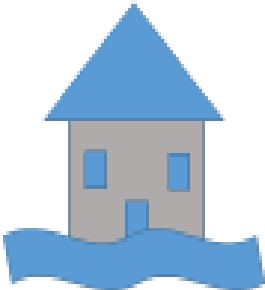
Impacts



Physical factors

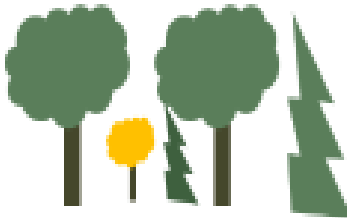


Biological factors



Human Factors

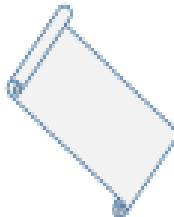
Adaptive Capacity



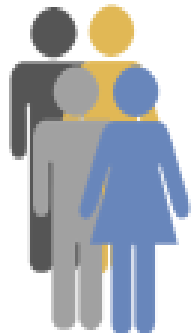
Biological factors



Economic factors



Organizational/technical factors



Social factors

Impacts: Native Species

The screenshot shows the homepage of the Climate Change Atlas. At the top, there is a header with the USDA logo, the text 'United States Department of Agriculture Forest Service', and 'Northern Research Station' with its logo. Below the header is a navigation bar with links for 'Forest Service Home', 'About the Agency', and 'Contact the National Office'. A breadcrumb trail indicates the current location: 'You are here: Northern Research Station Home / Tools & Applications / Climate Change Atlas'. The main content area is titled 'Climate Change Atlas' and features a large banner with the text 'Explore the Climate Change Tree Atlas' and three maps of the Eastern United States showing habitat shifts. Below the banner is a search box for trees and birds, with a list of trees and birds link. To the right, there is a section 'About the Climate Change Atlas' which describes the atlas's purpose and provides a link to the previous version. Below this are two featured research boxes: 'Ecosystem vulnerability assessment and synthesis: a report from the Climate Change Response Framework Project in northern Wisconsin' and 'Potential Changes by Region, State, Forest Type or National Forest and Parks'. At the bottom, there is a section for 'Climate Change Atlas Videos' with links to various guides and reports.

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

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/>

Models and Emissions Scenarios

PCM
Low emissions (B1
or RCP 4.5)

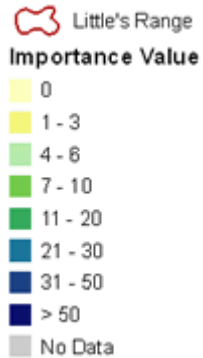
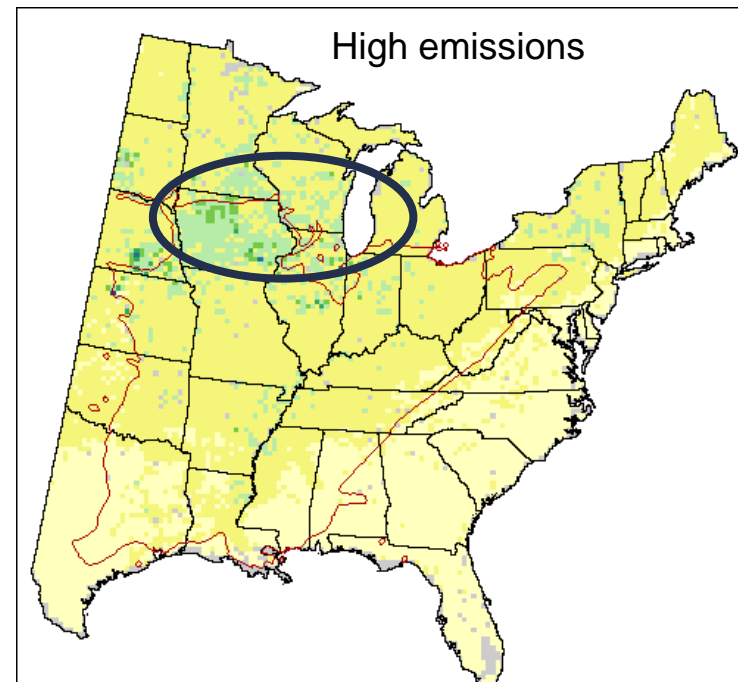
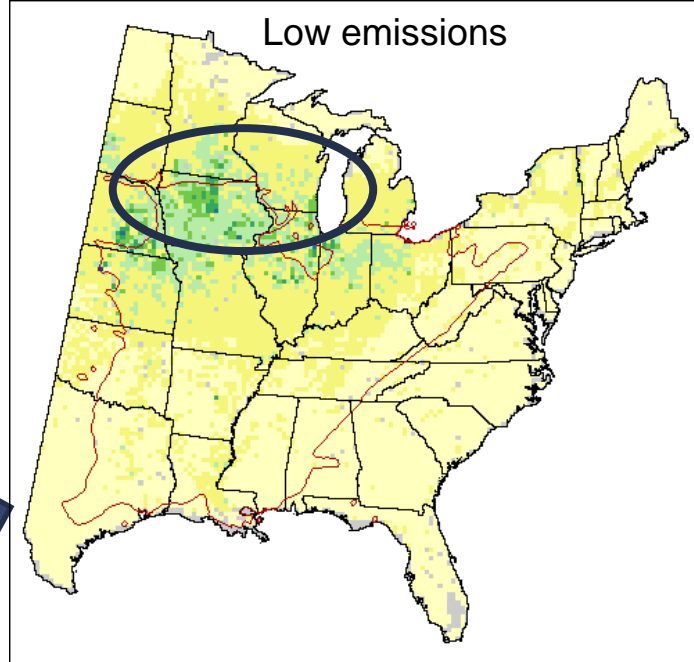
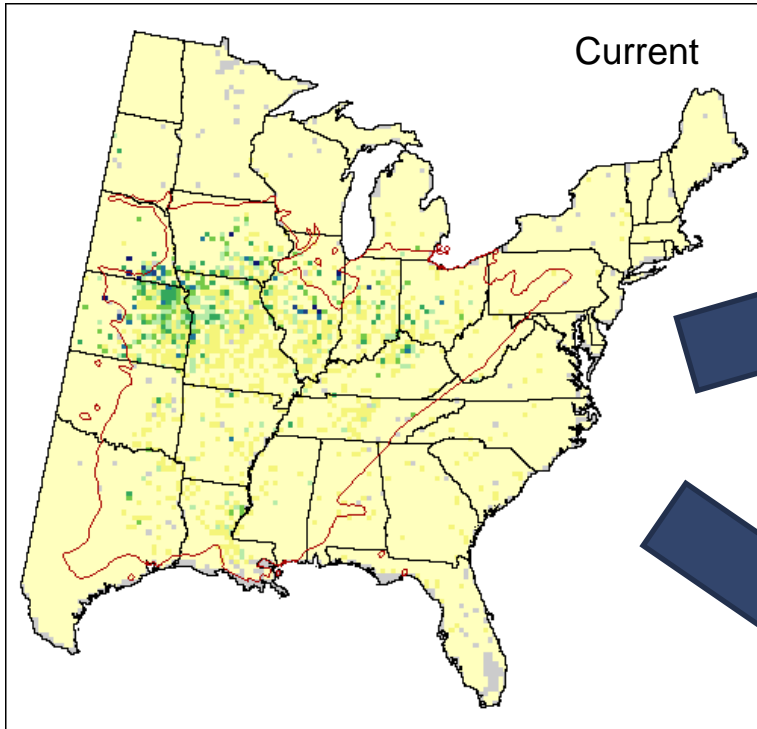
GFDL or HAD
High emissions (A1FI
or RCP 8.5)



Using Tree Atlas Information

- Projects changes in habitat suitability, not migration
- Coarse spatial scale (20km grid)
- Good for getting a general regional picture
- Does not account for microclimates, lake effect, or urban heat island
- DOES account for soils, precipitation, topography

Honeylocust



Tree Atlas Results

Latin name	Common name	ClimIndx	ModRelY	ModCur	HadHiDif	PcmLoDif	Gcm3Avg HiDif	Gcm3Avg LoDif	Change Class
Acer negundo	boxelder	0	2	3.07	2.65	1.63	4.73	2.54	Increase
Acer nigrum	black maple	1	3	0.01	-0.01	0	-0.01	0	No Change
Acer rubrum	red maple	3.5	1	0.13	0	0.11	0	0.02	No Change
Acer saccharinum	silver maple	2.5	2	4.54	-0.33	1.37	0.49	1.05	Increase
Acer saccharum	sugar maple	1	1	0.95	-0.55	0.47	-0.2	0.2	Mixed results
Aesculus glabra	Ohio buckeye	3.5	3	0.24	-0.2	0.06	-0.16	-0.04	No Change
Asimina triloba	pawpaw	3	3	0.05	0	0.55	0	0.03	Mixed Results
Betula nigra	river birch	2	3	0.29	0.57	0.18	0.72	0.36	Increase
Carya cordiformis	bitternut hickory	3.5	3	2.3	-0.59	0.98	-0.09	0.45	Mixed results
Carya glabra	pignut hickory	3.5	1	0.19	0.27	0.22	0.29	0.21	Increase

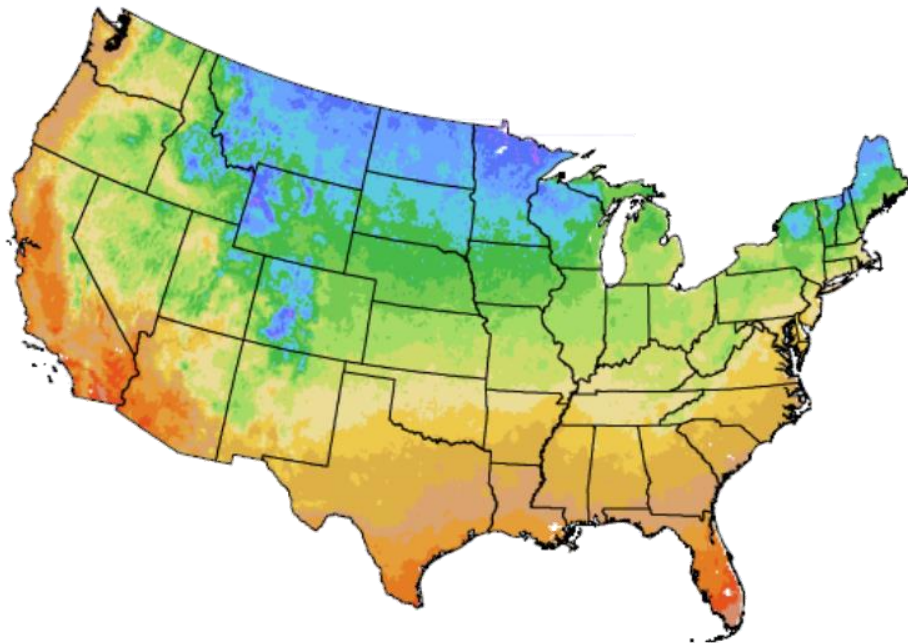
Questions?



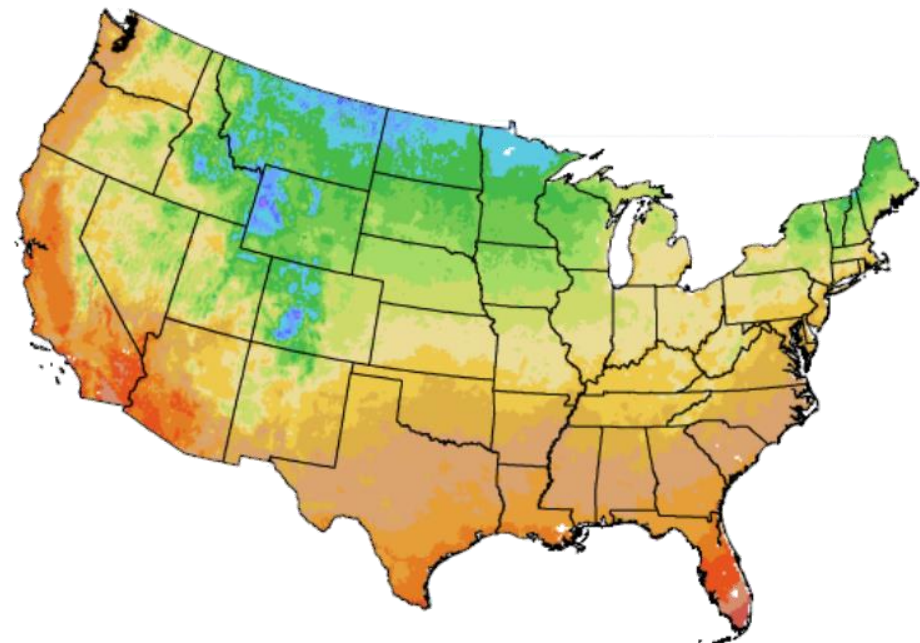
Impacts: Non-natives, cultivars, rare natives

- Compare species heat and hardiness zone range tolerance to future, projected heat and hardiness zones.

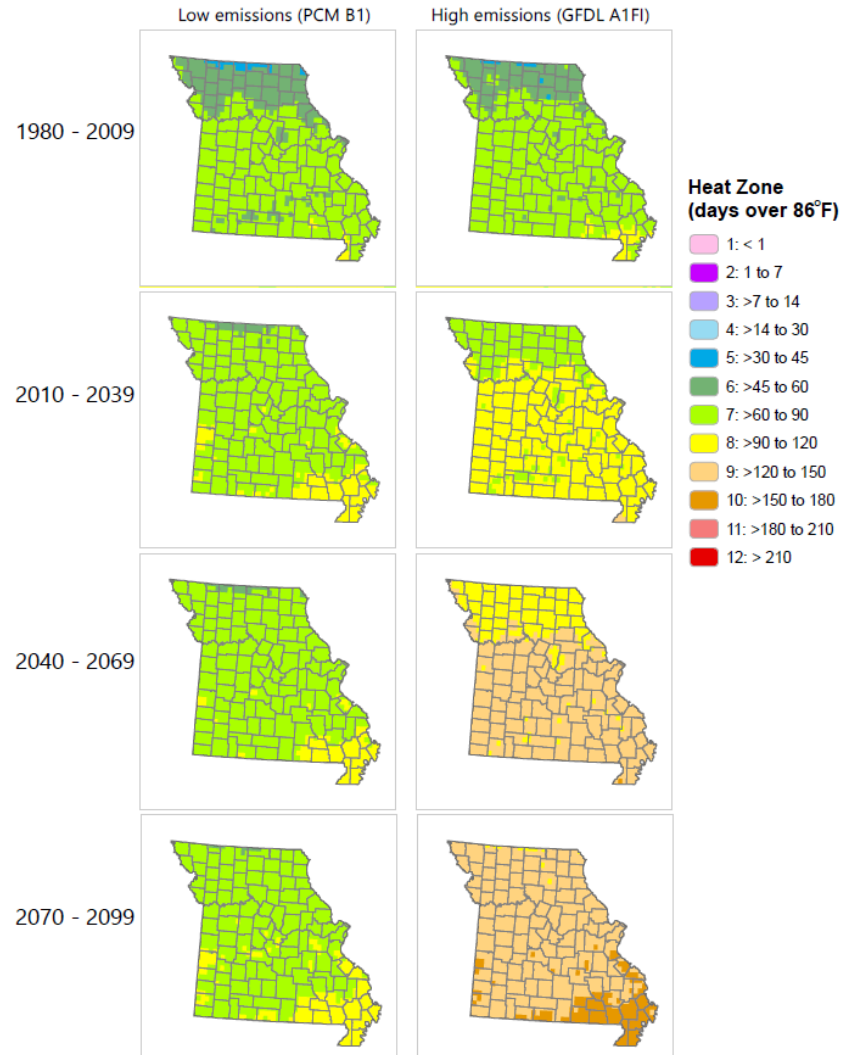
Low emissions (PCM B1)



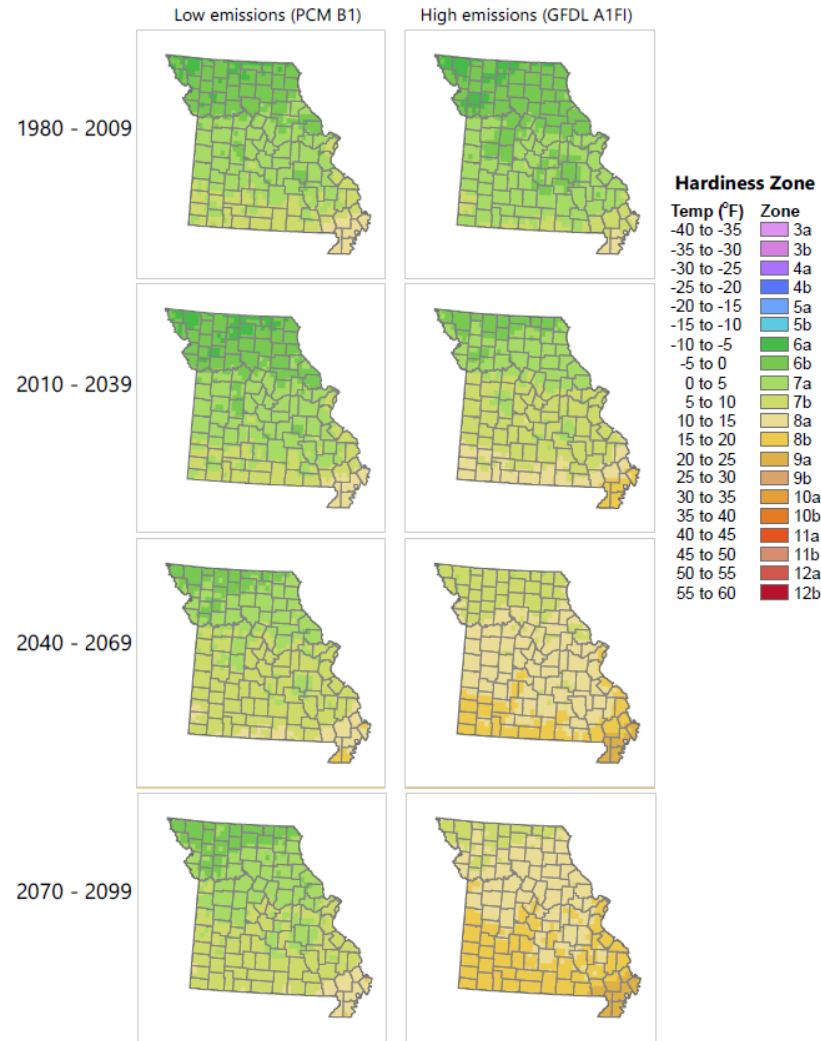
High emissions (GFDL A1FI)



Heat Zone Maps



Hardiness Zone Maps



Example: Black Hills Spruce

Look up published heat/hardiness zone ranges (on the web)

Hardiness Zone Range: 2 to 8

Heat Zone Range: 1 to 7

Look Up Current and Future Projected Zones Over Species' Lifespan

Hardiness zone range: 6 to 8

Heat zone range: 4 to 8

Compare species' tolerances to projections

Hardiness range within projected range (no impact)

Future heat zone > species' range (negative impact)

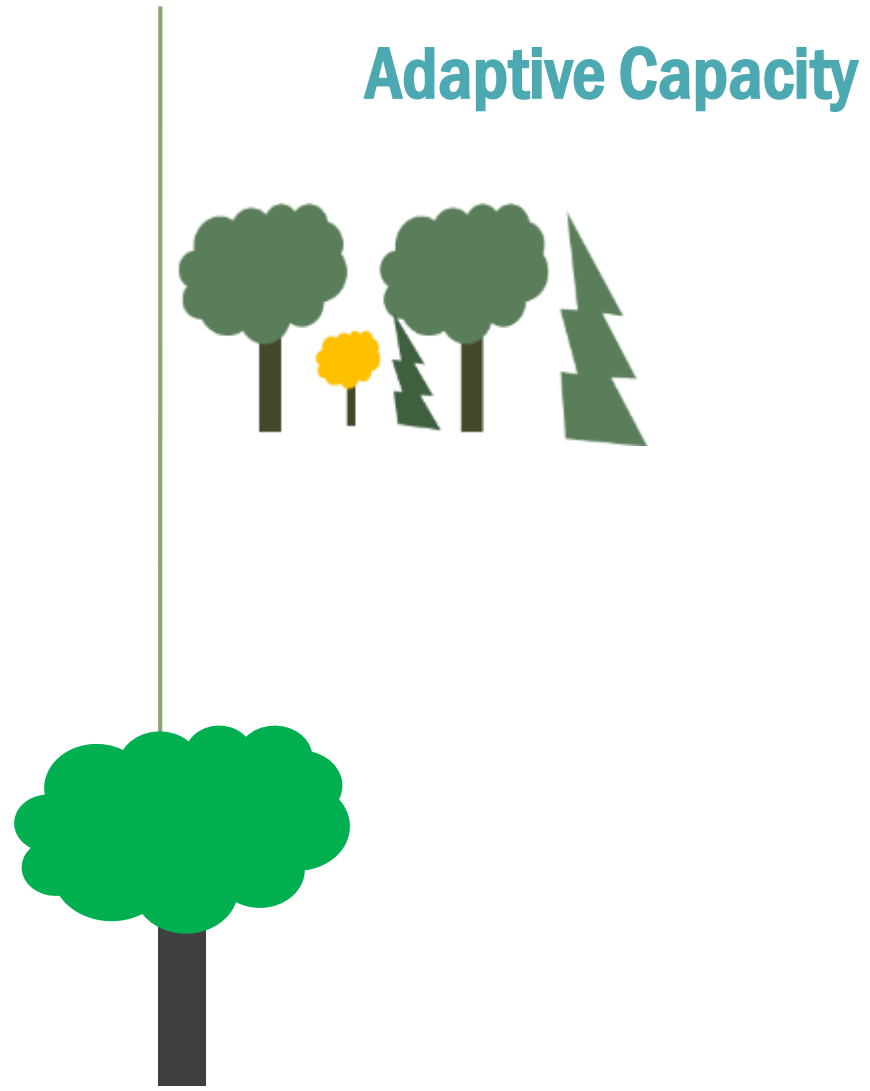


Vulnerability Components

Adaptive Capacity



Vulnerability Components



Adaptive Capacity Ratings

Based on Matthews et al. 2011



Disturbance Factors

Pest, disease, fire, drought, flood, pollution, heat, herbivory, invasive species, salt resistance



Biological Factors

Shade tolerance, edaphic specificity, propagation, pruning needed, establishment, rooting conditions

LOW

Intolerant,
Narrow growth requirements

HIGH

Tolerant,
adaptable

Making a climate informed species list: Native species with Tree Atlas Information

Species Name	Model Projections- low emissions	Model Projections- high emissions	Adaptive Capacity	Vulnerability
Red maple	No change	No change	High	Low
Red oak	No change	No Change	Medium	Medium
Sugar maple	Decrease	Decrease	Medium	Medium--high
Paper birch	Decrease	Decrease	Low	High

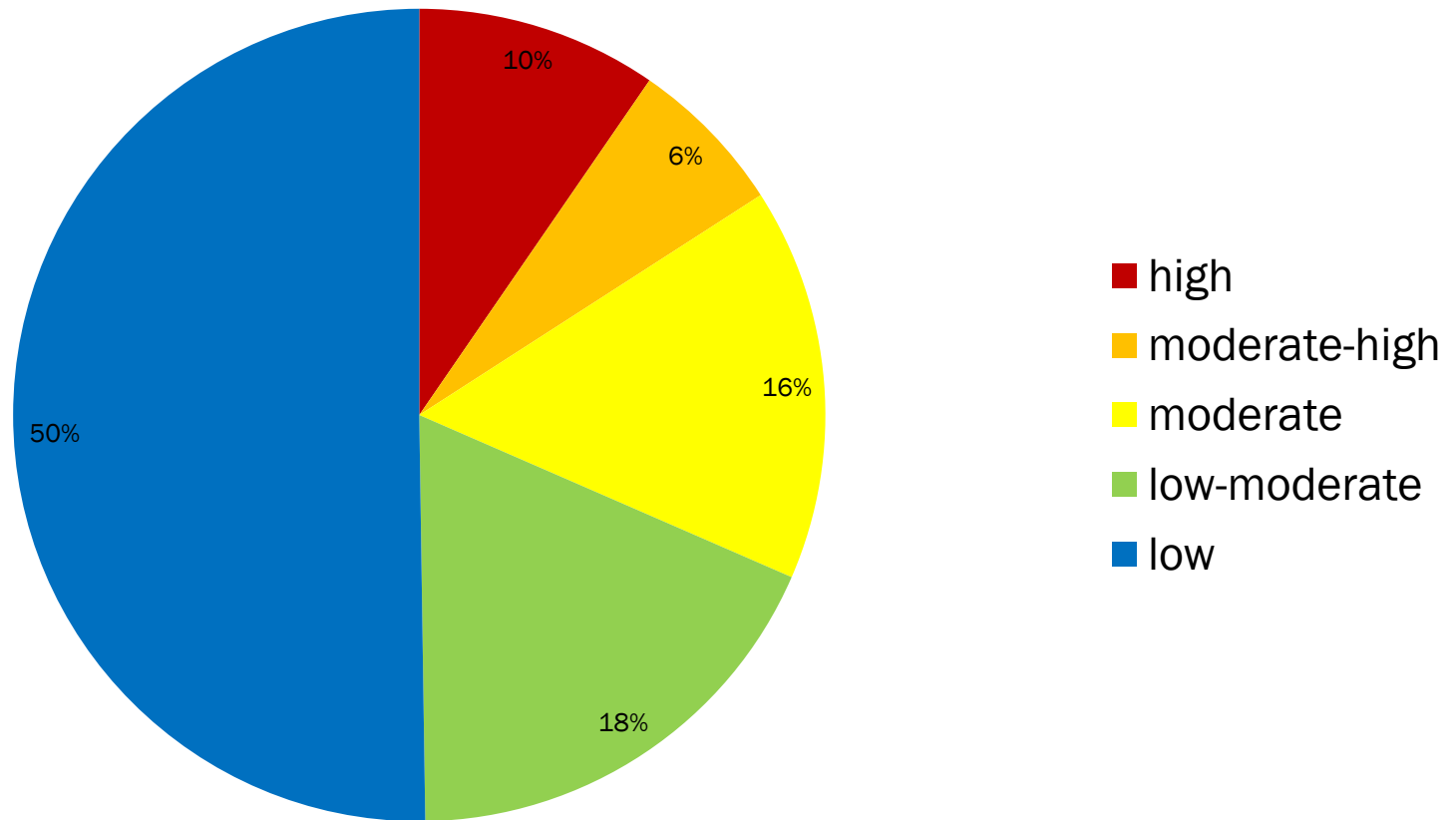
Making a climate informed species list:

Species with *no* Tree Atlas information

Species Name	Effect from zone shift-low emissions	Effect from zone shift-low emissions	Adaptive Capacity	Vulnerability
Gingko	No change	No change	High	Low
Korean Fir	No change	No Change	Medium	Medium
Norway maple	Medium	Decrease	Hlgh	Medium
Gray birch	Decrease	Decrease	Low	High

Example: Vulnerability of Trees in Chicago Region

% of Trees Sampled



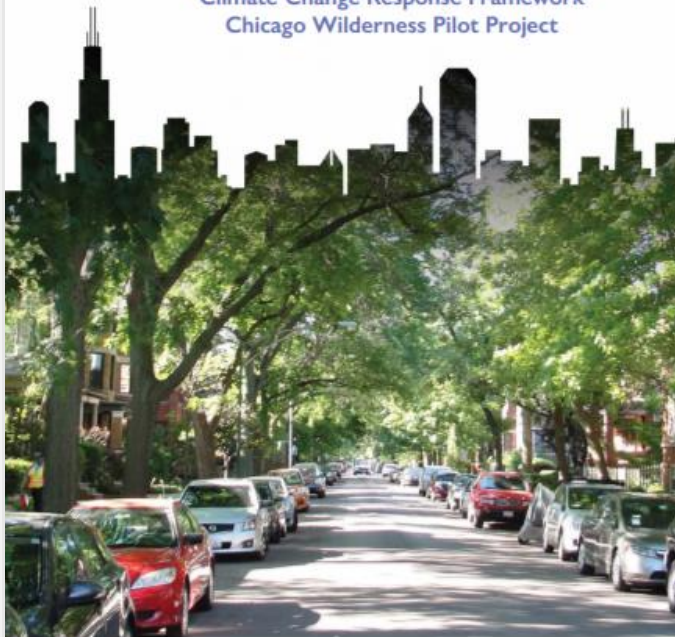
Chicago Wilderness Region Vulnerability Assessment



United States Department of Agriculture

CHICAGO WILDERNESS REGION URBAN FOREST VULNERABILITY ASSESSMENT AND SYNTHESIS:

A Report from the Urban Forestry
Climate Change Response Framework
Chicago Wilderness Pilot Project



Forest Service
Northern Research Station
General Technical Report NRS-168
April 2017

128 APPENDIX 7—Tree Species Vulnerability

Table 23.—Overall vulnerability, and associated information, for tree species in the Chicago Wilderness region

Common name	Origin	Estimated number of trees	Planted Adapt Class	Natural Adapt Class ¹	Projected change: Tree Atlas	Heat/Hardiness zone effect	Overall vulnerability	Confidence
Accolade® elm	cultivar	0	high	n/a	not modeled	positive	low	medium
'Accolade' flowering cherry	cultivar	0	medium	n/a	not modeled	positive	low-moderate	low-medium
Allegheny serviceberry	native	0	high	high	not modeled	no effect	low	low-medium
American basswood (American linden)	native	822,780	medium	medium	no change	not evaluated	low-moderate	medium
American beech	native	0	medium	medium	mixed results	not evaluated	moderate	medium
American elm	native	5,363,030	medium	high	increase	not evaluated	low-moderate	medium-high
American hornbeam	native	26,130	high	high	increase	not evaluated	low	high
American plum	native	150,100	medium	medium	mixed results	not evaluated	moderate	low-medium
American sycamore	native	7,970	medium	medium	increase	not evaluated	low-moderate	medium
American witchhazel	native	206,360	medium	high	not modeled	no effect	low-moderate	low
Amur cherry	nonnative	0	high	n/a	not modeled	+	low	low
Amur corktree	invasive	7,970	medium	high	not modeled	no effect	low-moderate	low
Amur honeysuckle	invasive	3,370,400	high	high	not modeled	no effect	low	low
Amur maackia	nonnative	744,480	high	n/a	not modeled	negative	moderate	low
Amur maple	invasive	36	medium	n/a	not modeled	negative	moderate-high	low
Apple serviceberry	nonnative	0	high	n/a	not modeled	negative	moderate	low
Apple/crabapple species	cultivar	1,724,980	medium	n/a	not modeled	no effect	moderate	low
Austrian pine	nonnative	983,160	medium	n/a	not modeled	positive	low-moderate	low
Autumn-olive	invasive	226,040	medium	high	not modeled	no effect	low-moderate	low
Baldcypress	native	26,030	high	n/a	not modeled	positive	low	medium
Balsam fir	native	206,390	medium	n/a	not modeled	negative	high	medium
Bigtooth aspen	native	0	low	high	decrease	not evaluated	high	medium-high
Bitternut hickory	native	186,540	medium	medium	increase	not evaluated	low-moderate	medium-high
Black cherry	native	7,737,030	low	medium	decrease	not evaluated	high	medium-high
Blackgum	native	0	high	high	increase	not evaluated	low	high
Blackhaw	native	68,650	high	high	not modeled	no effect	low	low
Black Hills spruce	native	0	medium	n/a	not modeled	negative	moderate-high	low
Black locust	native	2,372,090	medium	high	increase	not evaluated	low	high
Black maple	native	69,910	medium	high	not modeled	no effect	moderate	low
Black oak	native	53,670	medium	high	no change	not evaluated	low	medium
Black walnut	native	2,469,240	medium	medium	increase	not evaluated	moderate	medium
Black willow	native	44,830	low	low	increase	not evaluated	moderate	medium
Blue spruce	native	1,107,240	medium	n/a	not modeled	no effect	moderate	low
Bowater	native	8,597,890	medium	high	increase	not evaluated	low	high
Bur oak	native	1,603,410	high	high	no change	not evaluated	low-moderate	medium-high
Callery pear	invasive	257,690	medium	n/a	not modeled	positive	low-moderate	low
Cherry plum	nonnative	157,440	medium	n/a	not modeled	positive	low-moderate	low
Chestnut oak	native	0	high	high	not modeled	no effect	low	low
Chinese catalpa	nonnative	0	medium	n/a	not modeled	+	moderate	low
Chinese chestnut	nonnative	11,090	medium	n/a	not modeled	no effect	moderate	low
Chinese fringetree	nonnative	0	high	n/a	not modeled	positive	low	low
Chinese juniper	nonnative	0	high	n/a	not modeled	no effect	low	low
Chinkapin oak	native	75,770	medium	medium	new habitat	not evaluated	moderate	medium
Cockspur hawthorn	native	320,200	high	n/a	not modeled	negative	moderate	low
Common chokecherry	native	114,910	medium	medium	decrease	not evaluated	moderate-high	low-medium
Common elderberry	native	197,340	medium	high	not modeled	no effect	low-moderate	low
Common hackberry	native	1,030,060	high	high	increase	not evaluated	low	high

4-page summaries (some locations)

Twin Cities Region Urban Forest Impacts and Vulnerabilities

Effects on Twin Cities urban trees

Trees in the Twin Cities area will be affected by changing temperatures and precipitation patterns. Warmer summers can create stress for some species that cannot tolerate high temperatures. Milder winters may allow some species to survive in the area that previously would have suffered freezing damage. Warmer springs and falls may change the timing of leaf-out, flowering, and senescence.

Precipitation patterns will also affect local trees. More heavy precipitation events may increase the frequency or severity of flooding. Storms may break limbs or damage trees. Drier conditions in fall coupled with warmer temperatures could cause soil moisture deficits.

A changing climate can also affect the range and severity of pests, diseases, and invasive plant species. These biological stressors can also affect the survival and health of urban trees.

Low Vulnerability: Adapted to future climate and a range of other stressors	
<i>Acer truncatum</i>	Shantung maple
<i>Acer x freemanii</i>	Freeman maple
<i>Aesculus pavia</i>	red buckeye
<i>Amelanchier arborea</i>	downy serviceberry
<i>Amelanchier canadensis</i>	Canadian serviceberry
<i>Amelanchier laevis</i>	Allegheny serviceberry
<i>Carpinus caroliniana</i>	American hornbeam
<i>Celtis occidentalis</i>	northern hackberry
<i>Cladrastis kentukea</i>	yellowwood
<i>Ginkgo biloba</i>	gingko/maidenhair tree
<i>Gymnocladus dioica</i>	Kentucky coffeetree
<i>Juniperus virginiana</i>	eastern redcedar
<i>Maclura pomifera</i>	Osage orange
<i>Ostrya virginiana</i>	ironwood (eastern hophornbeam)
<i>Prunus maackii</i>	Amur cherry
<i>Quercus bicolor</i>	swamp white oak
<i>Quercus coccinea</i>	scarlet oak
<i>Quercus imbricaria</i>	shingle oak
<i>Quercus macrocarpa</i>	bur oak
<i>Quercus prinus</i>	chestnut oak
<i>Quercus x macdonnellii</i>	heritage oak
<i>Tilia cordata</i>	little leaf linden
<i>Ulmus spp</i>	disease-resistant elm cultivars
<i>Viburnum lentago</i>	nannyberry

These lists highlight species that may be more or less vulnerable to projected changes in the climate and other stressors of the Twin Cities in the coming decades. Some vulnerable species may still be an important part of the landscape; they just may require extra care or specific planting sites. Other factors, such as enhancing biodiversity and providing wildlife habitat, should also be considered when selecting species for planting.

Low-Moderate Vulnerability: Adapted to future climate and most stressors	
<i>Abies koreana</i>	Korean Fir
<i>Acer rubrum</i>	red maple
<i>Acer saccharinum</i>	silver maple
<i>Aescleus glabra</i>	Ohio buckeye
<i>Aescleus hippocastanatum</i>	horsechestnut
<i>Aesculus flava (octandra)</i>	yellow buckeye
<i>Carya cordiformis</i>	bitternut hickory
<i>Carya glabra</i>	pignut hickory
<i>Carya ovata</i>	shagbark hickory
<i>Catalpa ovata</i>	Chinese catalpa
<i>Celtis laevigata</i>	sugarberry
<i>Cercis canadensis</i>	eastern redbud
<i>Fagus grandifolia</i>	American beech
<i>Fagus sylvatica</i>	European beech
<i>Gleditsia triacanthos</i>	honeylocust
<i>Juglans nigra</i>	black walnut
<i>Magnolia acuminata</i>	cucumber tree
<i>Metasequoia glyptostroboides</i>	dawn redwood
<i>Morus rubra</i>	red mulberry
<i>Platanus occidentalis</i>	American sycamore
<i>Platanus x acerifolia</i>	planetree
<i>Prunus americana</i>	American plum
<i>Quercus alba</i>	white oak
<i>Quercus muehlenbergii</i>	chinkapin oak
<i>Quercus palustris</i>	pin oak
<i>Quercus velutina</i>	black oak
<i>Salix babylonica</i>	weeping willow
<i>Thuja occidentalis</i>	northern white cedar
<i>Ulmus americana</i>	American elm
<i>Ulmus pumila</i>	Siberian elm
<i>Ulmus rubra</i>	slippery elm

Some species will be more vulnerable to these changes than others. The species listed here were assessed for changes in species habitat suitability from climate impacts models and heat and hardiness zones. Traits that may make species more adaptable to stress, such as resistance to pests, diseases, drought, and flooding were also considered.

Twin Cities Region Urban Forest Impacts and Vulnerabilities

Moderate Vulnerability: May experience some stress from climate change or other stressors	
<i>Acer negundo</i>	boxelder
<i>Acer platanoides</i>	Norway maple
<i>Acer triflorum</i>	threeflower maple
<i>Betula alleghaniensis</i>	yellow birch
<i>Betula nigra</i>	river birch
<i>Carya illinoensis</i>	pecan
<i>Carya laciniosa</i>	shellbark hickory
<i>Catalpa speciosa</i>	northern catalpa
<i>Cercidiphyllum japonicum</i>	Katsura tree
<i>Cornus alternifolia</i>	pagoda dogwood
<i>Crataegus acutifolia</i>	cockspur hawthorn
<i>Liriodendron tulipifera</i>	tuliptree
<i>Maackia amurensis</i>	Amur maackia
<i>Magnolia stellata</i>	star magnolia
<i>Malus spp</i>	crabapple species
<i>Morus alba</i>	white mulberry
<i>Phellodendron amurense</i>	Amur corktree
<i>Picea abies</i>	Norway spruce
<i>Picea canadensis (glauca)</i>	White spruce
<i>Picea pungens</i>	blue spruce
<i>Pinus nigra</i>	Austrian pine
<i>Pinus resinosa</i>	red pine
<i>Populus balsamifera</i>	balsam poplar
<i>Populus deltoides</i>	cottonwood
<i>Prunus cerasus</i>	sour Cherry
<i>Prunus serrulata 'Kwanzan'</i>	Kwanzan Cherry
<i>Prunus x cistena</i>	purpleleaf Sand Cherry
<i>Pyrus spp.</i>	pear
<i>Quercus ellipsoidalis</i>	northern pin oak (Hill's Oak)
<i>Quercus rubra</i>	northern red oak
<i>Rhus typhina</i>	staghorn sumac
<i>Salix nigra</i>	black willow
<i>Sorbus alnifolia</i>	Korean mountain-ash
<i>Syringa reticulata</i>	Japanese tree lilac
<i>Tilia x euchlora</i>	Crimean linden

Moderate-High Vulnerability: Will likely experience considerable stress from climate or other stressors	
<i>Abies balsamea</i>	balsam fir
<i>Abies concolor</i>	white fir
<i>Abies fraseri</i>	Fraser Fir
<i>Acer ginnala</i>	Amur maple
<i>Acer nigrum</i>	black maple
<i>Acer saccharum</i>	sugar maple
<i>Acer tataricum</i>	tatarian maple
<i>Betula papyrifera</i>	paper birch
<i>Betula pendula</i>	European white birch
<i>Picea glauca var. densata</i>	Black Hills spruce
<i>Pinus ponderosa</i>	ponderosa pine
<i>Pinus strobus</i>	white pine
<i>Pinus sylvestris</i>	Scotch pine
<i>Prunus mandshurica</i>	Manchurian apricot
<i>Prunus virginiana</i>	common chokecherry
<i>Pyrus ussuriensis</i>	Ussurian pear
<i>Salix amygdaloides</i>	peachleaf willow
<i>Salix discolor</i>	pussy willow
<i>Sorbus aucuparia</i>	European mountain Ash
<i>Tilia americana</i>	American basswood

High Vulnerability: Will likely experience severe declines from climate or other stressors	
<i>Betula populifolia</i>	gray birch
<i>Populus tremuloides</i>	quaking aspen
<i>Populus grandidentata</i>	big-toothed aspen
<i>Prunus pensylvanica</i>	pin cherry
<i>Prunus serotina</i>	black cherry
<i>Pseudotsuga mucronata</i>	Douglas fir
<i>Sorbus decora</i>	showy mountain ash
<i>Fraxinus americana</i>	white ash
<i>Fraxinus nigra</i>	black ash
<i>Fraxinus pennsylvanica</i>	green ash



Eastern redbud, native to areas south of the Twin Cities, may benefit from milder winters.

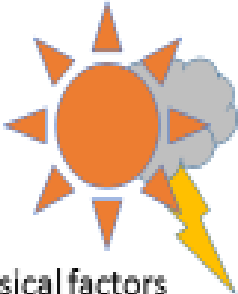
Confronting the challenge of climate change presents opportunities for land managers to plan ahead, foster resilient landscapes, and ensure that the benefits that forests provide are sustained into the future.

Resources are available to help forest managers and planners incorporate climate change considerations into forest management. A set of Forest Adaptation Resources is available at www.forestadaptation.org.

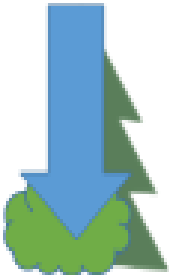
More information at: www.forestadaptation.org/urban

Vulnerability=Impacts + Adaptive Capacity

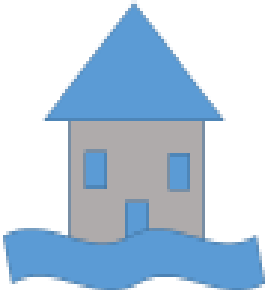
Impacts



Physical factors

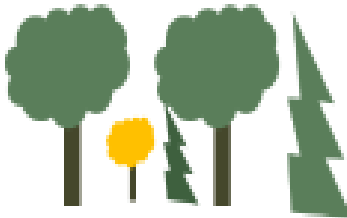


Biological factors



Human Factors

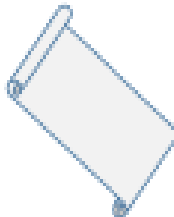
Adaptive Capacity



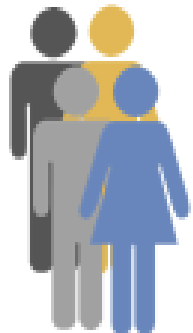
Biological factors



Economic factors

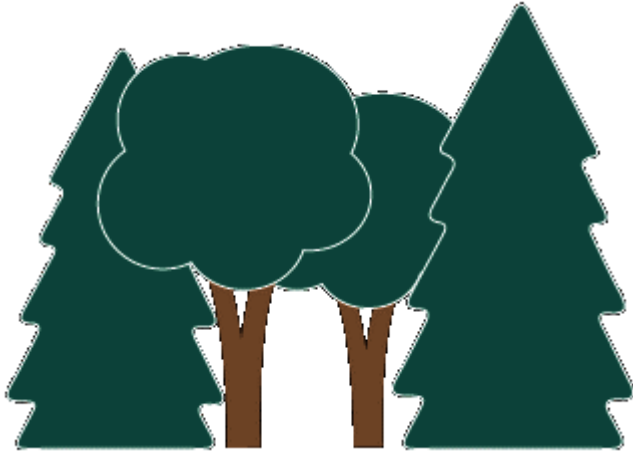


Organizational/technical factors



Social factors

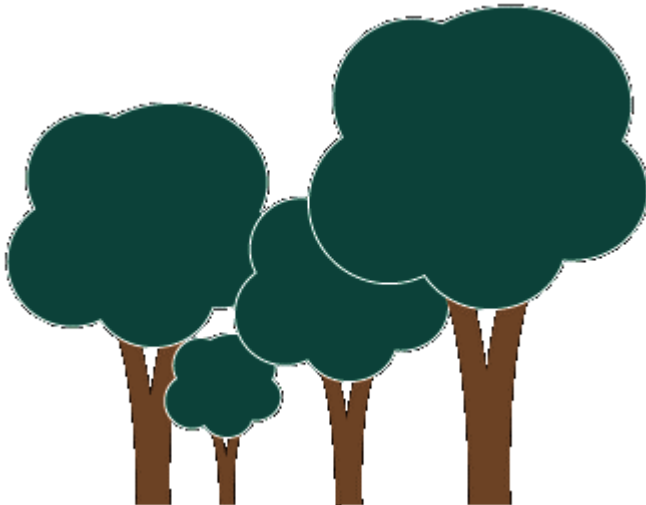
Other Biological Adaptive Capacity Factors



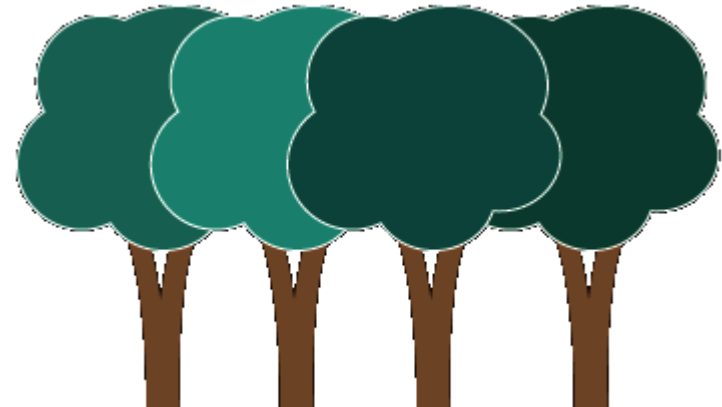
Species diversity



Connectivity



Age class diversity



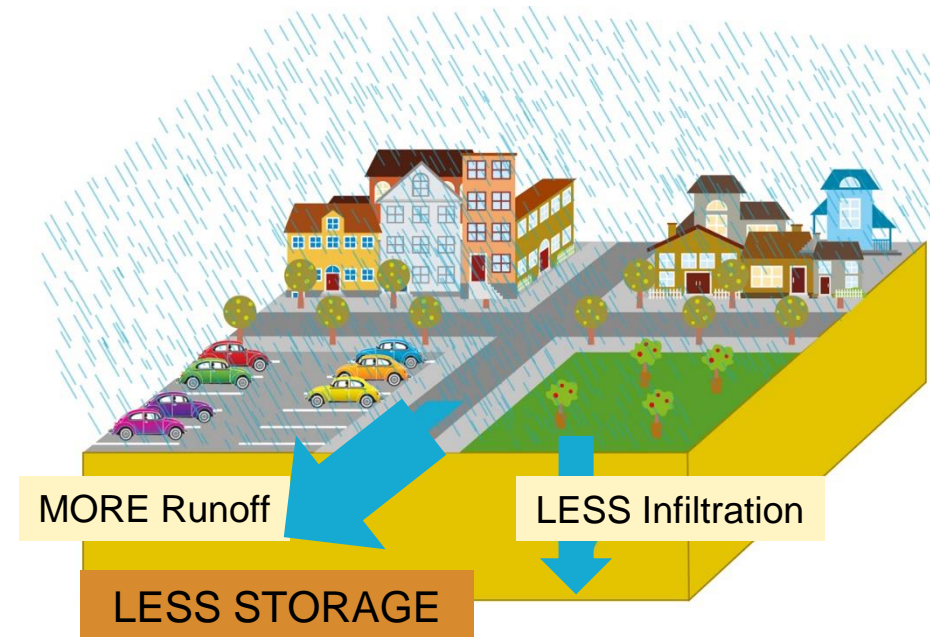
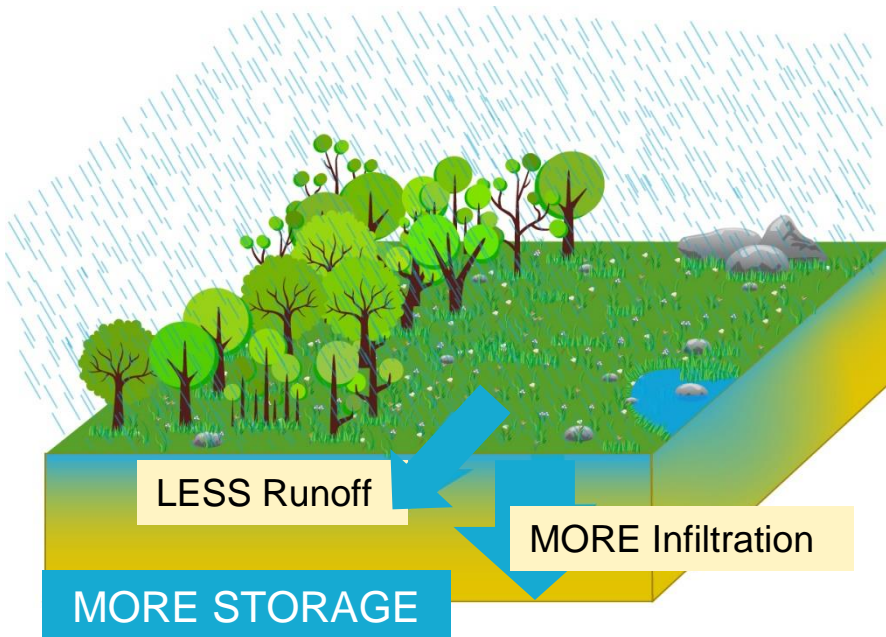
Genetic diversity

Adaptive capacity: Hydrologic features

The ability of your system to cope with changes

Basics

- **Hydrology:** Precipitation vs. Groundwater driven
- **Buffering capacity** (soils, slope, topography, wetlands, floodplains)
- **Site location in watershed** (headwaters, outlet)
- **Upstream neighbors** (land uses, pollutants)



Adaptive capacity: Hydrologic features

The ability of your system to cope with changes

Basics

- **Hydrology:** Precipitation vs. Groundwater driven
- **Buffering capacity** (soils, slope, topography, wetlands, floodplains)
- **Site location in watershed** (headwaters, outlet)
- **Upstream neighbors** (land uses, pollutants)

Physical features that may enhance a watershed to cope with climate changes (EPA): →

- Connectivity of habitats
- Maintenance of floodplain, wetland and other landscape features in their natural conditions to support natural hydrology and sediment supply

- Meander belts
- Riparian wetlands
- Floodplains
- Sediment transfer areas
- Water storage and nutrient cycling capabilities
- Natural hydrologic regimes
- Riparian corridors

Adaptive Capacity of Urban Forests: Human Factors

Organizational

- Plans, policies
- Trained, sufficient staffing

Economic

- Budgets
- Ability to get grants

Social

- Community support
- Volunteer base

Questions?



Starting Step 2.1

- Adaptation Workbook
- My dashboard
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Step 2.1: Assess climate change impacts

The Adaptation Workbook allows you to consider how general climate change impacts might be modified by the unique characteristics of your location. The first section on this page asks you to think about how **regional** impacts might affect your particular project area or land use types. The following sections ask you to think about more specific climate impacts related to **your chosen land use types and management topics**.

This is your opportunity to consider the particular site conditions that might affect whether your location is more or less vulnerable to climate change. Some of the things you will want to consider include **species and structural composition, soils, topography, level of development, forest health issues, and the urban heat island effect**.

Several climate impact statements are presented from published resources for your region. Please take time to explore the supporting information (click the "Show Evidence" button, or visit our resource library) to learn more about the projected risks and opportunities climate change may present for your location.

If you think any of the suggested impacts don't apply to your project location, you can remove them from the list. If you want to add more climate impacts to the regional list or for any of your forest types, you can **add custom climate impact statements** at the end of each section.

For example:

Most areas in the country are expected to experience warmer temperatures by the end of the century. If your project area sits on a north-facing slope, a sheltered landscape position, or next to a large water body, projected temperature increases might be moderated. You'd want to make note of that in the appropriate sections below.


 [Climate Impacts and Vulnerability Resources](#)







- Hover to learn more about a particular item
- Expand/collapse a section
- Click to add a comment or specific information about your project area


↑

« Previous Next »
Homework 1 Vulnerability Determination

flooding from stormwater
Evidence: Robust | Agreement: Moderate
How might this affect your property or project area? 

Extreme and exceptional droughts in the Chicago area may increase in duration, frequency, and spatial extent compared to the end of the 20th century ⓘ 
Evidence: Medium | Agreement: Moderate
How might this affect your property or project area? 

Increases in temperature may lead to an increase of 1-2 hardiness zones and 2-4 heat zones in the Chicago area. ⓘ 
Evidence: Medium | Agreement: Moderate
How might this affect your property or project area? 

Species distribution modeling for native species suggests that suitable habitat may decrease for 15 primarily northern species and increase or become newly suitable for 47 species in the Chicago area. ⓘ 

Step 2.1: List of impacts

REMOVE
IMPACT
IF IT DOES
NOT APPLY

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Climate Impacts and Vulnerability instructions

Step 2 Course Materials

Climate Impacts and Vulnerability

Potential Climate Impacts - Regional

Identified 12 Potential Climate Impacts

Potential Climate Impacts - Park

Identified 0 Potential Climate Impacts

Potential Climate Impacts - riparian buffer

Identified 0 Potential Climate Impacts

« Previous

Homework 1

Next »

Vulnerability Determination

Potential Climate Impacts - Regional

Mean annual temperature in the Chicago area is projected to increase by 2.3 ° to 8.2 ° F by the end of the 21st century, with temperature increases across all seasons.

Evidence: Robust | Agreement: High

How might this affect your property or project area?

Precipitation in the Chicago area is projected to increase in winter and spring over 21st century, but projections for summer and fall precipitation are less clear

Evidence: Robust | Agreement: Moderate

How might this affect your property or project area?

Heavy precipitation events in the Chicago area have been increasing and are projected to continue to increase further, which could increase runoff and local flooding from stormwater

Evidence: Robust | Agreement: Moderate

How might this affect your property or project area?

Extreme and exceptional droughts in the Chicago area may increase in duration, frequency, and spatial extent compared to the end of the 20th century

Evidence: Medium | Agreement: Moderate

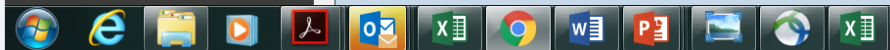
How might this affect your property or project area?

Increases in temperature may lead to an increase of 1-2 hardiness zones and 2-4 heat zones in the Chicago area.

Evidence: Medium | Agreement: Moderate

How might this affect your property or project area?

Species distribution modeling for native species suggests that suitable habitat may decrease for 15 primarily northern species and increase or become newly suitable for 47 species in the Chicago area.



Step 2.1: Supporting documentation

The screenshot displays the 'Adaptation Workbook' interface. On the left is a navigation sidebar with sections for 'My dashboard', 'Log out', 'Resources', 'Chicago project', 'Progress Summary', 'Step 1' (Define Management Topics, Management Goals and Objectives, Homework 1), 'Step 2' (Climate Impacts and Vulnerability, Vulnerability Determination, Homework 2), 'Step 3' (Evaluate Objectives, Homework 3), 'Step 4' (Adaptation Actions, Tactic Recommendations, Homework 4), and 'Homework 4'. The main content area shows a 'Climate Impacts and Vulnerability' report. A callout box highlights a finding: 'An analysis of vulnerability that combines model projections, shifts in heat and hardiness zones, and adaptive capacity showed that 15 percent of the trees currently present in the Chicago region have either moderate-high or high vulnerability to climate. Evidence: Medium | Agreement: Moderate'. Below this, a detailed paragraph explains the vulnerability assessment, mentioning species like Japanese red pine and Katsura tree, and listing vulnerable species like black cherry and white pine. A reference is provided: 'L. Brandt, A. Derby-Lewis, and others. May, 2017. Chicago Wilderness region urban forest vulnerability assessment and synthesis. USDA Forest Service Northern Research Station.' An orange callout box with the text 'Click on reference to follow up' has an arrow pointing to the reference link. The bottom of the screen shows a Windows taskbar with various application icons and a system tray displaying the time as 12:58 PM on 11/20/2017.

Step 2.1: Add local information

Adaptation Workbook

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 - Homework 4

Climate Impacts and Vulnerability instructions

Step 2 Course Materials

Climate Impacts and Vulnerability

- Potential Climate Impacts - Regional**
Identified 12 Potential Climate Impacts
- Potential Climate Impacts - Park**
Identified 0 Potential Climate Impacts

Get specific and tell us about the local factors that might modify the general climate impact

Climate Impacts and Vulnerability cards:

- Many invasive species, insect pests, and pathogens will increase or become more damaging in the Chicago area by the end of the century.**
Evidence: Medium | Agreement: Moderate
How might this affect your property or project area?
Think specifically about the forest conditions, soils, topography, level of development, and other specific information about your project area that might modify this general climate impact.
- The urban heat island effect can exacerbate the effects of increasing temperatures.**
Evidence: Medium | Agreement: High
How might this affect your property or project area?
- Impervious cover can exacerbate the effects of increased heavy precipitation events in urban areas.**
Evidence: Medium | Agreement: High
How might this affect your property or project area?

Navigation: << Previous (Homework 1) | Next >> (Vulnerability Determination)

Custom Climate Impacts - Regional

System tray: 1:43 PM 11/20/2017

Step 2.1: Custom impact

Adaptation Workbook

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- Log out
- Resources ▾
- Chicago project
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Climate Impacts and Vulnerability instructions

Step 2 Course Materials

Climate Impacts and Vulnerability

- Potential Climate Impacts - Regional**
Identified 12 Potential Climate Impacts >
- Potential Climate Impacts - Park**
Identified 0 Potential Climate Impacts ⚠
- Potential Climate Impacts - riparian buffer**
Identified 0 Potential Climate Impacts ⚠

« Previous
Homework 1

Next »
Vulnerability Determination

Custom Climate Impacts - Regional ⓘ

Add a Regional Climate Impact Statement +

Add your own. Check out the list of regional impacts for additional Using the climate impacts viewer

Adaptive capacity of tree species in the Chicago area has eroded using scoring systems for planted and natural environments, with invasive species among those with the highest capacity to adapt to a range of stressors.
How might this affect your property or project area? 🗨

An analysis of vulnerability that combines model projections, shifts in heat and hardness zones, and adaptive capacity showed that 15 percent of the trees currently present in the Chicago region have either moderate-high or high vulnerability to climate
Evidence: Medium | Agreement: Moderate ⓘ
How might this affect your property or project area? 🗨

Many invasive species, insect pests, and pathogens will increase or be damaging in the Chicago area by the end of the century.
Evidence: Medium | Agreement: Moderate
How might this affect your property or project area? 🗨

The urban heat island effect can exacerbate the effects of increasing temperatures.
Evidence: Medium | Agreement: High
How might this affect your property or project area? 🗨

Impervious cover can exacerbate the effects of increased heavy precipitation events in urban areas.
Evidence: Medium | Agreement: High
How might this affect your property or project area? 🗨

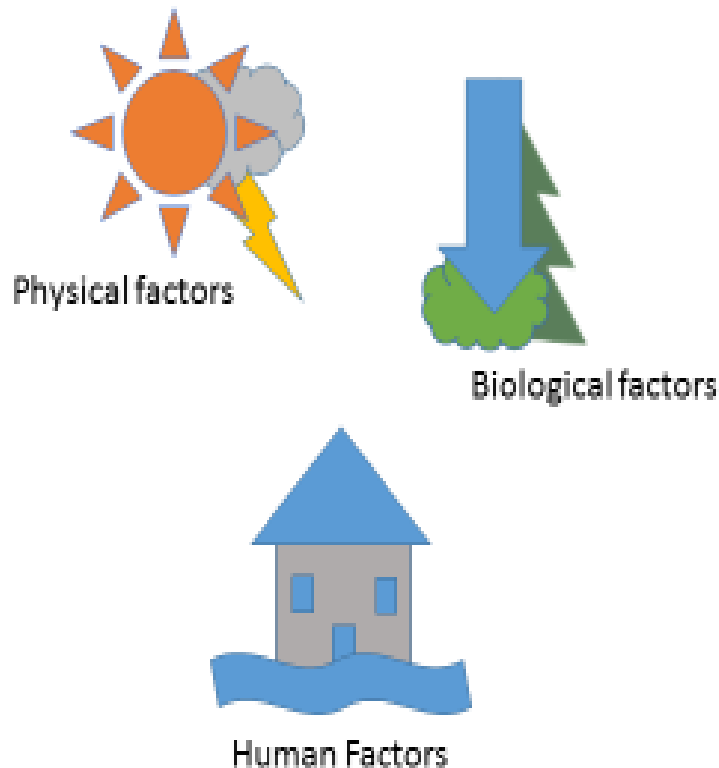
Windows Taskbar: 12:57 PM 11/20/2017

Questions?

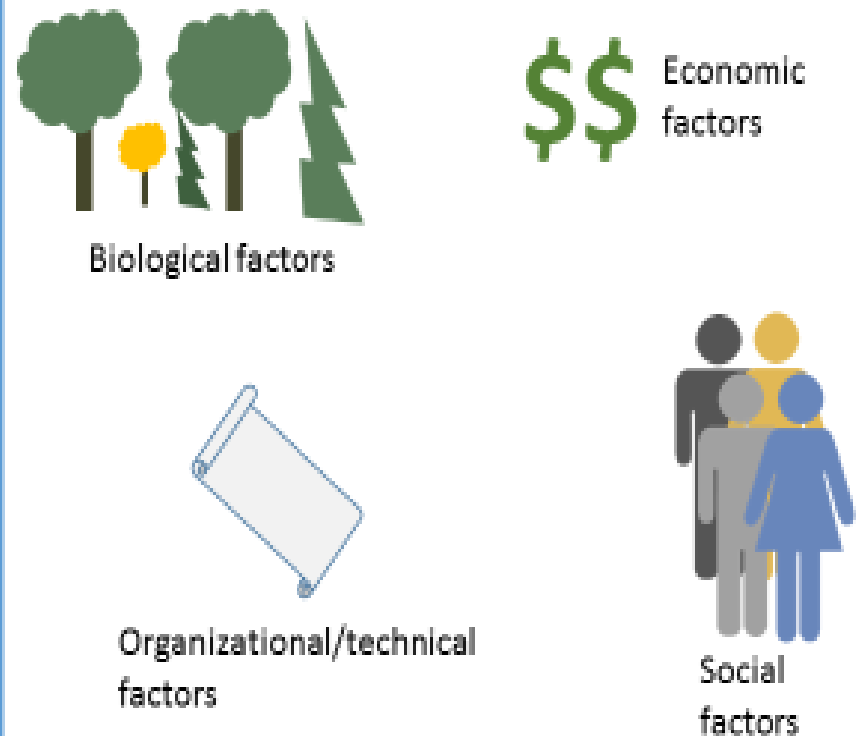


Step 2.2: DETERMINE the vulnerability level of the project area or land use

Impacts



Adaptive Capacity



Step 2.2: Vulnerability Determination

The screenshot displays the 'Vulnerability Determination' interface. On the left is a navigation sidebar with items like 'Adaptation Workbook', 'My dashboard', 'Log out', 'Resources', 'Chicago project', 'Progress Summary', 'Step 1', 'Define Management Topics', 'Management Goals and Objectives', 'Homework 1', 'Step 2', 'Climate Impacts and Vulnerability', 'Vulnerability Determination', 'Homework 2', 'Step 3', 'Evaluate Objectives', 'Homework 3', 'Step 4', 'Adaptation Actions', 'Tactic Recommendations', and 'Homework 4'. The main content area is titled 'Vulnerability Determination' and includes instructions and course materials. A 'Review Potential Regional Climate Impacts' window is open, showing 'Vulnerability Determination: Moderate'. It contains two sliders: 'Potential Impacts' (ranging from Very supportive to Very disruptive) and 'Adaptive Capacity' (ranging from Low to High). A 2D matrix plots these two variables, with a central orange dot representing the current state. Annotations include an orange arrow pointing to the sliders with the text 'Use the sliders to represent potential impacts, adaptive capacity', a large orange arrow pointing to the 'Moderate' label with the text '“Moderate”', and an orange arrow pointing to the matrix with the text 'Auto generates'.

Adaptation Workbook

My dashboard

Log out

Resources

Chicago project

Progress Summary

Step 1

Define Management Topics

Management Goals and Objectives

Homework 1

Step 2

Climate Impacts and Vulnerability

Vulnerability Determination

Homework 2

Step 3

Evaluate Objectives

Homework 3

Step 4

Adaptation Actions

Tactic Recommendations

Homework 4

Vulnerability Determination instructions

Step 2 Course Materials

Vulnerability Determination

Vulnerability Determination - Park
My vulnerability rating for this property: **Moderate**

Vulnerability Determination - riparian buffer
My vulnerability rating for this property: **not determined**
Region-wide vulnerability: Moderate

Review Potential Regional Climate Impacts

Vulnerability Determination: **Moderate**

Adjust sliders to represent your property or project area

Default values represent regional vulnerability determinations.

Potential Impacts
Collectively, how will potential climate change impacts affect this Land Use/Management Topic in your property or project area?

Very supportive Supportive Mixed/Neutral Disruptive Very disruptive

Adaptive Capacity
How resilient to climate change impacts or disturbance is this ecosystem/management topic on your property or project area?

Low Low-Moderate Moderate Moderate-High High

High

Low Very supportive Very disruptive

Potential Impacts

Adaptive Capacity

Use the sliders to represent potential impacts, adaptive capacity

“Moderate”

Auto generates

« Previous
Climate Impacts and Vulnerability

Next »
Homework 2

Step 2.2: Vulnerability Determination

“High”

Vulnerability Determination instructions

Step 2 Course Materials

Vulnerability Determination

- Vulnerability Determination - Park**
My vulnerability rating for this property: **High**
- Vulnerability Determination - riparian buffer**
My vulnerability rating for this property: **not determined**

Review Potential Regional Climate Impacts

Vulnerability Determination: High

Adjust sliders to represent your property or project area. Default values represent regional vulnerability determinations.

Potential Impacts Collectively, how will potential climate change impacts affect this Land Use/Management Topic in your property or project area?

Very supportive Supportive Mixed/Neutral Disruptive Very disruptive

Adaptive Capacity How resilient to climate change impacts or disturbance is this ecosystem/management topic on your property or project area?

Low Low-Moderate Moderate Moderate-High High

Adaptive Capacity

Potential Impacts

High

Low Very supportive Very disruptive

« Previous Climate Impacts and Vulnerability Next » Homework 2

Step 2.2: Vulnerability Determination

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Vulnerability Determination instructions

Step 2 Course Materials

Vulnerability Determination

- Vulnerability Determination - Park**
My vulnerability rating for this property: **High**
- Vulnerability Determination - riparian buffer**
My vulnerability rating for this property: **not determined**

Review Potential Regional Climate Impacts

Mean annual temperature in the Chicago area is projected to increase by 2.3 ° to 8.2 ° F by the end of the 21st century, with temperature increases of 1.0 ° to 4.0 ° F by the end of the 20th century.

Precipitation in the Chicago area is projected to increase in winter and spring over 21st century, but projections for summer and fall precipitation are mixed.

Heavy precipitation events in the Chicago area have been increasing and are projected to continue to increase further, which could increase runoff and local flooding from stormwater.

Extreme and exceptional droughts in the Chicago area may increase in duration, frequency, and spatial extent compared to the end of the 20th century.

Increases in temperature may lead to an increase of 1-2 hardiness zones and 2-4 heat zones in the Chicago area.

Species distribution modeling for native species suggests that suitable habitat may decrease for 15 primarily northern species and increase or become newly suitable for 47 species in the Chicago area.

For species for which no model information is available (rare, nonnative, or cultivars), shifts in heat and hardiness zones could have a positive effect on about 23 percent of species that are either present in the Chicago area or considered for planting.

Adaptive capacity of 179 species in the Chicago area was evaluated using scoring systems for planted and natural environments, with invasive species among those with the highest capacity to adapt to a range of stressors.

An analysis of vulnerability that combines model projections, shifts in heat and hardiness zones, and adaptive capacity showed that 15 percent of the trees currently present in the Chicago region have either moderate-high or high vulnerability to climate change.

Many invasive species, insect pests, and pathogens will increase or become more damaging in the Chicago area by the end of the century.

The urban heat island effect can exacerbate the effects of increasing temperatures.

Impervious cover can exacerbate the effects of increased heavy precipitation events in urban areas.

Vulnerability Determination: High

Adjust sliders to represent your property or project area. Default values represent regional vulnerability determinations.

Potential Impacts Collectively, how will potential climate change impacts affect this Land Use/Management Topic in your property or project area?

Very supportive Supportive Mixed/Neutral Disruptive Very disruptive

Adaptive Capacity How resilient to climate change impacts or disturbance is this

Step 2 Homework!

- Adaptation Workbook
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Homework 2

How vulnerable is your forest or project area to climate change? Briefly mention the broad-scale impacts and vulnerabilities most relevant to your project area, and why you flagged them as the most important for your forest. Are there other factors that affected your vulnerability determination?

How vulnerable is your forest or project area to climate change? Briefly mention the broad-scale impacts and vulnerabilities most relevant to your project area, and why you flagged them as the most important for your forest. Are there other factors that affected your vulnerability determination?

Assessing Vulnerability: give your honest ranking of the following (remember, no grades assigned here!)

	Low/disagree				High/agree
I understand the potential local impacts of climate change on the lands that I manage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I gave my forest or project area a climate change vulnerability ranking of...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I could easily identify the impacts that will be most severe for my forest/project area.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If asked, I could explain to a colleague how vulnerability assessments make climate model projections relevant at the regional and local scales.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are you interested in sharing your project via our webpage (www.forestadaptation.org/demos) now or in the future?

Are you interested in sharing your project via our webpage (www.forestadaptation.org/demos) now or in the future?

« Previous
Vulnerability Determination

Next »
Evaluate Objectives

To-do list:

- **Look at climate change impacts and vulnerability resources for your state and/or area**
- **Watch the video presentation** Impacts of Climate Change on Urban Forests
- **Complete Step 2: Assessing Impacts & Vulnerability**
- **Complete the Homework** section following Step 2
- **Come to Session 3 (Tuesday, November 20)** ready to talk about your project area's top vulnerabilities

Questions?



Climate Change Atlas

Projections are made based on species IMPORTANCE VALUE

- **High importance value** = **very suitable habitat**
- **Low importance value** = less suitable habitat

Projections are for last 30 years of this century compared to 1960-1990

- Future: current ratios above 1.2 = increase
- Future: current ratios below 0.8 = decrease

- Negative difference = decrease
- Positive difference = increase