Floods, Droughts, and Temperature Swings: Not your Grandfather's Weather

Mark W. Wysocki

Senior Lecturer in Meteorology Cornell University
New York State Climatologist

Nutrient in the Watershed, Unusual Weather, and Harmful Algal Blooms: A Public Conversation

Ovid, NY

28 September 2019

Cornell University.

DHAKA THURSDAY SEPTEMBER 3, 2009

UN Secretary General Ban Ki-Moon poses for photographers in front of a collapsed glacier at the atmospheric measuring station in Ny-Aalesund, a climate change research station on the Norwegian island of Svalbard on Tuesday. Ban is on a two-day trip to the Arctic Circle to see first-hand the effects of climate change ahead of key international climate talks in Copenhagen in December.

UN chief 'alarmed' at Arctic glacier melt

A mobile court team examines the fitness certificate of a bus at Kamalapur in the city yesterday as part of a crackdown on old vehicles, aimed at easing traffic congestion.

Climate change threatens food security in S Asia

Says ADB study

rss/from:1996

Satellite Measurements

El Nino Dissipa

1995 ... WoodForTrees.org

SWITZERLAND

Hottest decade kills 370,000

THE 21st century's first decade was the hottest on record, with temperatures rising at an unprecedented pace and weather extremes claiming 370,000 lives, the United Nations says.

In a new report on the period from 2001-2010, the World Meteorological Organisation said land and sea temperatures averaged 14.47C.

This compared with the long-term average measured from weather records dating back to 1881. When measured globally, every year of the decade except 2008 was among the 10 warmest on record, the report showed.

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Clooney's amazing mother

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Iran threatens serious action against sailors

THE BIG CLIMATE CHANGE 'FRAUD'

We are not to blame says top scientist... It's a con to raise tax

Great Ocean Conveyor Belt

taz.am wochene

... ZU SPÄT? DER VERTRAAAG!

Sunday Morning Post

THE JERUSALEM POST

Landmark climate deal reached in France

EL PAIS

Acuerdo mundial por el clima

la Repubblica

CLIMATE DEAL 'A TURNING POINT' FOR THE PLANET

The New York Times

NATIONS APPROVE LANDMARK CLIMATE DEAL
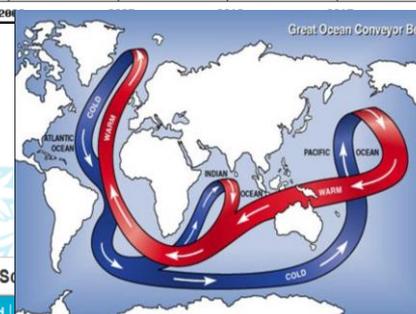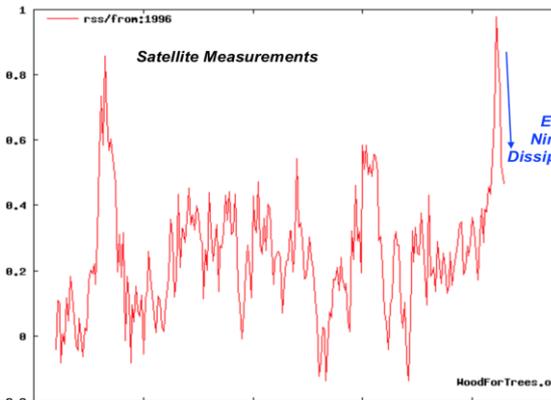
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EXCLUSIVE: 'We must act before it is too late and we test our world to destruction,' writes HRH THE PRINCE OF WALES

• Prince Charles writes exclusively for the Mail on Sunday on climate change
• He says the situation is too serious to look away or put our heads in the sand
• He says our present system is wasteful and cannot continue
• Prince Charles has even written a book, with exclusive extracts below

By HRH THE PRINCE OF WALES
PUBLISHED: 00:18, 22 January 2017 | UPDATED: 01:48, 22 January 2017

Columbus, Ohio • Jul 12, 2015 • 75° Overcast

The Columbus Dispatch

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CLIMATE SCIENCE

Study: Sea levels could rise 20 feet even if global warming curbed

ENVIRONMENT BLOG
» Hug the Earth

By Alister Doyle
Reuters • Sunday July 12, 2015 11:46 AM

Disaster risk reduction, climate change adaptation and environmental migration

A POLICY PERSPECTIVE

ding Thu Jul 20 2006 8PM EDT
Jul 21 2006 00Z

Database
6PM EDT

2014

NOAA: Global average temperatures for October 2014 and year-to-date are highest on record

NOAA: Contiguous U.S. experienced coldest March since 2002

Parts of the Northeast and Midwest experienced near-record cold, while much of the West was warmer than average. Drought intensified in parts of the West and Great Plains.

2016

January 2016 warmest January on record for the globe
Arctic sea ice extent smallest on record for January

August marks 16 consecutive months of record-breaking heat for the globe
June-August and January-August were also record warm

July was hottest month on record for globe
Marked 15 consecutive months of record-breaking heat

2016 was 2nd warmest year on record for U.S.
15 billion-dollar weather and climate disasters caused 138 deaths and $46B in damages

2018

2017 was 3rd warmest year on record for U.S.
Nation experienced 16 weather and climate disasters with total losses of over $300 billion, the costliest on record

Contiguous U.S. had 4th warmest and 3rd wettest September on record
Hurricane Florence brought flooding rains to the Carolinas and record heat impacted parts of the Southwest and East

2015

NOAA: March and 1st quarter 2015 were warmest in 136 years for the globe

Arctic sea ice extent smallest on record for March

October 2015 was warmest October on record for the globe
Year to date also continues to be record warm

2017

U.S. had 2nd warmest February and 6th warmest winter on record
Unseasonable warmth spanned 39 states; Western drought improved

Globe had 2nd warmest April and year to date on record
Last month also saw record-low Arctic, near-record-low Antarctic sea ice extents

Globe had 2nd warmest year to date, 3rd warmest August on record
Arctic and Antarctic sea ice extents remain near-record lows

2019

2018 was 4th hottest year on record for the globe
The U.S. experienced 14 billion-dollar weather and climate disasters

Contiguous U.S. surpasses wettest 12-month period on record for third time this year while Alaska sees second warmest June

U.S. impacted by six billion-dollar weather and climate disasters so far in 2019

Second warmest August and June-August for globe
Near-record low Arctic sea ice extent during August

July was the warmest month on record for the globe
Record low sea ice extent at the poles

THE WORLD NEWS

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THE SKY IS FALLING!

...CKEN LITTLE
...ERE TO BE FOUND

Flood Damage Information

GOVERNOR CUOMO ANNOUNCES $13 MILLION IN RELIEF FUNDS FOR COMMUNITIES DAMAGED BY SEVERE STORMS AND FLASH FLOODING

Assistance Available to Homeowners in Broome, Chemung, Schuyler, Seneca, Tioga, Delaware, and Chenango Counties

Governor Andrew M. Cuomo today announced $13 million is available for restoration and recovery efforts following the severe storms and flash flooding on August 13-15 that severely impacted communities in the Southern Tier and Finger Lakes regions.

National Weather Service data indicates these regions received between 10 and 20 inches of rain during the 30-day period beginning July 22, 2018. The August storms near the end of this period produced heavy rainfall, flash flooding and strong winds, and combined with ground saturated by this abnormally wet period, produced significant damage.

0.0   Trace   0.01 - 0.07   0.08 - 0.14   0.15 - 0.34   0.35 - 0.81   0.82 - 1.22   1.23 - 1.35

0.34

Wayne

0.22

Onondaga

0.48

0.57

Ontario

0.43

Seneca

Cayuga

0.71

0.48

0.65

0.61

Yates

Tompkins

0.

0.

1.28

Schuyler

1.25

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Seneca County, New York 7/25/2018

0.0 | Trace | 0.01 - 0.08 | 0.09 - 0.16 | 0.17 - 0.39 | 0.40 - 0.94 | 0.95 - 1.41 | 1.42 - 1.56

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
## Seneca County, New York 7/26/2018

Legend: 0.0 | Trace | 0.01 - 0.08 | 0.09 - 0.16 | 0.17 - 0.41 | 0.42 - 1.00 | 1.01 - 1.50 | 1.51 - 1.68

0.37

Wayne

1.04

1.40

Onondaga

0.71

1.52

Ontario

0.23

Seneca

Cayuga

0.81

0.56

0.71

0.67

Yates

Tompkins

0.47

Schuyler

1.68

1.37
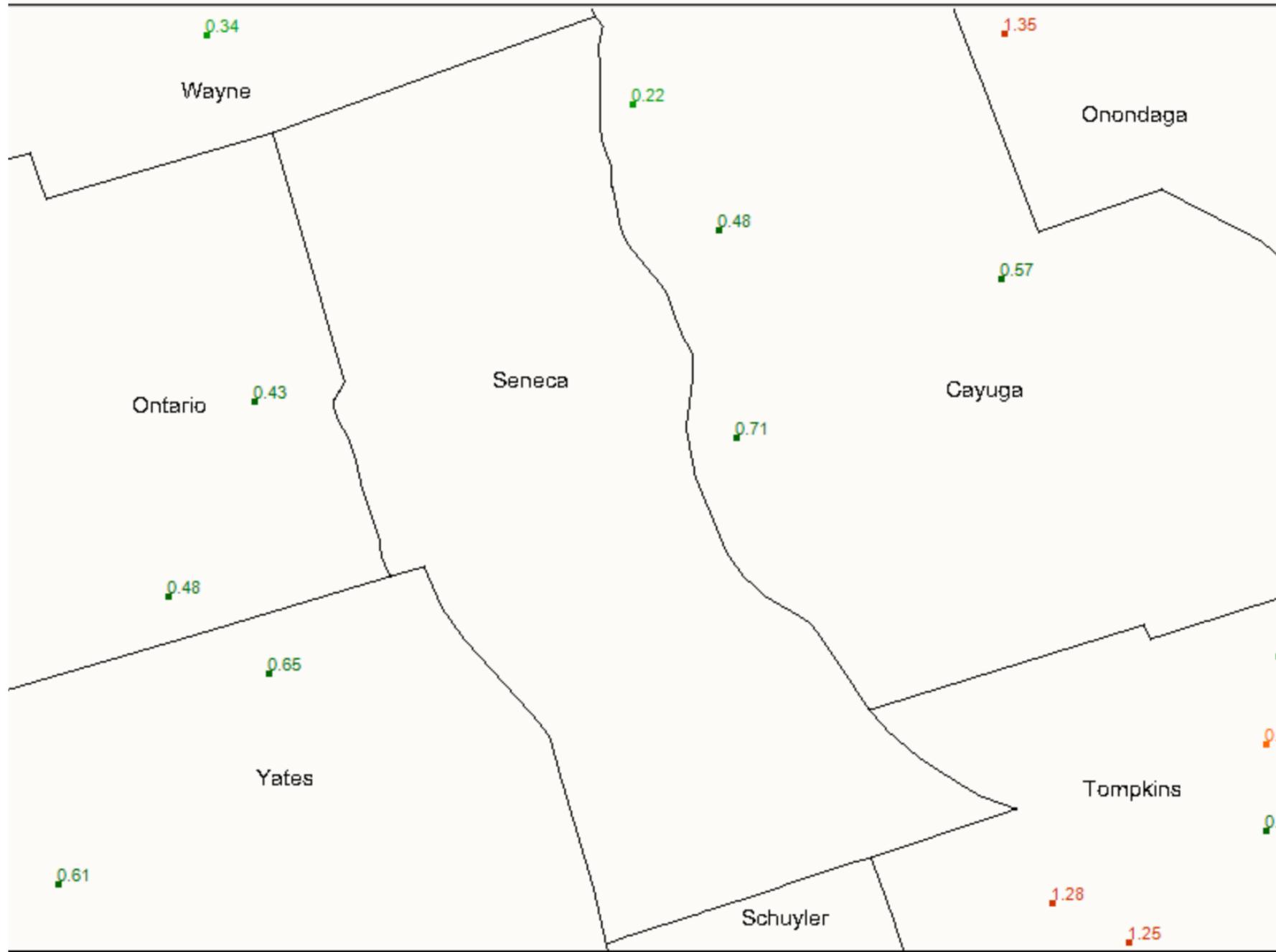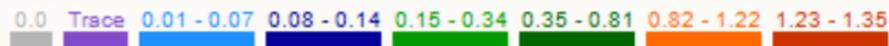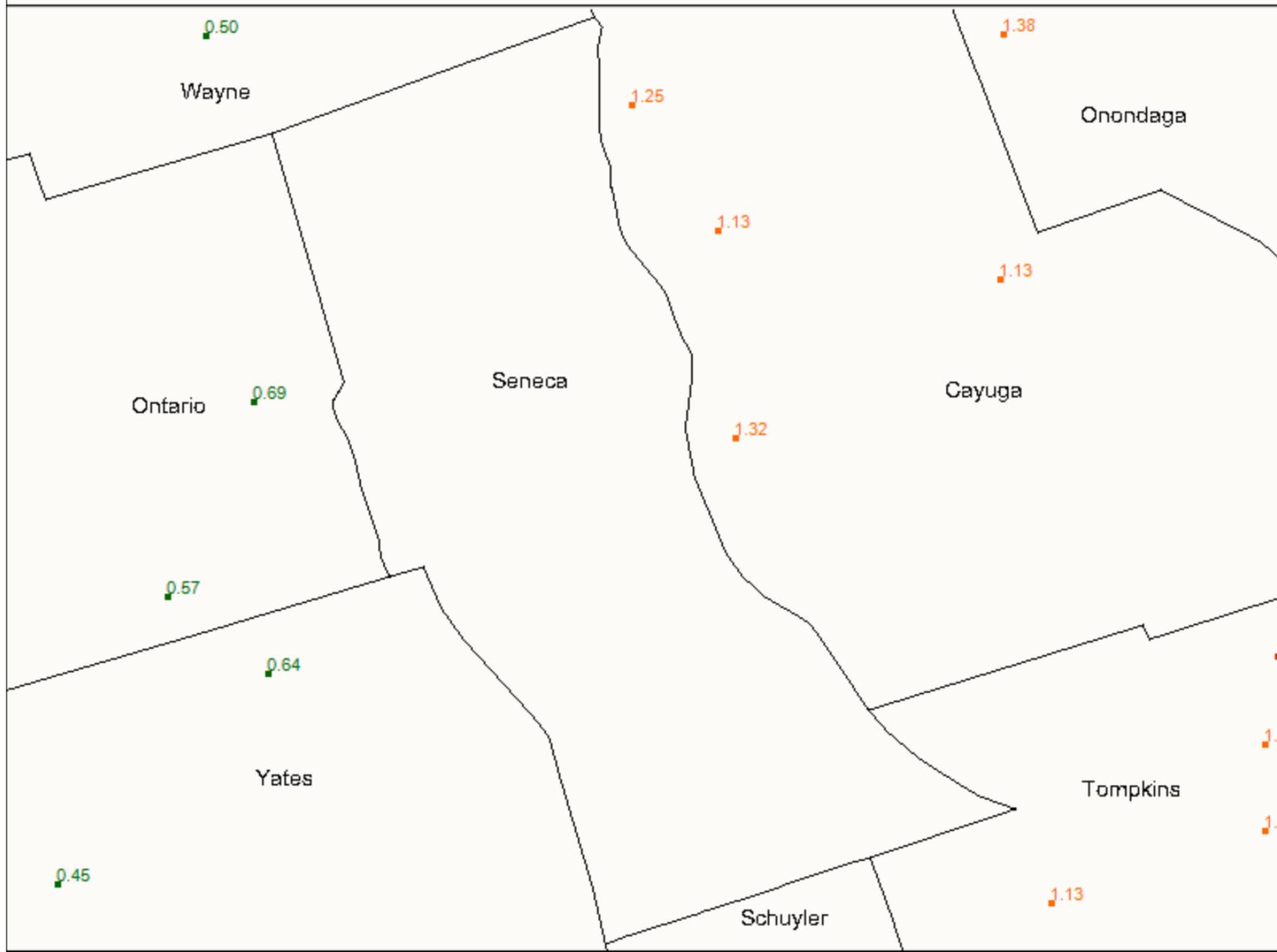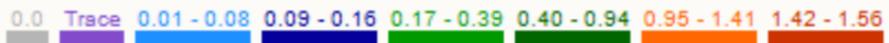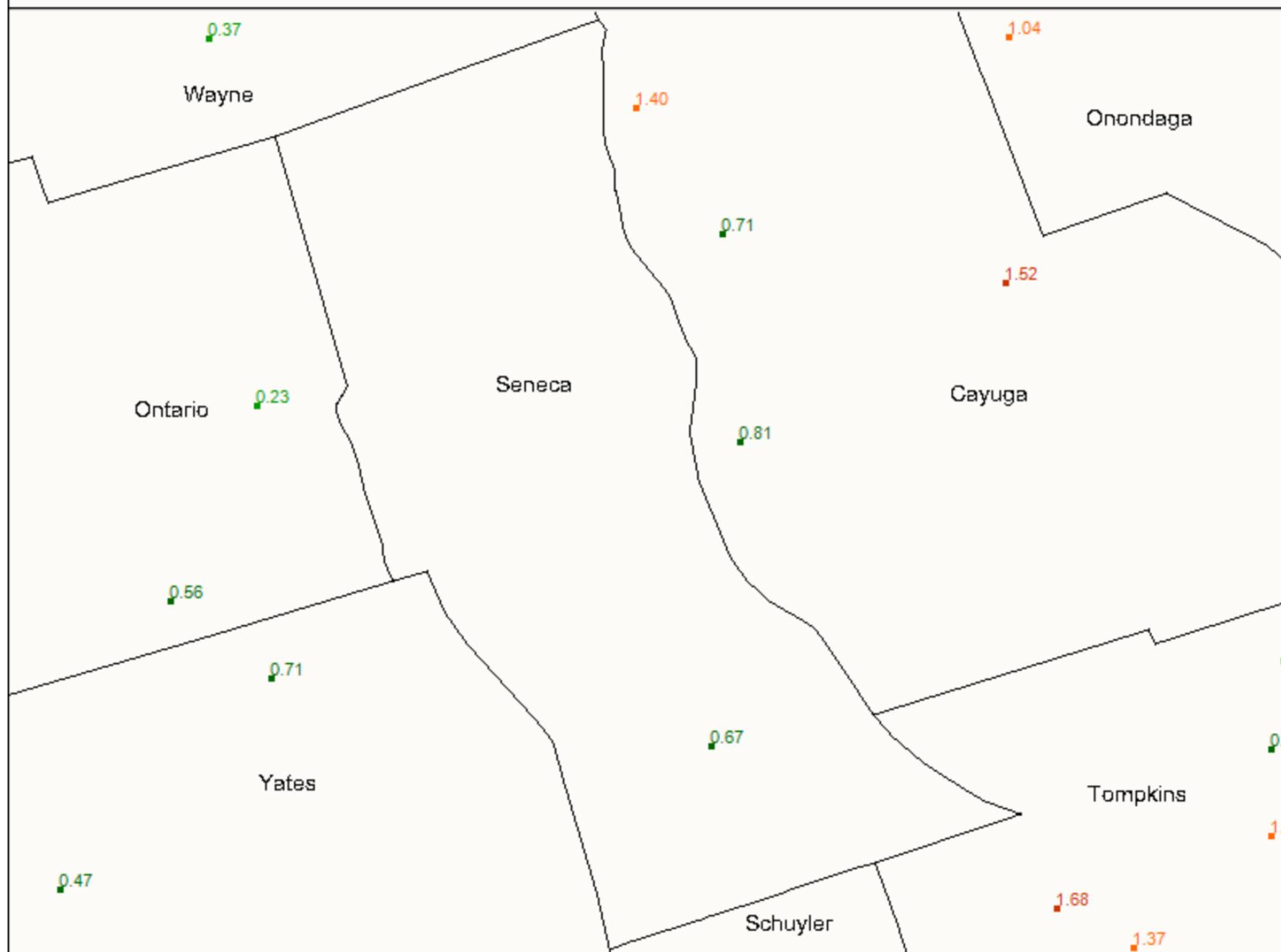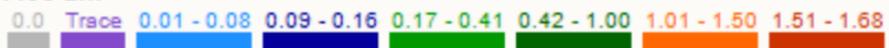
Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Seneca County, New York 8/14/2018

0.0 Trace 0.01 - 0.18 0.19 - 0.36 0.37 - 0.90 0.91 - 2.16 2.17 - 3.24 3.25 - 3.60
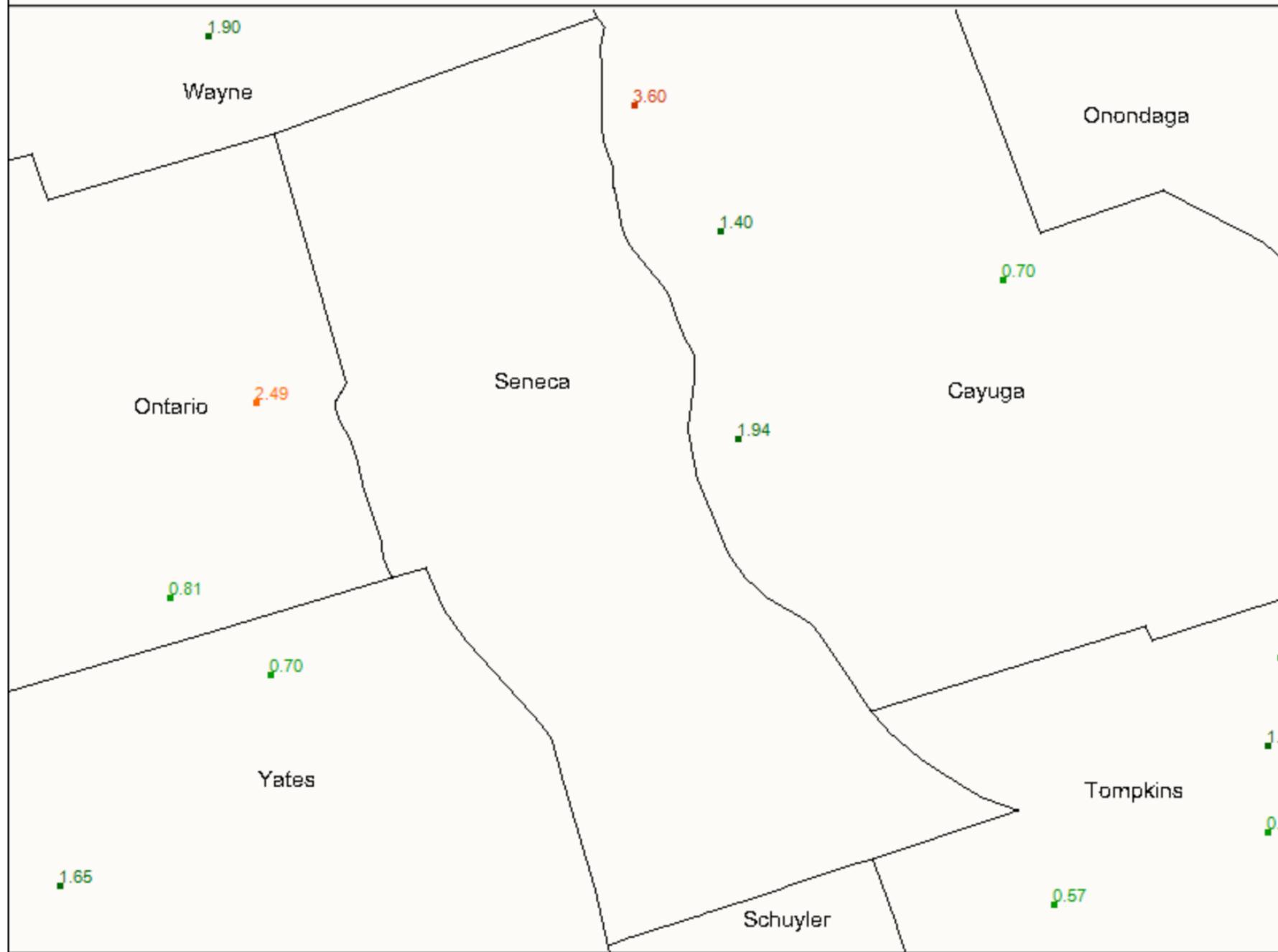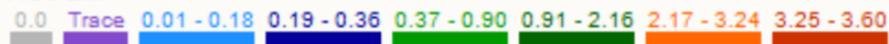
Heavy rain, flooding batter the Finger Lakes on Thursday

Severe Thunderstorm Warning including Lansing NY, Trumansburg NY, Dundee NY until 12:30 PM EDT

Severe Thunderstorm Warning

Valid Until
12:30 PM EDT Thursday
June 20, 2019

Threat Information

WIND
Up to
60 MPH

HAIL
Penny
Sized Possible

Potential Exposure

Population: 37,487
Schools: 11
Hospitals: 1

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Seneca County, New York 6/21/2019

Legend: 0.0 | Trace | 0.01 - 0.14 | 0.15 - 0.28 | 0.29 - 0.72 | 0.73 - 1.74 | 1.75 - 2.61 | 2.62 - 2.90

2.01

Wayne

0.66

Onondaga

2.90

1.75

1.59

Ontario   0.91   Seneca   Cayuga

1.58

1.41

2.25

Yates

0.77

Tompkins

1.32

1.05

Schuyler

So What are the Issues for New York State???

Complexities of New York State

Lakes

Topography

- Ontario
- Erie
- Finger Lakes
- Erie-Ontario Lowlands
- Adirondacks
- Mohawk River Valley
- Hudson River Valley
- Allegheny Plateau
- Catskills
- Atlantic Ocean

New York Climate Zones

http://www.dec.ny.gov/lands/93118.html

Number of recorded storms affecting New York

Month	Number of storms
June	4
July	7
August	23
September	37
October	14

Track map of all storms known to have made landfall in the state of New York
1800 - 2016

Hurricane Agnes

Track map of all storms known to have made landfall in the state of New York
1800 - 2016

Mid-Latitude Cyclone Track

10+

15+

Hurricane Agnes
June 19-24, 1972
1682 sites

1
3
5
7
10
15

Maximum: 19.00"
Western Schuylkill County, PA

Agnes Track

Hurricane Agnes

Track map of all storms known to have made landfall in the state of New York
1800 - 2016

14 August 2018

Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Central New York State, New York 8/14/2018

14 August 2018 Lodi, NY
Cuomo declared a state of emergency for more than a dozen counties in the Finger Lakes region and along New York's border with Pennsylvania

20 June 2019
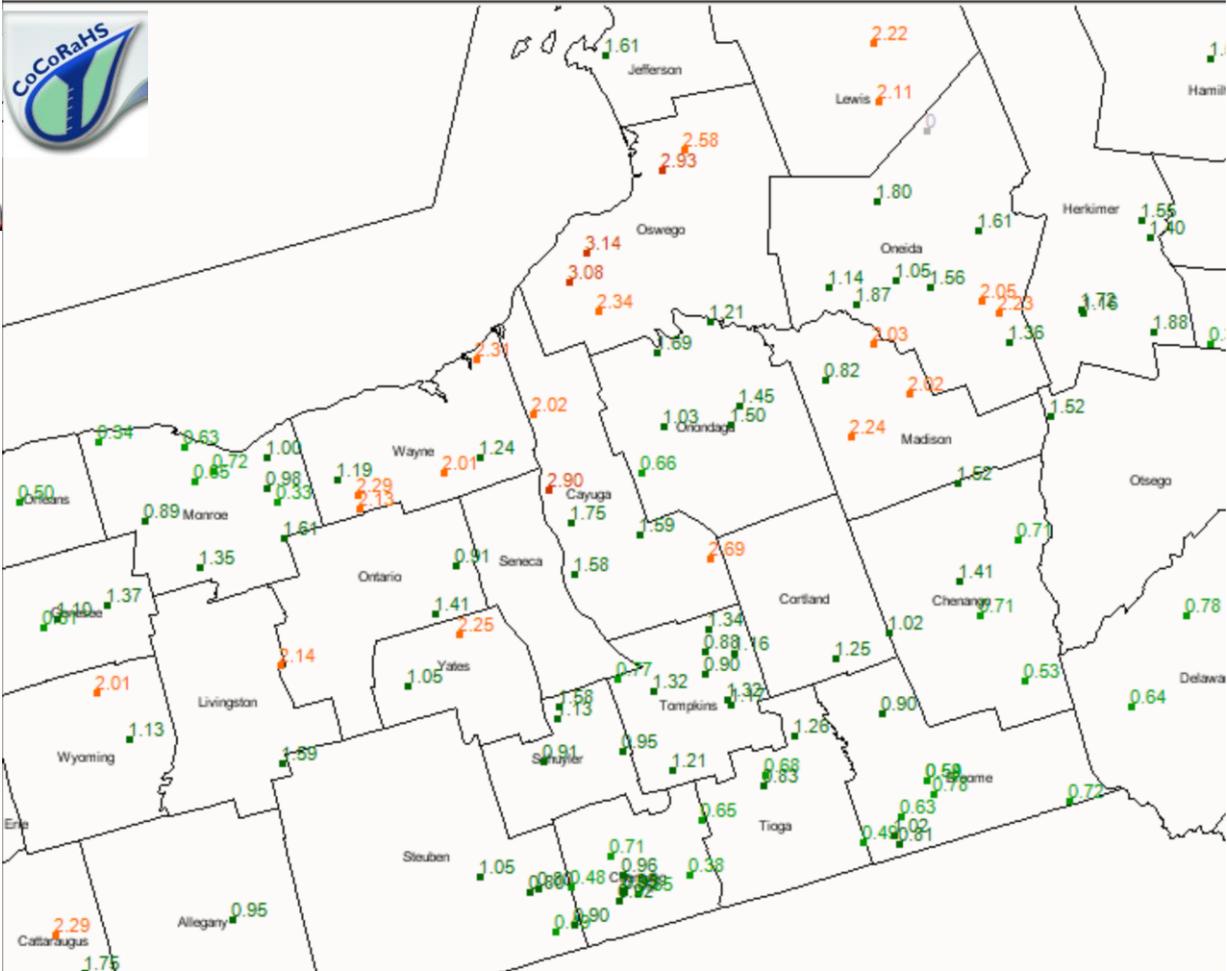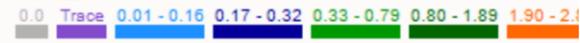
Daily Precipitation (inches x.xx), for the 24 hour period ending ~7:00 am
Seneca County, New York 9/16/2019

| 0.0 | Trace | 0.01 - 0.01 | 0.02 - 0.02 | 0.03 - 0.05 | 0.06 - 0.11 | 0.12 - 0.16 | 0.17 - 0.17 |

Wayne

Onondaga

Cayuga 4.0 NNE

Cayuga 3.2 ESE

Ontario

Seneca

Cayuga

Geneva Coop

Geneva 0.8 W

Aurora 2.4 N

Yates

Tompkins

Schuyler

Trumansburg 0.4 WNW

Maximum 1-Day Total Precipitation for AURORA RESEARCH FARM, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.27	2010-08-23
2	3.91	1975-09-26
3	3.70	1972-06-22
4	3.33	2017-10-30
5	3.19	2015-09-30
6	3.10	1969-06-24
7	3.08	2010-10-01
8	3.03	1989-09-15
9	2.93	2016-10-21
10	2.85	1988-07-22
Period of record: 1956-11-01 to 2019-09-20		

5/10 in the 2000's

Maximum 1-Day Total Precipitation for MECKLENBURG 4SW, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.40	2011-09-08
2	3.90	2014-08-21
3	3.82	2018-08-14
4	3.79	2013-08-09
5	3.60	2015-09-30
6	3.52	2017-07-14
7	3.32	2010-10-01
8	3.28	2017-10-30
9	2.90	2001-09-25
10	2.76	2012-09-19
Period of record: 2000-12-01 to 2019-09-20		

Maximum 1-Day Total Precipitation for ITHACA CORNELL UNIV, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	5.08	1981-10-28
2	4.60	1935-07-08
3	4.43	2011-09-08
4	4.34	1922-08-24
5	4.28	1924-09-30
6	4.02	1996-11-09
7	3.96	1947-08-16
-	3.96	1929-08-23
9	3.90	2001-09-25
10	3.78	2010-10-01
Period of record: 1893-01-01 to 2019-09-19		

3/10 in the 2000's

Maximum 1-Day Total Precipitation for GENEVA RESEARCH FARM, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	3.92	1975-09-26
2	3.60	1993-03-14
3	3.54	2016-10-21
4	2.95	2001-09-25
5	2.82	2014-07-29
6	2.79	2010-10-01
7	2.77	2004-09-09
8	2.76	2001-06-17
9	2.67	2000-08-01
10	2.57	2015-09-30
Period of record: 1969-01-01 to 2019-09-27		

8/10 in the 2000's

Maximum 1-Day Total Precipitation
for AURORA RESEARCH FARM, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.27	2010-08-23
2	3.91	1975-09-26
3	3.70	1972-06-22
4	3.33	2017-10-30
5	3.19	2015-09-30
6	3.10	1969-06-24
7	3.08	2010-10-01
8	3.03	1989-09-15
9	2.93	2016-10-21
10	2.85	1988-07-22
	Period of record: 1956-11-01 to 2019-09-20	

5/10 in the 2000's

Maximum 1-Day Total Precipitation
for MECKLENBURG 4SW, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.40	2011-09-08
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7	3.32	2010-10-01
8	3.28	2017-10-30
9	2.90	2001-09-25
10	2.76	2012-09-19
	Period of record: 2000-12-01 to 2019-09-20	

Maximum 1-Day Total Precipitation
for ITHACA CORNELL UNIV, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
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2	4.60	1935-07-08
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4	4.34	1922-08-24
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6	4.02	1996-11-09
7	3.96	1947-08-16
-	3.96	1929-08-23
9	3.90	2001-09-25
10	3.78	2010-10-01
	Period of record: 1893-01-01 to 2019-09-19	

Problem with a short observations record!
They are all in the 2000's

3/10 in the 2000's

Maximum 1-Day Total Precipitation for AURORA RESEARCH FARM, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.27	2010-08-23
2	3.91	1975-09-26
3	3.70	1972-06-22
4	3.33	2017-10-30
5	3.19	2015-09-30
6	3.10	1969-06-24
7	3.08	2010-10-01
8	3.03	1989-09-15
9	2.93	2016-10-21
10	2.85	1988-07-22

Period of record: 1956-11-01 to 2019-09-20

5/10 in the 2000's

Maximum 1-Day Total Precipitation for MECKLENBURG 4SW, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	4.40	2011-09-08
2	3.90	2014-08-21
3	3.82	2018-08-14
4	3.79	2013-08-09
5	3.60	2015-09-30
6	3.52	2017-07-14
7	3.32	2010-10-01
8	3.28	2017-10-30
9	2.90	2001-09-25
10	2.76	2012-09-19

Period of record: 2000-12-01 to 2019-09-20

Problem with a precipitation observations record in the early 2000's

Maximum 1-Day Total Precipitation for ITHACA CORNELL UNIV, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Value	Ending Date
1	5.08	1981-10-28
2	4.60	1935-07-08
3	4.43	2011-09-08
4	4.34	1922-08-24
5	4.28	1924-09-30
6	4.02	1996-11-09
7	3.96	1947-08-16
-	3.96	1929-08-23
9	3.90	2001-09-25
10	3.78	2010-10-01

Period of record: 1893-01-01 to 2019-09-19

3/10 in the 2000's

Number of Consecutive Days Precipitation >= 1.00 for GENEVA RESEARCH FARM, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Run Length	Ending Date
1	3	1972-06-23
2	2	2019-08-19
-	2	2017-07-14
-	2	2016-10-22
-	2	2014-07-29
-	2	2010-06-06
-	2	2000-08-02
-	2	1996-09-14
-	2	1995-10-22
-	2	1994-11-02
Last value also occurred in one or more previous years.		
Period of record: 1969-01-01 to 2019-09-27		

6/10 in the 2000's

3/10 in the 90's

Number of Consecutive Days Precipitation >= 1.0 for ITHACA CORNELL UNIV, NY

Click column heading to sort ascending, click again to sort descending.

Rank	Run Length	Ending Date
1	3	1936-03-18
-	3	1935-07-08
-	3	1930-06-18
4	2	2007-09-10
-	2	2006-06-27
-	2	2004-08-31
-	2	2003-07-23
-	2	2002-06-16
-	2	1995-10-22
-	2	1994-03-04
Last value also occurred in one or more previous years.		
Period of record: 1893-01-01 to 2019-09-26		

5/10

Number of Days Precipitation >= 1.00 – Jan through Dec – GENEVA RESEARCH FARM, NY

Rank	Year	Number of Days Precipitation >= 1.00	Missing Count
1	2015	10	0
-	1996	10	0
3	2010	9	1
-	2005	9	0
5	2006	8	0
-	1972	8	0
7	2017	7	3
-	2000	7	0
-	1992	7	1
-	1986	7	1

1969-2018

6/10 in the 2000's

4/10 in the 2000's

1893-2018

Number of Days Precipitation >= 1.00 – Jan through Dec – ITHACA CORNELL UNIV, NY

Rank	Year	Number of Days Precipitation >= 1.00	Missing Count
1	2011	11	0
-	2004	11	0
-	1961	11	0
4	2002	10	0
-	1942	10	0
6	2005	9	0
-	1977	9	0
-	1976	9	0
-	1905	9	0
-	1893	9	2

Total Precipitation – Jan through Dec – GENEVA RESEARCH FARM, NY

Rank	Year	Total Precipitation	Missing Count
1	1972	44.91	0
2	2017	43.49	1
3	1996	41.78	0
4	1990	40.91	31
5	1976	40.52	0
6	2006	39.60	0
7	2011	39.29	10
8	1992	38.88	1
9	1977	38.60	0
10	2010	38.31	1

1969-2018

4/10 in the 2000's

Total Precipitation – Jan through Dec – ITHACA CORNELL UNIV, NY

Rank	Year	Total Precipitation	Missing Count
1	2011	51.22	0
2	1996	47.76	0
3	1972	46.68	0
4	1958	46.48	0
5	1977	46.30	0
6	1945	45.82	0
7	2004	45.26	0
8	1976	44.45	0
9	2003	44.40	0
10	1990	43.74	0

1893-2018

3/10 in the 2000's

Ithaca, NY

Number of Days Precipitation >= 1.00 – Jan through Dec – ITHACA CORNELL UNIV, NY
Use navigation tools above and below chart to change displayed range
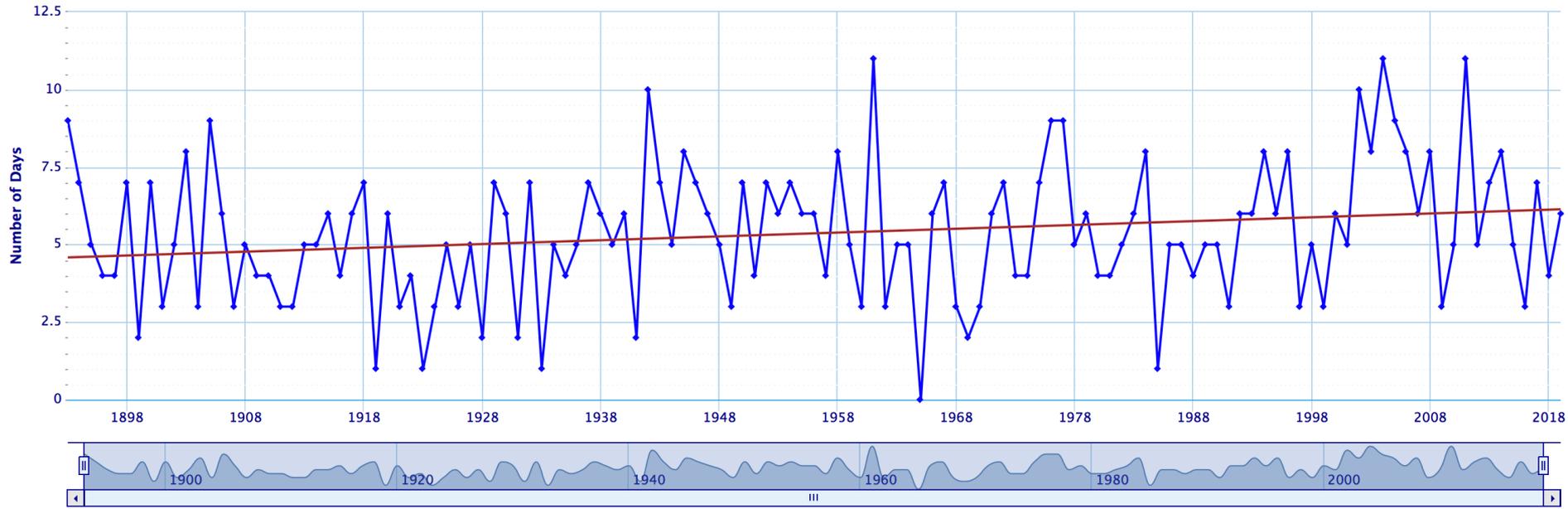
4 days   6.5 days

Geneva Research Farm, NY

Number of Days Precipitation >= 1.00 – Jan through Dec – GENEVA RESEARCH FARM, NY
Use navigation tools above and below chart to change displayed range
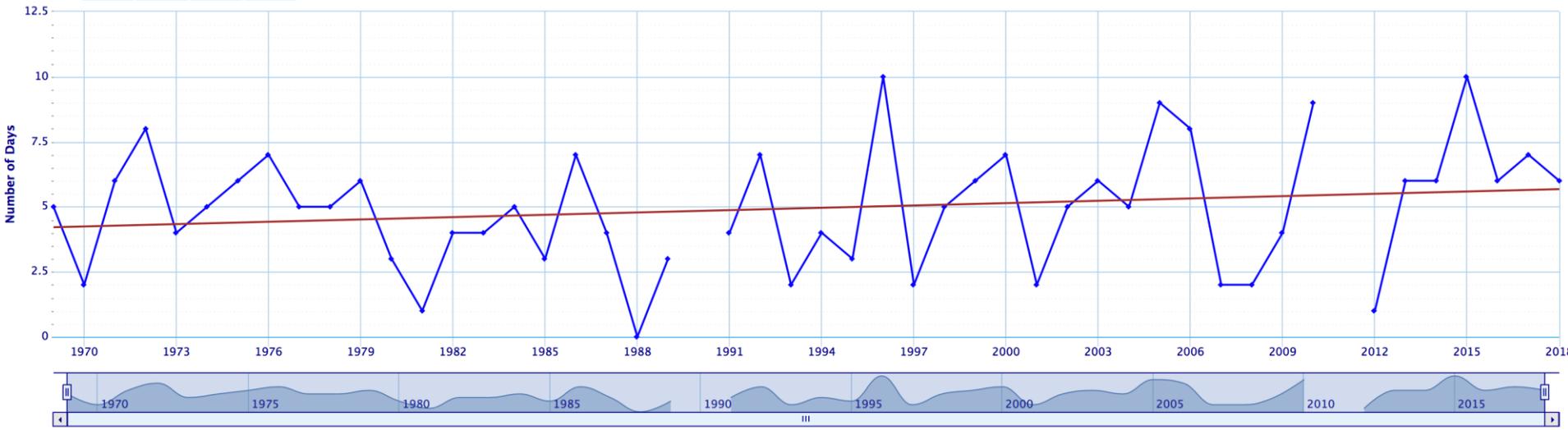
4.2 days

6 days

Difference in Normal Precip (Inches)
1981-2010 - 1971-2000 Annual
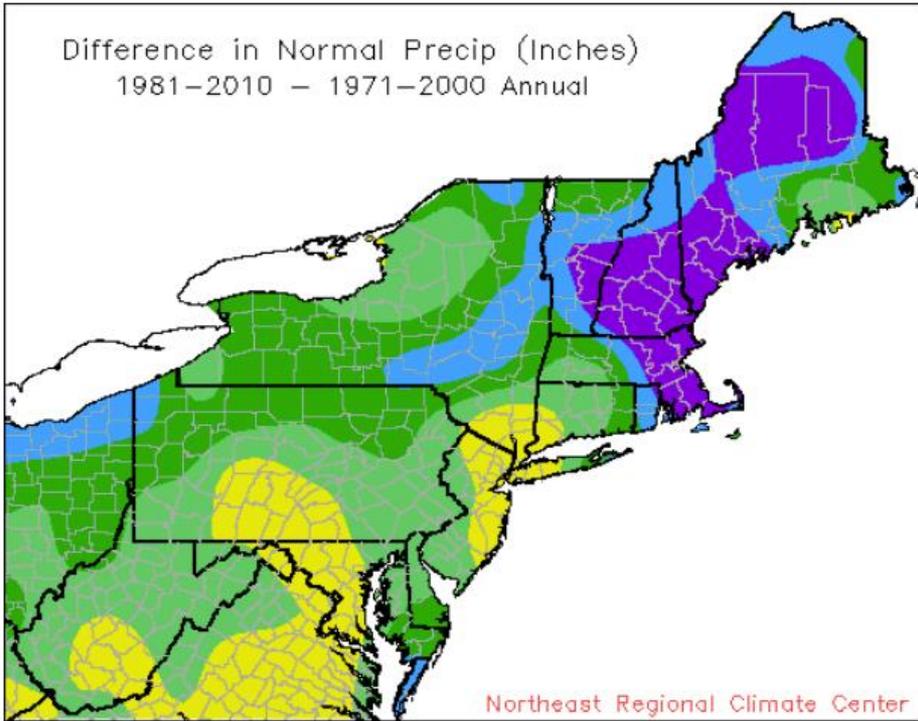
Difference in Normal Snow (Inches)
1981-2010 - 1971-2000 Annual

Northeast Regional Climate Center

0   0.5   1   1.5

-6   -4   -2   0
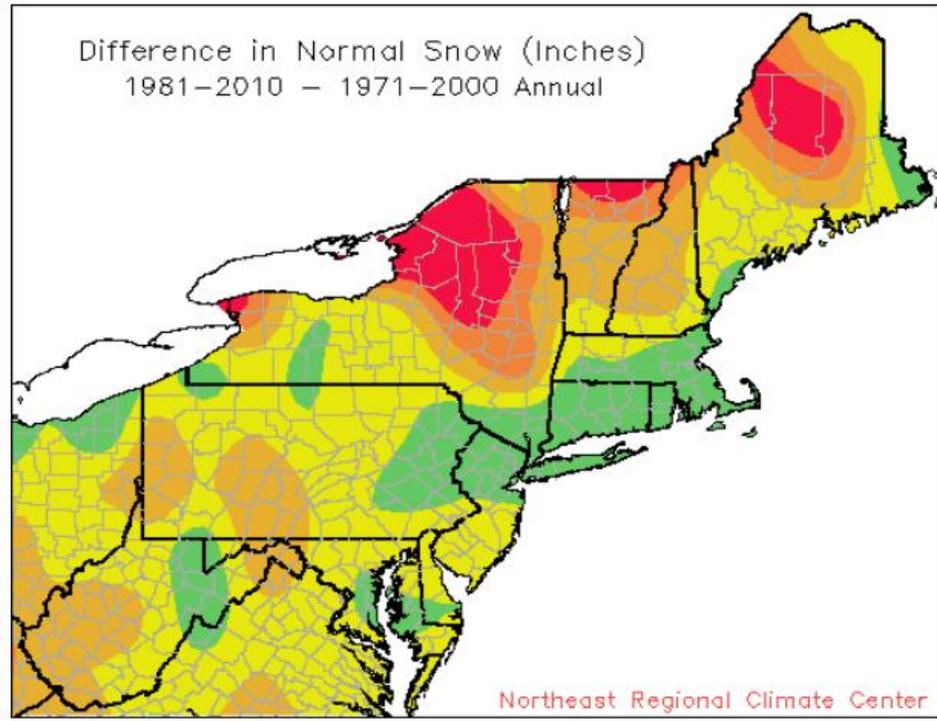
The Changing Face of Winter
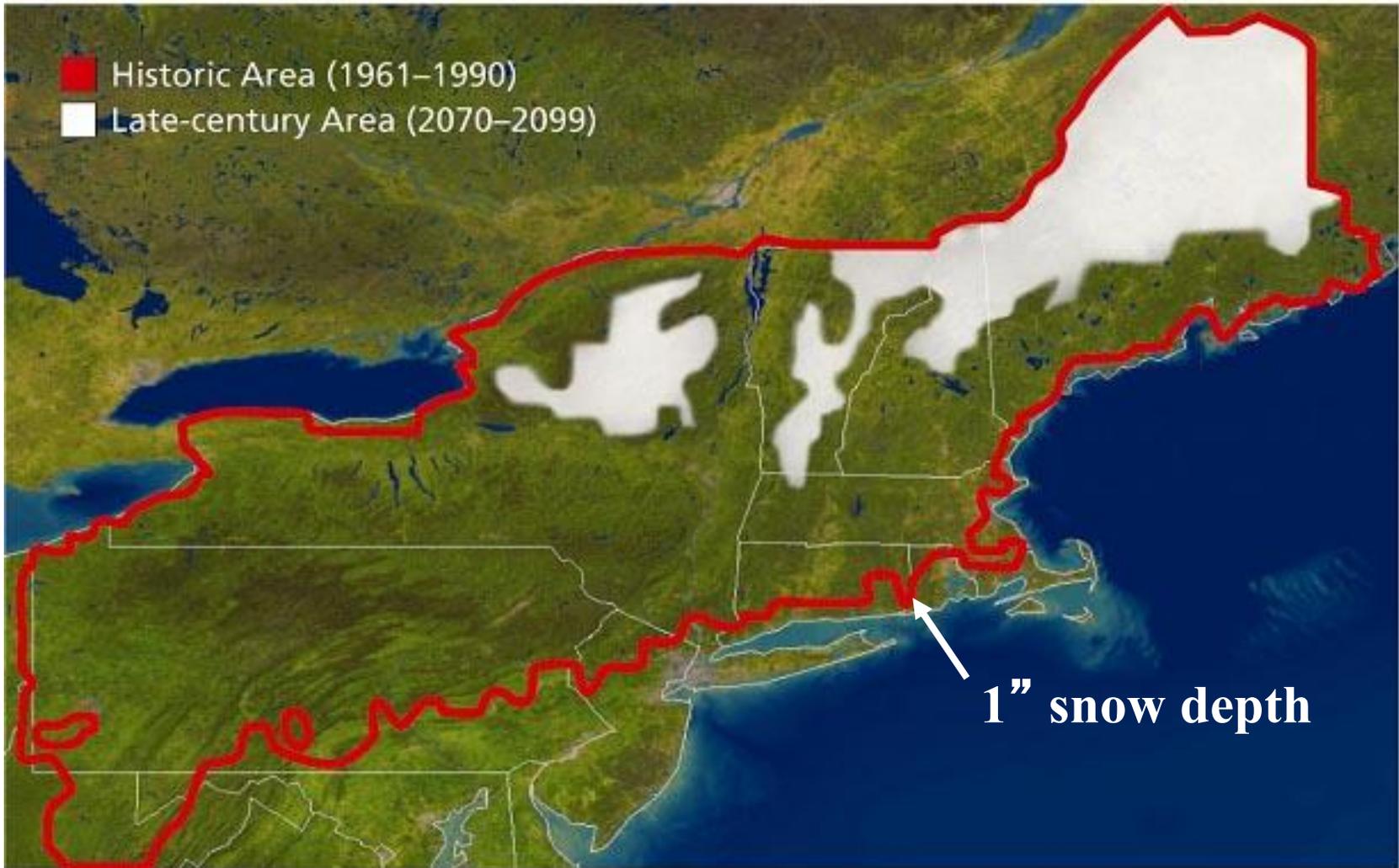
# Percent of Area in Drought
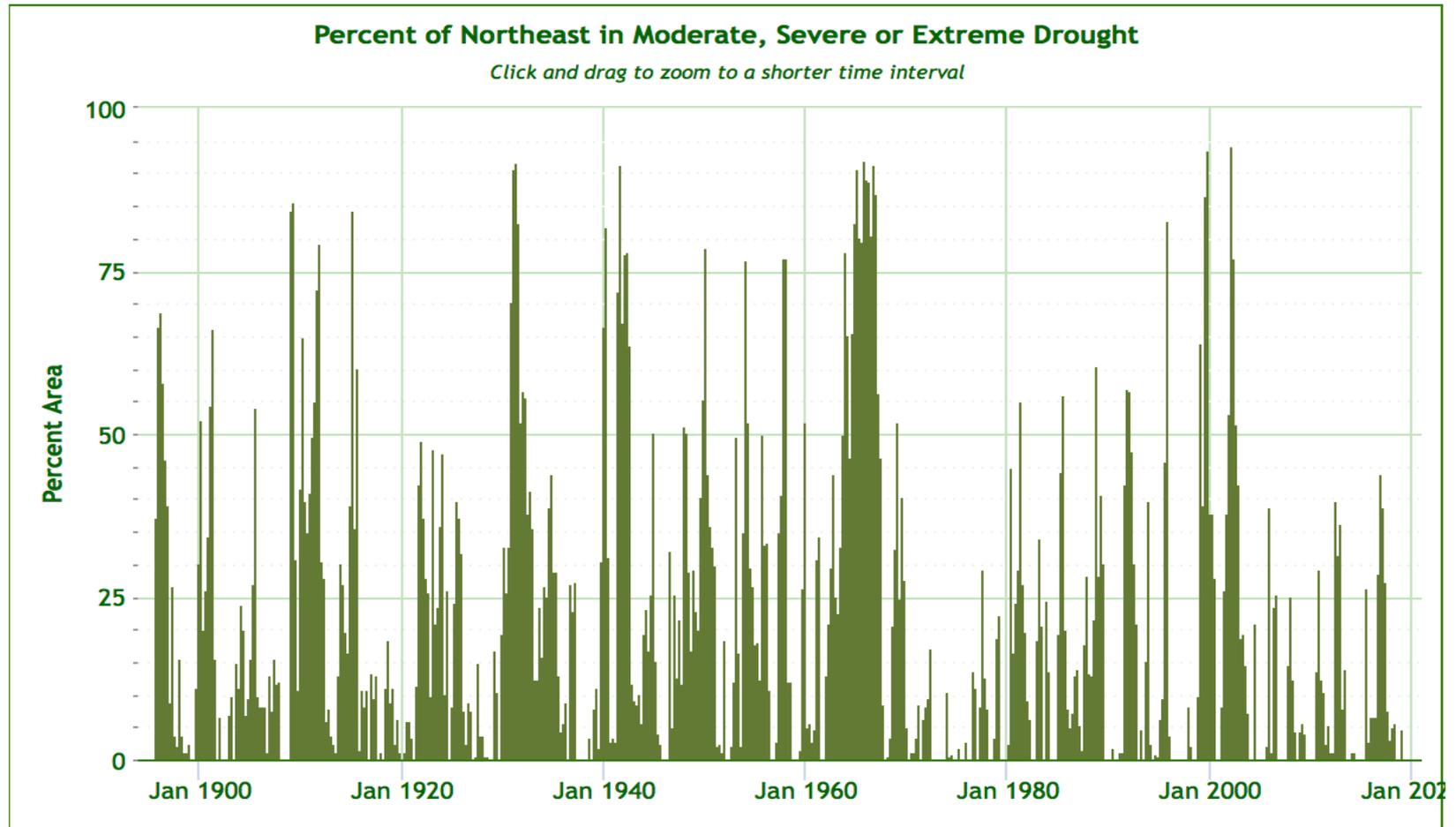
Based on the monthly Palmer Drought Severity Index as computed by the National Centers for Environmental Information. Period of record: January 1895 through August 2019.

Percent of Area in Drought
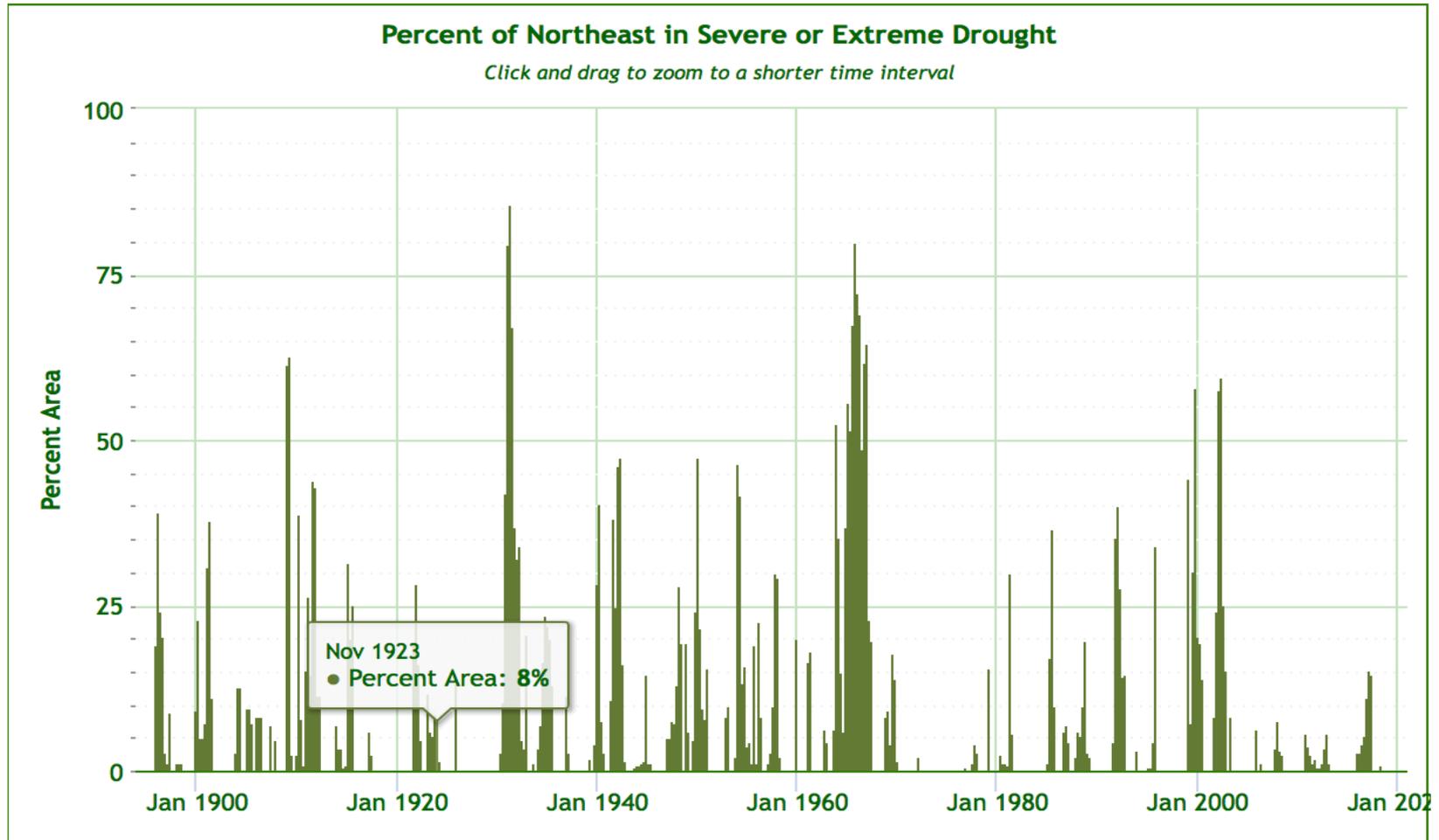
Based on the monthly Palmer Drought Severity Index as computed by the National Centers for Environmental Information. Period of record: January 1895 through August 2019.

Percent of Area in Drought

Based on the monthly Palmer Drought Severity Index as computed by the National Centers for Environmental Information. Period of record: January 1895 through August 2019.

Climate change

This translates to an increase of 20-25 inches per year of precipitation in New York State by the end of this century- about a 65% increase over current precip levels!

Precipitation Anomaly

Precipitation Flux Anomaly, December 2070-2099 mean.
Projected by the Geophysical Fluid Dynamics Laboratory, USA;
Scenario: A2 (SRES 2000); Model GFDL-CM2.1 (IPCC 2007).
Figure obtained from www.ipcc-data.org. 20 February, 2011.
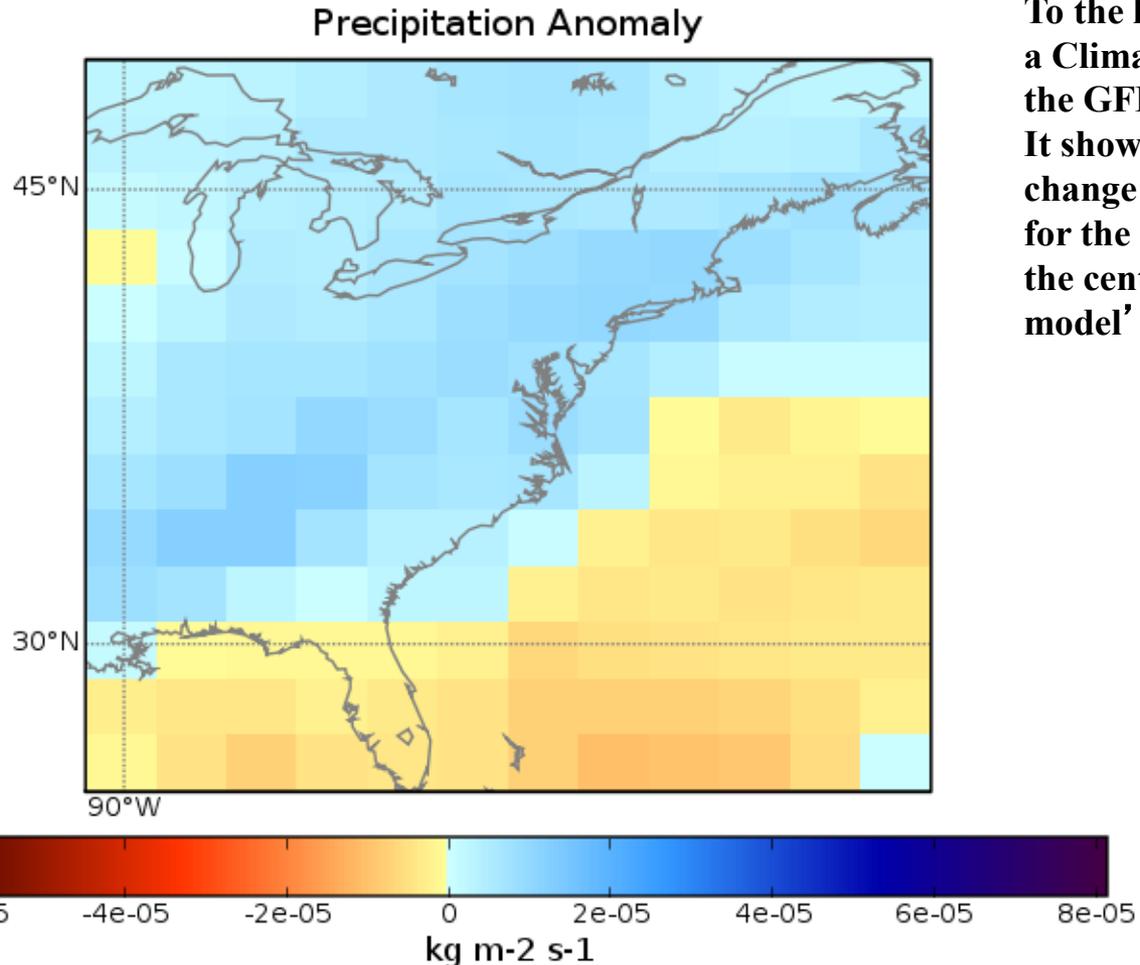
To the left is the output of a Climate Model run by the GFDL at Princeton. It shows the expected change in precipitation for the final 30 years of the century, based on the model's calculations.
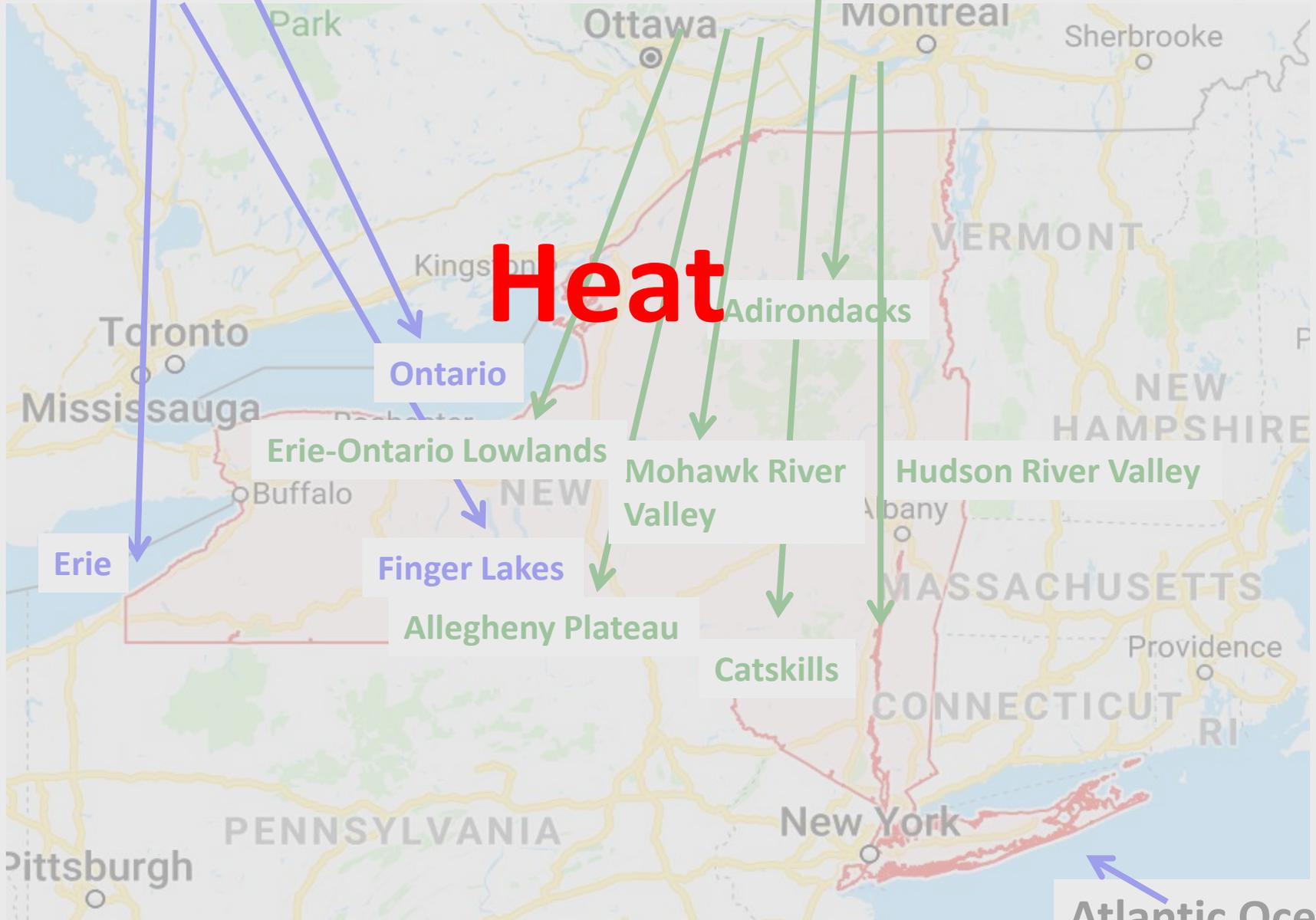
Created: 07/02/18 at 12:19 UTC

$95 - 100°F$
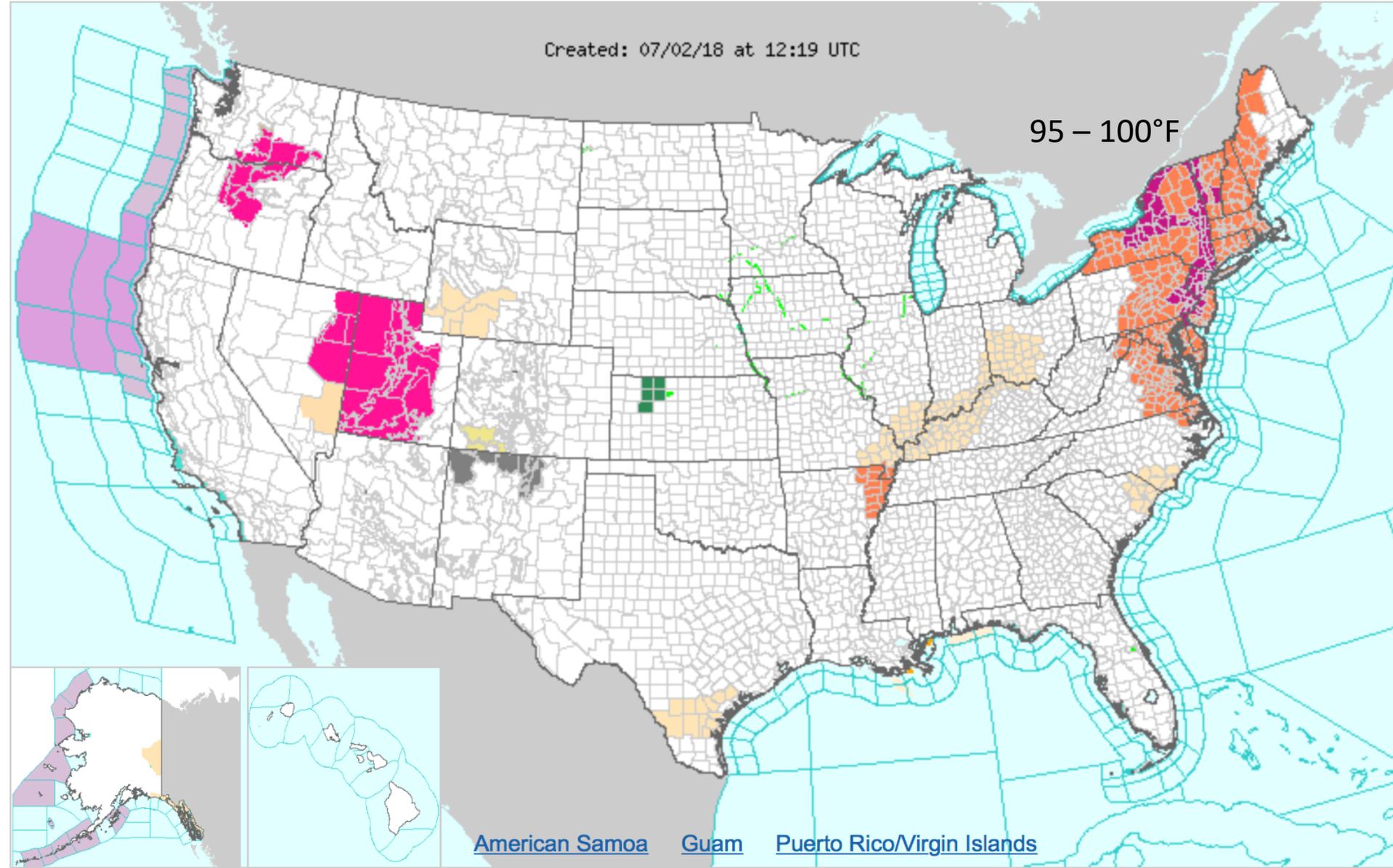
American Samoa   Guam   Puerto Rico/Virgin Islands

...EXCESSIVE HEAT WARNING REMAINS IN EFFECT UNTIL 10 PM EDT THIS EVENING...
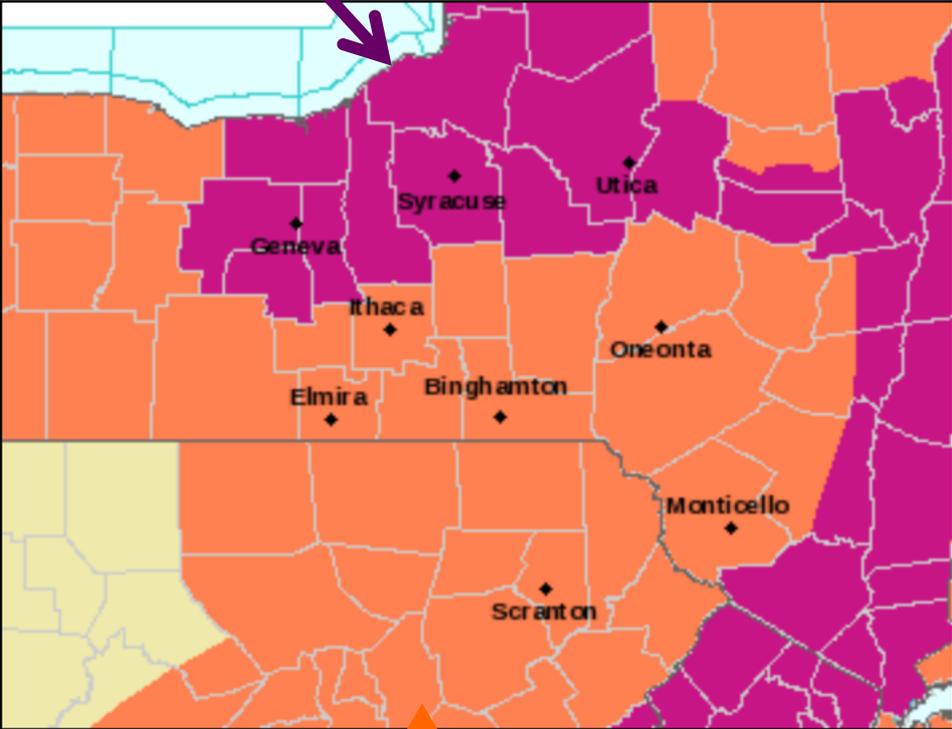
Watches, Warnings & Advisories | Zoom Out

|	
Excessive Heat Warning	
Heat Advisory	
Special Weather Statement	
Air Quality Alert	
Hazardous Weather Outlook	

Last Map Update: Mon, Jul. 2, 2018 at 8:16:10 am EDT

**...HEAT ADVISORY REMAINS IN EFFECT UNTIL 10 PM EDT THIS EVENING...**

Normal Average Temperatures (Deg F) Annual (1971–2000) — Northeast Regional Climate Center
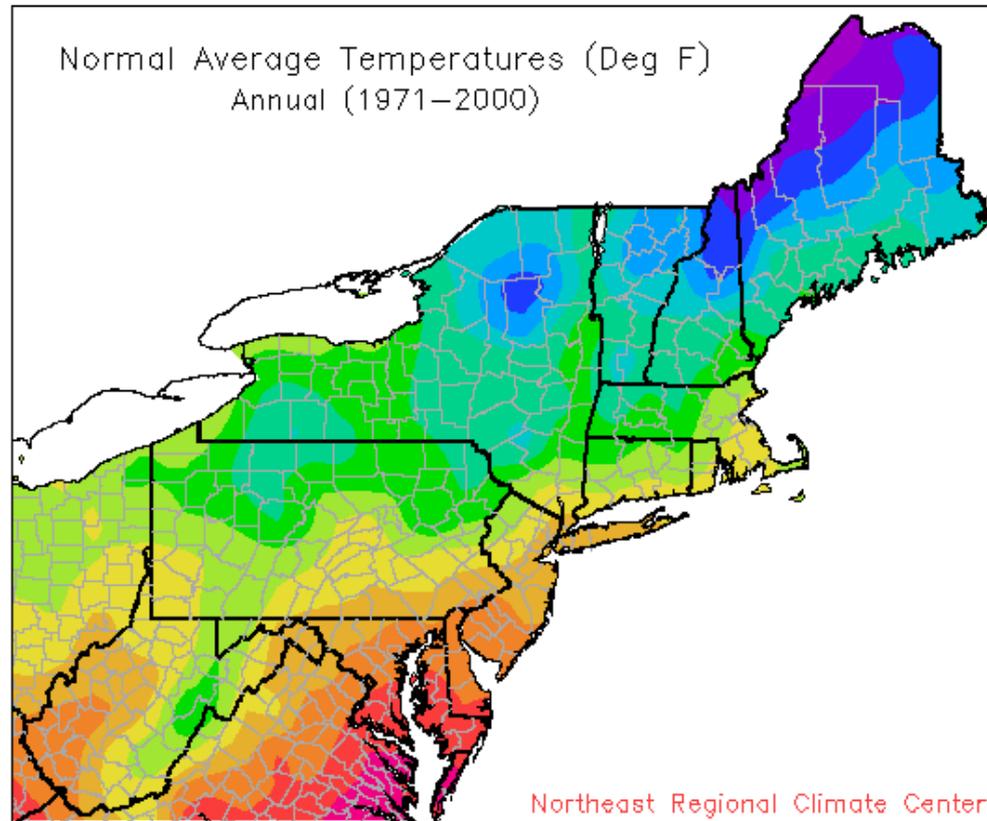
Normal Average Temperature (Deg F) Annual (1981–2010) — Northeast Regional Climate Center
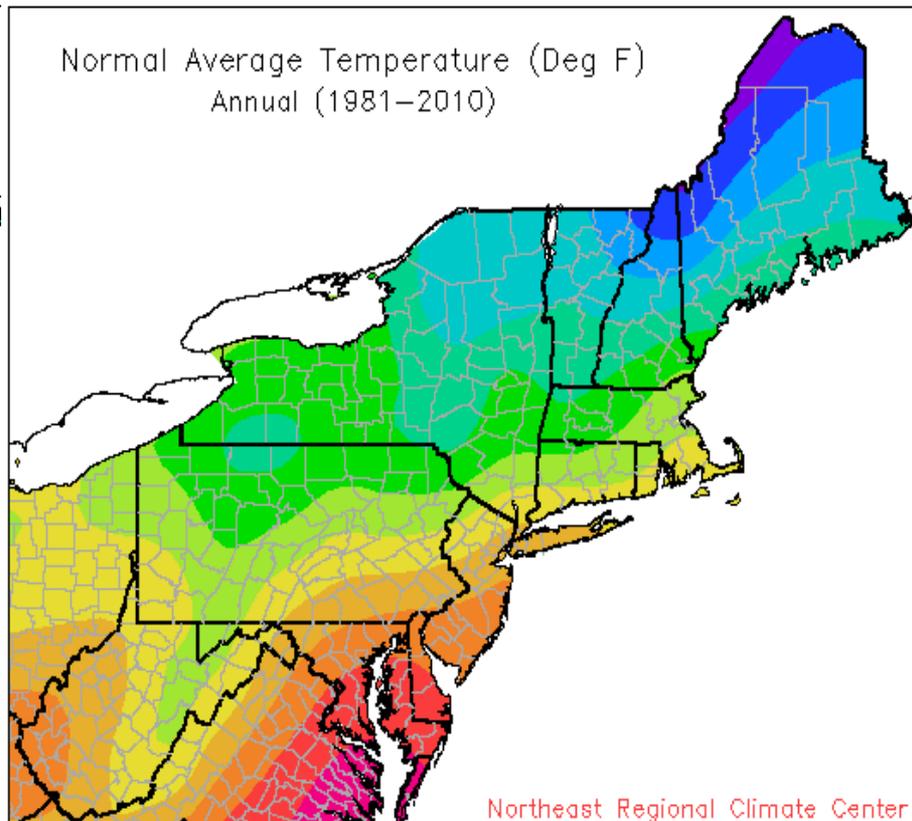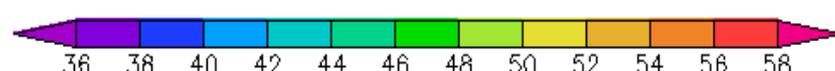
Difference in Normal Ave Temp (Deg F)
1981–2010 – 1971–2000 Annual

Northeast Regional Climate Center

0.2   0.4   0.6

Difference in Normal Max Temp (Deg F)
1981–2010 − 1971–2000 Annual

Northeast Regional Climate Center

0   0.2   0.4   0.6
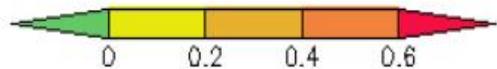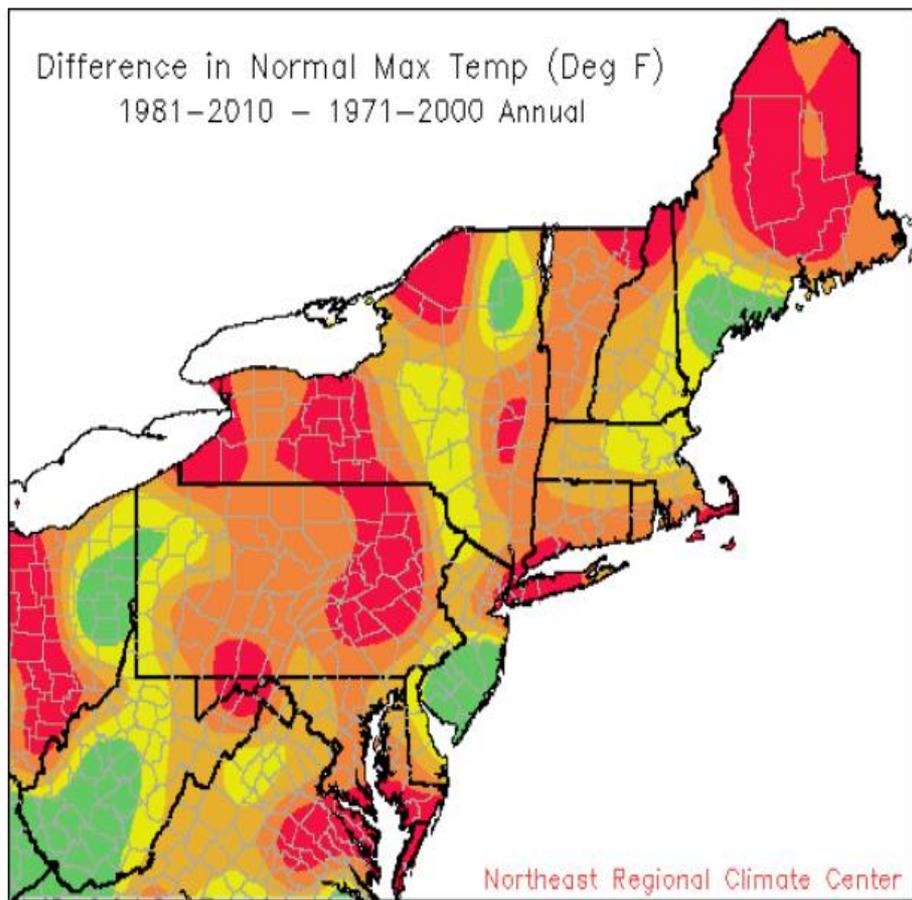
Difference in Normal Min Temp (Deg F)
1981–2010 − 1971–2000 Annual

Northeast Regional Climate Center

0.4   0.6   0.8
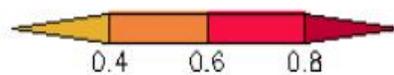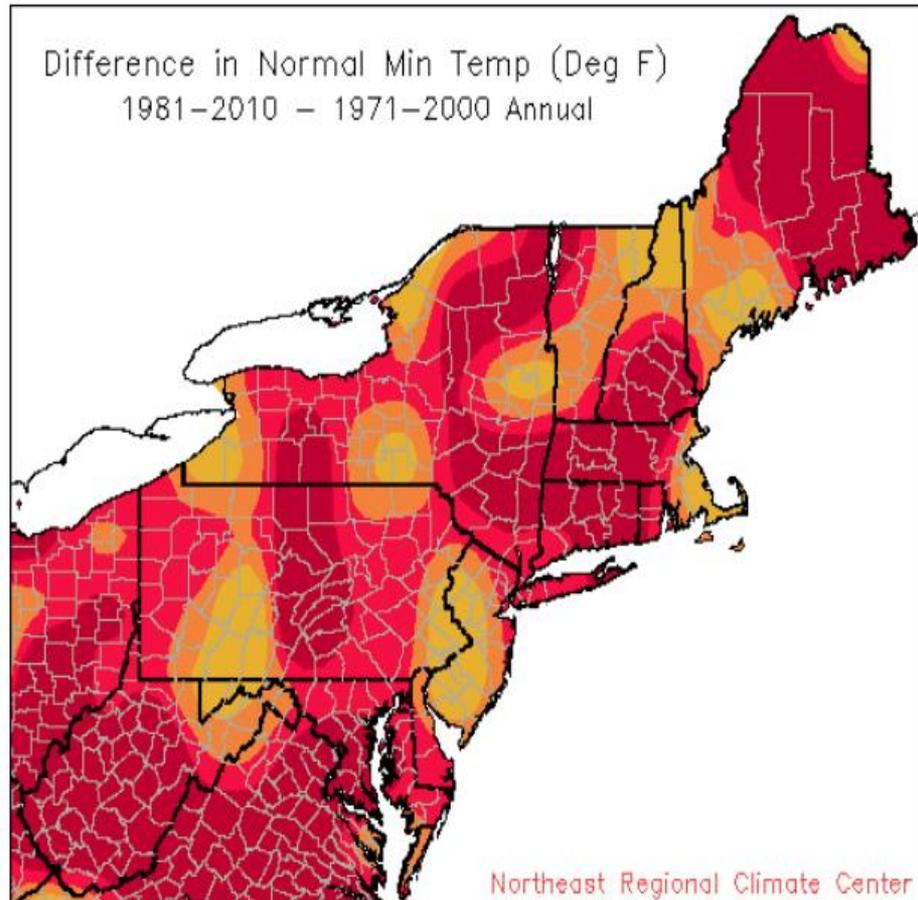
The Temperature Climatology is Changing

- Annual temperatures across New York have **warmed almost 2°F since 1970**

- **Winter** temperatures have **warmed by nearly 5°F** since 1970

- The date of the last **spring frost** has become **1 week earlier since 1950**

- There are about **2 more days >90°F** since 1970
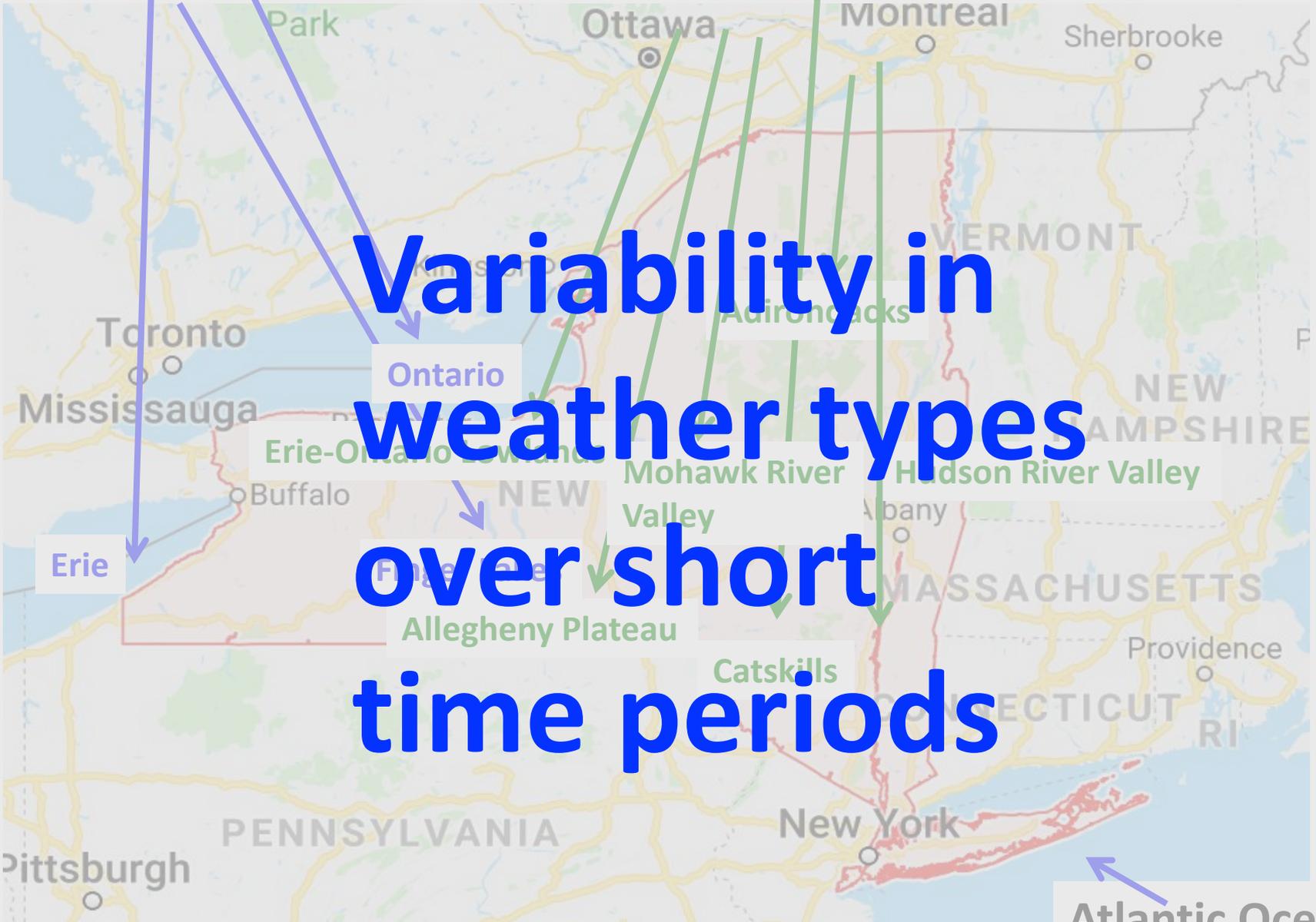
NRCC Art DeGaetano

Change in one year!!!!

Total Snowfall (inches) Oct 1, 2010–May 31, 2011

Northeast Regional Climate Center

Total Snowfall (inches) Oct 1, 2011–May 31, 2012

Northeast Regional Climate Center

5 10 25 50 75 100 200

Change in 4 days!!!!

ITHACA CORNELL UNIV, NY - February 2019
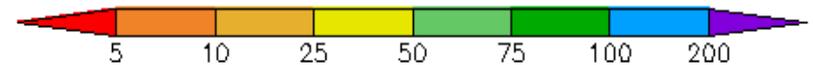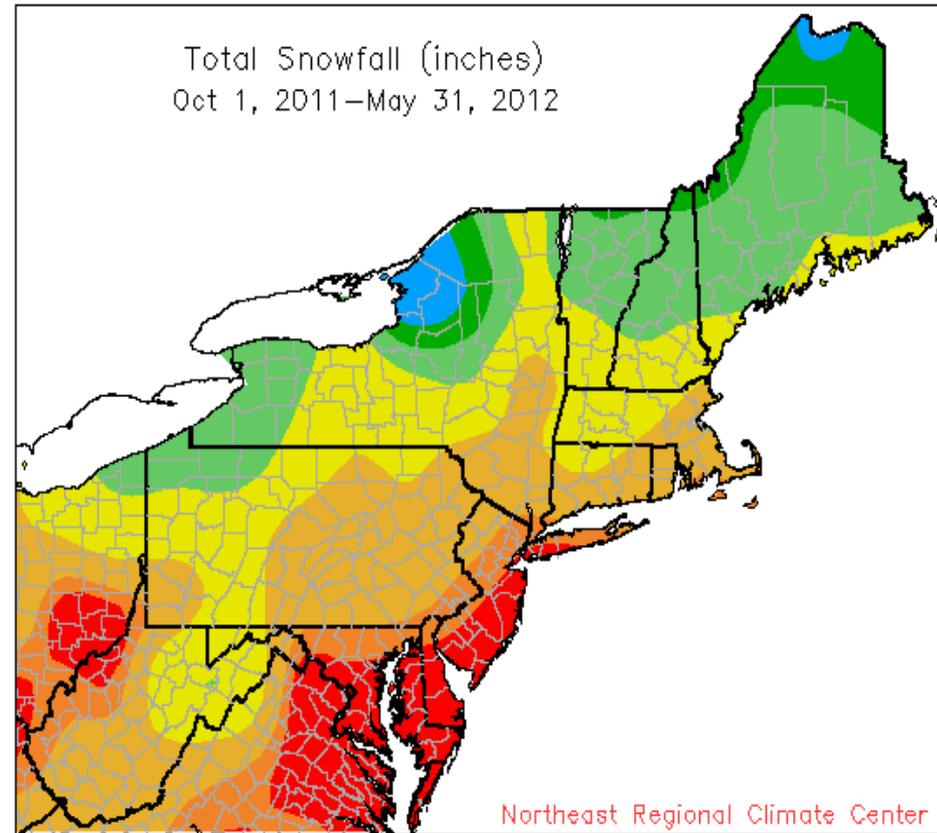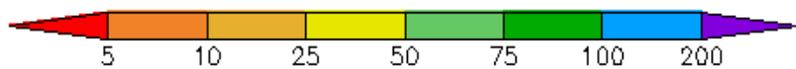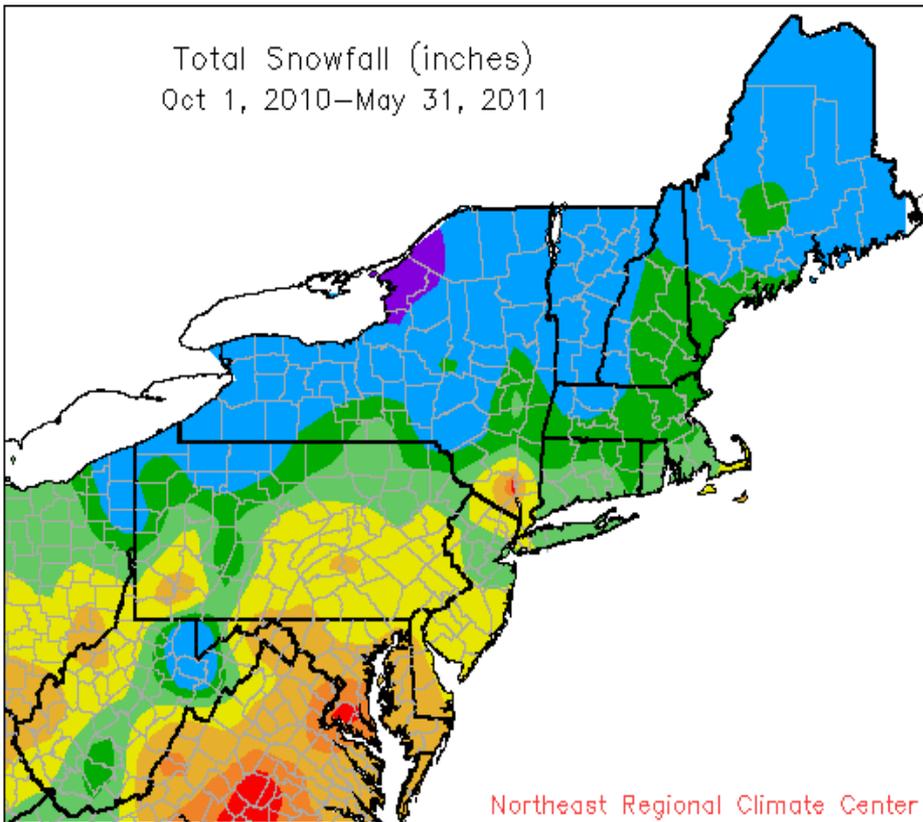
| Date	Maximum Temperature	Minimum Temperature	At Obs Temperature	Average Temperature	Avg Temperature Departure	Precipitation	Snowfall	Snow Depth
Feb 1	9	-14	-11	-2.5	-26.1	0.00	0.0	5
Feb 2	19	-11	-1	4.0	-19.7	0.00	0.0	4
Feb 3	37	-2	37	17.5	-6.3	0.00	0.0	3
Feb 4	49	36	42	42.5	18.6	0.00	0.0	Trace
Feb 5	61	42	47	51.5	27.5	0.01	0.0	0
Feb 6	52	27	27	39.5	15.4	0.00	0.0	0
Feb 7	39	27	37	33.0	8.8	0.26	0.0	0
Feb 8	50	33	41	41.5	17.2	0.16	0.0	0
Feb 9	41	14	14	27.5	3.1	0.00	0.0	0
Feb 10	22	11	12	16.5	-8.0	0.00	0.0	0
Feb 11	31	12	24	21.5	-3.1	0.01	0.1	Trace
Feb 12	31	23	24	27.0	2.3	Trace	Trace	Trace
Feb 13	34	21	31	27.5	2.6	0.25	1.6	2
Feb 14	32	22	24	27.0	2.0	0.01	0.4	2
Feb 15	41	24	40	32.5	7.4	0.00	0.0	2
Feb 16	48	24	24	36.0	10.7	0.02	Trace	1
Feb 17	27	16	20	21.5	-3.9	Trace	Trace	Trace
Feb 18	32	19	26	25.5	-0.1	0.06	0.4	Trace
Feb 19	26	12	12	19.0	-6.7	0.03	0.6	1
Feb 20	21	7	12	14.0	-11.9	0.00	0.0	Trace
Feb 21	36	12	35	24.0	-2.1	0.16	Trace	Trace
Feb 22	42	29	29	35.5	9.2	0.00	0.0	Trace
Feb 23	32	20	20	26.0	-0.5	0.00	0.0	Trace
Feb 24	38	19	35	28.5	1.8	Trace	0.0	Trace
Feb 25	47	24	24	35.5	8.6	0.03	0.1	Trace
Feb 26	24	16	17	20.0	-7.1	Trace	Trace	Trace
Feb 27	20	13	13	16.5	-10.8	Trace	0.2	Trace
Feb 28	22	12	12	17.0	-10.5	0.28	3.9	4
Sum	963	488	-	-	-	1.28	7.3	-
Average	34.4	17.4	-	25.9	0.6	-	-	0.9
Normal	34.0	16.5	-	25.3	-	1.98	14.2	-

More information

Questions?

"Don't worry too much about math, science, or history — just make sure you get good marks in *rhetoric*."

"Normal" weather distribution over time

Frequency of occurrence

Extreme events

Likely events

Extreme events

requires a large number of events

"Normal" weather distribution over time
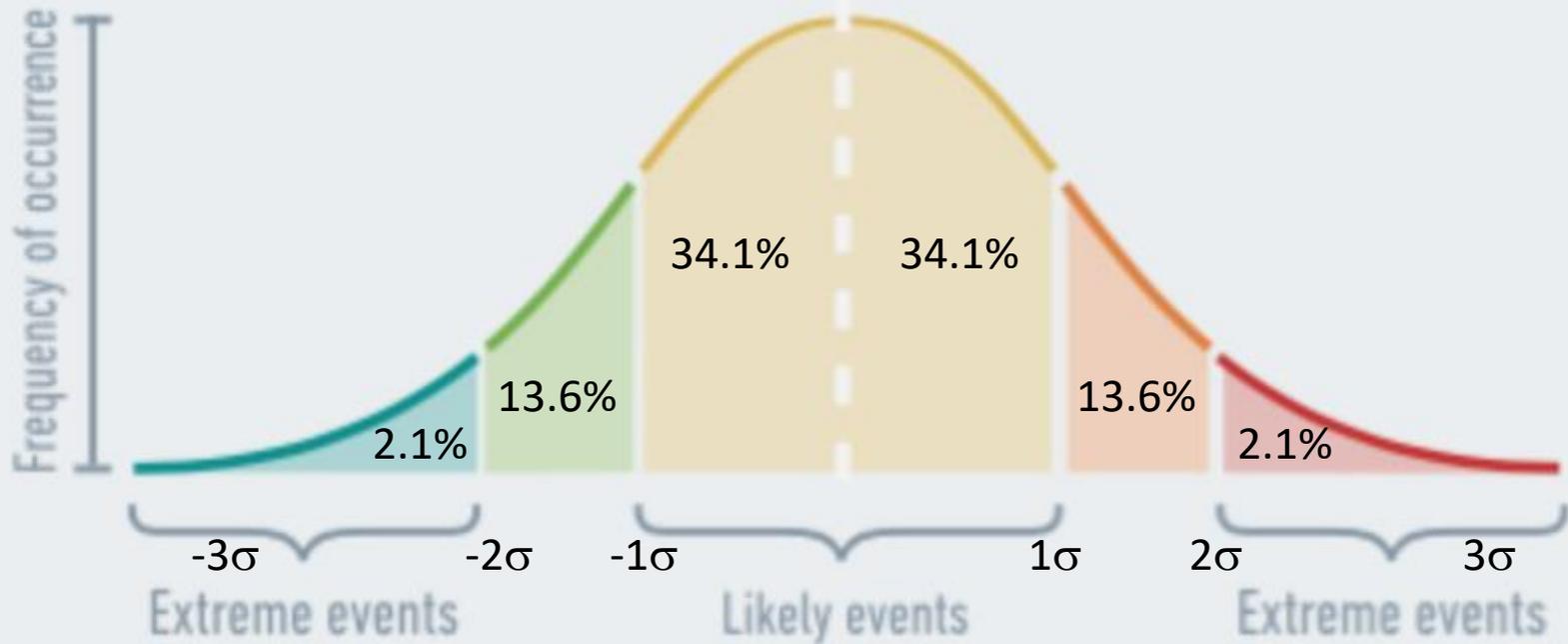
34.1%   34.1%

13.6%   13.6%

2.1%   2.1%

-3σ   -2σ   -1σ   1σ   2σ   3σ

Extreme events   Likely events   Extreme events

Frequency of occurrence

requires a large number [1,000] of events

"Normal" weather distribution over time

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-3σ　　-2σ　-1σ　　　　1σ　2σ　　3σ

Extreme events　　Likely events　　Extreme events
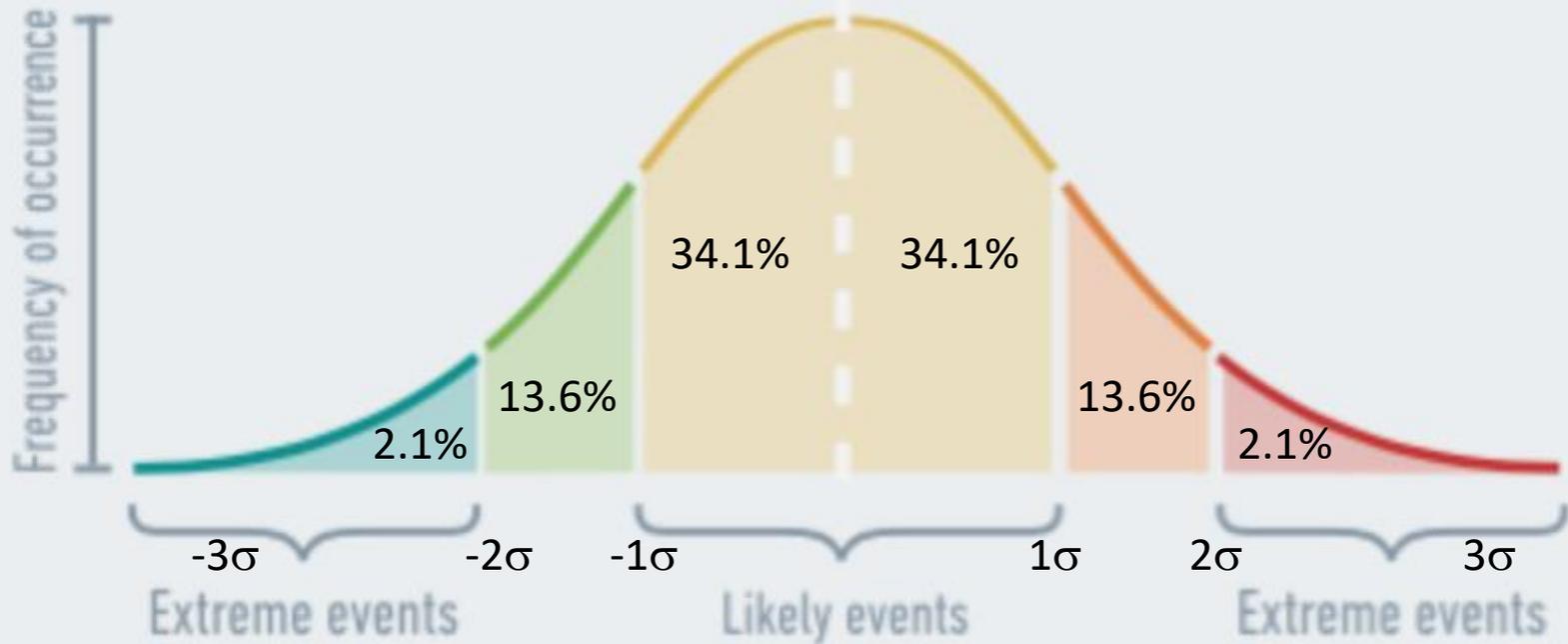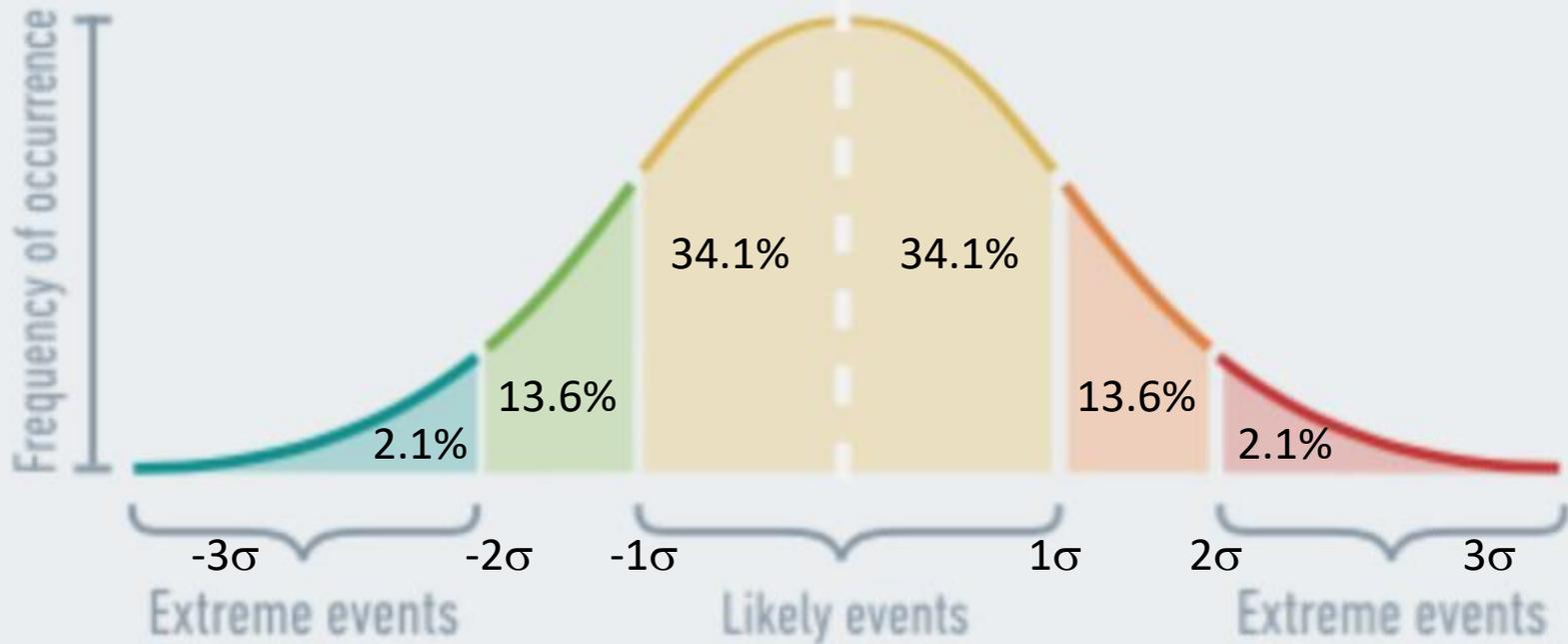
requires a large number [1,000] of events

weather events do not always fit these criteria

Percentage of total number of falls in each class interval

60

50

(1.9)[a]

40

30

(10.5)

20

(11.8)

10

(30.0)

(14.5)

(23.5)

(15.5)

(32.5)

0

0 - 5   6 - 10   11 - 15   16 - 20   21 - 25   26 - 30   31 - 35   > 35

Intensity of rainfall (mm/h)
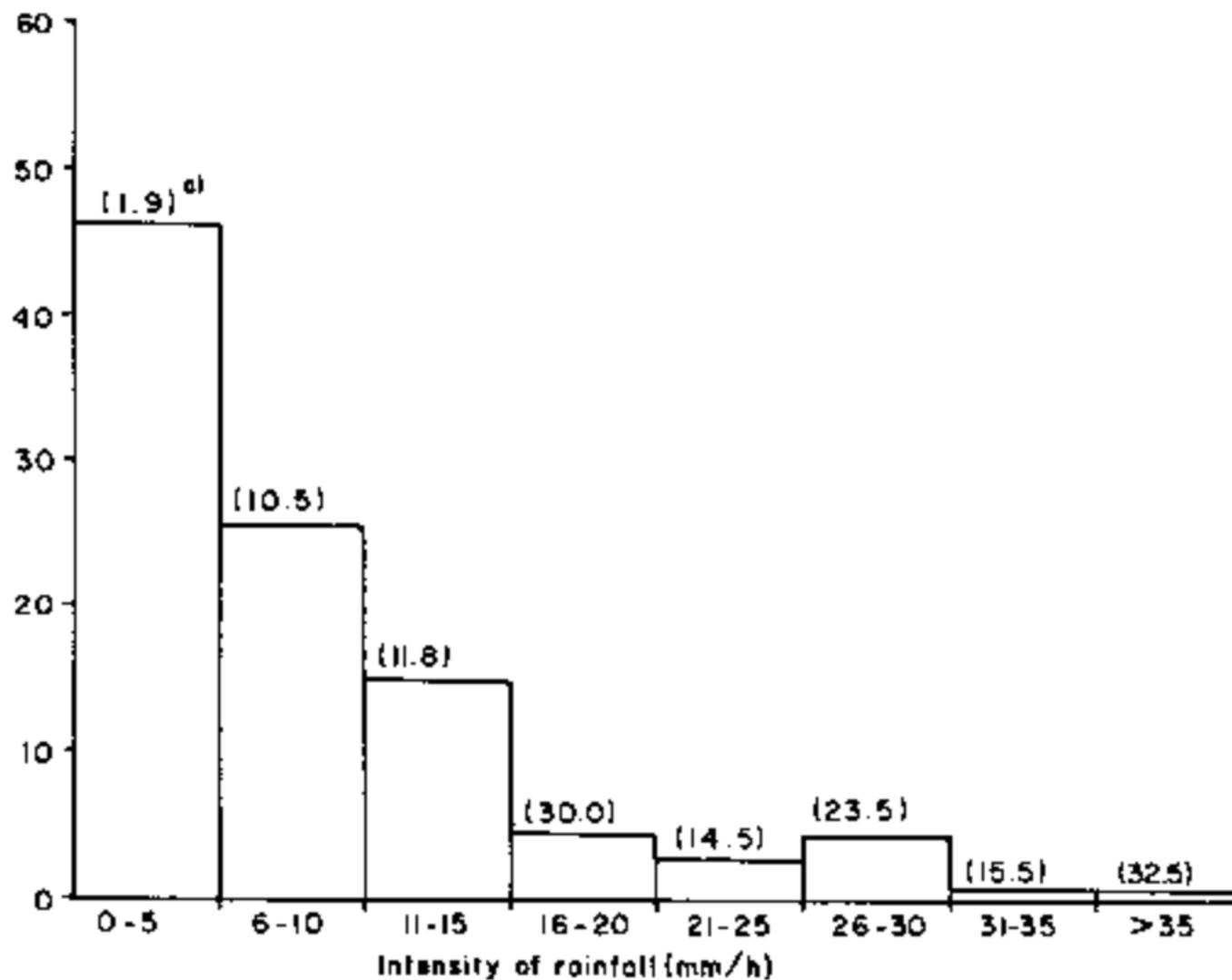
a) Mean rainfall amount (mm) at each intensity is shown in brackets.

Percentage of total number of falls in each class interval
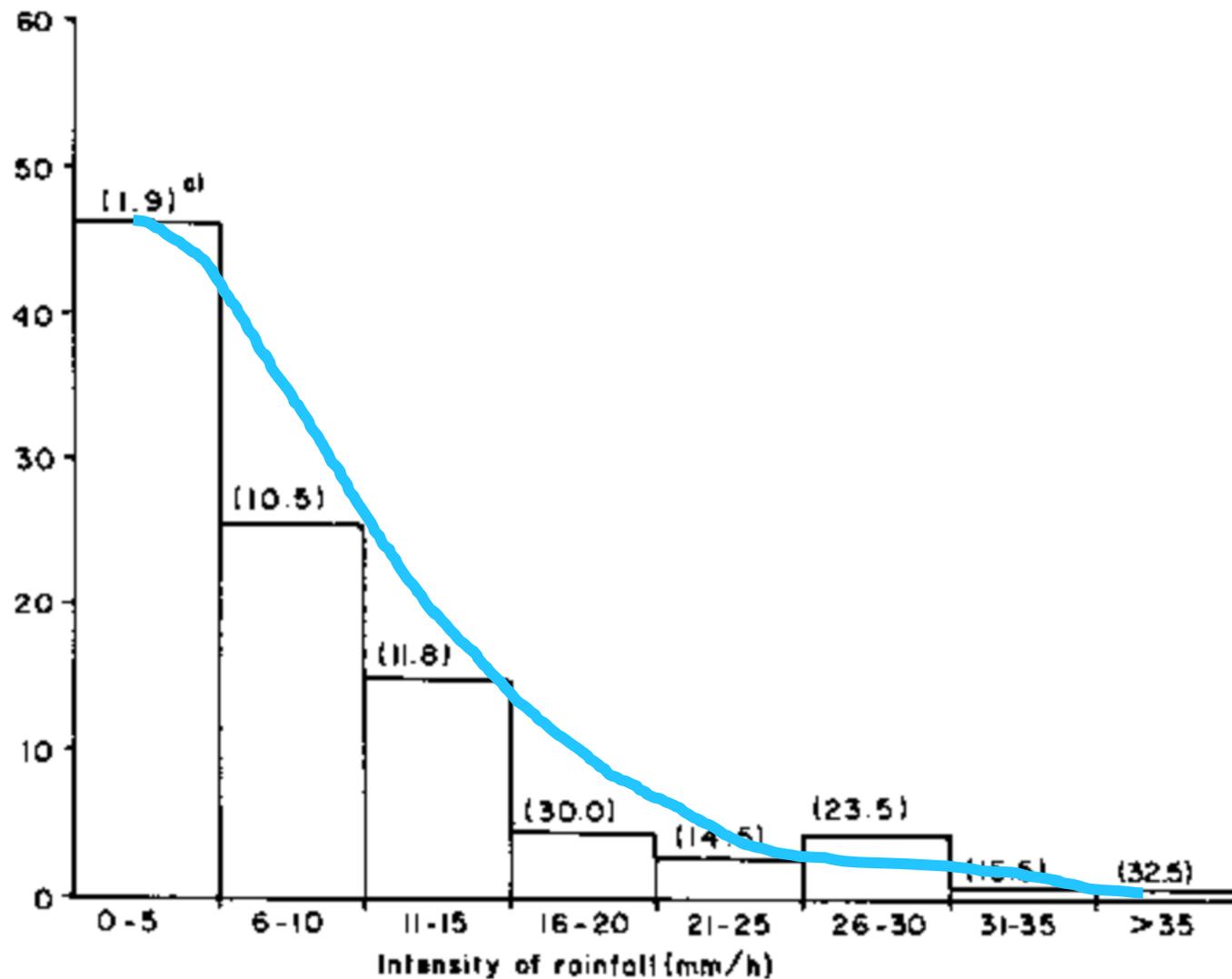
(1.9) a)
(10.5)
(11.8)
(30.0)
(14.5)
(23.5)
(15.5)
(32.5)

Intensity of rainfall (mm/h)

0-5   6-10   11-15   16-20   21-25   26-30   31-35   >35

a) Mean rainfall amount (mm) at each intensity is shown in brackets.

cold **warm**

Anomaly Frequency

-4 -3 -2 -1 0 1 2 3 4 5

Anomaly distribution for June, July and August
(standard deviations from normal local temp. 1951-80)

— 1951-61   — 1961-71   — 1971-81
— 1981-91   — 1991-01   — 2001-11

Figure adapted from New Scientist (2012); Data from Hansen et al. 2012.

"Normal" weather distribution over time

Frequency of occurrence

34.1% 34.1%

13.6%   13.6%

2.1%   2.1%

-3σ   -2σ -1σ   1σ   2σ   3σ
Extreme events   Likely events   Extreme events

1950s   60s   70s   80s   90s   2000s

record highs

record lows

1.09:1   0.77:1   0.78:1   1.14:1   1.36:1   2.04:1 ratios

(©UCAR, graphic by Mike Shibao.)

cold **warm**

Anomaly
Frequency

-4 -3 -2 -1 0 1 2 3 4 5

Anomaly distribution for June, July and August
(standard deviations from normal local temp. 1951-80)

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Figure adapted from New Scientist (2012); Data from Hansen et al. 2012.

"Normal" weather distribution over time

Frequency of occurrence

34.1% 34.1%

13.6% 13.6%

2.1% 2.1%

-3σ -2σ -1σ 1σ 2σ 3σ
Extreme events Likely events Extreme events
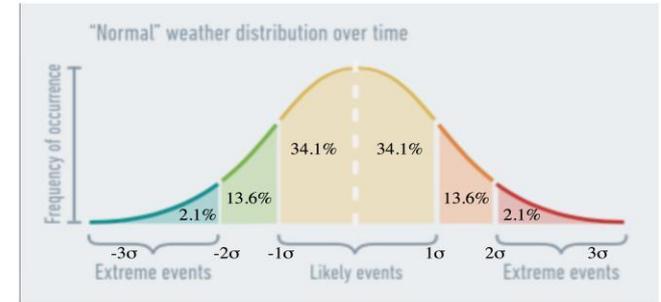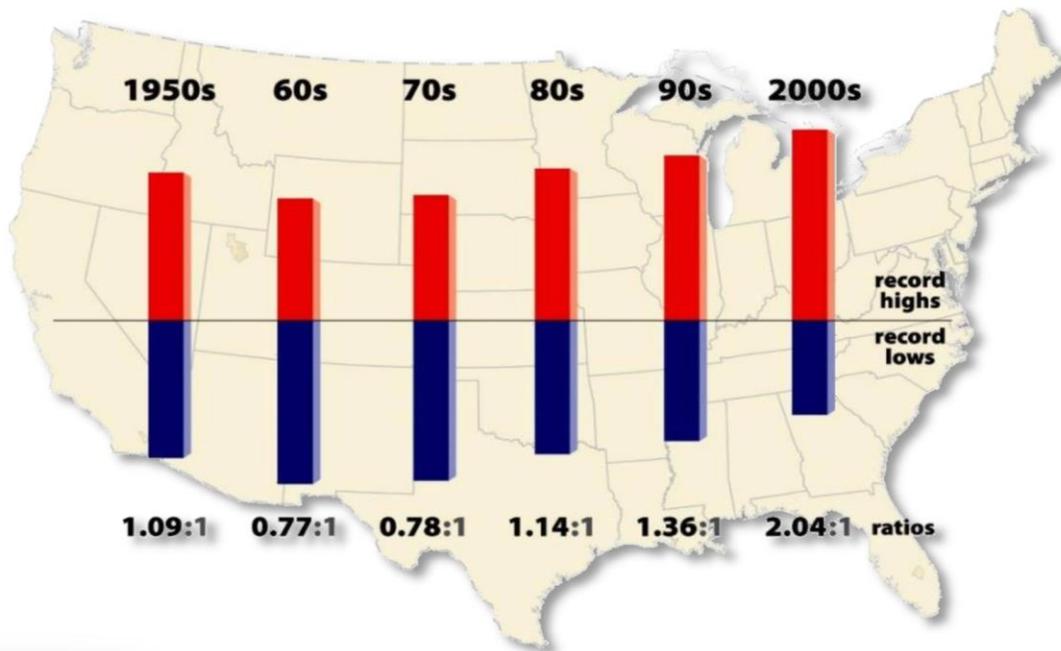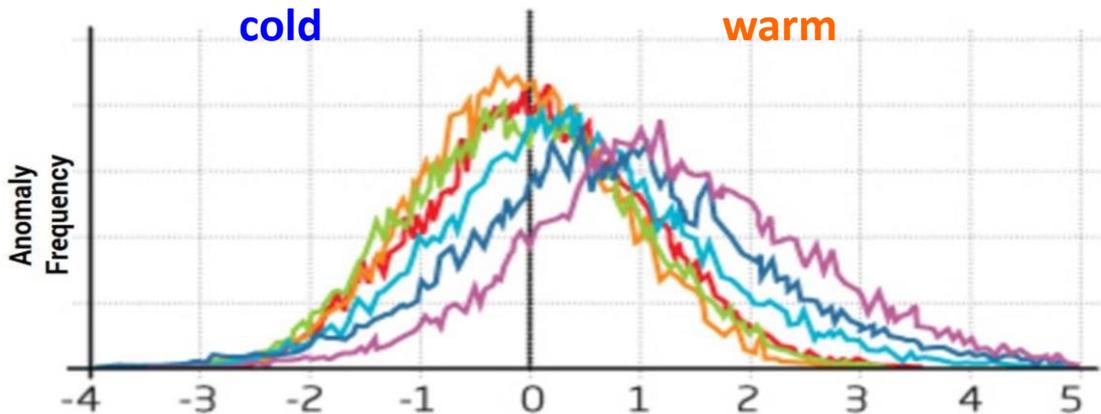
Movement of weather sites (cities to airports)

1950s 60s 70s 80s 90s 2000s

record highs
record lows

1.09:1 0.77:1 0.78:1 1.14:1 1.36:1 2.04:1 ratios
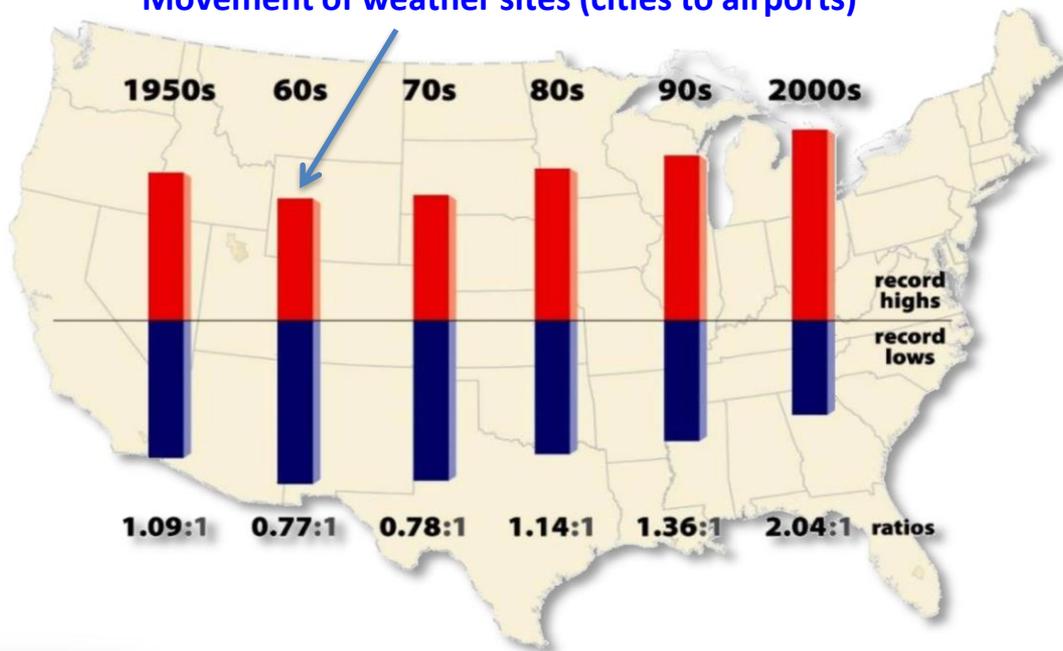
(©UCAR, graphic by Mike Shibao.)
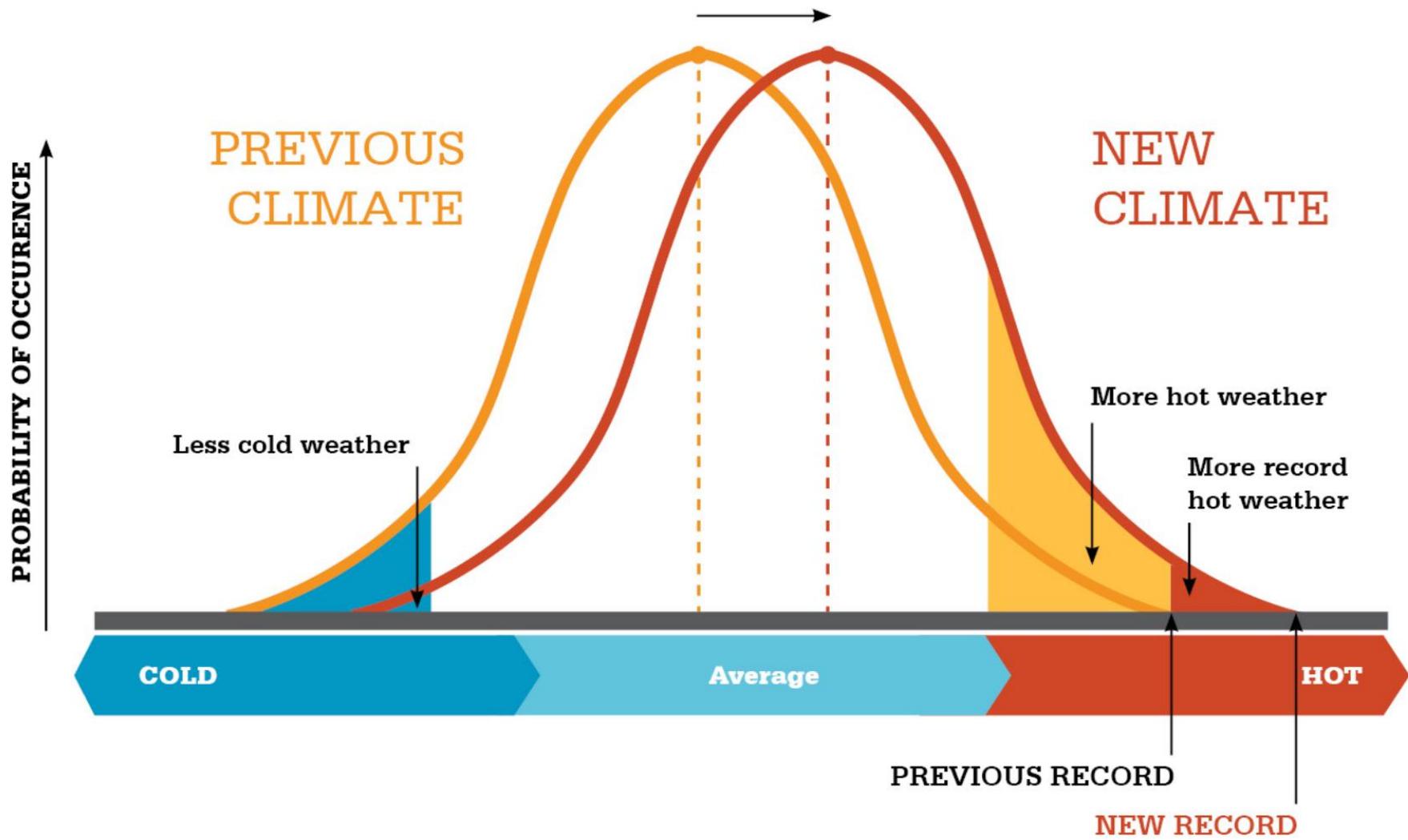
Source: Modified from IPCC, 2007

Upstate New York

1961–1990
2010–2039
2040–2069
2070–2090
2040–2069
2070–2090

Higher-Emissions Scenario
Lower-Emissions Scenario

Source: NECIA, 2007 (see: www.climatechoices.org/ne/)

NYC Tri-State Region

1961–1990
2010–2039
2040–2069
2040–2069
2070–2090
2070–2090

Higher-Emissions Scenario
Lower-Emissions Scenario
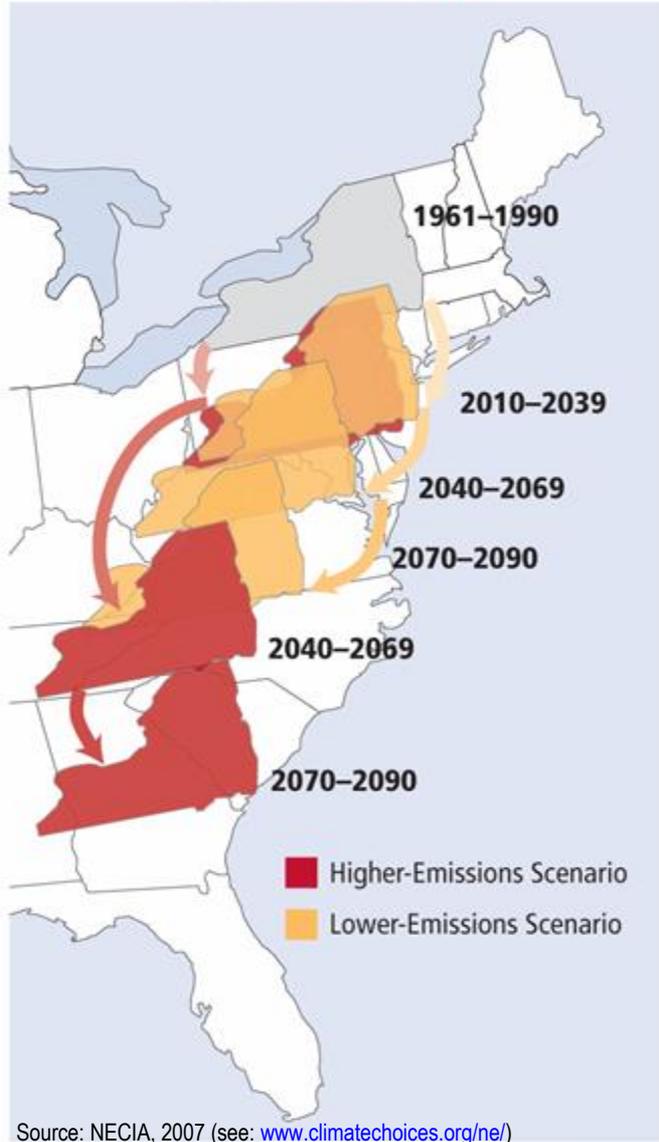
Changes in Suitable Climate Conditions For Different Forest Types by Late-Century
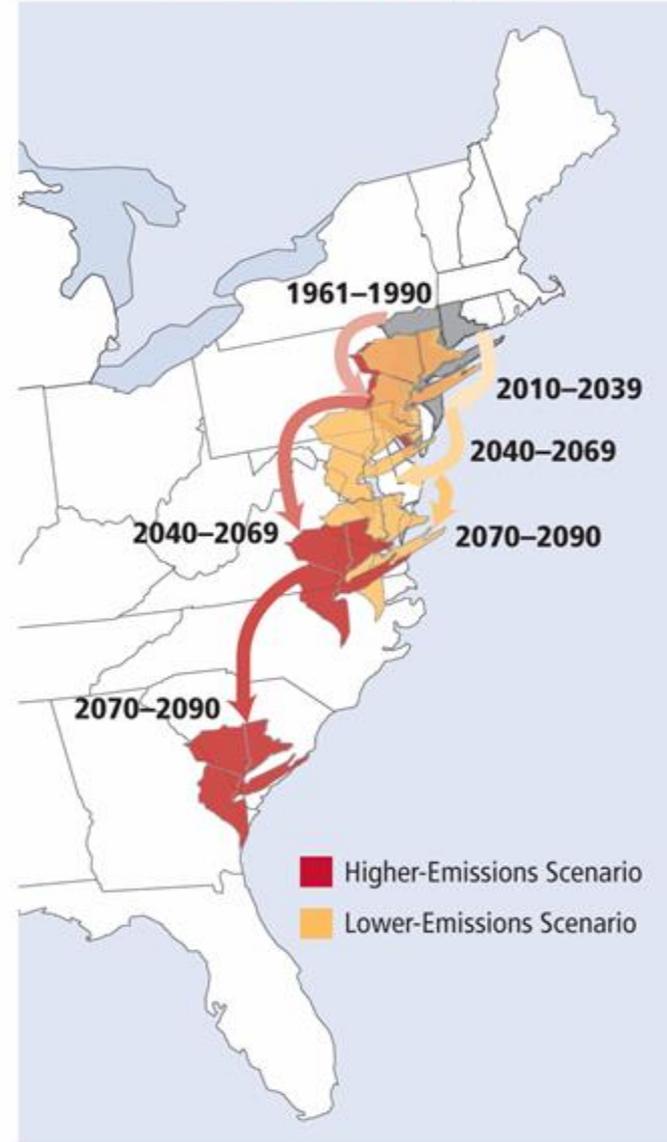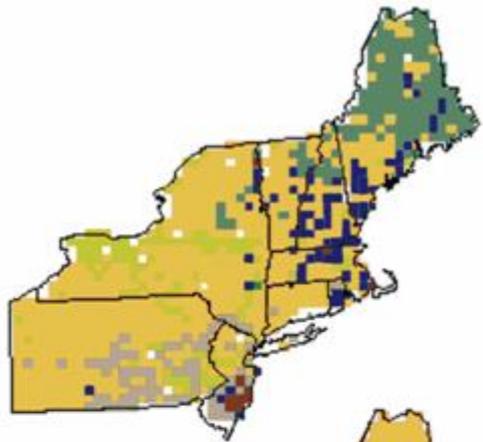
Current
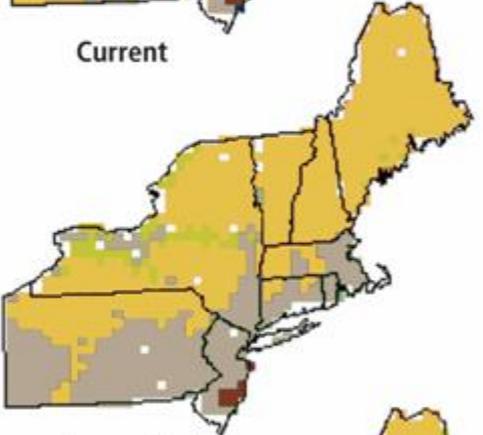
Lower Emissions
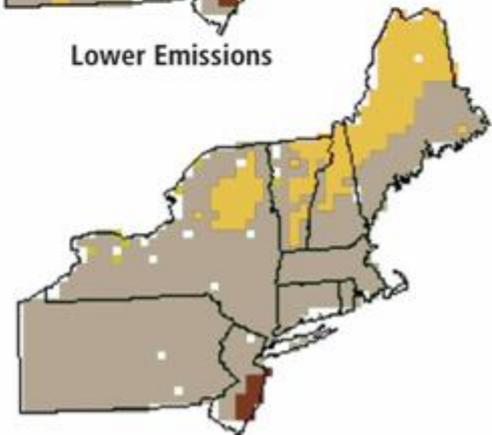
Higher Emissions

Spruce/Fir

Maple/Beech/Birch

Oak/Hickory

Elm/Ash/Cottonwood

Loblolly/Shortleaf Pine

Other

No Data

spruce/fir: Anastasiya Maksymenko; maple: Birthe Lunau; oak: Dave White;
ash: Chad Davis; loblolly: Kentucky Division of Forestry.
Source: NECIA, 2007 (see: www.climatechoices.org/ne/).

Jerry and Marcy Monkman

Percent Years Meeting 1000-hr Winter-Chill Requirement
(dark orange- most years meet requirement)

High emissions

NRCC
Art DeGaetano

Low emissions
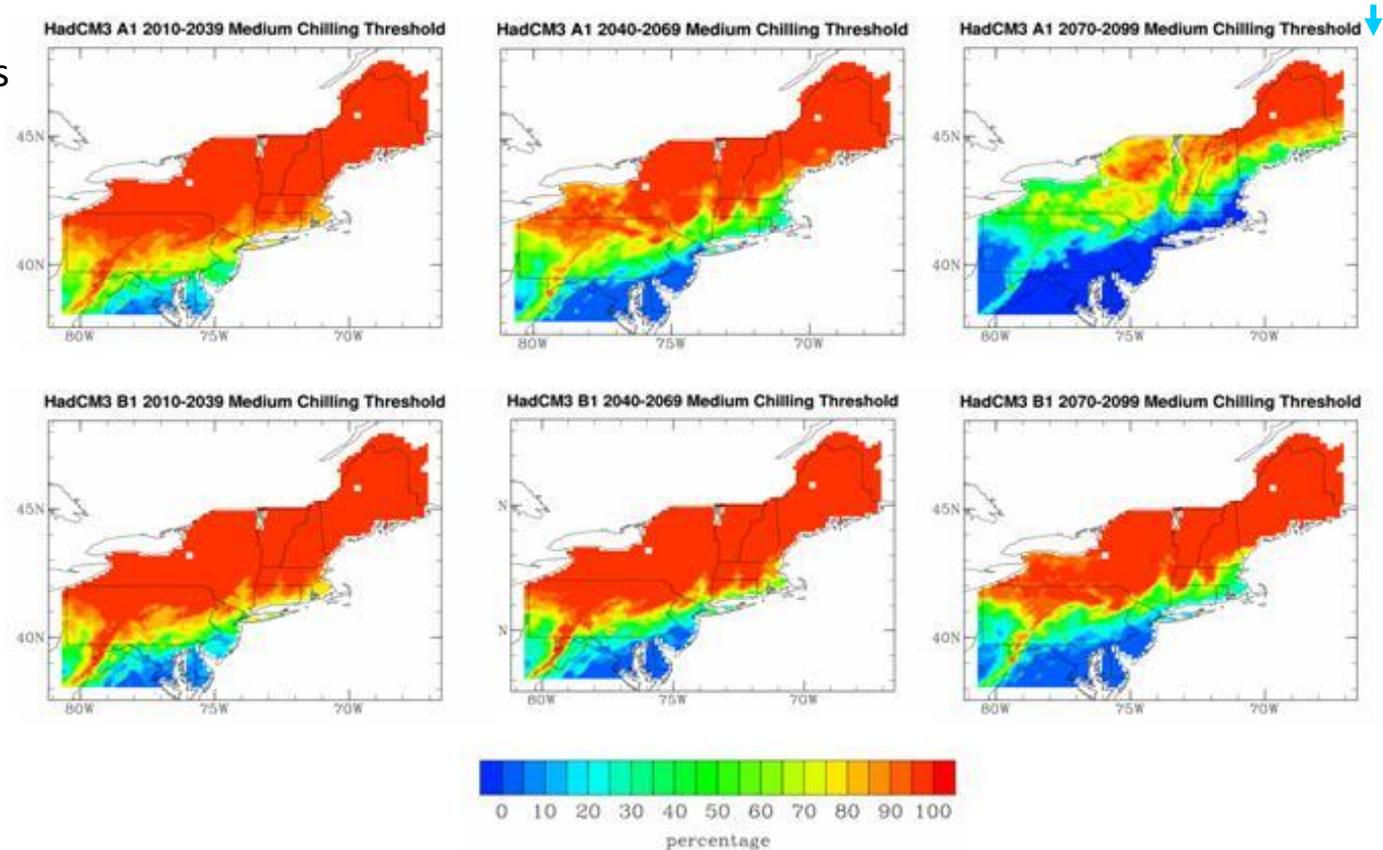
**July Dairy Thermal Heat Index
(THI > 72 [yellow-orange to red] reduces milk production)**

High emissions

Low emissions

NRCC
Art DeGaetano
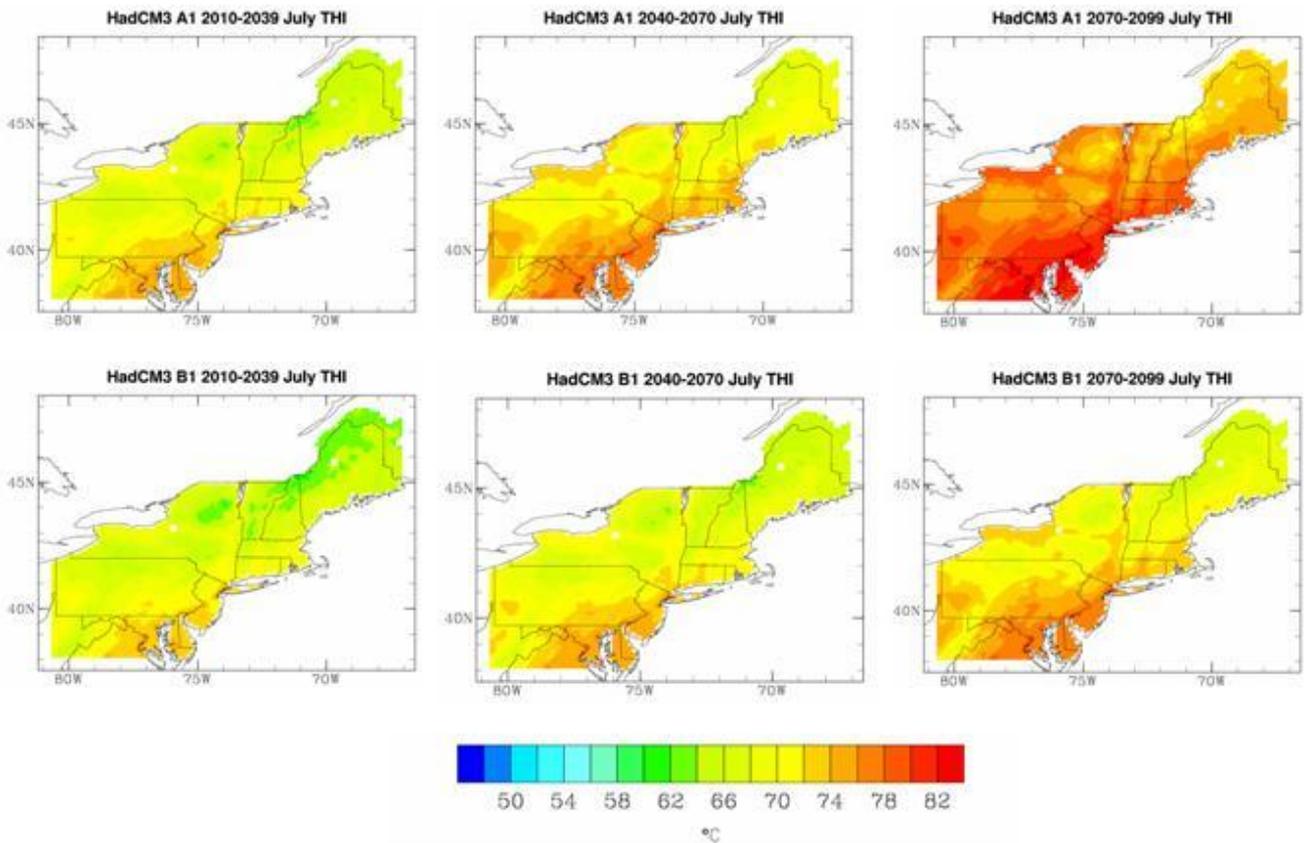
NYC : Today's 100-Year Flood Could Occur Every 10 Years under the Higher-Emissions Scenario

Landmarks

A. West Side Highway
B. Battery Park
C. Brooklyn-Battery Tunnel
D. South Ferry Subway Station
E. Ferry Terminals
F. Franklin D. Roosevelt Drive
G. Wall Street
H. South Street Seaport

Warmest

Rank	Year	Mean Avg Temperature	Missing Count
1	1998	51.2	0
2	1991	50.9	2
3	1990	50.8	2
4	2012	50.6	0
5	2006	50.5	0
6	1999	49.9	0
7	2001	49.4	2
8	2016	49.1	0
9	2017	49.0	0
-	1973	49.0	1

5/10 in the 2000's
4/10 in the 1990's

1956 – 2018   record length
Aurora Research Farm

Top Ten

Wettest

Rank	Year	Total Precipitation	Missing Count
1	1972	51.75	0
2	1996	45.05	0
3	1990	44.93	0
4	2017	43.77	3
5	1975	41.80	0
6	1974	41.78	0
7	1979	40.94	0
8	1976	40.90	0
9	2006	40.68	13
10	1984	40.48	0

2/10 in the 2000's
2/10 in the 1990's

Rank	Year	Mean Avg Temperature	Missing Count
1	1978	44.9	3
2	1958	45.2	2
3	2014	45.6	1
4	1980	45.7	0
5	1976	45.8	0
-	1972	45.8	2
7	1963	45.9	0
8	1981	46.0	1
9	1965	46.2	0
10	1979	46.3	0

Coldest

1/10 in the 2000's

1956 – 2018   record length
Aurora Research Farm

Top Ten

Rank	Year	Total Precipitation	Missing Count
1	1965	22.48	0
2	1964	23.60	0
3	1963	26.13	0
4	1960	26.92	0
5	1962	28.49	0
6	1966	29.48	0
7	1991	30.32	0
8	1999	30.72	0
9	2001	30.83	0
10	1980	31.67	0

Driest

1/10 in the 2000's
2/10 in the 1990's