WRITERS OF THE STORM

WFO PUEBLO / SOUTHEAST COLORADO NEWS

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Did You Know???

By Jennifer Stark

Did you know that the National Weather Service is a federal agency? We are a line office of the National Oceanic and Atmospheric Administration (NOAA). NOAA is a bureau under the Department of Commerce. It may be a surprise to learn that we are a part of the Department of Commerce, but the products and services provided by NOAA support economic vitality and affect more than one-third of America's gross domestic product.

Weather can significantly impact the economy of the United States. National Weather Service field offices, like the one in Pueblo, provide a 24 hour, 7 day per week continuous weather watch. However, our mission goes beyond just watching the weather. Our local meteorologists become experts on the terrain and topography that drive so much of the weather in southeast and south central Colorado. The meteorologists spend a lot of time analyzing the continuous flow of weather model data, radar data, satellite data, observations, and local storm reports to produce continuously updated forecast products. Forecast products include aviation forecasts, hydrologic forecasts, fire weather forecasts and public forecasts. More importantly, we are working harder than ever to interpret and communicate weather forecasts to government sector partners and agencies, specifically targeting emergency managers. Emergency managers can serve as a force multiplier by communicating high impact weather and preparedness messages to their local constituents.

Our staff includes meteorologists, technicians, electronics technicians, administrative staff, a hydrologist and IT personnel. These folks who live and work in the Pueblo area remained dedicated to our mission of a continuous weather watch and top notch forecasts, warnings, and decision support services throughout the federal lapse in appropriations. Weather never takes a break and neither does the staff at the National Weather Service!





New Faces Around NWS Pueblo

Dr. Bradley Carlberg:

Meteorologist



I grew up in Minnesota and have spent my entire life in the Midwest until moving to Pueblo. After high school, I worked for several years before taking any college courses. I mainly worked in production factories and retail. I earned my Bachelor's degree from St. Cloud State University, then went straight into the PhD program at Iowa State University. In mid-December, I received my PhD. Severe, convective weather is my favorite type of weather. When I am not working, I enjoy cycling, hiking, watching football, and travelling the U.S.

Greg Heavener:

Warning Coordinating Meteorologist

Greg was born and raised in Owings Mills, MD, a suburb of Charm City, Baltimore, MD. Greg's interest in weather began around the age of 6 after witnessing the severe damage created by a tornado touchdown near his hometown. Greg graduated with his Bachelor of Science in meteorology from Millersville University, an hour drive west of Philadelphia.



Prior to arriving in Pueblo, he was a Lead Meteorologist in Corpus Christi, TX from 2015-2018 and helped to fight off Major Hurricane Harvey and then being deployed to Key West, FL to help fight off Major Hurricane Irma, both in 2017.

Prior to his 3 years in South Texas, Greg started his public service career in 2008 at the forecast office in Mount Holly, NJ where he forecasted and experienced numerous nor'easters, severe weather events, including the June 2012 Mid-Atlantic Derecho and one of the costliest storms in US history, Hurricane Sandy.

While it won't win him any popularity contests, especially here in Southern Colorado, Greg is an avid Baltimore Orioles and Ravens fan.

Greg and his family are genuinely excited to be a part of the Southern Colorado community and is looking forward to many years providing outreach to the public and helping communities prepare for hazardous weather.



Have you ever wanted to know how you can help the National Weather Service report severe weather? Have you ever wanted to help us verify our Severe Thunderstorms and Tornado warnings? Register for one of our local storm spotter classes and learn how! We'll provide training on hail, severe wind gusts, tornado reporting, while also touching on fire weather and winter weather. Your reports provide vital information to us in near real time by helping us verify our warnings. Register and come to a training session in a location near you!

Storm Spotter Registration

Lamar, CO	**4/2/2019**	**6:00-8:00 PM**	**Lamar High School** **1900 S. 11th St.**
Pueblo, CO	**4/8/2019**	**6:00-8:00 PM**	**Pueblo Emergency Services** **101 W. 10th St.**
Ordway, CO	**4/10/2019**	**7:00-9:00 PM**	**Crowley County Fire Department** **611 E. 9th St.**
Alamosa, CO	**4/16/2019**	**5:00-7:00 PM**	**DHSEM** **West Highway 160**
Colorado Springs, CO	**4/17/2019**	**6:00-8:00 PM**	**El Paso County Emergency Services Authority** **3755 Mark Dabling Blvd.**
Westcliffe, CO	**4/25/2019**	**7:00-9:00 PM**	**Custer County Sheriff Building** **710 Rosita Ave.**
Pueblo, CO	**5/15/2019**	**6:00-8:00 PM**	**Pueblo Emergency Services Center** **101 W. 10th St.**
Fountain, CO	**5/16/2019**	**6:00-8:00 PM**	**Fountain Library** **230 S. Main St.**

Winter 2018-2019 Climate Review

By Mark Wankowski

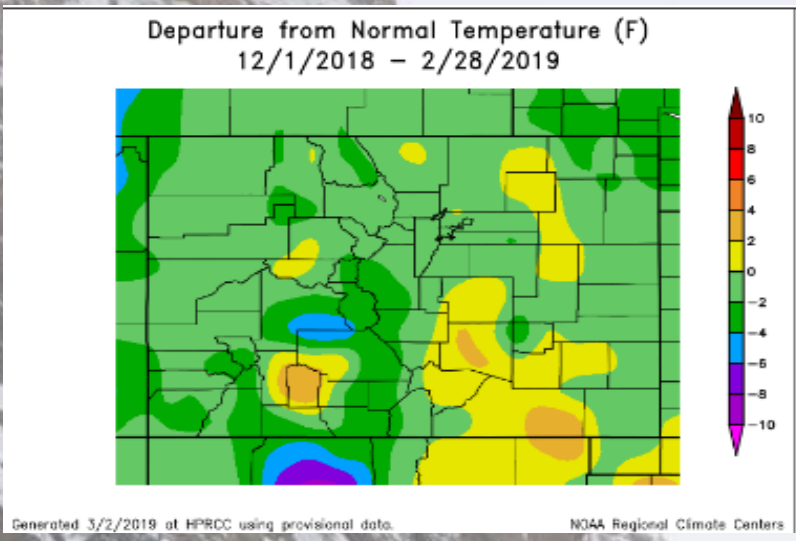
The start of "Meteorological Winter of 2018-2019" (December-January-February) was relatively warm and dry across south central and southeast Colorado, save for two stronger storm systems moving across the Rockies through out the last week of December, bringing beneficial moisture and cold temperatures to the area. For the month of December as a whole, near to slightly above normal temperatures and generally below normal precipitation were experienced across South Central Colorado and Southeast Colorado, except for at or above normal precipitation across portions of the southeast plains.

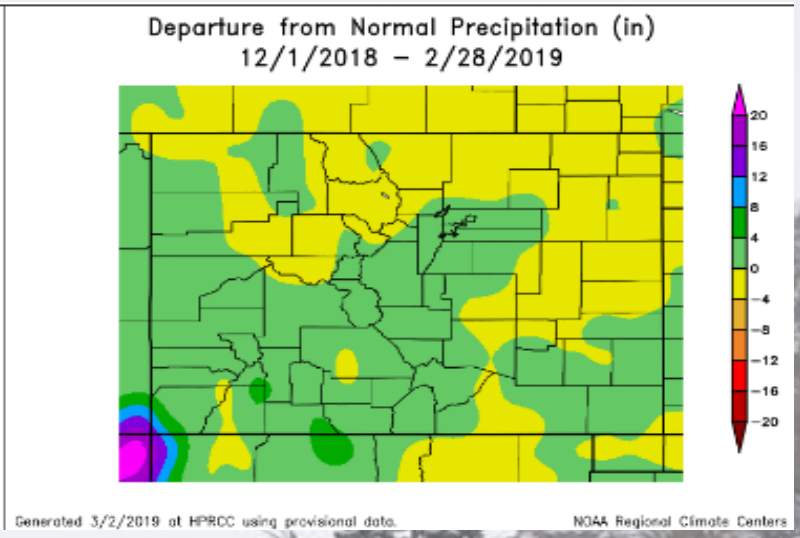
January of 2019 started out cold and unsettled, as a passing weather system ushered in some of the coldest air of the season across the area on New Years Day. The rest of January can be characterized by periodic weather disturbances moving through persistent moderate west to northwest flow aloft across the Rockies. This pattern brought beneficial snowfall to areas over and near the higher terrain, with periods of warm temperatures and strong winds, as well as brief periods of moisture and cold temperatures, to the southeast plains. For the month of January as a whole, near normal to below normal temperatures and above normal precipitation were experienced for areas over and near the higher terrain, with generally above normal temperatures and near normal to above normal precipitation experienced across the Southeast Colorado Plains.

February of 2019 continued the weather pattern of the previous month, with periodic weather disturbances moving through persistent moderate west to northwest flow aloft across the Rockies. This pattern brought abundant and beneficial snowfall to areas over and near the higher terrain, especially the Southwest Mountains, with Wolf Creek Ski Resort reporting over 5 feet of snow in one 7 day period. This pattern also brought periods of warm temperatures and strong winds, as well as brief periods of moisture and cold arctic intrusions to the Southeast Plains. For the month of February as a whole, below normal temperatures were experienced across the area, save for pockets of near normal temperatures across the Southern I-25 Corridor. As for precipitation, at or above normal precipitation was experienced across most of South Central and Southeast Colorado, with pockets of below normal precipitation experienced across the Southeast Colorado Plains.

For the Winter of 2018-2019 as a whole, at to below normal temperature were experienced across south central and southeast Colorado, with areas of above normal temperatures across the I-25 Corridor. As for precipitation, generally above normal precipitation was experienced across the area, with areas of at and below normal precipitation across the southeast plains.

The following graphics indicate seasonal temperature and precipitation departures from normal across the state through out the Winter of 2018-19.



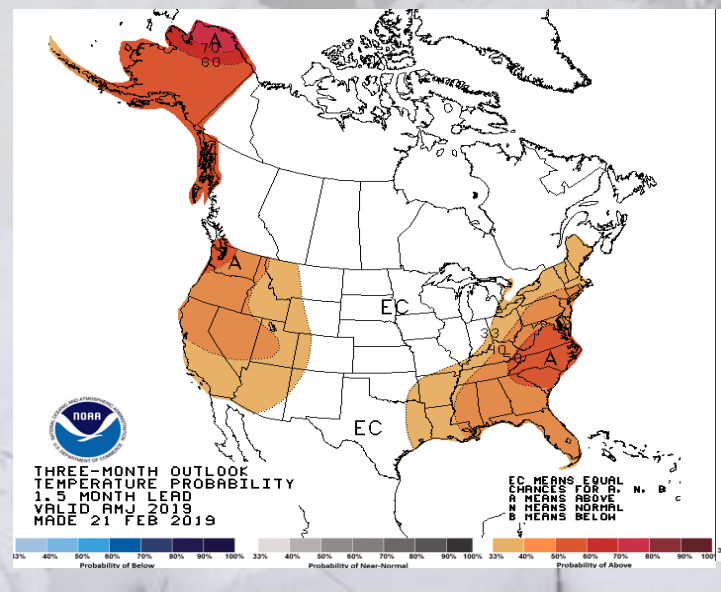


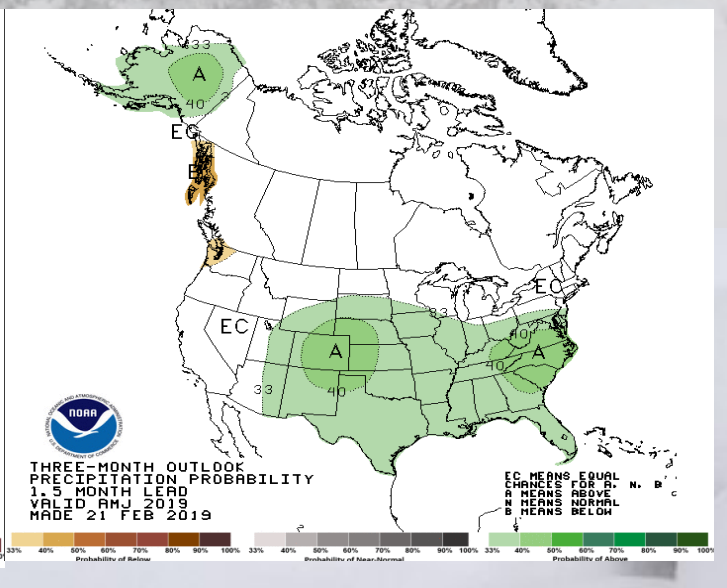
The preliminary average temperature for the Winter of 2018-2019 in Alamosa was 16.4 degrees, which is 2.6 degrees below normal. Alamosa recorded 1.86 inches of precipitation throughout the Winter. This is 0.99 inches above normal and makes the Winter of 2018-19 the 5th wettest Winter on record. Alamosa recorded 28.8 inches of snow through out the Winter. This is 16.5 inches above normal and makes the Winter of 2018-19 the 4th snowiest Winter on record.

The preliminary average temperature for the Winter of 2018-2019 in Colorado Springs was 31.9 degrees, which is 1.1 degrees above normal. Colorado Springs recorded 0.65 inches of precipitation through out the Winter, which is 0.35 inches below normal. Colorado Springs recorded 10.2 inches of snow through out the Winter, which is 6.0 inches below normal.

The preliminary average temperature for the Winter of 2018-2019 in Pueblo was 33.2 degrees, which is 1.7 degrees above normal. Pueblo recorded 0.83 inches of precipitation throughout the Winter, which is 0.20 inches below normal. Pueblo recorded 10.2 inches of snow through out the Winter, which is 5.6 inches below normal.

Below is the Climate Prediction Center's (CPC) temperature and precipitation outlook for the Spring of 2019 (April, May, June), which indicates equal chances of above, below and near normal temperatures and better chances for above normal precipitation across all of south central and southeast Colorado.





March 13th, 2019 "Bombogenesis" Event

By Klint Skelly

On March 13th, 2019 an extremely powerful low pressure system developed over southern Colorado, setting a record for the lowest pressure recorded over Colorado. It brought widespread rainfall over the plains, created blizzard conditions over El Paso County, and dropping feet of snow over the mountains. According to local news sources, around 1,500 motorists were stranded over northern El Paso County. CDOT closed I-25 north of Woodmen Road at 11:23 AM MDT due to "adverse weather conditions", reopening during the later afternoon hours on March 14th. The lowest recorded pressure was 970.4 hPa over Lamar, Colorado, which is the state record for lowest pressure ever recorded outside of a tornado. Pueblo, Colorado recorded a 974.2 hPa surface pressure at 9:00 AM MDT, which is a record for the lowest pressure over Pueblo.

The "bombogenesis" event is best described in sections...

1) **Pre-cyclogenesis (the overnight hours)**
2) **"Bombogenesis" (the morning hours)**
3) **Orographics (the early afternoon hours)**

1) Pre-cyclogenesis:

During the late evening and overnight hours of March 12th and 13th, rain bands formed over the I-25 corridor and the Eastern Plains. The rain band formations were created by warm air advection from the south and southeast of Colorado. Generally, the Raton Mesa creates a rain shadow (compressional heating due to downslope flow resulting in temperatures warming and moisture content remaining steady, leading to a drier atmosphere relative to where the air came from), but in this case, warm air advection overcame the effects of orographics to create overnight rain showers. The high temperatures on March 13th actually came during the overnight period. The extra moisture from the Gulf of Mexico and the stratus deck kept the temperature warm overnight producing the rain bands instead of snow.

2) "Bombogenesis":

So how did this happen? Why did we see the strongest low pressure system ever recorded in Colorado? Here over the Front Range, we see a phenomena called Lee Cyclogenesis. Essentially, an upper level low pressure system ejects off of the Rocky Mountains and over the high plains. During that time the upper level circulation must quickly go from the higher elevations all the way down to the lower elevations which causes the low pressure system to stretch and tighten up, causing the low pressure to rotate more quickly and intensify. The best way to describe this phenomena is by comparing it to a spinning ice skater. When the ice skater has their arms out, they spin slowly, but when they bring in their arms tight into their body, they spin more quickly (conservation of angular momentum). The same thing that was previously described happens to a low pressure system ejecting off of the Rocky Mountains (Fig 1).

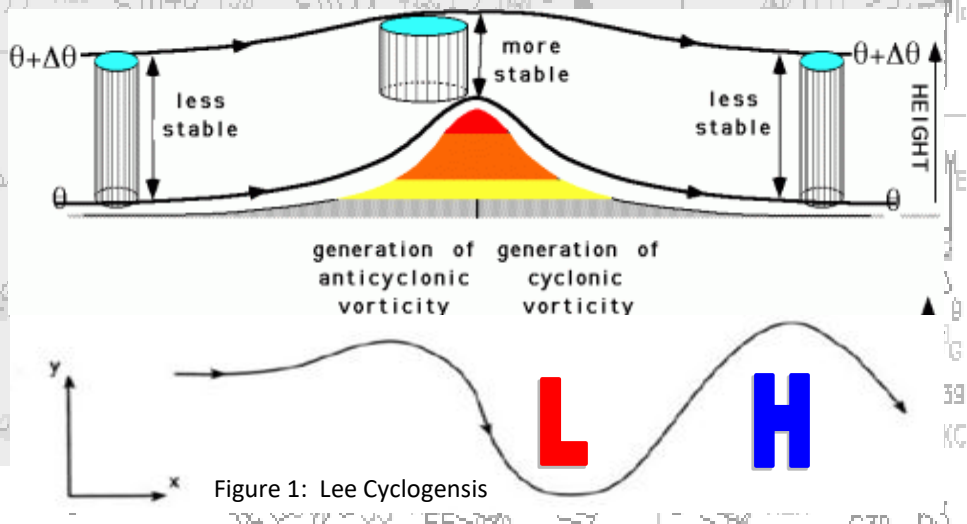


Figure 1: Lee Cyclogensis

Lee cyclogenesis happens all of the time, though, so what made this event special? Well, while the low pressure center ejected off of the Rockies there was a baroclinic zone located over southern Colorado. A baroclinic zone is a region in which a temperature gradient (temperature difference) exists, which also helps to intensify the low pressure system (Fig 2). So there was lee cyclogenesis and baroclinic cyclogenesis occurring, but there was another element that helped the cyclone to explosively intensify; a secondary trough located to the northwest, which lagged behind the closed upper level low. All of these interaction created the "bombogenesis" event.

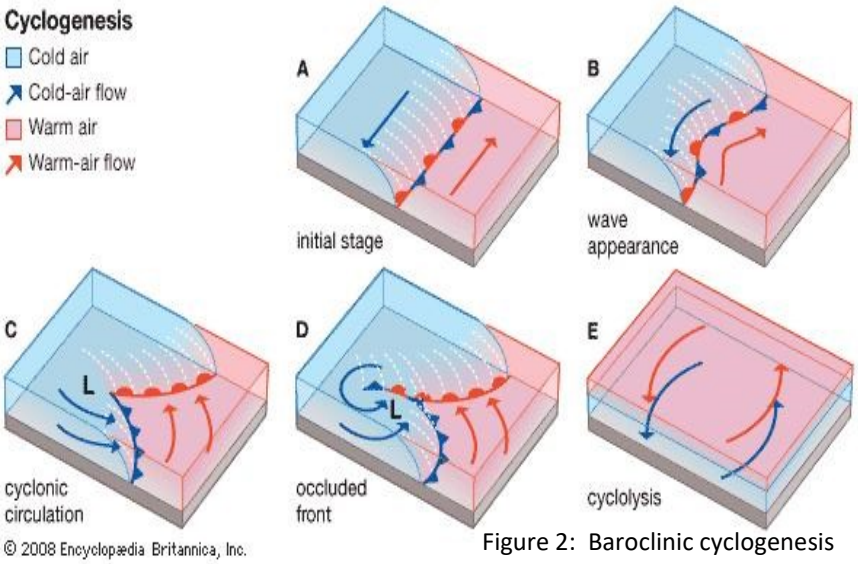


Figure 2: Baroclinic cyclogenesis

The rapid cyclogenesis caused "wrap-around" precipitation bands on the back side of the low pressure center. This kind of precipitation occurs when the upper level low and the surface transition to becoming vertically stacked, or reach the occulsion stage of its life cycle. Isentropic lift (upglide; warm conveyor belt) is responsible for this type of precipitation (Fig 3).

3) Orographics:

The final stage is when the low pressure system was located far enough east that the dynamics were overwhelmed by the orographics. The very strong northerly winds (downslope) off of the Palmer Divide ended precipitation over southern El Paso and Pueblo Counties, while blizzard conditions continued from Colorado Springs, north (Fig 4). Generally, the downslope flow off of the Palmer Divide is stronger than the dynamics of the low pressure system, but in this case, the dynamics were stronger, especially during the middle of the event. A key lesson in Colorado forecasting is that topography rules, and at the end of this event it did! During the afternoon hours, the strongest winds were observed which were caused (partly) by the topography as well. There was ageostrophic accelerations to the south due to wind hitting the mountains and being deflected south, evaporational cooling from the downslope effects off the Palmer Divide causing a density acceleration to the lower elevations, and the shear intensity of the low pressure system.

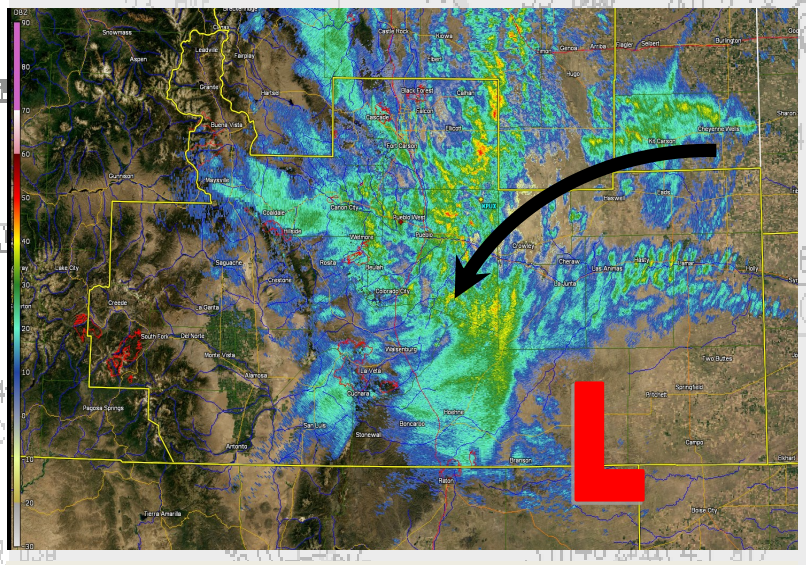


Figure 3: Radar March 13, 2019 at 1309 UTC with low pressure south of La Junta and isentropic lift around the low with widespread rain.

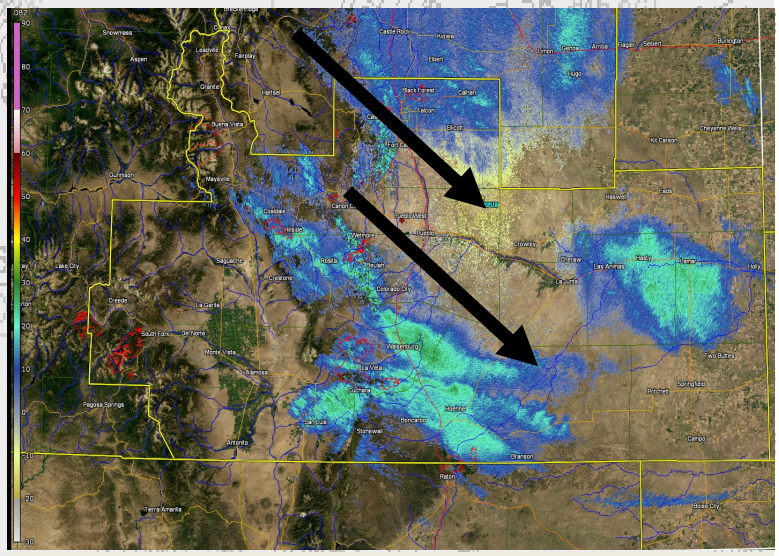


Figure 4: Radar March 13, 2019 at 2304 UTC. Northwest winds downslope off higher terrain, producing precipitation free area southern El Paso and Pueblo Counties.

Key Events:

KMNH (Monument, Colorado):
Rain transitioned to snow at 8:54 AM MDT, with blizzard conditions (sustained winds or frequent wind gusts >35 mph and visibility <1/4 mile) beginning at 9:06 AM MDT and lasting through 8:23 PM MDT, which was over 11 hours of blizzard conditions observed. Blowing snow continued through 6:24 AM MDT on March 14th, but visibility was greater than 1/4 mile during that time period.

KCOS (City of Colorado Springs Municipal Airport):
Rain transitioned to snow at 8:54 AM MDT, with blizzard conditions developing at 10:52 AM and lasting through 5:57 PM MDT, which is 7 hours of blizzard conditions. Blowing snow continued until 12:45 AM MDT on March 14th, but the visibility readings did not qualify for blizzard conditions. KCOS also broke the record for the highest wind gust recorded with a magnitude of 84 kts (96 mph) at 1:12 PM MDT. Stronger winds were likely to the east of KCOS, but there are no observation stations located in eastern El Paso County. KCOS also experienced 2.0" of snow according to the observer on station, but there were likely higher amounts that fell near the airport.

KLHX (La Junta Municipal Airport):
KLHX saw brief periods of light rain during the afternoon, but the main impacts were the winds gusts. At 3:53 PM MDT a wind gust of 77 kts (88.6 mph) was recorded.

KLAA (Lamar Municipal Airport):
KLAA saw brief periods of light rain and light snow during the afternoon, but the main impacts were the wind gusts. At 3:24 PM MDT, a wind gust of 68 kts (78.3 mph) was recorded. The state record for lowest pressure was 970.4 hPa recorded at 11:16 AM MDT.

Notable Snowfall Reports

3 ESE	Falcon	8.0 in	3:00 PM	3/13/2019
2 N	Black Forest	7.0 in	3:38 PM	3/13/2019
6 ENE	Black Forest	7.0 in	6:08 PM	3/13/2019
3 NW	Black Forest	6.5 in	1:46 PM	3/13/2019
2 NNE	Monument	4.0 in	11:37 AM	3/13/2019
2 N	Black Forest	16.0 in	7:00 AM	3/14/2019
3 NW	Black Forest	13.5 in	12:00 AM	3/14/2019
2 NNE	Monument	10.0 in	3:18 PM	3/13/2019
5 SSE	Air Force Academy	9.0 in	4:00 AM	3/14/2019
3 ENE	Manitou Springs	5.0 in	4:00 PM	3/13/2019
2 WNW	Peterson AFB	3.0 in	4:00 AM	3/14/2019
2 NW	Colorado Springs	2.5 in	10:50 AM	3/14/2019

Notable Wind Reports

8 S	Springfield	74 MPH	4:33 PM	3/13/2019
4 SW	Campo	62 MPH	8:59 AM	3/14/2019
	Pueblo Airport	78 MPH	2:54 PM	3/13/2019
1 NW	Pueblo	63 MPH	4:27 PM	3/13/2019
7 SE	Boone	63 MPH	2:56 PM	3/13/2019
1 SSE	Pueblo West	50 MPH	1:25 PM	3/13/2019
4 S	Black Forest	84 MPH	12:47 PM	3/13/2019
2 N	Black Forest	81 MPH	5:30 PM	3/13/2019
1 WNW	Palmer Lake	62 MPH	4:11 PM	3/13/2019
	Falcon Airport	59 MPH	11:55 AM	3/13/2019
	Lamar Airport	82 MPH	4:39 PM	3/13/2019
17 NW	Two Buttes	60 MPH	9:30 AM	3/14/2019
	La Junta Airport	89 MPH	3:46 PM	3/13/2019
4 S	Cheraw	81 MPH	2:40 PM	3/13/2019
18 SW	Forder	71 MPH	2:15 PM	3/13/2019
	Colorado Springs Airport	96 MPH	1:18 PM	3/13/2019
6 SW	Truckton	85 MPH	2:03 PM	3/13/2019

Severe Weather Safety Tips!

As spring approaches and winter fades away; do you know how to protect yourself from severe weather? Here are a few safety tips to use when severe weather threatens your area!

Severe Thunderstorm Safety:

Before

- **Be Weather Ready: Check the forecast regularly, listen to local news and NOAA weather radio to stay informed of approaching Thunderstorms.**
- **Create a Plan: Have a family plan that includes an emergency meeting and shelter place. Pick a safe room in your home (basement, storm cellar, an interior room on the lowest floor with no windows).**
- **Practice Your Plan: Conduct drills regularly so everyone knows what to do! Make sure all family members know where to go when a severe thunderstorm warning is issued. Don't forget pets!**
- **Prepare your home: Keep trees trimmed near your house. Put away loose objects, close windows and doors and move valuable objects inside or under a sturdy structure.**

During

- **Stay weather ready: Continue to monitor local news and NOAA weather radio to stay updated on watches and warnings.**
- **At your house: Go to your secure location if you hear a severe thunderstorm warning has been issued and damaging winds or large hail are expected.**
- **At your workplace or school: Stay away from windows if you are in a severe thunderstorm warning. Damaging winds or large hail could blow heavy objects at windows. Do not go to large open rooms.**
- **Outside: Go inside a sturdy building if severe thunderstorms are approaching. Sheds and storage facilities are NOT safe. Taking shelter under a tree can be deadly! The tree may fall on you and you are at risk of getting struck by lightning.**
- **In a vehicle: Being in a hard topped vehicle is safer than being outside. If you have time, drive to the nearest secure shelter.**

After

- **Stay informed: Keep your NOAA weather radio with you so you can listen for updates.**
- **Contact your family: Let your family and friends know you are ok so they can help spread the word. Power may be out and phone lines down.**
- **Assess the damage: After the severe weather has ended, check your property for damage. Wear long pants, long sleeved shirts and sturdy shoes. Contact local authorities if you see power lines down. Stay out of damaged buildings.**
- **Help your neighbors: If you see someone injured, call 911! If you are trained, provide first aid until emergency responders arrive.**

Severe Weather Safety Tips!

SEVERE THUNDERSTORM RISK CATEGORIES

	Thunderstorms (No Label)	✓ No Severe Thunderstorms Expected, Lightning/Flooding threats exist with all thunderstorms, Winds to 40 mph, Small hail.
1	MARGINAL (MRGL)	✓ Isolated severe thunderstorms possible, Limited in duration and / or intensity. Winds 40 - 60 mph. Low tornado risk.
2	SLIGHT (SLGT)	✓ Scattered severe thunderstorms possible. ✓ Short-lived and / or not widespread, isolated intense storms possible. One or two tornadoes. ✓ Reports of strong wind damage ✓ Hail - 1", Isolated - 2"
3	ENHANCED (ENH)	✓ Numerous severe thunderstorms possible ✓ More presistent and / or widespread. ✓ A few tornadoes. Several reports of strong wind damage. ✓ Damaging hail - 1 - 2"
4	MODERATE (MDT)	✓ Widespread severe thunderstorms likely ✓ Long-lived, widespread and intense. ✓ Strong tornadoes. ✓ Widespread wind damage ✓ Destructive hail - 2"+
5	HIGH (HIGH)	✓ Widespread severe thunderstorms expected. ✓ Long-lived, very widespread and particularly intense. ✓ Tornado Outbreak. ✓ Derecho

Developed by the Storm Prediction Center (SPC)



THUNDERSTORMS WATCH VS. WARNING

Severe Thunderstorm Watch: Be Prepared!

Severe thunderstorms are possible in and near the watch area. Stay informed and be ready to act if a severe thunderstorm warning is issued. Watches are issued by the Storm Prediction Center (spc.noaa.gov) for counties where severe thunderstorms may occur. The watch area is typically large, covering numerous counties or even states.

Severe Thunderstorm Warning: Take Action!

A severe thunderstorm has been indicated by radar or reported by a spotter producing hail one inch or larger in diameter and/or winds exceeding 58 mph. Warnings indicate imminent danger to life and property. Take shelter in a substantial building. Severe thunderstorms can produce tornadoes with little or no advance warning.



After a tornado, watch out for dangerous debris, such as sharp metal, glass, or downed power lines.. Photo: NOAA

For more information, check out:

Weather.gov/safety/thunderstorm

Weather.gov/safety/tornado

Severe Weather Safety Tips!

Tornado Safety:

Before tornadoes strike

- **Be Weather Ready: Stay informed through our website, NOAA weather radio and media to receive information about tornado watches and warnings.**
- **Create a Plan: Have a family plan that includes an emergency meeting and shelter place. Pick a safe room in your home (basement, storm cellar, an interior room on the lowest floor with no windows).**
- **Practice Your Plan: Conduct drills regularly so everyone knows what to do! Make sure all family members know where to go when a tornado warning is issued. Don't forget pets!**

During

- **Stay Weather Informed: Monitor local news, NOAA weather radio to stay updated on tornado watches and warnings.**
- **At Your House: If you are in a tornado warning area, go to your basement, safe room or an interior room away from windows.**
- **At Your Workplace or School: Follow your tornado drill and proceed to your tornado shelter quickly and calmly. Stay away from windows and don't go to large open rooms.**
- **Outside: Seek shelter inside a sturdy building. Sheds and storage facilities are NOT safe!**
- **In a Vehicle: This is NOT a safe place to be! Driving to a close shelter is preferred. If you are unable to make it to a safe shelter, either get down in your car and cover your head, or abandon your car and seek shelter in a low lying area such as a ditch or ravine.**

After

- **Stay Informed: Keep listening to your local news and NOAA weather radio for updates. More thunderstorms and severe weather may be possible.**
- **Contact Loved Ones: Let family and close friends know you are ok so they can spread the word.**
- **Assess Damage: Check your property for damage. Wear long pants, long sleeved shirt and sturdy shoes. Contact utilities if you see power lines down and stay away from them. Stay out of damaged buildings.**
- **Help Your Neighbors: Call 911 for injuries. Provide first aid if you are trained until emergency responders arrive.**







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Watch….Warning….Advisory

WHATS THE DIFFERENCE???

How many times have you seen the TV crawler with "**National Weather Service has issued a Watch/Warning/Advisory**" and wondered

" What's the difference?"

The difference determines the risk to life and property of the citizens of the United States, and more specifically, those folks that are in the hazard area that is defined.

The National Weather Service issues a variety of products to keep our customers in-formed of unusual, inconvenient and hazardous weather conditions. A multi-tier concept is employed to accomplish this task with Outlooks, Watches, Warnings and Advisories to point out specific conditions.

Definitions:

Outlook: Used to give considerable lead time that a hazardous event may develop.

Watch: Issued when the risk of a hazardous weather or hydrologic event has increased significantly, but its occurrence, location, and/or timing is still uncertain. It is intended to provide enough lead time so those who need to set their plans in motion can do so.

Warning: Issued when a hazardous event is occurring or has a very high probability of occurrence. Warnings advise of a **threat to life or property**.

Advisory: Issued when a hazardous event is occurring or has a very high probability of occurrence. Advisories describe events that **cause significant inconvenience.**

Here at NWS Pueblo.. we tweet and we post, using Twitter and Facebook as additional sources to reach the citizens that rely on us.