

El Niño 2015-16: Godzilla or Mothra?

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Arizona Cooperative Extension
The University of Arizona



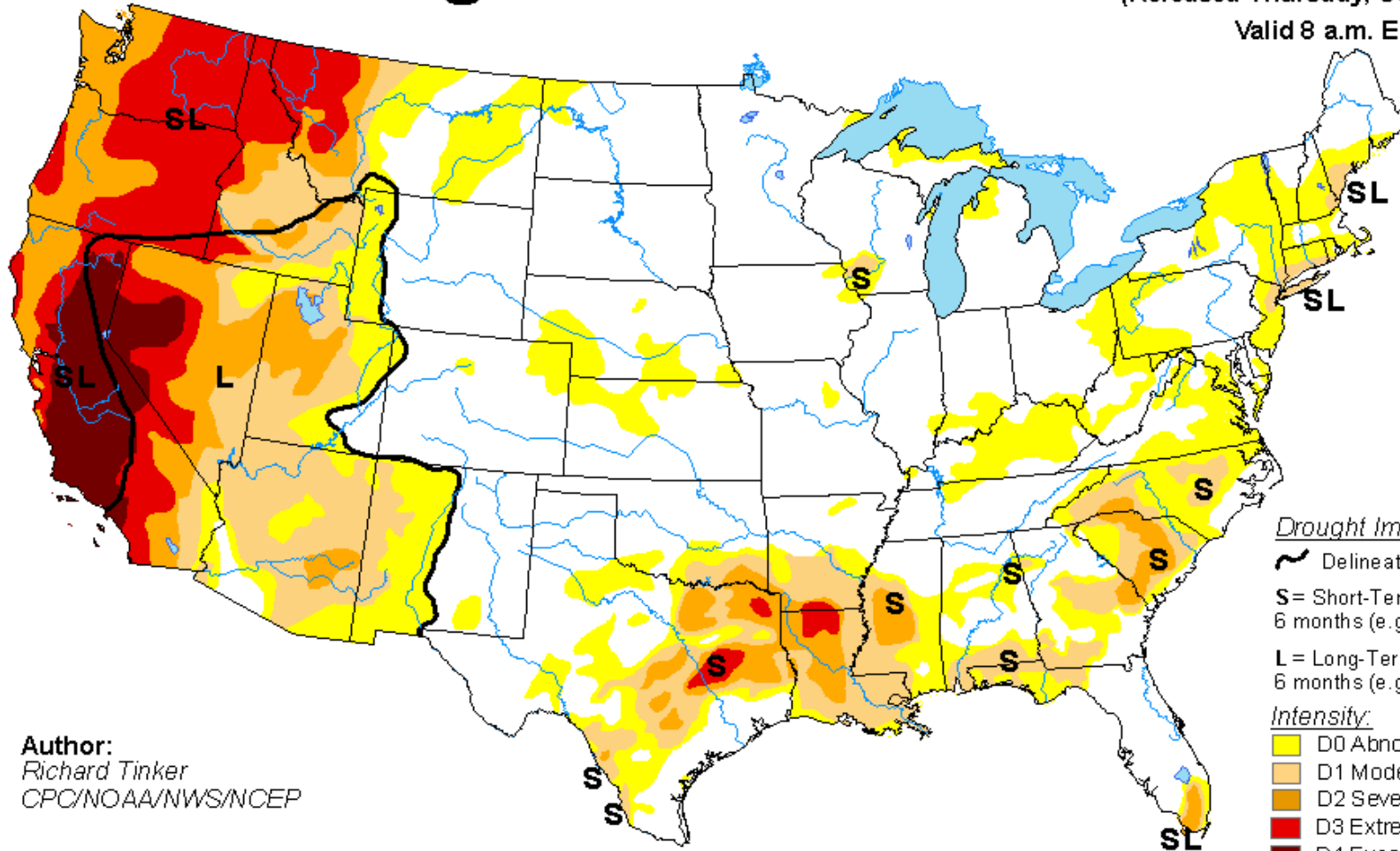
Presentation Overview

- Act I: The Drought
- Act II: The Monsoon
- Act III: The El Niño



U.S. Drought Monitor

September 8, 2015
(Released Thursday, Sep. 10, 2015)
Valid 8 a.m. EDT



Author:
Richard Tinker
CPC/NOAA/NWS/NCEP

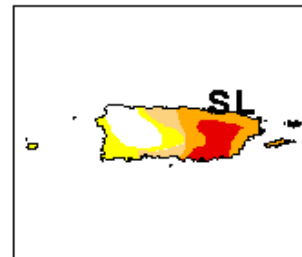
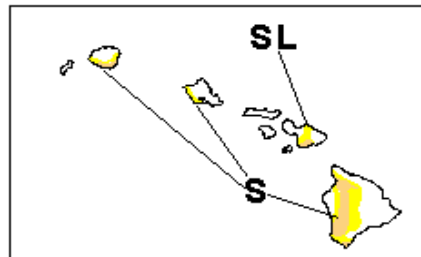
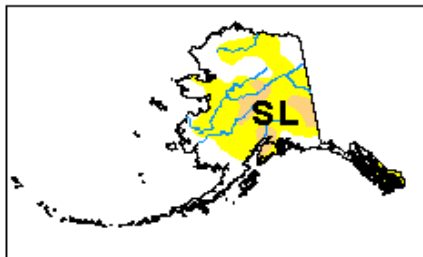
Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



<http://droughtmonitor.unl.edu/>

U.S. Drought Monitor Arizona

September 16, 2014
(Released Thursday, Sep. 18, 2014)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	87.51	43.82	3.77	0.00
Last Week 8/22/2014	0.00	100.00	87.51	48.93	3.77	0.00
3 Months Ago 6/17/2014	0.00	100.00	98.17	76.30	16.82	0.00
Start of Calendar Year 1/21/2013	20.72	79.28	53.58	14.73	0.00	0.00
Start of Water Year 10/1/2013	14.83	85.17	61.91	25.28	0.00	0.00
One Year Ago 9/17/2013	12.81	87.19	66.82	30.35	1.94	0.00

Intensity:

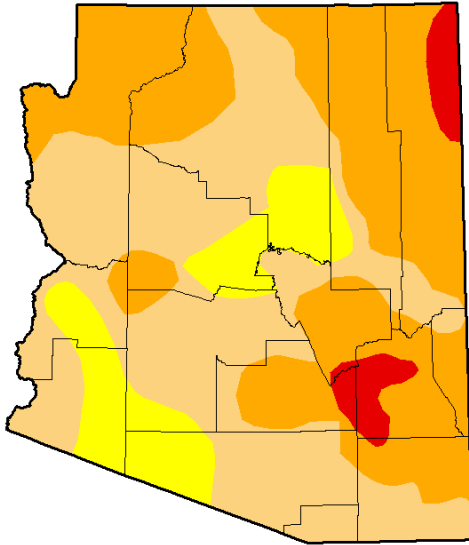
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Michael Brewer
NCDC/NOAA



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Arizona

December 16, 2014
(Released Thursday, Dec. 18, 2014)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	83.05	35.34	3.84	0.00
Last Week 12/8/2014	0.00	100.00	84.94	35.34	3.84	0.00
3 Months Ago 9/16/2014	0.00	100.00	87.51	43.82	3.77	0.00
Start of Calendar Year 1/21/2013	20.72	79.28	53.58	14.73	0.00	0.00
Start of Water Year 9/20/2014	0.00	100.00	84.58	37.92	3.76	0.00
One Year Ago 12/17/2013	20.72	79.28	53.58	16.32	0.00	0.00

Intensity:

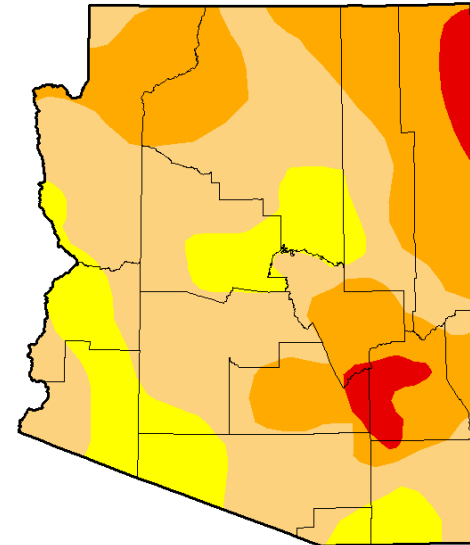
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
David Miskus
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Arizona

March 17, 2015
(Released Thursday, Mar. 19, 2015)
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	7.12	92.88	80.21	29.49	0.97	0.00
Last Week 3/6/2015	7.12	92.88	80.21	24.22	0.97	0.00
3 Months Ago 12/16/2014	0.00	100.00	83.05	35.34	3.84	0.00
Start of Calendar Year 1/20/2014	0.00	100.00	83.05	35.34	3.84	0.00
Start of Water Year 9/20/2014	0.00	100.00	84.58	37.92	3.76	0.00
One Year Ago 3/16/2014	6.12	93.88	88.06	57.04	5.18	0.00

Intensity:

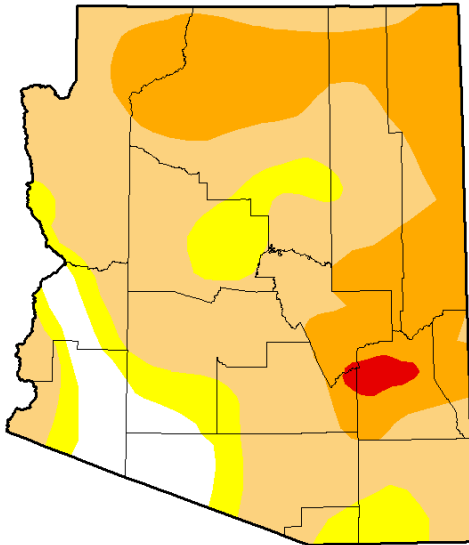
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Author:
Chris Fenimore
NCDC/NESDIS/NOAA



<http://droughtmonitor.unl.edu/>



U.S. Drought Monitor Arizona

July 14, 2015
(Released Thursday, Jul. 16, 2015)
Valid 8 a.m. EDT

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	7.04	92.96	76.15	24.56	0.00	0.00
Last Week 7/7/2015	7.04	92.96	76.15	24.56	0.00	0.00
3 Months Ago 4/14/2015	7.04	92.96	80.21	29.49	0.97	0.00
Start of Calendar Year 1/20/2014	0.00	100.00	83.05	35.34	3.84	0.00
Start of Water Year 9/20/2014	0.00	100.00	84.58	37.92	3.76	0.00
One Year Ago 7/15/2014	0.00	100.00	97.88	72.30	15.64	0.00

Intensity:

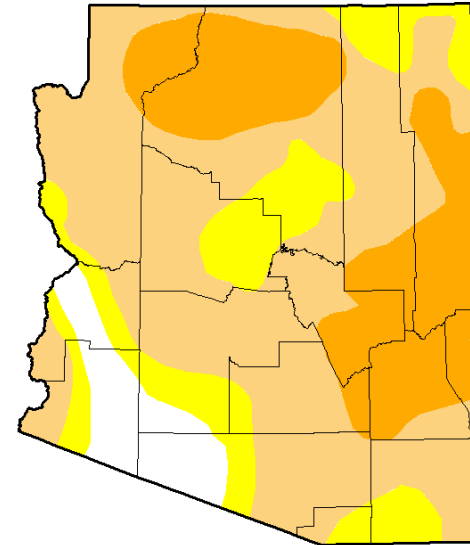
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

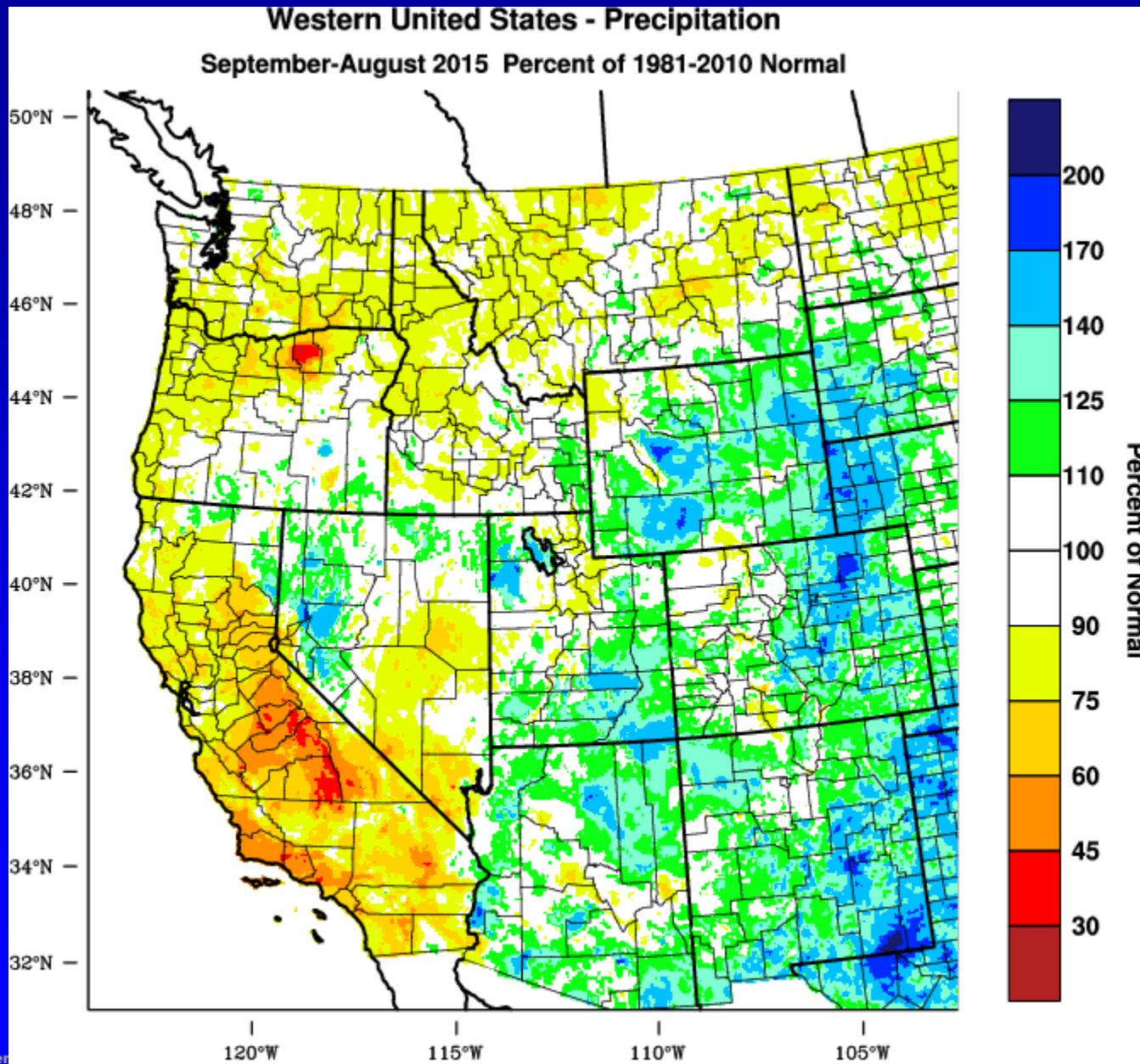
Author:
David Simeral
Western Regional Climate Center



<http://droughtmonitor.unl.edu/>

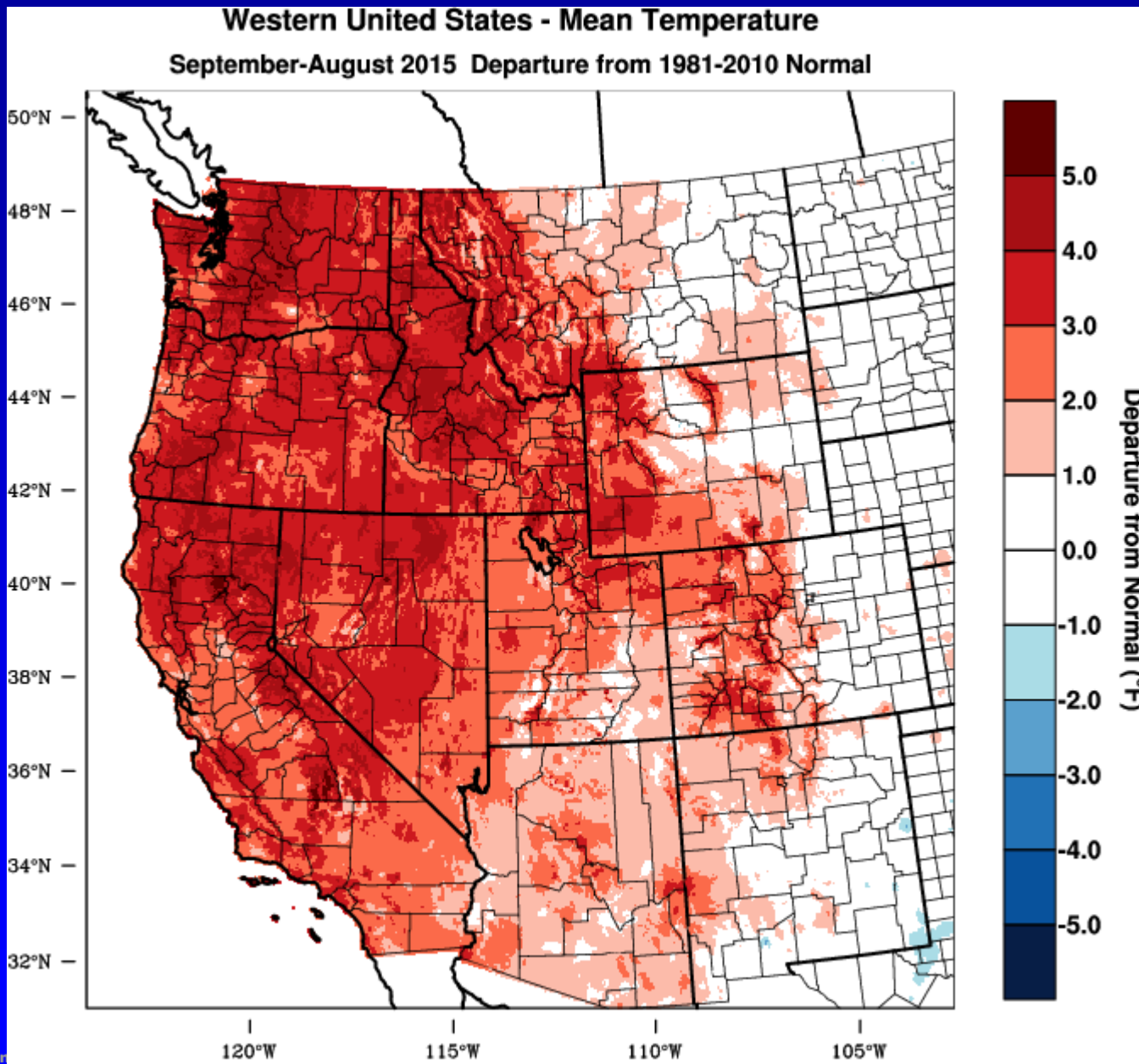


Sep-Aug Precipitation



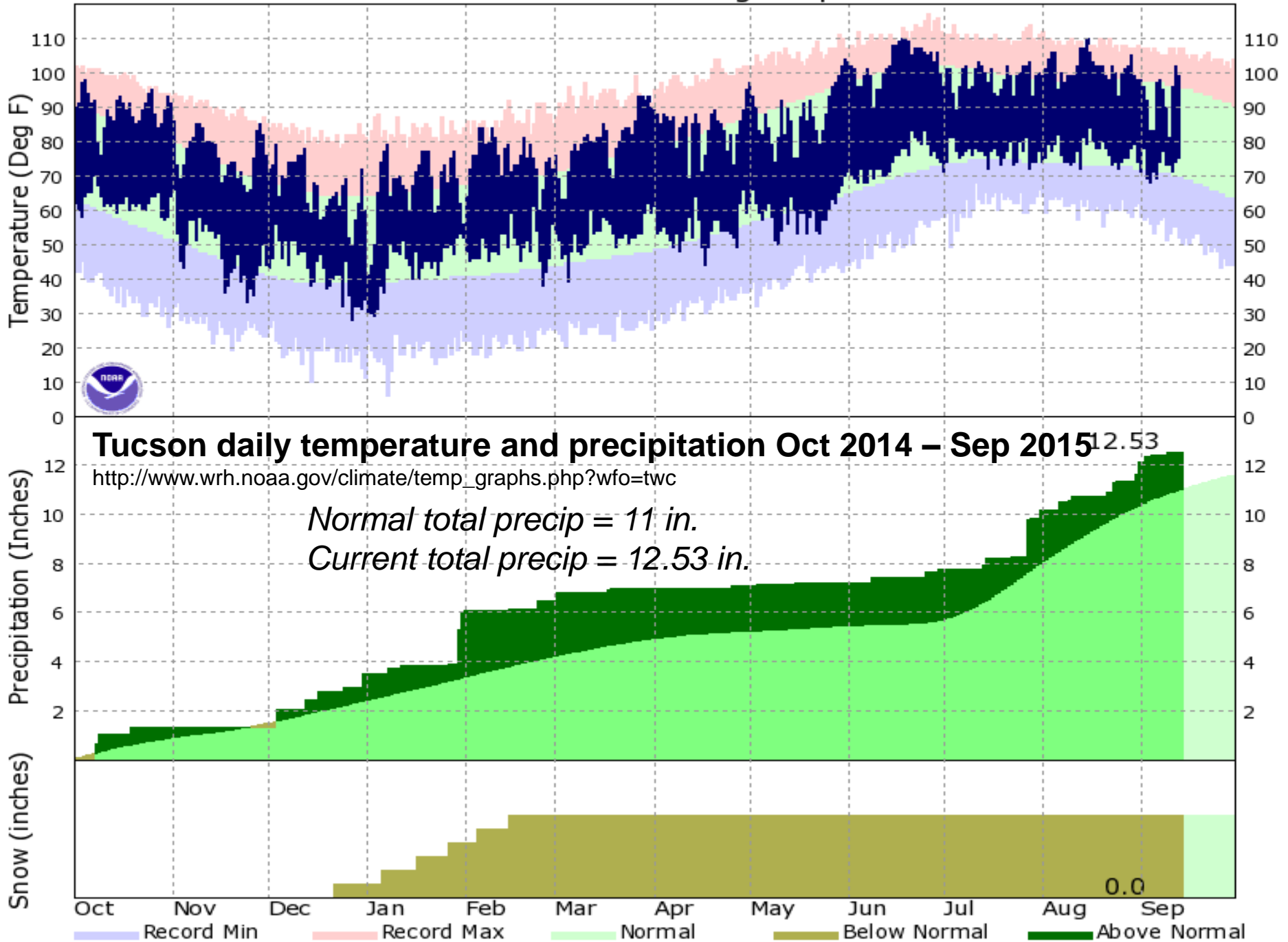
WestWide Drought Tracker - WRCC/UI Data Source - PRISM (Prelim), created 11 SEP 2015

Sep-Aug Temperature

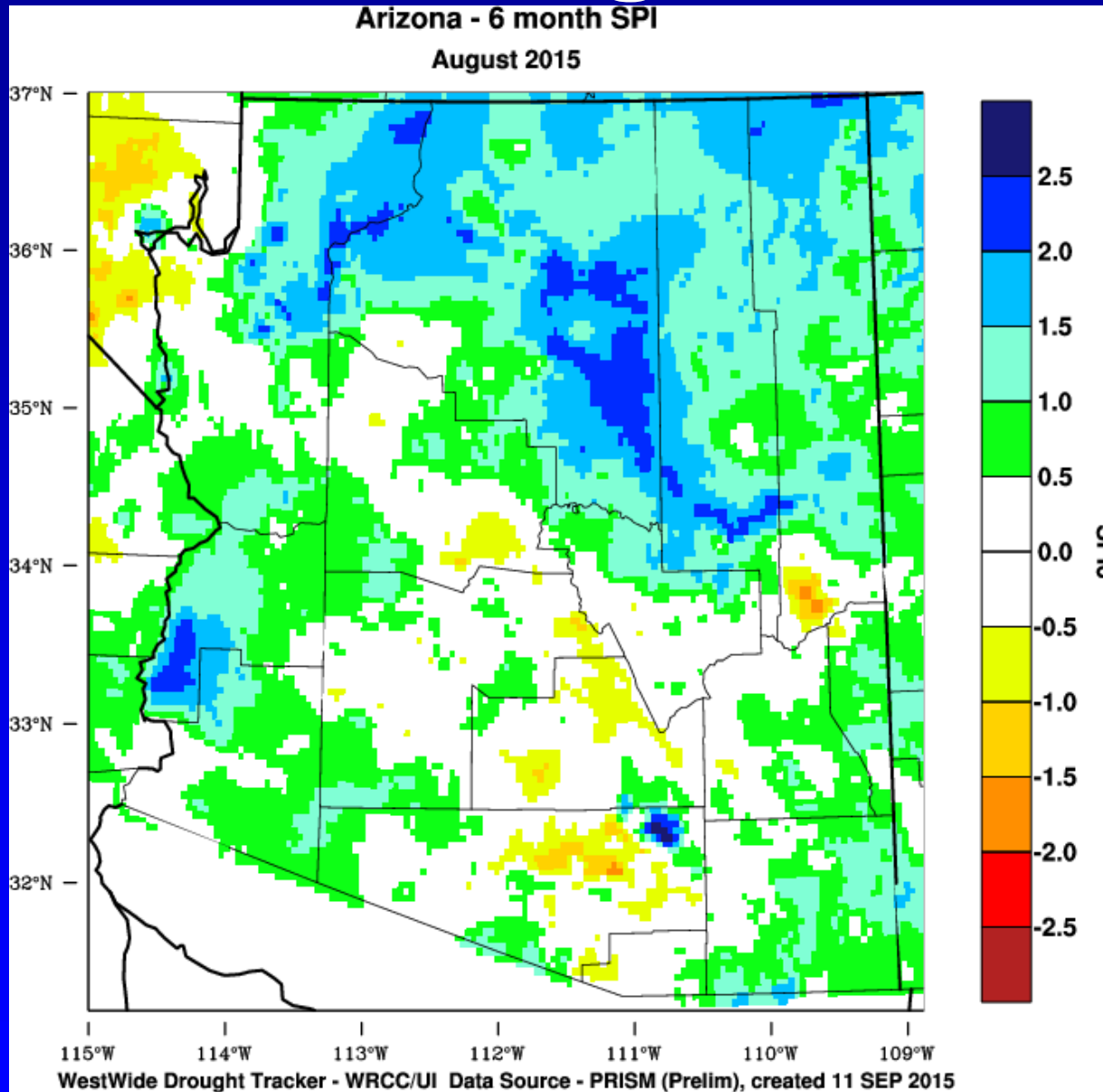


WestWide Drought Tracker - WRCC/UI Data Source - PRISM (Prelim), created 11 SEP 2015

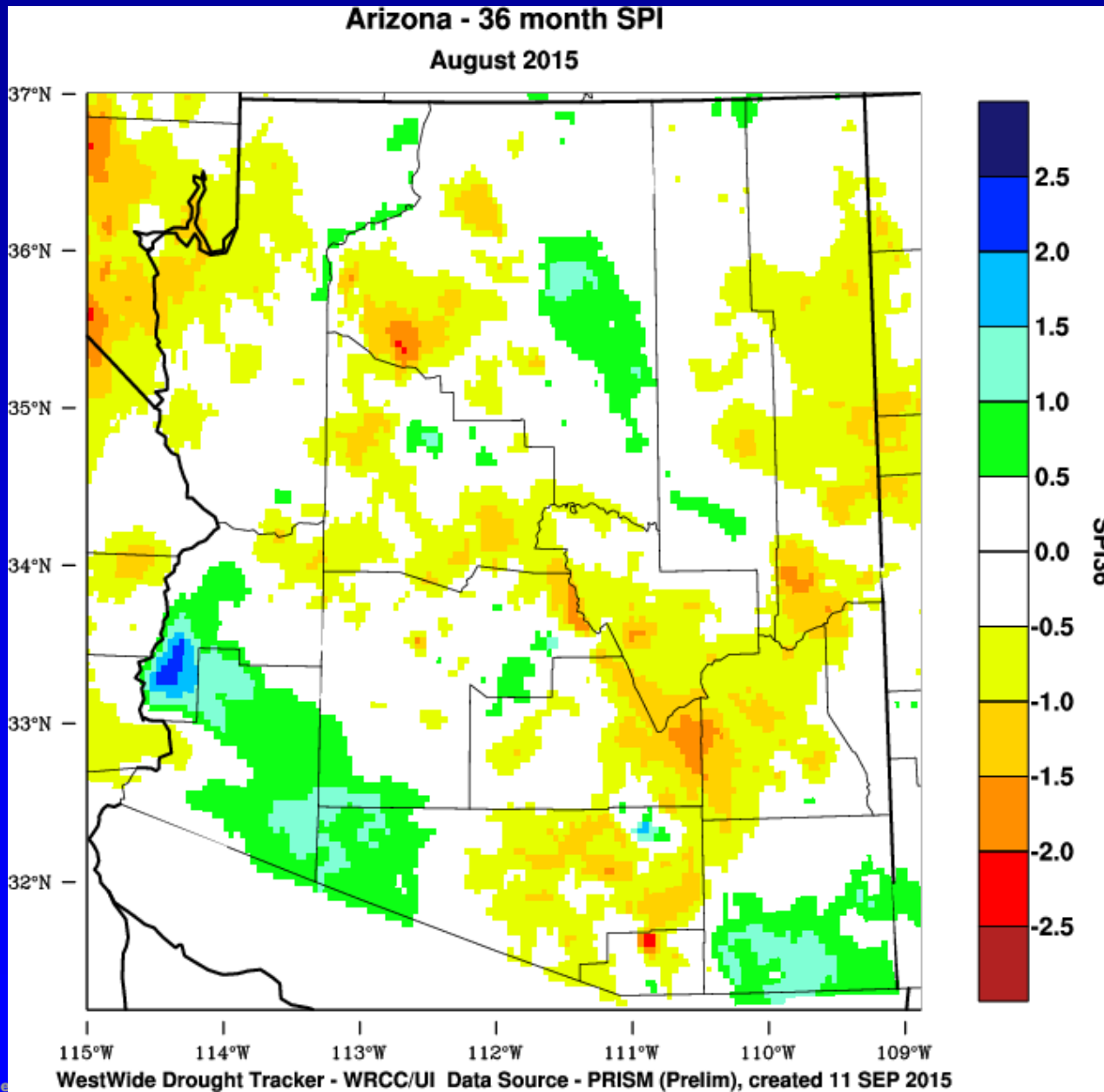
KTUS - Oct 2014 Through Sep 2015



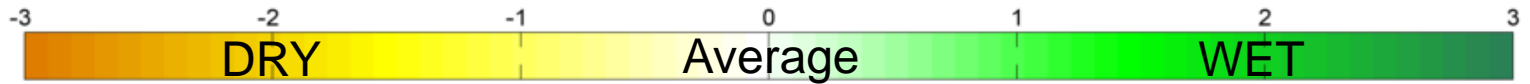
Short-term Drought Conditions



Long-term Drought Conditions



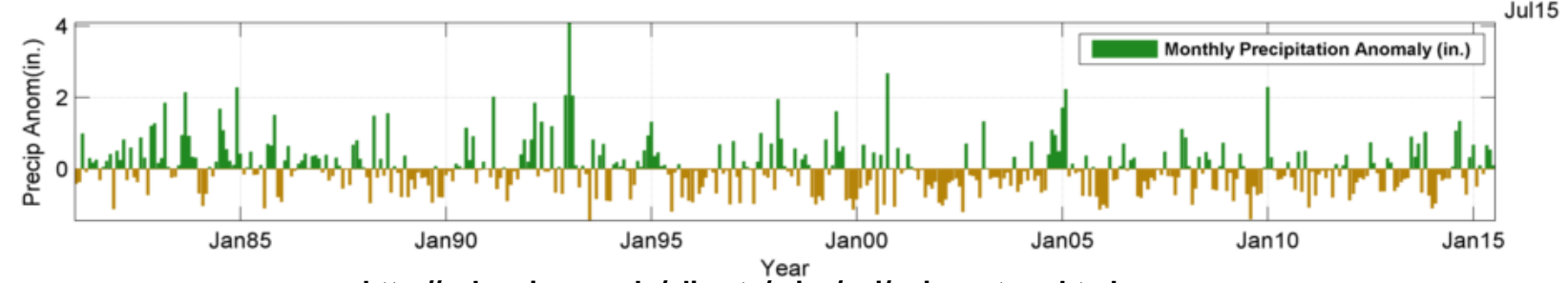
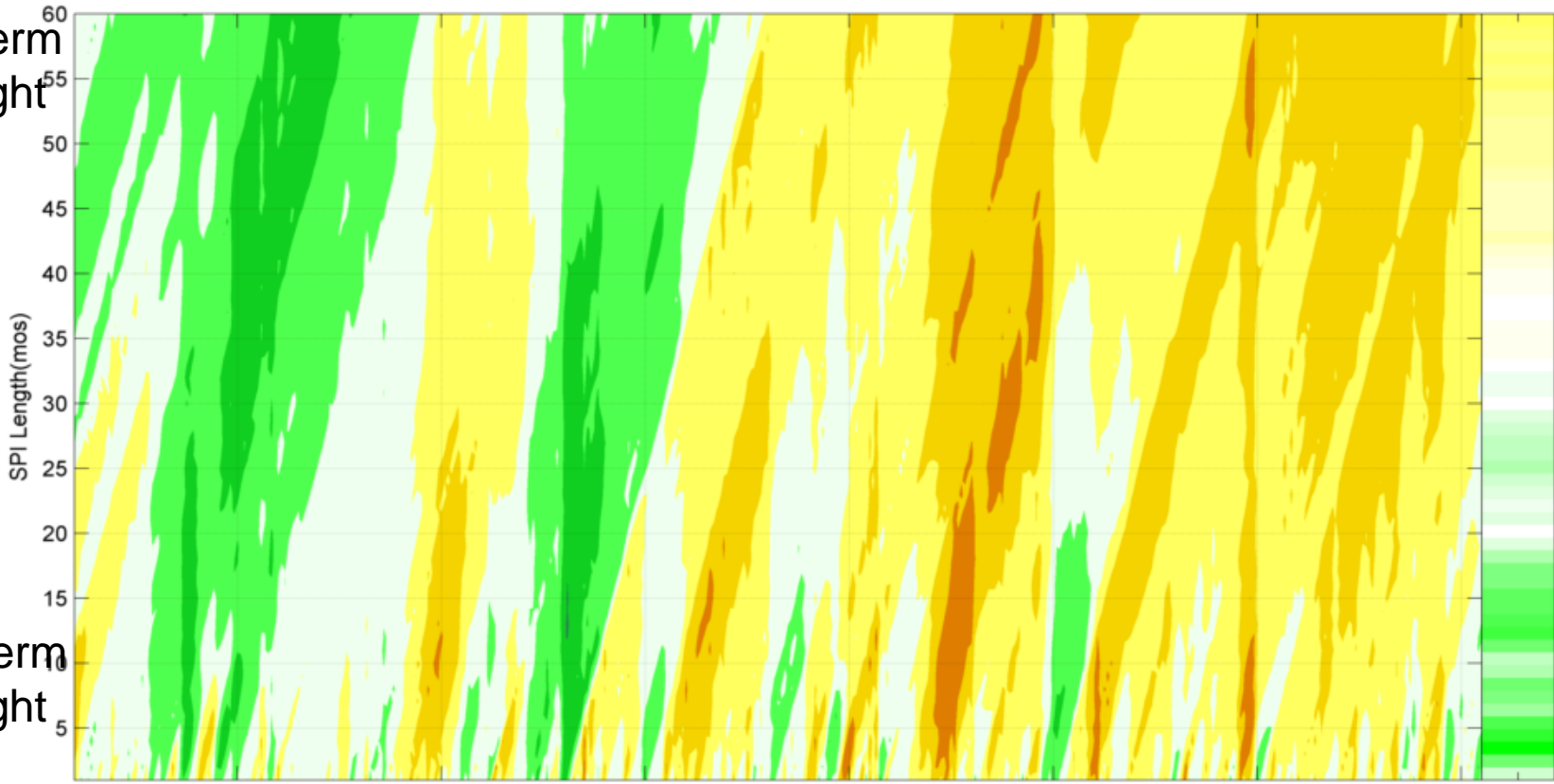
Arizona - Standardized Precipitation Index - (1-60 mos, Jan1981 - Jul2015)



Long-term
Drought



Short-term
Drought



http://cals.arizona.edu/climate/misc/spi/spi_contour.html



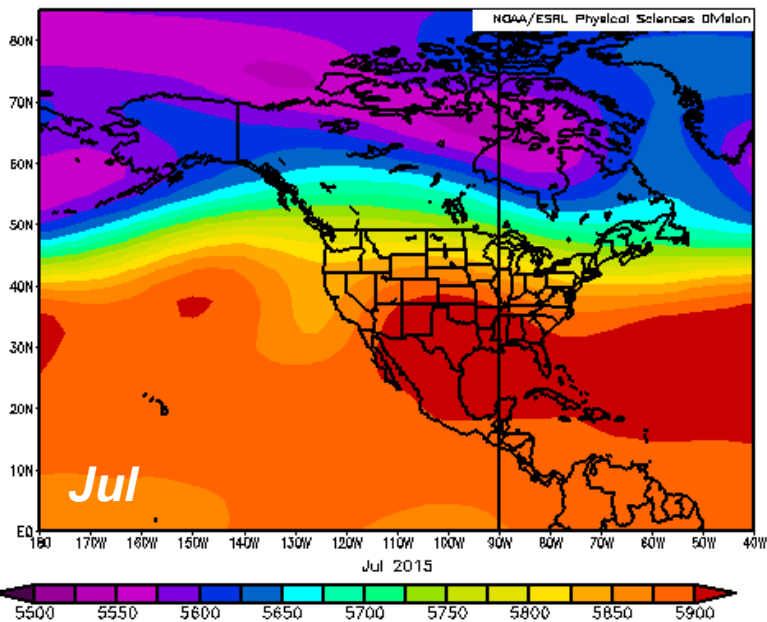
Climate Science Applications Program
University of Arizona Cooperative Extension
<http://cals.arizona.edu/climate>

Data source: NOAA National Climatic Data Center
<ftp://ftp.ncdc.noaa.gov/pub/data/cirs/climdiv>
Base Period= 1900-2015 Date created: 02-Sep-2015

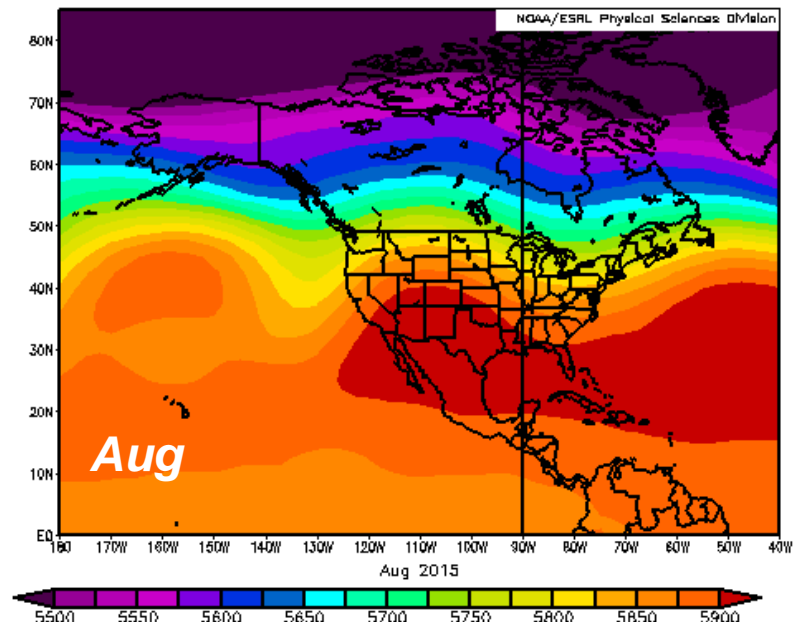
Monsoon Season 2015



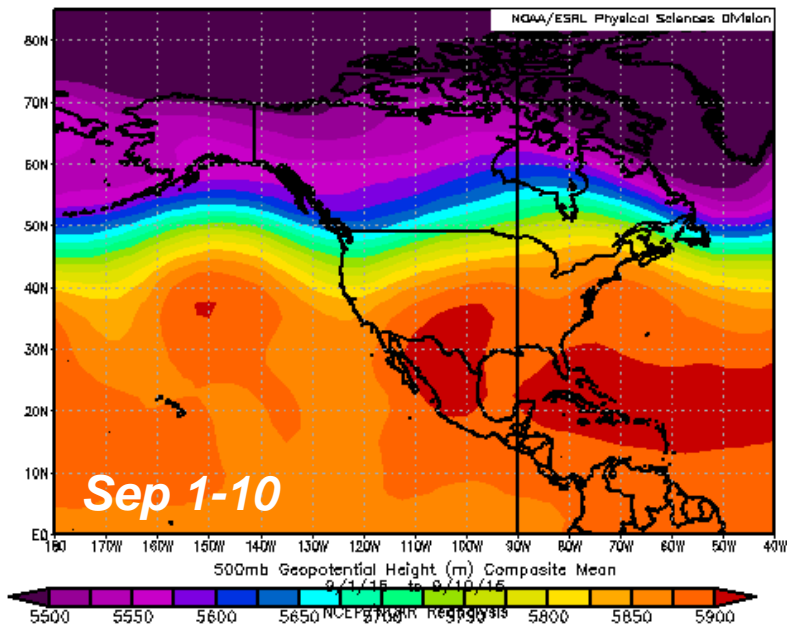
NCEP/NCAR Reanalysis
500mb Geopotential Height (m) Composita Mean



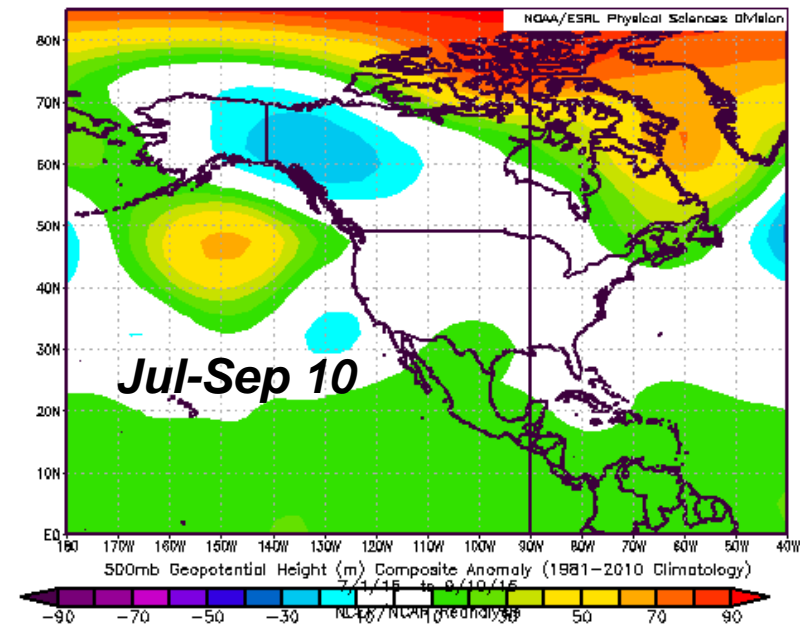
NCEP/NCAR Reanalysis
500mb Geopotential Height (m) Composita Mean



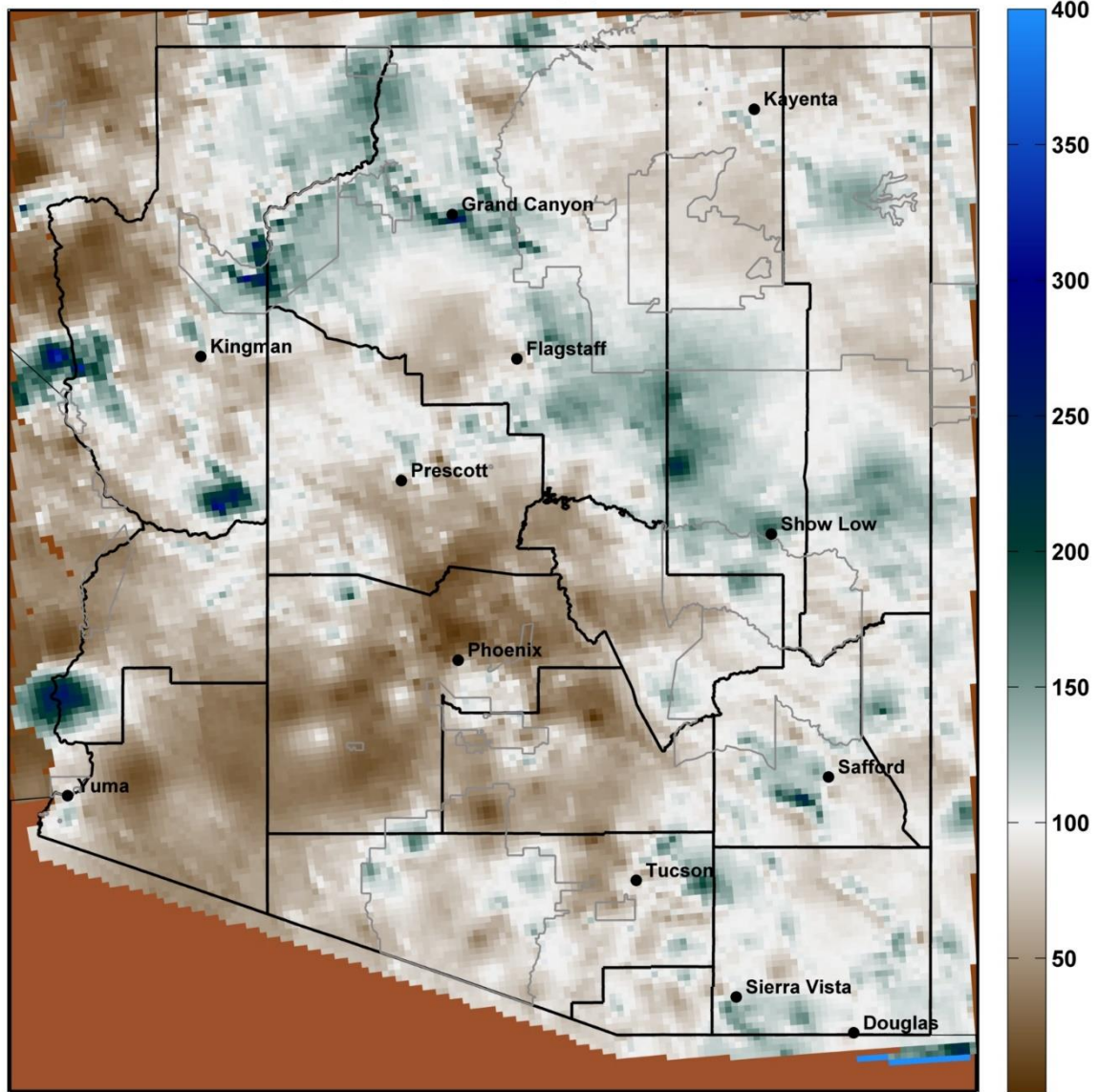
Sep 1-10



Jul-Sep 10



Percent of Average Precipitation (%): 06/15/15 to 09/12/15



Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at <http://water.weather.gov/precip/about.php>. Date created: 13-Sep-2015
University of Arizona - <http://cals.arizona.edu/climate/>



Arizona Precipitation Anomaly (% of ave) Coverage: 06/15/15 to 09/12/15

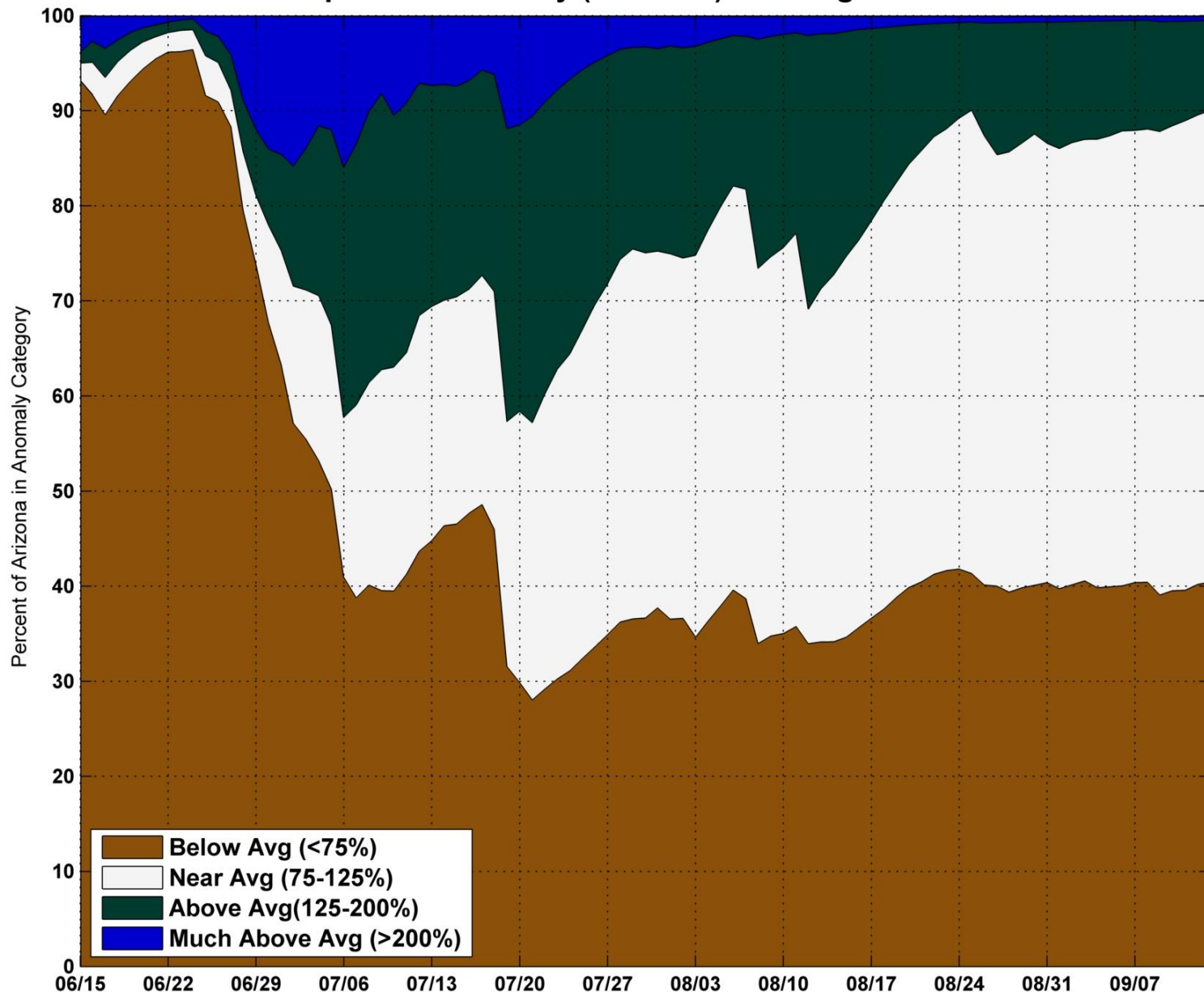
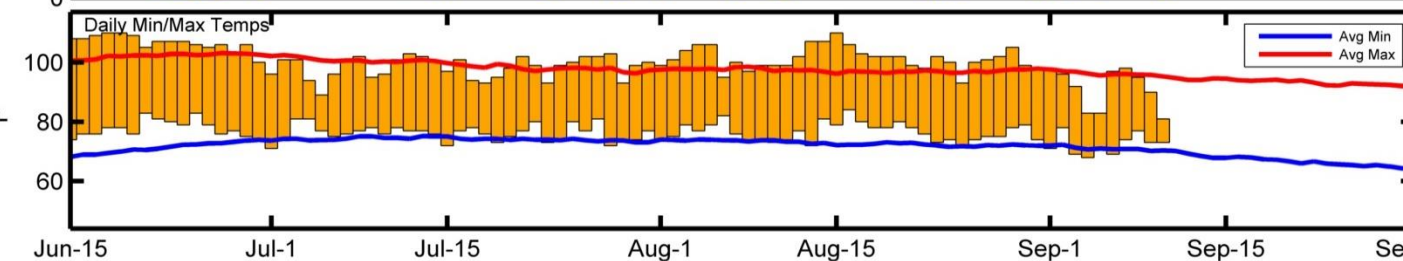
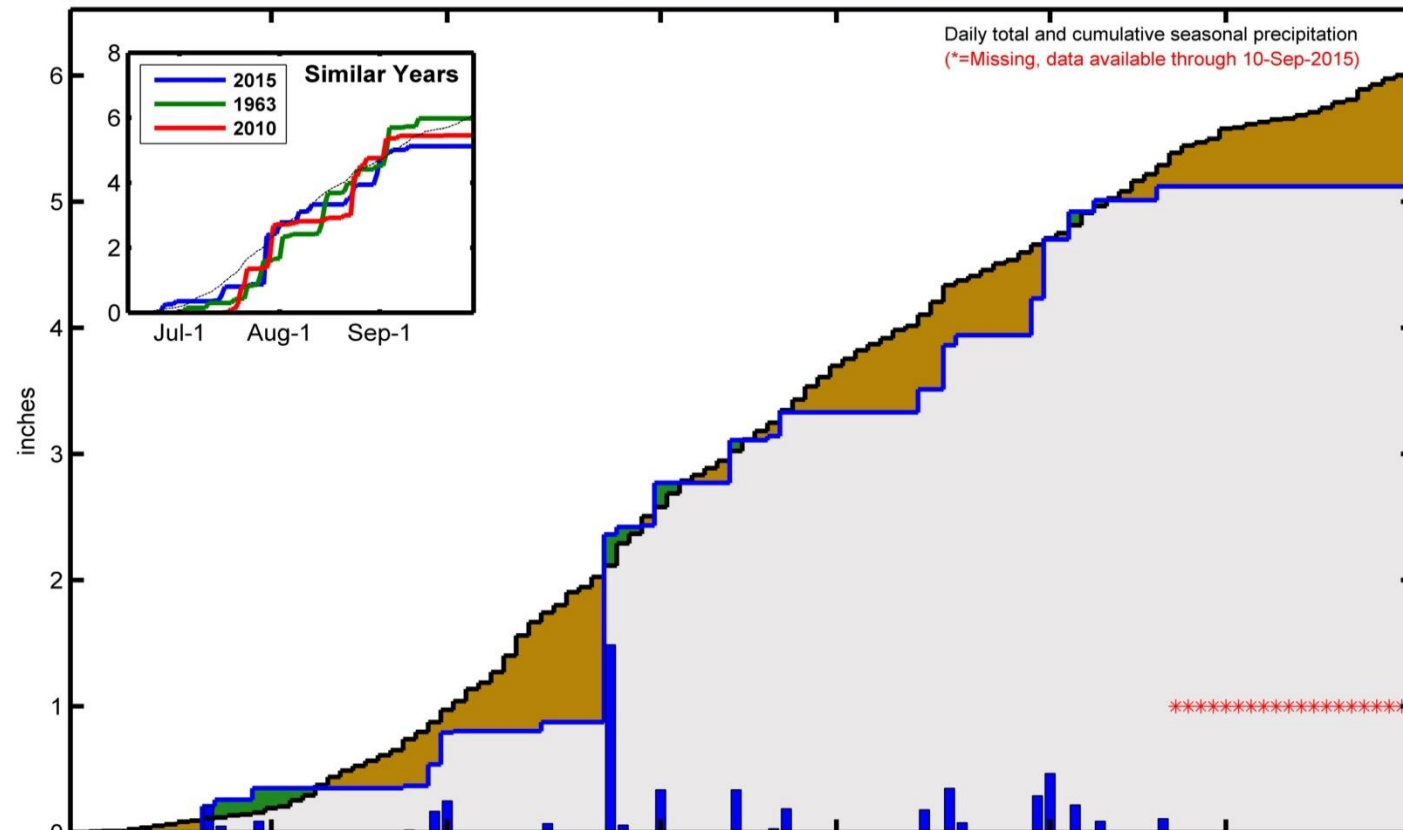
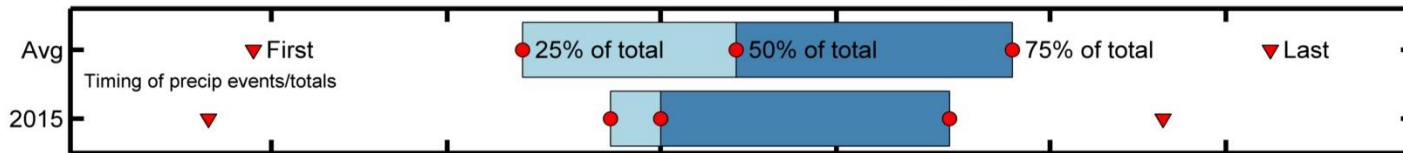


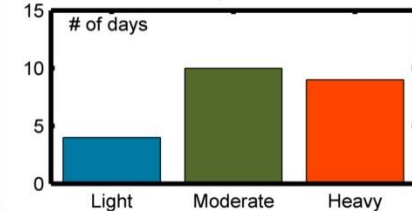
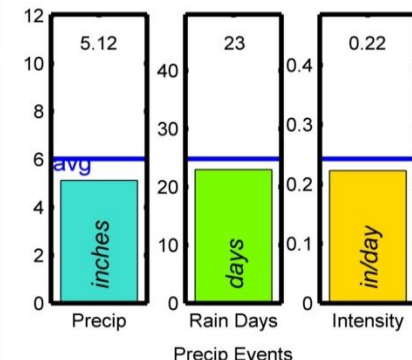
Figure produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at <http://water.weather.gov/precip/about.php>. Date created: 13-Sep-2015
 University of Arizona - <http://cals.arizona.edu/climate/>



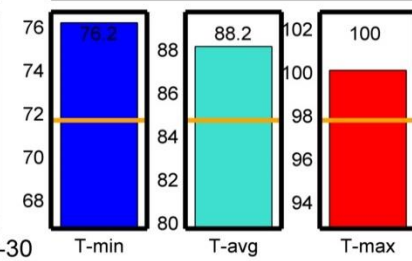
2015 Monsoon Summary



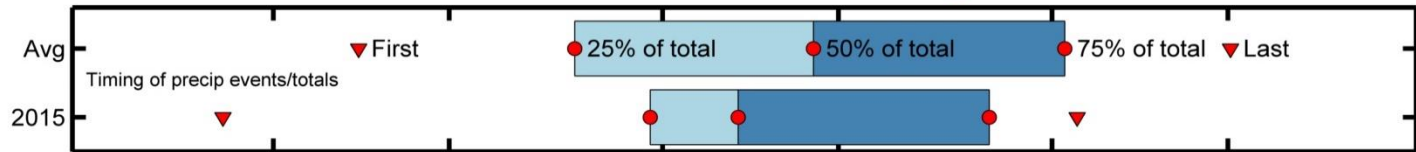
TUCSON INTL AP
 Elevation: 777m
 Period of record: 1948-2015
 Years in record: 68
 Precip rank: 45 (1, wettest)
 Temp rank: 2 (1, warmest)
 Missing in 2015: 20 days



Dry Spells
 Avg length: 4 days (avg: 5)
 Max length: 11 days (avg: 14)

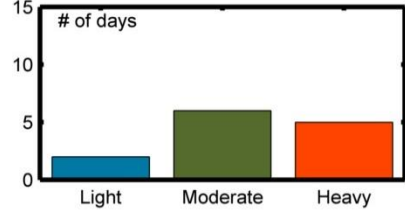
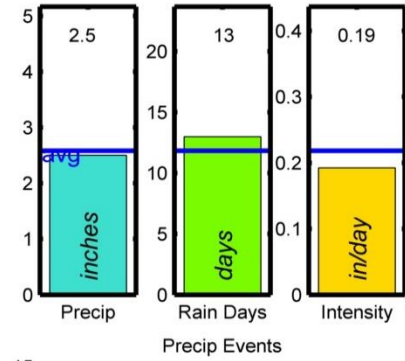
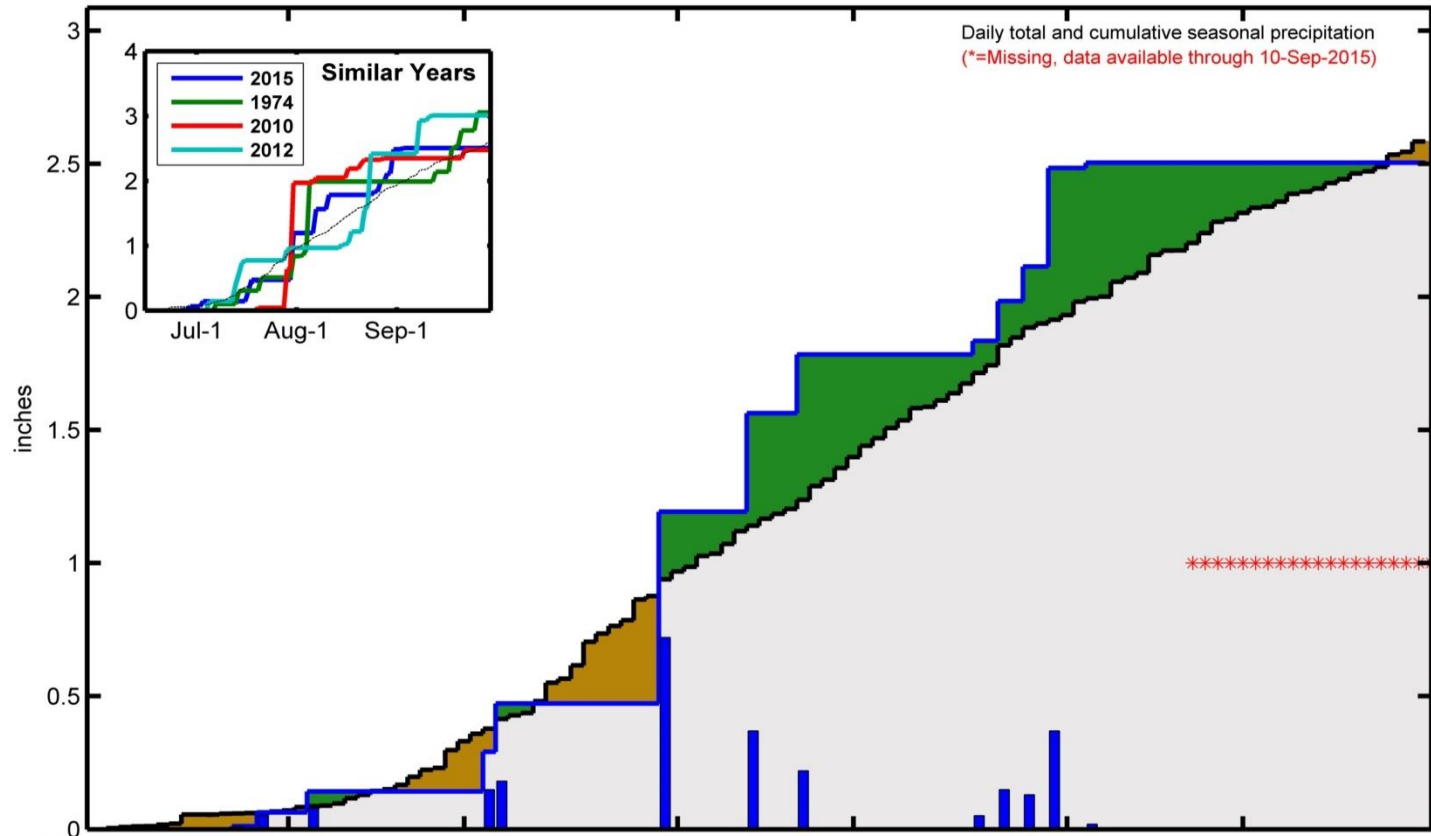


2015 Monsoon Summary



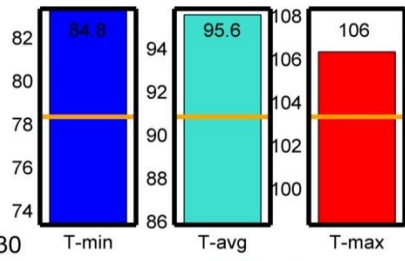
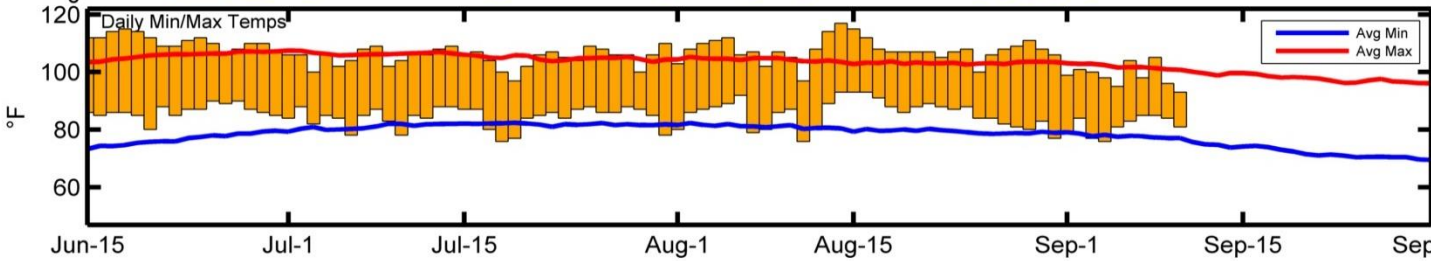
PHOENIX SKY HARBOR INTL AP

Elevation: 337m
 Period of record: 1947-2015
 Years in record: 69
 Precip rank: **29** (1, wettest)
 Temp rank: **2** (1, warmest)
 Missing in 2015: 20 days

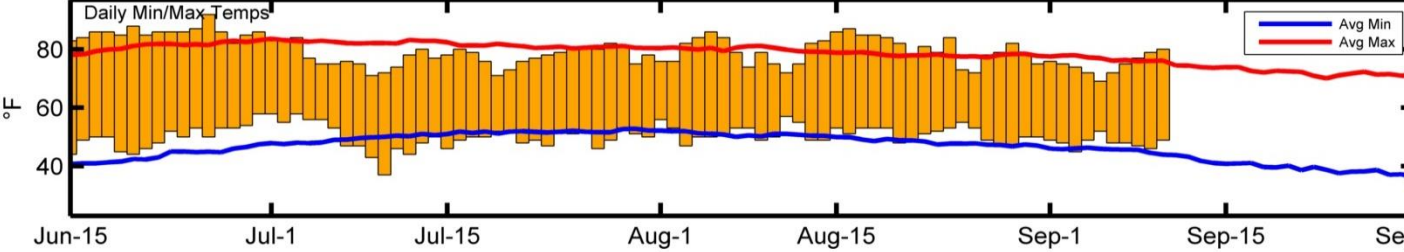
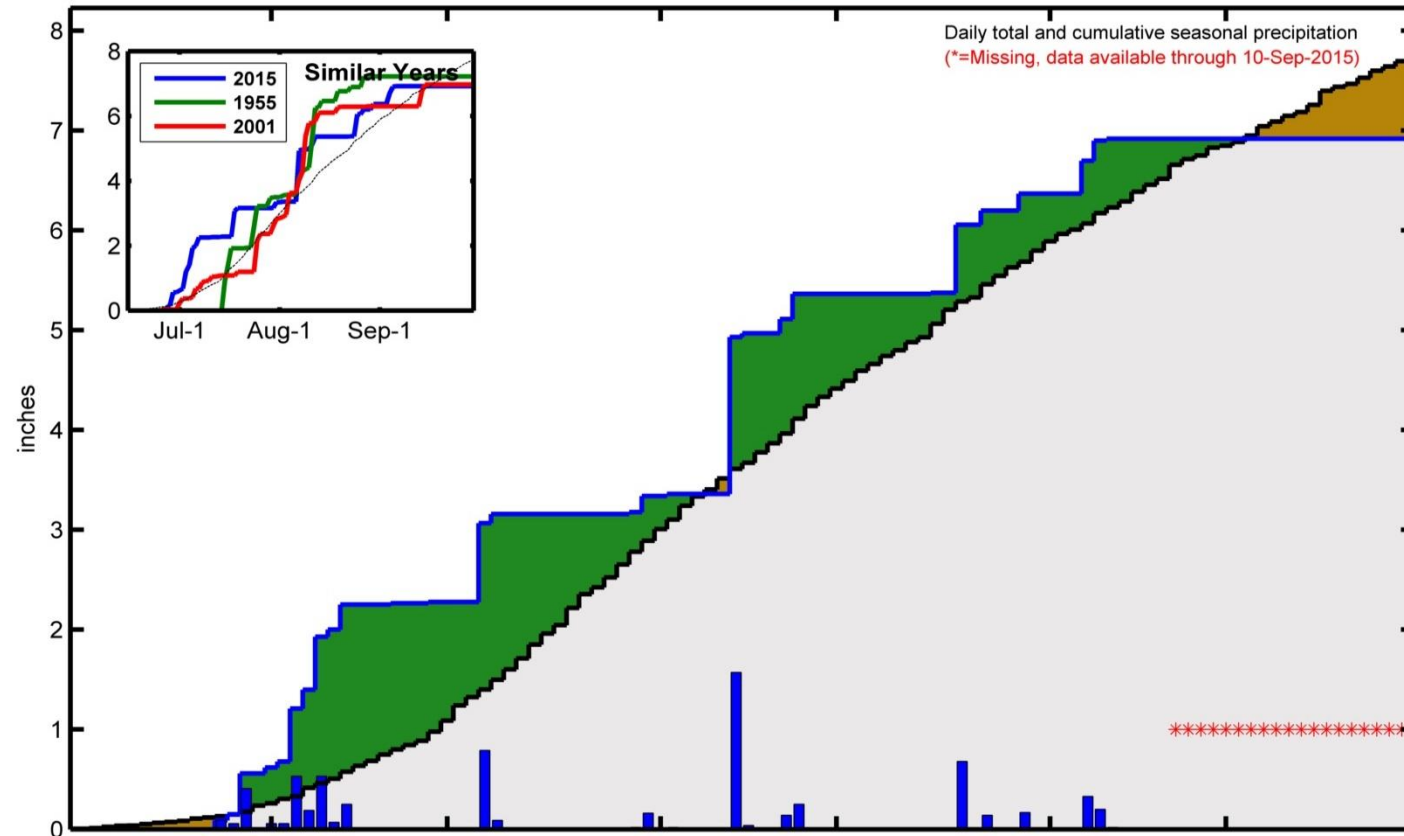
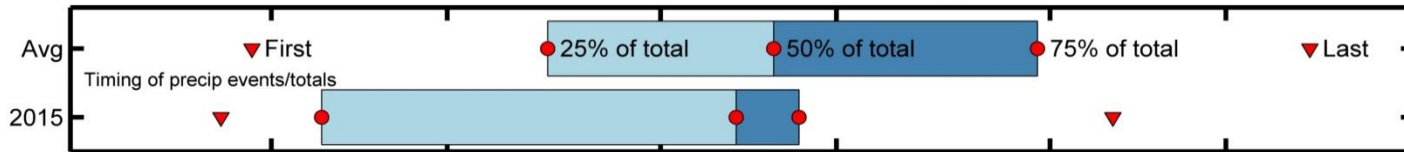


Dry Spells

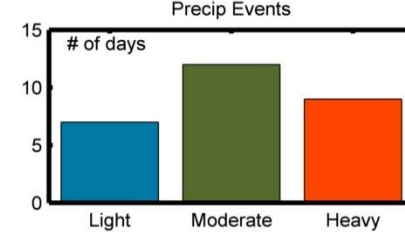
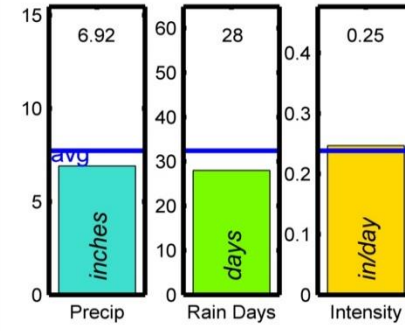
Avg length: 6 days (avg: 11)
 Max length: 13 days (avg: 21)



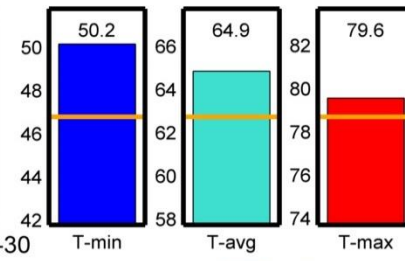
2015 Monsoon Summary



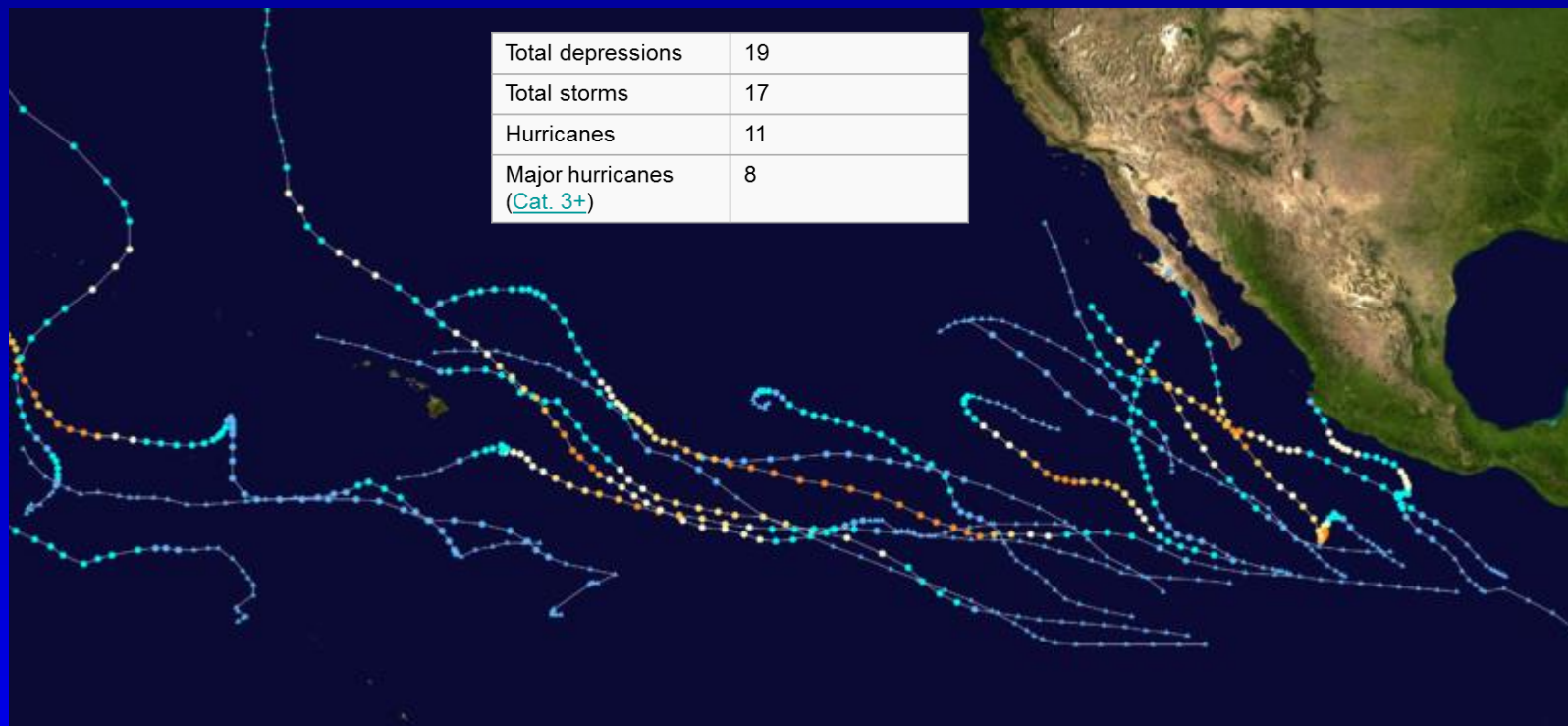
**FLAGSTAFF
PULLIAM AP**
Elevation: 2135m
Period of record: 1950-2015
Years in record: 66
Precip rank: **39** (1, wettest)
Temp rank: **2** (1, warmest)
Missing in 2015: 20 days



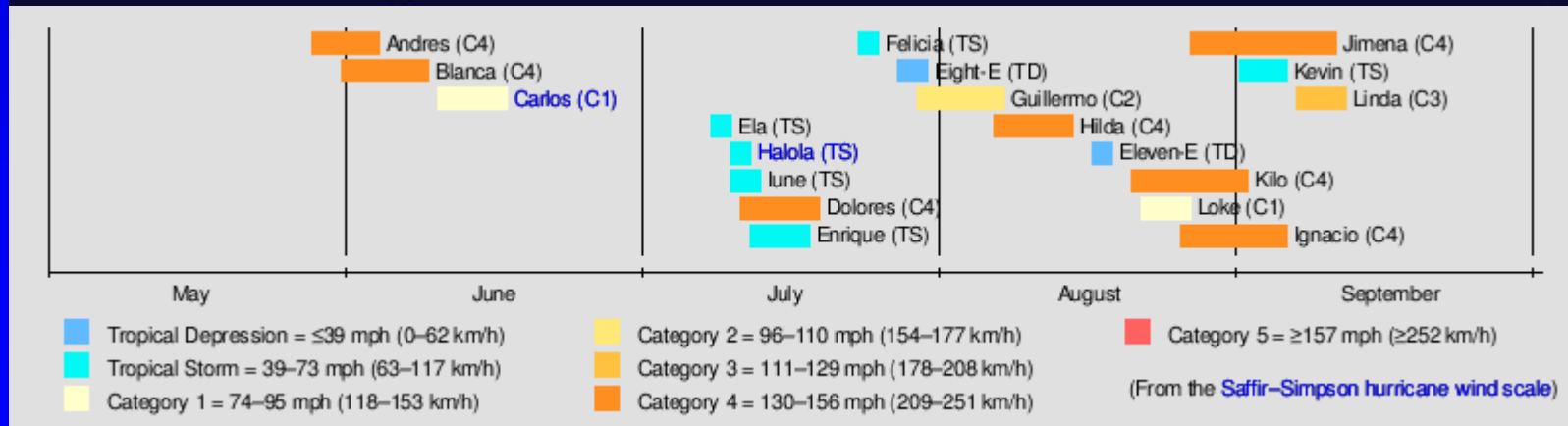
Dry Spells
Avg length: 4 days (avg: 5)
Max length: 10 days (avg: 12)



2015 East Pacific Hurricane Season (so far)



Total depressions	19
Total storms	17
Hurricanes	11
Major hurricanes (Cat. 3+)	8



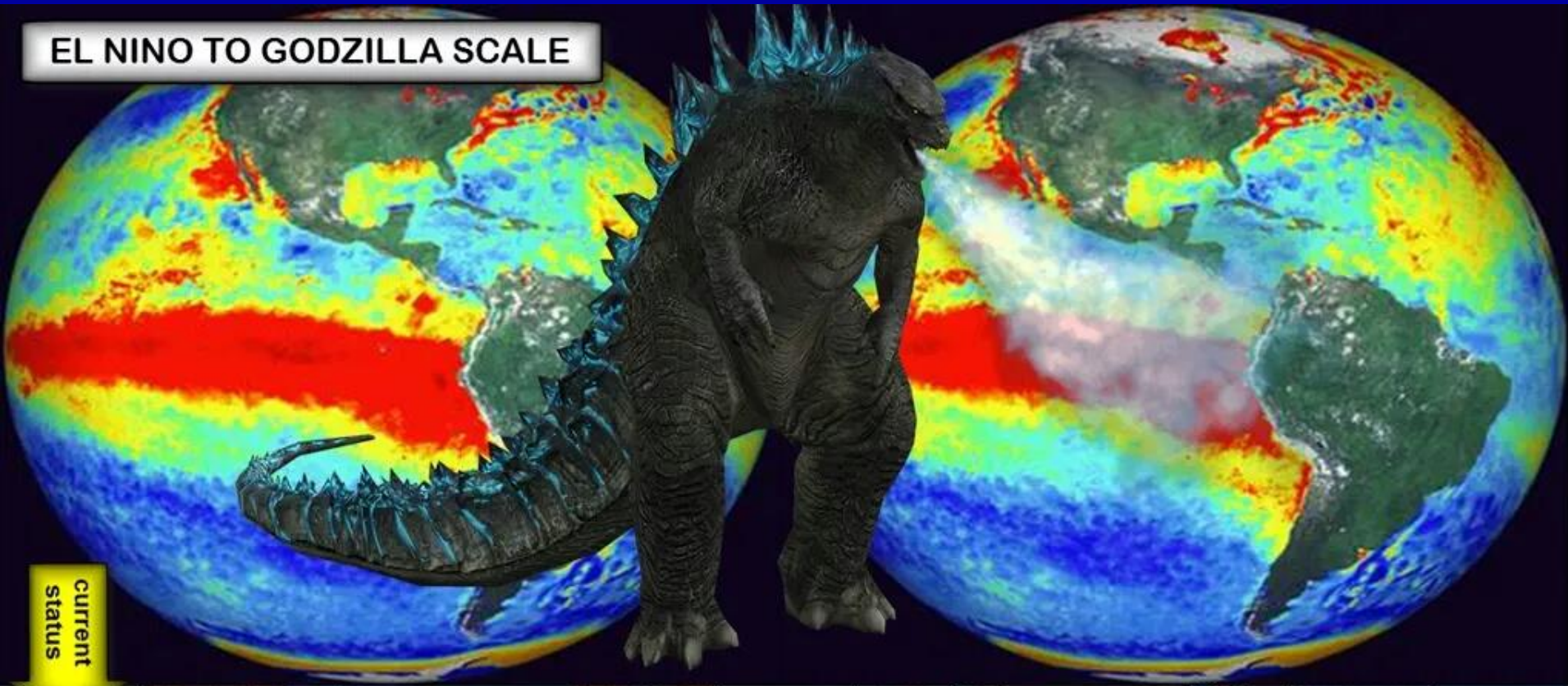
https://en.wikipedia.org/wiki/2015_Pacific_hurricane_season



El Niño



EL NINO TO GODZILLA SCALE



current status



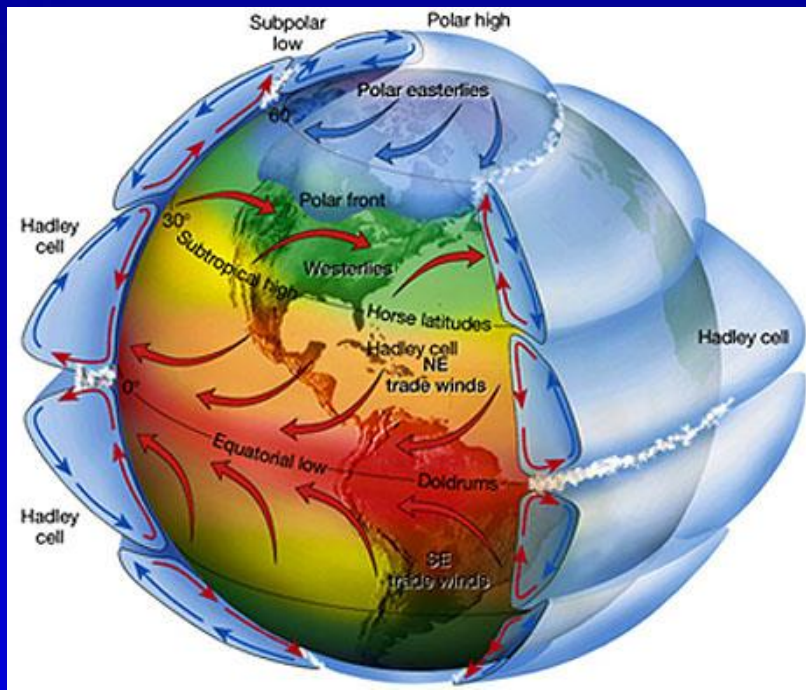
<https://twitter.com/wxbrad>



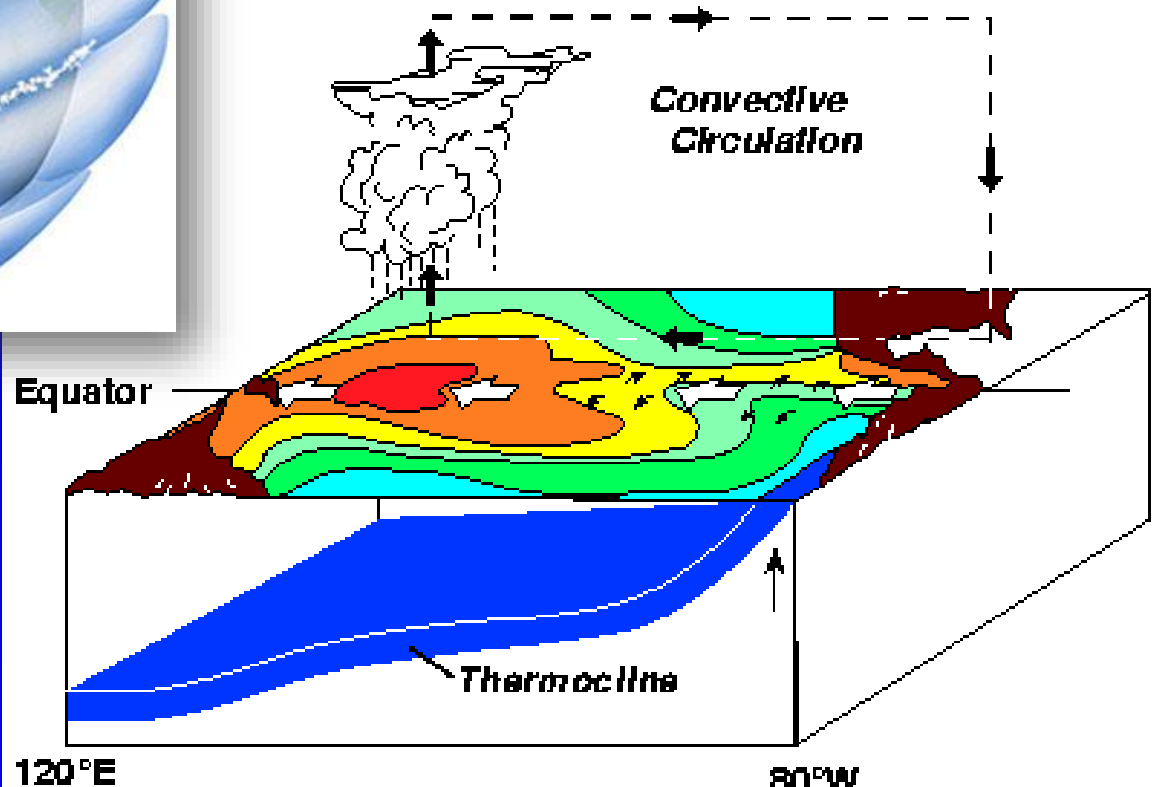
Climate Science Applications Program - University of Arizona Cooperative Extension



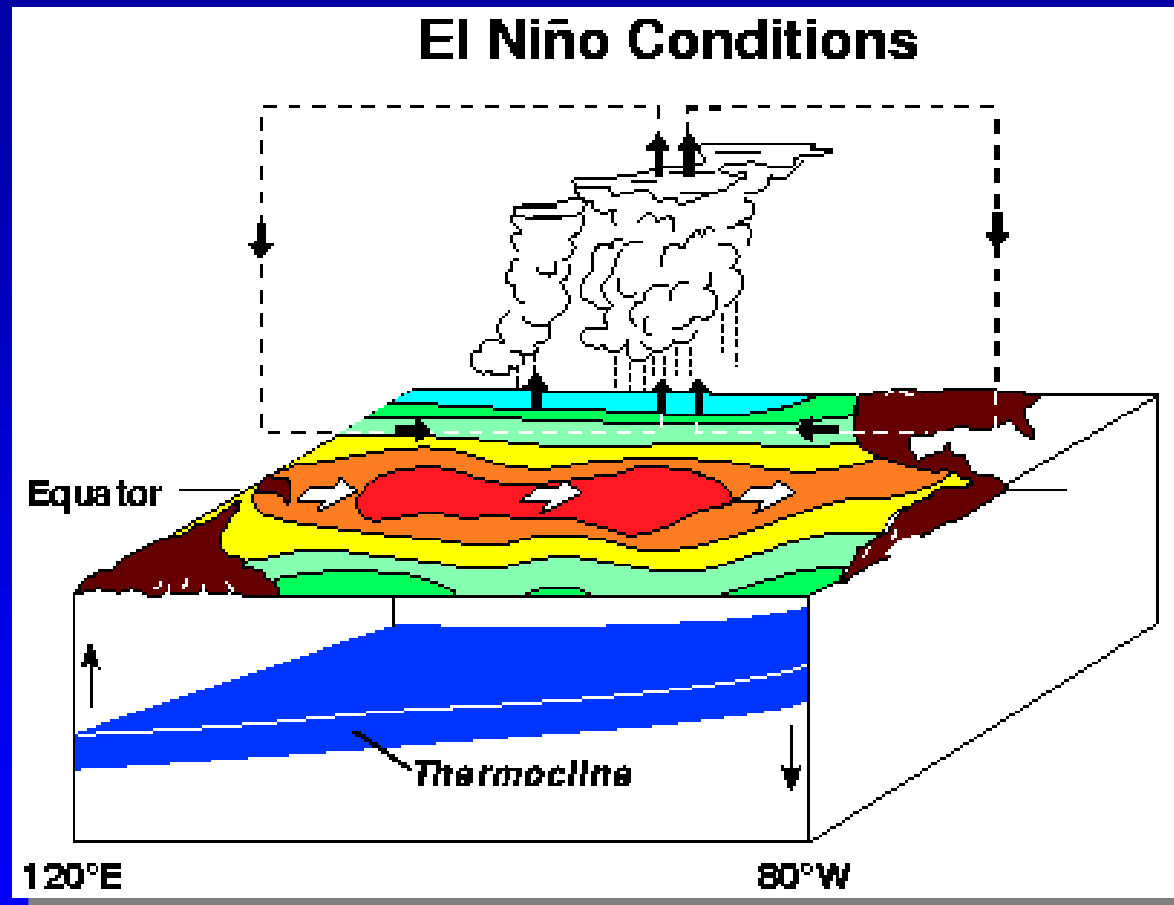
What is El Niño, again?



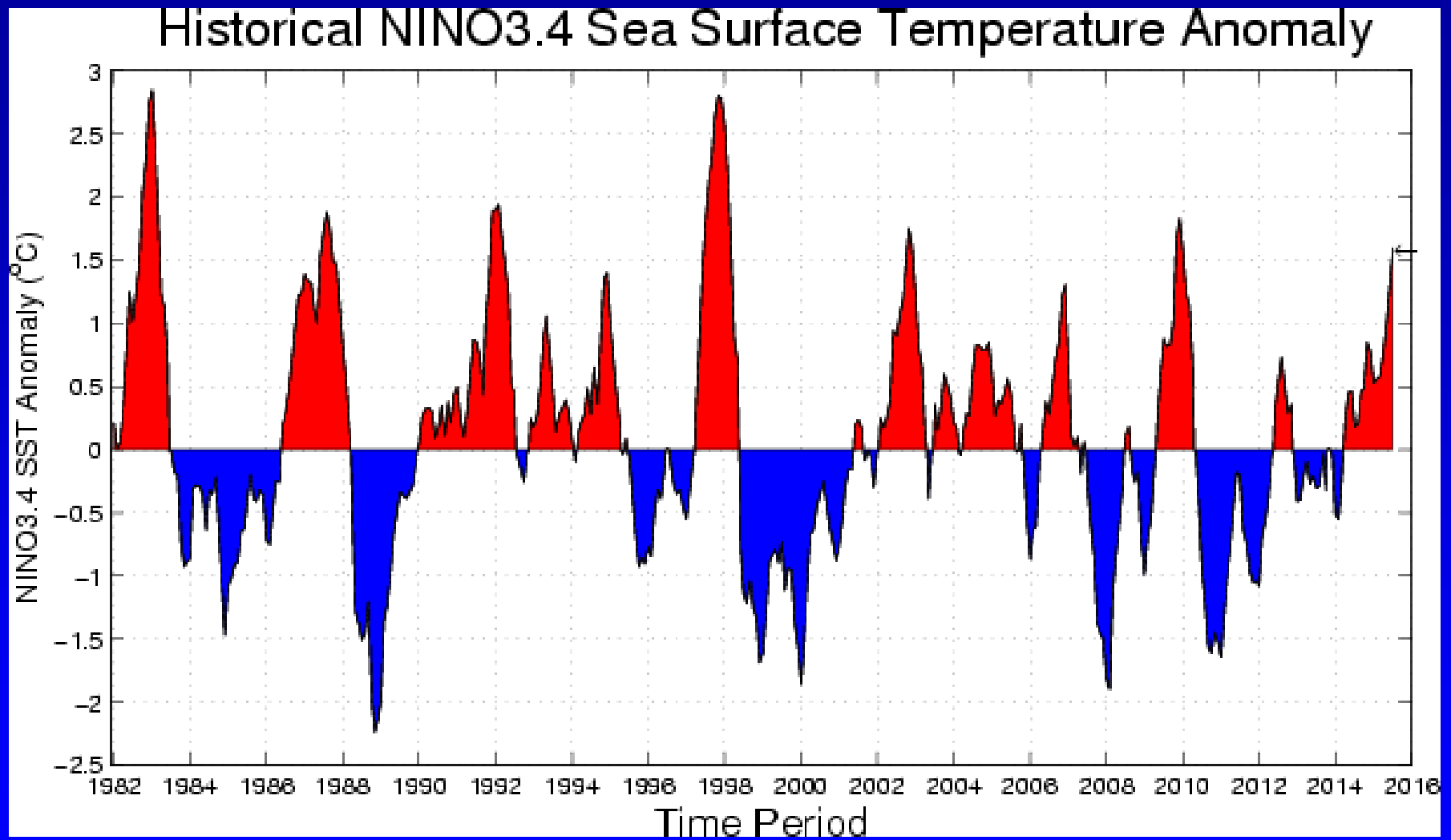
Normal Conditions



Atmosphere-Ocean Coupling

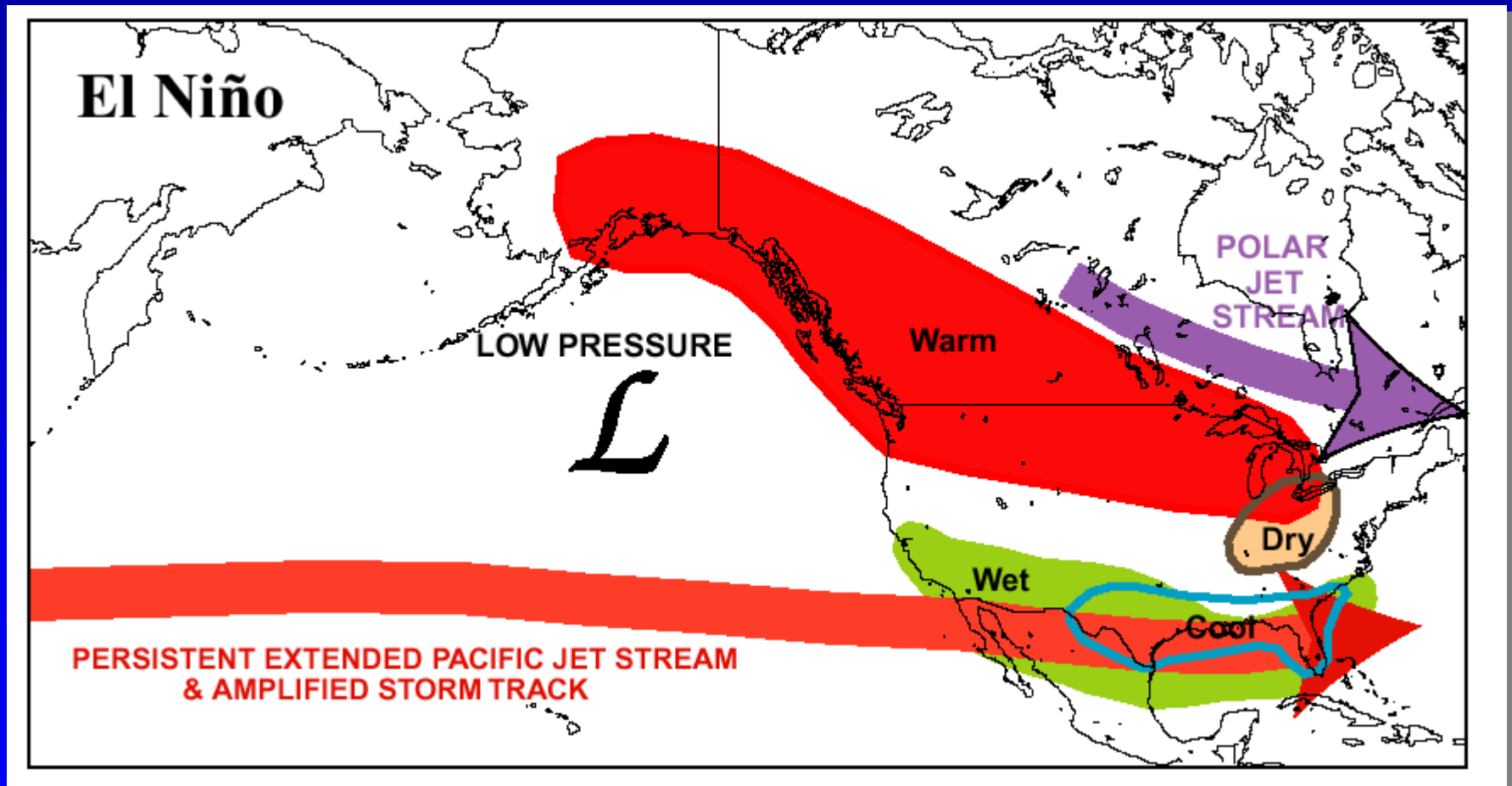


Historic ENSO Variability

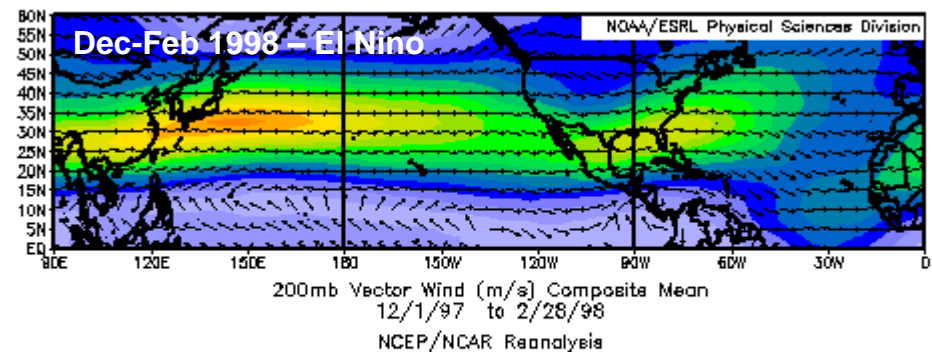
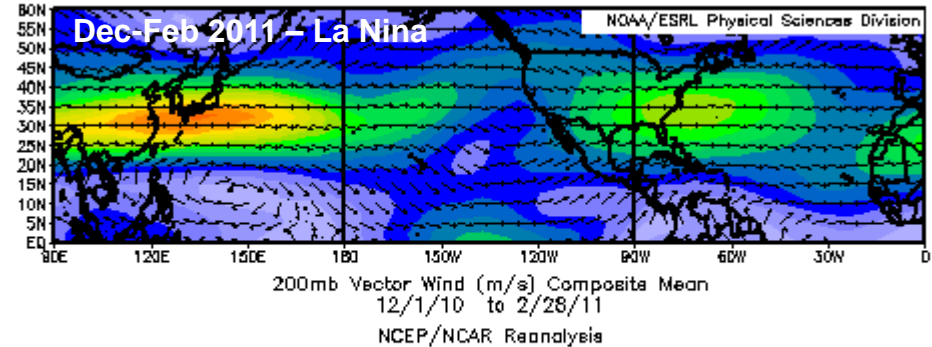
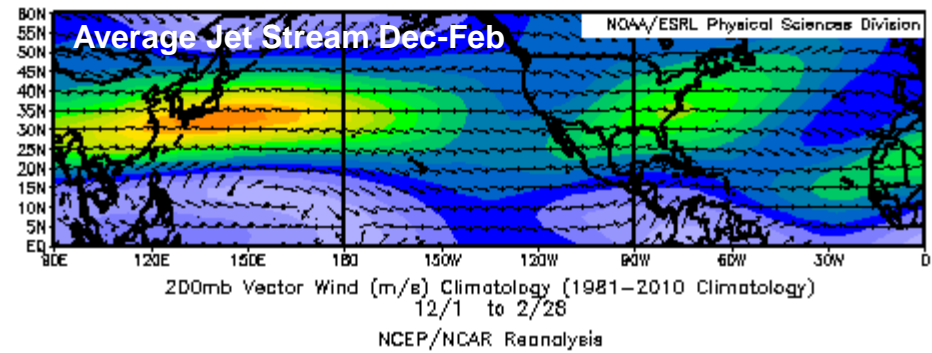


<http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/>

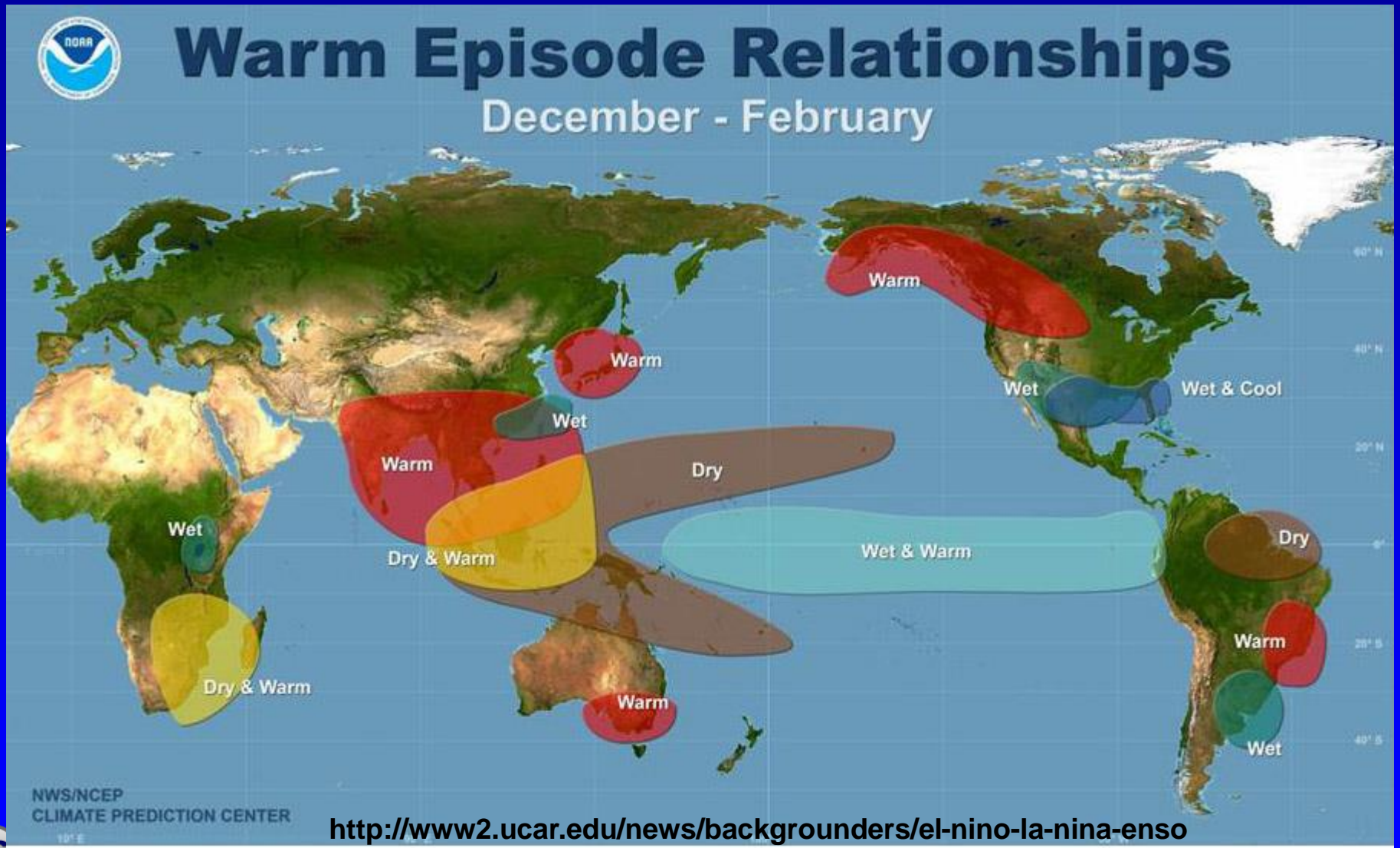
Dominant Circulation Pattern: El Niño Winter



Shifts in winter storm track: La Niña vs. El Niño

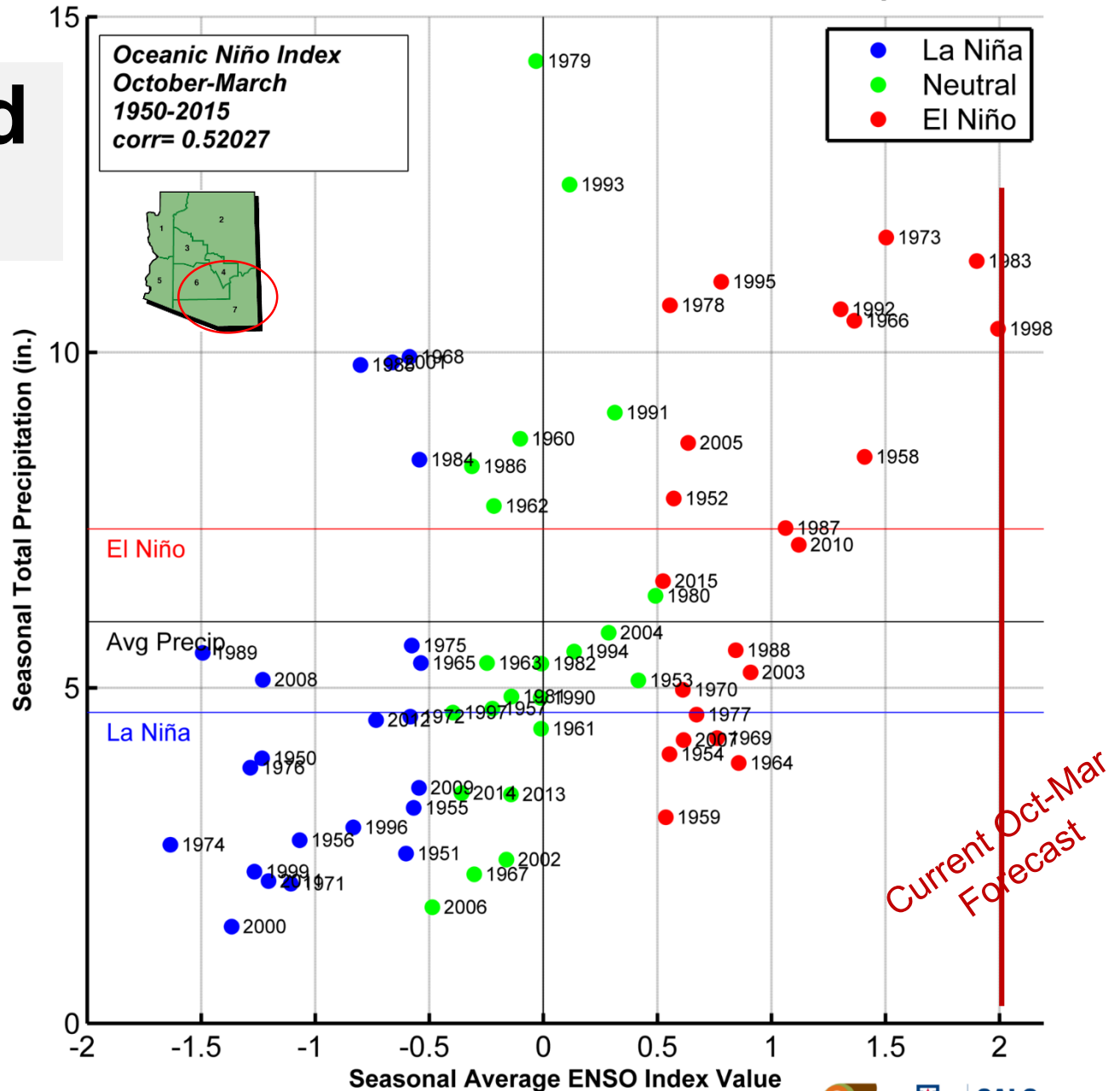


Global Impacts



El Niño and Arizona

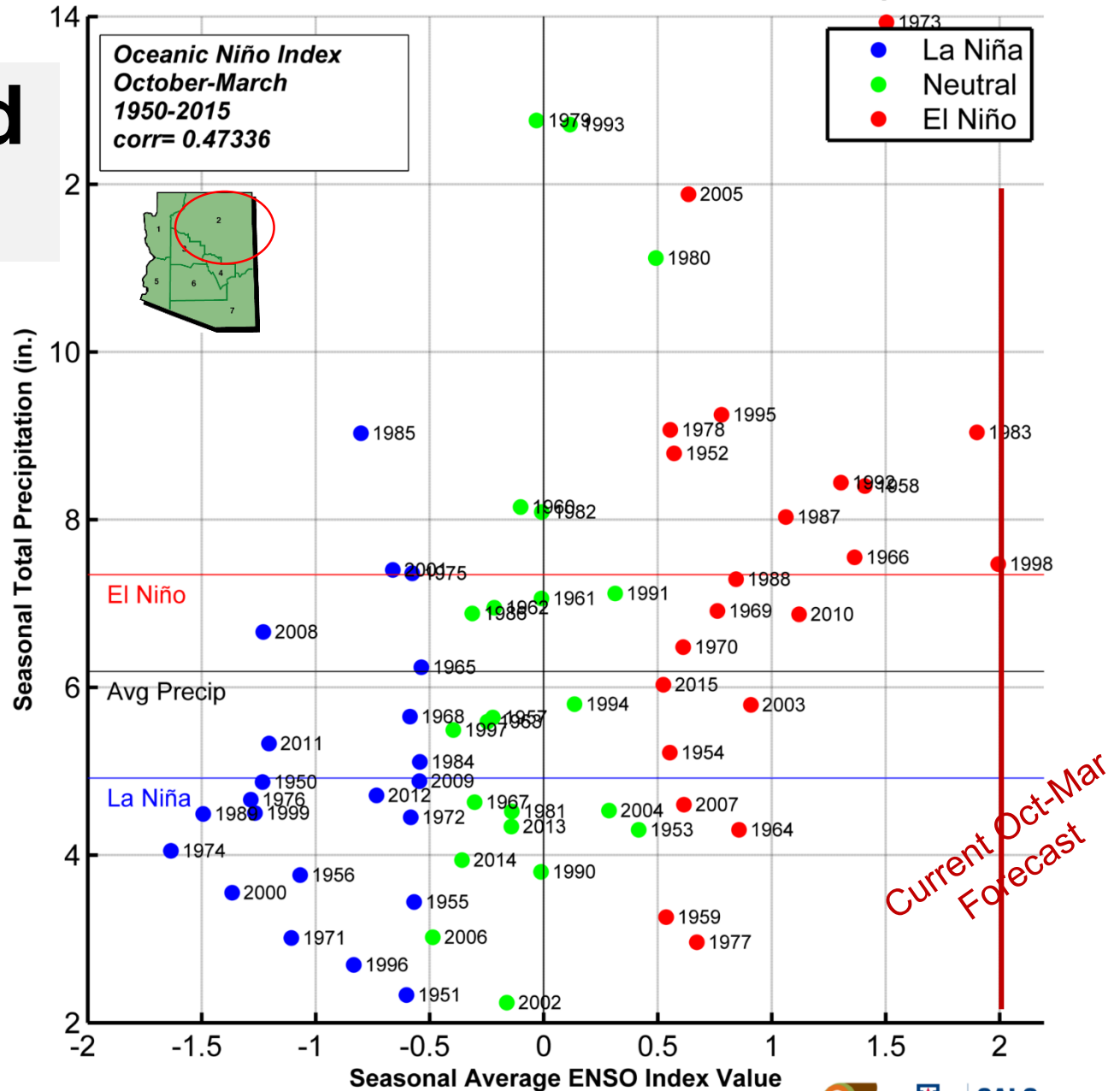
Arizona Climate Division 7, ENSO vs. Seasonal Precipitation



Data from NOAA-NCDC and NOAA ESRL, Date created: 17-Jul-2015
 University of Arizona - <http://cals.arizona.edu/climate/>

El Niño and Arizona

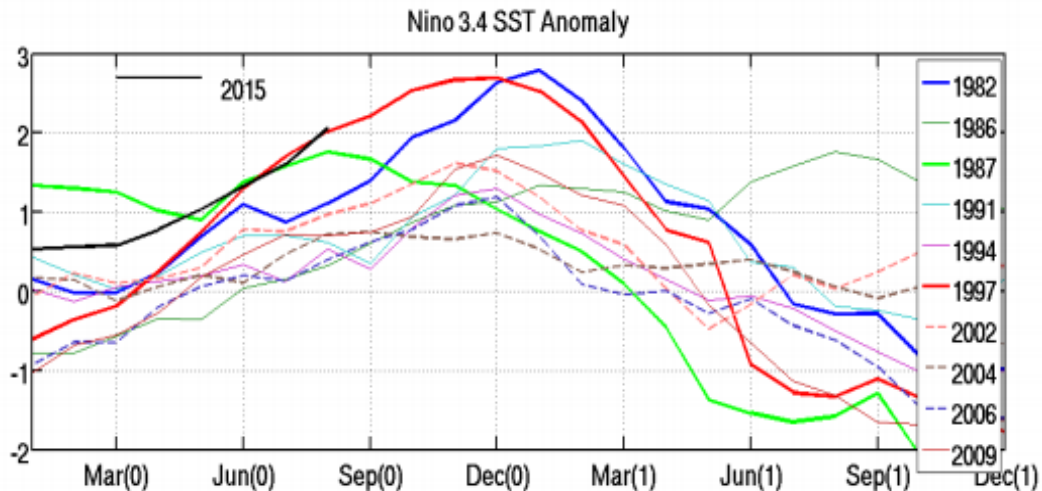
Arizona Climate Division 2, ENSO vs. Seasonal Precipitation



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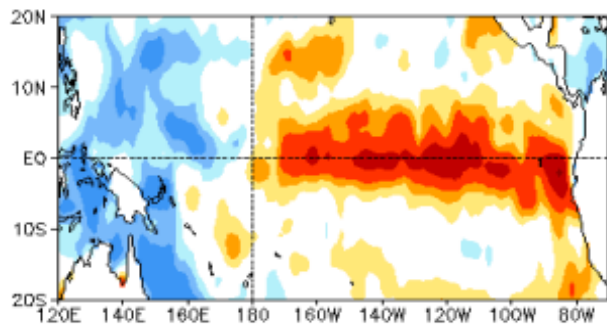
<https://twitter.com/EricBlake12>

SST, D20 and 925hp Wind anomalies in August



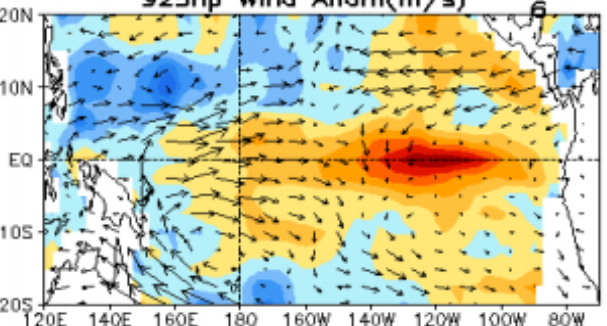
1982

AUG 1982 SST Anom. (°C)



-2.5 -1.5 -0.9 -0.6 -0.3 0.3 0.6 0.9 1.5 2.5

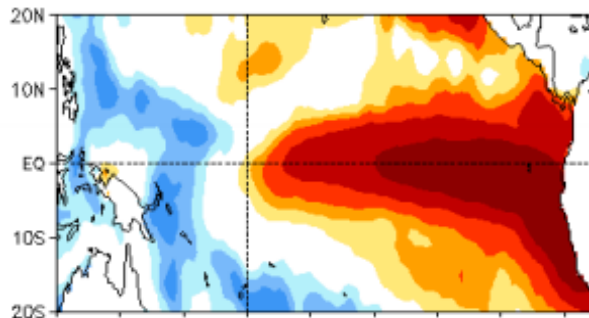
AUG 1982 D20 Anom. (m)
925hp Wind Anom(m/s)



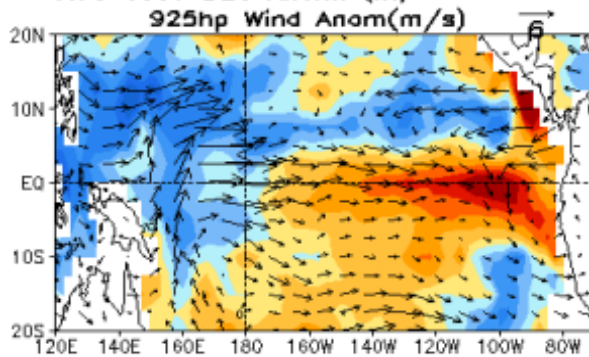
-50 -40 -30 -20 -10 0 10 20 30 40 50

1997

AUG 1997 SST Anom. (°C)



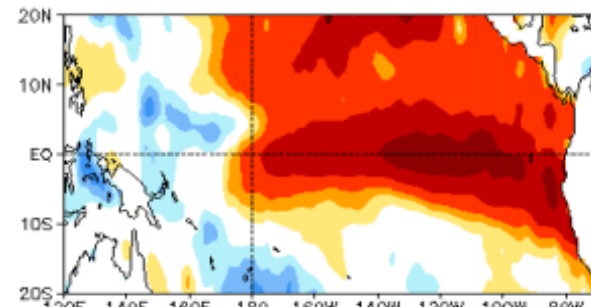
AUG 1997 D20 Anom. (m)
925hp Wind Anom(m/s)



-50 -40 -30 -20 -10 0 10 20 30 40 50

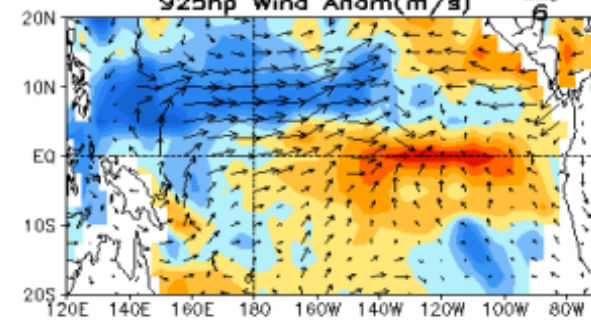
2015

AUG 2015 SST Anom. (°C)



-2.5 -1.5 -0.9 -0.6 -0.3 0.3 0.6 0.9 1.5 2.5

AUG 2015 D20 Anom. (m)
925hp Wind Anom(m/s)

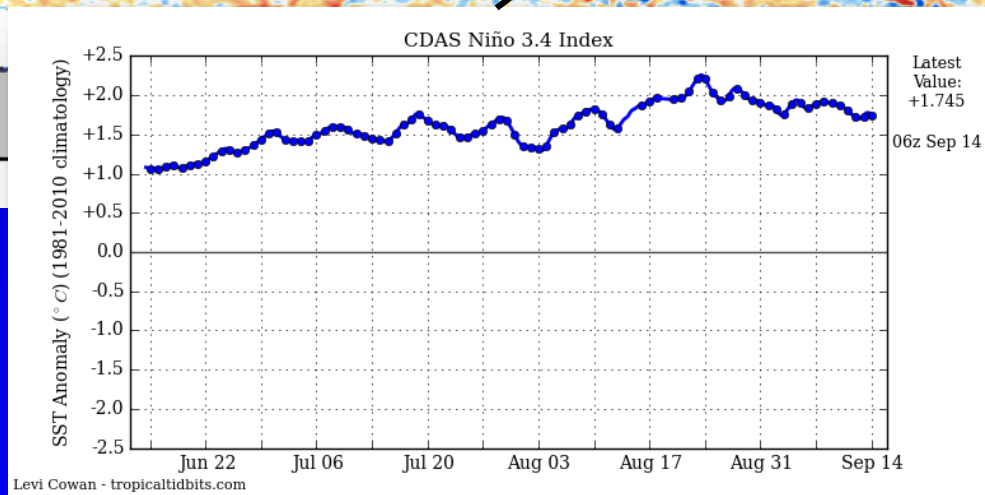
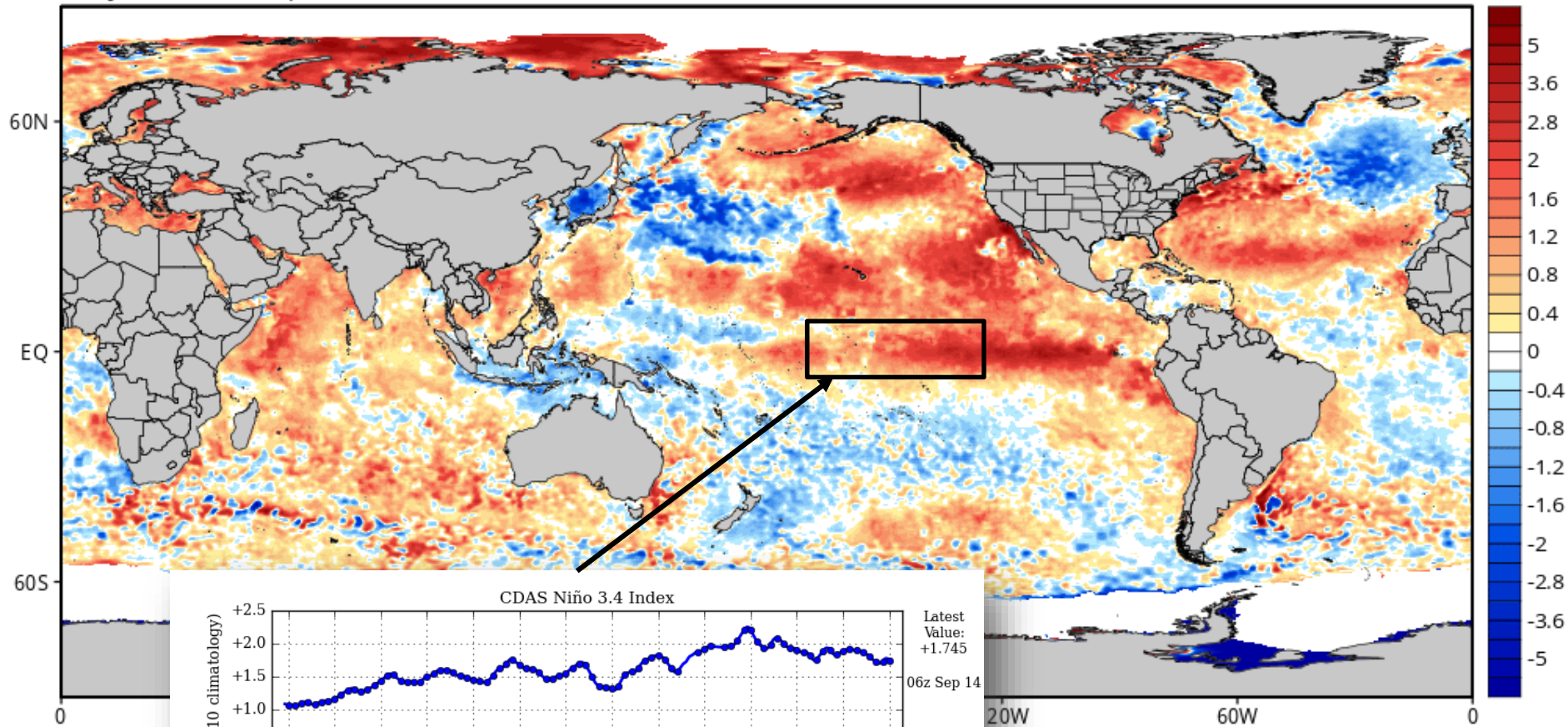


-50 -40 -30 -20 -10 0 10 20 30 40 50

CDAS Sea Surface Temperature Anomaly (°C) (based on CFSR 1981-2010 Climatology)

Analysis Time: 06z Sep 14 2015

Levi Cowan | tropicaltidbits.com

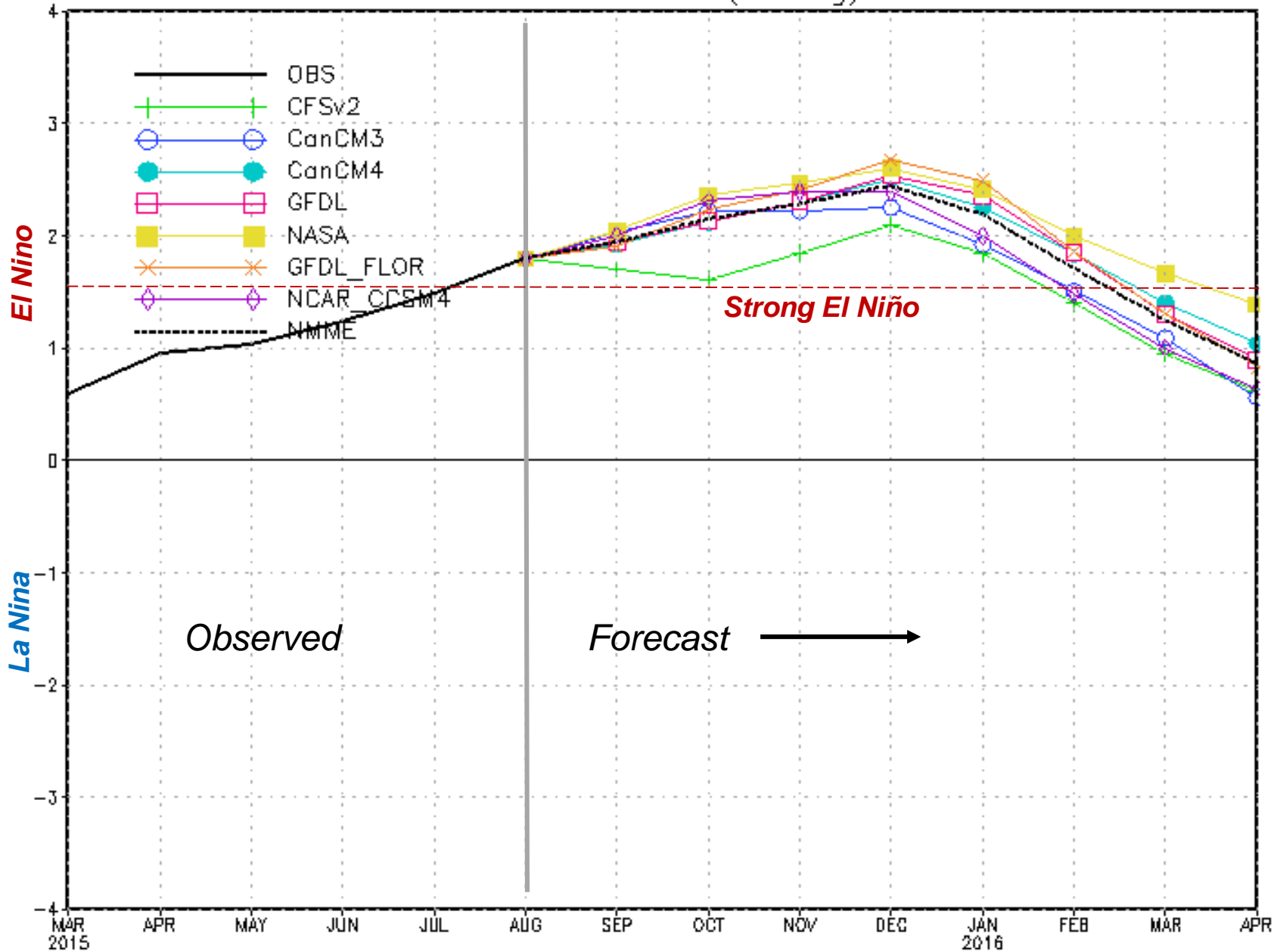


<http://www.tropicaltidbits.com/analysis/ocean.html>

Climate Science Applications Program - University of Arizona Cooperative Extension



NMME Forecast for Nino 3.4 (scaling) IC= 201509



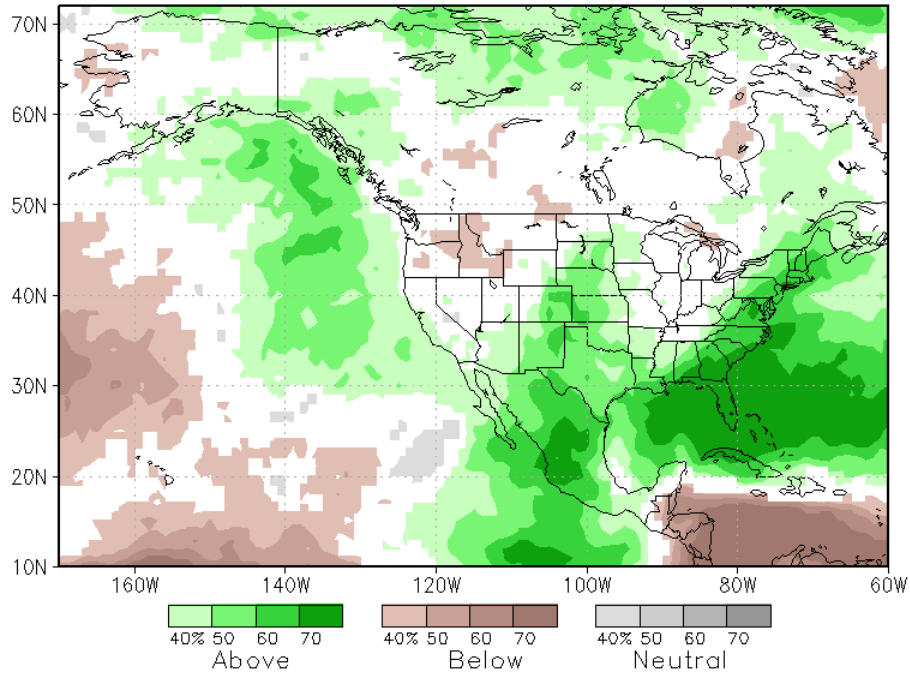
Observed

Forecast



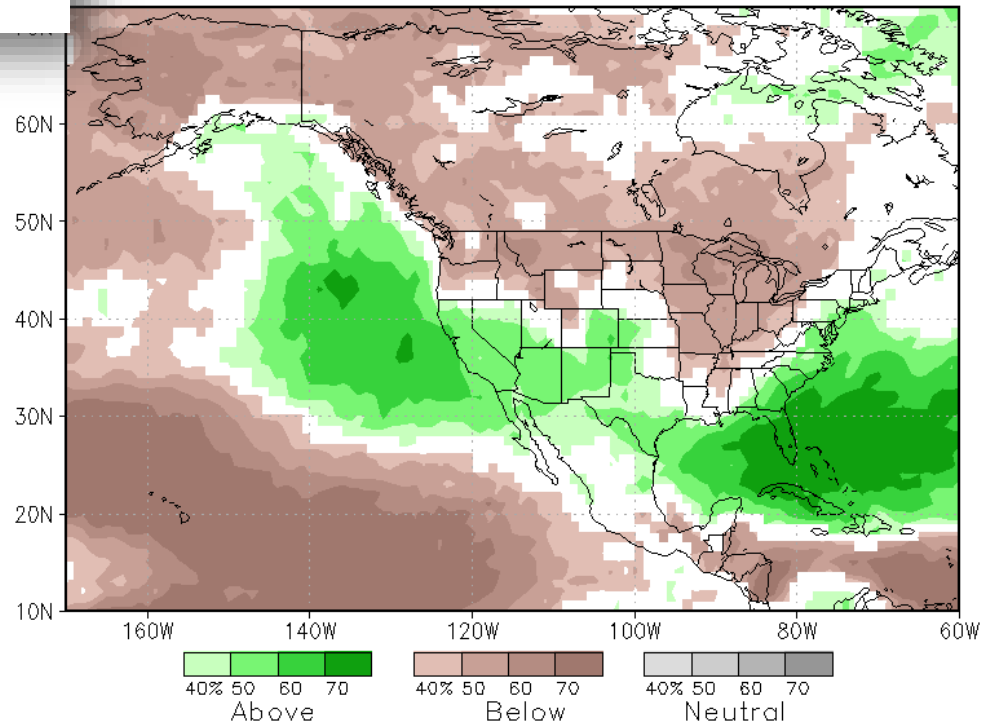
Strong El Niño

NMME prob fcst Prate IC=201509 for lead 2 2015 NDJ



Climate Outlooks

NMME prob fcst Prate IC=201509 for lead 4 2016 JFM

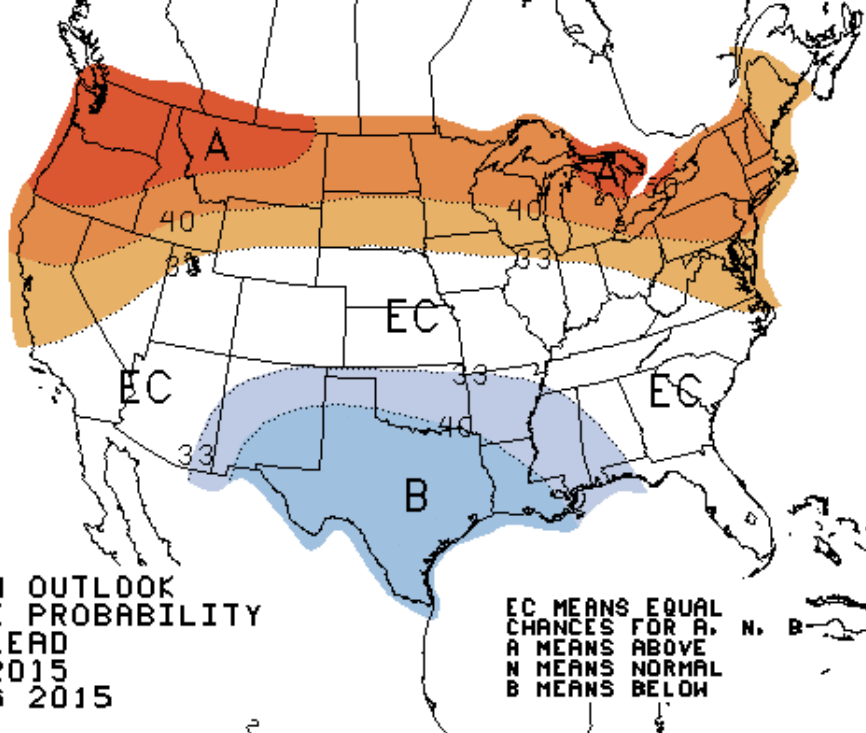


<http://www.cpc.ncep.noaa.gov/products/NMME/seasanom.shtml>

Climate Outlooks



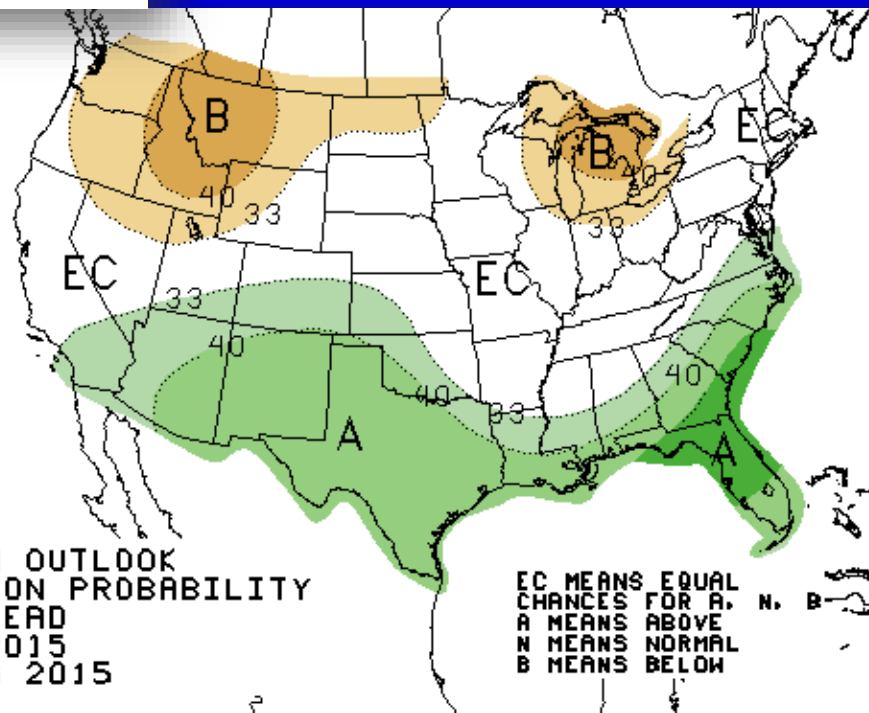
THREE-MONTH OUTLOOK
TEMPERATURE PROBABILITY
2.5 MONTH LEAD
VALID NDJ 2015
MADE 20 AUG 2015



<http://www.cpc.ncep.noaa.gov/products/predictions/90day/>



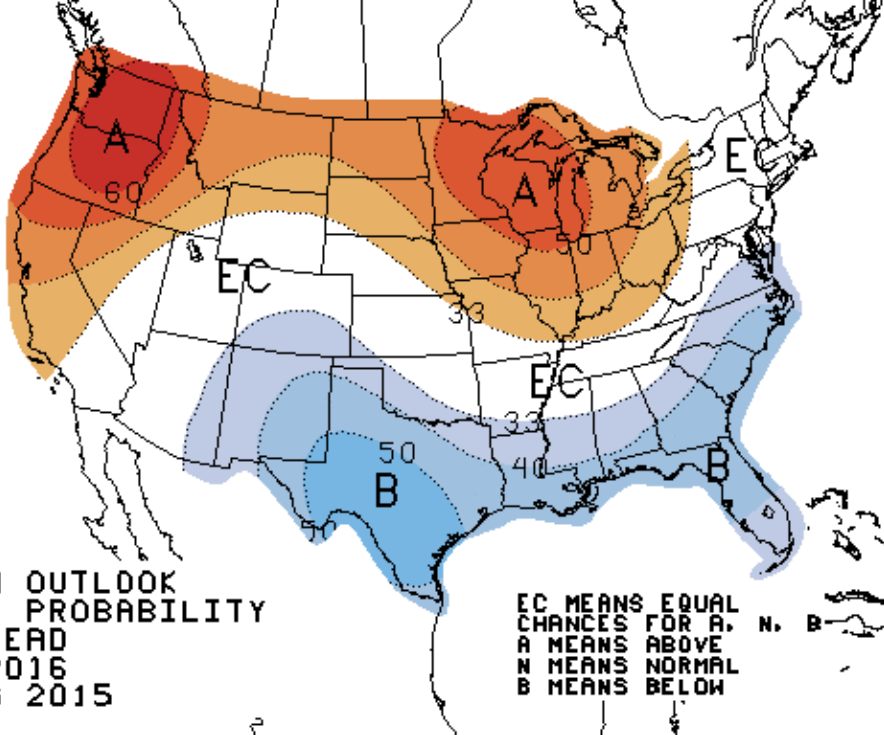
THREE-MONTH OUTLOOK
PRECIPITATION PROBABILITY
2.5 MONTH LEAD
VALID NDJ 2015
MADE 20 AUG 2015



Climate Outlooks



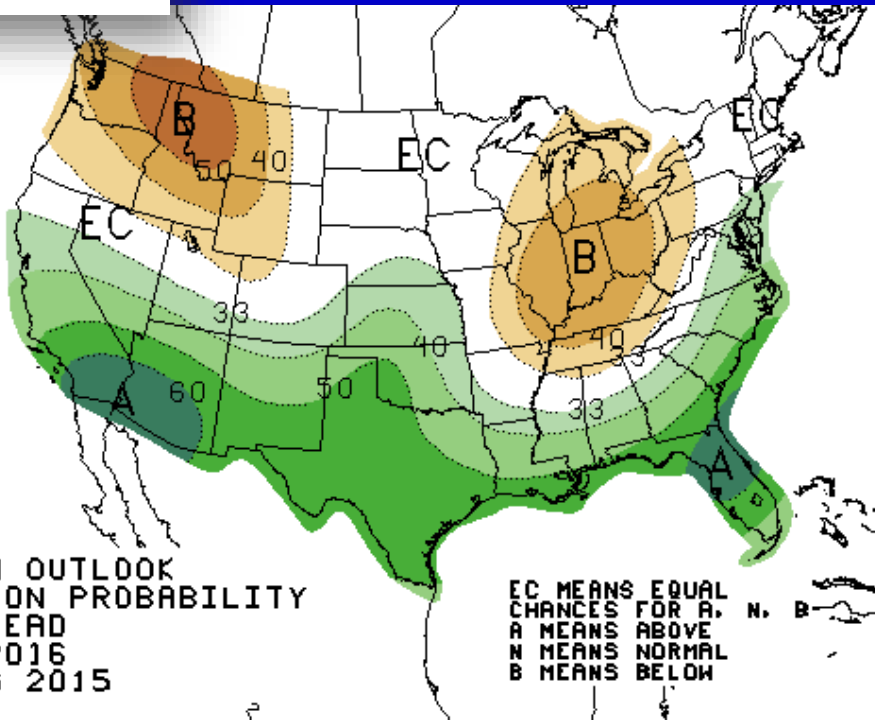
THREE-MONTH OUTLOOK
 TEMPERATURE PROBABILITY
 4.5 MONTH LEAD
 VALID JFM 2016
 MADE 20 AUG 2015



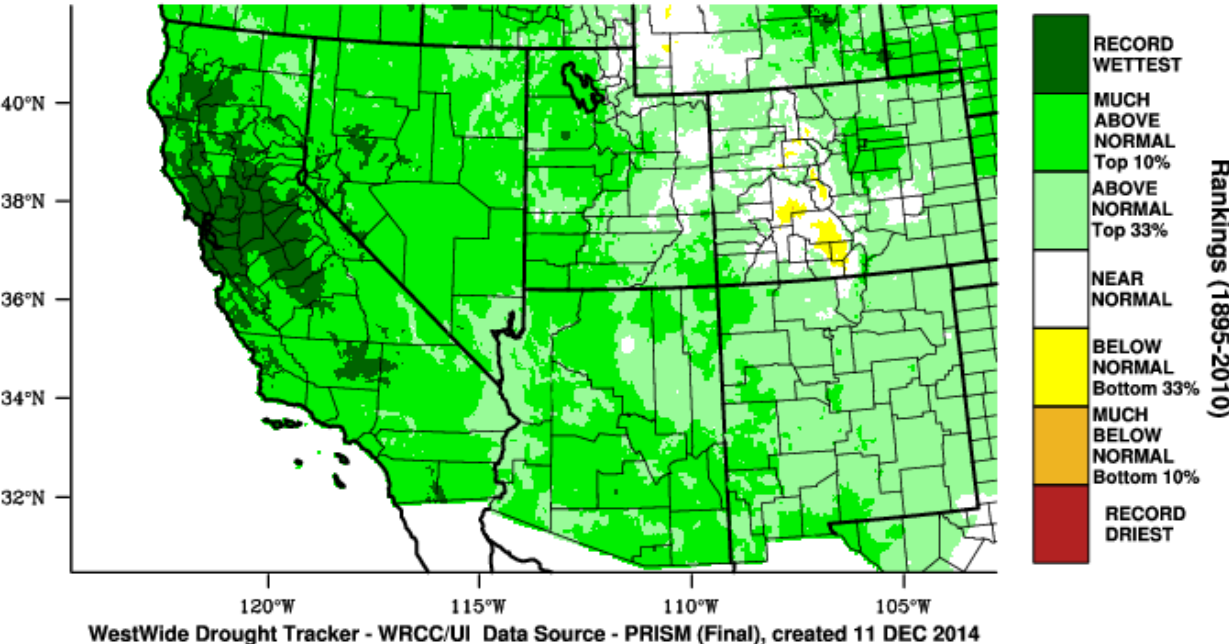
<http://www.cpc.ncep.noaa.gov/products/predictions/90day/>



THREE-MONTH OUTLOOK
 PRECIPITATION PROBABILITY
 4.5 MONTH LEAD
 VALID JFM 2016
 MADE 20 AUG 2015



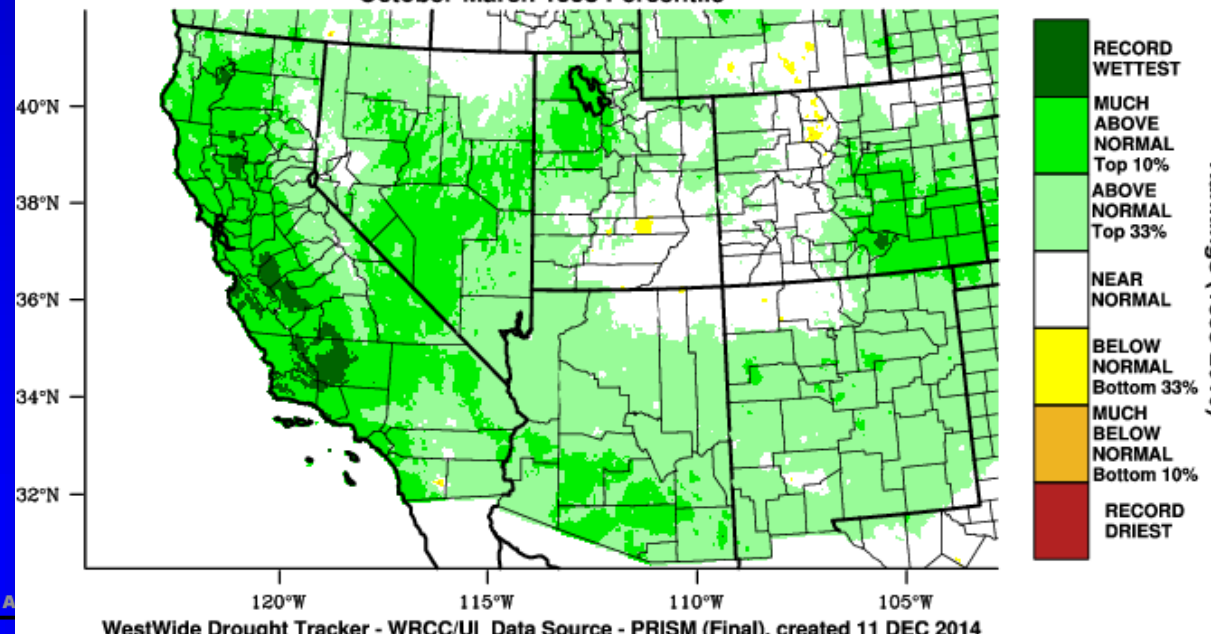
Southwest - Precipitation
October-March 1983 Percentile



Rankings (1895-2010)

Past Strong Events

Southwest - Precipitation
October-March 1998 Percentile

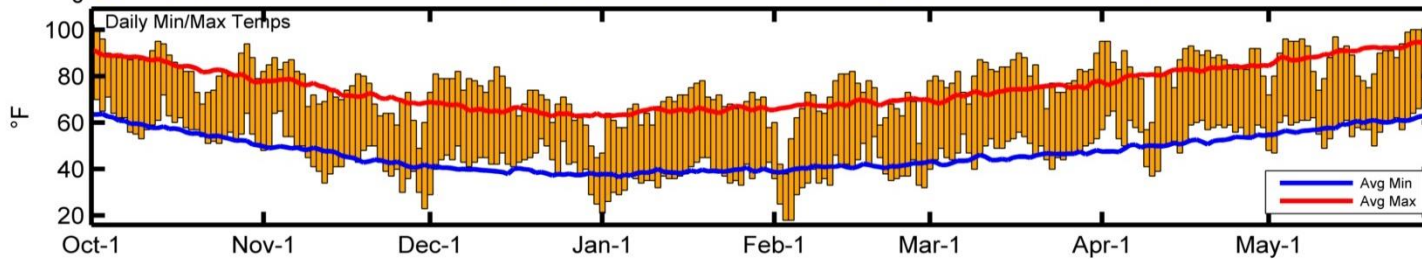
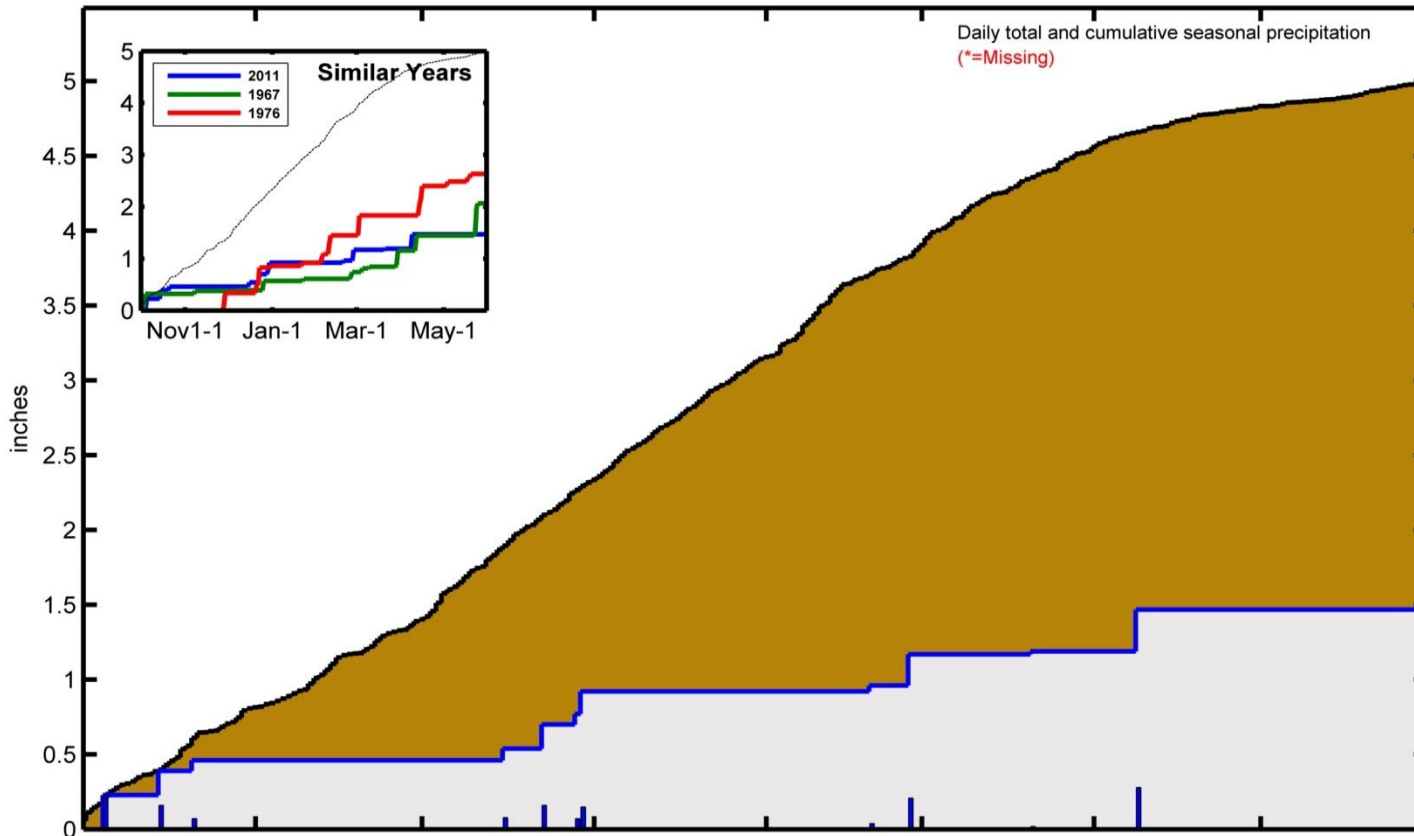
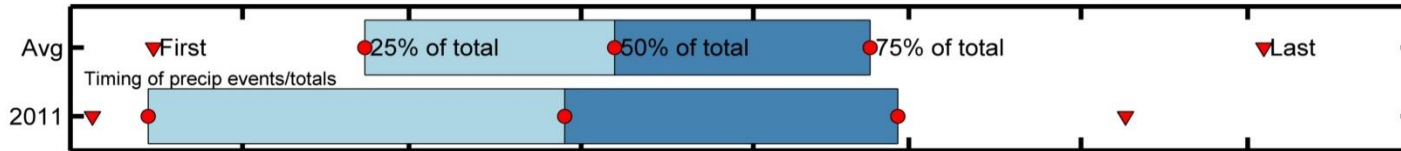


Rankings (1895-2010)

<http://www.wrcc.dri.edu/wwdt>

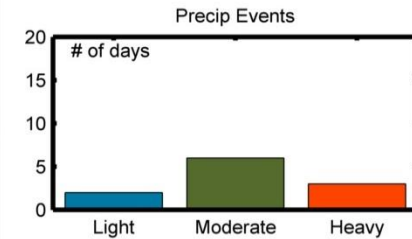
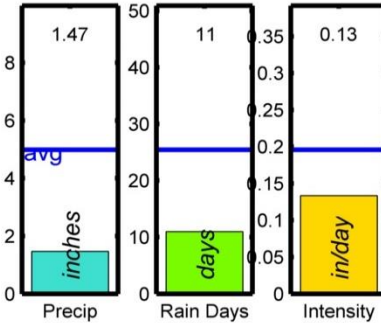
2010-2011 Cool Season Climate Summary

Moderate Strength La Niña Event



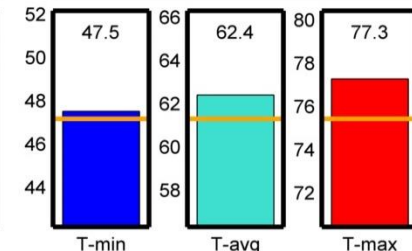
TUCSON INTL AP

Elevation: 777m
 Period of record: 1948-2014
 Years in record: 67
 Precip rank: 65 (1, wettest)
 Temp rank: 19 (1, warmest)
 Missing in 2011: 0 days



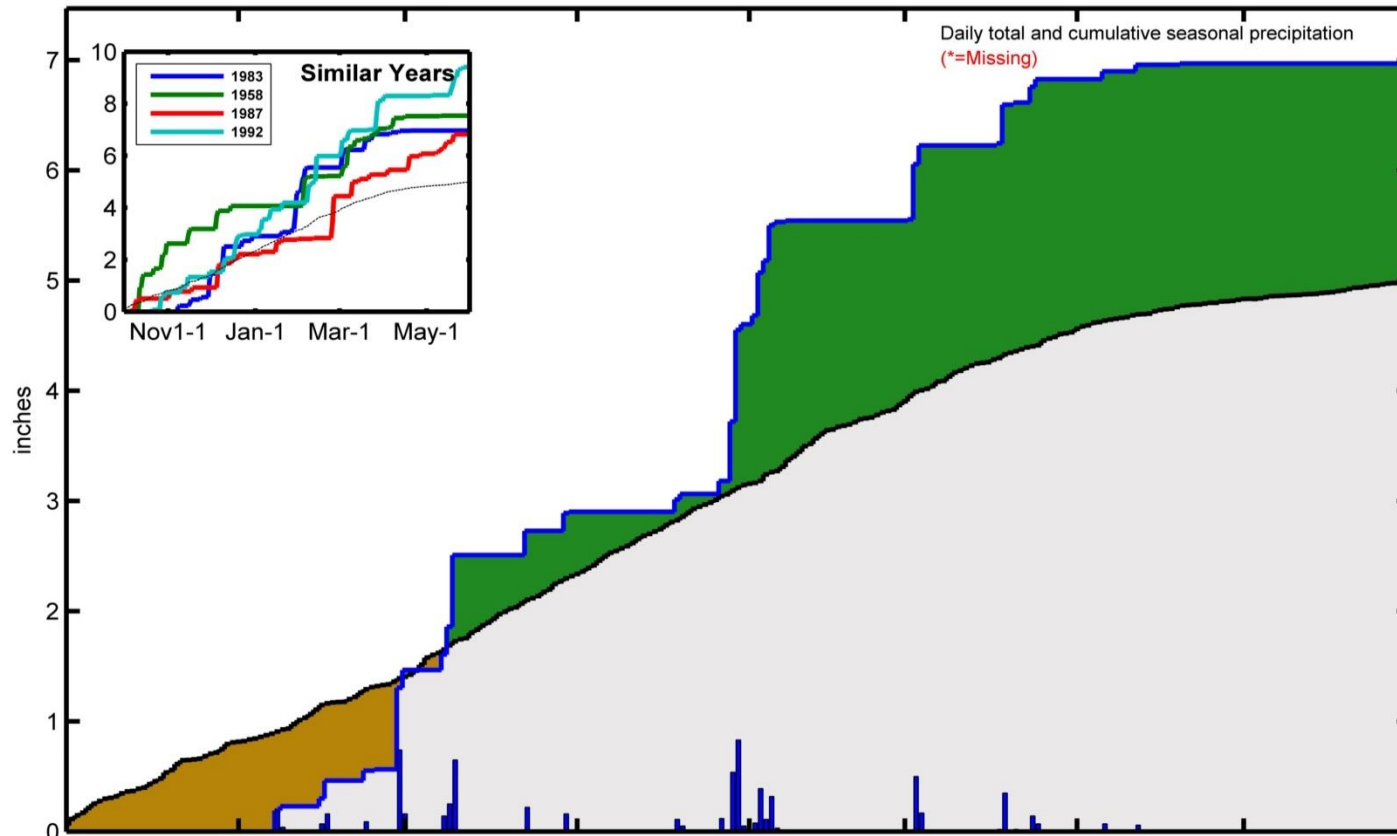
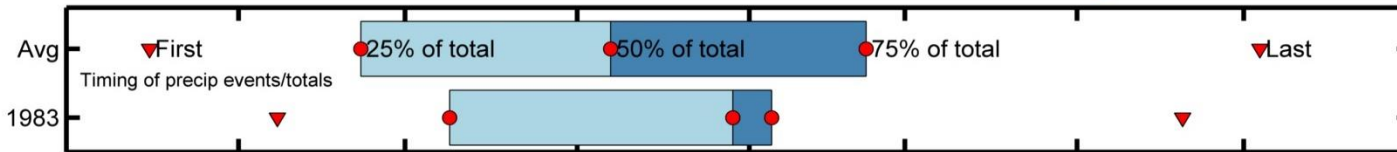
Dry Spells

Avg length: 18 days (avg: 14)
 Max length: 55 days (avg: 42)

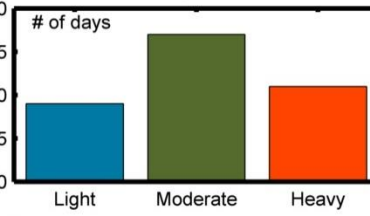
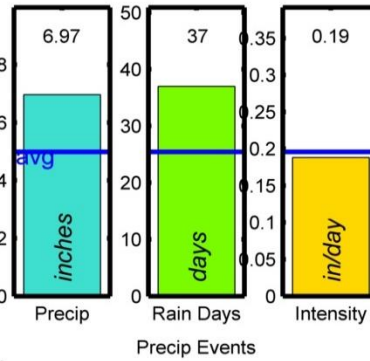


1982-1983 Cool Season Climate Summary

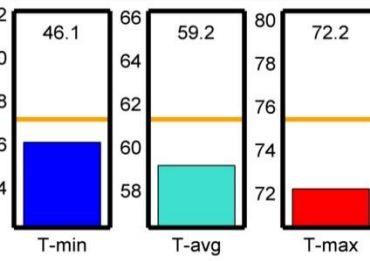
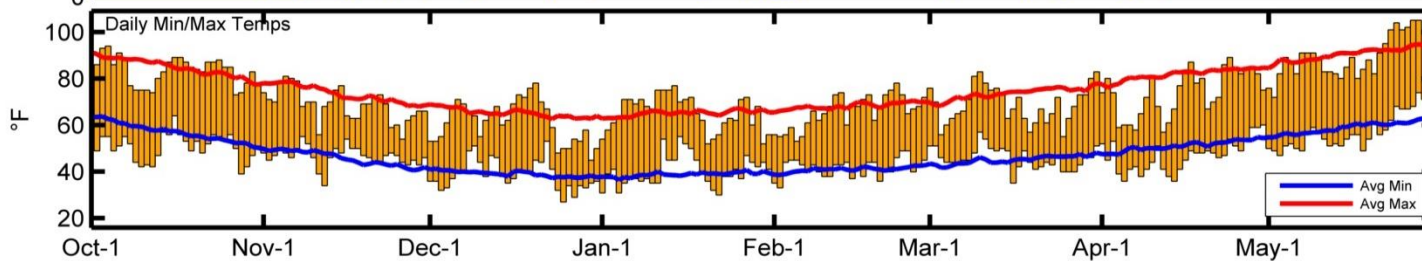
Strong El Niño Event



TUCSON INTL AP
 Elevation: 777m
 Period of record: 1948-2014
 Years in record: 67
 Precip rank: 16 (1, wettest)
 Temp rank: 61 (1, warmest)
 Missing in 1983: 0 days

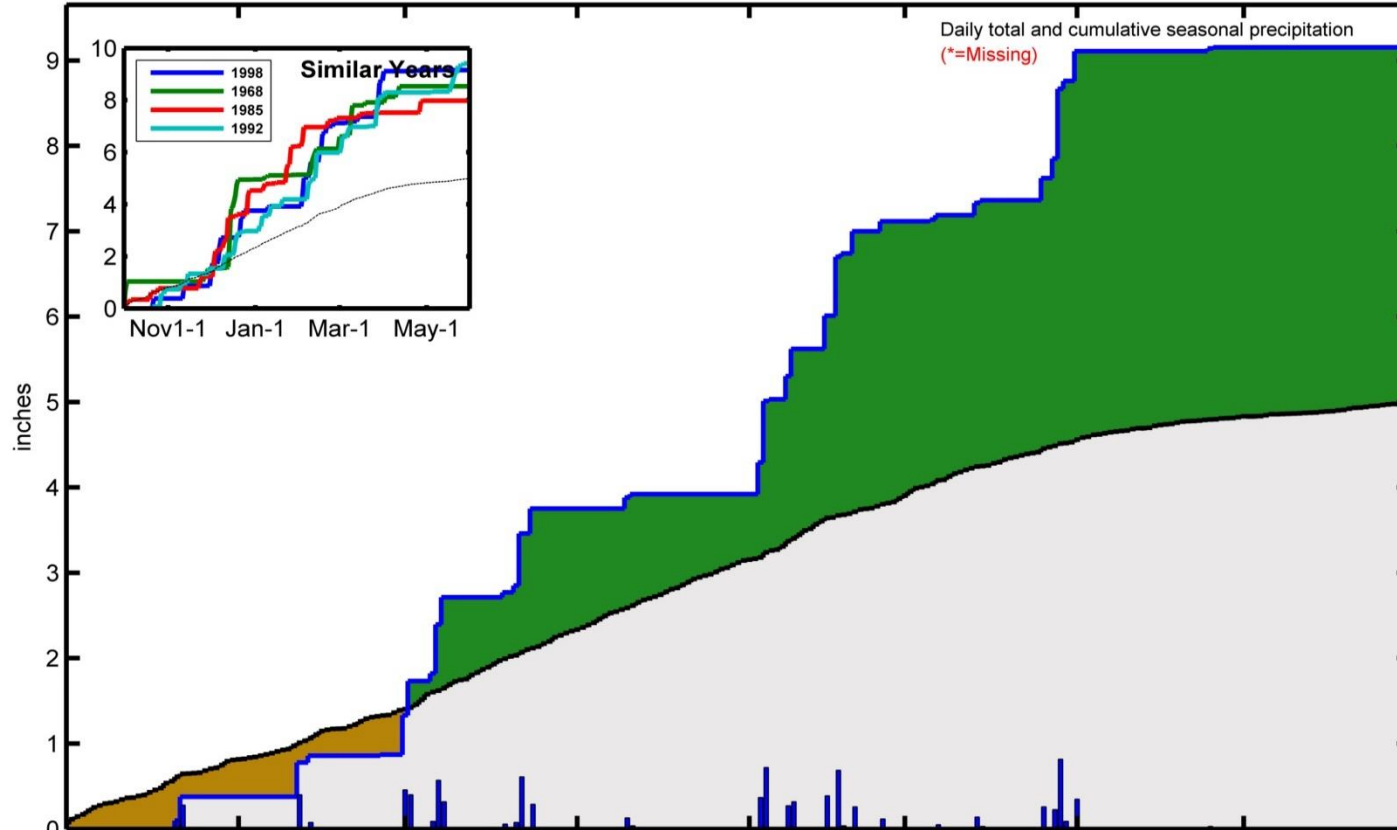
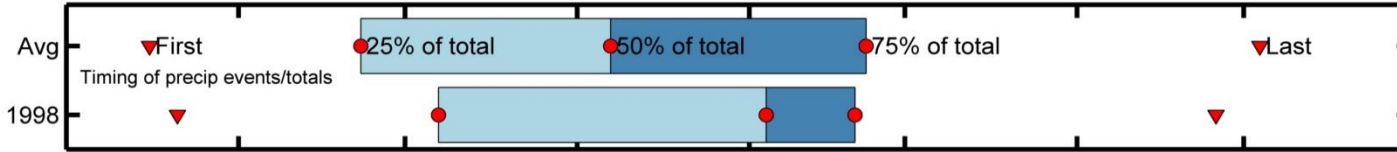


Dry Spells
 Avg length: 8 days (avg: 14)
 Max length: 21 days (avg: 42)



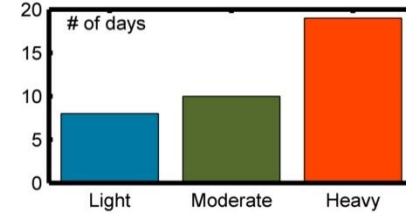
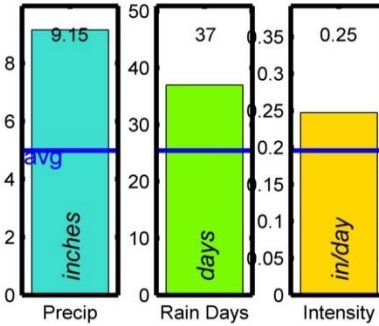
1997-1998 Cool Season Climate Summary

Strong El Niño Event



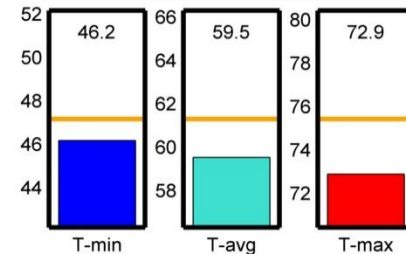
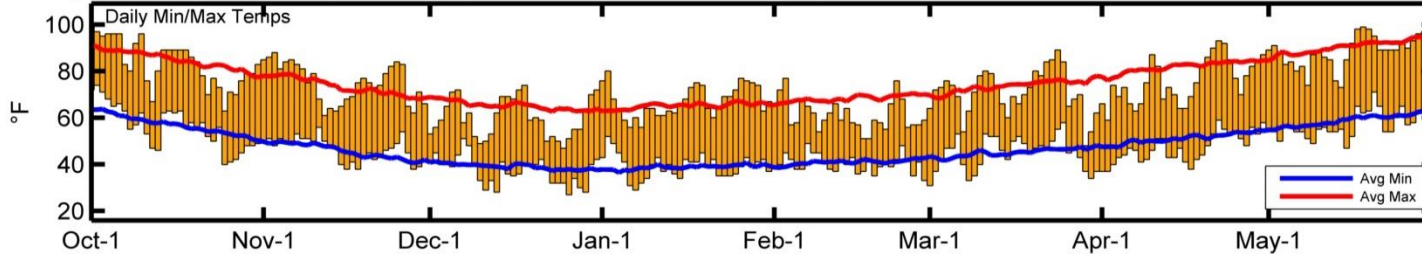
TUCSON INTL AP

Elevation: 777m
 Period of record: 1948-2014
 Years in record: 67
 Precip rank: 9 (1, wettest)
 Temp rank: 58 (1, warmest)
 Missing in 1998: 0 days



Dry Spells

Avg length: 8 days (avg: 14)
 Max length: 23 days (avg: 42)



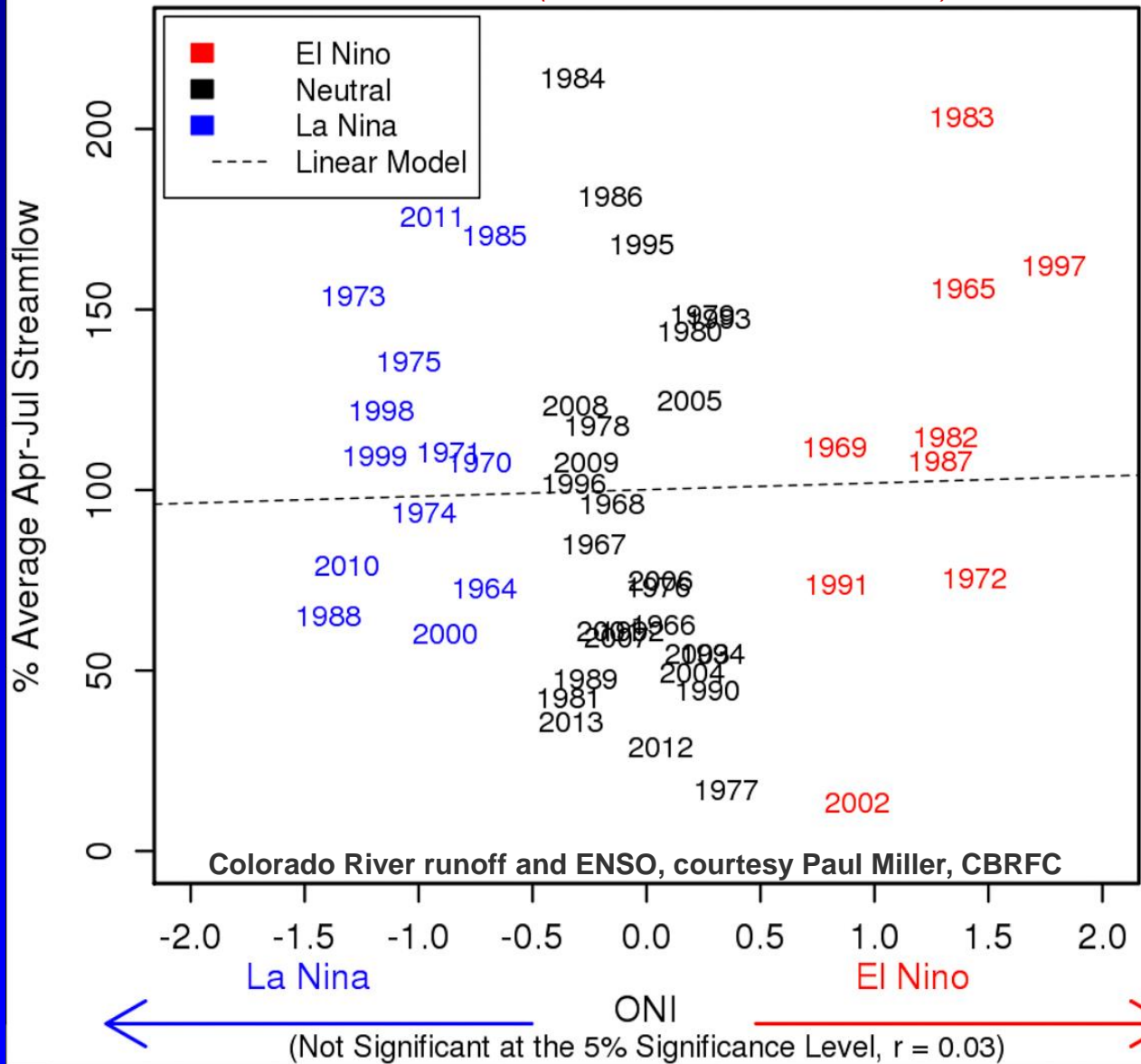
Climate stats from past strong El Niño events

Oct 1, 1982- May 31, 1983	AvgT	AvgT Anom	Precip	Precip Anom	Snow	Snow Anom	# Rain Days	Avg # Rain Days
TUCSON INTL AP	59.2	-2.66	6.95	1.49	T	0	37	29
PHOENIX SKY HARBOR INTL AP	64.2	-2.39	9.36	4.04	0	0	31	27
FLAGSTAFF PULLIAM AP	36.8	-1.69	20.99	7.59	142.6	40.9	70	50
Oct 1, 1997- May 31, 1998	AvgT	AvgT Anom	Precip	Precip Anom	Snow	Snow Anom	# Rain Days	Avg # Rain Days
TUCSON INTL AP	59.5	-2.3	9.15	3.69	T	0	37	33
PHOENIX SKY HARBOR INTL AP	63.5	-3.11	6.02	0.7	0	0	32	27
FLAGSTAFF PULLIAM AP	35.8	-2.67	13.82	0.42	136.7	35	62	42

El Niño and Colorado River

GLDA3 and Oceanic Nino Index

(Natural inflow into Lake Powell)



Take home messages...

- Short and long-term drought conditions continue to improve, but temperatures continue to run above-average
- Don't fear El Niño! → very good chance of above-average precip by spring 2015 with continued improvement in drought conditions across SW
- Overall expect more rainy days (some heavy), but also breaks throughout winter season, temps should run average to slightly below average
- Hopefully good snow pack in AZ and NM, but no guarantee (temperature and snow levels, extent of impacts through season)
- River flooding is sometimes an issue during El Niño events, but depends on antecedent conditions (e.g. tropical storms) and the run of weather events (e.g. rain on snow events) during season



FIRE BREATHING **GODZILLA**
KING OF THE MONSTERS

**YYAA
EEEE
UUH!**

**BLOW INTO HIS TAIL ...
BLOW EVERYTHING AWAY!**

RECOMMENDED FOR CHILDREN OVER 3 YEARS OLD

Imperial TOY CORPORATION NO. 8974
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FIRE BREATHING **GODZILLA**
KING OF THE MONSTERS

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NO LAWS AGAINST IT

POUR LIGHTER FLUID INTO MOUTH AS SHOWN

RADICAL ACTION!

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crimmins@u.arizona.edu

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