Air-sea interaction: Pacific Decadal Oscillation
Last week

- El Nino / La Nina

- The first independent mode captured from the sea surface temperature anomalies in the Pacific
Today

- Pacific Decadal Oscillation
- Other climate events in the world
Pacific Decadal Oscillation

- A variability with a period of about 20 years in the North Pacific
Pacific Decadal Oscillation

Warm phase

Cold phase

PDO and air-sea interaction

Sea level pressure anomaly in the warm phase of PDO

Sea surface temperature anomaly in the warm phase of PDO
WIND-SST IN LARGE SCALE

MIXING
WIND-SST IN LARGE SCALE

MORE MIXING
Correlation between wind speed and SST

Oceanic response to the atmosphere

2000-2009 satellite wind and SST data

A credit to Dr. Hyodae Seo (WHOI)
Impact of a warm phase of PDO on climate

1. Deepening of Aleutian low
2. Stronger wind over the Pacific > Cooler water temperature
3. Stronger southerly wind in the Northwest N. America > Warmer climate
4. Weakening of the equatorial wind along the California coast > poorer ocean
Teleconnection
PDO v.s. ENSO

From http://ffden-2.phys.uaf.edu/645fall2003_web.dir/Jason_Amundson/enso.htm
PDO v.s. ENSO

• Time scale
  • PDO events persist for 20 to 30 years
  • ENSO events persist for 6 to 18 months

• The climate fingerprints
  • PDO in the North Pacific / North American sector
  • ENSO in the tropics

From http://research.jisao.washington.edu/pdo/
PDO index

From https://www.nwfsc.noaa.gov/research/divisions/fe/estuarine/oeip/ca-pdo.cfm
Impact of PDO on climate

The Pacific Decadal Oscillation (PDO) affects climate patterns in the Pacific Ocean and beyond. Each phase lasts 20-30 years, with a warm phase (positive) and a cool phase (negative).

**Warm (Positive) Phase**
- Cooler than normal in some regions, warmer than normal in others.
- Normally wet areas may become drier.
- Polar Jet Stream extended, storm track amplified.

**Cool (Negative) Phase**
- Warmer than normal in some regions, cooler than normal in others.
- Normally wet areas may become drier.
- Polar Jet Stream retracted, storm track reduced.

Figure from http://the-mound-of-sound.blogspot.kr/2015/03/coming-soon-great-warming-spurt.html
And https://www.climate.gov/sites/default/files/LosNinoshighpressure_0.jpg
Impact of PDO on the climate of east Asia

From Zhao et al., 2016
Impact of PDO on the climate of east Asia

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Sea surface temperature near the Korean Peninsula

- Black: SST anomaly
- Blue: -1 x (PDO index)
- Red: ENSO index

Kim et al., 2011