

***“A Climate Conversation”***  
webinar will begin shortly

To avoid interference, please move cell phones and pagers away from your conference phonenumber

We welcome your questions and comments during the conversation via chat, and will open the conversation for all following the slide presentation.

voice line:  
800.779.9619 Passcode: 2696066#

## A Climate Conversation



**Trucks Carrying Hurricane Relief  
Supplies Await Distribution  
Instructions at NASA's  
Stennis Space Center**



***Olga Dominguez***

AA for Strategic Infrastructure  
NASA's Strategic Sustainability Officer

**Climate Projections for Washington, DC**



**Dan Bader**



Goddard Institute for Space Studies



Climate Adaptation Science Investigators (CASI) Working Group

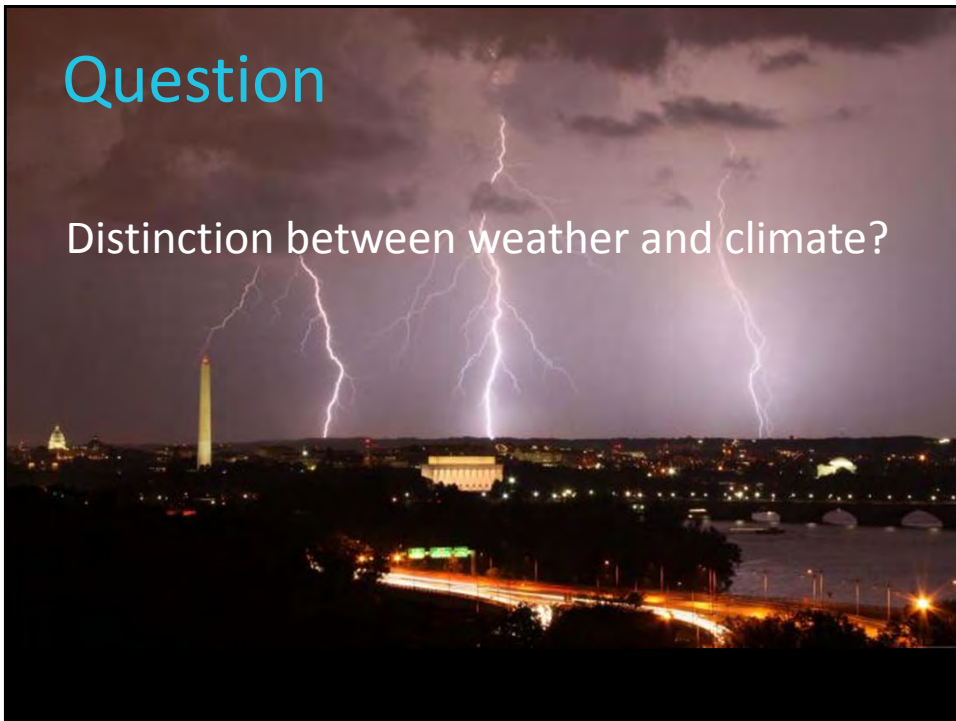
## Responding to Climate Risks

*Mitigate* to reduce our impact on natural systems...  
...and *adapt* where we nevertheless expect impacts.



## Question

Distinction between weather and climate?

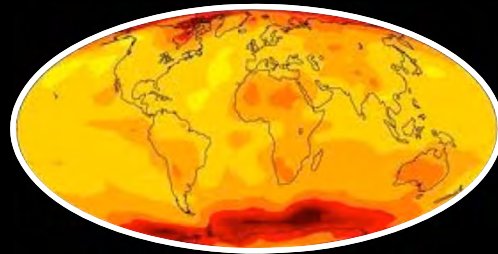


## Comparing Weather and Climate

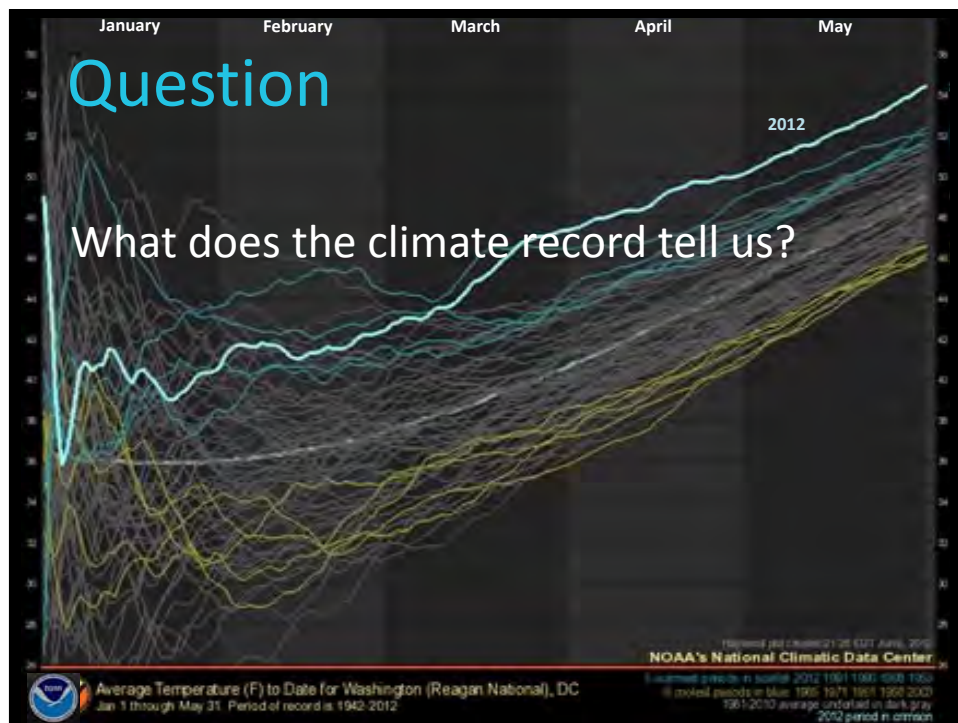
**Weather** describes current and near-term conditions



**Climate** describes weather patterns over a longer term

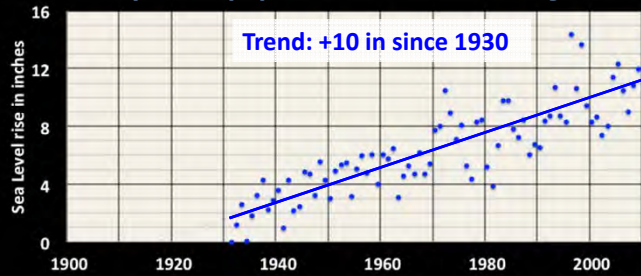


*"Weather is what you get; climate is what you expect."*

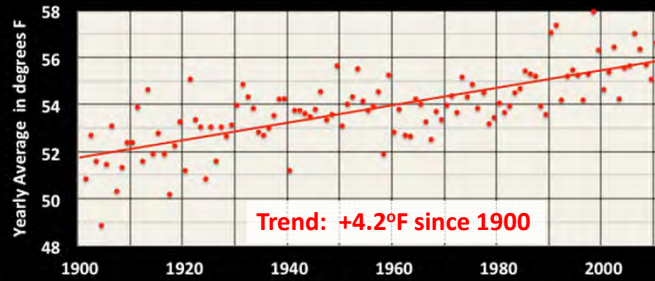


## What's already happened *locally*?

Sea Level  
has risen over decades, though individual years vary somewhat



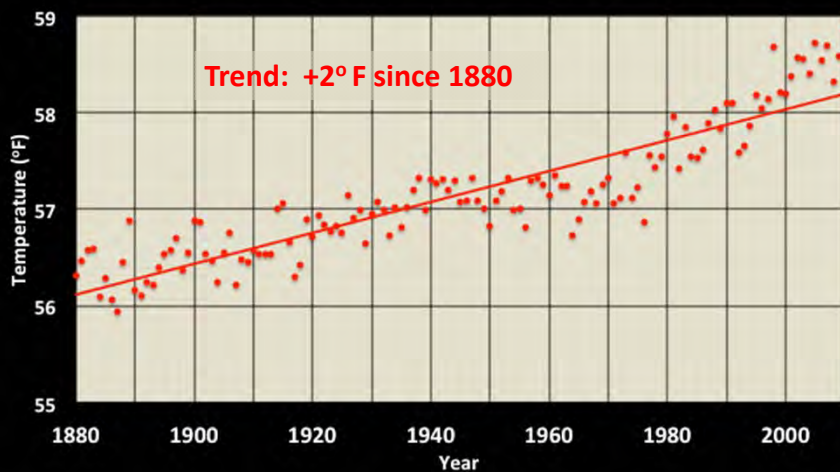
Temperature  
has risen too, but the trend varies more year-to-year



*A century of local data tells us the climate is changing*

## Part of a larger pattern?

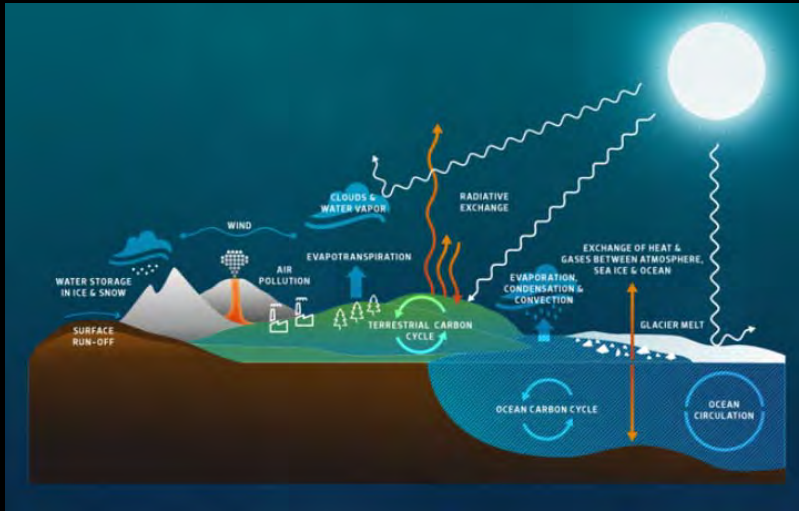
### Global Average Annual Temperature



*Observed local patterns reflect world-wide trends*



## Understanding interrelated systems



*This is more than just "heat in, heat out"...*

## Gathering better data



*NASA's orbital perspective is a critical vantage-point*

## Building on a strong foundation



*Powerful computer models let us test and refine hypotheses*

## Intergovernmental Panel on Climate Change

Three IPCC Synthesis Reports: 1995, 2001, and 2007. The 1995 report is titled 'The Science of Climate Change'. The 2001 report is titled 'Synthesis Report'. The 2007 report is titled 'SYNTHESIS REPORT' and features a world map. The IPCC logo and logos for WHO and UNEP are also visible.

**CLIMATE CHANGE 1995**  
The Science of Climate Change

**CLIMATE CHANGE 2001**  
Synthesis Report

**CLIMATE CHANGE 2007**  
SYNTHESIS REPORT

ipcc  
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

WHO UNEP

Consensus-based projections using

- Several models
- Several future greenhouse gas emission scenarios

Updated as the science advances

*NASA contributes to a worldwide consensus*

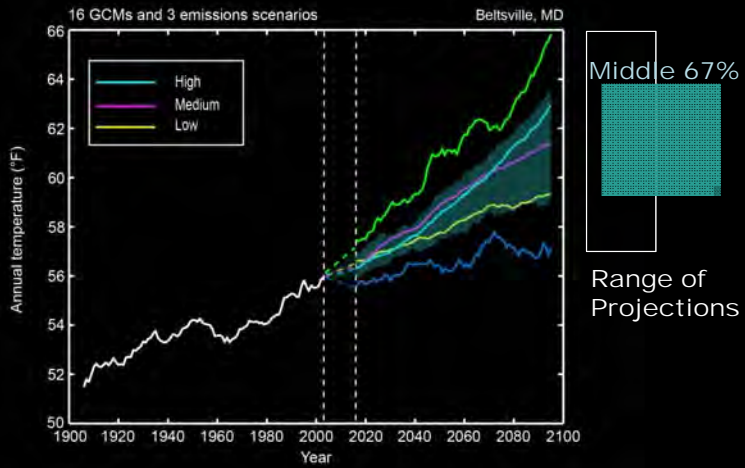


# Models and uncertainty

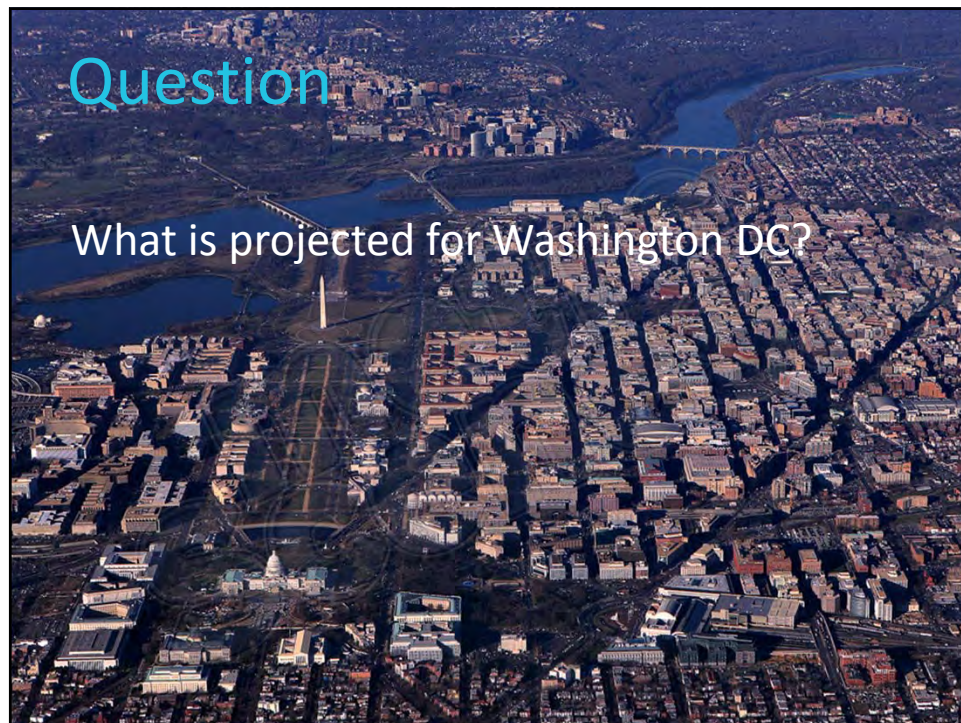
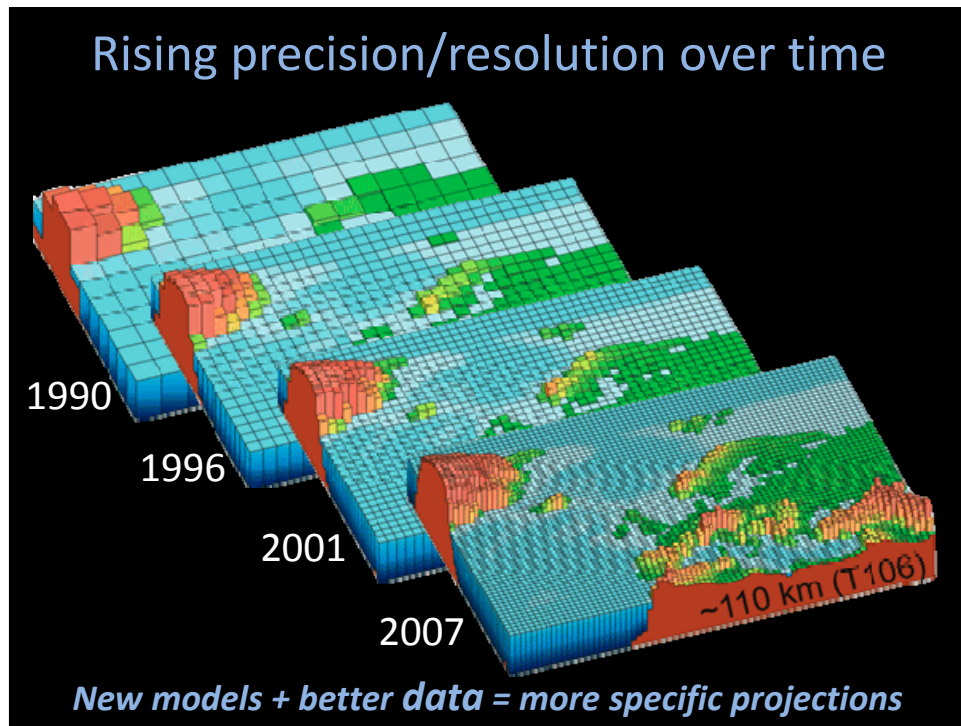


*Back-testing helps build confidence in model projections*

# IPCC Models

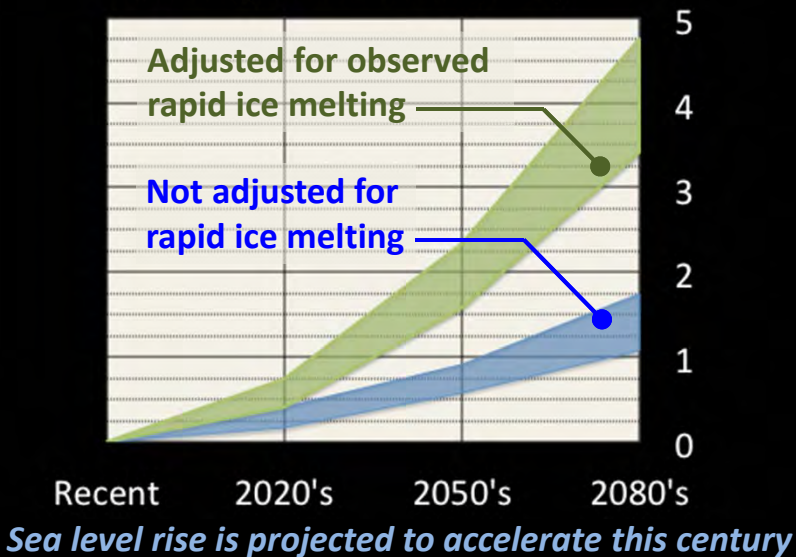


*Central range of models is basis for NASA's projections*



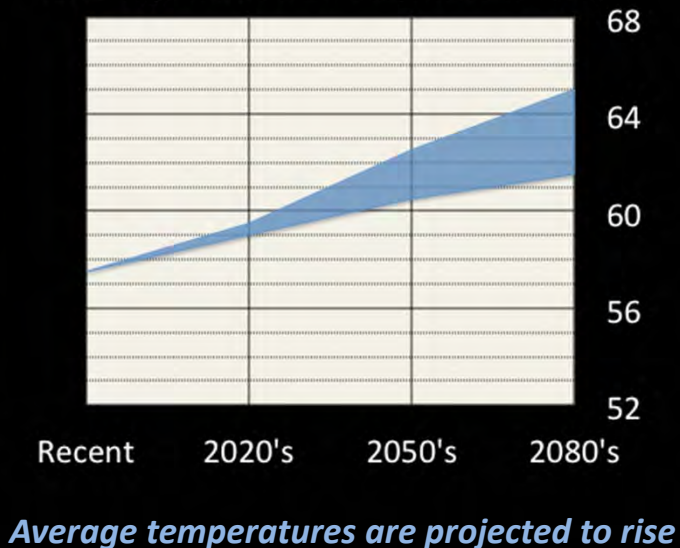
### What is projected locally?

#### Average Sea Level (feet)

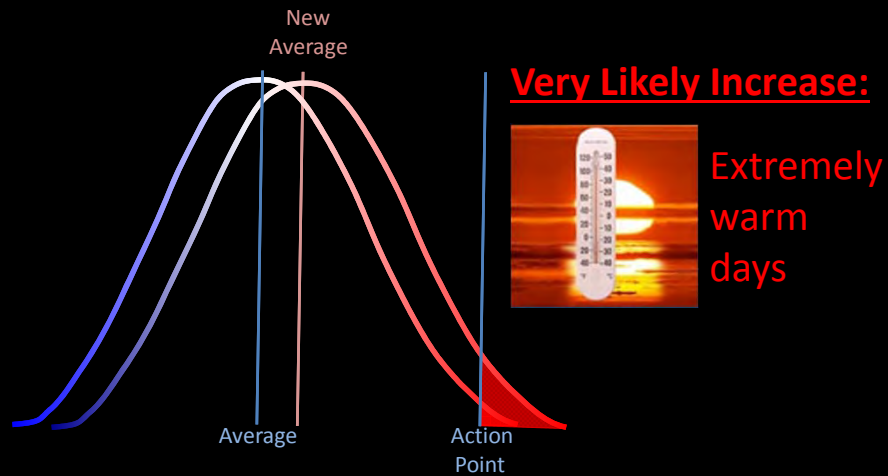


### What is projected locally?

#### Average Annual Temperature (°F)



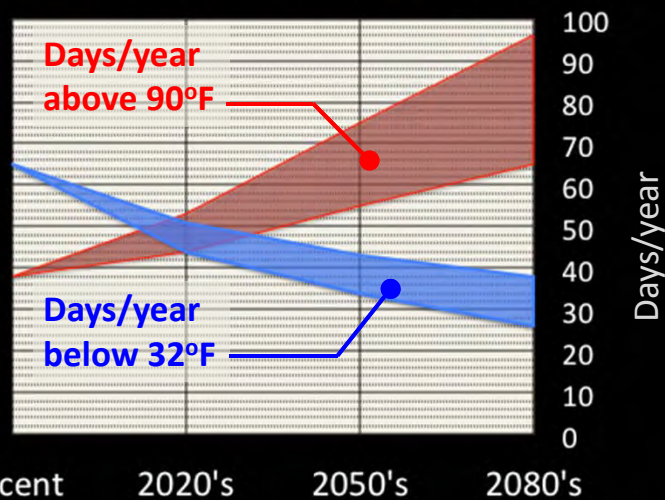
# What can a few degrees warmer do?



*A small average change can mean a big effect on extremes*

# What can a few degrees warmer do?

## Extreme Temperature Events



*Extremes can change much faster than averages.*

## Question

What other changes are projected?



## What other changes are projected?

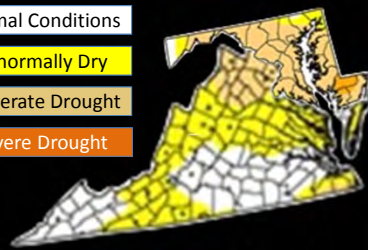
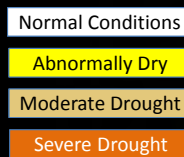
### Likely Increase



Intense  
rainfall  
events

### More likely than not

Increases in  
drought events



### Likely Decrease




Snowfall  
frequency  
& amount


*There's more to consider than averages*

# For more information...


<http://www.ncpc.gov/climate/>

National Aeronautics and Space Administration






### ADAPTING Federal Agency

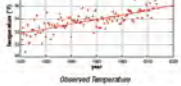


### What we're seeing now

Weather and climate are changing. Over 100 years of data collected from the sea tell the story: the average annual temperature has risen about 2.5° as measured in Baltimore, MD. Sea level measured at the Station of Chesapeake has risen almost 10 inches over the past 80 years.



Observed Sea Level



Observed Temperature

Scientists predict that these trends will continue and even accelerate, the reality. Furthermore, the warming is driving changes in the frequency and intensity of extreme weather events. Changes in extreme events may include more droughts, more droughts, and more heat waves. It's harder to predict coastal storms, rising sea levels magnify the effect of storm surges, and rising sea levels threaten the safety of communities and ecosystems.

### What scientists project

Washington, DC has experienced several extreme weather events in recent years, in three days of severe tropical downpours in June 2010, a record-breaking heat wave of 100 degrees in April 2011, and the city on edge. Hurricane Irene in September 2011 produced 7 inches of rain in 24 hours in some parts of the region. A string of rain over 100 degrees in July 2012 forced the death of a Marine. Being many counties affected. And DC residents learned it their worst day ever - disaster is a widespread and long-lived global event that accompanies equally moving climate and the weather. The Law 2012 scientific research the damage and flooding to the area, power outage across the District, disrupted life for several days.

Climate scientists from NOAA's Goddard Institute of Space Studies used state-of-the-art climate data from the DC area, combined with climate model outputs, to generate projections of future coastal rising temperatures and sea levels in the area. Sea levels may rise considerably faster if land-based ice melts faster than most current models project. Over the next 100 years, sea levels are projected to rise. But most people are more likely to notice the increase in rising levels of extreme weather. Changes in the number of hot days and cold days may affect energy usage patterns, health (e.g., asthma, heat and cold-related), and infrastructure function (e.g., flooding of concrete roads).

### What might the Metro DC area's future look like?

#### Sea Level Rise

2000s: 0.0 to 0.9  
2050s: 7.0 to 11  
2090s: 13 to 27

The Level Rise Projection (LR) is based by the NOAA scenario (RCP 8.5).

#### Extreme Event Changes This Century

Event	Description of Change	Likelihood
Coastal Flooding	Sea level rise	Very likely
Coastal Erosion	Sea level rise	Very likely
Storm Surge	Sea level rise	Very likely
Heat Waves	More frequent and intense	Very likely
Droughts	More frequent and intense	Very likely

#### Change in Average Annual Precipitation

2000s: 49.7 to 52.7  
2050s: 5.0 to 8.0  
2090s: 4.0 to 7.0

#### Change in Average Annual Temperature

2000s: 54.7 to 57.7  
2050s: 5.0 to 8.0  
2090s: 4.0 to 7.0

Temperature and precipitation projections reflect a 20-year average centered on the specific climate. Sea level rise is projected for the scenario RCP 8.5. Temperature and precipitation are projected for the scenario RCP 8.5. Sea level rise is projected for the scenario RCP 8.5. The model projections are for the period 2021-50. The model projections are for the period 2021-50. The model projections are for the period 2021-50.

#### Heat/Cold Days

2000s: 7 to 14  
2050s: 14 to 22  
2090s: 22 to 30

Days with max temperature > 90°F  
Days with min temperature < 60°F