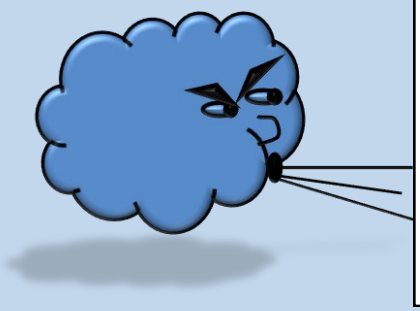
Jet Stream Jargon

National Weather Service
Billings, MT

October 2016 Fall Issue

Inside this issue:



From the Desk of the Meteorologist in Charge

As is typical in the Northern Rockies, we quickly transitioned the seasonal "feel" from hot Summer days to cool cloudy Fall weather during the month of September. For many, this transition was welcome as it brought much needed moisture during our secondary wet period in an attempt by the atmosphere to make up for precipitation our region missed during the primary wet period in April, May and June. The transition helped quench the wildfire threat that had existed much of the summer and into September. Certainly, the moisture can complicate the fall harvesting of sugar beets and other activities, but I think in the long run we can all appreciate timely moisture for our region.

Looking ahead to Winter, the common question I'm hearing is "Are we going to get more snow than last year?" I think you'll find some information to help answer that question within this newsletter, but with last year generally being among the least snowiest and one of the milder Winters over a large part of our region, the odds would suggest that this Winter is likely to be colder and wetter. How much colder and how much wetter? Read deeper into the newsletter for our latest thinking on those questions.

Recently, we had the luxury to host our Regional Director and introduce him to a number of our key partners in emergency management, transportation, wildfire support, hydrology, and the media. The conversations were helpful in providing him with an appreciation of the services we provide these key partners in our efforts to carry out our mission of protecting life and property, and enhancing the economy. The last part of our mission is one that is often overlooked but is critically important in assisting local, state and Federal partners, along with the private sector, to become more resilient to hazardous weather. Better use of weather information in decision making, saves all of us money through better planning and proactive mitigation and prevention (i.e. taking steps to limit the impact of expected hazardous weather rather than being satisfied to always recover).

This idea of building community resilience (from citizen through local/state/Federal government to the private sector) is being referred to as building a Weather-Ready Nation and has been, and will continue to be, our focus for our services. We are continually looking outward to ensure our expertise can be of service in limiting the impacts of hazardous weather.

Our spotter network and Cooperative Weather Observers provide critical ground truth which aids our ability to provide world class service to all of our customers and partners. Always remember that the information you provide, allows us to serve those that are "down the line." Even though we can't undo the impacts of hazardous weather, any information provided may help a "neighbor" downstream. Thanks in advance for all the timely ground truth you provide!

Keith W. Meier

Social Media

The widespread availability of smartphones and social media platforms has drastically changed the way we reach out to the public over the last few years in the National Weather Service. However, this road is not just a one way street where we speak to you, it is a two-way highway where we encourage conversation, and value your input. In fact, when skies darken and the weather heads "south", we utilize your input in our operations! When dangerous weather approaches the area, we make sure to always have someone monitoring our social media channels on Facebook and Twitter. Our tools and weather instruments have limitations and that's where you come into our mission; the protection of life, property, and the enhancement of our national economy.

Photo from Ty Hamilton on our Face-book Page on May 21 showing quarter sized hail in Columbus, Montana

Take for example the Yellowstone county hail storm on May 21st. We knew there was a potential for hail that day and we had advertised these risks on our Facebook and Twitter pages. Thunderstorms formed southwest of Columbus around 1:45 pm and we began to see severe hail signatures on our radar just before 2:00 pm. As the storms continued to strengthen, a Severe Thunderstorm Warning was issued for Columbus at 2:01pm. Our followers in Columbus began posting pictures of quarter-sized hail on our Facebook page around 2:11pm. These pictures, along with spotter reports, were very helpful to the radar operator as they verified the severity of the storms on radar. With this information in mind, making the warning decision for these storms approaching Billings and Laurel was not only easier, it allowed us to get a warning out for those residents quicker! The storms continued to look impressive on radar and a second Severe Thunderstorm Warning, including the cities of Billings and Laurel, was issued at 2:40pm as the storms progressed east. Thanks to help from our Facebook and Twitter users, we were able to get a Severe Thunderstorm Warning out to the public 15 minutes before the hail began to fall in Billings. After the storms passed, and hail reports continued to come in, we received a report of two inch hail in Billings!

Photo from Kari Hondi Karlin on our Facebook Page on May 21 showing quarter sized hail in Laurel, Montana

The National Weather Service is there for you when all types of weather threaten our part of the country, and if you do not follow us on Facebook or Twitter, we encourage you to hop on board! Click the images below to like our pages on Facebook and Twitter and let us know what's happening in your neck of the woods!

-NWS Billings Social Media Team

FOLLOW US ON facebook

facebook.com/NWSBillings

Follow us on twitter

twitter.com/NWSBillings

Weather-Ready Wednesday

Look for something new on our Facebook page and Twitter feed beginning this Fall and continuing each Wednesday. This new feature is called "Weather-Ready Wednesday," and will highlight a couple of seasonal preparedness or safety tips each week. However, we may change the theme of any particular Wednesday if a hazardous weather system is on our doorstep that does not match the theme of the week. For instance, if we are advertising winter safety tips, and a flooding event occurs, we can change Wednesday's message to flooding safety tips or other flood information. We hope you will find this new information helpful in planning for hazardous weather. Please share this information with family and friends!

CoCoRaHS

Vickie Stephenson– CoCoRahHS Coordinator

Community, Collaborative Rain, Hail & Snow Network

Dear Weather Spotters!

First of all, thanks for all you do! Your reports are so necessary and appreciated! Currently, we are in need of CoCoRaHS (Community, Collaborative Rain, Hail & Snow Network) observers and would like to invite you to sign up and join the fun. You would not only be a ***weather spotter***, but also a ***precipitation weather observer***, electronically reporting your precipitation (rain, hail, & snow) directly to the National Weather Service! The data received from you will be used by many important entities, including Emergency Managers, outdoor & recreation, city utilities, insurance adjusters, farmers and ranchers, just to name a few.

The specifics of the CoCoRaHS program can be found at www.cocorahs.org , where you can learn all about the program, its origin, and its importance to our nation's climate. If you are interested in joining us, please feel free to sign on, review the short training videos and click on "Join CoCoRaHS" under the Main Menu. I am the local coordinator of the program here in Billings and you can feel free to contact me at the phone/email listed below if you have any questions at all.

Current & New CoCoRaHS Observers!

Another summer has come and gone! I would like to thank you all for your tireless efforts in reporting your precipitation every day. Our CoCoRaHS Network in southeast Montana continues to have the best reporting record across the state, thanks to you, and you are all greatly appreciated!

It's again time to prepare for the winter season! Once you learn the first snowfall is on the way, set out your snowboards, and remove your tubes and funnels from your rain gauges, leaving only the canister. This should be done by at least mid-October. For a quick refresher on measuring snow, click here to watch the 5-minute snow measuring video.

NOTE: I am planning another webinar later this fall to refresh current observers and assist new observers with the program. Watch your email for dates and times.

THANKS AGAIN FOR ALL YOU DO!

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CoCoRaHS Additional Contact– Tom Frieders	tom.frieders@noaa.gov	406-652-0851 ext 223

Community Preparedness

Wright Dobbs-Meteorologist

NWS Employees Participate in Disaster Recovery Exercise

It has been said that by failing to prepare for upcoming events, we are preparing to fail. It is a common saying, but it is sadly not heeded by many folks across the world. However, the National Weather Service (NWS) has made preparedness a top priority in its mission. That is why two meteorologists from Team Billings (Tom Humphrey, and Wright Dobbs) joined 100 volunteers and the United Way in the "Day of Caring Tornado Exercise." The exercise, conducted at the Metra Park on Sept. 15, helped citizens understand how different government and volunteer organizations work together to aid the public in pre and post-disasters. The exercise began with a quick weather briefing from the NWS about the weather conditions that could produce a tornado in Billings. This briefing included a thunderstorm outlook for the day, and talked about the chance for severe weather. The scenario then skipped ahead a few hours when the exercise simulated that a tornado struck Billings. Different agencies from local government, religious, volunteer, local businesses, and the media, began planning out recovery efforts for such an event. Volunteers were assigned different roles and tasks that exercised the difficulty of pooling together hundreds of resources during a disaster. The NWS' role during this event was to help simulate our involvement in the recovery process. Most of our interaction was with the public information officer, but we also helped deliver important weather briefings. These briefings helped recovery coordinators keep their workers and volunteers safe. The simulation lasted 2.5 hours and ended 2 virtual days later when the recovery effort was nearly complete. The exercise concluded with a half hour de-brief and a discussion among volunteers and the different agencies in attendance.

If you want to know more about how you can prepare for numerous types of disasters, be sure to check out http://www.ready.gov . Also be sure to download the FEMA app on your smartphone to get the latest National Weather Service warning information!

COOP Corner

Larry Dooley-Observation Program Leader

Annual Cooperative Weather Observer Awards Luncheon

The National Weather Service in Billings, MT held our annual Cooperative Weather Observer Awards Luncheon recognizing several observers for reaching significant milestones. Dr. Grant Cooper, Director, National Weather Service Western Region out of Salt Lake City, and Keith Meier, Meteorologist-In-Charge of the National Weather Service Forecast Office in Billings, MT, presented the awards during a ceremony held on September 27th.

Willis Busenitz of Busby, Montana was presented the Jefferson Award for outstanding service in the Cooperative Weather Observing Program. This award is the Agency's most prestigious award, awarded to only a select few cooperative weather observers from around the country. Rev. Busenitz has provided timely, accurate and dependable weather data that has totaled nearly 16,000 observations during his 43 year period of service to the Nation. This award was named in honor of Thomas Jefferson, our third President, who kept an almost unbroken series of weather records from 1776 to 1816.

Thomas Jefferson Award

John Campanius Holm Award

Left Image: (Pictured left to right) Dr. Grant Cooper (Western Region Director), Willis Busenitz (COOP Observer), Keith Meier (National Weather Service Meteorologist-In-Charge).

Right Image: (Pictured left to right) Dr. Grant Cooper (Western Region Director), Bill Schwarzkoph (COOP Observer), Keith Meier (National Weather Service Meteorologist-In-Charge).

Bill Schwarzkoph of Forsyth, Montana was presented the agency's prestigious John Campanius Holm Award for outstanding service in the Cooperative Weather Observing Program. This award is the agency's second most prestigious award, awarded to only a select few cooperative weather observers from around the country. Mr. Schwarzkoph has provided timely, accurate and dependable weather data that has totaled nearly 15,000 observations during his 41 year period of service to the Nation. The award's namesake, John Campanius Holm, recorded weather observations without benefit of weather instruments in what is now Wilmington, Delaware. The observations were taken in 1644 and 1645, which were the earliest known recorded observations in the United States.

COOP Corner Continued

Montana State University Southern Agricultural Research Center

Pictured left to right: John C. Pulasky (COOP Observer), Dr. Grant Cooper (Western Region Director), Ken Kephardt (Director of Montana State University Southern Agricultural Research Center), Keith Meier (National Weather Service Meteorologist-In-Charge), Tom Fischer (COOP Observer).

A 100 year Honored Institution Award was presented to the Montana State University Southern Agricultural Research Center at Huntley, Montana, for outstanding service in the Cooperative Weather Observing Program for more than 100 years.

The Cooperative Weather Observer Program has given scientists and researchers continuous observational data since its inception more than a century ago. Today, over 10,000 volunteer observers participate in the nationwide program to provide daily reports on temperature, precipitation and other weather factors such as snow depth, river levels and soil temperature, which provide an accurate picture of a locale's normal weather, and give climatologists and others a basis for predicting future trends. These data are invaluable for scientists studying floods, droughts, heat and cold waves.

Forecast Improvement

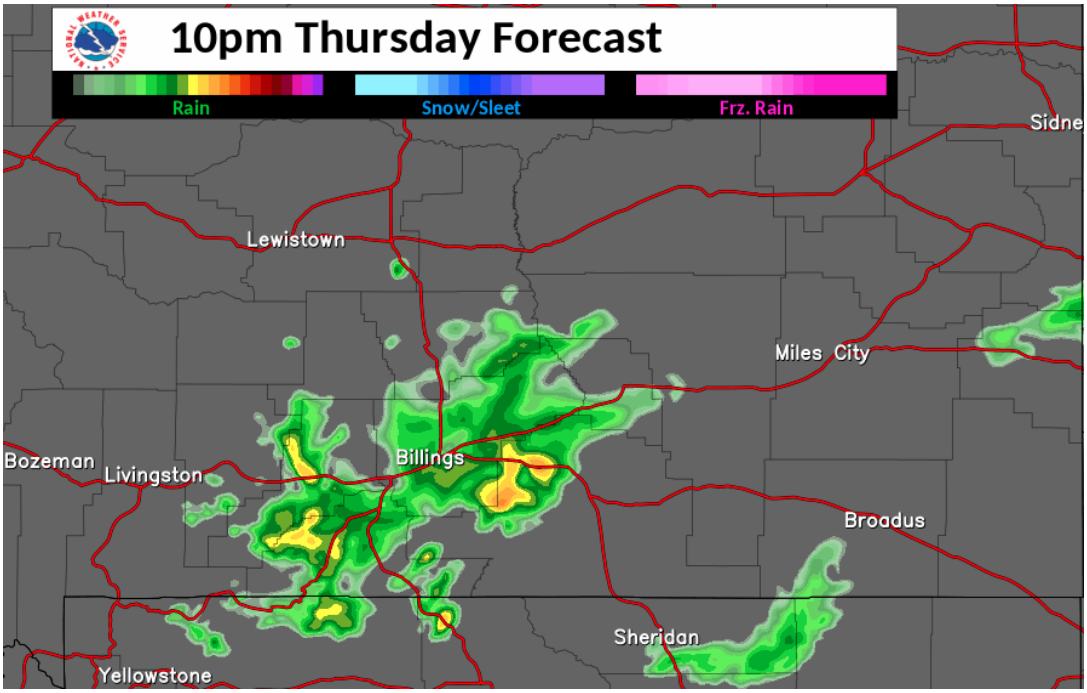
Marc Singer-Science and Operations Officer

Weather Models Are Getting Better and Better!

In recent years, numerical weather models have become better at predicting what may happen in the 12 to 24 hour time frame. Meteorologists can leverage the output of these models to make more accurate forecasts for phenomena such as severe thunderstorms, tropical storms, wind and precipitation. These forecasts are vitally important to decision makers both here in the Northern Rockies and across the globe.

During this past spring and summer, meteorologists at our office were able to look at future simulated radar data for the next 12 to 24 hours, to identify potential threats to life and property. By identifying the location and intensity of hail and damaging winds (for example), meteorologists can provide impactful decision support services to state and local authorities. Further, the general public can monitor social media for relevant information.

This is an amazing concept, as over a relatively short period of time, meteorologists have been given even more valuable tools in their quest to provide reliable forecasts. Some of the these models are able to resolve weather on the order of hours (as opposed to days) and over much smaller distances. It really is an exciting time to be in the field of meteorology!



Here is an example of an hourly precipitation forecast from a hi-resolution short term weather forecast model.

Summer Review

Joe Lester-Lead Forecaster

2016 Summer in Review

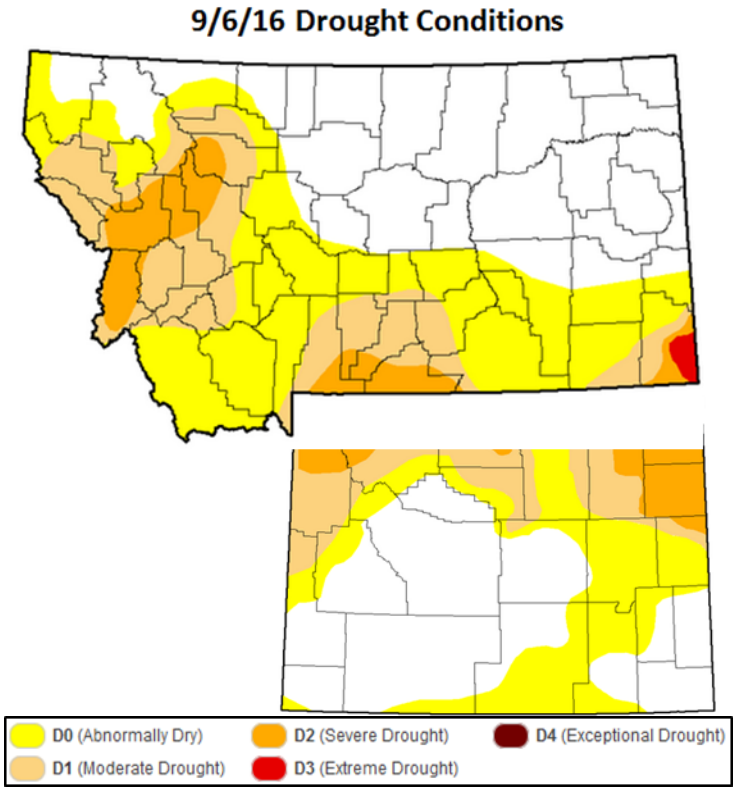
Overall, it was a warm and dry summer, with each of our main climate stations finishing in the top 17 for both warmest and driest summers on record. June in particular was a very warm and dry month, and in fact the 0.23 inches of rain that fell at Billings made it the driest June on record for the site! July and August were much closer to normal in terms of temperatures and precipitation. A couple of fairly wet weather systems impacted the region during August.

Billings failed to reach 100 degrees for the 2nd consecutive summer, and third time in the past four years. Average for Billings is 2-3 times per summer. Miles City and Sheridan each reached triple digits a few times, which is close to normal.

Severe Weather: The severe weather season started with a bang on **May 21st**. A severe thunderstorm produced large hail and strong winds across Billings (up to 2" diameter and gusts to 66 mph observed). Many cars and homes were damaged by the wind-driven hail. Also on this day, a EF-1 tornado touched down about 16 miles north of Pompey's Pillar, causing significant tree damage and snapping a couple of power poles. A bit later in the summer, an EF-3 tornado struck the east side of Baker during the early evening of **June 11th**. This tornado caused significant damage to several homes, especially in a subdivision on the northeast side of Baker Lake. No deaths occurred as a result of this tornado.

Drought: The dry and warm weather that dominated our region in the late summer and early spring, on the heels of a warm winter and early mountain snow melt, allowed drought conditions to escalate across parts of southeast Montana and northern Wyoming during the summer. Areas of severe (D2) to extreme (D3) drought developed along the foothills of the Beartooth Absarokas and in Carter County. Impacts to farming and recreation were felt across parts of the region, and some rivers in Montana experienced near record low flows. A significant portion of the Yellowstone River was closed to recreation for a period of time because of fish kill resulting from a parasite, which was partially due to the low and warm water. The following graphic shows drought conditions across Montana and Wyoming as of September 6th. Some gradual improvement in overall drought is expected as we approach winter.

Summer Review Continued



The following table is a summary of temperatures and precipitation at our four main climate sites during meteorological summer (June - July - August):

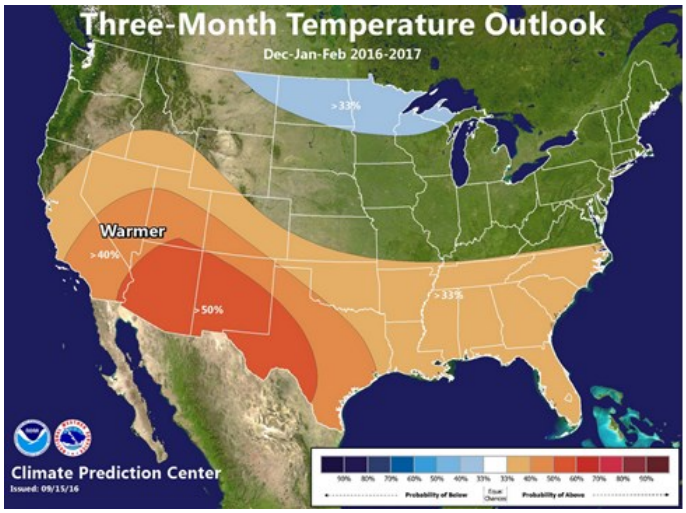
Jun - Aug	Average Temp (deg F)	Departure from Normal	Precipitation (inches)	Departure from Normal
Billings	**71.7 (8th warmest)**	**+ 2.0**	**2.35 (17th driest)**	**- 1.84**
Miles City	**73.0 (15th warmest)**	**+ 1.5**	**2.80 (12th driest)**	**- 2.26**
Sheridan	**69.7 (10th warmest)**	**+ 2.3**	**2.05 (14th driest)**	**- 2.00**
Livingston	**66.3 (12th warmest)**	**+ 1.4**	**3.28 (13th driest)**	**- 1.69**

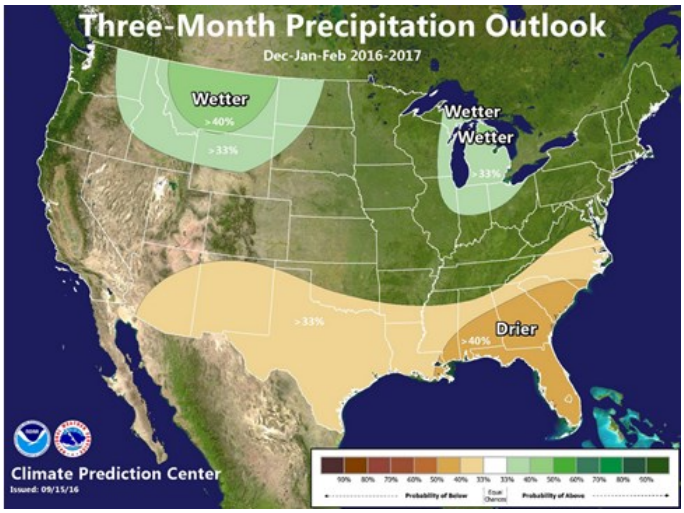
Winter Outlook

Joe Lester-Lead Forecaster

2016-17 Winter Outlook

2016-17 Winter Outlook: The official December-January-February outlook from the Climate Prediction Center, issued on September 15th, calls for equal chances of near, above or below normal temperatures, and a hedge toward wetter than normal conditions across our region. The primary reason for this outlook is the relatively cooler sea surface temperatures in the tropical eastern Pacific Ocean. A weak La Nina is possible, which historically favors a stronger polar jet stream and increased storminess across the northern Rockies during the winter. It should also be noted that arctic sea ice extent is second lowest on record. The below normal sea ice means cold air will be slower to form in the arctic regions this fall, but it will not prevent us from seeing cold snaps during the winter. Due to our location on the eastern slopes of the mountains (regardless of whether or not La Nina develops), the climatology of our winter season is characterized by alternating periods of cold and snowy Canadian air, and warm and dry chinook winds. As always, be prepared for both extremes during the upcoming winter.





Fall and Winter Data Tables

Fall Normals

Meteorological fall is considered the months of September, October and November. Here are the normal temperatures and precipitation for Billings, Miles City and Sheridan for the fall season. Normals are 30 year averages calculated from 1981 to 2010. All temperatures are in degrees Fahrenheit and all precipitation amounts are in inches.

Billings					
Date	**High**	**Low**	**Average**	**Precipitation**	**Snowfall**
9/1 – 9/30	73.1	47.5	60.3	1.30	1.1
10/1 – 10/31	59.4	37.1	48.2	1.18	4.1
11/1 – 11/30	45.3	26.3	35.8	0.63	6.5
9/1 – 11/30	59.3	37.0	48.2	3.11	11.7

Miles City				
Date	**High**	**Low**	**Average**	**Precipitation**
9/1 – 9/30	74.2	46.1	60.1	1.08
10/1 – 10/31	59.2	33.8	46.5	0.92
11/1 – 11/30	43.2	20.9	32.0	0.39
9/1 – 11/30	59.3	34.7	47.0	2.39

Sheridan				
Date	**High**	**Low**	**Average**	**Precipitation**
9/1 – 9/30	74.2	41.6	57.9	1.43
10/1 – 10/31	60.1	30.9	45.5	1.41
11/1 – 11/30	45.9	19.4	32.7	0.71
9/1 – 11/30	59.9	31.5	45.7	3.55

Fall and Winter Data Tables Continued

Winter Normals

Meteorological winter is considered the months of December, January and February. Here are the normal temperatures and precipitation for Billings, Miles City and Sheridan for the winter season. Normals are 30 year averages calculated from 1981 to 2010. All temperatures are in degrees Fahrenheit and all precipitation amounts are in inches.

Billings					
Date	**High**	**Low**	**Average**	**Precipitation**	**Snowfall**
12/1-12/31	35.2	17.8	26.5	0.50	8.2
1/1-1/31	36.4	17.8	27.1	0.48	8.4
2/1-2/28	40.2	20.6	30.4	0.48	6.2
12/1-2/28	37.2	18.7	28.0	1.46	22.8

Miles City				
Date	**High**	**Low**	**Average**	**Precipitation**
12/1-12/31	30.9	9.7	20.3	0.29
1/1-1/31	30.0	8.9	19.5	0.32
2/1-2/28	35.5	13.2	24.4	0.23
12/1-2/28	32.4	11.5	22.0	0.84

Sheridan				
Date	**High**	**Low**	**Average**	**Precipitation**
12/1-12/31	35.2	10.6	22.9	0.56
1/1-1/31	36.2	11.4	23.8	0.56
2/1-2/28	39.0	14.2	26.6	0.54
12/1-2/28	36.7	12.9	24.8	1.66

Average Frost and Freeze Dates

The following are the normal first frost, freeze and hard freeze dates for Billings, Miles City and Sheridan. The frost temperature is based on 36 degrees Fahrenheit, the freezing temperature is based on 32 degrees Fahrenheit and the hard freeze temperature is based on 28 degrees Fahrenheit. The normal dates are based on a 30 year average from 1981 to 2010. The first frost, freeze and hard freeze dates are based on a period of record. Recordkeeping began for the Billings Airport in 1934, the Miles City Airport in 1937 and at the Sheridan Airport in 1907.

City	Normal First Frost	Earliest Frost on Record	Normal First Freeze	Earliest Freeze on Record	Normal First Hard Freeze	Earliest Hard Freeze on Record
Billings	Sep 24	Aug 24	Oct 4	Sep 4	Oct 11	Sep 11
Miles City	Sep 21	Aug 22	Sep 29	Sep 2	Oct 7	Sep 11
Sheridan	Sep 11	Jul 2	Sep 20	Aug 17	Oct 3	Aug 25

Weather Watch

Understanding Winter Weather Alerts

Winter Storm Warning means Take Action!

> **Winter Storm Warning**s are issued for a significant Winter weather event including snow, ice, sleet or blowing snow or a combination of these hazards. Travel will become difficult and impossible in some situations.
>
> -Delay your travel plans until conditions improve.
>
> -If you must travel, bring a winter survival kit with you.
>
> -Wear warm, protective clothing.

Winter Storm Watch means Be Prepared

> **Winter Storm Watches** are issued when conditions are favorable for a significant winter storm event (Heavy Snow, Heavy Sleet, Ice Storm, Heavy Snow and Blowing Snow or a combination of events.)

Winter Weather Advisories mean Be Aware

> **Winter Weather Advisories** are issued when snow, snow and blowing snow, snow and ice, snow and sleet, or snow, ice and sleet is expected but should not meet warning criteria. Be prepared for winter driving conditions and possible travel difficulties. Use caution when driving.

Winter Weather Safety Tips

Sources for Winter Weather Alerts include NOAA Weather Radio All-Hazards, National Weather Service Forecast Office Billings, MT website, local television and radio stations, and your mobile phone.

* Slow down when driving, and leave early to give yourself plenty of time to reach your destination.
* If outside with no shelter, build a lean-to, windbreak or snow cave for protection from the wind. Build a fire for heat, and to attract attention.
* Melt snow for drinking water. Eating unmelted snow will lower your body temperature.
* Avoid overexertion such as shoveling heavy snow, pushing a car or walking in deep snow if you are not in good health.
* If you are stuck in your vehicle, stay there. Be visible to rescuers by tying a brightly colored cloth to your antenna or door, or raising the vehicle's hood.
* Run the motor about 10 minutes each hour for heat.
* While running the motor, open the window a little for fresh air to avoid carbon monoxide poisoning.
* Clear snow from the exhaust pipe to avoid gas poisoning.
* If dealing with a power outage, never use a portable generator inside your home or garage.
* Avoid downed power lines.

Information Stop

Weather-Ready Nation: Fall Weather Hazards
http://www.nws.noaa.gov/com/weatherreadynation/fall_safety.html

Winter Weather Preparedness
http://www.wrh.noaa.gov/byz/winter/index.php?wfo=byz

Red Cross Winter Storm Safety Checklist
http://www.redcross.org/images/MEDIA_CustomProductCatalog/m4240231_WinterStorms.pdf

Wind Chill Resources
http://www.nws.noaa.gov/om/winter/windchill.shtml

Local Climate Records
http://www.nws.noaa.gov/climate/index.php?wfo=byz