New York Weather and Climate Change Impacts

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MISSION

Provide weather, water, and climate data, forecasts and warnings to protect life and property and enhance the national economy

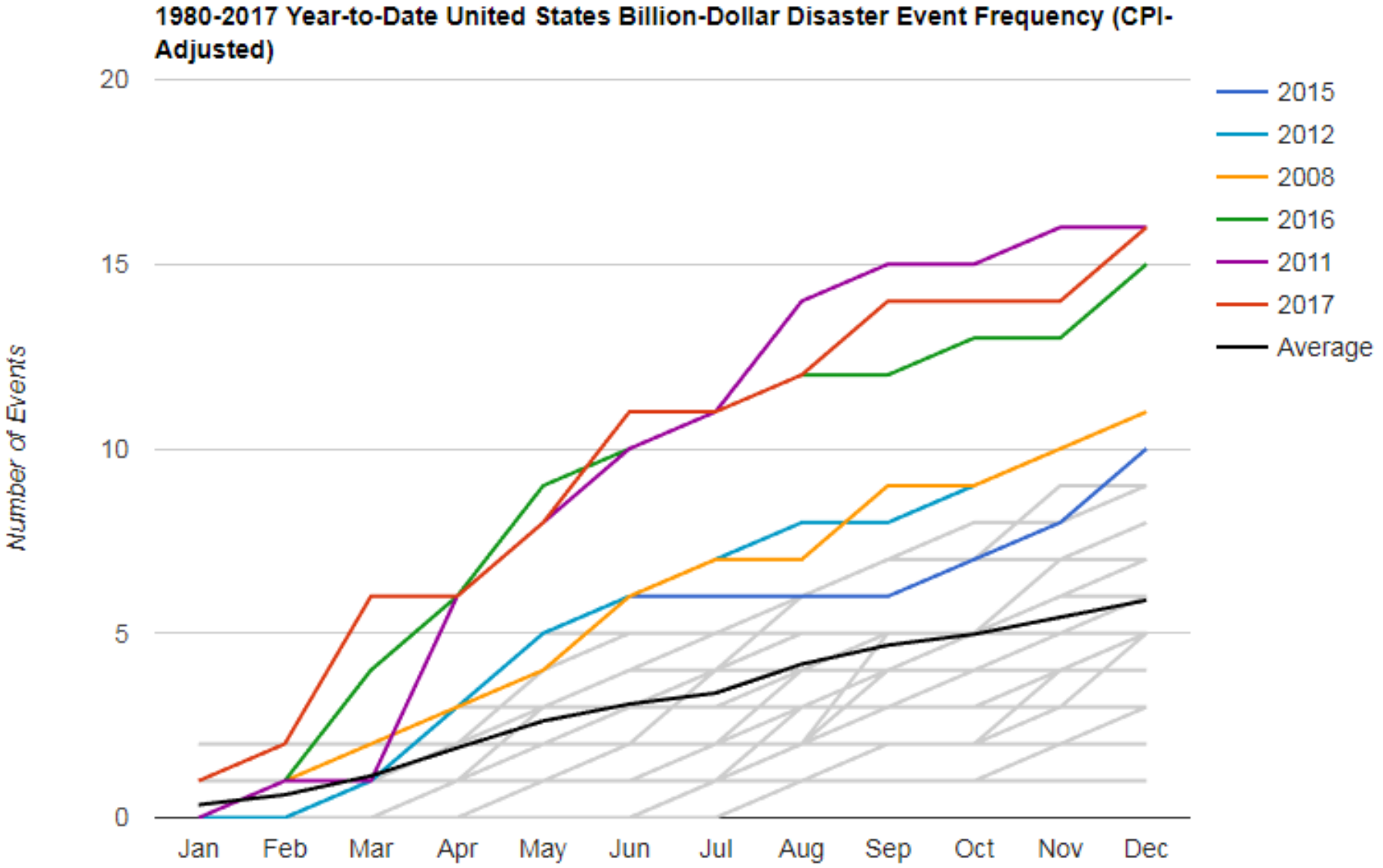
VISION

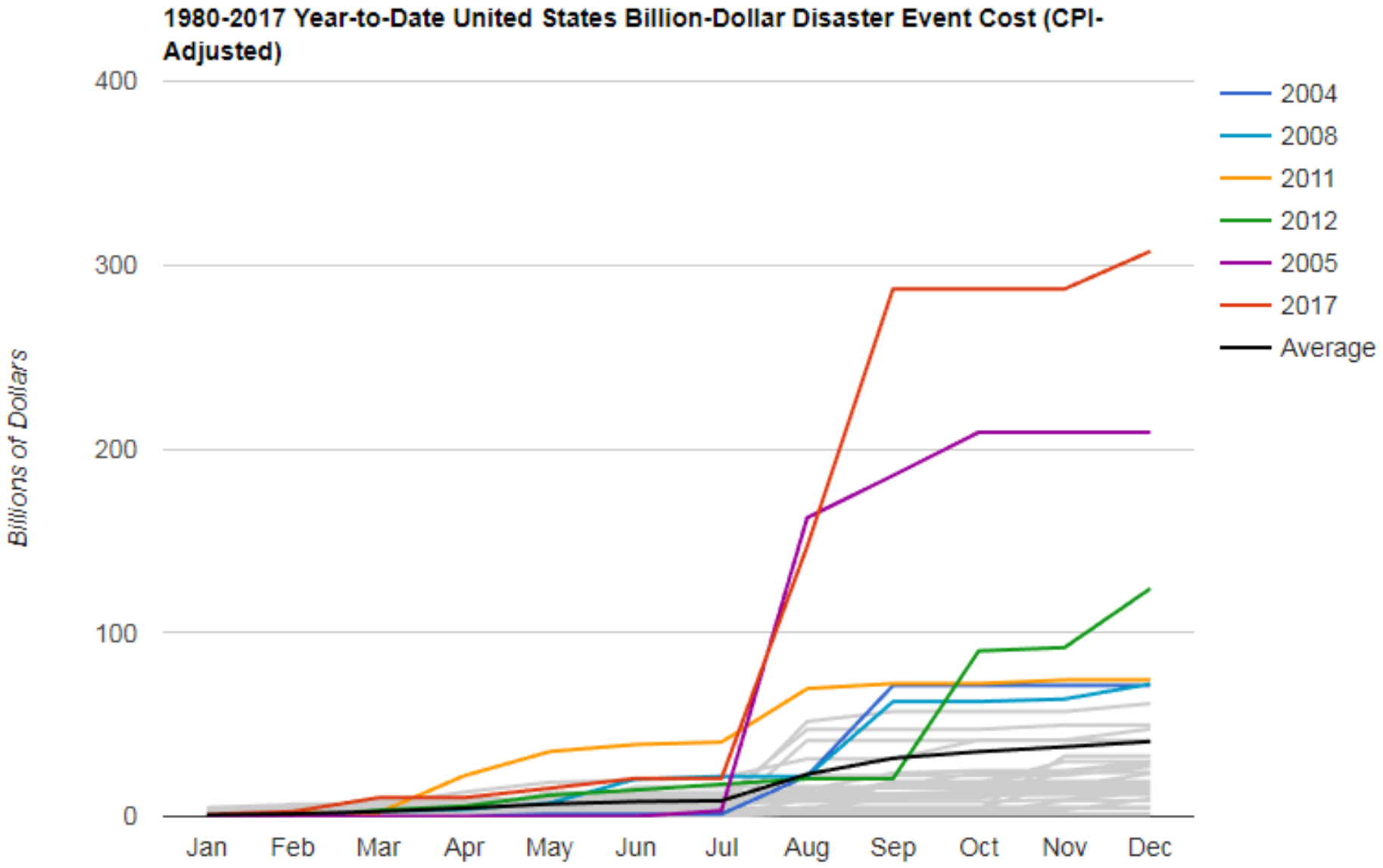
A Weather-Ready Nation: Society is Prepared for and Responds to Weather-Dependent Events

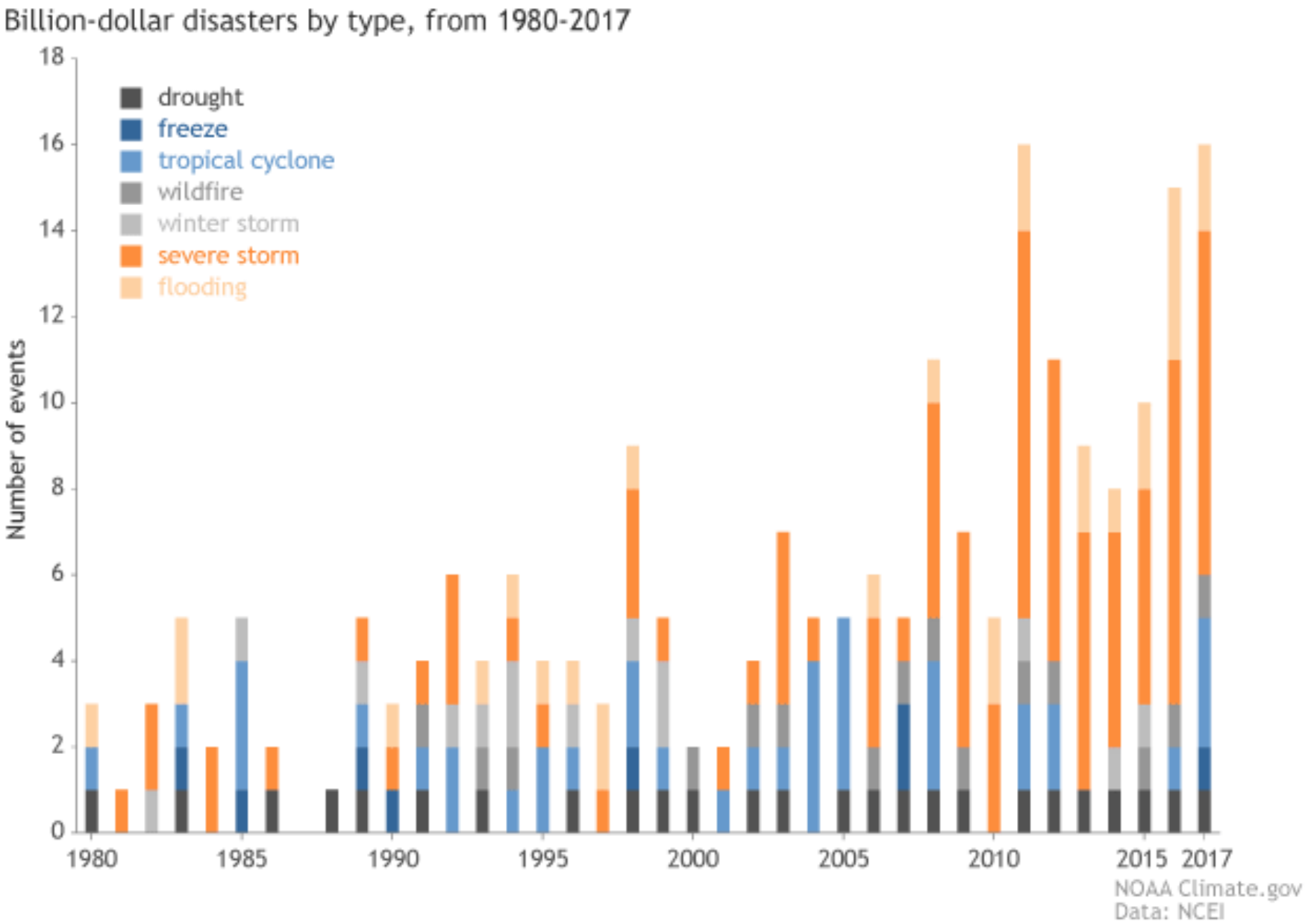
Billion Dollar Disasters in the U.S.

U.S. 2017 Billion-Dollar Weather and Climate Disasters

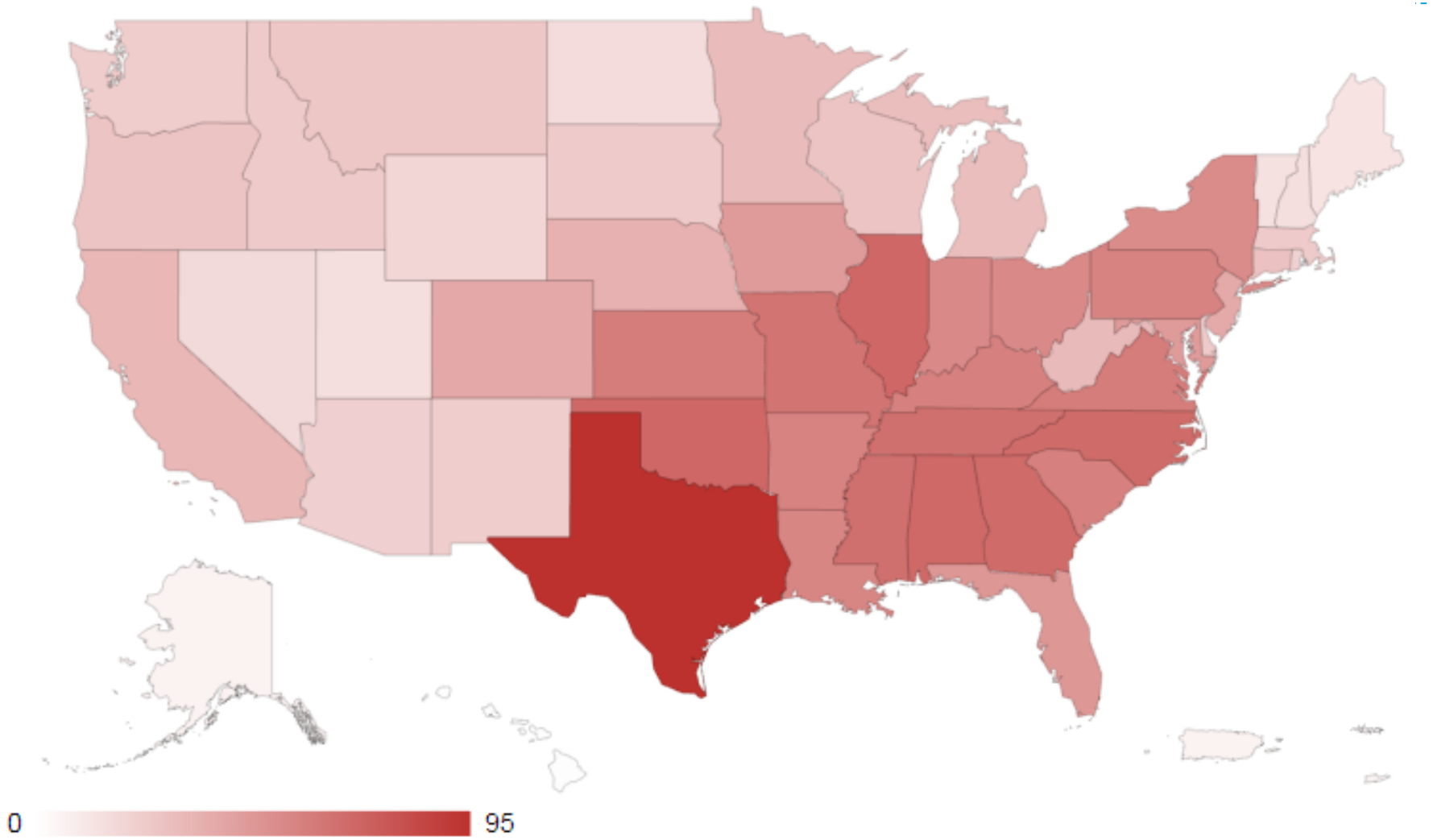
*This map denotes the approximate location for each of the **16 billion-dollar weather and climate disasters** that impacted the United States **during 2017**.*

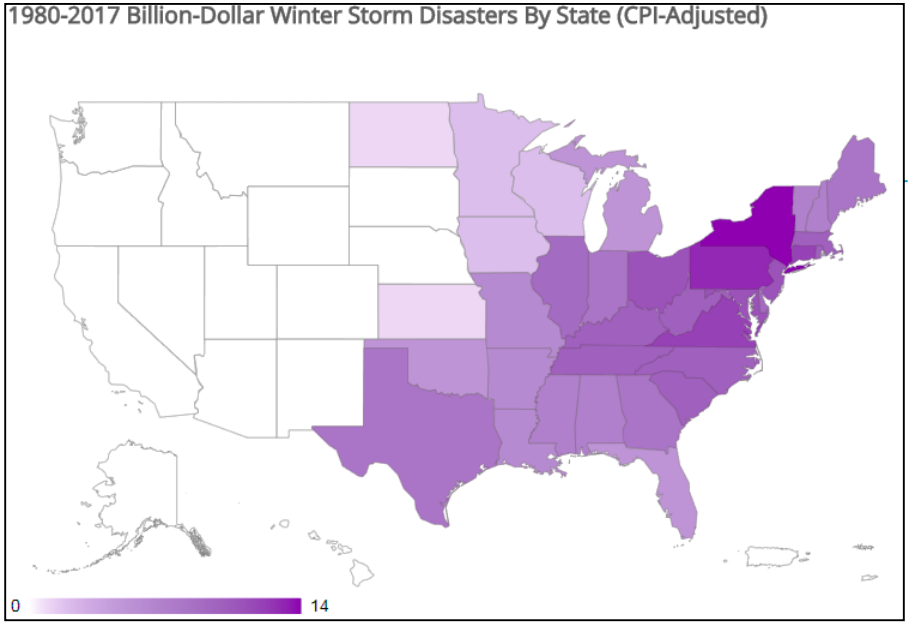

1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Frequency (CPI-Adjusted)
Number of Events
20
15
10
5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2015
2012
2008
2016
2011
2017
Average

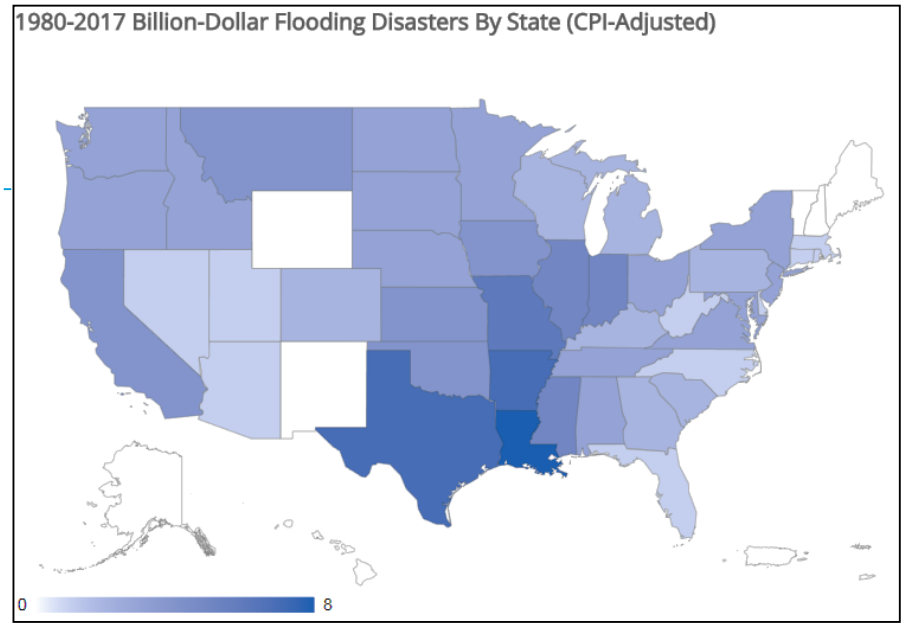

1980-2017 Year-to-Date United States Billion-Dollar Disaster Event Cost (CPI-Adjusted)
Billions of Dollars
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2004
2008
2011
2012
2005
2017
Average

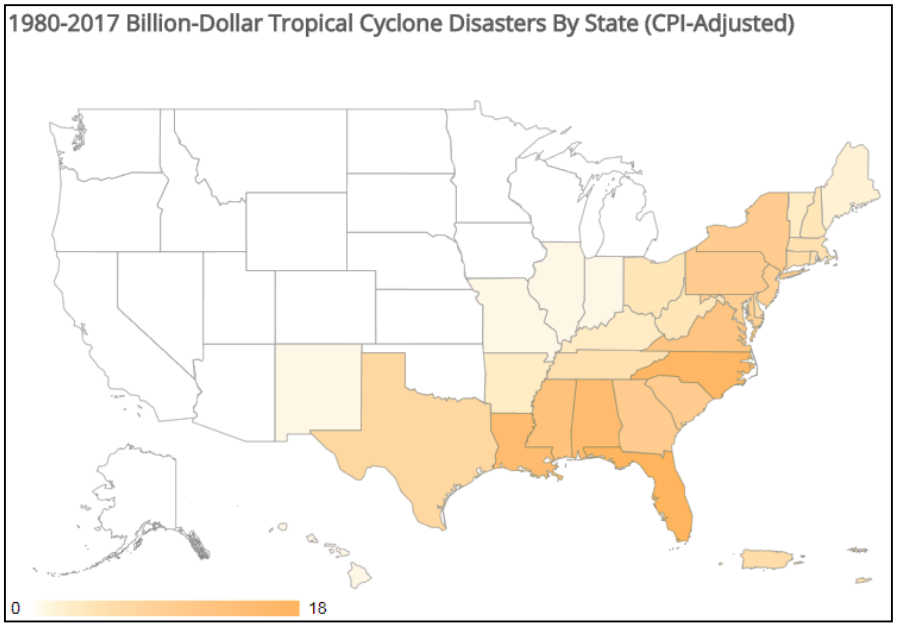

Billion-dollar disasters by type, from 1980-2017
drought
freeze
tropical cyclone
wildfire
winter storm
severe storm
flooding
Number of events
0
2
4
6
8
10
12
14
16
18
1980
1985
1990
1995
2000
2005
2010
2015
2017
NOAA Climate.gov
Data: NCEI

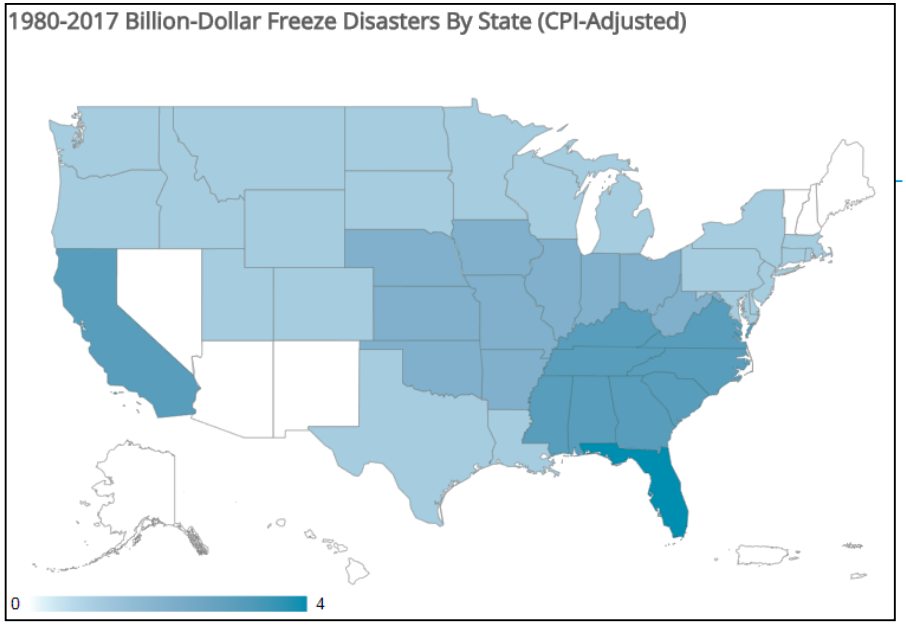
1980-2017 Billion-Dollar Weather and Climate Disasters By State (CPI-Adjusted)

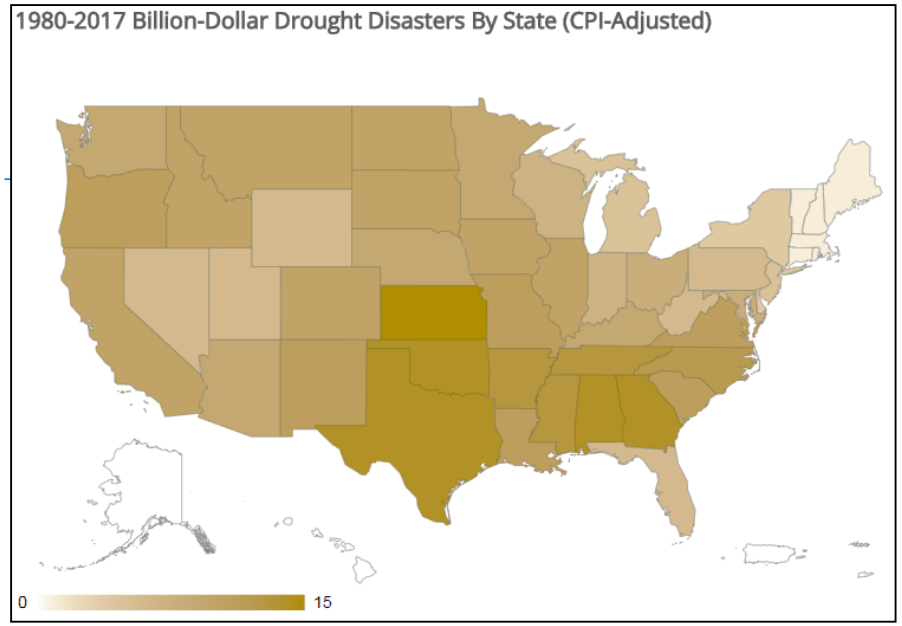


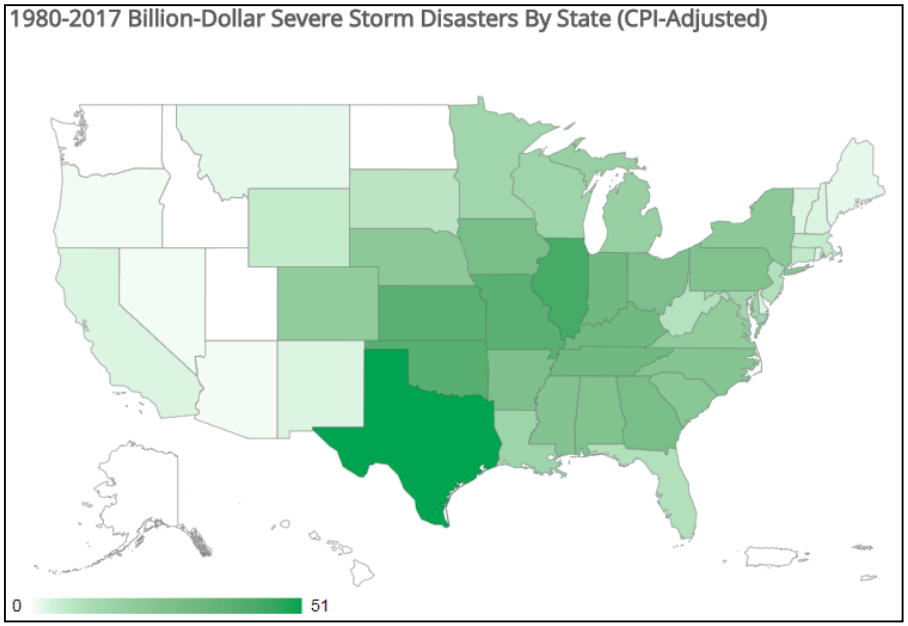

1980-2017 Billion-Dollar Winter Storm Disasters By State (CPI-Adjusted)
0
14


1980-2017 Billion-Dollar Flooding Disasters By State (CPI-Adjusted)
0
8

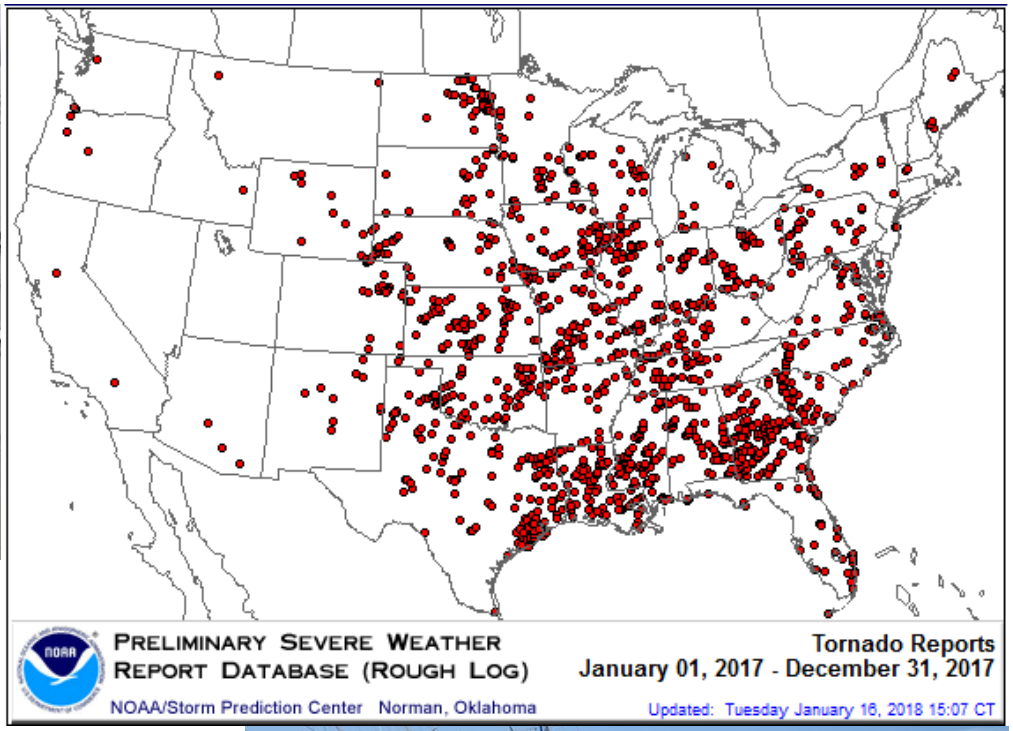

1980-2017 Billion-Dollar Tropical Cyclone Disasters By State (CPI-Adjusted)
0
18


1980-2017 Billion-Dollar Freeze Disasters By State (CPI-Adjusted)
0
4


1980-2017 Billion-Dollar Drought Disasters By State (CPI-Adjusted)
0
15

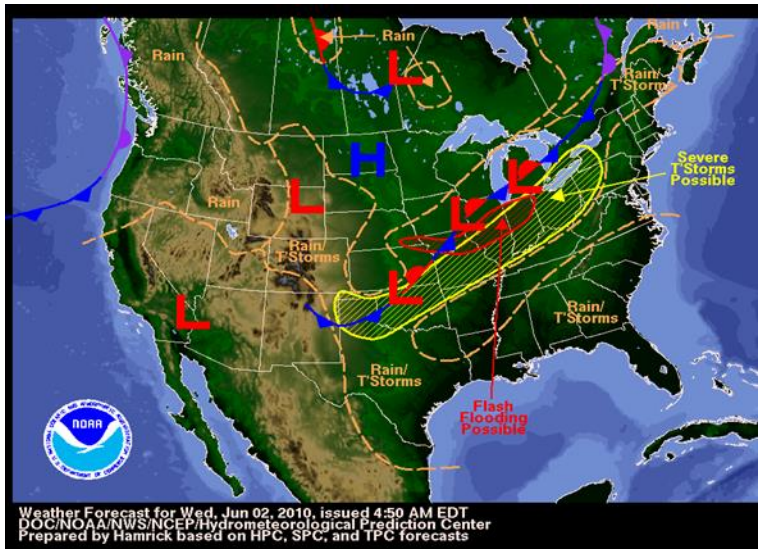

1980-2017 Billion-Dollar Severe Storm Disasters By State (CPI-Adjusted)
0
51

So What's Going on?

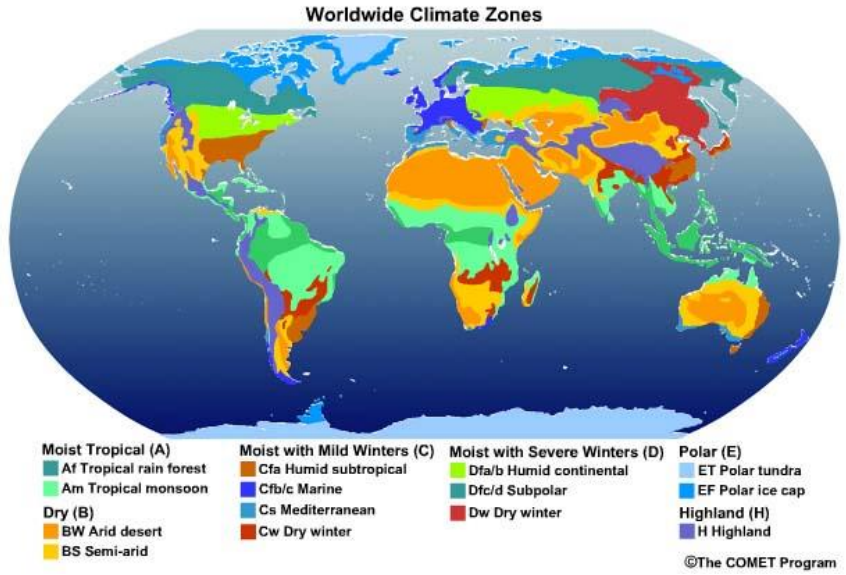


Weather vs. Climate

Weather is the state of the atmosphere at any given time and place (temperature, humidity, precipitation, cloudiness, wind, etc.).



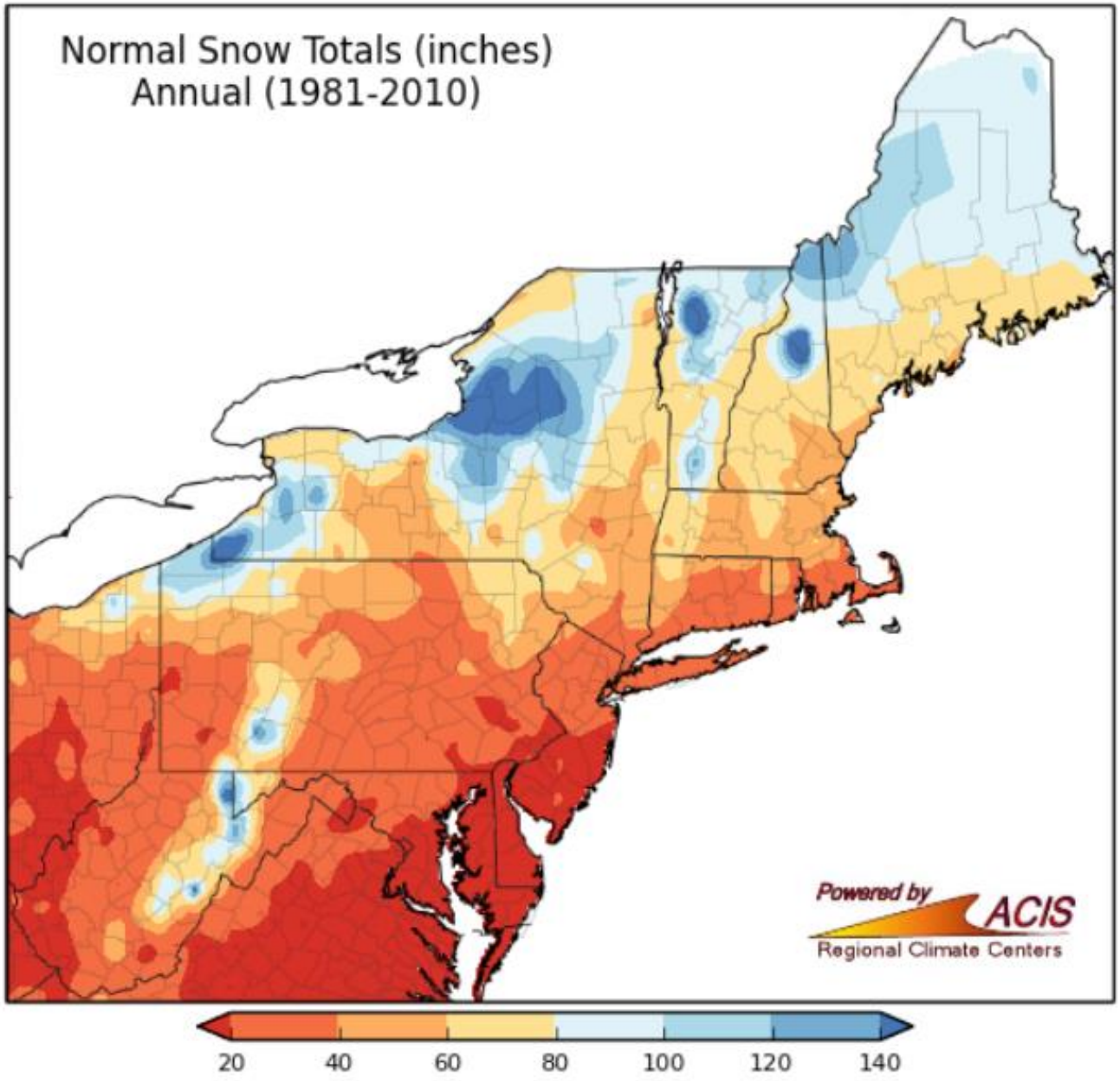
Climate is the set of meteorological conditions that prevail in a particular place or region over a long period of time.



Seasonal Climate

Winter

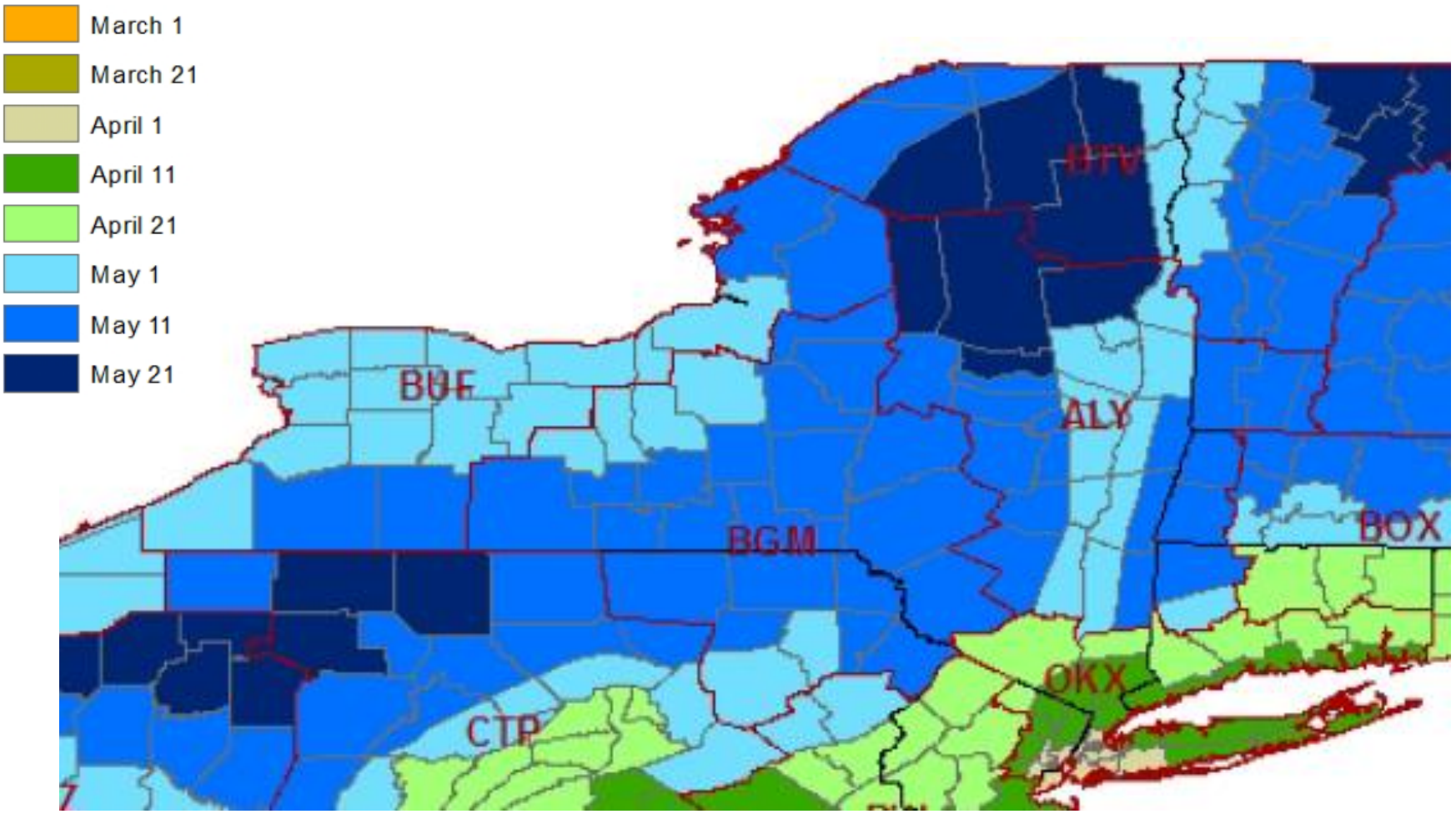
- Generally cloudy, cold and snowy
  - May include frequent thaws and rains
  - Great Lakes and Atlantic modify extreme cold temperatures,
    - On average about 10 to 15 nights below zero


Normal Snow Totals (inches)
Annual (1981-2010)
Powered by ACIS
Regional Climate Centers
20
40
60
80
100
120
140

Spring

- Spring comes slowly to upstate
- For much of the state, Spring months are the driest statistically
  - Due in part to the stabilizing effects of Great Lakes
- Near the lakes, sunshine increases markedly in May

Median Date of the Last Spring Freeze



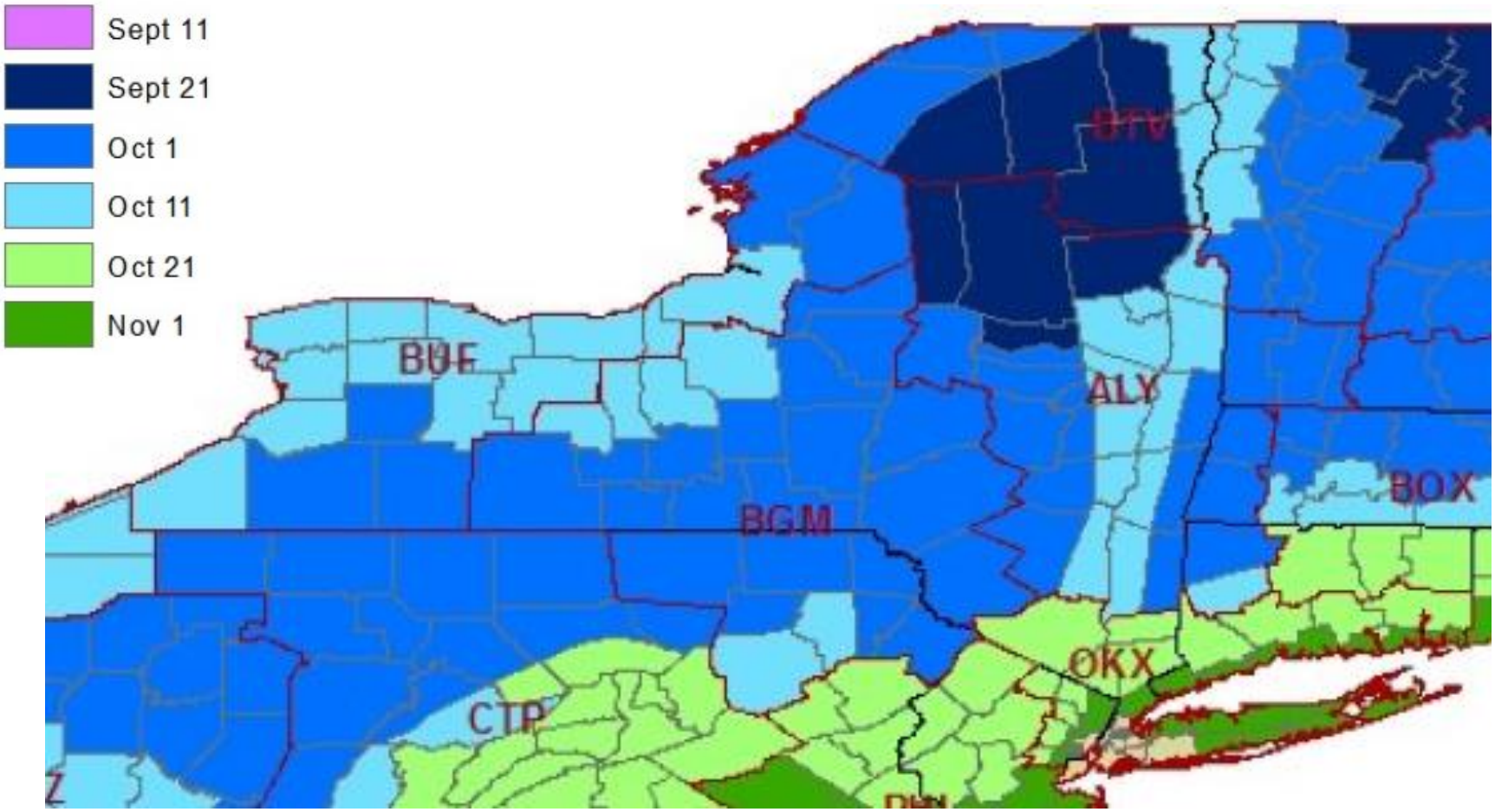
Summer

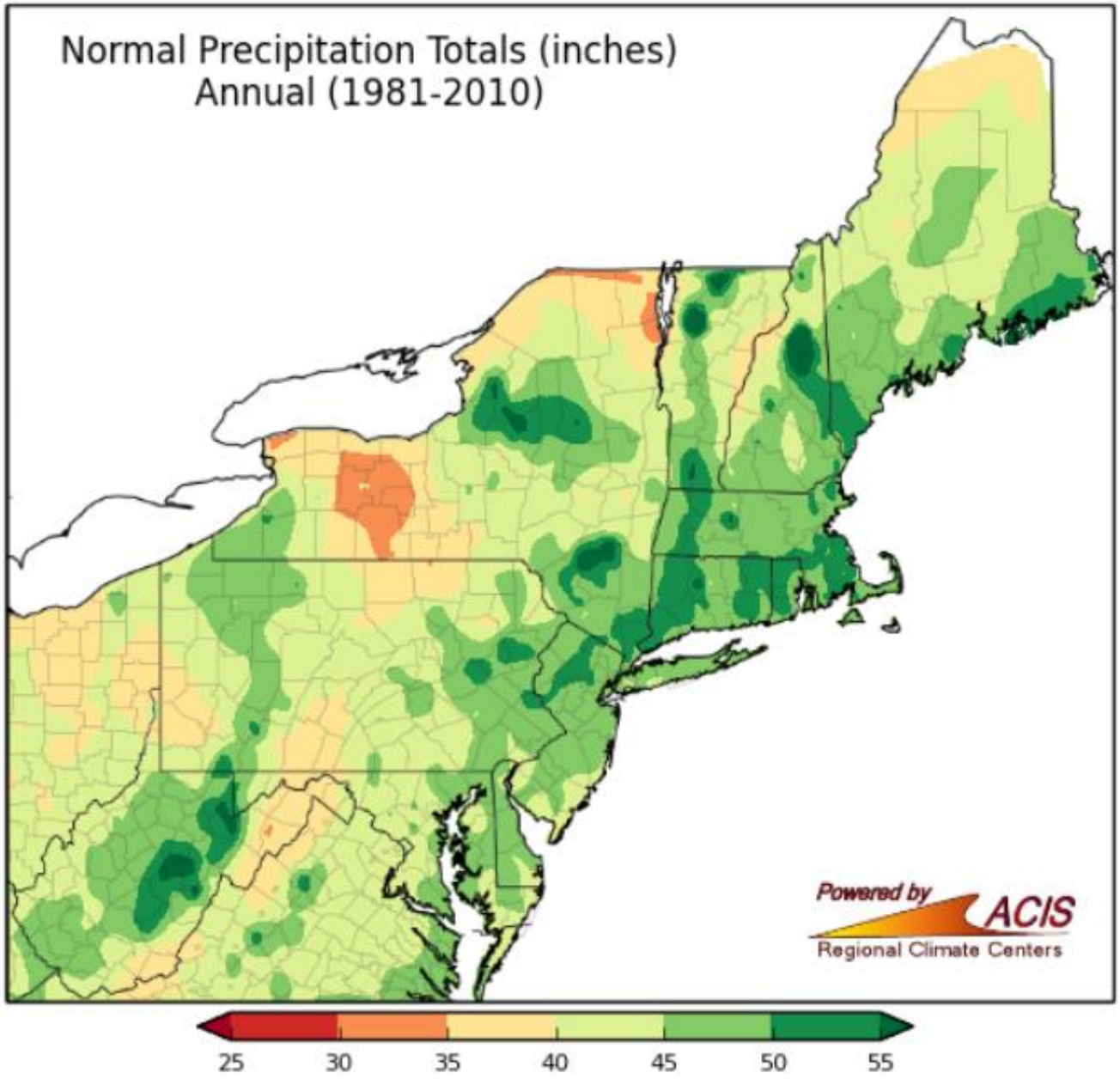
- Summers are warm and sunny across the region
  - There usually are several periods of uncomfortably warm and muggy weather
    - About 5 to 10 days reach the 90 degree mark
- Rain can be expected every third or fourth day
  - Mainly in the form of showers and thunderstorms
  - More common inland than along the lakeshore
  - Can be brief but intense
- Completely overcast days are rare

Autumn

- Pleasant, mild and dry through October
- Colder air masses across the lakes bring a dramatic increase in cloud cover downwinds, and first lake effect snows by mid-November
- Early snows generally melt off quickly

Median Date of the First Fall Freeze




Normal Precipitation Totals (inches)
Annual (1981-2010)
Powered by ACIS
Regional Climate Centers
25
30
35
40
45
50
55

Climate Change

Climate Change: The Fundamentals

Climate

- **Climate** describes how *Weather* varies at a particular location over a longer period of time.

Climate Variability

- **Climate Variability** describes fluctuations in the *Climate* itself over time.

Climate Change

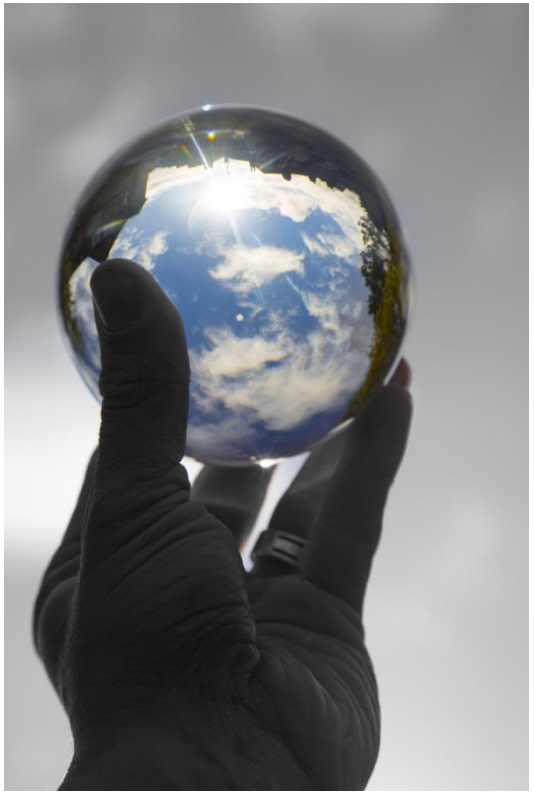
- **Climate Change** describes long-term (decades or longer) and persistent changes.

Global Climate Change: The Observations

- Carbon dioxide in the atmosphere is increasing
- Global average temperatures rising
- Global sea level has risen
- Arctic sea ice has decreased
- Increases in northern latitude precipitation and decreases in southern and subtropical regions

Climate Models

- Computer models are essential for understanding the complexities of climate change.
- Confidence in the ability of models to project future climate is growing.

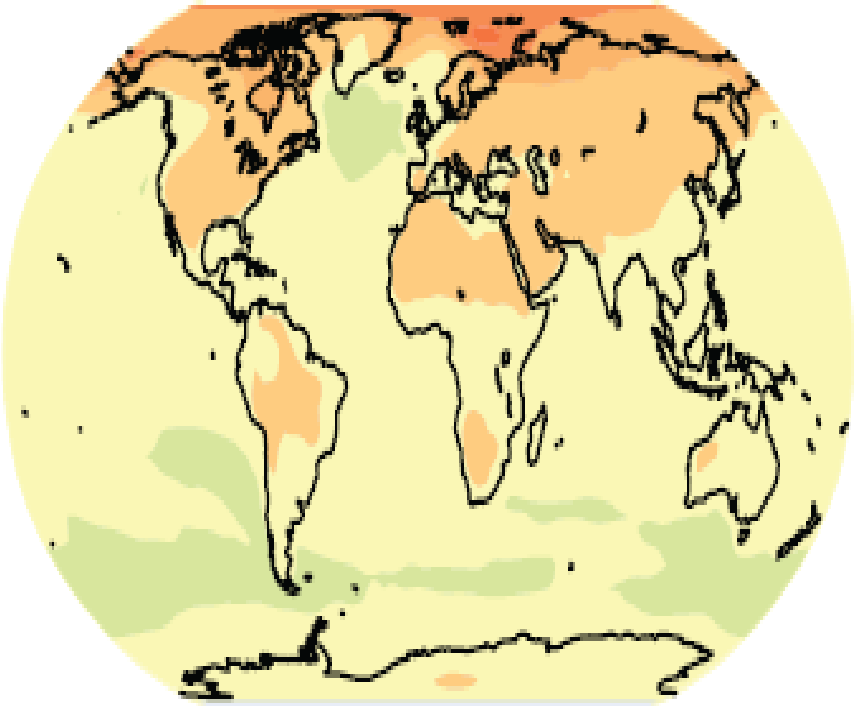


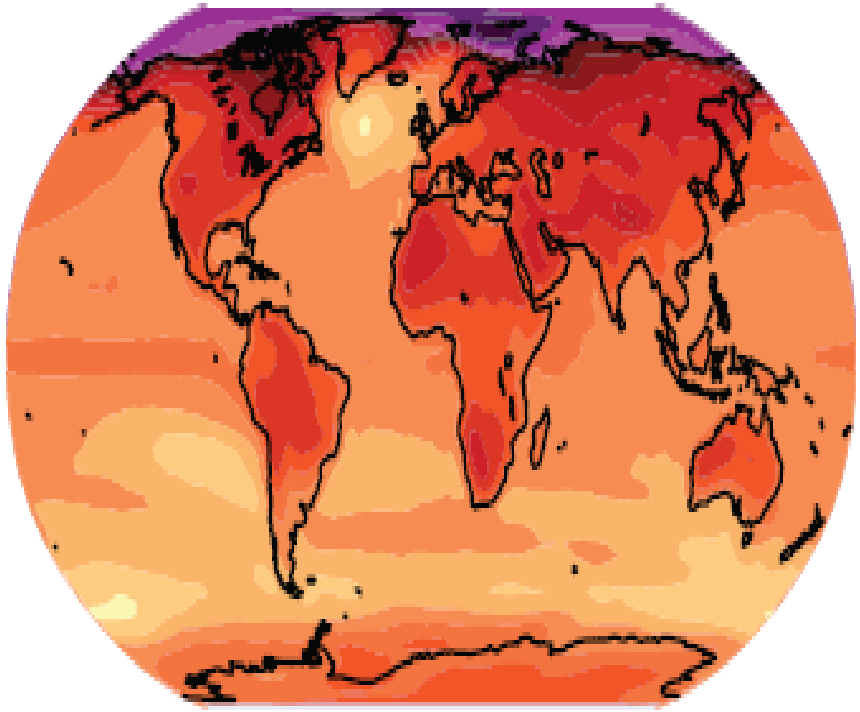
Global Climate Change: Likely Projections

2020-2029

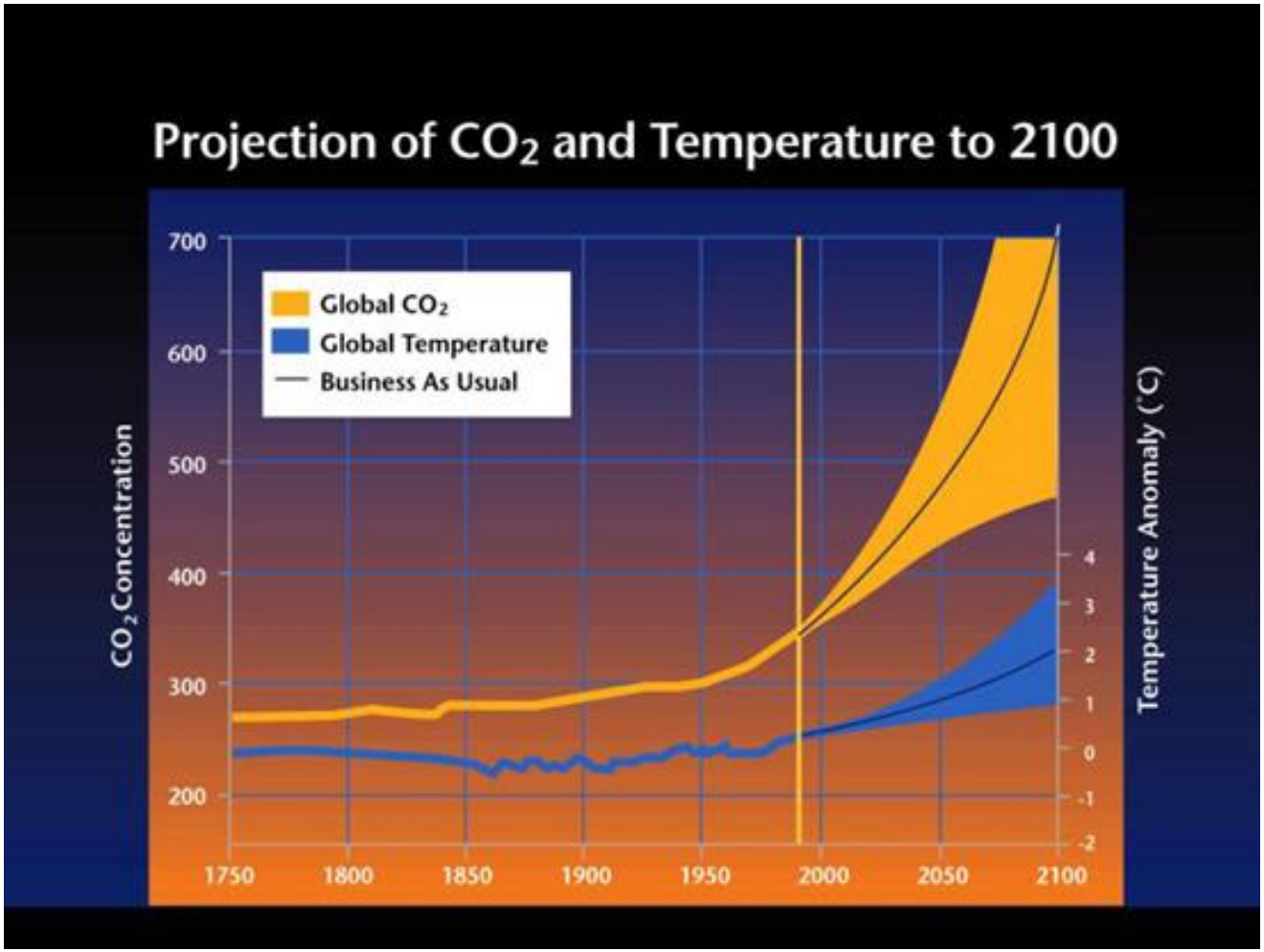
2090-2099

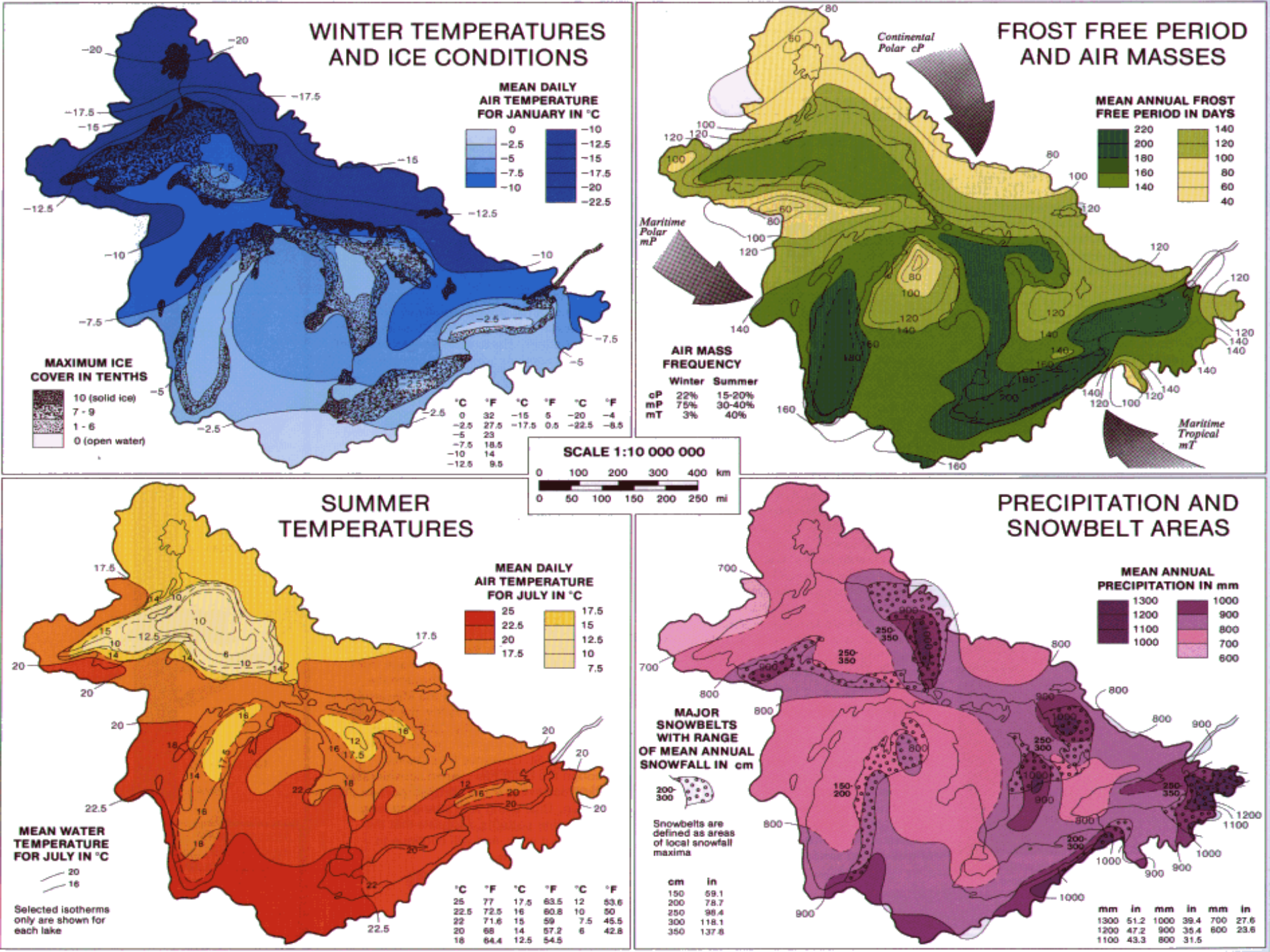
A1B





Global Climate Change: Likely Projections




WINTER TEMPERATURES AND ICE CONDITIONS
MEAN DAILY AIR TEMPERATURE FOR JANUARY IN °C
0
−2.5
−5
−7.5
−10
−10
−12.5
−15
−17.5
−20
−22.5
MAXIMUM ICE COVER IN TENTHS
10 (solid ice)
7 - 9
1 - 6
0 (open water)
°C °F °C °F °C °F
0 32 −15 5 −20 −4
−2.5 27.5 −17.5 0.5 −22.5 −8.5
−5 23
−7.5 18.5
−10 14
−12.5 9.5
FROST FREE PERIOD AND AIR MASSES
Continental Polar cP
Maritime Polar mP
Maritime Tropical mT
MEAN ANNUAL FROST FREE PERIOD IN DAYS
220
200
180
160
140
140
120
100
80
60
40
AIR MASS FREQUENCY
Winter Summer
cP 22% 15-20%
mP 75% 30-40%
mT 3% 40%
SCALE 1:10 000 000
0 100 200 300 400 km
0 50 100 150 200 250 mi
SUMMER TEMPERATURES
MEAN DAILY AIR TEMPERATURE FOR JULY IN °C
25
22.5
20
17.5
17.5
15
12.5
10
7.5
MEAN WATER TEMPERATURE FOR JULY IN °C
20
16
Selected isotherms only are shown for each lake
°C °F °C °F °C °F
25 77 17.5 63.5 12 53.6
22.5 72.5 16 60.8 10 50
22 71.6 15 59 7.5 45.5
20 68 14 57.2 6 42.8
18 64.4 12.5 54.5
PRECIPITATION AND SNOWBELT AREAS
MEAN ANNUAL PRECIPITATION IN mm
1300
1200
1100
1000
1000
900
800
700
600
MAJOR SNOWBELTS WITH RANGE OF MEAN ANNUAL SNOWFALL IN cm
200-300
Snowbelts are defined as areas of local snowfall maxima
cm in
150 59.1
200 78.7
250 98.4
300 118.1
350 137.8
mm in mm in mm in
1300 51.2 1000 39.4 700 27.6
1200 47.2 900 35.4 600 23.6
1100 43.3 800 31.5

Climate Changes Are Already Occurring

- Temperatures:
  - Winter – warmer and fewer cold days and nights
  - Summer – hotter and more frequent hot days/nights and heat waves

Climate Changes Are Already Occurring

- Precipitation:
  - Regions that already experience long-duration droughts, such as the Southwestern U.S., will likely see the area affected increase.
  - Many areas in the U.S. have seen an increase in the heaviest downpours, and that pattern is very likely to continue in the future.

Climate Changes Are Already Occurring

- **Hurricanes:** More intense hurricanes

  - Observations indicate an increase in hurricane intensity in the Atlantic and West Pacific

Projected Changes in New York Weather: Temperature

The following changes are ***likely*** over the next century:

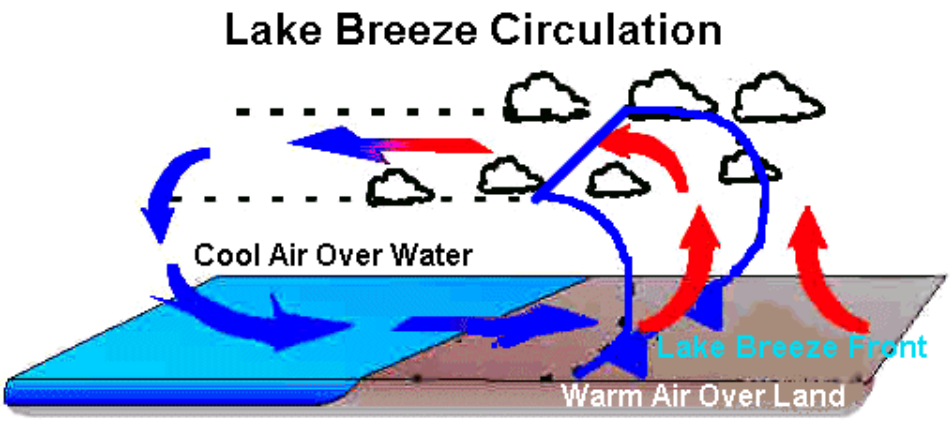
- Average temperature will continue to increase
- Number of days with:
  - Low temperatures below 0ºF will drop by 50% or more
  - High temperatures above 90ºF will more than double

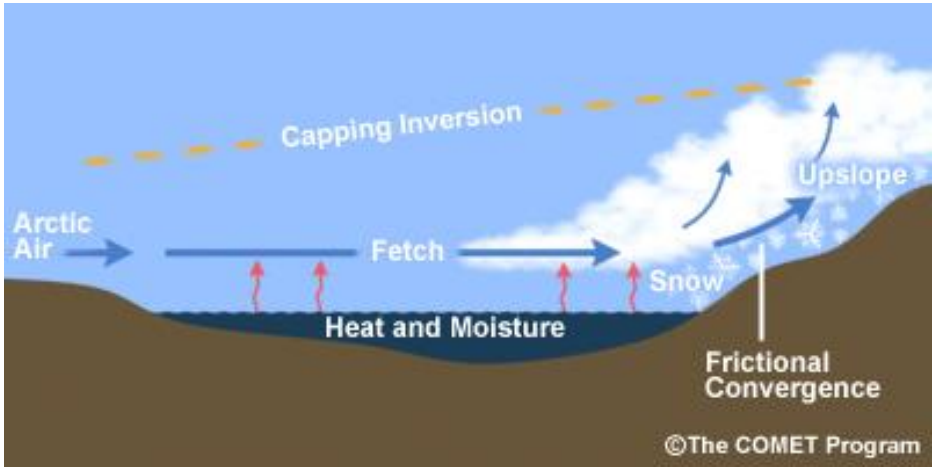
Projected Changes in New York Weather: Precipitation

The following changes are ***likely*** over the next century:

- Projected small increase in annual precipitation
- Larger variability
- Intense precipitation events (heavy downpours) are likely to increase

The Impact of the Great Lakes on Upstate Climate Change





In summer, lake breeze circulation keeps shoreline areas cooler

Lake-effect precipitation may become increasingly common in late fall and winter

Affects of Climate Change

- Lake and Sea Levels
- Great Lakes Ice Cover
- Severe Weather
- Human Health and Economy

Lake Levels

OR

Sea Levels

OR

Ice Cover

Severe Weather

- The relationship between climate change and localized severe weather events is complex
- No one event can be directly attributed to climate change however the increased frequency of severe weather events can

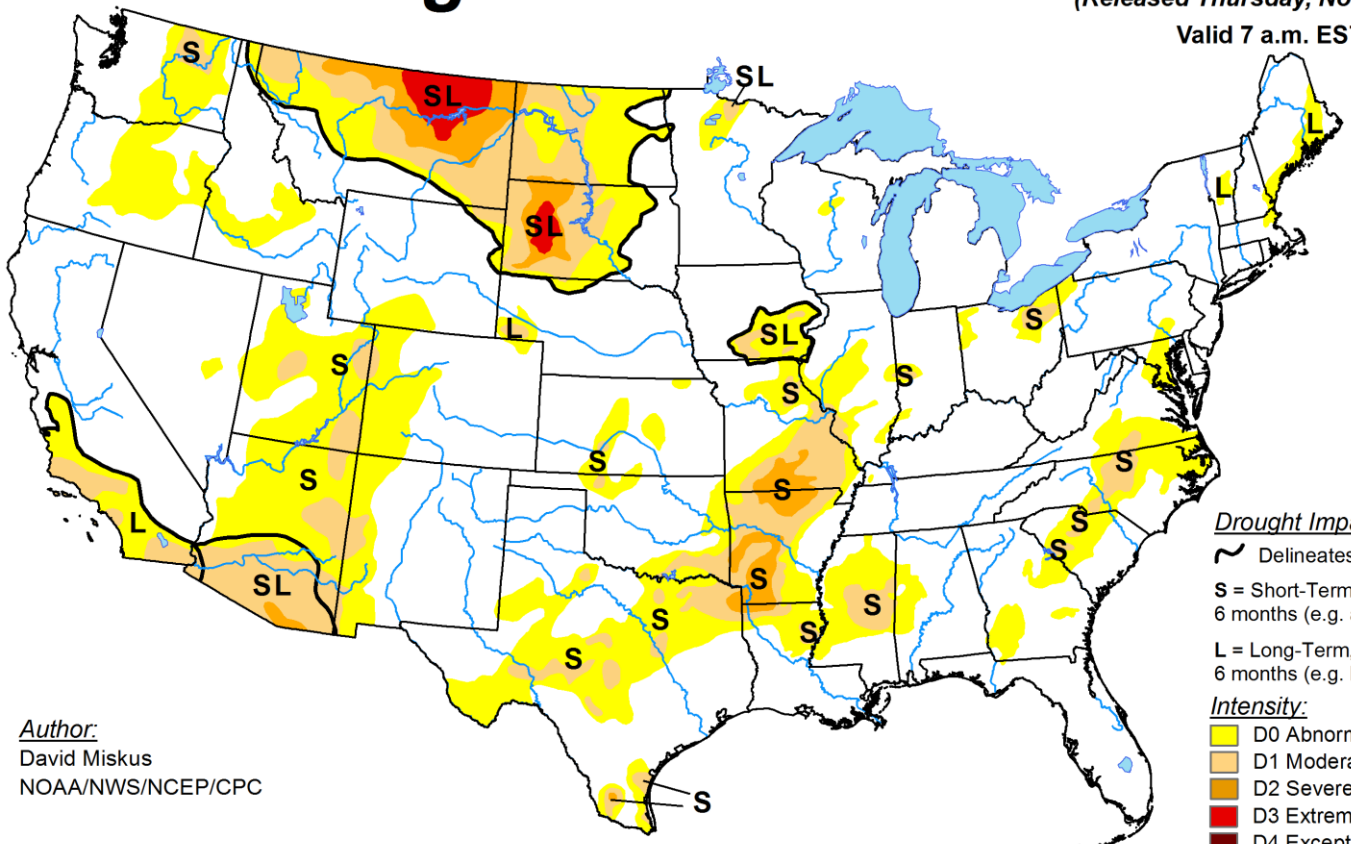
Severe Weather

U.S. Drought Monitor

November 7, 2017

(Released Thursday, Nov. 9, 2017)

Valid 7 a.m. EST



Author:
David Miskus
NOAA/NWS/NCEP/CPC

Drought Impact Types:

~ Delineates dominant impacts

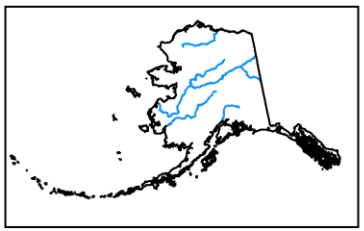
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

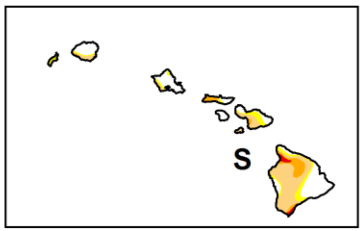
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

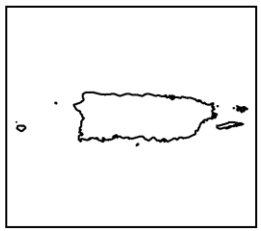
Intensity:

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.







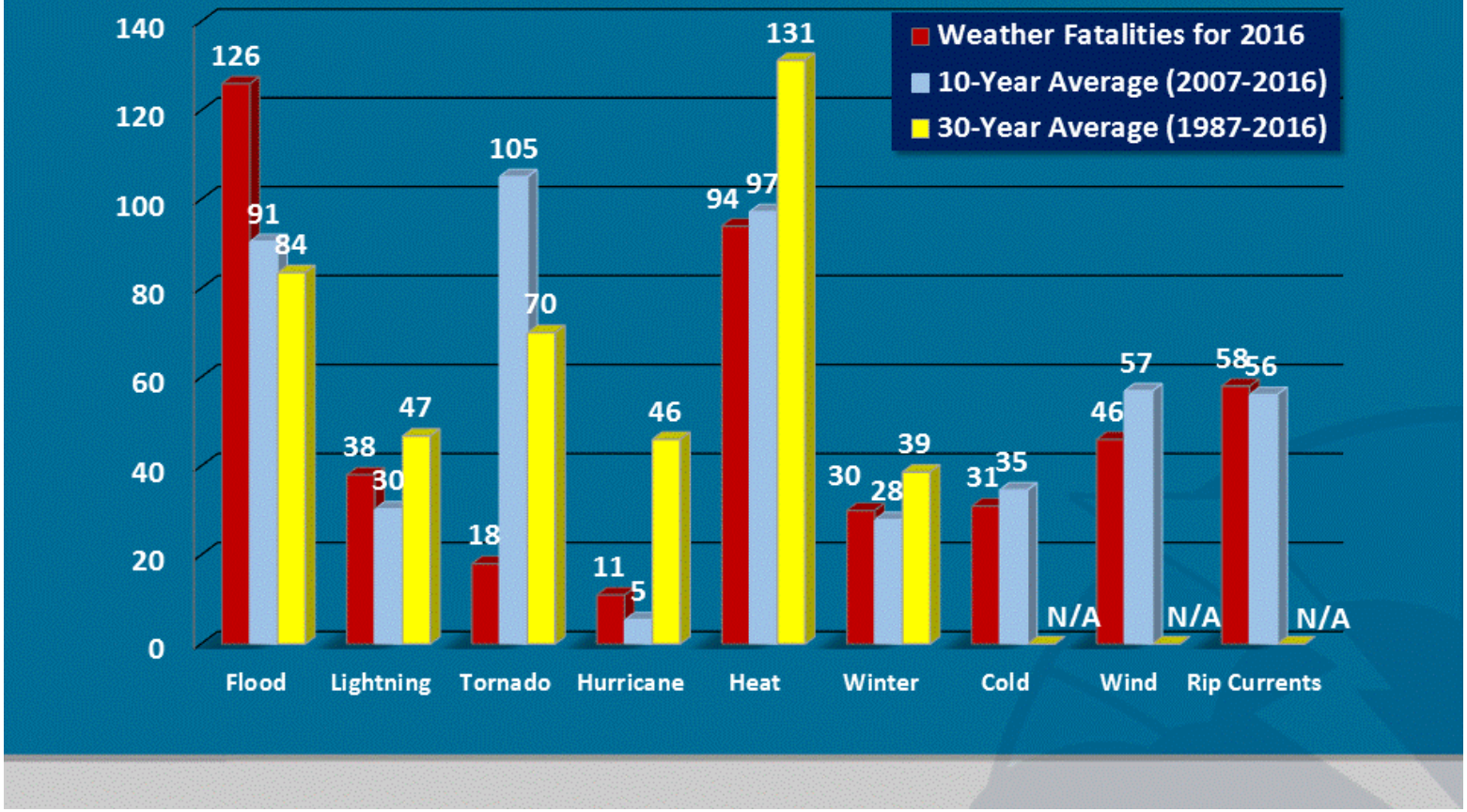
USDA NDMC

http://droughtmonitor.unl.edu/

Human Health Concerns

- Heat Waves
- Water and Air Quality
- Agriculture

Weather Fatalities 2016



More frequent More Severe Longer Lasting

Air Quality

- Air Temperature
- Air Stagnancy
- Emissions

- Air Quality

Water Quality

Agriculture

Economical Impacts

- Reduced heating demand and lower heating bills in winter
- Shifts in business opportunities
  - Longer summer vacation season (tourism)
  - Longer construction season
- Increased warm weather activities e.g. swimming, boating, golfing
- Less snow and ice will result in fewer shipping disruptions in winter
- City operations shift – lower expenses for snow removal

Summary

- Climate Changes Are Already Occurring
  - Temperatures:
    - Global Temperatures Rising
  - Precipitation:
    - Precipitation totals showing small increases
    - More frequent heavy precipitation events
    - Expanded drought areas
  - More intense hurricanes
- Projected Changes
  - Temperatures will continue to increase
    - Fewer cold nights and more hot days
  - Precipitation
    - Larger variability in winter (more rain than snow)
    - Less precipitation late summer, early fall
    - Increased number of high intensity precipitation events
- Climate Changes will affect lake levels, ice cover, severe weather, human health and the economy

QUESTIONS?

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References

- NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2018). https://www.ncdc.noaa.gov/billions/

- Climate Ready Great Lakes. Great Lakes SeaGrant Network, University of Michigan School of Natural Resources and Environment, and NOAA Great Lakes Collaboration Team. http://www.regions.noaa.gov/great-lakes/index.php/project/climate-ready-great-lakes/

- Northeast Regional Climate Center, 1123 Bradfield Hall, Cornell University, Ithaca, NY 14853. www.nrcc.cornell.edu