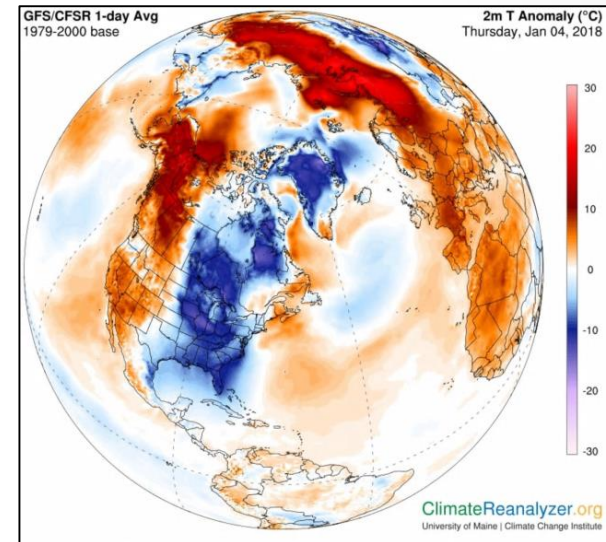
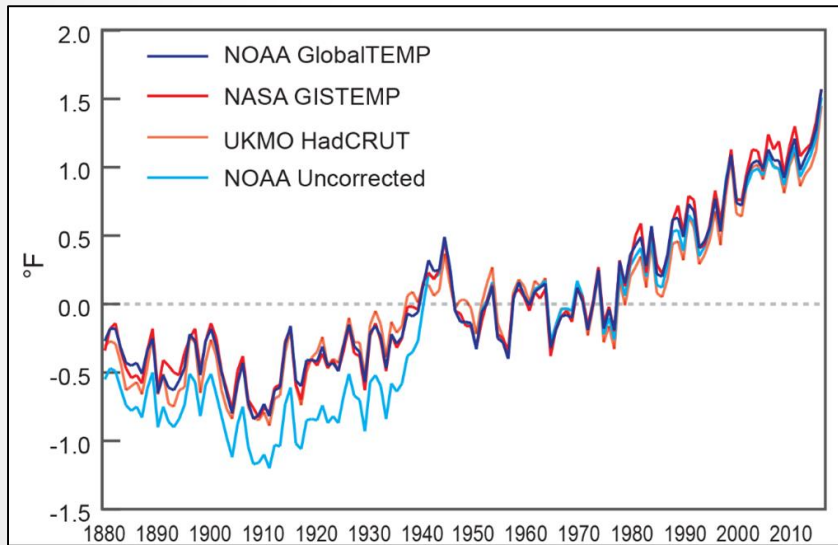


# Preparing Local Food Systems for Climate Change



Chris Skoglund, Climate and Energy Program  
NH Department of Environmental Services  
October 25, 2019

# Overview

- Presentation will:
  - Consider what is “climate”
  - Review local and state OBSERVED changes and impacts
  - Consider potential STATE and NATIONAL changes and impacts
- Review opportunities to respond
  - Considerations
  - Opportunities

# Key Ideas

1. Global warming and climate change are real, serious, and already happening.
1. The solutions to the problem exist now and will only become more cost effective.
1. Whether we chose the solutions that prevent the causes or manage the impacts is our choice.
1. Delayed action will increases the costs incurred.

# Background

- Climate and Energy Program Manager, NHDES
- Primary focus is encourage incorporation of climate change *mitigation* considerations into local, state, and regional energy planning and policy development.
- Secondary focus is to support incorporation of climate change *adaptation* considerations into local and state planning and policy.
- *Recent work on integrating climate considerations into food system policy and planning.*

# Background

- MS in Natural Resources (Climate Planning)
- BS in Biology
- Environmental Science Educator
  - Outdoor Educator (K-95)
  - Classroom Teacher (5<sup>th</sup> – 12<sup>th</sup>)
- Lab Tech
- Hospital Orderly
- Organic Farmhand
- Lifeguard
- Server and Busboy
- 

**Takeaway:** I have no delusions of grandeur, so please interrupt me with questions.

I have also taught 7<sup>th</sup> grade so I am tougher than I look.

**It's been a tough couple of  
years ...**

# 2017 Was A Year For the Record Books

## Hurricane Harvey - Houston



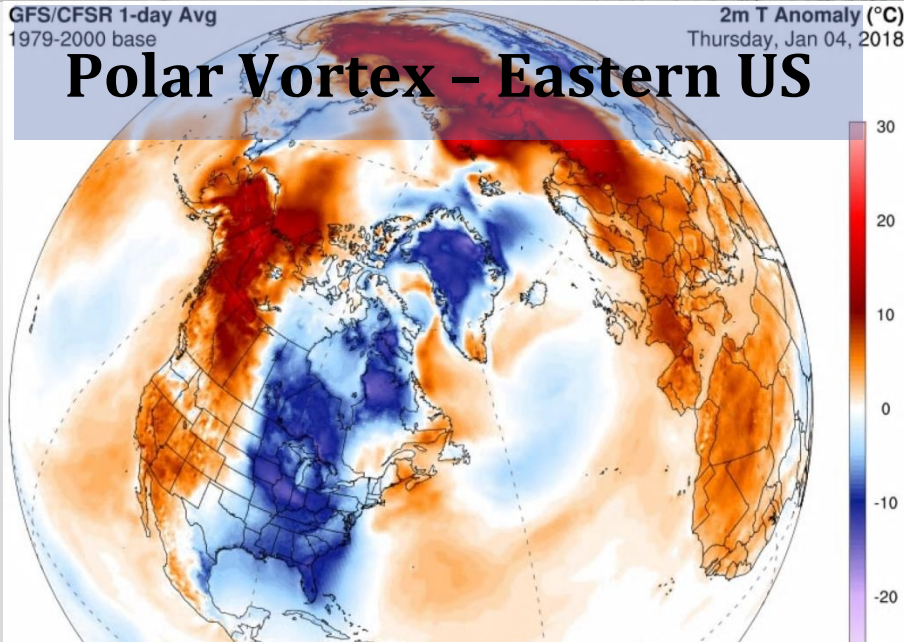
## Hurricane Maria - Puerto Rico



GFS/CFSR 1-day Avg  
1979-2000 base

2m T Anomaly (°C)  
Thursday, Jan 04, 2018

## Polar Vortex - Eastern US



## Widespread Wildfires - California



# 2018 Was A Year For the Record Books

## Tropical Storm Florence - North Carolina



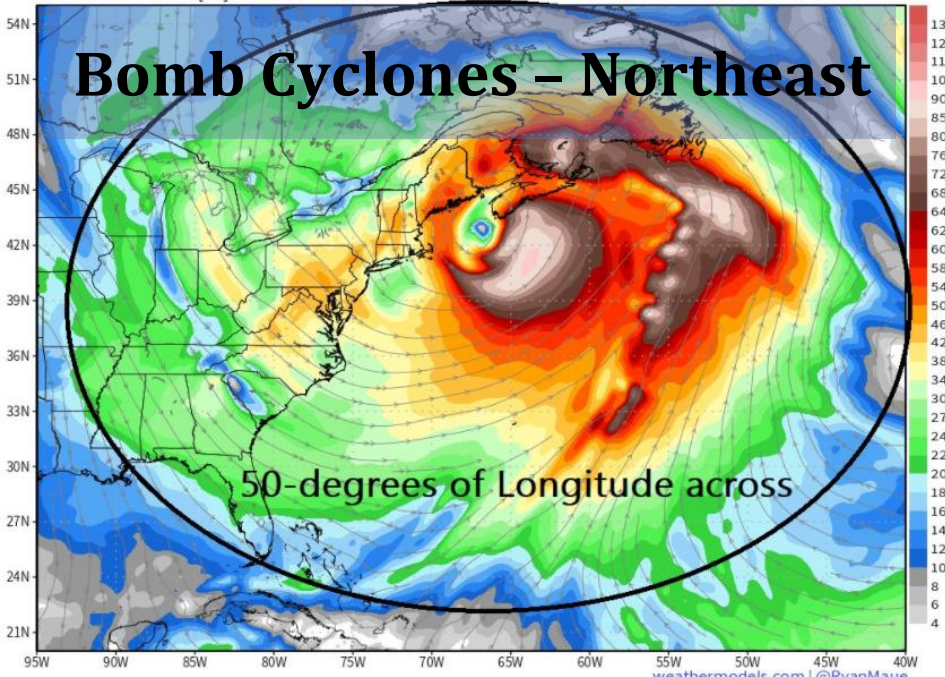
## Hurricane Michael - Florida



NCEP GFS 850 hPa Wind Speed [knots]  
Init: 18Z02JAN2018 -- [54] hr -> Valid Fri 00Z05JAN2018

MIN|MAX MSLP: 958.3 | 1039.2 hPa  
MAX WIND: 92.1 knots

## Bomb Cyclones - Northeast



## Wildfires - California



10/25/2018



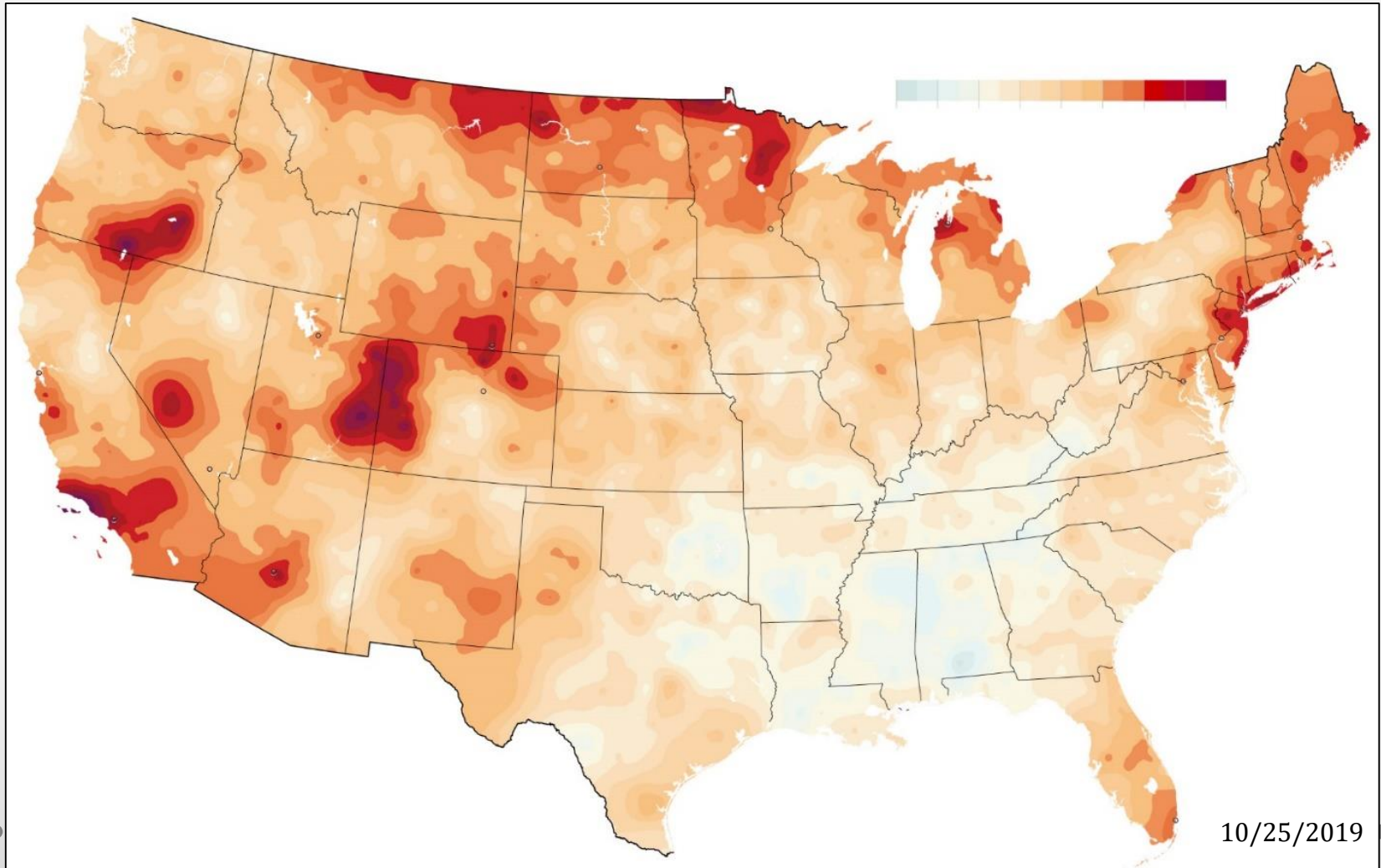
**2019??**

**It's been a tough couple of  
Months ...**

# “2°C: Beyond The Limit

Extreme Climate Change Has Arrived In America”

The Washington Post, August 13, 2019

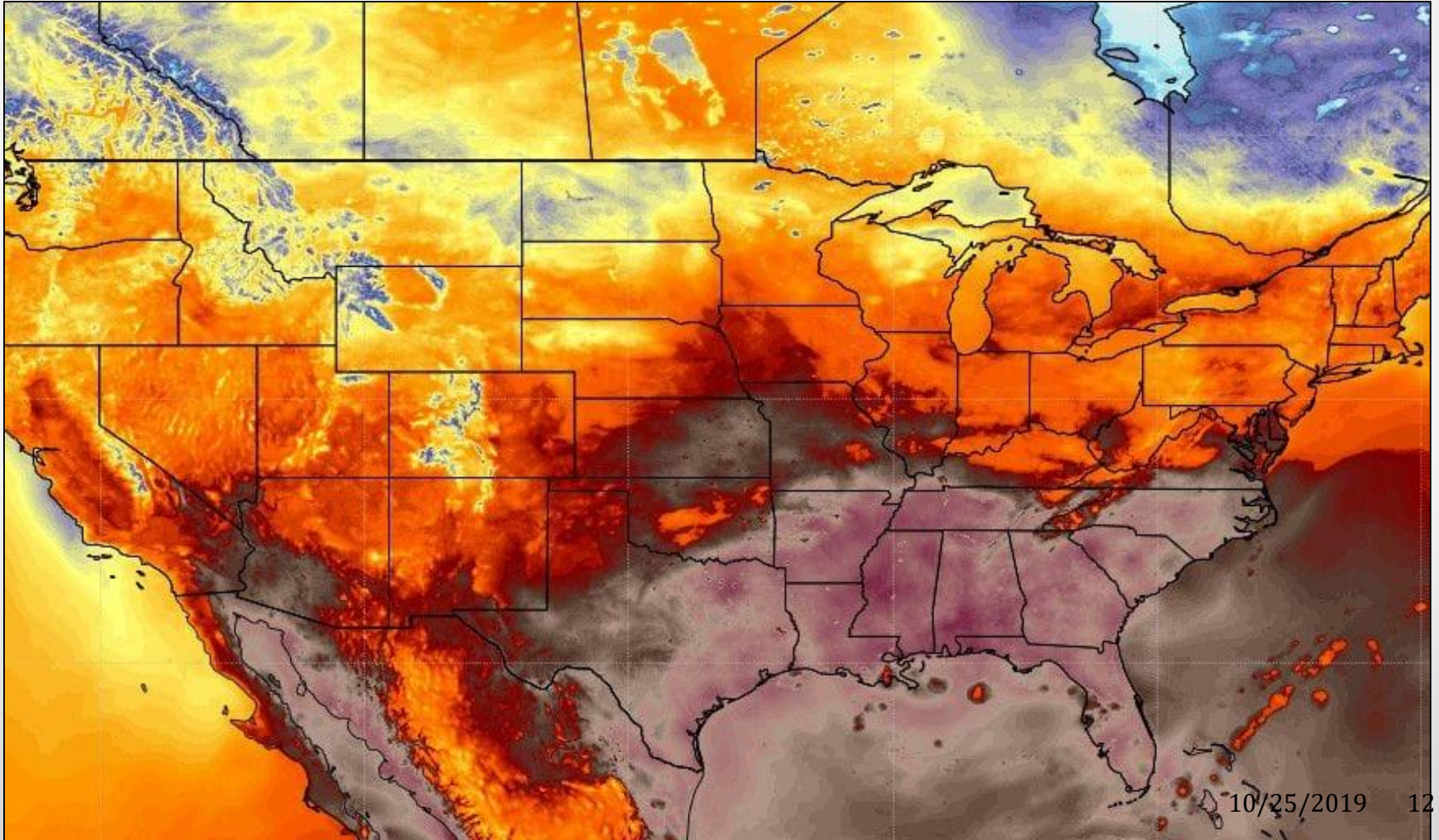


# **“Here’s How The Hottest Month [July] In Recorded History Unfolded [In] The World” Washington Post, August 5, 2019**



# “Coming Soon: Even Higher Heat Indexes”

The Washington Post, August 13, 2019



# **“Tree-damaging Pests Pose ‘Devastating’ Threat To 40% Of US Forests”**

**The Guardian, August 12, 2019**



# **“Unprecedented' Wildfires Burned Across the Arctic Circle In June”**

**Vice, July 4, 2019**



# **“1 Million Animal And Plant Species Are At Risk Of Extinction, U.N. Report Says”**

**NPR, May 6, 2019**



# **“Insect 'Apocalypse' In U.S. Driven By 50x Increase In Toxic Pesticides”**

## **National Geographic, August 6, 2019**



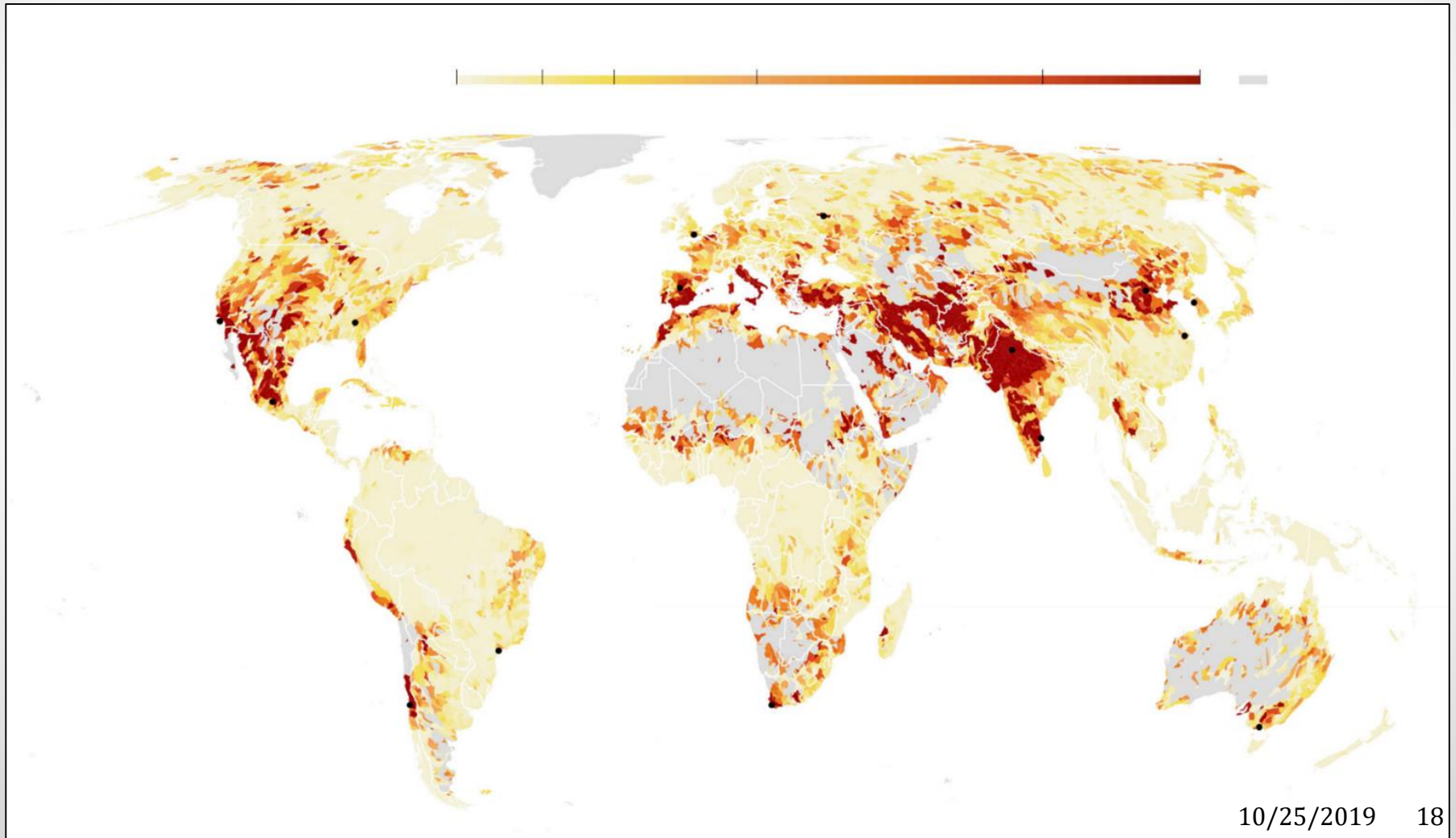


# “Changing Climate Imperils Global Food And Water Supplies, New U.N. Study Finds”

## Washington Post, August 6, 2019



# “A Quarter of Humanity Faces Looming Water Crises” The Guardian, August 6, 2019



# **“Another Historic Low For Corn Planting As 'Billion-dollar Disaster' Looms” Accuweather, June 6, 2019**



# **“No Industry Will Be Impacted By Climate Change Worse Than Agriculture”**

**The Hill, August 15, 2019**



# “People Are Dying’: How The Climate Crisis Has Sparked An Exodus To The Us”

The Guardian, July 29, 2019

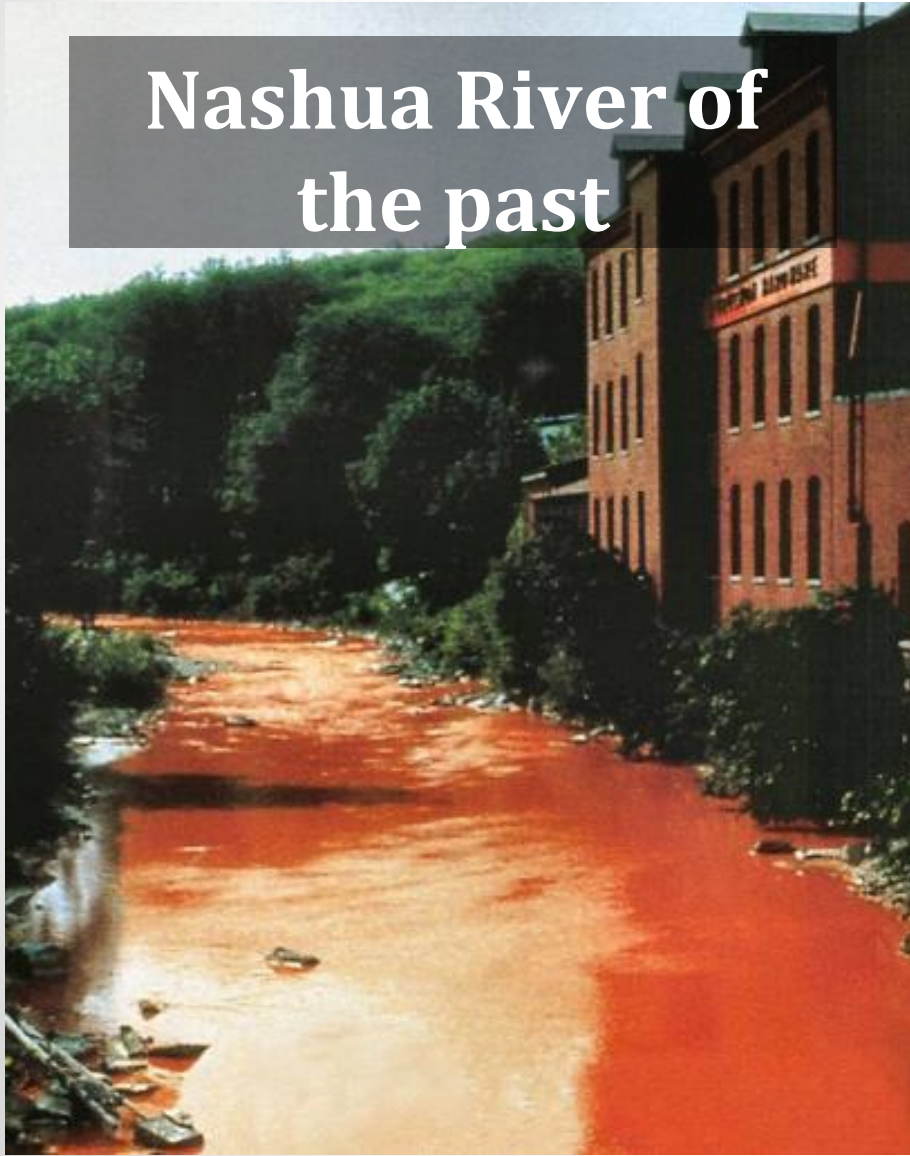


# Uhhmm.... OK, now what?

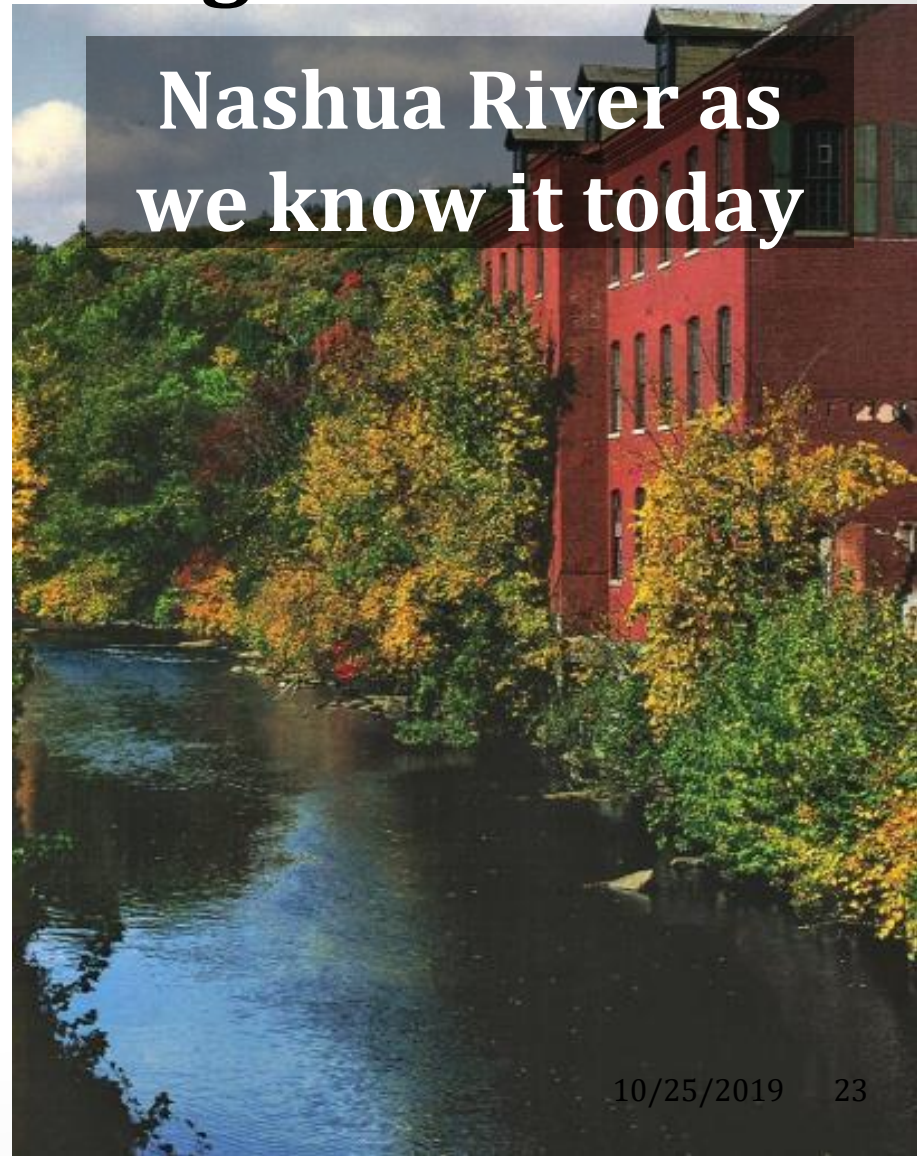


# DEEEEP Breath ... Remember We Have Made Great Progress

Nashua River of  
the past



Nashua River as  
we know it today



# **CURRENT Human Activities Causing Complex Interrelated Issues**

- Chemical use and pollution
- Population growth
- Resource consumption
- Ecosystem degradation
- Biodiversity loss
- Food security
- Economic inequality
- Public health issues
- Climate change



# CURRENT Human Activities Causing Complex Interrelated Issues

- Chemical use and pollution
- Population growth
- Resource consumption
- Ecosystem degradation
- Biodiversity loss
- **Food security**
- Economic inequality
- Public health issues
- **Climate change**

- **Complex**
- **Interrelated**

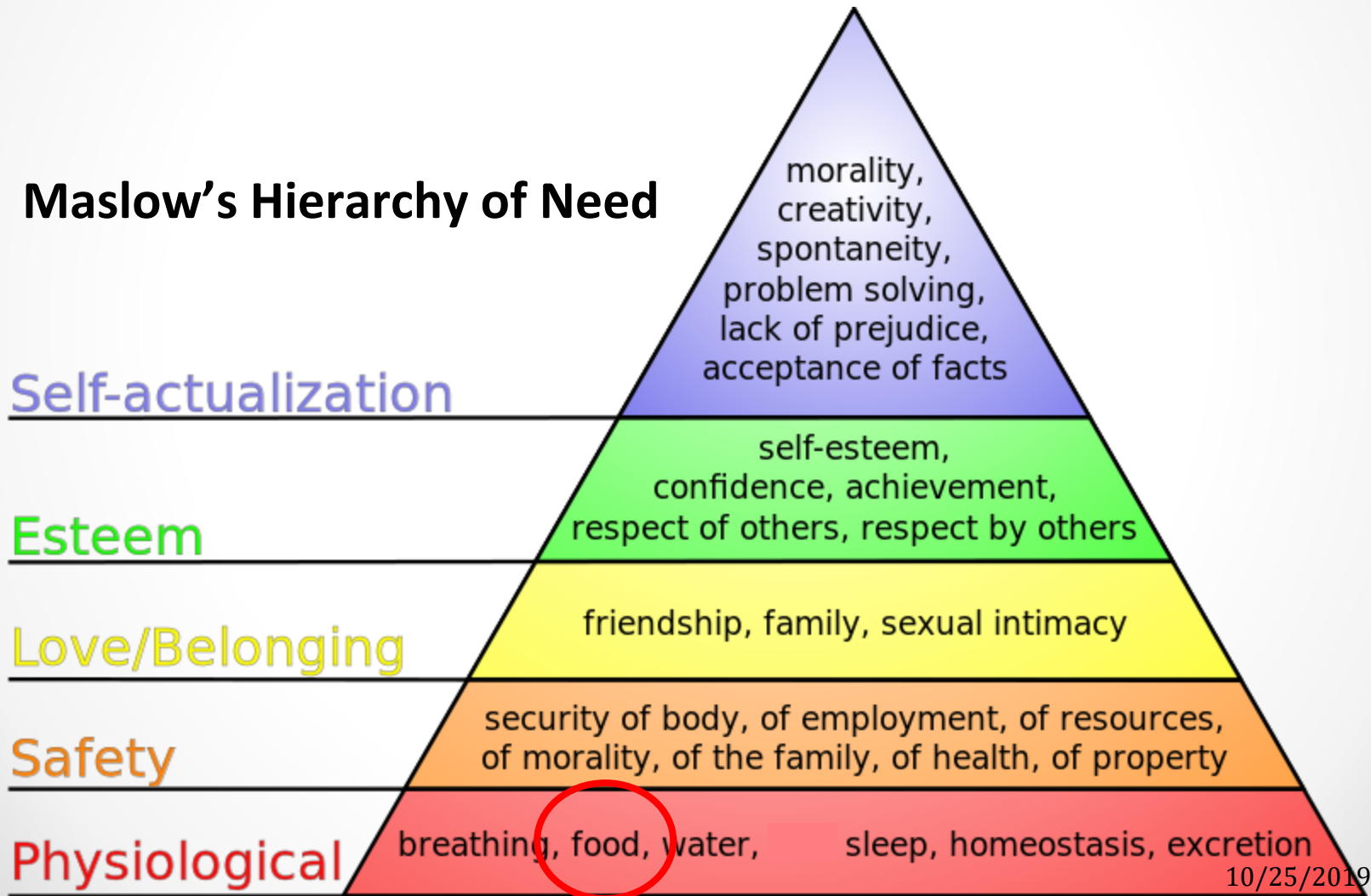
# Why Food?

In any extreme situation, you cannot survive for more than:

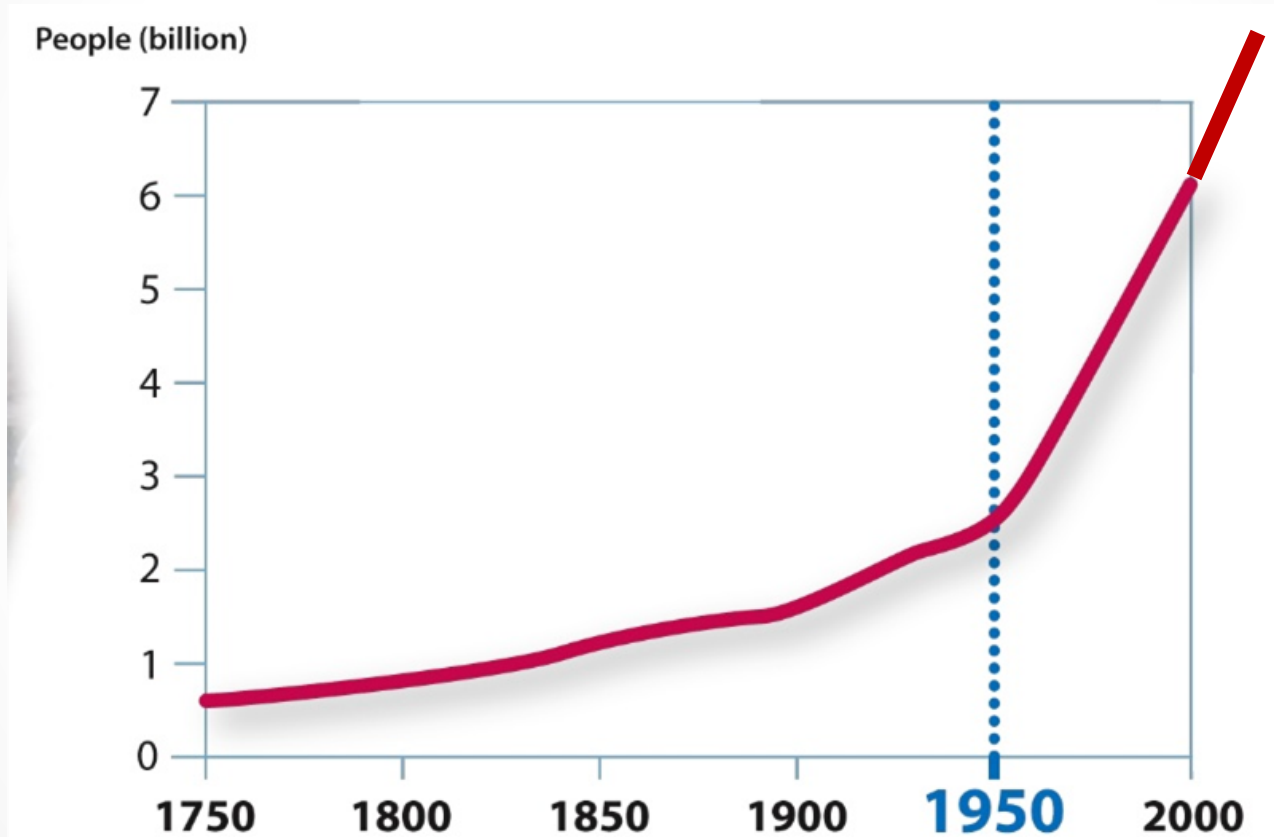
- 3 minutes without air
- 3 hours without shelter
- 3 days without water
- 3 weeks without food

# No Food. No Self. No Society.

## Maslow's Hierarchy of Need



# Risk to Food Supply Global



US Bureau of the Census (2000) International database  
IGBP synthesis: Global Change and the Earth System, Steffen et al 2004

# Risk to Food Supply

## New England

### New England Food Supply

50% the acreage required to produce its vegetables

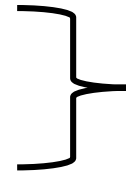
25% of the acreage for its fruits

50% of dairy consumption (~85% of the farmland)

2.5% of its grain, oils, sugar, beverage crops, and other food

5% of beef consumption

Small amounts of poultry and pork



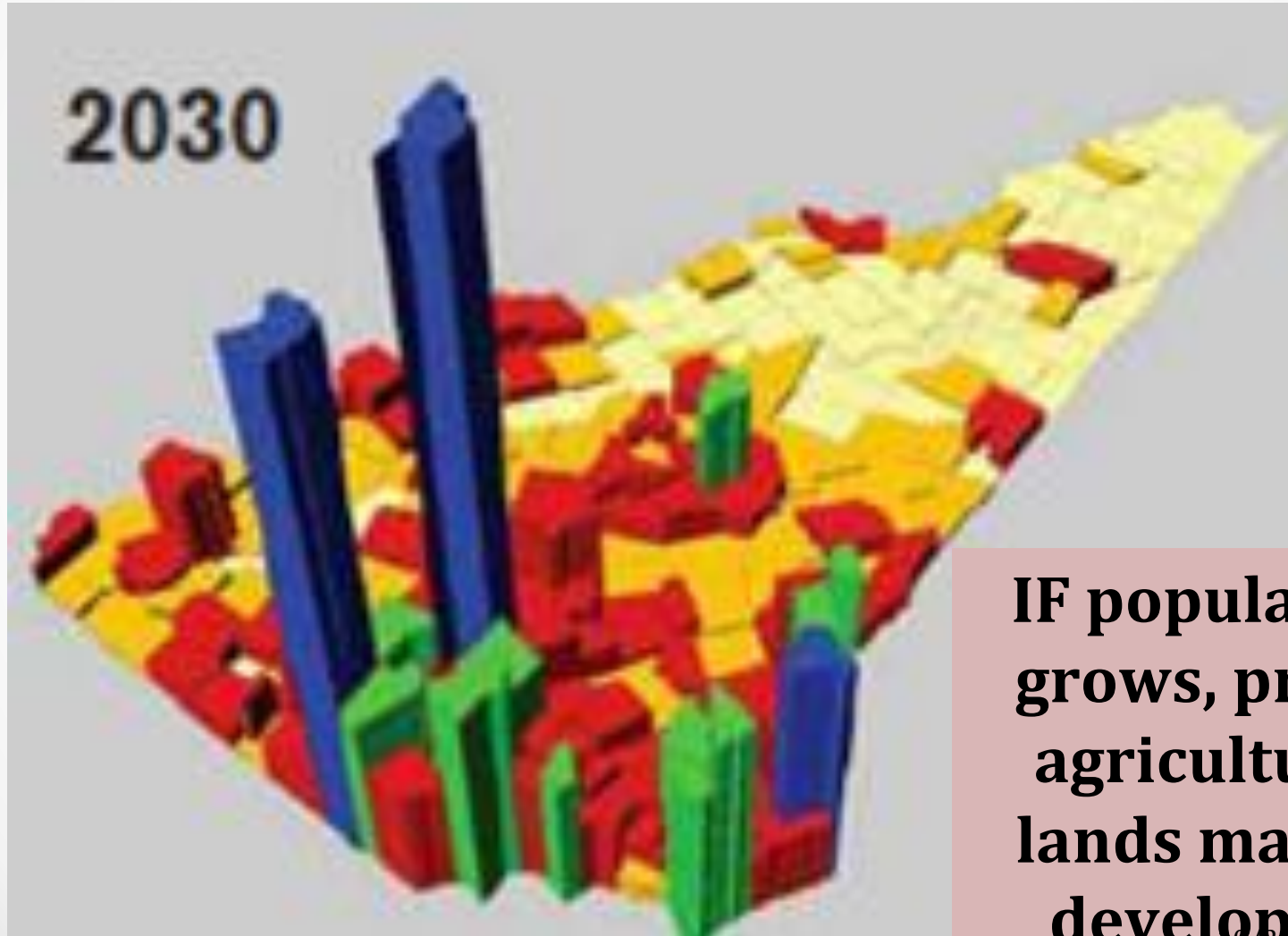
**Feed grain is almost  
entirely imported**

On an acreage basis, New England farmland supplies 12% of the region's food.

### New Hampshire Food Supply

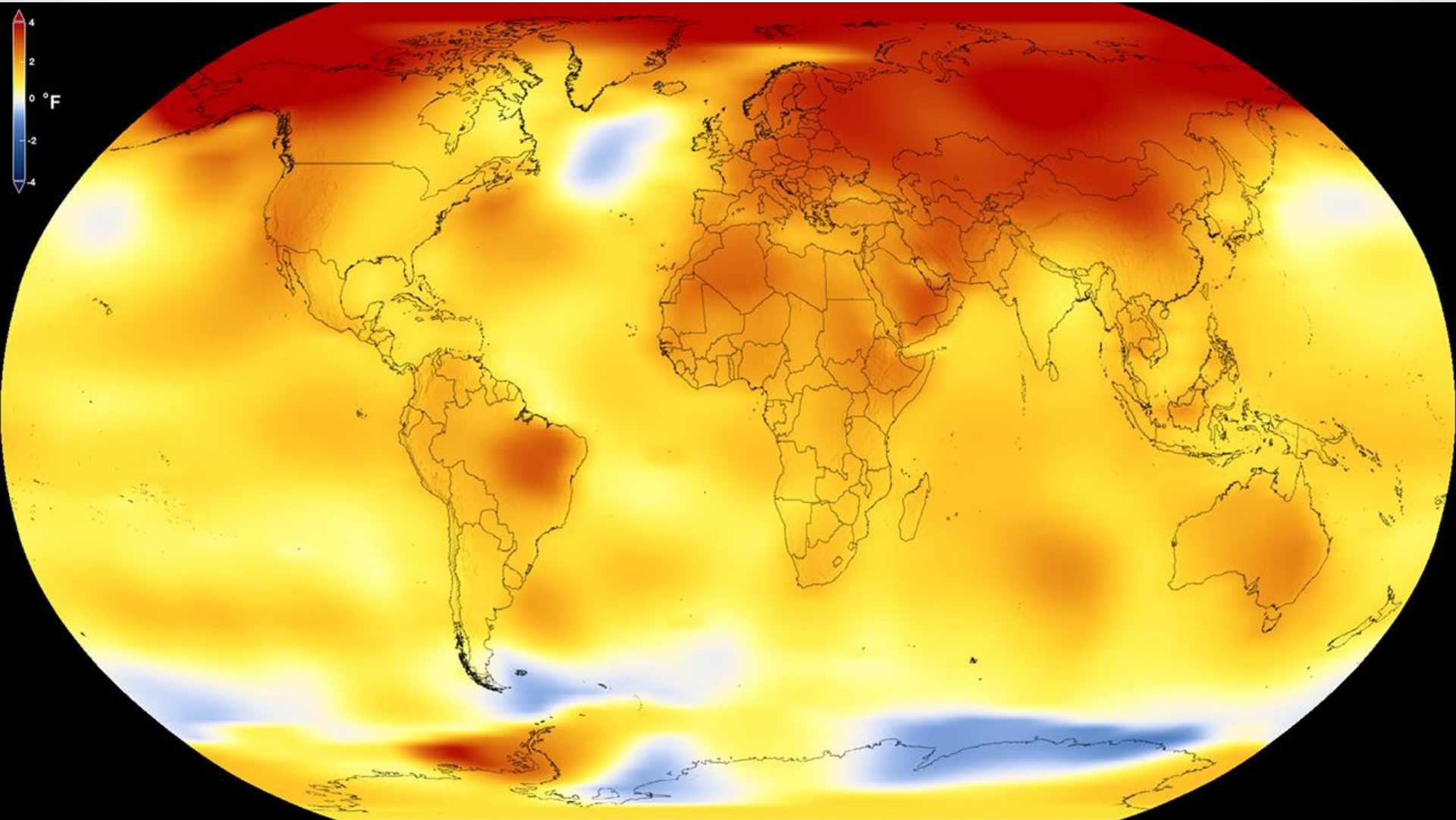
**3 days supply of food on hand in state**

# Risk to Food Supply New Hampshire



**IF population grows, prime agricultural lands may be developed.**

# Why Climate Change? It's A Threat Multiplier



**Natural  
Conditions**

**Human Activity**

**Increasing  
Global  
Temperatures**

To address climate change, we  
must understand how the pieces  
are related.

**Response**  
(Management)

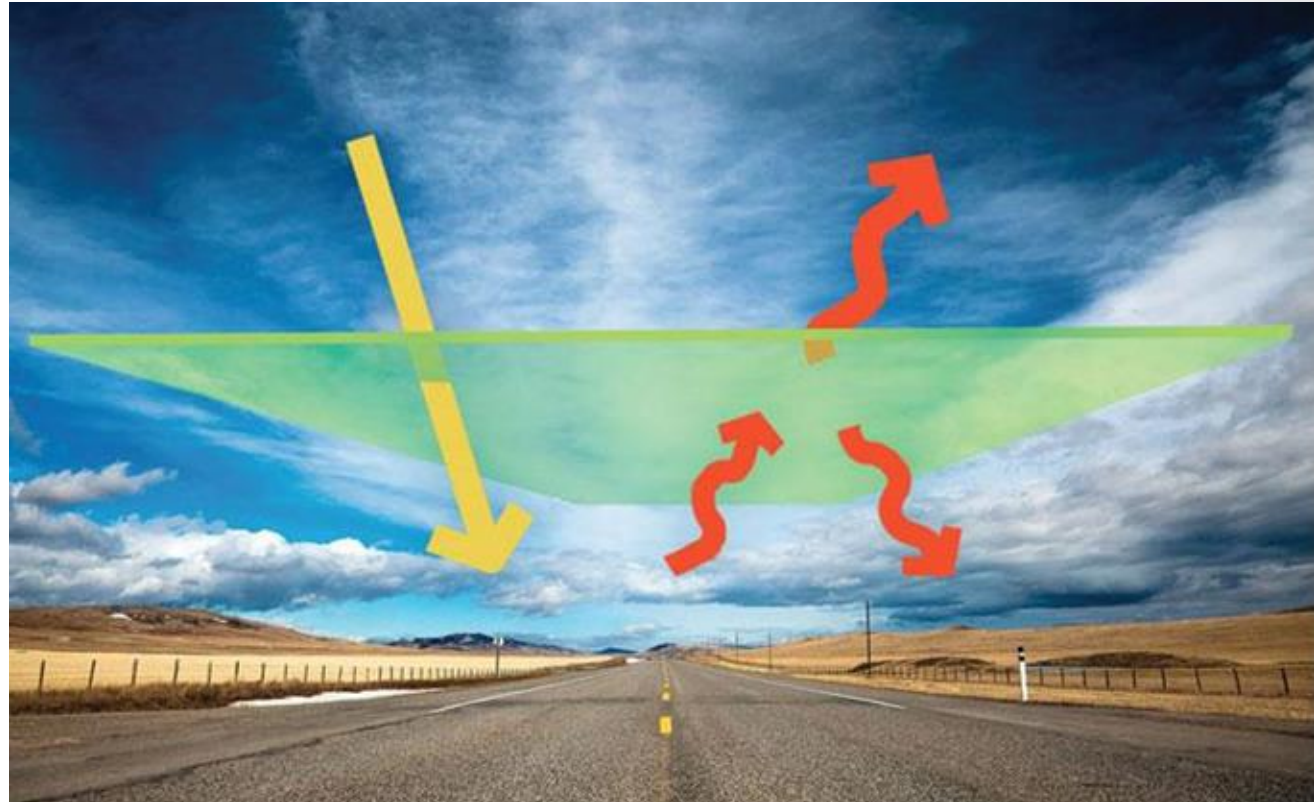
**Impact of  
Trends in NH**

**Impact of  
Warming  
Trends**



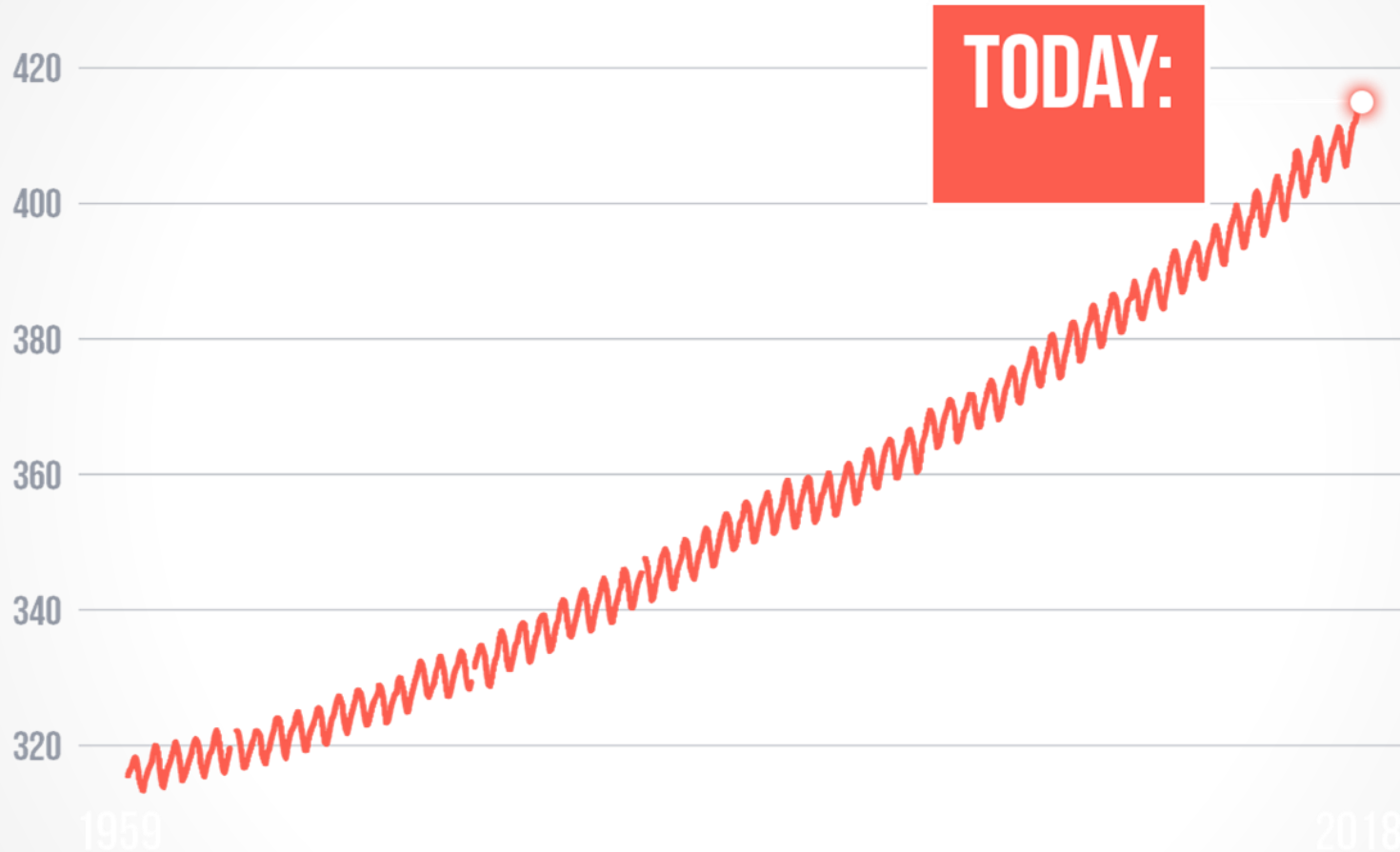
# **Natural Conditions: The Science of Climate**

# The Atmosphere Works Like a Blanket



## The Greenhouse Effect

# Atmospheric Carbon Dioxide Record



Source: NOAA ESRL ([esrl.noaa.gov](http://esrl.noaa.gov)), Mauna Loa Observatory

CLIMATE  CENTRAL

Source:

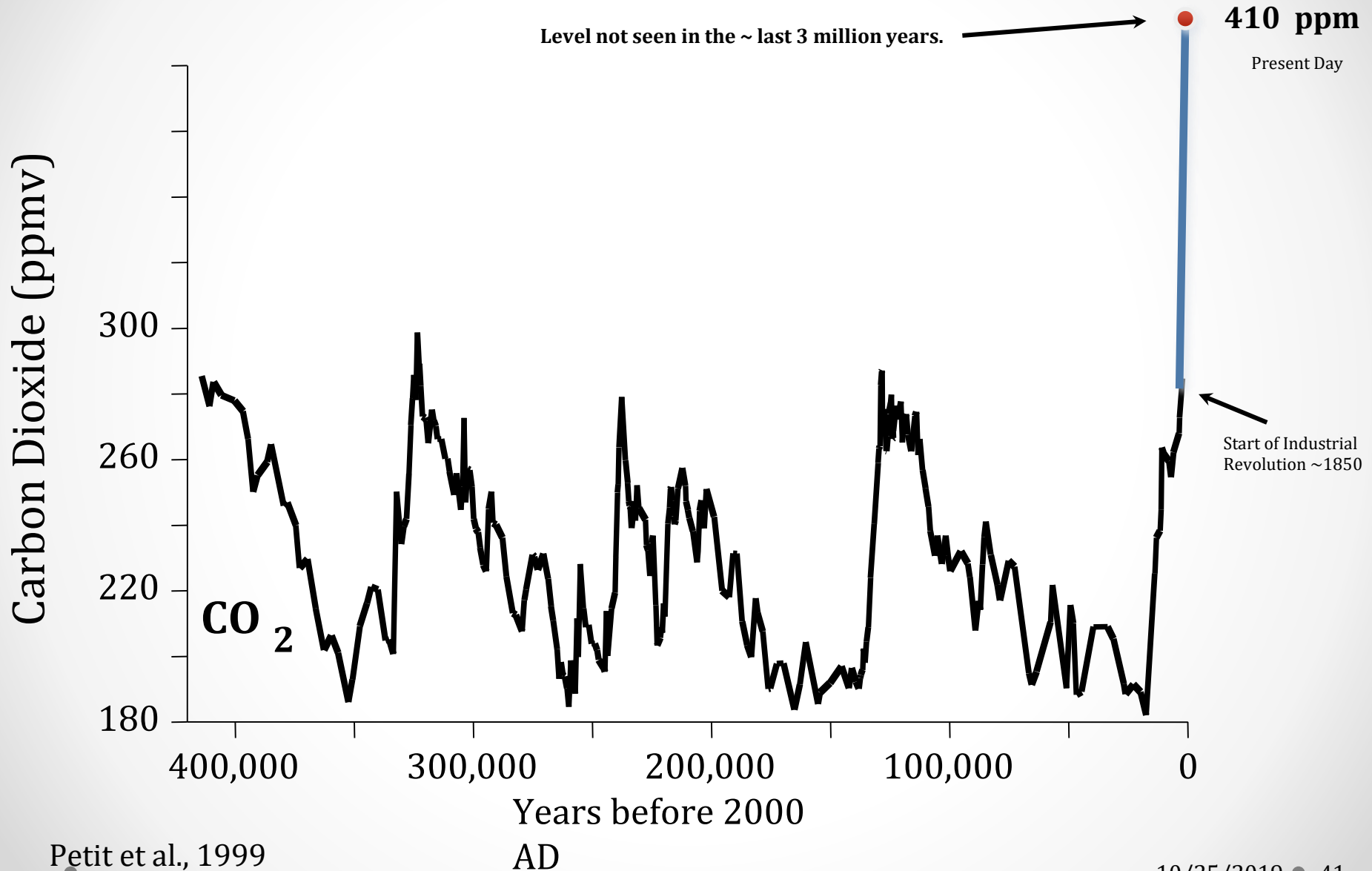
# Human Activities are Making the “Blanket” Thicker

The sources included:

1. fossil fuel combustion;
2. industrial processes;
3. landfills and wastewater treatment;
4. agriculture; and
5. land use change.



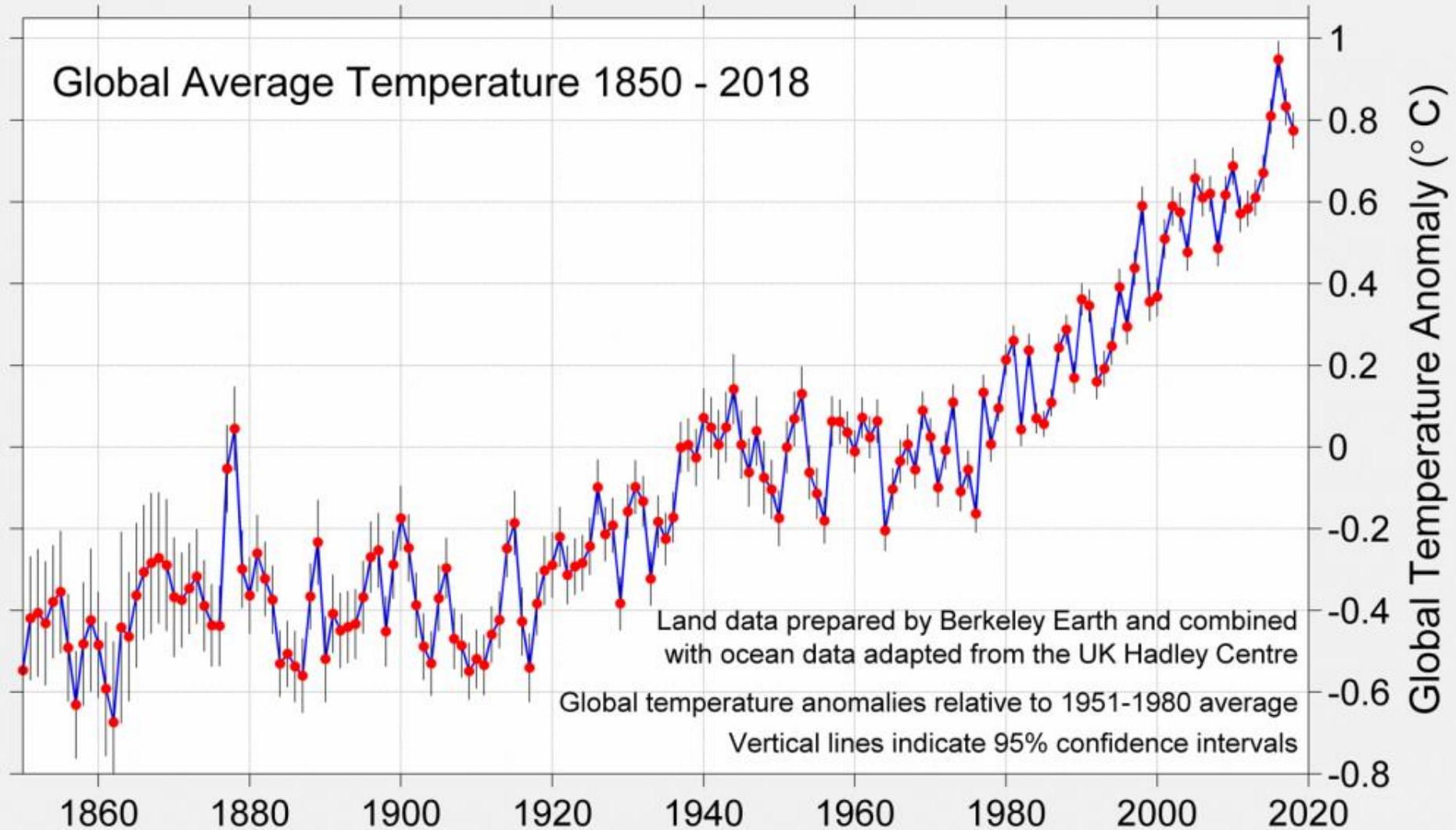
# Atmospheric Carbon Dioxide Record



Petit et al., 1999

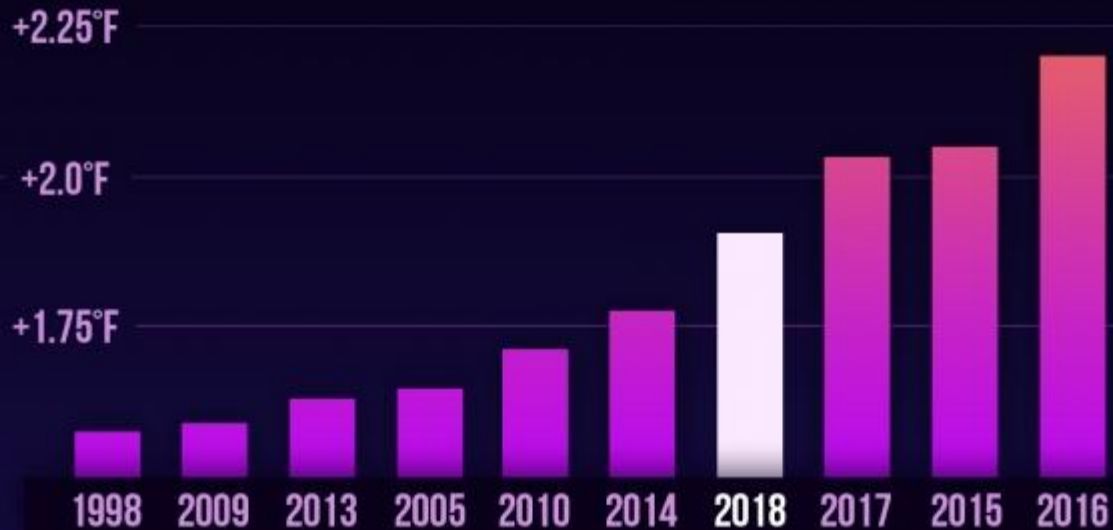
# **Increasing Global Temperature**

# Increasing Global Average Temperature



# Increasing Global Average Temperature 1880-2018

## HOTTEST YEARS ON RECORD GLOBALLY LAST 5 = HOTTEST 5

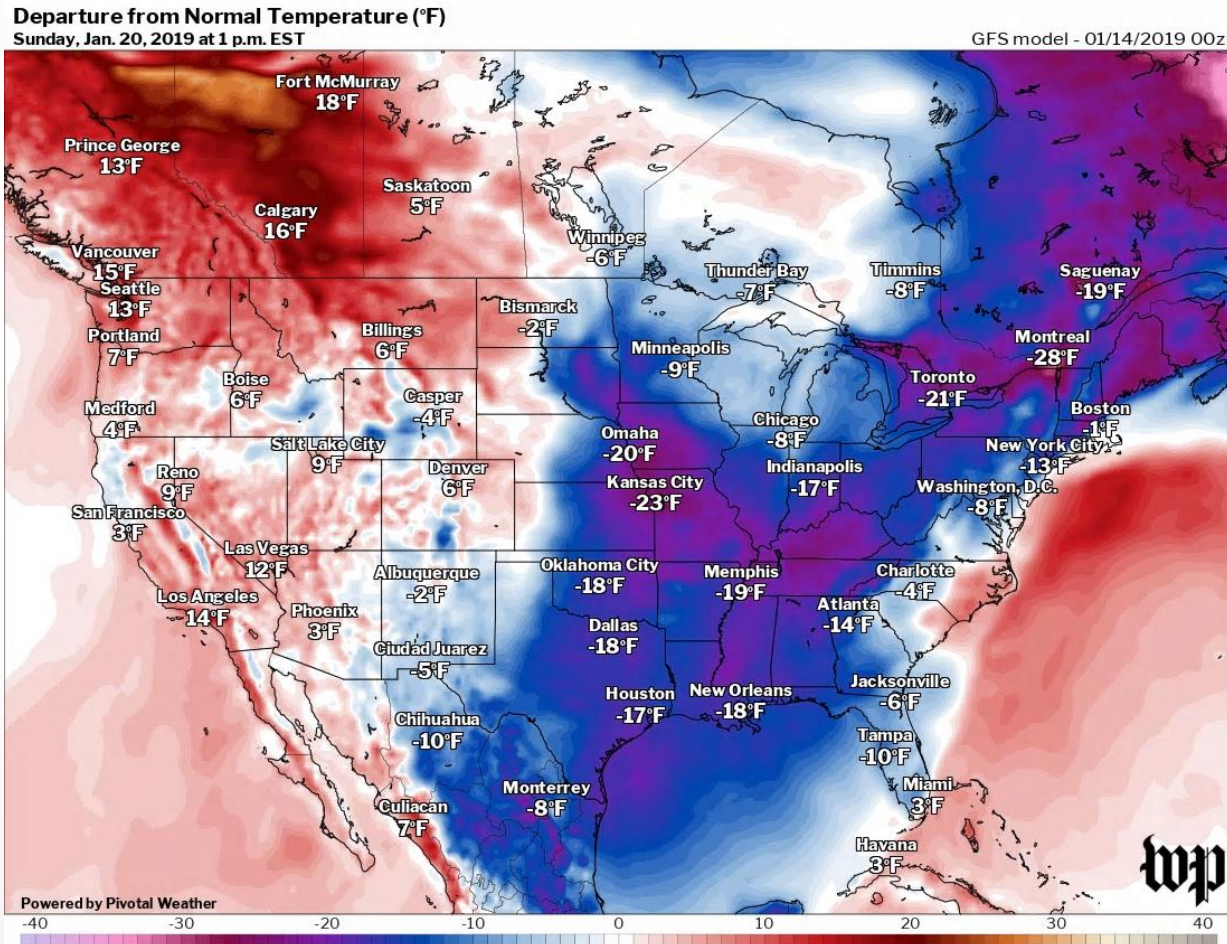


Source: NASA GISS & NOAA NCEI global temperature anomalies (°F) averaged and adjusted to early industrial baseline (1881-1910). Data as of 2/6/2019

CLIMATE  CENTRAL



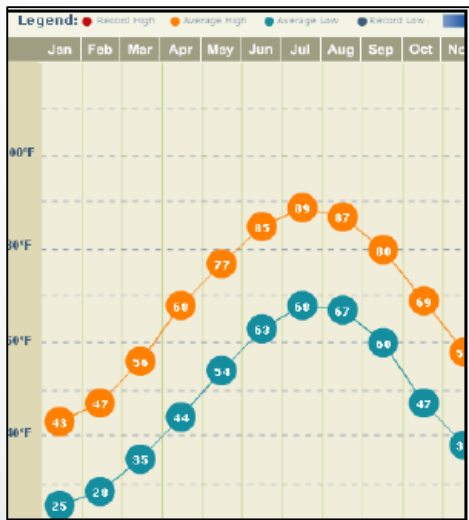
# Are You Kidding Me?! Have You Checked The WINTER Thermometer??



# The Climate is Not the Weather

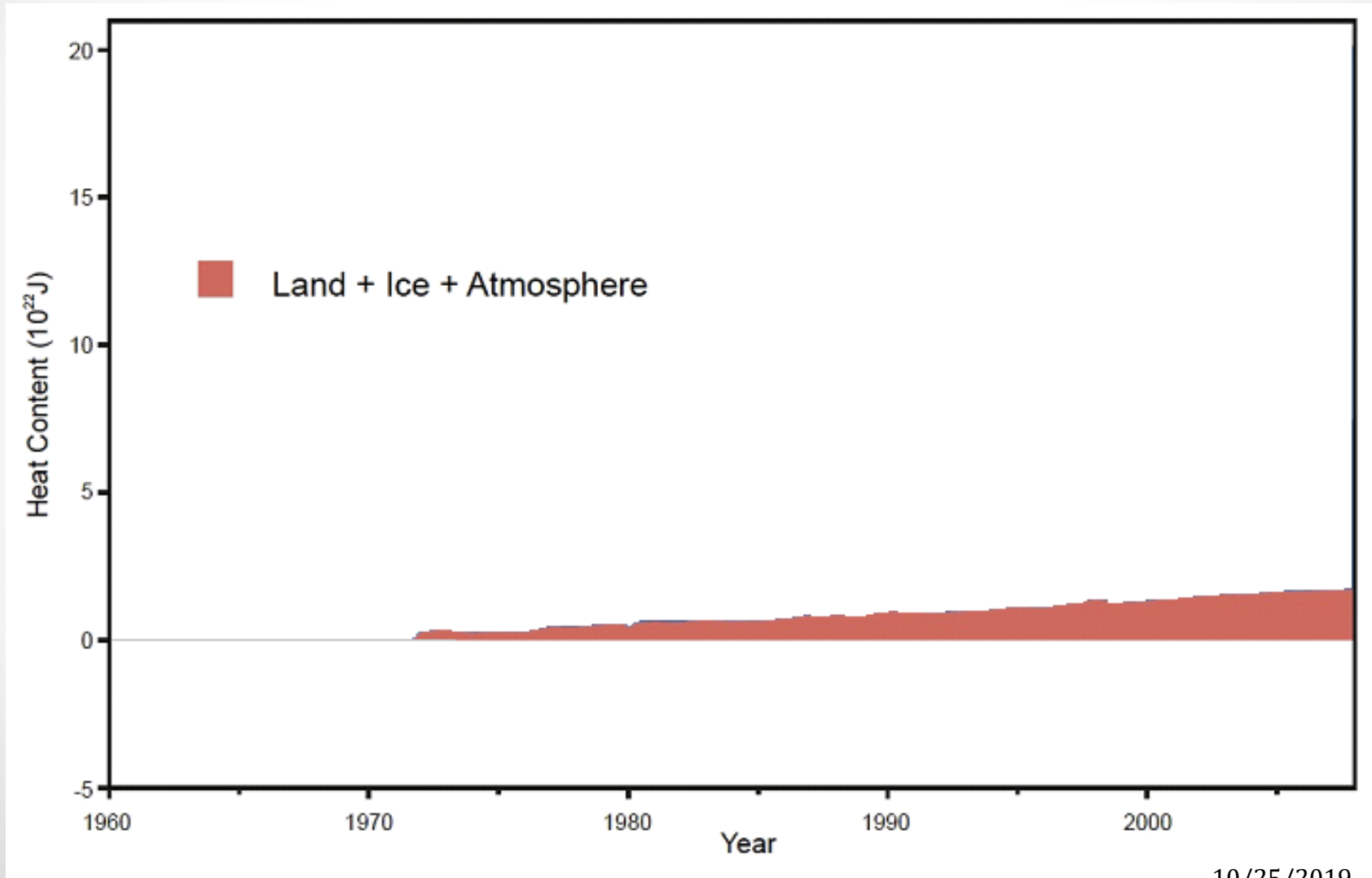


- Weather – the set of conditions at any given point in time
  - Today, tomorrow, this week



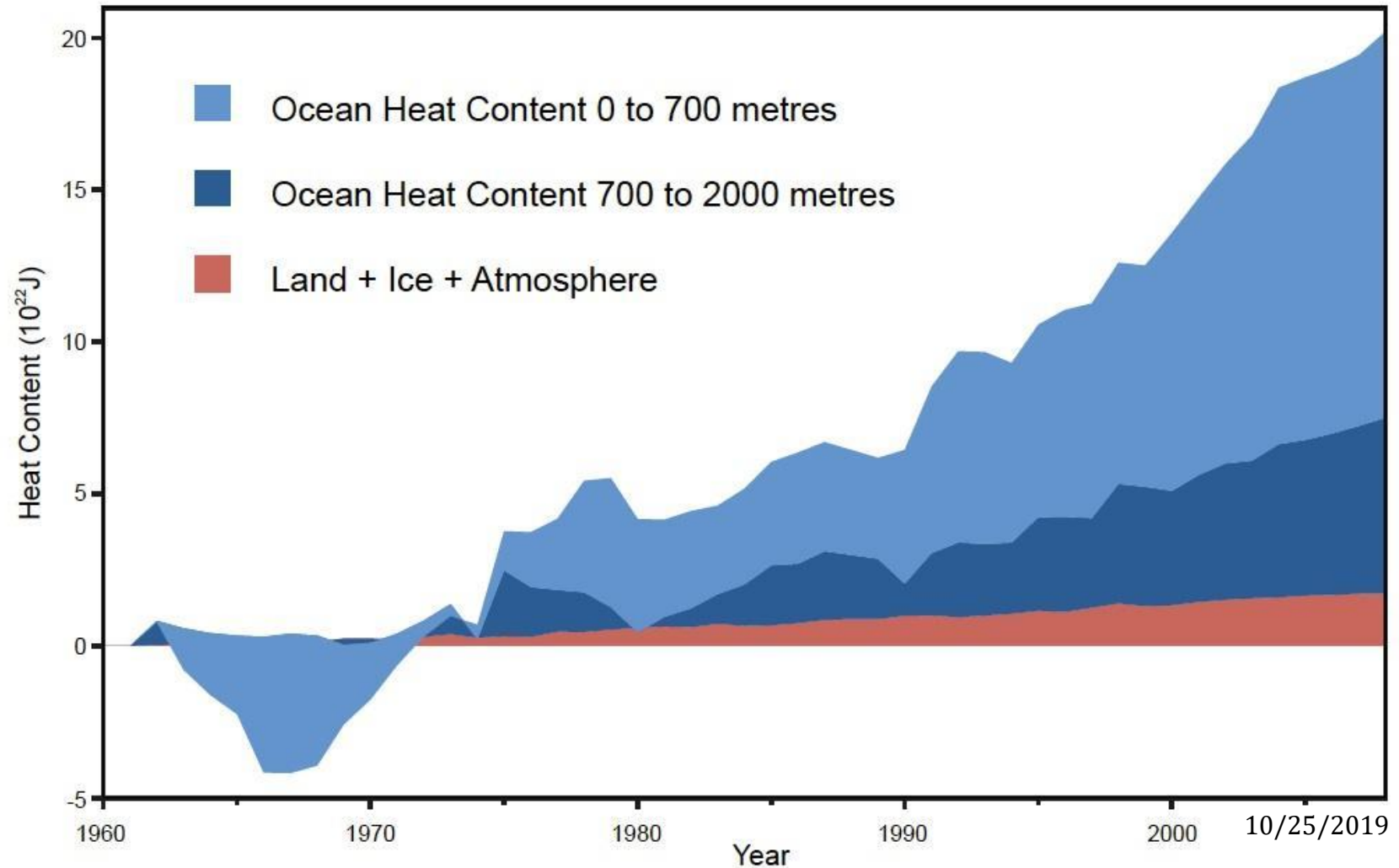
- Climate - the average set of conditions over a period of decades
  - 30 year averages
  - Ex. 1951-1980 Baseline

# The Earth is Not Warming Evenly



# The Earth is Not Warming Evenly

## Global Energy Content 1960 - Present



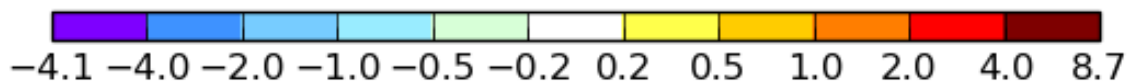
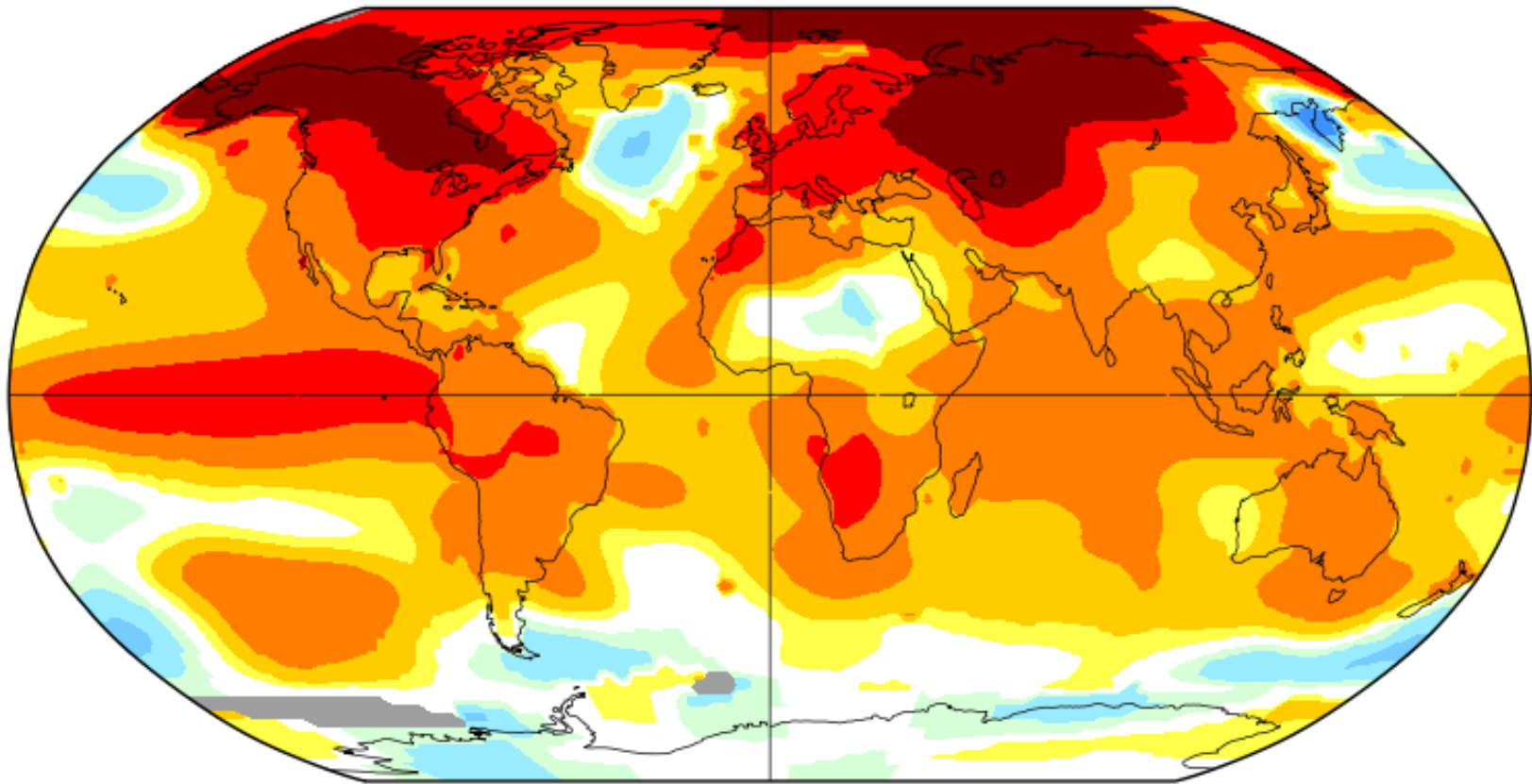
# **Impact of Warming Trend**

# Changing Weather vs. Changing Climate

Dec-Jan-Feb 2016

L-OTI(°C) Anomaly vs 1951-1980

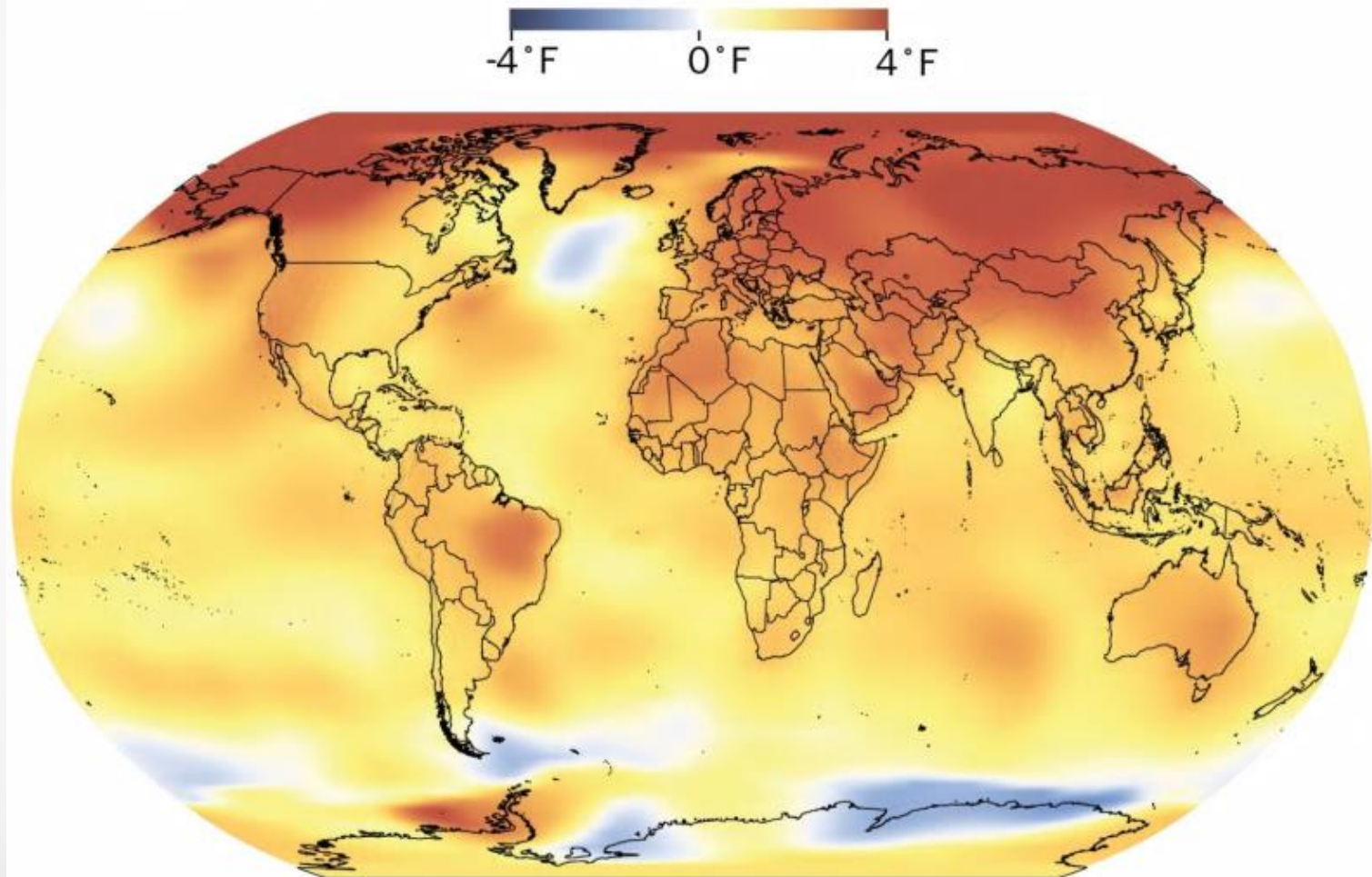
1.2



10/25/2019 50

# The Earth is Warming ON AVERAGE

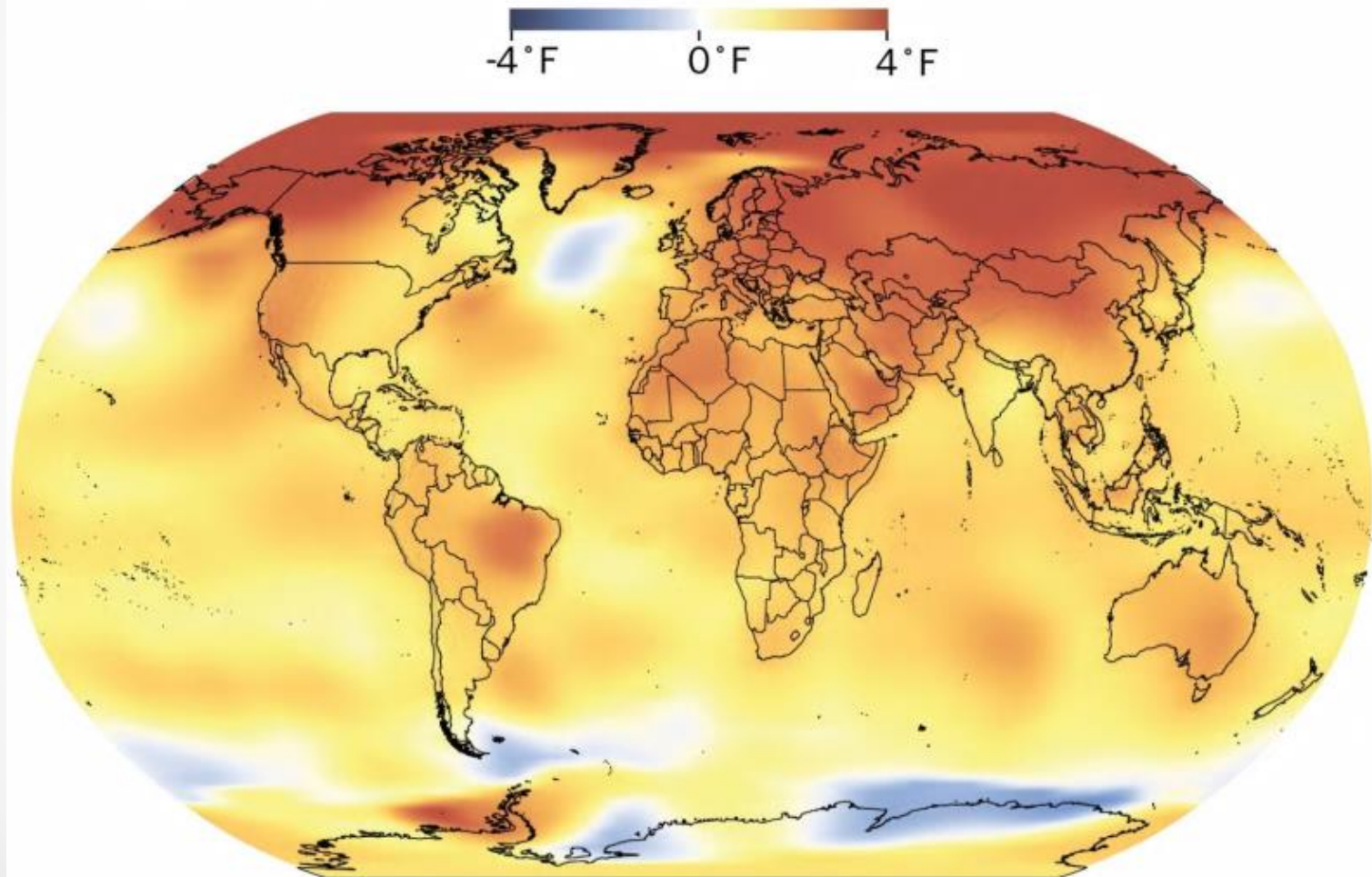
**Average temperature 2013-2017 compared to baseline**



- Note: Baseline temperature is average between 1951 and 1980  
Source: NASA's Scientific Visualization Studio

# The Earth is Not Warming Evenly

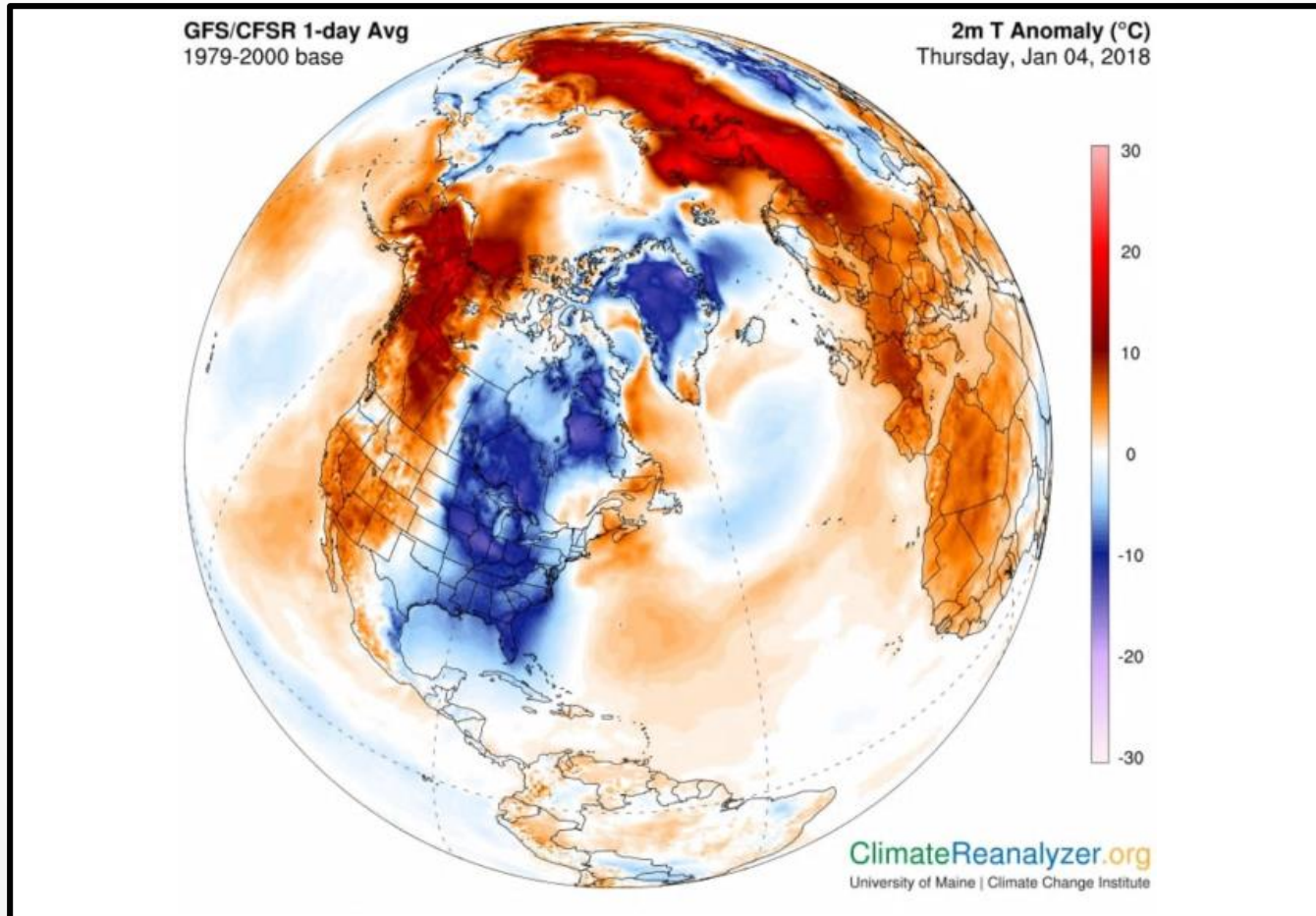
Average temperature 2013-2017 compared to baseline



- Note: Baseline temperature is average between 1951 and 1980  
Source: NASA's Scientific Visualization Studio



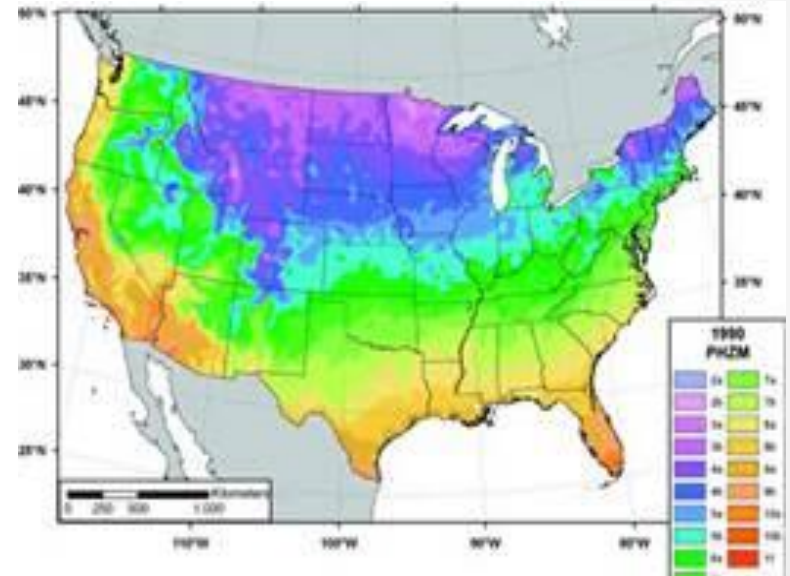
# Unequal Warming = Unusual Weather Patterns



**Weather Impacts  
in NH  
& The Northeast**

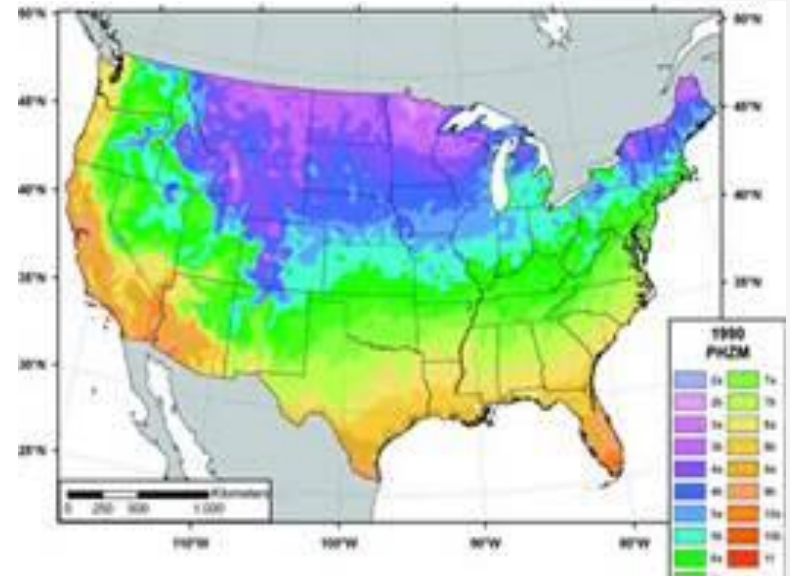
# NH's Observed Climate Patterns

- Increase in average temperature
  - Annual & seasonal
- Increase in precipitation
  - Amounts and intensity
- Change in precipitation
  - More in winter
  - More as rain
- Increase in extreme weather
- Changing seasonality
- Summer drought

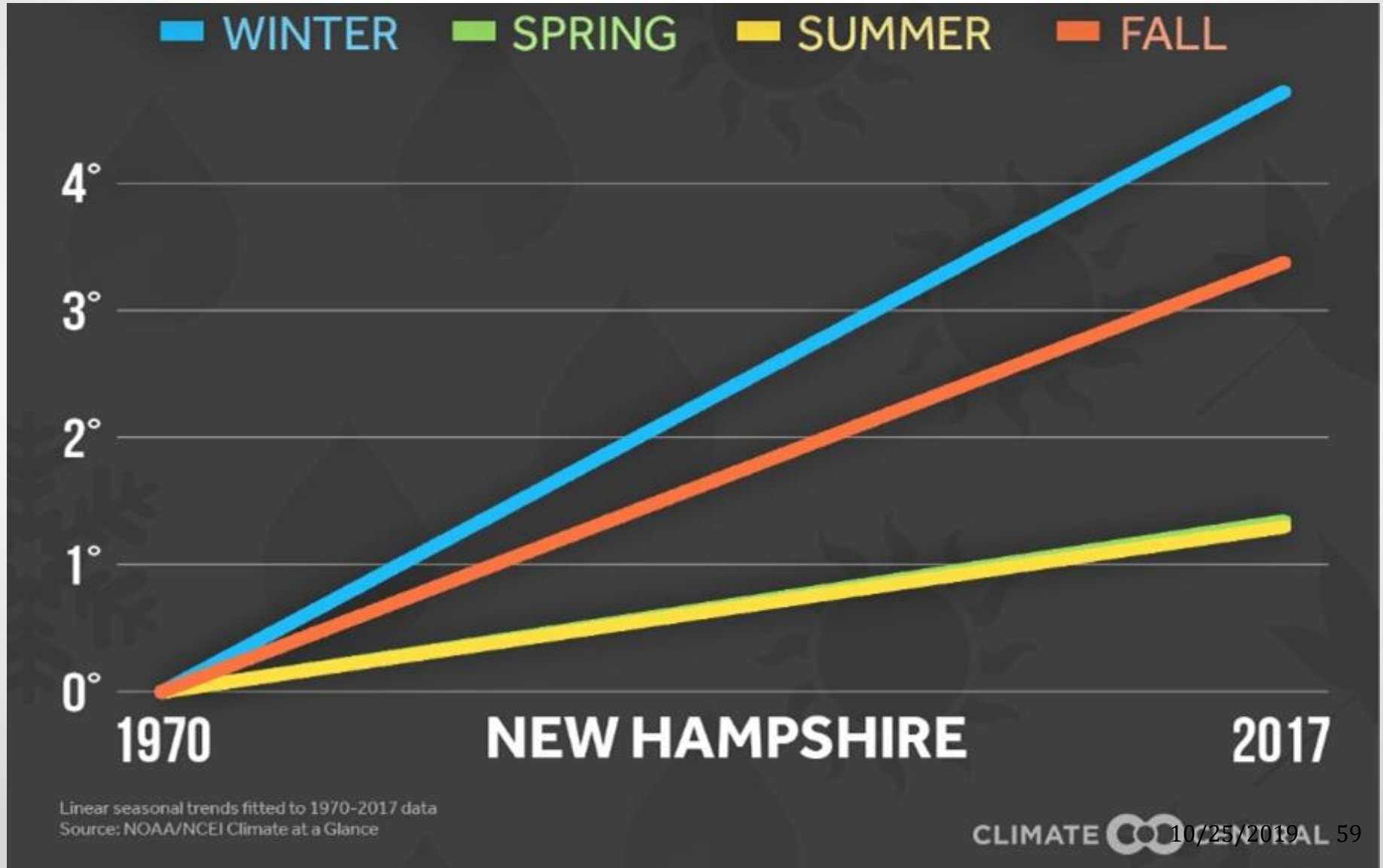


# NH's Observed Climate Patterns

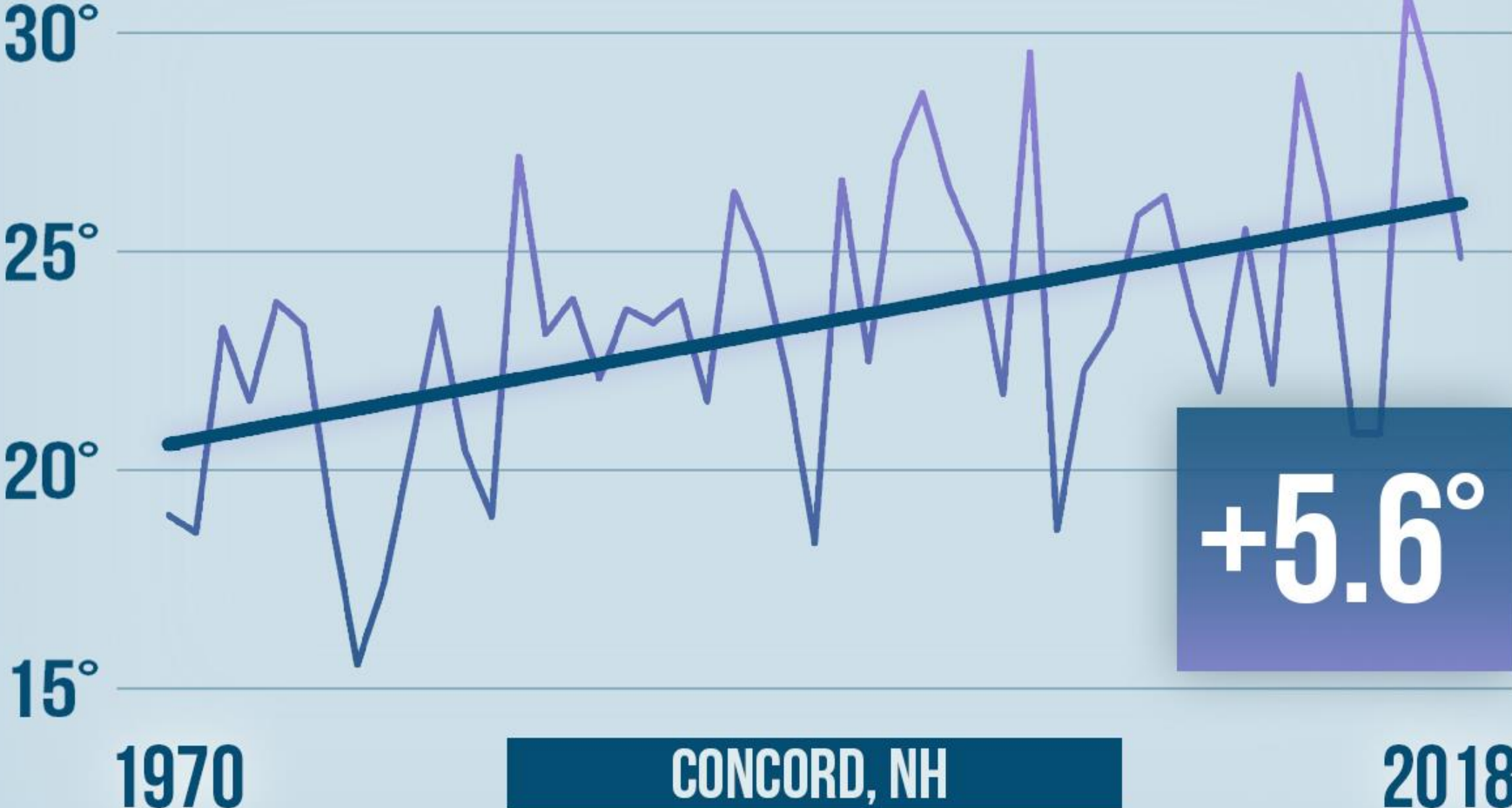
- Increase in average temperature ★
  - Annual & seasonal
- Increase in precipitation ???
  - Amounts and intensity
- Change in precipitation
  - More in winter ★
  - More as rain
- Increase in extreme weather
- Changing seasonality
- **Summer drought?**



# Seasonal Warming Average Temperature

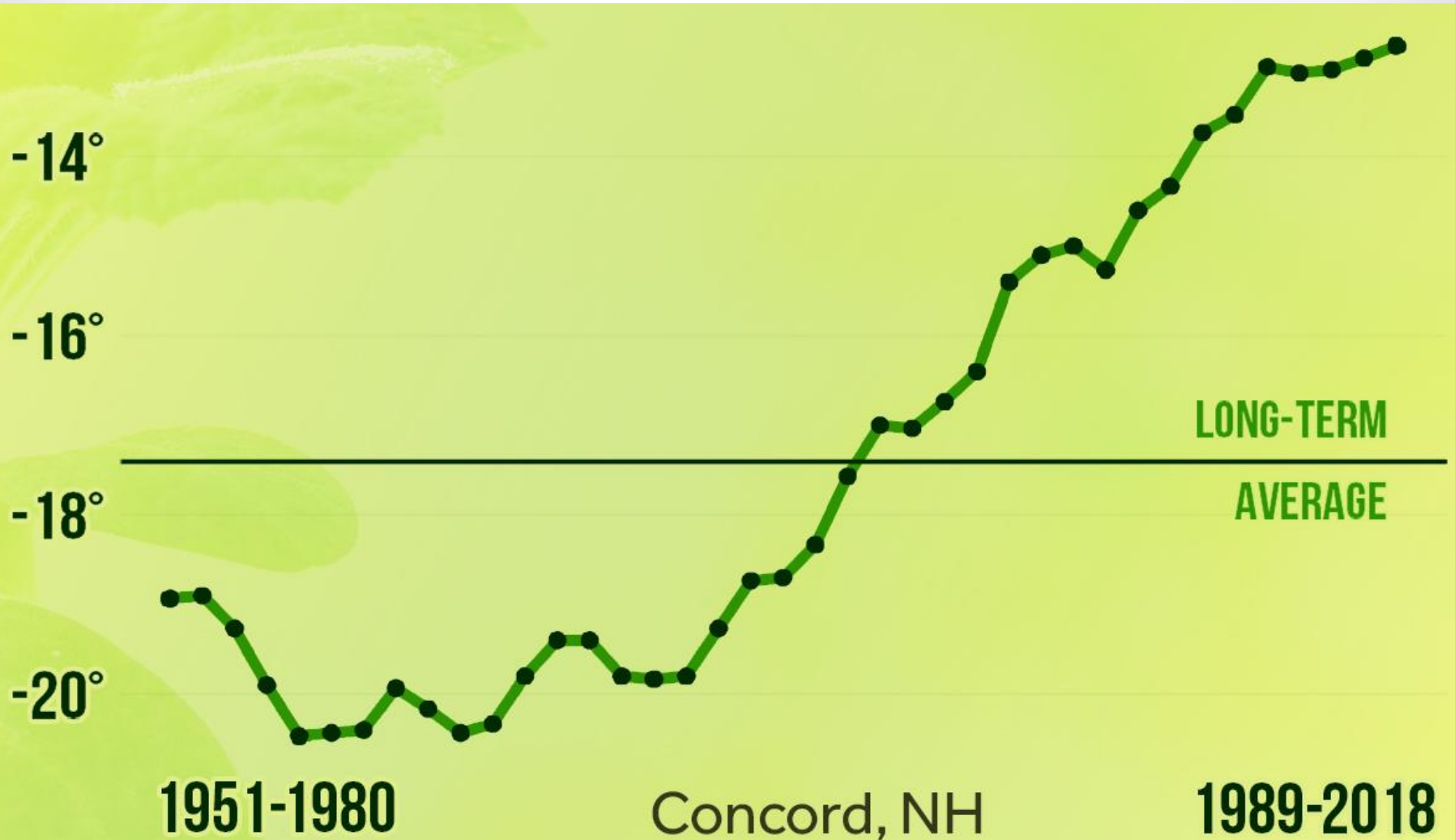


# Winter Warming Average Temperature



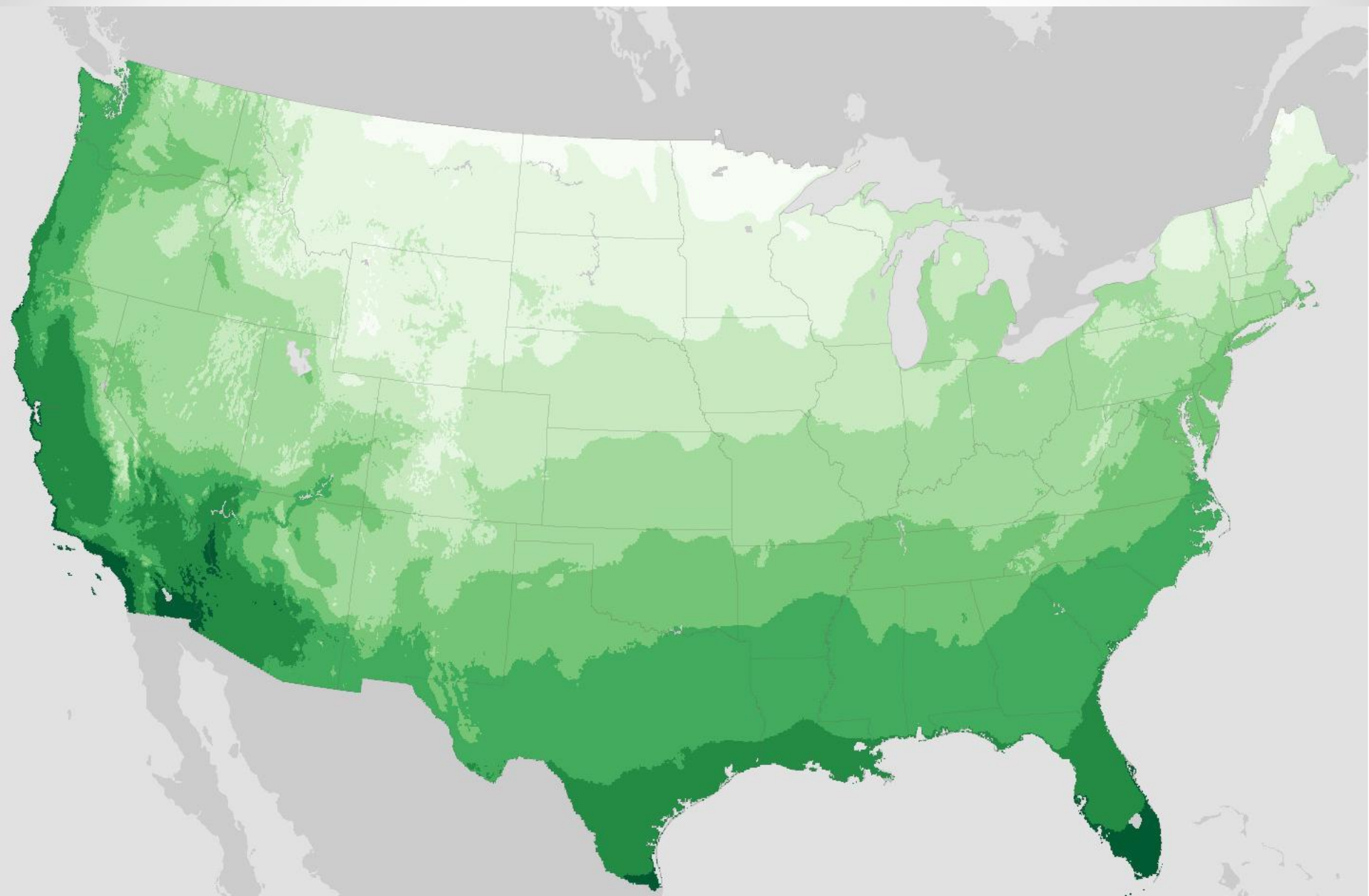
Source: RCC-ACIS.org

# Shifting USDA Hardiness Zones



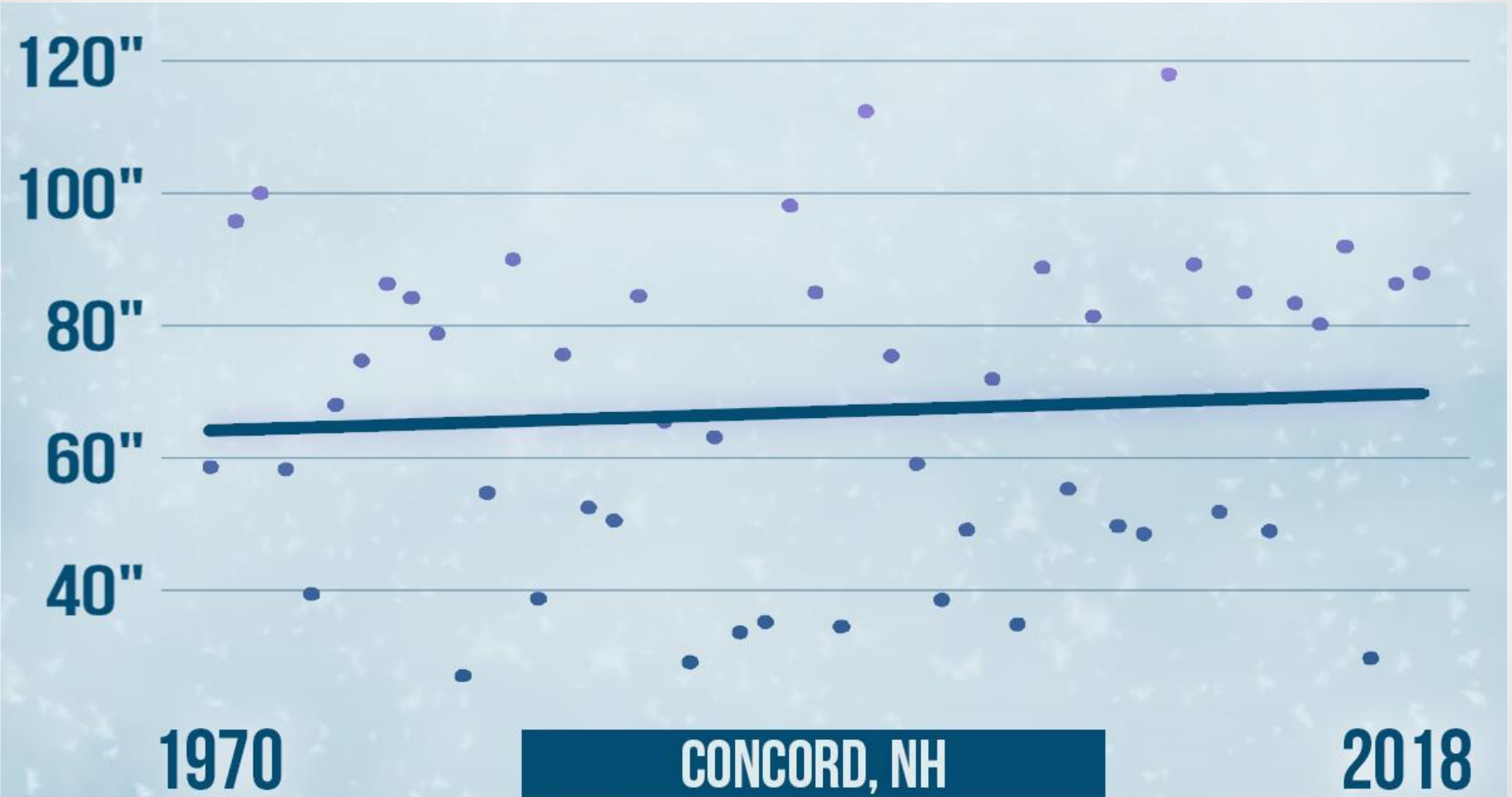
Long-term average is defined as the average from 1951-1980 to 1989-2018.  
Source: RCC-ACIS.org

# Shifting USDA Hardiness Zones



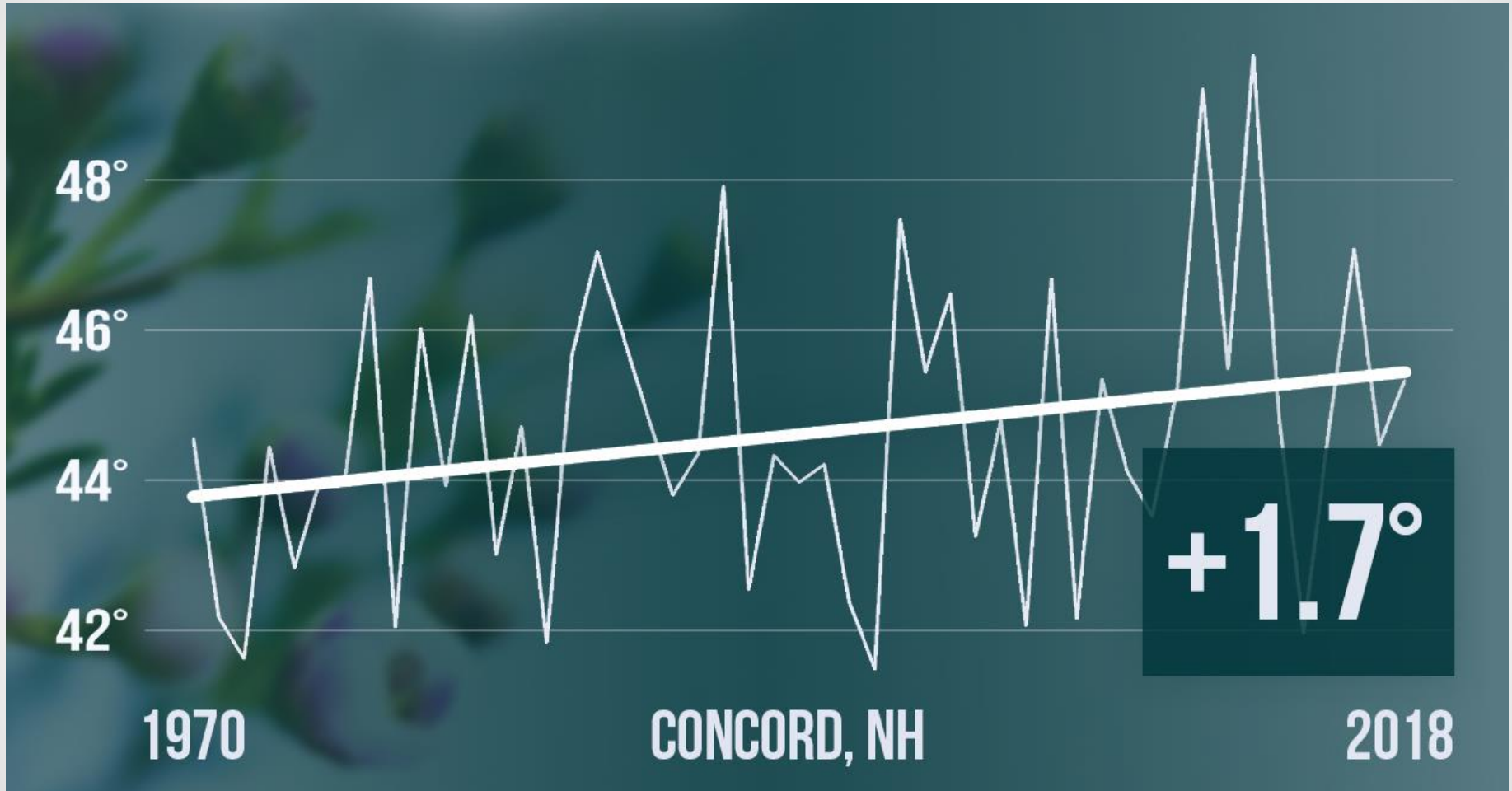


# Winter Snowfall Yearly Total



July-June totals  
Source: RCC-ACIS.org

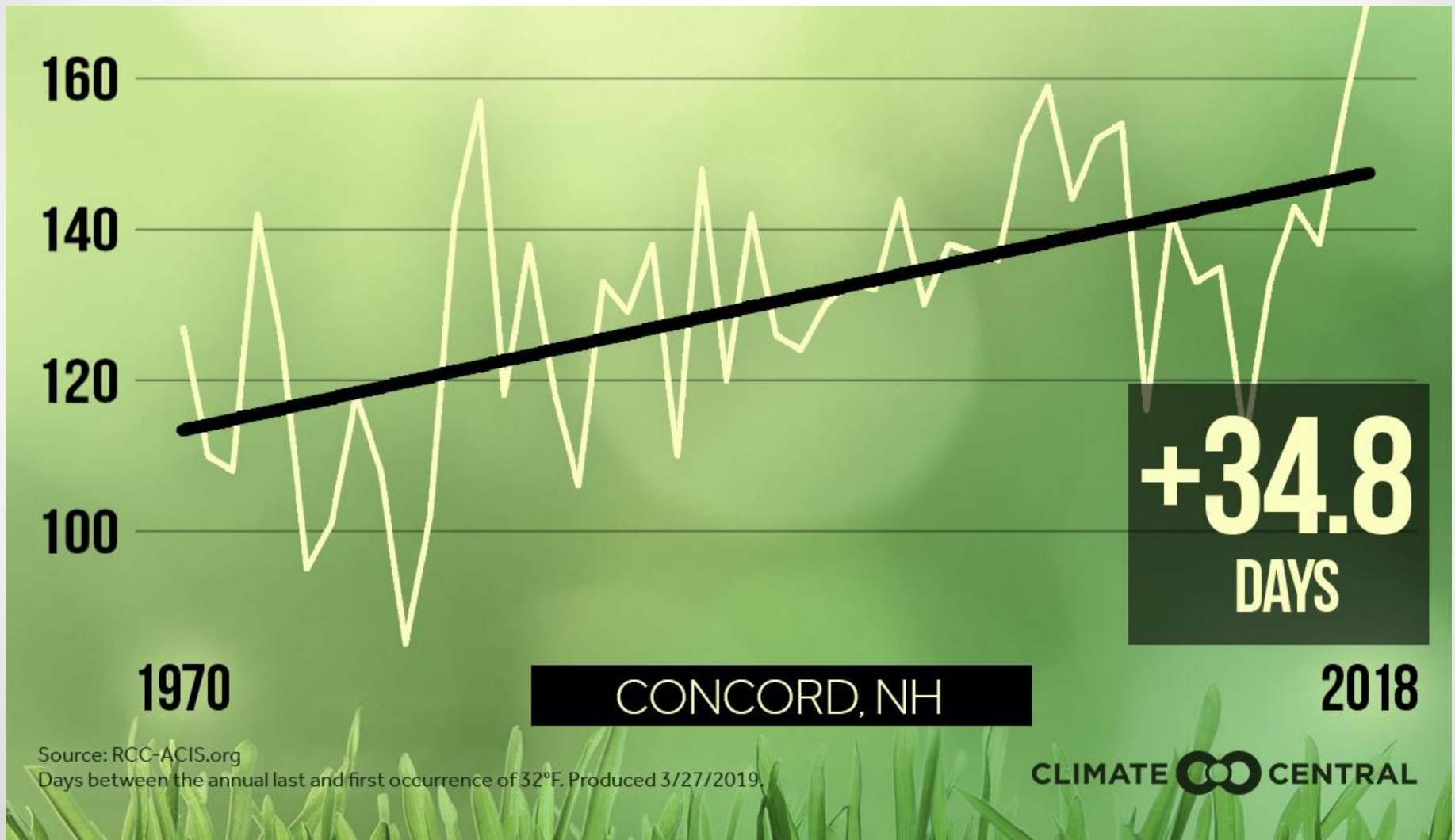
# Spring Warming Average Temperature



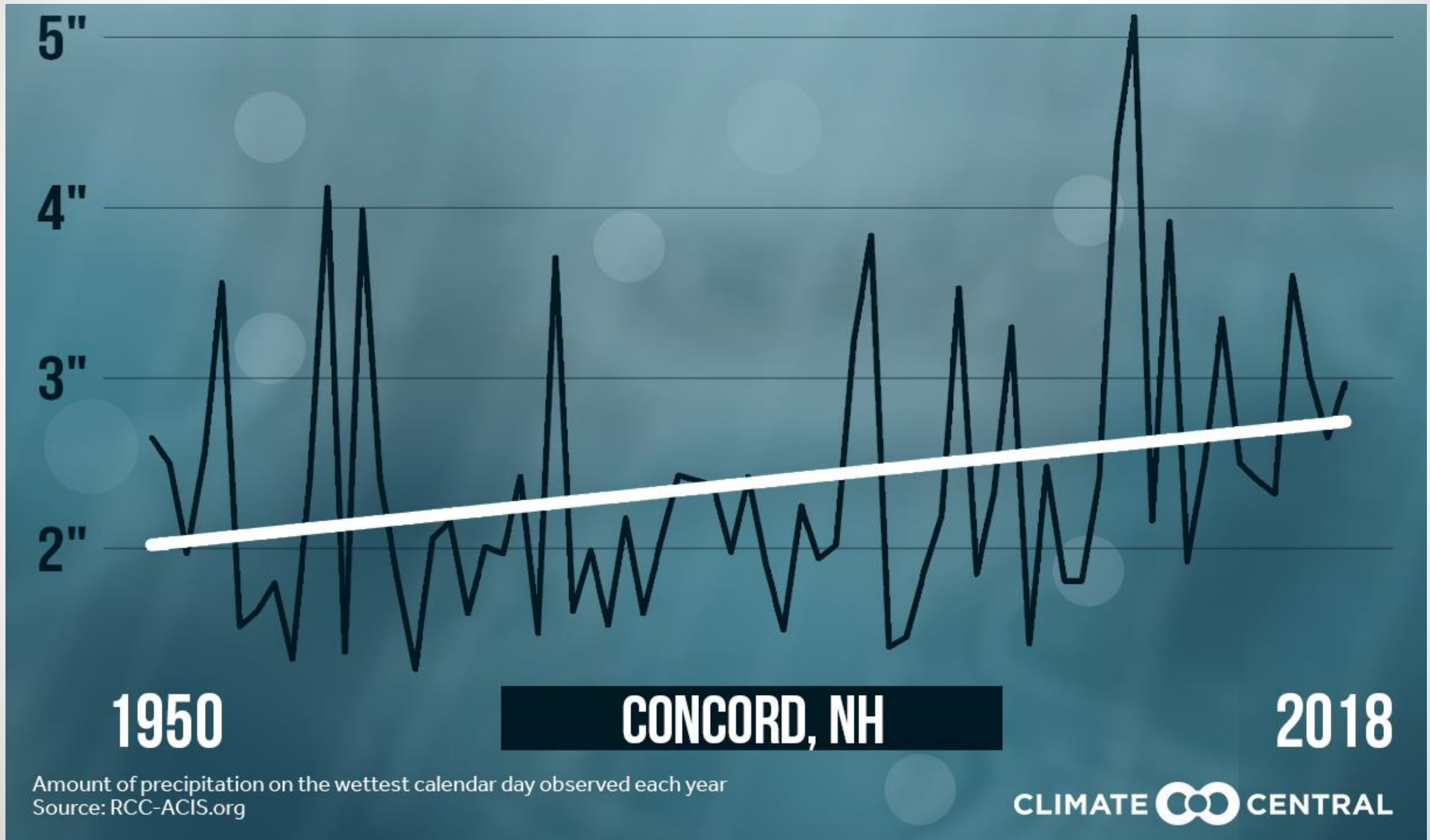
Source: RCC-ACIS.org  
Average temperature March-May. Produced 3/6/2019

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# Consecutive Days Above Freezing



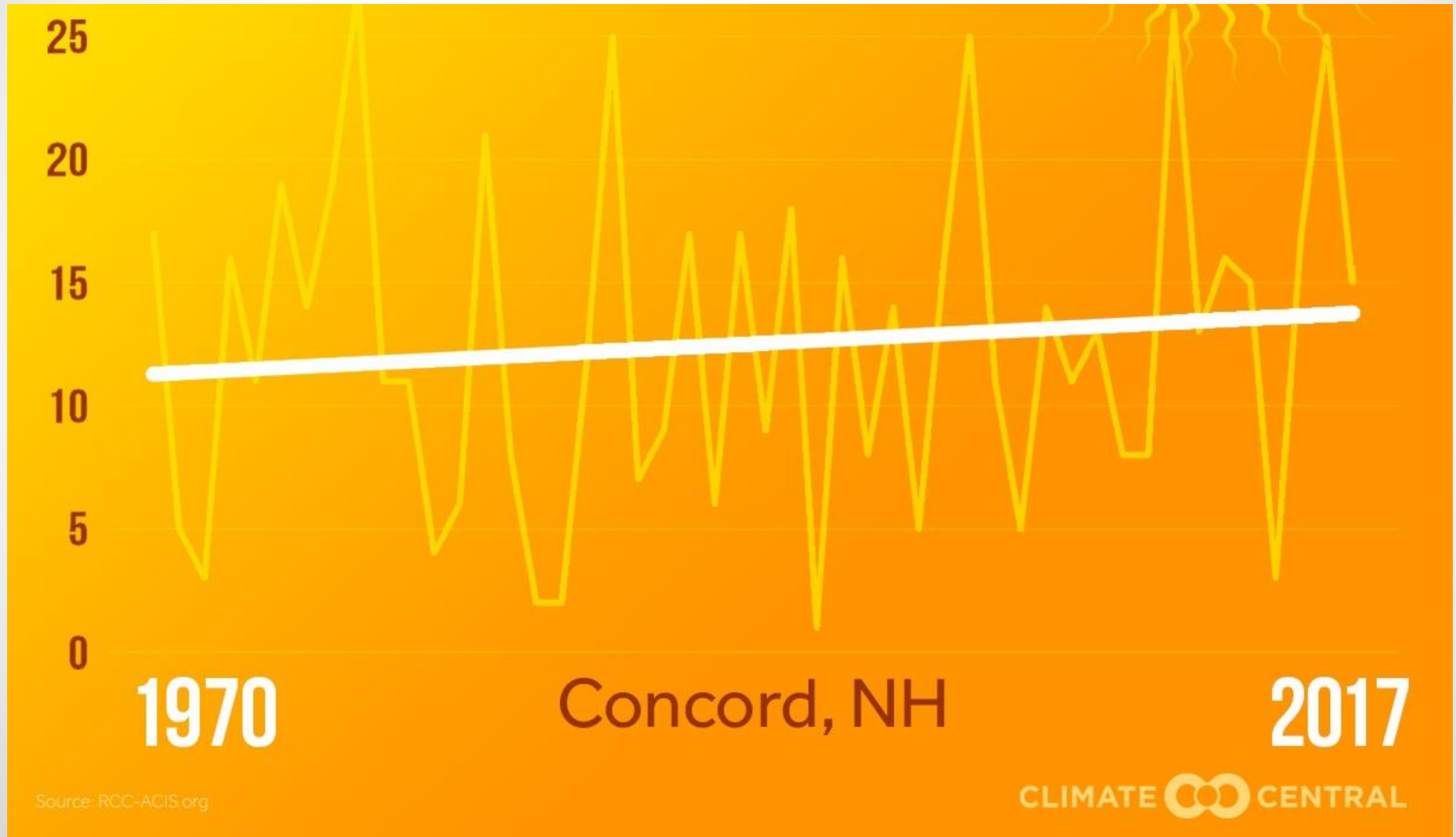
# Changing Precipitation Rainfall on Wettest Day of Year



Amount of precipitation on the wettest calendar day observed each year  
Source: RCC-ACIS.org

CLIMATE  CENTRAL

# Summer Warming Extreme Heat- Days Over 90

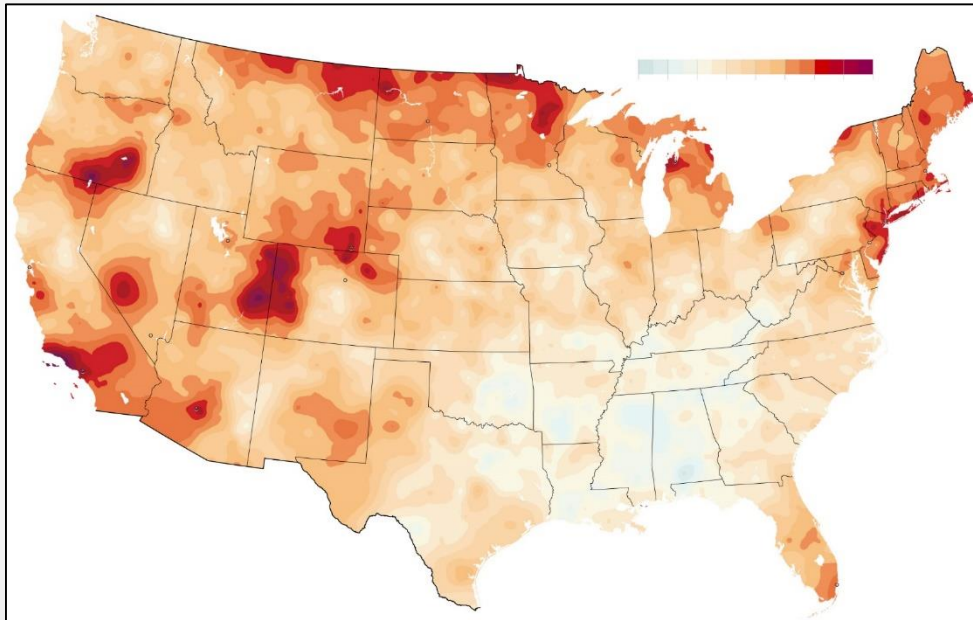


Source: RCC-ACIS.org

CLIMATE  CENTRAL

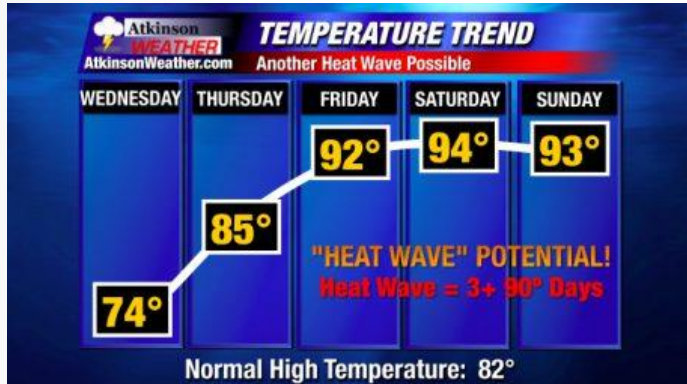
**Human Scale**  
**Impacts in NH**  
**& The Northeast**

# “2°C: Beyond The Limit Extreme Climate Change Has Arrived In [US]” The Washington Post, August 13, 2019



*“In the Northeast, changes are being felt in agriculture — which is witnessing a strong shift of the seasons and of winter most of all — and in greater pressure from insects, such as ticks and agricultural pests, which plague humans and wildlife alike.”*

# Impacts to Public Health





# Mosquito Borne Disease Transmission Risk

Percent probability

80%

40%

0%



50°

60°

70°

80°

90°

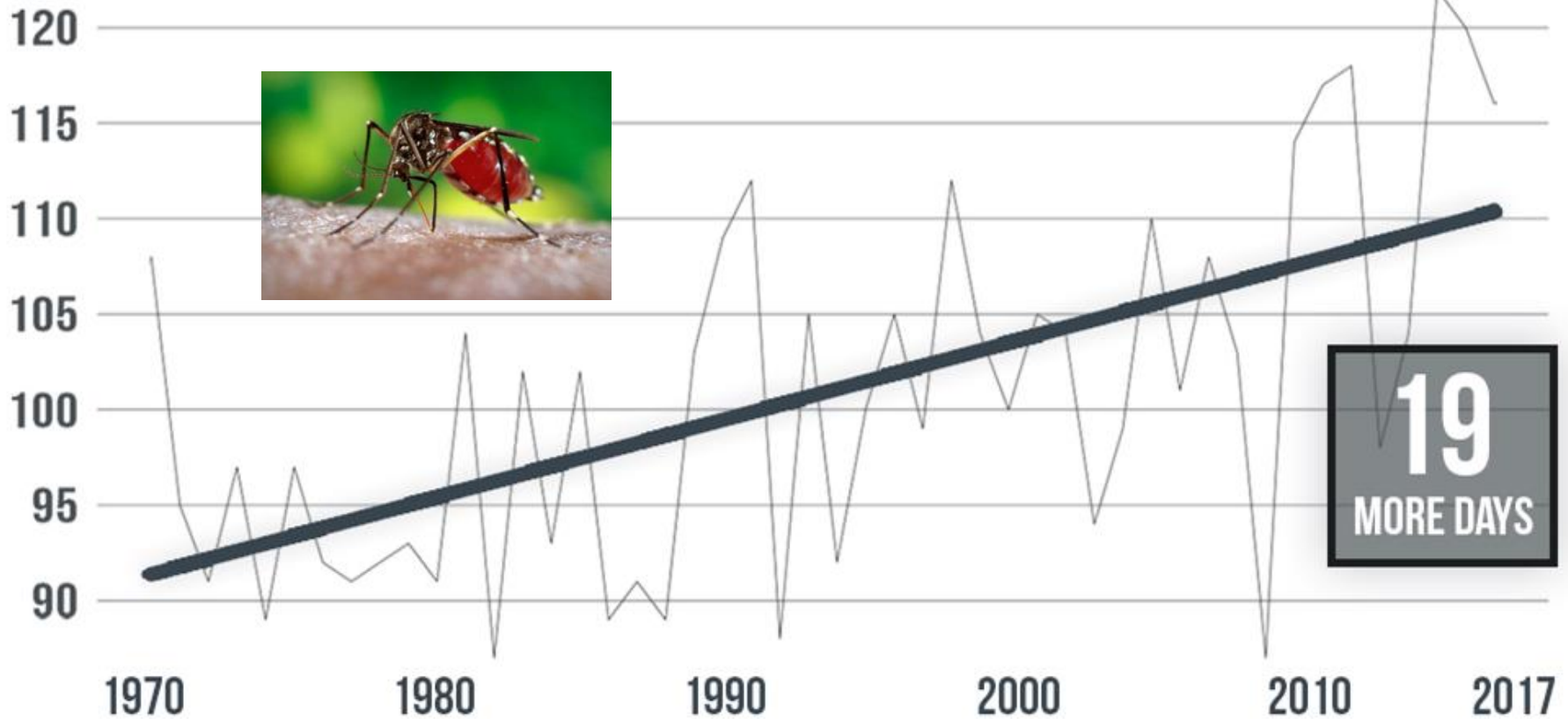
100°

TEMPERATURE (F°)

Source: RCC-ACIS.org; Annual cooling degree days  
Daily average temperature - 65° = number of cooling degree days

CLIMATE  CENTRAL

# Mosquito Borne Disease Transmission Risk - Days

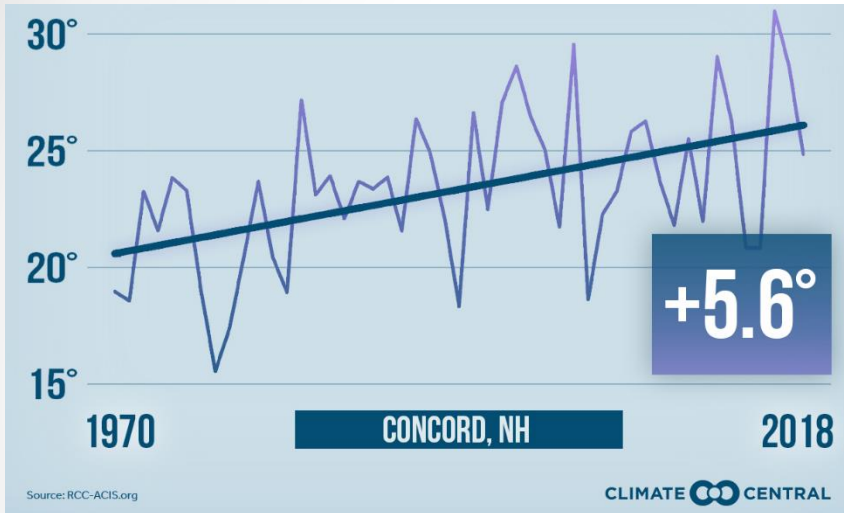


Days with average temp 61°-93° from Mar-Nov  
Source: RCC-ACIS.org; Mordecai et al. 2017

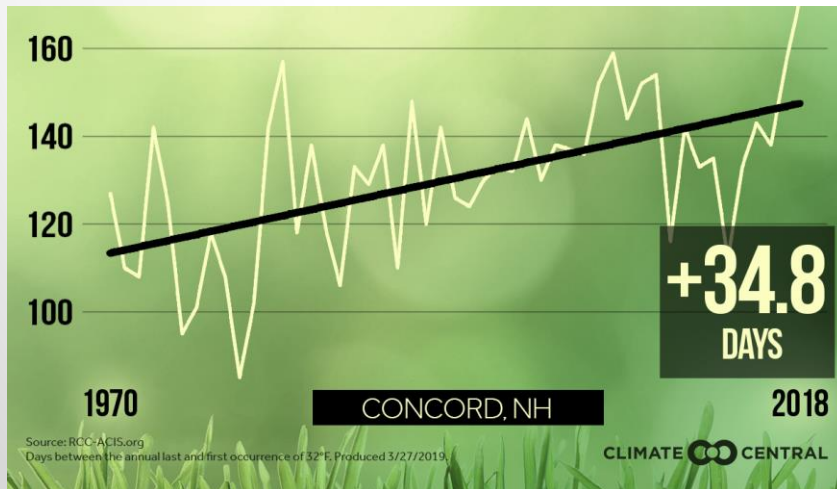
CLIMATE  CENTRAL

# Consecutive Days Above Freezing

## Winter Warming - Avg Temp



## Consecutive Days Above Freezing



# Impacts to Infrastructure



Somersworth  
Drinking Water  
Treatment Facility

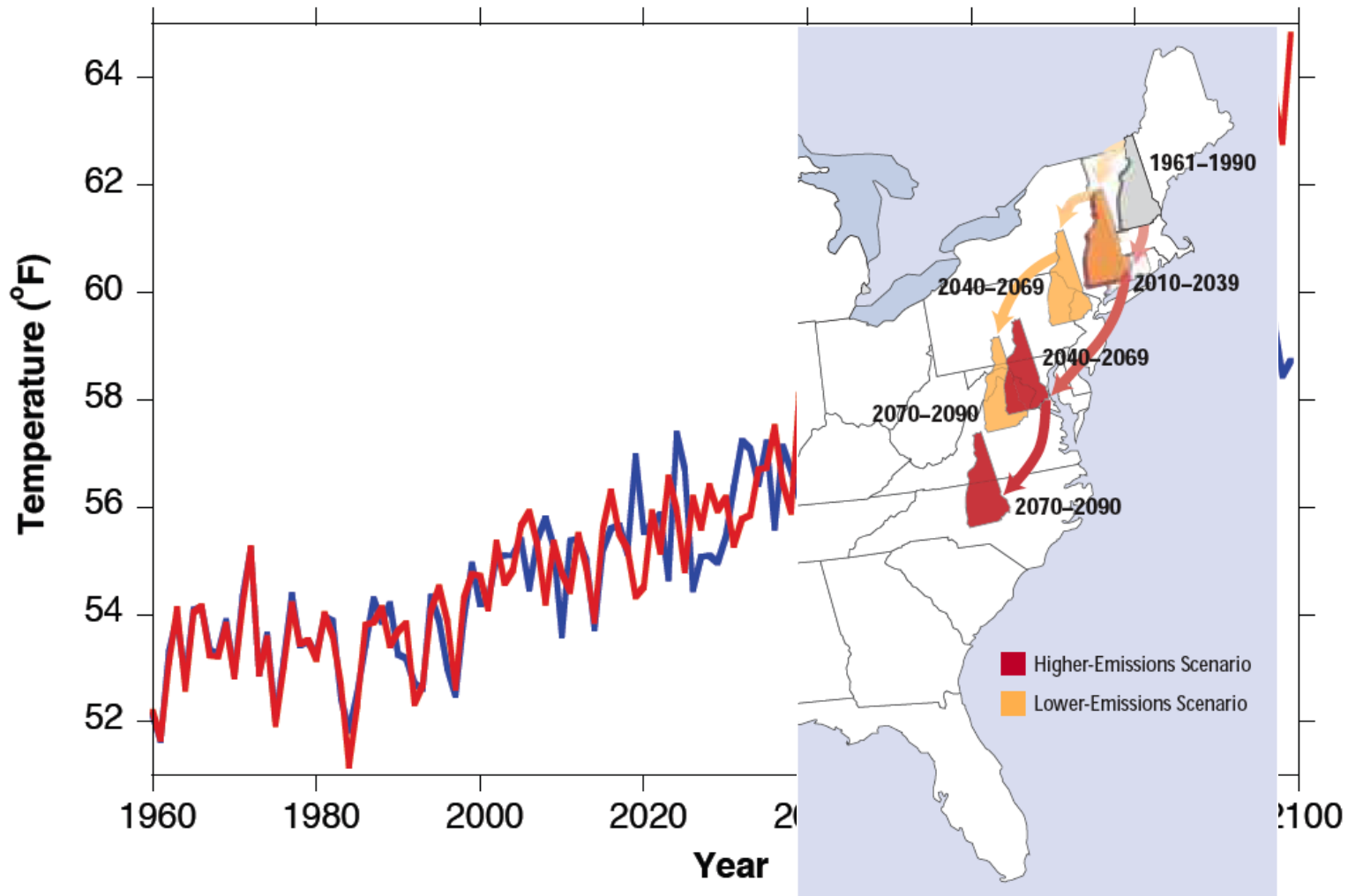
Hampton Beach, 2018

# Ecological Impacts to Northeast: Incremental Disasters

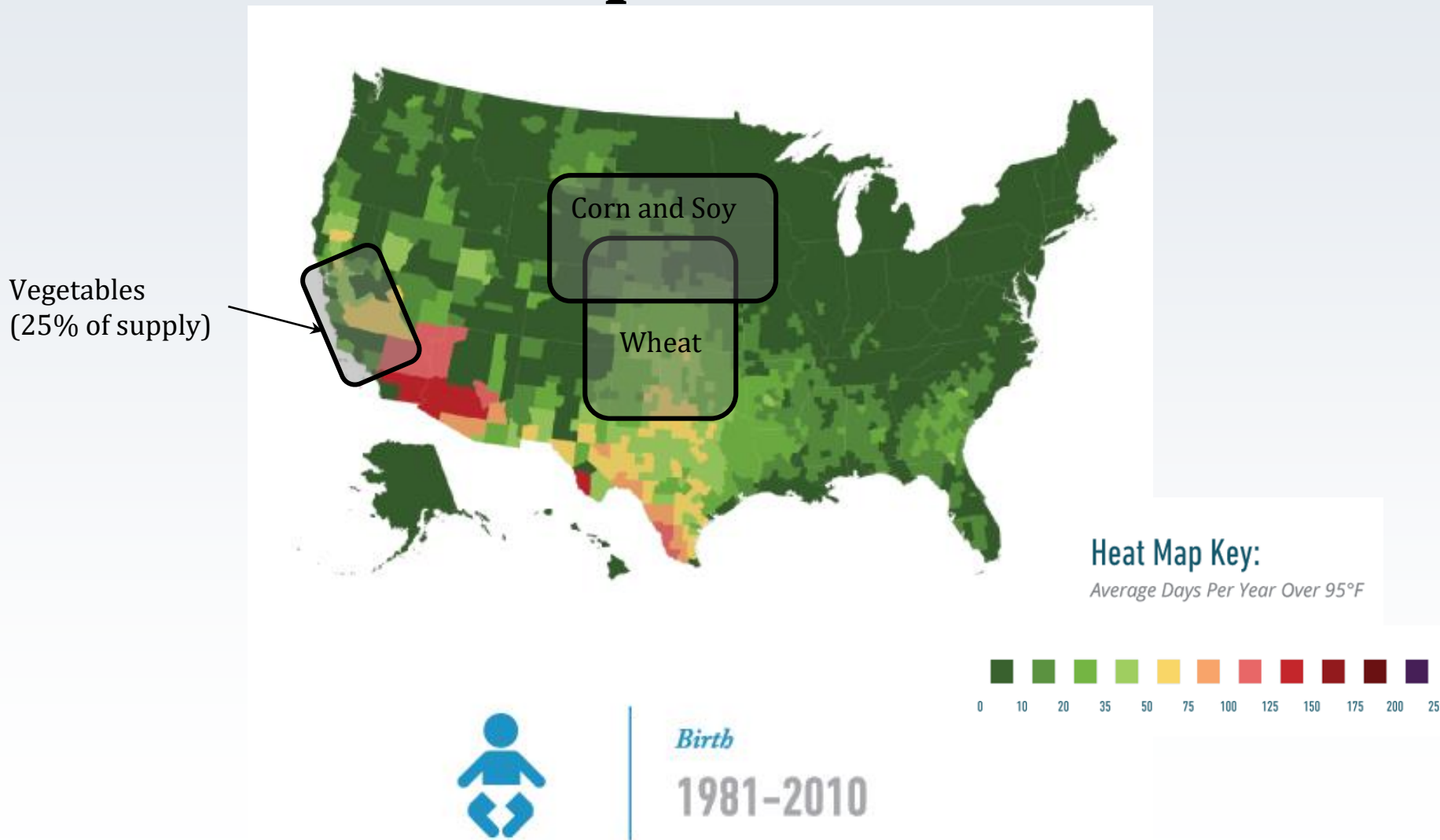


# **Future Trends & Impacts**

# Projected Annual Maximum Temp Northern New Hampshire

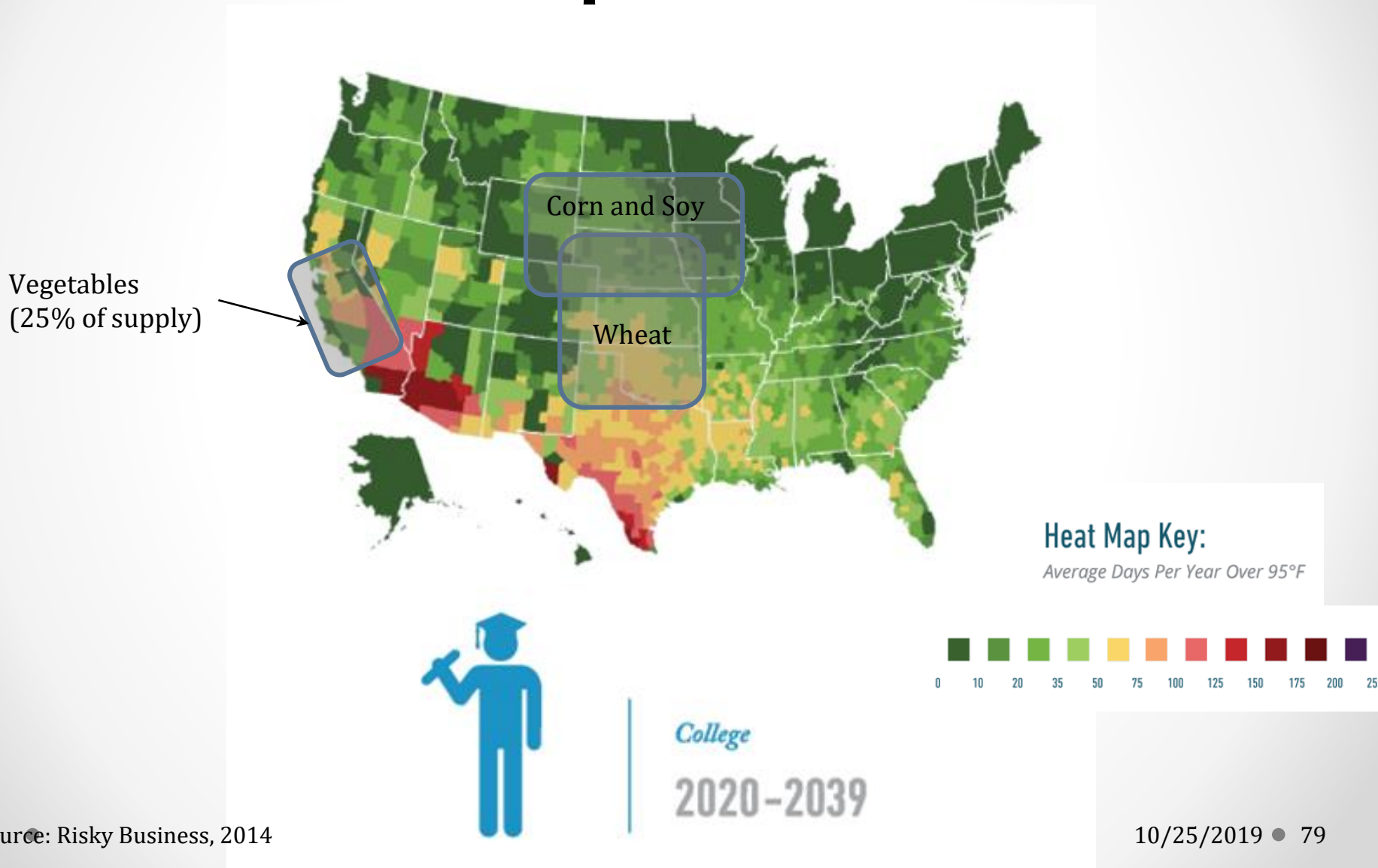


# Projected Annual Maximum Temperature

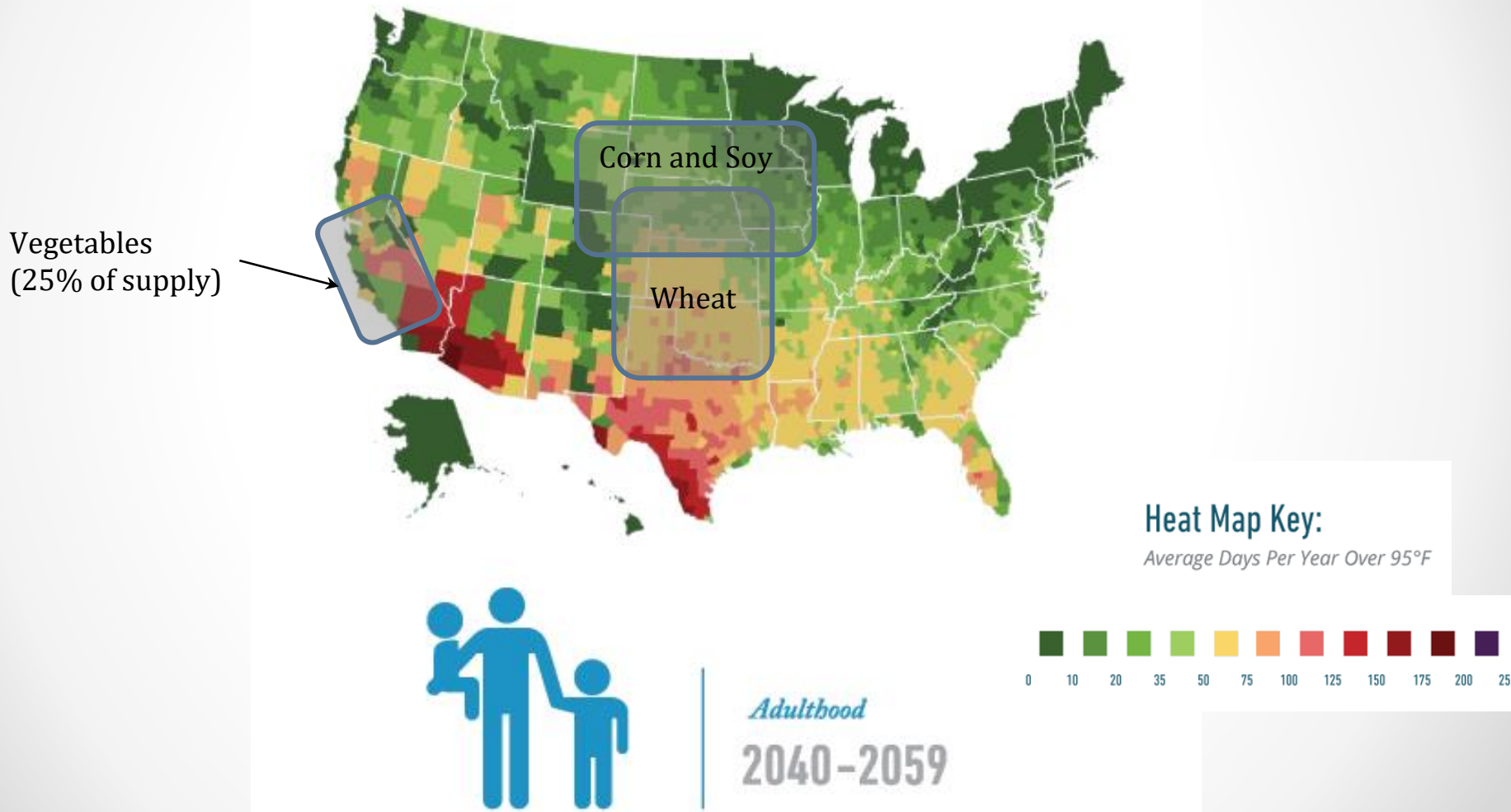




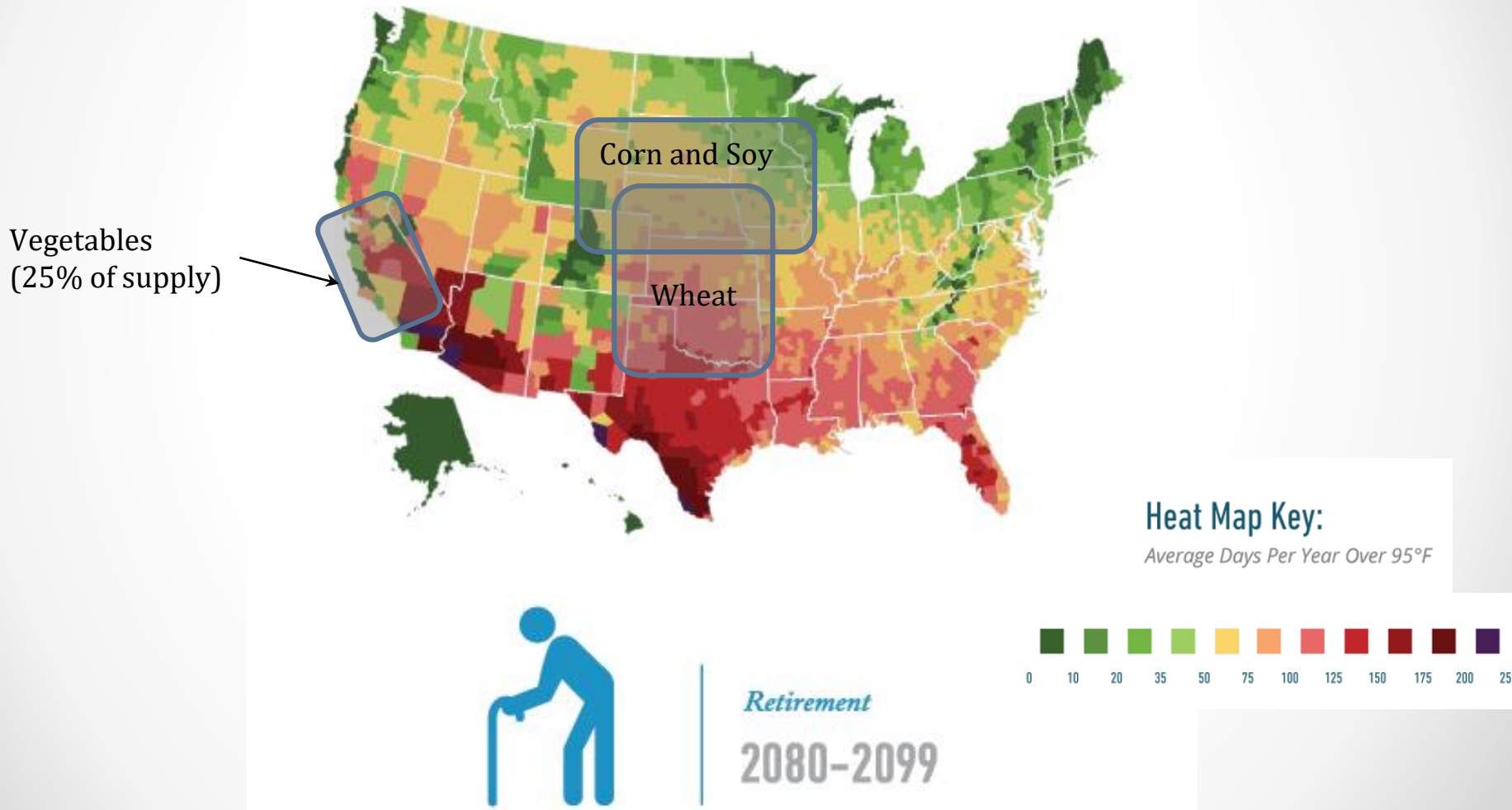
# Projected Annual Maximum Temperature



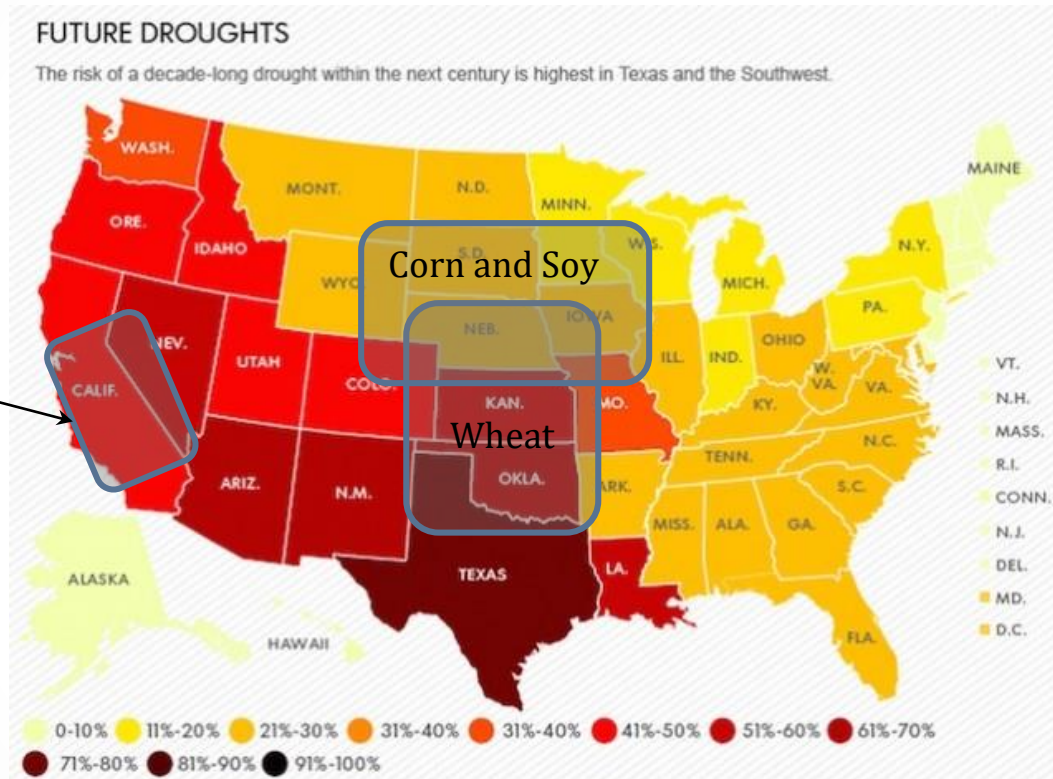
# Projected Annual Maximum Temperature



# Projected Annual Maximum Temperature



# Projected Likelihood of “Megadrought”



Vegetables  
(25% of supply)



Percent chance of drought last 1-3 decades. Current California drought is 5-6 years old.

# Takeaways

## Local climate will be more stressful:

- Warmer with more extreme temperatures
- Potential for extended periods of very cold weather in winter
- Wetter overall, but more falling during large rainfall events and more falling in winter as rain
- Longer growing season BUT dryer during summer with more frequent drought
- More frequent and intense extreme events
- New diseases and pests

## National & global food growing regions climate will be more stressed:

- Very warm with very long extreme temps becoming the norm
- Intense and extended drought in regions of the southwest

# Uhhmm.... OK, now what?



# Environmental Challenges in the Past

40 years ago – Smog

- Solution: Catalytic converters
- Smog reduced by 30% to 50%



# Environmental Challenges in the Past

35 years ago – Ozone layer destruction

- Solution:  
Chlorofluorocarbon (CFC)  
phase out
- CFCs all but eliminated,  
ozone layer (slowly)  
rebounding

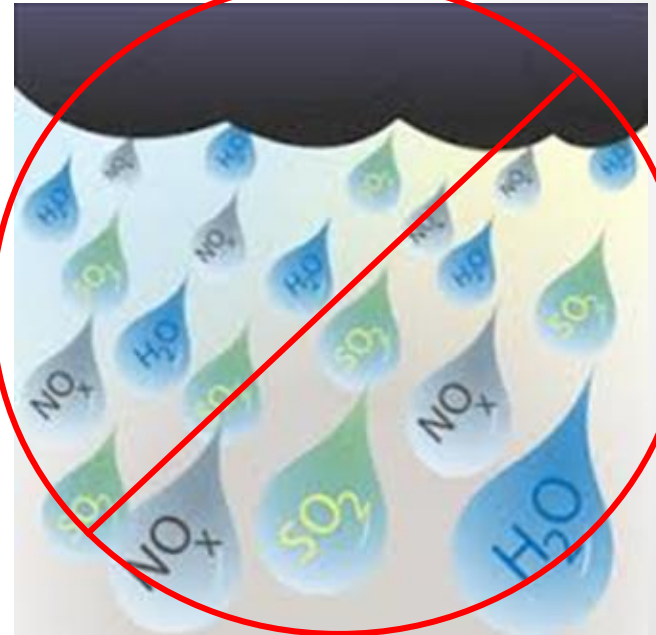




# Environmental Challenges in the Past

## 30 years ago – Acid Rain

- Solution: market-based program for regulating utility sulfur dioxide emissions
- Acid rain emissions cut by 50%; forests rebounding, lakes (slowly) rebounding



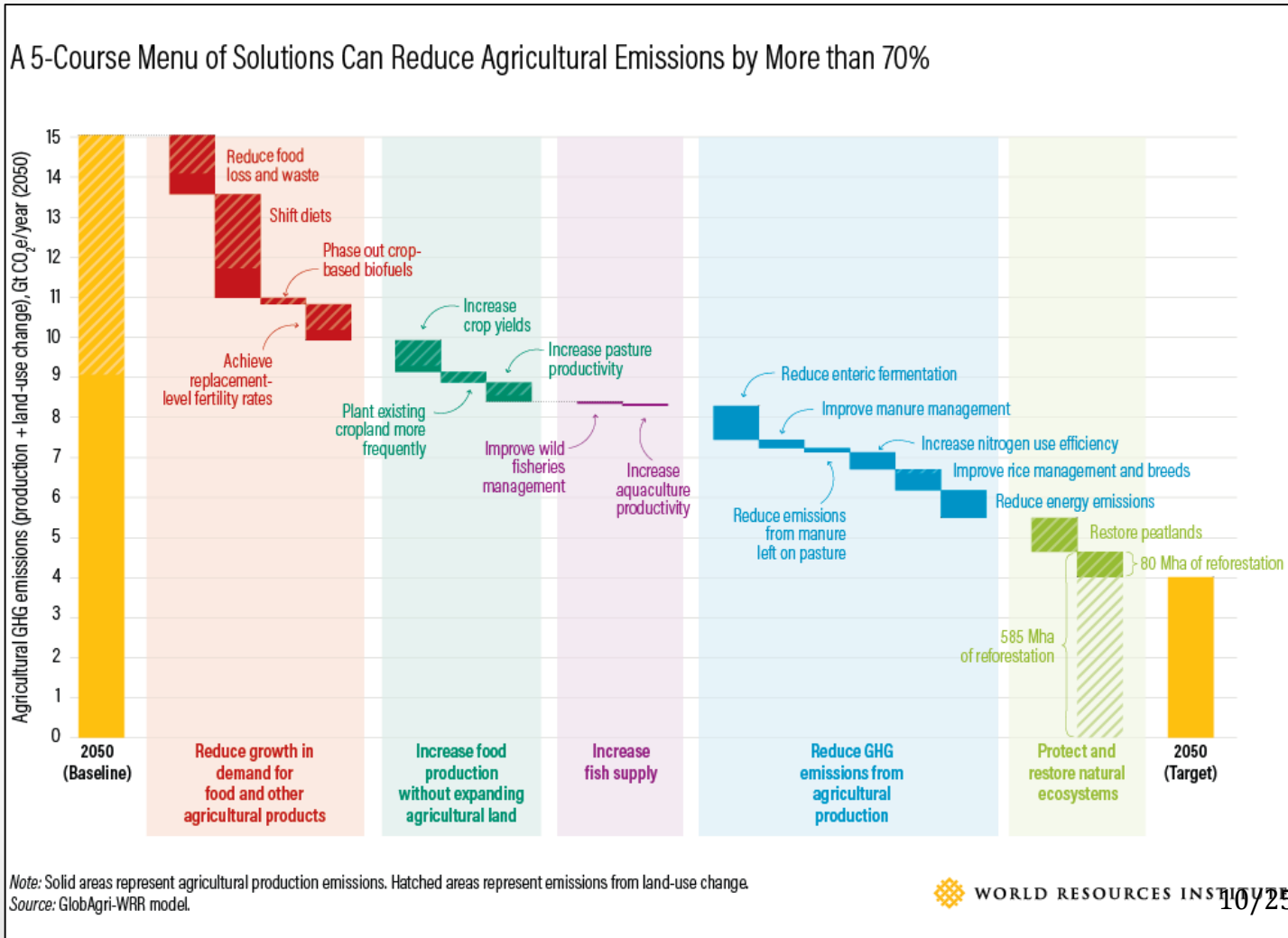
# **“Earth’s Food Supply Is Under Threat. These Fixes Would Go a Long Way.”**

**New York Times, August 9, 2019**



# “10 Breakthrough Technologies Can Help Feed The World Without Destroying It”

World Resources Institute, July 17, 2019



# **“U.S. Farmers Plant Crops You Won't Eat In Climate Change Fight” Bloomberg, August 15, 2019**



# Innovation Example: Evolution of Phones

1900



1950



2000



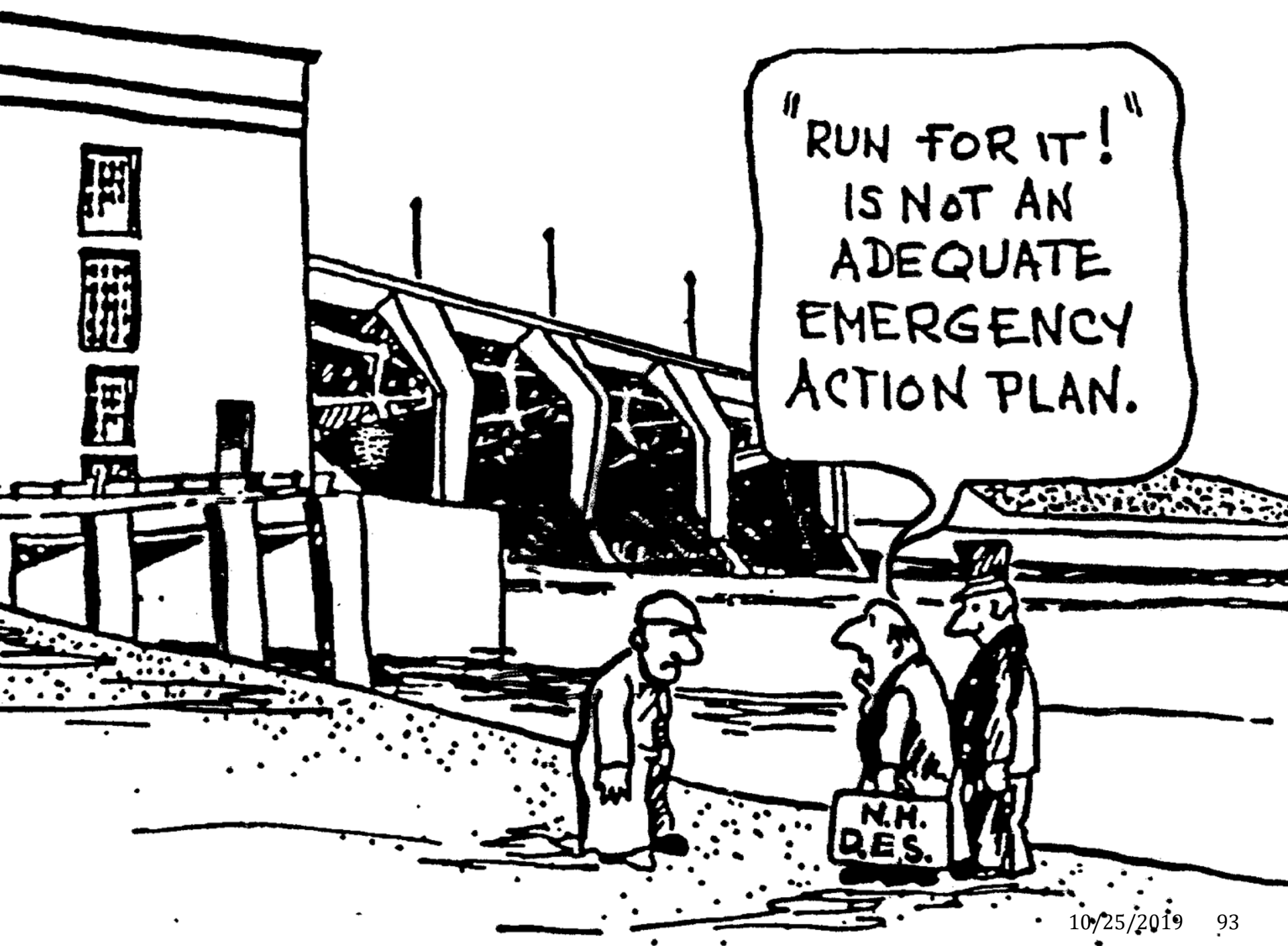
2015



# Innovation Example: Evolution of Phones

202?





# Food System Considerations

## Scales of Influence

### 1. Geographic scale

- a. Local
- b. Regional
- c. National
- d. Global

### 2. Temporal Scale

- a. Short - 5-10 years
- b. Medium - 10-30 years
- c. Long - 30-50 years
- d. Very Long - 50-100 years

### 3. Human Scale

- a. Individual
- b. Family
- c. Neighborhood
- d. Community
- e. Municipal
- f. ...

### Other Consideration

- a. Ecological
- b. Socioeconomic



# Questions?

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**Pickle Bucket Permaculture/Five-Year Farm**

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