Upper Missouri River Basin
January 2012 Calendar Year Runoff Forecast
January 3, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

2011 Calendar Year Runoff

December 2011 Missouri River runoff was 1.4 MAF (185% of normal) above Sioux City, and 1.1 MAF (162% of normal) above Gavins Point. While precipitation during this time period was largely below normal, much warmer than normal temperatures throughout the basin inhibited ice and soil frost formation, allowing rivers to flow freely resulting in much higher than normal runoff into the system. Calendar Year 2011 runoff above Sioux City, IA was **61.2 MAF** (247% of normal). Calendar Year 2011 runoff above Gavins Point Dam was **51.5 MAF** (226% of normal).

2012 Calendar Year Forecast Synopsis

The January 1 forecast for the 2012 Missouri River runoff above Sioux City, IA is 26.5 MAF (107% of normal). Runoff above Gavins Point Dam is forecast to be 22.8 MAF (100% of normal) using the 114 years of record from 1898 to 2011. Due to the amount of variability in precipitation and other hydrologic factors that can occur over the next 12 months, the range of expected inflow is quite large and ranges from the 36.2 MAF upper basic forecast to the 17.8 MAF lower basic forecast. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 12 months are being forecasted for this January 1 forecast (0 months observed/12 months forecast), the range of wetter than normal (upper basic) and lower than normal (lower basic) is attributed to all 6 reaches for all 12 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the

year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Nina)

The 2011 September-October-November period marked the onset of El Nino Southern Oscillation (ENSO) "La Nina" when sea surface temperature (SST) anomalies fell below the -0.5 deg C departure. In 2010-2011, the onset of La Nina began with the 2010 June-July-August period, which was three months earlier than what we currently experiencing in 2011. The 2010-2011 La Nina ended during the April-May-June period.

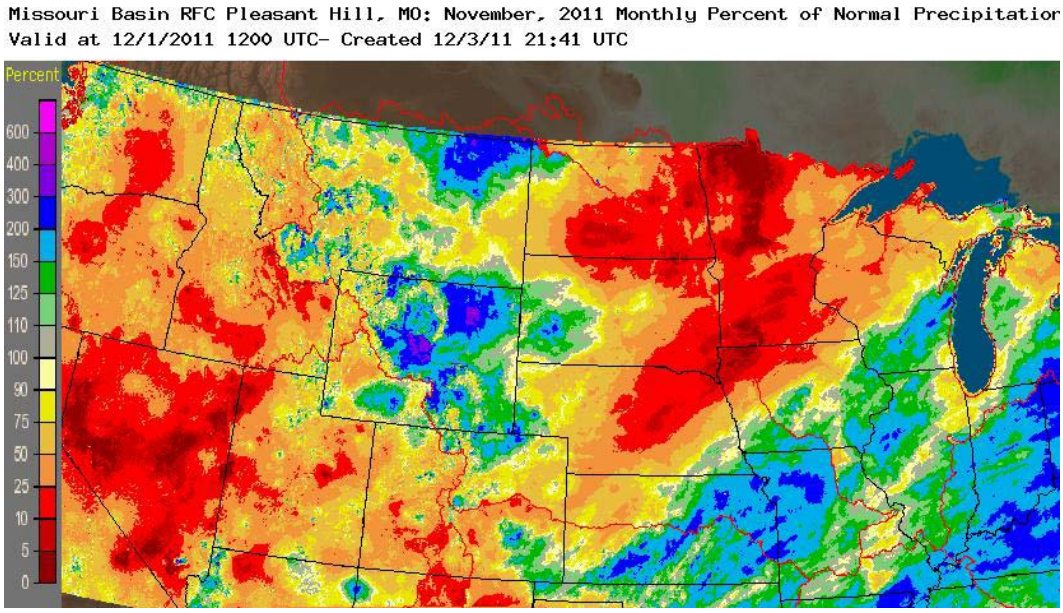
During La Nina episodes, the Pacific Northwest and portions of the Northern Rockies in the Missouri River Basin are expected to receive greater than normal precipitation as mountain snowfall, and generally colder than normal temperatures in the Northern Plains, usually during the January-February-March period. Increased plains snowfall and accumulations are generally expected due to the colder than normal temperatures. La Nina episodes create storm track conditions that move through the Pacific Northwest to the Northern Plains (Missouri River basin). **So far, during the winter of 2011-2012, the storm pattern and weather conditions have been nearly opposite of a characteristic La Nina, with warmer than normal temperatures in the upper Missouri River basin, and below normal precipitation and snow accumulation.**

Precipitation

Accumulated precipitation during the month of November (Figure 1) was above normal in northeast Montana and much of Wyoming; however, accumulated precipitation was below normal across the remainder of Montana, and significantly below normal (less than 25%) over very large portions of the Dakotas, Nebraska, Minnesota, and Iowa. The James River basin experienced one of its driest fall seasons on record. Though December 2011 (Figure 1) was not nearly as dry, precipitation accumulations were below normal in most of the upper basin. Northeast Montana and central Wyoming received above normal precipitation.

In comparison, November and December 2010 precipitation accumulations (Figure 2) exceeded 200% of normal in large areas of the Northern Plains. Some areas received over 400% of normal precipitation in Montana in November 2010. In December, a large majority of the upper basin received more than 200% of normal precipitation, with a large area receiving more than 400% of normal from northeast Montana into eastern South Dakota.

November 2011



December 2011

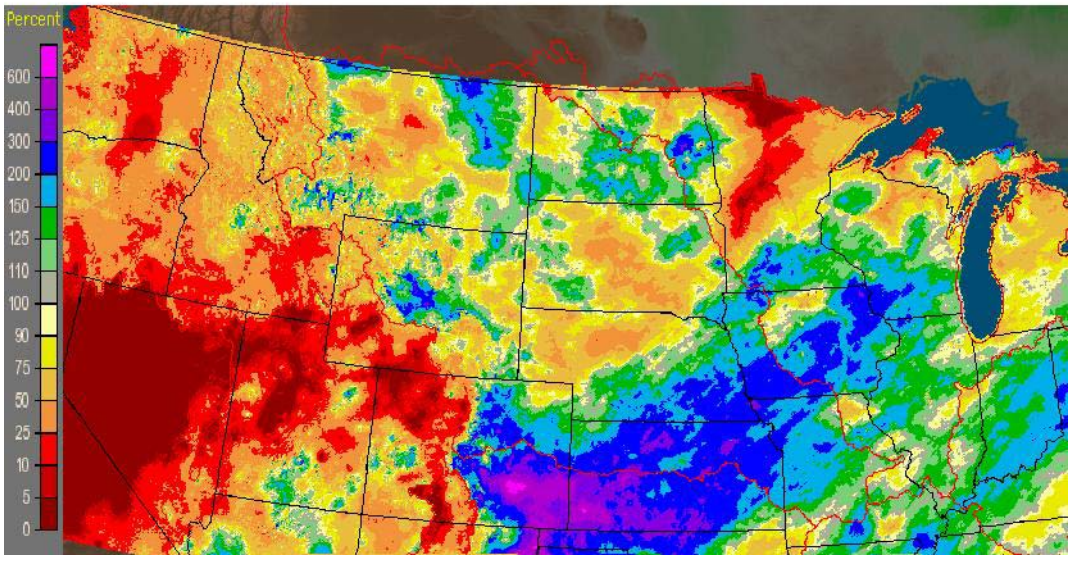
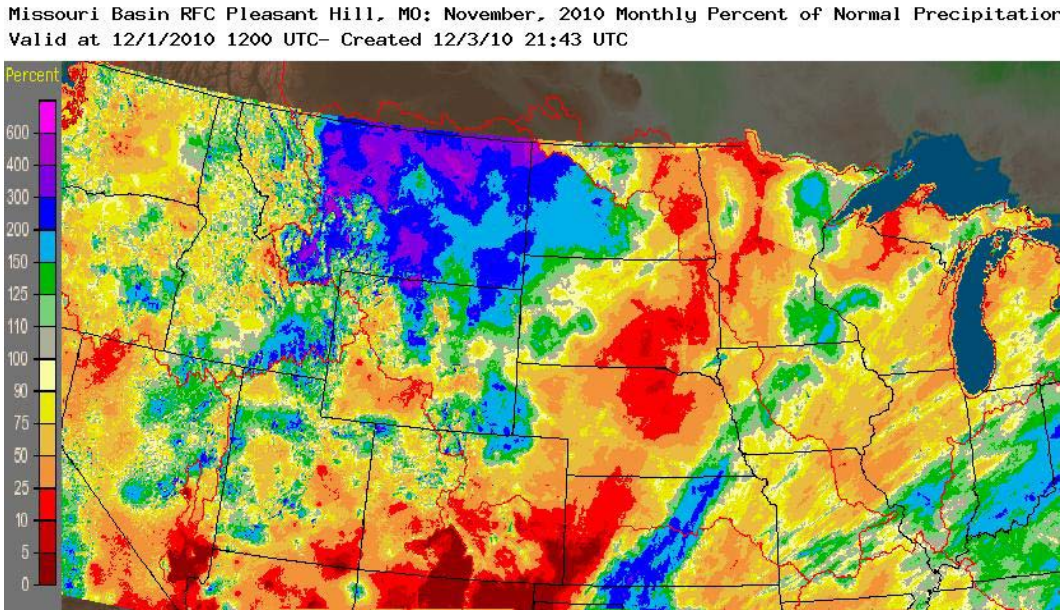


Figure 1. November and December 2011 Percent of Normal Precipitation

November 2010



December 2010

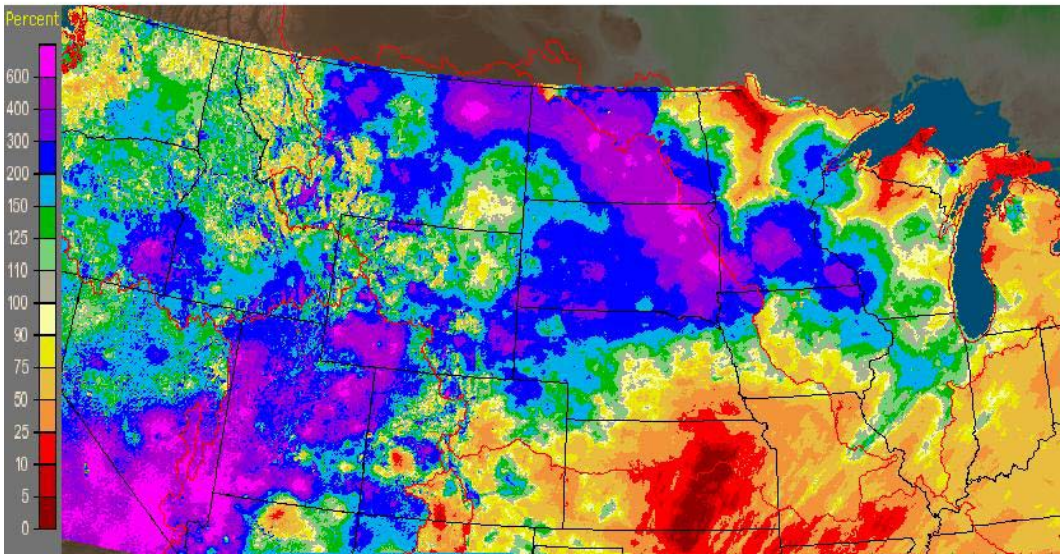


Figure 2. November and December 2010 Percent of Normal Precipitation

Temperature

Average temperatures throughout the basin above Sioux City, IA during the month of December 2011 were much above normal (Figure 3). The light gray shade represents positive temperature departures of six degrees Fahrenheit (F) occurring north of a line extending from northwest Iowa to northwest Montana. Positive temperature departures in this area ranged from six to ten degrees (F) above normal during December 2011. These higher than normal temperatures have been caused by positive swings in the Arctic and North Atlantic Oscillation, which sometime overshadow the seasonal affects of La Nina. Warmer than normal temperatures have greatly inhibited ice formation on the lakes and rivers, inhibited the formation of plains snowpack, and recently has resulted in frost depths decreasing in portions of the basin.

Ninety-day (90-day) temperature departures for 2011 and 2010 are shown in Figure 4. During the time period from early October 2011 to January 1, 2012, average daily temperatures have ranged from one to six degrees (F) above normal throughout the upper Missouri River Basin. The mountainous regions of the upper basin have been closer to normal with departures of about one degree (F), while the plains region has been much warmer with departures of three to six degrees above normal. In contrast to 2011, 2010 temperatures were zero to two degrees below normal in much of Montana, about normal in the plains, and zero to two degrees above normal in the mountains. During this time period, precipitation fell as snow and the colder temperatures allowed it to accumulate with no melting.

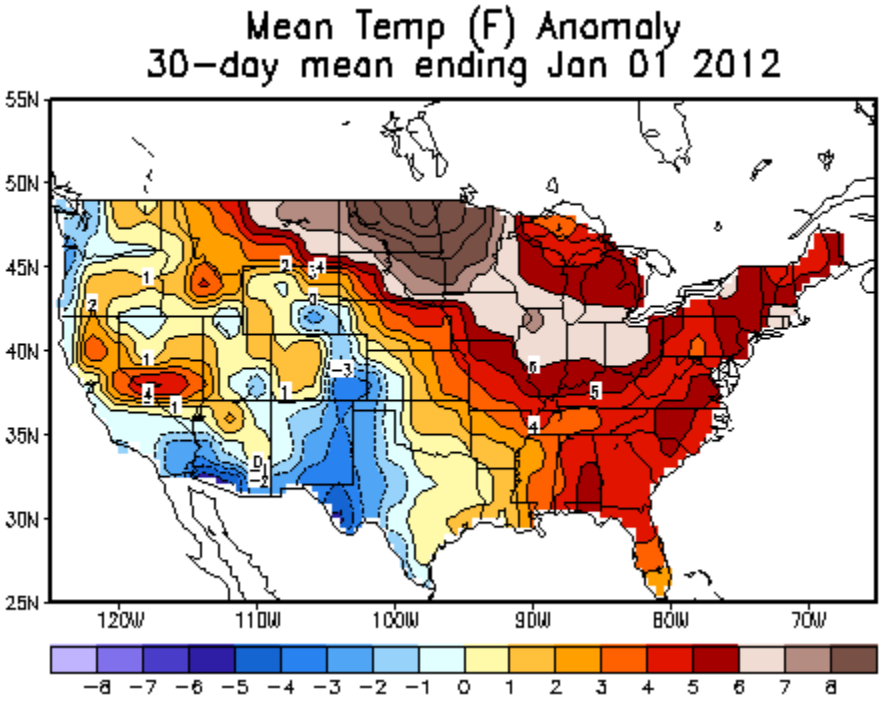


Figure 3. 30-day temperature anomaly (deg F) ending 01 Jan 2012.

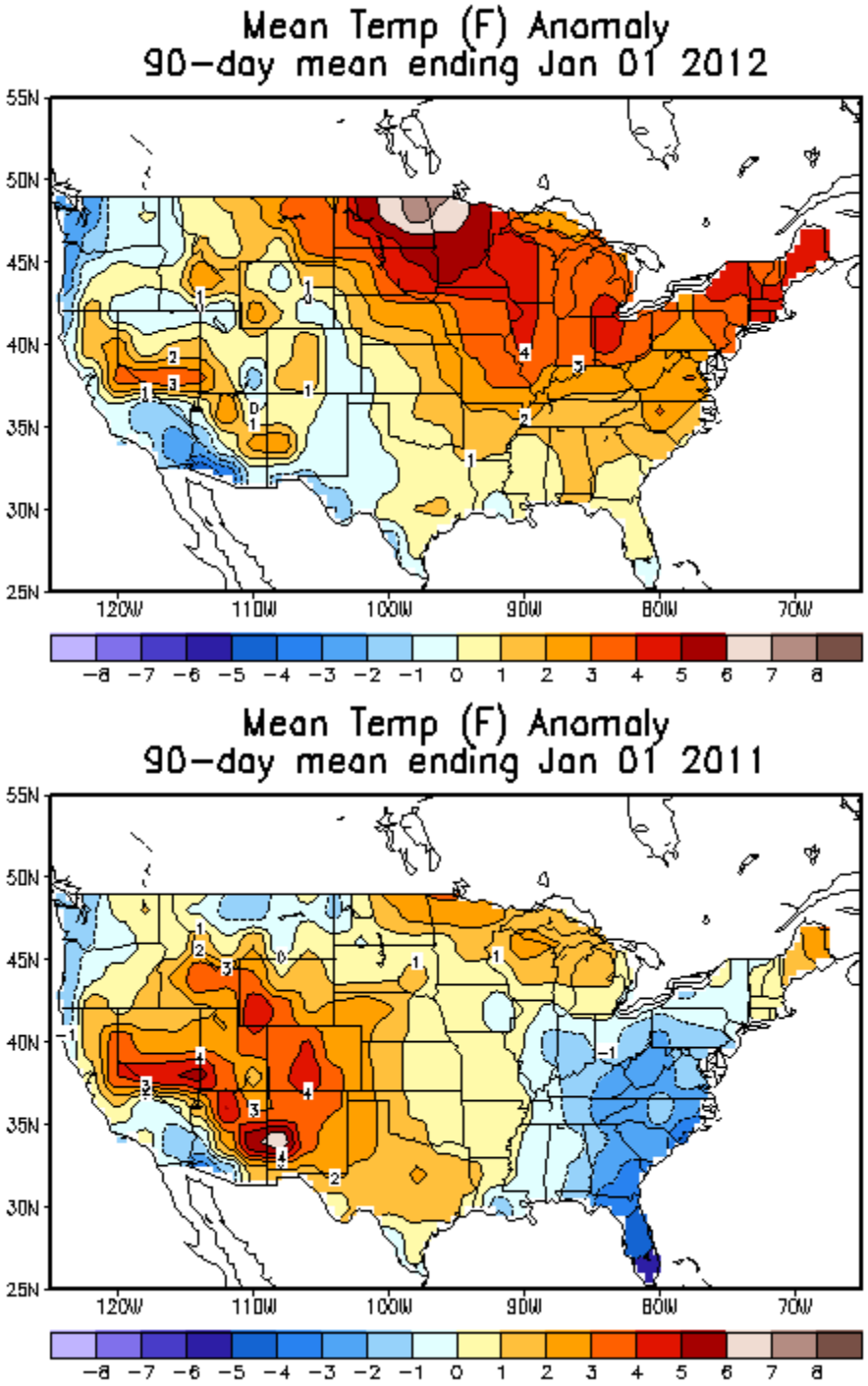


Figure 4. 90-day temperature anomaly (deg F) ending 01 Jan 2011 & 2012.

Soil Moisture and Frost Conditions

Soil moisture conditions at the end of December 2011 (Figure 5) were slightly wetter than the median soil moisture condition according to both the percentile rankings and soil moisture anomalies in the Upper Missouri River Basin mainly from the Missouri River westward to the Rocky Mountains. Percentile rankings range from the 70th to 80th percentile in the plains, and in the 90th percentile in small regions of northern Wyoming and central Montana. Moisture anomalies in the wettest areas range from 20 to 40 millimeters (< 1.0 – 2.0 inches) over a 1.6-meter depth. In the eastern half of the Dakotas, eastern Nebraska and northwest Iowa, soil moisture is much drier than the median soil moisture condition. Percentile rankings range from average down to the 20th percentile ranking; while anomalies are near normal to 100 millimeters (4.0 inches) below normal in northwest Iowa.

In contrast to 2011, 2010 soil moisture conditions were much wetter in December (Figure 6). Soil moisture percentile rankings ranged from the 70th to the 99th percentile ranking across most of the Dakotas, Montana, northern Nebraska, and most of Iowa. A large region north of the Missouri River was in the 90th percentile for soil moisture, and several areas reached the 99th percentile for soil moisture in the Big Sioux and James River basins, and in the Milk and Poplar River basins in Montana. Positive soil moisture anomalies ranged from 40 to 100 millimeters (<2.0 to 4.0 inches) over most of these areas. These extremely wet December conditions occurred as a result of much greater than normal fall 2010 precipitation followed by colder than normal temperatures in December.

Local observations for soil moisture and frost depth were made by the National Weather Service and Corps of Engineers project offices. Overall those soil moisture conditions are in agreement with the soil moisture assessment in Figure 5. Warm temperatures and less than normal Fall 2011precipitation has resulted in soils drying significantly in the top six inches, giving them the capacity to absorb more precipitation and snowmelt during the spring runoff season. Fall 2011 soils have a much greater capacity to store snowmelt water than Fall 2010 soils.

Two other factors that may affect runoff in 2012 include 1) soil frost conditions and 2) the depth to water tables. Soil frost depths (thicknesses) ranged from 14 to 18 inches according to NWS measurements in Montana, North Dakota and South Dakota. Per the NWS, these depths are considered “average” for the Northern Plains. Due to a lack of snow cover and warmer than normal temperatures in December, frost depths diminished slightly at the end of December. Per observation, in central and southern regions of South Dakota, there is no soil frost due to the lack of soil moisture. The second factor, depth to water table, is still much higher than normal, especially in the prairie potholes region of North and South Dakota. This factor has increased the contributing drainage area of the James River, and as a result has played a factor in the increased volume of runoff experienced in the James River basin over the past three years. Although soil moisture was much drier in the James River basin at the end of 2011, the shallow water table will likely contribute to greater than normal runoff in 2012.

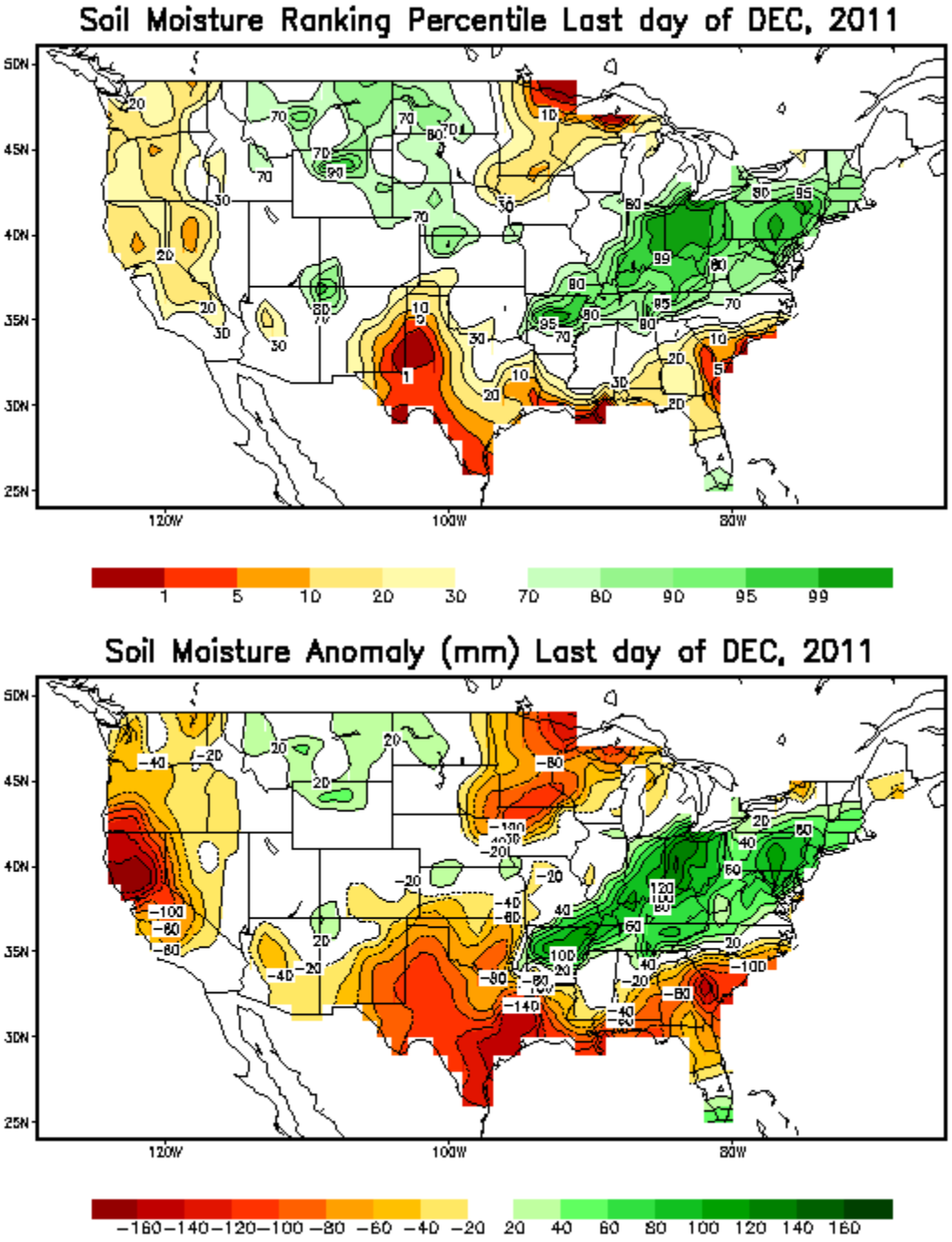


Figure 5. Calculated Soil Moisture Ranking Percentile (top) and Anomaly (bottom) in on the last day of December 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

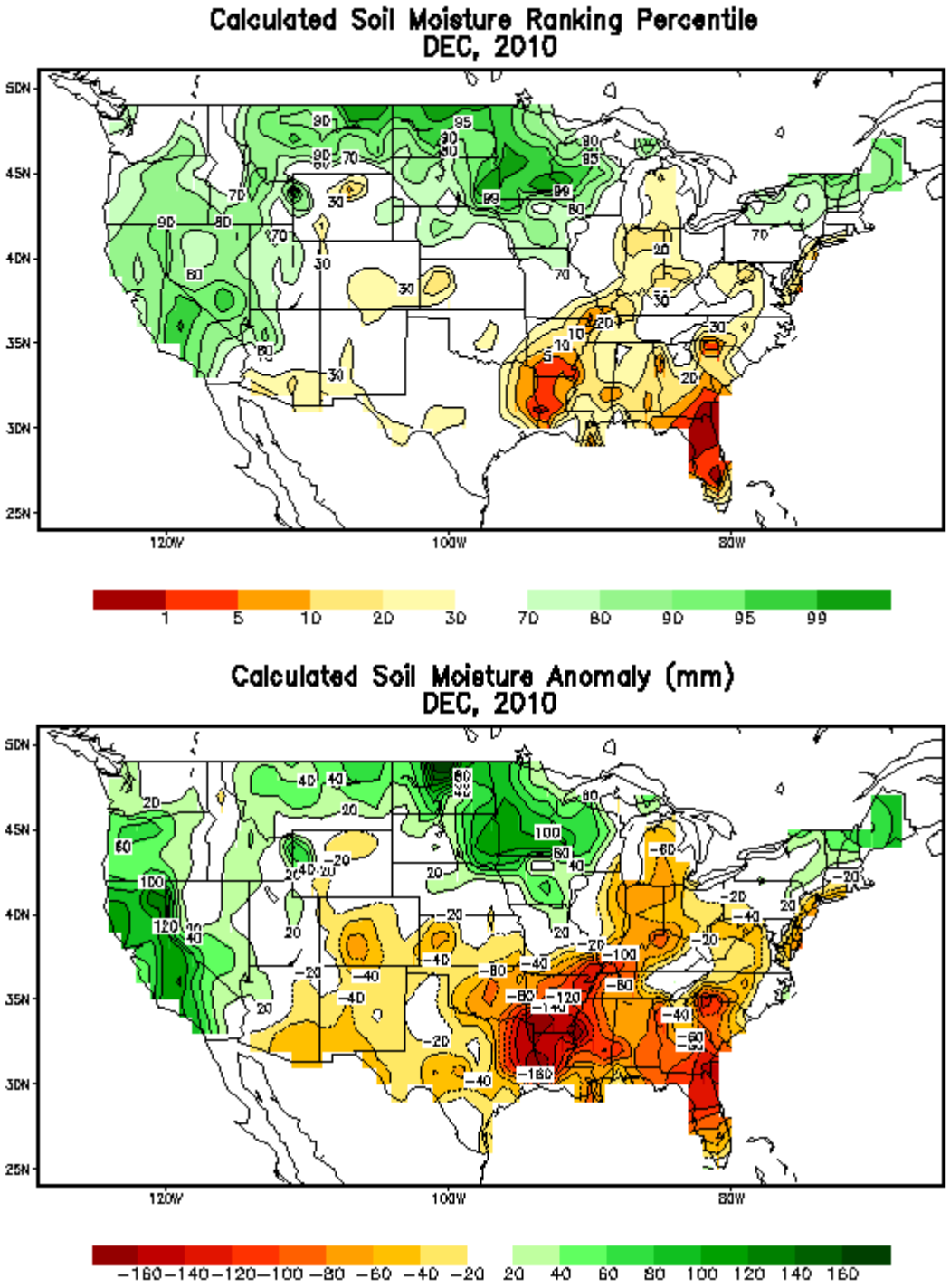


Figure 6. Calculated Soil Moisture Ranking Percentile (top) and Anomaly (bottom) in December 2010. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. A common misperception is that the March-April runoff is a result of plains snowmelt only. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due to both melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations are nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts, which for this year primarily includes long-term precipitation outlooks.

Plains snowpack as of January 2, 2012, was very sparse across the Missouri River basin upstream of Sioux City, IA (Figure 7). According to the National Operational Hydrologic Remote Sensing Center (NOHRSC), most plains snow water equivalent (SWE) amounts ranged from trace to one- inch amounts along the Montana-North Dakota highline, a portion of central North Dakota including the James River Basin, and parts of Wyoming, western Nebraska, northwest Iowa, and southwest Minnesota. For runoff forecasting purposes, plains snow in the six mainstem reservoir reaches is classified as follows:

Table 1. January 1, 2012 plains snowpack classification for runoff forecasting.

Reservoir Reach	Plains Snowpack Classification
Above Fort Peck	None to Light
Fort Peck to Garrison	None to Light
Garrison to Oahe	None
Oahe to Fort Randall	None
Fort Randall to Gavins Point	None
Gavins Point to Sioux City	None to Light

January 1, 2012

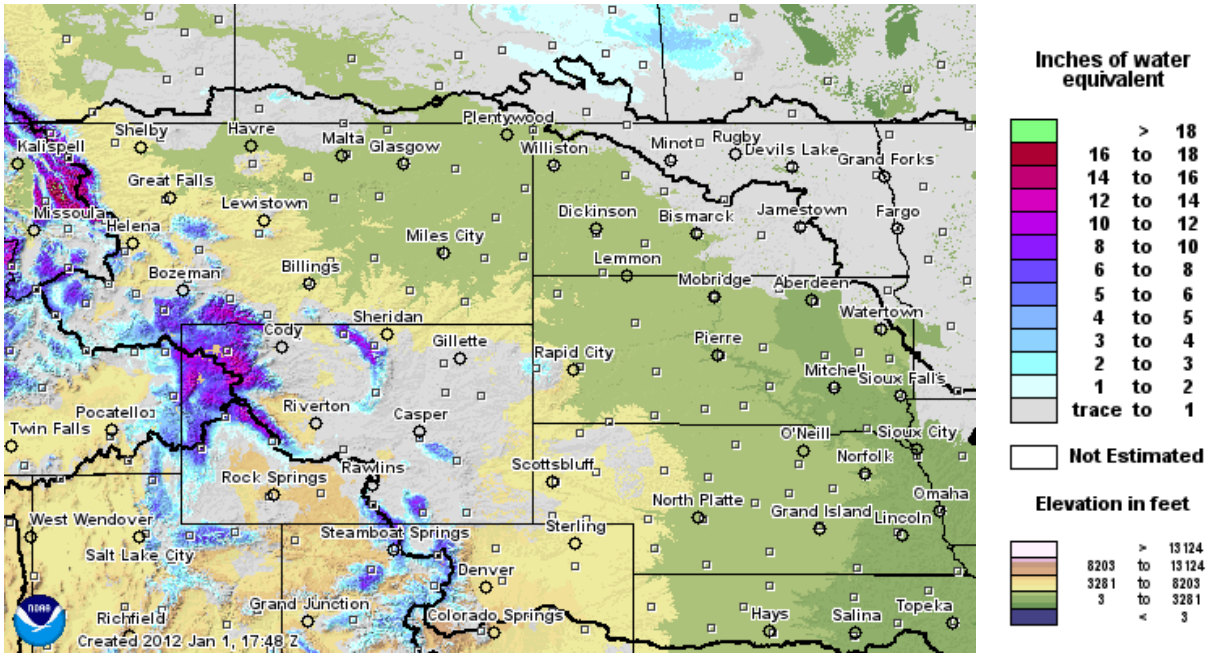


Figure 7. January 1, 2012 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

In contrast to January 1, 2012, plains snowpack on January 1, 2011 (Figure 8), was much more extensive in area and much greater in depth. An area of one-inch minimum SWE existed north a line extending from Sioux City, IA, to Shelby, MT. Heavy snow ranging from three to four inches of SWE covered a large area from Sioux Falls, SD, to Williston, ND; while similar amounts of plains snowpack were developing in northeast Montana. In general, plains snow covered most of the Missouri River basin this time last year.

January 1, 2011

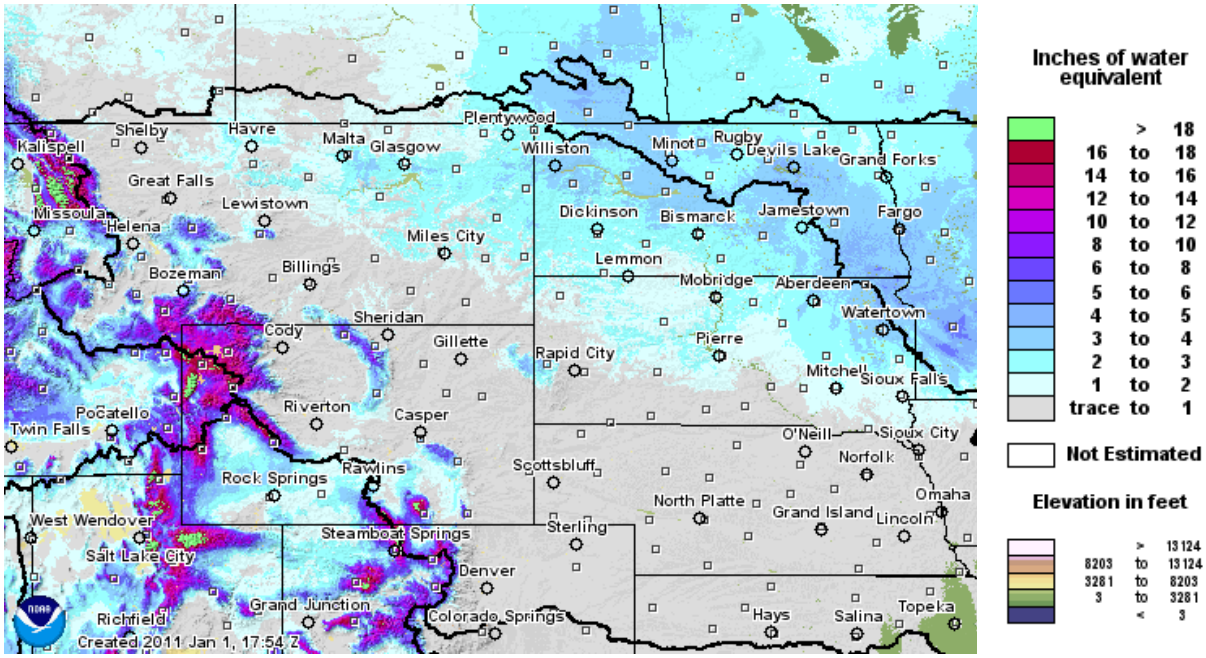


Figure 8. January 1, 2011 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

Mountain Snow Pack

Mountain snowpack is the primary factor used to predict May-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month May-July runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years. For example, we would expect to see greater than average runoff from an average mountain snowpack this year due to wetter than normal soil moisture conditions.

As of January 1, 2012, the Corps of Engineers' assessment of the mountain snowpack was 79% of normal in the drainage area above Fort Peck, and it was 96% of normal in the incremental drainage area between Fort Peck and Garrison (Figure 9). Normally by January 1, 42% of the peak snow accumulation has occurred in the mountains. In comparison, in 2011, January 1 snowpack was 110% of normal above Fort Peck, and it was 111% of normal between Fort Peck and Garrison. The NRCS depictions of the mountain SWE as a percent of normal SWE by mountain river basin as of January 1, 2012, are provided at the end of this report under the Additional Figures heading.

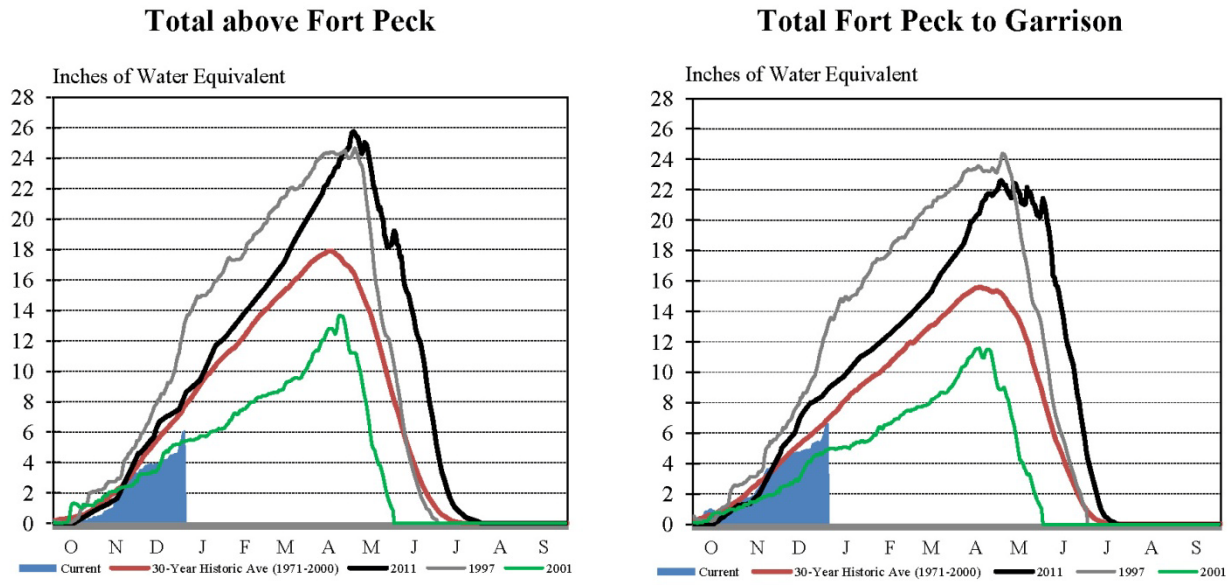


Figure 9. Mountain snowpack water content snow accumulation compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management.

Drought Analysis

According to the National Drought Mitigation Center (Figure 10), since December 2010 Abnormally Dry (D0) conditions have developed in the Missouri River basin in eastern Nebraska, northwest Iowa, the eastern Dakotas, and northwestern South Dakota and southwestern North Dakota. These conditions primarily came about near the end of the summer of 2011, and have intensified in the fall of 2011 as a result of above normal temperatures and below normal precipitation. Particularly dry areas include the eastern quarter of South Dakota, southern Minnesota, northwest Iowa and northeast Nebraska, which are classified in Moderate (D1) to Severe (D2) drought categories with short-term impacts. Short-term impacts generally affect agricultural interests. At this time, it appears that no long-term impacts related to hydrology and water supply are impacting any areas in the Missouri River Basin.

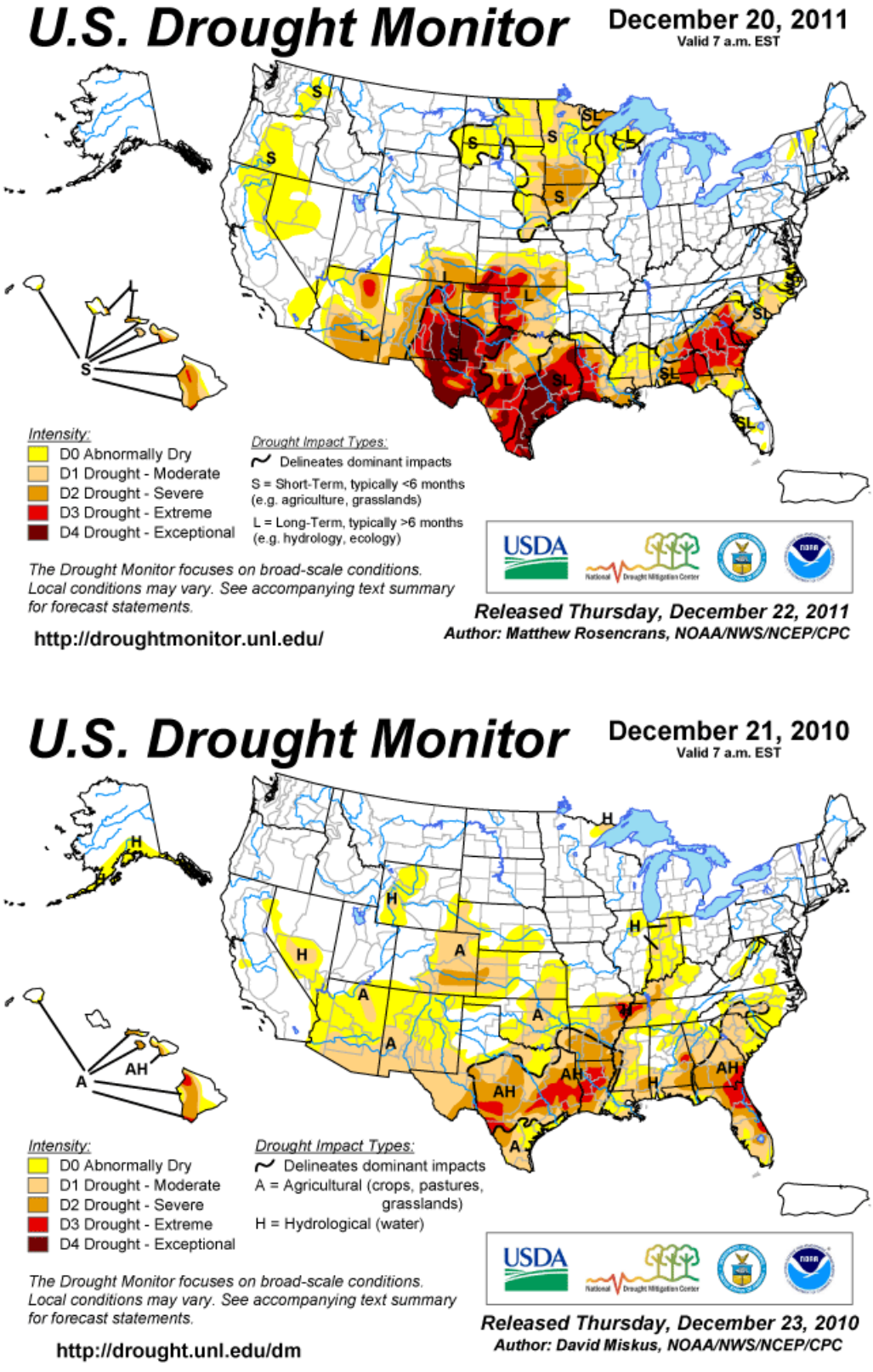


Figure 10. National Drought Mitigation Center U.S. Drought Monitors for December 20, 2011, and December 21, 2010.

Climate Outlook

La Nina is likely to continue with -1 to -2 degree Celsius anomalies along the equatorial Pacific through the winter of 2012. What has limited weather associated with La Nina so far have been very positive Arctic and North Atlantic Oscillations, which have limited the intrusion of cold air masses into the contiguous United States. According to the Climate Prediction Center, this has been the biggest difference in weather patterns between the winters of 2010-2011 and 2011-2012.

As of January 1, the North Atlantic Oscillation had shifted to a more neutral phase, which may indicate that more typical winter conditions are approaching. During the first one to two weeks of January, the Arctic and North Atlantic Oscillations are expected to remain positive to neutral, which will inhibit cold air masses from entering the continental U.S., favoring warmer than normal temperatures throughout the Missouri River Basin. The 6-10 Day Outlook (Figure 11) indicates temperatures are very likely to be above normal through January 13, while the possibility of a winter storm in the northern tier of states is likely. The 8-14 Day Outlook (Figure 12) indicates an increased probability for precipitation expanded over the entire Missouri River Basin accompanied by an increased probability for normal to below normal temperatures in the Northern Rockies. An increased probability for above normal temperatures will continue over the Plains.

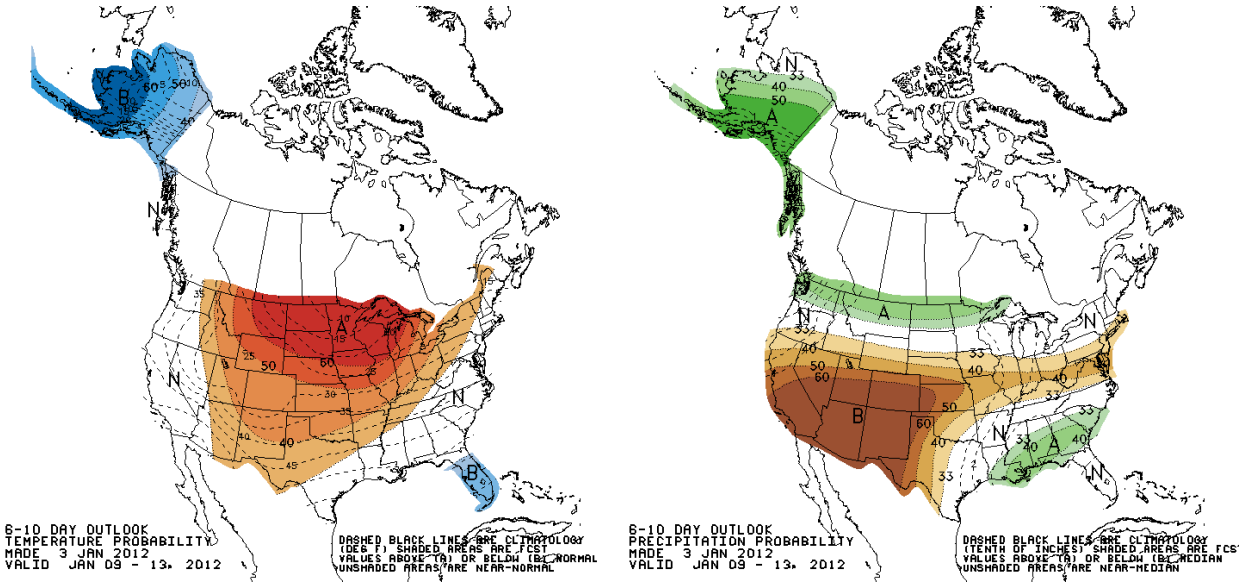


Figure 11. CPC 6-10 day temperature and precipitation outlooks.

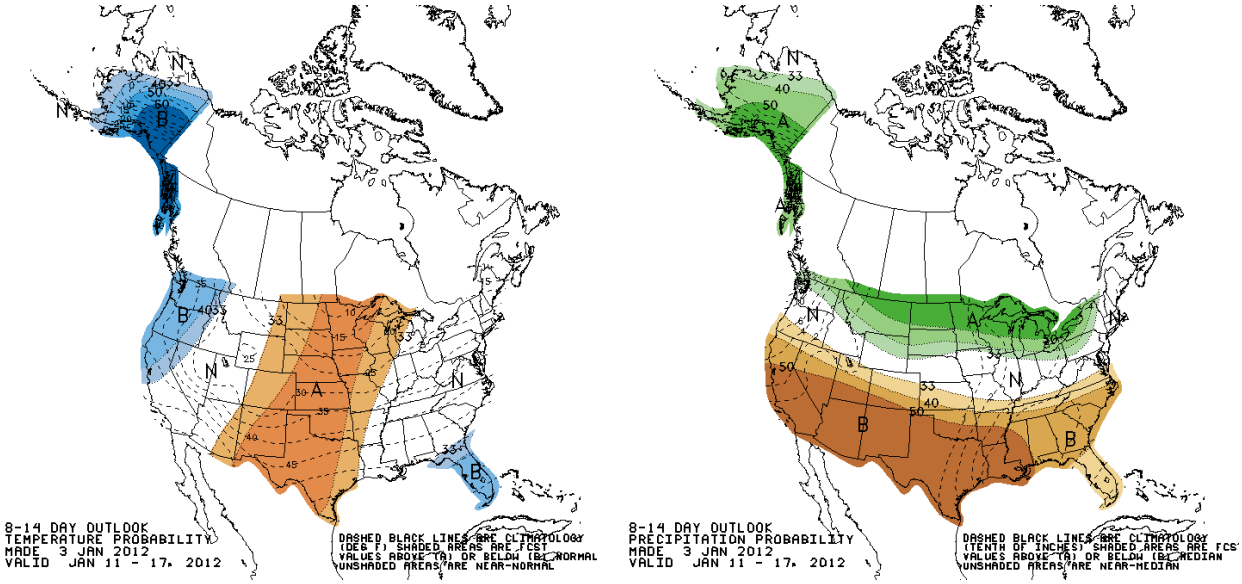


Figure 12. CPC 8-14 day temperature and precipitation outlooks.

The precipitation probability for January (Figure 13) will be consistent with La Nina composites, favoring above normal precipitation in the Northern Rockies extending into eastern Montana. The temperature outlook indicates an increased probability for below normal temperatures in the Northern Rockies and above normal temperatures in the Plains. If these conditions occur, expect greater than normal accumulations of snow in the mountains, with no definitive result in the Plains.

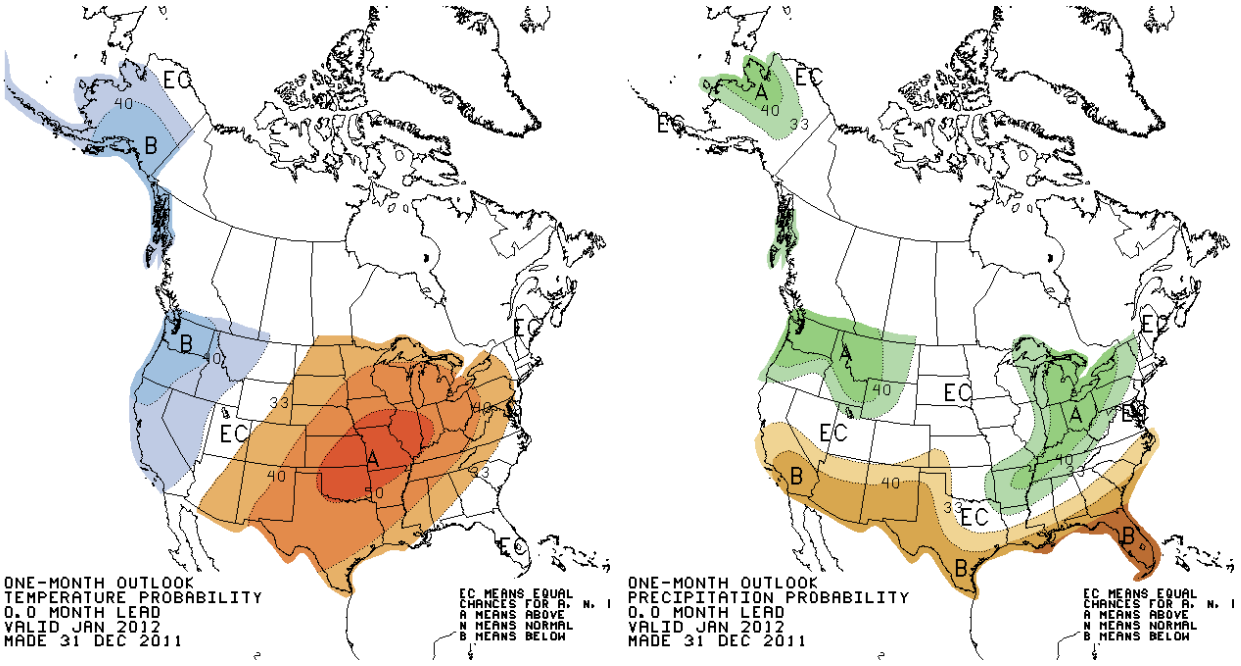


Figure 13. CPC January 2012 temperature and precipitation outlooks.

La Nina generally makes its greatest impact to North American weather in winter and early spring. In 2011 precipitation was above normal especially in the fall leading up to January 2011, and well above normal from January through June. Temperatures were generally much colder than normal throughout

the winter and spring. The upcoming 2012 January-February-March period is expected to receive above normal precipitation as a result of increased precipitation probabilities along with increased chances for below normal temperatures per the CPC's seasonal precipitation outlook (Figure 14). The expected result from these conditions would be greater than normal accumulations of snow in the mountains and plains.

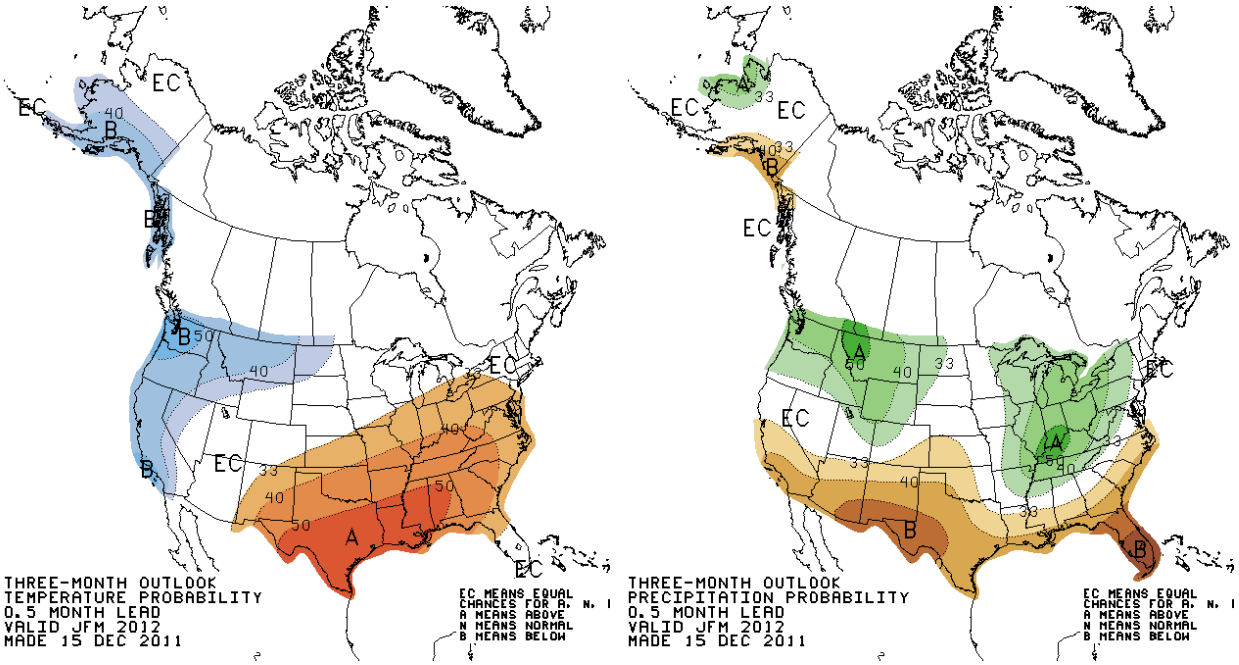


Figure 14. CPC January-February-March 2012 temperature and precipitation outlook.

Climate impacts of La Nina will continue during the spring and early summer; however, experts have indicated that La Nina is expected to weaken during the spring and summer. According to the CPC outlook, an increased probability for below normal temperatures will continue in the Northern Rockies and Plains in Montana through June 2012 (Figure 15). Additionally, La Nina has created an increased probability for above normal precipitation in the Northern Plains extending from northeast Montana into North Dakota. All other areas will have equal chances for above, normal, or below normal temperatures and precipitation. In July-August-September, the CPC climate outlook (Figure 16) is indicating there is a much greater probability for above normal temperatures throughout the West and Rocky Mountains, along with a slight increase in probabilities for below normal precipitation in the Northern Rocky Mountains. In this outlook there is no indication that precipitation will be above normal nor that temperatures will be below normal. Similarly in the October-November-December period, there are weak indications in the climate outlook (Figure 17) that temperatures will be above normal in the Central Rockies. There are equal chances for normal, above or below normal temperatures and precipitation throughout most of the Missouri River Basin.

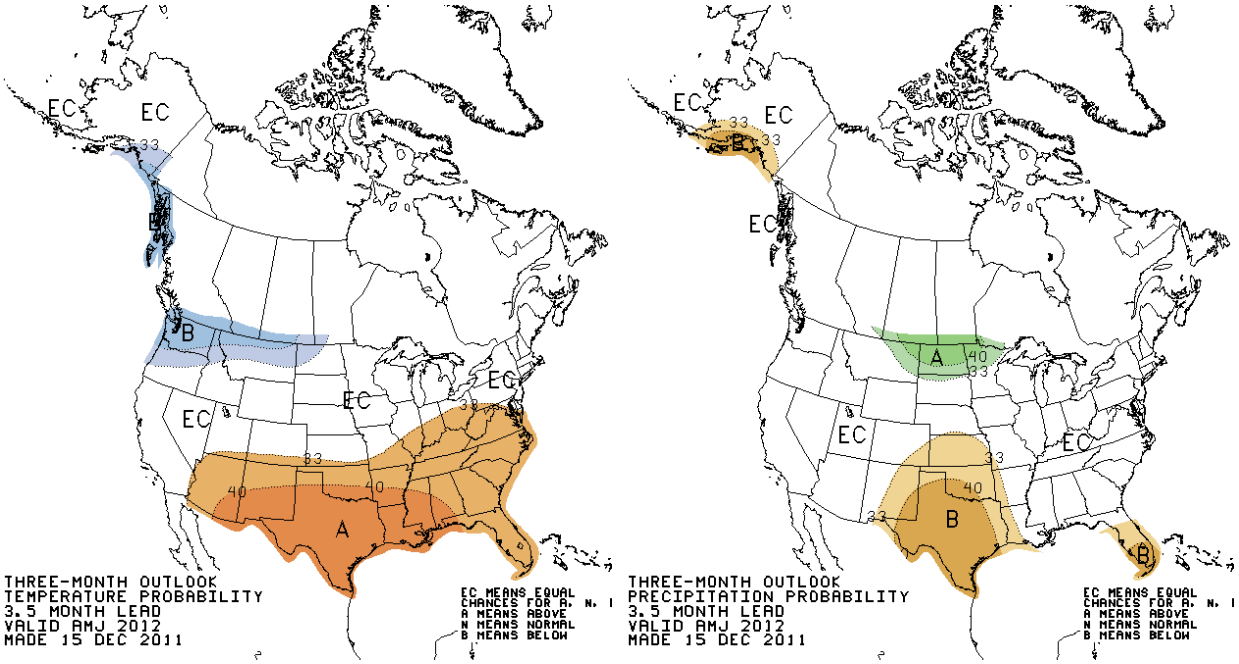


Figure 15. CPC April-May-June 2012 temperature and precipitation outlook.

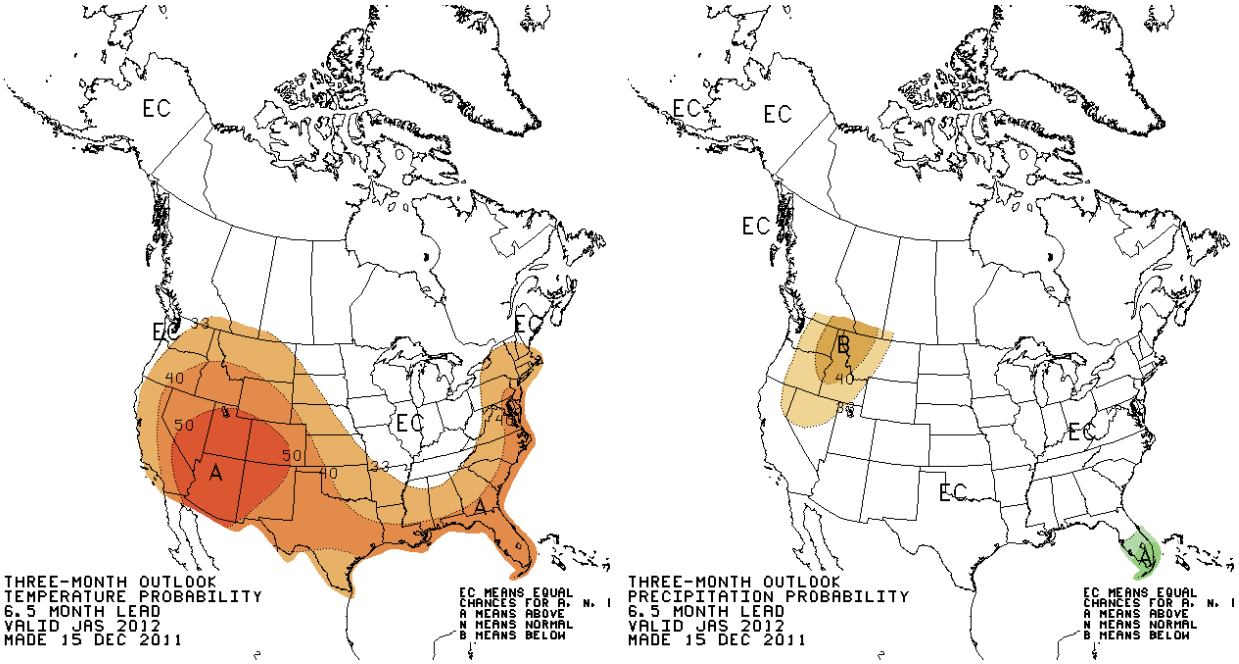


Figure 16. July-August-September 2012 temperature and precipitation outlook.

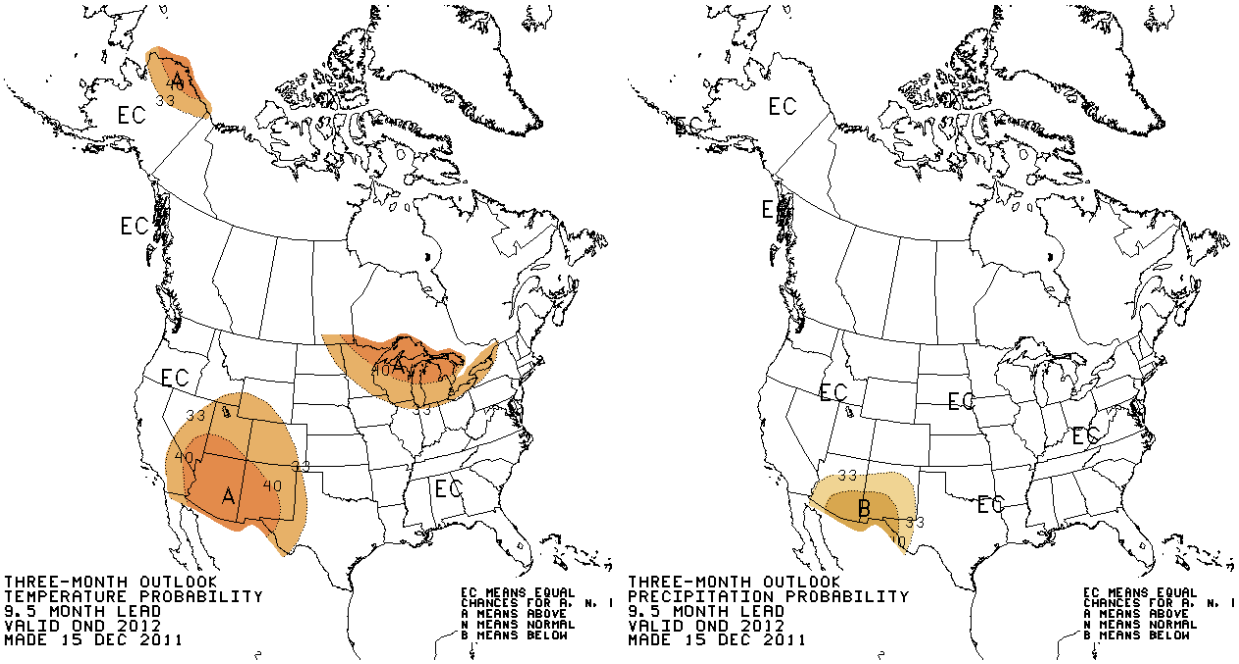


Figure 17. CPC October-November-December 2012 temperature and precipitation outlook.

January 2012 Calendar Year Runoff Forecast

2012 is shaping up to look similar to the 1998 runoff year, a year which also followed three years of high runoff. **The calendar year runoff forecast is 26.5 MAF above Sioux City, 22.8 MAF above Gavins Point.** Due to the amount of variability in precipitation that can occur over the next 12 months, the range of expected inflow is quite large and ranges from the 36.2 MAF upper basic forecast to the 17.8 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. In 1998, 26.4 MAF occurred above Sioux City and 23.4 occurred above Gavins Point. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff. It should be noted, however, that it is possible, due to either much higher or much lower than forecasted precipitation occurring, that these ranges may be exceeded on either end.

Factors taken into consideration while preparing the 2012 forecast include: soil moisture content, the presence of soil frost, the presence of high water tables in some regions, plains snowpack, mountain snowpack, and the CPC's monthly and seasonal temperature and precipitation outlooks.

Soil moisture in the basin is slightly above normal in northern and eastern Montana but quickly dries out moving east into the Dakotas, Iowa and Nebraska. Following the record year of runoff, water tables are still high in some regions, particularly northeast Montana, central and eastern North Dakota and northeast South Dakota. In general, the higher the soil moisture and water table, the higher the runoff and baseflow. Soil frost is mostly non-existent in central and eastern South Dakota, but is present at depths of 12 to 18 inches from northern South Dakota to northeast Montana.

The mountain snowpack was 79% and 96% of normal in the Fort Peck and Garrison reaches, respectively. In 1998 January 1 snow was 72% and 84%, but eventually peaked at 92% and 101% percent. As of January 1, 2012, plains snowpack was limited to a thin cover of less than 1-inch of SWE in far northern boundary areas of the Missouri River Basin in Montana and North Dakota. 2012 snow could increase in the mountains if the precipitation pattern changes to the more typical La Nina Pacific NW pattern accompanied by cooler than normal temperatures. This would also likely cause some plains snow formation.

The Climate Prediction Center (CPC) is expecting a change in winter conditions by mid-January to wetter than normal and colder than normal winter conditions in the Rocky Mountains. Similar conditions extending into the plains are expected in February and March, returning to normal by the summer. As the year progresses, there is an increased chance of precipitation in northeast Montana and North Dakota in April-May-June accompanied by an increased chance for below normal temperatures in the northern half of Montana and northwest North Dakota. This would likely enhance the amount of runoff during the summer snowmelt months into Fort Peck and Garrison.

January-February

Beginning in January and February, runoff is expected to be above normal in all reaches, with the exception of the Gavins Point reach, as a result of higher baseflows and above normal temperatures limiting ice formation. The runoff in the Gavins Point reach is expected to be just below normal based on previous months' runoff and exceptionally dry basin/soil conditions in this reach.

March-April

In March and April, in spite of no plains snow cover, runoff is forecast to be above normal in the Fort Peck and Garrison reaches as a result of above normal soil moisture content and the outlook for above normal precipitation accompanied by colder temperatures. Plains snow is a significant factor influencing the volume of runoff in March and April; however, precipitation during this time period as snow and rainfall are also very important factors that need consideration. In the Oahe reach, March-April runoff is forecast to be slightly above normal based on the expectation that January, February, March and April precipitation will be above normal in the reach with below normal temperatures, which favor plains snow formation. Similarly the Fort Randall and Gavins Point reaches are forecast to experience slightly above normal runoff in March and April.

In the Sioux City reach, though affected by very dry conditions and severe drought, runoff is forecast to be well above normal because elevated groundwater has effectively increased the contributing drainage areas, plus the rivers (James and Big Sioux) entered the winter with high levels of water in their channels. Another factor considered is that average runoff in this reach over the past 30 years is nearly double the long-term (1898-2011) average runoff, so monthly runoff is expected to be above normal throughout the year. Increased chances of precipitation in the winter and spring were a major factor for increasing March-April runoff to normal and above-normal volumes in spite of the dry soil conditions with no snow.

May-June-July

During the May-June-July period, the mainstem system receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River Basin, so runoff can vary significantly as a result of the above or below normal rainfall.

For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Using existing mountain snowpack (79% of normal in the reach above Fort Peck and 96% of normal in the reach between Fort Peck and Garrison) and the CPC 3-month outlooks of spring precipitation and temperatures, the May-June-July runoff is forecast to be less than normal in the Fort Peck reach and slightly above normal in the Garrison reach. Soil conditions are slightly wetter than normal, and the climate outlook is forecasting increased probabilities of precipitation and colder temperatures through June, increasing the likelihood that the snow formation rate in the mountains will increase. Thus, the Fort Peck runoff is forecasted to be about 90% of normal during this 3-month period; the Garrison runoff is forecasted to be about 101% of normal during this 3-month runoff period.

The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total annual runoff into the system.

Runoff in the Oahe, Fort Randall and Gavins Point reaches is forecast to be below normal based on the fact that there is no strong climate signal that will influence the weather during the time, plus the already dry soil moisture and drought conditions in the plains that are expected to persist at least into the spring.

August through December

During the August-December period, we forecast runoff to be about normal, primarily due to the equal-chances probabilities for above normal, below normal or normal precipitation and temperature conditions, per CPC long-term temperature and precipitation outlooks. As the year progresses and the July through December precipitation and temperature outlooks are updated with more detail, these values may change.

NRCS Water Supply Outlook

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: January 04, 2012 08:09:49 AM
   - Based on January 01, 2012 forecast values

PRELIMINARY MISSOURI RIVER BASIN FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Lima Reservoir Inflow	APR-JUL	62	65	98	77	47	26	96
	APR-SEP	65	63	106	82	48	24	104
Clark Canyon Reservoir Inflow	APR-JUL	75	57	173	115	45	30	131
	APR-SEP	89	57	197	133	53	36	156
Jefferson R nr Three Forks	APR-JUL	605	78	1060	790	420	145	780
	APR-SEP	655	76	1170	860	450	145	860
Hebgen Reservoir Inflow	APR-JUL	330	84	415	365	295	245	395
	APR-SEP	420	83	525	460	380	315	505
Ennis Reservoir Inflow	APR-JUL	560	82	715	625	495	405	680
	APR-SEP	700	82	885	775	625	515	850
Missouri R at Toston	APR-JUL	1680	82	2450	1990	1370	915	2050
	APR-SEP	1960	82	2850	2320	1600	1070	2390
Smith R bl Eagle Ck	APR-JUL	120	90	175	142	98	65	133
	APR-SEP	130	87	194	156	104	66	149
Gibson Reservoir Inflow	APR-JUL	405	88	525	455	355	285	460
	APR-SEP	445	88	570	495	395	320	505
Marias R nr Shelby	APR-JUL	375	90	575	455	295	177	415
	APR-SEP	395	90	600	480	310	190	440
Lake Sherburne Inflow	APR-JUL	100	95	120	108	92	80	105
	APR-SEP	117	96	137	125	109	97	122
St. Mary R at Int'l Boundary	APR-JUL	435	100	555	485	385	315	435
	APR-SEP	510	99	630	560	460	390	515
Milk R at Western Crossing	MAR-JUL	36	88	59	45	27	13.4	41
	MAR-SEP	38	88	62	48	28	14.0	43
	APR-JUL	31	94	48	38	24	13.8	33
	APR-SEP	33	92	51	40	26	15.1	36
Milk R at Eastern Crossing	MAR-JUL	79	95	146	106	52	32	83
	MAR-SEP	86	98	156	114	58	34	88
	APR-JUL	60	99	110	80	40	24	61
	APR-SEP	66	95	118	87	45	26	69
Beaver Ck nr Havre	MAR-JUL	5.0	52	11.6	7.7	3.6	2.0	9.6
	APR-JUL	4.8	55	13.0	7.2	3.2	1.77	8.7

PRELIMINARY YELLOWSTONE RIVER BASIN FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Wind R ab Bull Lake Ck	APR-JUL	365	84	525	430	300	205	435
	APR-SEP	450	84	630	525	375	270	535
Bull Lake Ck nr Lenore	APR-JUL	147	99	181	161	133	113	148
	APR-SEP	178	98	220	195	161	135	182
Boysen Reservoir Inflow	APR-JUL	550	77	930	705	395	168	717
	APR-SEP	605	75	1040	780	430	173	809
Greybull R nr Meeteetse	APR-JUL	167	113	205	182	152	131	148
	APR-SEP	225	113	270	245	205	179	200
Shell Ck nr Shell	APR-JUL	68	113	83	74	62	53	60
	APR-SEP	81	113	97	88	74	65	72
Bighorn R at Kane	APR-JUL	960	96	1430	1150	770	495	1000
	APR-SEP	1050	95	1570	1260	840	535	1110
NF Shoshone R at Wapiti	APR-JUL	475	103	575	515	435	375	460
	APR-SEP	535	103	640	575	495	430	520
SF Shoshone R nr Valley	APR-JUL	225	100	275	245	205	176	225
	APR-SEP	260	98	315	280	240	205	265
Buffalo Bill Reservoir Inflow	APR-JUL	715	99	875	780	650	555	720
	APR-SEP	795	99	965	865	725	625	805
Bighorn R nr St. Xavier	APR-JUL	1540	96	2110	1770	1310	965	1610
	APR-SEP	1670	95	2320	1930	1410	1020	1760

Little Bighorn R nr Hardin	APR-JUL	143	112	195	164	122	91	128
	APR-SEP	164	114	220	187	141	107	144
Tongue R nr Dayton	APR-JUL	109	114	143	123	95	75	96
	APR-SEP	125	115	162	140	110	88	109
Tongue River Reservoir Inflow	APR-JUL	265	120	375	310	220	153	220
	APR-SEP	300	120	420	350	250	182	250
NF Powder R nr Hazelton	APR-JUL	8.9	93	12.2	10.2	7.6	5.6	9.6
	APR-SEP	9.7	93	13.1	11.1	8.3	6.3	10.4
Powder R at Moorhead	APR-JUL	215	105	330	260	168	99	205
	APR-SEP	245	107	365	295	196	125	230
Powder R nr Locate	APR-JUL	245	104	385	300	188	104	235
	APR-SEP	280	108	430	340	220	128	260

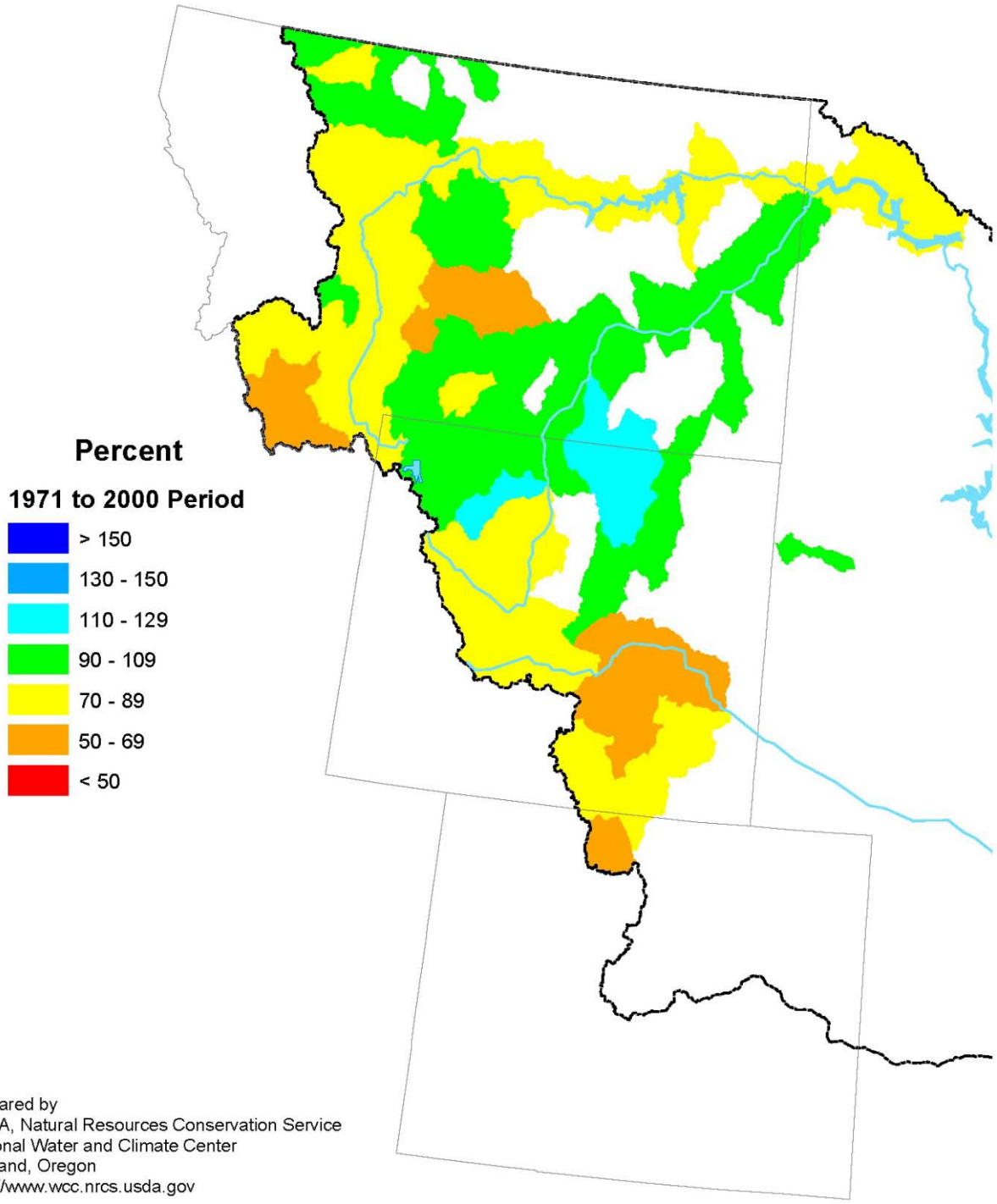
PRELIMINARY RAPID VALLEY UNIT FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Deerfield Reservoir Inflow	MAR-JUL	5.8	95	10.5	7.7	3.9	2.3	6.1
	APR-JUL	5.0	98	9.2	6.5	3.7	2.1	5.1
Pactola Reservoir Inflow	MAR-JUL	23	88	46	32	13.7	9.2	26
	APR-JUL	21	91	45	30	13.9	6.2	23

Max is 90th percentile and min is 10th percentile except with footnote 1 below.
Averages are for the 1971-2000 period.
All volumes are in thousands of acre-feet.

footnotes:
1) max is 95th percentile and min is 5th percentile
2) streamflow is adjusted for upstream storage
3) median value used in place of average

Missouri River Basin
Spring and Summer Streamflow Forecasts
as of January 1, 2012



Prepared by
USDA, Natural Resources Conservation Service
National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

NOAA Water Supply Forecast

Unavailable at this time.

Field Verification of Conditions

National Weather Service (NWS) warning forecast offices and Corps of Engineers mainstem project offices were consulted during the week of December 27-30 to assess local hydrologic factor field conditions. Their observations are summarized below.

NWS Glasgow - Temperatures have been 3 to 8 degrees F above normal in December 2011 with very little plains snow cover remaining in northeast Montana. Due to the warmer than normal temperature conditions, the Yellowstone and Missouri Rivers have had some ice jam issues. As of December 29 there was a little snow in the Milk, Frenchman and Poplar River basins in Canada. The soil frost depth was 18 inches. Soil moisture was still wetter than normal in the lower Milk and Yellowstone River basins and localized water tables were still high.

NWS Bismarck - The NWS in Bismarck reported that precipitation has been normal to below normal since September with August being the last month of above normal precipitation. With regard to snow, only the northwest corner had about one to two inches of snow depth. Soil conditions in North Dakota are drier than the CPC estimate reported; however water tables are still quite high, especially in the prairie potholes landform area. According to NWS, the higher water tables in this region have increased the contributing drainage areas of the James River. The soil frost depth in Bismarck was 14 inches as of December 29, in contrast to 2010-2011 in which hardly any frost existed in the soil because snow accumulation occurred before the soil had frozen. At present, there was no river ice on the Missouri River.

NWS Aberdeen – No snow existed in the north central and northeast South Dakota as of December 29. Significant snowfall of nine to ten inches occurred in November in the Pierre area; however, all of it had melted. The frost depth in Aberdeen was 14 inches, down from 16 inches earlier in the month. The James River was still in flood stage near Stratford, SD, but was falling below flood stage as parts of it remained ice free. With drought developing in eastern South Dakota, the Big Sioux River level and flow has dropped to safe levels.

COE Fort Peck. Very little snowfall has occurred this winter so far; however soil moisture is slightly higher than usual. The frost depth is not very deep as a result of warm temperatures this winter. Fort Peck Lake had not frozen over as of January 3.

COE Garrison. We have almost no snow cover in the area. We do have frost but I'd assume the depth is not the great based on the amount of open water we still have in the area. We did get about a quarter inch of rain late last week, which was actually running off. Some of that is probably attributable to having frost in the ground, but the water tables still appear to be high based on seeps still coming from the hillsides. Sloughs and retention areas are still holding a lot of water, i.e. do not have much

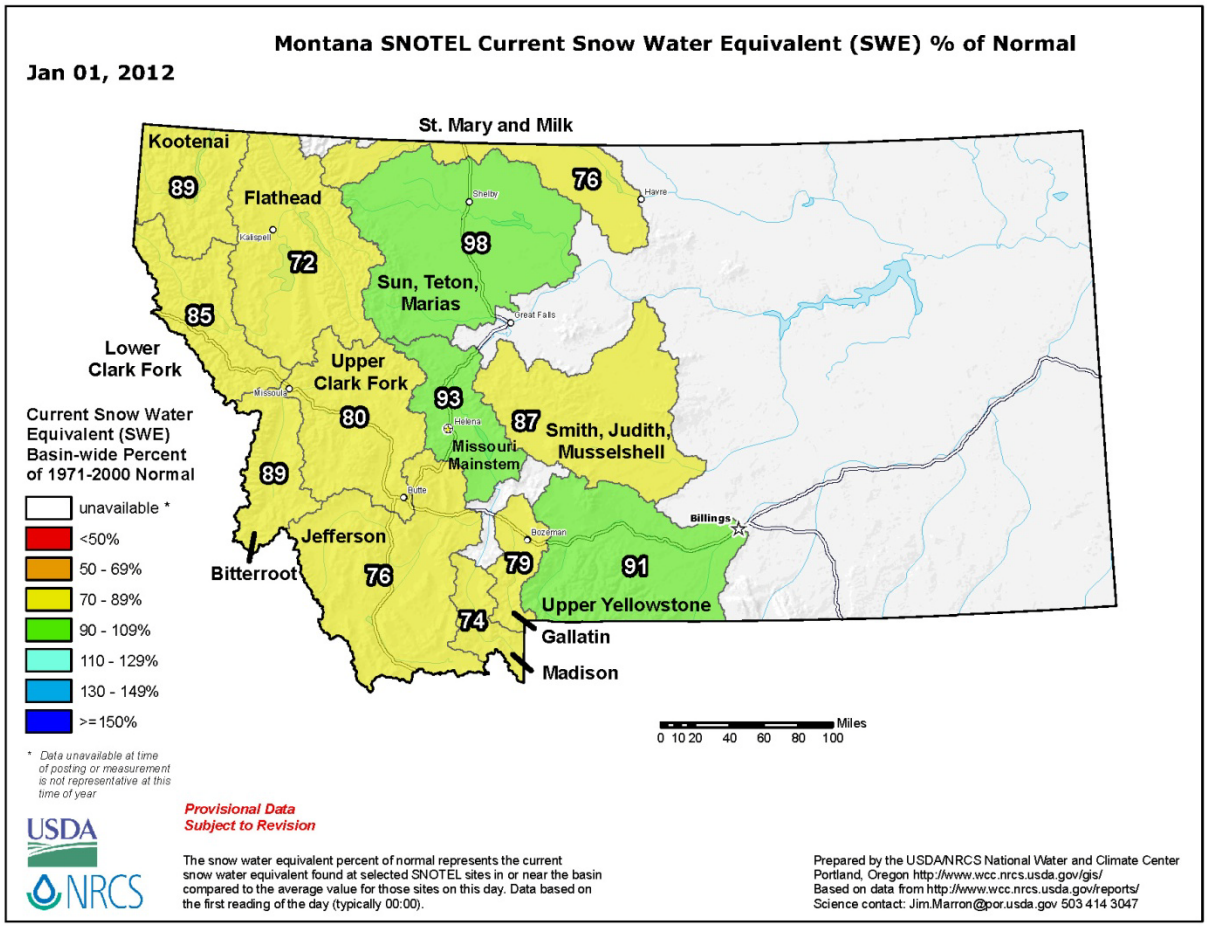
storage for snow melt or spring rains. This is pretty consistent for the Missouri River drainage from Pipestem to the Bowman-Haley area...

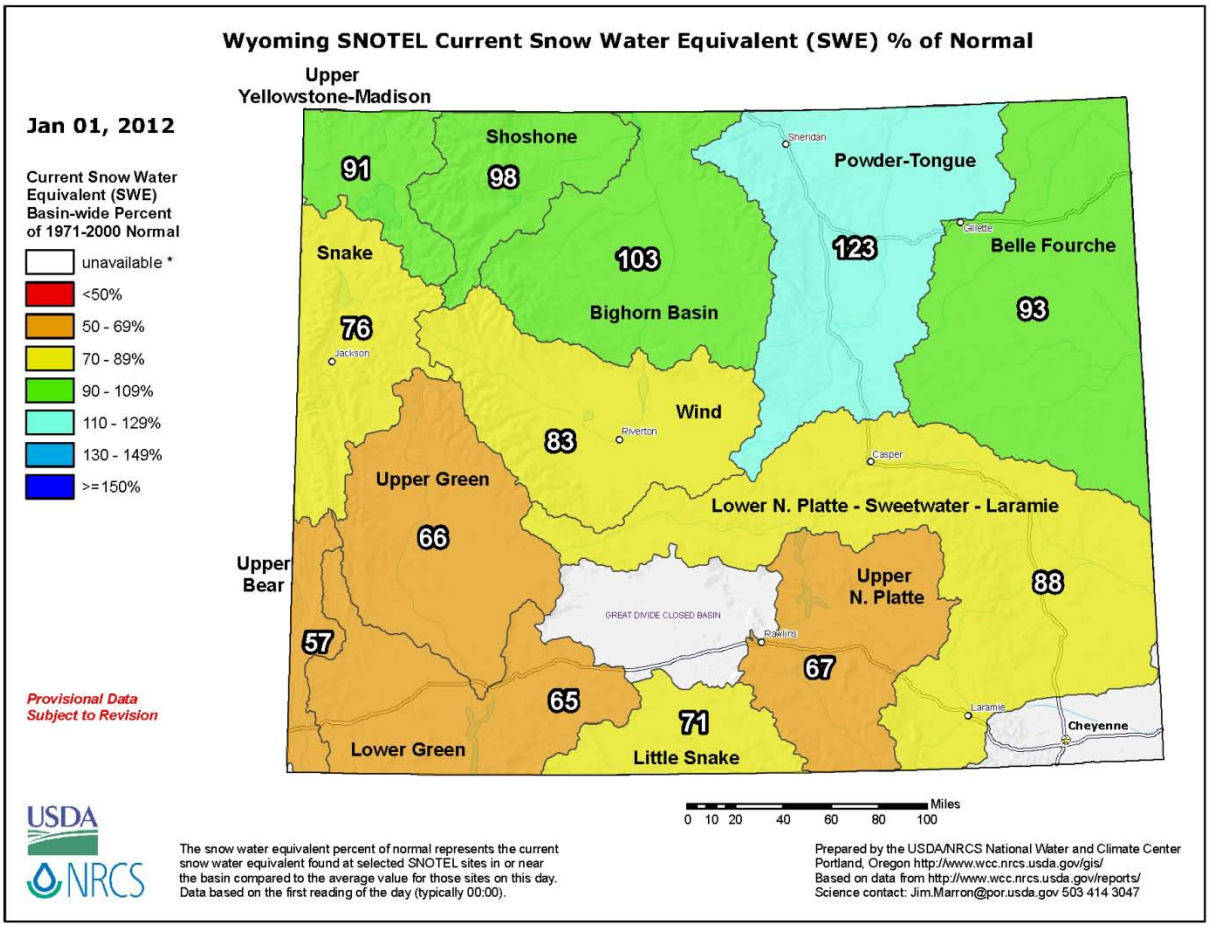
COE Oahe. As of December 29, there was not snow cover in the Oahe Dam area. Soil moisture was generally dry with no frost depth.

COE Fort Randall. In the Fort Randall watershed area, it is very dry with no snow cover. Since there is very little soil moisture 12 to 18 inches in depth, there was not frost in the soil. Surface storage areas are drying up as well, and some of the prairie potholes and marshes between Pickstown and Yankton are completely dry. Bigger lakes in the area continue to lose elevation as water table levels have begun declining.

COE Gavins Point. At Gavins Point there is now snow cover with no frost depth and very little soil moisture. The topsoil is noticeably “powder-dry”.

Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Jan 01, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Upper Yellowstone-Madison
91
Shoshone
98
Sheridan
Powder-Tongue
Gillette
123
Belle Fourche
93
Snake
103
Bighorn Basin
76
Jackson
Wind
Riverton
83
Casper
Upper Green
Lower N. Platte - Sweetwater - Laramie
66
Upper Bear
Upper N. Platte
88
GREAT DIVIDE CLOSED BASIN
Rawlins
57
67
65
71
Laramie
Cheyenne
Lower Green
Little Snake
0 10 20 40 60 80 100
Miles
USDA
NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

Upper Missouri River Basin
February 2012 Calendar Year Runoff Forecast
February 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

January 2012 Runoff

January 2012 Missouri River runoff was 980 KAF (131% of normal) above Sioux City, and 760 KAF (107% of normal) above Gavins Point. During the first half of January temperatures were drastically above normal allowing tributaries to flow freely causing much higher than normal reservoir inflows; however, by mid-January significantly colder temperatures caused tributaries and the Missouri River to freeze up, reducing inflows and reservoir storage in late January.

2012 Calendar Year Forecast Synopsis

The February 1 forecast for the 2012 runoff above Sioux City, IA is **25.6 MAF** (103% of normal). The February 1 forecast for runoff above Gavins Point Dam is **22.0 MAF** (97% of normal). This is an overall reduction of 0.9 MAF from the January 1 forecast, primarily due to lower than forecast January runoff, a continuing lack of plains snow, and an expected return to normal precipitation and warmer conditions forecast by the Climate Prediction Center. Due to the amount of variability in precipitation that can occur over the next 11 months, the range of expected inflow is quite large and ranges from the 34.9 MAF upper basic forecast to the 17.4 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 11 months are being forecasted for this February 1 forecast (1 months observed/11 months forecast),

the range of wetter than normal (upper basic) and lower than normal (lower basic) is attributed to all 6 reaches for all 11 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Nina)

The 2011 September-October-November period marked the onset of El Nino Southern Oscillation (ENSO) "La Nina" when sea surface temperature (SST) anomalies fell below the -0.5 deg C departure. In 2010-2011, the onset of La Nina began with the 2010 June-July-August period, which was three months earlier than what we currently experiencing in 2011. The 2010-2011 La Nina ended during the April-May-June period.

During La Nina episodes, the Pacific Northwest and portions of the Northern Rockies in the Missouri River Basin are expected to receive greater than normal precipitation as mountain snowfall, and generally colder than normal temperatures in the Northern Plains, usually during the January-February-March period. Increased plains snowfall and accumulations are generally expected due to the colder than normal temperatures. La Nina episodes create storm track conditions that move through the Pacific Northwest to the Northern Plains (Missouri River basin). **So far, during the winter of 2011-2012, the storm pattern and weather conditions have not been characteristic of a La Nina weather pattern, with warmer than normal temperatures in the upper Missouri River basin accompanied by below normal precipitation and snow accumulations.** La Nina is expected to weaken during the spring and early summer.

Precipitation

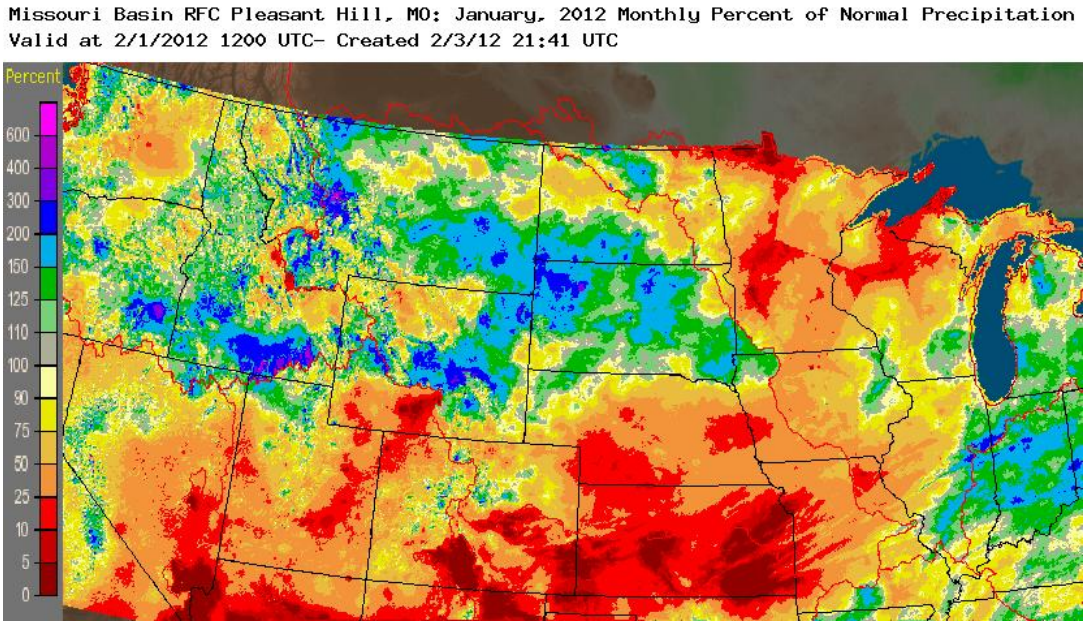
The January Climate Prediction Center precipitation outlook called for an increased chance of above normal precipitation in the northern Rocky Mountains including most of Montana and Wyoming with equal chances for above normal, normal, and below normal precipitation in the remainder of the Missouri River basin.

Accumulated precipitation during the month of January 2012 (Figure 1) was less than 50% of normal in most areas of the Missouri River basin below Sioux City, IA, while it was near normal to above normal in the upper basin above Sioux City. Throughout January, there has been a lack of precipitation in the lower basin with essentially no measureable precipitation across much of Nebraska and Kansas, with the exception of up to one-half inch amounts in northern Nebraska. Areas that have received greater than 150% of normal precipitation include southern Montana, central Wyoming, much of South Dakota, and southern North Dakota. Although greater than normal precipitation in these areas occurred in January, unseasonably warm temperatures have caused all precipitation as snow to melt. Other areas in the plains have received below normal precipitation. The mountains in Montana and central Wyoming benefitted from abundant late month precipitation which brought monthly totals to greater than

normal values (Figure 1). In contrast, the mountainous areas in the Yellowstone, Bighorn, and Wind River basins received normal to below normal precipitation in January.

Over the 90-day period (November-December-January), the precipitation accumulation map reveals that areas of normal to above normal precipitation occurred in eastern Montana, northeast Wyoming, and western South Dakota; but, precipitation accumulations in the eastern Dakotas and Nebraska were severely below normal, while the mountains received near normal precipitation.

January 2012



November-December-January 2012

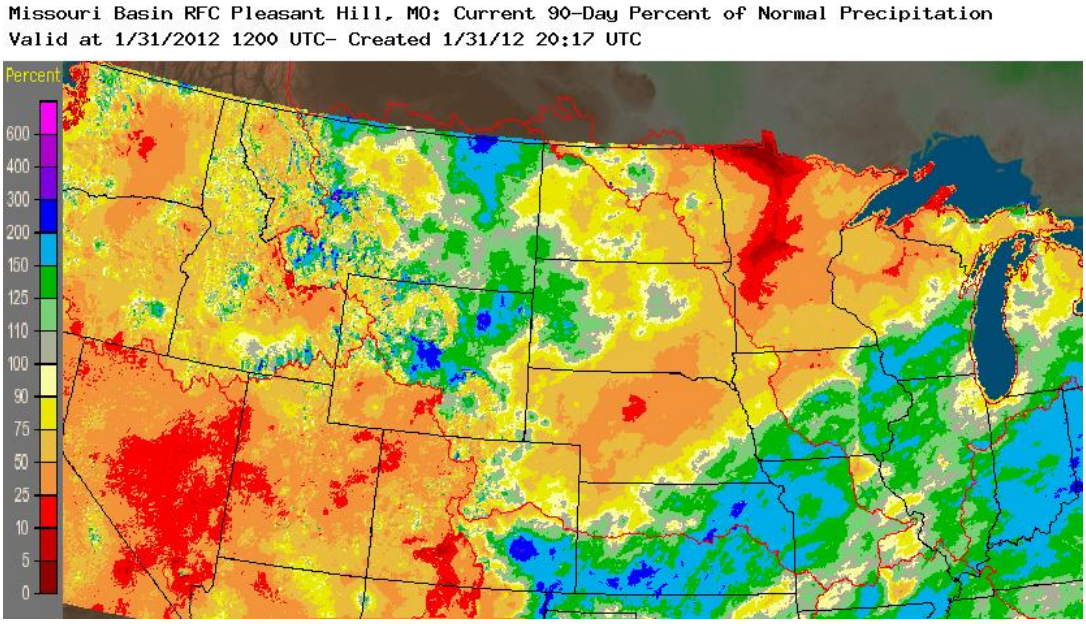


Figure 1. January 2012 and November-December-January 2012 Percent of Normal Precipitation

In comparison, January 2011 precipitation was greater than 200% of normal over a very large portion of the Upper and portions of the Lower Missouri River Basin (Figure 2).Northeast Montana received in excess of 600% of normal precipitation as snowfall in January 2011.

Please refer to the January 1 Calendar Year Forecast Narrative for information on the amount of precipitation that occurred in November and December 2011 as well as a comparison to the November and December 2010 precipitation amounts in the Missouri Basin.

January 2011

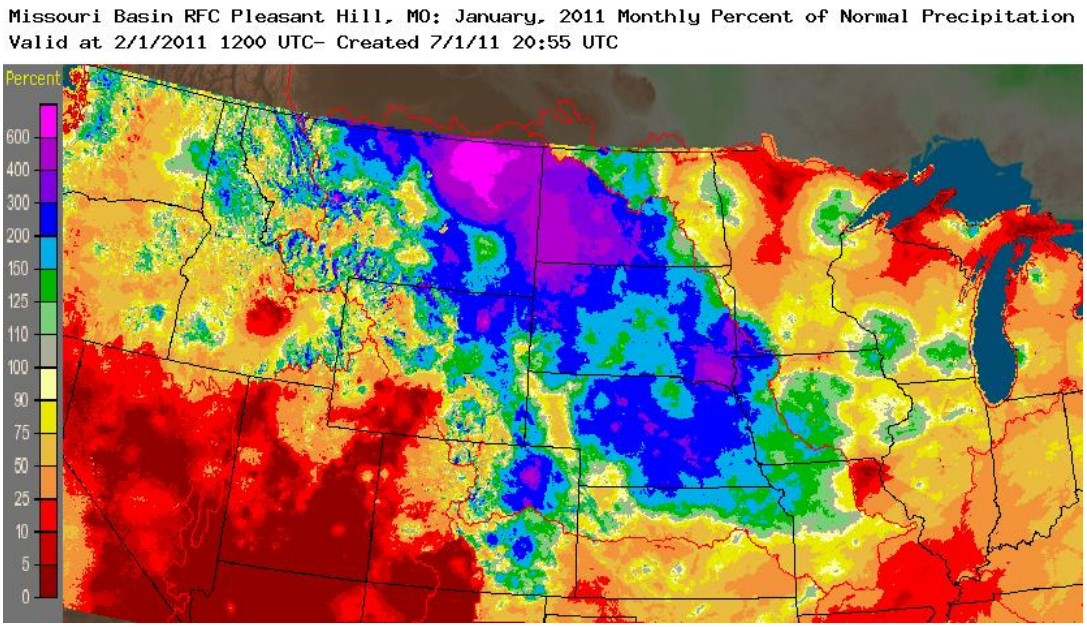


Figure 2. November and December 2010 Percent of Normal Precipitation.

Temperature

The January Climate Prediction Center temperature outlook called for an increased chance of below normal temperatures in the northern Rocky Mountains and an increased chance of above normal temperatures in the Plains.

Average temperatures throughout the basin above Sioux City, IA during the month of January 2011 were much above normal (Figure 3). With the exception of northwest Montana, temperatures were no less than four degrees F above normal, and six to eight degrees (F) above normal in southwest Montana and northwest Wyoming. Temperatures in the Northern Plains were 8 to 12 degrees F above normal. Warmer than normal temperatures have greatly inhibited ice formation on the lakes and rivers, inhibited the formation of plains snowpack, and recently has resulted in frost depths decreasing in portions of the basin.

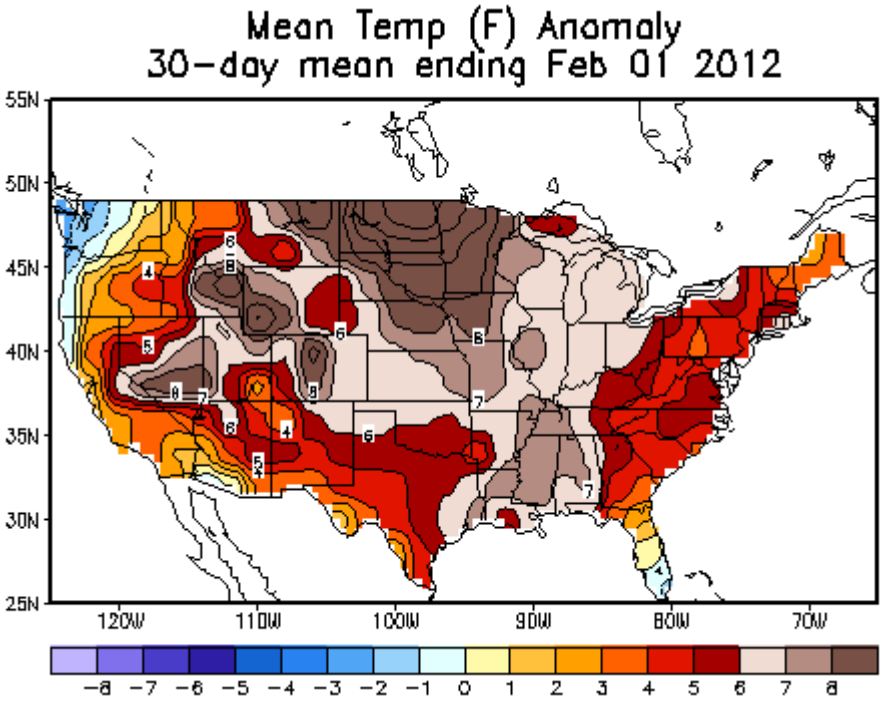


Figure 3. 30-day temperature anomaly (deg F) ending 01 Feb 2012.

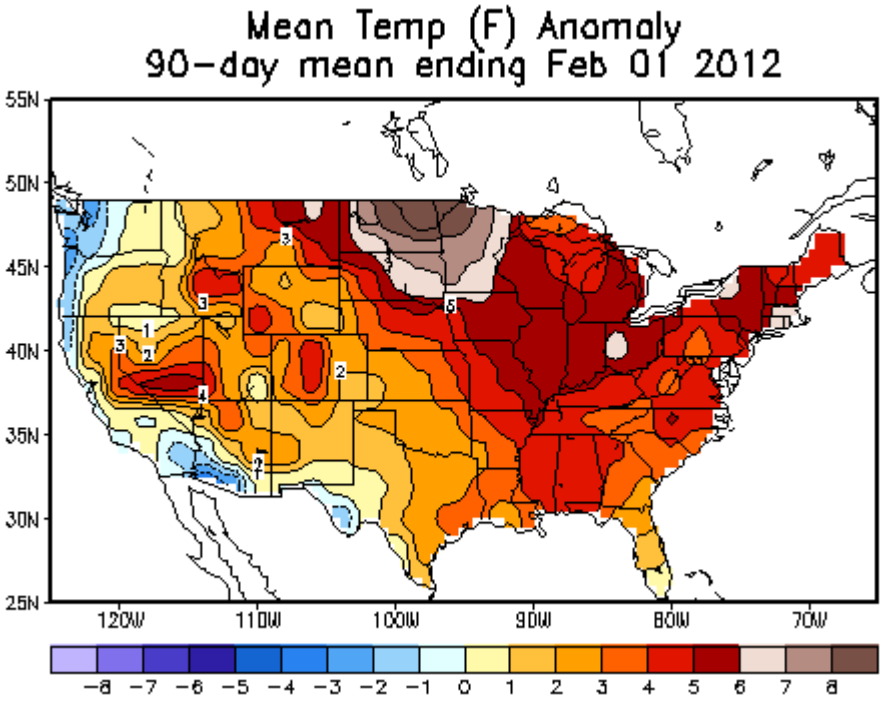


Figure 4. 90-day temperature anomaly (deg F) ending 01 Feb 2012.

Ninety-day (90-day) temperature departures ending on February 1, 2012 are shown in Figure 4. During the time period from early November 2011 to February 1, 2012, average daily temperatures have ranged from two to four degrees (F) above normal in the mountainous regions of the Missouri River

Basin, and four to eight degrees above normal in the plains region of the upper Missouri River Basin. In contrast, 90-day temperatures through February 1, 2011 (Figure 5) were zero to two degrees (F) below normal in much of the upper basin with the exception of slightly above normal temperatures in the Yellowstone and Missouri River headwaters in Montana and Wyoming.

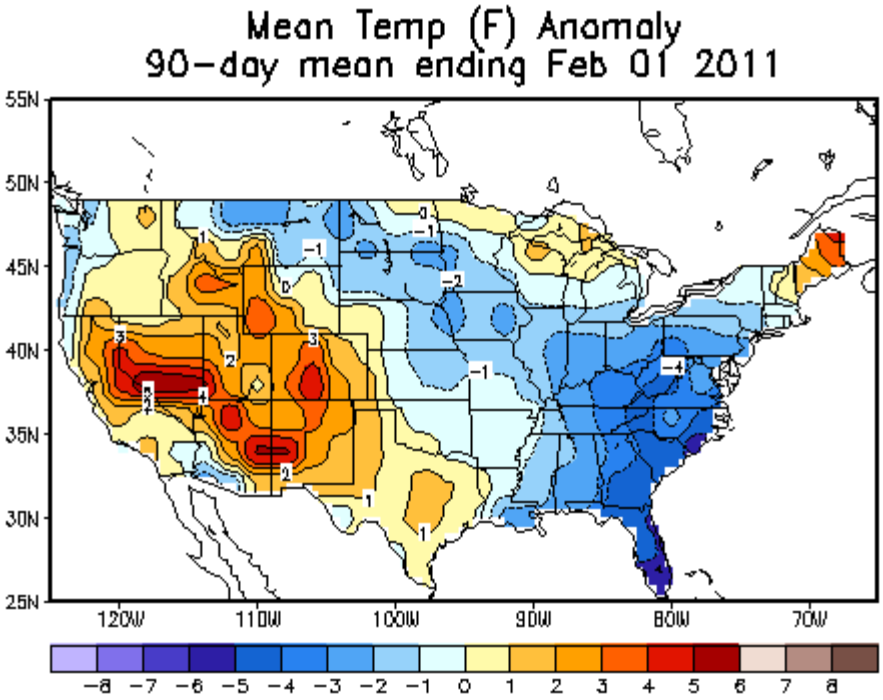


Figure 5. 90-day temperature anomaly (deg F) ending 01 Feb 2011.

Soil Moisture and Frost Conditions

Soil moisture conditions at the end of January 2012 were slightly wetter than the median soil moisture condition according to both the percentile rankings (Figure 6) and soil moisture anomalies (Figure 7) in the Upper Missouri River Basin mainly from the Missouri River westward to the Rocky Mountains. Percentile rankings range from the 70th to 80th percentile in the plains, and in the 90th percentile in small regions of northern Wyoming and central Montana. Moisture anomalies in Montana and Wyoming range from 20 to 40 millimeters (< 1.0 – 2.0 inches) over a 1.6-meter depth, while a small area in central North Dakota has a 20 millimeter anomaly. In the eastern half of the Dakotas, eastern Nebraska and northwest Iowa, soil moisture is much drier than the median soil moisture condition. Percentile rankings range from the 30th to the 20th percentile ranking; while anomalies range from 20 to 80 millimeters (about 3.0 inches) below normal in northwest Iowa.

In contrast to January 2012, January 2011 soil moisture conditions were much wetter. Soil moisture percentile rankings (Figure 8) ranged from the 70th to the 99th percentile ranking across most of the upper Missouri River Basin. Particularly wet areas with rankings greater than the 90th percentile existed east of the Missouri River in the Dakotas and north of the Missouri River in North Dakota and Montana. Positive soil moisture anomalies (Figure 9) ranged from 40 to 100 millimeters (<2.0 to 4.0 inches) over

most of these areas. These extremely wet January conditions occurred as a result of much greater than normal fall 2010 precipitation followed by colder than normal temperatures during the winter.

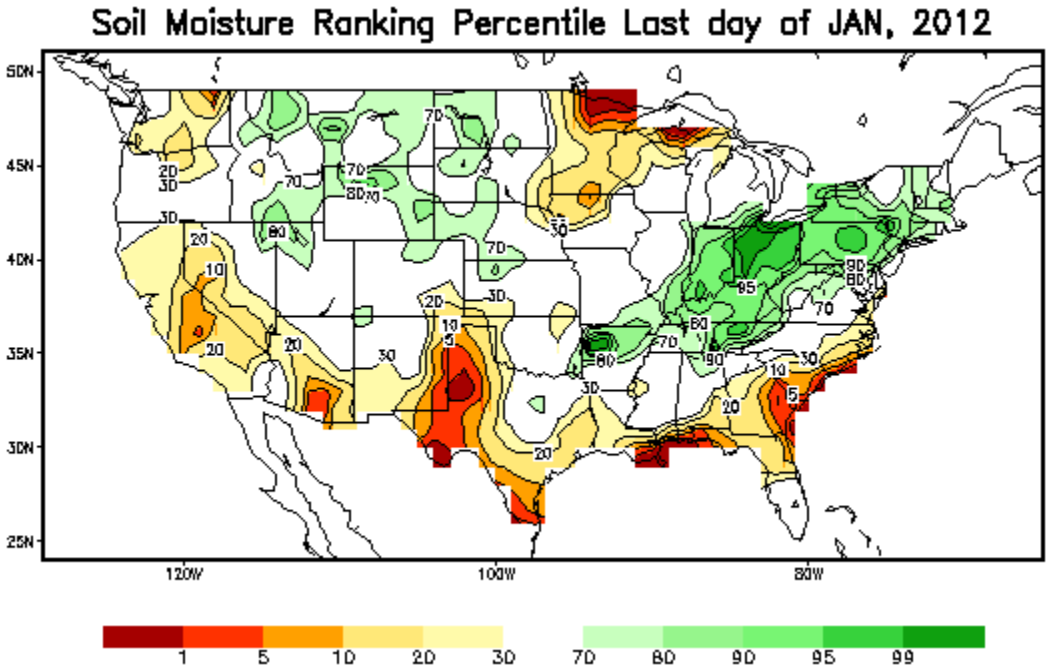


Figure 6. Calculated Soil Moisture Ranking Percentile on the last day of January 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

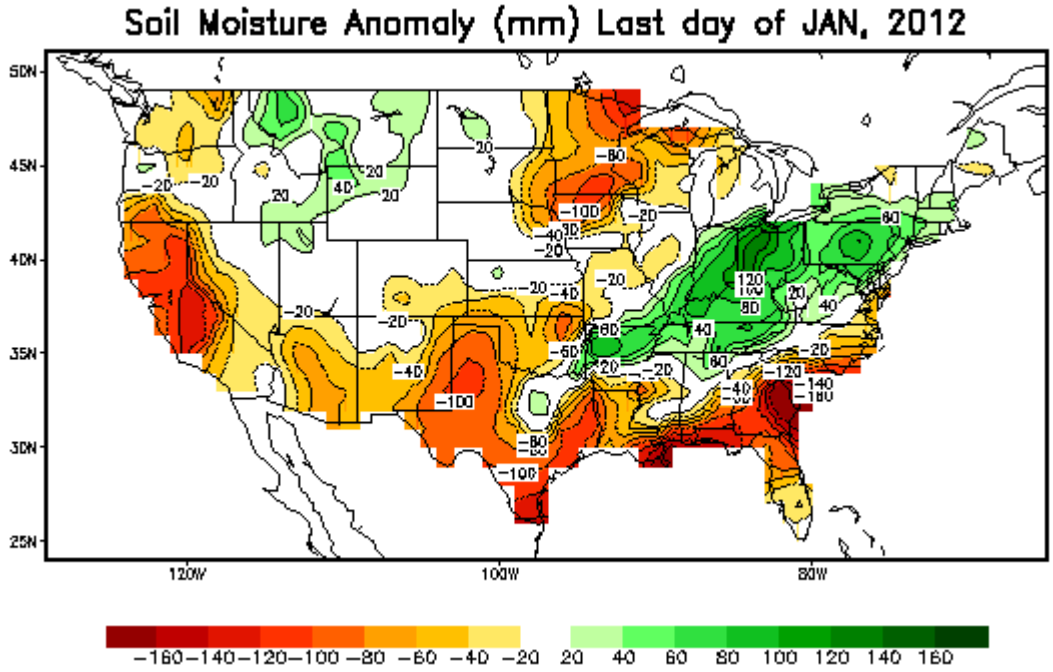


Figure 7. Calculated Soil Moisture Anomaly on the last day of January 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

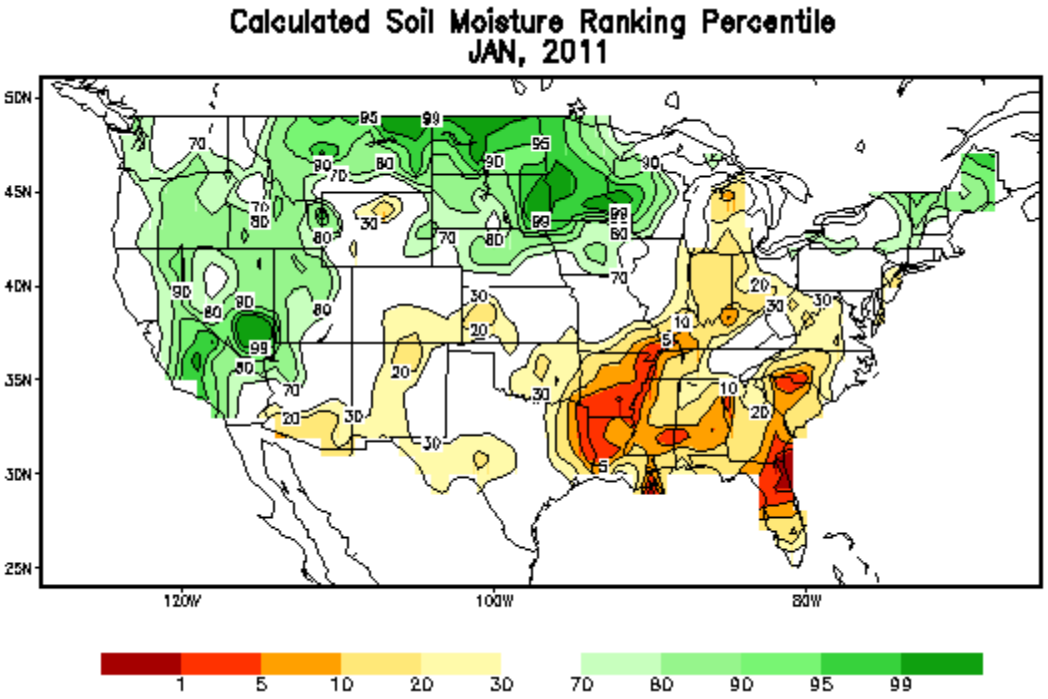


Figure 8. Calculated Soil Moisture Ranking Percentile in January 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

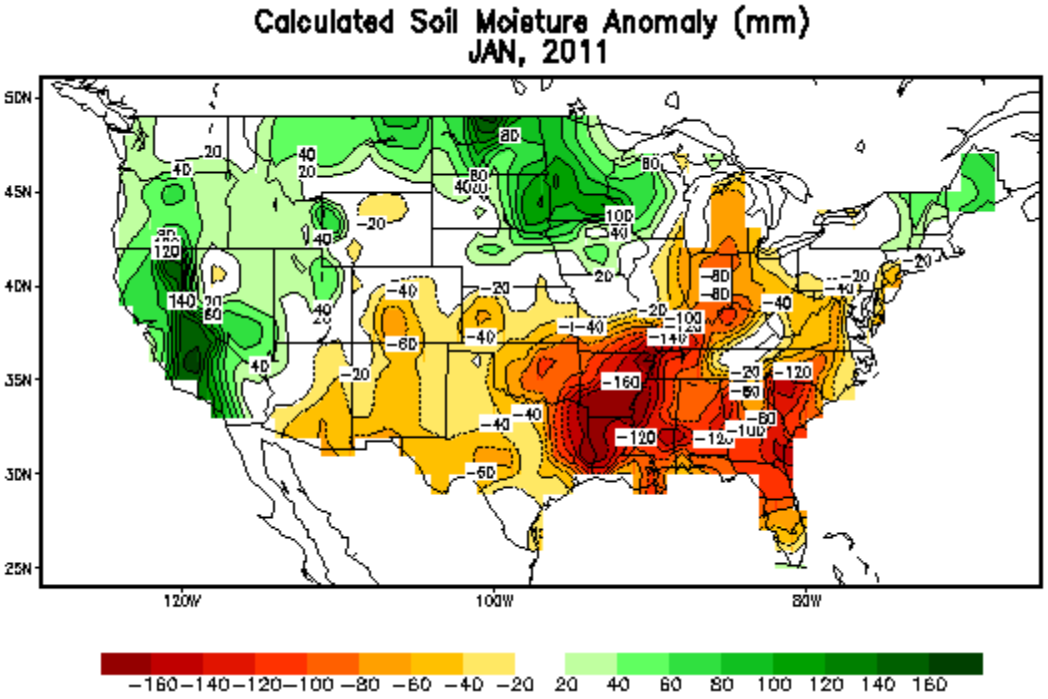


Figure 9. Calculated Soil Moisture Anomaly in January 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

For local observations of soil moisture, please refer to the January 2012 Calendar Year Forecast Narrative. January 1 soil frost depths (thicknesses) ranged from 14 to 18 inches according to NWS measurements in Montana, North Dakota and South Dakota. Per the NWS, these depths are considered "average" for the Northern Plains. Near Jamestown, ND, soil frost was about 24 inches deep. While warmer temperatures at the beginning of the month reduced frost thicknesses, cold temperatures at mid-month cause soil frost to thicken and develop once again in central South Dakota.

The second factor, depth to water table, is still much higher than normal, especially in the prairie pothole region of North and South Dakota. This factor has increased the contributing drainage area of the James River, and as a result has played a factor in the increased volume of runoff experienced in the James River basin over the past three years. Although soil moisture was much drier in the James River basin at the end of 2011, the shallow water table will likely contribute to greater than normal runoff in 2012.

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. A common misperception is that the March-April runoff is a result of plains snowmelt only. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due to both melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations are nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts, which for this year primarily includes long-term precipitation outlooks.

Temperatures in January 2012 were well above normal in the Northern Plains, limiting additional snow accumulation and maintenance of the existing snow cover. Due to unseasonably warm daytime temperatures with daytime highs reaching (50 to 60 degrees F) during the last week of the month, nearly all of the existing plains snowpack melted with the exception of drifted or sheltered areas. Plains snowpack as of February 1, 2012 is shown in Figure 10. Areas with continuous snow cover are limited to northern and eastern South Dakota and the southeast quarter of North Dakota. According to the NOHRSC snow model, snow water equivalent associated with the remaining snow cover was limited to trace amounts.

February 1, 2012

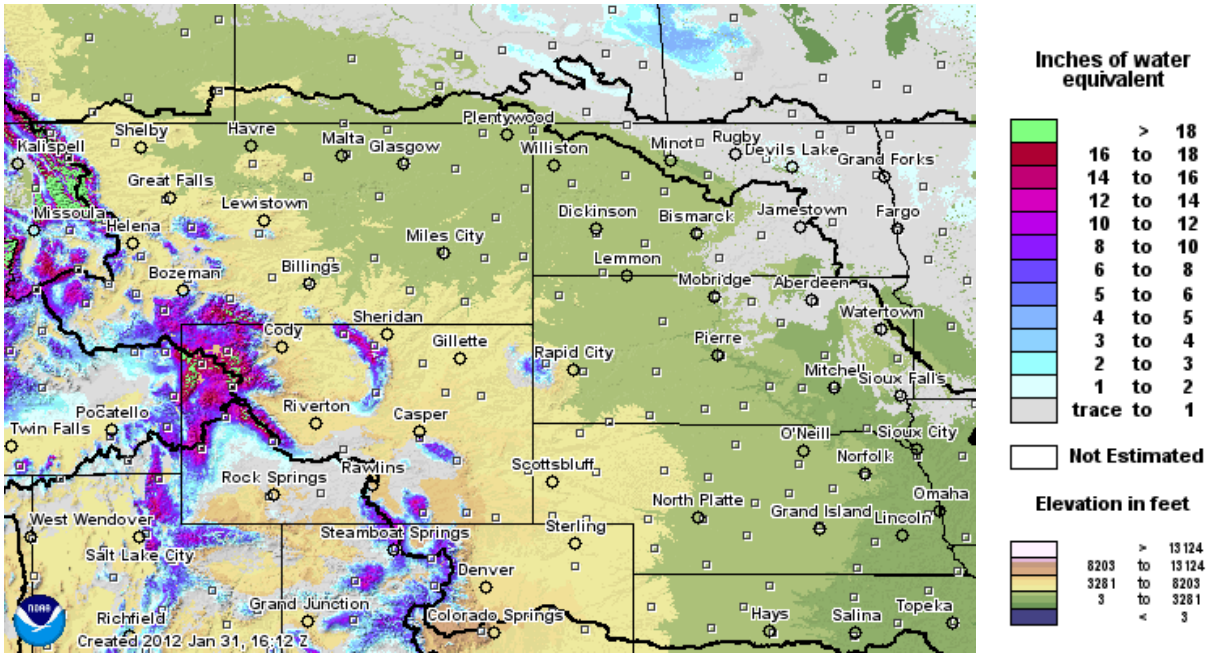


Figure 10. February 1, 2012 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

For runoff forecasting purposes, plains snow in the six mainstem reservoir reaches is classified has been classified as follows:

Table 1. January 1, 2012 plains snowpack classification for runoff forecasting.

Reservoir Reach	Plains Snowpack Classification	
	January 1, 2012	February 1, 2012
Above Fort Peck	None to Light	None
Fort Peck to Garrison	None to Light	None
Garrison to Oahe	None	None to Light
Oahe to Fort Randall	None	None
Fort Randall to Gavins Point	None	None
Gavins Point to Sioux City	None to Light	None to Light

In contrast, plains snowpack on February 1, 2011 (Figure 11) was very extensive in aerial coverage and much greater in depth. An area of one-inch minimum SWE existed north a line extending from Omaha, NE to Havre, MT. Heavy snow ranging from three to four inches of SWE covered a large area from Sioux Falls, SD, to Havre, ND. Throughout the area of heaviest snow cover, SWE amounts ranged from four to six inches.

February 1, 2011

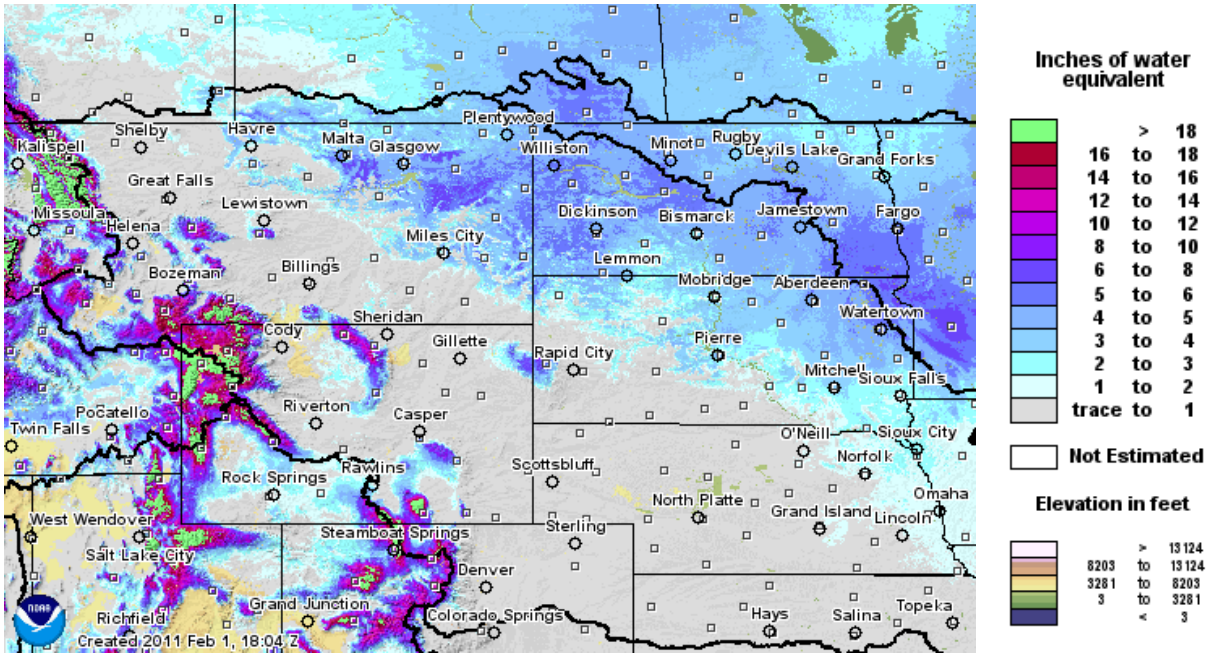


Figure 11. February 1, 2011 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

Mountain Snow Pack

Mountain snowpack is the primary factor used to predict May-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month May-July runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years. For example, we would expect to see greater than average runoff from an average mountain snowpack this year due to wetter than normal soil moisture conditions.

Persistent winter precipitation from January 18 to 22 caused significant gains in mountain SWE levels at SNOTEL stations. As of February 1, 2012, the Corps of Engineers' assessment of the mountain snowpack was 87% of normal in the drainage area above Fort Peck (Figure 12), an increase from 79% of normal on January 1, 2012. Mountain snowpack was 96% of normal in the incremental drainage area between Fort Peck and Garrison (Figure 12). In terms of peak snow accumulation, normally 61% has accumulated in the mountains by February 1. In comparison, February 1, 2011 snowpack was 112% of normal above Fort Peck, and it was 111% of normal between Fort Peck and Garrison. The NRCS depictions of the mountain SWE as a percent of normal SWE by mountain river basin as of February 1, 2012, are provided at the end of this report under the Additional Figures heading.

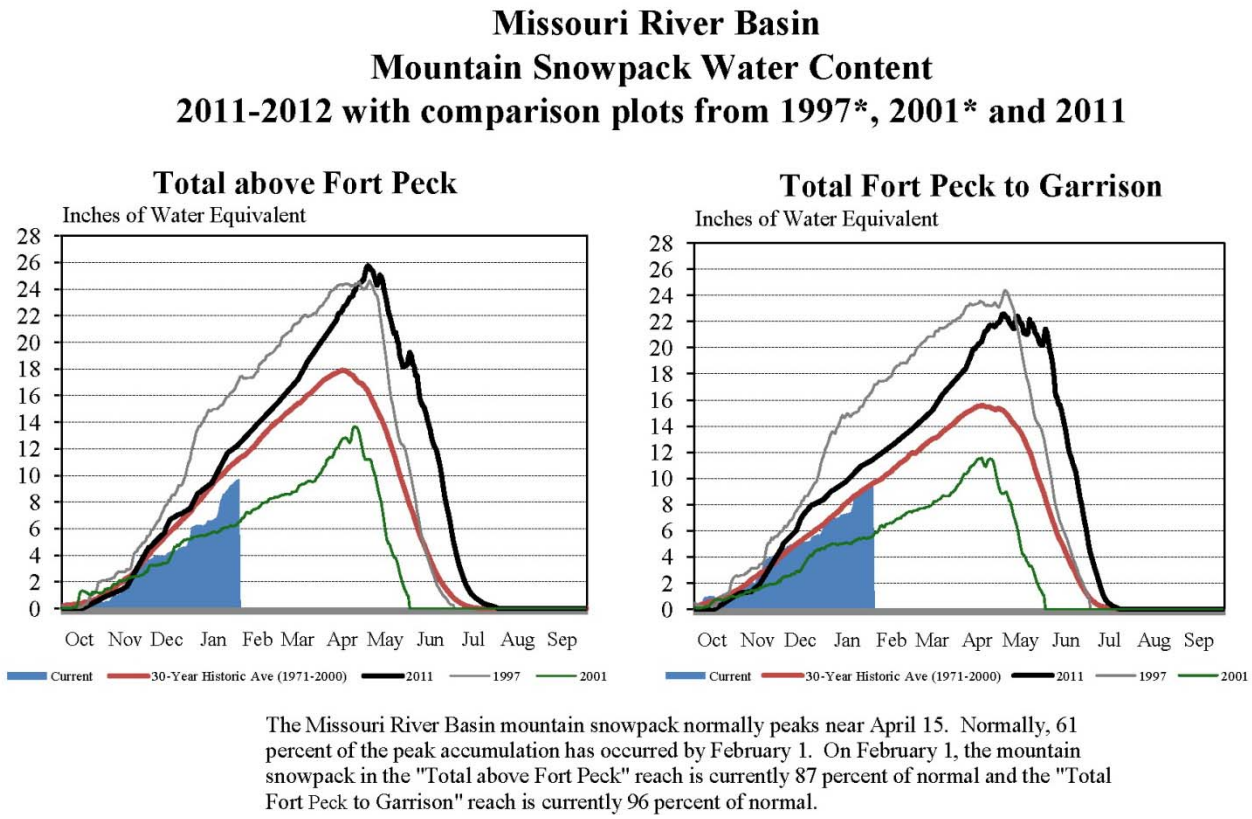


Figure 12. Mountain snowpack water content snow accumulation compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management.

Drought Analysis

According to the National Drought Mitigation Center (NDMC) in Figure 13, Abnormally Dry (D0) conditions have expanded into western Nebraska with further expansion in western North Dakota and South Dakota since the end of December 2011. Particularly dry areas include the eastern quarter of South Dakota, southern Minnesota, northwest Iowa and northeast Nebraska, which are classified in Moderate (D1) to Severe (D2) drought categories with short-term impacts. Short-term impacts generally affect agricultural interests. At this time, it appears that no long-term impacts related to hydrology and water supply are impacting any areas in the Missouri River Basin.

Over the next three months, the NDMC is predicting drought to develop across eastern North Dakota (Figure 14) affecting the upper James River basin which falls in the river reach below Gavins Point Dam. Furthermore, NDMC is predicting drought continuation with possible intensification in eastern portions of North Dakota, South Dakota and Nebraska.

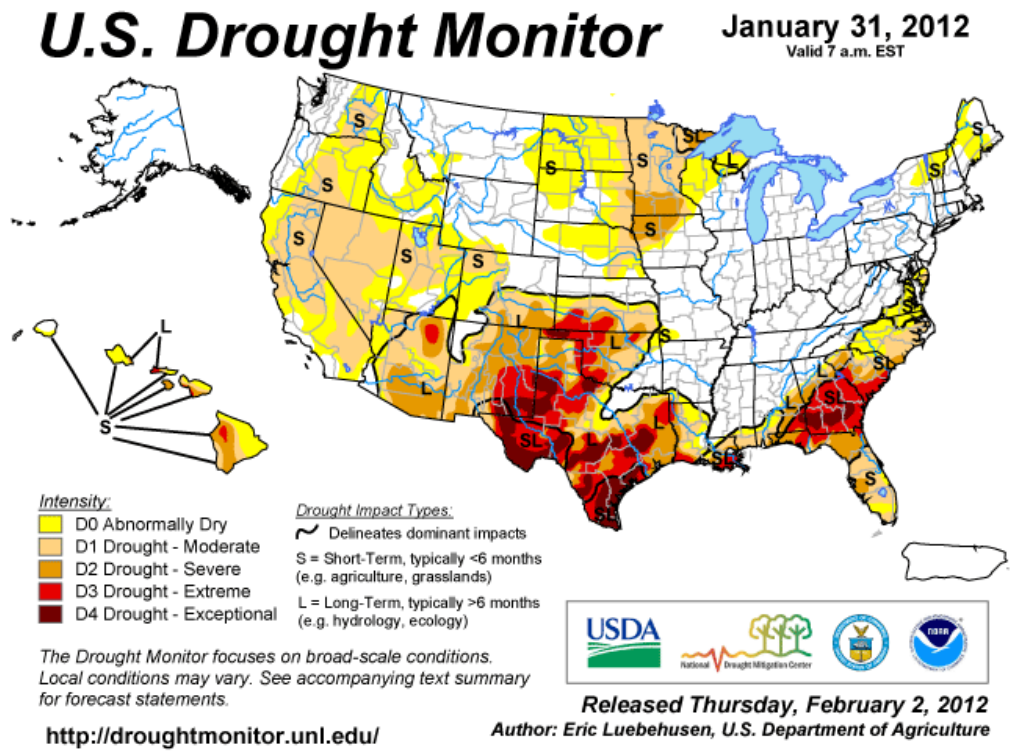


Figure 13. National Drought Mitigation Center U.S. Drought Monitors for January 31, 2012.

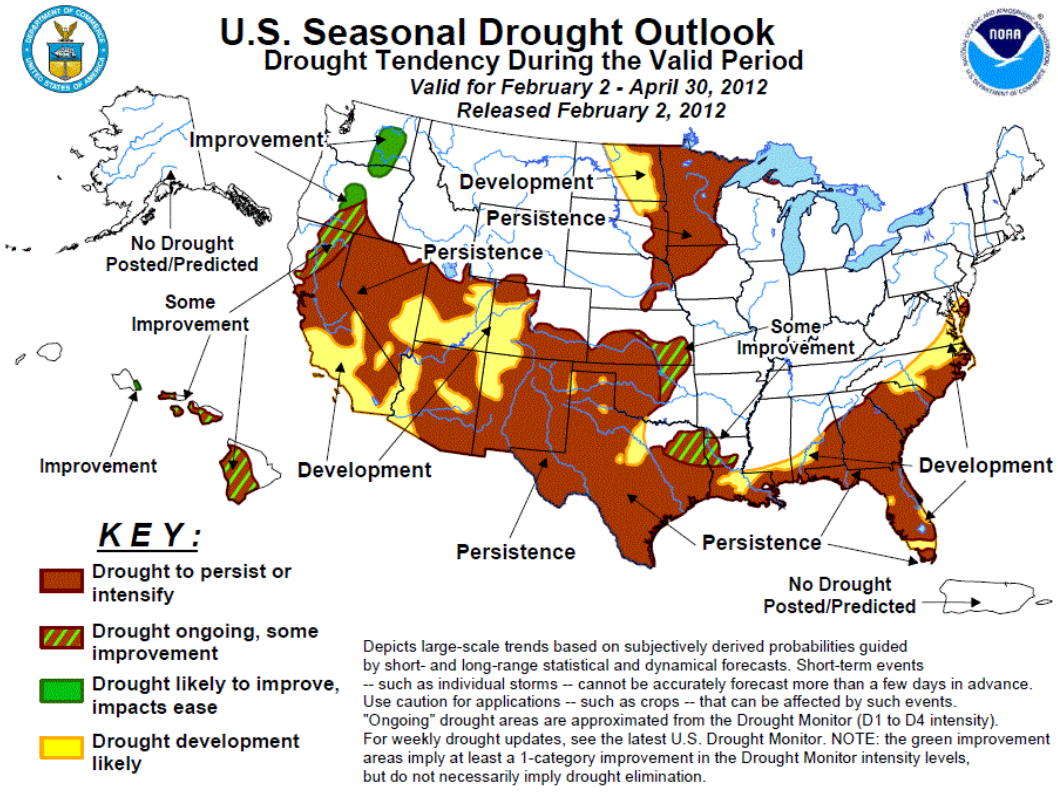


Figure 14. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for Feb-Mar-Apr 2012.

Climate Outlook

La Nina conditions are currently present along the equatorial Pacific with sea surface temperature anomalies colder than 1.0 degree Celsius below average. Although this has been a weak to moderate La Nina, atmospheric circulations are consistent with La Nina, and the La Nina is expected to continue into the Northern Hemisphere spring 2012. La Nina winters in the Missouri River Basin are associated with cooler than normal temperatures and possible above normal precipitation. What has limited weather associated with La Nina so far have been a positive Arctic and North Atlantic Oscillations, which have limited the intrusion of cold air masses into the contiguous United States. According to the Climate Prediction Center, this has been the biggest difference in weather patterns between the winters of 2010-2011 and 2011-2012.

During the next five days through February 5, the upper Missouri River Basin is expected to experience above normal temperatures and relatively dry conditions. In the lower basin, a winter storm is expected to move through the Kansas Basin and lower Missouri River Basin February 4-5, with abundant precipitation. The 6-10 Day (Figure 15) and 8-14 Day (Figure 16) Outlooks indicate temperatures are very likely to be above normal through February 14 in much of the upper Missouri River Basin, while precipitation has a higher probability of being below normal for this same period of time.

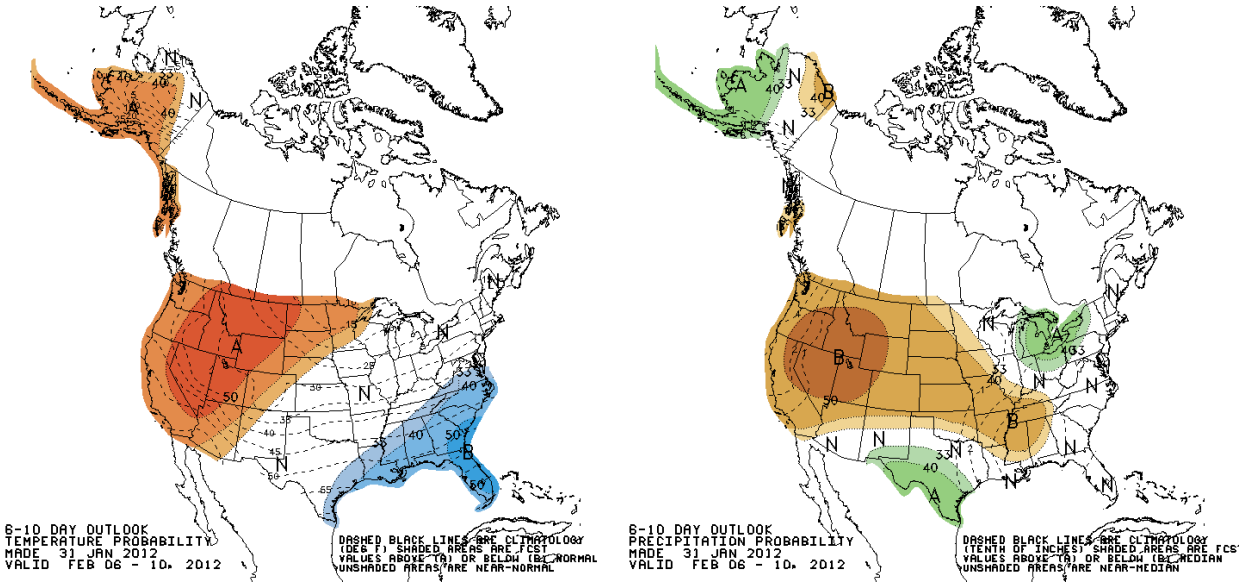


Figure 15. CPC 6-10 day temperature and precipitation outlooks.

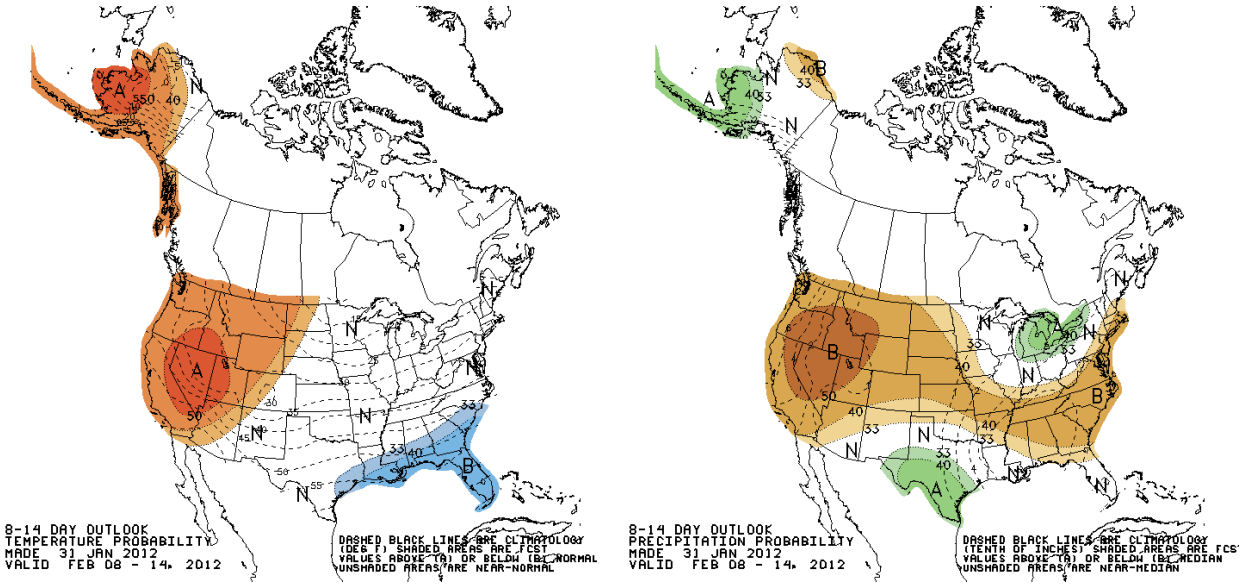


Figure 16. CPC 8-14 day temperature and precipitation outlooks.

The temperature outlook for February (Figure 17) indicates increased chances for above normal temperatures throughout much of the Missouri River Basin, while the precipitation outlook indicates equal chances for below normal, normal and above normal precipitation in the Upper Basin. Although trends have shown below normal precipitation, the equal chances are a result of continuing La Nina conditions potentially influencing winter precipitation in the Missouri River Basin. This is evident in the Ohio River Basin where increased precipitation chances exist.

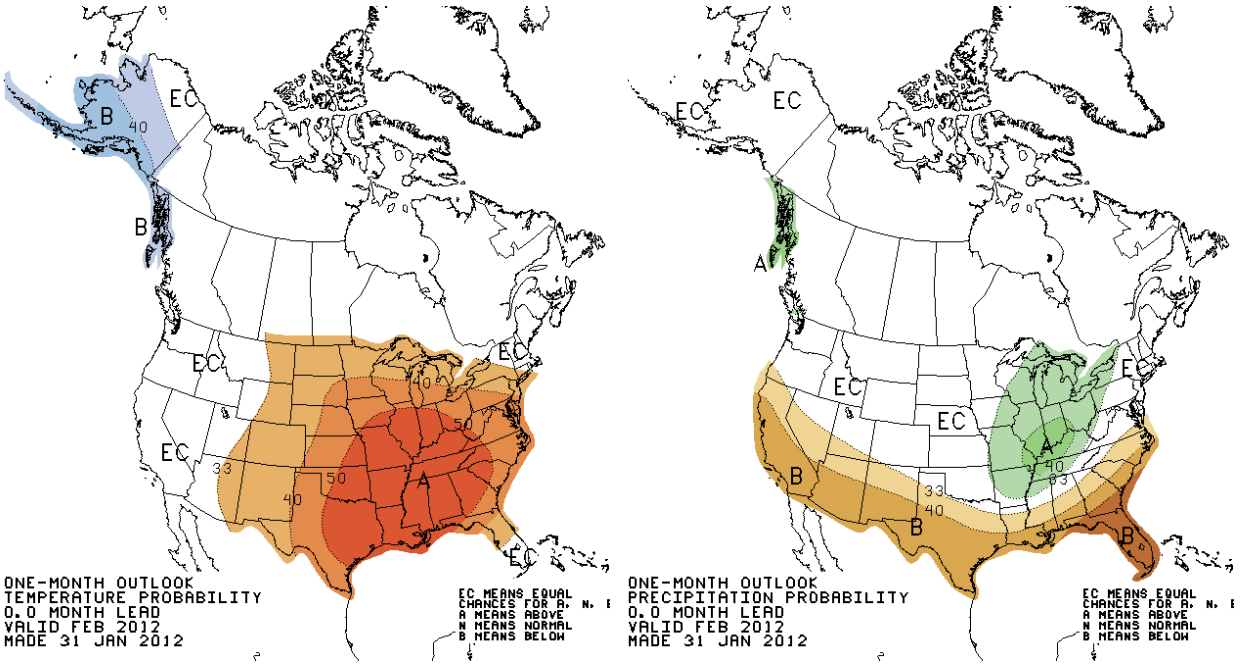


Figure 17. CPC February 2012 temperature and precipitation outlooks.

La Nina generally makes its greatest impact to North American weather in winter and early spring. In 2011 precipitation was above normal especially in the fall leading up to January 2011, and well above normal from January through June. Temperatures were generally much colder than normal throughout the winter and spring. The upcoming 2012 February-March-April period is expected to receive above normal precipitation in the Northern Rocky Mountains as a result of increased precipitation probabilities along with increased chances for below normal temperatures per the CPC's seasonal precipitation outlook (Figure 18). The expected result from these conditions would be greater than normal accumulations of snow in the mountains and plains, though the likelihood of plains snow accumulation diminishes in April as temperatures generally become warmer.

Compared to the December 19, 2011 February-March-April outlook, the area of greater probability for below normal temperatures is smaller than currently forecast (Figure 18), and the probability for below normal temperatures in North Dakota changed from 33-40% to Equal Chances (EC). In terms of precipitation, the area of greater probability for above normal precipitation contracted in size across Wyoming and Montana.

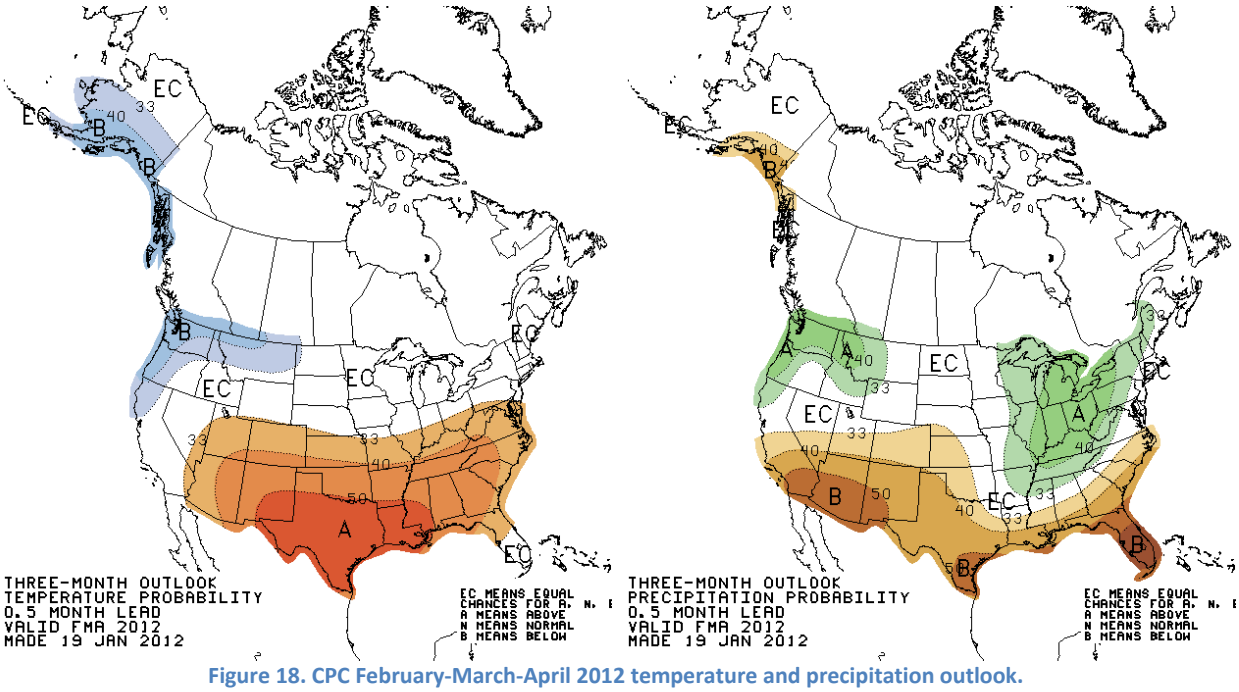


Figure 18. CPC February-March-April 2012 temperature and precipitation outlook.

Climate impacts of La Nina will continue during the spring and early summer; however, CPC forecasters have indicated that La Nina is expected to weaken during the spring and summer. According to the CPC outlook, there are Equal Chances for above normal, normal, and below normal temperatures and precipitation throughout the upper Missouri River basin in May-June-July 2012 (Figure 19). This reflects no change since the December 19, 2011 outlook for May-June-July 2012. In August-September-October, the CPC climate outlook (Figure 20) is indicating there is a much greater probability for above normal temperatures throughout the central Rocky Mountains, along with a slight increase in probabilities for below normal precipitation in the Northern Rocky Mountains and an increased chance for above normal

precipitation from western South Dakota through western Kansas. In the November-December-January outlook there are equal chances for above normal, normal and below normal temperatures and precipitation (Figure 21).

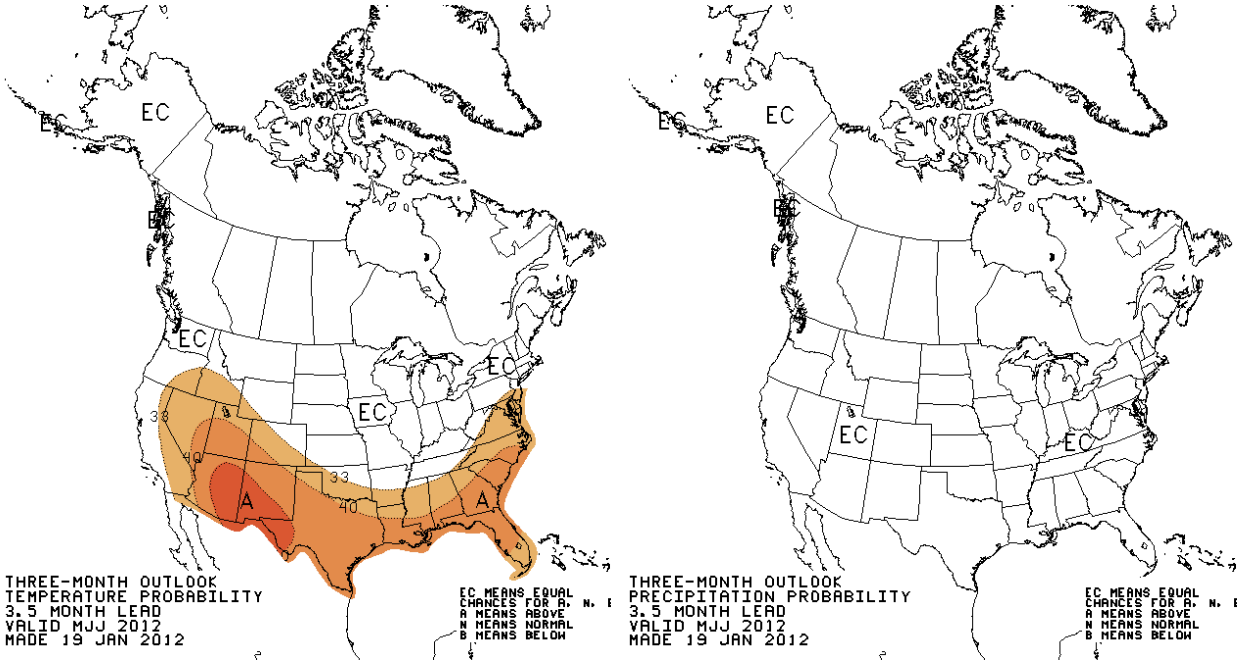


Figure 19. CPC May-June-July 2012 temperature and precipitation outlook.

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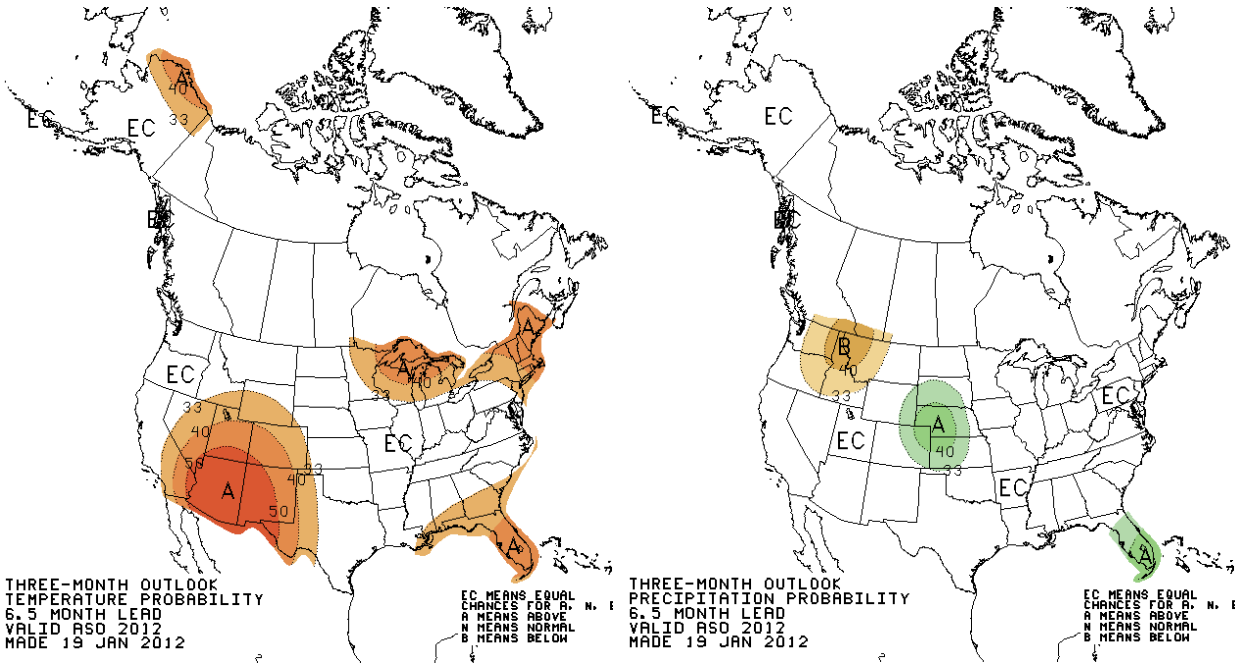

Figure 20. August-September-October 2012 temperature and precipitation outlook.

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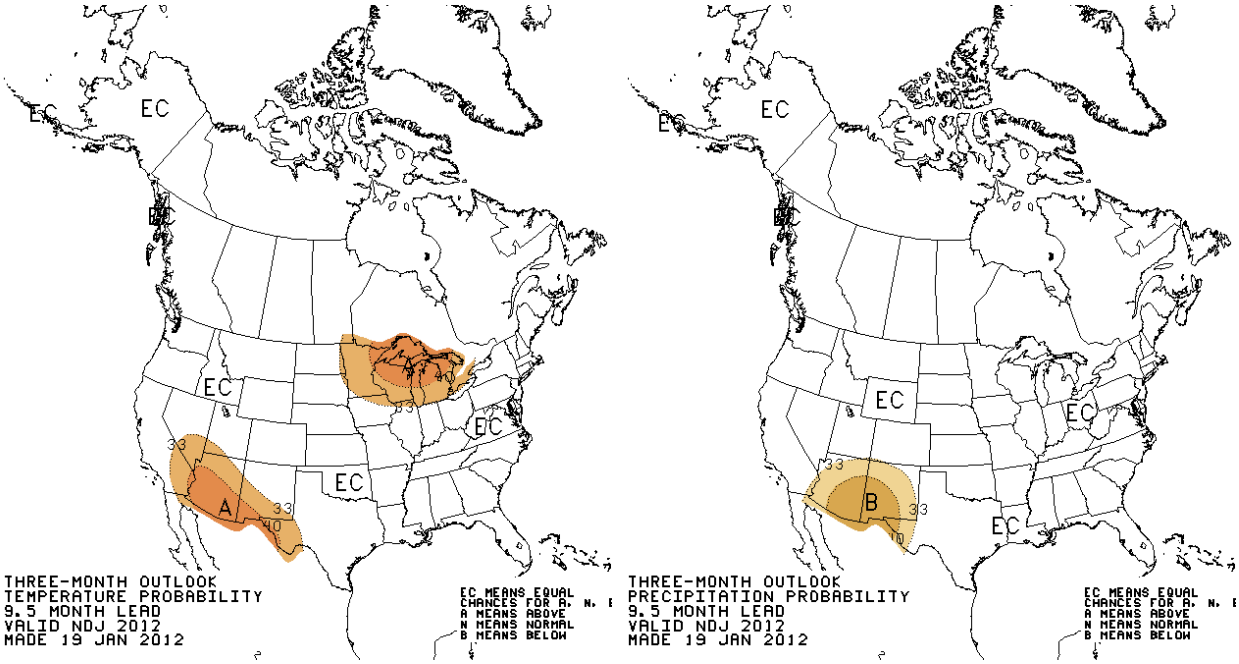


Figure 21. CPC November-December-January 2012 temperature and precipitation outlook.

February 2012 Calendar Year Runoff Forecast

The calendar year runoff forecast is 25.6 MAF above Sioux City, 22.0 MAF above Gavins Point. Due to the amount of variability in precipitation that can occur over the next 12 months, the range of expected inflow is quite large and ranges from the 34.9 MAF upper basic forecast to the 17.4 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff. It should be noted, however, that it is possible, due to either much higher or much lower than forecasted precipitation occurring, that these ranges may be exceeded on either end.

Factors taken into consideration while preparing the 2012 forecast include: soil moisture content, the presence of soil frost, the presence of high water tables in some regions, plains snowpack, mountain snowpack, and the CPC's monthly and seasonal temperature and precipitation outlooks.

Soil moisture in the basin is slightly above normal in areas west of the Missouri River in the upper basin, while it is below normal in areas east of the Missouri River. Soil frost is variable throughout the upper basin and ranges from no soil frost in southern portions of South Dakota up to 24 inches in North Dakota. Following the record year of runoff, water tables are still high in some regions, particularly northeast Montana, central and eastern North Dakota and northeast South Dakota. In general, the higher the soil moisture and water table, the higher the runoff and baseflow.

Mountain snowpack was 87% of normal above Fort Peck and 96% of normal from Fort Peck to Garrison. At this time last year mountain snowpack was 112% and 111% of normal. Mountain snowpack levels

reflect an 8% of normal increase in the Fort Peck reach and no increase in normal levels in the Garrison reach. As of Normally 61% of the peak mountain accumulation occurs by February 1.

As of February 1, 2012, plains snowpack was limited to a thin cover of less than 1-inch of SWE in northern and eastern South Dakota and eastern North Dakota. 2012 snow could increase in the mountains given the increased probability for below normal temperatures and above normal mountain precipitation in February-March-April 2012.

The February CPC outlook reflects an increased areal coverage of warmer than normal temperatures with continued equal chances of above, below, or normal amounts of precipitation. Through April, the CPC is forecasting increased probabilities for above normal precipitation and below normal temperatures in the Northern Rockies due to continuing La Nina conditions. The remainder of the upper basin is forecast to have equal chances for above, below, or normal precipitation and temperatures.

February

In February, lower than normal runoff volumes are forecast throughout the basin above Gavins Point. Likewise, lower than normal runoff is forecast in March and April, due to a lack of plains snow, equal chances for precipitation as snow, and a warmer than normal temperature forecast.

March-April

Plains snow is a significant factor influencing the volume of runoff in March and April; however, precipitation and air temperatures during this time period as snow and rainfall and soil moisture are also very important factors that need consideration. Factors taken into consideration in updating the March and April runoff forecast were: 1) the lack of plains snow cover, 2) a higher probability for warmer than normal temperatures, 3) an equal chance probability for above, normal, and below normal precipitation and 4) drier than normal soil moisture in the eastern Dakotas and slightly wetter than normal soil moisture in the western Dakotas and Montana.

In the Fort Peck, Garrison, Oahe, Fort Randall and Gavins Point reaches, March-April runoff has been reduced to below normal as a result of the contributing factors. The expectation for snow accumulation during February is low, and the possibility for above normal temperatures would prevent much plains snowpack from developing.

In the Sioux City reach, though affected by very dry conditions and drought in some locations, runoff is forecast to be well above normal because elevated groundwater has effectively increased the contributing drainage areas, plus the James and Big Sioux rivers entered the winter with high levels of water in their channels. The James River entered the winter season in flood stage. Another factor considered is that average runoff in this reach over the past 30 years is nearly double the long-term (1898-2011) average runoff, so calendar year runoff is expected to be 180% of normal throughout the year. In 2011, Gavins Point to Sioux City runoff was 480% of normal. Increased chances of precipitation in the winter and spring were another factor for increasing March-April runoff to normal and above-normal volumes in spite of the dry soil conditions with no snow.

May-June-July

During the May-June-July period, the mainstem system receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River Basin, so runoff can vary significantly as a result of the above or below normal rainfall.

For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Using existing mountain snowpack (87% of normal in the reach above Fort Peck and 96% of normal in the reach between Fort Peck and Garrison) and the CPC 3-month outlooks of spring precipitation and temperatures, the May-June-July runoff is forecast to be less than normal (90%) in the Fort Peck reach and slightly above normal (101%) in the Garrison reach. Soil conditions are slightly wetter than normal, and the climate outlook is forecasting increased probabilities of precipitation and colder temperatures through April, increasing the likelihood that the snow formation rate in the mountains will increase.

The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total annual runoff into the system.

Runoff in the Oahe, Fort Randall and Gavins Point reaches is forecast to be below normal based on the fact that there is no strong climate signal that will influence the weather during the time, plus the already dry soil moisture and drought conditions in the plains that are expected to persist at least into the spring. Runoff in the Sioux City reach is forecast to be about 177% of average.

August through December

During the August-December period, we forecast runoff to range from normal to below normal in all but the Sioux City reach, primarily due to the equal-chances probabilities for above normal, below normal or normal precipitation and temperature conditions, per CPC long-term temperature and precipitation outlooks. As the year progresses and the July through December precipitation and temperature outlooks are updated with more detail, these values may change.

NRCS Water Supply Outlook

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: February 06, 2012 01:13:22 PM
   - Based on February 01, 2012 forecast values

PRELIMINARY MISSOURI RIVER BASIN FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Lima Reservoir Inflow (2)	APR-JUL	62	65	95	75	49	29	96
	APR-SEP	65	63	103	81	49	27	104
Clark Canyon Reservoir Inflow (2)	APR-JUL	75	57	162	110	44	30	131
	APR-SEP	89	57	184	127	52	36	156
Jefferson R nr Three Forks (2)	APR-JUL	610	78	985	760	460	235	780
	APR-SEP	655	76	1080	825	485	235	860
Hebgen Reservoir Inflow (2)	APR-JUL	340	86	410	370	310	270	395
	APR-SEP	435	86	520	470	400	350	505
Ennis Reservoir Inflow (2)	APR-JUL	545	80	695	605	485	395	680
	APR-SEP	680	80	855	750	610	505	850
Missouri R at Toston (2)	APR-JUL	1590	78	2230	1850	1330	950	2050
	APR-SEP	1830	77	2590	2140	1520	1070	2390
Smith R bl Eagle Ck (2)	APR-JUL	125	94	178	146	104	72	133
	APR-SEP	137	92	198	162	112	76	149
Gibson Reservoir Inflow (2)	APR-JUL	455	99	550	495	415	360	460
	APR-SEP	500	99	600	540	460	400	505
Marias R nr Shelby (2)	APR-JUL	400	96	580	470	330	220	415
	APR-SEP	405	92	595	480	330	215	440
Lake Sherburne Inflow (2)	APR-JUL	109	104	124	115	103	94	105
	APR-SEP	126	103	141	132	120	111	122
St. Mary R at Int'l Boundary (2)	APR-JUL	475	109	575	515	435	375	435
	APR-SEP	550	107	650	590	510	450	515
Milk R at Western Crossing (3)	MAR-JUL	42	102	61	50	34	23	41
	MAR-SEP	44	102	65	53	35	23	43
	APR-JUL	34	103	48	40	28	19.9	33
	APR-SEP	37	103	52	43	31	22	36
Milk R at Eastern Crossing (2,3)	MAR-JUL	92	110	155	117	67	29	83
	MAR-SEP	98	112	164	125	71	32	88
	APR-JUL	65	107	111	84	46	18.6	61
	APR-SEP	74	107	122	94	54	26	69
Beaver Ck nr Havre	MAR-JUL	5.7	59	11.6	8.1	3.3	2.0	9.6
	APR-JUL	4.6	53	12.4	6.9	3.1	1.71	8.7

PRELIMINARY YELLOWSTONE RIVER BASIN FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
West Rosebud Ck nr Roscoe (2)	APR-JUL	53	88	61	56	50	45	60
	APR-SEP	68	88	79	72	64	57	77
Wind R ab Bull Lake Ck (2)	APR-JUL	365	84	500	420	310	230	435
	APR-SEP	450	84	590	505	395	310	535
Bull Lake Ck nr Lenore	APR-JUL	143	97	175	156	130	111	148
	APR-SEP	174	96	215	190	158	133	182
Boysen Reservoir Inflow (2)	APR-JUL	550	77	955	715	385	145	717
	APR-SEP	605	75	1040	780	430	168	809
Greybull R nr Meeteetse	APR-JUL	152	103	187	166	138	117	148
	APR-SEP	205	103	250	220	188	162	200
Shell Ck nr Shell	APR-JUL	62	103	77	68	56	47	60
	APR-SEP	74	103	90	81	67	58	72
Bighorn R at Kane (2)	APR-JUL	890	89	1410	1100	680	370	1000
	APR-SEP	965	87	1520	1190	740	410	1110
NF Shoshone R at Wapiti	APR-JUL	475	103	560	510	440	390	460
	APR-SEP	535	103	625	570	500	445	520
SF Shoshone R nr Valley	APR-JUL	225	100	265	240	210	183	225
	APR-SEP	260	98	305	280	240	215	265
Buffalo Bill Reservoir Inflow (2)	APR-JUL	715	99	855	770	660	575	720
	APR-SEP	795	99	945	855	735	645	805

Bighorn R nr St. Xavier (2)	APR-JUL	1470	91	2080	1720	1220	855	1610
	APR-SEP	1580	90	2260	1850	1310	900	1760
Little Bighorn R nr Hardin	APR-JUL	143	112	191	162	124	95	128
	APR-SEP	164	114	215	185	143	111	144
Tongue R nr Dayton (2)	APR-JUL	106	110	137	119	93	75	96
	APR-SEP	121	111	154	134	108	88	109
Tongue River Reservoir Inflow (2)	APR-JUL	260	118	365	305	215	153	220
	APR-SEP	290	116	400	335	245	178	250
NF Powder R nr Hazelton	APR-JUL	9.2	96	11.7	10.2	8.2	6.7	9.6
	APR-SEP	10.0	96	12.6	11.0	9.0	7.4	10.4
Powder R at Moorhead	APR-JUL	215	105	315	255	174	115	205
	APR-SEP	245	107	350	285	205	142	230
Powder R nr Locate	APR-JUL	245	104	370	295	195	121	235
	APR-SEP	280	108	415	335	225	147	260

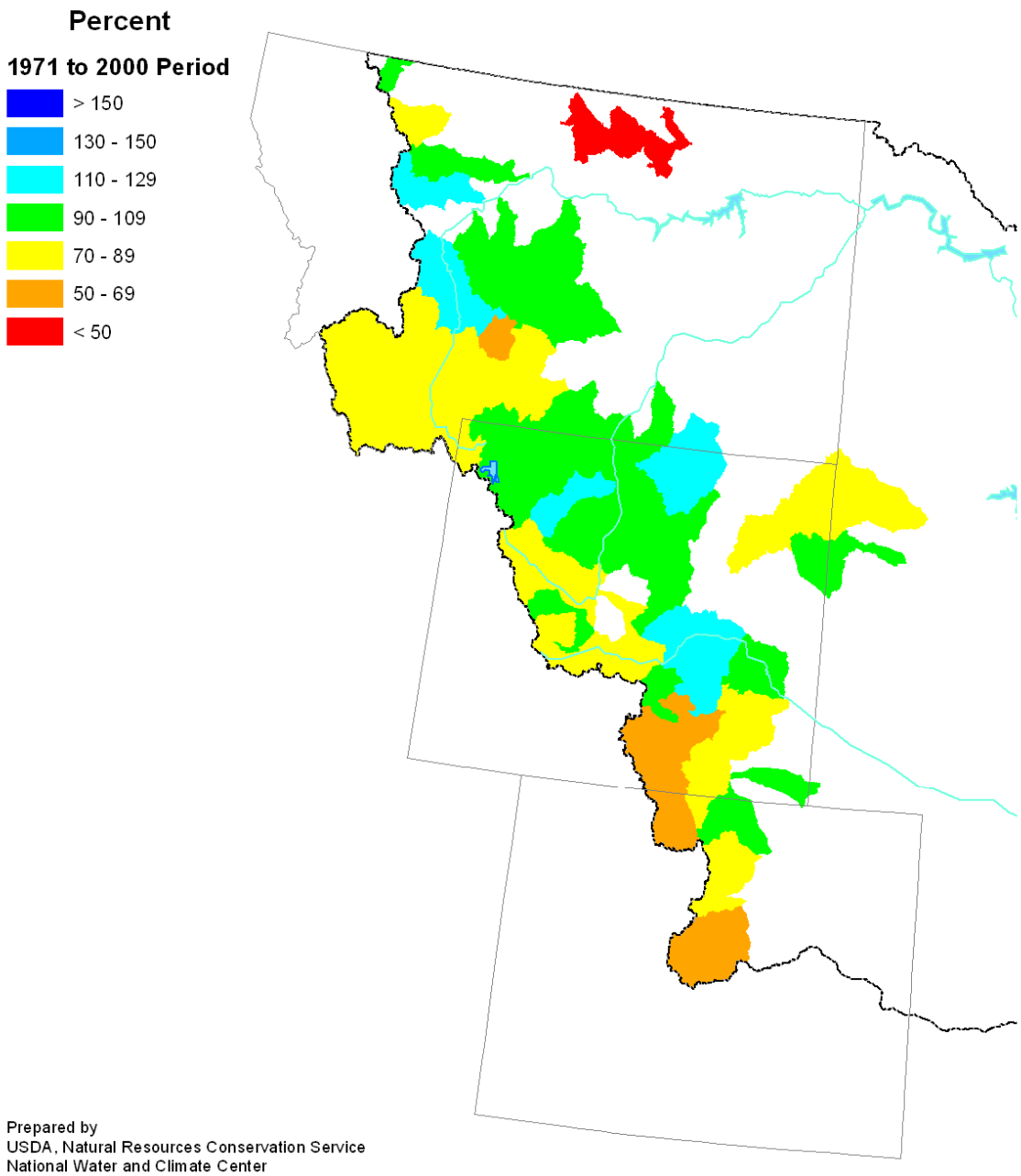
PRELIMINARY RAPID VALLEY UNIT FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Deerfield Reservoir Inflow (2)	MAR-JUL	6.0	98	10.1	7.7	4.3	1.90	6.1
	APR-JUL	5.0	98	8.5	6.3	3.8	2.4	5.1
Pactola Reservoir Inflow (2)	MAR-JUL	23	88	42	31	15.4	4.2	26
	APR-JUL	20	87	39	27	14.0	7.2	23

Max is 90th percentile and min is 10th percentile except with footnote 1 below.
Averages are for the 1971-2000 period.
All volumes are in thousands of acre-feet.

footnotes:
1) max is 95th percentile and min is 5th percentile
2) streamflow is adjusted for upstream storage
3) median value used in place of average

Missouri River Basin Mountain Snowpack as of February 1, 2012



Prepared by
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National Water and Climate Center
Portland, Oregon
http://www.wcc.nrcs.usda.gov

NOAA Water Supply Forecast

Table 2. Comparison of Fort Peck forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Jan 1 2012	Apr-Sep	3440	79%
Seasonal Ensemble Outlook*	Jan 24 2012	Apr-Sep	5378	125%
Monthly Ensemble Outlook*	Jan 24 2012			
February		Feb	316	N/A
March		Mar	517	N/A
April		Apr	778	N/A

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

Table 3. Comparison of Garrison forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes. The Corps forecast is the combined Fort Peck and Garrison runoff volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Jan 1 2012	Apr-Sep	9630	86%

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

Field Verification of Conditions

National Weather Service (NWS) warning forecast offices and Corps of Engineers mainstem project offices were consulted during the week of December 27-30 to assess local hydrologic factor field conditions. Their observations are summarized below.

NWS Glasgow - Temperatures have been 3 to 8 degrees F above normal in December 2011 with very little plains snow cover remaining in northeast Montana. Due to the warmer than normal temperature conditions, the Yellowstone and Missouri Rivers have had some ice jam issues. As of December 29 there was a little snow in the Milk, Frenchman and Poplar River basins in Canada. The soil frost depth was 18 inches. Soil moisture was still wetter than normal in the lower Milk and Yellowstone River basins and localized water tables were still high.

NWS Bismarck - The NWS in Bismarck reported that precipitation has been normal to below normal since September with August being the last month of above normal precipitation. With regard to snow, only the northwest corner had about one to two inches of snow depth. Soil conditions in North Dakota are drier than the CPC estimate reported; however water tables are still quite high, especially in the prairie potholes landform area. According to NWS, the higher water tables in this region have increased the contributing drainage areas of the James River. The soil frost depth in Bismarck was 14 inches as of December 29, in contrast to 2010-2011 in which hardly any frost existed in the soil because snow accumulation occurred before the soil had frozen. At present, there was no river ice on the Missouri River.

NWS Aberdeen – No snow existed in the north central and northeast South Dakota as of December 29. Significant snowfall of nine to ten inches occurred in November in the Pierre area;

however, all of it had melted. The frost depth in Aberdeen was 14 inches, down from 16 inches earlier in the month. The James River was still in flood stage near Stratford, SD, but was falling below flood stage as parts of it remained ice free. With drought developing in eastern South Dakota, the Big Sioux River level and flow has dropped to safe levels.

COE Fort Peck. Very little snowfall has occurred this winter so far; however soil moisture is slightly higher than usual. The frost depth is not very deep as a result of warm temperatures this winter. Fort Peck Lake had not frozen over as of January 3.

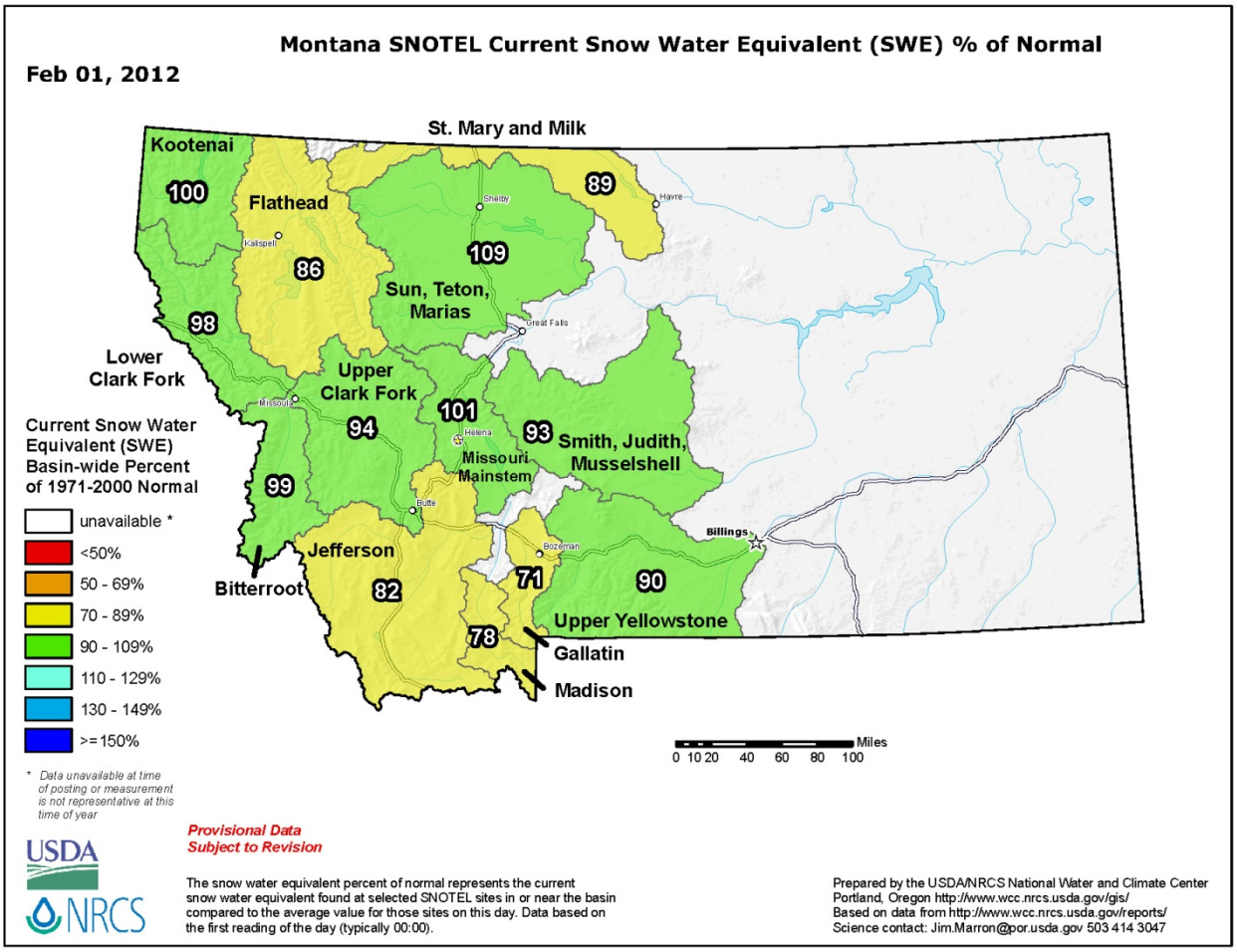
COE Garrison. We have almost no snow cover in the area. We do have frost but I'd assume the depth is not the great based on the amount of open water we still have in the area. We did get about a quarter inch of rain late last week, which was actually running off. Some of that is probably attributable to having frost in the ground, but the water tables still appear to be high based on seeps still coming from the hillsides. Sloughs and retention areas are still holding a lot of water, i.e. do not have much storage for snow melt or spring rains. This is pretty consistent for the Missouri River drainage from Pipestem to the Bowman-Haley area.

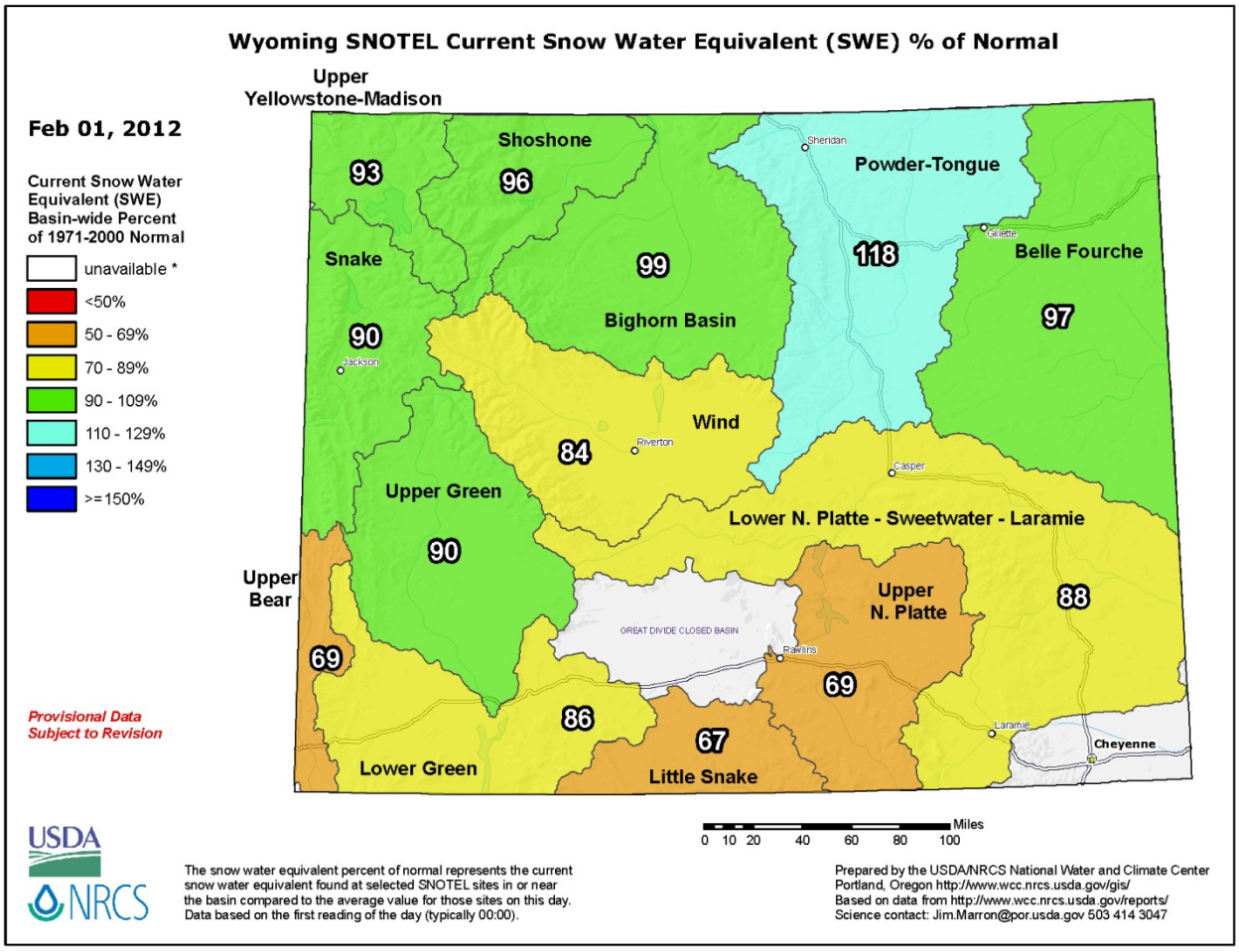
COE Oahe. As of December 29, there was not snow cover in the Oahe Dam area. Soil moisture was generally dry with no frost depth.

COE Fort Randall. In the Fort Randall watershed area, it is very dry with no snow cover. Since there is very little soil moisture 12 to 18 inches in depth, there was not frost in the soil. Surface storage areas are drying up as well, and some of the prairie potholes and marshes between Pickstown and Yankton are completely dry. Bigger lakes in the area continue to lose elevation as water table levels have begun declining.

COE Gavins Point. At Gavins Point there is now snow cover with no frost depth and very little soil moisture. The topsoil is noticeably “powder-dry”.

Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Feb 01, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Upper Yellowstone-Madison
93
Shoshone
96
Sheridan
Powder-Tongue
Gillette
Belle Fourche
Snake
99
118
97
Bighorn Basin
90
Jackson
Wind
84
Riverton
Casper
Upper Green
Lower N. Platte - Sweetwater - Laramie
90
Upper Bear
Upper N. Platte
88
GREAT DIVIDE CLOSED BASIN
Rawlins
69
69
86
67
Laramie
Cheyenne
Lower Green
Little Snake
0 10 20 40 60 80 100 Miles
USDA NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

Upper Missouri River Basin
March 2012 Calendar Year Runoff Forecast
March 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

February 2012 Runoff

February 2012 Missouri River runoff was 1,646 KAF (153% of normal) above Sioux City, and 1,472 KAF (149% of normal) above Gavins Point. Overall monthly temperatures were well-above normal allowing many tributaries to flow ice-free causing much higher than normal reservoir inflows. This was the second consecutive month of above normal runoff, resulting in a calendar year summation of 2,625 KAF (2.6 MAF) which is 144% of normal.

2012 Calendar Year Forecast Synopsis

The March 1 forecast for 2012 runoff above Sioux City, IA is **26.1 MAF** (105% of normal). The March 1 forecast for runoff above Gavins Point Dam is **22.7 MAF** (100% of normal). This is an increase of 0.5 MAF from the February 1 forecast due to continued above-normal runoff in February, modest increases in mountain snowpack, and the development of light to moderate plains snowpack in some regions of the basin. Due to the amount of variability in precipitation that can occur over the next 10 months, the range of expected inflow is quite large and ranges from the 35.2 MAF upper basic forecast to the 18.2 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 10 months are being forecasted for this March 1 forecast (2 months observed/10 months forecast), the range of greater than normal (upper

basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 10 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Niña)

The 2011 September-October-November period marked the onset of El Niño Southern Oscillation (ENSO) "La Niña" conditions when sea surface temperature (SST) anomalies fell below the -0.5 deg C departure. In 2010-2011, the onset of La Niña began with the 2010 June-July-August period, which was three months earlier than what occurred in 2011. The 2010-2011 La Niña ended during the April-May-June period.

During La Niña episodes, the Pacific Northwest and portions of the Northern Rockies in the Missouri River Basin are expected to receive greater than normal precipitation as mountain snowfall, and generally colder than normal temperatures in the Northern Plains, usually during the January-February-March period. Increased plains snowfall and accumulations are generally expected due to the colder than normal temperatures. La Niña episodes create storm track conditions that move through the Pacific Northwest to the Northern Plains (Missouri River basin). **So far the winter of 2011-2012 temperature pattern (warmer than normal) has not been typical of the expected temperature pattern during a La Niña episode. Though snowfall has been below normal over the plains, many portions of the upper Missouri River basin have experienced above normal precipitation.**

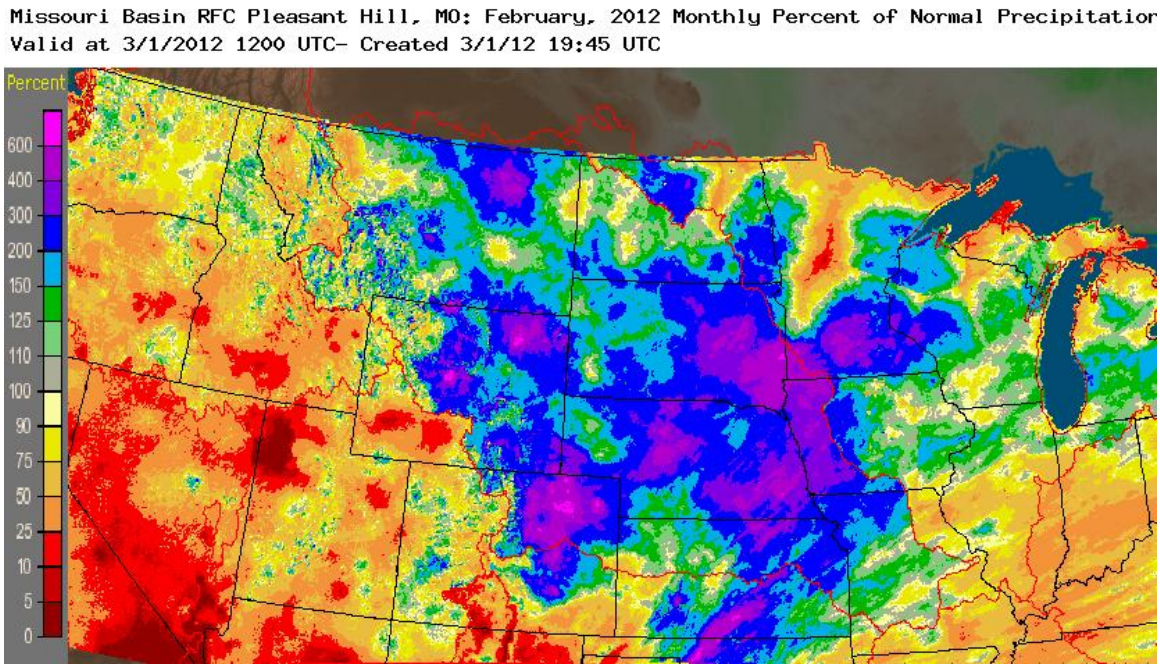
According to the NOAA Climate Prediction Center, sea surface temperatures are likely to transition to ENSO-neutral conditions during March-April-May 2012. Because the strength of impacts in the United States is not necessarily related to the exact strength of La Niña, CPC expects La Niña impacts to continue even as the episode weakens.

Precipitation

The February Climate Prediction Center precipitation outlook called for equal chances of precipitation in the Missouri River basin. Observed precipitation (see Figure 1) was above normal over a majority of the Missouri River basin as a result of several winter events that occurred during the last 10 days of February. The eastern half of South Dakota received more than 200% of normal precipitation, while many areas of the upper basin received between 125% and 200% of normal precipitation. Two notable February precipitation totals, which occurred mostly as rain, were 2.43 inches at Sioux Falls, SD and 2.24 at Sioux City, IA. The last event to occur in February produced much of this precipitation with amounts ranging from one-half inch to two inches of precipitation across the eastern half of South Dakota, western Iowa, and northern and eastern Nebraska. Average snowfall totals from this storm ranged from 6 to 10 inches over northeastern South Dakota while lesser amounts occurred in surrounding areas. Nonetheless, overall plains snowfall has been below average.

Over the 90-day period (December-January-February) in Figure 1, the precipitation accumulation map reveals that precipitation across the basin was above normal in many areas especially in the plains. These departures from normal were influenced largely by the recent February precipitation.

February 2012



December-January-February 2012

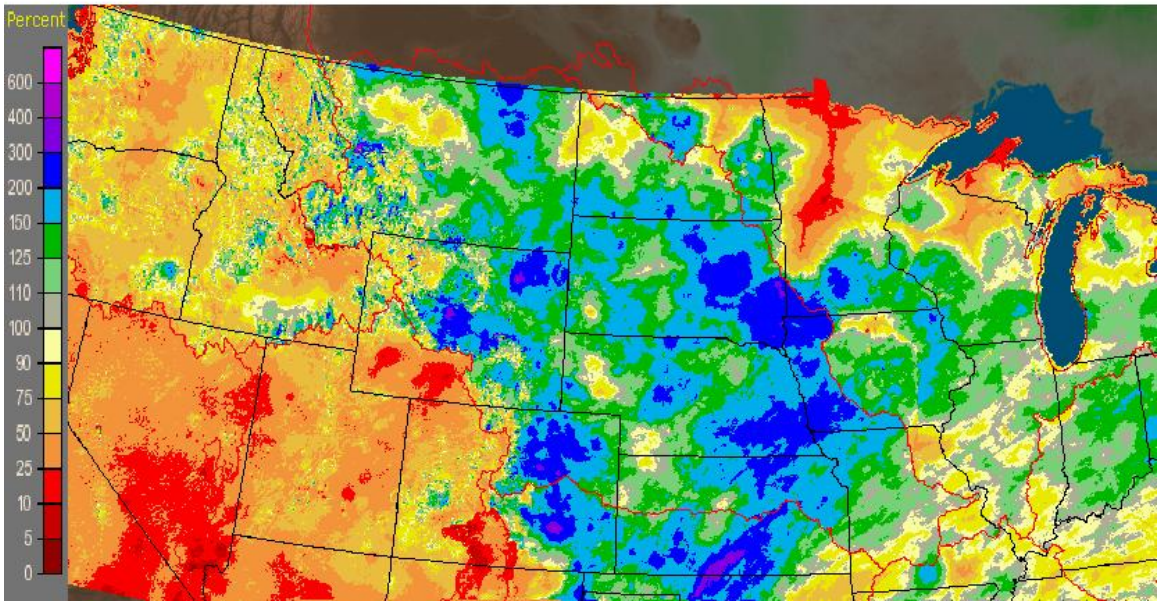


Figure 1. February 2012 and December-January-February 2012 Percent of Normal Precipitation

In comparison, February 2011 precipitation (see Figure 2) was similar in amount to 2012; however, almost all of the precipitation that occurred in 2011 was snowfall compared to a mix of snow and rain in 2012. Furthermore, the greatest precipitation departures in 2011 occurred over the upper basin above Sioux City, IA, whereas 2012 precipitation occurred throughout the basin with pockets of below normal to normal precipitation in the upper basin.

Please refer to the January and February Calendar Year Forecast narratives for information on the amount of precipitation that occurred in November and December 2011 as well as a comparison to the November and December 2010 precipitation amounts in the Missouri River basin.

February 2011

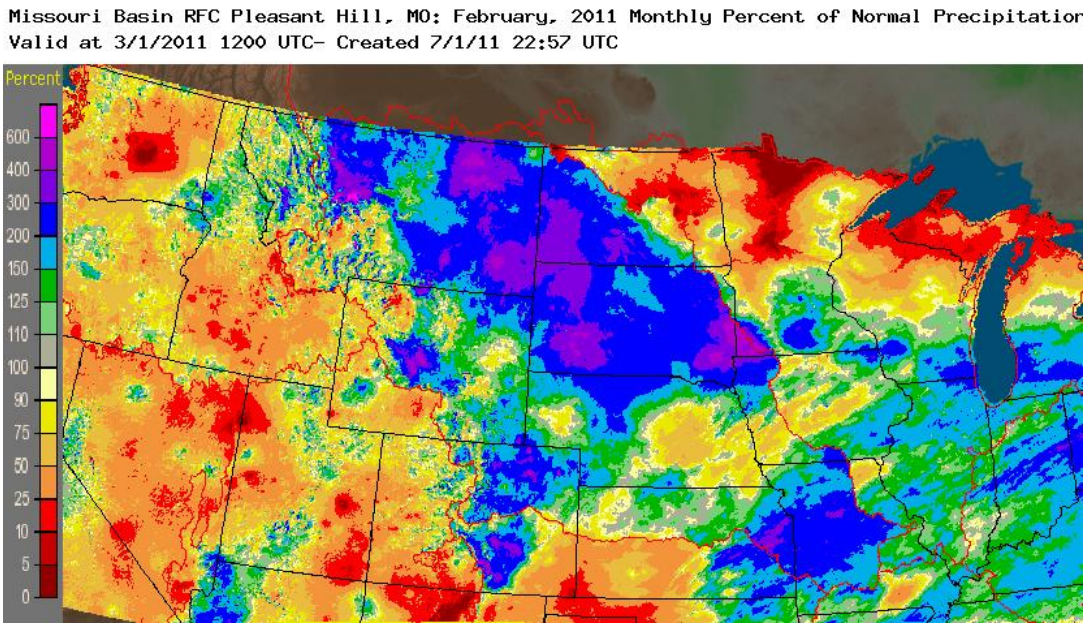


Figure 2. February 2011 Percent of Normal Precipitation.

Temperature

The February Climate Prediction Center temperature outlook called for an increased chance of above normal temperatures across most of the Missouri River basin with the greatest chance for above normal temperatures in the southeast portion of the basin (see February forecast discussion).

Average temperatures throughout the basin above Sioux City, IA during the month of February 2012 were above normal (Figure 3), especially north and east of the Missouri River where the mean temperature anomalies ranged from four to eight degrees Fahrenheit above normal. Temperature anomalies decreased to the west, and were near normal over a large portion of Wyoming and western Montana.

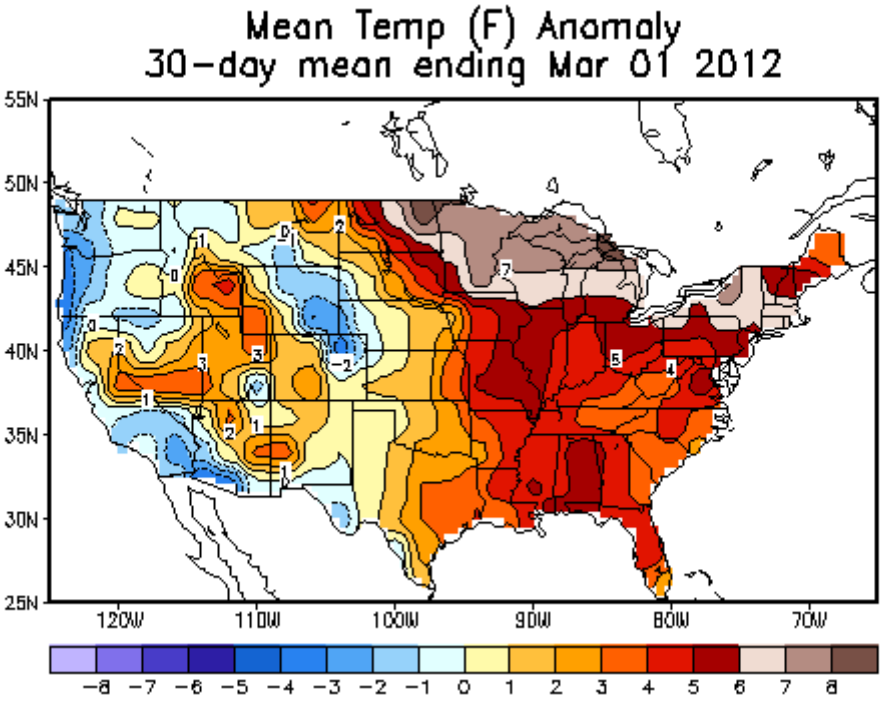


Figure 3. 30-day temperature anomaly (deg F) ending 1 Mar 2012.

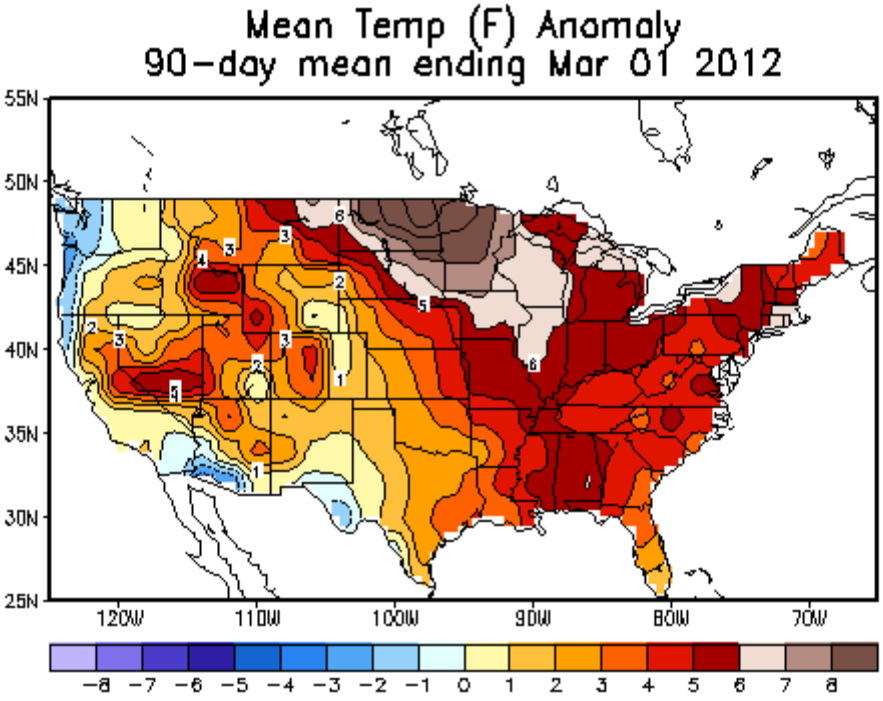


Figure 4. 90-day temperature anomaly (deg F) ending 1 Mar 2012.

Ninety-day (90-day) temperature departures ending on February 29, 2012 are shown in Figure 4. During the time period from December 1, 2011 to February 29, 2012, average daily temperatures have ranged from two to four degrees (F) above normal in the mountainous regions of the upper Missouri River

basin, and four to eight degrees above normal in the plains region of the upper Missouri River basin. In contrast, 90-day temperatures through March 1, 2011 (Figure 5) were two to four degrees (F) below normal in much of the upper basin with the exception of slightly above normal temperatures in the Yellowstone and Missouri River headwaters in Montana and Wyoming.

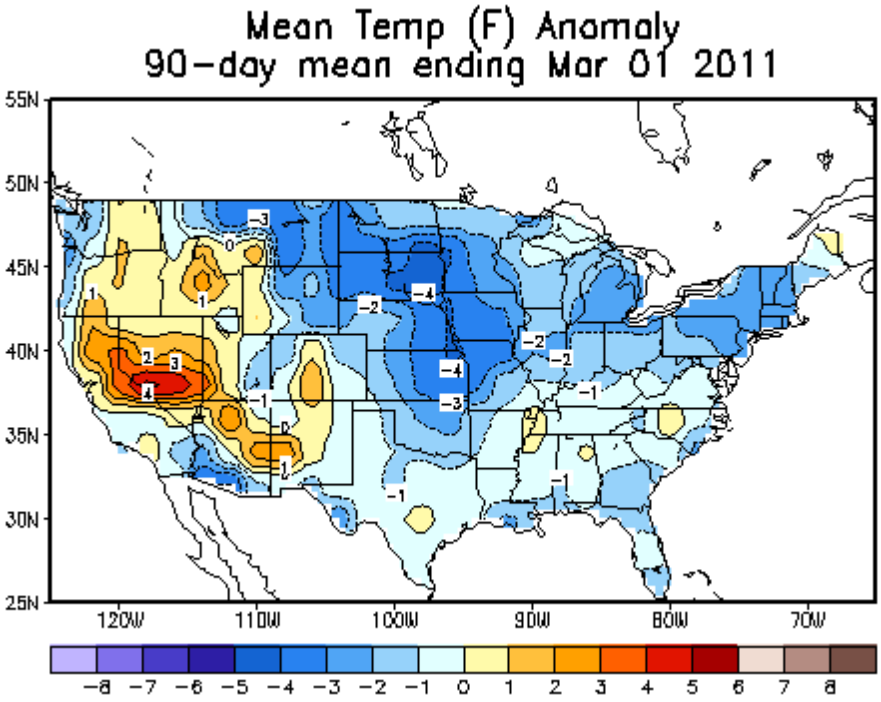


Figure 5. 90-day temperature anomaly (deg F) ending 01 Mar 2011.

Soil Moisture and Frost Conditions

Soil moisture conditions at the end of February 2012 were at or slightly above the median soil moisture condition (30th to 70th percentile) in much of the upper basin above Gavins Point (Figure 6). The exception was an area in eastern South Dakota where soil moisture ranked from the 5th to 30th percentile ranking. This area has experienced significant drying in the fall and winter as a result of above normal temperatures and below normal precipitation. Modeled soil moisture anomalies have been in the normal range in most of the upper basin (Figure 7); however, soil moisture anomalies in eastern South Dakota range from 20 to 80 millimeters below normal.

In contrast to February 2012, February 2011 soil moisture conditions were much wetter. Soil moisture percentile rankings (Figure 8) ranged from the 70th to the 99th percentile ranking across most of the upper Missouri River Basin. Particularly wet areas with rankings greater than the 90th percentile existed east of the Missouri River in the Dakotas and across North Dakota and the northern half of Montana. Positive soil moisture anomalies (Figure 9) ranged from 40 to 60 millimeters (<2.0 to 2.4 inches) over most of these areas, and up to 100 millimeters (4 inches) in northern North Dakota and eastern South Dakota. These extremely wet February conditions occurred as a result of much greater than normal fall 2010 precipitation followed by colder than normal temperatures during the winter.

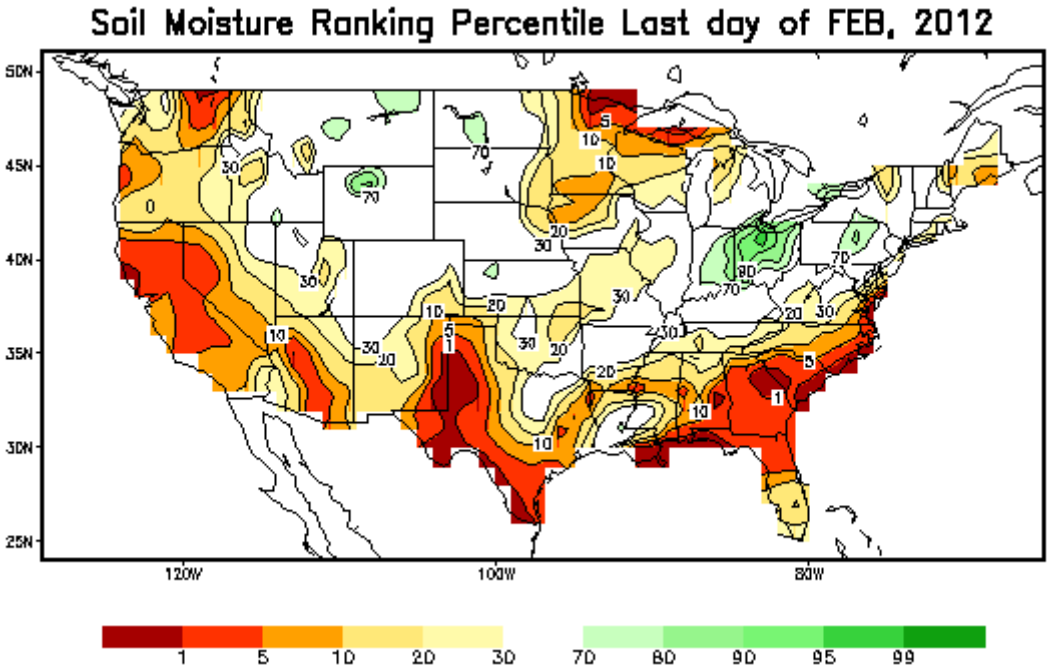


Figure 6. Calculated Soil Moisture Ranking Percentile on the last day of February 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

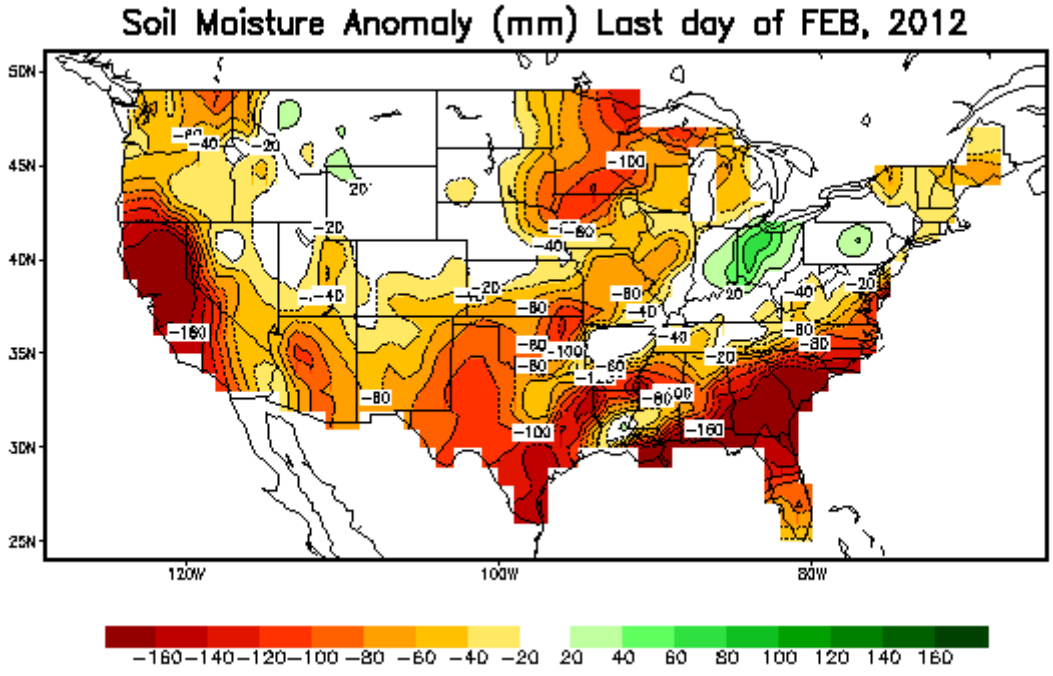


Figure 7. Calculated Soil Moisture Anomaly on the last day of February 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

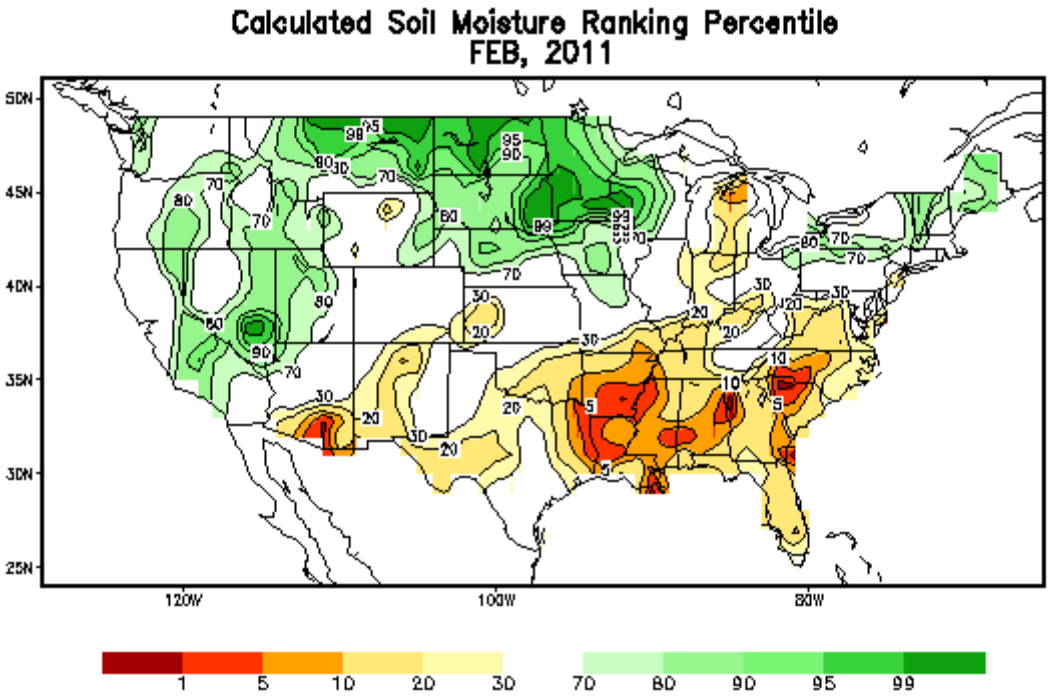


Figure 8. Calculated Soil Moisture Ranking Percentile in February 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

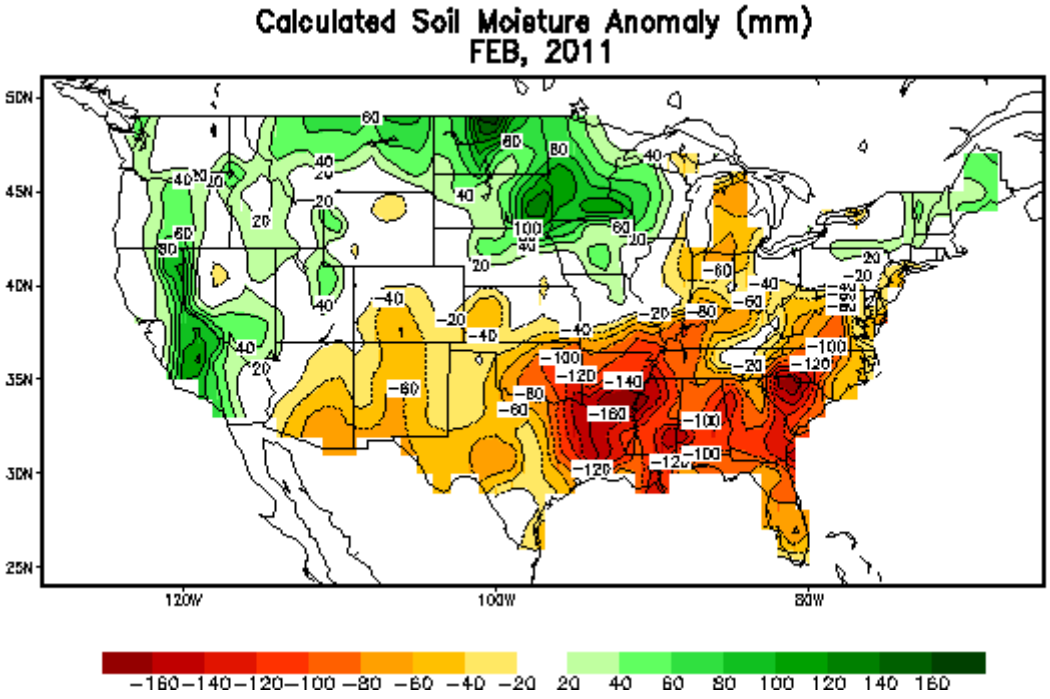


Figure 9. Calculated Soil Moisture Anomaly in February 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

For local observations of soil moisture, please refer to the end of this report for end-of-February 2012 soil moisture and frost conditions

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. A common misperception is that the March-April runoff is a result of plains snowmelt only. Historically, about 25% of annual runoff occurs in March and April, during the time when plains snow is melting, due to both melting snowpack and rainfall runoff. Runoff occurs in March and April whether or not there is any plains snow to melt. Determining exact rainfall amounts and locations are nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts, which for this year primarily includes long-term precipitation outlooks.

Temperatures in February were well above normal in the Northern Plains, limiting additional snow accumulation. Plains snowpack as of March 2, 2012 is shown in Figure 10. On March 2 the NOHRSC snow model was adjusted to observed plains snow depths and water equivalents, so the March 1 map did not reflect the more accurate analysis. The heaviest areas of SWE ranging from 1.0 to 2.0 inches are spread throughout portions of central and eastern North and South Dakota. Other areas contain trace to 1.0 inch amounts of SWE according to NOHRSC.

March 2, 2012

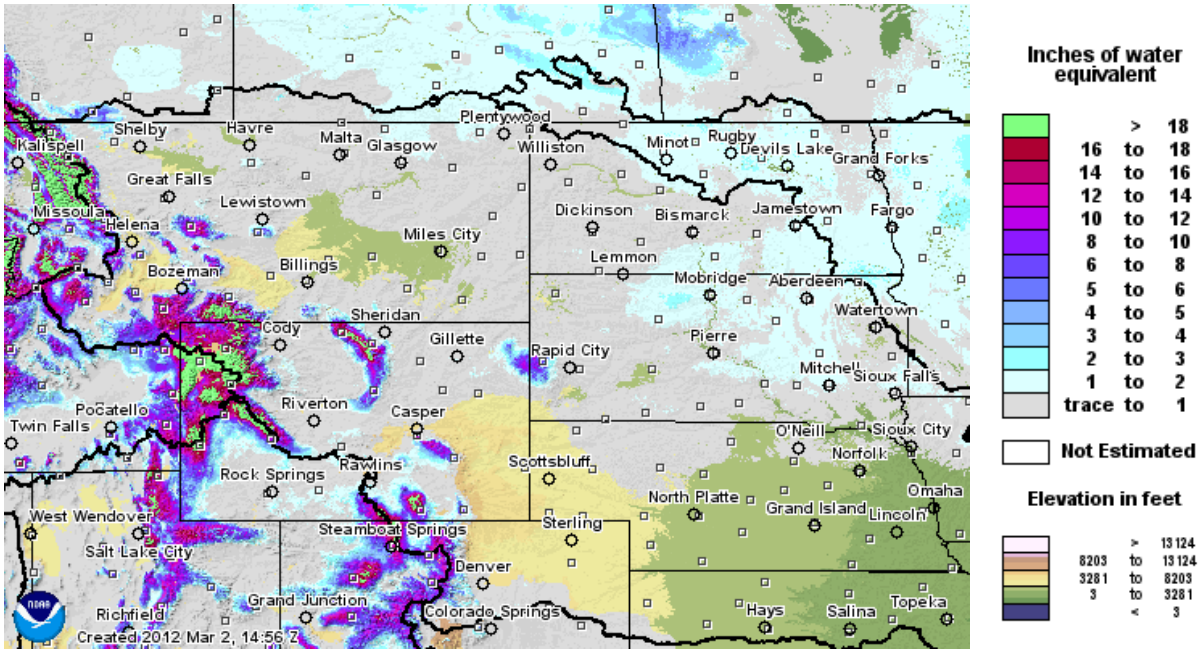


Figure 10. March 2, 2012 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

For runoff forecasting purposes, plains snow in the six mainstem reservoir reaches is classified has been classified as follows:

Table 1. January 1, February 1, and March 1, 2012 plains snowpack classification for runoff forecasting.

Reservoir Reach	Plains Snowpack Classification		
	January 1, 2012	February 1, 2012	March 1, 2012
Above Fort Peck	None to Light	None	None to Light
Fort Peck to Garrison	None to Light	None	None to Light
Garrison to Oahe	None	None to Light	Light
Oahe to Fort Randall	None	None	Light
Fort Randall to Gavins Point	None	None	None to Light
Gavins Point to Sioux City	None to Light	None to Light	Light to Moderate

In contrast, plains snowpack on March 1, 2011 (Figure 11) was very extensive in aerial coverage and much greater in depth. An area of one-inch minimum SWE existed north a line extending from Sioux City, IA to Havre, MT. Heavy snow ranging from three to four inches of SWE covered a large area north of a line from Sioux Falls, SD, to Havre, ND. Throughout the area of heaviest snow cover, SWE amounts ranged from four to six inches, with possibly heavier amounts in concentrated areas.

March 1, 2011

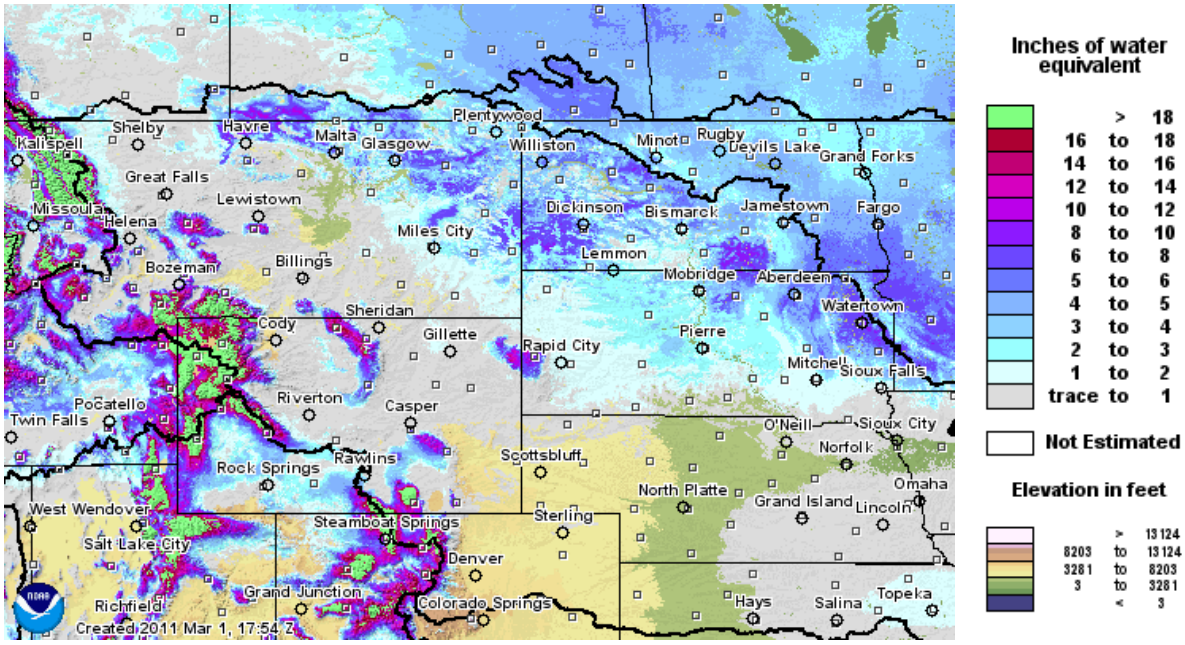


Figure 11. March 1, 2011 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

Mountain Snow Pack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff.

Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years. For example, we would expect to see greater than average runoff from an average mountain snowpack this year due to wetter than normal soil moisture conditions.

As of March 1, 2012, the Corps of Engineers' assessment of the mountain snowpack was 94% of normal in the drainage area above Fort Peck (Figure 12), an increase from 87% of normal on February 1, 2012. Mountain snowpack was 105% of normal in the incremental drainage area between Fort Peck and Garrison (Figure 12), an increase from 96% of normal on February 1, 2012. In terms of peak snow accumulation, normally 79% has accumulated in the mountains by March 1. In comparison, March 1, 2011 snowpack was 110% of normal above Fort Peck, and it was 107% of normal between Fort Peck and Garrison. The NRCS depictions of the mountain SWE as a percent of normal SWE by mountain river basin as of March 1, 2012, are provided at the end of this report under the Additional Figures heading.

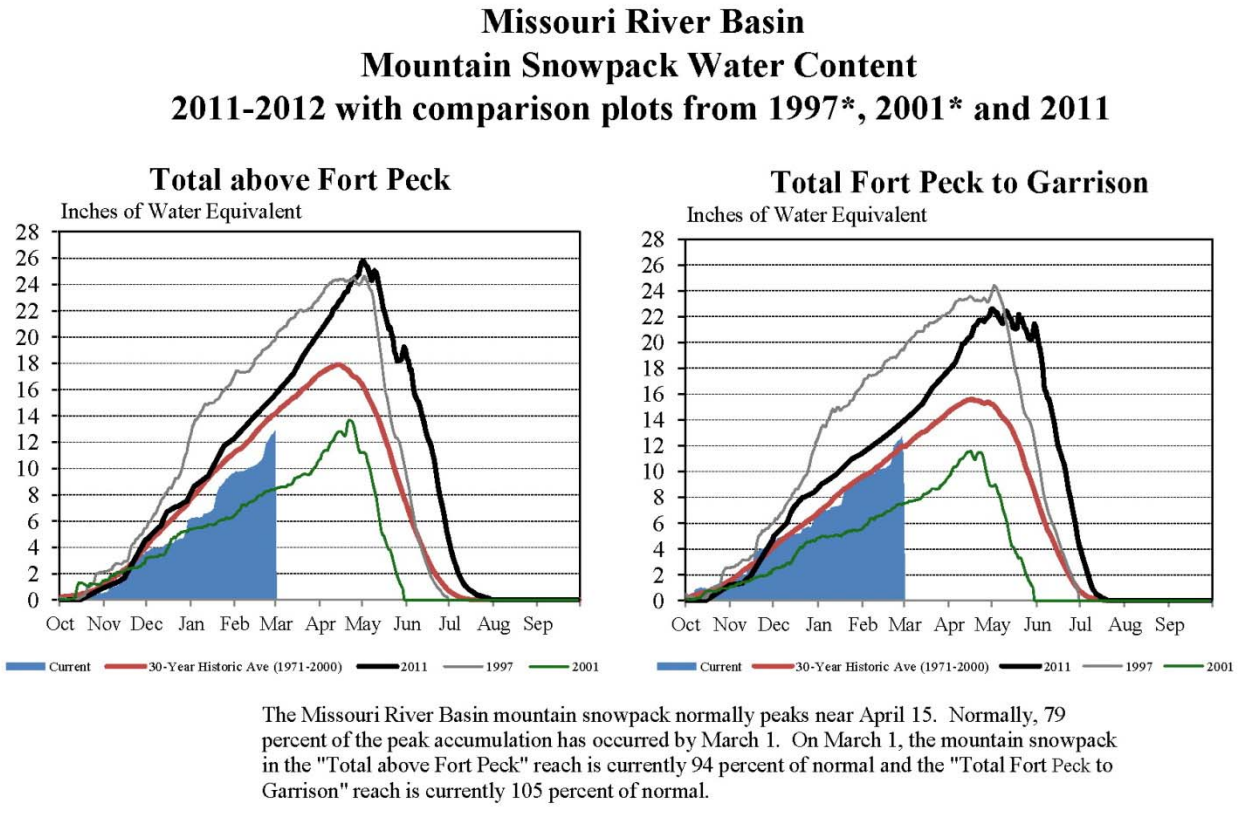


Figure 12. Mountain snowpack water content snow accumulation compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management.

Drought Analysis

According to the National Drought Mitigation Center (NDMC), Abnormally Dry (D0) conditions have persisted throughout the Dakotas, while there has been some relief in western and central Nebraska (see Figure 13). Particularly dry areas include the eastern quarter of South Dakota, southern Minnesota, northwest Iowa and northeast Nebraska, which are classified in Moderate (D1) to Severe (D2) drought categories.

Over the next three months through the end of May, the NDMC is predicting drought to develop across the western Dakotas (Figure 14) and drought to persist or intensify in eastern South Dakota, northeast Nebraska and northwest Iowa.

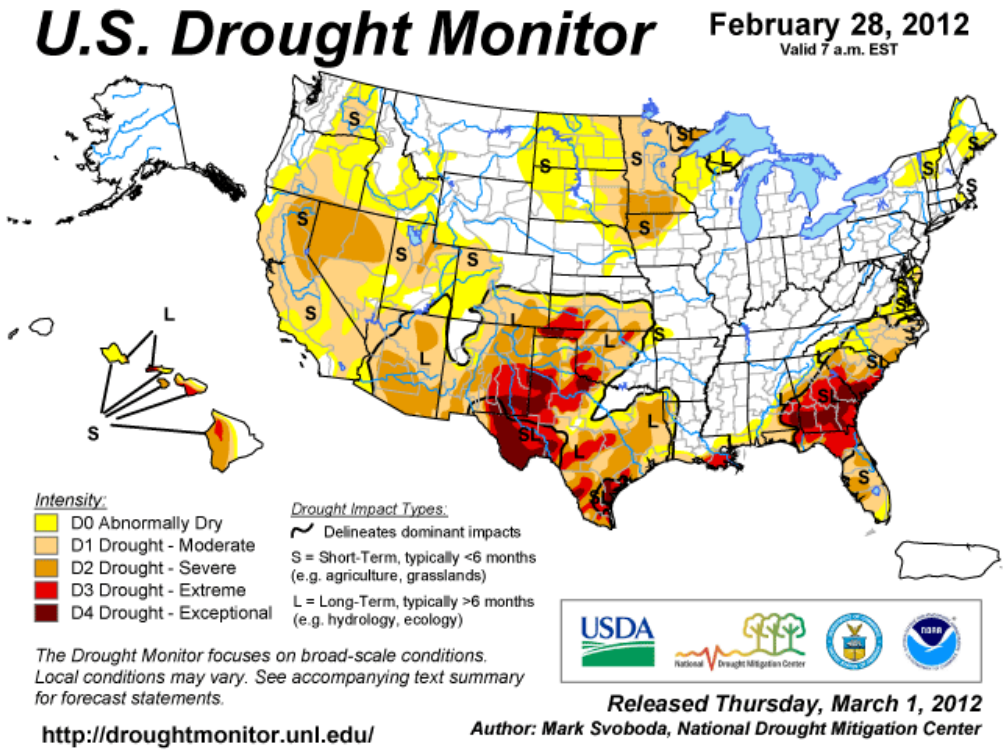


Figure 13. National Drought Mitigation Center U.S. Drought Monitors for February 28, 2012.

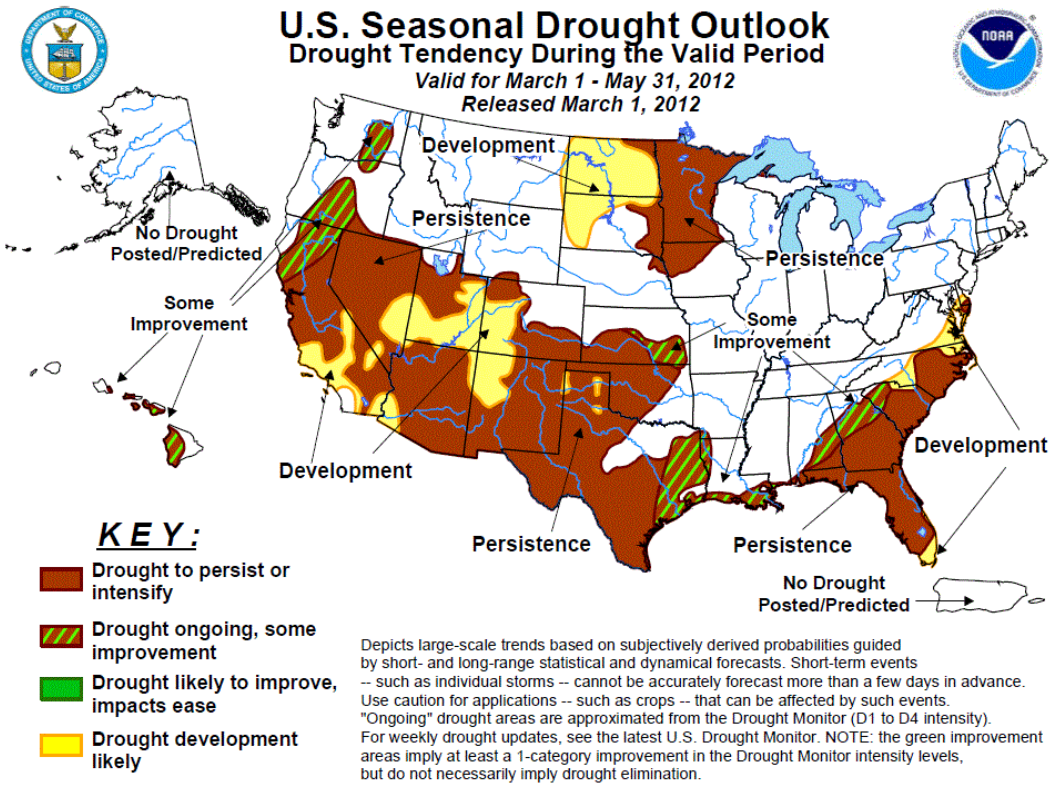


Figure 14. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for Mar-Apr-May 2012.

Climate Outlook

According to the NOAA Climate Prediction Center, La Niña is likely to transition to ENSO-neutral conditions during March-April-May 2012. Because the strength of impacts in the United States is not necessarily related to the exact strength of La Niña, CPC expects La Niña impacts to continue even as the episode weakens.

La Niña winters in the Missouri River Basin are associated with cooler than normal temperatures and possible above normal precipitation. The factors that have influenced weather so far are positive Arctic and North Atlantic Oscillations, which have limited the intrusion of cold air masses into the contiguous United States. According to the Climate Prediction Center, this has been the biggest difference in weather patterns between the winters of 2010-2011 and 2011-2012.

The 6-10 Day (Figure 15) and 8-14 Day (Figure 16) Outlooks indicate temperatures are very likely to be above normal through March 15 in all of the upper Missouri River basin, while precipitation has equal chances for being above normal, normal or below normal in most areas. The exception is an increased chance for above normal precipitation in the Northern Rockies of western Montana.

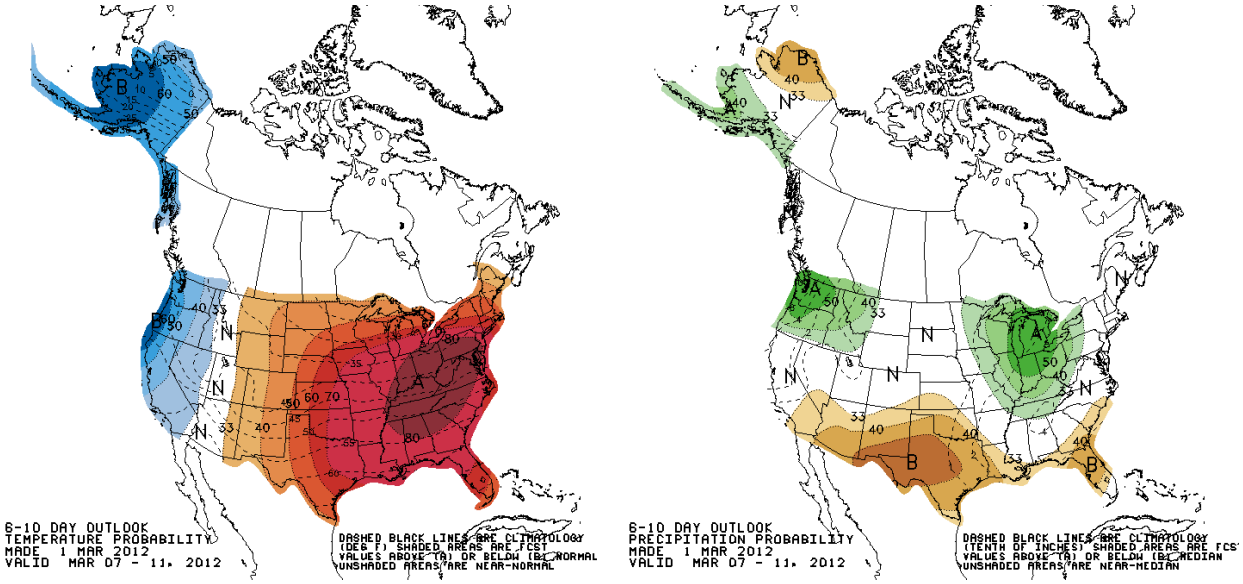


Figure 15. CPC 6-10 day temperature and precipitation outlooks.

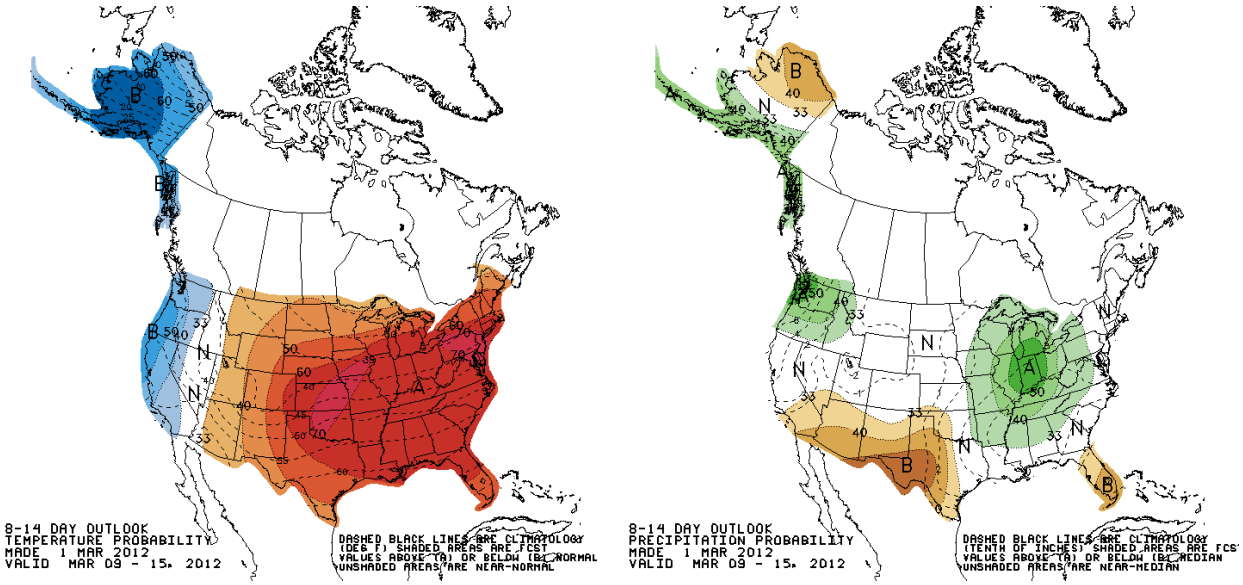


Figure 16. CPC 8-14 day temperature and precipitation outlooks.

The temperature outlook for March (Figure 17) indicates increased chances for above normal temperatures throughout much of the Missouri River Basin, while the precipitation outlook indicates equal chances for below normal, normal and above normal precipitation in the Upper Basin. Western Montana still has an increased chance for above normal precipitation through the end of March. This increased chance for above normal precipitation is a result of lingering La Niña impacts in the northwestern U.S. Lingering impacts of La Niña are also reflected in increased chances for above normal precipitation in the Ohio River Basin.

The three-month March-April-May period reflects a weakening La Niña and likely transition to ENSO-neutral conditions, leading CPC forecasters to forecast equal chances for above normal, normal, and

below normal temperatures in much of the upper basin, and increased chances for above normal temperatures in the eastern half of the basin (Figure 18). Because there is not a strong climate signal that would indicate what will happen with precipitation, there are equal chances for above normal, normal and below normal precipitation across the upper basin.

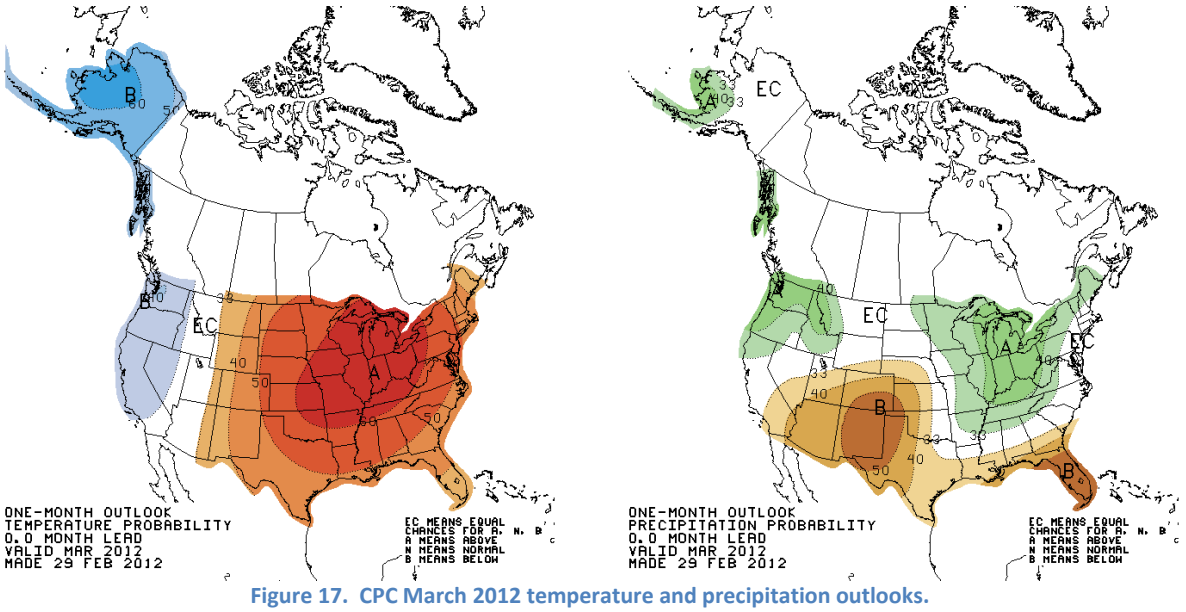


Figure 17. CPC March 2012 temperature and precipitation outlooks.

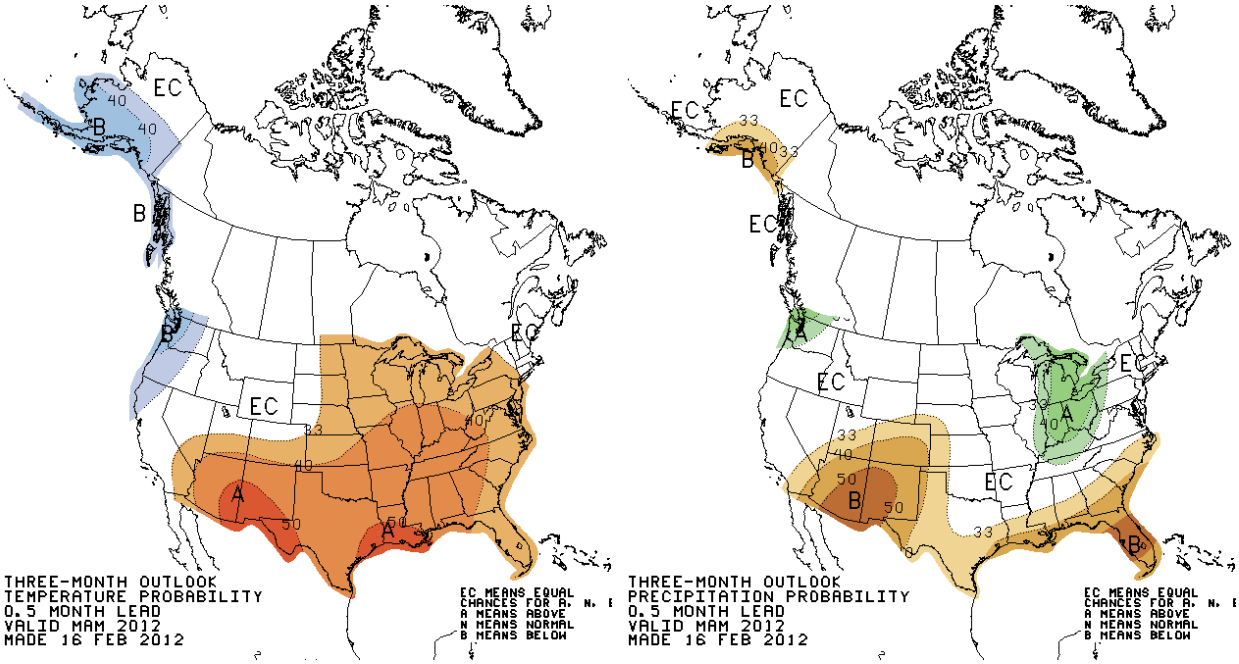


Figure 18. CPC March-April-May 2012 temperature and precipitation outlook.

According to the CPC outlook, there are Equal Chances for above normal, normal, and below normal temperatures and precipitation throughout most of the upper Missouri River basin in June-July-August 2012 (Figure 19), though there is a possibility for the Northern Rocky Mountains to receive below normal precipitation with above normal temperatures. In September-October-November, the CPC climate outlook (Figure 20) is indicating there are increased chances for above normal temperatures throughout the Missouri River basin, along with an increased chance for precipitation in the central plains. In the December-January-February outlook there are equal chances for above normal, normal and below normal temperatures and precipitation (Figure 21).

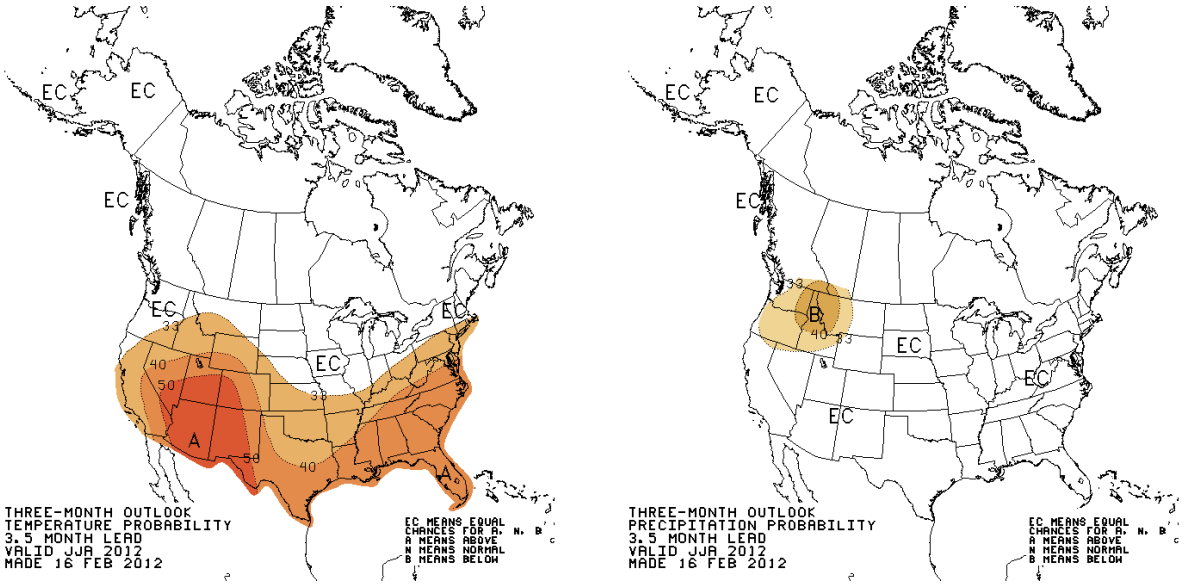


Figure 19. CPC June-July-August 2012 temperature and precipitation outlook.

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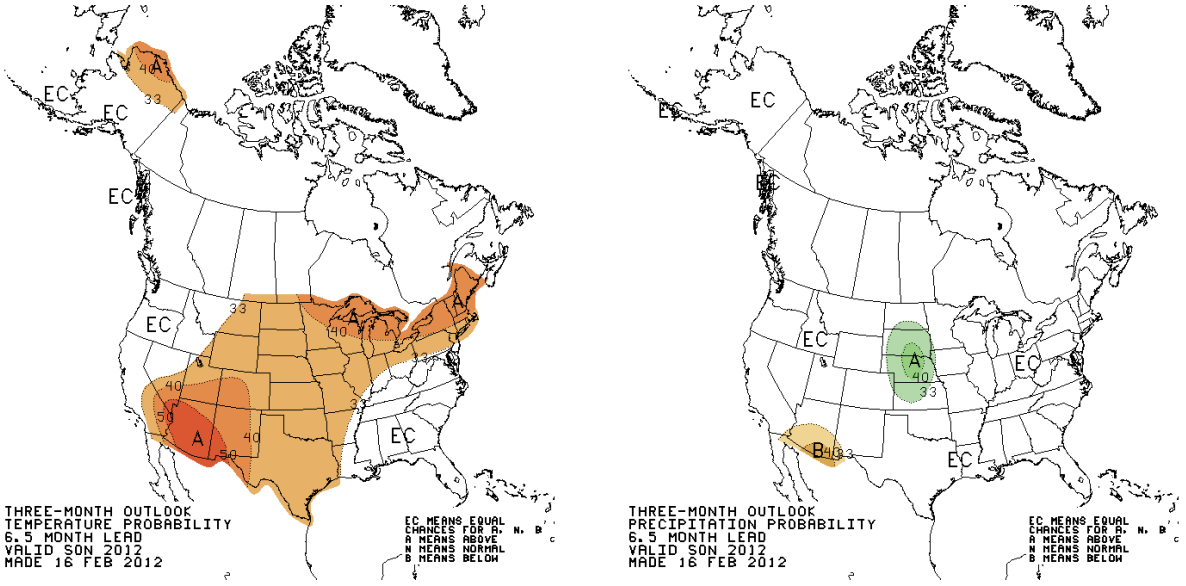


Figure 20. September-October-November 2012 temperature and precipitation outlook.

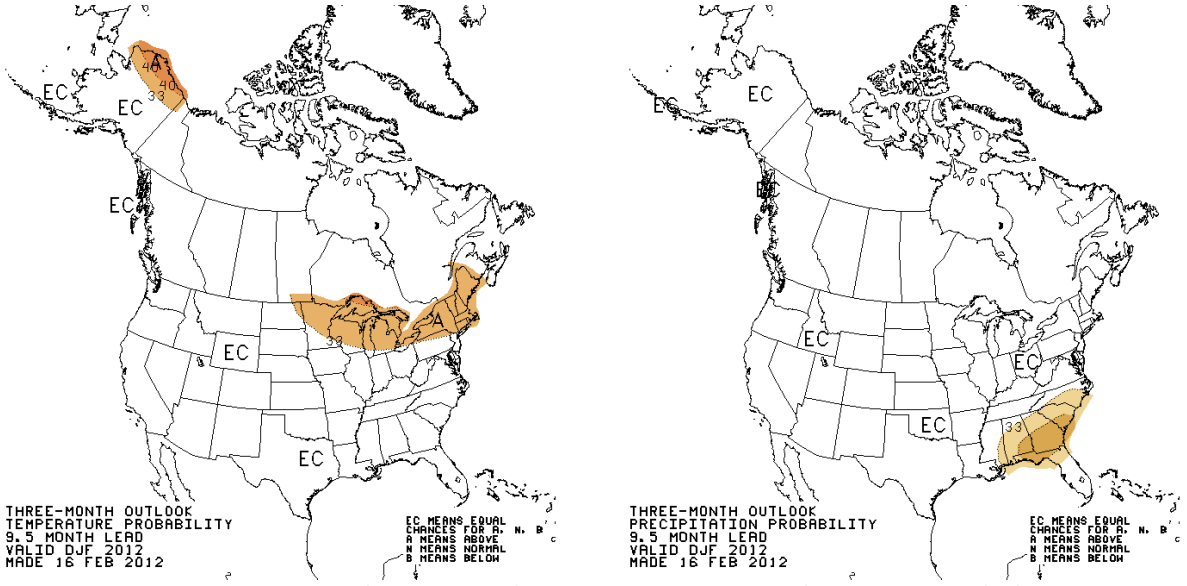


Figure 21. CPC December-January-February 2012 temperature and precipitation outlook.

March 2012 Calendar Year Runoff Forecast

As stated earlier in this report the March 1 forecast for 2012 runoff above Sioux City, IA is 26.1 MAF (105% of normal). The March 1 forecast for runoff above Gavins Point Dam is 22.7 MAF (100% of normal).

Factors taken into consideration while preparing the 2012 forecast include: soil moisture content, the presence of soil frost, the presence of high water tables in some regions, plains snowpack, mountain snowpack, and the CPC's monthly and seasonal temperature and precipitation outlooks.

March-April

Plains snow is a significant factor influencing the volume of runoff in March and April; however, precipitation and air temperatures during this time period as snow and rainfall and soil moisture are also very important factors that need consideration. Factors taken into consideration in updating the March and April runoff forecast were: 1) plains snow cover, 2) a higher probability for warmer than normal temperatures, 3) an equal chance probability for above, normal, and below normal precipitation and 4) drier than normal soil moisture in the eastern Dakotas and slightly wetter than normal soil moisture in the western Dakotas and Montana.

During the month of February average monthly temperatures were well-above normal, limiting the development of plains snowpack during the first half of February. Precipitation was normal to above-normal in the upper Missouri River basin as a result of several winter events that occurred during the last 10 days of February. The most recent event produced one-half inch to two inches of precipitation across the eastern half of South Dakota, western Iowa, and northern and eastern Nebraska. Average snowfall totals ranged from 6 to 10 inches over northeastern South Dakota while lesser amounts occurred in surrounding areas. Nonetheless, overall plains snowfall has been below average. Aside from the estimated 1 to 2.5 inches of SWE on the ground in the Dakotas, the remainder of the upper basin has trace to 1-inch amounts of SWE (much less than in 2011!).

In the Fort Peck, Garrison, Oahe, Fort Randall and Gavins Point reaches, March-April runoff is forecast to be about the same as the previous February forecast predicted. The additional plains snowfall and the outlook for equal chances of precipitation were the primary reasons why the runoff forecast was sustained. The fraction of runoff divided between March and April was adjusted so that more runoff is forecast for March than April due to the fact that temperatures have been well-above normal and temperatures are forecast to be above normal in March, leading to more runoff caused by snowmelt in March. The exception is in the Sioux City reach, where travel times in the James and Big Sioux Rivers historically delay the entry of a majority of the runoff into the Missouri River until April. Runoff into the Sioux City reach has been much higher than average in the past 30 years, so even though 2011-2012 plains snowfall is below average, runoff is forecast to be about 150% of the long-term average in this reach in March and April.

May-June-July

During the May-June-July period, the mainstem system receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River Basin, so runoff can vary significantly as a result of the above or below normal rainfall. The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total annual runoff into the system.

For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Using existing mountain snowpack (94% of normal in the reach above Fort Peck and 105% of normal in the reach between Fort Peck and Garrison) and the CPC 3-month outlooks of spring precipitation and temperatures, the May-June-July runoff is forecast to be less than normal (93%) in the Fort Peck reach and slightly above normal (102%) in the Garrison reach, which are slight increases in runoff from the previous February forecast. Soil conditions are about normal, and the climate outlook is forecasting equal chances for precipitation and temperatures through May when snow could accumulate. The best prediction for May-June-July runoff will be possible when the mountain snow reaches its peak accumulation sometime in April.

Runoff in the Oahe, Fort Randall and Gavins Point reaches is forecast to be below normal based on normal to below normal soil moisture conditions, developing drought conditions in the Dakotas, and the fact that there is no strong climate signal influencing weather in the basin. Runoff in the Sioux City reach is forecast to be about 151% of normal, a decrease since February's forecast. .

August through December

During the August through December period, runoff is forecast to be slightly below normal in all reaches from above Fort Peck to Gavins Point, primarily due to the equal-chances for above normal, below normal or normal precipitation and increased chances for above normal temperatures during the fall. As the year progresses and the August through December precipitation and temperature outlooks are updated with more detail, these values may change.

NRCS Water Supply Outlook

USDA NRCS National Water & Climate Center
 * - DATA CURRENT AS OF: March 04, 2012 01:51:42 PM
   - Based on March 01, 2012 forecast values

PRELIMINARY MISSOURI RIVER BASIN FORECASTS

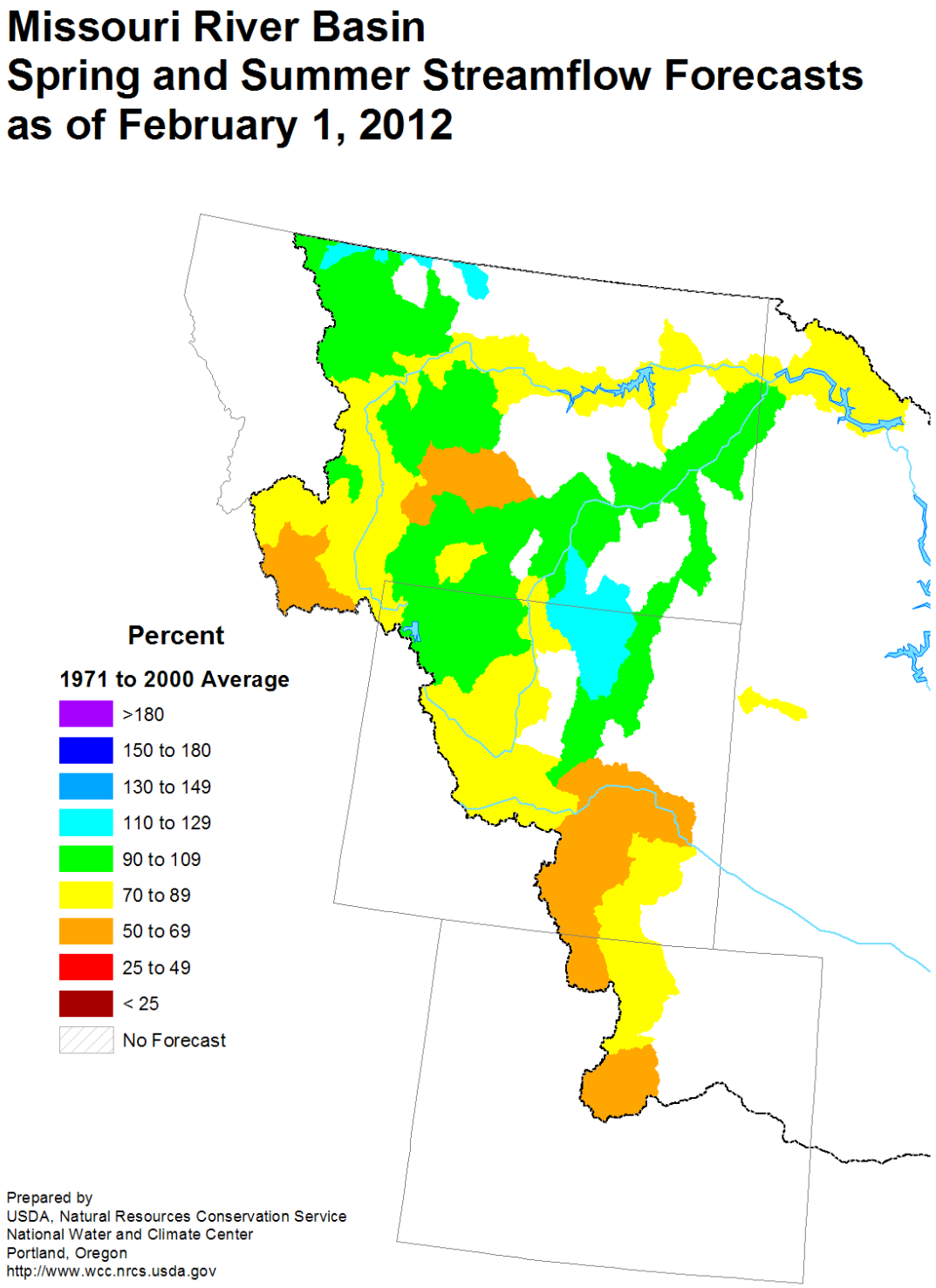
Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
Lima Reservoir Inflow (2)	APR-JUL	62	65	96	76	48	28	96
	APR-SEP	65	63	106	81	49	24	104
Clark Canyon Reservoir Inflow (2)	APR-JUL	86	66	171	120	52	1.29	131
	APR-SEP	101	65	194	139	63	8.2	156
Jefferson R nr Three Forks (2)	APR-JUL	645	83	1070	815	475	220	780
	APR-SEP	690	80	1160	880	500	220	860
Hebgen Reservoir Inflow (2)	APR-JUL	350	89	415	375	325	285	395
	APR-SEP	450	89	530	480	420	370	505
Ennis Reservoir Inflow (2)	APR-JUL	560	82	700	615	505	420	680
	APR-SEP	710	84	875	775	645	545	850
Missouri R at Toston (2)	APR-JUL	1650	80	2340	1930	1370	955	2050
	APR-SEP	1910	80	2720	2240	1580	1100	2390
Smith R bl Eagle Ck (2)	APR-JUL	145	109	200	168	122	89	133
	APR-SEP	158	106	225	185	131	92	149
Gibson Reservoir Inflow (2)	APR-JUL	440	96	545	480	400	335	460
	APR-SEP	480	95	590	525	435	370	505
Marias R nr Shelby (2)	APR-JUL	395	95	575	465	325	215	415
	APR-SEP	395	90	585	475	315	205	440
Lake Sherburne Inflow (2)	APR-JUL	102	97	117	108	96	87	105
	APR-SEP	117	96	134	124	110	100	122
St. Mary R at Int'l Boundary (2)	APR-JUL	445	102	545	485	405	345	435
	APR-SEP	515	100	620	555	475	410	515
Milk R at Western Crossing (3)	MAR-JUL	39	95	61	48	30	16.7	41
	MAR-SEP	41	95	65	51	31	16.6	43
	APR-JUL	32	97	51	40	24	13.2	33
	APR-SEP	34	94	55	42	26	13.3	36
Milk R at Eastern Crossing (2,3)	MAR-JUL	85	102	145	109	61	25	83
	MAR-SEP	90	103	154	116	64	26	88
	APR-JUL	61	101	106	79	43	16.5	61
	APR-SEP	68	98	115	87	49	21	69
Beaver Ck nr Havre	MAR-JUL	6.4	67	11.7	8.5	4.3	2.0	9.6
	APR-JUL	5.3	61	14.1	7.9	3.6	1.99	8.7

PRELIMINARY YELLOWSTONE RIVER BASIN FORECASTS

Forecast Point	period	50% (KAF)	% of avg	max (KAF)	30% (KAF)	70% (KAF)	min (KAF)	30-yr avg
West Rosebud Ck nr Roscoe (2)	APR-JUL	56	93	65	60	52	47	60
	APR-SEP	71	92	83	76	66	59	77
Wind R ab Bull Lake Ck (2)	APR-JUL	415	95	525	460	370	305	435
	APR-SEP	505	94	635	555	455	375	535
Bull Lake Ck nr Lenore	APR-JUL	145	98	176	157	133	114	148
	APR-SEP	178	98	215	194	162	140	182
Boysen Reservoir Inflow (2)	APR-JUL	645	90	1030	800	490	260	717
	APR-SEP	710	88	1140	885	535	280	809
Greybull R nr Meeteetse	APR-JUL	157	106	194	172	142	120	148
	APR-SEP	215	108	265	235	196	167	200
Shell Ck nr Shell	APR-JUL	69	115	84	75	63	54	60
	APR-SEP	81	113	98	88	74	64	72
Bighorn R at Kane (2)	APR-JUL	1030	103	1550	1240	820	510	1000
	APR-SEP	1130	102	1700	1360	900	565	1110
NF Shoshone R at Wapiti	APR-JUL	490	107	590	530	450	390	460
	APR-SEP	550	106	660	595	505	440	520
SF Shoshone R nr Valley	APR-JUL	240	107	285	260	220	194	225
	APR-SEP	275	104	325	295	255	225	265
Buffalo Bill Reservoir Inflow (2)	APR-JUL	760	106	920	825	695	600	720
	APR-SEP	840	104	1020	910	770	665	805

Bighorn R nr St. Xavier (2)	APR-JUL	1660	103	2290	1920	1400	1030	1610
	APR-SEP	1800	102	2510	2090	1510	1090	1760
Little Bighorn R nr Hardin	APR-JUL	155	121	200	174	136	108	128
	APR-SEP	175	122	225	196	154	123	144
Tongue R nr Dayton (2)	APR-JUL	114	119	145	127	101	83	96
	APR-SEP	128	117	162	142	114	94	109
Tongue River Reservoir Inflow (2)	APR-JUL	280	127	390	325	235	170	220
	APR-SEP	310	124	425	355	265	194	250
NF Powder R nr Hazelton	APR-JUL	11.8	123	15.0	13.1	10.5	8.6	9.6
	APR-SEP	12.7	122	16.0	14.1	11.3	9.4	10.4
Powder R at Moorhead	APR-JUL	270	132	385	315	225	156	205
	APR-SEP	295	128	415	345	245	177	230
Powder R nr Locate	APR-JUL	310	132	445	365	255	175	235
	APR-SEP	335	129	480	395	275	190	260

March 1, 2012 Streamflow Forecast was not available at the time the Calendar Year Forecast was made.



NOAA Water Supply Forecast

Table 2. Comparison of Fort Peck forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Feb 1 2012**	Apr-Sep	3460	80%
Seasonal Ensemble Outlook*	Feb 28 2012	Apr-Sep	5243	124%
Monthly Ensemble Outlook*	Feb 28 2012			
February		Mar	331	N/A
March		Apr	716	N/A
April		May	1448	N/A

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on March 1.

Table 3. Comparison of Garrison forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes. The Corps forecast is the combined Fort Peck and Garrison runoff volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Feb 1 2012**	Apr-Sep	9300	83%

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on March 1.

Field Verification of Conditions

Corps of Engineers mainstem project offices and some volunteer plains snow observers reported local hydrologic factor field conditions during the last week of February. Their observations are summarized below.

COE Garrison. Surface soil moisture was moist with frost present.

COE Oahe. Soil moisture conditions were moist at the soil surface. Soil frost was reported at about a one-foot depth.

COE Fort Randall. Surface soils received some moisture from snowmelt; however, the overall profile is pretty dry. The Fort Randall project manager reported that Pickstown, SD was much drier than Yankton. Soil moisture in Pickstown was dry to very dry. In Yankton it was normal. Last month the frost depth near Fort Randall was zero due to a lack of soil moisture. Near Chamberlain, topsoil soil moisture ranged from normal to moist but was dry underneath, and the frost depth was below average.

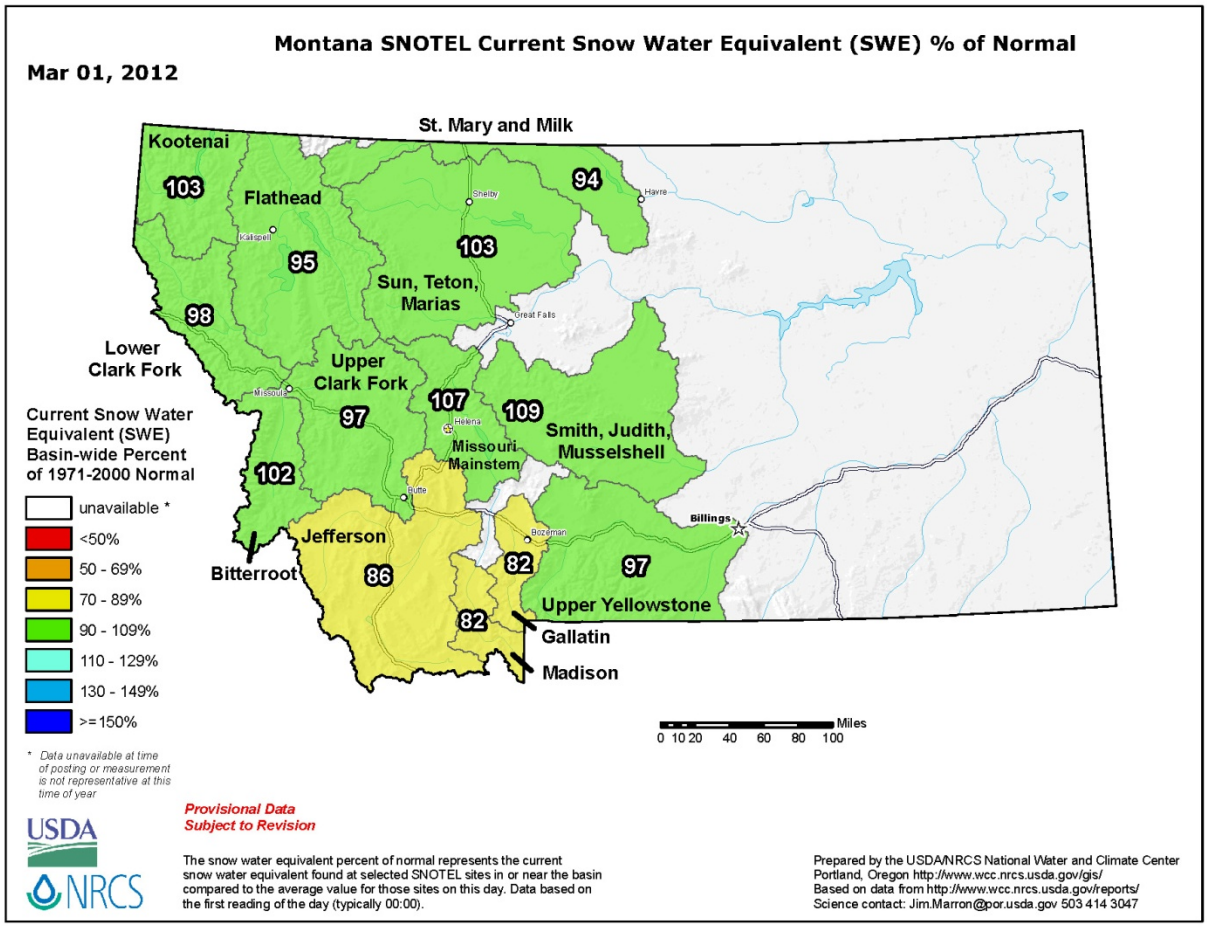
COE Gavins Point. At the end of February there was shallow soil frost and dry to normal soil moisture.

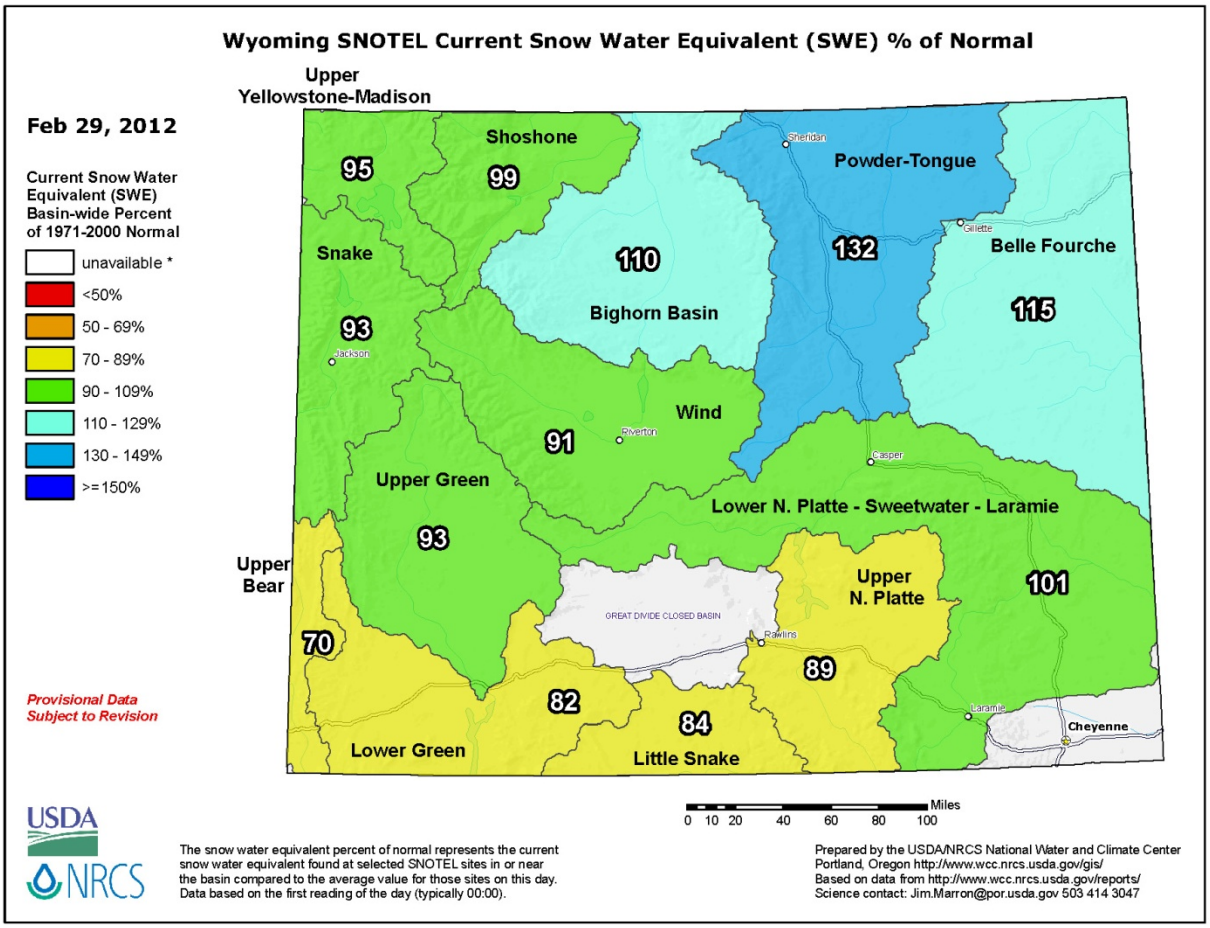
COE Jamestown-Pipestem. Subsoil moisture was wet and soil frost was reported at a depth of 24 inches.

Southeast South Dakota. According to a Union County snow survey observer, soil moisture conditions were dry and frost was evident, but thin. He expected the frost to disappear as soon as temperatures began to warm.

Eastern South Dakota. Near Hayti, SD, surface soil moisture conditions were dry.

Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Feb 29, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Upper Yellowstone-Madison
95
Shoshone
99
Powder-Tongue
Sheridan
Gillette
Snake
110
132
Belle Fourche
Bighorn Basin
115
93
Jackson
Wind
Riverton
91
Casper
Upper Green
Lower N. Platte - Sweetwater - Laramie
93
Upper Bear
Upper N. Platte
101
GREAT DIVIDE CLOSED BASIN
Rawlins
70
89
82
84
Laramie
Cheyenne
Lower Green
Little Snake
0 10 20 40 60 80 100
Miles
USDA NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

Upper Missouri River Basin
March 2012 Calendar Year Runoff Forecast
April 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

March 2012 Runoff

March 2012 Missouri River runoff was 2,246 KAF (78% of normal) above Sioux City, and 1,927 KAF (75% of normal) above Gavins Point. In January and February very warm temperatures caused a premature ice breakup on rivers and tributaries, and soil frost thawed earlier than usual allowing more runoff to occur in January and February than would normally occur during a year with normal temperatures. As a result, March runoff did not benefit from the spring thaw.

In March, record high temperatures across the upper basin melted the very light plains snowpack early in March. Throughout the month precipitation was less than 50% of normal across the plains, resulting in lower than normal runoff volumes in all reaches except the Sioux City reach. The calendar year runoff summation above Sioux City as of April 1, 2012 was 4,871 KAF (4.9 MAF) which is 103% of normal.

2012 Calendar Year Forecast Synopsis

The April 1 forecast for 2012 runoff above Sioux City, IA is **23.4 MAF** (94% of normal). The April 1 forecast for runoff above Gavins Point Dam is **21.0 MAF** (92% of normal). This is a decrease from the March 1 forecast due to much lower than normal runoff from plains snowmelt, a slight decrease in the mountain snowpack, much warmer than normal temperatures and below normal precipitation. Due to the amount of variability in precipitation that can occur over the next 9 months, the range of expected inflow is quite large and ranges from the 30.6 MAF upper basic forecast to the 17.2 MAF lower basic

forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 9 months are being forecasted for this April 1 forecast (3 months observed/9 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 9 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Niña)

The 2011 September-October-November period marked the onset of El Niño Southern Oscillation (ENSO) "La Niña" conditions when sea surface temperature (SST) anomalies fell below the -0.5 deg C departure. According to the Climate Prediction Center (CPC) La Niña conditions in the equatorial Pacific Ocean still existed as of April 2; however, La Niña has been weakening.

During La Niña episodes, the Pacific Northwest and portions of the Northern Rockies in the Missouri River Basin are expected to receive greater than normal precipitation as mountain snowfall, and generally colder than normal temperatures in the Northern Plains, usually during the January-February-March period. Increased plains snowfall and accumulations are generally expected due to the colder than normal temperatures. La Niña episodes create storm track conditions that move through the Pacific Northwest to the Northern Plains (Missouri River basin). **So far the 2012 temperature pattern (warmer than normal) has not been typical of the expected temperature pattern during a La Niña episode. Plains snowfall was well-below normal; however, some tributary basins in the upper Missouri River basin experienced above normal precipitation.**

According to the NOAA Climate Prediction Center, La Niña is expected to transition to ENSO-neutral conditions by the end of April 2012. During ENSO-neutral conditions, there is not a strong climate signature associated with these conditions that would suggest if weather in the Missouri River basin will be wetter or drier and warmer or cooler; however, because the strength of impacts in the United States is not necessarily related to the exact strength of ENSO, CPC expects La Niña impacts to continue even as the episode weakens.

Precipitation

The March CPC precipitation outlook called for equal chances of precipitation in much of the northern plains with increased chances for precipitation in western Montana, the northwest tip of Wyoming, and eastern North Dakota, while there were reduced chances of precipitation in southwestern portions of the Missouri River basin. During March observed precipitation (see Figure 1) was dominated by areas of less than 50% of normal precipitation over vast portions of the basin including all of South Dakota, Nebraska, most of Wyoming, North Dakota, eastern Montana and northern Kansas. Areas that received above normal precipitation include tributary areas to the Missouri downstream of Nebraska City, NE,

the Rocky Mountains in western Montana, a small part of the Bighorn River basin, and portions of central and north central Montana. Very dry areas including parts of northeast Colorado, western Nebraska, southern and eastern Wyoming, western South and North Dakota and eastern Montana received less than 25% of normal March precipitation.

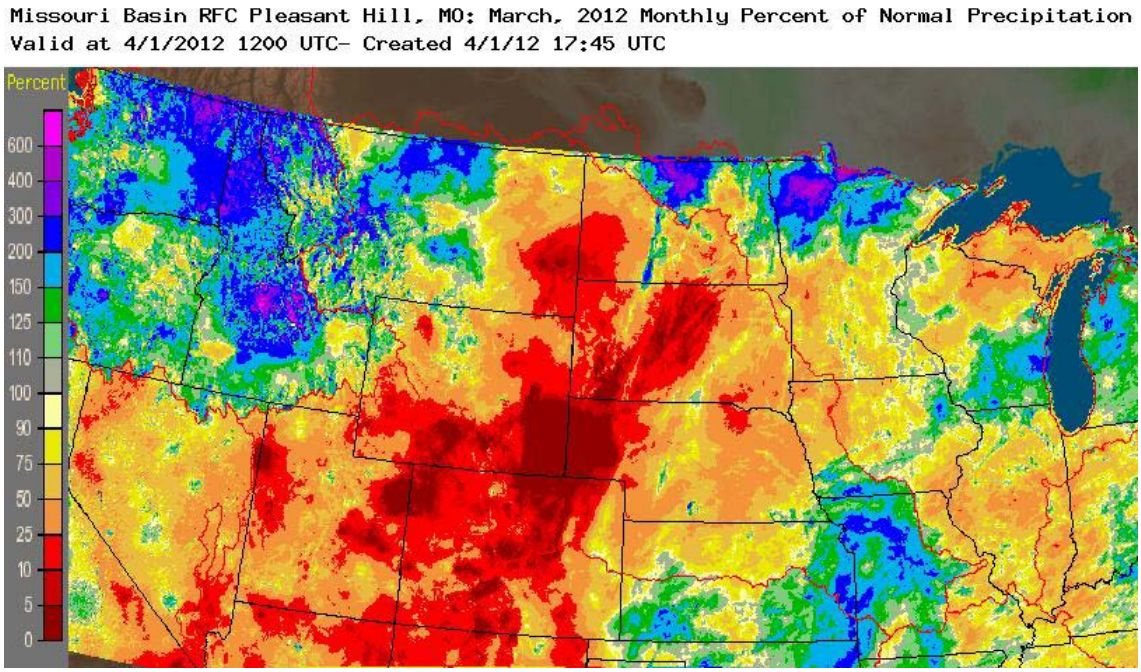


Figure 1. March 2012 Percent of Normal Precipitation. Source: National Weather Service.

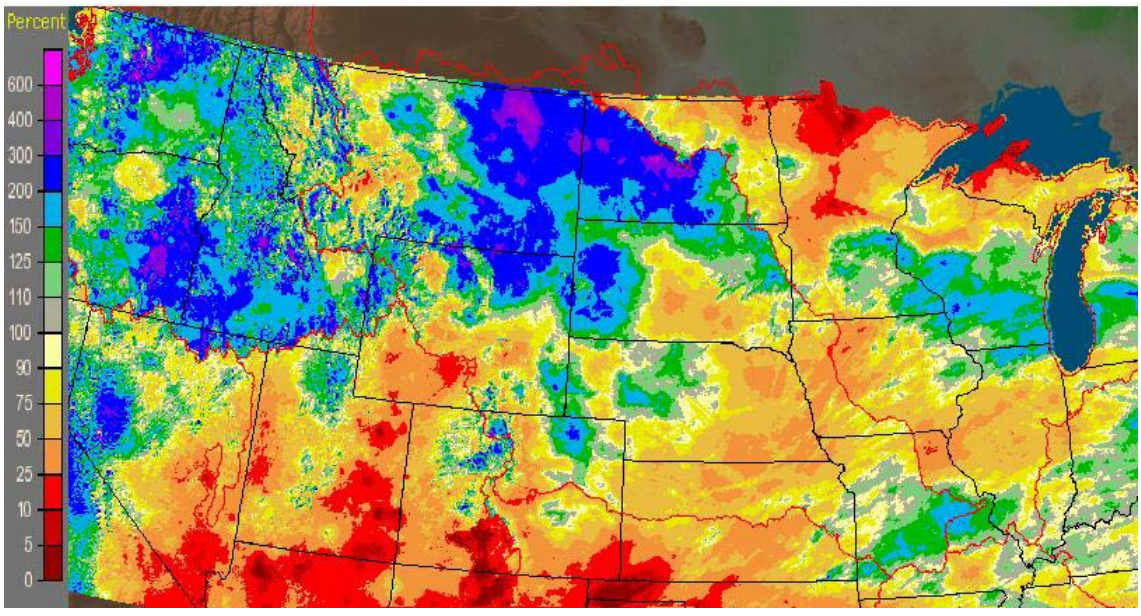


Figure 2. March 2011 Percent of Normal Precipitation. Source: National Weather Service.

In comparison, March 2011 precipitation (see Figure 2) was much wetter in the upper basin, particularly in northern Wyoming eastern Montana, western South Dakota, and much of North Dakota with departures of over 150% of normal and some areas receiving over 200% of normal.

Over the 90-day period (January-February-March) in Figure 3, the Missouri River basin has experienced both above and below normal precipitation. Most areas of Montana have received above normal precipitation while most other states are dominated by areas of below normal precipitation. An area of greater than 125% of normal precipitation covers a large portion of eastern South Dakota; however, this occurred as a result of one large winter storm. The Missouri River basin below Omaha, NE, has received nearly 125% of normal precipitation during the past three months.

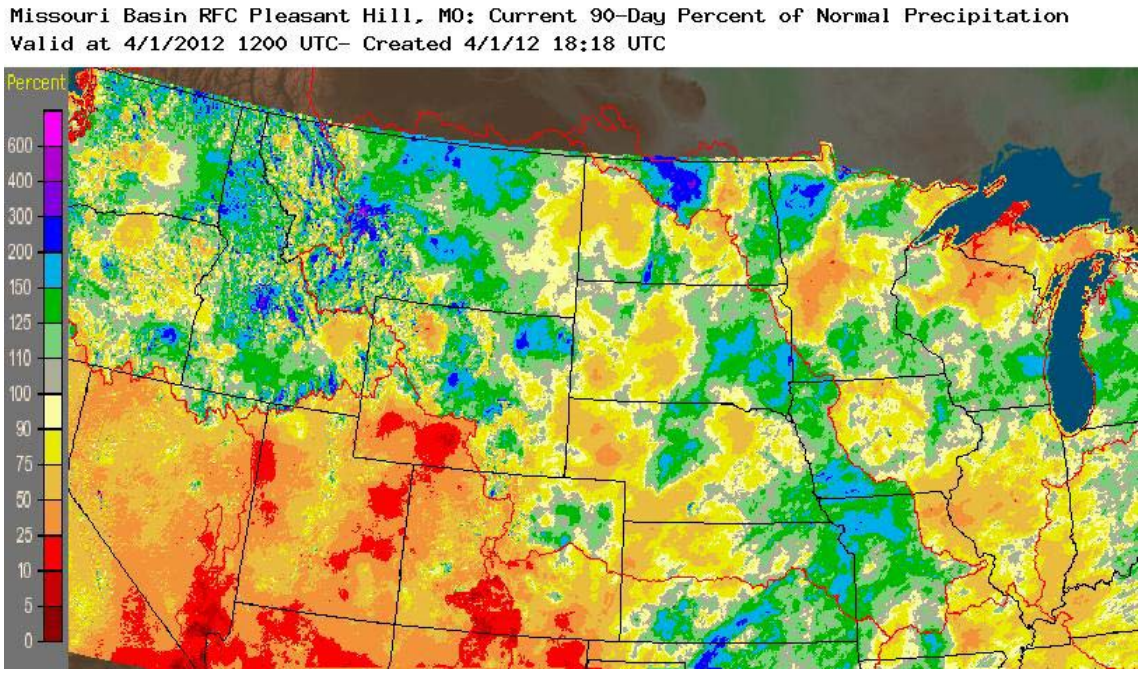


Figure 3. January-February-March 2012 Percent of Normal Precipitation. Source: National Weather Service.

Please refer to the January and February Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

The March Climate Prediction Center temperature outlook called for an increased probability for above normal temperatures across most of the Missouri River basin with the greatest chance for above normal temperatures in the southeast portion of the basin (see March forecast discussion).

Average temperatures throughout the entire Missouri River basin were well above normal in March 2012 (Figure 4). Temperature anomalies ranged from 8 to 16 degrees F above normal in the plains, while in the mountains temperatures were anywhere from 2 to 9 degrees above normal. Record high monthly March temperatures occurred in Billings, MT; Miles City, MT; Lander, WY; Rapid City, SD; Sioux

Falls, SD; Sioux City, IA and Omaha, NE. This very warm weather pattern has occurred due to a number of factors including strong southerly winds, a jet stream pattern that has locked cold air far to the north of the central U.S., and a persistent positive North Atlantic Oscillation, which favors warmth in the eastern and central U.S. These warm temperatures have been a major driving factor that has dried surface soils and reduced runoff to below normal volumes in March.

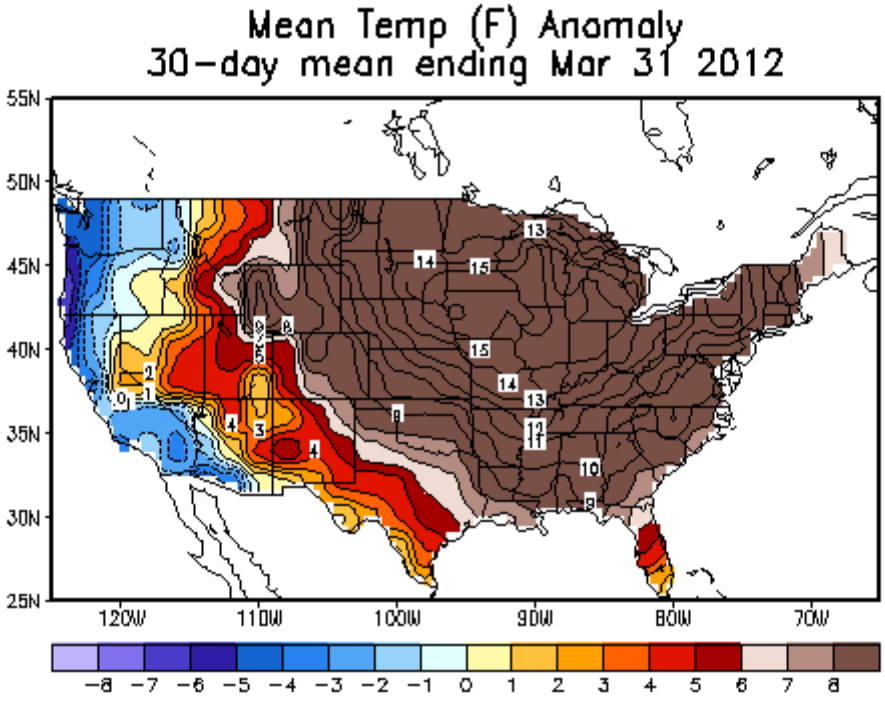


Figure 4. 30-day temperature anomaly (deg F) ending 31 Mar 2012.

Ninety-day (90-day) temperature departures ending on March 31, 2012 are shown in Figure 5. During the time period from January 1, 2012 to March 31, 2012, average daily temperatures have ranged from 3 to 6 degrees F above normal in the mountain regions of the upper Missouri River basin, and 4 to 10 degrees F above normal in the plains region of the upper Missouri River basin. In contrast, 90-day temperatures through March 1, 2011 (Figure 6) were 2 to 4 degrees F below normal in much of the upper basin with the exception of slightly above normal temperatures in the Yellowstone and Missouri River headwaters in Montana and Wyoming.

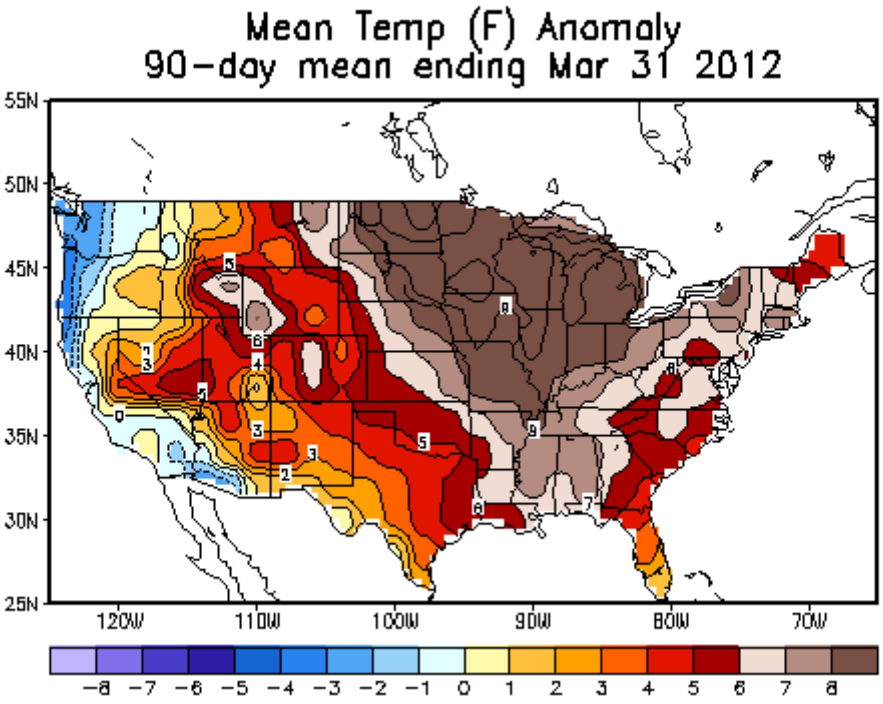


Figure 5. 90-day temperature anomaly (deg F) ending 31 Mar 2012.

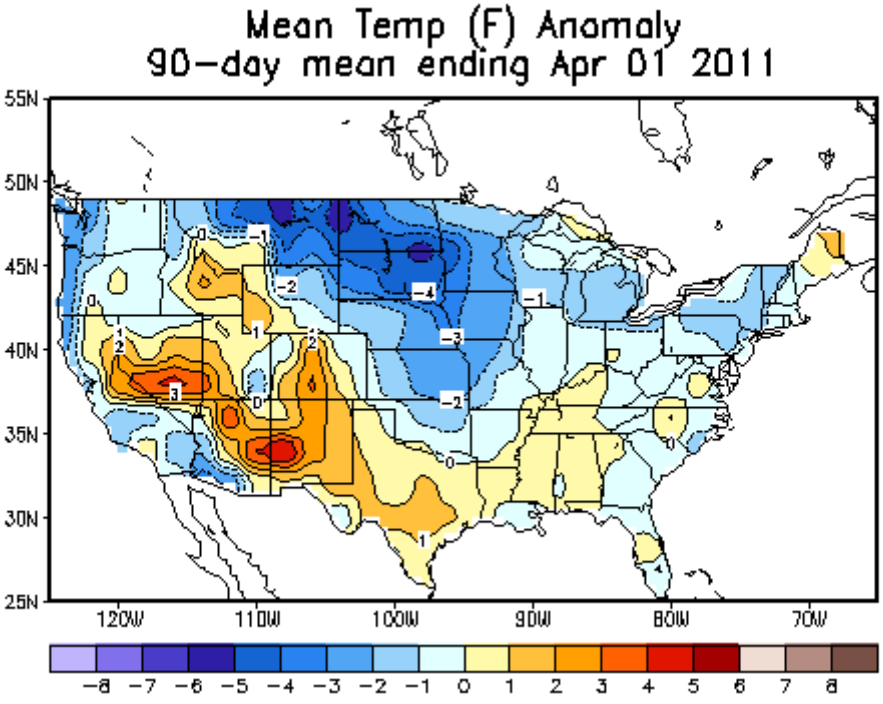


Figure 6. 90-day temperature anomaly (deg F) ending 1 Apr 2011.

Soil Moisture Conditions

Two independent assessments of soil moisture are provided below which include the CPC soil moisture percentile ranking (Figure 7) and the Variable Infiltration Capacity (VIC) soil moisture percentile ranking (Figure 8). The CPC soil moisture percentile ranking (Figure 7) shows very dry areas in northeast Nebraska, northwest Iowa and eastern South Dakota, with developing area of dry soils in the Dakotas. In the Rocky Mountains the CPC map shows areas of wet soil moisture conditions ranging from the 70 to 99th percentile ranking. These conditions have developed over the last two months due to some early low elevation mountain snowmelt according to local observations. The VIC model (Figure 8) shows the same dry in eastern South Dakota, northeast Nebraska and northwest Iowa as well as additional dry areas in the western Dakotas, western Nebraska, eastern Montana, and eastern Wyoming. In central and western Montana and western Wyoming, soil moisture conditions are slightly wetter than the median condition (30th-70th percentile) in some areas, but not nearly as wet as the CPC map would indicate.

In contrast to March 2012 conditions, March 2011 soil moisture conditions were much wetter in the plains. Soil moisture percentile rankings (Figure 9) ranged from the 70th to the 99th percentile ranking across most of the upper Missouri River Basin. Particularly wet areas with rankings greater than the 90th percentile existed east of the Missouri River in the Dakotas and across North Dakota and the northern half of Montana.

Local observations of soil moisture are provided in the Field Verification of Conditions section.

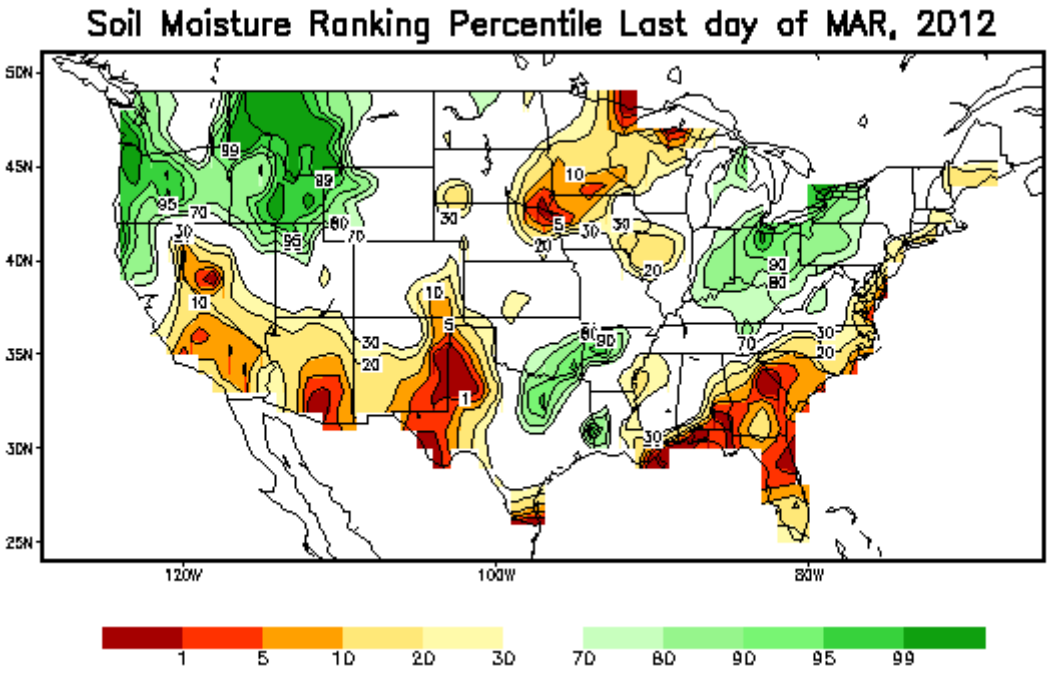


Figure 7. Calculated Soil Moisture Ranking Percentile on the last day of March 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

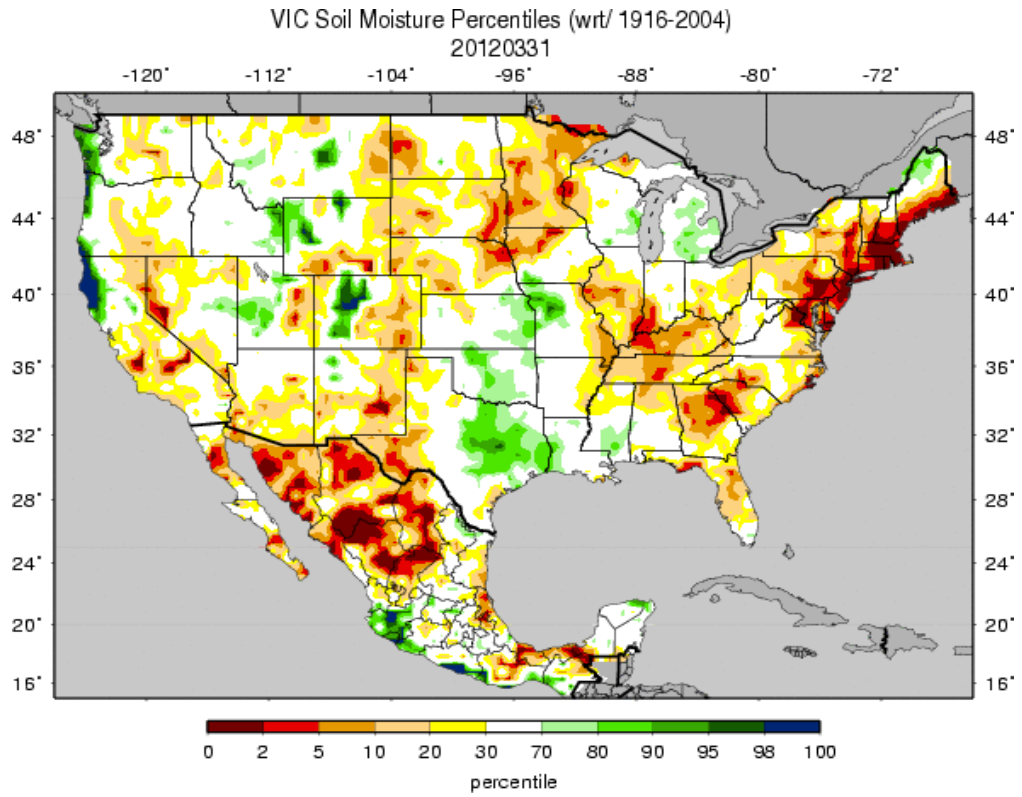


Figure 8. VIC modeled soil moisture percentiles as of March 31, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

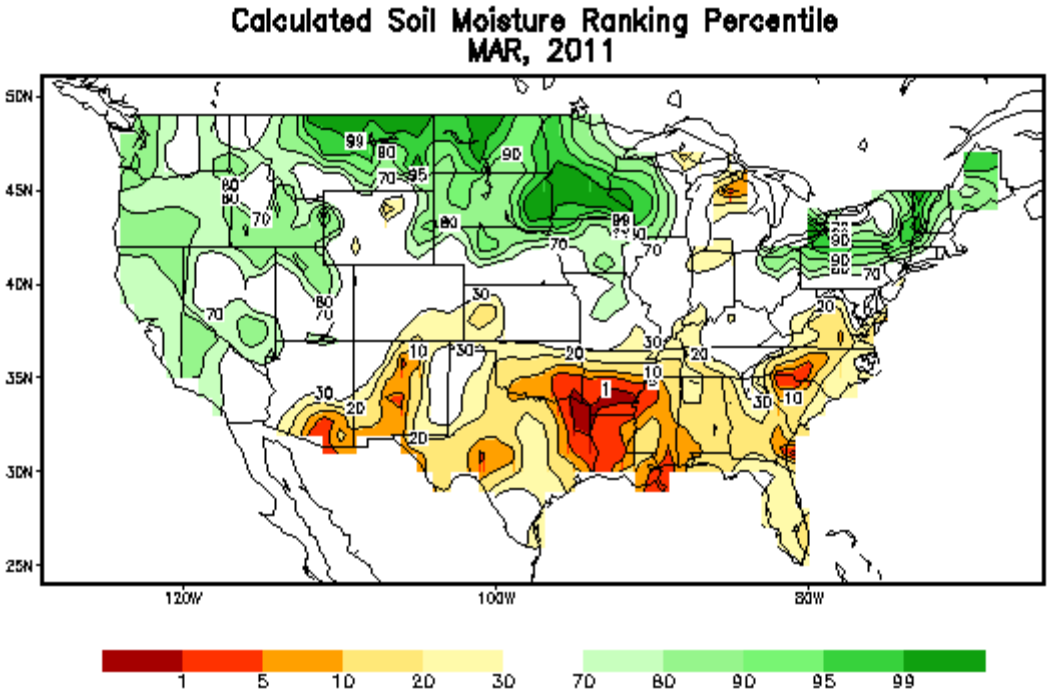


Figure 9. Calculated Soil Moisture Ranking Percentile in March 2011. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. Historically, about 25% of annual runoff occurs in March and April due to both melting snowpack and rainfall runoff; however, runoff occurs in March and April whether or not there is any plains snow to melt. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts.

Temperatures in March were well above normal in the Northern Plains, limiting additional snow accumulation. On March 1 the NOHRSC snow model estimated areas of SWE ranging from 1.0 to 2.0 inches in portions of central and eastern North and South Dakota. Other areas contained trace to 1.0 inch amounts. By March 12, 2012 (Figure 10) all plains snowpack in the Missouri River basin had melted.

In contrast, plains snowpack on March 12, 2011 (Figure 11) was very extensive in aerial coverage and heavy to very heavy in all locations. Heavy snow ranging from three to four inches of SWE covered a large area north of a line from Sioux Falls, SD, to Havre, ND. Throughout the area of heaviest snow cover, SWE amounts ranged from four to six inches, with possible heavier amounts in concentrated areas.

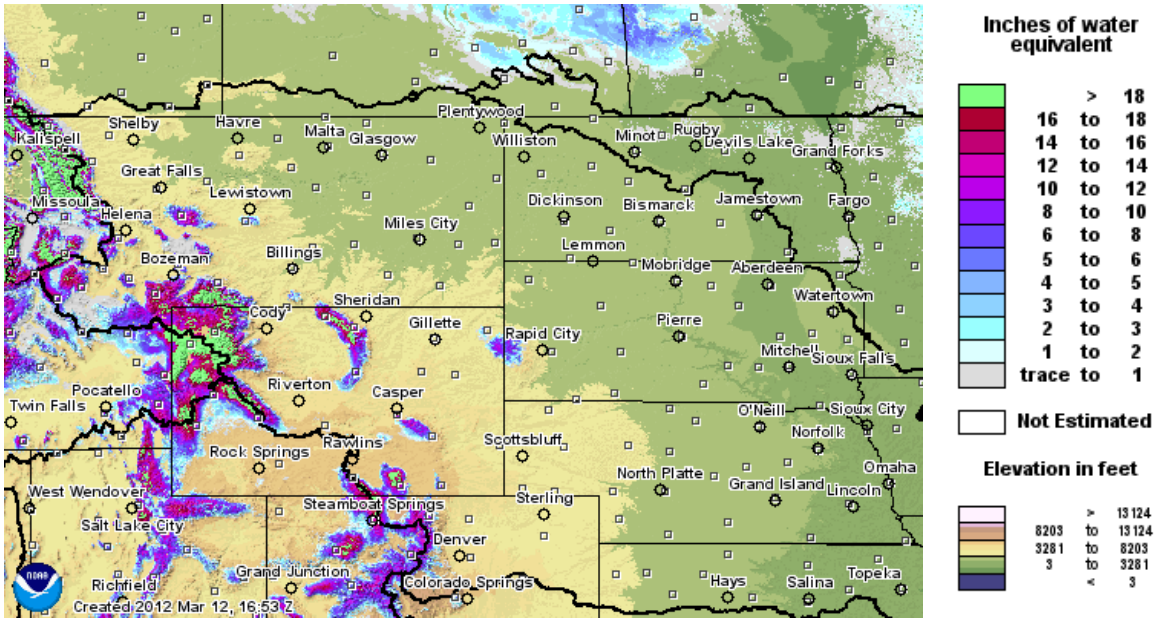


Figure 10. March 12, 2012 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

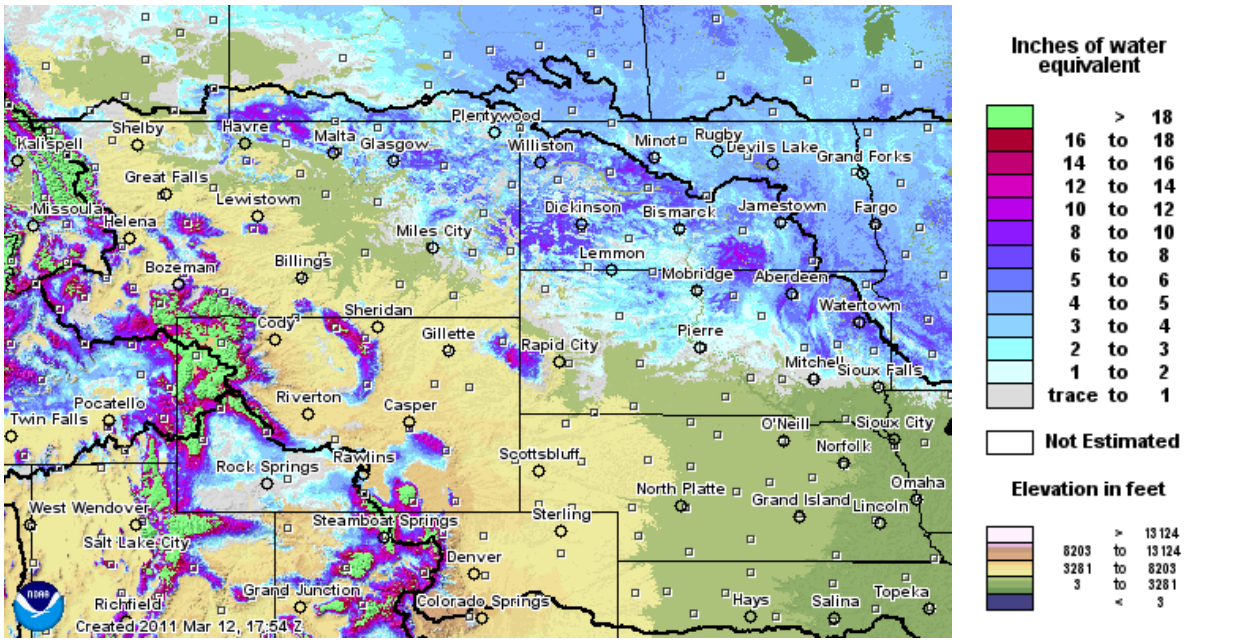


Figure 11. March 12, 2011 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

Mountain Snow Pack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

As of April 1, 2012, the Corps of Engineers' assessment of the mountain snowpack was 97% of normal in the drainage area above Fort Peck (Figure 12), an increase from 94% of normal on March 1, 2012. Mountain snowpack was 86% of normal in the incremental drainage area between Fort Peck and Garrison (Figure 12), a decrease from 105% of normal on March 1, 2012. In terms of peak snow accumulation, normally 96% has accumulated in the mountains by April 1. According to the NRCS, snowpack at many SNOTEL stations up to 9,000 feet of elevation are isothermal, meaning the snow is ready to melt, which is several weeks earlier than it would normally occur. In southern Montana and northern Wyoming, many SNOTEL stations have melted significant amounts of snow; whereas in northern Montana the snowpack is steady to slightly increasing due to colder temperatures. The NRCS depictions of the mountain SWE as a percent of normal SWE by mountain river basin in Montana and Wyoming (provided in the Additional Figures section at the end of this report) show this contrast in mountain SWE by basin. In comparison to 2012, 2011 snowpack on (bold black line in Figure 12) still increasing at 116% of normal above Fort Peck and 112% of normal between Fort Peck and Garrison.

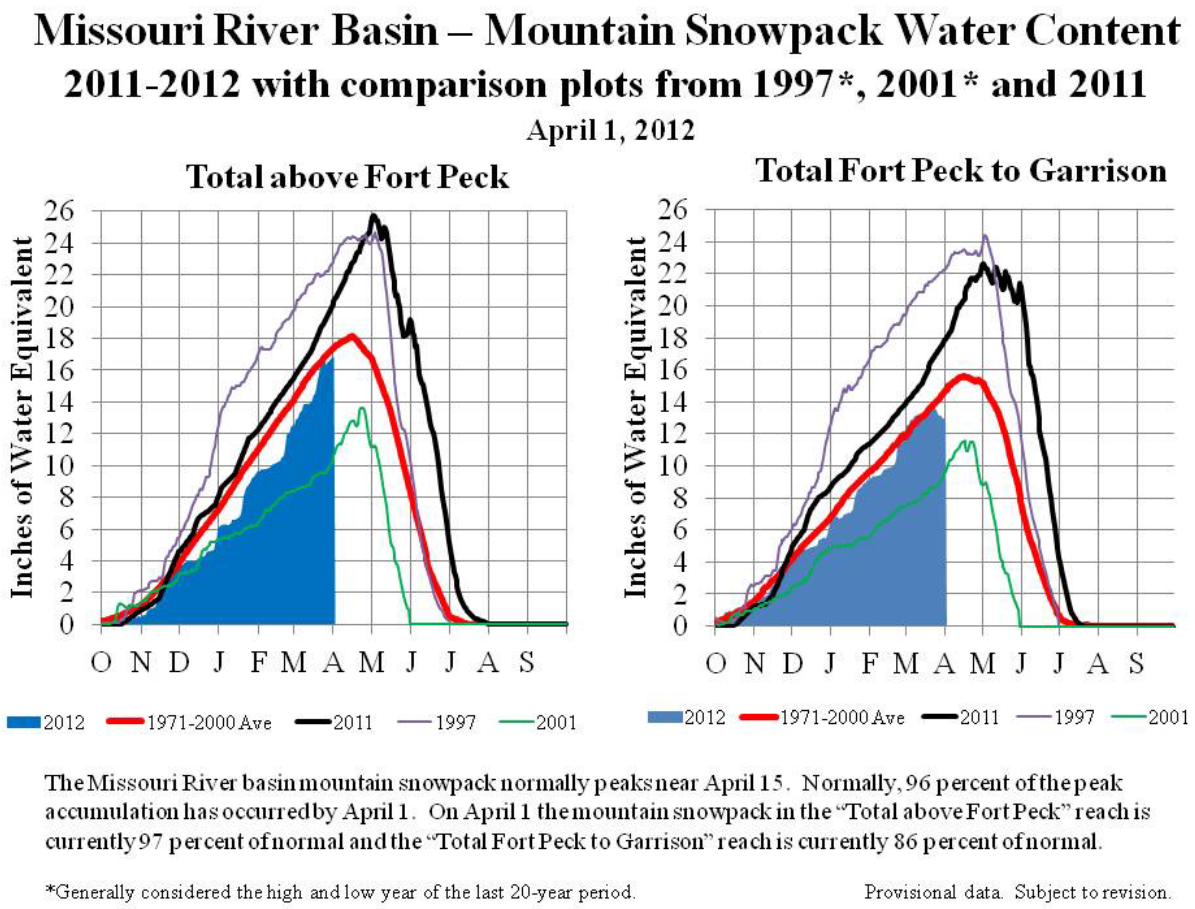


Figure 12. Mountain snowpack water content compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management. The shaded blue area indicates 2012 mountain SWE amounts. The bold black line indicates 2011 mountain SWE amounts.

Drought Analysis

According to the National Drought Mitigation Center (NDMC), Abnormally Dry (D0) conditions have expanded into eastern Montana, eastern Wyoming, western Nebraska and northeast Colorado; while areas of Moderate Drought (D1) developed in western South Dakota and western North Dakota (see Figure 13). Severe Drought (D2) continues to impact a narrow band in eastern South Dakota, southern Minnesota, and northwest Iowa. Through the end of June, the NDMC is predicting no change throughout much of the upper Missouri River basin; however, some improvement is possible in North and South Dakota, Minnesota, and northwest Iowa. (Figure 14).

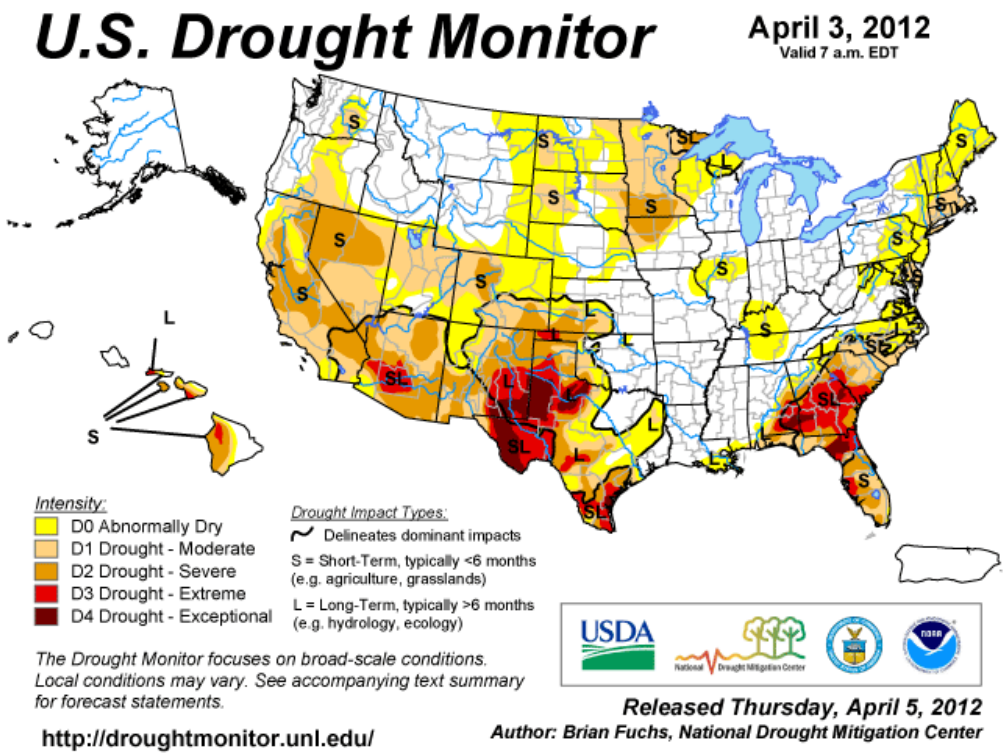


Figure 13. National Drought Mitigation Center U.S. Drought Monitors for April 3, 2012.

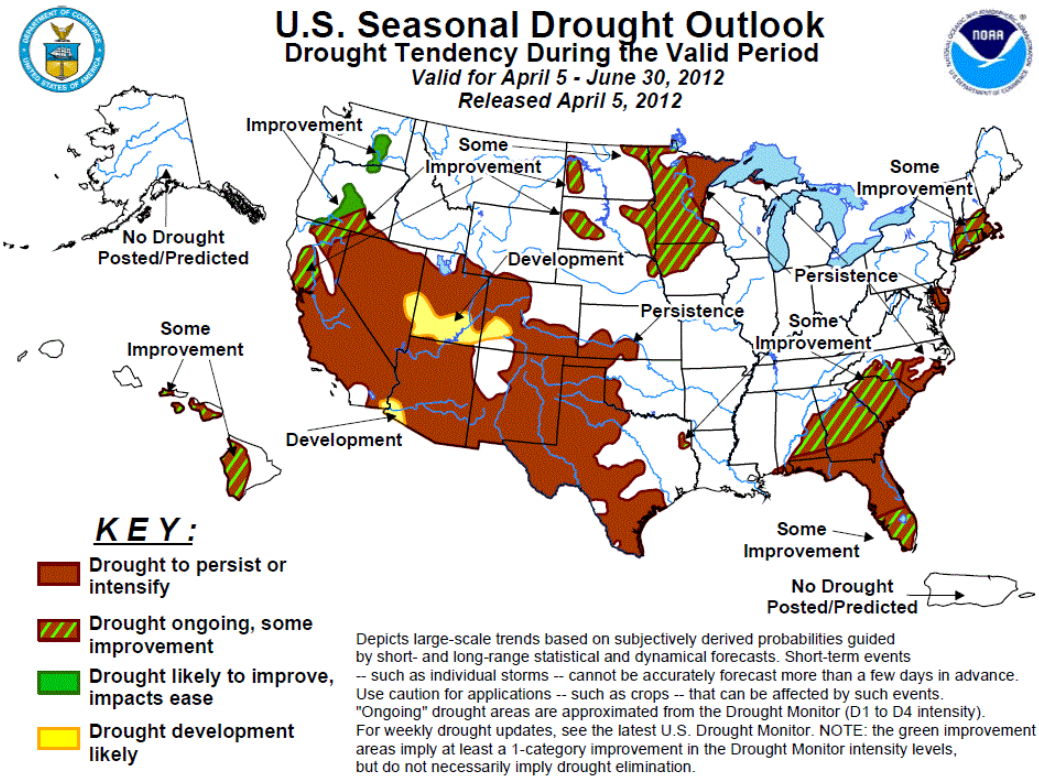


Figure 14. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 5 April to June 30, 2012.

Climate Outlook

According to the NOAA Climate Prediction Center, La Niña is expected to transition to ENSO-neutral conditions by the end of April 2012. During ENSO-neutral conditions, there is not a strong climate signature that indicates whether or not conditions in the Missouri Basin will be wetter or drier and warmer or cooler; however, because the strength of impacts in the United States is not necessarily related to the exact strength of ENSO, CPC expects La Niña impacts to continue even as the episode weakens.

The 6-10 Day (Figure 15) and 8-14 Day (Figure 16) Outlooks indicate temperatures are very likely to be above normal through April 15 in all of the upper Missouri River basin. If actual air temperatures are much warmer than, snow accumulation in the Fort Peck and Garrison reaches will likely be limited and possibly occur earlier than normal. The precipitation outlooks indicate there is an increased probability for precipitation in the northern Rocky Mountains and northern plains of North Dakota, while the central Rocky Mountains have increased probabilities for below normal precipitation.

The temperature outlook for April (Figure 17) indicates increased chances for above normal temperatures throughout much of the Missouri River Basin with the exception of an area of equal chances in Montana and northwest Wyoming, and increased chances for below normal temperatures in northwest Montana. Equal chances for above normal, normal and below normal precipitation exist across nearly the entire Missouri River basin with the exception of below normal chances for precipitation in Colorado and above normal chances in northwest Montana.

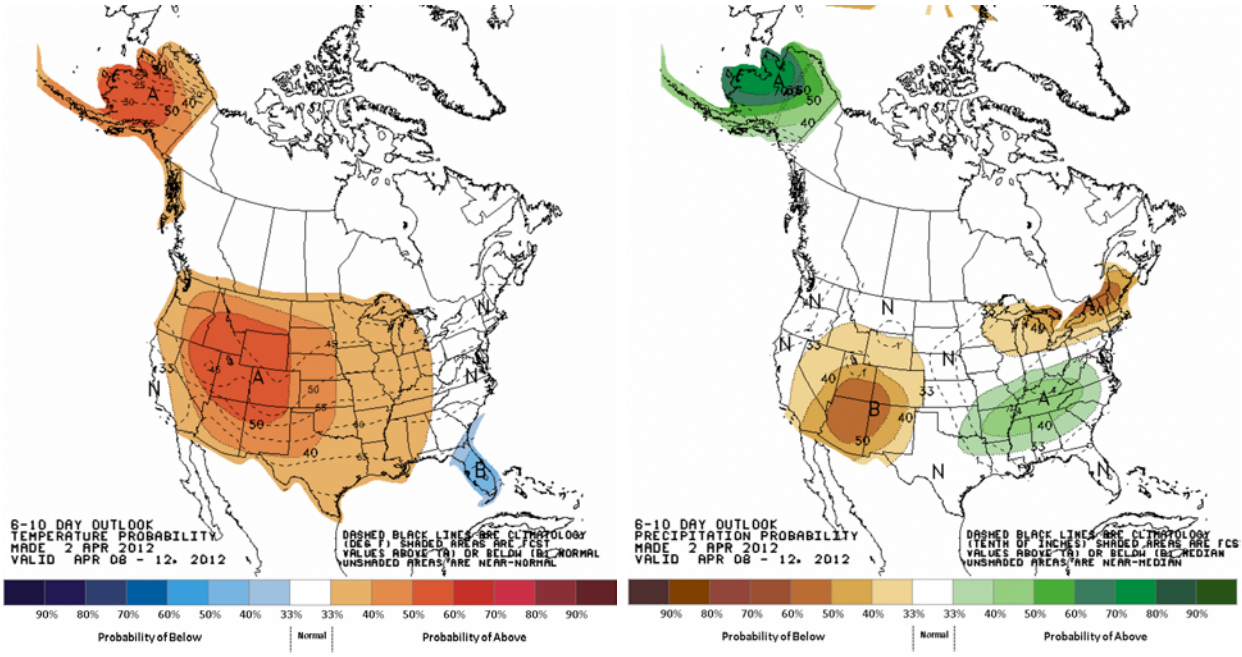


Figure 15. CPC 6-10 day temperature and precipitation outlooks.

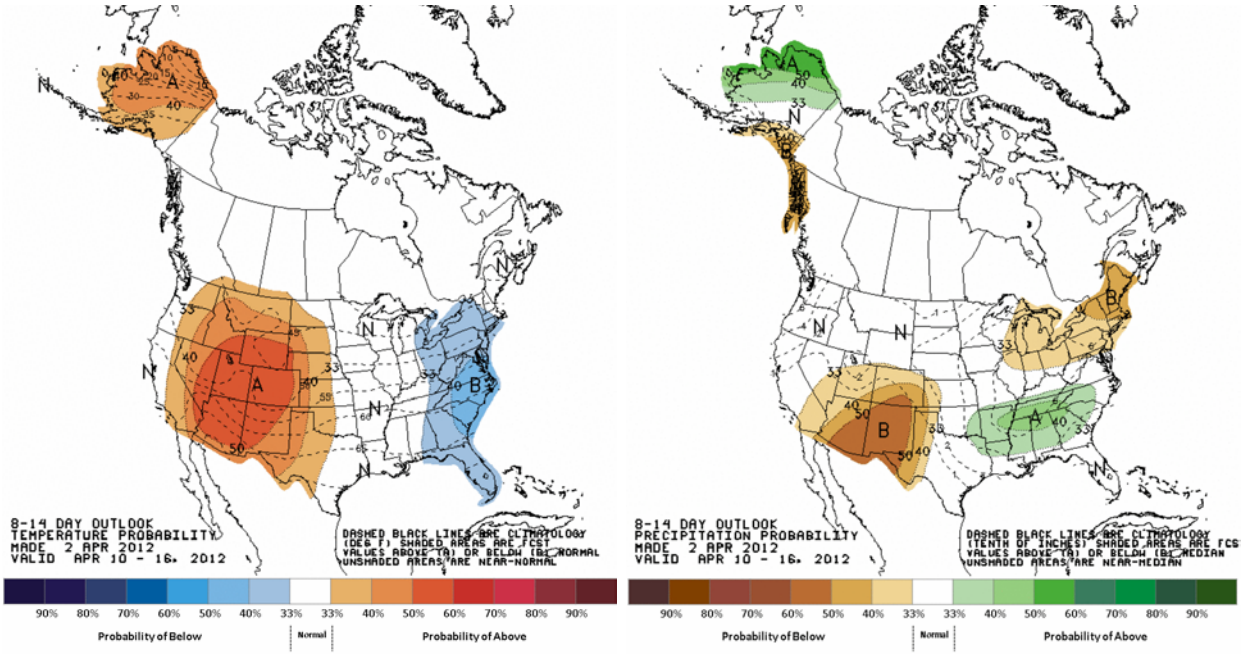


Figure 16. CPC 8-14 day temperature and precipitation outlooks.

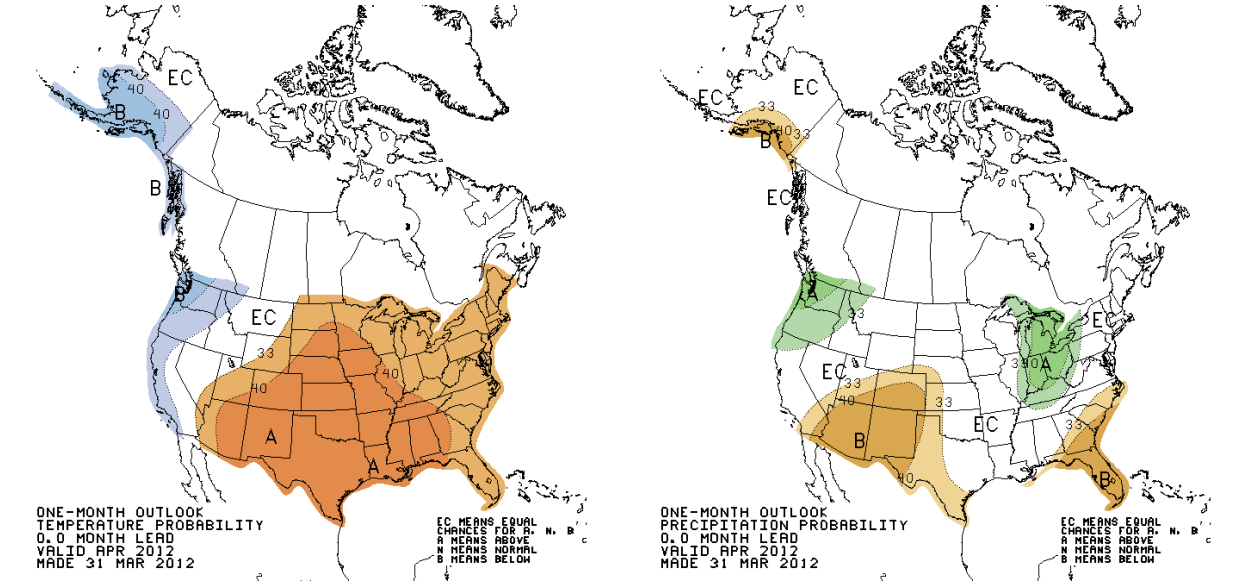


Figure 17. CPC April 2012 temperature and precipitation outlooks.

The three-month April-May-June outlook reflects a weakening La Niña and likely transition to ENSO-neutral conditions, leading CPC forecasters to forecast equal chances for above normal, normal, and below normal temperatures in much of the upper basin (Figure 18). With regard to precipitation, there is an indication that there will be an increased probability for below normal precipitation in the central Rocky Mountains and the adjacent plains, effecting Wyoming, western Nebraska, Colorado, and Kansas.

Longer term CPC outlooks indicate there is an increased probability for above normal temperatures in the western U.S. affecting the Rocky Mountains and bordering high plains regions, while there are equal chances for above normal, normal, and below normal temperatures throughout the midwest and northern plains during July-August-September 2012 (Figure 19). There are equal chances for

precipitation throughout most of the basin with the exception of central and western Montana, which has increased chances for below normal temperatures. The October-November-December temperature outlook (Figure 20) indicates increased probabilities for above normal temperatures throughout most of the basin, while there are equal chances for precipitation.

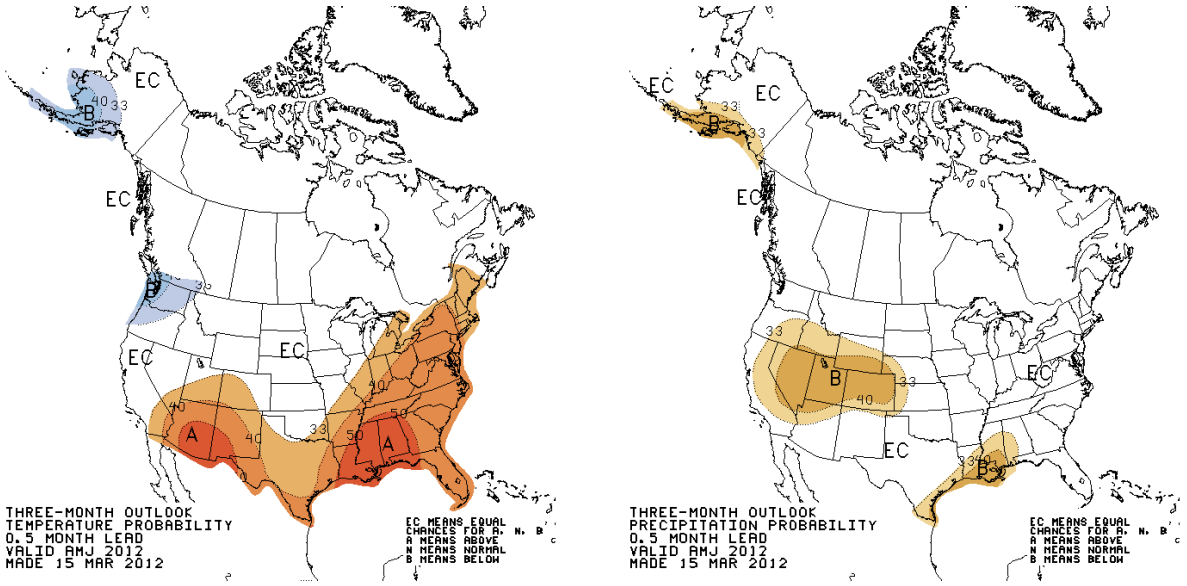


Figure 18. CPC April-May-June 2012 temperature and precipitation outlook.

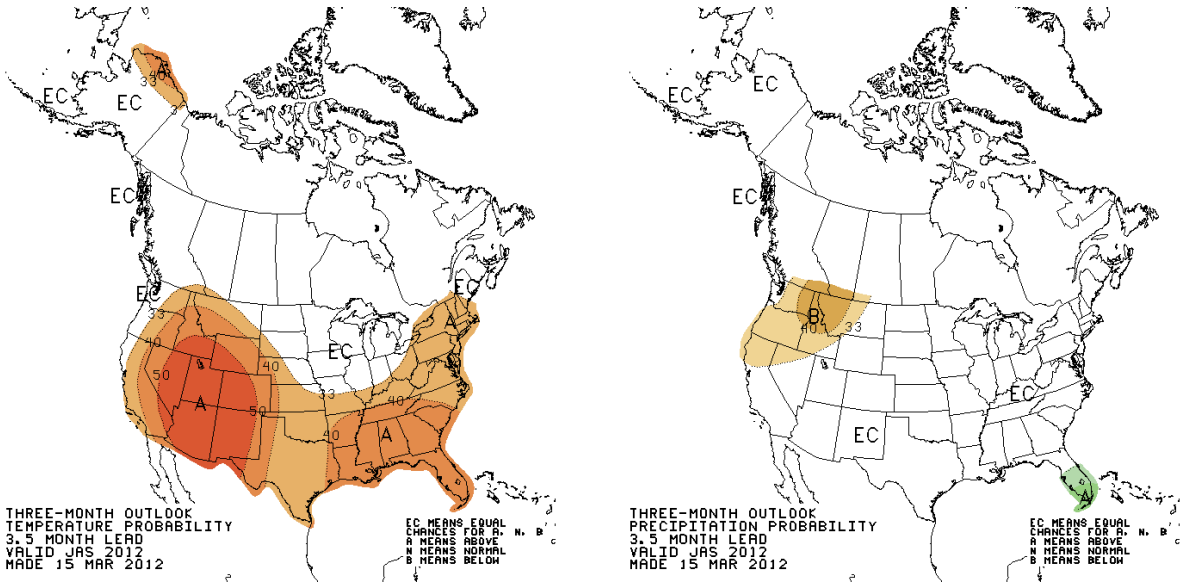


Figure 19. CPC July-August-September 2012 temperature and precipitation outlook.

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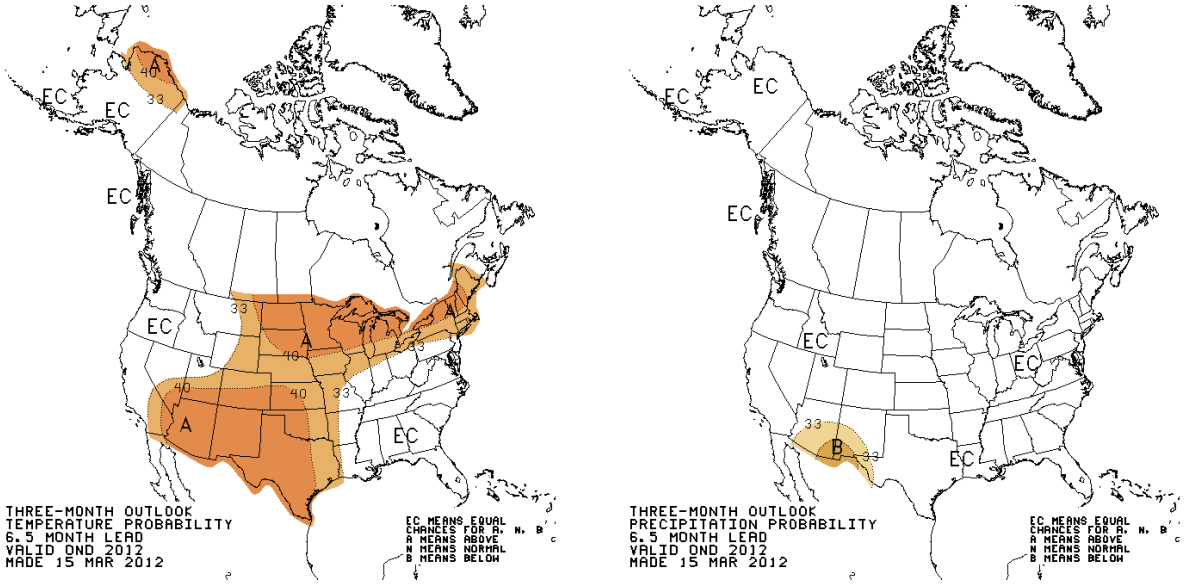


Figure 20. October-November-December 2012 temperature and precipitation outlook.

March 2012 Calendar Year Runoff Forecast

As stated earlier in this report the April 1 forecast for 2012 runoff above Sioux City, IA is 23.4 MAF (94% of normal). The April 1 forecast for runoff above Gavins Point Dam is 21.0 MAF (92% of normal).

Factors taken into consideration while preparing the 2012 forecast include: the previous months' runoff volumes and streamflow, soil moisture content, precipitation and temperature anomalies, mountain snowpack, and the CPC's monthly and seasonal temperature and precipitation outlooks.

April

Plains snow is a significant factor influencing the volume of runoff in March and April and often sets the stage for how much runoff will occur after the snow has melted; however, precipitation, air temperatures and soil moisture during this time period are also very important factors that need consideration. Factors taken into consideration in updating the April runoff forecast were: 1) low March runoff, 2) dry soil moisture conditions, 3) low runoff due to plains snowmelt, 4) a higher probability for warmer than normal temperatures, and 5) an equal chance probability for above, normal, and below normal precipitation.

Runoff during the months of January and February were 131% and 153% of normal, respectively, as a result of much warmer than normal temperatures causing some snowmelt runoff and allowing tributaries to flow freely. March runoff was below normal due to a number of factors described at the beginning of this report. Below normal runoff is expected to continue in April as a result of lower than normal antecedent precipitation, dry soil conditions, and low plains snowmelt runoff contribution. Furthermore, the April climate outlook is predicting greater chances for above normal temperatures and

equal chances for above normal, normal, and below normal precipitation. All reaches with the exception of the Sioux City reach are forecast to receive below normal April runoff. The overall runoff volume above Sioux City is 85% of normal.

May-June-July

During the May-June-July period, the mainstem system normally receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River Basin, so runoff can vary significantly as a result of the above or below normal rainfall. The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total average annual runoff into the system.

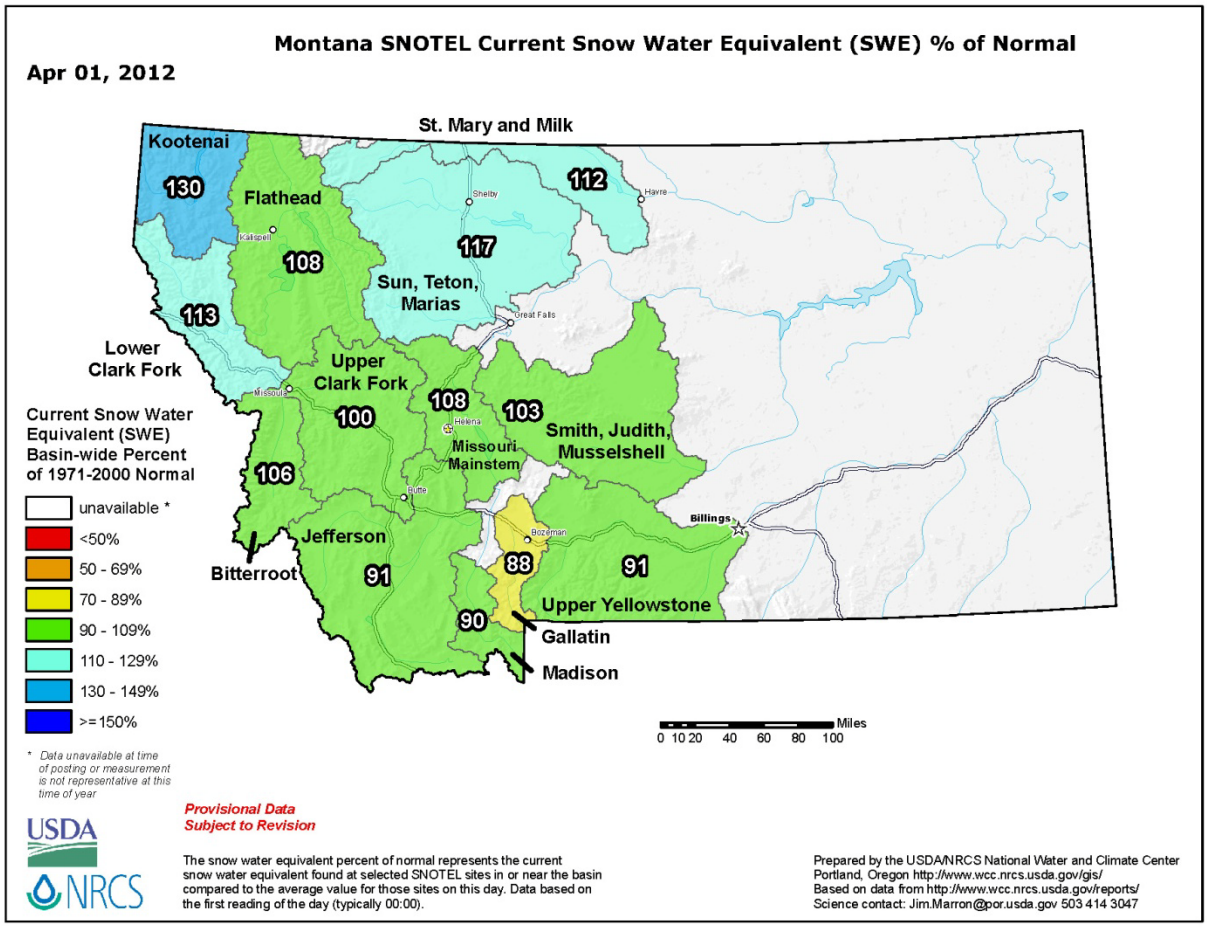
For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Existing mountain snowpack was 97% of normal in the reach above Fort Peck and 86% of normal in the reach between Fort Peck and Garrison on April 1. Soil conditions are about normal to slightly wet, and the CPC is forecasting equal chances for precipitation with a slightly higher probability for above normal temperatures in Wyoming through June. According to NRCS reports, mountain snowpack in southern Montana and northern Wyoming has begun to melt in many locations, and it has melted significant amounts of snow at lower elevations. Snow is still accumulating in northern Montana. Due to the lower than normal amounts of mountain snowpack and the earlier than normal snowmelt in some regions, overall runoff during May-June-July is forecast to be below normal and occur several weeks earlier than normal.

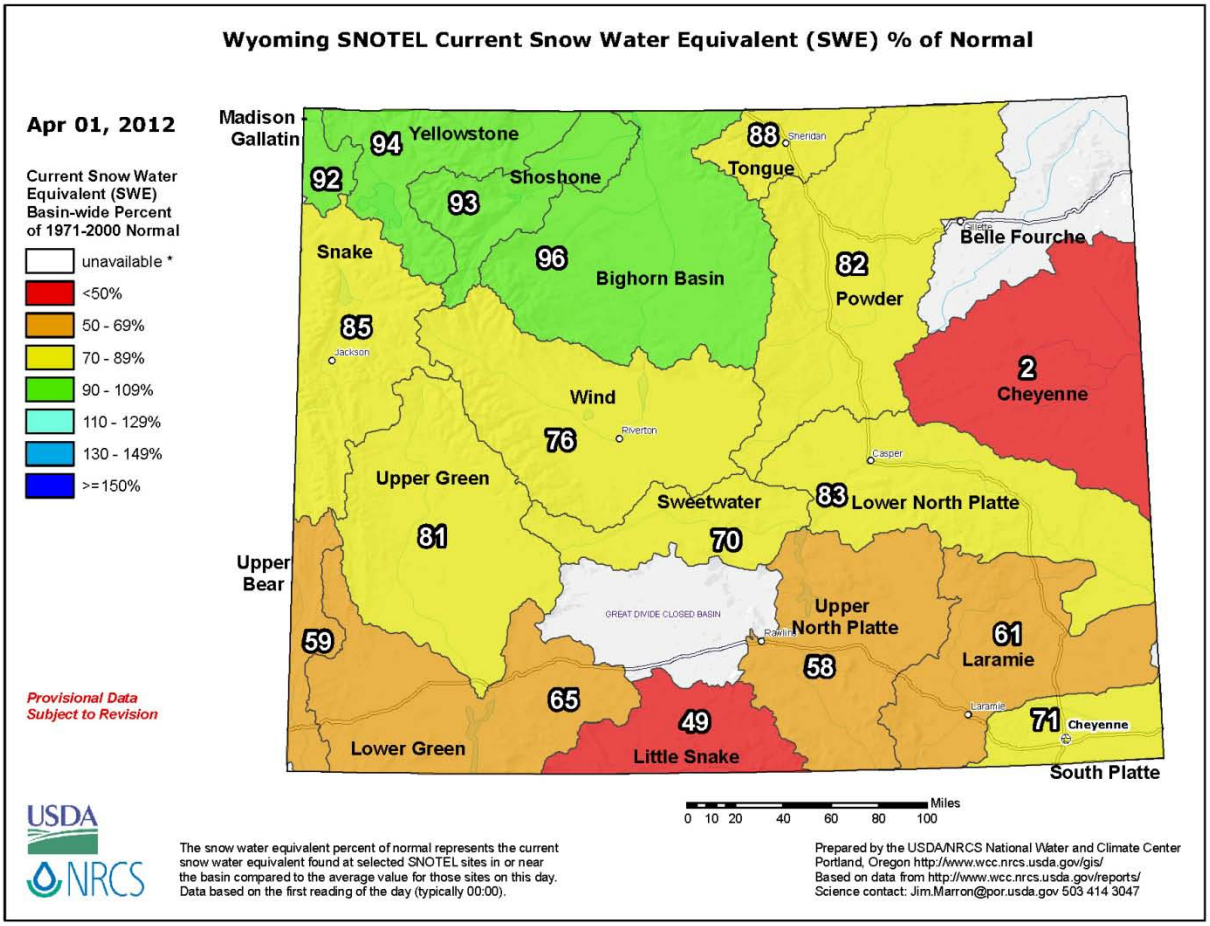
Runoff in the Oahe, Fort Randall and Gavins Point reaches is forecast to be below normal based on below normal soil moisture conditions, developing drought conditions in the Dakotas, and the fact that there is no strong climate signal influencing weather in the basin. Runoff in the Sioux City reach is forecast to be about normal.

August through December

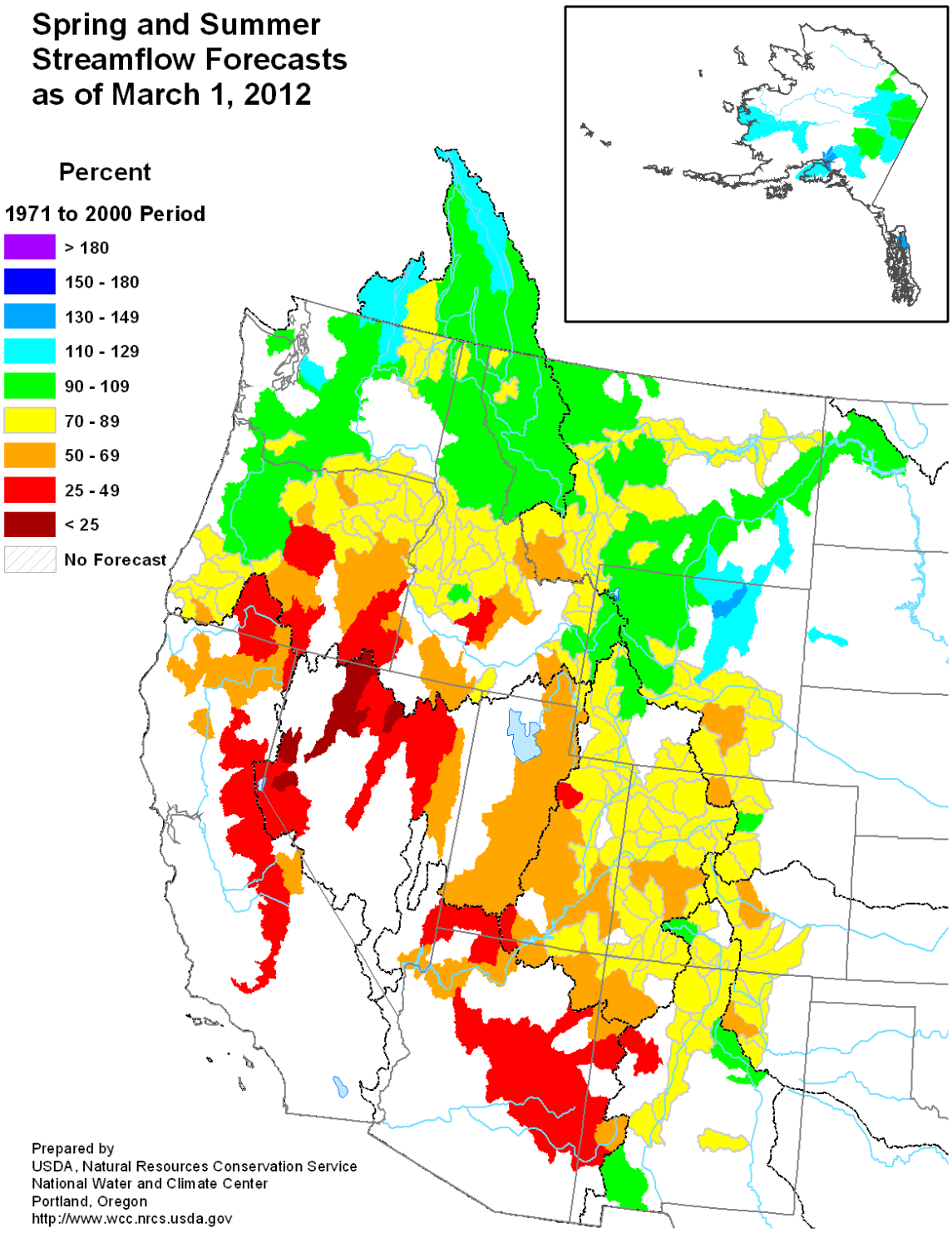
During the August through December period, runoff is forecast to be slightly below normal in all reaches from above Fort Peck to Gavins Point, primarily due to the increased chances for above normal temperatures during the fall. As the year progresses and the August through December precipitation and temperature outlooks are updated with more detail, these values may change.

Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Apr 01, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Madison Gallatin
94
Yellowstone
92
93
Shoshone
88
Sheridan
Tongue
Snake
96
Bighorn Basin
82
Powder
Belle Fourche
85
Jackson
Wind
76
Riverton
2
Cheyenne
Casper
Upper Green
Sweetwater
83
Lower North Platte
81
70
Upper Bear
GREAT DIVIDE CLOSED BASIN
Upper North Platte
Rawlins
59
58
61
Laramie
65
49
Laramie
71
Cheyenne
Lower Green
Little Snake
South Platte
Miles
0 10 20 40 60 80 100
USDA
NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

NRCS Water Supply Outlook



NOAA Water Supply Forecast

Table 1. Comparison of Fort Peck forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Mar 1 2012**	Apr-Sep	3510	81%
Seasonal Ensemble Outlook*	Mar 20 2012	Apr-Sep	5435	130%
Monthly Ensemble Outlook*	Mar 20 2012			
April		Apr	817	N/A
May		May	1577	N/A
June		June	1616	N/A

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on April 1.

Table 2. Comparison of Garrison forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes. The Corps forecast is the combined Fort Peck and Garrison runoff volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Mar 1 2012**	Apr-Sep	10200	83%

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on April 1.

Field Verification of Conditions

Corps of Engineers mainstem project offices and some volunteer plains snow observers reported local hydrologic factor field conditions during the last week of March. Their observations are summarized below.

North Dakota

Statewide Conditions (State Report): We don't have good information on soil moisture conditions; however ground water levels remain high around the state. Before today's rainstorm soil surface conditions were dry. Sloughs/and lakes around the state are fuller than normal, but I think this is residual from last year's moisture. Stream flow is on the low side. Vegetation is starting to green up.

Garrison Project: Soil dry/moist with no standing water and normal ground cover around Garrison Project, Riverdale ND. The surface conditions are very dry. Most of Western ND is in a fed flag warning for fire danger. However there is still moisture in the soil. I'm still seeing some areas seeping due high ground water tables, but some of the sloughs and areas that had standing water last year are drying out. If we stay in the 70's, with wind, like we've seen this will be exacerbated. Farmers are starting to plant their fields now and are planting through areas that they farmed around last year.

Jamestown: Pipestem Project Office area recorded 0.13" of rain since last Friday to this morning. Surface soil is generally dry in the Pipestem Lake watershed area. Subsurface soil is very wet/saturated in watershed area. All the wetlands/lakes in the watershed area froze FULL last fall and many of them continued to flow during the mild winter - Pipestem Dam released about 15-30 cfs most of Jan.-Feb. which is record amount for winter releases - Jamestown Res. water elevation increased about 24 vertical inches from Jan.- mid March and was releasing 13 cfs during that time period. Lakes/large wetlands in the watershed continue to surface drain into the system. Veg. ground cover - Thousands of acres of land is being taken out of CRP (grass cover) & converted into croplands in the watershed area which will probably contribute to increased runoff...especially if planted to soybeans!

South Dakota

Statewide (USGS): Most streams are below average across the state with the exception of the Belle Fourche which is still a little above normal and the James River where the lower James remains a little above normal. All of western SD is also dry enough that if we begin to get some spring rainfall, depending on intensity, most rainfall would soak in and not run off. Eastern SD also has many areas that could use moisture as well and we would not see a great deal of runoff.

Gavins Point: Surface and subsurface soil conditions are dry. Rain is coming today to eastern SD, but it is not enough to change conditions. Stream flow seems about normal.

Fort Randall: Very little if any soil moisture. Also from one of our engineers: Upper level soil moisture is slightly below average. With soil temperatures being higher than normal for this time of year, however, any precipitation that we see - rain or snow - should be almost entirely infiltration unless duration or intensity are extreme.

Fort Randall (Pickstown): Surface and subsurface soil conditions - Soil is very dry. Really haven't had much for precipitation for quite a while, other than a few light events. There is no standing water

anywhere that I have seen. Stream flow does appear to be low. Vegetative ground cover is greening up in the area. Vegetation is ahead of schedule for this time of year, due to the warmer than average temperatures. Grass is kind of struggling though due to the lack of moisture in the soil.

Oahe: We are dry around Oahe. Not much moisture so far this spring in the western half. Eastern SD has gotten more than us. BLUF: Soil moisture conditions around Oahe are in the Very Dry Category. Warm (hot) and dry. Yesterday we got up to 91. Extended temperatures are expected to be more seasonable over the next 10 days. Soil is dry on the surface and the subsoil is OK right now, but unless we get some moisture soon that will be declining also.

Oahe (NWS): NWS Says March was a Record Breaking Month for Temps. The start of a new month brings a look back at March and weather statistics by the National Weather Service. Weather observers at the NWS office in Aberdeen say that March in central and northeast parts of the state brought numerous daily and monthly records. The average high temperatures last month were said to be from 16 to almost 20 degrees above normal. The temperature reached 80 degrees or higher at several locations in northeast and central South Dakota in March; with Pierre reaching 80 or more at least five times last month. The warmest temperature in March was 88 at Pierre on March 18, which broke the all-time March high temp record for the community. Kennebec's warmest day in March was on the 18th, when it reached 87, Mobridge's warmest high was 83 on the 16th and Timber Lake got up to 82 on the 16th. The NWS also says that March was a dry month with precipitation amounts below normal. March is usually one of the snowiest months with 6-8 inches of snowfall, but for last month, snow amounts ranged from only trace amounts to up to three inches. Monthly precipitation levels in Pierre, Kennebec, Mobridge and Timber Lake are all said to be from a half an inch to just over an inch below normal for March.

Ashton: Very little rain since last reported snow fall. Ground is very dry as is the vegetation. Streams are flowing but a bit under the usual pattern. Most standing water is now gone.

Brookings: The soil condition here is dry. There isn't any standing water and the creek is well within its banks (very low compared to most springs). There is moderate growth to the grass. Everything is greening up, but we could use a good shot of rain.

Chamberlain: Here at Chamberlain, like so many places, has been unusually dry. We got that big snow/rain at the end of February, then had about .75" total for March until today. We fortunately had storms/rain all morning. I looked at lunch-about .85" and still drizzling. I don't think it's widespread, especially to the west.

We do have standing water in some low areas & ditches, but it was disappearing quickly. Farmers are working fields all the way to Pickstown. I see some stock dams are full; some are on the low side. I tilled the garden last weekend and there was some moisture down low, but not a great deal. My guess is there sufficient topsoil moisture with a dry layer below.

Last time across White River, I thought it was below normal flow for March. Streams were ok earlier, but were rapidly declining. I'll take a look today, but things will be skewed due to this morning's event. Vegetation is greening much ahead of normal, appears sufficient with good carryover from 2011.

Eureka: There was no snow to melt for runoff. The ground moisture is low but not dry. We would be able to handle quite a bit before runoff would become an issue. There are potholes but they have gotten less with the lack of moisture and all the wind we have had.

Huron: At Huron Airport the soil condition is moist, with little to no standing water. The area I was using for sampling is next to Broadland creek which is barely flowing at this time.

Pierre and statewide conditions (State Report): Here in the Pierre area n the past two weeks we have been experiencing above normal temps, 70's and 80's, and several days of windy conditions in the 20 - 30 mph range. We have not experienced any measurable precipitation since the last week of February.

Soils and sub-soils are in the dry to moist range but are drying out quickly.

The local dams and sloughs are still holding water but many are about half full. There really isn't any standing water in the small pot holes and the smaller prairie streams mostly have quit running about two weeks ago. The larger streams may still be flowing but not by much.

The prairies started greening up last week but really haven't started putting on new growth yet. Most of the farm land is black and farmers started working in the fields this past weekend drilling in spring wheat and if it stays warm, row crops will likely be put in two to three weeks earlier than normal. The winter wheat has come out of dormancy.

Spearfish: Surface and subsurface soil conditions are dry. There is no standing water. Spearfish Creek seems to flow at its normal rate.

Buffalo, Brule & Jerauld Counties: Soil conditions are quite dry. The soil moisture is low (I have seen farmers cultivating through depression areas that have been too wet the past couple years) and stream flow is low.

Day County: Webster SD, did not have any runoff, no major snow melt, land surfaces are on the dry side, farmers are planting now but appears dry over most of the county. Surface moisture is dry as prairie fire has been a problem.

Hamlin County: Hamlin County soil is dry with very little to no standing water. Many potholes and sloughs have dried up completely and water moving through the chain of lakes is slow. Even though temps have been abnormally high vegetation is just barely starting at this point. The county is receiving rain today but not significant amounts. My coop station for the NWS shows 0.18 for Jan, 1.39 for Feb and 0.30 so far in March total precipitation at Hayti.

Tripp County: In the Tripp County area we are very dry. Tripp County is receiving small amounts of rain today. In The past three weeks has been cloudy, but not much in rain from the clouds. In the last three weeks we have had less the .25 inch of moisture.

Montana/Wyoming

Fort Peck: It is dry around the project. Further west it is wetter.

Southern Montana/Northern Wyoming (NRCS report): Surface soil moisture - wet to less than slightly wet. Rain last night helped wet things up. Subsurface soil moisture - becoming moister as is typically the case this time of year. No standing water. Green-up is beginning to occur in the greater valley. Streamflow is up a bit from last night's rain/gropple storm in the valley.

SNOTEL sites at low elevations are showing the beginning signs of melting while mid elevations are approaching isothermal snowpack conditions. Upper elevations are holding relatively steady but some high elevations sites in the Big Horn mountains are going towards isothermal conditions as well. I

was talking to the Avalanche Center here this morning who gather mountain snowpack observations all around here, they concur that snowpack is isothermal up to 9000 feet which is the significant majority of the surface area driving streamflow. We made an attempt of measuring one of our mountain monthly manual snow courses (New World here outside of Bozeman) today but scrapped it because of tough access conditions due to low snow. Only extremely low elevation sites are in full melt mode but they do not seems to be affecting streamflow very much.

It certainly is setting up as an interesting year with very warm temps and high winds to further sublimation. Seems like we are 3 weeks early but all it takes is one storm to change everything. The fact that the Big Horn mountain snowpack is becoming isothermal this early is something to watch. Southern Montana is dryer than average and much closer to melting or already melting. In the field I saw snowmelt near at 6,900 feet. Northern Montana is above average snowpack with conditions further from isothermal meaning snow melt is not as far along as southern Montana.

Northeast Montana (NWS report): Northeast Montana has been very, very dry this winter, and much of the time we had no snow on the ground at all. The Drought Monitor updated today extends the abnormally dry conditions even further into eastern MT now.
http://droughtmonitor.unl.edu/DM_state.htm?MT,W

The soils were very wet across this entire region going into the winter season, with reports of combines getting stuck in the mud and sinking in on hilltops (not just the valleys) during the harvest last Sept/Oct.

We still have some soil moisture (sorry, we don't have any measurements I can think of in NE Montana), but each windy day is gradually taking more and more of that away. In the past month, I've been south of Glasgow to Gillette, WY, and there had been some ice on the Yellowstone left on the banks, but nothing major. It came through in late Feb with no impact this year to NE Montana. I've also been from Glasgow up to Plentywood and over to Williston (Poplar and Big Muddy basins), and again, no snow, some mild runoff with streams after our record high days, but nothing that caused any concerns.

There was a small dam breach NW of Glendive, MT about 10 days ago. The stock dam was damaged from last years runoff, and the owner was suppose to finish breaching it this summer. The little bit of snow runoff of the Big Sheeps wiped out the remainder of the dam. Caused some high water on Seven Mile Creek for about 12 hours, but by the time anyone noticed, and got around to investigating the cause, it was receded. That does flow into the Yellowstone.

We are actually more concerned about fires at this time, and have had a lot of them carry quickly with the winds, and the 1 and 10 hour fuels having been so thick last summer/fall. We are seeing some green up starting to occur, about 2-4 weeks earlier than normal.

Upper Missouri River Basin
May 2012 Calendar Year Runoff Forecast
May 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

April 2012 Runoff

April 2012 Missouri River runoff was 1,816 KAF (63% of normal) above Sioux City, and 1,600 KAF (63% of normal) above Gavins Point. In January and February very warm temperatures caused a premature ice breakup on rivers and tributaries, and soil frost thawed earlier than usual allowing more runoff to occur in January and February than would normally occur during a year with normal temperatures. As a result, March runoff did not benefit from the spring thaw. In March, record high temperatures across the upper basin melted the very light plains snowpack early in March. Although April precipitation was above normal in many areas, very dry soil moisture conditions absorbed most rainfall resulting in lower than normal runoff in the upper basin. The exceptions were the Fort Peck and Gavins Point reaches where abundant rainfall caused above normal runoff.

2012 Calendar Year Forecast Synopsis

The May 1 runoff forecast above Sioux City, IA is **21.6 MAF** (87% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is a decrease from the April 1 forecast due to much lower than normal plains snowpack runoff in March and April, lower than normal mountain snowpack, and the expectation that potentially drier conditions could continue into the fall of 2012. Due to the amount of variability in precipitation that can occur over the next 8 months, the range of expected inflow is quite large and ranges from the 27.4 MAF upper basic forecast to the 16.7 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much

wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 8 months are being forecasted for this May 1 forecast (4 months observed/8 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 8 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Niña)

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions, combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions to continue from April through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

Precipitation

The April Climate Prediction Center (CPC) precipitation outlook called for equal chances of precipitation in all of the upper Missouri River basin above Sioux City except for northwest Montana. Actual precipitation during April 2012 was over 150% of normal in the northern half of Montana and greater than 200% in localized areas, while in the mountains of Montana precipitation varied from about 75 to 150% of normal (Figure 1). Precipitation in Wyoming was predominantly less than 75% of normal. Precipitation in the Dakotas and Nebraska ranged from less than 75% of normal to greater than 200%. The 200% of normal rainfall was produced by moderate to heavy rain that occurred from April 13-16 in the eastern Dakotas, and another large system that produced widespread moderate rain across most of the basin April 27-29. Resultant end-of-month rainfall totals are shown in Figure 2. Even with much of the upper basin receiving above normal precipitation, runoff in April was below normal due to the lack of plains snowpack, warmer than normal temperatures during the winter and early spring and much drier than normal soil conditions

Over the 90-day period (February-March-April) shown in Figure 3, greater than normal precipitation in the areas of the Missouri River basin has occurred primarily as a result of above normal April rainfall in these same areas. The northern half of Montana has received greater than 150% of normal precipitation since February 1, 2012, while precipitation accumulations in the eastern Dakotas and the lower basin below Sioux City now ranges from normal to above normal with widely scattered areas of below normal precipitation.

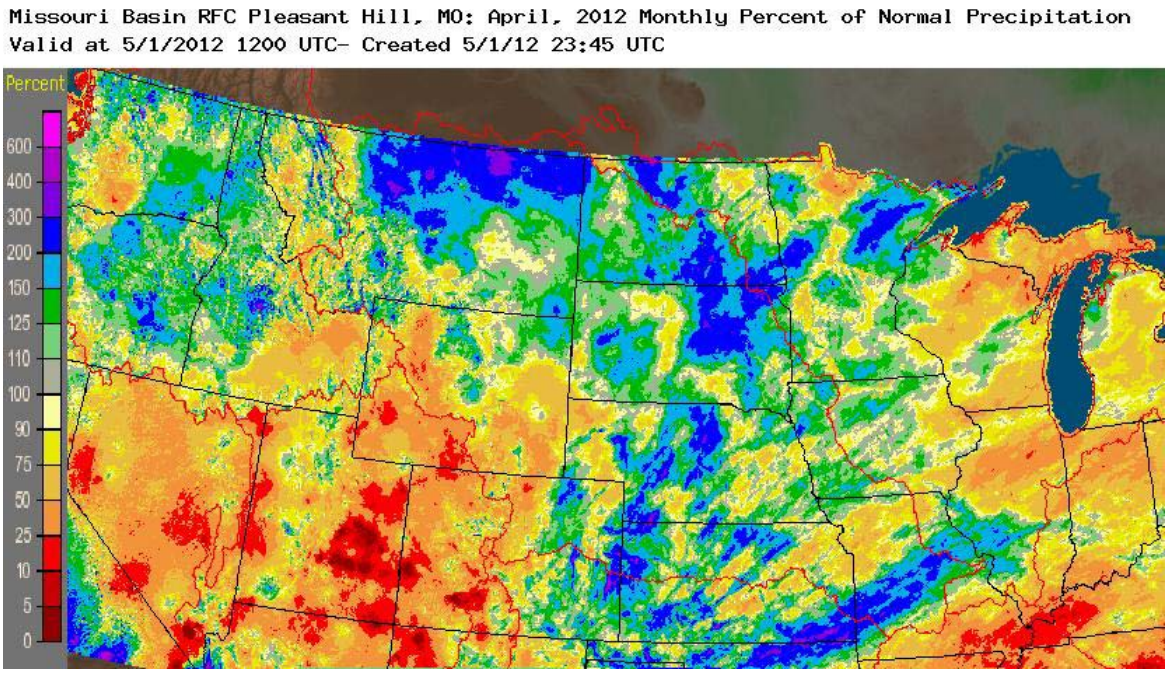


Figure 1. April 2012 Percent of Normal Precipitation. Source: National Weather Service.

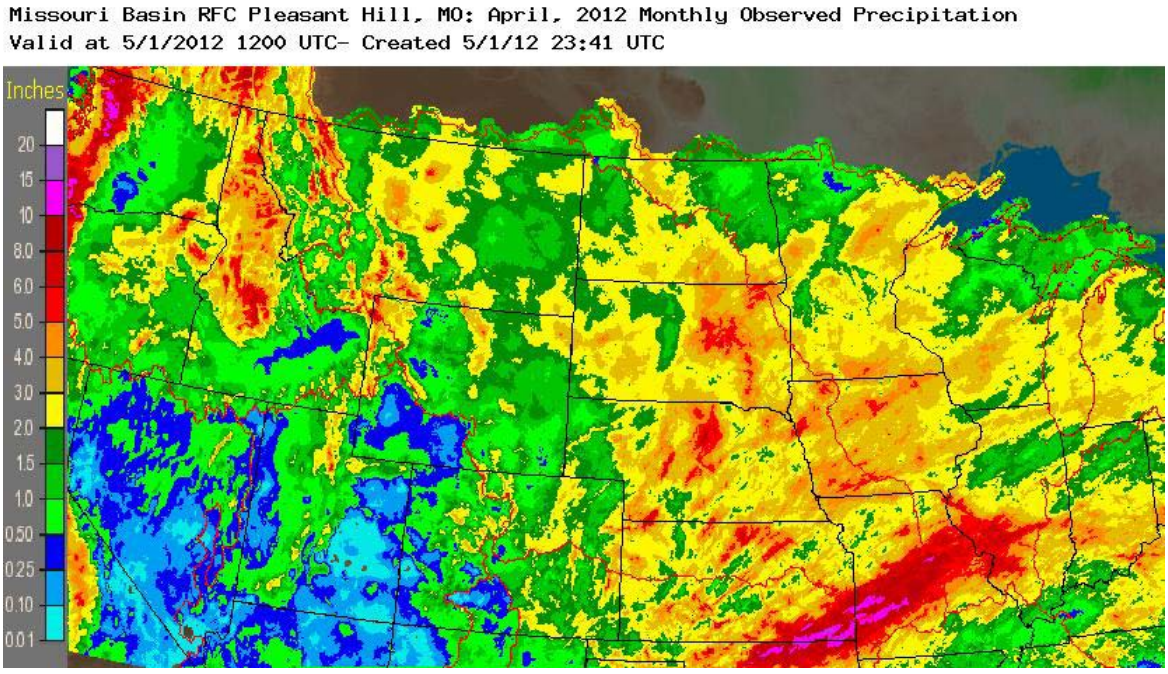


Figure 2. April 2012 Accumulated Precipitation (inches). Source: National Weather Service.

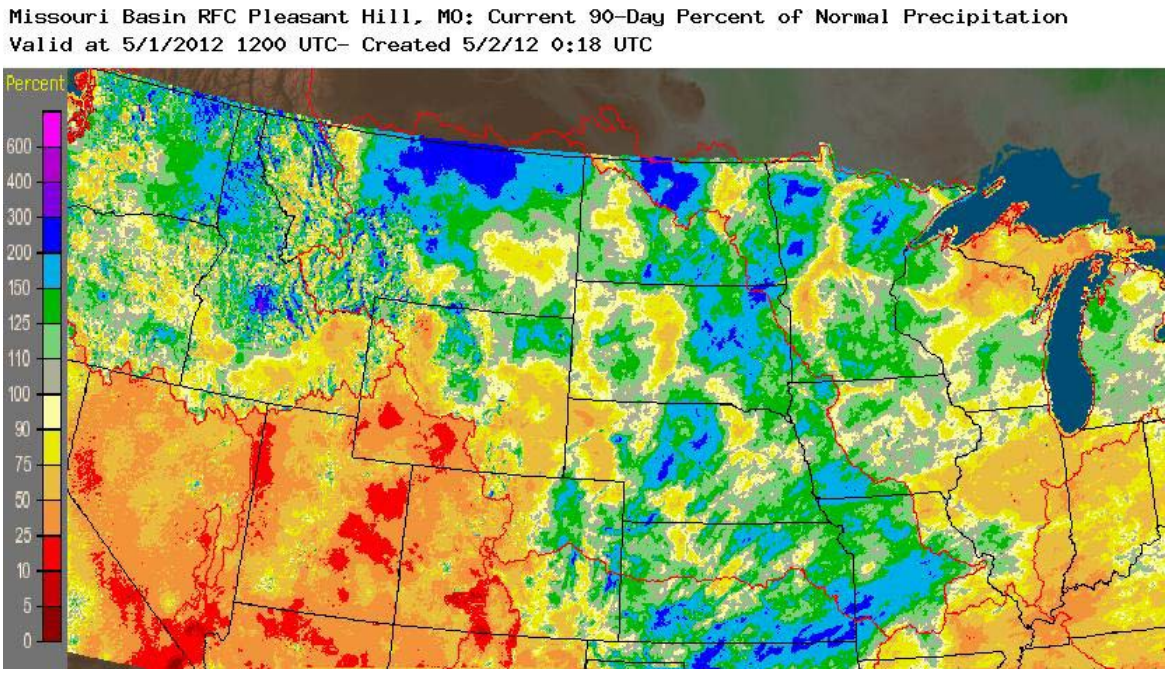


Figure 3. February-March-April 2012 Percent of Normal Precipitation. Source: National Weather Service.

Please refer to the January, February and March Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

The April (CPC) temperature outlook called for an increased probability for above normal temperatures across most of the Missouri River basin with the greatest chance for above normal temperatures in the southeast portion of the basin (see March forecast discussion), equal chances for most of Montana, and increased chances for below normal temperatures in the northwestern tip of Montana.

Average temperatures throughout the entire Missouri River basin were well above normal in April 2012 (Figure 4). Montana's temperatures were the least anomalous ranging from 2 to 5 degrees F above normal; while the most anomalous temperatures occurred in Wyoming ranging from 3 to 7 degrees F above normal. These warm temperatures have been a major driving factor that has dried surface soils and reduced the overall upper basin runoff volume to below normal.

Ninety-day (90-day) temperature departures ending on April 30, 2012 are shown in Figure 5. During the time period from February 1, 2012 to April 30, 2012, average daily temperatures ranged from 1 to 6 degrees F above normal in the mountain regions of the upper Missouri River basin, and 3 to 8 degrees F above normal in the plains region of the upper Missouri River basin. In contrast, 90-day temperatures through April 30, 2011 (Figure 6) were 3 to 7 degrees F below normal in much of the upper basin.

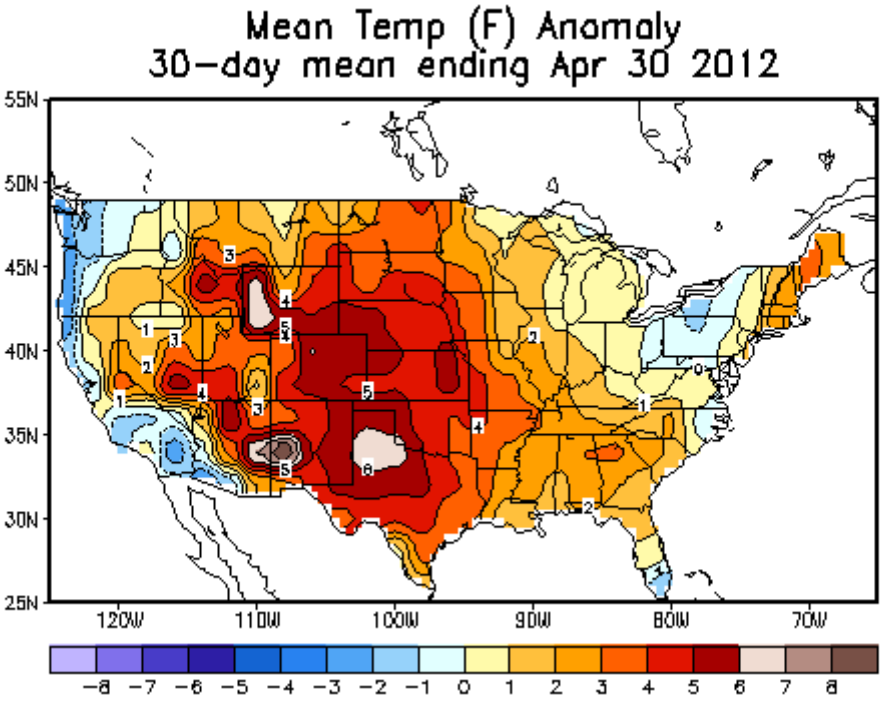


Figure 4. 30-day temperature anomaly (deg F) ending 30 Apr 2012.

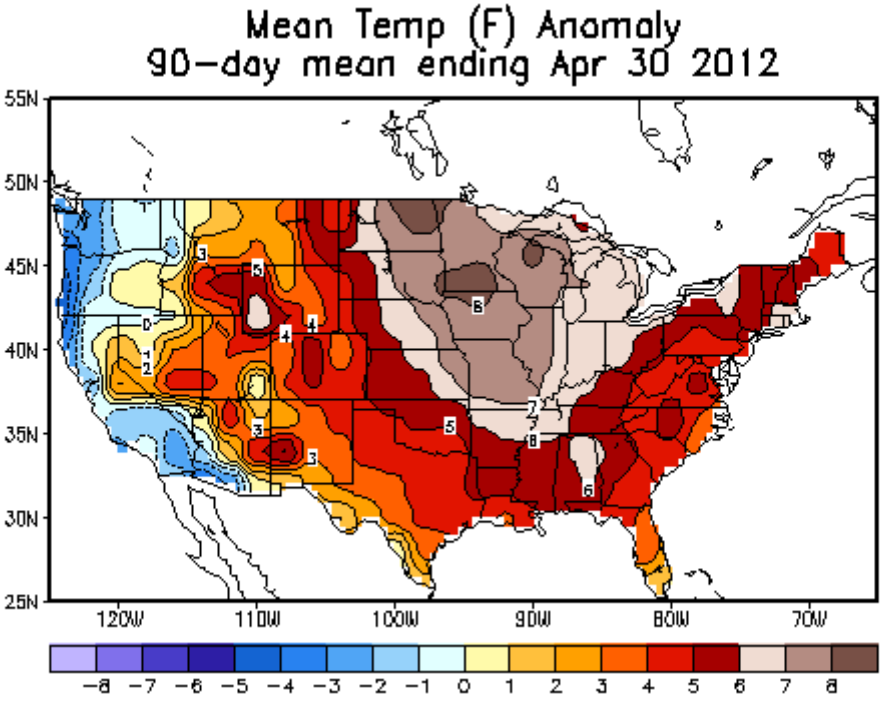


Figure 5. 90-day temperature anomaly (deg F) ending 30 Apr 2012.

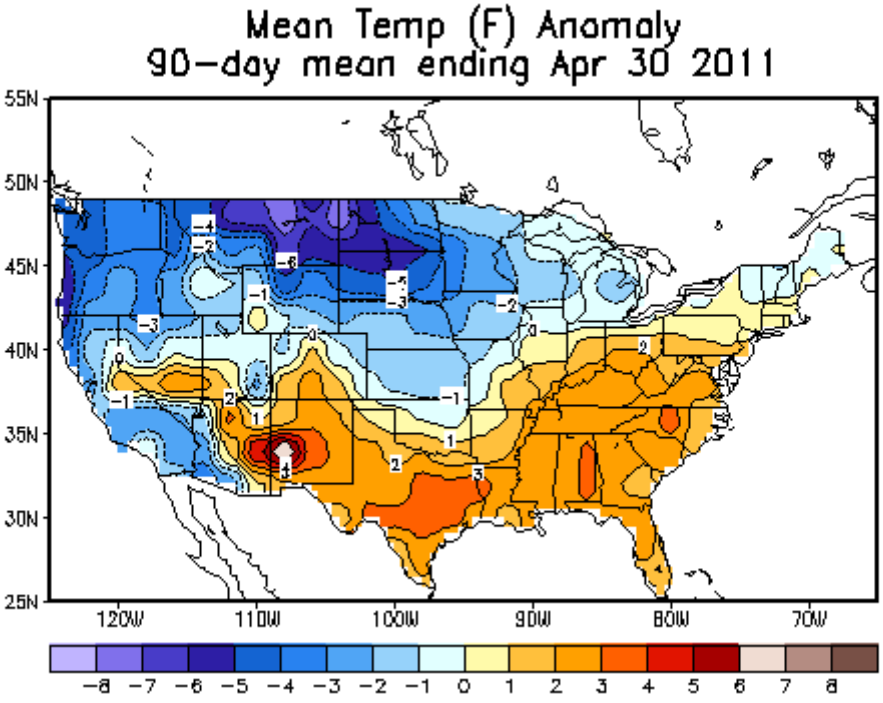


Figure 6. 90-day temperature anomaly (deg F) ending 30 April 2011.

Soil Moisture Conditions

Two independent assessments of soil moisture are provided below which include the CPC soil moisture percentile ranking (Figure 7) and the Variable Infiltration Capacity (VIC) soil moisture percentile ranking (Figure 8). The CPC soil moisture percentile ranking (Figure 7) continues to show below normal soil moisture in northeast Nebraska, northwest Iowa and southeast South Dakota. Additional areas of below normal soil moisture include eastern Wyoming, northwest Nebraska and southwest South Dakota. The CPC map also shows wet to very wet soils in the northern Rocky Mountains with percentile rankings ranging from the 70 to 99th percentile. These conditions have developed due to earlier than normal mountain snowpack and precipitation. The VIC model (Figure 8) shows the same dry areas in South Dakota, Nebraska and Iowa with additional areas of below normal soil moisture in North Dakota, and northern and southern Wyoming. The VIC model does not show the wet soils in western Montana to the same aerial extent as the CPC soil moisture map; however, it does show isolated areas of very wet soils greater than the 98th percentile ranking in central and western Montana, and the upper Yellowstone River basin. In summary, the two soil moisture assessments indicate wetter than normal conditions and in some cases much wetter than normal soil in Montana and the Yellowstone headwaters in Wyoming, and drier than normal soil conditions in the plains.

In contrast to April 2012 conditions, April 2011 soil moisture conditions were much wetter in the plains. Soil moisture percentile rankings (Figure 9) ranged from the 70th to the 99th percentile ranking across most of the upper Missouri River Basin. According to the CPC, the Rocky Mountain soils were less anomalous in 2011 because no mountain snowmelt had occurred by May 1; however, soil moisture was still above normal.

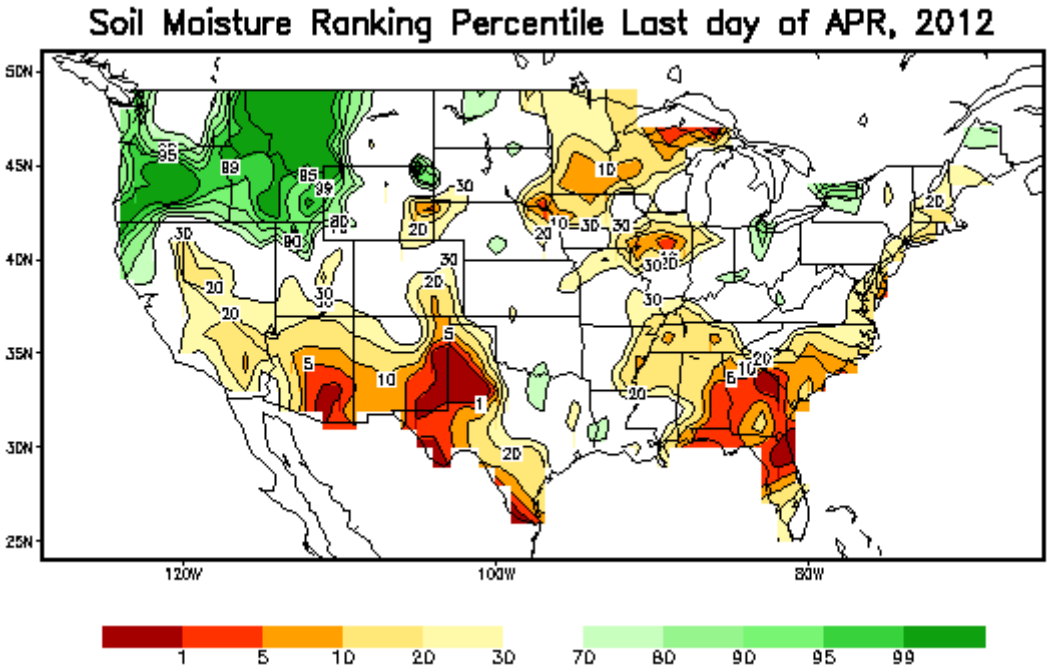


Figure 7. Calculated Soil Moisture Ranking Percentile on the last day of April 2012. Source: Climate Prediction Center.
http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

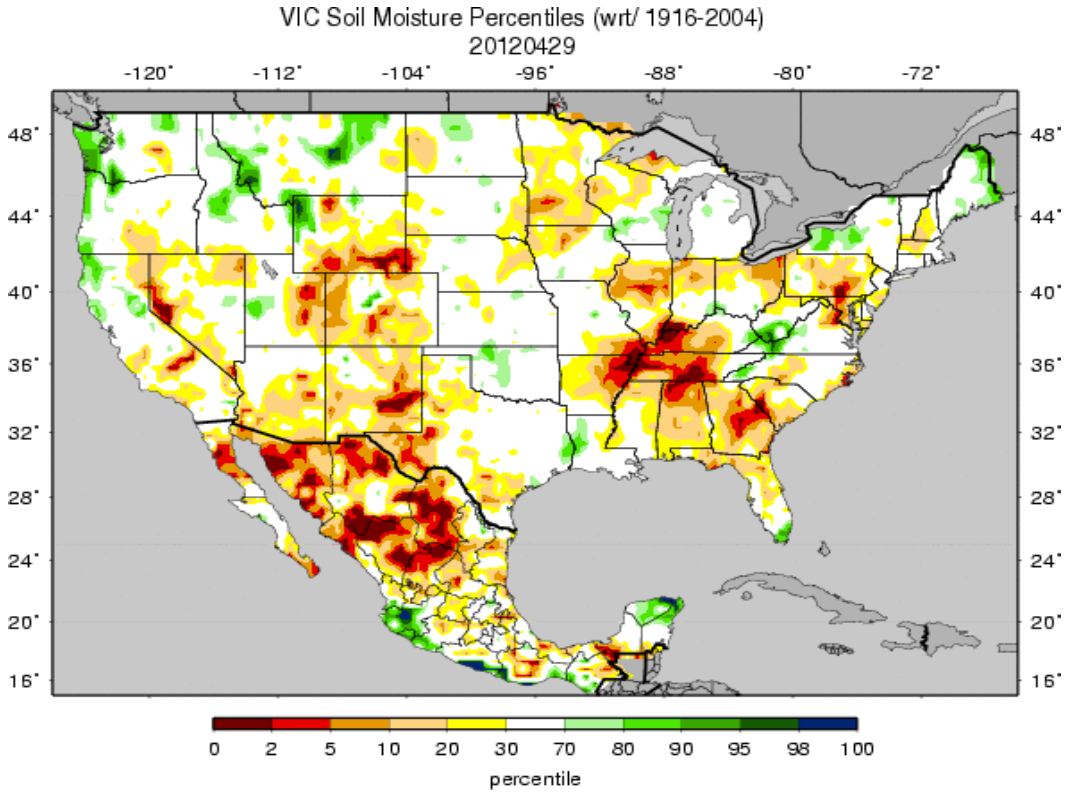


Figure 8. VIC modeled soil moisture percentiles as of April 29, 2012. Source: University of Washington.
http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

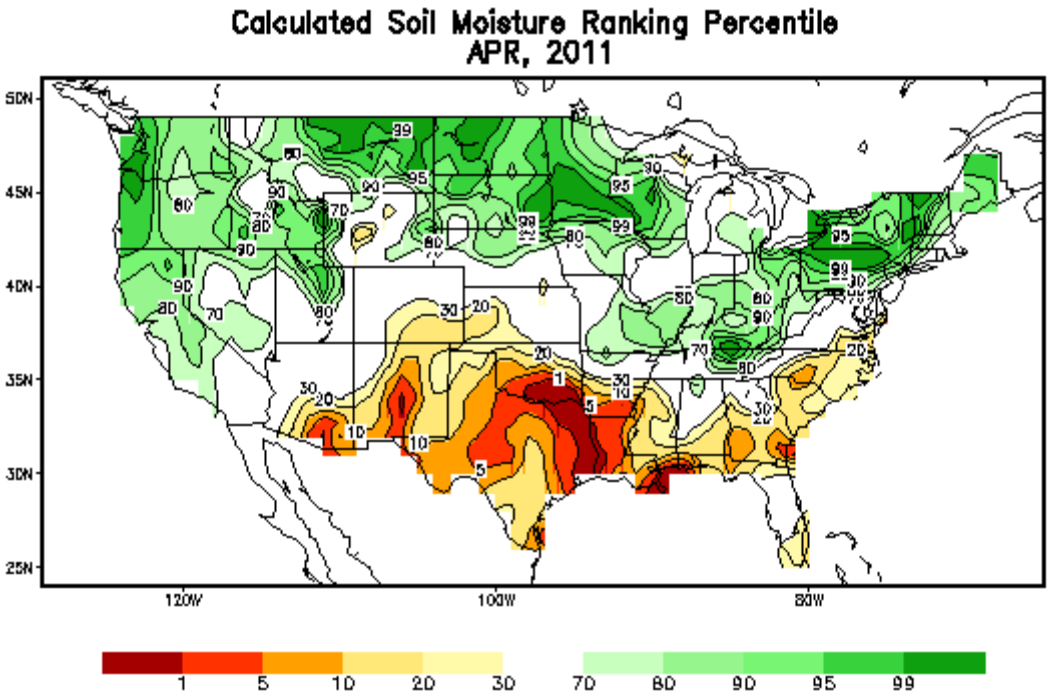


Figure 9. Calculated Soil Moisture Ranking Percentile in April 2011. Source: Climate Prediction Center.
http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. Historically, about 25% of annual runoff occurs in March and April due to both melting snowpack and rainfall runoff; however, runoff occurs in March and April whether or not there is any plains snow to melt. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts.

On May 1, 2012, no plains snowpack existed anywhere in the Missouri River basin. In contrast, on May 1, 2011, the heavy snowpack that had accumulated over the winter of 2010-2011 had melted; however, northern South Dakota and all of North Dakota had a very thin layer of snowpack as a result of a late spring snowfall event. Western North Dakota in the Fort Peck to Garrison reach was covered by up to 1.0 inch of SWE.

Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

The average mountain snow accumulation in the basin above Fort Peck Dam peaked on April 9, 2012 at 97% of the normal peak mountain snow accumulation that would normally occur on April 15. The peak SWE on April 9, 2012 was 17.4 inches compared to an average peak of 18.0 inches. The average mountain snow accumulation in the reach from Fort Peck Dam to Garrison Dam peaked on March 22, 2012 at 88% of the normal peak that would normally occur on April 15. The peak SWE on March 22, 2012 was 13.8 inches compared to an average peak of 15.6 inches. As of May 1, 2012, mountain snowpack continued to decline in both the Fort Peck and Garrison subbasins. Earlier than normal peak accumulations usually indicate that May-June-July mountain runoff due to snowmelt may be below average unless influenced by much greater than normal rainfall. In addition, earlier than normal peak accumulations cause the peak runoff discharge rate to occur earlier than normal in the runoff season

Table 1. 2012 mountain snowpack accumulation as a percent of normal.

Date	Above Fort Peck	Fort Peck to Garrison
January 1, 2012	79%	96%
February 1, 2012	87%	96%
March 1, 2012	94%	105%
April 1, 2012	97%	86%
Peak Accumulation as a % of the Normal April 15 Peak Accumulation	97% on April 9, 2012	88% on March 22, 2012
May 1, 2012	78%	68%

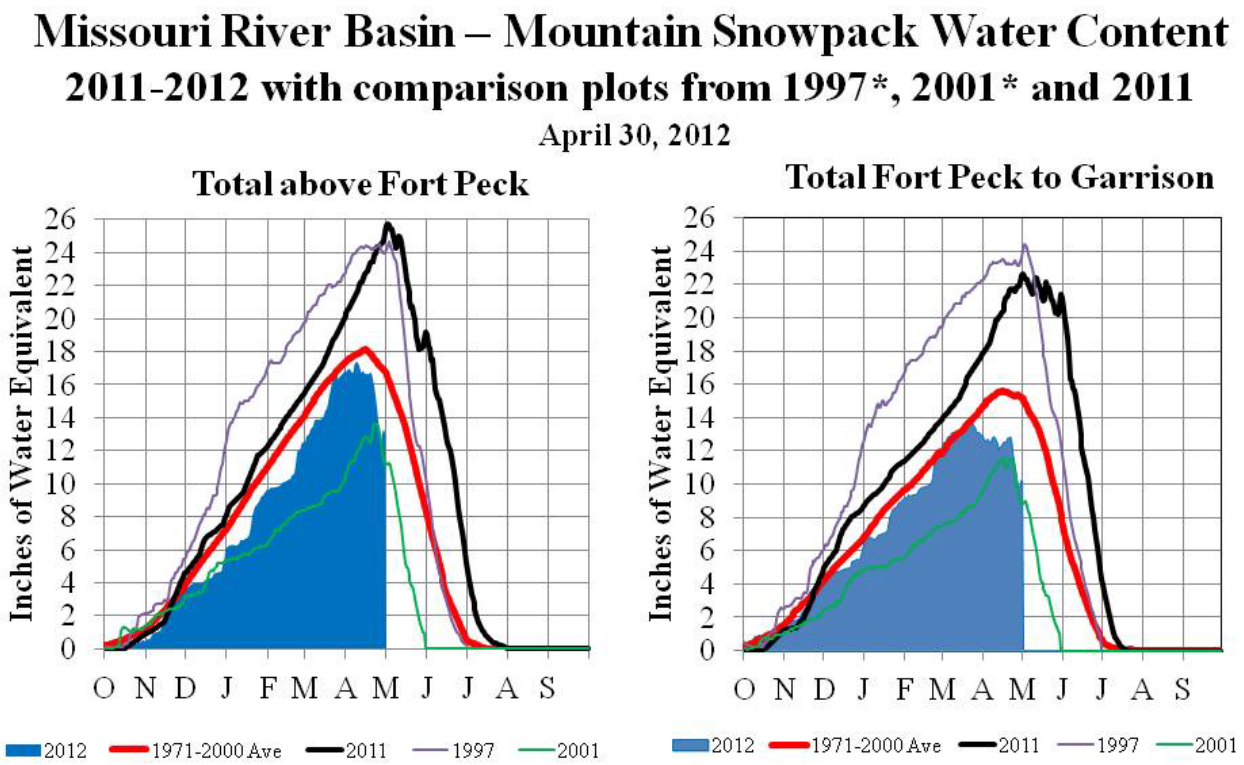


Figure 10. Mountain snowpack water content compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management. The shaded blue area indicates 2012 mountain SWE amounts. The bold black line indicates 2011 mountain SWE amounts.

Drought Analysis

According to the National Drought Mitigation Center (NDMC), Abnormally Dry (D0) conditions cover a region over eastern Montana, eastern Wyoming, the western Dakotas and western Nebraska. Moderate Drought (D1) conditions are impacting an area within this region (see Figure 11). Another area of drought covers a portion of southeast South Dakota, northwest Iowa and northeast Nebraska with conditions ranging from Abnormally Dry to Severe Drought (D2). While there has been some expansion of drought in the western area, the eastern area has undergone some improvement. The NDMC drought outlook (Figure 12) which extends through July 31, 2012 is forecasting some improvement in the western Dakotas and western Nebraska, as well as eastern South Dakota and southwest Minnesota. Drought improvement is very likely to occur in northwest Iowa and eastern Nebraska according to the NDMC outlook.

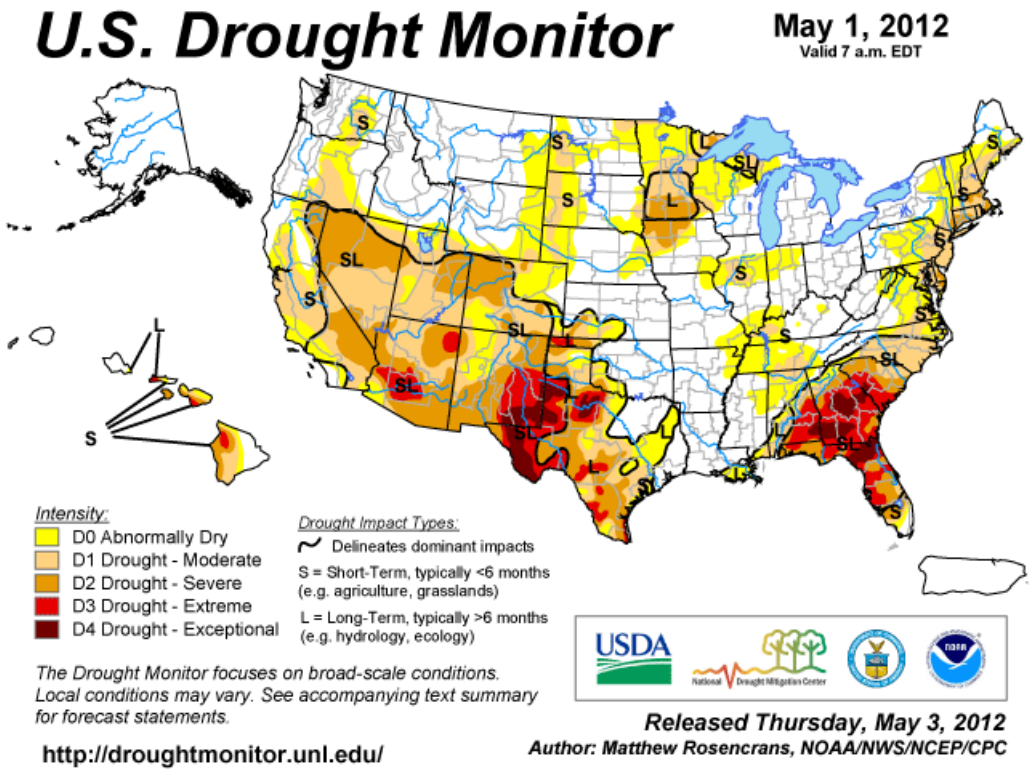


Figure 11. National Drought Mitigation Center U.S. Drought Monitors for May 1, 2012.

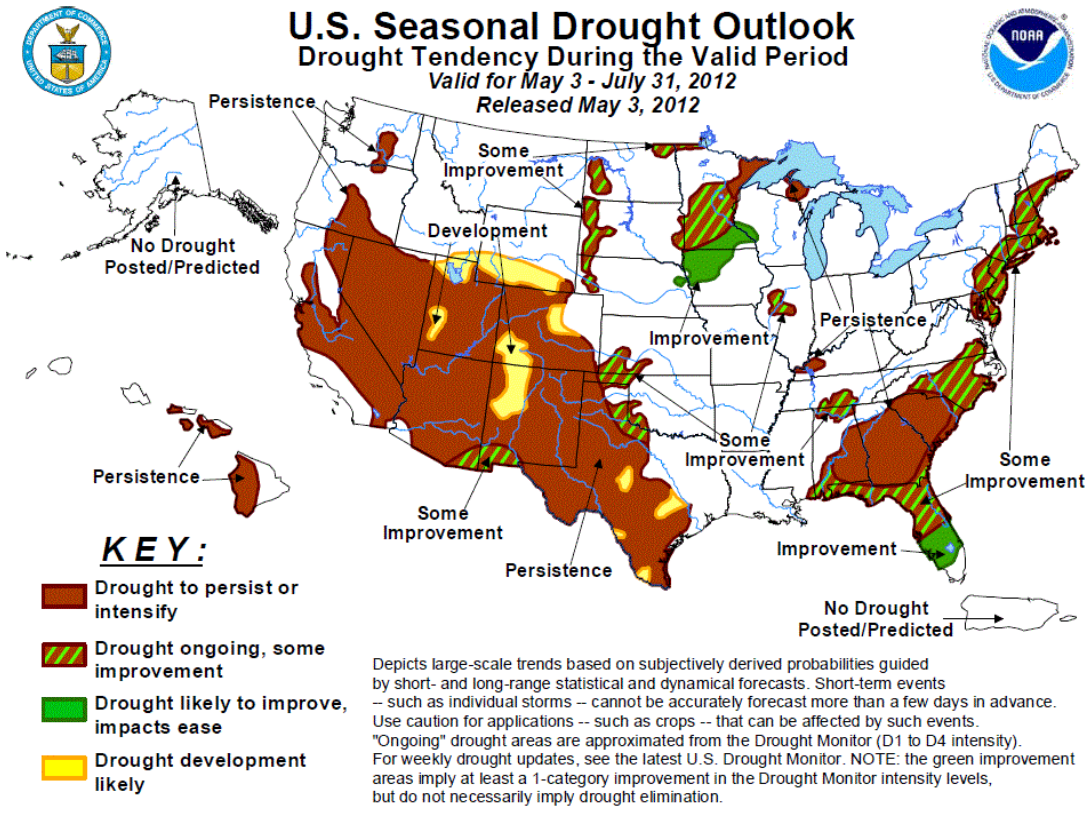


Figure 12. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 3 May to 31 July 2012.

Climate Outlook

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions continuing through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

The 6-10 Day (Figure 13) and 8-14 Day (Figure 14) Outlooks indicate that temperatures are very likely to be above normal in the northern Rocky Mountains and northern Plains through May 15. With regard to precipitation, there will be increased probabilities for below normal precipitation in the northern Rockies while there are increased probabilities for above normal precipitation in the central Plains and Midwest through May 11. During the 8-14 day period ending May 15, the precipitation probability is forecast to be below normal over a larger expanse of the northern Plains, with equal chances across Wyoming and Nebraska.

For temperature the May outlook (Figure 15) indicates equal chances for above, below and normal temperatures in Montana and North Dakota, while there are increased chances for above normal temperatures throughout the remainder of the Missouri River Basin. For precipitation (Figure 15) the May outlook indicates equal chances for above, below and normal precipitation in all areas of the basin with the exception of an increased likelihood of below normal precipitation in Wyoming and southwest Montana. The 3-month or May-June-July outlooks (Figure 16) call for increased chances of below normal temperatures in Montana, western North Dakota and northern Wyoming, with Equal Chances for the remainder of the upper basin. Precipitation chances favor below normal precipitation in Montana and Wyoming, while there are Equal Chances in the remainder of the basin.

Longer term CPC outlooks indicate there is an increased probability for above normal temperatures especially in the fall and winter in the western U.S. affecting the Rocky Mountains and bordering high plains regions (Figure 17 & 18). There are equal chances for precipitation throughout most of the basin with the exception of western Montana in August-September-October 2012 (Figure 17). In November-December-January, there is an equal chance for above, below and normal precipitation (Figure 18).

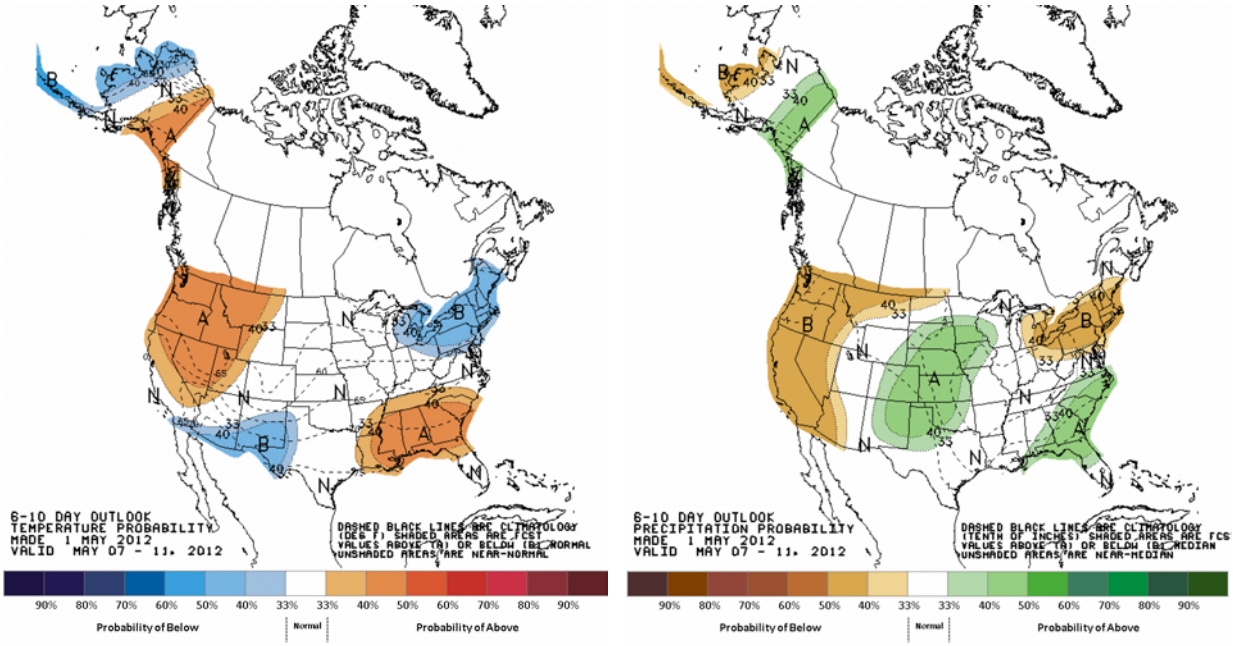


Figure 13. CPC 6-10 day temperature and precipitation outlooks.

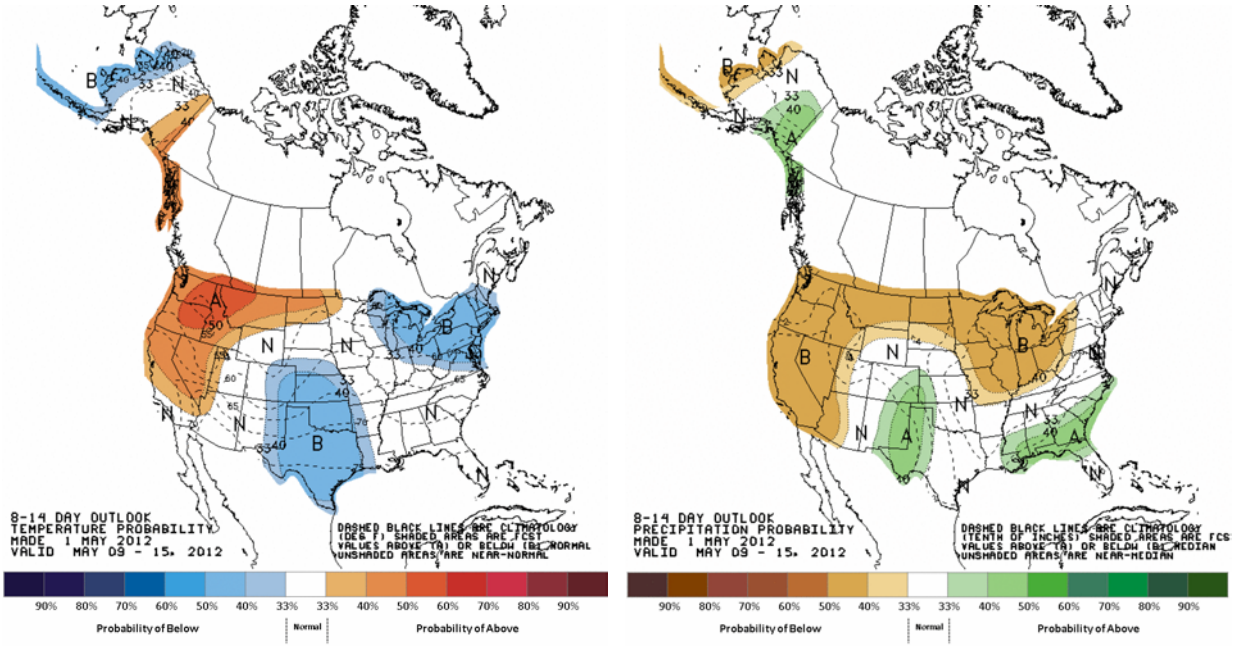


Figure 14. CPC 8-14 day temperature and precipitation outlooks.

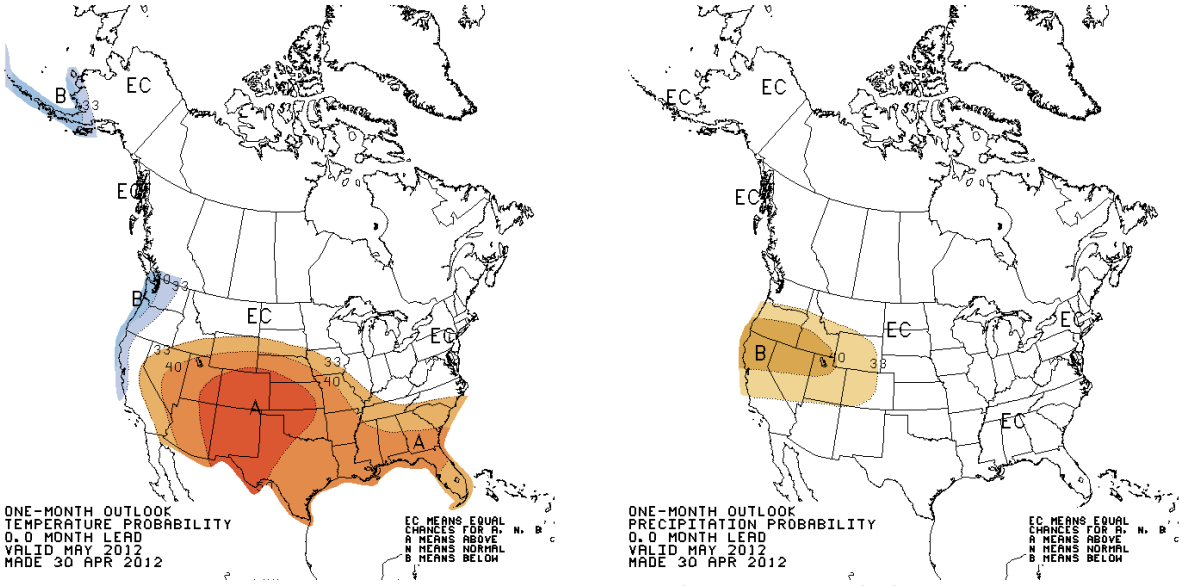


Figure 15. CPC May 2012 temperature and precipitation outlooks.

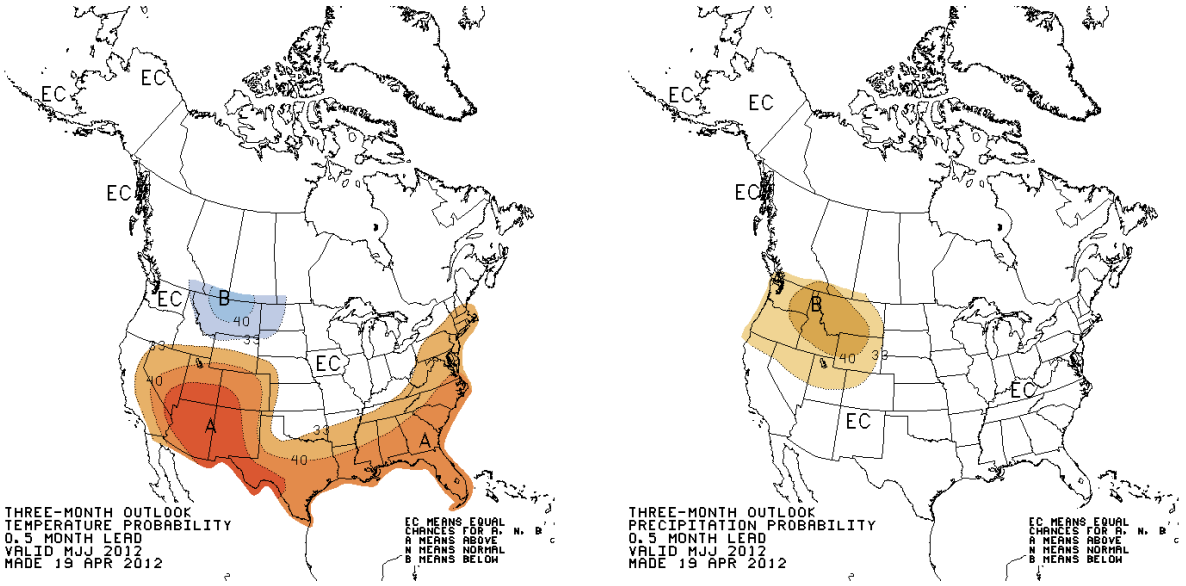


Figure 16. CPC May-June-July 2012 temperature and precipitation outlook.

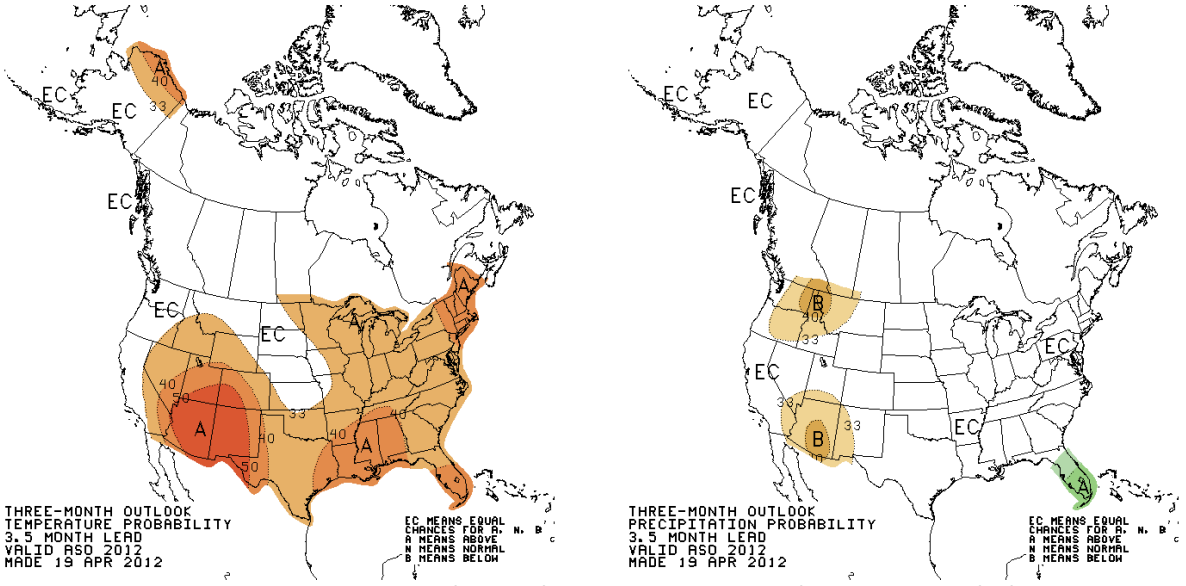


Figure 17. CPC August-September-October 2012 temperature and precipitation outlook.

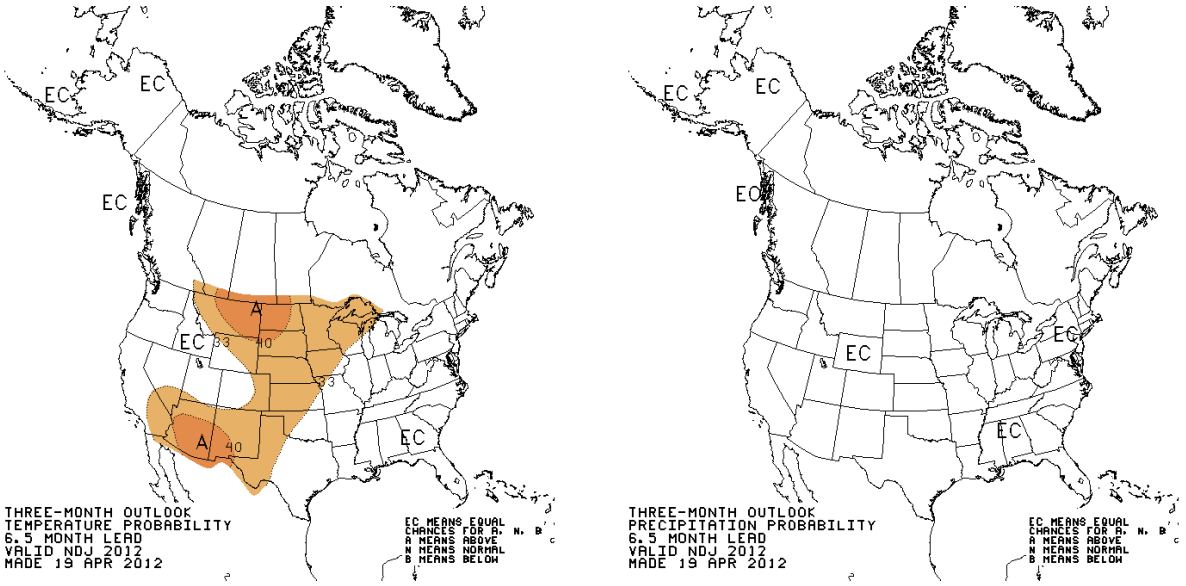


Figure 18. November-December 2012 – January 2013 temperature and precipitation outlook.

May 2012 Calendar Year Runoff Forecast

As stated earlier in this report the May 1 runoff forecast above Sioux City, IA is **21.6 MAF** (87% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is a decrease from the April 1 forecast due to much lower than normal plains snowpack runoff in March and April, lower than normal mountain snowpack, and the expectation that potentially drier conditions could continue into the fall of 2012. Runoff during March was 78% of normal above Sioux City and it was 63% of normal during April.

The end of April calendar year accumulation above Sioux City is 88% of normal or 6.7 MAF. Due to the amount of variability in precipitation that can occur over the next 8 months, the range of expected inflow is quite large and ranges from the 27.4 MAF upper basic forecast to the 16.7 MAF lower basic forecast.

May-June-July

During the May-June-July period, the mainstem system normally receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River basin, so runoff can vary significantly as a result of the above or below normal rainfall. The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total average annual runoff into the system.

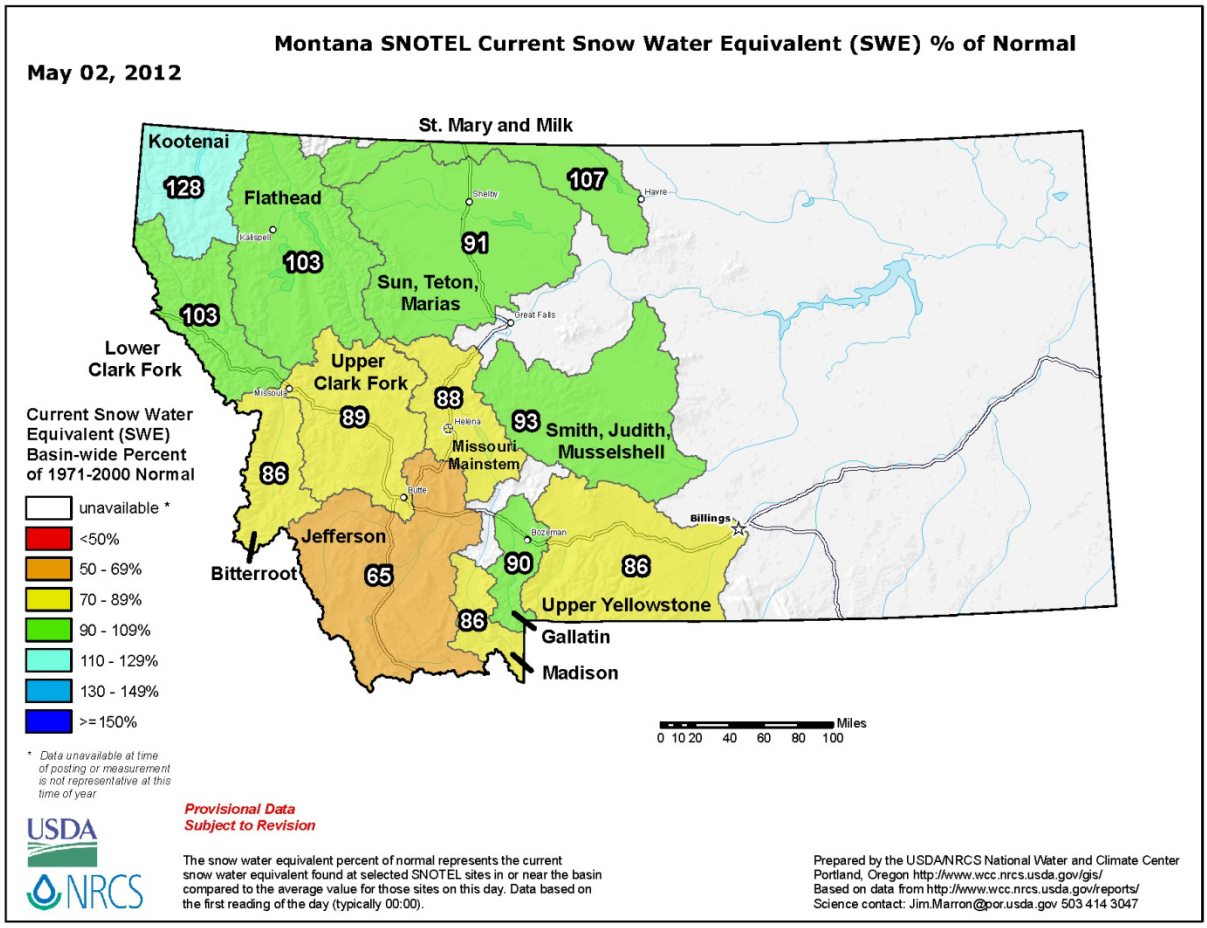
For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Existing mountain snowpack peaked at 97% of normal in the reach above Fort Peck on April 9 and 88% of normal in the reach between Fort Peck and Garrison on March 22. Since then, mountain snowpack has been steadily melting, and on May 1, it was 78% of the normal May 1 level above Fort Peck, and it was 68% of the normal May 1 level in the Fort Peck to Garrison reach. Soil moisture conditions in the mountain basins are above normal due to early season snowmelt. The chance for precipitation is forecast to be below normal through July and there is a greater probability for below normal temperatures. As a result runoff is forecast to be 3219 kaf (92% of normal) above Fort Peck and 4413 kaf (78% of normal) from Fort Peck to Garrison. Since mountain snowpack peaked much earlier than normal, the peak of the mountain snowmelt runoff is forecast to occur earlier than normal, placing some additional water in May.

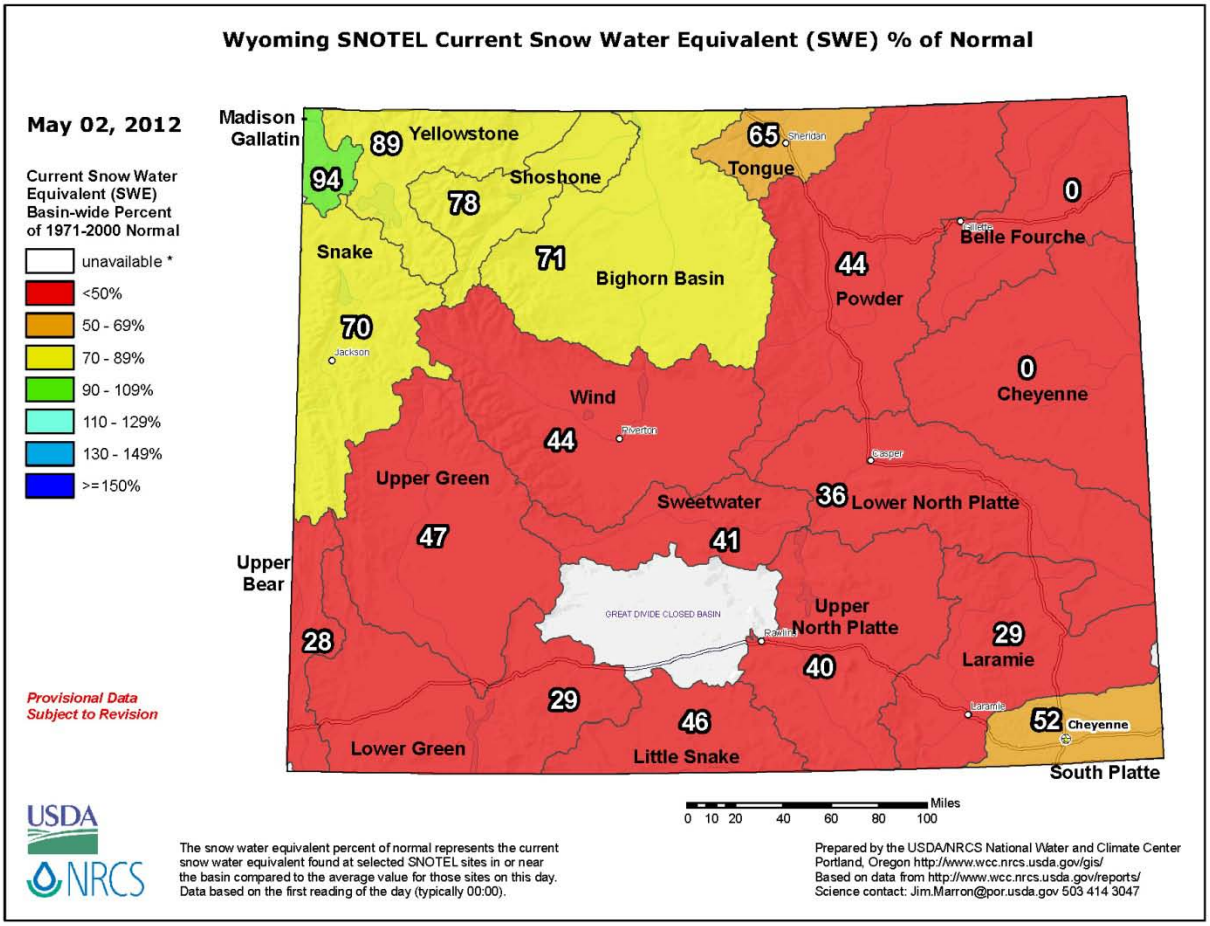
Following below-normal runoff in March and April, runoff in May, June and July is also expected to be below normal in the Oahe, Fort Randall, Gavins Point and Sioux city reaches. Drought conditions as defined by the National Drought Mitigation Center continue to impact the Dakotas, Nebraska, Iowa and Minnesota.

August through December

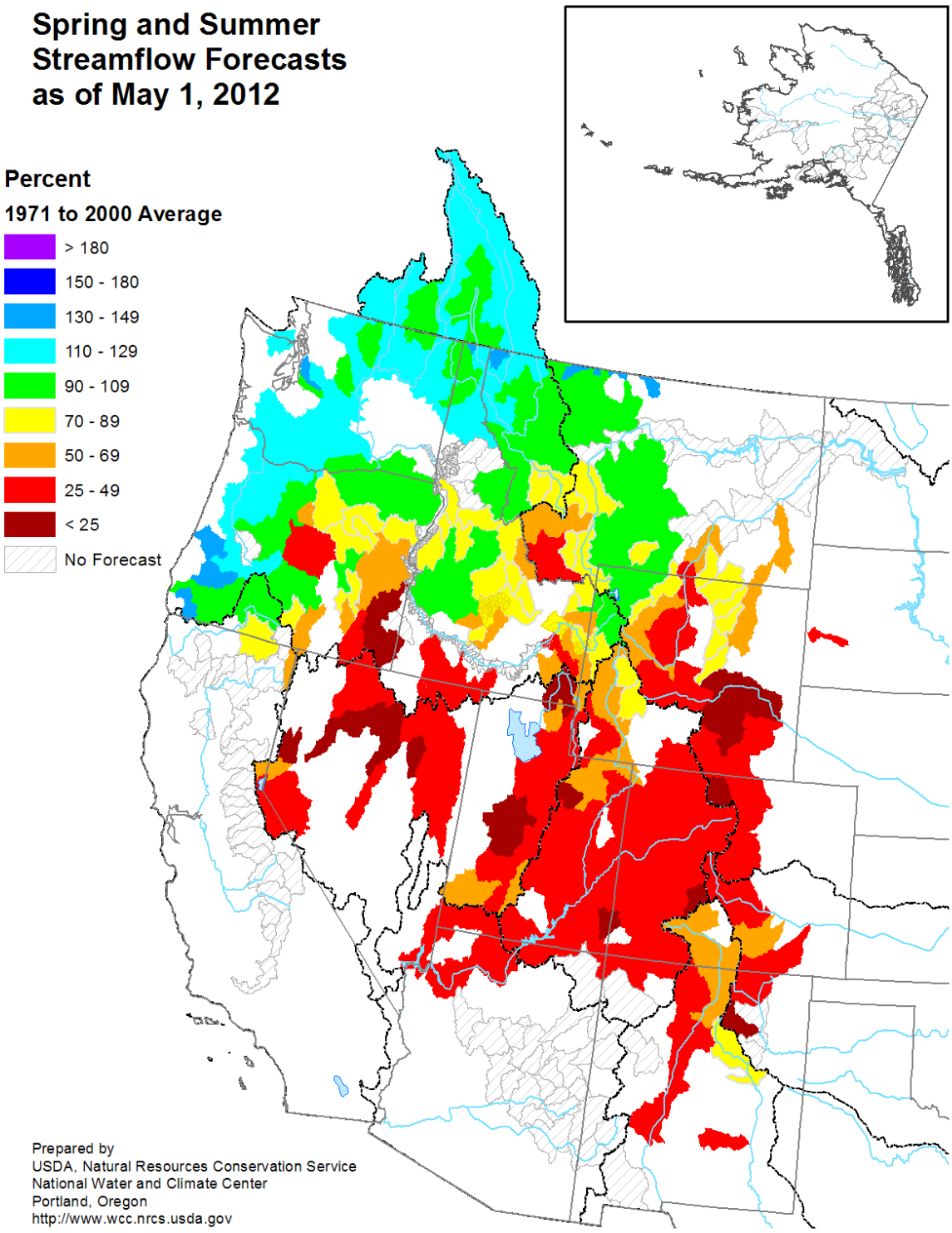
During the August through December period, runoff is forecast to be slightly below normal in all reaches from above Fort Peck to Gavins Point, primarily due to the increased chances for above normal temperatures during the fall. As the year progresses and the August through December precipitation and temperature outlooks are updated with more detail, these values may change.

Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
May 02, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Madison Gallatin
89
Yellowstone
94
78
Shoshone
65
Sheridan
Tongue
0
Belle Fourche
Snake
71
Bighorn Basin
44
Powder
70
Jackson
Wind
0
Cheyenne
Riverton
44
Casper
Upper Green
Sweetwater
36
Lower North Platte
47
41
Upper Bear
GREAT DIVIDE CLOSED BASIN
Rawlins
Upper North Platte
28
29
Laramie
40
29
Laramie
52
Cheyenne
46
Lower Green
Little Snake
South Platte
Miles
0 10 20 40 60 80 100
USDA
NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

NRCS Water Supply Outlook



NOAA Water Supply Forecast

Table 2. Comparison of Fort Peck forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Apr 1 2012**	Apr-Sep	3870	89%
Seasonal Ensemble Outlook*	Apr 24 2012	Apr-Sep	5603	129%
Monthly Ensemble Outlook*	Apr 24 2012			
May		May	1972	N/A
June		June	1833	N/A
July		July	804	N/A

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on May 1.

Table 3. Comparison of Garrison forecasts. NOAA/NRCS forecasts and outlooks are unregulated volumes. The Corps forecast is the combined Fort Peck and Garrison runoff volumes.

NOAA/NRCS Forecast	Issue Date	Time Period	Runoff kaf	% of Mean
Seasonal Water Supply (Official Forecast)*	Apr 1 2012**	Apr-Sep	9260	83%

*All NOAA/NRCS forecasts are the 50% exceedence forecast.

** The Seasonal Water Supply Forecast was not available on May 1.

Field Verification of Conditions on April 1, 2012

Corps of Engineers mainstem project offices and some volunteer plains snow observers reported local hydrologic factor field conditions during the last week of March. Their observations are summarized below.

North Dakota

Statewide Conditions (State Report): We don't have good information on soil moisture conditions; however ground water levels remain high around the state. Before today's rainstorm soil surface conditions were dry. Sloughs/and lakes around the state are fuller than normal, but I think this is residual from last year's moisture. Stream flow is on the low side. Vegetation is starting to green up.

Garrison Project: Soil dry/moist with no standing water and normal ground cover around Garrison Project, Riverdale ND. The surface conditions are very dry. Most of Western ND is in a fed flag warning for fire danger. However there is still moisture in the soil. I'm still seeing some areas seeping due high ground water tables, but some of the sloughs and areas that had standing water last year are drying out. If we stay in the 70's, with wind, like we've seen this will be exacerbated. Farmers are starting to plant their fields now and are planting through areas that they farmed around last year.

Jamestown: Pipestem Project Office area recorded 0.13" of rain since last Friday to this morning. Surface soil is generally dry in the Pipestem Lake watershed area. Subsurface soil is very wet/saturated in watershed area. All the wetlands/lakes in the watershed area froze FULL last fall and many of them continued to flow during the mild winter - Pipestem Dam released about 15-30 cfs most of Jan.-Feb. which is record amount for winter releases - Jamestown Res. water elevation increased about 24 vertical inches from Jan.- mid March and was releasing 13 cfs during that time period. Lakes/large wetlands in the watershed continue to surface drain into the system. Veg. ground cover - Thousands of acres of land is being taken out of CRP (grass cover) & converted into croplands in the watershed area which will probably contribute to increased runoff...especially if planted to soybeans!

South Dakota

Statewide (USGS): Most streams are below average across the state with the exception of the Belle Fourche which is still a little above normal and the James River where the lower James remains a little above normal. All of western SD is also dry enough that if we begin to get some spring rainfall, depending on intensity, most rainfall would soak in and not run off. Eastern SD also has many areas that could use moisture as well and we would not see a great deal of runoff.

Gavins Point: Surface and subsurface soil conditions are dry. Rain is coming today to eastern SD, but it is not enough to change conditions. Stream flow seems about normal.

Fort Randall: Very little if any soil moisture. Also from one of our engineers: Upper level soil moisture is slightly below average. With soil temperatures being higher than normal for this time of year, however, any precipitation that we see - rain or snow - should be almost entirely infiltration unless duration or intensity are extreme.

Fort Randall (Pickstown): Surface and subsurface soil conditions - Soil is very dry. Really haven't had much for precipitation for quite a while, other than a few light events. There is no standing water

anywhere that I have seen. Stream flow does appear to be low. Vegetative ground cover is greening up in the area. Vegetation is ahead of schedule for this time of year, due to the warmer than average temperatures. Grass is kind of struggling though due to the lack of moisture in the soil.

Oahe: We are dry around Oahe. Not much moisture so far this spring in the western half. Eastern SD has gotten more than us. BLUF: Soil moisture conditions around Oahe are in the Very Dry Category. Warm (hot) and dry. Yesterday we got up to 91. Extended temperatures are expected to be more seasonable over the next 10 days. Soil is dry on the surface and the subsoil is OK right now, but unless we get some moisture soon that will be declining also.

Oahe (NWS): NWS Says March was a Record Breaking Month for Temps. The start of a new month brings a look back at March and weather statistics by the National Weather Service. Weather observers at the NWS office in Aberdeen say that March in central and northeast parts of the state brought numerous daily and monthly records. The average high temperatures last month were said to be from 16 to almost 20 degrees above normal. The temperature reached 80 degrees or higher at several locations in northeast and central South Dakota in March; with Pierre reaching 80 or more at least five times last month. The warmest temperature in March was 88 at Pierre on March 18, which broke the all-time March high temp record for the community. Kennebec's warmest day in March was on the 18th, when it reached 87, Mobridge's warmest high was 83 on the 16th and Timber Lake got up to 82 on the 16th. The NWS also says that March was a dry month with precipitation amounts below normal. March is usually one of the snowiest months with 6-8 inches of snowfall, but for last month, snow amounts ranged from only trace amounts to up to three inches. Monthly precipitation levels in Pierre, Kennebec, Mobridge and Timber Lake are all said to be from a half an inch to just over an inch below normal for March.

Ashton: Very little rain since last reported snow fall. Ground is very dry as is the vegetation. Streams are flowing but a bit under the usual pattern. Most standing water is now gone.

Brookings: The soil condition here is dry. There isn't any standing water and the creek is well within its banks (very low compared to most springs). There is moderate growth to the grass. Everything is greening up, but we could use a good shot of rain.

Chamberlain: Here at Chamberlain, like so many places, has been unusually dry. We got that big snow/rain at the end of February, then had about .75" total for March until today. We fortunately had storms/rain all morning. I looked at lunch-about .85" and still drizzling. I don't think it's widespread, especially to the west.

We do have standing water in some low areas & ditches, but it was disappearing quickly. Farmers are working fields all the way to Pickstown. I see some stock dams are full; some are on the low side. I tilled the garden last weekend and there was some moisture down low, but not a great deal. My guess is there sufficient topsoil moisture with a dry layer below.

Last time across White River, I thought it was below normal flow for March. Streams were ok earlier, but were rapidly declining. I'll take a look today, but things will be skewed due to this morning's event. Vegetation is greening much ahead of normal, appears sufficient with good carryover from 2011.

Eureka: There was no snow to melt for runoff. The ground moisture is low but not dry. We would be able to handle quite a bit before runoff would become an issue. There are potholes but they have gotten less with the lack of moisture and all the wind we have had.

Huron: At Huron Airport the soil condition is moist, with little to no standing water. The area I was using for sampling is next to Broadland creek which is barely flowing at this time.

Pierre and statewide conditions (State Report): Here in the Pierre area n the past two weeks we have been experiencing above normal temps, 70's and 80's, and several days of windy conditions in the 20 - 30 mph range. We have not experienced any measurable precipitation since the last week of February.

Soils and sub-soils are in the dry to moist range but are drying out quickly.

The local dams and sloughs are still holding water but many are about half full. There really isn't any standing water in the small pot holes and the smaller prairie streams mostly have quit running about two weeks ago. The larger streams may still be flowing but not by much.

The prairies started greening up last week but really haven't started putting on new growth yet. Most of the farm land is black and farmers started working in the fields this past weekend drilling in spring wheat and if it stays warm, row crops will likely be put in two to three weeks earlier than normal. The winter wheat has come out of dormancy.

Spearfish: Surface and subsurface soil conditions are dry. There is no standing water. Spearfish Creek seems to flow at its normal rate.

Buffalo, Brule & Jerauld Counties: Soil conditions are quite dry. The soil moisture is low (I have seen farmers cultivating through depression areas that have been too wet the past couple years) and stream flow is low.

Day County: Webster SD, did not have any runoff, no major snow melt, land surfaces are on the dry side, farmers are planting now but appears dry over most of the county. Surface moisture is dry as prairie fire has been a problem.

Hamlin County: Hamlin County soil is dry with very little to no standing water. Many potholes and sloughs have dried up completely and water moving through the chain of lakes is slow. Even though temps have been abnormally high vegetation is just barely starting at this point. The county is receiving rain today but not significant amounts. My coop station for the NWS shows 0.18 for Jan, 1.39 for Feb and 0.30 so far in March total precipitation at Hayti.

Tripp County: In the Tripp County area we are very dry. Tripp County is receiving small amounts of rain today. In The past three weeks has been cloudy, but not much in rain from the clouds. In the last three weeks we have had less the .25 inch of moisture.

Montana/Wyoming

Fort Peck: It is dry around the project. Further west it is wetter.

Southern Montana/Northern Wyoming (NRCS report): Surface soil moisture - wet to less than slightly wet. Rain last night helped wet things up. Subsurface soil moisture - becoming moister as is typically the case this time of year. No standing water. Green-up is beginning to occur in the greater valley. Streamflow is up a bit from last night's rain/gropple storm in the valley.

SNOTEL sites at low elevations are showing the beginning signs of melting while mid elevations are approaching isothermal snowpack conditions. Upper elevations are holding relatively steady but some high elevations sites in the Big Horn mountains are going towards isothermal conditions as well. I

was talking to the Avalanche Center here this morning who gather mountain snowpack observations all around here, they concur that snowpack is isothermal up to 9000 feet which is the significant majority of the surface area driving streamflow. We made an attempt of measuring one of our mountain monthly manual snow courses (New World here outside of Bozeman) today but scrapped it because of tough access conditions due to low snow. Only extremely low elevation sites are in full melt mode but they do not seems to be affecting streamflow very much.

It certainly is setting up as an interesting year with very warm temps and high winds to further sublimation. Seems like we are 3 weeks early but all it takes is one storm to change everything. The fact that the Big Horn mountain snowpack is becoming isothermal this early is something to watch. Southern Montana is dryer than average and much closer to melting or already melting. In the field I saw snowmelt near at 6,900 feet. Northern Montana is above average snowpack with conditions further from isothermal meaning snow melt is not as far along as southern Montana.

Northeast Montana (NWS report): Northeast Montana has been very, very dry this winter, and much of the time we had no snow on the ground at all. The Drought Monitor updated today extends the abnormally dry conditions even further into eastern MT now.
http://droughtmonitor.unl.edu/DM_state.htm?MT,W

The soils were very wet across this entire region going into the winter season, with reports of combines getting stuck in the mud and sinking in on hilltops (not just the valleys) during the harvest last Sept/Oct.

We still have some soil moisture (sorry, we don't have any measurements I can think of in NE Montana), but each windy day is gradually taking more and more of that away. In the past month, I've been south of Glasgow to Gillette, WY, and there had been some ice on the Yellowstone left on the banks, but nothing major. It came through in late Feb with no impact this year to NE Montana. I've also been from Glasgow up to Plentywood and over to Williston (Poplar and Big Muddy basins), and again, no snow, some mild runoff with streams after our record high days, but nothing that caused any concerns.

There was a small dam breach NW of Glendive, MT about 10 days ago. The stock dam was damaged from last years runoff, and the owner was suppose to finish breaching it this summer. The little bit of snow runoff of the Big Sheeps wiped out the remainder of the dam. Caused some high water on Seven Mile Creek for about 12 hours, but by the time anyone noticed, and got around to investigating the cause, it was receded. That does flow into the Yellowstone.

We are actually more concerned about fires at this time, and have had a lot of them carry quickly with the winds, and the 1 and 10 hour fuels having been so thick last summer/fall. We are seeing some green up starting to occur, about 2-4 weeks earlier than normal.

Upper Missouri River Basin
June 2012 Calendar Year Runoff Forecast
June 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

May 2012 Runoff

May 2012 Missouri River runoff was 3,314 KAF (102% of normal) above Sioux City, and 2,726 KAF (92% of normal) above Gavins Point. In January and February very warm temperatures caused a premature ice breakup on rivers and tributaries, and soil frost thawed earlier than usual allowing more runoff to occur in January and February than would normally occur during a year with normal temperatures. As a result, March runoff did not benefit from the spring thaw. In March, record high temperatures across the upper basin melted the very light plains snowpack early in March. Although May precipitation was above normal in many areas, very dry soil moisture conditions absorbed most rainfall resulting in lower than normal runoff in the upper basin. The exceptions were the Fort Peck and Gavins Point reaches where abundant rainfall caused above normal runoff.

2012 Calendar Year Forecast Synopsis

The June 1 runoff forecast above Sioux City, IA is **22.2 MAF** (89% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is an increase from the May 1 forecast due to much higher than normal rainfall in the Gavins Point Dam to Sioux City reach. Due to the amount of variability in precipitation that can occur over the next 7 months, the range of expected inflow is quite large and ranges from the 26.9 MAF upper basic forecast to the 18.4 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term

regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 7 months are being forecasted for this June 1 forecast (5 months observed/7 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 7 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Niña)

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions, combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions to continue from April through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

Precipitation

The June Climate Prediction Center (CPC) precipitation outlook called for equal chances of precipitation in all of the upper Missouri River basin above Sioux City except for Montana and North Dakota. Actual precipitation during May 2012 was over 200% of normal in north-central Montana and greater than 300% in localized areas, while in the mountains of Montana, precipitation varied from about 50 to 125% of normal (Figure 1). Precipitation in Wyoming was predominantly less than 75% of normal. Precipitation in the Dakotas and Nebraska ranged from less than 50% of normal to greater than 300%. The greater than 300% of normal rainfall in southwest-Minnesota/northwest-Iowa was produced by moderate to heavy rain that occurred from May 23-28 in the eastern Dakotas and southwestern Minnesota. Resultant end-of-month rainfall totals are shown in Figure 2. Even with much of the upper basin receiving above normal precipitation, runoff in May was below normal due to the lack of plains snowpack, warmer than normal temperatures during the winter and early spring and much drier than normal soil conditions

Over the 90-day period (March-April-May) shown in Figure 3, greater than normal precipitation in the areas of the Missouri River basin has occurred primarily as a result of above normal April and May rainfall in these same areas. The northern half of Montana has received greater than 200% of normal precipitation since March 1, 2012, while precipitation accumulations in the eastern Dakotas and the lower basin below Sioux City now ranges from normal to above normal with widely scattered areas of below normal precipitation.

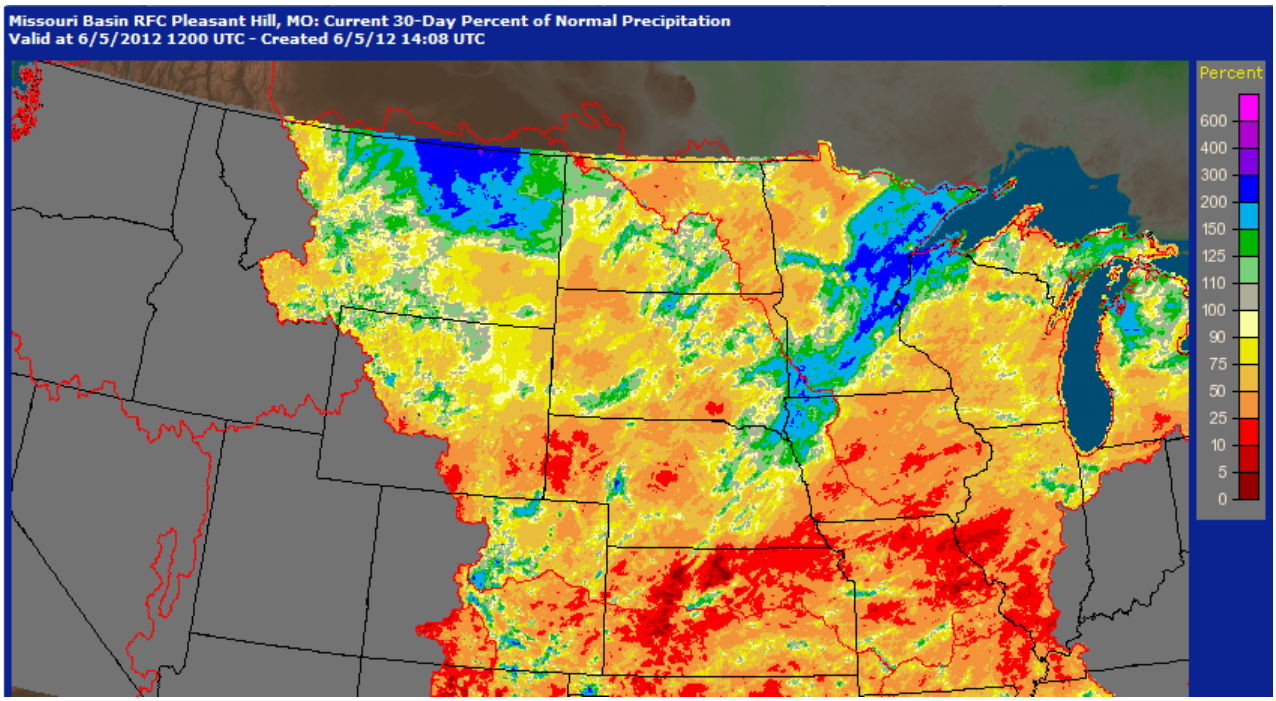


Figure 1. May 2012 Percent of Normal Precipitation. Source: National Weather Service.

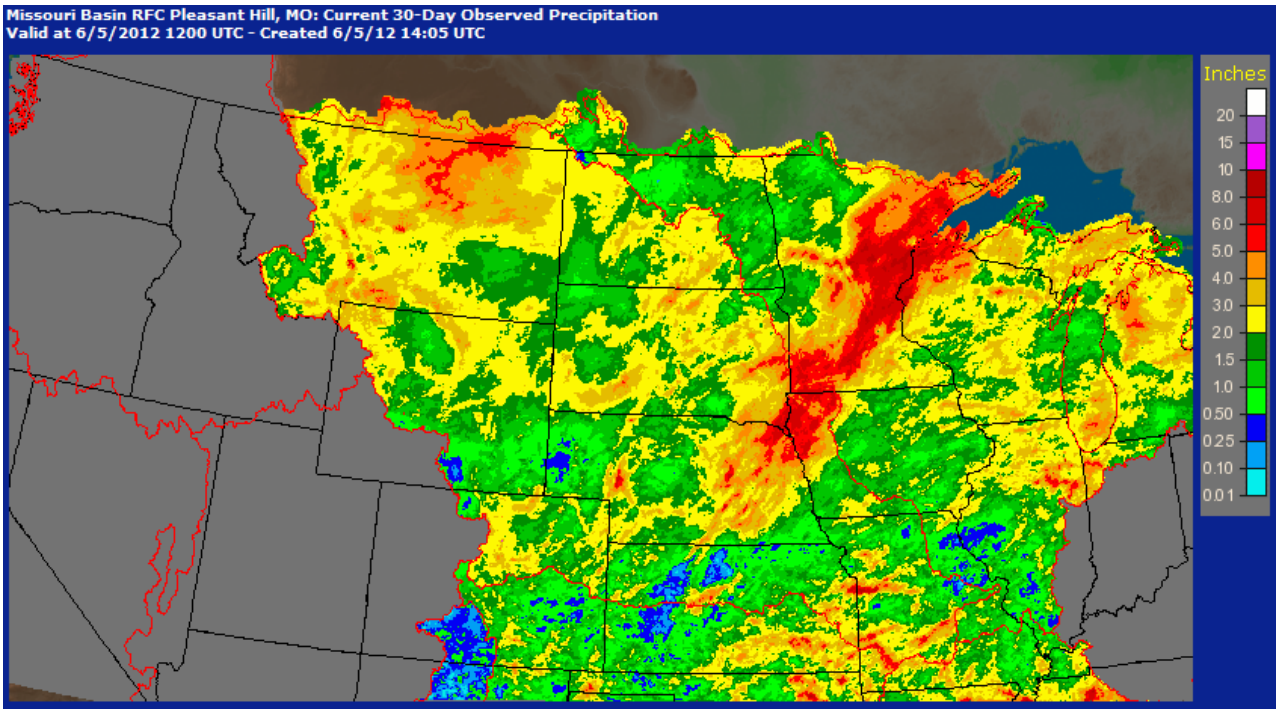


Figure 2. May 2012 Accumulated Precipitation (inches). Source: National Weather Service.

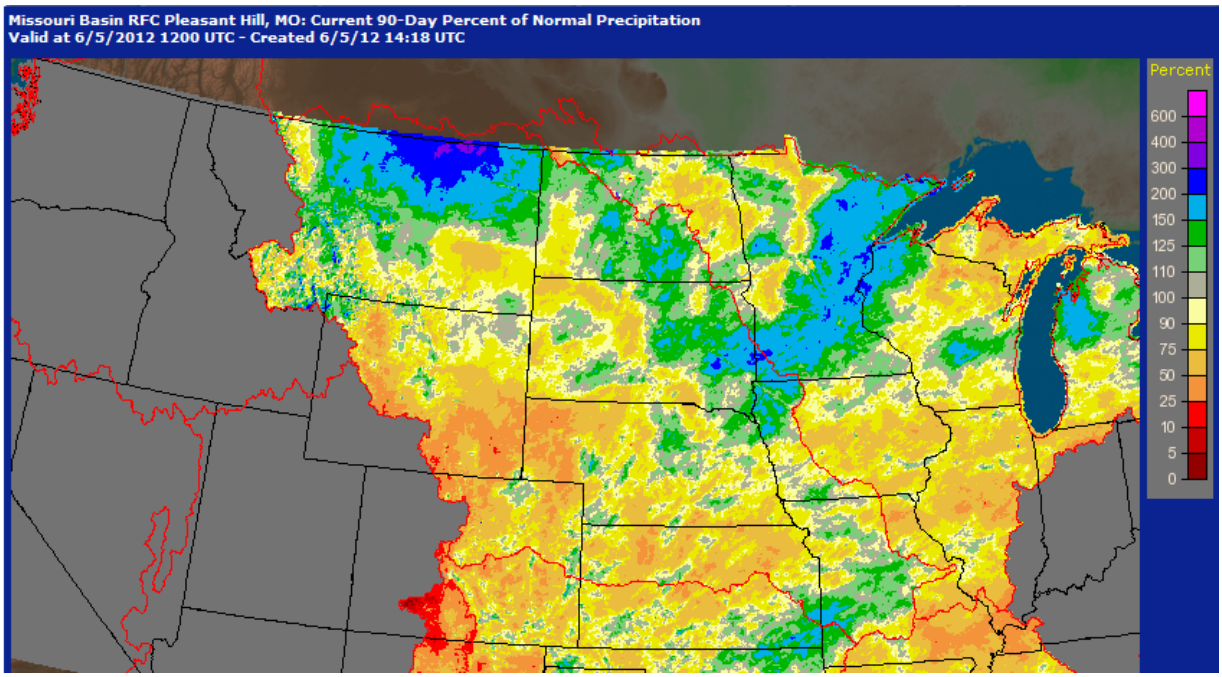


Figure 3. March-April-May 2012 Percent of Normal Precipitation. Source: National Weather Service.

Please refer to the January, February, March, April, and May Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

The June (CPC) temperature outlook called for an increased probability for above normal temperatures across most of the Missouri River basin with the exception of Montana and western North Dakota. The June-July-August temperature forecast is essentially equal chances of above normal, below normal, and normal temperatures throughout the basin.

Average temperatures throughout the Missouri River basin were well above normal in May 2012 (Figure 4), except for Montana and western North Dakota which were slightly below normal. These warm temperatures have been a major driving factor that has dried surface soils and reduced the overall upper basin runoff volume to below normal.

Ninety-day (90-day) temperature departures ending on May 30, 2012 are shown in Figure 5. During the time period from March 1, 2012 to May 30, 2012, average daily temperatures ranged from 1 to 6 degrees F above normal in the mountain regions of the upper Missouri River basin, and 3 to 8 degrees F above normal in the plains region of the upper Missouri River basin.

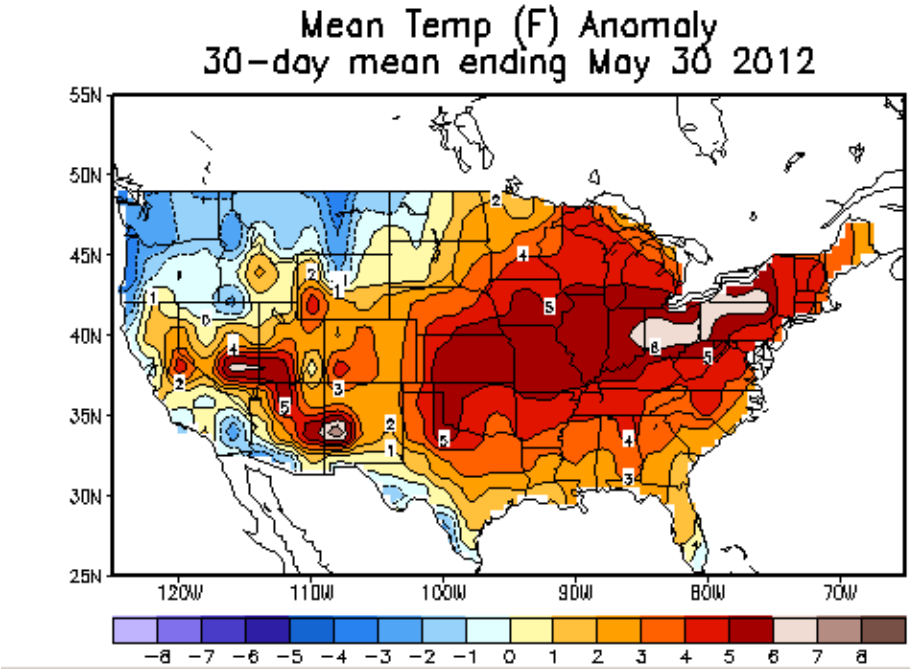


Figure 4. 30-day temperature anomaly (deg F) ending 30 May 2012.

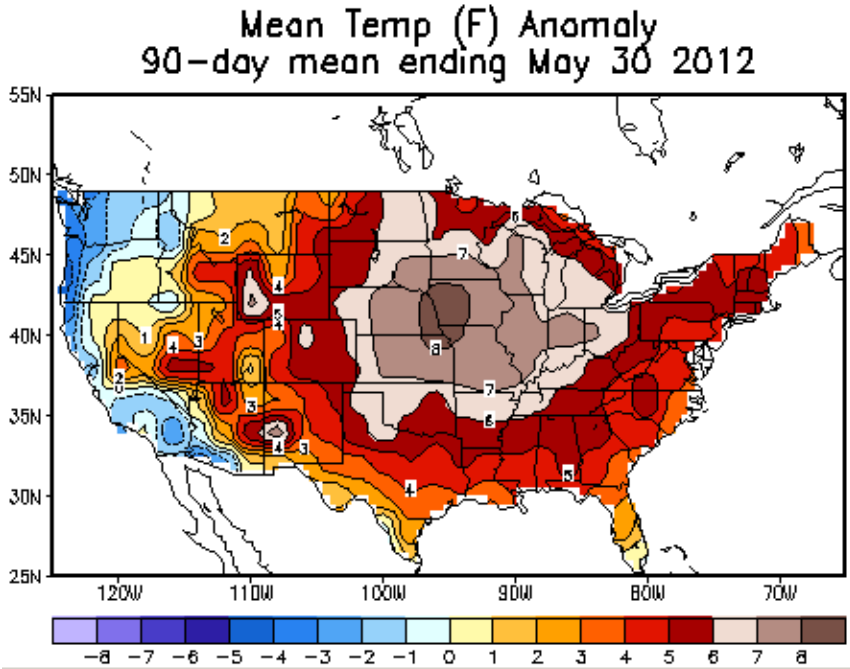


Figure 5. 90-day temperature anomaly (deg F) ending 30 Apr 2012.

Soil Moisture Conditions

Two independent assessments of soil moisture are provided below which include the CPC soil moisture percentile ranking (Figure 6) and the Variable Infiltration Capacity (VIC) soil moisture percentile ranking (Figure 8). The CPC soil moisture percentile ranking (Figure 6) continues to show below normal soil moisture in northeast Nebraska, northwest Iowa and southeast South Dakota. Additional areas of below normal soil moisture include eastern Wyoming, northwest Nebraska and southwest South Dakota. The CPC map also shows wet to very wet soils in the northern Rocky Mountains with percentile rankings ranging from the 70 to 99th percentile. These conditions have developed due to earlier than normal mountain snowpack and precipitation. The VIC model (Figure 7) shows the same dry areas in South Dakota, Nebraska and Iowa with additional areas of below normal soil moisture in North Dakota, and northern and southern Wyoming. The VIC model does not show the wet soils in western Montana to the same aerial extent as the CPC soil moisture map; however, it does show isolated areas of very wet soils greater than the 98th percentile ranking in central and western Montana, and the upper Yellowstone River basin. In summary, the two soil moisture assessments indicate wetter than normal conditions and in some cases much wetter than normal soil in Montana and the Yellowstone headwaters in Wyoming, and drier than normal soil conditions in the plains.

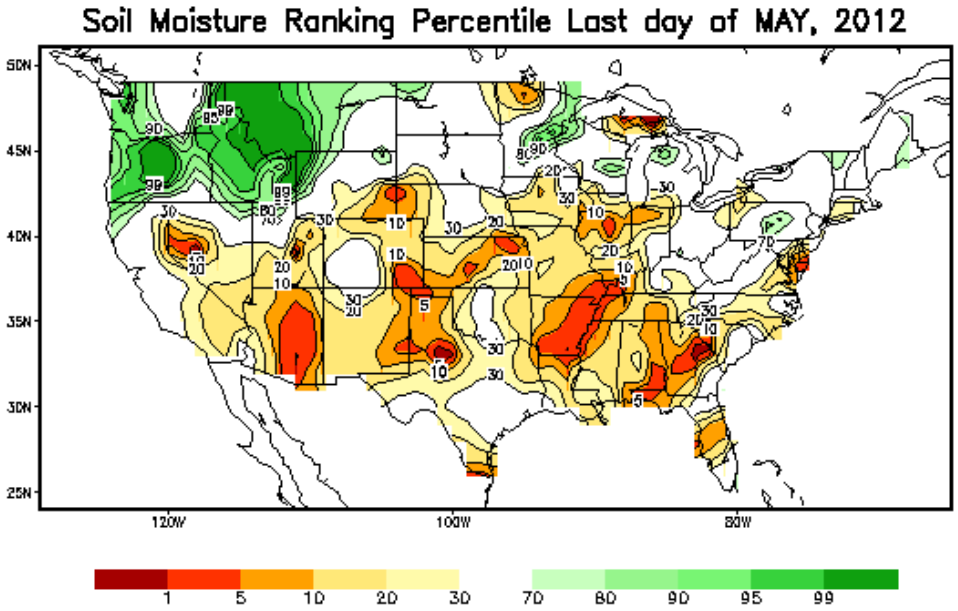


Figure 6. Calculated Soil Moisture Ranking Percentile on the last day of May 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

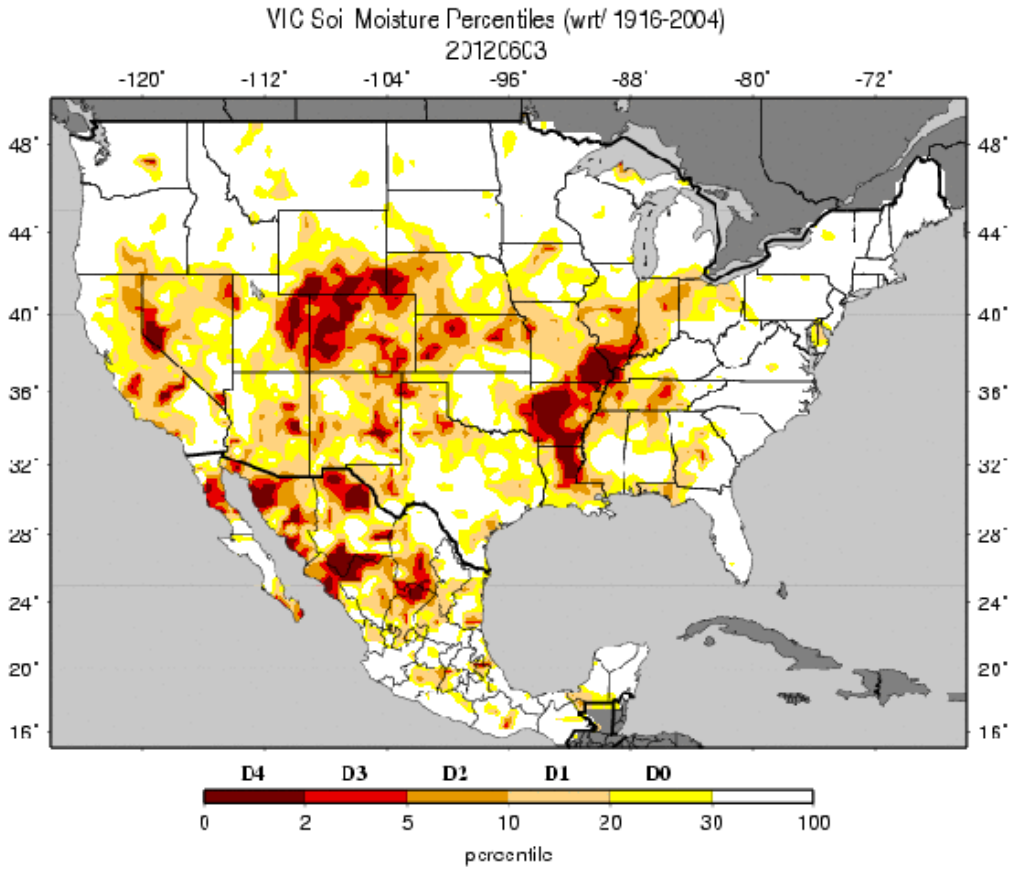


Figure 7. VIC modeled soil moisture percentiles as of May 31, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. Historically, about 25% of annual runoff occurs in March and April due to both melting snowpack and rainfall runoff; however, runoff occurs in March and April whether or not there is any plains snow to melt. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts.

Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

The average mountain snow accumulation in the basin above Fort Peck Dam peaked on April 9, 2012 at 97% of the normal peak mountain snow accumulation that would normally occur on April 15. The peak SWE on April 9, 2012 was 17.4 inches compared to an average peak of 18.0 inches. The average mountain snow accumulation in the reach from Fort Peck Dam to Garrison Dam peaked on March 22, 2012 at 88% of the normal peak that would normally occur on April 15. The peak SWE on March 22, 2012 was 13.8 inches compared to an average peak of 15.6 inches. As of June 1, 2012, mountain snowpack continued to decline in both the Fort Peck and Garrison subbasins. Earlier than normal peak accumulations usually indicate that May-June-July mountain runoff due to snowmelt may be below average unless influenced by much greater than normal rainfall. In addition, earlier than normal peak accumulations cause the peak runoff discharge rate to occur earlier than normal in the runoff season

Table 1. 2012 mountain snowpack accumulation as a percent of normal.

Date	Above Fort Peck	Fort Peck to Garrison
January 1, 2012	79%	96%
February 1, 2012	87%	96%
March 1, 2012	94%	105%
April 1, 2012	97%	86%
Peak Accumulation as a % of the Normal April 15 Peak Accumulation	97% on April 9, 2012	88% on March 22, 2012
May 1, 2012*	72%	66%
June 1, 2012*	37%	35%

* Percent of normal April 15 Peak

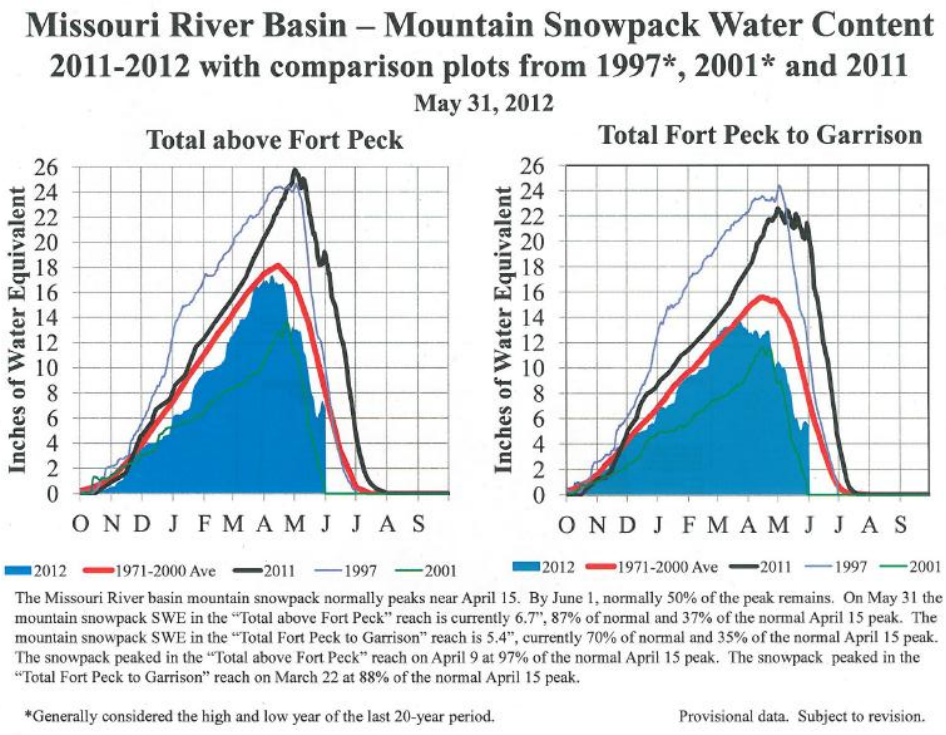


Figure 9. Mountain snowpack water content compared to normal and historic conditions. Corps of Engineers - Missouri River Basin Water Management. The shaded blue area indicates 2012 mountain SWE amounts. The bold black line indicates 2011 mountain SWE amounts.

Drought Analysis

According to the National Drought Mitigation Center (NDMC), Abnormally Dry (D0) conditions cover a region over southeastern Montana, eastern Wyoming, the western Dakotas and western Nebraska. Moderate Drought (D1) conditions are impacting an area within this region (see Figure 10). The NDMC drought outlook (Figure 11) which extends through August 31, 2012 is forecasting improvement in western South Dakotas and northwest Iowa, with some improvement in western Nebraska.

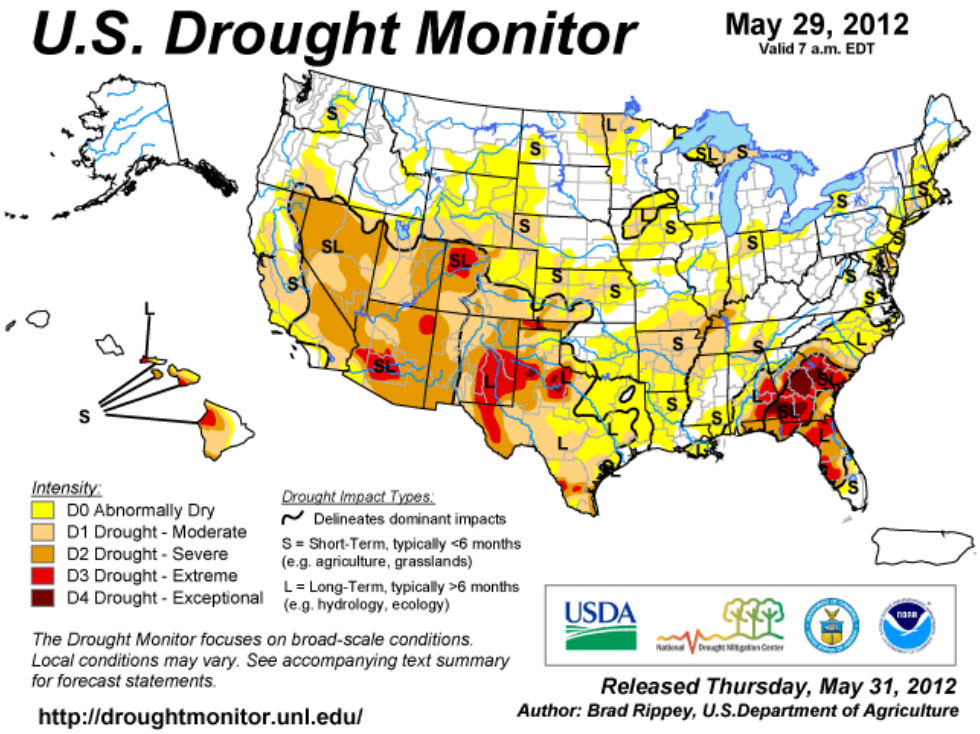


Figure 60. National Drought Mitigation Center U.S. Drought Monitors for May 1, 2012.

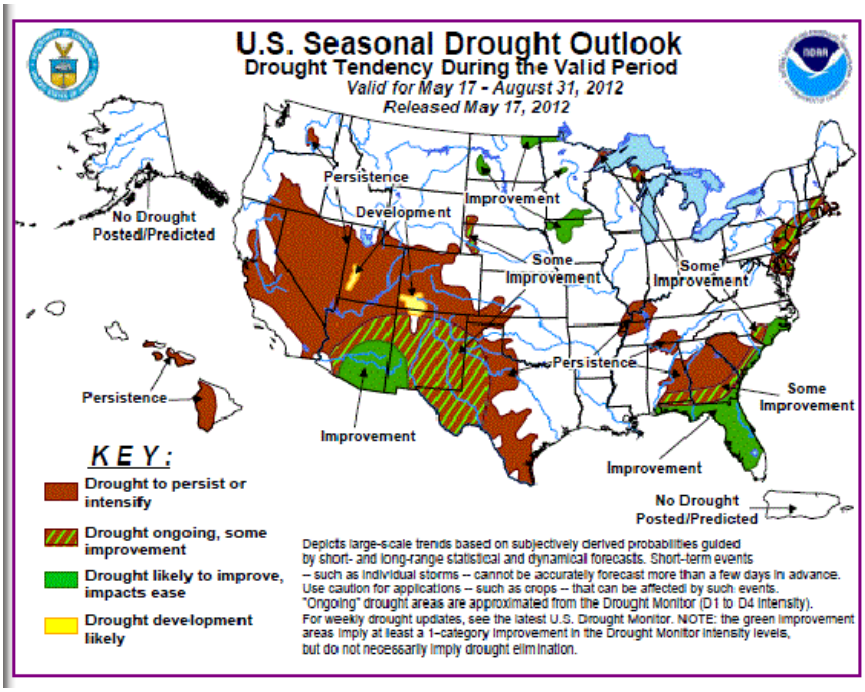


Figure 7. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 3 May to 31 July 2012.

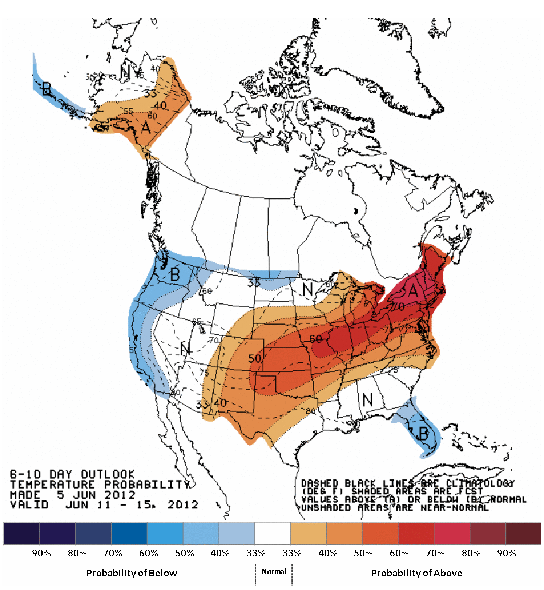
Climate Outlook

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions continuing through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

The 6-10 Day (Figure 13) and 8-14 Day (Figure 14) Outlooks indicate that temperatures are very likely to be above normal in the northern Rocky Mountains and northern Plains through May 15. With regard to precipitation, there will be increased probabilities for below normal precipitation in the northern Rockies while there are increased probabilities for above normal precipitation in the central Plains and Midwest through May 11. During the 8-14 day period ending May 15, the precipitation probability is forecast to be below normal over a larger expanse of the northern Plains, with equal chances across Wyoming and Nebraska.

For temperature the May outlook (Figure 15) indicates equal chances for above, below and normal temperatures in Montana and North Dakota, while there are increased chances for above normal temperatures throughout the remainder of the Missouri River Basin. For precipitation (Figure 15) the May outlook indicates equal chances for above, below and normal precipitation in all areas of the basin with the exception of an increased likelihood of below normal precipitation in Wyoming and southwest Montana. The 3-month or May-June-July outlooks (Figure 16) call for increased chances of below normal temperatures in Montana, western North Dakota and northern Wyoming, with Equal Chances for the remainder of the upper basin. Precipitation chances favor below normal precipitation in Montana and Wyoming, while there are Equal Chances in the remainder of the basin.

Longer term CPC outlooks indicate there is an increased probability for above normal temperatures especially in the fall and winter in the western U.S. affecting the Rocky Mountains and bordering high plains regions (Figure 17 & 18). There are equal chances for precipitation throughout most of the basin with the exception of western Montana in August-September-October 2012 (Figure 17). In November-December-January, there is an equal chance for above, below and normal precipitation (Figure 18).



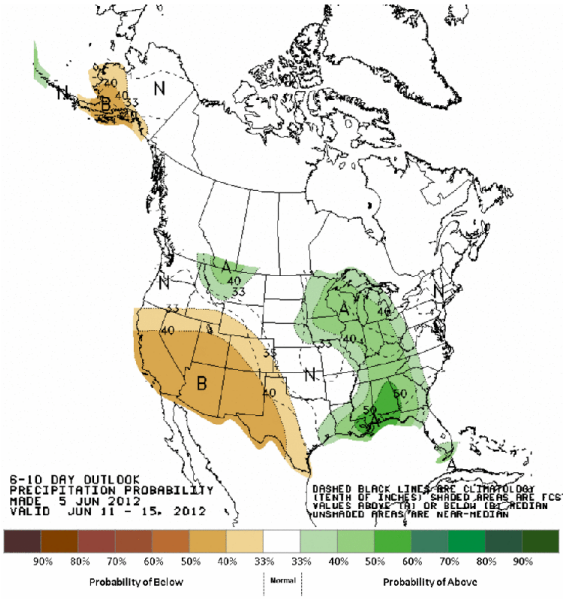
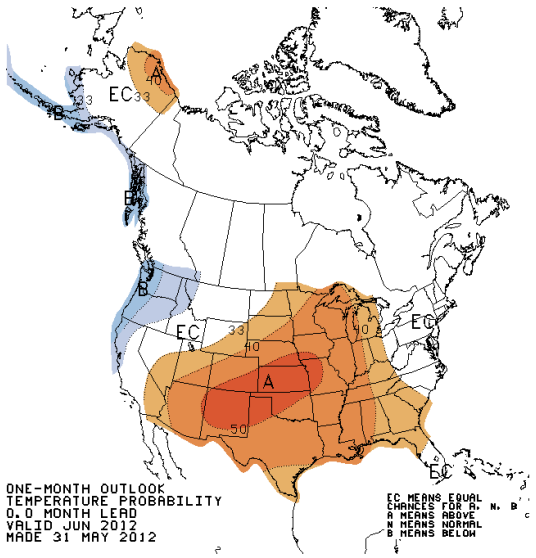


Figure 8. CPC 6-10 day temperature and precipitation outlooks.



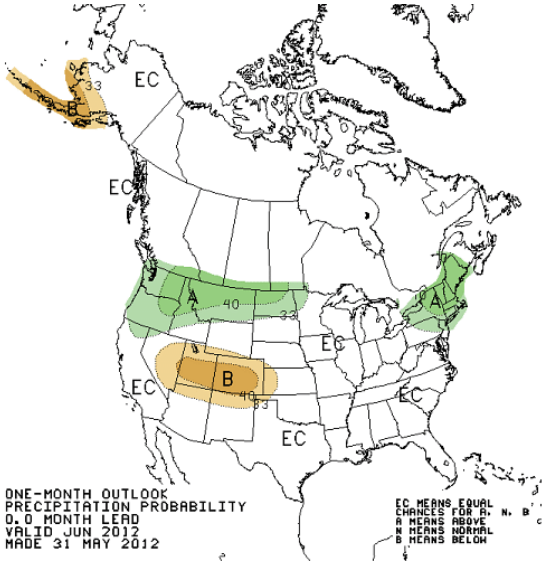


Figure 9. CPC June 2012 temperature and precipitation outlooks.

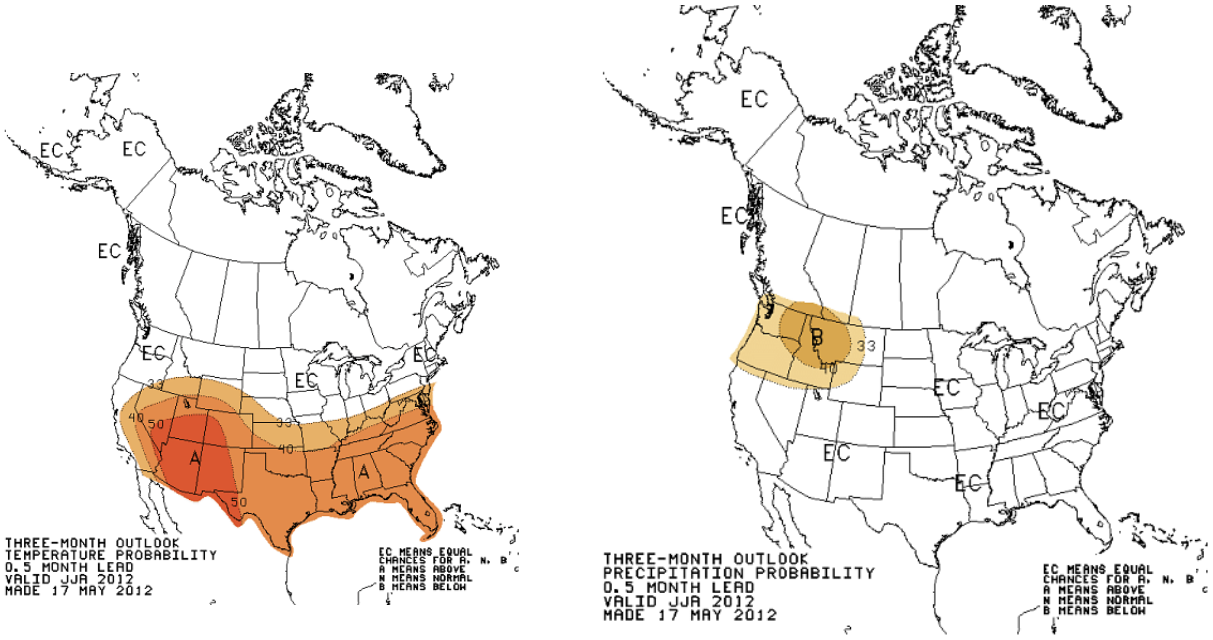


Figure 15. CPC June-July-August 2012 temperature and precipitation outlook.

June 2012 Calendar Year Runoff Forecast

As stated earlier in this report the June 1 runoff forecast above Sioux City, IA is **22.6 MAF** (89% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is a slight increase from the May 1 forecast due to higher than normal runoff in May between Gavins Point Dam and Sioux City. Actual May 2012 Missouri River runoff was 3.3 MAF (102% of normal) above Sioux City, and 2.7 MAF (92% of normal) above Gavins Point. The end of May calendar year accumulation above Sioux City is 92% of normal or 10.0 MAF. Due to the amount of variability in precipitation that can occur over the next 7 months, the range of expected inflow is quite large and ranges from the 26.9 MAF upper basic forecast to the 18.4 MAF lower basic forecast.

June-July-August

During the May-June-July period, the mainstem system normally receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River basin, so runoff can vary significantly as a result of the above or below normal rainfall. The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total average annual runoff into the system.

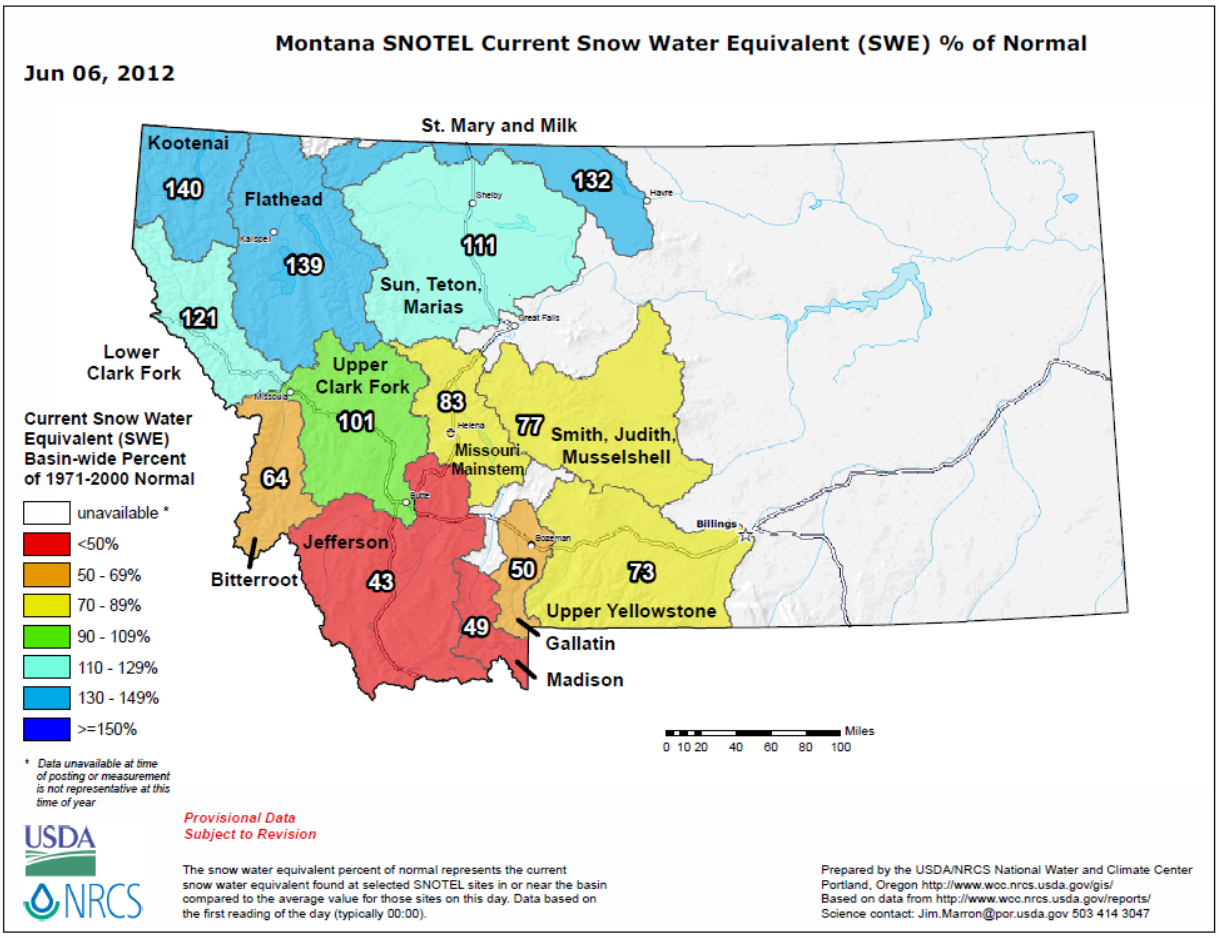
For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Existing mountain snowpack peaked at 97% of normal in the reach above Fort Peck on April 9 and 88% of normal in the reach between Fort Peck and Garrison on March 22. Since then, mountain snowpack has been steadily melting, and on June 1, it was 87% of the normal June 1 level above Fort Peck, and it was 70% of the normal June 1 level in the Fort Peck to Garrison reach. Soil moisture conditions in the mountain basins are above normal due to early season snowmelt. The chance for precipitation is forecast to be below normal through July and there is a greater probability for below normal temperatures. As a result runoff is forecast to be 3219 kaf (92% of normal) above Fort Peck and 4413 kaf (78% of normal) from Fort Peck to Garrison. Since mountain snowpack peaked much earlier than normal, the peak of the mountain snowmelt runoff is forecast to occur earlier than normal, placing some additional water in May.

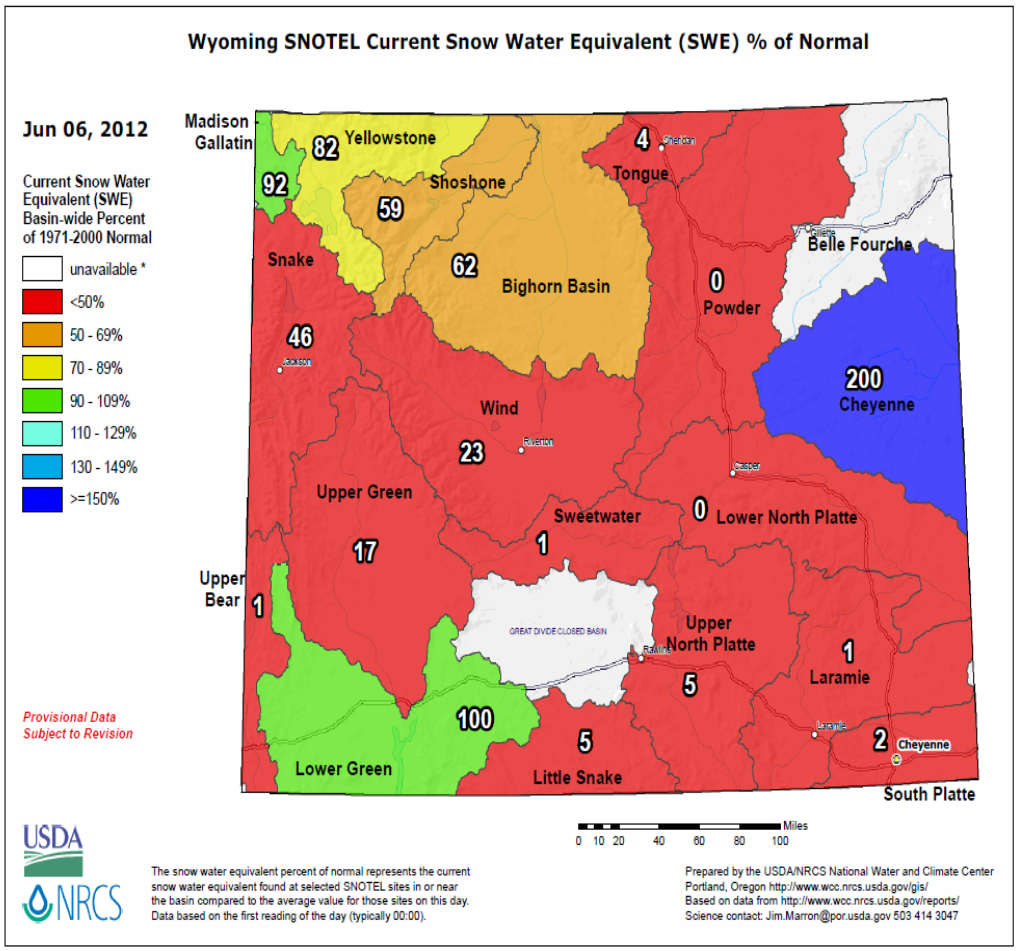
Following below-normal runoff in March and April, runoff in June and July is also expected to be below normal in the Oahe, Fort Randall, and Gavins Point reaches. Above average runoff is expected for June in the Sioux City reach. Drought conditions as defined by the National Drought Mitigation Center continue to impact the Dakotas, Wyoming, and Nebraska.

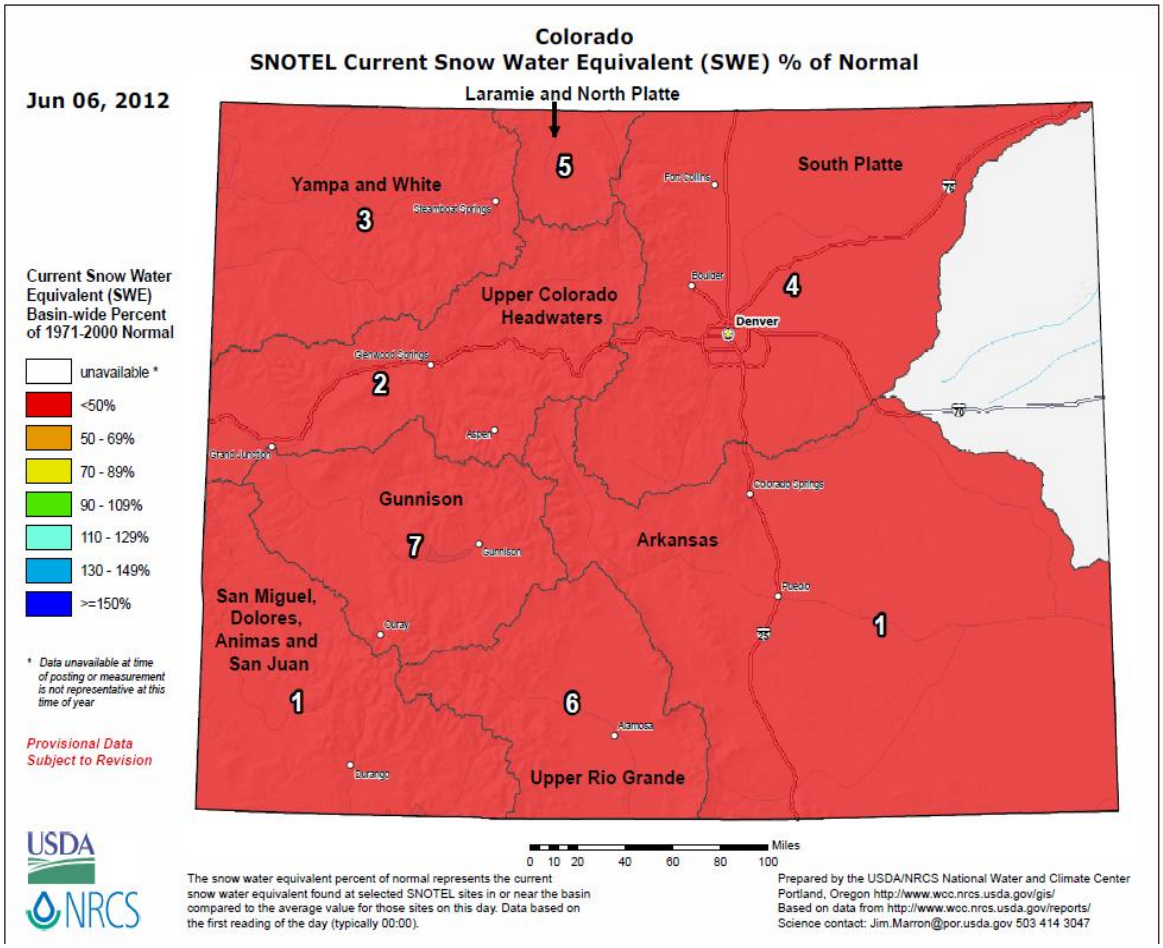
August through December

During the August through December period, runoff is forecast to be slightly below normal in all reaches from above Fort Peck to Gavins Point, primarily due to the increased chances for above normal temperatures during the fall. As the year progresses and the August through December precipitation and temperature outlooks are updated with more detail, these values may change.

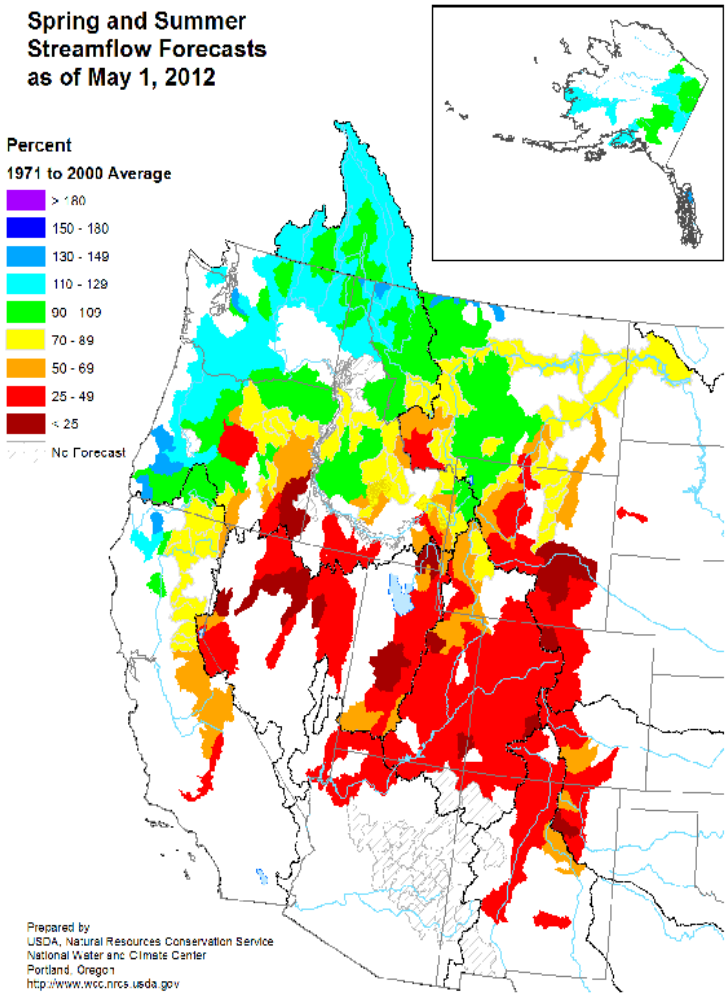
Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Jun 06, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Madison Gallatin
82
Yellowstone
92
Shoshone
59
4
Tongue
Sheridan
Snake
62
Bighorn Basin
Belle Fourche
Gillette
0
Powder
46
Jackson
200
Cheyenne
Wind
23
Riverton
Casper
Upper Green
Sweetwater
0
Lower North Platte
17
1
Upper Bear
1
GREAT DIVIDE CLOSED BASIN
Upper North Platte
Rawlins
1
Laramie
5
100
5
Laramie
2
Cheyenne
Lower Green
Little Snake
South Platte
Miles
0 10 20 40 60 80 100
USDA
NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047


Colorado
SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Jun 06, 2012
Laramie and North Platte
5
Yampa and White
3
Steamboat Springs
Fort Collins
South Platte
Boulder
4
Upper Colorado Headwaters
Denver
Glenwood Springs
2
Aspen
Grand Junction
Colorado Springs
Gunnison
7
Gunnison
Arkansas
Pueblo
San Miguel, Dolores, Animas and San Juan
Ouray
1
1
6
Alamosa
Durango
Upper Rio Grande
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
* Data unavailable at time of posting or measurement is not representative at this time of year
Provisional Data Subject to Revision
0 10 20 40 60 80 100
Miles
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

NRCS Water Supply Outlook (June not available)



Upper Missouri River Basin
June 2012 Calendar Year Runoff Forecast
June 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

May 2012 Runoff

May 2012 Missouri River runoff was 3,314 KAF (102% of normal) above Sioux City, and 2,726 KAF (92% of normal) above Gavins Point. In January and February very warm temperatures caused a premature ice breakup on rivers and tributaries, and soil frost thawed earlier than usual allowing more runoff to occur in January and February than would normally occur during a year with normal temperatures. As a result, March runoff did not benefit from the spring thaw. In March, record high temperatures across the upper basin melted the very light plains snowpack early in March. Although May precipitation was above normal in many areas, very dry soil moisture conditions absorbed most rainfall resulting in lower than normal runoff in the upper basin. The exceptions were the Fort Peck and Gavins Point reaches where abundant rainfall caused above normal runoff.

2012 Calendar Year Forecast Synopsis

The June 1 runoff forecast above Sioux City, IA is **22.2 MAF** (89% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is an increase from the May 1 forecast due to much higher than normal rainfall in the Gavins Point Dam to Sioux City reach. Due to the amount of variability in precipitation that can occur over the next 7 months, the range of expected inflow is quite large and ranges from the 26.9 MAF upper basic forecast to the 18.4 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given much wetter conditions or much drier conditions. The upper and lower basic forecasts are used in long-term

regulation planning models to "bracket" the range of expected runoff given much wetter or drier conditions, respectively. Given that 7 months are being forecasted for this June 1 forecast (5 months observed/7 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 7 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

ENSO (La Niña)

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions, combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions to continue from April through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

Precipitation

The June Climate Prediction Center (CPC) precipitation outlook called for equal chances of precipitation in all of the upper Missouri River basin above Sioux City except for Montana and North Dakota. Actual precipitation during May 2012 was over 200% of normal in north-central Montana and greater than 300% in localized areas, while in the mountains of Montana, precipitation varied from about 50 to 125% of normal (Figure 1). Precipitation in Wyoming was predominantly less than 75% of normal. Precipitation in the Dakotas and Nebraska ranged from less than 50% of normal to greater than 300%. The greater than 300% of normal rainfall in southwest-Minnesota/northwest-Iowa was produced by moderate to heavy rain that occurred from May 23-28 in the eastern Dakotas and southwestern Minnesota. Resultant end-of-month rainfall totals are shown in Figure 2. Even with much of the upper basin receiving above normal precipitation, runoff in May was below normal due to the lack of plains snowpack, warmer than normal temperatures during the winter and early spring and much drier than normal soil conditions

Over the 90-day period (March-April-May) shown in Figure 3, greater than normal precipitation in the areas of the Missouri River basin has occurred primarily as a result of above normal April and May rainfall in these same areas. The northern half of Montana has received greater than 200% of normal precipitation since March 1, 2012, while precipitation accumulations in the eastern Dakotas and the lower basin below Sioux City now ranges from normal to above normal with widely scattered areas of below normal precipitation.

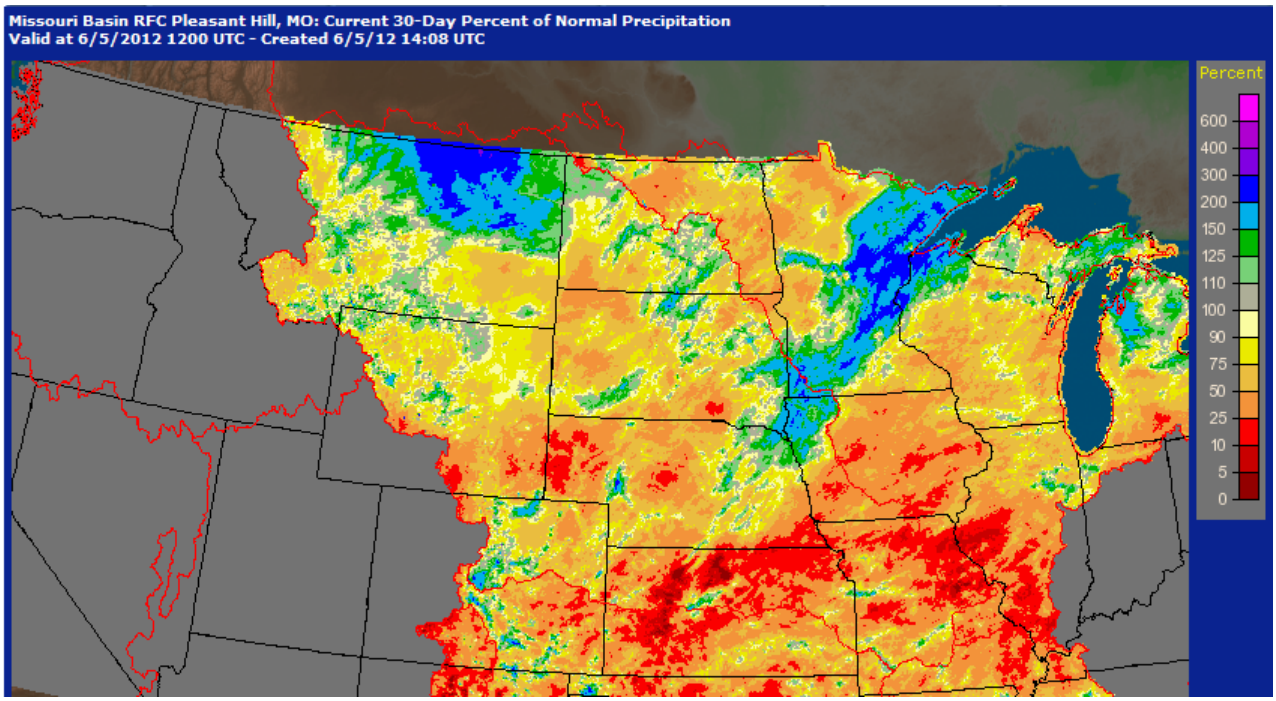


Figure 1. May 2012 Percent of Normal Precipitation. Source: National Weather Service.

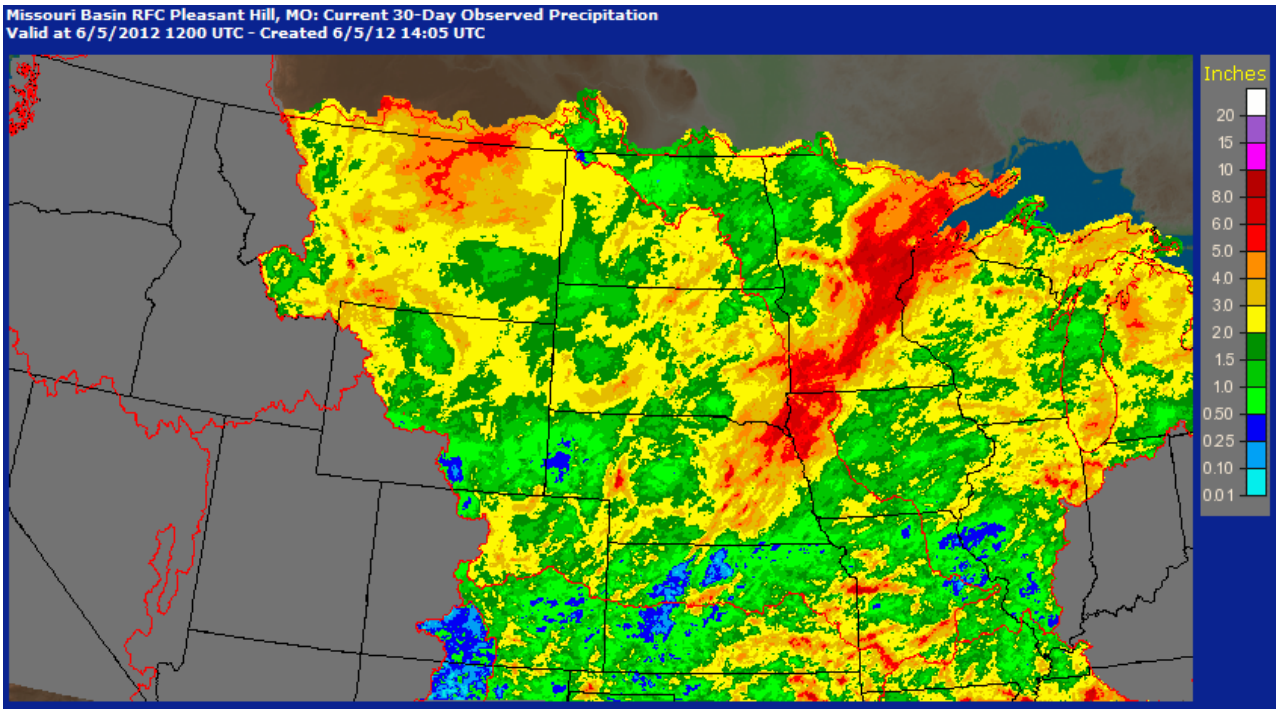


Figure 2. May 2012 Accumulated Precipitation (inches). Source: National Weather Service.

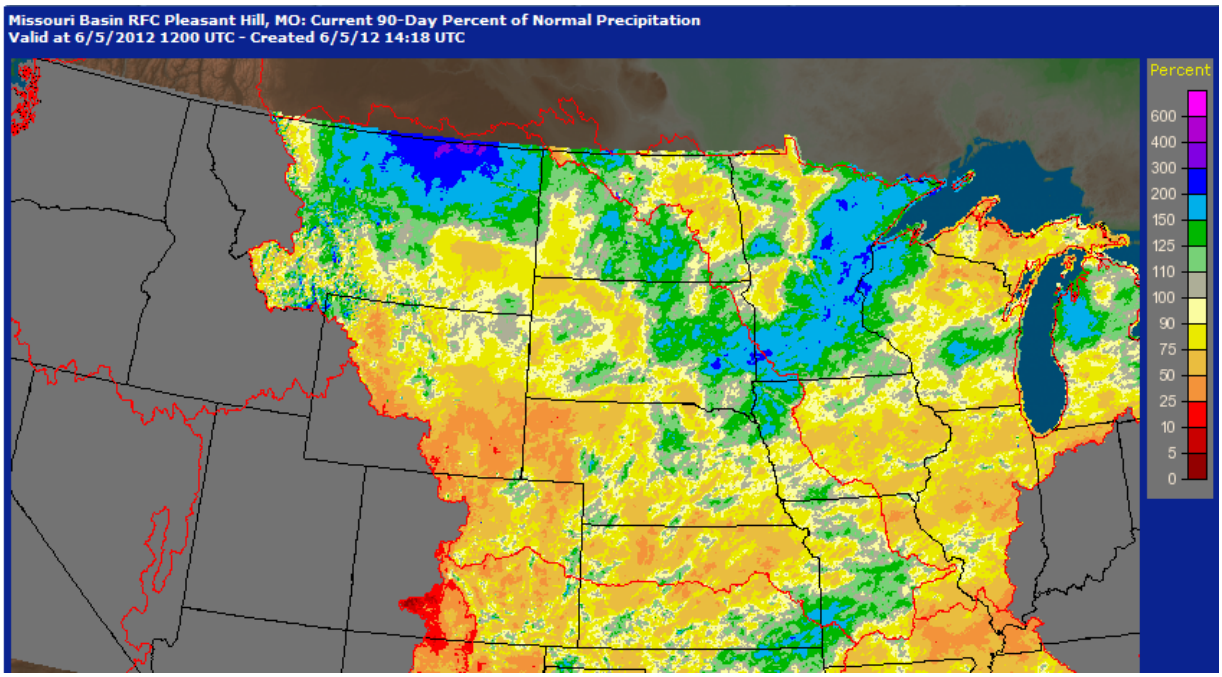


Figure 3. March-April-May 2012 Percent of Normal Precipitation. Source: National Weather Service.

Please refer to the January, February, March, April, and May Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

The June (CPC) temperature outlook called for an increased probability for above normal temperatures across most of the Missouri River basin with the exception of Montana and western North Dakota. The June-July-August temperature forecast is essentially equal chances of above normal, below normal, and normal temperatures throughout the basin.

Average temperatures throughout the Missouri River basin were well above normal in May 2012 (Figure 4), except for Montana and western North Dakota which were slightly below normal. These warm temperatures have been a major driving factor that has dried surface soils and reduced the overall upper basin runoff volume to below normal.

Ninety-day (90-day) temperature departures ending on May 30, 2012 are shown in Figure 5. During the time period from March 1, 2012 to May 30, 2012, average daily temperatures ranged from 1 to 6 degrees F above normal in the mountain regions of the upper Missouri River basin, and 3 to 8 degrees F above normal in the plains region of the upper Missouri River basin.

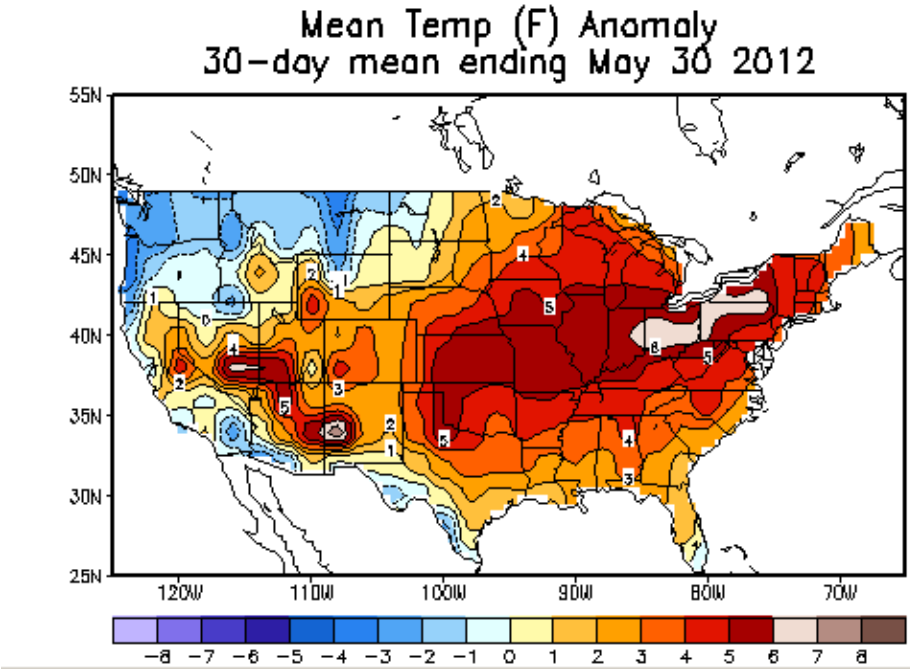


Figure 4. 30-day temperature anomaly (deg F) ending 30 May 2012.

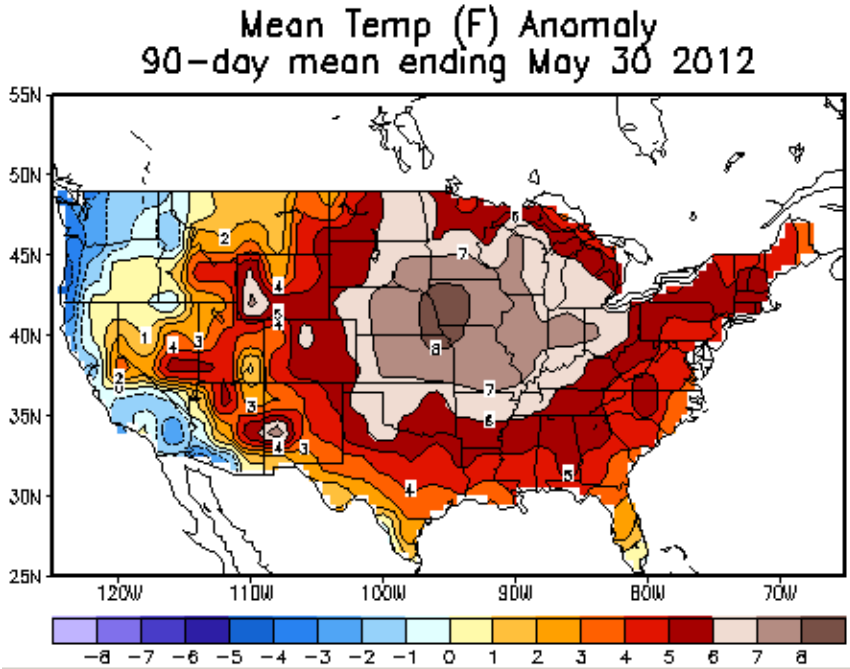


Figure 5. 90-day temperature anomaly (deg F) ending 30 Apr 2012.

Soil Moisture Conditions

Two independent assessments of soil moisture are provided below which include the CPC soil moisture percentile ranking (Figure 6) and the Variable Infiltration Capacity (VIC) soil moisture percentile ranking (Figure 8). The CPC soil moisture percentile ranking (Figure 6) continues to show below normal soil moisture in northeast Nebraska, northwest Iowa and southeast South Dakota. Additional areas of below normal soil moisture include eastern Wyoming, northwest Nebraska and southwest South Dakota. The CPC map also shows wet to very wet soils in the northern Rocky Mountains with percentile rankings ranging from the 70 to 99th percentile. These conditions have developed due to earlier than normal mountain snowpack and precipitation. The VIC model (Figure 7) shows the same dry areas in South Dakota, Nebraska and Iowa with additional areas of below normal soil moisture in North Dakota, and northern and southern Wyoming. The VIC model does not show the wet soils in western Montana to the same aerial extent as the CPC soil moisture map; however, it does show isolated areas of very wet soils greater than the 98th percentile ranking in central and western Montana, and the upper Yellowstone River basin. In summary, the two soil moisture assessments indicate wetter than normal conditions and in some cases much wetter than normal soil in Montana and the Yellowstone headwaters in Wyoming, and drier than normal soil conditions in the plains.

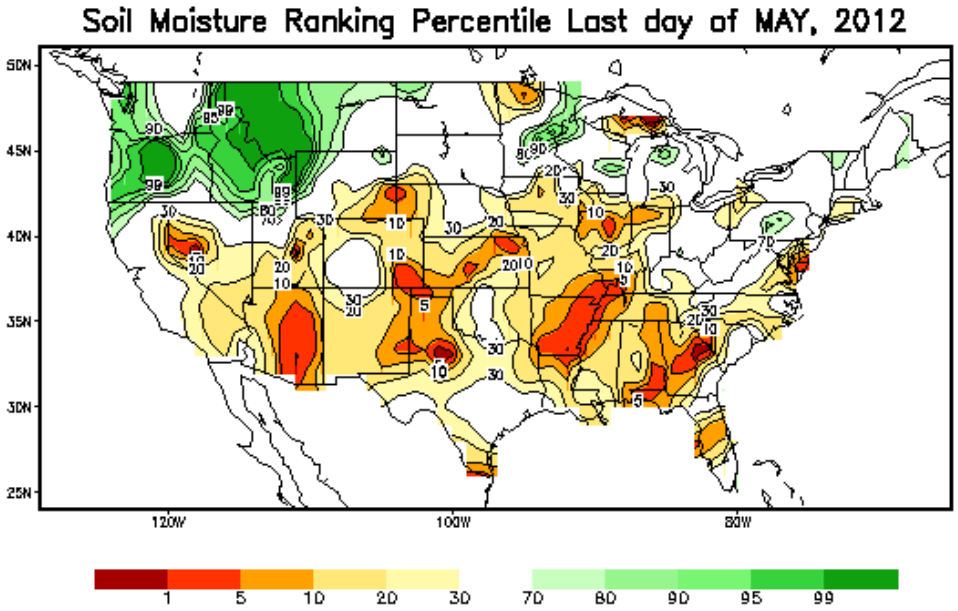


Figure 6. Calculated Soil Moisture Ranking Percentile on the last day of May 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

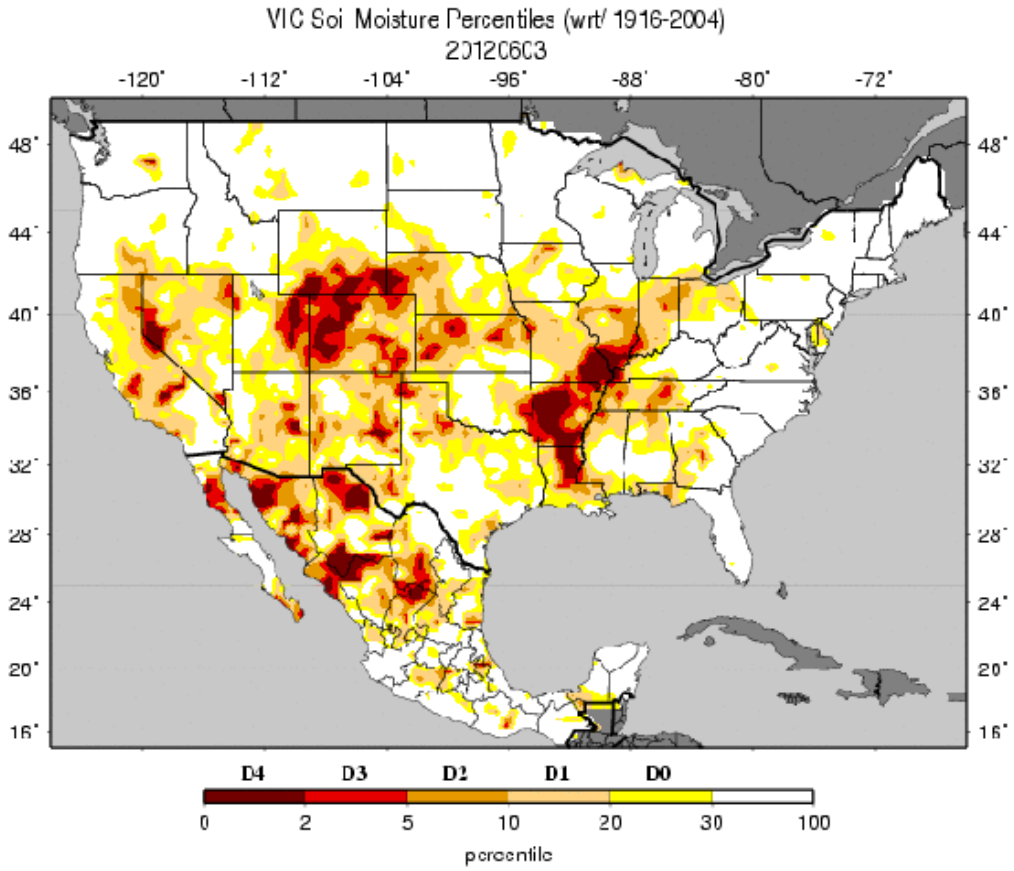


Figure 7. VIC modeled soil moisture percentiles as of May 31, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. Historically, about 25% of annual runoff occurs in March and April due to both melting snowpack and rainfall runoff; however, runoff occurs in March and April whether or not there is any plains snow to melt. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts.

Mountain Snowpack

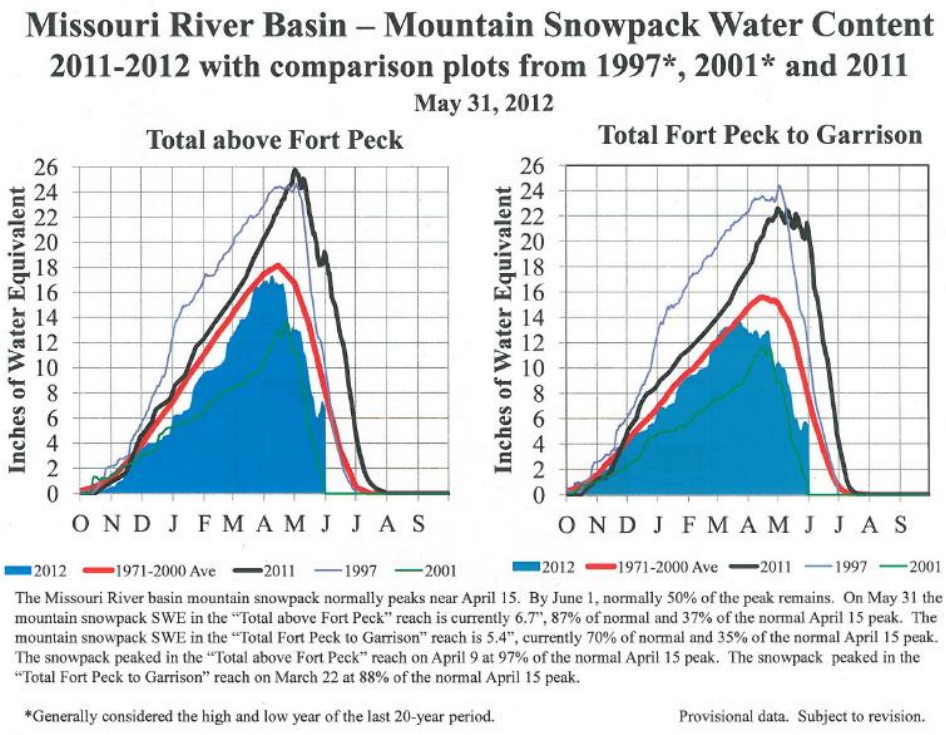
Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

The average mountain snow accumulation in the basin above Fort Peck Dam peaked on April 9, 2012 at 97% of the normal peak mountain snow accumulation that would normally occur on April 15. The peak SWE on April 9, 2012 was 17.4 inches compared to an average peak of 18.0 inches. The average mountain snow accumulation in the reach from Fort Peck Dam to Garrison Dam peaked on March 22, 2012 at 88% of the normal peak that would normally occur on April 15. The peak SWE on March 22, 2012 was 13.8 inches compared to an average peak of 15.6 inches. As of June 1, 2012, mountain snowpack continued to decline in both the Fort Peck and Garrison subbasins. Earlier than normal peak accumulations usually indicate that May-June-July mountain runoff due to snowmelt may be below average unless influenced by much greater than normal rainfall. In addition, earlier than normal peak accumulations cause the peak runoff discharge rate to occur earlier than normal in the runoff season

Table 1. 2012 mountain snowpack accumulation as a percent of normal.

Date	Above Fort Peck	Fort Peck to Garrison
January 1, 2012	79%	96%
February 1, 2012	87%	96%
March 1, 2012	94%	105%
April 1, 2012	97%	86%
Peak Accumulation as a % of the Normal April 15 Peak Accumulation	97% on April 9, 2012	88% on March 22, 2012
May 1, 2012*	72%	66%
June 1, 2012*	37%	35%

* Percent of normal April 15 Peak



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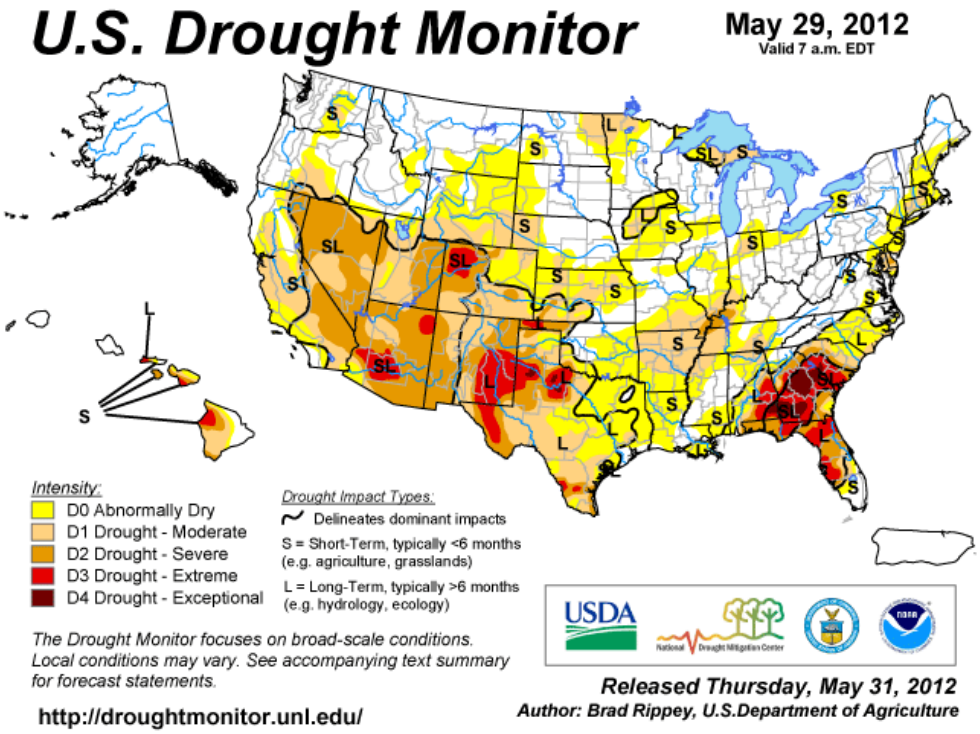
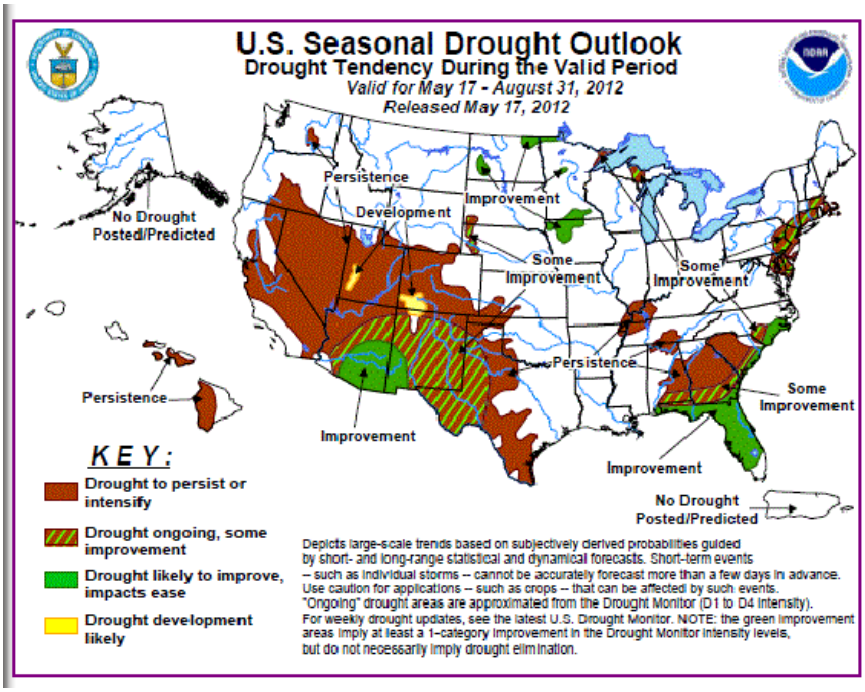


Figure 60. National Drought Mitigation Center U.S. Drought Monitors for May 1, 2012.



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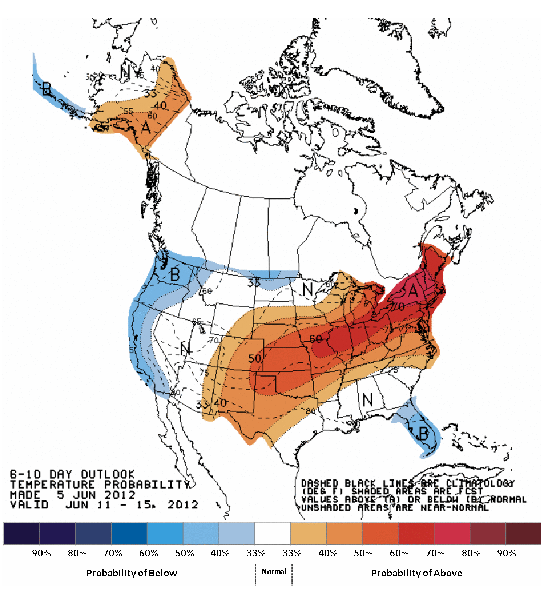
Climate Outlook

La Niña dissipated during April 2012 with the weakening of below-average sea surface temperatures in the equatorial Pacific and the continuation of above-average sea surface temperatures in the eastern Pacific. The official CPC forecast states that current and evolving conditions combined with model forecasts suggest that La Niña is unlikely to re-develop later in 2012, with models predicting ENSO-neutral conditions continuing through August. During ENSO-neutral conditions, there is not a strong climate signature that would suggest if weather in the Missouri River basin will be wetter or drier than normal and warmer or cooler than normal.

The 6-10 Day (Figure 13) and 8-14 Day (Figure 14) Outlooks indicate that temperatures are very likely to be above normal in the northern Rocky Mountains and northern Plains through May 15. With regard to precipitation, there will be increased probabilities for below normal precipitation in the northern Rockies while there are increased probabilities for above normal precipitation in the central Plains and Midwest through May 11. During the 8-14 day period ending May 15, the precipitation probability is forecast to be below normal over a larger expanse of the northern Plains, with equal chances across Wyoming and Nebraska.

For temperature the May outlook (Figure 15) indicates equal chances for above, below and normal temperatures in Montana and North Dakota, while there are increased chances for above normal temperatures throughout the remainder of the Missouri River Basin. For precipitation (Figure 15) the May outlook indicates equal chances for above, below and normal precipitation in all areas of the basin with the exception of an increased likelihood of below normal precipitation in Wyoming and southwest Montana. The 3-month or May-June-July outlooks (Figure 16) call for increased chances of below normal temperatures in Montana, western North Dakota and northern Wyoming, with Equal Chances for the remainder of the upper basin. Precipitation chances favor below normal precipitation in Montana and Wyoming, while there are Equal Chances in the remainder of the basin.

Longer term CPC outlooks indicate there is an increased probability for above normal temperatures especially in the fall and winter in the western U.S. affecting the Rocky Mountains and bordering high plains regions (Figure 17 & 18). There are equal chances for precipitation throughout most of the basin with the exception of western Montana in August-September-October 2012 (Figure 17). In November-December-January, there is an equal chance for above, below and normal precipitation (Figure 18).



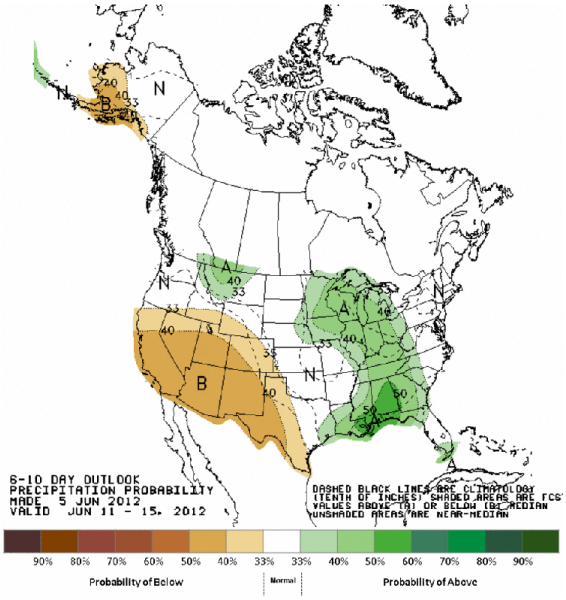
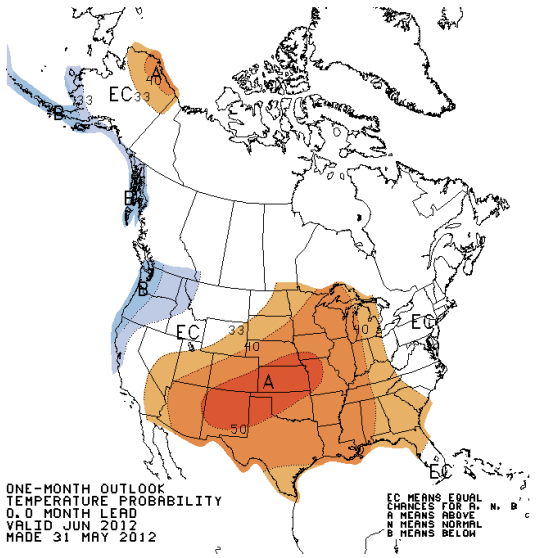


Figure 8. CPC 6-10 day temperature and precipitation outlooks.



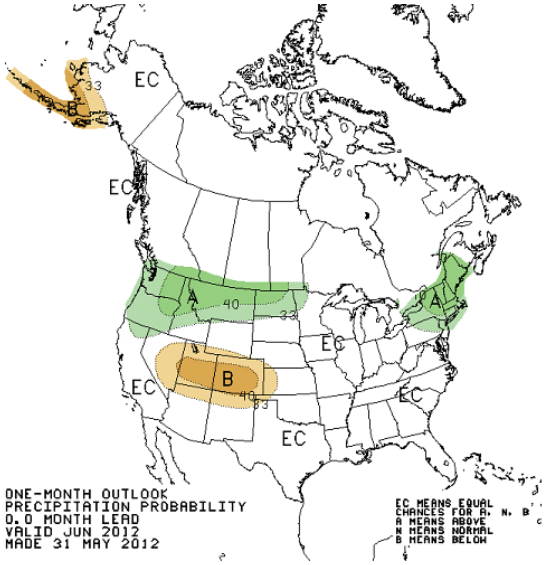


Figure 9. CPC June 2012 temperature and precipitation outlooks.

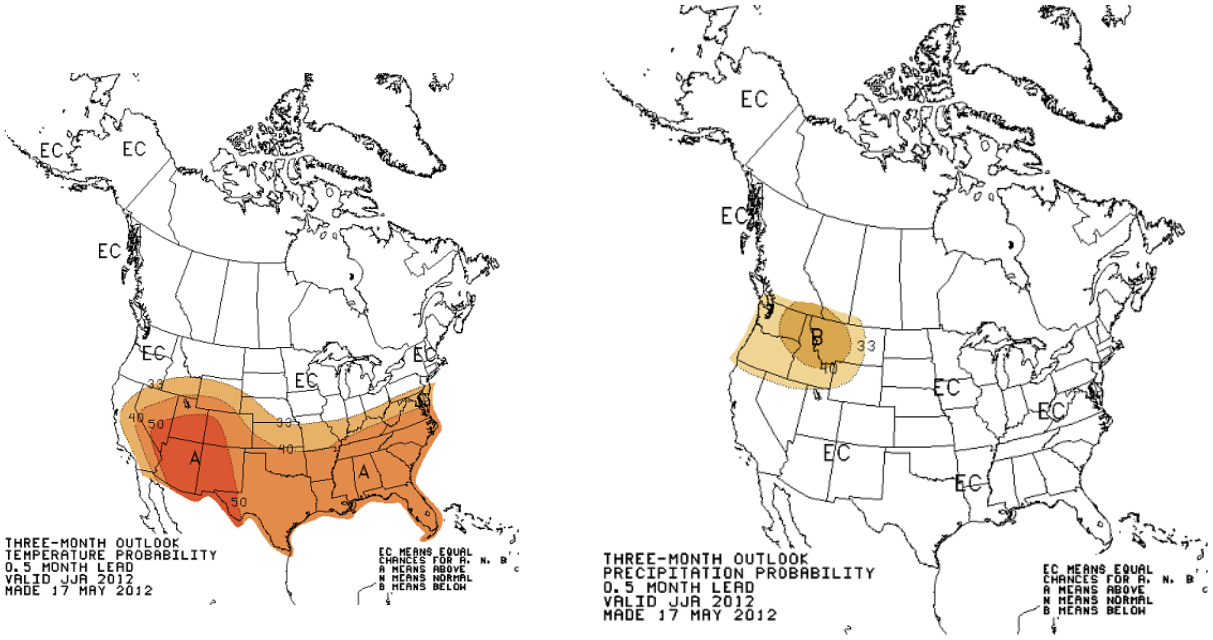


Figure 15. CPC June-July-August 2012 temperature and precipitation outlook.

June 2012 Calendar Year Runoff Forecast

As stated earlier in this report the June 1 runoff forecast above Sioux City, IA is **22.6 MAF** (89% of normal) and **19.6 MAF** (86% of normal) above Gavins Point Dam. This is a slight increase from the May 1 forecast due to higher than normal runoff in May between Gavins Point Dam and Sioux City. Actual May 2012 Missouri River runoff was 3.3 MAF (102% of normal) above Sioux City, and 2.7 MAF (92% of normal) above Gavins Point. The end of May calendar year accumulation above Sioux City is 92% of normal or 10.0 MAF. Due to the amount of variability in precipitation that can occur over the next 7 months, the range of expected inflow is quite large and ranges from the 26.9 MAF upper basic forecast to the 18.4 MAF lower basic forecast.

June-July-August

During the May-June-July period, the mainstem system normally receives 50% of its annual runoff as a result of mountain snowmelt and spring and summer precipitation. This is the most active period for precipitation in the Missouri River basin, so runoff can vary significantly as a result of the above or below normal rainfall. The significance of accurately forecasting the May-June-July runoff for the Fort Peck and Garrison reaches is based on the fact that, historically, an average of 9.2 MAF of runoff occurs during these 3 months into these 2 projects. That is 37% of the total average annual runoff into the system.

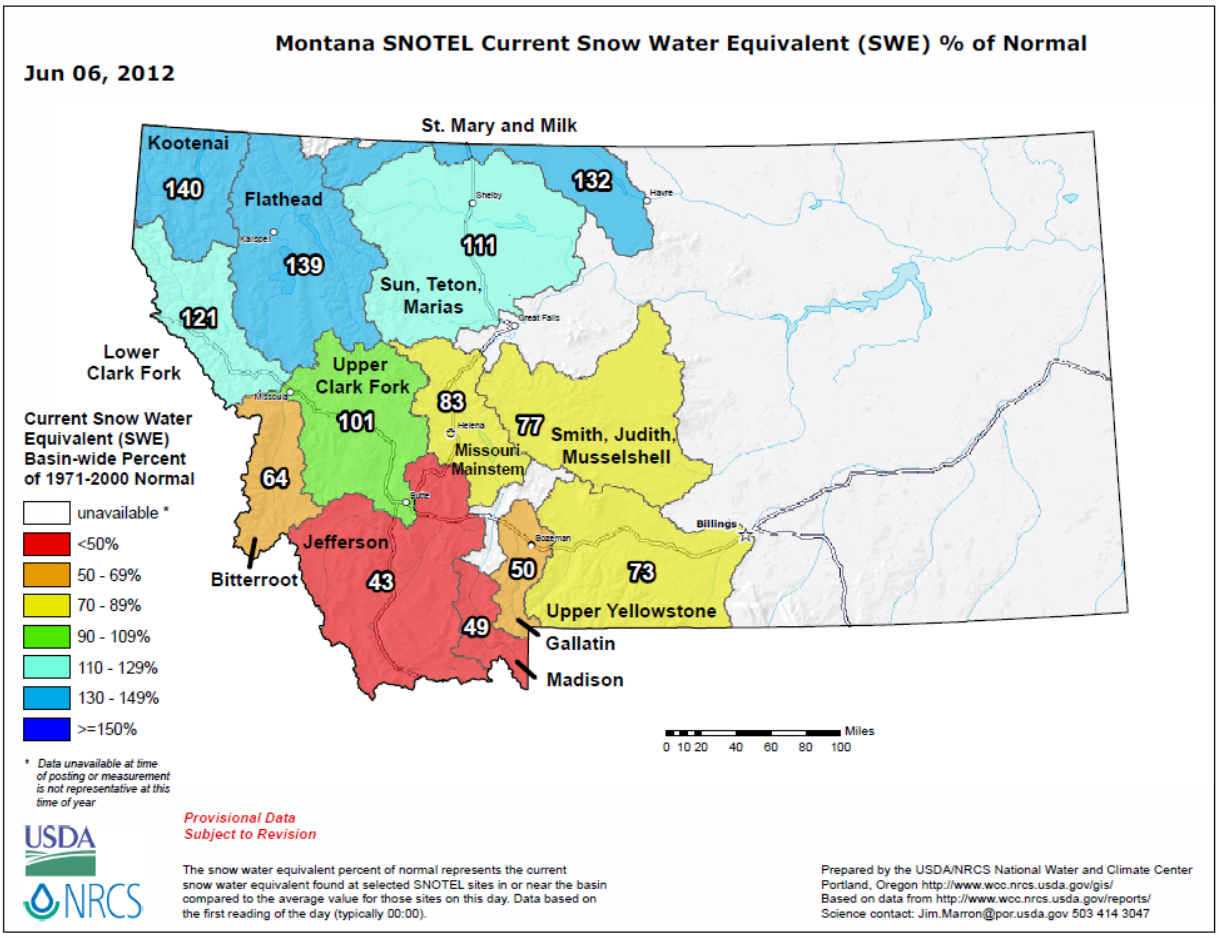
For this 3-month period, the most reliable method for predicting runoff into Fort Peck and Garrison reservoirs is through regression equations that relate mountain snowpack, precipitation, and temperature to runoff. Existing mountain snowpack peaked at 97% of normal in the reach above Fort Peck on April 9 and 88% of normal in the reach between Fort Peck and Garrison on March 22. Since then, mountain snowpack has been steadily melting, and on June 1, it was 87% of the normal June 1 level above Fort Peck, and it was 70% of the normal June 1 level in the Fort Peck to Garrison reach. Soil moisture conditions in the mountain basins are above normal due to early season snowmelt. The chance for precipitation is forecast to be below normal through July and there is a greater probability for below normal temperatures. As a result runoff is forecast to be 3219 kaf (92% of normal) above Fort Peck and 4413 kaf (78% of normal) from Fort Peck to Garrison. Since mountain snowpack peaked much earlier than normal, the peak of the mountain snowmelt runoff is forecast to occur earlier than normal, placing some additional water in May.

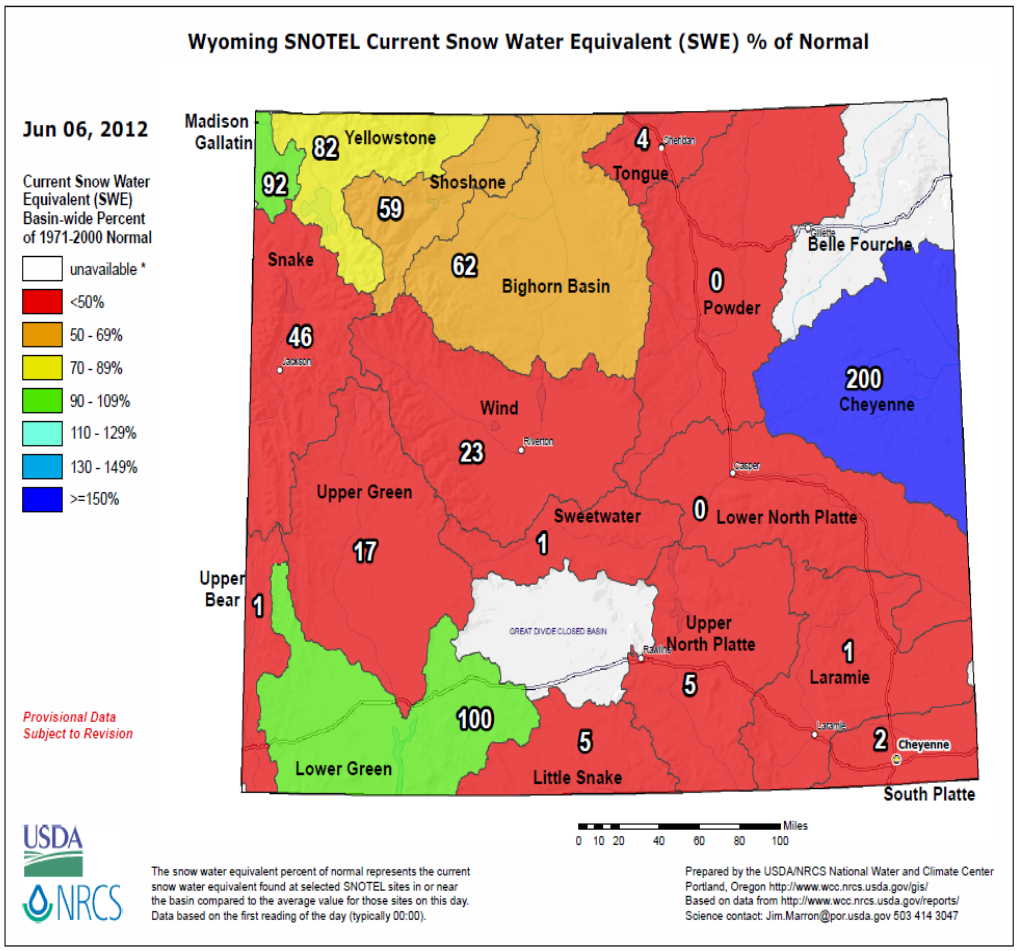
Following below-normal runoff in March and April, runoff in June and July is also expected to be below normal in the Oahe, Fort Randall, and Gavins Point reaches. Above average runoff is expected for June in the Sioux City reach. Drought conditions as defined by the National Drought Mitigation Center continue to impact the Dakotas, Wyoming, and Nebraska.

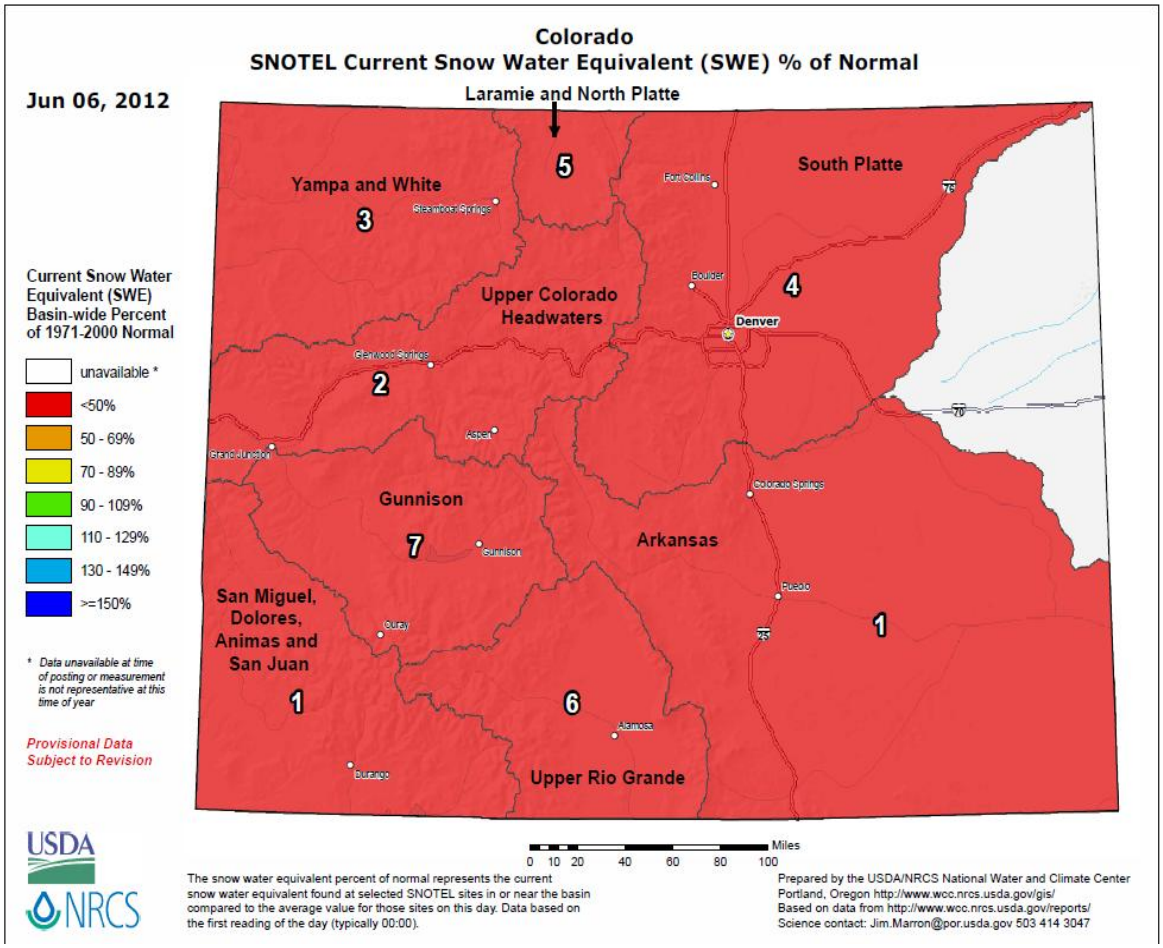
August through December

During the August through December period, runoff is forecast to be slightly below normal in all reaches from above Fort Peck to Gavins Point, primarily due to the increased chances for above normal temperatures during the fall. As the year progresses and the August through December precipitation and temperature outlooks are updated with more detail, these values may change.

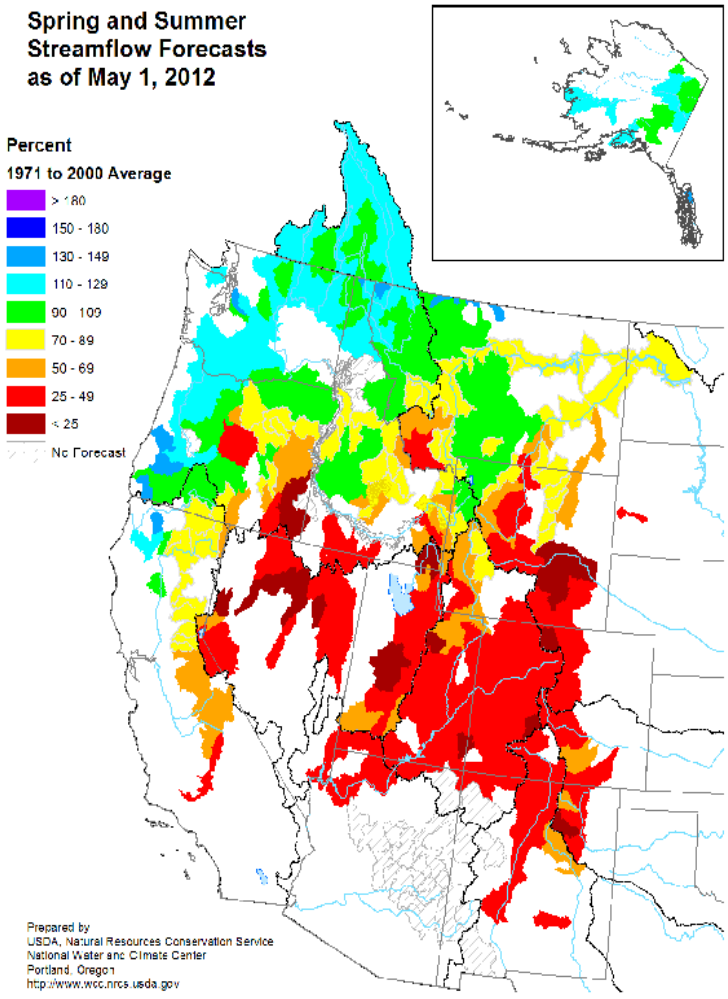
Additional Figures




Wyoming SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Jun 06, 2012
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
Provisional Data Subject to Revision
Madison Gallatin
82
Yellowstone
92
Shoshone
59
4
Tongue
Sheridan
Snake
62
Bighorn Basin
Belle Fourche
Gillette
0
Powder
46
Jackson
200
Cheyenne
Wind
23
Riverton
Casper
Upper Green
Sweetwater
0
Lower North Platte
17
1
Upper Bear
1
GREAT DIVIDE CLOSED BASIN
Upper North Platte
Rawlins
1
Laramie
5
100
5
Laramie
2
Cheyenne
Lower Green
Little Snake
South Platte
Miles
0 10 20 40 60 80 100
USDA
NRCS
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047


Colorado
SNOTEL Current Snow Water Equivalent (SWE) % of Normal
Jun 06, 2012
Laramie and North Platte
5
Yampa and White
3
Steamboat Springs
Fort Collins
South Platte
Boulder
4
Upper Colorado Headwaters
Denver
Glenwood Springs
2
Aspen
Grand Junction
Colorado Springs
Gunnison
7
Gunnison
Arkansas
Pueblo
San Miguel, Dolores, Animas and San Juan
Ouray
1
1
6
Alamosa
Durango
Upper Rio Grande
Current Snow Water Equivalent (SWE) Basin-wide Percent of 1971-2000 Normal
unavailable *
<50%
50 - 69%
70 - 89%
90 - 109%
110 - 129%
130 - 149%
>=150%
* Data unavailable at time of posting or measurement is not representative at this time of year
Provisional Data Subject to Revision
0 10 20 40 60 80 100
Miles
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).
Prepared by the USDA/NRCS National Water and Climate Center
Portland, Oregon http://www.wcc.nrcs.usda.gov/gis/
Based on data from http://www.wcc.nrcs.usda.gov/reports/
Science contact: Jim.Marron@por.usda.gov 503 414 3047

NRCS Water Supply Outlook (June not available)



Upper Missouri River Basin
August 2012 Calendar Year Runoff Forecast
August 1, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

July 2012 Runoff

July 2012 Missouri River runoff was 2,169 KAF (68% of normal) above Sioux City, and 2,079 KAF (70% of normal) above Gavins Point. Runoff in all reaches was below normal with the exception of the Gavins Point reach, which received 111% of normal runoff.

2012 Calendar Year Forecast Synopsis

The August 1 runoff forecast is **21.0 MAF** (85% of normal) above Sioux City, IA, and **18.8 MAF** (83% of normal) above Gavins Point Dam. This is a decrease from the July 1 forecast due to much drier and warmer than normal conditions in the upper Missouri River basin. Due to the amount of variability in precipitation that can occur over the next 5 months, the expected inflow ranges from the 21.9 MAF upper basic forecast to the 20.1 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given wetter or drier conditions. Given that 5 months are being forecasted on August 1 (7 months observed/5 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 5 months. The result is a large range or "bracket" for each reach, and thus, for the total runoff forecast. As the year progresses, the range will lessen as the number of observed months increases and number of forecast months decreases.

Current Conditions

Precipitation

Overall precipitation accumulations during the month of July were well below normal (Figures 1 and 2). All of the lower Missouri River basin received less than 50% of normal precipitation, though a majority of this area received less than 25% of normal precipitation and some areas less than 10% of normal precipitation. A majority of the upper Missouri River basin received below normal precipitation; however, several areas received greater than normal precipitation. Those areas included western and northwest South Dakota, northeast Wyoming, western North Dakota and extreme eastern Nebraska (Figure 2). In these areas precipitation ranged from 150 to 300% of normal.

A similar pattern with departures not as severe has occurred over the 90-day period (May-June-July) shown in Figure 3. A majority of the Missouri River basin has received less than 75% of normal, especially in the lower basin where accumulations are less than 50% of normal. Departures in northern Montana and western North Dakota have been primarily above normal.

Please refer to the January – July Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

Much warmer than normal temperatures have also been a major factor in calendar year runoff forecast. Warm temperatures have accelerated water consumption by plants and dried surfaces soils much more rapidly. Thirty day temperature departures have ranged from 2 to 7 degrees Fahrenheit above normal in all parts of the Missouri River basin. The hottest temperatures have occurred in South Dakota, Iowa, Nebraska and Missouri where temperature have ranged from 6 to 7 degrees Fahrenheit above normal. (Figure 4).

Ninety-day (90-day) temperature departures ending on July 31, 2012 are shown in Figure 5. During this time period including the months of May, June and July, average daily temperatures ranged from -1 to 4 degrees F above normal throughout the Missouri River basin. Temperatures in Montana have ranged from 0 to 2 degrees F above normal.

Soil Moisture Conditions

Two independent assessments of soil moisture are provided below which include the calculated Climate Prediction Center soil moisture anomaly (Figure 6) and percentile ranking (Figure 7) and the Variable Infiltration Capacity (VIC) soil moisture percentile ranking (Figure 8). The CPC calculated soil moisture anomaly (Figure 6) indicates very dry soils in the lower Missouri River basin and moderately dry soils in the upper basin. Soil moisture conditions in central Montana are near normal with slightly wet soils in northwest Montana. According to the calculated soil moisture ranking percentile (Figure 7), soil moisture conditions over a majority of the lower basin rank in the 10^{th} percentile or less. In the upper

basin soil moisture conditions rank in the 10th to 30th percentile with normal to above normal soil moisture conditions in much of Montana. The VIC model soil moisture percentiles show similarly dry soils in the Missouri River basin (Figure 8).

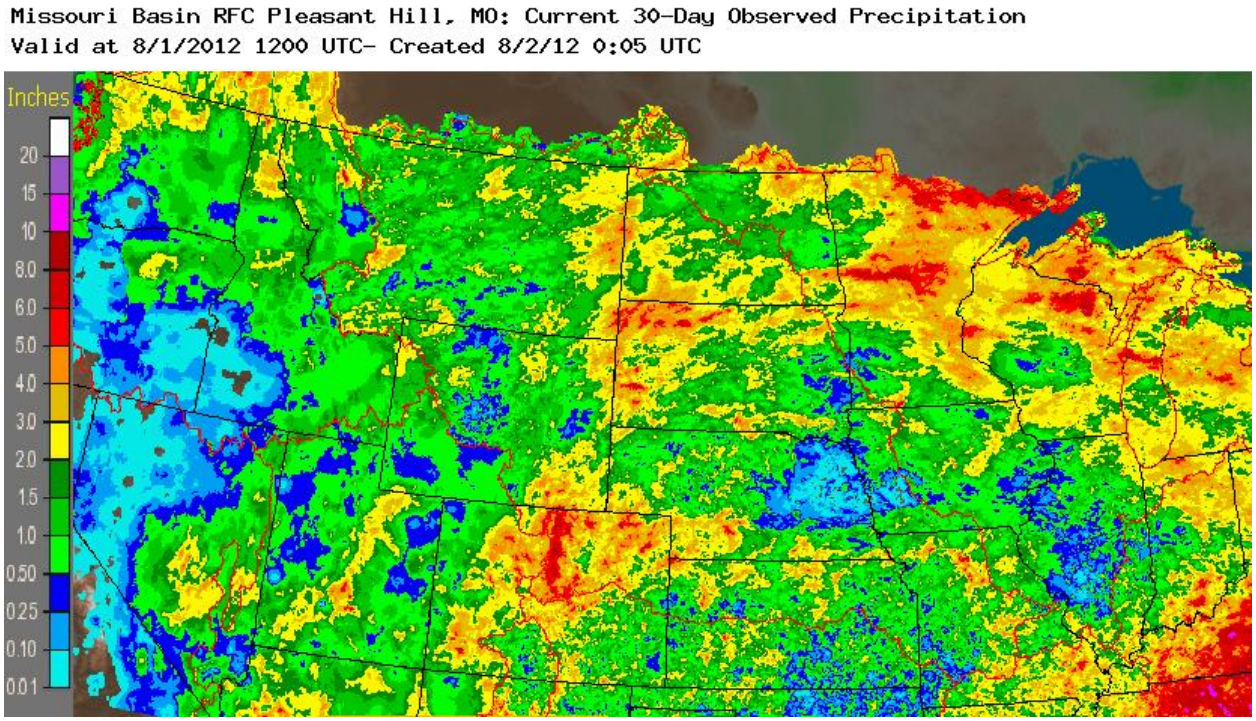


Figure 1. July 2012 Precipitation (inches). Source: National Weather Service.

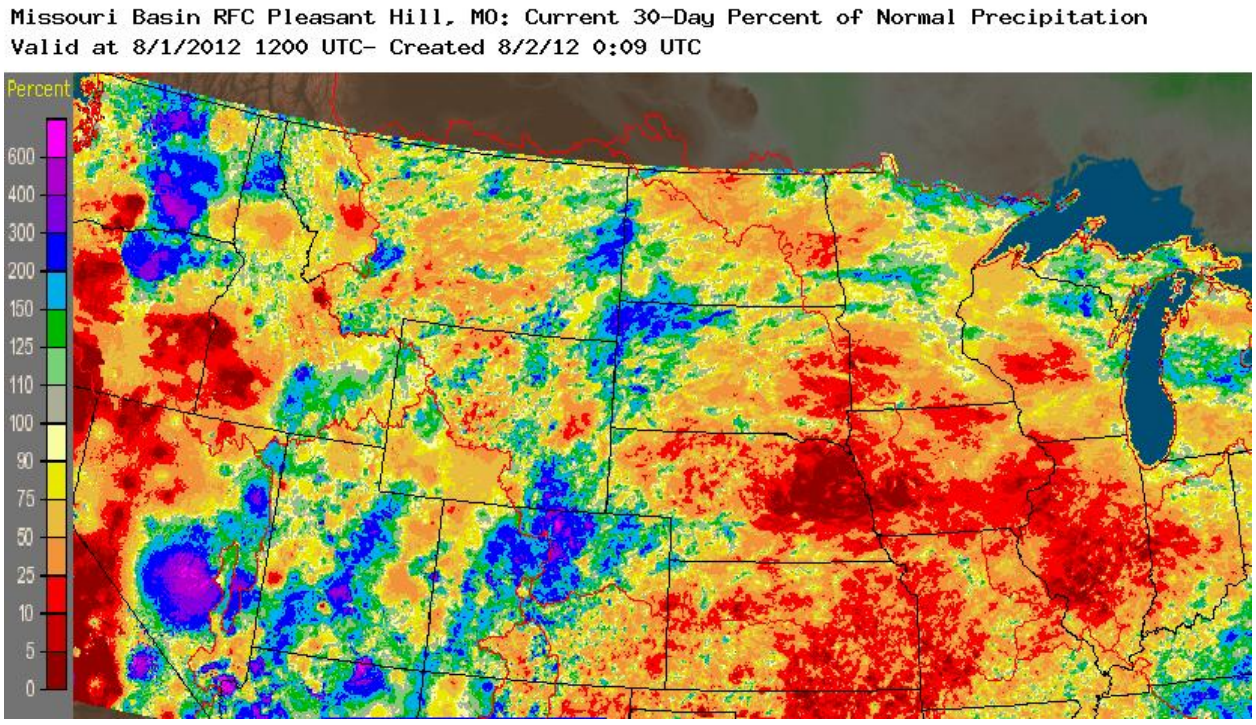


Figure 2. July 2012 Percent of Normal Precipitation. Source: National Weather Service.

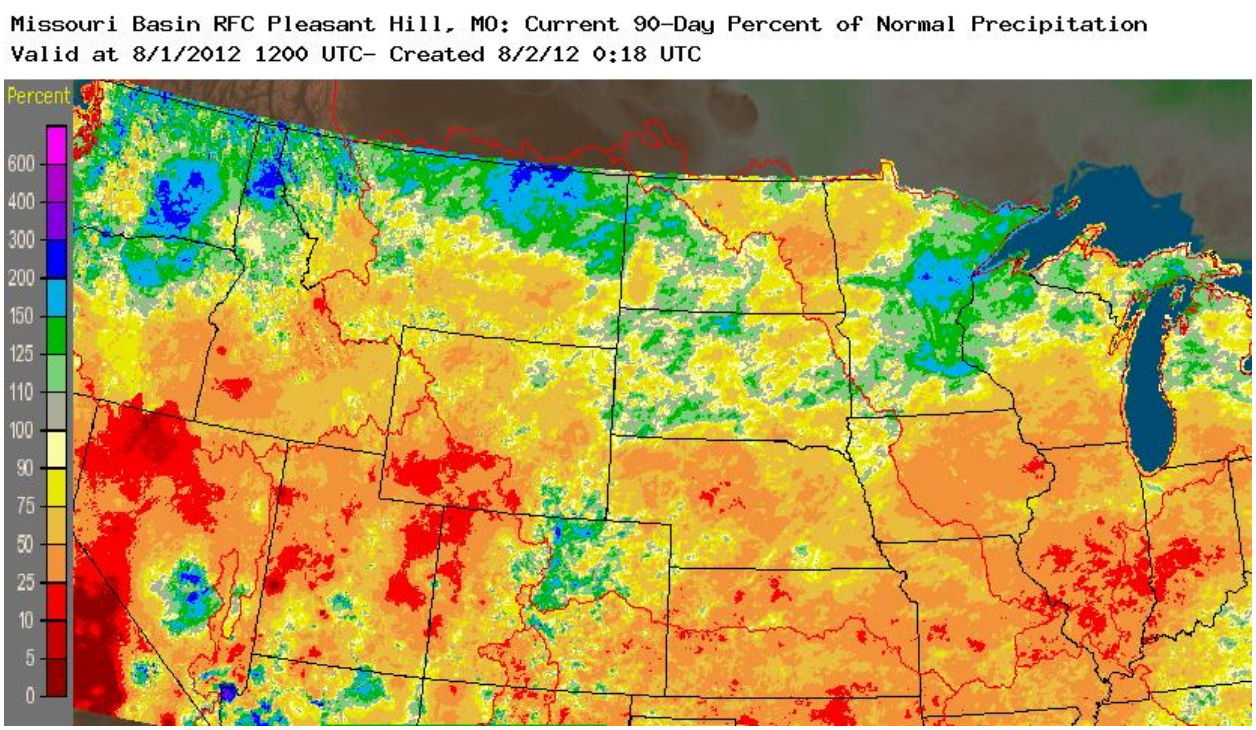


Figure 3. May-June-July 2012 Percent of Normal Precipitation. Source: National Weather Service.

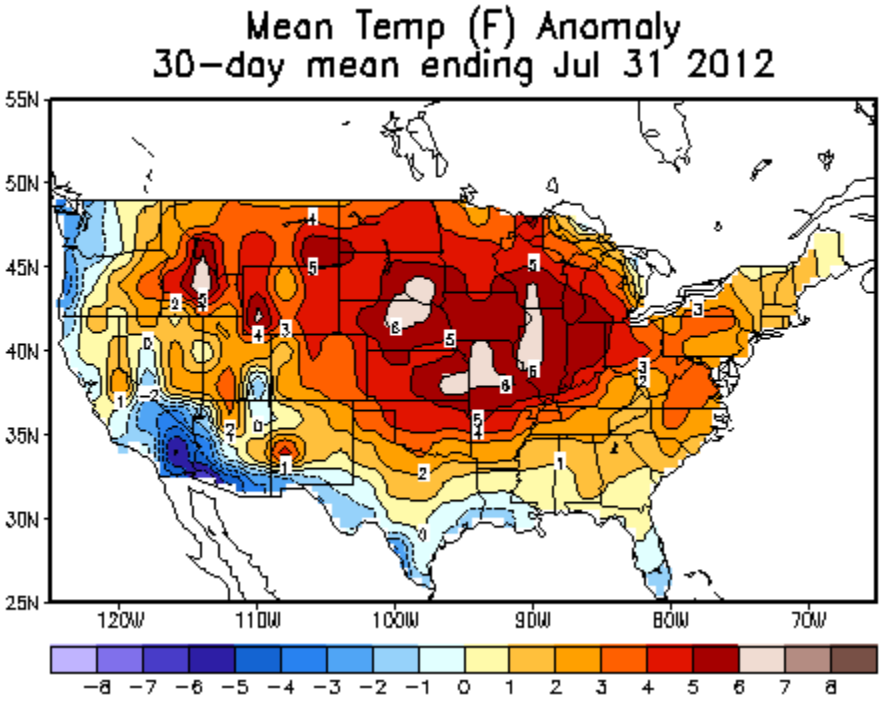


Figure 4. 30-day temperature anomaly (deg F) ending on July 31, 2012.

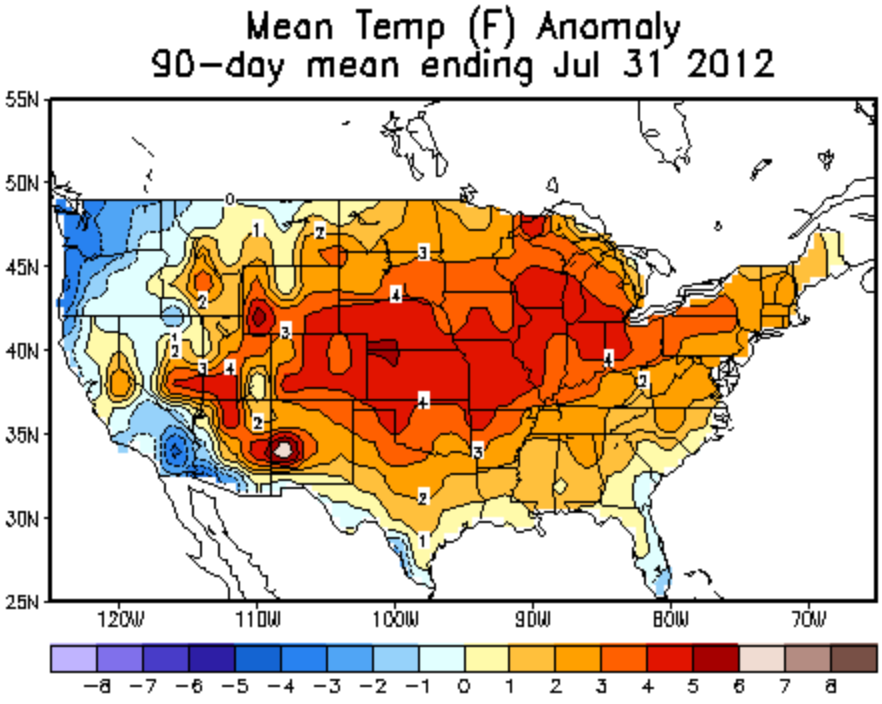


Figure 5. 90-day temperature anomaly (deg F) ending on July 31, 2012.

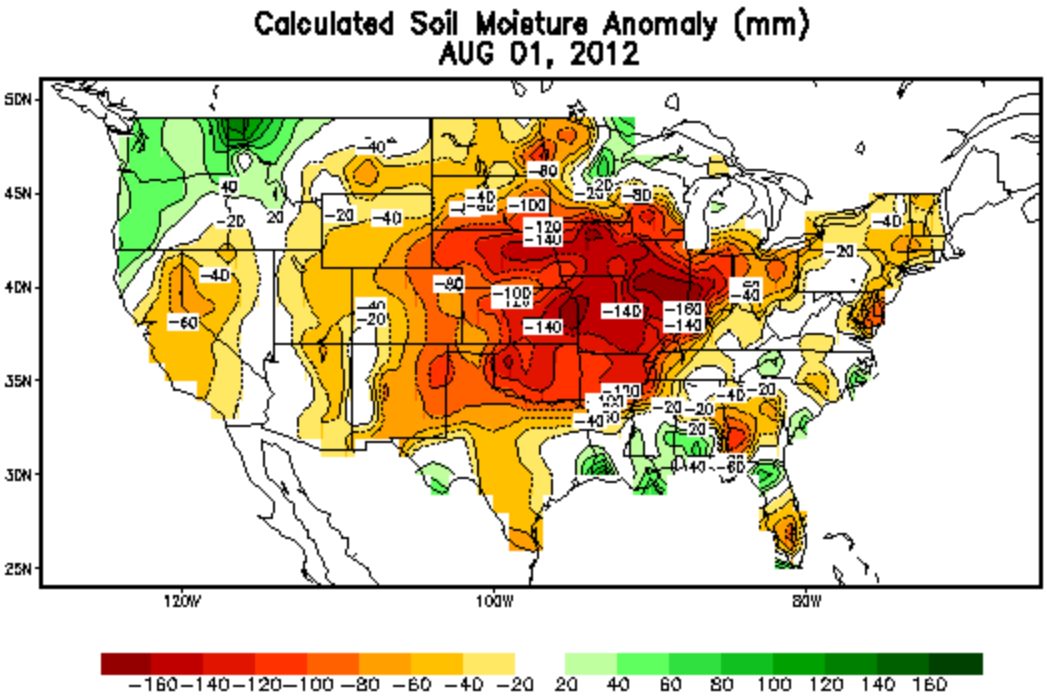


Figure 6. Calculated Soil Moisture Anomaly as of August 1, 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

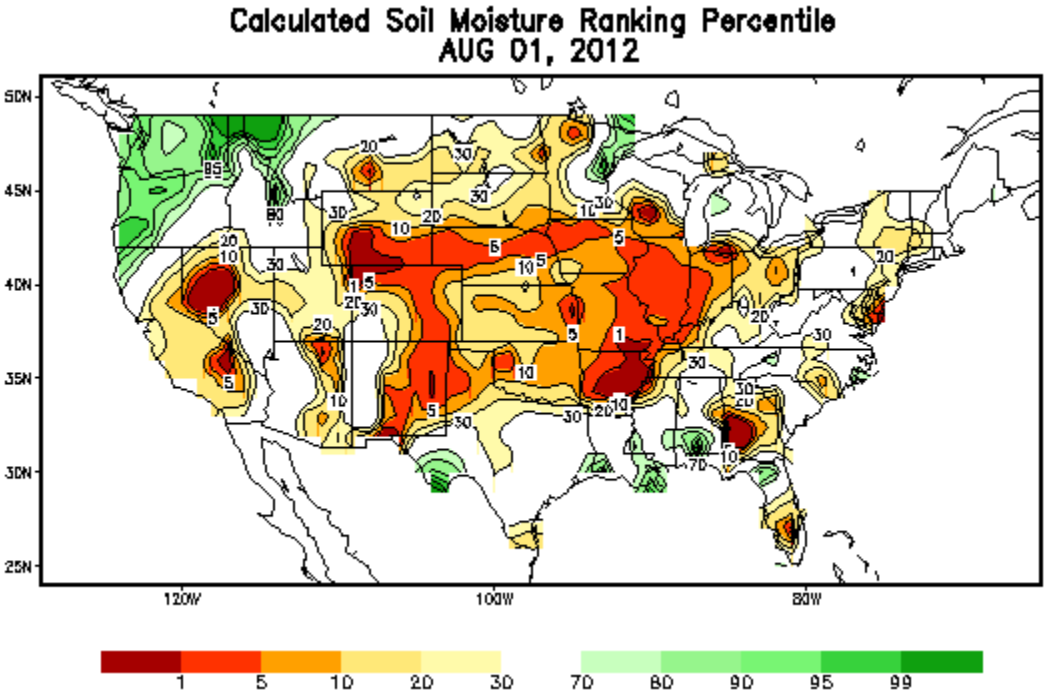


Figure 7. Calculated Soil Moisture Ranking Percentile as of August 1, 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/cgi-bin/US_Soil-Moisture-Monthly.sh#

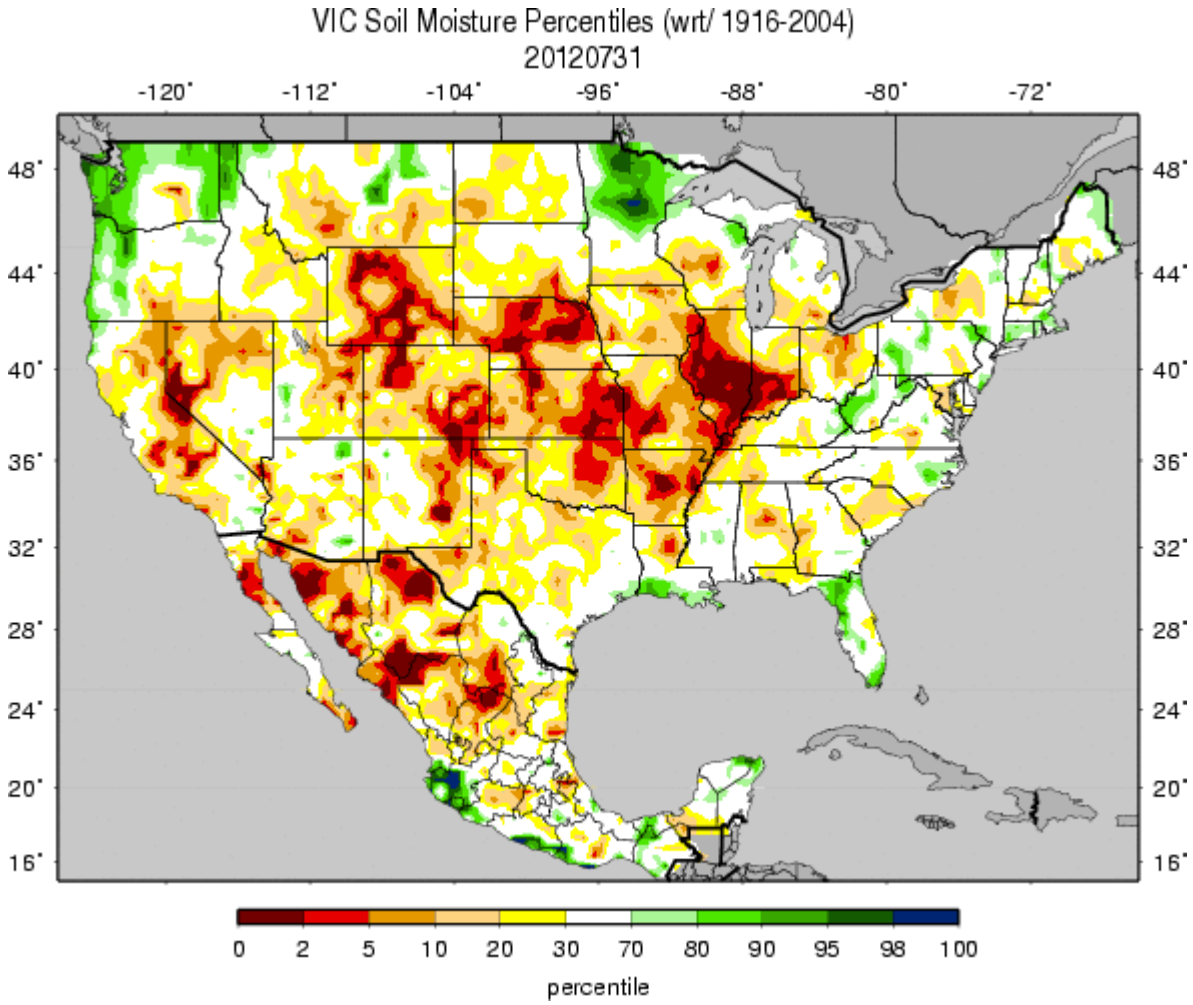


Figure 8. VIC modeled soil moisture percentiles as of July 31, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

The average mountain snow accumulation in the basin above Fort Peck Dam peaked on April 9, 2012 at 97% of the normal peak mountain snow accumulation that would normally occur on April 15. The peak SWE on April 9, 2012 was 17.4 inches compared to an average peak of 18.0 inches. The average mountain snow accumulation in the reach from Fort Peck Dam to Garrison Dam peaked on March 22, 2012 at 88% of the normal peak that would normally occur on April 15. The peak SWE on March 22, 2012 was 13.8 inches compared to an average peak of 15.6 inches. As of July 19, 2012, mountain

snowpack had melted at all monitoring locations throughout the Fort Peck and Garrison reaches. Mountain snowpack is illustrated in Figure 9.

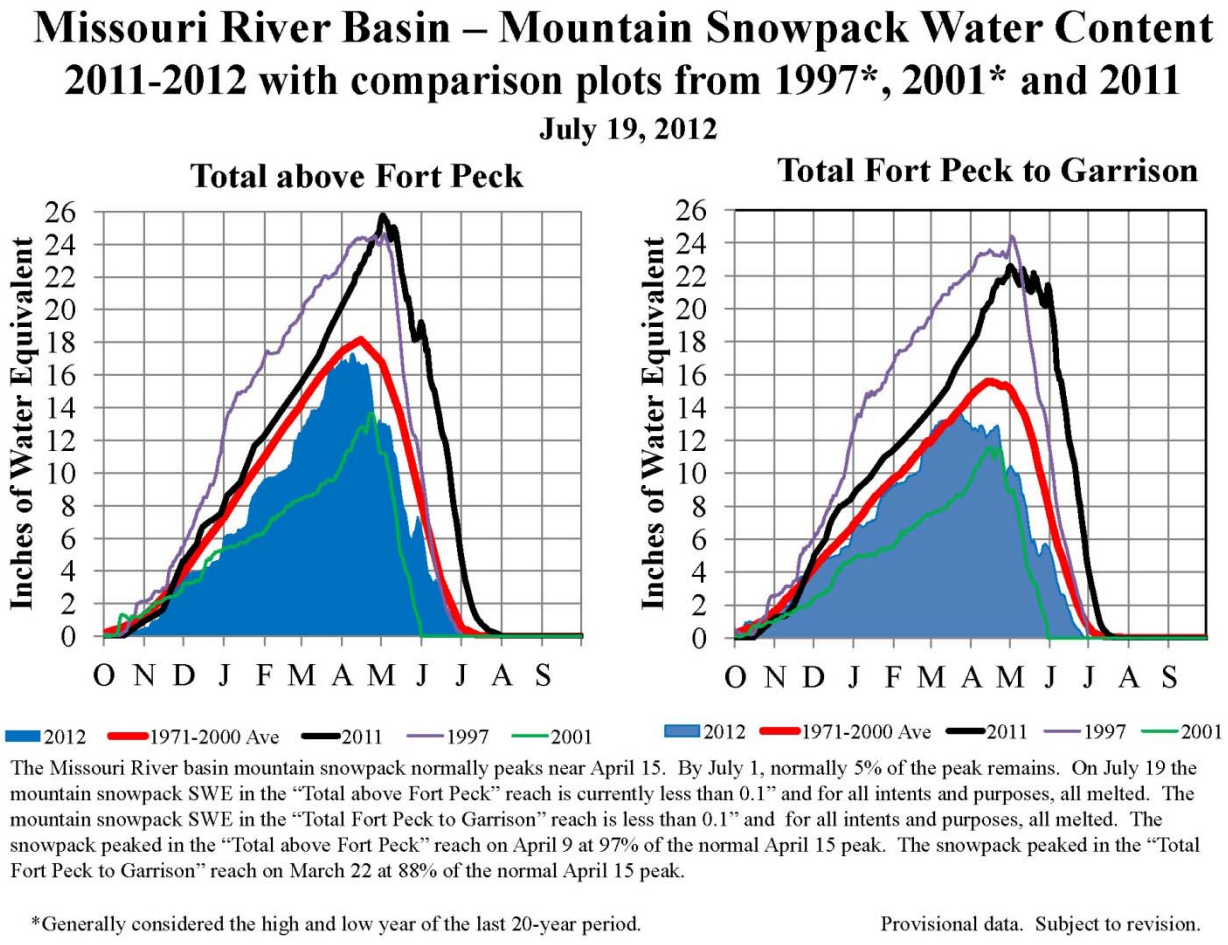


Figure 9. Missouri River mountain snowpack in the headwater basin above Fort Peck and the Fort Peck to Garrison reach..

Drought Analysis

Drought conditions grew worse over the month of July with many areas in the Missouri River basin moving one category to more severe conditions. According to the National Drought Mitigation Center's (NDMC) Drought Monitor, Moderate Drought (D1) and Severe Drought (D2) conditions are now impacting significant portions of the upper and lower Missouri River basin (Figure 10). In addition areas of Extreme Drought (D3) are impacting much of Nebraska, southern South Dakota, eastern Wyoming, Kansas and northern Missouri.

The U.S. Seasonal Drought Outlook is predicting persistent drought throughout most of the Missouri River basin (Figure 11) through October 31, 2012. Also the NDMC is predicting the development of drought in northern South Dakota and portions of North Dakota.

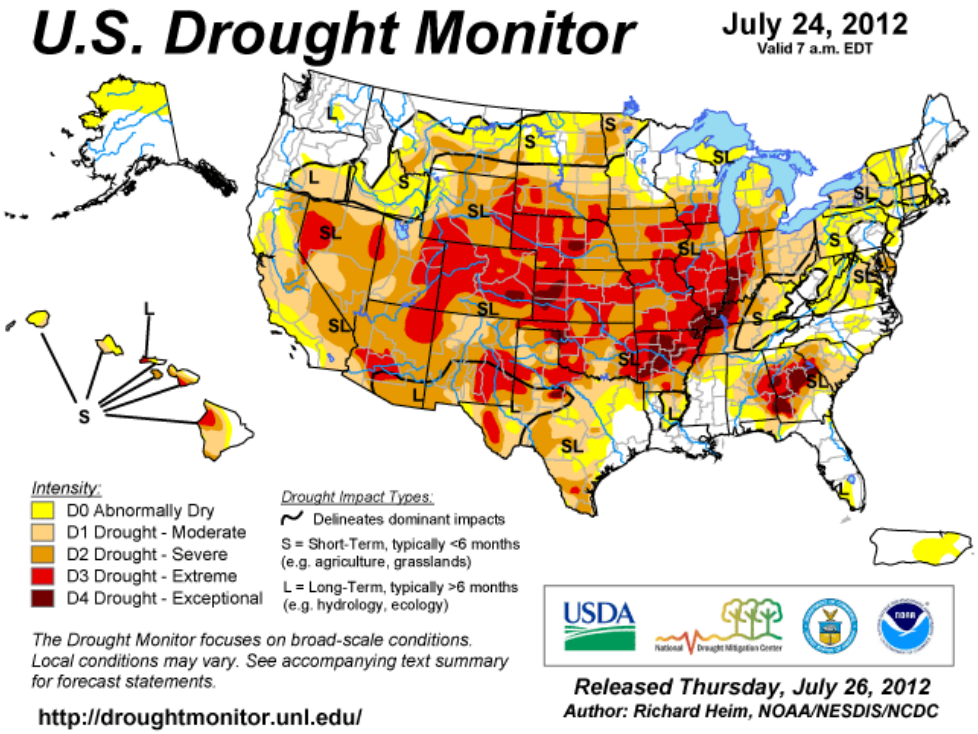


Figure 10. **National Drought Mitigation Center U.S. Drought Monitors for July 24, 2012.**

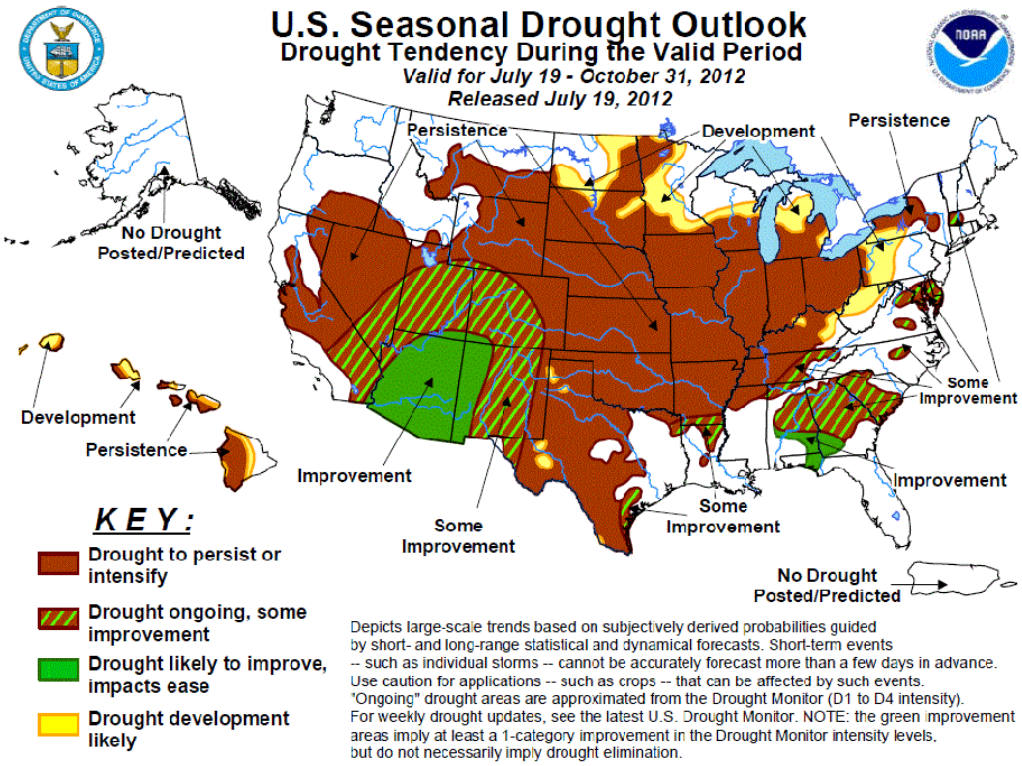


Figure 11. **National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 19 July to 31 October 2012.v**

Climate Outlook

ENSO-neutral conditions continue in the equatorial Pacific, although equatorial sea surface temperatures are 0.5 degrees C above average across the eastern Pacific Ocean. According to the CPC, there is a 50% chance that El Nino conditions will develop during the second half of 2012, and about a 50% chance sea surface temperatures will remain neutral. Chances for the development of El Nino increase through September 2012. The last time El Nino conditions persisted in the equatorial Pacific was during the fall and winter of 2009-2010. During El Nino (warm) episodes, winters in the Missouri River basin have a tendency to be warmer than normal.

The 6-10 Day (Figure 12) and 8-14 Day (Figure 13) Outlooks indicate that temperatures are very likely to be above normal in the Missouri River basin through August 14. Regarding precipitation, there are better chances for normal precipitation in central portions of the basin, while there are increased chances for below normal precipitation in the lower basin and the upper basin affecting the Fort Peck and Garrison reaches.

The CPC August outlook is forecasting increased chances for above normal temperatures throughout the entire Missouri River basin. With regard to precipitation the CPC is forecasting equal chances for above normal, normal, and below normal precipitation through central and western portions of the Missouri River basin; however, there is an increased chance for below normal precipitation in eastern portions of the Missouri River basin (Figure 14). The August-September-October outlook (Figure 15) is also forecasting increased chances for above normal temperatures in much of the basin. With regard to precipitation CPC is forecasting equal chances for precipitation in all areas of the basin with the exception of below normal chances in Iowa and Missouri. The October-November-December CPC Outlook (Figure 16) indicates a continuation of warmer than normal conditions in the Missouri River basin accompanied by equal chances for above normal, normal and below normal precipitation.

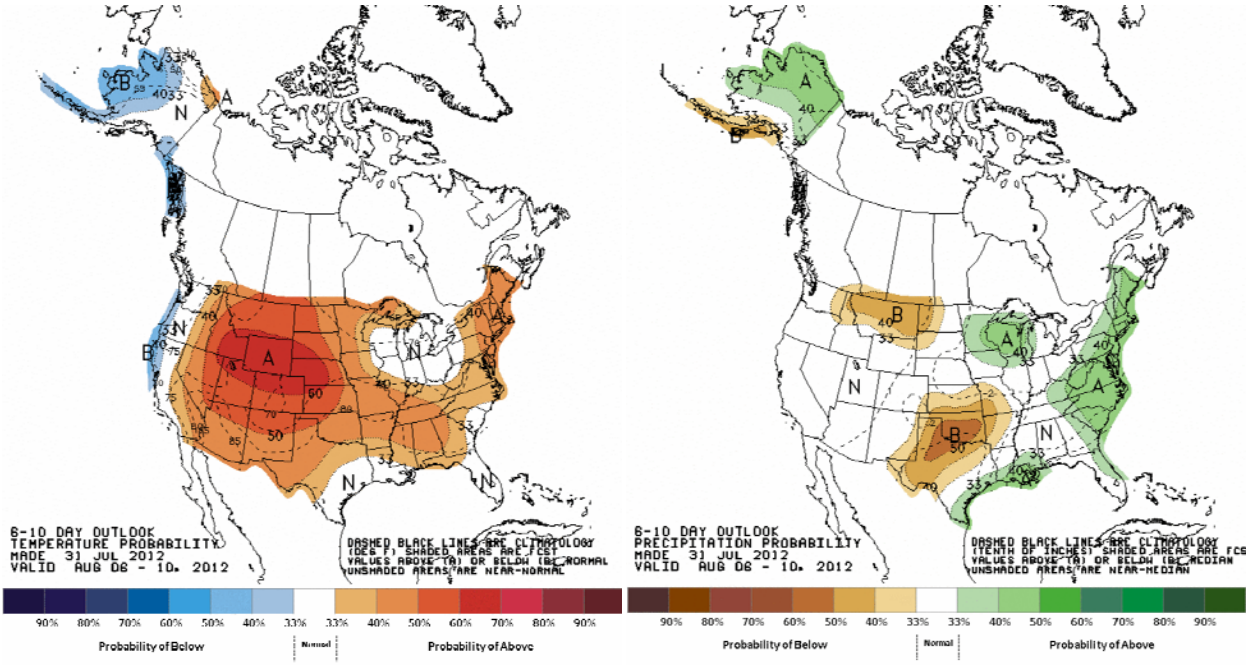


Figure 12. CPC 6-10 day temperature and precipitation outlooks.

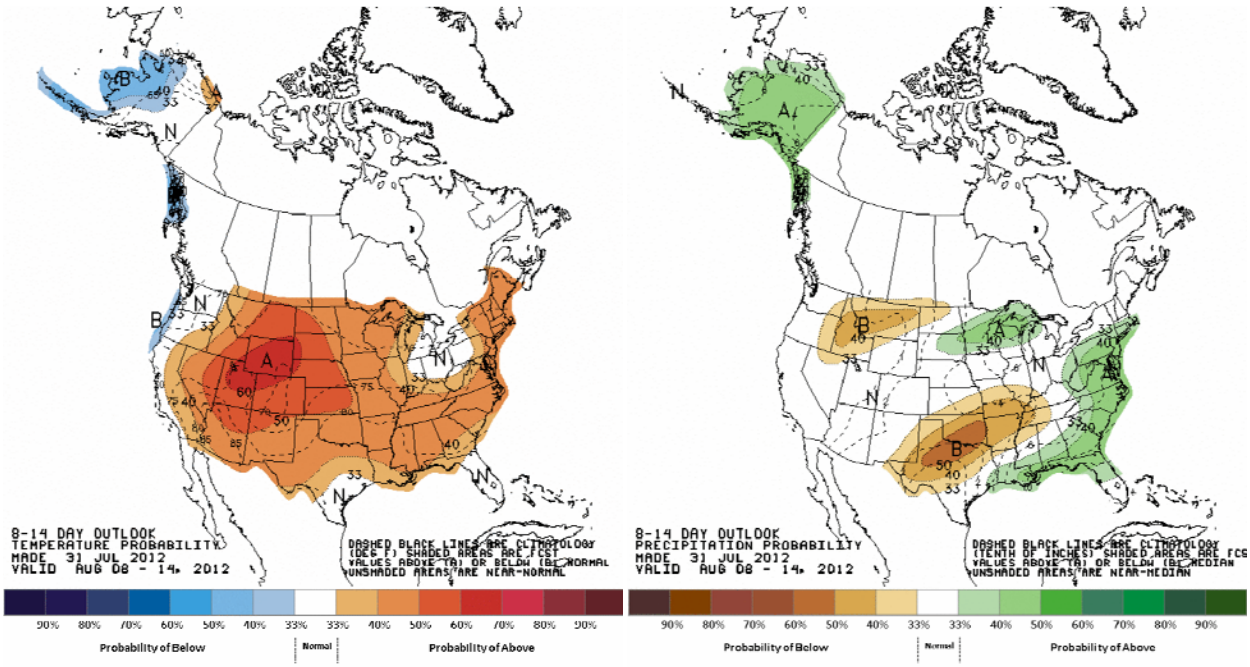


Figure 13. CPC 8-14 day temperature and precipitation outlooks.

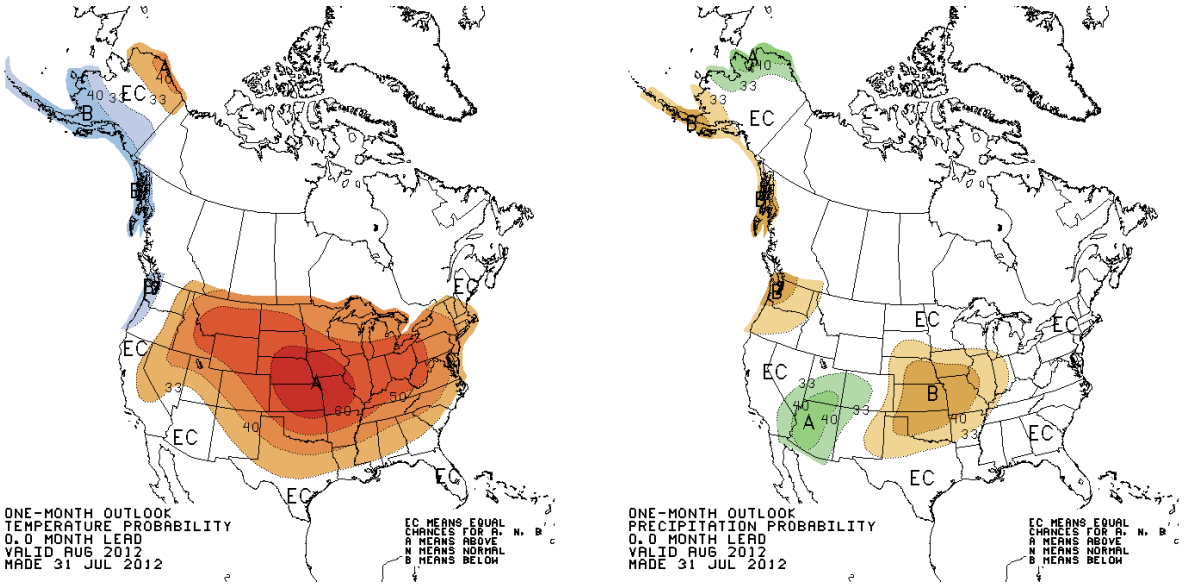


Figure 14. CPC August 2012 temperature and precipitation outlooks.

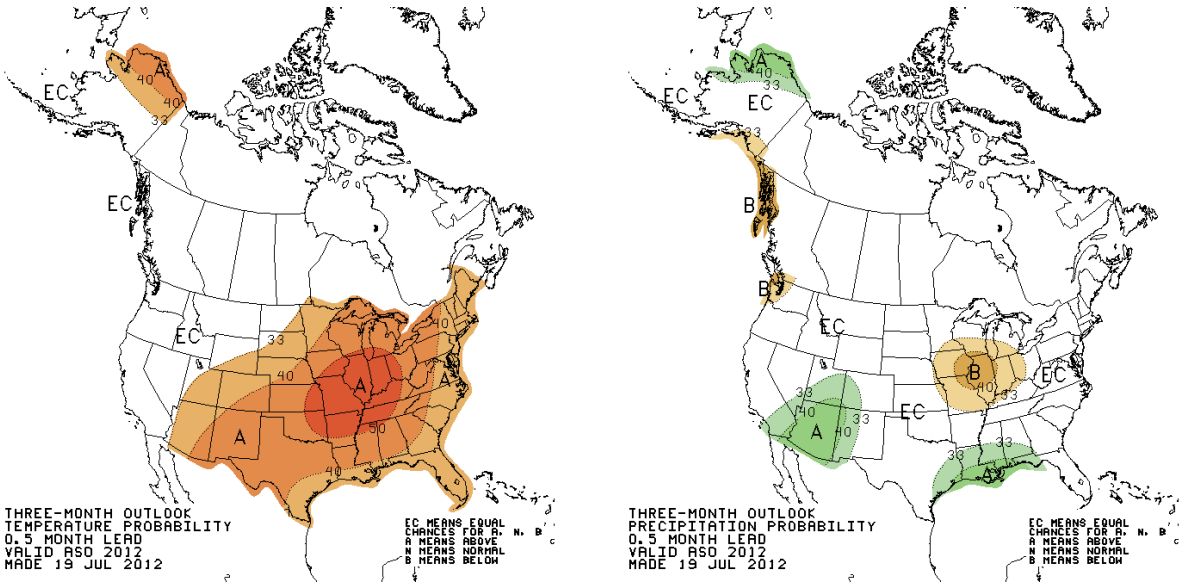


Figure 15. CPC August-September-October 2012 temperature and precipitation outlooks.

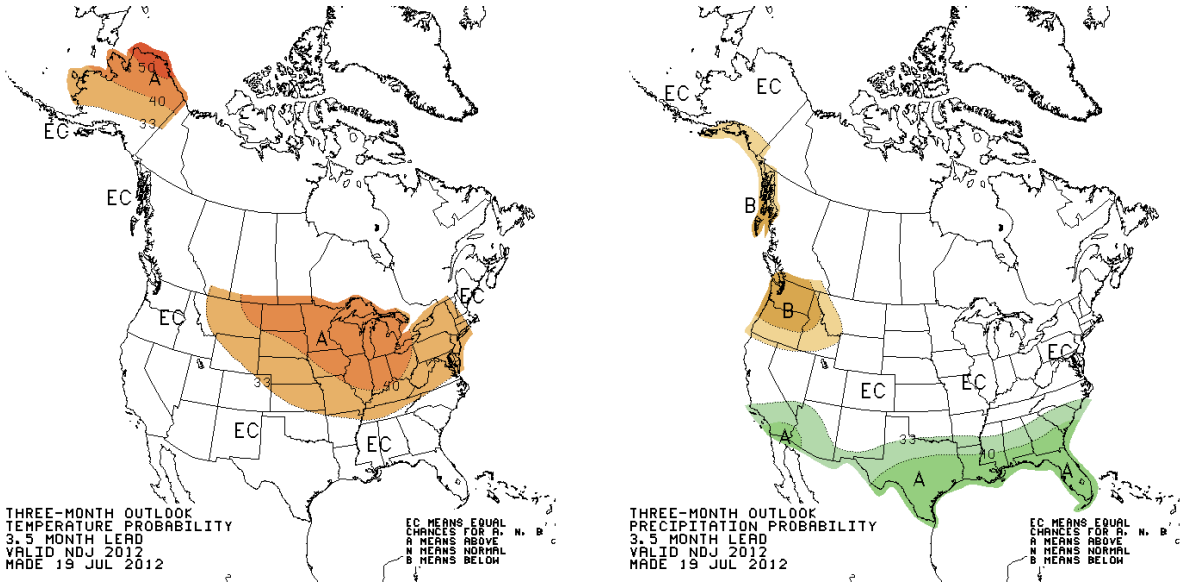


Figure 16. CPC November-December 2012-January 2013 temperature and precipitation outlooks.

August 2012 Calendar Year Runoff Forecast

The August 1 runoff forecast above Sioux City, IA is **21.0 MAF** (85% of normal) and **18.8 MAF** (83% of normal) above Gavins Point Dam. Actual July 2012 Missouri River runoff was 2.2 MAF (68% of normal) above Sioux City, and 2.1 MAF (70% of normal) above Gavins Point. The end of July calendar year accumulation above Sioux City is 85% of normal or 16.4 MAF. Due to the amount of variability in precipitation that can occur over the next 5 months, the expected inflow ranges from the 21.9 MAF upper basic forecast to the 20.1 MAF lower basic forecast.

The August runoff forecasts for all reaches were determined by first establishing a likely range of runoff volumes that could occur by reach given the observed 2012 reach and system runoff. Secondly the August volumes were adjusted to a likely historic ratio of July to August runoff. Finally, August runoff volumes converted to a monthly inflow were compared to current rates of inflow in order to verify that the volumes were reasonable. The resulting forecast August inflow volume above Gavins was 925 kaf (79% of normal) while above Sioux City it was 985 kaf (75% of normal).

Given the warm temperature outlook with a possible slight improvement to the precipitation outlook through October, September runoff is forecast to be 83% of normal above Sioux City with continued improvement in October. The November-December time period also shows some improvement; however, runoff is still projected to be 92% and 94% of normal, respectively. The November-December forecast is a reflection of existing dry conditions, limited recovery in accumulated precipitation, and the expectation of warmer than normal temperatures continuing into the winter of 2012-2013.

Upper Missouri River Basin
September 2012 Calendar Year Runoff Forecast
September 4, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

August 2012 Runoff

August 2012 Missouri River runoff was 837 KAF (64% of normal) above Sioux City and 769 KAF (65% of normal) above Gavins Point. Much less than normal runoff in the Fort Peck and Garrison reaches were the major factors for the limited August runoff, with the August runoff for the Fort Peck reach totaling only 75% of normal and the runoff for the Garrison Reach totaling only 46% of normal.

2012 Calendar Year Forecast Synopsis

The September 1 runoff forecast for 2012 is **20.7 MAF** (83% of normal) above Sioux City, IA, and **18.5 MAF** (81% of normal) above Gavins Point Dam. This is a decrease from the August 1 forecast due to much drier and warmer than normal conditions in the upper Missouri River basin. Due to the amount of variability in precipitation that can occur over the next 4 months, the expected inflow ranges from the 21.3 MAF upper basic forecast to the 20.0 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given wetter-than-expected or drier-than-expected conditions. Given that 4 months are being forecasted on September 1 (8 months observed/4 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 4 months. The result is a range or “bracket” for each reach, and thus, for the total runoff forecast.

Current Conditions

Precipitation

Overall precipitation accumulations during the month of August were well below normal (Figures 1 and 2). Most of the lower Missouri River basin received less than 50% of normal precipitation, though a majority of this area received less than 25% of normal precipitation and most of Nebraska, central South Dakota, portions of Wyoming, and the northwest corner of North Dakota received less than 10% of normal precipitation.

A similar pattern with departures not as severe has occurred over the 90-day period (June-July-August) shown in Figure 3. A majority of the Missouri River basin has received less than 75% of normal precipitation, especially in the lower basin where accumulations are less than 50% of normal. Departures in northern Montana and western North Dakota have been primarily above normal.

Please refer to the January – August Calendar Year Forecast narratives for information on the amounts of precipitation that occurred in previous months as well as a comparison to 2011 precipitation amounts in the Missouri River basin.

Temperature

Overall the mean temperatures in August were within a degree F below or above normal throughout the basin (see Figure 4).

Ninety-day (90-day) temperature departures ending on August 31, 2012 are shown in Figure 5. During this time period including the months of June, July, and August, average daily temperatures ranged from -1 to 5 degrees F above normal throughout the Missouri River basin.

Soil Moisture Conditions

As shown on Figure 6, the Variable Infiltration Capacity (VIC) model soil moisture percentiles show dry soils throughout the Missouri River basin, with the driest soils being in north-central Nebraska and south-central South Dakota where the soil moisture percentiles are as low as 5 percent.

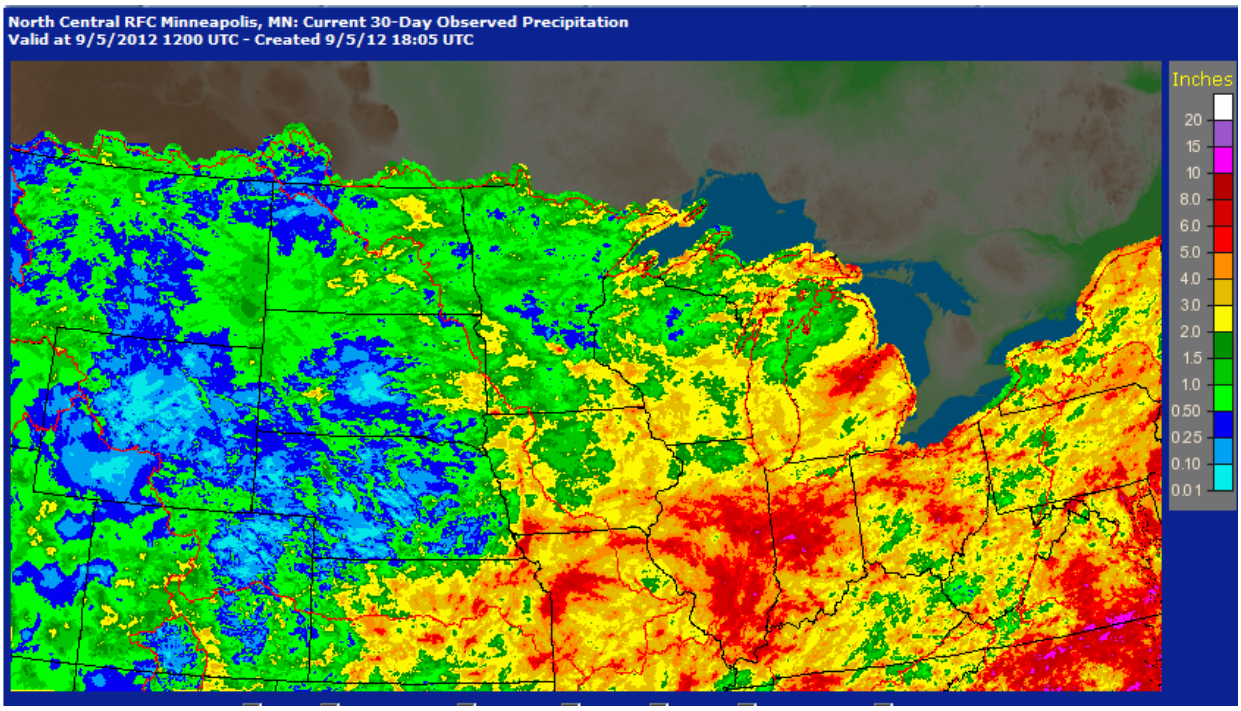


Figure 1. **August 2012 Precipitation (inches). Source: National Weather Service.**

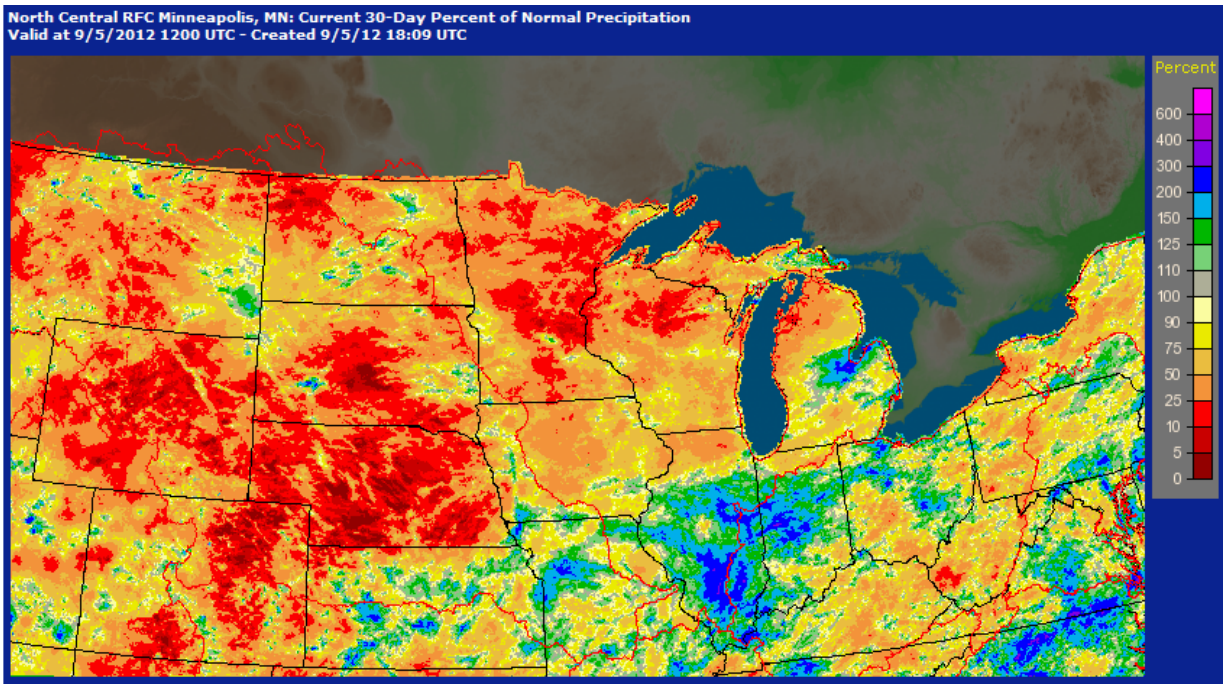


Figure 2. **August 2012 Percent of Normal Precipitation. Source: National Weather Service.**

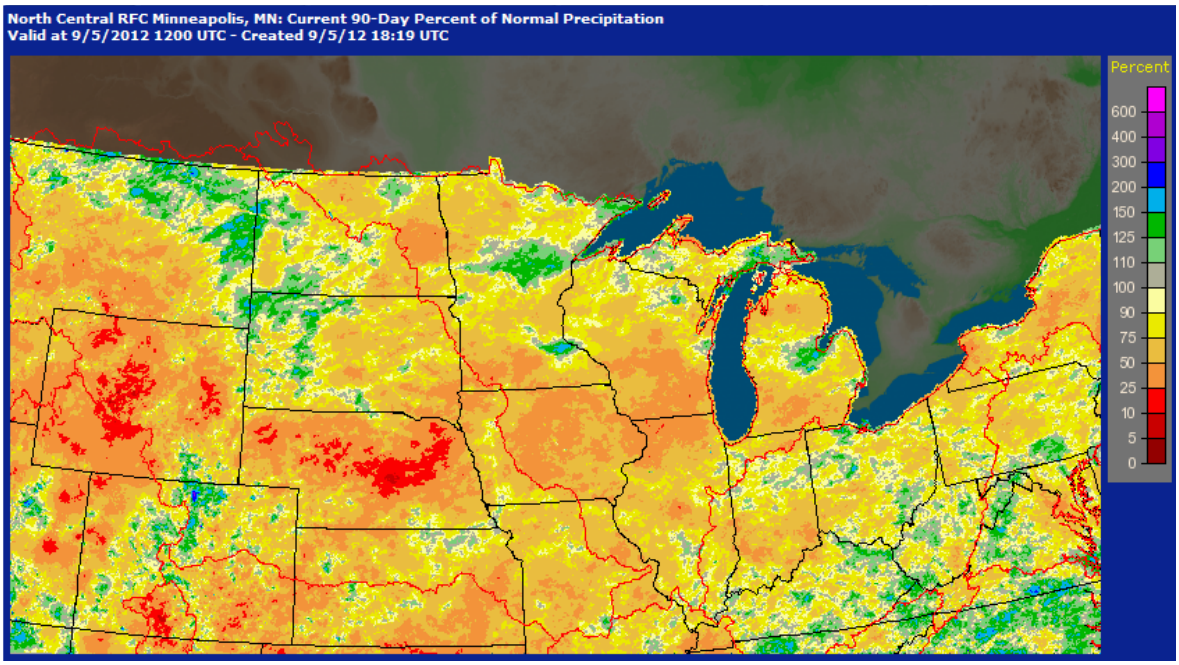


Figure 3. **June-July-August 2012 Percent of Normal Precipitation. Source: National Weather Service.**

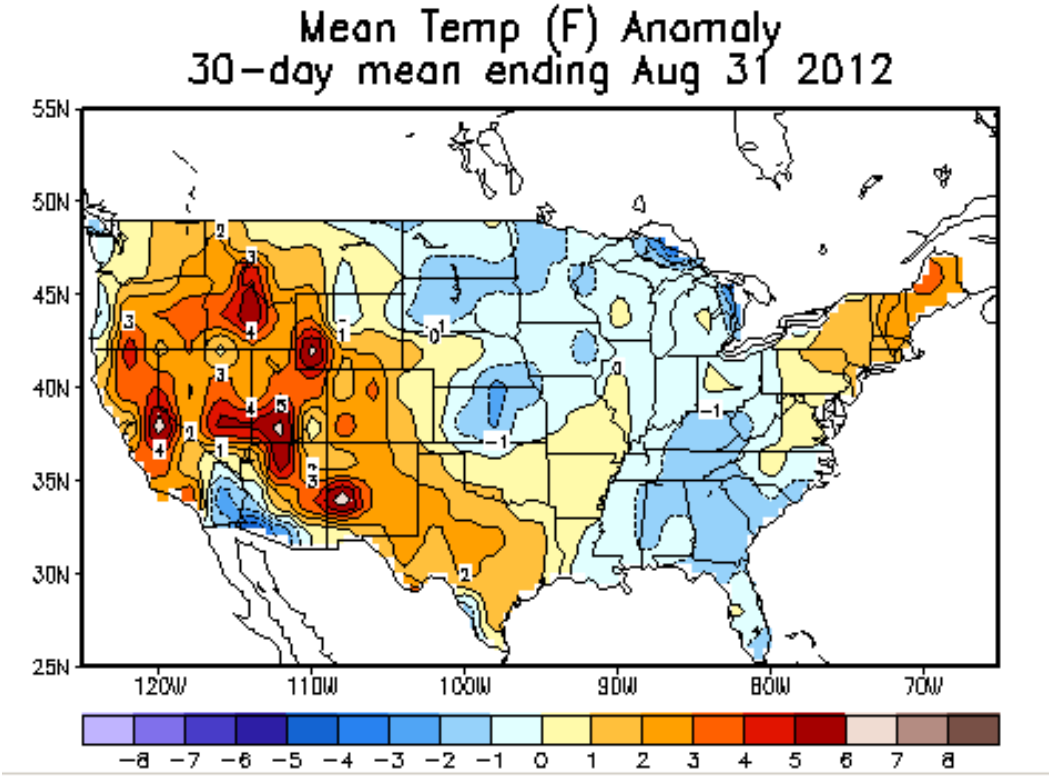


Figure 4. 30-day temperature anomaly (deg F) ending on August 31, 2012.

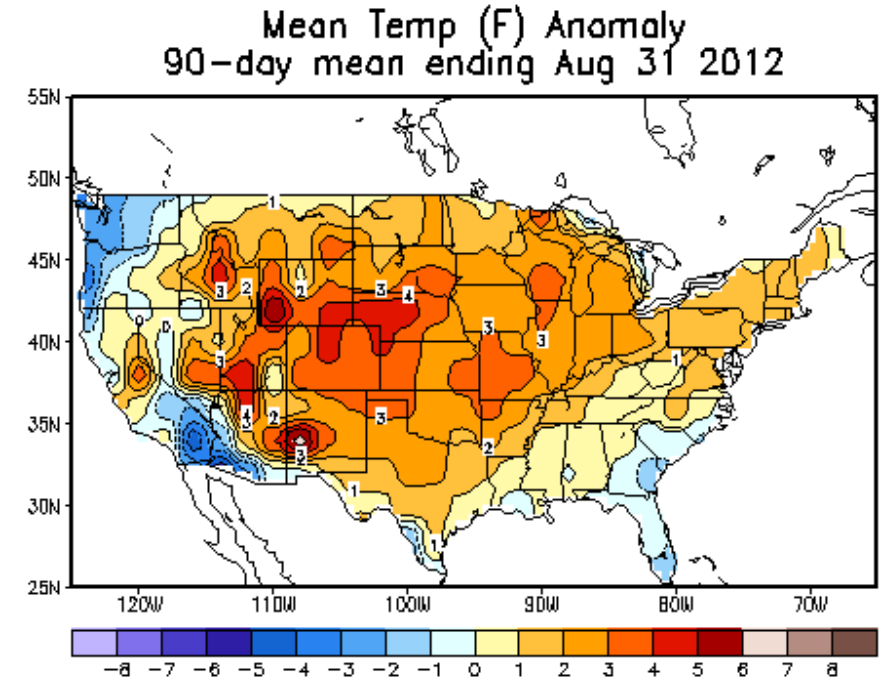


Figure 5. 90-day temperature anomaly (deg F) ending on August 31, 2012.

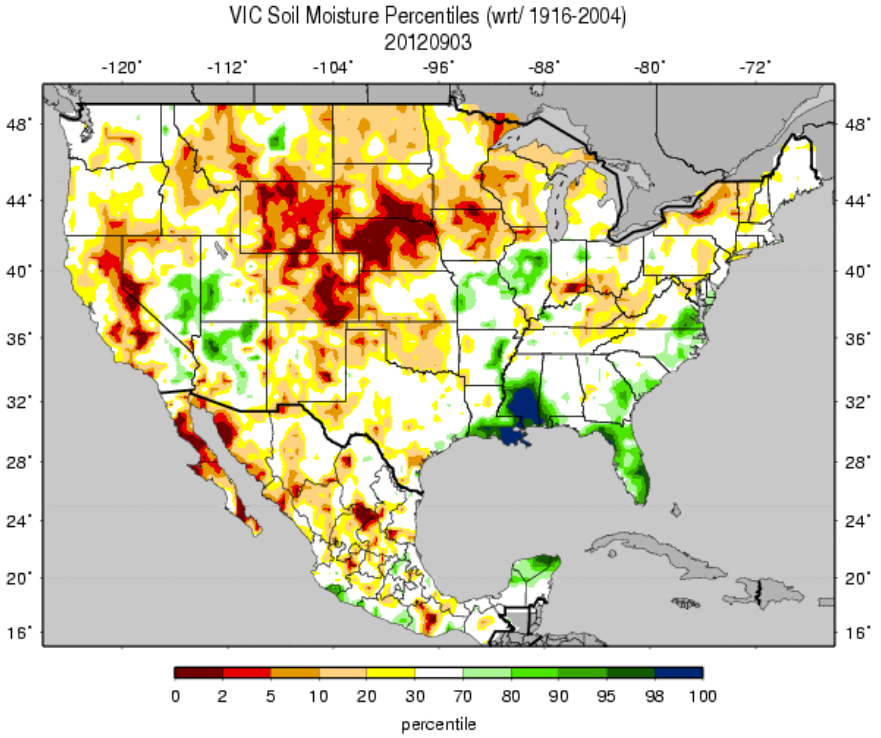


Figure 6. **VIC modeled soil moisture percentiles as of Sep 3, 2012. Source: University of Washington.** http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Mountain Snowpack

Mountain snowpack is the primary factor used to predict May-June-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-June-July runoff volumes, especially when mountain soil moisture conditions have been wetter than normal as in the past three years.

The average mountain snow accumulation in the basin above Fort Peck Dam peaked on April 9, 2012 at 97% of the normal peak mountain snow accumulation that would normally occur on April 15. The peak SWE on April 9, 2012 was 17.4 inches compared to an average peak of 18.0 inches. The average mountain snow accumulation in the reach from Fort Peck Dam to Garrison Dam peaked on March 22, 2012 at 88% of the normal peak that would normally occur on April 15. The peak SWE on March 22, 2012 was 13.8 inches compared to an average peak of 15.6 inches. As of July 19, 2012, mountain snowpack had melted at all monitoring locations throughout the Fort Peck and Garrison reaches. Mountain snowpack is illustrated in Figure 7.

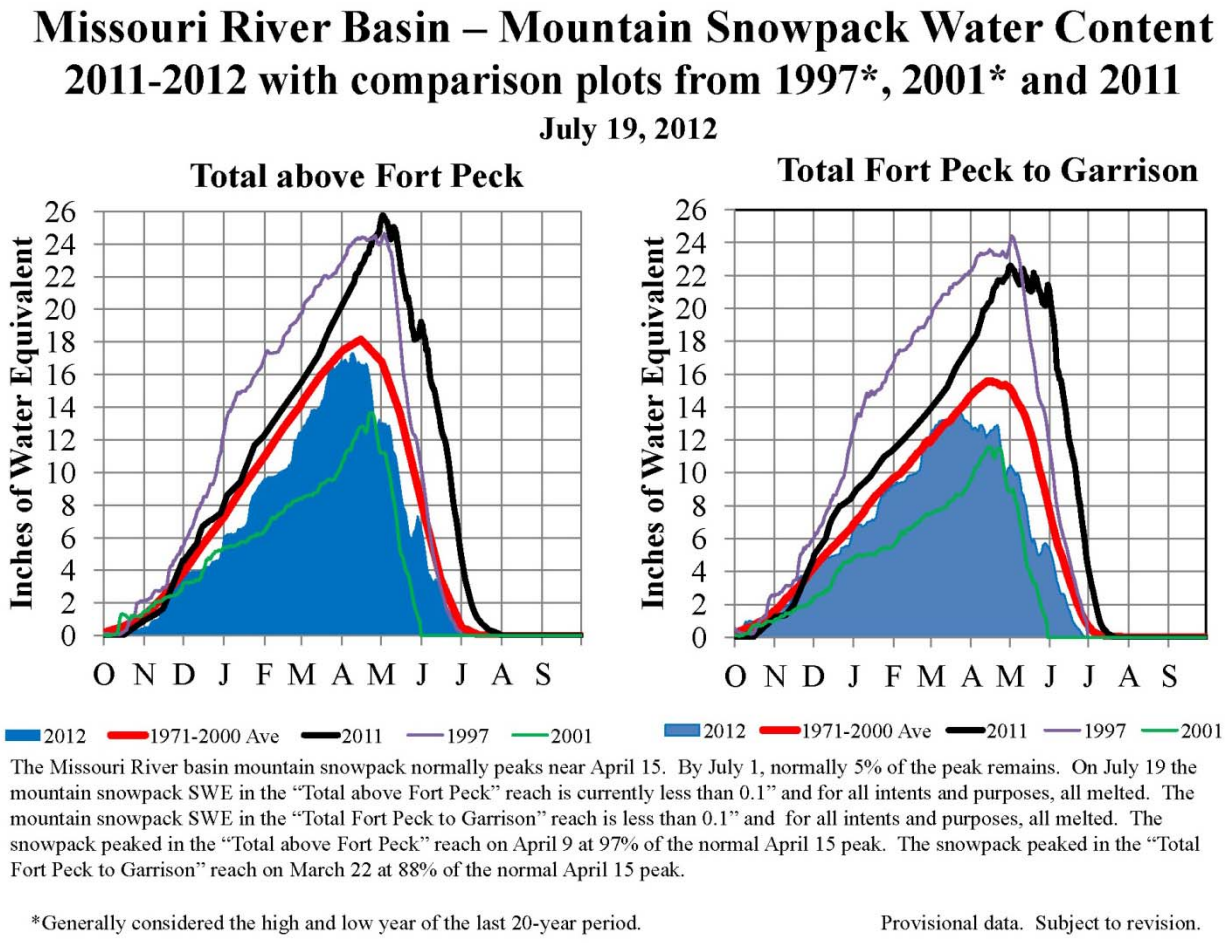


Figure 7. Missouri River mountain snowpack in the headwater basin above Fort Peck and the Fort Peck to Garrison reach.

Drought Analysis

Drought conditions in the basin grew worse over the month of August with many areas in the Missouri River basin moving one category to more severe conditions. According to the National Drought Mitigation Center's (NDMC) Drought Monitor, Moderate Drought (D1), Severe Drought (D2), and Extreme Drought (D3) conditions are now impacting significant portions of the upper and lower Missouri River basin (Figure 8). In addition, areas of Exceptional Drought (D4) are impacting west-central Nebraska, central Kansas, and eastern Missouri.

The U.S. Seasonal Drought Outlook is predicting persistent drought throughout a good portion of the Missouri River basin (Figure 9) through November 30, 2012. Some improvement is predicted in northern South Dakota and southwest Minnesota.

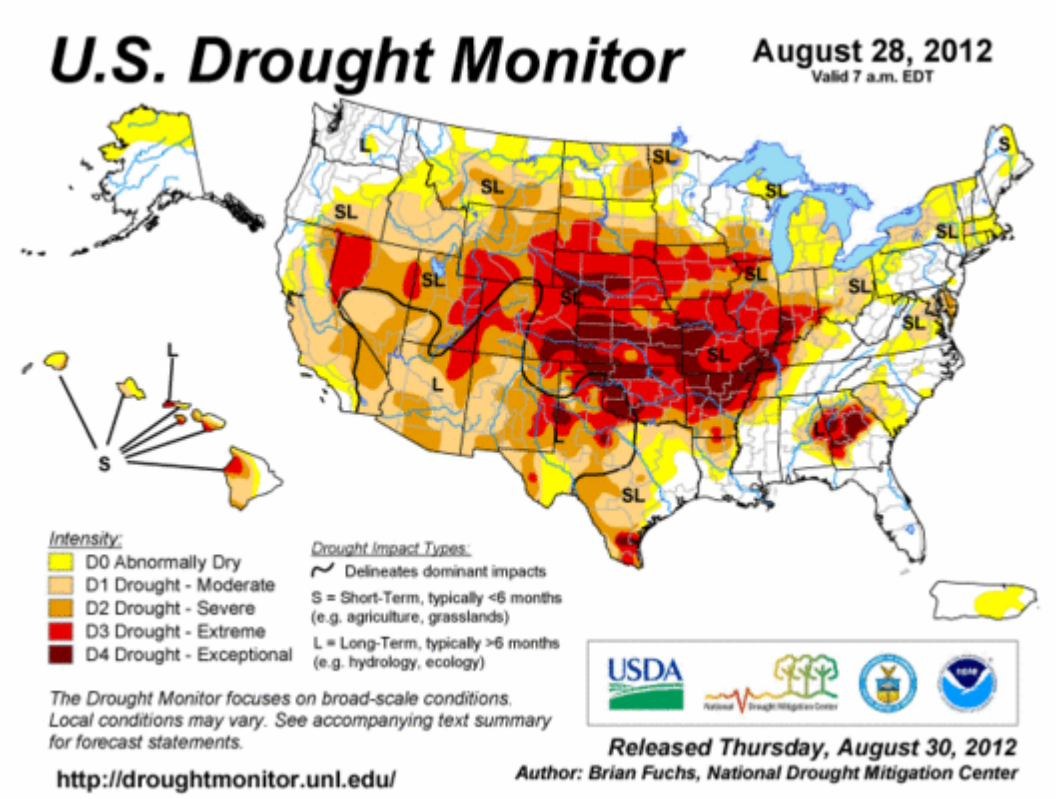


Figure 8. **National Drought Mitigation Center U.S. Drought Monitors for August 28, 2012.**

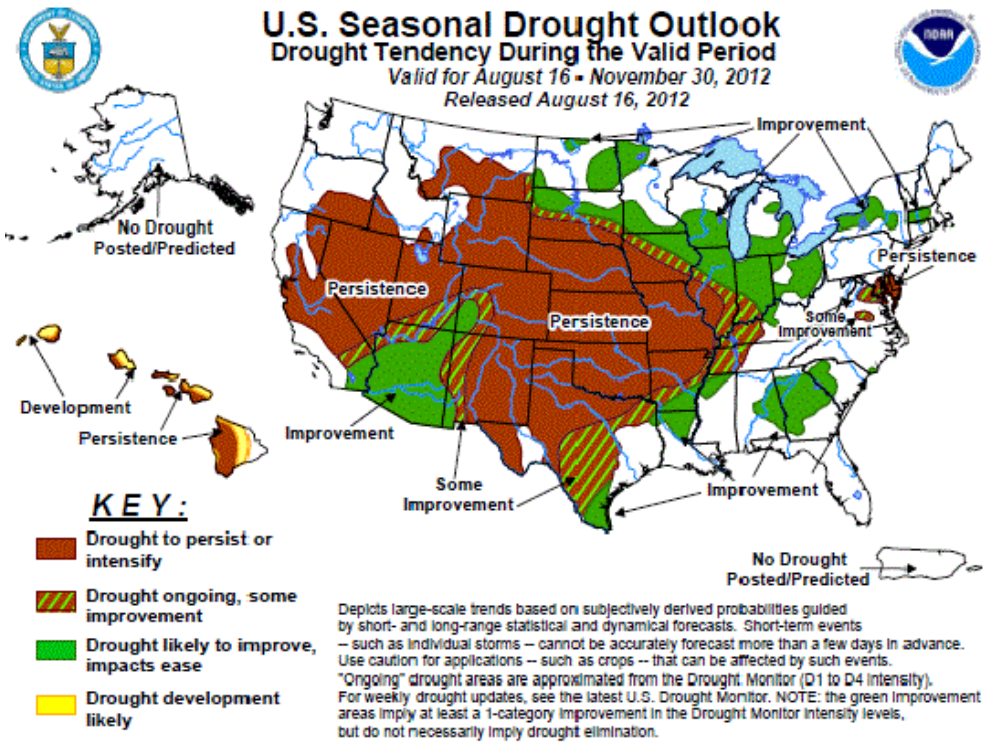


Figure 9. **National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 16 Aug – 30 Nov 2012**

Climate Outlook

ENSO-neutral conditions continue in the equatorial Pacific, although equatorial sea surface temperatures are 0.5 degrees C above average across the eastern Pacific Ocean, which indicates a possible transition from ENSO-neutral to El Nino conditions. According to the CPC, El Nino conditions are likely to develop during September 2012. The last time El Nino conditions persisted in the equatorial Pacific was during the fall and winter of 2009-2010. During El Nino (warm) episodes, winters in the upper portions of the Missouri River basin have a tendency to be warmer and drier than normal.

The 6-10 Day (Figure 10) and 8-14 Day (Figure 11) Outlooks indicate that temperatures are very likely to be above normal in the Missouri River basin through mid-September. Regarding precipitation, there are better chances for normal precipitation in North Dakota, while there are increased chances for below normal precipitation in the lower basin.

The CPC September outlook is indicating increased chances for above normal temperatures throughout the entire Missouri River basin. With regard to precipitation, the CPC is forecasting equal chances for above normal, normal, and below normal precipitation through central and western portions of the Missouri River basin; however, there is an increased chance for below normal precipitation in eastern portions of the Missouri River basin (Figure 12). The September-October-November outlook (Figure 13) is also forecasting increased chances for above normal temperatures in much of the basin. With regard to precipitation CPC is forecasting equal chances for precipitation in all areas of the basin with the exception of below normal chances in Iowa and Missouri. The December 2012 – February 2013 CPC

Outlook (Figure 14) indicates a continuation of warmer than normal conditions in the Missouri River basin accompanied by equal chances for above normal, normal and below normal precipitation.

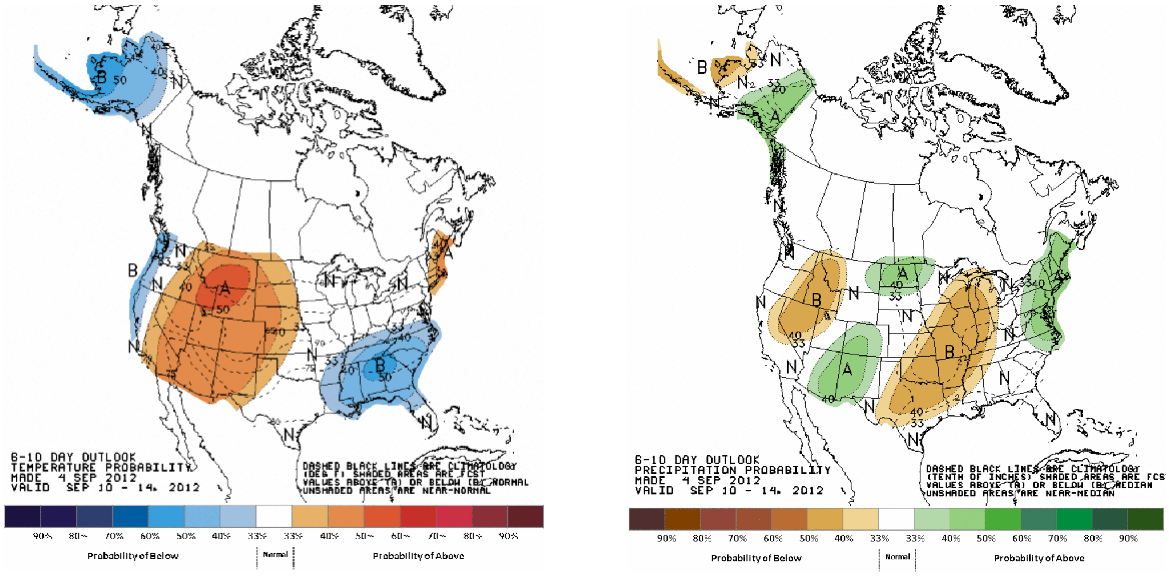


Figure 10. CPC 6-10 day temperature and precipitation outlooks.

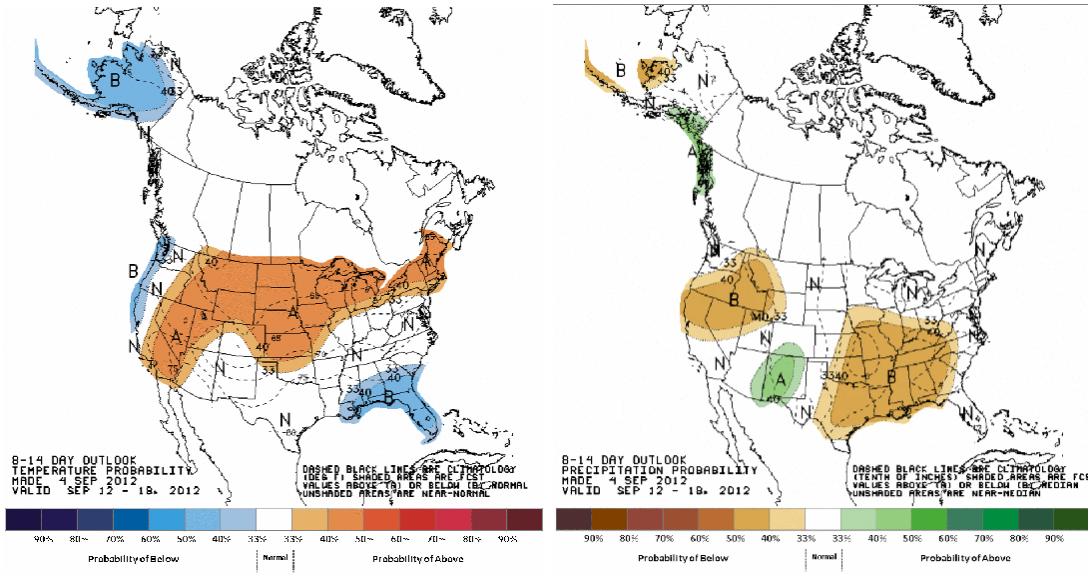


Figure 11. CPC 8-14 day temperature and precipitation outlooks.

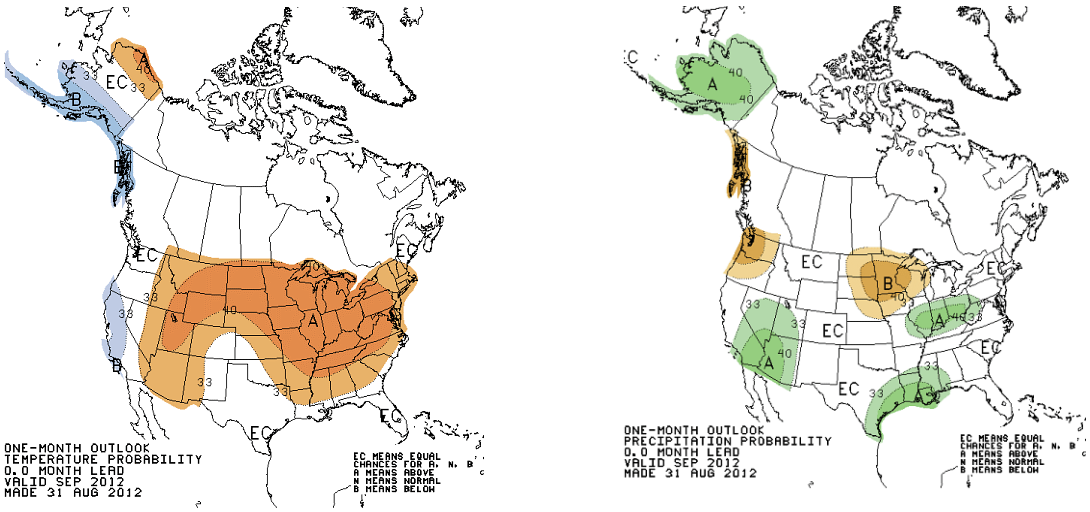


Figure 12 **CPC September 2012 temperature and precipitation outlooks.**

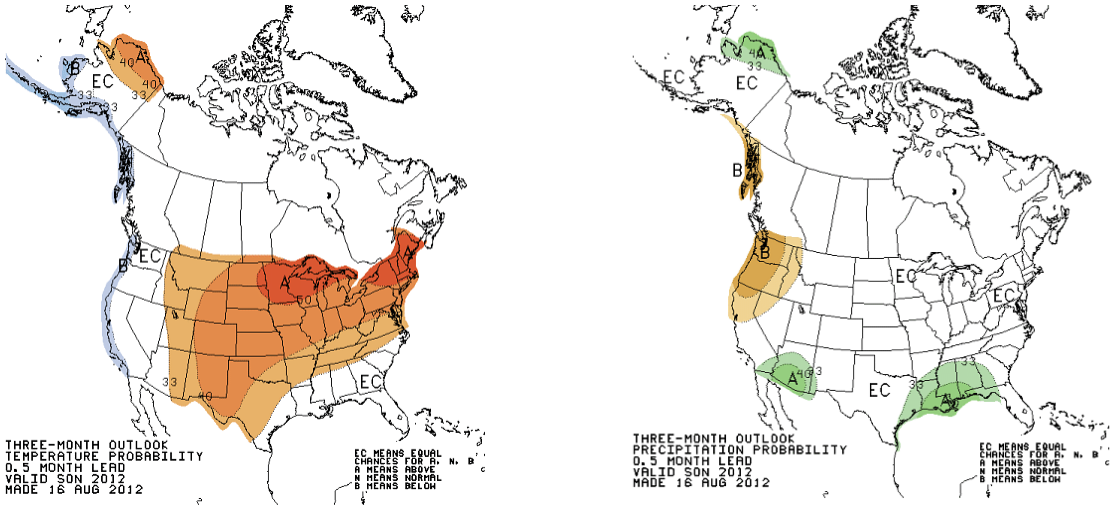


Figure 13. **CPC September-October-November 2012 temperature and precipitation outlooks.**

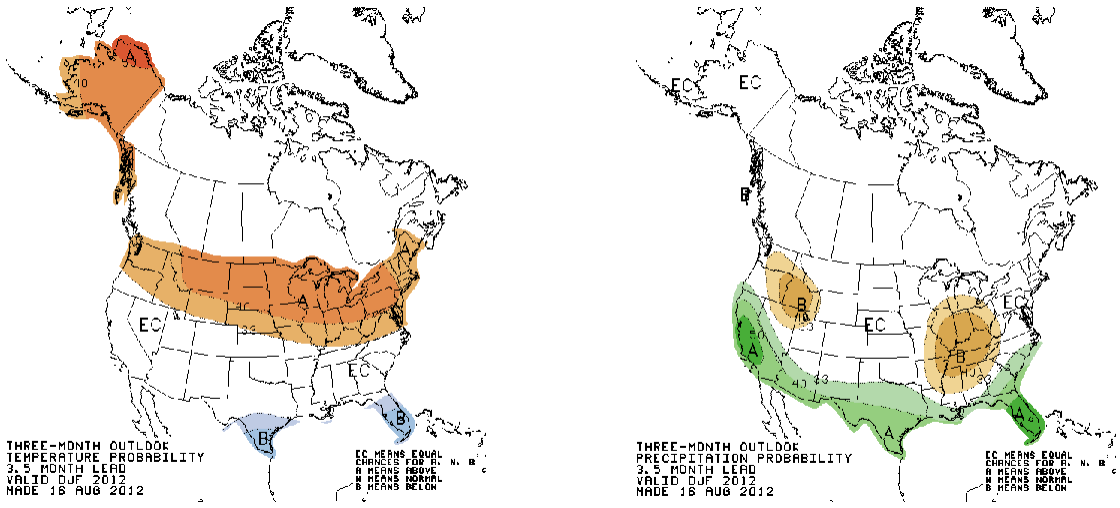


Figure 6. CPC December 2012-February 2013 temperature and precipitation outlooks.

Summary - September 2012 Calendar Year Runoff Forecast

The September 1 runoff forecast is **20.7 MAF** (83% of normal) above Sioux City, IA, and **18.5 MAF** (81% of normal) above Gavins Point Dam. This is a decrease from the August 1 forecast due to much drier and warmer than normal conditions in the upper Missouri River basin. Due to the amount of variability in precipitation that can occur over the next 4 months, the expected inflow ranges from the 21.3 MAF upper basic forecast to the 20.0 MAF lower basic forecast.

The September runoff forecasts for all reaches were determined by first establishing a likely range of runoff volumes that could occur by reach given the observed 2012 reach and system runoff. Secondly the September volumes were adjusted to a likely historic ratio of August to September runoff. Finally, September runoff volumes converted to a monthly inflow were compared to current rates of inflow in order to verify that the volumes were reasonable. The resulting forecast September inflow volume above Gavins was 803 kaf (77% of normal) while above Sioux City it was 868 kaf (76% of normal).

Given the warm temperature outlook with a possible slight improvement to the precipitation outlook through November, October runoff is forecast to be 85% of normal above Sioux City with continued improvement in November. December also shows some improvement; however, runoff is still projected to be 91% of normal. The November-December forecast is a reflection of existing dry conditions, limited recovery in accumulated precipitation, and the expectation of warmer than normal temperatures continuing into the winter of 2012-2013.

Upper Missouri River Basin
October 2012 Calendar Year Runoff Forecast
October 2, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

September 2012 Runoff

September runoff was 0.3 MAF (25% of normal) in the Missouri River basin above Sioux City, and 0.3 MAF (28% of normal) above Gavins Point. September 2012 runoff was the lowest September in 114 years of record, breaking the previous low of 0.4 MAF set in 1919. On an individual reach basis, Garrison received the lowest calculated September runoff on record, while Fort Peck received the 5th lowest calculated September runoff on record. The negative inflow into Garrison was an indication of more water evaporating than entering Lake Sakakawea during September.

2012 Calendar Year Forecast Synopsis

The calendar year runoff forecast above Sioux City, IA is **19.0 MAF** (77% of normal) and **17.0 MAF** (75% of normal) above Gavins Point Dam. This is a decrease of 1.7 MAF from the September 1 forecast. Due to the amount of variability in precipitation that can occur over the next 3 months, the expected inflow ranges from the 19.3 MAF upper basic forecast to the 18.7 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given wetter-than-expected or drier-than-expected conditions. Given that 3 months are being forecasted on October 1 (9 months observed/3 months forecast), the

range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for all 3 months. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

Current Conditions

Precipitation

Overall precipitation accumulations during the month of September were well below normal (Figures 1 and 2). Precipitation departures as a percent of normal were predominantly less than 25% for most of the upper basin. Large areas in Montana, North and South Dakota, and Wyoming received less than 5% of the September normal. The precipitation departure over the three-month July-August-September period ranged from 50% down to 10% (Figure 3).

Temperature

September temperatures in the upper basin west of the Missouri River were 0 to 2 degrees F above normal, while east of the Missouri River, temperatures were 0 to 1 degree F below normal (see Figure 4). Ninety-day (90-day) temperature departures ending on September 30, 2012 are shown in Figure 5. During this time period, average daily temperatures ranged from 1 to 3 degrees F above normal throughout the Missouri River basin.

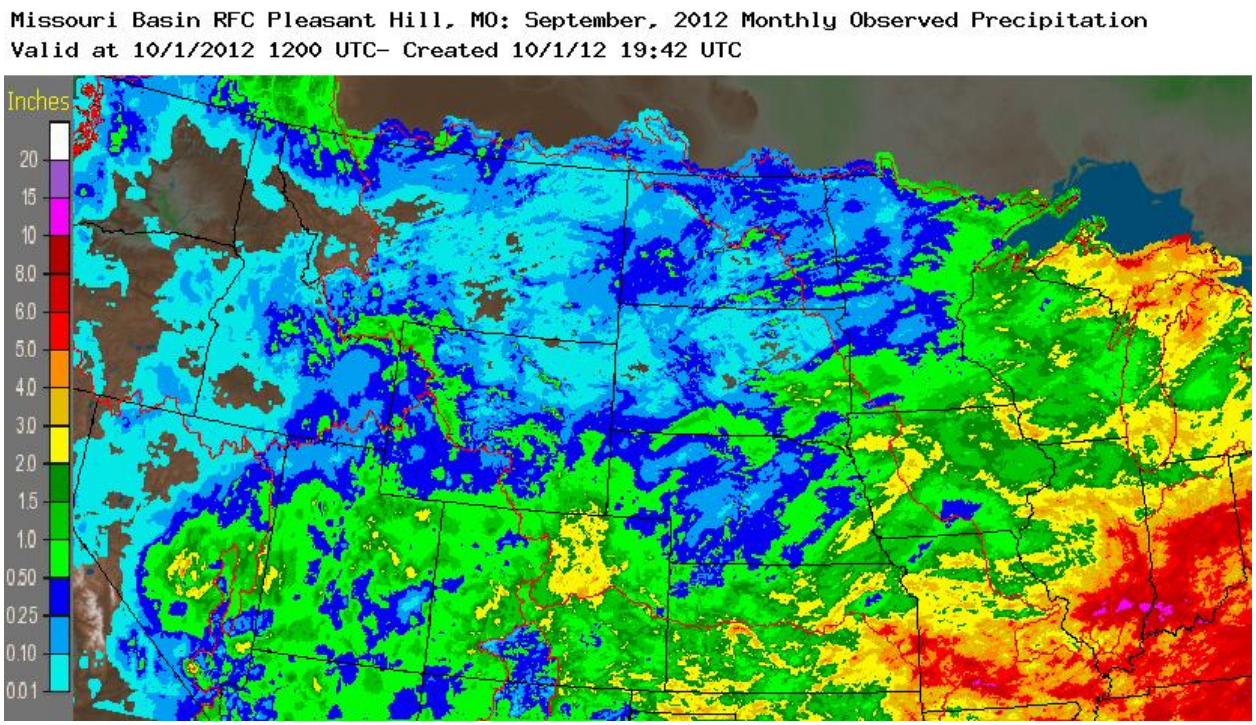


Figure 1. September 2012 Precipitation (inches). Source: National Weather Service.

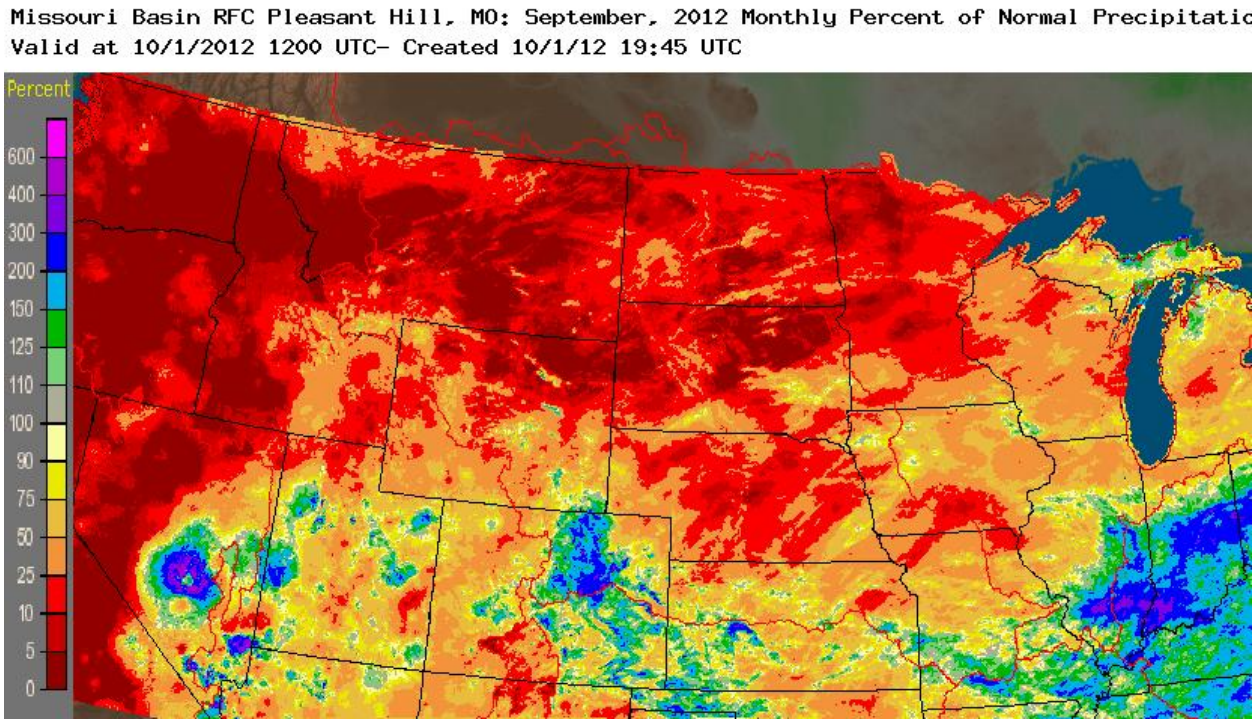


Figure 2. September 2012 Percent of Normal Precipitation. Source: National Weather Service.

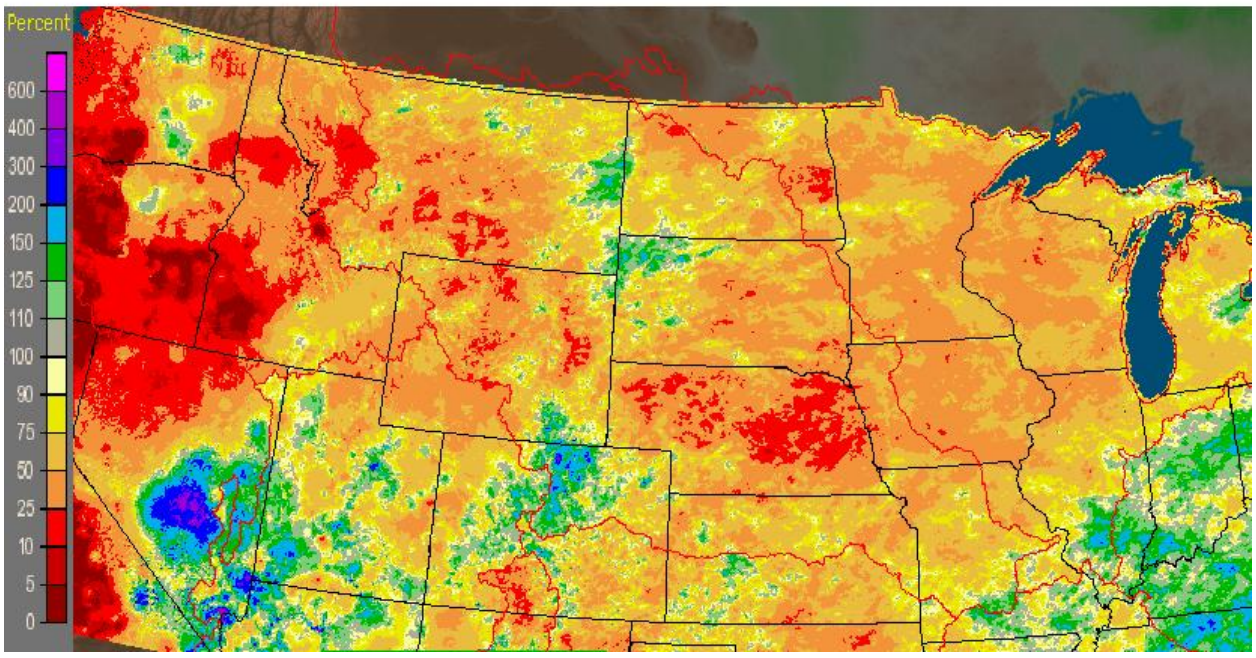


Figure 3. July-August-September 2012 Percent of Normal Precipitation. Source: National Weather Service.

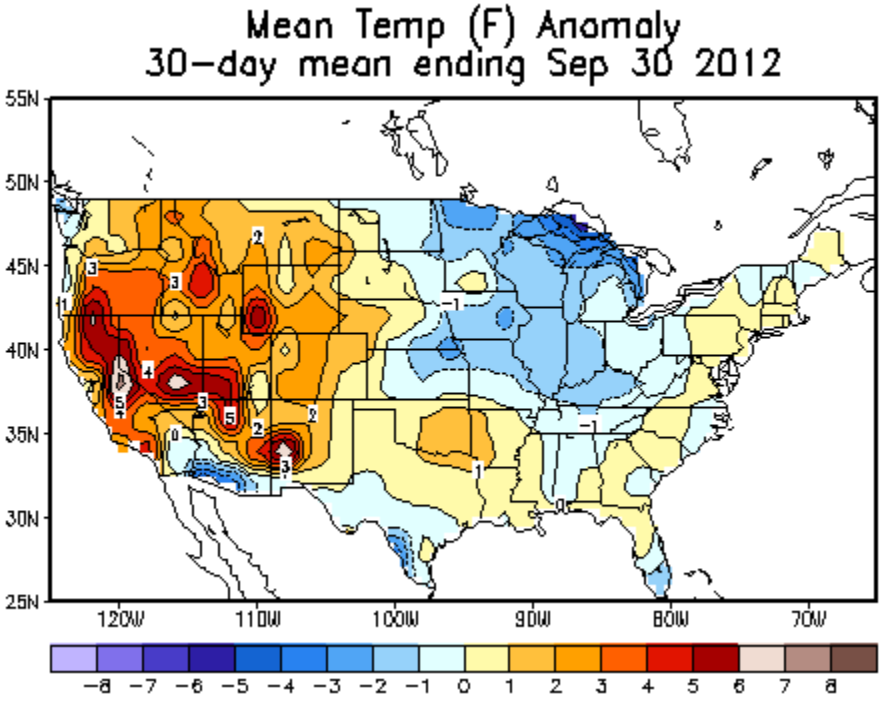


Figure 4. 30-day temperature anomaly (deg F) ending on September 30, 2012.

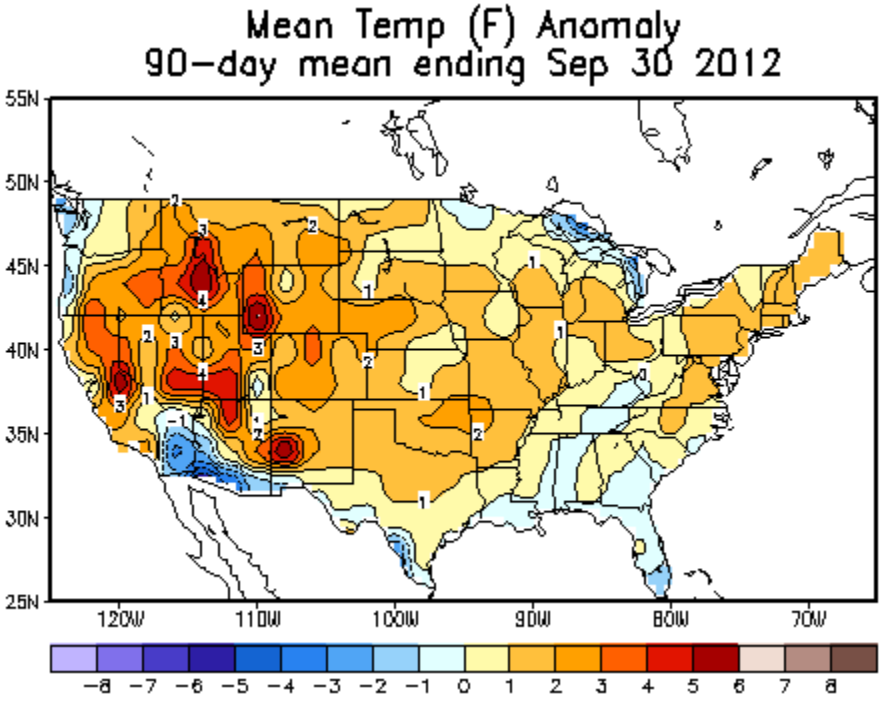


Figure 5. 90-day temperature anomaly (deg F) ending on September 30, 2012.

Soil Moisture Conditions

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically when soil moisture conditions are wet or greater than normal, rainfall and snowmelt runoff is greater than when soil moisture is dry or less than normal. Not only is soil moisture a physical parameter that influences runoff, it can be used as an indicator of future monthly runoff.

Two independent estimates of soil moisture are presented in this report. Figure 6 shows the Climate Prediction Center's calculated soil moisture ranking percentiles for September 2012. Figure 7 shows the Variable Infiltration Capacity model soil moisture percentiles as of October 1, 2012.

Both soil moisture rankings depict very dry soil moisture conditions throughout the upper Missouri River basin; however, there are some differences in the model results. CPC soil moisture conditions in the upper Missouri River basin rank from the 20th to the 1st percentile, which is extremely dry, while the VIC model soil moisture conditions rank from the 20th to a level just below the 2nd percentile. CPC's soil moisture places the driest soil conditions in southern Montana, southern South Dakota, Wyoming, Nebraska and Iowa. The VIC model places the driest soil moisture conditions throughout most of the upper Missouri River basin with the exception of central Montana. In our analysis of the influence of soil moisture on forecast runoff, neither model takes preference over the other. As an indicator of future monthly runoff, soil moisture conditions suggest runoff will be well-below average when considered along with the temperature and precipitation outlooks, which are discussed in more detail later in this write-up.

In comparison to this time last year, the CPC's soil moisture percentile rankings in much of the upper basin were in the 80th to 95th percentile. Runoff during the 2011 October-December period was 139% of normal.

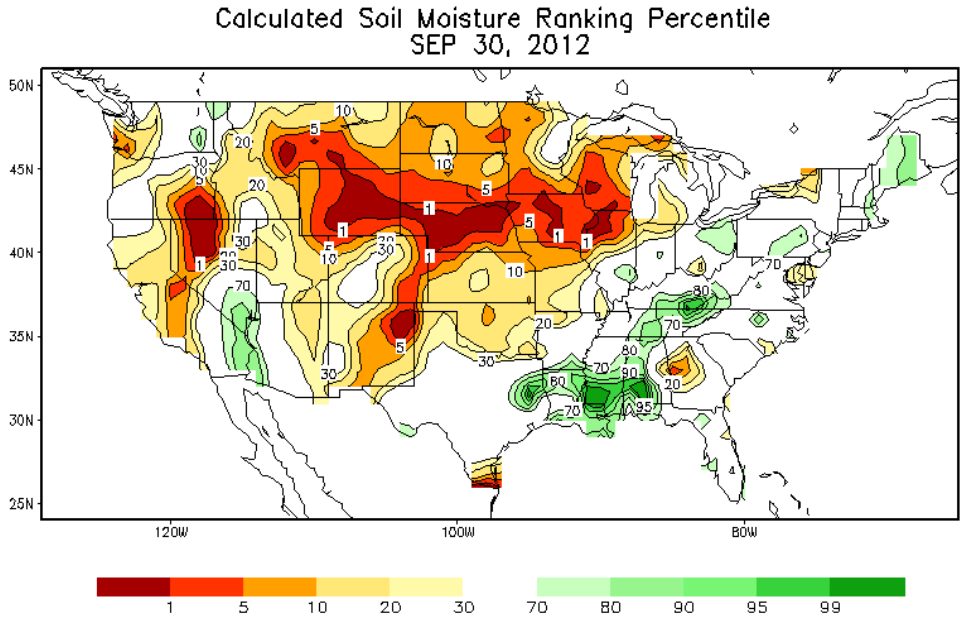


Figure 6. Calculated Soil Moisture Ranking Percentile for September 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml

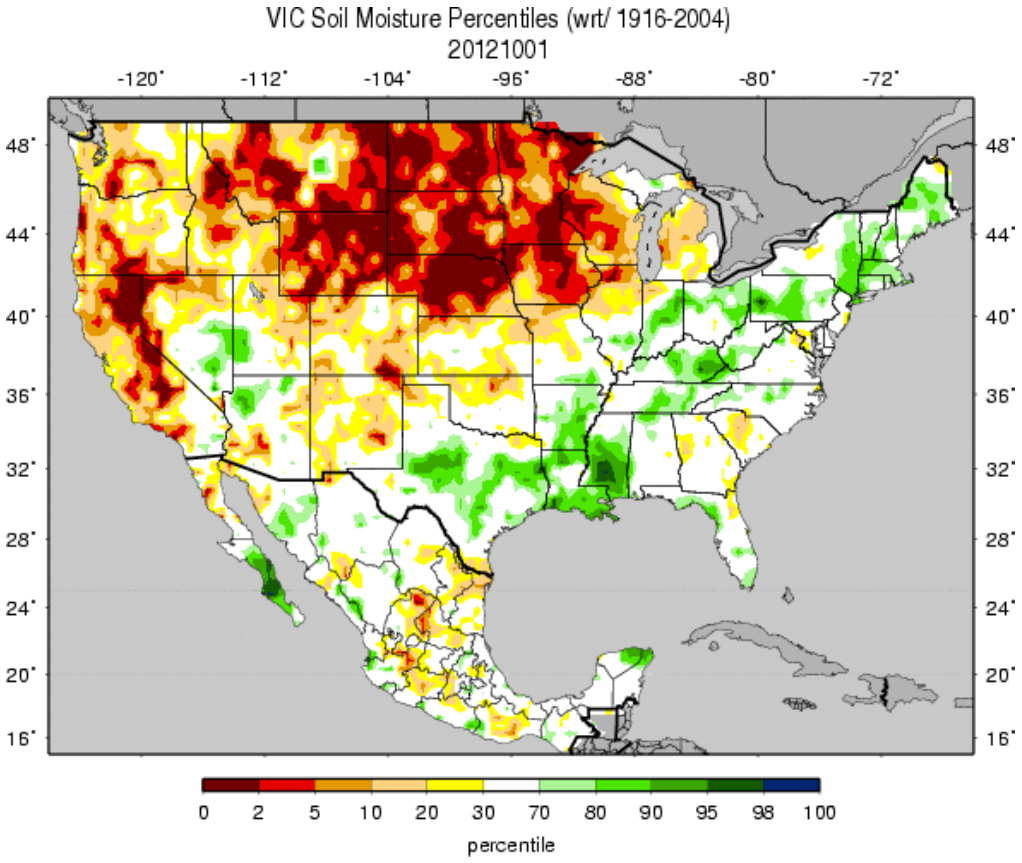


Figure 7. VIC modeled soil moisture percentiles as of October 1, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Drought Analysis

Drought conditions continued to worsen during September with many areas in the upper Missouri River basin degrading one drought category according to the National Drought Mitigation Center's (NDMC) drought monitor (Figure 8). Some form of drought is now affecting almost the entire upper Missouri River basin. Extreme (D3) and Exceptional (D4) Drought categories have expanded north and are now being seen over the southern half of South Dakota and portions of Wyoming.

The seasonal drought outlook effective from September 20 to December 31, 2012 is shown in Figure 9. The U.S. Seasonal Drought Outlook is predicting persistent drought in areas already impacted by drought, and the development of more intense forms of drought in parts of Montana and the Dakotas.

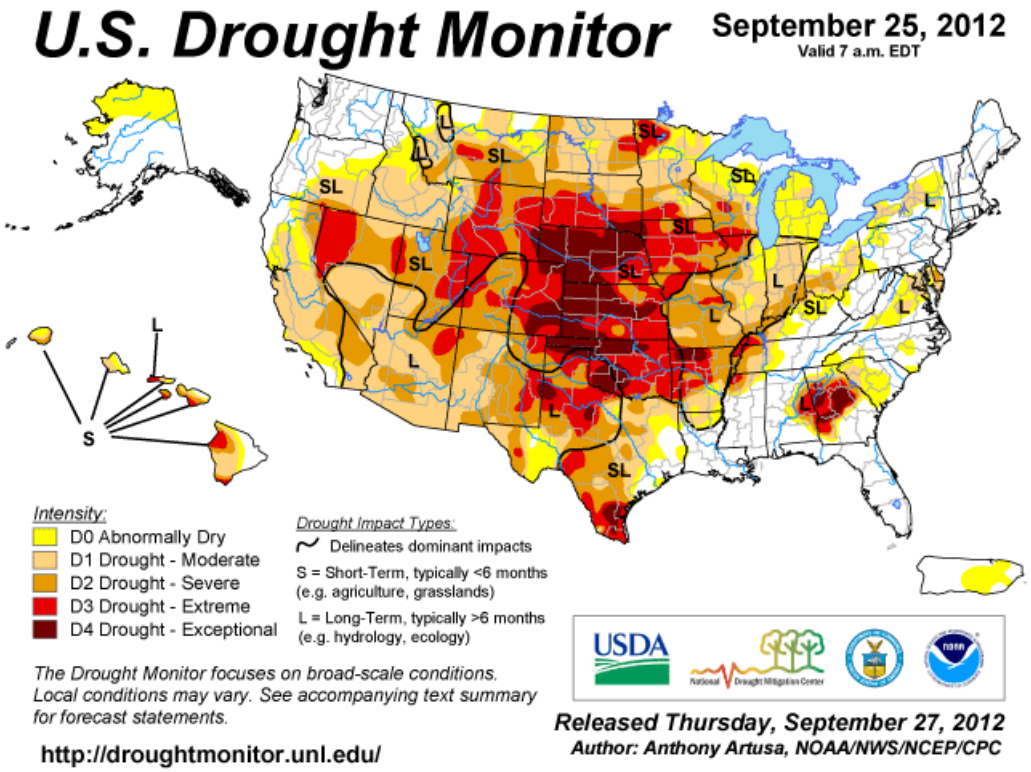


Figure 8. National Drought Mitigation Center U.S. Drought Monitors for September 25, 2012.

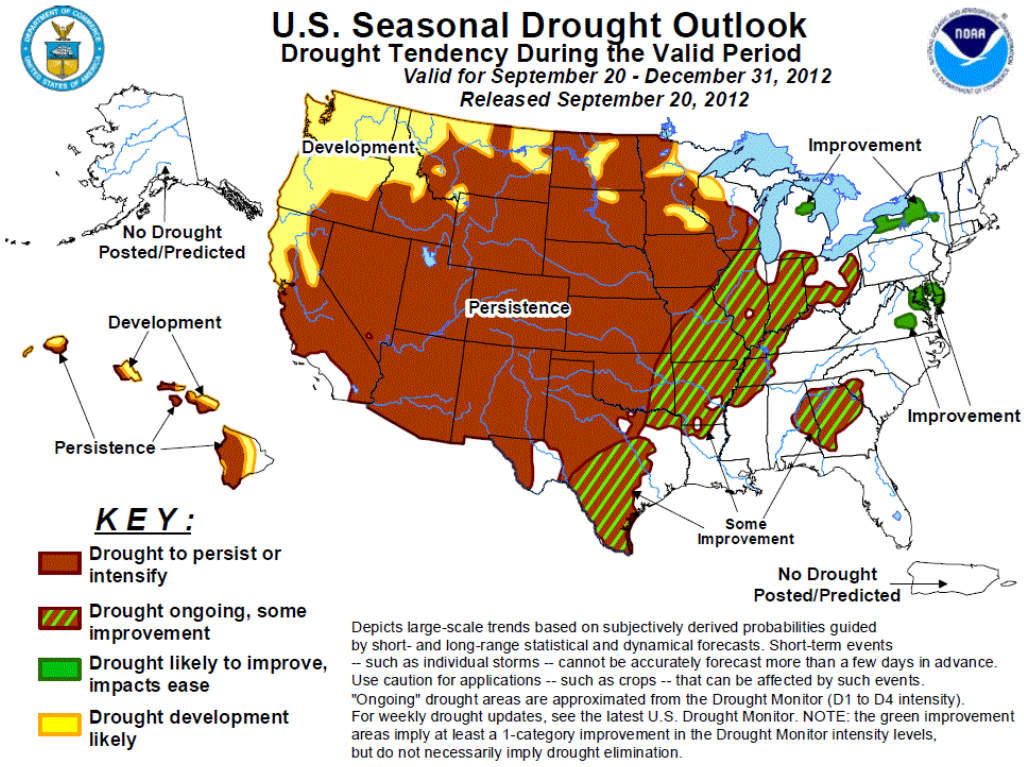


Figure 9. **National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for 20 Sept – 31 Dec 2012**

Climate Outlook

ENSO-neutral conditions continue in the equatorial Pacific, although equatorial sea surface temperatures are 0.5 degrees C above average across the eastern Pacific Ocean, which indicates a possible transition from ENSO-neutral to El Nino conditions. According to the CPC, El Nino conditions are likely to develop during Fall 2012. The last time El Nino conditions persisted in the equatorial Pacific was during the fall and winter of 2009-2010. During El Nino (warm) episodes, winters in the upper portions of the Missouri River basin have a tendency to be warmer and drier than normal.

The 8-14 Day (Figure 10) Outlooks indicate that temperatures are very likely to be above normal in the western half of Montana through mid-October, while temperatures in the mid to lower Missouri River basin are likely to be below normal. The probability for below normal precipitation is greater for much of the Missouri River basin through mid-October.

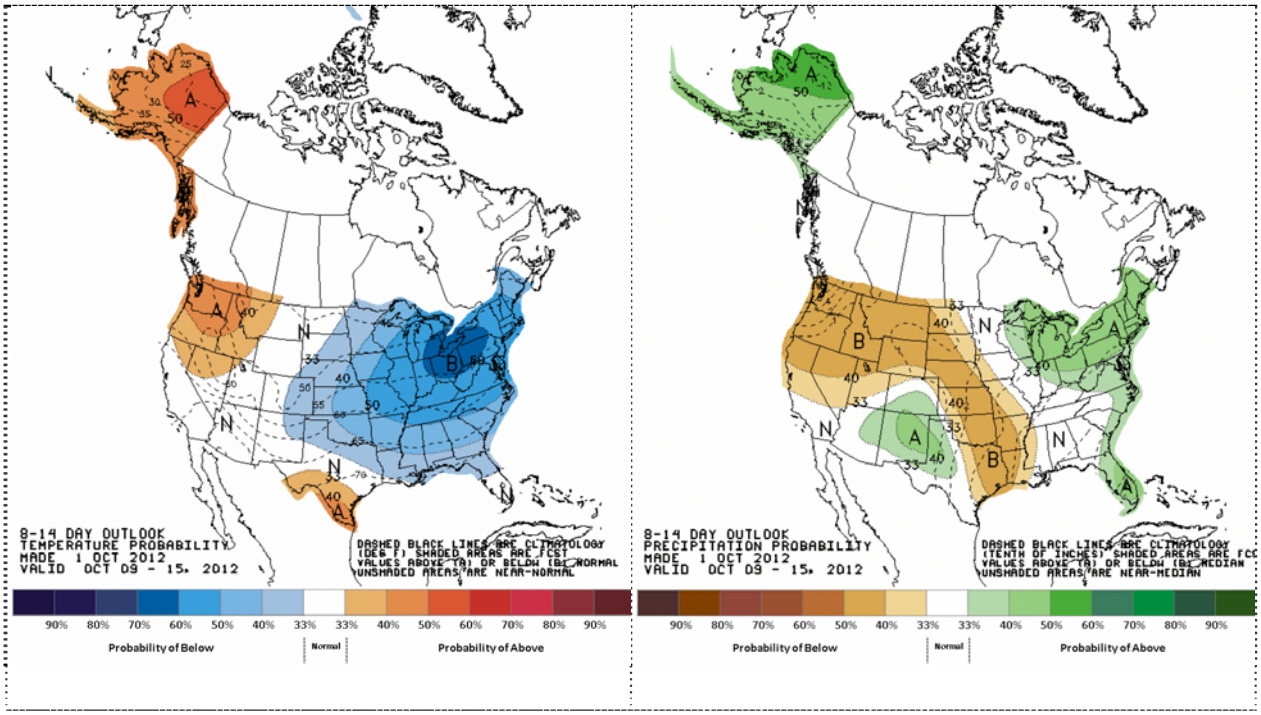


Figure 10. CPC 8-14 day temperature and precipitation outlooks.

During October the Climate Prediction Center is predicting increased chances for above normal temperatures in the Rocky Mountains and increased chances for below normal temperatures in eastern areas of the upper basin (Figure 11). The probability for above, below and normal precipitation is equal chances in the entire basin in October. According to the CPC, El Nino conditions are likely to develop in Fall 2012. As a result, the CPC 3-month outlook is predicting an increased probability for above normal temperatures in the Missouri basin through December; however, the impact to precipitation is less certain resulting in equal chances for above, below and normal precipitation throughout most of the basin (Figure 12). The exception is far western Montana where probabilities favor below normal precipitation. The January – March 2013 CPC Outlook (Figure 13) contains a forecast similar to the October – December 2012 outlook.

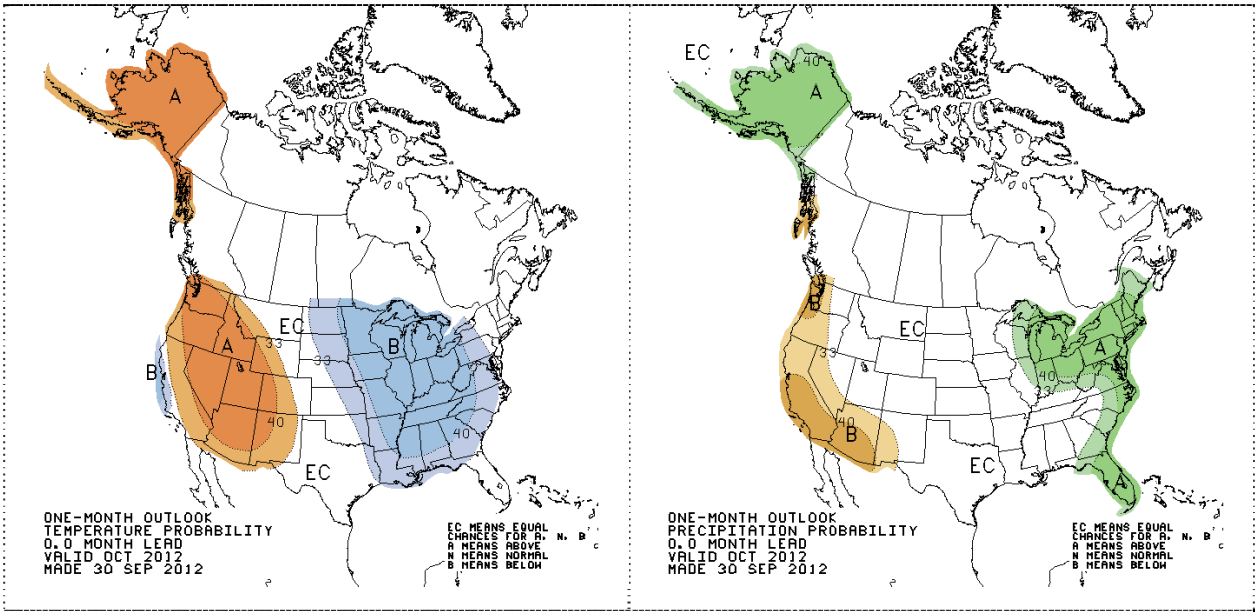


Figure 11 CPC October 2012 temperature and precipitation outlooks.

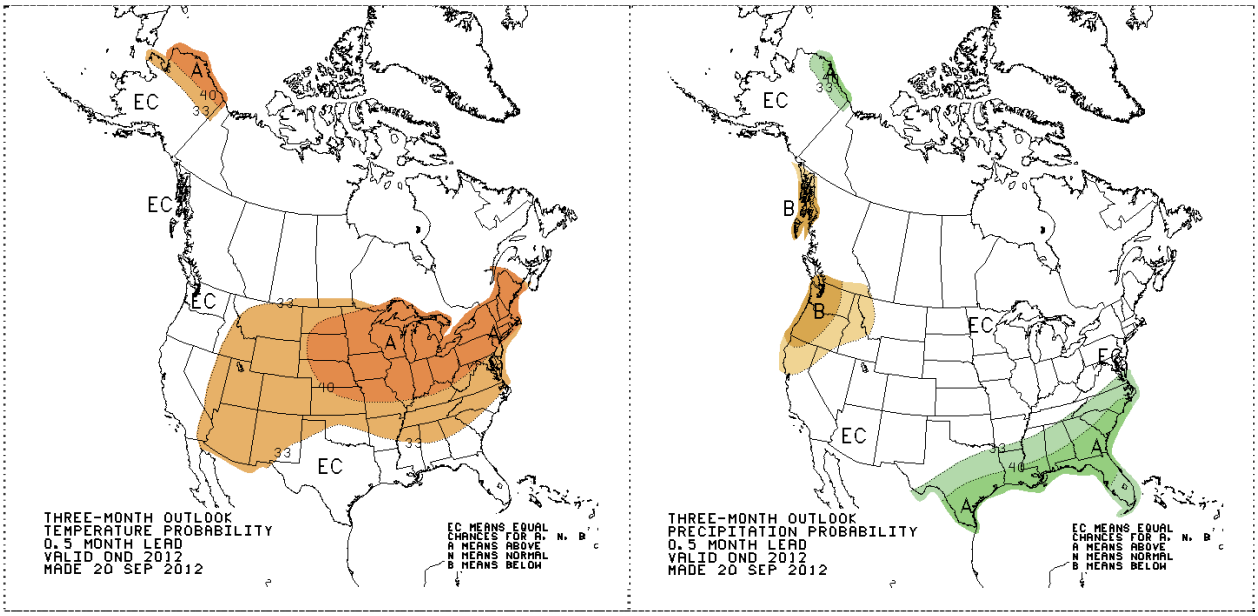


Figure 12. CPC October-November-December 2012 temperature and precipitation outlooks.

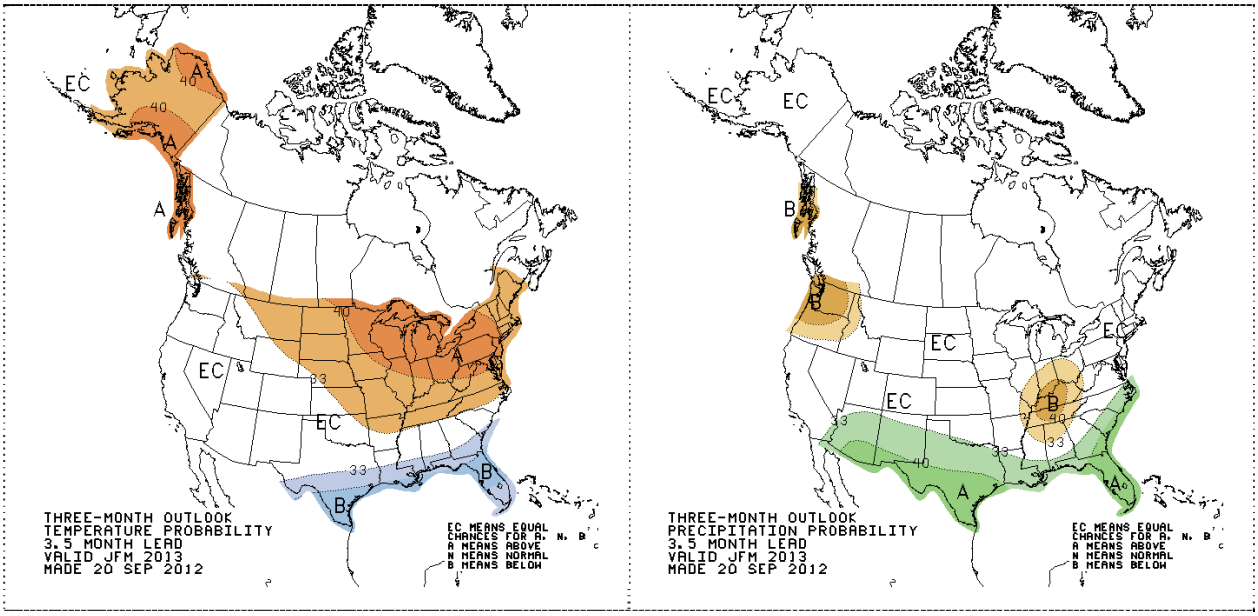


Figure 13. CPC January-February-March 2013 temperature and precipitation outlooks.

Summary – October 2012 Calendar Year Runoff Forecast

The October 1 calendar year runoff forecast above Sioux City, IA is **19.0 MAF** (77% of normal) and **17.0 MAF** (75% of normal) above Gavins Point Dam. This is a decrease of 1.7 MAF from the September 1 forecast. Due to the amount of variability in precipitation that can occur over the next 3 months, the expected inflow ranges from the 19.3 MAF upper basic forecast to the 18.7 MAF lower basic forecast.

The October–December runoff forecasts for all reaches were determined by first comparing the August–September 2012 runoff period with historic runoff periods. Additionally, September 2012 runoff was ranked versus historic September runoff. From this data, average October–December runoff volumes to be used as a starting point for the October–December 2012 runoff forecast were computed from a range of runoff volumes that occurred within a narrow range of historic runoff years similar to August–September 2012. Furthermore, surrogate runoff years similar to August–September 2012 were identified and used as monthly patterns that could be applied to the starting point runoff forecast. Finally, individual monthly volumes were adjusted to provide for a smooth transition between runoff months. These runoff volume forecasts were justified by evaluating the influence that current soil moisture conditions, antecedent precipitation conditions, precipitation and temperature outlooks would have on the October–December runoff.

The final October–December runoff forecast above Sioux City, IA is 1.5 MAF of runoff. This would rank as the second lowest 3-month October-December runoff volume behind 1.4 MAF in 1935. October runoff is forecast to be 0.5 MAF (41% of normal), which is an increase from the

0.3 MAF (25% of normal) of runoff that occurred in September. November runoff is forecast to be 0.6 MAF (53% of normal) while December runoff is forecast to be 0.5 MAF (64% of normal). The increase in runoff in the October–December period is supported by historic records which show that October, November and December runoff normally increases after very dry September periods, and the fact that seasonal increases in precipitation and decreases in evaporation allow runoff to increase. Though some improvement to runoff is expected during the remainder of 2012, extremely dry soil moisture conditions and the unclear precipitation forecast could limit the amount of runoff that occurs.

Upper Missouri River Basin
November 2012 Calendar Year Runoff Forecast
November 2, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

October 2012 Runoff

October runoff was 0.6 MAF (54% of normal) in the Missouri River basin above Sioux City, and 0.7 MAF (61% of normal) above Gavins Point.

2012 Calendar Year Forecast Synopsis

The calendar year runoff forecast above Sioux City, IA is **19.2 MAF** (78% of normal) and **17.3 MAF** (76% of normal) above Gavins Point Dam. This is an increase of 0.2 MAF from the October 1 forecast. Due to the amount of variability in precipitation that can occur over the next 3 months, the expected inflow ranges from the 19.5 MAF upper basic forecast to the 19.0 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given wetter-than-expected or drier-than-expected conditions. Given that 2 months are being forecasted on November 1 (10 months observed/2 months forecast), the range of greater than normal (upper basic) and lower than normal (lower basic) runoff is attributed to all 6 reaches for both months. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

Current Conditions

Precipitation

For the majority of the Basin, overall precipitation accumulations during the month of October were well below normal (Figures 1 and 2), although in Eastern Montana and Northern North Dakota were above normal. Portions of Nebraska and South Dakota received less that 25% of the normal October precipitation. The precipitation departure over the three-month August-September-October period ranged from 75% down to 10% (Figure 3).

Temperature

October temperatures in the Basin were 1 to 4 degrees F below normal (see Figure 4). Ninety-day (90-day) temperature departures ending on October 31, 2012 are shown in Figure 5. During this time period, average daily temperatures also ranged from 1 to 3 degrees F below normal throughout the Missouri River basin.

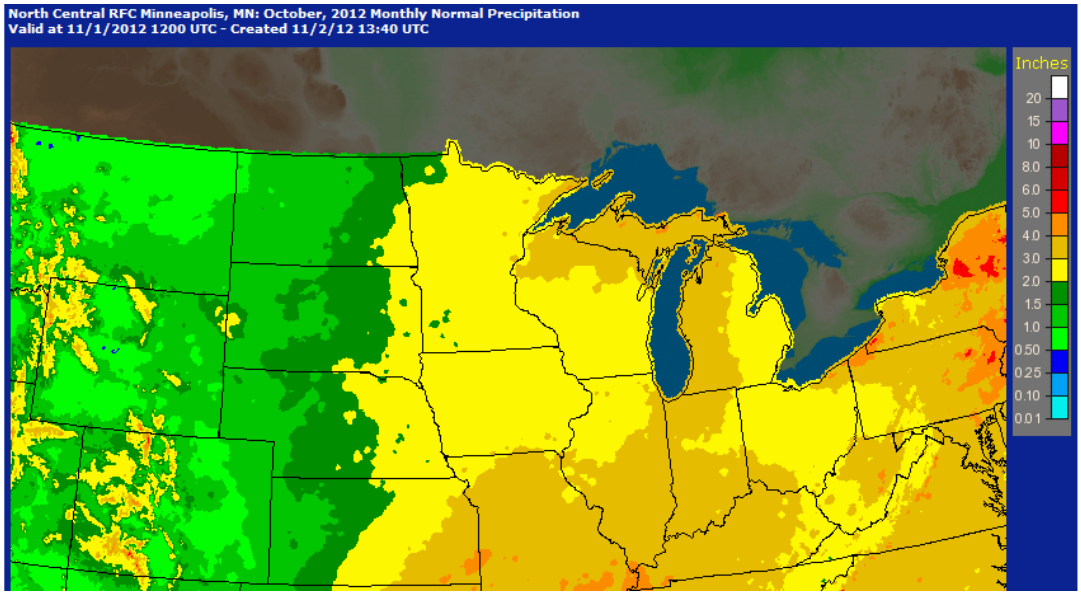


Figure 1. October 2012 Precipitation (inches). Source: National Weather Service.

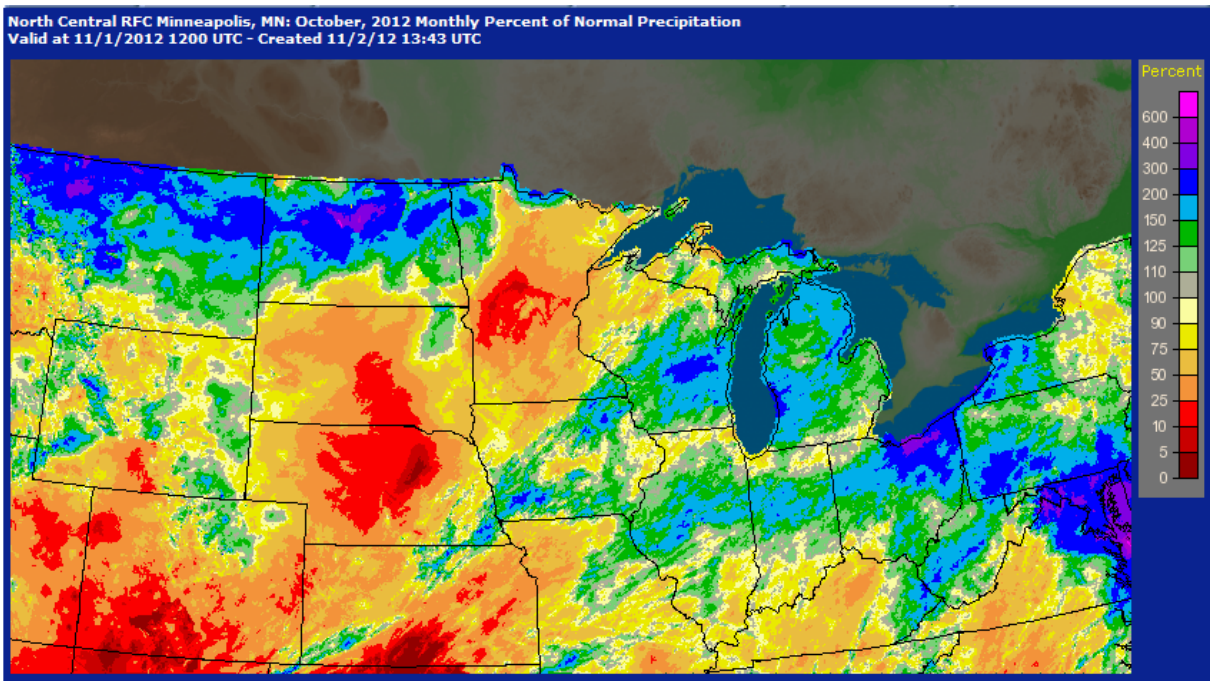


Figure 2. October 2012 Percent of Normal Precipitation. Source: National Weather Service.

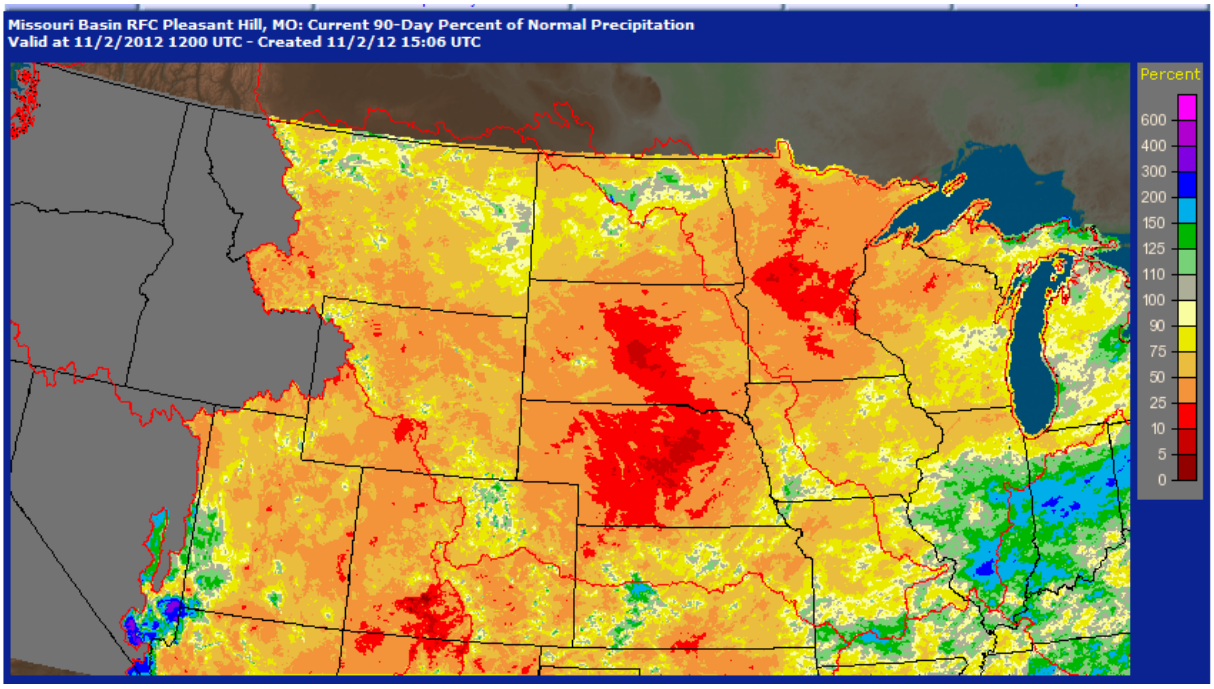


Figure 3. August-September-October 2012 Percent of Normal Precipitation. Source: National Weather Service.

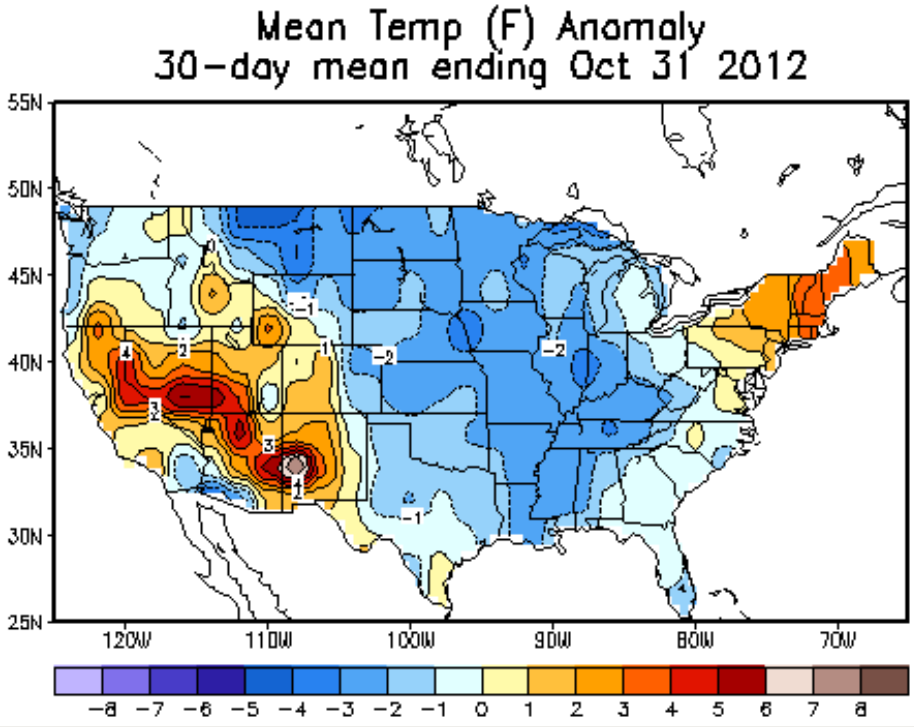


Figure 4. 30-day temperature anomaly (deg F) ending on October 31, 2012.

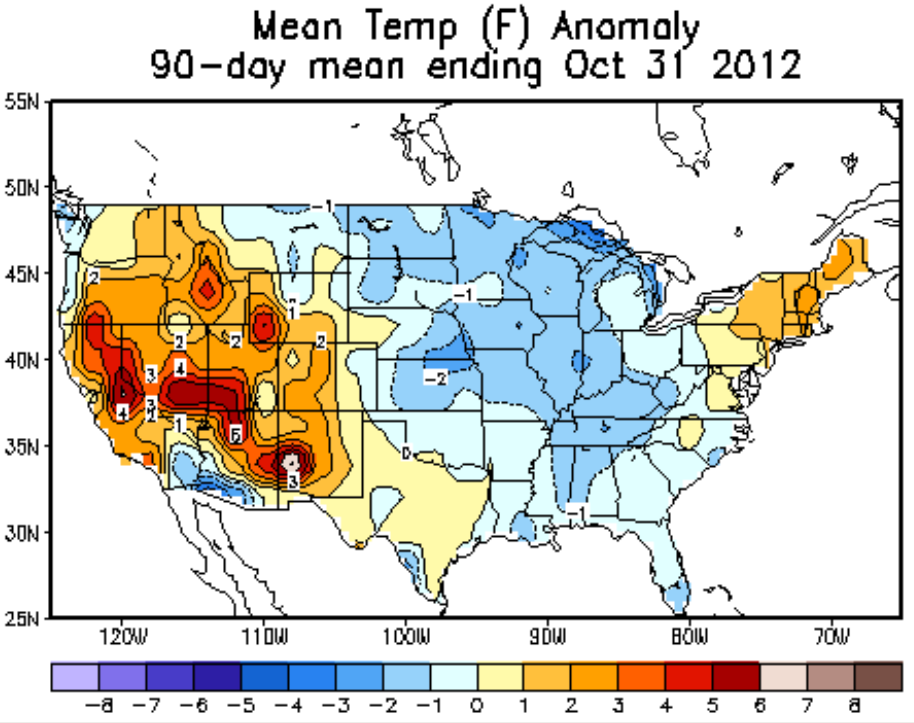


Figure 5. 90-day temperature anomaly (deg F) ending on Oct 31, 2012.

Soil Moisture Conditions

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically when soil moisture conditions are wet or greater than normal, rainfall and snowmelt runoff is greater than when soil moisture is dry or less than normal. Not only is soil moisture a physical parameter that influences runoff, it can be used as an indicator of future monthly runoff.

Two independent estimates of soil moisture are presented in this report. Figure 6 shows the Climate Prediction Center's calculated soil moisture ranking percentiles for October 2012. Figure 7 shows the Variable Infiltration Capacity model soil moisture percentiles as of November 1, 2012.

Both soil moisture rankings depict very dry soil moisture conditions throughout the upper Missouri River basin; however, there are some differences in the model results. CPC soil moisture conditions in the upper Missouri River basin rank from the 20th to the 1st percentile, which is extremely dry, while the VIC model soil moisture conditions rank from the 20th to a level just below the 2nd percentile. CPC's soil moisture places the driest soil conditions in southern Montana, southern South Dakota, Wyoming, Nebraska and Iowa. The VIC model places the driest soil moisture conditions throughout most of the upper Missouri River basin with the exception of central Montana. In our analysis of the influence of soil moisture on forecast runoff, neither model takes preference over the other. As an indicator of future monthly runoff, soil moisture conditions suggest runoff will be well-below average when considered along with the temperature and precipitation outlooks, which are discussed in more detail later in this write-up.

In comparison to this time last year, the CPC's soil moisture percentile rankings in much of the upper basin were in the 80th to 95th percentile. Runoff during the 2011 October-December period was 139% of normal.

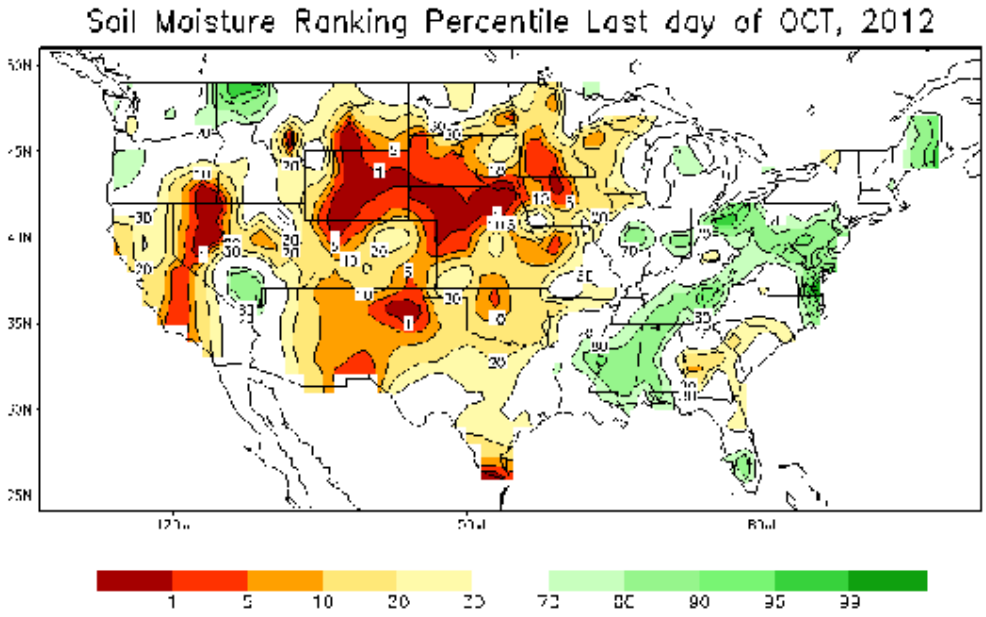


Figure 6. Calculated Soil Moisture Ranking Percentile for October 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml

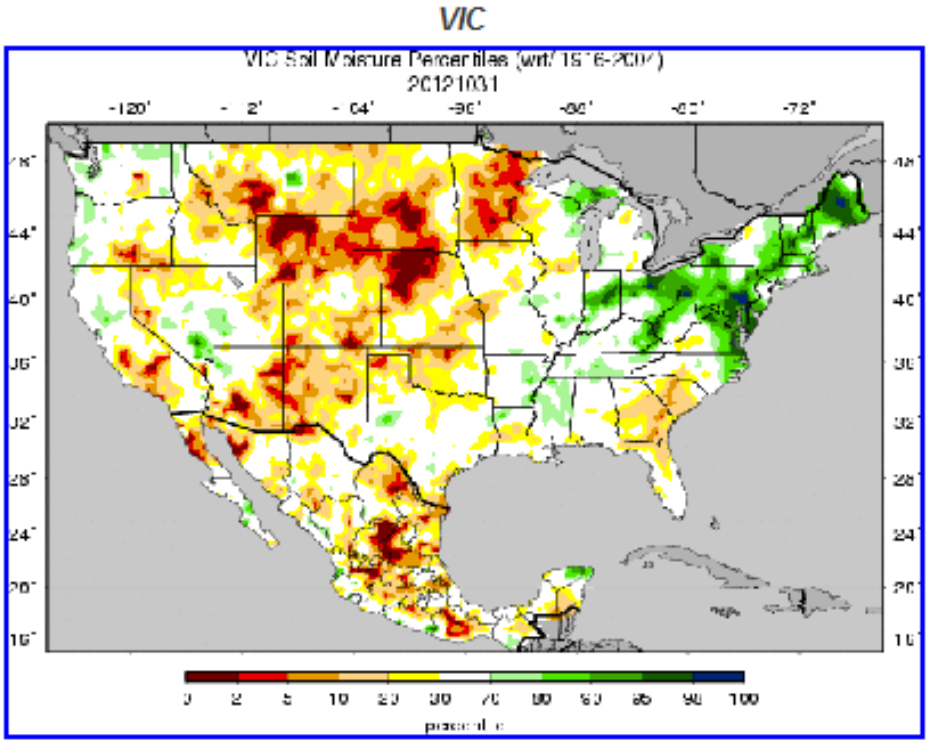


Figure 7. VIC modeled soil moisture percentiles as of November 1, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Drought Analysis

Drought conditions remained relatively the same in October as they did in September according to the National Drought Mitigation Center's (NDMC) drought monitor (Figure 8). Some form of drought is now affecting almost the entire upper Missouri River basin. Extreme (D3) and Exceptional (D4) Drought categories have expanded north and are now being seen over the southern half of South Dakota and portions of Wyoming.

The seasonal drought outlook effective from November 1, 2012 to January 31, 2013 is shown in Figure 9. The U.S. Seasonal Drought Outlook is predicting persistent drought in areas already impacted by drought, with some improvement in Montana and North Dakota

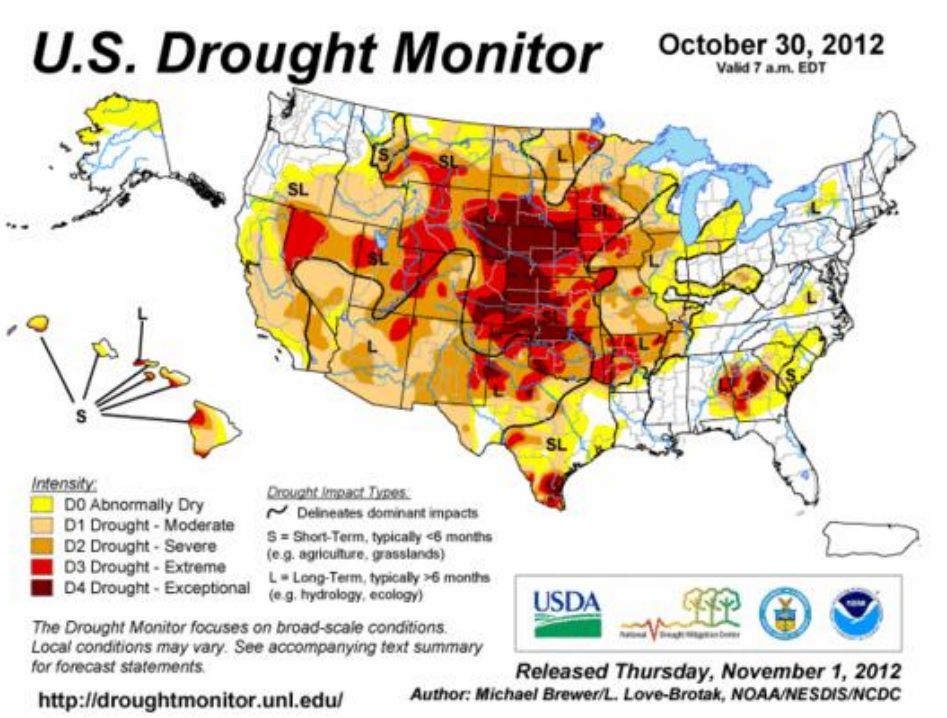


Figure 8. National Drought Mitigation Center U.S. Drought Monitors for October30, 2012.

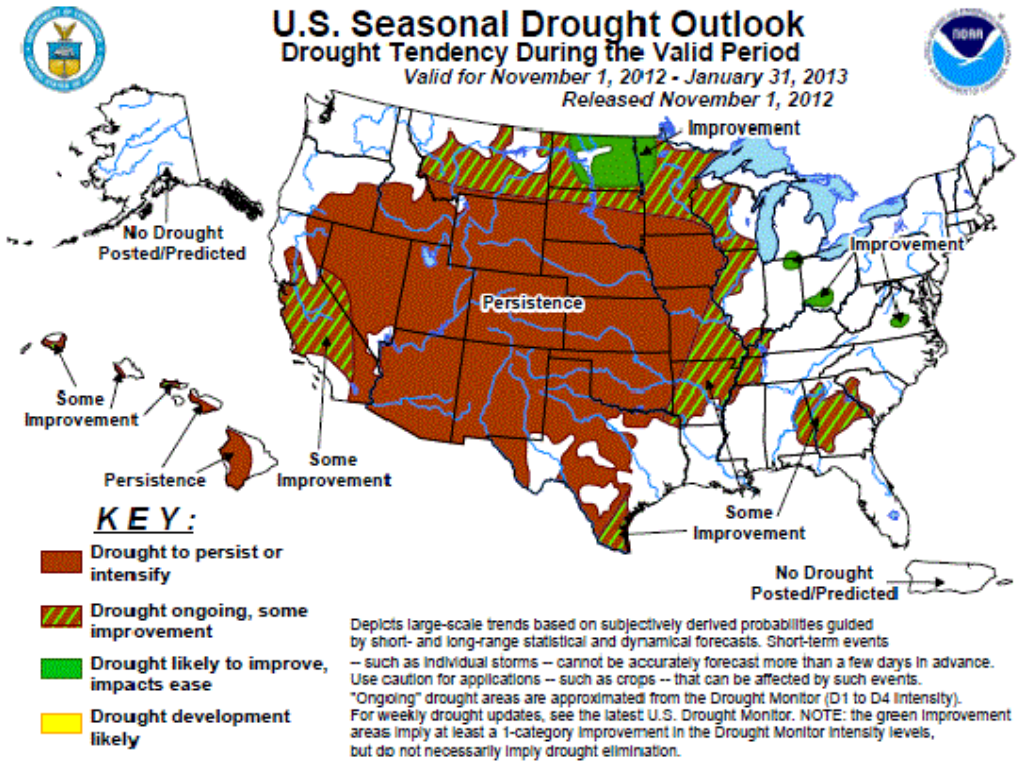


Figure 9. **National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for November 1, 2012 – January 31, 2012**

Climate Outlook

ENSO-neutral conditions continue in the equatorial Pacific, with weakening El Nino conditions. According to the CPC, El Nino conditions are likely to develop during Fall 2012. The last time El Nino conditions persisted in the equatorial Pacific was during the fall and winter of 2009-2010. During El Nino (warm) episodes, winters in the upper portions of the Missouri River basin have a tendency to be warmer and drier than normal.

The 8-14 Day (Figure 10) Outlooks indicate that temperatures are very likely to be above normal in the majority of the Basin. The probability for above normal precipitation is greater for much of the Missouri River basin through mid-November.

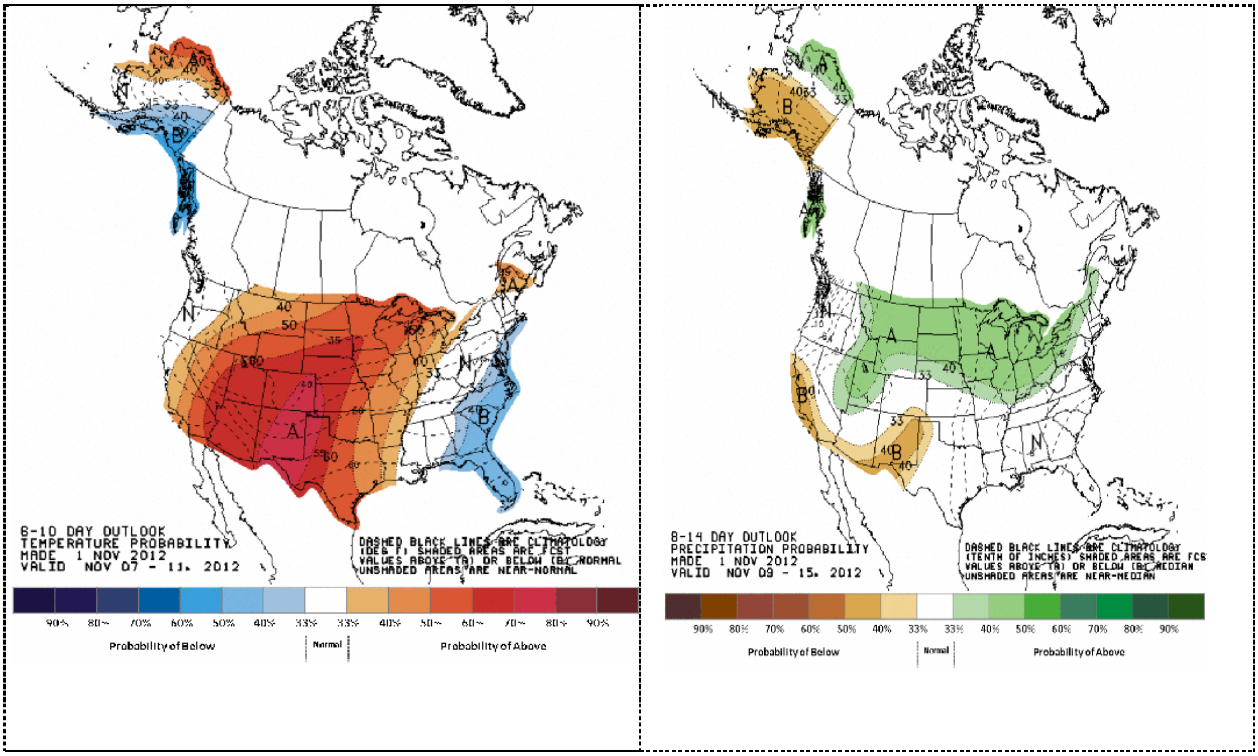


Figure 10. CPC 8-14 day temperature and precipitation outlooks.

During November the Climate Prediction Center is predicting increased chances for above normal temperatures for the majority of the Basin (Figure 11). The probability for above, below and normal precipitation is equal chances in the majority of the Basin in November, except for Montana and North Dakota. The CPC 3-month outlook is predicting an increased probability for above normal temperatures in the Missouri basin through January; with equal chances for above, below and normal precipitation in the Western portion of the Basin, and below chances for precipitation in the Eastern portion of the Basin (Figure 12). The January – March 2013 CPC Outlook (Figure 13) contains a forecast similar to the November - January 2013 outlook for temperature, but equal chances for above, below and normal precipitation in the Basin.

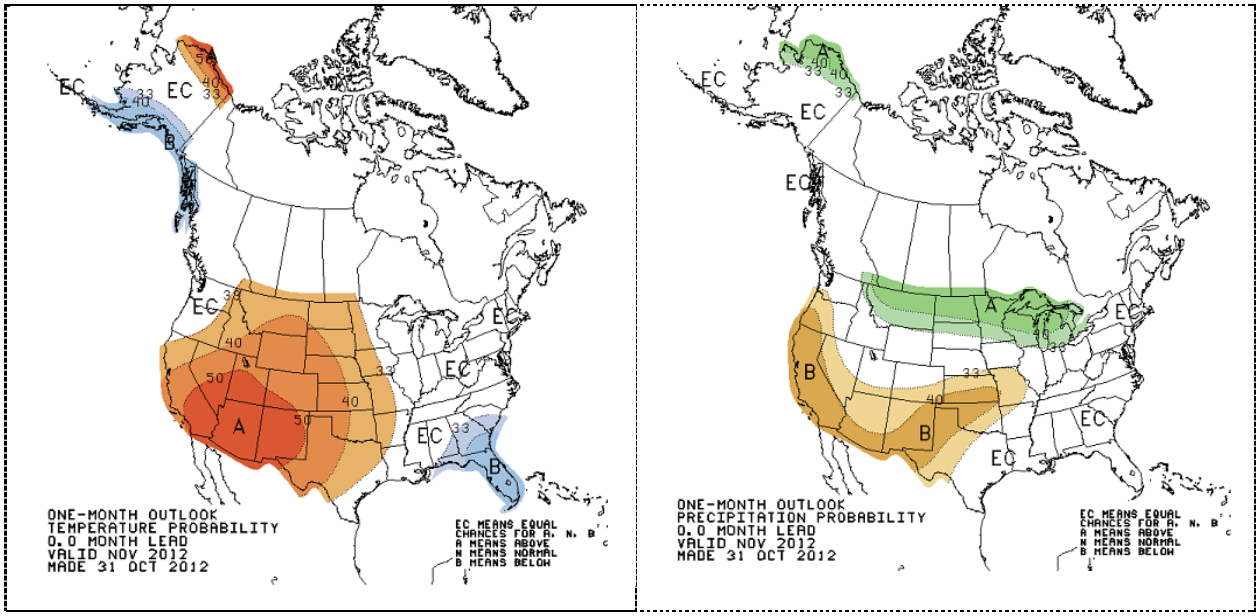


Figure 11 CPC November 2012 temperature and precipitation outlooks.

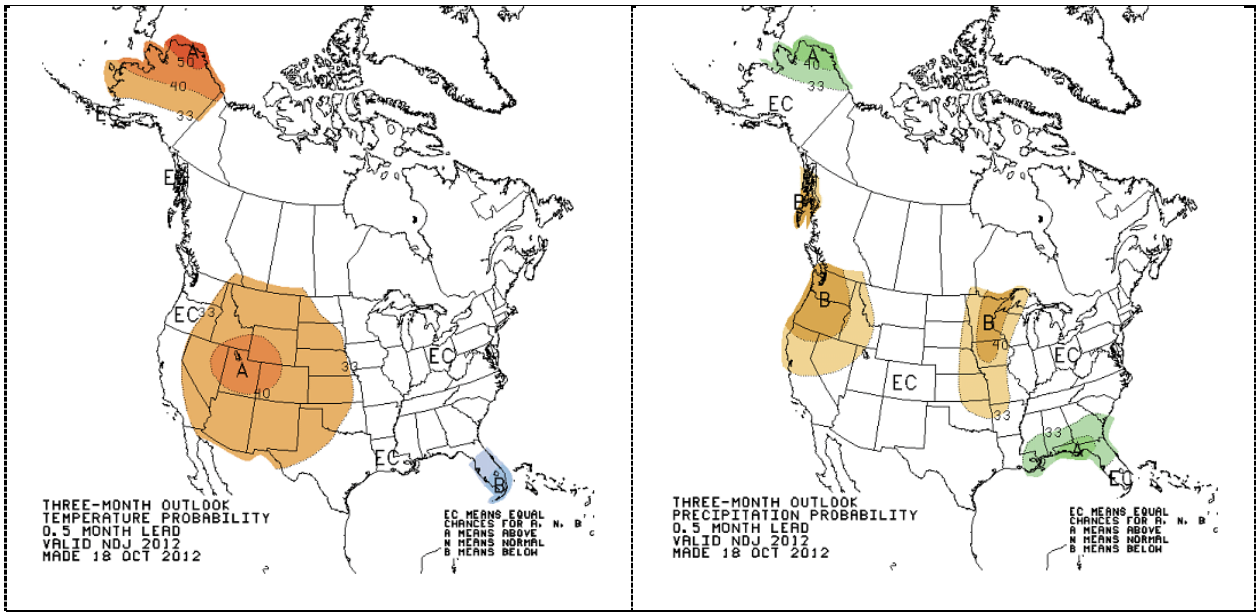


Figure 12. CPC November-December-January 2012/2013 temperature and precipitation outlooks.

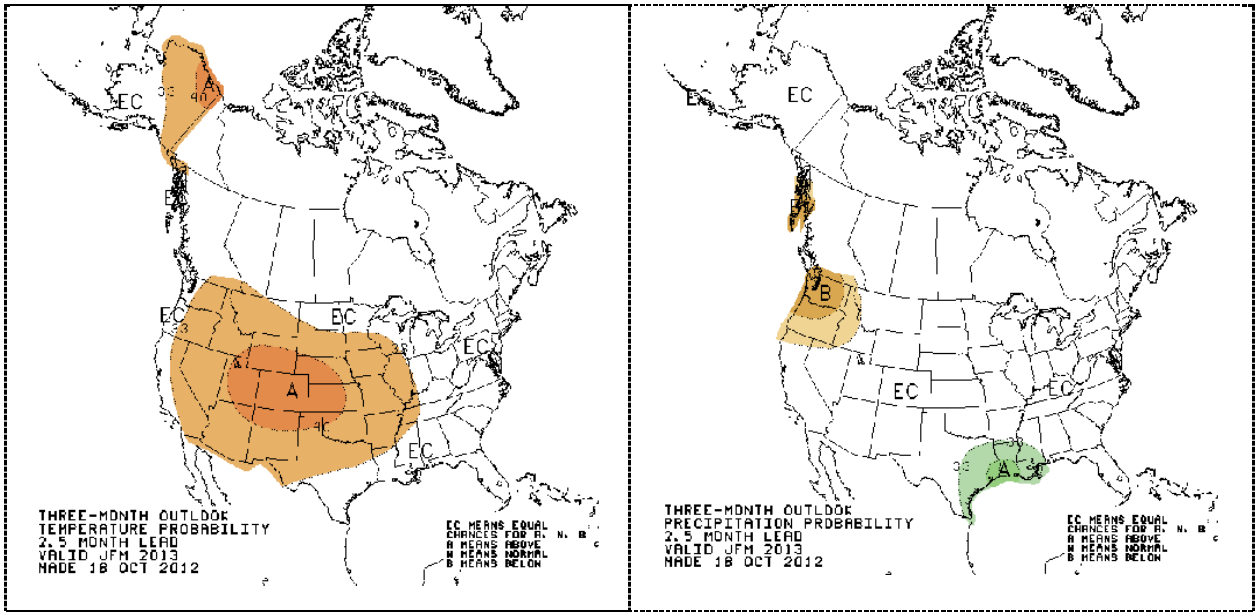


Figure 13. CPC January-February-March 2013 temperature and precipitation outlooks.

Summary – November 2012 Calendar Year Runoff Forecast

The November 1 calendar year runoff forecast above Sioux City, IA is **19.2 MAF** (78% of normal) and **17.3 MAF** (76% of normal) above Gavins Point Dam. This is an increase of 0.2 MAF from the October 1 forecast. Due to the amount of variability in precipitation that can occur over the next 2 months, the expected inflow ranges from the 19.5 MAF upper basic forecast to the 19.0 MAF lower basic forecast.

The November–December runoff forecasts for all reaches were determined by first comparing the September-October 2012 runoff period with historic runoff periods. From this data, average November–December runoff volumes to be used as a starting point for the November–December 2012 runoff forecast were computed from a range of runoff volumes that occurred within a narrow range of historic runoff years similar to September-October 2012. These runoff volume forecasts were justified by evaluating the influence that current soil moisture conditions, antecedent precipitation conditions, precipitation and temperature outlooks would have on the November–December runoff.

November runoff is forecast to be 0.6 MAF (59% of normal). December runoff is forecast to be 0.5 MAF (67% of normal). Though some improvement to runoff is expected during the remainder of 2012, extremely dry soil moisture conditions and the unclear precipitation forecast could limit the amount of runoff that occurs.

Upper Missouri River Basin
December 2012 Calendar Year Runoff Forecast
December 3, 2012

U.S. Army Corps of Engineers, Northwestern Division
Missouri River Basin Water Management
Omaha, NE

Calendar Year Runoff Forecast

Explanation and Purpose of Forecast

The long-range runoff forecast is presented as the Calendar Year Runoff Forecast. This forecast is developed shortly after the beginning of each calendar year and is updated at the beginning of each month to show the actual runoff for historic months of that year and the updated forecast for the remaining months of the year. This forecast presents monthly inflows in million acre-feet (MAF) from five incremental drainage areas, as defined by the individual System projects, plus the incremental drainage area between Gavins Point Dam and Sioux City. Due to their close proximity, the Big Bend and Fort Randall drainage areas are combined. Summations are provided for the total Missouri River reach above Gavins Point Dam and for the total Missouri River reach above Sioux City. The Calendar Year Runoff Forecast is used in the Monthly Study simulation model to plan future system regulation in order to meet the authorized project purposes throughout the calendar year.

November 2012 Runoff

November runoff was 0.9 MAF (917 KAF) in the Missouri River basin above Sioux City, which is 87% of normal. Rainfall in excess of 150% of normal in the Fort Peck and Garrison reaches were the primary factors leading to increased runoff in November. Previous accumulated monthly runoff volumes above Sioux City included 0.3 MAF (285 KAF) in September and 0.6 MAF (639 KAF) in October.

2012 Calendar Year Forecast Synopsis

The December 1 calendar year runoff forecast above Sioux City, IA is **19.7 MAF** (79% of normal) and **17.8 MAF** (78% of normal) above Gavins Point Dam. This is an increase of 0.5 MAF from the November 1 forecast. Due to the amount of variability in precipitation that can occur over the next month, the expected inflow ranges from the 19.8 MAF upper basic forecast to the 19.6 MAF lower basic forecast. The upper and lower basic forecasts provide a likely range of runoff scenarios that could occur given wetter-than-expected or drier-than-expected conditions. Given that 1 month is being forecasted on December 1 (11 months observed/1 months forecast), the range of greater than normal (upper basic) and lower than normal (lower

basic) runoff is attributed to all 6 reaches for both months. The result is a range or "bracket" for each reach, and thus, for the total runoff forecast.

Current Conditions

Precipitation

November precipitation accumulations ranged from 0.5 to 1.5 inches in the plains region of Montana, northern Wyoming and northern North Dakota. The mountain region of Montana and Wyoming received 2.0 to 4.0 inches of precipitation (Figure 1). These regions received between 150 and 300 percent of normal with some locally greater departures (Figure 2). For the majority of the Missouri River basin, overall precipitation accumulations during the month of November were well below (Figure 2). There was a lack of precipitation in the central area of the basin where accumulations were less than 50% of normal. Portions of Nebraska and South Dakota received less that 25% of the normal November precipitation. During the three-month September-October-November period, precipitation ranged from 75% down to 10% of normal, especially in central Nebraska and central South Dakota (Figure 3).

Year-to-date precipitation has produced some of the driest conditions in the 118-year precipitation record. Among Missouri River basin states, the January-October 2012 precipitation accumulation was the driest on record in Wyoming and Nebraska. South Dakota, Iowa, Kansas and Colorado also ranked much below normal.

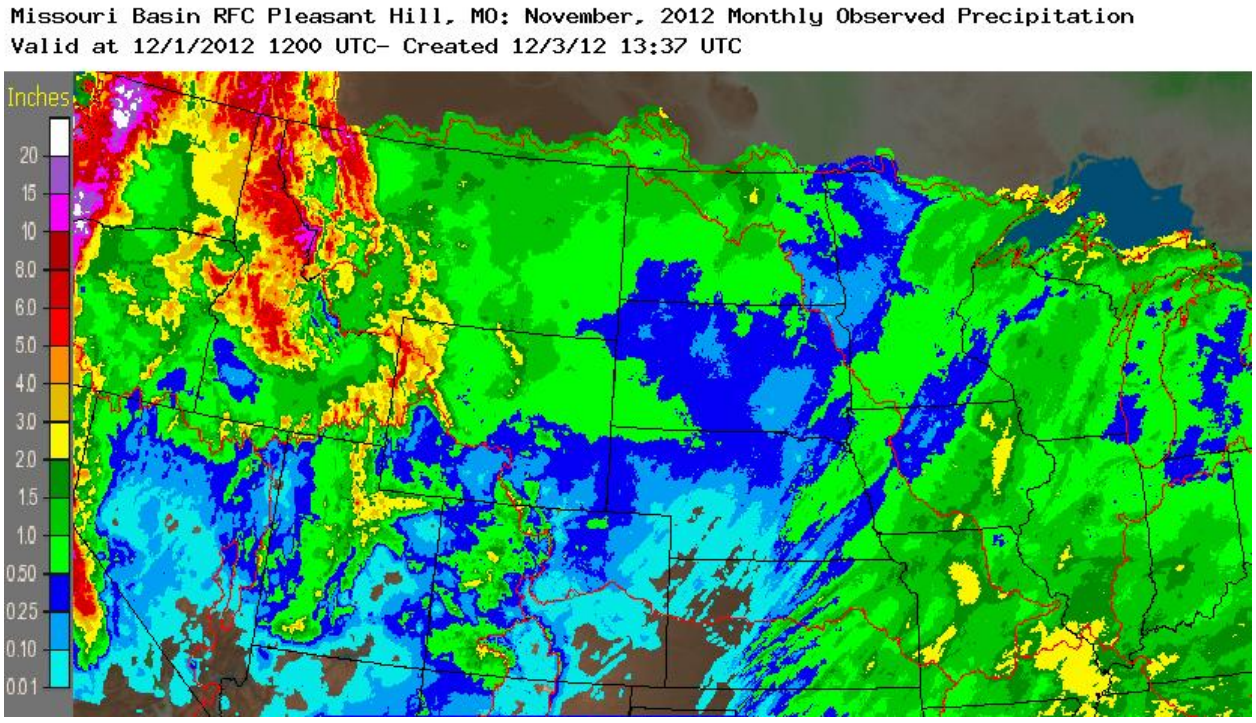


Figure 1. November 2012 Precipitation (inches). Source: National Weather Service.

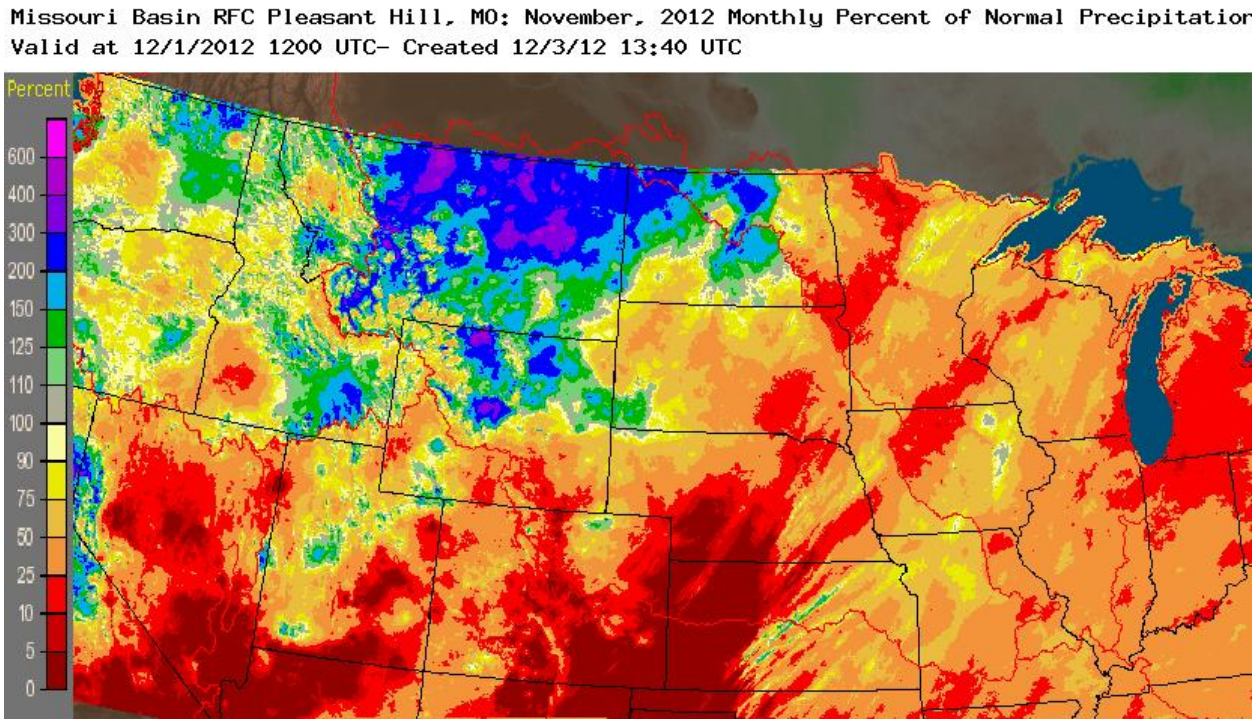


Figure 2. November 2012 Percent of Normal Precipitation. Source: National Weather Service.

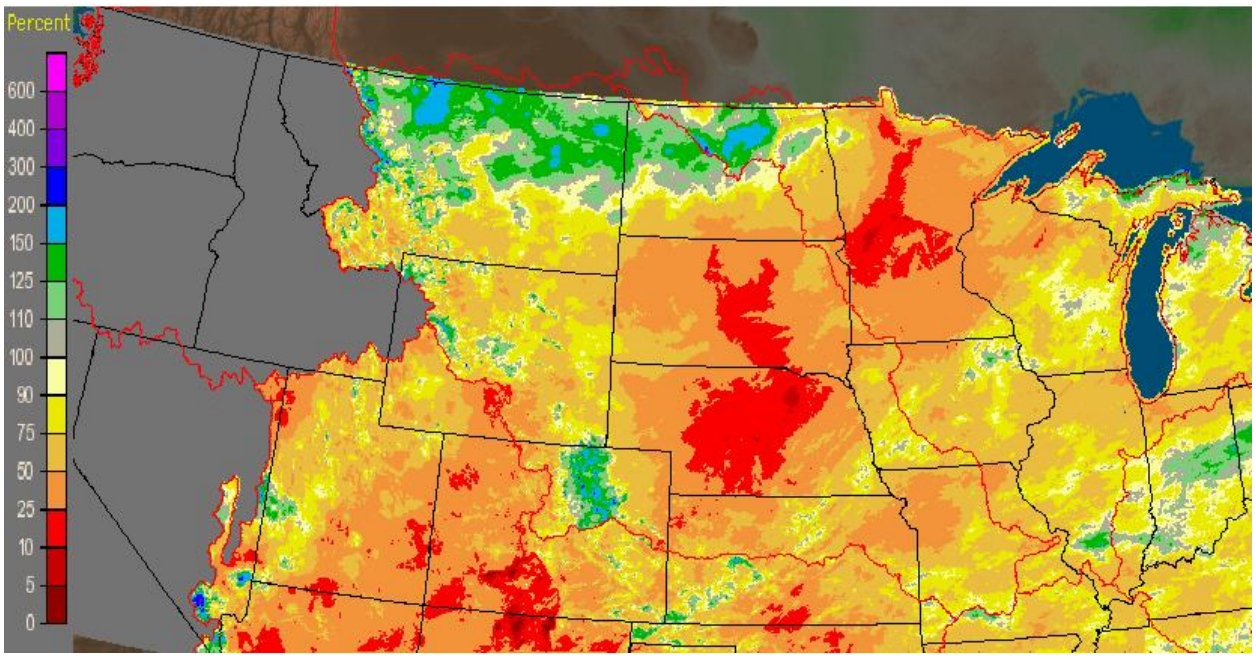


Figure 3. September-October-November 2012 Percent of Normal Precipitation. Source: National Weather Service.

Temperature

November temperatures were 2 to 5 degrees F above normal throughout most of the Missouri River basin (see Figure 4). The greatest departures occurred in the Rocky Mountain regions of Montana and Wyoming. The northern plains of Montana and North Dakota experienced November temperature departures of about 1 degree F. Ninety-day (90-day) temperature departures ending on December 1, 2012 are shown in Figure 5. During this time period, average daily temperatures ranged from normal to 2 degrees F above normal throughout the Missouri River basin.

Year-to-date temperatures have been among the warmest temperatures in the 118-year temperature record. Among Missouri River basin states, the January-October 2012 temperatures were the warmest on record in North Dakota, South Dakota, Wyoming, Iowa, Kansas and Missouri. Temperatures in Montana, Nebraska and Colorado were the 2nd warmest in 118 years of record.

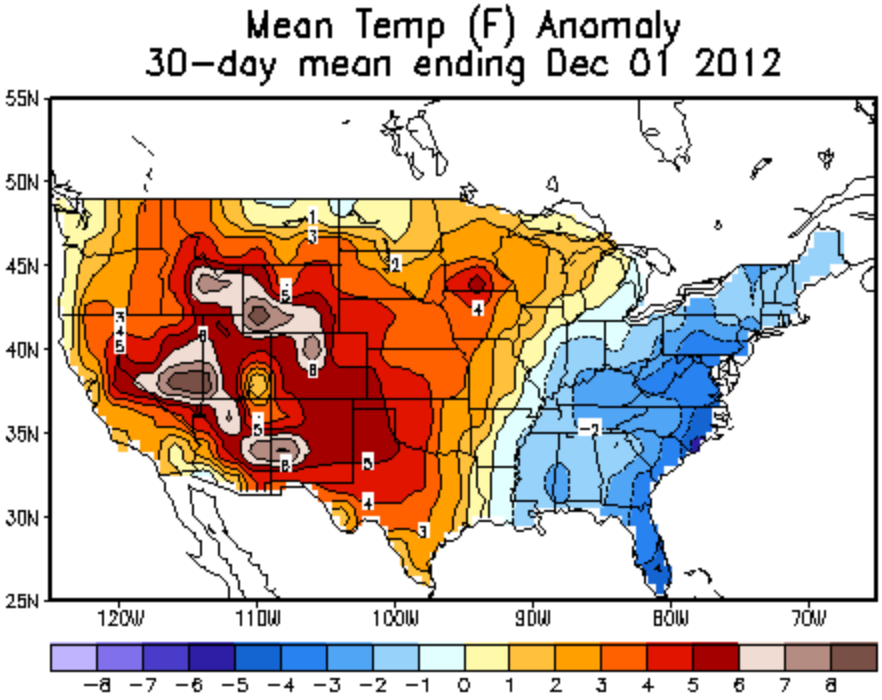


Figure 4. 30-day temperature anomaly (deg F) ending on Nov 28, 2012.

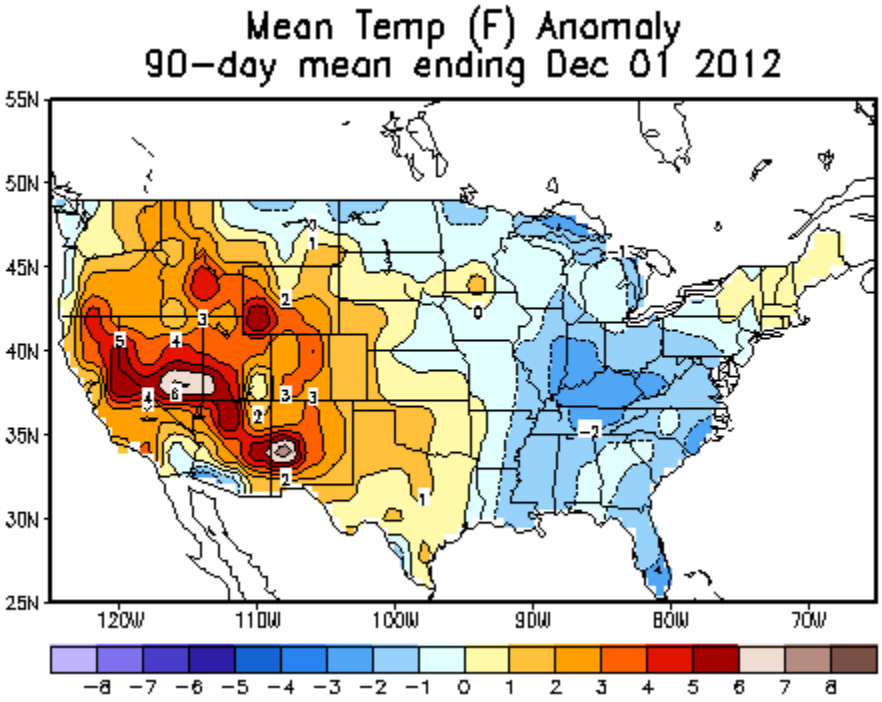


Figure 5. 90-day temperature anomaly (deg F) ending on December 1, 2012.

Soil Moisture Conditions

Soil moisture is factored into the forecast as an indicator of wet or dry hydrologic basin conditions. Typically when soil moisture conditions are wet or greater than normal, rainfall and snowmelt runoff is greater than when soil moisture is dry or less than normal. Not only is soil moisture a physical parameter that influences runoff, it can be used as an indicator of future monthly runoff.

Two independent estimates of soil moisture are presented in this report. Figure 6 shows the Climate Prediction Center's calculated soil moisture ranking percentiles for the end of November 2012. Figure 7 shows the Variable Infiltration Capacity model soil moisture percentiles.

Both soil moisture rankings depict very dry soil moisture conditions throughout the upper Missouri River basin, especially in South Dakota, Nebraska, Wyoming and southern Montana. CPC soil moisture conditions in these areas rank from the 5th to the 1st percentile, which are exceptionally dry. In North Dakota and northern Montana, soil moisture ranges from near normal conditions down to the 10th percentile. In comparison, the VIC model depicts very dry soils in the same areas with soil moisture percentiles ranking from the 5th to below the 2nd percentile. In our analysis of the influence of soil moisture on forecast runoff, neither model takes preference over the other. As an indicator of future monthly runoff, soil moisture conditions suggest runoff will be well-below average when considered along with the temperature and precipitation outlooks, which were discussed previously in this forecast discussion.

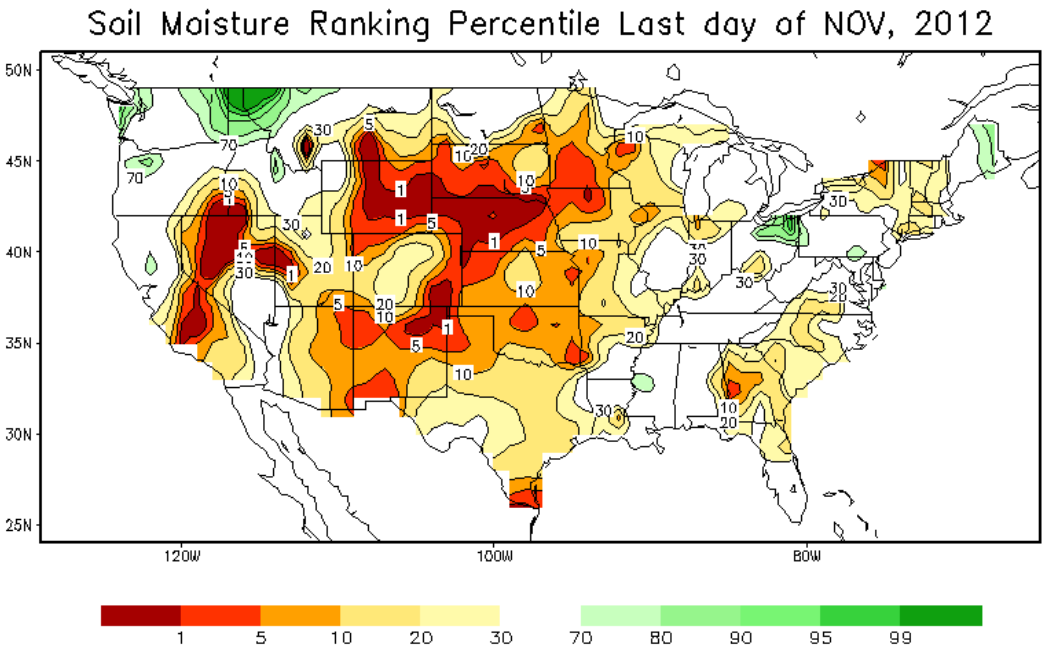


Figure 6. Calculated Soil Moisture Ranking Percentile at the end of November 2012. Source: Climate Prediction Center. http://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml

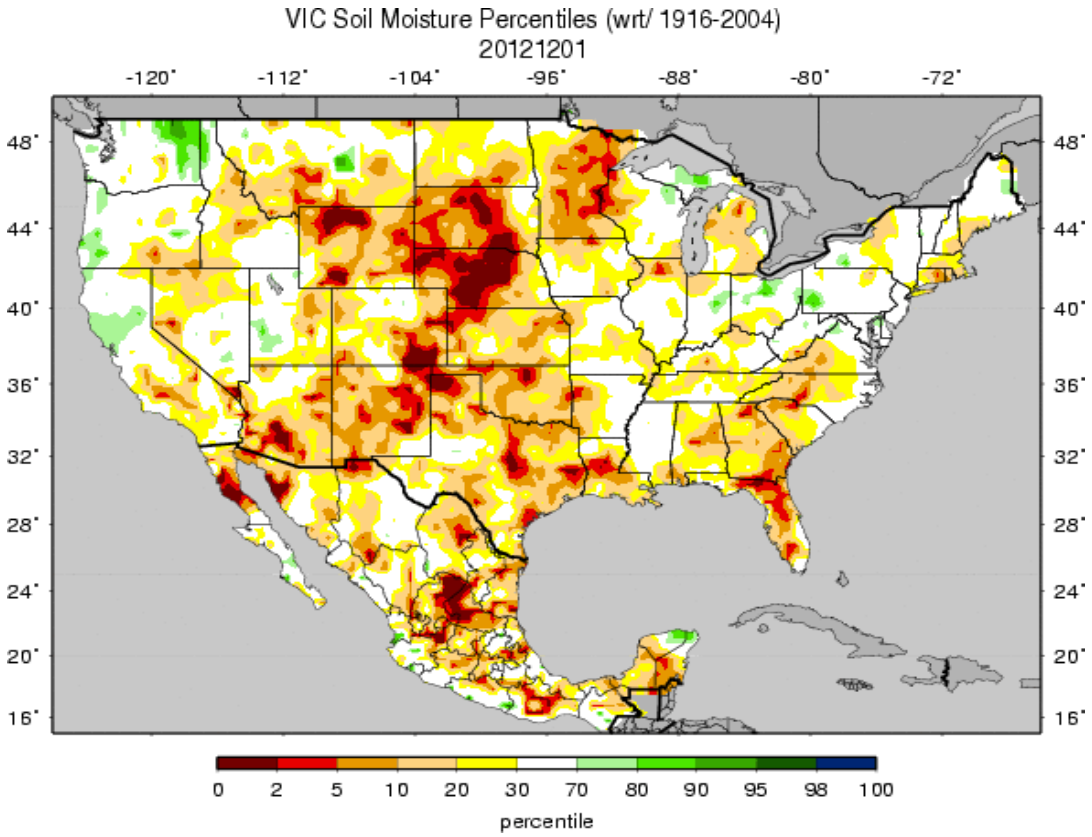


Figure 7. VIC modeled soil moisture percentiles as of December 1, 2012. Source: University of Washington. http://www.hydro.washington.edu/forecast/monitor/curr/conus.mexico/main_sm.multimodel.shtml

Plains Snowpack

Plains snowpack is an important parameter that influences the volume of runoff occurring in the basin during the months of March and April. A common misperception is that the March-April runoff is a result of plains snowmelt only, while in actually, about 25% of annual runoff occurs in March and April, due to both plains snow melt and rainfall runoff. Determining exact rainfall amounts and locations are nearly impossible to predict more than a week in advance. Thus, the March-April runoff forecast is formulated based on existing plains snowpack and existing basin conditions and hydrologic forecasts. A March-April 2013 forecast will not be released until January 1, 2013.

In November, light amounts of SWE had accumulated in the plains; however, warmer than average temperatures melted the snow resulting in some soil moisture recovery and additional November runoff. According to the National Operational Hydrologic Remote Sensing Center (NOHRSC), there is currently a very light layer of snow (trace to 1.0 inches of SWE) over northern Montana and portions of North Dakota (Figure 8).

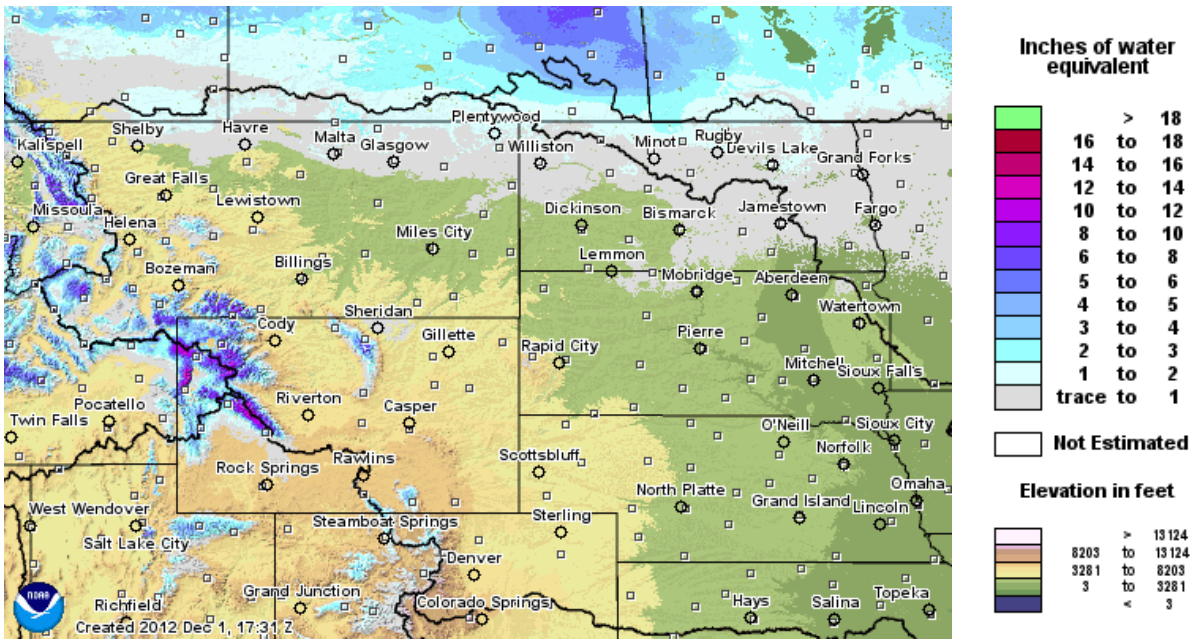


Figure 8. December 1, 2012 NOHRSC modeled plains snow water equivalent. Source: NOAA National Operational Hydrologic Remote Sensing Center. http://www.nohrsc.nws.gov/interactive/html/map.html

Mountain Snow Pack

Mountain snowpack is the primary factor used to predict May-July runoff volumes in the Fort Peck and Fort Peck to Garrison mainstem reaches. During the 3-month May-July runoff period, about 50% of the annual runoff enters the mainstem system as a result of mountain snowmelt and rainfall runoff. Greater than average mountain snow accumulations are usually associated with greater than average May-July runoff volumes, especially when mountain soil moisture

conditions have been wetter than normal as in the past three years. For example, we would expect to see greater than average runoff from an average mountain snowpack this year due to wetter than normal soil moisture conditions. The May-June-July 2013 forecast will not be released until January 1, 2013.

Mountain snowpack is measured by the USDA Natural Resources Conservation Service using a network of Snow Telemetry (SNOTEL) stations in the Rocky Mountains. Mountain snowpack is determined by averaging the snow water equivalent measurements from the SNOTEL stations located in the Fort Peck and Garrison reservoir basins. In the Fort Peck headwater basin, the Corps uses 49 SNOTEL stations to determine the average mountain SWE, while in the Fort Peck to Garrison subbasin, 47 SNOTEL stations are used to determine the average mountain SWE. The current mountain snowpack figure developed by the Corps may be found at: http://www.nwd-mr.usace.army.mil/rcc/reports/snow.pdf. As of December 3, 2012, the Corps of Engineers' assessment of the mountain snowpack was 96% of normal in the drainage area above Fort Peck, and it was 89% of normal in the incremental drainage area between Fort Peck and Garrison.

Drought Analysis

Drought conditions remained relatively the same in November as they did in October according to the National Drought Mitigation Center's (NDMC) drought monitor (Figure 9). The worst classification of drought, Exceptional Drought (D4) persisted in southern South Dakota, eastern Wyoming, and most of Nebraska. Drought in central and western Wyoming is classified as Extreme (D3) Drought, however some recovery occurred in this band of drought impacting northwest Wyoming and southwest Montana. Furthermore, drought impacts have lessened in northern Montana where Abnormally Dry (D0) and Moderate Drought (D1) conditions have been alleviated due to above normal precipitation in November.

The seasonal drought outlook effective from November 15, 2012 to February 28, 2013 is shown in Figure 10. According to the drought outlook, drought is likely to persist or intensify through much of the Missouri River basin, especially southern Montana, Wyoming, South Dakota, Nebraska and Iowa. Some improvement could occur in Montana and North Dakota; however, improvement of more than one drought category is not likely through February 28, 2013.

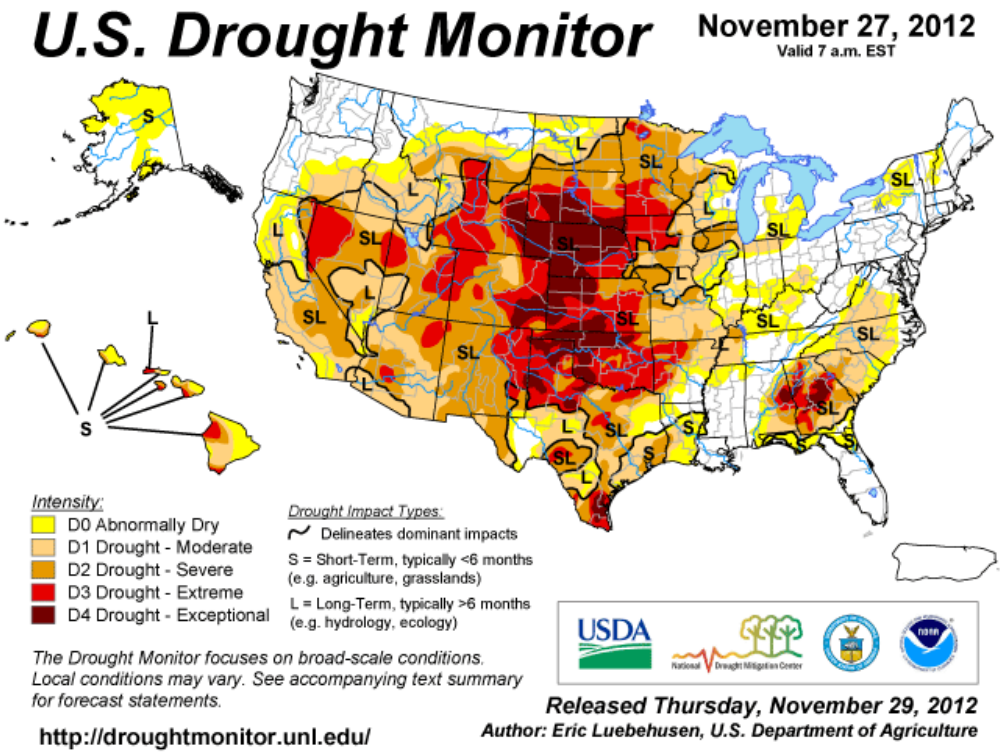


Figure 9. National Drought Mitigation Center U.S. Drought Monitors for November 27, 2012.

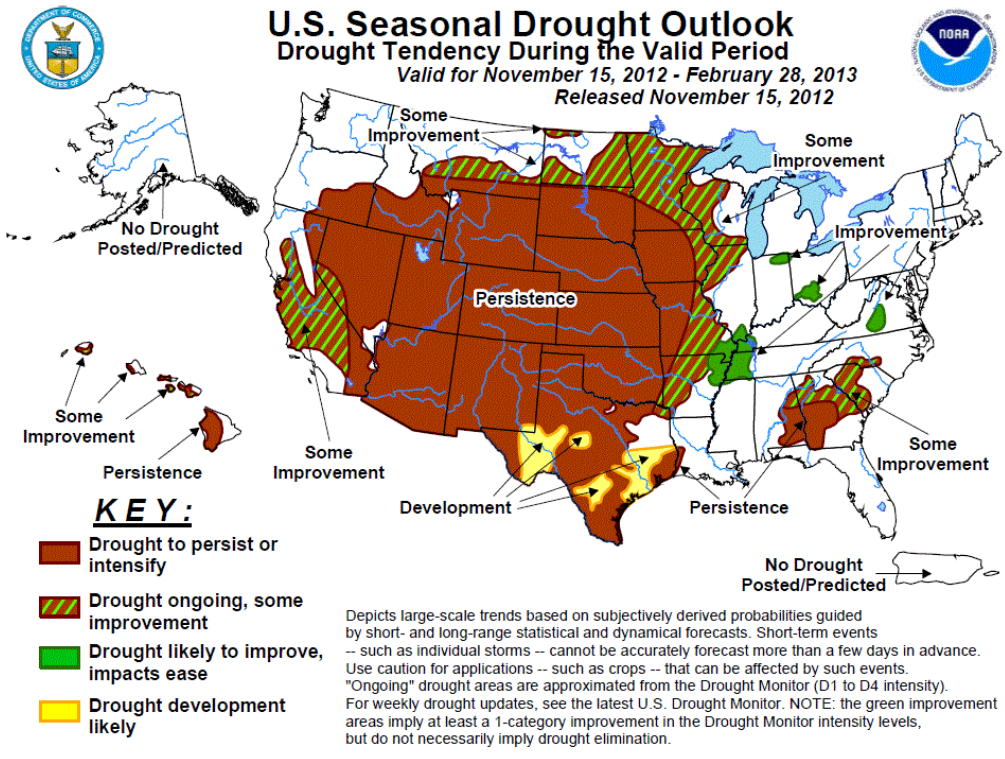


Figure 10. National Drought Mitigation Center U.S. Drought Seasonal Drought Outlook for November 15, 2012 – February 28, 2012

Climate Outlook

ENSO-neutral conditions continue in the equatorial Pacific, though equatorial sea surface temperatures remain above average across the Pacific Ocean. ENSO-neutral conditions are favored in the Northern Hemisphere through the winter of 2012-2013; therefore, there is not a strong indication of future winter temperature and precipitation conditions in the Missouri River basin.

The 8-14 day (Figure 11) CPC climate outlooks, which extend into mid-December, indicate that temperatures are very likely to be below normal in a majority of the upper Missouri River basin. There is also an increased probability for precipitation across Montana, northern Wyoming, North Dakota and South Dakota.

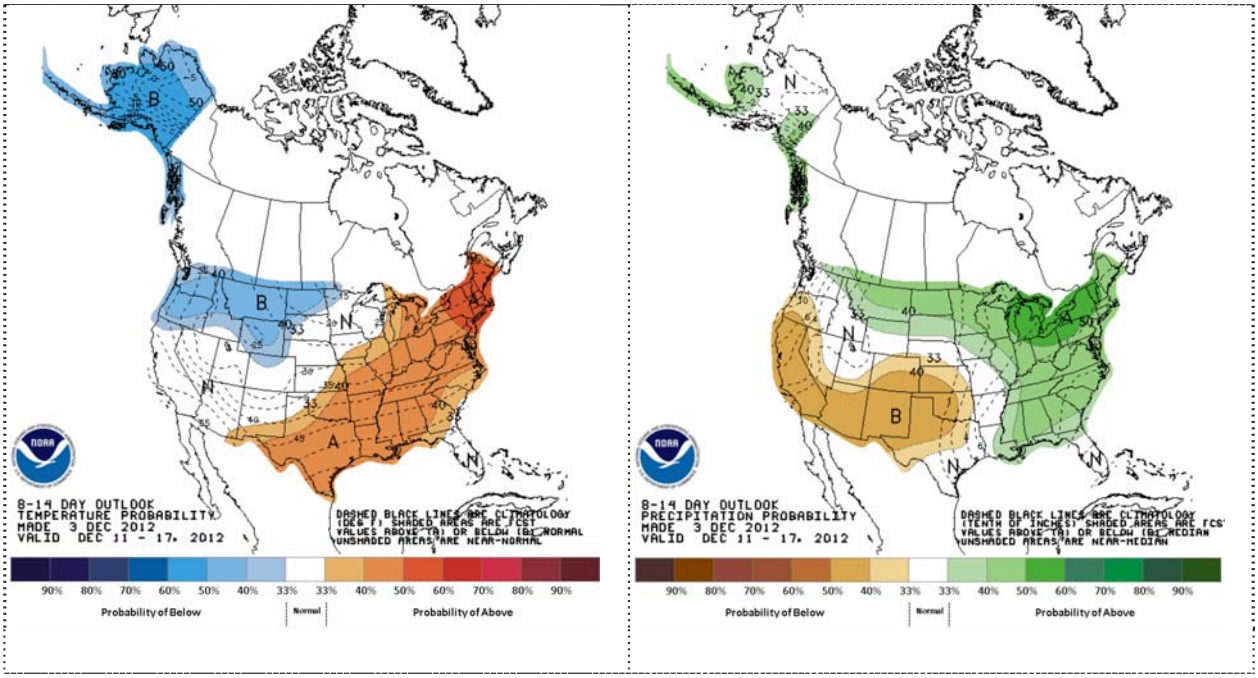


Figure 11. CPC 8-14 day temperature and precipitation outlooks.

During December the Climate Prediction Center is predicting equal chances for above normal, normal and below normal temperatures throughout most of the upper Missouri River basin (Figure 12) with an increased probability for above normal temperatures in the lower basin below Gavins Point Dam. With regard to precipitation, CPC is predicting an increased probability for above-normal precipitation in portions of the upper Missouri River basin covering most of Montana and northwest Wyoming. The CPC 3-month outlook ending in February 2013 is predicting an increased probability for above normal temperatures in upper regions of the Missouri basin over the Rocky Mountains; with equal chances for above, below and normal temperatures in central regions of the basin, and increased chances for below normal temperatures in North Dakota and northeast South Dakota (Figure 13). Precipitation chances through the end of February are forecast to be equal for all regions of the Missouri River basin.

The March-May 2013 CPC Outlook (Figure 14) indicates there is an increased probability for above normal temperatures in the lower Missouri River basin below Gavins Point dam, while there are equal chances for above normal, normal and below normal temperatures in the upper basin. The precipitation forecast indicates equal chances for above normal, normal and below normal precipitation during the March-May 2013 time period.

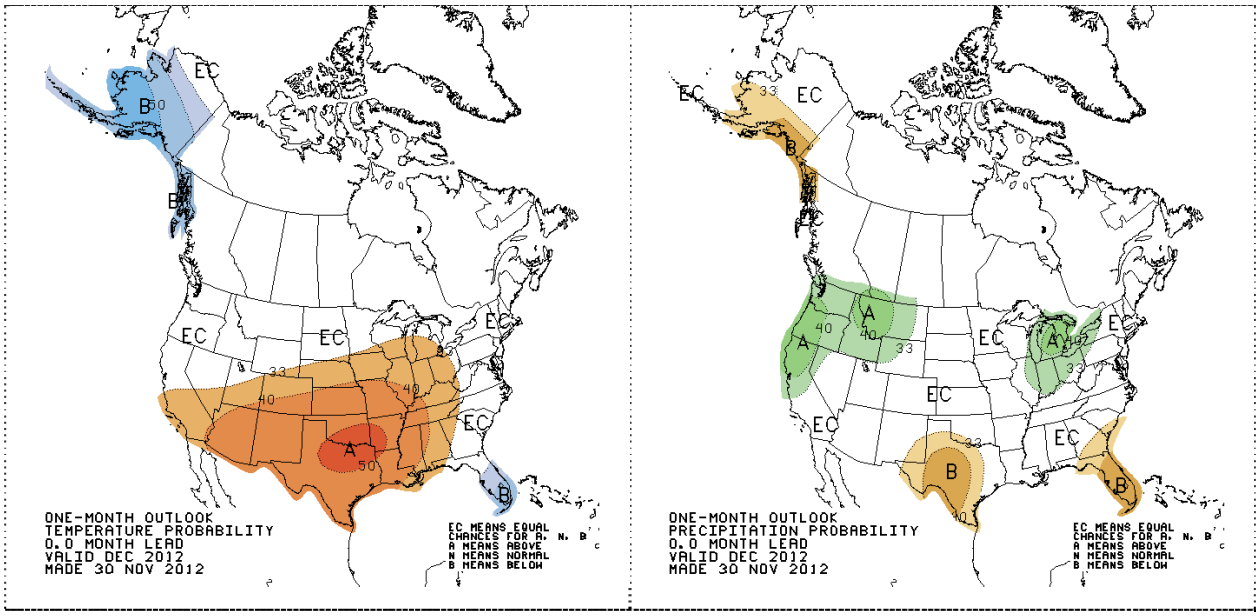


Figure 12. CPC December 2012 temperature and precipitation outlooks.

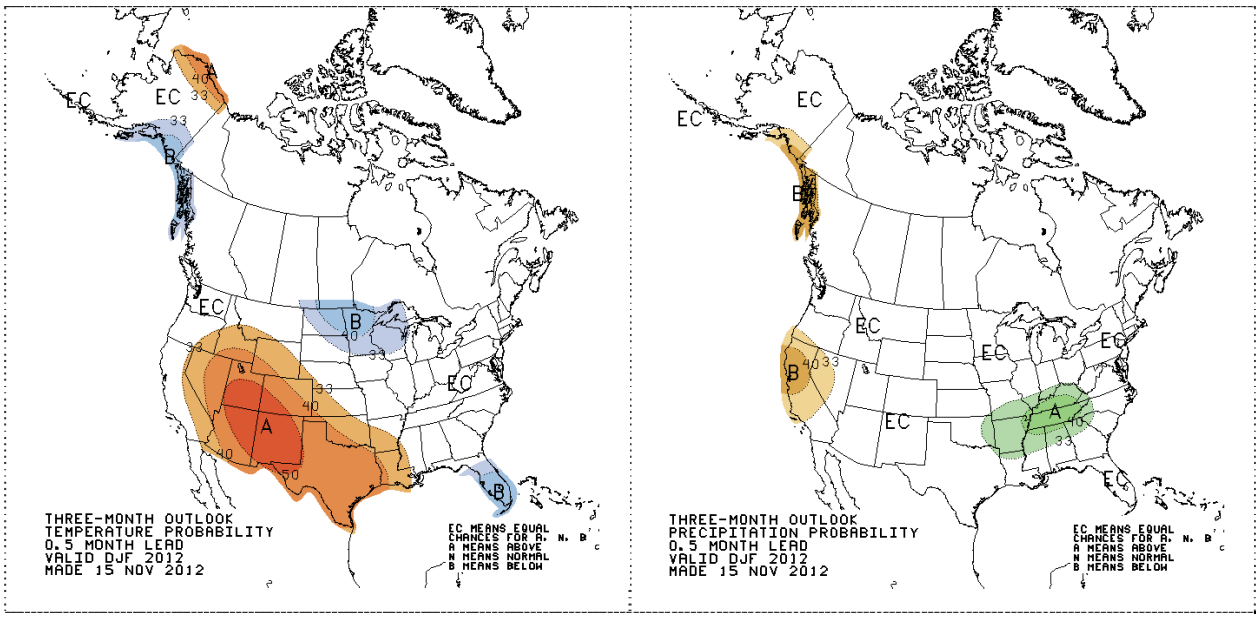


Figure 13. CPC December-January-February 2012/2013 temperature and precipitation outlooks.

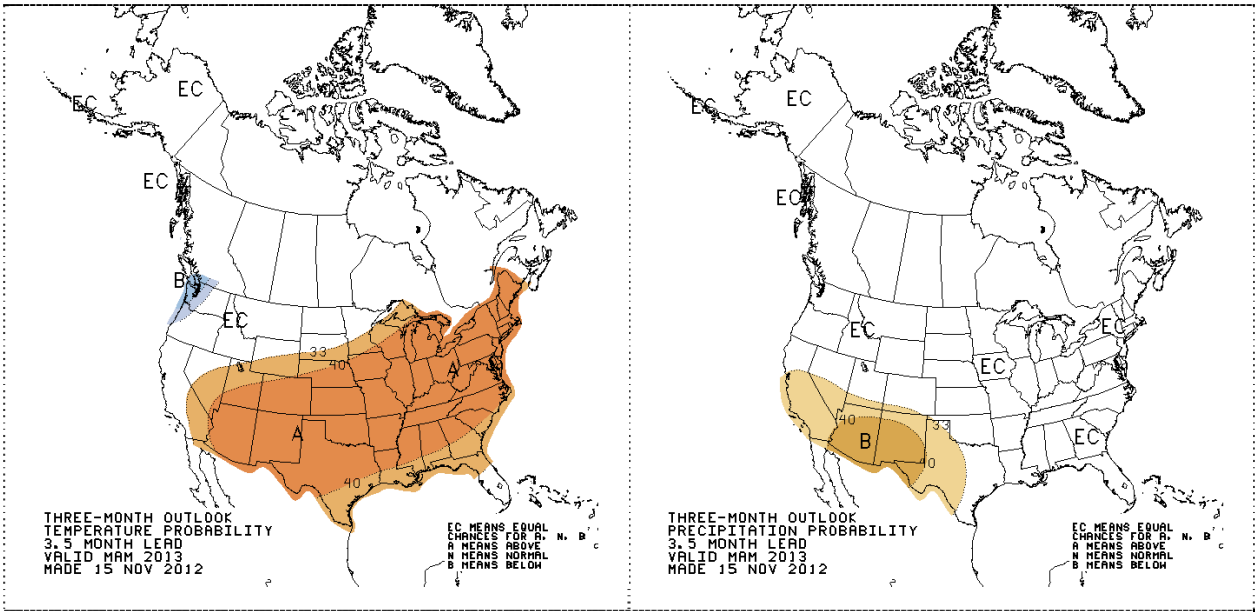


Figure 14. CPC March-April-May 2013 temperature and precipitation outlooks.

Summary – November 2012 Calendar Year Runoff Forecast

The December 1 calendar year runoff forecast above Sioux City, IA is **19.7 MAF** (79% of normal) and **17.8 MAF** (78% of normal) above Gavins Point Dam. This is an increase of 0.5 MAF from the November 1 forecast. Due to the amount of variability in precipitation that can occur over the next month, the expected inflow ranges from the 19.8 MAF upper basic forecast to the 19.6 MAF lower basic forecast.

Since the precipitation outlook is indicating an increased probability for above normal precipitation in the Fort Peck and Garrison reservoir subbasin, some runoff in addition to baseflow is expected to occur. In November precipitation in excess of 150% of normal occurred in the Fort Peck and Garrison reaches resulting in 87% of normal runoff. The December runoff forecast for all reaches is expected to be similar to November runoff due to the increased precipitation probability in approximately the same region. December runoff is expected to be 630 KAF, which is 85% of normal.