El Niño: what it is and what to expect in Southern California

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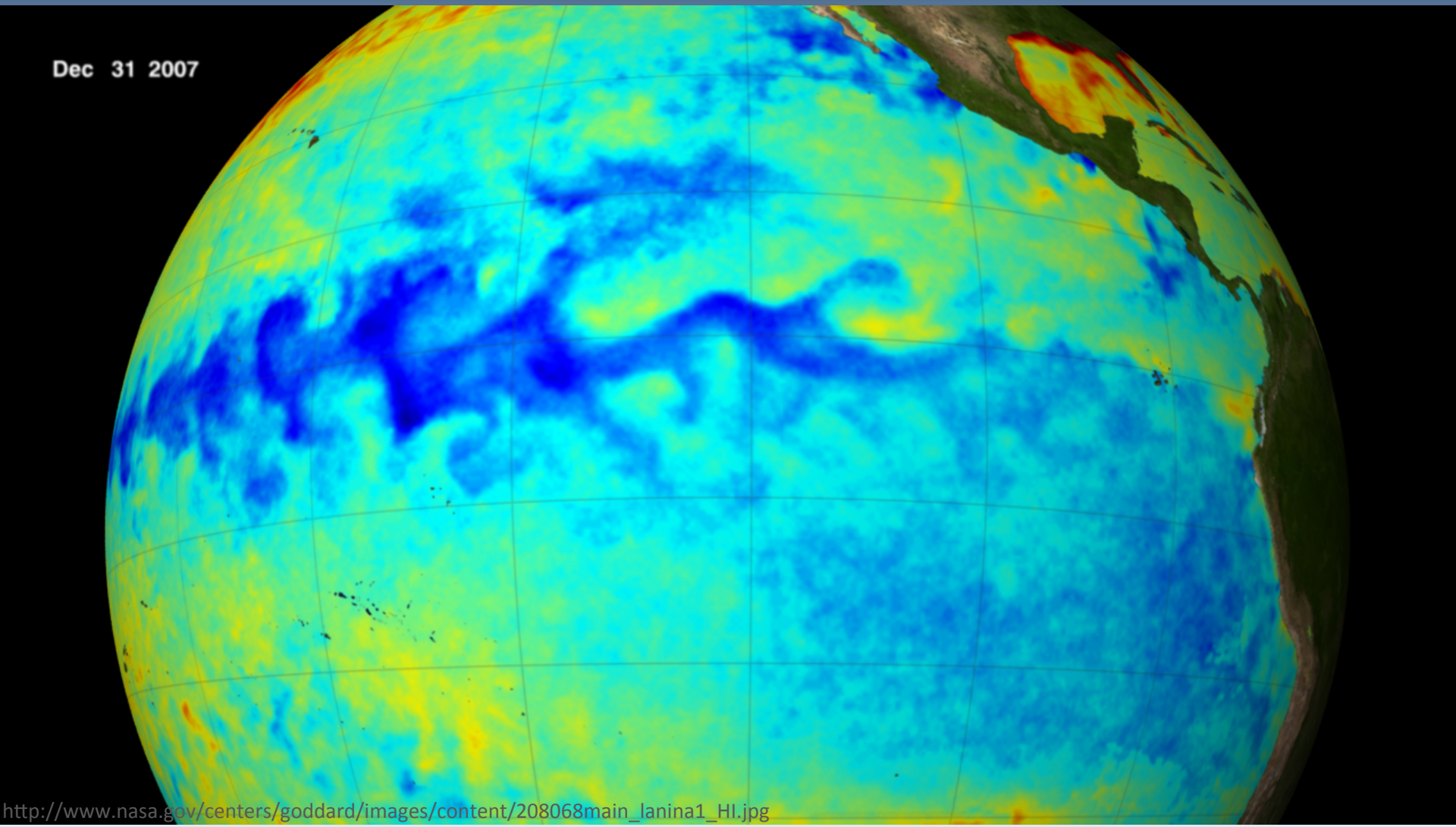
Outline

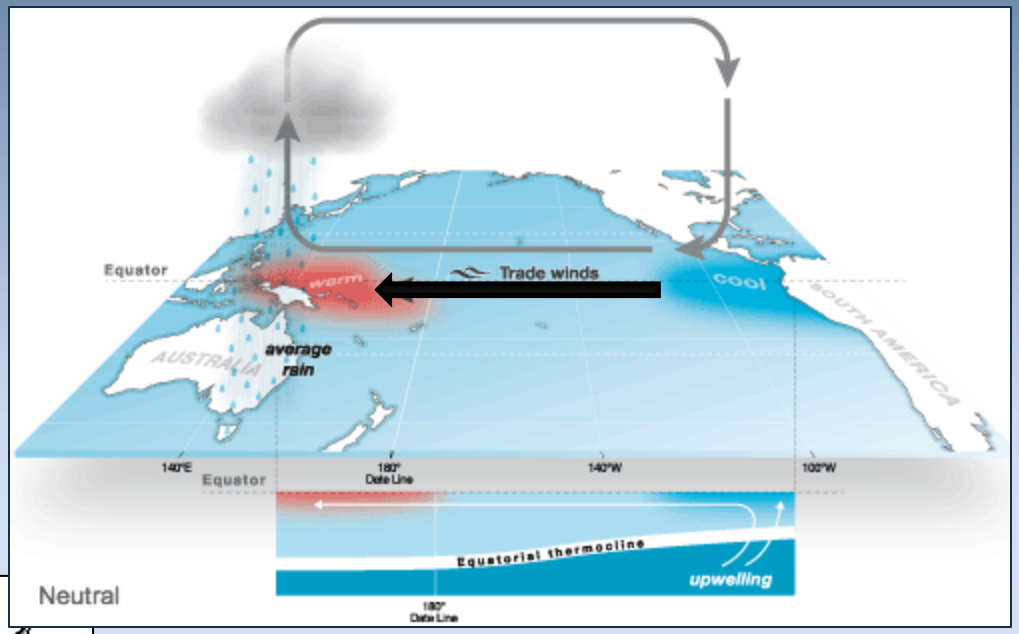
- Tropical Ocean and El Niño
- Impacts beyond the tropics
  - Atmospheric circulation and storms: temperature, wind, waves, precipitation
- El Niño conditions – past and present
- Resources for weather and storm-related hazard projections



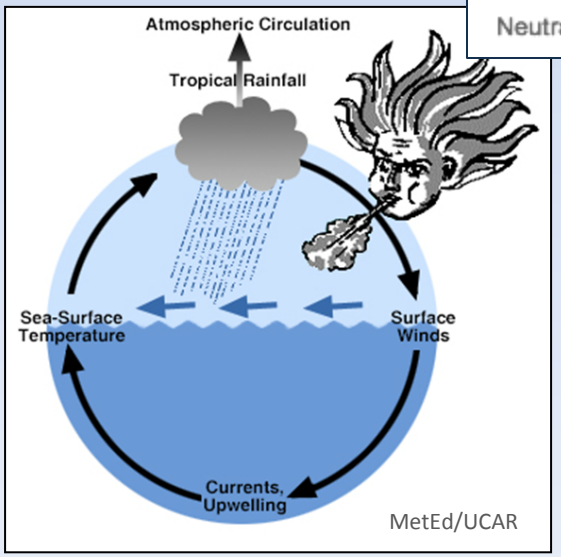
http://www.nasa.gov/centers/goddard/images/content/208068main_lanina1_HI.jpg

Neutral conditions

- Trade winds
- East – cool (upwelling)
- West - warm water, precipitation

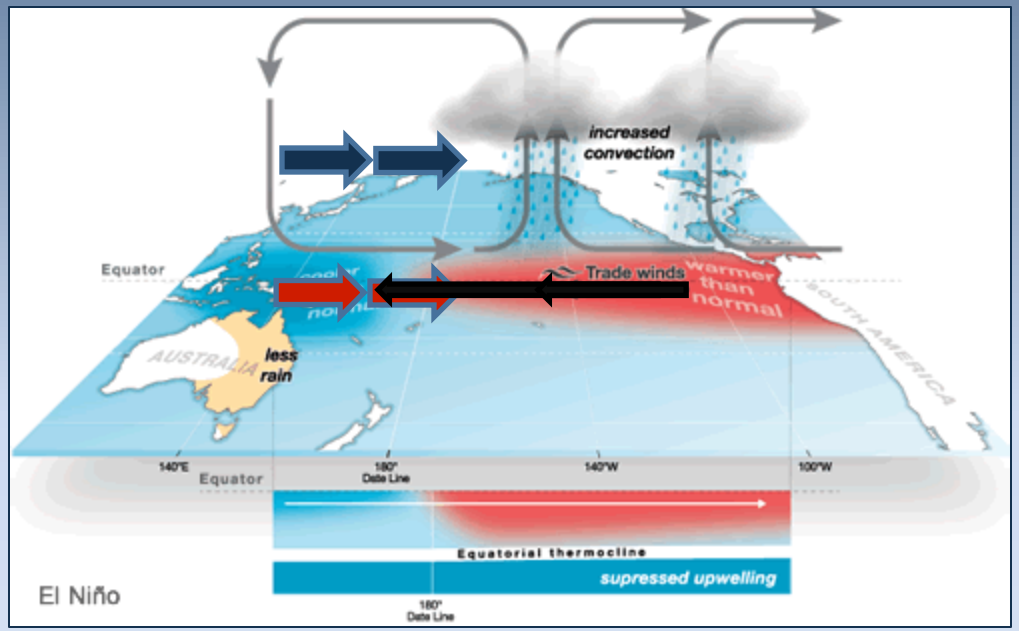


http://www.bom.gov.au/climate/enso/history/ln-2010-12/three-phases-of-ENSO.shtml

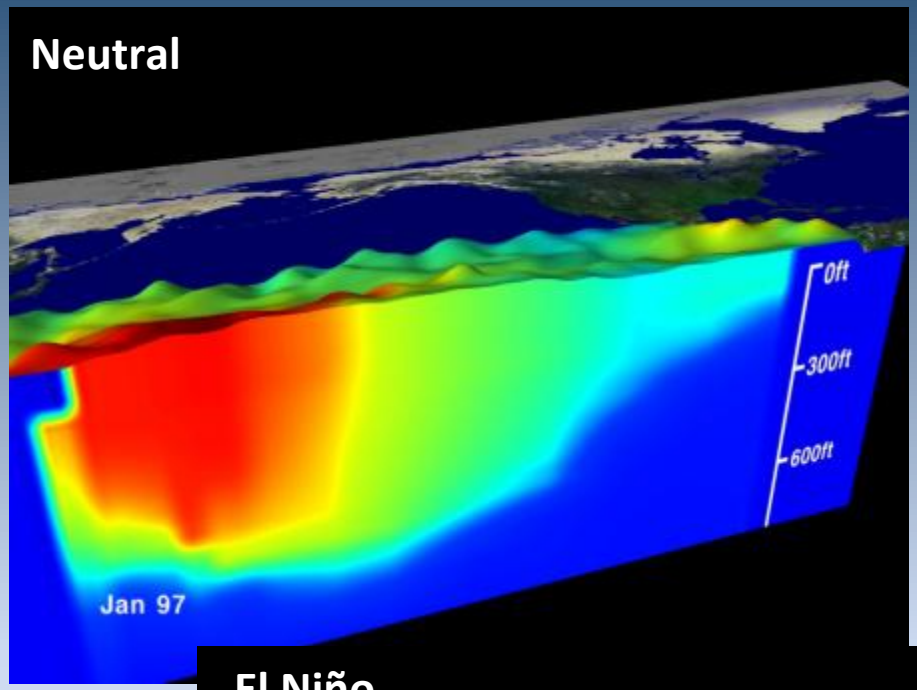


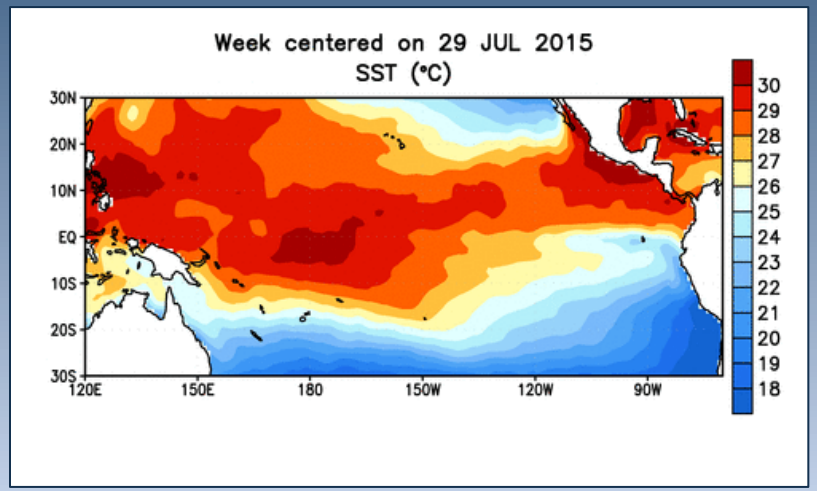
El Niño conditions

- Decreased winds
- Warmer water in east
- Shift in precipitation
- Shift in pattern of available heat→ Shift in atmospheric circulation

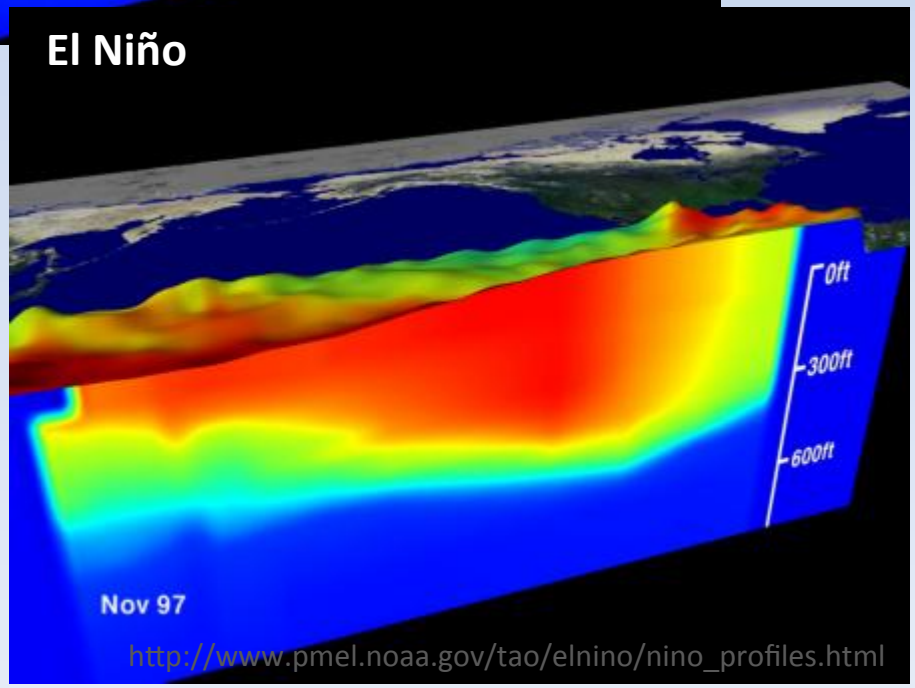


http://www.bom.gov.au/climate/enso/history/ln-2010-12/three-phases-of-ENSO.shtml





http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml

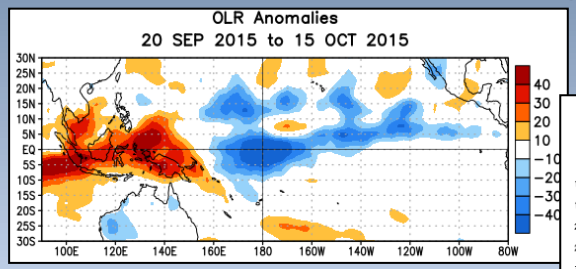


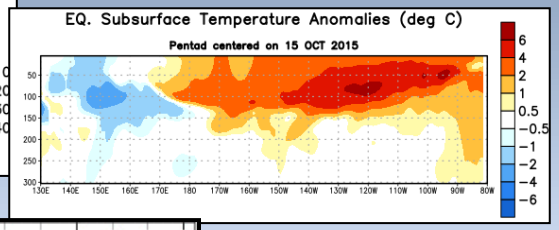
http://www.pmel.noaa.gov/tao/elnino/nino_profiles.html

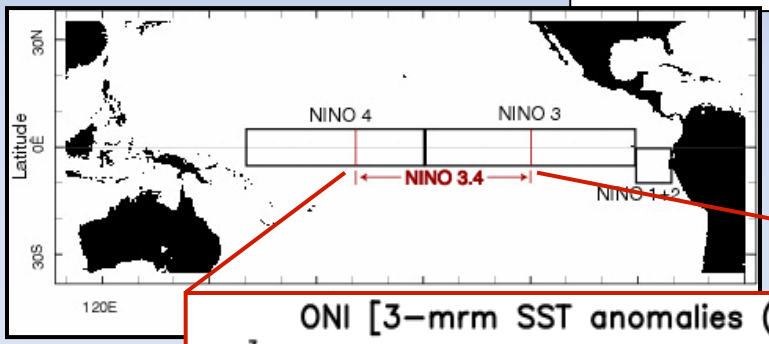
Monitoring El Niño

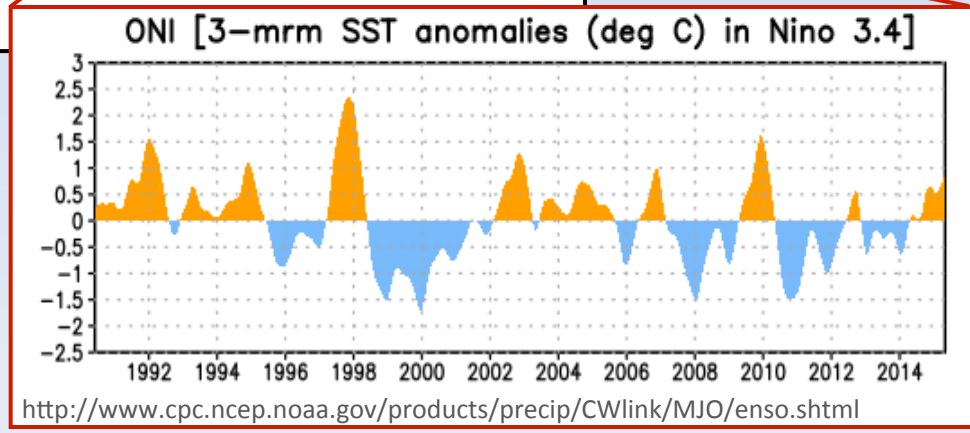
El Niño identified and monitored by changes in:

- Sea Surface Temperature
  - (SST Anomaly)
- Temperature at depth
- Atmospheric surface pressure
- Wind
- Precipitation patterns across Equator (OLR)
- **ONI**









http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml

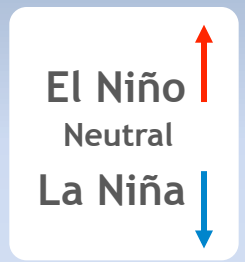
Oceanic Niño Index

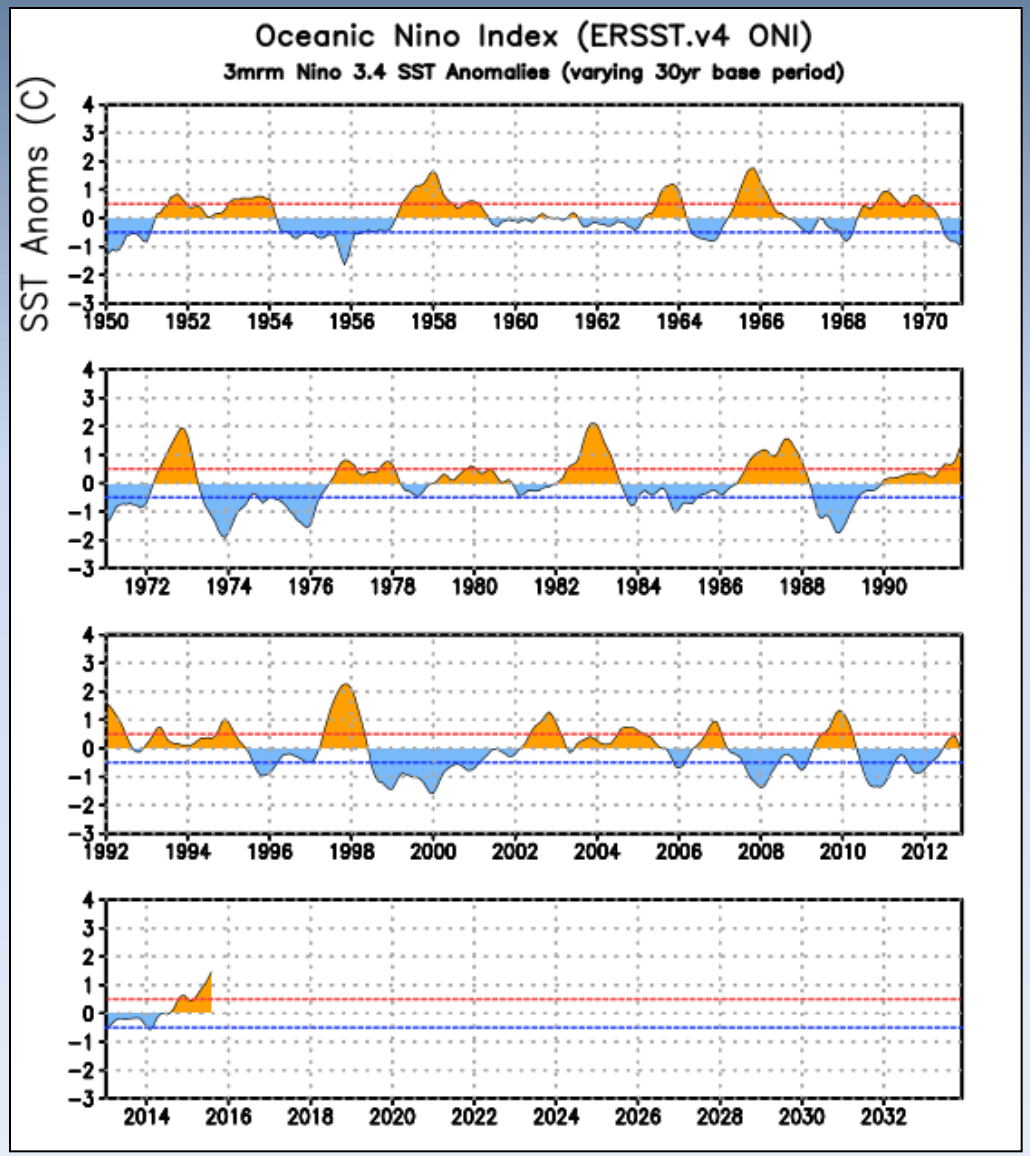
- El Niño:

  ONI greater than +0.5 C

- La Niña:

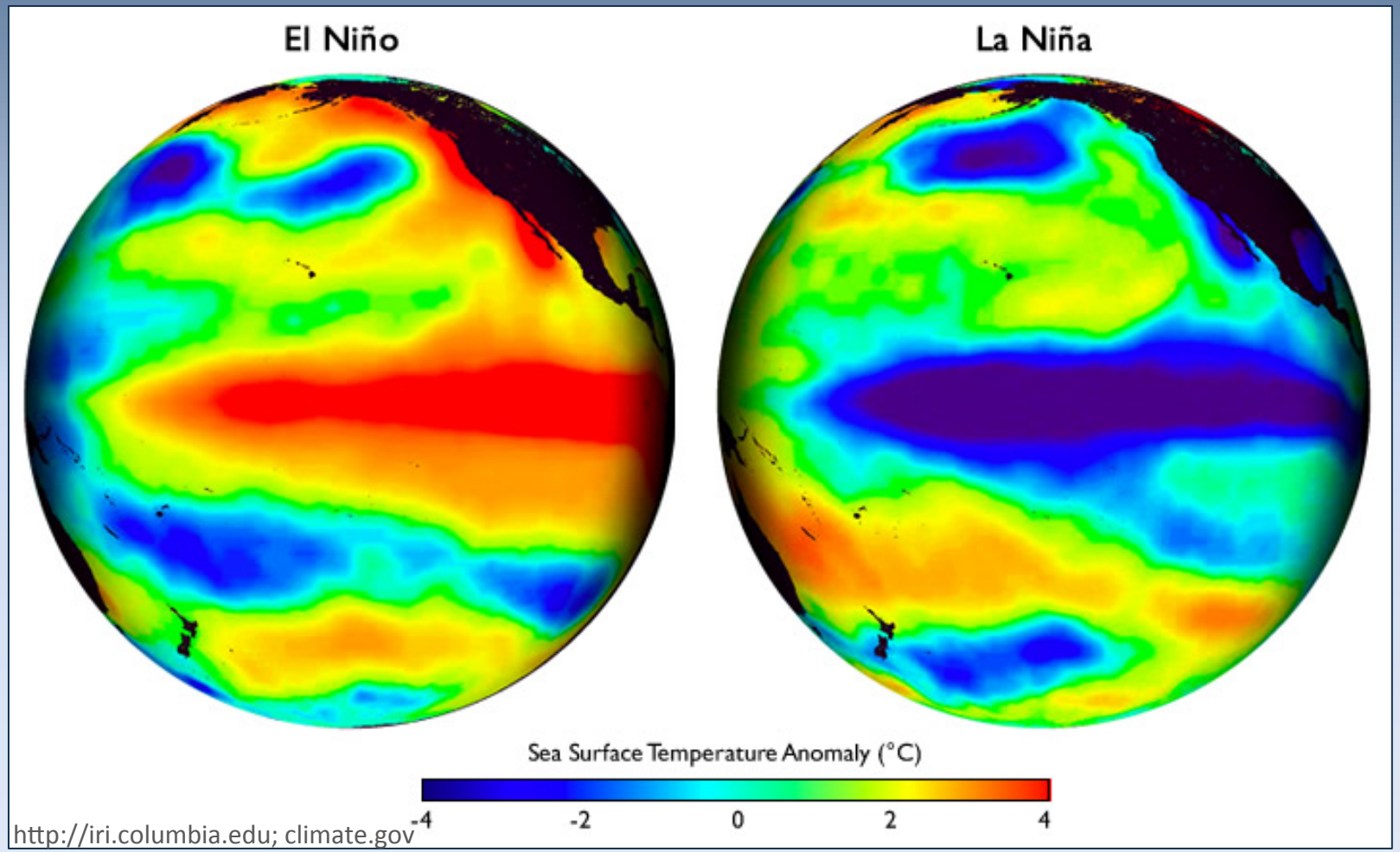
  ONI less than -0.5 C





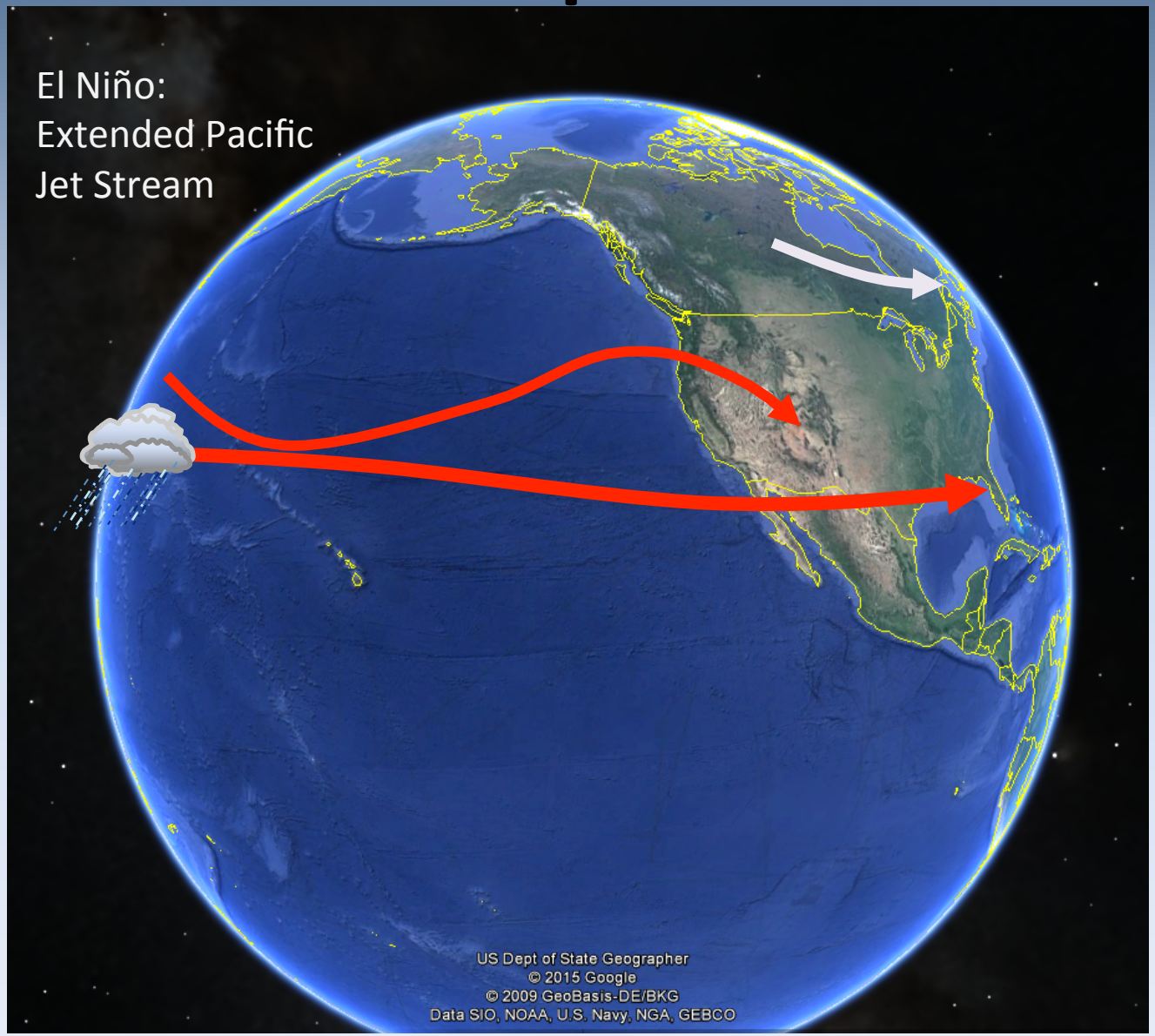
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/

El Niño and La Niña

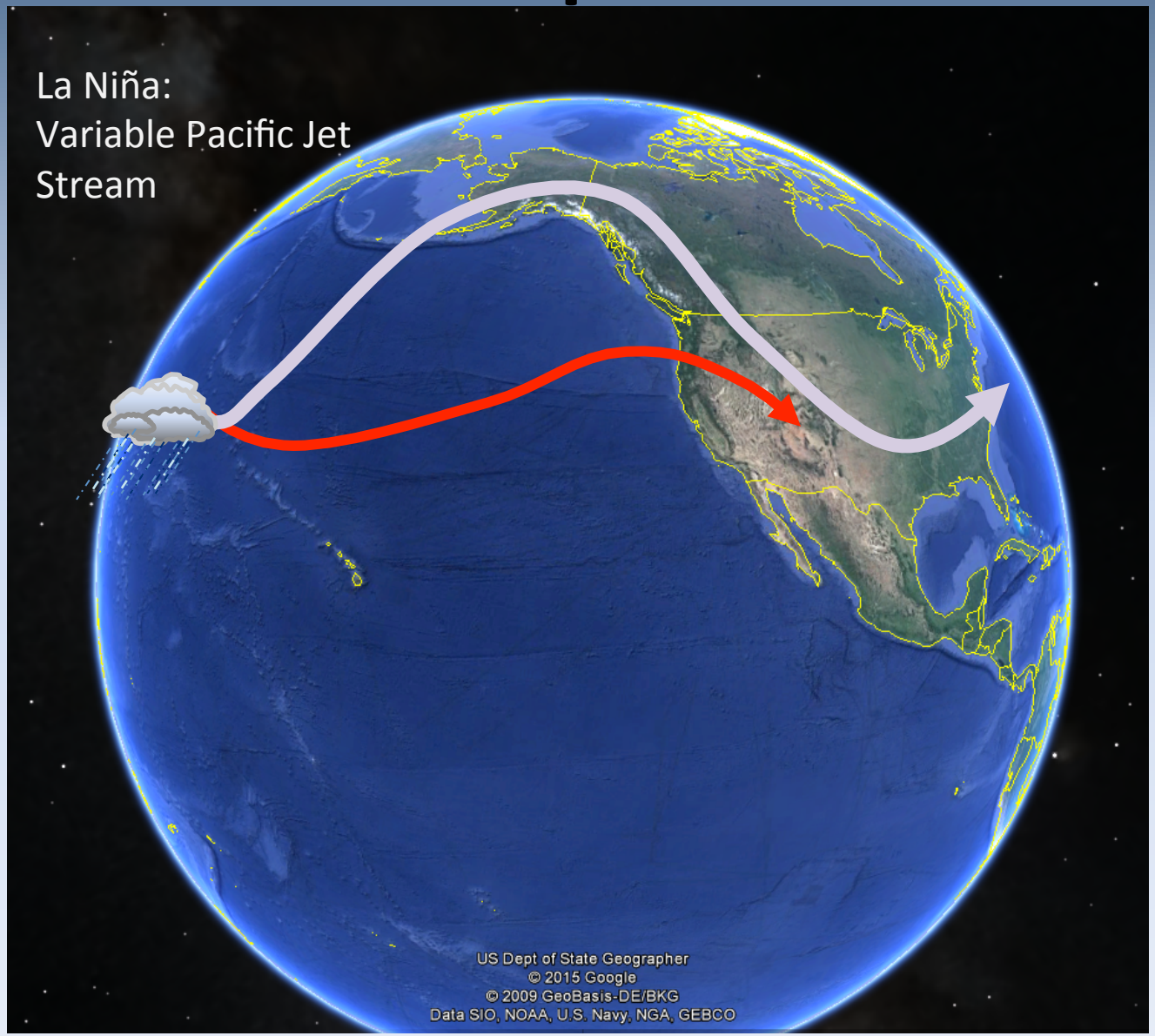


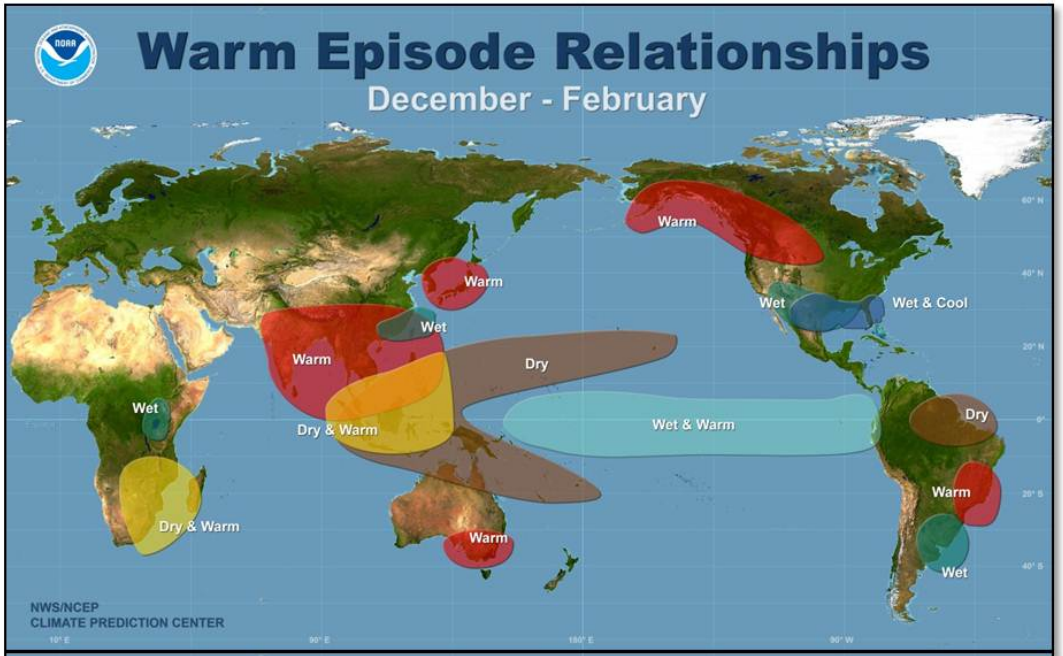
http://iri.columbia.edu; climate.gov

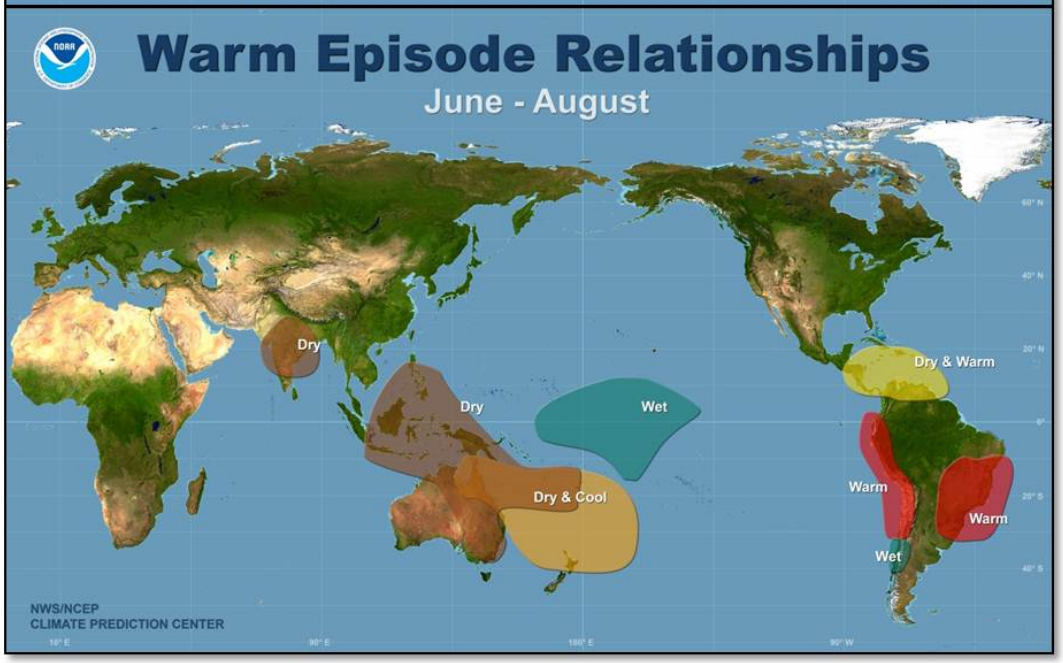
Impacts on Atmospheric Circulation



Impacts on Atmospheric Circulation

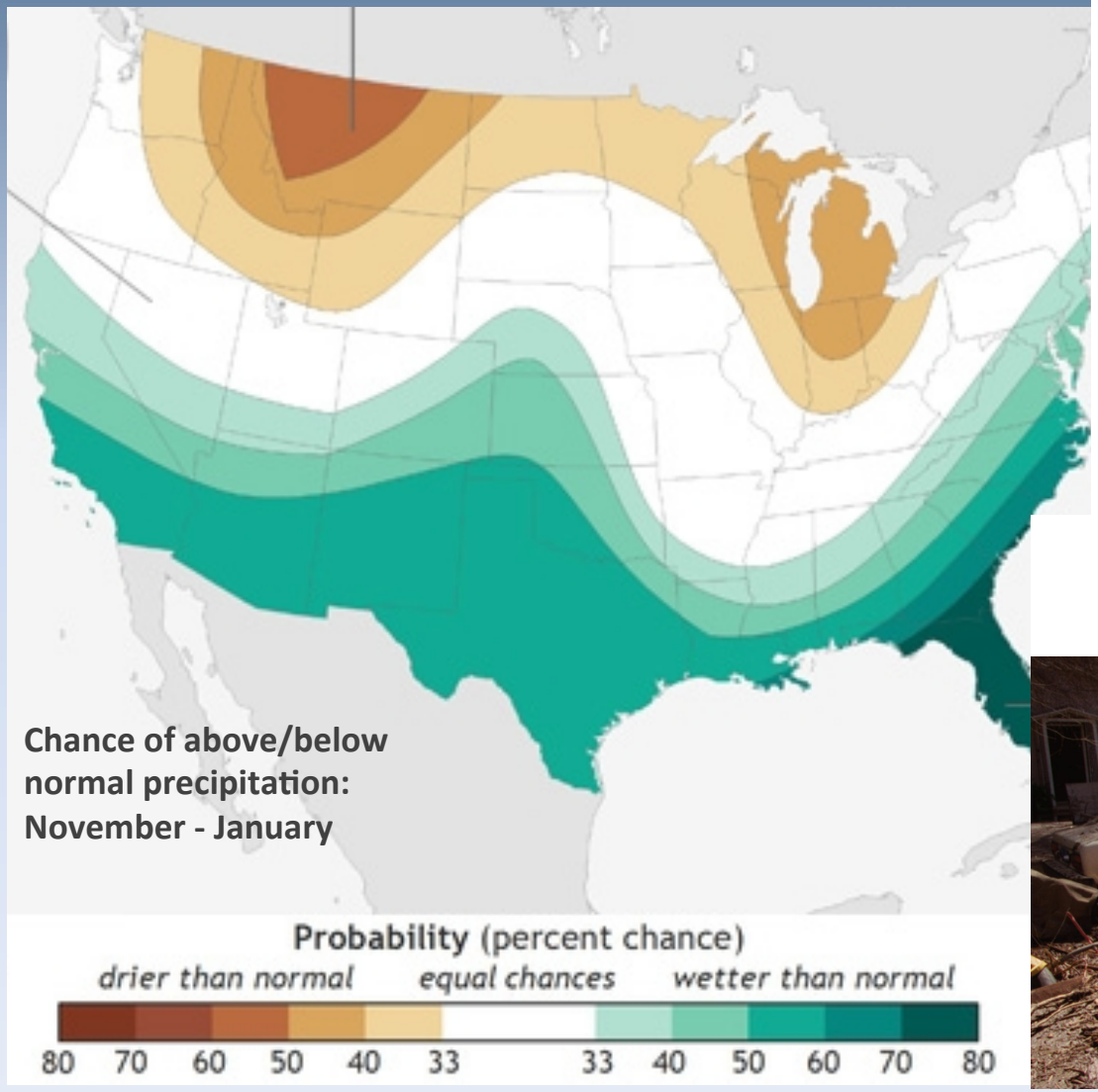


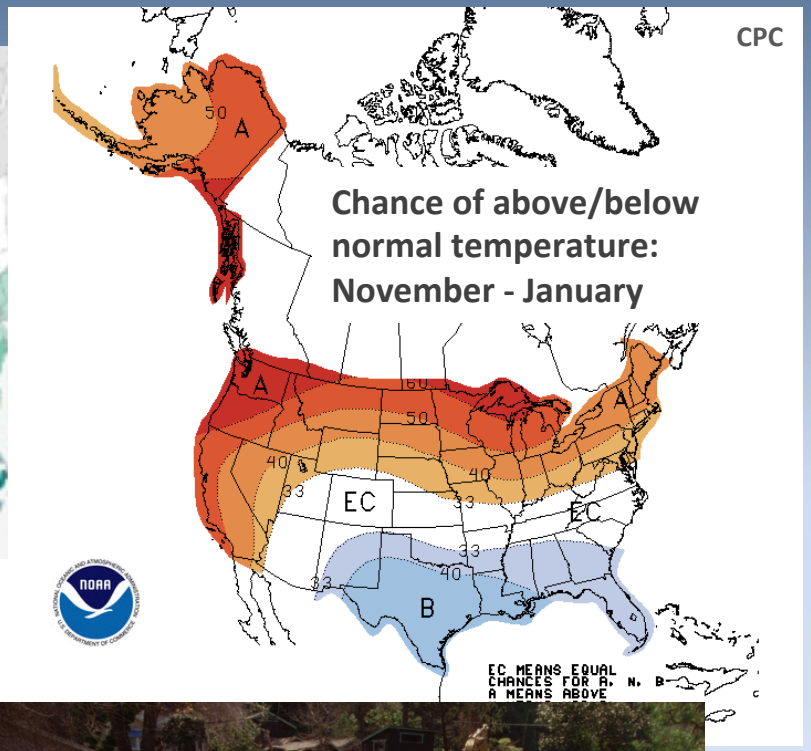




High Resolution Images can be found at:
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/ENSO/ENSO-Global-Impacts/

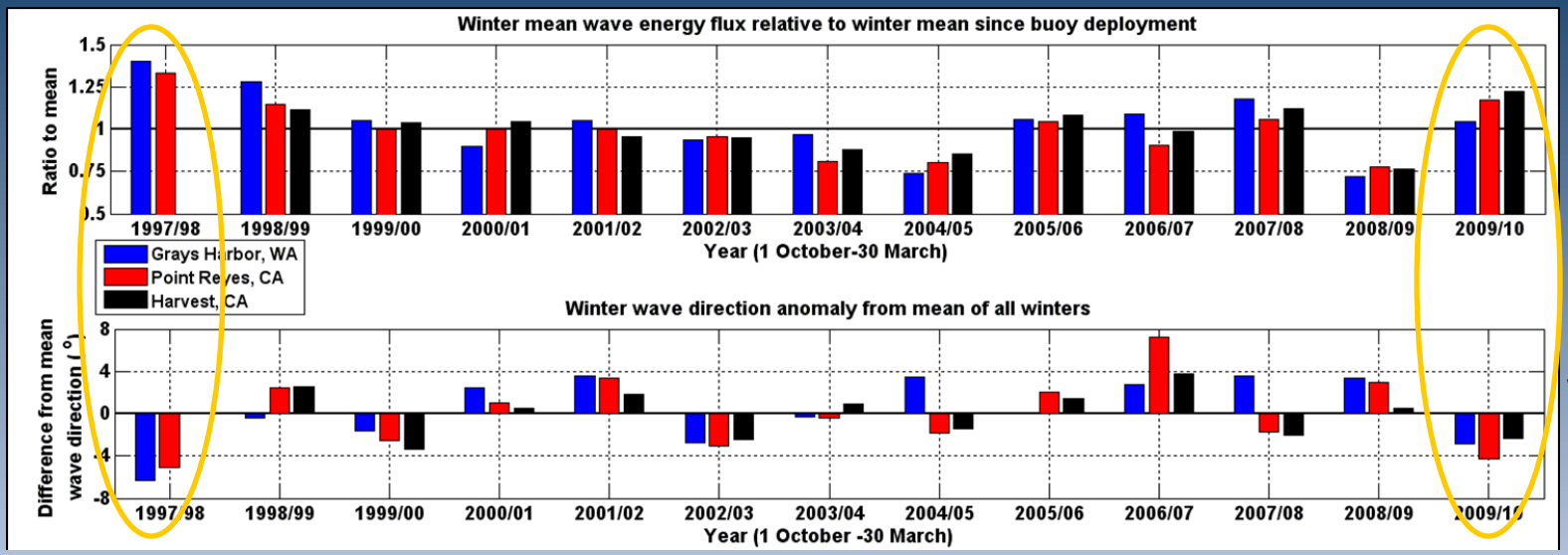
El Niño impacts





Alexander Gallardo, Los Angeles Times

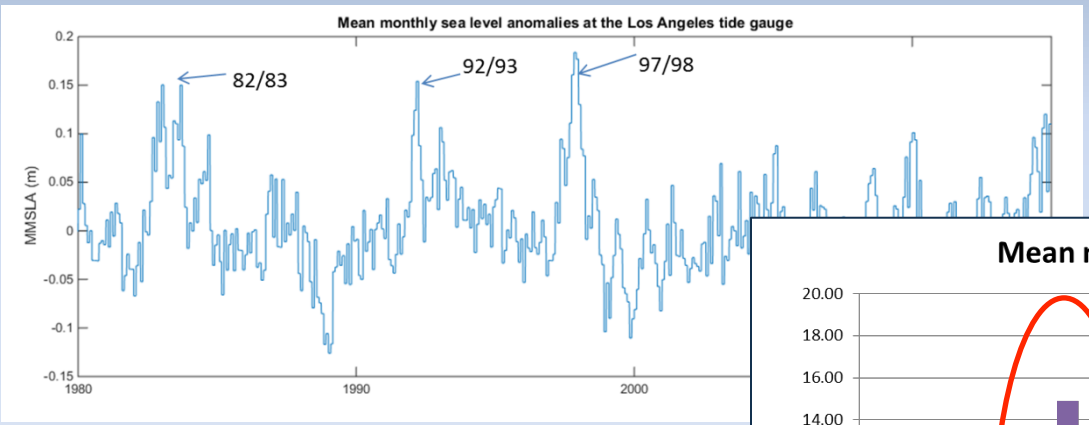
climate.gov, CPC



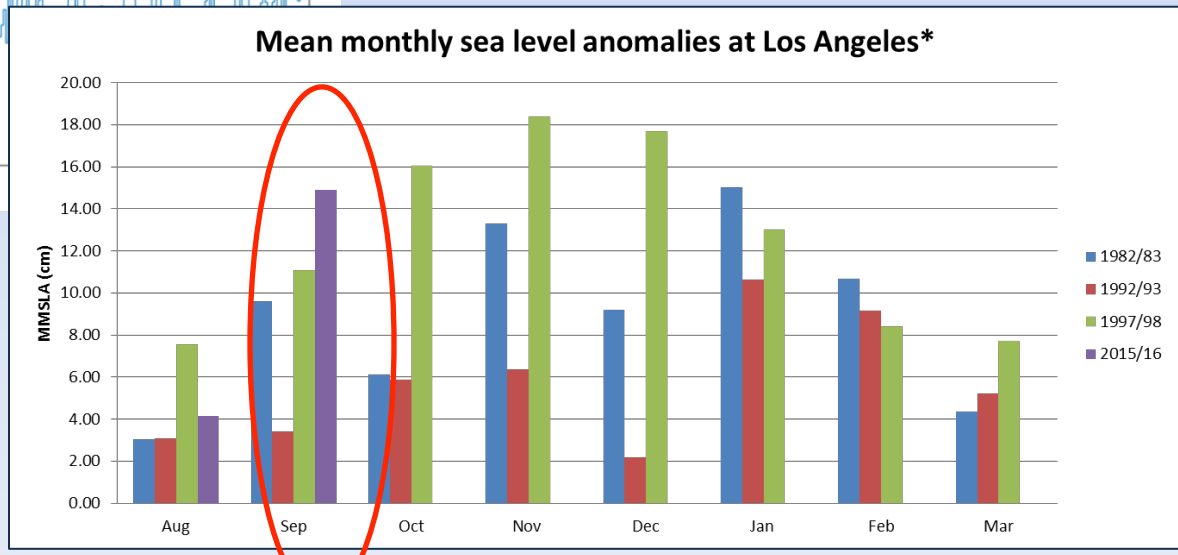
Wave energy

Wave direction

Barnard, P., Kaminsky, G., Hansen, J., Allan, J., Ruggiero, P., and Hoover, D. The Impact of the 2009-10 El Niño on West Coast Beaches, AGU 2010

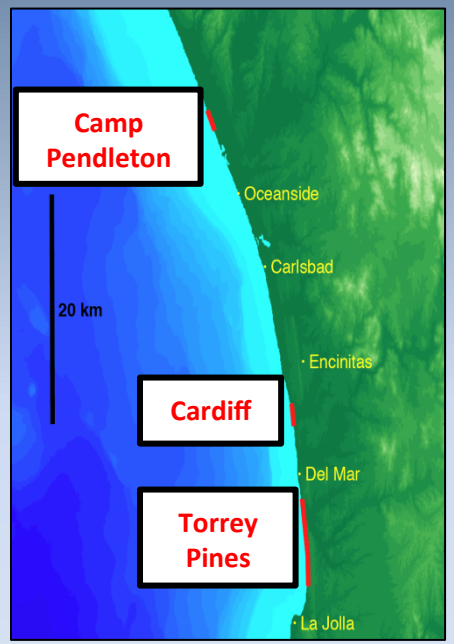


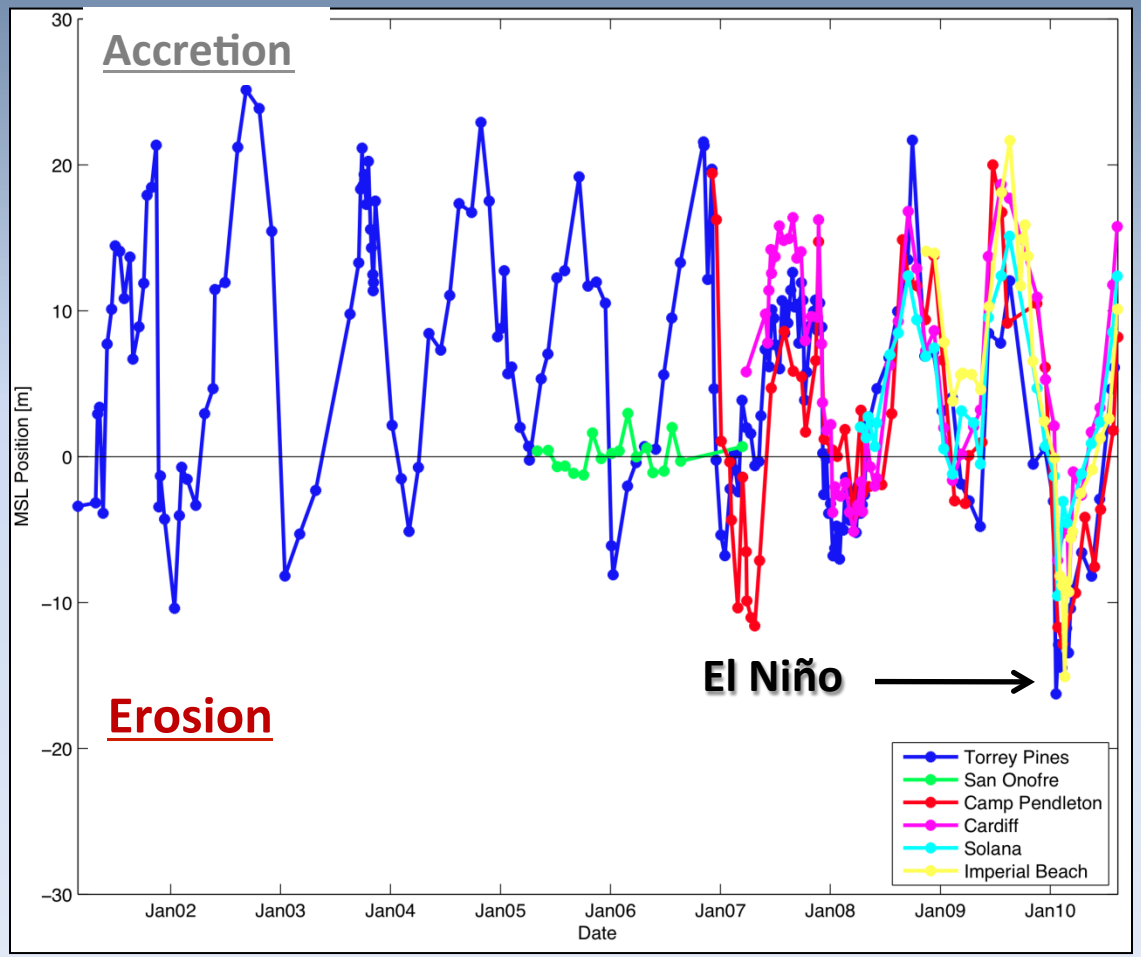
Increased water levels



* Data for September 2015 not available for L.A. tide gauge (https://tidesandcurrents.noaa.gov download date: 10/20/2015); Santa Monica gauge for Aug & Sep 2015 are used

El Niño impacts





Southern California Beaches during the El Niño Winter of 2009/2010 A. Doria, R.T. Guza, M.L. Yates, and W. O'Reilly
Nearshore Processes II. Thursday, December 16, 4:30PM, MW-3007 (Moscone West), Abstract OS44B-03

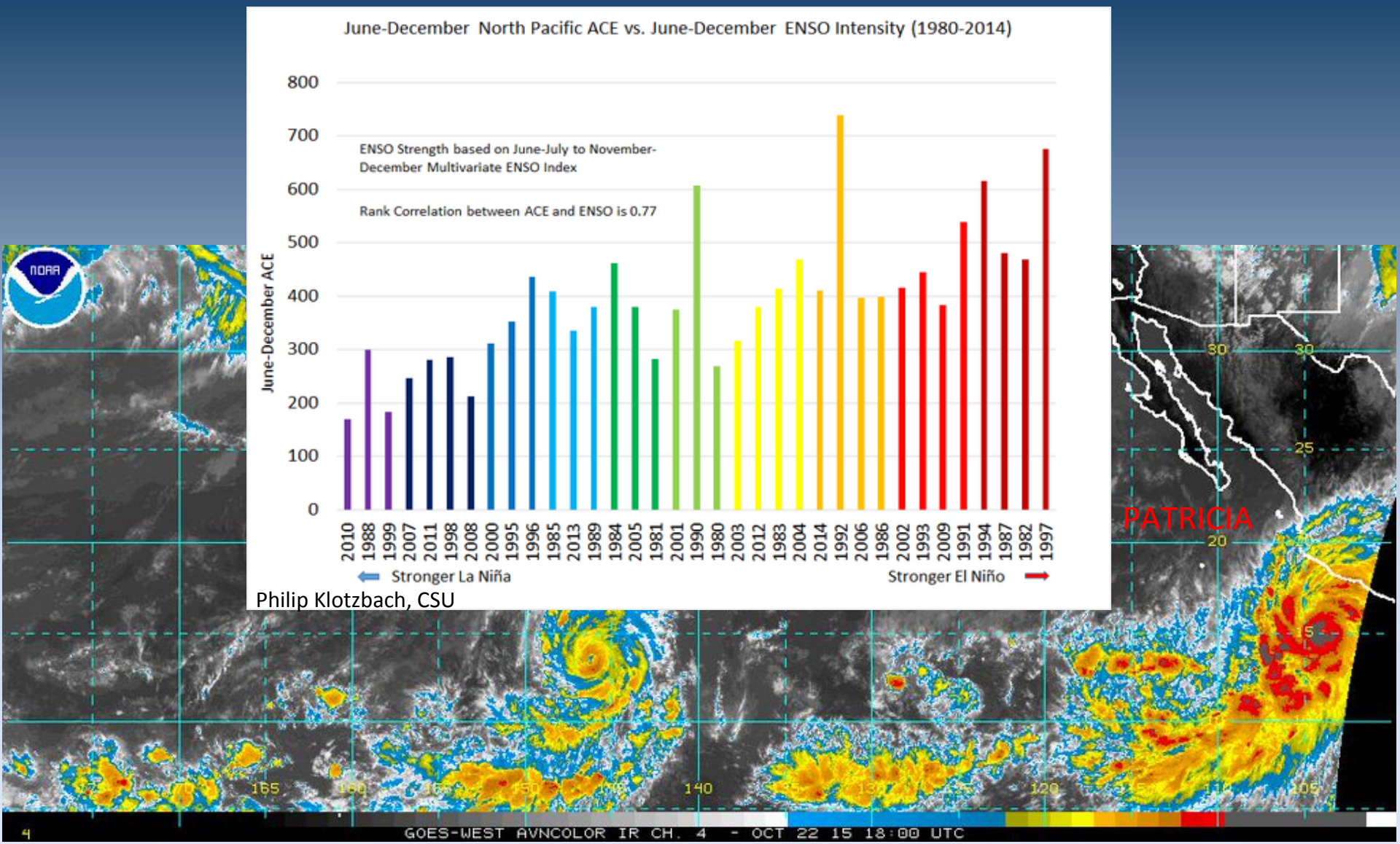
El Niño - impacts

Mel Melcon, Los Angeles Times

Ken Lubas, Los Angeles Times

Alan Hagman, Los Angeles Times

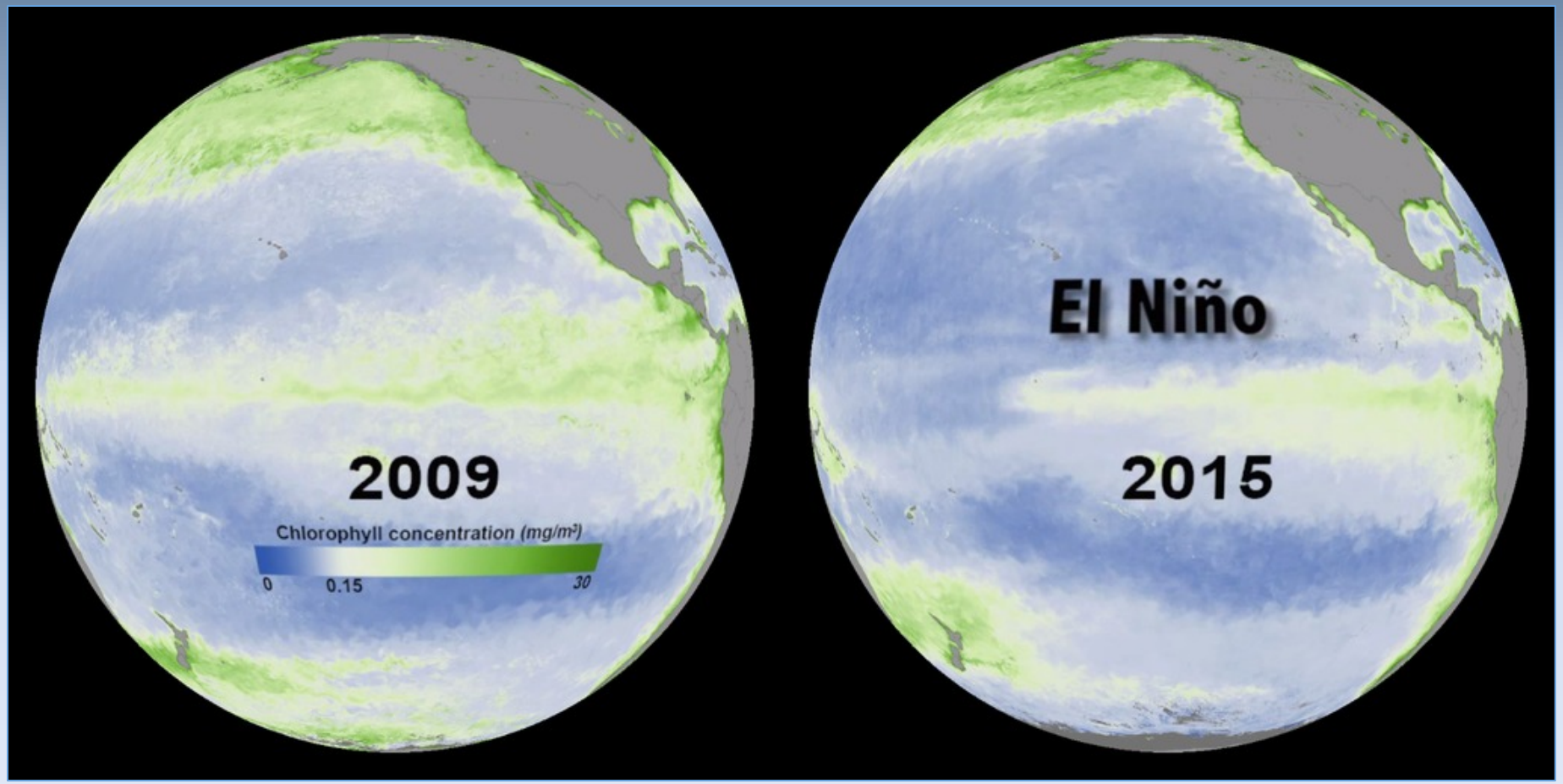
Carlos Chavez , Los Angeles Times



Philip Klotzbach, CSU

NOAA

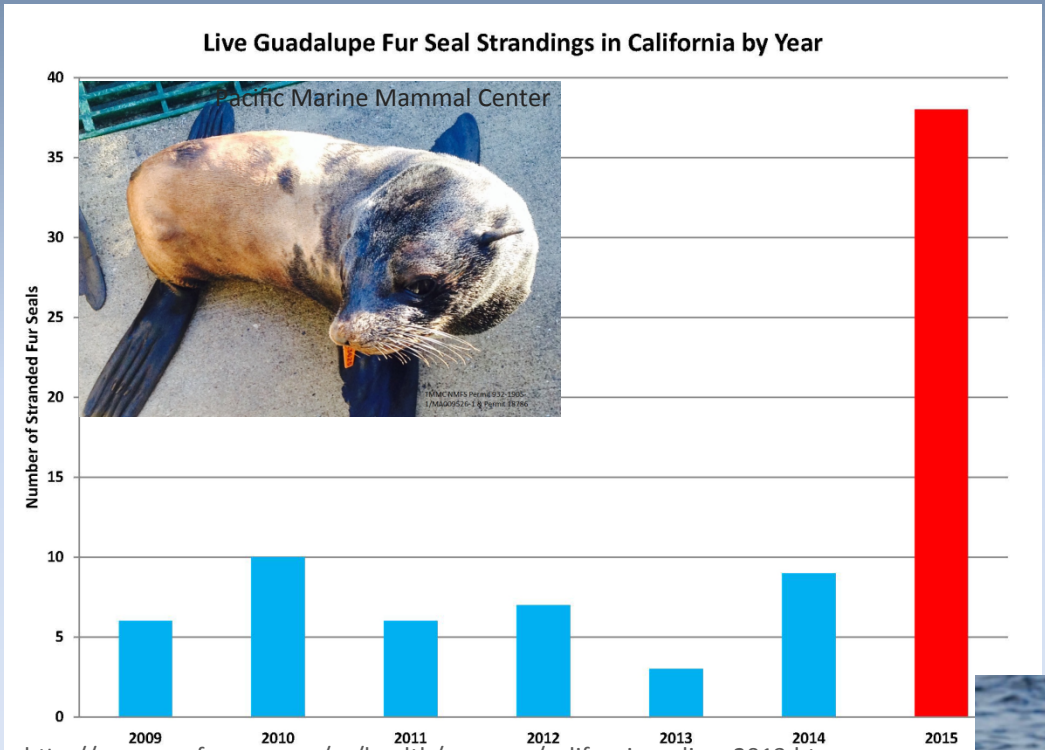
El Niño - impacts



MODIS – ocean color and phytoplankton.

Source: http://climatebits.org; http://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4387&button=recent

El Niño - impacts



http://www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm

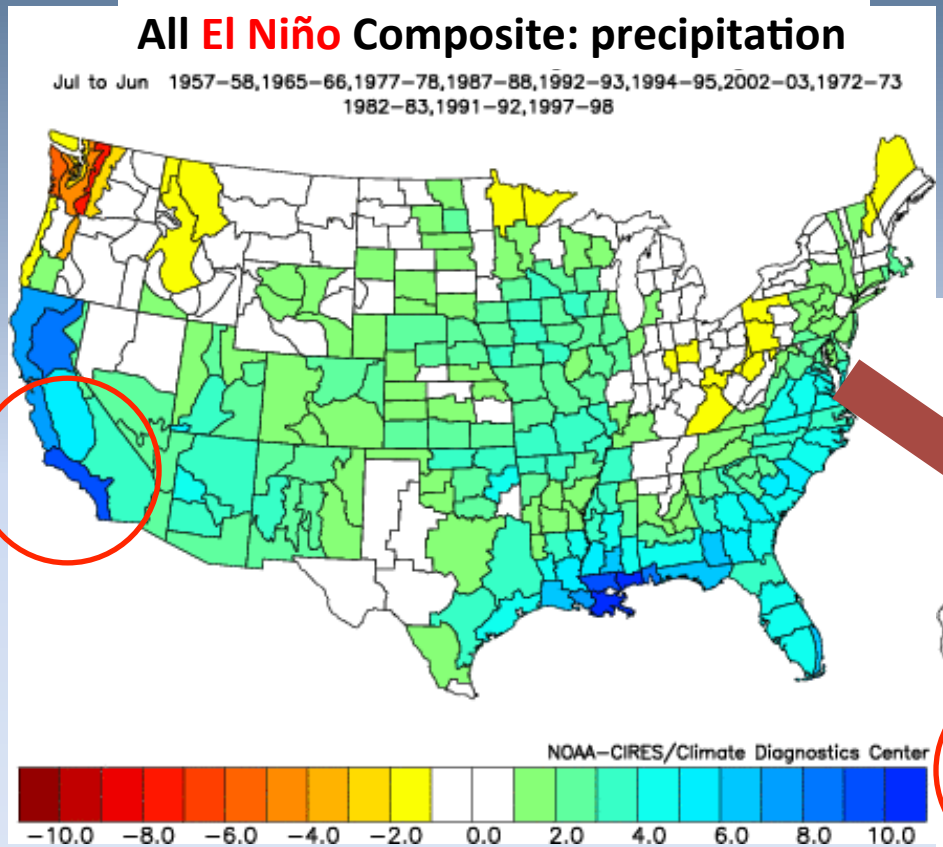
Unusual Mortality Events for Guadalupe Fur Seals; tough year for California Sea Lions - http://www.nmfs.noaa.gov/pr/health/mmume/

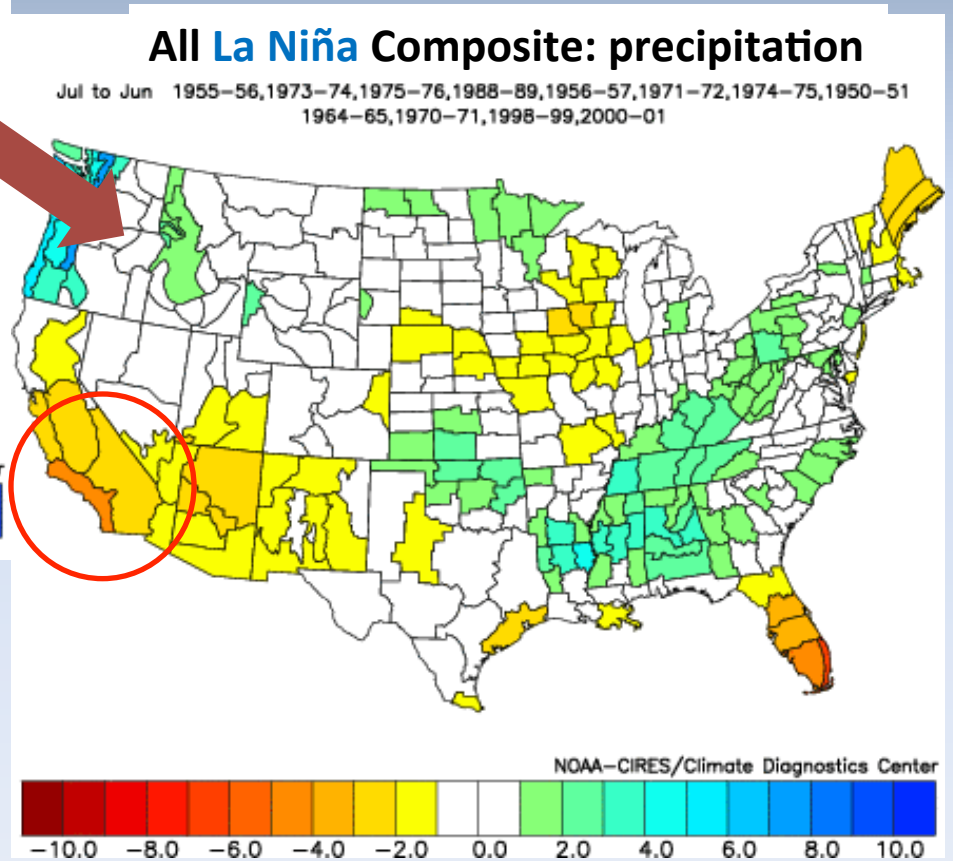
Hammerhead shark sighting near Oceanside; http://www.petethomasoutdoors.com/

Sea snakes near Oxnard; photo by Mark Pampanin/ KPCC http://www.scpr.org/

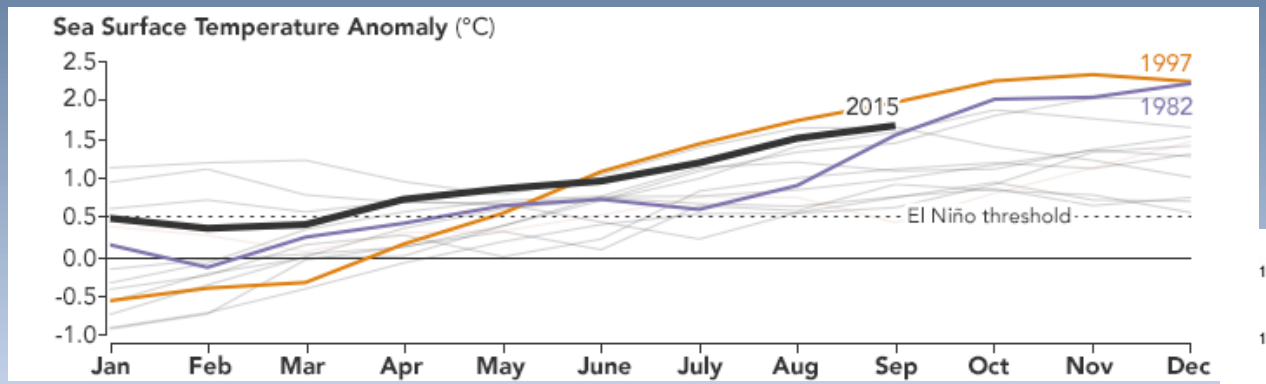
Mahimahi near Newport Beach; photo by ©Slater Thomas Moore via http://www.petethomasoutdoors.com/

Impacts

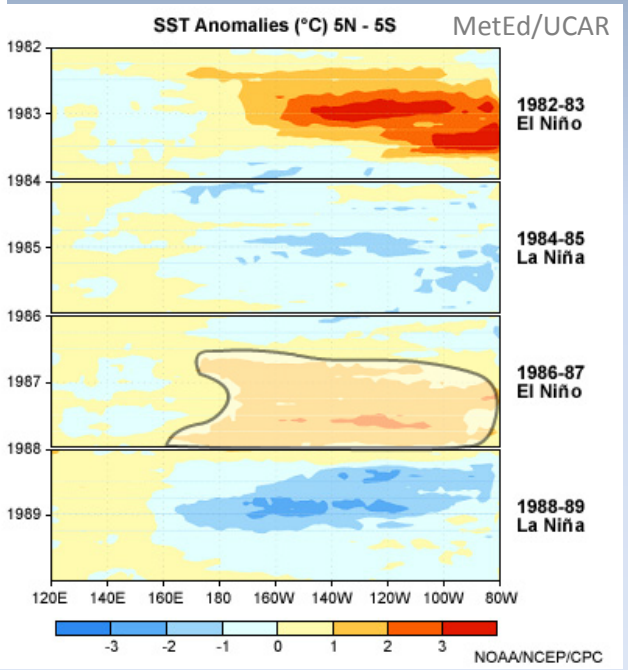

All El Niño Composite: precipitation
Jul to Jun 1957–58,1965–66,1977–78,1987–88,1992–93,1994–95,2002–03,1972–73
1982–83,1991–92,1997–98
NOAA–CIRES/Climate Diagnostics Center
−10.0 −8.0 −6.0 −4.0 −2.0 0.0 2.0 4.0 6.0 8.0 10.0

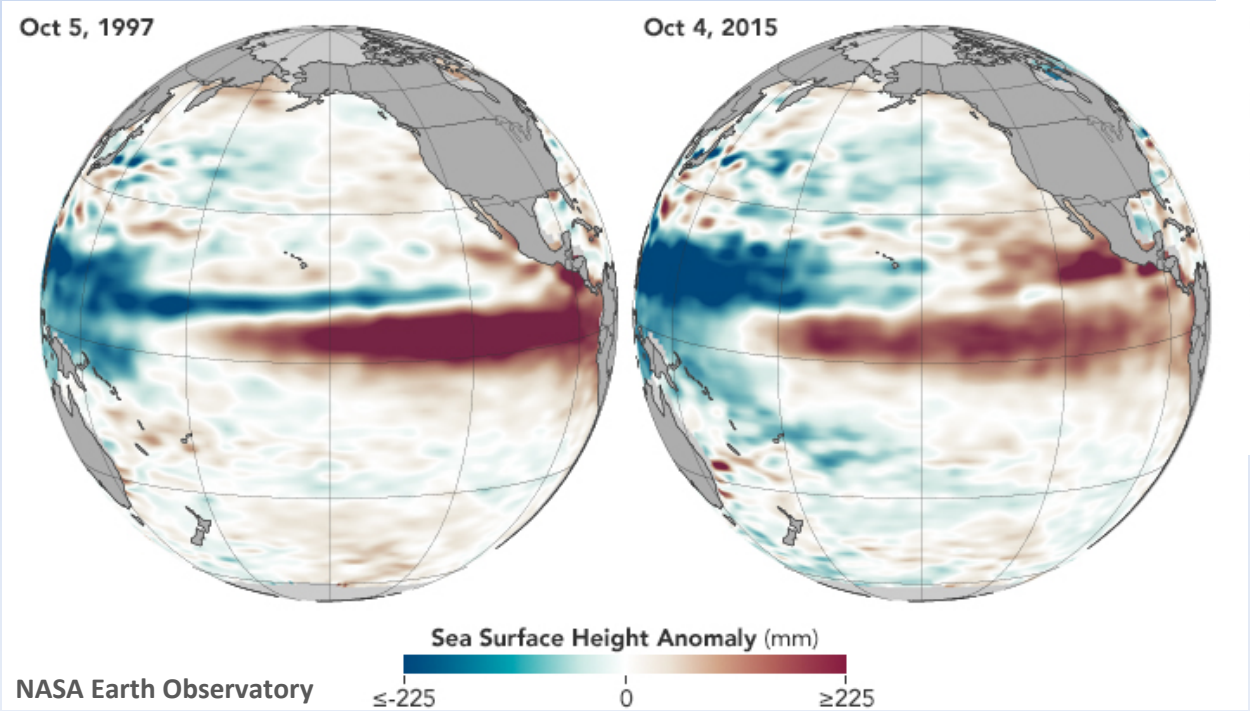

All La Niña Composite: precipitation
Jul to Jun 1955–56,1973–74,1975–76,1988–89,1956–57,1971–72,1974–75,1950–51
1964–65,1970–71,1998–99,2000–01
NOAA–CIRES/Climate Diagnostics Center
−10.0 −8.0 −6.0 −4.0 −2.0 0.0 2.0 4.0 6.0 8.0 10.0

El Niño - variability



NASA Earth Observatory





NASA Earth Observatory

El Niño - variability

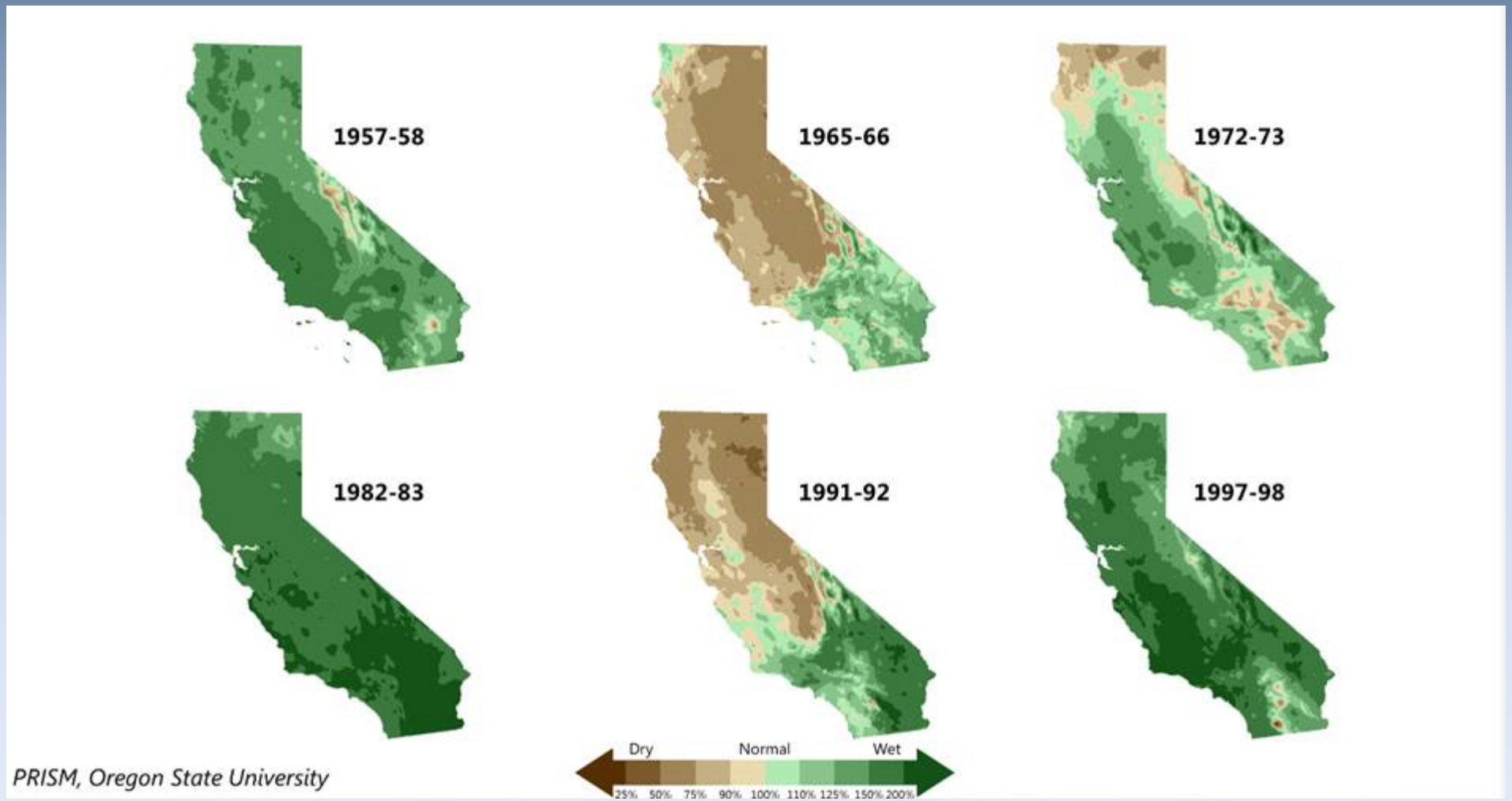
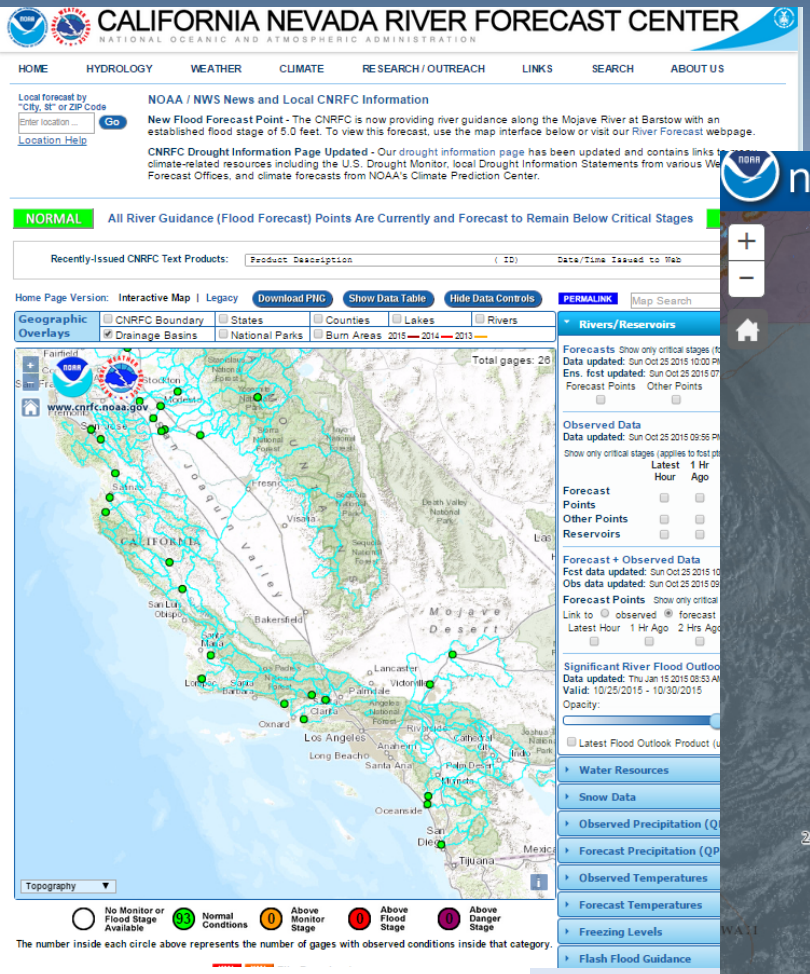


Image courtesy NWS Sacramento

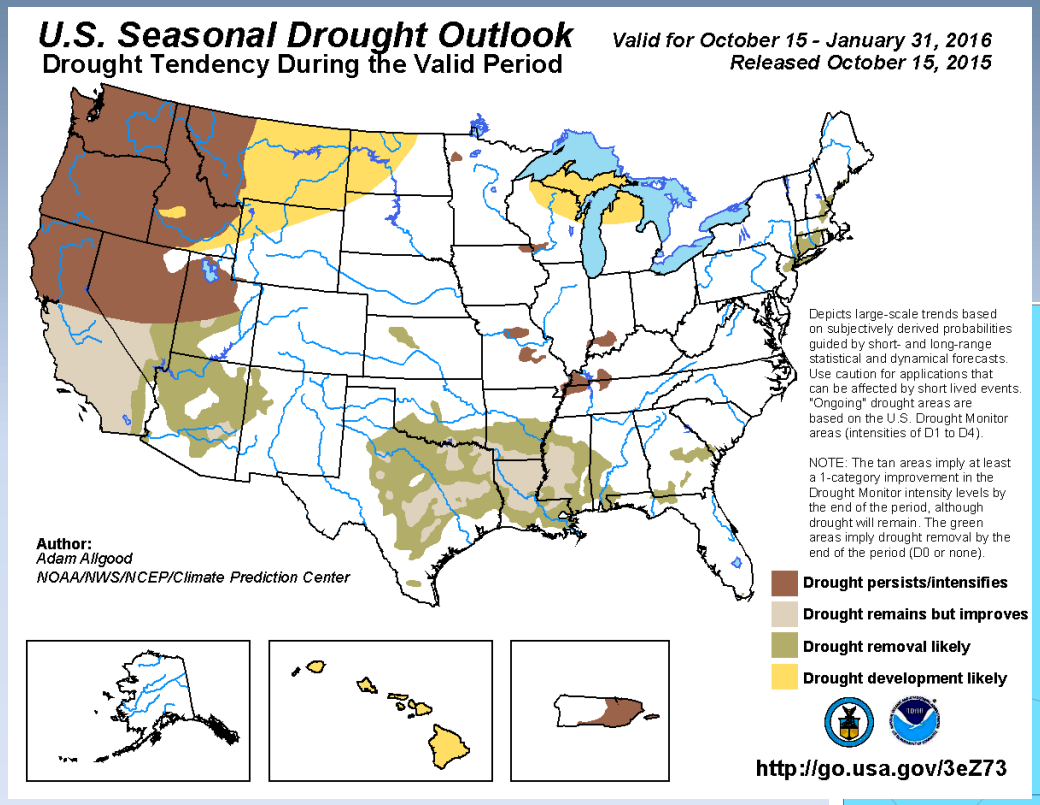
Resources



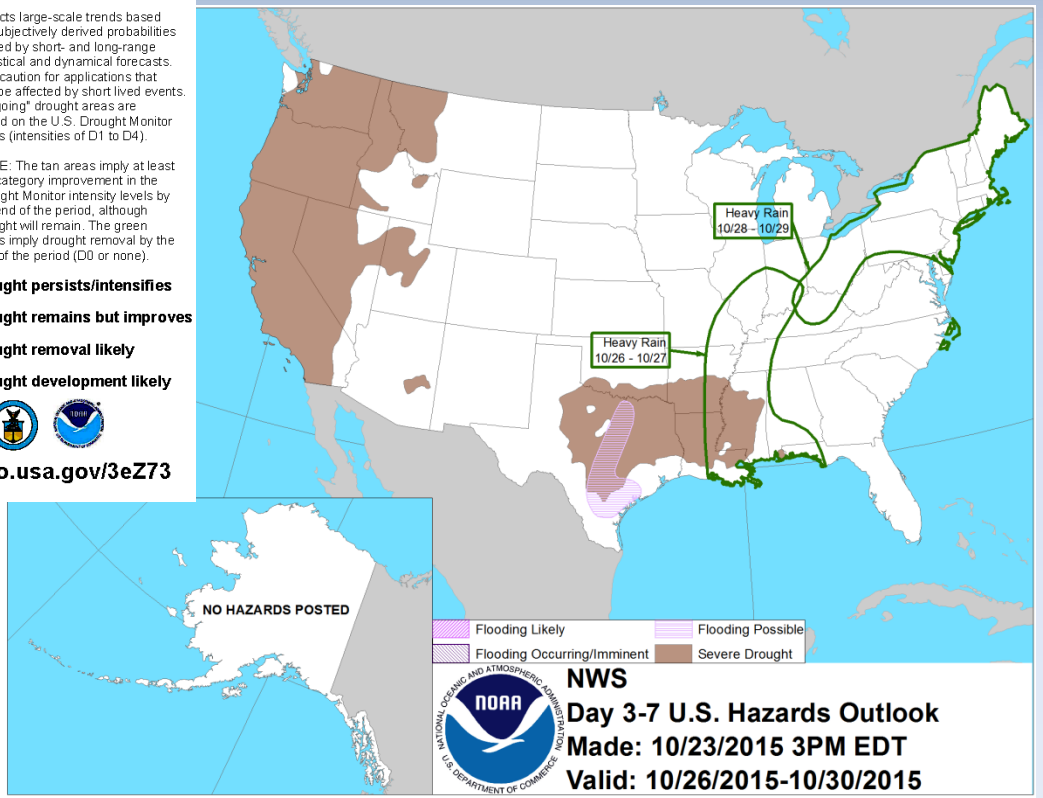
http://www.cnrfc.noaa.gov/

http://nowcoast.noaa.gov/

Resources

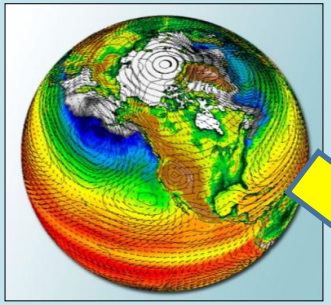


http://www.cpc.ncep.noaa.gov/



Resources

Global



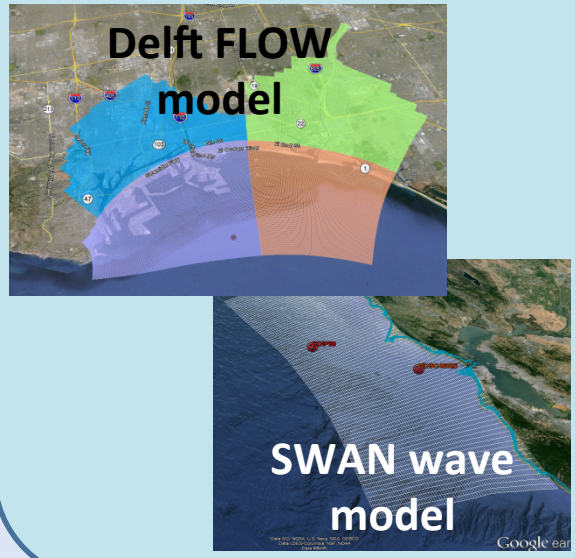
Global winds and wave models of future climate scenarios

Community-level impacts from storm hazards →

local-scale projections: explicit, deterministic modeling system to capture relevant physics related to coastal storms

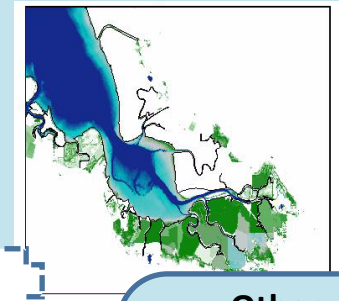
Regional

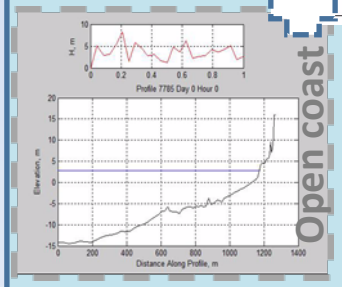
Tides, regional water levels, circulation, and waves



Local

High resolution hydrodynamics and waves





Other components:

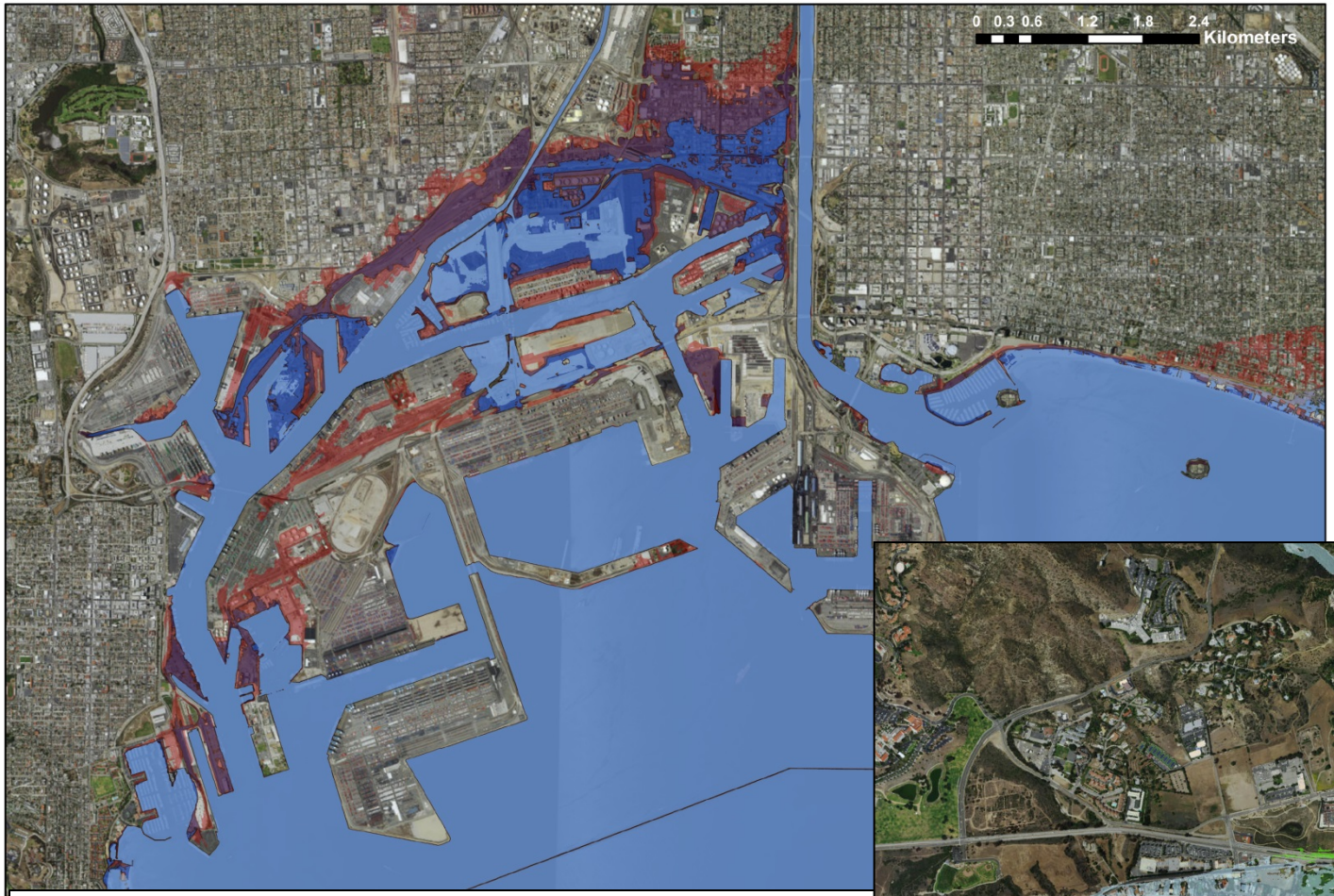
Fluvial discharges (marsh accretion) (vertical land motion)

TWL applied onto hi-res DEM

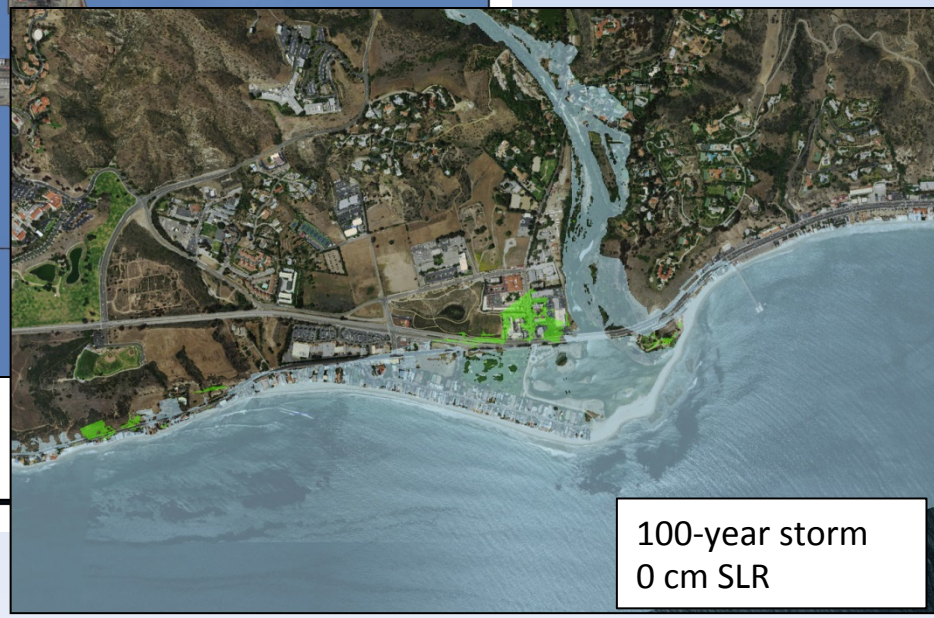
Coastal Storm Modeling System

https://walrus.wr.usgs.gov/coastal_processes/cosmos/

Resources



Coastal Storm Modeling System (CoSMoS)
100-year storm, sea-level rise: 0, 50, 100, 150 cm



100-year storm
0 cm SLR

Questions