Using the J Bar 4 weather website

Background

Most of you know I'm a meteorologist by profession but I traded that job for a real one cleaning stalls. My passion for understanding the atmosphere began as a kid when I desperately wanted to know if it would snow enough to close school. Today that passion is as strong as ever but I have a new respect for the role it plays in the lives of people who make their living outdoors. Most of us are weather watchers to a certain degree and we have a wonderful place to watch it right here in the theater of Colorado's High Plains. The weather is beautiful in itself but to begin to understand it, we need numbers, data, the physical observations, the precious few specks of evidence upon which to build our concept of the physical processes at work. Weather pros and amateurs alike have an insatiable thirst for data.

Before my addiction to horses, I had other outdoor interests. I fish, ski, bike, backpack, shoot trap, sail, golf - all weather dependent activities for sure and all opportunities for me to apply my trade to my hobbies. Over the years as weather information became more accessible via the internet, I began making simple websites that would support my hobbies. They were nothing more than one-stop pages that showed the current conditions and forecast for a particular place. Lots of commercial websites do the same but they also try to sell you mortgages or car insurance.

Disclaimer

I built the J Bar 4 weather webpage for my own personal use, never intending it for public consumption. It is not an official J Bar 4 Ranch website. Most of the information requires a background in meteorology and meteorological data in order for it to make sense. If you want a website that is for public use and needs no explanation, check out weather.com or watch one of the local TV stations. I am also going to leave out many important details. If you want to know more, just ask.

Sources of data

Virtually all weather data (and there are many, many types of data) originate with a few tax-funded government agencies, primarily the National Weather Service, a division of the National Oceanic and Atmospheric Administration. The FAA, state governments and military operations provide some but very little in comparison. When I say "originate", I mean the NWS makes the original observations (e.g., temperature, pressure, radar scans or satellite images). These original observations are the raw data that are part of the public domain and are available to anyone with the need and know-how to use them.

For example, all raw data go to various National Weather Service offices around the country. NWS forecasters analyze them and produce the local forecasts that are then distributed by the media. The Colorado Avalanche Information Center (CAIC) uses the same raw data to make specific forecasts of high country avalanche potential. Colorado Department of Transportation (CDOT) uses it to assess road conditions and issue travel alerts. The Forest Service and BLM use it for forest management and wild fire control. There is a long list of users - I use it to plan for a day at the ranch.

Web browser recommendation

Many of the links you'll be surfing contain animations, such as movies of satellite and radar images or various kinds of weather maps. I highly recommend using Mozilla's Firefox as your web browser instead of MS Internet Explorer. Maybe some MS fan out there can tell me how to configure IE so that it can operate the animation buttons – so far I haven't been able to figure it out. Firefox does it nicely so why wrestle with IE?

Page layout

Once you get past the pictures and title, the webpage is organized into four categories: **current conditions, weather radar, satellite images, and forecasts**. Let's look at each one.

Current conditions

The box on the left displays the current weather for Watkins - the current temperature, sky cover, wind chill temperature, relative humidity, wind direction and speed. The "current weather" widget is provided by the Weather Channel for web designers. An astute student should ask, "I didn't know there is a weather station in Watkins", and "when were these measurements taken?" The answer is a) there isn't one and b) about 10 minutes before the top of the current hour.

Conventional weather observations are made at instrumented weather stations, spaced about 50 to 100 miles apart, roughly once per hour. Most of the weather stations are at airports to support aviation operations. The surface weather stations pertinent to J Bar 4 are at DIA, Buckley AFB, Limon, and Centennial airport.

If the widget says it's 50^{o} with a south wind at 10 mph in Watkins, where do these measurements come from if there is no local weather station? The answer is it's an educated guess, an estimate, an interpolation from what's going on in places that have weather stations, to places that don't. How accurate are the interpolations? Well, it depends. It depends on how far away the real observations are, how long ago the observations were taken, how different the topography is, the type of weather pattern we're under, etc, etc. It gets complicated fast. Most of the time, what you see on the page is a reasonable estimate of what is actually happening at the ranch, and frankly, it's better than nothing.

A note about wind direction and speed – wind is measured at the top of a tower, 30 feet above ground. The direction is usually more steady and the velocity is higher at this height than it is on the ground. Wind direction is defined as the direction the wind is coming from, not going to. A "northwest" wind is air moving from northwest to southeast.

Regarding wind speed, I don't have to remind you that the wind blows in Watkins, but when you're looking at the website, what do the wind speeds mean in terms of whether you can ride outside, inside or not at all? Most people overestimate how strong the wind is blowing. I use the following rules of thumb: wind that is under 10 mph is fine for riding outdoors. Between 10 and 15, you will think it's windy and you may want to be in the indoor arena. Over that, the wind becomes increasingly annoying. Winds over 20 are very strong with dirt and dust blowing across the ranch. Many thunderstorm related winds are in the 25 to 50 mph range. The wind (a microburst) that blew down the pasture shed in the spring of '06 was probably over 60 mph.

Other current weather links

In general these links take you to information that is happening now or happened in the last 24 hours - not forecasts.

latest hourly weather – a table of latest hourly weather observations at major weather stations around the state.

latest regional map – a weather map with numbers and symbols that represent the current weather. I'll explain later..

latest 24 hours at Buckley – a table of the last 24 hourly weather observations at Buckley Air Force Base, about 8 miles west of J Bar.

live webcam - live snapshot of downtown Denver for those who want to see what it really looks like outside.

24hr rain/snow reports – an interactive map of rain and snow from the last 24 hours – provides a good idea of how wet it might be at the ranch.

CDOT road conditions – CDOT's real time road condition website. Check it for webcams of the roadways and travel restrictions.

sunrise/sunset – calculated for Denver – it's about five minutes earlier at the ranch.

Front Range RADAR

Radar is used to detect precipitation. The specifics of how this is done can be found in the link provided (*Radar questions?*) so I won't repeat them here. The radar that covers northeast Colorado happens to be just north of Watkins, at Front Range airport. If you look north from the ranch, you can see a tower with a white dome on top – that's the Front Range National Weather Service radar.

The radar makes a complete scan of its viewing area (a circle with 140 mile radius) once every ten minutes during clear conditions and once every five minutes when precipitation is occurring. Areas of precipitation, or radar ***echoes*****,** are shown on the radar map. The echoes are colored to indicate the intensity of the precipitation. A color bar is shown on the bottom of the image, ranging from the lightest in blue to the heaviest in red.

Latest image – selecting the latest image will give you just that, the latest radar scan across the area. It's typically less than 10 minutes old. The first thing you should do is locate the ranch. This is pretty easy since the radar site itself is the dot in the center of the two range rings (70 and 150 miles) and the ranch is just south, across the Arapahoe county line. You'll find other features like I-70, I-25, the county borders, etc. so look it over and make sure you can navigate your way around.

What time is it? There are other details on the display, the most important being the time. You need to be able to read the time so you can be sure you're looking at reasonably current data and not something from yesterday. In meteorology we don't use local time, we use Universal Time (UTC), (Greenwich Time (GMT), or "Z"ulu Time). This is because worldwide weather operations must all use the same clock so we're all doing things at the same time. That way we can synchronize all the weather observations into a worldwide database.

In Colorado during Mountain Daylight Time, we are 6 hours earlier than in Greenwich England. Subtract 6 hours from the "Z" time displayed in the image to get local MDT. In winter during Mountain Standard Time, we are 7 hours earlier, so subtract 7 hours from the time stamp to get MST. For example, if the image says 1430Z, it's 8:30am MDT or 7:30am MST. If the image says 2315Z, it's 5:15pm MDT or 4:15pm MST. Sorry about all the acronyms.

Interpreting the echoes - When no precip is in the area, the image will generally be a black. The map background features will be there and there will be lots of green and yellow specks, especially within the inner range ring. Don't panic – it's not a swarm of African killer bees, it's what is known as ***ground clutter***. They are false echoes from some of the radar's transmitted energy bouncing off the ground and coming back to the antenna as a weak echo. Learn to ignore it.

Echo colors – Echoes are colored to indicate the intensity of precipitation. Under normal conditions they range from light blue (very light precip), green (moderate), yellow (heavy) and finally to red (heaviest). But when the precipitation is very light as it often is in winter, the color range uses only the yellow through red. The normal blue-red range is called the **precip mode** while the yellow-red range is called the **clear air mode**. You might see individual frames of an animation flip from one mode to the other.

Precip mode - warm (rain) season:

__ continuous area of light blue - very light rain, maybe not even reaching the ground. The darker the blue, the more likely it is.

__ area of green inside of blue – light to moderate rain reaching the ground

__ yellow – moderate to heavy rain, weak thunderstorm

__ orange – heavy rain, moderate thunderstorm, small hail

__ red, dark red – strong thunderstorm, moderate to large hail, look out!

Clear air mode - cold (snow) season:

The radar can't detect snow as well as it can rain and hail, so you should use the clear air mode color scheme for estimating snow intensity. Light snow usually shows up as orange-red. Moderate snow as red-purple, and heavy snow is purple-white. Very light, dry snow may not show up at all.

Animations – You can't tell much about a horse when it's standing in a pasture – you need to watch it move. The same is true of radar echoes. A single image is only a snapshot in time of where the echo is, how big it is and something about its intensity. It tells you nothing about how it's changing or where it's going.

There are several options for running animations. I prefer to select the "latest image" first and then click the top "loop" from the menu on the left. You can select the "animation" link directly and this will display the same radar data, but in a slightly different format. Try them both and use the one you like.

Pay attention to the intensity of the echoes, the changes in intensity, how fast they are moving and whether they are moving toward you or away. Keep in mind that areas of precipitation are not like train cars, moving on a track with a predictable speed and arrival time. They are in a constant state of change. Just because you see a thunderstorm 50 miles away, heading your way at 25 mph, doesn't always mean it will be thundering at your place in two hours.

Helpful radar hints

__ echoes within the first range ring (70 miles) are the most useful. The farther you are from the radar, the less useful the information.

__ the farther you are from the radar, the higher the beam is above ground. This is because the radar beam is aimed at a 0.5^{o} angle above horizontal and because of the earth's curvature. The beam is about 1,500 ft over downtown Denver. At the 70 mile range ring, the beam is about 3,000 ft above ground. At 140 miles, it's about 6,500 ft, AGL.

__ looking at a radar display is like looking into a large, rather flat funnel, with its spout at the radar site. The radar is scanning the air along the surface of the funnel. It slices through the clouds and displays those slices on the map. It's like taking an MRI of the atmosphere.

__ radar is not a good tool in the mountains. This is because the terrain blocks the beam in the foothills and west of that, the beam is too high above ground to provide useful information. This is the same rule as the first one above.

__ radars don't show clouds distribution – only precipitation. Tiny water droplets and ice crystals that make up clouds are too small to be detected by weather radars. They are designed to see precipitation-sized objects only.

__ there a lots of peculiar details about using radar data. They can be complicated, confusing, contradictory. Use caution..

Satellite images

A satellite image is a digital picture of the earth and atmosphere using data gathered from instruments on satellites in space. Again, I'll refer you to the *satellite questions?* link on the webpage if you want more detail, or ask me. Of the hundreds of satellites flying overhead, two provide most of the images you'll commonly see. They are both in a fixed position over the Equator – one over the Atlantic Ocean and one over the Pacific Ocean. The images are generated every 15 minutes. The Atlantic satellite is positioned to provide optimal viewing of Atlantic tropical storms while the Pacific satellite gives us an early view of storms approaching from the west. Unfortunately, the middle of the US lies at the edge of the field of view of both satellites, so our imagery is always a bit distorted. In a perfect world, we'd have a satellite directly over Colorado.

There are two main types of images – **visible** and **infrared**, and like the radar images described previously, we can look at single images or loops that show the atmosphere in motion. Satellites view the earth both day and night. During daytime, when the earth below is lit by the sun, the satellite can take pictures using **visible** wavelengths of light. They look like black and white photos.

The satellite can also take pictures in the **infrared** wavelengths and these can be taken both day and night. They don't rely on the subject being in sunlight but rather use the fact that the warmer an object, the shorter the wavelength it emits. So an infrared image is really a map of emitted wavelengths, which can then be used to calculate an object's temperature. This is very handy since clouds are usually colder than the land or water surface underneath, so IR images are sort of a map of clouds.

Satellite images are primarily used to provide a realistic look at where clouds are, how they are moving and how extensive a cloud layer might be. It's always fascinating to look at the weather from above and look at all the things you can't really see from the ground. They put weather systems in a useful perspective and help us develop our conceptual models of how the atmosphere works.

Weather forecasts

After a quick glance at the current weather, most of you will probably want the day's forecast. You'll want to know how the day is shaping up or which day of the week looks best for riding. Besides knowing what the weather is doing right now, this is what most people want from the meteorologist. It's my feeling that while this is the information people want most, it is also the most misunderstood. So here's some insight that should help.

Where do forecasts come from? Weather forecasts are a blend of computer-generated predictions and human input. In the years prior to computers, all forecasts were made by hand. Today, the majority of the workload is done by NOAA computers and the forecaster's role is to oversee and interpret the computer output. However, for small-scale, rapidly developing and potentially dangerous weather situations, the forecaster's role is very important, but for everyday general weather patterns, the computer can do a more consistent job. When we talk of computers, we really mean the complex mathematical models of the atmosphere that run on supercomputers, and the calculations from the models

are summarized into the public forecast. The computers can handle much more data, can consider more physical processes, and do it all much faster than can the forecaster.

Channel 4, 7 or 9? Most people get their weather information from TV or radio, but here's a little secret they don't want you to know – there is only one forecast. It's the one issued by the National Weather Service. It is issued twice a day, more often during rapidly changing or when hazardous weather may occur. It is available to anyone, including media outlets, free of charge. Since there are no restrictions on the use of the forecasts, each weather reporter simply makes his or her own 3-minute version of the NWS forecast, perhaps changing a number here or there, to make it appear unique and superior to their competitors. It isn't.

Long gone are the days when some media companies hired people whose job it was to actually spend time analyzing charts and make a prediction. Those were the days when the NWS forecasts came at a significant cost to the station, so it was a business decision whether a station would hire its own forecaster or pay for the NWS forecast. Today it is all free and available to anyone with an internet connection.

So, regardless of which weather reporter you like, the forecast all comes from the same place – it only looks different since each station wants you to think they do it "best". With a few rare exceptions, your favorite media personality is not a meteorologist and is merely reading a script and pointing to maps.

Is it going to snow? We never know for sure which is why all precipitation forecasts are issued as a **probability** (i.e., a 20% chance of scattered snow showers). The forecast of precipitation is by far the most challenging for the forecaster and misunderstood and misinterpreted part of the forecast by the user. How many times have you heard, "They said it's supposed to snow tomorrow" when the forecast actually was "a slight chance of isolated snow showers tomorrow afternoon." Most people hear key words and take them out of context, ignoring the all-important qualifiers.

It's important that you listen to the entire forecast and not just the parts you want (or don't want) to hear. Sometimes, the source of the confusion comes from the broadcast itself, when announcers take liberties with the script and reword or omit words. There's a big difference between a *slight* chance of light snow and snow *likely* – both are forecasts of snow but mean very different things.

Precipitation Forecasts – expressed as a percent probability, the likelihood of $1/100^{th}$ of an inch of liquid precipitation occurring within a specific time period and within a specified area. In English this means the chance of you getting wet. How wet? We use the following terms:

10-20% probability - slight chance - (don't count on it, but if it really matters to you, plan accordingly)
30-50% probability - chance - (be prepared and don't be surprised if you get wet)
60-70% probability - likely – (very good chance, it will probably happen)
80-100% probability - occasional (count on it)

Summer showers - The annoying showers that seem to happen like clockwork each summer afternoon are nearly impossible to predict with any accuracy. Thunderstorm forecasts are based on an assessment of the general conditions that make thunderstorms more favorable from one day to the next, but we cannot predict where or when an individual storm will actually form. Some days show a greater potential than others and the wording will reflect that by including things like "some storms may be severe with large hail, damaging winds or tornadoes". You should pay attention to these, especially if they are for our area.

The gusty winds that accompany thunderstorms can be almost as annoying, especially if you're sitting on a nervous horse on a trail ride. These winds are caused by the rain from the thunderstorms, falling in the distance and probably not even making it to the ground. The rain evaporates as it falls and leaves a column of cool air in its wake. The cool air is heavier than the surrounding warm air so down it comes, hitting the ground and producing the gusty, dusty winds. Watch for grey streaks of rain falling from the clouds, dust swirls on the ground in the distance and you'll likely be feeling those winds before long.

Lightning – is serious business. More people are injured or killed by lightning than any other weather phenomena. Most of these are people doing what we do – playing outside. Common sense can prevent many lightning encounters – but not all. Pay attention to ominous dark clouds, rain streaks and obviously, thunder. Thunder is produced by lightning. The old rule about five seconds per mile (time between lightning and hearing thunder) is fine but not practical. Don't waste valuable time trying to remember the rule or counting. The shorter the time between lightning and thunder, the greater your risk. If you hear thunder within half a minute of seeing lightning, think about moving to safety. If you hear thunder within a few seconds, get to safety immediately.

How accurate are forecasts? This is a complicated question but I'll give some guidelines.

__ Overall, the general public expects way more out of the forecast than we can deliver. Forecasts are educated guesses. There is much more we don't know about the atmosphere than what we do know.

__ If the weather is really important for what you have planned, use some common sense and be prepared.

__ Our ability to predict the weather depends heavily on how much we know about what the atmosphere is doing right now. In general we know very little about it. In North America our observing networks measure less than 20% of the atmosphere. Worldwide, it's much less than that.

__ The farther out in time, the less accurate the forecast. The first 12 hours is better than the second 12, which is better than the third 12, etc. Beyond 3 days, details get lost and beyond a week, it is a general impression only. There is no practical skill in longer-range forecasts.

__ The smaller the storm, the harder it is to predict. We have the greatest skill at predicting the general features of weather systems that cover large parts of the country for the next 24 hours. We have virtually no skill at predicting if a hailstorm will hit your car tomorrow.

__ Precipitation is the most difficult part of the local forecast. Snow amount is even harder.

__ All forecasts are verified at DIA (snow is verified at the old Stapleton airport). Regardless of the wording of the forecast, the forecaster is forecasting for DIA since that's where it counts. The weather might be very different where you are.

official NWS forecast – the official National Weather Service forecast, interpolated to Watkins., updated four times per day. This is what goes to the media, so read it here and avoid all the hype.

hourly forecast graphs - hourly time series plots of temperature, wind and precipitation probability, interpolated to Watkins. Other parameters can be selected by the user. These come from the National Digital Forecast Database and are quite useful for the ranch since they provide hourly detail, trends, highs and lows. They provide very useful wind forecasts for the ranch – refer to the interpretation of wind speed and direction in the Background above. They are also useful for the timing of precipitation but the probabilities and amounts are approximate.

NCAR weather website – NCAR is the National Center for Atmospheric Research. It is located in Boulder and is one of the premier scientific facilities in the world. This website provides all the raw model output and is for meteorologists who understand how to use the data and prefer to do their own analysis and interpretation. If you are curious, take a look and I'll be glad to explain what you're looking at.

Denver-Boulder National Weather Service – this is the website of the NWS office that covers northeast Colorado. Lots of additional weather information is here. Check it out.

Tony's forecast checklist – I used to teach the classes on forecasting. One of the greatest challenges for students is learning how to collect and organize the vast amount of information and effectively use it in the decision making process. I made this checklist for my students and used it for years. It needs to be updated with new data sources and technology but these days I'd rather ride a horse than sit at the computer.

NWS forecast discussion – This is the written explanation behind the forecast. It is issued twice a day by the NWS forecasters. The wording is highly technical and contains forecasting terminology. If you want to get a feel for the kinds of things forecasters consider when developing the forecast, take a look.

latest SREF - the Short Range Ensemble Forecast is a high resolution model that I like to use. It's pretty technical, so enter at your own risk..