

A Decade (or more) of Drought



Photo: Jacob Lashot

2013 Monsoon Briefing

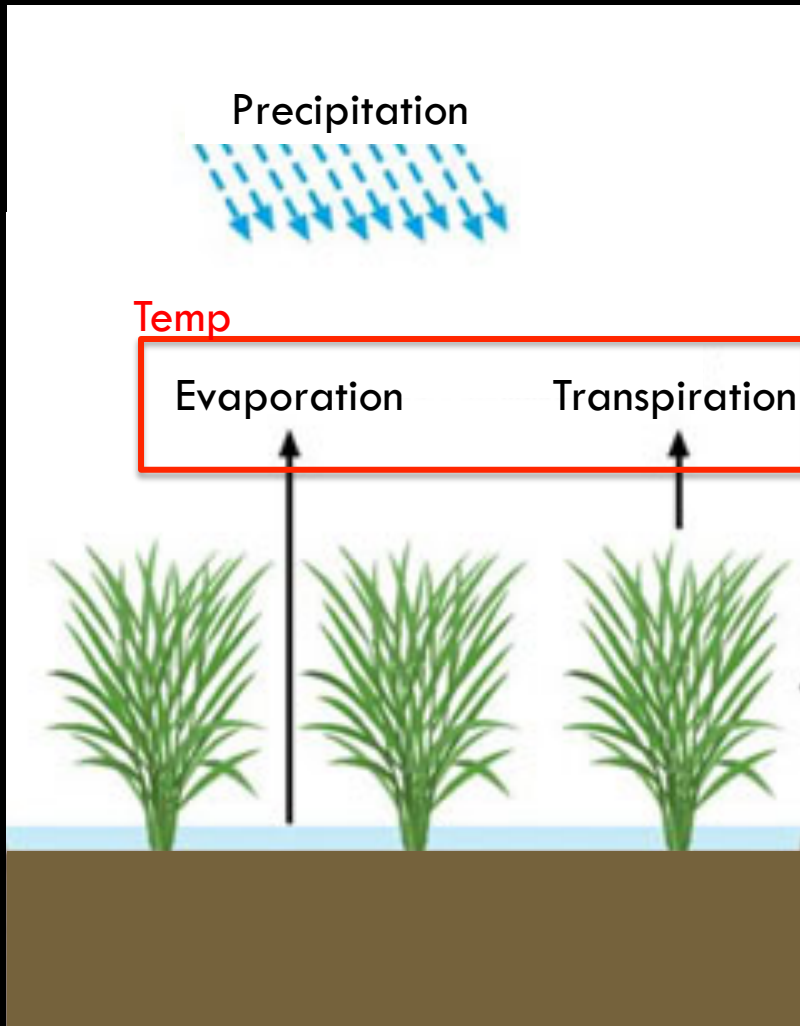
Zack Guido | CLIMAS

June 20, 2013

2 Burning Questions

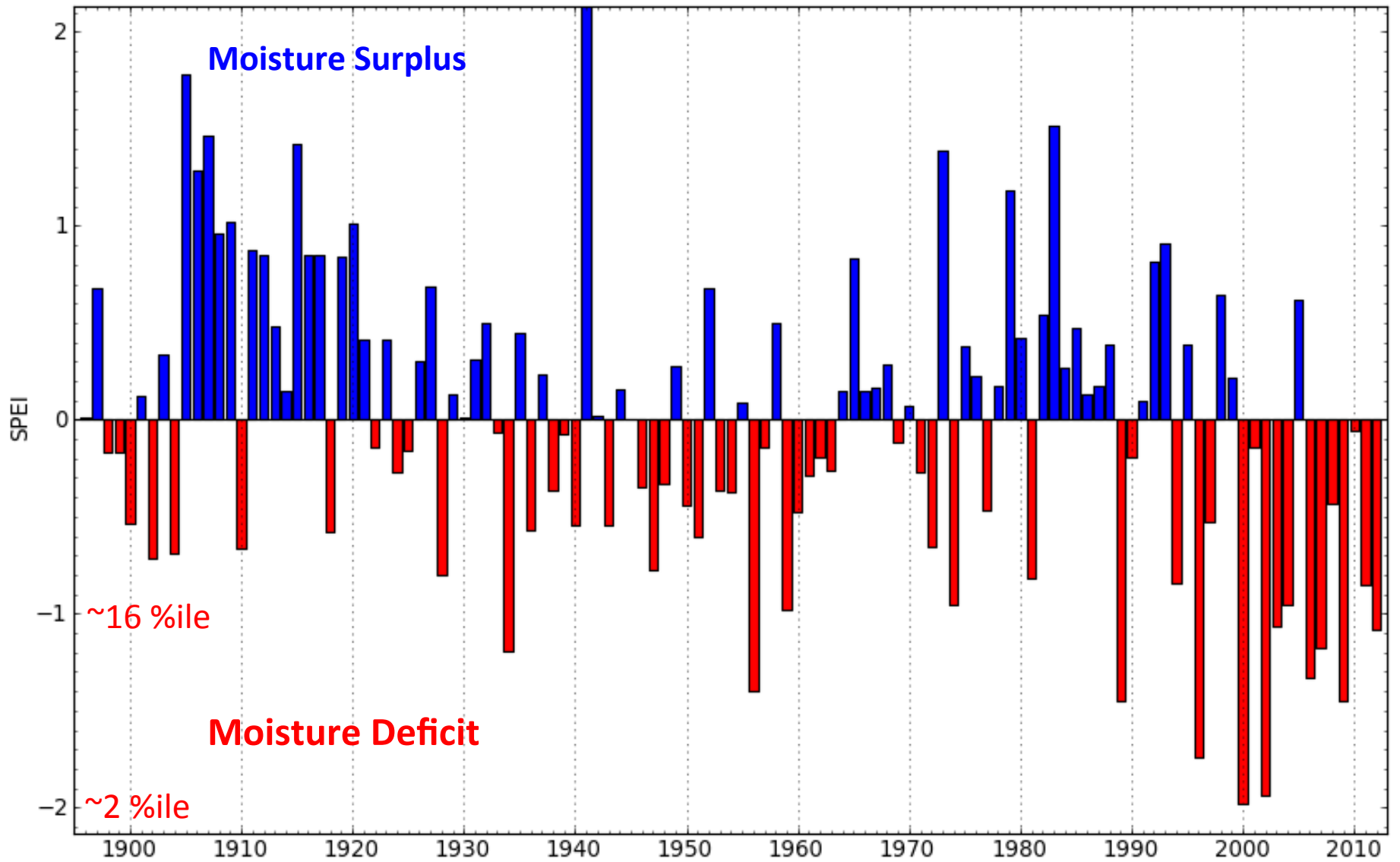
- 1) When did the drought start?
- 2) Are we experiencing compounding impacts from a succession of drought seasons?

SPEI: More than Just P

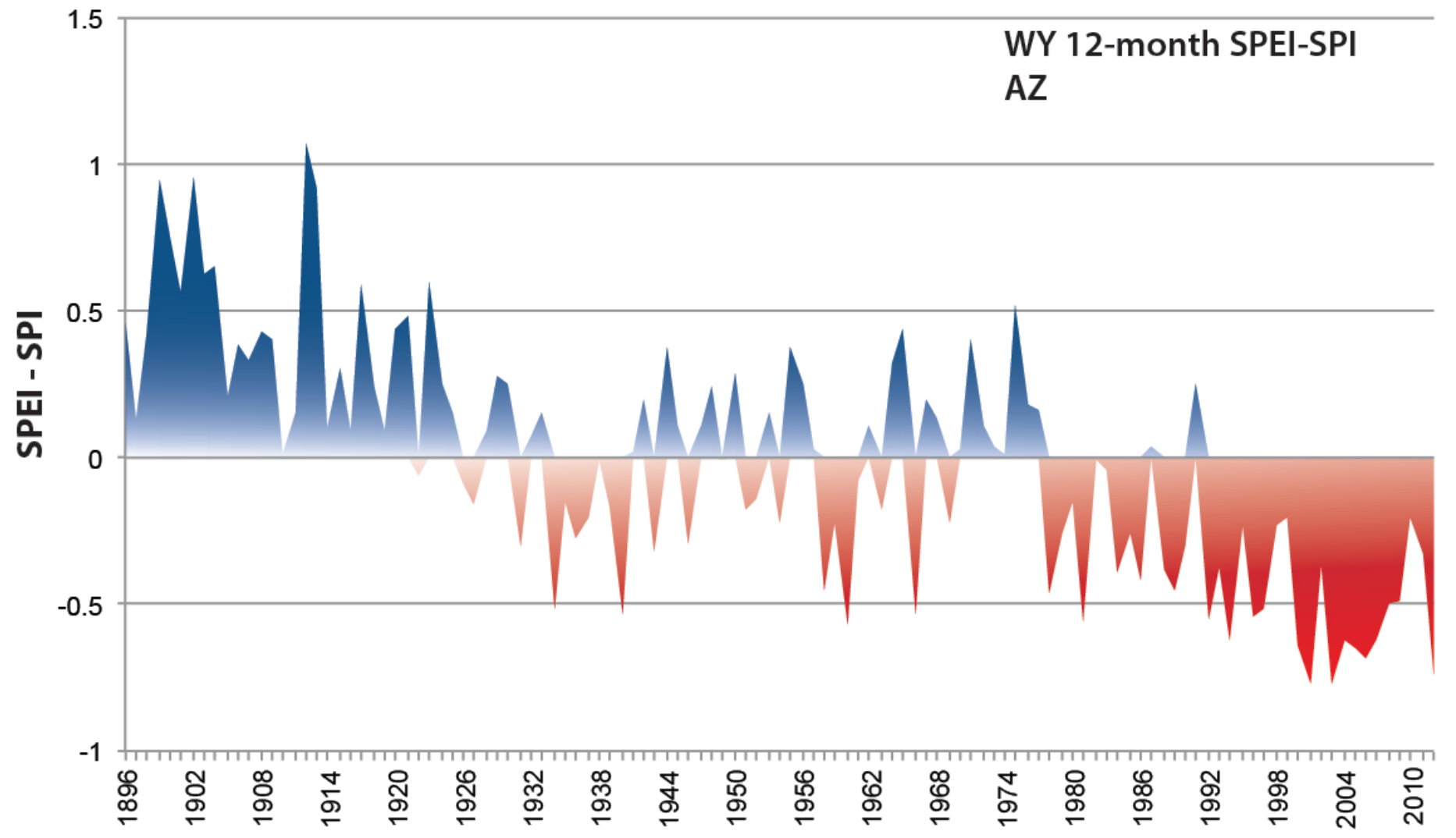


$$\text{SPEI} = \text{Precipitation} - \text{Evapotranspiration}$$

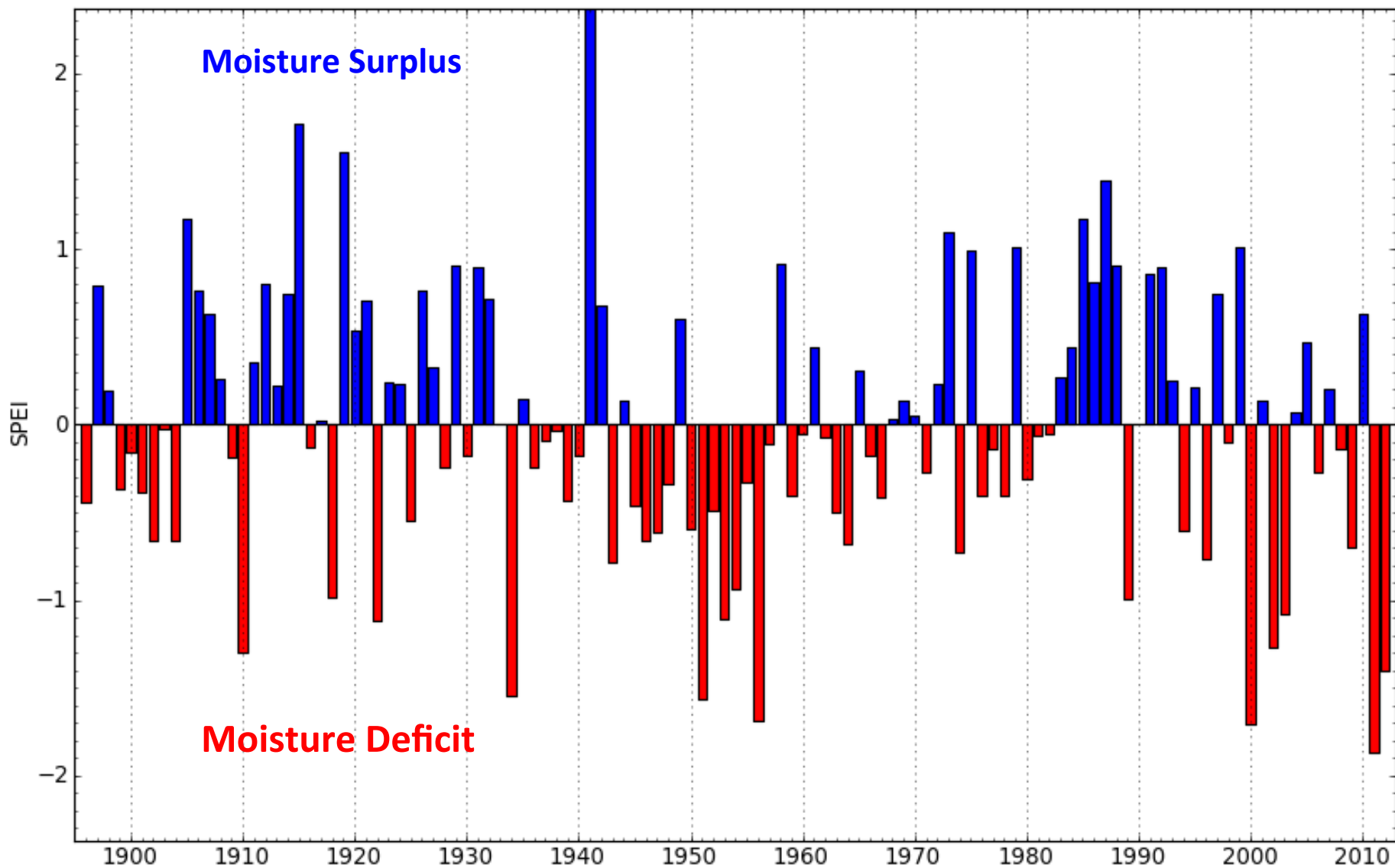
Standardized Precipitation-Evapotranspiration Index, 12-Months Ending in September Arizona

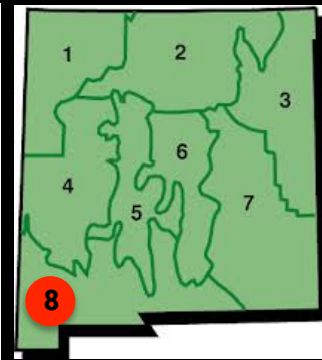
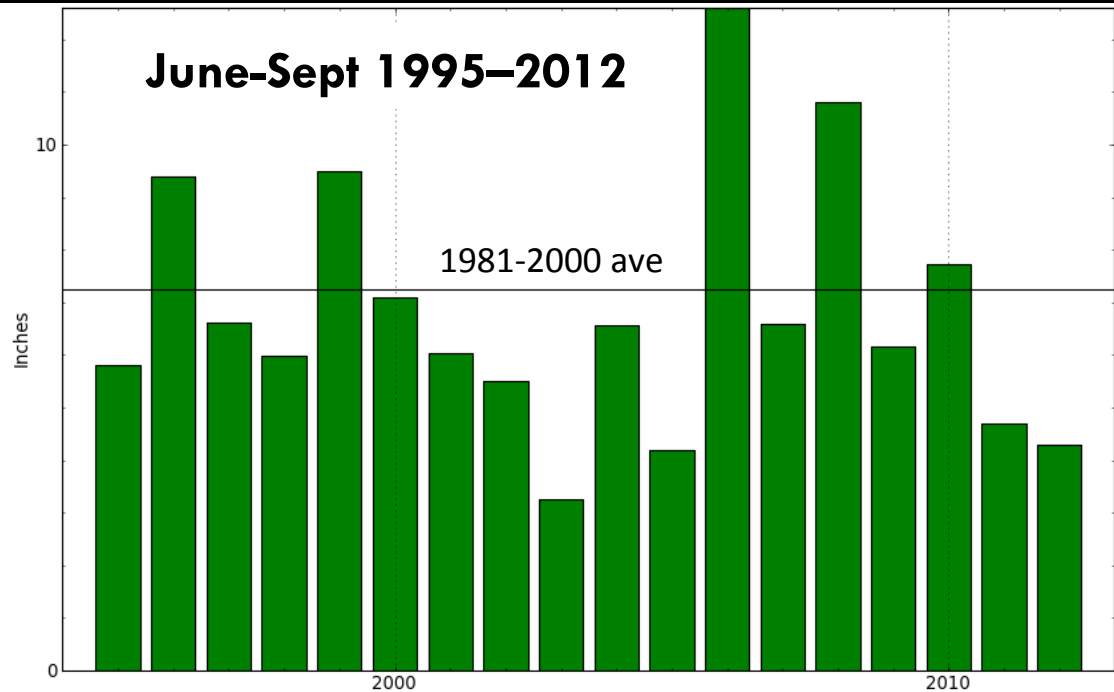
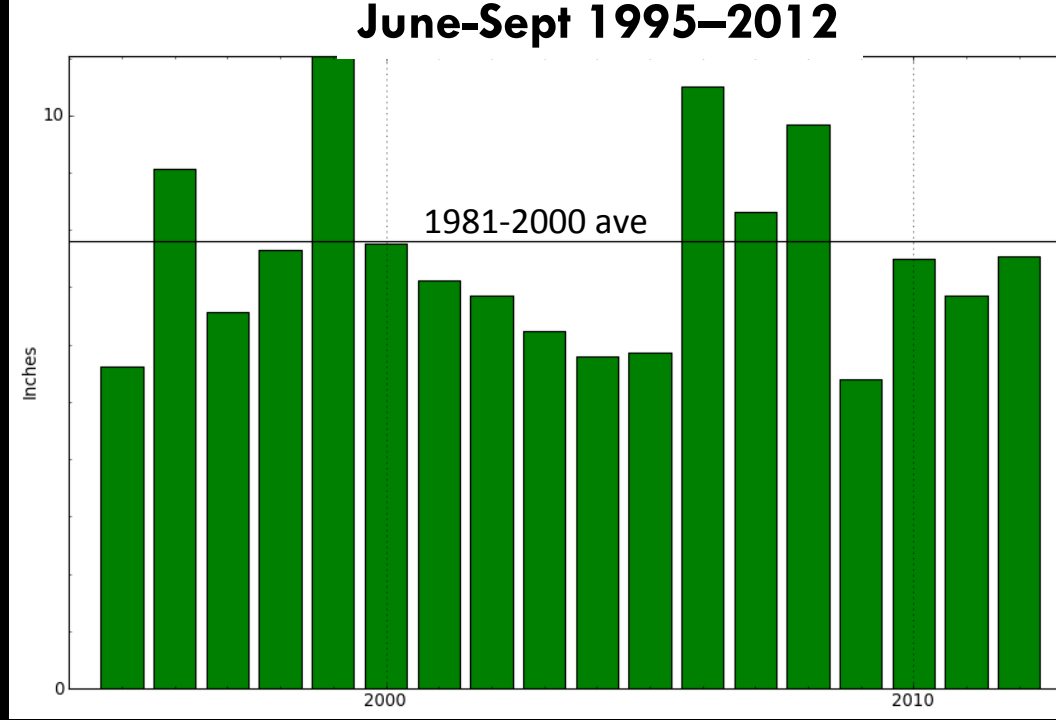
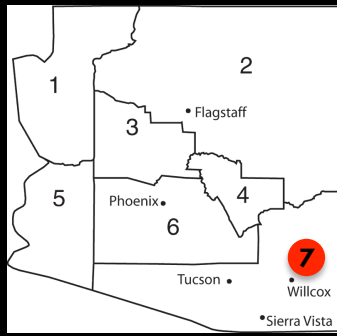


Temperature Matters

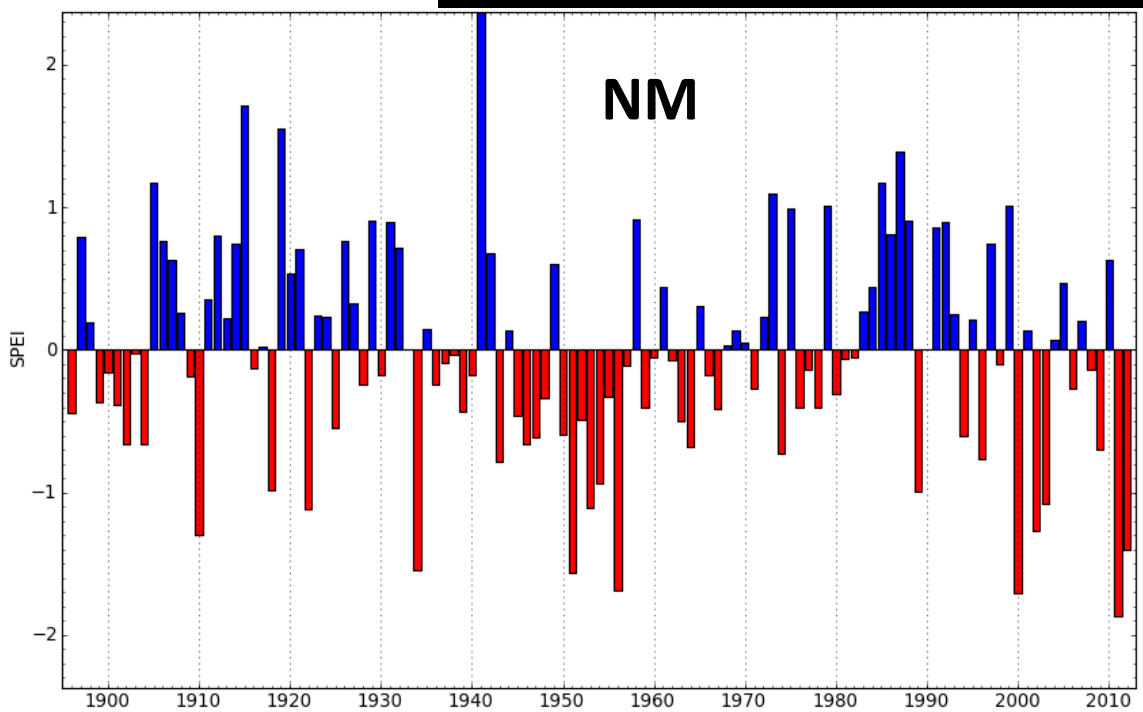
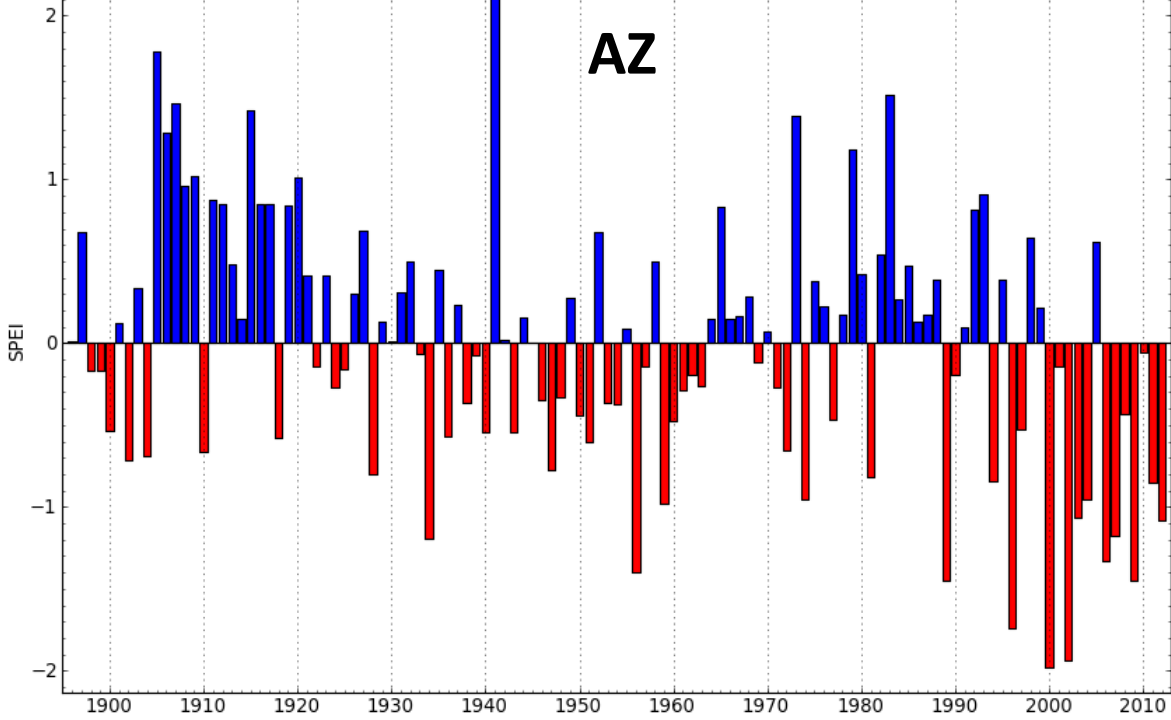


Standardized Precipitation-Evapotranspiration Index, 12-Months Ending in September New Mexico





Data from Westwide Drought Tracker; WRCC/UI

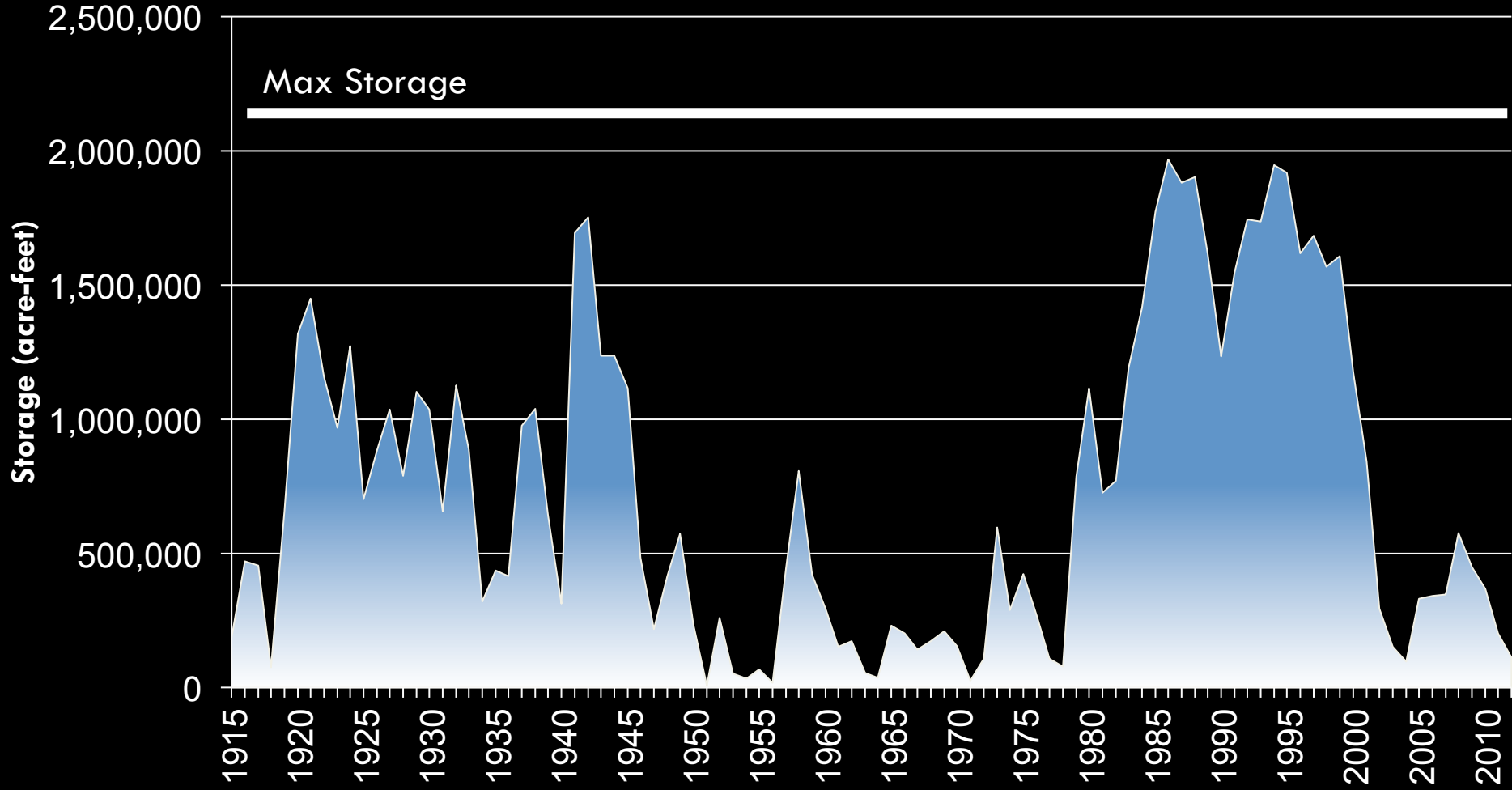


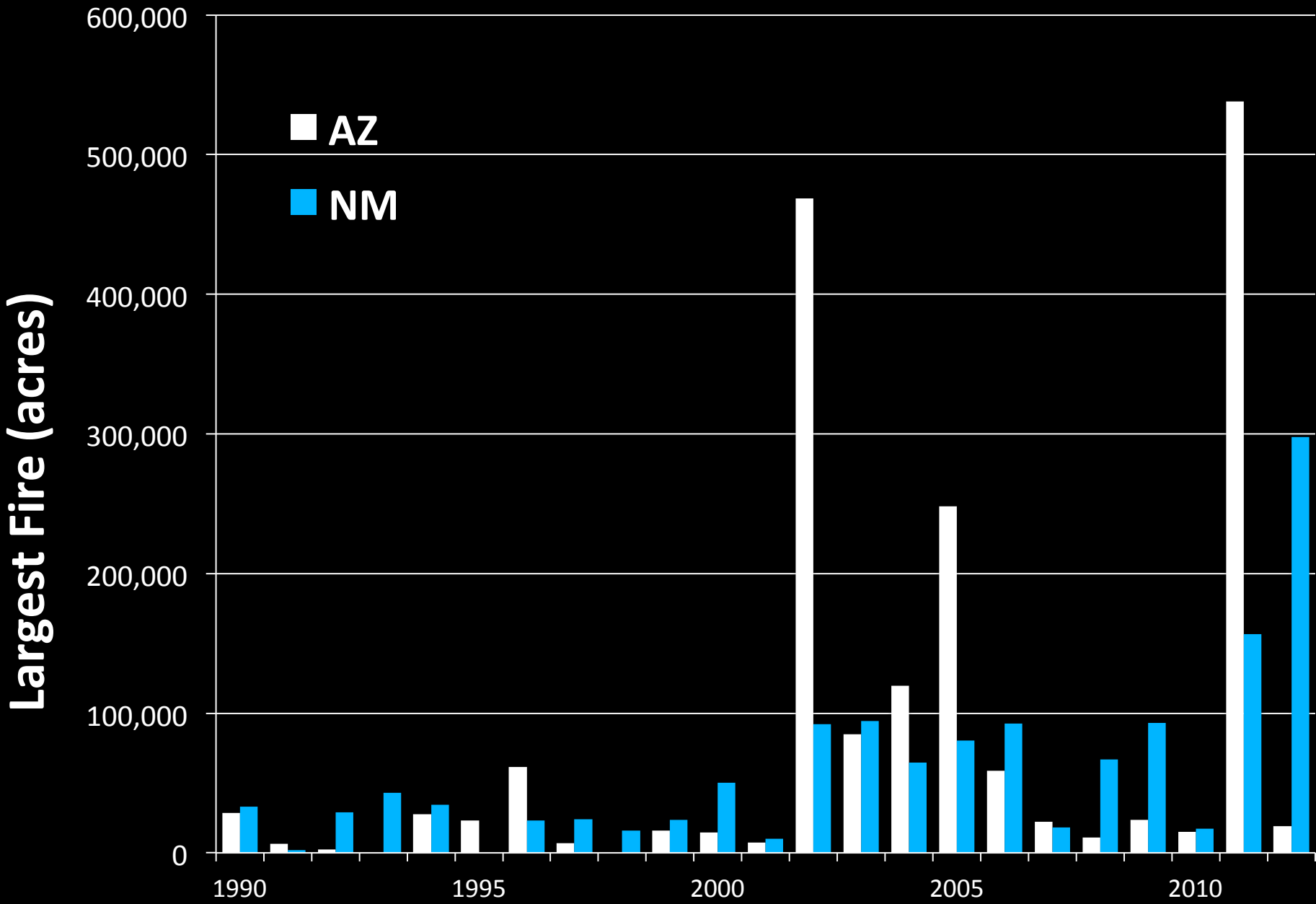
Burning Questions # 2

Are we experiencing compounding impacts from a succession of drought seasons?

| | Impacts | response times |
|------------------|---|-----------------------|
| Ranching | Summer & winter grasses | Seasonal |
| Health | Dust & ozone | Seasonal |
| Landscape | Fires | Seasonal–years |
| Water | Reservoirs & groundwater | Years |

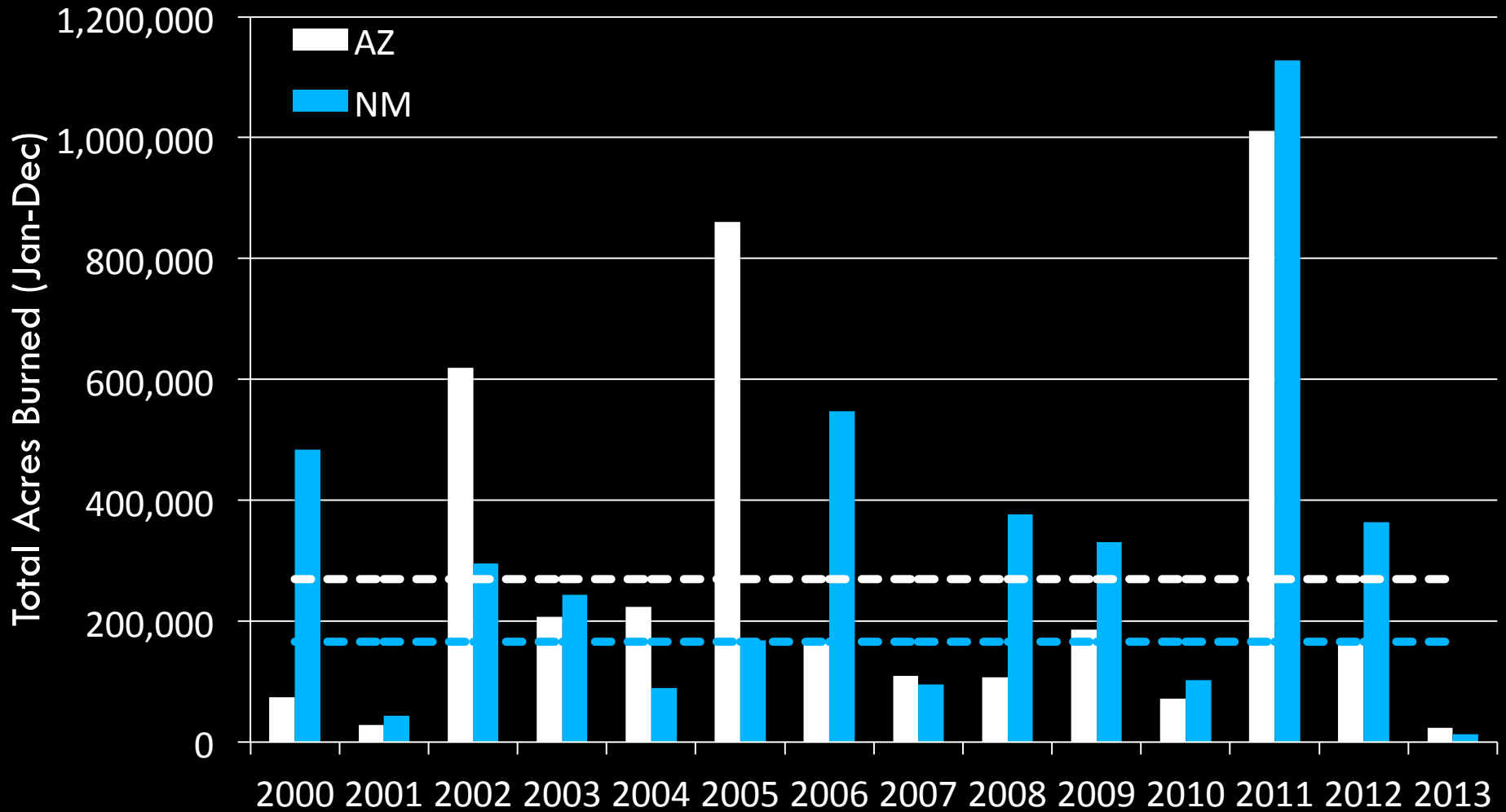
End of Water Year Storage in Elephant Butte Reservoir, NM





Data from: SW Coordination Center

Total Acres Burned in AZ and NM



As of June 12, 2103

Data from: SW Coordination Center



Monsoon Flavors: Looking beyond total seasonal precipitation

Mike Crimmins
Assoc. Professor/Extension Specialist
Dept. of Soil, Water, & Environmental Science &
Arizona Cooperative Extension
The University of Arizona

Monsoon flavors

- Total precipitation is typically used to characterize and rank past monsoon seasons
- Many different ways to get to the same value of total precipitation (e.g. many small rain events vs. a handful of large ones)
- Timing, distribution, and types of rainfall events can lead to different types of impacts not necessarily reflected in total seasonal precipitation



Ingredients that create different monsoon season flavors

- When does it start raining in June/July?
- When does it stop raining in September?
- How often does it rain? How is it distributed through the season?
- How many rain events are heavy vs. light?
- How many 'breaks' occur? How long are they?
- Temperatures?



What are your favorite ingredients?

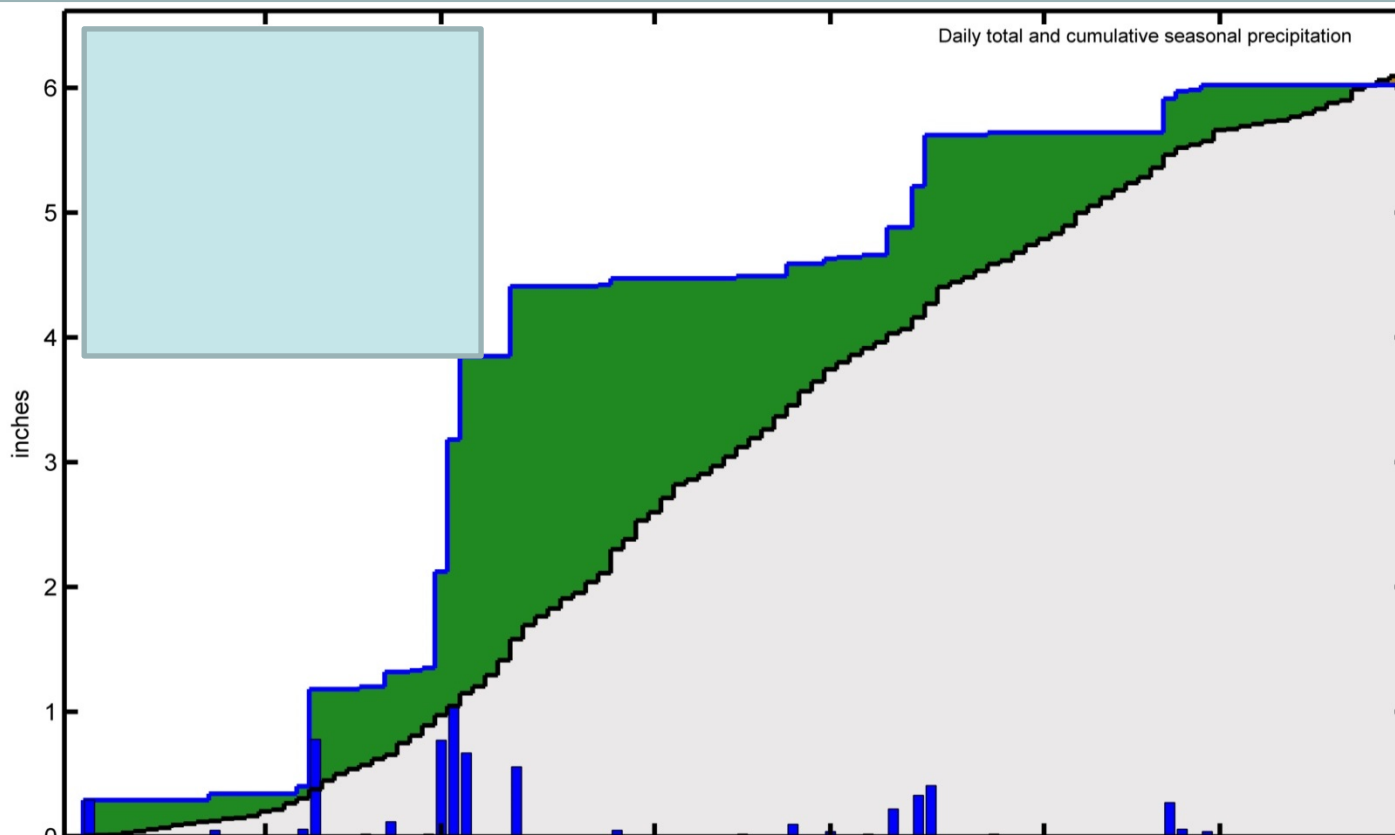
- Onset/end: end of fire season; length of growing season
- Event frequency/distribution: charging and maintenance of soil moisture; antecedent conditions for flash flooding events
- Cumulative amounts: water harvesting; water resources management ('beat the peak')
- Intensity: frequency of flooding events; overall amount of 'effective' precipitation



2012 Monsoon Summary

TUCSON INTL AP

Elevation: 777m
Period of record: 1950-2012
Years in record: 63
Precip rank: **31** (1, wettest)
Temp rank: **9** (1, warmest)
Missing in 2012: 0 days

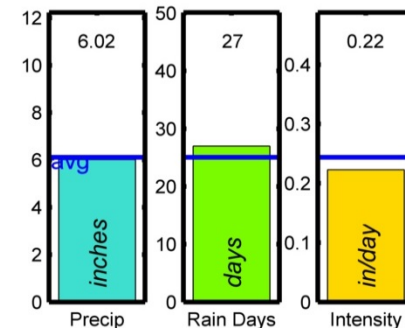
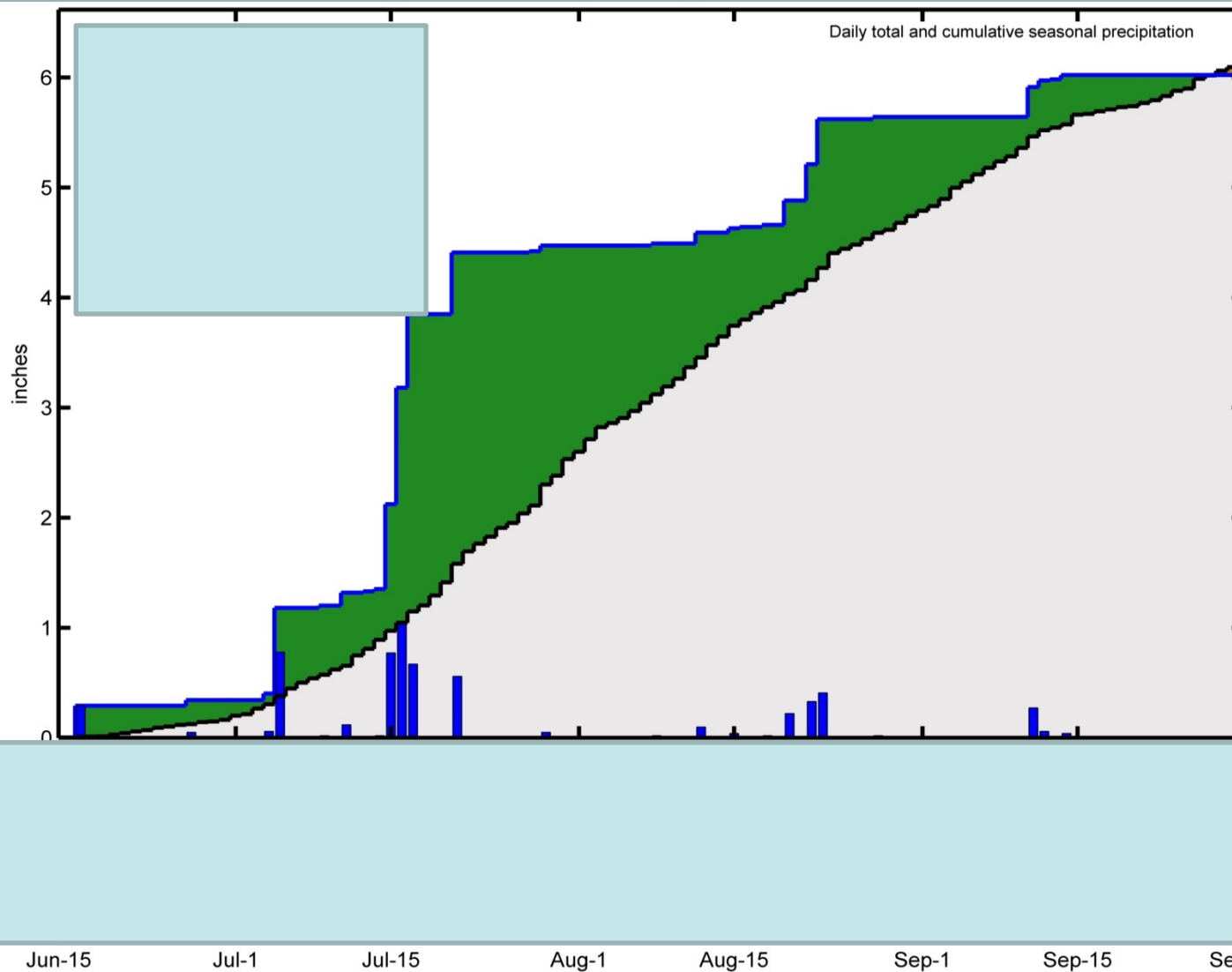


Jun-15 Jul-1 Jul-15 Aug-1 Aug-15 Sep-1 Sep-15 Sep-30 T-min T-avg T-max

2012 Monsoon Summary

TUCSON INTL AP

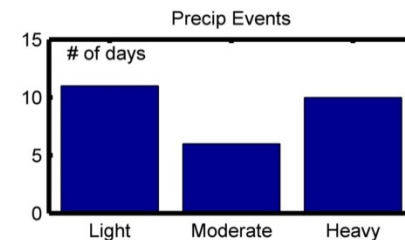
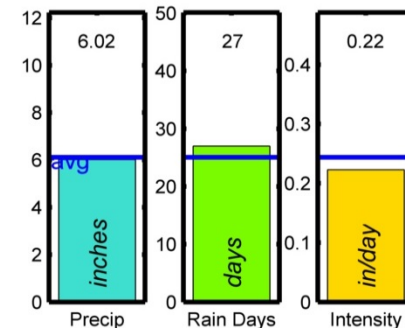
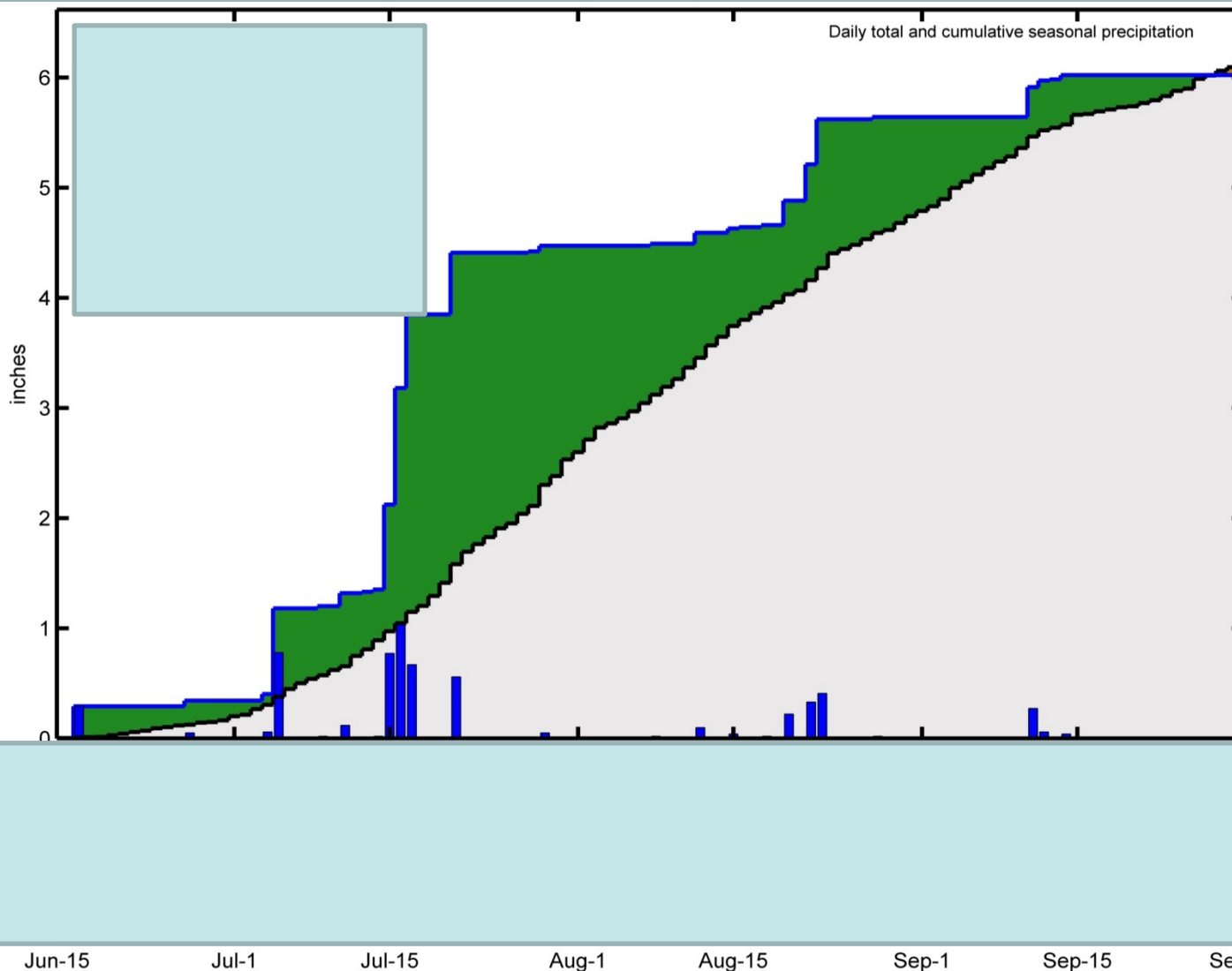
Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **31** (1, wettest)
 Temp rank: **9** (1, warmest)
 Missing in 2012: 0 days



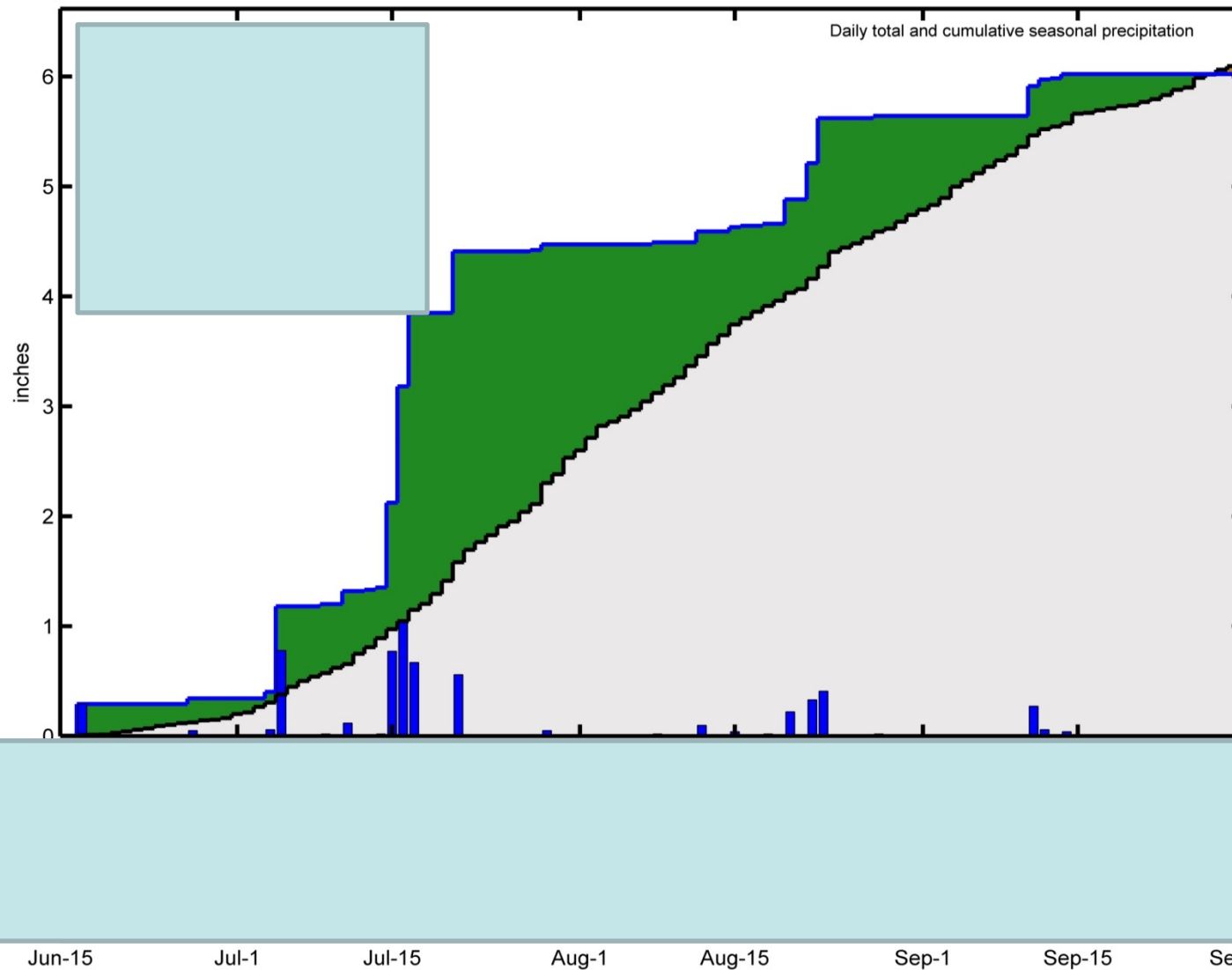
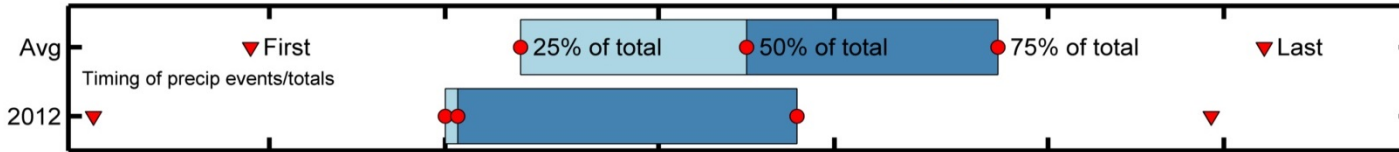
2012 Monsoon Summary

TUCSON INTL AP

Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **31** (1, wettest)
 Temp rank: **9** (1, warmest)
 Missing in 2012: 0 days

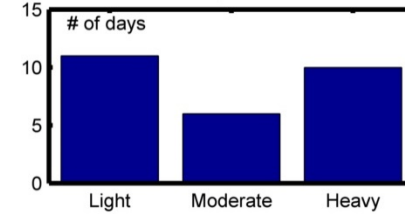
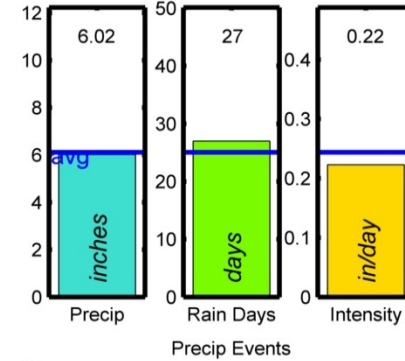


2012 Monsoon Summary

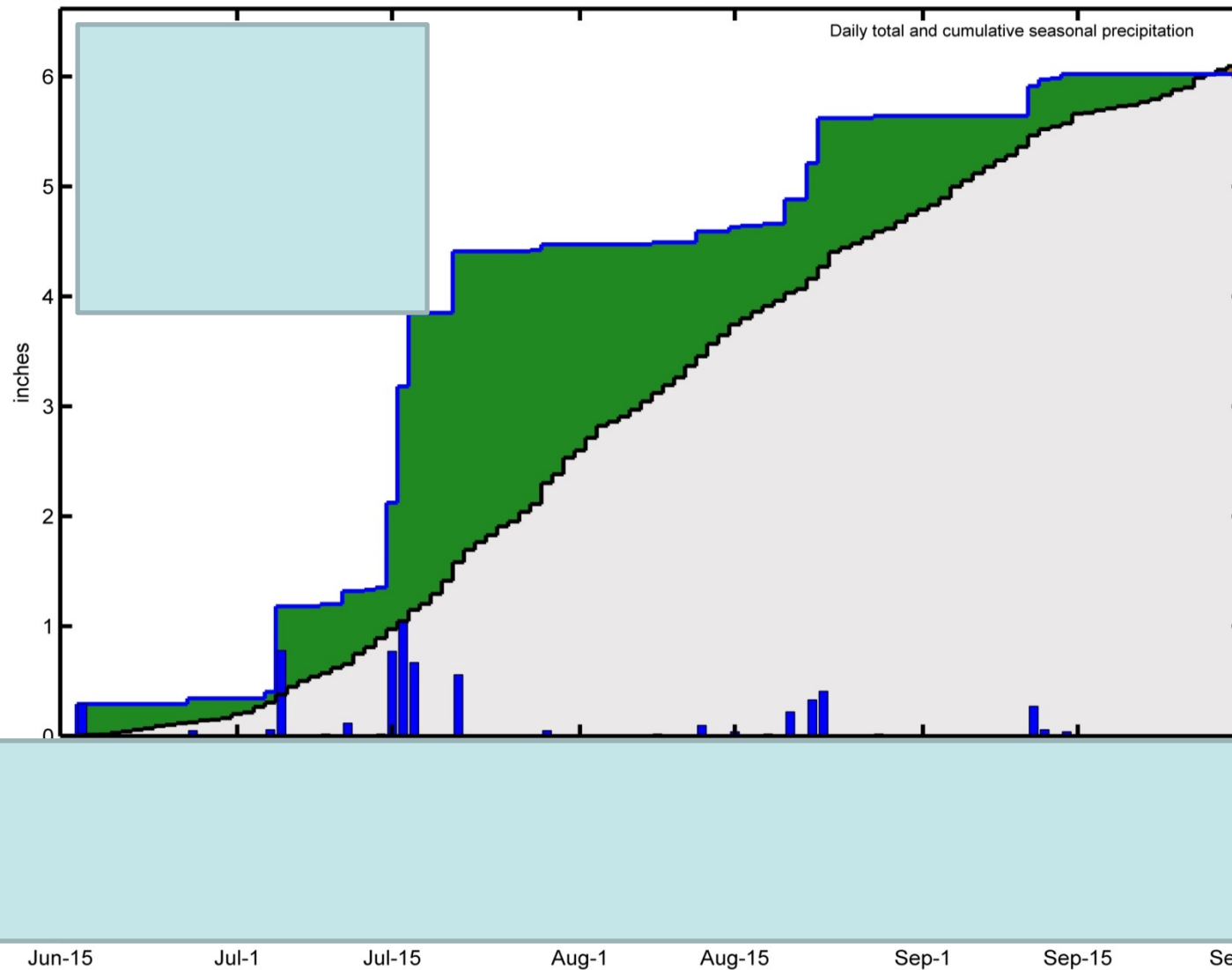
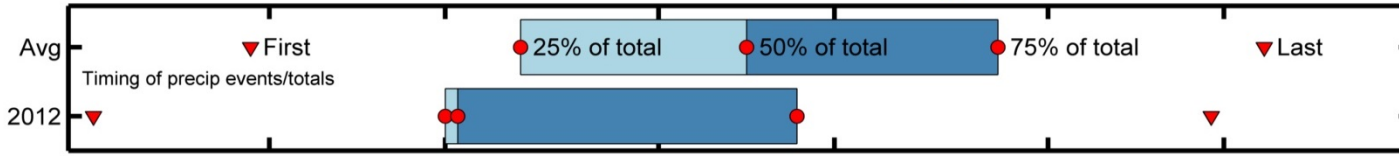


TUCSON INTL AP

Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: 31 (1, wettest)
 Temp rank: 9 (1, warmest)
 Missing in 2012: 0 days

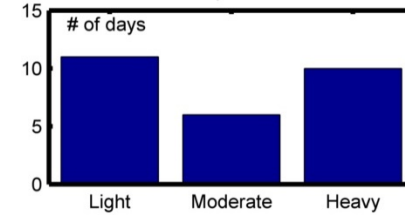
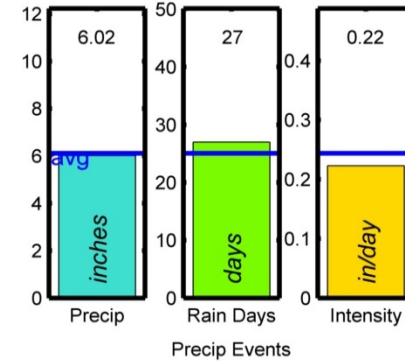


2012 Monsoon Summary



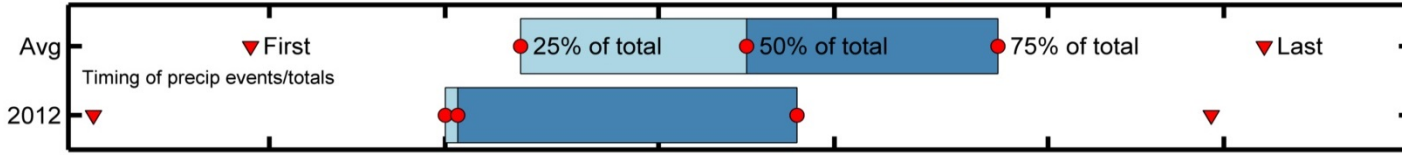
TUCSON INTL AP

Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: 31 (1, wettest)
 Temp rank: 9 (1, warmest)
 Missing in 2012: 0 days

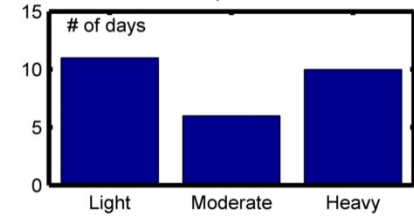
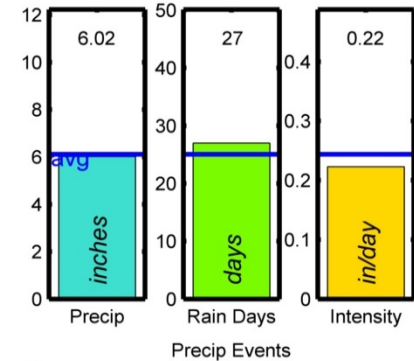
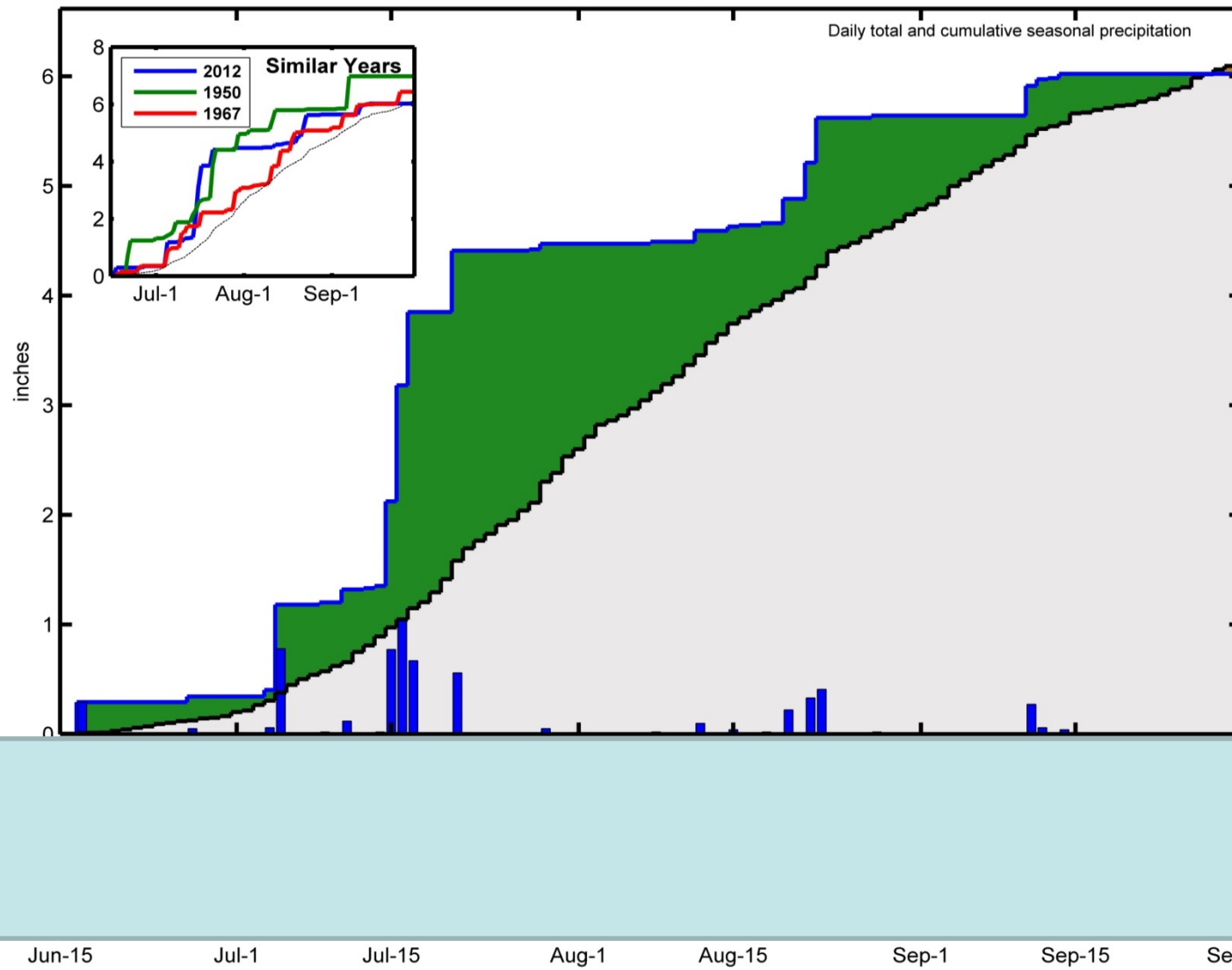


Dry Spells
 Avg length: 4 days (avg: 5)
 Max length: 13 days (avg: 14)

2012 Monsoon Summary

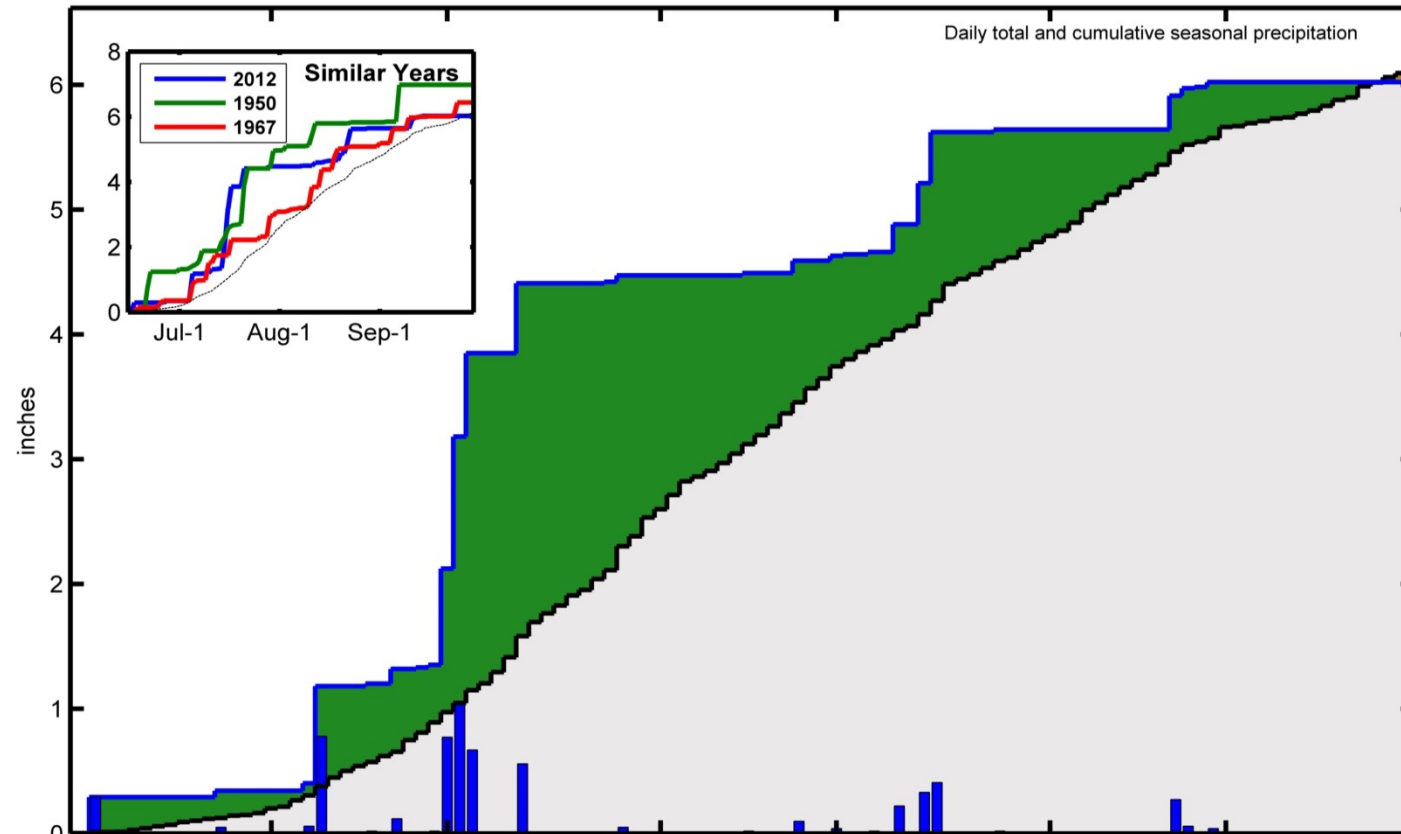
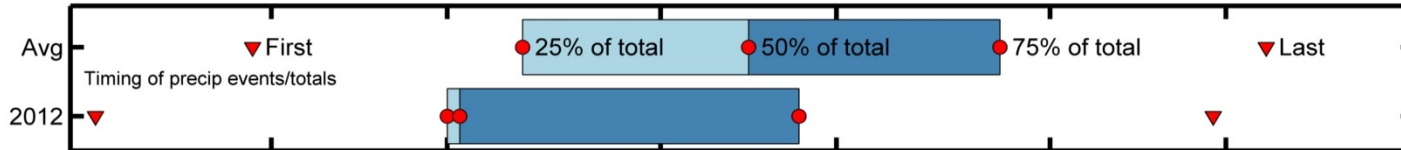


TUCSON INTL AP
 Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: 31 (1, wettest)
 Temp rank: 9 (1, warmest)
 Missing in 2012: 0 days



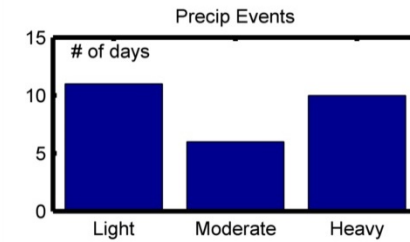
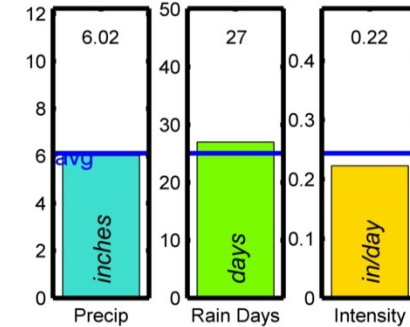
Dry Spells
 Avg length: 4 days (avg: 5)
 Max length: 13 days (avg: 14)

2012 Monsoon Summary



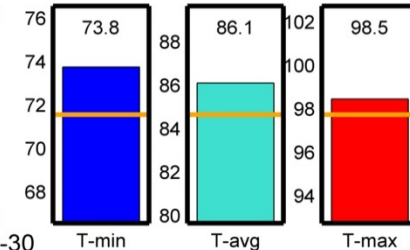
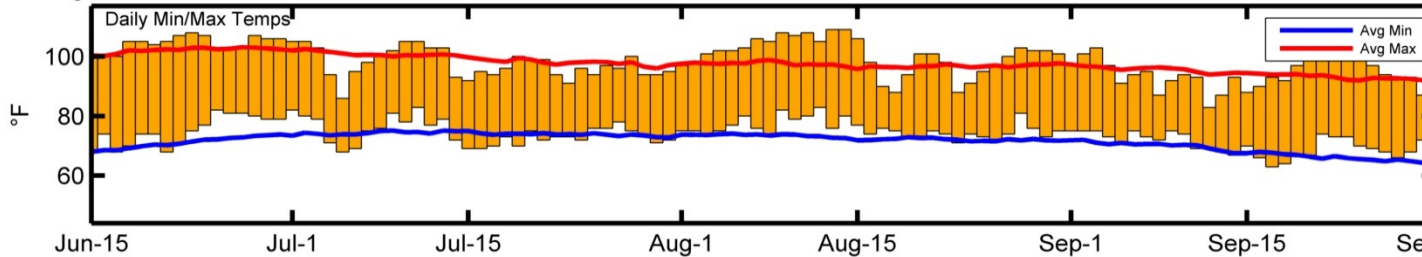
TUCSON INTL AP

Elevation: 777m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **31** (1, wettest)
 Temp rank: **9** (1, warmest)
 Missing in 2012: 0 days

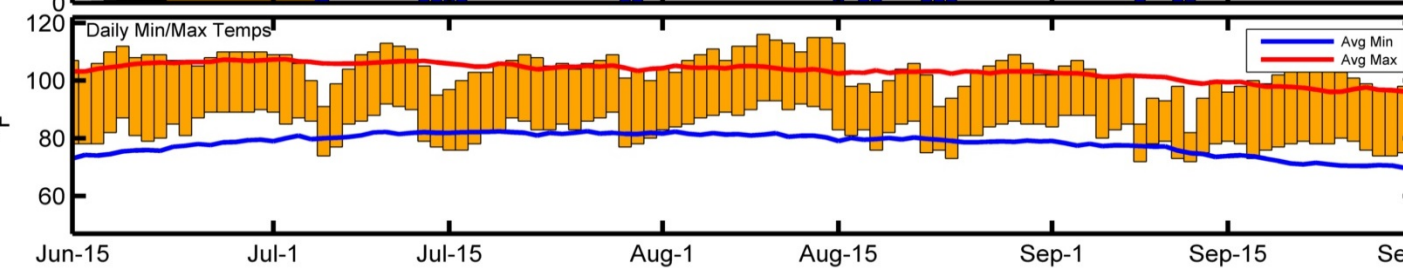
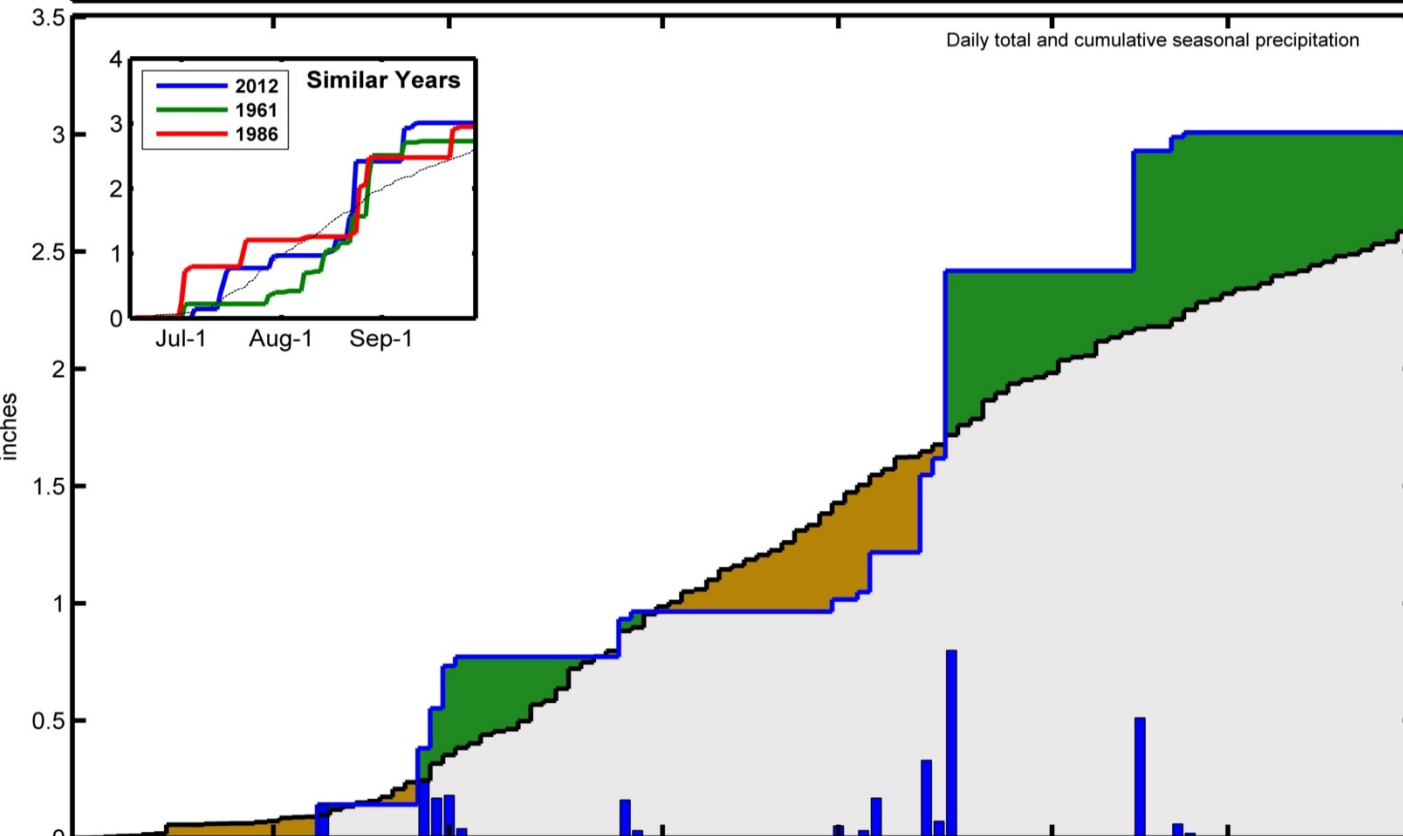


Dry Spells

Avg length: 4 days (avg: 5)
 Max length: 13 days (avg: 14)

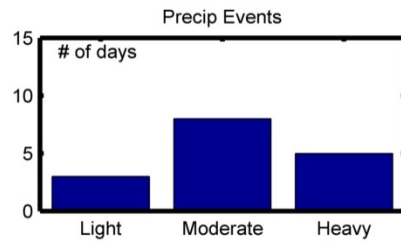
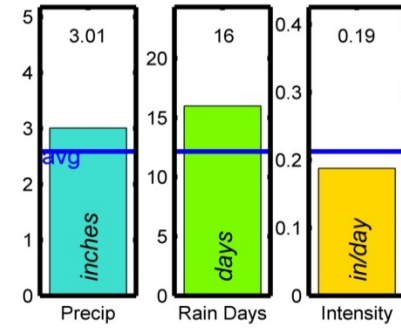


2012 Monsoon Summary



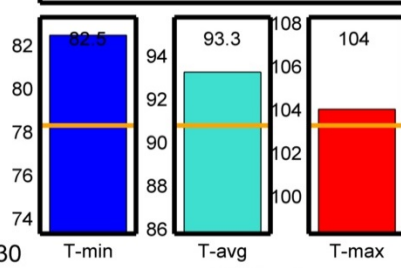
PHOENIX SKY HARBOR INTL AP

Elevation: 337m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **20** (1, wettest)
 Temp rank: **12** (1, warmest)
 Missing in 2012: 0 days

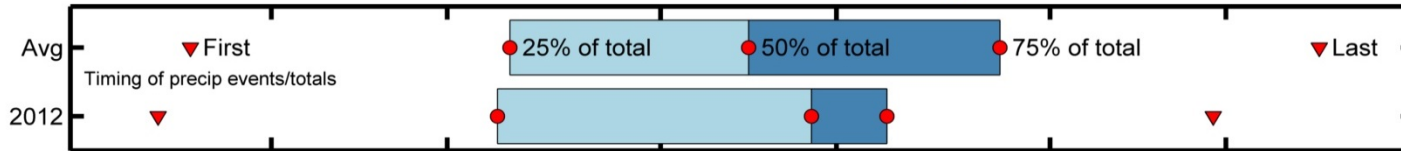


Dry Spells

Avg length: 9 days (avg: 11)
 Max length: 15 days (avg: 21)

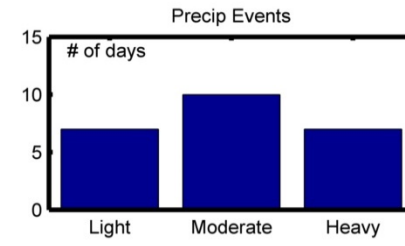
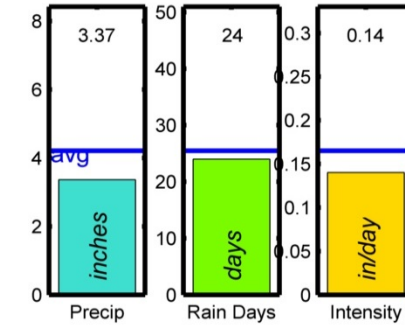
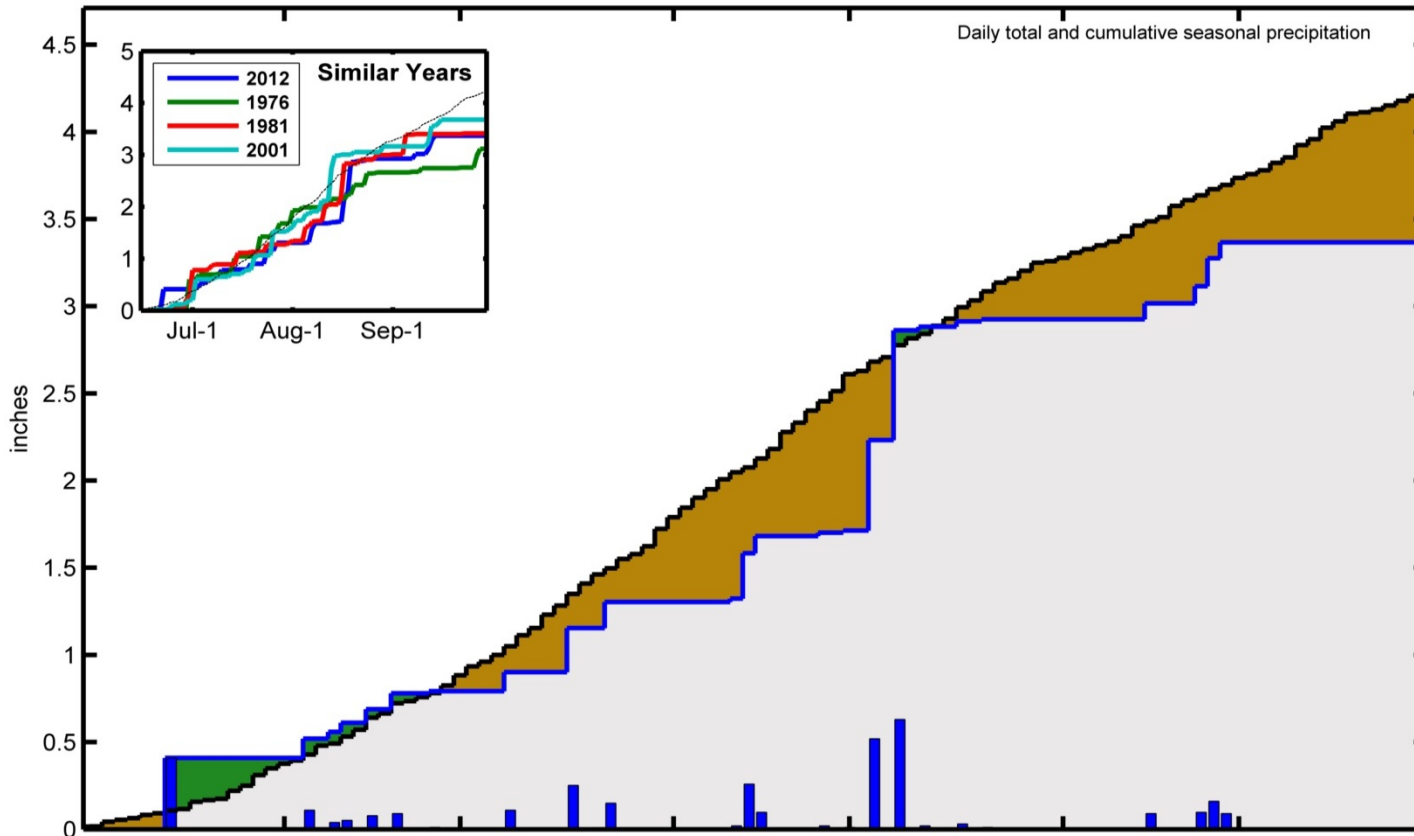


2012 Monsoon Summary



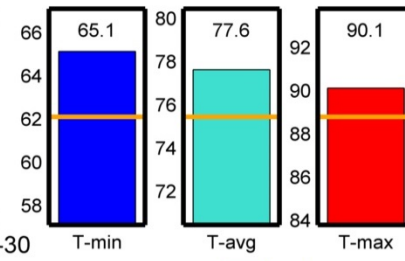
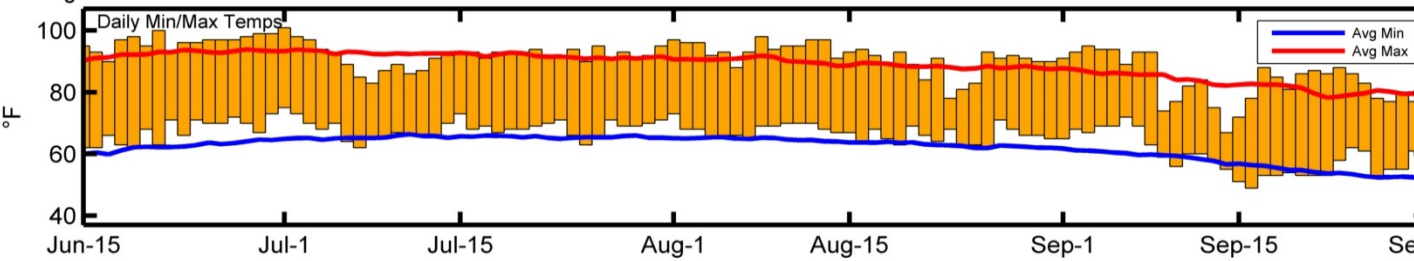
ALBUQUERQUE INTL AP

Elevation: 1619m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **47** (1, wettest)
 Temp rank: **3** (1, warmest)
 Missing in 2012: 0 days

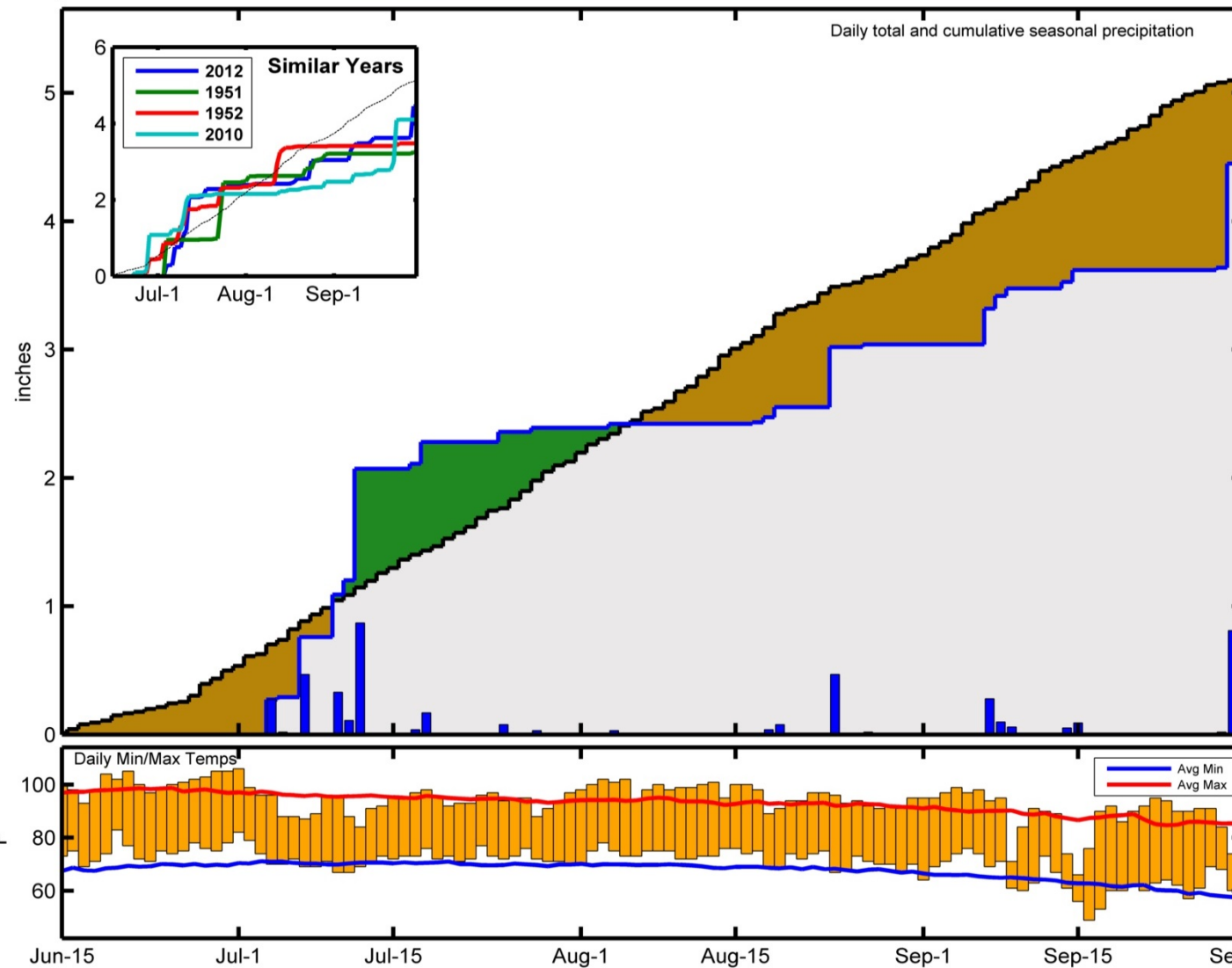
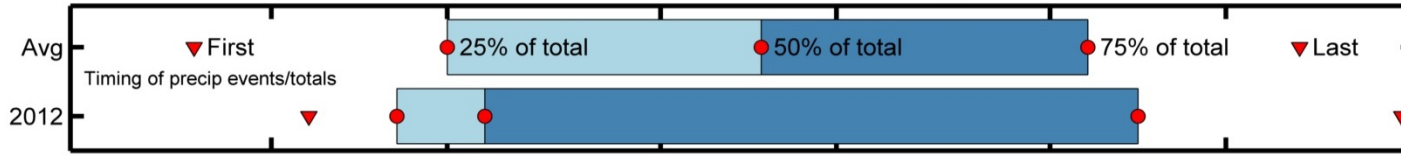


Dry Spells

Avg length: 4 days (avg: 5)
 Max length: 12 days (avg: 16)

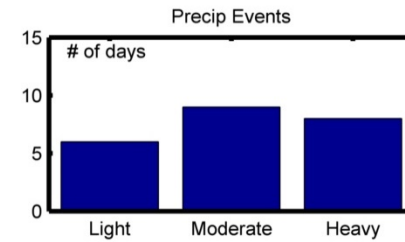
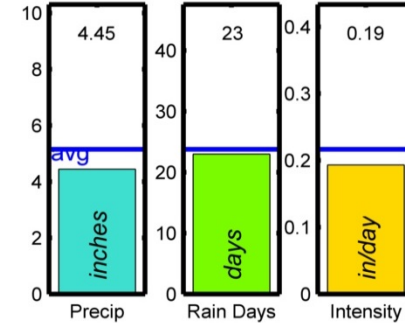


2012 Monsoon Summary



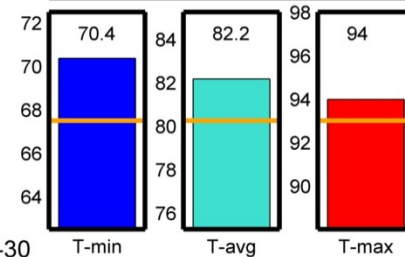
EL PASO INTL AP

Elevation: 1194m
 Period of record: 1950-2012
 Years in record: 63
 Precip rank: **32** (1, wettest)
 Temp rank: **7** (1, warmest)
 Missing in 2012: 0 days



Dry Spells

Avg length: 6 days (avg: 6)
 Max length: 12 days (avg: 17)



Stay tuned!

- 2013 monsoon summaries for many stations across AZ and NM will be posted on the CLIMAS website in October
- Access to summaries for all years in station record
- Evaluation of trends/patterns in metrics
- Refinement of summary infographic; additional metrics? What would you like to see?





Monsoon 2013 Forecast

John J. Brost

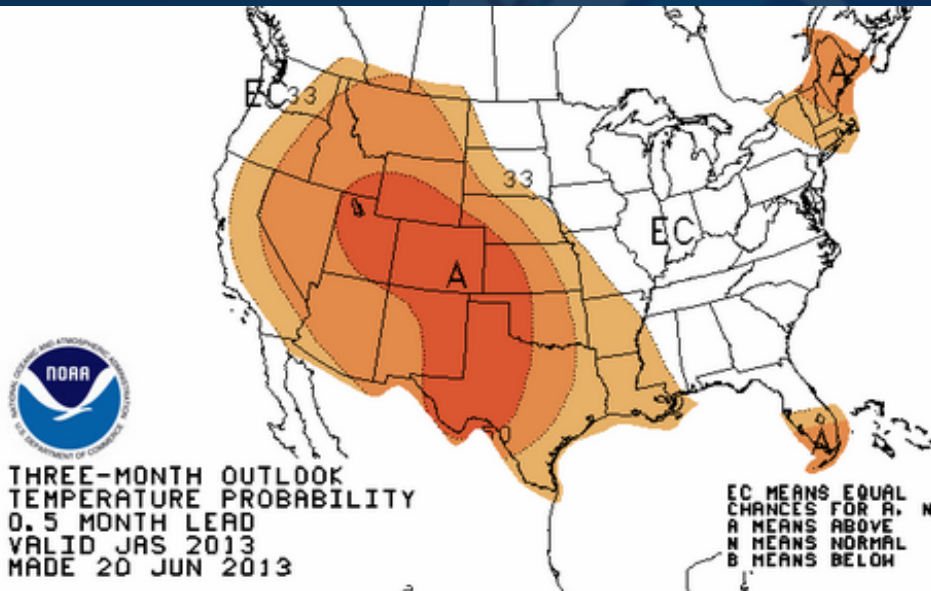
Science and Operations Officer

National Weather Service, Tucson

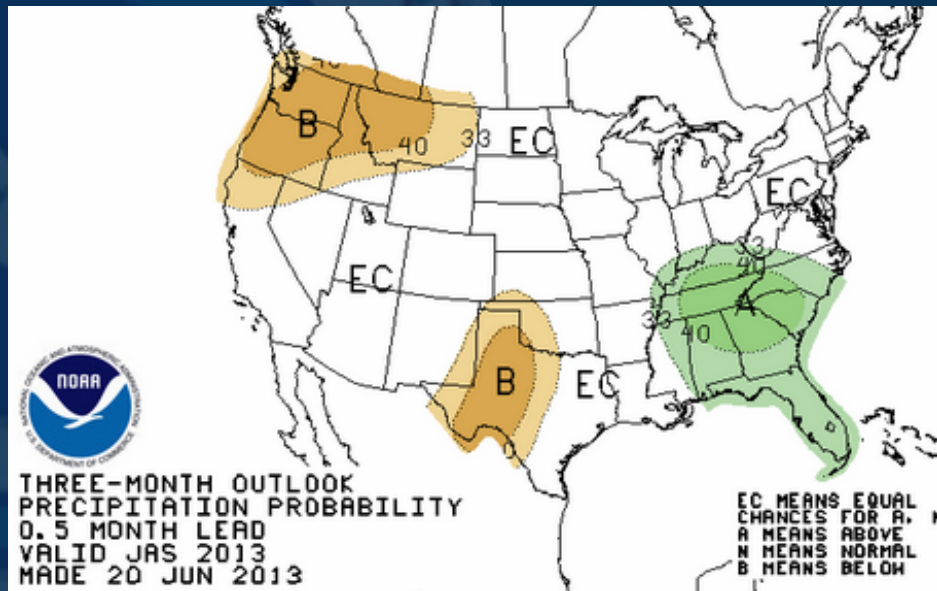


Official CPC Forecast

Temperature Outlook for July/ August/September



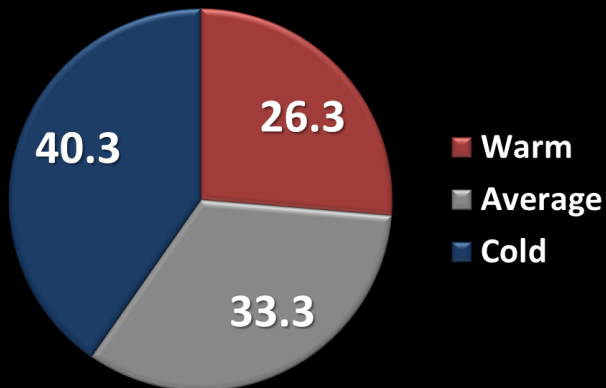
Precipitation Outlook for July/ August/September



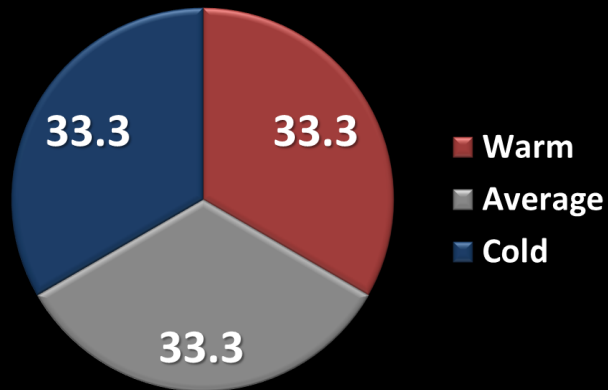
What is EC?

Some signals showing colder conditions.

"Cold"

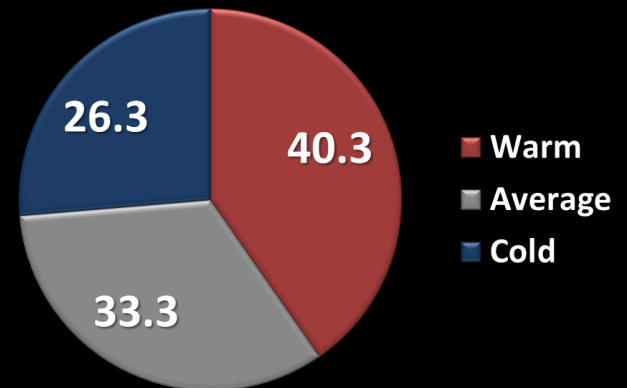


EC



Some signals showing warmer conditions.

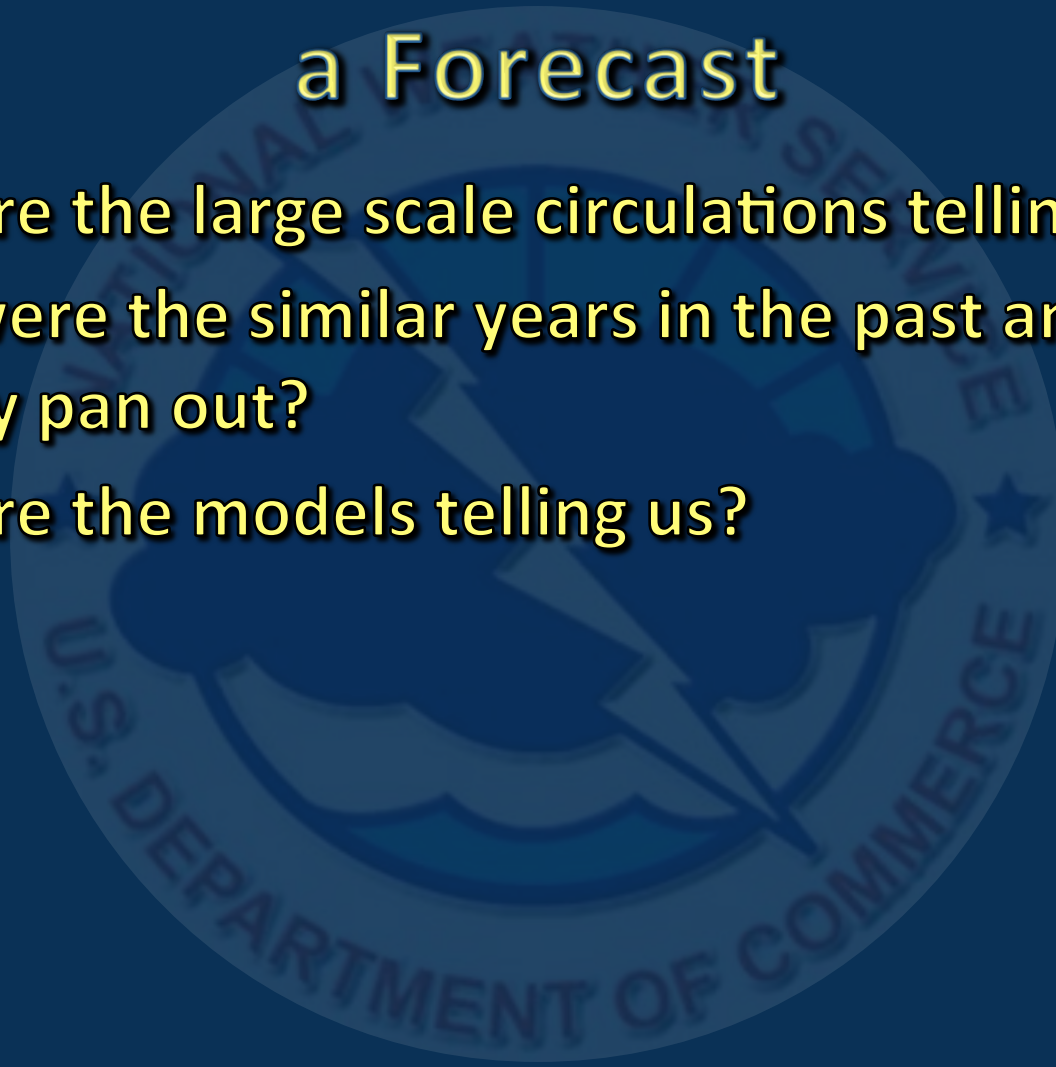
"Warm"



Weak or no signals indicating warm or cold.

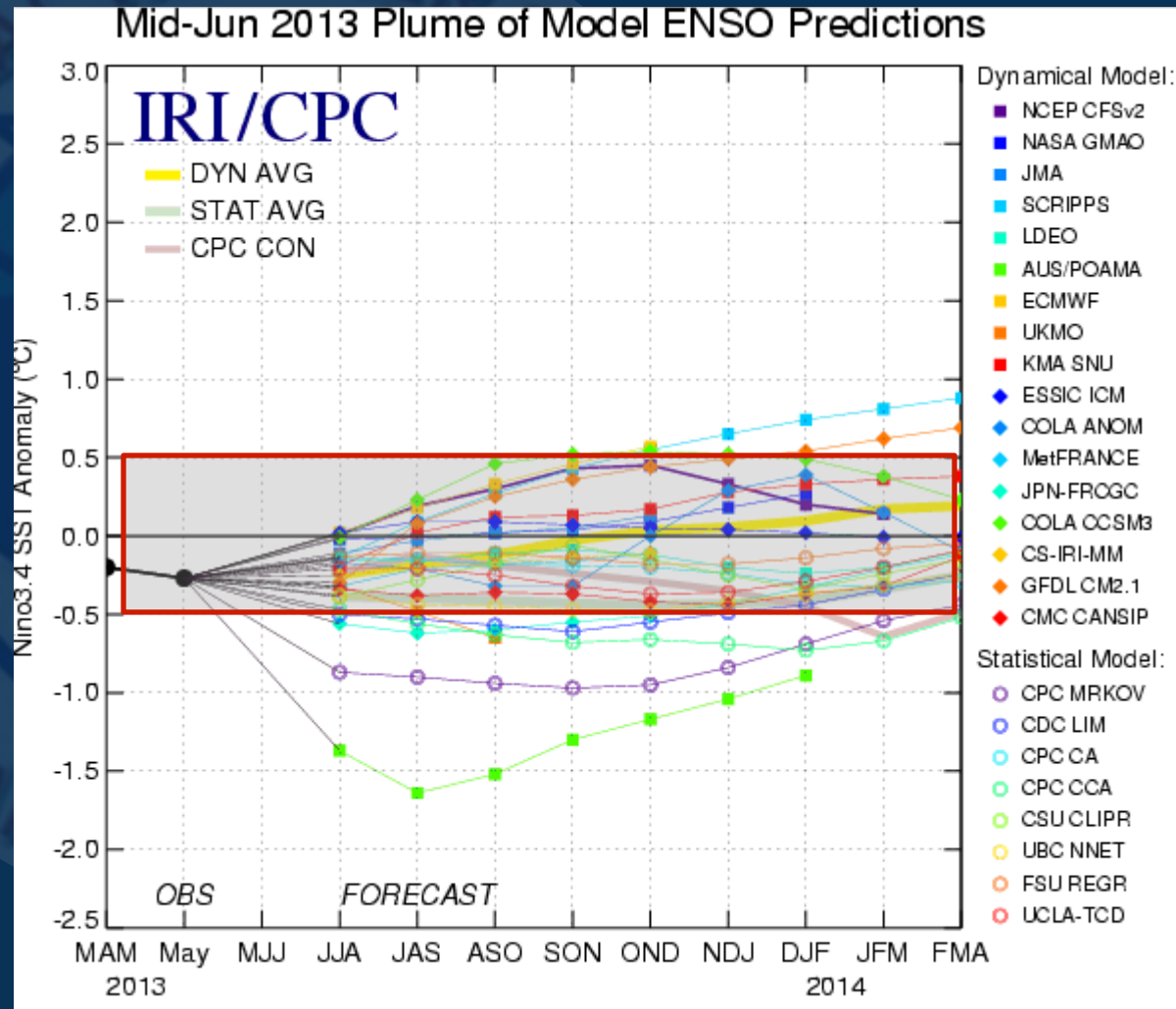
A Few Methods to Develop a Forecast

- What are the large scale circulations telling us?
- What were the similar years in the past and how did they pan out?
- What are the models telling us?



Large Scale Circulations

- ENSO
 - Neutral
 - Can go either way – many wet / dry / average years in Neutral events.

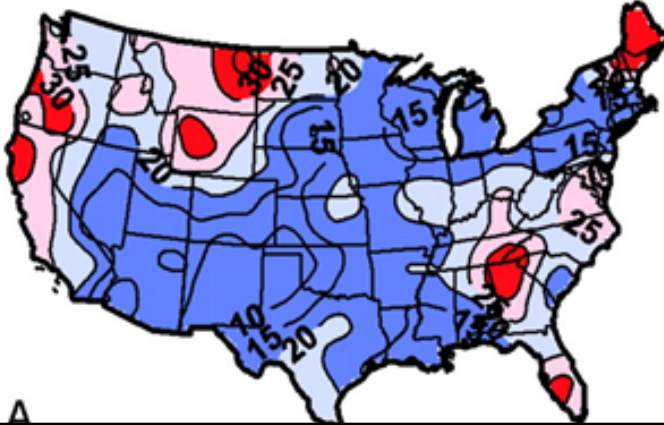


Other Lesser Known Circulations

- **AMO – Atlantic Multidecadal Oscillation**
 - Kinda like El Nino (sea surface temperatures) but in the North Atlantic Ocean and on a longer time scale
- **PDO – Pacific Decadal Oscillation**
 - Also like El Nino but in the more northern latitudes of the Pacific Ocean and on a longer time scale

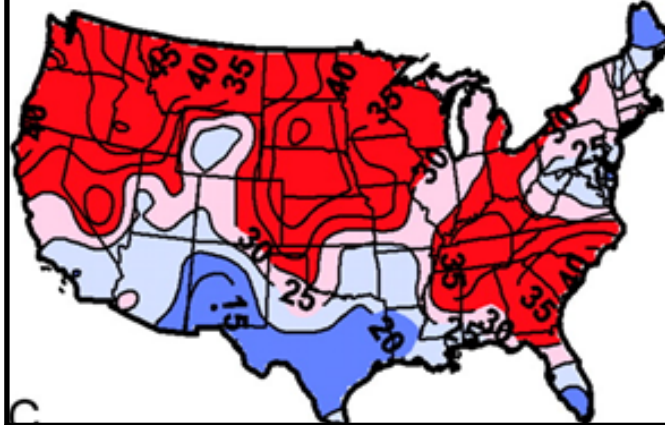
What Do These Mean?

+PDO -AMO



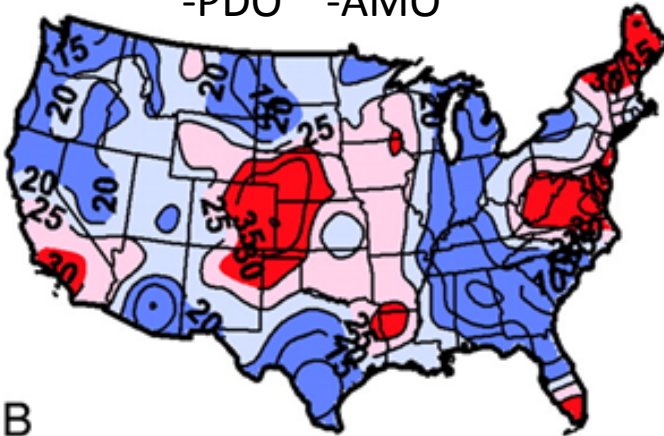
A

+PDO +AMO



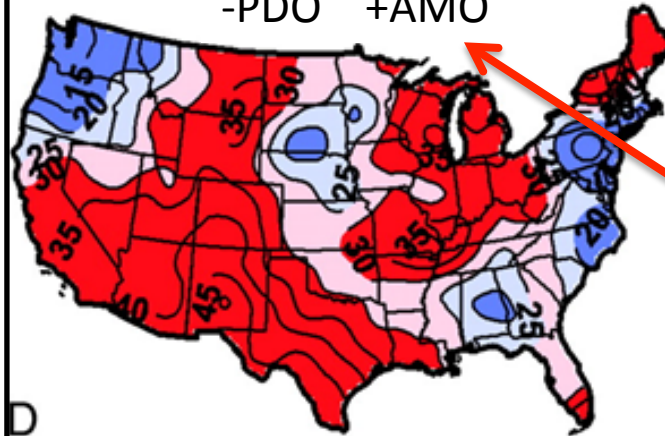
C

-PDO -AMO



B

-PDO +AMO



D

Current Conditions
(May, 2013)

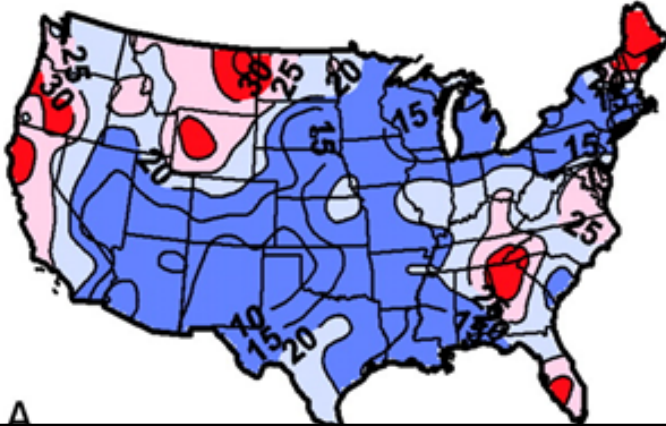
-PDO and +AMO
(Takes longer for
the phase of AMO
to change – It has
been positive since
mid 1990's)

McCabe G J et al. PNAS 2004;101:4136-4141

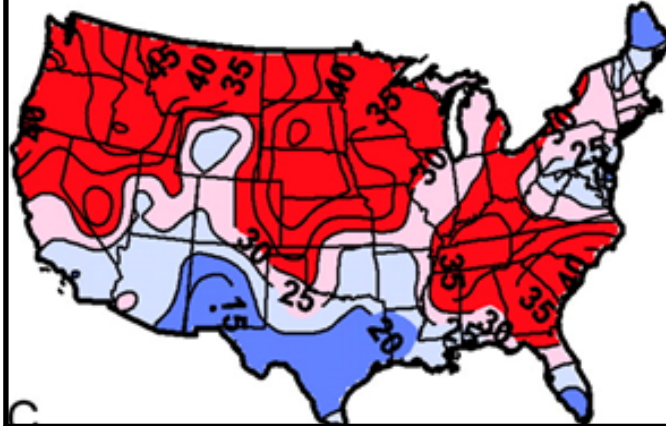
Drought Frequencies based on the AMO and PDO Phases – RED is bad, BLUE is better ☺.

What Do These Mean?

+PDO -AMO

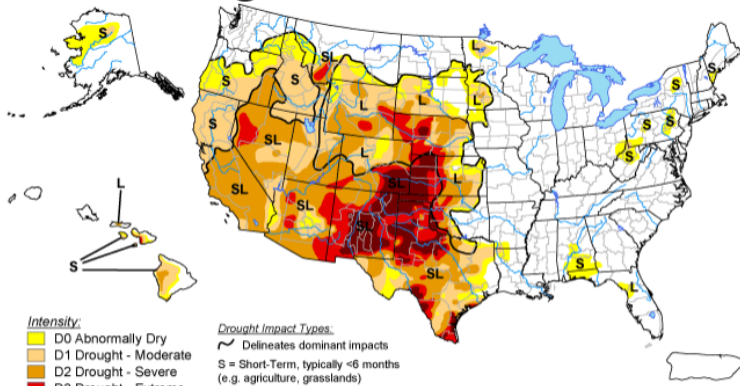


+PDO +AMO



U.S. Drought Monitor

June 11, 2013
Valid 7 a.m. EDT



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

Drought Impact Types:
 ~ Delineates dominant impacts
 S = Short-Term, typically <6 months
 (e.g. agriculture, grasslands)
 L = Long-Term, typically >6 months
 (e.g. hydrology, ecology)

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

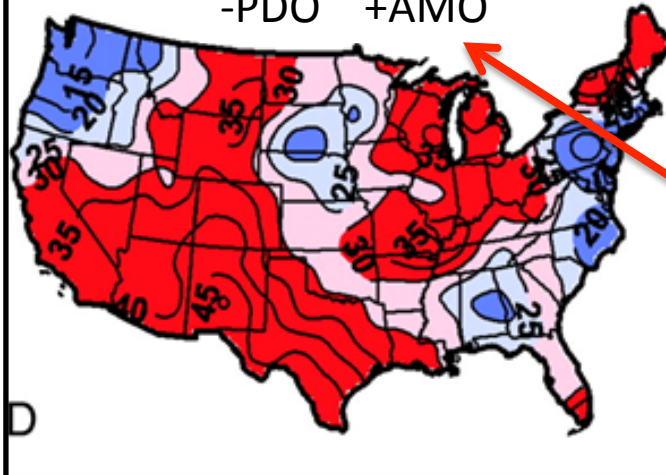


Released Thursday, June 13, 2013

Author: David Simeral, Western Regional Climate Center

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

-PDO +AMO



Current Conditions
(May, 2013)

-PDO and +AMO
(Takes longer for the phase of AMO to change – It has been positive since mid 1990's)

Drought Frequencies based on the AMO and PDO Phases – RED is bad, BLUE is better ☺.

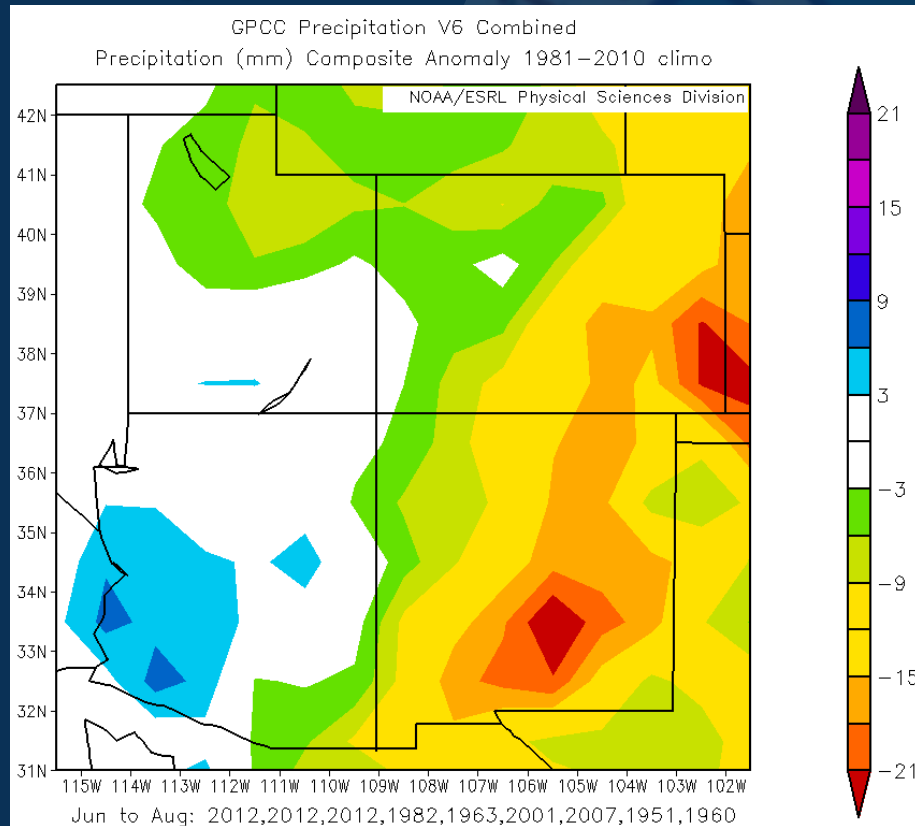
Large Scale Circulation Predictors

Possibly favor drier conditions on a longer term average, but it is not clear cut this year.

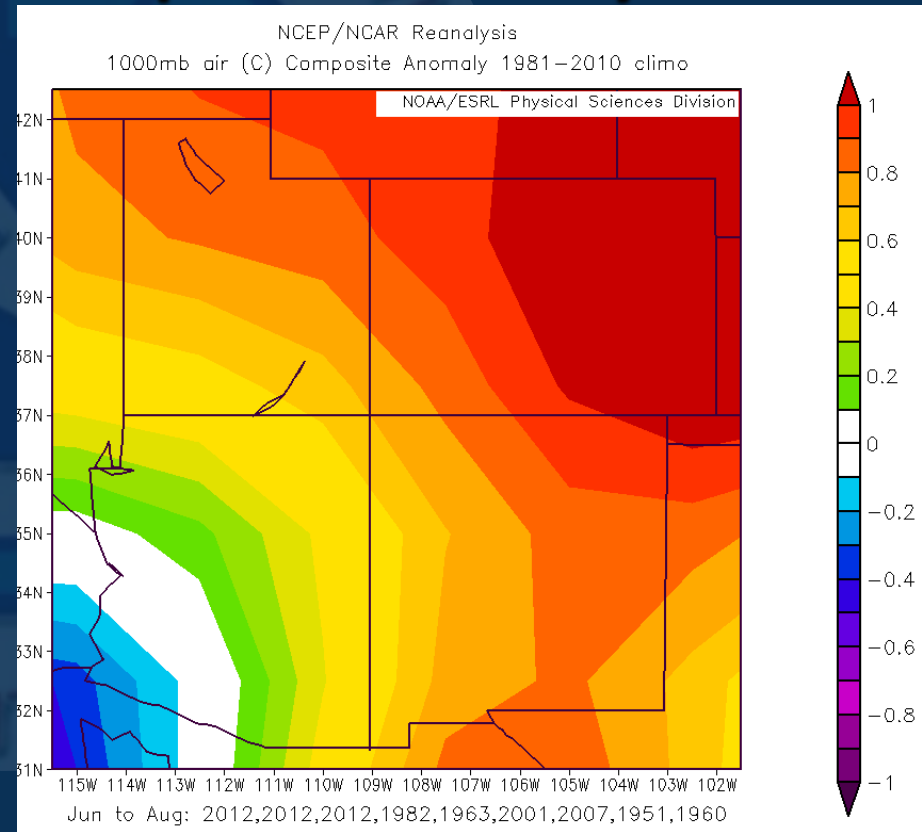
Similar Years in the Past

2012, 2000, 1999, 1995, 1960, 1955 and 1953

Precipitation Anomaly



Temperature Anomaly

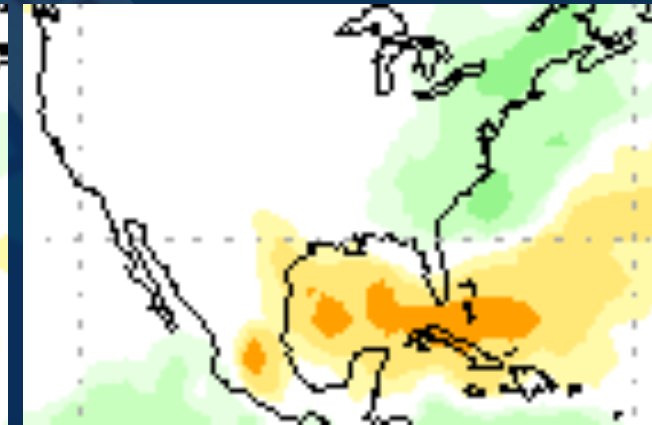
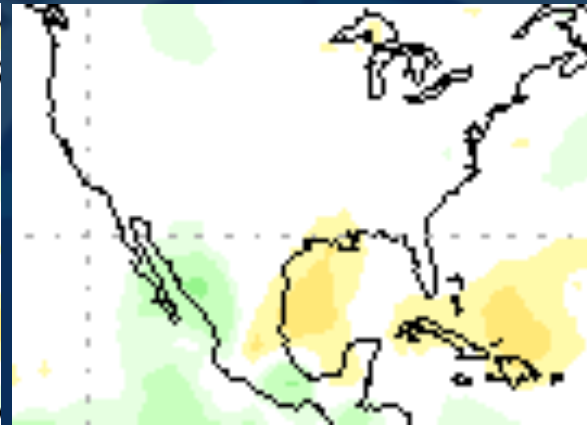
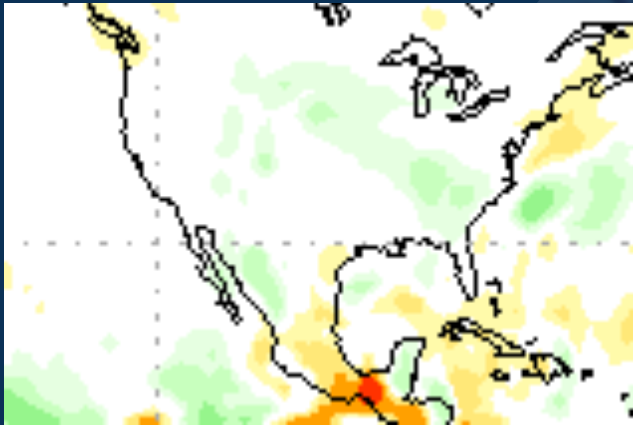


Computer Model Forecast (Daily Precipitation Rate Anomaly for JAS)

CFSv2

CMC1

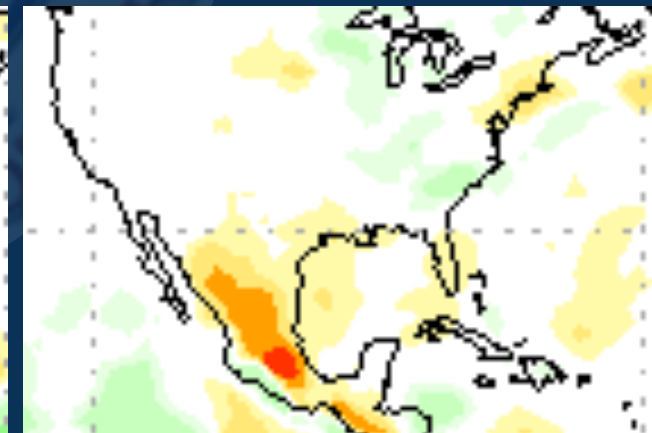
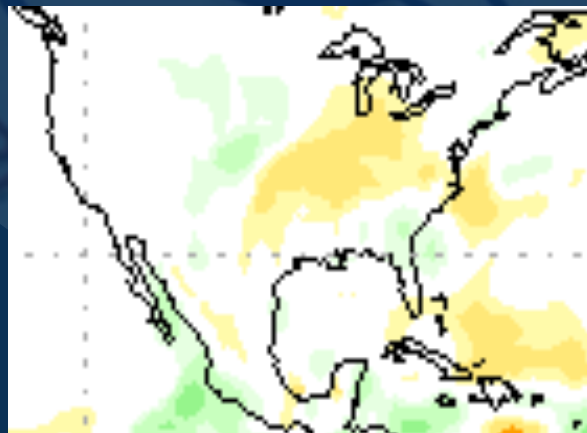
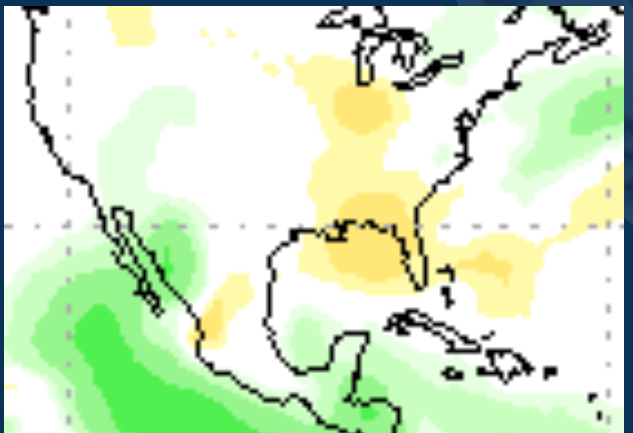
CMC2



GFDL

NCAR

NASA



Computer Model Forecast (Daily Precipitation Rate Anomaly for JAS)

CFSv2

CMC1

CMC2

The BIG POINTS

1. There is no “super dry” consensus among the models 😊!
2. There is also no “really wet” consensus ☹️.
3. The mixed signals make it hard to change the forecast away from “EC”

Final Thoughts

- There are no clear signals pushing the forecast to either “wet” or “dry” – but “hot” is a good bet
 - I would bet some locations will be wetter than average, while others will fall short of average
- We’ve already experienced a few stormy days so hopefully that is a good sign for things to come

John.Brost@noaa.gov
(520) 670-5156 ext 224

| | Good (Wet) | Neutral | Bad (Dry) |
|----------------------|------------|----------|-----------|
| ENSO = Neutral | | X | |
| -PDO +AMO | | | X |
| Analog Years | | X | |
| Computer Models | | X | |
| Midwest Drought | X | | |
| Rocky Mtn. Snow Pack | | X | |