Welcome to the ACCAP’S
Alaska Climate Webinar Series

Tuesday, August 26, 2014

Webinar Moderated by:
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Photo courtesy of Matt Druckenmiller
El Nino and Alaska – Past, Present and Future

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Alaska Climate Webinar
August 26, 2014
Outline

• Overview of the El Nino-Southern Oscillation (ENSO)

• How prospects for El Nino may impact large scale global circulation and temperature / precipitation patterns

• Current status and forecast of El Nino
Outline

• **Overview of the El Nino-Southern Oscillation (ENSO)**

• How prospects for El Nino may impact large scale global circulation and temperature / precipitation patterns

• Current status and forecast of El Nino
ENSO Overview

• An irregular, naturally occurring cycle (every 2-7 years) of warm (El Nino) or cold (La Nina) conditions in the tropical Pacific Ocean.

• Ocean changes occur alongside changes in the tropical atmosphere circulation and rainfall

• On average, events last 9-12 months (La Niñas can persist longer) and peak in strength during N. Hemisphere winter
Sea Surface Temperatures

EL NIÑO
Jan-Mar 1998

LA NIÑA
Jan-Mar 1989

Red colors: above average sea surface temps (SST)

Blue colors: below average sea surface temps (SST)
Neutral conditions

- Warm water heats the atmosphere and makes it rise
- Low-level trade winds blow towards warm water to fill the gap
- Subsiding air occurs in the eastern Pacific basin
El Nino conditions

- Easterly trade winds weaken
- Thermocline deepens and the cold water upwelling decreases in the eastern Pacific
- Rainfall shifts eastward over the central and/or eastern Pacific Ocean
- Rainfall becomes suppressed over the far western Pacific/Indonesia
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Precipitation

Enhanced rainfall occurs over warmer-than-average waters during El Niño.

Reduced rainfall occurs over colder-than-average waters during La Niña.
Tropical rainfall and so atmospheric heating can lead to “wavetrains” that can influence the global circulation (red arc).

These “teleconnections” are why El Nino is important to the rest of the globe outside the Tropics, including Alaska.
Jet stream over the Pacific and North America is stronger than average and shifted *equatorward*. Flow is more *zonal* than average from the central Pacific eastward across the U.S.
Typical Global Impacts

Warm Episode Relationships
December - February

NWS/NCEP
CLIMATE PREDICTION CENTER
Typical Global Impacts

Warmer than Average

Wetter than average Southeast, drier than average northwest

Correlation is low indicating high uncertainty in this composite signal
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Current SST conditions

Weekly SST Anomalies (DEG C)

30 JUL 2014

06 AUG 2014

13 AUG 2014

20 AUG 2014

SST Anomalies (°C)

Nino 3.4

Nino3.4 is a climate sensitive region
Strong warming in the eastern Pacific during late Spring associated with a downwelling oceanic Kelvin wave.

Upwelling component of this Kelvin wave resulted in cooling of ocean temperatures in the central Pacific during the second half of July.

Warming at depth is once again evident during August across much of the Pacific basin.
Atmospheric coupling to the ocean has been difficult to achieve to date.
Forecasts for Nino3.4 most likely favor a weak El Nino at the current time.
ENSO Alert System Status: El Niño Watch

The odds of El Niño are about 65% during the fall and early winter.
Past El Niño events as forecast tool

- Not all El Niños are equal
  - Actual sea surface temperatures and large scale response have changed in the past 60 years
- Event frequency analysis during El Niños
- Composites (averages of past El Niños)
- CPC Outlooks for Autumn and Winter (for which El Niño is just one of several important factors)
September through November
El Niño 500mb Heights and Anomalies
September through November
500mb Height Trends: 1950 to 2013

Sep to Nov: 1950 to 2013: 500mb Geopotential Height
Seasonal Correlation w/ Sep to Nov Trend
NCEP/NCAR Reanalysis

NOAA/ESRL Physical Sciences Division
December through February
El Niño 500mb Heights and Anomalies

NCEP/NCAR Reanalysis


December through February
500mb Height Trends: 1949-50 to 2012-13

Dec to Feb: 1950 to 2013: 500mb Geopotential Height
Seasonal Correlation w/ Dec to Feb Trend
NCEP/NCAR Reanalysis
• Do storms that produce significant coastal flooding occur more frequently during a particular ENSO phase?
• How do the frequency of storms vary by ENSO phase?
Significant Bering/Chukchi Coastal Floods

Significant Bering/Chukchi Sea Storm Years by ENSO Phase
Since 1960

- **Neutral**: 7 years
- **La Niña**: 3 years
- **El Niño**: 2 years
• Seasonal count of storms in the central and northern Bering and southern Chukchi seas than had a minimum pressure ≤ 988mb (in the region)
• Zhang et al 2004's storm track/intensity algorithm on NCEP/NCAR reanalysis data
Moderate to Strong Bering/Chukchi Sea Storms

Bering Sea Storm Counts by ENSO Phase
September-November
1950-2011
El Niño Composites and Alaska

- Composting at varying scales
  - Regional: Northwest North America and northeast Pacific (NCAR/NCEP reanalysis 1948-present)
  - Higher Resolution Regional
    - ERA-Interim dynamically downscale reanalysis (20km, USGS Alaska Climate Science Center and UAF/SNAP, 1980-2013)
  - Point Based (individual stations)
September through November 1950-2013
ENSO Temperature & Precipitation Correlations
September through November, 1980-2013
Weak & Moderate El Niños

Mean Temp Departure (°C, 1981-2010)

Mean Pcpn Departure (mm, 1981-2010)


Graphics: Peter Bieniek, UAF/IARC
Recent Weak El Niños
Autumn Temperature Departures

1994

2004

2006

2009

Graphics: Peter Bieniek, UAF/IARC
Recent Weak El Niños
Autumn Precipitation Departures

Graphics: Peter Bieniek, UAF/IARC
September through November 1950-2013

Juneau Airport

Anchorage Airport

Fairbanks Airport
December through February 1977-2014
ENSO Temperature & Precipitation Correlations

Dec to Feb: 1977 to 2014; 925mb Air Temperature
Seasonal Correlation w/ Dec to Feb Nino3.4

Dec to Feb: 1977 to 2014; Surface Precipitation Rate
Seasonal Correlation w/ Dec to Feb Nino3.4

NOAA/ESRL Physical Sciences Division
December through February, 1980-2013
Weak & Moderate El Niños

Mean Temp Departure (°C, 1981-2010)
Mean Pcpn Departure (mm, 1981-2010)


Graphics: Peter Bieniek, UAF/IARC
Recent Weak-Moderate El Niños
Winter Temperature Departures

1987-88

1994-95

2004-05

2006-07

Graphics: Peter Bieniek, UAF/IARC
Recent Weak-Moderate El Niños
Winter Precipitation Departures

1987-88
1994-95
2004-05
2006-07

Graphics: Peter Bieniek, UAF/IARC
December through February
1976-77 to 2013-14

Juneau Airport
Anchorage Airport
Fairbanks Airport
CPC Outlook
September through November

THREE-MONTH OUTLOOK
TEMPERATURE PROBABILITY
0.5 MONTH LEAD
VALID SON 2014
MADE 21 AUG 2014

THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
0.5 MONTH LEAD
VALID SON 2014
MADE 21 AUG 2014
Thank you for your attention

Feel free to contact us anytime via e-mail if you have comments or questions.

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