

## Colorado CoCoRaHS Fall 2023

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Colorado CoCoRaHS Coordinator

Howdy,

My name is Peter, and I am the Community Collaborative Rain, Hail, and Snow Network State Coordinator! That means I am here to help with any CoCoRaHS-related questions or concerns you have. Feel free to reach out to me any time at [peter.goble@colostate.edu](mailto:peter.goble@colostate.edu). One of the things I enjoy doing most as coordinator is sending out this newsletter with some info on what is new in Colorado Weather and Climate over the last few months. Welcome to the Fall 2023 edition.



*Double rainbow over Fort Collins, CO on 10/11/2023. Photo credit: Russ Schumacher.*

**Cold Weather Inbound:** Most of us have been enjoying a stretch of warm, pleasant, sunny weather. The lack of cold and wind has allowed colorful leaves to remain on the trees longer than most years. I am sure many of us have been enjoying this long stretch of golden fall days. However, golden fall days probably aren't the reason any of us are participating in CoCoRaHS. If you're like me, you probably joined this group because you have a penchant for enjoying rainy, snowy, sleety, severe, or downright miserable weather.

I can't promise the coming weather will be "miserable," but things are about to change. Our first big push of cold air is currently building over Alaska and the Northwest Territories of Canada. It is about to march down along the lee side of the Colorado Rockies and bring our coldest air of the season thus far

to Colorado. For many of us, this will mean snow. Parts of northwestern Colorado could see flakes Thursday night into Saturday morning. Most of the rest of us will see either a dash of rain, or at least windy conditions followed by a major cooldown. This bout of cold air is expected to stick around for a while, and by Tuesday (Halloween) morning, many of us across the state may see our first measurable snow.

I think snow measurement might be the most fun part of participating in CoCoRaHS, but please keep in mind that it is more difficult than just reading your rain gauge. If you have any questions, please do reach out. We have both print and video resources to help you with your snow measurement questions on the CoCoRaHS website. Here are a couple quick primers:

1. If freezing weather is in the forecast, remove the funnel and inner tube from your rain gauge. This will make it easier to capture the bounty from the storm.
2. We want to know how much liquid water was in your snow. When measuring the contents of your gauge, measure out a known quantity of hot water using the inner cylinder to melt the snow in your gauge. Then subtract this quantity from your final measurement when report your "gauge catch."
3. Have a well-marked place to measure snowfall, preferably on a snowboard.
4. If snow drifts heavily, take several measurements around your observation site, and report a "representative" average snow depth on your CoCoRaHS form.
5. Safety first! Sometimes snow and ice can make collecting data more dangerous. Always put your health first if you are not comfortable going outside.
6. Relax, have fun, reach out with questions, and keep in mind that this is all optional. We have some observers who love to measure rainfall but say "forget it" when the snow starts. We understand completely.

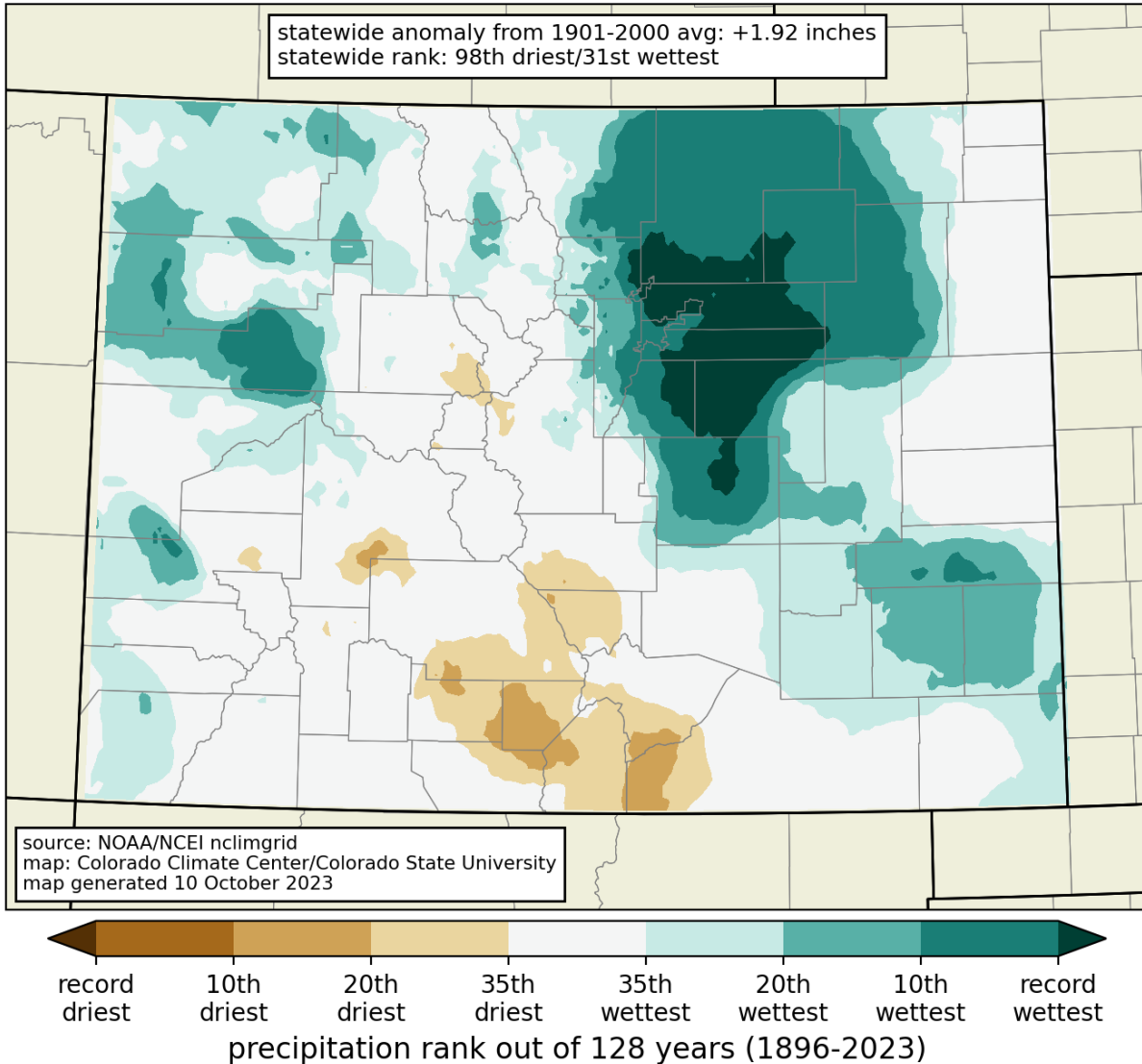
**Water Year 2023:** Have you viewed your station's water year statistics yet? I highly encourage doing so. Look for the "Station Water Year Summary Certificates" section when logged onto the website. I also encourage you to view the "Dex," or "Data Explorer" section. There are some terrific ways to visualize your data!

Some of you might be thinking, "water year?" What is he talking about? A water year is just like a calendar year, but phase shifted by three months (kind of like a fiscal year). We track water years from October 1<sup>st</sup> to September 30<sup>th</sup> of the following calendar year. The reason for doing this is a water year more neatly tracks the water cycle in Colorado: snowpack buildup through the winter, snowmelt and runoff in the spring, and water use/irrigation in the summer. We are now in Water Year 2024. Pretty neat!

I think this has been an exceptionally fun water year for being a CoCoRaHS observer. I had at least a trace of rainfall everyday from June 1<sup>st</sup>- June 18<sup>th</sup>. The National Centers for Environmental Information NCLimGrid product (which uses CoCoRaHS data among other sources) estimates that this was the wettest water year on record for much of eastern Colorado going back to 1896. This includes portions of Weld, Boulder, Morgan, Adams, Arapahoe, Denver, Douglas, and El Paso Counties. This was largely due to a rainy stretch in May and June. Conversely, for western Colorado, the wet water year was the result of a great snow season. Was it your wettest water year on record?

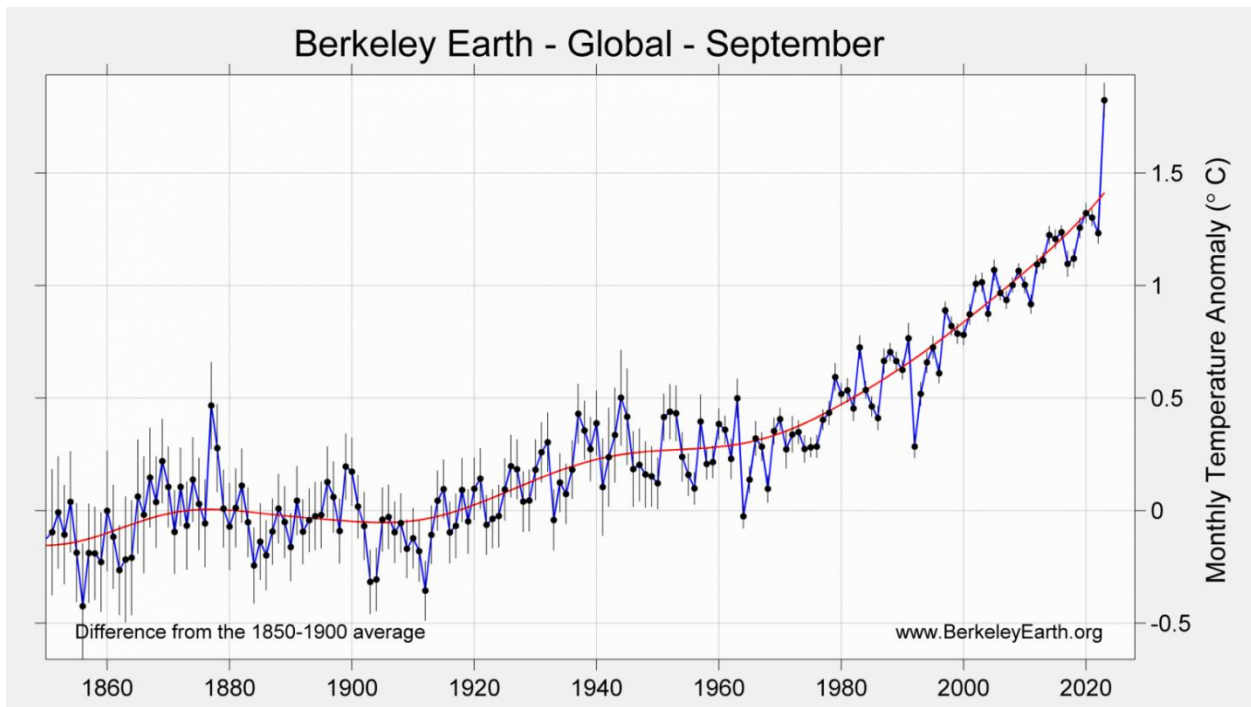
We can see in the image below that it was not wet everywhere. Southern Colorado had a poor monsoon season. The monsoon season (mid-July through early September) is when most of the rain falls in the San Luis Valley climatologically. As a result, folks around Alamosa were left out of the fun.

precipitation rank: 12 months ending September 2023 (Oct-Sep)

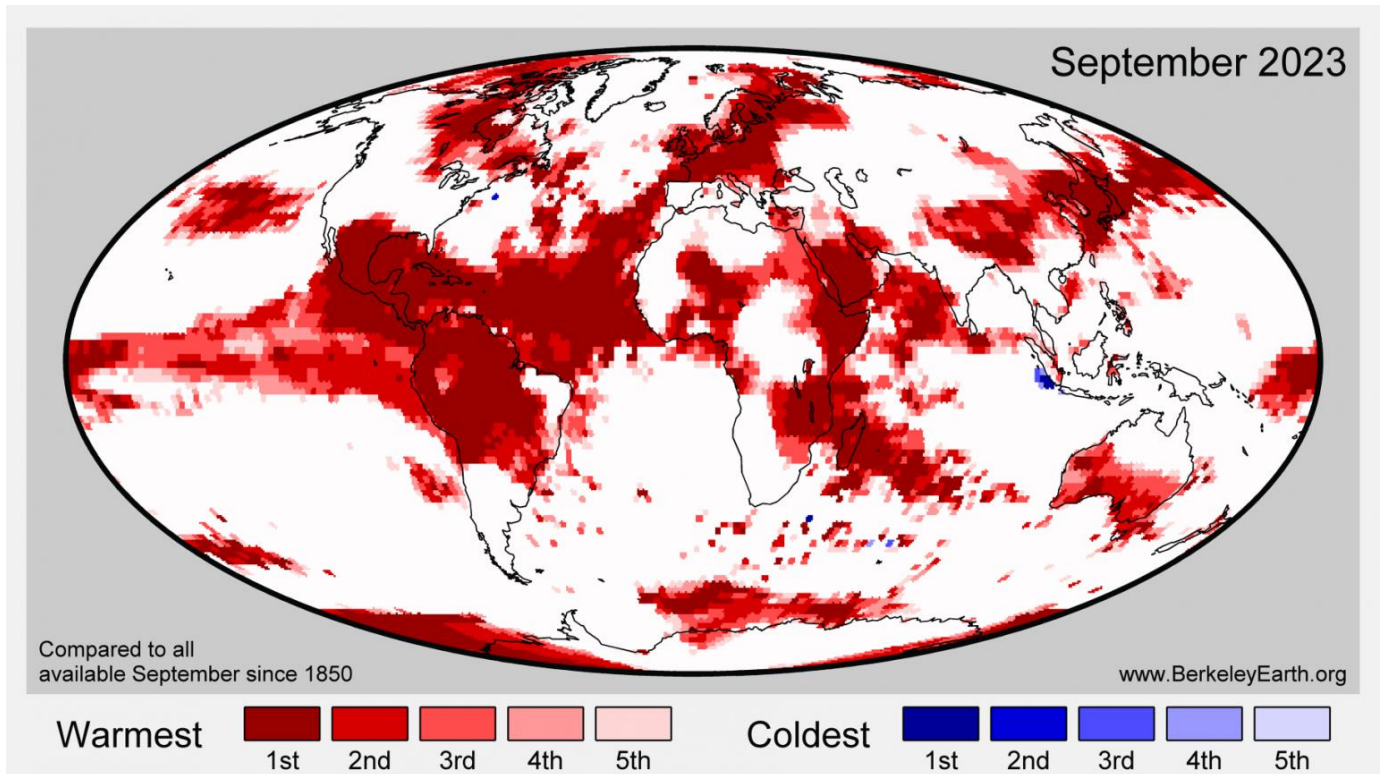


*Precipitation rank map for Colorado for water year 2023. Areas in green-shaded areas were wetter than historical averages. Brown-shaded areas were drier than historical averages.*

**A September to Remember:** It's true. Colorado did have a much wetter and cooler than normal water year by recent standards, but what about the globe? It turns out that this was the warmest September globally by a considerable margin, and that 2023 may be on track to be the warmest year yet recorded with modern measurements. Colorado's cooler than average winter and spring were more the exception than the rule globally. Check out these charts from the University of California Berkeley showing how exceptional September was:

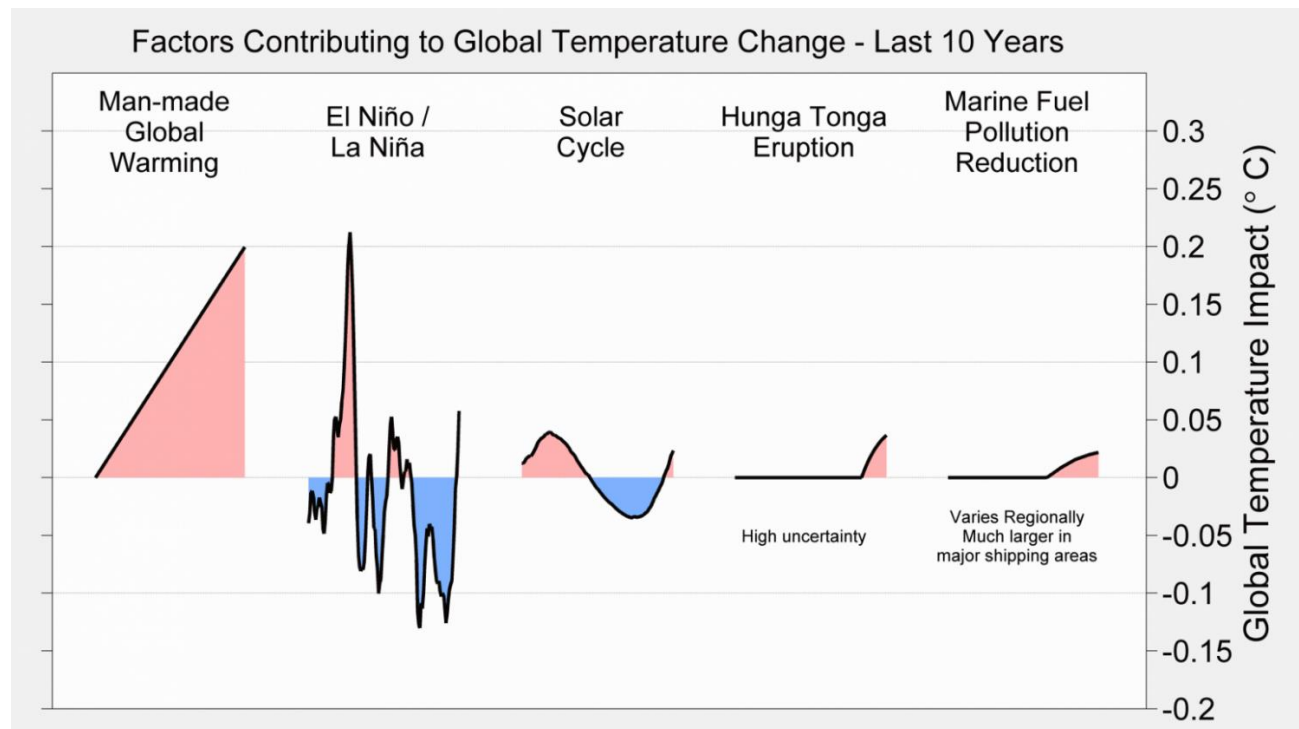


University of California Berkely global temperature timeseries reconstructed from observations. Observed temperature is shown with black dots connected by a blue line. The long-term trend is shown in red. Measurement uncertainty is represented with gray bars. Note: uncertainty is much higher early in the timeseries.



University of California Berkely global temperature ranking map for September 2023. Areas in red experienced one of the five warmest Septembers on record. Dark red indicates the warmest September on record. Areas in blue experienced a top 5 cool September.

What is going on here? Yes, anthropogenic climate change was a major factor. Due to human emissions, we are living in an increasingly carbon-intensive atmosphere. Living in an atmosphere with more greenhouse gases is like being outside with a thicker coat. This is by far the forcing factor responsible for most of the planet’s warming over the last 150 years, but it is not the only factor necessary to explain the rapid jump in temperatures this September. The rapid shift from La Niña to El Niño also means warmer ocean surface temperatures over the equatorial Pacific Ocean. A warmer ocean vents heat into the atmosphere. Additionally, the solar cycle has played a role. Sunspot activity has a predictable 11-year cycle that heats and cools the earth. We just got out of a sunspot minimum and are approaching the next sunspot maximum. Interestingly, the Hunga Tonga Eruption from last year has also warmed the atmosphere (remember the images of the global shockwave it created?) Volcanic eruptions cool the earth’s surface in the near term after an eruption because they spew particulate matter into the air. Suspended particulates block incoming sunshine. But when the dust settles, we are left with just the excess atmospheric CO<sub>2</sub> that the volcano spews, which lasts over 100 years on average.



Relative influence of different global climate forcing factors on the temperature trend over the last 10 years. Source: University of California Berkeley.

**Our Coming Winter:** At this time of year many folks get curious about what kind of winter is around the corner. You may here all kinds of conjecture “it was a warm fall, so it will be a cold winter.” “It was a wet summer, so it will be a dry winter.” “The Farmer’s Almanac says it will be a very cold winter.” The truth is that our Colorado winters have little correlation to previous seasons, and seasonal forecasting models leave a lot to be desired. We will have an El Niño winter, which does influence the behavior of the polar

jet stream, and therefore has some influence on what type of winter we will endure. El Niño winters tend to be associated with a weaker polar jet stream over the northern US and Canada and enhanced subtropical jet stream activity over the southern US and Gulf of Mexico. This makes for milder than normal winters in the northern part of the country, and wetter than normal winters over the southern portion of the country. There are known physical reasons why this happens that I will not get into here. Please reach out if you want to know more. It is not entirely clear what El Niño means for Colorado, but we know historically that it does raise the probability of a mild winter with lower-than-normal snowfall over the northern Rockies, but it also raises the probability of a wet spring statewide.

That is all my yammering for now. Again, you're always welcome to reach out to me with any CoCoRaHS or climate-related questions and concerns. Have a wonderful remainder of fall!

Kindest Regards,

Peter