GLERL

La Niña and the Great Lakes Region

What are La Niña and El Niño?

La Niña and El Niño are extreme phases of the naturally occurring climate cycle known as El Niño/ Southern Oscillation (ENSO). ENSO results from the interaction between the surface of the ocean and the atmosphere in the tropical Pacific. Changes in the ocean impact the atmosphere and climate patterns around the globe.

Under normal conditions the trade winds in the tropical Pacific travel from east to west and from high pressure areas to low pressure areas. Thus, the eastern tropical Pacific is dominated by high pressure and the western by low pressure and associated storm cells or tropical convections (Figure 1).

As these surface winds travel west, they push the warm water over to the west, allowing the equatorial thermocline (a buffer between the warmer upper water and the deeper colder ocean water) to move closer to the surface in the east.

Under El Niño conditions this circulation pattern collapses and sometimes reverses (Figure 2). This collapse and/or reverse not only sends warm water sloshing back towards the eastern Pacific, driving the thermocline down, but also changes the tropical convection patterns.

During La Niña conditions, the circulation looks more like normal, however it is *more of normal*. In other words, more intense normal conditions prevail. Not only do the winds blow from east to west again, but they blow stronger and the tropical convection is pushed further westward (Figure 3).

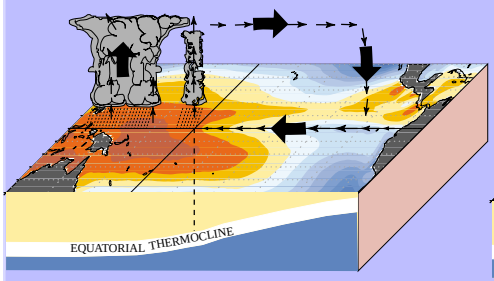


Figure 1. Normal tropical Pacific conditions for December-February.

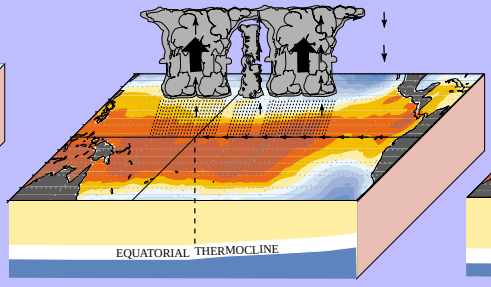


Figure 2. El Niño conditions during December-February.

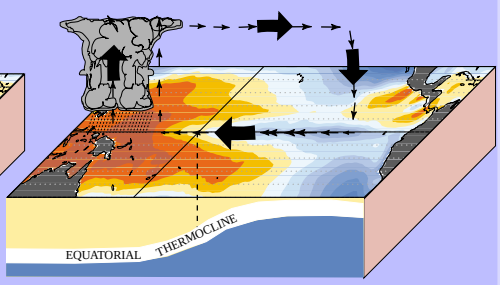


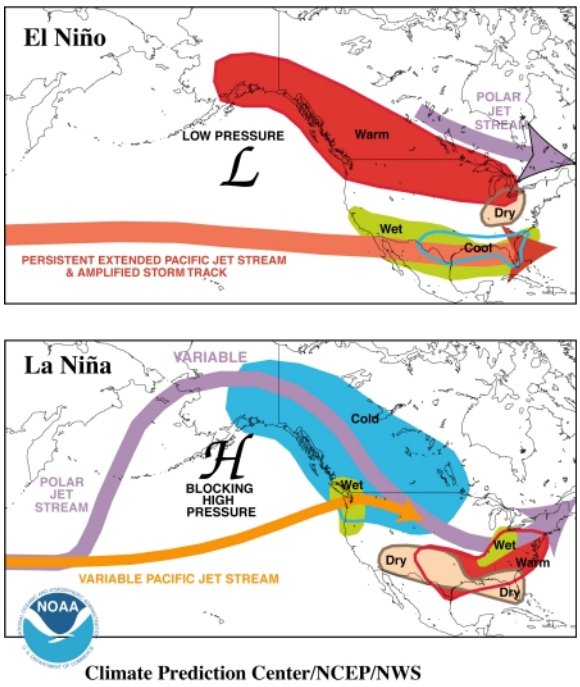
Figure 3. La Niña conditions during December-February.

[Source: NOAA's Climate Prediction Center http://www.cpc/ncep.noaa.gov/]

Tropical convection represents the primary "heat engine" for the global atmospheric circulation. Changes in the location of this convection can alter the global circulation (i.e. strengthen, weaken or alter the jet stream). The jet stream has different positions during El Niño and La Niña for the North American continent (Figure 4). During El Niño, the Polar Jet stream is north of the continental United States, allowing warm air to enter during the winter months. The opposite is true for the same time period during La Niña. The polar jet stream dips beneath the northern tier states allowing cold polar blasts of air.

La Niña and El Niño do not directly create weather; they merely shift the odds in favor of certain weather patterns. La Niña occurs every 3-5 years and usually lasts approximately 9-12 months with some episodes persisting for two years. A La Niña episode may, but does not always follow an El Niño.

Figure 4 (right) shows typical January-March weather anomalies and atmospheric circulation during moderate to strong El Niño and La Niña.



The 1998-2000 La Niña

After the strongest El Niño, La Niña began with a sudden cooling in the tropical Pacific in May 1998; Sea Surface Temperatures (SST) cooled rapidly (5^{o} C below normal) within a 30-day time frame. NOAA models are predicting the La Niña episode to persist through the end of the year 2000. Figures 5 and 6 are temperature and precipitation distributions in the United States based upon past moderate to strong La Niñas. Based upon these distributions, NOAA's Climate Prediction Center has forecast cooler and somewhat wetter weather across the Great Lakes later in the winter and into the spring. More forecasts can be found at: www.nnic.noaa.gov/products/predictions/threats/enso/.

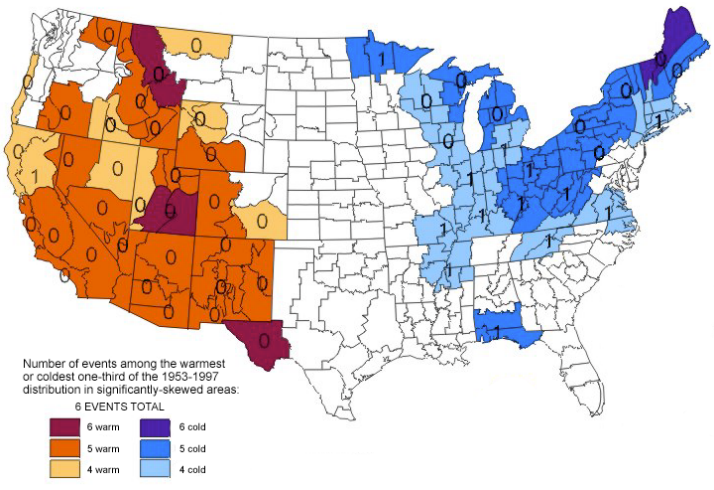
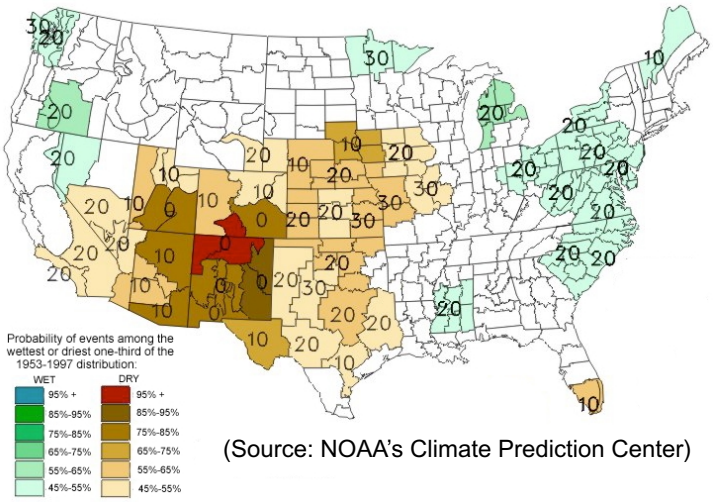


Figure 5. Significantly-Skewed La Niña Temperature Distributions, March-May.



(Source: NOAA's Climate Prediction Center)

Figure 6. La Niña Precipitation Probabilites, March-May.

Effects of La Niña

It is difficult to predict the exact effects that La Niña will have on the United States because impacts vary from region to region and depend on the strength and timing of the La Niña. However, it is reasonable to examine past La Niñas to understand possible outcomes. Nationally, the effects can be severe. The drought associated with the very strong 1988 La Niña contributed to an estimated 10,000 deaths from heat stress, caused $30 billion in agricultural losses, and produced record forest fires in the United States. Corn production in the Midwest went down by 20%, with Illinois hit the hardest at 40%. Several aquatic species that are adversely affected by herbicides in agricultural runoff benefitted from the lack of rain, while other populations such as the *Hexagenia* mayfly crashed. Species such as the mayfly are important sources of food for Great Lakes fish, and the crash of their populations can lead to a decline in the population of fish.

Need More Information on La Niña?

General Information

What is La Niña?
http://www.pmel.noaa.gov/toga-tao/la-nina-story.html

La Niña Page
http://www.dir.ucar.edu/esig/la_nina_home

Previous La Niña and El Niño Years
http://www.nnic.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.html

U.S. Impacts

Historical U.S. La Niña Impacts
http://www.nnic.noaa.gov/products/analysis_monitoring/ensostuff/lanina/

Severe Weather Forecasts
http://www.nws.noaa.gov/data.html

Impact on Atlantic Hurricane Activity
http://www.publicaffairs.noaa.gov/stories/sir12.html

NOAA Web Sites

Climate Prediction Center
http://www.cpc/ncep.noaa.gov/

Climate Diagnostic Center
http://www.cdc.noaa.gov

Pacific Marine Environmental Lab
http://pmel.noaa.gov

Office of Global Programs
http://www.ogp.noaa.gov

This brochure is a summary of information available from a number of agencies and web sites and was compiled by C. Sellinger, of NOAA's Great Lakes Environmental Research Laboratory, 2205 Commonwealth Blvd., Ann Arbor, MI 48105, 734-741-2235 www.glerl.noaa.gov

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