



2022

Shareholders Report

Welcome to the annual Shareholders Report. The purpose of this report is to highlight specific activities your local National Weather Service office was engaged in during 2022 as a part of our core mission of protecting lives and property, and our desire to provide high quality weather information and education. The National Weather Service values its relationships with its core partners and the communities it serves, and we want to continue to enhance our products and services to meet your needs.

National Weather Service Goodland, Kansas



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Note From The Station Manager

Grady Bonsall, Acting Meteorologist-in-Charge

Welcome to the 2022 National Weather Service (NWS) Goodland Shareholder's Report. This has been another active year throughout the Tri-State Region of Southwest Nebraska, far Eastern Colorado, and Northwest Kansas.

Currently our Meteorologist-In-Charge (MIC) position is vacant. Grady Bonsall is serving as the Acting MIC in the interim until the new MIC is hired, which will be mid 2023. Ed Holicky, who was our MIC, has taken on a new MIC position at the Davenport, IA NWS office. We wish Ed all the best and know he will continue to do well.

There have been some other changes in our staffing. In addition to Ed leaving, one of our Lead Forecaster's was promoted to an MIC at another office, and we have hired two new Forecasters. Our Observation Program Leader (OPL) position remains vacant, but our COOP Team continues to do an excellent job with this program and supports the services needed.

We have been very active in outreach this past year since many of the COVID-19 restrictions have ceased, and our staff is able to attend events and other outreach opportunities. This past year our staff has been to several school events, career days, county fairs, partner visits, and many other outreach programs. One of the main outreach highlights of the year was the staff being able to participate in a Fall Outreach Blitz.

Note From The Station Manager (Continued)

Grady Bonsall, Acting Meteorologist-in-Charge

This is where we did numerous partner visits in a three day period, and met with partners and others to see how we could meet their weather needs. This event was very successful and our partners appreciated the personal one-on-one visits. We were able to have visitors and give tours this past year as well.

As you know the weather never stops in our region, so it was another active and challenging year for our forecasters. Not so much dealing with severe weather and tornadoes but other events, such as high winds, dust storms, fire weather, and drought. We did have a few tornadoes that come to mind in the region; Sharon Springs, KS, Mingo, KS, and Selden, KS to name a few. Fire weather has been very active. April had the highest number of Red Flag Warnings on record for our region. The wind has been extreme as well as the dust storms. For example, on April 6th we had high wind gusts across the area. The dry, windy conditions were favorable for several wildfires to start across the area. On October 23rd high wind gusts up to 64 mph occurred, with reports of reduced visibility in the blowing dust. On December 2nd high wind gusts up to 75 mph with a wall of dust (pictured to right) moving north to south resulted in a fatality.



Photo By: Jessica Husted

Note From The Station Manager (Continued)

Grady Bonsall, Acting Meteorologist-in-Charge

Our forecasters continue to work hard and do a great job for you. They understand the impacts and are continually striving to communicate consistent, accurate, and timely weather information in order to provide the best service to you. If you have any suggestions on how we can better serve you please don't hesitate to contact us.

Grady Bonsall
Acting Meteorologist In Charge

Tri-State Area High Impact Weather Event on April 22-23, 2022

Matt Chyba, Meteorologist

A significant weather system impacted the Tri-State Area beginning in the morning hours of April 22nd that lasted into the early morning hours of April 23rd in 2022. This weather system began the day by producing high winds gusting up to 74 mph causing wind damage, blowing dust, and large wildfires across the region during the morning and afternoon hours. This was followed by two rounds of severe thunderstorms starting in the evening and lasting until a few hours after midnight that produced damaging winds gusting up to 100 mph, hail up to baseballs (2.75 inches in diameter) in size, and several tornadoes within the Tri-State Area. In preparation for this system, the National Weather Service (NWS) Goodland staff began mentioning this threat in their forecast products on the morning of April 16th, and started providing daily reports to partners on April 18th that increased in frequency as the event drew closer. Preparations were also made by NWS Goodland to increase staff coverage for the event due to the expectation of multiple weather threats as well as the long duration of the event. The event produced a total of 173 local storm reports with the breakdown as follows:

High Wind & Blowing Dust: One hundred eleven local storm reports. A surface low pressure centered in Northeastern Colorado produced damaging non-thunderstorm wind gusts up to 74 mph during the late morning and afternoon hours. Ahead of this event, the NWS Goodland staff issued a High Wind Watch that was later upgraded to a High Wind Warning on the day prior to the event. The strongest wind gust of 74mph

Tri-State Area High Impact Weather Event on April 22-23, 2022 (Continued)

Matt Chyba, Meteorologist

was reported at Burlington, CO airport. Most of the reported wind damage stayed confined to Kit Carson and Yuma counties in Colorado, along with Cheyenne, Decatur, Sherman, and Wallace counties in Kansas. This reported damage included a blown over semi truck on I-70, damage to trees and structures in the area, and downed power poles. In addition to the damage, the high winds produced blowing dust plumes that spread across the region and lowered the visibility down to under one mile at times. The NWS Goodland staff tracked these plumes using surface observations and satellite imagery, and issued Blowing Dust Advisories to help prepare counties for when conditions were at their worst.

Wildfires: Four local storm reports. The NWS Goodland staff issued a Red Flag Warning the day prior to this event across the entire Tri-State Area due to the extreme fire weather conditions expected. The wildfires began during the afternoon hours with the high winds before the severe weather began. NWS Goodland staff issued hot spot notifications to inform emergency personnel when a potential wildfire was spotted on satellite and radar imagery. One wildfire occurred in Yuma County that was caused by a downed powerline. The fire grew to 4,000 acres before it was contained and put out by the firefighting crew in the area by around 10 PM MDT that night. One home was reported to be lost and Highway 34 was closed for several hours during the Yuma County fire. Another wildfire occurred in Benkelman, NE that caused a temporary

Tri-State Area High Impact Weather Event on April 22-23, 2022 (Continued)

Matt Chyba, Meteorologist

evacuation for the town near the fire. There were no known injuries or damage to property reported with the Benkelman wildfire, and the evacuation order was lifted a few hours later when the wildfire became contained. The NWS Goodland staff had issued a fire warning at the request of the Dundy County Emergency Manager to help spread the news about the evacuation order. The last fire that occurred during this event in the Tri-State Area was called the Road 702 Fire. The Road 702 Fire burned approximately 44,024 acres in Red Willow and Furnas counties in Nebraska as well as Decatur County in Kansas. One fatality and five injuries were reported in the 702 Fire, along with the evacuations of the towns of Bartley and Indianola in Nebraska. The NWS Goodland staff kept in contact with emergency personnel to provide constant forecast updates all throughout the duration of this fire. A NWS Incident Meteorologist (IMET) was also deployed to provide on-site assistance to those fighting this fire, which was a first for the NWS Goodland forecast area. The wildfire burned for about a week and was reported to be officially put out on April 29th.

Thunderstorm Wind Gusts & Hail: Fifty-two local storm reports. Evening thunderstorms yielded hail up to baseballs in size within Decatur, Logan, Sherman, Greeley, Red Willow, and Wichita counties. The largest hail fell in Leoti, KS that caused damage to windows on a house and also to a car in town. The thunderstorms also produced damaging wind gusts up to 100 mph across a good portion of the

Tri-State Area High Impact Weather Event on April 22-23, 2022 (Continued)

Matt Chyba, Meteorologist

Tri-State Area. The highest wind gust was recorded in the Colby, KS area. No injuries were reported with these winds, but there were many wind damage reports in the Kansas counties of the Tri-State Area. The NWS Goodland staff monitored these thunderstorms, and issued severe thunderstorm warnings as needed while messaging these risks to the public ahead of time.

Tornadoes: Six local storm reports. All tornadoes were reported in the Northwestern Kansas counties during the evening hours of April 22nd. The NWS Goodland staff monitored the tornadic storms and issued warnings as needed. The NWS Goodland staff also conducted damage surveys the next day and found that an EF1-rated (just shy of an EF-2) tornado touched down in Sharon Springs, KS in Wallace County. Another tornado in the region was also rated as an EF-1 that traveled across portions of Decatur and Sheridan counties northeast of Selden, KS. Two additional tornadoes that were rated an EF-0 and an EF-U respectively were observed in Thomas and Logan counties. While there was some property damage reported, there were no injuries or lost livestock reported with these tornadoes.

Many types of different weather hazards were seen during this two day period in April of 2022. NWS Goodland was able to get word out days prior to the event so that their partners and the public could prepare. In addition, the NWS Goodland staff worked around the clock during this

Tri-State Area High Impact Weather Event on April 22-23, 2022 (Continued)

Matt Chyba, Meteorologist

during this significant event to keep their partners and the public updated on which hazards were imminent. In the days following the event, NWS Goodland did what they could to support those dealing with the event aftermath, whether it was providing forecast updates for firefighting efforts or going out to survey tornado damage. This was all in an effort to accomplish the NWS mission of providing weather support to help protect lives and property.

A Historic Snowband for the Tri-State Area on January 25th

Tyler Trigg, Meteorologist

One of the biggest events from 2022 was the historic snowband that set up across western portions of the forecast area on January 25th. Forecasters at WFO Goodland picked up the potential for snowfall over a week in advance. As the event drew closer, confidence increased in the potential for an intense convective snow band to develop within the forecast area. Winter storm highlights were issued 48 hours in advance, with warnings being issued the night before the event. Snowfall totals in excess of eight inches were forecast. The interesting aspect of this storm was the model inconsistency even up to two hours before the snow band developed. The office had high confidence in a snow band developing, but very low confidence in where as models had the snow band oscillating anywhere from Cheyenne Wells, CO to McCook, NE.

As the event began, a snow band did develop where the original Winter Storm Warning was issued. Then around sunrise a second band developed from southern Yuma County extending southeast through Wallace County. This second band intensified as the first snow band dissipated. A corridor of 18+ inches of snow fell under the snow band, with multiple reports of over two feet of snow. The highest snow report was 27 inches at Mt. Sunflower in western Wallace County. The snow persisted



Photo By: Celia Mai
(Location: Sharon Springs)

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A Historic Snowband for The Tri-State Area on January 25th (Continued)

Tyler Trigg, Meteorologist

throughout the day as the band remained nearly stationary, with a slight southeast progression as the intense snow band shifted into Wichita and Scott counties. Outside of the main band snowfall amounts of two to eight inches were common. The snow lingered for several weeks after the event, which allowed the temperatures within the area of highest snowfall to remain noticeably cooler than surrounding areas.

This event was beneficial for forecasters at the office because it gave forecasters an opportunity to experience how to forecast and communicate a high impact but low confidence weather event. The forecasters who dealt with the high levels of uncertainty the night before the snow band formed wrote an After Action Report (AAR) that included feedback from many of our partners such as emergency managers, superintendents, etc. The AAR was also partnered with WFO Dodge City, who was also impacted by this snow band. The goal of the AAR is to pass on what was learned from this event so the office can improve our services for a similar event in the future.

Overall, this event was one of the more high profile events of 2022. In terms of magnitude this snow band was historic in the snowfall amounts that it produced (in the top five highest ever in Kansas), and with the overall narrow swath that it occurred in. It was also a beneficial event from the office standpoint as it addressed areas that we excelled in and areas that the office as a whole could improve on in similar scenarios in the future.

NWS Goodland Participates in 2022 Fair Season

Kyle Knight, Meteorologist

After a few years' absence, NWS Goodland was back out participating in local community events this past year. We had the pleasure of visiting the Kit Carson County Fair, Thomas County Fair, and Flatlanders. At each of these events we had two staff attend, whether it was forecasters or electronic technicians. In each case, we handed out informative material and answered many different questions from the public. Some of the more unusual questions were about a high altitude balloon from New Mexico that drifted over the Goodland area. Many of the interactions were positive and allowed us to further explain to the public what we do, what products we issue, how weather data is collected, and discuss the different weather conditions we have experienced. We were also able to test our new outreach tent and backdrop, which worked perfectly and kept us sheltered from the hot sun.



** Kyle (left) and Matt (right) at the Flatlanders Festival*



** Tyler (left) and Jesse (right) at the Kit Carson County Fair.*

We look forward to participating in more fairs this year. But more than that, we look forward to continuing to be more involved in the community, and increase awareness and understanding of the weather on the High Plains. After all, we are here to help and serve our community!

NWS Goodland Provides Onsite Support

Jesse Lundquist, Lead Meteorologist

This past year provided several great opportunities for staff at the Goodland office to furnish on-site weather support for a variety of venues. On-site weather support is a service that is requested by an emergency manager. This service allows the meteorologist to be colocated with the partner, allowing for face-to-face communication of weather information. This type of support is most commonly provided during large community events, hazardous incidents such as a wildfire, or during storm damage cleanup.

One of the venues for on-site weather support was the Colby, KS airshow. The airshow was sponsored by many of the businesses of Colby so that it could be free to the public. The airshow consisted of a variety of airplanes on display, airplane rides for kids, a comedy skit, and finally an acrobatic airshow; all of which lasted for several hours on June 18th. Jesse Lundquist (pictured to right) was the meteorologist designated to provide weather support for this event. He spent the airshow in a trailer outfitted with electricity and WIFI monitoring the weather conditions transmitted by the weather instrument at the airport. The weather parameter the air boss was most concerned about was the wind gusts. The south winds were breezy that day but otherwise the weather was perfect for an airshow.



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NWS Goodland Provides Onsite Support (Continued)

Jesse Lundquist, Lead Meteorologist

Another opportunity to provide on-site weather support was during a couple college football games in Colorado. (The staff at the Boulder, CO office had already committed to provide weather support to other venues, so the Goodland office was able to help in their place.) These were two home games, one at the Colorado State campus and one at the Colorado University campus on the same day. Jesse Lundquist (picture on right) and Ryan Husted were designated to provide the weather support for these games. Both meteorologists were in charge of monitoring the weather for any potential impacts to the game. They maintained situational awareness of the weather through a variety of webpages. The most excitement Jesse had was watching the campus police handle rowdy fans in the stadium.



The staff at the Goodland forecast office look forward to more opportunities of providing on-site weather support for our partners this year.

WFO Goodland Blowing Dust/Dust Storm Research Project Update for 2022

Dave Thede, Lead Meteorologist

2022 was a very successful test of the locally developed weather parameters needed for high impact blowing dust and dust storms.

The first event occurred on Wednesday, April 6th. On that day, peak wind gusts of 70 mph were reported, along with blowing dust, at nearly every observing site across our forecast area. Visibilities were as low as $\frac{3}{4}$ of a mile, with the lowest visibility reported in Oberlin, KS. Several roads were closed across the area with a few vehicle accidents as well. Three fires were also reported. The Goodland forecast office mentioned medium confidence in blowing dust and a potential for a significant weather day on April 1st, five days prior to the event. On April 2nd and 3rd, social media graphics highlighted the areas of greatest concern for blowing dust, also mentioning visibilities as low as one to three miles.

The second event occurred on Sunday, October 23rd. On that day, visibilities as low as two miles were first reported in Burlington, CO, spreading northeast in an expected plume of dust into Hitchcock County where visibilities as low as one mile were reported. Northwest portions of Rawlins County also reported visibilities as low as one mile. A second area of lower visibilities developed from Hill City, KS to Colby, KS and Goodland, KS on south, where reports as low as two miles were reported. Based on our research findings, we began messaging that a significant weather day was possible for fire and blowing dust on October 18th, five days before the event. Social media graphics highlighted low to medium confidence in blowing dust and visibilities in the one to five-mile range on October 20th.

WFO Goodland Blowing Dust/Dust Storm Research Project Update for 2022 (Continued)

Dave Thede, Lead Meteorologist

On October 21st, two days before the event, a detailed social media graphic depicted two areas of concern for blowing dust and visibilities as low as one mile. We also began to mention the expectation of a high impact weather day. This graphic turned out to be spot on when comparing the two plumes in the graphic to real time satellite imagery and reports from weather spotters, automated weather station visibility sensors, and core partners on October 23rd.

The third event occurred on Friday, December 2nd. On this day a wall of dust, with visibilities as low as zero, raced southeast across the area at 65 mph along a cold front from very late in the morning through the afternoon. The strongest wind gust was 75 mph with several reports of 50 to 65 mph. A few traffic accidents were reported, one with a fatality. The first mention of the



potential for a wall of blowing dust moving through was early Wednesday morning November 30th in our Area Forecast Discussion, about 60 hours before the event developed. About 24 hours later on Thursday, December 1st, the meteorologist on shift specifically mentioned that “local office dust research parameters are supportive of organized blowing dust just ahead of the front” in his Area Forecast Discussion. This was a highly successful test of our blowing dust/dust storm research findings.

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WFO Goodland Blowing Dust/Dust Storm Research Project Update for 2022 (Continued)

Dave Thede, Lead Meteorologist

Finally, on December 14, an early morning message was sent to the forecasters at the National Weather Service office in Dodge City regarding the potential for some blowing dust to develop in their area during the afternoon hours based on our research findings. That afternoon visibility in the Ulysses and Sublette areas dropped to at least two miles in blowing dust. At least one of their staff members requested further information regarding our findings to assist them in forecasting this type of phenomena in the future.

To help spread the word about our dust research, a team of three meteorologists at WFO Goodland, who researched and developed specific environmental weather parameters needed for high impact blowing dust and dust storms, presented their findings virtually at the American Meteorological Society's 102nd annual meeting in January of last year.

Looking ahead to 2023, we plan on continuing to collect data with the Davis station and evaporation pan installed in 2021, continue refining the findings of our dust storm research, and hopefully publish a paper with our findings to share with the world. We also hope to identify when conditions will meet Blowing Dust Advisory (visibility of 1/4 to 1 mile) and Dust Storm Warning criteria (visibility less than one quarter mile) with as much lead time as possible.

Hydrology Update

**Jason Neilson,
Lead Meteorologist and Hydro Program Manager**

Another unique Hydro year across the Tri State region for 2022. While we did see some flooding occur, much of our severe season was dry with well above normal temperatures. Some areas did see thunderstorm occurrence, and storm track played the main role as to what areas received beneficial rainfall. The hot and dry days in between storms did dry out much of the area, despite green up for some. As seen below, many river channels were either dry or with very low water in them. Below is a summary of some of the events through 2022.

Flooding activity by month:

January through April...no warnings issued.

May...2 Flood Warnings issued/1 Flash Flood Warning issued.

(Kit Carson, Decatur and Norton counties were affected.)

June...1 Flood Warning issued/4 Flash Flood Warnings issued.

(Yuma and Red Willow counties were affected.)

July...7 Flood Warnings issued/3 Flash Flood Warnings issued.

(Cheyenne CO, Kit Carson, Greeley, and Wichita counties were affected.)

August...7 Flood Warnings issued.

(Cheyenne KS, Yuma, Dundy, Hitchcock, and Red Willow counties were affected.)

September through December... no warnings issued.

Hydrology Update (Continued)

**Jason Neilson,
Lead Meteorologist and Hydro Program Manager**

Flagler Dam/Reservoir

The last week of July saw a slow moving thunderstorm cluster to the west/southwest of Flagler, CO. Several inches of rain occurred overnight from this cluster. Topography in the Flagler area slopes down to the east/northeast. The result of the excessive rainfall caused the Flagler Dam/Reservoir to fill up for the first time in a decade!! Officials were concerned that this amount of water, along with the potential of additional rainfall, could cause the dam to overtop and even break/breach. If additional rainfall did occur west of the reservoir, we had to monitor the drainage area east of the reservoir for flooding until we were notified water had receded low enough to lessen the concern for those downstream.

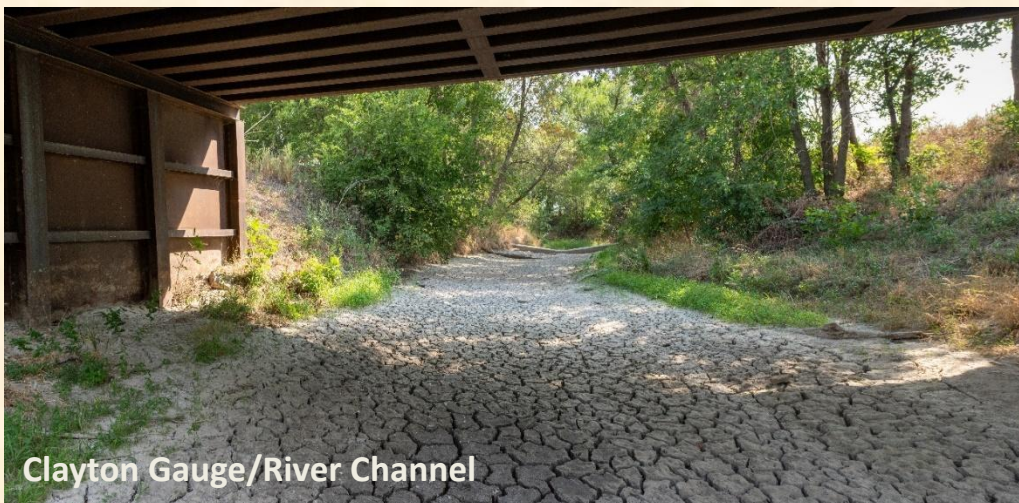
A trip to the field occurred on September 9th with myself and 2 other members of the Hydro team. The first stop was a required visit to the gauge NCRK1, which is located in the northern portion of Norton County near the Nebraska border. A check of the gauge and surrounding area was performed. Fresh pictures and video were obtained as part of an ongoing effort to keep NWS Goodland staff informed of conditions at river gauge sites. Not all staff can visit these sites, so the pictures/video provided gives those working some insight into conditions in and around the gauge when flooding concerns may arise.

Hydrology Update (Continued)

**Jason Neilson,
Lead Meteorologist and Hydro Program Manager**

Time allowed for stops to three other gauges for updated pictures and video and to see how the summer rain/no rain affected these gauges. They were CLNK1 northeast of Clayton, KS, LDLK1 south of Ludell, KS, and CDBK1 near Cedar Bluffs, KS or about halfway between Oberlin, KS and McCook, NE.

As with other areas in our forecast region, many hot and dry days took their toll on the sites, despite receiving rainfall. This was seen in the photos below:



Clayton Gauge/River Channel



Cedar Bluffs Gauge/River Channel

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Hydrology Update (Continued)

**Jason Neilson,
Lead Meteorologist and Hydro Program Manager**

The office held a winter weather workshop for staff training on November 8th. I presented training on Ice Jam Flooding. While this is a low occurrence for the Tri State region, it has occurred. This training helped the staff to see areas prone to ice jams when conditions are favorable. I went over what products to issue, and steps to take before, during, and after such an occurrence.

We are looking forward to 2023 and the challenges ahead.

Cooperative Observation Program (COOP)

Drew Mantei, Electronic Technician

The Cooperative Observation Program (COOP) of Goodland, KS is well on its way to having an exciting year in 2023 following an eventful 2022. This past year, the Goodland COOP program has worked towards modernization changes to keep up with the challenges of limited personnel supporting its duties.

The first notable change was consolidating activities, deadlines, goals, and resources together into a COOP Intranet page (homepage pictured below). It is a user-friendly outlet for any person to turn to and carry out duties pertaining to the COOP program. Our four-person team is able to maintain continuity this way, and has eased the stresses of needing to locate information quickly. Our COOP Intranet page has been shared with over five

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COOP Locations and Contacts		Sites to Shut Down		<input type="checkbox"/>	Message Board
Spring/Fall FPR Locations		Routes and Map Links		<input type="checkbox"/>	
COOP Maintenance List		Newspapers		<input type="checkbox"/>	
FPR Maintenance		2022 Awards List		<input type="checkbox"/>	
Annual Site Visits		SIS Update List		<input type="checkbox"/>	
3 year Site Survey		To-Do List		<input type="checkbox"/>	
Site Details: Colorado		COOP Related Websites		<input type="checkbox"/>	
Site Details: Nebraska		Site Details: Kansas		<input type="checkbox"/>	
	QC Feed back for WxCoder				
	QC Screen Shots				
	Addressed QC Feed Back				
	QC Tracker				

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Cooperative Observation Program (COOP) (Continued)

Drew Mantei, Electronic Technician

offices and has been shared with the National Weather Service Training Center (NWSTC). Now part of the COOP class, it is available for distribution there. It has been positively reviewed for its valuable usage among offices preparing for staffing changes and retirements.

Second, the Goodland COOP team developed better training aids for our observers. Our shared mission and goals are to be uniformly proficient in the way that data is collected and documented among the observers. Part of that proficiency and training is maintaining a team connection with our observers. Our enduring relationship with our observers is key to carrying on our shared mission and goals.

Lastly, 2022 has been a great year to re-establish a baseline for our COOP operations. A baseline will provide consistency for us to solidify our relationships with current observers and recruit new members. This consistency is reflected in our distribution of awards this last year. Totalling 190 years of combined COOP observation time shows the overwhelming support our regional communities have for our cause. This paves the way for a more prepared and knowledgeable Weather-Ready region.

Science and Operations

Jeremy Martin, Science and Operation Officer

In Goodland the main area of research over the past year was focused on better understanding dust storms. Using numerous years of data, local meteorologists have found several atmospheric conditions that favor the development of these events. While the atmospheric conditions are a critical ingredient in the development of a dust storm, the soil conditions play just as important of a role. Determining the soil conditions ahead of time continues to be difficult and a source of uncertainty in forecasting dust storm events.

While real time land use and soil condition information is not readily available, it can be estimated by monitoring evaporation rates. To aid in understanding how the evaporation rate changes, the staff at NWS Goodland has set up an evaporation and soil measurement station that will be in operation during the growing season (pictured to right). This station measures

evaporation, wind speed, temperature (air and water), incoming solar radiation, two inch soil temperature and moisture, eight inch soil temperature and moisture, and precipitation. Evaporation is measured via a standard evaporation pan by monitoring the amount of water lost during each 24 hour period, while the other variables are being measured using a Davis weather station. Data collection began in June and continued until October 15th, just after the killing frost. It will resume this spring with plans to make this data available to the public each day. Initial data analysis

Photo By: Jessica Husted



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Science and Operations (Continued)

Jeremy Martin, Science and Operations Officer

indicated that evaporation rates vary greatly each day and are strongly tied to things such as cloud cover and sun angle. Additionally, the soil moisture data is providing important insight to how the soil responds to weather conditions, which will directly improve how dust storms are forecasted. Some of this local research was presented at the National Weather Association's annual meeting in Pittsburgh in August.

The Goodland office also is participating in an experiment focused on improving winter storm watch coordination. Software used in this experiment was partially developed at Goodland over the past year and is being used in this year's coordination experiment. These tests will help further the National Weather Service's goal of consistent weather information between local offices and national centers. On a more local level, we have deployed snow forecast graphics for the main highways in our area. For the time being these just provide snow totals along each highway, but will be expanded this year into other weather elements.

WCM/Outreach Support Team

Ryan Husted, Warning Coordination Meteorologist

The WCM/Outreach Support Team is a team of individuals within NWS Goodland that are highly skilled in outreach services, as well as bringing a diverse background of experiences to help our team find ways to best support our customers. Each year, our team addresses areas of need that we see within our outreach service capabilities, as well as within the communities that we serve.

Over the past year, the WCM/Outreach Support Team decided to address our ability to provide improved virtual services. As technology evolves, new tools are now available for NWS Goodland to utilize to reach our customers in



perhaps more impactful ways. For example, we are in the process of implementing our capability to livestream on Facebook. This tool is intended to reach the public via Facebook. You may have seen our video briefings ahead of recent high impact weather events ([December 2nd, 2022 high wind and dust storm event](#) and [October 23rd blowing dust, high wind, and fire weather event](#)). For other events in which we used Facebook Live, one of our forecasters was recognized in the community after the broadcast. People knew when that forecaster did a video, they needed to pay attention as a dangerous weather event would likely strike within a few hours. This is the effect that we want, and we will use this tool as an attention grabber to build community preparedness ahead

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WCM/Outreach Support Team (Continued)

Ryan Husted, Warning Coordination Meteorologist

of a major weather event.

In addition, our WCM/Outreach Support Team also worked to conduct a large-scale Fall Outreach Campaign to reconnect with our partners in-person after having to reduce our outreach services for a couple years due to COVID. Our goal was to visit all 19 of our counties within our service area to find ways in which our office can better serve the community. We visited emergency managers, dispatch centers, school superintendents, local media, and a wide variety of additional partners. So far, we have visited 17 counties. However, due to recent weather events we will not reach our final two counties until early this year. With the counties we visited, we worked to ensure actionable weather information is received by our partners, increased membership within our [local Weather-Ready Nation Ambassador](#) program and StormReady communities, and sought answers to address how to better serve vulnerable communities. (Our definition of vulnerable communities is a community of people that may not be familiar with the forecast area, where there is a language or socioeconomic barrier to having the means to receive warning information, or areas where there are large populations that, if struck by a disaster, may overwhelm local emergency resources.) Based on the input we received from our conversations with partners, we are confident that we have improved weather awareness and preparedness across the area, and will continue work on developing tools to better serve all citizens of the High Plains.

Electronics and Equipment

**Grady Bonsall,
AMIC/Electronic Systems Administrator**

The Goodland Weather Forecast Office (WFO) Electronics / ITO staff continues to stay active and has maintained all WFO systems and equipment including: WSR 88D Doppler radar, NOAA Weather radio transmitter sites, Automated Surface Observing Systems (ASOS), Advanced Interactive Processing System (AWIPS), WFO network and computer systems, and the WFO facilities equipment. We assist with the service of the COOP Program equipment and have helped with the local dust research project by installing new equipment at the office (a new DAVIS weather station, evaporation pan, soil sensors, and dust sensors). One of the major projects we were involved in this past year was the Service Life Extension Program (SLEP) for the WSR 88D radar pedestal. This was a 10-day project that involved removing the radar dome, Antenna dish, and replacement of the pedestal with a retrofitted pedestal (pictured right). This project will extend the life of the radar for another 20 plus years or until new technology takes its place, such as the Phased Array Antenna. Maintaining and upgrading the WFO and remote site equipment keeps the technicians busy.



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Electronics and Equipment (Continued)

**Grady Bonsall,
AMIC/Electronic Systems Administrator**

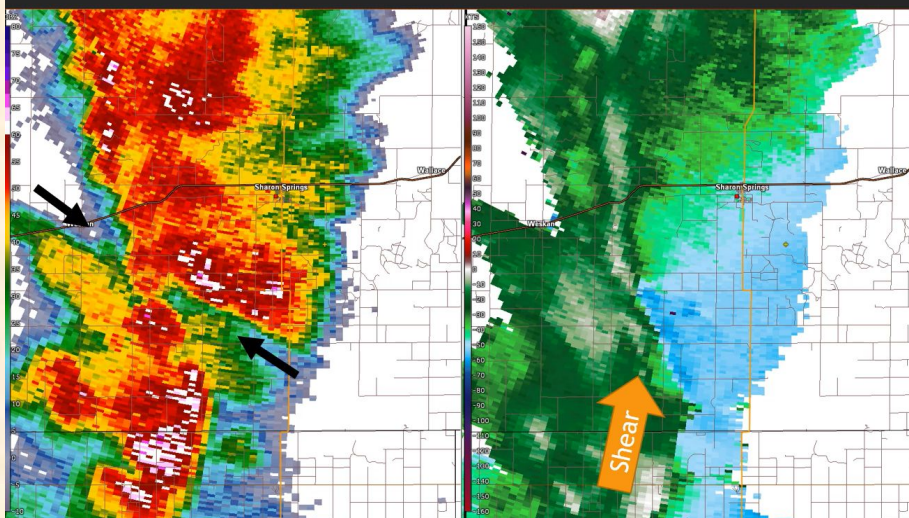
The ET program has contributed to many outreach events and projects, moving forward in joining the whole office concept. This has allowed us to better use resources and build relationships with our staff, partners and customers. We have participated in a booth at a county fair, airshows, and the Flatlanders Festival in Goodland as well as others. We assisted in the recent 2022 Fall Outreach Campaign where our focus was to visit with partners/customers and see how we can better meet their weather needs. These opportunities have allowed our staff to meet our customers and learn the importance of why we are here, in addition to providing them a great service.

Severe Weather and Remote Sensing Team

Jesse Lundquist, Lead Forecaster

This was the second year the Severe Weather and Remote Sensing team had been in operation at the Goodland office. The goal of this team is to help meteorologists improve how the office uses radar and satellite data during severe weather events in order to better serve our customers. The team accomplishes this in two ways: by putting together a monthly quiz and Storm of the Month presentations. The monthly quiz focuses on how to correctly interpret the effects of subtle changes in the surface weather observations and near term model data on the expected weather in the next couple of hours. The purpose of this is to help the staff become more aware of how minor changes in the observations can have a major influence on the behavior of a thunderstorm, and to be ready for that change instead of reacting to it. The bulk of the team's efforts have been focused on Storm of the Month presentations.

Radar Analysis - 10 minutes Prior to Tornado



- Notch or inflection point starting to form on velocity along UDCZ.
- UDCZ changes from balanced to shear dominant N of inflection point.
- Paired notches?
- 0-3KM shear 40-45kts

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Severe Weather and Remote Sensing Team (Continued)

Jesse Lundquist, Lead Forecaster

The Storm of the Month presentations are essentially a mini case study aimed at highlighting a storm which behaved counter to what was expected or had a major impact. Through these presentations the team shares characteristics in the observations, radar, or satellite data that we can learn from to improve how we handle a similar storm in the future. These videos are also shared on YouTube in case there are students or weather enthusiasts that would benefit from these presentations. To view the presentations from the last two years go to: youtube.com/@NWSGoodland/playlists and click on the Storm of the Month playlists for each respective year.

Fire Weather Program

Dave Thede, Lead Forecaster

In 2022, the theme of the fire weather program team was to continue analyzing ways we can improve the service we provide regarding Fire Weather Watches and Red Flag Warnings.

During 2022 we issued a total of 462 Red Flag Warnings for the Goodland County Warning Area (CWA), the highest since 2014. (In 2021 we issued 224 Red Flag Warnings.) Due to the continuing drought we wanted to see if there are certain model guidance parameters that perform better than others regarding fire weather. With this in mind the team continued gathering and analyzing data regarding which of the numerous computer model guidance parameters we have access to (temperature, dew point, sustained wind, wind gusts) performed the best on days when a Red Flag Warning is in effect. This research effort first began in April of 2021. The following is a summary of what the team found so far for each model parameter.

There are 43 different model solutions for temperature that have performed in the top three at least once since April 2021 when a Red Flag Warning was in effect. Of those 43 different model solutions, the top five that performed the best 29.5% of the time.

Dew point temperature is an important fire weather parameter because it and surface temperature are needed to calculate relative humidity. There are 46 different model solutions that have performed in the top three at least once since April 2021 when a Red Flag Warning was in effect. Of those 46 different model solutions, the top five have performed the best 27.9% of the time.

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Fire Weather Program (Continued)

Dave Thede, Lead Forecaster

Regarding sustained wind speed, there are 47 different model solutions with a similar methodology as temperature and dew point. Of those 47 different model solutions, the top five performed best on Red Flag Warning days 28.9% of the time.

Finally, let's look at wind gust. This parameter had less variability when compared to the other three key parameters, with 29 different model solutions performing the best on Red Flag Warning data. The top five model solutions for wind gust performed the best 44.7% of the time on Red Flag Warning days.

So what does this mean? It means that we as meteorologists have a tremendous amount of computer-generated model guidance to choose from, and knowing which one will perform the best on a specific day is very challenging. Even with knowing which models tend to do best on Red Flag Warning days, they only do so up to 30% of the time for temperature, dew point, and sustained wind speed. There is a lot of room for us to improve. Hopefully continuing this analysis project in 2023 will improve our ability to provide better fire weather forecasts, Fire Weather Watches, and Red Flag Warnings.

Similar to 2021, we continue to look for ways to increase the number of weather stations across a few of the counties we serve, specifically Dundy and Hitchcock counties in Nebraska, Rawlins, Decatur, and Sheridan counties in Kansas, and Cheyenne County Colorado. In these counties it's very difficult to get real time weather information (temperature, relative humidity, wind speed, precipitation, etc.) which makes verifying the Red Flag Warnings we issue difficult to say the least.

Social Media Program

Kyle Knight, Meteorologist

It has been a busy year for social media here at NWS Goodland. Our presence and following continues to grow and we continue to experiment with new ways to communicate and share our weather messages with everyone. This year has brought about a few changes that we hope will make our communication through social media better.

First is that we are transitioning all graphics to a widescreen format. This allows us to fit more information into slides, especially whenever a map or forecast graphic is included. This also allows us to match a format that is more in line with platforms like Facebook that display graphics in a widescreen format.

Next, we are sharing more information from and about our partners. We recognize many of the agencies and people we work with share information on a regular basis as well. Many times this year, we have retweeted information shared by our partners to help get important information out and keep our communities informed. We have already been doing this but will look to do more as we are able. As for sharing information about our partners, we have many agencies and individuals who contribute to collecting and sharing weather information. During the past few years, we have been limited regarding interaction and highlighting of our various partners. Since we were able to visit with more partners this year, we were able to go back to highlighting more

Social Media Program (Continued)

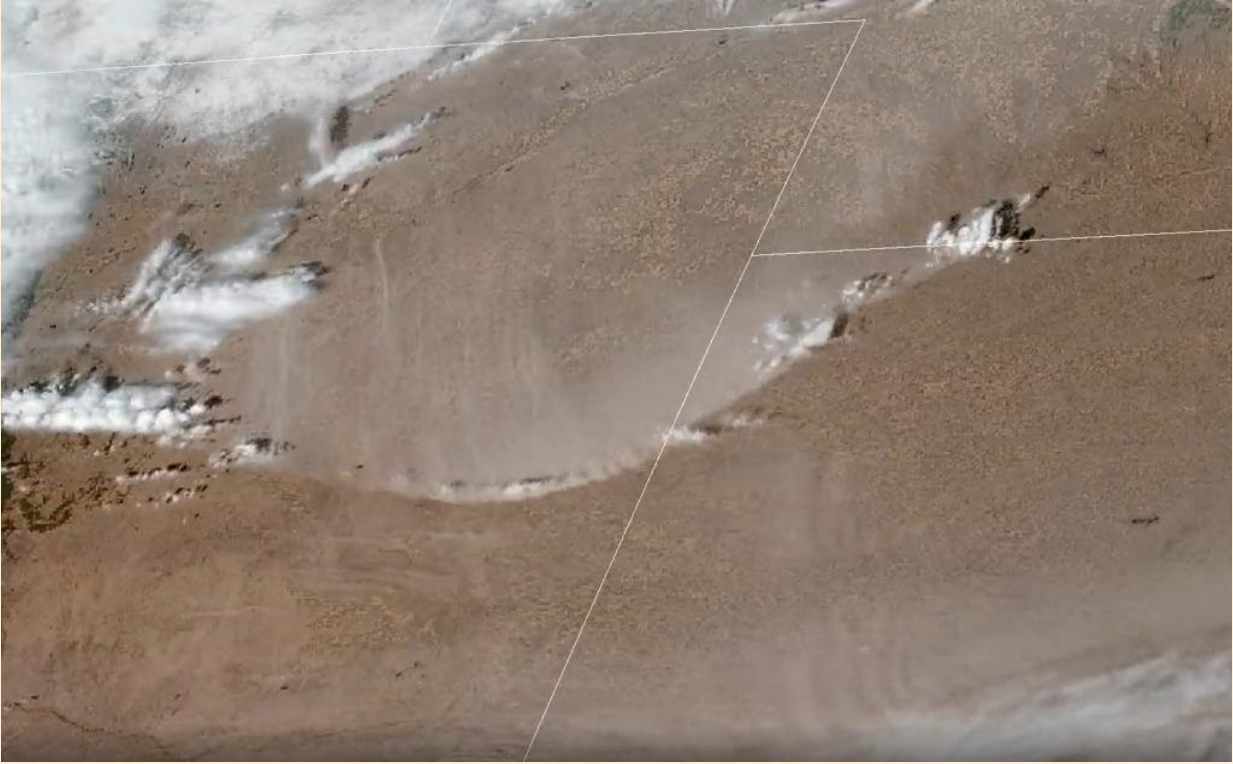
Kyle Knight, Meteorologist

When it comes to experimenting with new things, we've done so in a couple of ways. The first is that we are experimenting with new automated graphics including a graphic that shows expected snowfall along a specific highway. We've also been experimenting with design, mainly how to incorporate multiple maps/images in a readable format within our posts. Finally, we have changed how we will be crafting graphics going forward. With a new platform for creating our slides, we have made a few changes. First, most of our graphics going forward will have a common bottom banner with a timestamp to make identification easier. Secondly, as mentioned we will be creating more graphics through a different platform. A major goal from this is that forecast offices would be able to see neighboring offices' graphics and have greater ease in sending a graphic for a particular office in a backup situation. This will allow for a greater continuity of service should a disaster or disruption occur. The new platform also allowed for some different functionality, allowing us to be able to share information more easily. There will be some growing pains, but this is an expected side effect as we work to do our best in providing timely and helpful weather information.

As for some statistics, our Facebook page gained around 2000 more followers this year which is a growth of nearly 10%. Our Twitter page gained about 800 followers for a growth of about 7%. For Facebook, it is estimated that we reached around 710,000 people which is 10 times as many people as the population of our CWA.

Social Media Program (Continued)

Kyle Knight, Meteorologist



During the dust storm in December that produced a wall of dust, we posted a loop of satellite images (image from loop shown above) showing the wall moving across our area. That post on Facebook was seen by 113,000 people which was 4000% higher than our average post. It also received 3000 reactions which is 15000% higher than our average post.

CoCoRaHS Summary for 2022

Dave Thede, Lead Forecaster

CoCoRaHS (Community Collaborative Rain, Hail & Snow Network) is used by a wide variety of organizations and individuals. The National Weather Service, other meteorologists, hydrologists, emergency managers, city utilities (water supply, water conservation, storm water), insurance adjusters, USDA, engineers, mosquito control, ranchers and farmers, outdoor & recreation interests, teachers, students and neighbors in the community are just some of the examples of those who visit the CoCoRaHS web site and use their data.

For the year of 2022, the program had 138 active stations across Northwest Kansas, extreme Southwest Nebraska and far Eastern Colorado. In 2021, there were 164 active stations. In 2020, there were 163 active stations. Active stations are defined as those who reported at least one observation over the past 365 days.

Water year summaries have been finalized for all reporting sites across the country. For 2022, the water year runs from October 2021 through September 2022. The top 5 precipitation amounts (rain and melted snow) for the Tri-State Area include:

Colorado:

CO-KC-139 (Burlington 7.7 NW) - 15.12"

CO-YU-62 (Vernon 3.6 NNE) – 15.08"

CO-CH-24 (Kit Carson 3.2 SE) – 13.67"

CoCoRaHS Summary for 2022 (Continued)

Dave Thede, Lead Forecast

CO-CH-28 (Cheyenne Wells 1.6 N) – 13.67”

CO-YU-68 (Wray 4.2 NNE) – 12.02”

Kansas:

KS-WH-8 (Leoti 14.6 SSE) – 16.74”

KS-WA-10 (Sharon Springs 9.4 SSE) – 13.46”

KS-GO-7 (Park 2.8 S) – 13.43”

KS-DC-1 (Norcatur 3.1 WSW) – 13.14”

KS-LG-10 (Oakley 0.3 NE) – 13.02”

Nebraska:

Red4234 (Bartley 4.29 S) – 13.44”

Dund011 (Max 4.6 WNW) – 12.26”

Dund019 (Benkelman 4.9 NW) – 12.23”

Dund010 (Parks 6.0 NW) – 11.93”

Dund023 (Parks 5.4 N) – 11.62”

CoCoRaHS Summary for 2022 (Continued)

Dave Thede, Lead Forecast

A complete report for every site across the country is available at

<https://wys.cocorahs.org/>

Other ways to view precipitation data for any CoCoRaHS site in the country is available here <https://cocorahs.org/ViewData/>

If you're interested in participating in the CoCoRaHS program visit cocorahs.org

Climate Program

Tyler Trigg, Meteorologist

The National Weather Service (NWS) Goodland Climate program strives to record and quality control all weather data daily to provide the most accurate climate database for the Tri-State Area. Additional responsibilities include issuing monthly and annual reports for all four of our ASOS sites (Goodland, Burlington, Hill City, and McCook), along with assisting in the quality control of our COOP sites across our 19 counties monthly. We also provide input to the Drought Monitor on local conditions, along with coordinating with the High Plains Regional Climate Center and local climatologists.

As we continue into the new year we are monitoring a third consecutive La Nina winter, which is only the third time since records have started that three consecutive La Nina winters have occurred. Signs do point to the La Nina pattern breaking down as we head into spring, which hopefully will bring some drought relief to the area. 2022 saw one of the drier years on record as McCook recorded its sixth driest year, Goodland saw its 16th driest year and Hill City its 10th driest year on record.



Clayton Gauge/River Channel [September]

Climate Program (Continued)

Tyler Trigg, Meteorologist

From the office standpoint there has also been greater priority placed on a more complete understanding of the drought, not only from the weather standpoint but also from the standpoint of those who we serve. We, along with other NWS offices that serve Kansas, participate with other state and county agencies in the monthly Kansas Climate Interagency Workgroup. However Kansas is not the only state we collaborate with, as we also communicate with state entities in Nebraska and Colorado. We have also been working on building new partnerships and rekindling old ones such as the county USDA offices around the area.

In an effort to build new partnerships, an outreach/partner visit was made to Lincoln, NE to visit the High Plains Regional Climate Center (HPRCC), and the National Drought Mitigation Center (NDMC) at the end of August. Meeting with the HPRCC was very beneficial as they presented a “Water Deficit” tool. The Water Deficit tool shows visually where areas are lacking or exceeding in precipitation. The big takeaway from this visit was the ability to overlay the Drought Monitor over the Water Deficit tool so one can easily see where any changes may need to be made to the Drought Monitor. Overall our partnership is working well with them as they consider us “testers” for their tools, and they would appreciate any feedback for any of the tools and products that they send out. A discussion was had with NDMC about additional ways to address the ongoing drought, and how to help users of the Drought Monitor have a better understanding of the data they are using, including how the data is gathered. Over the course of the next year we look forward to posting some of the new information learned to help the public and partners understand the extent and magnitude of the ongoing drought.

Winter Weather Program

Kalitta Kauffman, Meteorologist

This year, the Winter Weather Program at National Weather Service (NWS) Goodland focused on forecasting snowbands, snow squalls, and developing better methods to communicate snow forecasts to our partners and the public. The Tri-State Area observed several snowbands at the beginning of the year that produced heavy snow accumulations, with amounts up to 27” measured. Following the January 25th event that produced that impressive amount of snow, meteorologists at the office conducted an After Action Review to help us learn from what went well and where we may be able to improve for future events (picture on next page).

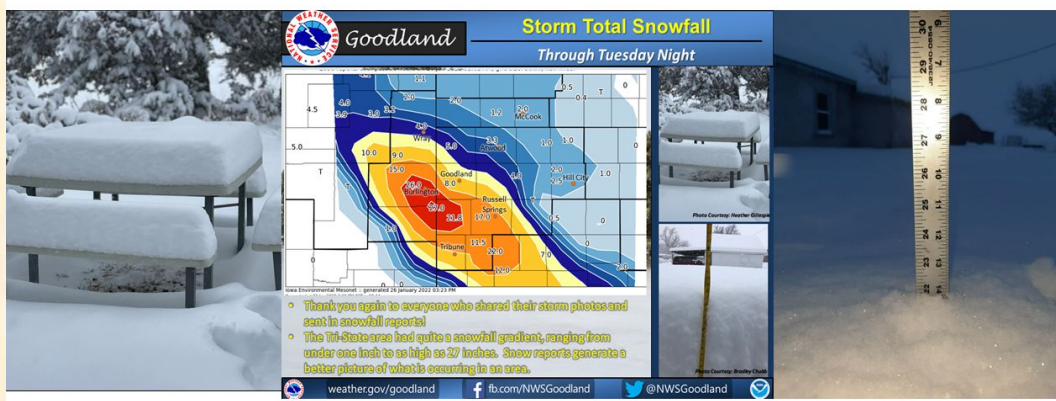
A few of the things learned from the After Action Review were focused on how we can better communicate our forecast message to the partners. One example is using webinars to communicate in further detail with our partners about forecast uncertainty and how we expect the event to unfold. Another example is communicating the potential for heavy bands of snow and snow squalls similar to our other outlooks, where we highlight areas with the best potential for bands to form and/or diminish along with using probability and potential graphics to message snow amounts.

Winter Weather Program (Continued)

Kalitta Kauffman, Meteorologist

January 25th, 2022 Historic Snow Band and Messaging

By Tyler Trigg



To continue the trend of enhancing forecast communication, the focus of this year's Winter Weather Seminar for the office meteorologists was on ways to best serve our customers. Talks this year were focused on improving our briefing skills both verbally and visually, as well as how to effectively message probabilistic information. Topics included speaking confidently and authoritatively, what makes effective Decision Support Services (DSS) packets, and how to describe various scenarios with probabilistic messaging in order to aid our messaging efforts. A few partners from various professions across the Tri-State Area were invited to come share feedback about how our forecasts impact their jobs, and provided feedback to the forecasters during a forecast briefing exercise. The feedback and tips from the seminar are being utilized by the meteorologists at our office as we work to improve our messaging abilities for partners and the public. NWS Goodland appreciates all of the feedback we have received from our partners as we navigate these new communication methods in order to promote the National Weather Service mission of protecting lives and property.

CLOUD (Culture, Leadership, Office Unity, Diversity) Team

Kyle Knight, Meteorologist

For 2022, the CLOUD team continued to work on and encourage a better understanding of each office member and build a better office culture. With a better office culture and understanding of each other, we continue to improve the way we work with each other. This allows us to better and more efficiently function as a group when tough weather or hard circumstances come our way. So far, we can say that NWS Goodland has been able to stand up to everything that has come our way. But we aren't done yet, there is still plenty more we can do to improve ourselves.

For this year, we continued to do a variety of activities and also shared some good food (there are definitely some good chefs here). Some of our

activities included participating in two truths and a lie, naming a stuffed animal we were given, creating an ultimate weather song playlist (you'd be surprised how many songs can be tied to weather or are weather related) and making Jack O Lanterns at home and bringing them in (picture to right). In regard to food, we held multiple potlucks with different themes such as



comfort foods and Independence Day themed dishes. With these potlucks, we often gave different presentations, such as history related to the summer

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CLOUD (Culture, Leadership, Office Unity, Diversity) Team (Continued)

Kyle Knight Meteorologist

military holidays and notes from a leadership conference one of our office members attended. Finally, we sent out emails with various presentations ranging from how to maintain a healthy work life balance, to history and information about some nearby national park sites (Nicodemus and Sand Creek Massacre).

We certainly have done a lot and will continue to do so. But these activities and presentations weren't just done because they are interesting. They were done to better ourselves and help foster a group that is excited to come to work and help the community we are a part of. The better we are, the better we can serve those in this area as we continue to build a great culture at the NWS Goodland office.

While we have added more things such as an activity every month and a monthly email highlighting different topics, there is more out there for us to experience, learn, and take part in. As we look to 2023, we hope to bring even more new ideas and ways of learning about each other and the community around us. We also hope to participate in more community events as that is not only a way to give back to the community we are in, but a fun way to interact and work together in ways that we don't normally do. It can only make us better.



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