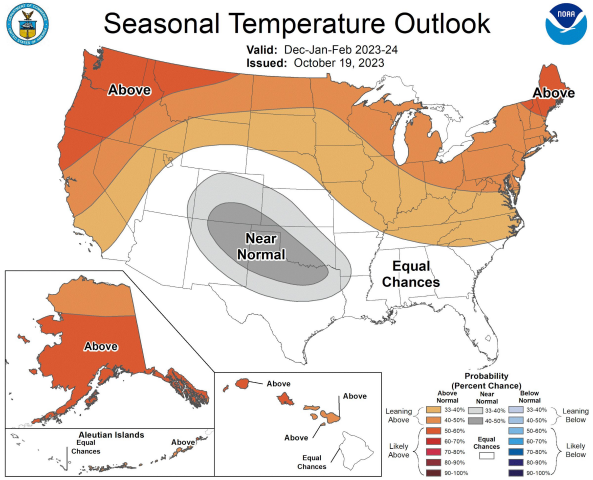
Northern Michigan Winter 2023-2024 Outlook

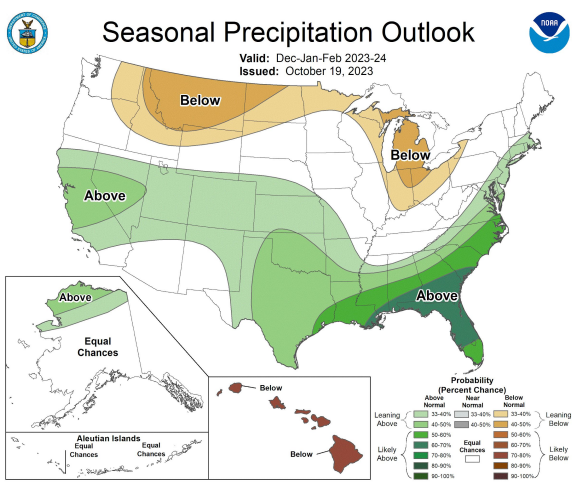
For the period December-January-February (DJF)

Key Messages

- Current forecasts favor **above average temperatures** and **below normal precipitation**
- **El Niño** is expected to be the ENSO cycle this season.
- Drought Outlook shows **drought could persist in some areas.**
- This outlook is not an indicator of daily weather events, but **a summation of the entire season**.

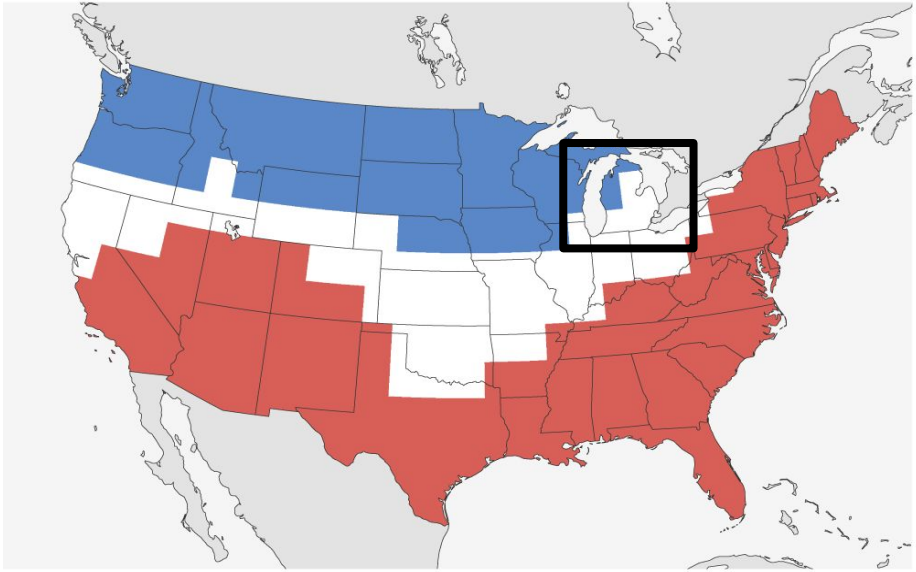
Climate Prediction Center Forecast

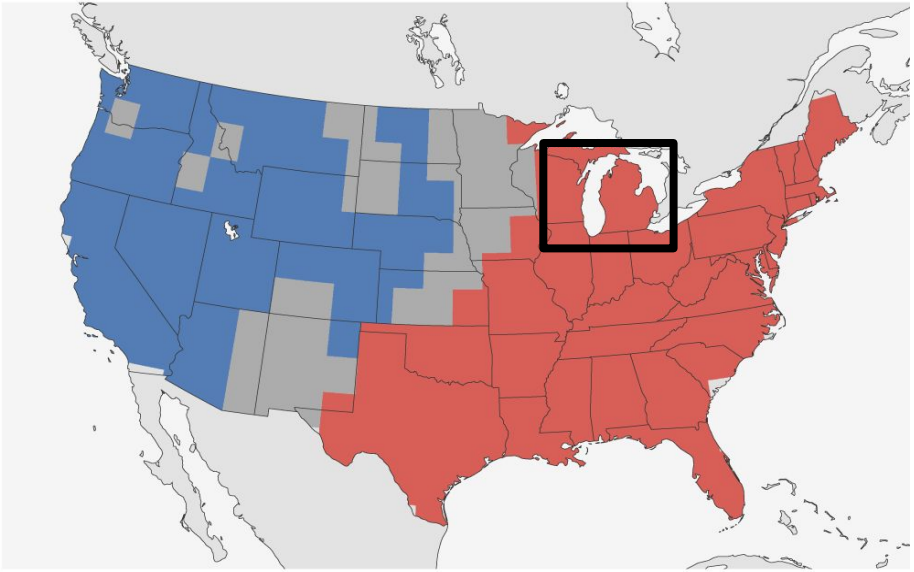




How Did Last Year Go?

Forecasted temperature versus actual, Dec 2022–Feb 2023





Forecasted temperature

equal chances | below normal | near normal | above normal

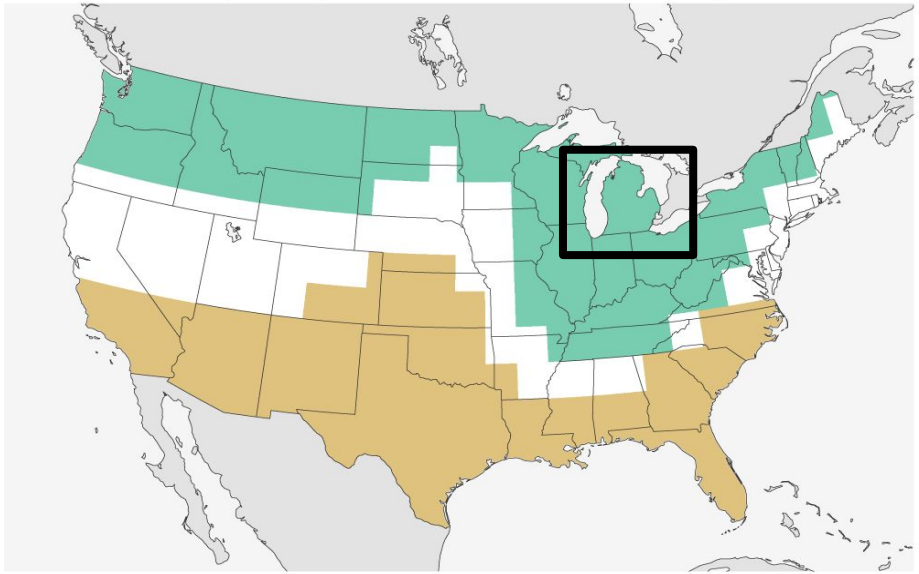
Observed temperature

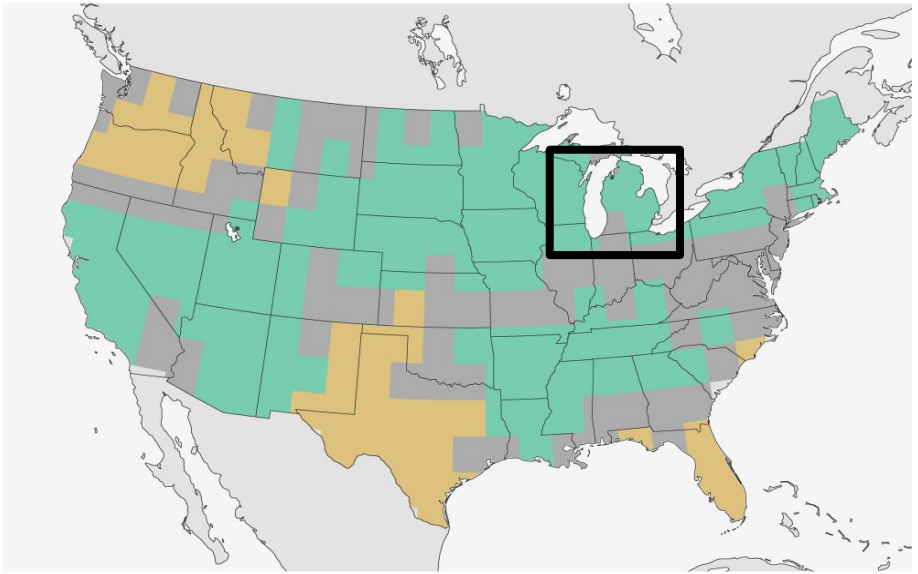
below normal | near normal | above normal

Climate.gov
Data: CPC

How Did Last Year Go?

Forecasted precipitation versus actual, Dec 2022–Feb 2023





Forecasted precipitation

equal chances | below median | near median | above median

Observed precipitation

below median | near median | above median

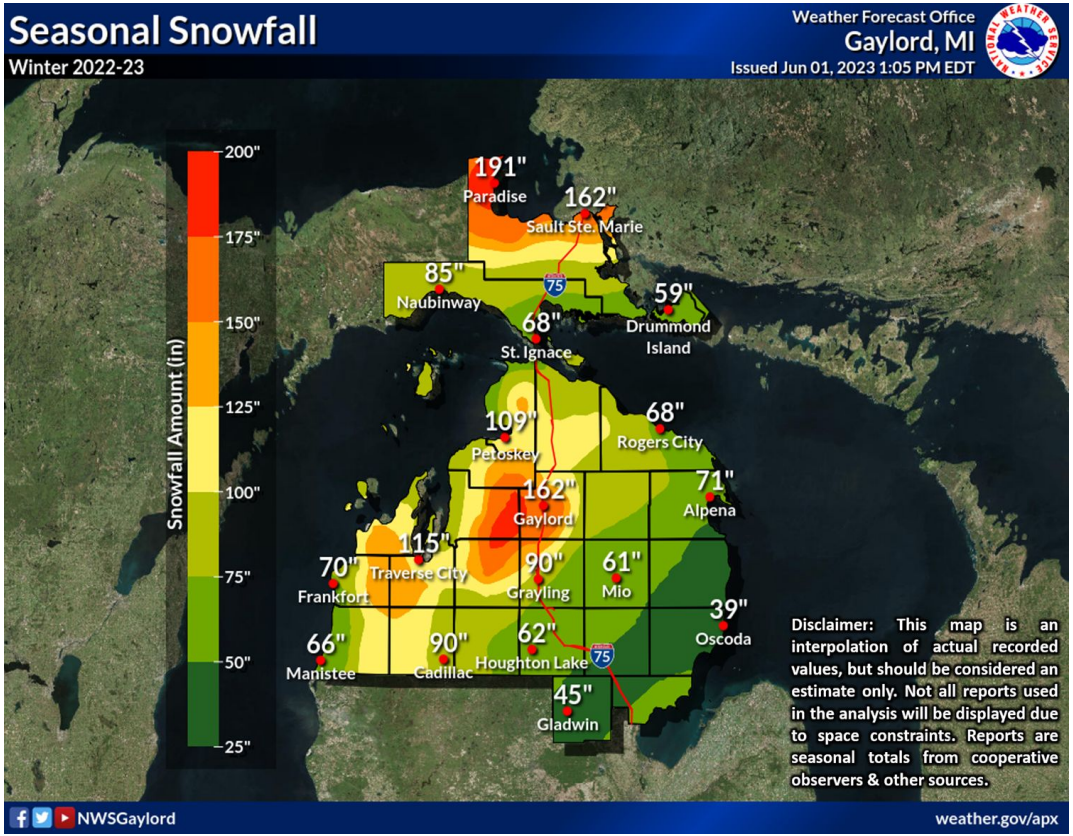
Climate.gov
Data: CPC

How Did Last Year Go?

Northern Michigan

Winter 2022-2023 Summary

- ➔ Above normal temperatures, especially during the first half of the winter.
- ➔ A slow starting winter, with seasonal snowfall numbers ending up very close to normal across much of northern Michigan
- ➔ Lake effect area snowfall numbers were heavily influenced by the Christmas blizzard, where 2-3’ of snow fell in some areas



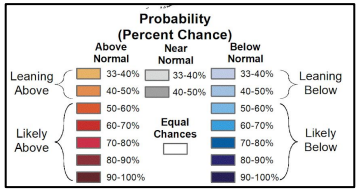
Climate Prediction Center Forecast

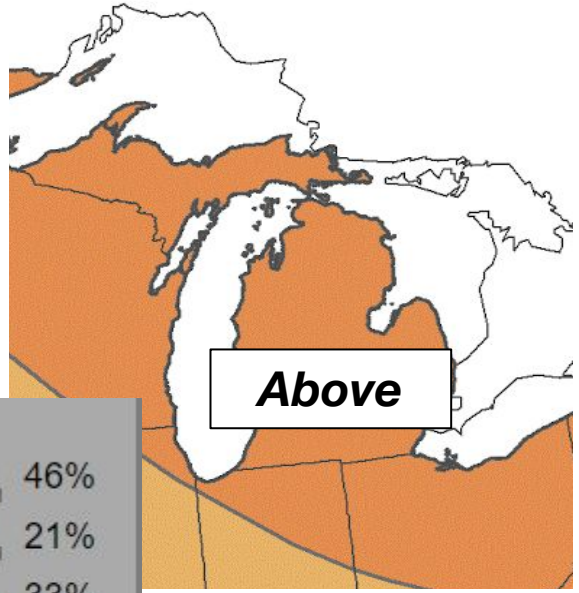
Temperature (for the period December-January-February (DJF))

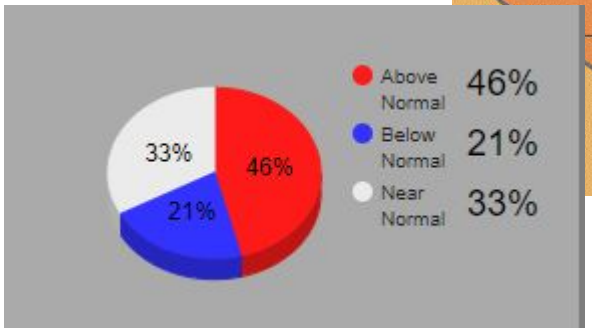
Overview

- ➔ Best chance is for **above normal temperatures**.
  - ◆ 40-50% chance of above normal temperatures.
  - ◆ 20-30% chance below normal temperatures.
  - ◆ ~33% chance for near normal temperatures.
- ➔ Uncertainty:
  - ◆ Does not forecast how much above normal temperatures will be or the magnitude of the warmth. Could be increased frequency of bursts of gulf air, just slightly above normal temps, etc.
  - ◆ Temperatures can be strongly influenced by other teleconnections, which can *only be forecast several weeks in advance*.

Temperature Outlook Dec-Feb







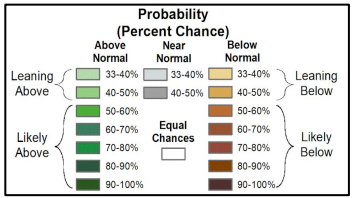
Climate Prediction Center Forecast

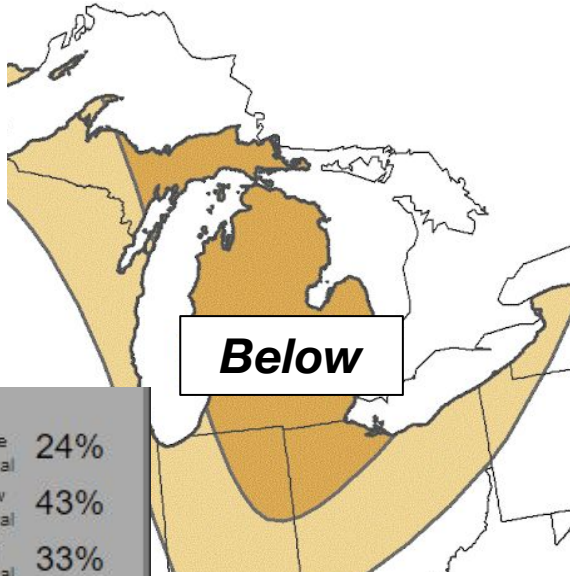
Precipitation (for the period December-January-February (DJF))

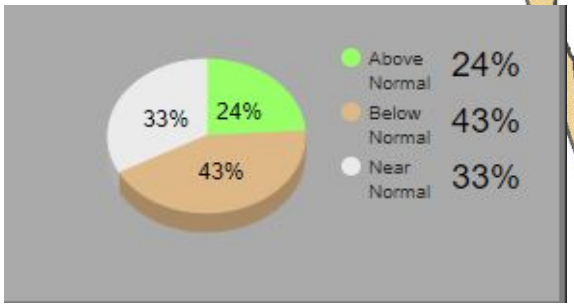
Overview

- Most of the area has **chances for below normal precipitation**.
  - 40-50% chance below normal precipitation.
  - 20-33% chance above normal precipitation.
  - ~33% chance near normal precipitation.
- "Below normal" could mean **less snow or less mixed precipitation events, or both.**
- Snow storms will likely occur at times this winter. However, **the frequency, number, and intensity of these events cannot be predicted on a seasonal timescale**.
  - Seasonal outlooks like this also do not factor in local effects like lake and terrain impacts.

Precipitation Outlook Dec-Feb







El Niño: What Can We Expect?

Strong El Niño Expected

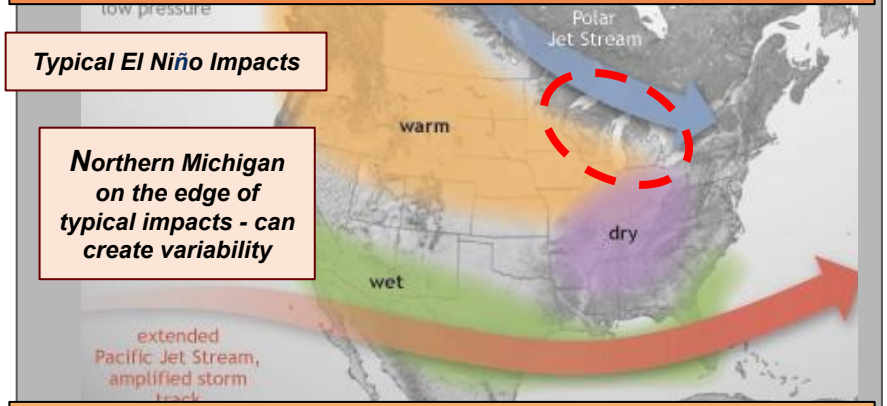
Overview

- Typical Impacts for Northern Michigan:
  - **Greater chance for warm air intrusions** - does not mean cold air outbreaks are not possible!
  - **Slight chance for less precipitation**, but this can be very dependent on El Nino strength and other calculations.

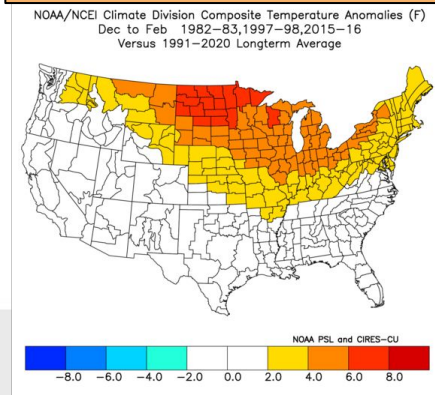
- **No two El Niños are the same**, the last several El Niños were all very different!
  - ***"The influence of El Niño on U.S. winter climate is a matter of probability, not certainty." - climate.gov***

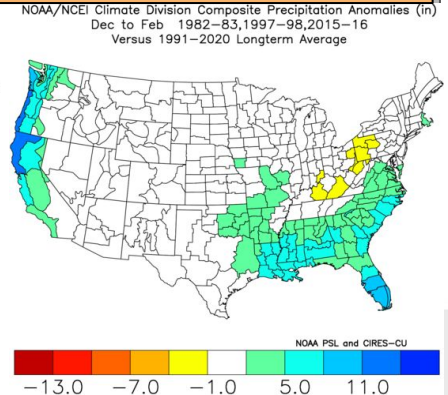
- Can be highly influenced by other shorter term teleconnections.
  - These are predicted on shorter timescales and will come into better focus within several weeks of an event, rather than months.

El Niño Favored Through This Winter



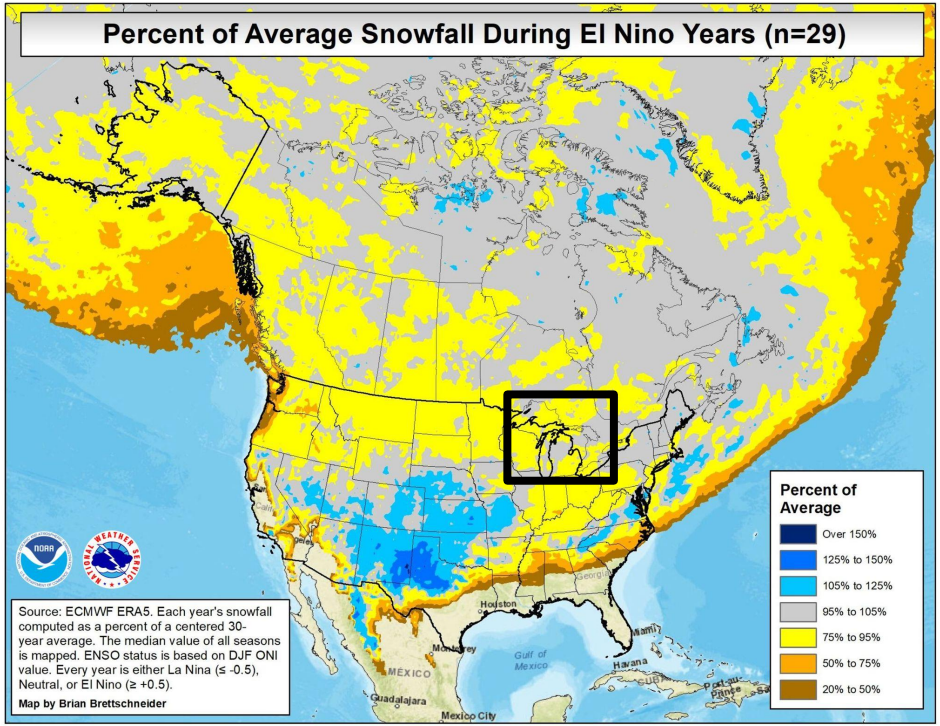
Winter Temperature and Precipitation Anomalies During Last 3 Strong El Nino's



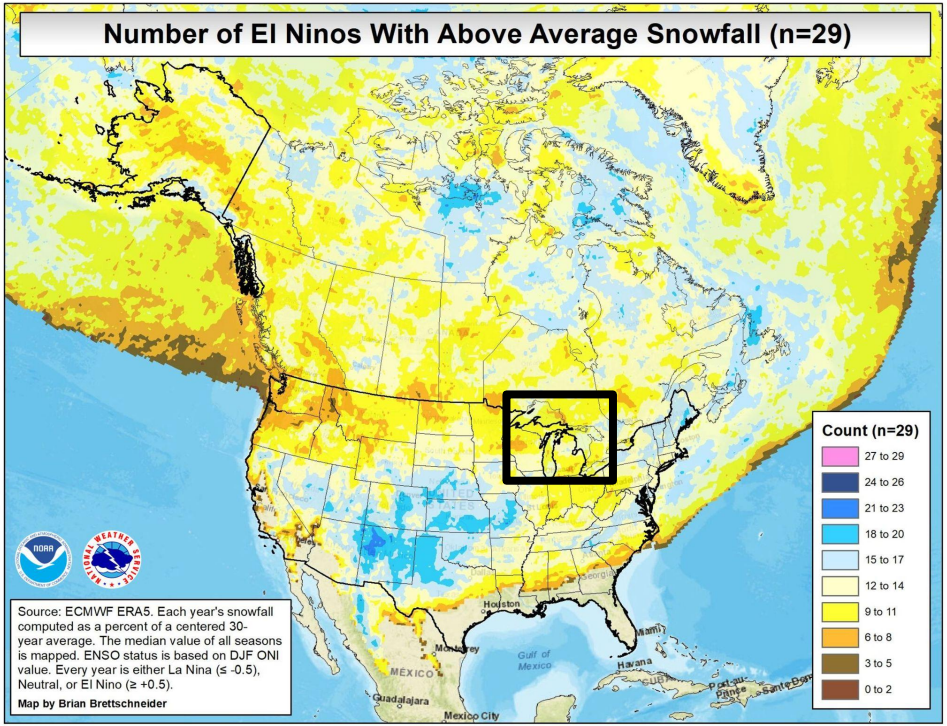


El Niño Influence on Snowfall

For the period from October through April



Northern Michigan snowfall averages 75-90% of normal during El Nino winters



Approximately 30% of Northern Michigan El Nino Winters had above normal snowfall

Climate Stats - El Nino Years

An overview of weather trends for December, January, and February

Gaylord			
Year (strength)	**DJF Temps**	**DJF Precip**	**DJF Snowfall**
2018-19 (weak)	0°	+0.96"	-6.0"
2015-16 (strong)	+7.8°	+0.66"	-11.1"
2014-15 (weak)	-4.3°	-3.30"	-35.3"
2009-10 (strong)	+2.5°	-5.10"	-23.0"
2006-07 (weak)	+3.4°	-0.91"	+0.8"
All El Ninos (25)	+2.1°	-1.07"	-11.1"

- El Nino winters in the Gaylord area historically trend toward a drier and warmer than normal season overall.
- Owing to the drier season trend, snowfall also tends to be below normal… in some cases, well below normal.

Climate Stats - El Nino Years

An overview of weather trends for December, January, and February

Sault Ste. Marie			
Year (strength)	**DJF Temps**	**DJF Precip**	**DJF Snowfall**
2018-19 (weak)	-1.3°	+3.82"	+19.7"
2015-16 (strong)	+5.2°	+2.60"	-26.5"
2014-15 (weak)	-6.2°	+0.19"	+1.6"
2009-10 (strong)	+1.1°	-2.36"	-17.6"
2006-07 (weak)	+0.3°	-0.23"	-4.4"
All El Ninos (24)	-1.8°	-0.38"	-9.5"

***Data from 1997-98 for Sault Ste. Marie was excluded owing to excessive missing data**

- El Nino winters in Sault Ste. Marie are historically known for being **drier and less snowy than normal**.
- Temperature trends in Sault Ste. Marie during El Nino winters actually favor **slightly below normal temperatures**.
  - Its location being surrounded by colder Great Lakes waters can lead to dramatic warmups being moderated in comparison to lower Michigan.

Climate Stats - Strong El Nino Years

****El Nino Years of 1982-1983, 1997-1998, 2015-2016 in particular were "very strong"**

Gaylord			
Year	**DJF Temps**	**DJF Precip**	**DJF Snowfall**
2015-2016**	+7.8°	+0.66"	-11.1"
2009-2010	+2.5°	-5.10"	-23.0"
1997-1998**	+7.9°	-3.03"	-41.2"
1991-1992	+3.7°	+1.75"	+1.3"
1982-1983**	+7.2°	-1.04"	-38.2"
All Strong El Ninos (7)	+4.8°	-1.27"	-21.3"

→ Winters in the **Gaylord** area are historically **well warmer, drier, and less snowy** than normal during strong El Ninos.

→ **In all three very strong El Nino winters, Gaylord has observed average temperatures over 7°F above the 1991-2020 climatological normals.**

Climate Stats - Strong El Nino Years

****El Nino Years of 1982-1983, 1997-1998, 2015-2016 in particular were "very strong"**

Sault Ste. Marie			
Year	**DJF Temps**	**DJF Precip**	**DJF Snowfall**
2015-2016**	+5.2°	+2.60"	2.4"
2009-2010	+1.1°	-2.36"	-9.5"
1991-1992	-2.1°	-0.08"	-6.2"
1982-1983**	-2.2°	+1.22"	-20.7"
1972-1973	+1.1°	+0.44"	-12.4"
All Strong El Ninos (6)	+0.2°	+0.14"	-12.1"

*Data from 1997-98 for Sault Ste. Marie was excluded owing to excessive missing data

→ Winters in the **Sault Ste. Marie** area are historically **slightly warmer**, **slightly wetter**, but **slightly less snowy** than normal during strong El Ninos.

→ Sault Ste. Marie's northern location allows for better precipitation from an anomalously north displaced Polar Jet.

Climate Stats- Spring in El Nino Years

Gaylord			
Year (strength)	**Mar-Apr. Temps**	**Mar-Apr Precip**	**Mar-Apr Snowfall**
2018-19 (weak)	-1.7°	+0.13"	-4.3"
2015-16 (strong)	+3.5°	+2.81"	+5.9"
2014-15 (weak)	0°	-1.97"	-8.3"
2009-10 (strong)	+9.6°	-2.13"	-21.4"
2006-07 (weak)	+2.6°	-0.60"	+10.6"
All El Ninos (25)	+2.6°	-0.34"	+0.4"

- Springs that follow El Nino winters in Gaylord are historically **warmer than normal**. Precipitation and snowfall generally tend to be **near climatologically normal, though can vary in extremes in either direction.**
- **Snow was observed in May 11 of 25 times following an El Nino winter.**
  - 3 of these 11 May snow observations logged over an inch of accumulation. **This includes Gaylord's snowiest May ever (8.3" in 1954).**

Climate Stats- Spring in El Nino Years

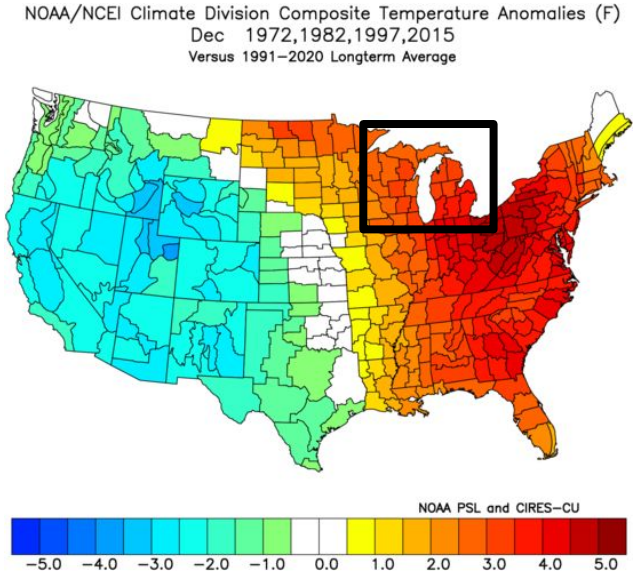
Sault Ste. Marie			
Year (strength)	**Mar-Apr Temps**	**Mar-Apr Precip**	**Mar-Apr Snowfall**
2018-19 (weak)	-1.9°	+1.46"	-5.2"
2015-16 (strong)	+1.3°	+0.64"	7.1"
2014-15 (weak)	-3.2°	-1.28"	-0.9"
2009-10 (strong)	+8.9°	-3.15"	-12.9"
2006-07 (weak)	-0.5°	-0.27"	+1.3"
All El Ninos (24)	-0.8°	-0.34"	-2.3"

*Data from 1997-98 for Sault Ste. Marie was excluded owing to excessive missing data

- Springs that follow an El Nino winter in **Sault Ste. Marie** average out to **near normal** temperatures, precipitation and snowfall.
- **Snow was observed in May 14 of 24 winters following an El Nino winter.**
  - 4 of these 14 occurrences resulted in over 1" of snow being observed in Sault Ste. Marie for the month of May.

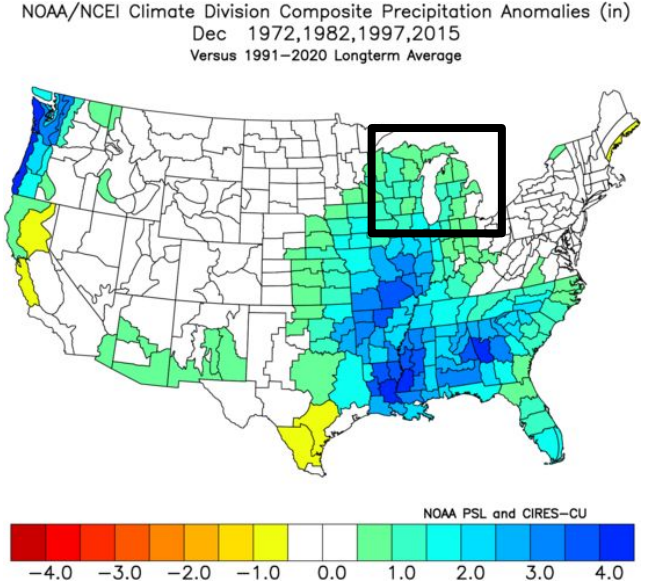
Near Term Forecast vs December Trends

Trends for Decembers with strong El Ninos in the past



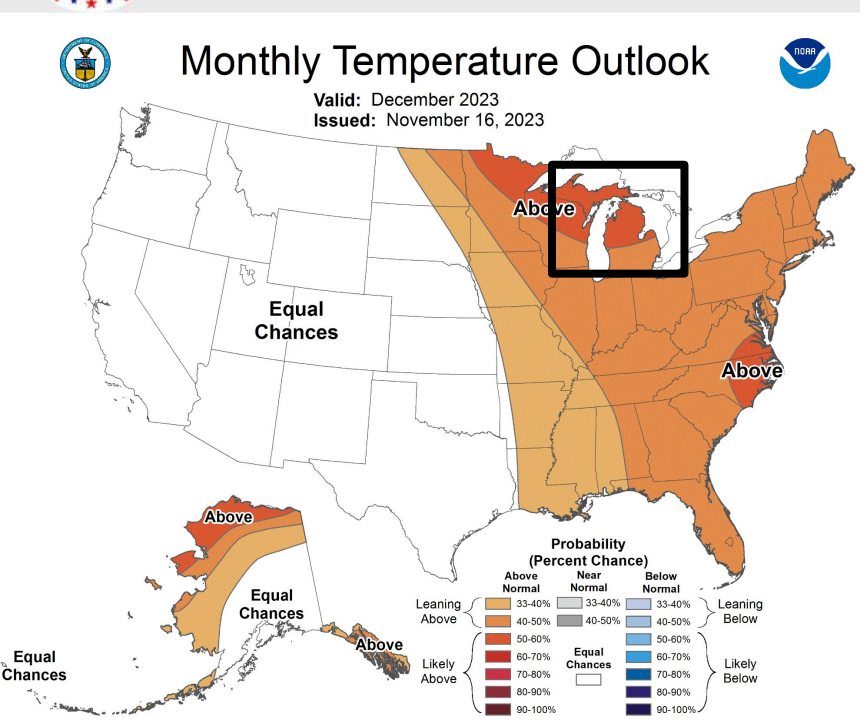
➔ **Strong correlation between warmer than normal temperatures in December.**

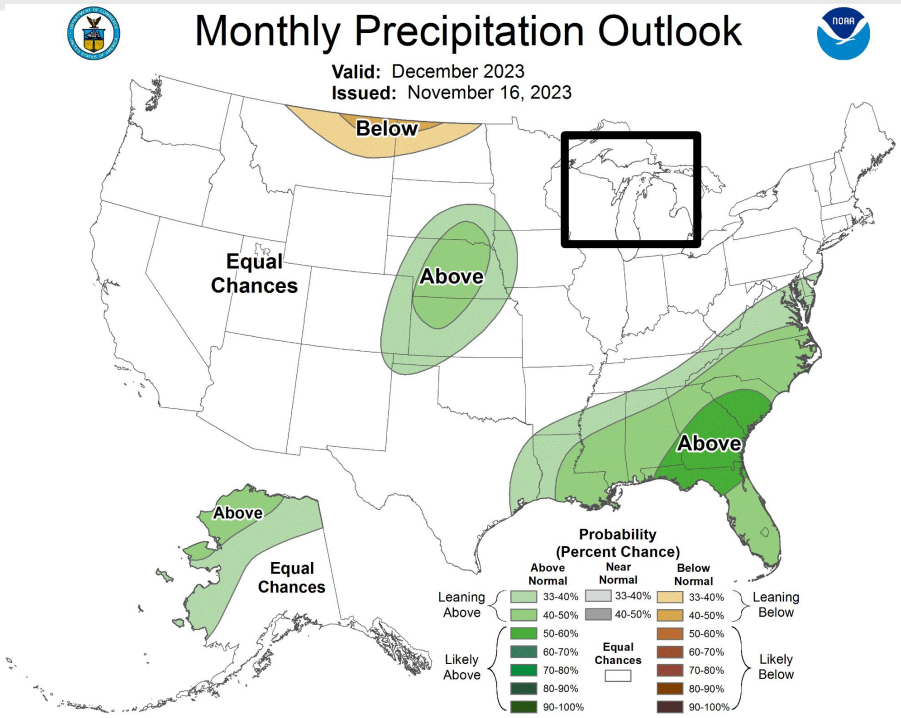
➔ **Far less correlation** (and therefore, less certainty) in either direction for **precipitation** for December.



Near Term Forecast vs December Trends

A look at what current data shows for December 2023



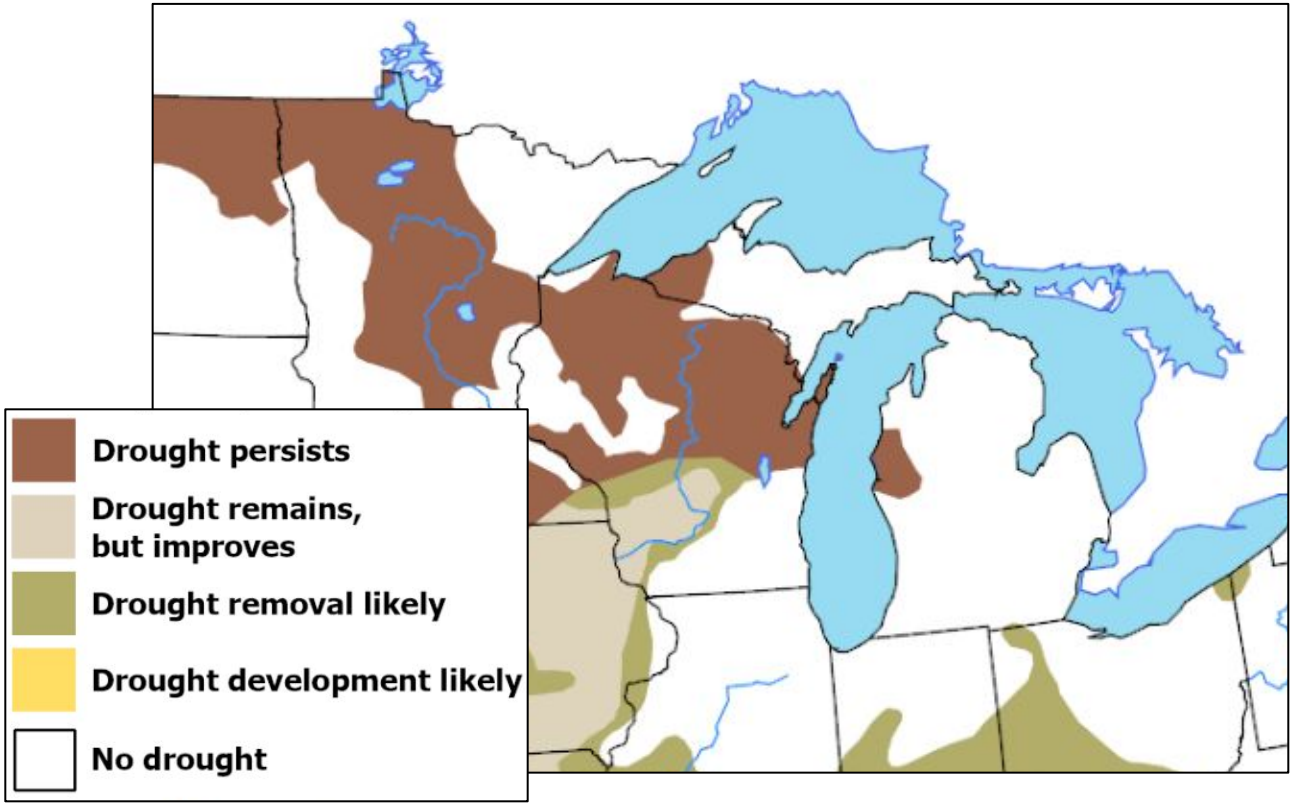


➔ The latest Climate Prediction Center winter outlook favors **above normal temperatures** and **EQUAL CHANCES of dry or wetter than normal conditions**. The strong signal for above normal warmth suggests a continued slow start to the winter season across northern Michigan.

Drought Outlook

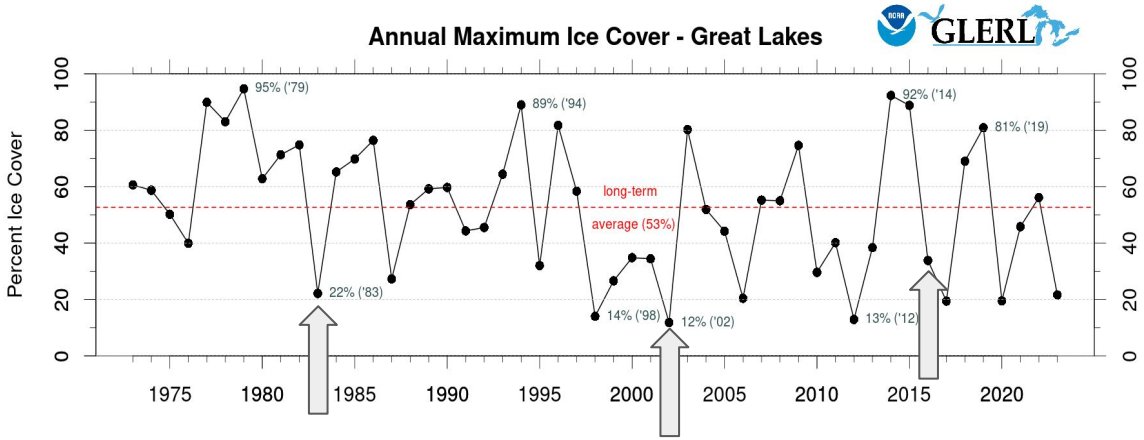
For November through January

- Drought conditions may persist along portions of the Lake Michigan coast.
- Any prolonged drier than normal conditions may lead to expansion of drought conditions both inland and near the coasts of the Great Lakes.



El Niño Influence on Great Lakes Ice Cover

- El Niños, with generally warmer temperatures, are **often associated with below-normal ice cover**, especially Strong and Very Strong El Ninos.
- Open waters can lead to greater amounts of lake effect precipitation (rain or snow, dependent on temperatures), and increased evaporation.



Strong El Nino's in 1982-83, 1997-98, and 2015-2016 coincided with low ice cover years

Summary

What is Expected

- Current forecasts favor **above average temperatures** and **below normal precipitation.**
- A **Strong El Niño** is expected, with El Nino conditions persisting into the Spring.
  - There is a chance (30%) for a historically strong El Niño event.
- Drought Outlook shows **drought could persist in some areas along the Lake Michigan coast.**

What is Uncertain

- El Niño can have **high variability for temperature and precipitation in Northern Michigan** - and is sensitive to other climate patterns than cannot be predicted seasonally.
- Cannot predict exact timing, intensity, or frequency of winter weather events. This includes seasonal snowfall amounts.
- **Prior analogs do not make a forecast** as every winter is unique and sample sizes are small.
  - Climate patterns and connections like ENSO simply ***tilt the odds*** towards certain seasonal values.

Rationale for the Winter Forecast

- ✔ There is a >**95% chance of El Niño during the Northern Hemisphere winter (December-February) 2023-24**
- ✔ El Niño is anticipated to affect temperature and precipitation across the United States during the upcoming months, so the **CPC temperature and precipitation outlooks generally reflect El Niño impacts**
- ✔ **Greatest El Niño impacts typically occur January – March.**
- ✔ This El Nino is directly following a three-peat La Nina, which has occurred once in the winter of 1976-1977.
- ✔ **This El Niño has a high chance of remaining into at least early spring and is expected to be moderate to strong.** For the DJF period, there is only a 1% chance that the ENSO cycle will be Neutral, and a 0% chance of La Niña.
    - There is a **99% chance of a weak (0.5 to 0.9°C) El Niño**, **92% chance of a moderate (1.0 to 1.4°C) El Niño**, and **a 62% chance that it could be a strong (1.5°C or warmer) El Niño**. The strength of El Niño can impact temperatures, precipitation, and seasonal snowfall.
        - There is a *30% chance of a historically strong El Niño that rivals 2015-16 and 1997-98*.
- ✔ **Recent temperature & precipitation trends were also considered.** El Niños can be variable and there are other global connections that will play a role this winter. Seasonal and sub-seasonal models and their signals and trends were also considered.