La Niña On the Way Out and a Look Ahead to March, April and May 2011

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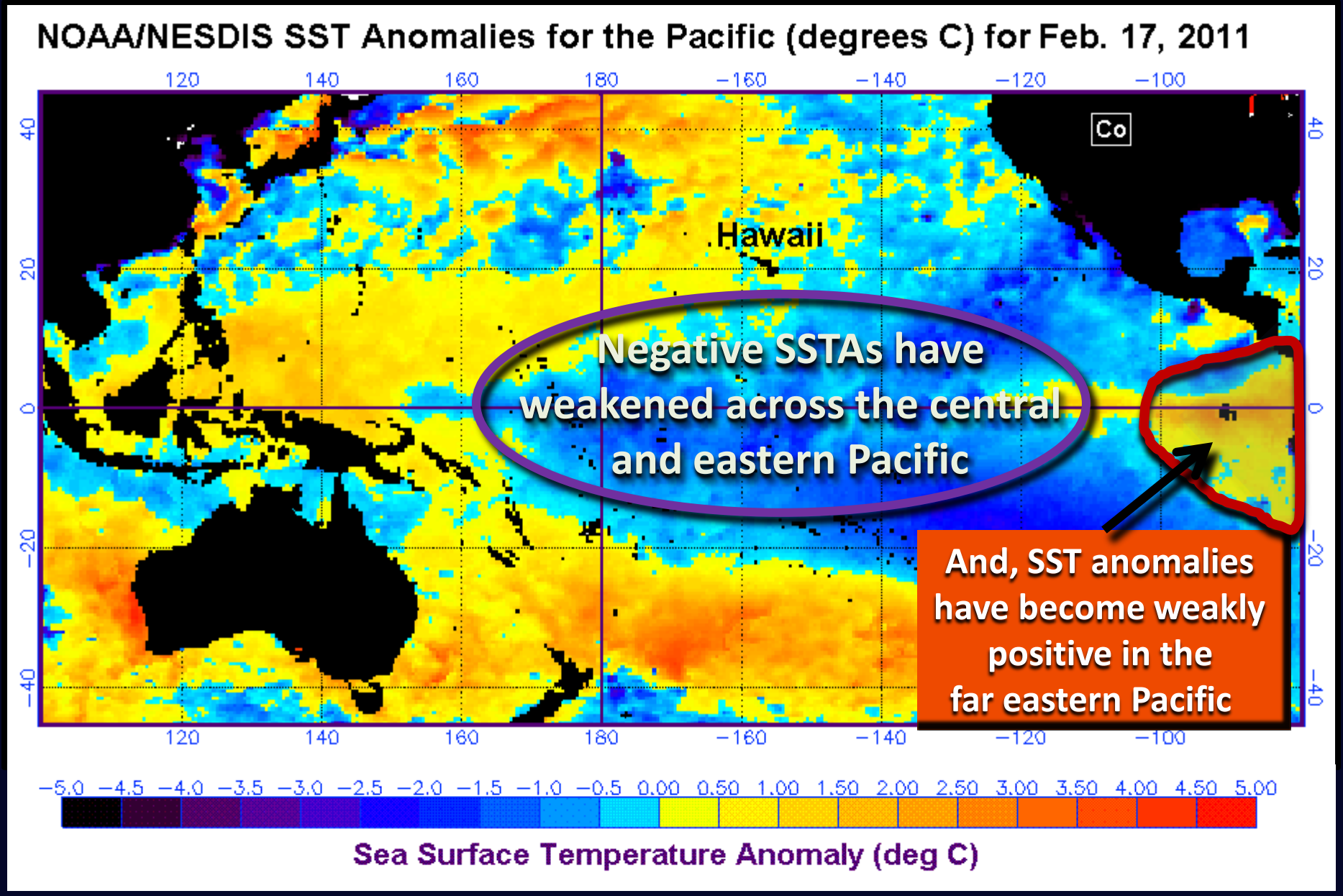
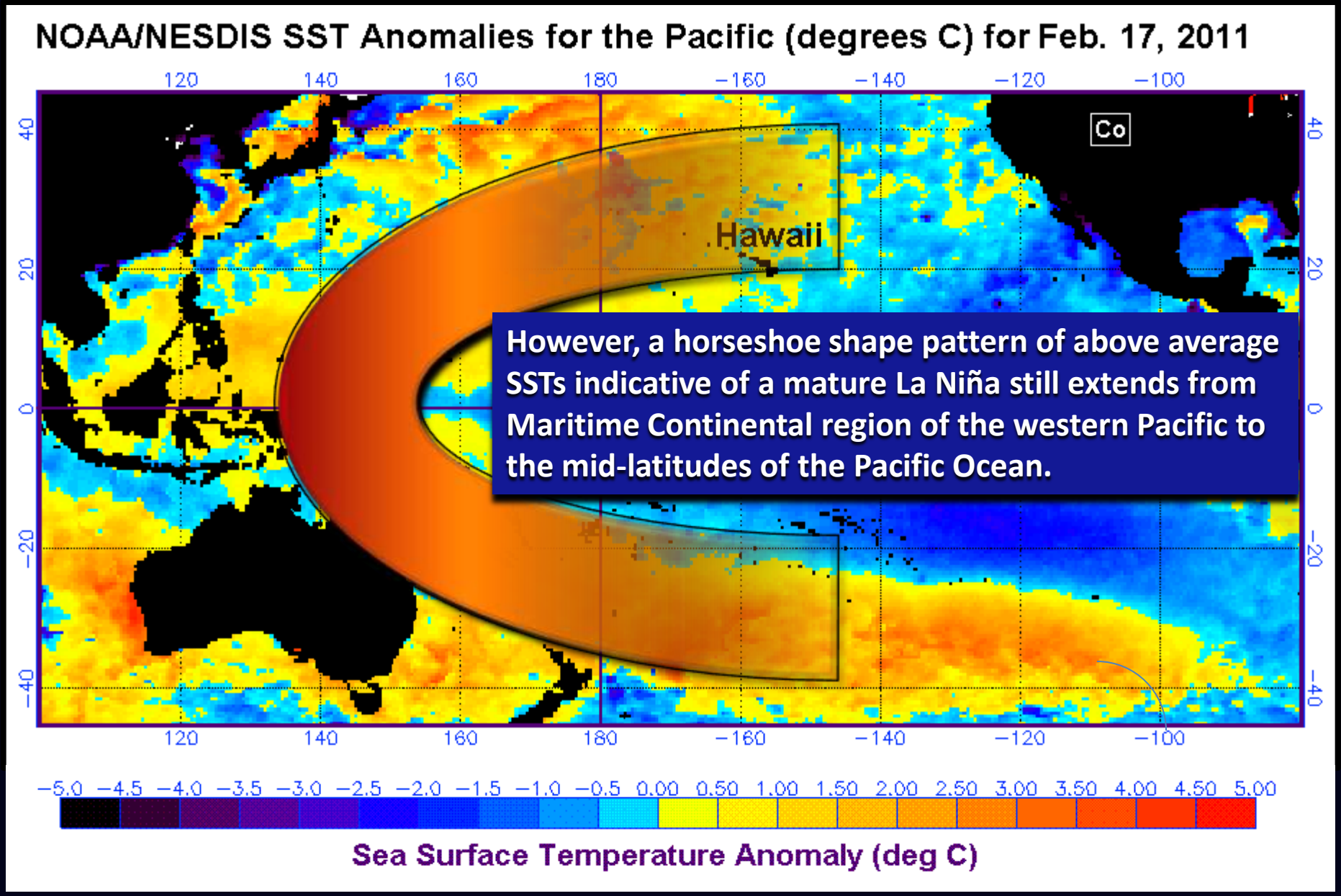
Preview

- La Niña is showing signs of weakening.
- The current moderate to strong La Niña behaved similarly to four other La Niña events of similar strength that occurred during the last 40 years.
- A look back to the last 30 and 90 days.
- How La Niña and the Pacific jet stream may continue to influence Colorado weather during the next three months.
- The latest temperature and precipitation outlooks for Colorado from NOAA's Climate Prediction Center (CPC).


La Niña Showing
Signs of Weakening


NOAA/NESDIS SST Anomalies for the Pacific (degrees C) for Feb. 17, 2011
120
140
160
180
−160
−140
−120
−100
40
20
0
−20
−40
Co
Hawaii
Negative SSTAs have weakened across the central and eastern Pacific
And, SST anomalies have become weakly positive in the far eastern Pacific
−5.0 −4.5 −4.0 −3.5 −3.0 −2.5 −2.0 −1.5 −1.0 −0.5 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
Sea Surface Temperature Anomaly (deg C)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120
140
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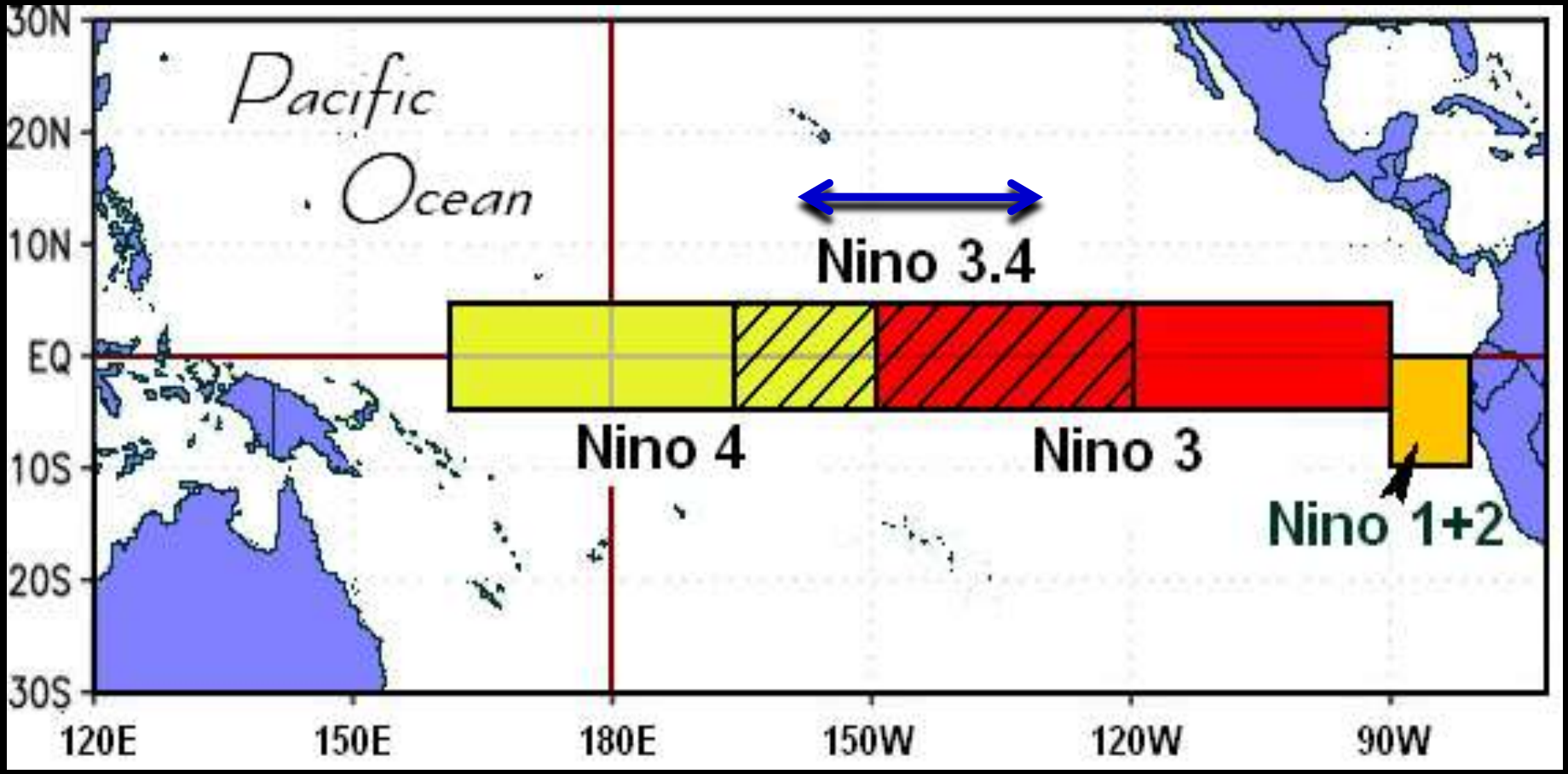
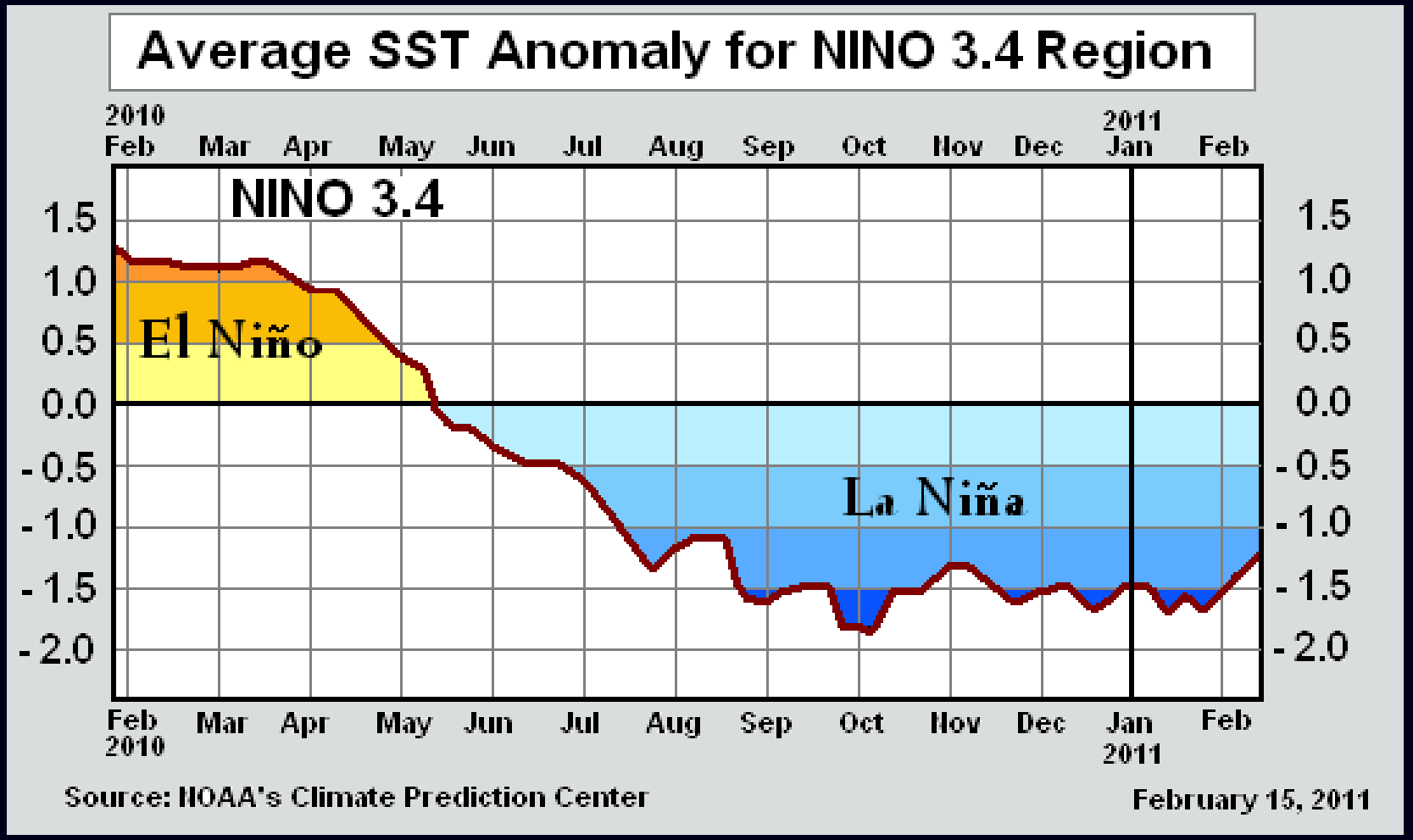
40
20
0
−20
−40
Co
Hawaii
However, a horseshoe shape pattern of above average SSTs indicative of a mature La Niña still extends from Maritime Continental region of the western Pacific to the mid-latitudes of the Pacific Ocean.
−5.0 −4.5 −4.0 −3.5 −3.0 −2.5 −2.0 −1.5 −1.0 −0.5 0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50 5.00
Sea Surface Temperature Anomaly (deg C)

Niño Regions in the Tropical Pacific Ocean



Nino 3.4 – The principal region in the eastern tropical Pacific used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO.



The average sea surface temperature anomaly (SSTa) for the NINO 3.4 region in the eastern tropical Pacific has risen in the past few weeks, a probable indication that the mature La Niña in the Pacific has begun to weaken.

The average SST anomaly for NINO 3.4 region for the week of Feb 14, 2011 was -1.2C.

Oceanic Niño Index (ONI)

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

- Defined as the three-month running-mean SST departures in the Niño 3.4 region

- Used to place current events into a historical perspective

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

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a ***positive*** ONI greater than or equal to +0.5 C.

La Niña: characterized by a ***negative*** ONI less than or equal to −0.5 C.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5°C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1	-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	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	-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

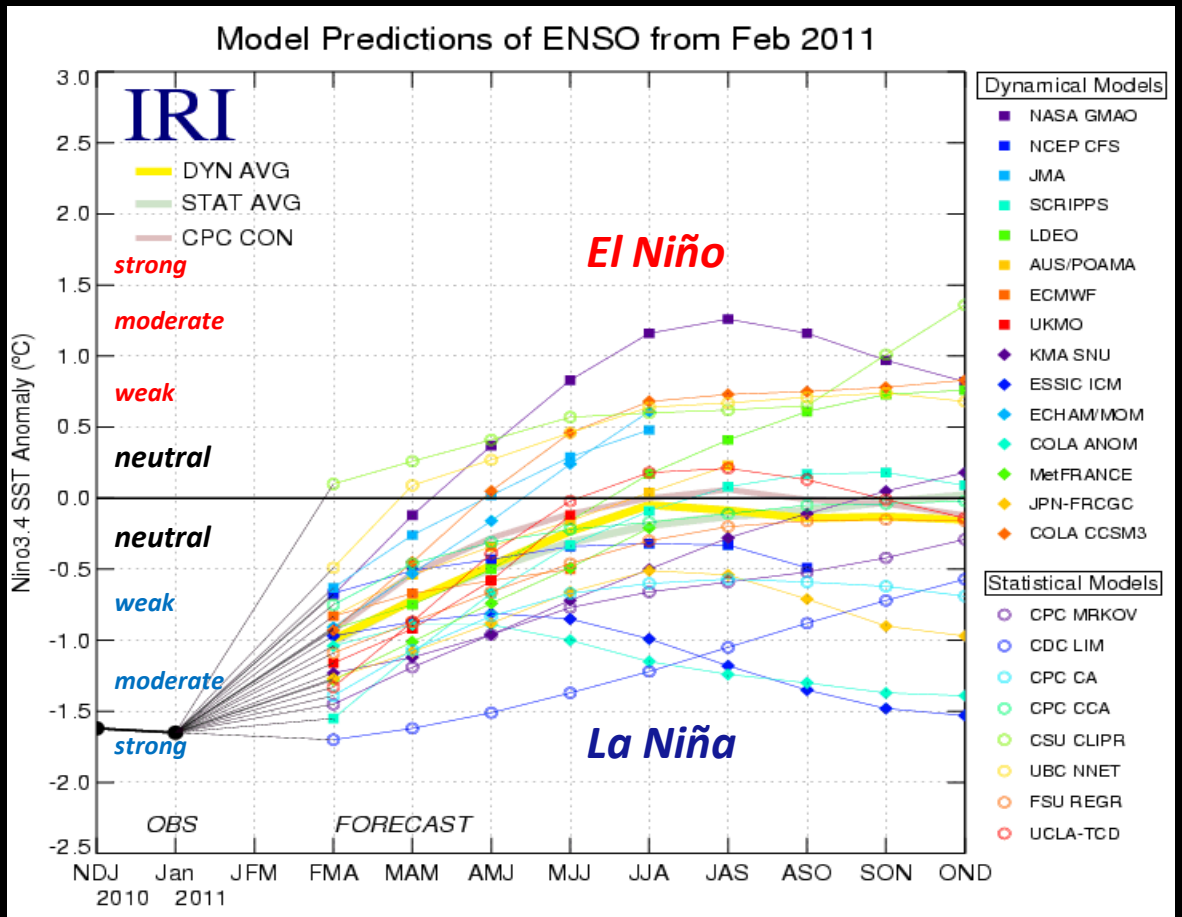
Warm Episodes - El Niños: ONI +0.5 and above (red numbers)

Cold Episodes - La Niñas: ONI of -0.5 and below (blue numbers)

Neutral or non-ENSO Episodes: ONI above -0.5 and below 0.5 (black numbers)

NOAA/CPC Feb 18 2011 Baker

Pacific Region Niño 3.4 ENSO Outlook



Average Sea Surface Temperature Anomalies for All Models for the following Three-Month Seasons in 2011

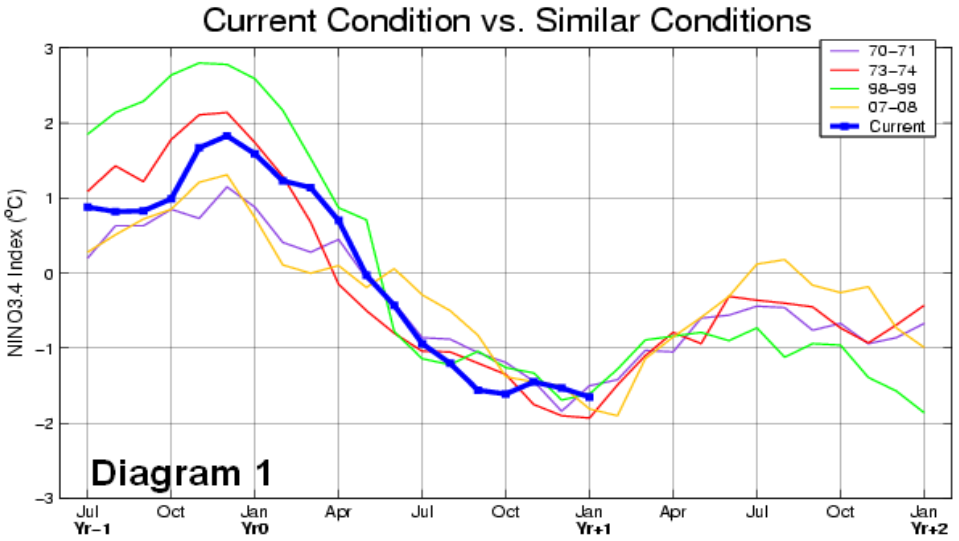
FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND
-1.0	-0.7	-0.5	-0.3	-0.1	-0.1	-0.1	-0.1	-0.1

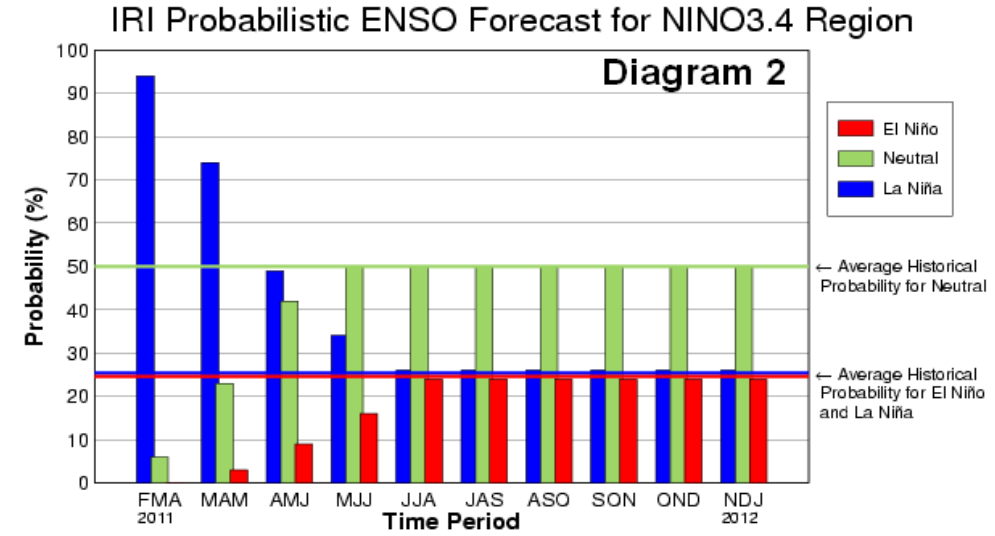
- **All 23 dynamical and statistical ENSO models continue to forecast gradual warming of the SST anomalies across the eastern tropical Pacific region Niño 3.4 during the next several months. A majority of the models indicate either ENSO-neutral (+0.5 C to -0.5 C) or weak La Niña (-0.5 C to -1.0˚C) conditions by the three-month climate season May-June-July of 2011.**

- **Beyond this spring, the models offer a wide range of possibilities; some indicating a return to La Niña, while others indicate ENSO-neutral conditions or even the hint of El Niño conditions as early as this September.**

Source: International Research Institute for Climate and Society (IRI) – Updated 2/17/11

La Ninas Past, Present and Future





Source: International Research Institute for Climate and Society (IRI)
Updated Feb. 17, 2011

Diagram 1: Compares the Niño 3.4 Index for the current La Niña to that of the past four moderate to strong La Niña episodes in 1970-71, 1973-74, 1998-99 and 2007-08.

Notice the weakening (warming) in the index for the current La Niña during November and December compared to the strengthening (cooling) of the indices of the other La Niña events during the same period. Otherwise, the trend lines appear similar with the last four events bottoming out around the first of January.

Diagram 2: The bar graph depicts the probability of El Niño, La Niña and ENSO-neutral or non-ENSO conditions during the next 12 months, based on the latest ENSO model forecasts.

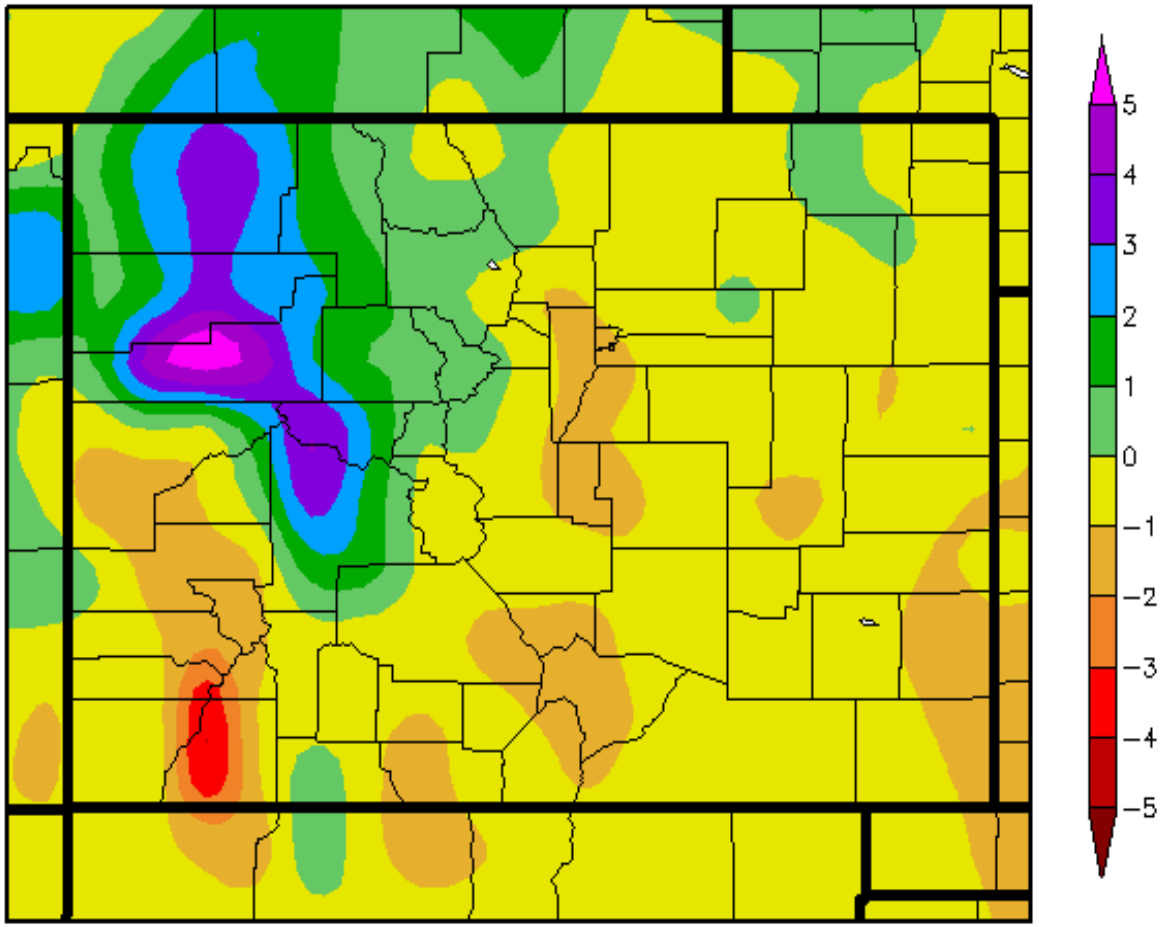
By the summer season of June-July-August, models indicate equal chances for La Niña and El Niño conditions, with no clear preference towards warming or cooling in the SSTs during the remainder of 2011.

A Look Back to the Last 90 Days

Winter 2010-2011
on the Colorado Western Slope

Review of Temperature, Precipitation, Snow Pack and Snow-Water Equivalency Across Colorado During the Last 90 Days

Departure from Normal Preciptation (in inches)
For Colorado
Nov. 1, 2010 - Jan. 31, 2011

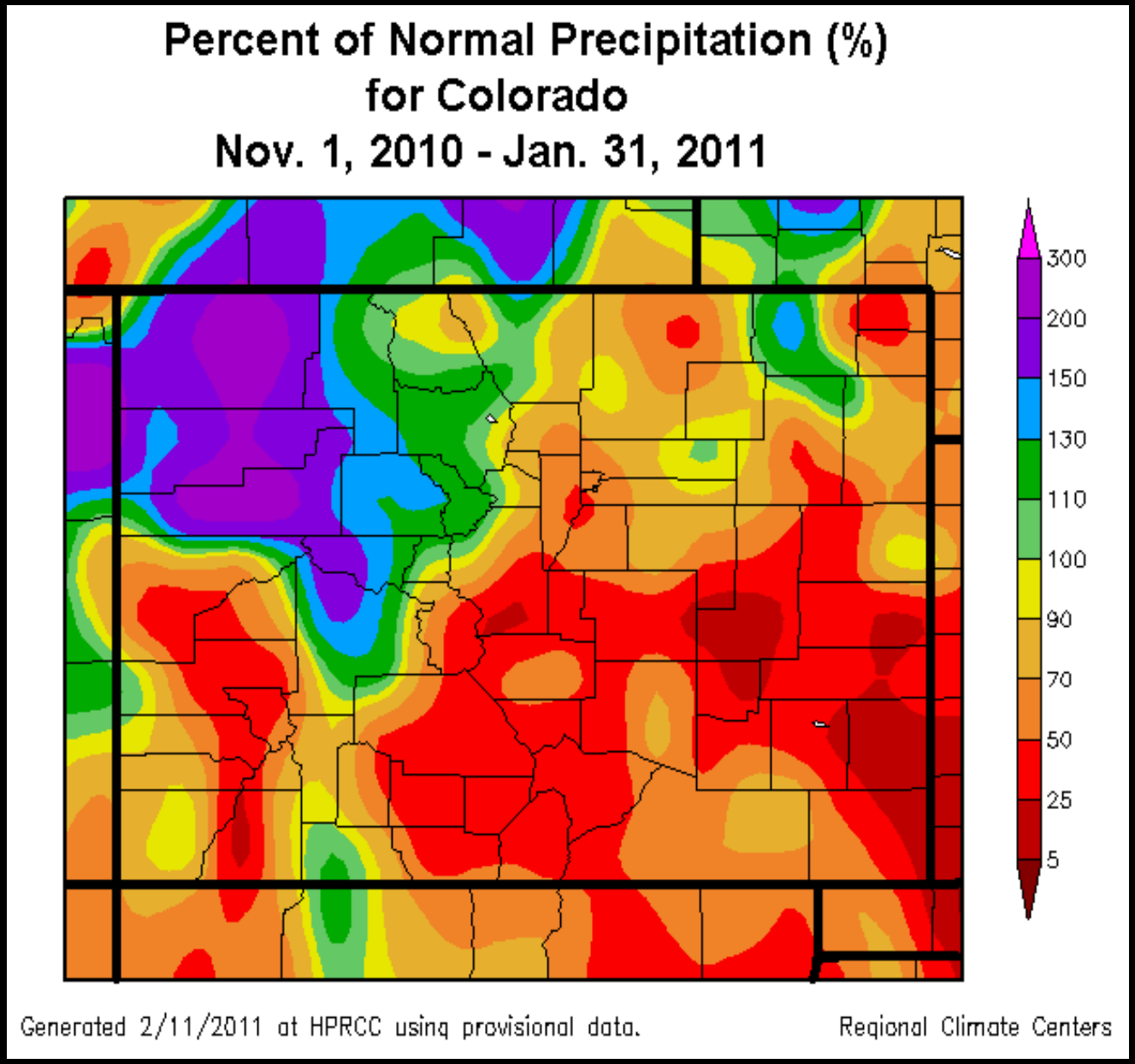


Generated 2/11/2011 at HPRCC using provisional data.

Regional Climate Centers

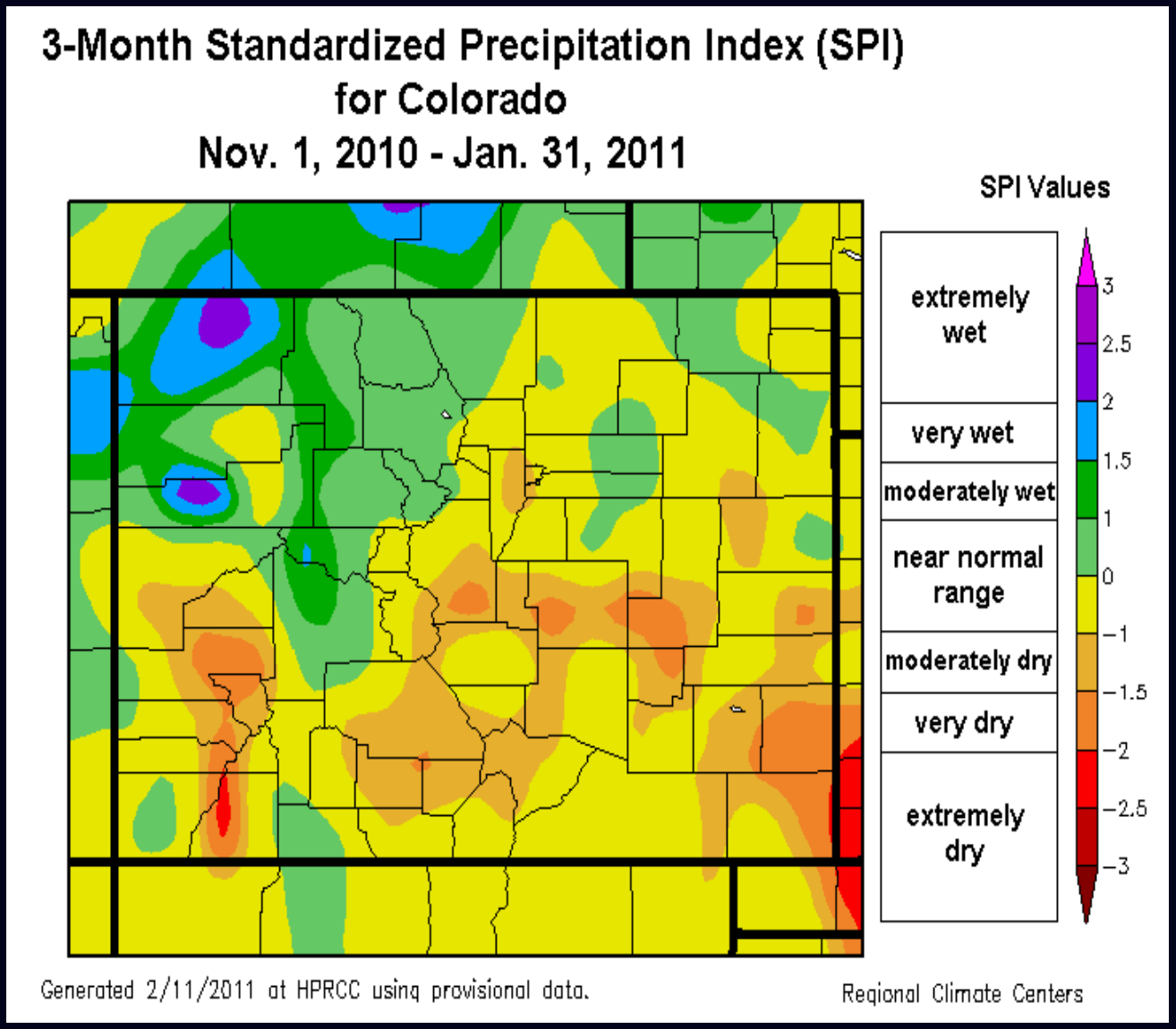
Above normal precipitation fell across much of northwest and west central Colorado during this three month period, with the greatest departures from normal on the Roan Plateau, Grand Mesa, the West Elk Mountains and central portions of the Yampa River Valley.

Below normal precipitation fell across southern and eastern Colorado during the same period. The greatest departures were observed in and around the Animas and Gunnison River Valleys in southwest Colorado, the Sangre de Cristo and Rampart mountain ranges, and lower portions of the Arkansas River Valley in southeast Colorado.



The northwest corner of Colorado continued to record the greatest percent of normal precipitation during the three month period as indicated by the shades of purple across the region.

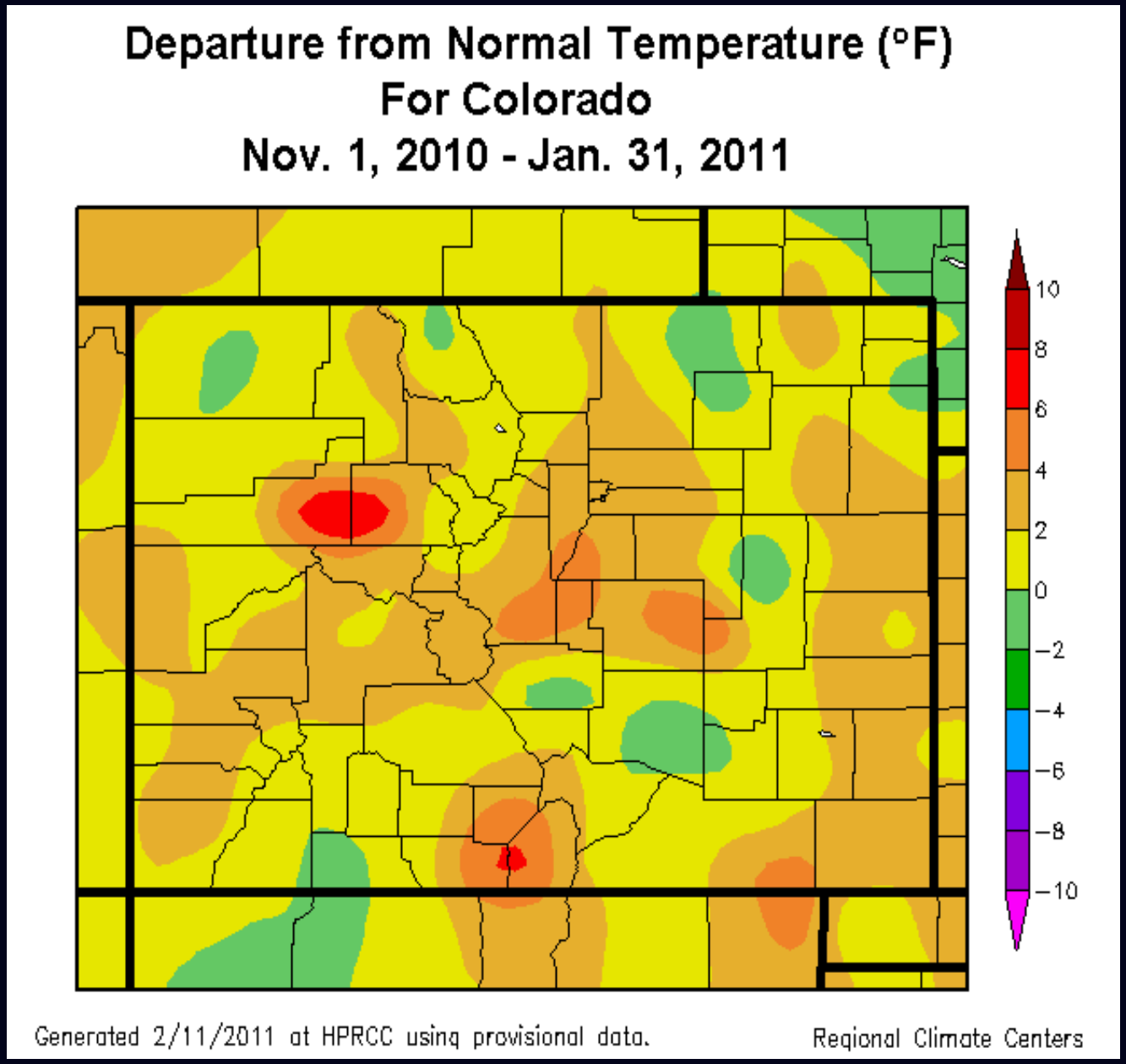
The remainder of the state witnessed modest to significant departures from normal, notably across the southwest, south central and southeast portions of Colorado. This cross-state pattern of precipitation anomalies can be attributed to the prevalence of west-northwesterly flow aloft this winter.



The **Standardized Precipitation Index (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.

During the 90-day period ending January 31, 2011, the SPI continued to indicate wetter than normal conditions across the northwest, west central and north central portions of the state. The driest conditions persisted in the southwest, the Rio Grande Valley and on the plains of eastern Colorado, most noticeably within the Arkansas River Basin.

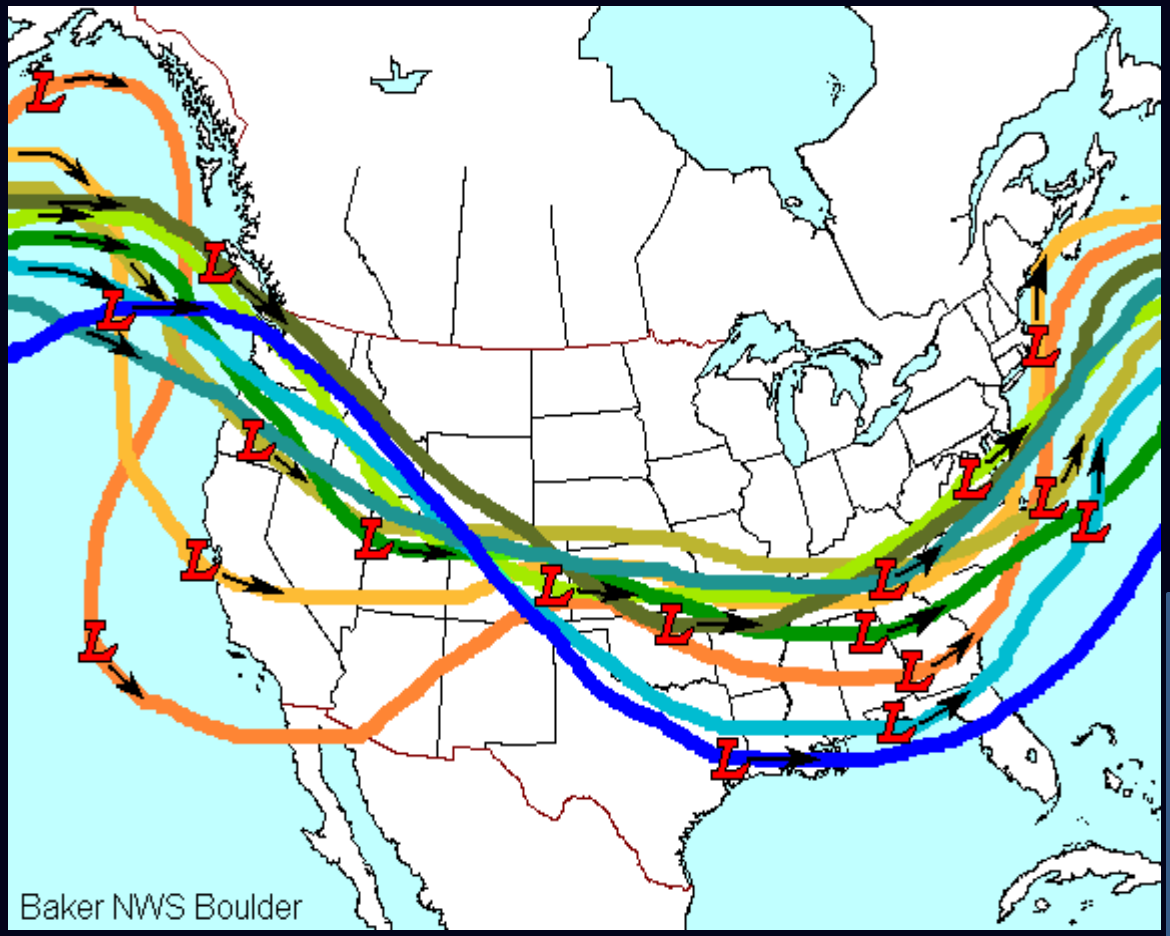
The copious amounts of snow that fell on southwest Colorado and especially the San Juan Mountains during the latter half of December only raised the SPI to within the near normal range. Before the heavy snowfall arrived the region was abnormally dry and warm.



Temperatures during the 90-day period ending January 31, 2011 were generally above normal across the state, with a few exceptions on the eastern plains, the San Juan Mountains near the New Mexico border, North Park and the northwest plateau region.

Warmest readings were observed along the Park and Gore Ranges, and most notably the White River Plateau region in northwest Colorado, over higher elevations of central Colorado, the San Luis Valley in south central Colorado, and most of eastern Colorado including the Rampart and Front Ranges, the Palmer Divide and across the southeast corner of the state.

Average Weekly Trajectories of the Pacific Jet Stream From Late November 2010 to Mid-January 2011



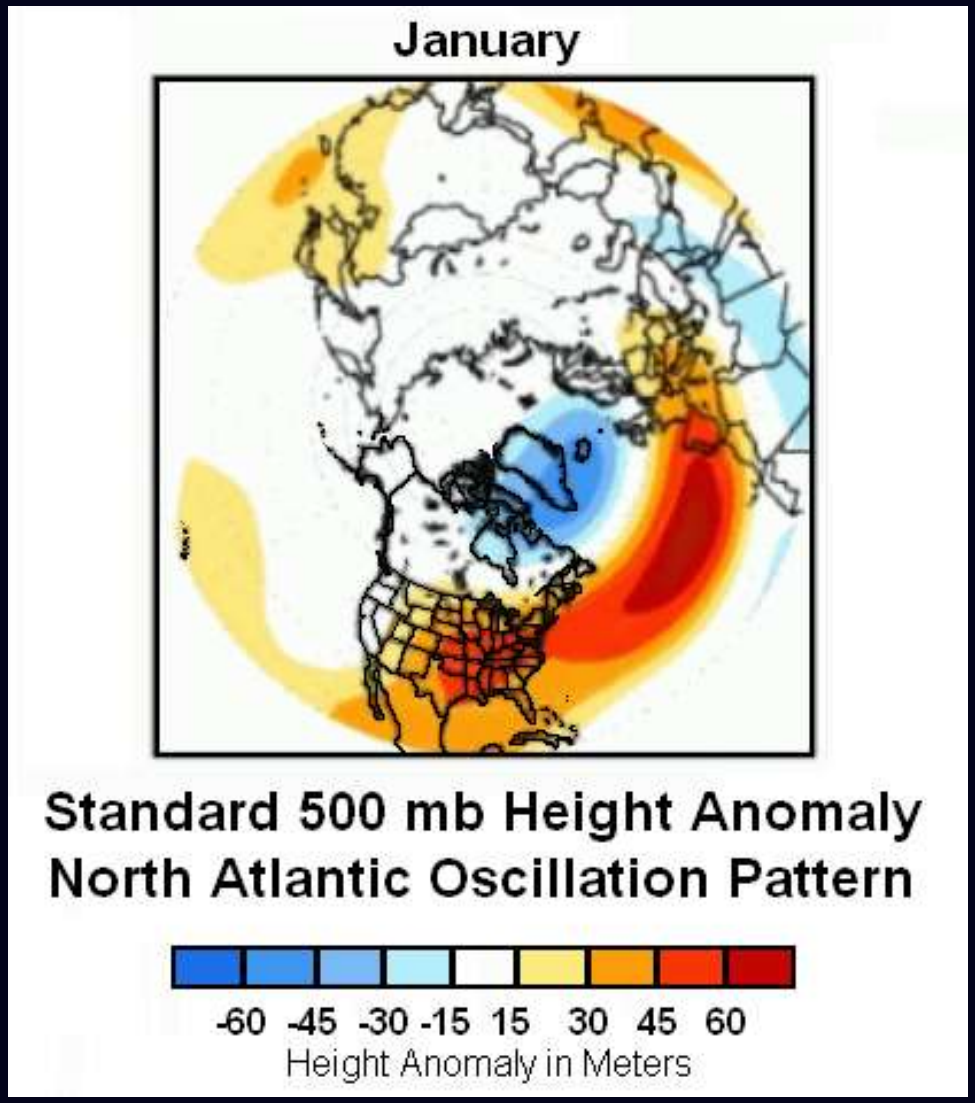
1) The Pacific jet stream played an important role in producing the wide variety of intensity weather across the continental United States this winter. Strong ridging out west and deep troughing over the eastern U.S. prevailed during most of November through January; a height and jet stream pattern commonly observed during La Niña episodes.

2) However, in late December, this simple sine wave pattern broke down. Arching well up over the Gulf of Alaska then sharply down the west coast, an abnormally strong Pacific jet stream carved out a large trough of low pressure that remained over the southwestern U.S. for nearly two weeks. These west coast oscillations in the Pacific jet tend to occur more often during the winter seasons of El Niño episodes.

3) The unexpected buckle in the Pacific jet stream (e.g., storm track) this past December resulted in record breaking rain and snowfall, coastal flooding and fierce winds across central and southern California, the desert southwest, and the Four Corners region including southwestern portions of Colorado.

The North Atlantic Oscillation (NAO)

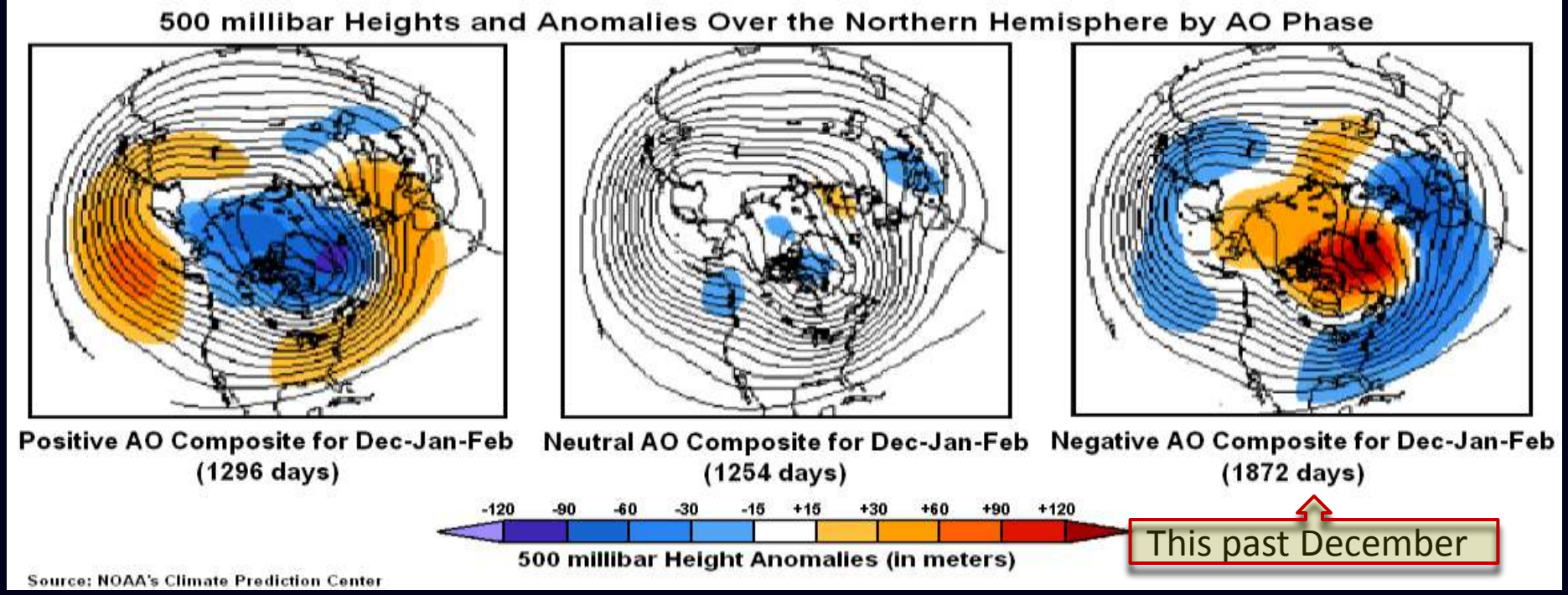
The Role it May Have Played in the Wild Weather on the West Slope in December



The North Atlantic Oscillation (NAO) is an interseasonal manifestation of the atmosphere over the northern and central Atlantic Ocean. Oscillations in pressure and geopotential heights produce potentially large fluctuations in surface wind, temperature and precipitation patterns across the north Atlantic region, western Europe and, at times, across eastern portions of North America.

NAOs rarely last longer than a few weeks and are more prevalent during the colder winter months.

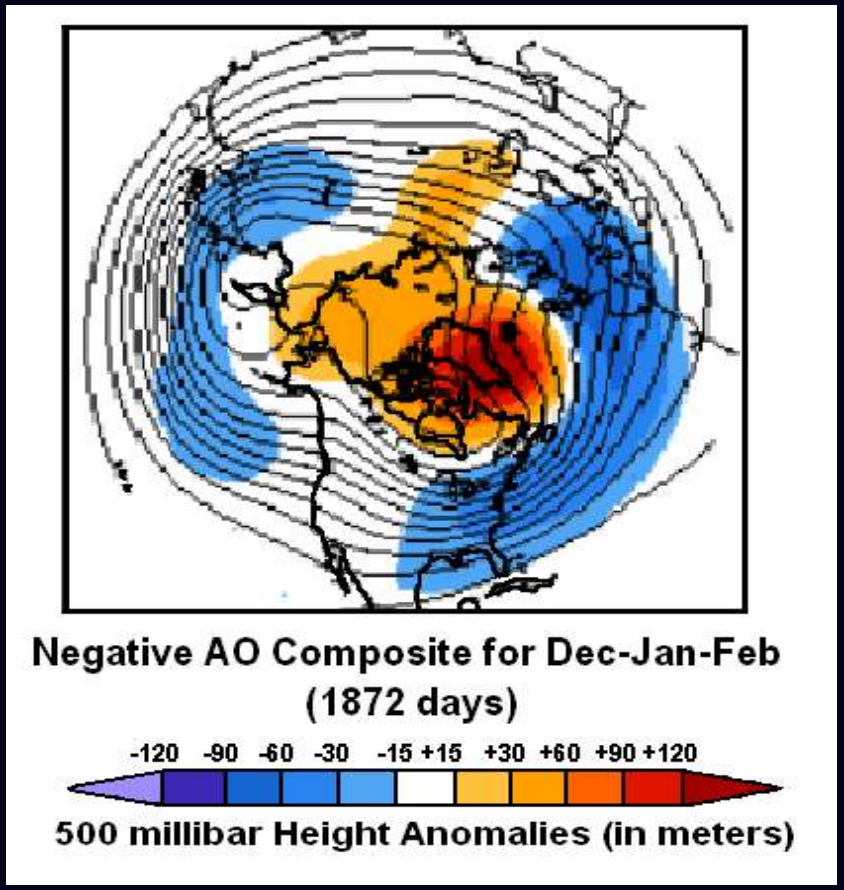
An abnormally strong AO developed over the north Atlantic early this winter. As strong as it was, could it have affected weather patterns as far away as the western continental United States?



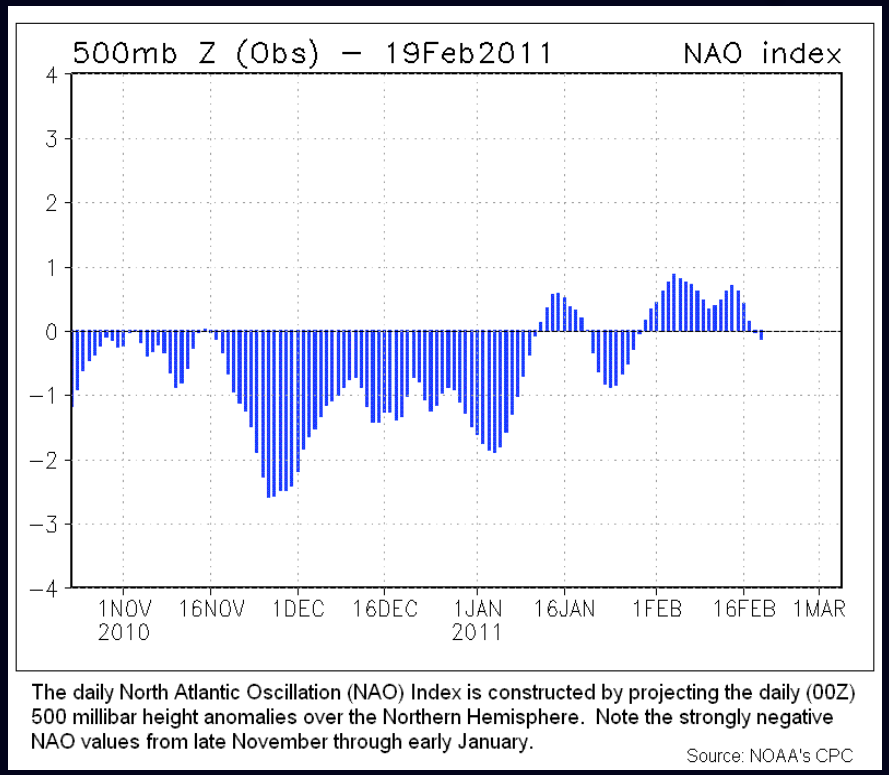
Under +AO conditions, below average geopotential heights associated with a stronger than normal Polar Vortex exist over the Arctic, Iceland, Greenland, the north Atlantic and as far west as Alaska; while above average heights are commonly observed over the central Atlantic and eastern United States. A strong surface pressure gradient between the Icelandic Low and Azore High also produces greater than normal westerly wind speeds across the Atlantic and eastern portions of the U.S., conditions also observed when El Niño conditions exist in the Pacific Ocean.

Under neutral AO conditions, near normal geopotential heights are generally observed across the Northern Hemisphere. The surface pressure gradient between the Icelandic Low and Azore High also remains generally weak, resulting in lighter than average wind speeds across the north Atlantic Basin. Flatter (weaker) upper level ridges also persist over western portions of North America and Europe, with flat upper level troughs over eastern portions of North America and the northern and western Atlantic Basin.

Under -AO conditions, above average heights due to a weaker than normal Polar Vortex, are found over the Arctic, Iceland, Greenland, northern Canada and the north Atlantic; while below average heights exist over the central Atlantic, western Europe and the eastern U.S.. Meanwhile strong upper level high pressure ridges develop and persist along the west coast of North America. This anomalous height pattern appeared in late last December with an unusually strong ridge over Alaska and western Canada producing abnormally warm and dry conditions in the region.



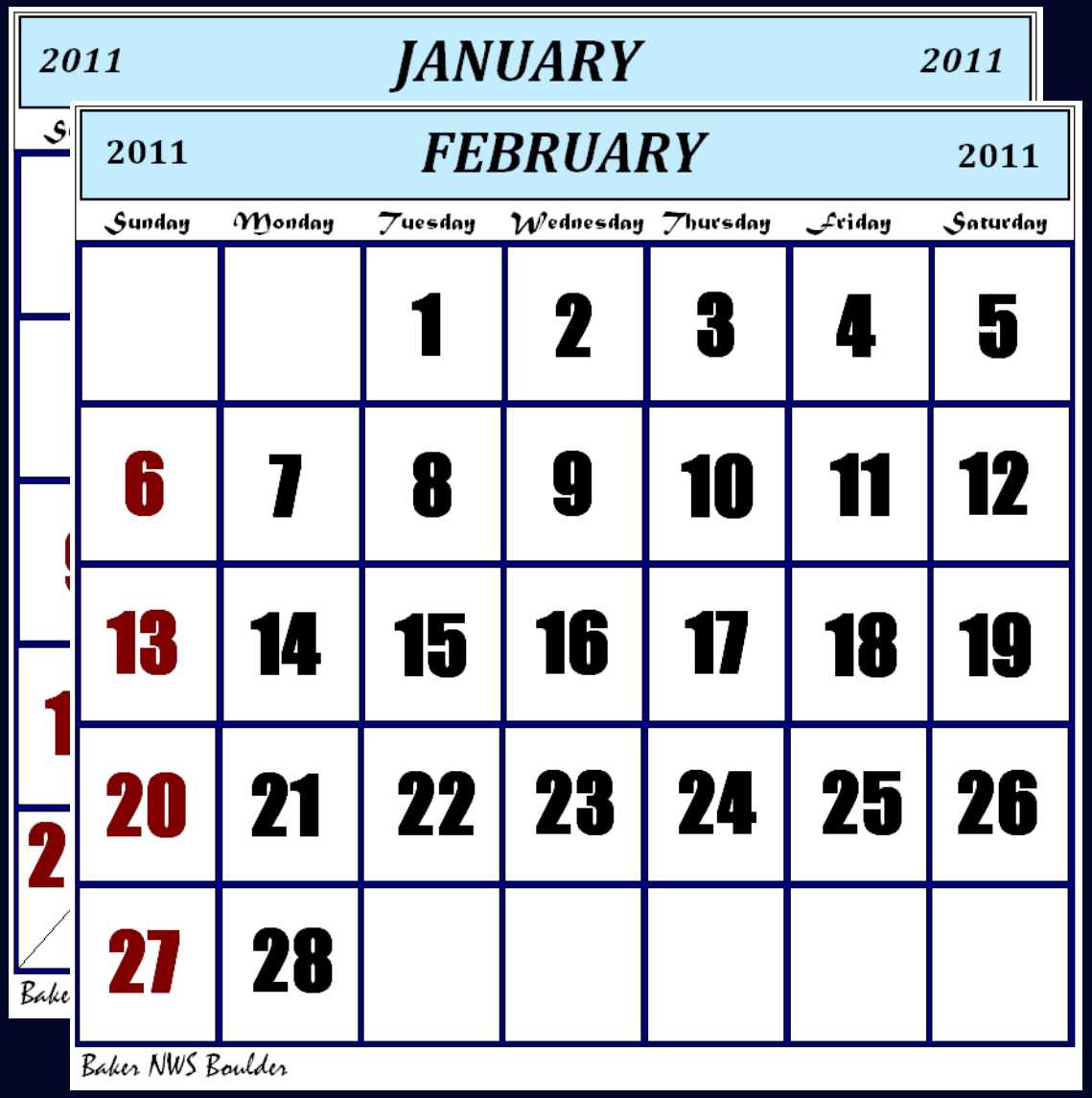
North Atlantic Oscillation Index (NAO) from late October 2010 to mid-February 2011



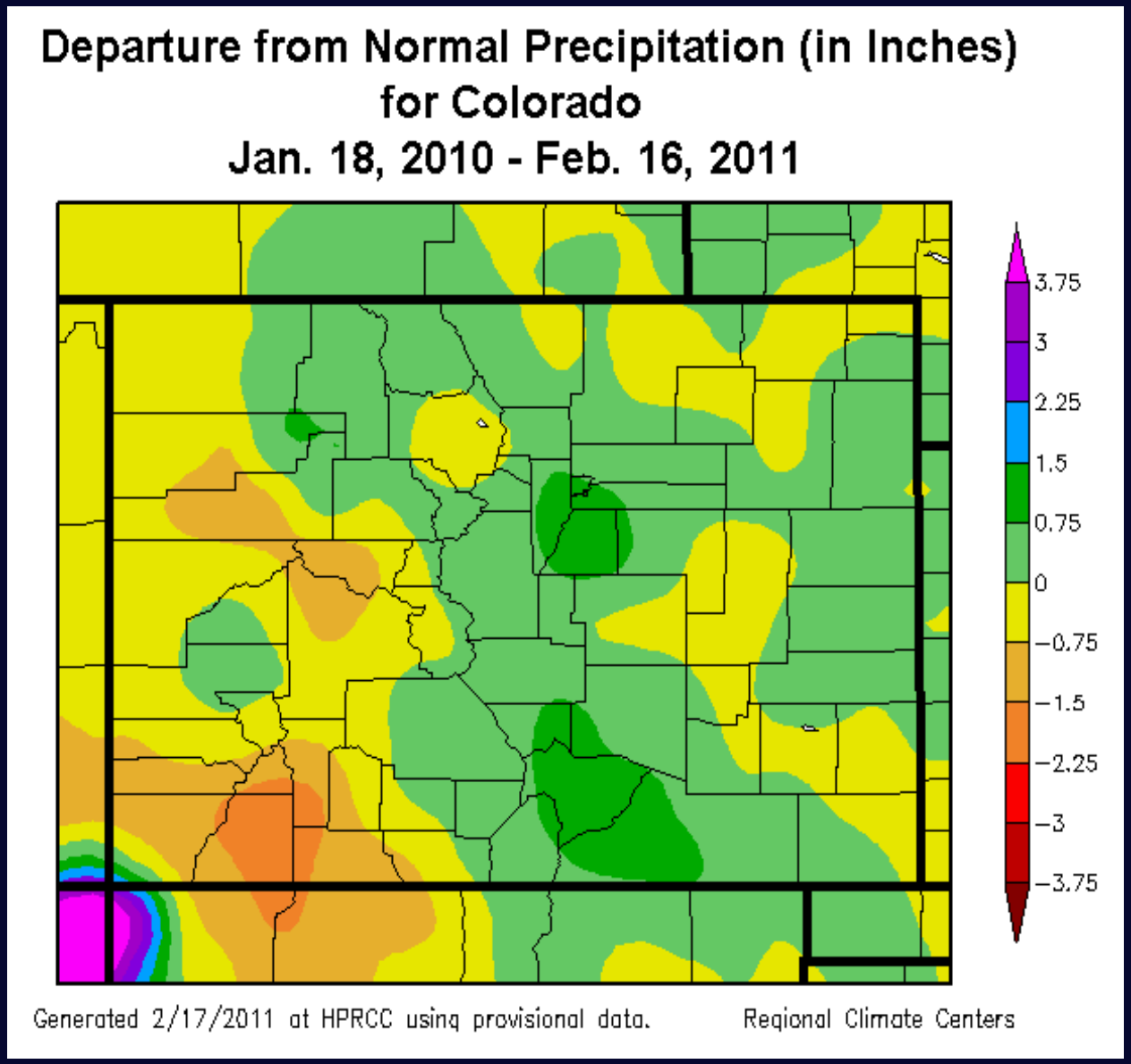
The daily North Atlantic Oscillation (NAO) Index is constructed by projecting the daily (00Z) 500 millibar height anomalies over the Northern Hemisphere. Note the strongly negative NAO values from late November through early January.

Source: NOAA's CPC

The abnormally strong high pressure ridge that formed over Alaska and northwest Canada in December coincided with exceptionally low NAO values across the north Atlantic (see daily NAO values in the upper right). At the same time, northern and western Europe, southeastern Canada and eastern portions of the United States experienced some of the coldest air on record, together with frequent bouts of strong winds and heavy snowfall. These hostile conditions may have been produced by an abnormally large eastward shift in the Icelandic Low which allowed extraordinarily cold air to stream down from the Polar region. An even greater southward shift in the Polar Vortex also created a “block” in the atmosphere which possibly caused the Pacific jet stream to sharply buckle, forming the deep low pressure system that produced the record snowfall and gale force winds across southwestern Colorado late last December.

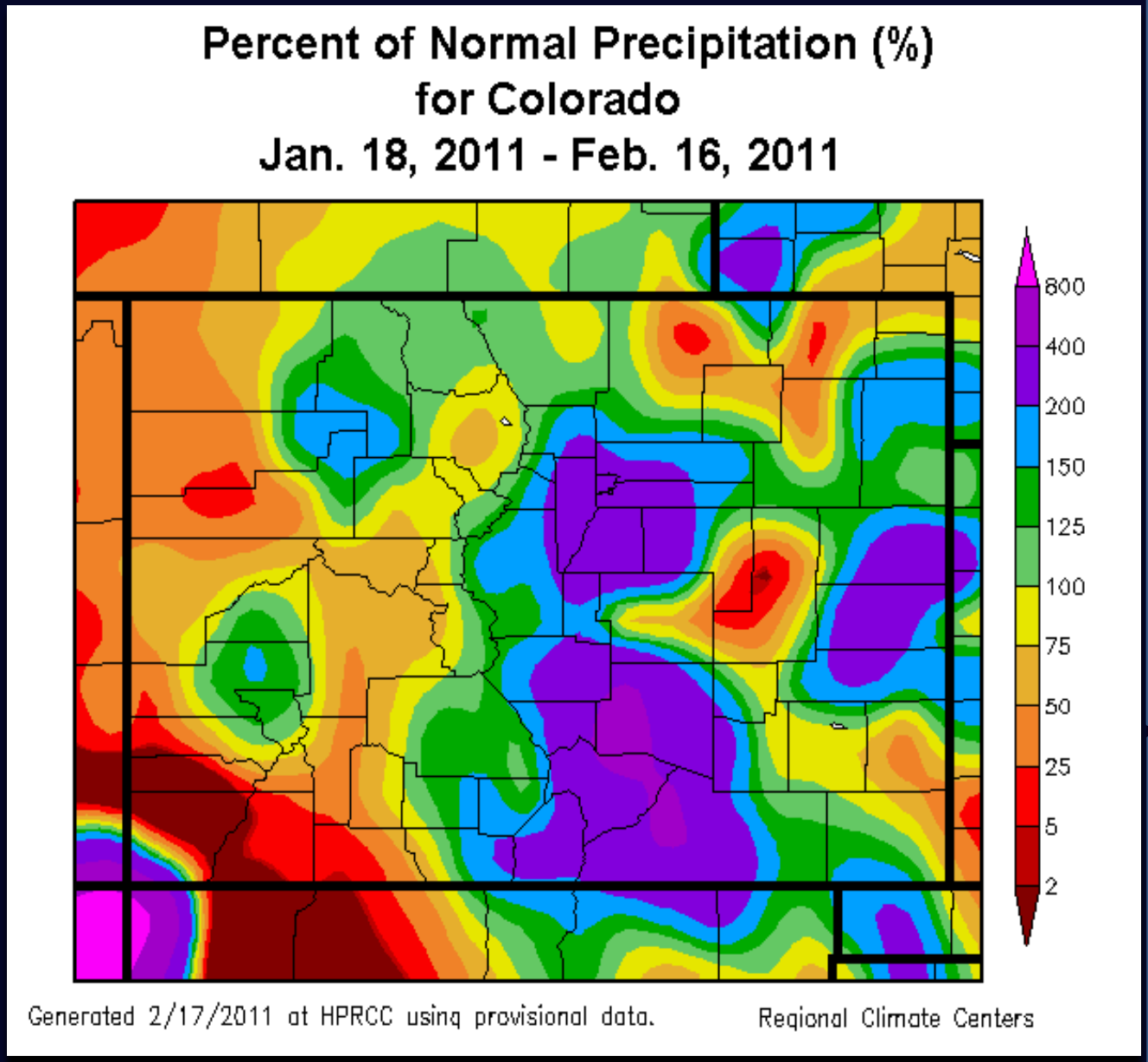


Review of Temperature, Precipitation, Snow Pack and Snow-Water Equivalency Across Colorado During the Last 30 Days



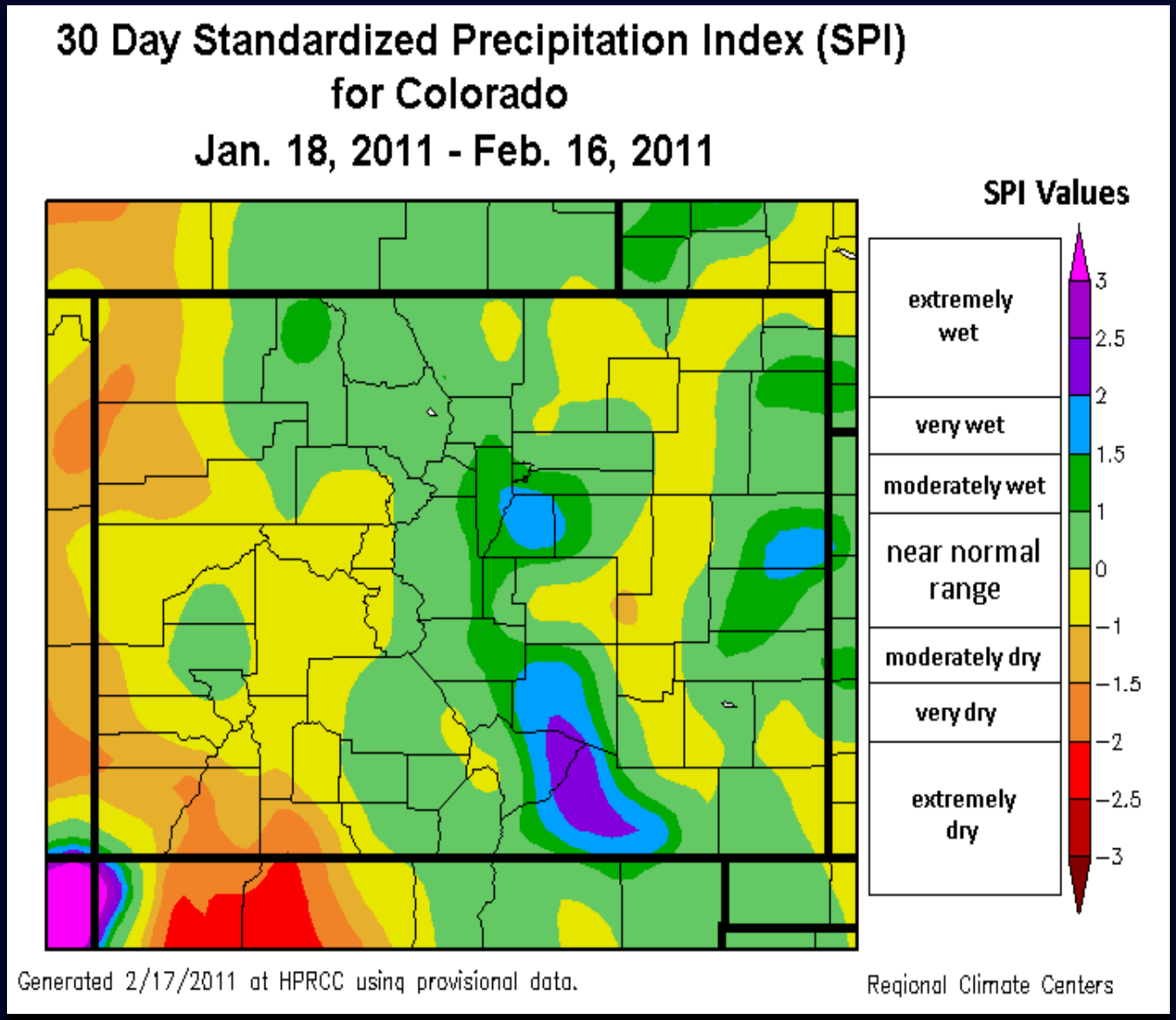
Colorado saw a significant shift in the distribution of precipitation during this 30-day period. As the Pacific jet stream winds became more northerly in orientation, aligning with much stronger Polar jet stream over the Great Plains, precipitation baring cold fronts swept down out of eastern Montana and across eastern Colorado on at least three occasions. These fast moving frontal systems each produced several hours of moderate to heavy snowfall along the Front Range, over the Palmer Divide, and down along the east slope of the Sangre de Cristo Mountains and north side of the Raton Ridge in southern Colorado.

The western slope saw a drop-off in snowfall with the greatest departures in precipitation in the southwest mountains.



Precipitation varied from 200 to 400 percent above normal on the higher terrain south and west of Denver, the Denver Metro area, areas near the Kansas border, and on and near the Sangre de Cristo and Wet Mountain ranges in southern Colorado. East and northeast facing slopes of the Wet Mountains southwest of Pueblo saw precipitation totals exceeding 400 percent of normal.

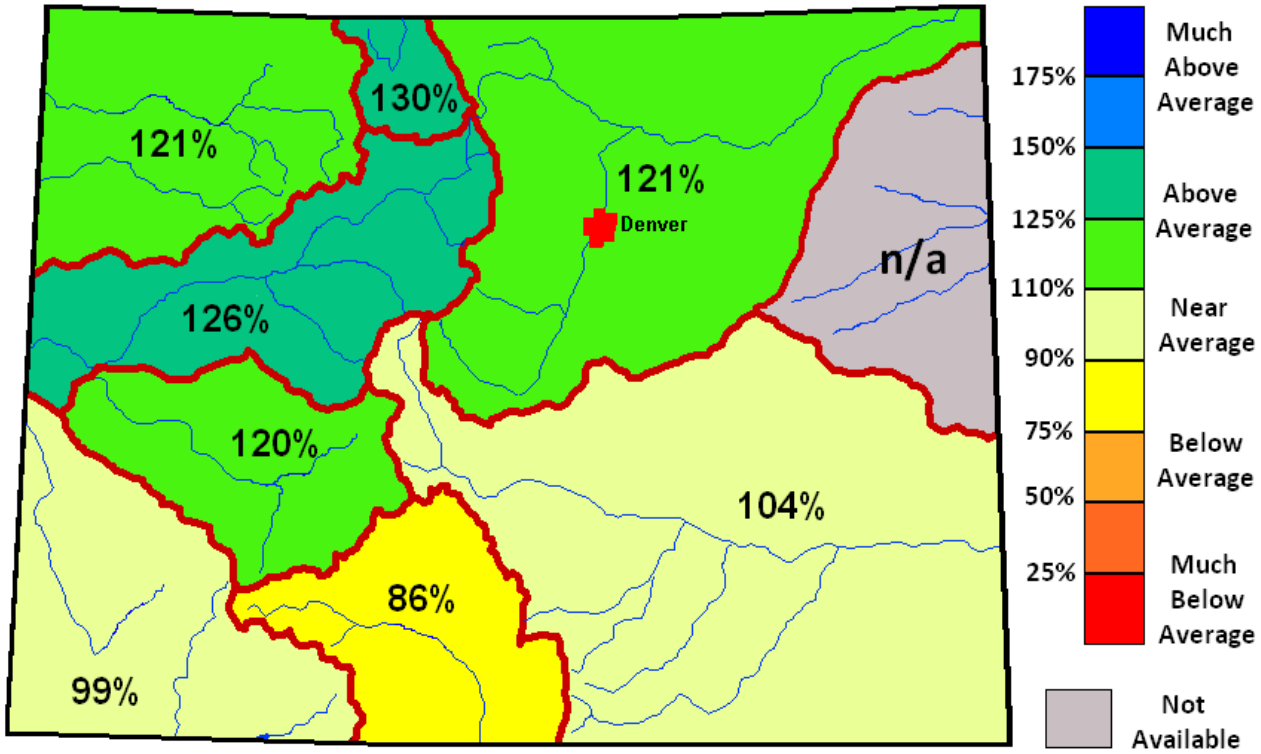
The greatest month-to-month change in precipitation occurred across portions of northwest and west central Colorado, largely due to the directional shift in the Pacific jet stream.



During the 30 day period ending February 16, 2011, the SPI indicated wetter than normal conditions along the spine of the Rocky Mountains, parts of the northwest and the eastern plains. The most significant improvement in moisture levels appeared over and along the eastern slopes of the Front Range, Rampart Range, Wet and Sangre de Cristo Mountains and Raton Ridge near the New Mexico border.

The northwest plateau dried out and the southwest saw little, if any, improvement in moisture levels from the previous month.

Snow Water Equivalent as a Percent of Average (%) for Colorado by River Basin as of Thursday, February 17, 2011



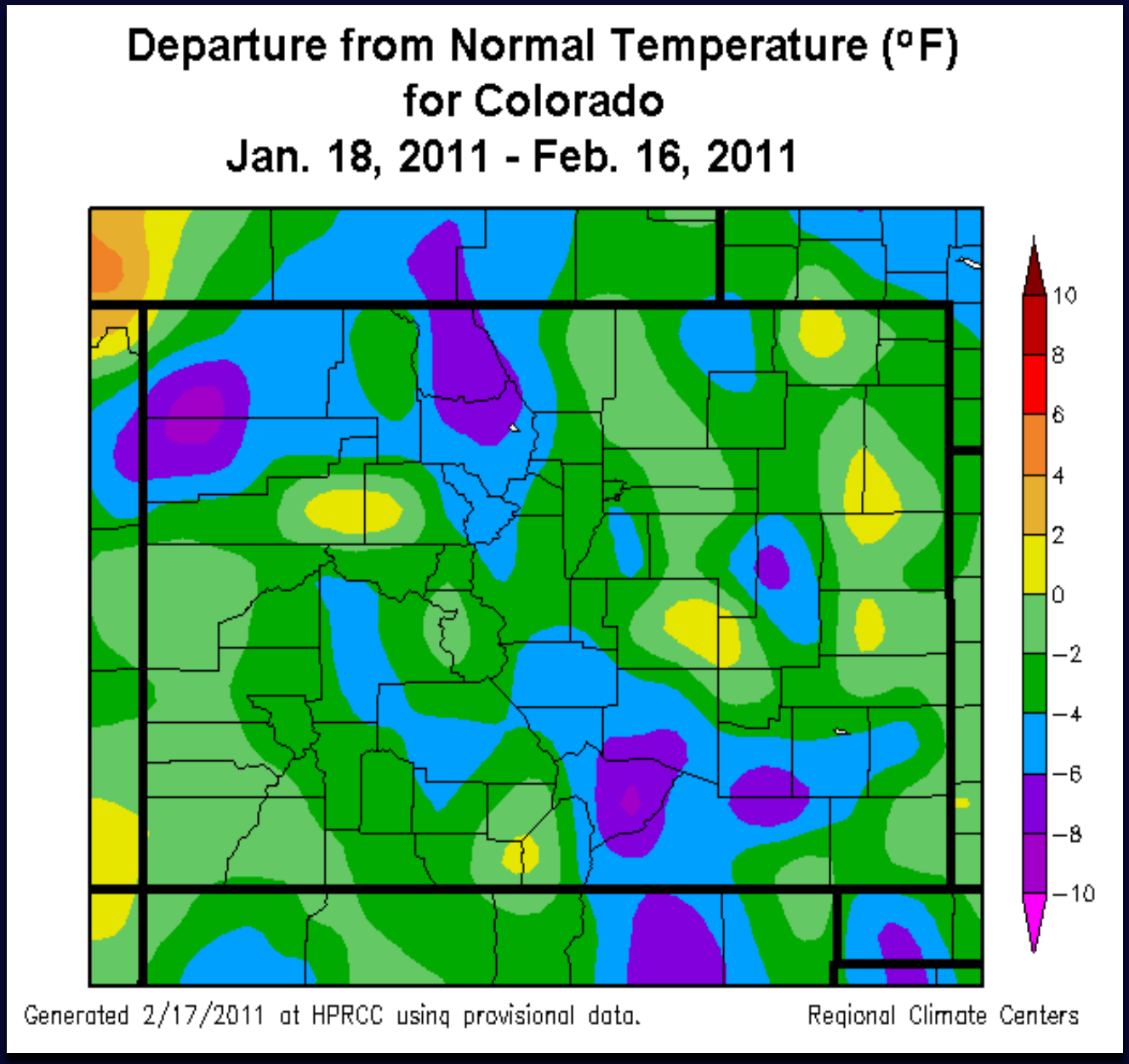
Basin Wide Percent of Average (%)

WEST SLOPE		EAST SLOPE	
Yampa and White River Basins	121%	South Platte River Basin	121%
Upper Colorado River Basin	126%	Arkansas River Basin	104%
Gunnison River Basin	120%		
San Migual, Dolores, Animas & San Juan River Basins	99%	Statewide Avg....115%	
Upper Rio Grande Basin	86%		

Source: USDA Natural Resources Conservation Service--Water and Climate, Portland, Oregon
provisional data, subject to revision

Snow Water Equivalents decreased in the river basins of northwest and west central Colorado during the 30-day interval, while basins on the east slope saw only a slight increase.

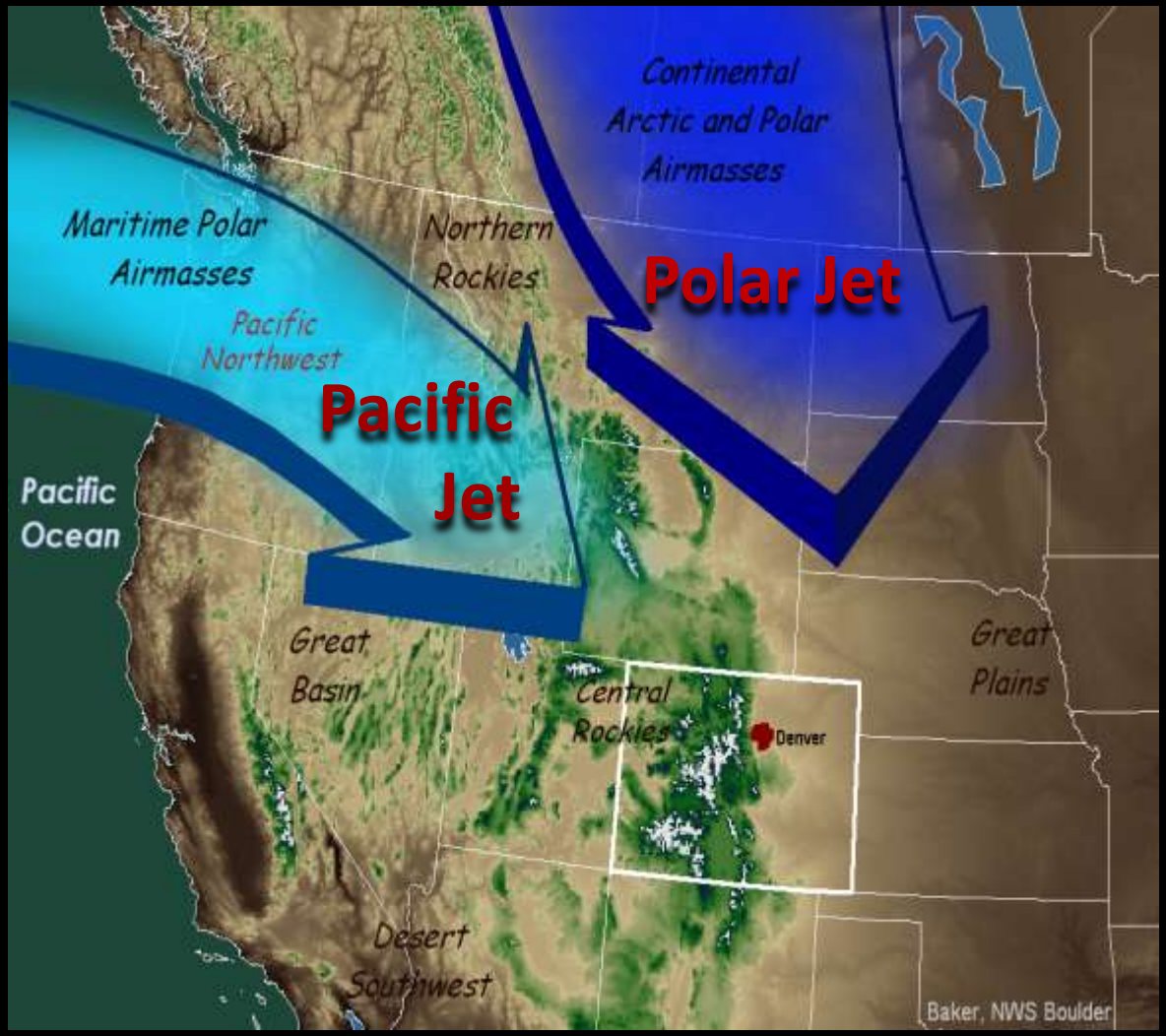
River basins in the southwest and south central portions of Colorado continued to see a reduction in snow water equivalents during the period.



Temperatures during the 30-day period ending February 16, 2011, reversed course and became significantly colder across Colorado, especially across northern and eastern portions of the state. The southwest managed to escape these onslaughts of arctic air. The arrival of these bitterly cold arctic air masses in January and early February drove daily temperatures downward by as much as 25 to 40 degrees F below normal, mainly across northern and eastern portions of Colorado.

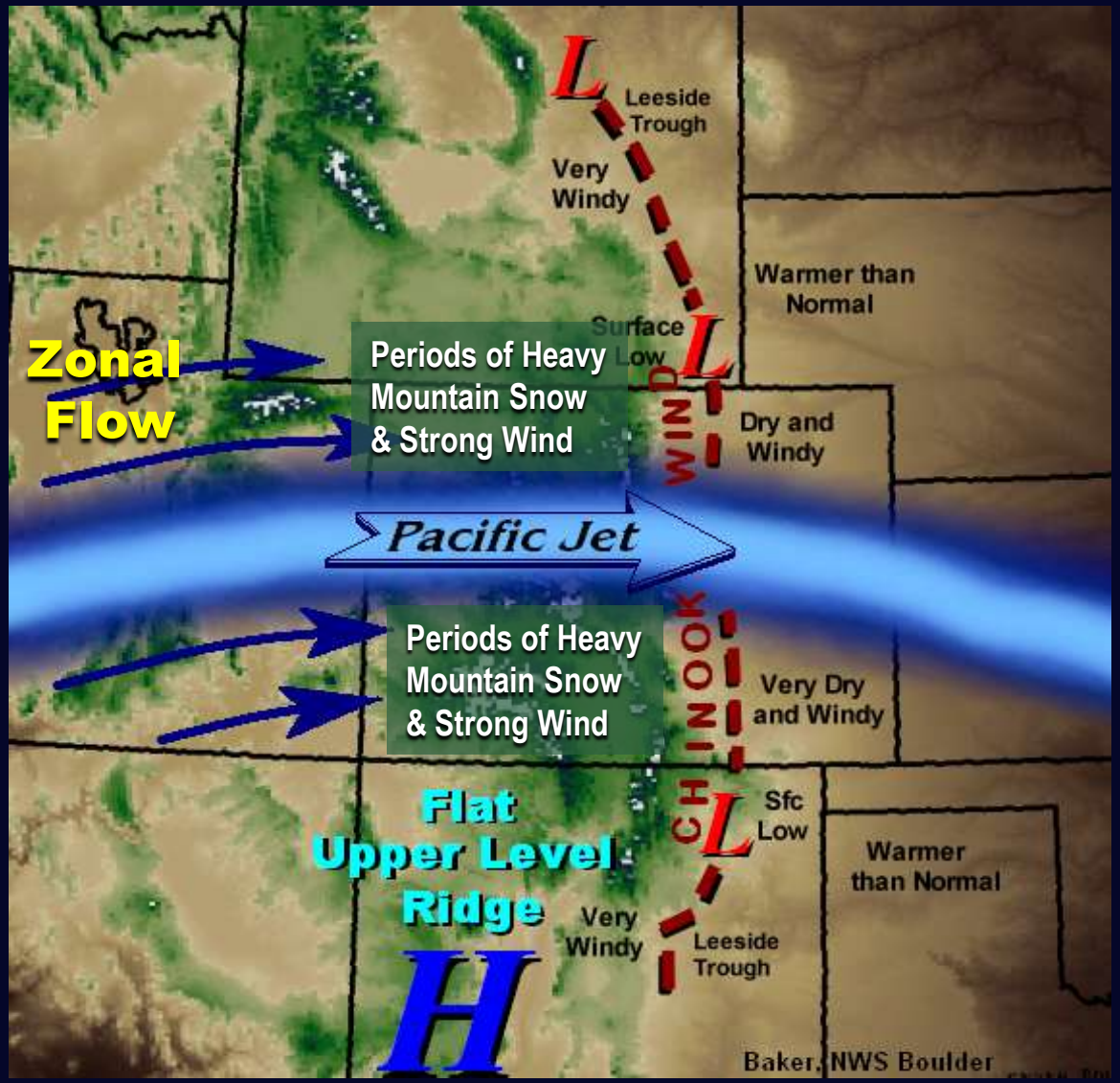
A Weakening La Niña and a Shifting Jet Stream Pattern – How They May Still Influence Colorado Weather During the Upcoming Spring

The Changing Jet Stream Pattern Over the Western U.S.



In the past few months the Pacific and Polar jet streams played key roles in influencing the weather across Colorado. A strong Pacific jet stream helped to produce abundant snowfall and strong winds across western sections of the state, and the Polar jet blasts of arctic air and light snow mainly to eastern parts of Colorado.

As we approach the vernal (spring) equinox, these jet streams have already begun their migration to higher latitudes with the sun's warming rays shining more directly upon the Northern Hemisphere. However, this northward shift in the Pacific jet may be delayed somewhat due to the lingering La Niña conditions in the Pacific.

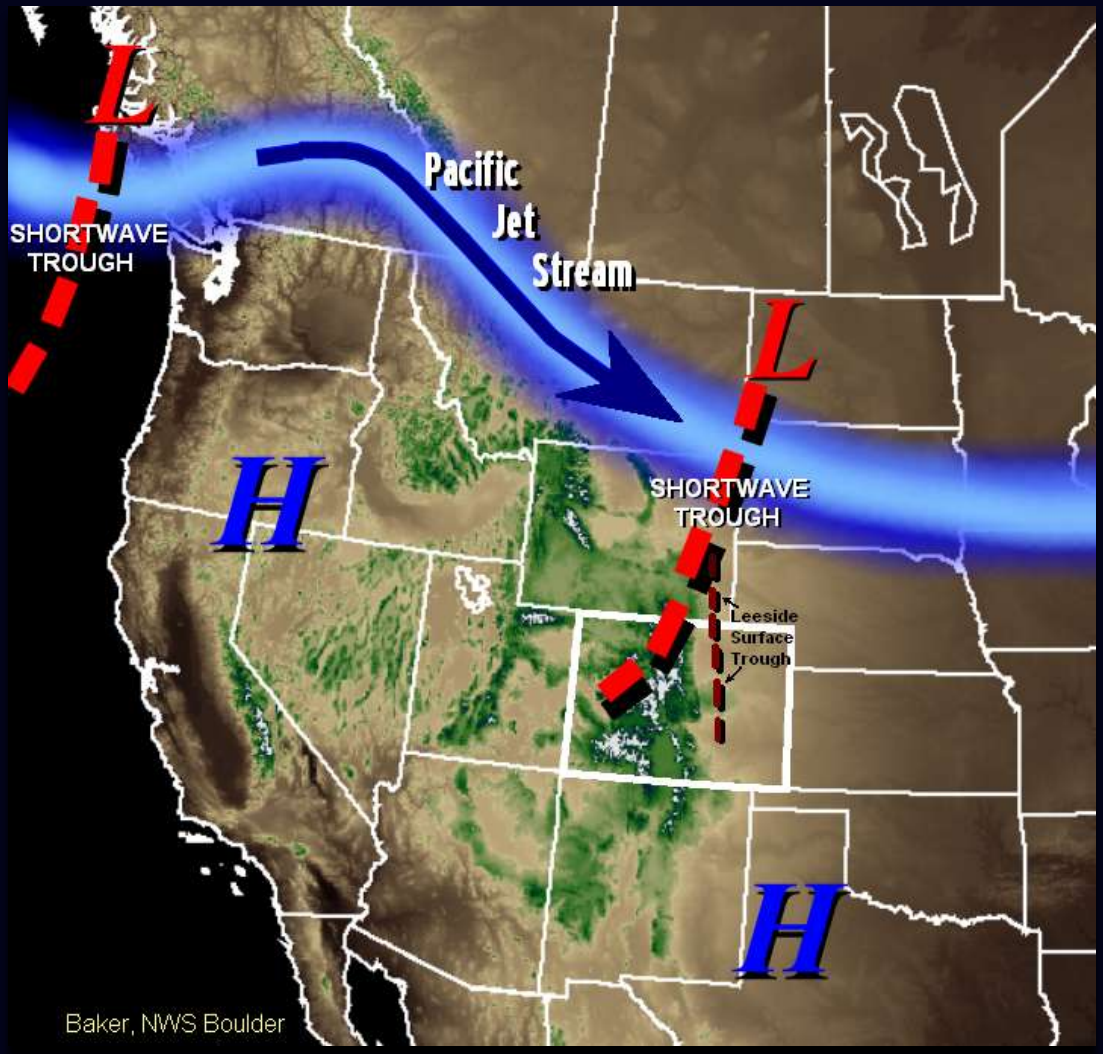


Abnormally warm and dry conditions created by winds down-sloping off the Front Range will likely increase the wildland fire danger in areas east of the mountains.

In late winter and early spring of moderate to strong La Niñas, the Pacific jet stream is often seen straddling the central Rocky Mountain region. Beneath this jet stream strong zonal (westerly) surface winds will often form, particularly in mountain areas, in the San Luis Valley, and on the adjacent high plains. Strong and potentially damaging downslope winds, known as Chinook winds, may also form in the presence of a surface trough of low pressure in the lee of the Front Range.

Mountain areas generally along and west of the Continental Divide will also continue to see periods of precipitation, usually in the form of moderate to heavy snow; while valley locations may be shrouded in low clouds and fog, sometimes for days at a time.

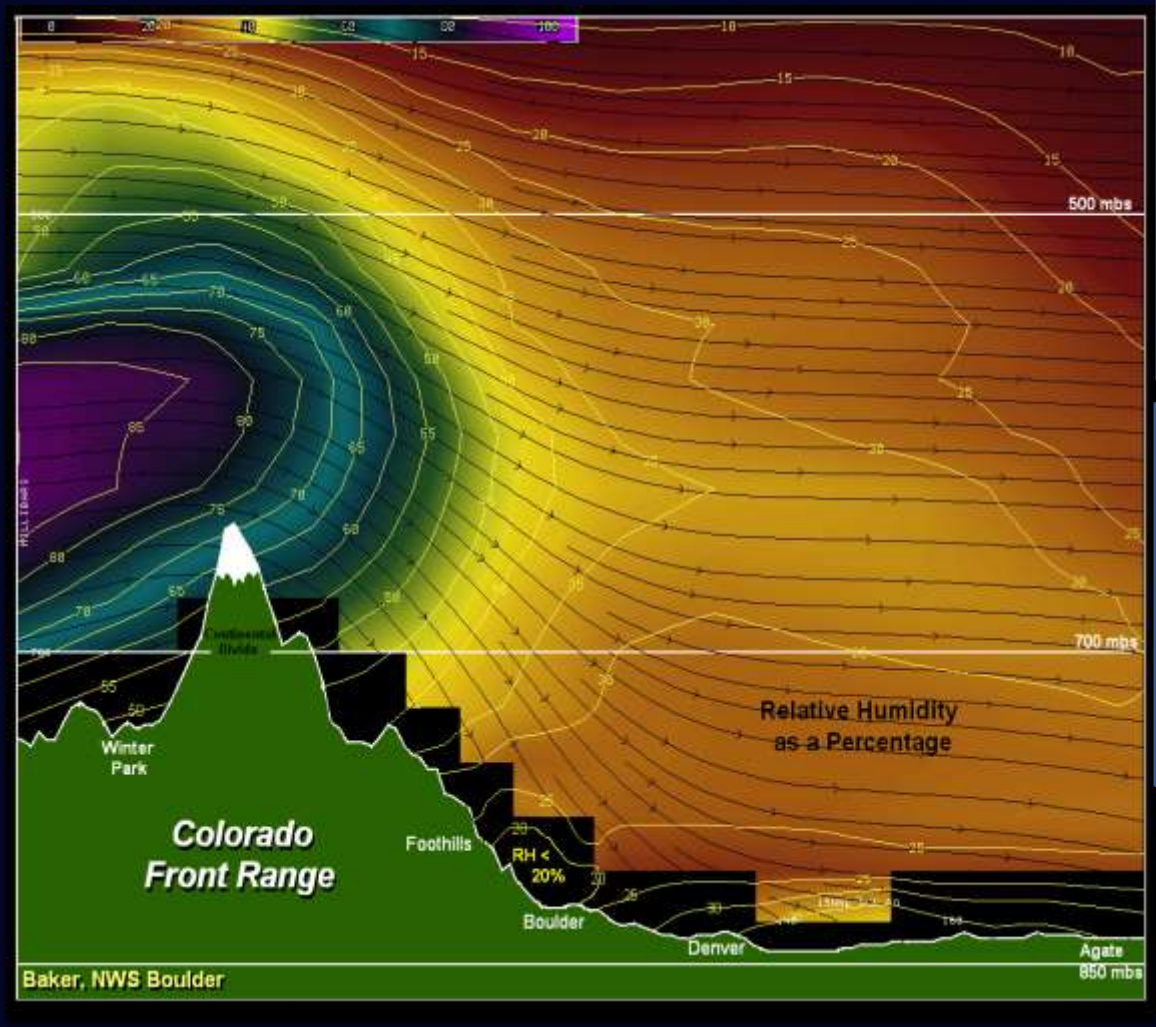
The Pacific Jet Stream and Its Seasonal Shift Northward



As La Niña continues to weaken this spring, so too will the Pacific jet stream as its path slowly migrates northward.

Even as La Niña weakens and the Pacific jet stream moves farther away from Colorado, their subtle effects on our weather will probably persist for most of this spring.

Upper level troughs of low pressure, whisked along by the Pacific jet stream will continue to brush northern portions of Colorado in the weeks to come. These waves of energy will continue to produce periods of snowfall, sometimes heavy, and strong westerly winds in the northern mountain ranges. While in areas east of the mountains drier and warmer than normal conditions will continue, particularly during periods of gusty downslope winds.



Downslope winds along the Colorado Front Range, commonly referred to as Chinook winds, can produce the lowest relatively humidities and warmest temperatures along the base of the Front Range.

Relative humidity values of less than five percent are not uncommon in these windy areas near the Front Range foothills. At the same time, nearby areas with less wind may see relative humidity values as much as 20 to 30 percent higher.

These desiccating downslope winds will often play a critical role in the enhancement and spread of **wildland fire**.

Potential Critical Weather Impacts Along the Colorado Front Range During the Final Days of La Niña

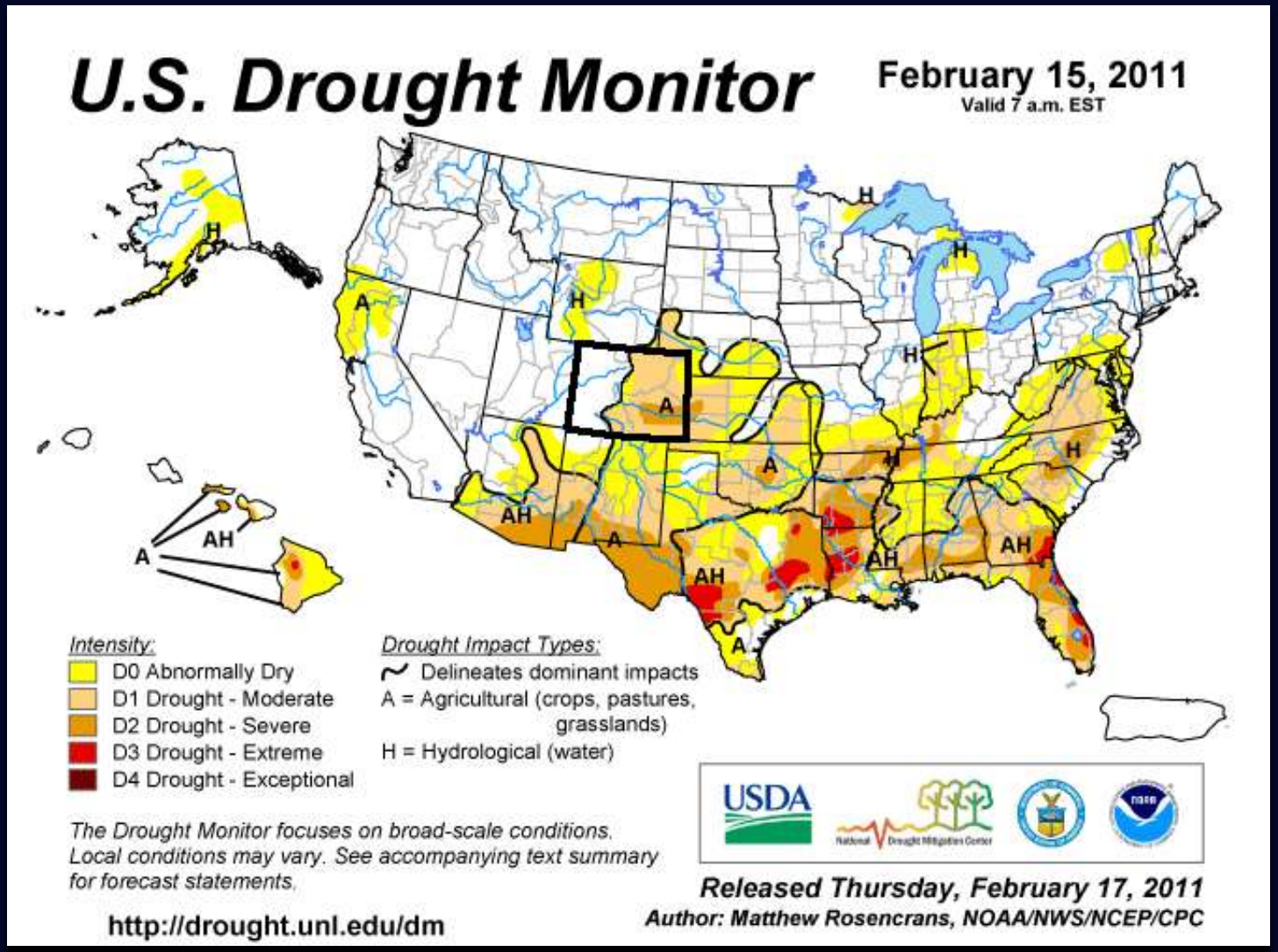
Record Heat

Abnormally Dry Conditions Leading to Regional Drought

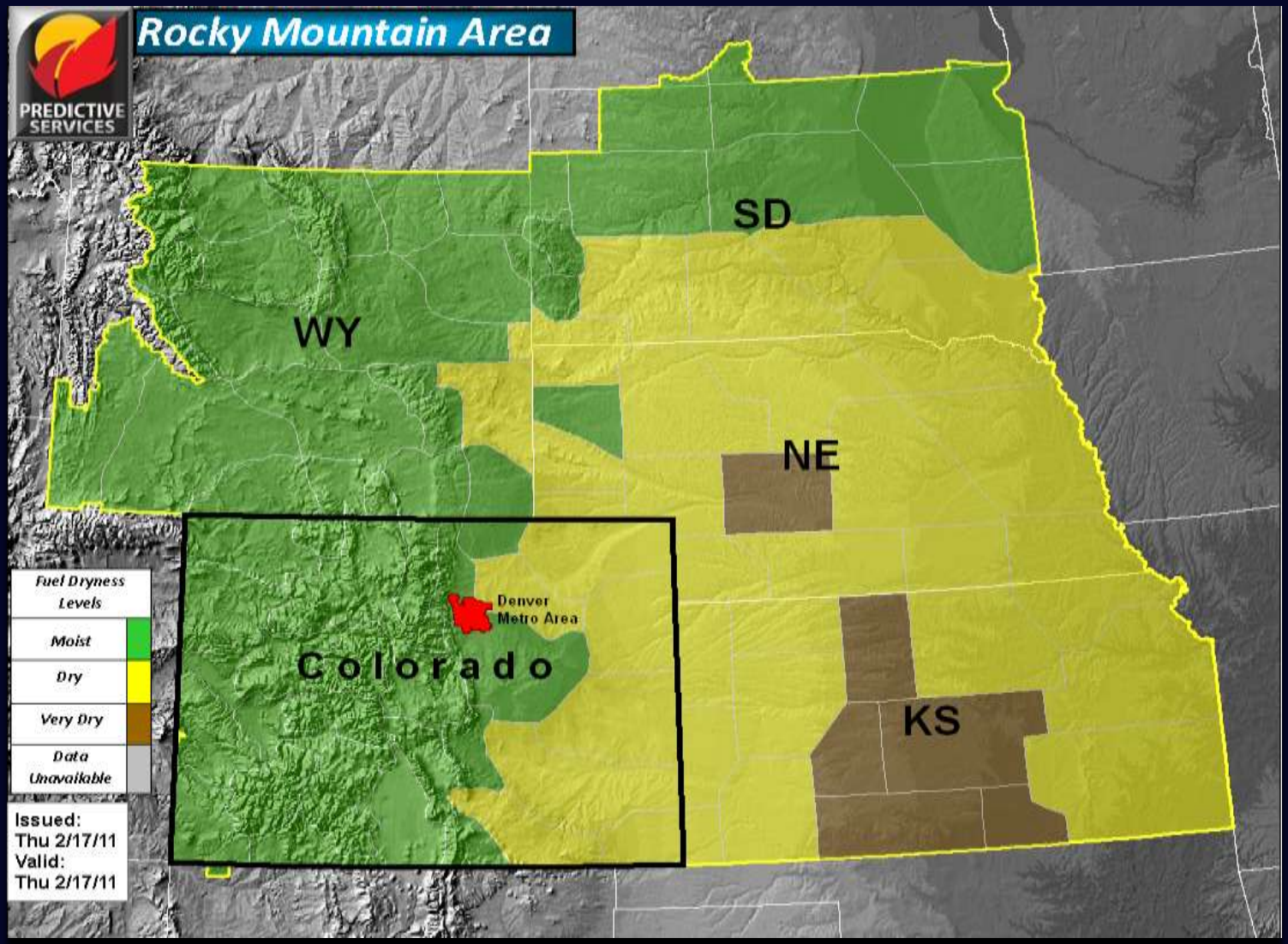
Reduced Runoff To Area Lakes and Reservoirs

A Growing Risk of Wildland Fires

Strong and Potentially Damaging Downslope Wind Storms



The U.S. Drought Monitor indicates that moderate to severe drought conditions affecting agricultural activities in eastern Colorado exist as of February 15, 2011.



Fuels such as short and tall grasses and shrubs have already begun to dry out across eastern Colorado with the recent warm and windy conditions. As of the middle of February, Predictive Services in Boise, Idaho indicated dry fuels on the plains of eastern Colorado. Otherwise fuels were determined to be moist over the remainder of the state.

Seasonal Significant Wildland Fire Potential Outlook – March to May 2011

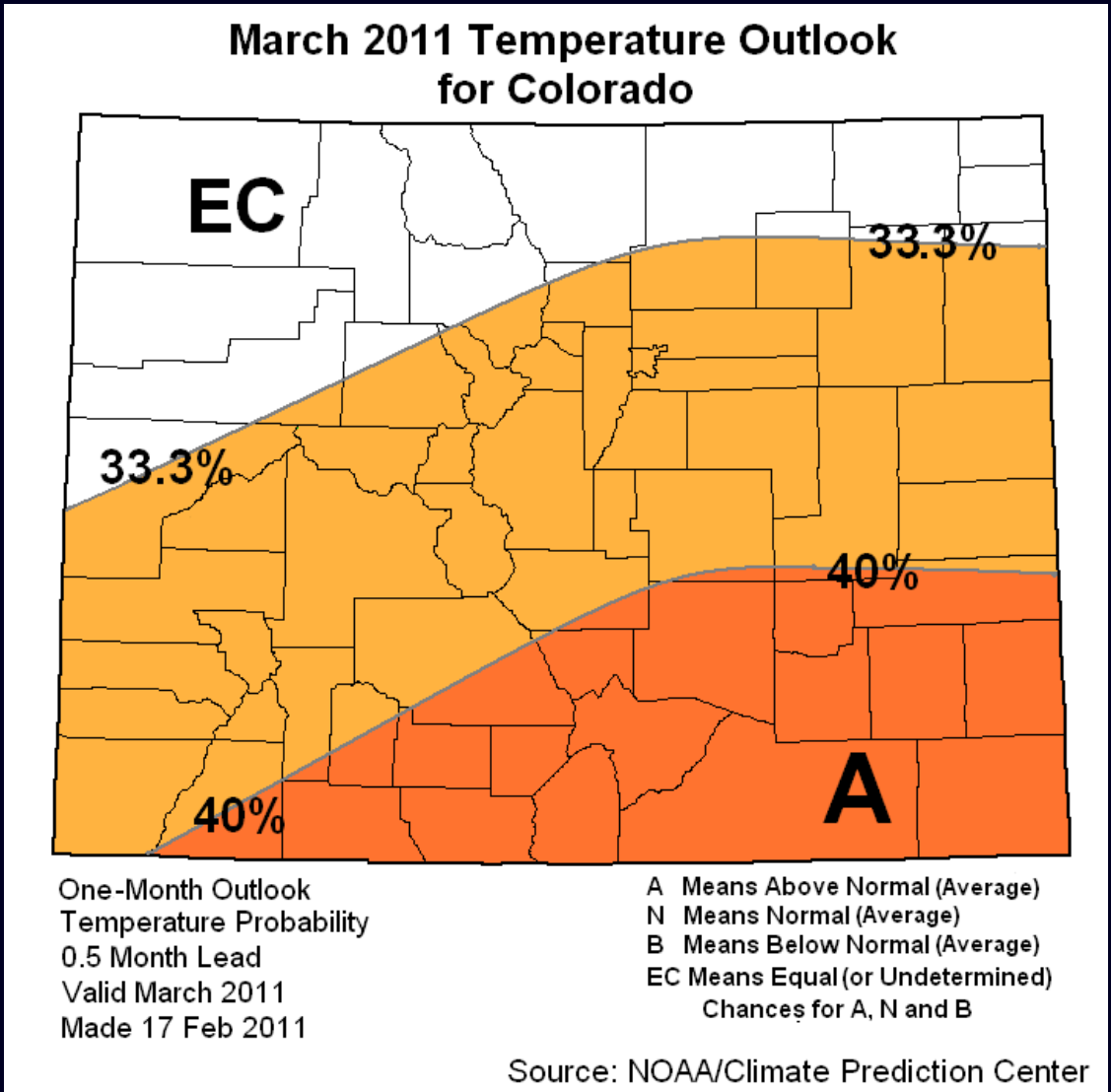
Significant fire potential is the likelihood that a wildland fire event will require mobilization of additional resources from outside the area in which the fire situation originates.

Predictive Services at the National Interagency Coordination Center in Boise, Idaho predicts that southeast Colorado will see the potential for significant wildland fire increasing to above normal during the upcoming spring.

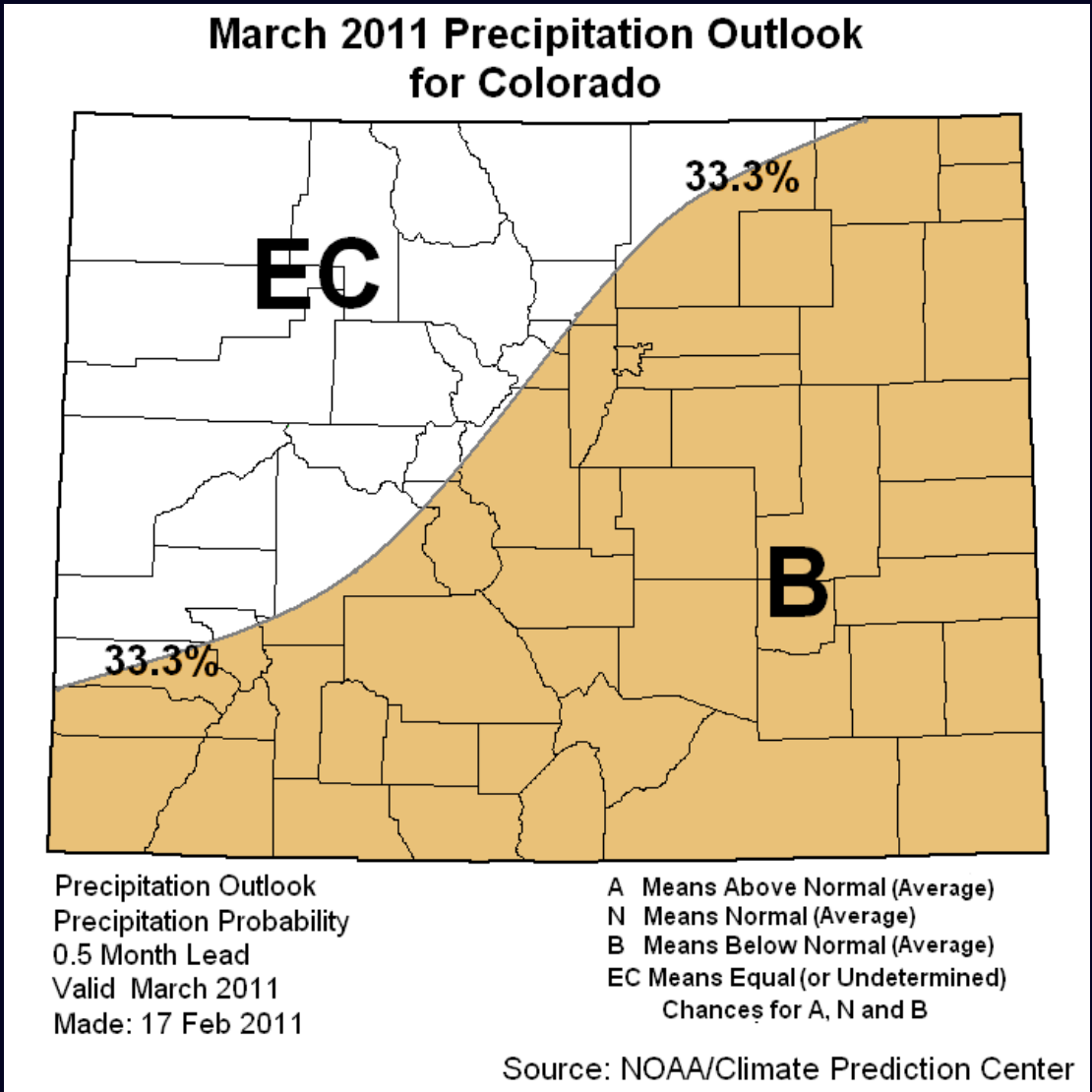
Other parts of Colorado, such as the northeast plains and the San Luis Valley, could also see an increase in wildland fire potential during this period; a condition brought on an extended period of abnormally warm temperatures and very low humidity, gusty downslope winds and little or no precipitation.

Map produced by
Predictive Services,
National Interagency
Coordination Center
Boise, Idaho
Issued February 1, 2011
Next issuance March 1, 2011

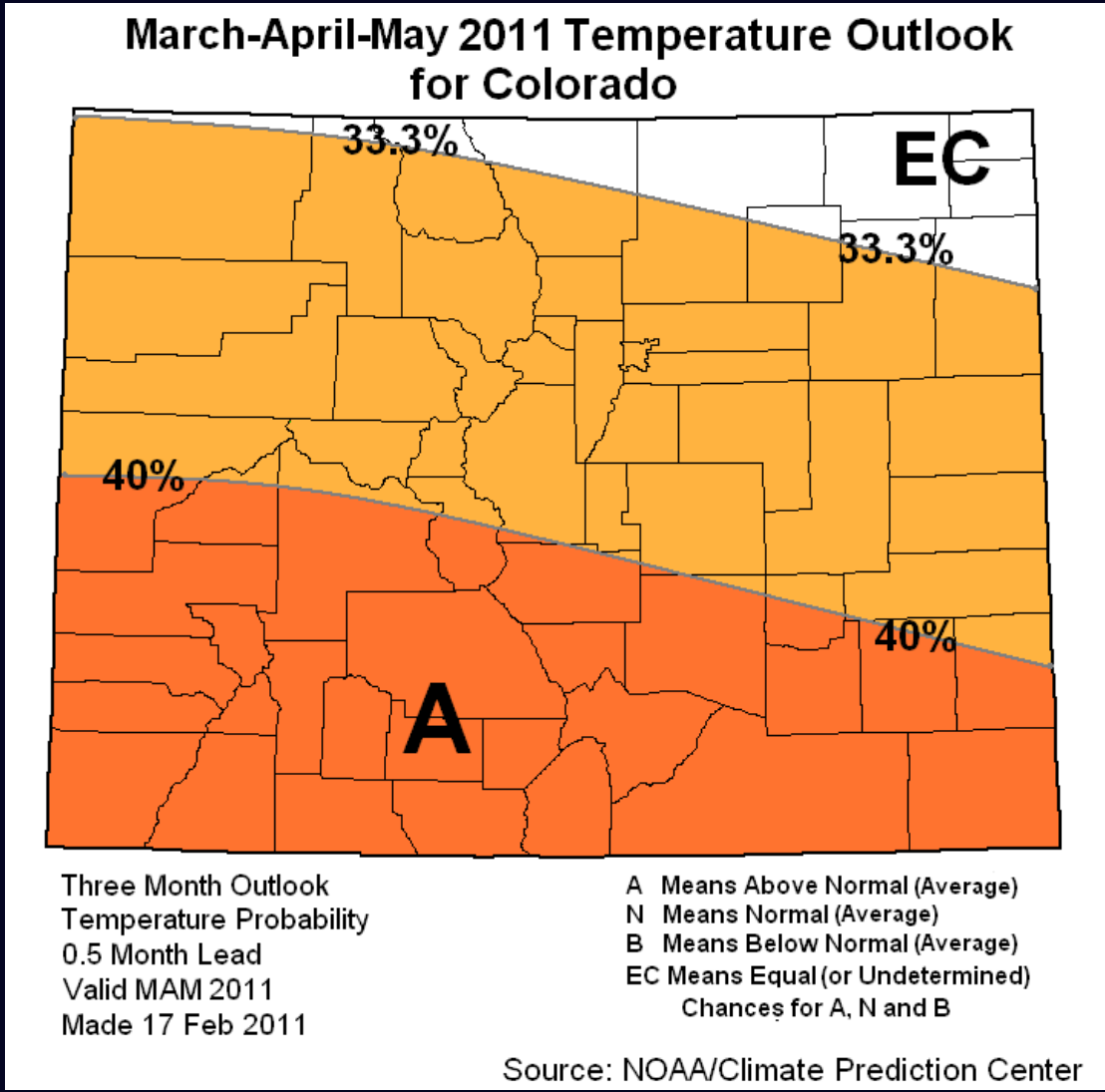
Temperature and Precipitation Outlooks
For March-April-May 2011
Issued by NOAA's
Climate Prediction Center



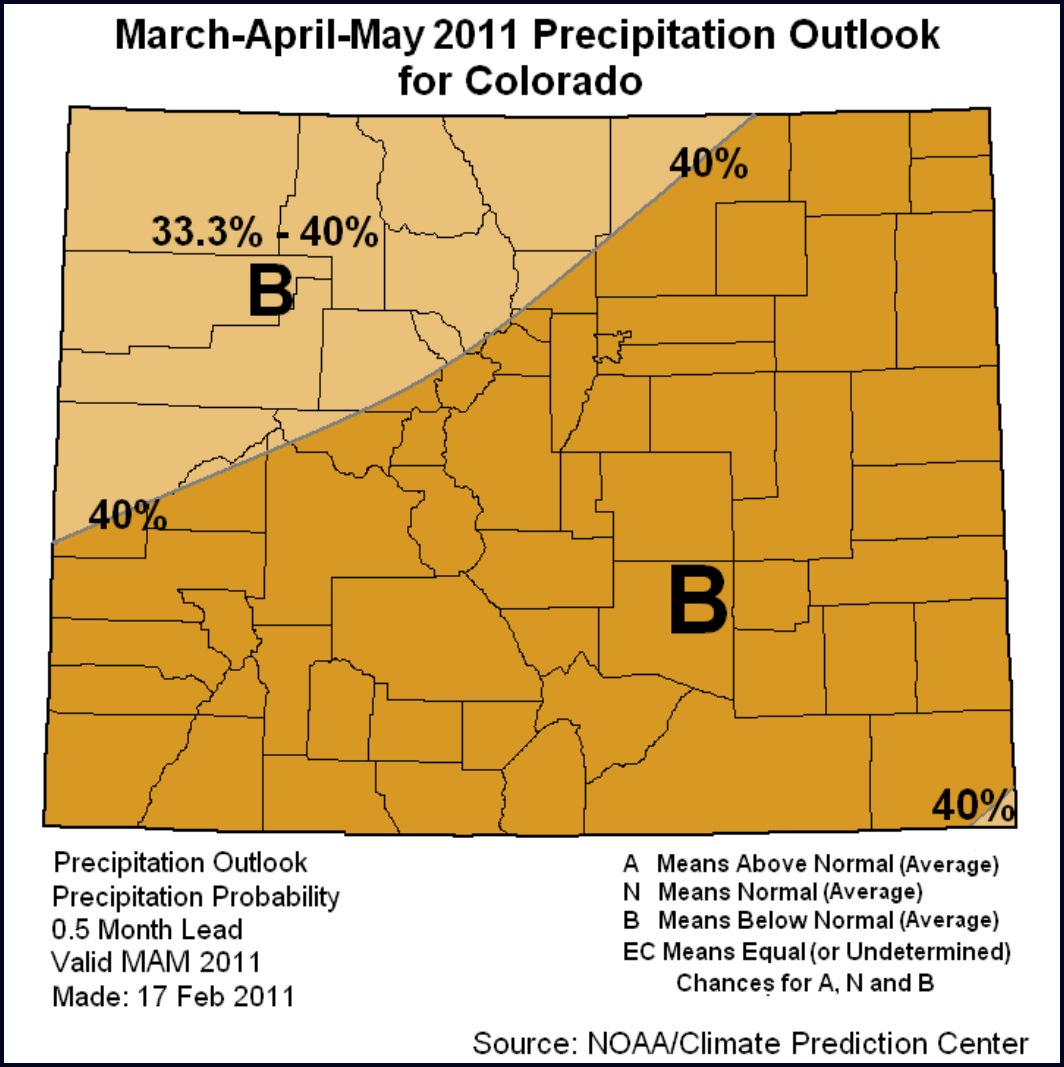
For the month of March, there is at least a 40% probability of below normal (average) temperature across southeast and south central portions of Colorado, a 33.3 to 40% probability of below average temperature across central portions of Colorado, and an equal or undetermined chance of above, below or near normal (average) temperature across the northwest corner of the state.



For March, there is a 33.3 to 40% probability of below normal (average) precipitation across southern and eastern portions of Colorado, and an equal or undetermined chance of above, below or near normal (average) precipitation across the northwest corner of the state.



For the months of March, April and May, there is at least a 40 percent probability of above normal (average) temperature across the southern one-third of Colorado, a 33.3 to 40 percent probability of above normal (average) temperature across the remainder of the state, except the far northeast corner of the state where there is an equal or undetermined chance for above, below or near normal (average) temperature during the period.



For the months of March, April and May, there is at least a 40 percent probability of below normal (average) precipitation across the southeast two-thirds of Colorado, and a 33.3 to 40 percent probability of below normal (average) precipitation across the remaining one-third of the state as well as in the extreme southeast corner of Colorado.

Summary and Conclusions

- Negative sea surface temperature (SST) anomalies indicative of a mature La Niña have begun to weaken across the central and eastern tropical Pacific Ocean. SSTs have even become slightly warmer than normal in the past coupe of weeks in the far eastern tropical Pacific.
- The latest forecasts from nearly two dozen ENSO-climate models indicate an equal chance for ENSO-neutral and weak La Niña conditions in the tropical Pacific Ocean by late this spring.
- Even as La Niña continues to weaken, it is possible that will continue to have an impact on weather conditions across Colorado and the western United States through the upcoming spring season.
- The latest outlook from NOAA's Climate Prediction Center (CPC) indicates better than a 33 percent probability of above normal (average) temperature and below normal (average) precipitation across nearly all of the Colorado during the months of March, April and May of 2011.