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SUMMIT

AUGUST 21-23, 2018 • CLEVELAND, OHIO

Risky Business

New Tools for Understanding and Addressing Disaster Risk in Multifamily Housing

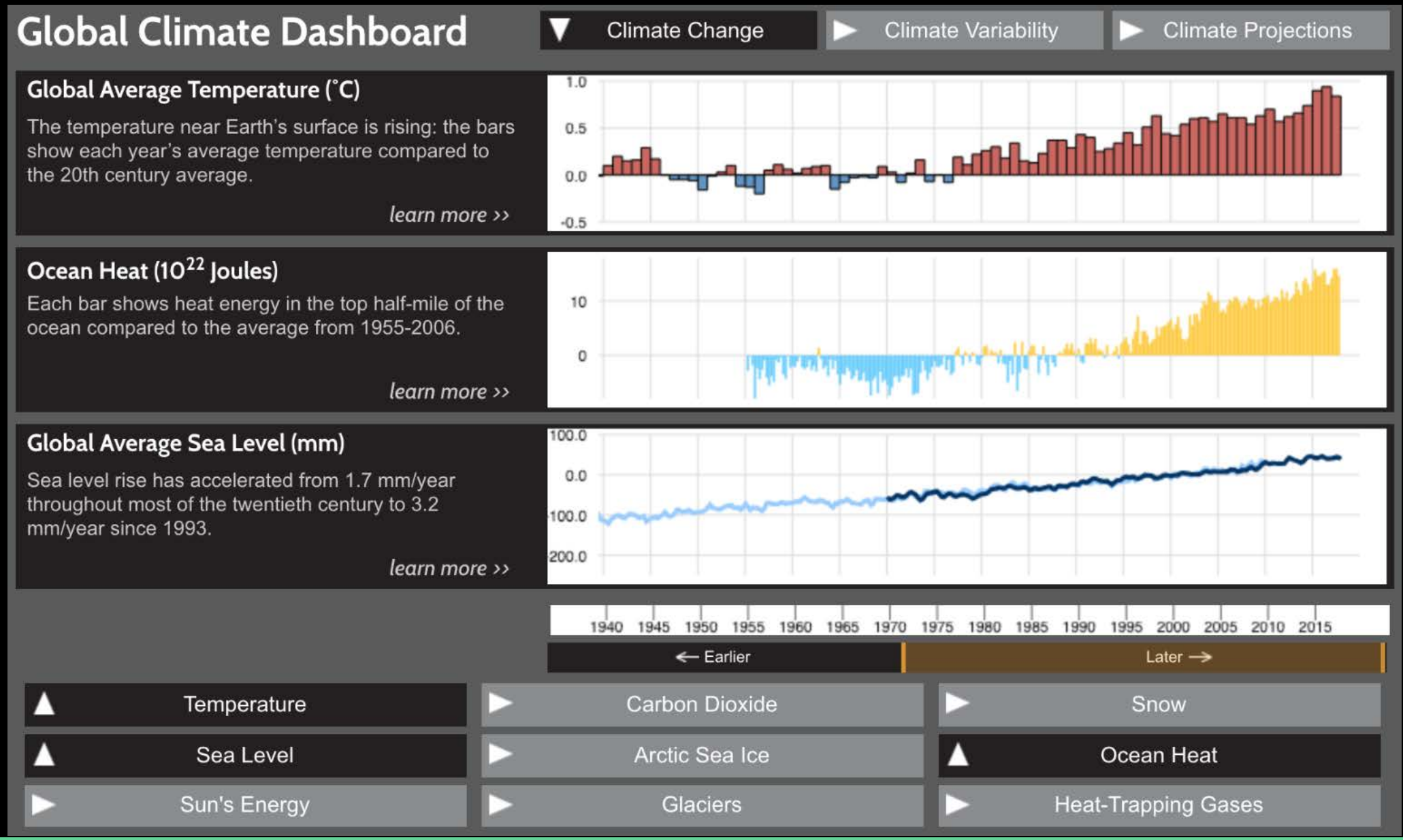
Energy Exchange | Better Buildings SUMMIT

2018 Better Buildings Summit

Risky Business: New Tools for Addressing Disaster Risk in Multi-family Housing

LuAnn Dahlman
U.S. Climate Resilience Toolkit
Climate Explorer
luann.dahlman@noaa.gov

Observations show climate is changing

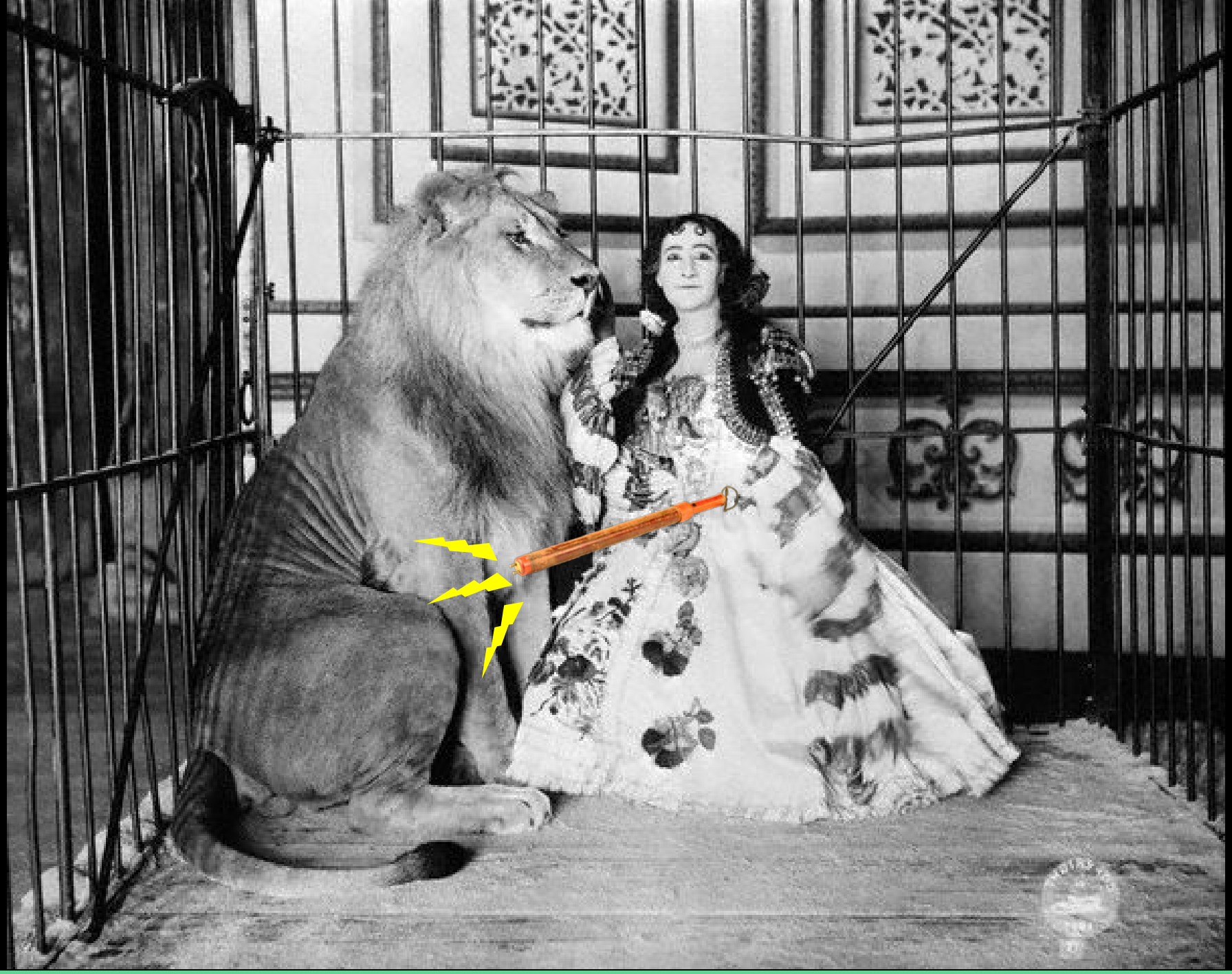


Climate.gov

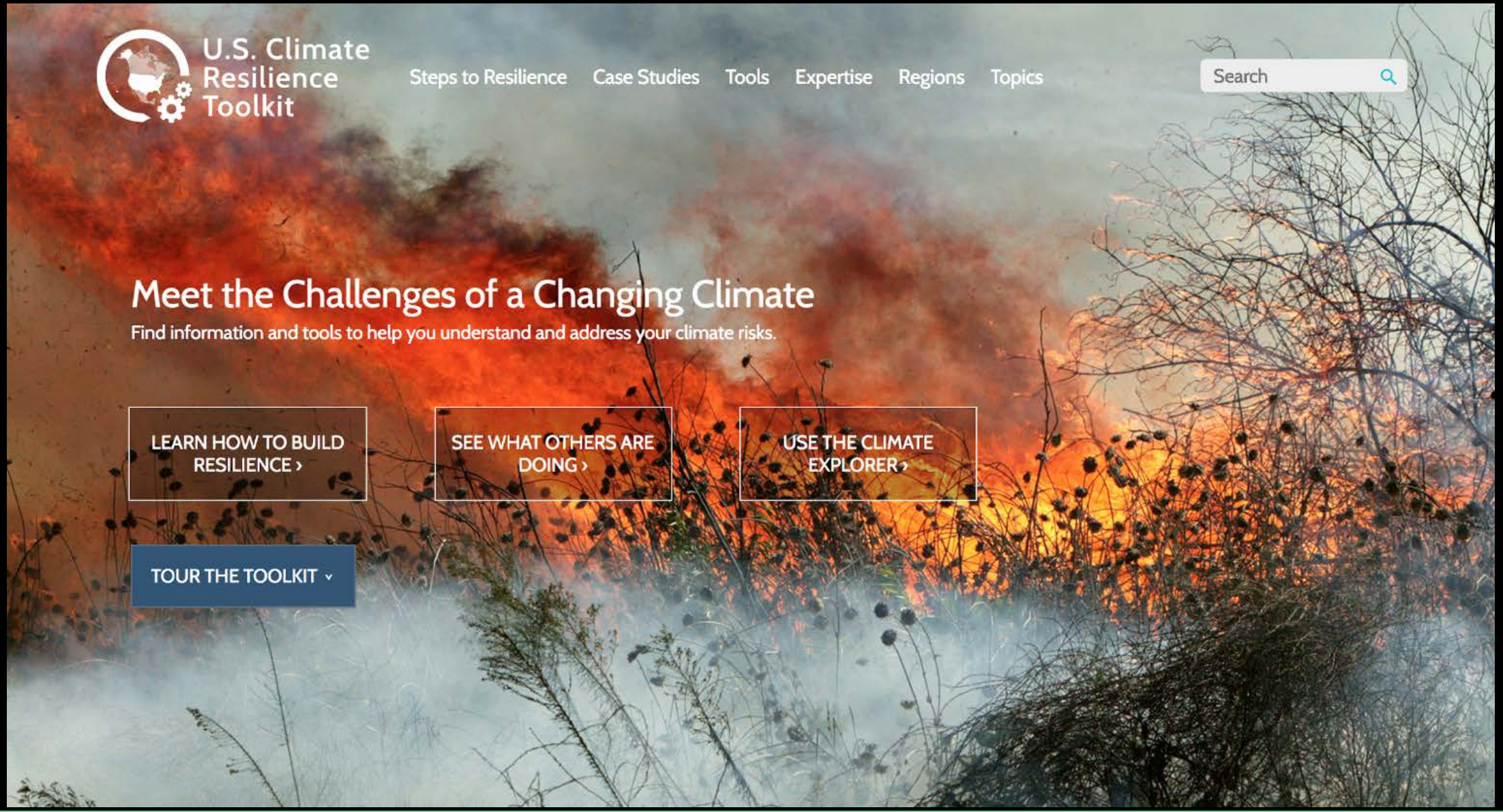
It’s the impacts of changing conditions that we care about

U.S. 2017 Billion-Dollar Weather and Climate Disasters

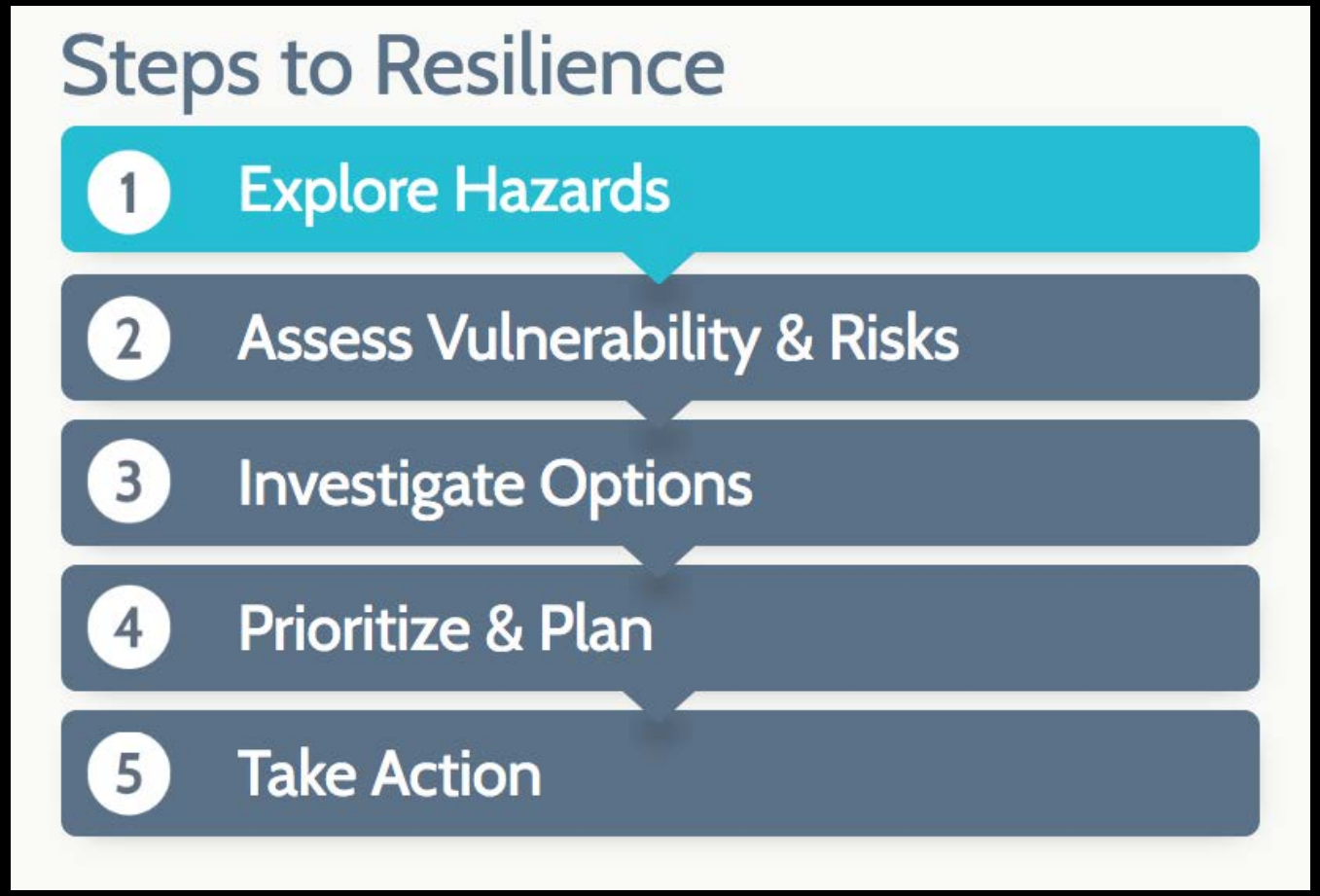
*This map denotes the approximate location for each of the **16 billion-dollar weather and climate disasters** that impacted the United States **during 2017**.*



U.S. Climate Resilience Toolkit toolkit.climate.gov



The toolkit offers a five-step framework for building resilience



Past

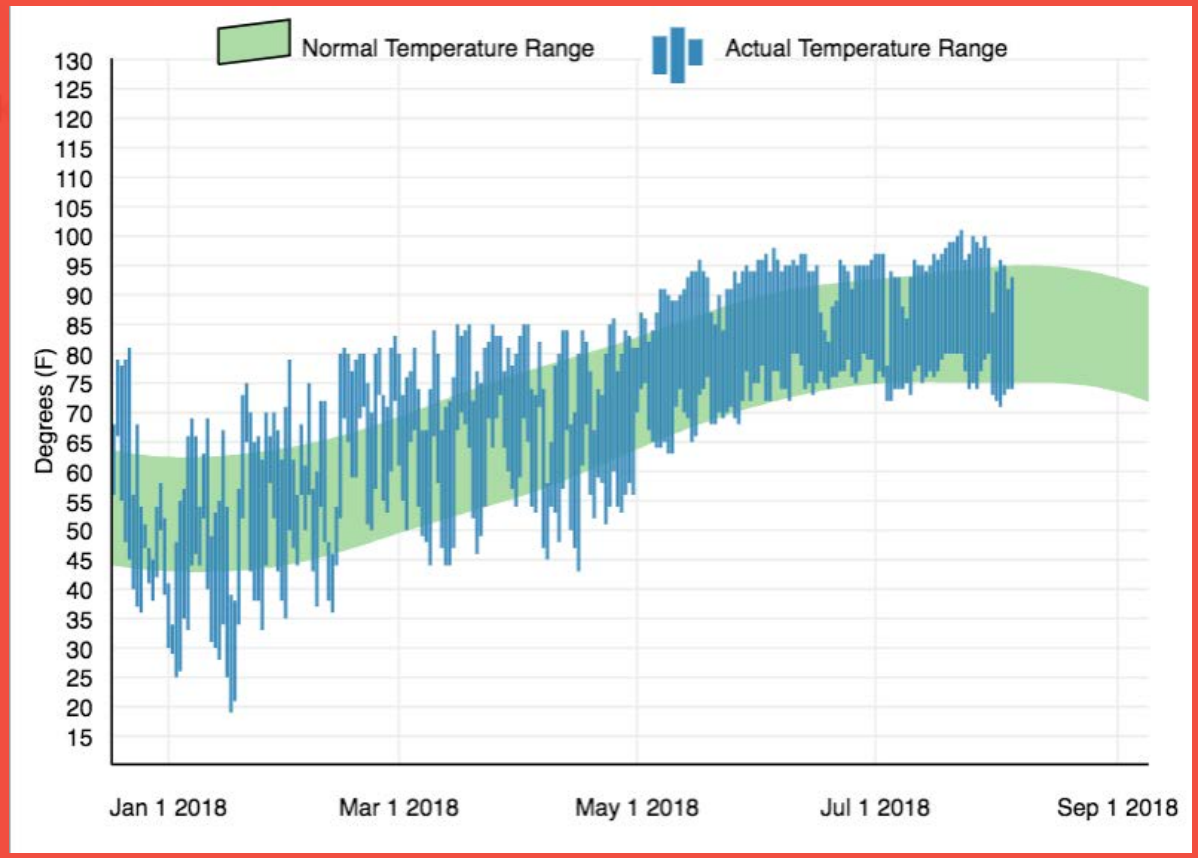
Present

Future

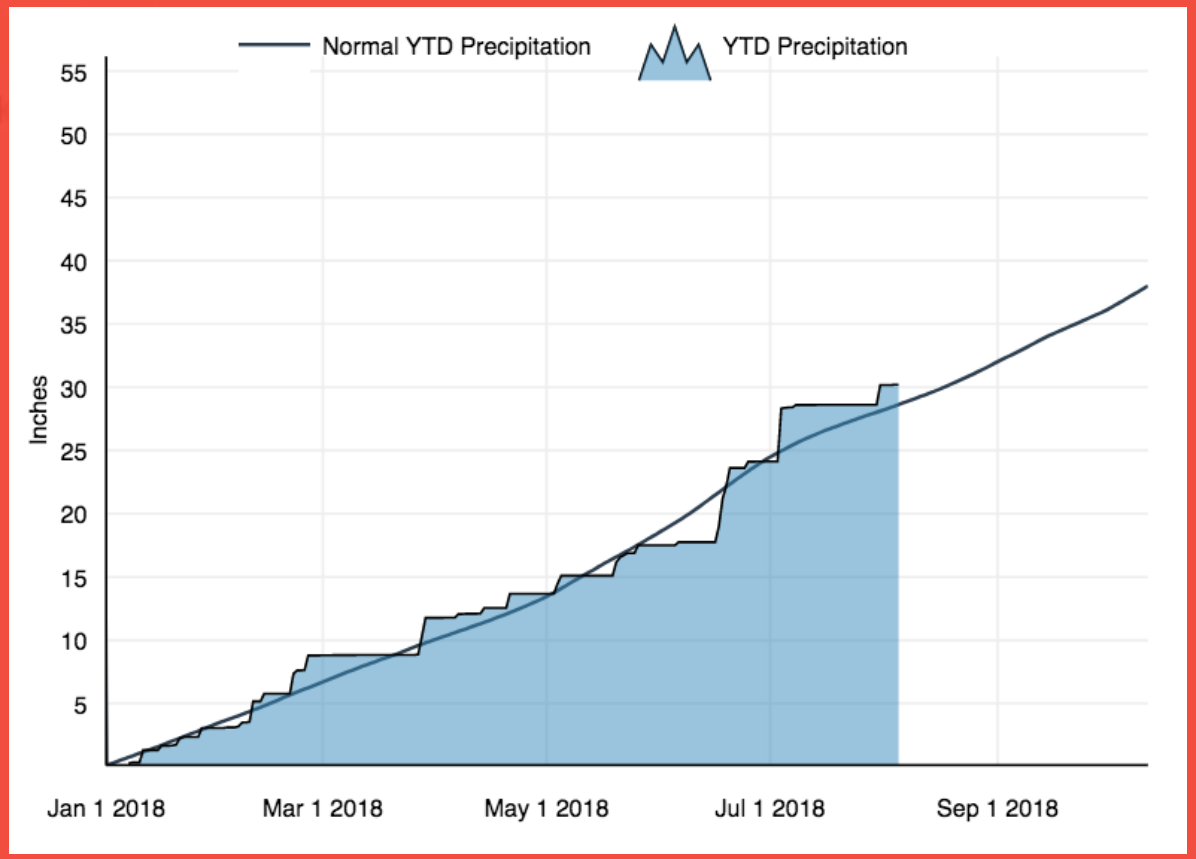
Past

- NOAA has more than a hundred years of daily weather records from thousands of weather stations.
- These records document extreme events in the past that can serve as benchmarks of potential hazards.

Compare daily temperature to Climate Normals



Compare cumulative precipitation to Climate Normals

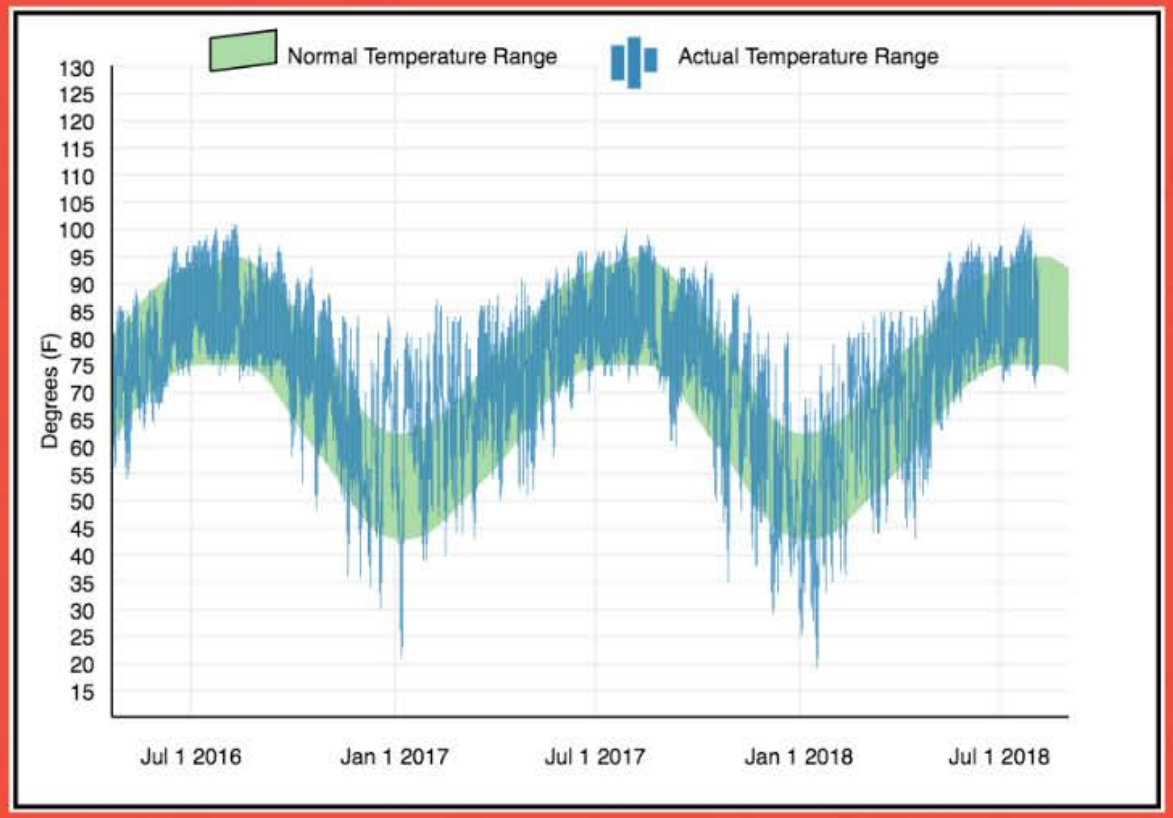


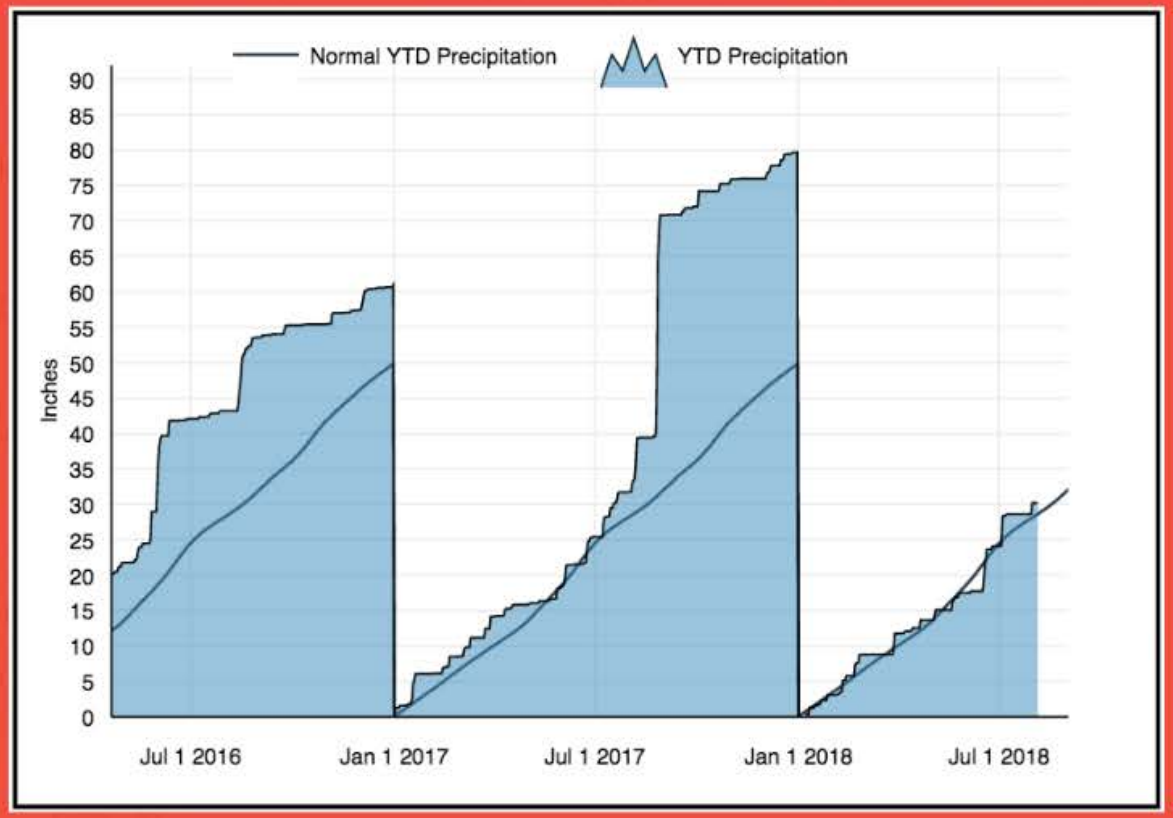
Compare daily temperature and precipitation with Climate Normals

Weather Station

Name: HOUSTON INTERCONTINENTAL AP

Station ID: USW00012960





Check how often conditions have exceeded user-defined thresholds

Weather Station

Name: HOUSTON INTERCONTINENTAL AP

Station ID: USW00012960

Variable:

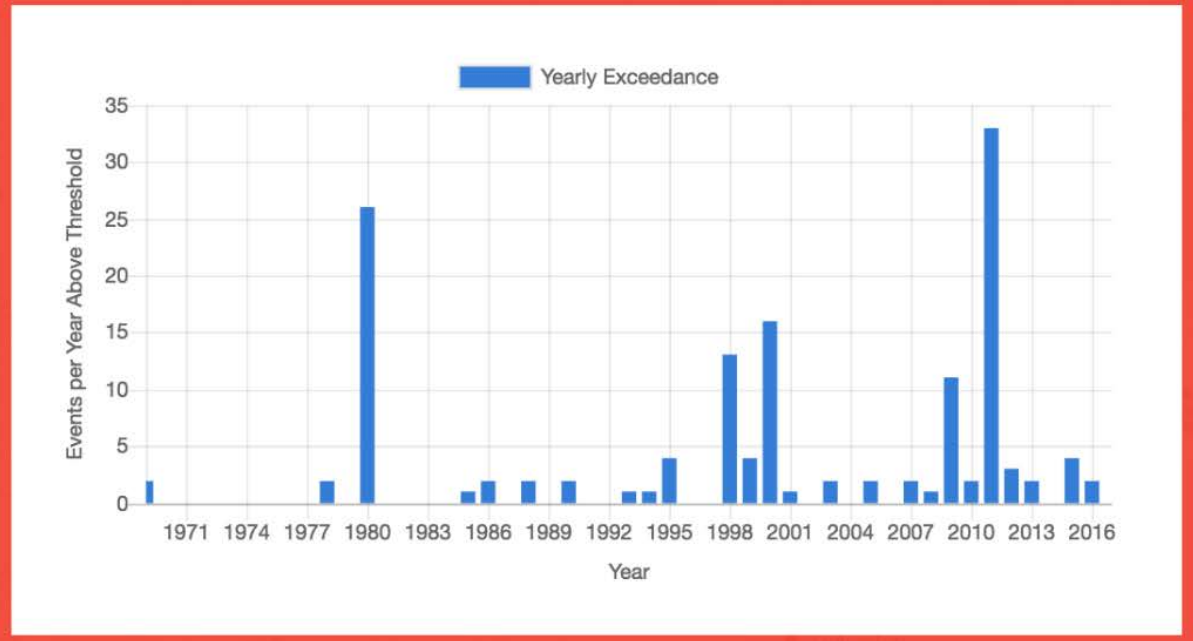
Maximum Temperature

Threshold:

100 °F

Window:

1 days



This graph shows how often the selected threshold has been exceeded per year. For consistency, this chart excludes any years that are missing more than five daily temperature reports or more than one precipitation report in a single month. Data from Global Historical Climatology Network, served by ACIS.

Check how often conditions have exceeded user-defined thresholds

Weather Station

Name: HOUSTON INTERCONTINENTAL AP

Station ID: USW00012960

Variable:

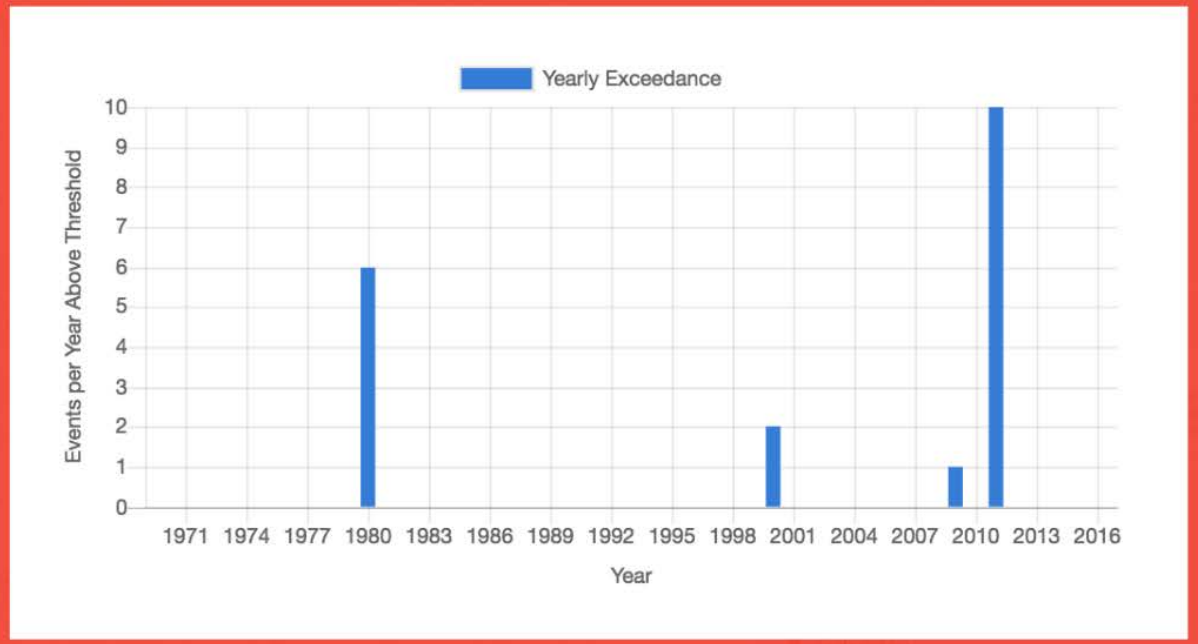
Maximum Temperature

Threshold:

100 °F

Window:

7 days

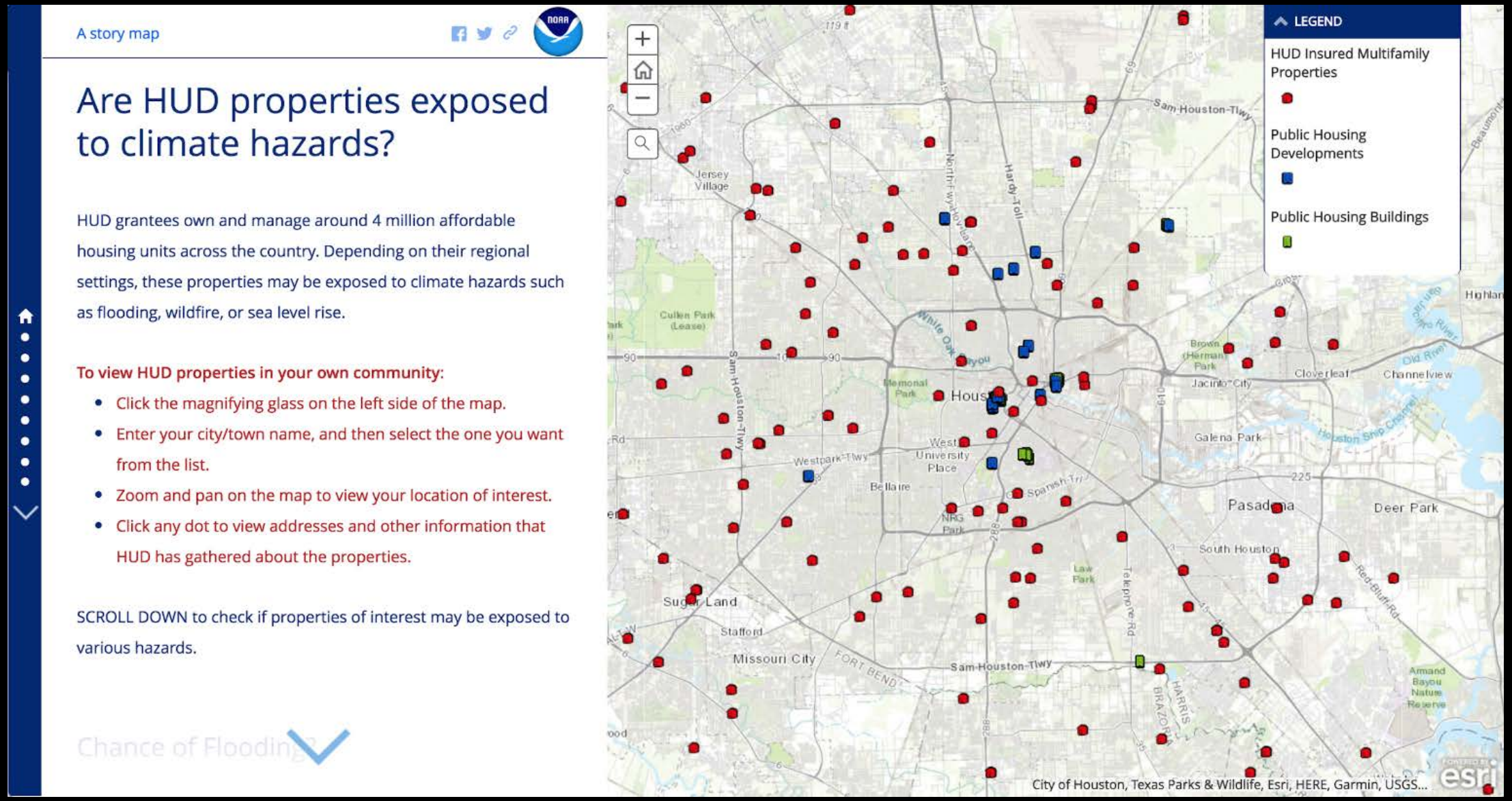


This graph shows how often the selected threshold has been exceeded per year. For consistency, this chart excludes any years that are missing more than five daily temperature reports or more than one precipitation report in a single month. Data from Global Historical Climatology Network, served by ACIS.

Present

- FEMA and other federal agencies offer map services highlighting potential hazards such as flooding.
- You can check where assets of interest intersect with potential climate hazards

Explore where assets and potential hazards intersect



Explore where assets and potential hazards intersect

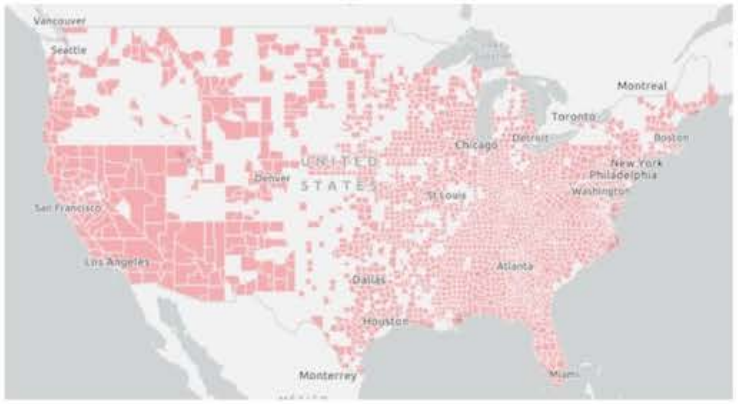
A story map

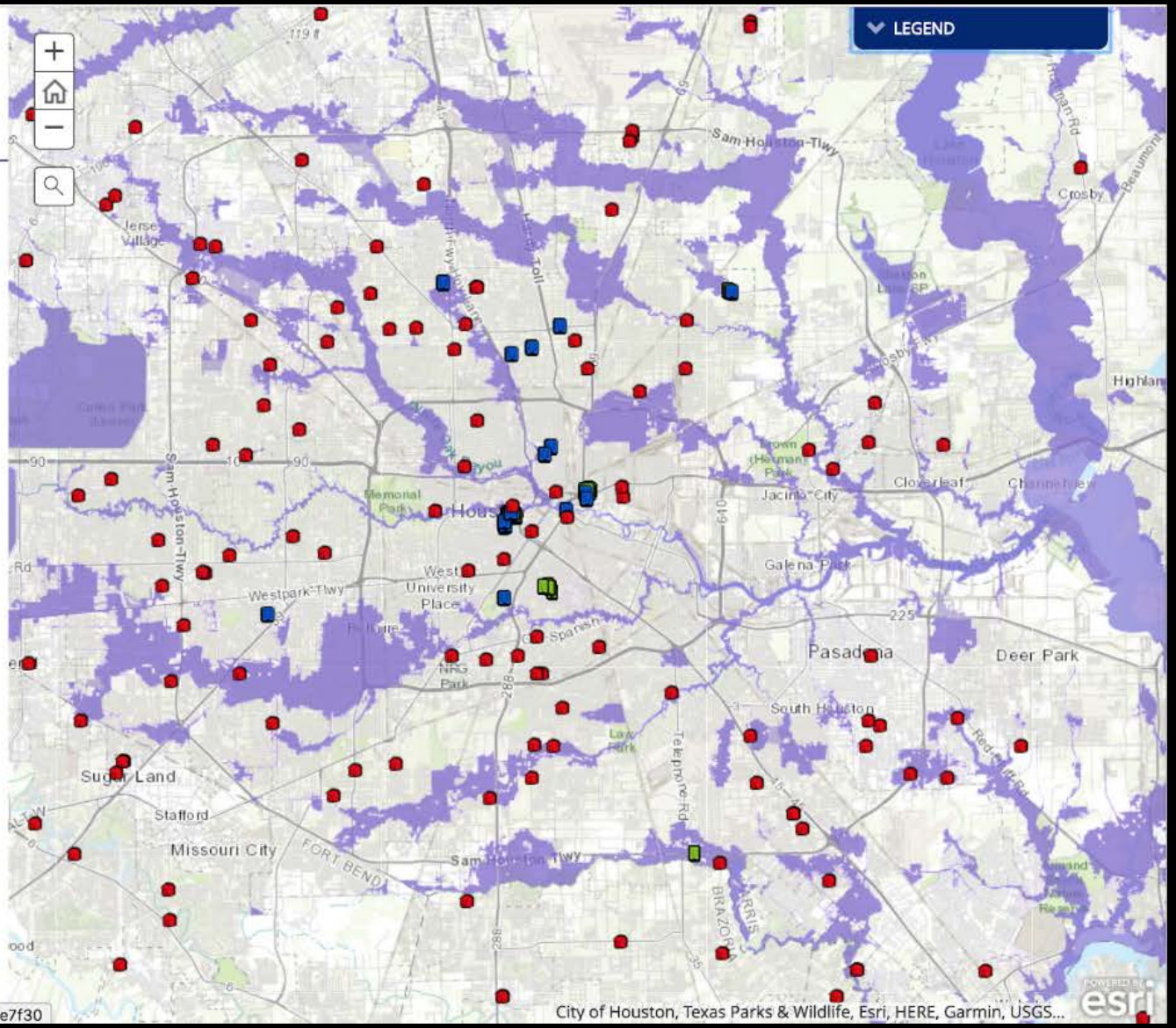
Are HUD properties exposed to climate hazards?

Chance of Flooding?

In counties where FEMA has compiled digital flood hazard maps, shading shows where the land is judged to have some chance for flooding each year. Blue areas show the 1% annual chance of flooding—also known as the "hundred-year" flood zone. Click the LEGEND tab to check other flood risk categories.

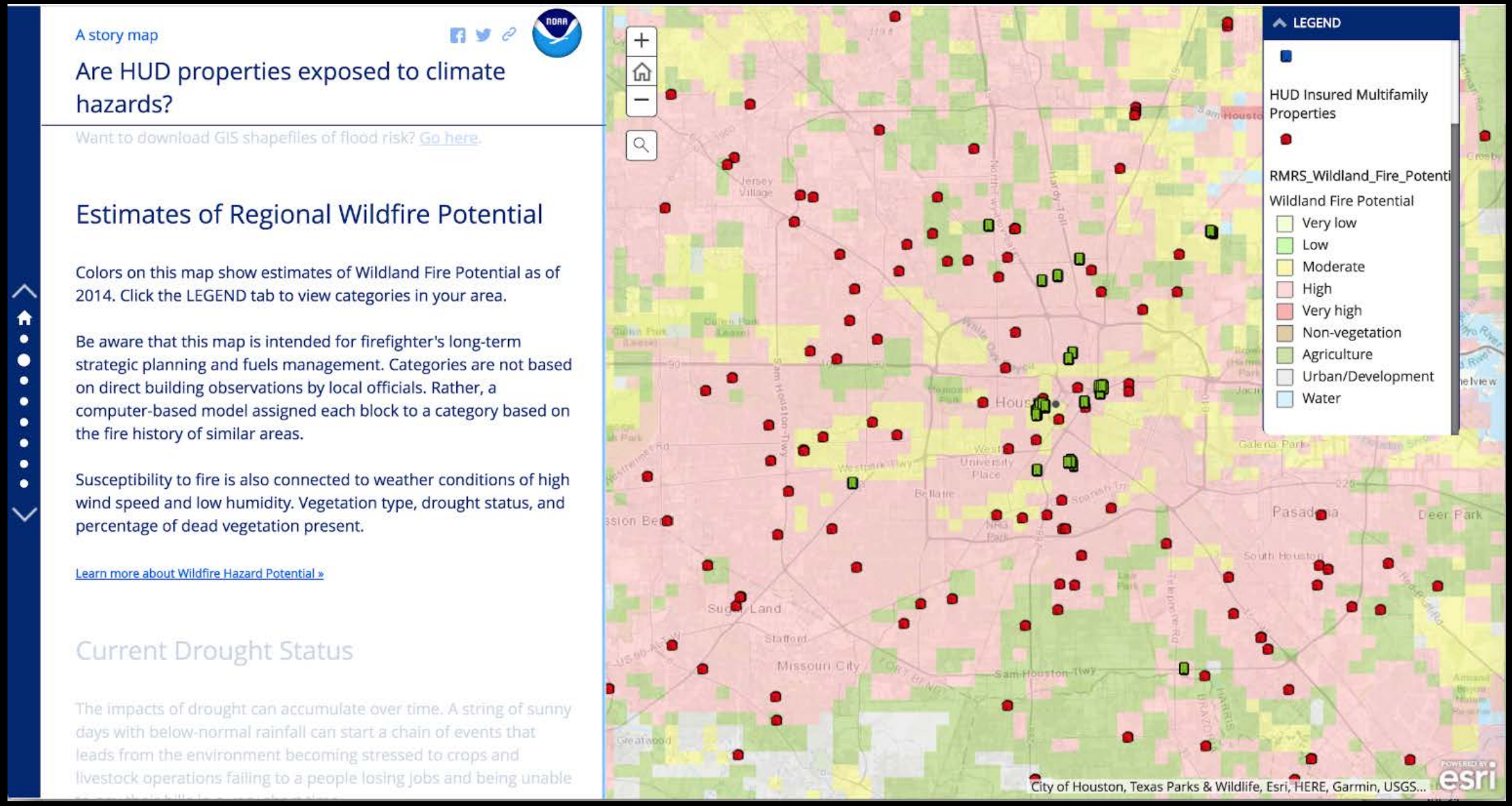
Note that flood hazards only show up when you zoom in fairly close, generally at the scale of a neighborhood. If you don't see and shading along waterways in your area, your county may not have digital flood hazard maps available yet. Click the image below to open FEMA's official map to check for your county.



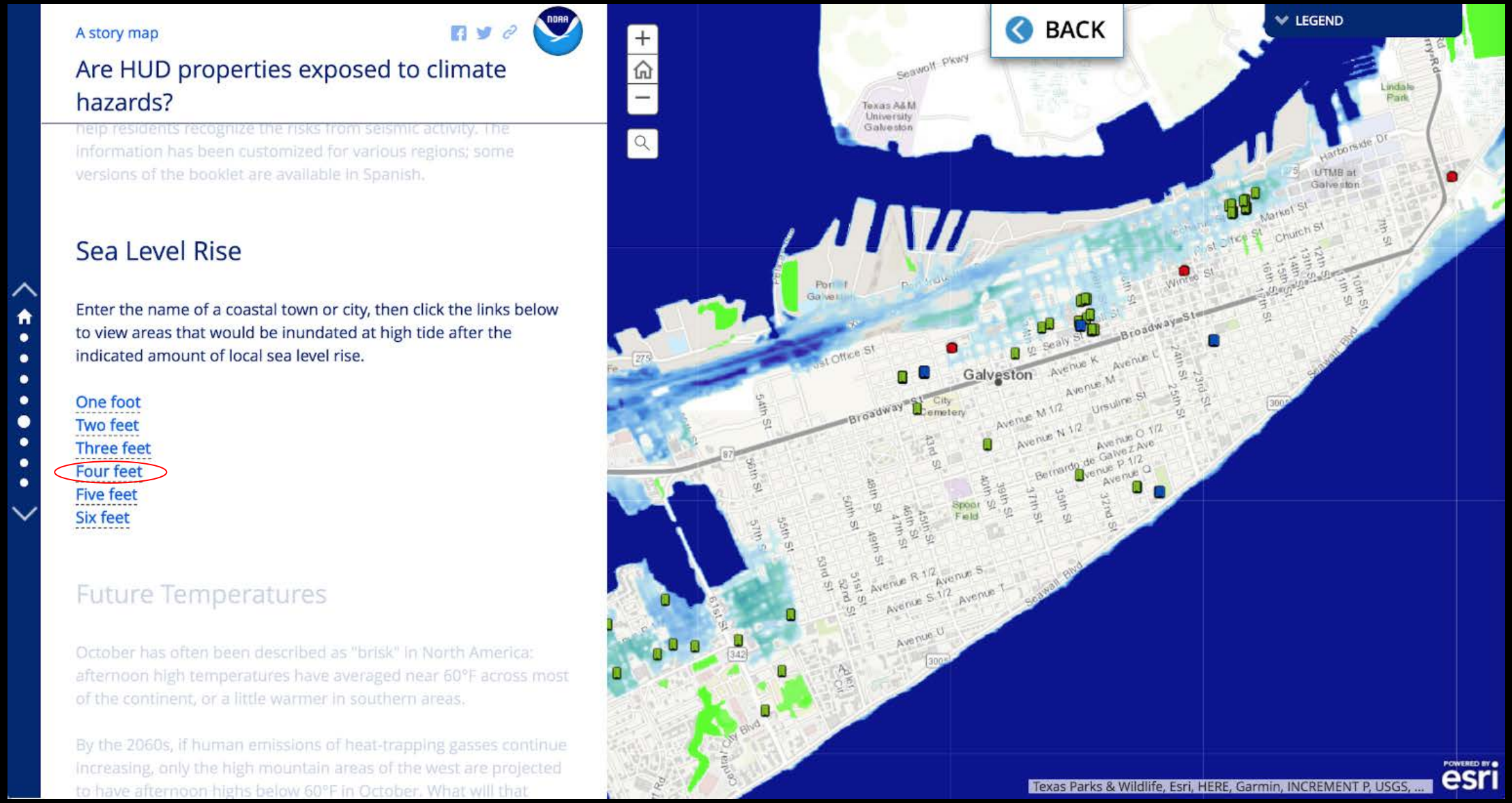


https://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464aa0fc34eb99e7f30

Explore where assets and potential hazards intersect



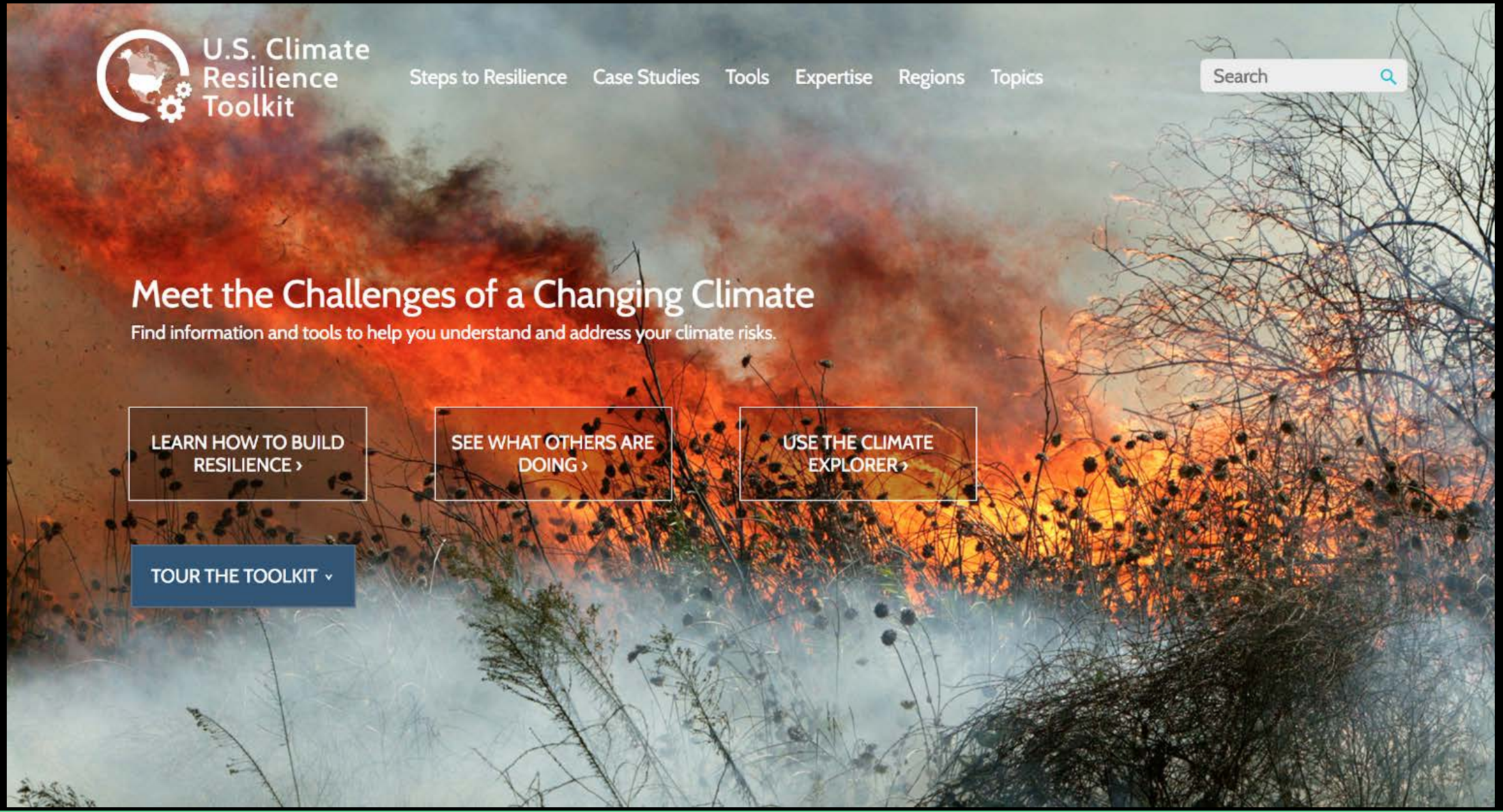
Explore where assets and potential hazards intersect



Future

- Climate model projections represent scientists' best efforts to foretell the future.
- You can access easy-to-interpret graphs and maps showing projected conditions through 2100 for any county in the contiguous United States.

U.S. Climate Resilience Toolkit toolkit.climate.gov



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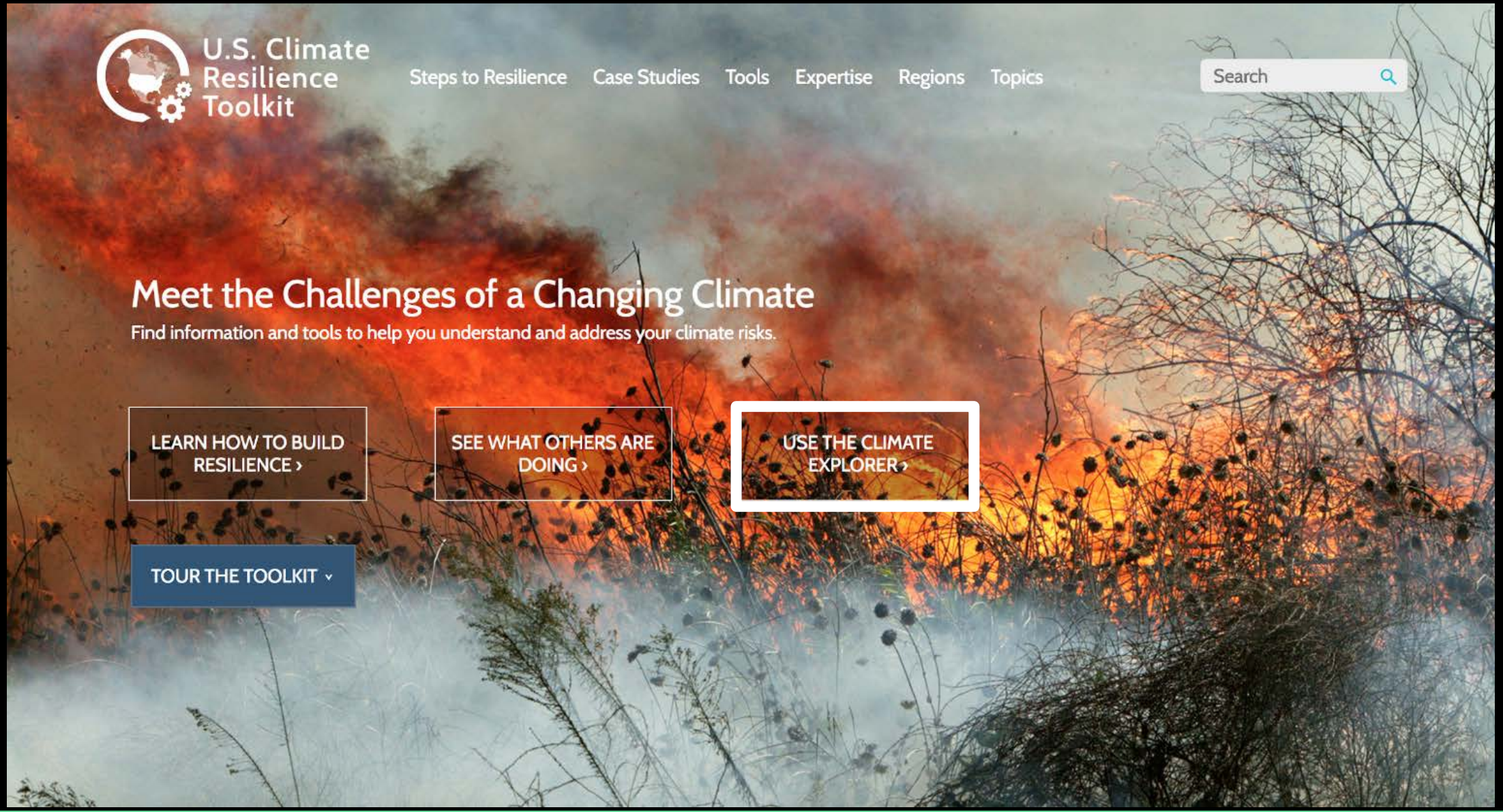

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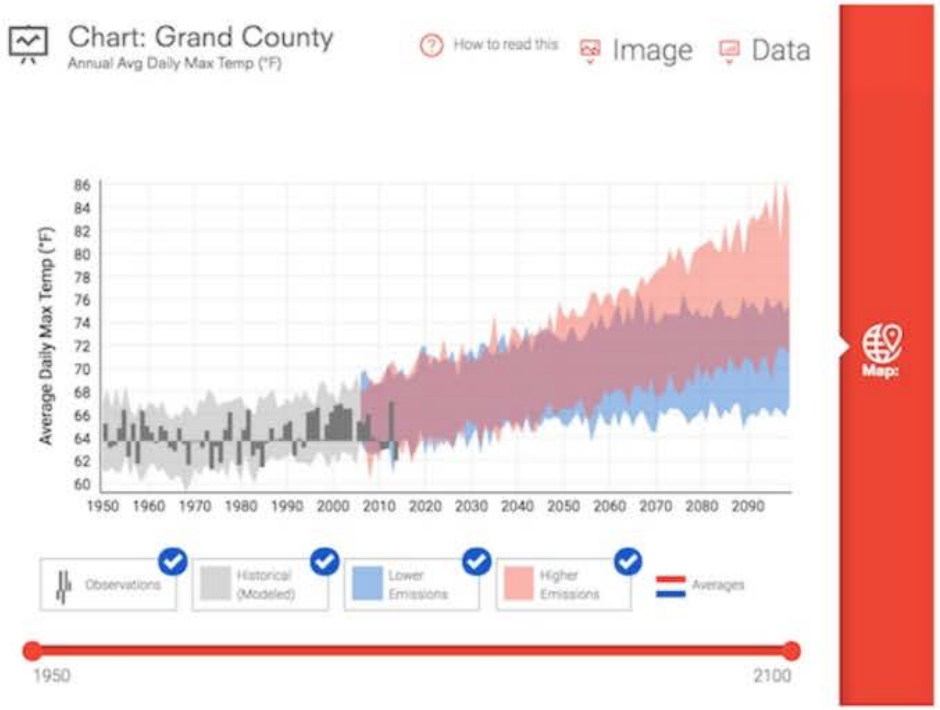
CLIMATE EXPLORER

This visualization tools generates interactive graphs and maps showing climate projections and observations for any county in the contiguous United States. You can also explore historical temperature and precipitation observations at hundreds of climate stations, and view observed and projected days of high-tide flooding at more than 90 coastal tide-gauge stations.



LAUNCH THE CLIMATE EXPLORER ›

LAUNCH THE CLIMATE EXPLORER (WITH INTRODUCTORY SIDEBAR) ›

LEARN WHAT'S NEW IN THE LATEST VERSION OF THE TOOL ›

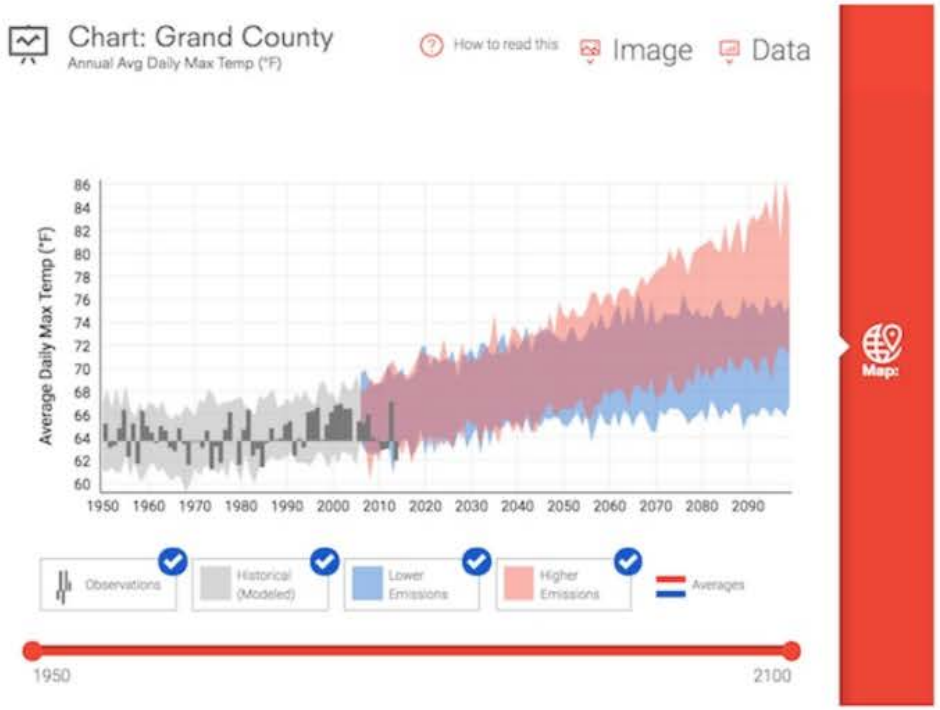
LEARN MORE ABOUT CLIMATE EXPLORER ›

LAUNCH THE LEGACY VERSION OF CLIMATE EXPLORER ›

What about future hazards?

CLIMATE EXPLORER

This visualization tools generates interactive graphs and maps showing climate projections and observations for any county in the contiguous United States. You can also explore historical temperature and precipitation observations at hundreds of climate stations, and view observed and projected days of high-tide flooding at more than 90 coastal tide-gauge stations.



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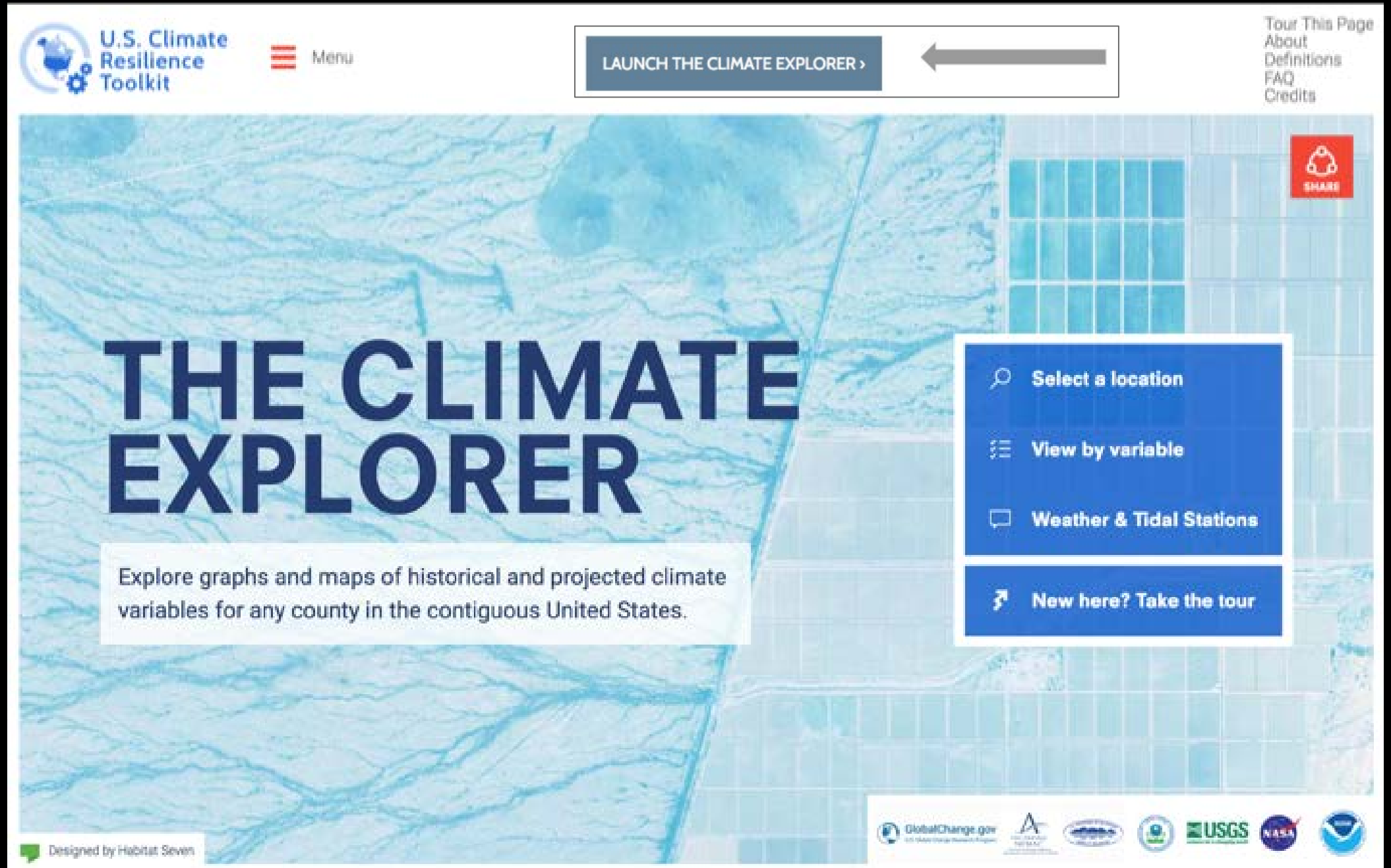
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THE CLIMATE EXPLORER
Explore graphs and maps of historical and projected climate variables for any county in the contiguous United States.
Select a location
View by variable
Weather & Tidal Stations
New here? Take the tour
GlobalChange.gov
USGS
NASA
Designed by Habitat Seven

Getting Started with the Climate Explorer

What are the elements of the graph?

Results from climate models

Simulations (hindcasts) for the historical period (1950-2005)

Projections for higher emissions (2006-2100)

Projections for lower emissions (2006-2100)

Observations

Annual averages from observations (1950-2013)

Try this »

Display or hide graph elements by clicking their legend icon under the graph.

What do the colored bands show?

U.S. Climate Resilience Toolkit

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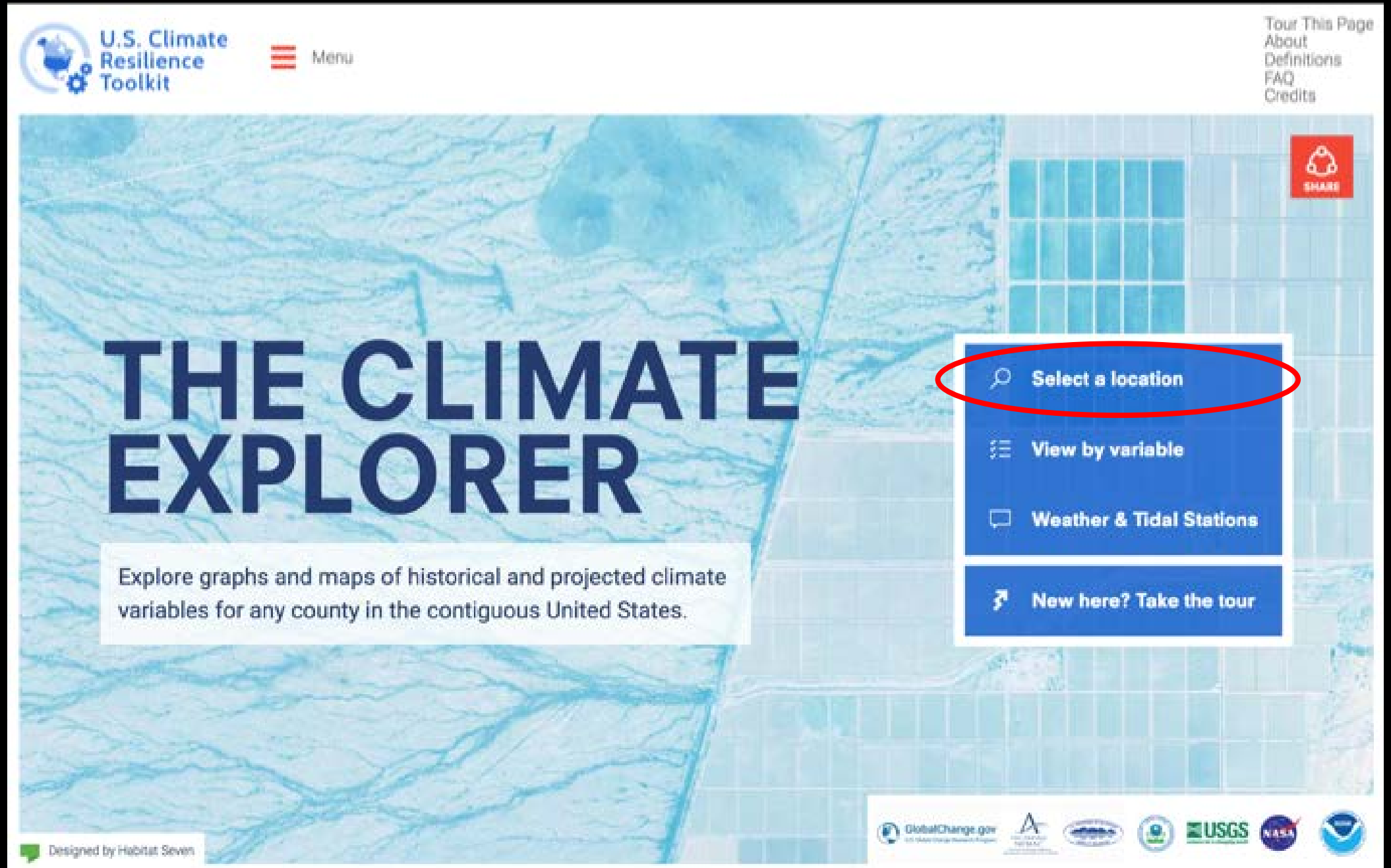
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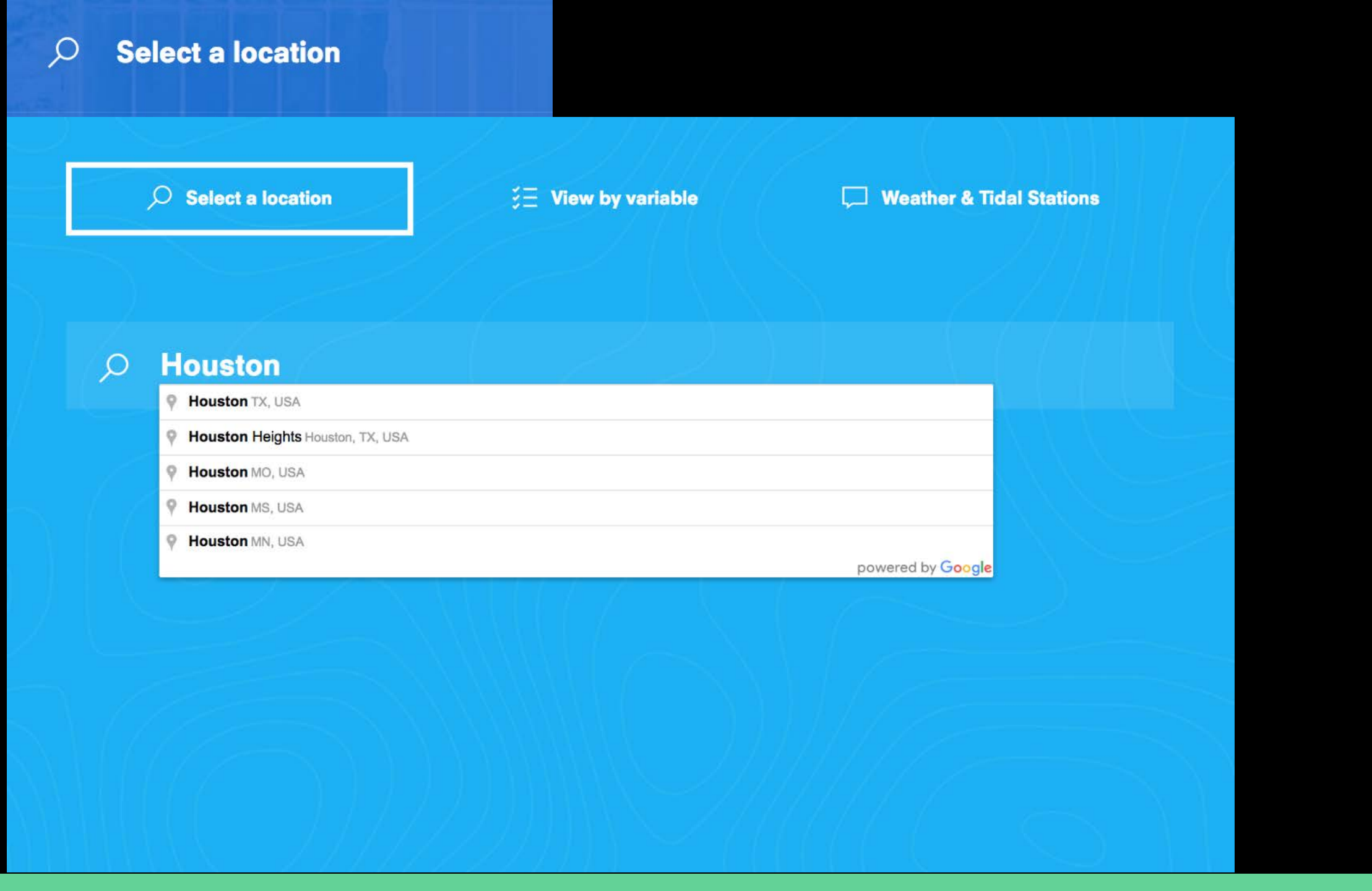

Select a location
Select a location
View by variable
Weather & Tidal Stations
Houston
Houston TX, USA
Houston Heights Houston, TX, USA
Houston MO, USA
Houston MS, USA
Houston MN, USA
powered by Google

Select a location

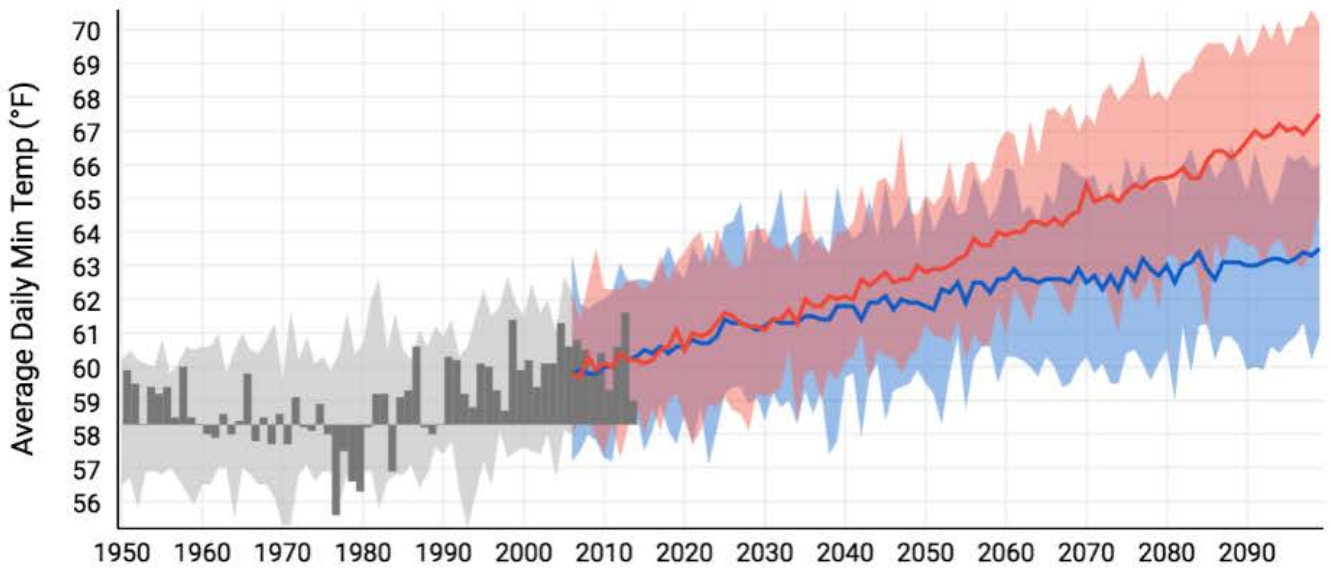
Temperature

- Avg Daily Max Temp (°F)
- Avg Daily Min Temp (°F)
  - Annual
  - Monthly
- Days w/ max > 90°F
- Days w/ max > 95°F
- Days w/ max > 100°F
- Days w/ max > 105°F
- Days w/ max < 32°F
- Days w/ min < 32°F
- Days w/ min > 80°F
- Days w/ min > 90°F

Chart: Harris County

Annual Avg Daily Min Temp (°F)

How to read this | Image | Data



Observations | Historical (Modeled) | Lower Emissions | Higher Emissions | Averages

1950 — 2100

Select a location

Precipitation

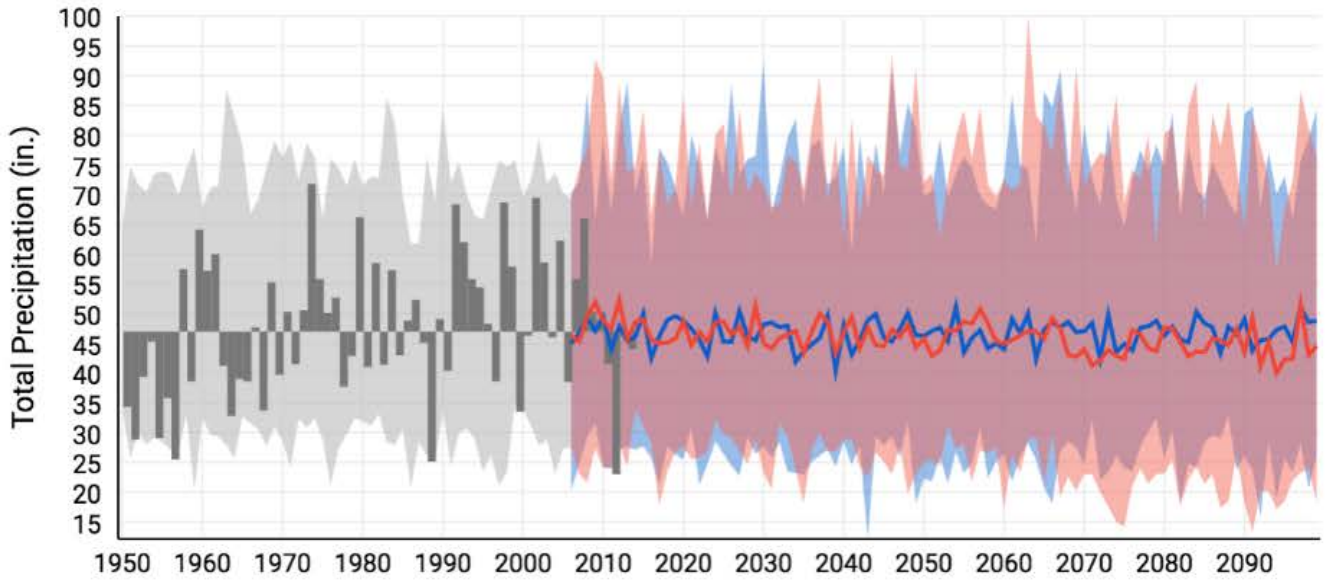
- Total precip
  - Annual
  - Monthly
- Days w/ > 1 in
- Days w/ > 2 in
- Days w/ > 3 in
- Dry Days

Display: Actual

Chart: Harris County

Annual Total precip

How to read this | Image | Data



Observations | Historical (Modeled) | Lower Emissions | Higher Emissions | Averages

1950 — 2100

Select a location

Other Variables

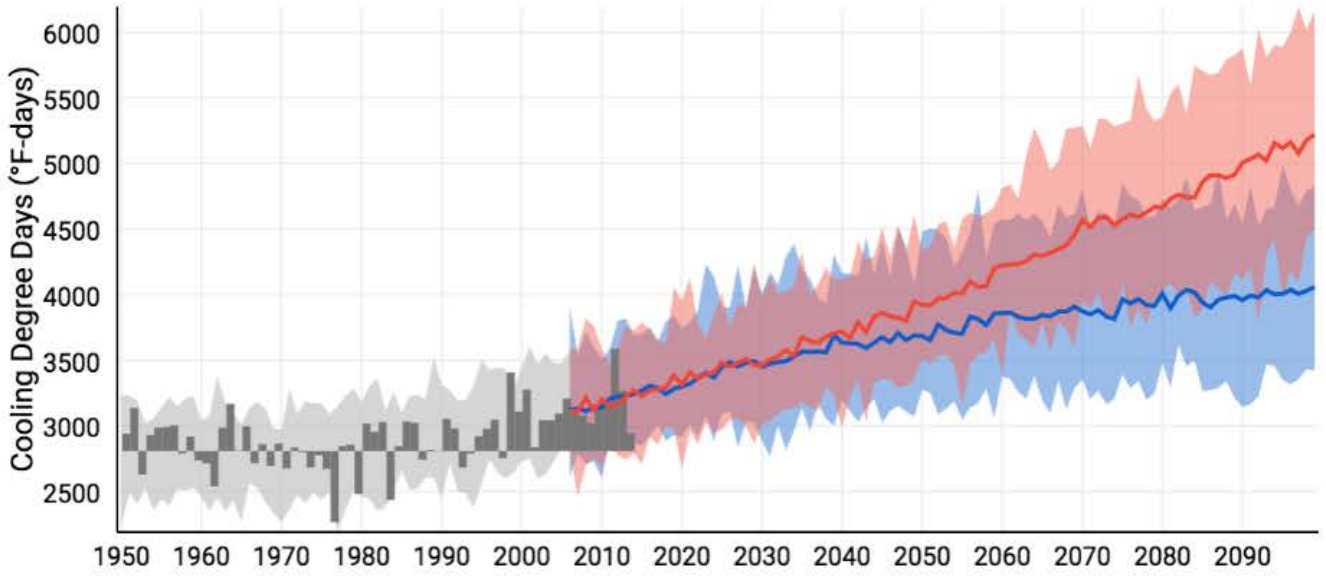
- Heating Degree Days (°F-days)
- Cooling Degree Days (°F-days)
  - Annual
- Growing Degree Days (°F-days)
- Modified Growing Degree Days (°F-days)

Display: Actual

Chart: Harris County

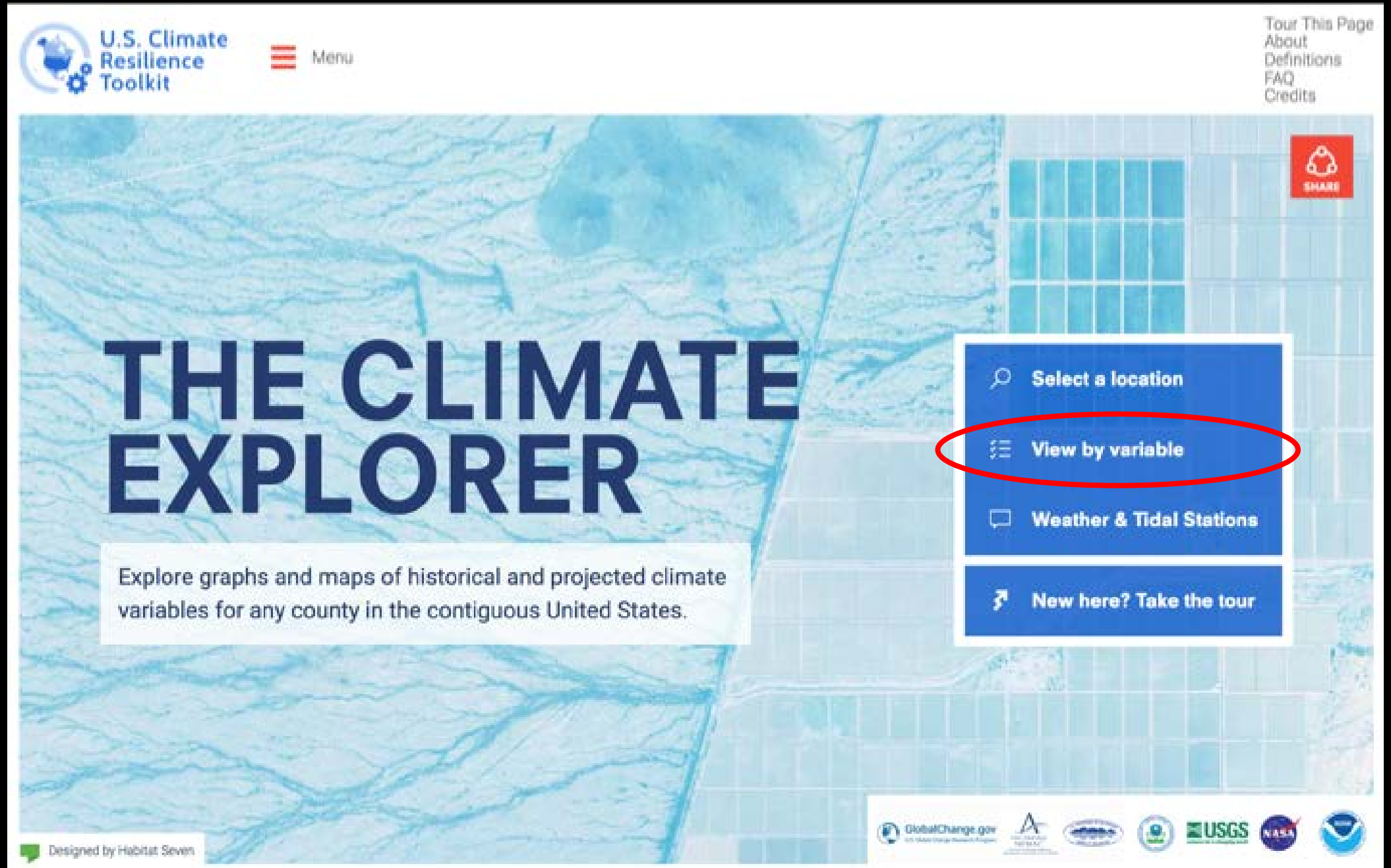
Annual Cooling Degree Days (°F-days)

How to read this | Image | Data



Observations | Historical (Modeled) | Lower Emissions | Higher Emissions | Averages

1950 — 2100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NASA
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View by variable

(Explore and compare maps)

Choose a variable

Temperature

- Avg Daily Max Temp (°F)
- Avg Daily Min Temp (°F)
- Days w/ max > 90°F
- Days w/ max > 95°F
- Days w/ max > 100°F
- Days w/ max > 105°F
- Days w/ max < 32°F
- Days w/ min < 32°F
- Days w/ min > 80°F
- Days w/ min > 90°F

Precipitation

- Total Precipitation
- Days w/ > 1 in
- Days w/ > 2 in
- Days w/ > 3 in
- Dry Days

Other

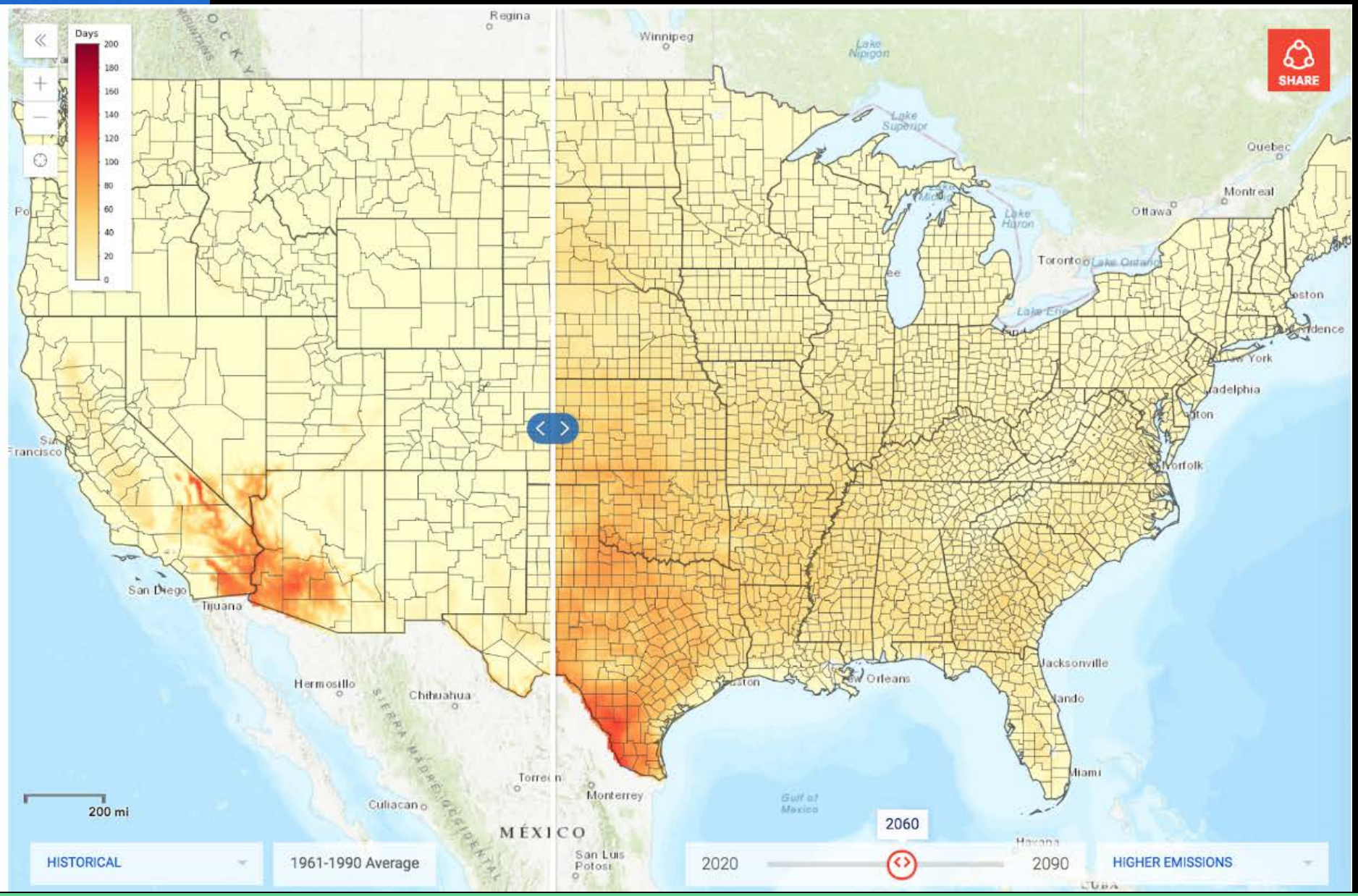
- Heating Degree Days
- Cooling Degree Days
- Growing Degree Days
- Mod. Growing Degree Days

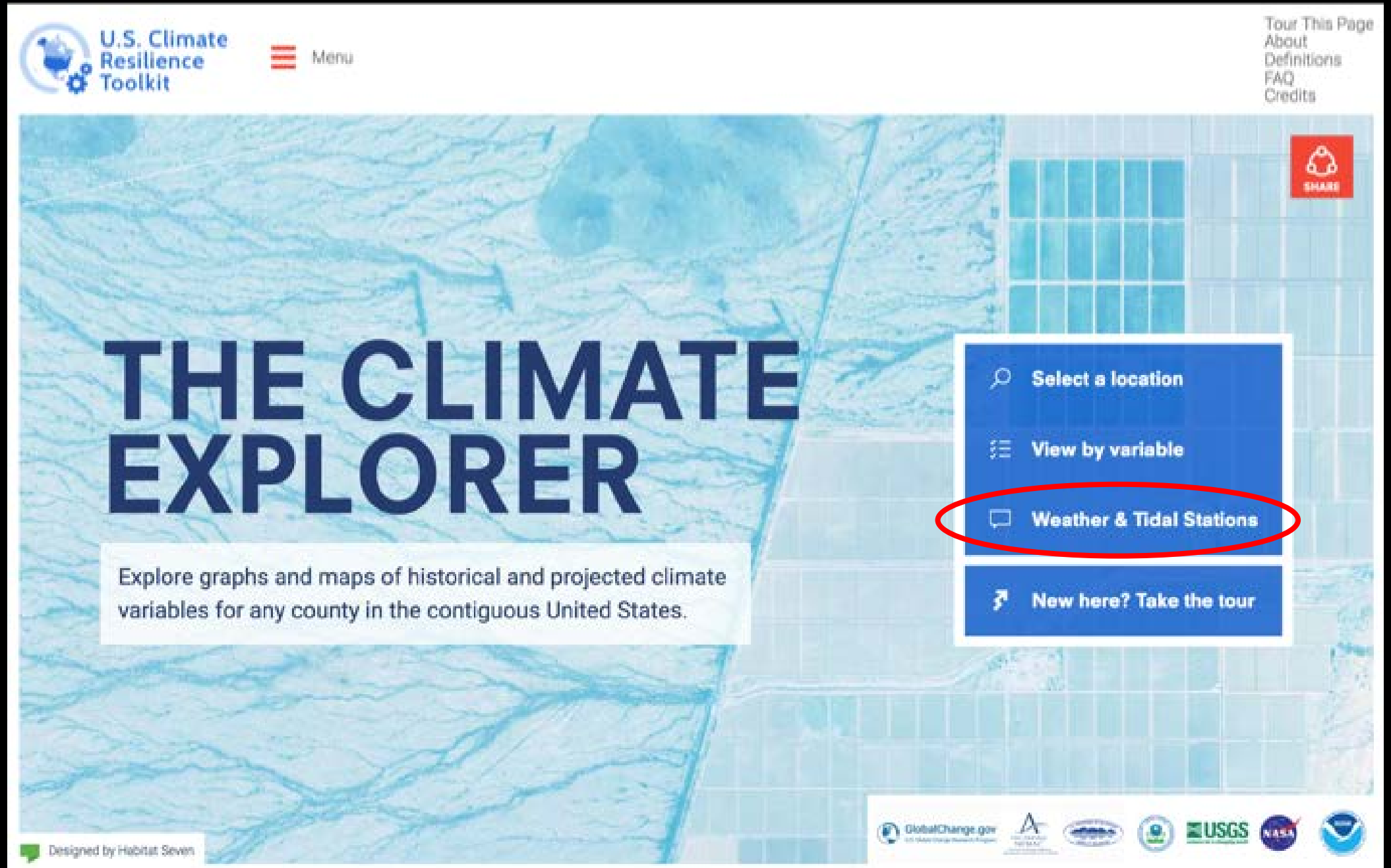
View by variable

Zoom to location

Days w/ max > 100°F

About Days w/ max > 100°F

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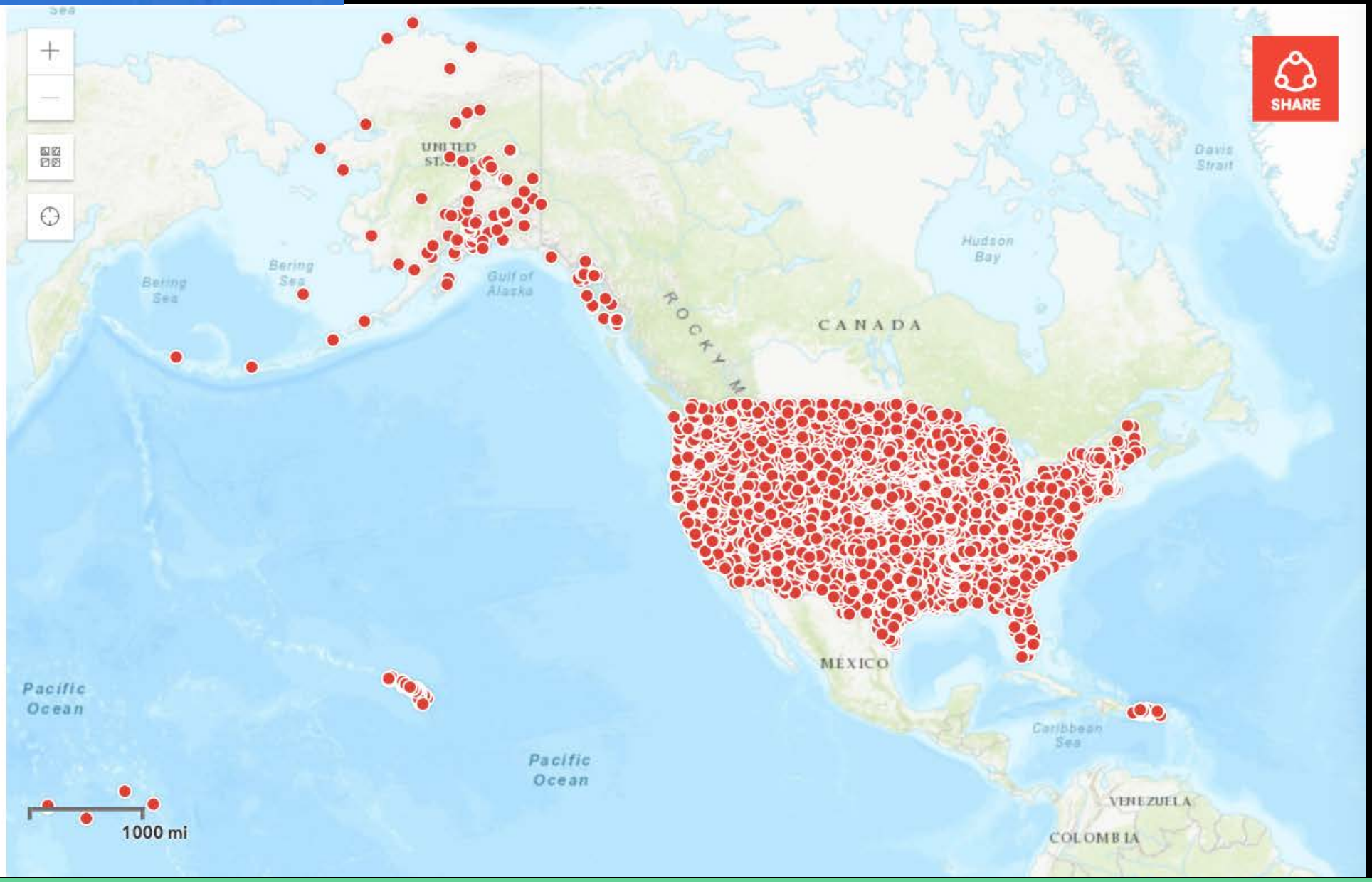
Weather & Tidal Stations

Zoom to location

Daily vs. Climate

About Daily vs. Climate

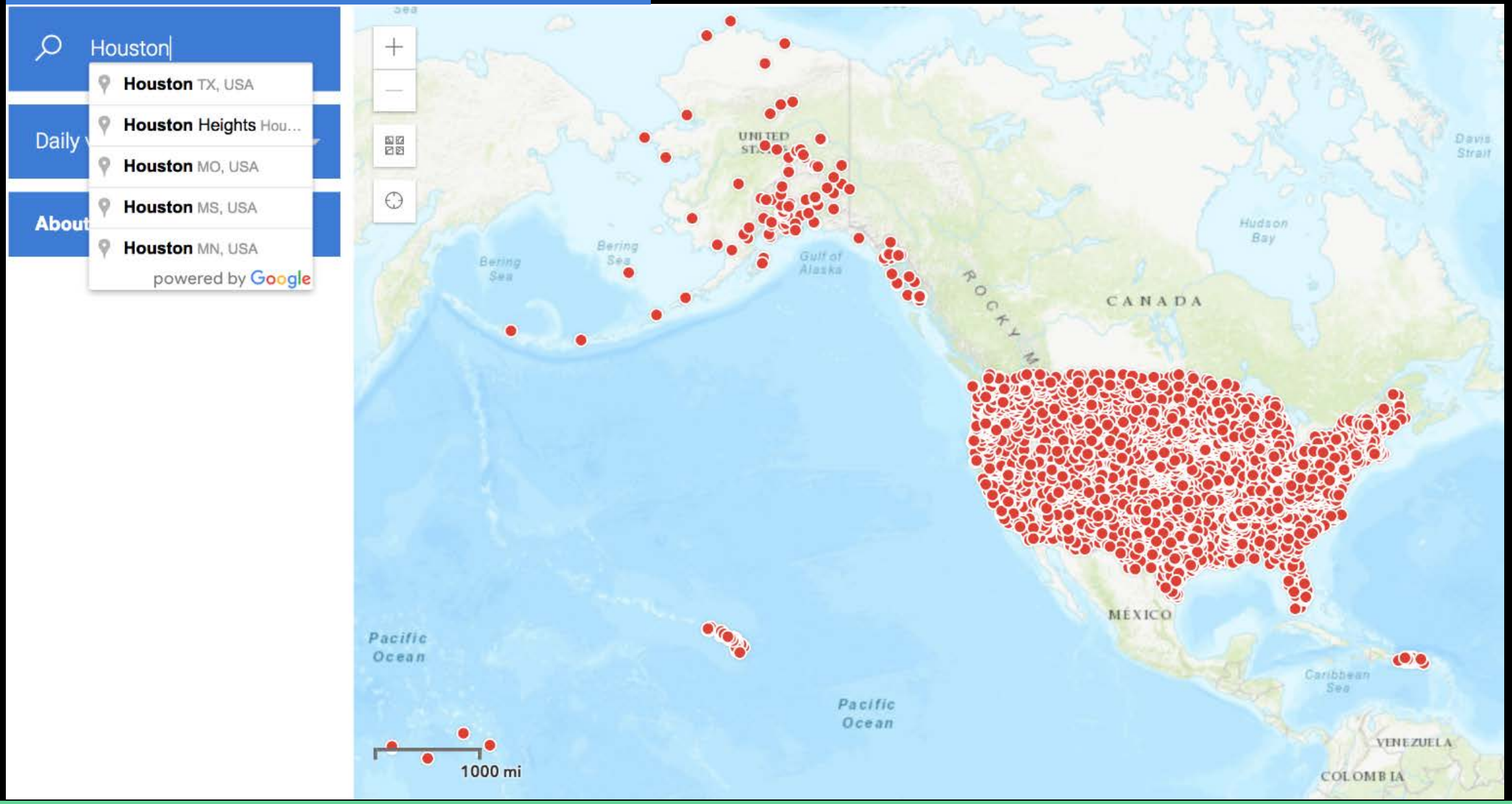


Weather & Tidal Stations

Select a location | View by variable | Weather & Tidal Stations

Choose analysis type

Daily vs. Climate | Thresholds | Days with High-tide Flooding

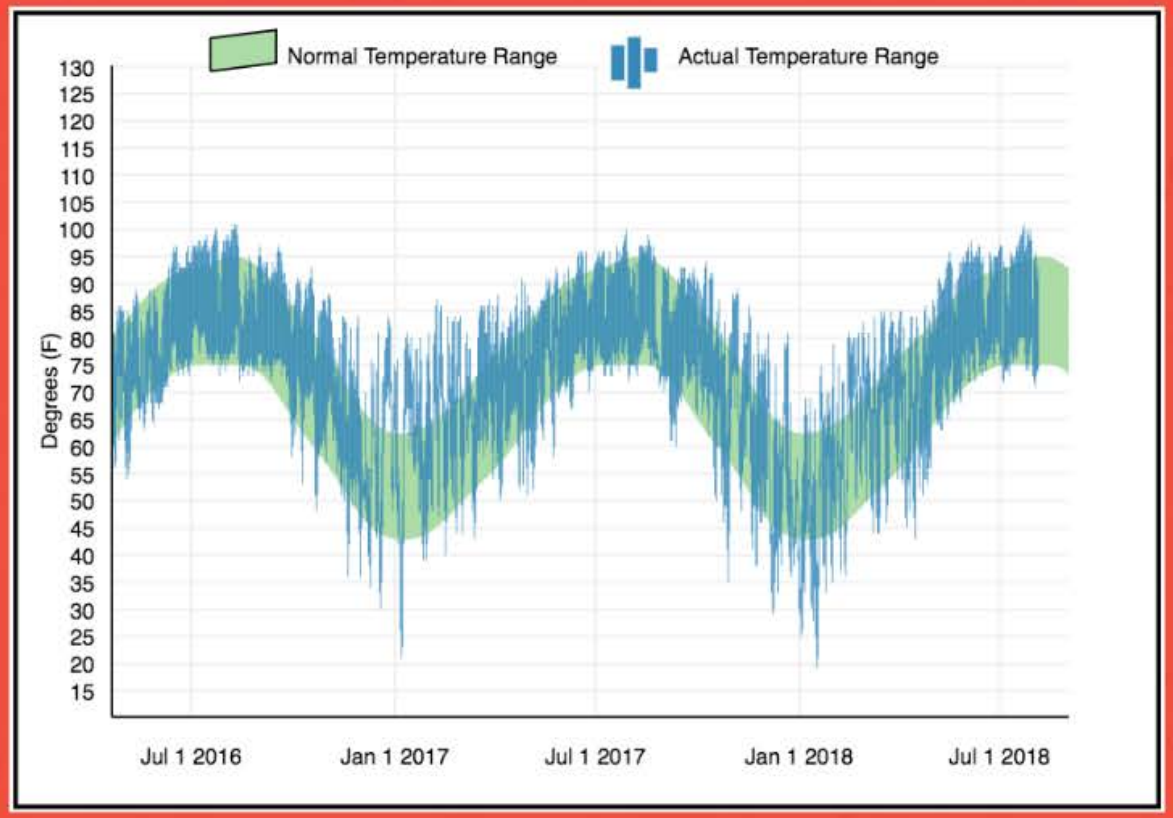

Daily vs. Climate
Houston
Houston TX, USA
Houston Heights Hou...
Houston MO, USA
Houston MS, USA
Houston MN, USA
powered by Google
Daily
About
Bering Sea
Bering Sea
Gulf of Alaska
Hudson Bay
Davis Strait
CANADA
MÉXICO
Pacific Ocean
Pacific Ocean
Caribbean Sea
VENEZUELA
COLOMBIA
1000 mi

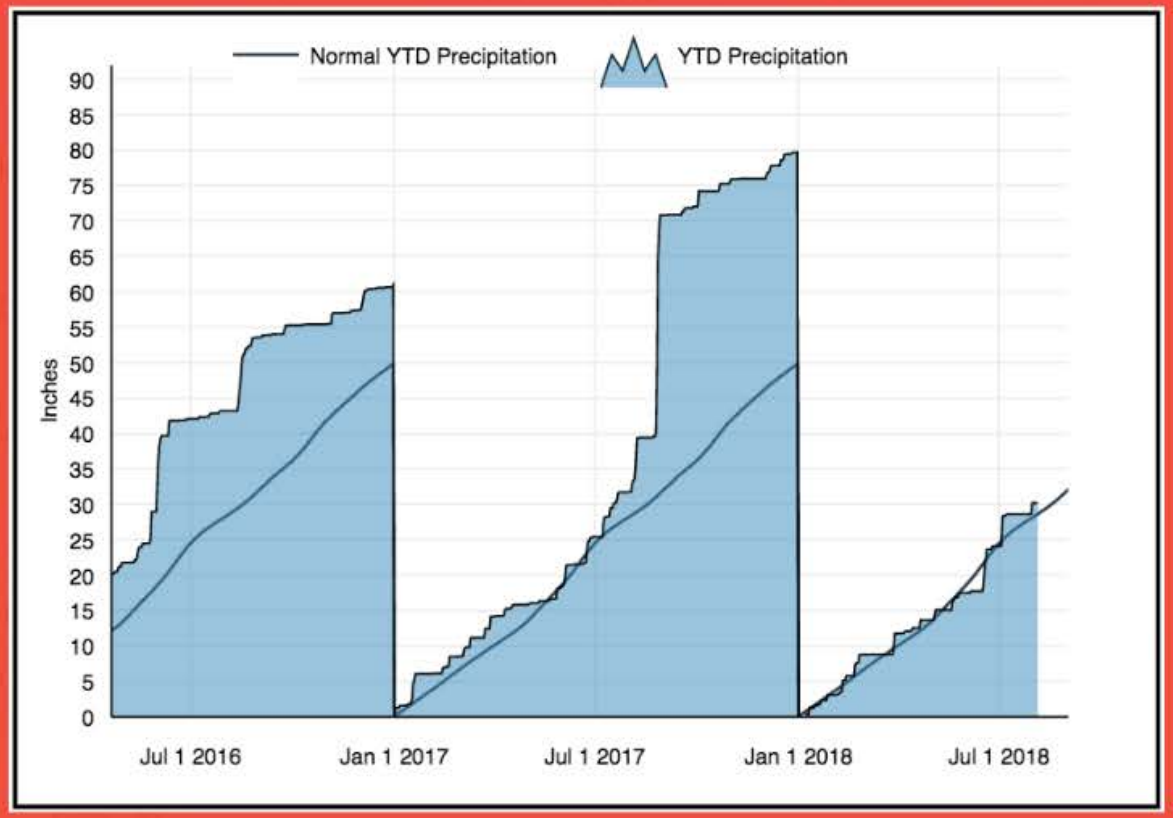
Compare daily temperature and precipitation with Climate Normals

Weather Station

Name: HOUSTON INTERCONTINENTAL AP

Station ID: USW00012960





Thresholds

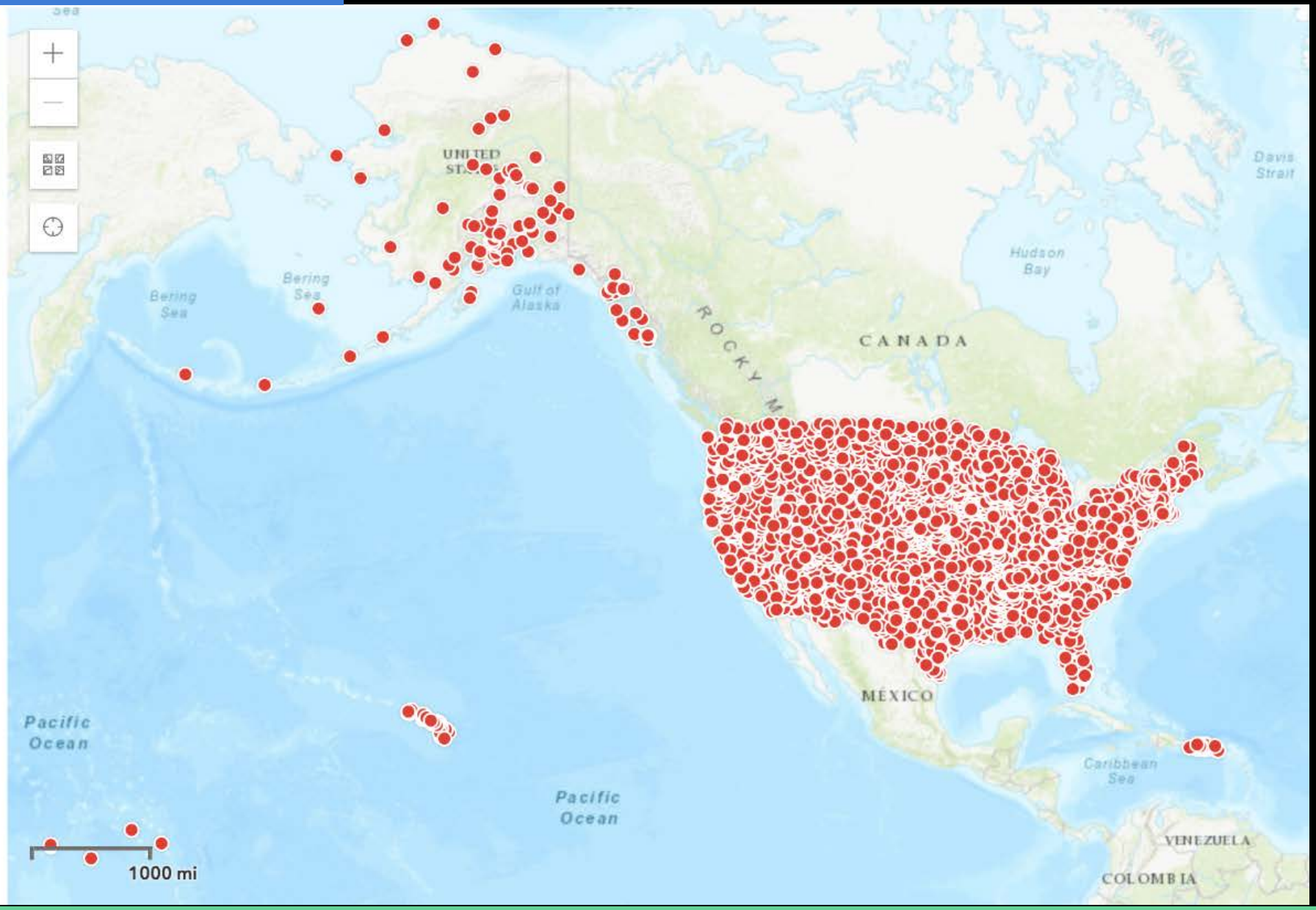
Houston

- **Houston** TX, USA
- **Houston** Heights Hou…
- **Houston** MO, USA
- **Houston** MS, USA
- **Houston** MN, USA

powered by Google

Daily

About



Check how often conditions have exceeded user-defined thresholds

Weather Station

Name: HOUSTON INTERCONTINENTAL AP

Station ID: USW00012960

Variable:

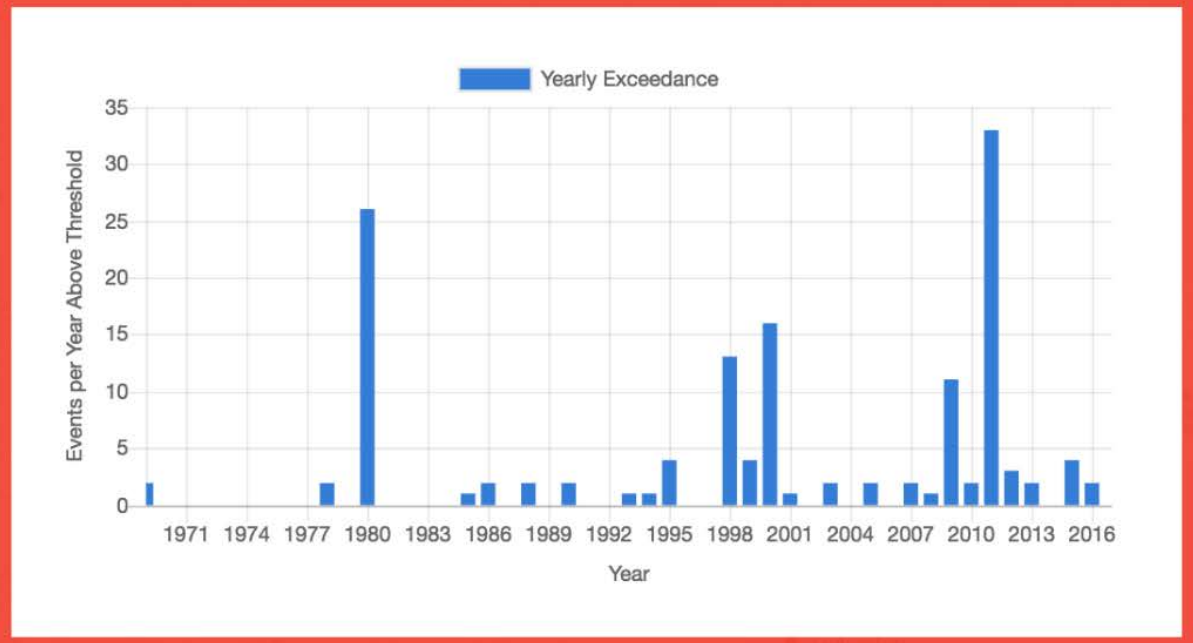
Maximum Temperature

Threshold:

100 °F

Window:

1 days



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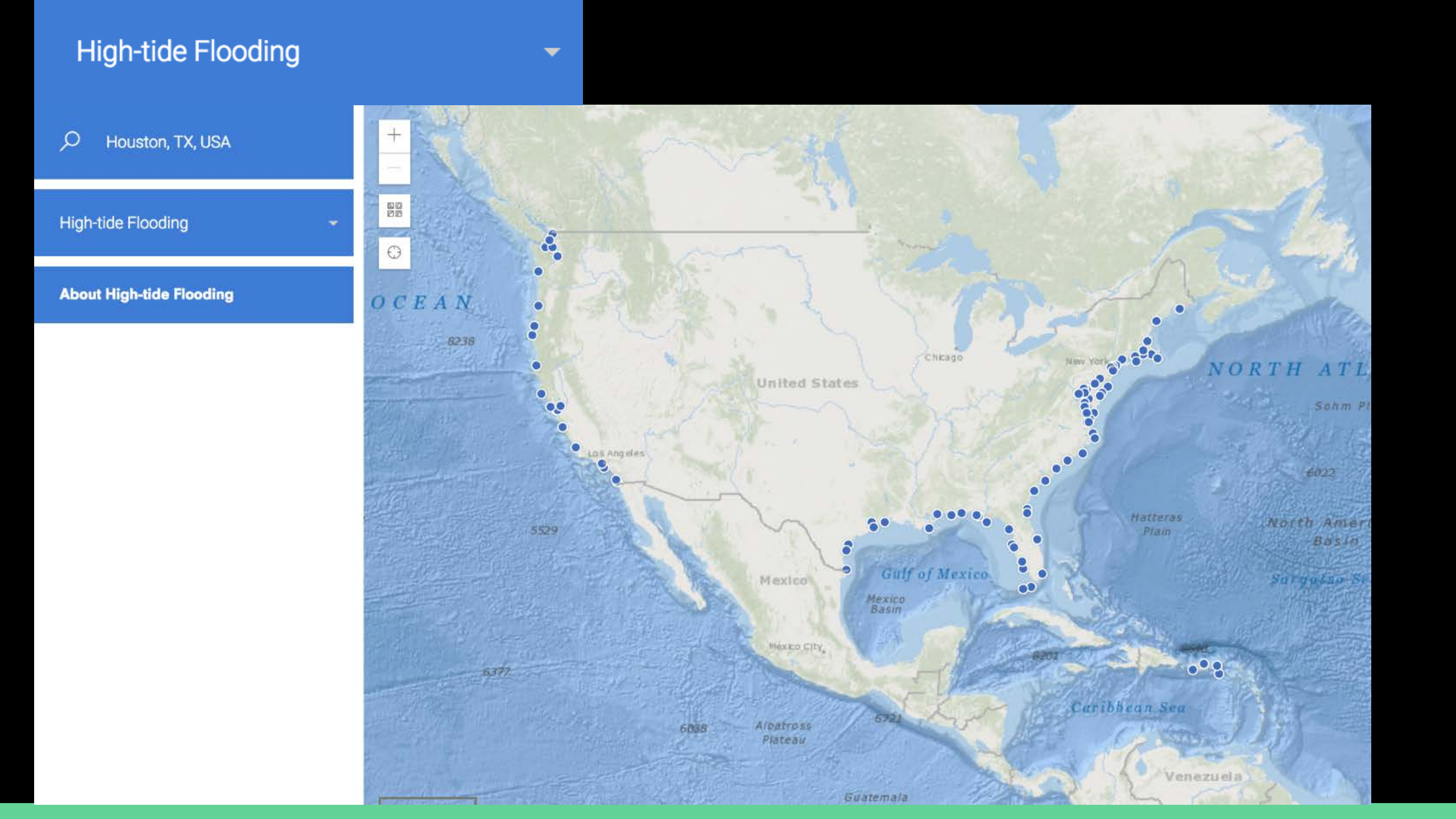

High-tide Flooding
Houston, TX, USA
High-tide Flooding
About High-tide Flooding
OCEAN
8238
United States
Chicago
New York
NORTH ATL
Los Angeles
5529
Mexico
Gulf of Mexico
Mexico Basin
Hatteras Plain
6022
Mexico City
6377
8201
Caribbean Sea
6038
Albatross Plateau
6721
Venezuela
Guatemala

High-tide Flooding

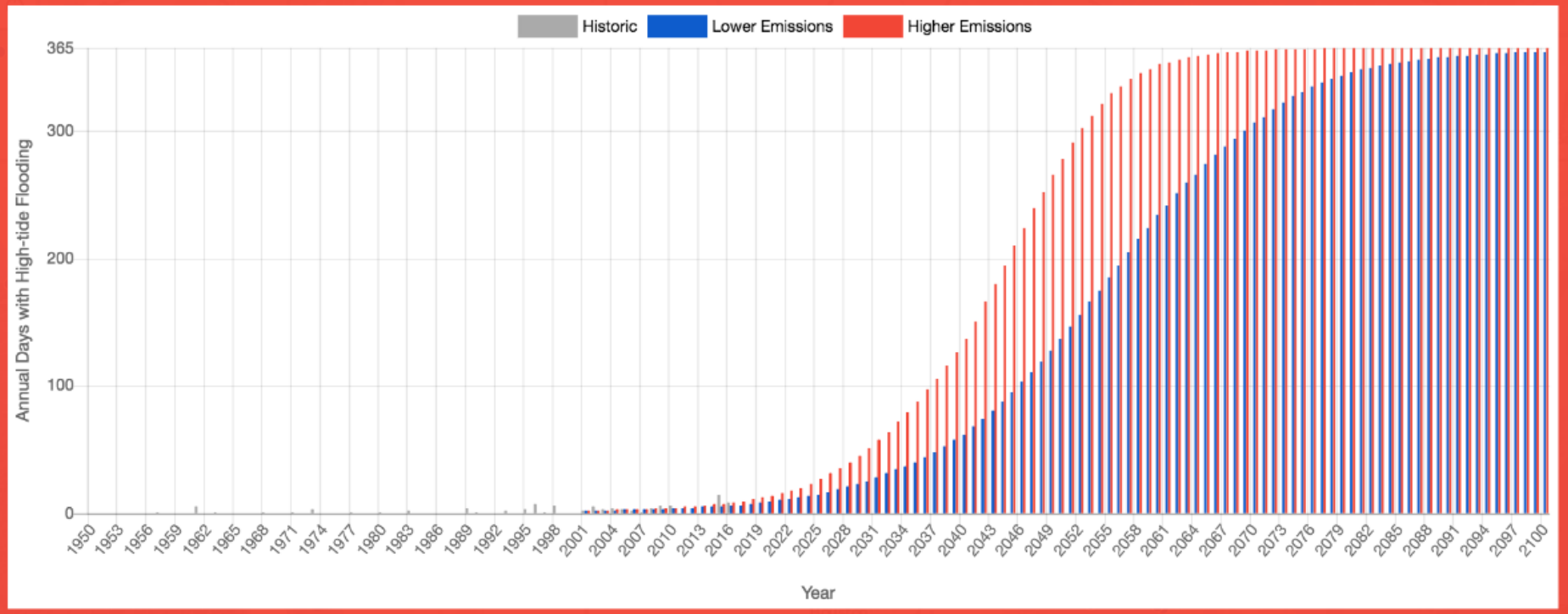
Zoom to location

High-tide Flooding

About High-tide Flooding

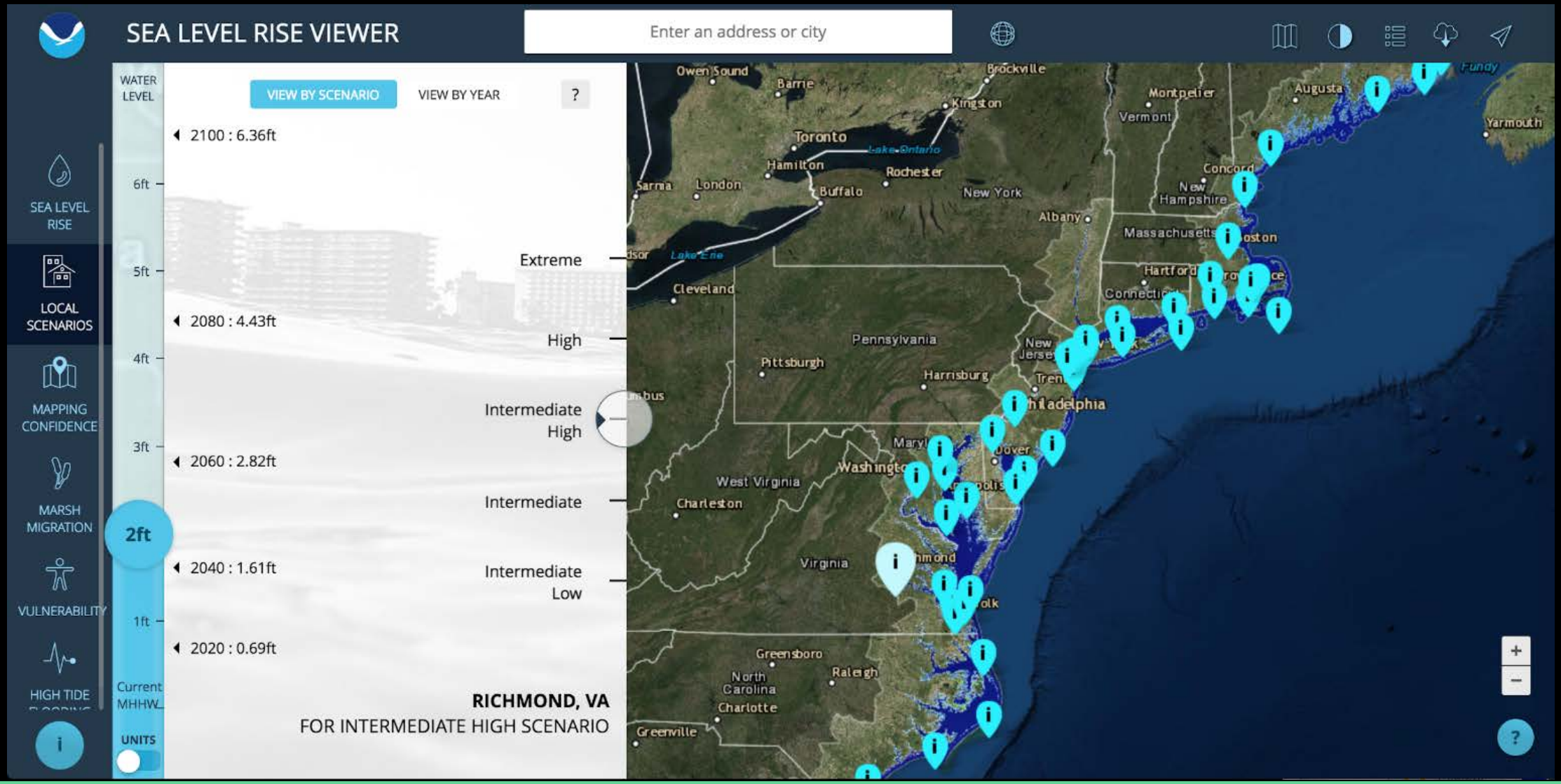
Tidal Station

Name: Galveston Pier 21, TX Station ID: 8771450 Local threshold: 0.52m over MHHW



Place your cursor over the annual bars on this graph for details. Gray bars from 1950 to 2016 show observed annual counts of high-tide flooding. Red and blue bars show the average number of high-tide flooding events projected for future years under two scenarios. Data from NOAA Technical Report NOS CO-OPS 086 - Patterns and Projections of High-tide Flooding.

One more new tool, indispensable for coastal locations:
NOAA Digital Coast Sea Level Rise Viewer – Local Scenarios



Thank you!

Please feel free to email me with questions or comments

LuAnn Dahlman
U.S. Climate Resilience Toolkit
Climate Explorer
luann.dahlman@noaa.gov

RECOVER Rebuild

Enterprise®

Who We Are

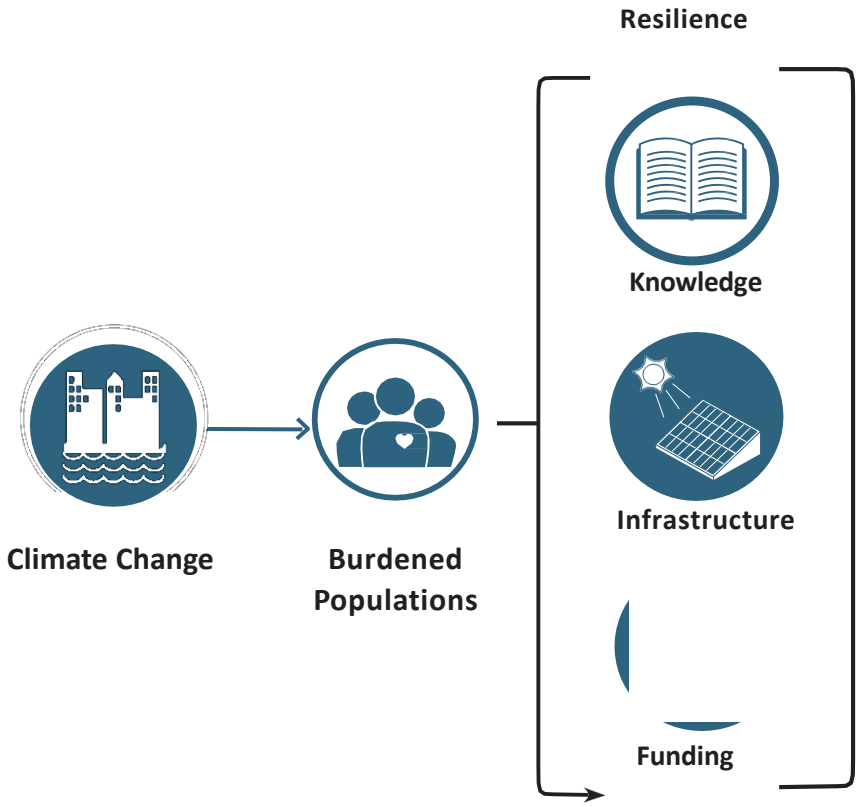
Enterprise Community Partners is a national nonprofit that makes well-designed homes affordable and strengthens communities.

Enterprise®

Enterprise Disaster Recovery & Rebuilding

Helping vulnerable communities manage long-term recovery and rebuilding efforts following floods and other weather emergencies.

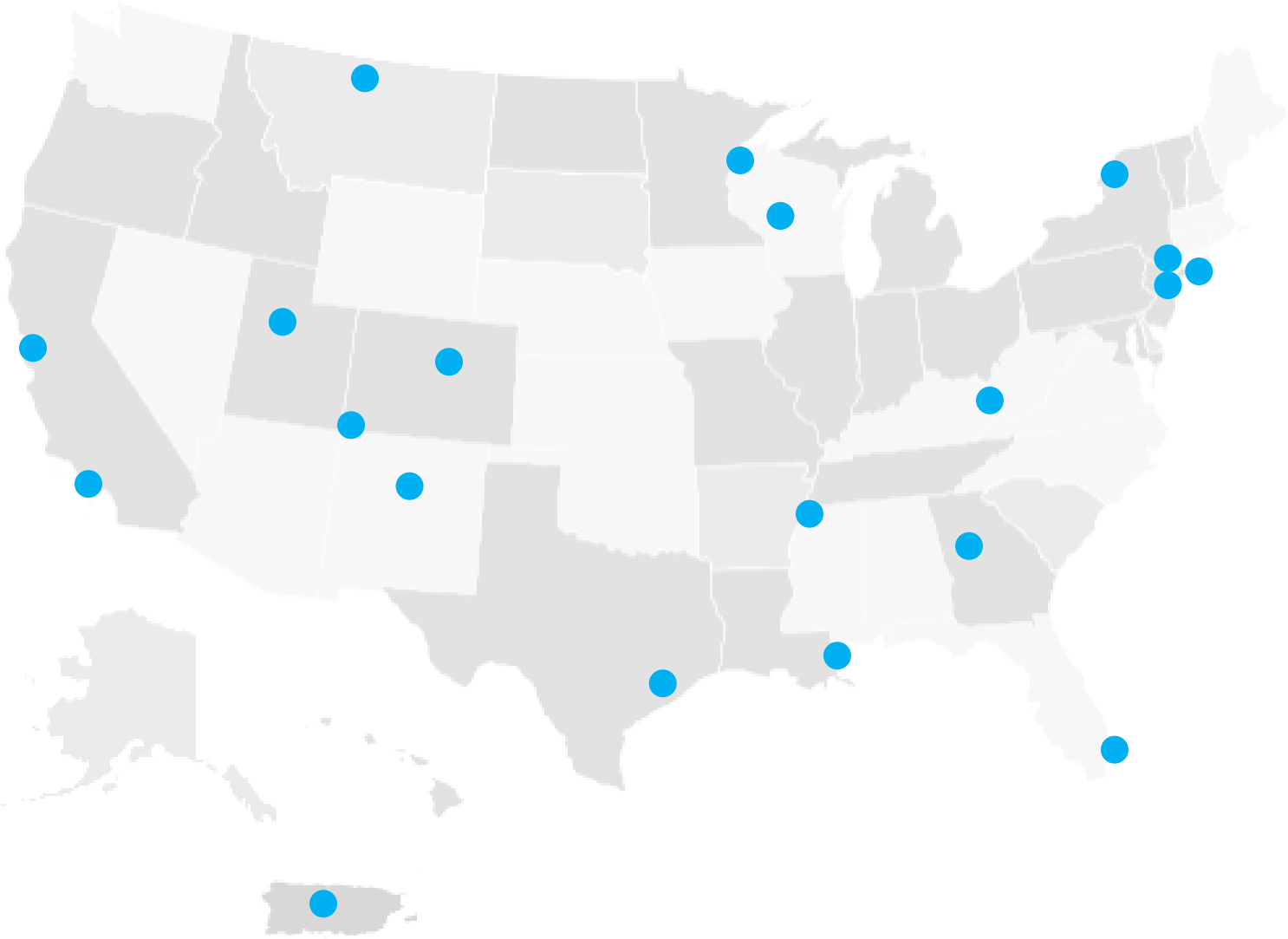
Resilience is the capacity for households, communities, and regions to adapt to changing conditions and to maintain and regain functionality in the face of stress or disturbance.


Resilience
Knowledge
Infrastructure
Funding
Climate Change
Burdened Populations

Targeted, Effective Support

- Ensuring services for the most vulnerable families
- Advocating for policy, program design and adequate funding
- Providing training and hands-on support to build the capacity of local developers and nonprofits
- Promoting and guiding construction and rehabilitation of durable homes to withstand future storms and flooding
- Offering technical assistance and tools to developers and homeowners for resilient planning and building practices

Where We're Helping



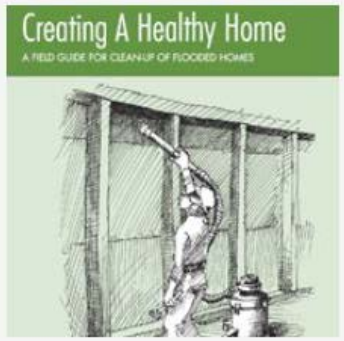
Hurricane Katrina & Gulf Coast Rebuilding

Hurricane Sandy Recovery & Rebuilding

The devastation unleashed by Hurricane Sandy in 2012 made evident that our most vulnerable residents are least able to adapt in a crisis; and propelled investment into programs and tools for resilience.

Tools for Resilience

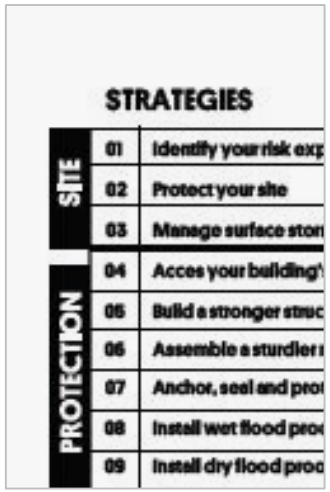
Disaster Staffing Toolkit

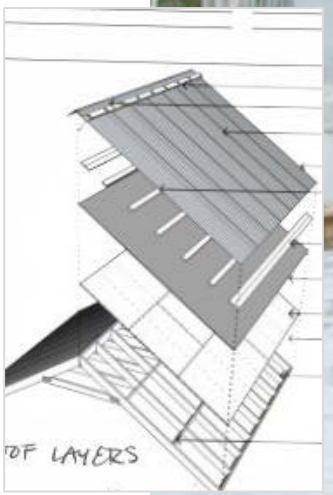


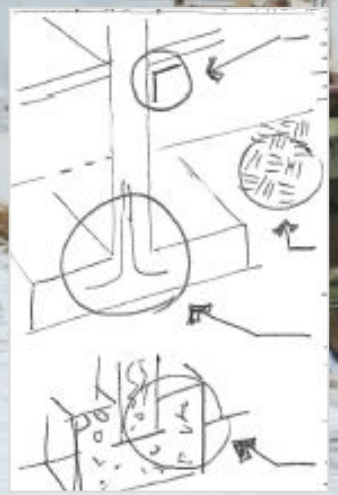
Creating a Healthy Home: A Field Guide for Clean-up of Flooded Homes

https://www.enterprisecommunity.org/solutions-and-innovation/tools

Keep Safe Puerto Rico: A Guide for Resilient Buildings







Safer & Stronger Communities: DC Multi-Family Resilience Assessment Tool

"We aim to help developers and owners of affordable housing better understand and address their own vulnerabilities early on; mitigating damage in the long run and protecting communities nationwide from risks of extreme weather." *– Laurie Shoeman, Senior Director Resilience Initiative*

Safer & Stronger Communities: DC Multi-Family Resilience Assessment Tool

Resilience Opportunity Assessment
DC DOEE Resilience Audits/Solar for Affordable Housing
Solar for All

Category		Question	Assessment
	13	Is bicycle storage onsite, covered, and at ground level?	
	14	Are grab bars present in stairways, hallways, and bathrooms?	
Resilience - Mitigation and Adaptation	15	Is the building located in a FEMA or Climate Ready DC flood zone?	Yes
	16	Is there an elevation certificate (FEMA document describing building's elevation relative to flood zones) for the building (if yes, please provide)?	Yes
	17	Are there stormwater catch basins located around or on the site?	No
	18	Are stormwater and sanitary sewer systems separated at this location?	No
	19	If known, is the size of stormwater sewer piping adequate?	No
	20	Is more than 50% of the site, not including building footprint, impervious surface or compacted soil?	No
	21	Does the building share a party wall(s) with neighboring buildings?	Yes
	22	Is the exterior siding material flood damage resistant?	Yes
	23	Is there visible evidence of rot at the exterior walls, especially near the ground?	Yes
	24	Is there structural wood in direct contact with soil?	No
	25	Are there ground-level apartments located below the base flood elevation (BFE, the elevation to which floodwaters are expected to rise in a 1% annual chance or 100-year flood)?	No
	26	Does the building have a basement or crawlspace below the BFE?	No
	27	Is the foundation material a permeable type such as brick, stone, or rubble?	Yes
	28	is the foundation in poor condition?	Yes
	29	Are any vents or penetrations located below the BFE?	Yes
	30	Are any utility connections, mechanical, electrical, telecom, or plumbing equipment located below the BFE?	Yes
	31	Are washers and dryers located below the BFE?	Yes
	32	Are there interior floor drains?	Yes
	33	Do all storm and sanitary sewer lines have backwater valves?	
	34	Does the building have an elevator(s) with motors, controls and other equipment located below the BFE?	
	35	Do elevators have flooding sensors and second floor return programming in the event of flooding?	
	36	Is HVAC equipment distributed (for example, is the main heating and cooling equipment for each apartment	

1 - Project Information | 2 - Resilience Assessment | 3 - Strategies | 4 - Energy and Water | 5a - Solar

- Building and site vulnerabilities assessment
- Custom property analysis and prioritized strategy output
- Cost benefit analysis

Summary of Financial Impact
Net Investment without ITC or Additional Incentives
Additional Incentives
Net Investment with ITC and Additional Incentives
Total Life Cycle Savings (NPV) with ITC and Incentives
Annual Utility Saving Year 0

Strategies
Wet Floodproofing

Assessment Questions	EGC 2015 Criteria	Hazards	
15, 21, 22, 23, 26	5.8a	Flood	Mold

3 - Strategies | 4 - Energy and Water | 5a - Solar PV Feasi


Looking ahead with Resilience

RECOVER Rebuild

Enterprise®

Hurricane Harvey and its Effects on the Houston Housing Authority

HOUSTON
HOUSING AUTHORITY

Transforming Lives & Communities

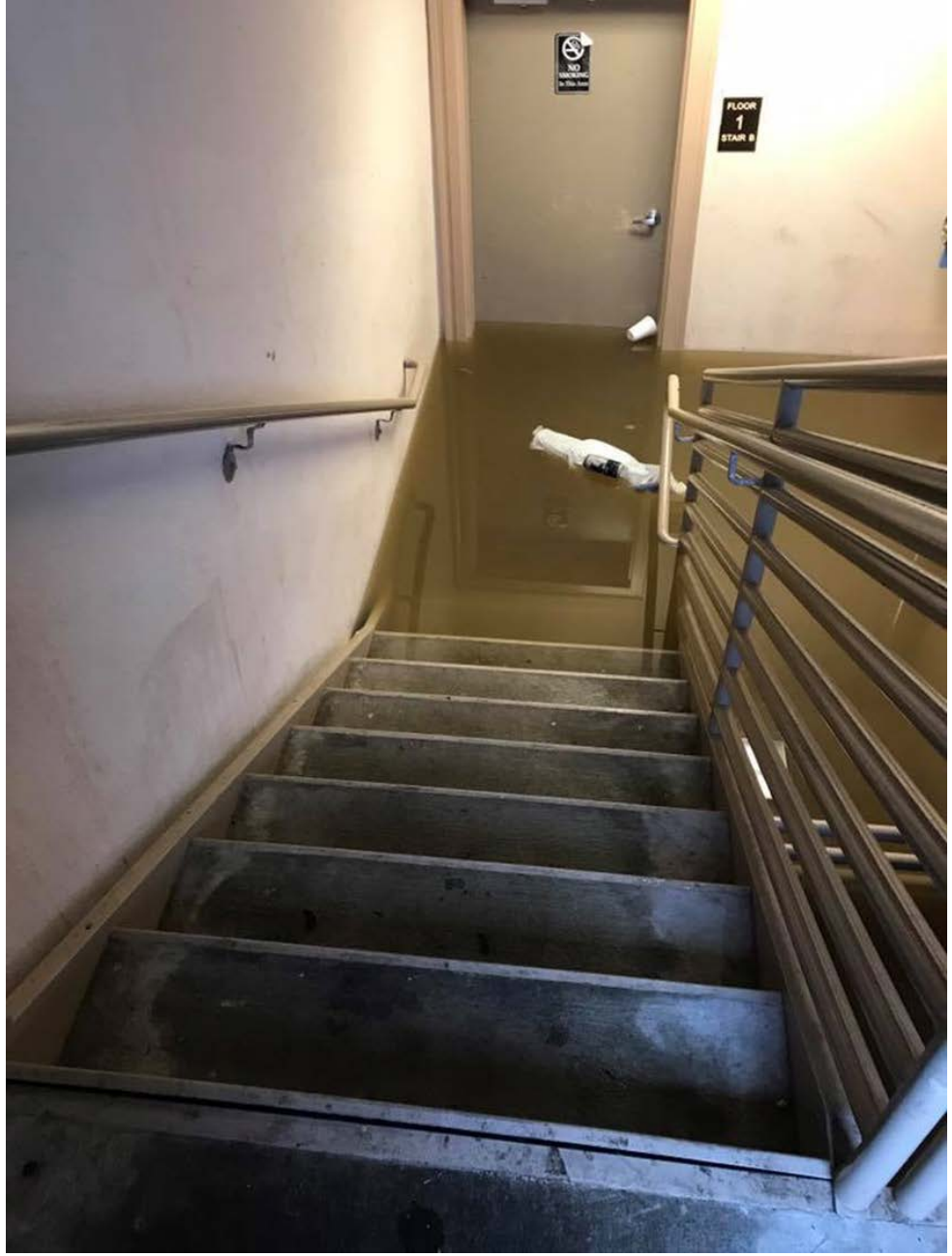
DAMAGE ON HHA OWNED UNITS

324 units flooded

559 units had leaks

1,056 units damaged

18% of HHA Inventory was Damaged


FLOOR
1
STAIR B


A - 11
233-240

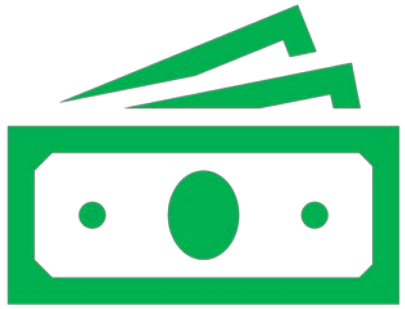
ESTIMATED COST OF DAMAGE

Public Housing

Property	Est. Repair Cost
APV/HOAPV	$464,000.00
Bellerive	$5,000.00
Clayton Homes	$14,445,300.00
Cuney Homes	$55,000.00
Forest Green	$3,972,146.75
Fulton Village	$185,000.00
Heatherbrook	$288,500.00
Historic Oaks	$250,000.00
HHA	$516,000.00
Irvinton Village	$1,936,000.00
Kennedy Place	$125,000.00
Lincoln Park	$160,000.00
Oxford Place	$85,000.00
Sweetwater Point	$1,399,500.00
Victory Place	$40,000.00
	$23,926,446.75

Tax Credit/PBV

Property	Est. Repair Cost
2100 Memorial	$16,013,400.00
Long Drive	$63,860.00
Mansions at Turkey Creek	$3,644,500.00
Peninsula Park	$59,500.00
Pinnacle on Wilcrest	$11,500.00
Telephone Road	$12,000.00
Uvalde Ranch	$3,257,000.00
Villas on Winkler	$2,383,500.00
Willow Park	$15,595.00
	$25,460,855.00



Total Amount of Damages is about

$50 Million

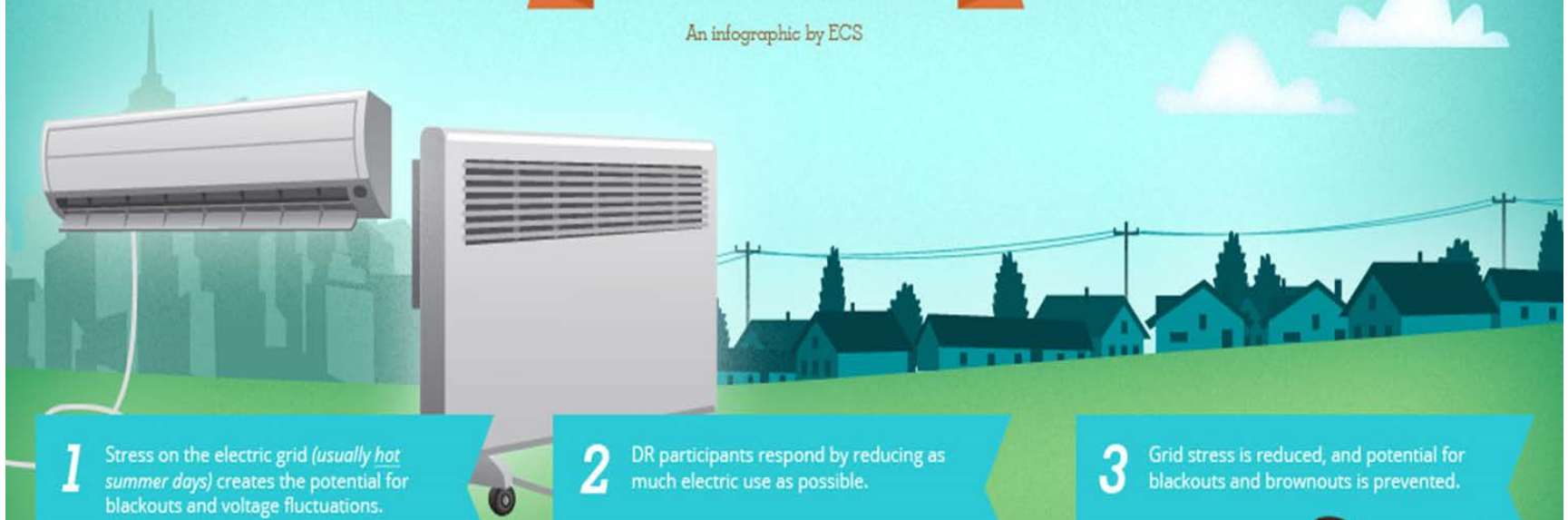
Emergency Back-up Generators and Demand Response Program

- New ATS switch with remote access at two sites
- Two sites have full capacity back-up generators with Dual fuel capacity
- Registered with the local utility to participate in Demand Response Program

DEMAND RESPONSE

HOW IT WORKS

An infographic by ECS

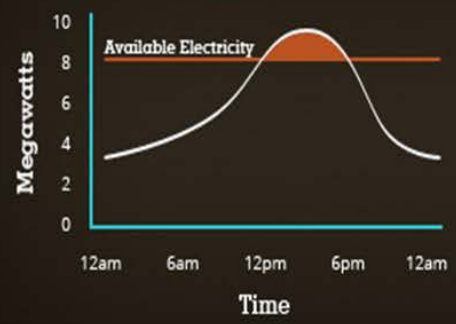


1 Stress on the electric grid *(usually hot summer days)* creates the potential for blackouts and voltage fluctuations.

2 DR participants respond by reducing as much electric use as possible.

3 Grid stress is reduced, and potential for blackouts and brownouts is prevented.

Blackouts!



Reduce!

Energy Curtailment Specialists, Inc.
www.ecsgrid.com | 877.711.5453

New Generator installed part of a Demand Response rebate program with NRG

	HOUSTON HOUSING AUTHORITY
PROBLEM	▪ Elderly Tenants are most susceptible to negative affects of power outage, building only has Life and Safety power in emergency. ▪ HHA was in need of alternative continuity of operations site in case of disaster.
SOLUTION	▪ Energy saving program created capital to implementing energy efficiency upgrades.
BENEFITS	▪ Single building with large community area provided for continuing business operations. ▪ Demand Response program generates revenue. ▪ Resident safety and security during disaster.

Resilience Tools for Multifamily Buildings

- NFIP Flood Insurance Manual: https://www.fema.gov/flood-insurance-manual
- FEMA Library on a number of topics for building & design details for flooding: https://www.fema.gov/media-library/assets/documents/2655;https://www.fema.gov/es/media-library/assets/documents/725
- CDC Prevention Guide to Extreme Heat:https://www.cdc.gov/disasters/extremeheat/index.html
- Emergency Preparedness for Seniors: https://www.thezebra.com/insurance-news/4674/emergency-preparedness-seniors-disabled/
- Better Homes Disaster Safety for Renters: https://www.homecity.com/disaster-safety-for-renters
- Humane Society Disaster Safety for Pets:http://www.humanesociety.org/issues/animal_rescue/tips/pets-disaster.html
- Climate Central Sea Level Rise Tools: http://sealevel.climatecentral.org/
- Stormwater Management Best Practices & SF Stormwater Management Guidelines

Resilience Tools, continued

- Enterprise Ready to Respond Tools https://www.enterprisecommunity.org/solutions-and-innovation/green-communities/tools-and-services/ready-to-respond
- Enterprise Resilience Series – Insurance and Recovery Webinar:https://www.enterprisecommunity.org/resources/resiliency-speakers-series-disaster-recovery-insurance-coverage-and-building-resiliency
- ARUP Resilience Framework: https://www.arup.com/perspectives/city-resilience-index
- Resilience Cities Initiative: http://www.100resilientcities.org/#/-_/
- NOAA US Climate Risk Toolkit: https://toolkit.climate.gov/
- NYC Climate Risk Panel Findings 2013:http://www.nyc.gov/html/planyc2030/downloads/pdf/npcc_climate_risk_information_2013_report.pdf
- ULI Guide for Assessing Climate Change Risk: https://uli.org/wp-content/uploads/ULI-Documents/ULI-A-Guide-for-Assessesing-Climate-Change-Risk-final.pdf