



Interacciones entre eventos extremos climáticos, factores socioambientales y infraestructura crítica



12 de Agosto 2022

Expo Convención

Colegio de Ingenieros y Agrimensores de Puerto Rico

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Graduate School of Public Health
University of Puerto Rico-Medical Sciences Campus



PR-CLIMAH
THIS IS PUBLIC HEALTH

NASA Principal Investigator: Grant Number 80NSSC19K0194

NASA Principal Investigator: Grant Number 80NSSC20K1588



Sections

The Washington Post
Democracy Dies in Darkness

Try four v

Climate & Environment Climate Solutions Global warming World impacts Global emissions Extreme heat Biden's actions

Biden finally has a climate bill. What happens next?



By [Dino Grandoni](#)

August 10, 2022 at 11:11 a.m. EDT

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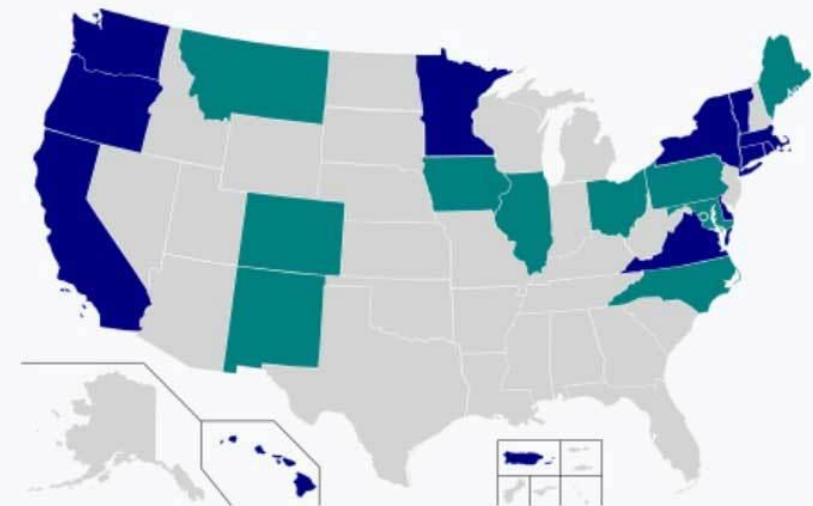
AUDIO HUB SUBSCRIBE

Secretary-General welcomes US return to Paris Agreement on Climate Change



UN Photo/Amanda Voisard | Former United States Secretary of State John Kerry, accompanied by his grand-daughter, signs the Paris Agreement at UN headquarters in April 2016.

United States Climate Alliance



United States Climate Alliance
Other areas whose governing officials have expressed support for the [Paris Agreement](#)

Call for Action: Managing the Infodemic

A global movement to promote access to health information and mitigate harm from health misinformation among online and offline communities



WHO: An **infodemic** is an overabundance of information, both online and offline. It includes deliberate attempts to disseminate wrong information to undermine the public health response and advance alternative agendas of groups or individuals.

<https://www.who.int/news/item/11-12-2020-call-for-action-managing-the-infodemic>

Socio-ecological & Technological Systems & Ecosystem Services



THREATS TO CORAL REEFS CLIMATE CHANGE

Increased greenhouse gases from human activities result in climate change and ocean acidification.

CLIMATE CHANGE = OCEAN CHANGE



CO₂

The world's ocean is a massive sink that absorbs carbon dioxide (CO₂). Although this has slowed global warming, it is also changing ocean chemistry.

HOW YOU CAN HELP

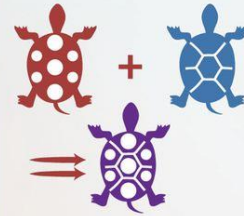
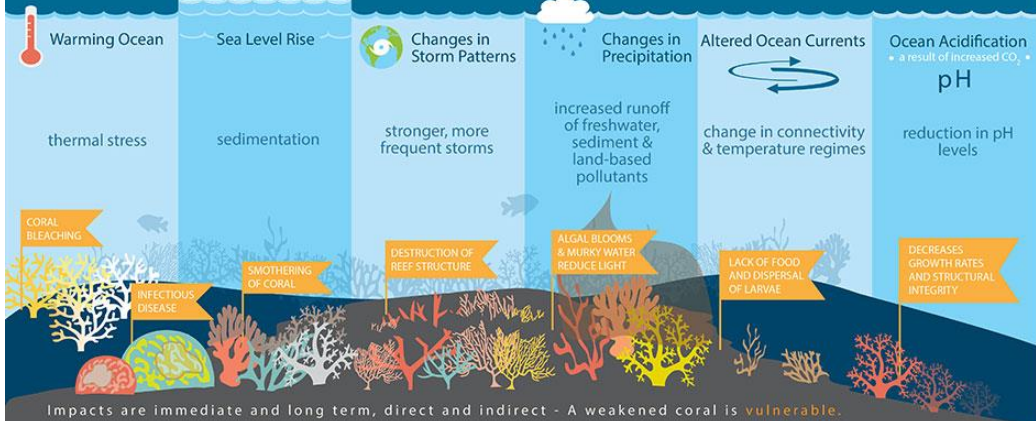
Shrink your carbon footprint to reduce greenhouse gases.

- Drive less.
- Reduce, reuse or recycle.
- Purchase energy-efficient appliances and lightbulbs.
- Print less. Download more. Use less water.

Do your part to help improve overall coral reef condition.

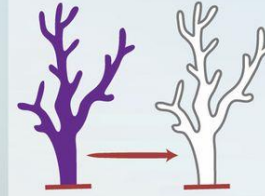
- Reduce the use of lawn and garden chemicals.
- DO NOT dump household chemicals in storm drains.
- Choose sustainable seafood. www.FishWatch.gov
- Learn about good reef etiquette and practice it when in the water.
- Volunteer for beach and waterway clean ups.

CLIMATE CHANGE dramatically affects CORAL REEF ECOSYSTEMS



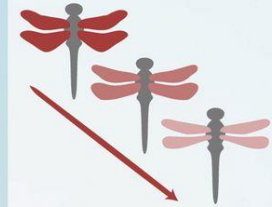
GENETICS:

- Adaptive evolution to heat stress in small organisms with short generations
- Limited evidence for adaptive evolution in higher level vertebrates and trees
- Increased hybridization



PHYSIOLOGY:

- Increases in coral disease
- Extensive dissolution of carbonate-shelled organisms and corals
- Direct mortality from heat stress
- Changes in life history traits and migration timing



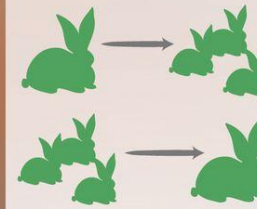
MORPHOLOGY:

- Decreases in body size and changes in shape
- Changes in color and brightness



PHENOLOGY:

- Changes in spawning times of marine and freshwater fish
- Earlier budding and flowering in plants and earlier growing season
- Early and later migration in birds
- Increased asynchrony



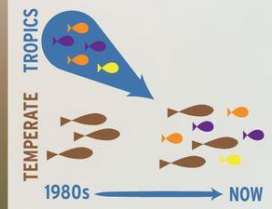
DYNAMICS:

- Changes in recruitment and age structure
- Changes in abundance of reef-building corals, plants, mammals, and birds
- Changes in sex ratio



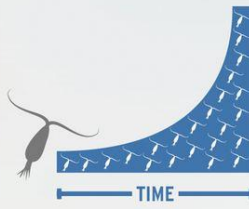
DISTRIBUTION:

- Latitude and altitude range shifts
- Range expansion and contraction
- Loss of habitat



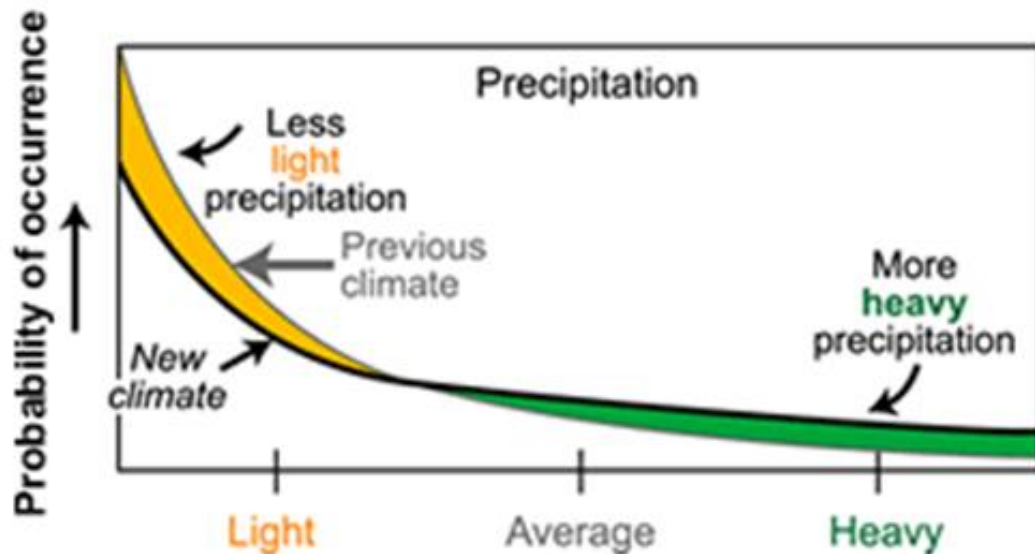
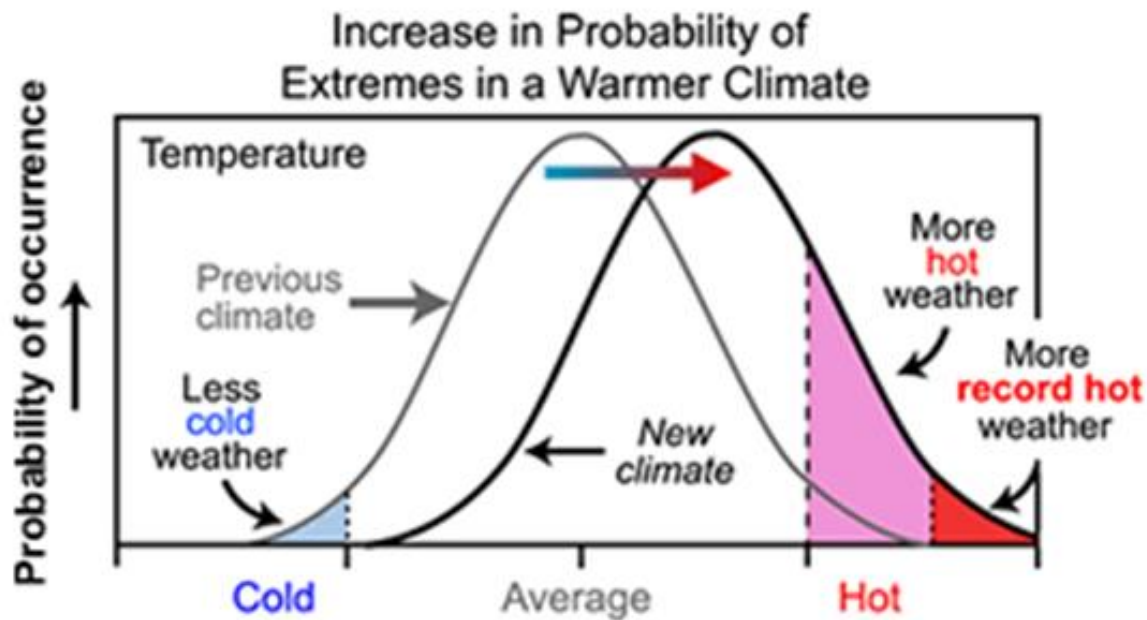
INTERSPECIFIC RELATIONSHIPS:

- Tropicalization of temperate ecosystems
- Borealization of Arctic ecosystems
- New competitive interactions among species
- Desynchronization among dependent species



PRODUCTIVITY:

- Changes in net primary productivity on land
- Changes in phytoplankton biomass in marine and freshwater ecosystems

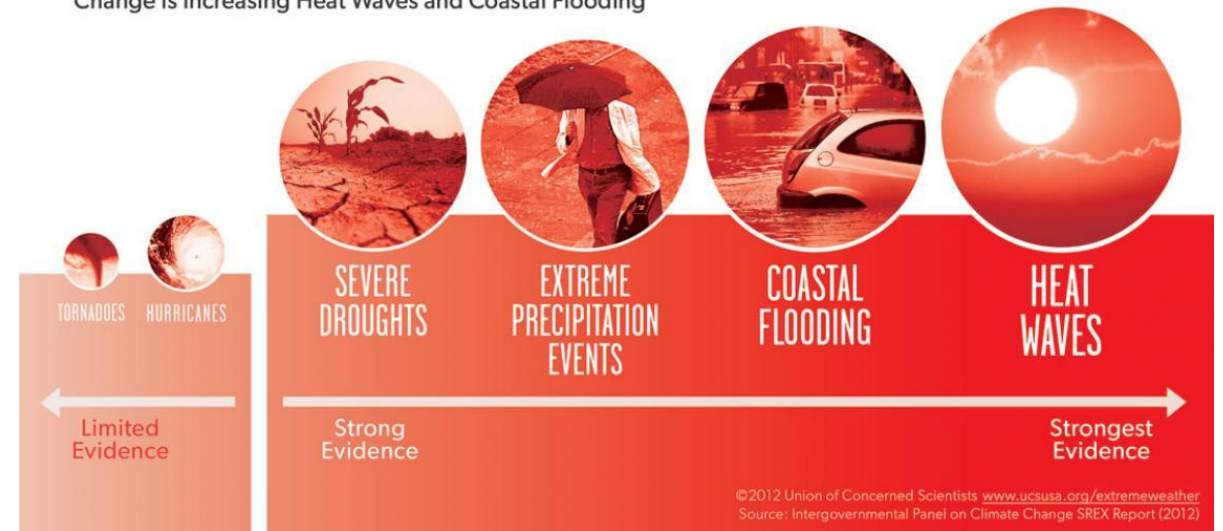


NOAA

Intensity-Duration-Frequency

SCIENCE CONNECTIONS → EXTREME WEATHER & CLIMATE CHANGE

→ Strongest Scientific Evidence Shows Human-Caused Climate Change Is Increasing Heat Waves and Coastal Flooding



AGU PUBLICATIONS

Earth's Future

RESEARCH ARTICLE

10.1002/2017EF000686

Defining Extreme Events: A Cross-Disciplinary Review

Lauren E. McPhillips¹, Heejun Chang², Mikhail V. Chester³, Yaella Depietri⁴, Erin Friedman⁵, Nancy B. Grimm⁶, John S. Kominoski⁷, Timon McPhearson^{4,8}, Pablo Méndez-Lázaro⁹, Emma J. Rosi⁸, and Javad Shafei Shiva¹⁰

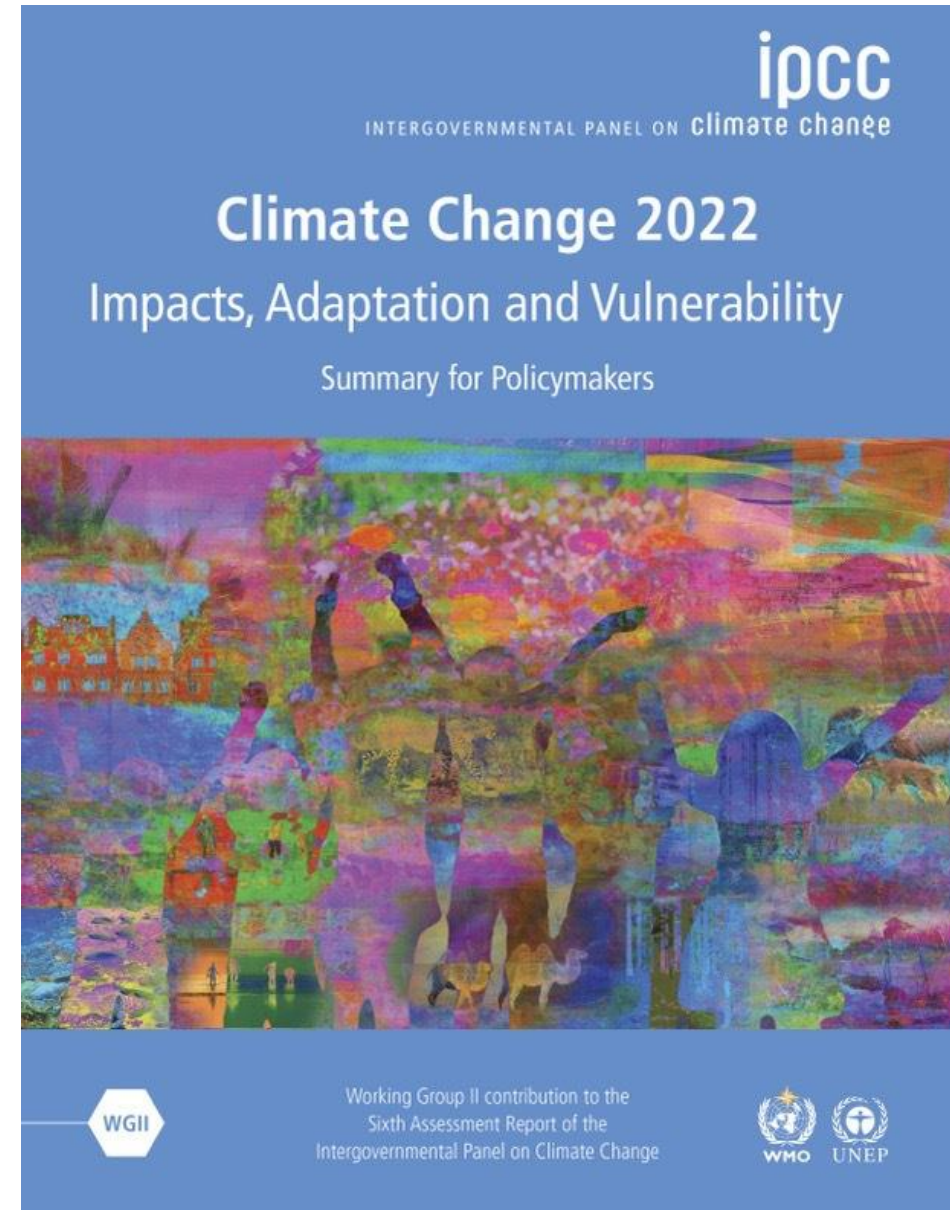
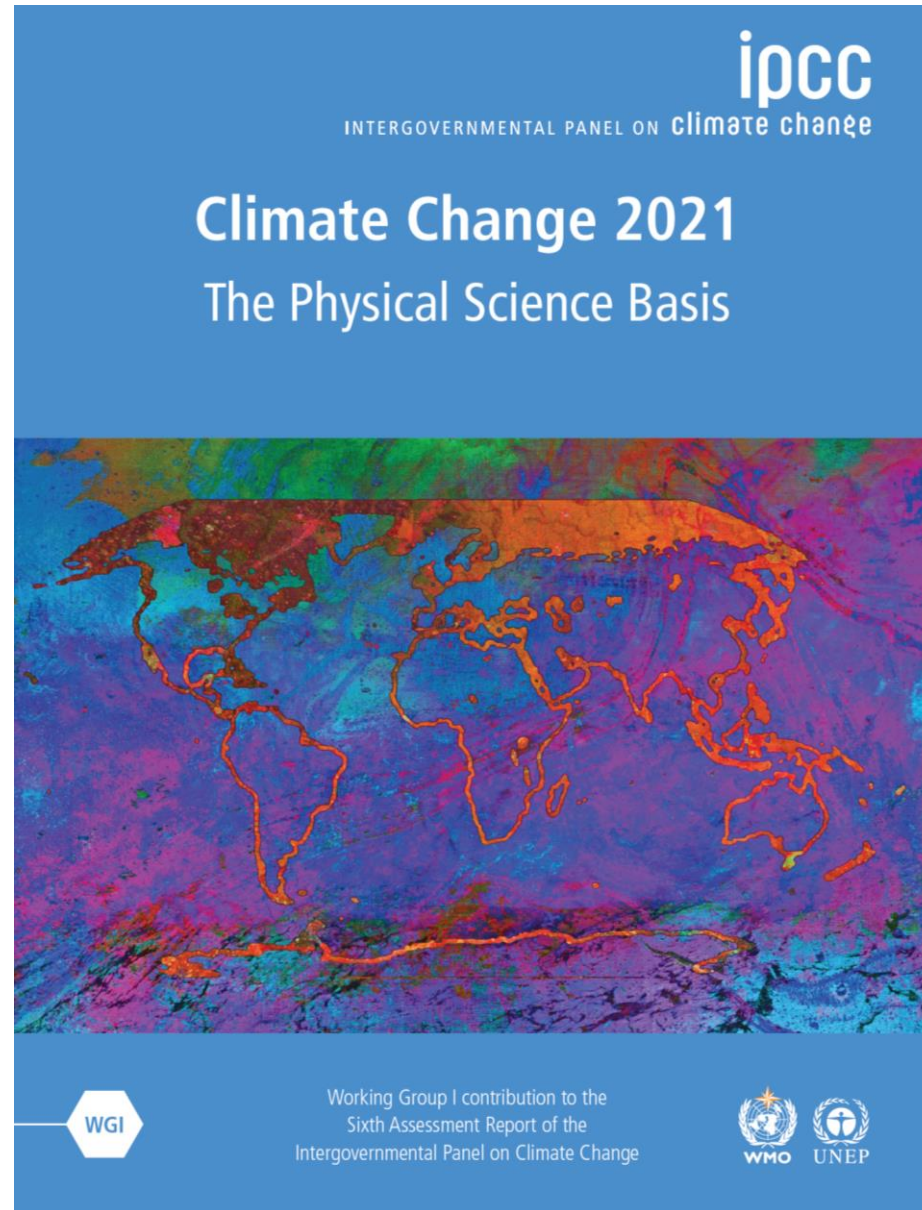
Key Points:

- What constitutes an extreme event varies by study and discipline; thus we must be explicit in how we define extreme events
- Extreme events are often conflated with their impacts, but this will inhibit future recognition of resilience
- Bridging across disciplinary differences in communication and definitions is critical for holistic management of extreme events

¹Global Institute of Sustainability, Arizona State University, Tempe, AZ, USA, ²Department of Geography, Portland State University, Portland, OR, USA, ³School of Sustainable Engineering and the Built Environment, Arizona State University, Tempe, AZ, USA, ⁴Urban Systems Lab, The New School, New York, NY, USA, ⁵Earth and Environmental Sciences, The Graduate Center, City University of New York, New York, NY, USA, ⁶School of Life Sciences and Global Institute of Sustainability, Arizona State University, Tempe, AZ, USA, ⁷Department of Biological Sciences, Florida International University, Miami, FL, USA, ⁸Cary Institute of Ecosystem Studies, Millbrook, NY, USA, ⁹Environmental Health Department, Graduate School of Public Health, University of Puerto Rico—Medical Sciences Campus, San Juan, PR, USA, ¹⁰Department of Civil and Environmental Engineering, Syracuse University, Syracuse, NY, USA

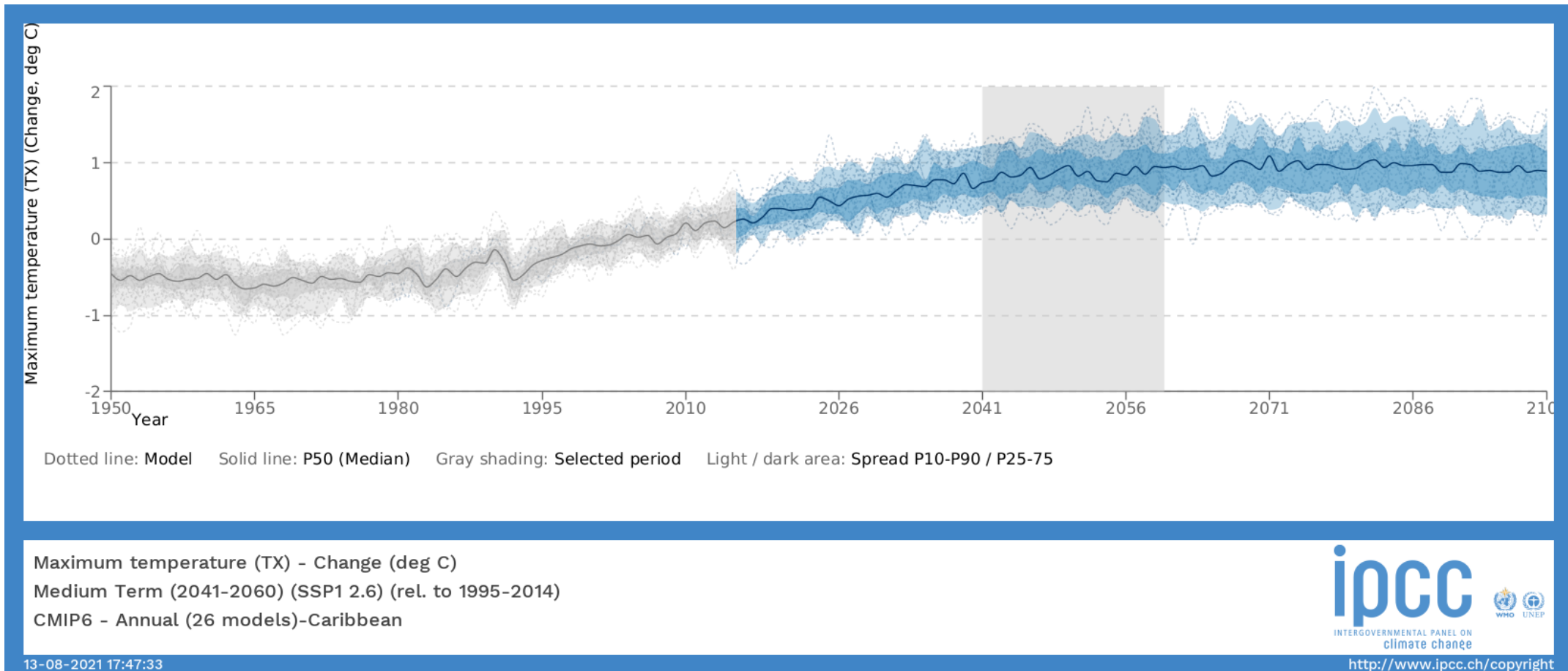
Table 2. The Extreme Temperature and Precipitation Indices.

ID	Indicator Name	Indicator Definitions	Units
TN10p	Cool nights	Percentage of time when daily min temperature < 10th percentile	%
TX10p	Cool days	Percentage of time when daily max temperature < 10th percentile	%
TN90p	Warm nights	Percentage of time when daily min temperature > 90th Percentile	%
TX90p	Warm days	Percentage of time when daily max temperature > 90th percentile	%
WSDI	Warm spell duration indicator	Annual count when at least six consecutive days of max temperature > 90th percentile	days
CSDIN	Cold spell duration indicator	Annual count when at least six consecutive days of min temperature < 10th percentile	days
CSDIX	Cold spell duration indicator	Annual count when at least six consecutive days of max temperature < 10th percentile	days
PRCPTOT	Annual total wet-day precipitation	Annual total precipitation from days ≥ 1 mm	mm
R10	Number of heavy precipitation days	Annual count when precipitation ≥ 10 mm	days
R20	Number of very heavy precipitation days	Annual count when precipitation ≥ 20 mm	days
CDD	Consecutive dry days	Maximum number of consecutive days when precipitation < 1 mm	days
CWD	Consecutive wet days	Maximum number of consecutive days when precipitation ≥ 1 mm	days
R95p	Very wet days	Annual total precipitation from days > 95th percentile	mm
R99p	Extremely wet days	Annual total precipitation from days > 99th percentile	mm



Climate change is happening, and is **widespread, rapid, and intensifying** – IPCC Many of the changes observed in the climate are **unprecedented** in thousands, if not hundreds of thousands of years, and some are **irreversible** over hundreds to thousands of years.

Temperatures

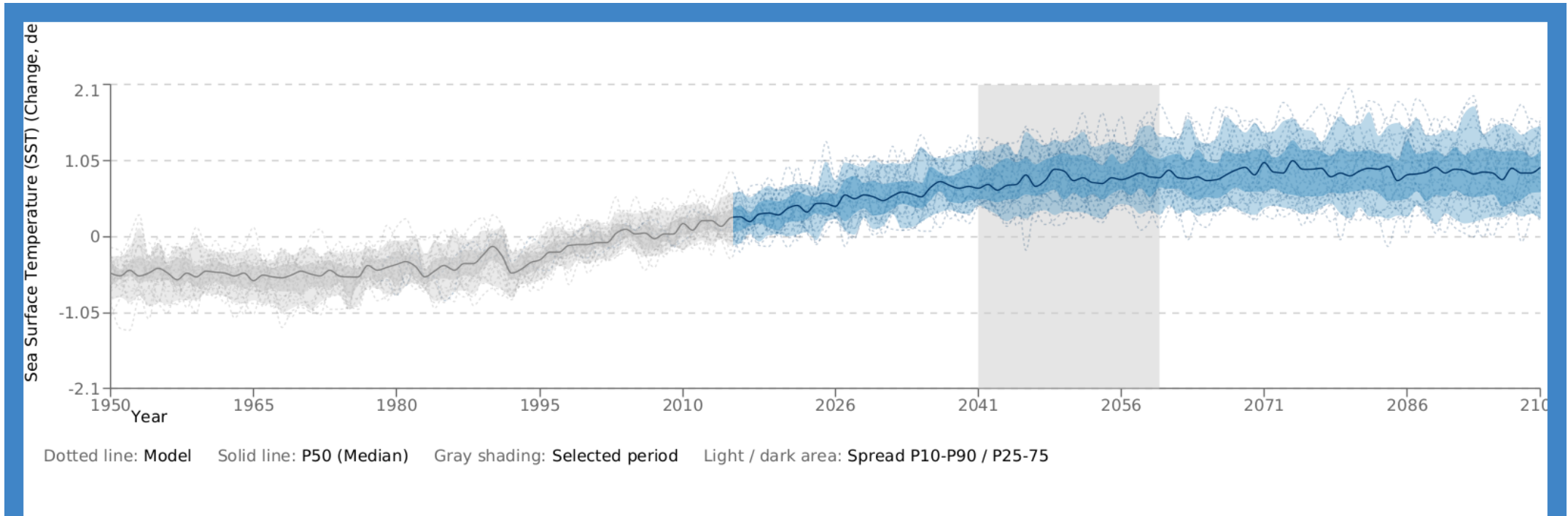


2041-2060

Se pronostica el doble de días con temperaturas $>35.5^{\circ}\text{C} = 96^{\circ}\text{F}$

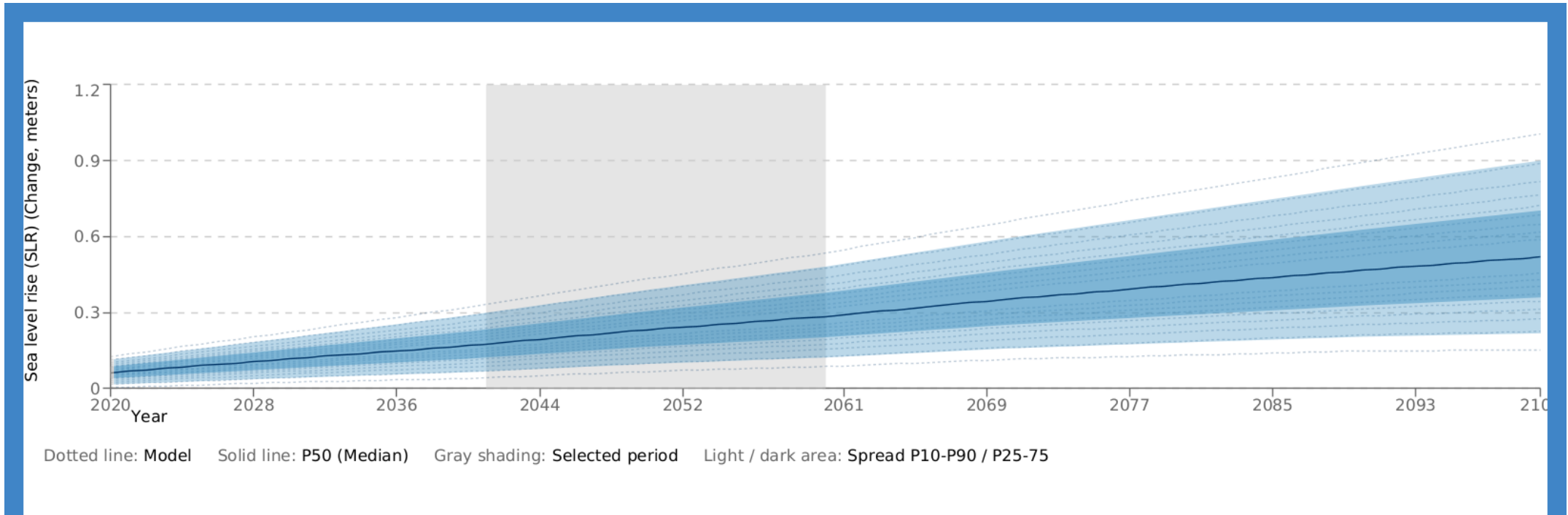
Se pronostica un aumento de $1.7\text{-}2.7^{\circ}\text{C}$ ($5\text{-}7^{\circ}\text{F}$) por encima de la norma durante los meses de Aug-Octubre

Sea Surface Temperature



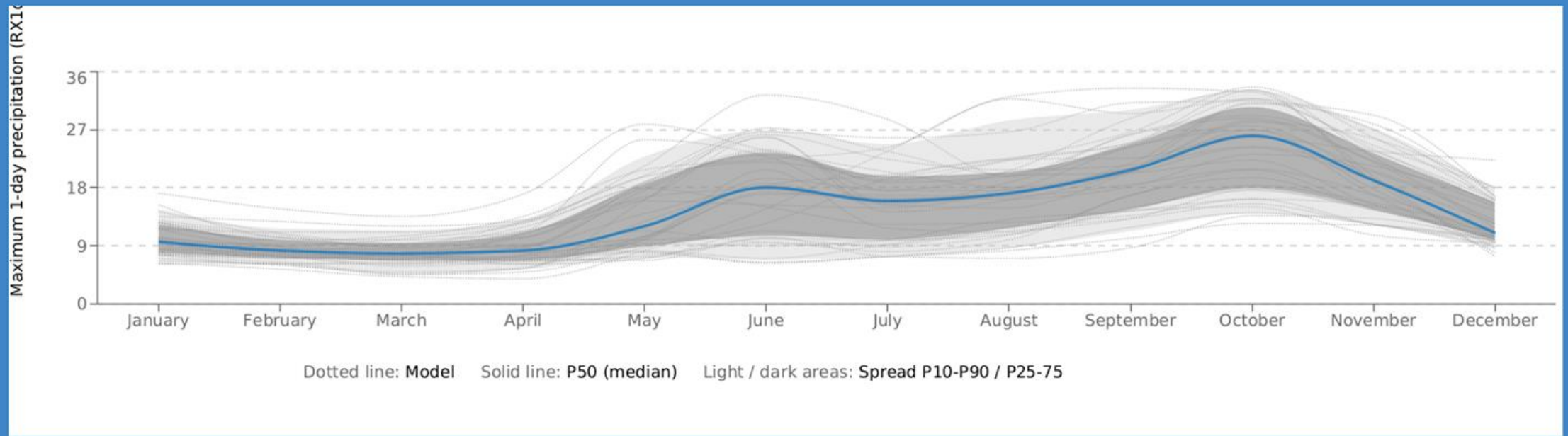
Sea Surface Temperature (SST) - Change (deg C)
Medium Term (2041-2060) (SSP1 2.6) (rel. to 1995-2014)
CMIP6 - Annual (26 models)-Caribbean

Sea Level Rise



Sea level rise (SLR) - Change (meters)
Medium Term (2041-2060) (SSP1 2.6) (rel. to 1995-2014)
CMIP6 - Annual -Caribbean

Precipitation



Maximum 1-day precipitation (RX1day) - (mm)
1850-1900 ()
CMIP6 - Annual (34 models)-Caribbean

Se pronostica 2041-2060

Aumento en la Cantidad de Días Secos

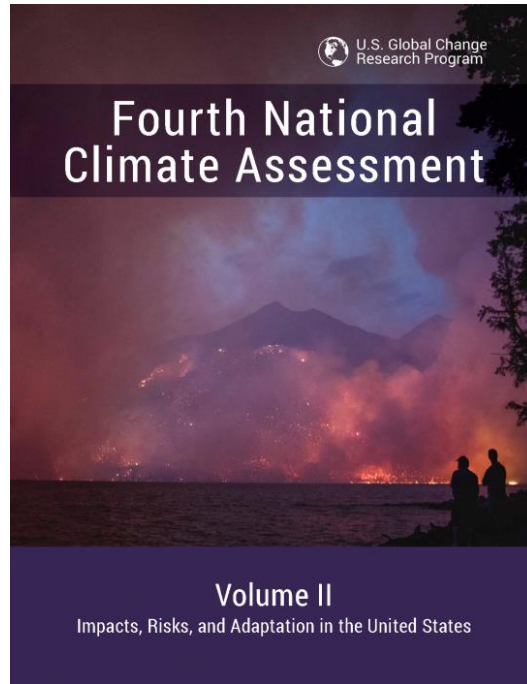
Reducción de Lluvia annual 25-50%

La mayor reducción en la Lluvia se pronostica para Verano (meses como junio se observa -46%)

Aumento significativo en lluvias extremas durante los meses de septiembre-octubre



U.S. Global Change Research Program
**National Climate
Assessment**



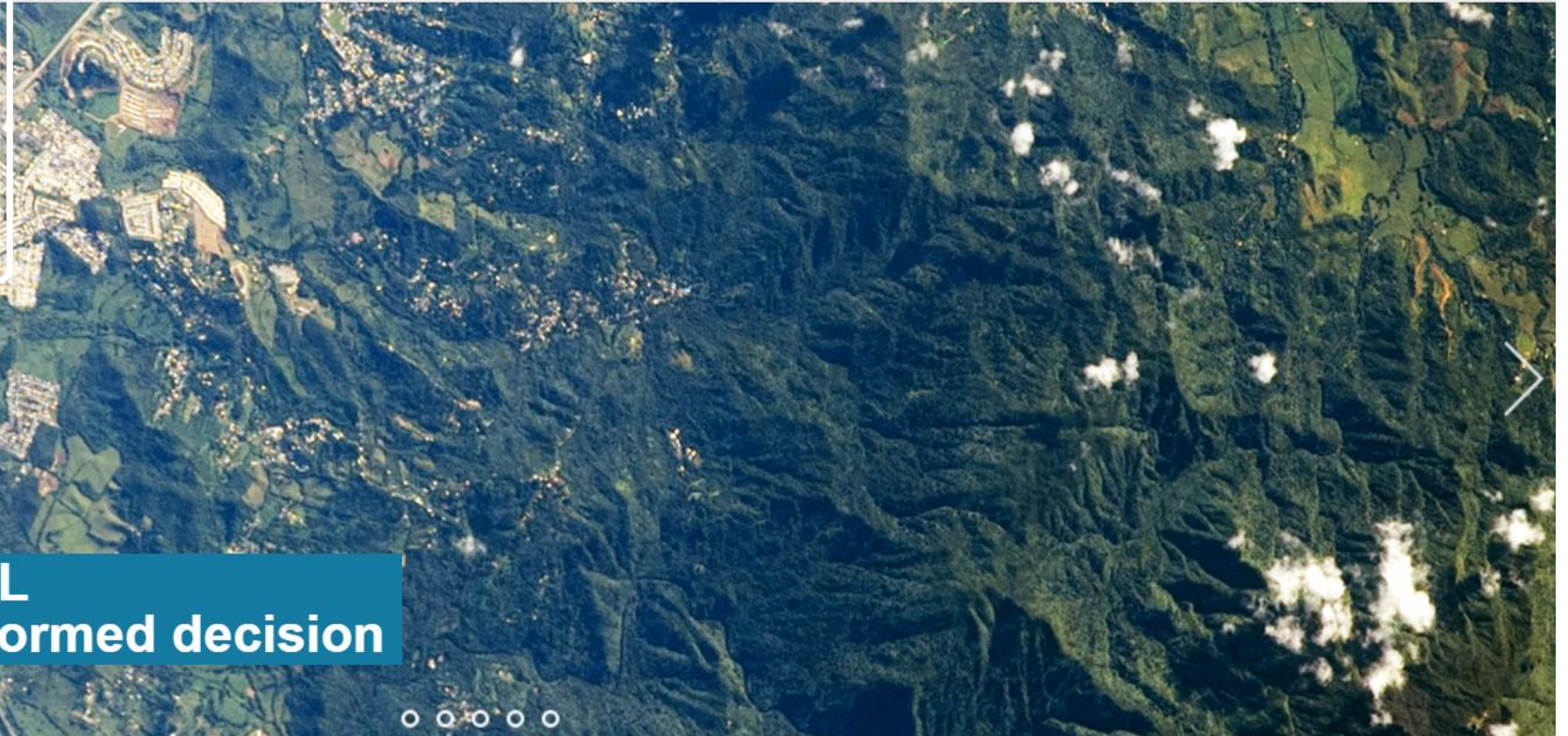
4th National Climate Assessment: US Caribbean Chapter 2018

The U.S. Global Change Research Program (USGCRP) was established by Presidential initiative in 1989 and mandated by Congress in the Global Change Research Act (GCRA) of 1990.

Its mandate is to develop and coordinate “a comprehensive and integrated United States research program which will assist the Nation and the world to understand, assess, predict, and respond to human-induced and natural processes of global change.”

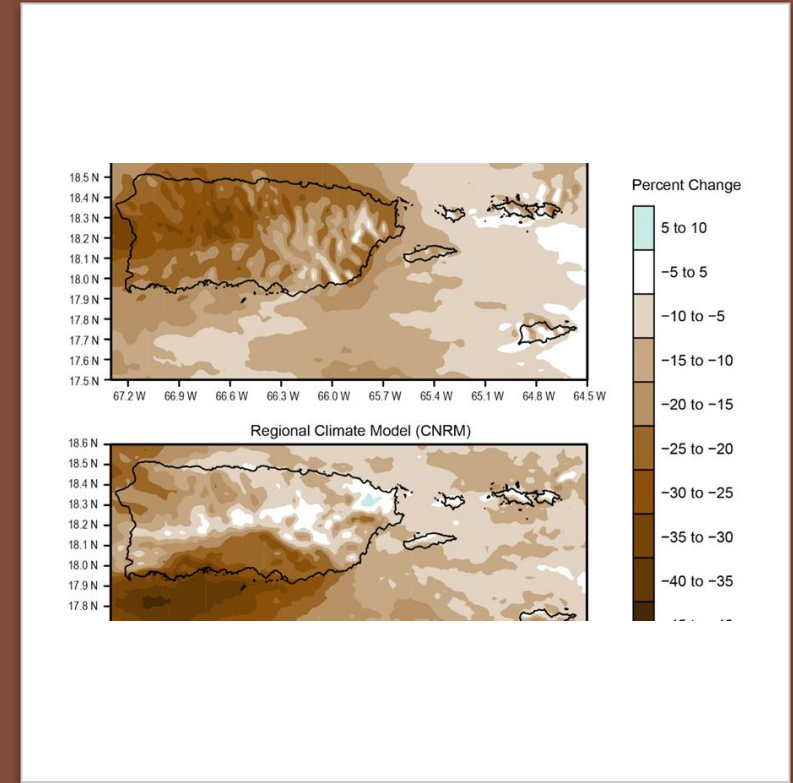
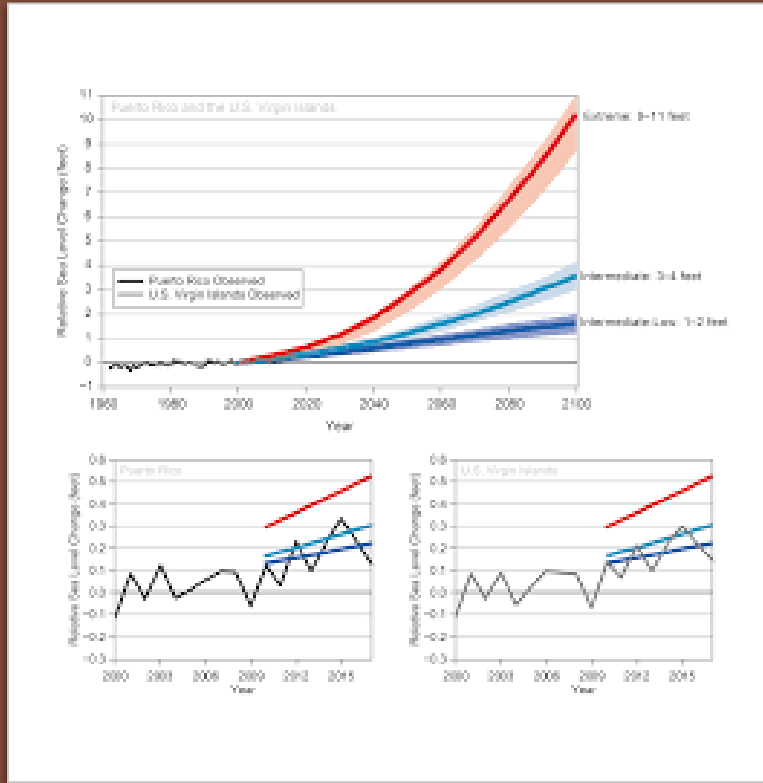
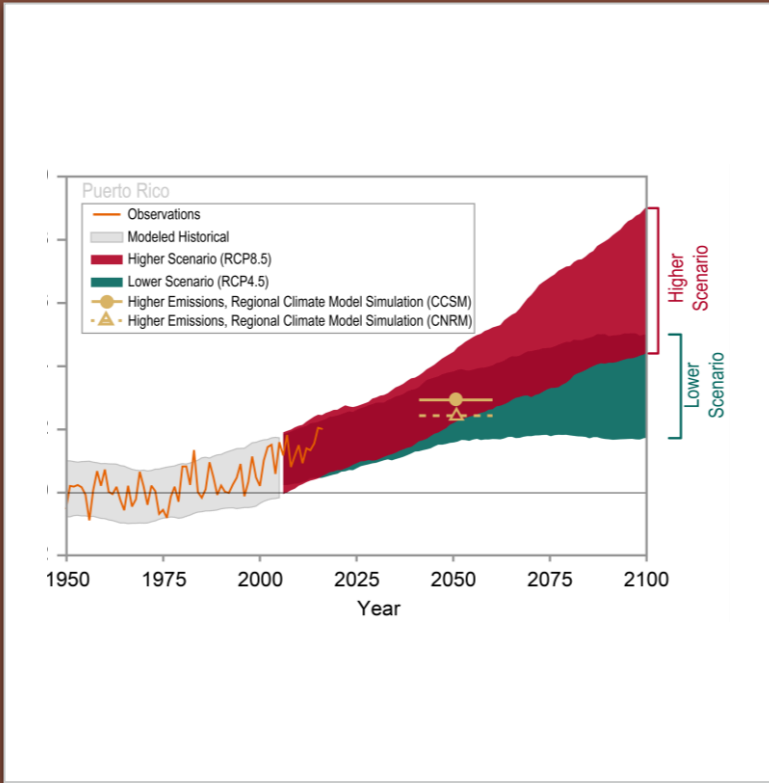
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Puerto Rico Climate Change Council



CLIMATE DATA TOOL
We need to make informed decision





4th National Climate Assessment: US Caribbean Chapter 2018

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5th National Climate Assessment

32 Chapters

2 Earth System, 17 National Topics, 10 Regions, Adaptation and Mitigation

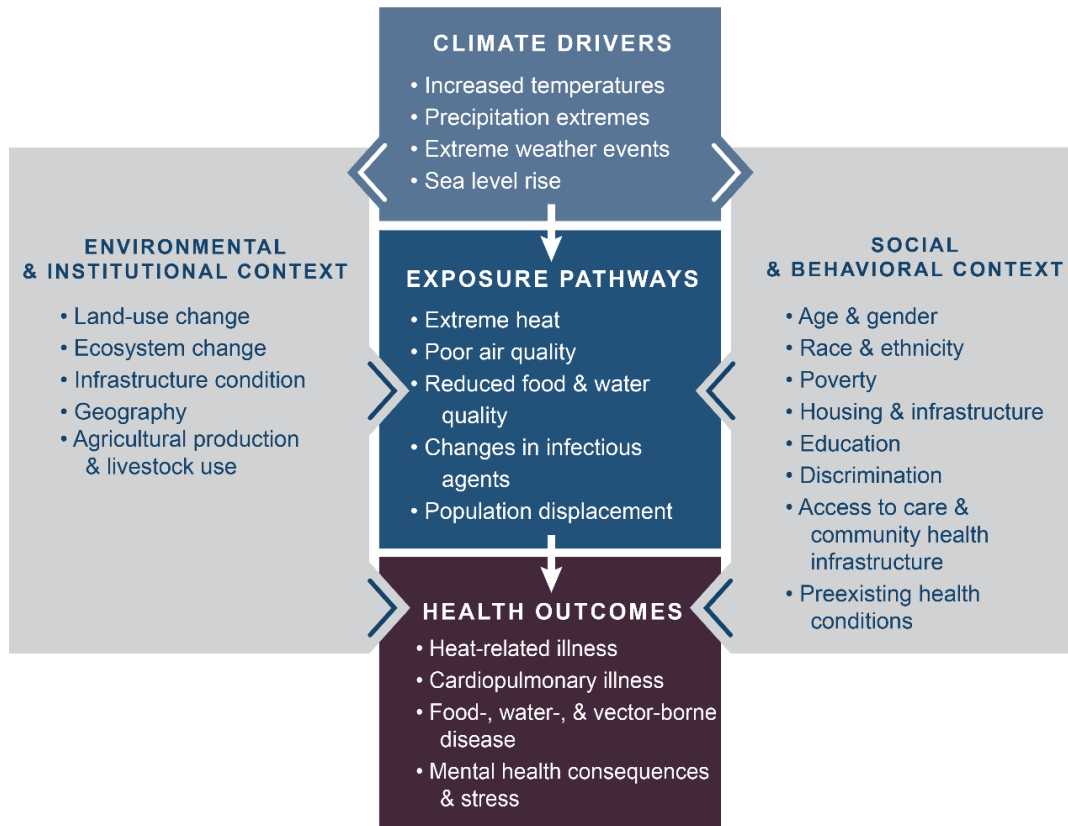


U.S. Global Change Research Program

**National Climate
Assessment**

<https://nca2018.globalchange.gov/chapter/14/>

Climate Change and Health



Ecosystems

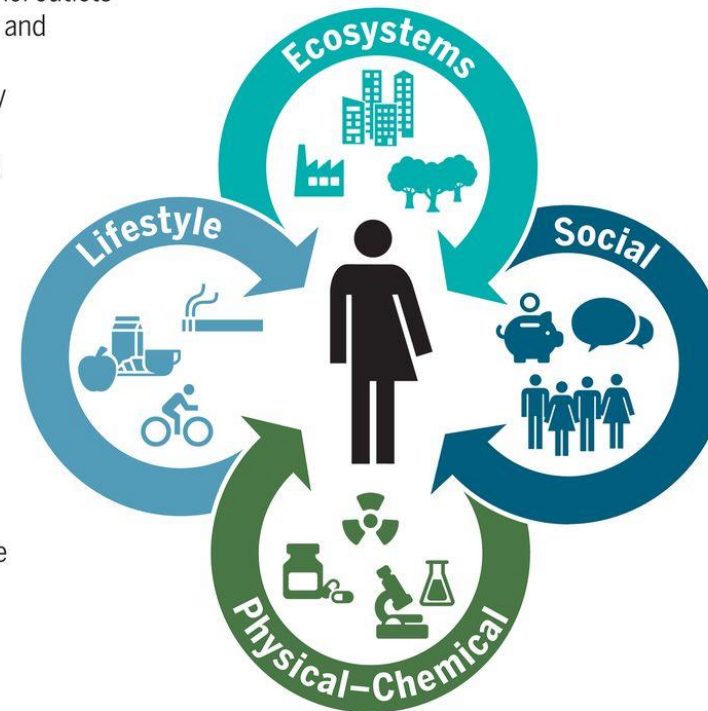
Food outlets, alcohol outlets
Built environment and urban land uses
Population density
Walkability
Green/blue space

Lifestyle

Physical activity
Sleep behavior
Diet
Drug use
Smoking
Alcohol use

Social

Household income
Inequality
Social capital
Social networks
Cultural norms
Cultural capital
Psychological and mental stress



Physical-Chemical

Temperature/humidity
Electromagnetic fields
Ambient light
Odor and noise
Point, line sources, e.g., factories, ports
Outdoor and indoor air pollution
Agricultural activities, livestock
Pollen/mold/fungus
Pesticides
Fragrance products
Flame retardants (PBDEs)
Persistent organic pollutants
Plastic and plasticizers
Food contaminants
Soil contaminants
Drinking water contamination
Groundwater contamination
Surface water contamination
Occupational exposures

Adaptive Capacity, Sensitivity, Exposure, Capacity to Cope



"In these tropical ocean regions, the heat just can't escape. And if nothing escapes, that part of the world just gets hotter and hotter."

- Graeme Stephens, director of the Center for Climate Sciences at NASA's Jet Propulsion Laboratory (JPL)



[NEWS](#) | March 22, 2018

Scientists assess potential for super greenhouse effect in Earth's tropics



THE WHITE HOUSE



BRIEFING ROOM

FACT SHEET: President Biden's Executive Actions on Climate to Address Extreme Heat and Boost Offshore Wind

JULY 20, 2022 • STATEMENTS AND RELEASES

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THE WHITE HOUSE



BRIEFING ROOM

FACT SHEET: 10 Ways the Biden-Harris Administration Is Responding to Extreme Heat

JULY 26, 2022 • STATEMENTS AND RELEASES

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THE WHITE HOUSE



BRIEFING ROOM

FACT SHEET: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat

SEPTEMBER 20, 2021 • STATEMENTS AND RELEASES

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Heat Presidential Initiatives



HEAT.gov

National Integrated Heat Health Information System

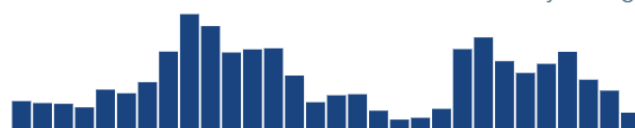
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Extreme Heat

25,748,842

people in warning area

30-Day Change



Source: NOAA National Weather Service

At left, see the current number of people in the U.S. that are currently under active National Weather Service extreme heat advisories, watches, and warnings.

Below, interact with current and future heat tools to understand where dangerous heat conditions may exist in the future.

[Current Heat Forecast](#)[Current Temperature](#)[Climate Outlooks](#)[Extreme Heat Days in 2050](#)[Days Above 90 deg F in...](#)

87°F
Mostly sunny



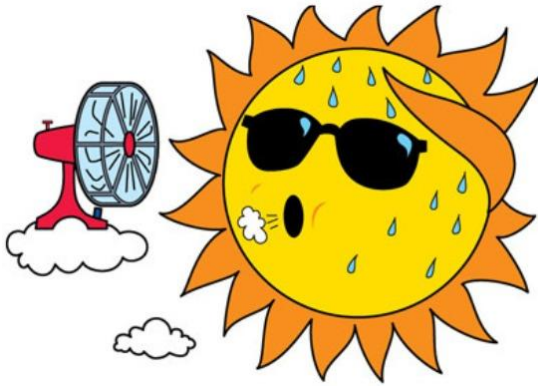
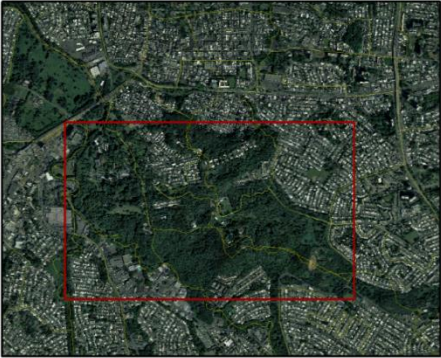
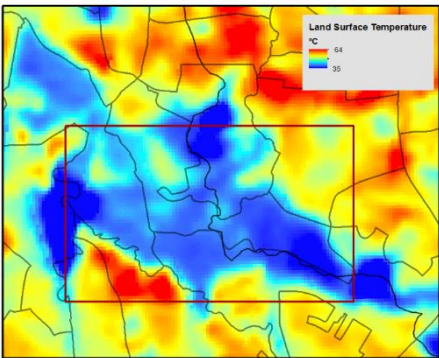
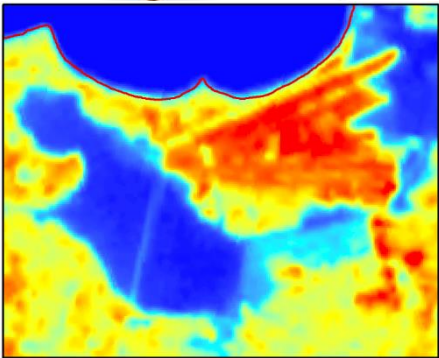
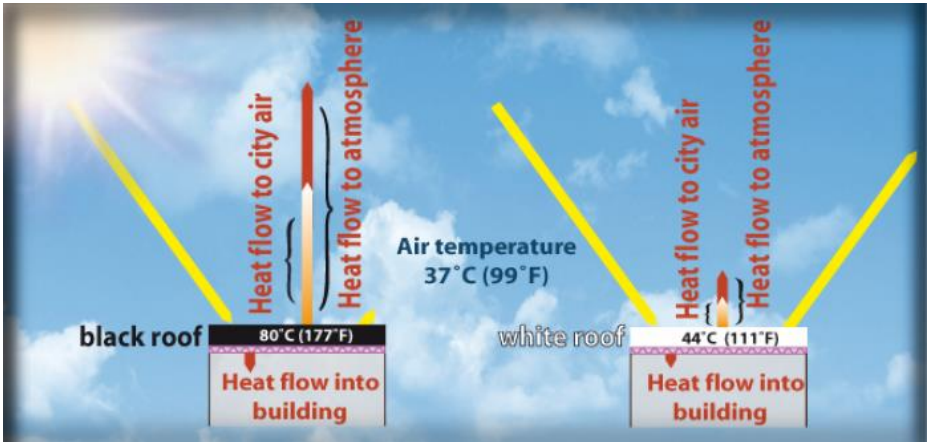
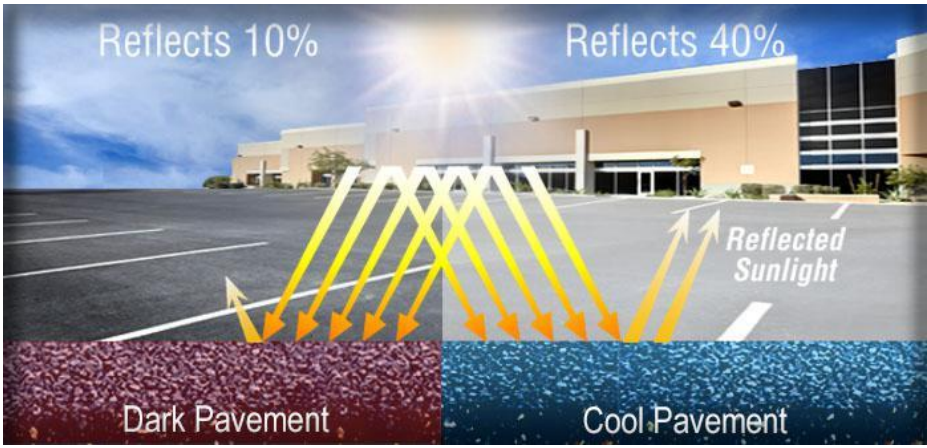
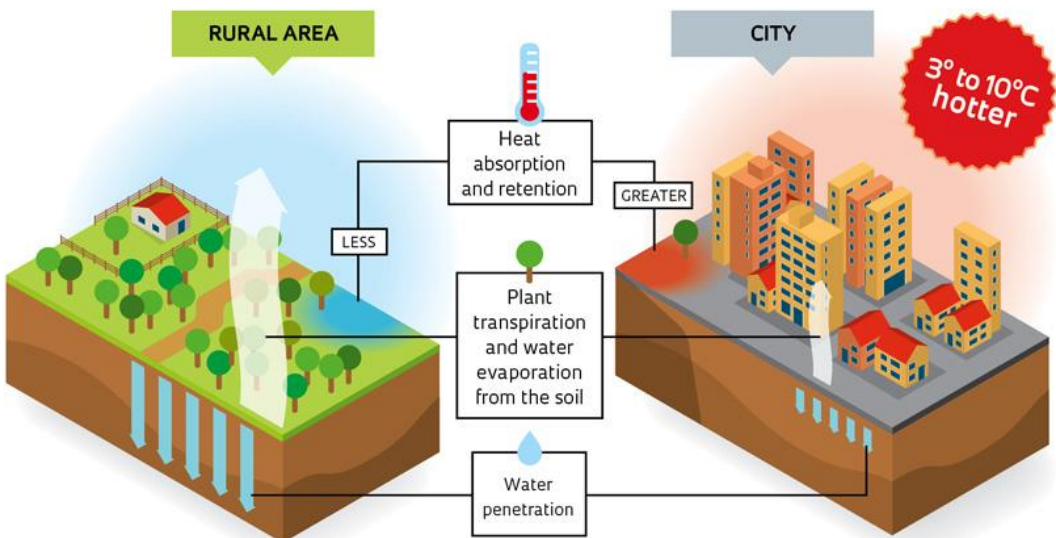
4:48 PM
8/10/2022



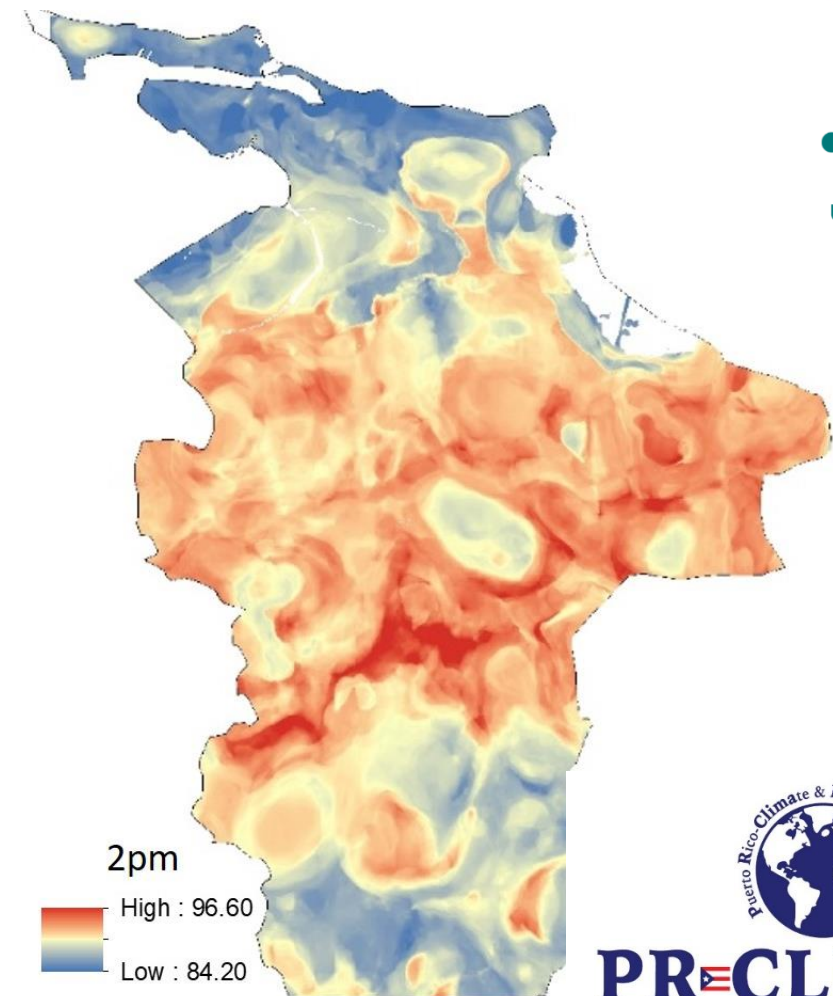
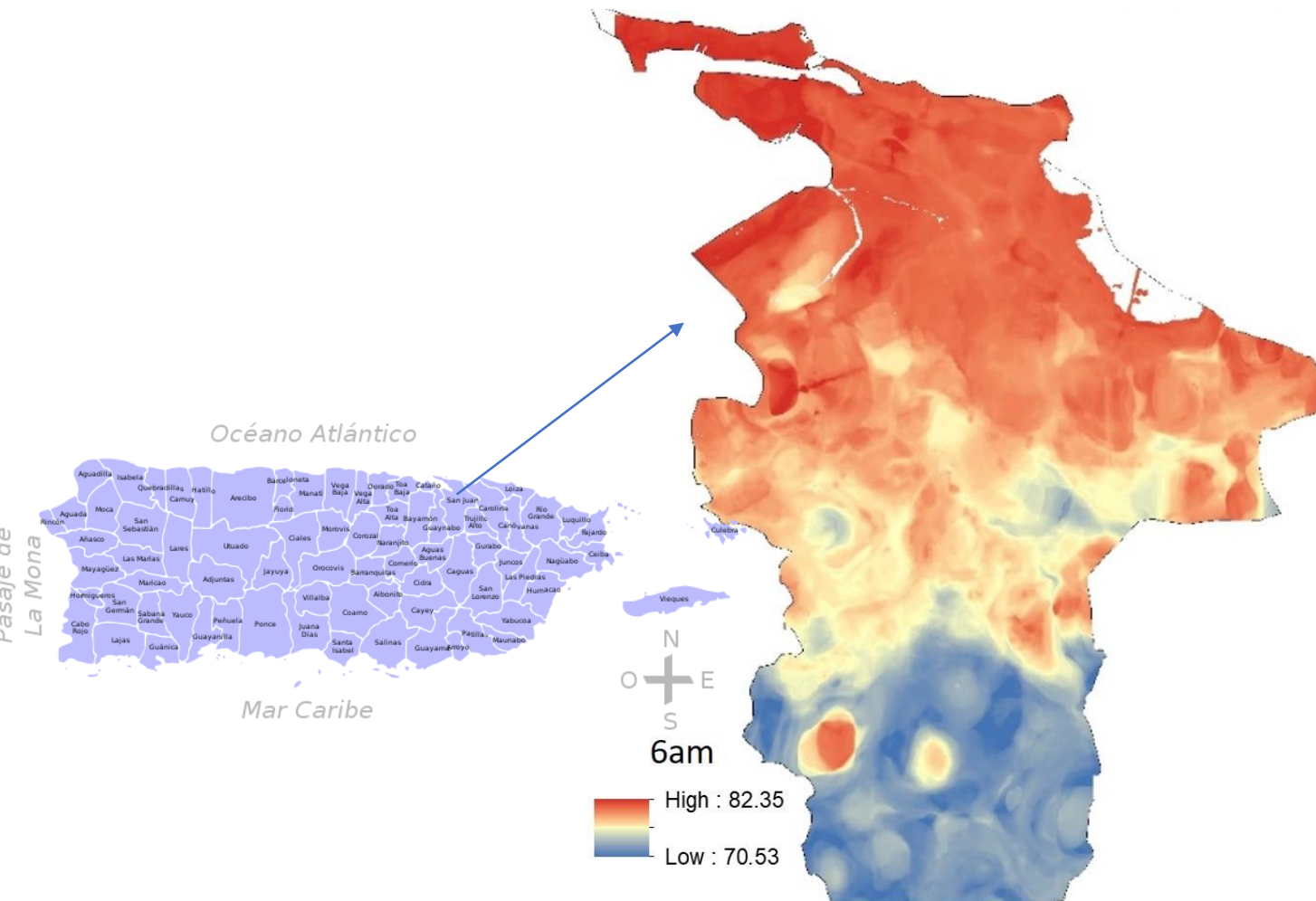
Heat Presidential Initiatives

- Lowering cooling costs for families
- Supporting community cooling centers
- Keeping workplaces safe
- Developing the first national heat standard to protect workers (OSHA)
- Leveraging nature to cool down cities
- Investing in proactive resilience projects
- Funding innovative cooling technologies
- Helping health professionals prepare and respond

Why the urban heat island effect occurs



UHI and Intra-urban heat distribution in San Juan, PR (June 23rd, 2019)



PRCLIMAH
THIS IS PUBLIC HEALTH

Temperature Related Illness and Mortality



Press Release



Beginning on June 1st 2018, Heat Advisories and Excessive Heat Warnings will be issued by WFO San Juan.

Each year heat-related illnesses, as well as fatalities, are reported around the world. In order to achieve our mission of protecting and saving lives, the National Weather Service Forecast Office (WFO) in San Juan in collaboration with the Department of Environmental Health, University of Puerto Rico - Medical Sciences Campus has developed a heat index criterion to issue heat advisories and/or warnings.

Beginning on June 1st 2018, **Heat Advisories** and **Excessive Heat Warnings** will be issued by WFO San Juan.

The **Heat Advisories** would be issued by zone when any location within that zone the heat index is expected to remain at or above 108°F for a minimum of 2 hours. The issuance of a heat advisory is important to raise public awareness that precautions need to be taken.



Autoridad de Energía Eléctrica ✓
@AEEONLINE

El @NWS emitió un aviso de altas temperaturas para PR que junto con la humedad pudiera alcanzar índices de calor cerca de 110°F. Exhortamos a nuestros clientes a ejercer prudencia en el consumo de energía para evitar interrupciones de servicio por alta demanda de electricidad.

[Translate Tweet](#)



1

1 comment

HAZARDOUS WEATHER OUTLOOK

HEAT



THREAT LEVEL: SLIGHT

Heat Indices between 102 and 107 degrees Fahrenheit are expected between 10:00 AM and 3:00 PM AST today.



DRINK PLENTY OF WATER,
EVEN IF NOT THIRSTY



AVOID STRENUOUS ACTIVITY
DURING HOTTEST PART OF DAY



WEAR LIGHTWEIGHT,
LIGHT-COLORED, LOOSE CLOTHING



AVOID CONSUMPTION OF
ALCOHOL AND CAFFEINE



WEAR SUNSCREEN



NEVER LEAVE KIDS
OR PETS UNATTENDED IN
VEHICLES



Servicio Nacional de Meteorología
San Juan, Puerto Rico

Friday, October 1st, 2021

HEAT CALOR



Maximum Heat Indices | Valid: 6:00 PM AST

Índices de Calor Máximos | Válido: 6:00 PM AST

Cotton Valley, USVI	113°F
Aguada, PR*	111°F
Fajardo, PR*	109°F
Ponce, PR*	106°F
Arecibo, PR*	106°F
Vega Baja, PR*	106°F
Carolina, PR*	105°F
Guanica, PR	105°F
St Thomas, PR*	104°F
Mayaguez, PR*	104°F

* These are reports from Public Networks. | Estos son reportes de Redes Públicas.



National Weather Service
San Juan, Puerto Rico

Tuesday, September 28th, 2021

Air Temperature	Relative Humidity (%)																
	40	45	50	55	60	65	70	75	80	85	90	95	100				
110	136																
108	130	137															
106	124	130	137														
104	119	124	131	137													
102	114	119	124	130	137												
100	109	114	118	124	129	136											
98	105	109	113	117	123	128	134										
96	101	104	108	112	116	121	126	132									
94	97	100	103	106	110	114	119	124	129	135							
92	94	96	99	101	105	108	112	116	121	126	131						
90	91	93	95	97	100	103	106	109	113	117	122	127	132				
88	88	89	91	93	95	98	100	103	106	110	113	117	121				
86	85	87	88	89	91	93	95	97	100	102	105	108	112				
84	83	84	85	86	88	89	90	92	94	96	98	100	103				
82	81	82	83	84	84	85	86	88	89	90	91	93	95				
80	80	80	81	81	82	82	83	84	84	85	86	86	87				

Heat Index
(Apparent
Temperature)

With Prolonged Exposure
and/or Physical Activity

Extreme Danger

Heat stroke or sunstroke
highly likely

Danger

Sunstroke, muscle cramps,
and/or heat exhaustion likely

Extreme Caution

Sunstroke, muscle cramps,
and/or heat exhaustion possible

Caution

Fatigue possible

HEAT CALOR



Maximum Heat Indices | Valid: 11:00 AM AST

Índices de Calor Máximos | Válido: 11:00 AM AST

San Juan, PR*	111°F
Cotton Valley, ISX	109°F
Vega Baja, PR*	107°F
Fajardo, PR*	106°F
Arecibo, PR*	105°F
Juncos, PR*	105°F
Humacao, PR*	104°F
Charlotte Amalie, IST*	104°F
Carolina, PR*	104°F
Guanica, PR	102°F

* Non-official reports from Public Networks. | Reportes no oficiales de Redes Públicas.

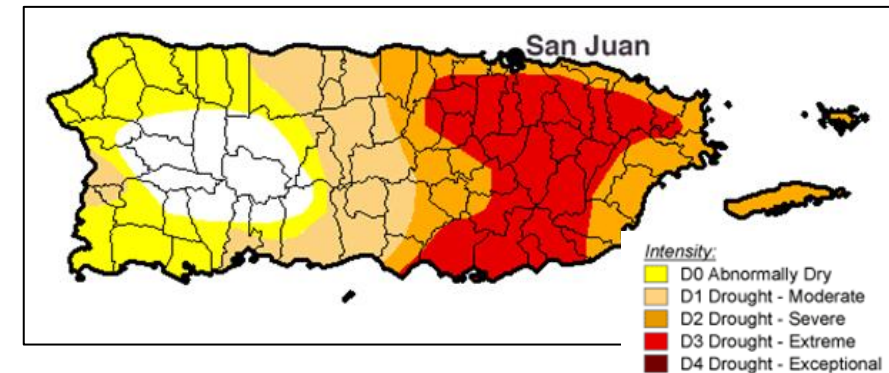
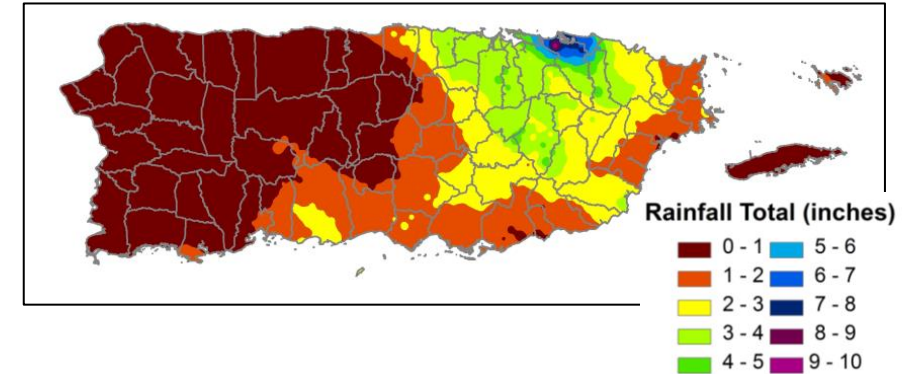


National Weather Service
San Juan, Puerto Rico

Friday, September 3rd, 2021

Water Resources

4th Nat. Climate Assessment

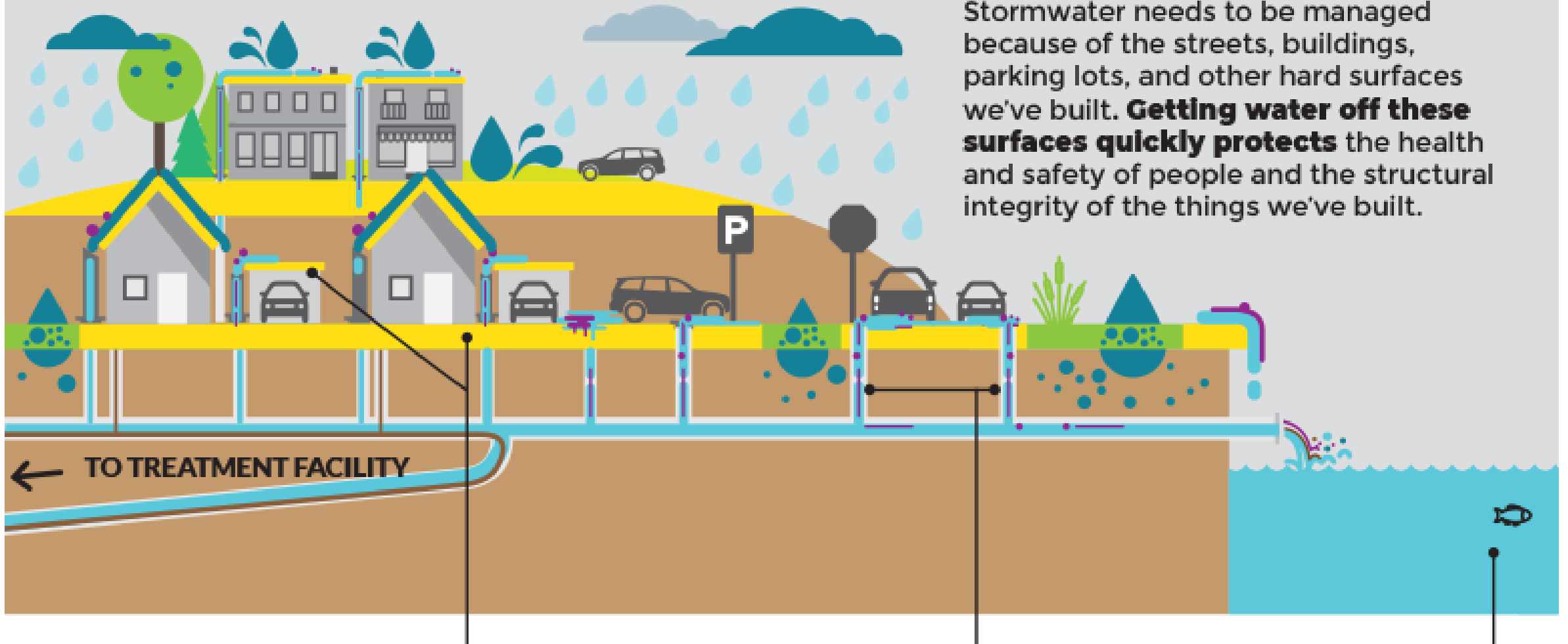


24hr Rainfall Total July 18, 2013

Simultaneous extreme events related to precipitation

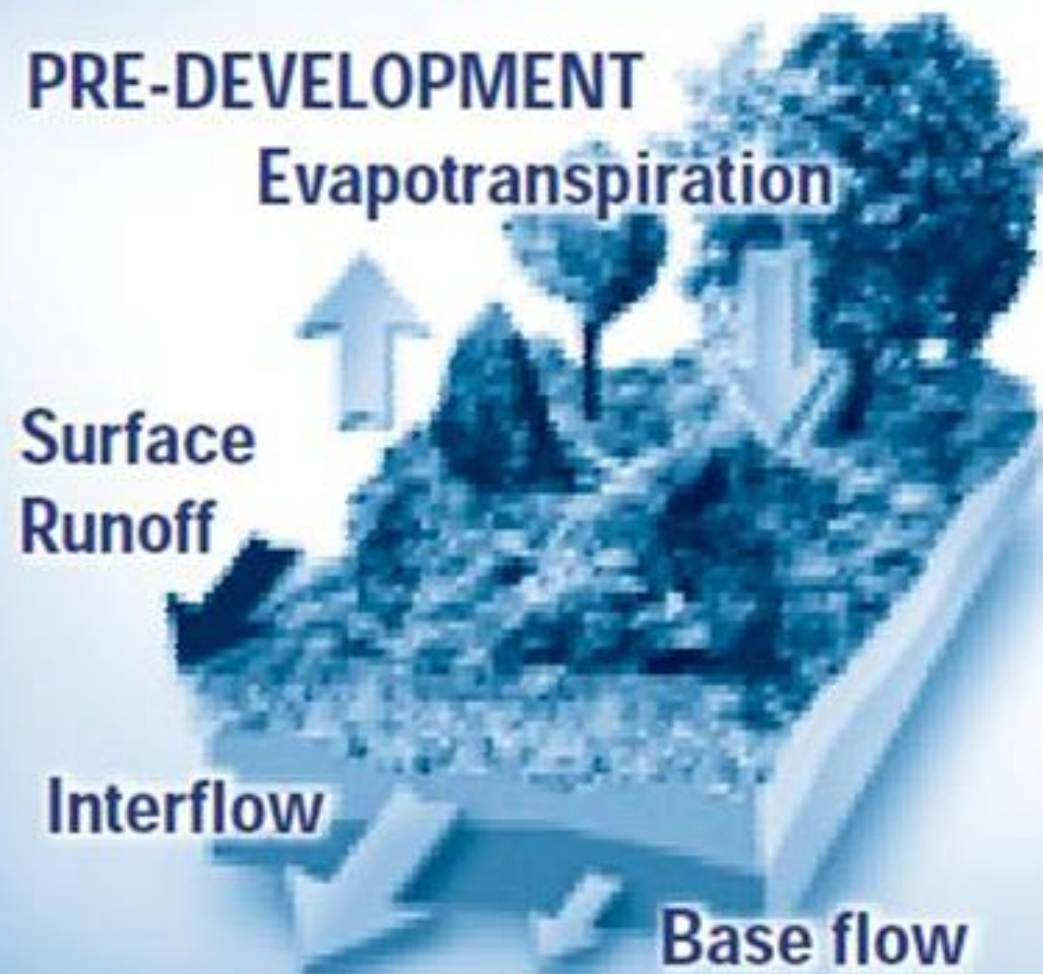
When stormwater falls in an urban environment

Stormwater needs to be managed because of the streets, buildings, parking lots, and other hard surfaces we've built. **Getting water off these surfaces quickly protects** the health and safety of people and the structural integrity of the things we've built.



Increased Stormwater Runoff Due to Development (Increased Imperviousness)

PRE-DEVELOPMENT

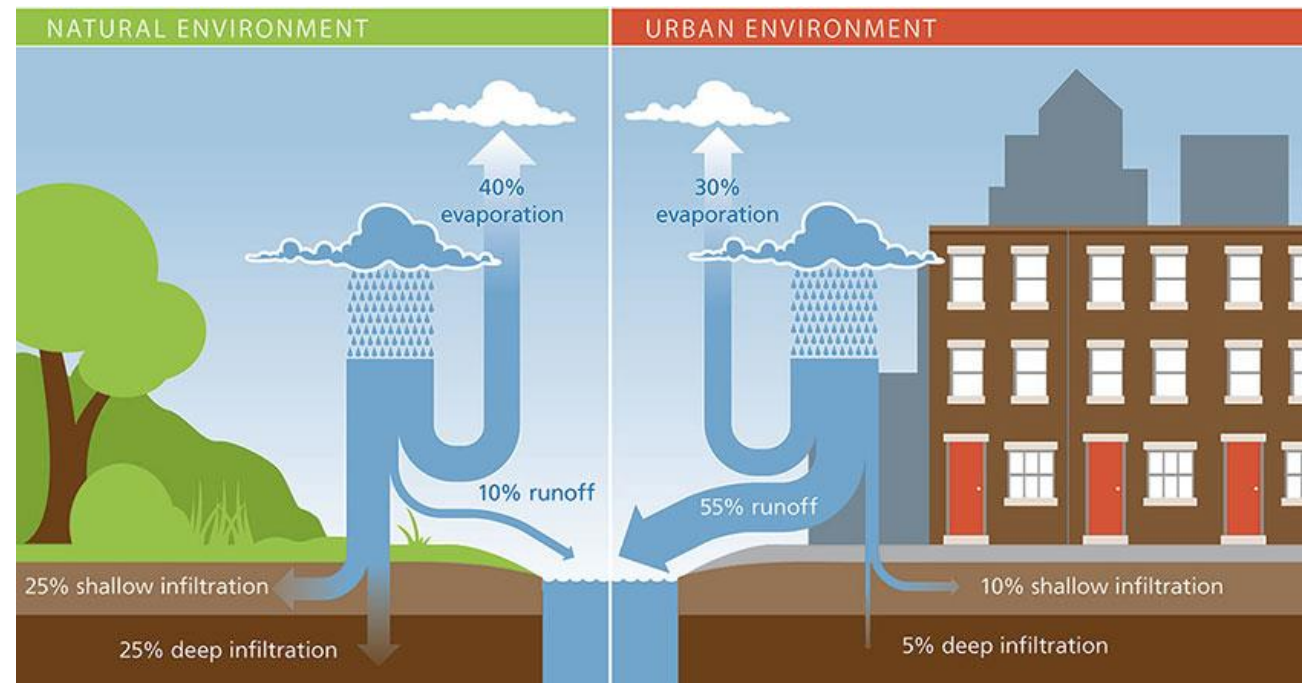
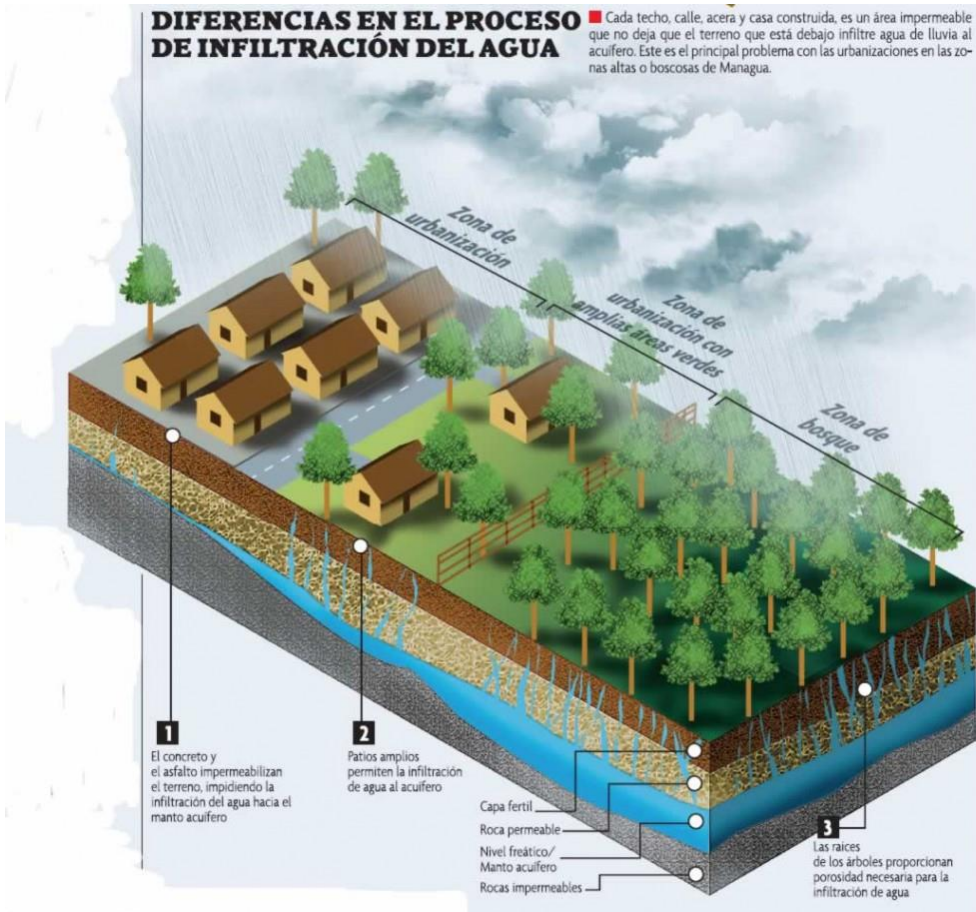


POST-DEVELOPMENT



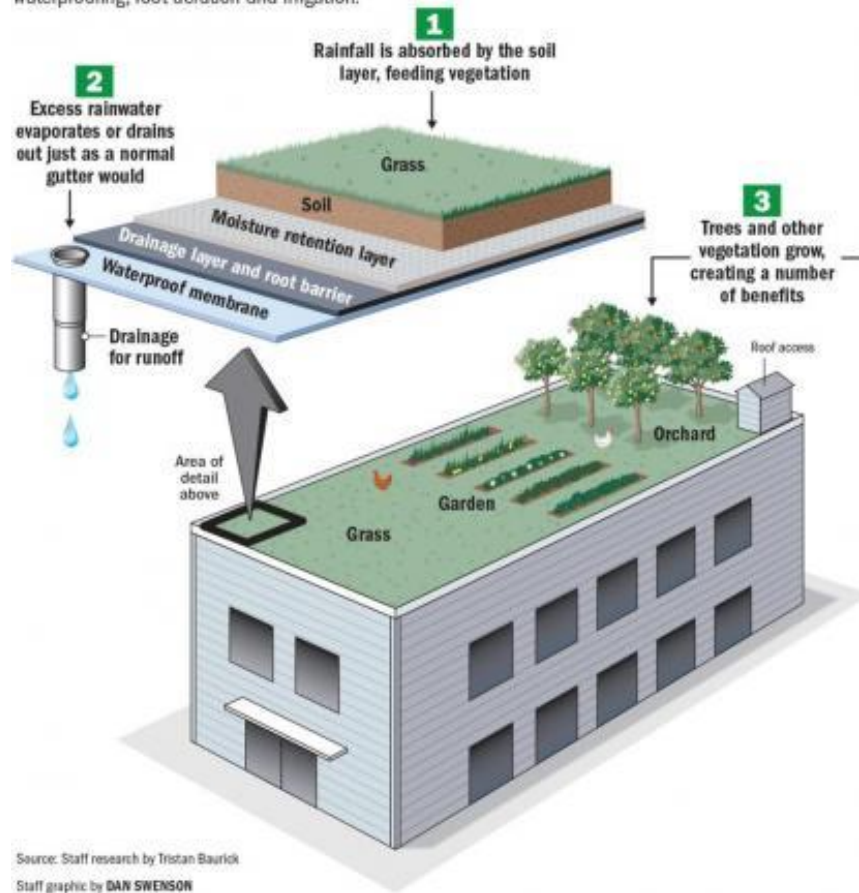
Water Resources

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How a green roof works

The city of Rotterdam has turned more than 100 acres of rooftop green over the past decade. A green roof has a top layer of soil and vegetation that captures rain and reduces the amount of water that flows onto streets and stormwater systems. It may also have additional layers for waterproofing, root aeration and irrigation.



Source: Staff research by Tristan Baurick
Staff graphic by DAN SWENSON

BENEFITS OF A GREEN ROOF

REDUCES STORMWATER RUNOFF: By holding rainwater like a sponge, green roofs ease street flooding and pressure on aging, overwhelmed stormwater systems. Retaining water allows excess moisture to evaporate or slowly drain.

COOLS URBAN AREAS: Green roofs can provide shade and reduce indoor and outdoor temperatures by adding pervious, moist surfaces in areas dominated by streets and other concrete surfaces. Green roof temperatures are typically 30°F lower than conventional roofs and reduce ambient temperatures by 5°F.

REDUCES ENERGY USE: By reducing rooftop temperatures and acting as insulators for buildings, they can cut energy use by 7% in summer and 3% in winter.

CREATES HABITAT: They offer an oasis for plants and animals in urban areas where natural spaces are limited.

PRODUCES FOOD: From vegetable gardens to chicken coops, green roofs can accommodate a variety of food-growing enterprises.

INCREASES ROOF LIFESPAN: They can cut down on maintenance and replacement costs by decreasing the roof's exposure to storms, temperature fluctuations and sun damage.



Sequía(2014/2016)

Embalse Cerrillos 8 de julio del 2014. Fotos tomadas por Gaspar Pons Cintrón, Oficial de Manejo del Embalse Cerrillos. Suministradas por: División de Monitoreo del Plan de Aguas y del Negociado de Costas, Reservas y Refugios del Departamento de Recursos Naturales.

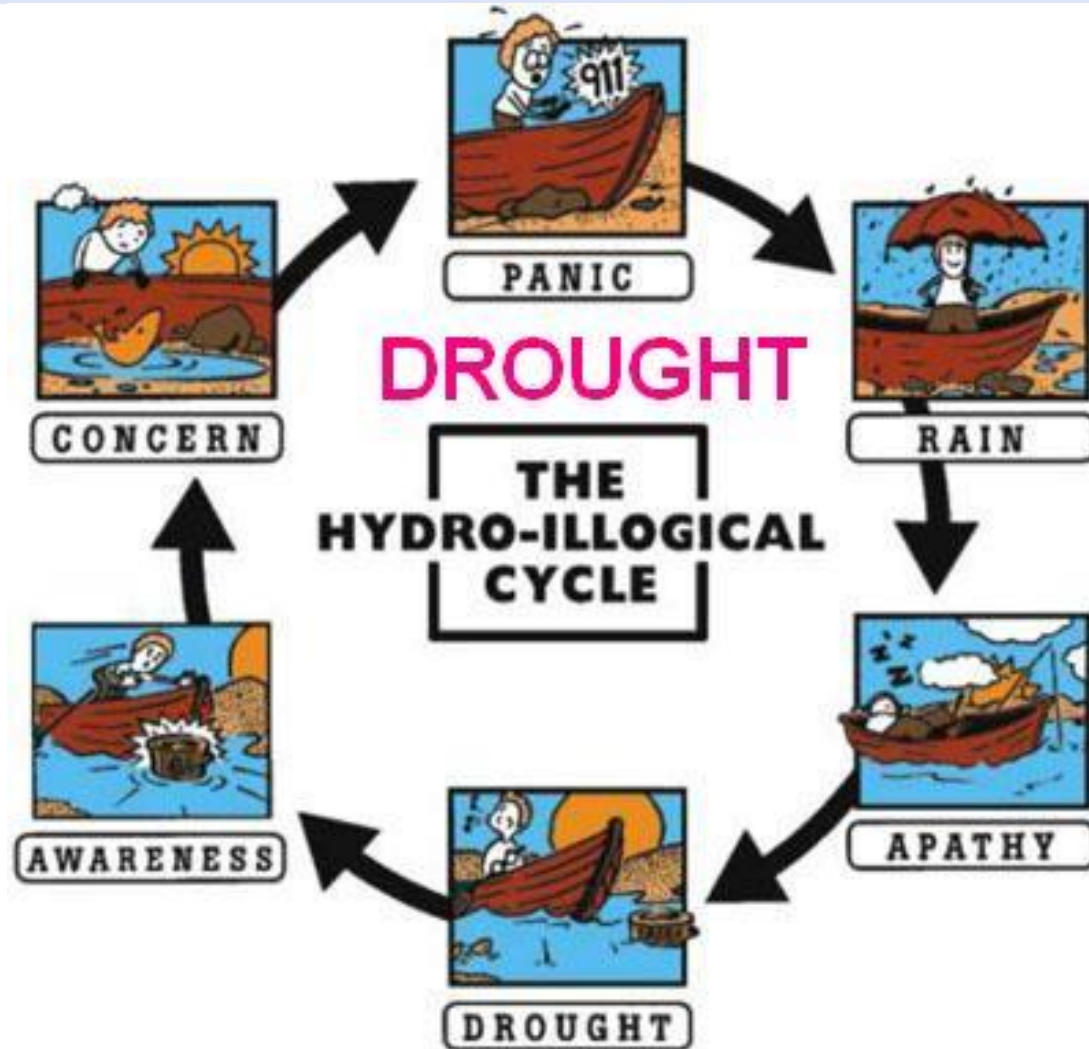


Embalse la Plata 2 de julio del 2014 y Embalse Carraízo 1 de agosto del 2014.

Fotos tomadas y suministradas por: División de Monitoreo del Plan de Aguas y del Negociado de Costas, Reservas y Refugios del Departamento de Recursos Naturales.



Hydro-Illogical Cycle

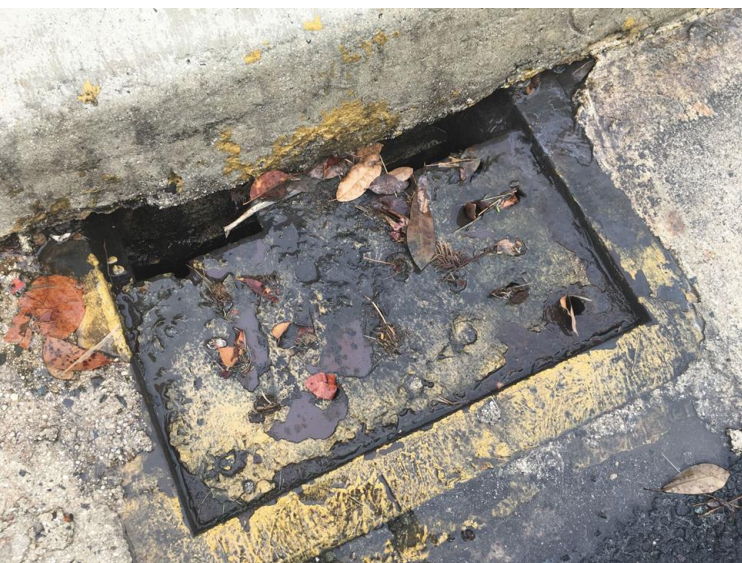


HISTERIA



COLECTIVA!!





Sargassum

DECLARED JULY 25, 2022

SUMMARY

TERRITORY: U.S. Virgin Islands

NUMBER: FEMA-3581-EM

INCIDENT: Water Shortage and Health Impact from Unprecedented Sargassum Seagrass Influx

INCIDENT PERIOD: July 15, 2022, and continuing

DATE REQUESTED BY GOVERNOR: July 23, 2022

FEDERAL COORDINATING OFFICER: Patrick Cornbill
National FCO Program

DESIGNATIONS AND TYPES OF ASSISTANCE:

The Department of Homeland Security, Federal Emergency Management Agency (FEMA), is authorized to provide appropriate assistance for required emergency measures, authorized under Title V of the Stafford Act, to save lives and to protect property and public health and safety, or to lessen or avert the threat of a catastrophe in the designated areas. Specifically, FEMA is authorized to provide emergency protective measures (Category B), limited to direct federal assistance, under the Public Assistance for a period of 90 days.

This assistance is for the island of St. Croix.

ENVIRONMENT

A record amount of seaweed is choking shores in the Caribbean

August 3, 2022 · 11:00 AM ET

THE ASSOCIATED PRESS



THE WHITE HOUSE



Make our infrastructure resilient against the impacts of climate change, cyber-attacks, and extreme weather events.

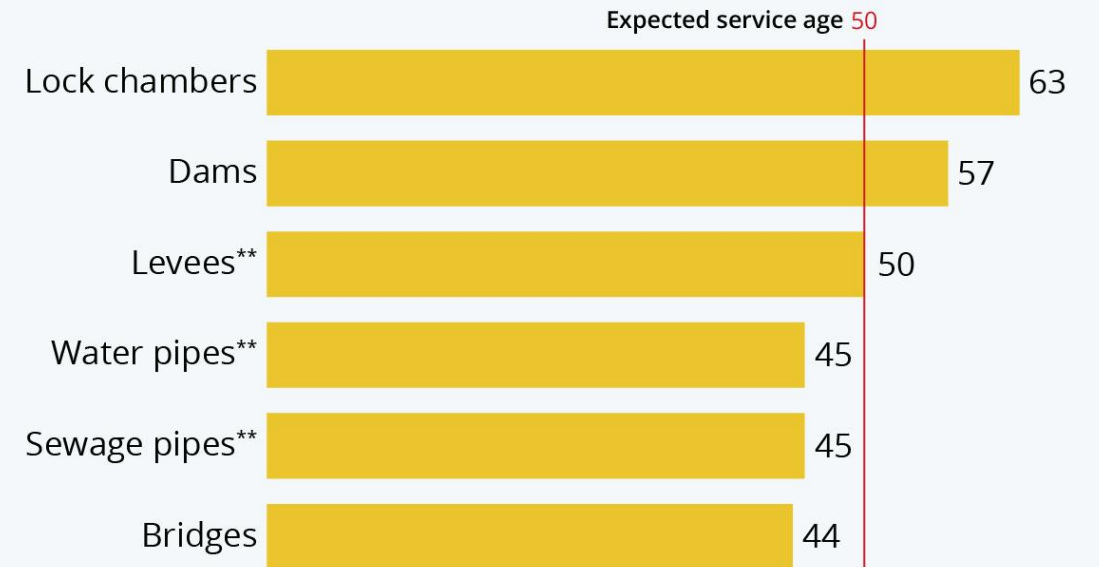
THE WHITE HOUSE



PRESIDENT BIDEN'S BIPARTISAN INFRASTRUCTURE LAW

The Age of American Infrastructure

Average age of different types of infrastructure in the U.S. 2020-2021* (in years)



* lock chambers: 2017 ** 50-100 years for some

Sources: American Society of Civil Engineers, U.S. Army Corps of Engineers



statista

LAUNCH EVENT



International Guidelines on NNBF for Flood Risk Management

16 September 2021
10 AM US CT

Engineering With Nature®

AN ATLAS, VOLUME 2



Questions!

Environmental Health Department

Graduate School of Public Health

University of Puerto Rico-Medical Sciences Campus

[PR-CLIMAH \(Puerto Rico Climate and Health Research Group\)](#)

Principal Investigator: NASA Grant Number
80NSSC19K0194

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Space and Earth Science (ROSES-2020), Program
Element A.28 Rapid Response and Novel Research in
Earth Science (RRNES).