Genesee/Finger Lakes Severe 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
Seasonal Conditions
Winter

- Generally cloudy, cold and snowy
  - May include frequent thaws and rains
  - Snow mainly covers the ground from Christmas through early March however periods of bare ground are not uncommon
  - Lake Ontario modifies extreme cold temperatures
    - On average about ten nights below zero

Average Annual Seasonal Snowfall
Spring

- Spring comes slowly to the region
- Last frost usually late April/early May
- Spring months are the driest statistically
  - Due in part to the stabilizing effects of Lake Ontario
- Sunshine increases markedly in May
Summer

- Summers are warm and sunny across the region
  - Average temperature in the 70 to 75 degree range
  - There usually are several periods of uncomfortably warm and muggy weather
    - About five 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
- Completely overcast days are rare
Autumn

- Pleasant, mild and dry through October
- Colder air masses across Lake Ontario brings a dramatic increase in cloud cover and first lake effect snows by mid-November
- Early snows generally melt off quickly
Summer Convective Weather

- **Thunderstorm Winds** – damage producing or ≥ 50 knots
  - About 10 events per year
  - Estimated $600,000 damage each year

- **Hail**
  - About 5 events per year
  - Largest Hail reported (since 1950) – 2.00”
    - Most recently May 2013
      Seneca Castle, Ontario Co

- **Lightning**
  - Last 25 years:
    - 2 deaths (Batavia, Genesee Co. 8/10/2016)
    - 12 Injuries (Monroe, Livingston, Ontario, Wyoming Cos.)
    - There have been several lightning-sparked fires
Summer Convective Weather

- Derechos
  - Long lived high wind event
  - Occurs about once every 10 to 15 years

- Tornados – 25 since 1950
  - Once every 3 years
  - 2 Deaths
    - Batavia, Genesee Co 9/3/1993
  - Strongest EF2
    - Wayne and Wyoming Counties
Winter Weather

- Winter Weather
  - Snow Storms – five to ten per year (areal and lake effect)

- Blizzards
  - About once every 10-15 years
    - Most recent – March 2014

- Ice Storms
  - About once every 5 to 10 years
    - Most recent – December 2013

Photos credit: Rochester D&C
Flooding

- Floods/Flash Floods
  - About five events per year
  - Floods can occur any time of year
    - Winter/Spring – ice jams, snowmelt and/or heavy rain with large storm systems
    - Spring/Summer - slow moving thunderstorms
    - Summer/Fall - Tropical Storms
Climate Change
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.
Climate Change: The Fundamentals

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

- **Climate Variability** describes fluctuations in the Climate itself over time. These changes are usually natural and brief.

- **Climate Change** describes long-term (decades or longer) and persistent changes in Earth's Climate.
Global Climate Change: The Observations

- Carbon dioxide in the atmosphere is increasing
- There has been a significant increase in globally-averaged surface temperatures over the last century.
- Global sea level has risen 4–8 inches over the past century.
- Arctic sea ice has decreased
- Climatologists have observed 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

Projection of CO₂ and Temperature to 2100

- Global CO₂
- Global Temperature
- Business As Usual
Lake Effects Have Significant Impact on the Regional Climate System

WINTER TEMPERATURES AND ICE CONDITIONS

Mean daily air temperature for January in °C

Mean annual frost free period in days

FROST FREE PERIOD AND AIR MASSES

Air mass frequency

Summer Temperatures

Mean daily air temperature for July in °C

Precipitation and Snowbelt Areas

Mean annual precipitation in mm

Major snowbelts with range of mean annual snowfall in cm

Selected isotherms only are shown for each lake.
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

© UCAR/NCI
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 Great Lakes Weather: Temperature

The following changes are likely over the next century:

- Average temperature will continue to increase
  - Projected increases of
    - 1.5 to 3°F in the 2020s, and
    - 3 to 5.5 °F in 2050s

- Number of days with:
  - Low temperatures below 0°F will drop by 50% or more
  - High temperatures above 90°F will more than double
Projected Changes in Great Lakes Weather: Precipitation

The following changes are likely over the next century:

- Projected small increase in annual precipitation
- Larger variability
  - More precipitation in winter
  - Less precipitation in late summer early fall
- Intense precipitation events (heavy downpours) are likely to increase
  - Some projections say 50-100% more frequent
The Impact of the Great Lakes on Regional Climate and Climate Change

In summer, lake breeze circulation keeps shoreline areas cooler (as compared to surrounding inland areas).

Lake-effect precipitation may become increasingly common in late fall and winter (as cool wintertime air flows over warm lake waters).
Affects of Climate Change

- Lake Levels
- Ice Cover
- Severe Weather
- Human Health and Economy
Lake Levels

An overall downward trend in lake levels is expected
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
Human Health Concerns

- Heat Waves
- Water and Air Quality
- Agriculture
Weather Fatalities 2016

- More frequent
- More Severe
- Longer Lasting

Building a Weather-Ready Nation
Air Quality

- Air Temperature
- Air Stagnancy
- Emissions
Water Quality
Agriculture

Changes in the length of the growing season in the eastern and western U.S. (1900-2002)

Deviation from average (days)

Year

Data source: Kunkel, 2009

EPA / http://www.epa.gov/climatechange/indicators
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:
    - Winter – warmer and fewer cold days and nights
    - Summer – hotter and more frequent hot days/night and heat waves
  - Precipitation:
    - Precipitation totals will show a small increase
    - Regions that already experience long-duration droughts will likely see the area affected increase.
  - More intense hurricanes

- Projected Changes to the Great Lakes Weather
  - 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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