EL NIÑO: WHAT IS IT AND THE 2015 – 2016 EVENT
Quick intro to the CBRFC

What is the El Niño Southern Oscillation (ENSO)
  • What causes an El Niño (or La Niña) event?
  • Is this a teleconnection?
  • Where/What are the typical impacts?
  • What’s the deal with this current El Niño event?

How does ENSO impact the Colorado River Basin and the DLCC region?

How does the CBRFC account for ENSO events?
NOAA’s River Forecast Centers

- Northwest
- California
- Nevada
- Colorado
- Missouri Basin
- Arkansas Red Basin
- Lower Mississippi
- West Gulf
- Southeast
- Northeast
- Middle Atlantic
- North Central
- Ohio
- Alaska-Pacific
Colorado Basin River Forecast Center

- River Forecast Centers (RFCs)
  - Support for WFOs
  - River levels and flows
  - Reservoir inflows
  - Each RFC is unique

- CBRFC
  - Seasonal Water Supply forecasts, in addition to many other products
    - Most advanced, involved
    - Reclamation is a key stakeholder
    - www.cbrfc.noaa.gov

Weather Forecast Offices (WFOs)
- Everyday weather
- Extreme weather
- Warnings, watches, and advisories
- Floods, tornadoes, heat, etc...
What is ENSO?

- The most influential climate pattern used in seasonal forecasting (of precipitation and temperature NOT STREAMFLOW!)
- The ENSO is a large scale phenomenon mostly identified through departures (deviations from average) in sea surface temperatures (SSTs) along the central equatorial Pacific
  - It is a coupled oceanic/atmospheric phenomenon, which means that in addition to seeing the warmer SSTs, we also need to see the atmosphere respond (what we call a weakened Walker Circulation)
  - More rainfall near the Date Line and less rainfall near Indonesia, along with anomalously westerly surface winds
ENSO is kind of like a stove... if you pretend the ocean is your heat source and the atmosphere is what you’re cooking.

- Not El Niño, no atmospheric response.
- Not El Niño, no ocean driver.
- El Niño!
SST Monitoring Regions

This is this region we typically look at.
When departures, over a three month period, are $\geq 0.5^\circ$C (El Niño) or $\leq -0.5^\circ$C (La Niña) for 5 consecutive periods.

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Okay, we have the SSTs down, so what about the atmospheric side of things?

- More rainfall near the date line? Check!
- Less rainfall near Indonesia? Check!
Anomalous westerly surface winds? Check!

There’s EVEN MORE to look at if you really want to get into it, but these are the basics.
Numerous models use monthly and daily data to project ENSO conditions. This shows the usual peak of an ENSO event in winter, declining in spring.
Once a month, forecasters get together to examine models and trends to project long-term ENSO conditions. Neutral conditions next year?
That’s a lot of stuff to keep up on!

- It is, but luckily, there are some great NOAA resources that make it easy
- I’ll have a list at the end of the presentation

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**EL NIÑO/SOUTHERN OSCILLATION (ENSO) DIAGNOSTIC DISCUSSION**

issued by

CLIMATE PREDICTION CENTER/NCEP/NWS and the International Research Institute for Climate and Society

12 November 2015

**ENSO Alert System Status:** **El Niño Advisory**

**Synopsis:** El Niño will likely peak during the Northern Hemisphere winter 2015-16, with a transition to ENSO-neutral anticipated during the late spring or early summer 2016.

A strong El Niño continued during October as indicated by well above-average sea surface temperatures (SSTs) across the central and eastern equatorial Pacific Ocean (Fig. 1). Most Niño indices were well-above-normal, with strong El Niño conditions observed in the Niño3.4 sub-region (Table 1) and the Niño3.4 index at +2.0°C (Fig. 2).
Is this a teleconnection?
Teleconnection is a term that has been around for a while, but seems to have gained some popularity lately.

Just a fancy way of saying that one climate anomaly is related to another a long distance away (think of “tele”phone – placing a call from New York can be related to the actions of the receiver in California).

All ENSO events are teleconnections, but not all teleconnections are ENSO events!
We typically look at ENSO impacts in the winter, because global atmospheric flow is more influential then. In the summer, small-scale events like thunderstorms (monsoon season!) tend to be more important.
El Niño events, regardless of strength, can vary quite a bit in the extent of their impacts. For instance, the 77-78 weak event brought wet conditions to the West, but the 65-66 strong event brought dry conditions to most of the West, including California.
This El Niño event has received a lot of media attention due to possible impacts:

- Drought
- Flooding
  - Extreme Precip
  - Wildfire
- Agriculture

And because...
...someone thought it would be cool to call it “Godzilla El Niño.” And it is kinda cool because it brings opportunities like this one along. But we don’t have Godzilla El Niños, just “weak,” “moderate,” and “strong.”

Precipitation Anomalies

Composite

NOAA/NCDC Climate Division Composite Precipitation Anomalies (in)
Versus 1950-2007 Longterm Average
What does this mean for the Colorado River Basin and the Desert LCC?

- It is important to remember that the correlation between ENSO and most of the area in the Upper CBRFC region is not strong, and probably only applicable to the Lower Colorado Region (and DLCC region), which doesn’t have as much impact on basin water supply.

- Also important to remember is that the ENSO phenomenon has been correlated with precipitation, not streamflow, so antecedent conditions could still play a large role.
CPC Strong Events:
1957-1958* (pre-Powell)
1965-1966 (below avg)
1972-1973 (above avg)
1982-1983 (above avg)
1991-1992 (below avg)
1997-1998 (near avg)

*Based on Reclamation Natural Flow, this was an above average year
We typically do see a statistically significant correlation between strength of an ENSO event and streamflow at forecast points in the Lower Basin, but the correlation values are low.

- During El Niño (or La Niña) years, we only use historical information from El Niño and Neutral (or La Niña and Neutral) to develop our water supply forecasts in the Lower Colorado River Basin.

- ENSO conditions do not impact other water supply forecasts (Upper Colorado River Basin and Great Basin areas).
More Local ENSO Impacts

Gila River

Virgin River

GILN5 and Seasonal ONI

VLTA3 and Seasonal ONI

(Significant at the 5% Significance Level, r = 0.38)

(Significant at the 5% Significance Level, r = 0.41)
More Local ENSO Impacts

Little Colorado River

Verde River

LCLA3 and Seasonal ONI

VDTA3 and Seasonal ONI

(Significant at the 5% Significance Level, r = 0.31)

(Significant at the 5% Significance Level, r = 0.38)
Current models are indicating that strong El Niño conditions will peak over the next month or two. ENSO conditions will weaken through Spring, and neutral conditions are expected to be in place by late Spring. Likely to see wetter conditions in the Lower Colorado and Desert LCC regions. Warmer conditions in the western portion of the Lower Colorado River Basin and Desert LCC?
How can we help?

- Able to communicate physical basis for streamflow forecasts
- Provide forecasts for additional locations if needed
- Provide forecast information in a format that is most convenient for you
- We can work to develop additional products to meet your needs
  - Seriously, let us know if you need something and we will do our best to make it happen!
Useful Links

- NOAA’s ENSO Blog (I really love this):
  - https://www.climate.gov/news-features/department/8443/all

- CPC’s ENSO Diagnostic Discussion:

- Columbia University’s IRI ENSO Page:

- CPC’s Historical ONI values:

- CBRFC’s Home Page (Us!):
  - www.cbrfc.noaa.gov
More Useful Links

- **UK Met Office’s ENSO summary:**

- **Australia's BOM’s ENSO page:**

- **CLIMAS El Niño page (A NOAA RISA!):**
  - [http://www.climas.arizona.edu/sw-climate/el-ni%C3%B1o-southern-oscillation](http://www.climas.arizona.edu/sw-climate/el-ni%C3%B1o-southern-oscillation)

- **WRCC ENSO page:**
  - [http://www.wrcc.dri.edu/enso/enso.html](http://www.wrcc.dri.edu/enso/enso.html)
Contact us!

- Michelle Stokes – Hydrologist In Charge
- Brenda Alcorn – Colorado Headwaters Basin Focal Point
- Greg Smith – Gunnison and San Juan Basins Focal Point
- Ashley Nielson – Green River Basin Focal Point
- Tracy Cox – Lower Colorado Basin Focal Point
- Paul Miller – Great Basin Focal Point

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QUESTIONS?
Another factor that makes this ENSO event unique!

General thinking is that the warm waters off the Northwest Coast (aka “The Blob”) is a symptom of the high pressure ridge that has allowed the California drought to persist.
In theory, this ENSO event should break down that ridge and the warmer water will cool back down.

I love this informative cartoon:

Incorporating other atmospheric teleconnections, like PDO, has not provided additional confidence.
Warm Episode Relationships

June - August
ENSO Impacts

Warm Episode Relationships

December - February
The ENSO is a large scale phenomenon identified through departures (deviations from average) in sea surface temperatures (SSTs) along the central equatorial Pacific.

- Persistent warmer than average SSTs is an El Niño event and typically correlates with wetter winter conditions in the Lower Colorado River Basin.
- Persistent cooler than average SSTs is a La Niña event and typically correlates to drier winter conditions in the Lower Colorado River Basin.

Correlations with ENSO and other parts of the CBRFC basin are not well defined, but in the Lower Colorado River Basin it is relevant.
How do we define ENSO?

- It is important to remember that these departures are basically compared to 30-year averages updated every 10 years*
  - Important due to the impacts of climate change
  - As oceans warm, weak El Niño events may no longer qualify; cold events previously not defined as La Niña may now qualify
  - Currently using the 1981-2010 average
- AND we need to see a coupling between the atmosphere and ocean!
  - Weakened Walker Circulation
  - More rain over the Central Pacific and less rain over Indonesia

*It’s actually slightly more complicated than that, with departures also being developed relative to recent 5-year periods. But for most purposes, it is probably okay to use the data as derived by the most recent 30-year period. For those interested in the details please take a look at: “In Watching for El Niño and La Niña, NOAA adapts to Global Warming” at: [http://www.climate.gov/news-features/understanding-climate/watching-el-ni%C3%B1o-and-la-ni%C3%B1a-noaa-adapts-global-warming](http://www.climate.gov/news-features/understanding-climate/watching-el-ni%C3%B1o-and-la-ni%C3%B1a-noaa-adapts-global-warming). Also, see “Linear trends in sea surface temperature of the tropical Pacific Ocean and Implications for the El Niño-Southern Oscillation” by L’Heureux et al. 2012 in *Climate Dynamics.*
How do we define ENSO?

Average SST in the Nino-3.4 region (ERSST.v3b)- 30yr base periods

Sea Surface Temperatures (degC)

Month

J F M A M J J A S O N D

28.2
28
27.8
27.6
27.4
27.2
27
26.8
26.6
26.4
26.2

1936 1965
1941 1970
1946 1975
1951 1980
1956 1985
1961 1990
1966 1995
1971 2000
1976 2005
1981 2010
How do we define ENSO?

Seasonal temperature anomalies since 2000

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La Niñas that we didn’t know we had when using the 1971-2000 average!

Blue = La Niña event
Red = El Niño event