
Metropolitan North Georgia Water Planning District
COUNCIL for QUALITY GROWTH
STORMWATER WORKSHOP
Stormwater Won't Work Until We Do
June 14, 2023 | 8:30 AM
Georgia Association of Water Professionals

Katherine Zitsch

Director, Metro North Georgia
Water Planning District

Jennifer Flowers

Manager of Leadership Development
Programming & Member Relations
Georgia Association of Water Professionals

Georgia Association of Water Professionals

COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District

Kerry Armstrong

Chairman

Atlanta Regional Commission

ARC

Atlanta Regional Commission

COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District

Michael Paris

President & CEO

Council for Quality Growth

CQG & MNGWPD's Stormwater Working Group Joint Statement

"Recent litigation wins have help ensure the metro Atlanta region's long-term water supply to support economic vitality, quality of life, and progress. Good management of stormwater helps protect human life, property, and natural resources. As more of metro Atlanta urbanizes and is more densely developed, robust stormwater infrastructure improves water quality, mitigates flooding, and protects ecosystems. And as the intensity and frequency of storms increases, we must take collaborative action to improve the region's stormwater management practices and policies – to ensure our continued quality of life."

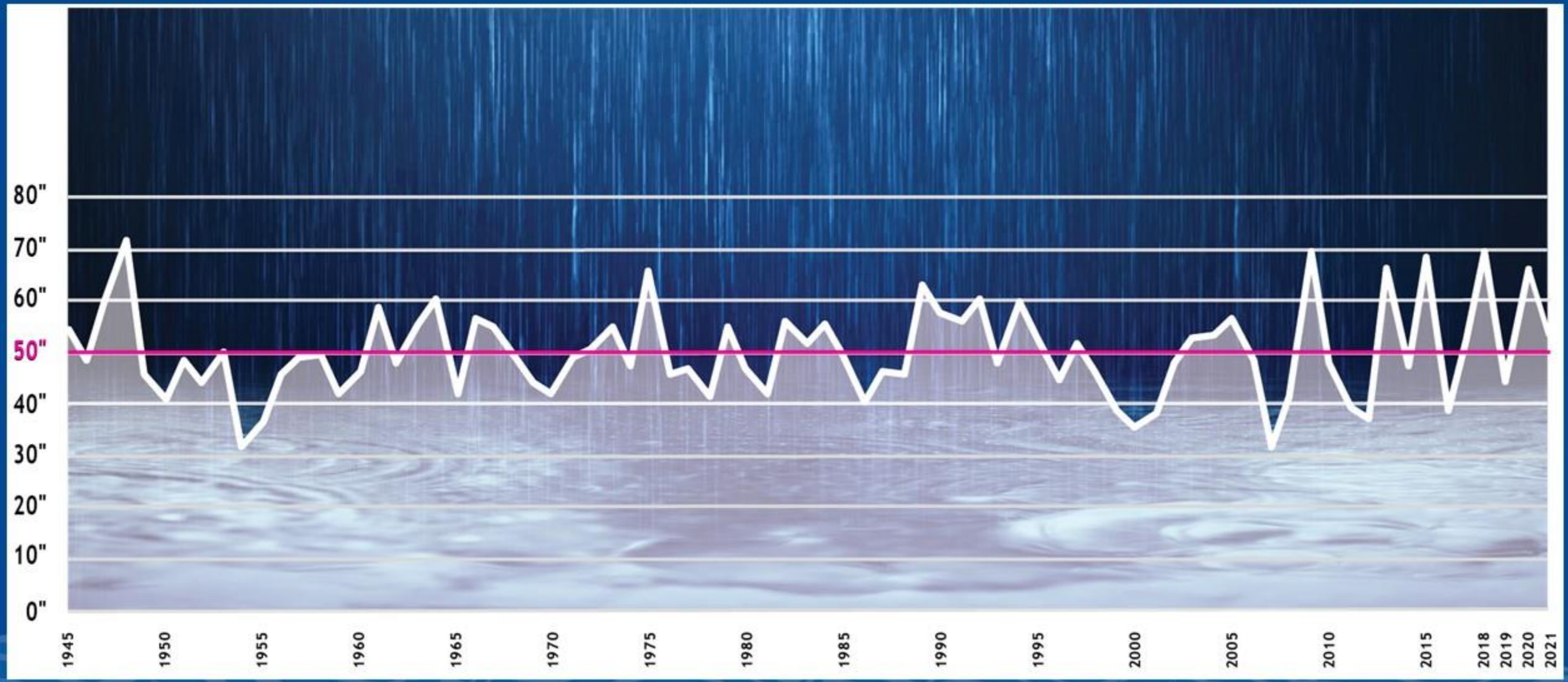
Partnerships for Stormwater's Future

Katherine Zitsch
Director, Metropolitan North Georgia Water Planning District

Metro Atlanta's Rainfall is Changing

Annual Rainfall

Average Annual Rainfall = 50 inches



The Atlanta Journal-Constitution

Jan. 4, 2023 flash flooding

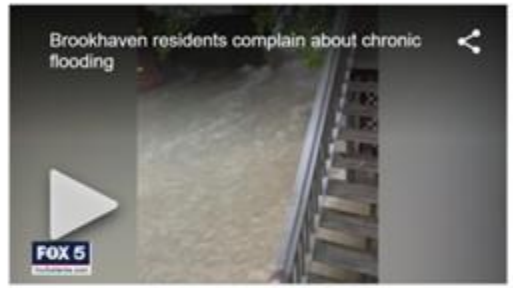
WSB-TV 2 ATLANTA

LOCAL

Water rescues, heavy flooding reported in parts of metro Atlanta

FOX5 Live News Weather Good Day Sports Contests Email More

Brookhaven residents want city to fix flooding problem



Brookhaven residents complain about chronic flooding

BROOKHAVEN, Ga - Neighbors in one Brookhaven neighborhood said they've had problems with flooding for years, but said over time, it has gotten worse.

Hey check out these, shows

ANF | ATLANTA NEWS FIRST

Large sinkhole closes portion of Herndon Road in South Fulton

City of South Fulton (City of South Fulton)

By Catherine Catoura

Published: Apr. 1, 2022 at 4:42 PM EDT | Updated: Apr. 2, 2022 at 5:48 PM EDT

The Atlanta Journal-Constitution

Georgia Politics AJC Podcasts Opinion Sports AJC Events EPaper Newsletters

WEATHER UPDATE: School districts delay start due to expected heavy rain

Credit: WSBTV Video

CRIME & PUBLIC SAFETY

By Rosana Hughes, The Atlanta Journal-Constitution

The Atlanta Journal-Constitution

Gridlock Guy: Like snow days, Atlanta needs storm days

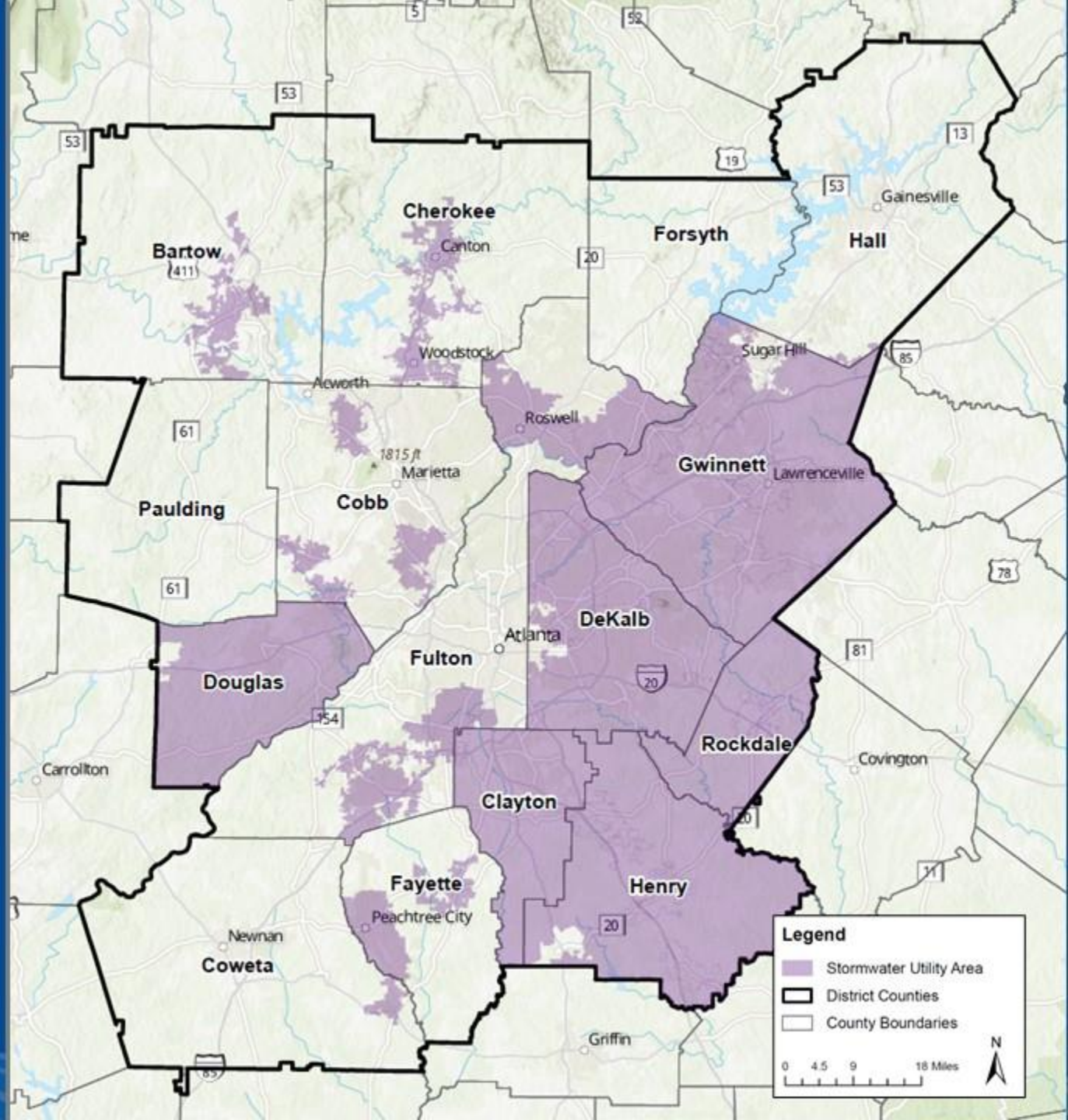
Local Jurisdictions with Stormwater Utilities in the District

Counties (40% of Counties in the District)

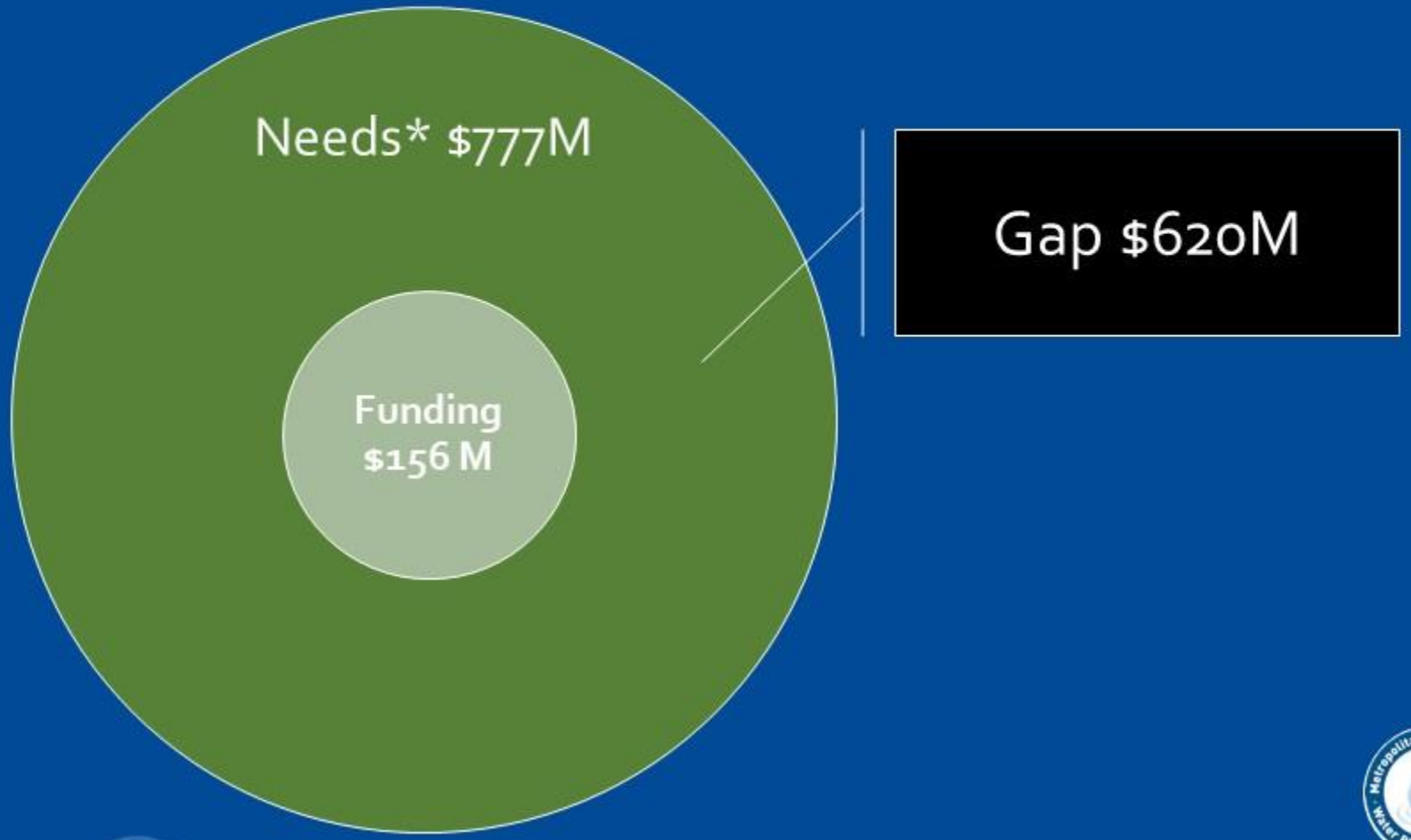
Clayton
Dekalb
Douglasville-Douglas County
Gwinnett
Henry
Rockdale

Cities (44% of Cities in the District)

Auburn
Austell
Avondale Estates
Braselton
Brookhaven
Canton
Cartersville
Chamblee
Clarkston
College Park
Conyers
Decatur
Doraville
Duluth
Dunwoody
East Point
Fairburn
Fayetteville
Hapeville
Holly Springs
Johns Creek
Kennesaw
Lawrenceville
Lithonia
Locust Grove
Loganville
McDonough
Norcross
Peachtree City
Peachtree Corners
Pine Lake
Powder Springs
Roswell
Senoia
Smyrna
Snellville
Stockbridge
Stone Mountain
Sugar Hill
Suwanee
Union City
Woodstock



Metro Water District Annual Stormwater Funding, Needs, and Gap

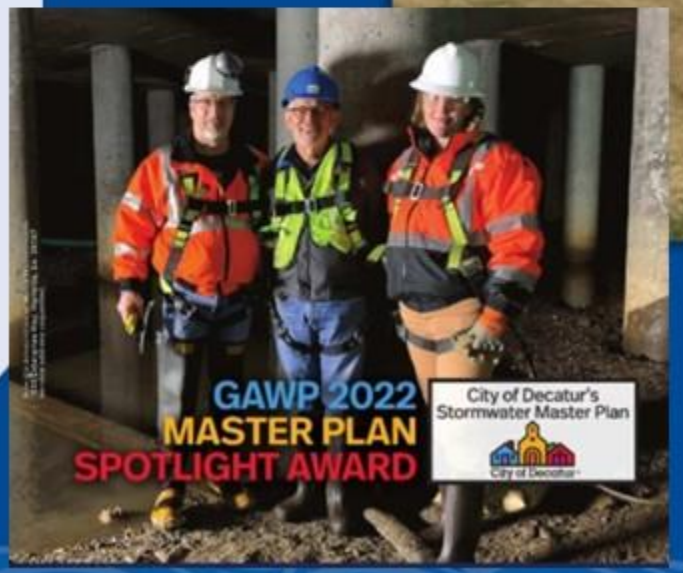


** Averaged Funding Needs in SW Master Plans (Decatur, Doraville, Avondale Estates, Roswell)*

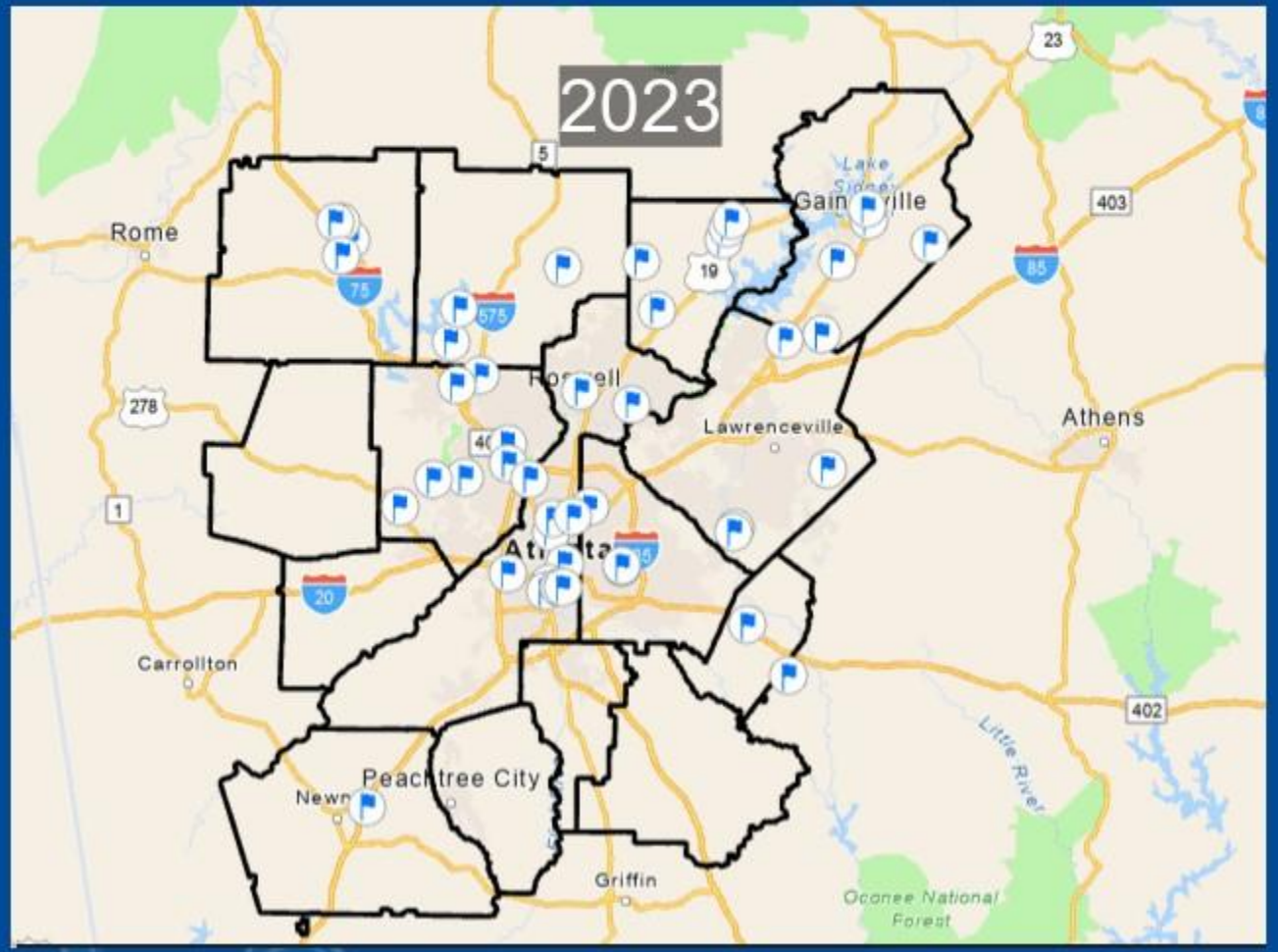
27% of SW volume managed in this basin

LOCAL FACT

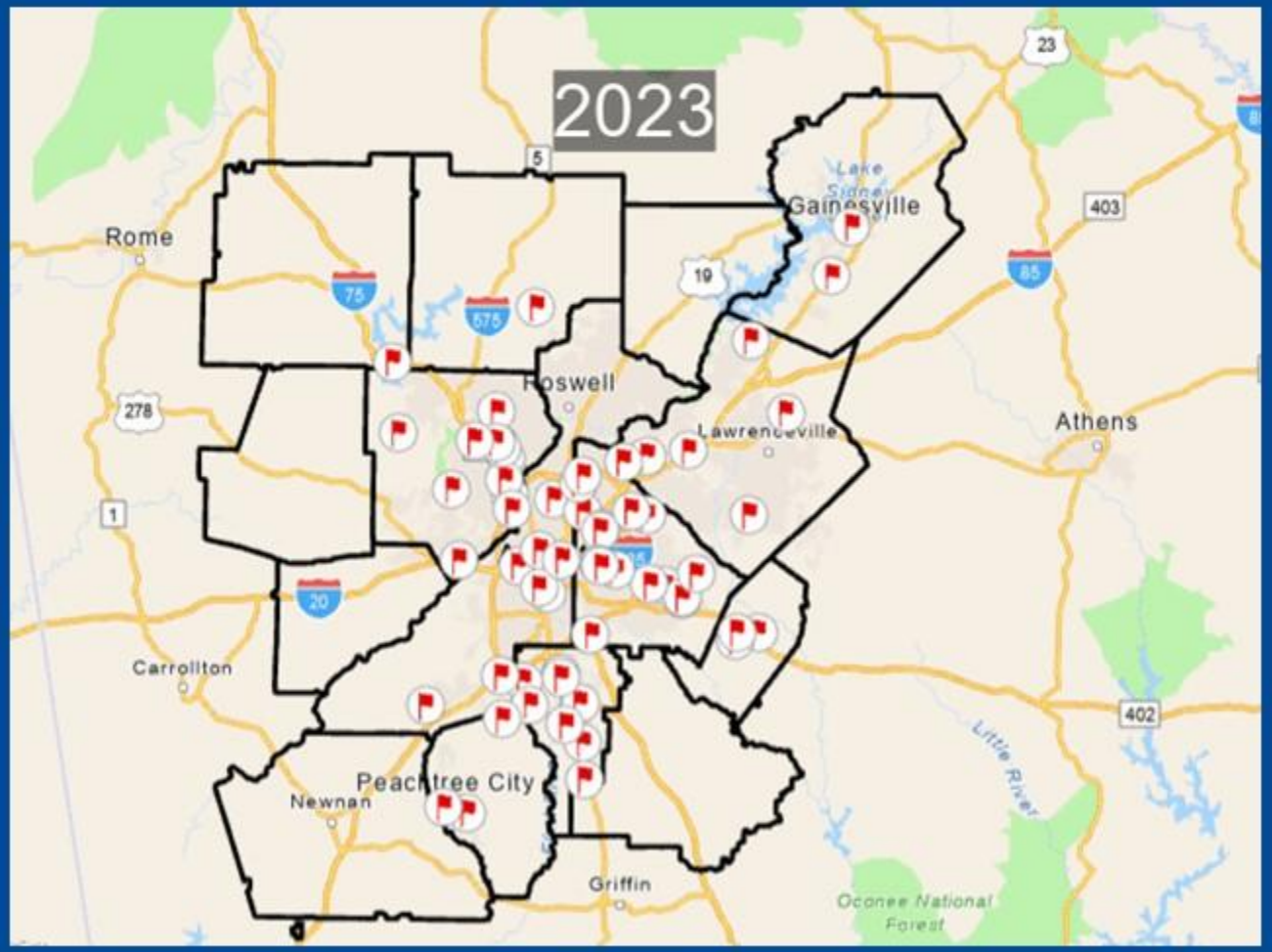
In 2013 the city began large-scale improvements to the downtown drainage system. Underneath Ebster Field is a massive flood control vault, which reduces the flooding risk downtown and improves water quality.



Regional Flooding (2013-2023)



Regional Sink Holes (2013-2023)



The New York Times

Bricks Alive! Scientists Create Living Concrete

"A Frankenstein material" is teeming with — and ultimately made by — photosynthetic microbes. And it can reproduce.

An arch made from living buil
Engineering & Applied Science

PROJECTS IDEAS PEOPLE ABOUT

NEWS + EVENTS | JANUARY 12, 2023

Regenerative Design: What It Is and How It's Driving Innovation

PHYS.ORG

Researchers propose a more effective method to predict floods

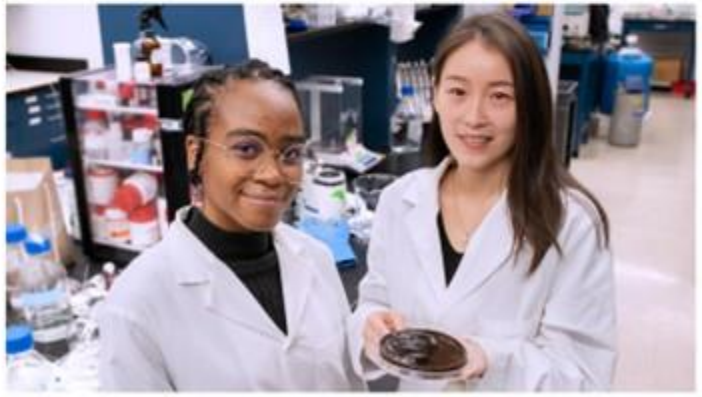
by Yi Qian , Xi'an jiaotong-Liverpool University

ASME | *The American Society of Mechanical Engineers*

About ASME | Codes & Standards | Certification & Accreditation | Learning & Development

Topics & Resources > Content > A Solar-Powered Hydrogel Cleans Water Fast

A Solar-Powered Hydrogel Cleans Water Fast



Fresh water is getting harder to come by. But now this hydrogel will simply, quickly, and cheaply turn filthy water clean.

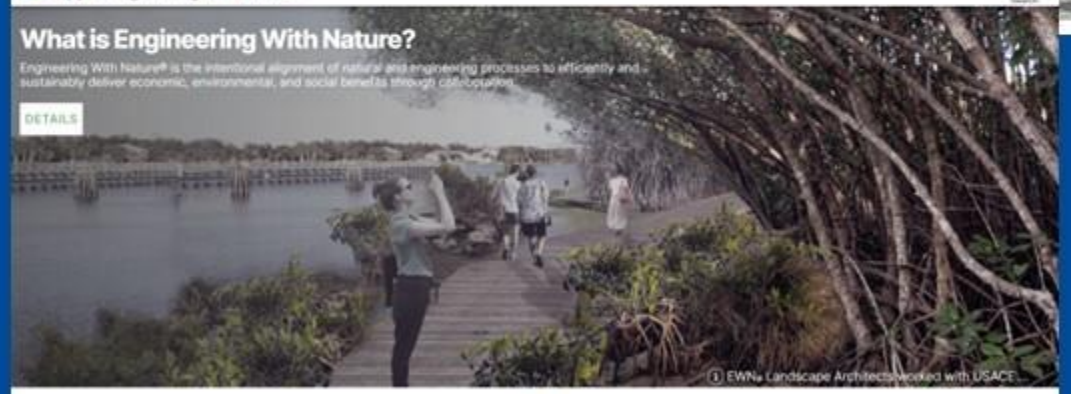
EWN Engineering With Nature

About | News | Podcast | Implementation | Research | Resources | NBS

What is Engineering With Nature?

Engineering With Nature® is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration.

DETAILS



"These projects are delivering broad engineering, economic, environmental, and social value and demonstrate the potential and power of Engineering WITH Nature."

– LTG Scott A. Spellmon, 55th Chief of Engineers, and Commanding General U.S. Army Corps of Engineers, EWN An Atlas, Volume 2 Book Launch Ceremony (7 April 2021)

CQG & MNGWPD Joint Statement

Recent litigation wins have help ensure the metro Atlanta region's long-term water supply to support economic vitality, quality of life, and progress. Good management of stormwater protects human life, property, and natural resources. As more of metro Atlanta urbanizes and is more densely developed, robust stormwater infrastructure improves water quality, mitigates flooding, and protects ecosystems. And as the intensity and frequency of storms increases, we must take collaborative action to improve the region's stormwater management practices and policies – to ensure our continued quality of life.

COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District

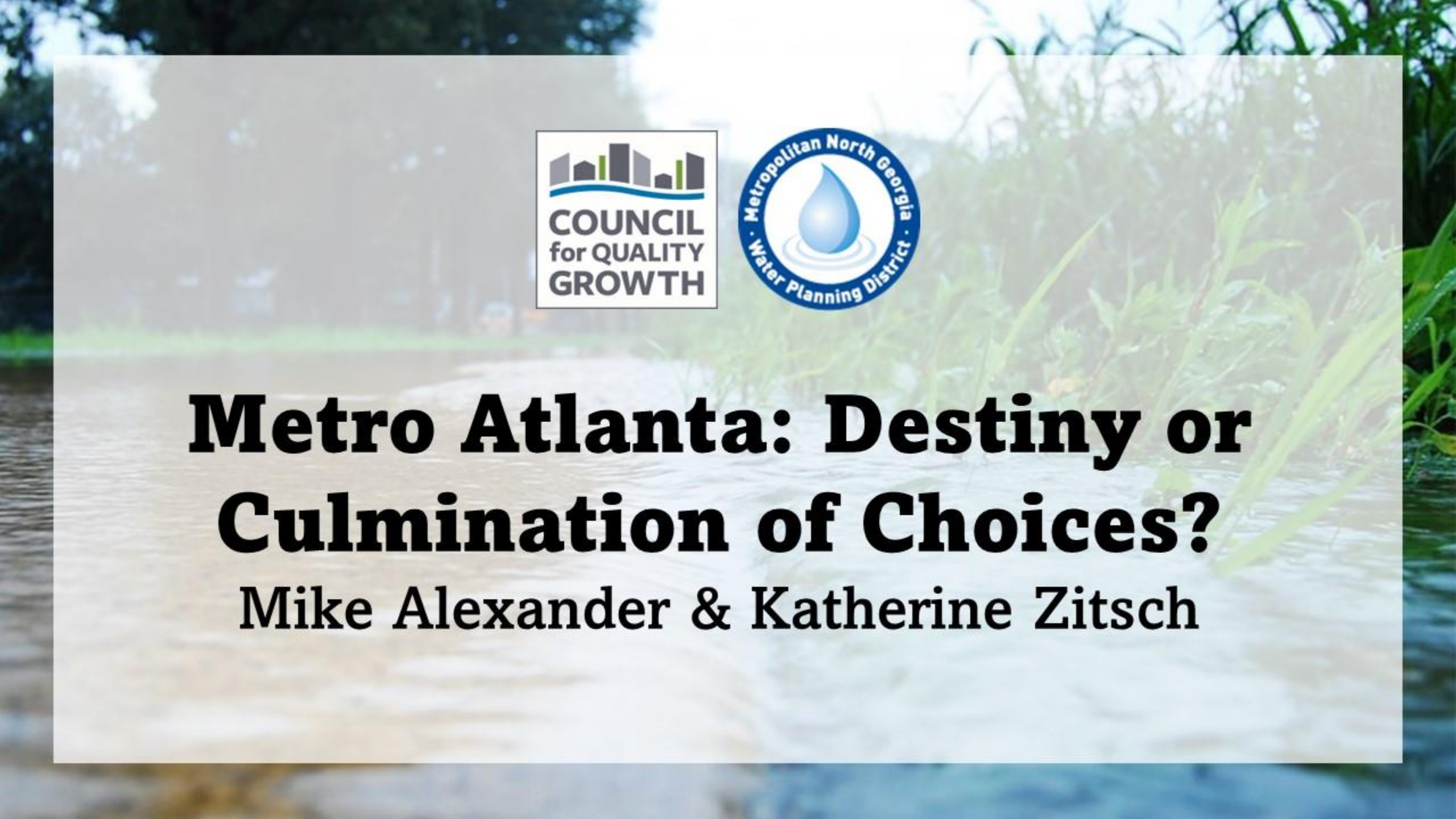
Mike Alexander

Chief Operating Officer
Atlanta Regional Commission

ARC
Atlanta Regional Commission

COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District



Metro Atlanta: Destiny or Culmination of Choices?

Mike Alexander & Katherine Zitsch





Regional Growth Trends

focus on Development

Mike Alexander

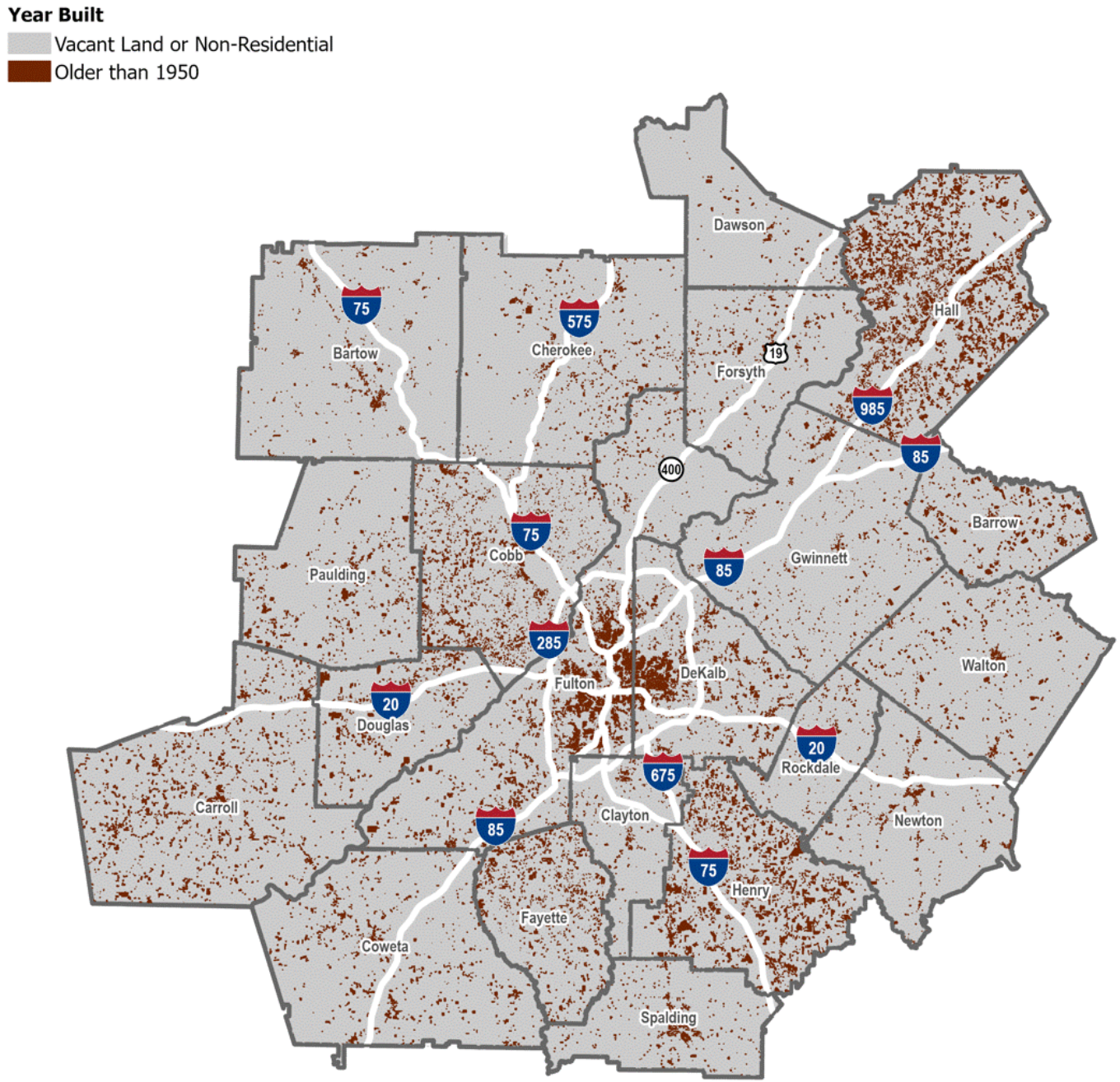
Chief Operating Officer

malexander@atlantaregional.org

Atlanta Regional Commission

Residential Construction Growth by Decade

Residential growth significantly slowed down in the last decade. Many counties have limited available land for residential growth.



ONE great REGION

Executive Summary

Land development patterns changed after the great recession. **Fewer residential units have been constructed this past decade than in any of the previous five decades.**

Housing prices have risen across the region. **The median sales price increased 52% from Jan 2019 to Jan 2023 ($230K to $350K).** Supply is at record lows.

Similarly, the region has seen fewer office and retail developments. **Current economic conditions will further this slowdown**.

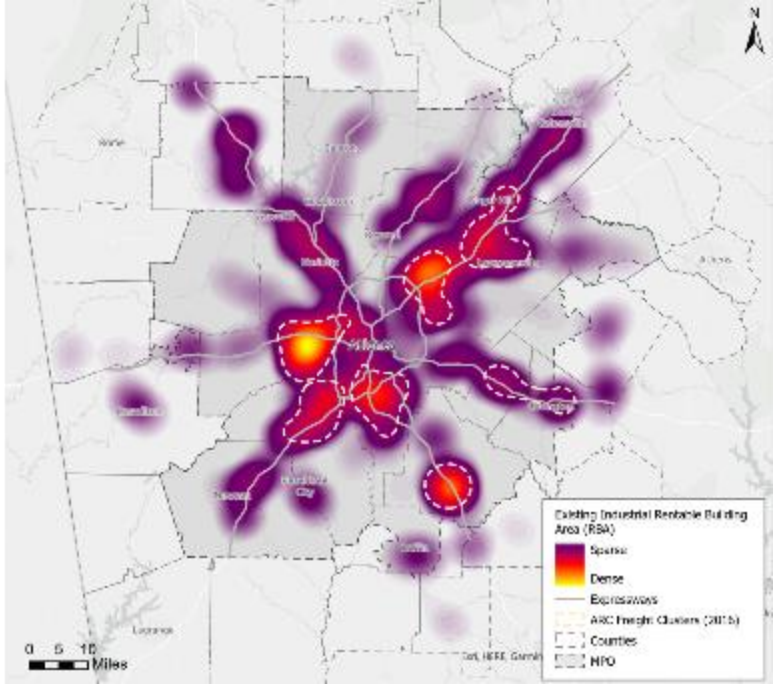
Industrial development, especially distribution, has increased in total development compared to previous decades. Announced new manufacturing developments, with substantial new jobs in more rural areas of North Georgia, will impact our economic growth trajectory and land use pattern change assumptions.

Housing is Infrastructure https://www.hud.gov/ourwayhome/blog_06_30_22

Existing Industrial

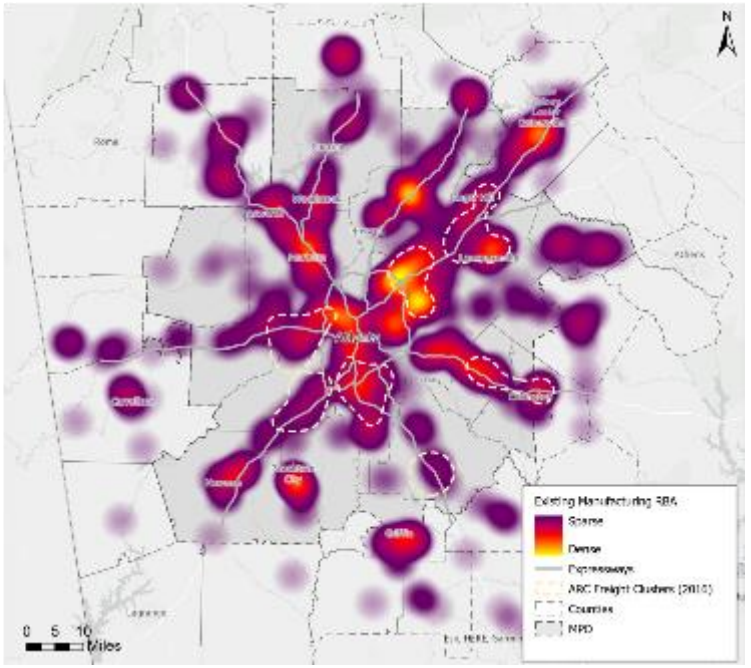
Properties: 18,114
Total Rentable Building Area (RBA): 846.2M SF
Max RBA: 2.8M SF
Min RBA: 240 SF

(RBA) Rentable Building Area



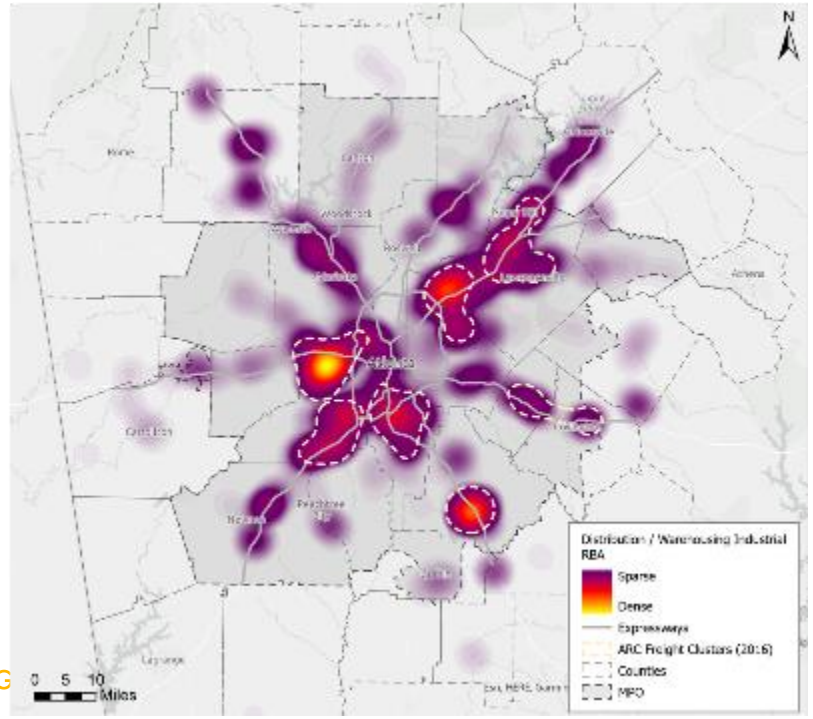
Manufacturing

Properties: 1,011
Total RBA: 89.12M SF
Max RBA: 2.2M SF
Min RBA: 627 SF

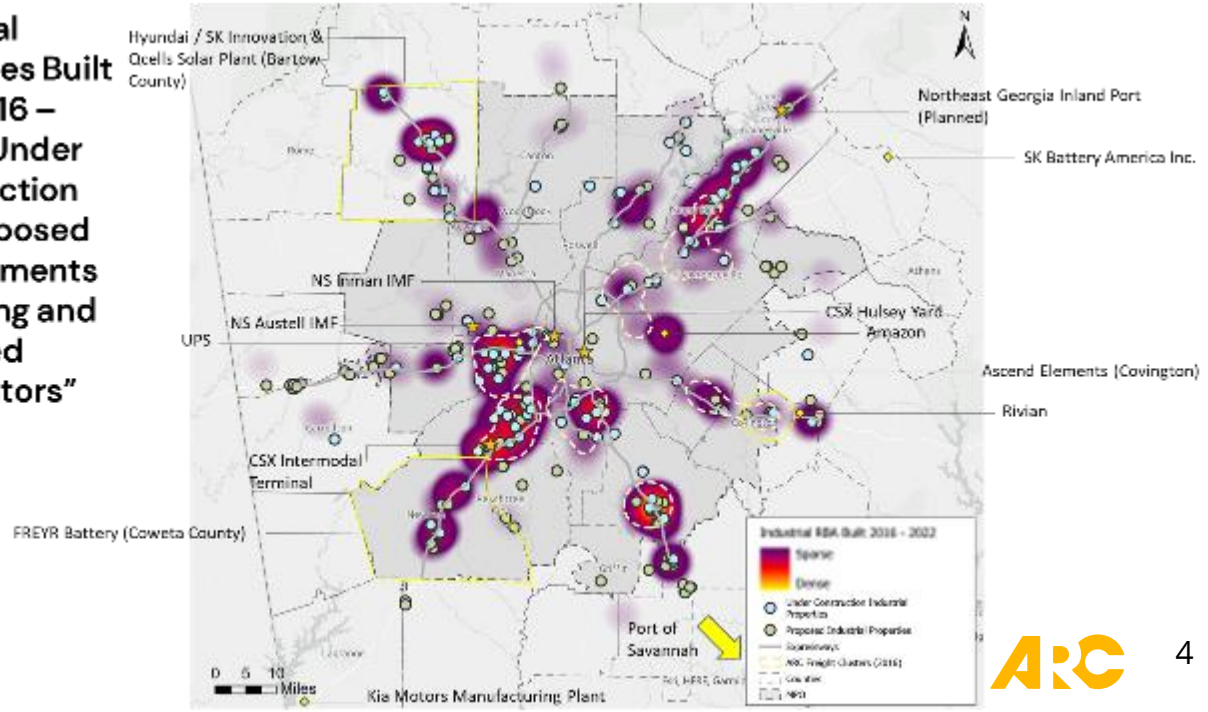


Distribution

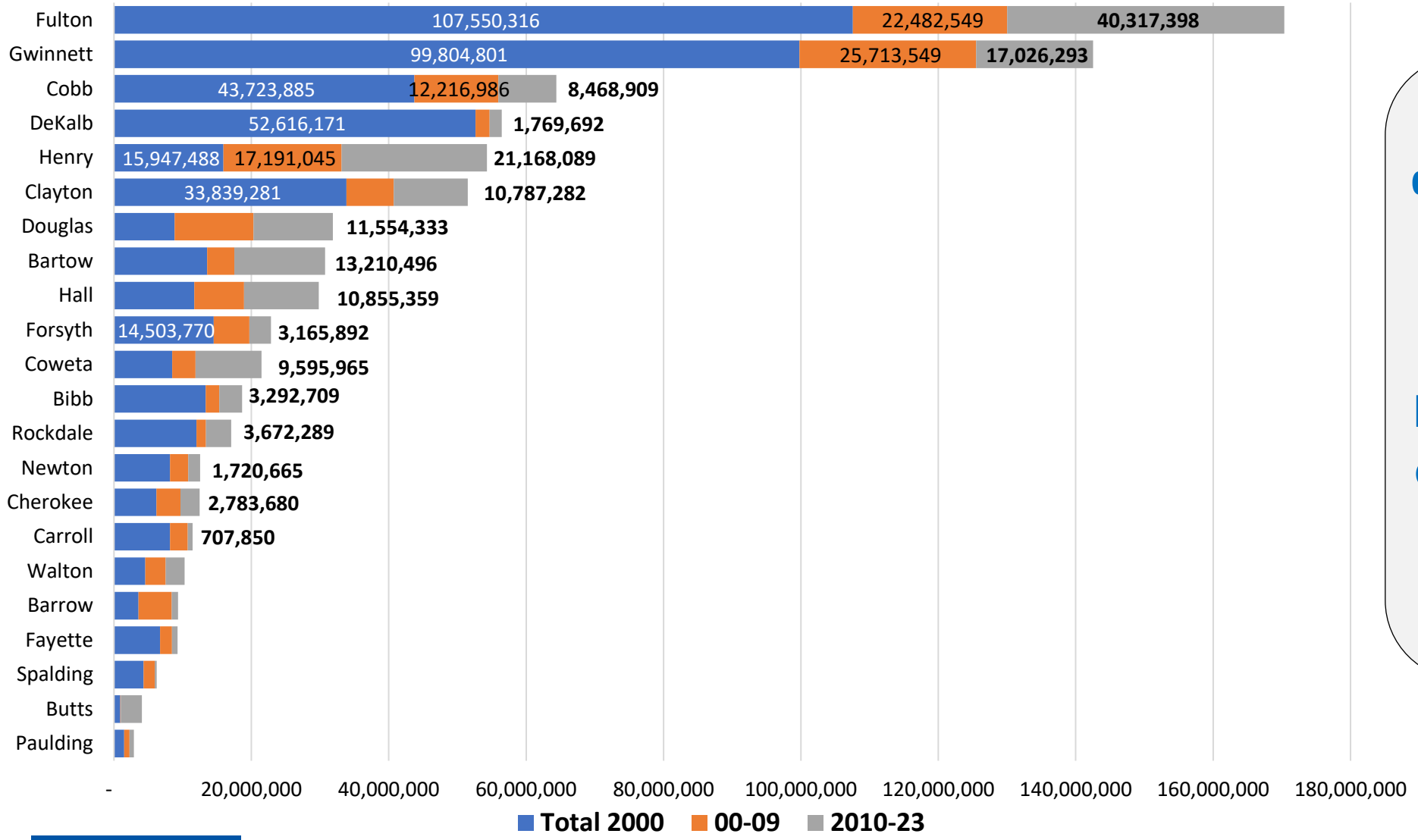
Properties: 12,141
Total RBA: 660.7M SF
Max RBA: 2.8M SF
Min RBA: 300 SF



Industrial Properties Built from 2016 – 2022 + Under Construction and Proposed developments + Existing and Proposed "Generators"



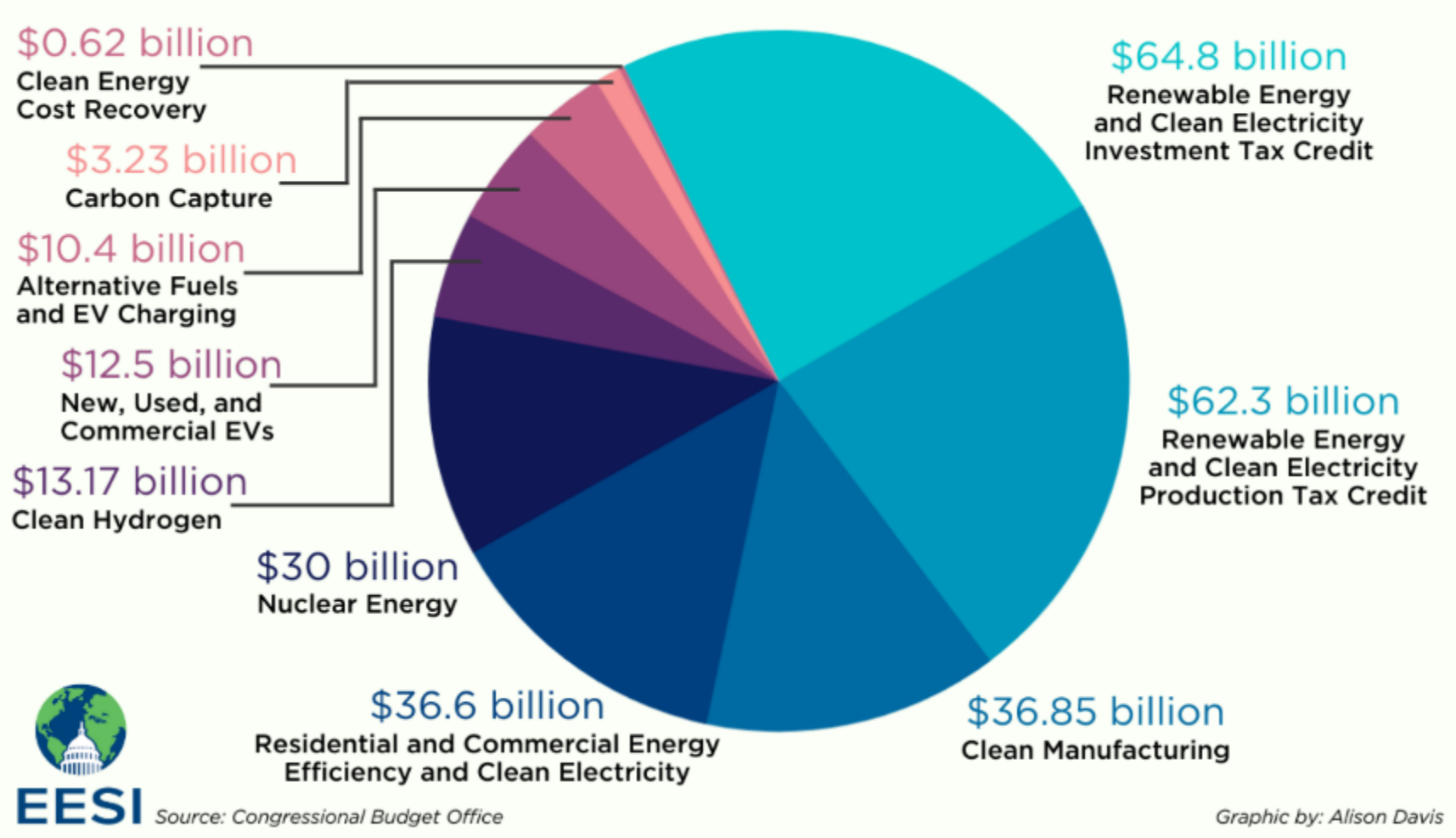
Distribution Space Construction is Growing Rapidly in All Counties



The Atlanta region is a national distribution center. Fulton, Henry, Gwinnett, Douglas, Clayton (as well as Bartow and Hall) have each added more than 10 M sq ft of space since 2010.

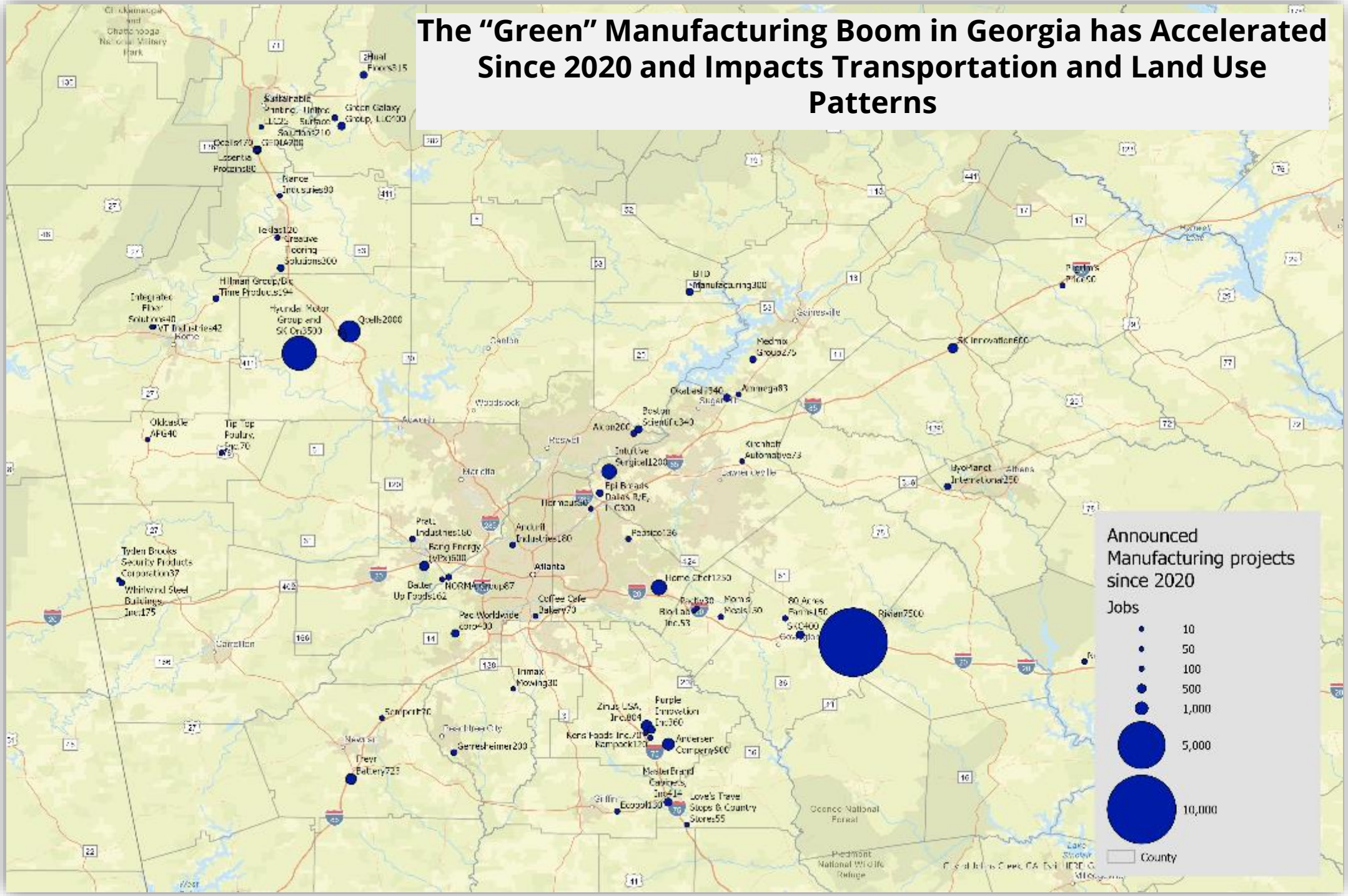
Federal Implementation Priority: Climate and Resilience

*The **Inflation Reduction Act (IRA)**, through the use of $270 billion in tax credits, is contributing to a major "on-shoring" of green manufacturing and energy businesses in Georgia*



The IRA has supported a green manufacturing and energy boom in Georgia. The IRA has increased manufacturing in Georgia for several "green" technologies - such as electric vehicles and solar panels

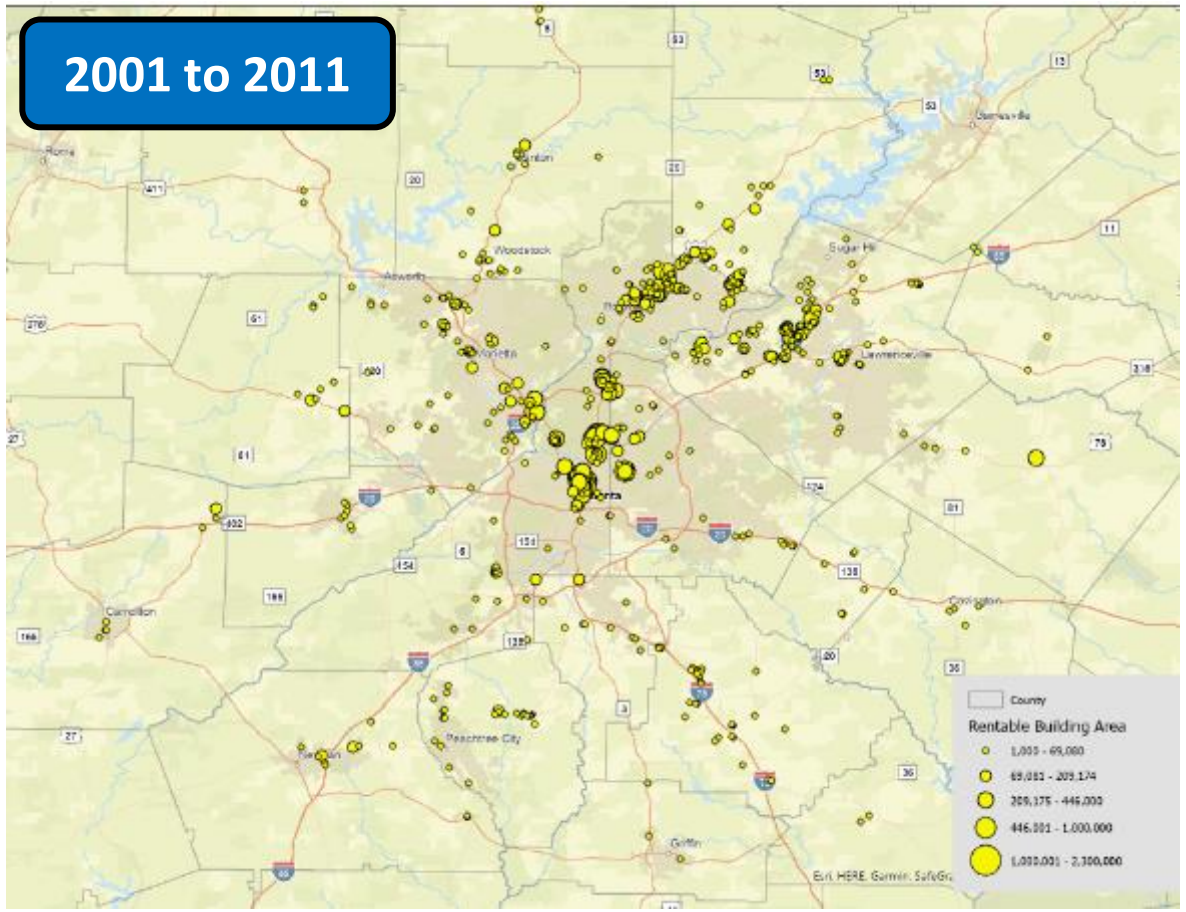
The "Green" Manufacturing Boom in Georgia has Accelerated Since 2020 and Impacts Transportation and Land Use Patterns

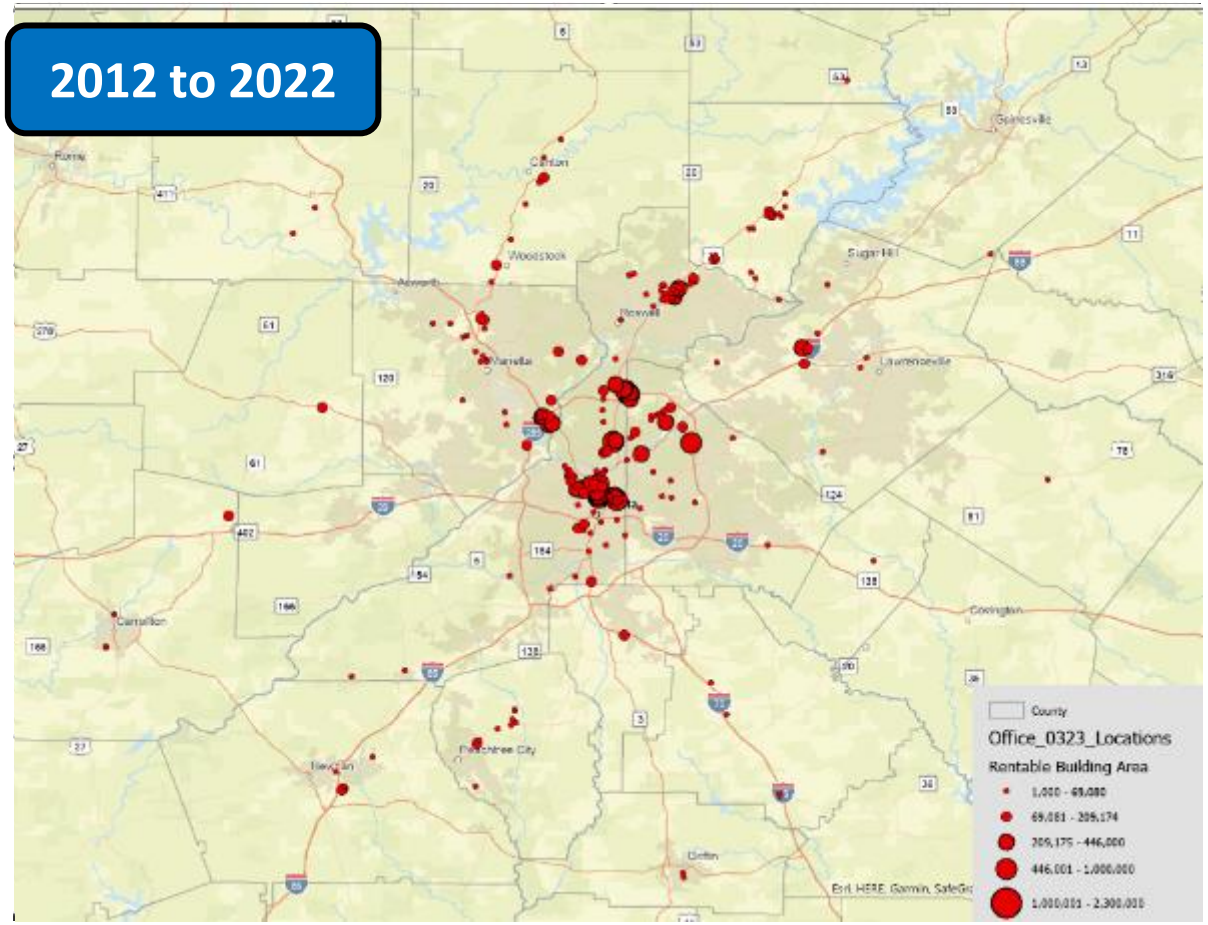


The dramatic expansion of manufacturing since 2020 – which previously decreased for decades – is a major factor that must be included in future land use and transportation plans

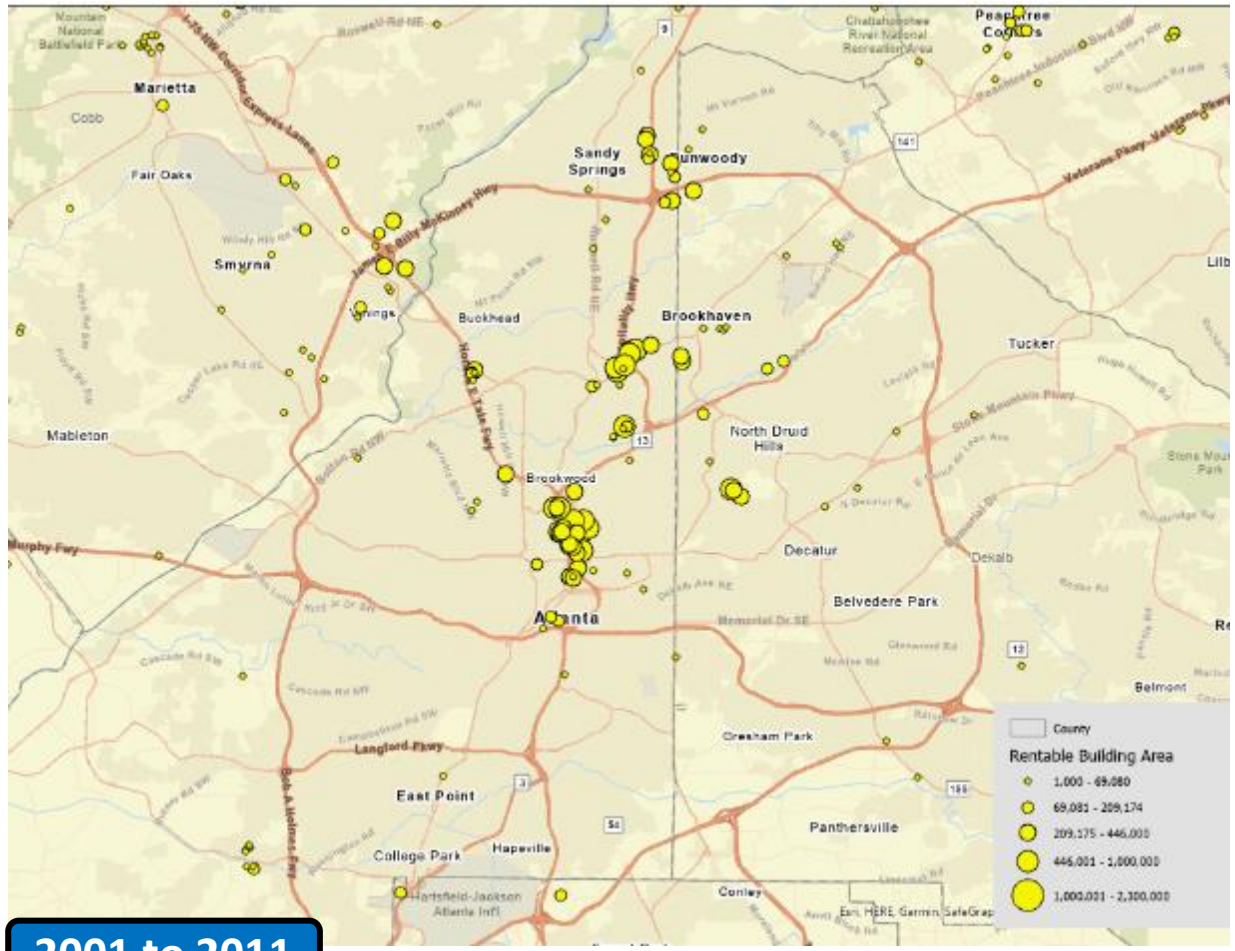
Major Office Construction Projects (over 50,000 sq ft) Decreased Over the Last Decade, Impacting Transportation Patterns (down 49%)

With generally higher office vacancy rates and fewer major construction projects in our traditional office centers, This challenge has a major impact on transportation patterns in the region.

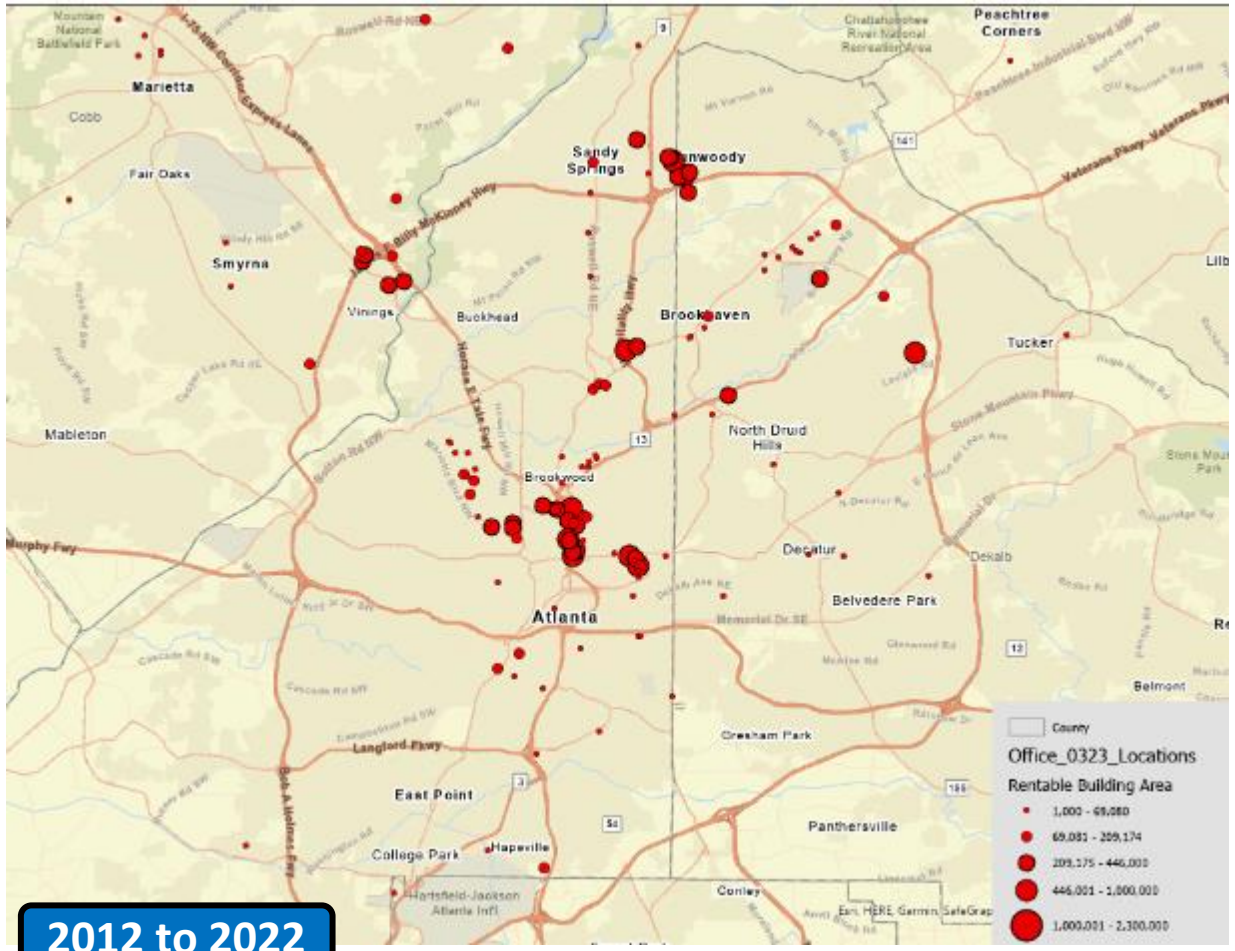




Central Region: Office Building Construction (over 15,000 sq ft)



2001 to 2011

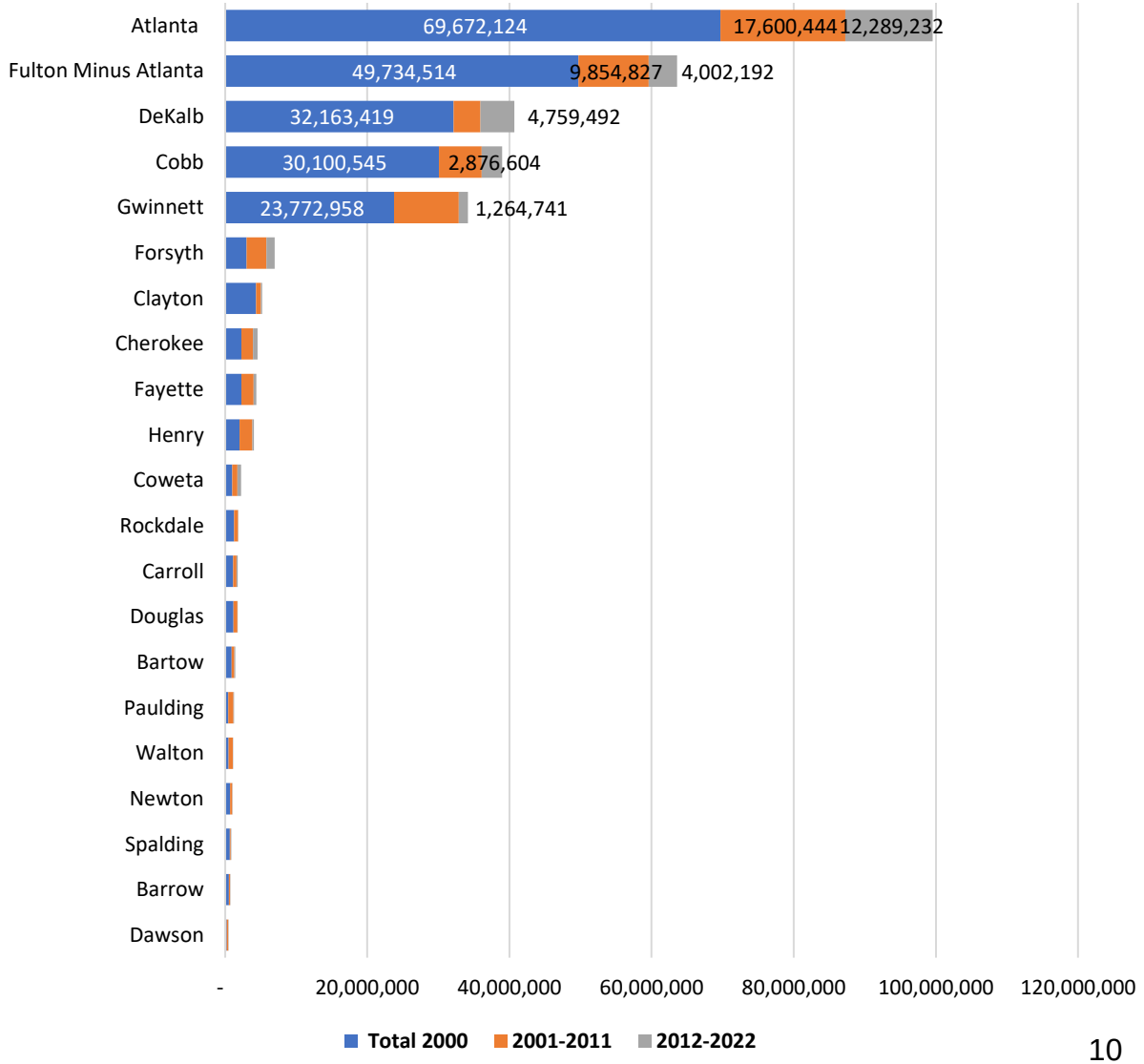


2012 to 2022

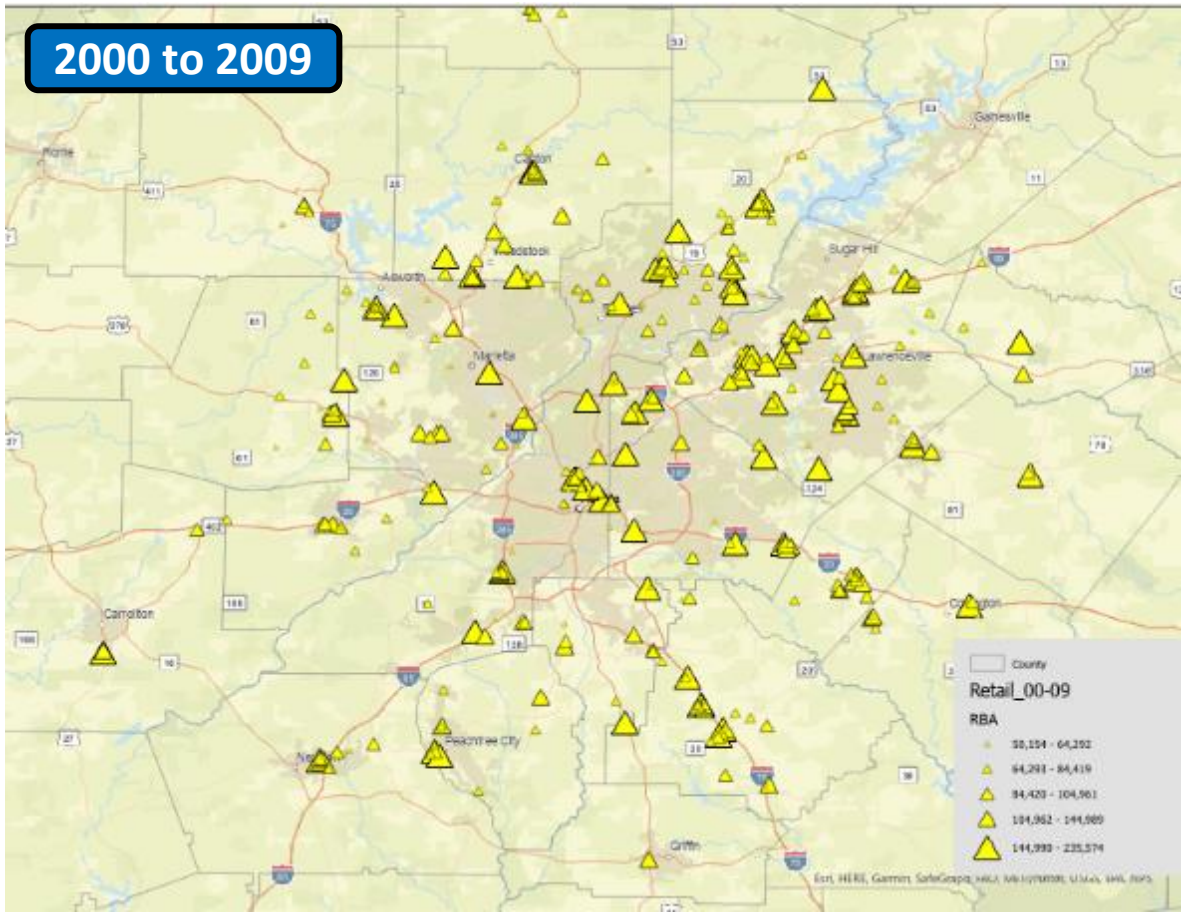
Office Space Construction Increased by 49% Between 2012-2022 in Comparison to the Prior Decade, with the Majority of Construction in Atlanta, Fulton and DeKalb.

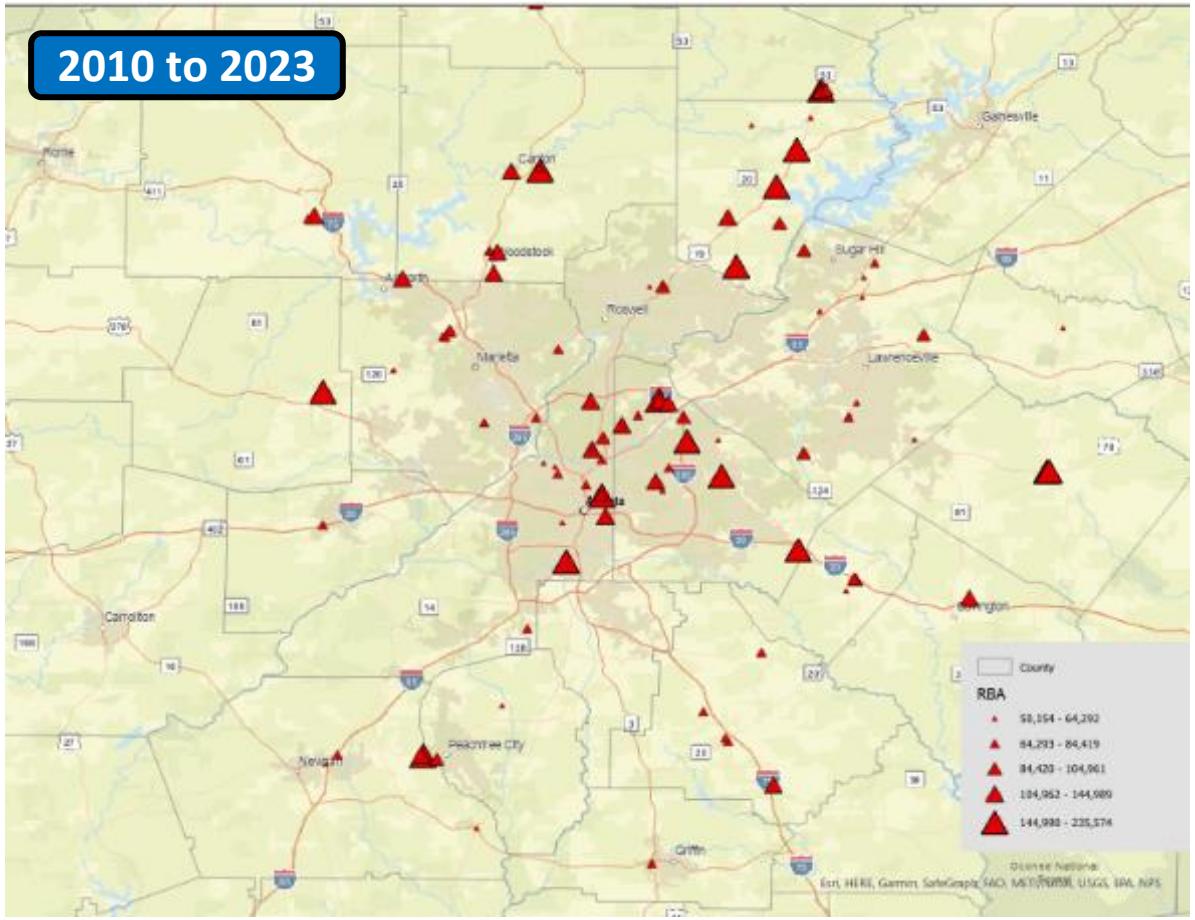
How will the increase in remote working impact the levels of future office construction?

	Total 2000	2001-2011	2012-2022	Share Comparison 2010s to 2000s	Total
Atlanta	69,672,124	17,600,444	12,289,232	70%	99,561,800
Fulton Minus Atlanta	49,734,514	9,854,827	4,002,192	41%	63,591,533
DeKalb	32,163,419	3,780,162	4,759,492	126%	40,703,073
Cobb	30,100,545	6,014,777	2,876,604	48%	38,991,926
Gwinnett	23,772,958	9,112,287	1,264,741	14%	34,149,986
Forsyth	3,037,342	2,764,962	1,179,120	43%	6,981,424
Clayton	4,368,048	688,652	132,108	19%	5,188,808
Cherokee	2,270,014	1,631,533	666,732	41%	4,568,279
Fayette	2,307,456	1,692,274	387,440	23%	4,387,170
Henry	2,024,904	1,796,193	237,215	13%	4,058,312
Coweta	1,000,364	730,346	501,844	69%	2,232,554
Rockdale	1,250,971	556,826	56,192	10%	1,863,989
Carroll	1,125,323	458,015	199,440	44%	1,782,778
Douglas	1,168,366	582,688	3,676	1%	1,754,730
Bartow	933,111	379,040	118,000	31%	1,430,151
Paulding	449,247	706,268	85,872	12%	1,241,387
Walton	494,974	577,564	47,855	8%	1,120,393
Newton	708,642	303,472	26,632	9%	1,038,746
Spalding	642,866	160,421	80,610	50%	883,897
Barrow	528,933	188,999	40,833	22%	758,765
Dawson	210,434	223,634	49,497	22%	483,565
Grand Total	227,964,555	59,803,384	29,005,327	49%	316,773,266

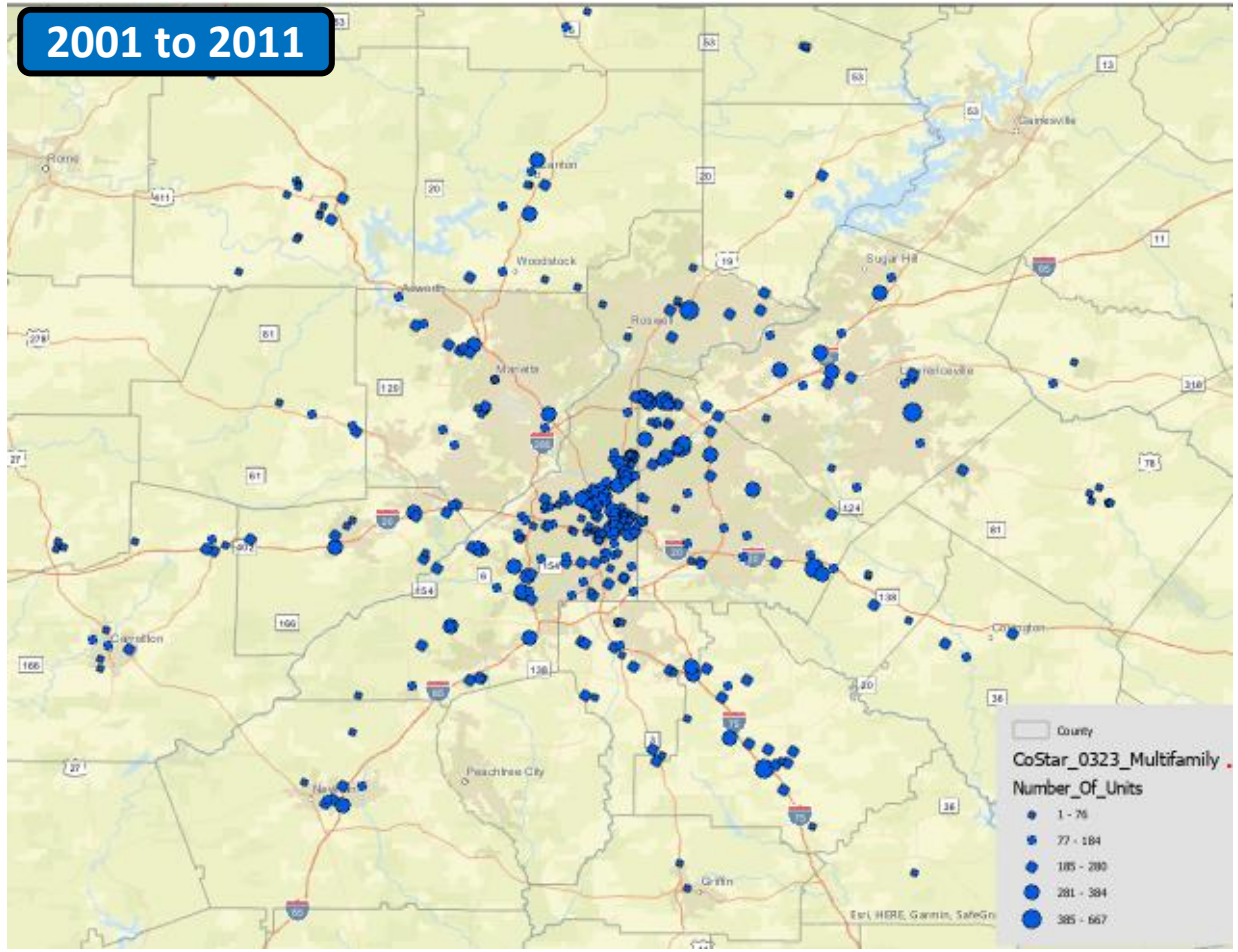


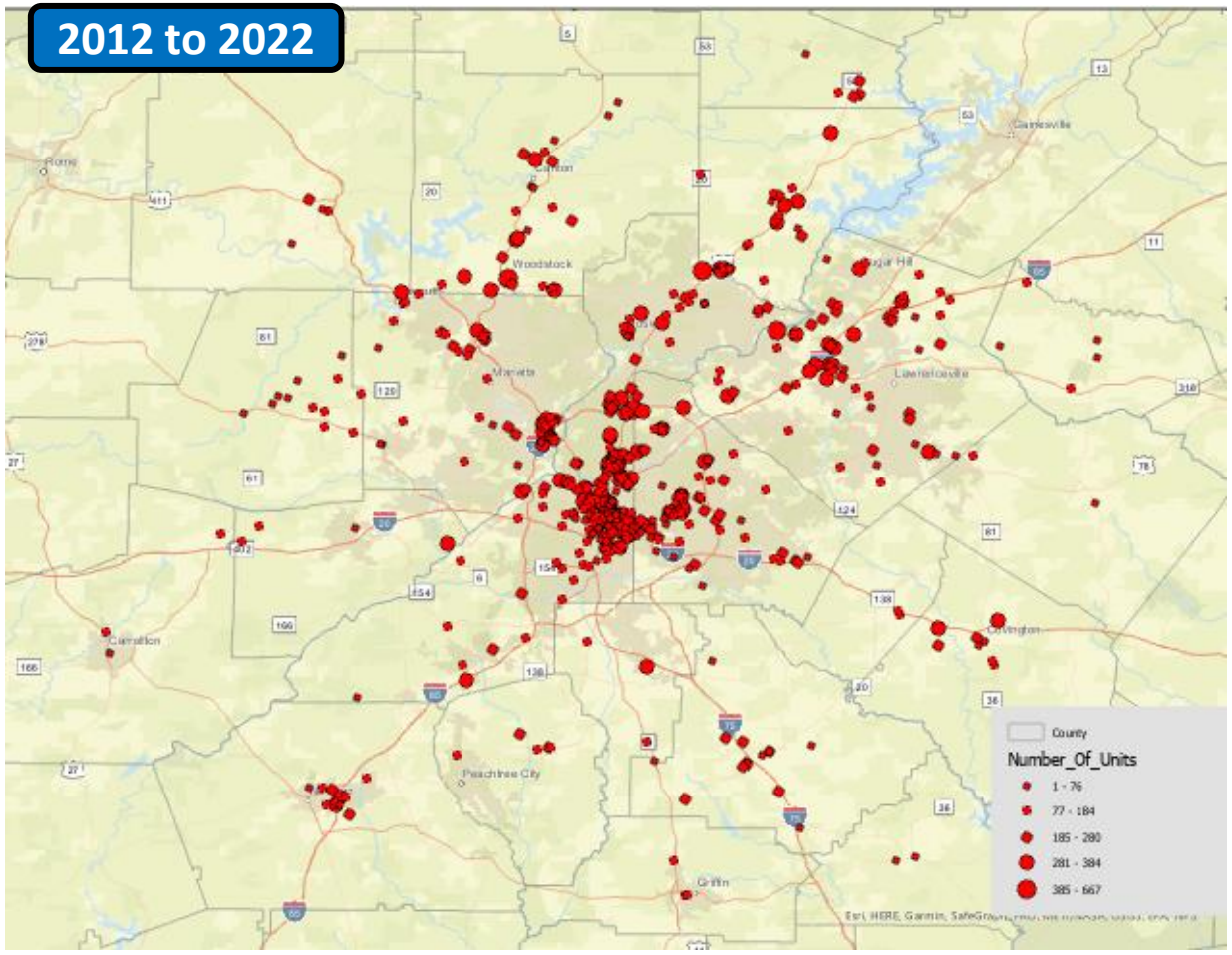
New Retail Construction (15,000 sq ft) has Slowed Significantly Compared to the Prior Decade



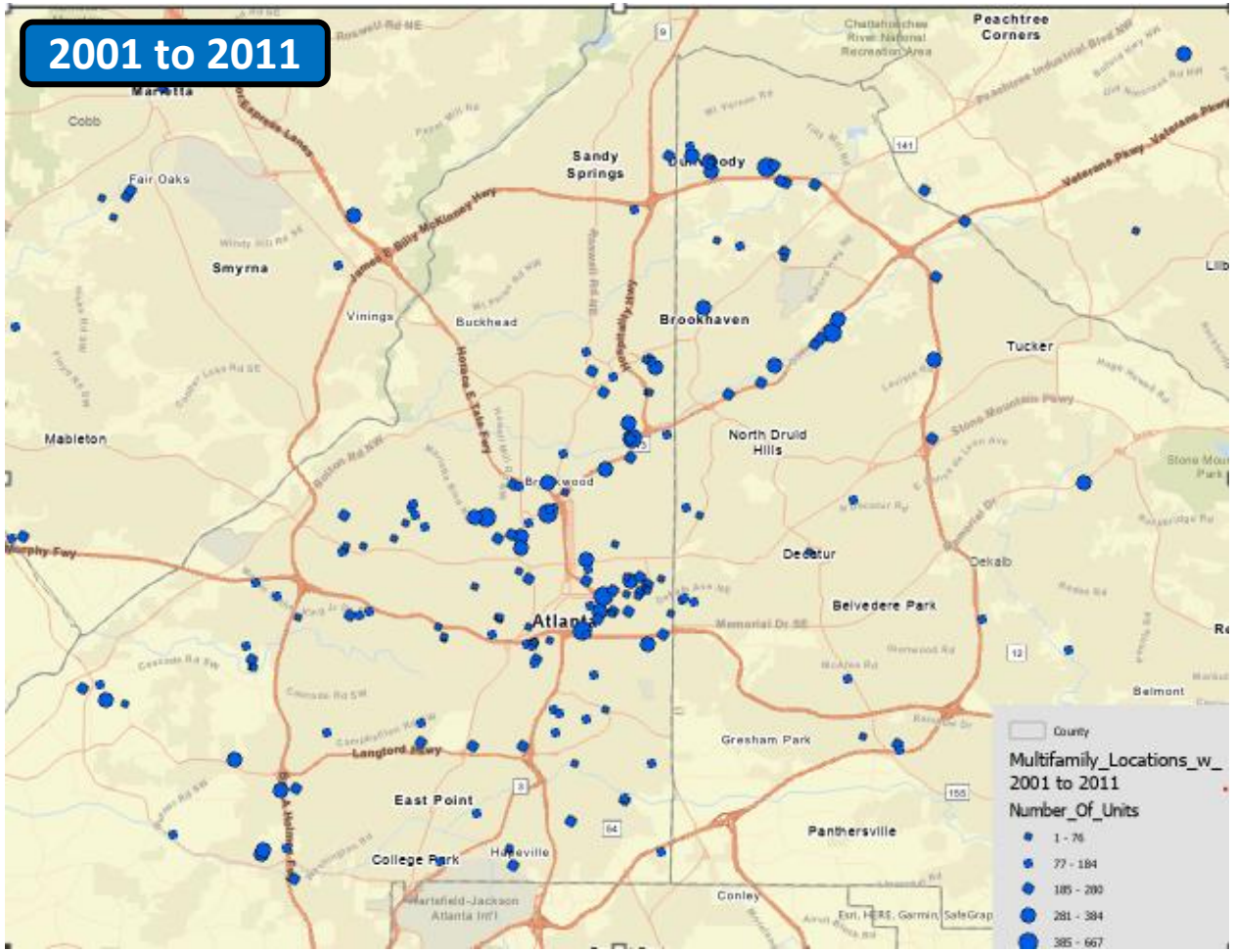


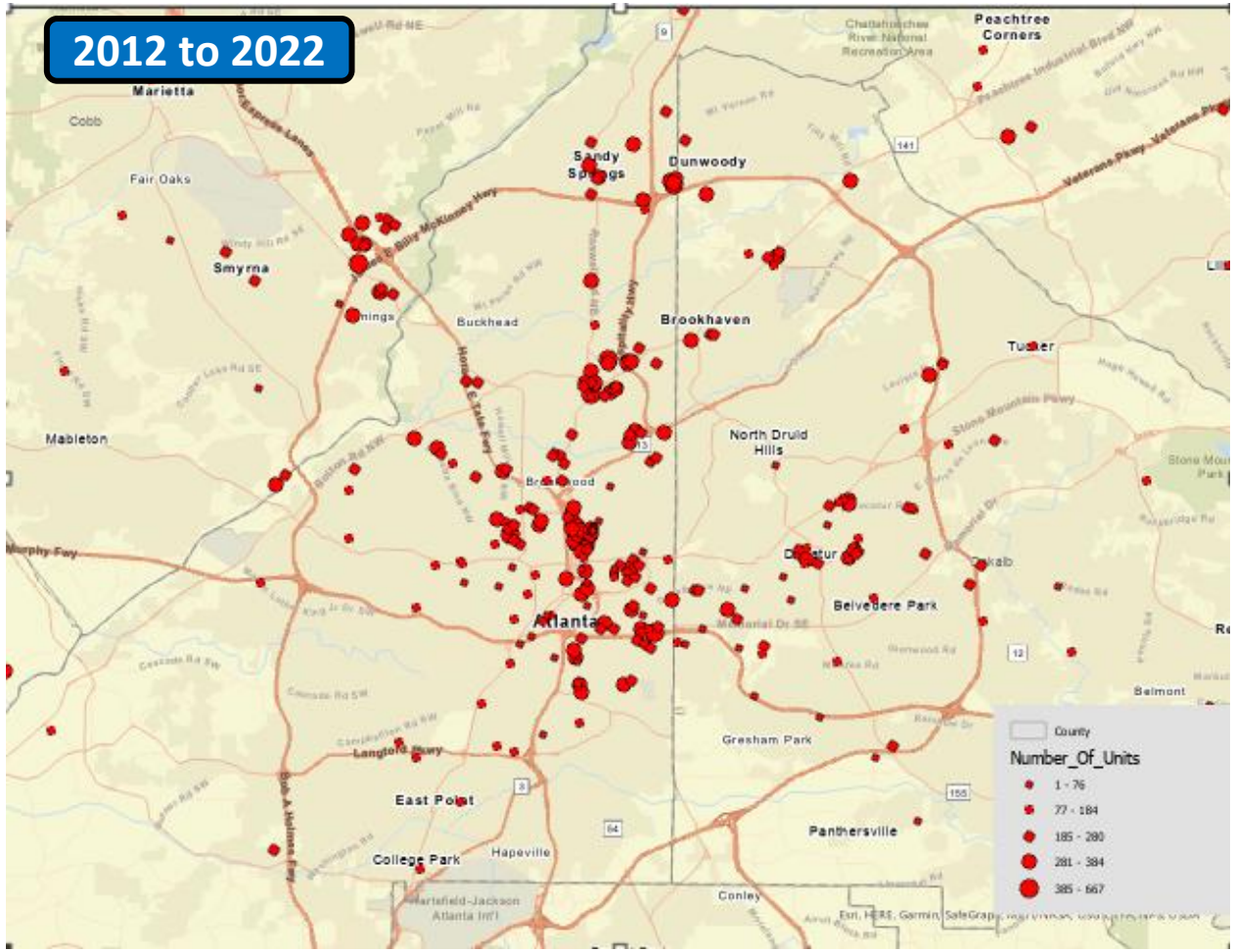
Regional Multi-Family Construction Continues to Concentrate Around the Interstate System and Major Arterial Roadways





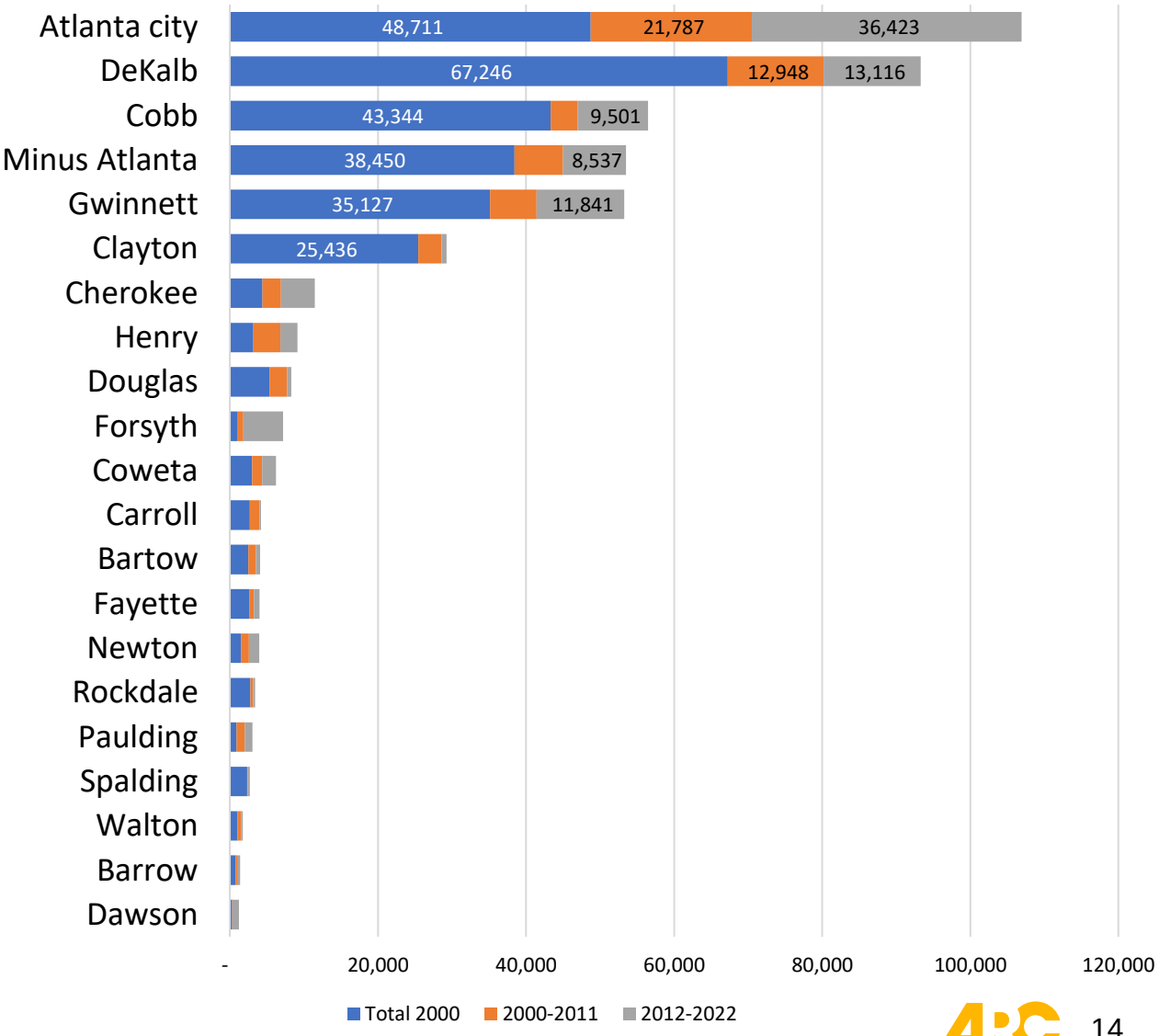
Core Region: Multi-Family Construction Increased Over the Last Decade in Many Activity Centers (Midtown, Buckhead, Cumberland, Decatur, etc.)





Multi-Family Construction Increased in Most Jurisdictions, Especially in the Core

Row Labels	Total 2000	2000-2011	2012-2022	Share Comparison 2010s to 2000s
Atlanta city	48,711	21,787	36,423	167%
DeKalb	67,246	12,948	13,116	101%
Cobb	43,344	3,649	9,501	260%
Fulton Minus Atlanta	38,450	6,527	8,537	131%
Gwinnett	35,127	6,278	11,841	189%
Clayton	25,436	3,161	662	21%
Cherokee	4,375	2,518	4,579	182%
Henry	3,165	3,661	2,302	63%
Douglas	5,363	2,377	541	23%
Forsyth	970	841	5,345	636%
Coweta	2,985	1,357	1,878	138%
Carroll	2,703	1,305	203	16%
Bartow	2,473	1,043	543	52%
Fayette	2,614	615	774	126%
Newton	1,497	1,052	1,422	135%
Rockdale	2,771	364	250	69%
Paulding	916	1,098	1,034	94%
Spalding	2,328	72	289	401%
Walton	1,008	508	202	40%
Barrow	792	167	411	246%
Dawson	313	36	865	2403%

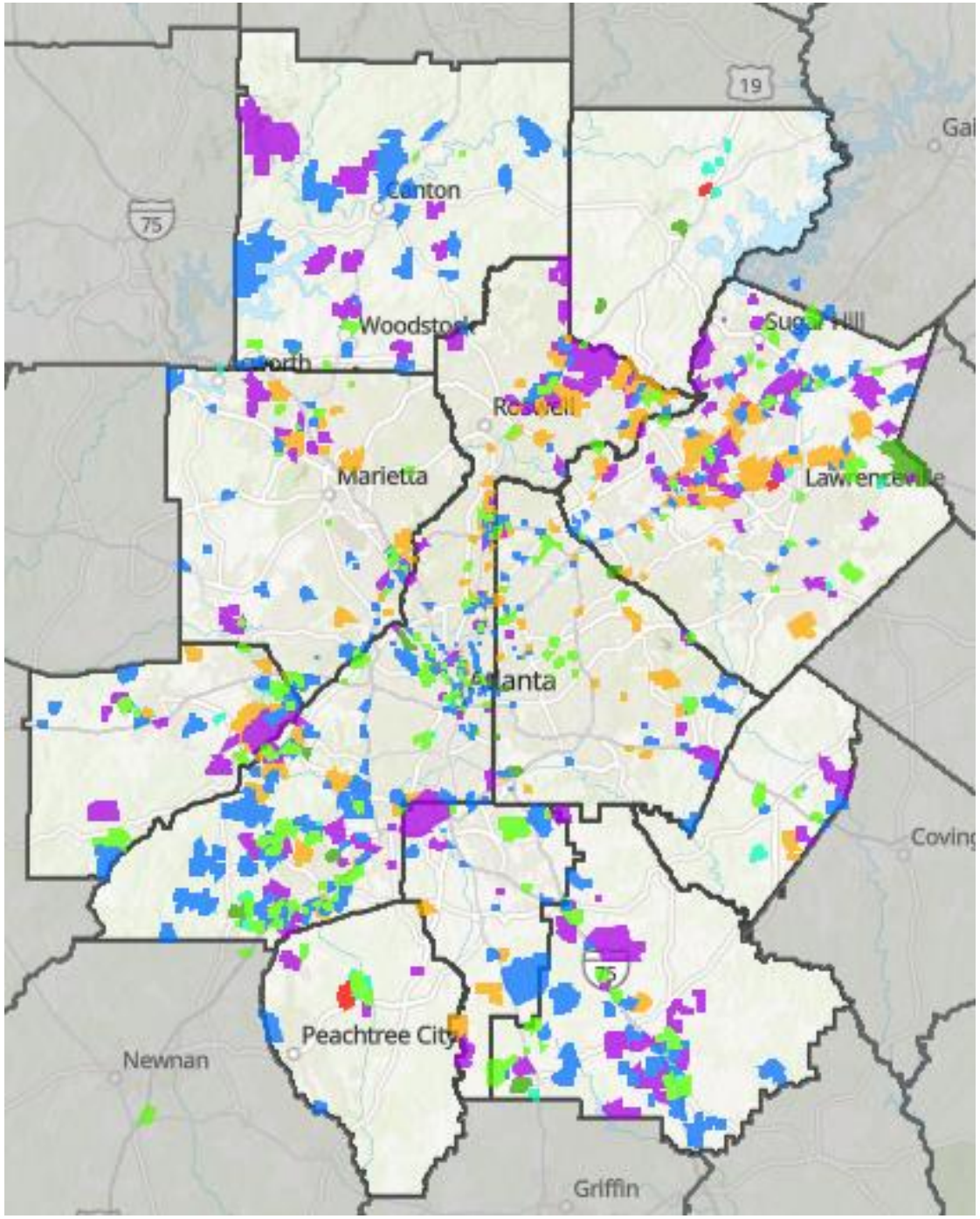


Residential Units Authorized by Permits Lag Levels from the 2001-2010 Period by **59%**

Between 2011 to 2020, only Forsyth County issued building permits at the same level as in 2001-2010.

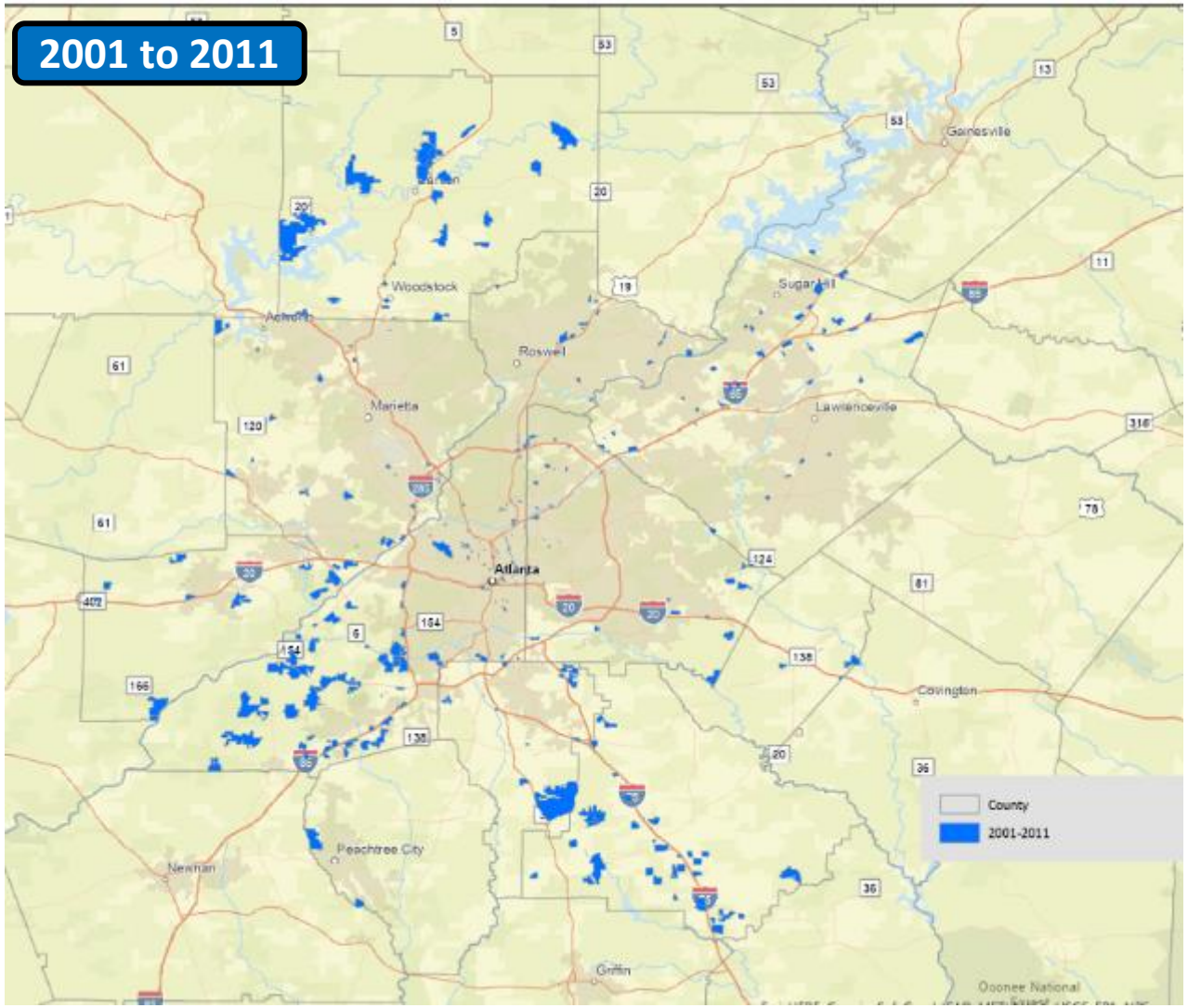
Jurisdiction	2019	2020	2021	2022	Avg 01-10	Av 11-20	Share of 01-10
ATLANTA	3283	1674	2413	11853	6168	4419	72%
Barrow	740	940	1124	1040	874.7	479.8	55%
Bartow	860	864	1135	2405	818.8	453.4	55%
Carroll	792	792	1251	746	1195.6	373.8	31%
Cherokee	2443	2394	2754	3021	2674.3	2039.6	76%
Clayton	905	954	929	373	1817.9	441.7	24%
Cobb	3567	2494	2953	2873	4045.6	2739.9	68%
Coweta	1344	1014	1716	717	1431.6	887	62%
Dawson	423	430	581	553	291	267.3	92%
DeKalb	2011	2200	2844	2409	4587.1	1884	41%
Douglas	449	747	1639	665	1391.2	323	23%
Fayette	518	564	762	602	615.4	414.4	67%
Forsyth	1851	2485	2359	2601	2665.9	2740.1	103%
Fulton not Atlanta	3107	2600	2778	2772	4409.5	2790.7	63%
Gwinnett	4165	4539	4754	5359	6871.7	3424.7	50%
Hall	1096	1080	1588	2067	1142.3	838.3	73%
Henry	1816	1867	2761	2522	2738.5	1212.4	44%
Jackson	1097	1422	1782	2056	828.6	714.4	86%
Paulding	1635	1893	2193	1534	2174.4	1117.6	51%
Rockdale	275	269	218	1024	627.4	172.6	28%
Spalding	417	257	623	524	384.3	203.2	53%
Walton	782	855	1136	810	989.7	438.8	44%
Grand Total	35926	32818	41265	58920	54468.9	32183.4	59%

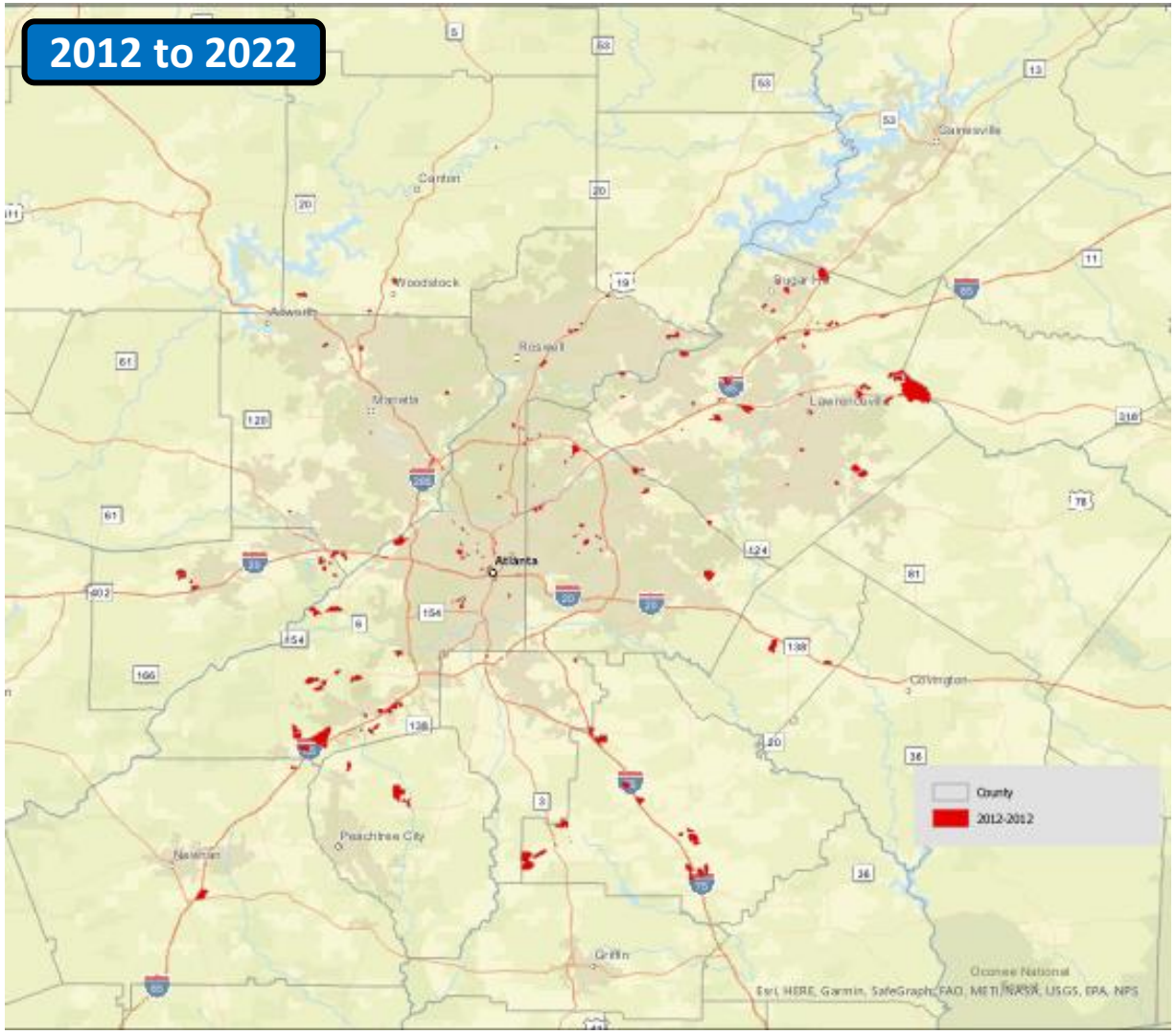
DRIs by Decade



Developments of Regional Impact (DRI) Reviews

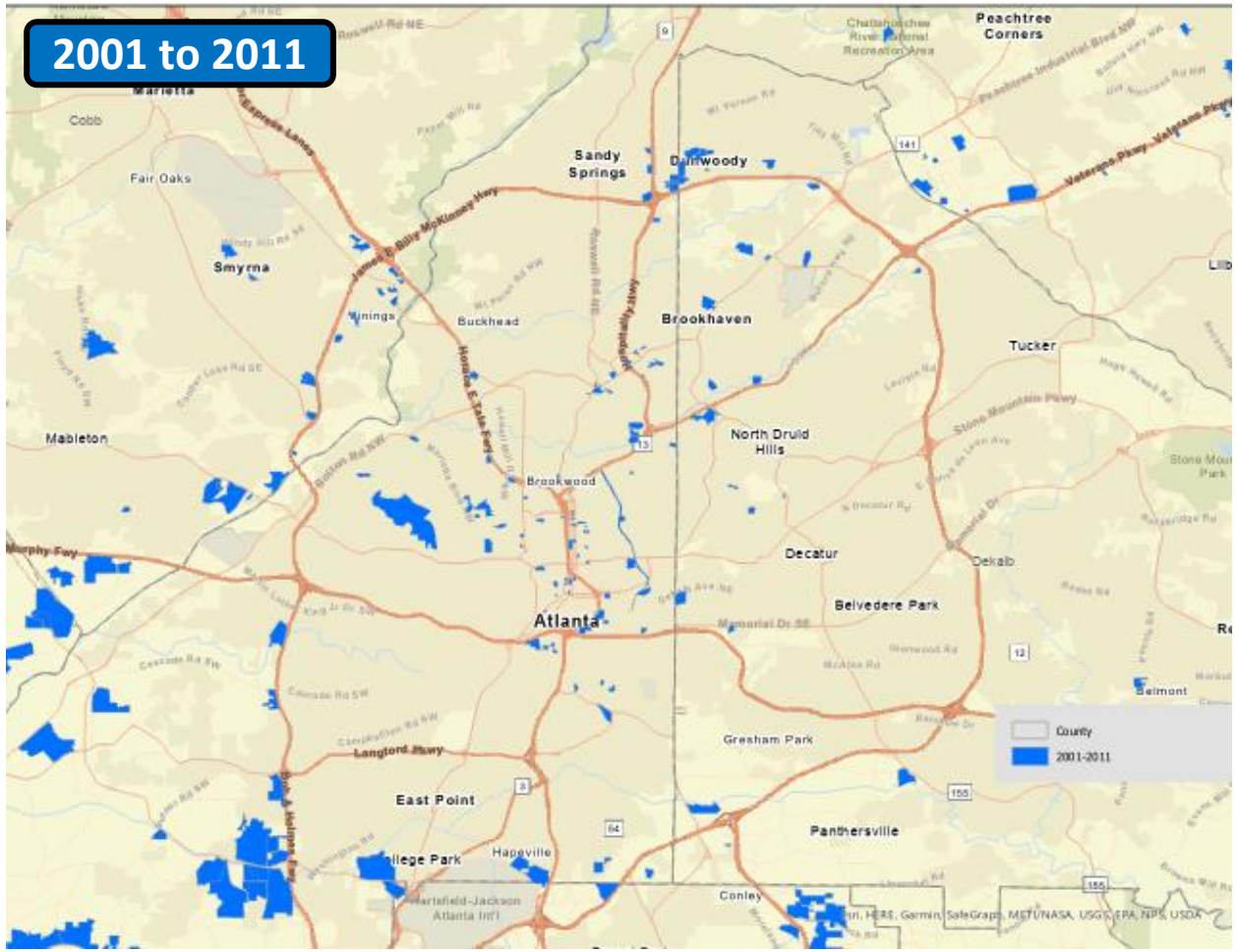
Generally, over the past decade, the scale of individual DRIs has decreased compared to prior decades. However, many of the DRIs previously reviewed from 2001 to 2011 are returning for updated reviews





Core Region: Developments of Regional Impact (DRI) Reviews

During the 2001 to 2011 period, the rapid growth of light industrial and distribution land uses in the SR 6 corridor (South Fulton and Douglas) is clearly illustrated



DRAFT Land Classification by County 2020

Jurisdiction	Developed	Undevelopable	Unknown	Vacant Developable	Total	Share of Land that is Vacant Developable
Barrow County	29,740	4,619	162	69,751	104,272	67%
Bartow County	43,166	9,205	218	247,843	300,433	82%
Carroll County	43,856	13,467	364	264,726	322,412	82%
Cherokee County	68,644	10,103	281	198,924	277,952	72%
City of Atlanta	62,640	717	265	23,719	87,341	27%
Clayton County	60,171	5,379	19	26,873	92,441	29%
Cobb County	150,560	5,168	2,408	62,396	220,532	28%
Coweta County	48,716	21,627	242	214,796	285,382	75%
Dawson County	17,245	1,541	100	118,373	137,259	86%
DeKalb County	115,791	5,720	338	45,996	167,846	27%
Douglas County	40,117	4,336	462	83,821	128,736	65%
Fayette County	36,073	14,611	2,520	74,457	127,661	58%
Forsyth County	61,713	16,210	812	79,446	158,181	50%
Gwinnett County	176,036	8,380	3,166	91,977	279,559	33%
Hall County	48,839	24,294	16,750	184,968	274,852	67%
Henry County	68,248	13,566	1,071	126,055	208,941	60%
Newton County	34,423	11,916	149	132,223	178,711	74%
North Fulton County	72,516	2,889	748	38,488	114,641	34%
Paulding County	42,528	5,956	940	151,757	201,182	75%
Rockdale County	26,283	4,947	153	53,178	84,561	63%
South Fulton County	49,642	5,797	1,632	89,022	146,092	61%
Spalding County	22,136	11,472	105	94,005	127,718	74%
Walton County	33,688	14,374	349	162,807	211,219	77%
Grand Total	1,352,772	216,297	33,253	2,635,601	4,237,923	62%


Metropolitan North Georgia Water Planning District
COUNCIL for QUALITY GROWTH
STORMWATER WORKSHOP
Stormwater Won't Work Until We Do
June 14, 2023 | 8:30 AM
Georgia Association of Water Professionals

Dr. J Marshall Shepherd

Director, Atmospheric Sciences Program,
University of Georgia

UNIVERSITY OF GEORGIA

COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District

Georgia, Climate Change, and an Evolving Metro Atlanta

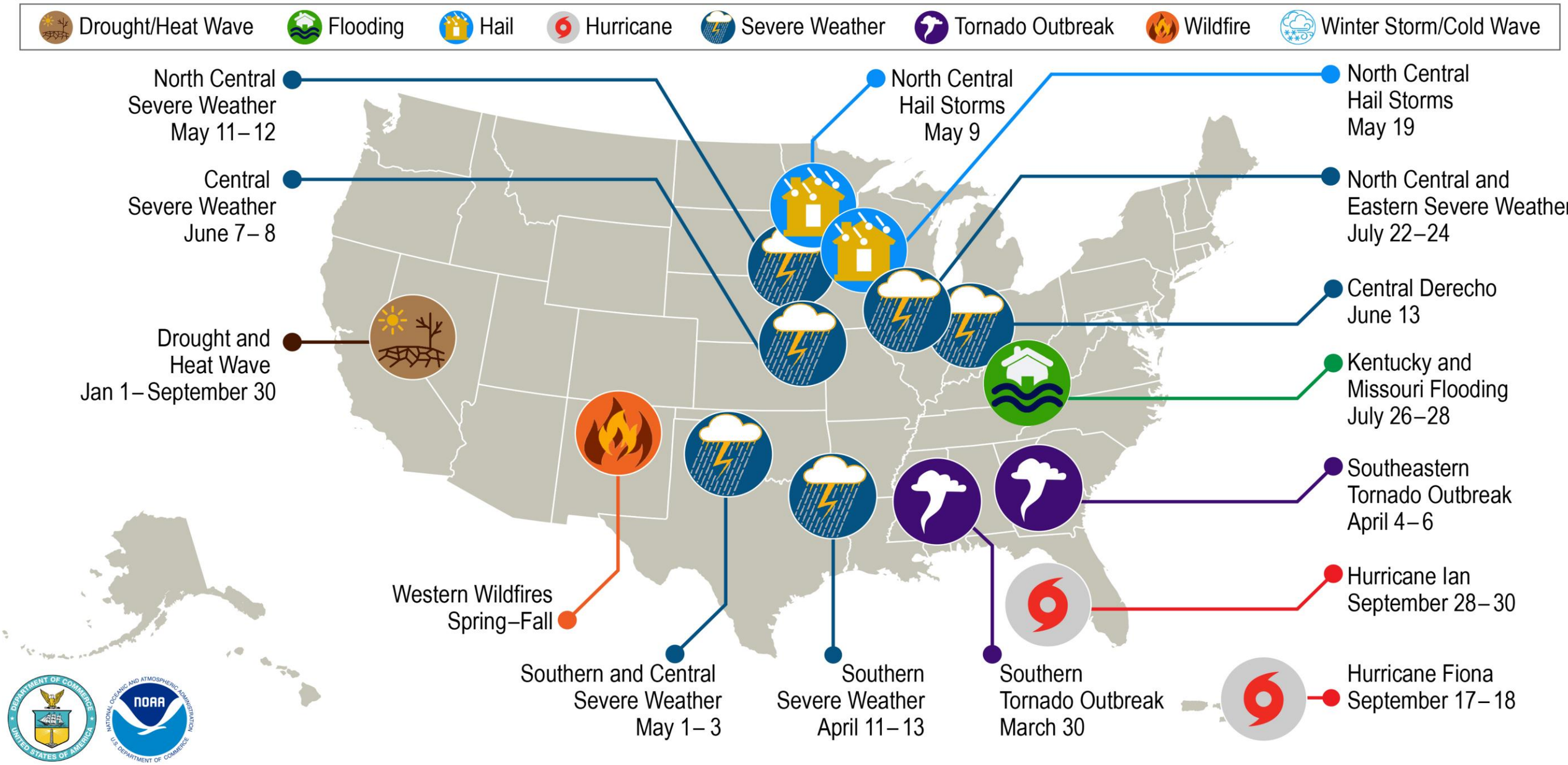
Dr. J Marshall Shepherd

Georgia, Climate Change and A Evolving Metro Atlanta

Dr. J. Marshall Shepherd (marshgeo@uga.edu)
Georgia Athletic Association Distinguished Professor
Director, Atmospheric Sciences Program

Member, National Academy of Engineering
Member, National Academy of Sciences
Member, American Academy of Arts and Sciences

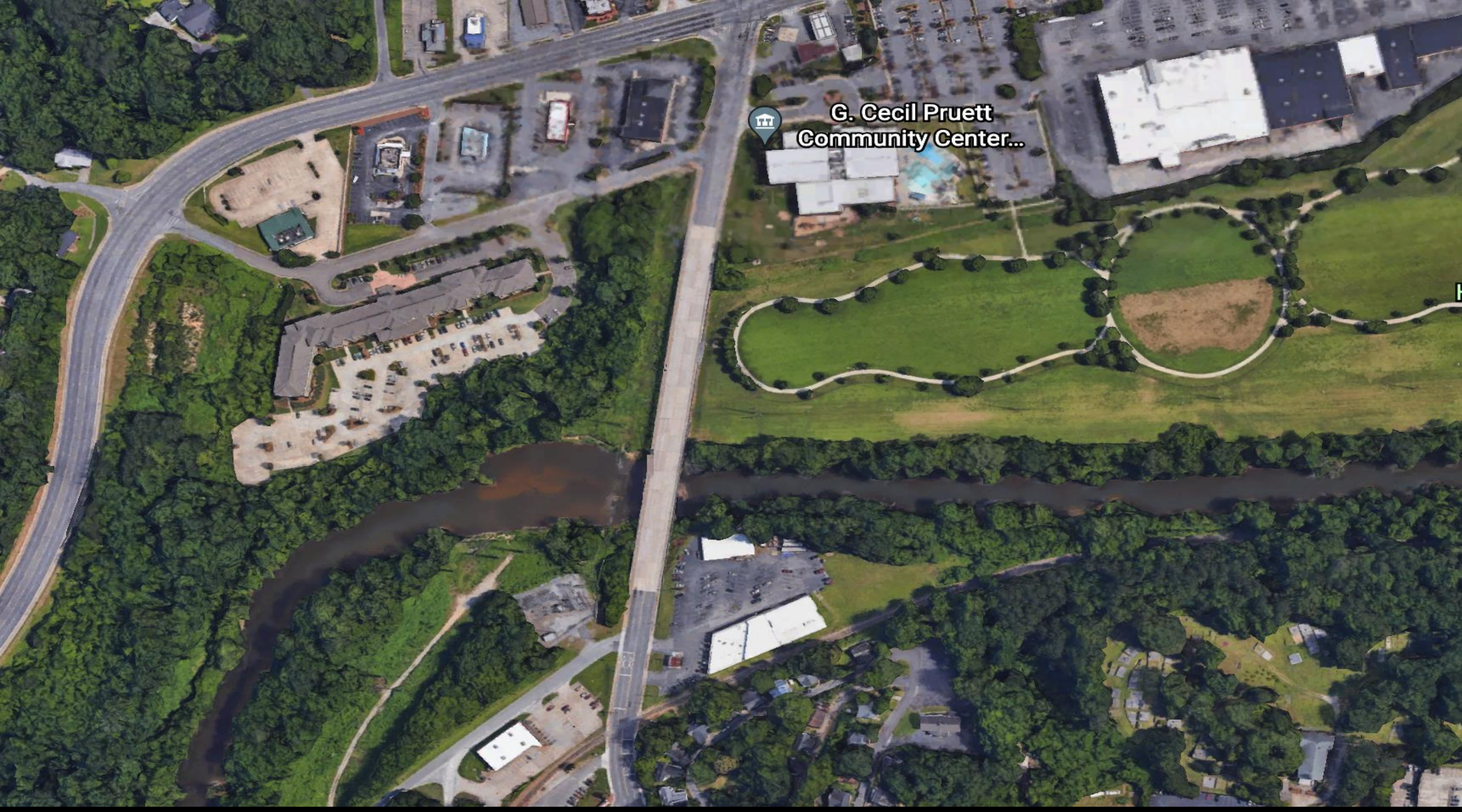
U.S. 2022 Billion-Dollar Weather and Climate Disasters



*This map denotes the approximate location for each of the **15 separate billion-dollar weather and climate disasters that impacted the United States January – September of 2022.***

Last 5 Years (2017-2021)

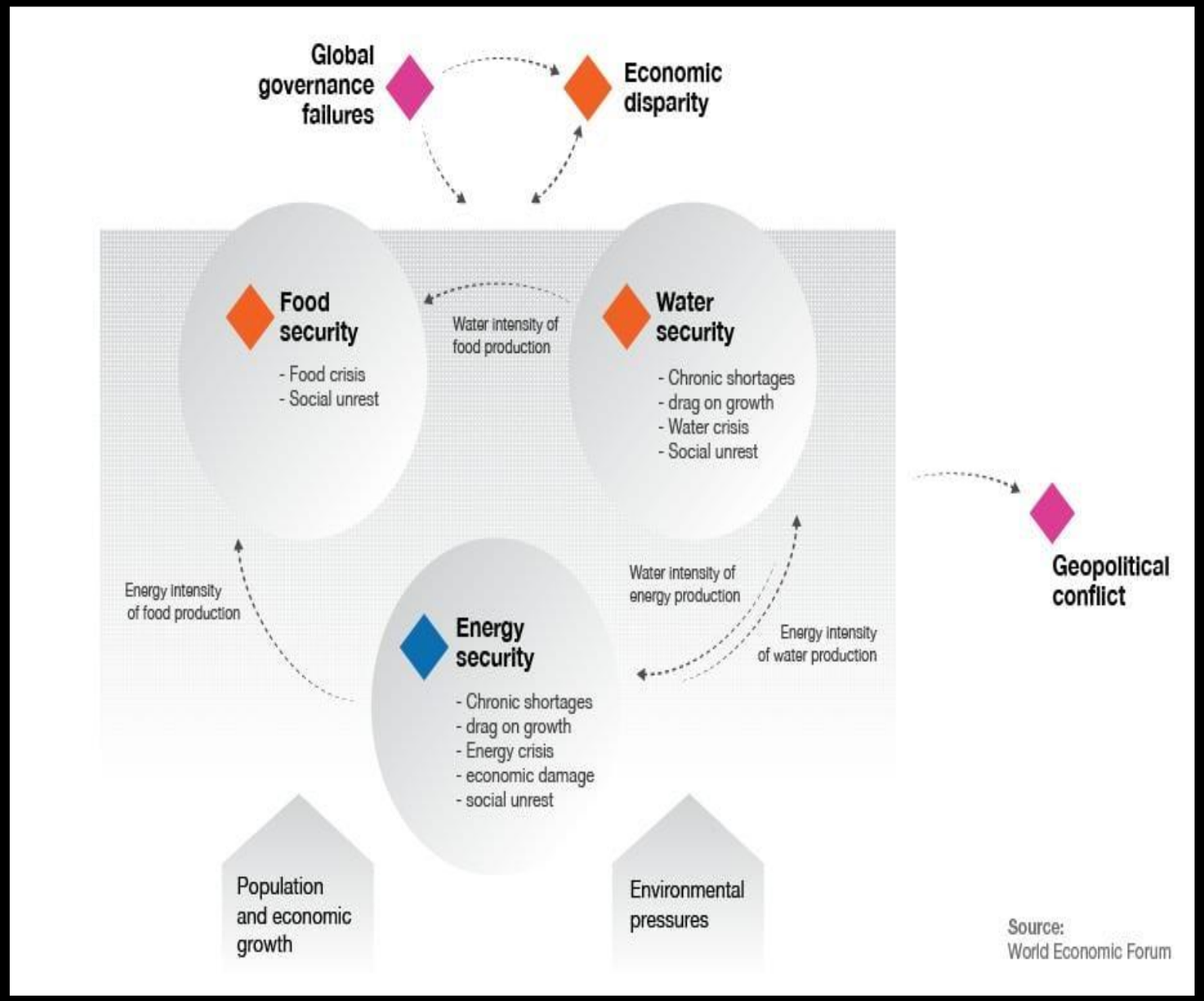
Events	Cost	Deaths
89	$788.4B	4,557
17.8 per year	$157.7B per year	911 per year



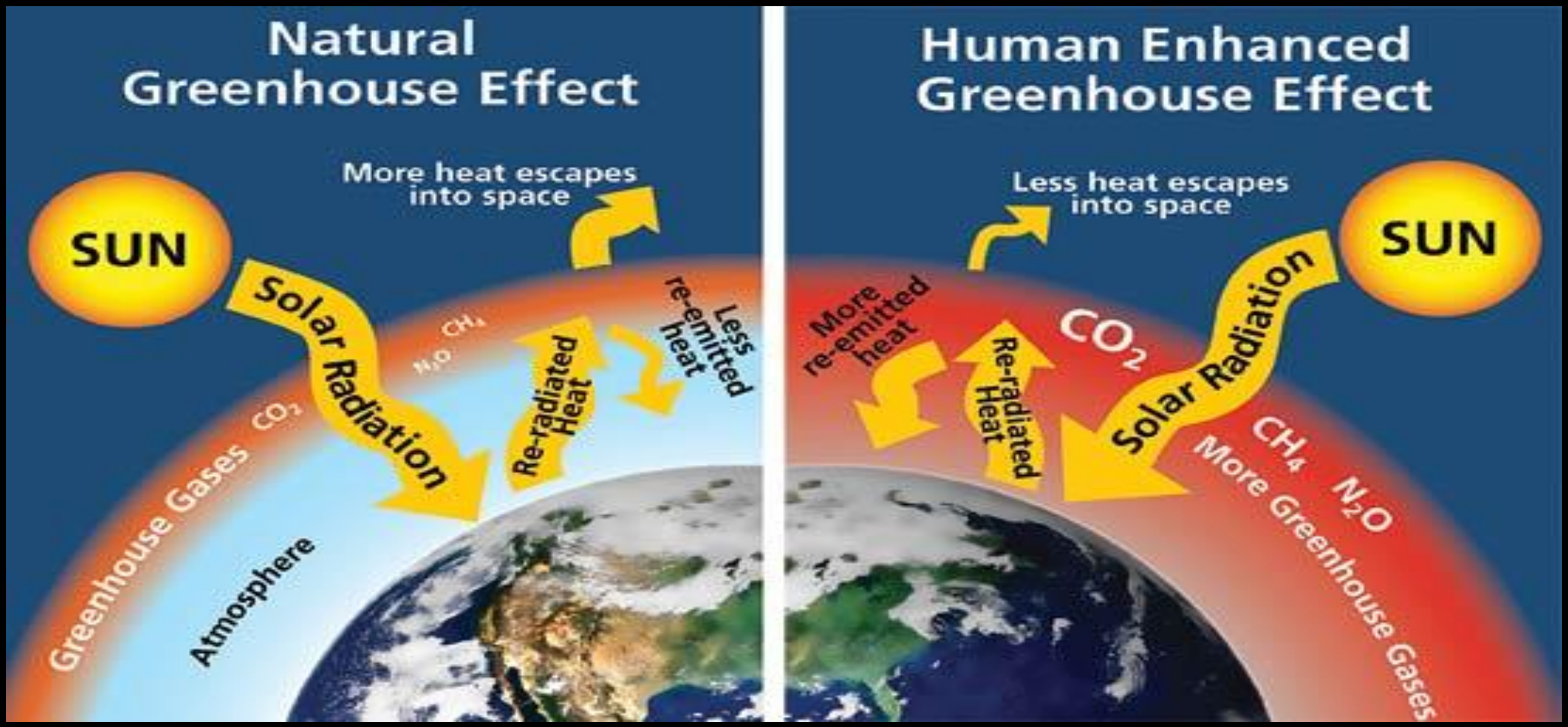
What do you remember most about the climate you grew up in?

Climate is (not will be) Changing

- The signs of changing climate are all around us:
  - Greenhouse gases are increasing
  - Sea level is rising
  - Ice sheets and glaciers are melting
  - Global temperatures are increasing
- Climate change impacts people, ecosystems, and the economy



Why Is Climate Changing?



Why It Matters?

1. Climate change presents real risks to Georgia and the rest of the world.
2. Tackling those risks presents real opportunities.
3. Addressing climate change at scale will require creativity and innovation.

https://www.exploregeorgia.org/article/georgias-famous-foods-you-just-have-to-try-when-you-visit

After Michael

Oct. 18, 2018

ALABAMA

Dothan

Albany

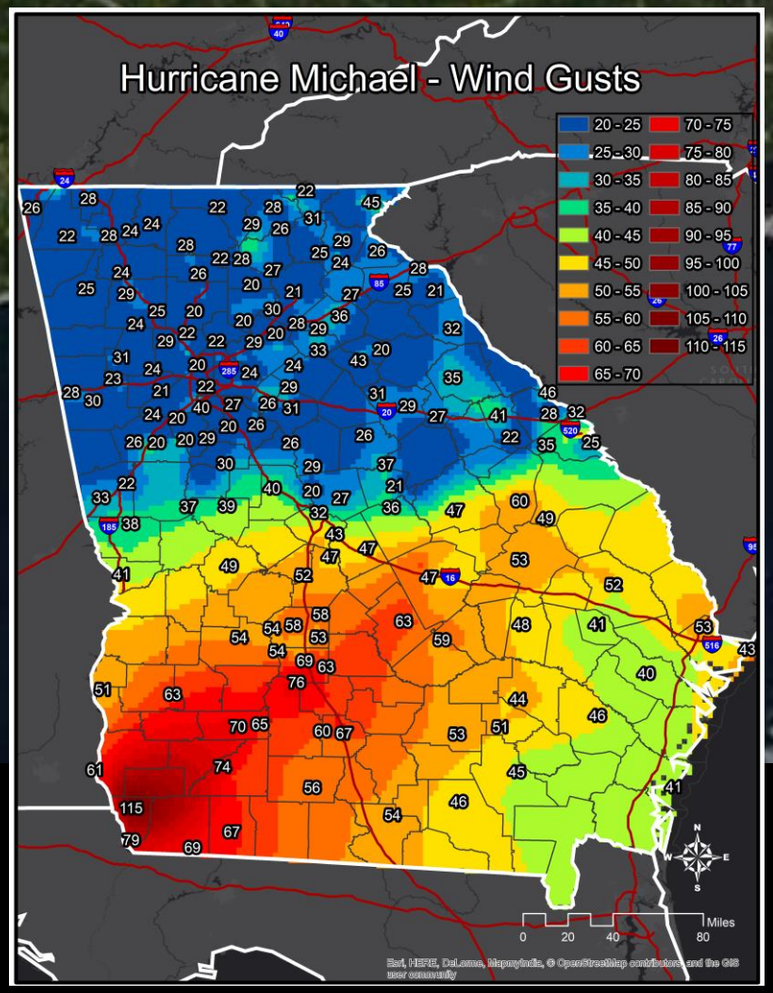
GEORGIA

Crestview

Tallahassee

FLORIDA

Panama City



Kitchen Table Issues, Georgia Families

UNIVERSITY OF GEORGIA EXTENSION

Hurricane Michael moved through southwest Georgia Oct. 10-11, 2018, causing more than $2.5 billion in losses to the state's agriculture industry, according to estimates from University of Georgia Cooperative Extension agents and agricultural economists.

Cotton

$550-600 million
Direct losses

Timber

$763 million
Direct losses

Pecans

$100 million
Direct losses: crops

$260 million
Direct losses: trees

$200 million
Direct losses: future income

Vegetables

$480 million
Direct losses

http://agr.georgia.gov/GDA-Hurricane-Response/media/2018/Hurricane-Michael-Georgia-ag-impacts.pdf

Industry Awakens to Threat of Climate Change

By CORAL DAVENPORT JAN. 23, 2014

WASHINGTON — Coca-Cola has always been more focused on its economic bottom line than on global warming, but when the company lost a lucrative operating license in India because of a serious water shortage there in 2004, things began to change.

Today, after a decade of increasing damage to Coke's balance sheet as global droughts dried up the water needed to produce its soda, the company has embraced the idea of climate change as an economically disruptive force.

A Coke bottling plant in Winona, Minn. The company has been affected by global droughts.
Andrew Link/Winona Daily News, via Associated Press

"Increased droughts, more unpredictable
floods every two years,"
t, Coke's vice president
water resources, listing
said were also
any's supply of sugar
, as well as citrus for its
e look at our most essential ingredients, we see those

WEATHER & NATURAL DISASTERS

AT&T, hit by higher natural disaster costs, unveils 30-year climate change model

PUBLISHED WED, MAR 27 2019 • 2:45 PM EDT

Emma Newburger
@EMMA_NEWBURGER

SHARE

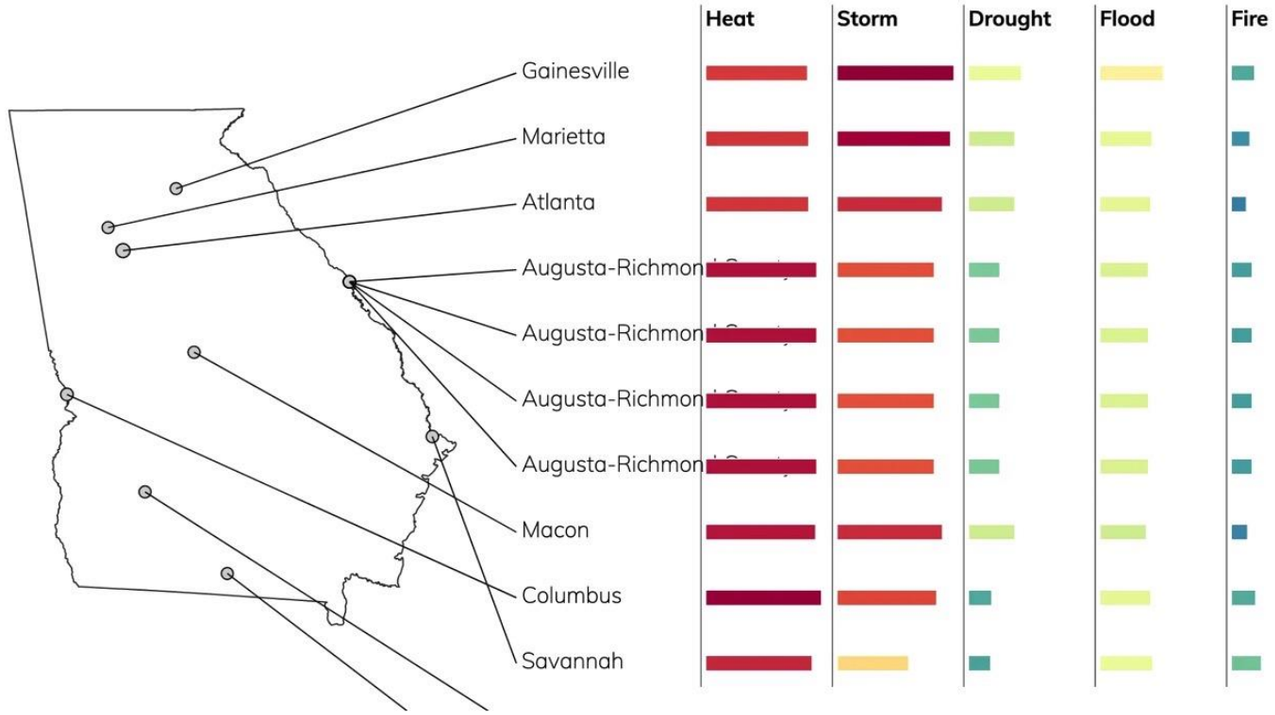
KEY POINTS

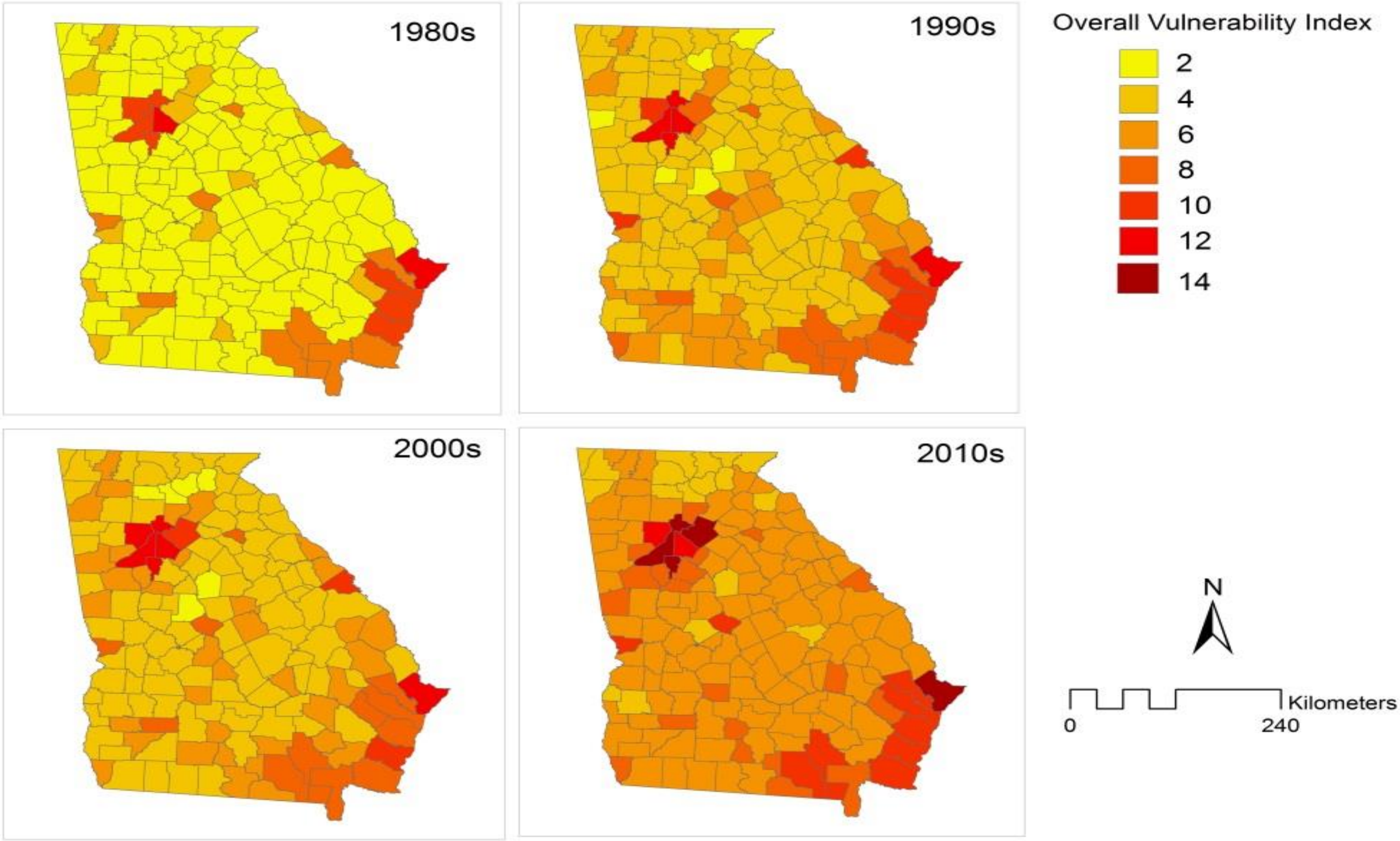
- AT&T is paying the U.S. Department of Energy's Argonne National Laboratory to predict climate-related events that could damage the company's infrastructure over the next 30 years.
- The announcement follows several natural disasters that cost the telecommunications company $847 million since 2016, including $626 million in 2017 alone.
- Other major US companies are also bracing for climate-related risks that could harm profits and strategy.

Climate Risks for Cities in Georgia

Of these top cities in Georgia, the city with the highest overall risk is **Atlanta**. The city with the lowest overall risk is **Albany**.

- For heat, Gainesville has the lowest risk and Albany has the highest risk.
- For precipitation, Savannah has the lowest risk and Gainesville has the highest risk.
- For drought, Valdosta has the lowest risk and Gainesville has the highest risk.
- For fire, Atlanta has the lowest risk and Savannah has the highest risk.
- For flood, Valdosta has the lowest risk and Gainesville has the highest risk.

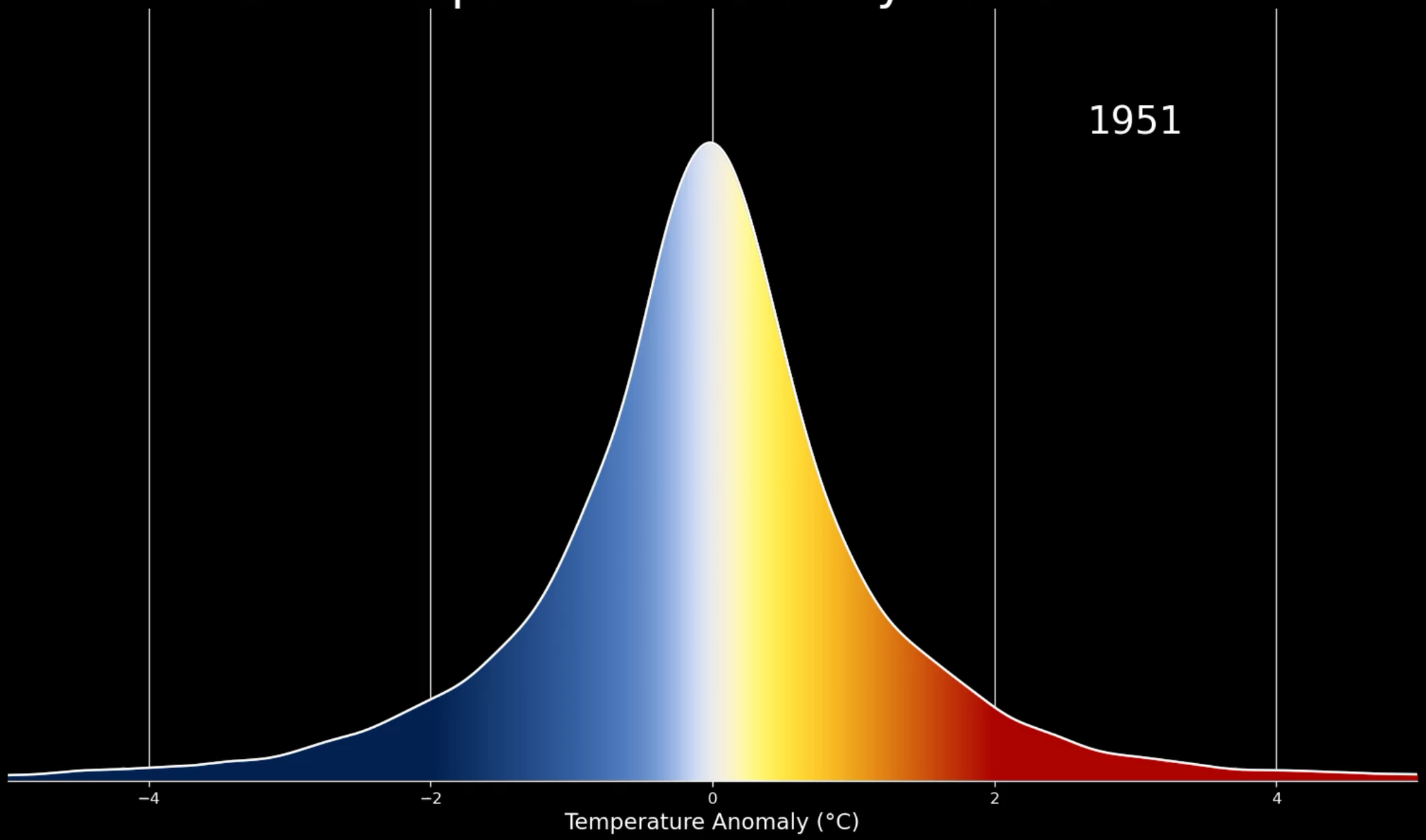




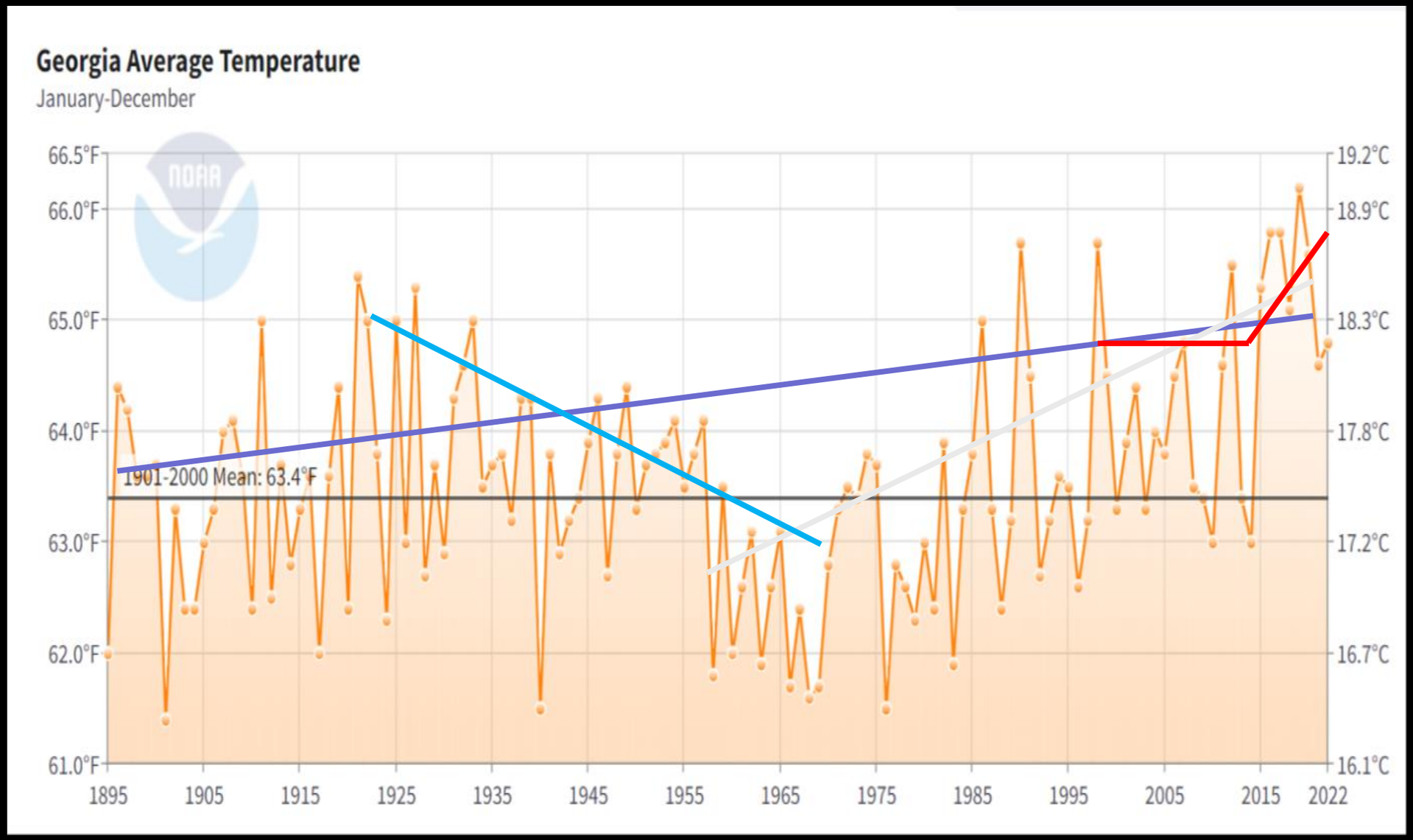
Georgia is Climate Vulnerable (from KC, Shepherd an Johnson 2015)

UNIVERSITY OF GEORGIA

Land Temperature Anomaly Distribution



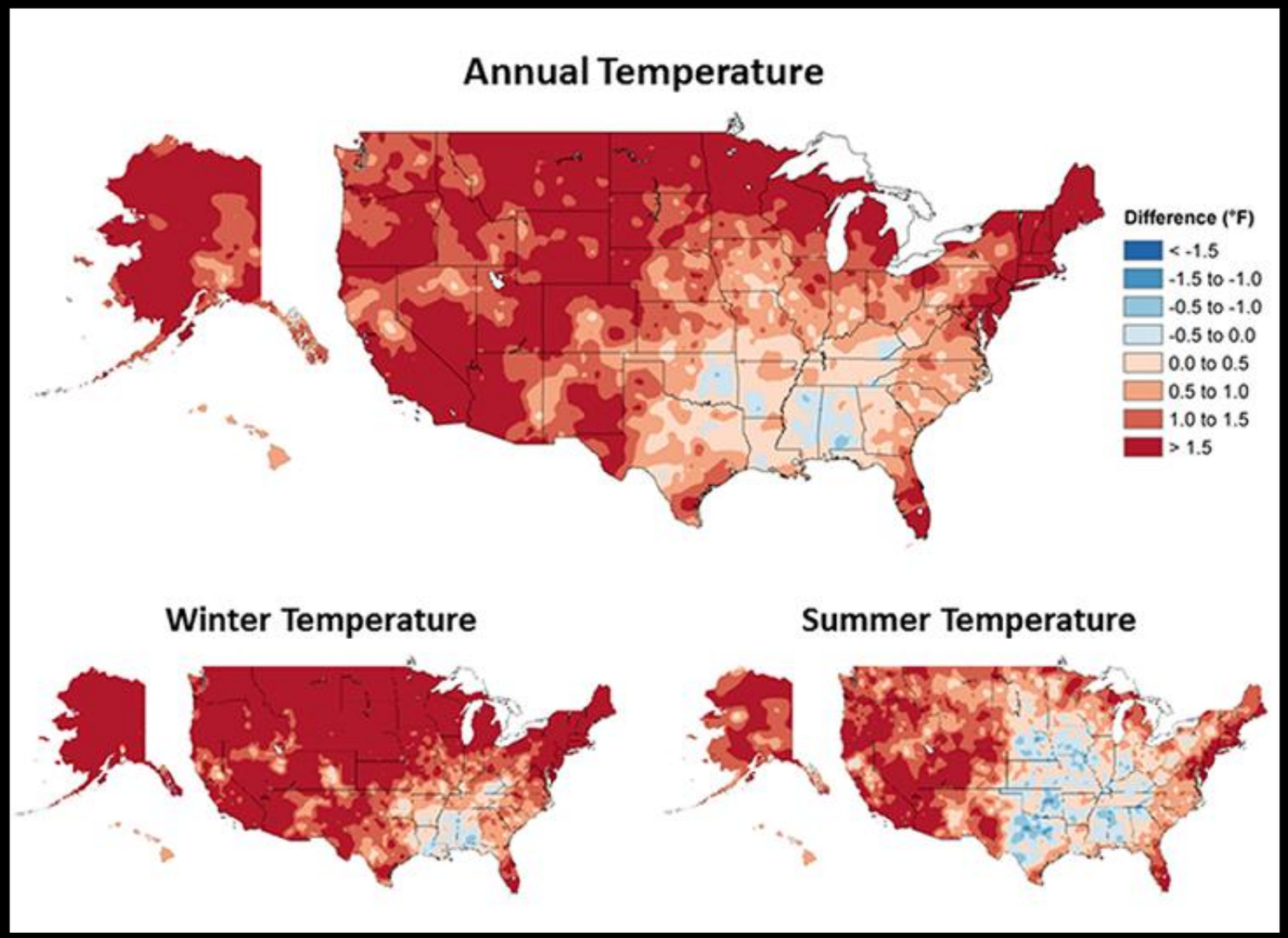
How temperature has changed over time



The trend you see depends on how old you are and when you lived

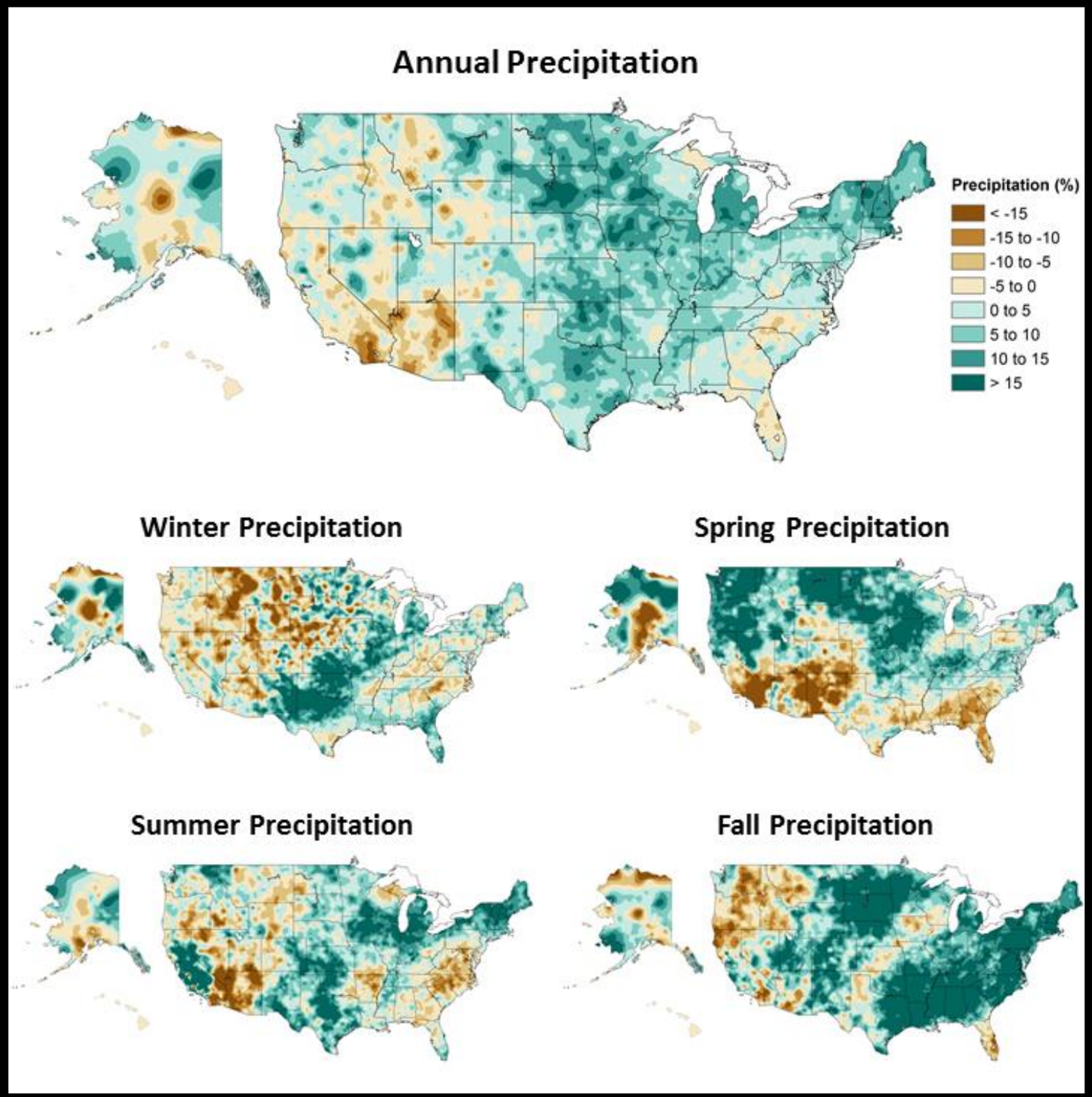
https://www.ncei.noaa.gov/cag/

How temperature has changed over time



- The trend is different depending on where you are
- “Warming Hole” in SE caused by land use change and coal pollution before Clean Air Act of 1970
- Summer cooling due to irrigation and crops

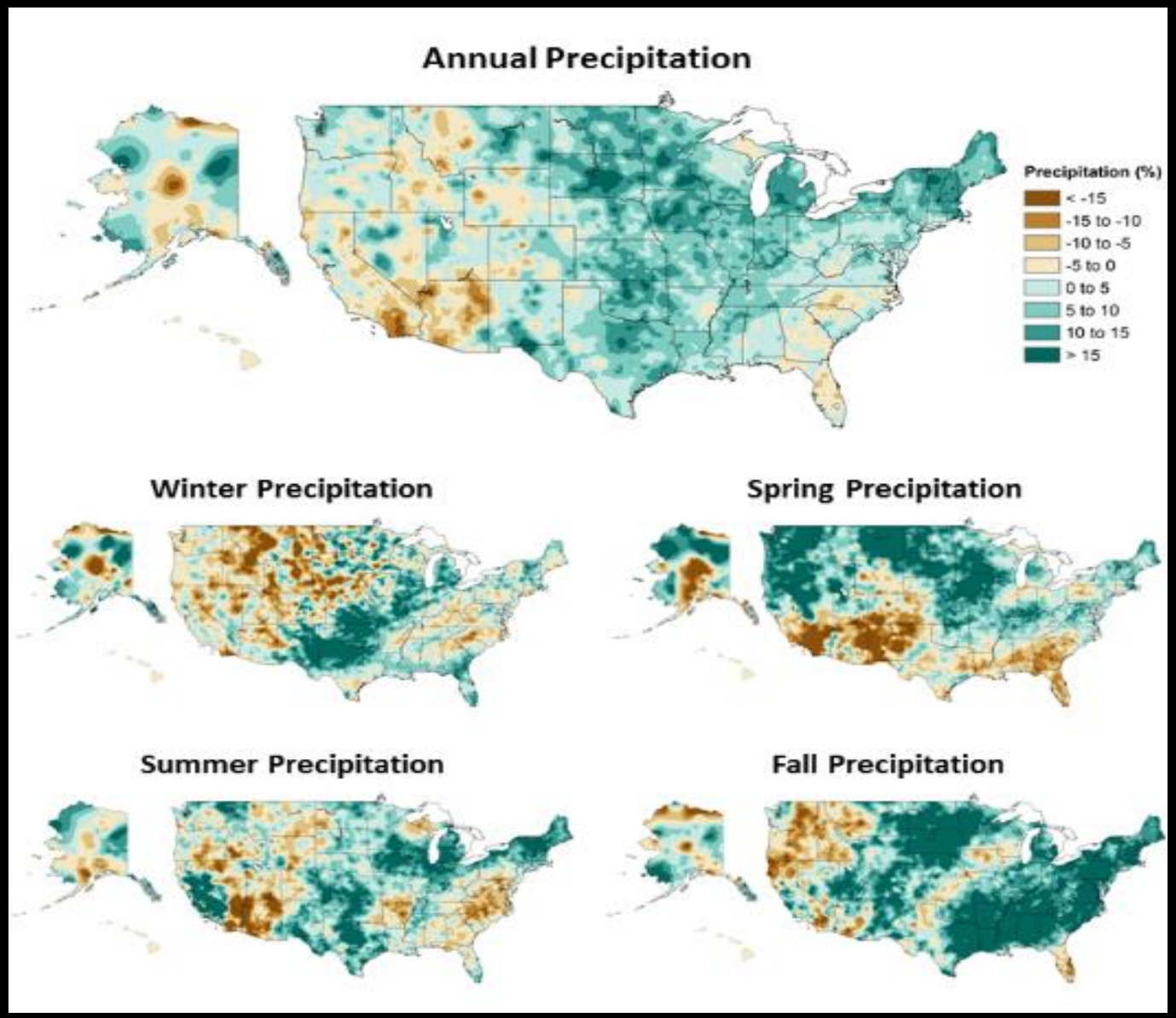
How Precipitation has changed over time



Annual average precipitation has not changed much in Georgia over the last 125 years

BUT.....

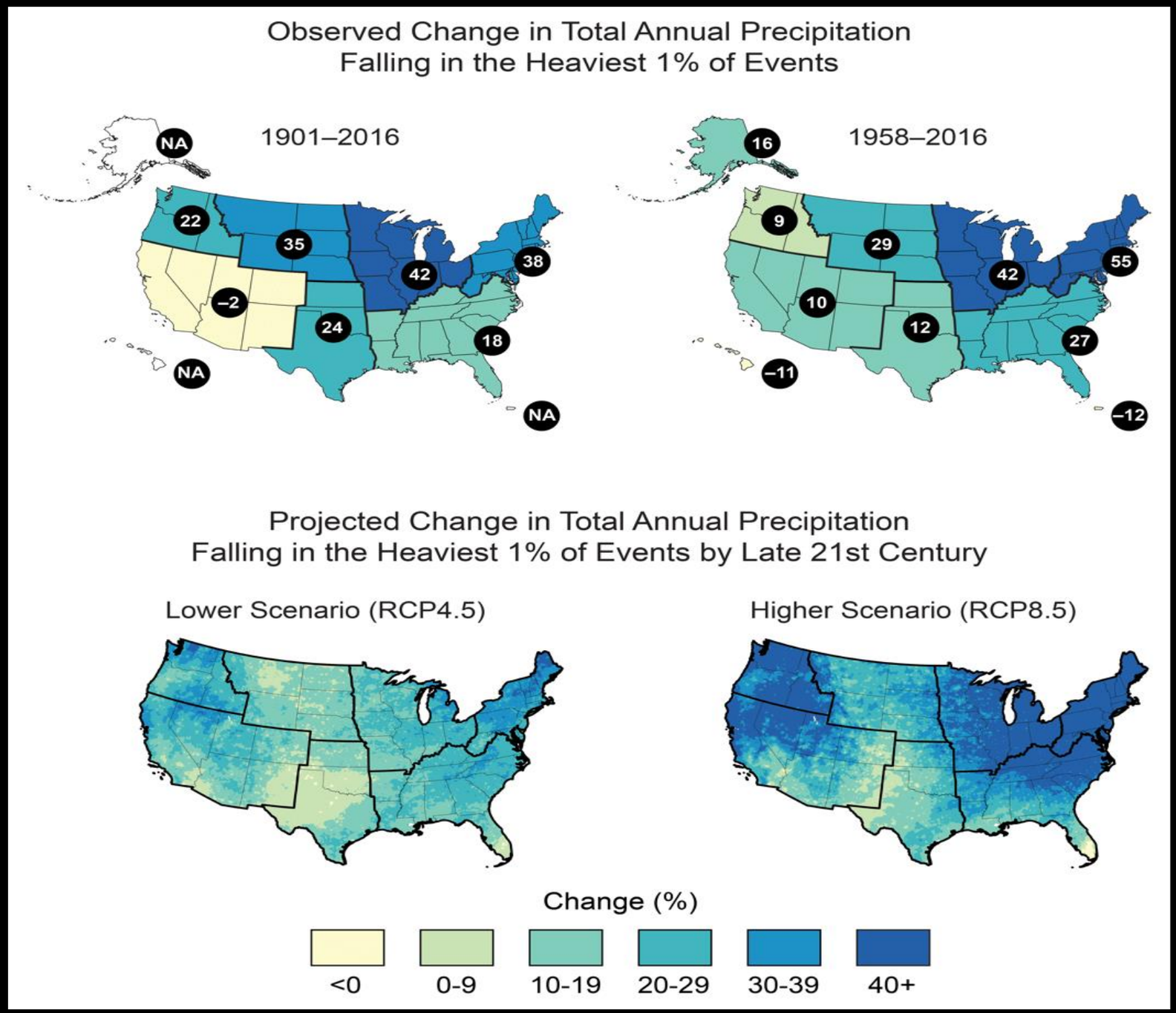
How Precipitation has changed over time



- The Central and NE US is getting wetter while the Southwest is drying out
- Seasonal changes affect planting and harvest conditions

https://science2017.globalchange.gov/

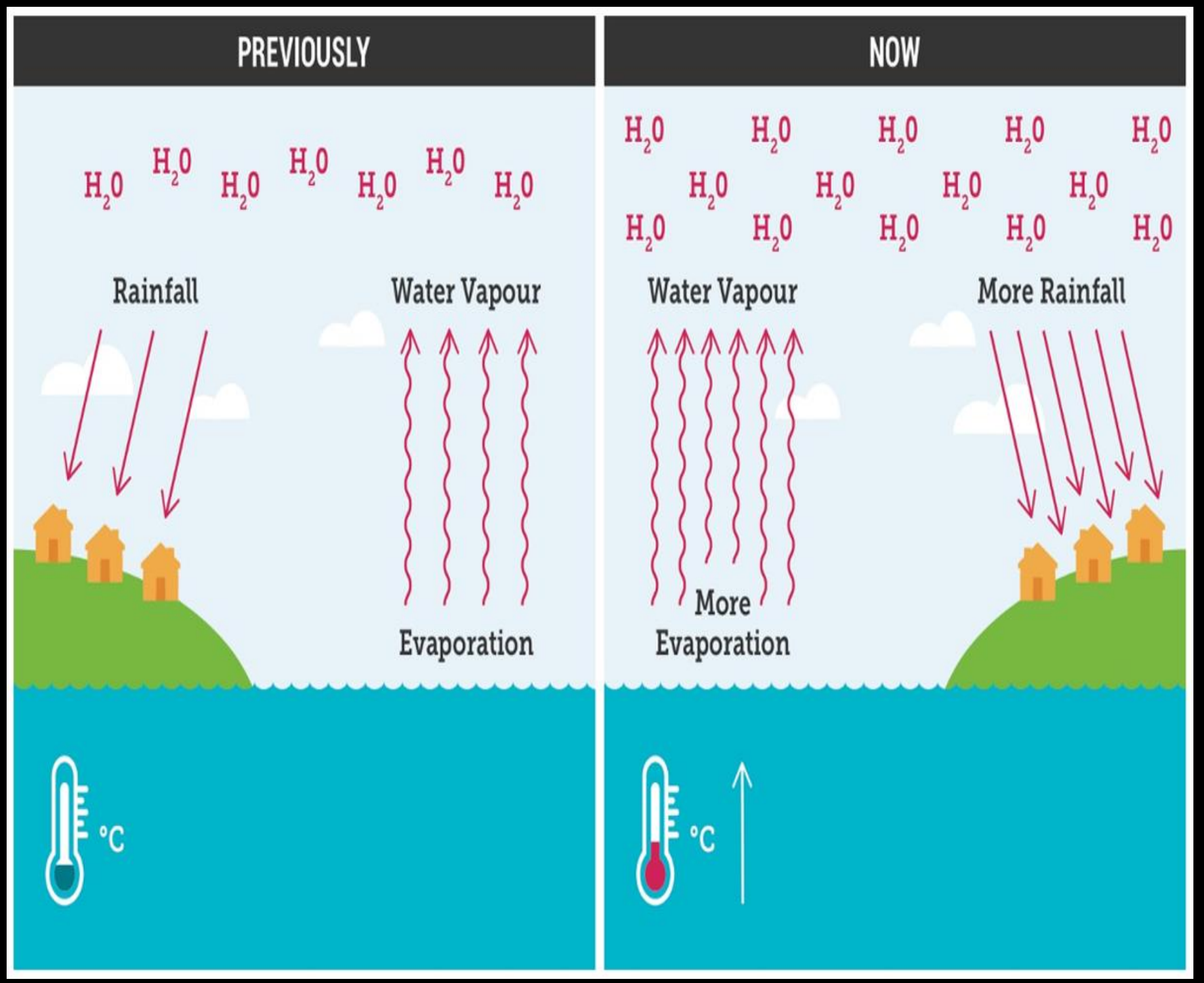
How Precipitation extremes have changed over time



- When rain falls, it is heavier
- Dry spells between rain events have increased

https://science2017.globalchange.gov/

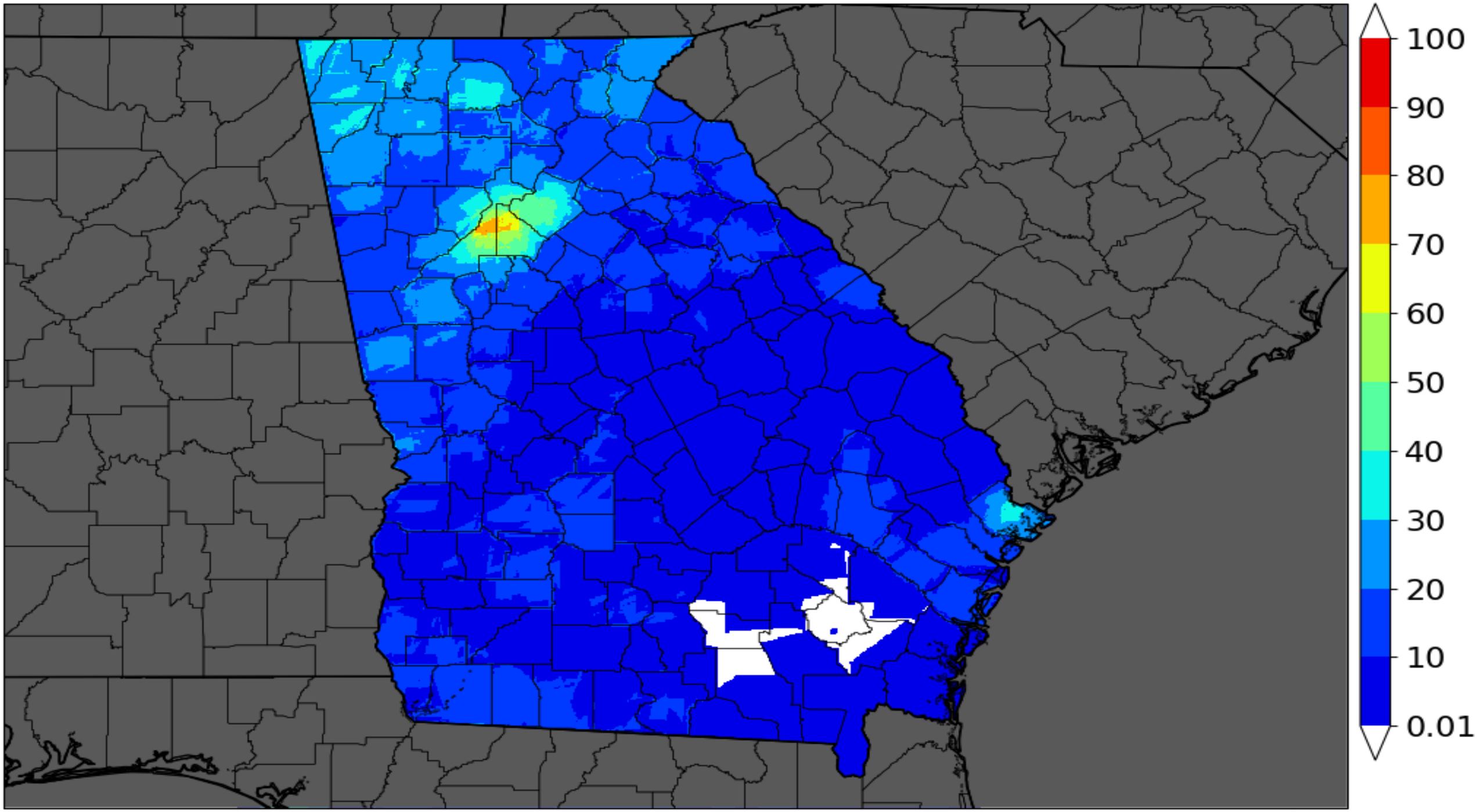
Heaviest rainfall events are increasing in the U.S. in most places



Flooding and Intense Rainfall

Total Flash Flood Warning (FF.W)

Plotted for Georgia, based on IEM Archives between 01 Jan 2000 0000 and 01 Sep 2021 0000 UTC



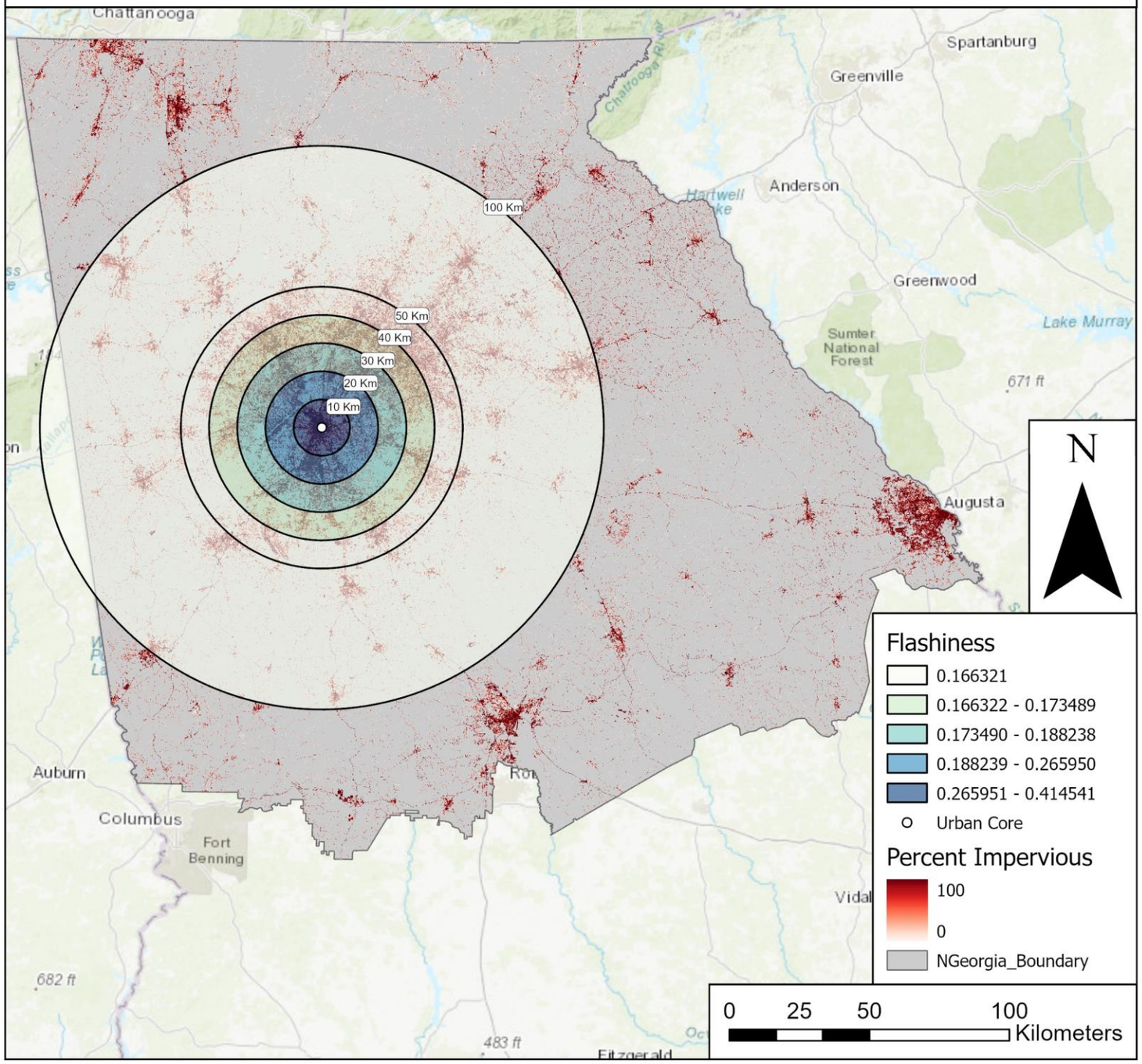
data units :: count

Generated at 1 Sep 2021 8:05 PM CDT in 20.04s

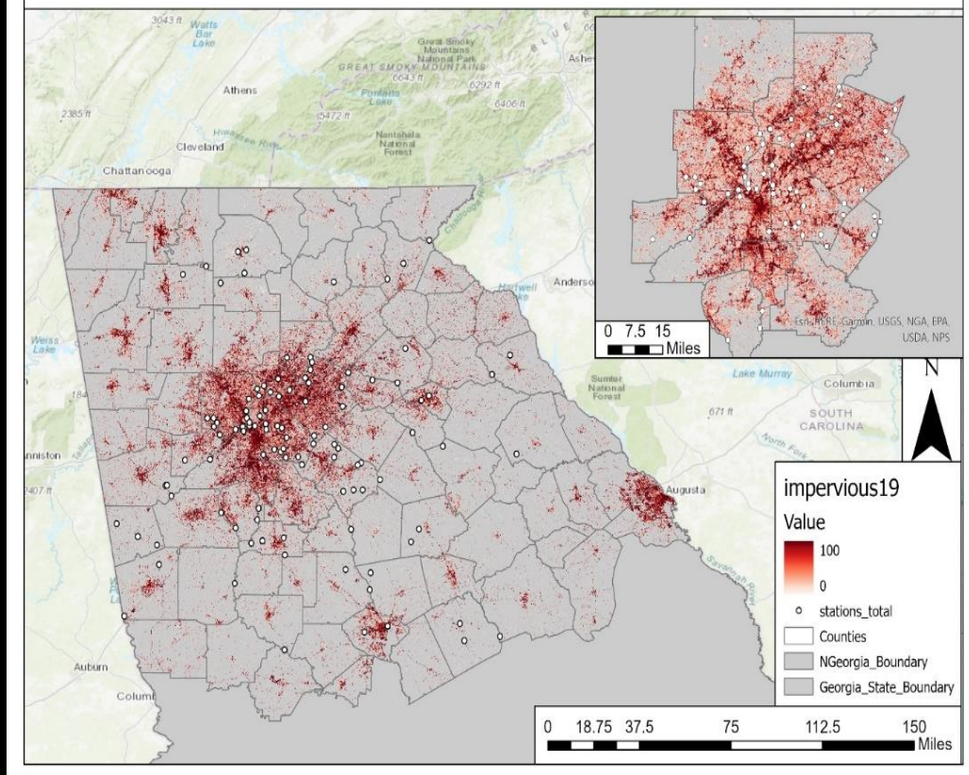
IEM Autoplot App #90

A flash flood is defined as a rapid rise in water levels, along rivers, creeks, normally dry washes, arroyos, or even normally dry land areas. Flash floods generally occur within 6 hours of the rainfall or other event that causes them. They frequently happen with little advance notice. – NWS

Distance from the Urban Core and Average Maximum Flashiness

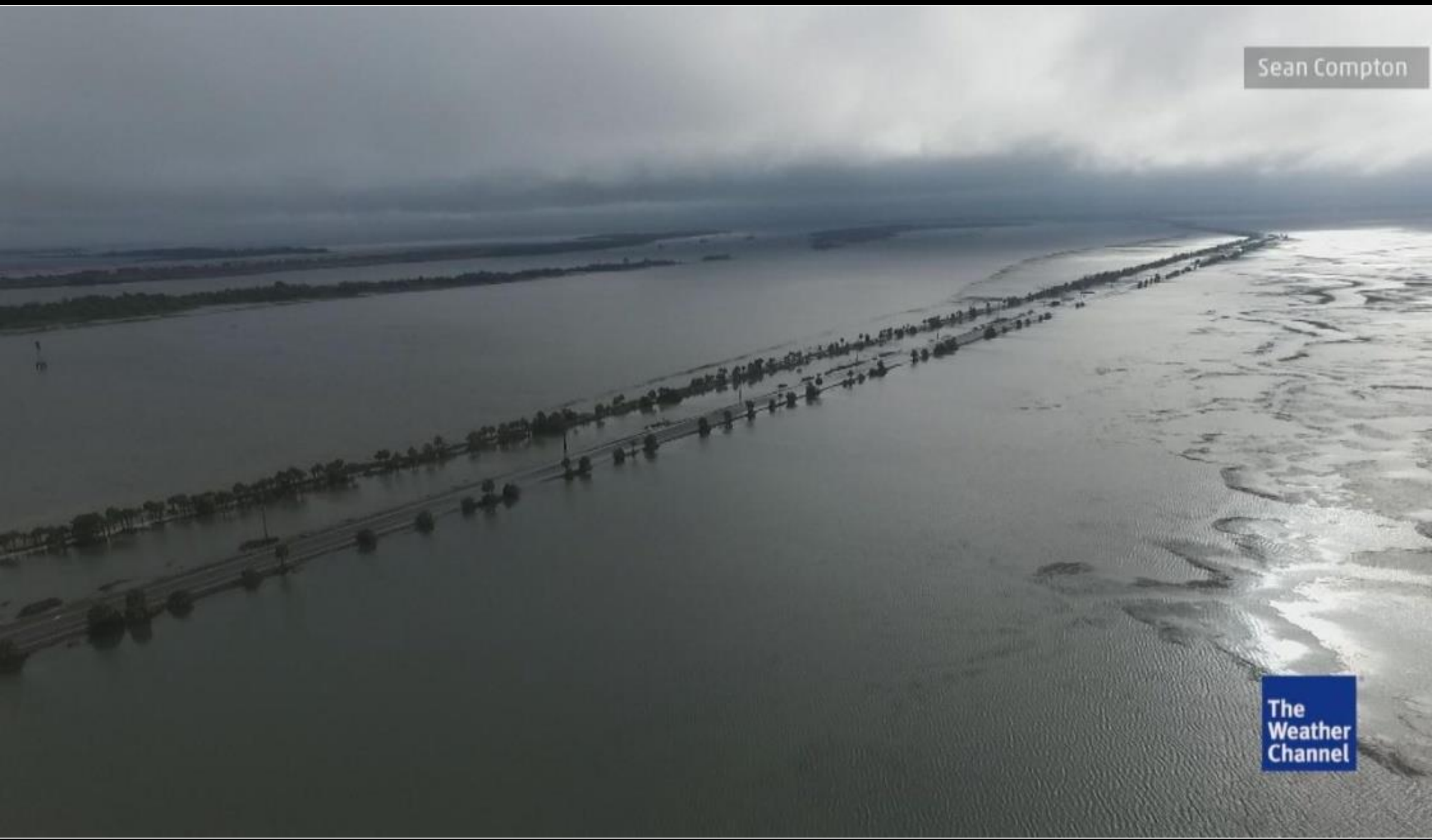


Percent Imperviousness

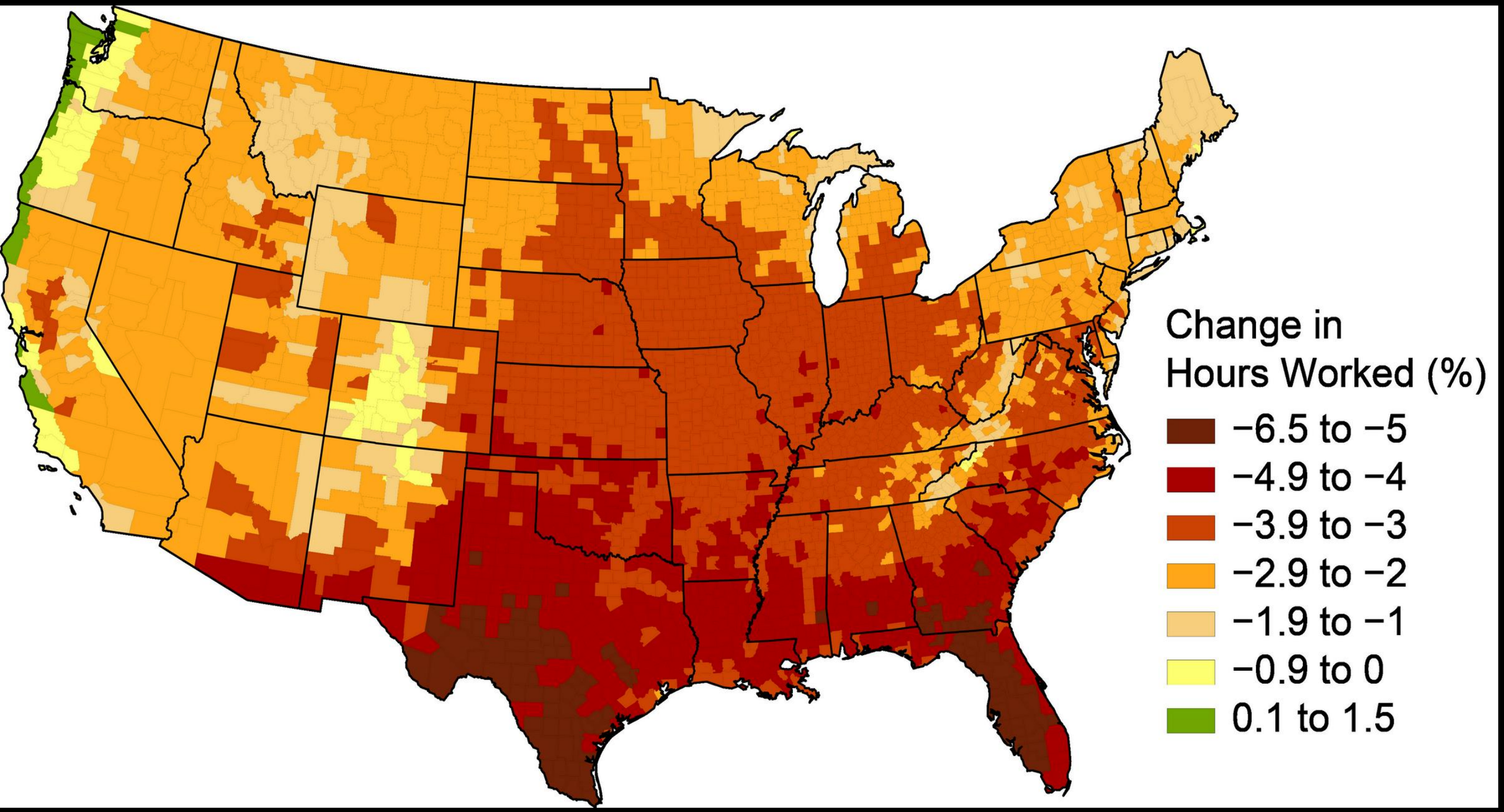


Urban flashiness is a factor (Nixon 2023)

Georgia and Its New Normal Weather and Climate

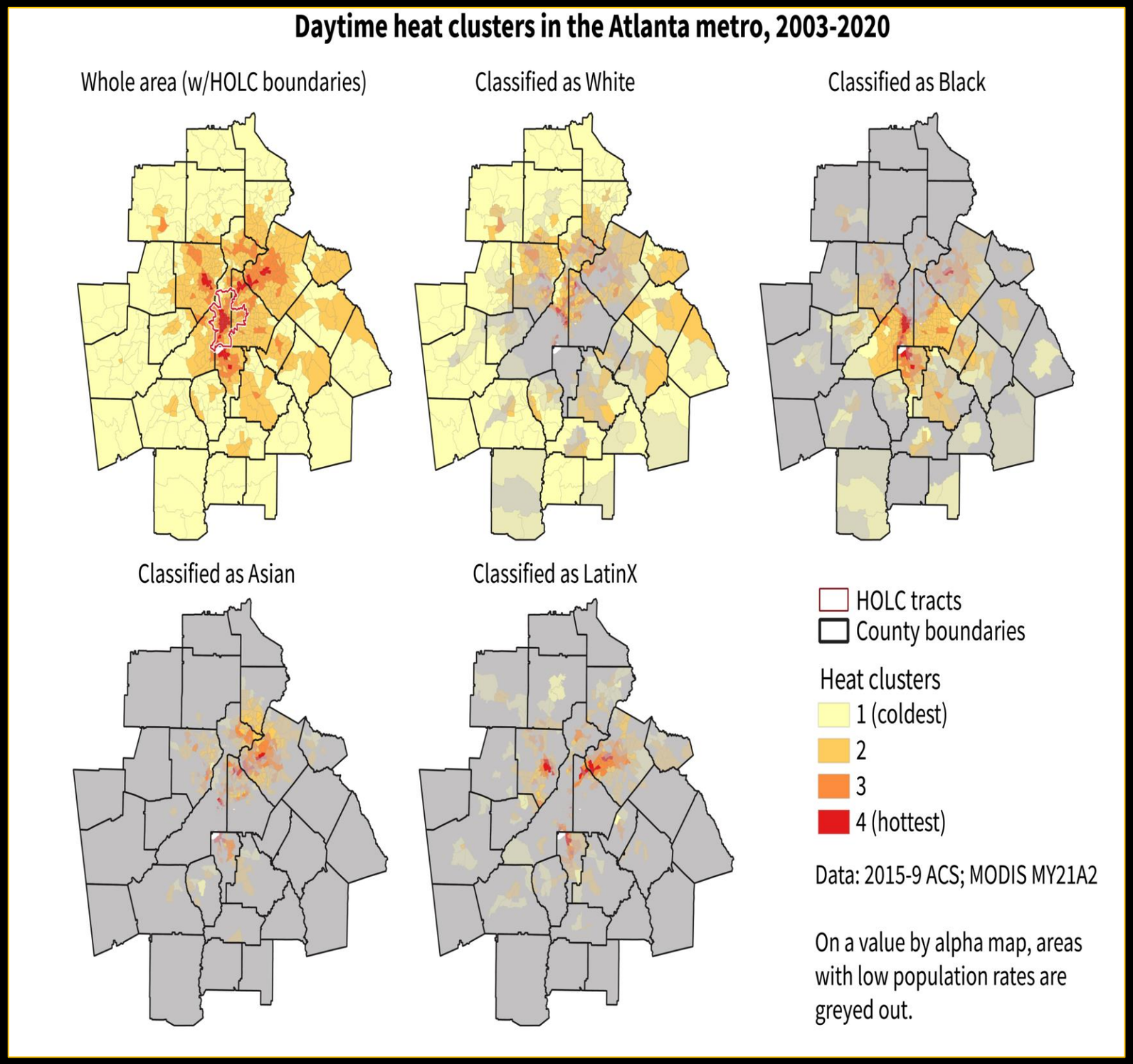


Some Worrisome Trends In Georgia



NCA, 2018

Urban heat amplifies climate change and heatwave impacts



Source: Shepherd et al. 2022

COMMUNITIES OF COLOR

Some communities of color living in risk-prone areas face cumulative exposure to multiple pollutants.

Adaptation plans that consider these communities and improve access to healthcare help address social inequities.

OLDER ADULTS

Older adults are vulnerable to extreme events that cause power outages or require evacuation.

Checking on elderly neighbors and proper emergency communication can save lives.

CHILDREN

Children have higher risk of heat stroke and illness than adults.

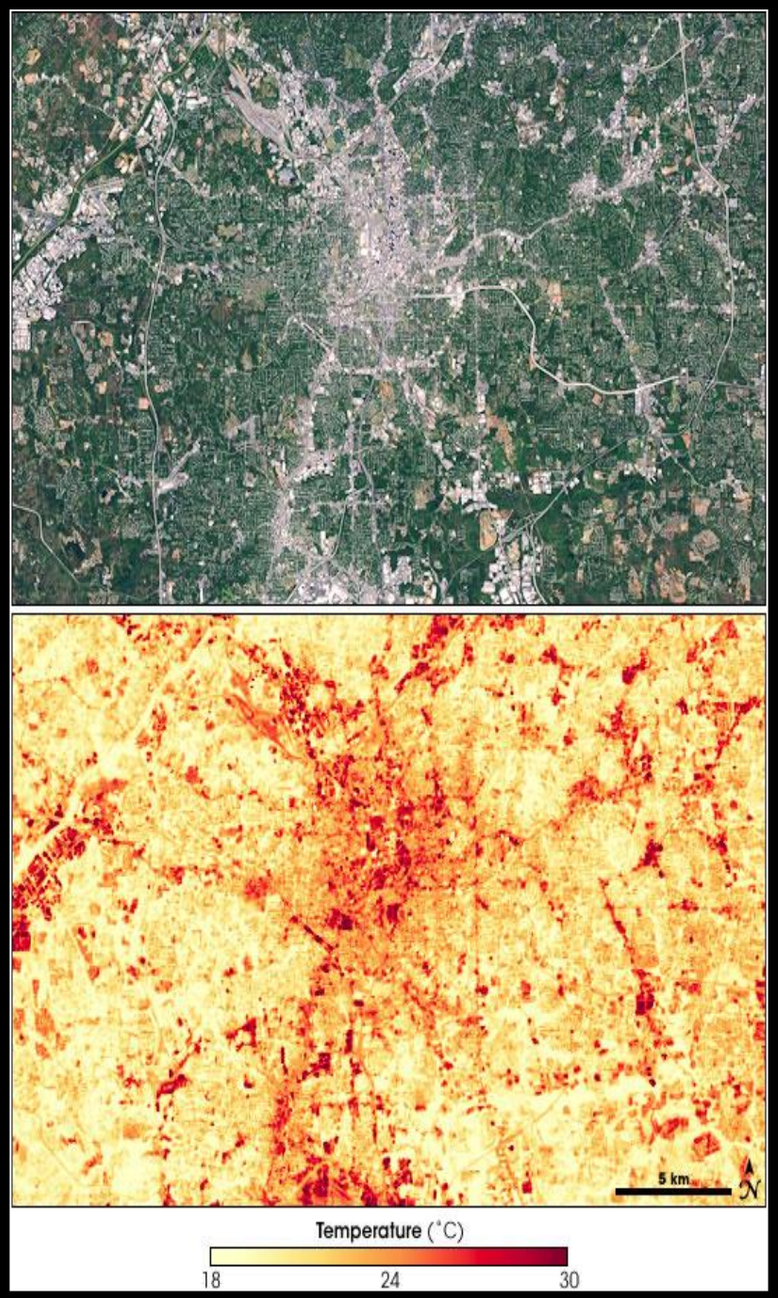
Adults can lessen risk by monitoring exertion and hydration.

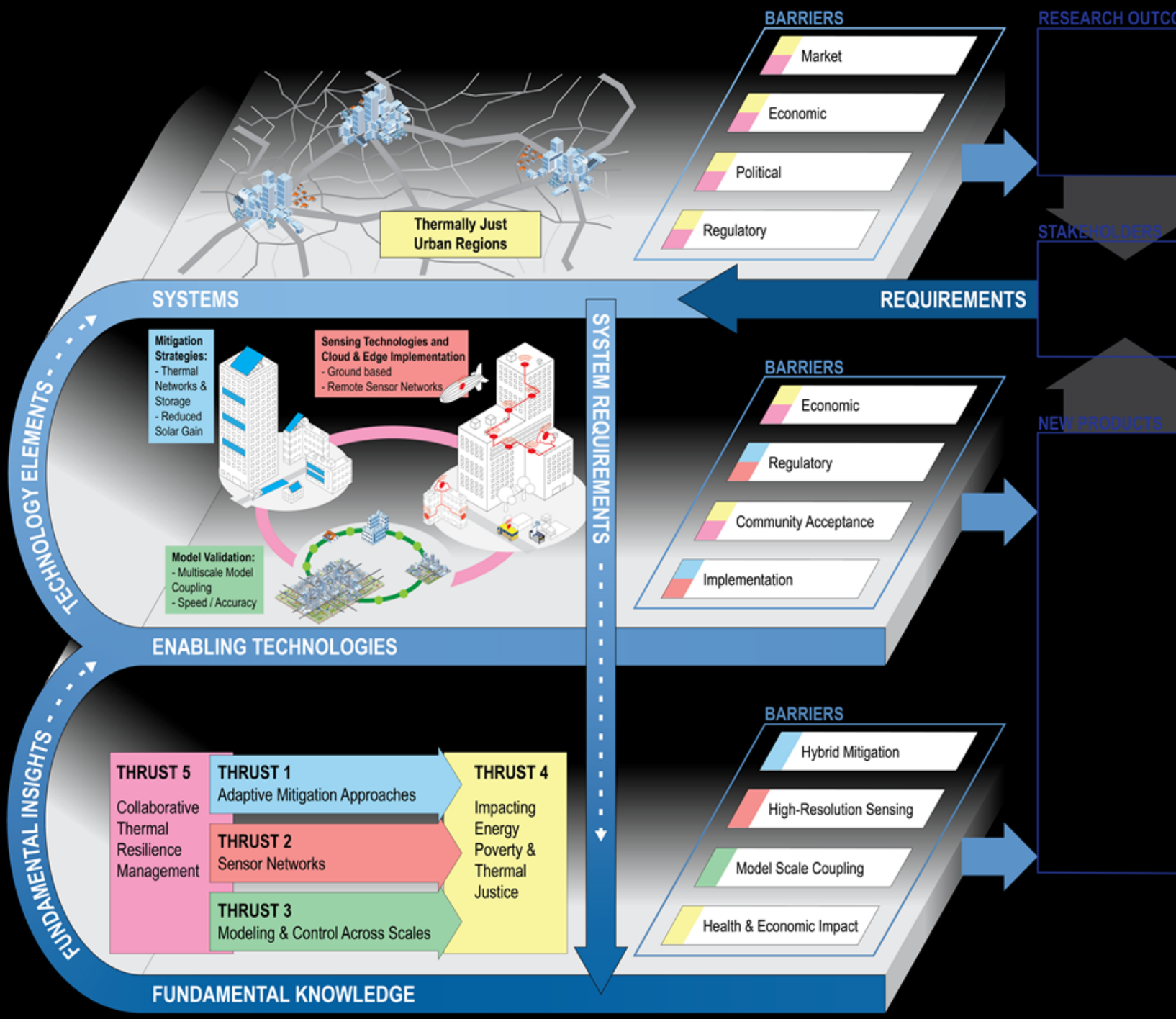
LOW INCOME COMMUNITIES

Low income families are at risk of physical and mental illnesses during flooding and in crowded shelter conditions.

Comprehensive disaster management can improve resiliency for people with limited resources.

Engineering Cities For Thermal Justice:
A Georgia Tech – UGA – Arizona State – NC A&T Initiative





The Extremes are becoming more extreme, and people feel them far more than “averages”

--Dr. Marshall Shepherd

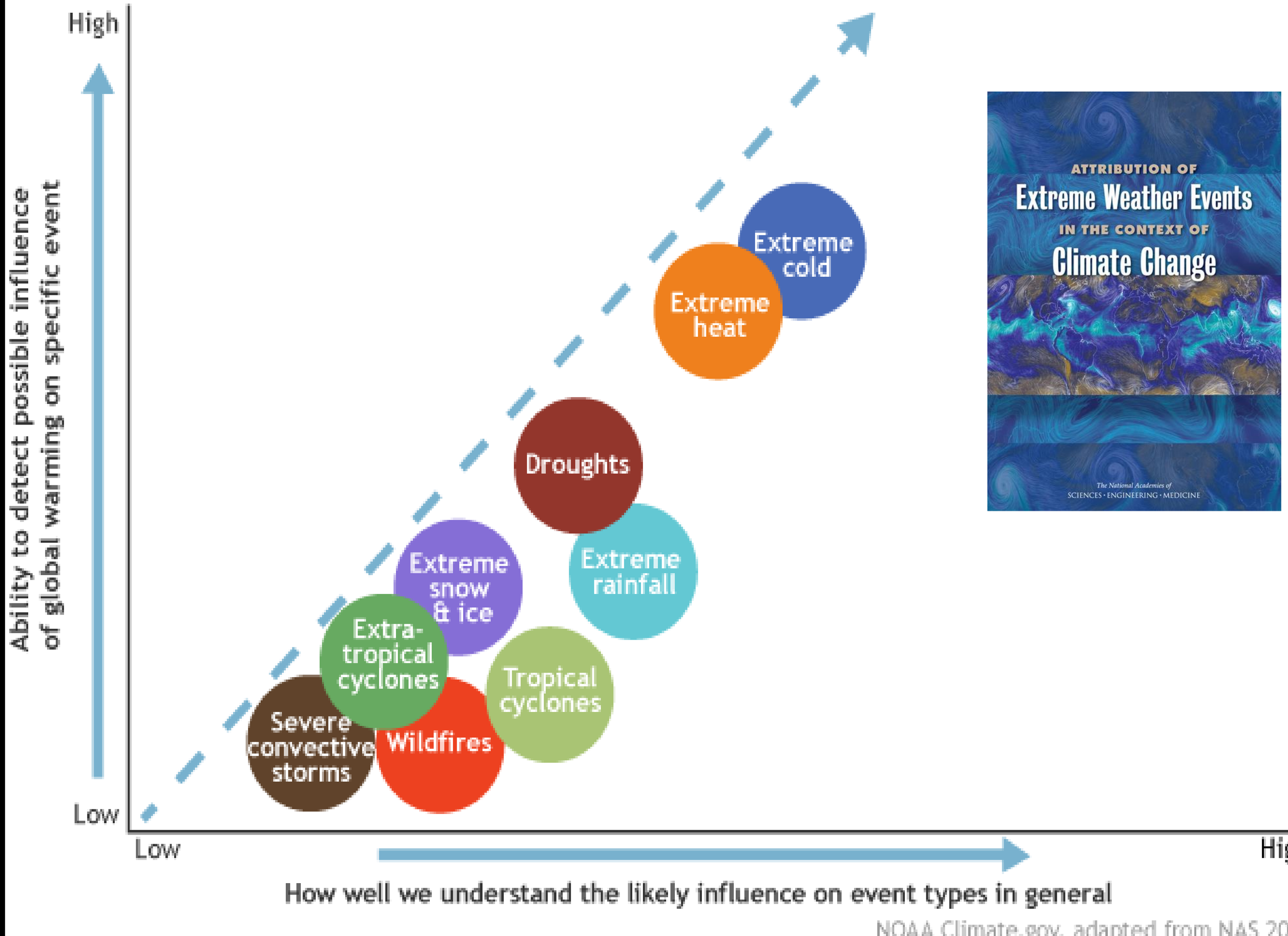
Testifying Before The U.S. House of Representatives Science Committee in 2019

UNIVERSITY OF GEORGIA

What Factors Influence an Extreme Event?

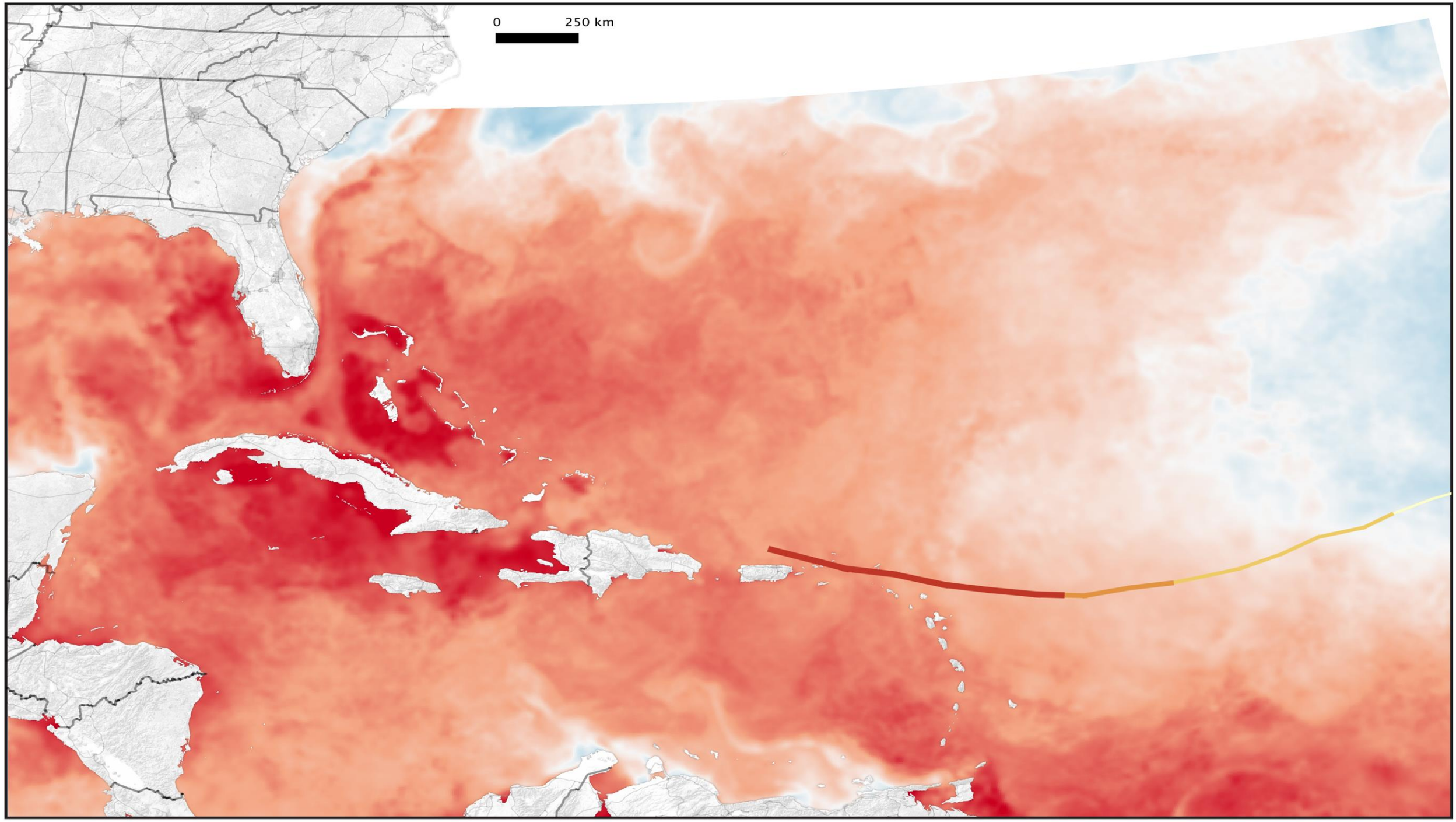
- Many conditions must align to set up a particular event
- Each extreme event has a host of possible causes
  - **Natural** → large-scale circulation, internal modes of climate variability, specific weather pattern
  - **Human-caused** → climate change, but also land use, etc.

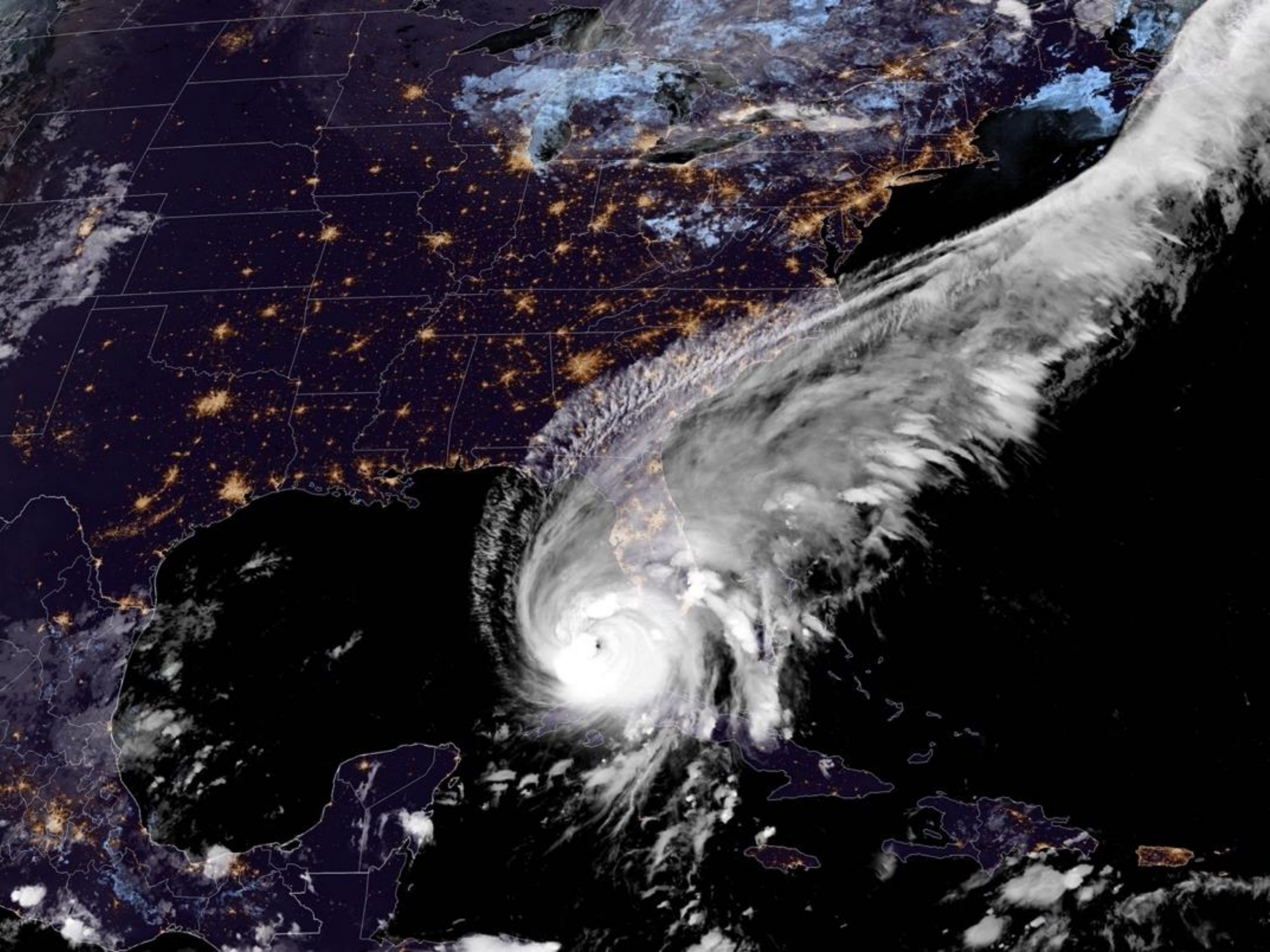
Relative confidence in attribution of different extreme events



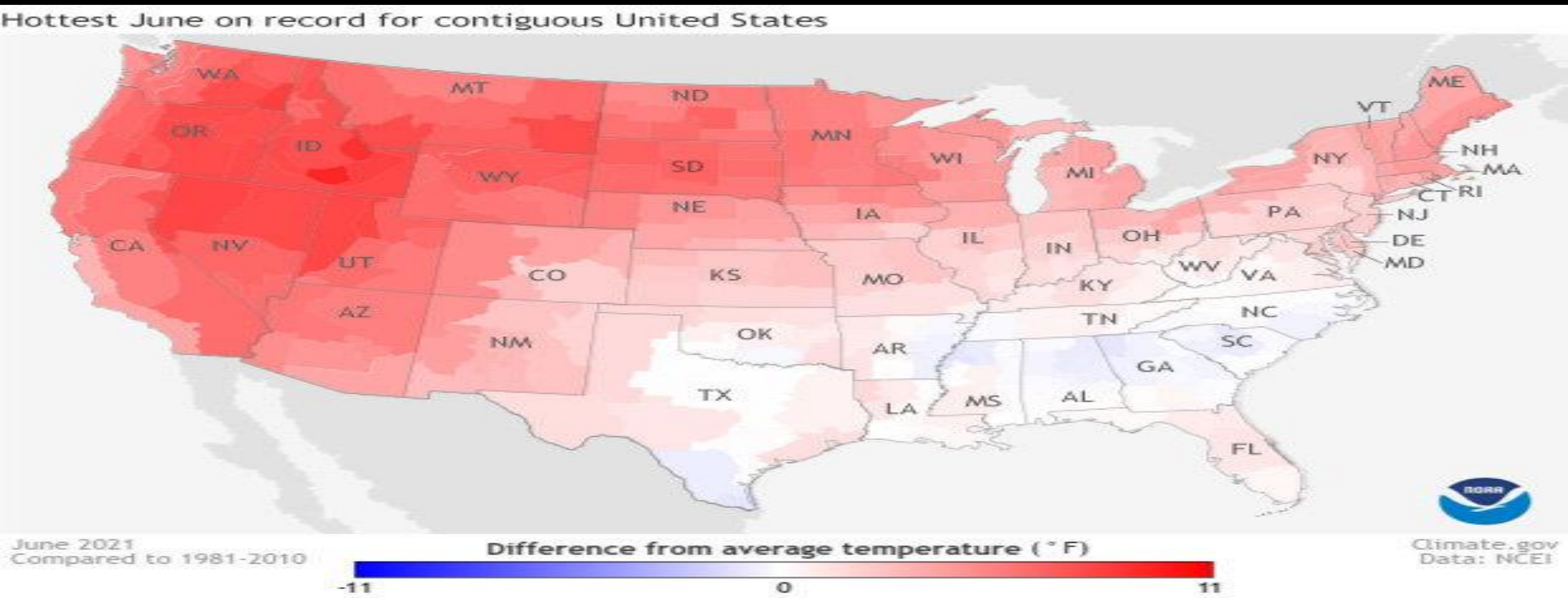
NOAA Climate.gov, adapted from NAS 2016

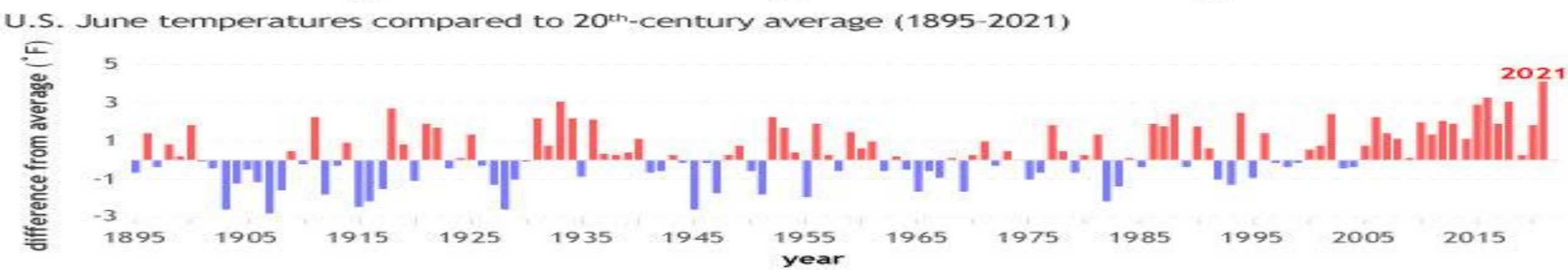
Warm Oceans Fuel Hurricane Intensity





The 2021 Pacific NW Heatwave 150 times more like due to global warming. Theoretically, a 1-in-150,000-year event—so rare, they concluded, that it's fair to say it would have been "virtually impossible" in pre-industrial times.





Key Points

- Climate is changing (because of us) and extreme weather events are responding (2021 IPCC Report)
- ”Hope” Or “Let’s Wait And See” Are No Longer Viable Risk Mitigation or Resilience Strategies
- Climate resilience requires a mix of traditional engineering, engineering with nature solutions, and out-of-the box innovation

$$Risk = \frac{Hazard \times Exposure \times Vulnerability}{Resilience}$$

Climate Risk

0.5 2 4 6 8 10 20

Original Paper | Open Access | Published: 01 November 2020

Multi-hazard climate risk projections for the United States

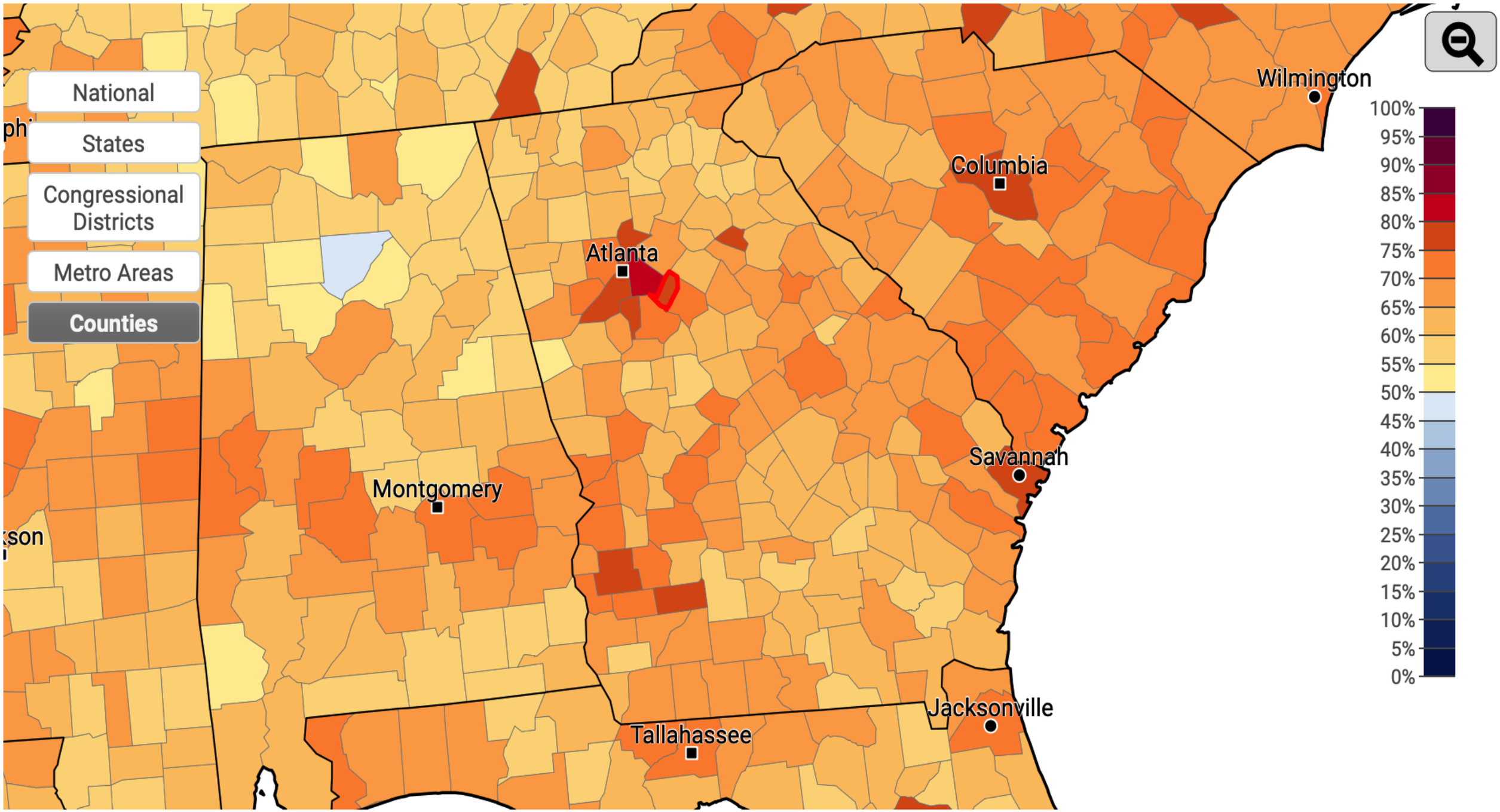
Binita KC, J. M. Shepherd, Anthony W. King & Cassandra Johnson Gaither

Natural Hazards **105**, 1963–1976 (2021) | Cite this article

Abstract

• Climate risk in the 2040s. Indices of climate hazard, exposure, and vulnerability of orange, red, and darker colors indicate high climate risk counties. (KC et al. 2021)

Estimated % of adults who think global warming is happening



UCSB UNIVERSITY OF CALIFORNIA SANTA BARBARA

YALE PROGRAM ON Climate Change Communication

UtahState University

Break

Program will resume in 15 minutes

It’s really important for us to remember how much power we have… Humans made the system; humans can change the system.

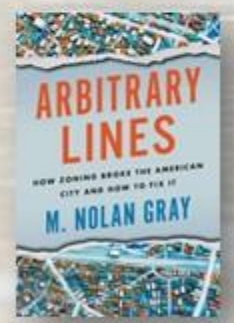
INGRID LAFLEUR


Metropolitan North Georgia Water Planning District
COUNCIL for QUALITY GROWTH
STORMWATER WORKSHOP
Stormwater Won't Work Until We Do
June 14, 2023 | 8:30 AM
Georgia Association of Water Professionals

M. Nolan Gray

Author

Arbitrary Lines



COUNCIL for QUALITY GROWTH

Metropolitan North Georgia Water Planning District

Katherine Atteberry

Stormwater Planning Manager, Metro North Georgia Water Planning District

Rethinking Land Use & Zoning Regulations

M. Nolan Gray & Katherine Atteberry


Metropolitan North Georgia Water Planning District
COUNCIL for QUALITY GROWTH
STORMWATER WORKSHOP
Stormwater Won't Work Until We Do
June 14, 2023 | 8:30 AM
Georgia Association of Water Professionals

Juli Beth Hinds

Principal

Birchline Planning LLC

Financial Impacts of Stormwater Requirements for Infill Development

Juli Beth Hinds

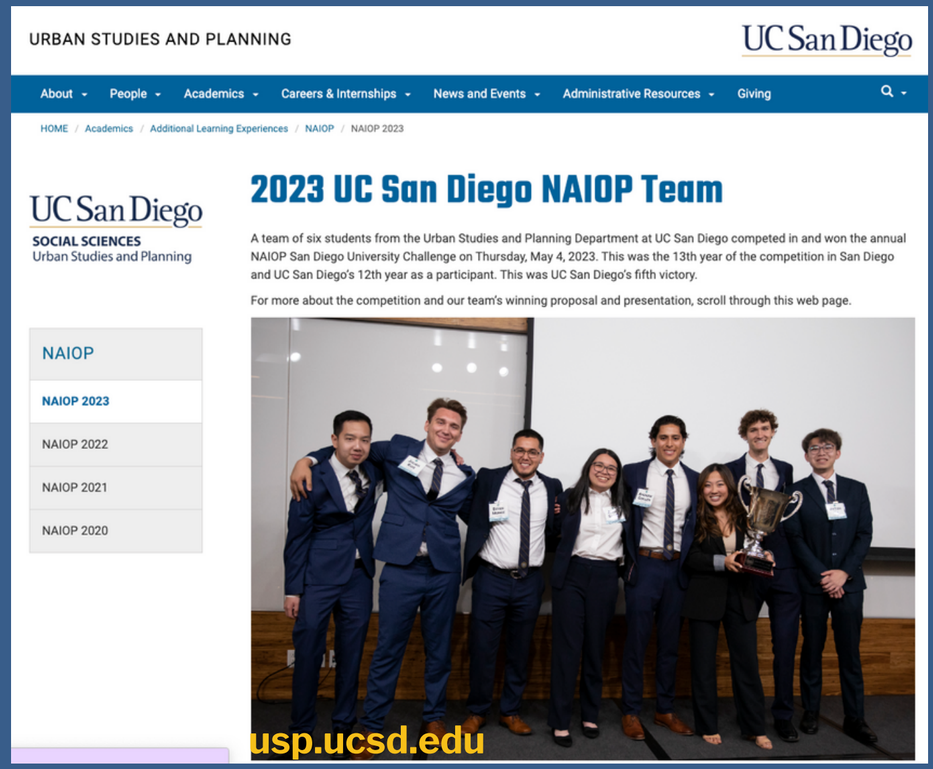
Metropolitan North Georgia Water Planning District + Council for Quality Growth Stormwater Workshop

Financial Impacts of Stormwater Requirements for Infill Development

Juli Beth Hinds, AICP
Birchline Planning LLC

Department of Urban Studies & Planning
UC San Diego

June 14, 2023



UC San Diego
SOCIAL SCIENCES
Urban Studies and Planning

Developer Reactions to Increased Stormwater Volume Management Requirements

Financial Impacts: Research Questions

FINANCIAL IMPACT on HOUSING and INFILL

- Developers say increased volume and infiltration requirements make projects financially infeasible
- Regulators say that's bunk, developers are just greedy
- Who's right?
- Who is credible?

COSTS of SURFACE vs. UNDERGROUND

- What happens to costs if more water can be managed with surface green infrastructure?
- Can that infrastructure be maintained well enough to meet regulatory requirements?
- Do municipal codes allow it?

OFF-SITE MITIGATION/ ALTERNATIVE COMPLIANCE

- Is off-site compliance an environmentally sound means of meeting requirements?
- Who will manage and oversee compliance?

PEOPLE PROBLEMS

- Are regulators on board with analysis?
- With solutions?
- With anything?

Western Riverside County - Financial Impact Analysis & Alternative Compliance Program

Chula Vista Alternative Compliance

Region 9 Water Quality Control Board Processing Times

**Evaluating whether certain agencies, and certain staff members within certain agencies, had materially longer permit processing times

Chicago MWRD 'StormStore' (Alternative Compliance)

**Specific research on the impact of changes to stormwater rules on the financial feasibility of land development

Oakland County - GWK Drainage District Water Quality Rules

City of Detroit Alternative Compliance

**Developing off-site or 'alternative compliance' frameworks to facilitate compliance with stormwater rules

NHL PLAYOFFS

LOOKIT

The Stanley Cup's arrival at United Center is delayed due to flooding in Chicago

Not good!

By Brandon Lee Gowton | @BrandonGowton | Jun 15, 2015, 11:02pm EDT

PERFECT STORM

How flooding overwhelmed metro Detroit's stormwater system — and why it's so hard to fix

INFILL SITES

FLASHY HYDROLOGY & IMPACTS

Annual average precipitation

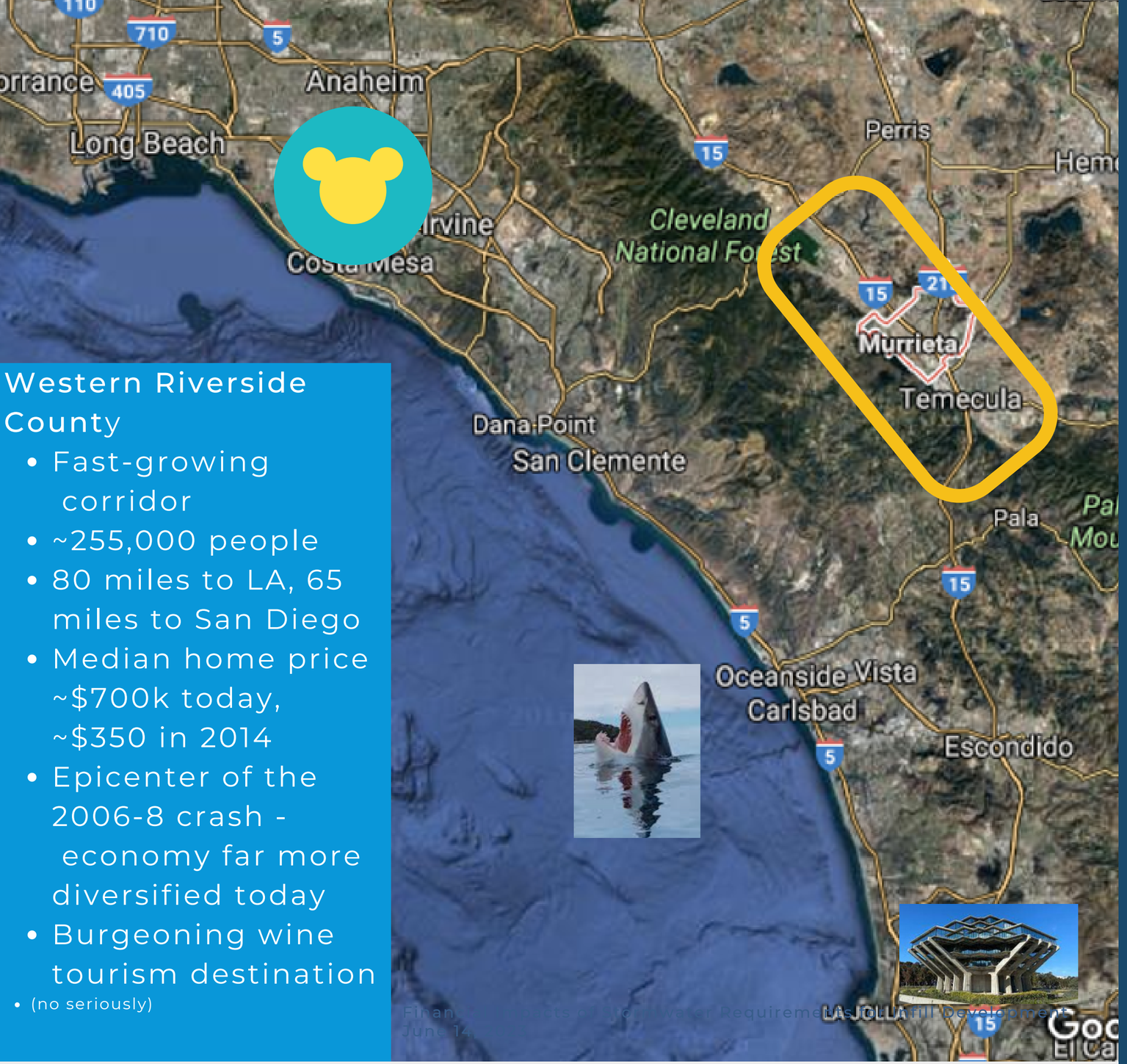
11 - 15 inches

Current water year

Temecula 23 inches

Murrieta 17 inches

Southwest Riverside County



Western Riverside County

- Fast-growing corridor
- ~255,000 people
- 80 miles to LA, 65 miles to San Diego
- Median home price ~$700k today, ~$350 in 2014
- Epicenter of the 2006-8 crash - economy far more diversified today
- Burgeoning wine tourism destination
- (no seriously)

2015-2016 Study

Evaluate financial feasibility impacts on planned development of a major change in post-construction stormwater control requirements

- 3 cities came under San Diego County RWQCB permit as of end of 2015 - Substantial change in PCSW requirements:
- Infiltration of 85th % storm instead of flow-through
- **Roughly doubled the volume to be managed – or more if hydromod requirements apply**
- Much more challenging to use usual go-to (basins)

Stormwater compliance cost as a % of total development cost		
Impact	% of Total Development Cost	% of Contingency
Low	< 2.0%	< 40%
Medium	2.1% - 3.9%	40% - 79%
High	> 4.0%	> 80%

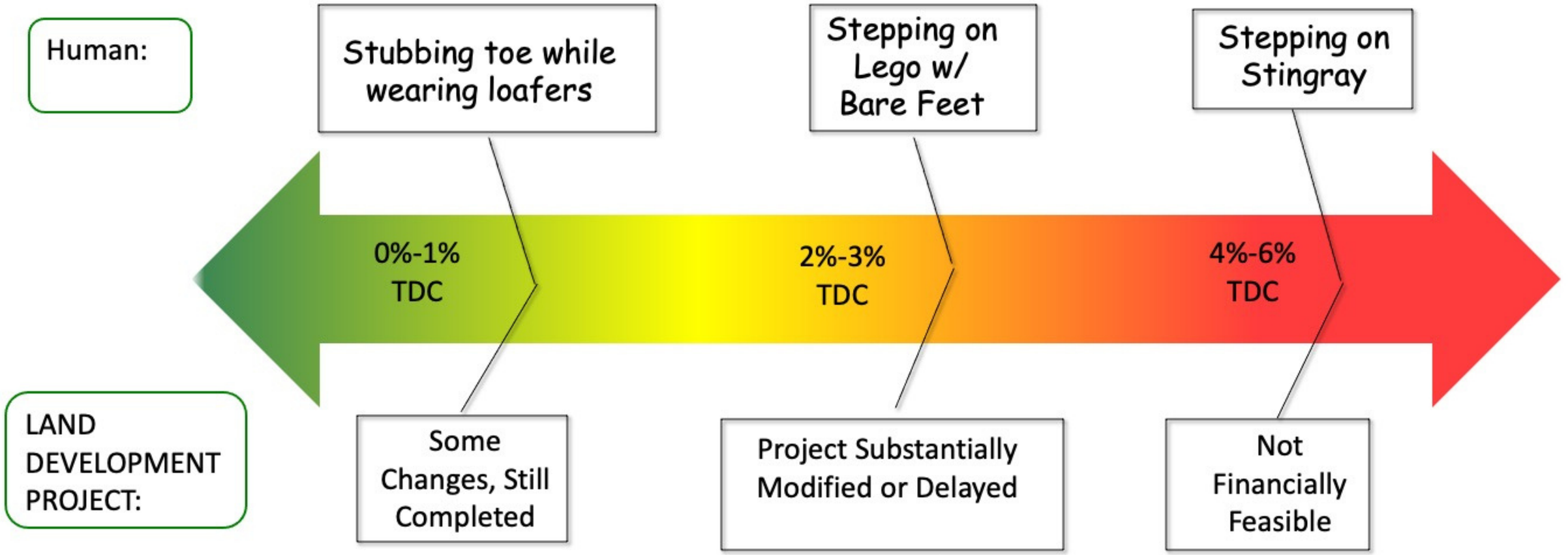
Hypothesis:

Stormwater Cost ÷ Total Development Cost = Development Feasibility Impact

WHY?
Impact on typical CONTINGENCY (5% TDC) and PROFIT/FEE (8%-11% TDC)

***No project had a stormwater cost >6% of TDC**

What Kind of Pain Are We Talking About?



1. **Can we quantify the Pain of the change in PCSW regulations – overall, and in terms of project types and densities affected?**

2. How much volume must be provided through Alternative Compliance, and at what price per gallon, to prevent Pain?

Study Methodology

1 -Catalog Potential Development

Worked with planners, developers to identify reasonably foreseeable development using 10 year horizon

Types & densities
Devel. costs/ SF
Sites, slopes, SOILS
Zoning

2 - Create Site Plans and Calculate Required Stormwater Volumes

Estimated impervious area and required stormwater volumes for each of 25 potential developments

Required surface area of infiltration (basins) and biofiltration

DOES IT FIT??

3 - Estimate total development cost and cost of stormwater compliance

Estimated impervious area and required stormwater volumes for each of 25 potential developments

Financial impact of stormwater compliance

PAIN?

4 - WHAT HAPPENS IF 30% OF VOLUME CAN BE TREATED OFF SITE?

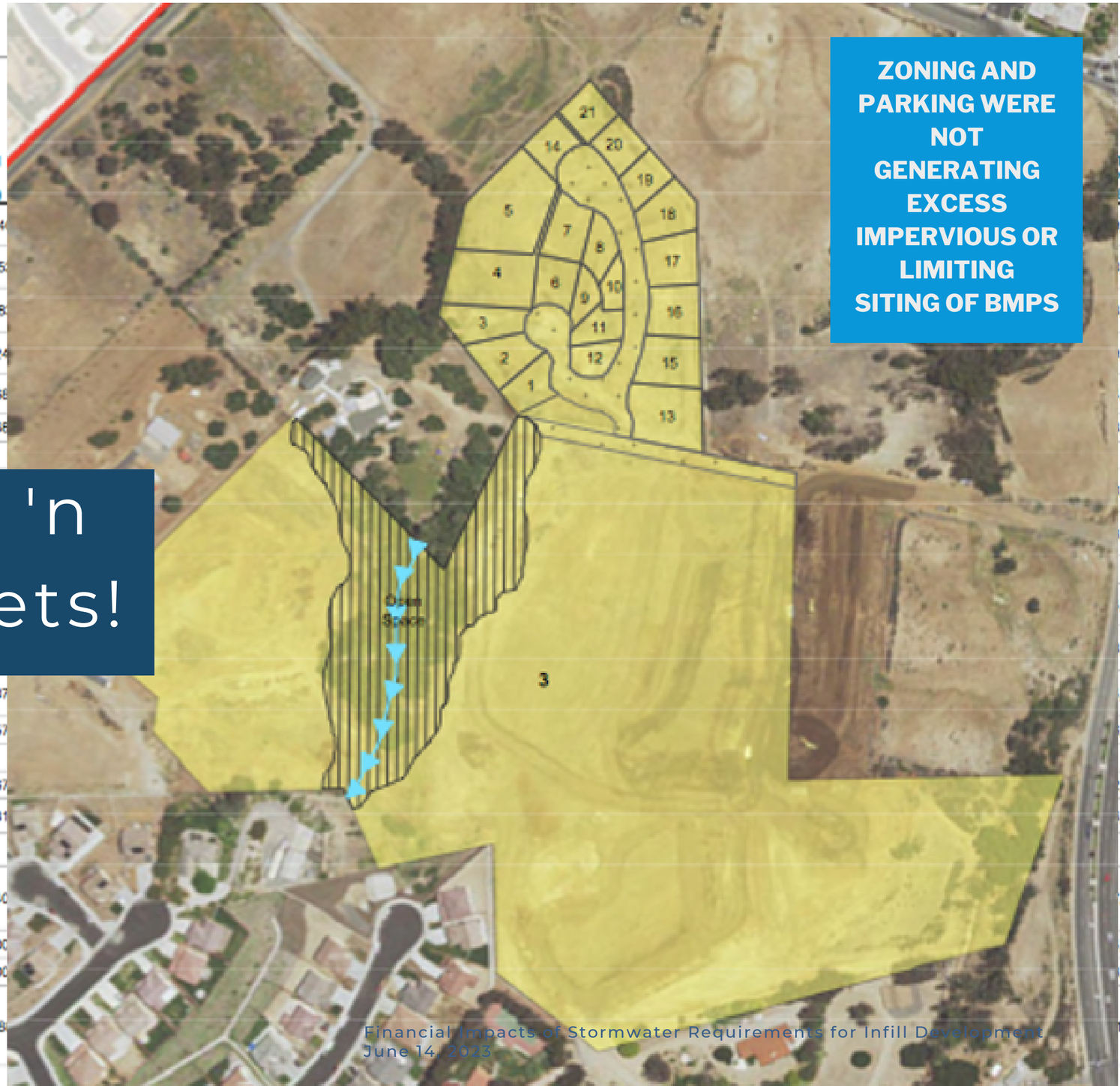
If a fee in lieu is available, does that overcome site and financial constraints?

Recommend Alternative Compliance Option

Table 4.3 WILDOMAR LAND USE

Map #	Applicant	Land Use	Units or SF	Residential Unit Type	Estimated Development Cost per SF (excluding land)	Parcel (Acres)	Density (Units/Ac or FAR)	Parcel SF (Total)
1	Lennar Residential	Residential	67	Single-Family	$150	26.8	2.50	1,167,4
2	CV Communities	Residential	102	Single-Family	$150	42.0	2.43	1,829,5
3	Lennar Homes North Ranch	Residential	84	Single-Family	$150	27.2	3.09	1,184,8
4	McVicar	Residential	49	Single-Family	$150	12.9	3.80	561,924
5	Grove Park	Residential	162	Multi-Family		10.3	15.73	448,668
5	Strata/Clinton Keith	Commercial	40,000	n/a		10.3	0.09	448,668
TOTAL Grove Park Mixed Use Project					$225			
6	Horizons/Strata	Residential	14					
6	Horizons/Strata	Assisted Living	86					
TOTAL Horizons/Strata								
8	Beazer Homes	Residential	10					
9	Clinton Keith condominiums	Residential	10					
10	Rancon Medical/Retail	Office/ Commercial	96,240	n/a		7.2	0.31	315,107
10	Rancon business park	Industrial	294,900	n/a		22.2	0.31	965,557
TOTAL Rancon					$300			
11	Westpark Promenade	Commercial	86,000	n/a		6.6	0.30	286,667
11	Westpark Promenade	Residential	322	Multi-Family		21.7	14.83	946,081
TOTAL Westpark Promenade					$250			
12	Clinton Keith commercial (19-Acre Commercial)	Commercial	248,292	n/a	$225	19.0	0.30	827,640
13	Business Park	Industrial	261,360	n/a	$150	20.0	0.30	871,200
14	Sycamore Academy	Educational	28,000	n/a	$300	10.0	0.06	435,600
15	College and Joint Use Park	Mixed-use/ Open Space	210,000	n/a	$300	48.0	0.10	2,090,8

Site Plans 'n Spreadsheets!



Anticipated Projects in Study Area:				Assumed Development Cost:	Calculated:		IMPACT:
Single-Family Residential	6	418	2 – 4 du/ac	$150/SF	Infiltration Volume, Area & Cost (Surface Basins) Volume under new MS4 Permit rule; cost $1.48 - $4.08/gallon	Biofiltration Volume, Area & Cost (Engineered Media). Volume under new rule = 1.5x infiltration volume; cost $1.94 - $20.50/gallon (complex urban sites)	0 - 1 %
Multi-Family Residential	4	863	7 – 15 du/ac	$225/SF			1 - 2%
Institutional (School, College, Recreation)	4	238,000	--	$300/SF (schools)			Stormwater cost as % of total development cost
General Commercial	4	305,892	--	$225-$250/SF			
Industrial	1	261,360	--	$150/SF			
Urban Mixed Use (Temecula Downtown Specific Plan)	3	1,072	45 du/ac	$300/SF			3 - 4%
Medium Density Mixed Use (Murrieta & Wildomar)	3	484 du/517,140	15 du/ac	$250 - $300/SF			4 - 6%

"Infeasible" = The required volume of stormwater cannot be physically accommodated on the site without materially altering the development plan

STUDY FINDINGS:

THE PAIN IS REAL - ESPECIALLY FOR THE 'MIDDLE'

...and in one unlucky area with terrible soils.

LAND USE	100% ON-SITE INFILTRATION	100% ON-SITE BIOFILTRATION
SINGLE FAMILY	2%	4%
MULTI-FAMILY	INFEASIBLE	2% - 5%
MIXED USE	INFEASIBLE	6%
INSTITUTIONAL	INFEASIBLE	1%
URBAN CORE	INFEASIBLE	1%
UNLUCKY SITES	INFEASIBLE	INFEASIBLE

WHY?

Enough SPACE for infiltration basins

NOT ENOUGH SPACE FOR LESS COSTLY BMPS
NOT ENOUGH VALUE TO ABSORB COSTS

Enough VALUE to carry cost of biofiltration or underground

LAND USE	100% ON-SITE INFILTRATION	100% ON-SITE BIOFILTRATION
SINGLE FAMILY	2%	4%
MULTI-FAMILY	INFEASIBLE	2% - 5%
MIXED USE	INFEASIBLE	6%
INSTITUTIONAL	INFEASIBLE	1%
URBAN CORE	INFEASIBLE	1%
UNLUCKY SITES	INFEASIBLE	INFEASIBLE

WITH AN OFF-SITE ALTERNATIVE COMPLIANCE OPTION - THE PICTURE IMPROVED

- **Assumed 70% of volume managed on site, 30% off-site/fee in lieu**
- **ALL sites could comply physically with the permit requirements**
- **High cost impact reduced to 3 of 23 site plans - but still bad for lower-intensity infill**

LAND USE	100% ON SITE INFILTRATION	100% ON SITE BIOFILTRATION	70% ON-SITE/30% INFILTRATION COST
MIXED USE	5%	6%	5%
INSTITUTIONAL	NO	6%	4%
INDUSTRIAL	4%	5%	4%
INSTITUTIONAL	0%	1%	4%
COMMERCIAL	NO	NO	3%
COMMERCIAL	NO	4%	3%
SINGLE FAMILY	NO	4%	3%
SINGLE FAMILY	2%	4%	3%
SINGLE FAMILY	2%	4%	3%
SINGLE FAMILY	2%	4%	2%
COMMERCIAL	NO	3%	2%
SINGLE FAMILY	2%	3%	2%
SINGLE FAMILY	2%	3%	2%
URBAN	NO	NO	1%
MIXED USE	NO	2%	1%
MULTI FAMILY	NO	2%	1%
MULTI FAMILY	NO	2%	1%
MULTI FAMILY	NO	2%	1%
MULTI FAMILY	NO	2%	1%
MIXED USE	1%	2%	1%
MULTI FAMILY	1%	2%	1%
URBAN	NO	1%	1%
URBAN	NO	0%	1%

wierd outlier

Table 4.3 WILDOMAR LAND USE

Map #	Applicant	Land Use	Units or SF	Residential Unit Typ	Estimated Develop-ment Cost per SF (excluding	Parcel	Density (Units/Ac	Parcel SF
1	Lennar Residential	Residential	67	Single-Family				
2	CV Communities	Residential	102	Single-Family				
3	Lennar Homes North Ranch	Residential	84	Single-Family				
4	McVicar	Residential	49	Single-Family				
5	Grove Park	Residential	162	Multi-Fa				
5	Strata/Clinton Keith	Commercial	40,000	n/a				
TOTAL Grove Park Mixed Use Project								
6	Horizons/Strata	Residential	140	Townho				
6	Horizons/Strata	Assisted Living	86	Assisted Living				
TOTAL Horizons/Strata								
8	Beazer Homes	Residential	108	Single-Family				
9	Clinton Keith condominiums	Residential	101	Multi-Fa				
10	Rancon Medical/Retail	Office/ Commercial	96,240	n/a				
10	Rancon business park	Industrial	294,900	n/a				
TOTAL Rancon								
11	Westpark Promenade	Commercial	86,000	n/a				
11	Westpark Promenade	Residential	322	Multi-Fa				
TOTAL Westpark Promenade					$250			
12	Clinton Keith commercial (19-Acre Commercial)	Commercial	248,292	n/a	$225	19.0	0.30	827,640
13	Business Park	Industrial	261,360	n/a	$150	20.0	0.30	871,200
14	Sycamore Academy	Educational	28,000	n/a	$300	10.0	0.06	435,600
15	College and Joint Use Park	Mixed-use/ Open Space	210,000	n/a	$300	48.0	0.10	2,090,8

KEY QUESTIONS:

1. COULD THE CITIES AND COUNTY BUILD ALTERNATIVE COMPLIANCE PROJECTS AT A PER-GALLON PRICE COMPARABLE TO THE COST OF INFILTRATION BASINS?
2. WOULD THE REGIONAL WATER QUALITY CONTROL BOARD APPROVE AN OFF-SITE OPTION?

CALIFORNIA Water Boards

GAVIN NEWSOM
GOVERNOR

JARED BLUMENFELD
SECRETARY FOR
ENVIRONMENTAL PROTECTION

San Diego Regional Water Quality Control Board

July 15, 2022

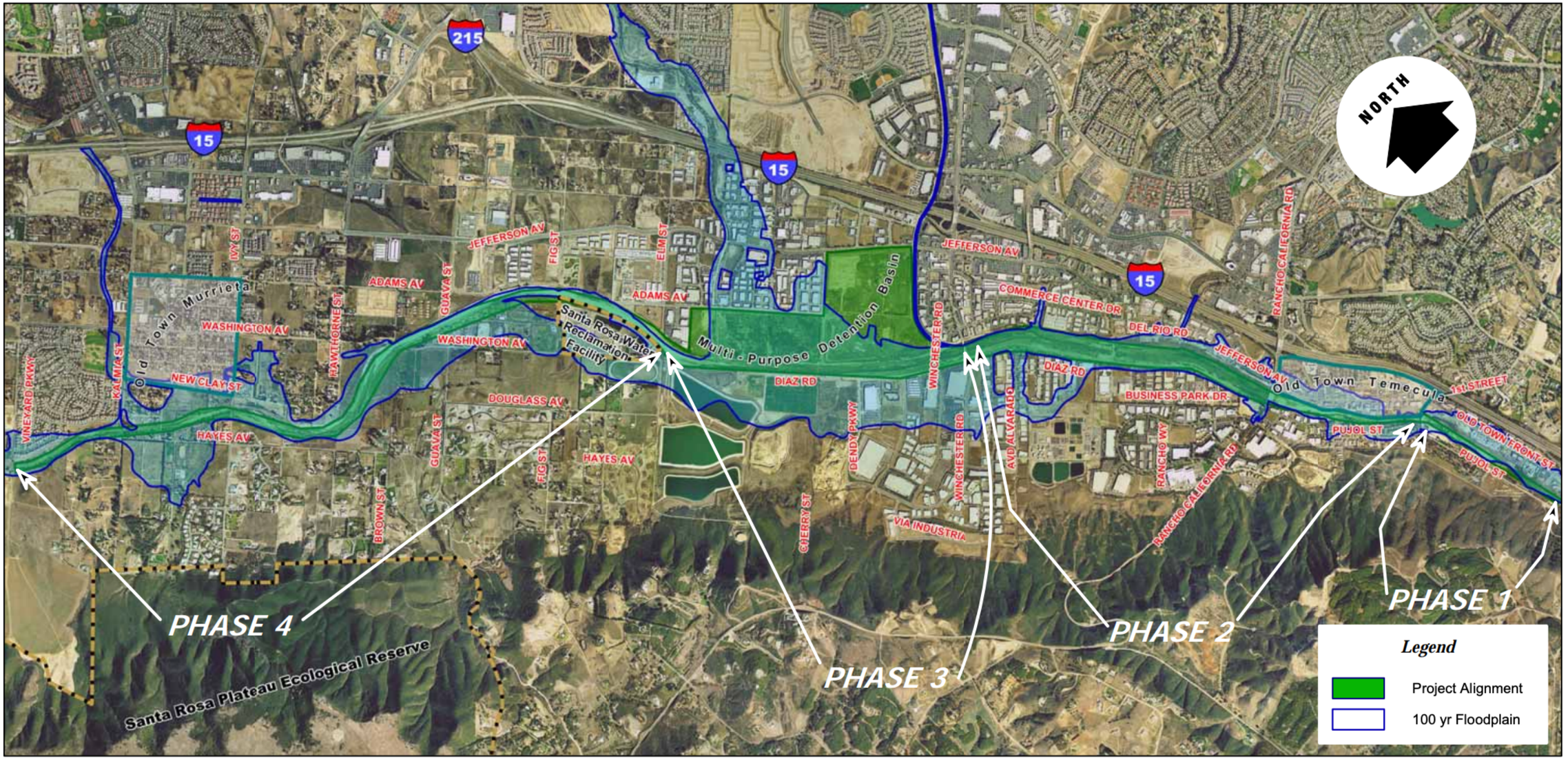
Stuart Kuhn
City of Temecula
41000 Main St
Temecula, CA 92590
Via Email Stuart.Kuhn@TemeculaCA.gov

In reply refer to/ attn:
CW-794828:ERyan

Subject: Notice of Acceptance - Alternative Compliance Water Quality Credit System

Stuart Kuhn:

Murrieta Creek Flood Control
Environmental Restoration and Recreation Project



WHAT'S NEXT IN RIVERSIDE & Chula Vista:

Other findings:

- *Notwithstanding DC Water, off-site compliance programs are complicated - and require dedicated financial and staff resources within municipal government (Chicago, Detroit)*
- ***Integrating green infrastructure with required landscape and parking can shrink underground detention and improve stormwater costs (Oakland County, Michigan)*
- *Specific Regional Board staff at Region 9 had demonstrably longer review times that affected project financial feasibility*

	Detention							
Ref.	Threshold	Standard	Storm	Release Rate	Calc.	Use of Pkg Lots	Waiver?	Proj/ Year
City Devel. Eng. Standards	All developments; treatment of runoff from area being developed only, not from off-site	Store all storm water runoff from 25 year frequency in excess of agricultural runoff	25 yr.	0.1 to 0.2 cfs	OCDC Simple Method 12/73	City Engineer approves	Parking lot or under-ground allowed	
City Engineering Design Standards	All developments	Treat + store first flush + bank full flood	100 yr.		OC		No policy	
Title II Ch. 18	Construction of 3,500 SF of new impervious area	Runoff from 10 year storm shall not exceed greater of 1 cfs/acre or 0.2 cfs	10 yr.	1 cfs/ acre or 0.2 cfs	City		No policy	1-5
644-4	Any development/redevelopment > 6100 SF; any renovations/ additions that involve parking lot, private street, drive or sidewalk removal and	0.2 cfs for total property area > 1.5 ac; 0.3 cfs for property area ≤1.5 ac		0.2 or 0.3 cfs	OC		City Eng. may vary 644-14	
Article V, Section 126			100 yr. (new development)		OC		No policy	@ 6
13.13			10 yr. if outlet; 2 x 100 yr. if no outlet		OC		Discretion of bldg. official	
29-115	"Al	o the agricultural off equal to 0.2 cfs 0 yr storm"	10 yr.	0.2 cfs	OC		No policy	
8-109		w from a site or e restricted to an of runoff"			OC			
18-353	Re			0.1 cfs	OC	Up to 8" storage		
6-390		5 acres; 0.3 cfs if < 1.5 acres	10 yr.	0.2 or 0.3 cfs	OC	No	Generally not, but some discretion	5 - 10
34-604 (Site Plan)	"Appropriate measures shall be taken to ensure that site drainage will not adversely affect adjoining properties or the capacity of the public storm drainage system"						No policy	
n/a	none							

"LOW HANGING FRUIT OF LOCAL REFORM"

Look at stormwater, parking, landscaping standards and requirements among neighboring communities - who is doing what and who is flooding out their downstream neighbors?

Thank you!

I appreciate your time!

Birchline Planning LLC

Great Waters + Great Communities

Instagram
@birchlinevt

Phone
802-324-5760

Emails
jhinds@ucsd.edu

birchlineplanningllc@gmail.com

Lunch & Discussion

Every now and then one's mind is stretched by a new idea or sensation, and never shrinks back to its former dimensions.

Oliver
Wendell
Holmes Sr.

CQG & MNGWPD's Stormwater Working Group Joint Statement

"Recent litigation wins have help ensure the metro Atlanta region's long-term water supply to support economic vitality, quality of life, and progress. Good management of stormwater helps protect human life, property, and natural resources. As more of metro Atlanta urbanizes and is more densely developed, robust stormwater infrastructure improves water quality, mitigates flooding, and protects ecosystems. And as the intensity and frequency of storms increases, we must take collaborative action to improve the region's stormwater management practices and policies – to ensure our continued quality of life."

Wrapping Up

Katherine Zitsch

It's clear that **the problems** we refuse to solve **today will complicate** and intensify **the crises we face tomorrow.**

Jane McGonigal


Metropolitan North Georgia Water Planning District
COUNCIL for QUALITY GROWTH
STORMWATER WORKSHOP
Stormwater Won't Work Until We Do
June 14, 2023 | 8:30 AM
Georgia Association of Water Professionals