



# Foreboding Weather

*Live-it-up While You Can!*


Presented by  
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**edited**

S. Mukhopadhyay, UBC Trek

March 4, 2014





- W E A T H E R :  
t e m p e r a t u r e   a n d  
r a i n ;   a l s o   h u m i d i t y ,  
w i n d ,   a n d   p r e s s u r e .  
D u r a t i o n   m e a s u r e d  
i n   h o u r s   o r   d a y s .





**CLIMATE**  
The weather  
averaged over a  
long time - say  
100 years.

It's *stable*.  
We associate  
different weather  
averages with  
different climates.

A photograph of a landscape under a dark, ominous sky. The foreground is a green, grassy field. In the middle ground, there is a line of dark trees. The sky is filled with dark, heavy clouds, suggesting an approaching storm or severe weather. The overall tone is dark and dramatic.

# Soon, climate will no longer be stable



# Anchorage, Alaska

June 17, 2013

Talkeetna, Alaska  
hit **96° F** June 17





# 2013

## California Has Driest Year Ever -- And It May Get Worse

The Huffington Post | By Robin Wilkey 

Posted: 01/15/2014 10:10 pm EST | Updated: 01/16/2014 11:00 am EST

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# Chicago, Illinois

January 7, 2014



A. Nelles, AP photo



# Yenisei River Krasnoyarsk, Siberia, Russia

Dec 15, 2013





# Lovund, Norway

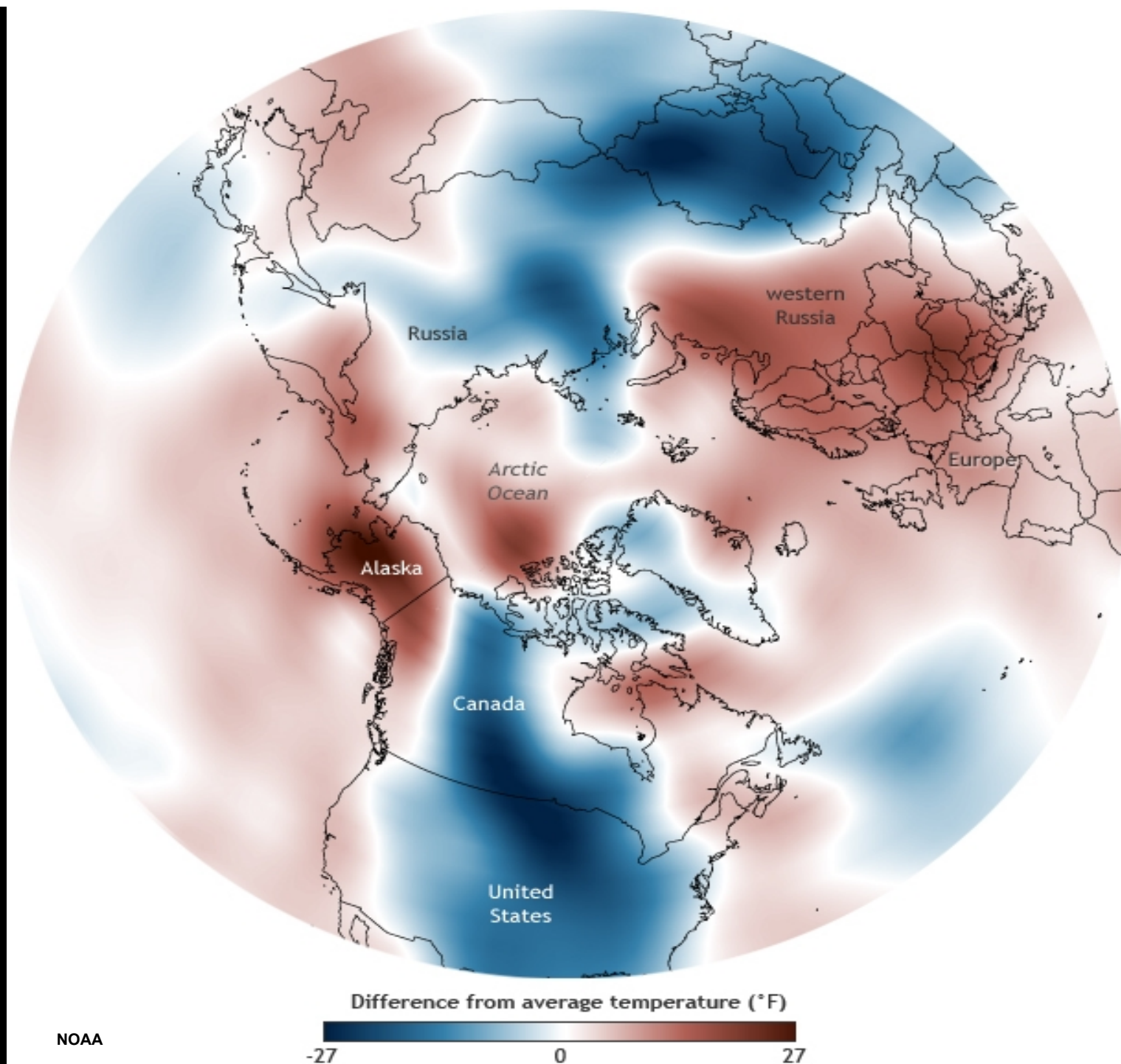
January 12, 2014





# Difference from Average Air Temperature

January 5-7, 2014



NOAA



# Typhoon Bopha

## Compostela, Philippines

December 4-5, 2012





# SuperTyphoon Haiyan Tacloban, Phillipines

Nov 8, 2013





# Toowoomba, Australia

January 10, 2011





# **The Great Australian Flood of 2011**

**covered an area  
equivalent to California,  
Nevada, Oregon, &  
Washington  
combined**



**“The only plausible explanation for the rise in weather-related catastrophes is climate change.”**

**Munich Re**

**One of the two largest re-insurance companies in the world**

September 27, 2010



**BIG STORMS**  
**are becoming**  
**bigger**  
**AND**  
**more frequent**



The energy *trapped* by man-made  
global warming pollution is now  
“...equivalent to exploding

**400,000**

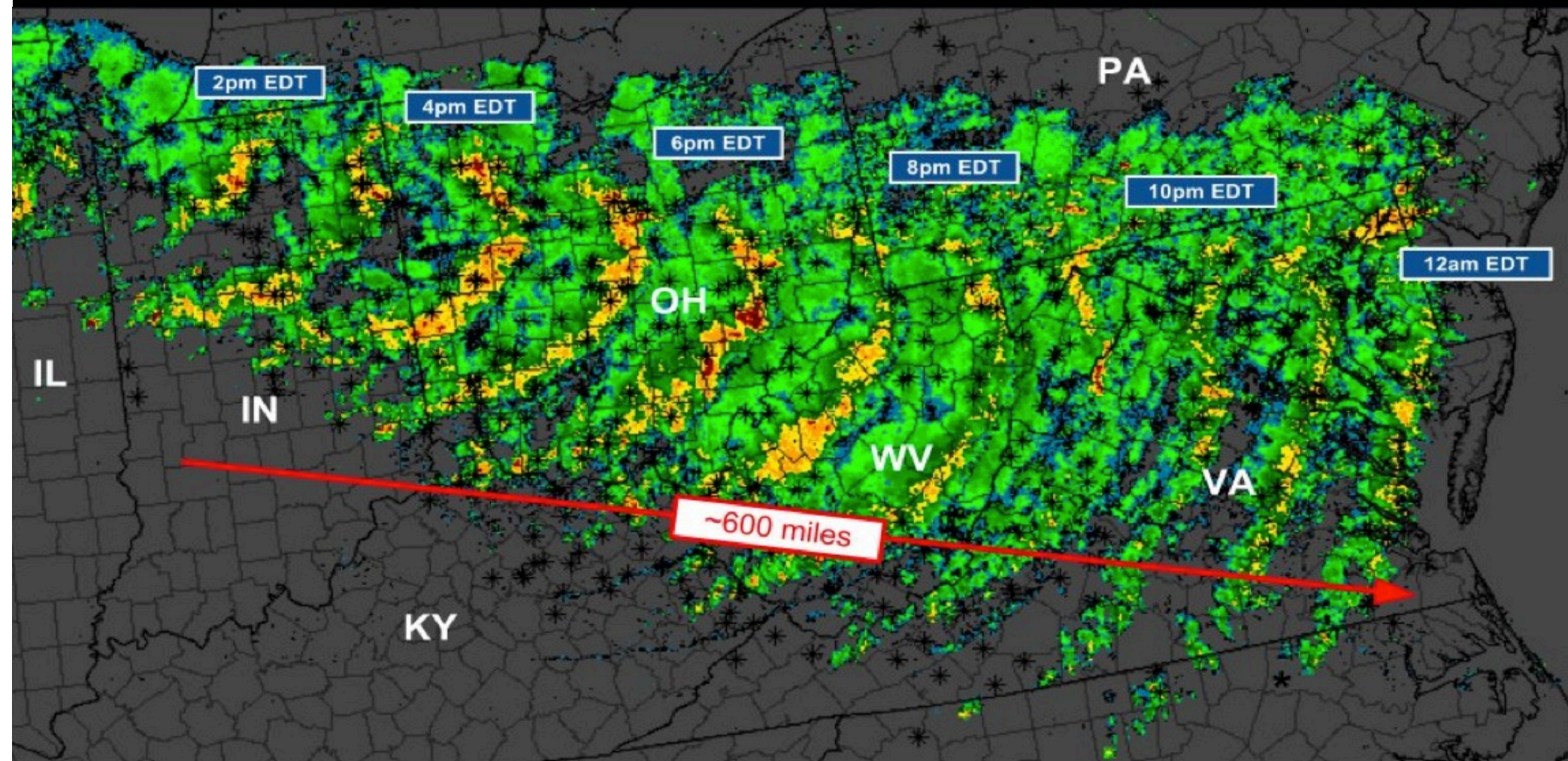
Hiroshima atomic bombs  
per day 365 days per year.”

James Hansen  
Former Director, NASA Goddard Institute for Space Studies



# Midwest to East Coast Thunderstorms

June 29, 2012







# **“Derecho” Storm Chicago, Illinois**

**June 29, 2012**

**The windstorm traveled over 600 miles in ten hours, killing at least 18 people and leaving millions without power—one million for over five days.**



# Highland Park, Los Angeles

December 1, 2011





# San Gabriel Valley

March 1, 2014

Tornado 'rotation signature' seen by radar in West Covina, tornado warning issued for parts of Los Angeles County



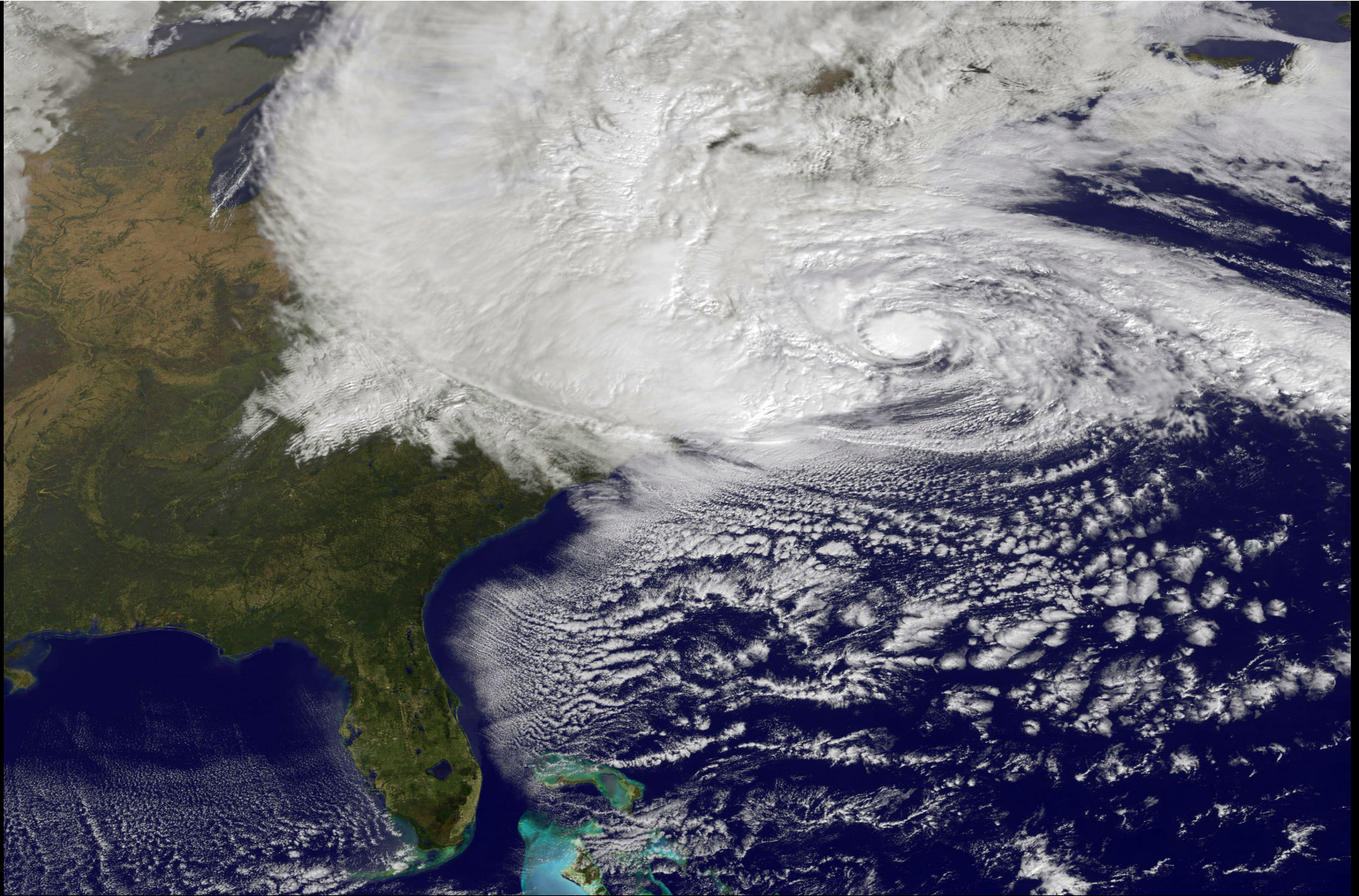


# **Tropical Storm Irene**

**August 27 – 29, 2011**

**Damages reached  
\$15 billion**





# Hurricane Sandy

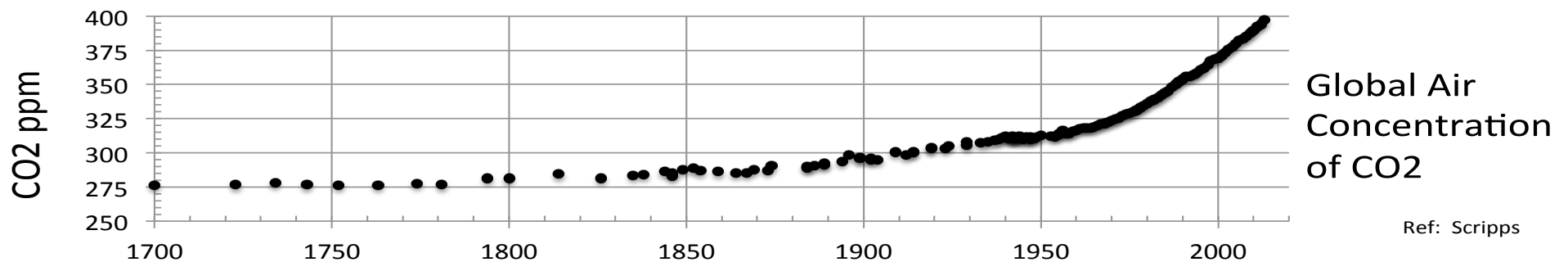
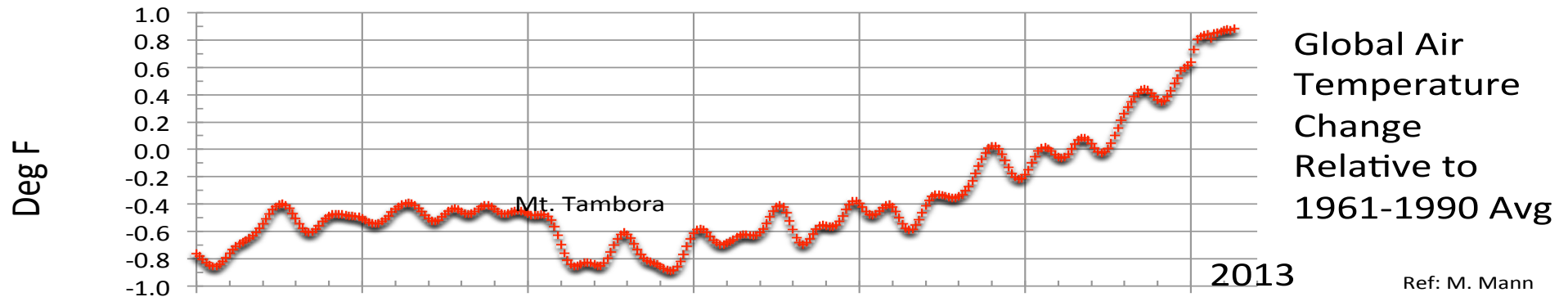
October 29-31, 2012

**Damages greater than  
\$60 billion**

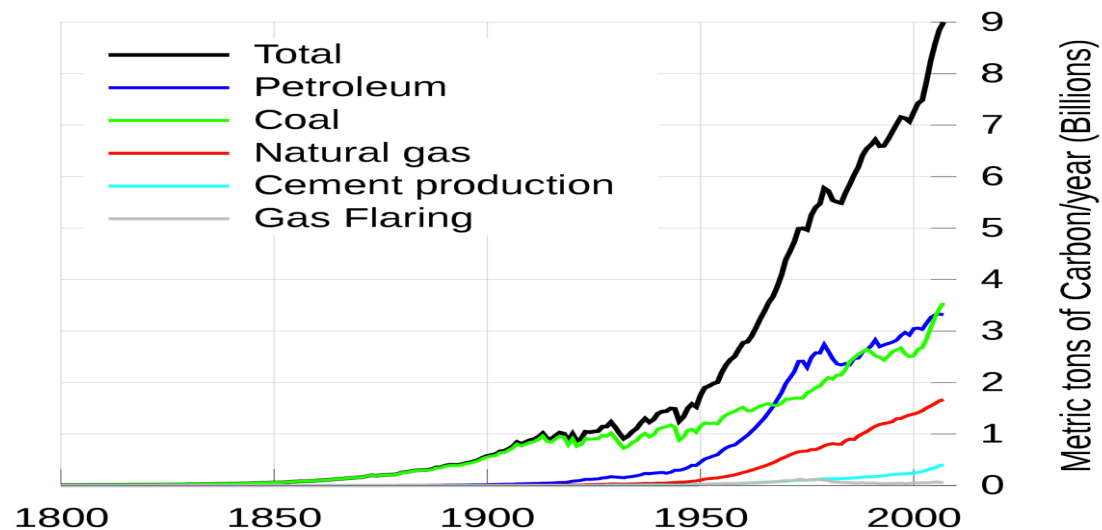


# 300 Years of CO<sub>2</sub> and Global Temperature

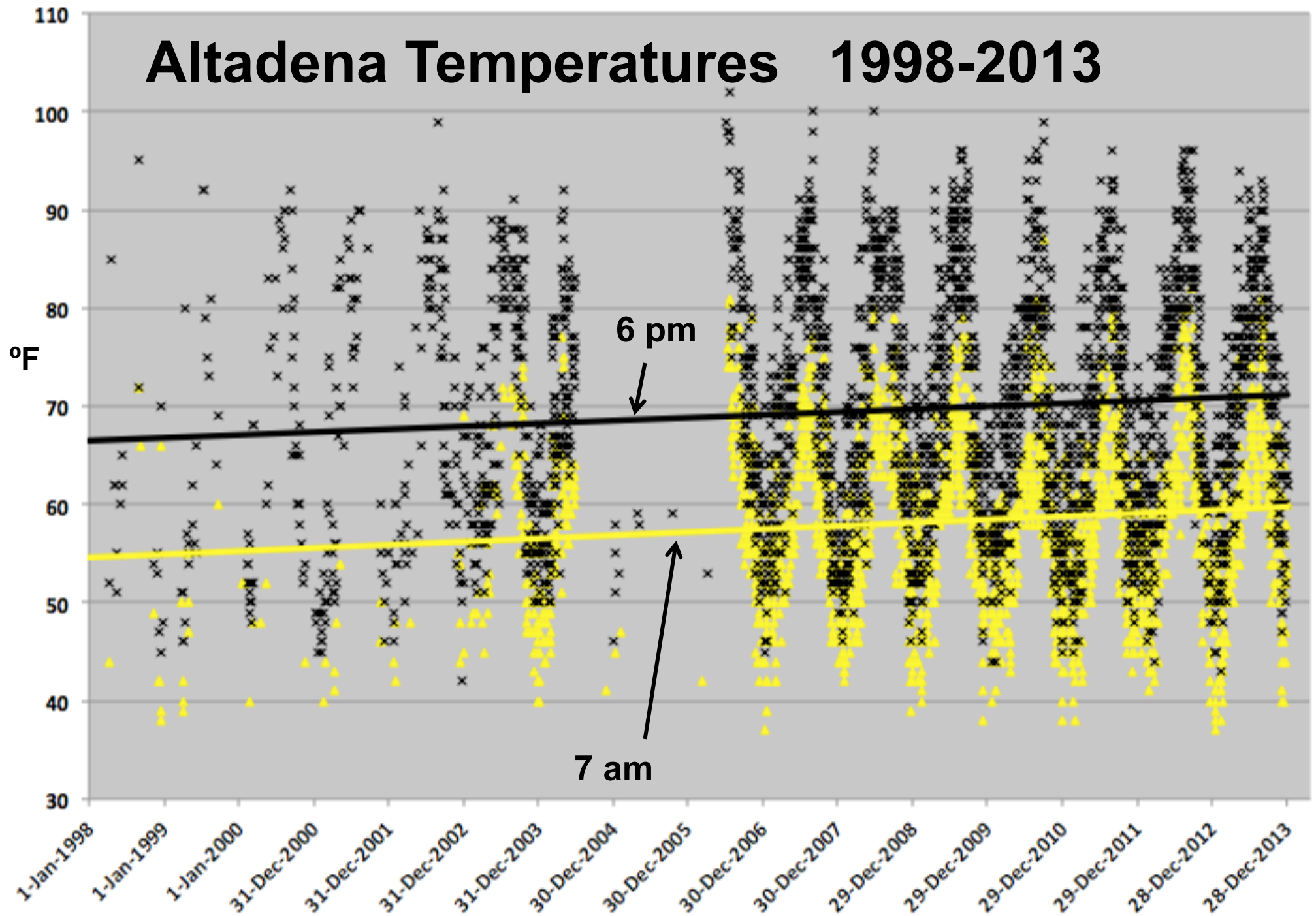
## As CO<sub>2</sub> Increases, So Does the Temperature



Industrial Sources of CO2



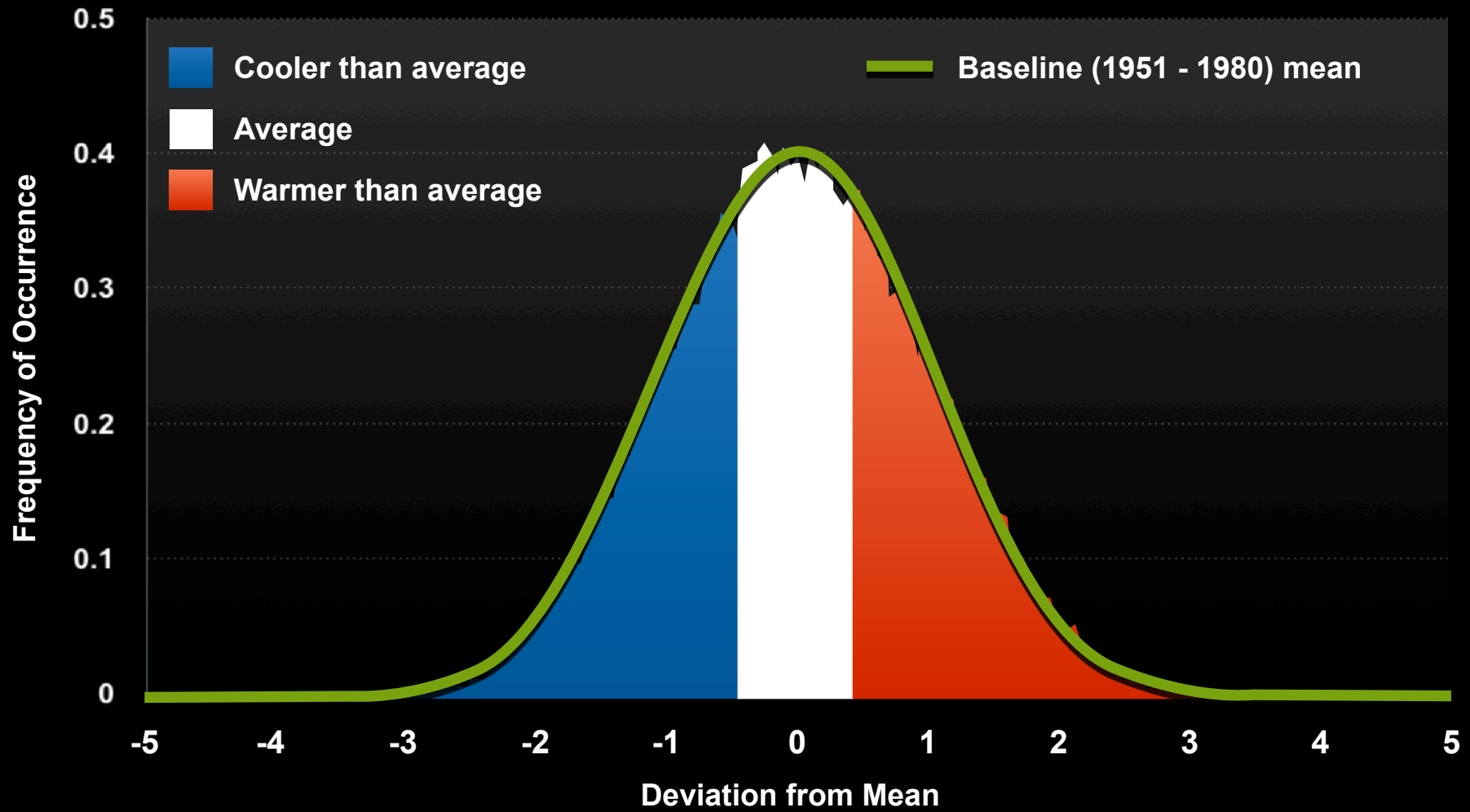
# Altadena Temperatures 1998-2013





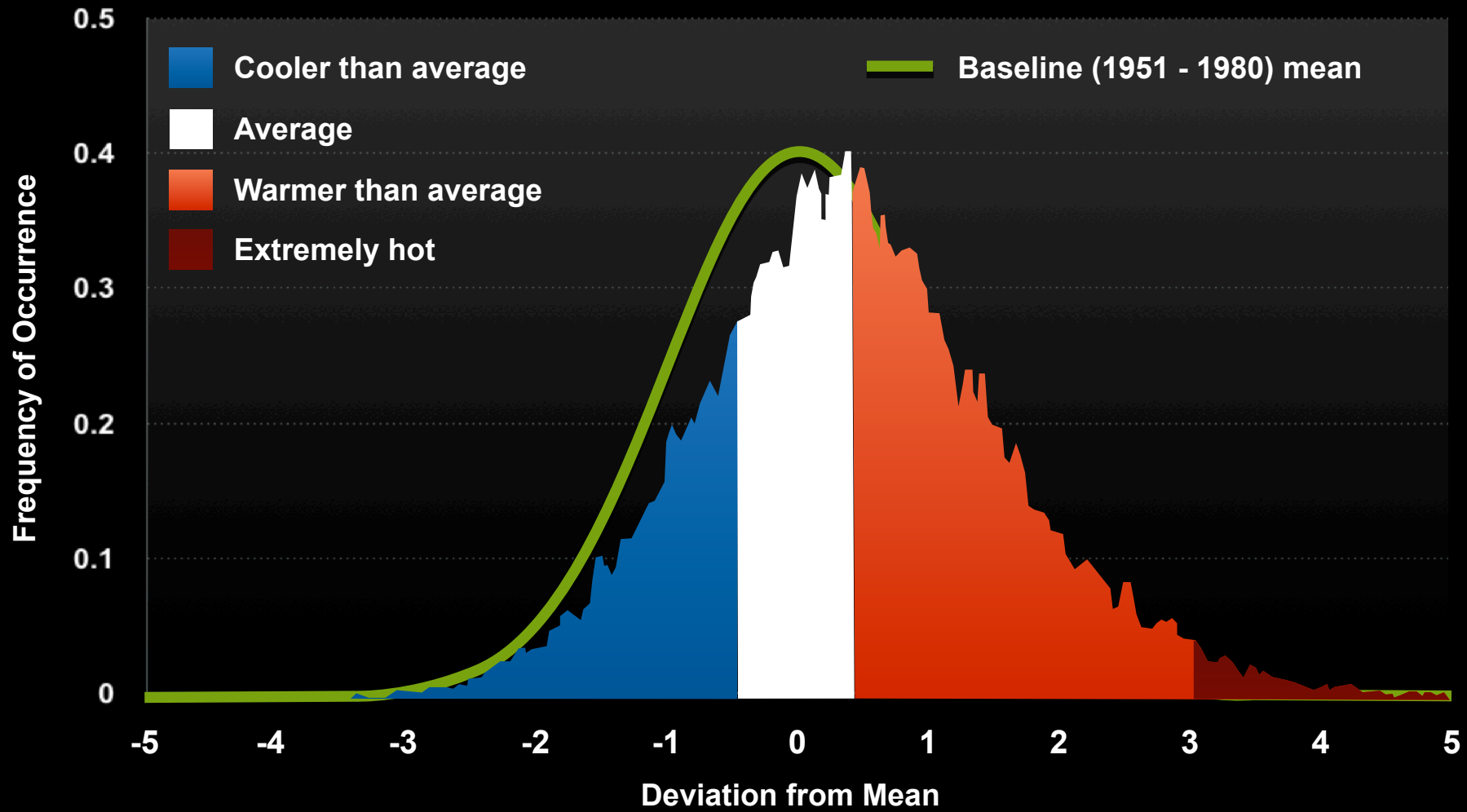
# Summer Temperatures Have Shifted

## 1951 – 1980



# Summer Temperatures Have Shifted

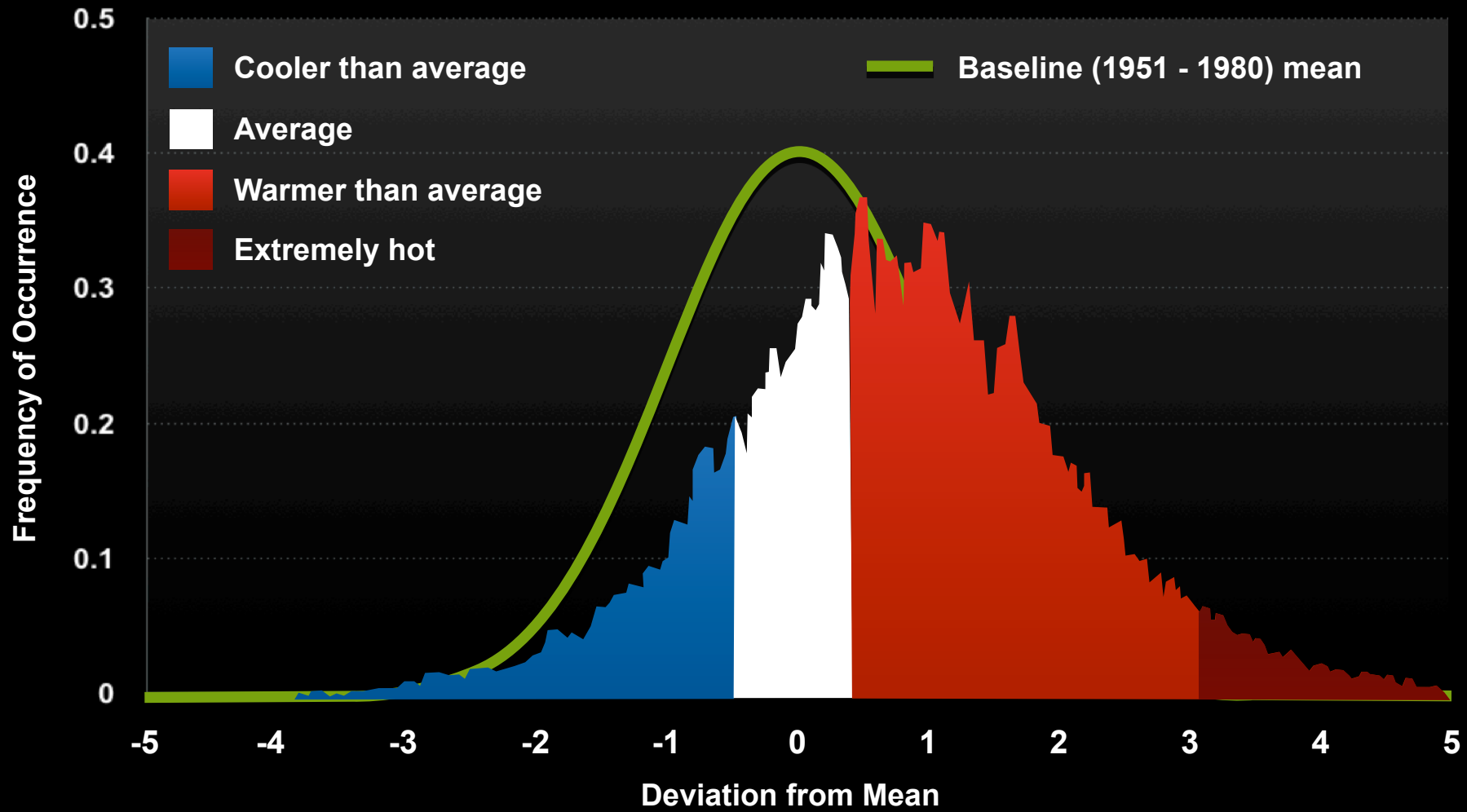
## 1981 – 1991





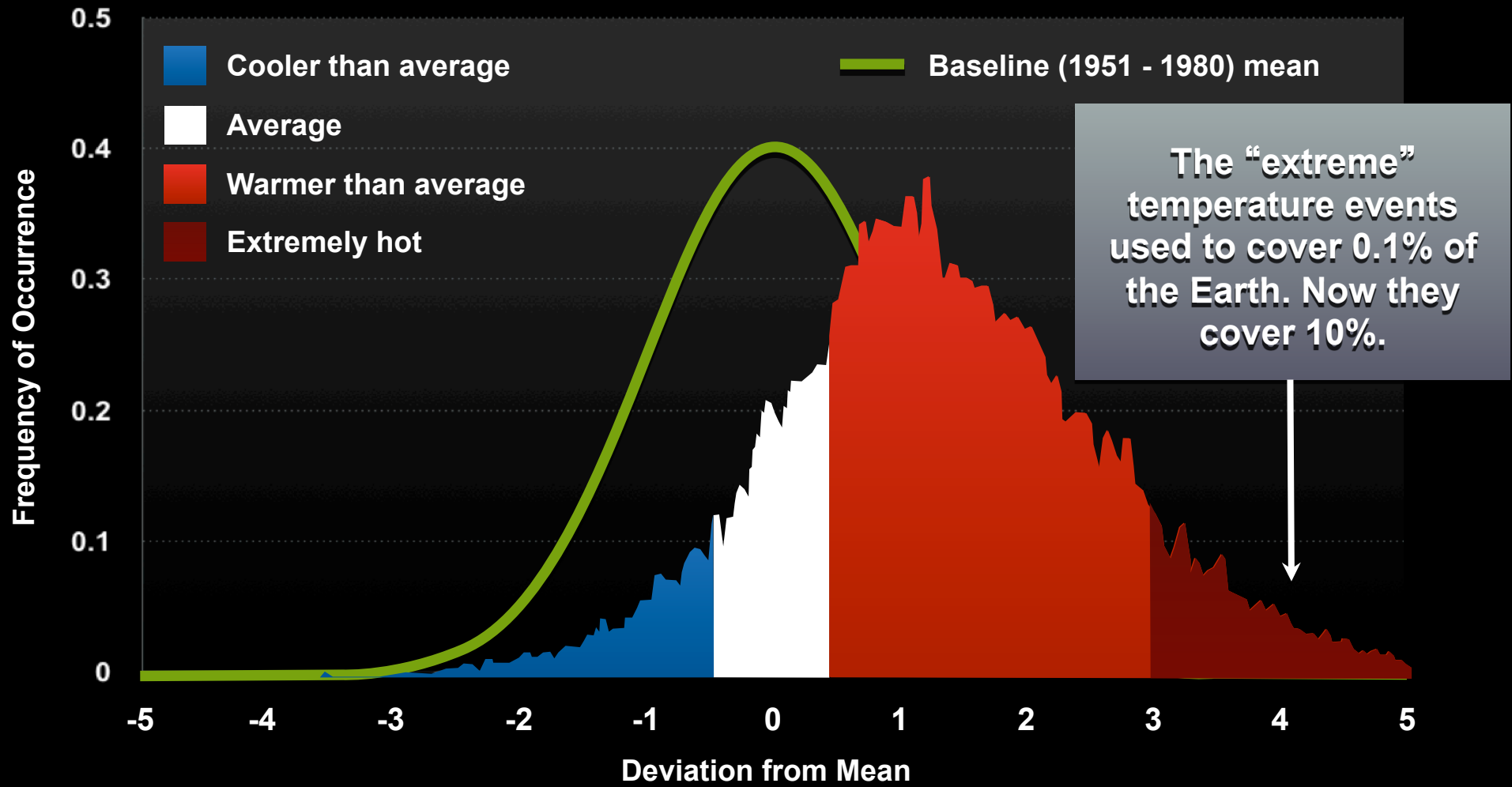
# Summer Temperatures Have Shifted

## 1991 – 2001

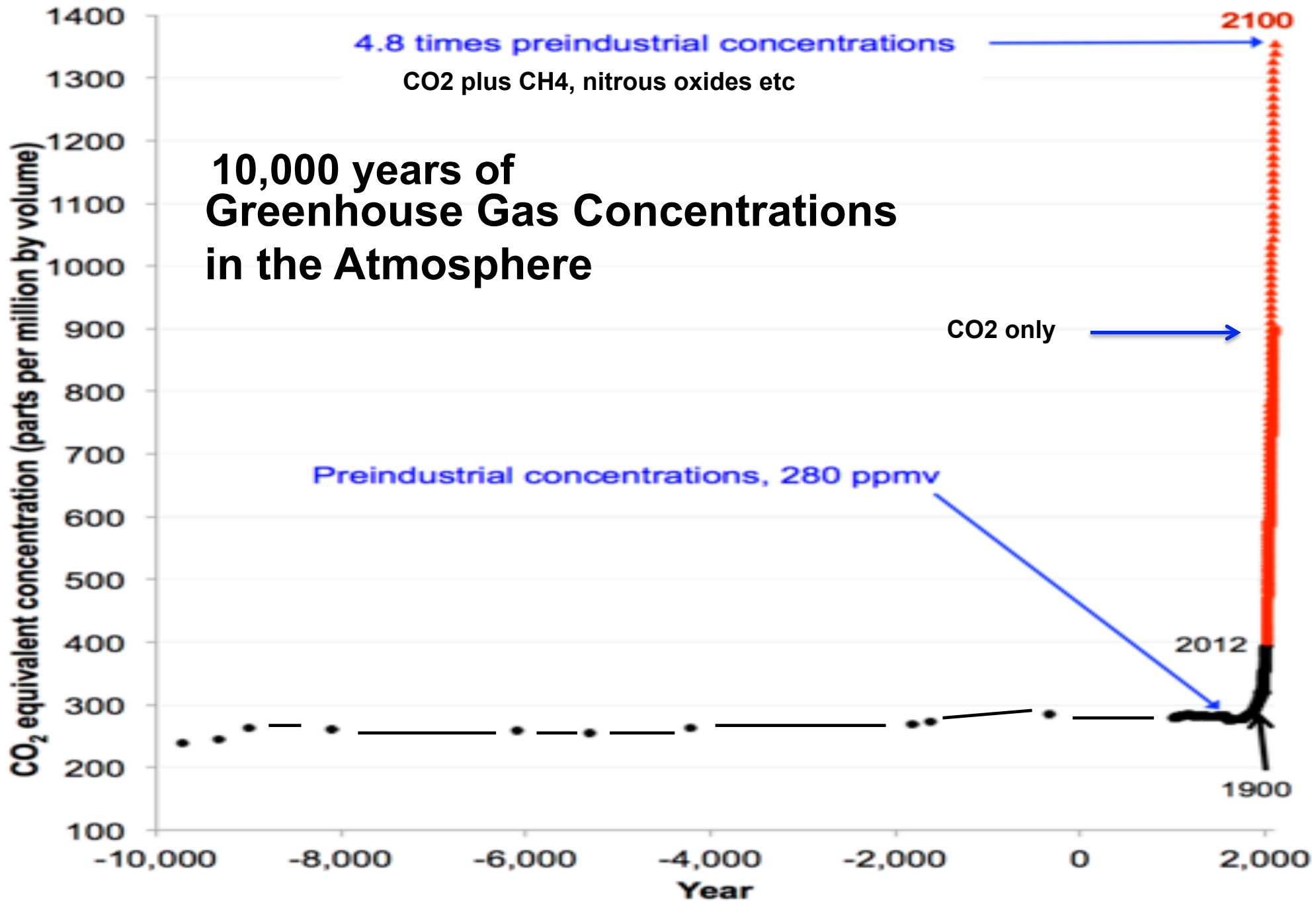


# Summer Temperatures Have Shifted

## 2001 – 2011

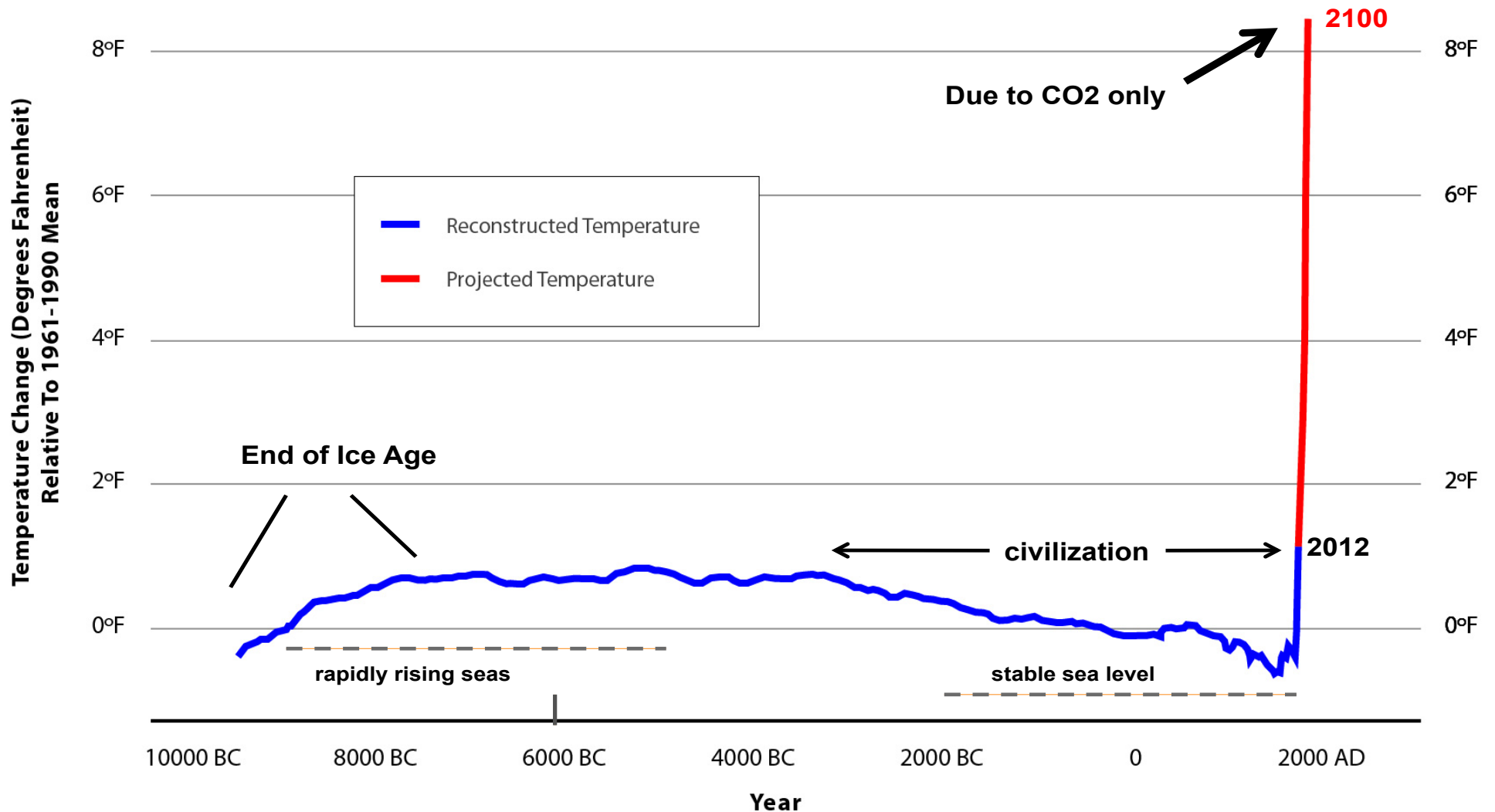






# 10,000 years of Global Average Air Temperature

wrt Mean Temp 1961-1990



Source: *Science & ClimateProgress.org*



**Where is the  
Heat Going?**

**Ice is Melting  
Everywhere**





# Alaska

## Columbia Glacier Retreat, 1984-2012



Source: USGS images as composed by Google Earth Engine

# Arctic Sea Ice Extent

September 1984

Russia

Greenland

Alaska  
(U.S.A)

Canada

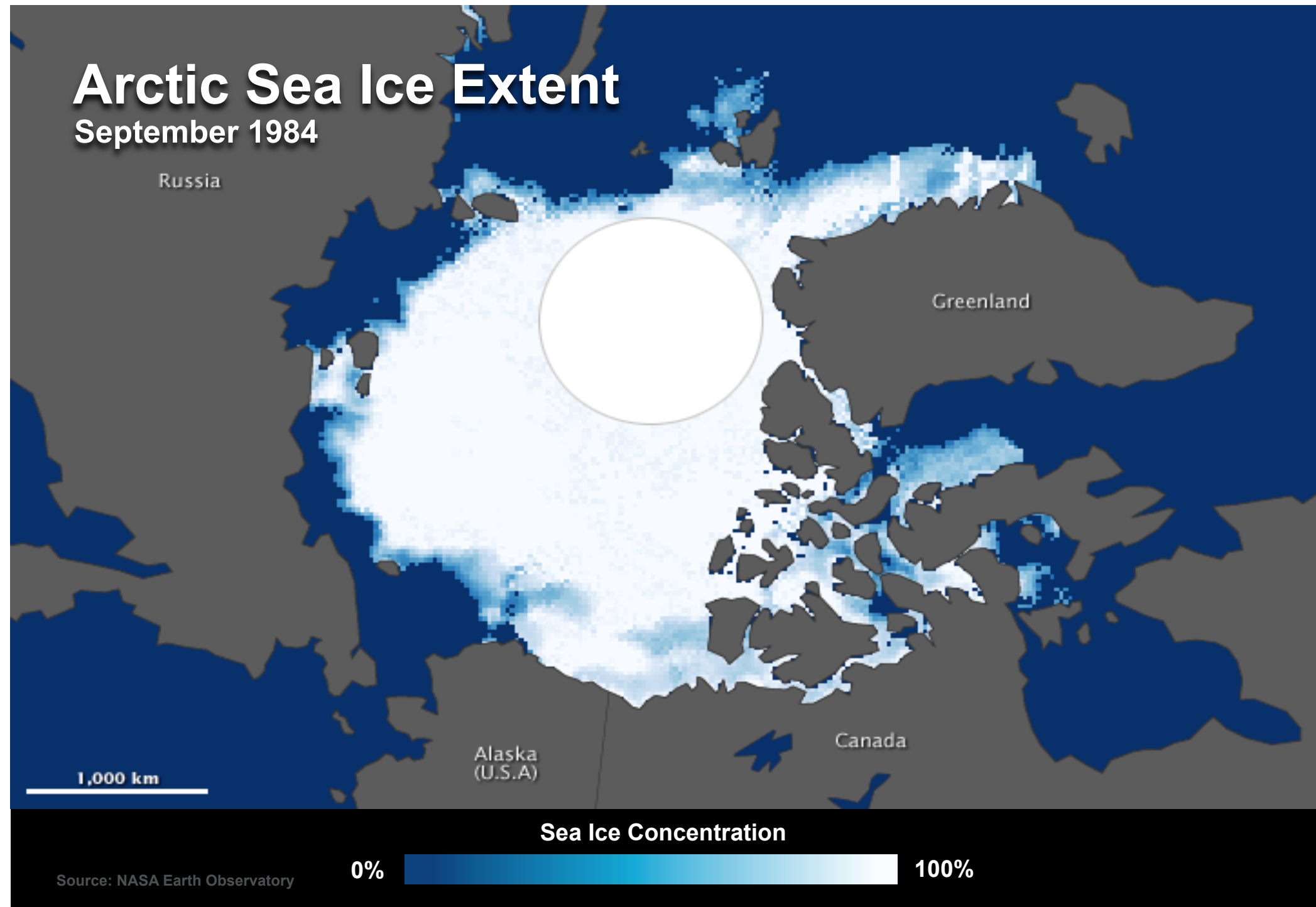
1,000 km

Sea Ice Concentration

0%

100%

Source: NASA Earth Observatory





**As global  
temperatures  
increase,  
Earth's water cycle  
intensifies**

**Higher temperatures ...**

**Melt Ice,**

**Cause Bigger, Harder Downpours,**

**and *Simultaneously* —**

**Cause Longer and Deeper  
DROUGHTS**



# Loire River, Ancenis, France

May 20, 2011





# Susita River, near the Danube River Romania

December 2, 2011



# Mississippi River, Vicksburg

August 22, 2012





# Rio Grande, New Mexico

August 4, 2013

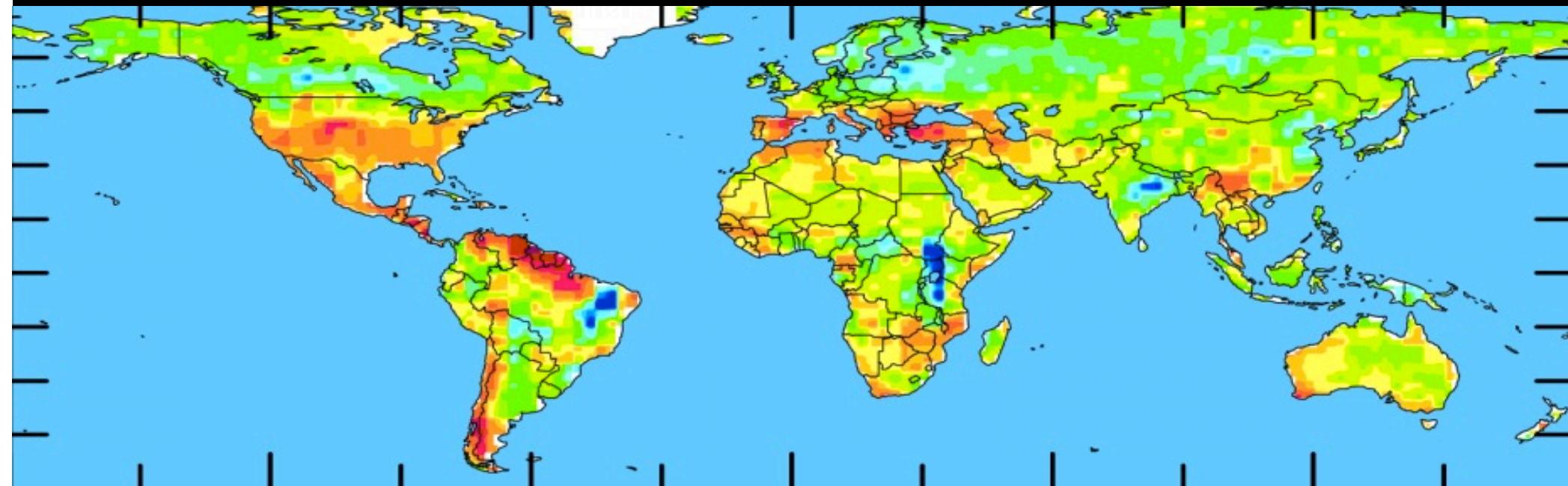


M.R. Chavez, Los Angeles Times



# Recent Drought Conditions, Worldwide

2000 – 2009



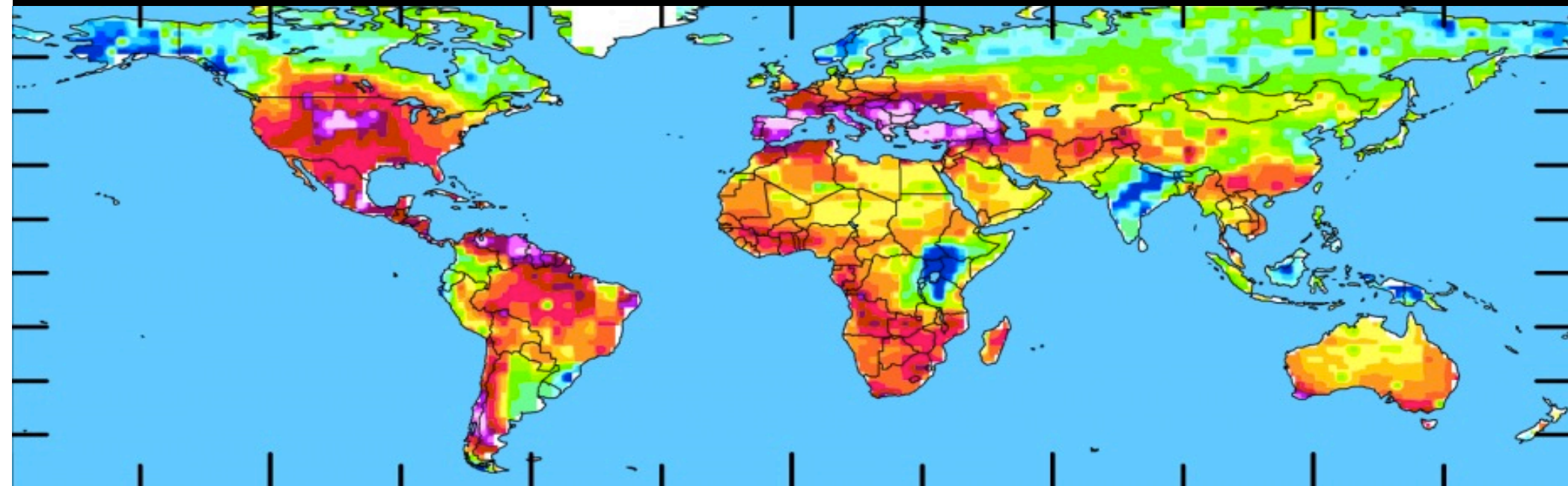
Dry



Wet

# Predicted Drought Conditions, Worldwide

2060 – 2069



Dry



Wet



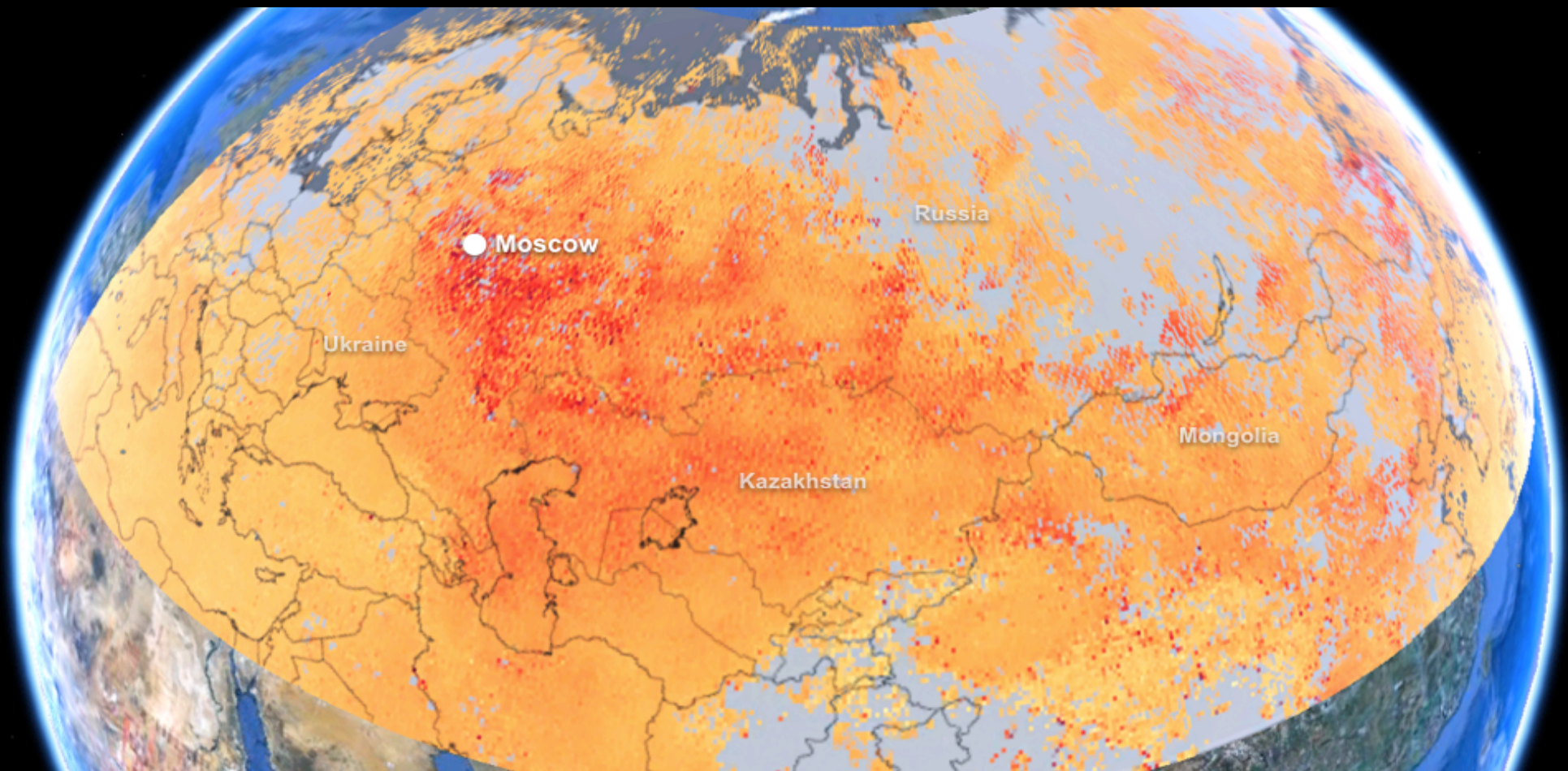
# Station Fire, San Gabriel Mountains

August 29 – September 6, 2009



# Wild Fires in Western Russia

August 1 – 8, 2010



Carbon Monoxide (ppbv)



© 2010 Google, TeleAtlas, Europa Technologies  
NASA, NCAR, University of Toronto MOPITT



# Rim Fire, Groveland, Calif.

Near Yosemite National Park

Aug 22, 2013



E. Joyce



# **Colby Fire, Angeles National Forest Glendora, Calif.**

**January 16, 2014**

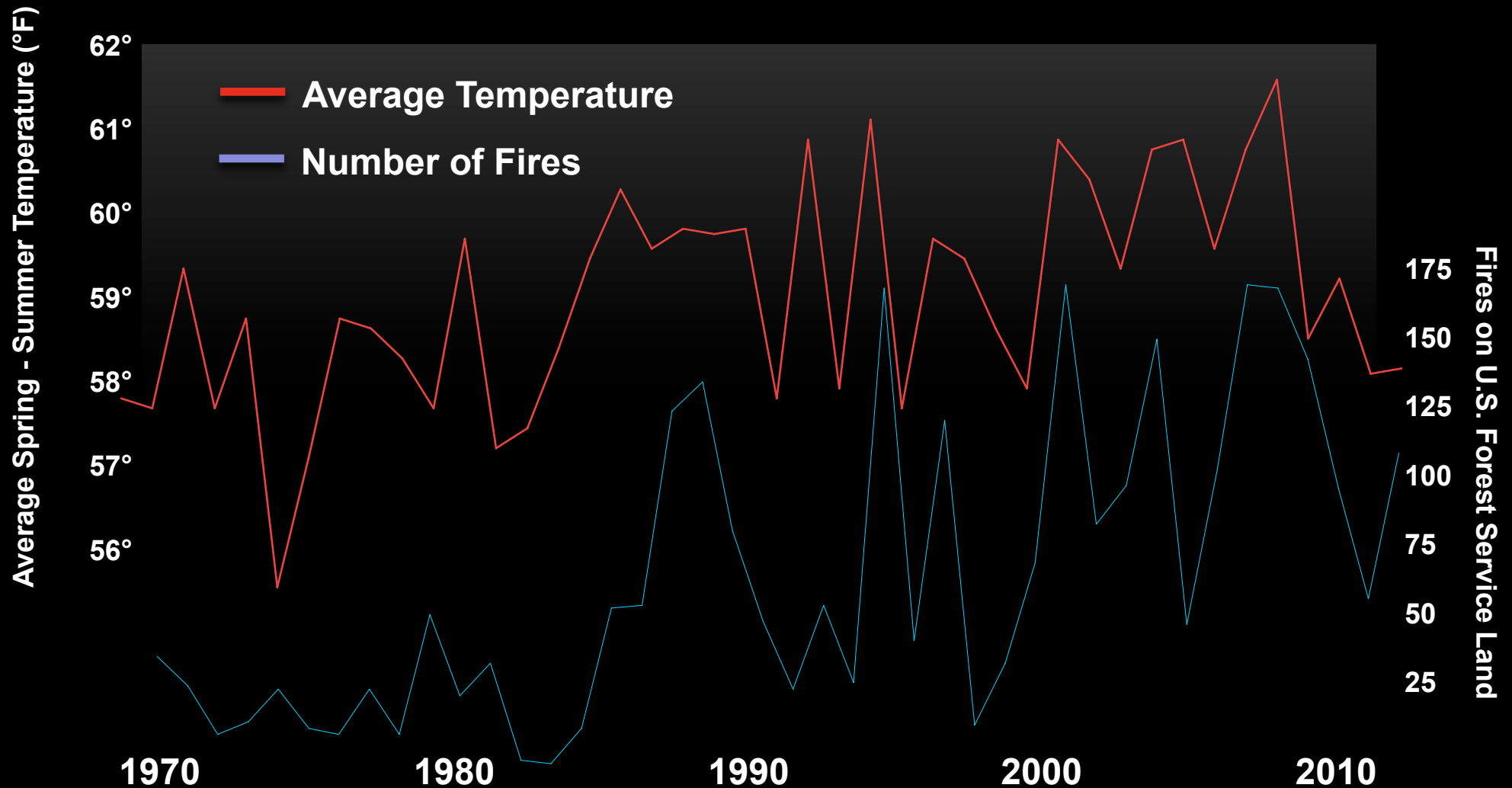
**January wildfires in California are highly unusual**





# Hotter Years Typically Have More Fires

40 Years of Western U.S. Fire and Temperatures

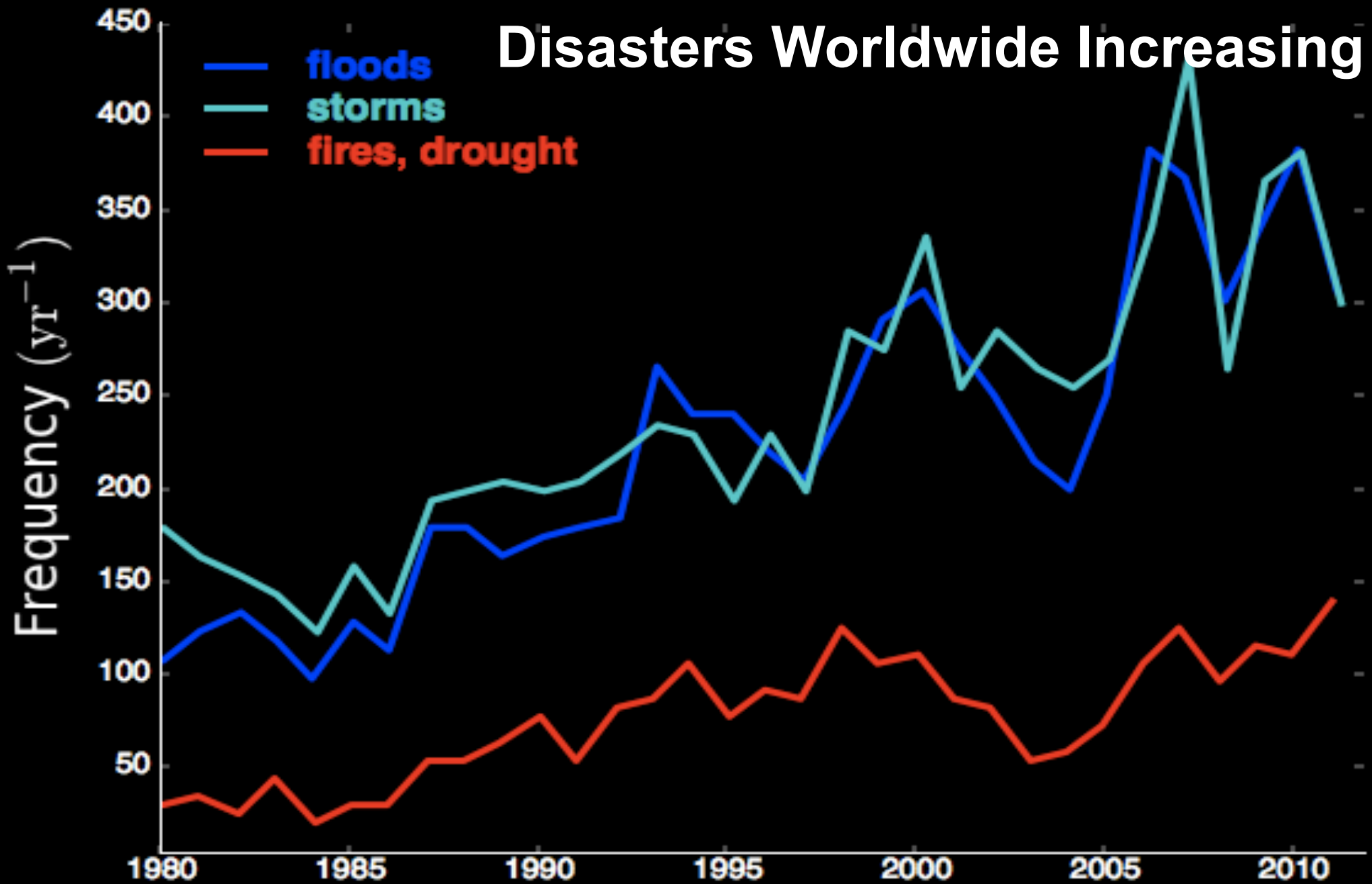


Data: Climate Central, "The Age of Western Wildfires," September, 2012

**What's this  
going  
to cost us?**



# Number of Weather-related Disasters Worldwide Increasing



# Los Angeles Times

*February 14, 2014*

**Severe winter weather  
estimated to cost  
U.S. economy nearly  
\$50 billion**



**Sea level is  
rising**

## **Real Estate & Habitat Losses**

### **Kiribati, South Pacific**

**April, 2012**





New Jersey shore

Nov 1, 2012

Sandy  
Storm Surge

