

# GLOBAL CLIMATE PATTERNS & IMPACTS ON COASTAL S.E. ALASKA

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## TAKE HOME MESSAGE

In the North Pacific Ocean, there are three major climate patterns that impact both weather and oceanographic conditions. The El Niño - Southern Oscillation (ENSO) cycle has a warm, neutral, and cold phase of the ENSO cycle - during the warm phase, Alaska gets particularly warm weather. The Pacific Decadal Oscillation (PDO) is a similar pattern, but operates over much longer time periods and its effects are more pinpointed in the North Pacific. Warm PDO phases lead to higher biological productivity in the North Pacific. Finally, the North Pacific High and the Aleutian Low are high and low pressure areas that drive much of the seasonal weather in the North Pacific. Unusual pressure systems and the PDO are thought to be potentially responsible for "the blob" - a patch of stagnant warm water that appears in the North Pacific.

## WHAT IS THE EL NIÑO - SOUTHERN OSCILLATION? <sup>1, 2, 3, 4</sup>

The El Niño - Southern Oscillation (or ENSO cycle) is a recurring, naturally-occurring climate pattern that involves water temperatures in the eastern & central tropical Pacific Ocean. It occurs over time periods between 2-7 years. Changes in sea surface temperature (SST) leads to changes in rainfall and global atmospheric patterns. These cycles are known to impact marine ecosystems, and, due to the size of the Pacific Ocean, can have an impact on weather patterns around the world.

### THREE PHASES OF THE ENSO CYCLE

#### EL NIÑO

- Easterly trade winds diminish
- Warm water in W. Pacific moves east and upwelling in E. Pacific slows
- Increased rainfall over E. Pacific, decreased rainfall over W. Pacific
- Global temperatures rise temporarily
- Lasts 2-4 years

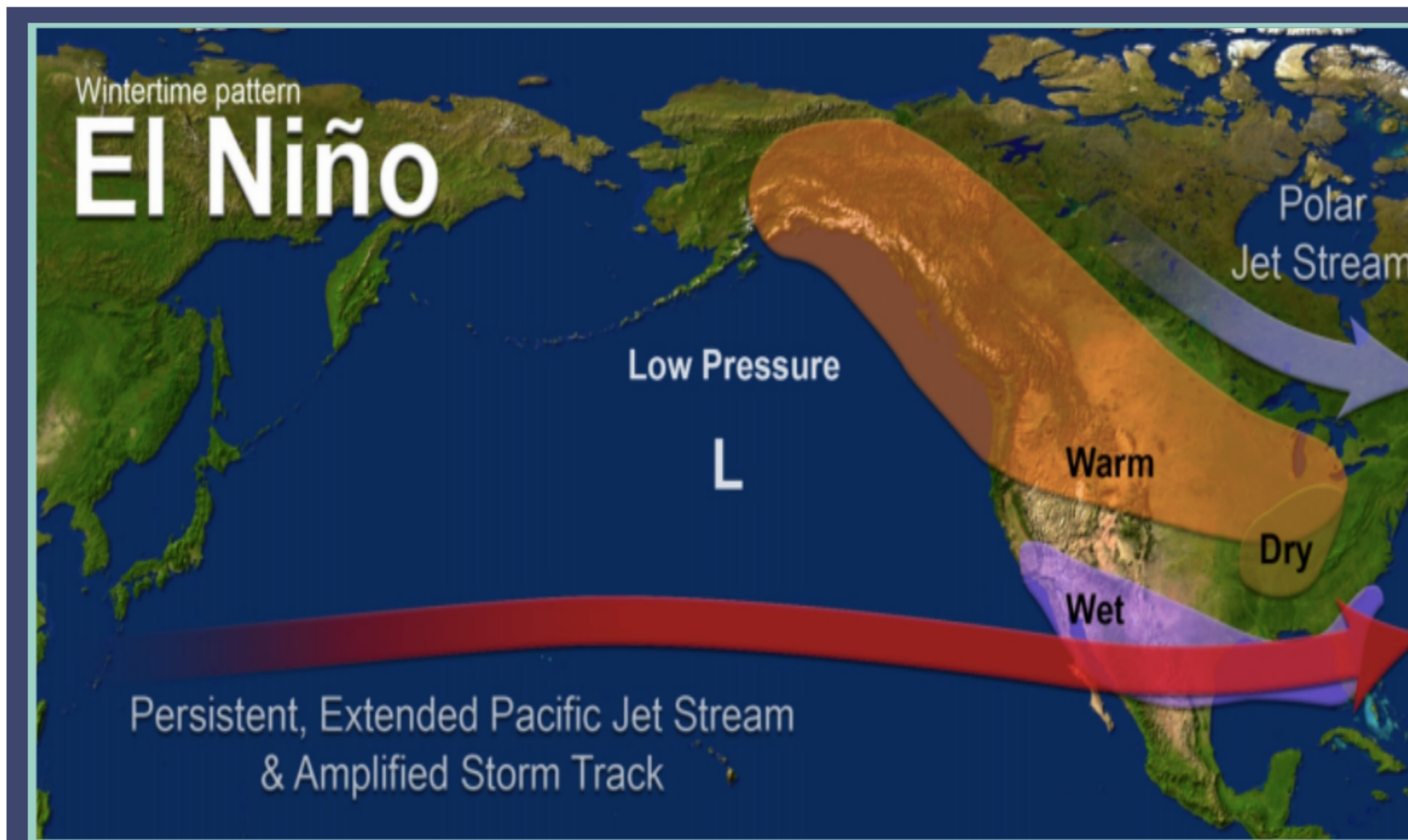
#### NEUTRAL

- Warmer water is pooled/sea surface is higher in western Pacific due to easterly trade winds
- SST & weather patterns are closer to average

#### LA NIÑA

- Reversal of El Niño conditions
- Regular easterly trade winds strengthen
- Even more warm water is pushed toward W. Pacific
- Even more rainfall over W. Pacific, E. Pacific may experience droughts
- Global temps. cool temporarily
- Lasts 1-3 years

ENSO & S.E. ALASKA <sup>5, 6, 7</sup>

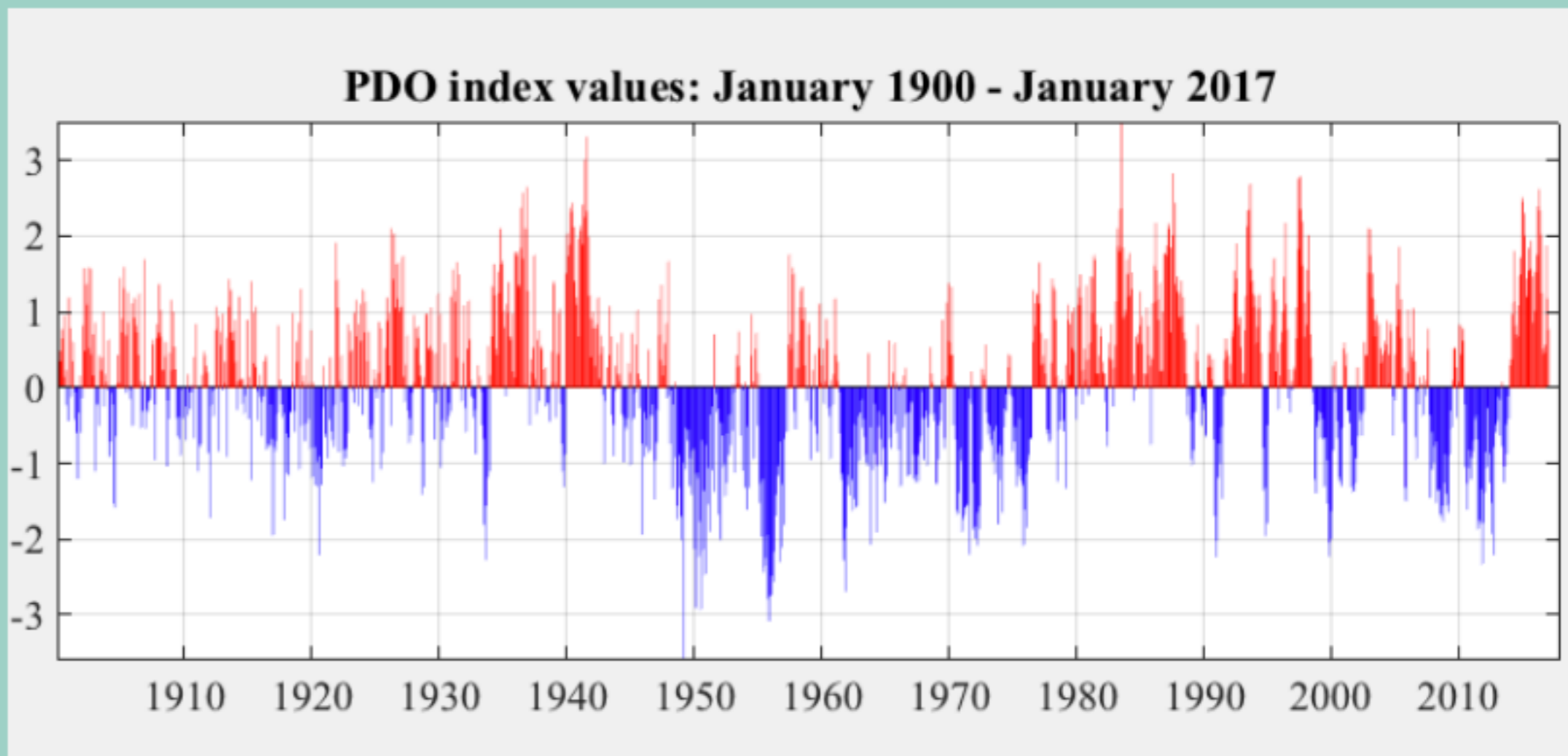
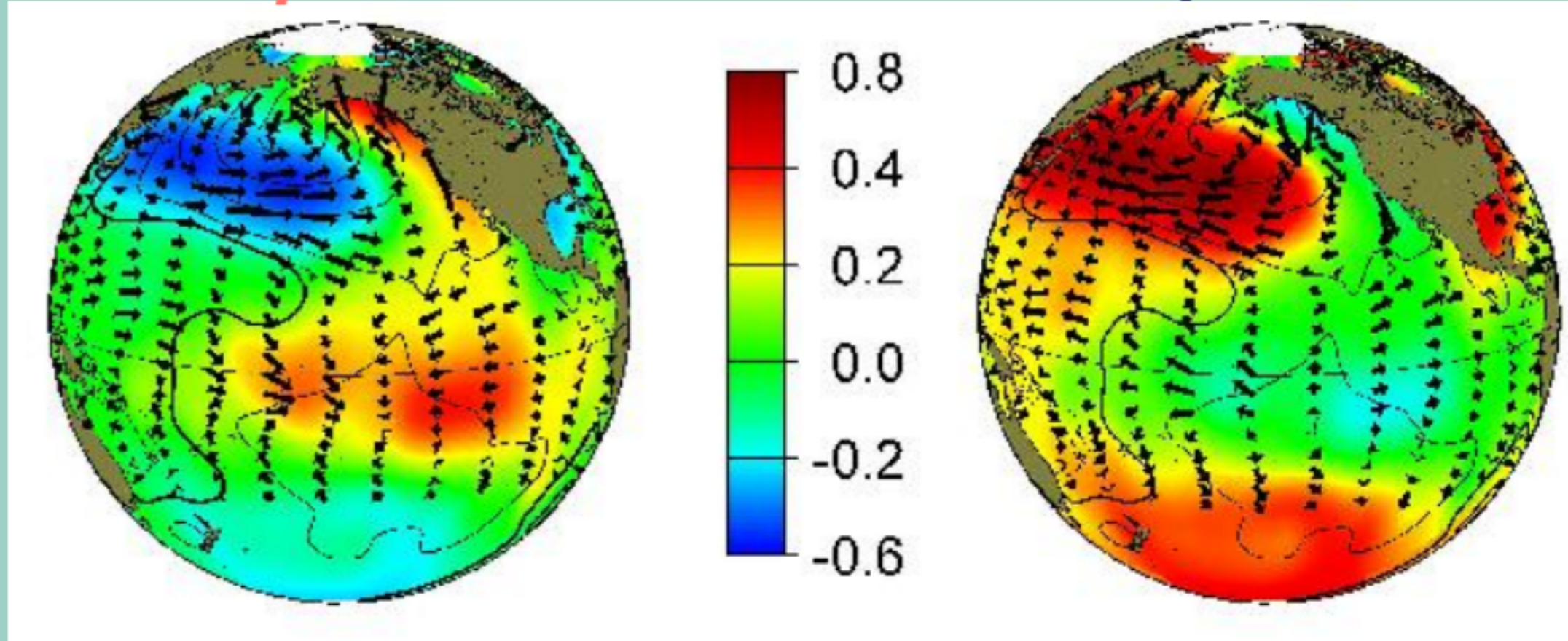


Though many of the major effects of the ENSO phases are felt at equatorial latitudes, the impacts extend worldwide, including to Southeast Alaska. During an El Niño event warmer air to flow into Alaska. This is caused by the Pacific jet stream increasing and shifting towards the equator, leaving an area of lower pressure over the North Pacific. During La Niña, the opposite occurs and colder air builds up over Alaska. Currently, there is a 65% chance of El Niño development by Spring 2019.

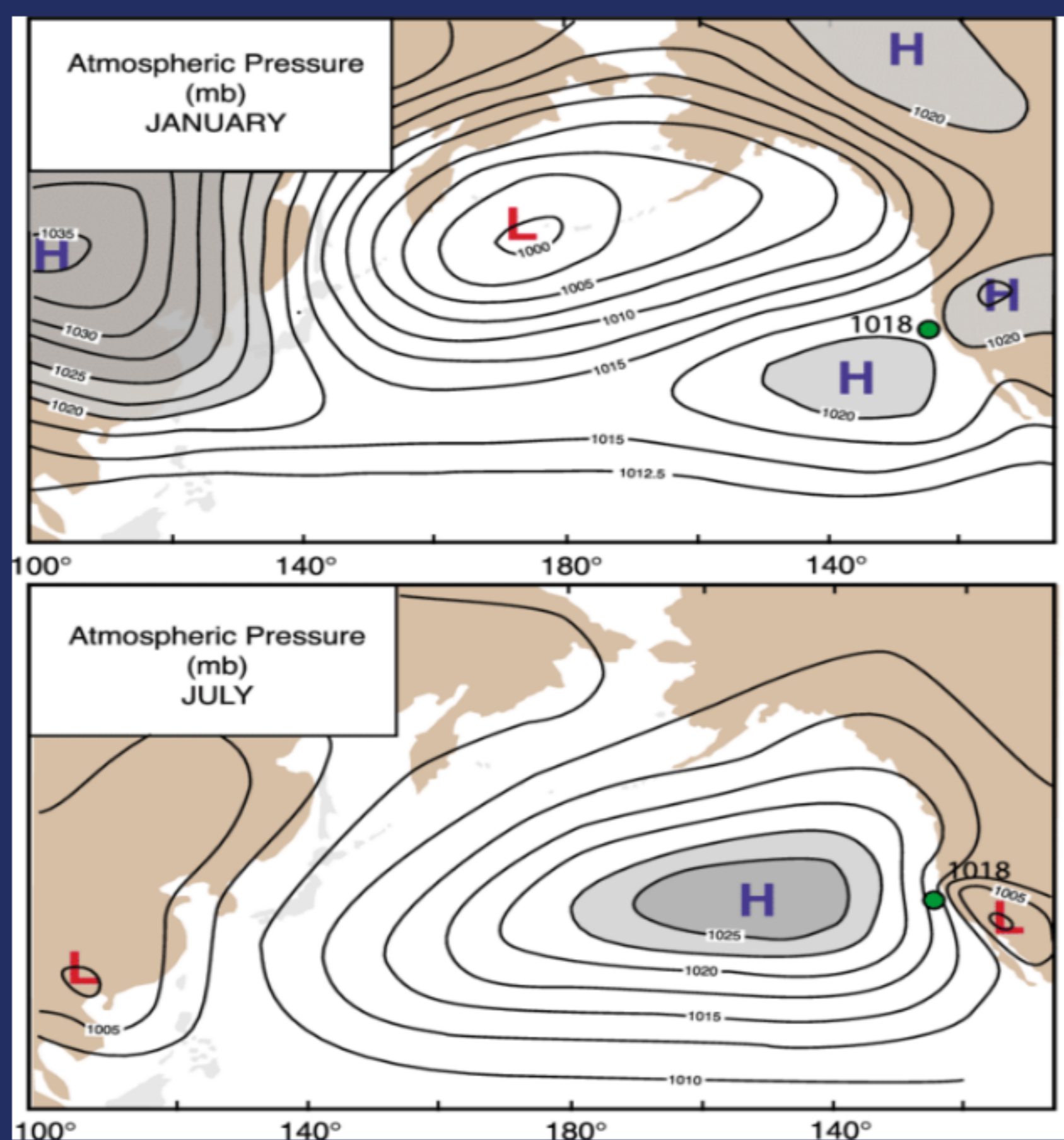
The Pacific Decadal Oscillation (PDO) is a recurring and naturally-occurring pattern of climate variability in the Pacific Ocean, similar to the ENSO cycle. However, a few key points differentiate the two. First, the PDO time scale is decades long (20-30 years), documented since the early 1900s. Secondly, the main impacts of the PDO are felt in the North Pacific, with secondary impacts felt in tropical regions. The cause of the PDO is unknown. PDO cycles can have significant impacts on ecosystems in Southeast Alaska:

- Warm/Positive: increased streamflow & beneficial nearshore mixed layer conditions that lead to increased biological productivity - including increased Alaskan salmon populations.
- Cold/Negative: the opposite - decreased biological productivity.
- During each phase, the opposite effect is seen on the west coast of contiguous U.S.

**SST DURING VARYING PDO PHASES**  
**WARM/POSITIVE** **COLD/NEGATIVE**

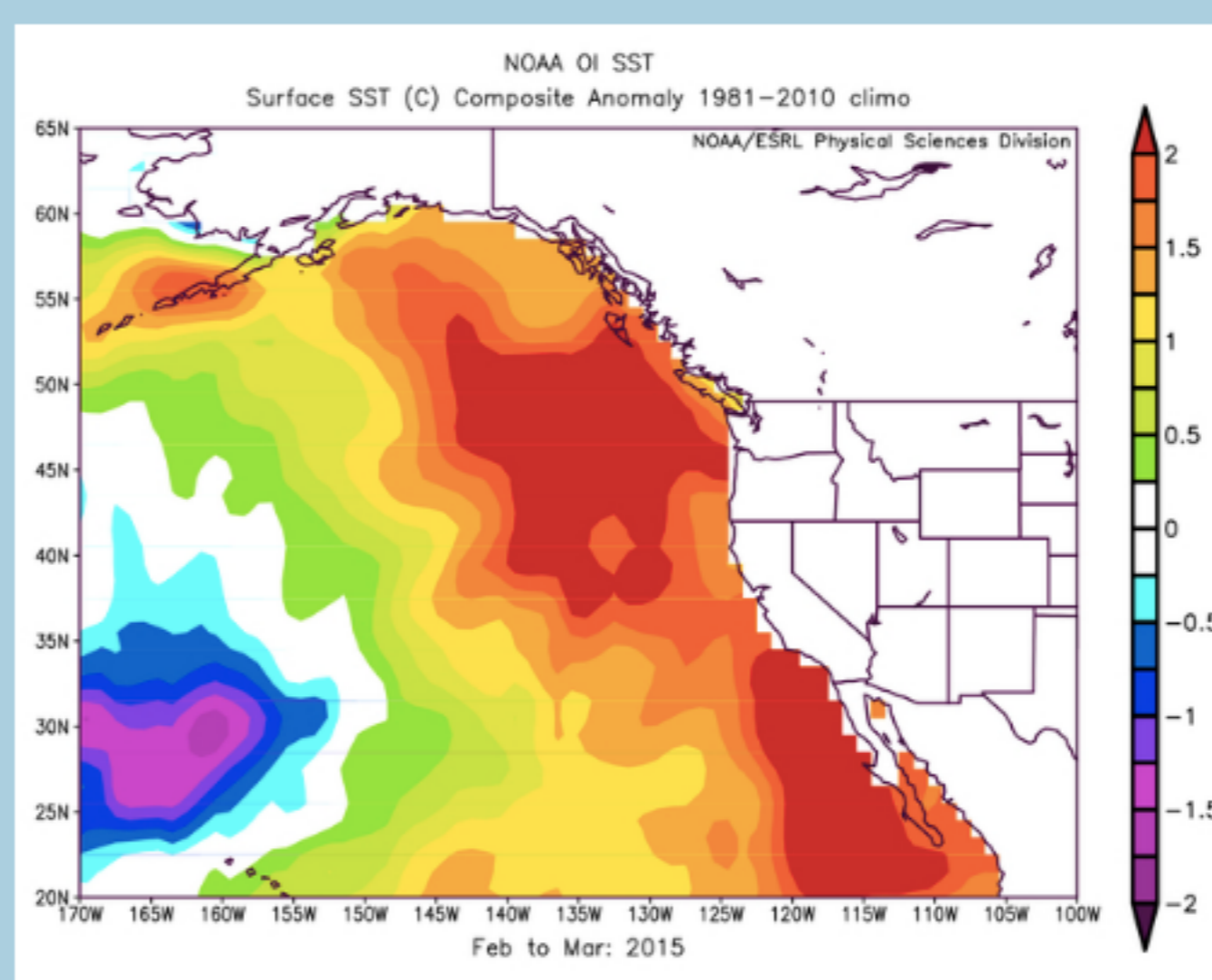


**SEASONAL CYCLE OF NORTH PACIFIC HIGH & ALEUTIAN LOW**



The North Pacific High - or the Hawaiian High, or North Pacific Subtropical High - is an area of high pressure in the North Pacific Ocean. In the Northern Hemispheric summer the high pressure area peaks and is located farther north; in the Northern Hemispheric winter the high pressure area subsides and moves closer toward the equator as the Aleutian Low becomes the more dominant force. The Aleutian Low is considered a generating area for storms. These alternating areas of high and low pressure play an important role in the region's weather patterns, and can even impact the marine environment - see "the blob" below.

**NORTH PACIFIC HIGH & ALEUTIAN LOW** 10, 11



In October of 2013 to February of 2014, unusually strong high pressure and weak low pressure caused the formation of an area of abnormally warm water - what scientists eventually dubbed the blob." The unusual pressure system

has been attributed to potentially the PDO or a weak Aleutian Low, though the science seems to be unsettled. Either way, the blob that lasted through 2015 impacted weather all over the US (warm & dry on the west coast, cold and snowy on the east) and reduced ocean mixing - thus reducing biological productivity. The blob appeared to return in late 2018, but was dissipated before the end of the year.

**EDITORIAL NOTE**

You may notice that the name "El Niño - Southern Oscillation" only gives credit to one phase of the ENSO cycle. Before La Niña or the neutral phase were recognized by science, fishermen in South America noticed that once every few years around Christmas the waters were particularly warm, so they named this warming "El Niño" - Spanish for little boy and associated with the Christmas holiday because of the birth of Jesus (TEK at work!!). Scientists later connected this warming to the previously discovered southern oscillation, and "ENSO" was created in the 1960s. La Niña and the neutral phase didn't gain prominence until the 1980s.

# CITATIONS

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## CONTENT

1. <https://earthobservatory.nasa.gov/features/ElNino>
2. <https://www.conserve-energy-future.com/what-is-el-nino.php>
3. <https://www.weather.gov/mhx/ensowhat>
4. [https://www.weather.gov/jan/el\\_nino\\_and\\_la\\_nina](https://www.weather.gov/jan/el_nino_and_la_nina)
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13. <https://www.iflscience.com/environment/what-warm-blob-pacific-and-what-can-it-tell-us-about-our-future-climate/>
14. <https://komonews.com/weather/scotts-weather-blog/uw-prof-warm-blob-of-pacific-ocean-waters-is-dead>

## MAPS & IMAGES

1. El Nino Weather Pattern Image - same as #5 above
2. PDO Globe Image - same as #9
3. PDO 100-Year Record - same as #9
4. North Pacific High/Aleutian Low Seasonal Changes - [https://www.researchgate.net/figure/Seasonal-cycle-of-the-NE-Pacific-high-and-north-Pacific-surface-currents-Lyle-et-al\\_fig2\\_228629784](https://www.researchgate.net/figure/Seasonal-cycle-of-the-NE-Pacific-high-and-north-Pacific-surface-currents-Lyle-et-al_fig2_228629784)
5. The Blob - same as #13 above