

Eastern Lake Erie Severe Weather and Climate Change Impacts

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Building a Weather-Ready Nation

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

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Winter

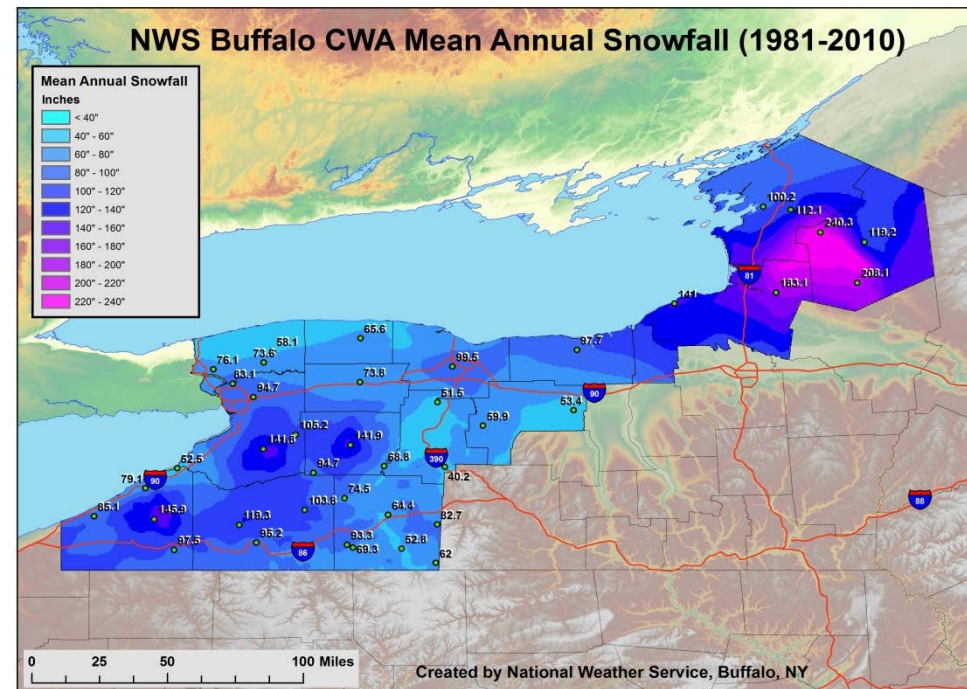
- ▶ Generally cloudy, cold and snowy
 - ▶ May include frequent thaws and rains
 - ▶ Snow mainly covers the ground more often than not from Christmas through early March however periods of bare ground are not uncommon
 - ▶ Lake Erie modifies extreme cold temperatures
 - ▶ On average about four nights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



Winter

- ▶ Snowfall averages vary by location
 - ▶ Over half of the annual snowfall comes from “lake effect” processes
 - ▶ Areas south of Buffalo derive much more snow than the densely populated northern suburbs
 - ▶ Lake effect snow can start as early as October, usually peaks in December and can almost shut down when Lake Erie freezes

Average Annual
Seasonal Snowfall

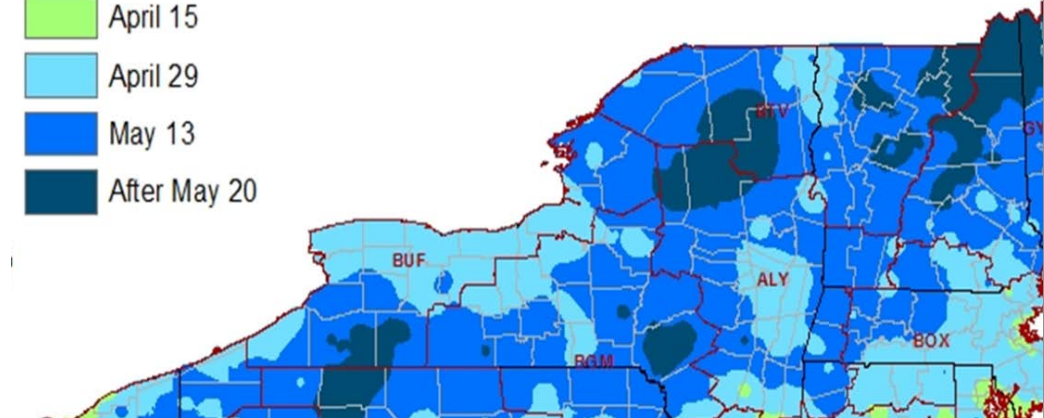


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Spring

- ▶ Spring comes slowly to the Niagara Frontier
 - ▶ With ice on Lake Erie usually through the start of April the Lake remains chilly through most of May
- ▶ 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

MEDIAN DATE OF THE LAST SPRING FREEZE
Based on 1981-2010 Climatology



Summer

- ▶ Summers are beautiful!
 - ▶ Sunshine is plentiful, temperatures are warm but seldom hot
 - ▶ Average temperature in the 70 to 75 degree range
 - ▶ There usually are several periods of uncomfortably warm and muggy weather
 - ▶ Only about three days per year 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
 - ▶ As the lakes warm, nighttime thunderstorms are often a feature of late summer
- ▶ Completely overcast days are very rare



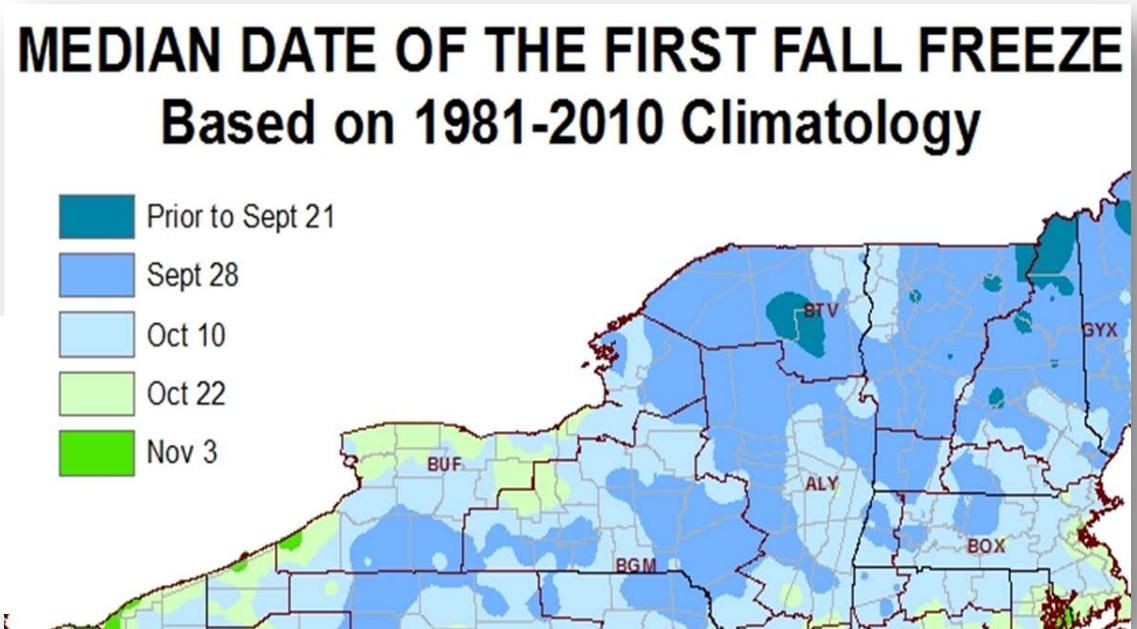
Autumn

- ▶ Pleasant but rather brief
- ▶ September and much of October usually tame
- ▶ Colder air masses surging from Canada become more common starting in late October
 - ▶ The passage over the warmer lake water results in a dramatic increase in cloud cover in late October and early November
- ▶ The first measurable snows can be expected in mid November
 - ▶ Early snows generally melt off quickly



Autumn

- ▶ The first frosts can be expected in Lake September over interior sections, but not until mid-October in the metro area
 - ▶ The warm lake can extend the growing season into early November during some years close to the lakeshore
- ▶ The growing season is relatively long for the latitude
 - ▶ about 180 days



Severe Weather

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Summer Convective Weather

- ▶ Thunderstorm Winds – damage producing or ≥ 50 knots
 - ▶ About 10 events per year
 - ▶ Estimated \$150,000-200,000 damage each year
- ▶ Hail
 - ▶ 3 to 4 events per year
 - ▶ Largest Hail reported (since 1950) – 1.75”
 - ▶ Snyder during the widespread June 2008 event
- ▶ Lightning
 - ▶ Last 20 years:
 - ▶ Seven injuries
 - Most recent Buffalo 2011
 - ▶ There have been several lightning-sparked fires



Summer Convective Weather

- ▶ Derechos
 - ▶ Long lived high wind event
 - ▶ Occurs about once every 10 to 20 years
- ▶ Tornadoes – Eighteen since 1950
 - ▶ Once every 5 years
 - ▶ Most recent
 - ▶ 6/30/2006 Cheektowaga



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Winter Weather

▶ Winter Weather

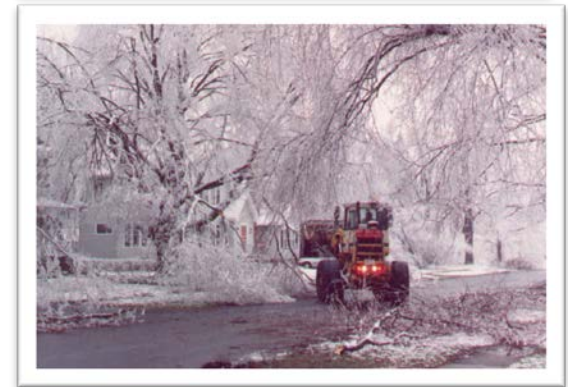
- ▶ Snow Storms – about five times per year

▶ Blizzards

- ▶ About once every 10 years
 - Most Recent January and March 2014

▶ Ice Storms

- ▶ About once every 5 to 10 years
 - Most recent December 2013



Photos credit: Rochester D&C



Flooding

- ▶ Floods/Flash Floods
 - ▶ One to two 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

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Global Warming vs. Climate Change

- ▶ The term **Global Warming** refers to the observation that the atmosphere near the Earth's surface is warming, without any implications for the cause or magnitude.
- ▶ **Climate change** is the departure from the expected average weather or climate normals for a given place and time of year.



- ▶ It is an individual's or community's vulnerability to the adverse effects of extremes that largely determines whether a particular event is a disaster or something beneficial
- ▶ Of course, extreme weather events can have some positive effects
 - ▶ The warm winter of 2011-2012 in the U.S. resulted in lower heating bills, and many communities also saved by not needing snow removal services.



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 / NCU



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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.



Public Domain



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Climate Changes Are Already Occurring

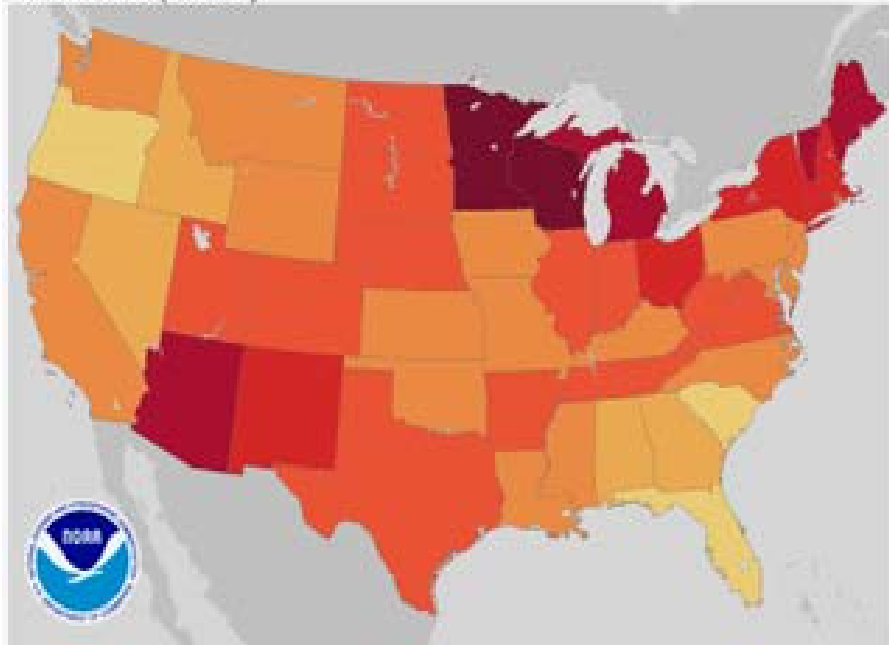
- ▶ **Hurricanes:** More intense hurricanes
- ▶ Observations indicate an increase in hurricane intensity in the Atlantic and West Pacific



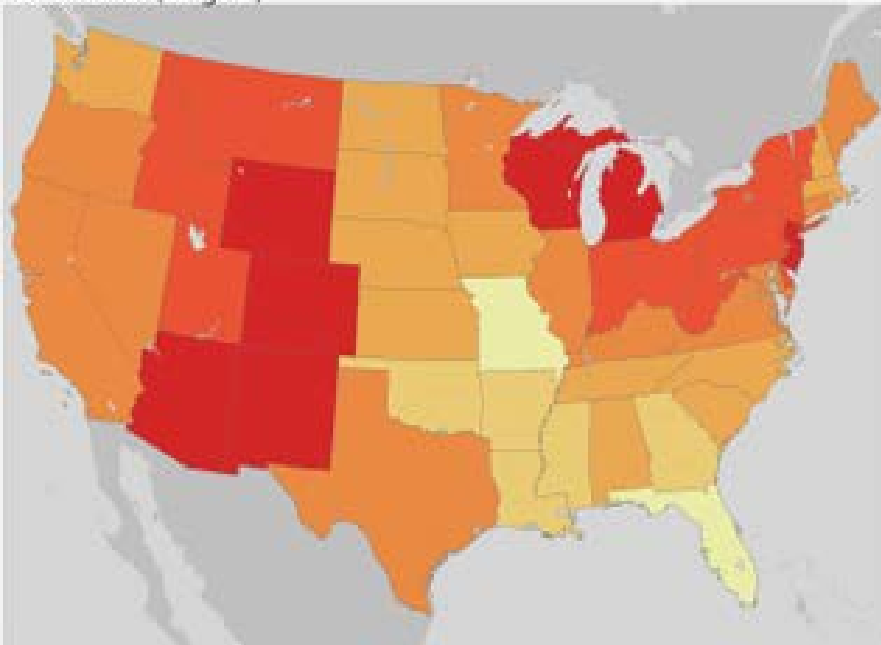
What about regional changes?

Statewide Changes in Annual "Normal" Temperatures (1981–2010 compared to 1971–2000)

Minimums ("Lows")



Maximums ("Highs")



Temperature change (°F)

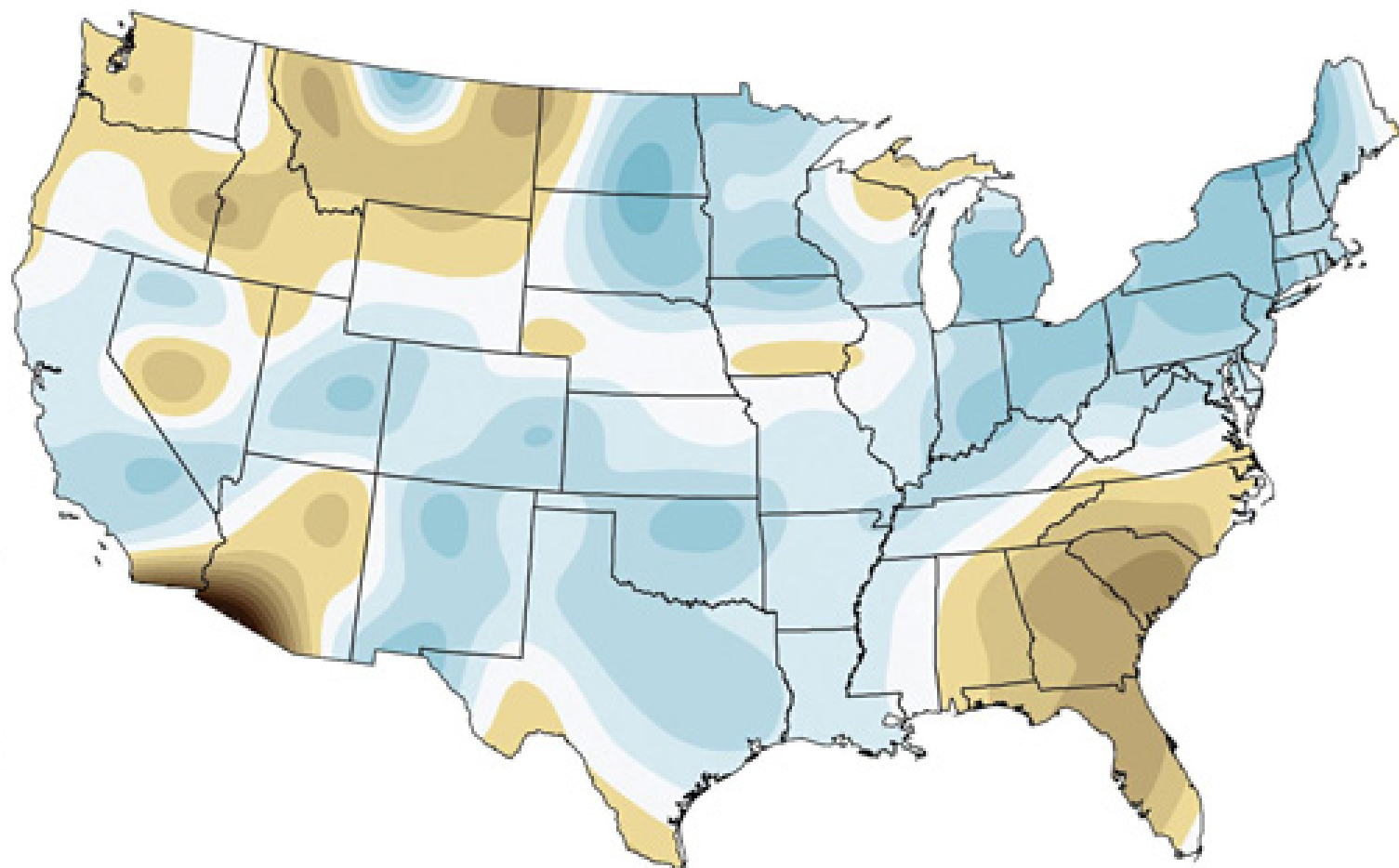


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Percent Change in Precipitation



Percent Change

NOAA/NCDC¹¹¹



<-40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 >40

While U.S. annual average precipitation has increased about 5 percent over the past 50 years, there have been important regional differences as shown above.

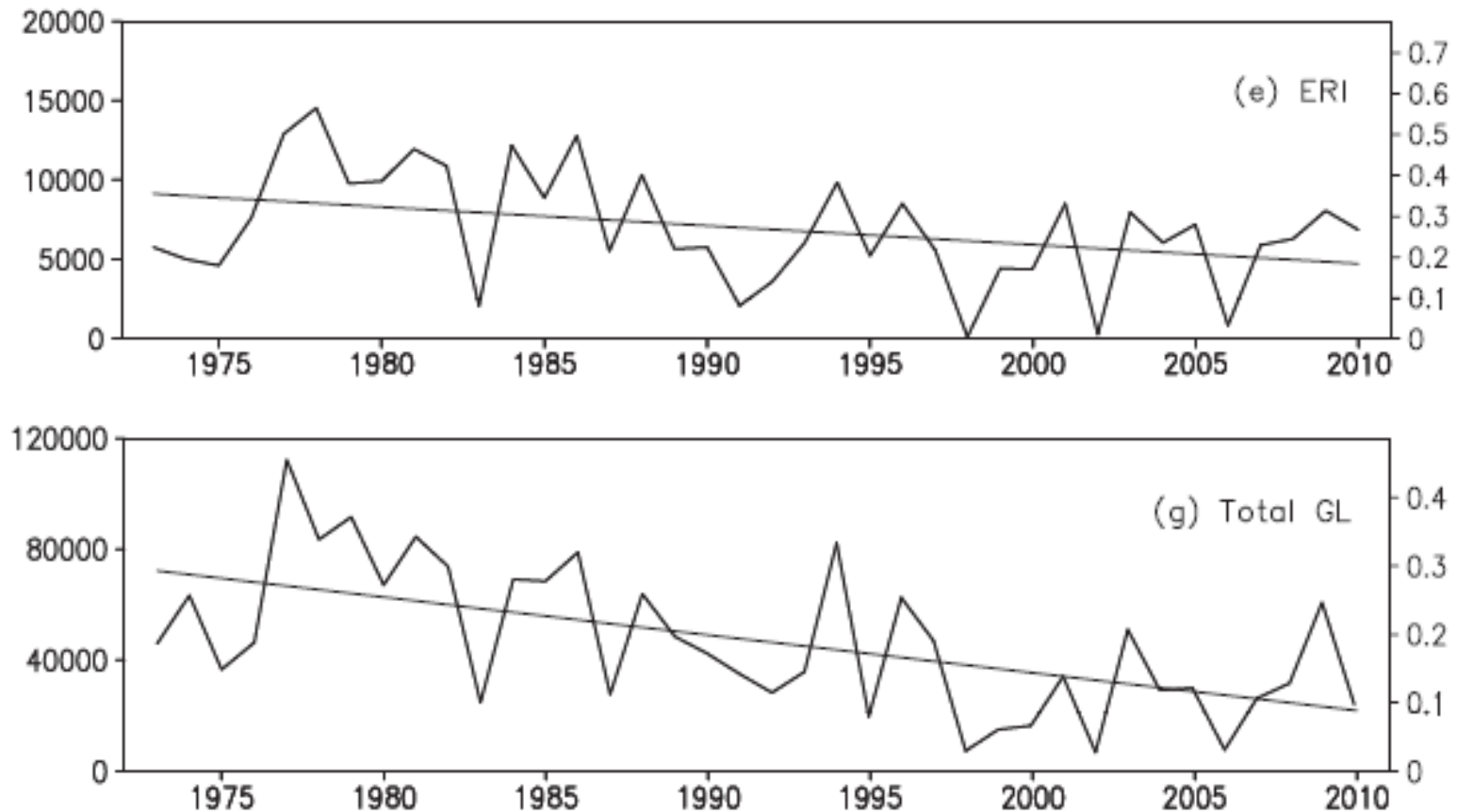
Changes in the length of the growing season in the eastern and western U.S. (1900-2002)



Data source: Kunkel, 2009⁶

Annual mean lake ice area (km²)

Lake Erie and total Great Lake ice – 1973-2010



Jia Wang, Xuezhi Bai, Haoguo Hu, Anne Clites, Marie Colton, and Brent Lofgren, 2012: Temporal and Spatial Variability of Great Lakes Ice Cover, 1973–2010*. *J. Climate*, **25**, 1318–1329.



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Projected Change in the Great Lakes – Temperature

- ▶ 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 Change in the Great Lakes – Temperature

► **Impacts**

- More heat waves, air quality worsens – respiratory health issues
- Less ice cover – shoreline erosion
- Decrease in lake water levels – evaporation/evapotranspiration
- Agriculture/Dairy – crop shift and milk production



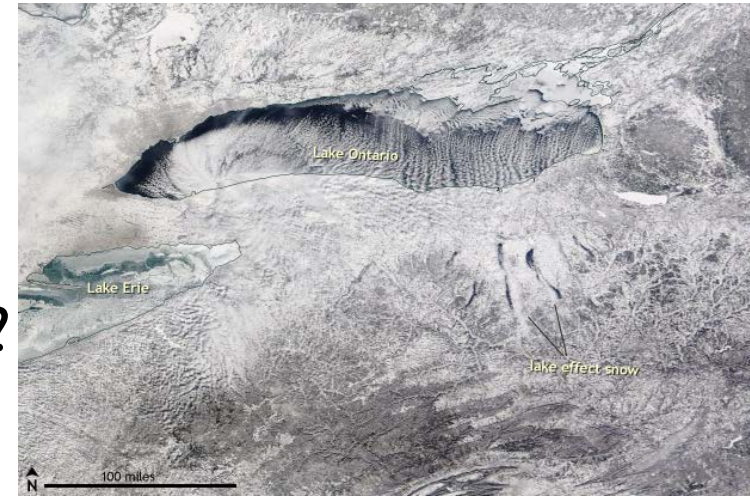
Projected Change in the Great Lakes – Precipitation

- ▶ Projected small increase in annual precipitation
- ▶ Larger variability
 - ▶ More precipitation in winter (more rain rather than snow)
 - ▶ Less precipitation in late summer early fall
- ▶ Intense precipitation events (heavy downpours) are likely to increase
 - ▶ Some projections say 50-100% more frequent



Projected Change in the Great Lakes – Lake Effect Snow

- ▶ Ingredients for Lake Effect Snow
 - ▶ Cold air
 - ▶ *Relatively* warm water
- ▶ Less ice cover on lakes = More snow???
 - ▶ Not necessarily...
 - ▶ May also have warmer temperatures
 - ▶ Reduces temperature differential = Less snow...
 - ▶ Climate simulations are inconclusive...
- ▶ Seasonal Means don't always tell the whole story...
 - ▶ One or two big events can define a season



Projected Change in the Great Lakes – Precipitation

► **Impacts**

- Decrease in lake water levels – winter rain
- More frequent severe flooding – infrastructure damage
- Impacts on agriculture – planting and harvesting



QUESTIONS?



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