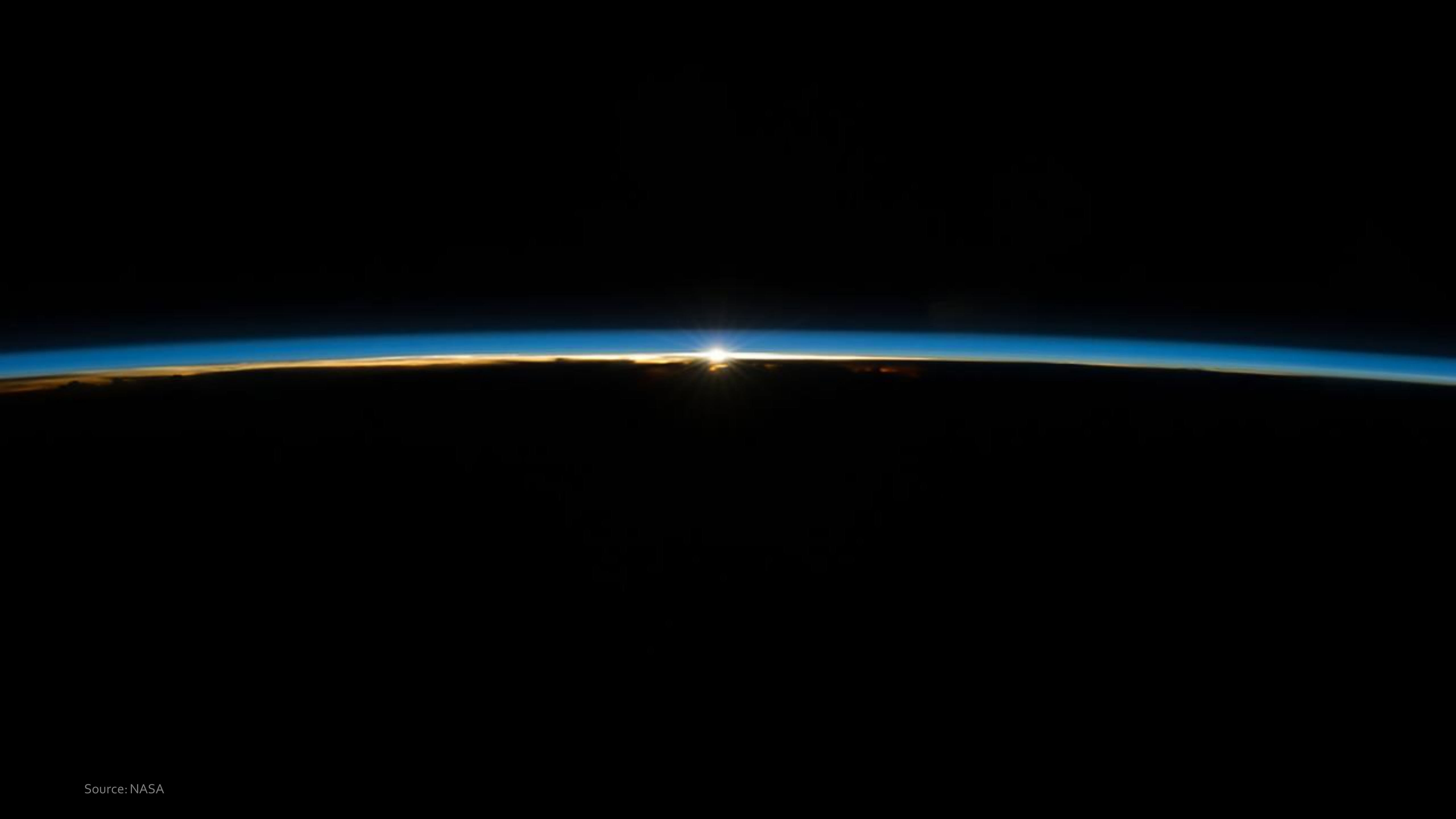
Wait, What? Ecological Services can impact my MS4?

B. Scott Southall, CDP
Dan Stever, Klausing Group

Source: NASA



Source: NASA

Ecological (Ecosystems) Services:

Why ecological services

What are ecological services

Where to identify the resources

How to place a value on the benefits

When

Ecological (Ecosystems) Services:

Why ecological services

What are ecological services

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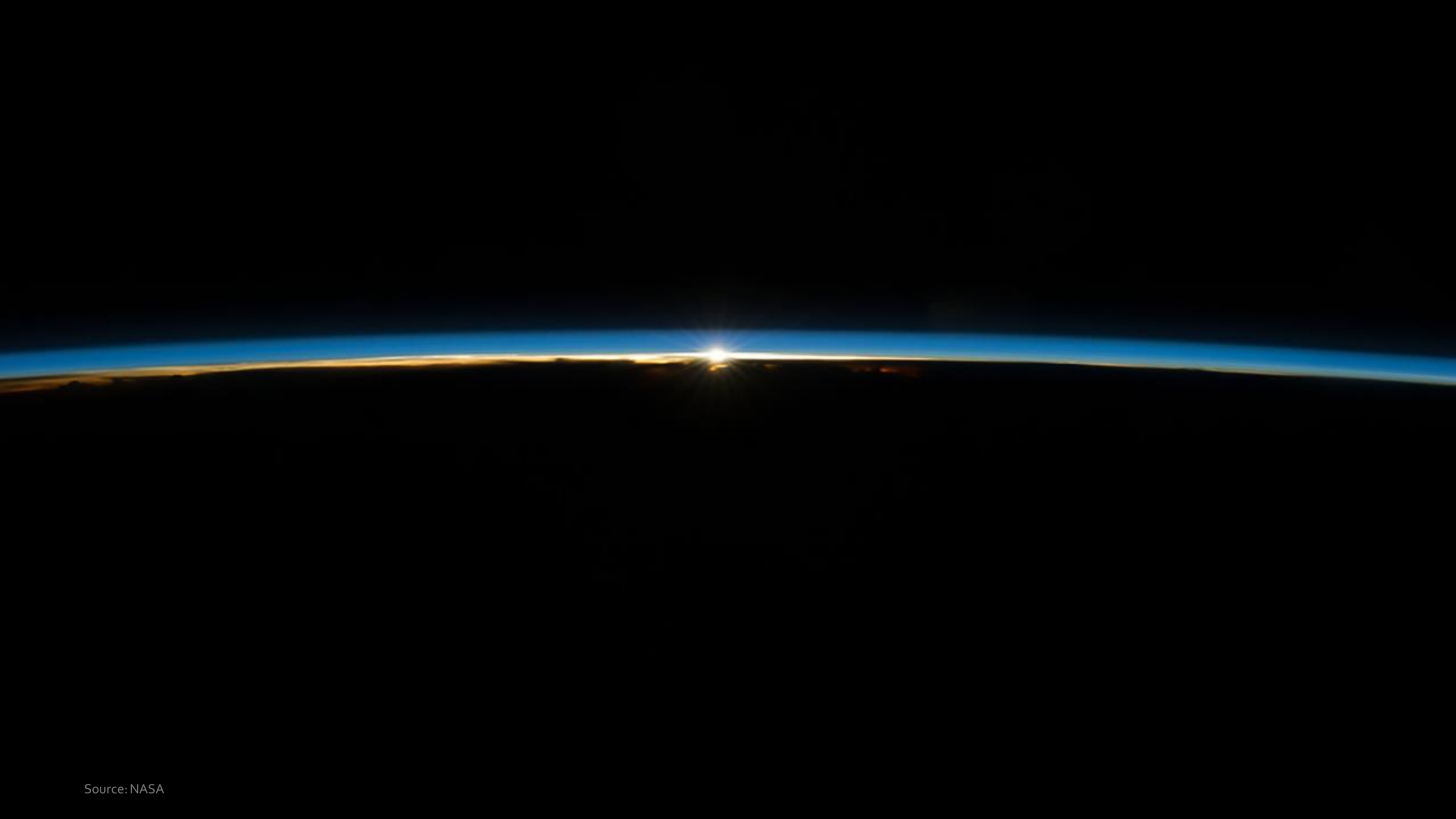
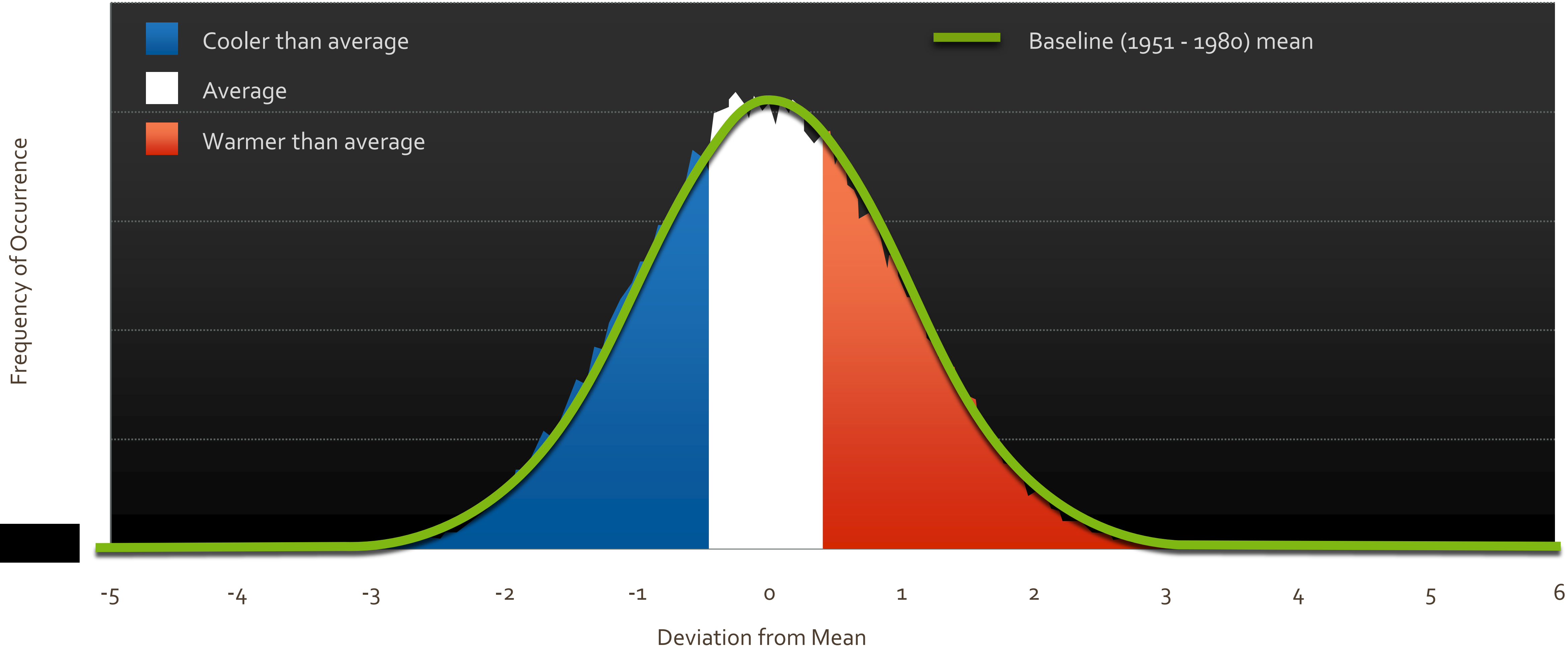


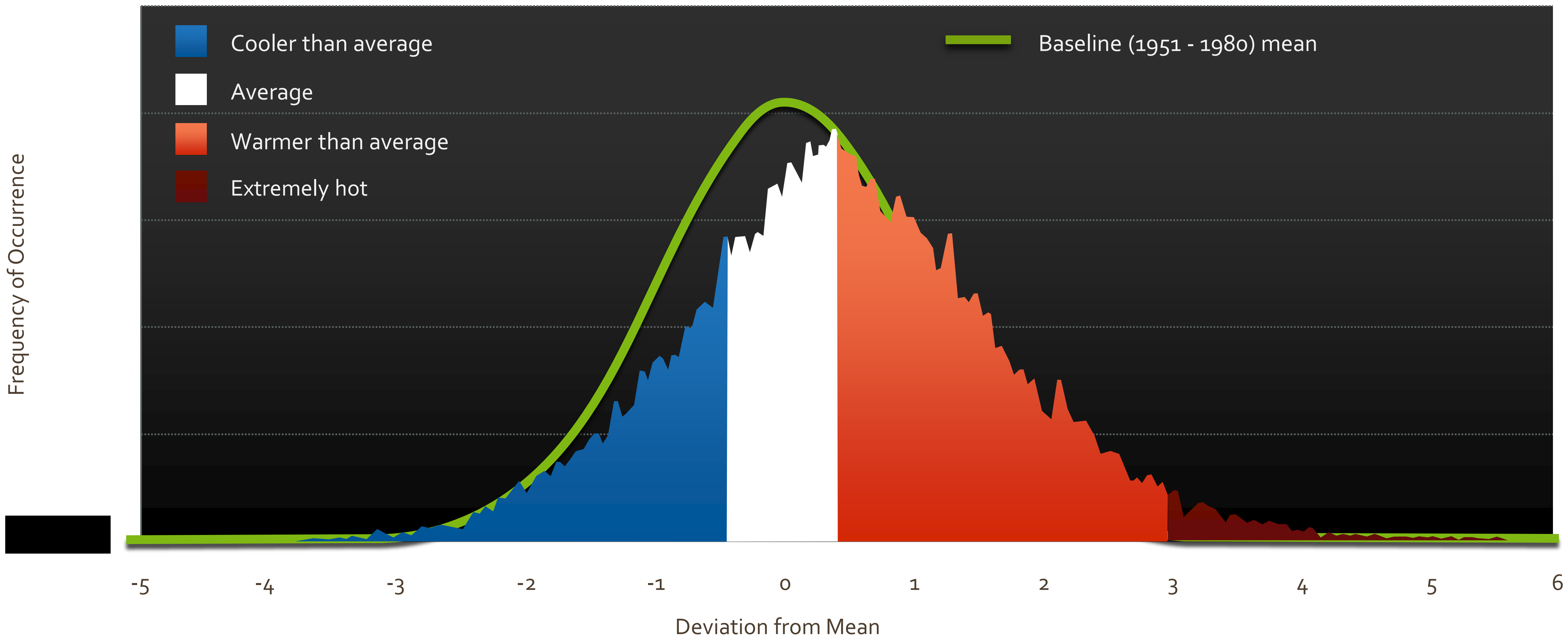
Source: NASA

Summer Temperatures Have Shifted

- 1951 – 1980

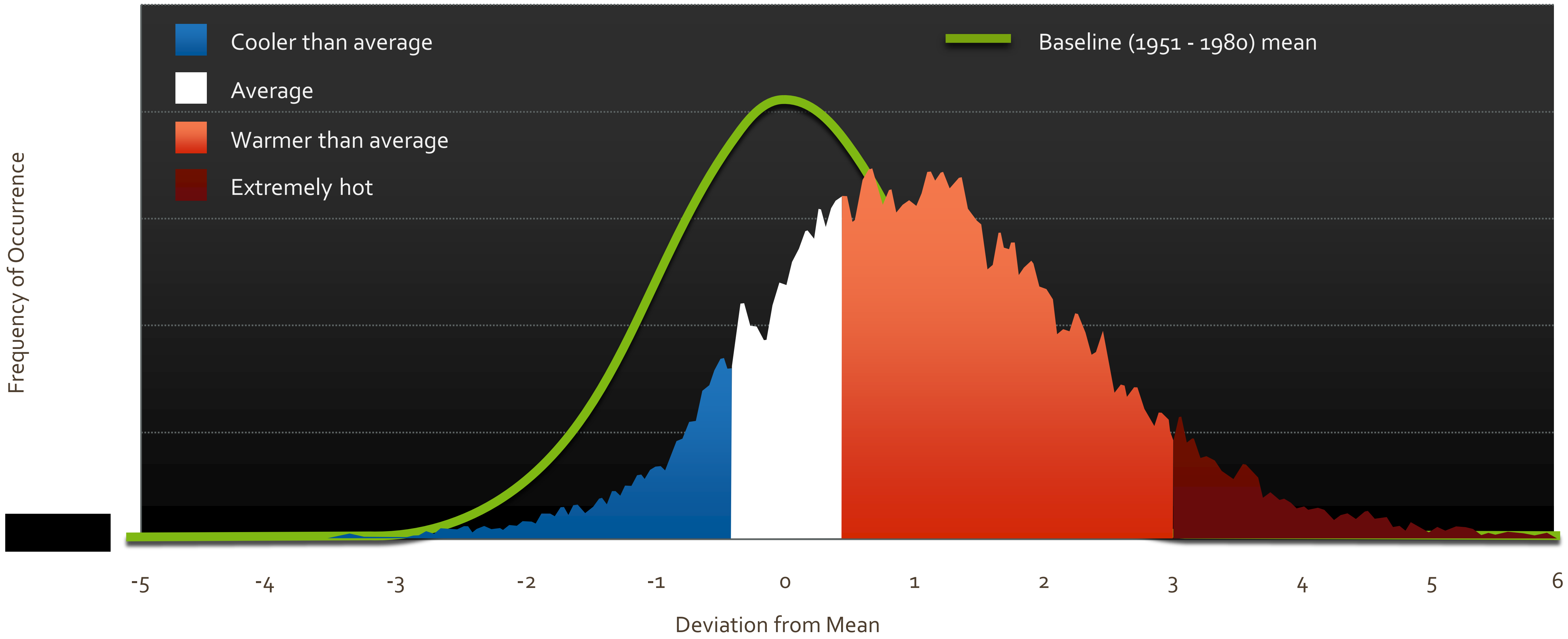


• 1983 – 1993

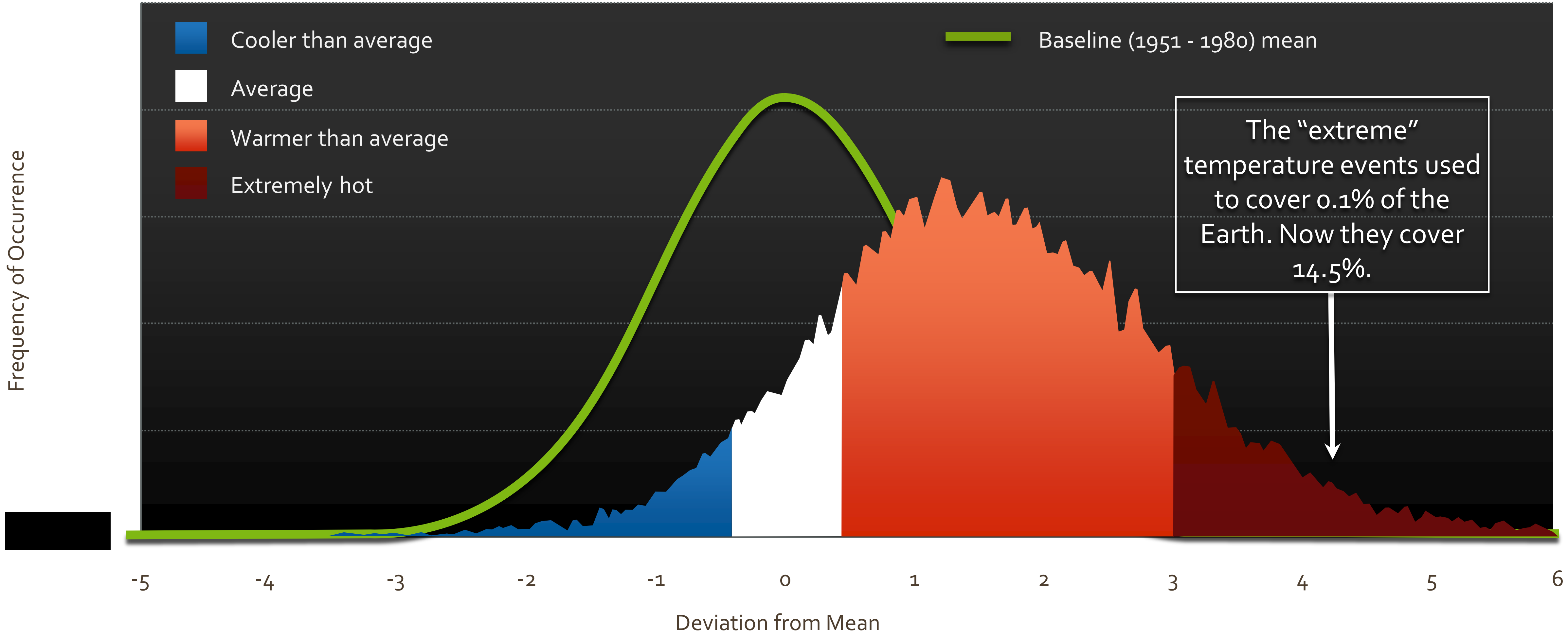


Cooler than average
Average
Warmer than average
Extremely hot
Baseline (1951 - 1980) mean
Frequency of Occurrence
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Deviation from Mean

• 1994 – 2004

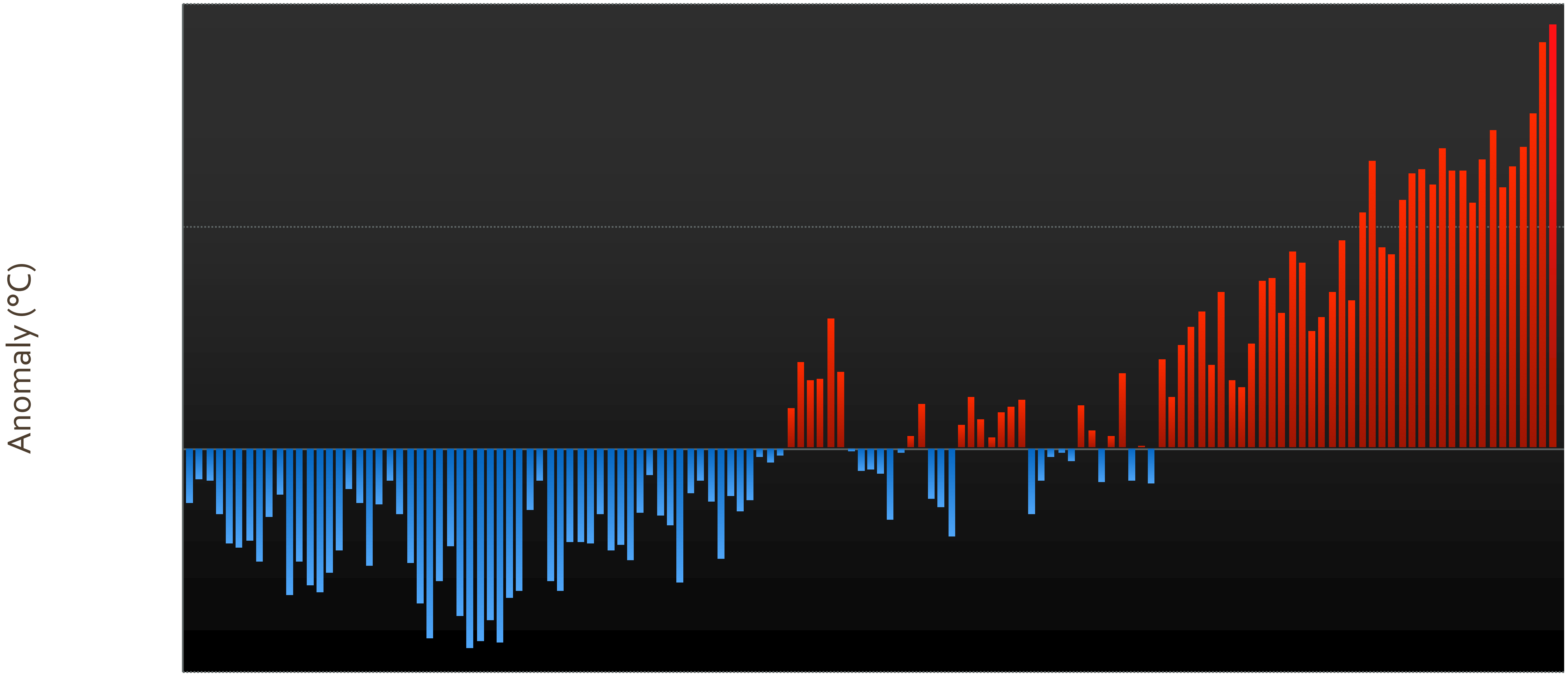

Cooler than average
Average
Warmer than average
Extremely hot
Baseline (1951 - 1980) mean
Frequency of Occurrence
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Deviation from Mean

- 2005 – 2015

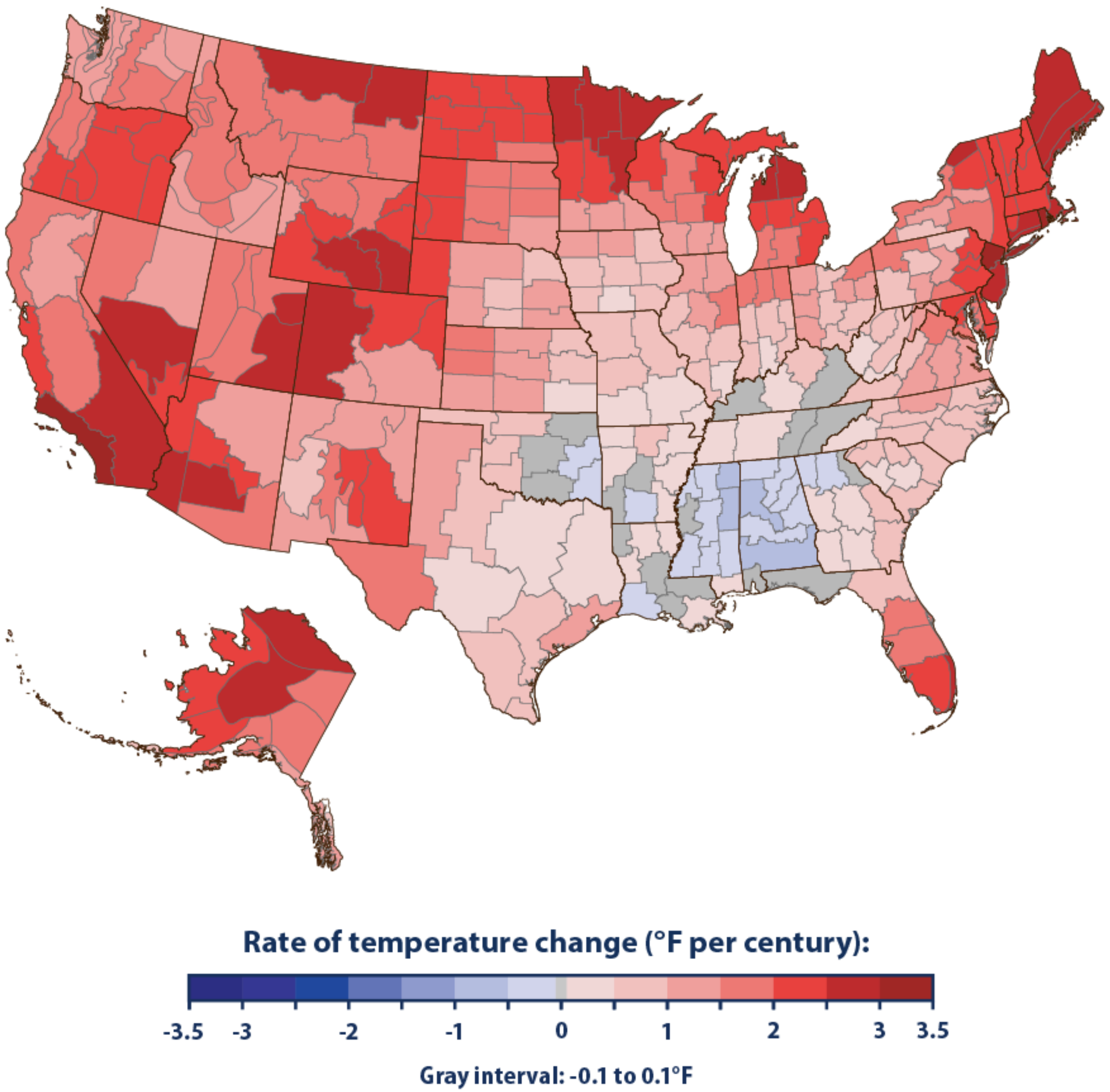

Cooler than average
Average
Warmer than average
Extremely hot
Baseline (1951 - 1980) mean
The "extreme" temperature events used to cover 0.1% of the Earth. Now they cover 14.5%.
Frequency of Occurrence
-5
-4
-3
-2
-1
0
1
2
3
4
5
6
Deviation from Mean

Global Surface Temperature – Departure from Average

- 1880 – 2016



Rate of Temperature Change in the United States, 1901–2015

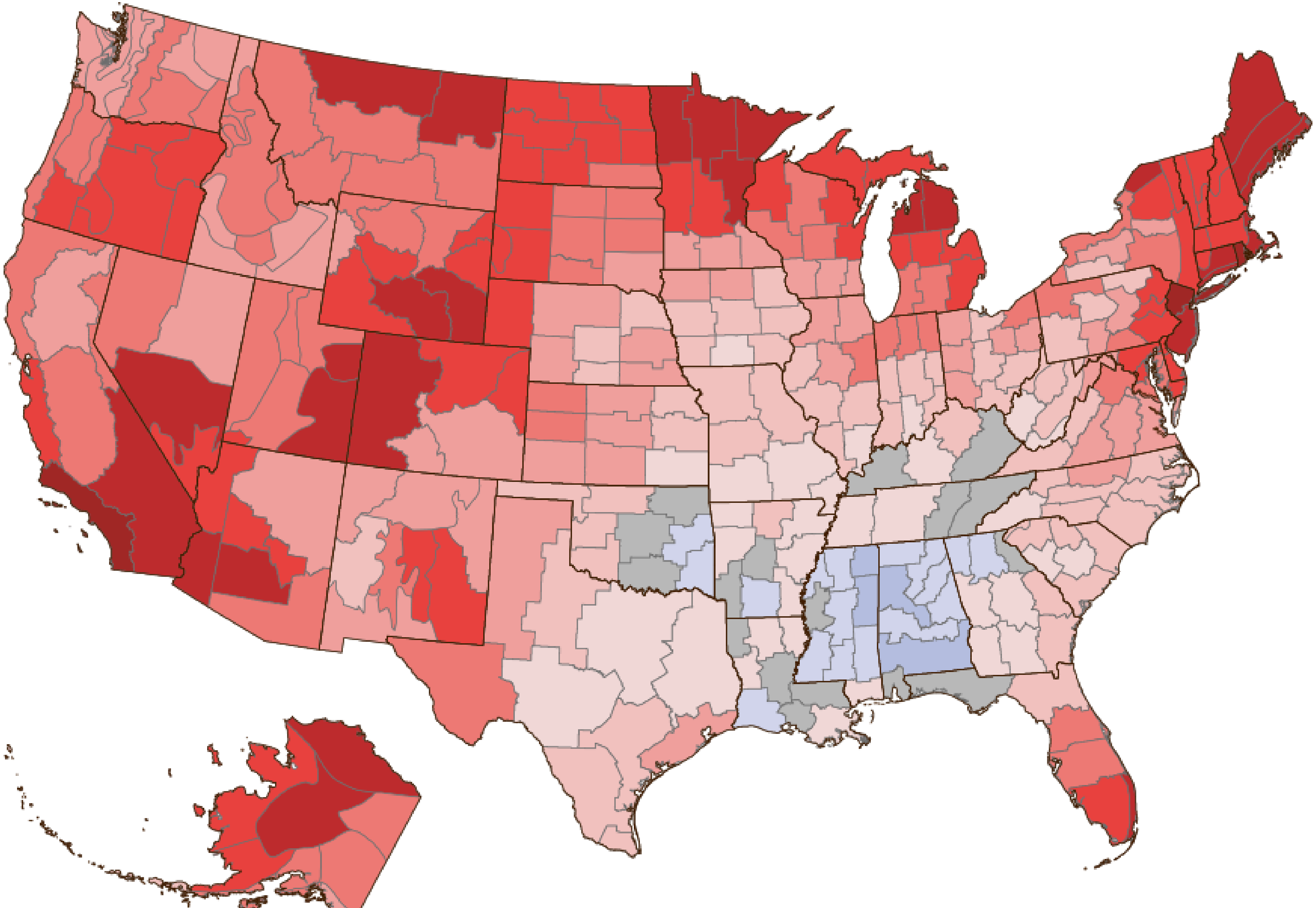


*Alaska data start in 1925.

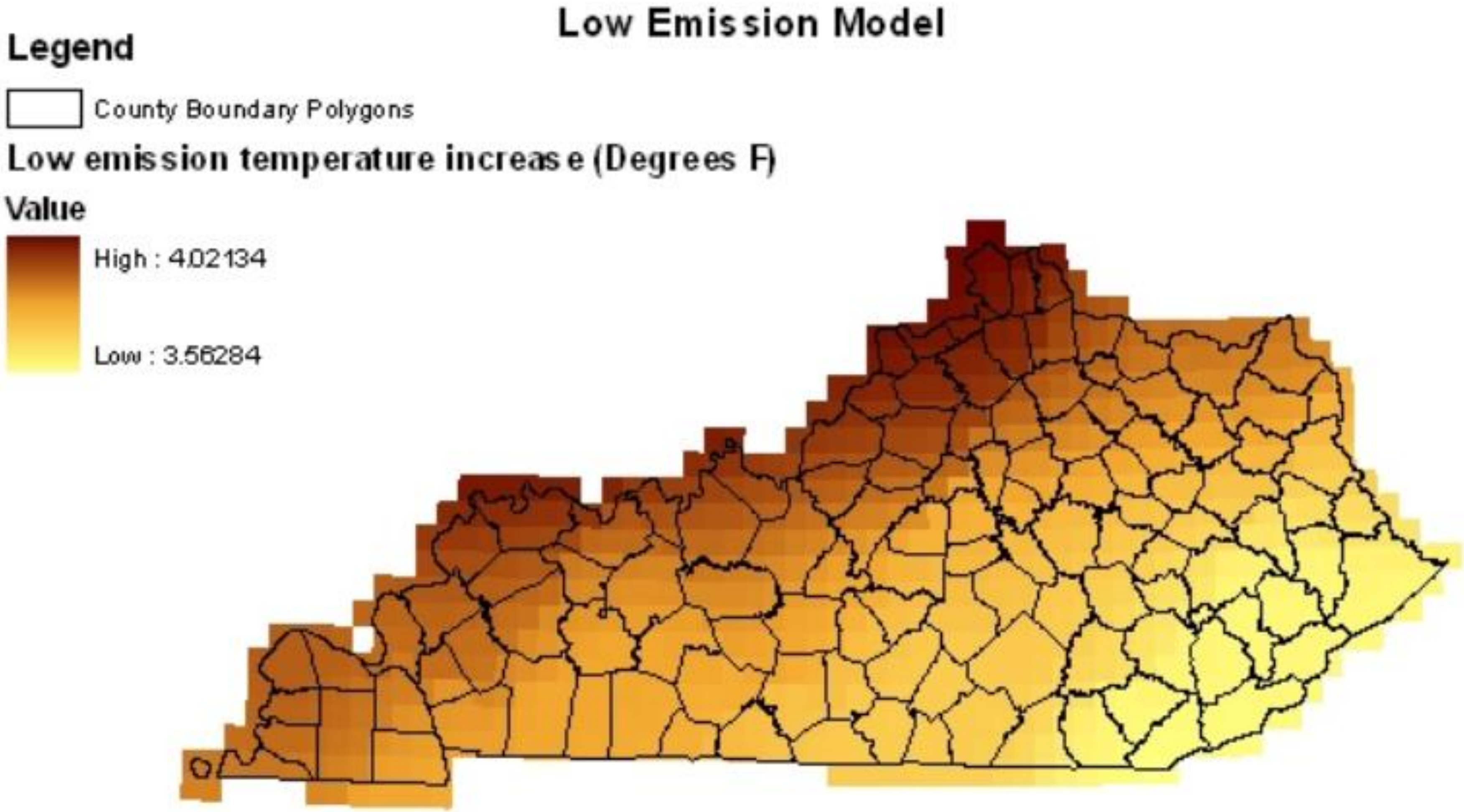
Data source: NOAA (National Oceanic and Atmospheric Administration). 2016. National Centers for Environmental Information. Accessed February 2016. www.ncei.noaa.gov.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Rate of Temperature Change in the United States, 1901–2015

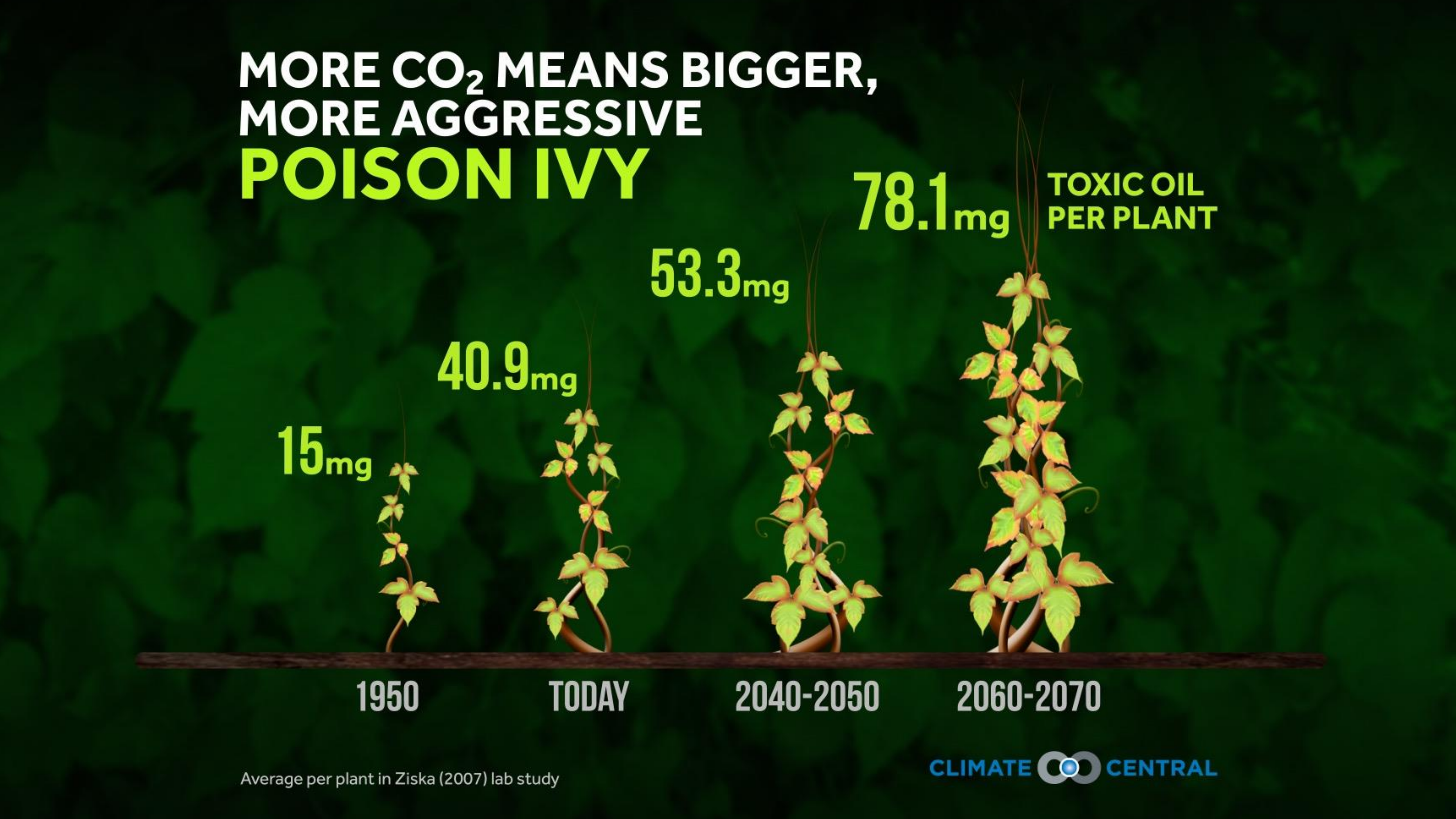


Figre 3. Predicted Average Temperature Increase for Kentucky through 2050 (Degrees F)



CDC – National Health Statistics Report 2014

1 degree F associated with statistically significant increases in mortality rates during high temp events


MORE CO_2 MEANS BIGGER, MORE AGGRESSIVE
POISON IVY
15mg
40.9mg
53.3mg
78.1mg
TOXIC OIL PER PLANT
1950
TODAY
2040-2050
2060-2070
Average per plant in Ziska (2007) lab study
CLIMATE CENTRAL


PADUCAH
MOSQUITO SEASON GROWING
THEN
117
DAYS
On average per year
1980-1989
NOW
139
DAYS
On average per year
since 2006
Source: Yamana and Eltahir (2013), NCBI, National Institutes of Health, Daymet Data, Oak Ridge National Laboratory
CLIMATE CENTRAL

With each additional 1° (C) of temperature, the atmosphere's capacity to hold water vapor increases by 7%

Warmer air can hold more water vapor

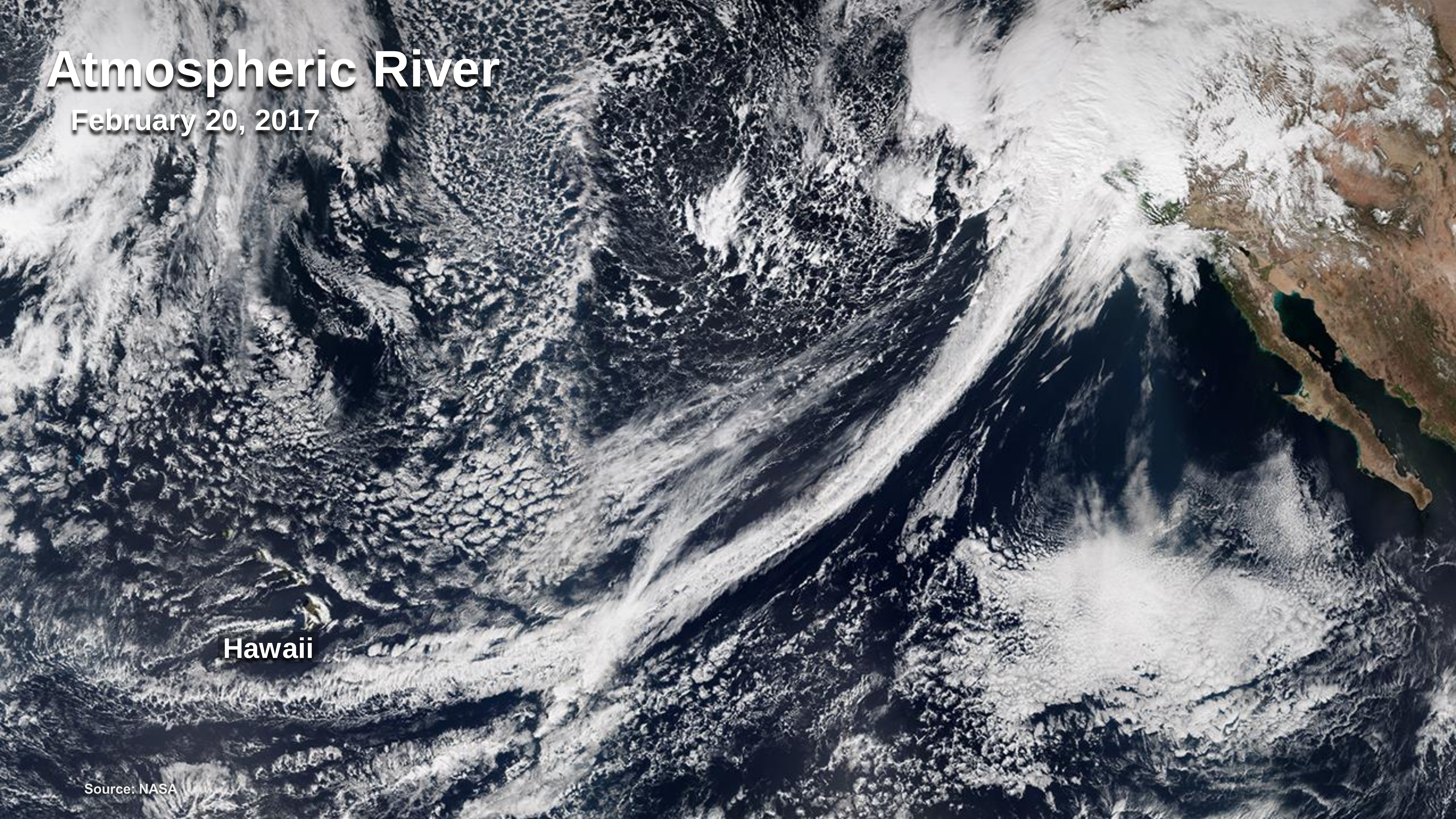
There is already 4% more water vapor over the oceans than there was only 30 years ago

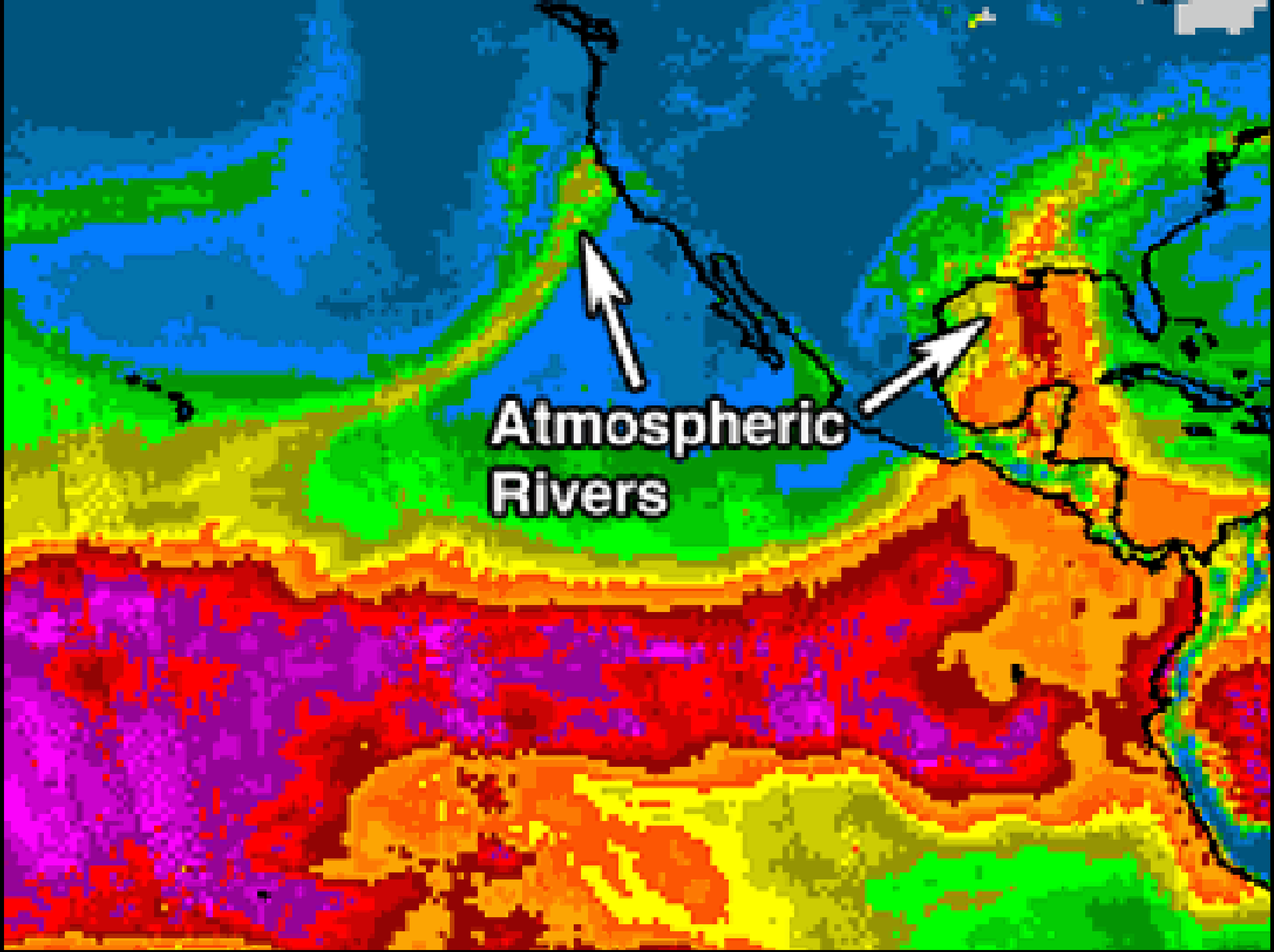
Source: K. Trenberth, "Changes in Precipitation with Climate Change," *Climate Research,* March 2011

**There have been seven
1,000-year flood events in the U.S.
since May of 2010**

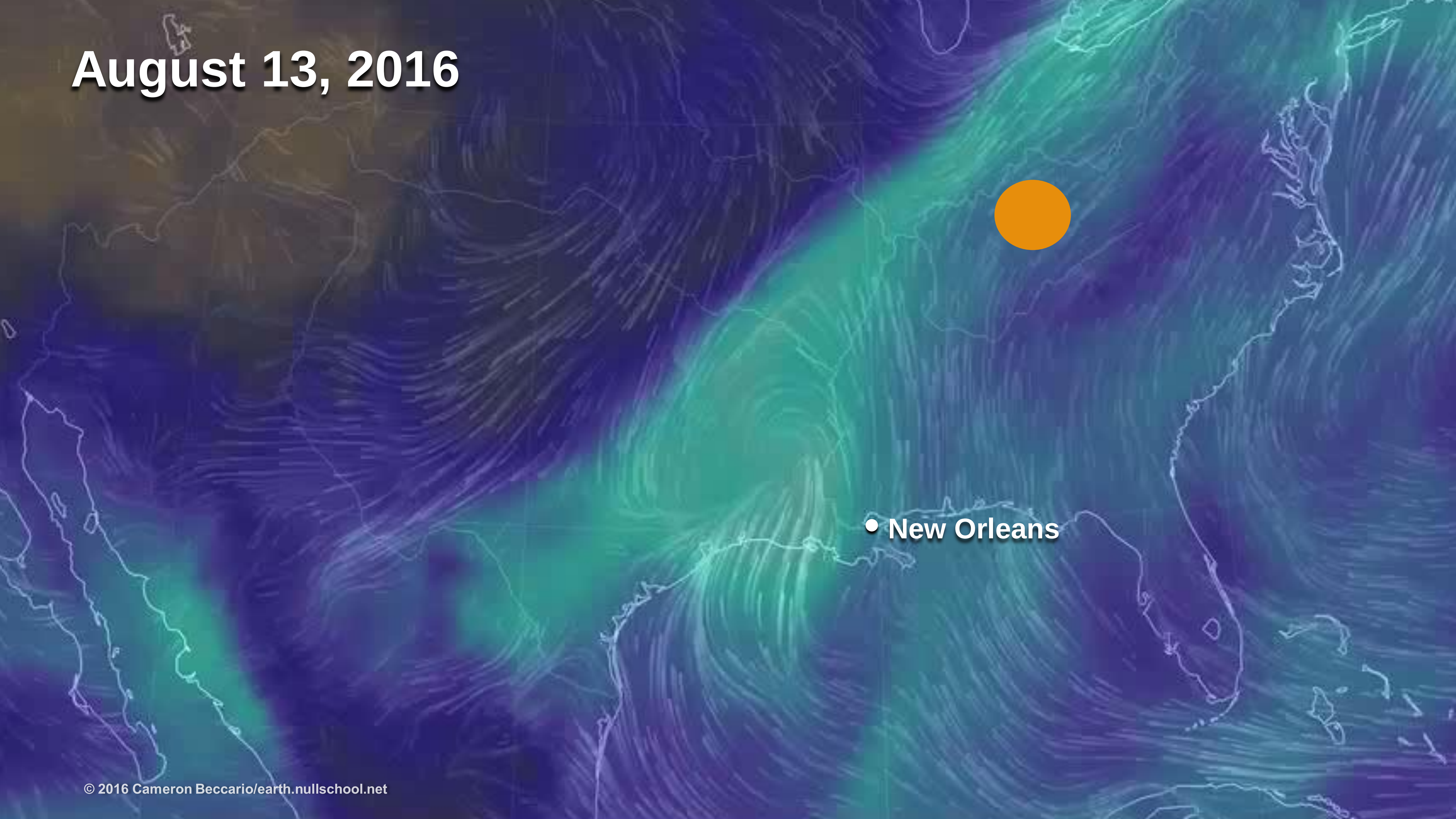
So the downpours get bigger

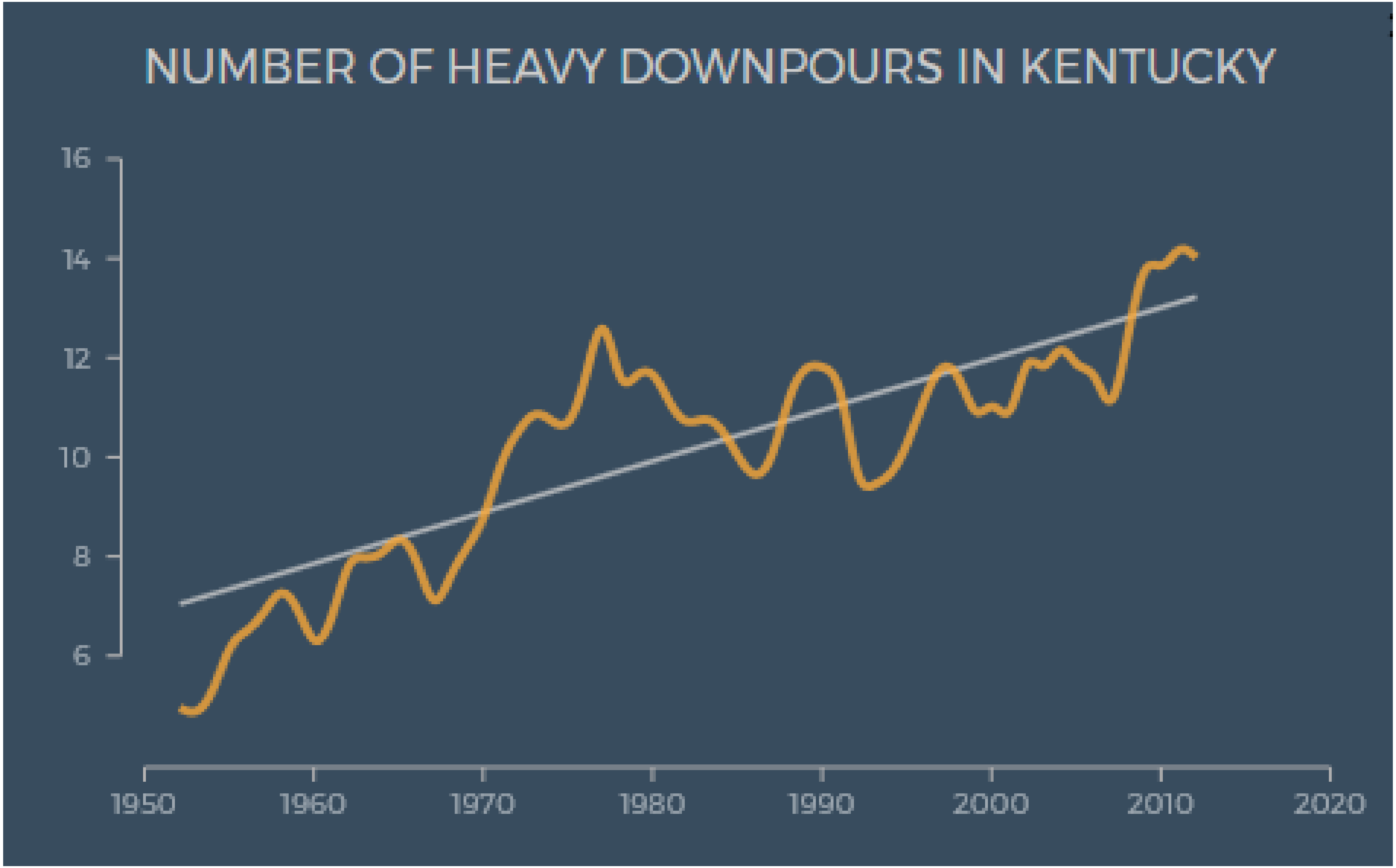

Tucson, Arizona
August 8, 2015
© 2015 Bryan Snider / Live Storms Media


Atmospheric River
February 20, 2017
Hawaii
Source: NASA

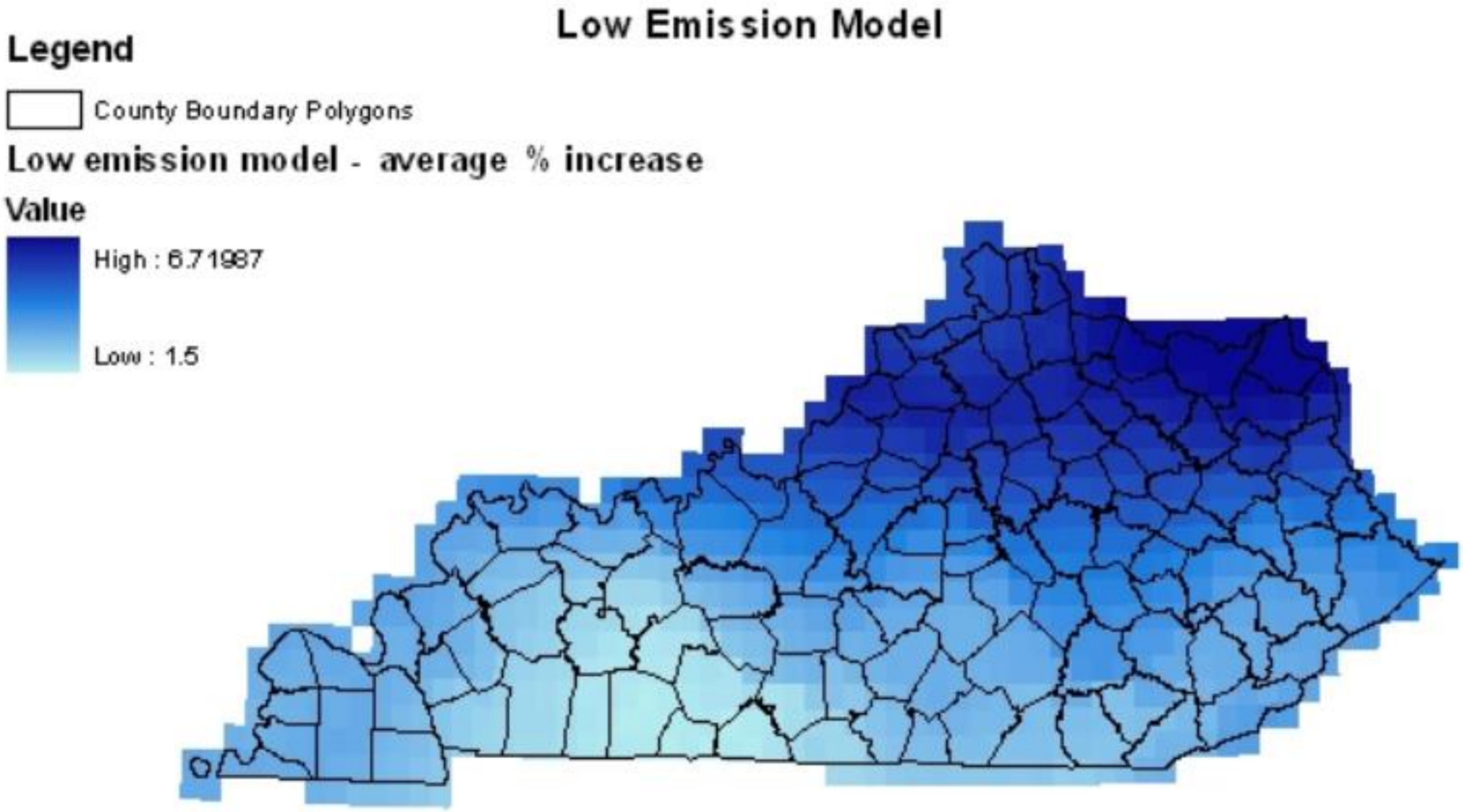

Atmospheric
Rivers

August 13, 2016




NUMBER OF HEAVY DOWNPOURS IN KENTUCKY
16
14
12
10
8
6
1950
1960
1970
1980
1990
2000
2010
2020

Figre 4. Average Annual Percent Precipitation Increase for Kentucky Predicted through 2050



Climate Trends – Annual Scale

Climatic Average Annual Temperature (°F)

Climate Division	1970	1980	1990	2000	2010
Western	56.7	57.0	57.3	57.7	58.2
Central	55.6	55.8	56.2	56.5	56.8
Bluegrass	54.1	54.3	54.8	55.2	55.5
Eastern	54.7	54.8	55.0	55.3	55.2

Climatic Average Annual Precipitation (in.)

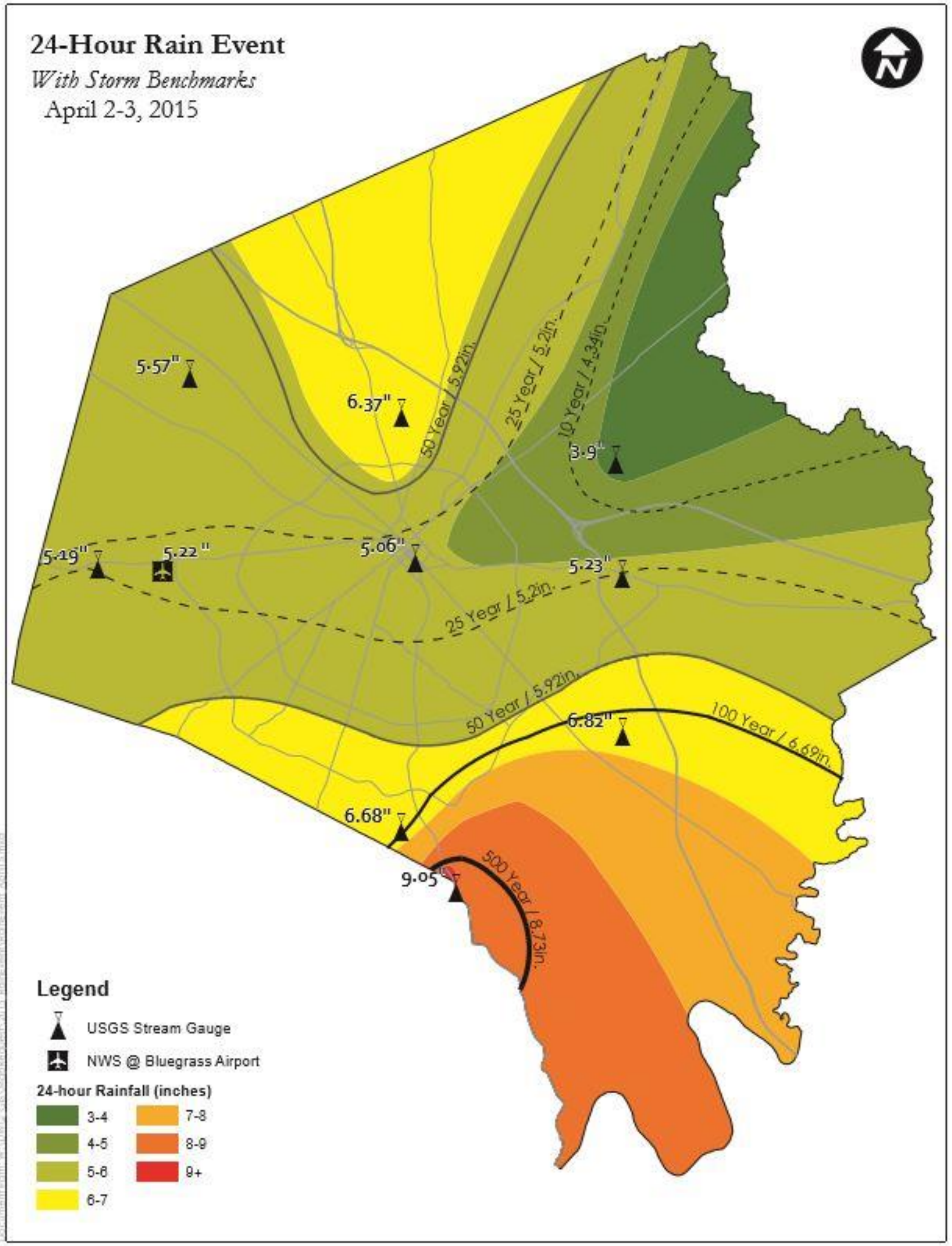
Climate Division	1970	1980	1990	2000	2010
Western	48.99	50.14	48.77	49.51	50.98
Central	50.18	51.16	49.36	50.54	52.51
Bluegrass	45.42	45.63	45.22	46.54	47.15
Eastern	47.77	47.94	47.89	48.35	48.00

WKU

KENTUCKY CLIMATE CENTER

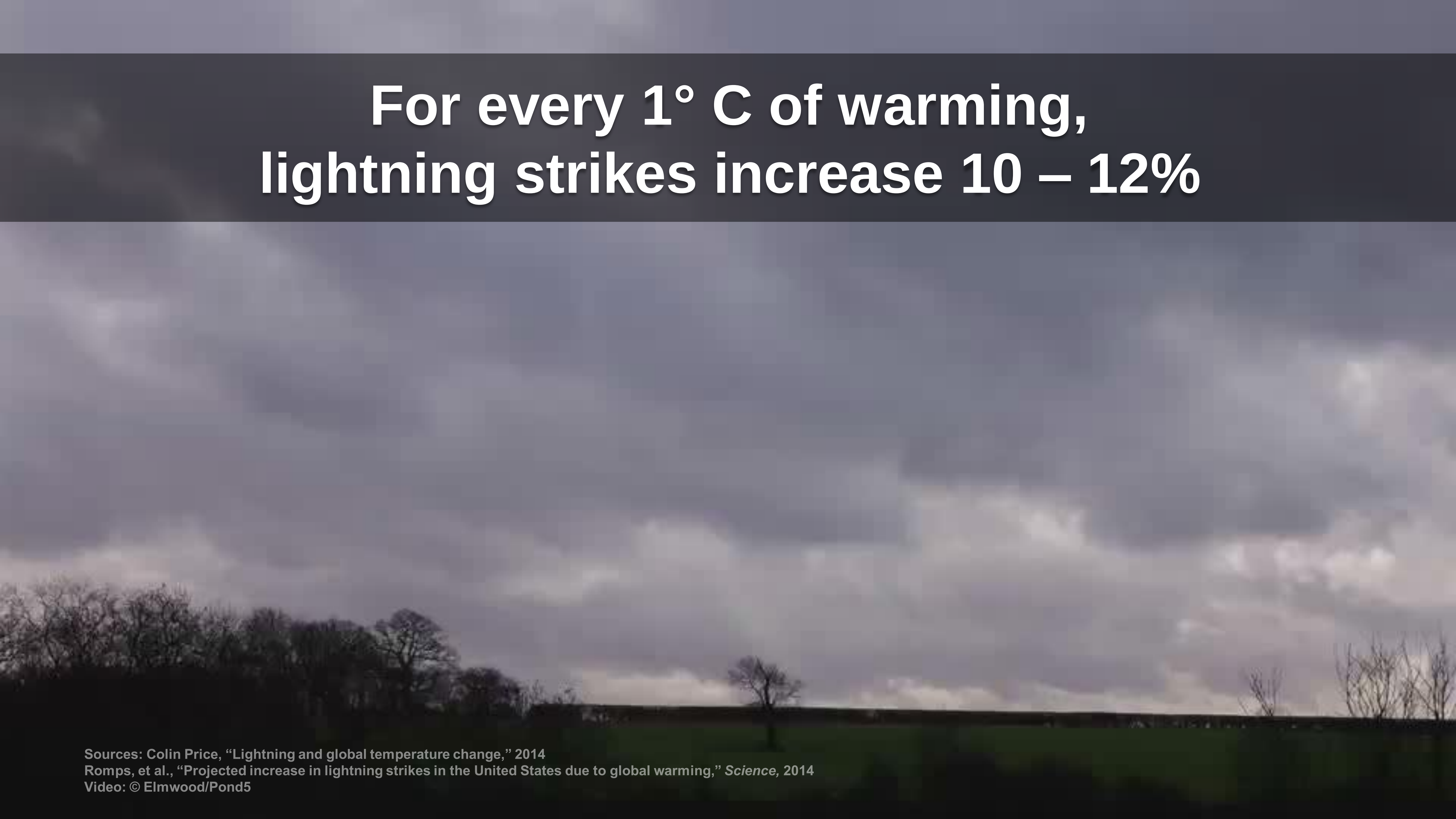
Lexington, Ky
April 2-3, 2015

LFUCG Stormwater Manual
100 yr 24 hr – 6.81" (2016)




Central Bank


ospital for Cats
AUDIGY
Hearing Center



For every 1° C of warming, lightning strikes increase 10 – 12%

Sources: Colin Price, "Lightning and global temperature change," 2014
Romps, et al., "Projected increase in lightning strikes in the United States due to global warming," *Science,* 2014
Video: © Elmwood/Pond5

10% Impervious cover results in

- Measurable impacts on water quality and biota
- Significant impacts to stream banks, channel, erosion, groundwater recharge, etc.

Stream Quality Is Related to Impervious Cover

Impervious Cover

Urban areas only cover 3% of contiguous US but account for impairment of:

- 13% of rivers
- 18% of lakes
- 32% of estuaries
- 55% of ocean shores

ASLA.org

Ecological (Ecosystem) Services:

Why ecological services

What are ecological services

Where to identify the resources

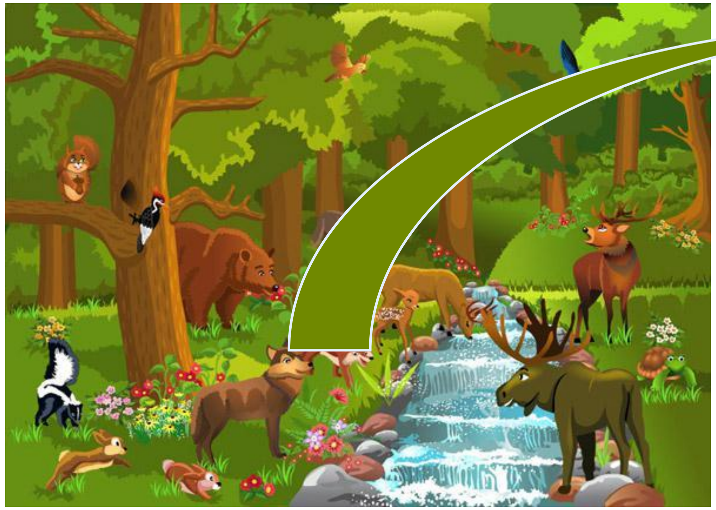
How to place a value on the benefits

When

•

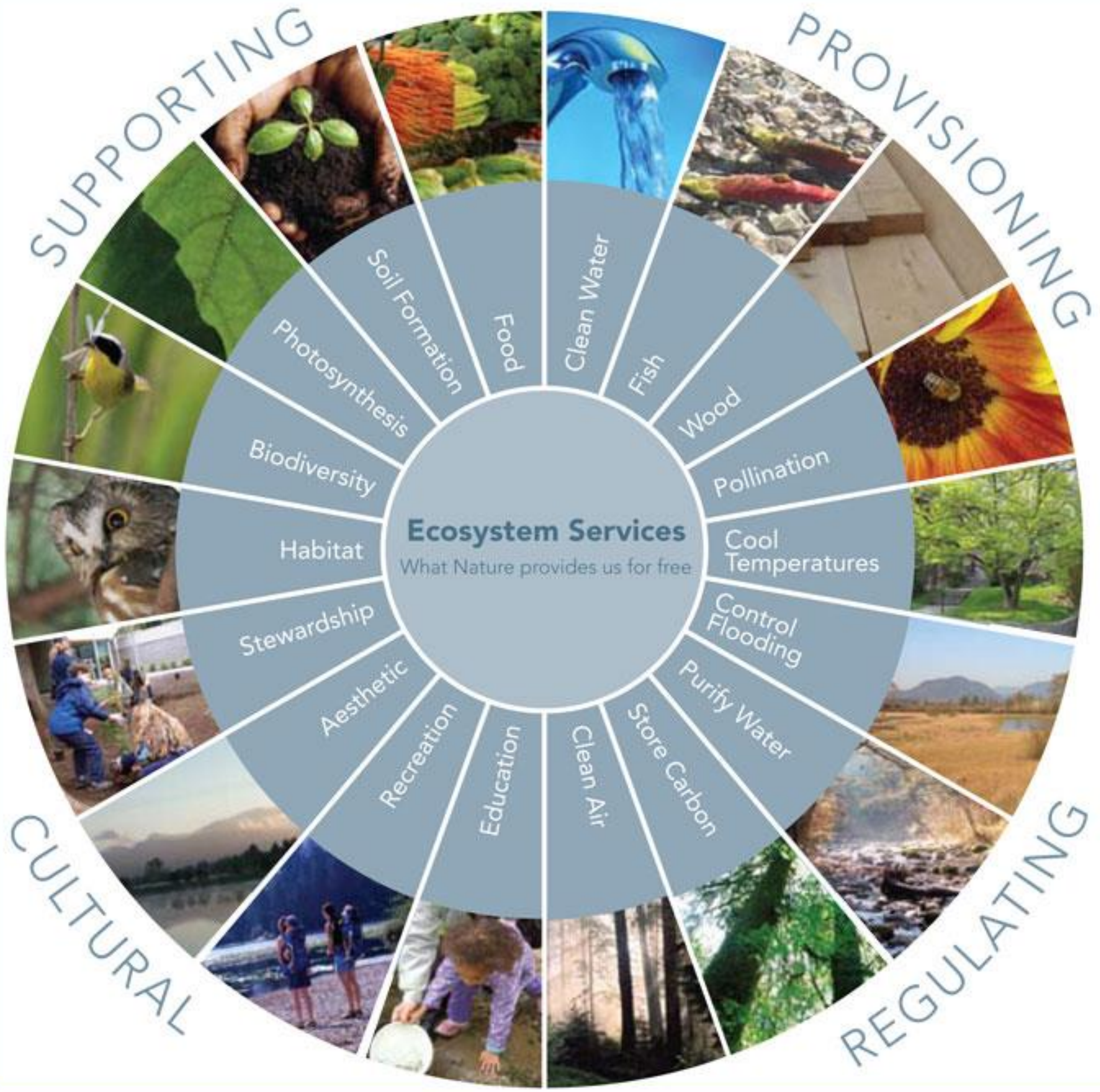
Spectrum of Ecosystems

Less | Disturbance | More



Green Infrastructure

More | Functionality | Less

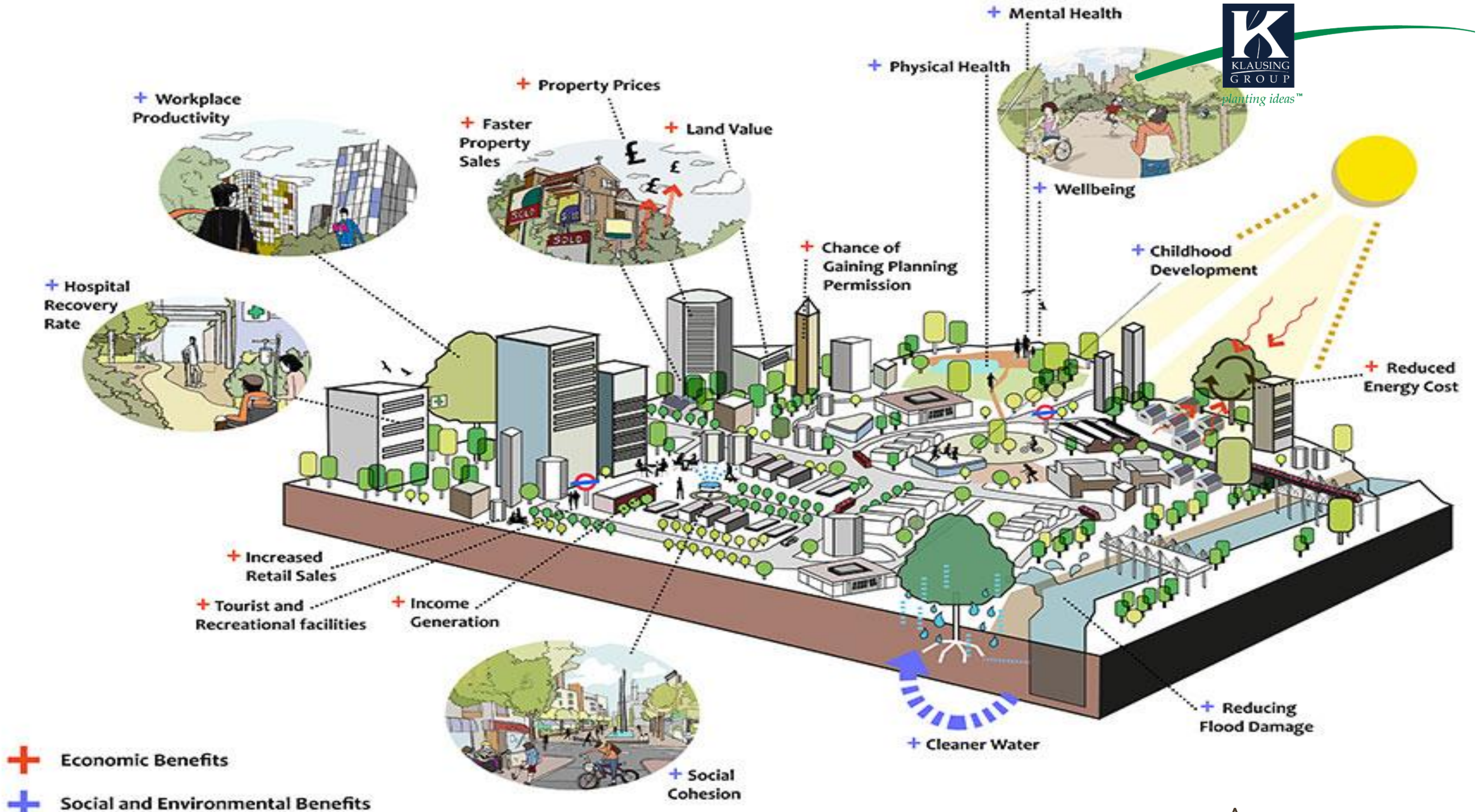


Ecosystem Services

- Estimated $145 trillion per year
  - Ecosystem services contribute more than twice as much to human well-being as does global GDP

Costanza, et. al., 2014 *Changes in the global value of ecosystem services.* Global Environmental Change Vol 26, May 2014, Pgs 152-158

http://ecosystemsandtheeconomy.blogspot.com/



+ Mental Health
+ Physical Health
+ Property Prices
+ Workplace Productivity
+ Faster Property Sales
+ Land Value
+ Wellbeing
+ Hospital Recovery Rate
+ Chance of Gaining Planning Permission
+ Childhood Development
+ Reduced Energy Cost
+ Increased Retail Sales
+ Tourist and Recreational facilities
+ Income Generation
+ Reducing Flood Damage
+ Cleaner Water
+ Social Cohesion
+ Economic Benefits
+ Social and Environmental Benefits

Arup.com

Tale of Two Cities – Sewer Overflow Projects

- Cleveland
  - $3 billion over 25 years
  - 2.5% dedicated to green infrastructure projects

- Philadelphia
  - $2.4 billion over 25 years
  - 70% dedicated to green infrastructure projects

KLAUSING GROUP

Cleveland.com

Green Infrastructure: Philadelphia

Philadelphia comparative study:

Plan to invest 50% in GI versus 100% grey

Construction delays & maintenance over 40 year period

Green = 346,883 hrs (or $5.6 mm in costs)

Grey = 796,597 hours (or $13.4 mm in costs)

Saves: 450,000 hrs (or $7.8 mm in cost)

Phillywatersheds.org

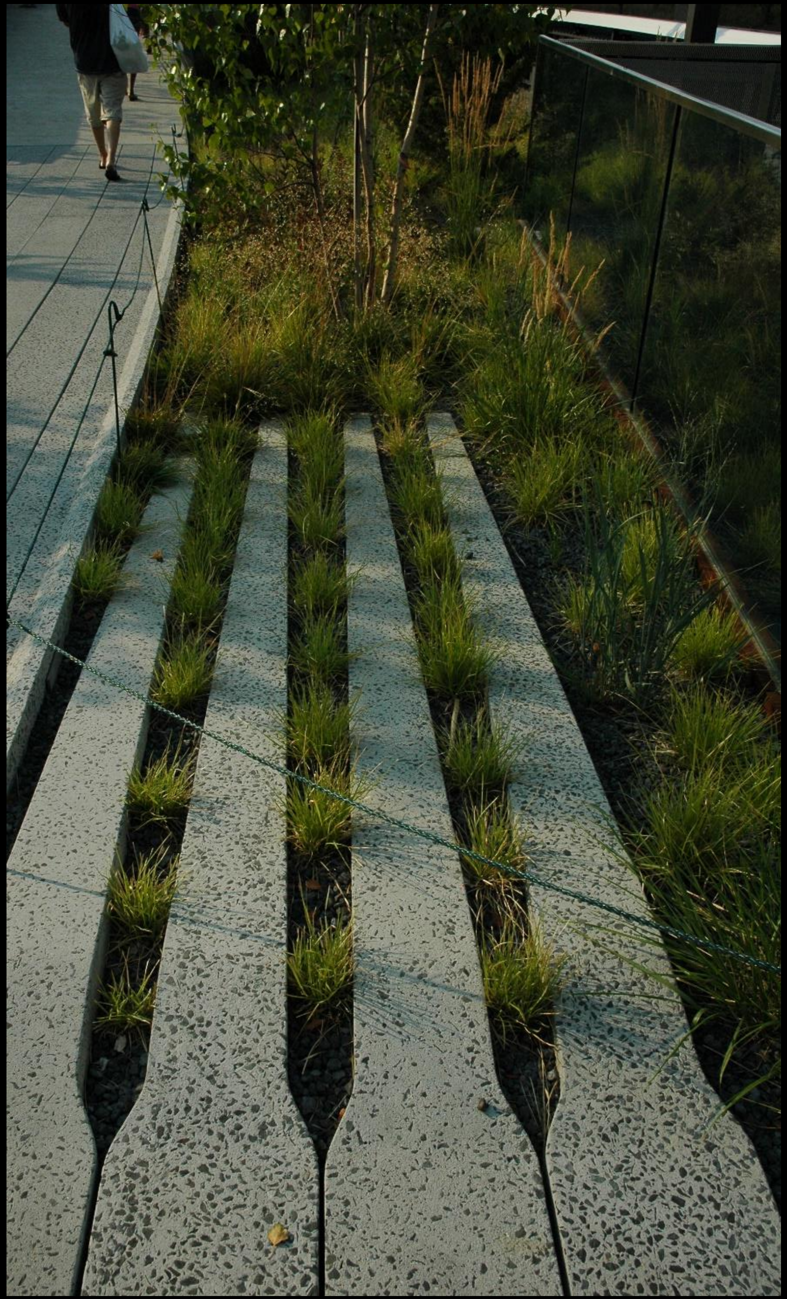
KLAUSING GROUP

NYC Green Infrastructure Plan

Plan to capture 10% runoff from impervious surfaces in CSO areas

Green infrastructure estimated cost of $1.5 billion versus grey estimate of $3.9 billion

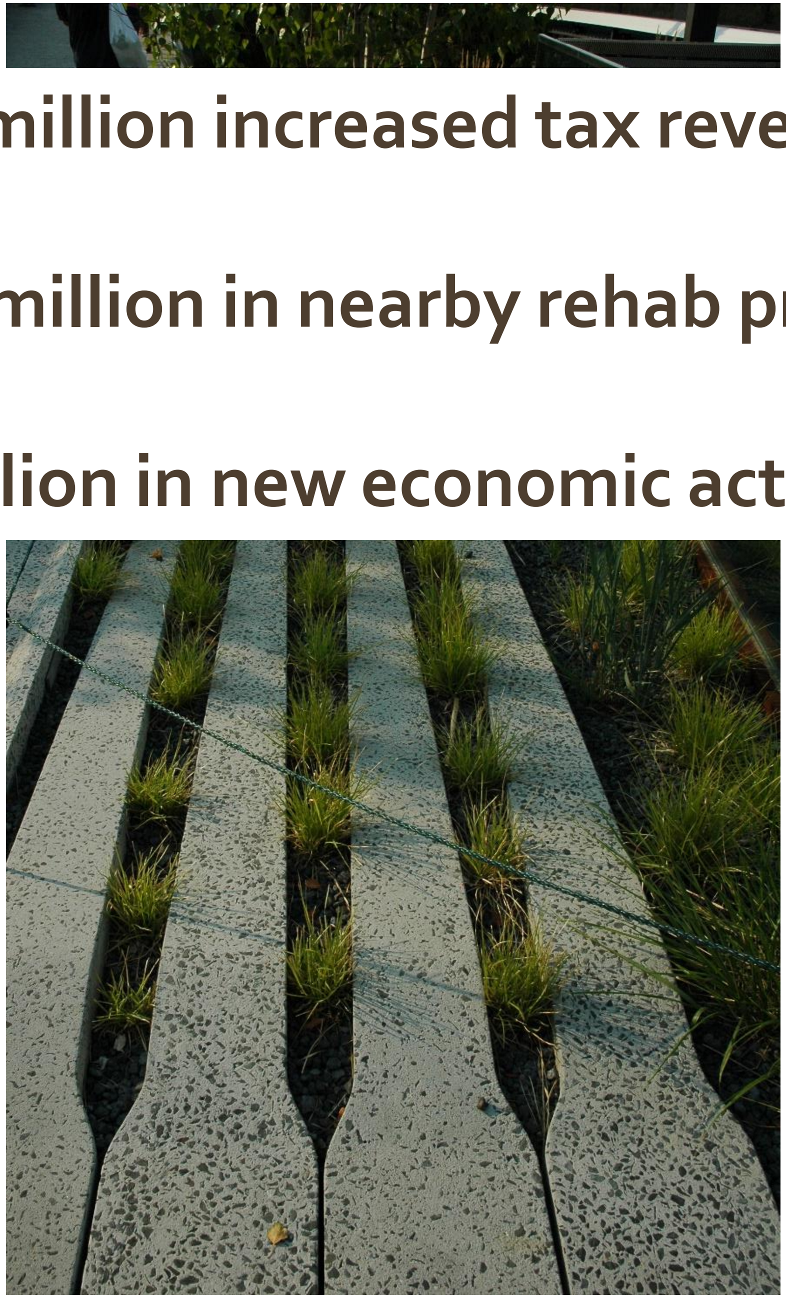
Green estimated 1.5 billion gallons per year reduction in CSO

$250 million increased tax revenue

$900 million in nearby rehab projects

$2 billion in new economic activity



Coldstream:

Coldstream:

Ecological (Ecosystem) Services:

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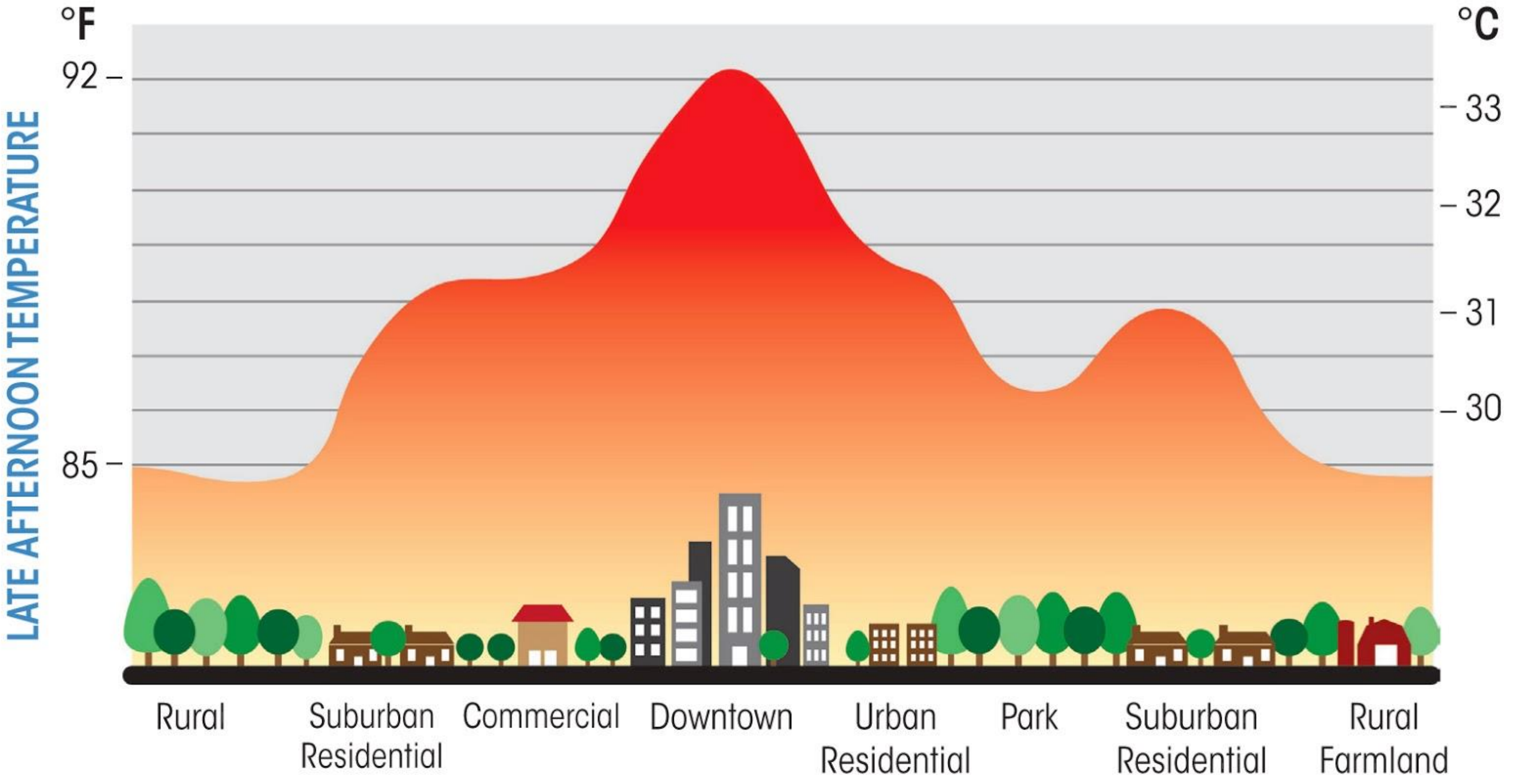
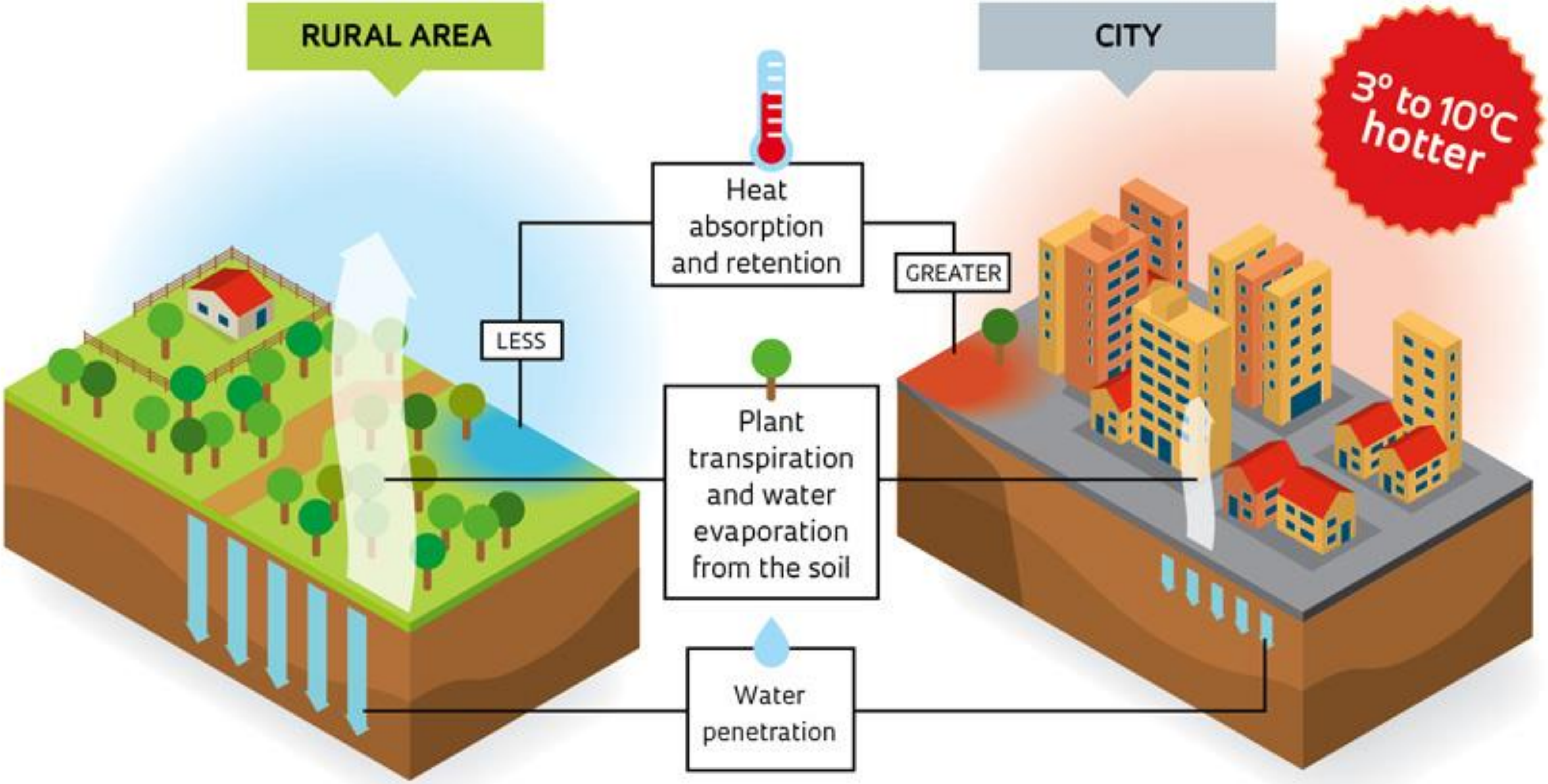
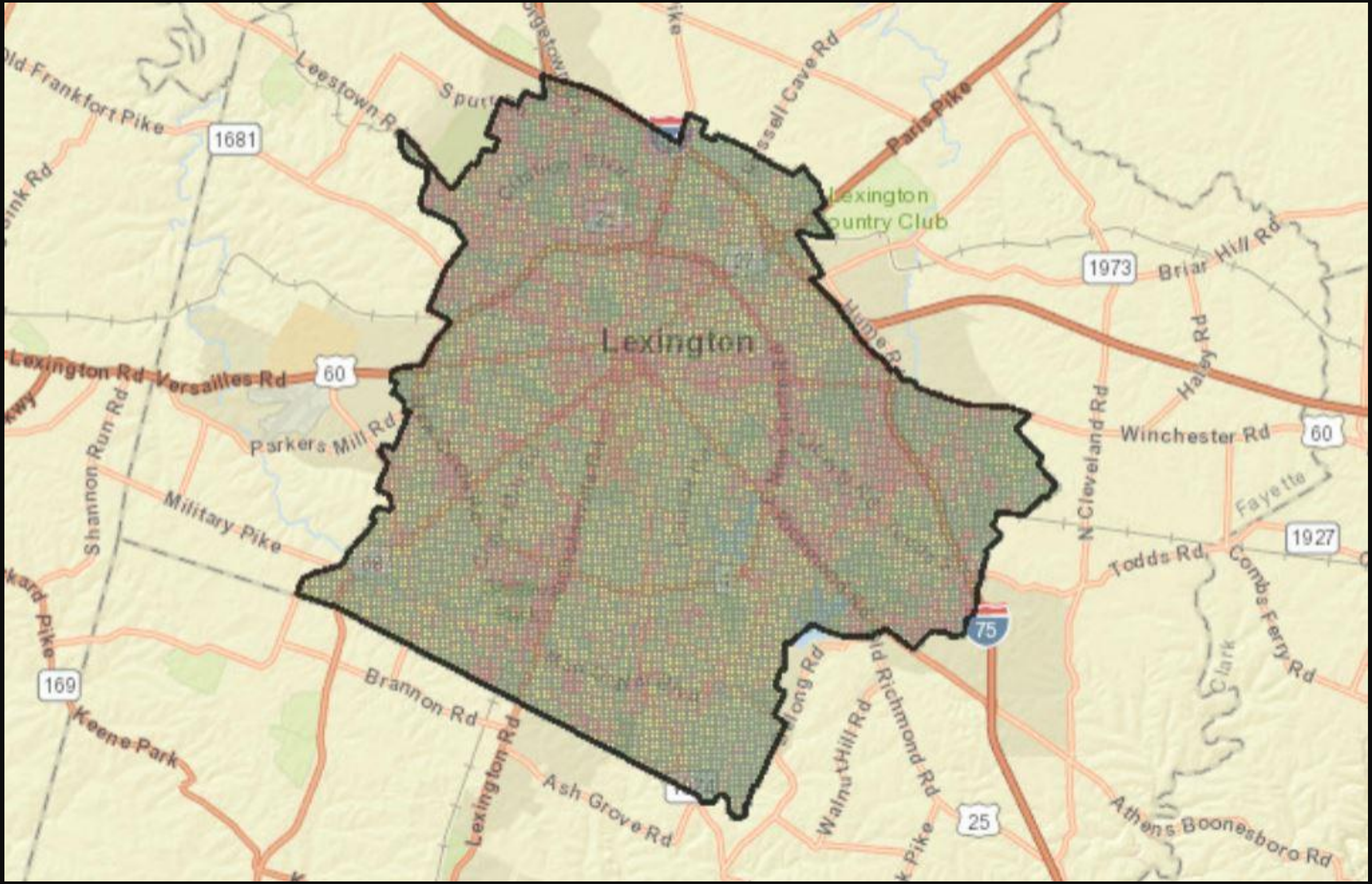
When


°F
°C
92
85
33
32
31
30
LATE AFTERNOON TEMPERATURE
Rural
Suburban Residential
Commercial
Downtown
Urban Residential
Park
Suburban Residential
Rural Farmland

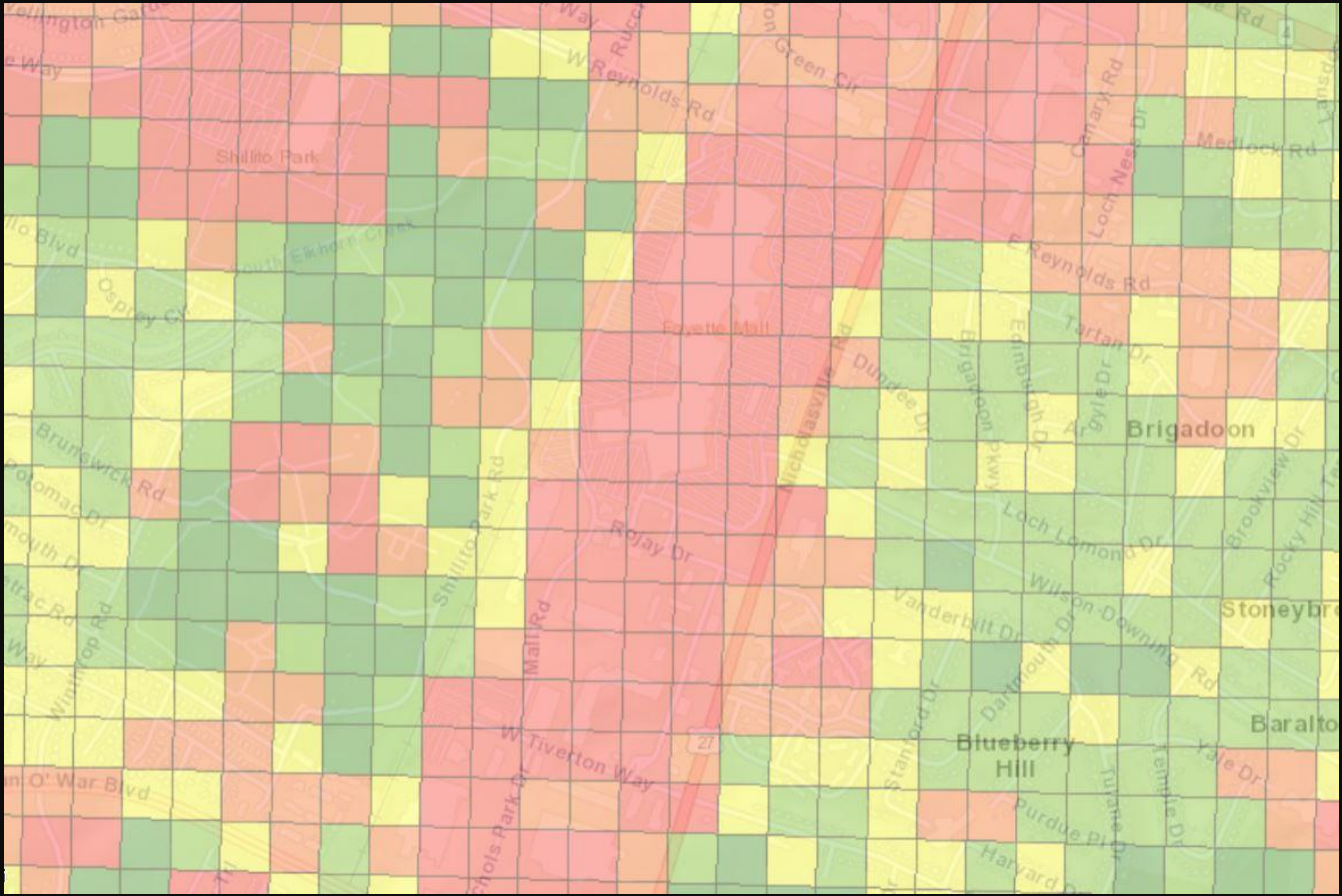
Why the urban heat island effect occurs

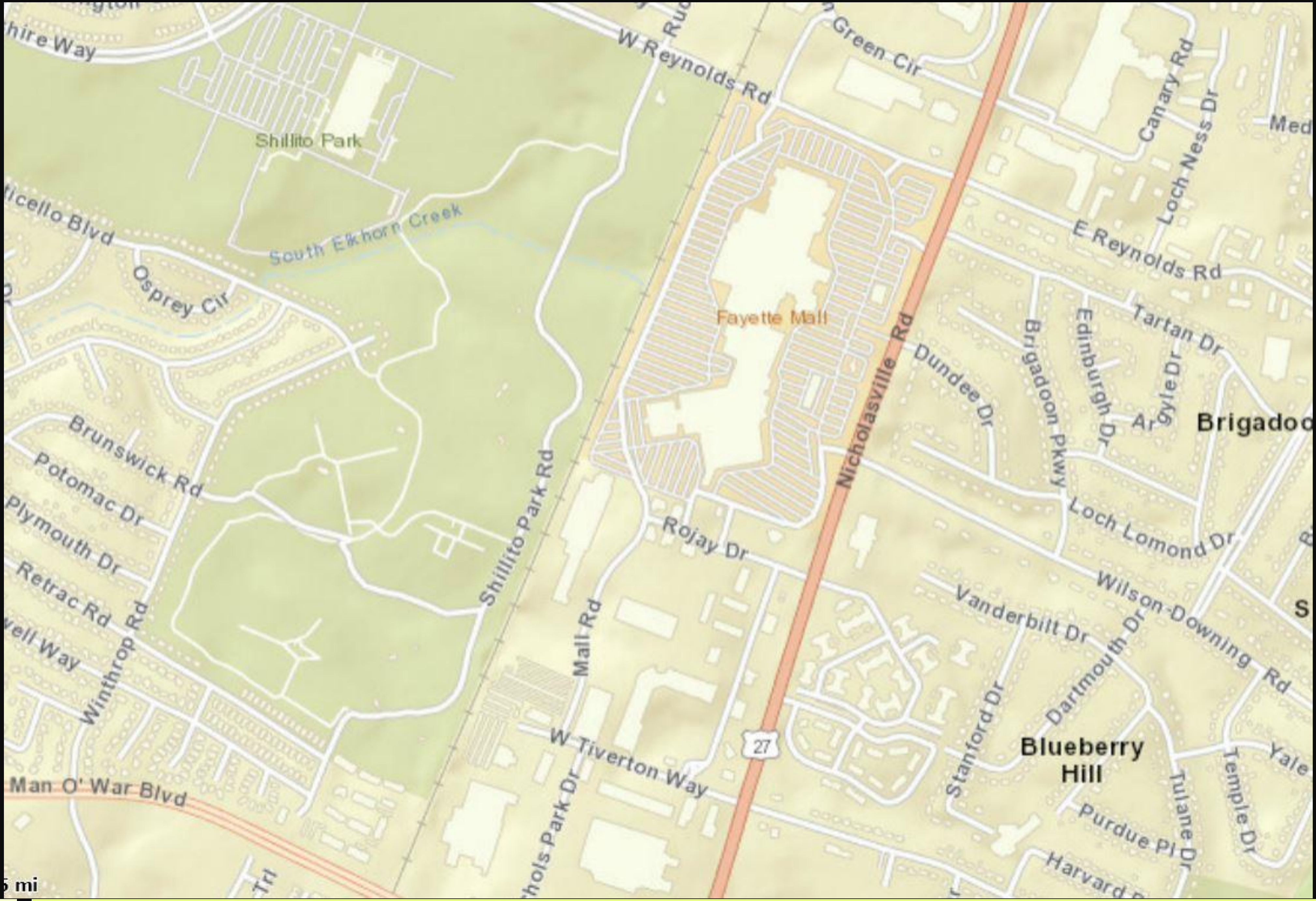


Lexington Urban Tree Canopy Study

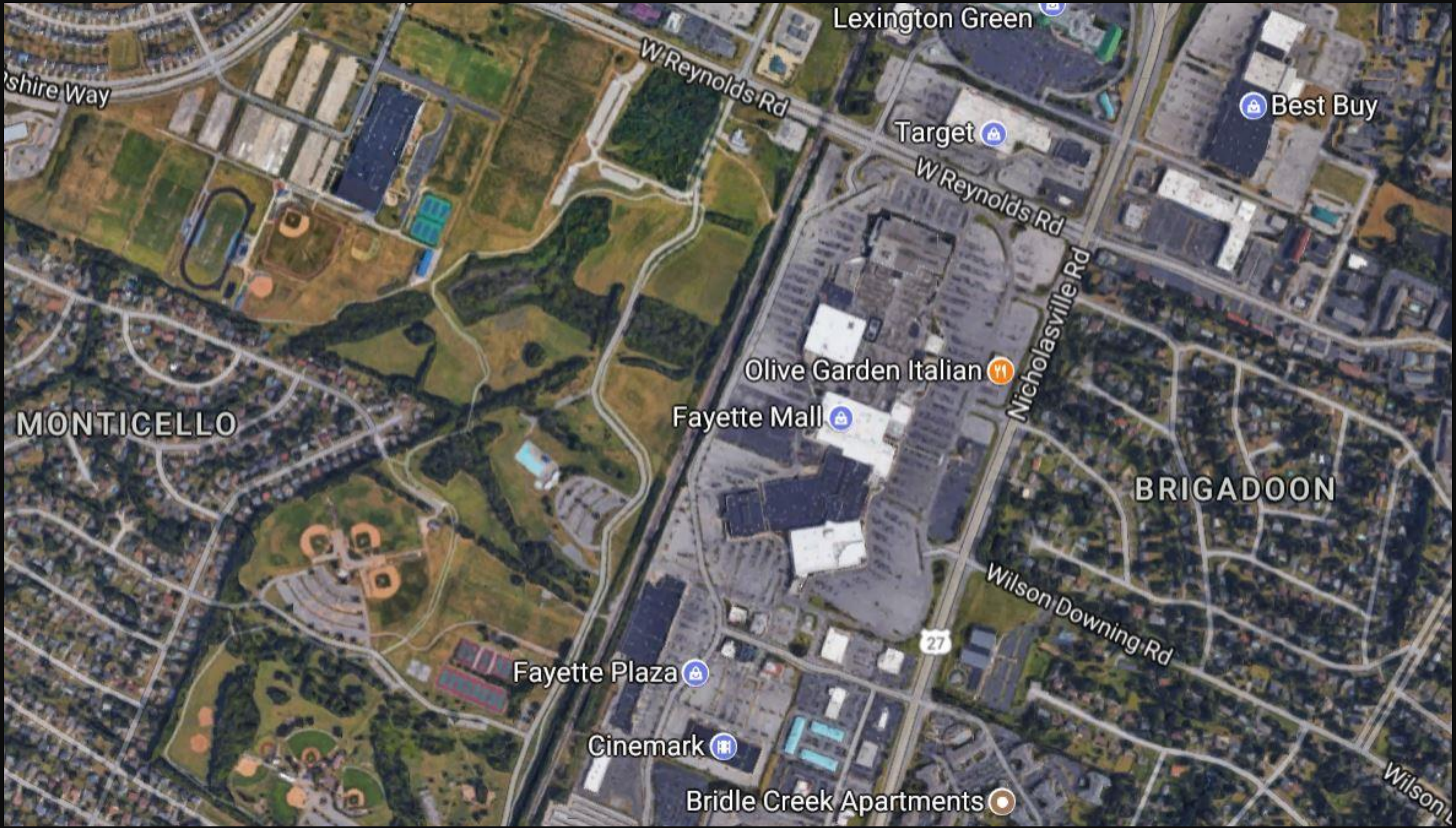



80


W Reynolds Rd
Shillito Park
Medlock Rd
Loch Ness Dr
E Reynolds Rd
Fayette Mall
Nicholasville Rd
Tartan Dr
Dundee Dr
Brigadoon Pkwy
Edinburgh Dr
Argyle Dr
Brigadoon
Brookview Dr
Osprey Cir
Brunswick Rd
Shillito Park Rd
Rojay Dr
Loch Lomond Dr
Wilson-Downing Rd
Vanderbilt Dr
Mall Rd
Winthrop Rd
Dartmouth Dr
Stanford Dr
Blueberry Hill
W Tiverton Way
Yale Dr
Purdue Pl
Tulane Dr
Temple Dr



hire Way
W Reynolds Rd
Green Cir
Canary Rd
Loch Ness Dr
Med
Shillito Park
ticello Blvd
South Elkhorn Creek
E Reynolds Rd
Osprey Cir
Fayette Mall
Tartan Dr
Dundee Dr
Brigadoon Pkwy
Edinburgh Dr
Argyle Dr
Brigadoo
Nicholasville Rd
Brunswick Rd
Potomac Dr
Plymouth Dr
Shillito Park Rd
Loch Lomond Dr
Rojay Dr
Retrac Rd
Wilson-Downing Rd
Vanderbilt Dr
Winthrop Rd
Mall Rd
Dartmouth Dr
Stanford Dr
Blueberry Hill
27
W Tiverton Way
Yale
Tulane Dr
Temple Dr
Man O' War Blvd
Purdue Pl
Harvard
mi

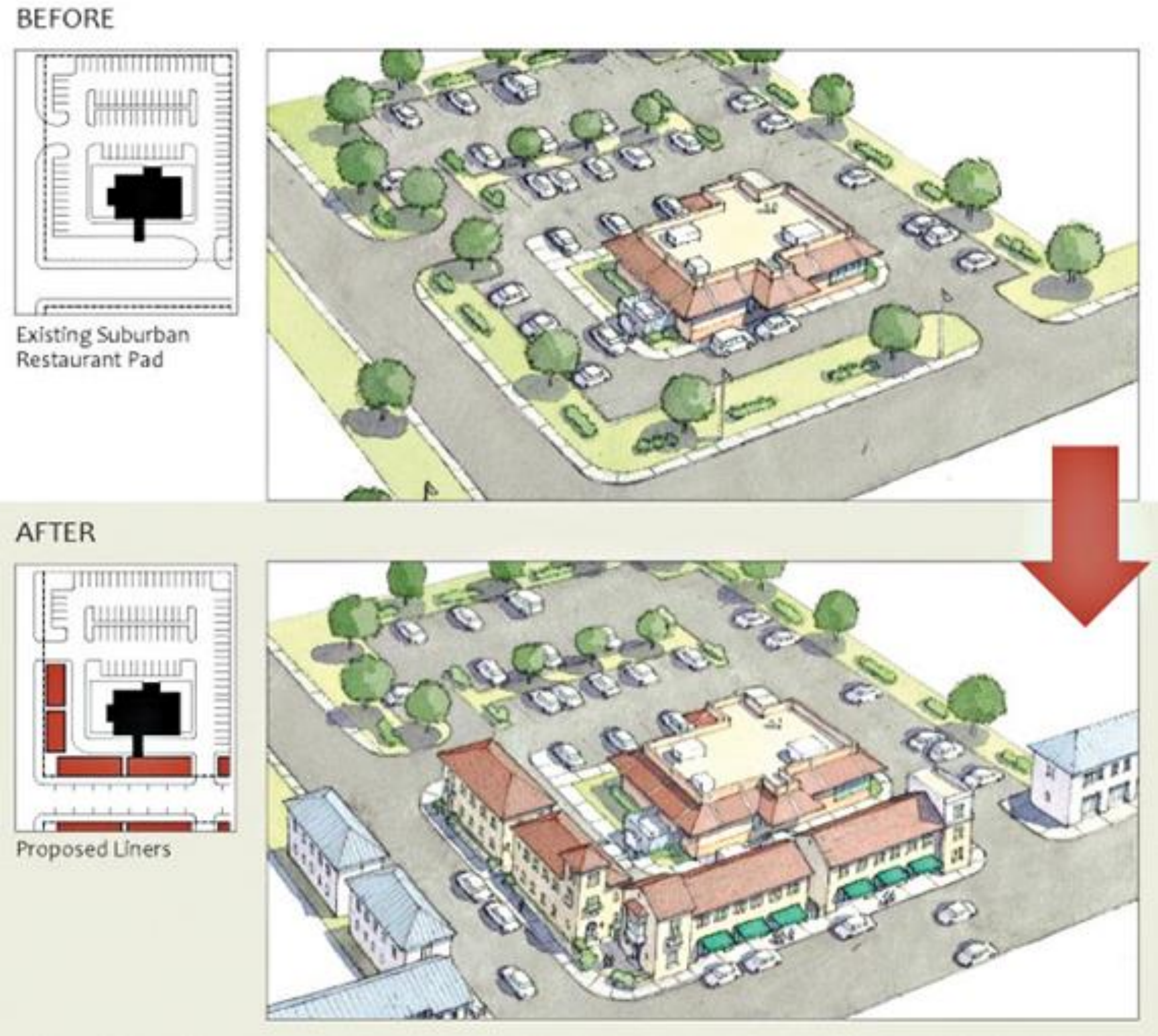

Lexington Green
shire Way
W Reynolds Rd
Target
W Reynolds Rd
Best Buy
Nicholasville Rd
Olive Garden Italian
Fayette Mall
MONTICELLO
BRIGADOON
Wilson Downing Rd
27
Fayette Plaza
Cinemark
Bridle Creek Apartments


87
Fayette Mall
97
98
97
99

Hamburg Pavilion
90
92
91
92

GI/LID Site Planning Process

- Neighborhood Scale;
- Increase in building density
- Reduction in autocentric design
- Opportunity for rain water harvesting
- Work with the landscape – architecture in harmony



“Fixing the Mess We Made” *By Emily Talen, AICP, Planning 2010*

GI/LID Site Planning Process

- Site Planning Objectives:
  - Opportunities abound

"Fixing the Mess We Made" *By Emily Talen, AICP, Planning 2010*

Examples of Green Infrastructure:

Rain Gardens

Planter Boxes

Grass Swale

Infiltration Swale

Dry Wells

Permeable Pavements

Green Roof

Examples of Green Infrastructure:

Green Streets

Grass Swale

Capture

Rain Barrels & Cisterns

Disconnection

Downspouts & Pavement Removal

Ecological (Ecosystem) Services:

Why ecological services

What are ecological services

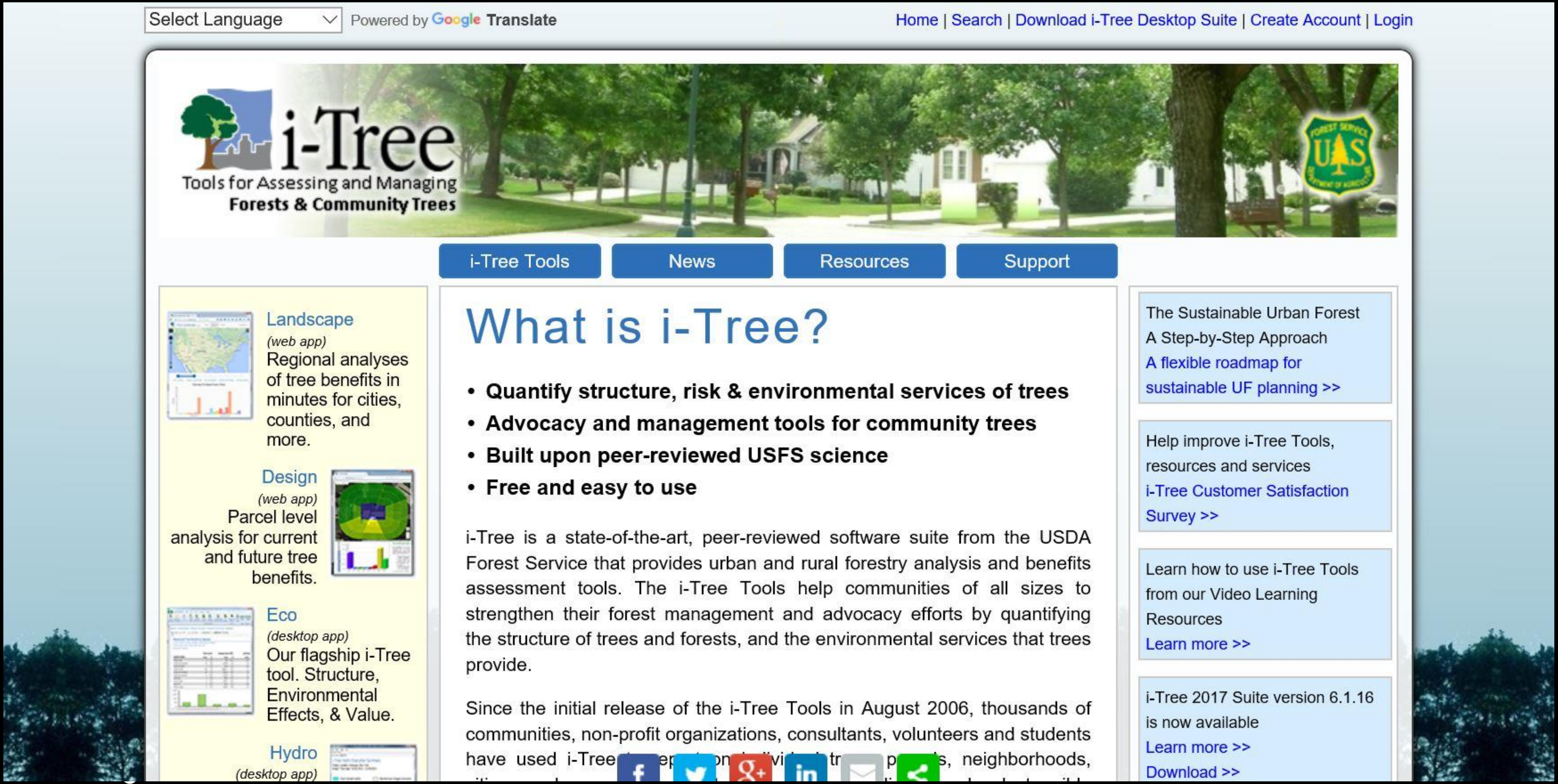
Where to identify the resources

How to place a value on the benefits

When

•

itree


Select Language
Powered by Google Translate
Home | Search | Download i-Tree Desktop Suite | Create Account | Login
i-Tree
Tools for Assessing and Managing
Forests & Community Trees
i-Tree Tools
News
Resources
Support
Landscape
(web app)
Regional analyses of tree benefits in minutes for cities, counties, and more.
Design
(web app)
Parcel level analysis for current and future tree benefits.
Eco
(desktop app)
Our flagship i-Tree tool. Structure, Environmental Effects, & Value.
Hydro
(desktop app)
What is i-Tree?
• Quantify structure, risk & environmental services of trees
• Advocacy and management tools for community trees
• Built upon peer-reviewed USFS science
• Free and easy to use
i-Tree is a state-of-the-art, peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools. The i-Tree Tools help communities of all sizes to strengthen their forest management and advocacy efforts by quantifying the structure of trees and forests, and the environmental services that trees provide.
Since the initial release of the i-Tree Tools in August 2006, thousands of communities, non-profit organizations, consultants, volunteers and students
The Sustainable Urban Forest
A Step-by-Step Approach
A flexible roadmap for sustainable UF planning >>
Help improve i-Tree Tools, resources and services
i-Tree Customer Satisfaction Survey >>
Learn how to use i-Tree Tools from our Video Learning Resources
Learn more >>
i-Tree 2017 Suite version 6.1.16 is now available
Learn more >>
Download >>

National Tree Benefit:

National Tree Benefit Calculator

Beta

Instruction:

Species: If you're looking for a Willow Oak it's listed as "Oak, Willow". If your tree isn't listed, use the general "Other" listings.

Diameter: How wide is your tree at about 4.5 feet from the ground?

Trees in urban areas provide a number of important benefits. They help to clean the air, curb stormwater runoff, raise property values, sequester carbon, and reduce energy costs.

Enter your tree info:

Enter your tree's species:

Hornbeam, American

Enter your tree's diameter (between 0 and 45 inches):

12

What land-use type is this tree nearest?

Small commercial business

Calculate

You have chosen:

Zip Code: 40502
City: LEXINGTON, KY, US
Climate Zone: Lower Midwest

change

Enter information about a street-side tree and learn about the benefits it provides. Street-side trees are typically located in front yards, medians, parkways, planting strips or other common planting areas adjacent to streets.

Casey Trees WASHINGTON DC

The National Tree Benefit Calculator was conceived and developed by Casey Trees and Davey Tree Expert Co.

DAVEY

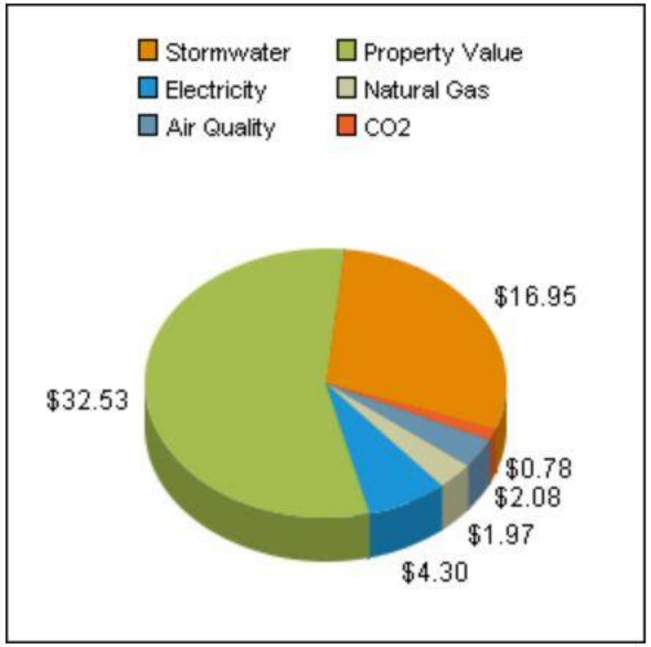
National Tree Benefit:

Home   Calculate another tree

National Tree Benefit Calculator

Beta

Overal Benefits | Storm Water | Property Value | Energy | Air Quality | CO2 | About the Model



Breakdown of your tree's benefits
Click on one of the tabs above for more detail

This **12 inch Red maple 'Armstrong'** provides overall benefits of: $59 every year.

While some functional benefits of trees are well documented, others are difficult to quantify (e.g., human social and communal health). Trees' specific geography, climate, and interactions with humans and infrastructure is highly variable and makes precise calculations that much more difficult. Given these complexities, the results presented here should be considered initial approximations—a general accounting of the benefits produced by urban street-side plantings.

Benefits of trees do not account for the costs associated with trees' long-term care and maintenance.

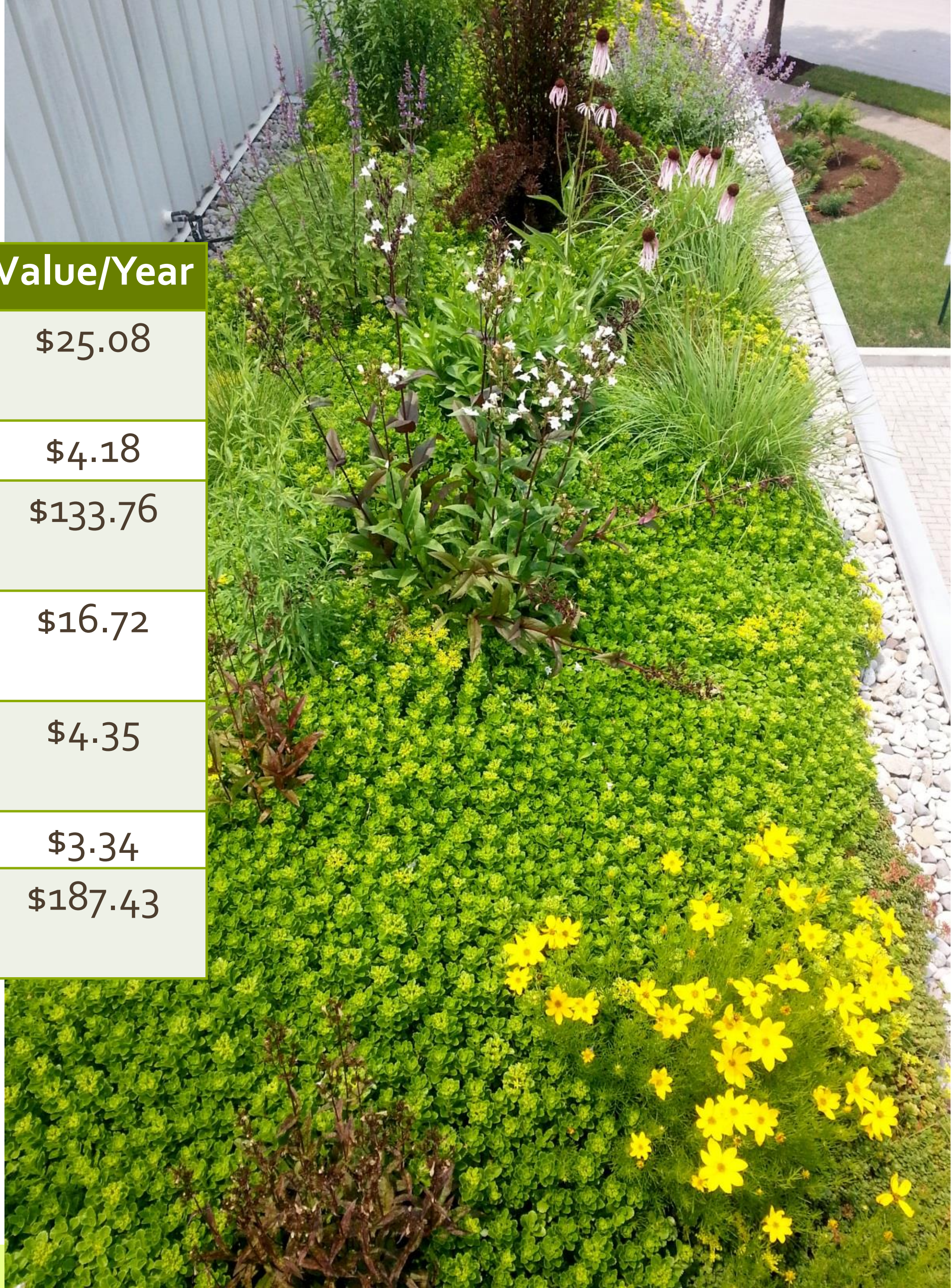
If this tree is cared for and grows to 17 inches, it will provide $72 in annual benefits.

Tree Picture
Not Available

Red maple 'Armstrong'
Acer rubrum 'Armstrong'

400 Sq Ft

Category of Benefit	Value/Year
Reduction in Stormwater Infrastructure Costs	$25.08
Air Particulate Reduction	$4.18
Urban Heat Island Reduction	$133.76
Greenhouse Gas Reduction	$16.72
Greenhouse Gas Sequestration	$4.35
Habitat Creation	$3.34
TOTAL BENEFITS PER YEAR	$187.43



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Green Infrastructure Resources:

EPA Benefits:

http://water.epa.gov/infrastructure/greeninfrastructure/

EPA National Stormwater Calculator:

http://www2.epa.gov/water-research/national-stormwater-calculator

Milwaukee, WI – GI calculator - H2OCapture:

http://www.h2ocapture.com/

National Tree Benefit Calculator:

http://www.treebenefits.com/calculator/

Itree

https://www.itreetools.org/

Center for Neighborhood Technology:

http://www.cnt.org/water/projects/green-infrastructure/



Ecological (Ecosystem) Services:

Why ecological services

What are ecological services

Where to identify the resources

How to place a value on the benefits

When

•


"The best time to plant a tree
is twenty years ago.
The second best time is now."
- Chinese Proverb

42% of urban space within the U.S. is projected to be redeveloped by 2030 providing an opportunity for Green Infrastructure solutions

ASLA.org

“When the well is dry, we know the worth of water.”

Benjamin Franklin

Thank You

Dan Stever
Director of Education & Outreach
Klausing Group
dstever@klausinggroup.com

B. Scott Southall, RLA, LEED AP BD+C, AICP
Vice-President for Sustainability
CDP
southall@cdpengineers.com