



# How Climate Change can Change California

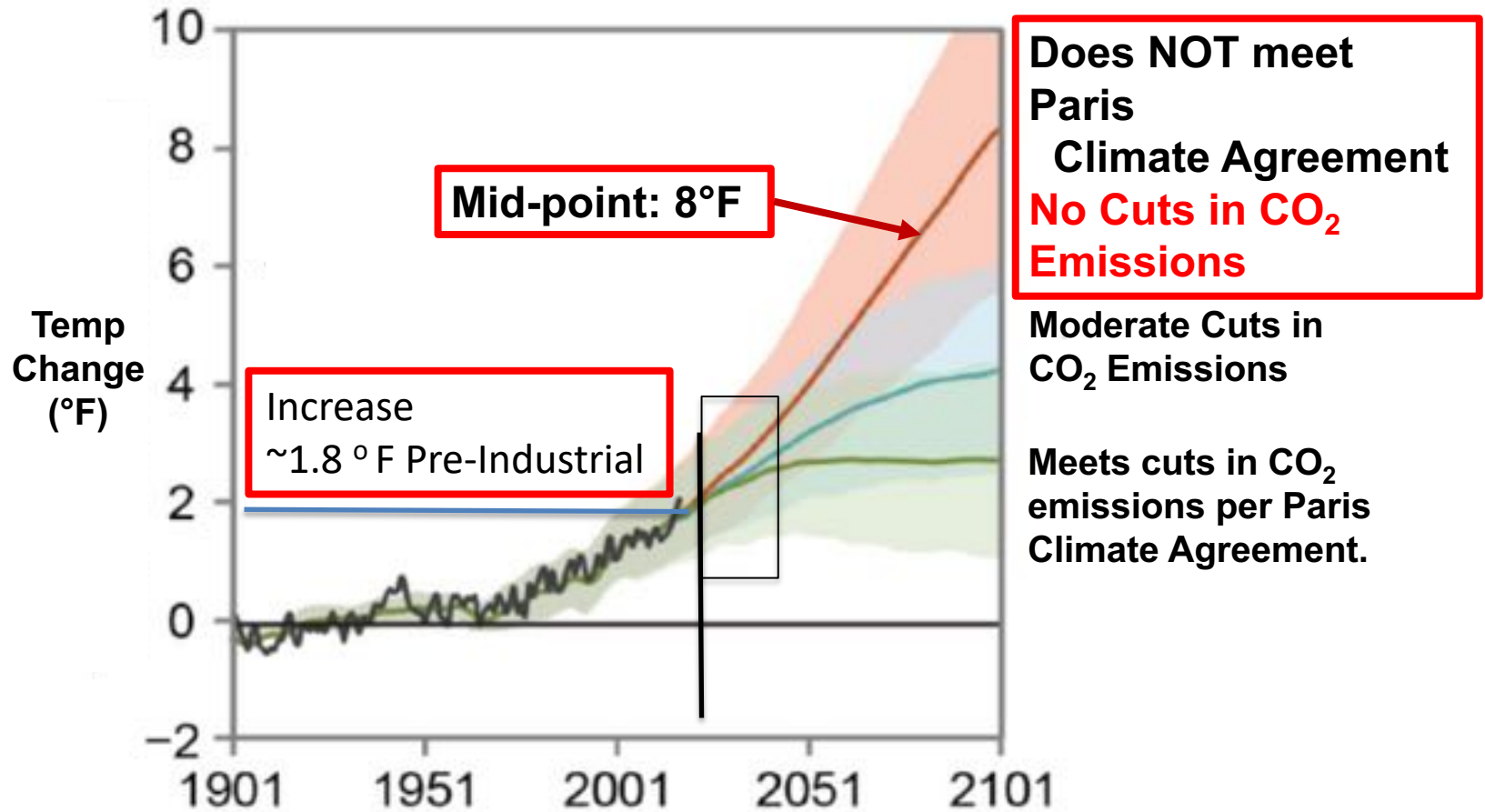
San Carlos Sister Cities Association  
23 April 2018


Gary Latshaw, Ph.D., Stan Farkas, Ph.D., Philip  
Russell, Ph.D.

[Securethefuture2100.org](http://Securethefuture2100.org)



# Projected Global Temperatures





**Definition of Climate Change**  
**GLOBAL Climate and Climate**  
**Trends that are statistically**  
**distinct from the pre-industrial era**

# Elevator-Ride Synopsis



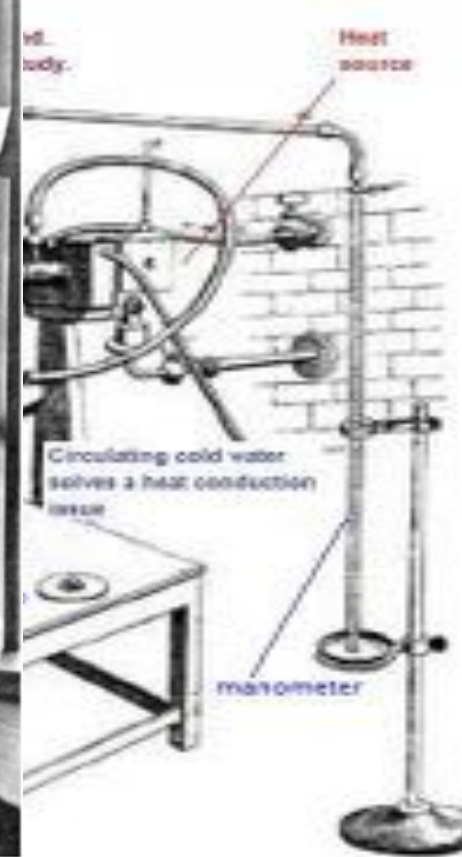
- **“Current” California Climate Change and Trends will persist at least through ~2040**
- **Continued Economic Dependence on Fossil Fuels will constrain Foreign Policy and continue to Degrade our Air and Water Quality**
- **Eliminating Fossil Fuels as Significant Energy Source will be a Gift to Future Generations**



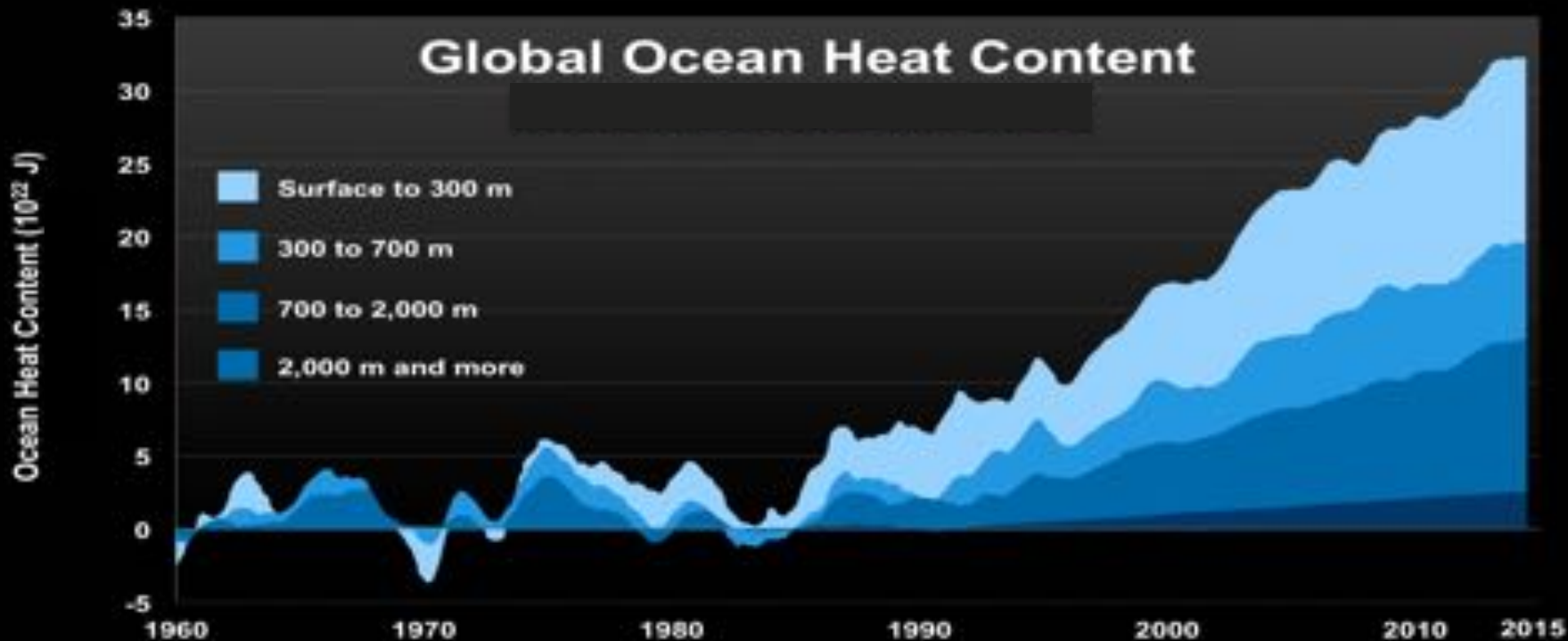
Rece

Real Heat-  
CO2

John T



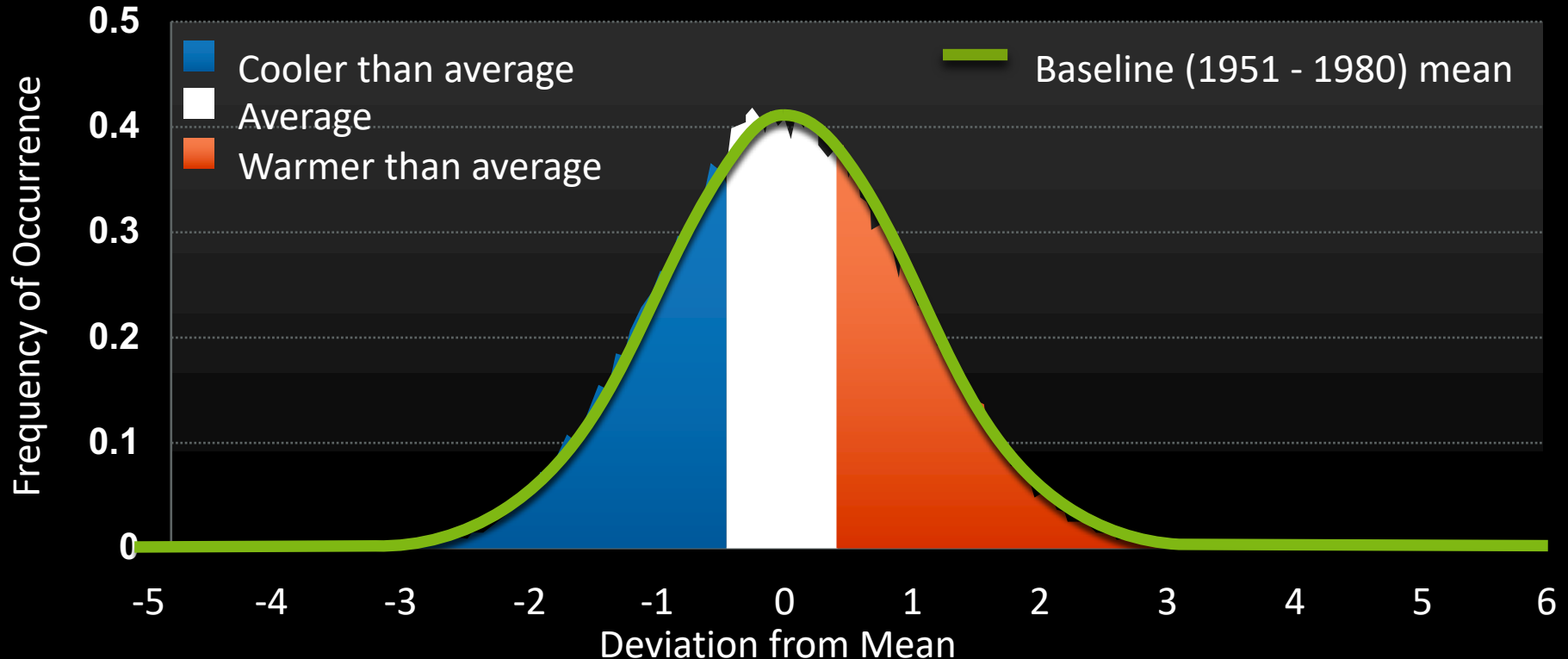
# Global Ocean Heat Content



Data: P. Gleckler, et al., Industrial-era global ocean heat uptake doubles in recent decades, *Nature Climate Change* 5, 394-398 (2015) Fig. 4

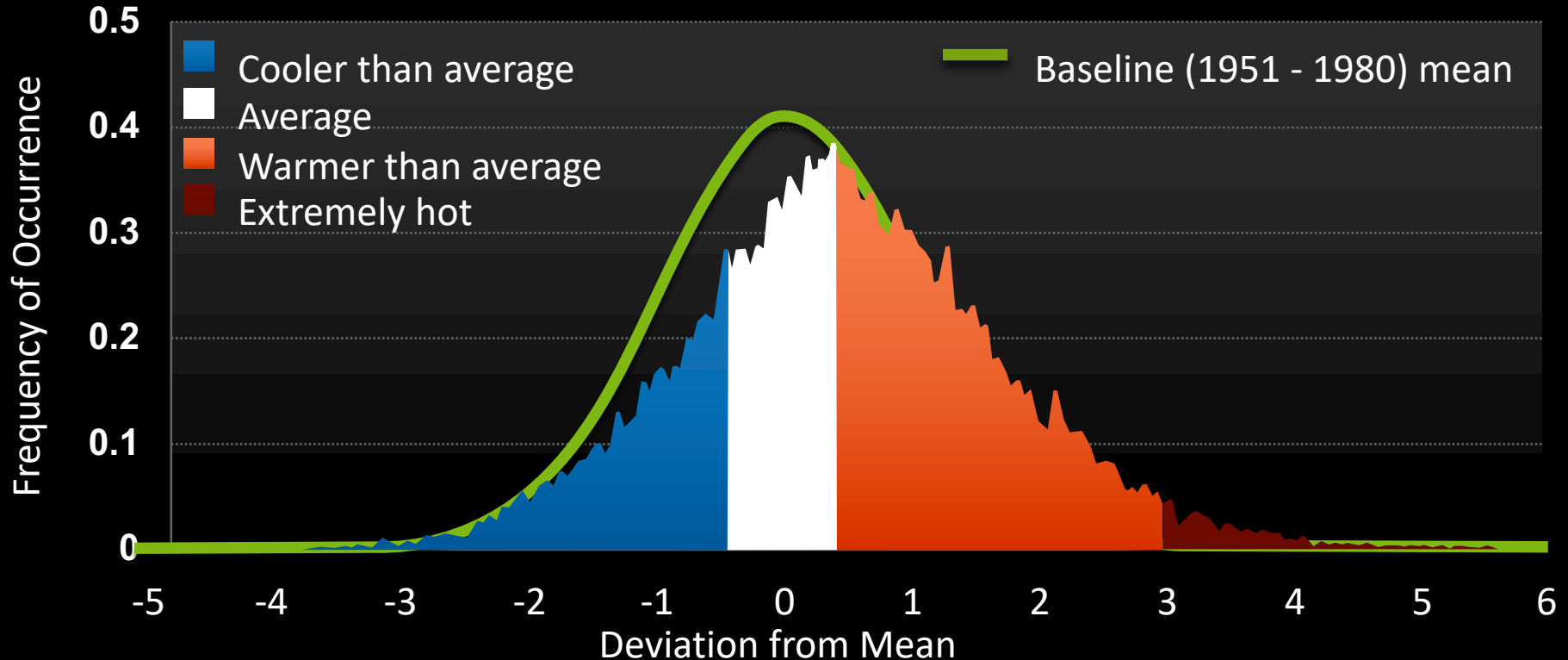
# Summer Temperatures Have Shifted

- 1951 – 1980



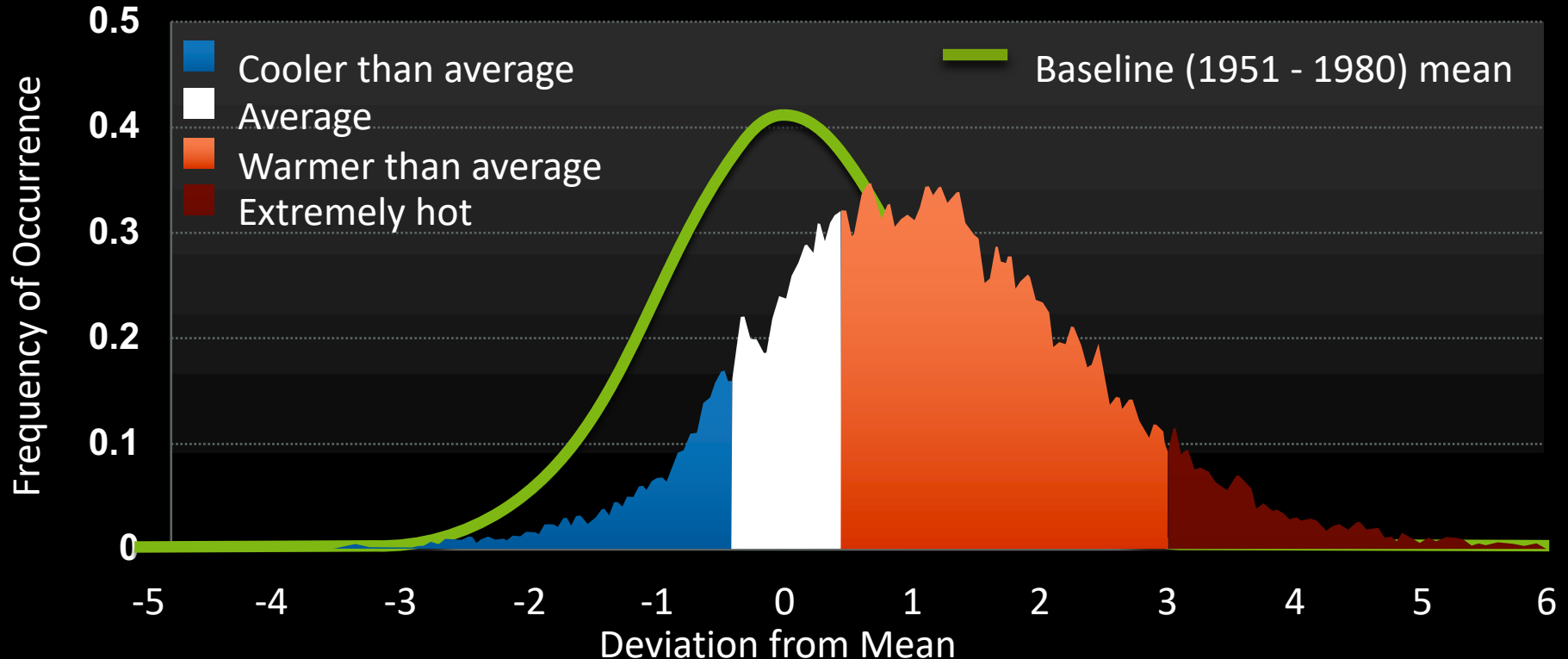
Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012 – Updated 2016

- 1983 – 1993



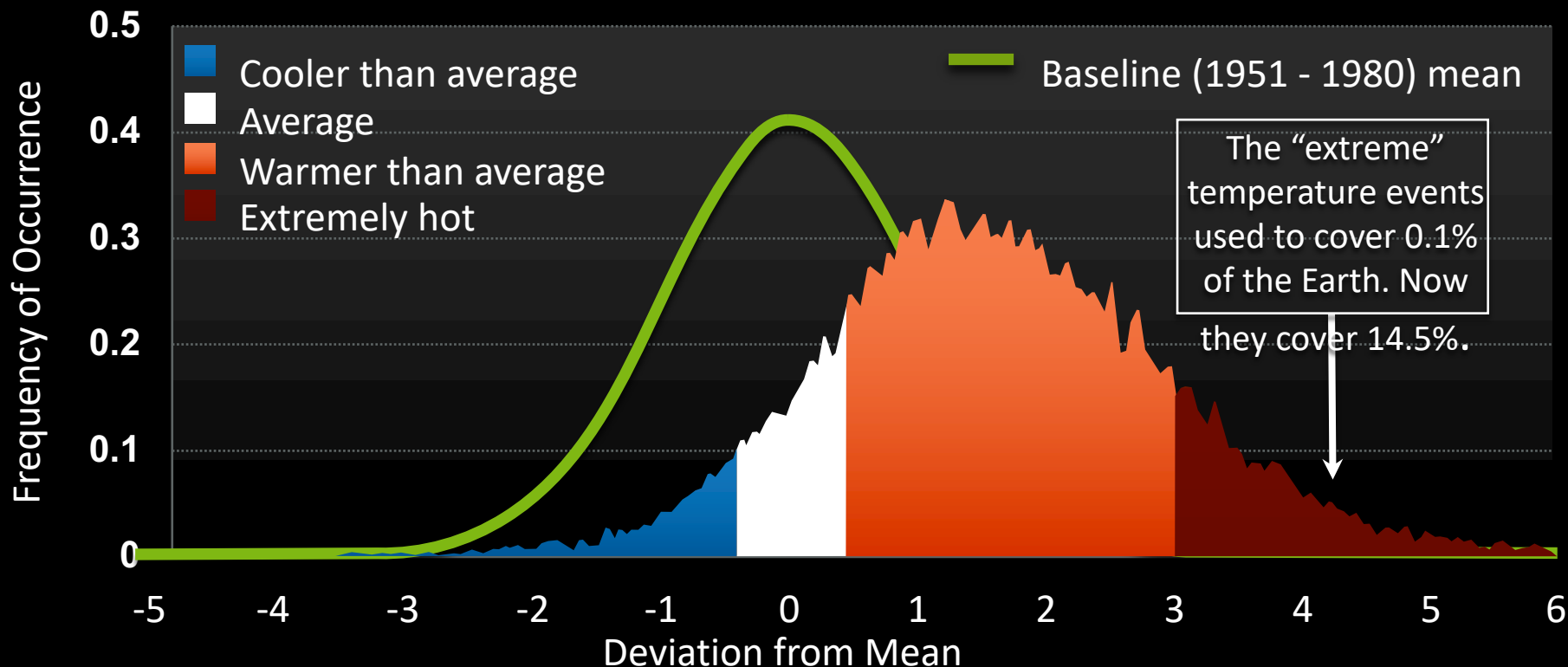


• 1994 – 2004

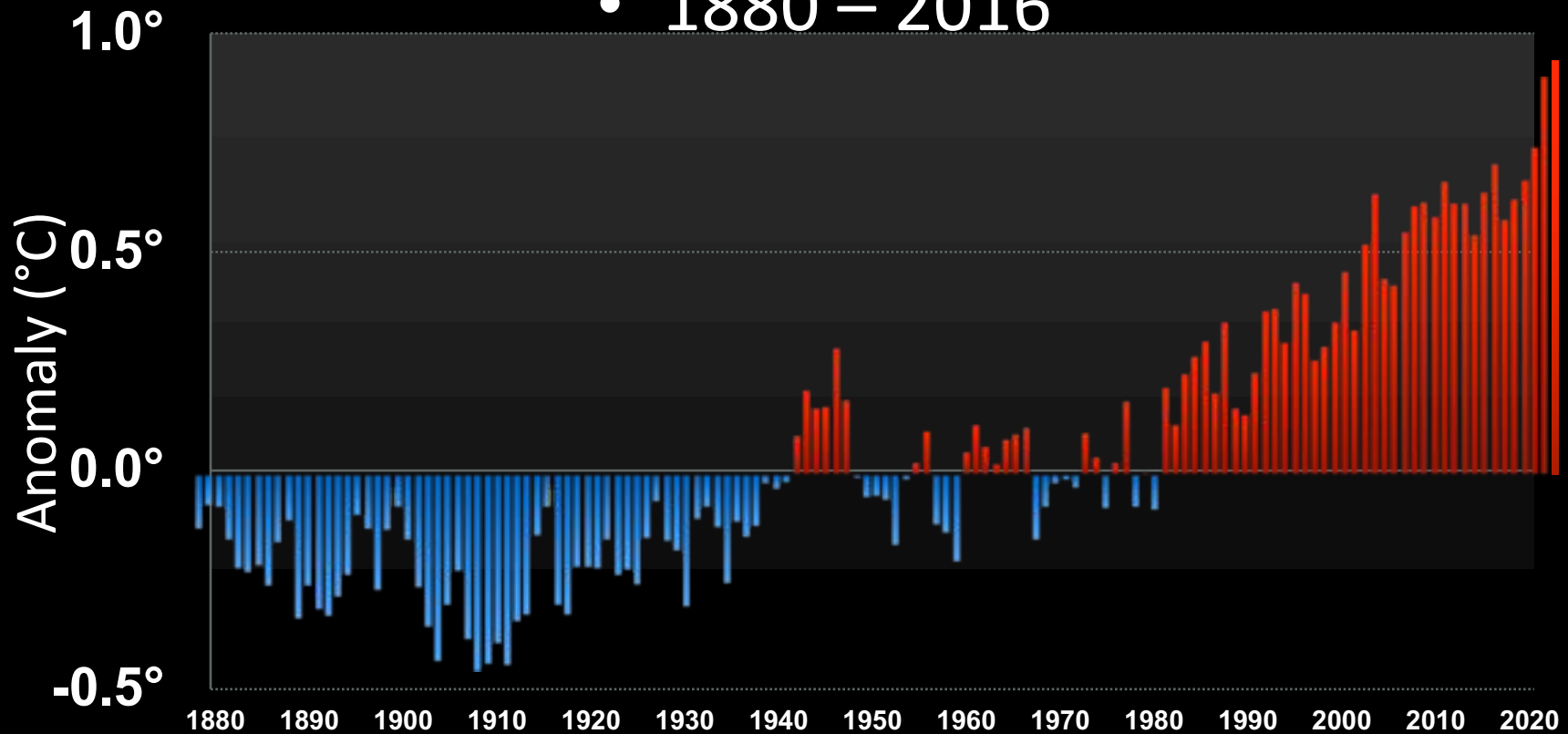


Source: NASA/GISS; Hansen, et al., "Perceptions of Climate Change," Proc. Natl. Acad. Sci. USA 10.1073, August 2012 – Updated 2016

- 2005 – 2015



# Global Surface Temperature – Departure from Average • 1880 – 2016



Data: NOAA

# 16 of the Hottest 17 Years Have occurred since 2001

2016

2015

2014

2010

2005

2007

2013

2009

2012

2006

1998

2002

2003

2011

2004

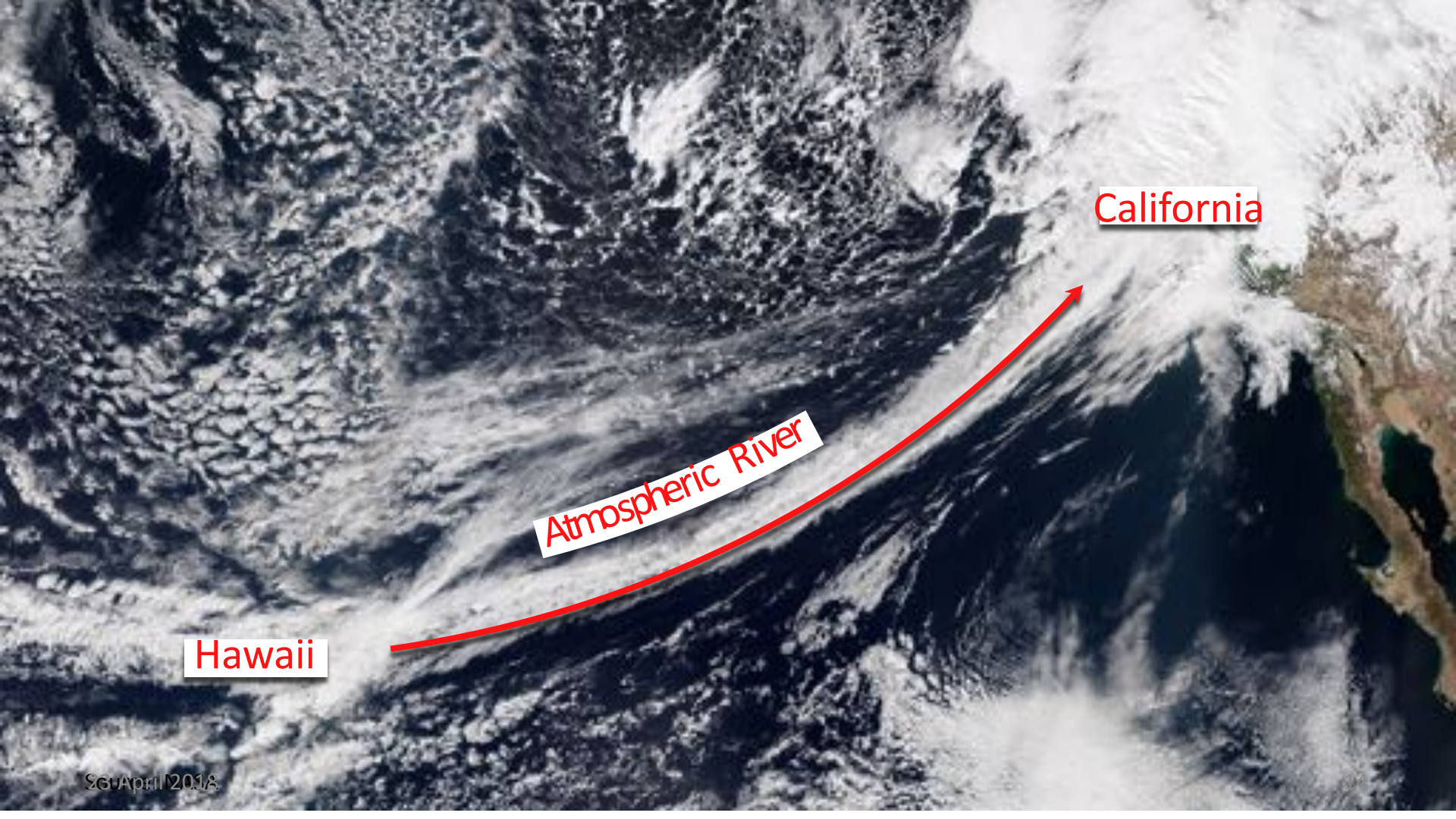
2001



# Climate Crystal Ball



- **Most Unambiguous:**
  - Global Temperatures Warmer
  - Glacier and Seasonal Ice Melting
  - Sea Level Rise
  - Extreme Weather Events



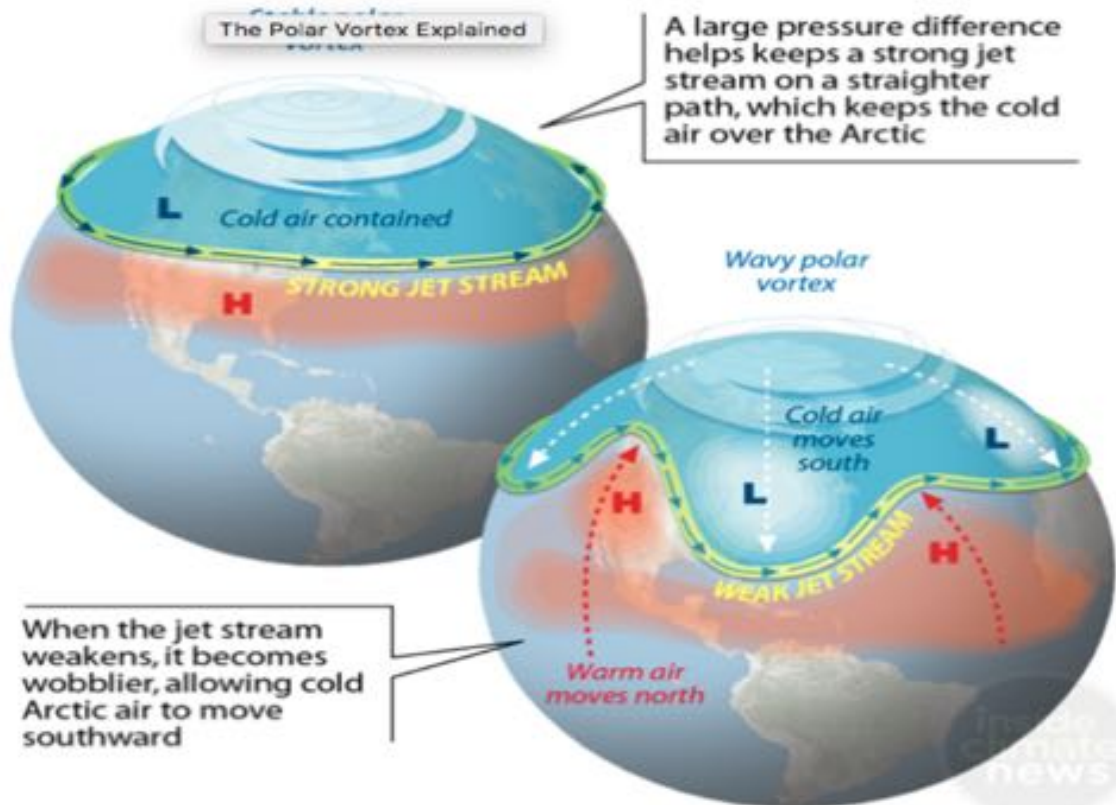
California

Atmospheric River

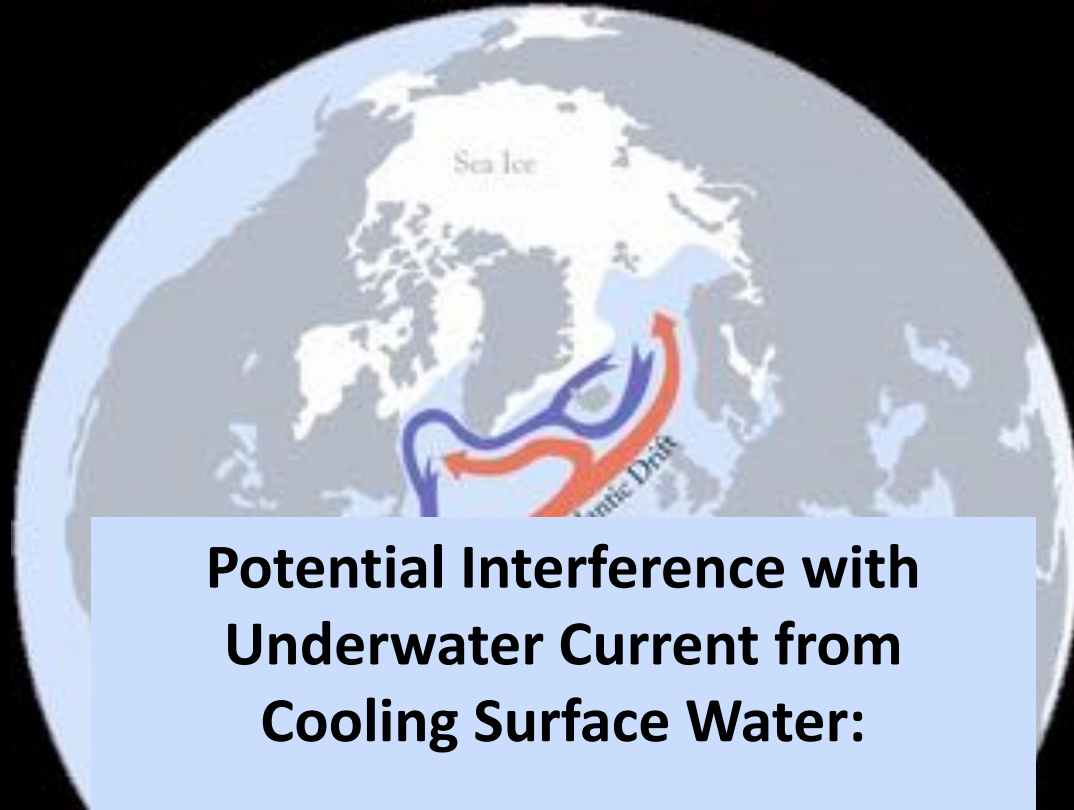
Hawaii

## Polar Vortex Explained

The polar vortex is a large area of low pressure and cold air over Earth's North and South Poles. When the jet stream weakens, it becomes wavier, allowing that cold air to dip southward in places while warmer air pushes northward elsewhere.







## Potential Interference with Underwater Current from Cooling Surface Water:

- Shrinking Ice Cap
- Warmer Surface Water
- Freshwater from Greenland

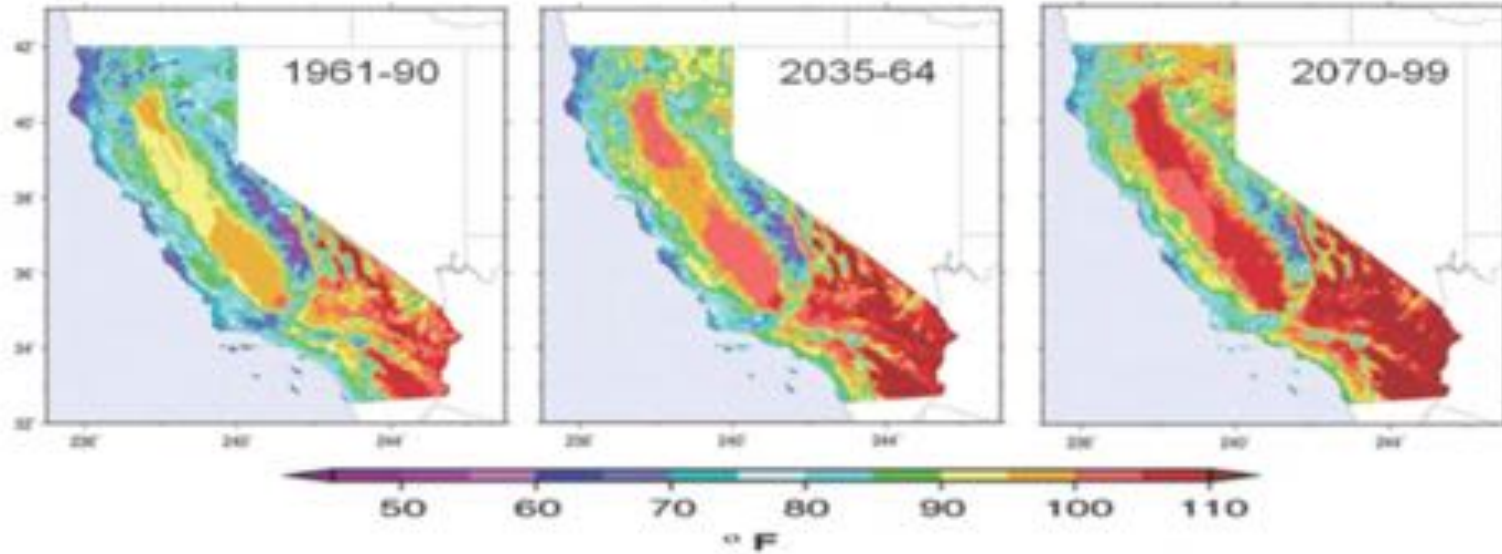




# Climate Change will impair the Health of Californians

# Temperature Projections

Figure 1. California Historical & Projected July Temperature Increase 1961-2099



Source: Dan Cayan et al. 2009.

# Public Health: Dirty Air & Heat Waves

*Higher temperatures can increase risk of:*

- Dehydration
- Exhaustion
- Heat Stroke
- Night time heat retention in urban areas: heat waves

*Increased Smog Risk:*

- Affects asthma and other respiratory illnesses

*Increased Smoke from Wildfires:*

- Promotes short and long term respiratory illnesses

**\* Low socioeconomic population is most vulnerable to all climate change-related public health issues**

# Extreme Heat Days Pose Health Risks

Estimate Extreme Heat Days May 1 to October 1 (150 days)

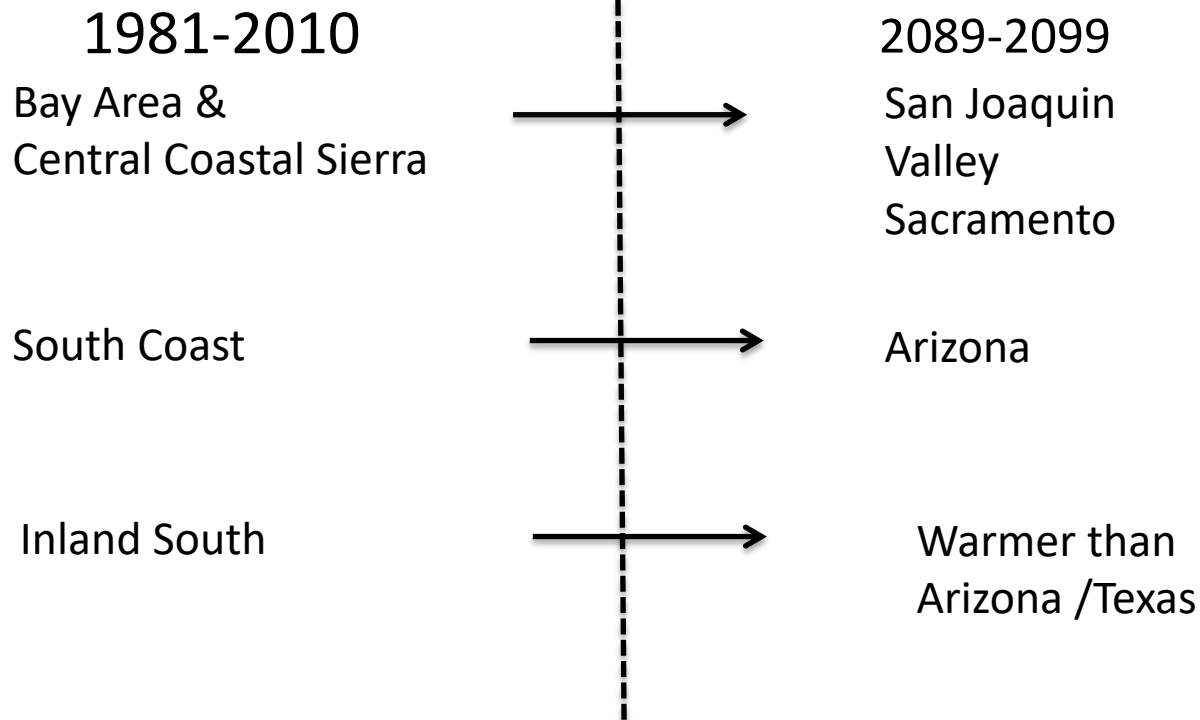
City	1961-90 reference	2050	2099
San Francisco	3	39	126
San Jose	3	71	111
Sacramento	3	44	85
San Diego	3	76	129
Los Angeles	3	78	100

Reference: 98<sup>th</sup> Percentile of maximum temperature from 1961-1990



# Summer Temperature Shifts

## 1981-2010 averages to 2089 -2099



# Adaptation Measures



- Shading of building, asphalt, and other dark surfaces to reduce urban heating
- Green Building Standards
- Cool Roofing and Cool Pavements
- Energy Efficient Measures in homes and commercial buildings
- Proliferation of Parks and Riparian Zones



## Lawrence Berkeley Laboratories:

- 1000 sqft = 10 Tons of CO<sub>2</sub>
- Summer Cooling

# Public Health: Vector-Borne Diseases

Warm, moist regions encourage establishment of vector-borne diseases including:

- Human Hantavirus
- Dengue Fever
- Lyme Disease
- Yellow Fever
- West Nile Virus
- Zika Virus
- Malaria
- Encephalitis





# Water and Food Borne Diseases

A close-up photograph of a person's hand holding a clear petri dish. The dish contains a white, opaque, and somewhat clumpy substance, which appears to be a microbial culture or a sample of water. The hand is positioned on the left side of the frame, with the thumb and index finger visible. The background is dark and out of focus, suggesting a laboratory or clinical setting.

- Drinking Contaminated Water
- Eating Seafood from contaminated water
- Eating produce irrigated by contaminated water
- Harmful Algae blooms

# Public Health: Water and Food Borne Diseases

**Higher temperatures can accelerate the spread of water-borne diseases:**

- **Drinking contaminated water**
- **Eating seafood from contaminated water**
- **Eating produce irrigated by contaminated water**
- **Harmful algae blooms threatens aquatic organisms and food safety**



# Adaptation Measures



- **Control food that is transferred long distances without refrigeration**
- **Reduce impact of urban heat islands**
- **Greater Health Access**
- **Education Outreach**

# US Environmental Protection Agency



“Climate change is having direct and indirect impacts on the health of people. More extreme weather events, heat waves, spread of infectious diseases and detrimental impacts on air and water quality have impacts on our health...”

# California Infrastructure and Climate Change



- Flooding of Coastal Airports
- Degradation of Coastal Landfill
- Upgrades and Relocation of Water Treatment Facilities, Trash Dumps, etc.



# San Mateo County at Most Risk in State With

## Sea Level Rise

**2050  
SLR (2 ft) &  
Mild Storm  
(2 ft): 4 ft**

**2100  
SLR (6.5 ft) &  
Major Storm  
(2.6 ft): 9 ft**

**Below Water  
Level**

**Below Water  
Level**

**Below Water  
Level but  
Isolated by  
Levees, Sea  
Walls**

**Below Water  
Level but  
Isolated by  
Levees, Sea  
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Source:

<http://www.climatecentral.org>

# MEASURE P: FUNDING LEVEE IMPROVEMENTS

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Foster City maintains the levee along the Bayfront, surrounding the majority of the outer perimeter of the City. The City's levee system provides protection from flood hazards and storms and is a valuable safety element. The levee has withstood challenges so far, but it is in need of critical improvements for safety and savings.

The Federal Emergency Management Agency (FEMA) has determined that Foster City's levee system does not meet FEMA requirements into future years. Unless the City upgrades the levee to meet the required FEMA standards, Foster City will be designated as a flood zone and the average homeowner of homes with federally insured loans will be mandated to pay an estimated \$2,000-\$3,000 per year in flood insurance, while





# Fund Levee Improvements

- ✓ \$272/year Current Avg. Homeowner
- ✓ Meet FEMA Standards
- ✓ Safe from floods



# Flood Zone Designation

- ✓ Estimated \$2-3,000/Yr Flood Insurance
- ✓ Flood risk remains



# San Jose Wins!



# Wildfires



**Higher temperatures and drier soils increases frequency, severity, and extent of wildfires**

- **Destruction to Forests**
- **Destruction to homes and communities**
- **Harm to health from reduced air quality**

**Destabilizes Soil resulting in Mudslides during rainy season**

**Results in ecological succession starting from bare ground**



# Costs to Fight 2017 California Wildfires Shatter Records

MATTHEW RENDA January 8, 2018



(CN) – With rain finally headed toward Southern California this week, the state’s worst wildfire season ever may finally end if precipitation snuffs out what’s left of the largest fire in California history still smoldering in the back country.

The complete containment of the last large fire of 2017 will finally allow officials to tally the costs to taxpayers, most of which is related to fire suppression. And the final figures will show the past season was the most



Motorists on Highway 101 watch flames from the Thomas fire leap above the roadway north of Ventura, Calif., on Wednesday, Dec. 6, 2017. (AP Photo/Noah Berger)



- Record Rainfall
- Increase in brush/grass
- Record Hot Summer
- Dead Trees from
- ▶ Drought/Infestations
- > Record Wildfires

Climate News: Record Hot Summer, Wet Winter Created Explosive



# Santa Ana winds

In addition to increasing the threat of wildfires, Santa Ana winds can cause trouble for drivers and pilots in Southern California.

**1** Desert winds originate from a clockwise flow of air around a high-pressure system east of the Sierras.



**2** Air extends from the mountains, and is compressed and warmed, becoming less humid. This lowers relative humidity and dries out vegetation and can fan any existing fires.



**3** Winds squeeze through canyons with gusts between 40 and 60 m.p.h.



**4** Strong winds create turbulence for area flights and can make interstate travel difficult.

Source: National Weather Service

# Agriculture: What Crops?

An aerial photograph of a vineyard. The image shows numerous rows of grapevines planted in neat, parallel lines across a hilly landscape. The vines are a vibrant green color. In the upper right quadrant, there is a circular pond with a light blue-green hue. The surrounding fields are also green, and there are some trees and a small building visible in the background.



# Enhanced Threats

- **Agricultural Drought**
- **Dry Soil**
- **More Frequent Hot Spells**
- **Ground Water Depletion**

# Parched South Africa City Struggles to Avoid 'Day Zero': Water Shutdown

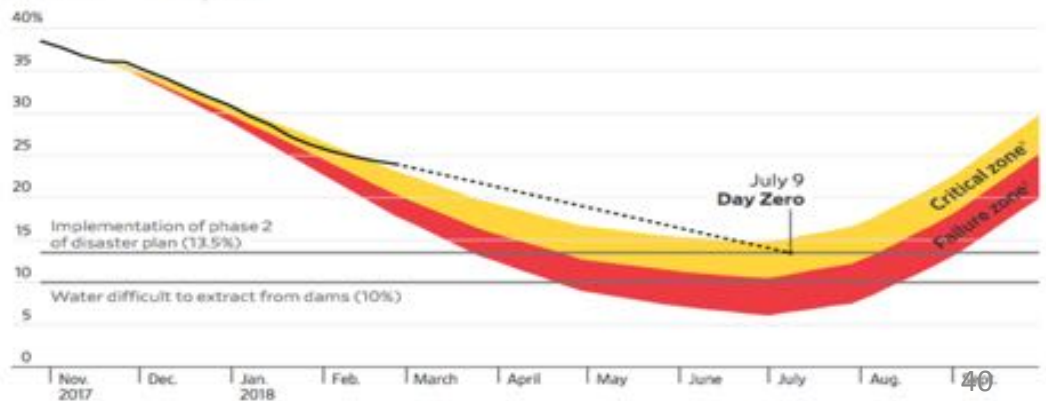
Cape Town orders strict water rationing as reservoirs reach perilously low levels, a harbinger of what scientists say may bedevil other cities as the global climate changes

## Urban Crisis

Cape Town plans to shut off municipal water delivery on July 9 if the supply continues to fall at the current alarming rate.

Water stored in the major dams of the Western Cape Water Supply System as a percentage of capacity

— Actual    --- Projected



\*Assumes partial compliance with Department of Water and Sanitation restrictions and normal evaporation



# Desalination Projects

\$1 Billion Project

In this Sept. 4, 2015 photo is the Carlsbad, Calif. desalination plant. America's largest seawater desalination plant, the \$1 billion facility produces 50 million gallons of drinking water for the San Diego area each day, but at a cost double the price of other sources.

(AP Photo/Lenny Ignatz/FILE)

23 April 2018



# Crops of the Future?



- **Nuts (incl. Almonds) and Fruit need :**
  - Water Annually
  - Days of “Chill” Temp < 45°F
- **Grapevines**
  - Water Annually
  - Avoid Hot Spells
- **Annuals Threatened (Lettuce, Rice, Tomatoes)**

# CHILL TIME NEEDED

Hours required before spring growth

 APPLE	800-1,100 HOURS	 BLUEBERRY	900-1,000 HOURS
 PEACH	400-1,050 HOURS	 CHERRY	1,000 + HOURS

Source: Alabama Cooperative Extension

CLIMATE  CENTRAL

# Recreational Venues Imperiled



gettyimages™  
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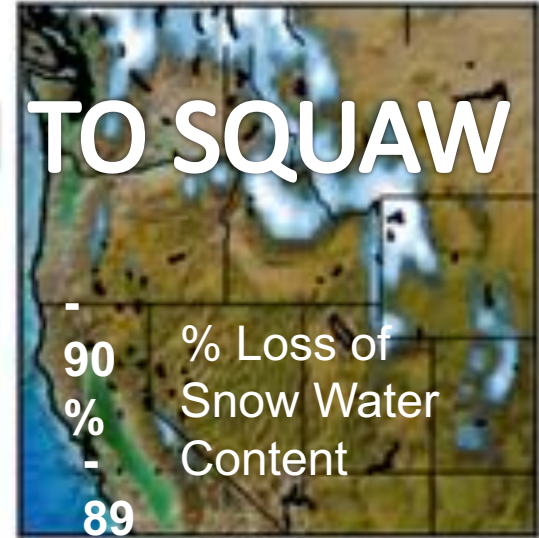
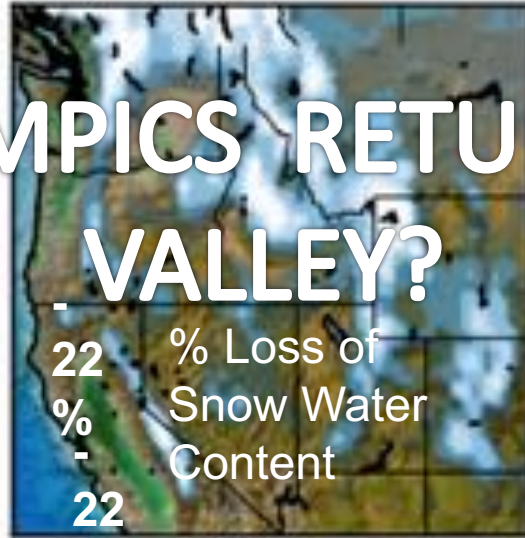


# Disappearing Snow Pack in Winter

Historical

Mid-Century

End-Century



## WILL THE OLYMPICS RETURN TO SQUAW VALLEY?

Less precipitation falls as snow

More snow melts during the winter by falling rain and temperature rise

23 April 2018 = Diminishing Water Levels of Largest State Reservoirs



## California's Shoreline:

- Beaches reduced or eliminated
- Construction of Sea Walls at Major Coastal Metropolitan Areas?



# Security

- “...climate change is a challenge that requires a broader, whole-of-government response. If confirmed.”
- Secretary of Defense James Mattis

Congress inserted funding for Pentagon Study for Identification of Military Bases at Risk

# Broad Military Response

An aerial photograph of two US Navy amphibious assault ships, likely LHA-class, sailing on the open ocean. The ships are dark grey with white superstructures and are moving from left to right, leaving a white wake. The water is a deep blue.

- Increased Foreign Threats
  - Climate Change has disrupted entire countries
  - Famine in Tunisia, Syria, Sudan..
- Adaptation or Replacement of Military Bases & Equipment
- Training

# Plan for California





# Reducing Energy Demand

Improving energy efficiency and powering the grid with electricity from the wind water and sun positively reduces the overall energy demand.



# Future Energy Costs 2050

- Fossil Fuels
- WWS (Wind, water & solar)

State average fossil fuel plus nuclear energy costs\*



10.7¢/kWh

State average WWS energy costs\*



9.7¢/kWh

\*Health and climate externality costs of fossil fuels are another 5.7¢/kWh



## 40-Year Jobs Created

Number of jobs where a person is employed for 40 consecutive years.



Construction jobs: **315,982**

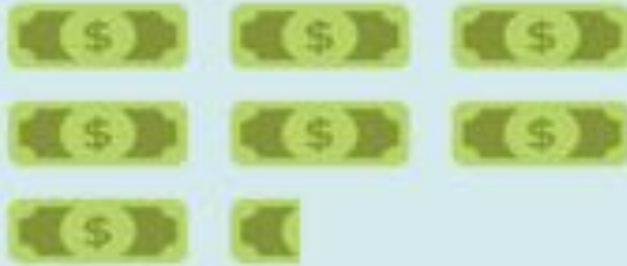


Operation jobs: **142,153**

# Money in Your Pocket

 = \$1,000

Annual energy, health, and climate cost savings per person in 2050: **\$7,395**



Annual energy cost savings per person in 2050: **\$161**



## 40-Year Jobs Created

Number of jobs where a person is employed for 40 consecutive years.



Construction jobs: **315,982**



Operation jobs: **142,153**

# China: Xi Jinping





## Positives

- Renewable Energies \$ Declining
- Improving Battery Technology
- Electrification of Transportation
- Many Jurisdictions Understand
- Major Countries Understand



## Negatives

- Risk Multi-Events
- Difficulties Several Centuries
- US Lack of Understanding
- Release of Naturally Sequestered Carbon

# Elevator-Ride Synopsis



- **“Current” California Climate Change and Trends will persist at least through 2040**
- **Continued Economic Dependence on Fossil Fuels will constrain Foreign Policy and continue to Degrade our Air and Water Quality**
- **Eliminating Fossil Fuels as Significant Energy Source will be a Gift to Future Generations**

# For Them and Ourselves





# Pending Legislation



- **Executive Order B-48-18**
  - 2.5 B Infrastructure over 8 years
  - 225 M rebates (including low-income)
- **Clean Cars Act 2040 (AB1745)**
  - All new car registrations must be ZEV
- **Renewable Portfolio Standard (SB100)**
  - 100% Retail Electricity by 2045
  - 60% Retail Electricity by 2030



# Secure The Future 2100

## What we do, Who we are

**Our Goal is to Support Elected Officials and to Inform the Public on Climate Issues.**

**Co-founders:**

**Stan Farkas, PhD - Retired NASA Project Manager \***

**Gary Latshaw, PhD - Retired Physics Professor**

**Phil Russell, PhD - Retired NASA Atmospheric Scientist**

– **Point of Contact: Glatshaw@gmail.com**

– **Please visit our website for more information at:  
<https://securethefuture2100.org>**