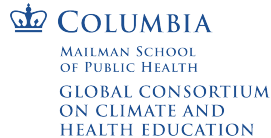


Caribbean Climate and Health Responders Course

Temperature Related Illness and Mortality- April 28, 2022

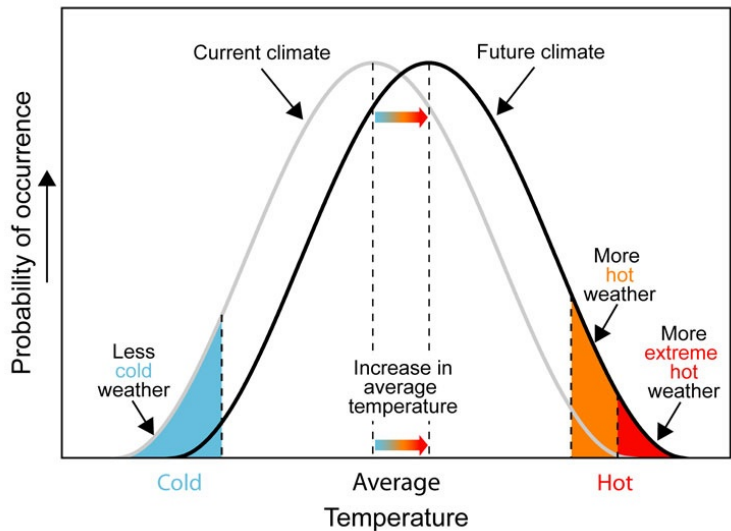
Pablo A. Méndez-Lázaro Ph.D
University of Puerto Rico
Medical Sciences Campus
Environmental Health Department



Learning Objectives

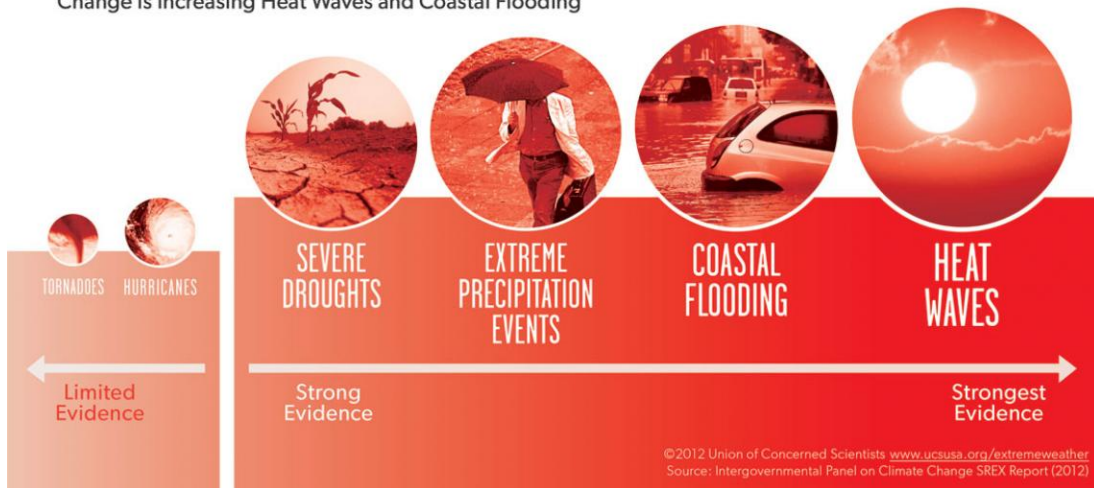
- Upon completion of this course, students will be expected to:
- Understand connections among climate, extreme heat, human health and well-being.
- Understand climate change, extreme heat and impacts on socio-ecological system.
- Understand hazards, risks and vulnerabilities to extreme heat in a changing climate.

Future Climate Shift



SCIENCE CONNECTIONS → EXTREME WEATHER & CLIMATE CHANGE

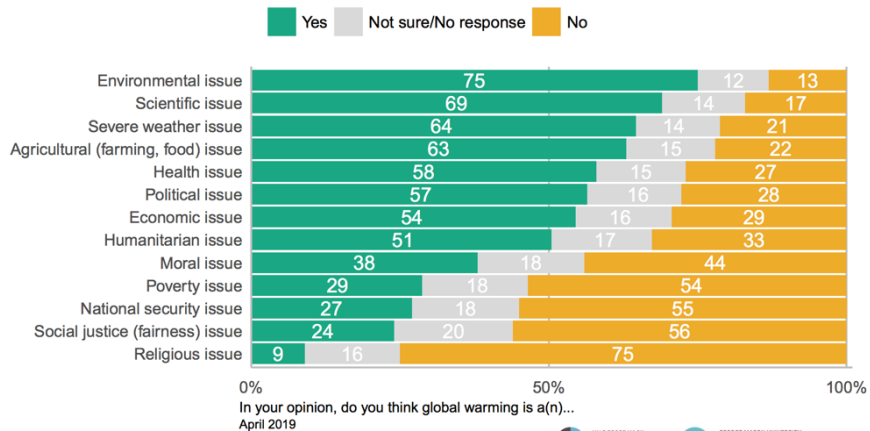
→ Strongest Scientific Evidence Shows Human-Caused Climate Change Is Increasing Heat Waves and Coastal Flooding



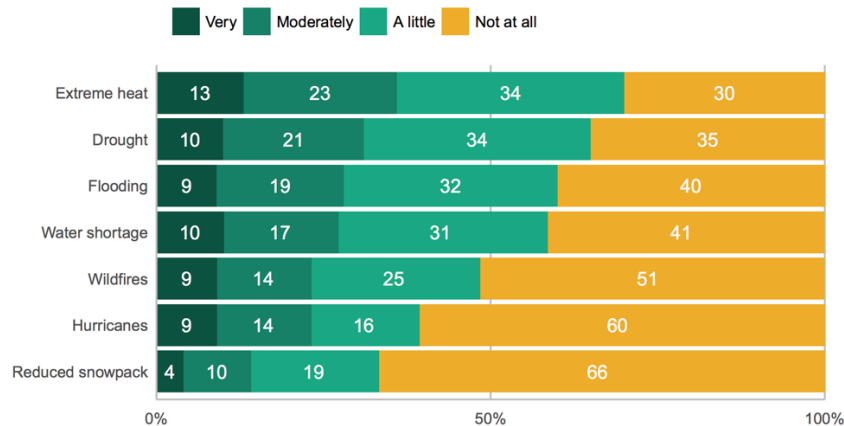
© 2012 Union of Concerned Scientists www.ucsusa.org/extremeweather
Source: Intergovernmental Panel on Climate Change SREX Report (2012)

Climate Change in the American Mind: April 2019

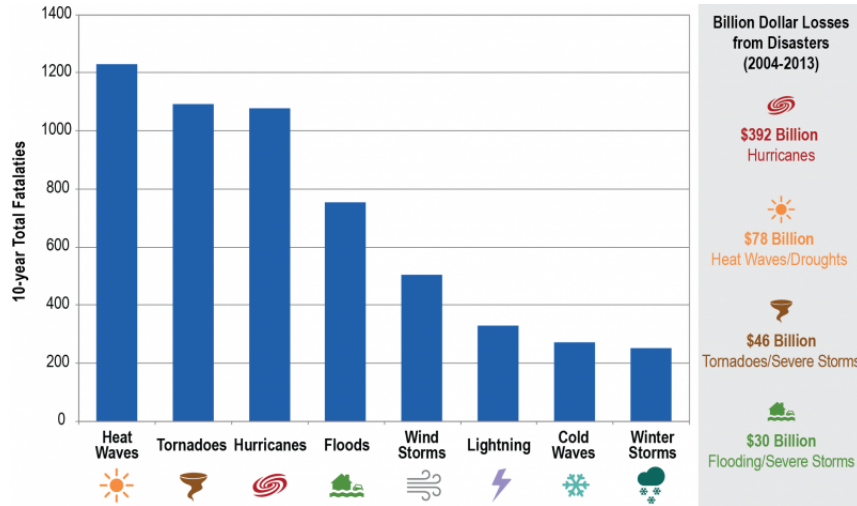
Americans are most likely to think of global warming as an environmental and/or scientific issue



A majority of Americans are worried about harm from extreme events in their local area



Temperature Related Illness and Mortality

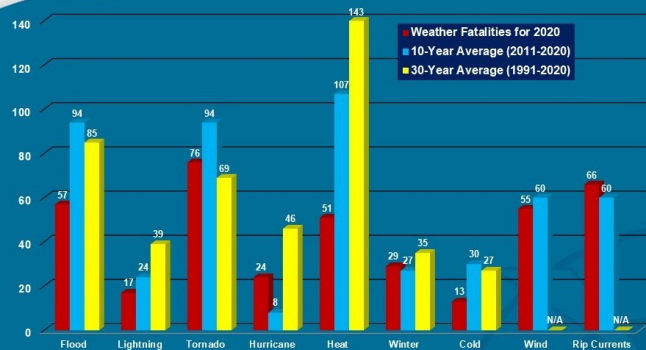


“ IF YOU HAVE A NATURAL DISASTER LIKE A CYCLONE OR AN EARTHQUAKE OR A FLOOD... THINGS GET WASHED AWAY, PEOPLE DROWN. BUT HEAT IS A SILENT KILLER. ”

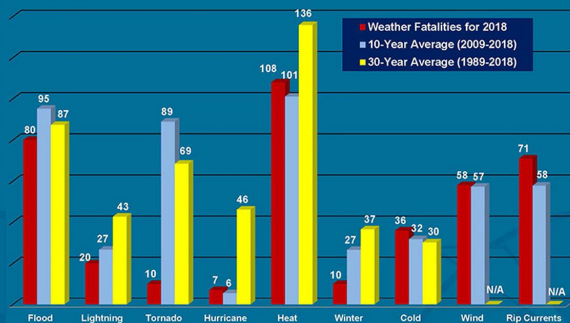
SARAH PERKINS-KIRKPATRICK, A CLIMATE CHANGE RESEARCHER AT AUSTRALIA'S UNIVERSITY OF NEW SOUTH WALES

Temperature Related Illness and Mortality

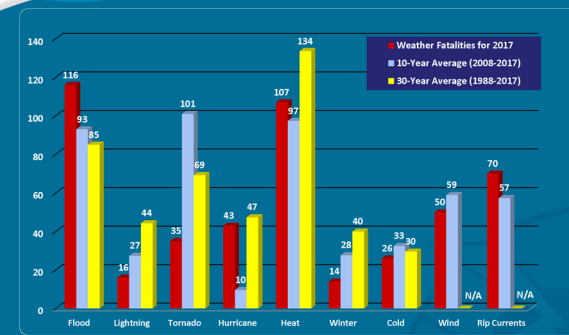
Weather Fatalities 2020



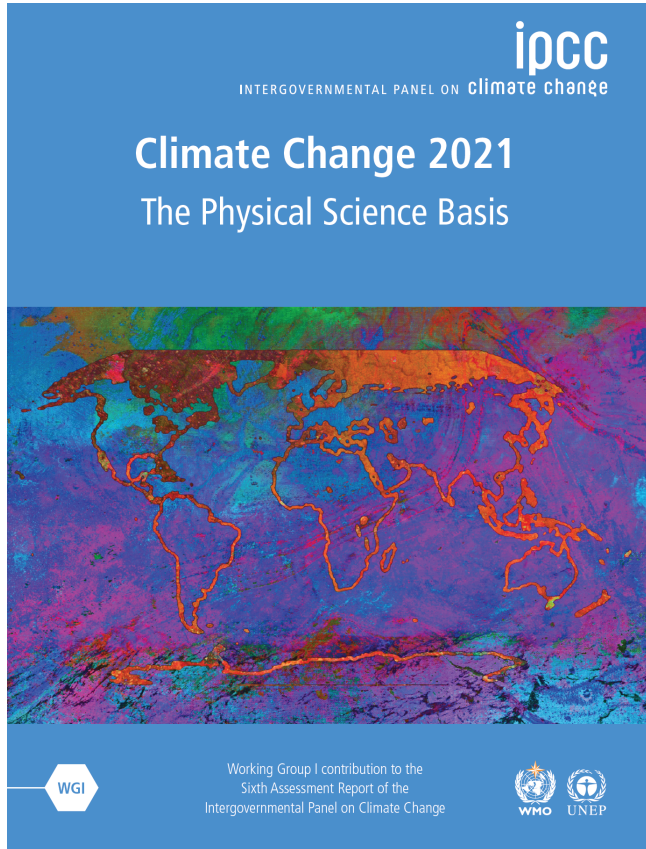
Weather Fatalities 2018



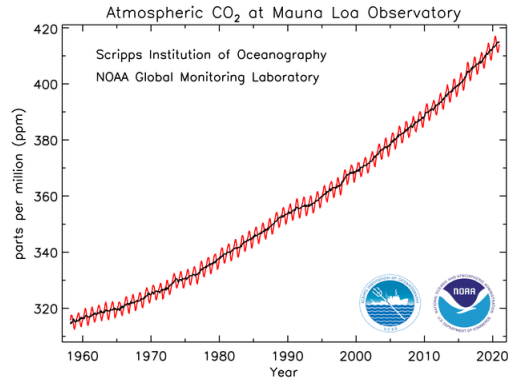
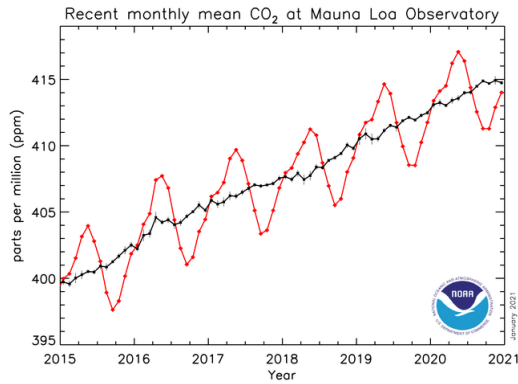
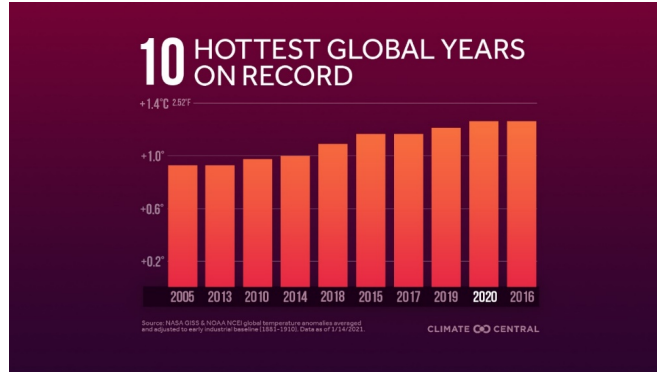
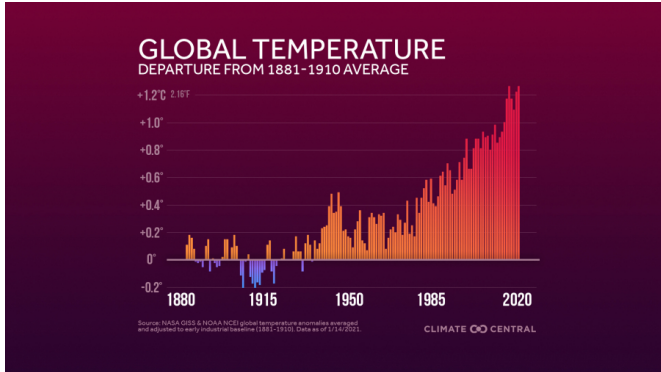
Weather Fatalities 2017



Extreme Heat in the Caribbean under climate change scenarios



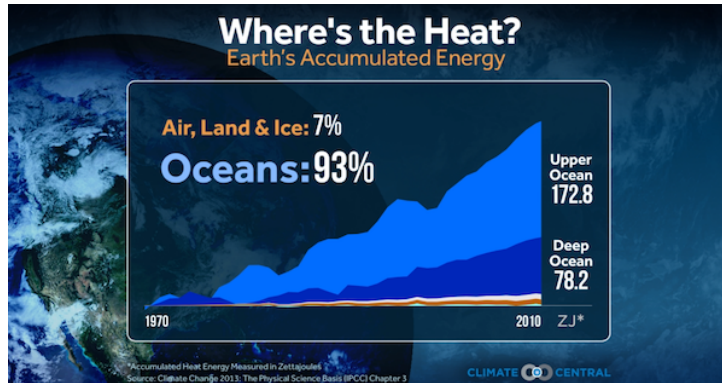
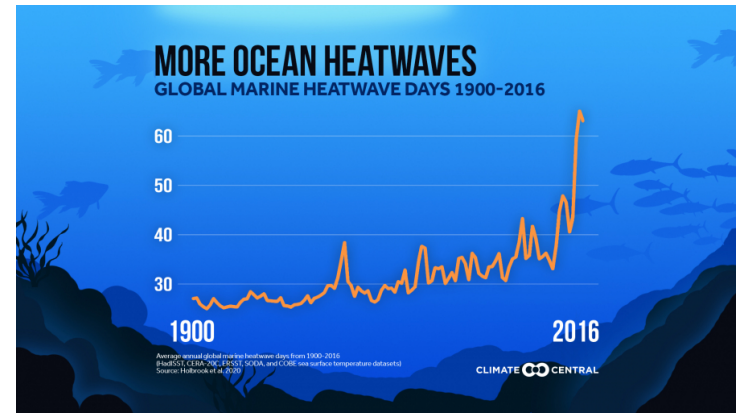
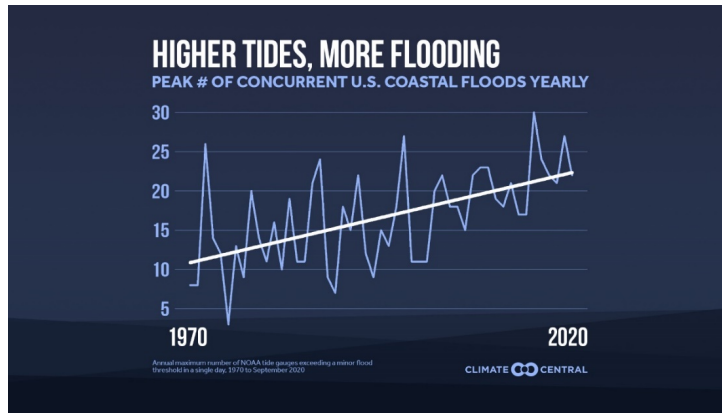
Many of the changes observed in the climate are **unprecedented** in thousands, if not hundreds of thousands of years, and some of the changes already set in motion—such as continued sea level rise—are **irreversible** over hundreds to thousands of years.



Scientists say temperatures globally at highest level since start of human civilization

There is a question on how humans, animals and plants that have established themselves in a particular location can adapt to higher average temperatures (Tomlinson et al. 2011).





Analysis of ocean surface temperatures shows human-driven climate change has put the world in “uncharted territory”, the scientists say. The planet may even be at its warmest for 125,000 years, although data on that far back is less certain.

“Seasonal origin of the thermal maxima at the Holocene and the last interglacial”

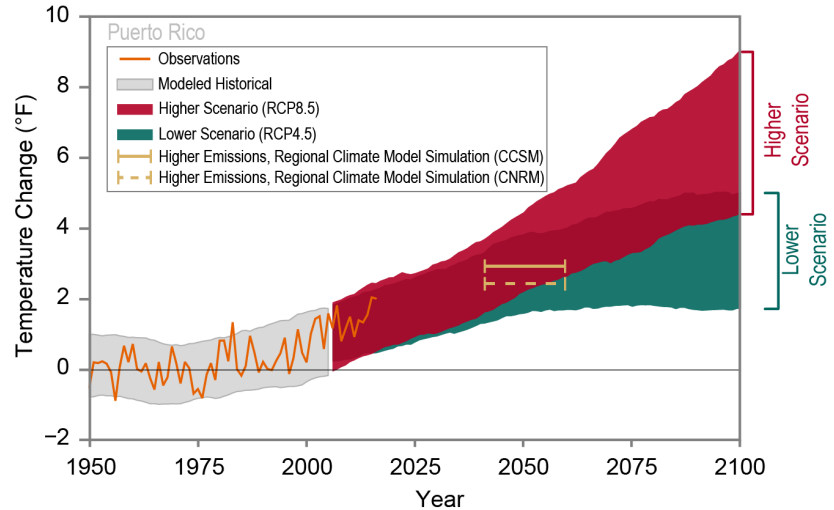
January 2021 Nature 589(7843):548-553

DOI: 10.1038/s41586-020-03155-x

Extreme Temperatures

4th Nat. Climate Assessment

- Key Message 4: Natural and social systems adapt to the temperatures under which they evolve and operate.
- Changes to average and extreme temperatures have direct and indirect effects on organisms and strong interactions with hydrological cycles, resulting in a variety of impacts.
- Continued increases in average temperatures will likely lead to decreases in agricultural productivity, changes in habitats and wildlife distributions, and risks to human health, especially in vulnerable populations.
- As maximum and minimum temperatures increase, there are likely to be fewer cool nights and more frequent hot days, which will affect the quality of life in the U.S. Caribbean.
- <https://nca2018.globalchange.gov/chapter/20/>



Extreme Heat in the Caribbean under climate change scenarios



"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)

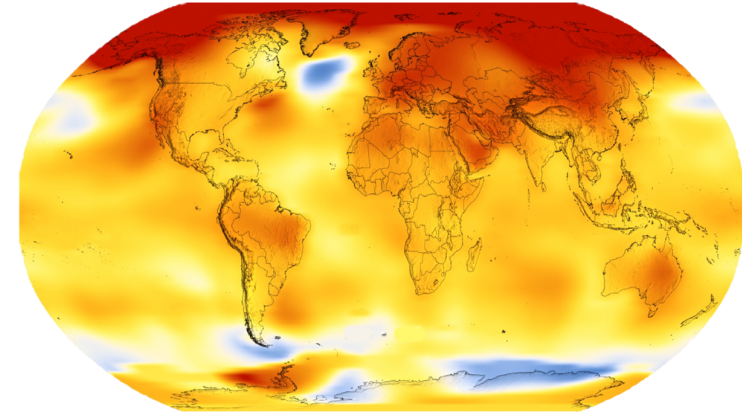


NEWS | March 22, 2018

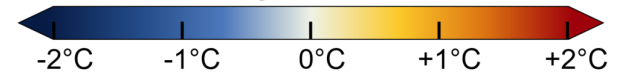
Scientists assess potential for super greenhouse effect in Earth's tropics



Temperature Change in the Last 50 Years



2014-2018 average vs 1951-1980 baseline



PR=CLIMAH
THIS IS PUBLIC HEALTH

CLIMATOLOGY

The emergence of heat and humidity too severe for human tolerance

Colin Raymond^{1,2*}, Tom Matthews³, Radley M. Horton^{2,4}

Humans' ability to efficiently shed heat has enabled us to range over every continent, but a wet-bulb temperature (TW) of 35°C marks our upper physiological limit, and much lower values have serious health and productivity impacts. Climate models project the first 35°C TW occurrences by the mid-21st century. However, a comprehensive evaluation of weather station data shows that some coastal subtropical locations have already reported a TW of 35°C and that extreme humid heat overall has more than doubled in frequency since 1979. Recent exceedances of 35°C in global maximum sea surface temperature provide further support for the validity of these dangerously high TW values. We find the most extreme humid heat is highly localized in both space and time and is correspondingly substantially underestimated in reanalysis products. Our findings thus underscore the serious challenge posed by humid heat that is more intense than previously reported and increasingly severe.

INTRODUCTION

Humans' bipedal locomotion, naked skin, and sweat glands are constituents of a sophisticated cooling system (1). Despite these thermoregulatory adaptations, extreme heat remains one of the most dangerous natural hazards (2), with tens of thousands of fatalities in

exceed 35°C in parts of South Asia and the Middle East by the third quarter of the 21st century (14–16).

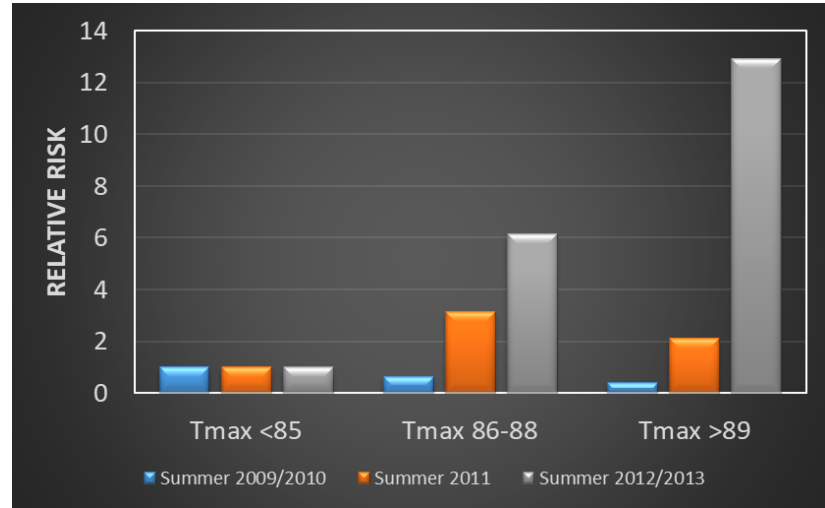
Here, we use quality-assured station observations from HadISD (17, 18) and high-resolution reanalysis data from ERA-Interim (19, 20), verified against radiosondes and marine observations (see

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Temperature Related Illness and Mortality

Higher frequency, duration, and intensity of extreme heat episodes are triggering public health issues in most mid-latitude and continental cities.

Results show a significant increase in the effect of high temperatures on mortality, during the summers of 2012 and 2013.



Mendez-Lazaro, P; Perez-Cardona, C; Rodriguez, E.; Martinez, O; Taboas, M; Bocanegra, A; Mendez-Tejeda, R. 2016. **Climate change, heat, and mortality in the tropical urban area of San Juan, Puerto Rico**. International Journal of Biometeorology. DOI 10.1007/s00484-016-1291-z



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

SEPTEMBER 20, 2021 • STATEMENTS AND RELEASES

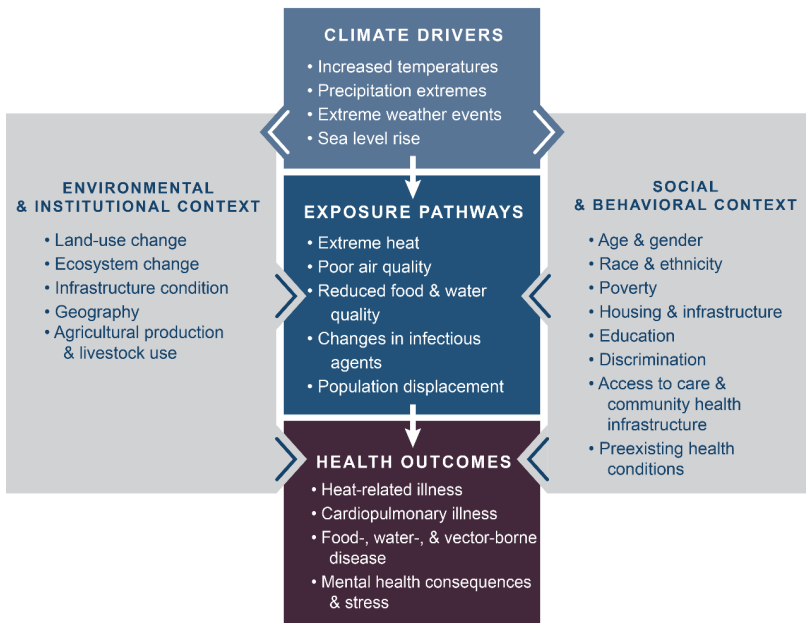
New Initiatives at OSHA and Across Agencies Will Enhance Workplace Safety, Build Local Resilience, and Address Disproportionate Heat Impacts

Today, President Biden is launching a coordinated, interagency effort to respond to extreme heat that threatens the lives and livelihoods of

Interactions with social-
environmental conditions

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

Climate Change and Health



Ecosystems

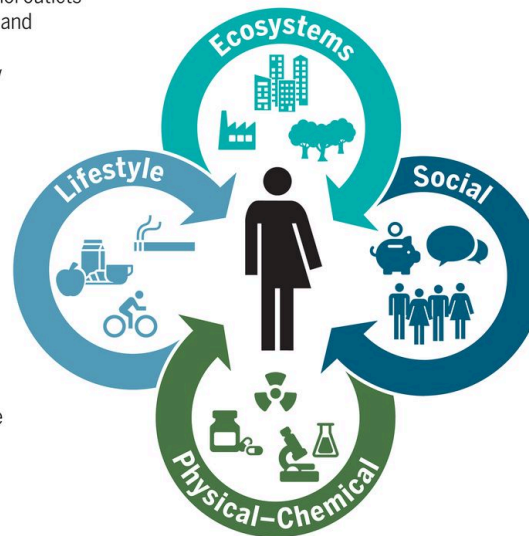
Food outlets, alcohol outlets
 Built environment and urban land uses
 Population density
 Walkability
 Green/blue space

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

Climate change

Vulnerability

Vulnerability factors

- Demographic factors
- Geographic factors
- Biological factors & health status
- Sociopolitical conditions
- Socioeconomic factors

Exposure pathways

- Extreme weather events
- Heat stress
- Air quality
- Water quality and quantity
- Food security and safety
- Vector distribution & ecology

Health system capacity & resilience

- Leadership & governance
- Health workforce
- Health information systems
- Essential medical products & technologies
- Service delivery
- Financing

Climate-sensitive health risks

Health outcomes



Injury and mortality from extreme weather events



Heat-related illness



Respiratory illness



Water-borne diseases and other water-related health impacts



Zoonoses



Vector-borne diseases



Malnutrition and food-borne diseases



Noncommunicable diseases (NCDs)



Mental and psychosocial health

Health systems & facilities outcomes



Impacts on healthcare facilities



Effects on health systems

Population at risk



Curso On Line Internacional 

Estrés por Calor en Ganado Lechero:

Impactos y Mitigación

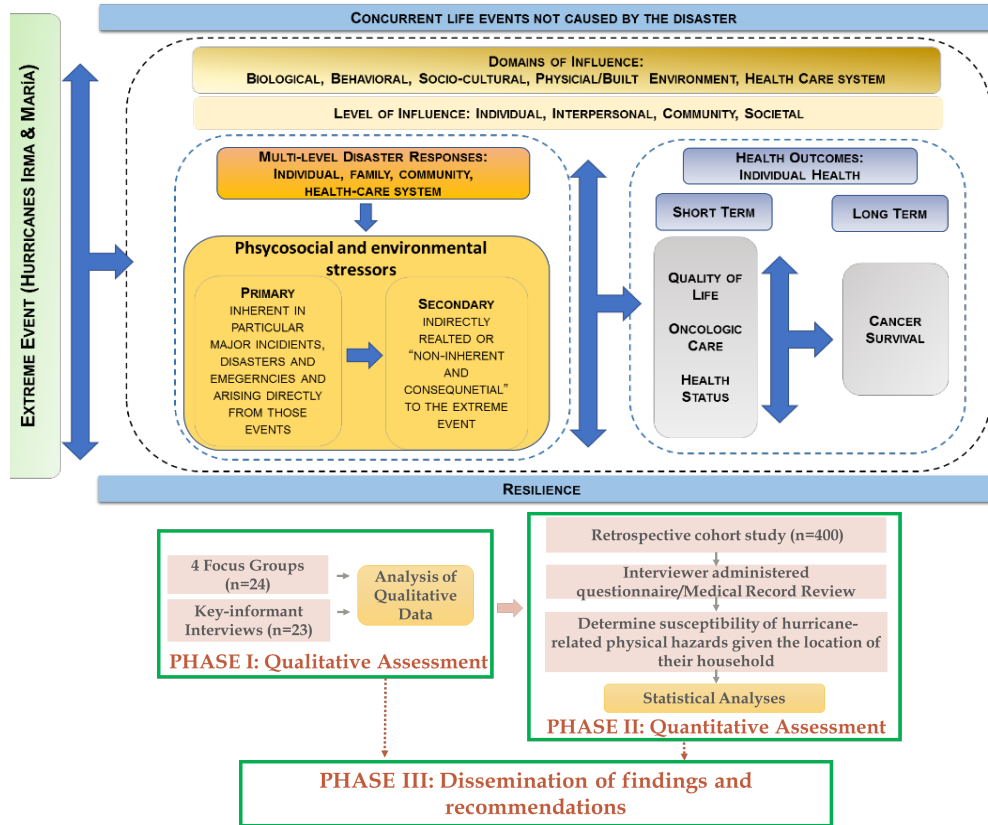
30 octubre al 13 diciembre 2013
A Distancia (Via Internet)



BUILDER

Extreme Heat in the Caribbean Case Studies in Puerto Rico

Impact of Hurricane-Related Stressors and Responses on Oncology Care and Health Outcomes of Women with Gynecologic Cancers from Puerto Rico and US Virgin Islands (*NCI Grant #R21CA239457*)



4G LTE 71% 12:05 PM

San Juan 88°

NOTICEL

CORREA COMPRE ONLINE www.correatr.com

English

With heat, misery rising, Puerto Ricans fear months of shortages

Signs of desperation showing

By:
MALLORY SIMON
RACHEL CLARKE
JASON KRAVARIK
JENNIFER RIVERA
RAFAEL ROMO
LEYLA SANTIAGO
MONICA SERRANO
BRIAN VITAGLIANO AND BILL WEIR
CNN

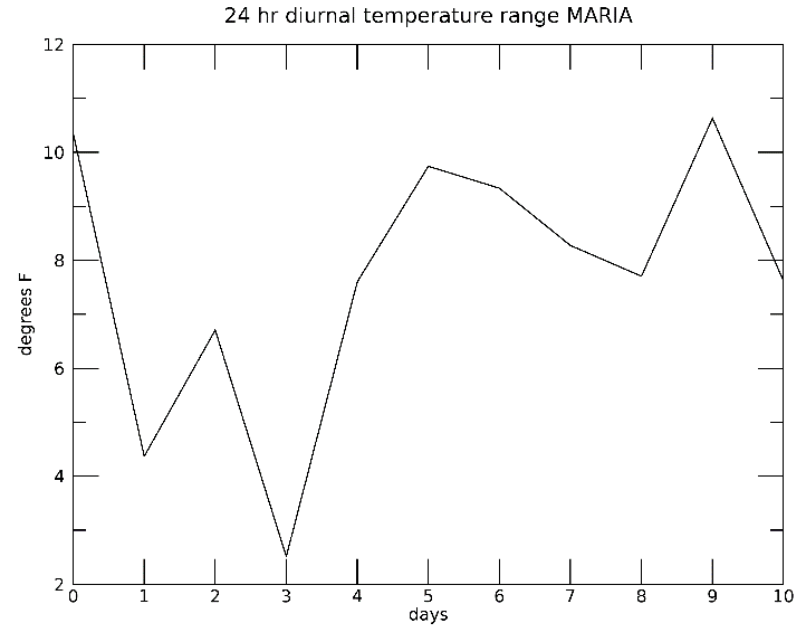
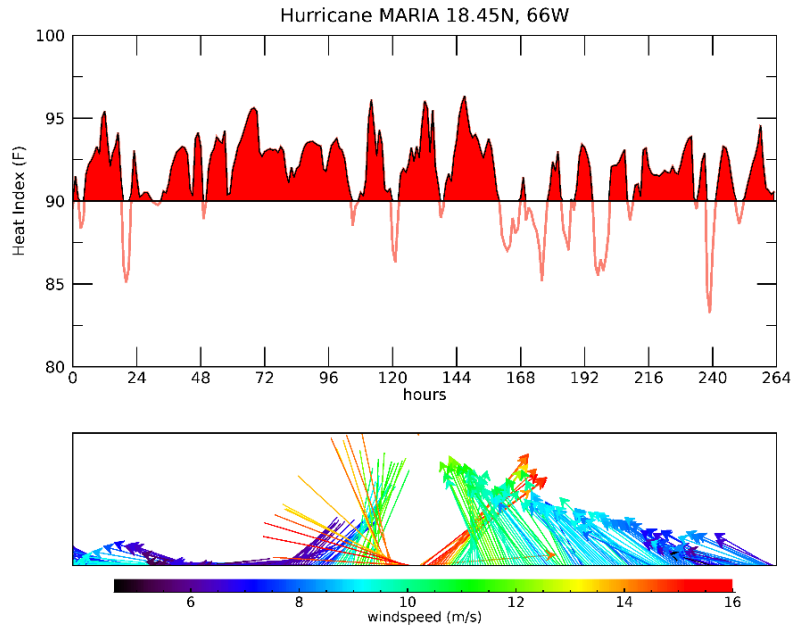
Posted: Sep 26, 2017 03:25 PM AST
Updated: Sep 27, 2017 09:16 AM AST

Impact of Hurricane-Related Stressors and Responses on Oncology Care and Health Outcomes of Women with Gynecologic Cancers from Puerto Rico and US Virgin Islands

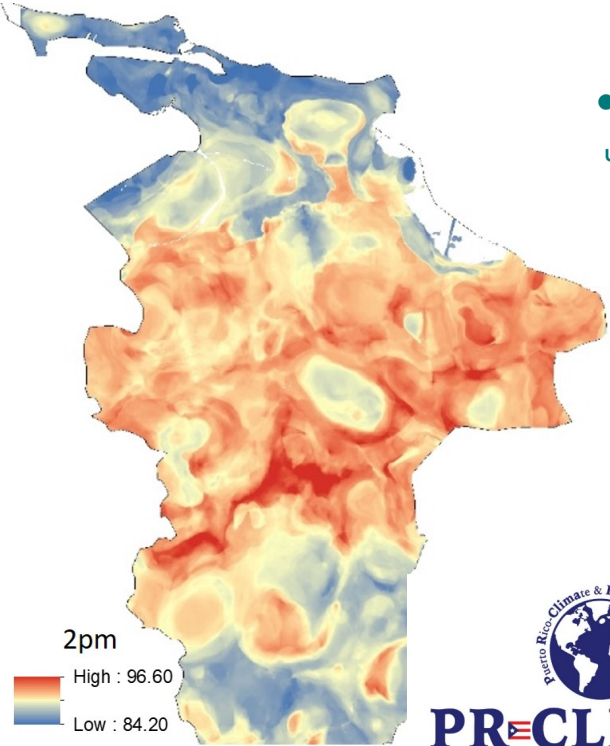
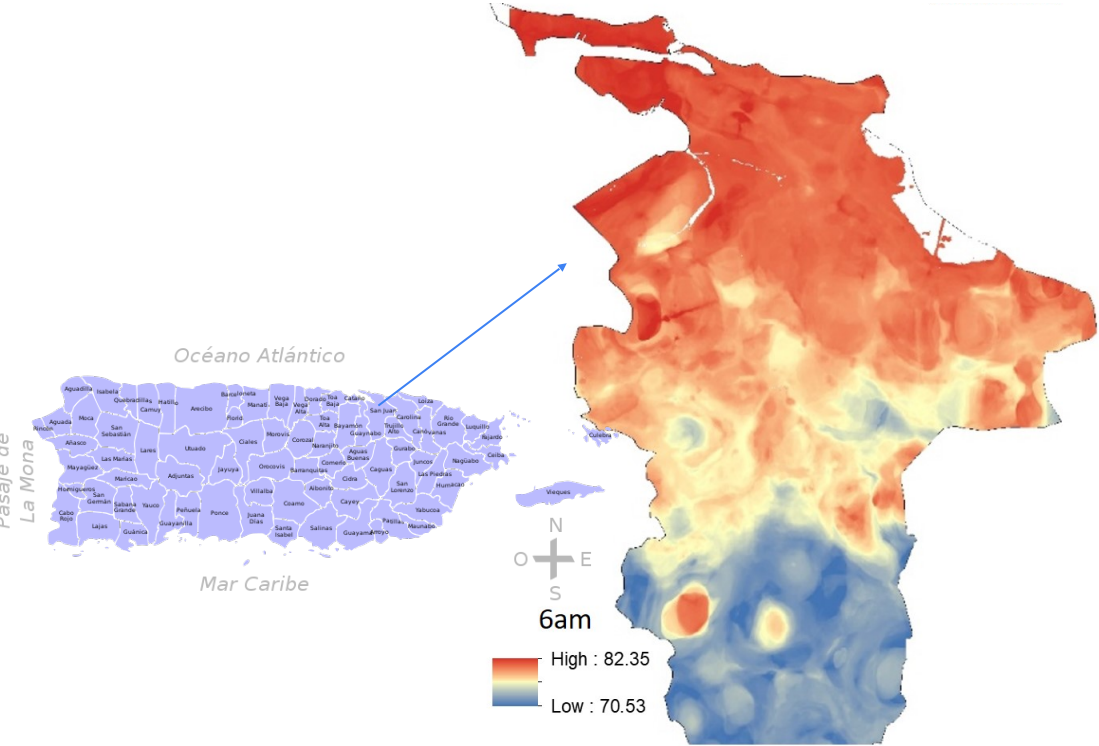
NCI Grant #R21CA239457



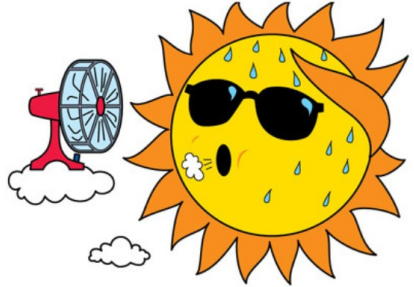
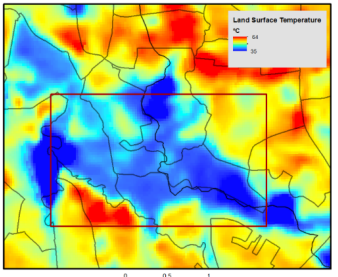
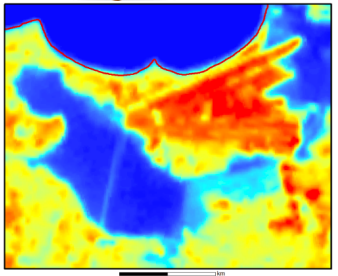
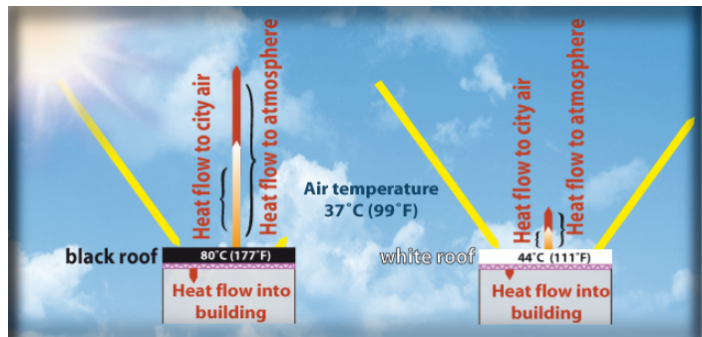
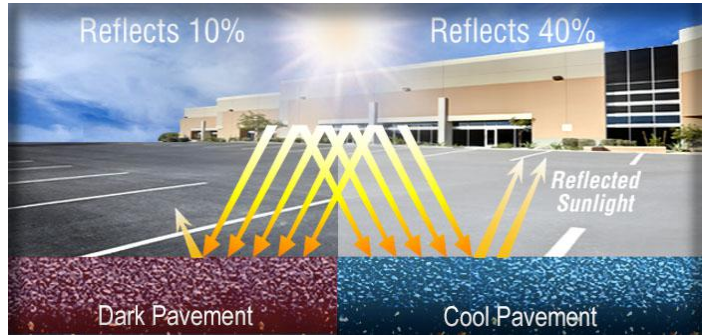
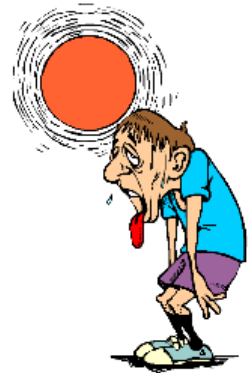
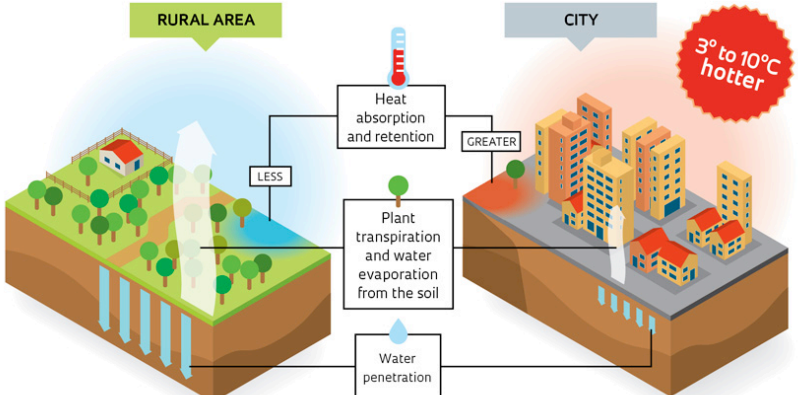
NOAA: Building Knowledge about the Intersections of Public Health Issues, Hurricanes, and Heat



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



Why the urban heat island effect occurs



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.

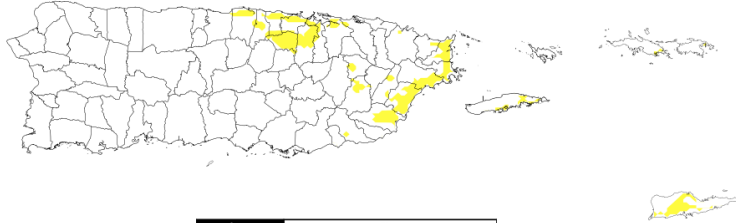
Beginning on June 1st 2018, **Heat Advisories** and **Excessive Heat Warnings** will be issued by WFO San Juan.

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.

https://www.weather.gov/sju/heat_risk

Heat Threat

Valid from 6 AM AST Oct 07, 2021 to 6 PM AST Oct 07, 2021



Threat	Heat
SLIGHT	Heat Index of 102 to 107 degrees possible.
MODERATE	Heat Index of 108 to 111 degrees possible.
HIGH	Heat Index of 112 or greater possible.



National Weather Service
San Juan, PR
10/07/2021 07:11 GMT

Follow Us:   
weather.gov/sju

*The criteria listed above was a collaboration between WFO San Juan and Department of Environmental Health, University of Puerto Rico - Medical Sciences Campus. / El criterio mencionado anteriormente fue una colaboración entre WFO San Juan y el Departamento de Salud Ambiental, Universidad de Puerto Rico - Recinto de Ciencias Médicas.

Méndez-Lázaro P, Muller-Karger FE, Otis D, McCarthy MJ, Rodríguez E. A heat vulnerability index to improve urban public health management in San Juan, Puerto Rico. *Int J Biometeorol.* 2017 Feb 17. doi:10.1007/s00484-017-1319-z.

Méndez-Lázaro PA, Pérez-Cardona CM, Rodríguez E, Martínez O, Taboas M, Bocanegra A, Méndez-Tejeda R. Climate change, heat, and mortality in the tropical urban area of San Juan, Puerto Rico. *Int J Biometeorol.* 2016 Dec 15. doi:10.1007/s00484-016-1291-z

Méndez-Lázaro P, Martínez-Sánchez O, Méndez-Tejeda R, Rodríguez E, Morales E, et al. (2015) Extreme Heat Events in San Juan Puerto Rico: Trends and Variability of Unusual Hot Weather and its Possible Effects on Ecology and Society. *J Climatol Weather Forecasting* 3: 135. doi:10.4172/2332-2594.1000135

Heat Safety

Stay cool, stay hydrated, and stay informed!

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

Relative Humidity (%)

Air Temperature °F	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

Temperature Related Illness and Mortality

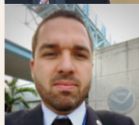
WEBINAR: EXTREME HEAT AND PUBLIC HEALTH

Friday, June 11th, 2021 | 2:30 PM - 3:30 PM AST



Ernesto Morales

Warning Coordination Meteorologist, NWS



Ernesto Rodríguez

Science and Operations Officer, NWS



Dr. Pablo Méndez-Lázaro

Investigator, UPR Medical Campus

Moderators:



Emanuel Rodríguez (left)
Fernanda Ramos (right)

National Weather Service | San Juan, Puerto Rico



SEMINARIO: CALOR EXTREMO Y SALUD PÚBLICA

viernes, 11 de junio de 2021 | 1:00 PM - 2:00 PM AST



Ernesto Morales

Meteorólogo de Cordinación de Avisos, SNM



Ernesto Rodríguez

Oficial de Ciencias y Operaciones, SNM



Dr. Pablo Méndez-Lázaro

Investigador, UPR Recinto de Ciencias Médicas

Moderadores:



Emanuel Rodríguez (izq.)
Fernanda Ramos (der.)

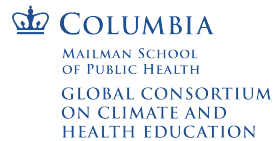
National Weather Service | San Juan, Puerto Rico



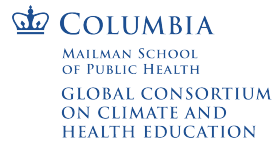
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Zoom Poll Question 1



Zoom Poll Question 2



Open-ended question

