La Niña is Back…
2011-2012 Winter Outlook

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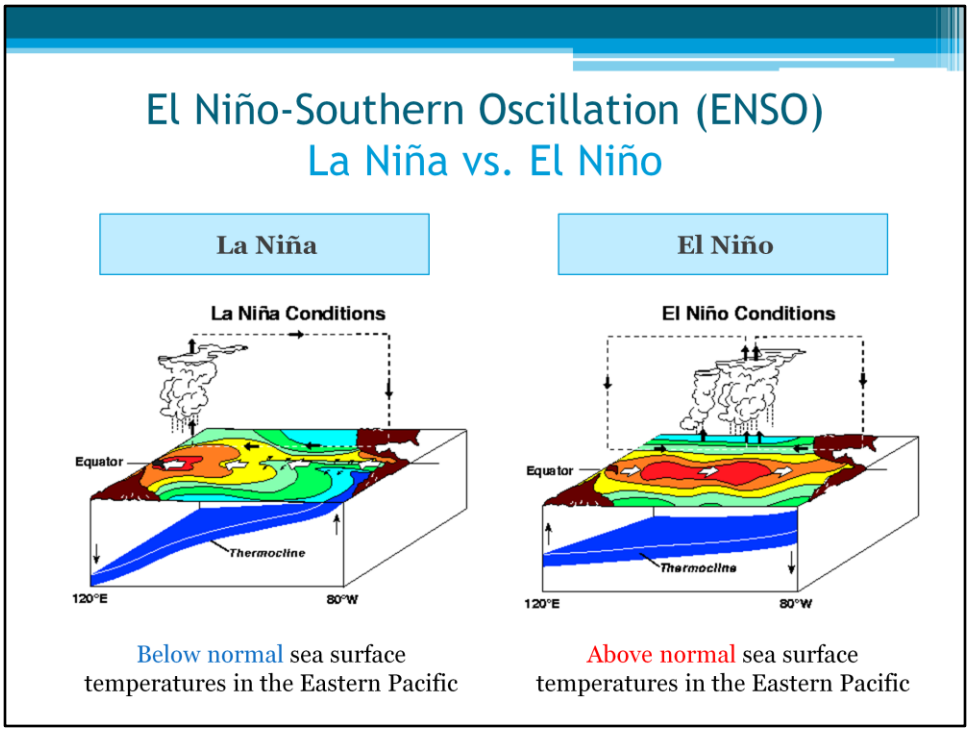
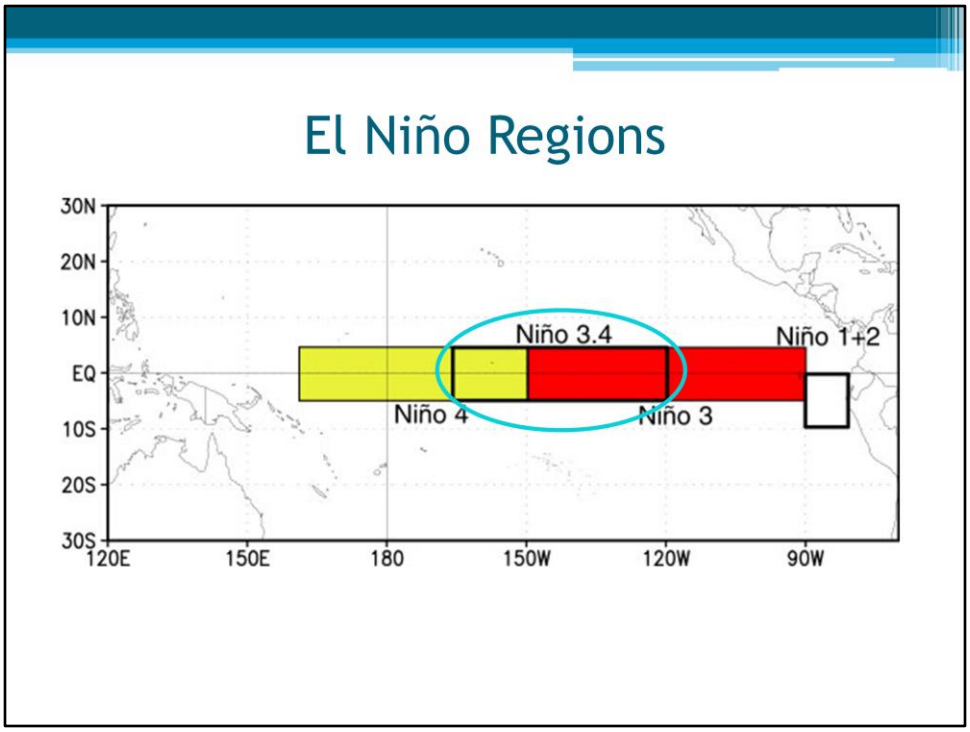
Outline

- Overview of
  - El Niño-Southern Oscillation (ENSO)
  - Oceanic Niño Index (ONI)
  - Pacific Decadal Oscillation (PDO)
- Where We Are Now
- Where We Are Headed
- Climate Prediction Center (CPC) Winter Outlooks
- La Niña Local Impacts
- Summary



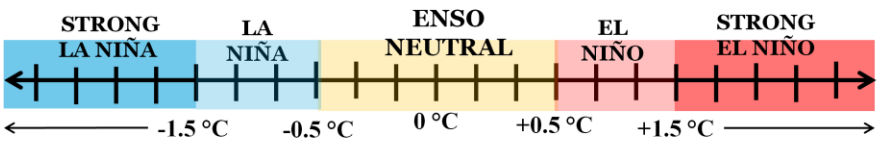
La Niña and El Niño make up what is called the El Niño-Southern Oscillation (ENSO). La Niña is characterized by unusually cold ocean water temperatures off the coast of South America in the Eastern Pacific. El Niño is the opposite to La Niña and is characterized by unusually warm water temperatures off the coast of South America in the Eastern Pacific. Both La Niña and El Niño are known to impact the weather patterns across North America, especially during the winter and spring.



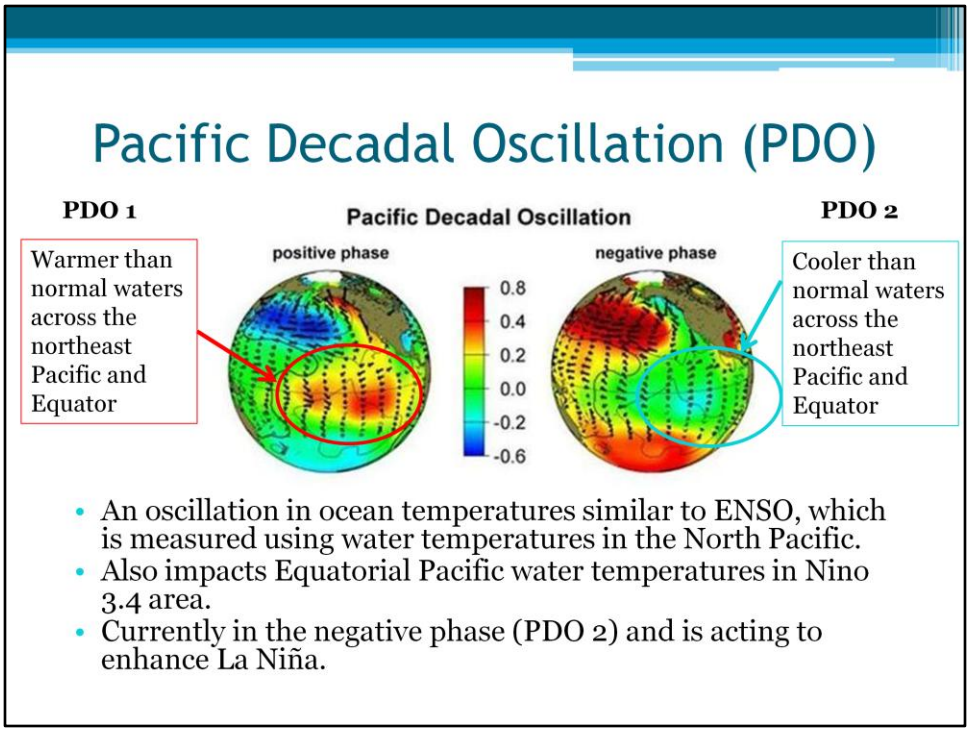
The Niño 3.4 region is the official region used to monitor and measure ocean water temperatures to determine whether a La Niña or El Niño event is occurring.

Oceanic Niño Index

- Sea surface temperature anomalies in the Niño 3.4 region are used as the measure for monitoring ENSO.
- El Niño: characterized by a *positive* ONI greater than or equal to +0.5 °C.
- La Niña: characterized by a *negative* ONI less than or equal to -0.5 °C.



We use Niño 3.4 data (as discussed on the previous slide) to determine the Oceanic Niño Index. El Niño is characterized by warmer than normal temperature anomalies greater than or equal to +0.5 °C and is represented by the red region in the figure. La Niña is characterized by colder than normal temperature anomalies less than or equal to -0.5 °C and is represented by the blue region in the figure at the bottom of the slide.

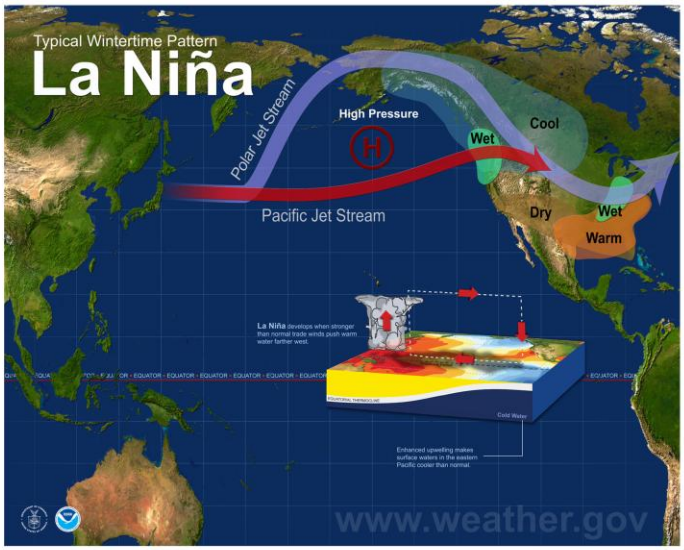


It is an ENSO-like oscillation that occurs over a 50-70 year period within the eastern Pacific Ocean basin. Similar to ENSO, the PDO has different phases.

PDO 1 (+PDO/positive phase): characterized by colder than normal western and central north Pacific waters and warmer than normal eastern Pacific Ocean waters (as seen on the left above).

PDO 2 (-PDO/negative phase): characterized by warmer than normal western and central north Pacific waters and cooler than normal eastern Pacific waters (as seen on the right above).

There have been studies that have shown that the PDO can act to modulate ENSO variability on an interdecadal timescale. Constructive interference is said to occur when ENSO events are in phase with the PDO. Therefore, La Nina events tend to be stronger during the negative PDO phase and tend to be weaker during a positive PDO phase. When ENSO and PDO are “in phase” and stronger, it tends to have a greater influence on local climate parameters and seasonal climates.



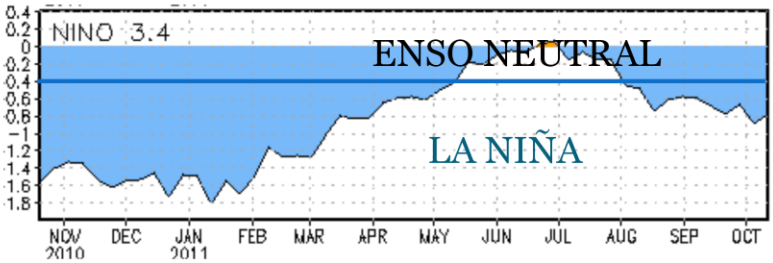
La Niña effects are enhanced by the PDO 2

As discussed on the previous slide, we are currently in a PDO 2, which is in phase with La Niña and is acting to enhance the atmospheric affects of La Niña.

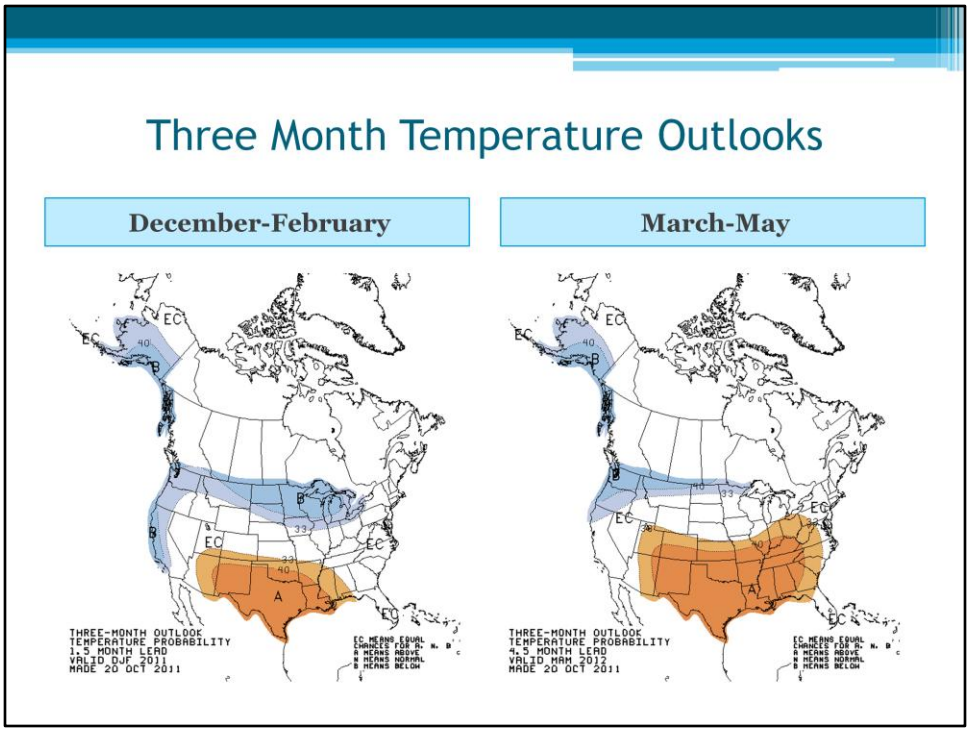
During a typical La Niña winter, the polar jet stream (purple) is diverted such that the flow is from the northwest across the northern tier of the U.S. and North Dakota. This allows for the cold arctic air from southern Canada to more easily penetrate into the Northern Plains and is why colder than normal conditions are favored across Northern Plains during a La Niña event. When considering the effects of the PDO 2 event, the favored region for wetter than normal conditions across the Northwest during a typical La Niña event is extended eastward into the Northern Plains.

Observations

- During July and August sea surface temperatures cooled resulting in negative SST anomalies.
- La Niña conditions have returned as negative SST anomalies continued to strengthen in the eastern equatorial Pacific basin.
- Strong wintertime La Niña episodes are typically followed by weaker La Niña episodes the following winter.

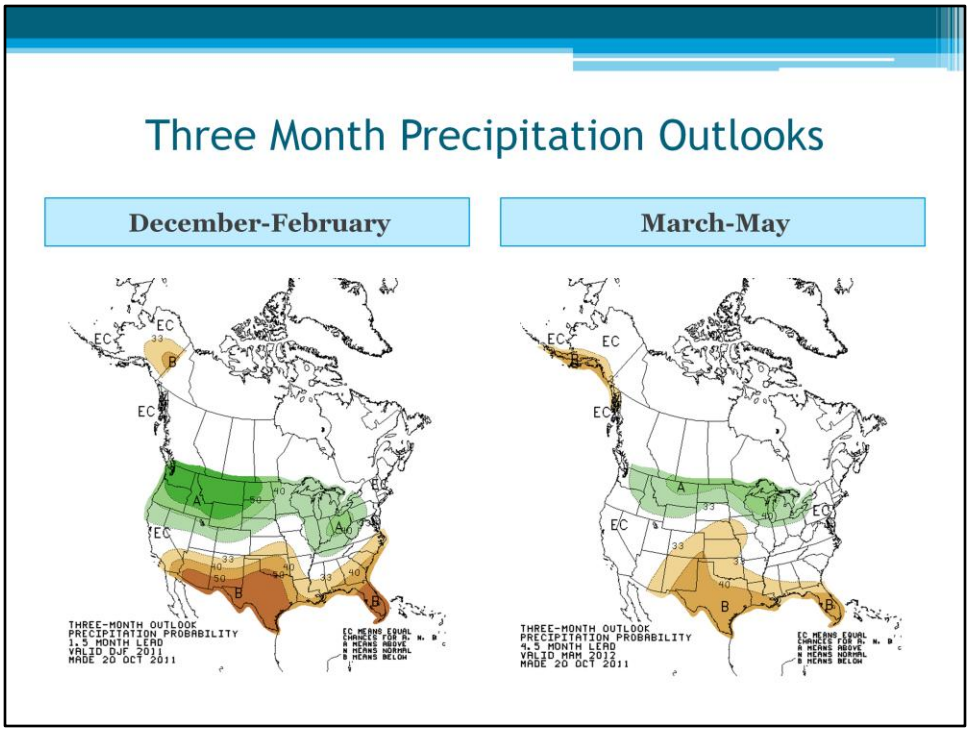


Last winter's strong La Nina became neutral in late spring. However, NINO 3.4 sea surface anomalies became negative once again late this summer (ocean waters have cooled). This signaled the onset of another La Niña. Historically, a strong wintertime La Niña event (such as the event last winter) is typically followed by a weaker La Niña event the following winter (such as this winter). Models consistently forecast La Niña to continue to strengthen during the late fall and early spring. However, the current thinking is that this La Niña event will be a weak to moderate strength event, which is weaker than last winter's La Niña event.



The shaded areas represent the most favored categories with blue being below normals and orange being above normal. No shading repsresents equal chances for above normal, normal, or below normal temperatures.

North Dakota and eastern Montana are favored for below average temperatures December through May.



The shaded areas represent the most favored categories with brown shading being below normal and green being above normal. No shading represents equal chances for above normal, normals, and below normal.

Eastern Montana and North Dakota are favored for above average precipitation December through May. Looking at the past 15 years, though, North Dakota is approximately 20% more wet than it was in the previous 30 to 40 years.

Local Impacts: Temperatures

Bismarck, ND		PDO 2
		Anomaly
	Average	La Nina
Month	Temperature	Temperature
December	15.8	-2.1
January	9.5	-2.8
February	14.4	-2.2
Winter	13.2	-2.4

Below average monthly temperatures are likely with a La Niña

This table displays the winter monthly and seasonal long-term average temperatures along with the average temperature anomalies experienced during a La Niña/PDO 2 episode. On average, La Niña events show the coolest mean temperatures during the winter season with peak intensity in January. Monthly temperature anomalies during La Niña/PDO 2 episodes average about 2 to 3 °F below normal, with the winter season being a little over 2 °F below normal.

Local Impacts: Snowfall

PDO 2 La Nina Events		
Month	**Average Snowfall**	**Snowfall Anomalies**
December	6.7	**+1.7**
January	6.9	**+2.3**
February	6.4	-0.2
Winter	19.9	**+3.9**

Above average monthly snowfall is likely during a La Niña winter

This table displays the winter monthly and seasonal average snowfall along with the average snowfall anomalies experienced during a La Niña/PDO 2 episode. On average, La Niña events show the highest mean snowfall during the winter season and show a peak intensity in January. Monthly snowfall anomalies during La Niña/PDO 2 episodes average about 2 to 3 inches above normal in December and January, with February showing slightly below normal snowfall. However, the winter season snowfall is typically about 4 inches above normal.

Summary

- La Niña is occurring, and will be strongest during late winter and spring.
- Below normal temperatures are expected for North Dakota.
- Above average precipitation and snowfall is expected statewide.
  - Greater than 50% chances for above normal precipitation across western North Dakota.
  - Above average snowfall is a result of colder temperatures increasing amount of snow per inch of liquid.

La Niña is occurring and is expected to persist and strengthen during the late winter and spring.

Summarizing the winter outlook:

Temperatures: North Dakota and eastern Montana are favored for below average temperatures December through May.

*With below normal temperature expected into May, there is an increased likelihood of a delayed thaw.

Precipitation: Eastern Montana and North Dakota are favored for above average precipitation December through May.

*There is a 50% or greater probability of above average precipitation over western North Dakota.

This means there is a 16% chance of below normal precipitation and a 33% chance for normal conditions.

Hydro issues…

Allen Schlag, Service Hydrologist, addressed a few concerns regarding the potential for spring flooding, which are summarized below.

*Cold and snowy does not always equal devastating flooding. Spring melt conditions including rain, melt season duration, frozen ground will all play a very large role in flood severity!

First really good look at flood potential comes out in late January as an ESF (probabilistic hydrologic outlook).

*The lack of natural surface water storage may exacerbate spring flooding.

Questions?

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Normal and Record Snowfall

City	Normal	Record	2010-2011
Bowman	54.9	107.1 (1994)	85.8
Dickinson	35.5	74.9 (2011)	74.9
Williston	45.3	107.2 (2011)	107.2
Minot	46.1	100.0 (1950)	73.5
Bismarck	51.2	101.6 (1997)	85.4
Bottineau	43.2	90.3 (2011)	90.3
Jamestown	44.5	103.8 (1950)	89.8

The normals above are the new 30 year normals (1981-2010).

The long-term average (1875ish to the present) is around 40 inches, with the 30 year average being near 50.