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So Change is a good thing, right? It’s the speed that gets ya

Jason Grabosky
Urban Forestry Program

Setting the ground rules

- Trees take time, are linked to their surrounding environment when healthy, and will grow in response to their environment as possible.
- If the environment changes faster than the plant can grow, the plant is considered “stressed”
- Trees (and most plants) live in the averages, but die in the extremes
- Species and communities of species adapt for recurring events (disturbances or re-setting events), but are either temporarily or permanently displaced as the baseline environment//site // competitive pressure changes
- As the environment changes, the tree often adapts as an individual, but the changing linkage to habitat suitability might limit regeneration and competition.

And…….

- I am really lousy at pretty tree picture presentations
- There is a banana tree growing outside of the old Agriculture museum on New Brunswick Campus, it’s about 7 feet in height

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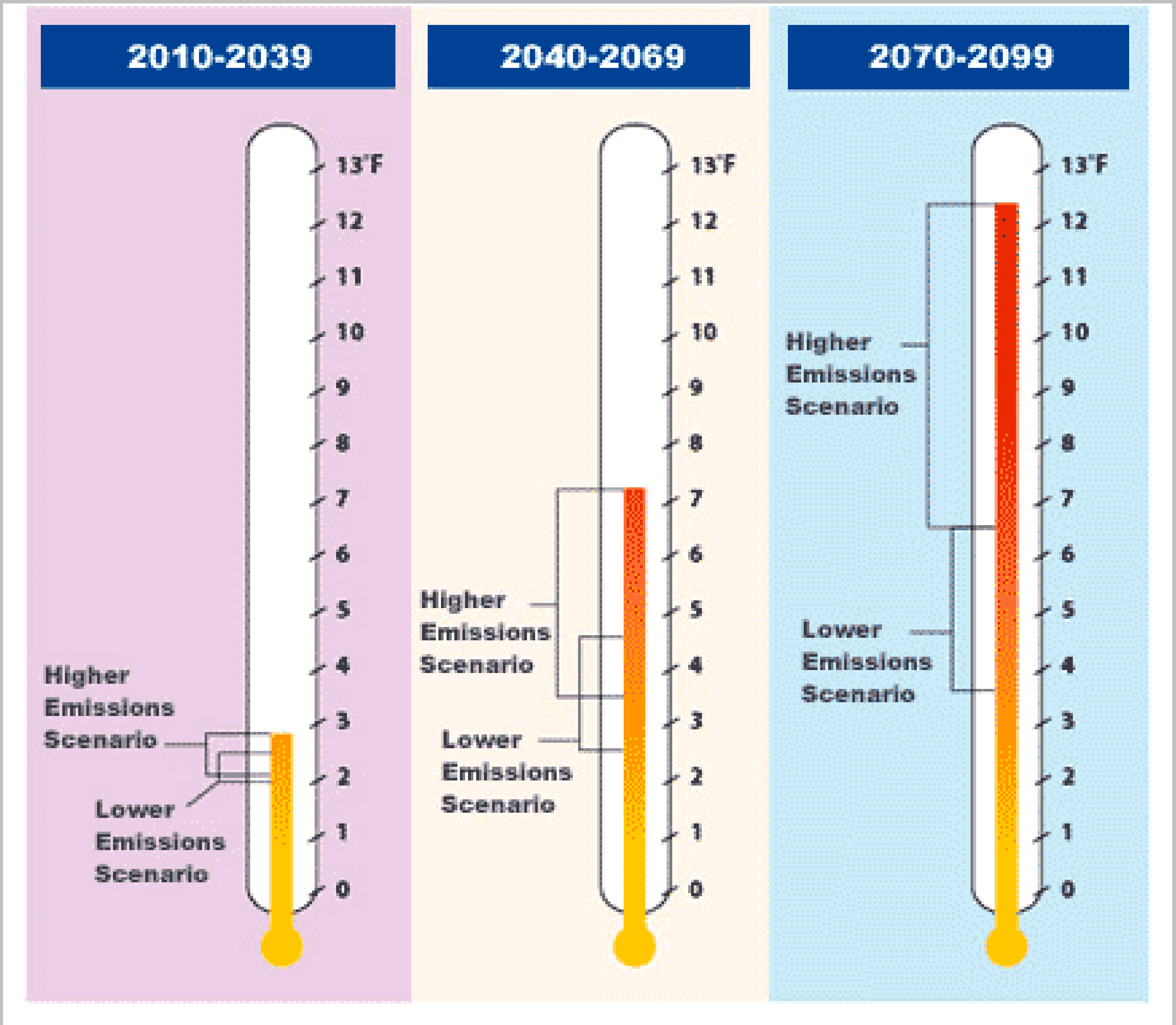
- Trees take time
- Over time our environment will be changing.
- In the NE US, the forest of the future will be marked by changed temperature and water patterns.
- This ultimately suggests a shift in plant selection strategy and management planning.

"Long term, I'm worried about global warming— short term, about freezing my ass off."

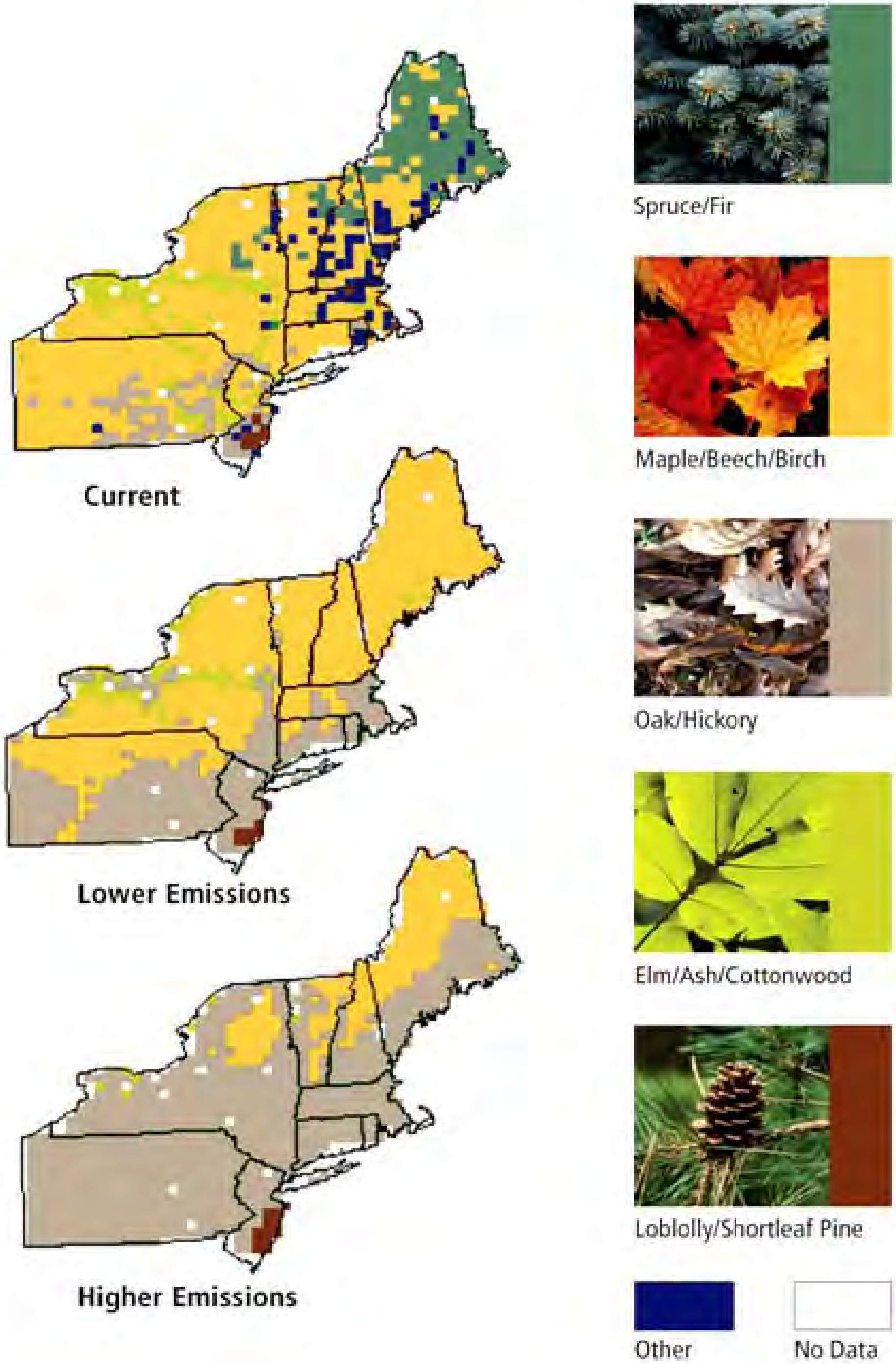
Future Climate Change for the Northeast
(www.climatechoices.org/ne)

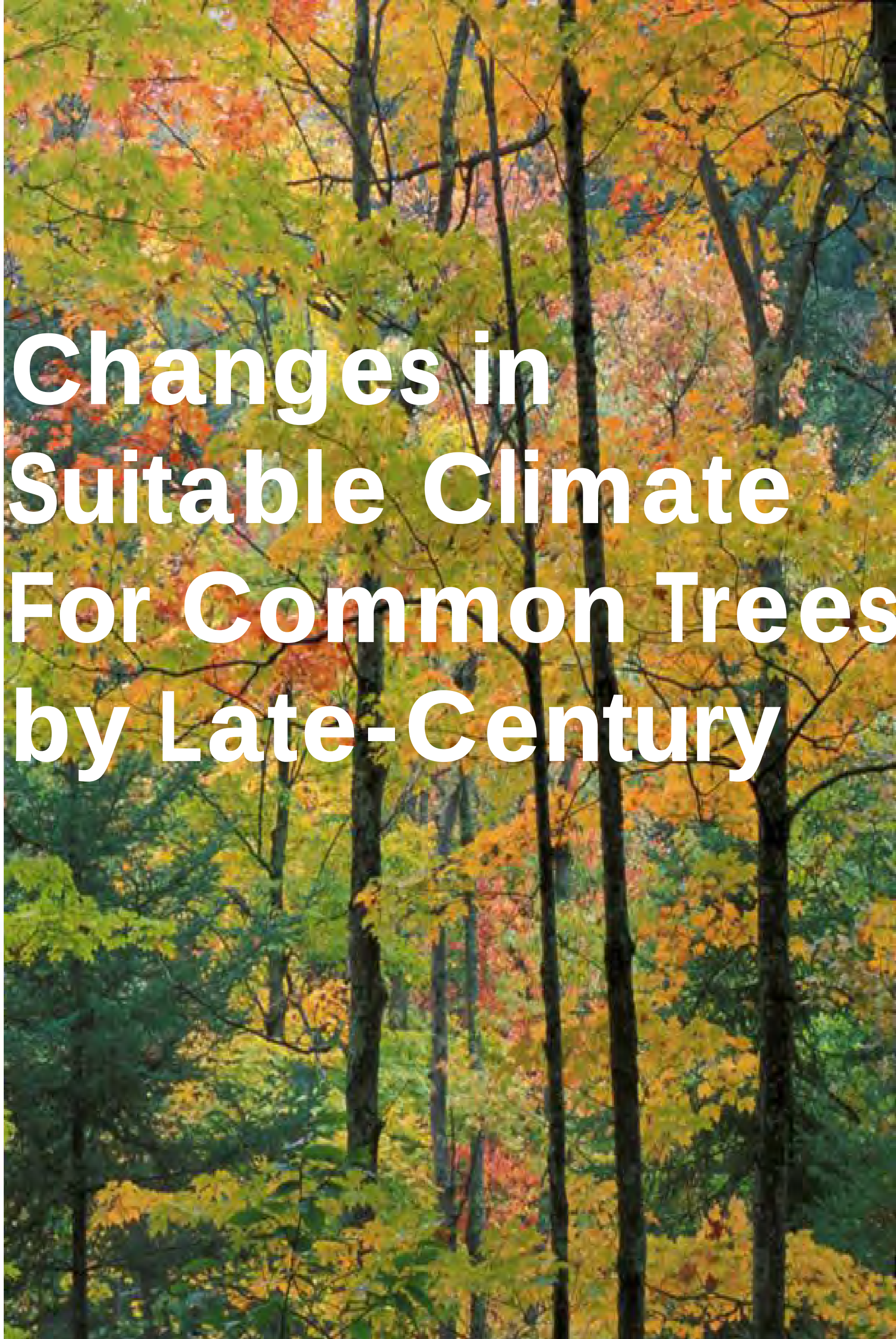


Climate change will forever alter the fabric of our forests and other natural landscapes…

…with implications for ecosystem "services"

Changes in Suitable Climate For Common Trees by Late-Century





On top of the rest of the new diseases and pests moving into New Jersey landscapes…..

We also have roving herds of viscous tree-dwelling goats

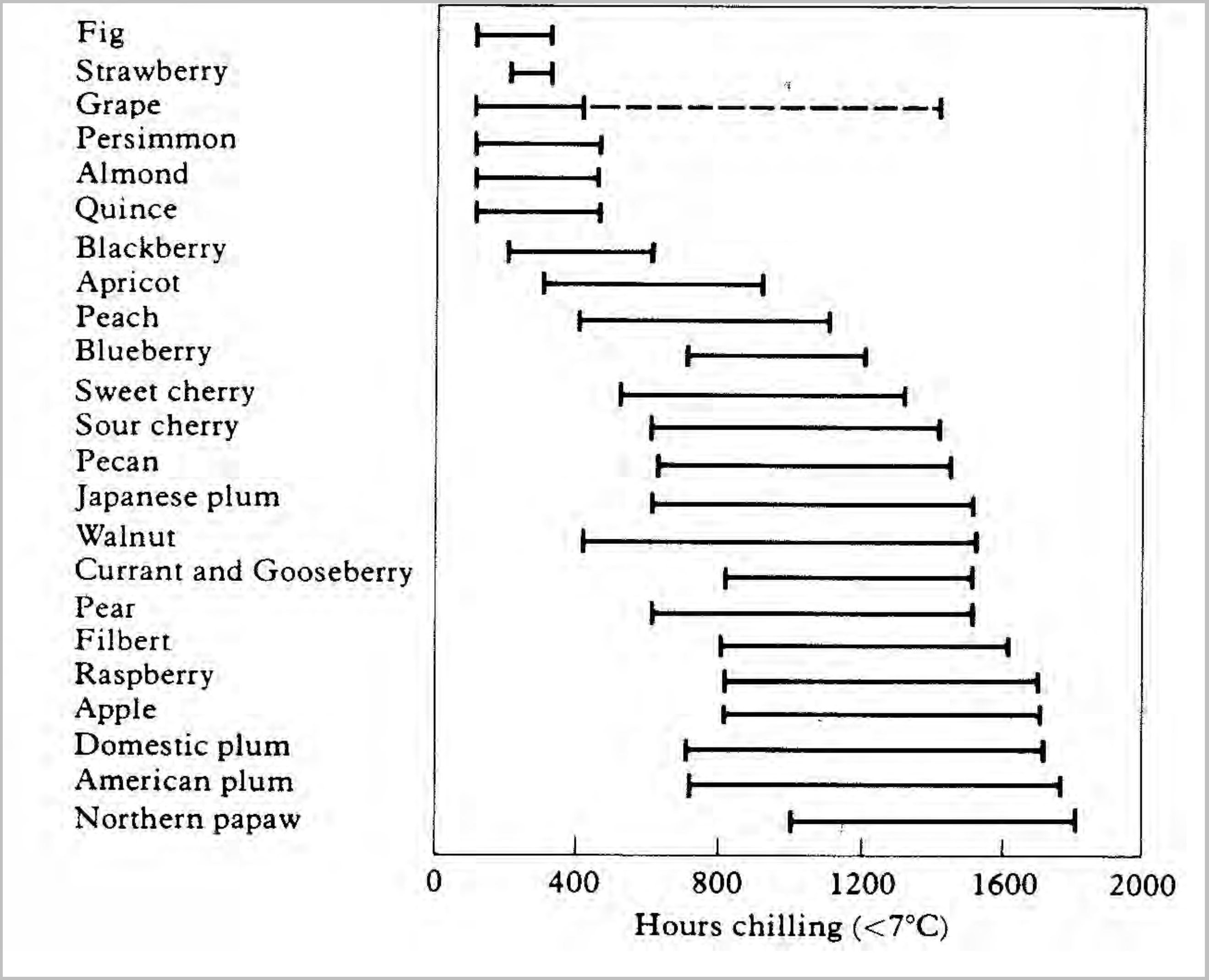
Some perennials could benefit from warmer winters,. . .

while for others there is evidence of *reduced* yields following warmer winters.

(less vine and root damage in European wine grapes with less frequent -12 F winter temps)

(inadequate “winter chill” period (cumulative hours < 45 F), and poor fruit development in apples)

Winter Chill (< 45 F) Hour Requirements



Source: Westwood MN. 1988. Temperate Zone Pomology. p. 386.

Percent Years Meeting 1000-hr Winter-Chill Requirement
(dark orange= most years meet requirement)

2010-39 | 2040-69 | 2070-99

"Business as usual"

Lower emissions

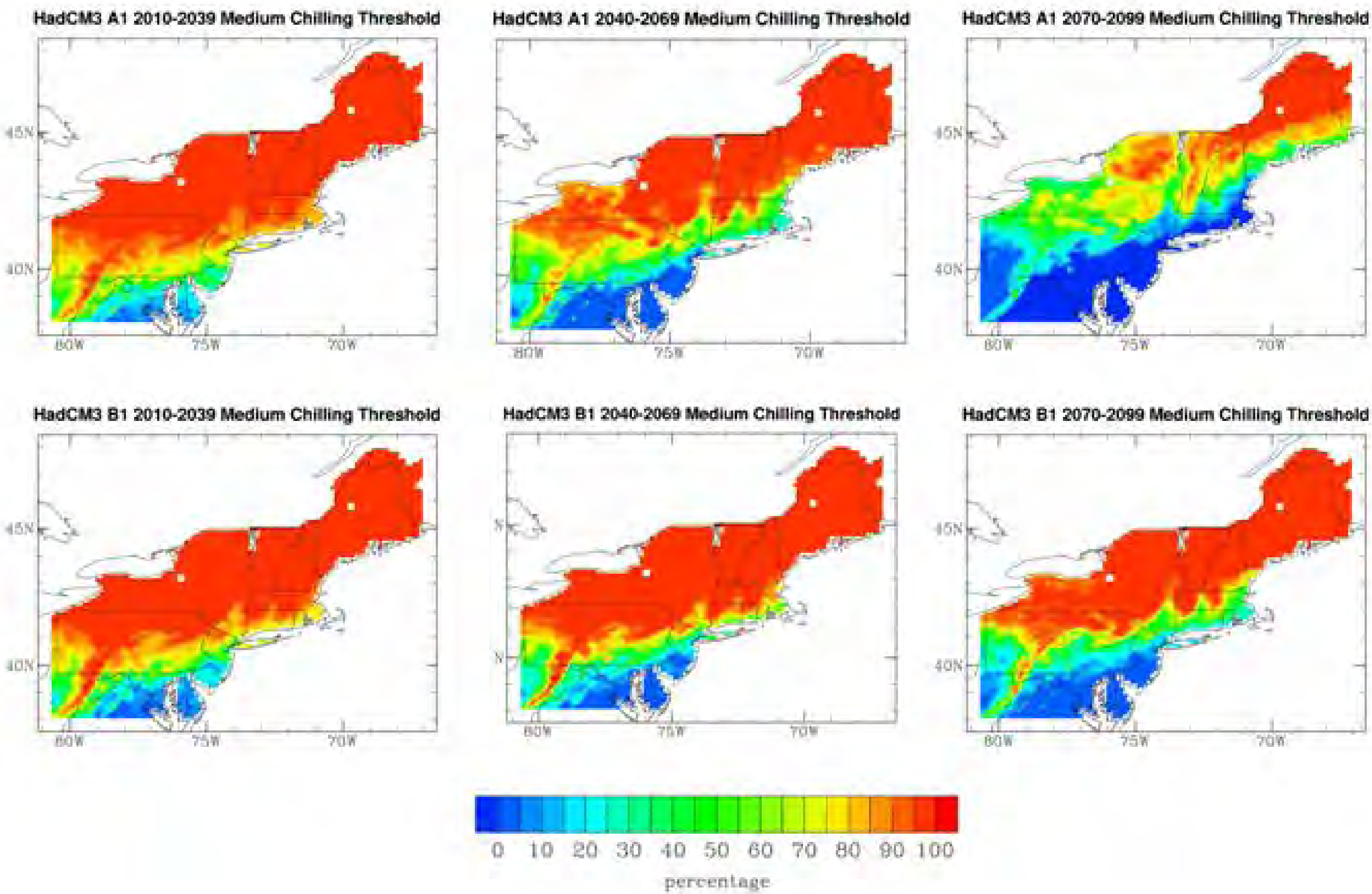


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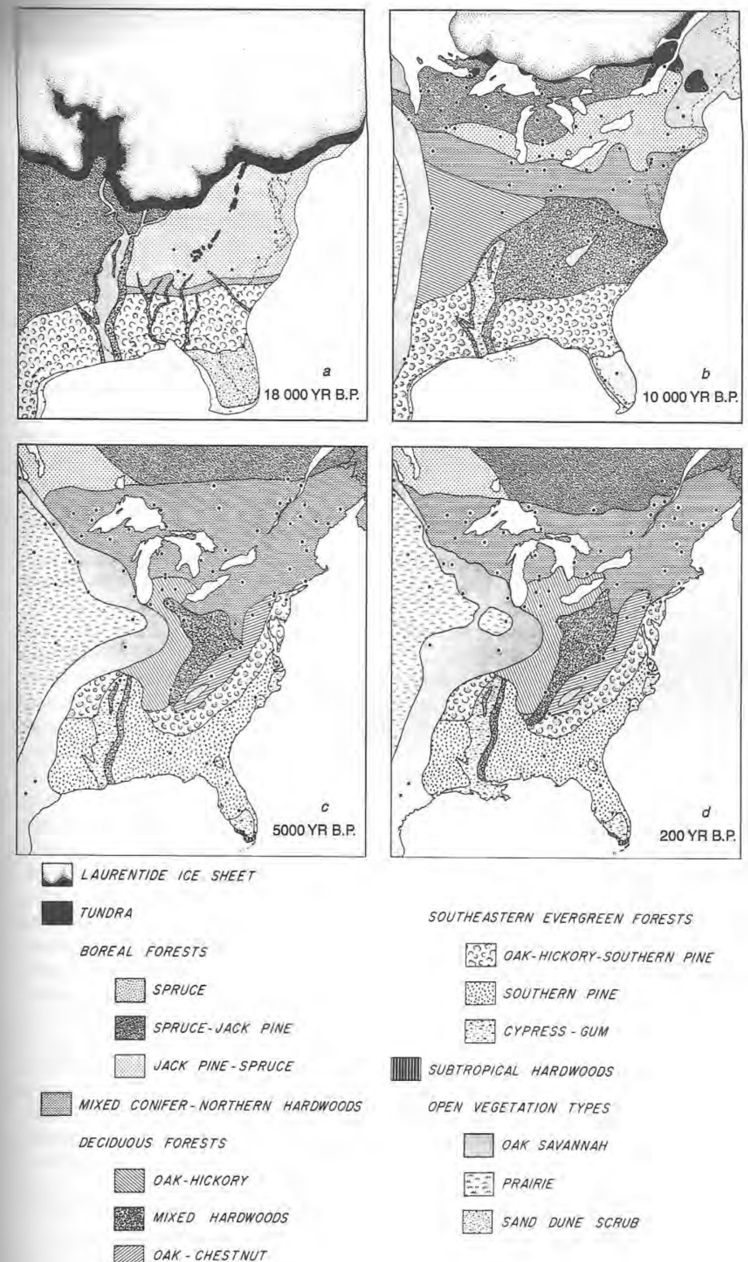
Figure from Forest Ecology 4th Ed. Barnes, Zak, Denton, and Spurr



As the environment will change, so too will plant communities and niches change

- There are opportunities to influence the trajectory of the change (a human filter in community assemblage theory)

- Trees take time, selections should be based on the site of today, with an eye for fitness in the expected environmental site parameters of 2060…fitness rather than aesthetics in design function

- Our designs will need to become more water-savvy.

- So we might think of what is changing (and maybe by how much) and what is not changing so much.

We are still in a seasonal temperate climate and the axis has not shifted (that much). Light

Photoperiod

Solar Intensity

Drought-heat severity

Metasequoia glyptostroboides as an example

Invasive species cycles, movements to new areas, introductions

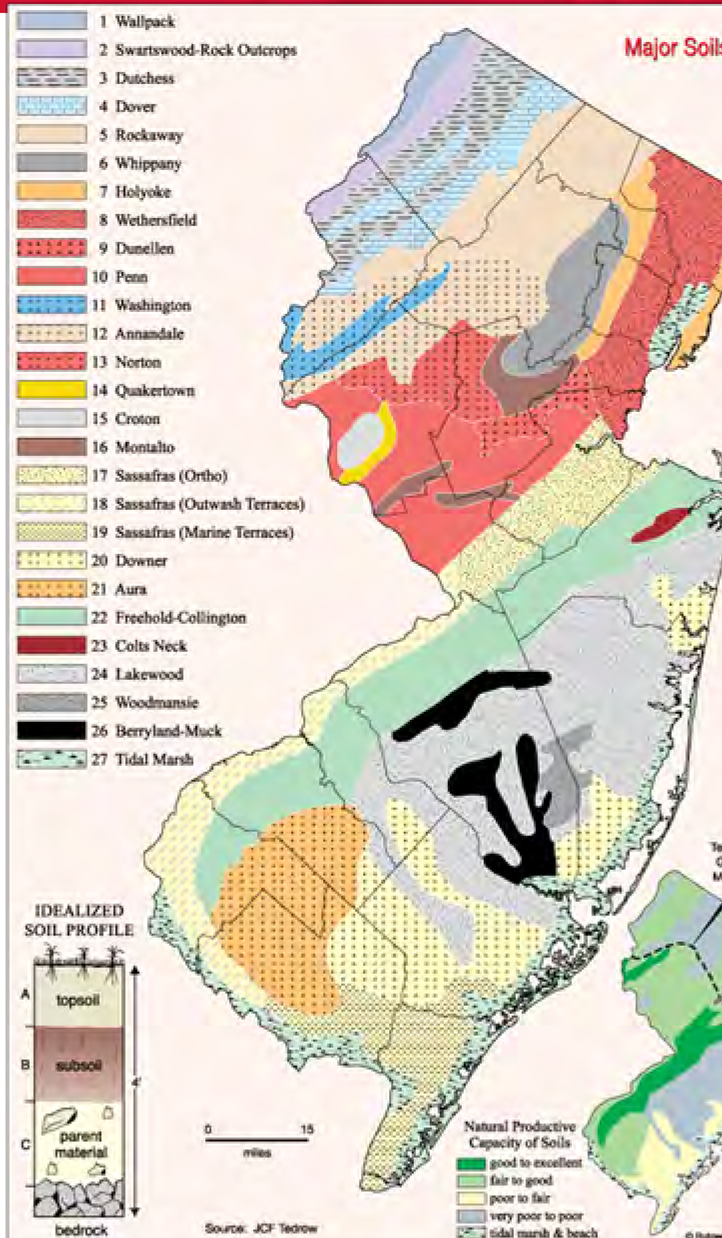
We could consider the role of abscission in storm damage profiles

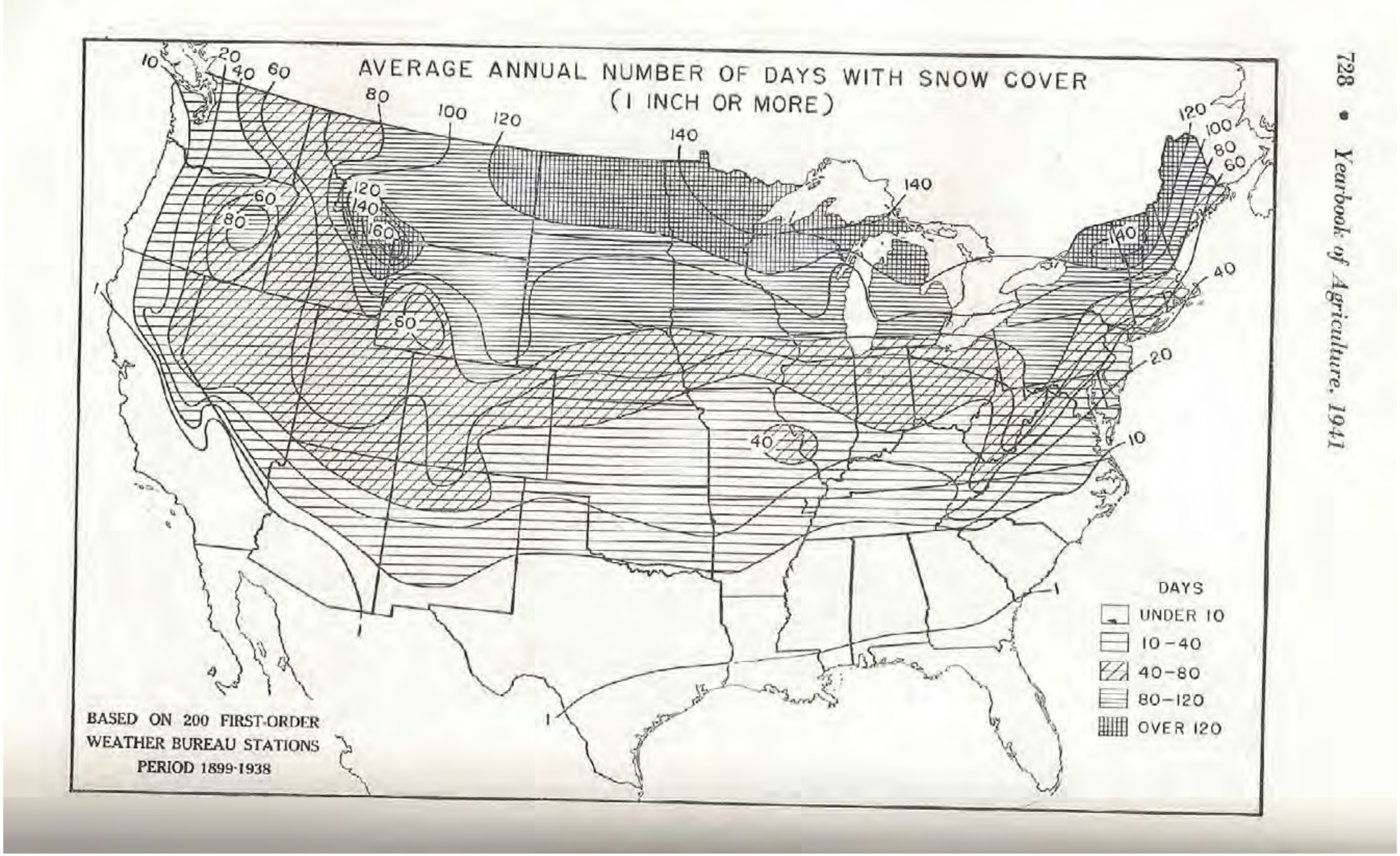
There is a potential for novel communities and novel disturbance regimes

Our underlying geology has not changed, and soils change slowly.

N. Jersey mineral cycles will change with changing snow cover and growing season.

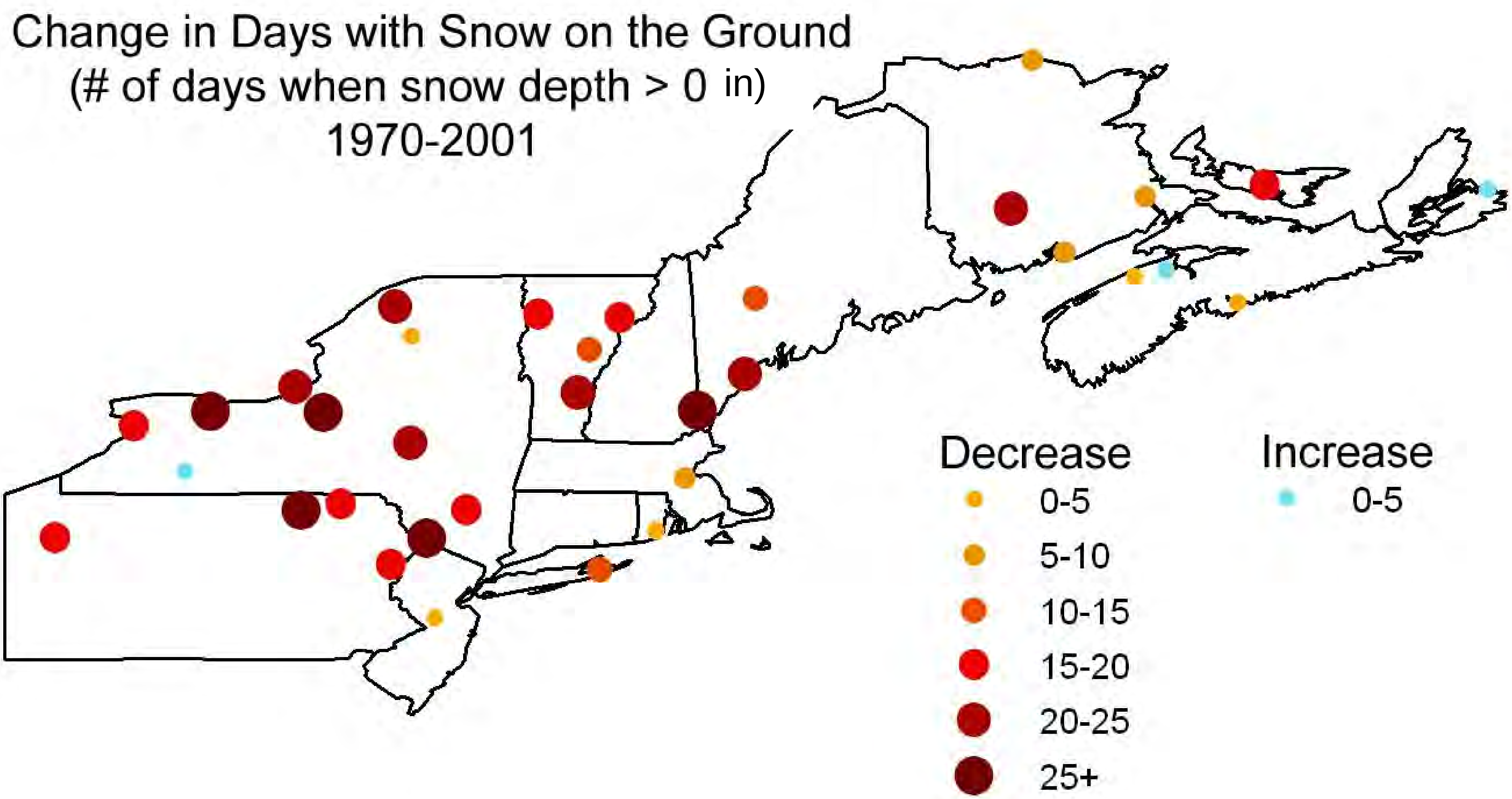
Construction damage happens quickly, impacting hydrology in a changing storm profile





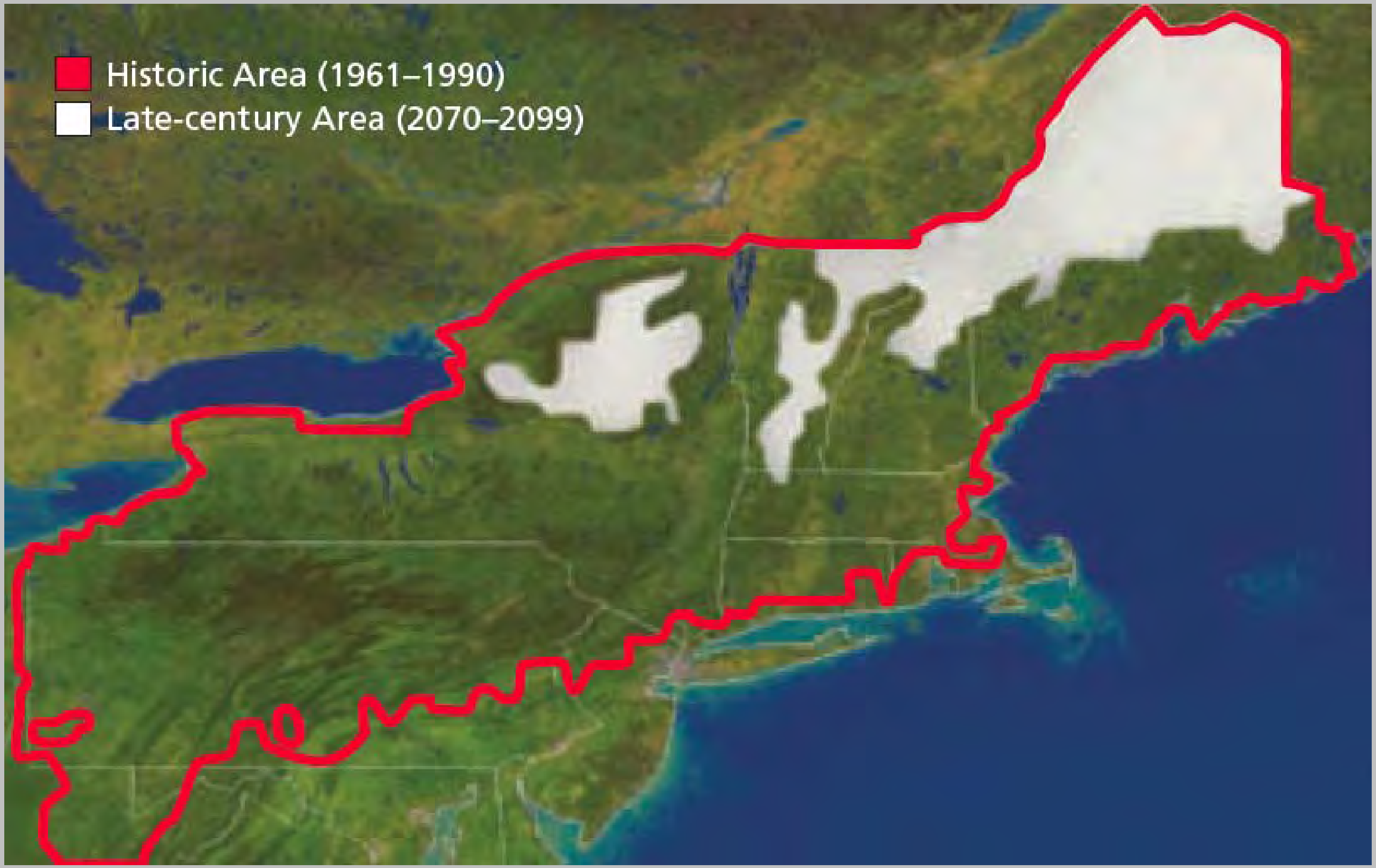
USDA 1941 Yearbook of Agriculture: Climate and Man

Spatial Variation of Days with Snow on Ground 1970-2002



The snow on ground trend was calculated from a linear regression of annual total snow on ground days for each station.

Projected Change in Snow Cover Days
(Area with greater than 30 days of snow on ground)



Higher emissions: 50% reduction in snow-covered days (shown here)

Lower emissions: 25% reduction in snow-covered days

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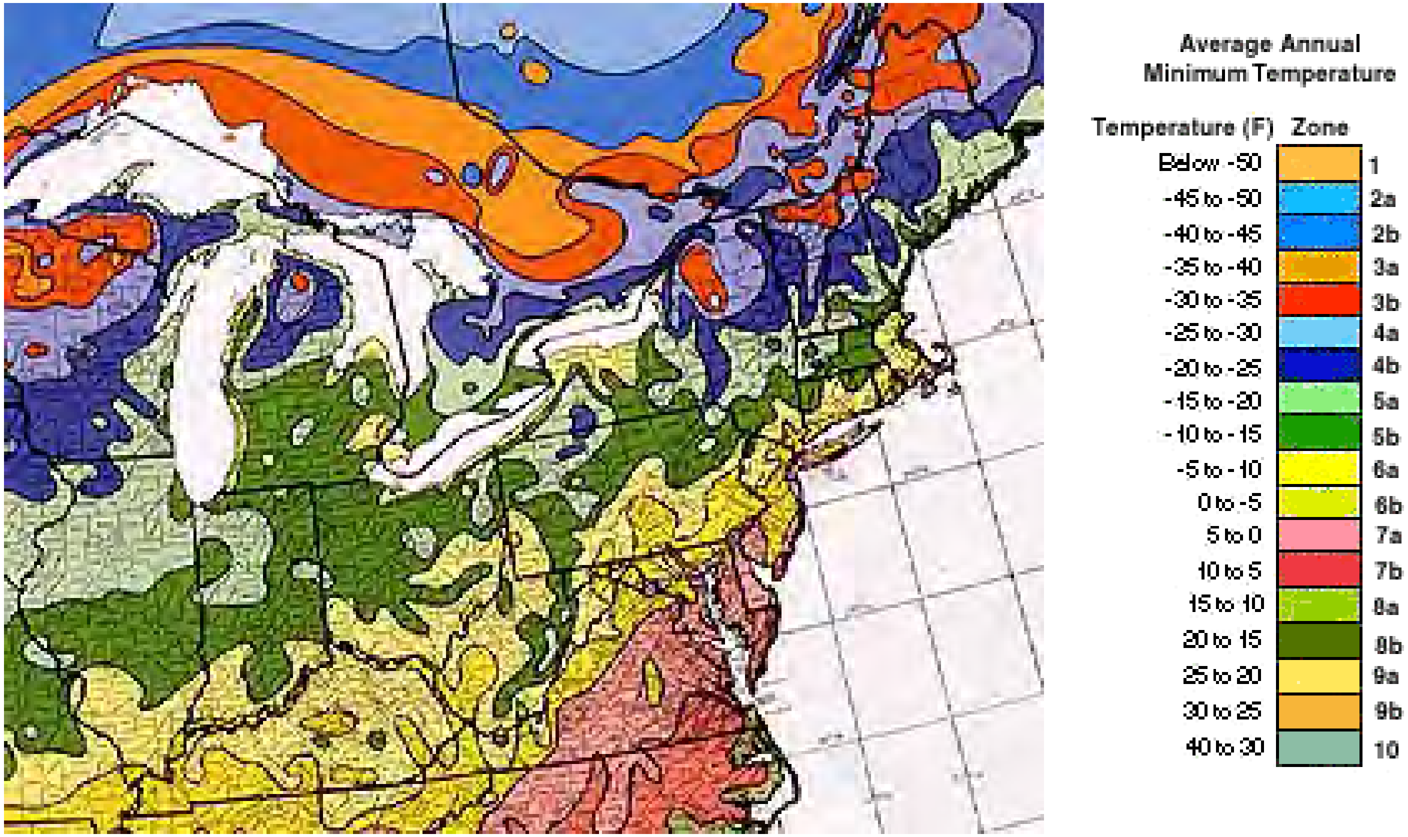
1990 USDA Plant Hardiness Zone Map

for the North East United States



http://www.usna.usda.gov/Hardzone/ushzmap.html

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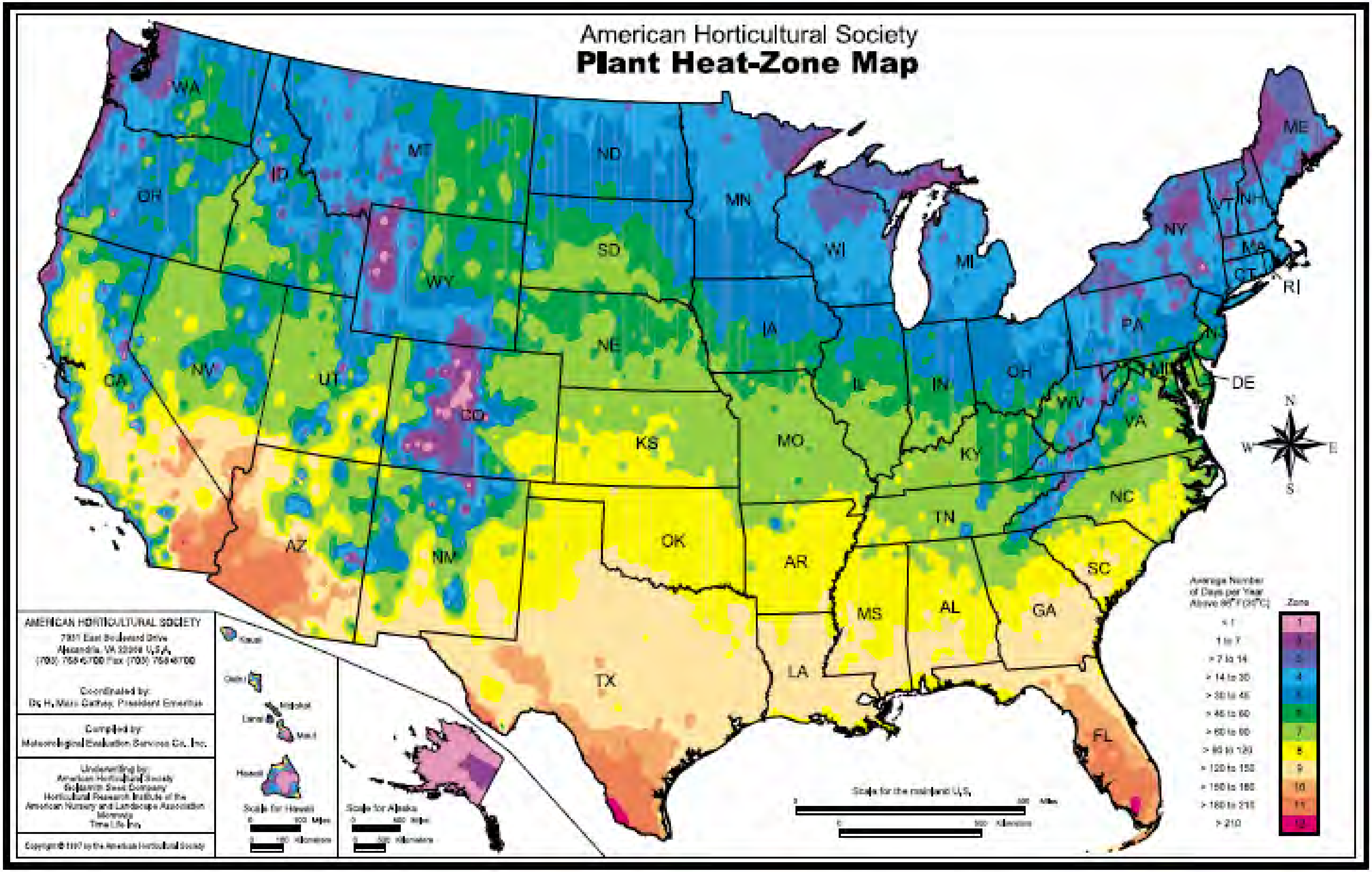


1974-1995, days over 86° F

Heat Zones

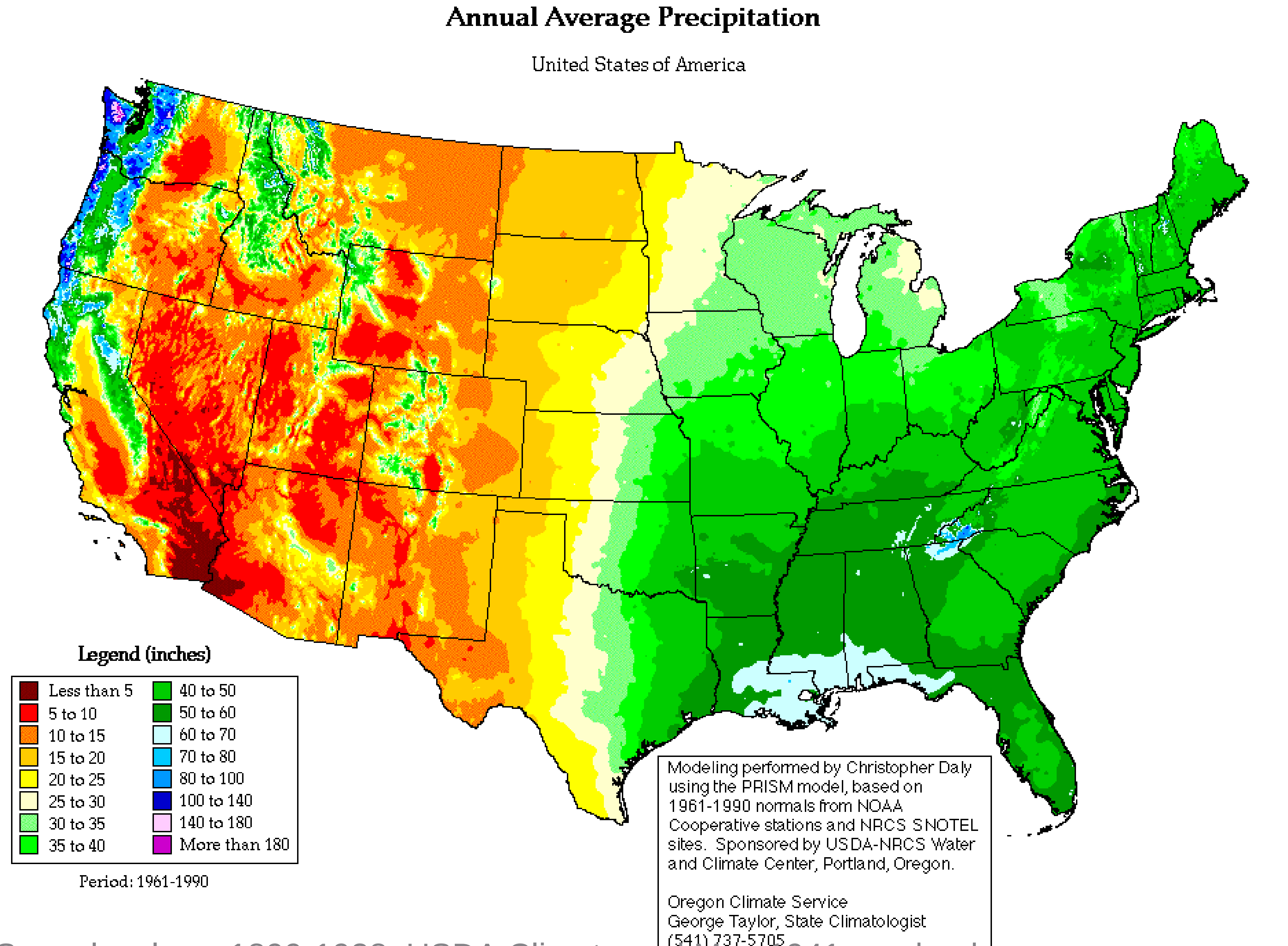
1 = 1 day > 86^{o}F

2 = 1 - 7 days > 86^{o}F

3 = 8 -14 days > 86^{o}F

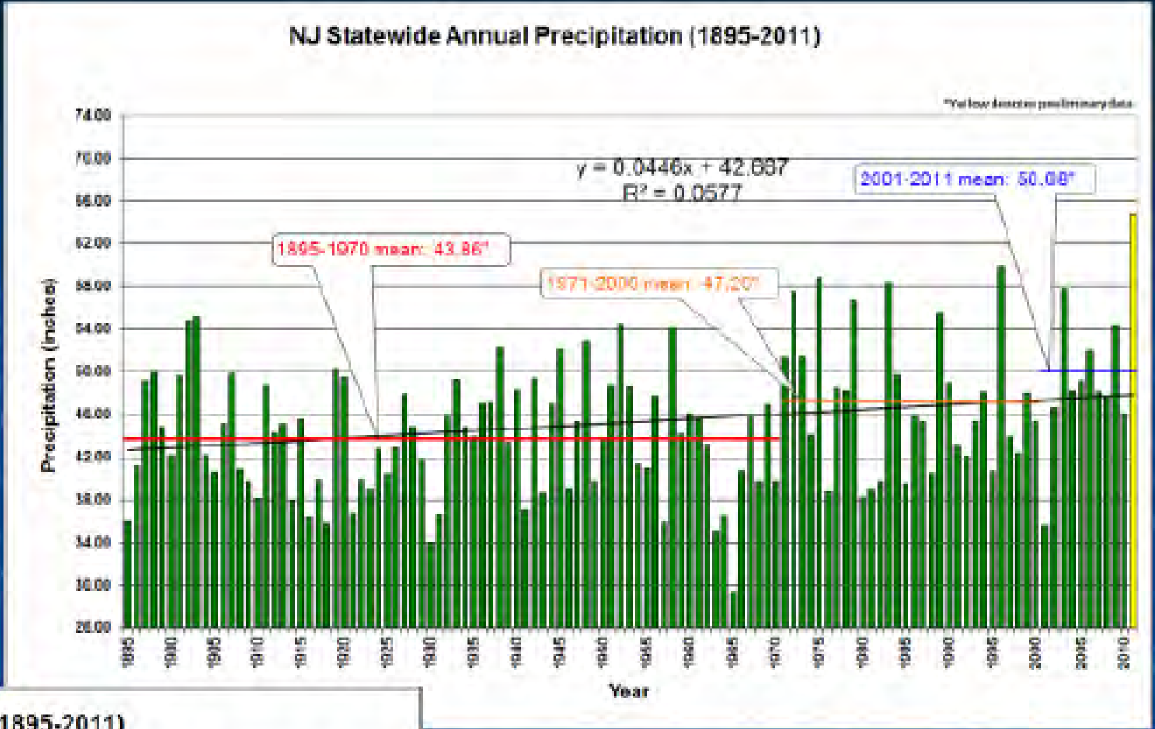
4 = 15 - 30 days > 86^{o}F

5 = 31 - 45 days > 86^{o}F

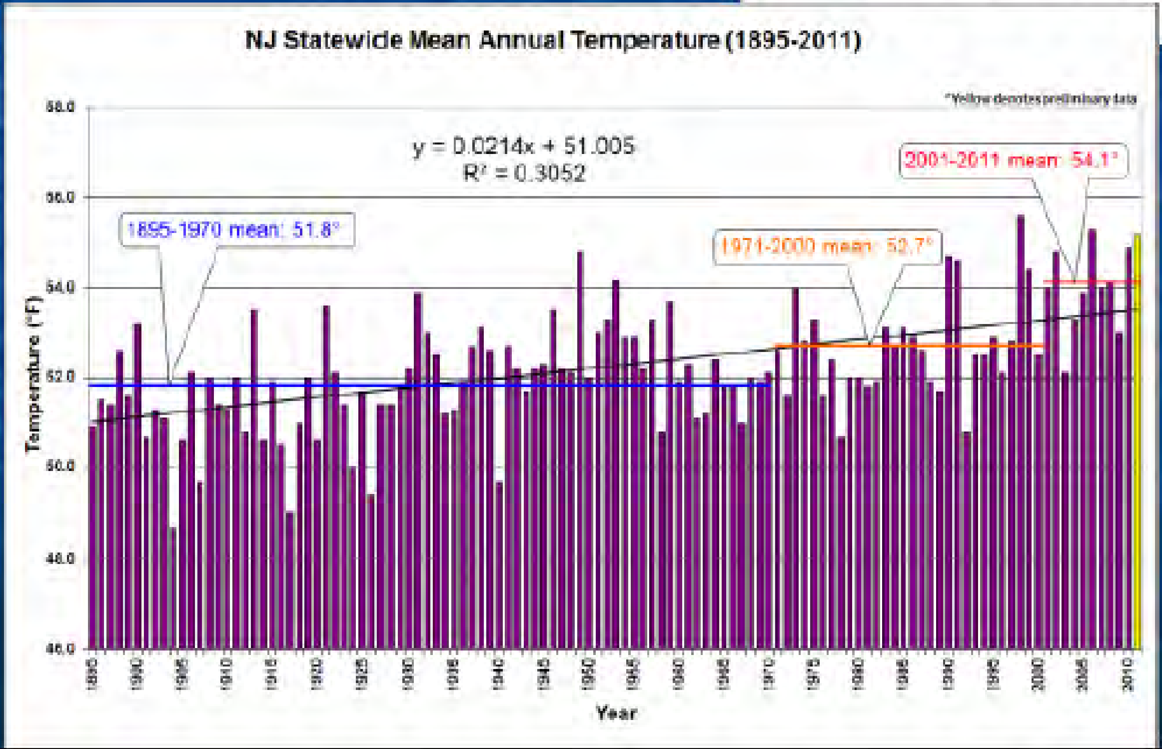


Same levels as 1899-1938 USDA Climate and Man 1941 yearbook

NJ historic perspective



wetter



warmer

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water

- Amount periodicity and intensity

- Almost all rain
- Rain in winter months to increase upwards of 10-20 percent by scenario
- Little change in summer rains, but in higher heat, the transpiration demands (increased with temp and carbon) suggest short-term droughty conditions during high heat periods….
- Things grow fast till they crash

Air quality

- Expecting increased concentration of CO_2
- O_3 formation in smog is a temperature dependant process

- Plant productivity can go up if other aspects not limited
- Root turnover up as growth rate increases with seasonal turnover conditions.
- Soil macroporosity seen to increase over time in SE US enrichment study

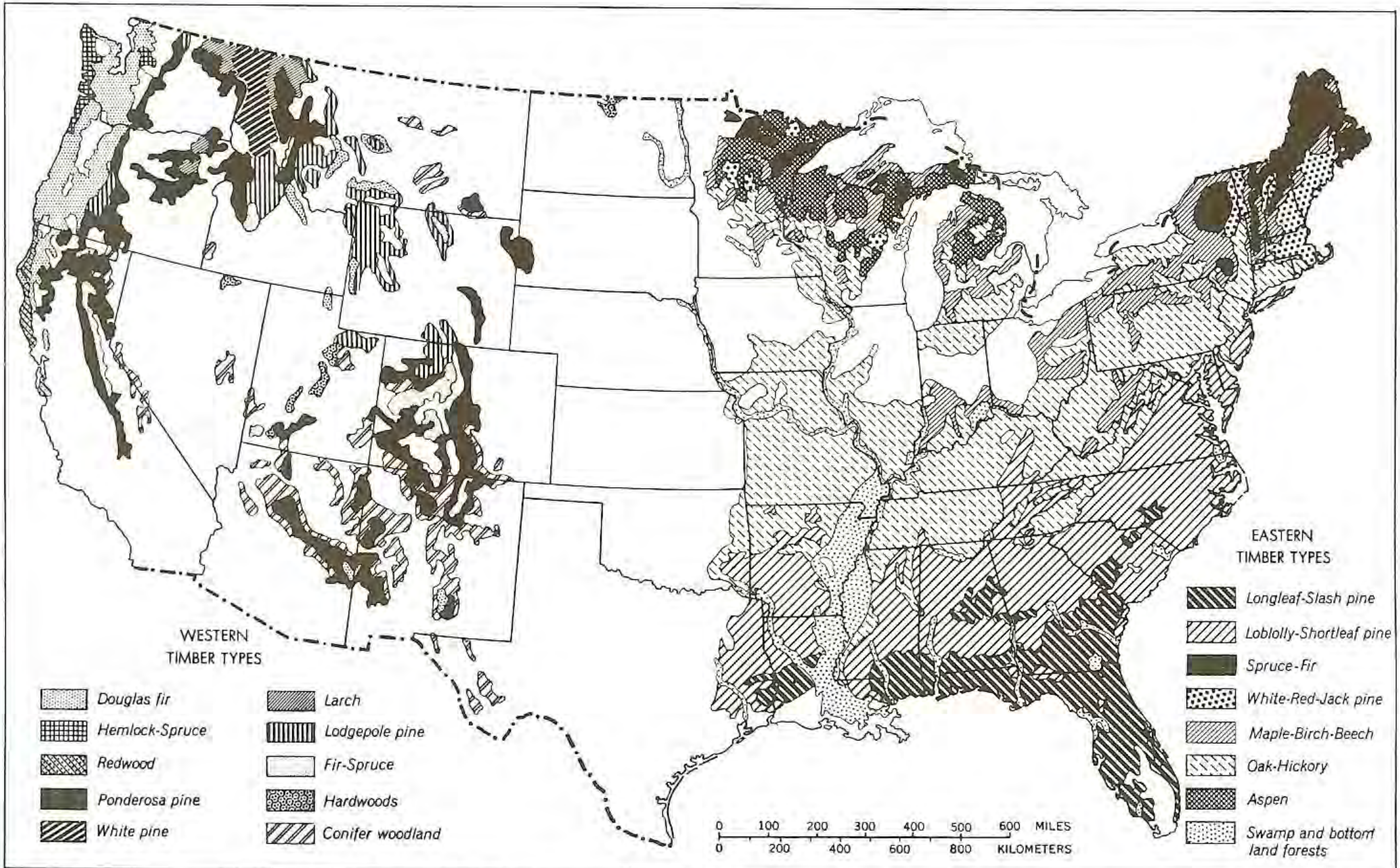

Figure 1-4. Present distribution of major forest types in the conterminous United States. The different types are designated in terms of the species that make up most of the timber volume. (Adapted from Haden-Guest et al., 1956; based on a map prepared by the USDA Forest Serv., 1949.)

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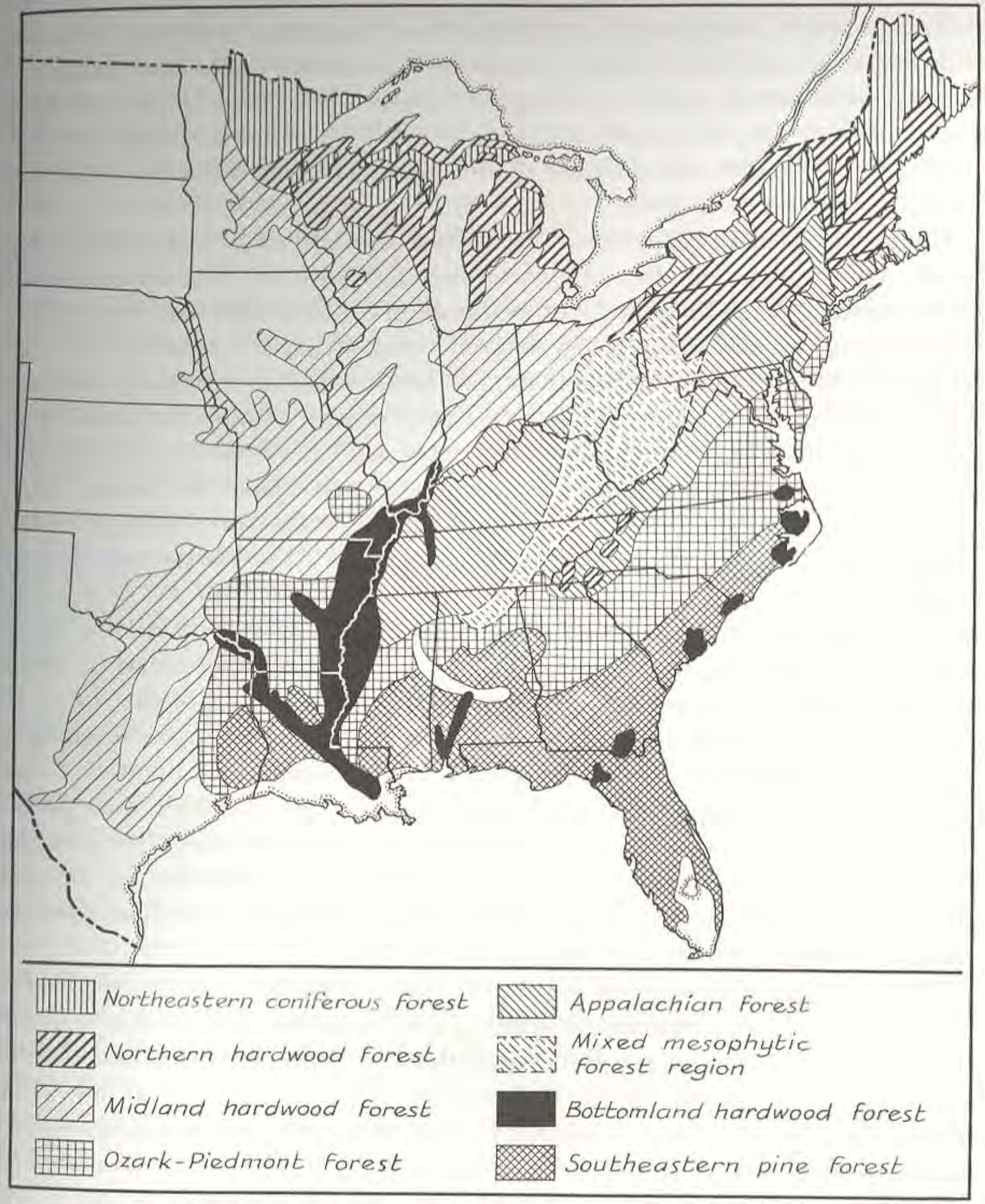


Figure 1-5. The major subdivisions of the Eastern Deciduous Forest as it existed in the original vegetation of the eastern United States. The Mixed Mesophytic Forest Region is shown as part of the Appalachian Forest. Only the broadest belts of the Bottomland Hardwood Forest are shown (adapted from Shantz and Zon, 1924; Braun, 1950).

USDA United States Department of Agriculture Forest Service

Climate Change Tree Atlas

Northern Research Station

You are here: NRS Home / Tools & Applications / Climate Change Atlas / Tree Atlas

Climate Change Tree Atlas (A Spatial Database of 134 Tree Species of the Eastern USA)

Anantha M Prasad, Louis R Iverson, Steve Matthews, Matt Peters
NRS-4151, USDA Forest Service, Northern Research Station, Delaware, Ohio

Atlas Background | What's New | Citations | Credits | Atlas Help | Other Links (DropDownMenu)

Table of 134 Tree Species:

(Click Table-Header-Link to Sort by that Column - Ascending/Descending)

Model Reliability: High Medium Low

Reliability	Spp. #	Common Name	Scientific Name
Medium	951	American basswood	*Tilia americana*
High	531	American beech	*Fagus grandifolia*
Medium	421	American chestnut	*Castanea dentata*
Medium	972	American elm	*Ulmus americana*
High	591	American holly	*Ilex opaca*
Medium	391	American hornbeam:musclewood	*Carpinus caroliniana*
Medium	935	American mountain-ash	*Sorbus americana*
Low	43	Atlantic white-cedar	*Chamaecyparis thyoides*
Low	808	Durand oak	*Quercus durandii*
Medium	356	Serviceberry	*Amelanchier spp.*
Medium	311	Florida maple	*Acer barbatum*
Low	571	Kentucky coffeetree	*Gymnocladus dioicus*
Low	828	Nuttall oak	*Quercus nuttallii*

134 Species Combined/Compared

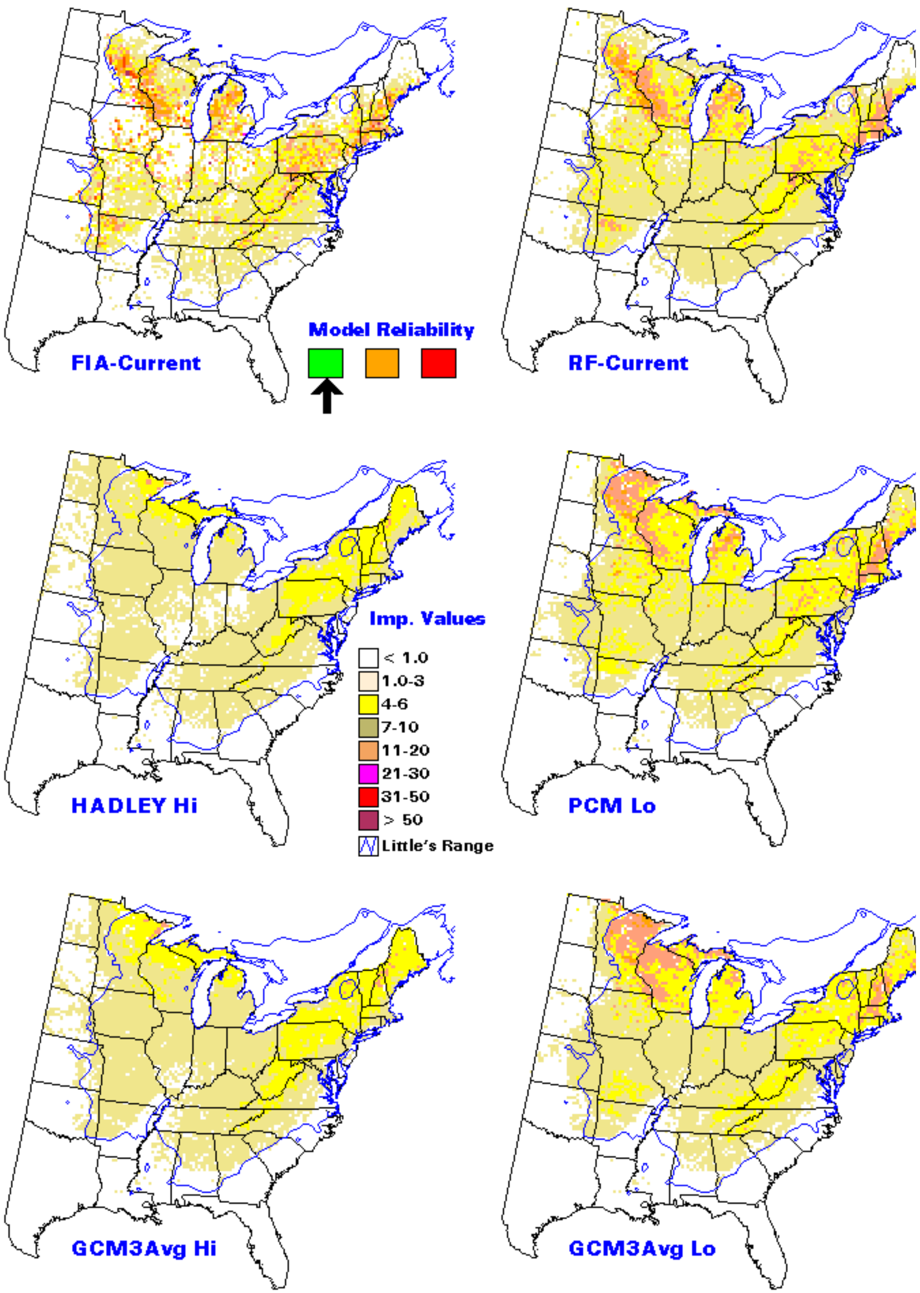
Combined Species Outputs

Summary of Predictors

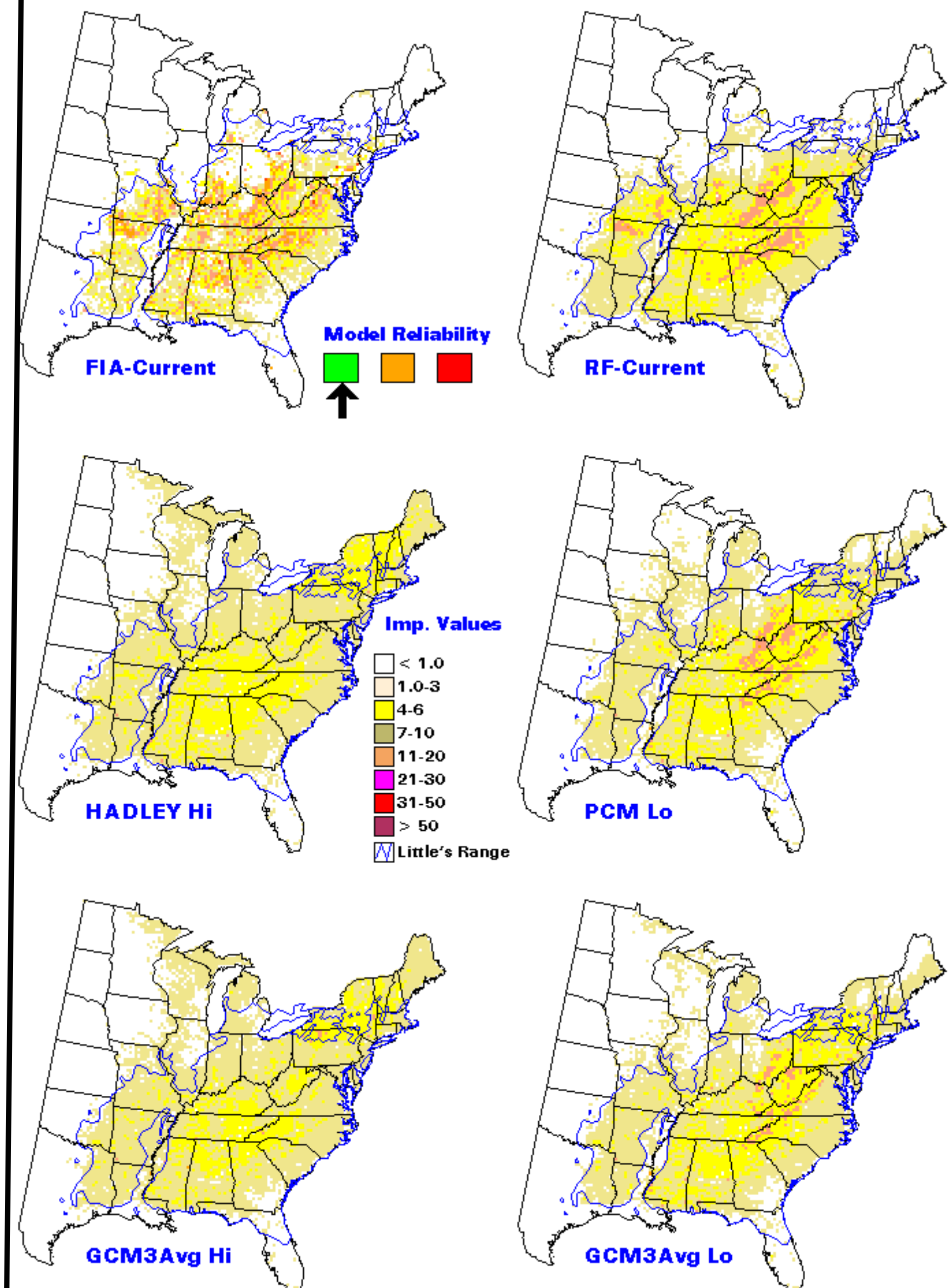
Google Earth Maps

The following maps show habitat suitability in 2100; not arrival dates of migrating species

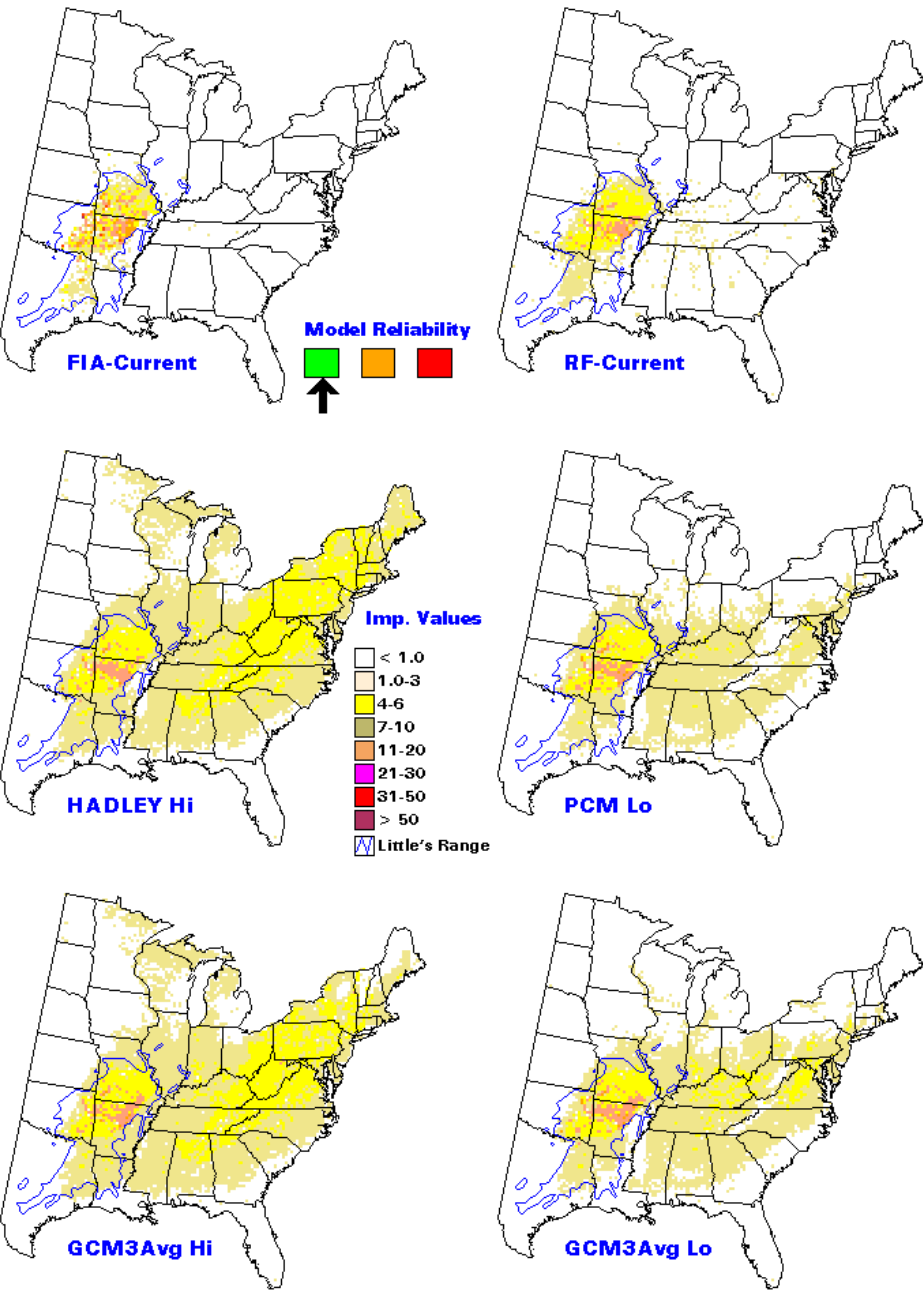
northern redoak - Quercus rubra - (833)



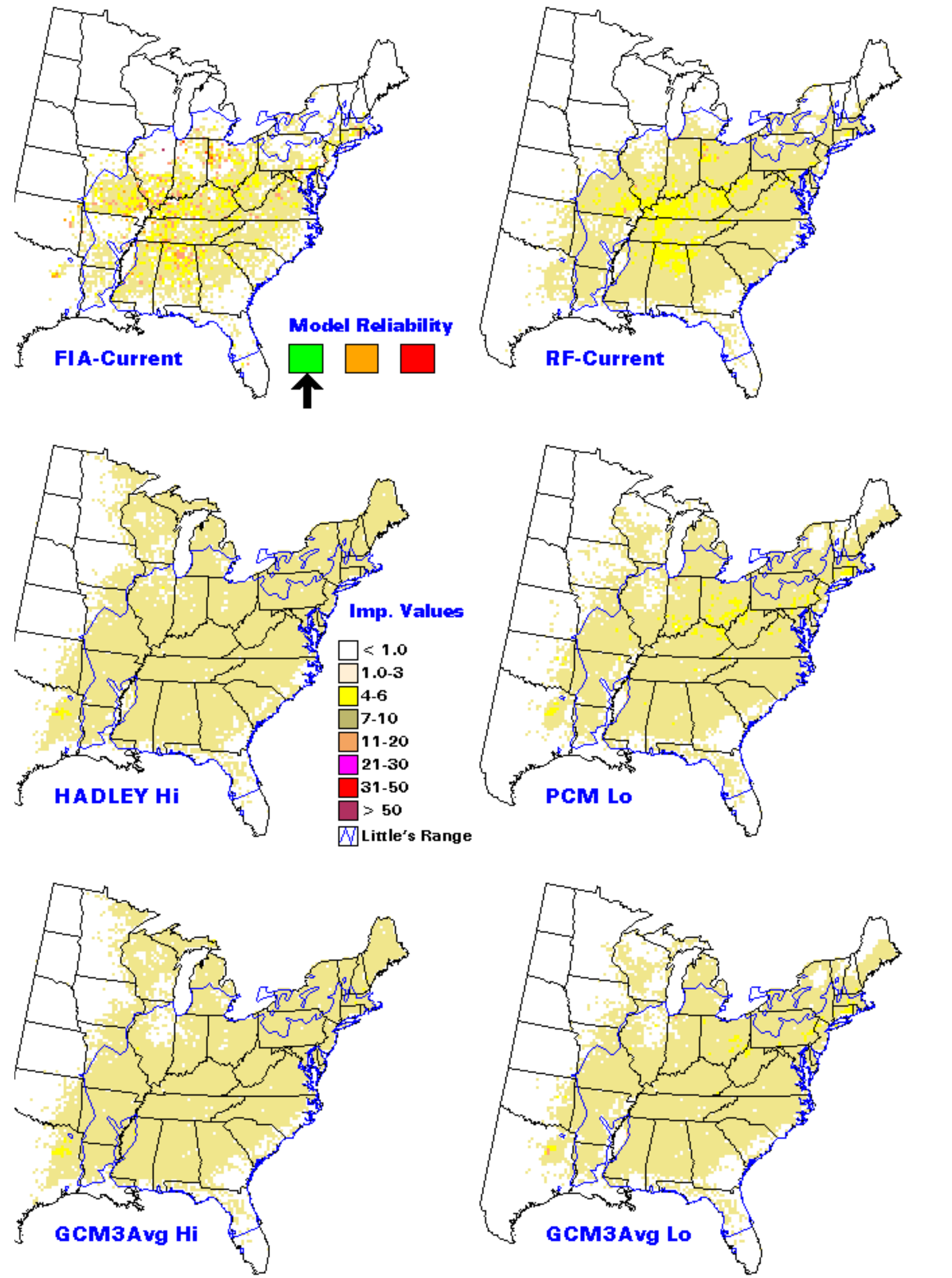
flowering dogwood - Cornus florida - (491)



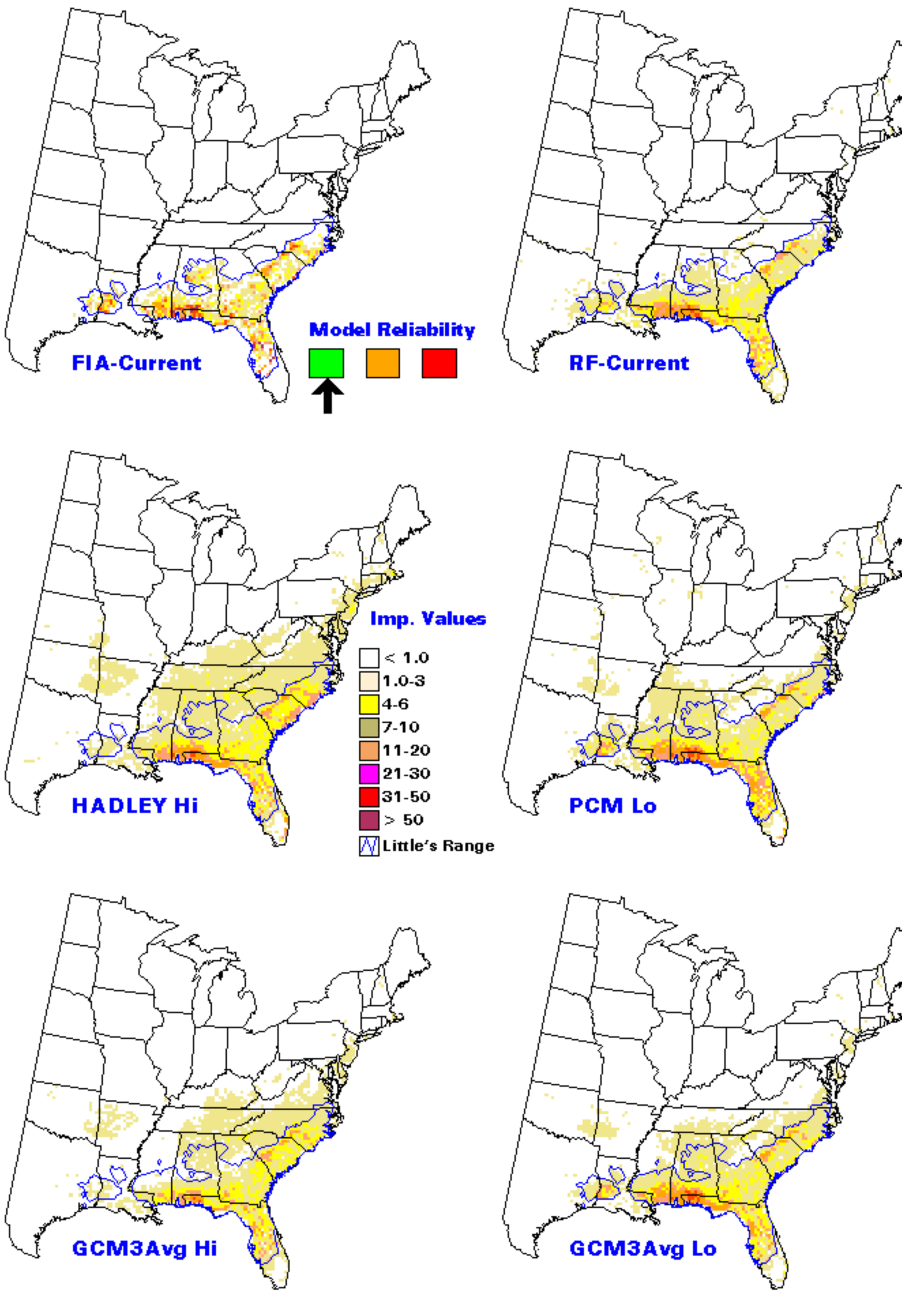
black hickory - Carya texana - (408)



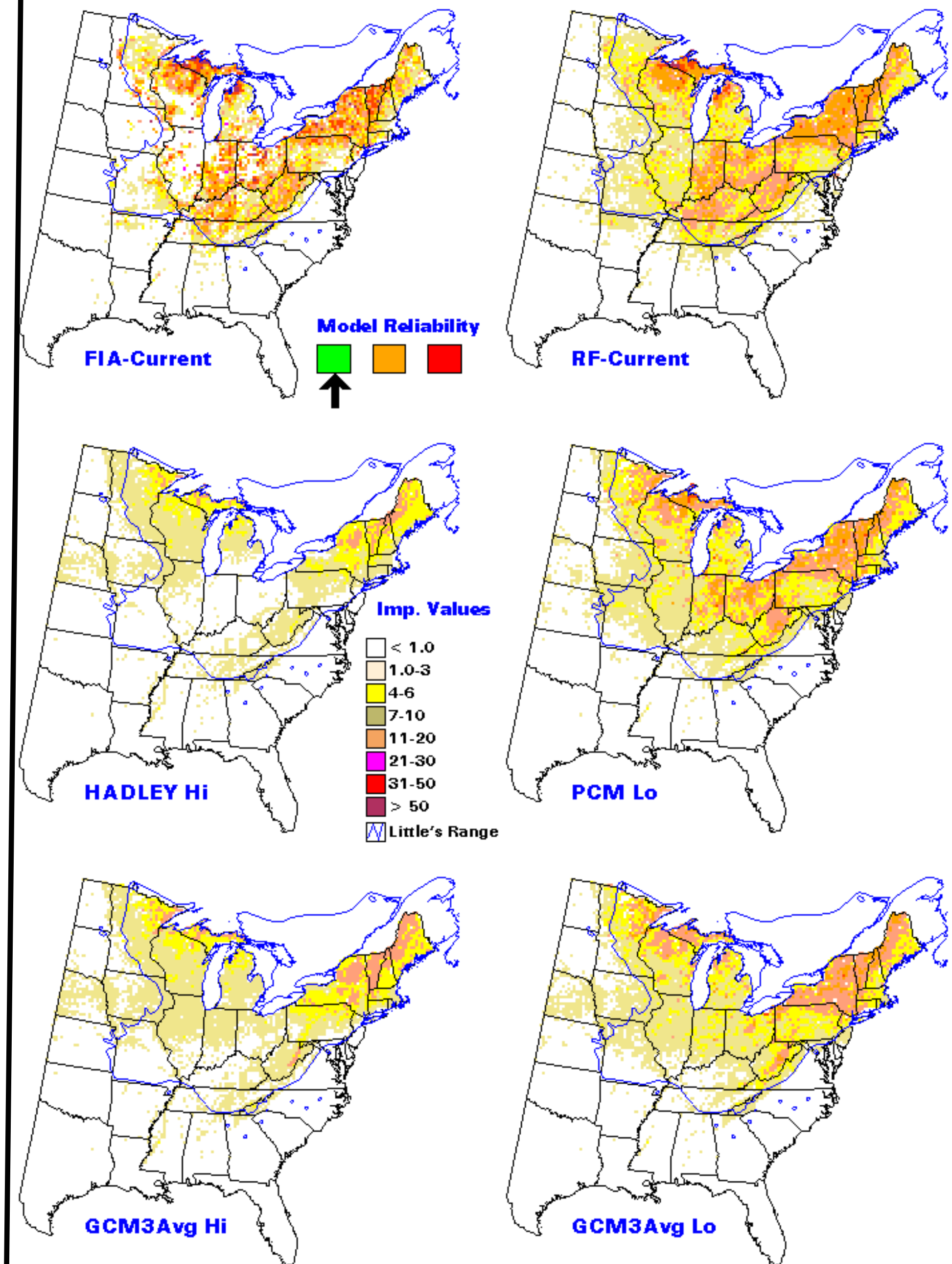
pignut hickory - Carya glabra - (403)



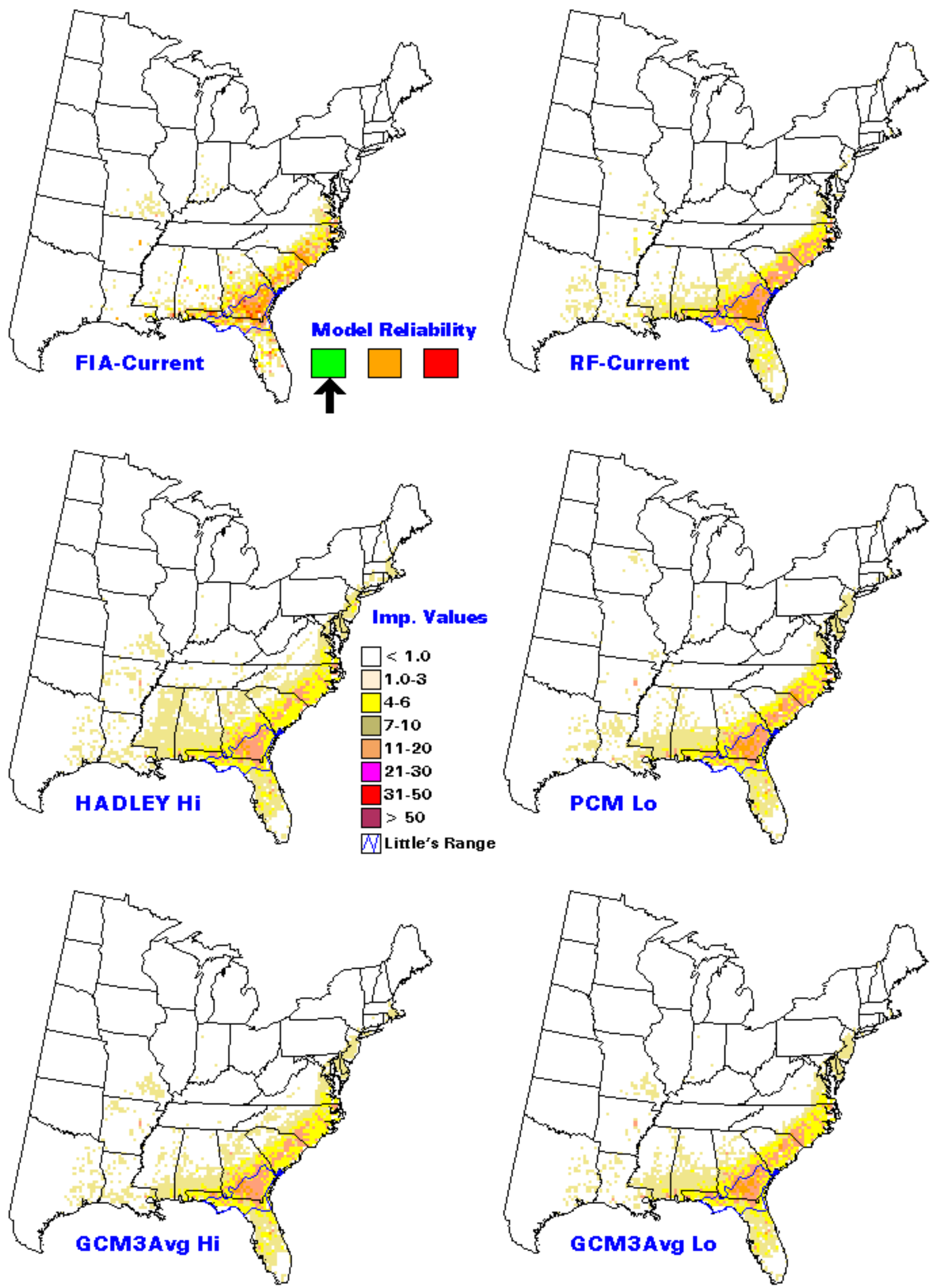
longleaf pine - Pinus palustris - (121)



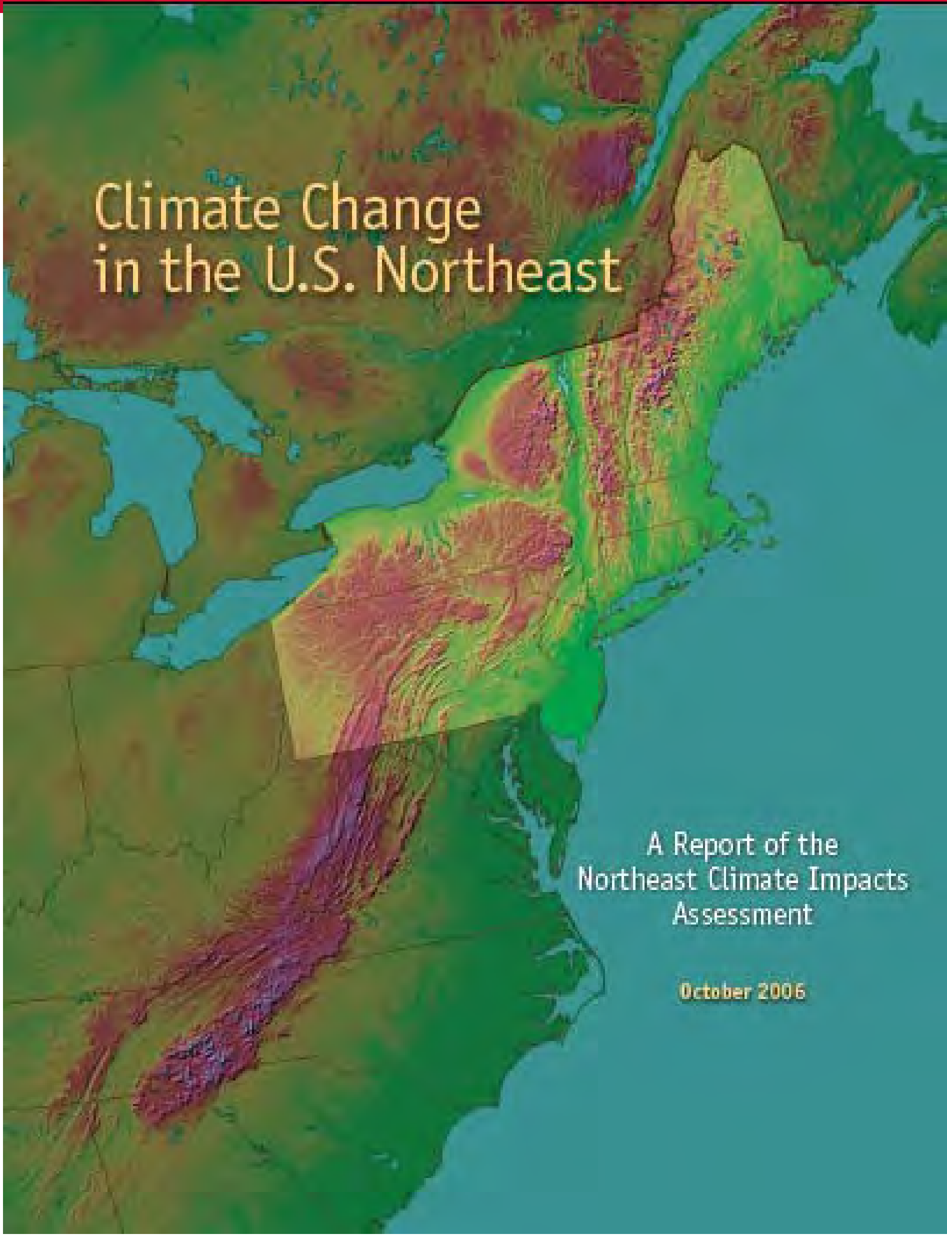
sugar maple - Acer saccharum - (318)



swamp tupelo - Nyssa sylvatica var. biflora - (694)



- While trees grow in the averages, they die at the extremes
- Cold tolerances might change less than heat loading norms
- Plants might not go through needed acclimatization prior to extreme cold events
- Changes in the periodicity of precipitation (seasonal and days between events) and the intensity of events….. Results in changes in growth season and water availability
- Change in snow-covered days and albedo change mineral cycling in forest soils, more like non-snow soils of similar provenance along Appalachian ridge and Piedmonts



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Tremendous tree-hugging tedium Batman…how does all of this inform practice in New Jersey?

- In a landscape design-management context, it might suggest changes in approach to plant selection
- We have challenges in managing stormwater during rain events and in capturing that rain for future plant water needs between events.
- Later fall abscission, possibly marked by large late season storms….

Individual trees do not tend to move great distances once planted

- As the temperature and moisture regimes shift, existing trees can fall into the category of species-site disconnect where they previously were apt as a species.
- Others which were questionable choices may come into a stronger species-site match.

- Pest problems can explode into new areas, but regeneration could be impaired

- The quality of the linkage influences disease-pest and other maintenance expenditures

- Current local markets? Species aptness for trees will change over time, but caution is warranted since cold winters are still possible, (without a needed acclimatization period). Water becomes an issue on both wet and dry ends, really a factor accentuated by development pressures.
- Does change in Maryland-northward impact market advantage? Provides a market as heat loading shifts market demands for many mainstays of the NJ nursery production inventories, though they can shift with the demand.
- Scale of such markets? I really do not know
- Barriers to market development?
  - Homework on finding links between today's sites and tomorrow's expectations in either good or bad scenarios….
  - Overcoming "nativeness"
  - Shifting selection toward future species aptness over aesthetic alone
  - Carbon cost to market proximity
  - Packaging for urban heat-load stocking packages

A tally of N Jersey communities

- Total Number of 41,771 Trees
- 34% (14,226) were maple species (red, Norway, silver, sugar)
- 17% (7,260) were either red or pin oak

Size Classification			
	Small	Medium	Large
Number of Trees Occurring	3012	2898	35861

OBSERVATION COUNTS

Species	Size Classification	Total Observed	Pit	Strip	Lawn
Acer platanoides	large	7450	94	4052	3304
Acer rubrum	large	3842	30	1404	2408
Acer saccharinum	large	930	8	530	392
Acer saccharum	large	2004	30	694	1280
Aesculus hippocastanum	large	147	9	49	89
Gleditisia triacanthos	large	792	60	225	507
Platanus x acerfolia	large	2337	43	1411	883
Quercus palustris	large	5397	66	1973	3358
Quercus rubra	large	1863	32	337	1494
Tilia cordata	large	917	32	334	551
Zelkova serrata	large	919	47	529	343
Pyrus calleryana	medium	1537	136	714	687

Creating typologies on site condition groupings

- Often it is challenging, if not impractical at municipal level to derive a species-site matching rubric customized for each planting event.
- Often the stress filters can cluster into a discrete set of site types
- As site types emerge, clusters of species options emerge
- The key is to avoid cross-listing adaptable species into several site types

Chair throwing anyone?
A series of words on the use of native species

- After the shouting………it is about defining the site
- It is truly a cosmopolitan disease-pest environment…..and they move faster than trees
- TREES TAKE TIME…..so choices might take cues from the expected future, with some healthy respect for the current situation


A gratuitous pretty plant image

Northern Trees - Microsoft Internet Explorer

http://orb.at.ufl.edu/TREES/index.html

Northern Trees

Home

Tree Indexes
- Scientific Names
- Common Names

Tools for Novices
- Tree Expert System
- Tree Identification

Tools for Experts
- Site Analysis
- Tree Selector

References
- Glossary of Terms
- Hardiness Zone
- State Trees

Related Sites
- Urban Design
- Nursery Growing

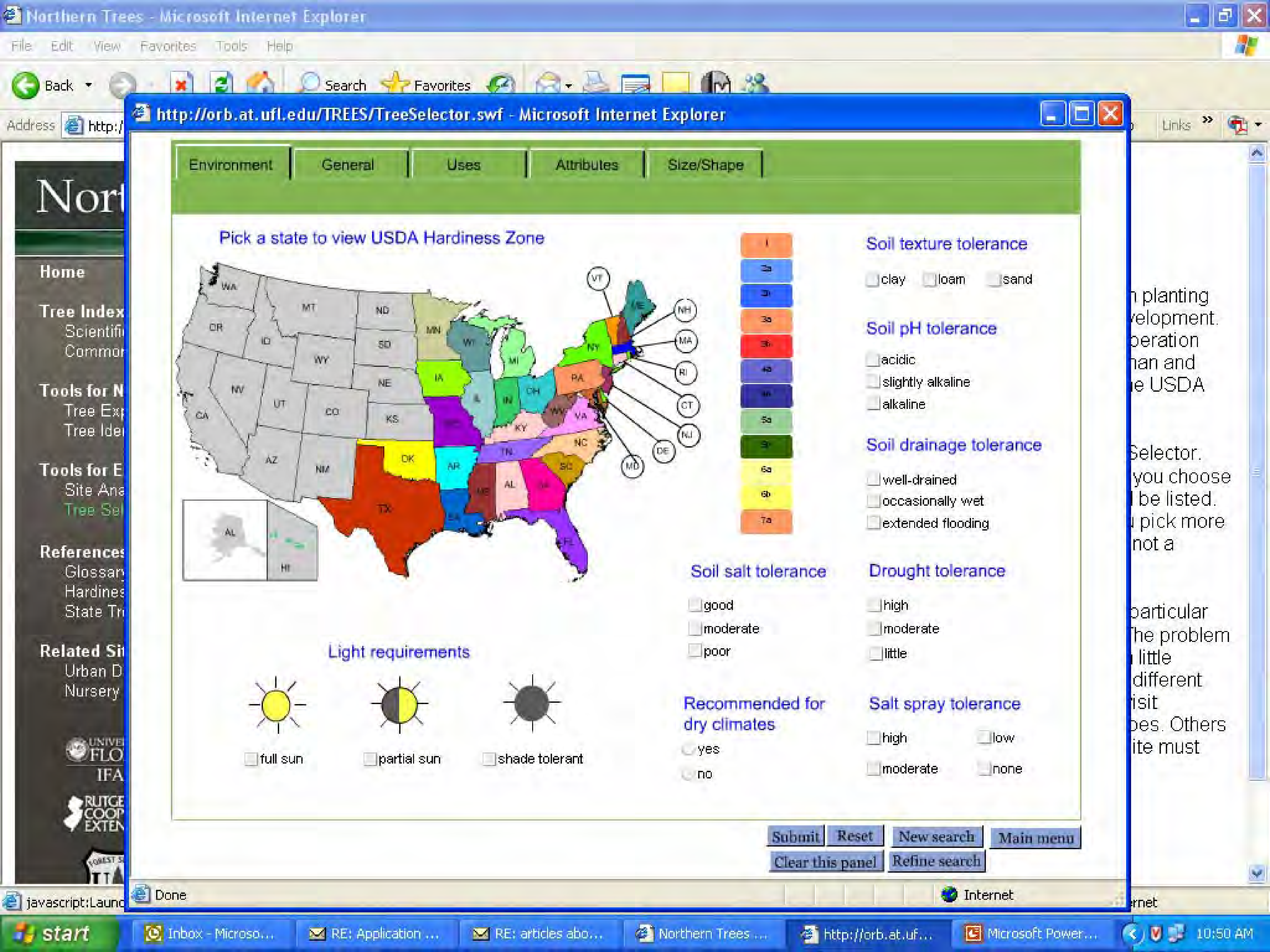
University of Florida IFAS

Rutgers Cooperative Extension

This web site is designed to help guide you through the process of choosing trees for urban and suburban planting sites. Several tools listed on the left side of this screen are available to you now. Others are still under development. This information was assembled through a grant from the USDA Forest Service Northeast Region in cooperation with Rutgers University and University of Florida. The principle authors of this system include Drs. Ed Gilman and Howard Beck, professors at University of Florida and Dr. Jason Grabosky at Rutgers. Robin Morgan at the USDA Forest Service was instrumental in executing the agreements that lead to completion of this project.

Using the Tree Selector: You can mark more than one value of an attribute such as soil pH in the Tree Selector. This chooses trees that can grow in soils with either one of the values of soil pH. On the other hand, when you choose more than one attribute, such as acid soil pH and 25-50 feet tree height, only trees with both attributes will be listed. You may choose as many attributes as you like but remember the list of matching trees diminishes as you pick more attributes. You will find that some planting sites are so harsh no trees are suited for growing there. This is not a shortcoming of this software; it is a shortcoming of the planting site.

More on selecting trees for urban and suburban landscapes: One method of choosing a tree for a particular site is to drive around town to find out which species grow well in landscapes with similar site attributes. The problem with this approach is that most people do not do it, and when they do, it can create urban landscapes with little species diversity. The other problem with this approach is the soil conditions at your planting site may be different from other sites around town. Many professionals who specify trees for urban and suburban landscapes visit arboreta and botanic gardens. This is good because it potentially brings new plants to our urban landscapes. Others rely on books and computer software to choose trees. This is reasonable, however the specific planting site must first be evaluated to determine the cultural and physical attributes required of trees at the site.


Northern Trees - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http:/
http://orb.at.ufl.edu/TREES/TreeSelector.swf - Microsoft Internet Explorer
Links
Environment
General
Uses
Attributes
Size/Shape
Pick a state to view USDA Hardiness Zone
Soil texture tolerance
clay
loam
sand
Soil pH tolerance
acidic
slightly alkaline
alkaline
Soil drainage tolerance
well-drained
occasionally wet
extended flooding
Soil salt tolerance
good
moderate
poor
Drought tolerance
high
moderate
little
Light requirements
full sun
partial sun
shade tolerant
Recommended for dry climates
yes
no
Salt spray tolerance
high
low
moderate
none
Submit
Reset
New search
Main menu
Clear this panel
Refine search
Done
Internet
Home
Tree Index
Tools for
References
Related Si
javascript:Launc
start
Inbox - Microso...
RE: Application ...
RE: articles abo...
Northern Trees ...
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Microclimate factors (site specific)

- Light levels and shade patterns
- Wind exposure or wind tunnels
- Rain shadows
- Reflected heat loads
- Frost pockets and air drainage

Common selection filters

- Soil pH tolerance
- Salt, a companion to pH
- High temperature
  - Above ground
  - Below ground
- Drought-flood-compaction
- Space limits above ground (lines and views)

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Acer leucoderme

Magnolia virginiana
Sweetbay Magnolia

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Pinus palustris
Longleaf Pine

Soil pH tolerance

- Plant species adaptable to wide soil ranges
- Tolerant of elevated pH

- Parrotia
- Gingko

Quercus cerris

Tolerant of elevated pH and occasional drought

TRANSPLANTING ISSUE pH tolerant

Acer buergerianum

Slightly elevated pH possible (≤7.5)

moderately tolerant of aerial salt

tolerant of occasional dry periods

susceptable to verticillium wilt

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Salt tolerances

- Difference between soil salinity and aerial salt tolerance in example, Gingko spray maybe ok, soil not good
- Road maintenance salts impact pH

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Styphnolobium japonica 'Regent'

Tolerant of:
Drought
elevated pH
some salt
Probably NOT all at one time

Celtis australis
Tolerant of:
Drought
moderate salt
elevated pH
Surface rooting an observed problem

Carpinus betulus

Wide soil range, drought tolerant BUT NOT SALT tolerant

Temperature

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Questions….

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