Central Hardwoods Climate Change Response Framework

Hoosier National Forest

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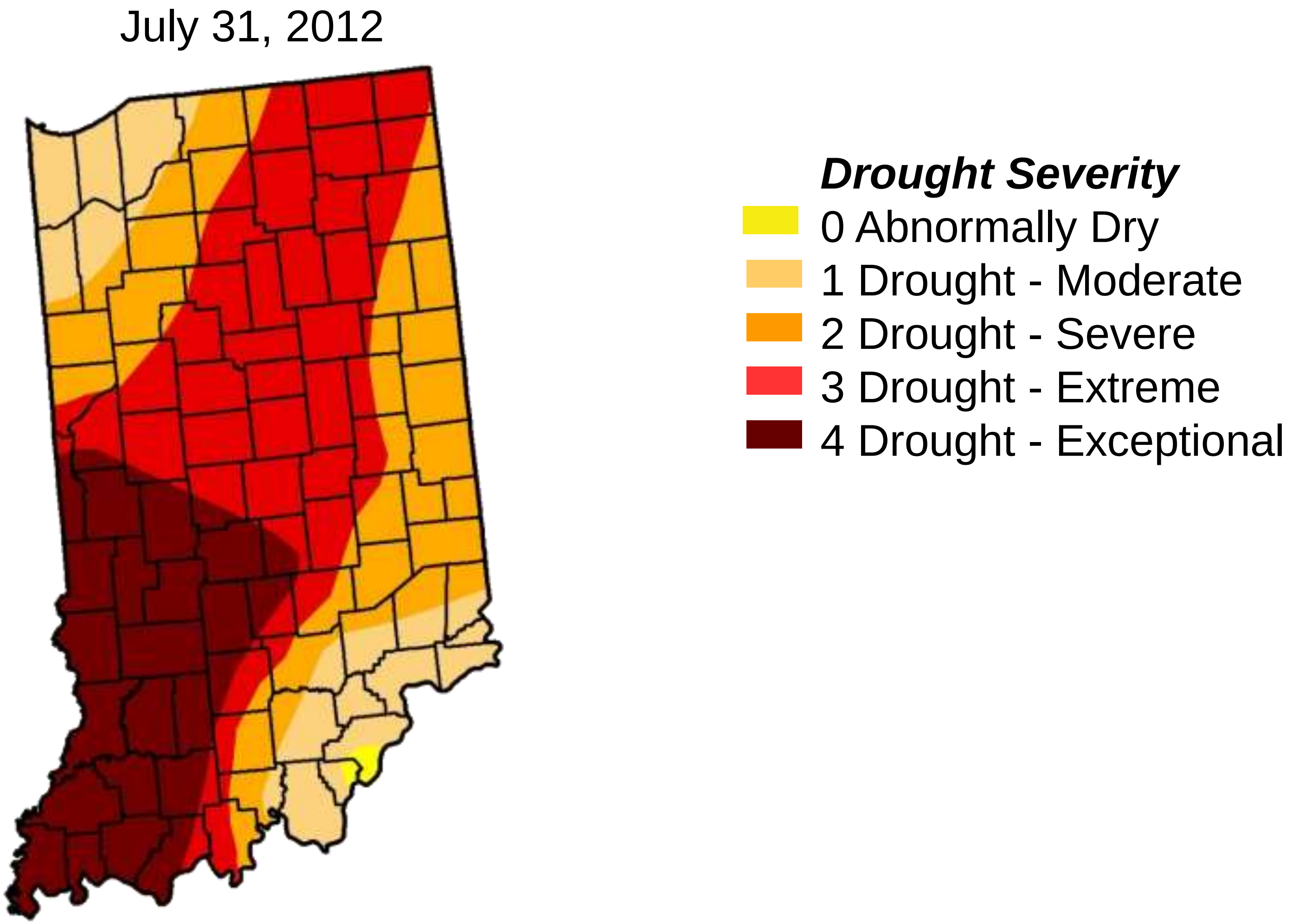
Northern Research Station and Eastern Region

2012 Drought Severity



Source: US Drought Monitor


Holiday Hill Christmas Tree Farm
Terre Haute, Indiana


northern Vigo County, Indiana


Morse Reservoir
Noblesville, Indiana


Are droughts like this
one becoming more
frequent?


Is there a link to underlying changes in climate?


What does this mean to the land we manage?

Climate Change Response Framework

Central Hardwoods

www.climateframework.org

Climate Change Response Framework

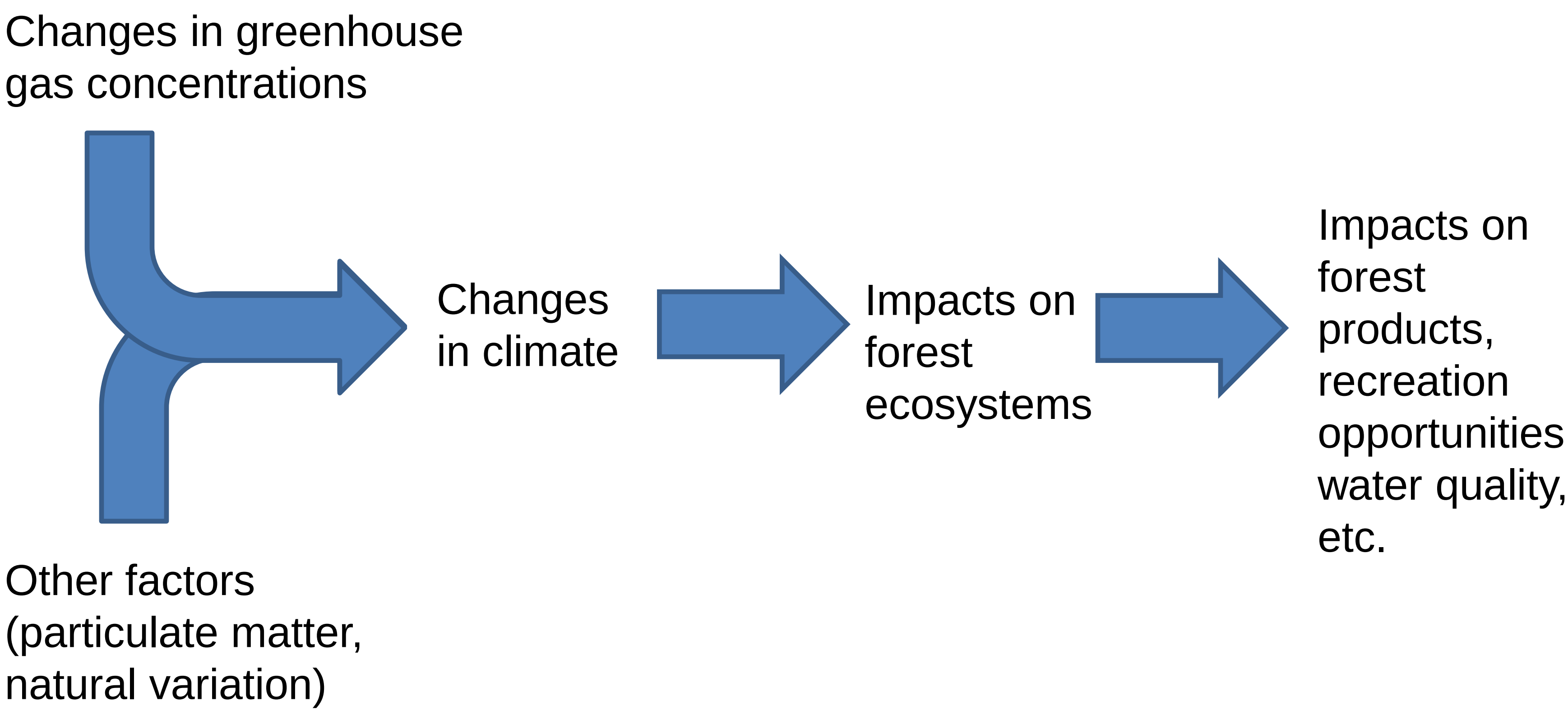
Partnerships — work with scientists, land managers federal, state, NGO, university, industry organizations

Vulnerability Assessment — understand how climate change may affect forests in a specific area

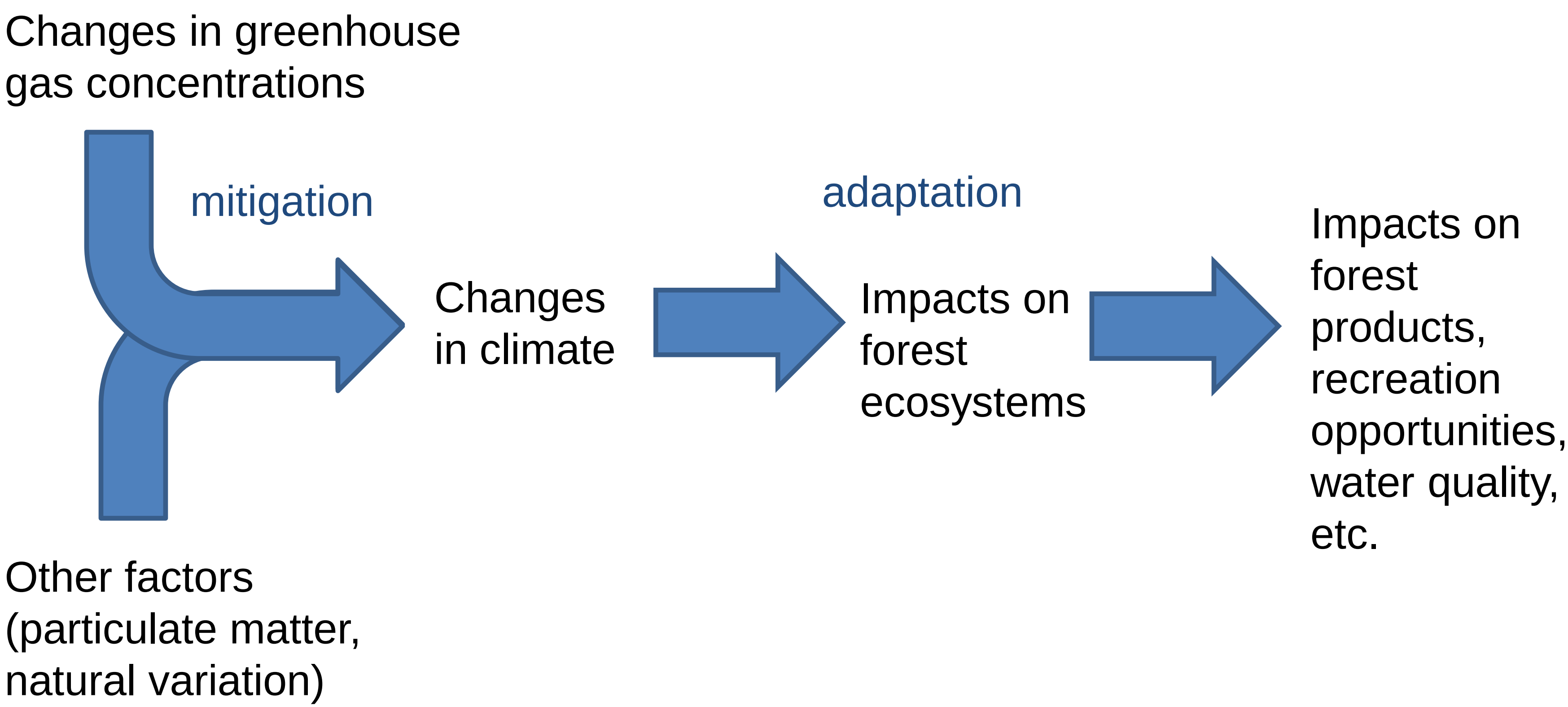
Forest Adaptation Resources — identify strategies, approaches, and tactics to adapt to climate change

Demonstration Projects — incorporate information into decision-making and on-the ground projects

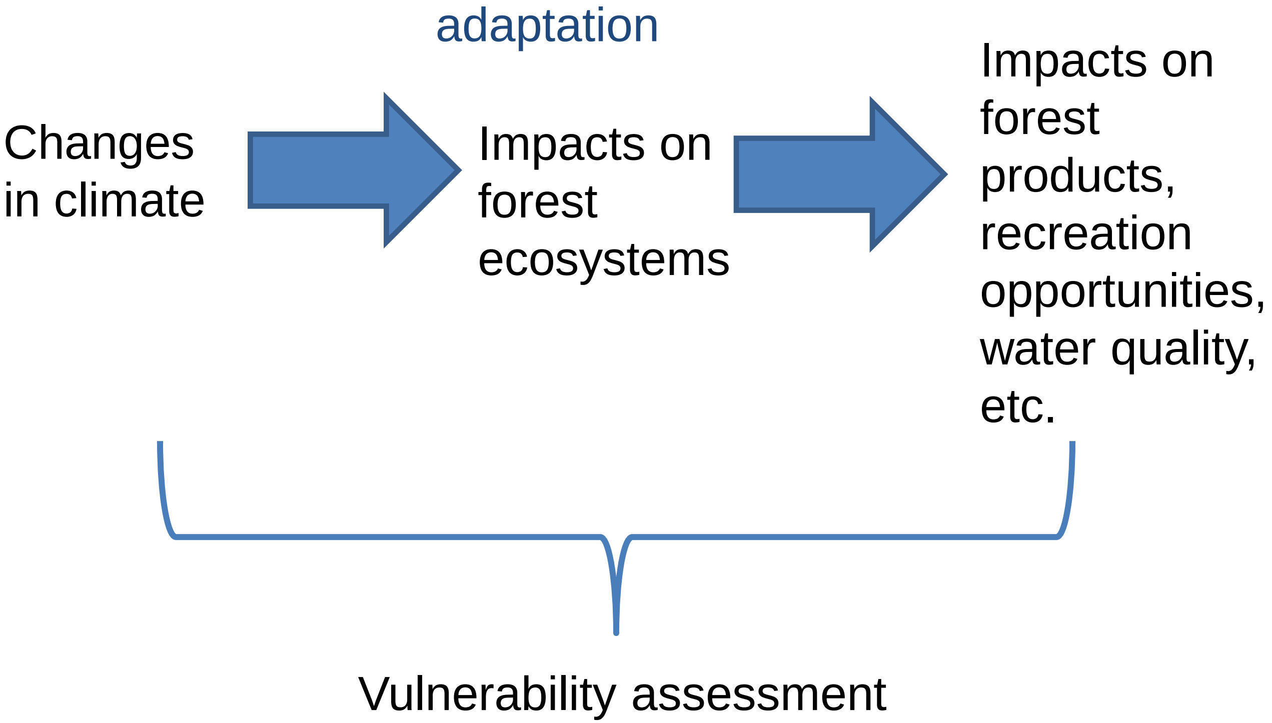
Climate Change Response Framework



Climate Change Response Framework



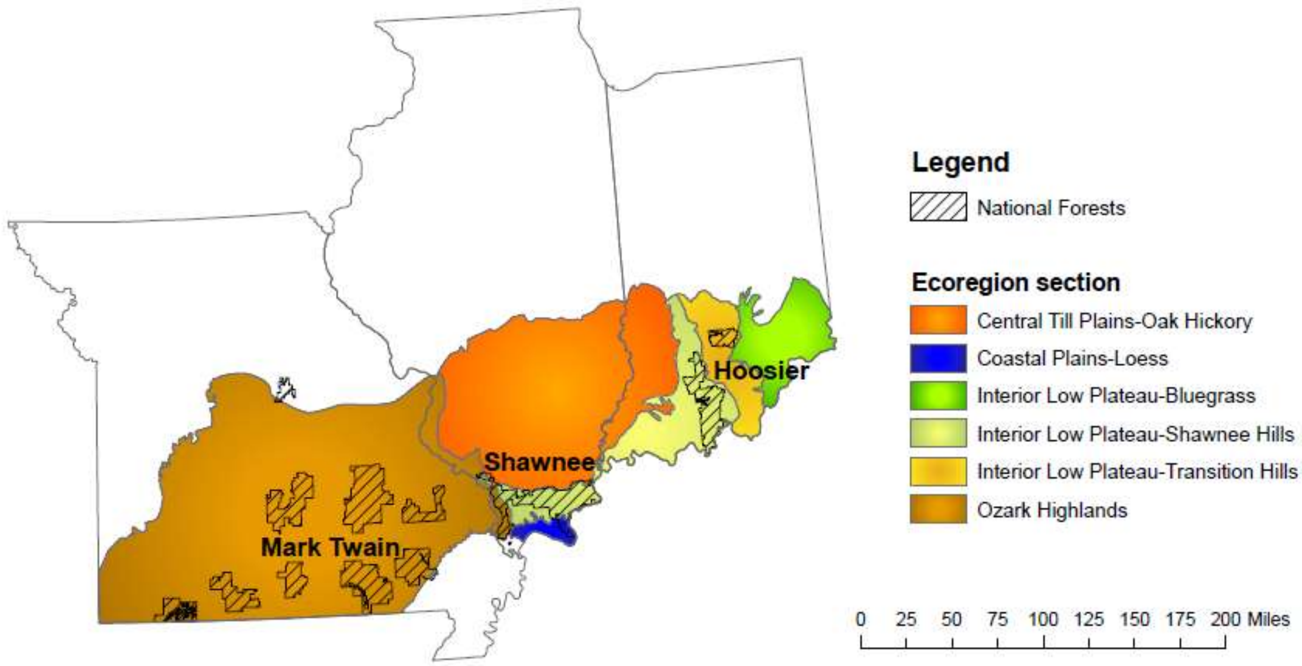
Climate Change Response Framework



Questions

1. How has climate changed in southern Indiana over the past century?
2. How is climate projected to change in southern Indiana over the next century?
3. What does this mean for the forests we manage?

Assessment Area

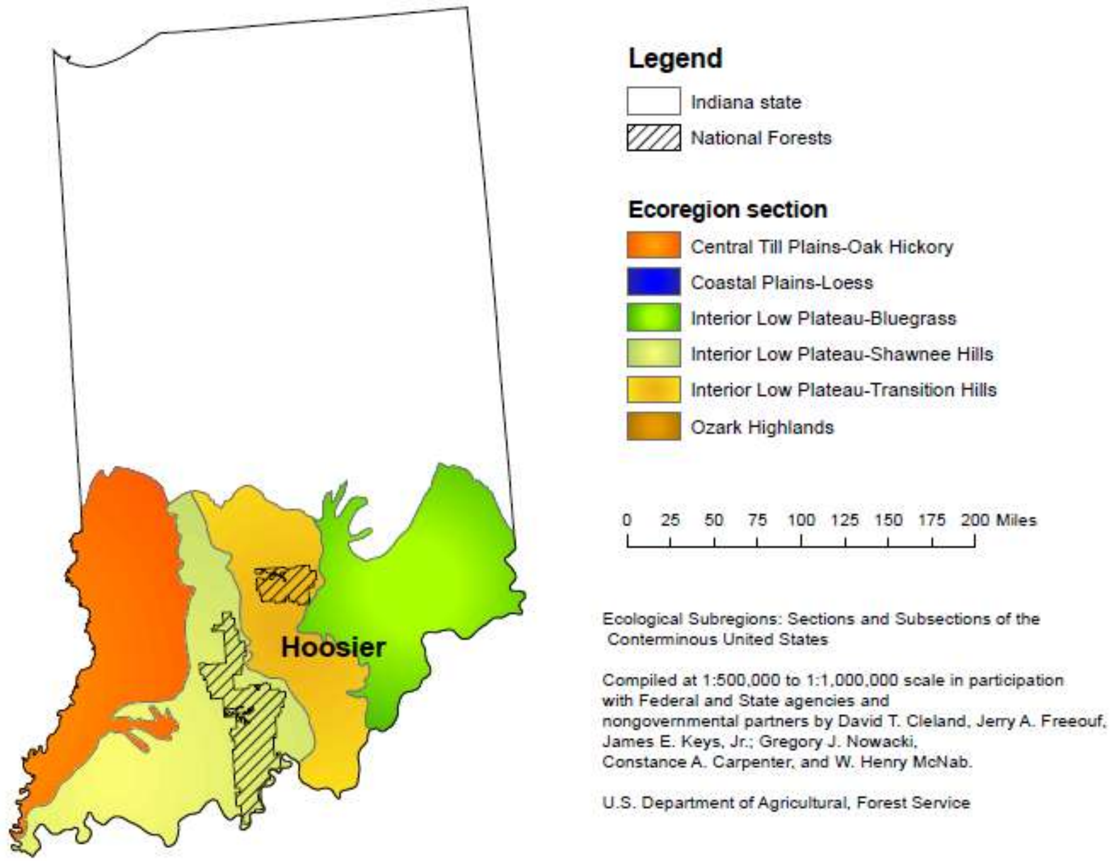


Ecological Subregions: Sections and Subsections of the Conterminous United States

Compiled at 1:500,000 to 1:1,000,000 scale sin participation with Federal and State agencies and nongovernmental partners by David T. Cleland, Jerry A. Freeouf, James E. Keys, Jr.; Gregory J. Nowacki, Constance A. Carpenter, and W. Henry McNab.

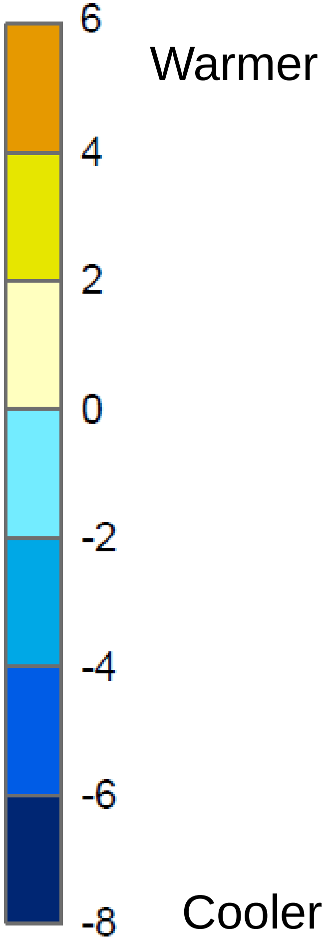
U.S. Department of Agricultural, Forest Service

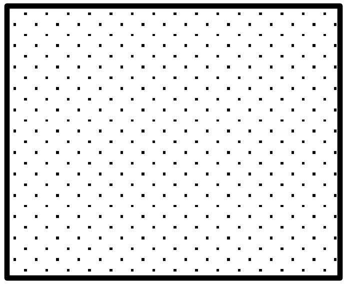
Today’s Focus



PAST CLIMATE

1901-2006 Temperature Change (°F)

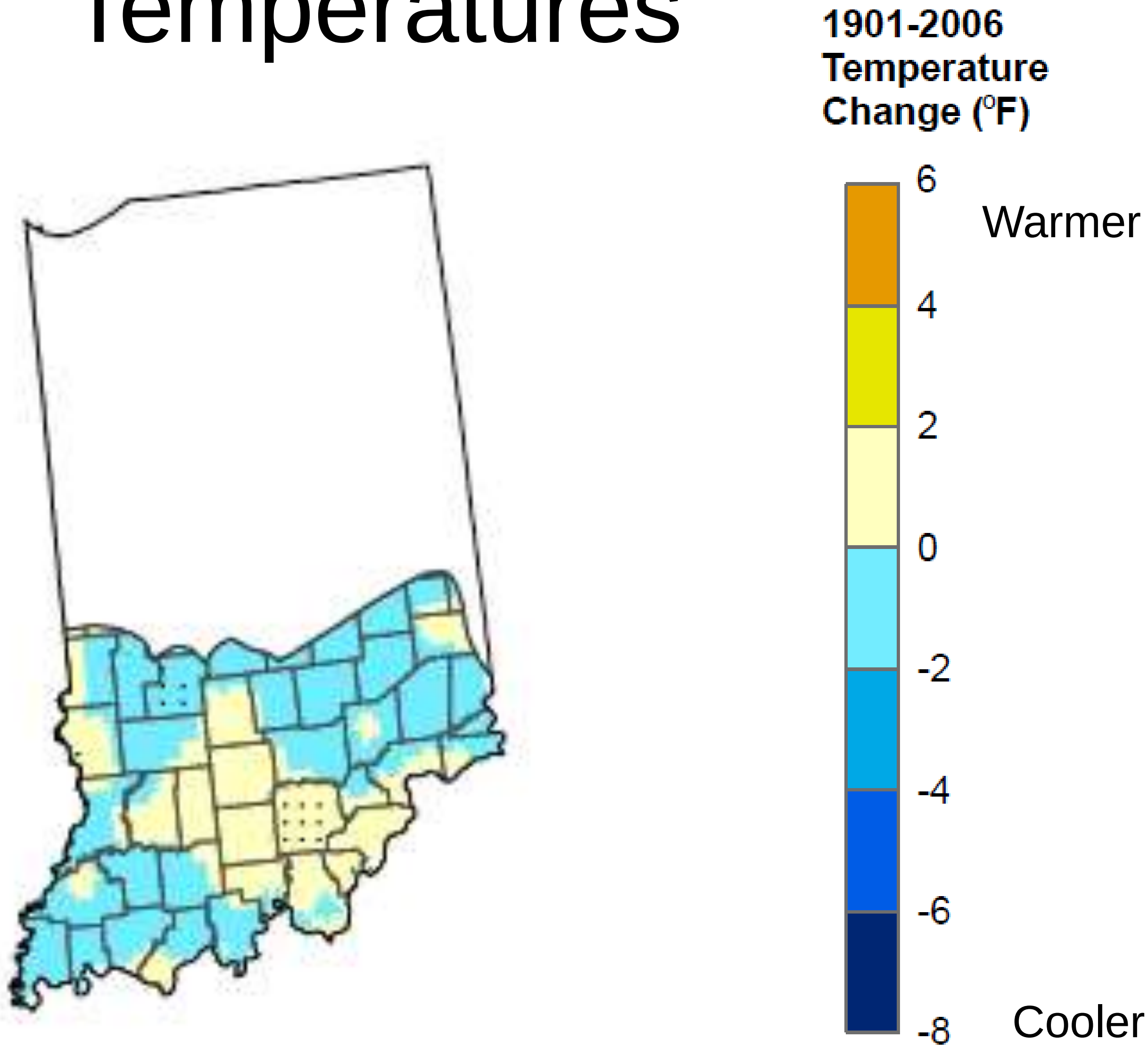




Statistically significant at 0.10 level

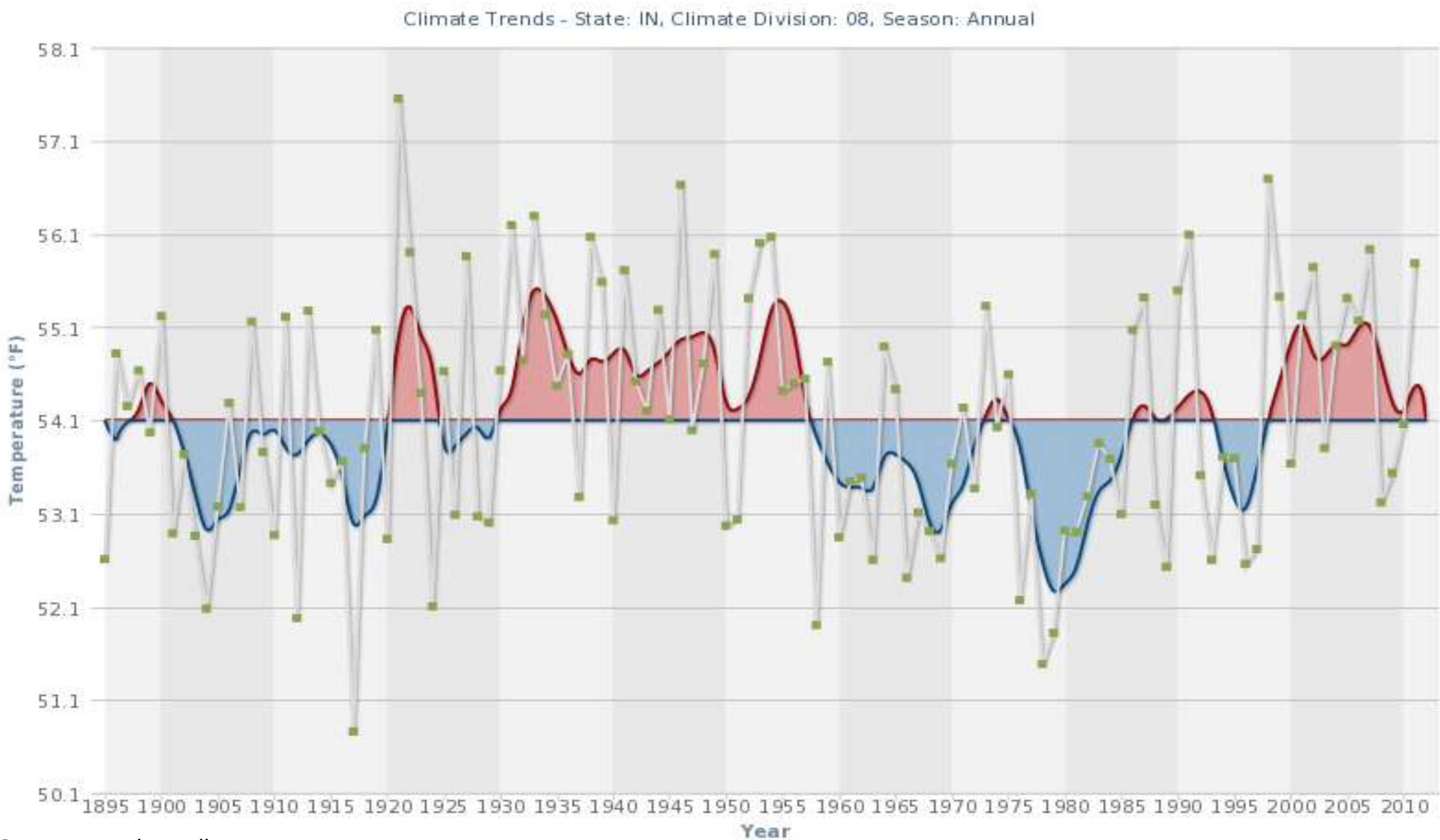
Source: www.climatewizardcustom.org

Little Change in Mean Annual Temperatures



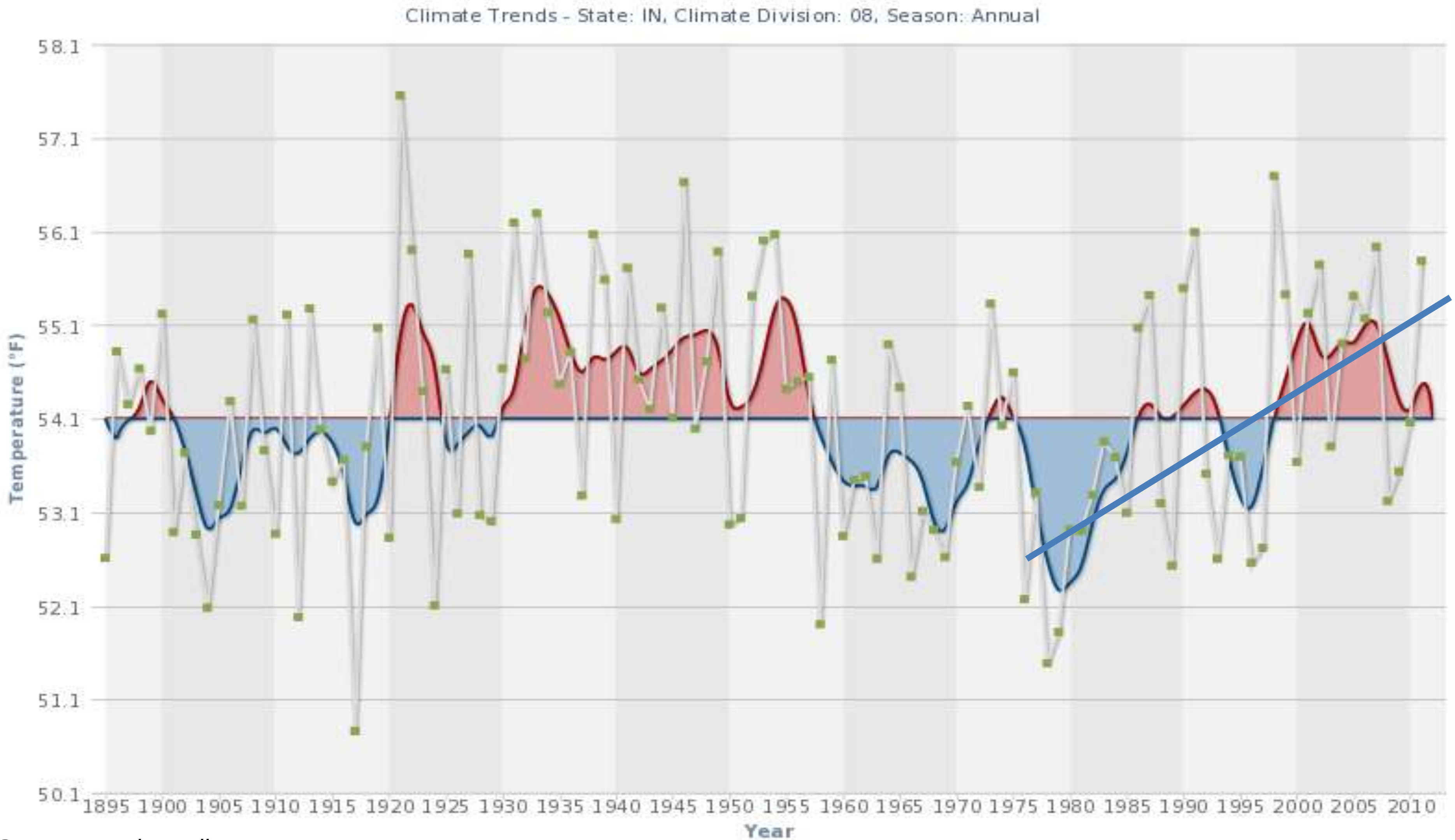
Source: www.climatewizardcustom.org

South-Central Indiana Trends



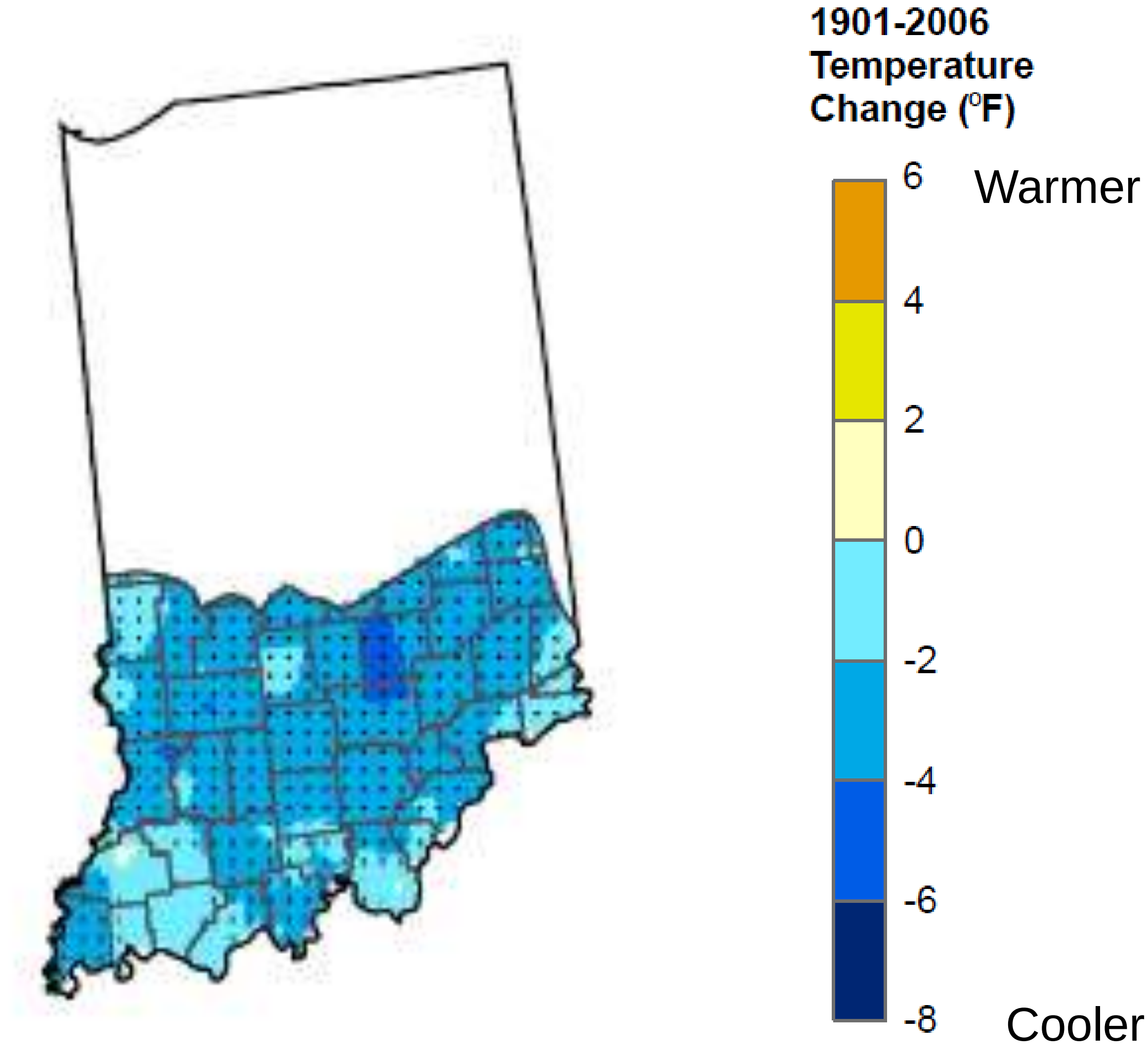
Source: southernclimate.org

South-Central Indiana Trends



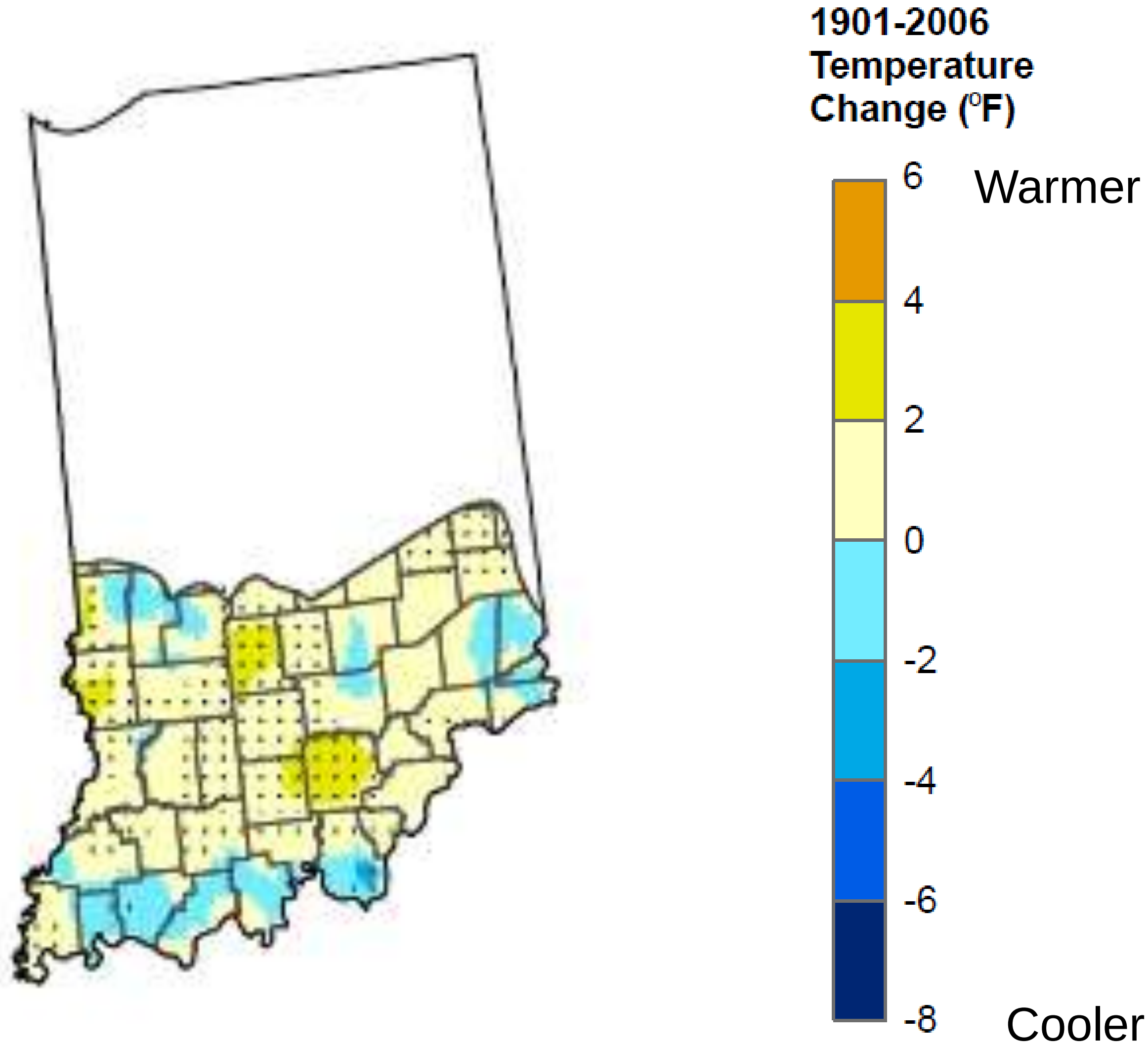
Source: southernclimate.org

Summer Highs Have Decreased

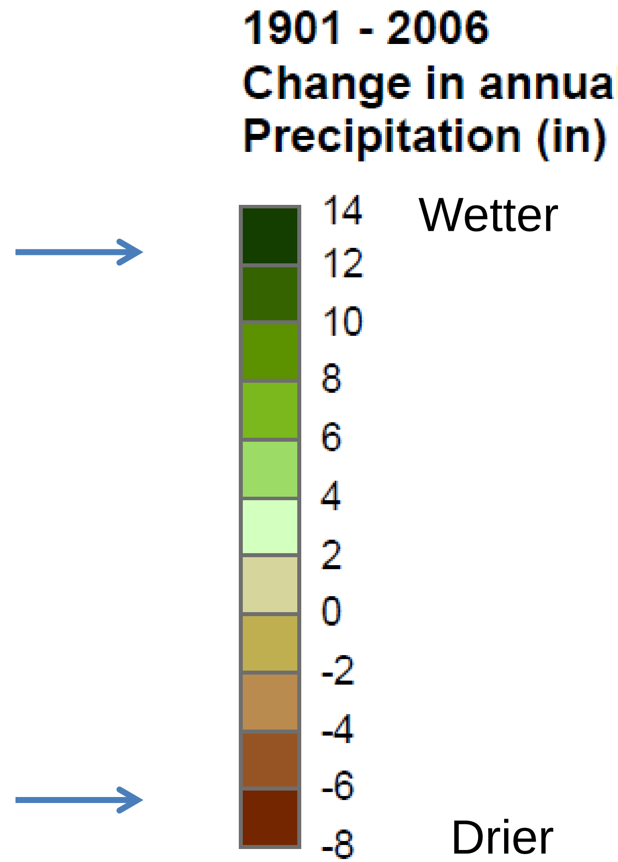


Source: www.climatewizardcustom.org

Summer Lows Have Increased

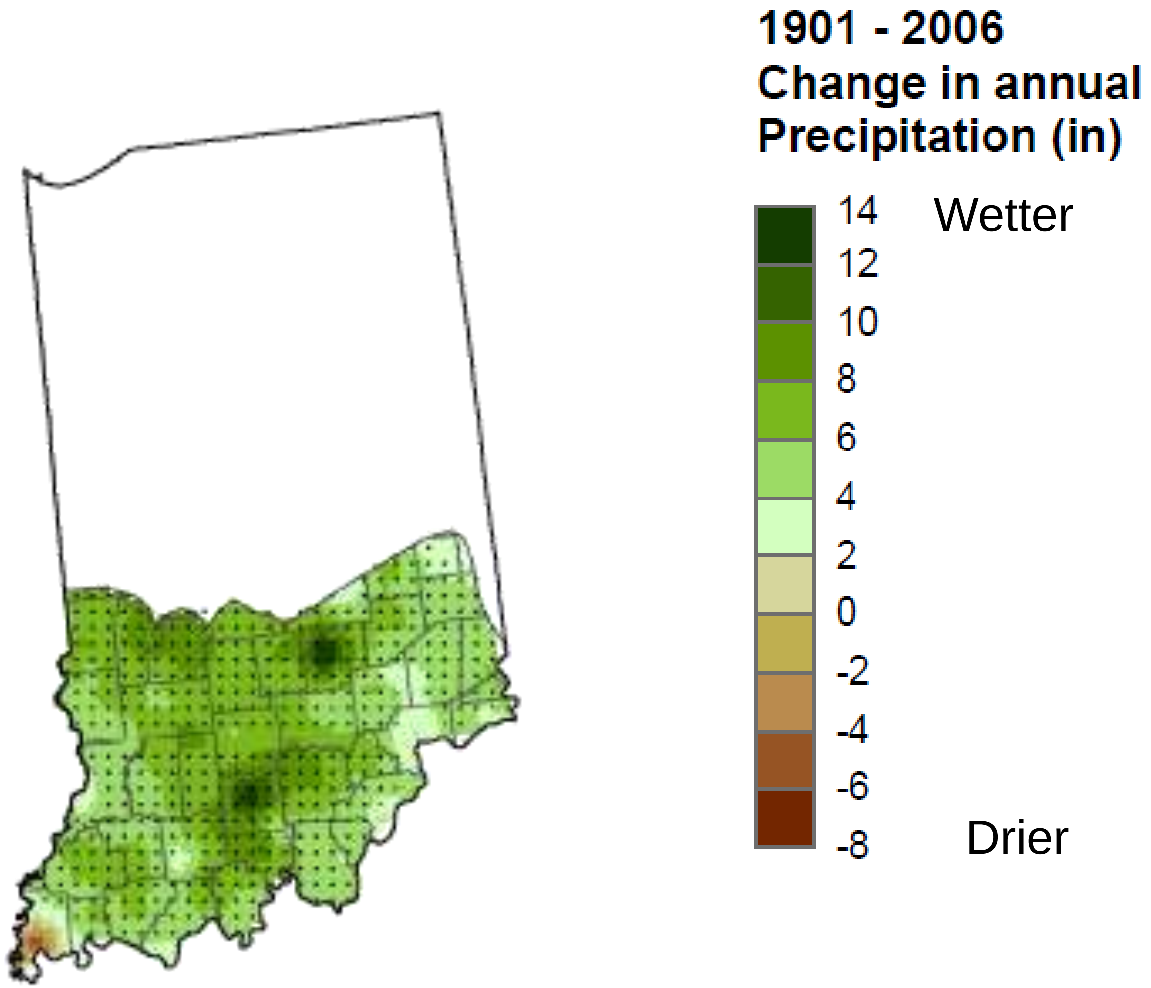


Source: www.climatewizardcustom.org



Source: www.climatewizardcustom.org

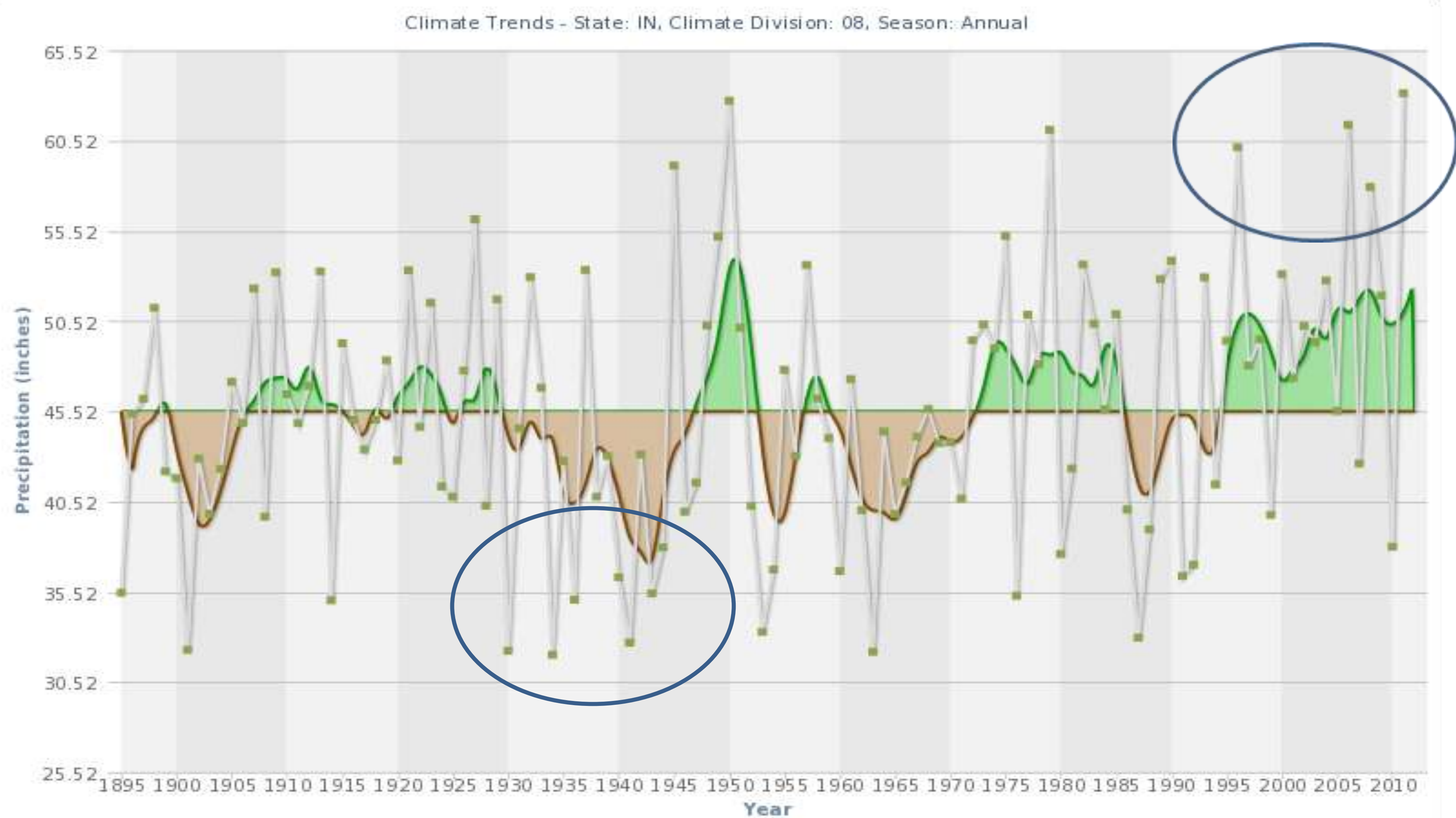
Precipitation Has Increased



Average annual : 45 inches

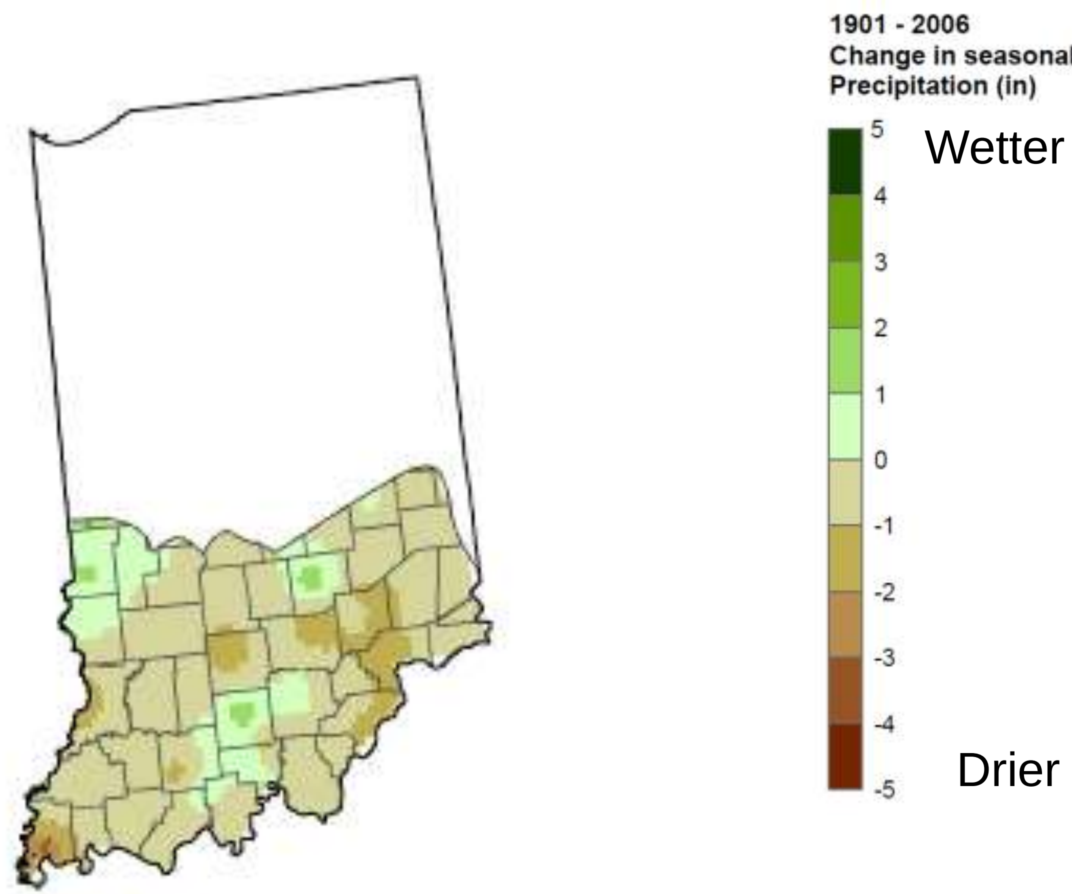
Source: www.climatewizardcustom.org

South-Central Indiana Trends



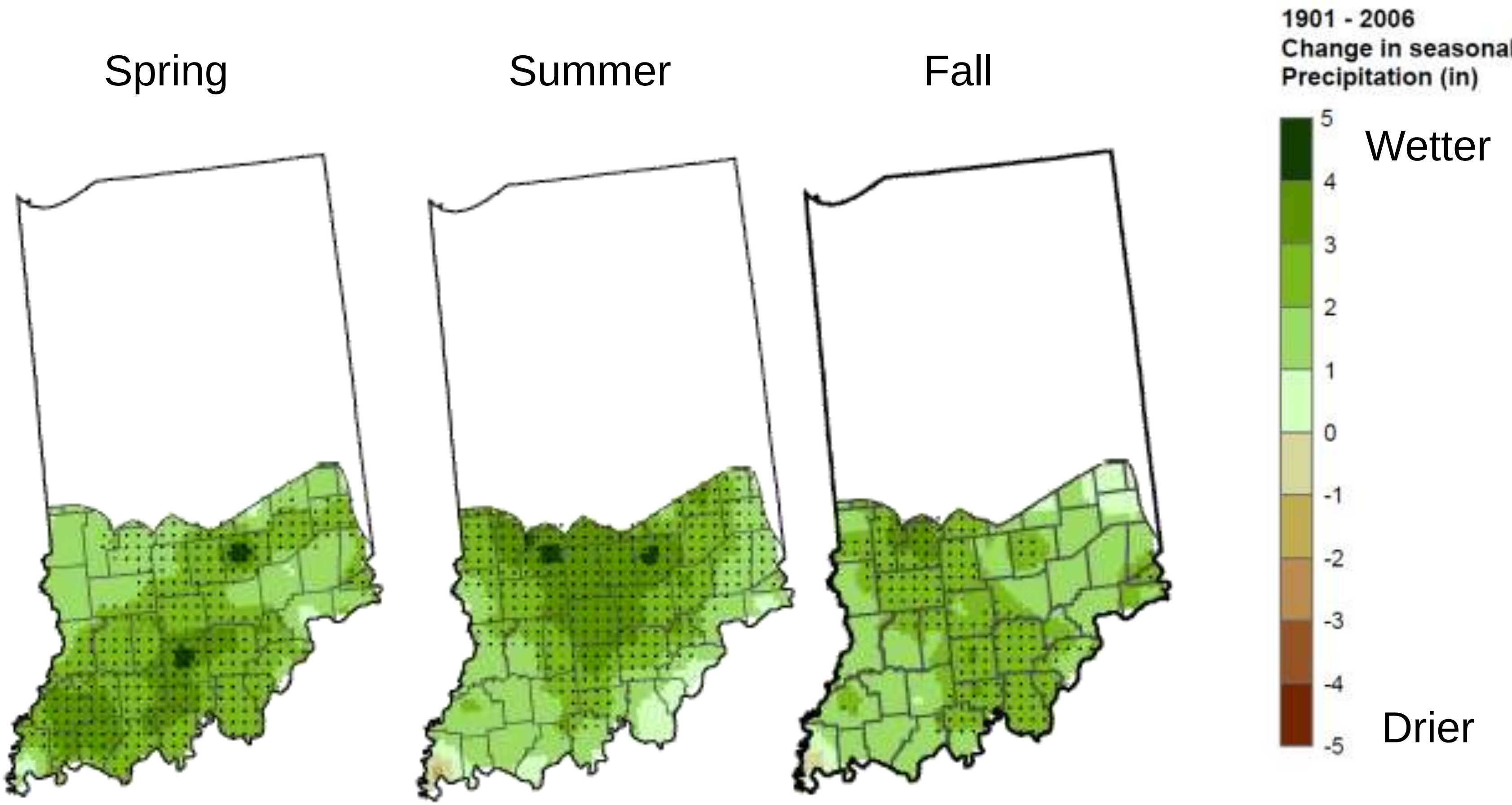
Source: southernclimate.org/

Winters Have Become Slightly Drier

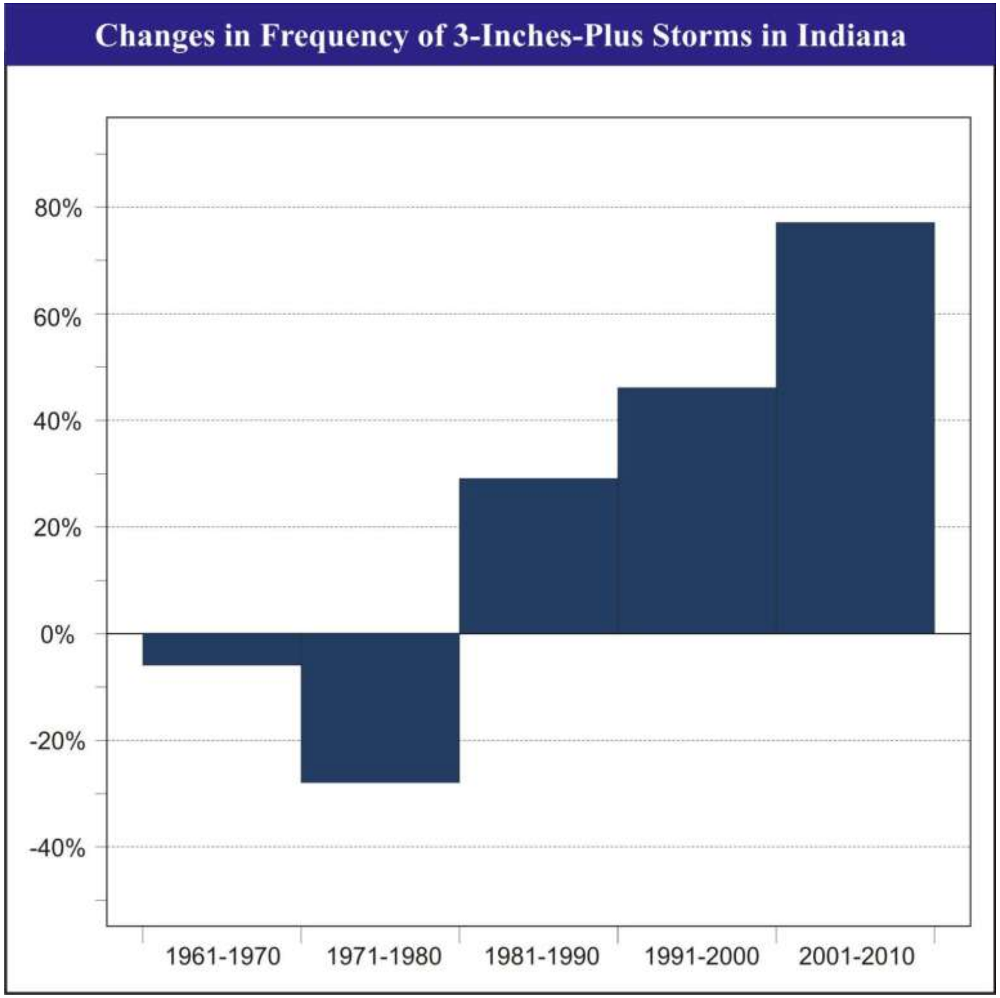


Source: www.climatewizardcustom.org

Growing Seasons Have Gotten Wetter



Heavy Precipitation Events Have Increased



Saunders et al. 2012

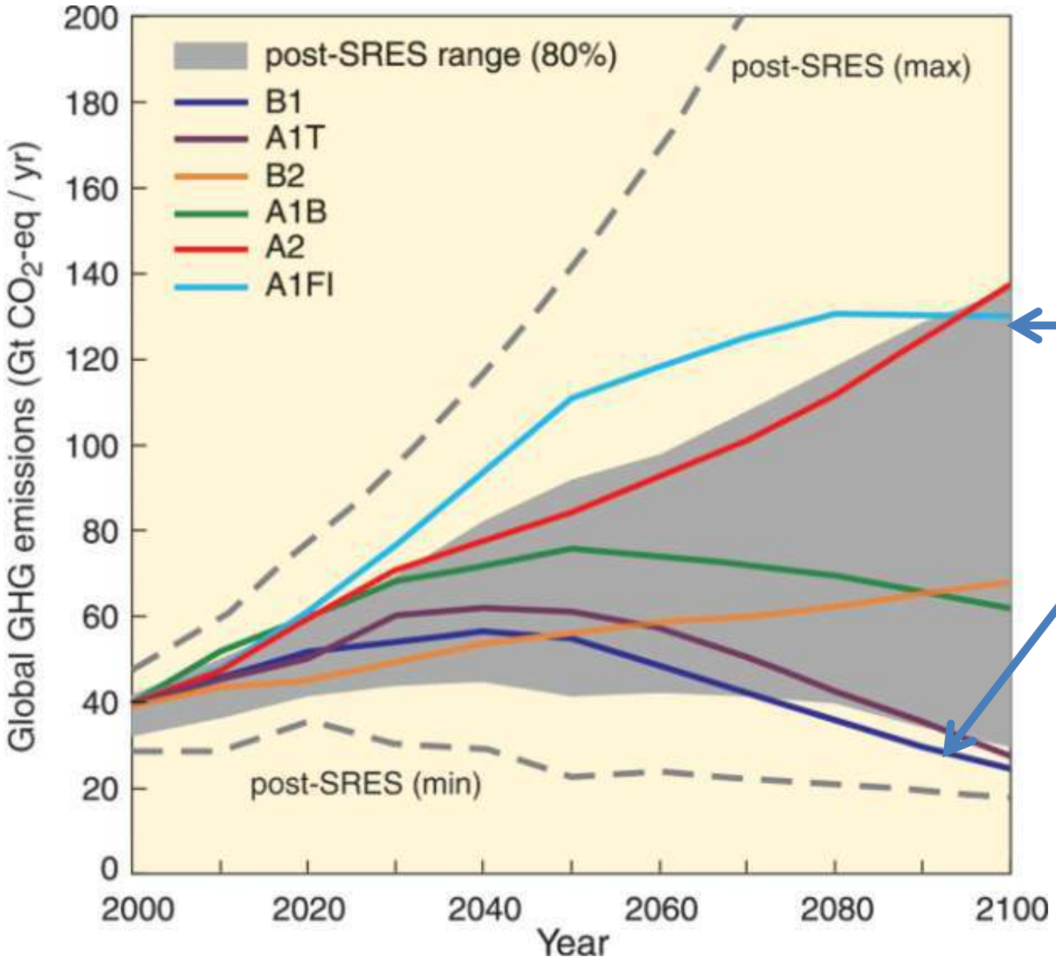
Other Observed Climate-Related Changes

- The frequency of extreme and exceptional droughts decreased between 1916 and 2007
- Earlier snowmelt and decreasing snow depth in the area
- Increase in number of days with frozen soil
- Tornado detection has increased, but severe tornadoes have decreased

Sources: Diffenbaugh et al. 2008, Dyer and Mote 2006, Kunkel et al. 2008, Mishra et al. 2010,

PROJECTED CLIMATE

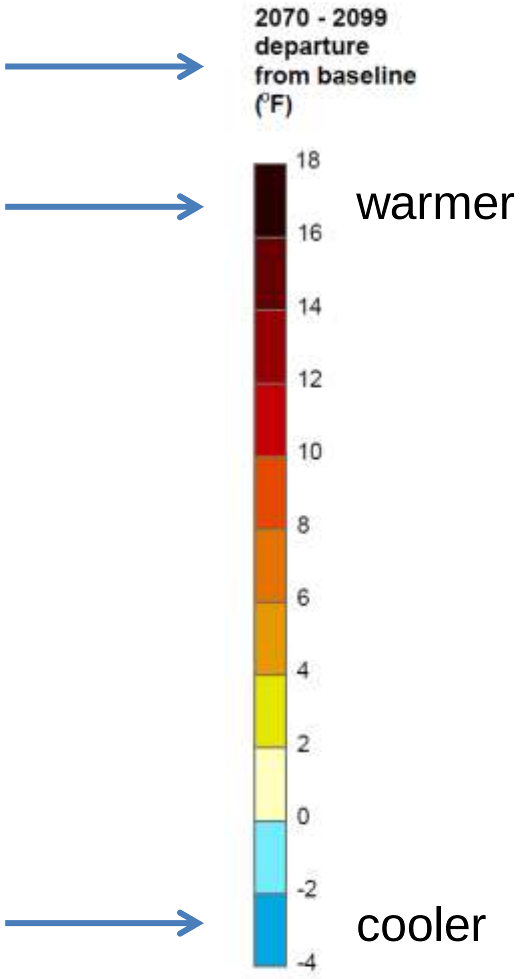
Emission Scenarios



Emission scenarios used

Source: IPCC 2007

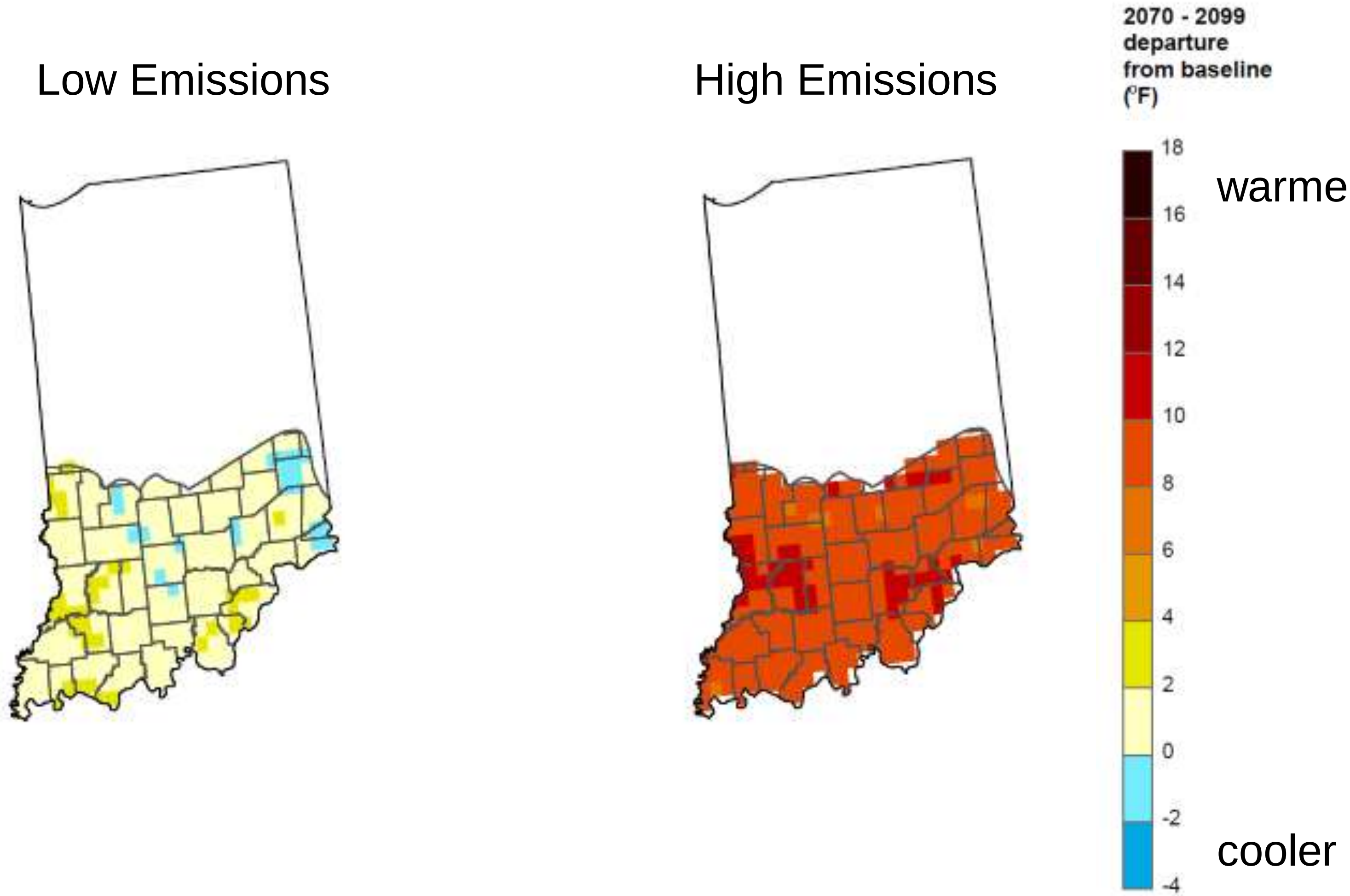

CALIFORNIA
OUTATIME
Modeling occurs…..



Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

Baseline=1971-2000

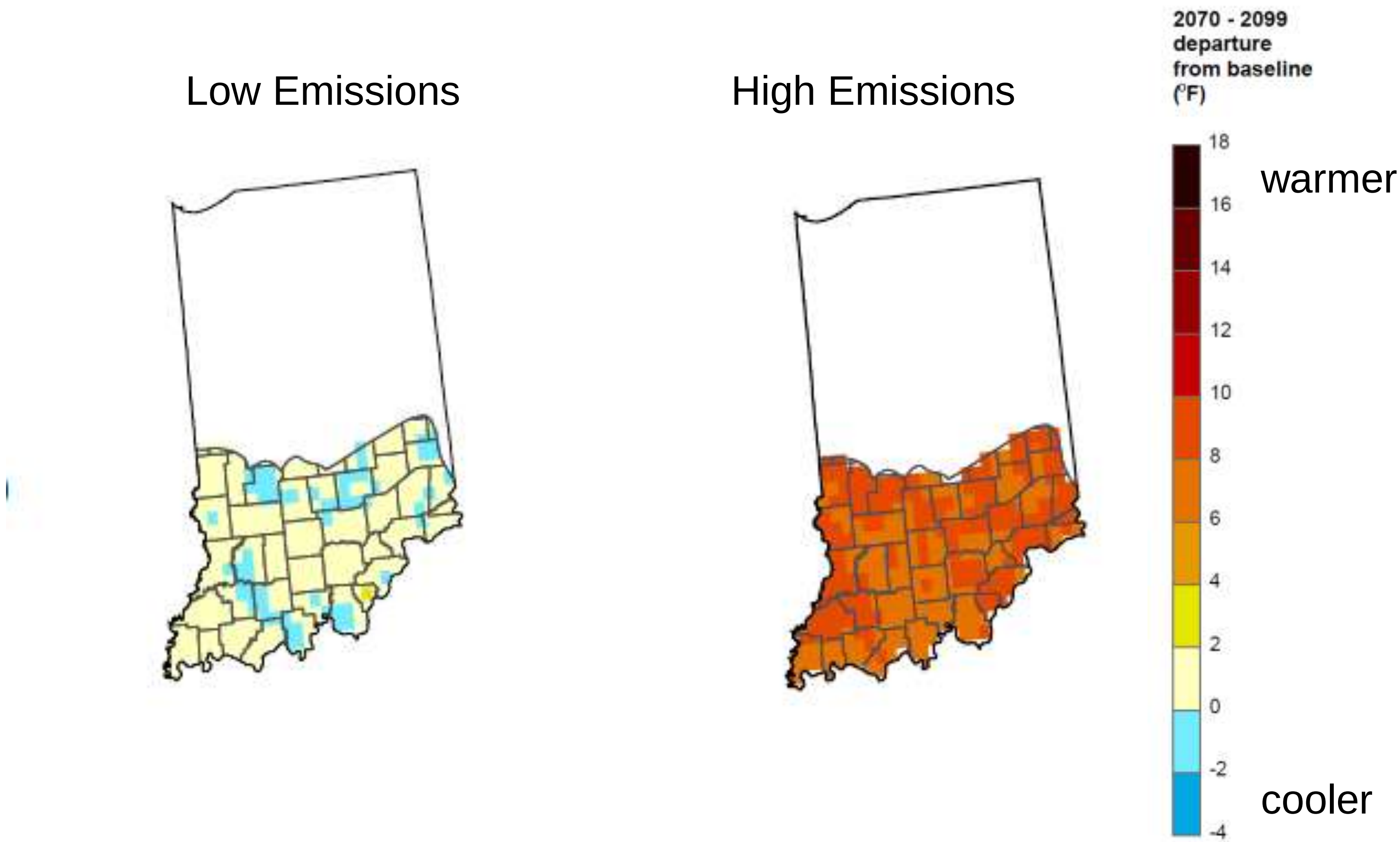
Mean Annual Temperatures Will Get Warmer



Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

Baseline=1971-2000

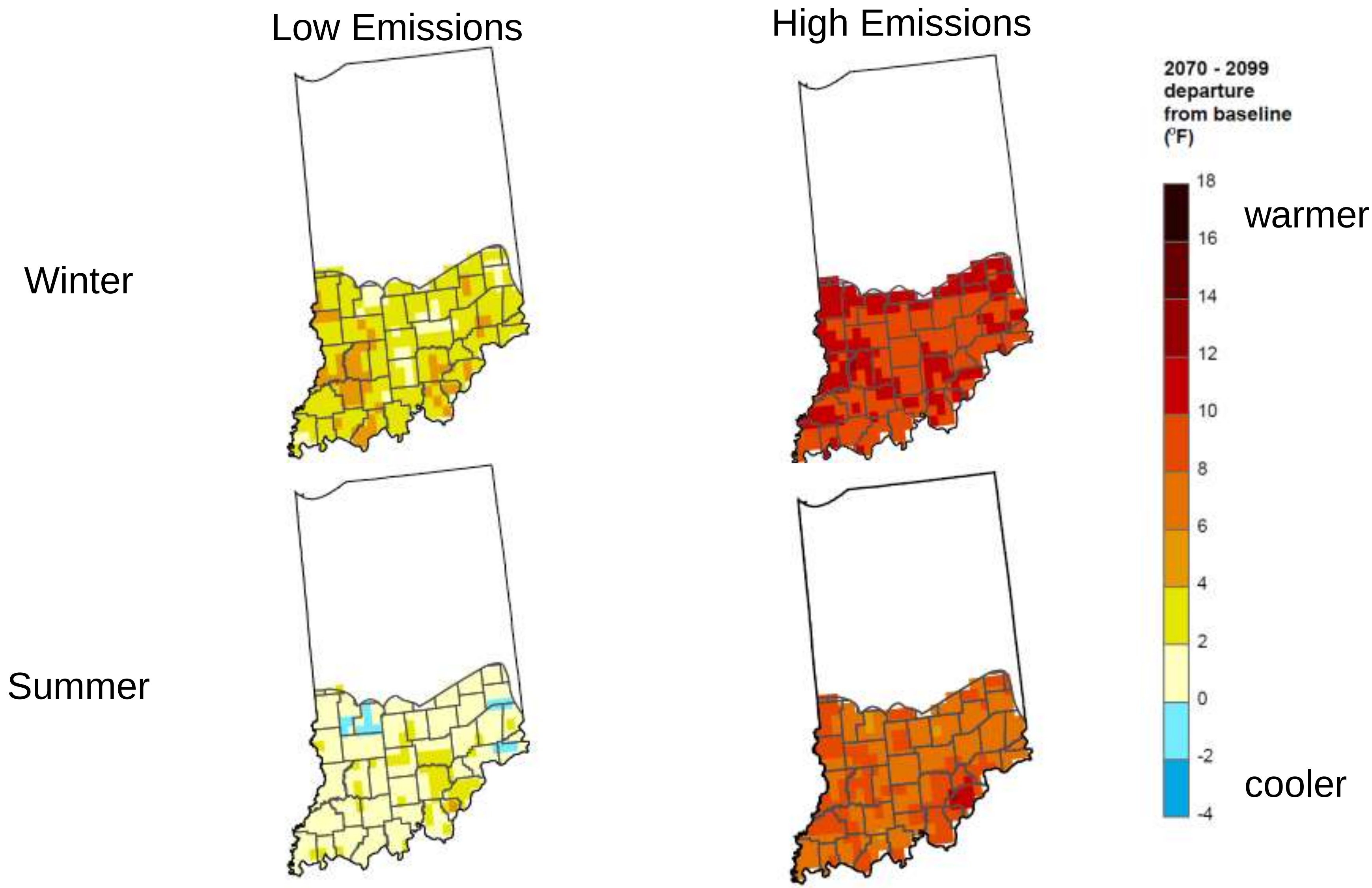
Summer Highs May Change the Least



Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

Baseline=1971-2000

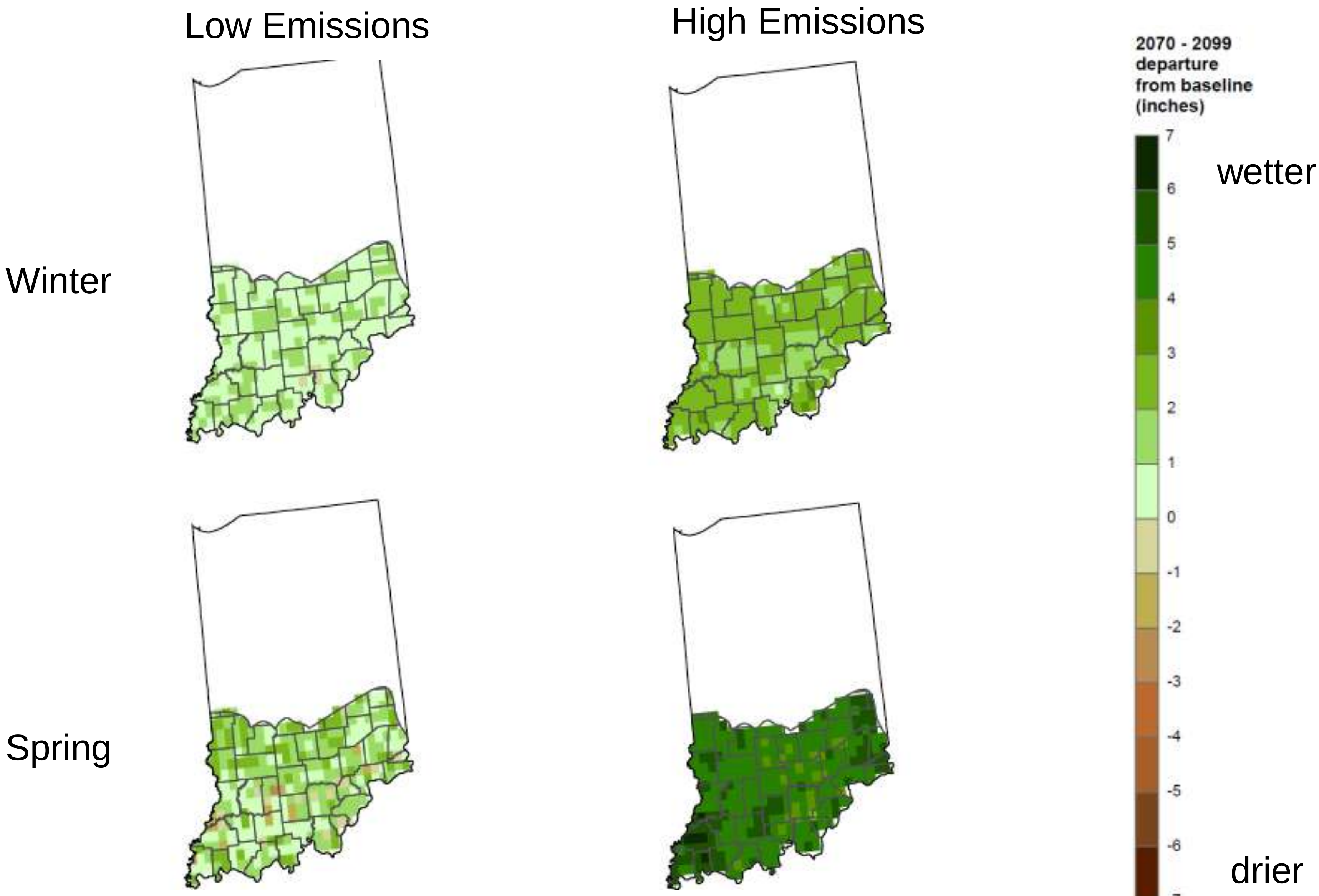
Winter Lows May Increase Most



Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

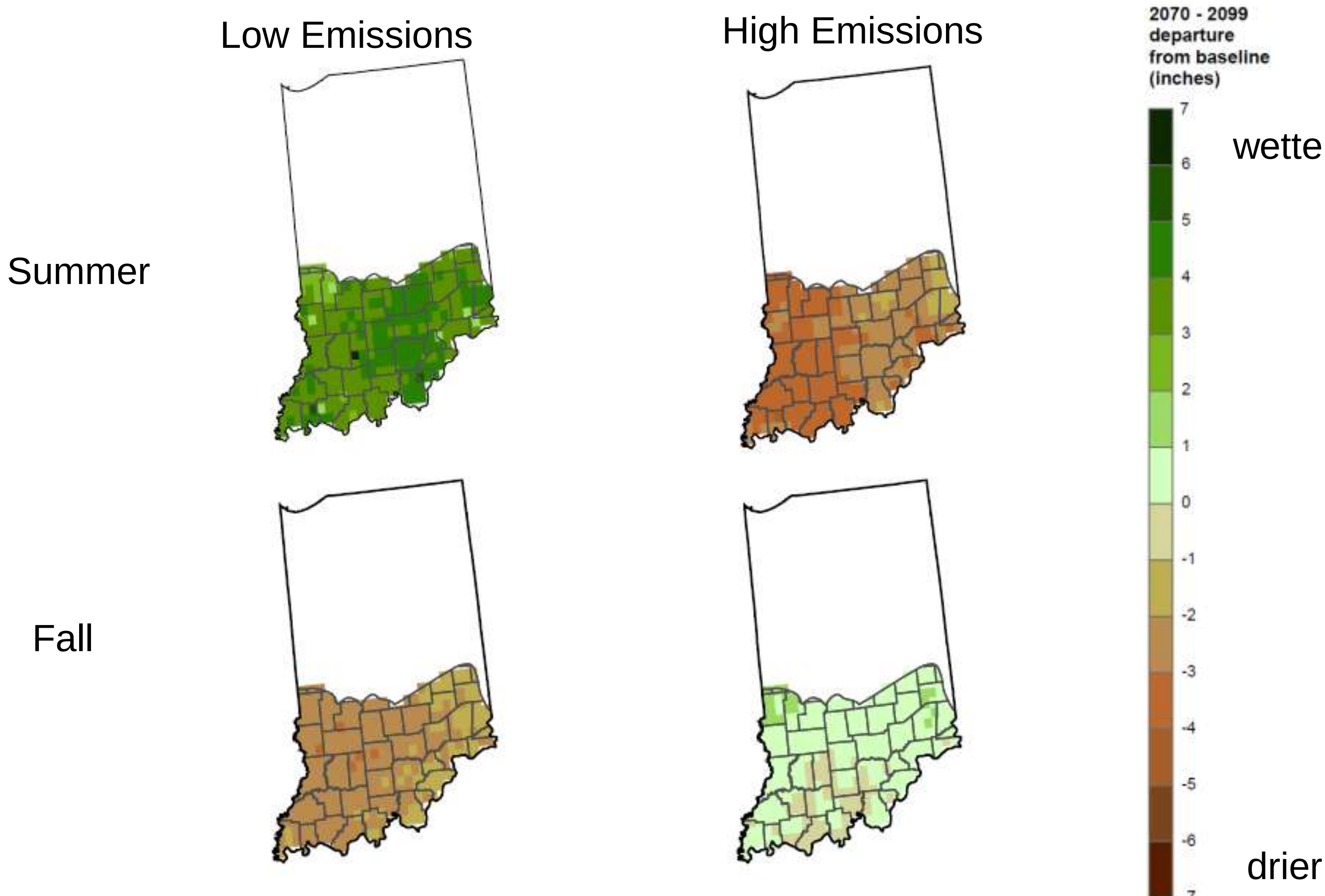
Baseline=1971-2000

Winters and Springs Will Get Wetter



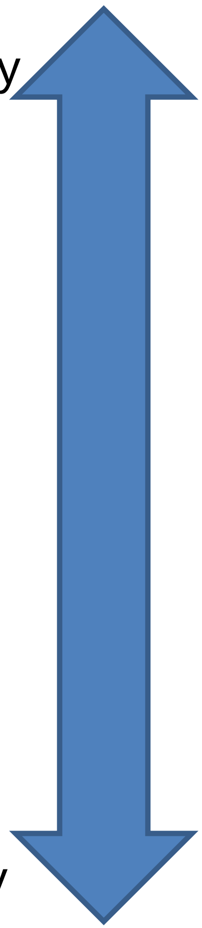
Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

Summers or Falls May Be Drier



Source: USGS Geo Data Portal: http://cida.usgs.gov/climate/

Other Projected Climate Changes



- Less snow and soil frost
- Longer growing seasons
- More heavy precipitation events
- Longer, more regional-scale droughts
- Reduction in soil moisture during summer or fall
- Increased flooding
- Earlier, more frequent tornadoes?

Sources: Cherkauer and Sinha 2010;Mishra et al. 2010; Sinha and Cherkauer 2010; IPCC 2012

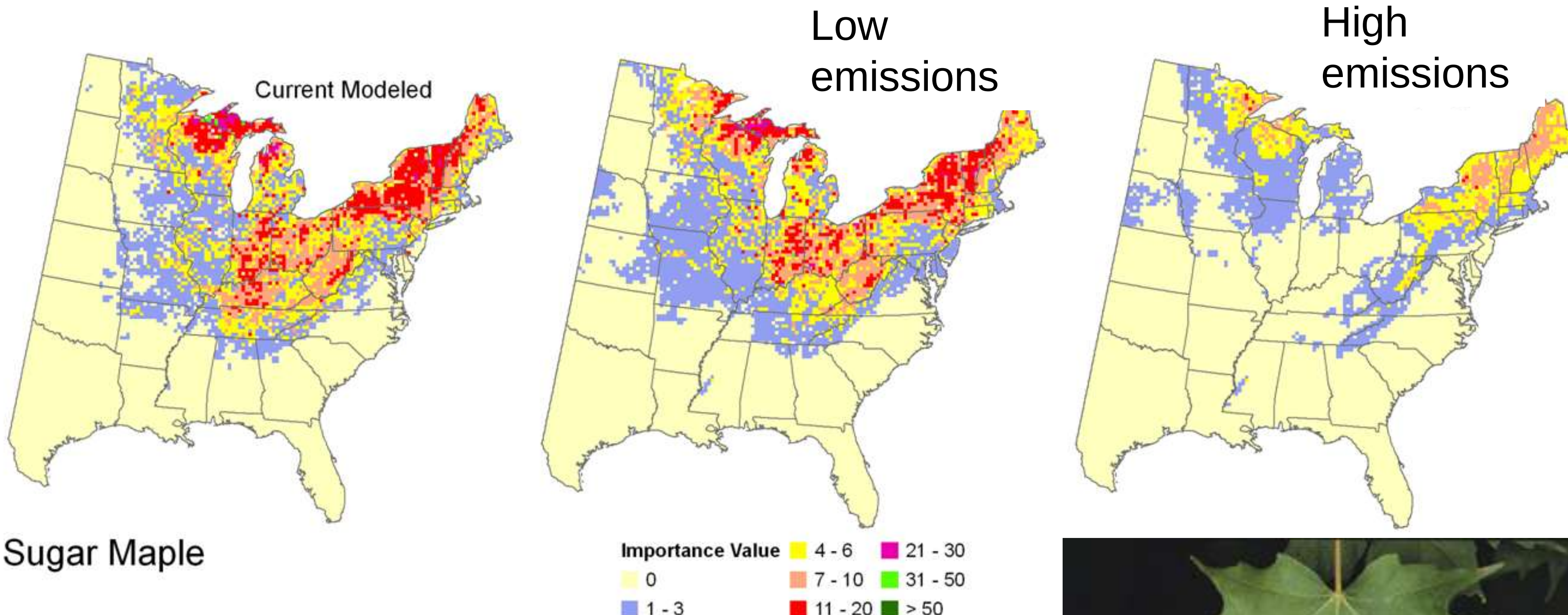
IMPACTS ON FORESTS

Current Habitat Suitability

Future Habitat Suitability (Low Emissions)

Future Habitat Suitability (High Emissions)

Decline in Sugar Maple Habitat Suitability



Source: Iverson et al., in development

Other "losers"

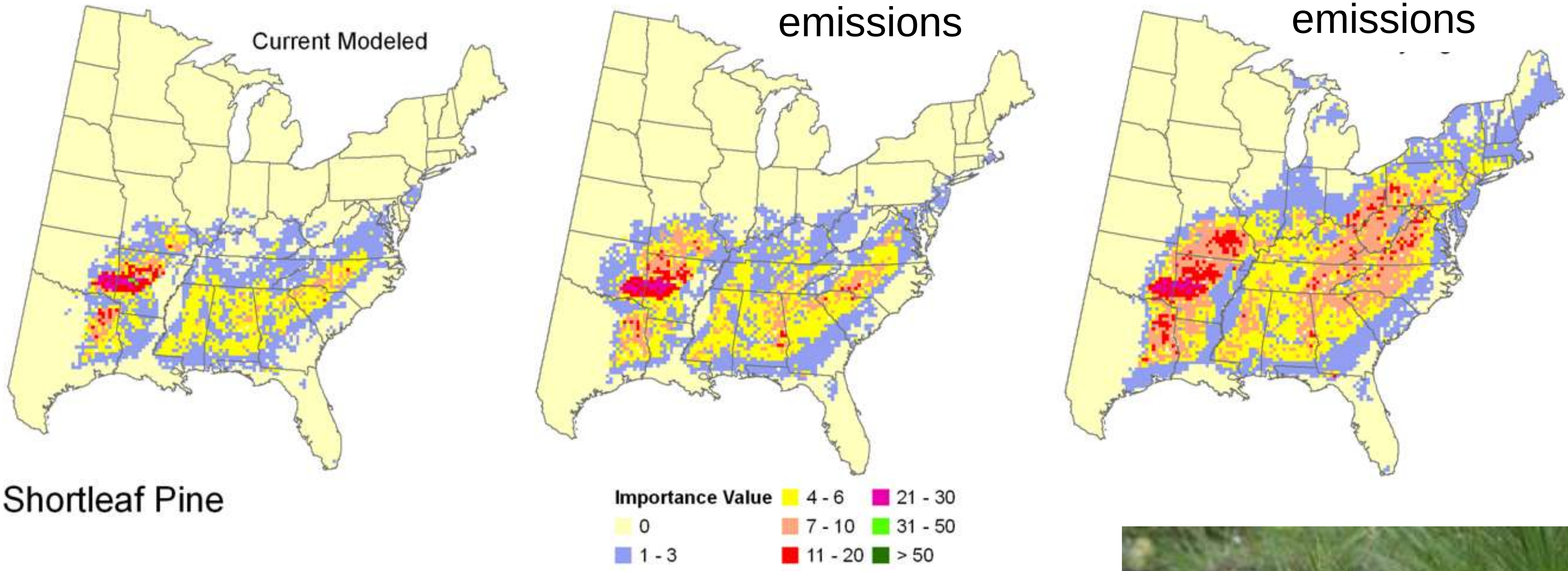
	Species
Extirpated	northern pin oak
Large decreaser	black cherry, white ash, American beech, American basswood, black locust
Large decreaser, high emissions No change, low emissions	black walnut, chinkapin oak, pin oak, sugar maple, bigtooth aspen, black willow, bur oak, eastern white pine, Ohio buckeye, pawpaw, scarlet oak, shingle oak, shingle oak
Small decreaser	American elm, hackberry, northern red oak, pignut hickory, hackberry, northern red oak, pignut hickory, red maple, sassafras, slippery elm, sycamore, white oak, yellow poplar, eastern redbud, shagbark hickory, silver maple, chestnut oak

Source: Iverson et al., in development

Increase in Shortleaf Pine Habitat Suitability

Low emissions

High emissions



Source: Iverson et al., in development

Other "winners"

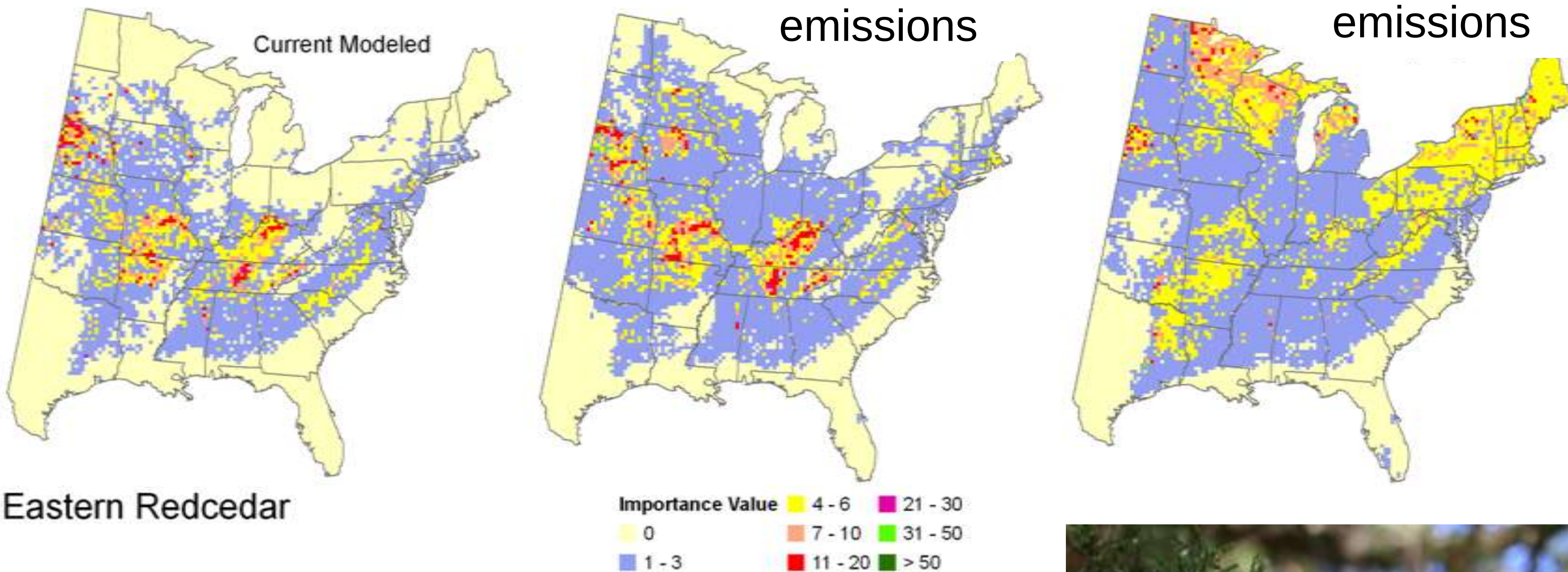
	Species
Small Increaser	blackgum, common persimmon, green ash, osage-orange, northern catalpa, overcup oak, red mulberry, river birch
Large Increaser	sweetgum, black hickory, blackjack oak, loblolly pine, post oak, shortleaf pine, southern red oak, sugarberry, willow oak, winged elm, baldcypress, cherrybark oak, pecan, Shumard oak
New migrants	longleaf pine, cedar elm, water oak, slash pine

Source: Iverson et al., in development

Habitat May Remain Suitable for Eastern Redcedar

Low emissions

High emissions



Source: Iverson et al., in development

Other “non-changers”

	Species
Non-Changer	American Hornbeam/musclewood, bitternut hickory, black oak, boxelder, eastern hophornbeam , eastern redcedar , flowering dogwood, honeylocust , mockernut hickory , Virginia pine, wild plum, blue ash, eastern cottonwood, Kentucky coffeetree, rock elm, shellbark hickory, swamp tupelo, yellow birch

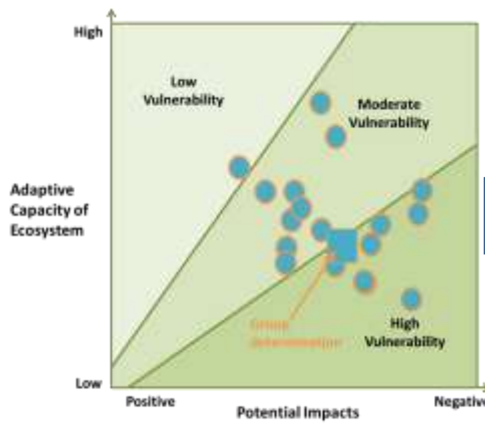
Source: Iverson et al., in development

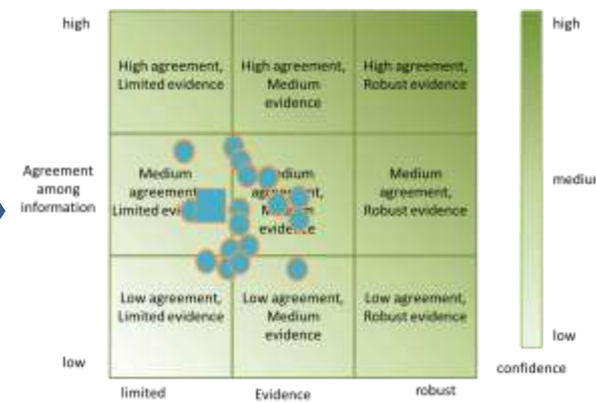
Other Forest Impacts

- Increased probability of wildfire by end of century
- Greater susceptibility to non-native species invasions
- More pest and disease outbreaks
- Carbon dioxide fertilization

Sources: Moritz et al. 2012, Dukes et al. 2009, Lenihan et al. 2008

Assessing Vulnerability





Panel of experts evaluate information

Vulnerability determined based on impacts and adaptive capacity

Level of Confidence Determined


MESIC UPLAND FORESTS

Mesic Upland Forests

Vulnerability: High

Mesic Upland Forests

Major Drivers:

- cooler temperatures
- mesic moisture regime
- absence of fire

Mesic Upland Forests

Climate Change Impacts on Major Drivers:

- Temperatures will increase
- Precipitation/soil moisture declines at end of growing season
- Increased wildfire risk

Mesic Upland Forests

Dominant Species:

- sugar maple, beech, basswood, white ash, black cherry, northern red oak, yellow poplar, red maple, bitternut hickory, white oak

Mesic Upland Forests

Climate Change Impacts on Dominant Species:

- “Winners”: (none)
- “Non-changers”: bitternut hickory; white oak; yellow poplar; red maple
- “Losers”: sugar maple; beech; basswood; white ash; black cherry; northern red oak

Mesic Upland Forests

Major stressors:

- deer overbrowsing
- emerald ash borer
- non-native species invasion

Mesic Upland Forests

Climate Change Impacts on Major Stressors:

- Potential increase in EAB spread with longer growing season

Mesic Upland Forests

Adaptive Capacity:

- Not resilient to drought, fire
- Few places on the landscape to serve as refugia


BARRENS

Barrens

Vulnerability: Low

Barrens

Major Drivers:

- frequent low-intensity fires
- shallow, excessively well-drained soils

Barrens

Climate Change Impacts on Major Drivers:

- Potential increase in fire frequency
- Decreased precipitation/soil moisture during summer months

Barrens

Dominant Species:

- blackjack, post oak; black hickory; chestnut oak, red cedar; white oak; bur oak; shagbark hickory; black, chinkapin oak

Barrens

Dominant Species:

- "Winners": shortleaf pine, blackjack, post oak; black hickory
- "Non-changers": chestnut oak, red cedar; white oak; black oak
- "Losers": bur oak; shagbark hickory; chinkapin oak

Barrens

Major Stressors:

- fire exclusion
- non-native and woody species invasion
- fragmentation

Barrens

Climate Change Impacts on Major Stressors:

- An increase in wildfire could reduce woody species invasion; non-woody species could increase

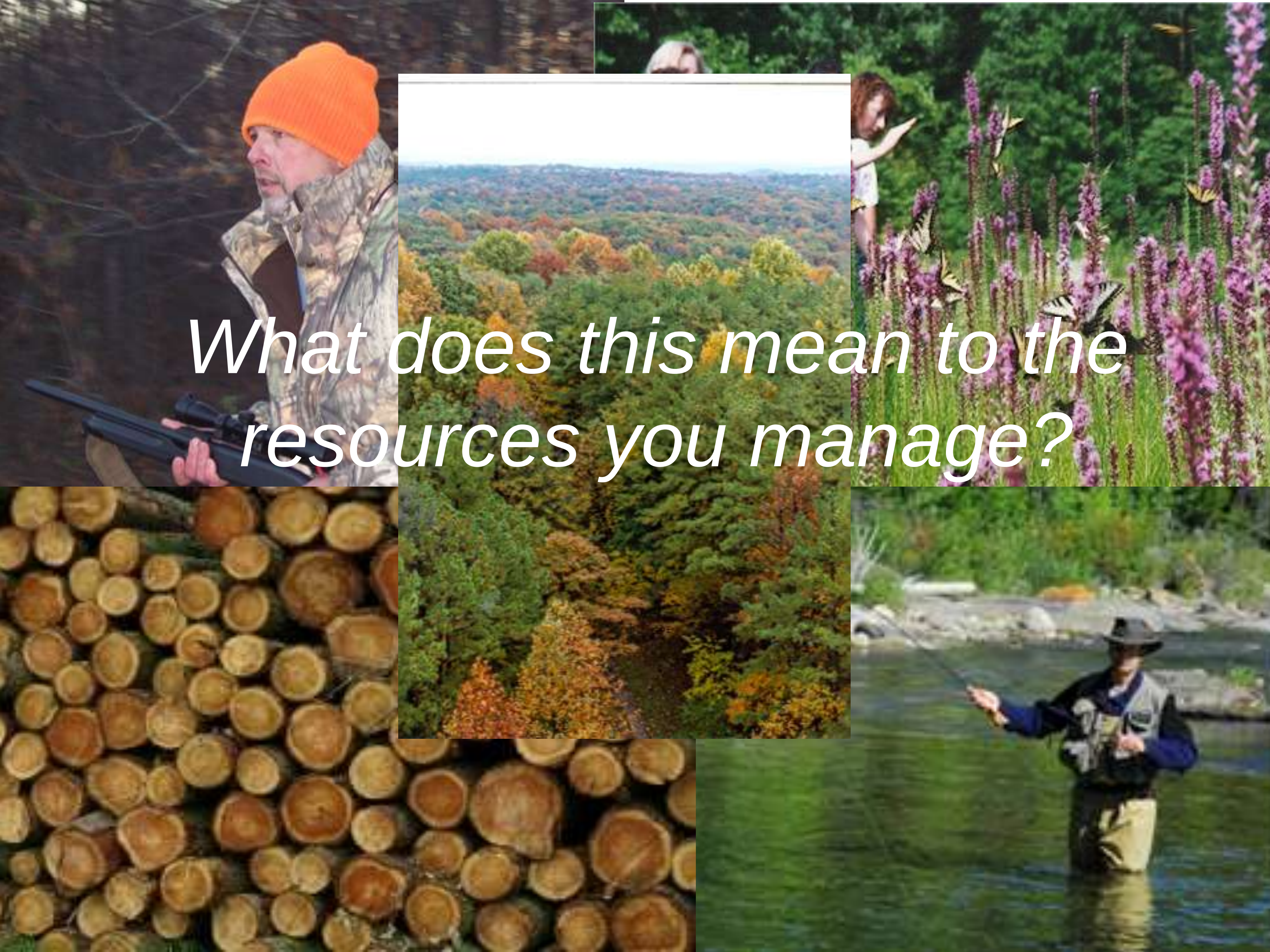
Barrens

Adaptive Capacity:

- Success depends on whether systems are managed with prescribed fire
- Systems could potentially expand if open woodlands convert to this type

Other Communities Assessed

Community Type	Potential Impacts	Adaptive Capacity	Vulnerability	Confidence
Barrens	Moderate	High	Low	Medium-high agreement; Medium evidence
Closed Woodland	Positive	High	Low	Medium agreement; Limited evidence
Open Woodland	Positive	High	Low	Medium agreement: Medium to Limited evidence
Dry-Mesic Upland Forest	Moderate	High	Low-Moderate	Medium to high agreement; Medium evidence
Flatwoods	Slightly Positive	Moderate	Low-Moderate	Medium agreement.; Limited to medium evidence
Glade	Slightly Positive	Moderate	Low-Moderate	Medium to high agreement; Medium evidence
Mesic Bottomland Forest	Moderate	Moderate	Moderate	Medium agreement; Medium to limited evidence
Wet Bottomland Forest	Slightly Negative	Moderate	Moderate- High	Medium agreement; Medium to limited evidence
Mesic Upland Forest	Negative	Low	High	Medium-high agreement; medium evidence



What does this mean to the resources you manage?


Visit: www.climateframework.org
Contact: lbrandt@fs.fed.us
Bibliography available on request