FALL 2020 UPDATE

Welcome to the October 2020 Montana Drought & Climate newsletter. We hope that Montana farmers and ranchers find the information here useful. The online version of this newsletter has maps that allow you to zoom in on your local area. Check it out at climate.umt.edu/mtdrought/latest/.

Here’s what you’ll find in this newsletter:

**Summer 2020 Review** — Understanding current and past conditions aids in predicting future conditions. This section provides an overview of what happened this past summer.

**Winter Forecast** — The seasonal forecast discusses predictions for temperature, precipitation, and drought, as well as the global air circulation patterns that impact growing conditions and water availability in Montana.

**Mid-century Outlook** — What do Montanans need to do to prepare for the future? In this section we present projections of mid-century conditions across Montana. Comparing these projected conditions to current or past conditions gives an improved understanding of how to respond to a changing climate.

**Reference** — A helpful glossary of terms found in this newsletter.

In Brief

- While June and July were near normal across Montana, August was hot and dry, leading to rapid onset of drought conditions across the state.
- Soil moisture going into winter is low. It will be critical to monitor whether soil moisture improves prior to the winter freeze.
- The NOAA seasonal forecast for December through February is for cooler and wetter than normal conditions due to a moderate La Niña climate event.
Weather and climate forecasters use words and information in very particular ways that may be different from what we are accustomed to. Here is a list of terms we use in this newsletter:

**Weather and Climate** — The difference between weather and climate is timescale. 
*Weather* is the day-to-day interaction of factors like temperature, humidity, precipitation, cloudiness, visibility, and wind. To understand *climate* at a given place requires looking at weather trends over relatively long periods of time—months, years, and decades. In addition to studying weather, scientists examine climate trends or cycles of variability to understand the bigger picture of long-term changes.

**Temperature and Precipitation** — Throughout this newsletter, we report past temperature and precipitation data derived directly from the GridMET daily 4-km-gridded meteorological dataset from the University of Idaho. Temperature data are reported as seasonal averages; precipitation data are reported as seasonal total precipitation. Our three-month temperature and precipitation forecasts come from NOAA’s Climate Prediction Center.

**Normal(s)** — Climatologists use the term “normal” to compare current conditions or forecasts, such as temperature or precipitation, to the past. Here, the normal value is the statistical mean (the average) for a given measurement in a specific place during a specific period of time. Climatologists use the most recent 30-year period, rounded to the nearest decade, to define normal in North America: 1981–2010. The goal is to look far enough back in time to capture variation in weather patterns, but not so far as to be irrelevant to recent conditions. In 2021, we will start using the 1991–2020 period.

**Drought** — The US Drought Monitor identifies general areas of drought and labels them by intensity. Maps of drought intensity are used by policy-makers, resource managers, and agricultural producers to make decisions. More information about the US Drought Monitor can be found at the US Drought Monitor website.

**La Niña/El Niño** — El Niño and La Niña are the warm and cool phases of a recurring climate pattern across the tropical Pacific, the *El Niño Southern Oscillation* (ENSO). When ENSO is between warm and cool phases, conditions are called ENSO Neutral. ENSO is one of several global climate phenomena that affect Montana’s weather patterns, and ENSO conditions often guide seasonal climate projections for Montana. Current ENSO conditions and up-to-date projections are available on NOAA’s ENSO website.

**Root Zone Soil Wetness** — Root Zone Soil Wetness is a measure of how much water has saturated the soil. More specifically, it’s the relative saturation between completely dry (indicated by a 0) and completely saturated (indicated by a 1) between 0 and 100 cm depth. In the maps in this newsletter, soil saturation comes from NASA’s Soil Moisture Active Passive (SMAP) satellite program “SPL4SMGP” data product. Soil moisture is mapped using a combination of radar and radiometer measurements from space and surface observations at an approximately 9-km spatial resolution.

**Mid-century Projections** — We present summaries of mid-century (AD 2040–2069) climate change impacts from the Montana Climate Assessment (MCA). The MCA findings are derived from careful analysis of many global climate projections that were run as part of the Coupled Model Intercomparison Project Phase 5 (CMIP5), and how those projections will likely affect people in Montana. Climate change projections and impacts are uncertain. Each key message provided here is followed by an expression of confidence that assesses a) the level of agreement among experts with relevant knowledge used to craft the message, and b) the quality of the evidence supporting the message.
**TEMPERATURE**

After a July of near-normal temperatures, August brought the heat, leading to above-normal temperatures across Montana as a whole. Portions of western Montana were 3 °F above normal, and the western Crazy mountains north of Livingston were 2 °F above normal. Northeastern Montana had slightly cooler than normal temperatures throughout the summer.

The graph (right) compares historical daily temperatures (shaded bands and dashed lines) to current daily temperatures so far in 2020 (solid-jagged lines) across Montana. The shaded bands represent the range of recorded temperatures during the 1981–2010 period on any given day. The red bands and lines represent the high temperatures and the blue bands and lines represent the lows. The dashed red and blue lines represent the average high and average low temperatures during the 1981–2010 period.

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**DROUGHT**

According to the US Drought Monitor (USDM), drought and abnormally dry conditions expanded across Montana during late summer. Much of western Montana has moderate drought conditions, and portions of northeastern and southeastern Montana are experiencing severe drought. Warmer than normal conditions during early fall have delayed drought recovery, but a moderate La Niña should bring wetter conditions as we head into the winter.
**PRECIPITATION**

Dry conditions continued across the state. For example, the Crazy mountains received only about 30% of its normal summer precipitation, and the Highwood mountains east of Great Falls received only about 25% of its normal precipitation. Persistent below-normal precipitation across Montana continues to be the primary driver of ongoing drought conditions.

The graph (right) compares historical daily precipitation (shaded band and dashed line) to current daily precipitation so far in 2020 (vertical bars) across Montana. The shaded band represent the range of recorded precipitation during the 1981–2010 period on any given day. The dashed line represents the average precipitation during the 1981–2010 period.

**SOIL MOISTURE**

While satellite-derived estimates of soil moisture for Western Montana continue to be very low, conditions in central and northern Montana have improved as we head into the fall. Soil moisture in northeastern Montana also remains low. Given the climate outlook for the winter, which includes wetter than normal conditions, soil moisture conditions should continue to improve across the state if early rainfall and snowmelt recharge soils prior to the winter freeze up.
EL NIÑO UPDATE

The El Niño Southern Oscillation (ENSO) is a natural seasonal fluctuation in the sea surface temperature of the Pacific Ocean near the equator. “El Niño” conditions exist when the sea surface temperatures are warmer than normal, and “La Niña” conditions exist when they are cooler than normal; “ENSO Neutral” conditions occur when sea surface temperatures are near normal. ENSO impacts on Montana’s weather vary from moderate impacts during El Niño and ENSO Neutral conditions, to consistently large impacts during La Niña. In early October, NOAA advised that we are currently experiencing a moderate La Niña event that is expected to continue through the 2020/2021 winter (~85% chance) and may persist into spring 2021 (~60% chance during February–April). La Niña conditions may strengthen or weaken as we continue into winter. In Montana, La Niña conditions during the winter typically bring cooler than normal temperatures and wetter than normal precipitation conditions.

High winds rapidly spread range fire south of Ekalaka on October 12.
PHOTO: KEVIN HYDE

Average daily temperature (°F)

-10 0 10 20 30 40 50 60 70 80
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

- El Niño
- ENSO Neutral
- La Niña
You can see that in the two graphs (opposite page and right) show how Montana as a whole is affected by the ENSO climate patterns. The solid lines represent the average conditions in each of El Niño, La Niña, and ENSO Neutral conditions (see the Reference section for an explanation of these conditions). The dashed lines represent the range of recorded conditions during the 1981–2010 period on any given day. Notice that the range for ENSO Neutral conditions (orange dashed lines) is wider than for El Niño or La Niña—ENSO Neutral conditions can be warmer or cooler, and wetter or dryer, than normal conditions.

**TEMPERATURE**
NOAA’s Climate Prediction Center (CPC) is projecting cooler than normal conditions throughout the winter (December–February), especially in the northeastern part of the state. Colder than normal conditions increase the odds of extreme cold spells and may require ranchers to keep an eye on their cattle.

**PRECIPITATION**
NOAA’s Climate Prediction Center (CPC) is forecasting that December–February precipitation will be higher than normal across all of Montana, with more confidence in wetter conditions for northern Montana. Increased precipitation should help reduce drought conditions across much of the state the winter months, and can be expected to provide heavy snowpack in the high country.
A peach orchard near Grand Junction, Colorado. By mid-century, portions of eastern Montana may feel like western Colorado. PHOTO: RONDA KIMBROW PHOTOGRAPHY

**Mid-century Outlook**

CLIMATE

Agriculture is an incredibly important part of Montana’s culture, economy, and landscape, and an industry that is directly impacted by changes in temperature, precipitation, and extreme weather events. Each fall, we provide information about how climatic conditions in Montana are projected to change over the next 30 years. We realize that agricultural operations in Montana are diverse and that each producer will need to respond differently to changing conditions. Below, we provide summary information from the Montana Climate Assessment (MCA), an effort to synthesize, evaluate, and share credible and relevant scientific information about how our climate is changing in Montana, produced by Montana State University and the University of Montana. This is only a summary of the MCA — visit MontanaClimate.org for more details on changes in your region.

The Montana Climate Assessment outlines the following changes to temperature and precipitation. Each point is followed by an expression of confidence. For more information, see the Climate chapter of the Montana Climate Assessment.

- Annual average temperatures, including daily minimums, maximums, and averages, have risen across the state between 1950 and 2015. The increases range between 2.0–3.0°F during this period. [high agreement, robust evidence]
- Montana is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century. By mid-century, Montana temperatures are projected to increase by approximately 4.5–6.0°F, in addition to the 2–3°F warming we have already seen. These state-level changes are larger than the average changes projected globally and nationally. [high agreement, robust evidence]
- Despite no changes in average annual precipitation between 1950 and 2015, there have been changes in average seasonal precipitation over the same period. Average winter precipitation decreased by 0.9 inches, which can largely be attributed to natural variability and an increase in El Niño events, especially in the western and central parts of the state. A significant increase in spring precipitation (1.3–2.0 inches) also occurred during this period for the eastern part of the state. [moderate agreement, robust evidence]
- Across the state, precipitation is projected to increase in winter, spring, and fall; precipitation is projected to decrease in summer. The largest increases in precipitation are expected to occur during spring in the southern part of the state. The largest decreases in precipitation are expected to occur during summer in the central and southern parts of the state. [moderate agreement, moderate evidence]
Montana agricultural producers have long contended with changes in climate and weather, including extreme events and climate variability. The changes impact all aspects of Montana agriculture, from rangeland productivity and crop yields to disease, pests, and weeds. However, predictions about the exact ways that climate will impact agricultural producers are difficult, because every operation is different and there are many uncertainties related to climate projections, commodity prices and the cost of inputs, available technology, and insurance, among others. Each producer knows their land and operation and is best positioned to understand how current and future changes will affect them.

Here are some of the projections about impacts to Montana agriculture. Each point is followed by an expression of confidence in that message. For more information, see the Agriculture chapter of the Montana Climate Assessment.

• Decreasing mountain snowpack will continue to lead to decreased streamflow and less reliable irrigation capacity during the mid-late summer. Reduced irrigation capacity will have the greatest impact on hay, sugar beet, malt barley, market garden, and potato production across the state. [high agreement, robust evidence]

• Increases in temperature will allow winter annual weeds, such as cheatgrass, to increase in distribution and frequency in winter wheat cropland and rangeland. Their spread will result in decreased crop yields and forage productivity as well as increased rangeland wildfire frequency. [high agreement, medium evidence]

• Changes in other parts of the world will impact the price of commodity crops, such as small grains, that are more directly driven by global markets. Crops that are more directly tied to local markets or specialized non-local markets may not be impacted as much by impacts to agriculture in other parts of the world. [high agreement, medium evidence]

Increasing resilience in the face of change
Social and economic resilience to withstand and adapt to variable conditions has always been a hallmark of Montana farmers’ and livestock producers’ strategies for coping with climate variability. Producers build resilience in different ways, depending on their operations and their goals. Diversified cropping systems, including rotation with pulse crops and innovations in tillage and cover-cropping, along with other measures to improve soil health, may enable producers to adapt to the changes described here.

Resources for producers can be found online at the USDA Northwest Climate Hub, the USDA Northern Plains Climate Hub, the Natural Resources Conservation Service, USDA Farm Service Agency, and Montana State University Extension.

Planning for the Future
The analogs presented in the next section reflect uncertainty regarding future greenhouse gas emissions and the severity of climate change. In short, scientists know that things are changing and we often know the direction of the change (for example, warmer and drier), but we can’t predict exactly what your climate will look like in 2050. Also, the year 2050 is pretty far off in the future and your long-term planning might be focused on the next 5–10 years. So how do you plan for the future? Here’s what your fellow farmers and ranchers have told us in response to this question:

• As you observe what’s happening on your farm or ranch, think about what changes you will need to make to your operation as things continue to shift. What would you need to do if there is more prolonged drought? Make a plan and think about when you need to start transitioning to new practices.

• Montana farmers and ranchers often tell us how risky it is to transition to new crops or management practices. Watch what’s working for your neighbors who are experimenting with new practices. Talk with the Agricultural Research Center in your region. Take a small patch and try something new to see how it works as conditions change.

• Build in flexibility and diversity as much as you can. Diversify your operation so you have multiple income streams. Experiment in ways that require small investments and are easy to reverse if they don’t work out.
ANALOGS

What will my climate be like in 2050?
To better understand where your climate is heading, we’ve provided spatial analogs for three locations in Montana. Spatial analogs have become popular with agricultural producers because they provide a tangible and plausible representation of future climate in a particular place, based on what scientists currently know about how the climate is changing. For example, in 2050, it’s plausible that the climate of Fort Benton will similar to the current climate of the Utah Valley south of Salt Lake City, UT. This information provides farmers and ranchers with an understanding of what kind of agriculture can thrive under future conditions.

Photo: Lewiston, Idaho, at the southern edge of the Palouse region, is known for its dryland wheat and chickpea production.
PHOTO: BRAD STINSON.

Photo: Palisade, Colorado, just outside of Grand Junction along the western edge of the Rocky Mountains, is known for growing peaches, cherries, and wine grapes.
PHOTO: RONDA KIMBROW PHOTOGRAPHY.

Lewiston, Nez Perce County, ID
(Analog for Frenchtown, MT, near Missoula)
Climate shift: During summer, Lewiston, Idaho is typically about 9°F warmer than Frenchtown and receives slightly less precipitation.
Land in farms by use:
Cropland ................................................... 61%
Pastureland .................................................. 27%
Woodland ..................................................... 10%
Other ........................................................... 2%
% of farmland irrigated: ...................... < 1%
Top Crops (acres):
Wheat for grain, all ...................... 105,449
Chickpeas .......................................... 44,982
Forage (hay/haylage), all ............... 14,538
Lentils ..................................................... 6,247
Barley for grain ..................................... 6,116

Photo: Lewiston, Utah County, UT
(Analog for Fort Benton, MT, near Great Falls)
Climate shift: During summer, Salem, Utah is typically about 9°F warmer than Fort Benton and receives about half as much precipitation.
Land in farms by use:
Cropland ................................................... 39%
Pastureland .................................................. 54%
Woodland ..................................................... 9%
Other ........................................................... 2%
% of farmland irrigated: ...................... < 1%
Top Crops (acres):
Forage (hay/haylage), all ............... 39,125
Wheat for grain, all ......................... 13,093
Corn for silage or greenchop .......... 8,163
Cherries, tart ........................................... 4,630
Corn for grain ......................................... 2,738

Photo: Baled hay outside of Salem, UT in the Utah Valley south of Salt Lake City.
PHOTO: WIKIMEDIA COMMONS.

Grand Junction, Mesa County, CO
(Analog for Hesper, MT, near Billings)
Climate shift: During summer, Grand Junction, Colorado is typically about 7°F warmer than Hesper and receives about half as much precipitation.
Land in farms by use:
Cropland .................................................... 23%
Pastureland .................................................. 60%
Woodland ..................................................... 9%
Other ........................................................... 7%
% of farmland irrigated: ...................... 22%
Top Crops (acres):
Wheat for grain, all ......................... 105,449
Chickpeas .............................................. 44,982
Forage (hay/haylage), all ............... 14,538
Lentils ..................................................... 6,247
Barley for grain ..................................... 6,116

Photo: Palisade, Colorado, just outside of Grand Junction along the western edge of the Rocky Mountains, is known for growing peaches, cherries, and wine grapes.
PHOTO: RONDA KIMBROW PHOTOGRAPHY.
Because of uncertainties related to how technology, economics, and policy will influence carbon emissions in the future, we’re showing you analogs from two scenarios: RCP 4.5 (“moderating emissions”) where carbon emissions peak around 2040 and then decline, and RCP 8.5 (“accelerating emissions”) where carbon emissions continue to increase through the 21st century. Under both scenarios Montana is projected to be much warmer in the future.

Climate analogs are courtesy the Future Urban Climates project, University of Maryland Center for Environmental Science. Research methods are published in *Nature Communications*.

Agricultural statistics are from the USDA National Agricultural Statistics Service 2017 Census of Agriculture.

**Boise, Boise County, ID**
(Analogue for Frenchtown, MT, near Missoula)

**Climate shift:** During summer, Boise, Idaho is typically about 7°F warmer than Frenchtown and receives about 40% as much precipitation.

**Land in farms by use:**
- Cropland: 3%
- Pastureland: 88%
- Woodland: 8%
- Other: < 1%

**% of farmland irrigated:** 2%

**Top Crops (acres):**
- Forage (hay/haylage), all: 892

**Photo:** The region around Boise, in western Idaho, is known for its dairy and beef industry. Ranch cooperatives such as Desert Mountain Grassfed Beef utilize federal, state, and private leasing agreements for grazing.

PHOTO: DESERT MOUNTAIN GRASSFED BEEF.

**Grand Junction, Mesa County, CO**
(Analogue for Fort Benton, MT, near Great Falls)

**Climate shift:** During summer, Grand Junction, Colorado is typically about 7°F warmer than Fort Benton and receives about half as much precipitation.

**Land in farms by use:**
- Cropland: 23%
- Pastureland: 60%
- Woodland: 9%
- Other: 7%

**% of farmland irrigated:** 22%

**Top Crops (acres):**
- Forage (hay/haylage), all: 36,164
- Corn for grain: 5,111
- Wheat for grain, all: 2,821
- Peaches, all: 1,971
- Corn for silage or grenchope: 1,589

**Photo:** Palisade, Colorado, just outside of Grand Junction along the western edge of the Rocky Mountains, is known for growing peaches, cherries, and wine grapes.

PHOTO: RONDA KIMBROW PHOTOGRAPHY.

**St. George, Washington County, UT**
(Analogue for Hesper, MT, near Billings)

**Climate shift:** During summer, St. George, Utah is typically about 14°F warmer than Hesper and receives about one-third as much precipitation.

**Land in farms by use:**
- Cropland: 14%
- Pastureland: 73%
- Woodland: 8%
- Other: 5%

**% of farmland irrigated:** 8%

**Top Crops (acres):**
- Forage (hay/haylage), all: 8,507
- Vegetables harvested, all: 114
- Peaches, all: 70

**Photo:** The growing season in Washington County is one of the longest in Utah, averaging five and a half months.

PHOTO: ST. GEORGE NEWS.
About Montana Drought & Climate and the Montana Climate Office

Montana Drought & Climate is a USDA-funded project of the Montana Climate Office (MCO) at the W.A. Franke College of Forestry & Conservation at the University of Montana, in collaboration with the Montana State University Extension Service. The MCO is an independent state-designated body that provides Montanans with high-quality, timely, relevant, and scientifically-based climate information and services. We strive to be a credible and expert source of information for decision makers that rely on the most current information on climate to make important decisions. It is also the role of the MCO to assist stakeholders in interpreting climate information or adapting climate products to their needs.

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WE WANT TO HEAR FROM YOU... QUESTIONNAIRE COMING SOON!

We need your feedback on the MT Drought and Climate newsletter! In the New Year, we will send you a questionnaire to learn that you think about the climate information presented in the newsletter. Please consider taking the survey and letting us know what you think.

A major grasshopper infestation affected crops across eastern Montana. The impacts of pests like grasshoppers are closely tied to climate conditions.

PHOTO: GILLETTE NEWS RECORD