

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

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Senior Lecturer in Meteorology Cornell University

New York State Climatologist

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

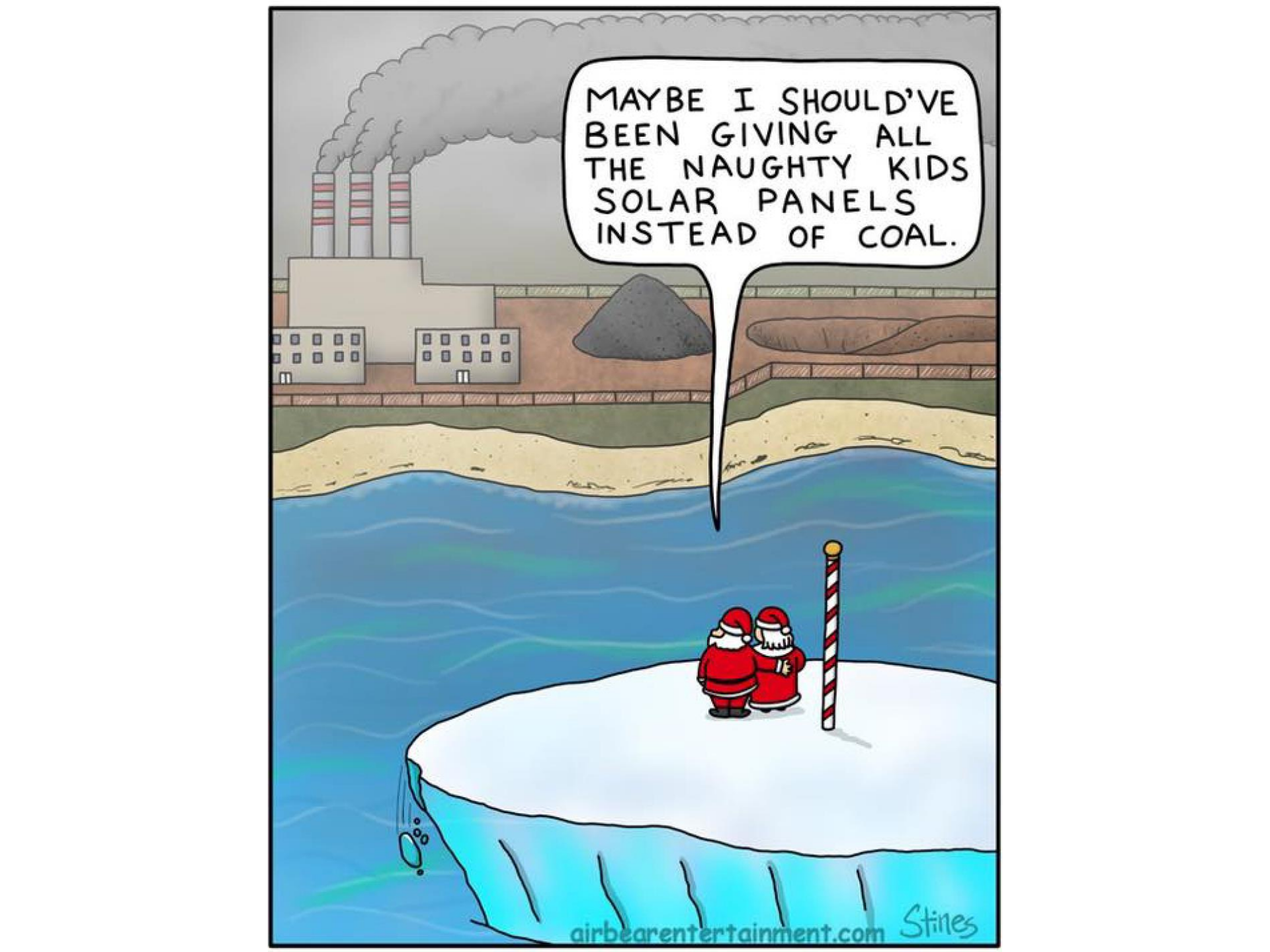
Aurora, NY

23 March 2018

Thanks to:

Jessica Spaccio and Samantha Borisoff [NRCC]



A cartoon illustration showing two Santa Claus figures standing on a small, white ice floe in a blue body of water. To their right is a red and white striped lighthouse. In the background, across a sandy beach, is a large industrial factory with three smokestacks emitting thick grey smoke. A large pile of dark grey coal sits on the beach. A speech bubble from the Santas points towards the factory.

MAYBE I SHOULD'VE
BEEN GIVING ALL
THE NAUGHTY KIDS
SOLAR PANELS
INSTEAD OF COAL.



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

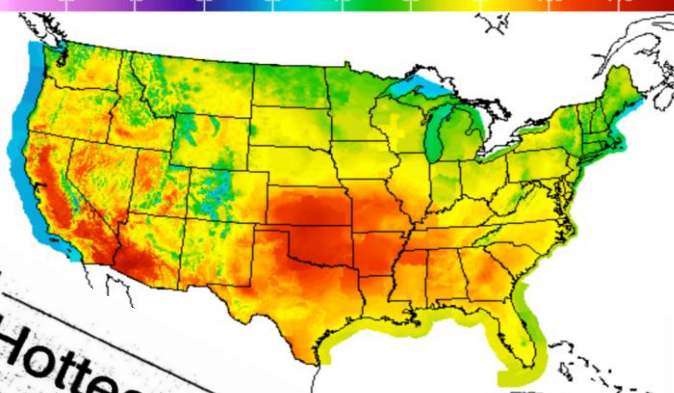
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DAILY EXPRESS
 Clooney's amazing mother
 FREE £5 SPEND AT WHSmith FOR EVERY READER
 Iran threatens serious action against sailors

THE BIG CLIMATE CHANGE 'FRAUD'

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

Sunday Morning Post
EL PAIS
la Repubblica
The New York Times
CLIMATE DEAL 'A TURNING POINT' FOR THE PLANET
NATIONS APPROVE LANDMARK CLIMATE DEAL

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Hottest decade kills 370,000

SWITZERLAND
 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, except 2006 was among the 10 warmest on record, the report showed.

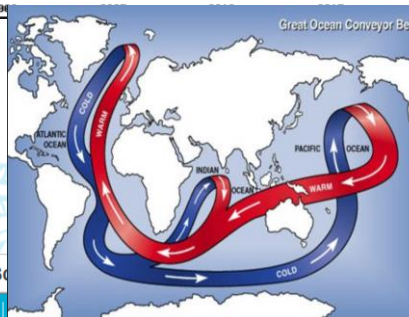
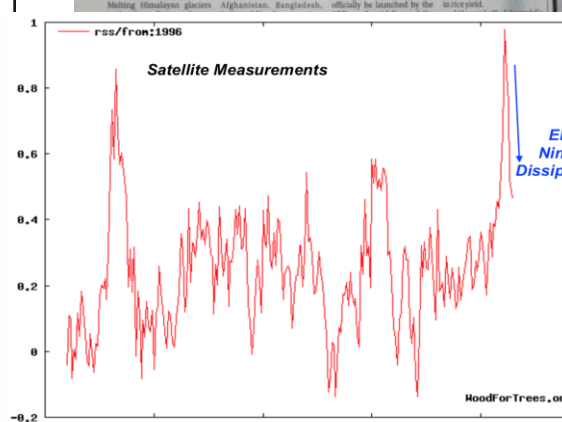
United Nations says. In a new report on the period from 2001-2010, the World Meteorological Organisation said land and sea temperatures averaged 14.47C. This compared with the long-term average measured from weather records dating back to 1881. When measured globally, except 2006 was among the 10 warmest on record, the report showed.

Climate change threatens food security in S Asia

Says ADB study

ADB, Dhaka

The study warns that four countries in South Asia - Afghanistan, Bangladesh, holding Climate Resilience in the Agriculture Sector, will officially be launched by the in water production, 10 per cent in wheat and 18 percent in rice.



MailOnline

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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

The Columbus Dispatch
 Columbus, Ohio • Jul 12, 2015 • 75° Overcast
 News Sports Opinion Life & Entertainment Services Contact Subscribe
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Study: Sea levels could rise 20 feet even if global warming curbed

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

Disaster risk reduction, climate change adaptation and environmental migration

A POLICY PERSPECTIVE



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

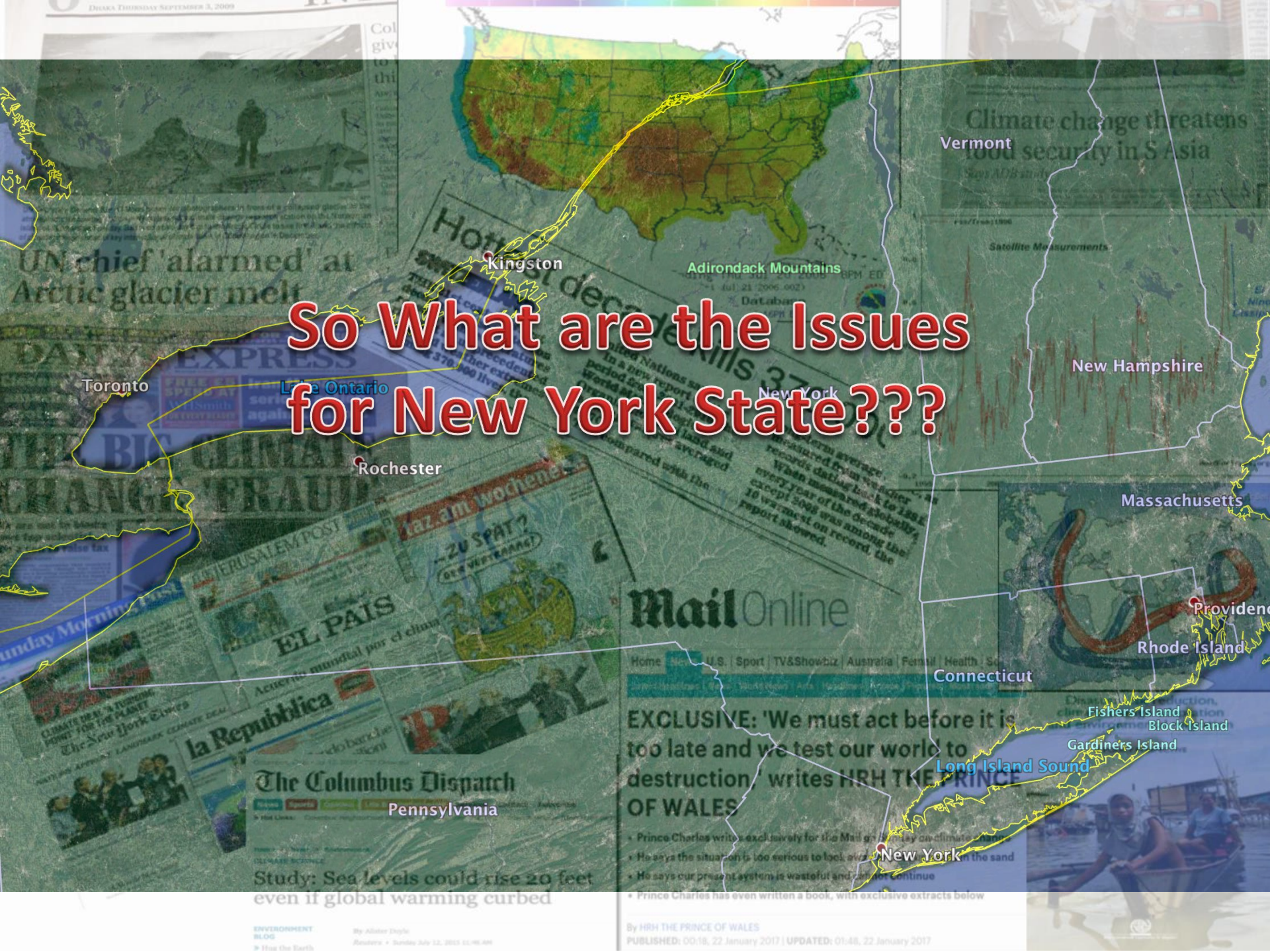
2019

2018 was 4th hottest year on record for the globe

The U.S. experienced 14 billion-dollar weather and climate disasters

Future Climate issues





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

Toronto

Ontario

Kingston

Adirondack Mountains

Vermont

New Hampshire

Massachusetts

Providence

Rhode Island

Connecticut

Fishers Island

Block Island

Gardiners Island

Long Island Sound

New York

The Columbus Dispatch

Pennsylvania

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

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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

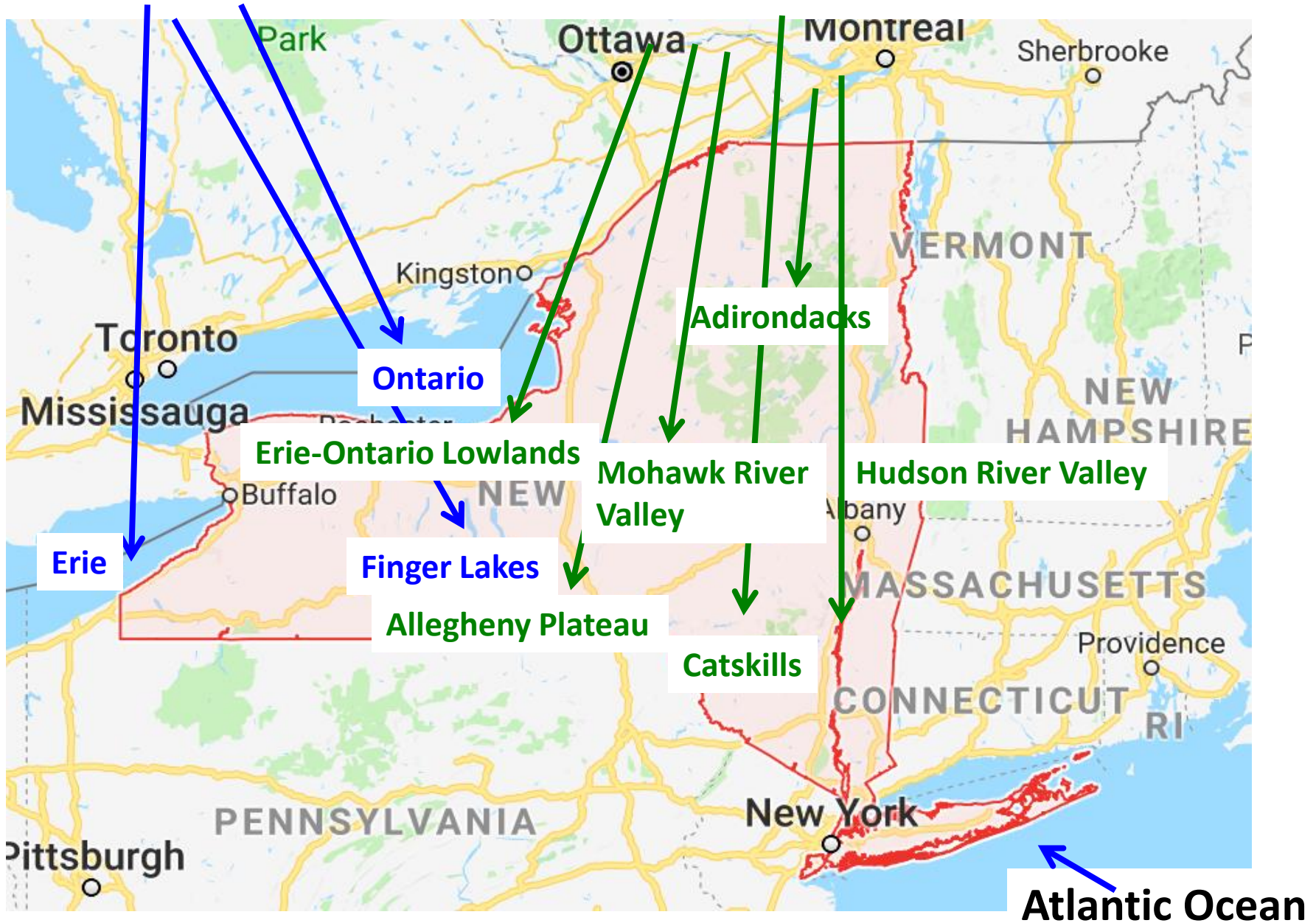
- Prince Charles writes exclusively for the Mail online on climate change
- He says the situation is too serious to look away
- He says our present system is wasteful and must continue
- Prince Charles has even written a book, with exclusive extracts below

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

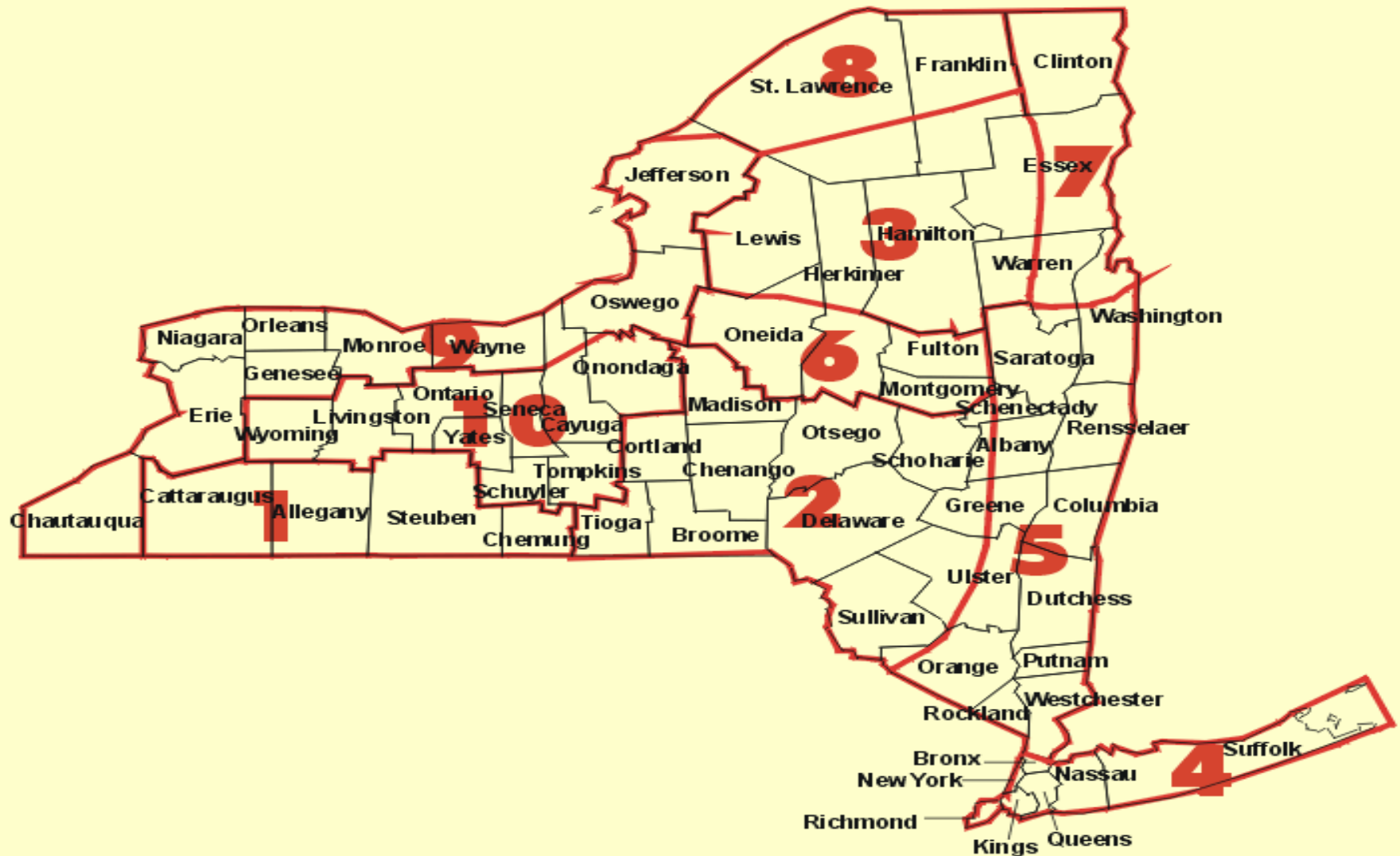
Complexities of New York State

Lakes

Topography



New York Climate Zones

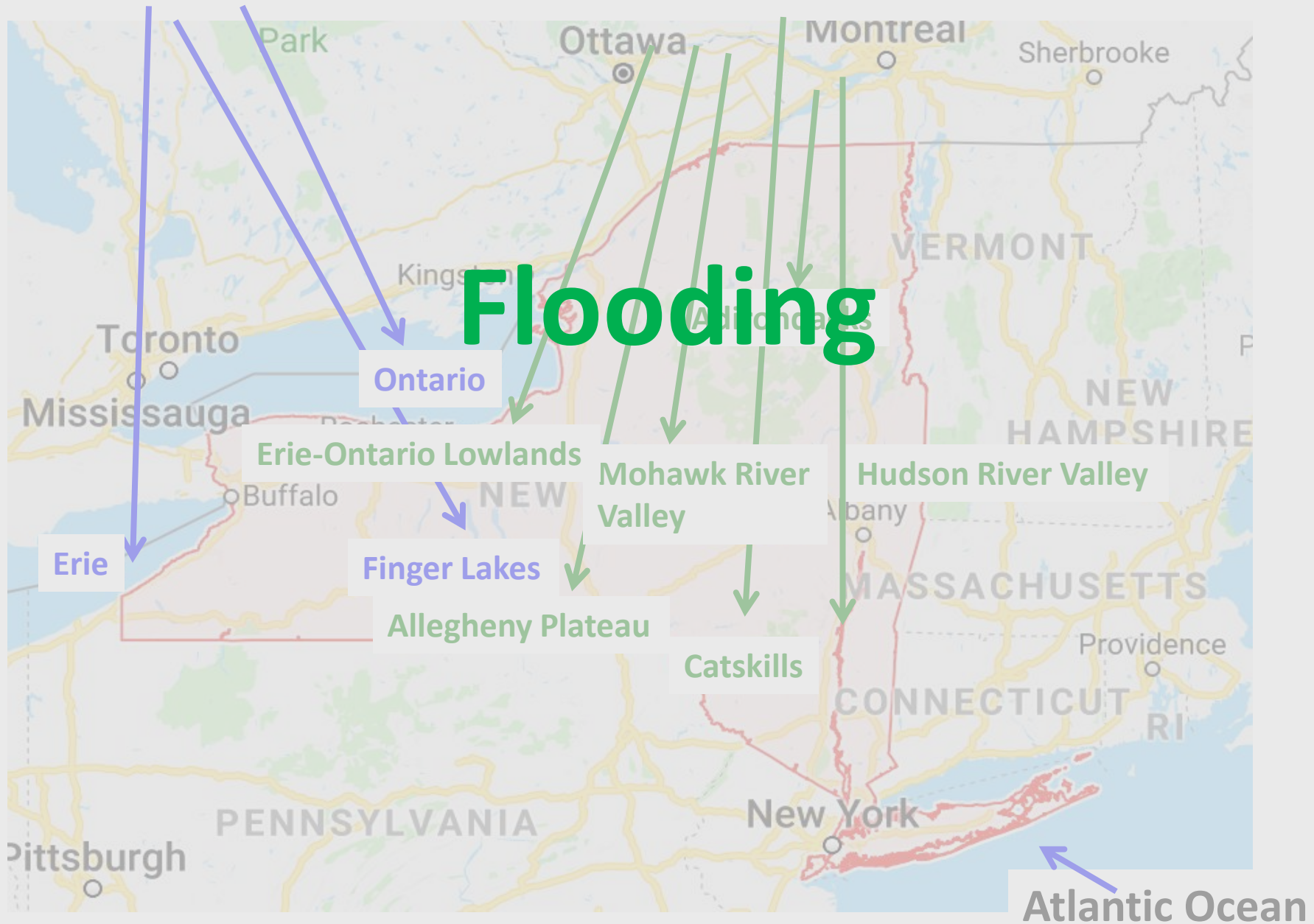


Complexities of New York State

Lakes

Topography

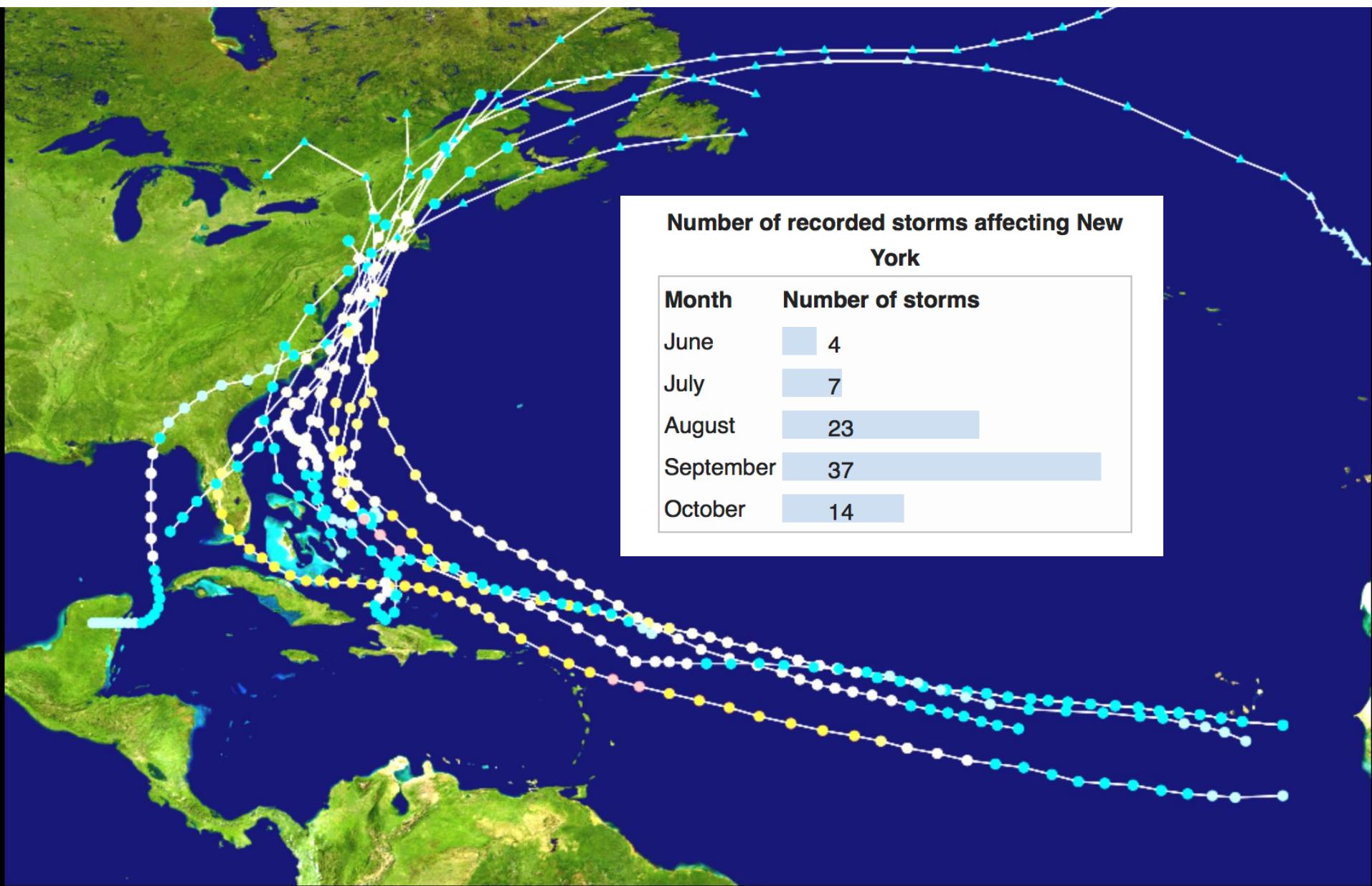
Flooding



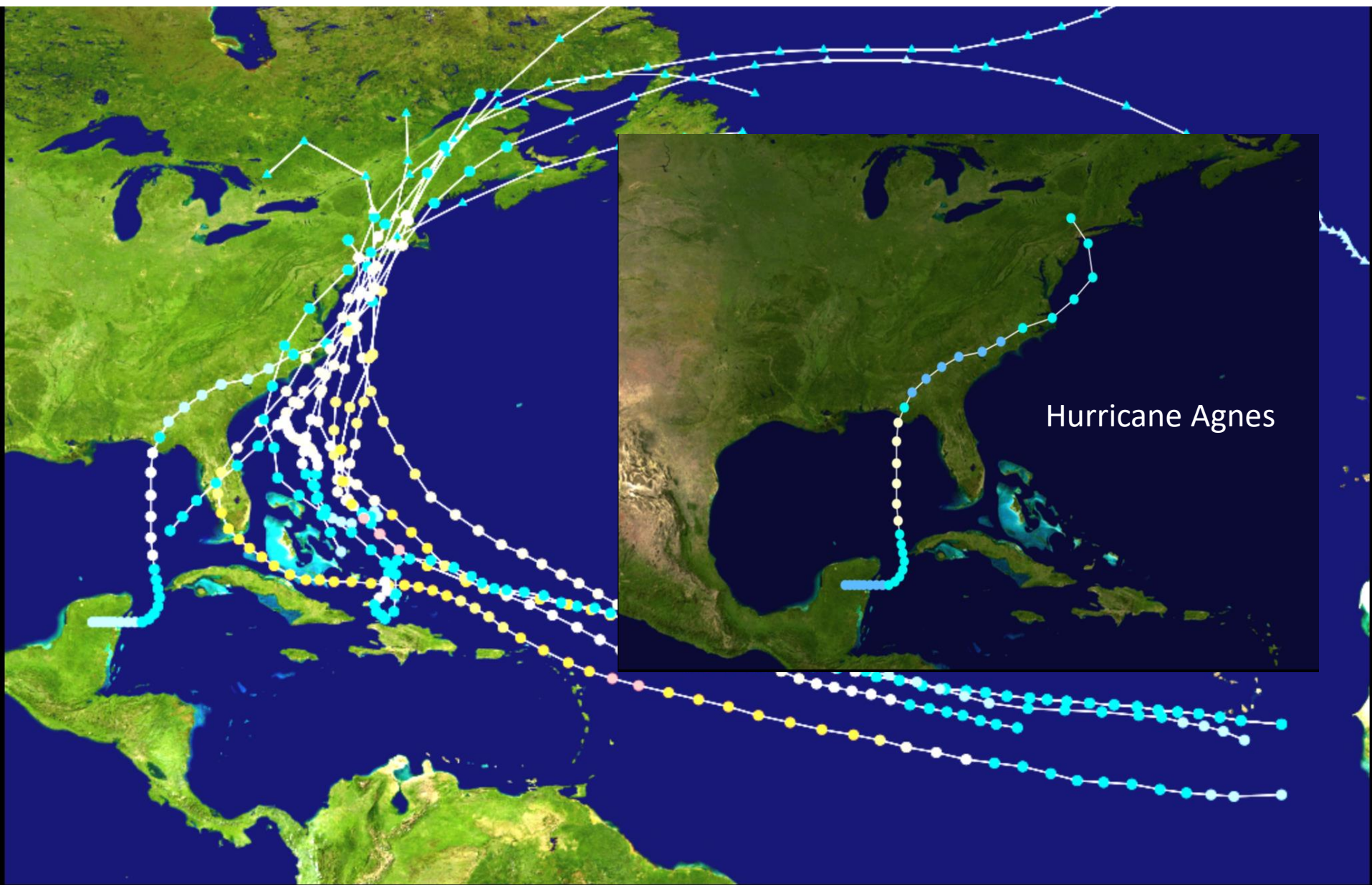
New York State Great Lakes Basin



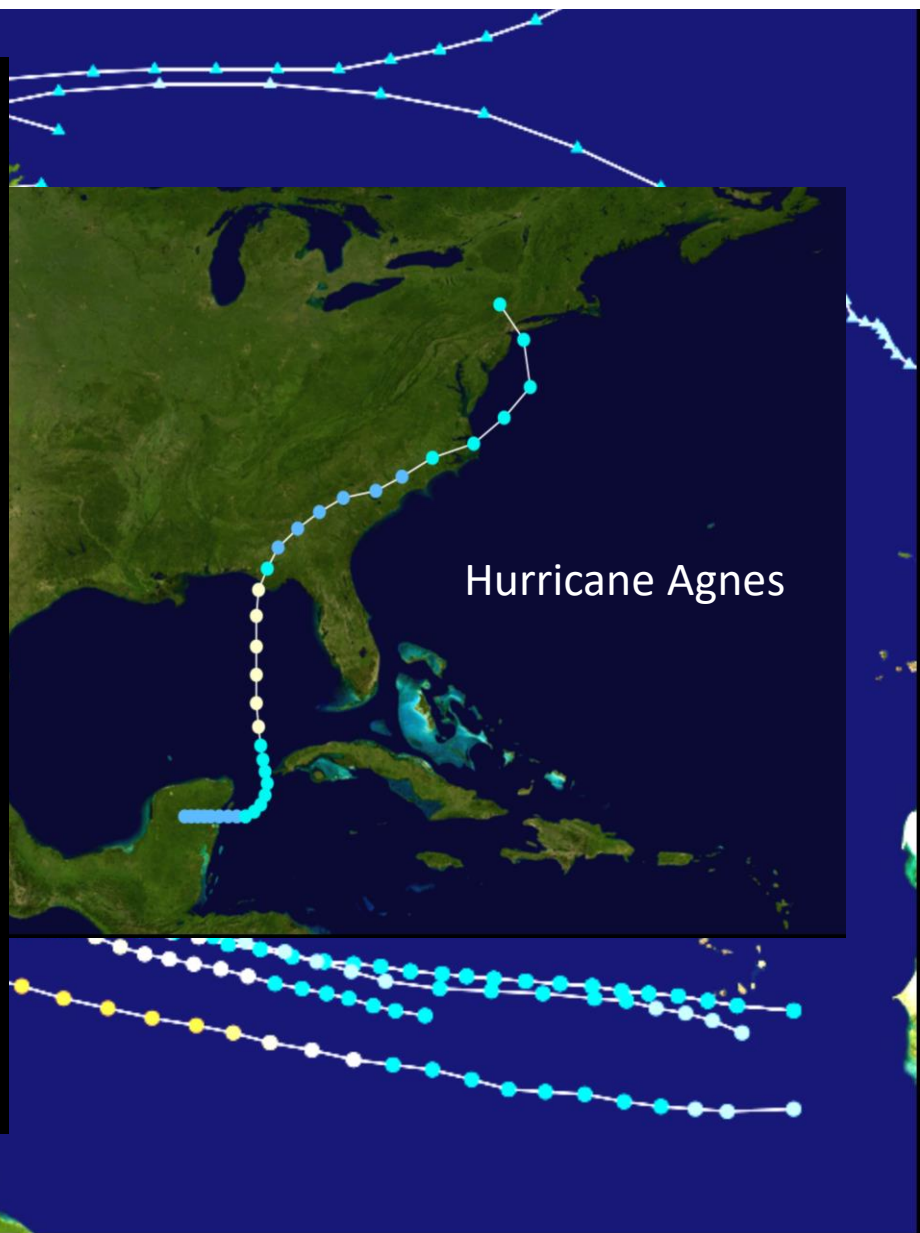
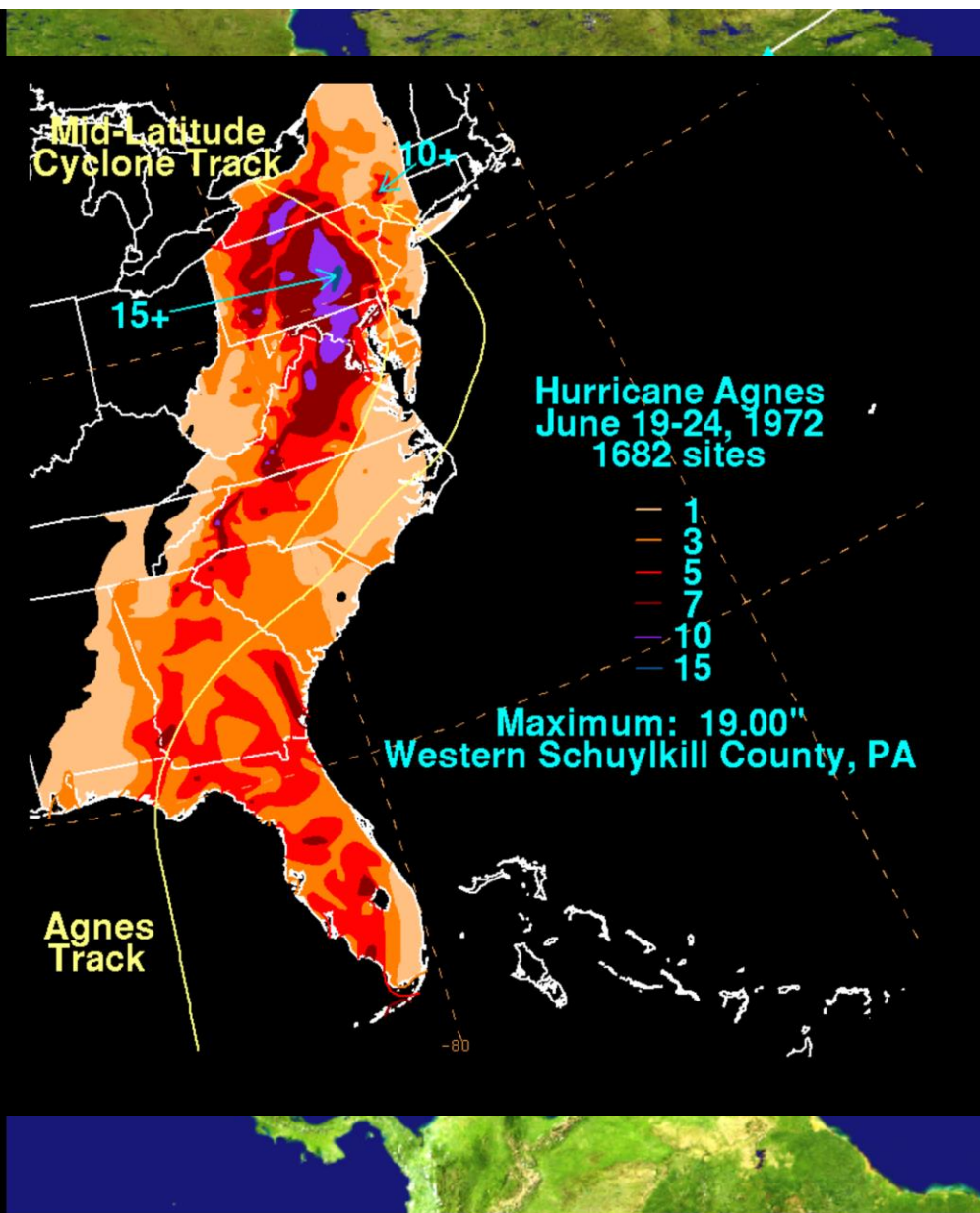
<http://www.dec.ny.gov/lands/93118.html>



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



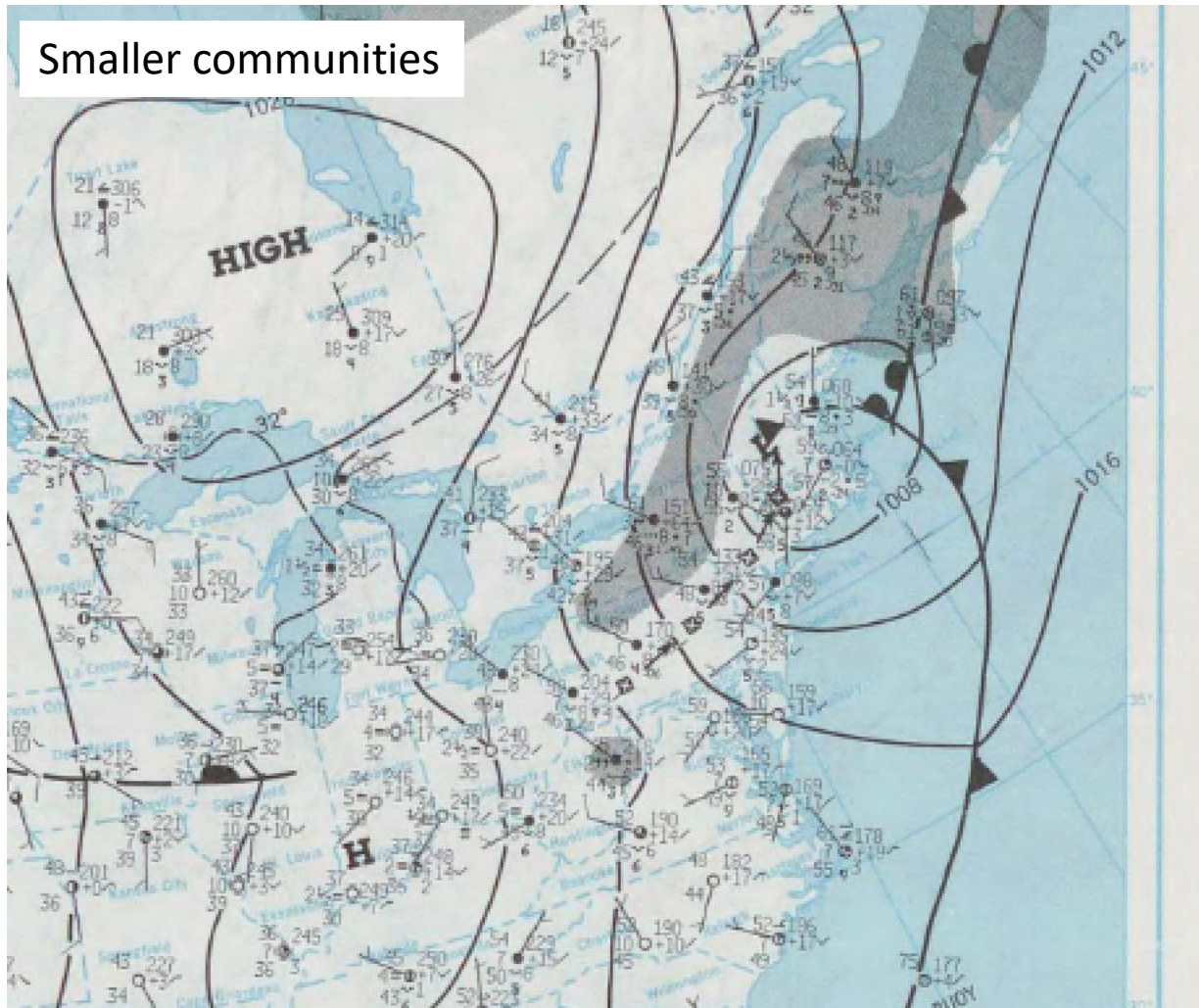
Track map of all storms known to have made landfall in the state of New York
1800 - 2016



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

Mid-Latitude Storms

Smaller communities



28 October 1981

Extreme Precipitation in New York & New England

An Interactive Web Tool for Extreme Precipitation Analysis

About this Project

Data & Products

Daily Monitoring

Documentation

View: **Map** Table Calendar

Date: 1981-10-28

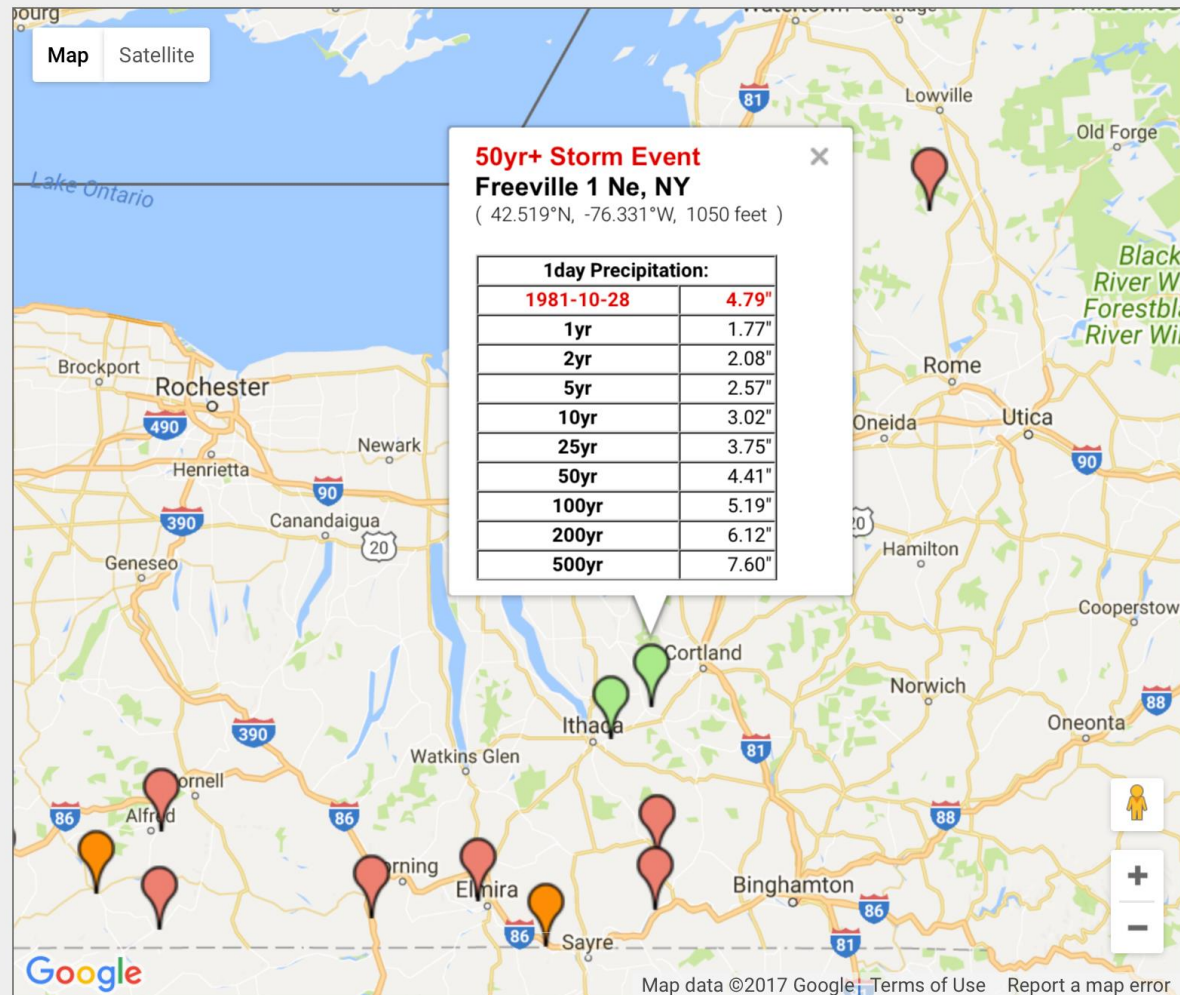
Duration: 1day

CONTINUE >>

50yr: Freeville 1 Ne, NY
50yr: Ithaca Cornell Univ, NY
5yr: Camden, NY
2yr: Cayuga Lock #1, NY
2yr: Chemung, NY
2yr: Indian Lake 2sw, NY
2yr: Piseco, NY
2yr: Rochester, VT
2yr: Tupper Lake Sunmount, NY
2yr: Wellsville, NY
1yr: Alfred, NY
1yr: Allegany Sp, NY
1yr: Brewerton Lock 23, NY
1yr: Candor 2 Se, NY
1yr: Elmira, NY
1yr: Friendship 7 Sw, NY
1yr: Highmarket, NY
1yr: Lindley 2 N, NY
1yr: Owego 3 Wsw, NY

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ACIS
Northeast Regional
Climate Center

Real-time monitoring is in BETA testing. Please be patient - products may take 10-15 seconds to load.



1yr

2yr

5yr

10yr

25yr

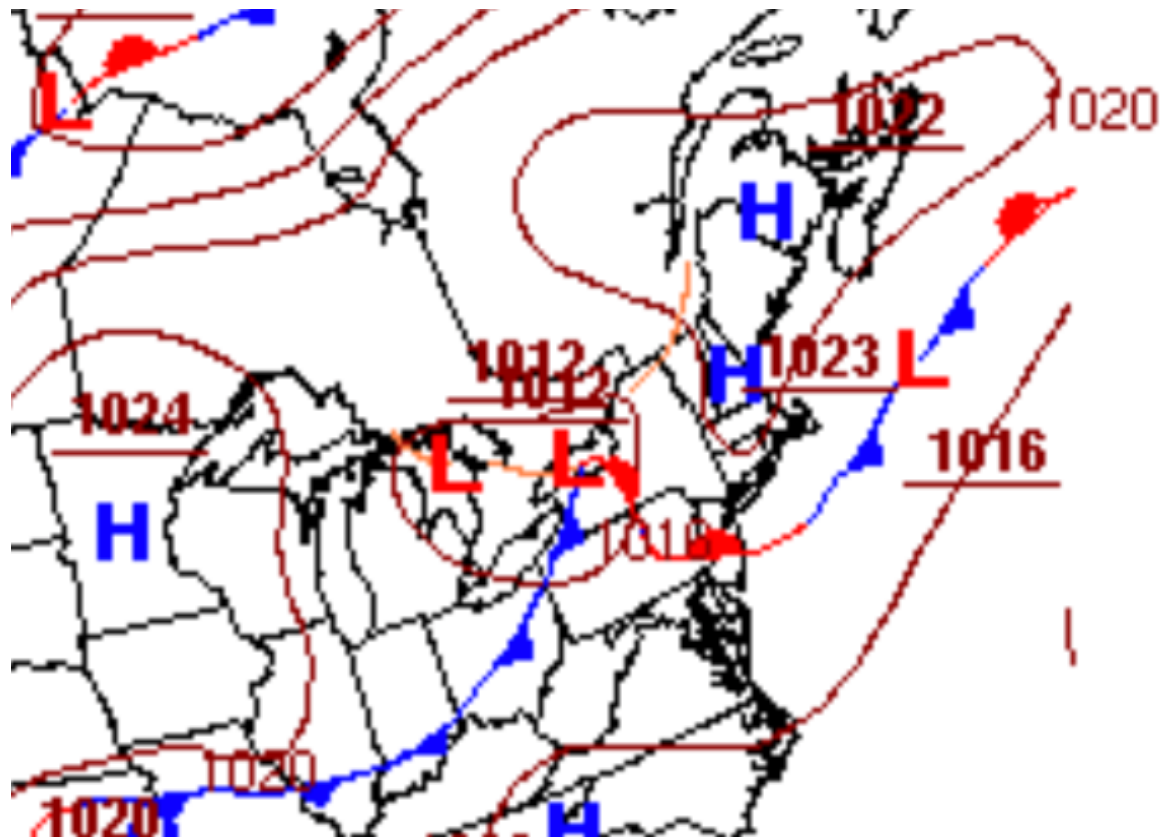
50yr

100yr

200yr

500yr

14 July 2017



Extreme Precipitation in New York & New England

An Interactive Web Tool for Extreme Precipitation Analysis

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Daily Monitoring

Documentation

View: **Map** Table Calendar

Date: 2017-07-15

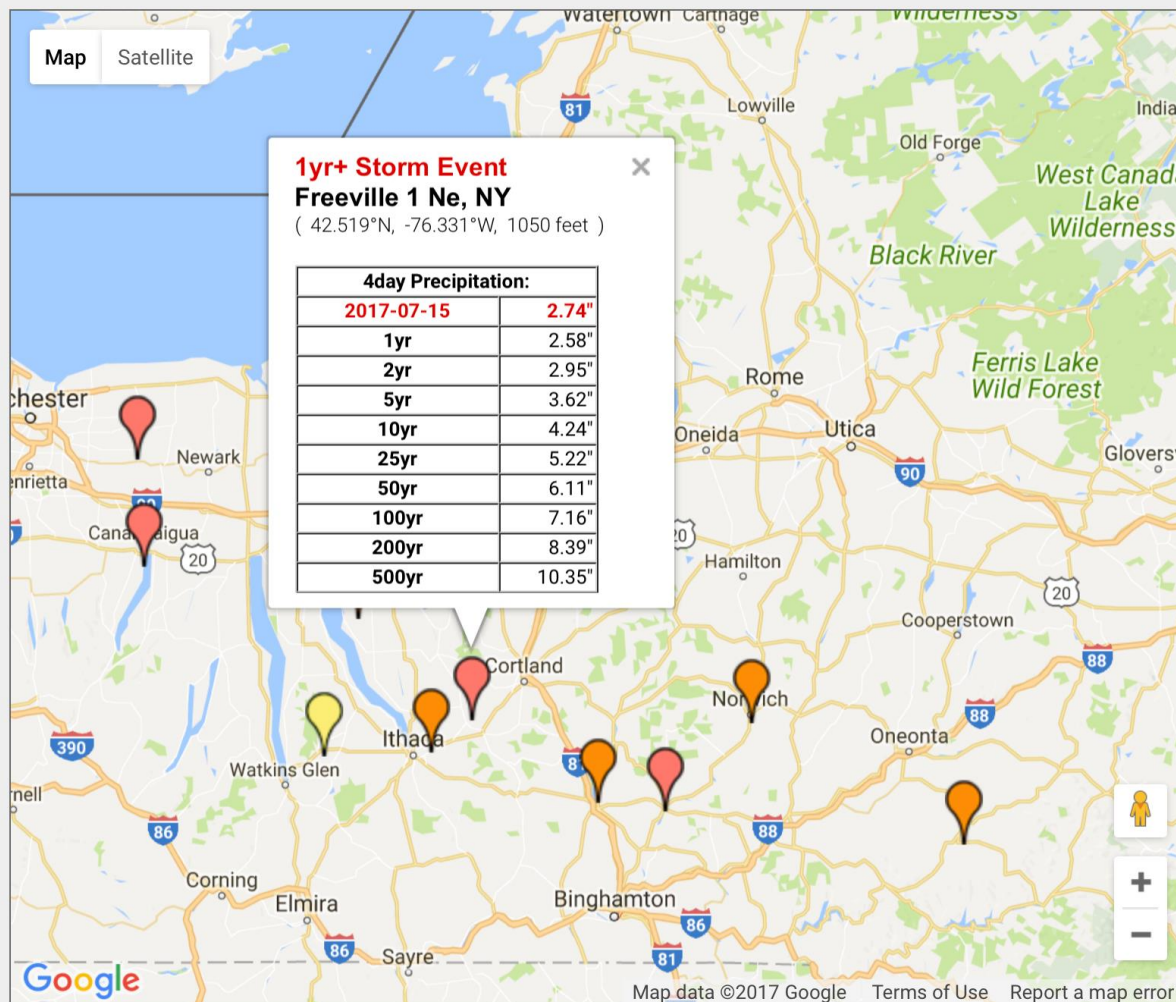
Duration: 4day

CONTINUE >>

50yr: Attica 7 Sw, NY
5yr: Mecklenburg 4sw, NY
2yr: Aurora Rsch Farm, NY
2yr: Batavia, NY
2yr: Delhi 2 Se, NY
2yr: Ithaca Cornell Univ, NY
2yr: Norwich, NY
2yr: Skaneateles, NY
2yr: Whitney Point Dam, NY
1yr: Buffalo Niagara Intl, NY
1yr: Camden, NY
1yr: Canandaigua 3 S, NY
1yr: Freeville 1 Ne, NY
1yr: Greene, NY
1yr: Hampton, CT
1yr: Macedon, NY
1yr: Pavilion, NY
1yr: Portageville, NY
1yr: Whitesville, NY

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Climate Center

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1yr

2yr

5yr

10yr

25yr

50yr

100yr

200yr

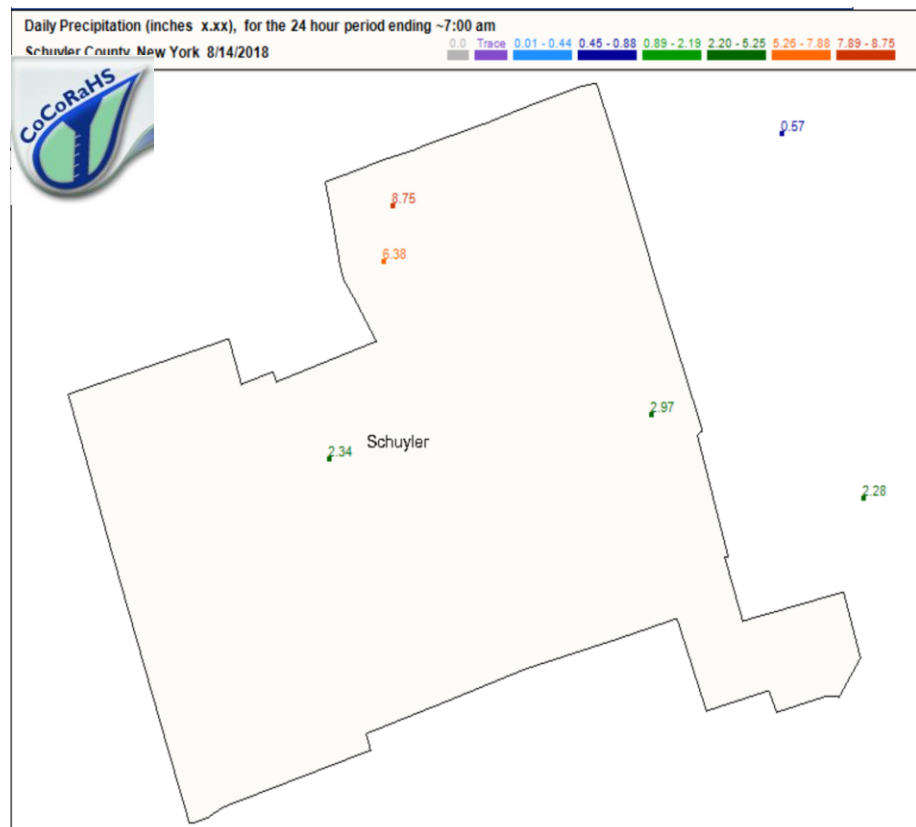
500yr

14 July 2017



Photos of the flooding in the village submitted by Bruce Drowne.

14 August 2018





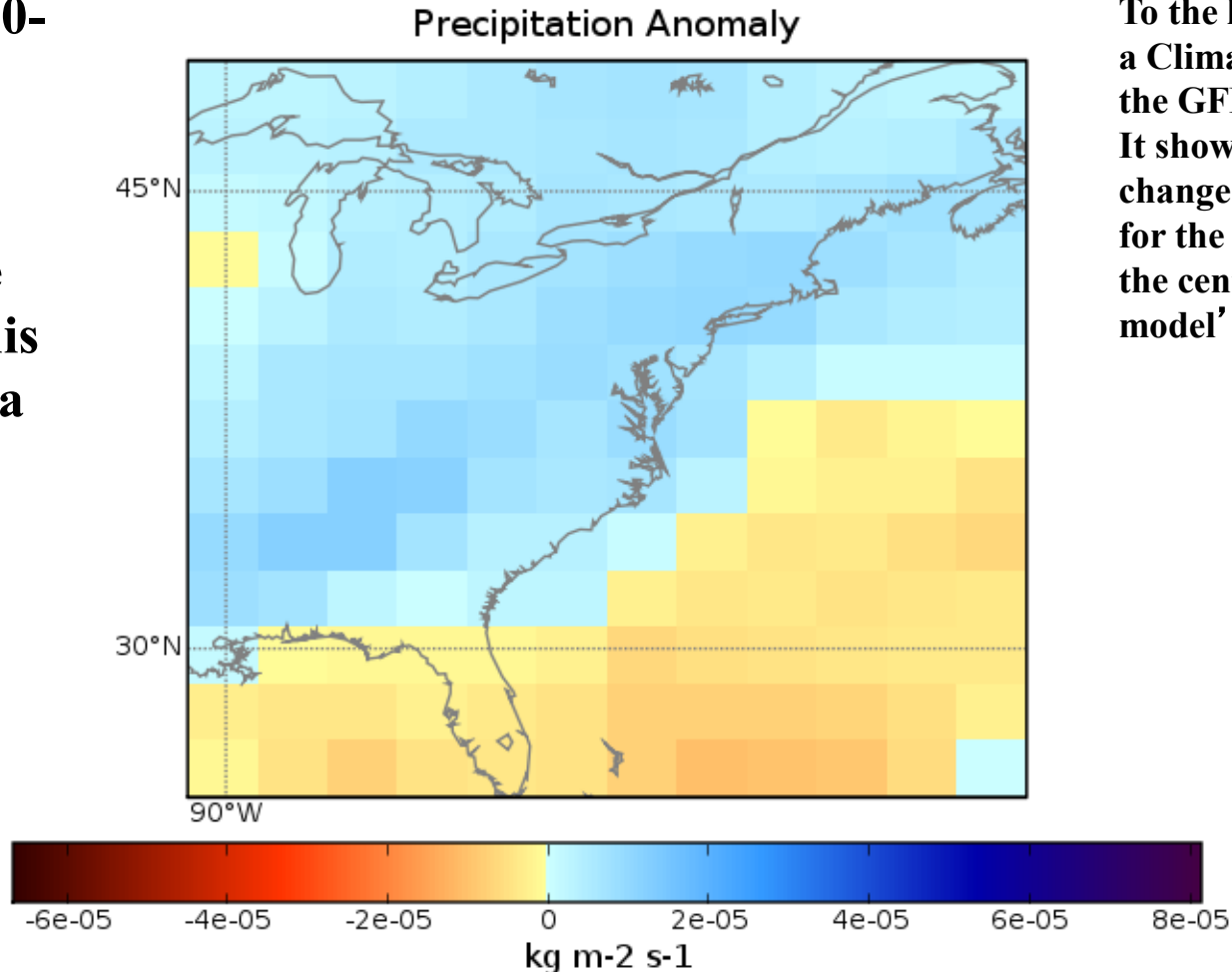
14 August 2018 Lodi, NY

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

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!

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.



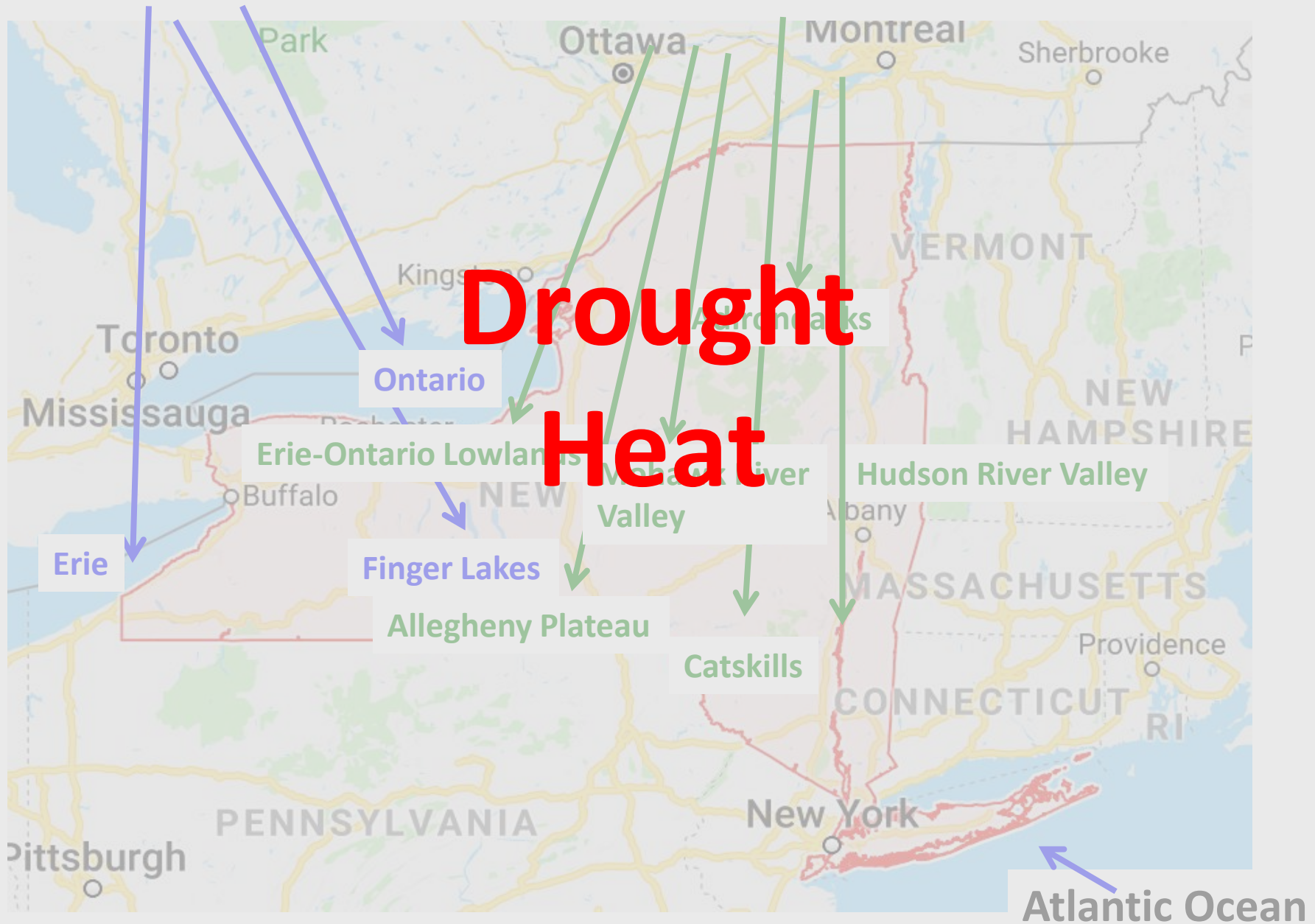
Precipitation Flux Anomaly, December 2070-2099 mean.
Projected by the Geophysical Fluid Dynamics Laboratory, USA;
Scenario: A2 (SRES 2000); Model GFDL-CM2.1 (IPCC 2007).
Figure obtained from www.ipcc-data.org. 20 February, 2011.

Complexities of New York State

Lakes

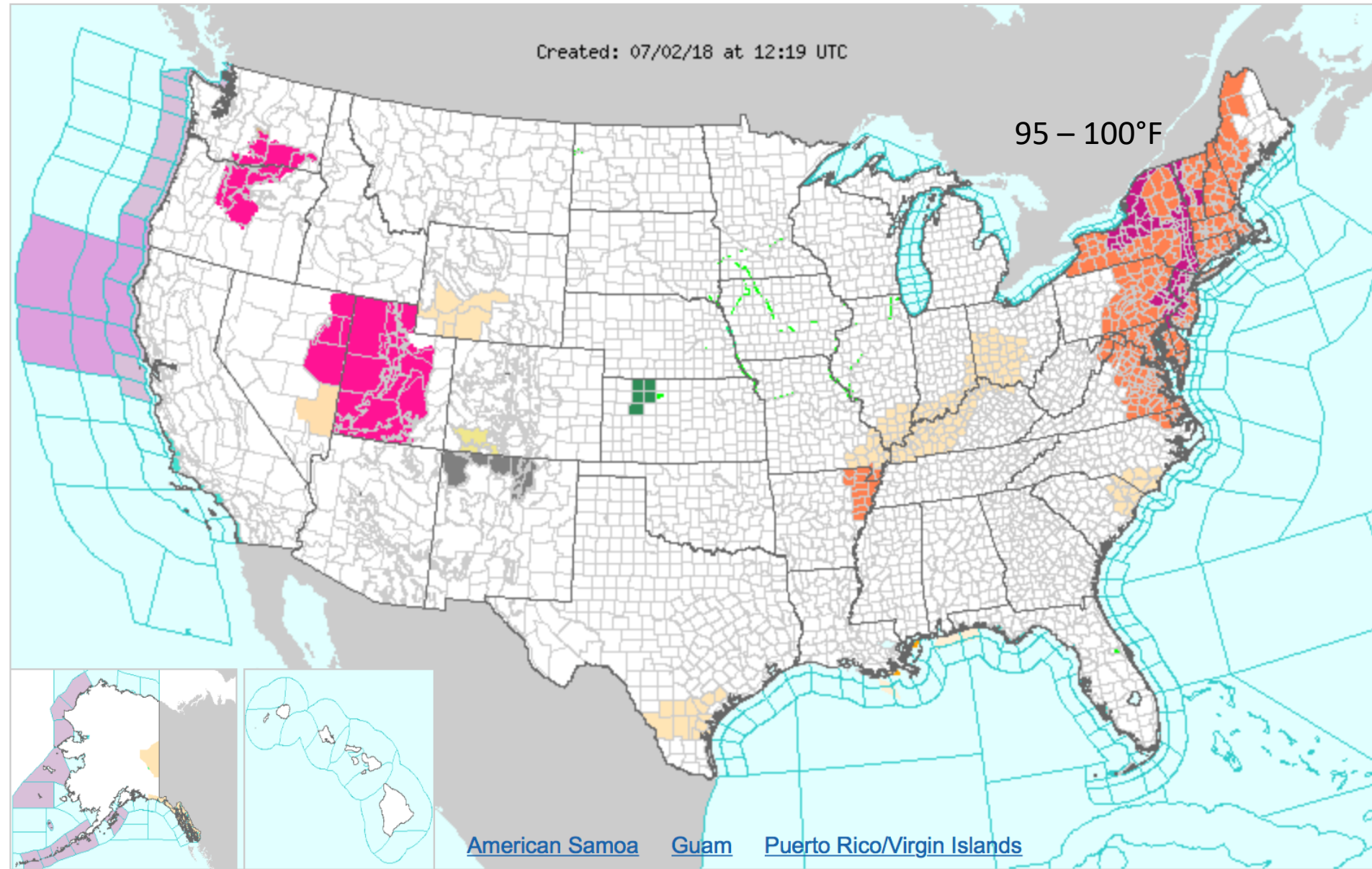
Topography

Drought
Heat

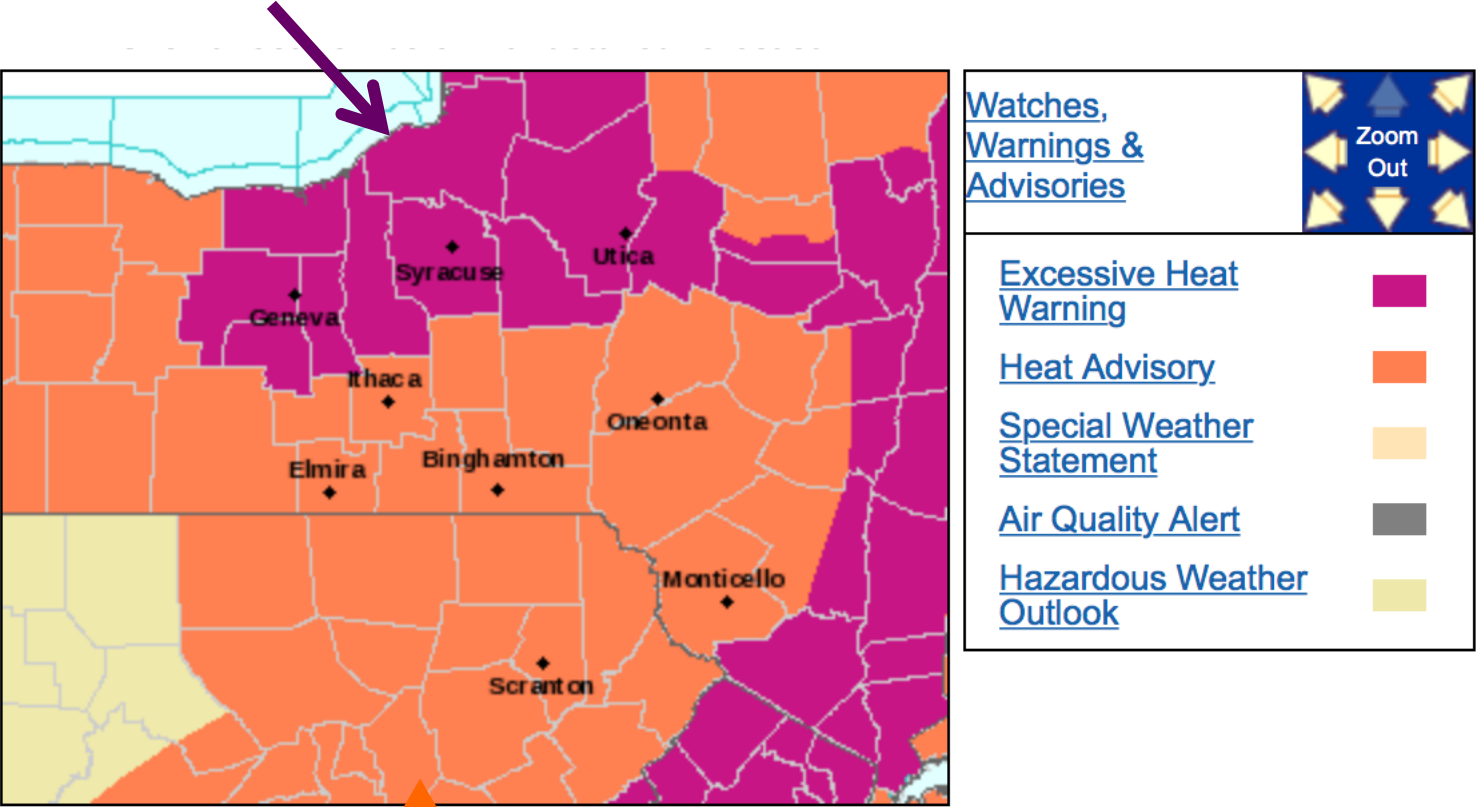


Created: 07/02/18 at 12:19 UTC

95 – 100°F



...EXCESSIVE HEAT WARNING REMAINS IN EFFECT UNTIL 10 PM EDT THIS EVENING...



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

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

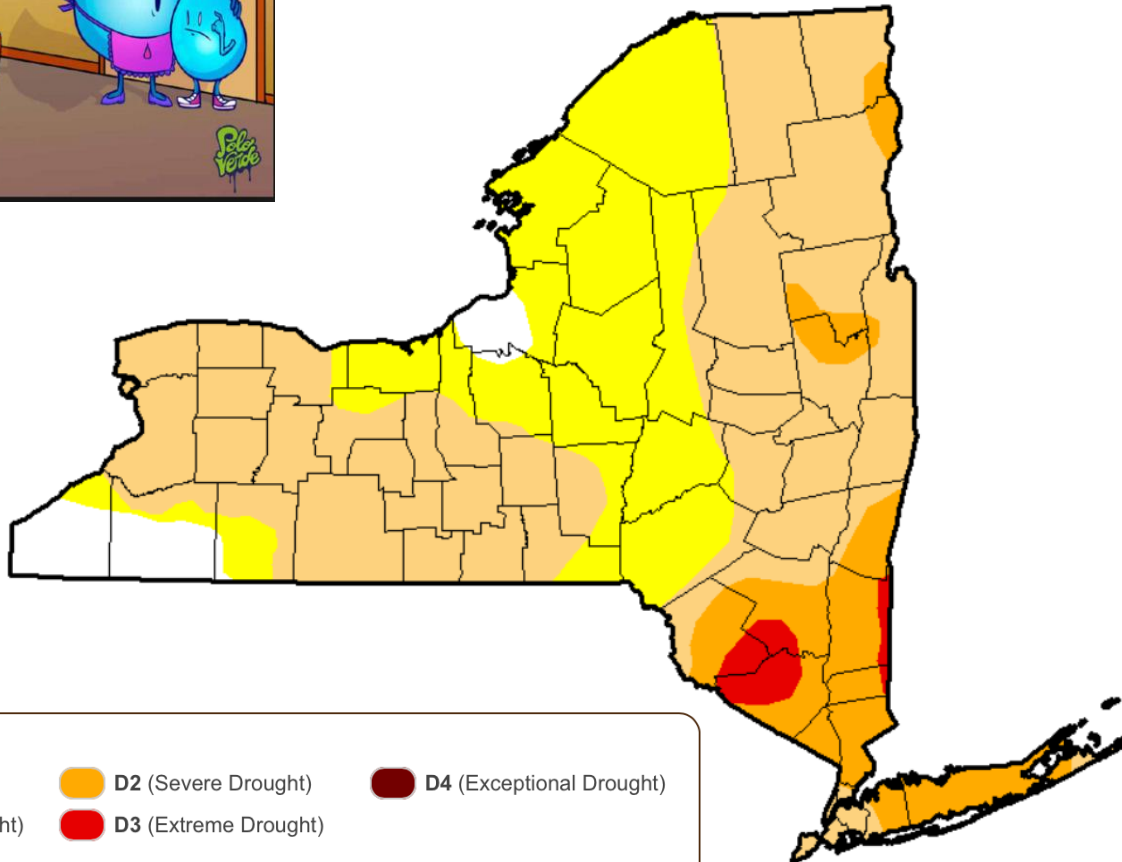
U.S. Drought Monitor

New York

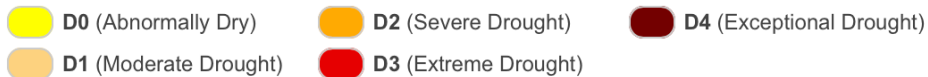
December 6, 2016

(Released Thursday December 8, 2016)

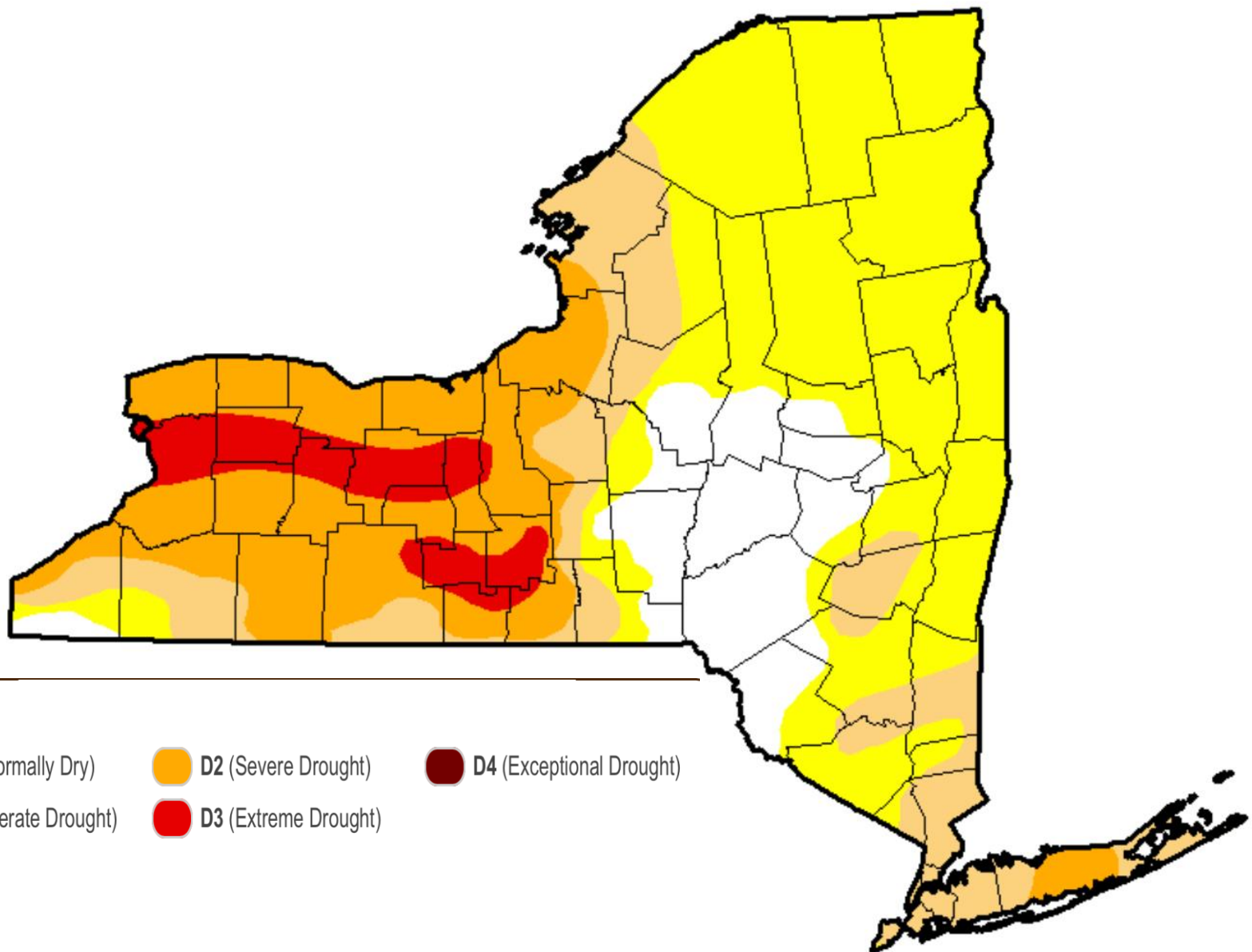
Valid 7 a.m. EST



Intensity:



25 Aug 2016



U.S. Drought Monitor

New York

September 27, 2016

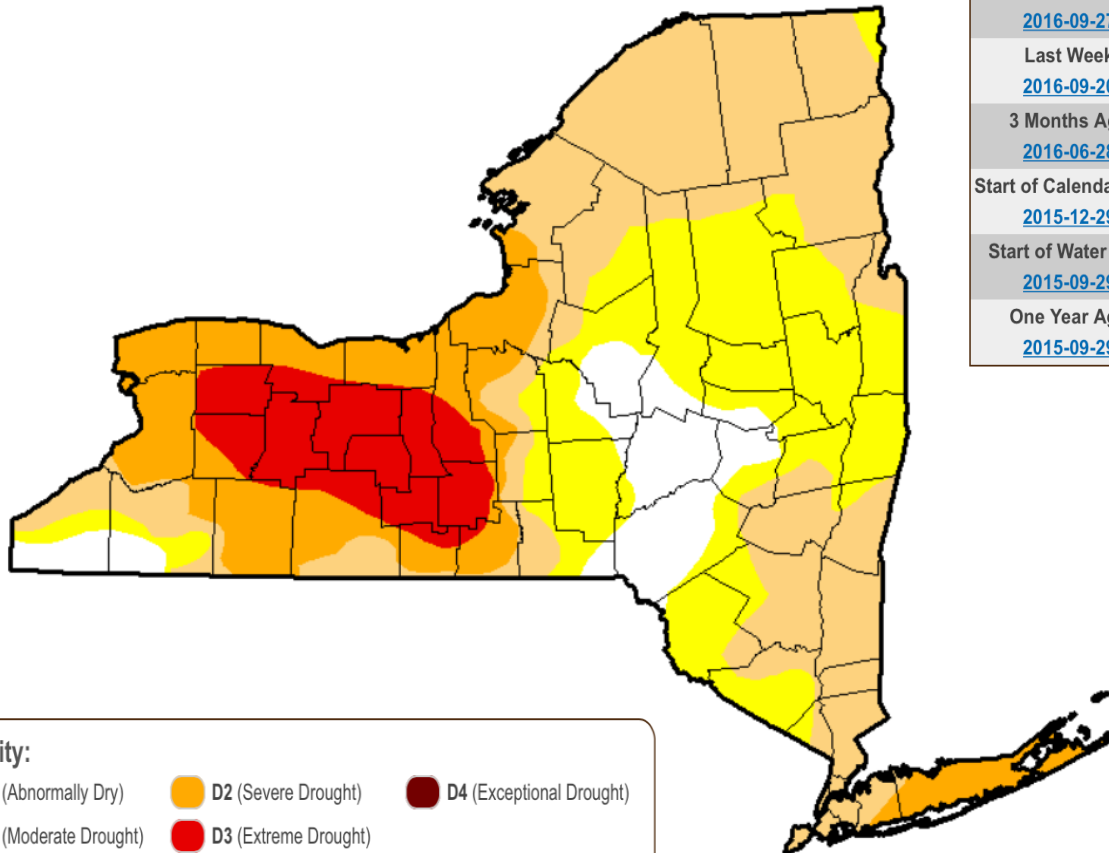
(Released Thursday September 29, 2016)

Valid 8 a.m. EDT

Login

Statistics type: Traditional Percent Area

Export table: [PNG](#) [CSV](#) [XLS](#)



Intensity:



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

Week	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current 2016-09-27	9.21	90.79	64.25	27.12	9.94	0.00
Last Week 2016-09-20	14.28	85.72	64.25	27.12	9.94	0.00
3 Months Ago 2016-06-28	8.15	91.85	16.14	0.00	0.00	0.00
Start of Calendar Year 2015-12-29	50.48	49.52	7.06	0.00	0.00	0.00
Start of Water Year 2015-09-29	37.33	62.67	5.18	0.00	0.00	0.00
One Year Ago 2015-09-29	37.33	62.67	5.18	0.00	0.00	0.00

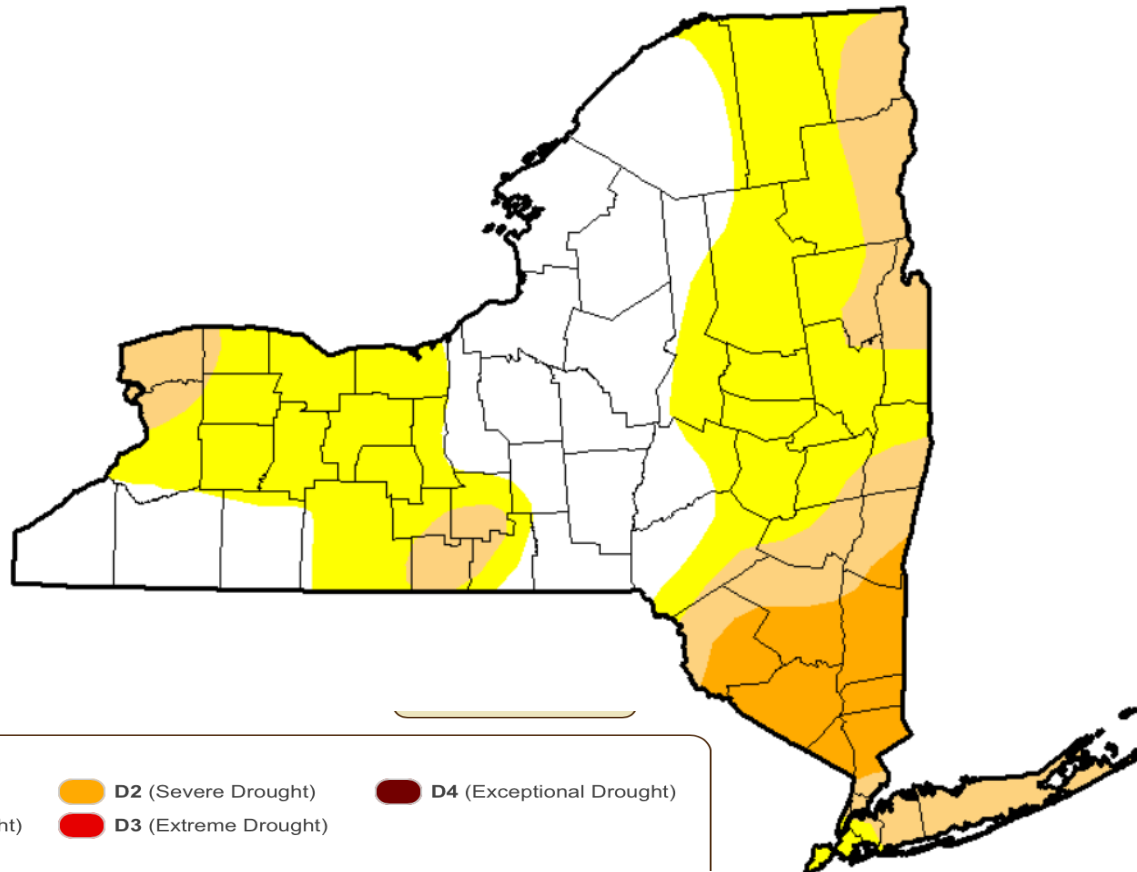
U.S. Drought Monitor

New York






February 7, 2017

(Released Thursday February 9, 2017)

Valid 7 a.m. EST

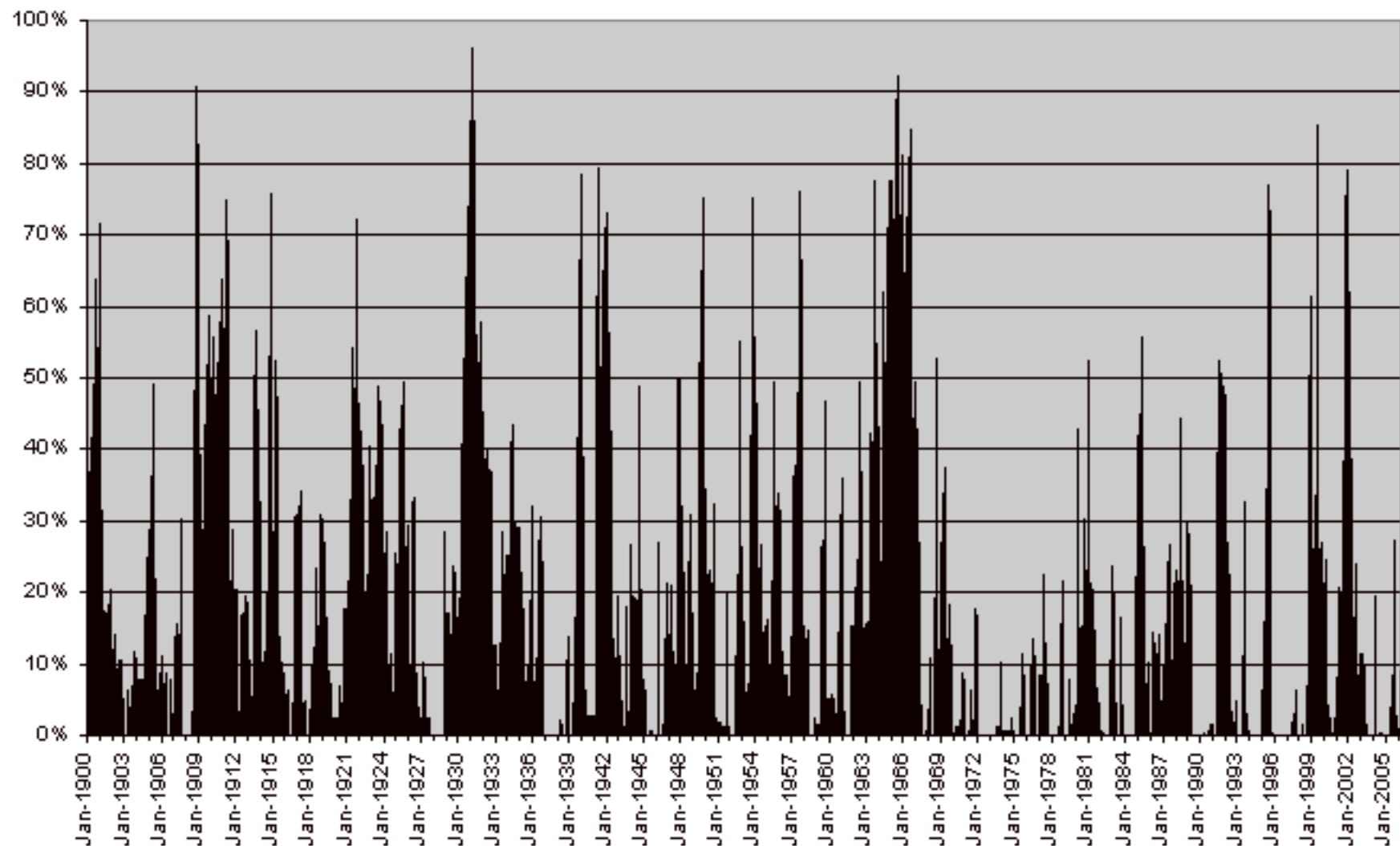


Intensity:

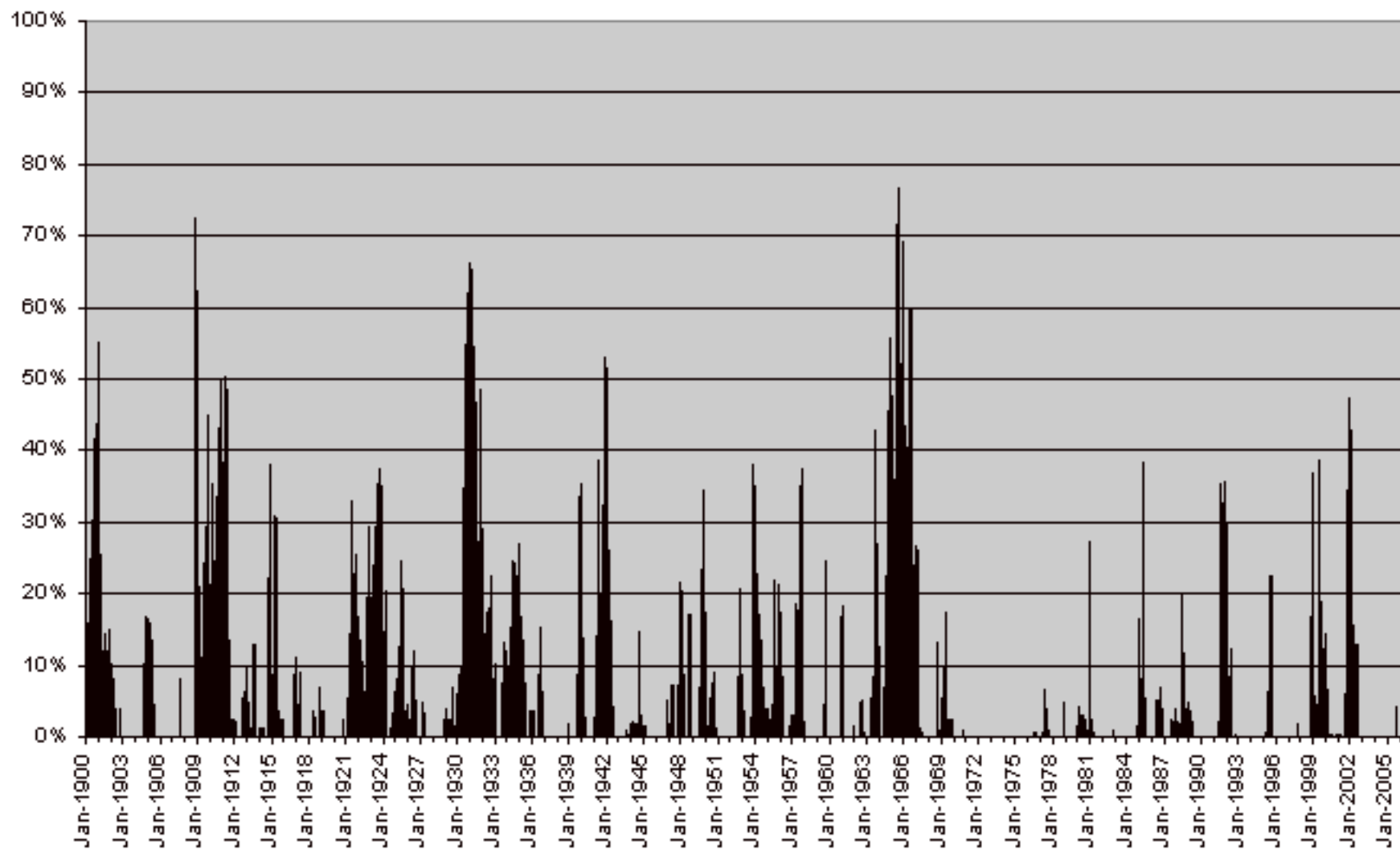
- | | | |
|--|---|---|
|  D0 (Abnormally Dry) |  D2 (Severe Drought) |  D4 (Exceptional Drought) |
|  D1 (Moderate Drought) |  D3 (Extreme Drought) | |

Northeast Drought Frequency (NRCC) Keith Eggleston

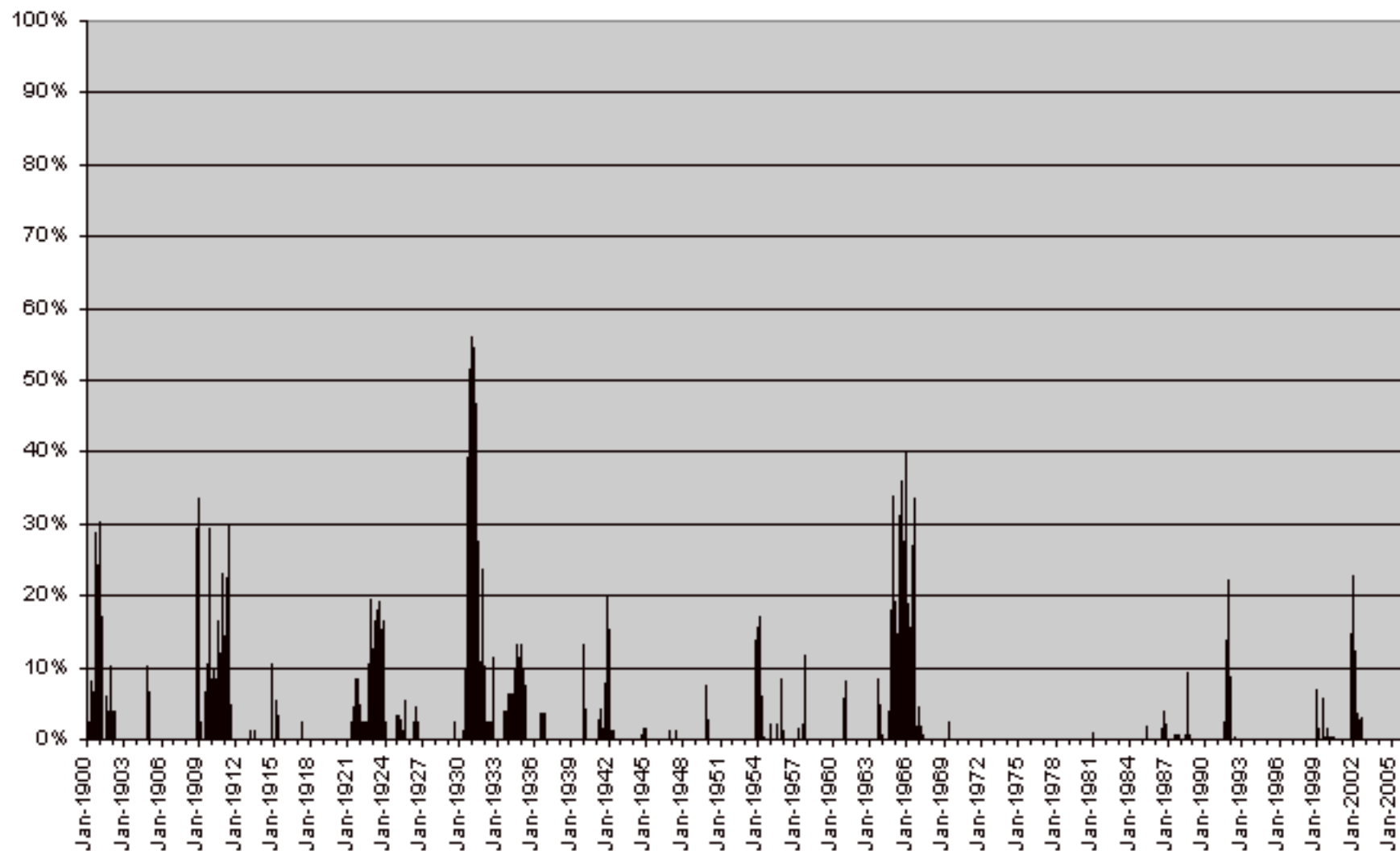
Percent of Northeast in Moderate, Severe or Extreme Drought



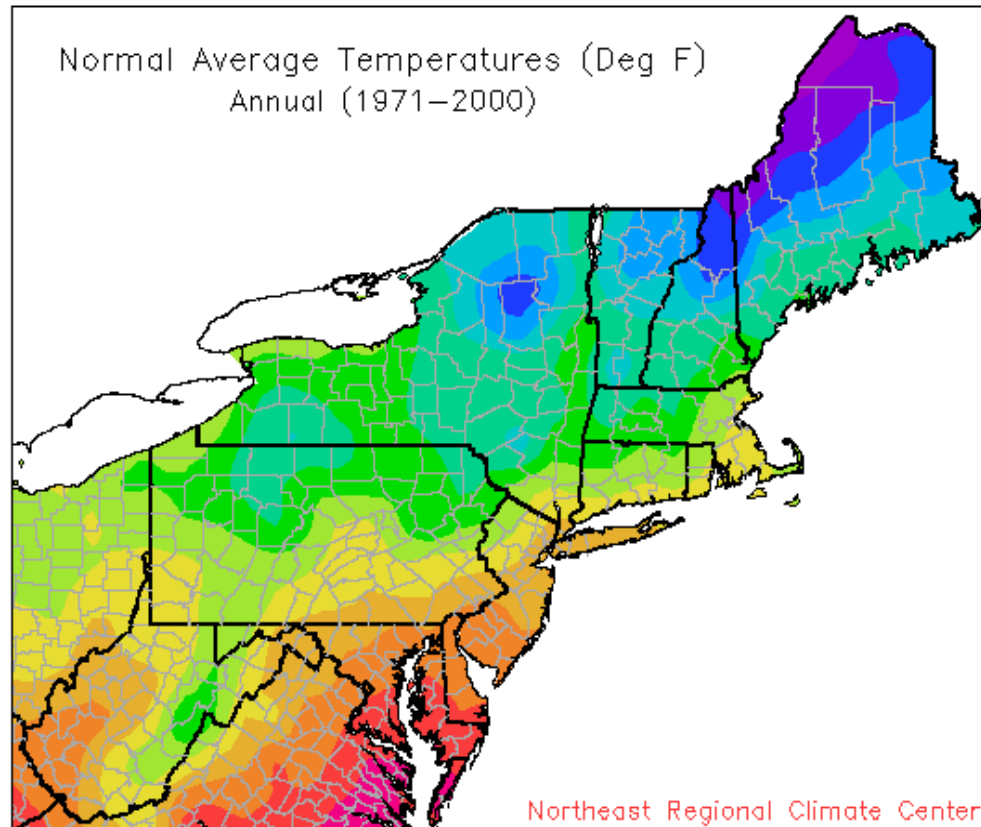
Percent of Northeast in Severe or Extreme Drought



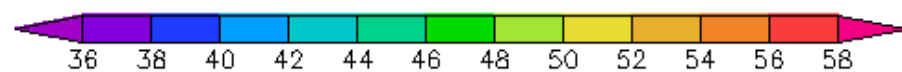
Percent of Northeast in Extreme Drought



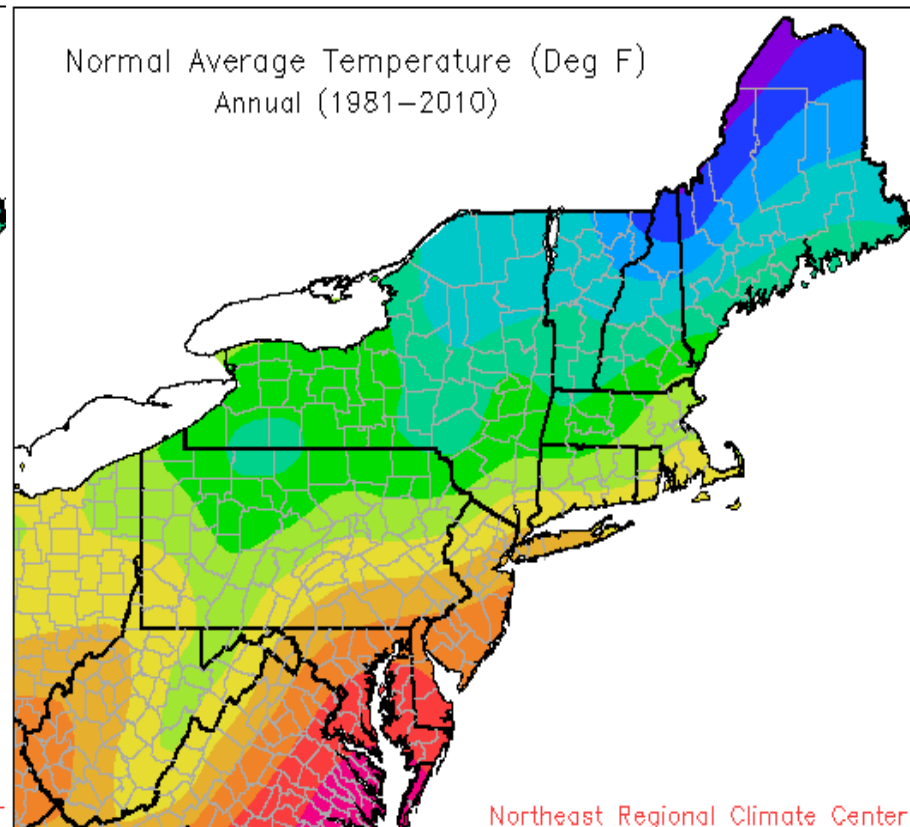
Normal Average Temperatures (Deg F)
Annual (1971–2000)



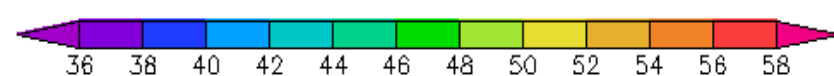
Northeast Regional Climate Center



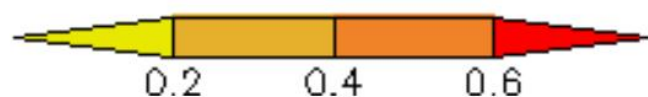
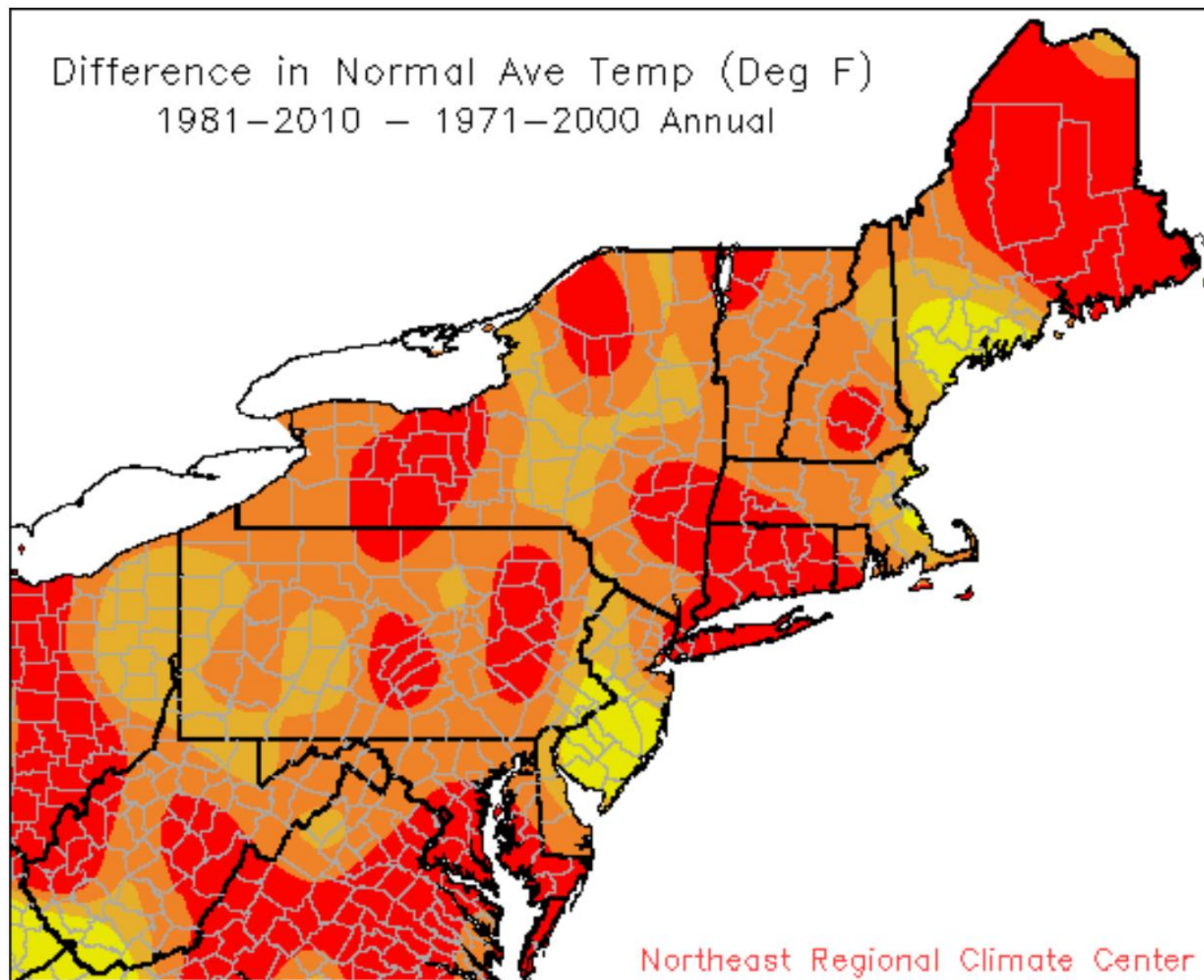
Normal Average Temperature (Deg F)
Annual (1981–2010)



Northeast Regional Climate Center



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



The Temperature Climatology is Changing

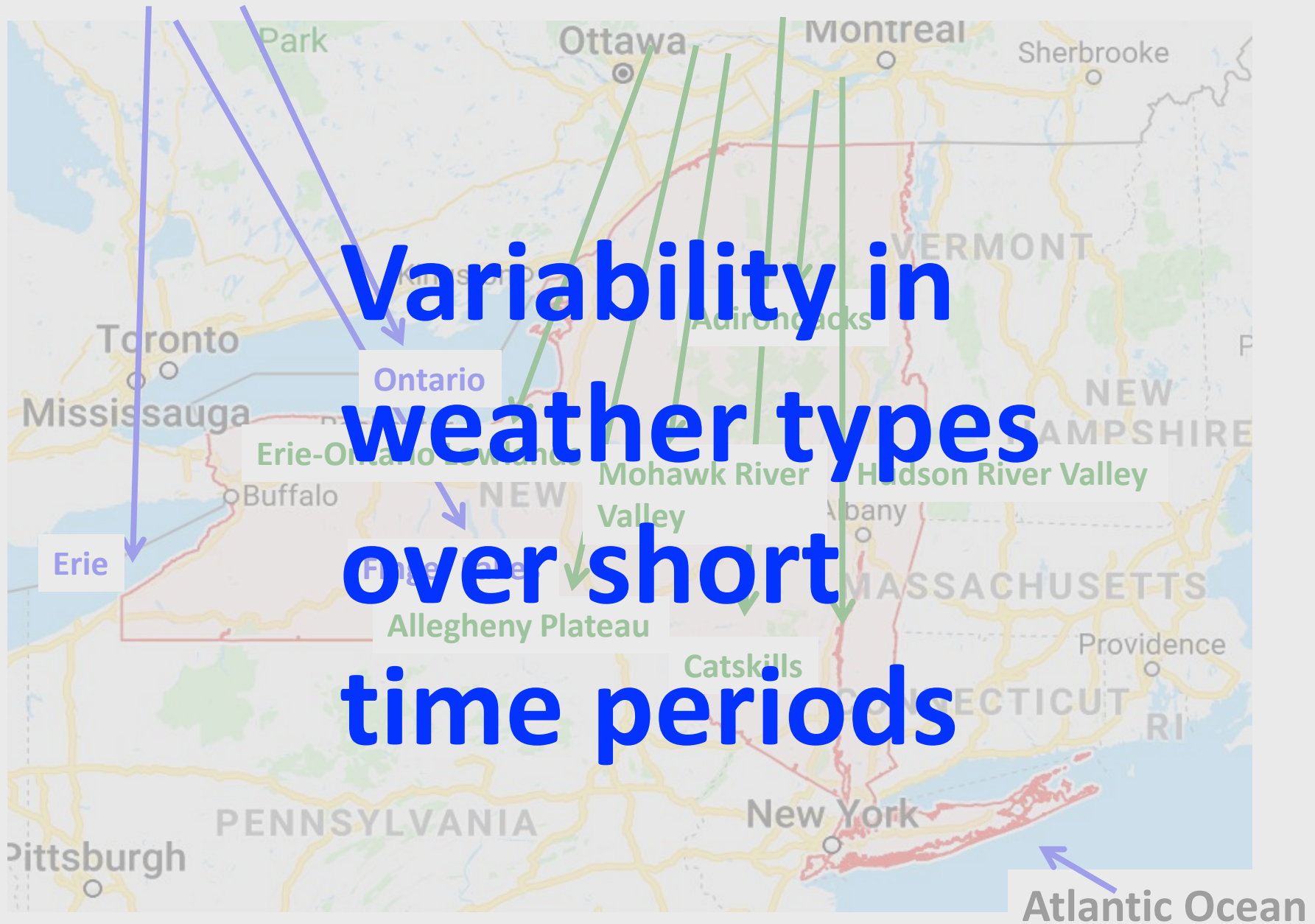
- Annual temperatures across New York have **warmed almost 2° F since 1970**
- **Winter** temperatures have **warmed by nearly 5° F since 1970**
- The date of the last **spring frost** has become **1 week earlier since 1950**
- There are about **2 more days >90° F since 1970**

Complexities of New York State

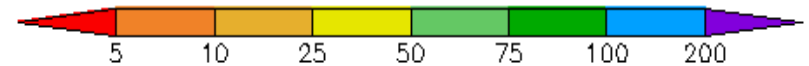
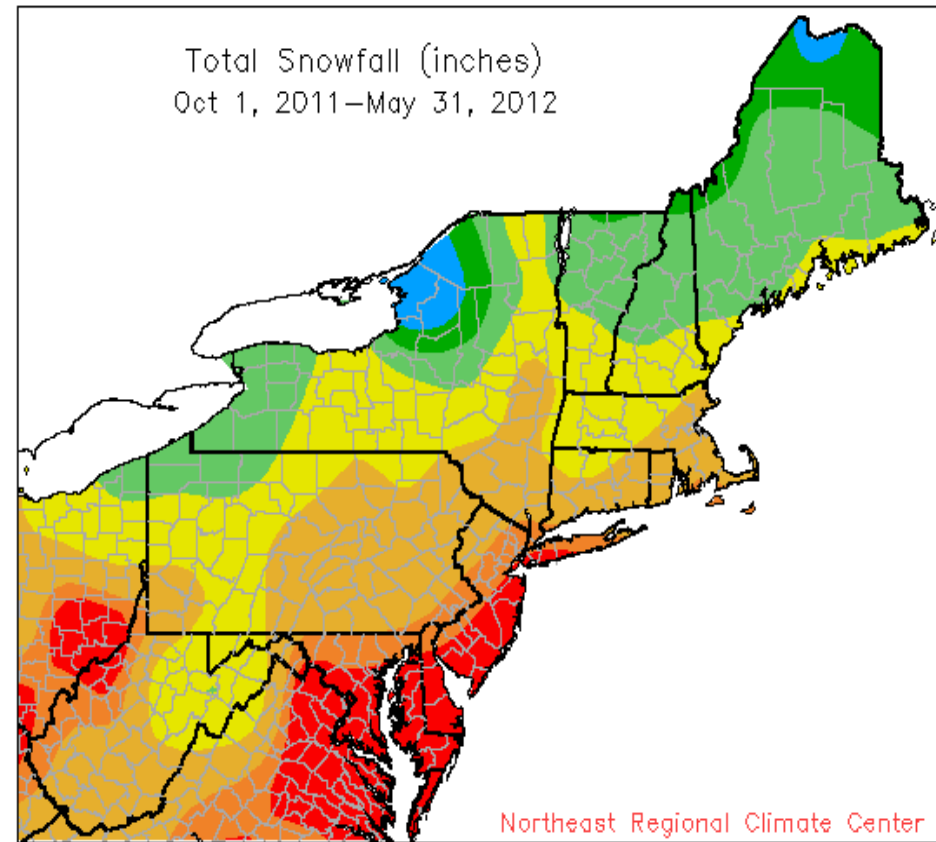
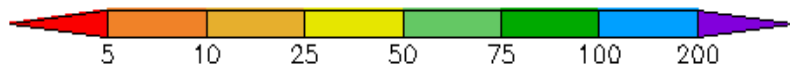
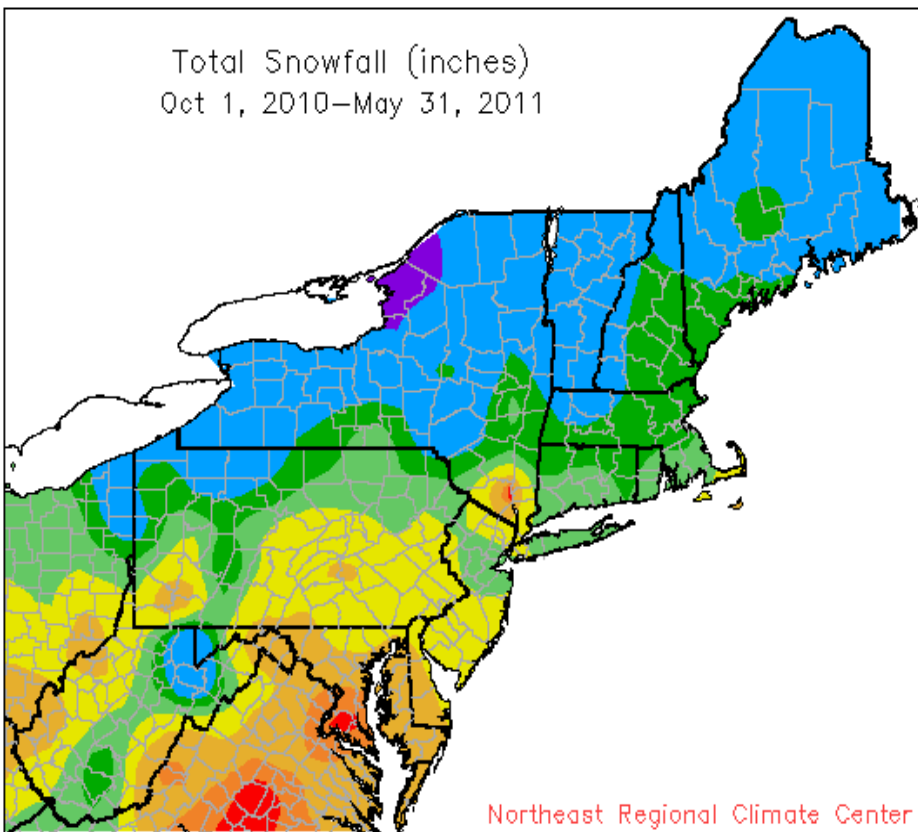
Lakes

Topography

**Variability in
weather types
over short
time periods**



Change in one year!!!!



ITHACA CORNELL UNIV, NY - February 2019

Change in 4 days!!!!

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

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

1959 – 2018 record length
Aurora Research Farm

Warmest

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

Top Ten

Rank	Year	Total Precipitation	Missing Count
1	1972	51.75	0
2	1996	45.05	0
3	1990	44.93	0
4	1975	41.80	0
5	1974	41.78	0
6	1979	40.94	0
7	1976	40.90	0
8	1984	40.48	0
9	2018	39.62	0
10	1986	39.22	0

Wettest

1/10 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

1959 – 2018 record length
Aurora Research Farm

Coldest

1/10 in the 2000's

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