September 2010
Fall/Winter Issue

Online version available at:
http://www.wrh.noaa.gov/byz/jargon/fall10.pdf

JetStream Jargon

National Weather Service—Billings, Montana
weather.gov/billings

The Value of Teamwork

Submitted by: Keith Meier
Meteorologist in Charge

Over the past few months, our area has seen its share of active weather including late season snowfall over portions of southeast Montana in May, the late snowmelt runoff season on area rivers, above average occurrence of tornadoes in late June and early July, and many locations still reporting above normal precipitation totals as of this writing.

All of this active weather requires teamwork between our volunteer weather spotters, Cooperative Weather Observers, CoCoRAHS volunteers, city/county emergency officials and those of us here at the National Weather Service. Even with the vast amount of technology we have at our disposal, we rely heavily on actual observations to validate the weather threats to our communities and document the climate of our locations. This relies on all of the groups listed above operating with teamwork in mind. Often folks believe the National Weather Service is always aware of the various noteworthy pieces of weather information (i.e. reports of severe weather, rainfall or snowfall amounts, etc.). Our knowledge base relies almost exclusively on our interaction with you and the information you provide.

We welcome the phone calls to pass along any weather related information that you find noteworthy. Maybe a neighbor shared a story of some damage they received from a previous thunderstorm or maybe someone at the hardware store was relating a weather related experience they had during the last snow storm. Please don't hesitate to pass those reports along either by calling our office or sending an email to:

Billings.NWS@noaa.gov or Tom.Frieders@noaa.gov or myself, Keith.Meier@noaa.gov

Over the summer, we contacted most of you to make sure the email address we have for you is valid. We appreciate your willingness to share this information with us. We plan to utilize these email addresses to notify you of impending weather events for which we need your help and your observations of rainfall/snowfall/ etc. Additionally, we hope to send email notifications of upcoming NWS training sessions or other events in your area, as well as sending this newsletter to you as a convenience and a method by which we can validate the accuracy of our email list.

We understand not everyone is comfortable with email and the internet, so we will always also communicate with you in the traditional ways. However, we realize that many folks prefer some of the newer forms of communication and are more likely to send us a report via email than through a phone call. We want to leverage everything we can to expand the teamwork that helps us carry out our mission of the protection of lives and property related to weather, water and climate events.

I look forward to another year of teamwork from all of you and commit that all of us here at the NWS will continue to work hard to provide the best weather, water and climate information to the citizens of southern Montana and Sheridan County, Wyoming.

Points of Interest

- Father's Day – first confirmed tornado in Billings since 1958
- Cool, Wet Summer
- Ten confirmed tornadoes in Montana this past summer

Inside this issue:

A piece of plywood is embedded in pine tree after the June 20 Billings tornado.

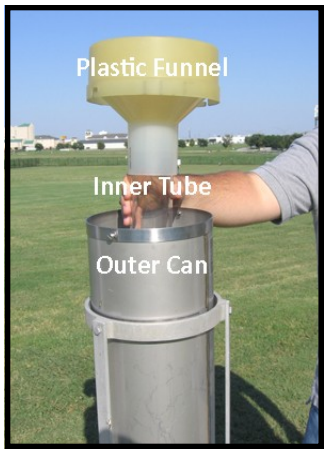
Photo by Carolyn Willis

Coop Corner

Submitted by Carolyn Willis
Observing Program Leader

The JetStream Jargon is published semi-annually by the National Weather Service in Billings, Montana.

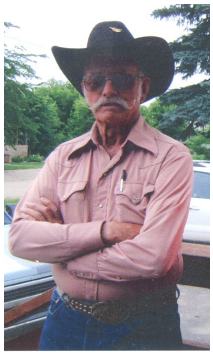
Questions or comments, please email: carolyn.willis@noaa.gov or call 406-652-0851.



Stock Photo

Remember to take out the inner tube, take off the plastic funnel and leave your gage open to catch snow.

Obituaries



James T. Carroll - Belltower

http://www.stevensonfuneralhome.com/Obits_details.asp?ID=2074

James T. Carroll had been a Cooperative Observer for the National Weather Service in Belltower, Montana since 1994. Jim passed away unexpectedly on Monday, July 26, 2010, in Ekalaka, MT. I (Carolyn) enjoyed visiting with Jim and his wife "Marty." Jim was always cheerful and had interesting stories to tell. He told of extra cold winters with record snow drifts and about travelers who became stranded at his ranch in times of bad weather.

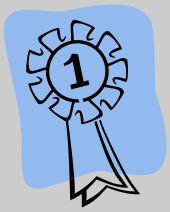
Barbara Jaquith - Red Lodge

http://billingsgazette.com/lifestyles/announcements/obituaries/article_3238c856-bbb6-11df-aece-001cc4c002e0.html

Barbara Jaquith had only been a Cooperative Observer for the National Weather Service two years, before her health forced her to retire. Barbara passed away on September 7, 2010. In her two years as an observer, she faithfully phoned her daily observation to the Billings office every evening at 5pm. Barbara was an avid bird watcher and would tell me interesting bird stories every time I visited her.

Both of these observers will be greatly missed.

Coop AWARDS



Alex Collie - MacKenzie - 60 year Length of Service (Longest in Montana)
Don and Lucille Ottesen - Sonnette - 45 years
Wyoming Department of Transportation - Burgess Junction - 50 years
Bill Swartzkoph - Forsyth - 35 years
Brice Lambert - Ekalaka - 25 years
Valerie Rumph - Biddle - 20 years
David Paugh - Ryegate 18NNW - 20 years
Sharon Higgins - Ridgway - 15 years

Eunice Achtenberg - 2010 Holm Award. (See article on page 7)

Measuring Snow - It's time to pull out your snow measuring instructions and review them, before you wake up to find snow blanketing your yard. Remember, snowfall is measured to the nearest TENTH of an inch, while snow depth is to the nearest whole inch. Rarely are those two readings exactly alike, due to blowing, settling, and melting.

Submitting Your Data - We would like to thank all of you for mailing in your B-91 monthly forms so quickly after the end of the month, as we use your data as soon as we receive it for various reports.

For those of you who submit your observations through the computer-based Weather Coder program, we receive your data as soon as you enter it, which is very helpful to us throughout the month. Please be sure to run the monthly "closeout" when you have finished checking over your entries, so we know you are finished entering data. Thanks again to all of our observers for your dedication to the program.

Measuring Snowfall 101

Submitted by Tom Frieders

Here are some key points to think about when measuring snowfall this upcoming winter:

- Place a snowboard (16x24 inch plywood painted white) in an open and representative location on your property.
- Allow snow to accumulate on the board, then measure the depth of the new snowfall (using a yard stick or something similar) as soon as possible after the snow ends. Before settling or melting occurs. Snowfall is measured to the nearest tenth of an inch. (i.e., 3.2 inches)
- After the measurement is complete, clear off the board and place the board on top of the newly fallen snow. Now you have a clean board and you are ready for the next snowfall or observation.
- Report the snowfall to the National Weather Service!

These are great steps for those instances where the snow falls with only light winds. Strong winds combined with the falling snow result in a much more difficult measurement, but it can be done! For these situations in which you note considerable blowing and drifting snow, you must take an average of several measurements. Take 5 or 6 measurements (some in drifts and some in windswept areas with near zero depth) throughout your property. Add these values up and take the average of these measurements to the nearest tenth of an inch. This is your new snowfall.

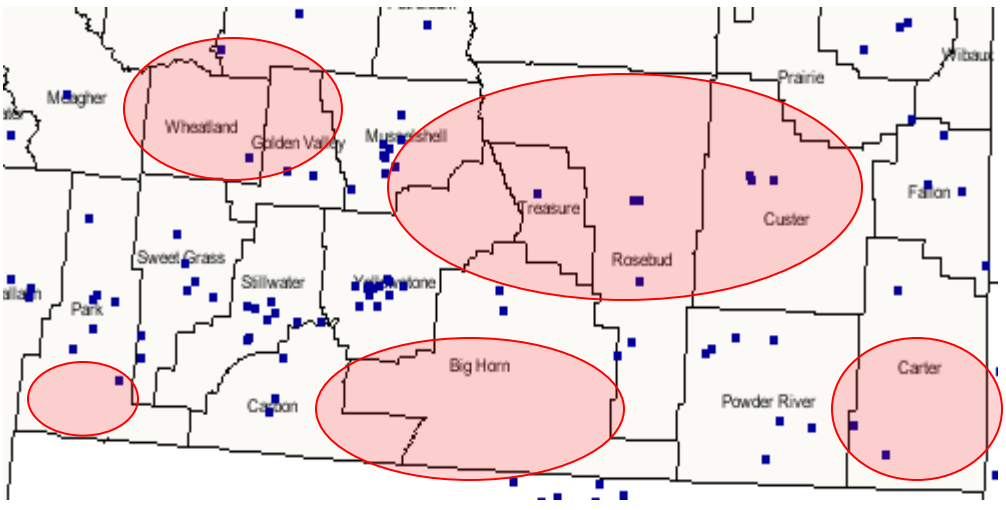
For more details on measuring snowfall and melting down the water equivalent of snowfall, see training resources at http://www.cocorahs.org.

Community Collaborative Rain, Hail and Snow Network (CoCoRaHS)

Submitted by Tom Frieders
Title: Warning Coordination Meteorologist

We want to thank all of our current CoCoRaHS observers for their dedication in reporting daily observations. As an observer myself, I know the dedication that it takes, especially as we progress into the challenging winter months with measuring snow. Our forecasters use your observations every day as they play a key role in our forecast process.
If you are not a current observer but think you might be willing to help out (or you know someone that might), you can view details on the program at http://www.cocorahs.org.

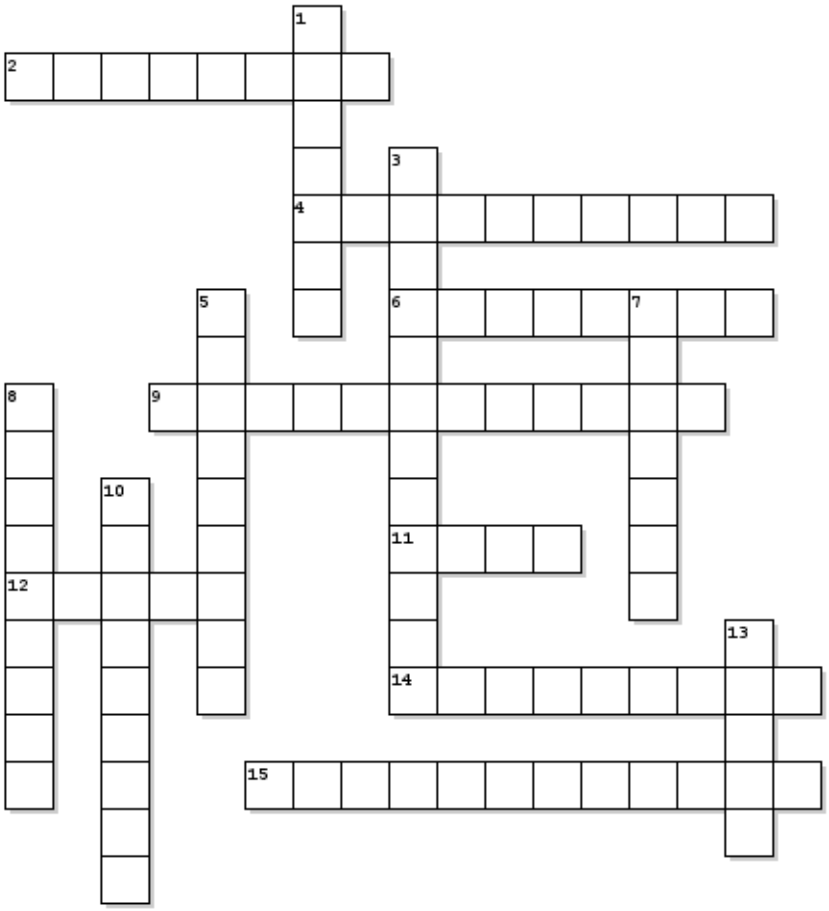
As you know, precipitation can vary significantly in a matter of just a few miles so we continue to make it a high priority on continuing to expand this network. Below is a map of active observers in southern Montana and Sheridan County Wyoming. We have highlighted some areas we are currently concentrating our efforts to enhance our network. If you might be interested in the program, please contact Vickie Stephenson (vickie.stephenson@noaa.gov) or Tom Frieders (tom.frieders@noaa.gov).



We are currently scheduling some fall training sessions for this network. Please keep an eye on the following website for potential training in a location near you: http://www.wrh.noaa.gov/byz/local_news/2010/cocorahs10.php.

Winter Weather Crossword

Submitted by Vickie Stephenson
Hydrometeorological Technician



Down

1. A soft, solid form of snow crystals usually about the size of a pea
3. The mounding or piling of snow driven by wind
5. A device used to measure air pressure
7. Pendants, tapering masses of ice formed by the freezing of dripping water
8. The edge of a cold air mass, displacing warmer air in its path
10. An episode of bad weather in winter with frozen precipitation
13. Another name for ice pellets

Answers on Page 15

Across

2. Winter storm with 35 mph winds accompanied by cold temperatures, blowing snow, and visibility of 1/4 mile or less
4. The permanent freezing of the subsoil in a tundra region
6. The term for when liquid turns to solid in cold temperatures
9. Rain falling through a sub-freezing layer of air near the ground and freezing on contact
11. A precipitation in the form of ice crystals, formed directly from the freezing of water vapor in the air
12. Ice crystals which form on surfaces when the dewpoint is below freezing
14. A measure of temperature that uses the effect of wind and temperature on the human body
15. Snow falling intermittently with little or no accumulation

Frost and Freeze Dates

Submitted by Sean Campbell, Meteorologist Intern
Matt Solum, General Forecaster

Two important dates to keep in mind are the first frost and freeze dates in the fall. The table below lists the average and earliest frost and freeze dates for Billings, Miles City and the Sheridan. The frost temperature is based on 36 degrees Fahrenheit and the freezing temperature is based on 32 degrees Fahrenheit. The average dates are based on a 30 year average from 1971 to 2000. The first frost and freeze dates are based on the following periods of record: Billings Airport 1934 - present; Miles City Airport 1937 - present; Sheridan Airport 1934 - present.

City	Average First Frost	Earliest Frost On Record	Average First Freeze	Earliest Freeze on Record
Billings	September 21	August 24	October 1	September 4
Miles City	September 20	August 22	September 28	September 2
Sheridan	September 13	August 17	September 19	August 17

Montana Tornadoes - Summer 2010

Submitted by Tom Frieders
Warning Coordination Meteorologist

May 27 - Near Brockway, McCone County, 15 second tornado (EF-0)
June 16 - South of Frazer, McCone County (EF-1)
June 16 - Bowler Flats, east of Bridger, Carbon County EF-2)
June 20 - Billings Heights, Yellowstone County (EF-2)
June 21 - Otter, Powder River County (EF-1)
June 21 - Cache Creek, Southwest of Broadus, Powder River County (EF-2)
June 21 - SW Valley County (also seen from Garfield County) (EF-0)
July 2 - Crazy Mountains, Park and Meagher Counties (EF-2)
July 26 - Sheridan County (EF-3)
September 9 - 13 miles Southwest of Harlowton (EF-0)

2010 Total: 10 (1950-2009 state average: 6/year)
EF-0: 3 (65-85 mph) (3/year)
EF-1: 2 (86-110 mph) (1/year)
EF-2: 4 (111-135 mph) (0.6/year; total: 37)
EF-3: 1 (136-165 mph) (total: 3)

1950-2009: Fatalities 2, Injuries 20
2010: Fatalities 2, Injuries 1 (Sheridan County)

Cache Creek Tornado
Photo by Dennis McEuen

Crazy Mountains Tornado Damage
Photo by Tom Frieders

Montana Photo Gallery

Photos by Carolyn Willis

1. **Old Farmstead - Near Sonnette, Montana**
2. **Buildings and Windmill - Powderville, Montana**
3. **Field of Deer - Near Moorhead, Montana**

Hellos and Goodbyes - New Employees, and Family Updates

Submitted by Vickie Stephenson
Hydrometeorlogical Technician

David Smith, Electronics Technician, transferred to the Billings office from the National Weather Service in Marquette, Michigan.

Shawn Palmquist, a student from The University of North Dakota and **Kathleen Lewis,** a student from Iowa State University worked in our office over the summer. Although they both have gone back to school, they plan to work at our office in Billings again during holiday breaks.

Barry Loy, Electronics Technician, transferred to the National Weather Service office in Sioux Falls, South Dakota.

Ryan Leach, Meteorologist Intern, and his wife Kari, welcomed Jacob Patrick Leach to their family on July 18. Two year old son Paul now has a baby brother!

Matt Solum, General Forecaster, and his wife Gwen, welcomed Paxton Dillon Solum to their family on June 13th, giving two year old son Rylan a baby brother.

The 1.67 inches of rain that fell in Billings on August 29-30 was the 4th wettest 2-day August precipitation total on record in Billings.

PLEASE REMEMBER TO CALL US with your winter snowfall reports! Besides helping us with our forecasts and verification, we often compose reports and make maps of snowfall across the area. This is used by the media and others. We would like to make sure your area is included in these reports.

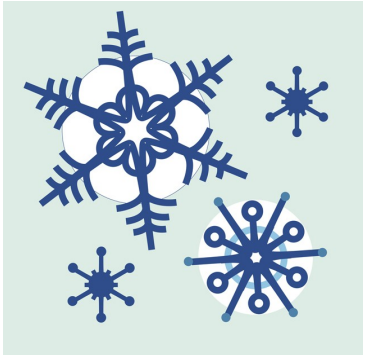
Hysham Observer Wins Holm Award

Submitted by
Carolyn Willis,
Observing Program Leader

Eunice Atchenberg, of Hysham, has been selected to receive the prestigious John Companius Holm Award for outstanding service. Only 26 of these awards were given out nationwide in 2010. This award acknowledges Eunice's outstanding and dedicated service as a cooperative observer, while also raising a family and being active in her local community. For over 23 years, along with taking her own weather observations, Eunice has regularly called her friends and neighbors across Treasure County, relaying their severe weather reports to the NWS office in Billings. Since Eunice was born on a night of record cold, she wonders if that is why she has always been interested in weather. She says her greatest pleasures come from spending time with her family and "visiting with the great people of our little town and county." A celebration and presentation of Eunice's Holm Award is being planned for November at the "Great Divide Workshop" in Billings.

Who was the "Snowflake Man?" American photographer and farmer Wilson A. Bentley was nicknamed "The Snowflake Man," or just "Snowflake" Bentley, because he photographed images of over 2,400 snowflakes. His stunning photo collection capturing the natural beauty of snowflakes was published in 1931's *Snow Crystals.*

From "The Handy Weather Answer Book," by Kevin Hile, p. 111.



Fall Normals

Submitted by Sean Campbell, Meteorologist Intern
Matt Solum, General Forecaster

Meteorological fall arrives at midnight on Wednesday, September 1, 2010, and ends at 1159 pm on Tuesday, November 30, 2010. Below are the average temperatures and precipitation for Billings, Miles City and the Sheridan for the fall season. Averages below are 30 year averages calculated from 1971 to 2000. All temperatures are in degrees Fahrenheit and all precipitation amounts are in inches.

Medicine Rocks near Ekalaka
Photo by Carolyn Willis

Billings					
Date	**High**	**Low**	**Average**	**Precipitation**	**Snowfall**
9/1 – 9/30	71.8	47.1	59.5	1.34	1.3
10/1 – 10/31	58.9	37.2	48.1	1.26	4.2
11/1 – 11/30	42.7	25.6	34.1	0.75	7.5
9/1 – 11/30	58.7	36.3	47.5	3.35	13.0

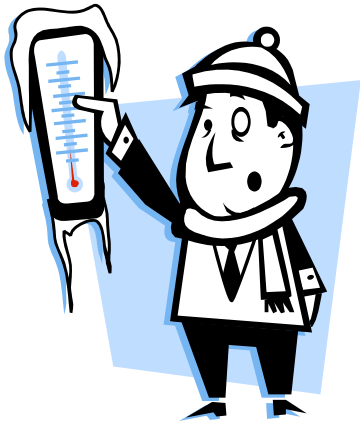
The earliest measurable snowfall in Billings occurred on September 7th, 1962. Over 6 inches of snow fell on the 7-8th.

German physicist Gabriel D. Fahrenheit developed the temperature scale that bears his name in 1714. The 'zero point' on his scale was the lowest temperature he could attain with a mixture of ice, water and salt.

www.sercc.com/wxtrivia.html

Miles City				
Date	**High**	**Low**	**Average**	**Precipitation**
9/1 – 9/30	74.0	46.8	60.4	1.19
10/1 – 10/31	60.0	35.3	47.7	1.13
11/1 – 11/30	41.8	21.6	31.7	0.52
9/1 – 11/30	58.6	34.5	46.6	2.81

Sheridan				
Date	**High**	**Low**	**Average**	**Precipitation**
9/1 – 9/30	73.1	41.0	57.1	1.38
10/1 – 10/31	59.8	30.3	45.1	1.41
11/1 – 11/30	43.4	18.5	31.0	0.80
9/1 – 11/30	59.8	31.1	45.5	3.59



Winter Weather Terminology

Submitted by: Carolyn Willis
Observing Program Leader
http://www.noaanews.noaa.gov/stories/s794c.htm

The National Weather Service urges residents to keep informed of local forecasts and warnings and familiarize themselves with key weather terminology. The following weather terms and definitions are commonly used throughout South Central Montana and Northern Wyoming. Although freezing rain is not common in our area, it does at occur from time to time, especially across Eastern Montana.

Winter Storm Outlook: Issued prior to a Winter Storm Watch. The Outlook is given when forecasters believe winter storm conditions are possible and are usually issued 3 to 5 days in advance of a winter storm.

Winter Storm Watch: Alerts the public to the possibility of a blizzard, heavy snow, heavy freezing rain, or heavy sleet. Winter Storm Watches are usually issued 12 to 48 hours before the beginning of a Winter Storm.

Winter Storm Warning: Issued when hazardous winter weather in the form of heavy snow, heavy freezing rain, or heavy sleet is imminent or occurring. Winter Storm Warnings are usually issued 12 to 24 hours before the event is expected to begin.

Blizzard Warning: Issued for sustained or gusty winds of 35 mph or more, and falling or blowing snow creating visibilities at or below ¼ mile; these conditions should persist for at least three hours.

Winter Weather Advisories: Issued for accumulations of snow, freezing rain, freezing drizzle, and sleet which will cause significant inconveniences and, if caution is not exercised, could lead to life-threatening situations.

Blowing Snow: Wind-driven snow that reduces visibility and causes significant drifting. Blowing snow may be snow that is falling and/or loose snow on the ground picked up by the wind.

The world's first weather satellite, Tiros 1, was launched on April 1, 1960 and sent back thousands of images during its short life span of only 79 days.

www.sercc.com/wxtrivia.html

Wind Chill Advisory: Issued when wind chill temperatures are expected to be a significant inconvenience to life with prolonged exposure, and, if caution is not exercised, could lead to hazardous exposure.

Dense Fog Advisory: Issued when fog will reduce visibility to ¼ mile or less over a widespread area.

Snow Flurries: Light snow falling for short durations. No accumulation or light dusting is all that is expected.

Snow Showers: Snow falling at varying intensities for brief periods of time. Some accumulation is possible.

Sleet: Rain drops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects. However, it can accumulate like snow and cause a hazard to motorists.

What is a "Snow Roller?"

People aren't the only ones who enjoy building snowmen. Sometimes nature gets into the game as well. In windy, wintry conditions, breezes have been known to start small collections of snowflakes rolling. As they roll, snowfall accumulates, and the snowball gets bigger and bigger. Such snow rollers have been known to grow to diameters of several feet.

From "The Handy Weather Answer Book," by Kevin Hile, p. 113.

Storm Chasing on the Day of the Billings Tornado

Submitted by Carolyn Willis
Observing Program Leader

June 20, 2010 - I bought a new telephoto lens for my camera that morning. Since there was a risk of severe weather, my husband and I decided to go storm chasing, hoping to get some good thunderstorm photos. There were few clouds in the sky around 11 a.m. as we headed west from Billings to Columbus, and then turned north towards Rapelje. Cumulonimbus clouds began to build as we took Big Coulee Road to Ryegate, headed east to Lavina, then south towards Billings. Around 4p.m., when we were about 10 miles south of Lavina, a thunderstorm approached from the west. It was low-based and had ominous black cloud fragments hanging from it. We turned west towards it on Granary Road when a black appendage dropped from the lowered cloud base. There was weak rotation, and my husband said, "It would be cool if this thing dropped a tornado now, you'd get a great photo - except it's moving right toward us!" We stopped, I got out and took some photos of it. It just couldn't get a strong enough rotation going, and soon the appendage fell apart. I was disappointed!

A thunderstorm tries to produce a funnel cloud, south of Lavina - June 20, 2010 Photo by Carolyn Willis

We headed back to Billings and noticed how black the clouds looked to our east. We arrived in town around 5pm. As we drove down Airport Road, we saw emergency vehicle lights flashing on Main Street, and thought there must have been a wreck, so we took the Aronson Road exit. We immediately ran over debris scattered across the road. I stated to my husband, "if I didn't know better, I'd think that was tornado debris." We headed to Hilltop Road where we ran over more of the same type of debris.

Just then, I received a text from my sister in Great Falls asking, "Did you hear the Metra Convention Center was destroyed by a tornado?" I turned to my husband and said, "I think we just ran over the Metra back there." In our back yard, which is less than a mile from the Metra, we found debris from the tornado - insulation, paper, and a ticket. The paper turned out to be a financial statement from the Metra offices. The ticket had been sold to a customer on June 19 for the Brad Paisley concert, but hadn't been mailed before the tornado decided to distribute it itself. Our neighbors said the large, white funnel was plainly visible from our house. Had we stayed home that day, instead of storm chasing, I could have had the perfect tornado photo from my own back deck!

Tornado photos by Darrel Buszmann, damage photos by Carolyn Willis

Be Prepared Before the Storm Strikes

Submitted by Carolyn Willis
Observing Program Leader

http://www.nws.noaa.gov/om/brochures/wntrstm.htm

At Home and Work...

Primary concerns are the potential loss of heat, power, telephone service, and a shortage of supplies if storm conditions continue for more than a day.

Have available:

- Flashlight and extra batteries.
- Battery-powered NOAA Weather Radio and portable radio to receive emergency information. These may be your only links to the outside.
- Extra food and water. High energy food, such as dried fruit or candy, and food requiring no cooking or refrigeration is best.
- Extra medicine and baby items.
- First-aid supplies.
- Heating fuel. Fuel carriers may not reach you for days after a severe winter storm.
- Emergency heating source, such as a fireplace, wood stove, space heater, etc.
- Learn to use properly to prevent a fire.
- Have proper ventilation.
- Fire extinguisher and smoke detector.
- Test units regularly to ensure they are working properly.

In Automobiles...

Plan your travel and check the latest weather reports to avoid the storm!

- Fully check and winterize your vehicle before the winter season begins.
- Carry a WINTER STORM SURVIVAL KIT:
- Keep your gas tank near full to avoid ice in the tank and fuel lines.
- Try not to travel alone.
- Let someone know your timetable and primary and alternate routes.

On the Farm...

- Move animals to sheltered areas. Shelter belts, properly laid out and oriented, are better protection for cattle than confining shelters, such as sheds.
- Have a water supply available. Most animal deaths in winter storms are from dehydration.

Winter Storm Survival Kit Suggestions...

- blankets/sleeping bags
- flashlight with extra batteries
- first-aid kit
- knife
- high-calorie, non-perishable food;
- extra clothing to keep dry
- a large empty can and plastic cover with tissues and paper towels for sanitary purposes
- a smaller can and water-proof matches to melt snow for drinking water
- sack of sand (or cat litter)
- shovel
- windshield scraper and brush
- tool kit
- tow rope
- booster cables
- water container
- compass and road maps

Winter Regions

Submitted by Carolyn Willis
Observing Program Leader
http://www.nws.noaa.gov/om/brochures/wntrstm.htm


Stock Photo

From the Mid-Atlantic Coast to New England... The classic storm is called a Nor'easter. A low pressure area off the Carolina coast strengthens and moves north. Wind-driven waves batter the coast from Virginia to Maine, causing flooding and severe beach erosion. The storm taps the Atlantic's moisture-supply and dumps heavy snow over a densely populated region. The snow and wind may combine into blizzard conditions and form deep drifts paralyzing the region. Ice storms are also a problem. Mountains, such as the Appalachians, act as a barrier to cold air trapping it in the valleys and adjacent low elevations. Warm air and moisture moves over the cold, trapped air. Rain falls from the warm layer onto a cold surface below becoming ice.

Along the Gulf Coast and Southeast... This region is generally unaccustomed to snow, ice, and freezing temperatures. Once in a while, cold air penetrates south across Texas and Florida, into the Gulf of Mexico. Temperatures fall below freezing killing tender vegetation, such as flowering plants and the citrus fruit crop. Wet snow and ice rapidly accumulate on trees with leaves, causing the branches to snap under the load. Motorists are generally unaccustomed to driving on slick roads and traffic accidents increase. Some buildings are poorly insulated or lack heat altogether. Local municipalities may not have available snow removal equipment or treatments, such as sand or salt, for icy roads.

In the Midwest and Plains... Storms tend to develop over southeast Colorado in the lee of the Rockies. These storms move east or northeast and use both the southward plunge of cold air from Canada and the northward flow of moisture from the Gulf of Mexico to produce heavy snow and sometimes blizzard conditions. Other storms affecting the Midwest and Plains intensify in the lee of the Canadian Rockies and move southeast. Arctic air is drawn from the north and moves south across the Plains and Great Lakes. Wind and cold sometimes combine to cause wind chill temperatures as low as 70F below zero. The wind crosses the lakes, tapping its moisture and forming snow squalls and narrow heavy snow bands. This is called "lake-effect snow."

From the Rockies to the West Coast... Strong storms crossing the North Pacific sometimes slam into the coast from California to Washington. The vast Pacific provides an unlimited source of moisture for the storm. If cold enough, snow falls over Washington and Oregon and sometimes even in California. As the moisture rises into the mountains, heavy snow closes the mountain passes and can cause avalanches. The cold air from the north has to filter through mountain canyons into the basins and valleys to the south. If the cold air is deep enough, it can spill over the mountain ridge. As the air funnels through canyons and over ridges, wind speeds can reach 100 mph, damaging roofs and taking down power and telephone lines. Combining these winds with snow results in a blizzard.

In Alaska... Wind-driven waves from intense storms crossing the Bering Sea produce coastal flooding and can drive large chunks of sea ice inland destroying buildings near the shore. High winds, especially across Alaska's Arctic coast, can combine with loose snow to produce a blinding blizzard and wind chill temperatures to 90F below zero! Extreme cold (-40F to -60F) and ice fog may last a week at a time. Heavy snow can impact the interior and is common along the southern coast. With only brief glimpses of the winter sun across the southern horizon, the snow accumulates through the winter months. In the mountains, it builds glaciers, but the heavy snow accumulations can also cause avalanches or collapse roofs of buildings. A quick thaw means certain flooding. Ice jams on rivers can also cause substantial flooding.

The Fathers Day Tornado in Billings

Submitted by Tom Frieders
Warning Coordination Meteorologist

Officials from NOAA's National Weather Service in Billings completed an assessment of the tornado that occurred in the city of Billings the afternoon of June 20th, 2010 (Fathers Day).

Figure 1: Photo Courtesy Les Stone

Based on the observed damage, the tornado is being classified as an EF-2 on the Enhanced Fujita Scale. Wind speeds within an EF-2 tornado range from 111-135 mph, and the associated damage observed at the Billings MetraPark and nearby businesses is consistent with this classification. The damage path was 120 yards wide with a length of about a half mile (Figure 5) and on the ground an estimated 12 minutes.

The damage assessment and eyewitness accounts indicate that the tornado developed near the intersection of Lake Elmo Drive and Main Street in the Billings Heights at approximately 4:24 pm, with significant EF-2 damage to several nearby businesses (Figure 3). Damage included rooftops being blown off of three structures, windows blown out, power poles downed, business signs and billboards blown down along with several trees uprooted. The tornado appeared to weaken slightly as it progressed southeast across Alkali Creek. Limbs were broken off numerous trees in the vicinity of the creek. The tornadic circulation then appears to have strengthened once again as it moved south over the Rimrock Auto Arena at MetraPark. EF-2 damage was again observed to the arena with much of the roof blown off along with other damage to the exterior of the building (Figure 4). Debris from the arena impacted other nearby businesses creating additional damage, mainly in the form of broken windows. Debris from the arena was reported landing as far away as a mile from the tornado touchdown. The tornado then dissipated over the arena around 4:36 pm.

(continued on page 13)

Figure 3: Main Street and Lake Elmo Drive

Figure 2: Photo Courtesy Darrell Buszmann

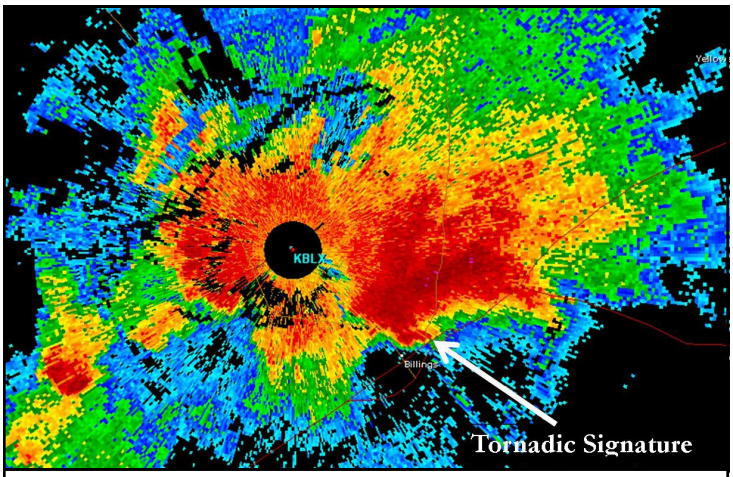


Figure 6: WSR-88D KBLX 0.5 ° Base Reflectivity Image valid Sunday June 20, 2010 at 4:29 pm

Father's Day Tornado - Continued From Page 12

The associated thunderstorm then moved northeast away from Billings. Numerous sightings of funnel clouds were reported as this storm moved east-northeast of Billings, however no additional tornado touchdowns were reported.

Meteorologically speaking, this was a very active severe weather day for south central Montana. The Storm Prediction Center in Norman, Oklahoma, had issued a Severe Thunderstorm Watch for parts of Southern Montana, including Yellowstone County, at 1:55 pm on 6/20/10. Strong southwesterly flow aloft combined with a moderately unstable air mass created conditions favorable for producing severe thunderstorms, and potentially tornadoes.

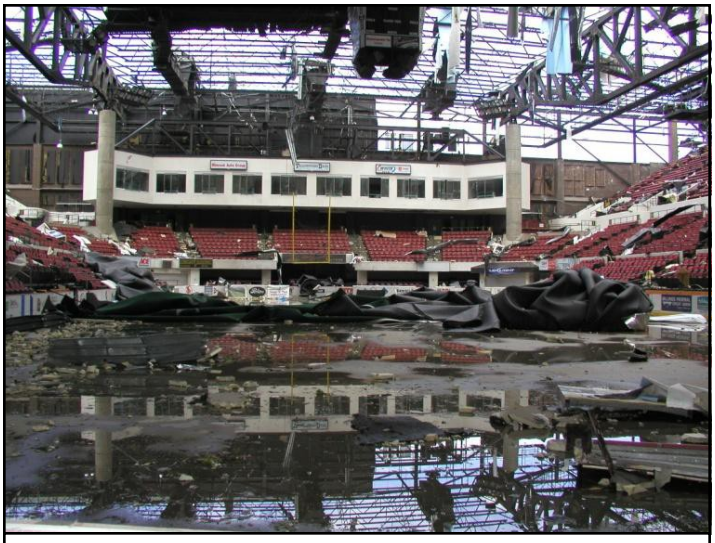


Figure 4: Rimrock Auto Arena Damage

The tornadic producing supercell thunderstorm is shown in Figure 6 at 4:29 pm on 6/20/10. This particular storm formed to the southeast of the Billings Doppler Radar (KBLX). The structure of this storm displayed a very distinct hook echo with very strong inflow. Figure 7 shows the storm-relative velocity profile from the same time. As a reference, green colors represent winds flowing toward the radar and red colors represent winds flowing away from the radar. The area of circulation at this particular time was quite impressive.

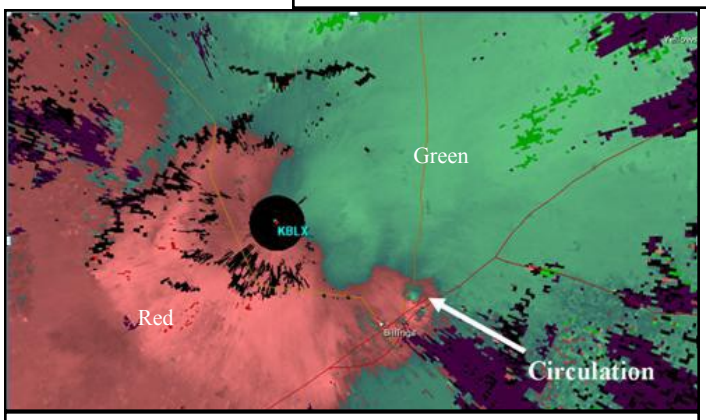


Figure 7: WSR-88D KBLX 0.5 ° Storm Relative Motion Image valid Sunday June 20, 2010 at 4:29 pm

Note: These photos and radar images show up much better in color in our online version of this newsletter, at: http://www.wrh.noaa.gov/byz/jargon/fall10.pdf

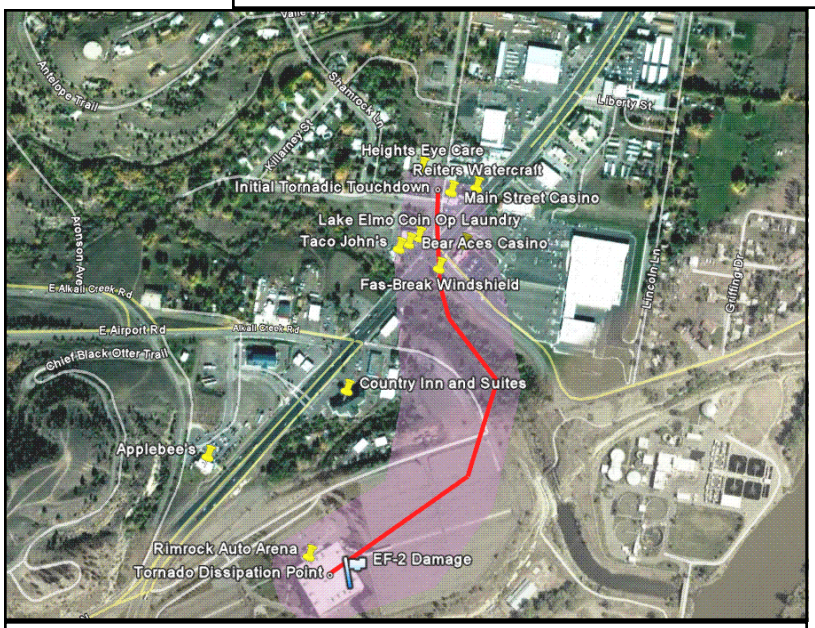


Figure 5: Damage Path - Father's Day Tornado - June 20, 2010

Through September 9th, the Billings airport reported a thunderstorm on 44 days since May 1st. This is the most since 1998, when 47 thunderstorm days were observed.

2010 Summer Review

Submitted by: Sean Campbell - Meteorologist Intern
Matt Solum - General Forecaster

Meteorological summer began at midnight on Tuesday, June 1, 2010, and ended at 1159 pm on Tuesday, August 31, 2010. The Billings NWS County Warning Area was hit hard by severe weather this summer with 175 severe hail and wind reports and 5 confirmed tornadoes. Both of these numbers are double the 1986 – 2010 averages. Much of the area was below normal for the 2010 summer months in terms of temperature and well above normal in terms of precipitation. Here is a look at the temperature and precipitation statistics for Billings, Miles City and Sheridan for the 2010 summer season. Normals are 30 year averages calculated from 1971 to 2000. All temperatures are in degrees Fahrenheit and all precipitation amounts are in inches.

June 2010 was the 8th wettest June ever in Billings.
August 2010 was the 2nd wettest August ever in Billings.
The meteorological summer of 2010 was the 2nd wettest summer ever in Billings.

Billings								
Date	**Normal High**	**2010 Average High**	**Normal Low**	**2010 Average Low**	**Normal Average**	**2010 Average**	**Normal Precip.**	**2010 Precip.**
6/1 – 6/30	78.0	75.3	52.5	52.4	65.2	63.8	1.89	5.10
7/1 – 7/31	85.8	84.9	58.3	58.1	72.0	71.5	1.28	1.70
8/1 – 8/31	84.5	83.7	57.3	57.2	70.9	70.5	0.85	2.78
6/1 – 8/31	83.0	81.4	55.6	55.9	69.3	68.7	4.02	9.58

Sheridan								
Date	**Normal High**	**2010 Average High**	**Normal Low**	**2010 Average Low**	**Normal Average**	**2010 Average**	**Normal Precip.**	**2010 Precip.**
6/1 – 6/30	76.4	74.0	46.8	47.0	61.6	60.5	2.02	2.68
7/1 – 7/31	85.2	84.7	52.4	52.7	68.8	68.7	1.11	1.54
8/1 – 8/31	84.9	85.9	51.5	52.2	68.2	69.0	0.80	0.79
6/1 – 8/31	83.0	81.6	51.0	50.7	67.0	66.2	3.93	5.01

July 2010 was the 6th wettest July ever in Miles City.

Miles City								
Date	**Normal High**	**2010 Average High**	**Normal Low**	**2010 Average Low**	**Normal Average**	**2010 Average**	**Normal Precip.**	**2010 Precip.**
6/1 – 6/30	79.9	77.2	54.2	53.9	67.1	65.6	2.42	2.26
7/1 – 7/31	87.9	85.1	60.2	59.1	74.1	72.1	1.61	3.69
8/1 – 8/31	86.8	85.6	58.9	58.4	72.9	72.0	1.16	1.54
6/1 – 8/31	84.9	82.7	57.8	57.2	74.1	70.0	5.20	7.49

Winter Weather Awareness Week

Submitted by: Tom Frieders
Warning Coordination Meteorologist

Every year, winter claims dozens of lives and causes millions of dollars in damage. Cold weather exposure and automobile accidents are the main causes of winter weather related deaths in Montana. 2010 Winter Weather Awareness Week will take place Oct 18-22. Check out our website at http://www.wrh.noaa.gov/byz/winter/index.php?wfo=byz and be prepared before the first winter storm impacts the region!

It is estimated that about 35 million Americans suffer from Seasonal Affective Disorder, or SAD, which results from decreased exposure to sunlight during winter months. Treatment for these cases of the 'winter blues' include light therapy and trips to sunny places.

www.sercc.com/wxtrivia.html

Winter Normals

Submitted by: Sean Campbell - Meteorologist Intern
Matt Solum - General Forecaster

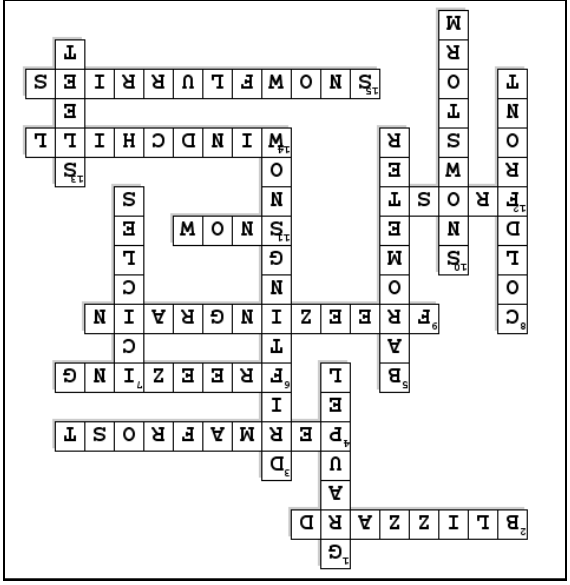
Meteorological winter arrives at midnight on Wednesday, December 1, 2010, and ends at 1159 pm on Monday, February 28, 2011. Here are the average temperatures and precipitation for Billings, Miles City and Sheridan for the winter season. Averages are 30 year averages calculated from 1971 to 2000. All temperatures are in degrees Fahrenheit and all precipitation amounts

Billings					
Date	**High**	**Low**	**Average**	**Precipitation**	**Snowfall**
12/1 – 12/31	34.5	17.7	26.1	0.67	8.9
1/1 – 1/31	32.8	15.1	24.0	0.81	10.9
2/1 – 2/28	39.5	20.1	29.8	0.58	6.5
12/1 – 2/28	35.8	17.5	26.6	2.05	26.3

Sheridan				
Date	**High**	**Low**	**Average**	**Precipitation**
12/1 – 12/31	34.4	10.4	22.4	0.68
1/1 – 1/31	33.0	9.7	21.3	0.77
2/1 – 2/28	39.0	14.9	26.9	0.57
12/1 – 2/28	35.9	11.8	23.8	1.95

Miles City				
Date	**High**	**Low**	**Average**	**Precipitation**
12/1 – 12/31	30.6	10.5	20.6	0.45
1/1 – 1/31	27.3	7.4	17.4	0.50
2/1 – 2/28	35.2	14.3	24.8	0.34
12/1 – 2/28	31.3	10.9	21.1	1.20

Answers to Winter Weather Crossword on Page 4



The record for the most snowfall from a single storm in the U.S. belongs to Mt. Shasta, California, where 189 inches fell from Feb. 13-19, 1959.

www.sercc.com/wxtrivia.html

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