

# August-September-October 2011 Outlook for Colorado And the Summer Monsoon

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July 26, 2011

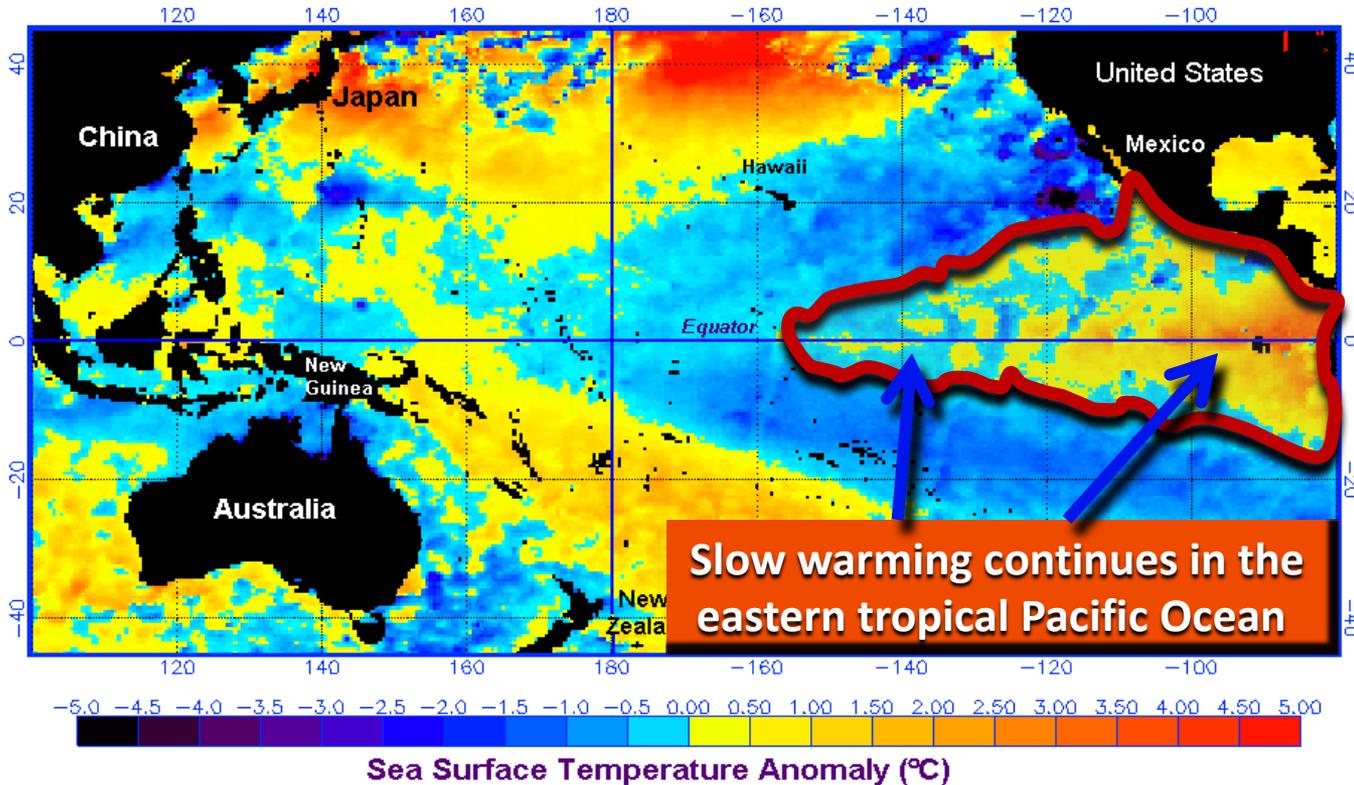


# Topics Covered

- The status of ENSO (El Niño/Southern Oscillation) – and the forecast for ENSO for the next 12 months
- Precipitation, temperature and drought conditions across Colorado during the 90-day period ending July 24, 2011
- The Southwest Monsoon - What is it, when does it normally occur and for how long, what forms does it take, how can it influence the weather along the Front Range and the rest of Colorado, and what can we expect from the monsoon for the rest of this summer?
- What influence has the monsoon already had on precipitation and temperature across Colorado as of July 24, 2011?
- Drought conditions and the drought outlook for Colorado as of July 24, 2011
- Finally, the latest temperature and precipitation outlooks and historical composites for Colorado for August, September and October of 2011

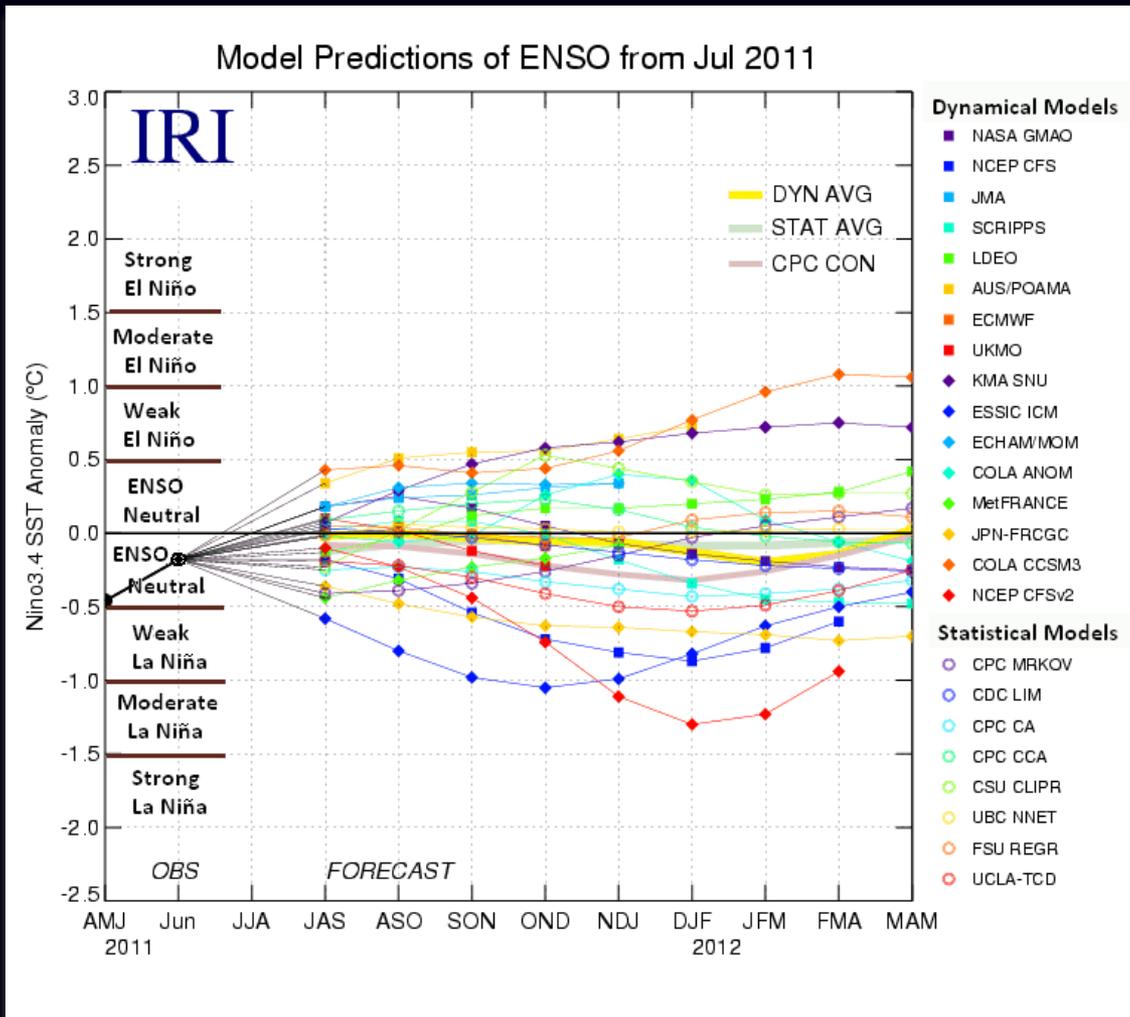
# La Niña Is No More

NOAA/NESDIS Sea Surface Temperature Anomaly (°C)  
for July 21, 2011



In recent weeks, sea surface temperature (SST) departures from average in the tropical Pacific Ocean have continued to shrink, except off of the northwest coast of South America (center right side of this map). In this region of the Pacific positive SST anomalies have steadily increased. Otherwise, as of mid-July, SSTAs along the Equator generally range from -0.5 to 0.5 deg C, indicative of **ENSO- neutral conditions.**

# Model Predictions for El Niño/Southern Oscillation (ENSO) Through March-April-May of 2012

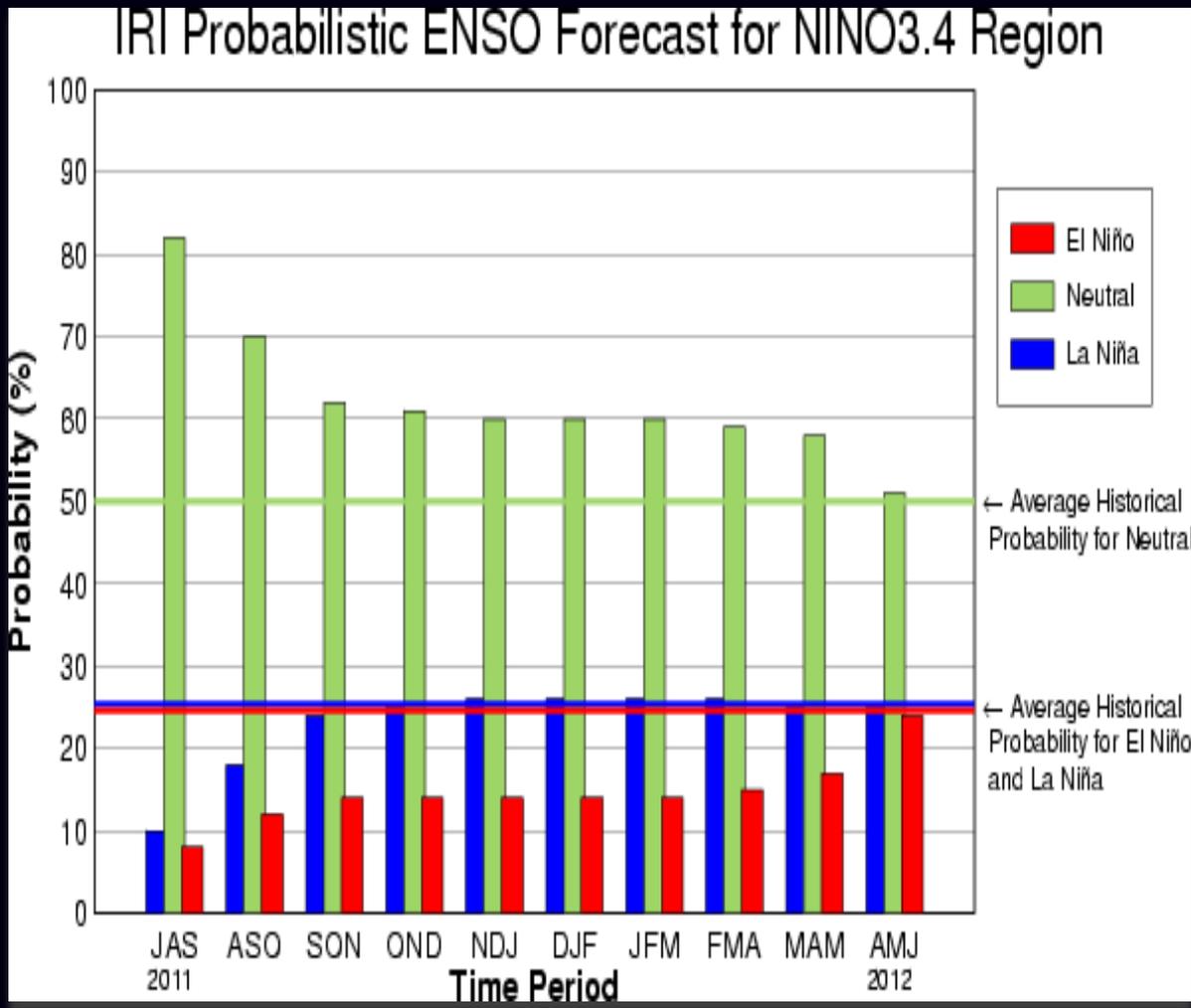


Since the demise of La Niña last May, ENSO-neutral oceanic conditions have prevailed across the tropical Pacific Ocean.

Based on observational trends and a majority of the dynamical and statistical ENSO models, the current outlook is for a continuation of ENSO-neutral conditions in the tropical Pacific Ocean through the winter season of 2011-2012.

However, the direction of ENSO beyond this summer remains uncertain due to lower model forecast skill that far out, particularly at this time of year. Still some models predict a weak El Niño by fall, while a few others including NCEP's CFS model indicate a weak La Niña by then.

Source: International Research Institute for Climate and Society (IRI) – Updated 7/21/11



The probabilistic forecast from IRI indicates a 60 percent chance that ENSO-neutral conditions will prevail across the tropical Pacific Ocean this fall and most of this winter.

There is also an average historical probability (approximately 25 percent) for La Niña conditions and a lower chance (about 15 percent) for El Niño conditions by this fall.

Source: International Research Institute for Climate and Society (IRI) – Updated 7/21/11

## Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1.0	-0.8	-0.6	-0.5	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7
2001	-0.6	-0.5	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1.0	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	0.5	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.1
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1.0	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0	0	0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	-0.6	-1.0	-1.3	-1.4	-1.4	-1.4
2011	-1.3	-1.2	-0.9	-0.6	-0.2							

Latest ONI

El Niños (warm phase events): ONI of +0.5 and higher (red numbers)

La Niñas (cold phase events): ONI of -0.5 and lower (blue numbers)

ENSO-Neutral (near average conditions): ONI below 0.5 and above -0.5 (black numbers)

An ONI of -0.2 is an indication of ENSO-neutral conditions in the Niño 3.4 region during the three-month climate season of April-May-June of 2011.

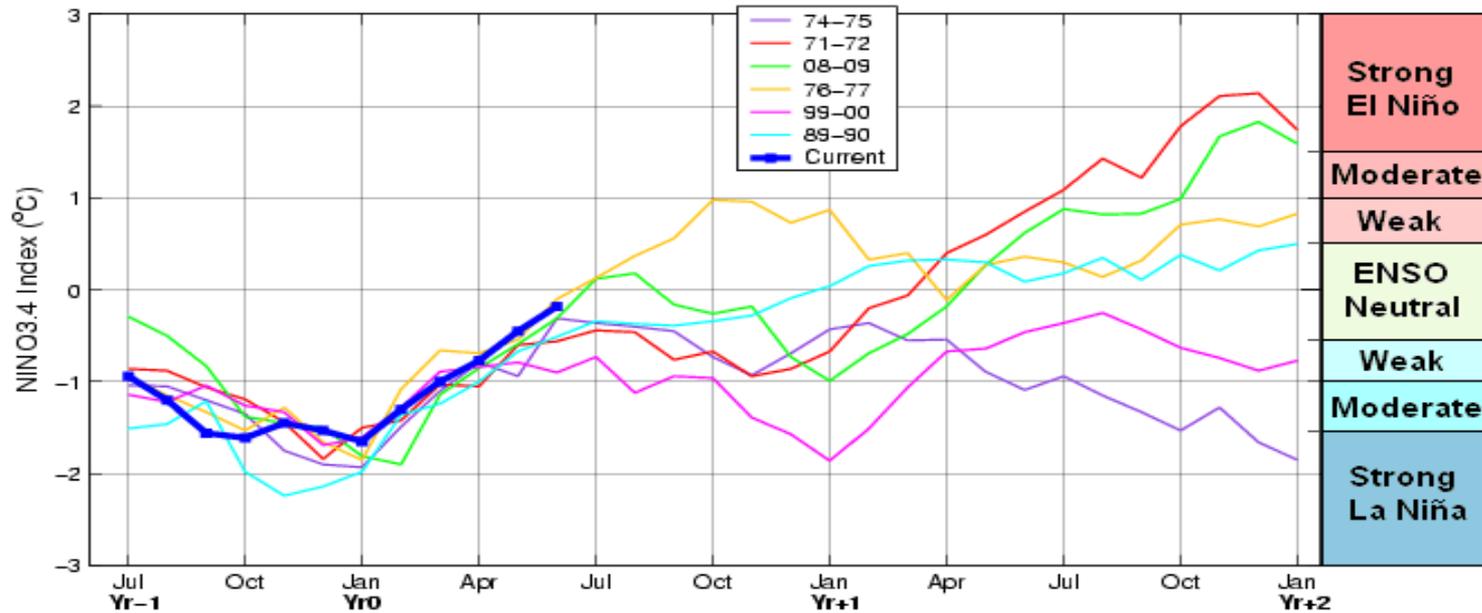
The ONI is based on sea surface temperature (SST) departures from average in the Niño 3.4 region of the eastern tropical Pacific and is a principal measure for monitoring, assessing and predicting ENSO.

ONI is defined as the three-month running-mean SST departures in the Niño 3.4 region.

ONI is used to place current ENSO and non-ENSO events into a historical perspective.

NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.

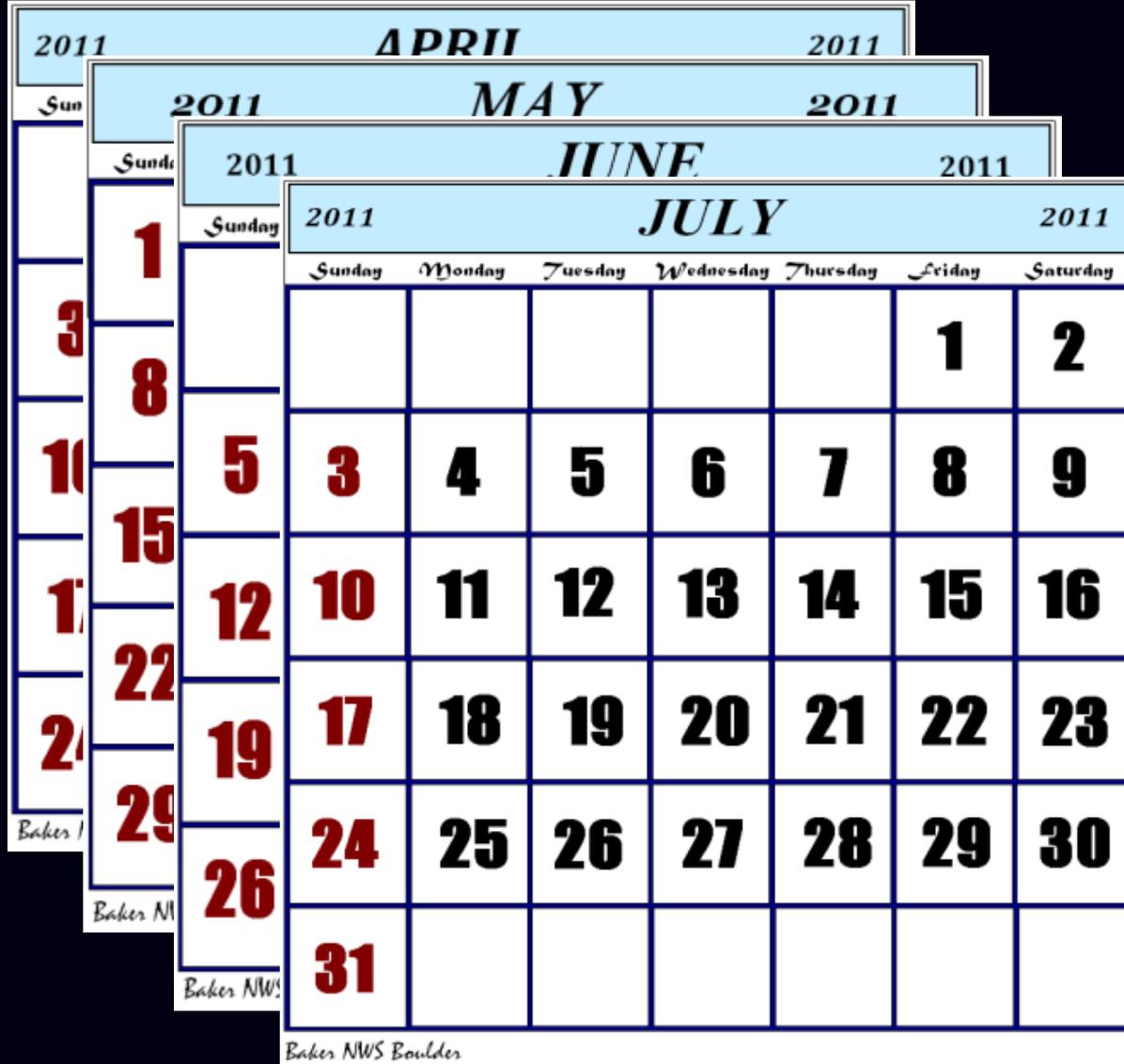
## A Comparison of the Seven Strongest La Niña Events Since 1970 Current vs. Past Niño3.4 Indices (°C)



Source: The International Research Institute for Climate and Society -IRI - July 2011

Above is a comparison of current and past Niño 3.4 indices for the seven strongest La Niña events since 1970. All seven events were classified as weak by April following the winter season of greatest intensity, and a majority of them ended by the start of summer. The current Niño 3.4 index (thick blue line) has continued to weaken at a pace similar to that observed following the 1976-77 and 2008-09 La Niñas.

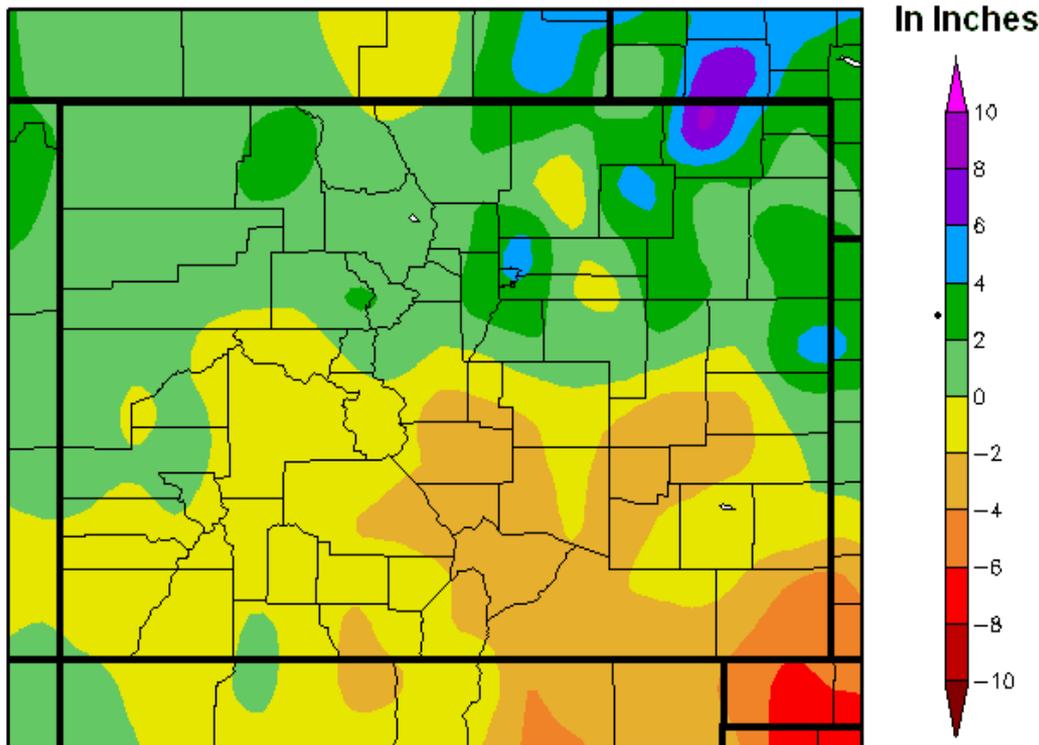
Except for the strong La Niña events of 1999-2000 and 2010-2011, Niño 3.4 indices for the other five events indicated ENSO-neutral conditions during the following summer. Not until the following autumn did it become apparent what direction these indices would take for the next winter. A majority of these indices stayed within the range of 0 to -1, indicating neutral to weak La Niña conditions.



Precipitation,  
and Drought  
Conditions  
Across Colorado  
from Mid-April to  
Mid-July 2011

# Departure from Normal Precipitation For Colorado

April 26 to July 24, 2011

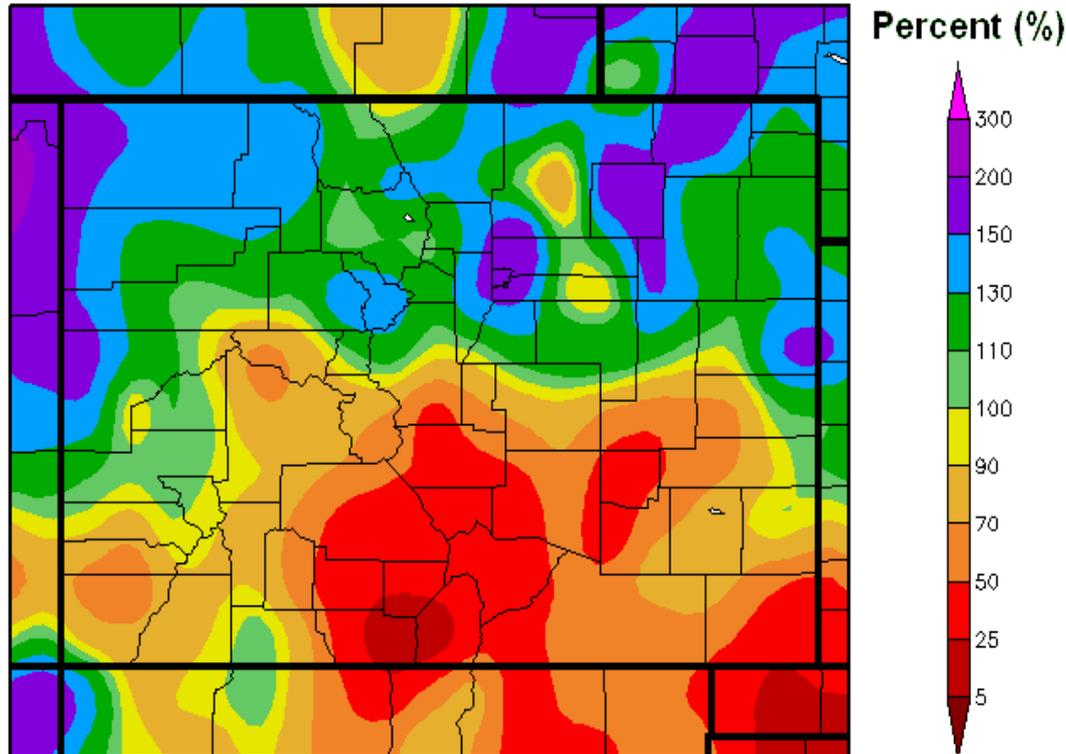


During the 90-day period ending July 24, 2011, precipitation varied widely across Colorado. Departures from normal ranged from around 8 inches in the northeast corner of Colorado to near 6 inches in the far southeast corner of the state.

Overall, precipitation was above normal across northern Colorado, including portions of the Front Range, and below normal across the southern half of the state.

# Percent of Normal Precipitation for Colorado

April 26 to July 24, 2011



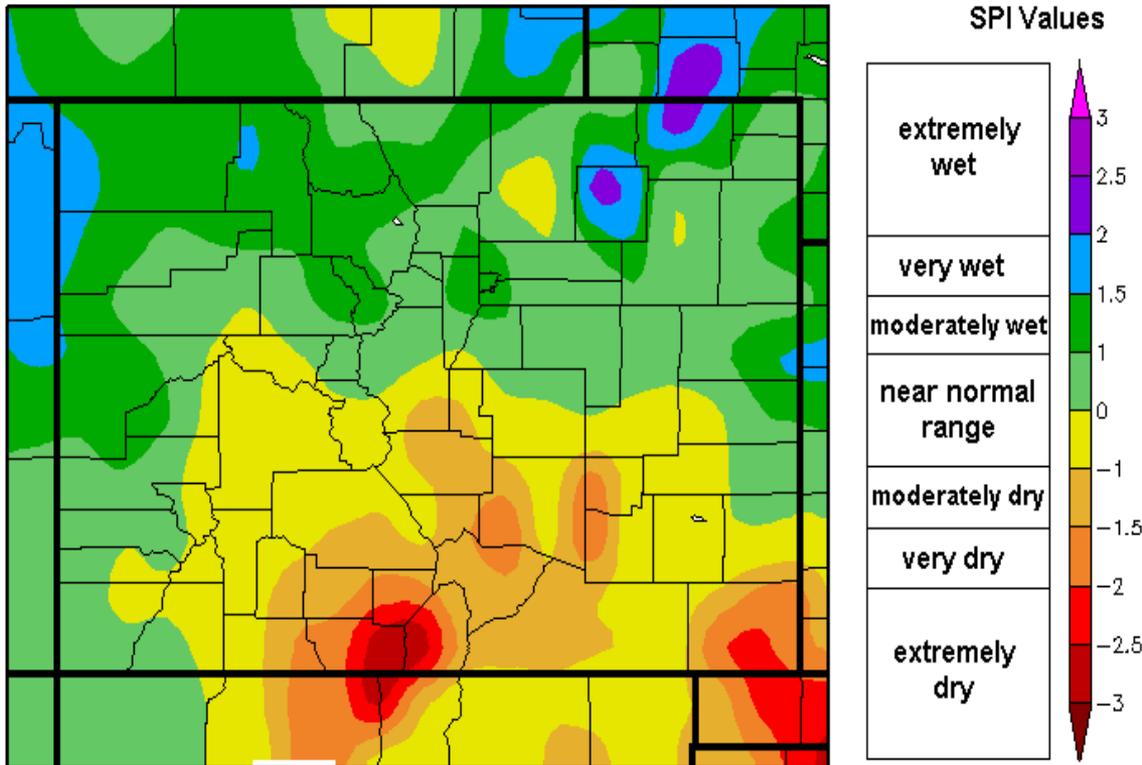
Precipitation totals during the same 90-day period ranged from a high around 200 percent of normal in the far northwest, the northeast and along the Front Range around Denver.

In contrast, southern Colorado continued to record large precipitation deficits. Ninety day totals ranged from 15 to 90 percent of normal. Once again, areas with the least rainfall include the San Luis Valley in south central Colorado and lower portions of Arkansas River Basin in southeast Colorado.

Generated 7/25/2011 at HPRCC using provisional data.

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# 3-Month Standardized Precipitation Index (SPI) for Colorado April 26 to July 24, 2011



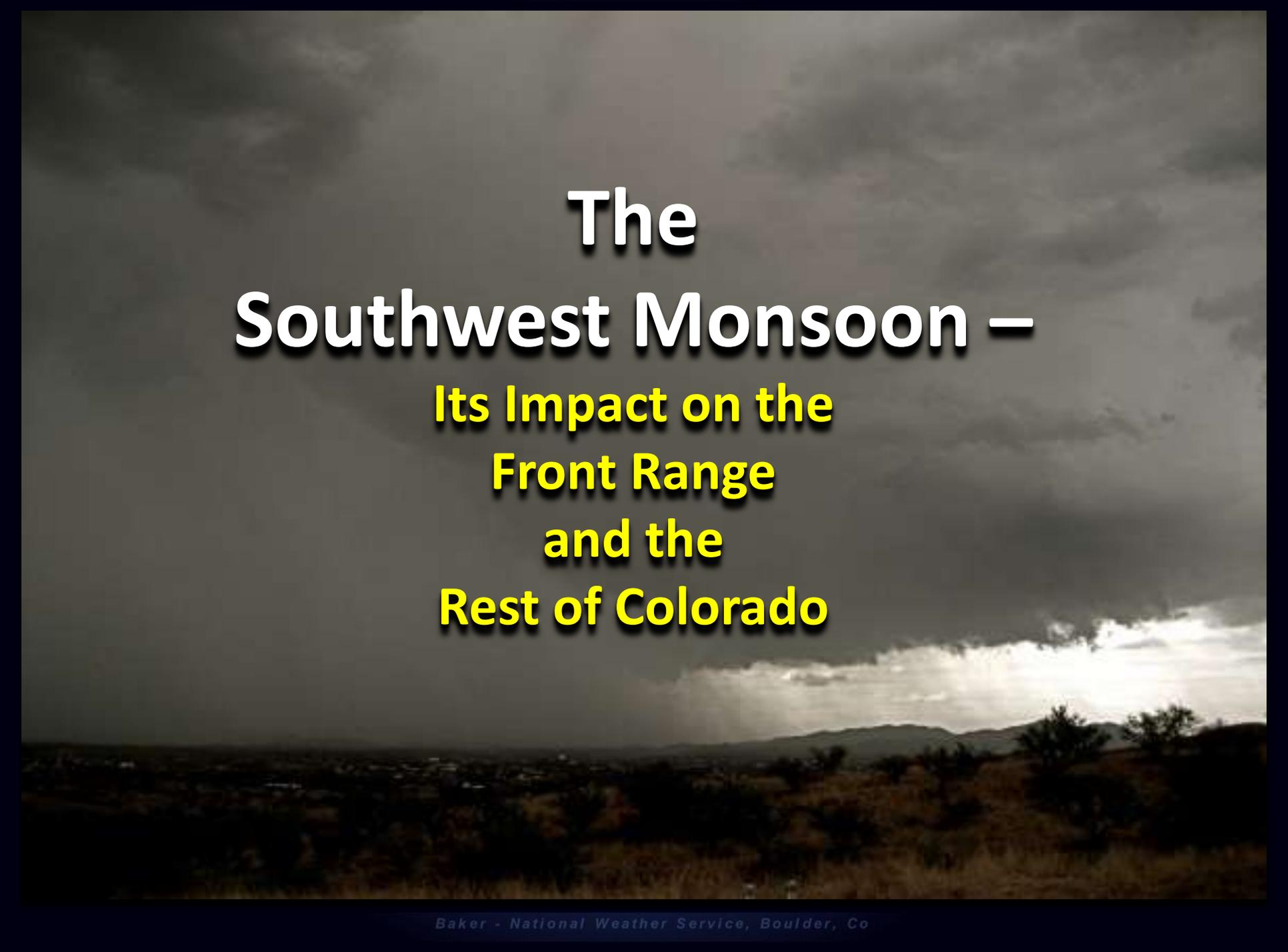
Generated 7/25/2011 at HPRCC using provisional data.

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During the same three month period, the **Standardized Precipitation Index (SPI)** indicated moderately wet to very wet conditions across northern and western portions of Colorado, with pockets of extremely wet conditions near the Nebraska border.

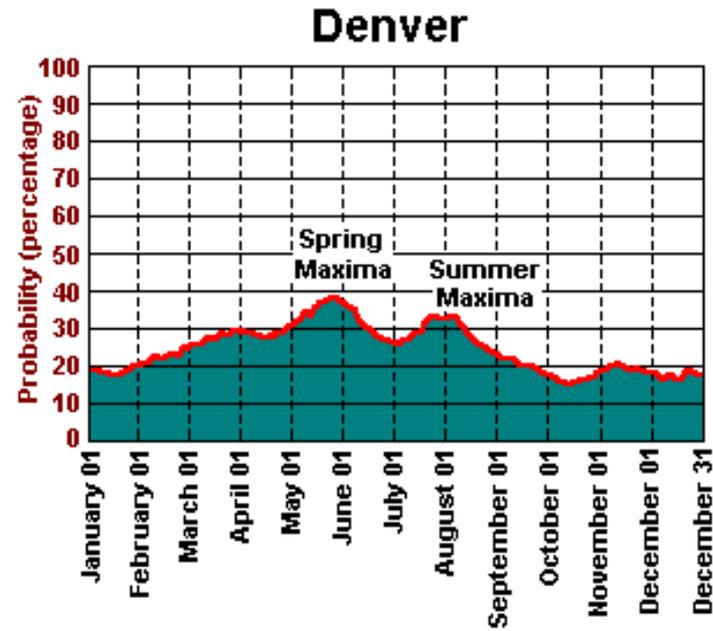
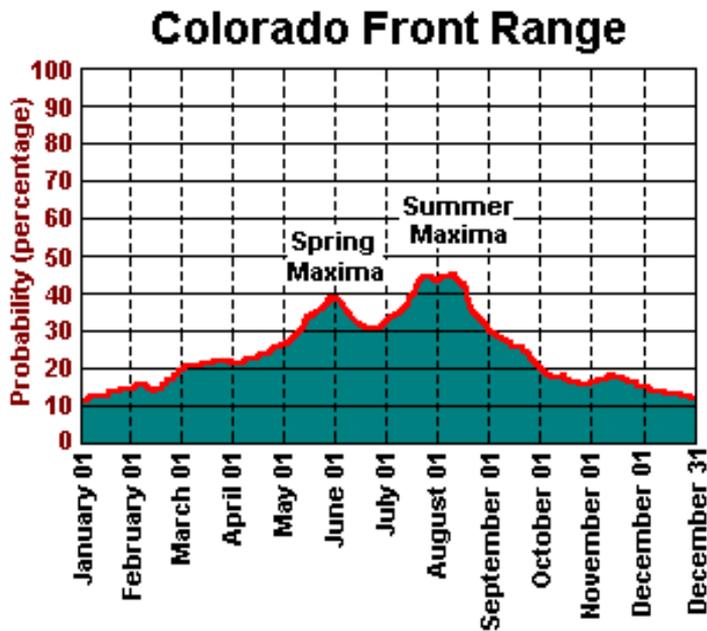
Near normal to extremely dry conditions were indicated across south central and southeast Colorado, with the driest conditions along the state's southern border.

The **SPI** was developed to monitor potential short term agricultural and long-term hydrological drought conditions. The SPI is a probability index that considers only precipitation.



**The  
Southwest Monsoon –  
Its Impact on the  
Front Range  
and the  
Rest of Colorado**

# Probability of 0.01 inch of Precipitation for the Colorado Front Range and Denver



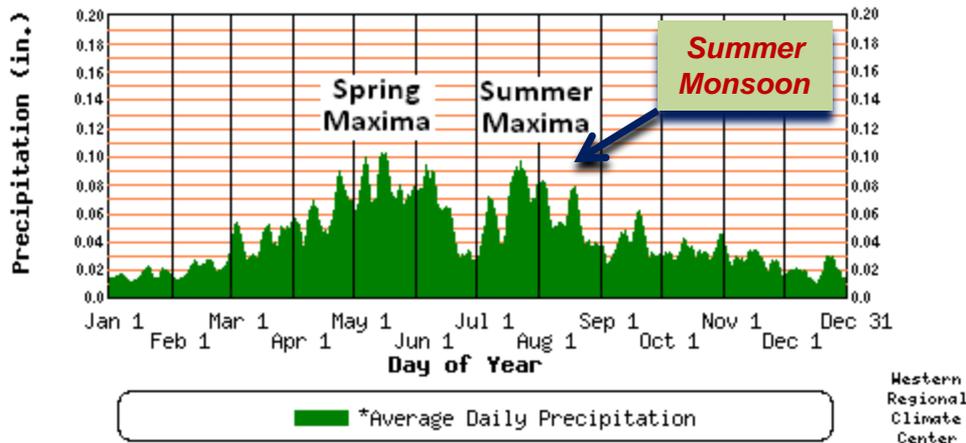
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Data Provided by Western Regional Climatic Center

The probability for measurable precipitation (at least 0.01 inch) peaks, on average, during mid-summer for the Colorado Front Range and in late spring for the Denver metropolitan area.

DENVER STAPLETON AP, COLORADO

Period of Record : 8/ 1/1948 to 12/31/2010



\* 5 day running average of all daily precipitation recorded for the day of the year. The day of interest is centered in the running average.

Western Regional Climate Center

In the Denver Metro Area...

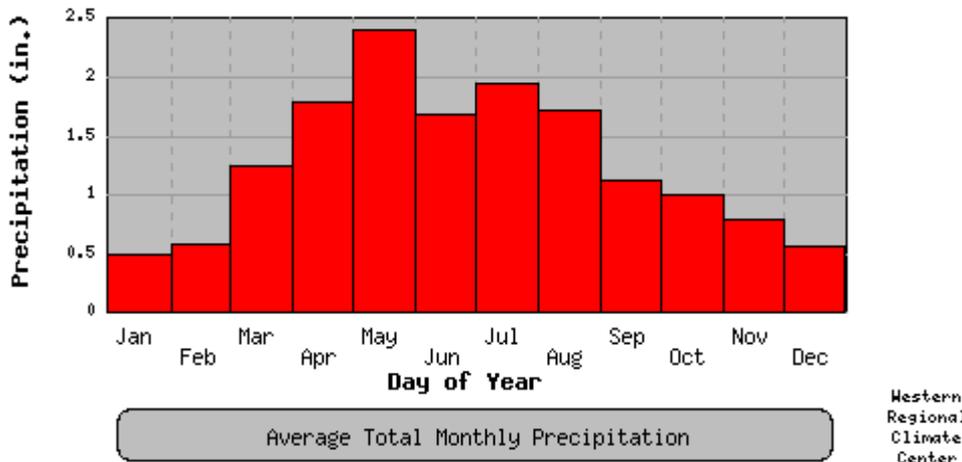
The second peak in precipitation occurs, on average, during the last two weeks of July and the first week of August. This period of enhanced precipitation (thunderstorm activity) is associated with the **summer monsoon**.

Average total monthly precipitation for Denver is greatest for the month of May. However, the heaviest rainfall resulting in **flash flooding** is more likely to occur during the summer monsoon when thunderstorms move slower and precipitable water (total atmospheric moisture) is much greater.

Monthly precipitation totals then steadily decrease during the late summer and autumn months with diminishing atmospheric moisture and falling temperatures.

DENVER WSFO AP, COLORADO (052220)

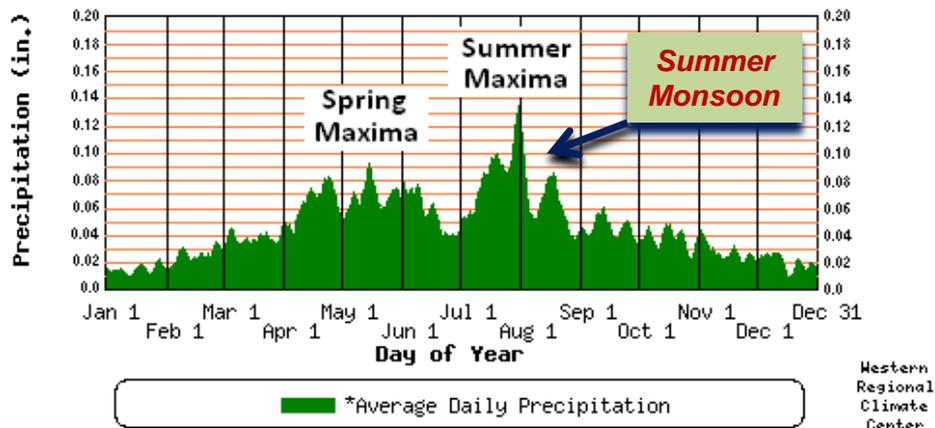
Period of Record : 8/ 1/1948 to 12/31/2010



Western Regional Climate Center

### ESTES PARK, COLORADO

Period of Record : 2/ 1/1896 to 5/31/1994



\* 5 day running average of all daily precipitation recorded for the day of the year. The day of interest is centered in the running average.

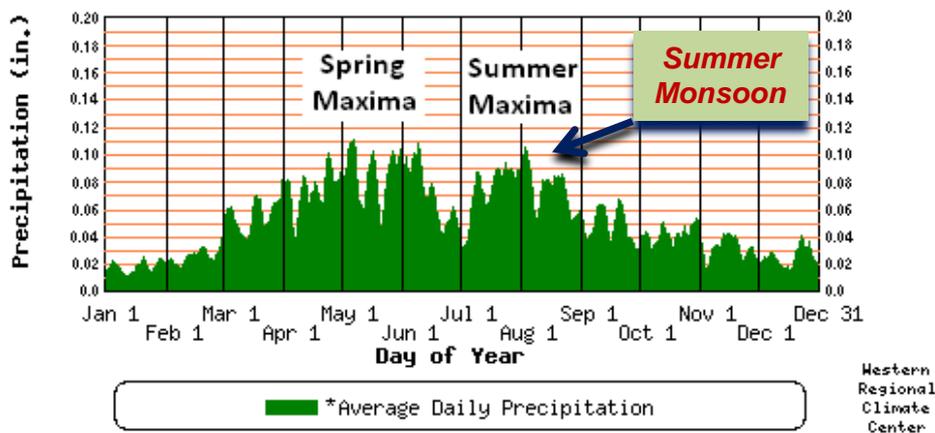
## For the Front Range Communities of Estes Park and Evergreen...

Average daily precipitation peaks around the middle of May and for a second time near the end of July at these locations.

This mid-summer spike in precipitation is a manifestation of the **summer monsoon**.

### EVERGREEN, COLORADO

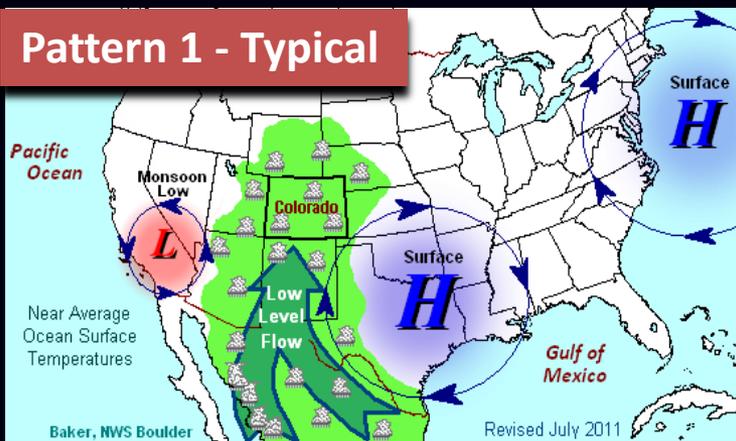
Period of Record : 5/24/1961 to 12/31/2010



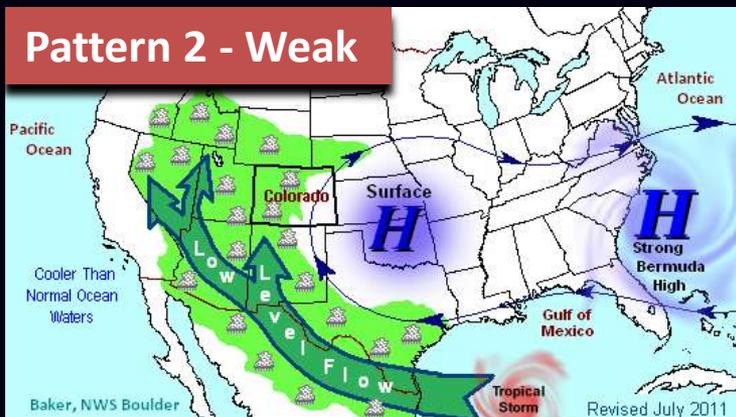
\* 5 day running average of all daily precipitation recorded for the day of the year. The day of interest is centered in the running average.

Average daily precipitation is slightly greater in the spring at Evergreen and greater in the summer at Estes Park. However, the threat of heavy rainfall from slow moving thunderstorms resulting in flash flooding is greatest during the summer at both locations.

## Pattern 1 - Typical



## Pattern 2 - Weak



## Pattern 3 - Strong



## The American Southwest Monsoon – Three Common Flow Patterns

Monsoon - is derived from the Arabic word “mausim”, meaning *season*. In meteorology, the name commonly refers to a *seasonal wind*.

The American southwest monsoon hardly compares to the greatest monsoon on the planet, the southwest monsoon in India that produces very heavy to torrential rains across the Indian peninsula and much of southeast Asia during the summer and fall.

Across the southwestern U.S., strong solar heating during the spring and early summer produces an extensive wind and pressure pattern that transports moist and unstable air northward from subtropical and tropical regions such as the Gulf of Mexico and the very warm waters off the southwest coast of Mexico during July and August.

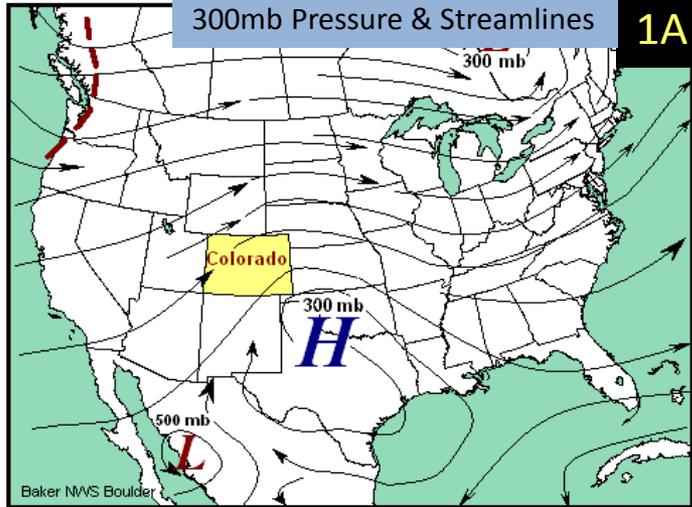
The American monsoon can take many different trajectories. Its start time and longevity varies widely from year-to-year. Some of this variation can be attributed to different phases of ENSO. The following slides depict three major wind, pressure and thunderstorm distribution patterns associated with American southwest monsoon. Which of these patterns have we seen thus far this summer and what pattern(s) could we still see in the weeks to come will be discussed.

## Pattern 1

## Typical Summer Monsoon Pattern for Colorado

300mb Pressure & Streamlines

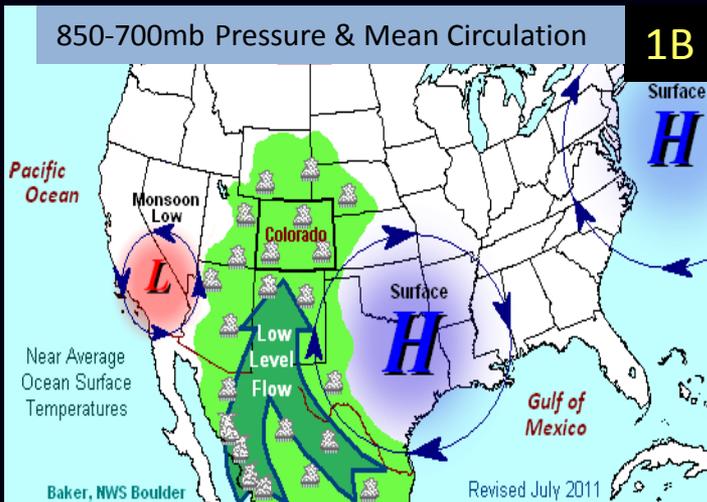
1A



Pattern 1, the most common monsoon pattern, appears over the western half of the continental United States during the summer roughly from late June through the middle of August. The affect that this large scale wind and pressure pattern has on temperatures and precipitation across the entire region, including Colorado, can last up to a couple weeks at a time. A strong, often hot upper level ridge of high pressure centered over the southern Great Plains will normally produce light southwesterly flow aloft over Colorado (refer to panel 1A).

850-700mb Pressure & Mean Circulation

1B



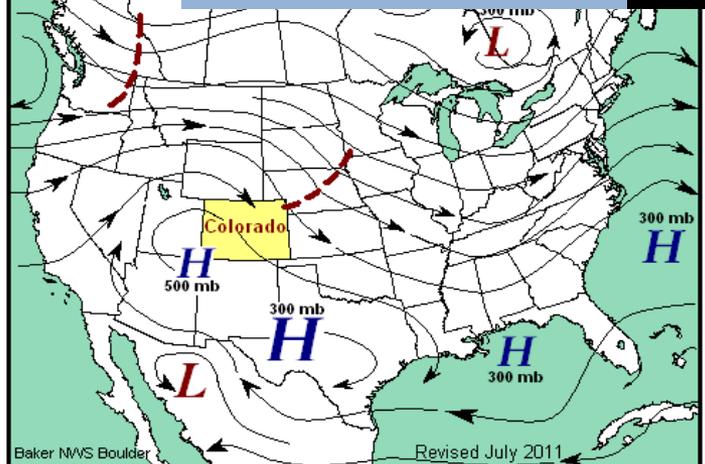
In the lower atmosphere, roughly below 10,000 feet ASL, the diurnal wind across Colorado will predominantly be southerly in direction with this pattern (refer to panel 1B). Circulation around a strong, often stationary high pressure in the Ark-la-tex-oma region, and a cut-off or heat low (referred to by researchers as the monsoon low) in southern California will transport moist subtropical air of maritime origin up into Arizona, New Mexico and western Texas usually by late June, and up into eastern Utah, Colorado and southern Wyoming by early to mid-July. Arrival of the monsoon is often marked by a jump in daily thunderstorm occurrence, higher dew point temperatures and relative humidity, and warmer nighttime temperatures. **This monsoon pattern is more often observed in the presence of ENSO-neutral and weak ENSO conditions.**

## Pattern 2

## Weak Summer Monsoon Pattern for Colorado

300mb Pressure & Streamlines

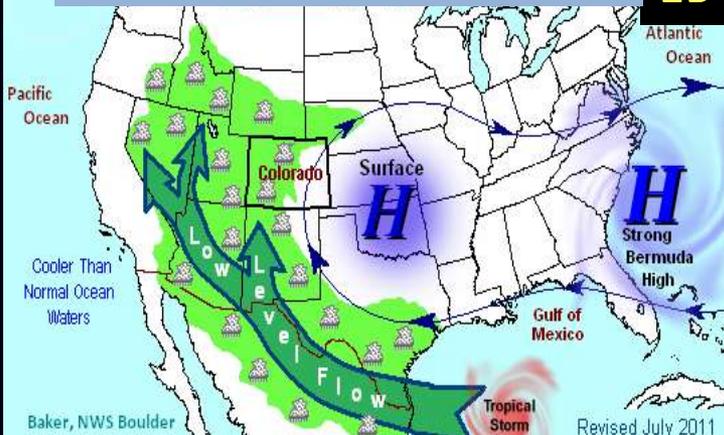
2A



Monsoon pattern 2 is not as common as pattern 1. In this setup, the strong upper level high pressure ridge that is normally over the Great Plains for much of the summer will sometimes shift westward over the Rocky Mountain region and perhaps as far west as the Great Basin (refer to panel 2A). This shift in the upper ridge often coincides with a similar westward migration of a strong Bermuda High across the southeast United States or northern Gulf of Mexico. This repositioning of the upper ridge causes the monsoon moisture plume to deflect away from Colorado and towards the Great Basin, possibly reaching as far north as Idaho and eastern Oregon (refer to panel 2B). This northwesterly oriented flow pattern normally will not persist as long as a pattern 1, typically no longer than a week at a time.

850-700mb Pressure & Mean Circulation

2B



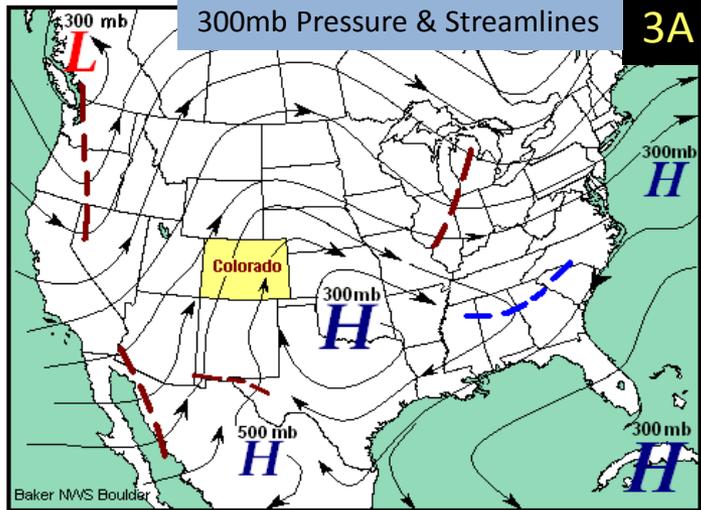
With this pattern, eastern Colorado will often experience abnormally warm and dry conditions except for the occasional late day thunderstorm drifting off the mountains. Whereas western Colorado may still have an active summertime thunderstorm season with this redirected moisture plume, although storms are less likely to produce heavy rainfall resulting in flash flooding. An active tropical storm season in the Gulf of Mexico can perpetuate this monsoon pattern well into September. **Monsoon pattern 2 is more likely to appear prior to the development of La Niña conditions in the Pacific and in the midst of a La Niña event .**

## Pattern 3

## Strong Summer Monsoon Pattern for Colorado

300mb Pressure & Streamlines

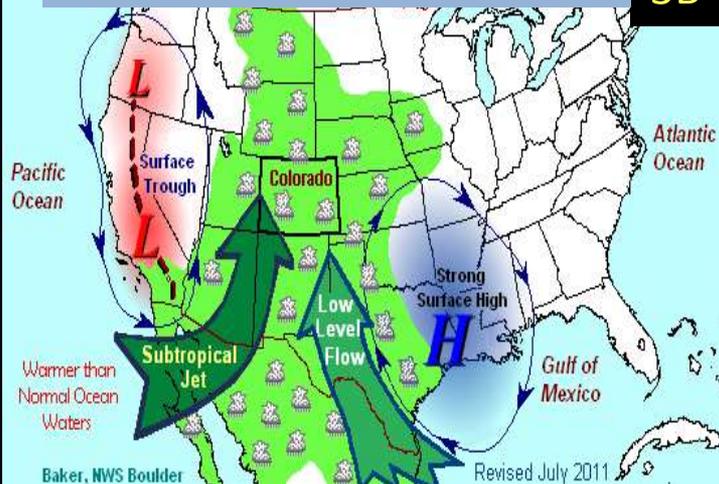
3A



Pattern 3 is similar, in some respects, to the typical monsoon pattern (1) described earlier, but its effects on Colorado is more pronounced. A strong upper level high pressure ridge over the central U.S. can be seen arching well up into Canada. The center of this high amplitude ridge is usually over the southern Great Plains (see panel 3A). Coincidentally, an abnormally strong upper level low pressure trough will be located along the west coast. The general flow aloft over Colorado will be light in speed from a south-southwesterly direction. This pattern can appear for weeks at a time and potentially last well into late August.

850-700mb Pressure & Mean Circulation

3B



In the lower atmosphere, the combined circulation around a strong surface high in the lower Mississippi River Valley and an elongated surface trough at the foot the Sierra Nevada Mountains in California channels waves of moisture laden subtropical air northward over the southwest U.S. and up along the spine of the Rocky Mountains. What makes this pattern different from pattern 1 is the additional influx of very moist tropical air by a subtropical jet stream located about 10,000 to 15,000 feet above the ground (see panel 3B). This broad conveyor belt of moisture rich air significantly enhances thunderstorm formation across all of Colorado, and the potential for very heavy rainfall resulting in flash flooding. **This monsoon pattern is more likely to appear prior to the onset of a moderate to strong El Niño event.**

## The Summer Monsoon Along the Colorado Front Range

2011 <i>JULY</i> 2011						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7	8	9
10	11	12	13	Average Start 14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

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2011 <i>AUGUST</i> 2011						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	Average End 8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

Baker NWS Boulder

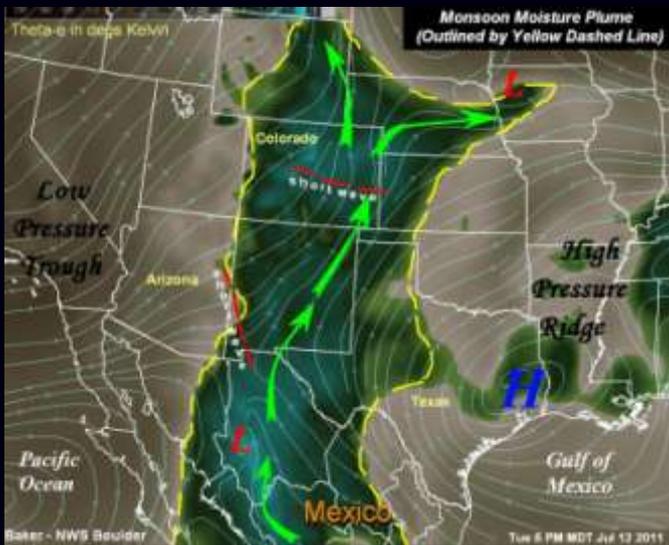
The summer monsoon in Denver and along the Colorado Front Range, begins, on average, on July 14<sup>th</sup> and ends about August 8<sup>th</sup>. These dates can vary by as much as 10 days on either side, and do not take into account the different phases of ENSO (El Niño, La Niña, and ENSO-neutral.) This summer, the monsoon along the Front Range began several days early, on or about July 6<sup>th</sup>.



6 PM MDT Monday July 11, 2011



12 Noon MDT Monday July 12, 2011



6 PM MDT Tuesday July 12, 2011



6 AM MDT Wednesday July 13, 2011

This 4-panel series is a forecast model presentation of initial 5000-18,000 feet ASL moisture (theta-e) and wind streamlines beginning late on July 11, 2011.

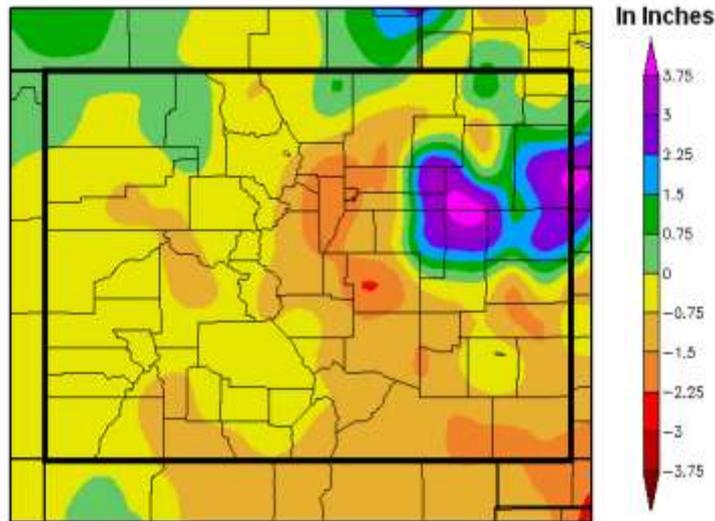
Some of the heaviest rain to fall on the Denver Metro Area so far this summer fell with the monsoon plume positioned over eastern Colorado. The heaviest rainfall occurred with the passage of a relatively strong shortwave trough late on the 13<sup>th</sup>.

**This is an excellent example of a typical mid-summer monsoon pattern, pattern 1.**

2011		<i>JUNE</i>						2011			
Sunday		2011		<i>JULY</i>						2011	
		Sunday		Monday	Tuesday	Wednesday	Thursday	Friday	Saturday		
								<b>1</b>	<b>2</b>		
<b>5</b>		<b>3</b>		<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>		
<b>12</b>		<b>10</b>		<b>11</b>	<b>12</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>		
<b>19</b>		<b>17</b>		<b>18</b>	<b>19</b>	<b>20</b>	<b>21</b>	<b>22</b>	<b>23</b>		
<b>26</b>		<b>24</b>		<b>25</b>	<b>26</b>	<b>27</b>	<b>28</b>	<b>29</b>	<b>30</b>		
Baker NWS I		<b>31</b>									
Baker NWS Boulder											

**Impact of the  
 Summer Monsoon  
 on Temperature,  
 Precipitation  
 and Drought  
 Conditions  
 Across Colorado  
 From Mid-June to  
 Mid-July 2011**

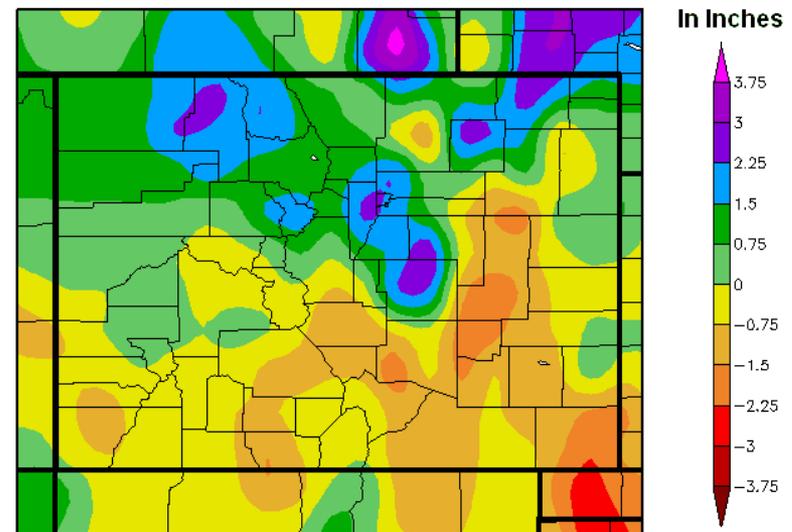
## Departure from Normal Precipitation for Colorado May 21 to June 19, 2011



Generated 6/20/2011 at HPRCC using provisional data.

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## Departure from Normal Precipitation for Colorado June 25 to July 24, 2011



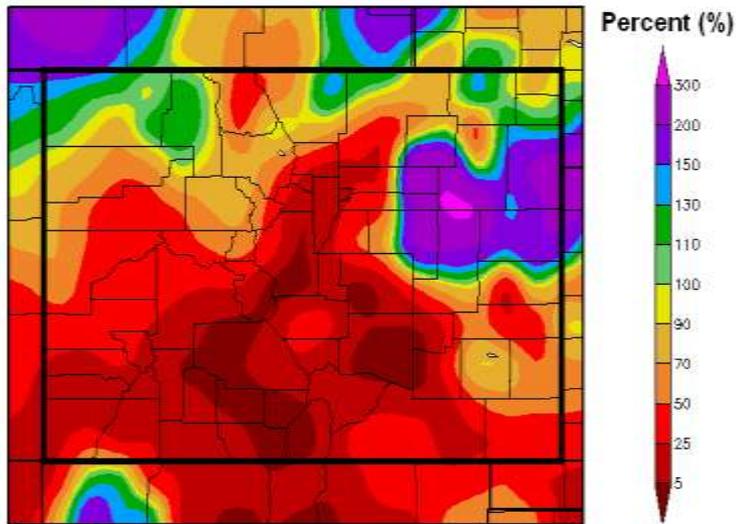
Generated 7/25/2011 at HPRCC using provisional data.

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During the 30-day period ending June 19, 2011, precipitation across most of Colorado was below normal except on the northeast plains where totals were above 3.5 inches. Compare that to the 30-day period ending July 24<sup>th</sup>. Precipitation departures above normal increased across northern Colorado and most dramatically along the Front Range around the Denver area. Days of heavy rainfall from thunderstorms fed by a very moist monsoon moisture flow sent 30-day precipitation totals over 3 inches in the Denver area, on portions of the Palmer Divide southeast of Denver, and across the northeast corner of the state. Southern sections of the state saw relatively little change from the departures recorded during the previous 30-day period.

## Percent of Normal Precipitation for Colorado

May 21 to June 19, 2011

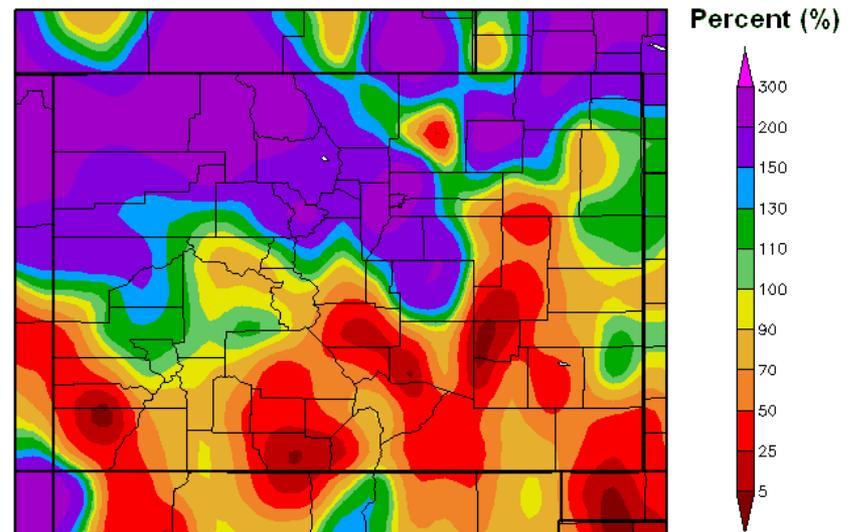


Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

## Percent of Normal Precipitation for Colorado

June 25 to July 24, 2011

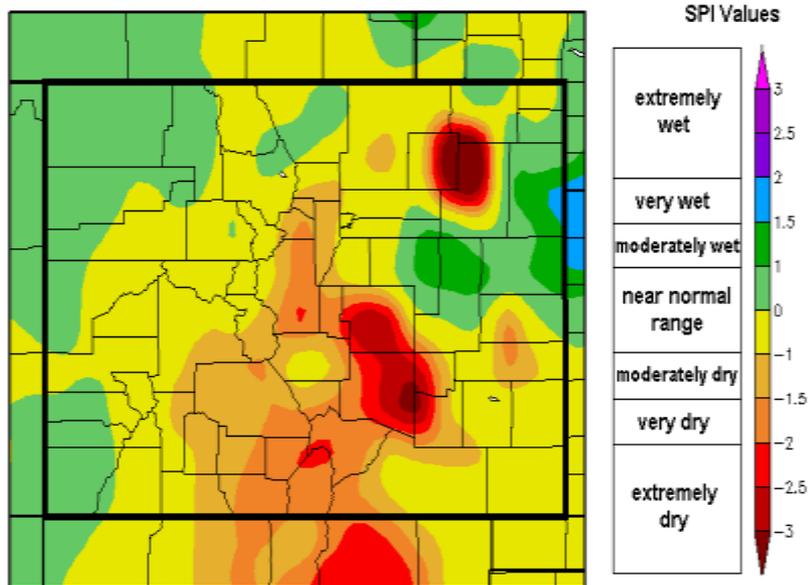


Generated 7/25/2011 at HPRCC using provisional data.

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During the 30-day period ending June 19, 2011, precipitation across the southern two-thirds of Colorado was as much as 50 percent of normal. This included the northern I-25 urban corridor along the Front Range. Compare this to the 30-day period ending July 24<sup>th</sup> when most of this same area saw a surplus in precipitation. The most notable improvement in precipitation during this roughly 60-day period occurred in the southern and central mountains and in the vicinity of the Front Range around Denver. Precipitation during this period was as much as 300 percent above normal in and around Denver, attributable to heavy monsoon thunderstorms early in July.

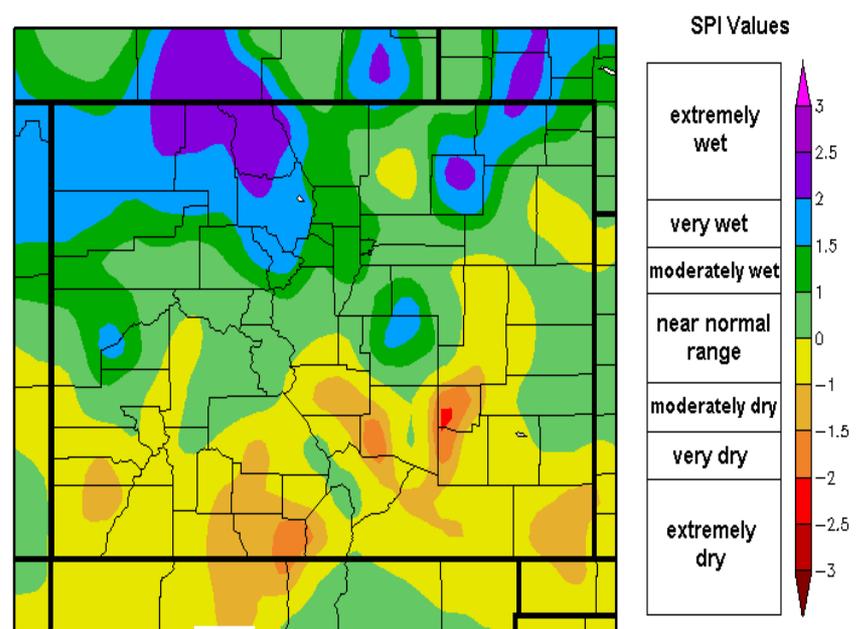
30 Day Standardized Precipitation Index (SPI)  
for Colorado  
May 21 to June 19, 2011



Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

30 Day Standardized Precipitation Index (SPI)  
for Colorado  
June 25 to July 24, 2011



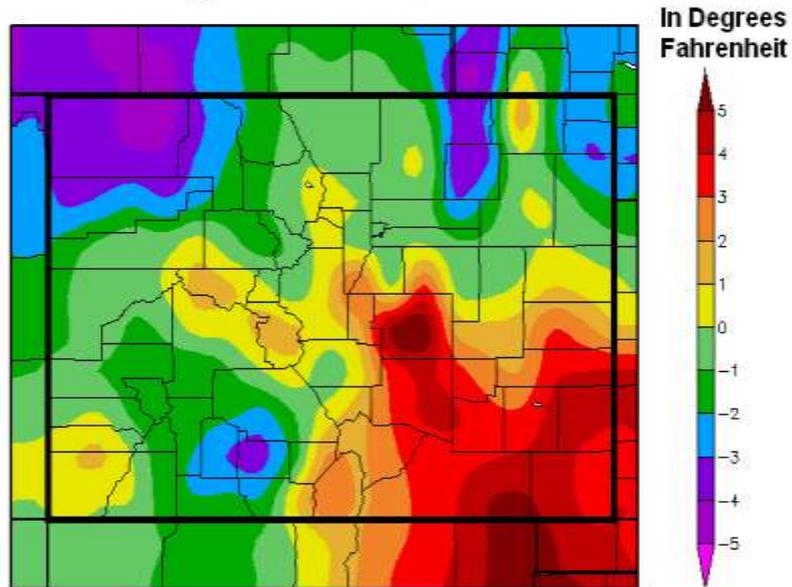
Generated 7/25/2011 at HPRCC using provisional data.

Regional Climate Centers

The Standardized Precipitation Index (SPI) also changed significantly across most of Colorado from the 30-day period ending June 19<sup>th</sup> and the 30-day period ending July 24<sup>th</sup>. Most notable change in the SPI occurred east of the mountains in the vicinity of Colorado Springs and in Morgan and Washington counties on the northeast plains where very wet to extremely wet conditions were indicated. Keep in mind that **SPI** was developed to monitor potential short term agricultural and long-term hydrological drought conditions, and that it is a probability index that considers only precipitation.

## Departure from Normal Temperature for Colorado

May 21 to June 19, 2011

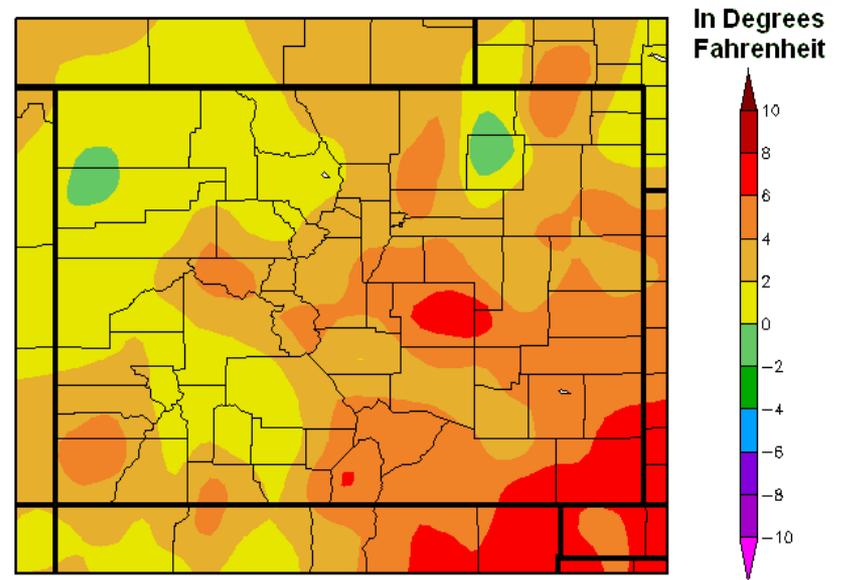


Generated 6/20/2011 at HPRCC using provisional data.

Regional Climate Centers

## Departure from Normal Temperature for Colorado

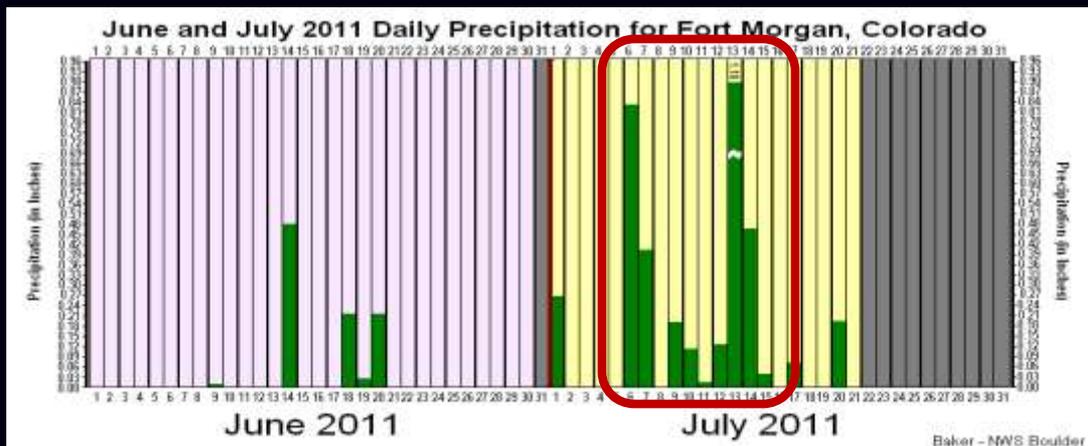
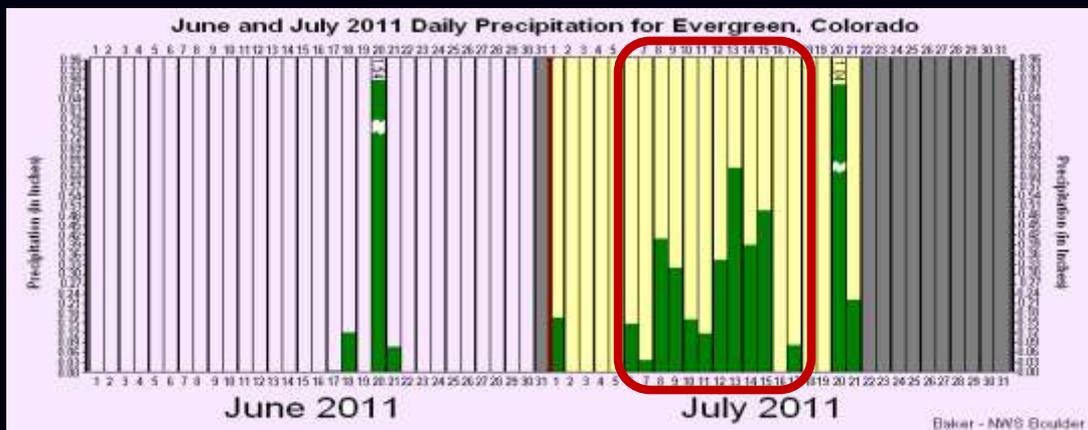
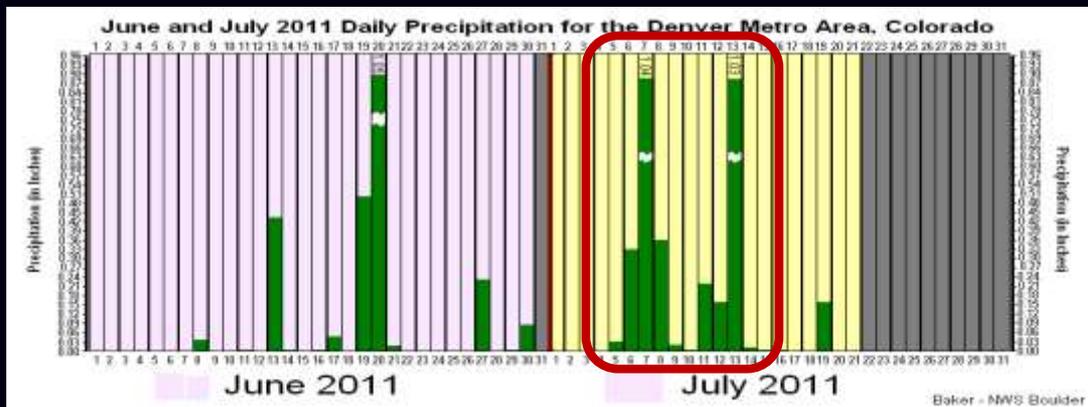
June 25 to July 24, 2011



Generated 7/25/2011 at HPRCC using provisional data.

Regional Climate Centers

During the 30-day period ending June 19<sup>th</sup>, temperatures varied widely across Colorado from abnormally cool readings in the northwest to unseasonably warm temperatures across the southeast. This was not the case during the 30-day period ending July 24<sup>th</sup>. Temperature departures from normal eased across the west, while they increased uniformly in the mountains and east. A shift to a warm and moist southerly monsoon flow early in July caused temperatures to rise, particularly at night, due in part to an increase in the precipitable water vapor content (or humidity) of the atmosphere.



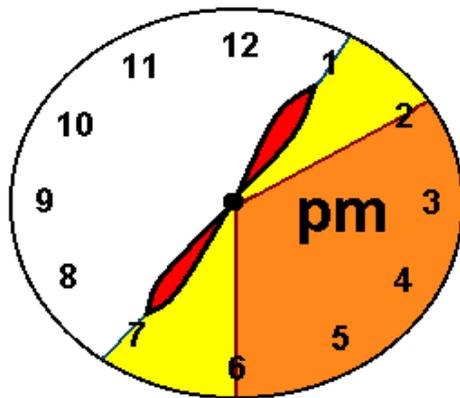
## Daily precipitation data recorded at three locations along the Front Range in northeast Colorado from June 1 to July 21, 2011

This past June, precipitation in the Denver Metro Area, at Evergreen in the foothills southwest of Denver, and at Fort Morgan on the plains northeast of Denver, was confined mainly to a handful of days centered on the 19<sup>th</sup> of the month.

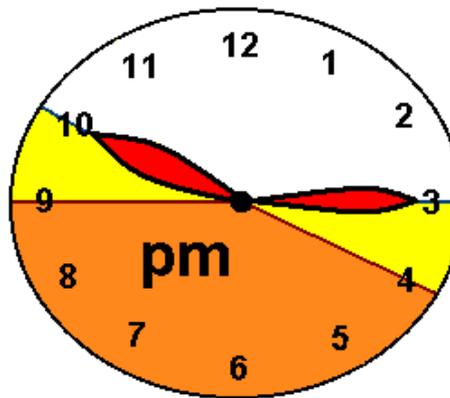
Essentially no precipitation fell at these locations during the last 8 days of June and the first 5 days of July; historically a period of low precipitation and hot temperatures along the Colorado Front Range.

On July 6<sup>th</sup>, the early arrival of the monsoon resulted in several straight days of measurable precipitation, at times quite heavy, on the Front Range and across northeast Colorado.

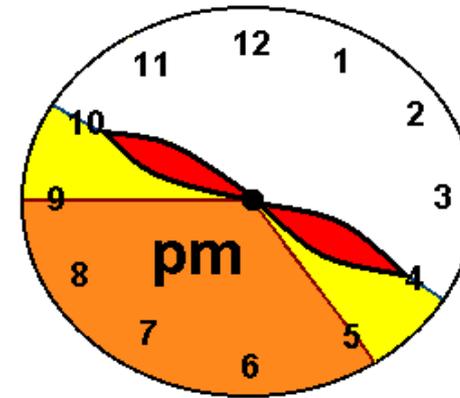
### Springtime Thunderstorms



### Summertime Thunderstorms



### Flash Flooding (principally during the evening)



Color Key



Baker - NWS Boulder

## Average Time of Occurrence Along the Colorado Front Range

During April, May and June, convection (i.e., thunderstorms) is more likely to occur along the Colorado Front Range in the afternoon. Storms normally form first over the sun drenched east-facing slopes of the Front Range in the late morning and early afternoon before moving east and/or forming new storms on the nearby plains during the afternoon (see left diagram.)

During July and August, particularly in the presence of the summer monsoon, thunderstorms along the Front Range tend to occur later in the day, and are more likely to persist well into the evening (see middle diagram.)

Thunderstorms, particularly those that form in the presence of moisture rich subtropical air (the monsoon) are more likely to produce heavy rainfall resulting in flash flooding. Due to lighter winds aloft in the summer, thunderstorms generally move slower, potentially lengthening the time that rain will fall on an area (see right diagram.)

## Influence of Slope and Vegetation on Rainfall Runoff

Exposed rock and soils with sparse vegetation



Baker

Potential for heavy runoff with rainfall rates of less than 1 inch per hour

Shrubs, bushes and tall grasses



Potential for heavy runoff with rainfall rates of 1 to 2 inches per hour

Dense tree stands with thick under brush



Potential for heavy runoff with rainfall rates of 2 to 4 inches per hour

Baker - NWS Boulder

Many factors contribute to flash flooding. In addition to heavy rainfall over a relatively short duration, the type and amount of vegetation and the degree of slope of the ground are also major contributors to the flash flood equation. Sparsely vegetated slopes, particularly those recently denuded by a recent wildfire, are especially prone to flash flooding. The steeper the slope, the greater the risk of flash flooding. On the other hand, flat or gently sloped ground heavily covered with vegetation are least likely to flash flood, even with very heavy rainfall.

*Never Let Your Guard Down-  
Even on Sunny Days!*



*Baker-NWS Boulder*

Even on a clear day along the Colorado front range, the risk of flash flooding may be only hours away. One should **never** ignore the possibility of **flash flooding**, particularly in steep mountainous terrain and in areas recently burned over by wildfire.

# U.S. Drought Monitor

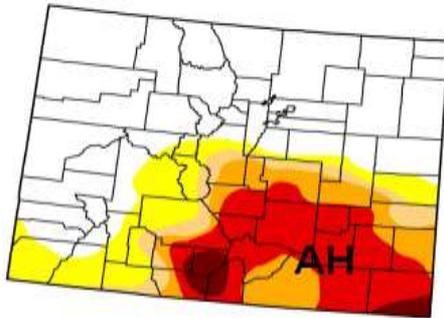
July 19, 2011

Valid 7 a.m. EST

## Colorado

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	55.80	44.20	32.29	27.21	17.81	2.23
Last Week (07/12/2011 map)	54.57	45.43	32.84	27.21	16.88	2.22
3 Months Ago (04/19/2011 map)	39.57	60.43	54.13	42.86	1.12	0.00
Start of Calendar Year (12/28/2010 map)	40.40	59.60	49.57	10.13	0.00	0.00
Start of Water Year (09/28/2010 map)	28.86	71.14	10.70	0.00	0.00	0.00
One Year Ago (07/13/2010 map)	77.80	22.20	0.00	0.00	0.00	0.00



Intensity:



Drought Impact Types:

- Delineates dominant impacts
- A = Agricultural (crops, pastures, grasslands)
- H = Hydrological (water)

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

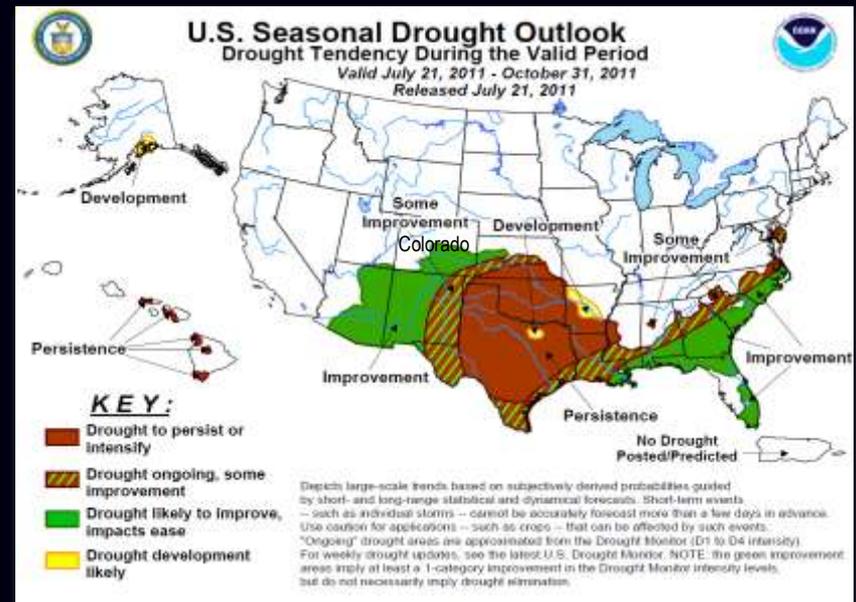
<http://drought.unl.edu/dm>

Released Thursday, July 21, 2011  
Matthew Rosencrans, NOAA/NWS/NCEP/CPC

# Recent Drought Conditions and Outlook for Colorado

As of the middle of July, drought was principally confined to the south central mountains and valleys, the southeast plains and the extreme southwest corner of Colorado. According to the July 19, 2011 issue of the U.S Drought Monitor, exceptionally dry conditions still exist on the far southeast plains and in the San Luis Valley of south central Colorado.

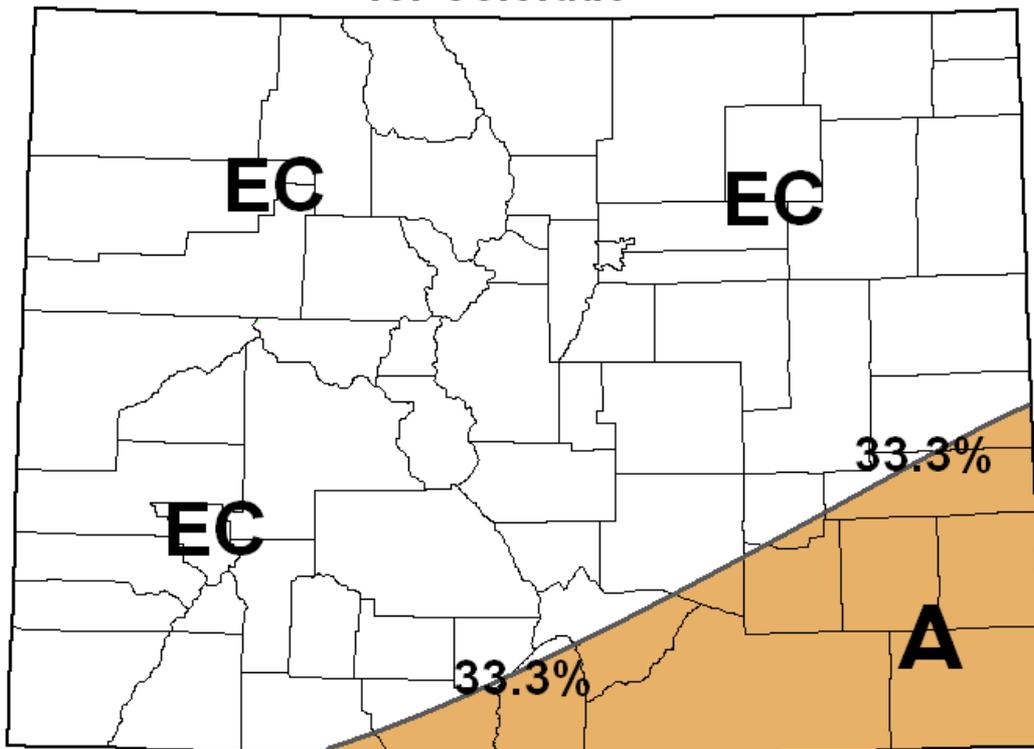
In recent weeks, drought conditions have eased across Colorado, due in large part to the enhanced thunderstorm activity associated with the summer monsoon. Not all areas benefitted from these storms, but those areas that did, such as northeast Colorado, saw a marked improvement. The latest U.S. Seasonal Drought Outlook calls for likely improvement in the drought conditions across southeast Colorado in the months to come.



Source: National Drought Mitigation Center

**August - October 2011  
Temperature and Precipitation  
Outlooks and Composites  
for Colorado  
From NOAA's  
Climate Prediction Center**

## August 2011 Temperature Outlook for Colorado



One-Month Outlook  
Temperature Probability  
0.5 Month Lead  
Valid August 2011  
Made: 21 July 2011

A Means Above Normal (Average)  
N Means Normal (Average)  
B Means Below Normal (Average)  
EC Means Equal (or Undetermined)  
Chances for A, N and B

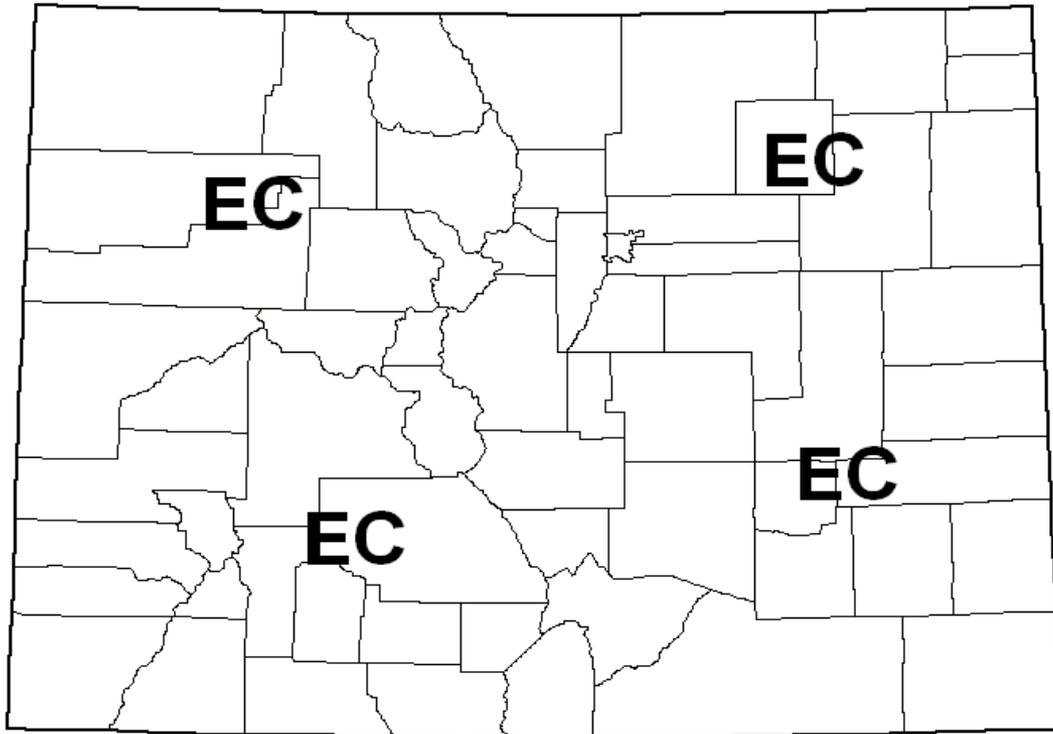
Source: NOAA/Climate Prediction Center

## August 2011 Temperature Outlook For Colorado

The August temperature outlook from the Climate Prediction Center (CPC) calls for at least a 33 percent chance for above average temperature across the southeast corner of Colorado.

The outlook is less certain for the remainder of the state as indicated by the EC designation.

## August 2011 Precipitation Outlook for Colorado



One-Month Outlook  
Precipitation Probability  
0.5 Month Lead  
Valid August 2011  
Made: 21 July 2011

A Means Above Normal (Average)  
N Means Normal (Average)  
B Means Below Normal (Average)  
EC Means Equal (or Undetermined)  
Chances for A, N and B

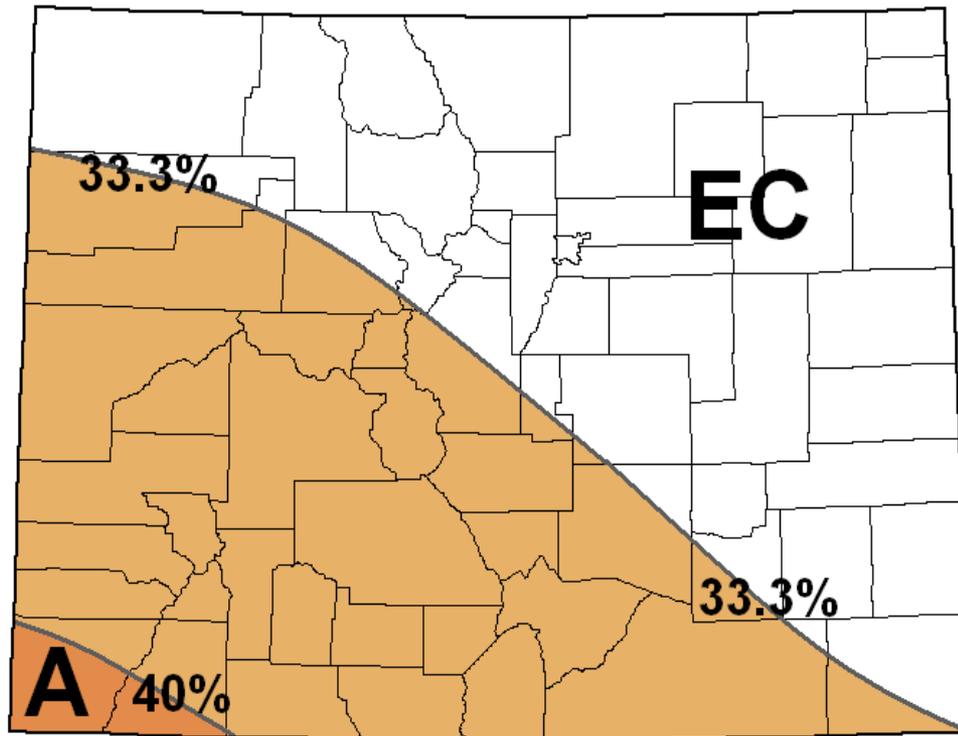
Source: NOAA/Climate Prediction Center

## August 2011 Precipitation Outlook For Colorado

The August precipitation outlook from CPC calls for an equal or undeterminable chance for above, below and normal (average) precipitation, as indicated by the EC designation.

# August, September and October 2011 Temperature Outlook for Colorado

## August-September-October 2011 Temperature Outlook for Colorado



Three-Month Outlook  
Temperature Probability  
0.5 Month Lead  
Valid ASO 2011  
Made: 21 July 2011

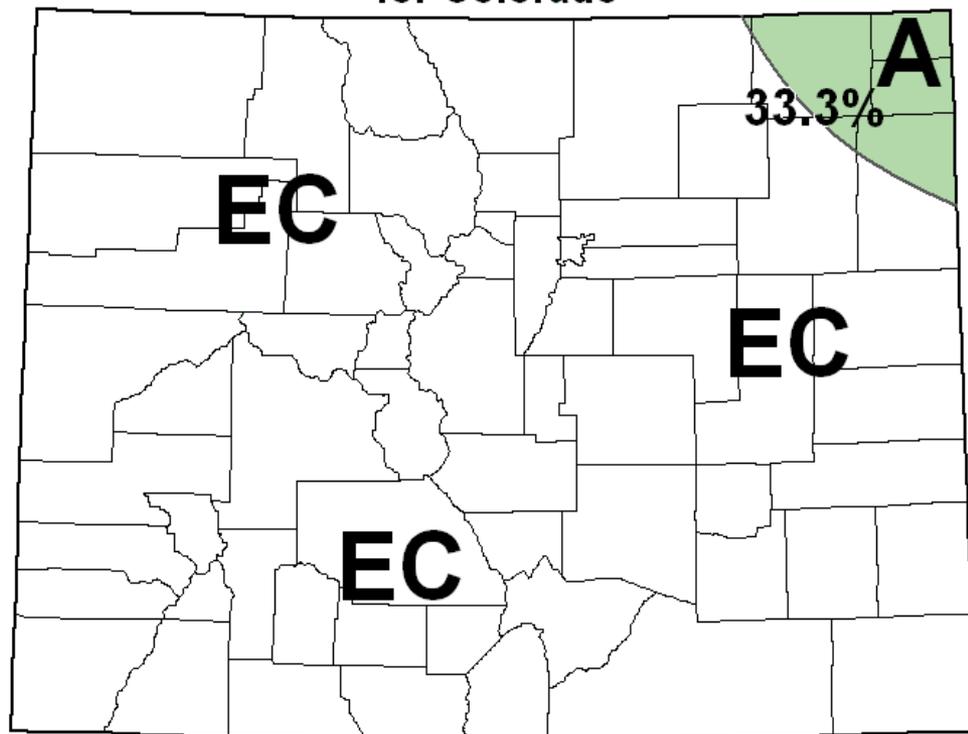
A Means Above Normal (Average)  
N Means Normal (Average)  
B Means Below Normal (Average)  
EC Means Equal (or Undetermined)  
Chances for A, N and B

Source: NOAA/Climate Prediction Center

The latest CPC outlook calls for better than a 33 percent chance for above average temperature across roughly the southwest one-half of Colorado and at least a 40 percent chance for above average temperature in the extreme southwest corner of the state.

The outlook for the rest of Colorado is less certain, with an equal of undeterminable chance for above, below and average temperatures as designated by the EC symbol.

## August-September-October 2011 Precipitation Outlook for Colorado



Three-Month Outlook  
Precipitation Probability  
0.5 Month Lead  
Valid ASO 2011  
Made: 21 July 2011

A Means Above Normal (Average)  
N Means Normal (Average)  
B Means Below Normal (Average)  
EC Means Equal (or Undetermined)  
Chances for A, N and B

Source: NOAA/Climate Prediction Center

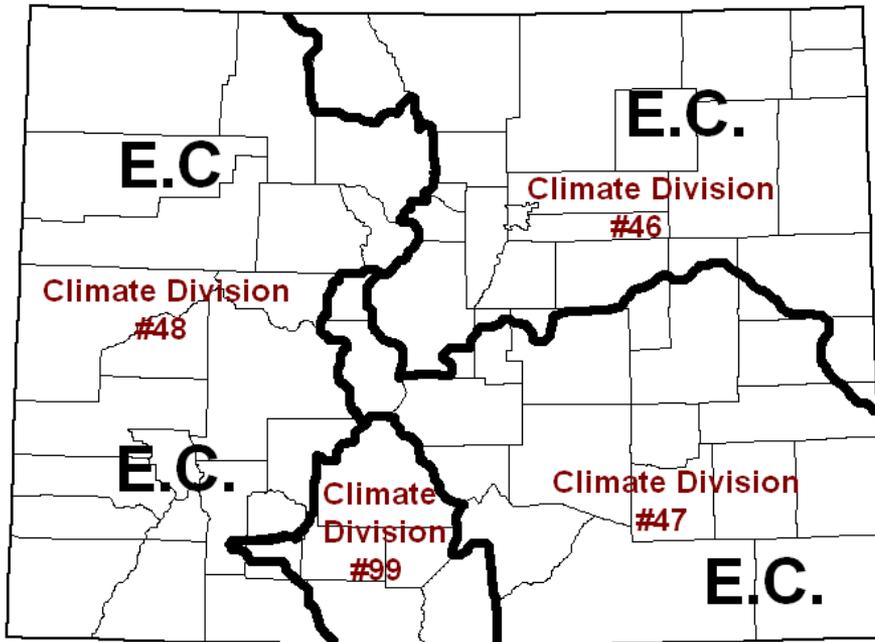
## August, September and October 2011 Precipitation Outlook for Colorado

The latest CPC outlook calls for at least a 33 percent chance for above normal (average) precipitation across the far northeast corner of Colorado during the period.

For the remainder of the state, the outlook is less certain, as indicated by the EC symbols.

# Adding Value to An “EC” Outlook from CPC

September-October-November Precipitation Outlook  
for Colorado



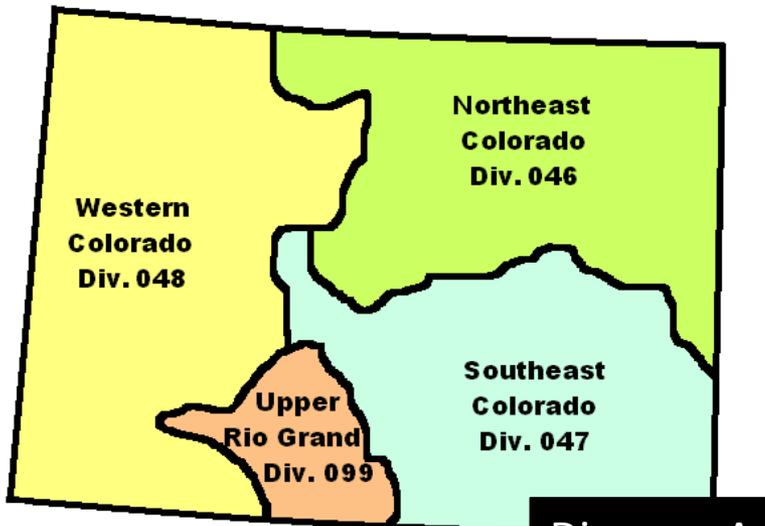
Three-Month Outlook  
Precipitation Probability  
0.5 Month Lead  
Valid SON  
Made: xxxxxx

A Means Above Normal (Average)  
N Means Normal (Average)  
B Means Below Normal (Average)  
EC Means Equal (or Undetermined)  
Chances for A, N and B

Climate outlooks issued by the Climate Prediction Center (CPC) will often indicate an equal or undeterminable (EC) chance for above, below and average temperature or precipitation outlook for a region. An EC outlook by itself provides little indication for a particular trend in temperature and precipitation for a given season.

However, to add some value to an “EC” outlook, one can refer to temperature and precipitation composites prepared by CPC for every climate division in the United States. These composites provide the user with a historical perspective of how temperatures and precipitation have trended during El Niño, ENSO-neutral and La Niña conditions.

## Colorado Climate Divisions



NOAA/Climate Prediction Center

Diagram A

Diagram A: Colorado is sub-divided into four climate divisions. Climate divisions 046, 047 and 099 are located east of the Continental Divide, and division 048 west of the Divide.

NOAA's Climate Prediction Center (CPC) has produced historical distributions of 3-month temperature and precipitation associated with three different ENSO categories – El Niño, La Niña and neutral (non-ENSO) events – for each of climate division.

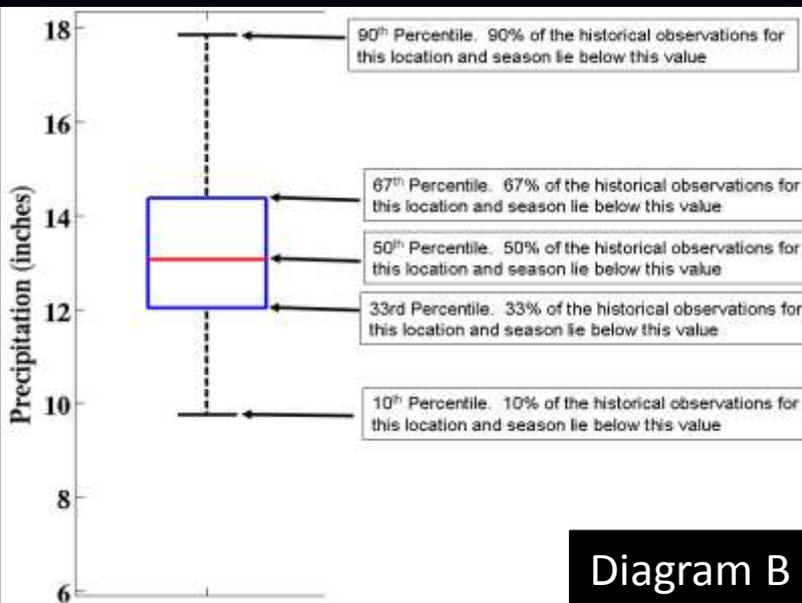
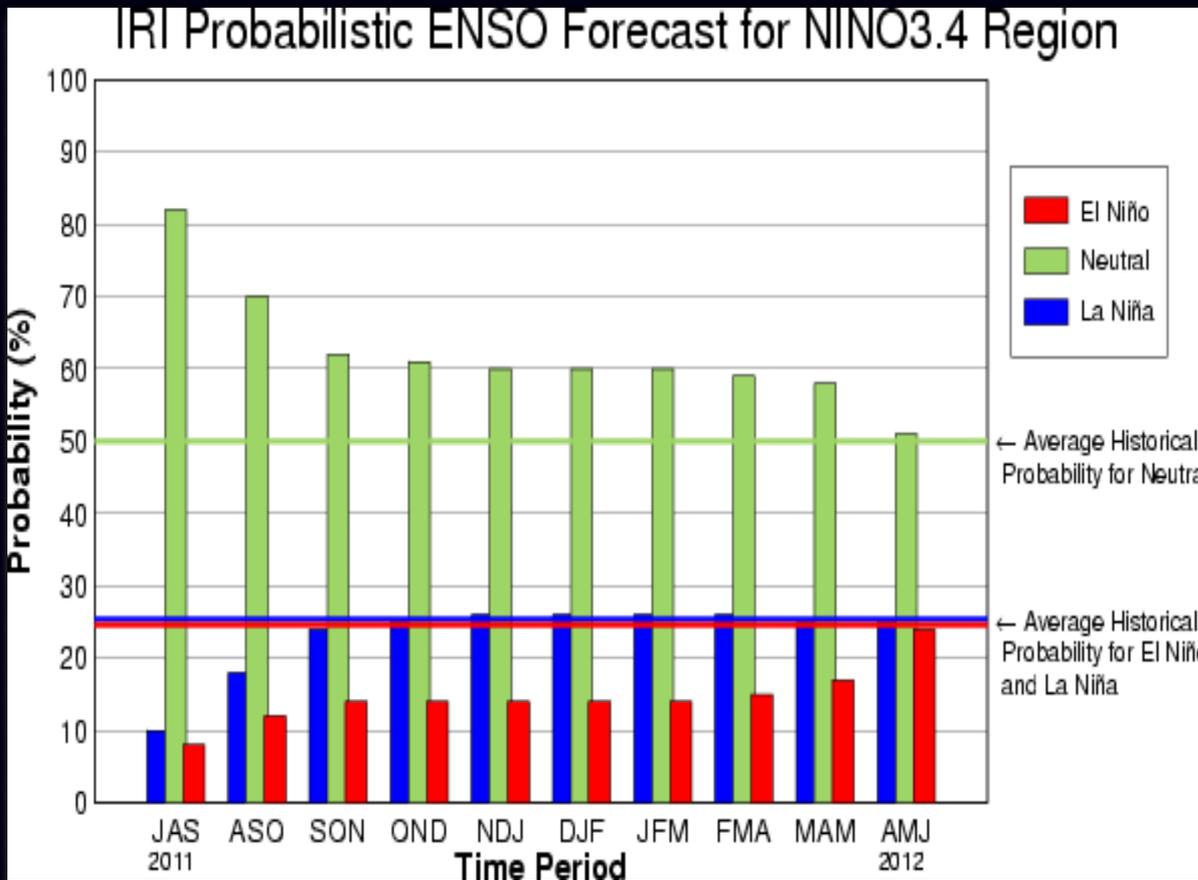


Diagram B

Diagram B: These historical temperature and precipitation distributions can be viewed using an ENSO box and whisker analysis plot (explanation to the left).

The red line inside the ENSO box represents the mean or 50<sup>th</sup> percentile of the data (temperature or precipitation) distribution. Approximately 34% of the total observations exist within the ENSO box, and the remaining observations (or 66%) outside of the box.



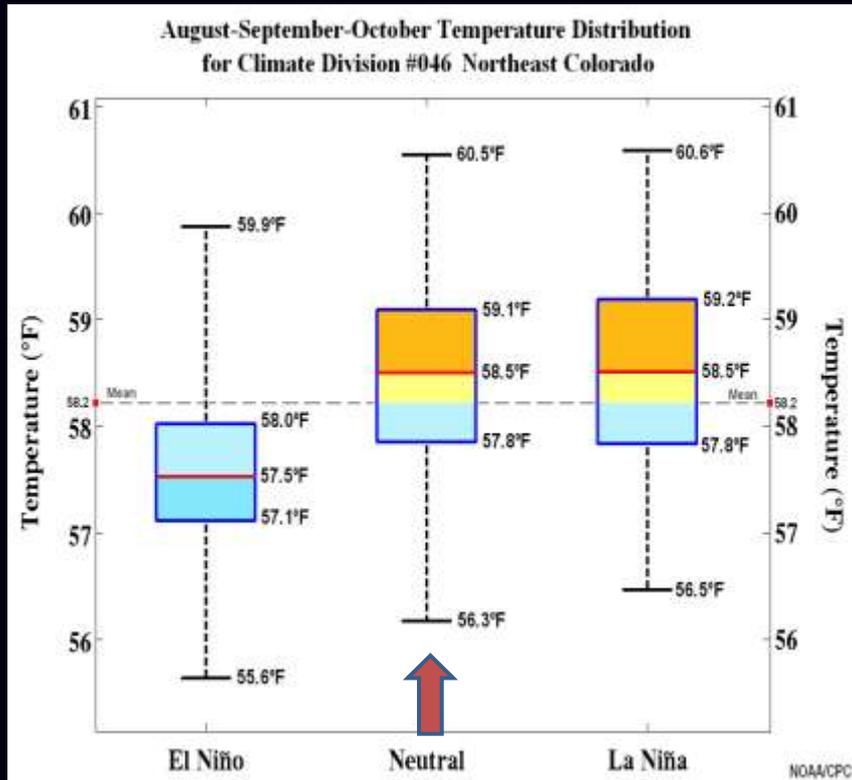
Before proceeding to the final slides...

recall that the latest probabilistic ENSO forecast is for ENSO-neutral conditions this fall and winter.

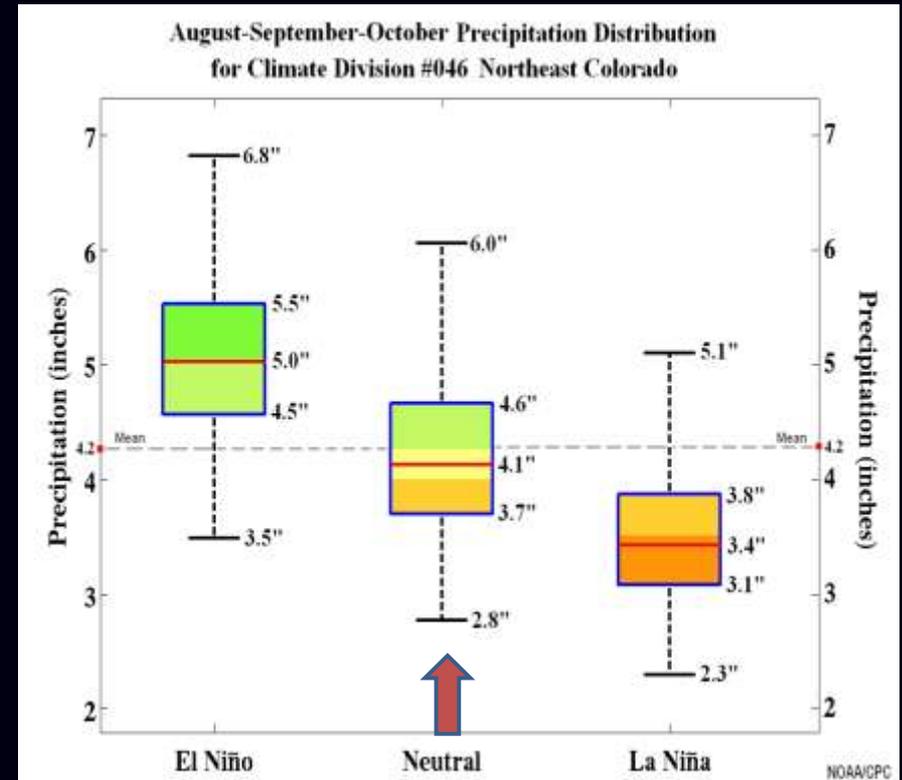
However, the forecast for ENSO beyond this summer remains uncertain due to lower model forecast skill out that far.

Source: International Research Institute for Climate and Society (IRI) – Updated 7/21/11

## ENSO Box and Whisker Analysis Plots for the Northeast Colorado Climate Division #046 for the 3-Month Season August-September-October

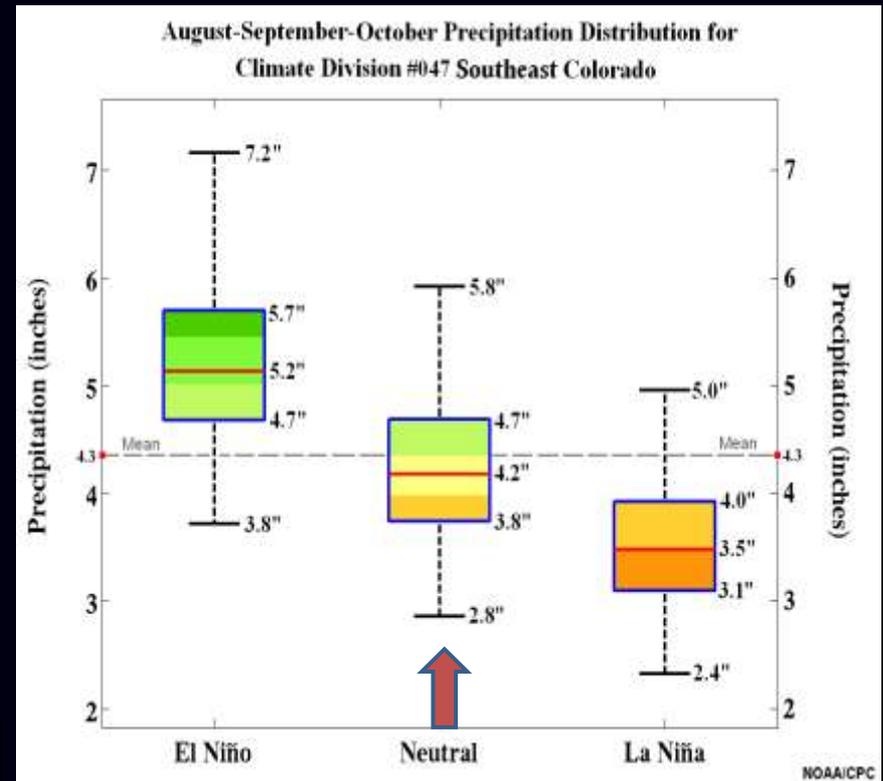
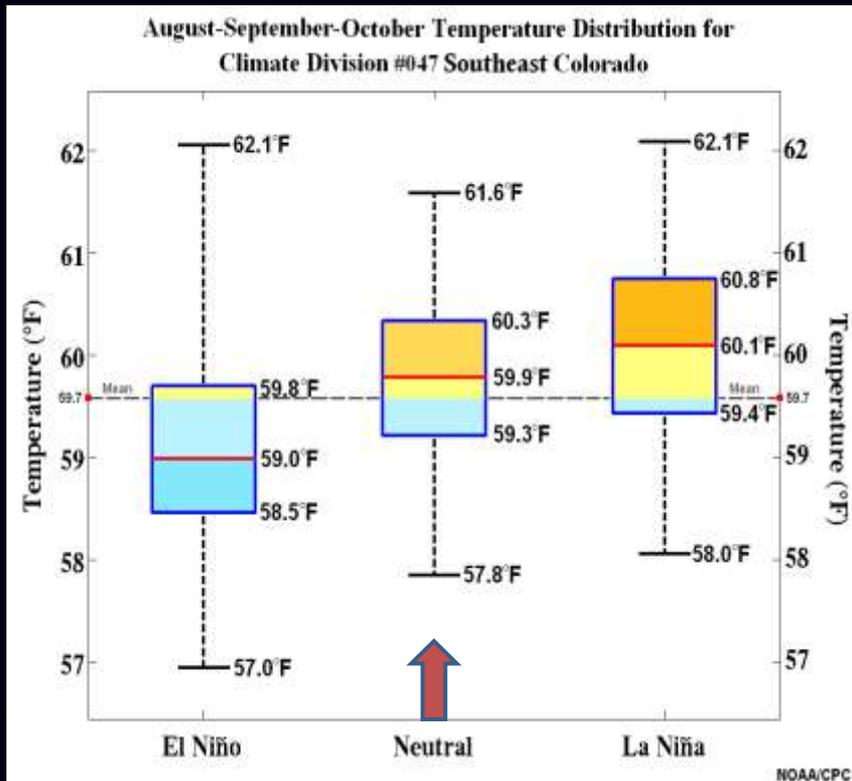


According to composites prepared by the Climate Prediction Center, temperature in northeast Colorado was **slightly above average during ENSO-neutral** and La Niña conditions and, below average during El Niño conditions for the three month period of August, September and October.



Historically, precipitation in northeast Colorado was above average during El Niño conditions, **near average with ENSO-neutral conditions**, and below average with La Niña conditions during the same three month period.

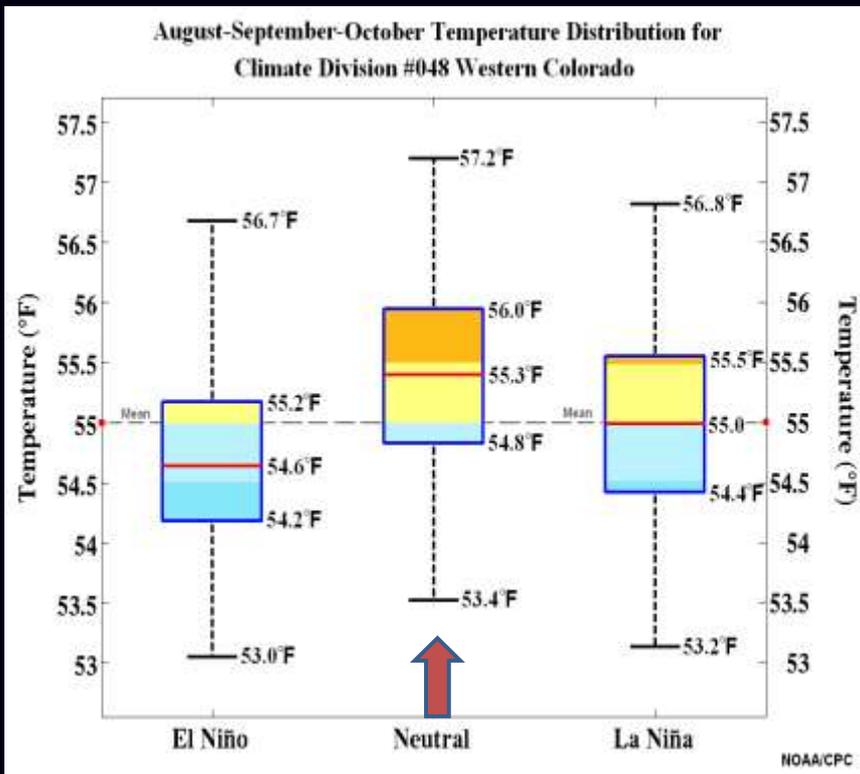
# ENSO Box and Whisker Analysis Plots for the Southeast Colorado Climate Division #047 for the 3-Month Season of August-September-October



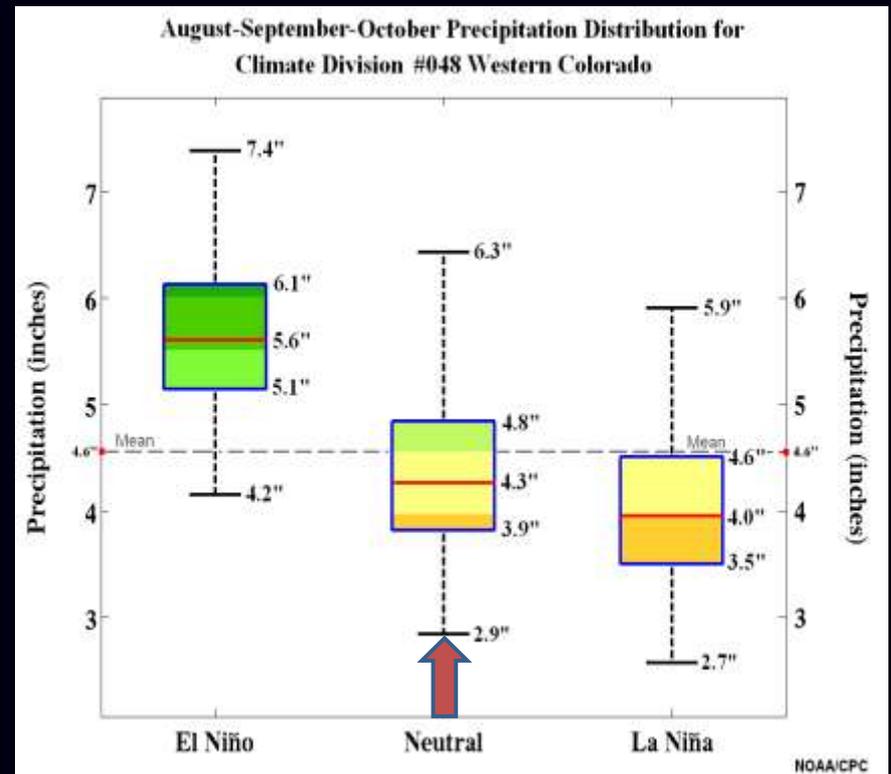
Historically, temperature in southeast Colorado was slightly below average during El Niño conditions, **near average with ENSO-neutral conditions**, and slightly above average during La Niña conditions for this three month period.

Precipitation in southeast Colorado was above average during El Niño conditions, **near average with ENSO-neutral conditions** and below average during La Niña conditions for this period.

# ENSO Box and Whisker Analysis Plots for the Western Colorado Climate Division #048 for the 3-Month Season of August-September-October



For western Colorado, temperature was slightly below average during El Niño conditions, **slightly above average with ENSO-neutral conditions**, and average during La Niña conditions for this three month period.



Historically, precipitation in western Colorado was above average during El Niño conditions, **slightly below average with ENSO-neutral conditions**, and below average during La Niña conditions for this period.