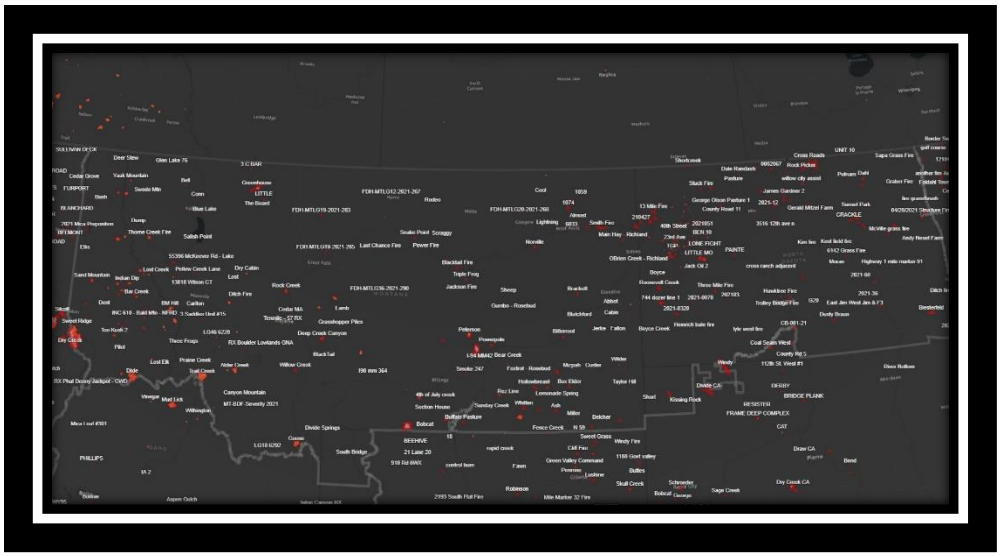
Northern Rockies Geographic Area

Fire Season Assessment

2021



Northern Rockies Geographic Area Wildfires July 18, 2021

Northern Rockies Geographic Area Wildfires August 7, 2021

Sept 3, 2021

Introduction

The Northern Rockies Geographic Area (NRGA) saw increased fire activity throughout the spring in North Dakota, moved West to the rest of the Region in early June 2021 and has an outlook for continued hot and dry conditions across the area. Due to the size of the Geographic Area and the disparity in fuels and conditions, the assessment was divided into two regions: northern Idaho/western Montana and eastern Montana/North Dakota.

This assessment provides more detailed information about the current situation, outlooks, and supplies fire managers with a consolidated source of reference to help evaluate risk and plan future operations.

NRGA initially entered Preparedness Level (PL) 5 on July 11th, the regions earliest ever ascent to that preparedness level, suggesting the onset of an early fire season with fire-fighting resources in demand. The NRGA have since decreased to PL3 following above normal precipitation and cooler temperatures in August. Nationally, the country remains in PL 5 with federal land management agencies taxed from prolonged fire suppression efforts.

Essentially what we have seen during the last 3 weeks is an extended August singularity, several upper trough episodes that brought cooling to near and below average temperatures at different times, to all areas of the NRGA. As well as above average precipitation to all but a few areas. Which are the lowest elevations of North ID, PSAs 05/06, NE MT, PSA 15, and portions of Central ND. This extended cool/somewhat moist pattern brought widespread significant dead fuel moisture boosts all areas to near or moister than average values for the date. However during the past few days, although cool temps. have been present, drying has occurred, and these are dropping quickly back toward average or drier than average levels (100 hours mainly)

Significant warming, drying, and increasing winds Sat-Mon will be occurring in North ID, all of MT, and Yellowstone NP. Which will rapidly further dry out fuels, and bring critical fire weather Sunday/Monday, along and east of the Divide mainly. North Dakota will dry out as well during this time, but will be cooler, with somewhat higher RHs. This critically dry and windy period is forecast by both long-range models (the European and American, GFS) to be followed by hot and dry conditions Tue/Wed next week, but with lighter winds. After which, a weak dry trough may bring some cooling, but little or no precip. In fact, both models do not show any widespread precip. event occurring over the next 10 days. Naturally, probabilities of season-slowing and even ending upper trough events increase as we head into mid-September. But so far, the longer-range models are not pointing in that direction.

Watch out situations as the season progresses are:

- Live fuel have cured and are no loner a barrier to fire spread.
- Large dead fuels are in a drying trend with 100 hour fuels near average.
- Cooler weather is expected but no wide spread precipitation is anticipated over the next 10 days.

Considerations as the season progresses:

- Potential for season slowing events increases in mid- September.
- Build strategies using realistic expectations of resources and shortages that are likely to occur as fire season progresses
- Ensure staff is getting adequate rest for a long fire season, bringing in necessary re-enforcement as available.

Potential Season Scenarios:

The fire season is likely to continue for several more weeks. Weather conditions are uncertain over this time period, so three likely scenarios for the remainder of the season were examined with the help meteorologists from Northern Rockies Predictive Services. Due to the current number of large fires, current drying trend, and ongoing drought the season is expected to extend into the coming weeks.

Scenario 1 – *Most likely scenario.* Fire activity picks up moderately for the next 2 weeks followed by a **gradual tapering of fire activity into October.** Existing active large fires in ID and west MT continue to consume increasingly available fuels with potential for perimeter growth. Inactive fires dampened by the August rains begin to creep and smolder as fuels dry. Eventually, shorter day length, nighttime moisture, and cooler temperatures begin to limit activity at the end of September and beginning of October.

Scenario 2 – *Least likely scenario.* Weather conditions **continue hot and dry until mid-October**. Fire danger worsens through September and October with an increasing number of large fires and resistance to control. Preparedness level is increased as competition for resources with other GACCs intensifies. All areas of the NRGA see above average fire activity. Large fires continue to grow under this scenario, lightning episodes will cause additional fires, overall acres burned and numbers off fire starts will be above average, especially in the western portion of the Geographic Area.

Scenario 3 – *Moderately likely scenario.* The current drying trend is interrupted by increasing moisture events and cooler temperatures. Fuel moistures rise and a decrease in fire activity resumes. By October, cool land moist fall conditions further reduce fire danger.

- Note: The "August singularity" as defined by Soule et al. 2008 is a "significant deviation from normal daily maximum temperatures that occur following the passage of a strong mid-latitude cyclone in mid- to late August in the northern Rocky Mountains." They also found that a 3-day singularity exists for August 24-26 and a single day negative maximum temperature exists for August 13th. This definition does NOT include precipitation, only reduced temperatures. https://geo.appstate.edu/sites/geo.appstate.edu/files/DoesanAugustSingularity.pdf

Management Implications:

Several factors need to be considered when looking at the current fire situation that has potential to last the next several weeks or months. These factors include:

- resource availability and competition
- develop long-term, operational plans including Management Action Points (MAPs) and additional relevant decision elements given the current situation and resource availability. Implement actions that have the highest probability of success.
- communicate the current and expected situation with cooperators and local communities (including smoke impacts)
- Associate costs with ongoing incidents. The capability to expand and contract the amount and type of resources to fit the immediate needs of an incident will assist with cost containment.

However, with the size, complexity, and duration of fires, it should be acknowledged that costs will exceed historically normal costs.

Additional management implications related to decision development and long-term planning will be included in subsequent versions of the regional assessment.

Contents

Analysis Findings and Recommendations

Expected outcomes

It is expected this season will be an above average fire season. Extreme fire spread potential resulting from dry cold fronts in addition to no mitigation of fuel conditions as a result of extended drought can be expected as conditions likely continue to be hot and dry. Late August has historically produced widespread dry lightning. This expected outcome is supported throughout the document by assessing fire history and fires year-to-date, looking at fire danger indices and trends, and evaluating winds while considering the weather forecast into October.

Indicators of increased fire behavior

Watch out situations as the season progresses are:

- Live fuel moistures decreasing with continued drying and become receptive to burning
- North aspects, wet creeks, and timber treatments start to burn readily
- Predicted cold front or back door cold front
- Predicted dry lightning or thunderstorms with isolated precipitation
- Humidity recovery at night is less than 30%

Current Situation

What is a Typical Fire Season in the Northern Rockies?

EARLY SEASON: In May and June, low pressure systems can bring moisture from the Pacific which promotes the green-up of live fuels. The high pressure ridge becomes established over the Northern Rockies Geographic Area during late June to early July which begins a drying trend.

MID-SEASON: By late July to early August, the drying trend is moderated by occasional pulses of monsoon moisture from the south, which can bring lightning sometimes accompanied by moisture. Fires can become established during this period which can extend into late August. Fire growth can be moderated by occasional pulses of monsoon moisture.

LATE SEASON: Through September the passage of low pressure systems becomes more frequent. These systems can suppress or even break down the high pressure ridge, bringing periods of cooler temperatures, increased winds and occasionally enough moisture to retard or even suppress fire growth. Dry frontal passages associated with these low pressure systems can dramatically increase fire growth for short periods. Eventually the ridge gets pushed to the south and a west-to-east zonal flow becomes established. Low pressure systems riding this flow continue to bring periods of cooler temperatures, increased winds and occasional moisture until late October when seasonally decreasing temperatures and day length bring an end to the potential for fire growth.

How is the 2021 Fire Season Different from a Typical Fire Season?

In the Northern Rockies Geographical Area (NRGA) the 2020 fire season peaked late - in late August/September and continued east of the Continental Divide through May with considerably higher than average fire activity on the Plains in November-January, and again March-May. February was extremely colder than average, but also much drier than average which effectively freeze-dried the vegetation which lacked snow cover and remained as standing dead fuel, exposed to frequent

downslope wind events. Through the period, long-term drought and warm/dry weather exacerbated the fuels dryness and fire danger that began increasing last Summer/Fall.

West of the Continental Divide saw adequate snowpack during the winter months but spring months leading into the traditional fire season were dry and have increasingly led to drought. So, all of the NRGA is in drought now according to the US Drought Monitor. The least extreme area is along the Northern Rocky Mountain Front where several multi-day periods of spring rain brought localized flooding.

EARLY SEASON: Following two notable rain events in May (Mother's Day and again before the Memorial Day weekend), warmer than normal temperatures and below average precipitation were most notable in the months of June and early July with three separate heat waves. The last week of June brought an historic heat wave that broke all-time records for both daytime and nighttime periods, as well as multi-day periods of poor humidity recovery. A 95th percentile hot/dry/windy event occurred east of the Divide on June 15th with ongoing large fires that spread quickly.

MID-SEASON: By mid-July, the fourth major heat wave impacted the Northern Rockies with record-setting high temperatures 100 to 110 degrees recorded in Bozeman, Glasgow, and Billings, Montana. The weather features responsible for this record-setting/breaking heat are exceptionally strong high-pressure ridges oriented from south to north from the Four-Corners Region into the Canadian prairies. Additionally, the NRGA has been getting monsoonal moisture pushes streaming up from the Great Basin under the ridges to ignite new fires with abundant lightning, but minimal precipitation. One feature to note is the breakdown of these ridges by dry, weak Canadian weather systems, which are typically more common in the fall and bring dry, gusty winds that shift in direction. Long term weather patterns and how they evolve over the later part of the summer will be key to how the remainder of the fire year plays out. Additionally, climate patterns including ENSO state will help determine the weather features, especially since another weak La Niña is expected to develop this Fall.

Assessment of Current Situation Compared to History

Temperature and Precipitation

Temperatures were above normal and precipitation was below normal for much of the Northern Rockies GA through June, July and and in to August (Figure 1).

The June and July brought widespread warmth to the western U.S., including the Northern Rockies where overall it has been 3 to 6 degrees warmer than average. Southern and western Montana and Northern Idaho have been the most extreme – similar to the Great Basin and Wyoming – with temperatures 6 to 8°F above average in June and July. That is because of a pattern with high pressure ridging events that were more typical of summer than late spring. Mid-June and late-July brought a heatwave with record-breaking temperatures east of the Continental Divide in the 90s and low 100s. During this short-lived event, the Hot-Dry-Windy Index indicated that these conditions exceeded the 95th percentile of events for the Northern Rockies. (https://www.nifc.gov/nicc/predictive/outlooks/monthly_seasonal_outlook.pdf Page 5).

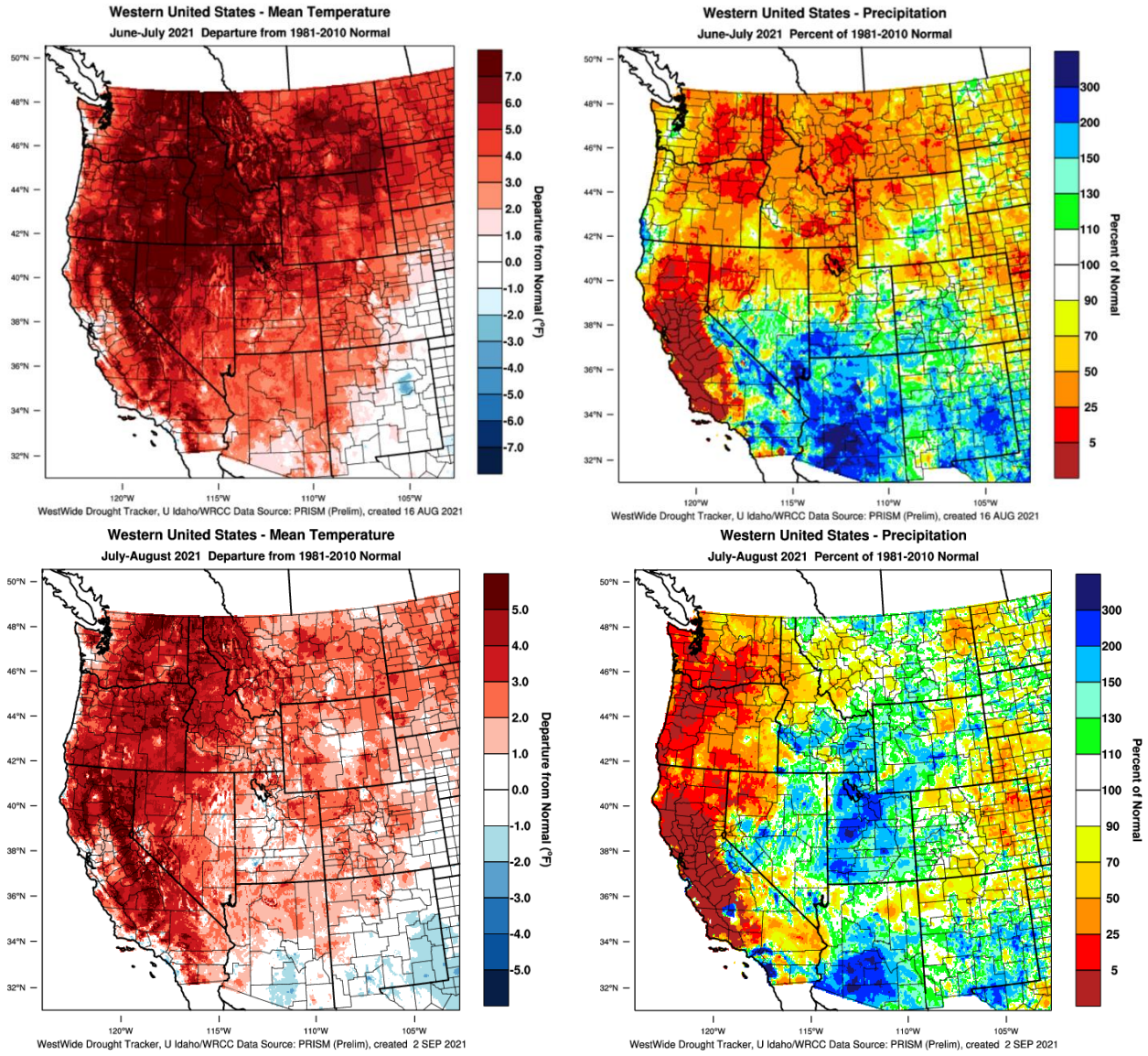


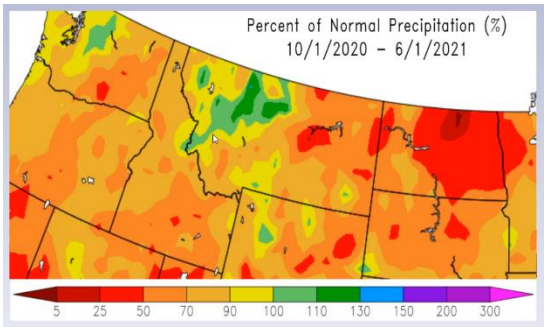
Fig. 1. Departure from normal for mean temperatures and precipitation for June-July and July - August

https://wrcc.dri.edu/wwdt/index.php?folder=mdn2

https://wrcc.dri.edu/wwdt/index.php?folder=pon2

The southeast portion of Idaho, northern Montana, and much of North Dakota and Wyoming received some precipitation in early to mid-July; however, the amount was less than expected. Additionally, most areas within the NRGA experienced below normal precipitation since last fall. As we moved through July the southeast portion of Idaho did get some repreive, however continued drought and precipitation values increased in northern Idaho, western Montana and mid North Dakota. By early to mid August, most portions of the GA...Eventually, wet storms began moving thru the GA and dropped measurable precipitaiton on most fires. Some fires reported up to an inch or two of rain. While the central and northeast portion of Montana and south central North Dakota are now seeing a surplus of moisture, most other areas within the GA remain deficit with some areas of central Idaho still only

seeing 10-25% of normal precipitation. September began with a drying trend expected to persist up to ten days.



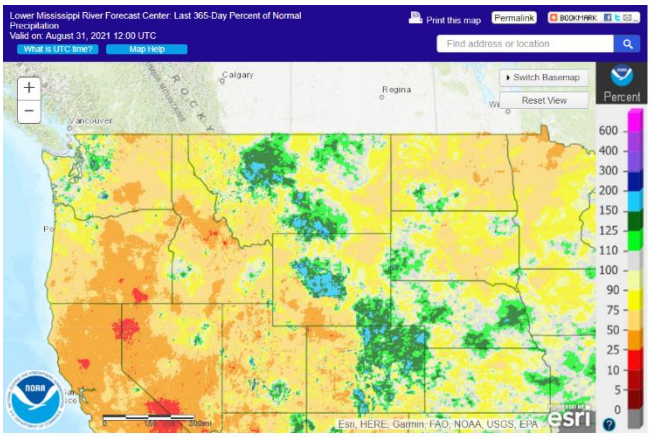
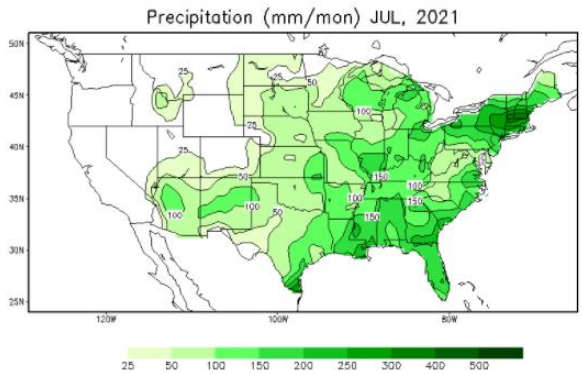
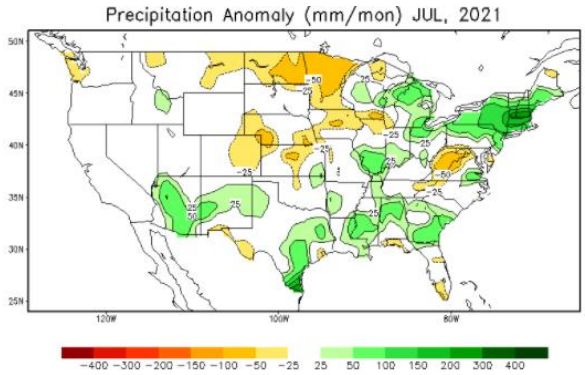


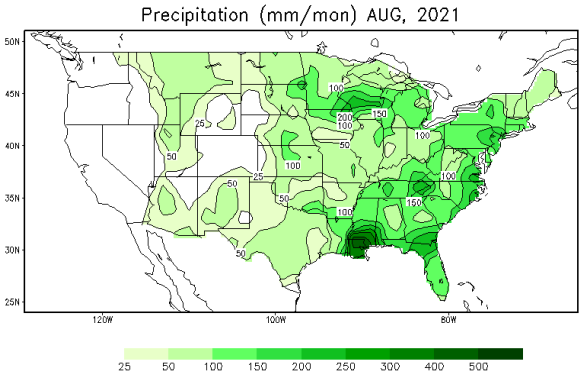
Fig. 2a. Percent of Normal Precipitation map from NRCC Seasonal Outlook slide deck. https://gacc.nifc.gov/nrcc/predictive/outlooks/Monthly_Seasonal_Outlook.pdf

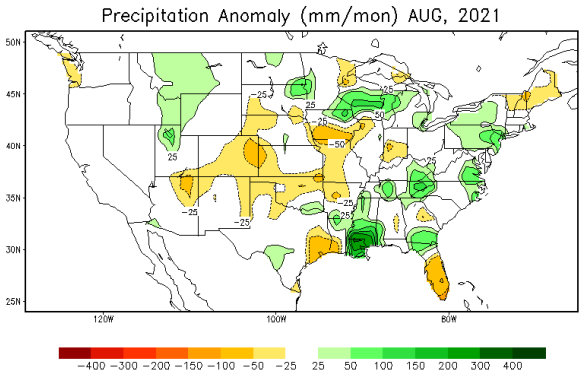
Fig. 2b. Percent of Normal Precipitation map from Advanced Hydrologic Predictive Service, last 365 Days from August 31, 2021

https://water.weather.gov/precip/index.









https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Precip/Precipitation.shtml

Fig. 3 (A) Accumulated Precipitation (mm) for July shows that some precipitation was received but generally less than what has occurred historically as displayed in the Accumulated Precip Anomaly (B). For August, precipitation (C) exceeded the monthly average for central portions of the NRGA, as seen in the anomaly map (D).

Soil Moisture

The lack of precipitation contributed to decreasing soil moisture over the months of June and July. A comparison between May and June displays intensifying dryness occurring throughout the entire NRGA. Increasing, monsoonal moisture at the end of July raises soil moisture in mid Montana, western North Dakota, however those showers were isolated which led to increasingly dry soil moistures in the middle of North Dakota, western Montana, and the middle of Idaho. Further, while soil moisture rankings remained relatively low in most areas of the NRGA into August, more frequent wet precipitation events reduced it considerably in the areas of central portions of Montana.

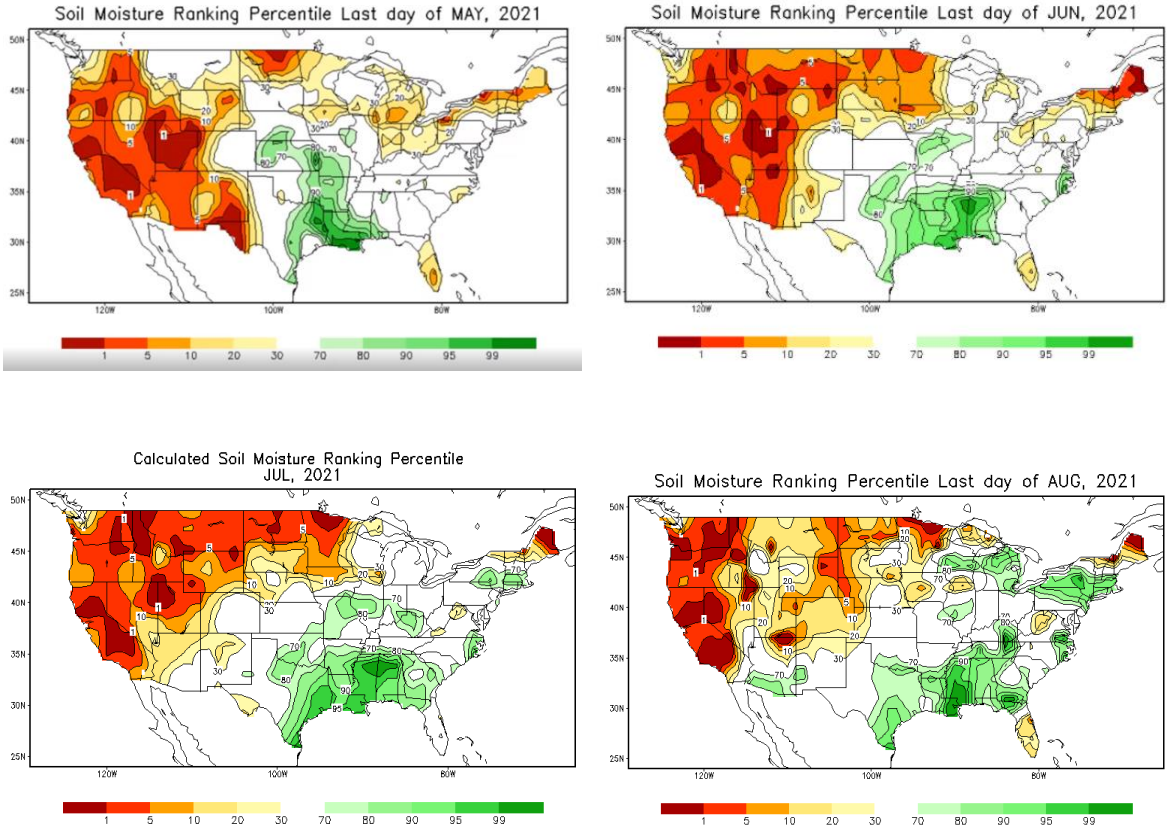


Fig 4. Soil Moisture Rankings comparing May, June & July 2021
(https://www.cpc.ncep.noaa.gov/products/Soilmst_Monitoring/US/Soilmst/Soilmst.shtml#)

Drought

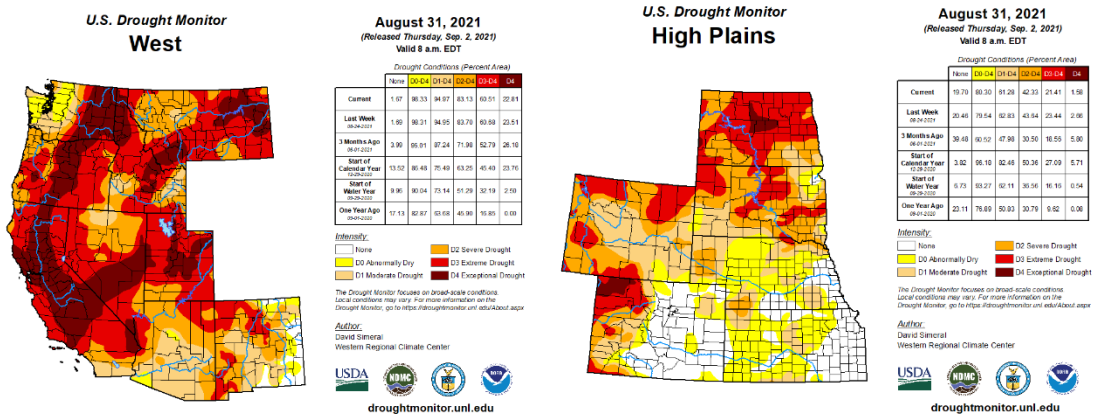


Fig 5. Current Drought conditions for the NRGA (https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?West) Precipitation in August did not reduce drought levels in the Northern Rockies substantially. Drought levels in Montana are mostly unchanged with 20% of the state remaining in the exceptional drought category. North Dakota has improved slightly with decreases in the highest categories. The percentage of the state in the exceptional category decreased from 15% in mid – July to 5% on August 31st. The Idaho panhandle has greater than 50% of its area in exceptional drought.

Fall 2020 was abnormally warm and dry in some areas of the NRGA which led to a busier than normal "shoulder" fire season. While cold temperatures returned over winter, conditions remained relatively dry, especially in eastern Montana and North Dakota where snowpack was light and previous year's fuels remain standing and dry.

Extreme, record-breaking heat leading up to mid-July and into August has resulted in rapid deteriorations in drought conditions across the Pacific Northwest, northern Great Basin, and Northern Rockies, with a small area of improvement in northwestern Montana, where 1 to 2 inches of rainfall resulted in modest improvements to soil moisture and short-term Standardized Precipitation Index (SPI) values.

Above-normal temperatures persisted across in the northwestern CONUS, resulting in continued degradations of drought conditions from the Pacific Northwest eastward to Montana and into North Dakota.

Standardized Precipitation Evaportranspiration Index

The Standardized Precipitation Evaportranspiration Index (SPEI) takes into account the main impact of increased temperatures on water demand. The SPEI uses monthly precipitation and average monthly temperature in its calculation and was developed to help overcome some limitations of the Standardized Precipitation Index (Vicente-Serrano et al., 2010).

The SPEI were calculated on July 16, 2021 for 1-month datasets for May and June and August 3, 2021 for July (https://wrcc.dri.edu/wwdt/archive.php?folder=spei1) using data from 1895 to the present. The index suggests that a combination of temperature, lack of precipitation and evaporative stress pushed the index well above 1.0 for most of the NRGA by the end of June 2021, with some reprieve for northwestern North Dakota. Short duration monsoonal storms in late July did show overall

improvement from June. In July the index in northern Idaho and southwestern Montana ranged from 2.0 to 1.0, however east of the Continental Divide received little wetting rain and shows deterioration in eastern North Dakota. Precipitation and cooler temperatures improved the monthly SPEI average for August drastically in comparison to the July.

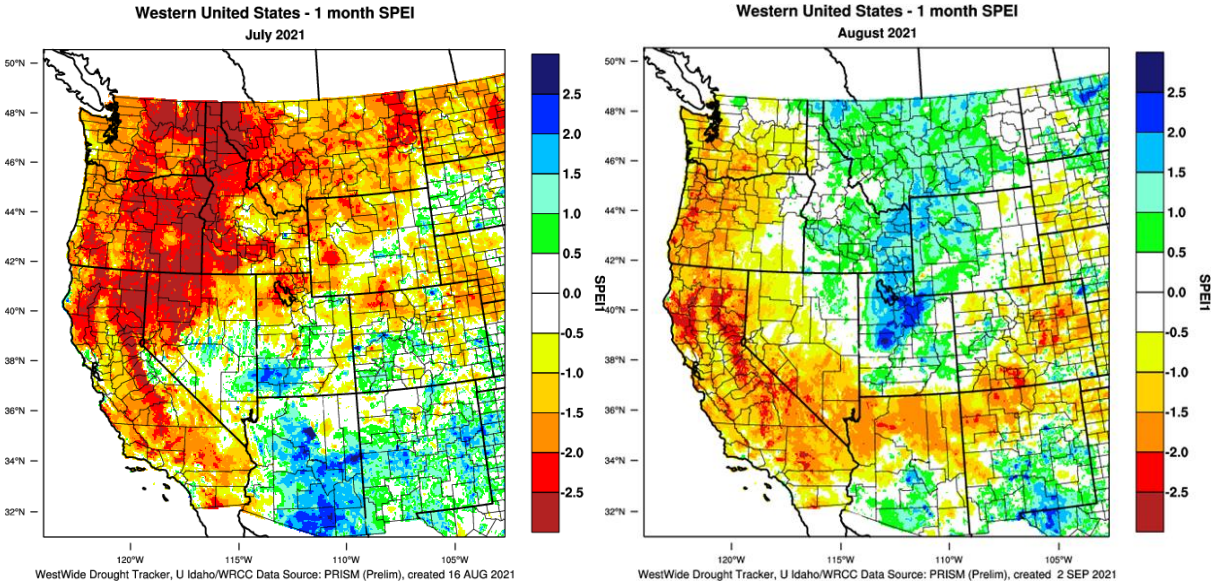


Fig. 6 - Standardized Precipitation Evapotranspiration Index Graphs for July and August

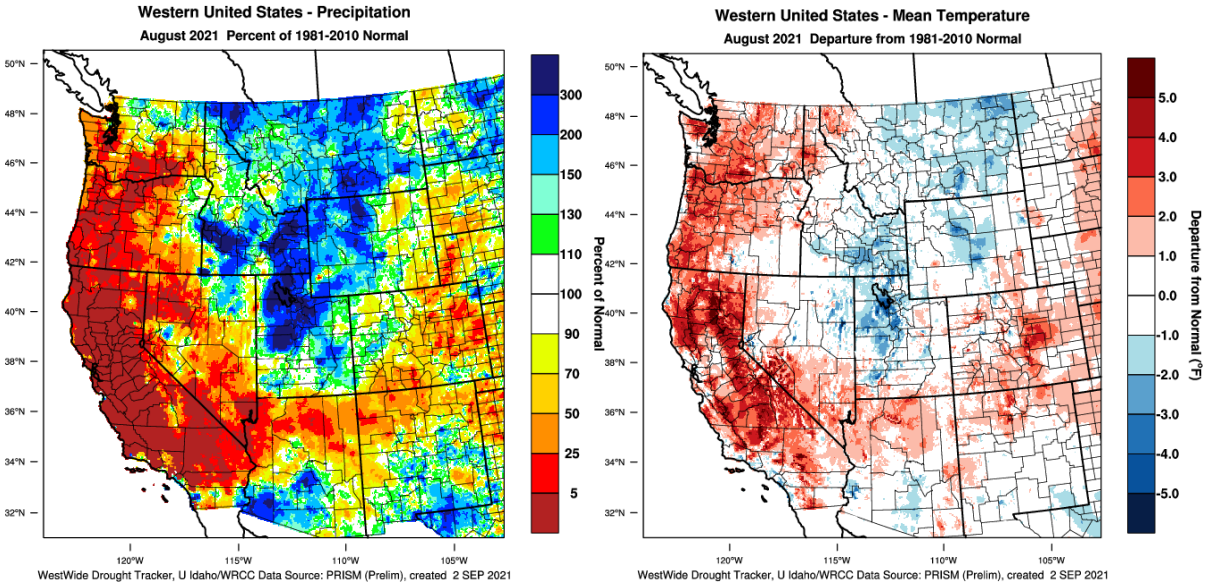


Fig. 7 – Precipitation and temperature anomaly maps for the previous month (August). Illustrate the departure from normal for the NRGA. Areas in blue received 1.5 to 3 times the average rainfall in August.

Energy Release Component Graphs (ERC)

ERC graphs suggest that most of the NRGA has average fire danger for this time of year. A series of precipitation events in the third week of August reduced ERC levels to well below average. Since then, ERC values for fuel model Y have risen to near average in most of the PSAs. Currently, areas west of the continental divide have slightly higher percentiles than mountain areas to the east.

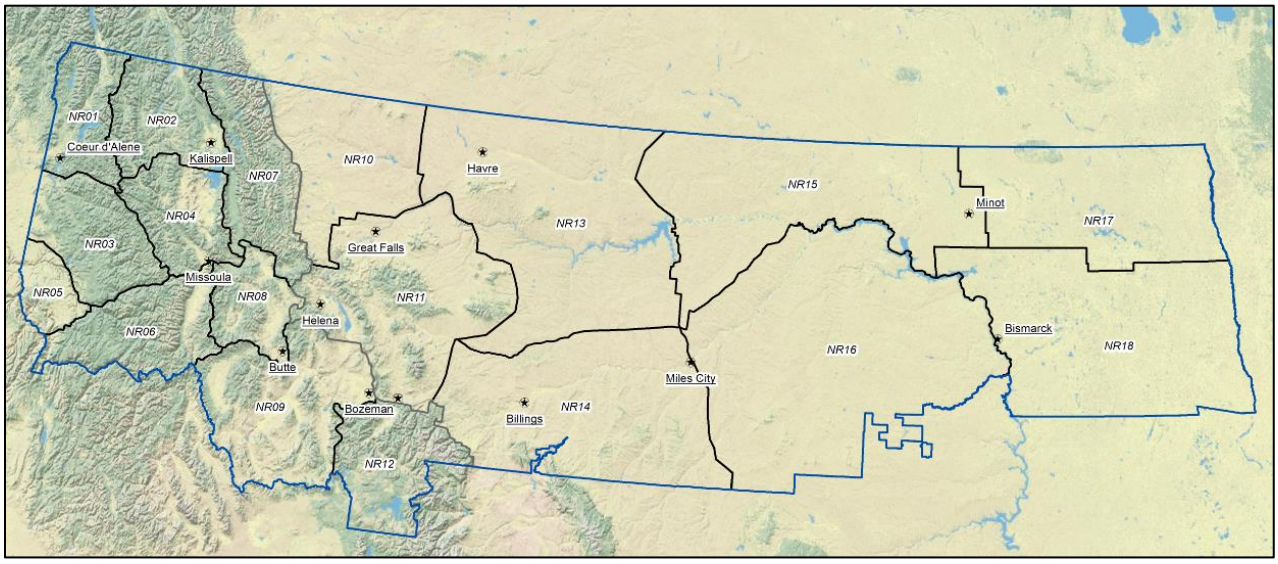
On the east side of the GA. ERC values in PSAs using fuel model V have returned to much higher levels since the August dip. For example, NR15 and NR16 are at the 90th percentile. A reminder that there is a distinct disparity of fuels between the eastern and western part of the region. Fuel model V is more sensitive to drying and wetting due to its composition of 1-hour and herbaceous fuels. As herbaceous fuels cure this model will respond more rapidly.

The energy release component (ERC) is a number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. Variations in ERC are due to changes in moisture content of the various fuels present, both live and dead, solar radiation and precipitation. The ERC for fuel model Y (NFDRS 2016) can be like fuel model G (NFDRS) which has been used to predict large fire activity. The ERC-G has been shown to be strongly correlated with areas burned in the western United States (Riley et al. 2013).

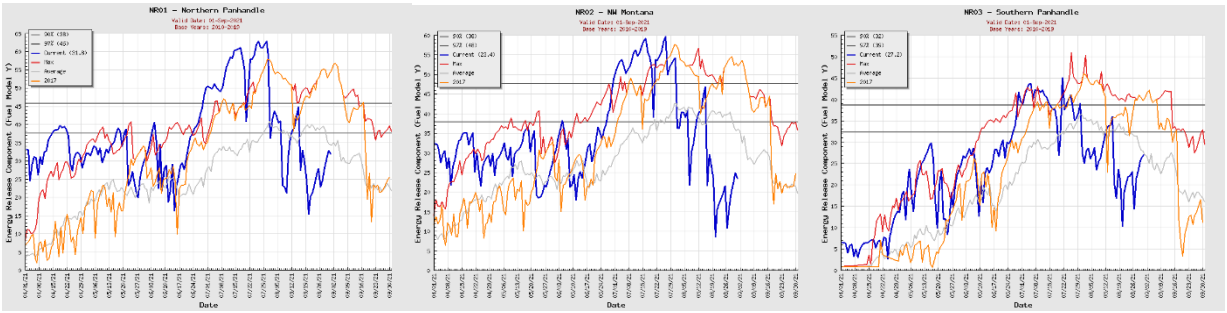
ERC charts were computed for a selection of PSA locations in the Northern Rockies GA and are available on the Risk Management Assistance Dashboard Fire Danger tab:

https://www.arcgis.com/apps/MapSeries/index.html?appid=c5bc811ee22e4da0bde8abec7c20b8b4

Readers are encouraged to review this Dashboard to find the most up to date Fire Danger information. These charts provide a snapshot of the recent historical record (2010 through 2019). Mountainous areas of the Northern Rockies GA use fuel model Y and eastern areas of Montana and North Dakota use the fuel model V (grass) to display fire danger.



Predictive Service Areas (PSAs) in the NRGA



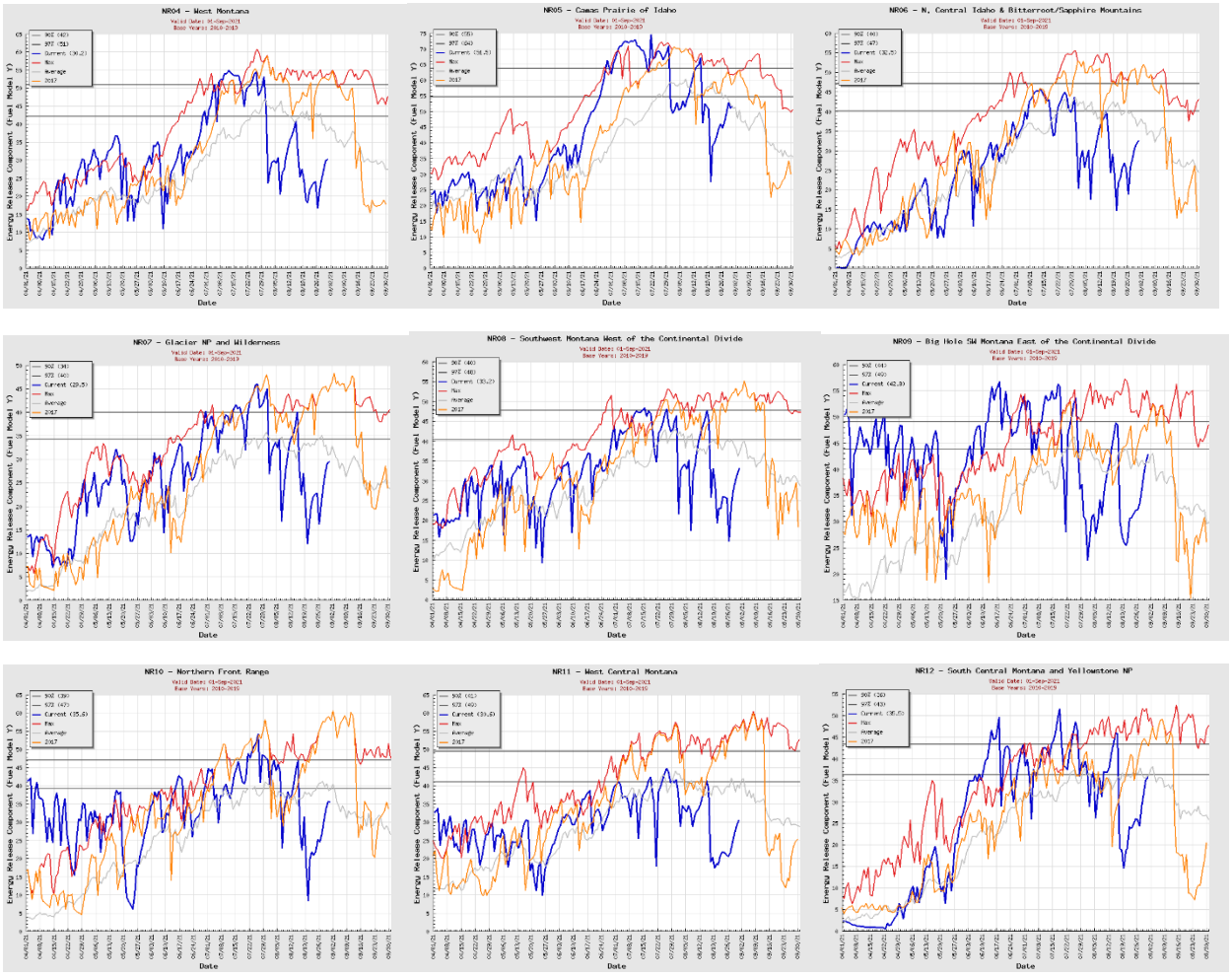


Fig 8. August 30st ERC-Y graphs for PSAs Regions NR01 through NR12.

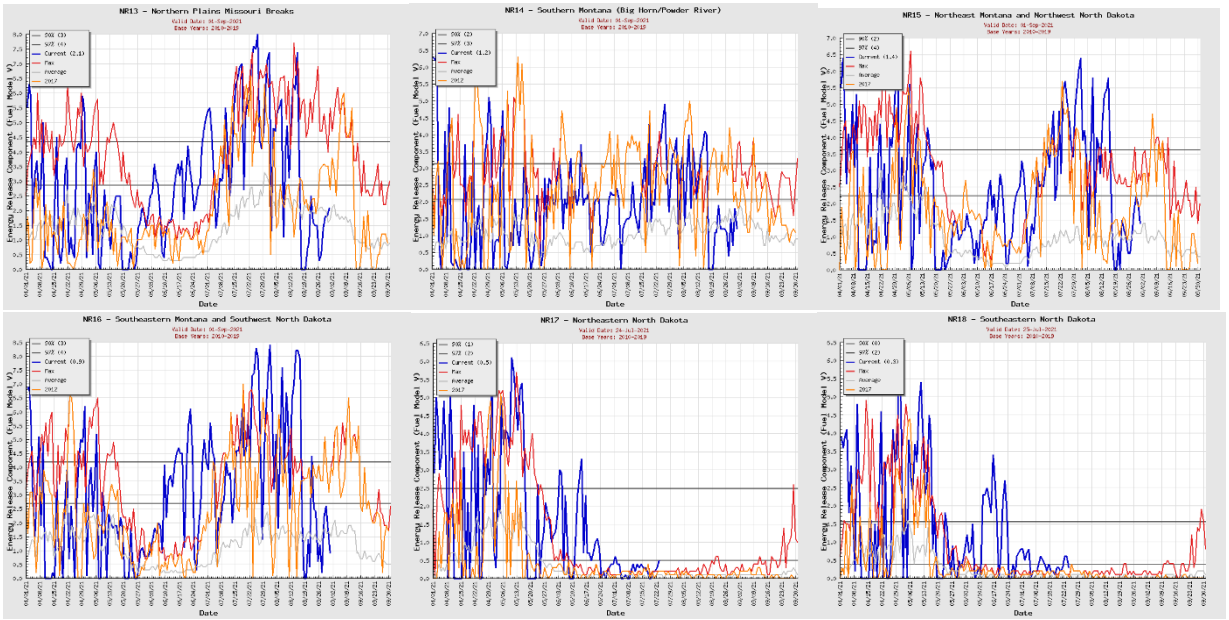


Fig 9. August 30st ERC-V graphs for six PSA Regions NR13 through NR18.

Fuels and Fire Behavior

Heavy fuel moistures are above average for the late August early September time frame in the NR.

- 1000-hour fuel moistures are slowly drying but remain above average across the Northern Rockies region with minimum values in the driest areas at 11% or greater
- 100-hour fuel moistures have fallen to average or just below average from recent highs reached in the third week in August.
- Live fuels are cured and have been contributing to fire spread.
- Lowest fuel moisture values are in south west MT, the lower panhandle of Idaho, and south-central Montana.
- Further drying of fuels is expected based on the weather forecast.

Green vegetation fraction (GVF) represents the fraction of a pixel containing healthy, photosynthetically active vegetation. It is derived from the Normalized Difference Vegetation Index (NDVI) composites from Moderate Resolution Imagine Spectroradiometer (MODIS) data. The maps below show the one-year difference in GVF for the Northwest and North Central regions of the United States. These images indicate that much of central and western North Dakota, eastern and central Montana, and northwestern and southwestern Idaho have a GVF deficit from last year.

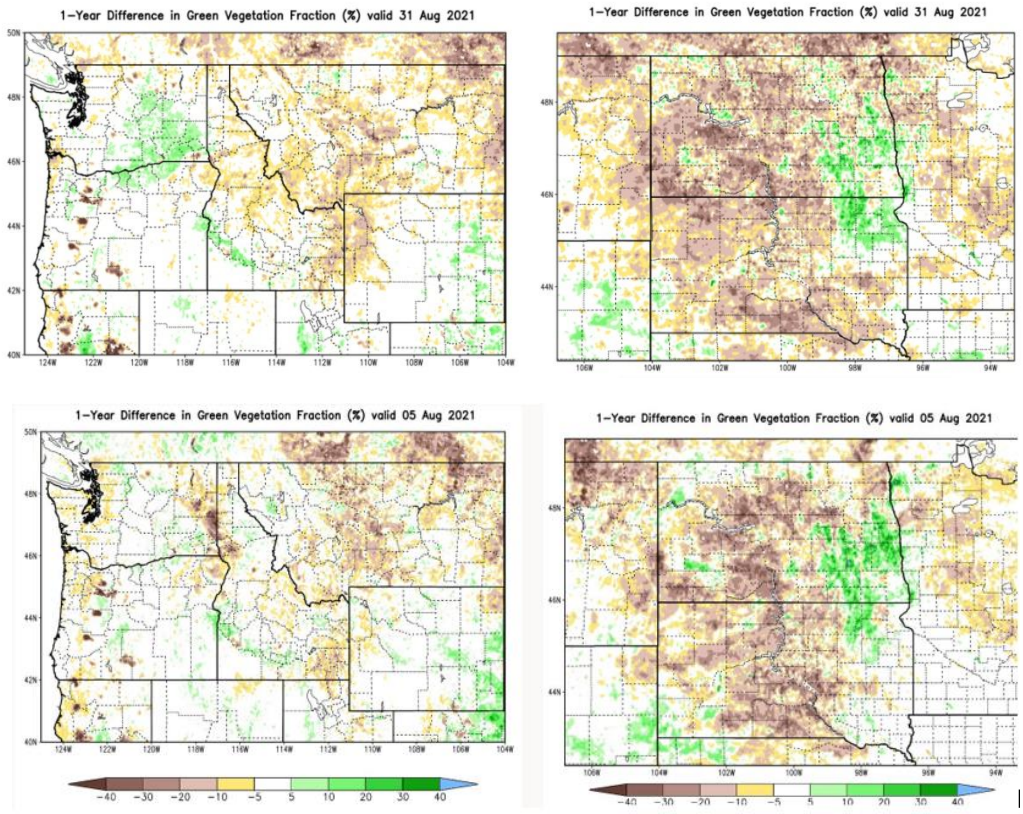


Fig. 11 GVF maps for ID, MT, and ND. Displays 1 year difference in GVF as a percent. August https://weather.msfc.nasa.gov/sport/modeling/modisGVF.html

The eastern portion of the region is dominated primarily by prairies and grasslands. These areas are very dry due to drought conditions and can experience fast moving, wind-driven fire spread. Moisture through frontal passages will dampen the fire behavior for short periods, but warm and windy weather will bring burning conditions back within a short timeframe. While fuels will likely remain available to fire spread into September, these finer fuels respond more quickly in the fall to increased humidity as the days cool and burning periods are shorter. Typically, the season-slowing and ending events appear earlier in the east and move westward as fall conditions arrive.

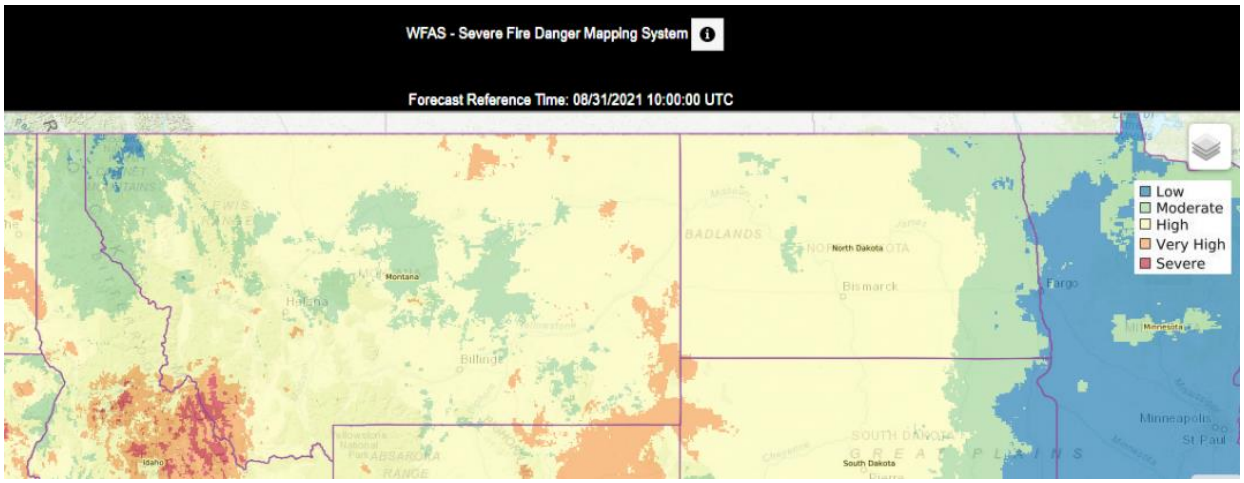


Fig. 12 – Wildfire Safe displaying the Severe Fire Danger Index for August 31st, 2021. The combination of ERC and BI can provide a gauge for daily Severe Fire Danger Index (SFDI). ERC is used to represent the underlying fuel dryness and BI can be used as a measure of the daily weather. The combination of daily weather and fuel conditions will produce the measure of significant fire potential where a significant fire is one that is very resistant to control, is type 3 complexity or higher and generally requires resources outside of the local response area. - Register for your account at https://wildfiresafe.technosylva.com/#register

Monitoring the Severe Fire Weather Potential, warnings for lighting and critical conditions will be important. Potential for large fire growth exists in any areas with high, very high or extreme indices. Priorities will need to be set based on values at risk and managing exposure of firefighters during the long term. Capitalizing on previous fire history for managing the fires will be critical in managing firefighter exposure and limited resources.

What are the probabilities of a frontal passage, red flag wind events, and the frequency?

Analyses were conducted for cold front passages (roughly defined as a 15-25 deg drop in temperature accompanied by significant moisture over 2 days) and conditions at which high wind speeds may occur that would influence fire behavior. One analysis identified the first cold front passages through history for Missoula, with mid-August as the peak probability (57% occurrence) for the first strong frontal passage, with lesser rates before and after.

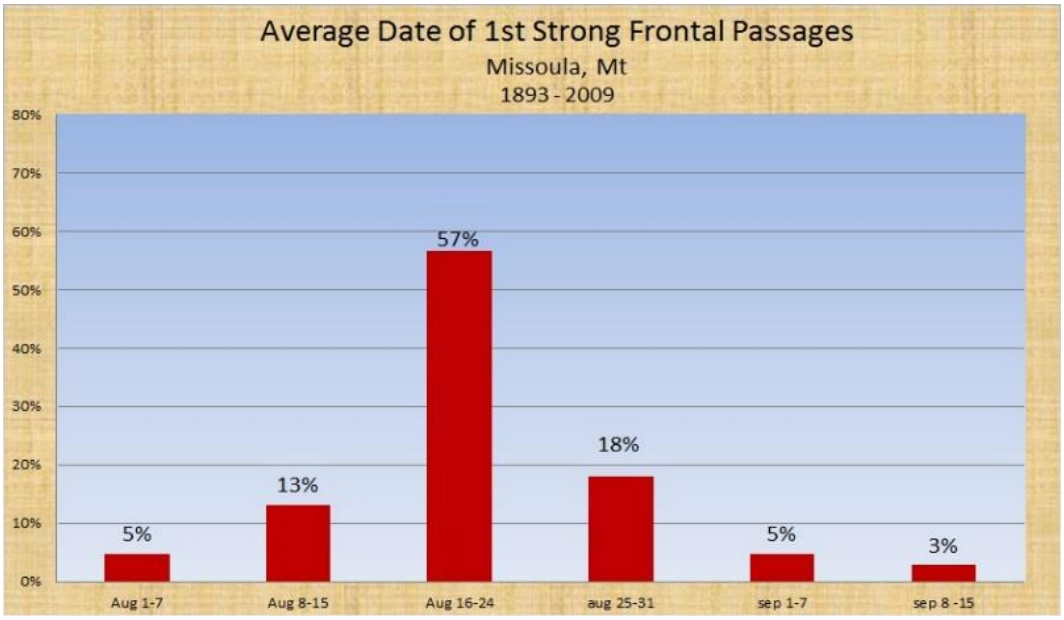


Fig. 13 – Graph of Average Date of 1st Strong Cold Front Passage

Wind Gusts and Fire Spread Potential

An analysis of representative RAWS weather stations offers insights on critical wind thresholds for fire spread.

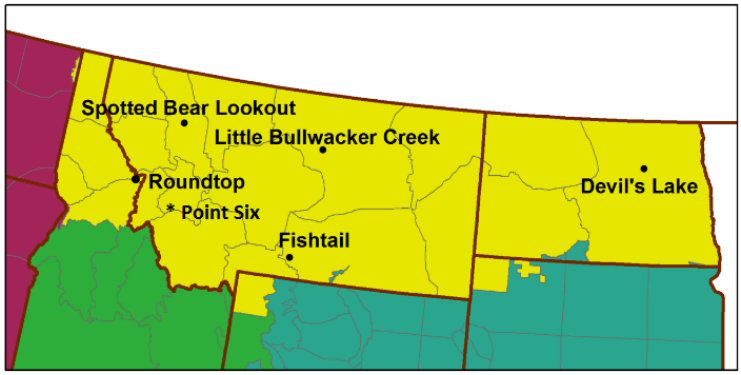


Fig. 14 –Image of RAWS stations utilized for the wind analysis

Criteria for choosing weather stations were as follows:

- Predictive Services Key RAWS were used
- Longer periods of record were preferred
- More complete records were preferred (for example, a station that operates year-round would be chosen over a station that operates only during fire season, all else equal)
- RAWS on ridge tops were preferred. Wind roses and/or station photos were examined; stations where wind direction and speed were not dominated by topography were preferred where available.

(See Appendix for additional notes and wind analyses methodology.)

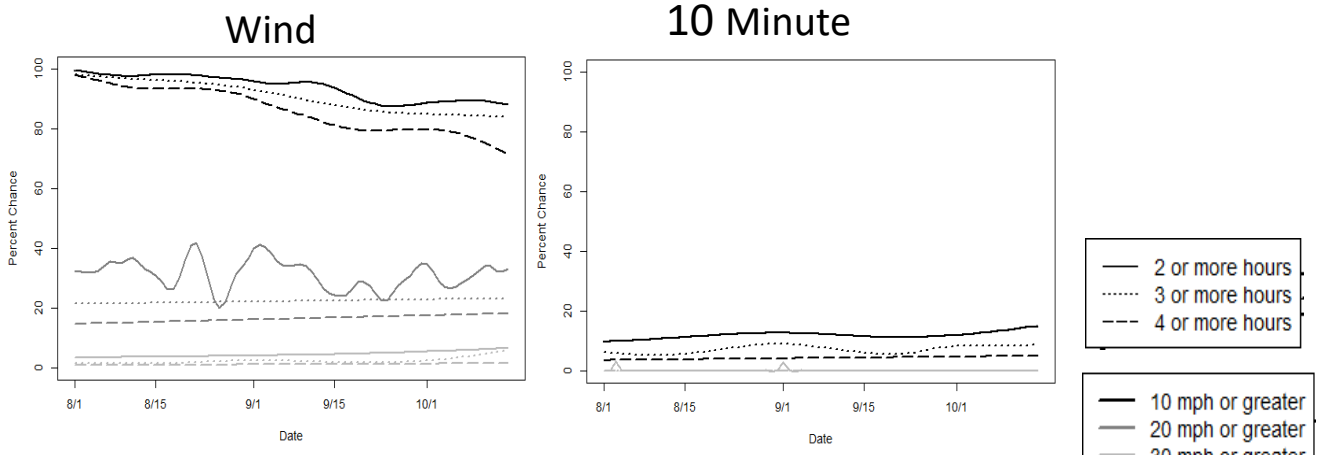
The Thompson Creek Fire of 2003 was examined for thresholds in wind gusts that caused extreme fire growth. The Thompson Creek Fire made a run on 8/19/2003, going from 7,530 acres to 17,410 acres (based on the GeoMAC perimeter data). It appears that the fire may have traveled as much as 10.7 miles on that day. The high temperature was 95 degrees Fahrenheit at the nearby Pardee weather station and winds gusted up to 39 mph at the Roundtop weather station. From this case study, a determination was made to use gusts of 30 mph or greater as a threshold for identifying days prone to extreme fire spread. Additionally, days with 20 and 10 mph winds were examined.

This analysis is unlikely to capture occurrence of thunderstorm downdraft winds as they may be localized some distance from the weather station. However, five of these sites display a signature of potential cold-front passage as higher and longer period winds may occur as the front approaches and passes the weather station.

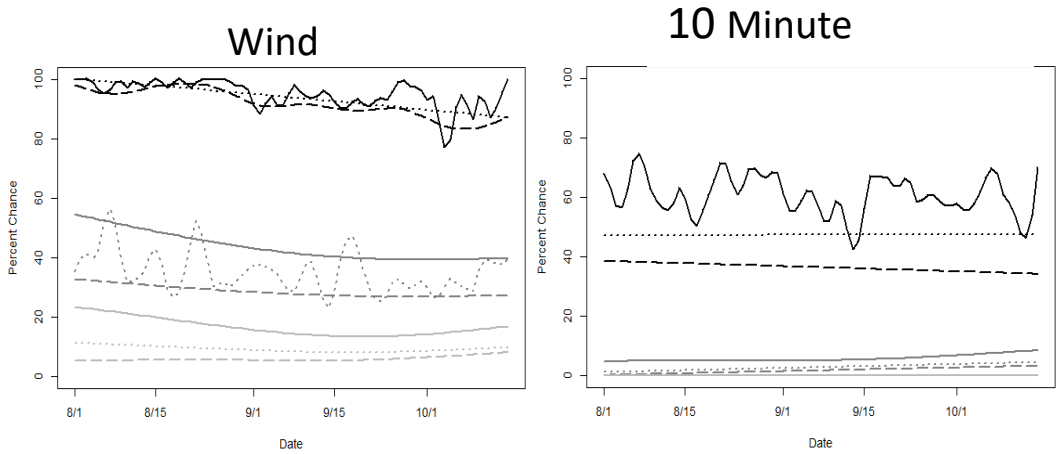
All sites except Roundtop Weather Station show a probability greater than 30% of 10 mph wind gusts into October. However, the 10 mph gusts may not be associated as clearly with active fire spread. Of the six sites, Fishtail, Spotted Bear and Point Six showed significant probability (40-60%) of 2–4-hour periods of 20+mph wind gusts, which may indicate a higher probability in such locations of active fire spread. As with other thresholds and watch-outs, these indicators should be adapted to local situations and watch-outs, these indicators should be adapted to local situations and observations, and adapted based on local knowledge and fire experience.

Eastern Montana / North Dakota

Little Bullwacker Hill



Fishtail Weather



Devil's Lake

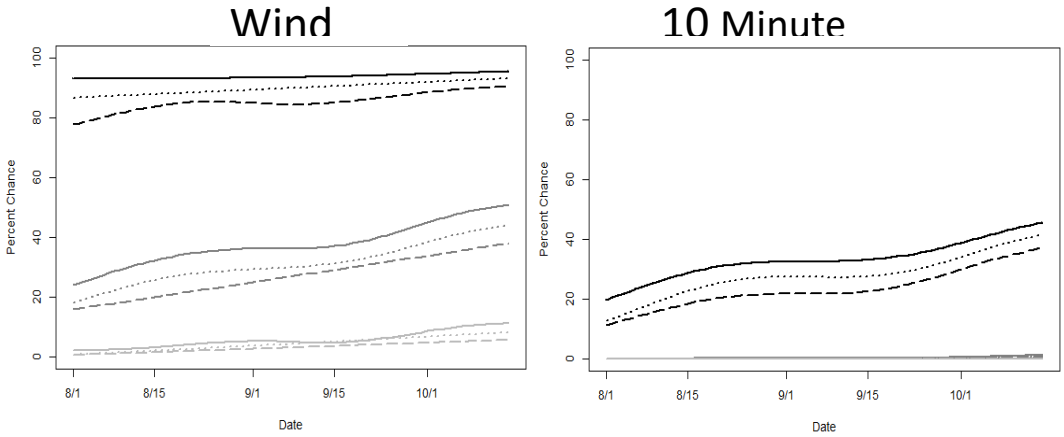
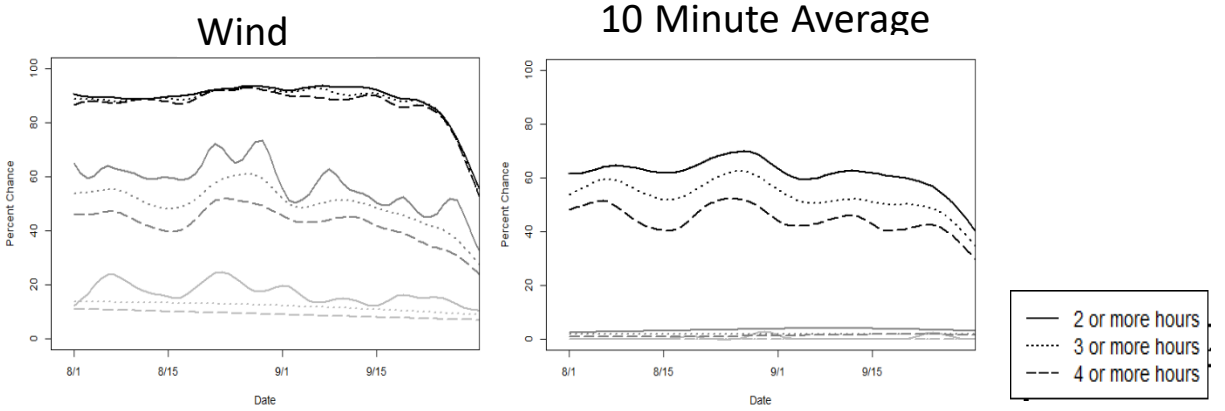


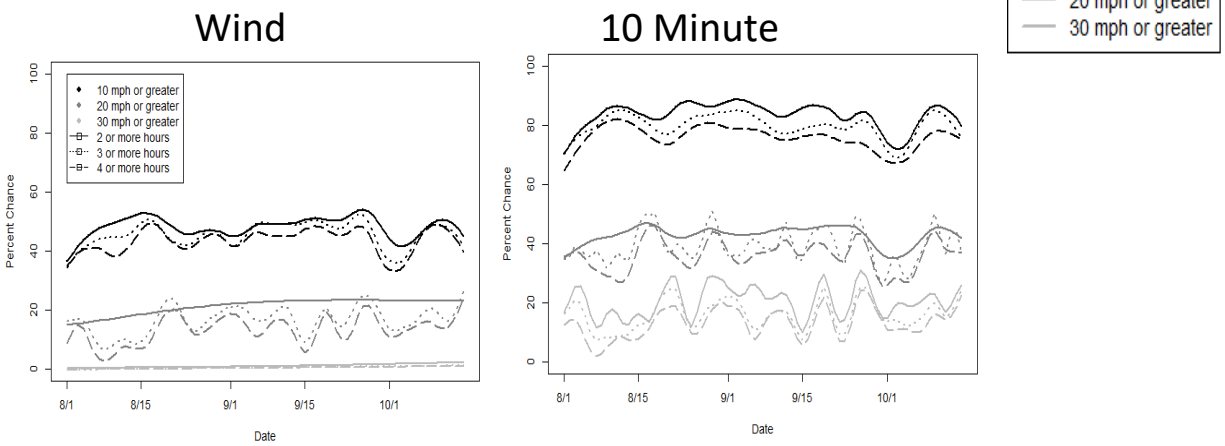
Fig. 15 - Eastern Montana/North Dakota - Wind Analysis of 2 Representative RAWS stations. Daily probability of 10-minute average winds and wind gusts at or greater than 10, 20, and 30 mph over a period of 2, 3, and 4 hours.

Western Montana / Northern

Spotted Bear



Point Six



Roundtop

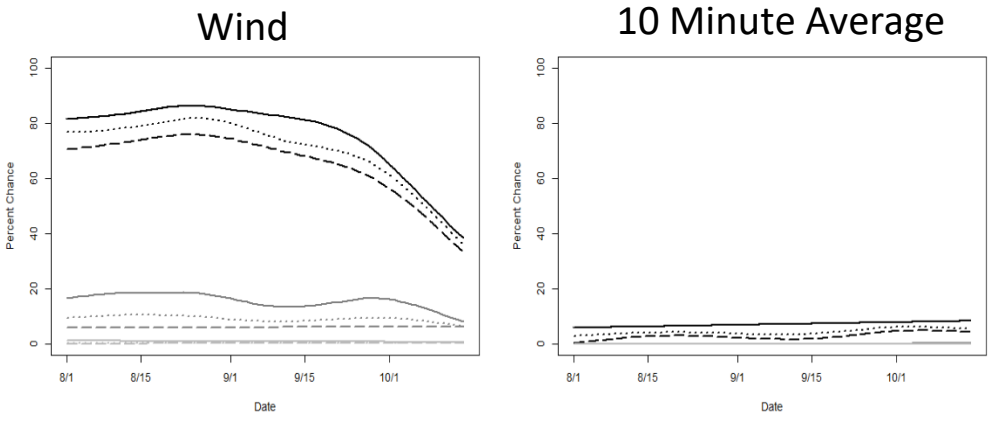


Fig. 16 - Western Montana/Northern Idaho - Wind Analysis of 2 Representative RAWS stations. Daily probability of 10-minute average winds and wind gusts at or greater than 10, 20, and 30 mph over a period of 2, 3, and 4 hours.

Possible Future Situations and Implications

What is the probability of an above average fire season and what are the anticipated impacts?

The weather outlook and current conditions indicate that the season will extend, and the Northern Rockies Geographic Area will continue to experience large fire growth, potentially setting new records for acres burned. Impacts to communities, road corridors, and firefighting resources can be expected based on fire activity and smoky conditions.

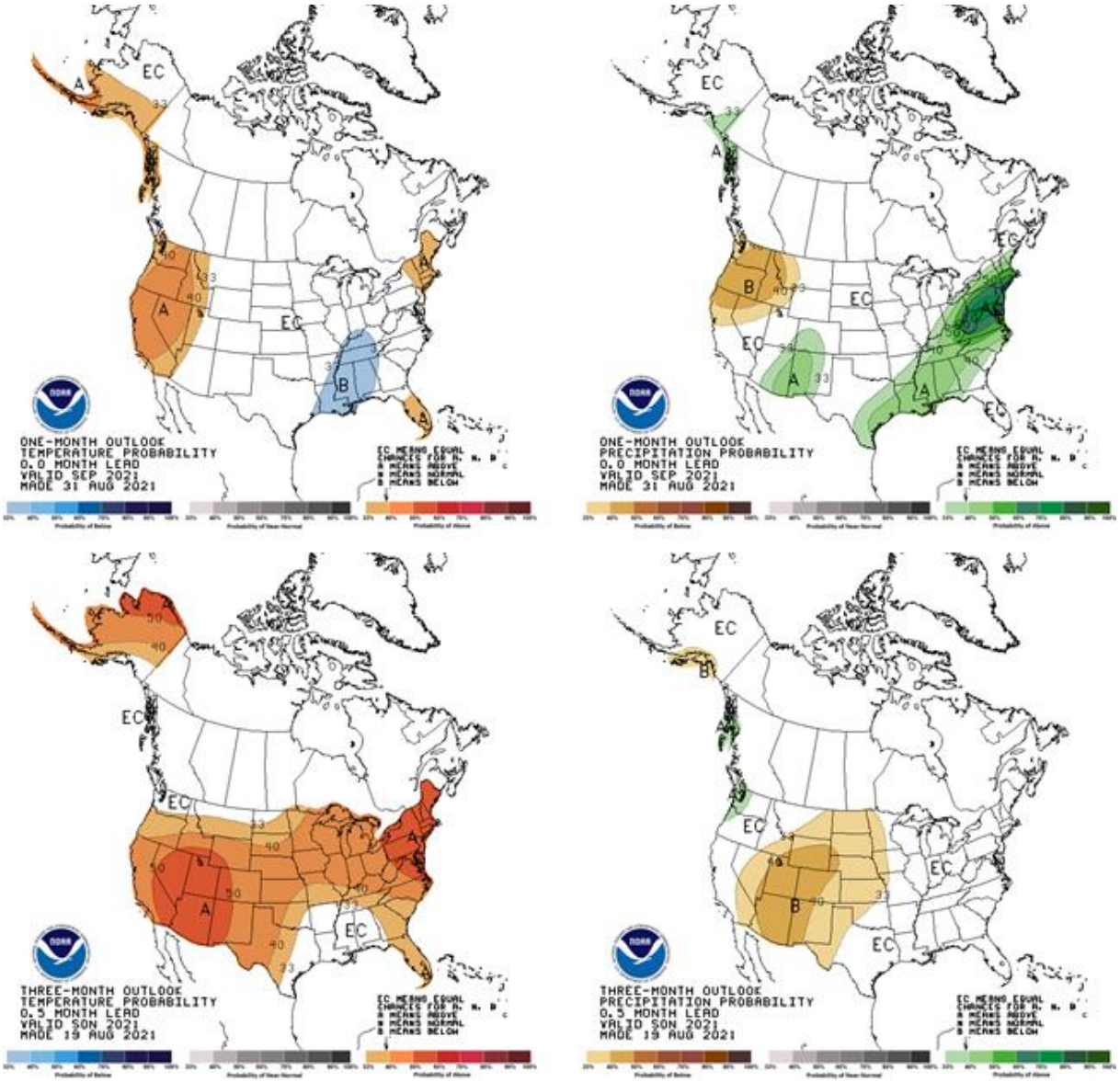


Fig 17. Climate Prediction Center (CPC) projections of higher average temperatures and below average precipitation valid for September-October-November 2021. Projections were made on August 19, 2021 (for the 3-month) and August 31st (for the one month) and should be re-evaluated using the links above for the most up to date information.
(https://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/page2.gif
https://www.cpc.ncep.noaa.gov/products/predictions/long_range/lead01/off01_prcp.gif)

Extended Drought

Drought is forecasted to persist throughout all of the NRGA through the end of November.

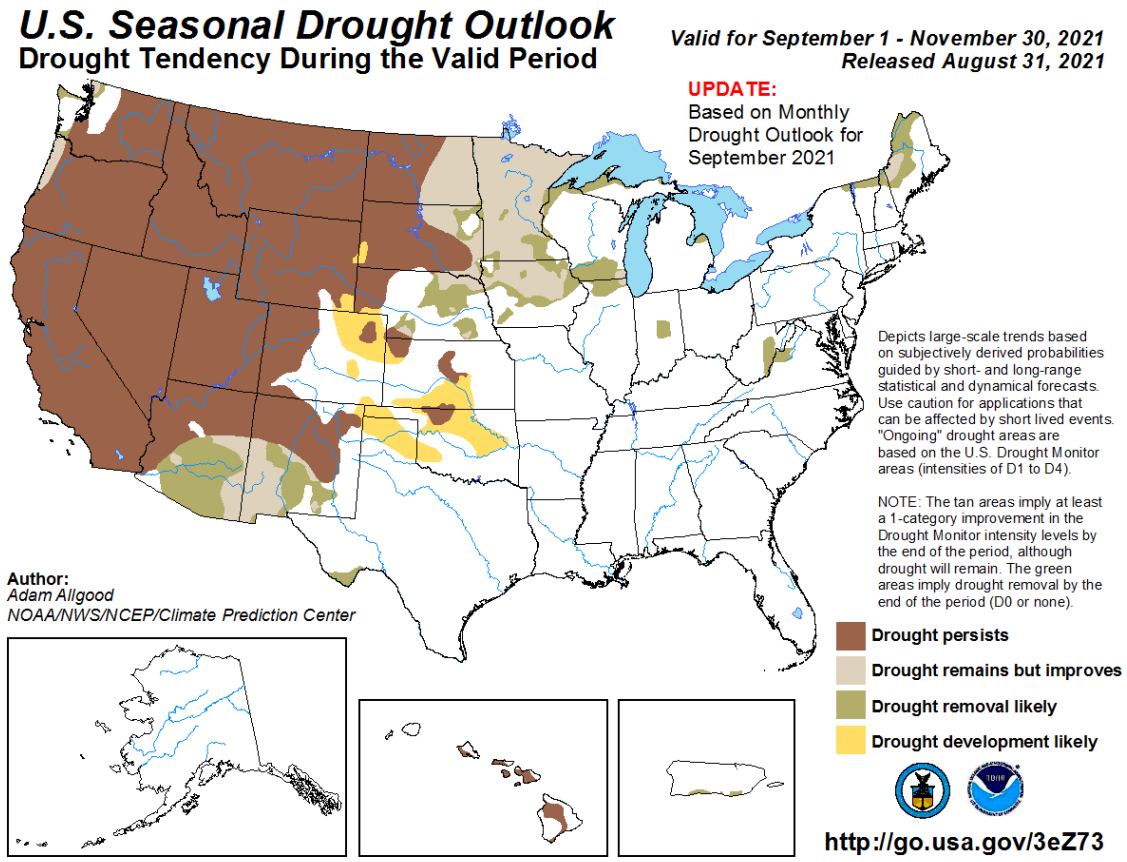


Fig. 18. Seasonal drought outlook for September through November 2021
https://droughtmonitor.unl.edu/ConditionsOutlooks/Outlooks.aspx

Longer Term

Longer term models indicate dry conditions into September and through Fall. Most long-term guidance (models and CPC) are trending towards above average temperatures and below average precipitation through September and possibly into October. This would indicate the possibility of an extended fire season before any season ending precipitation and cold air event occurs. Drought is forecasted to persist through the end of October for most of the NRGA. Thus 100 and 1000-hour fuels will continue to remain at elevated to critical levels and be receptive to ignition and fire spread through August and into Fall. While critical fire weather conditions may subside (lower temperatures due to shortening of daylight and eventual transition back to an active polar jet stream across the CONUS), containment and control of large fires may be delayed due to projected above-average temperatures and the possibility of delayed season-ending precipitation event and the continued drought.

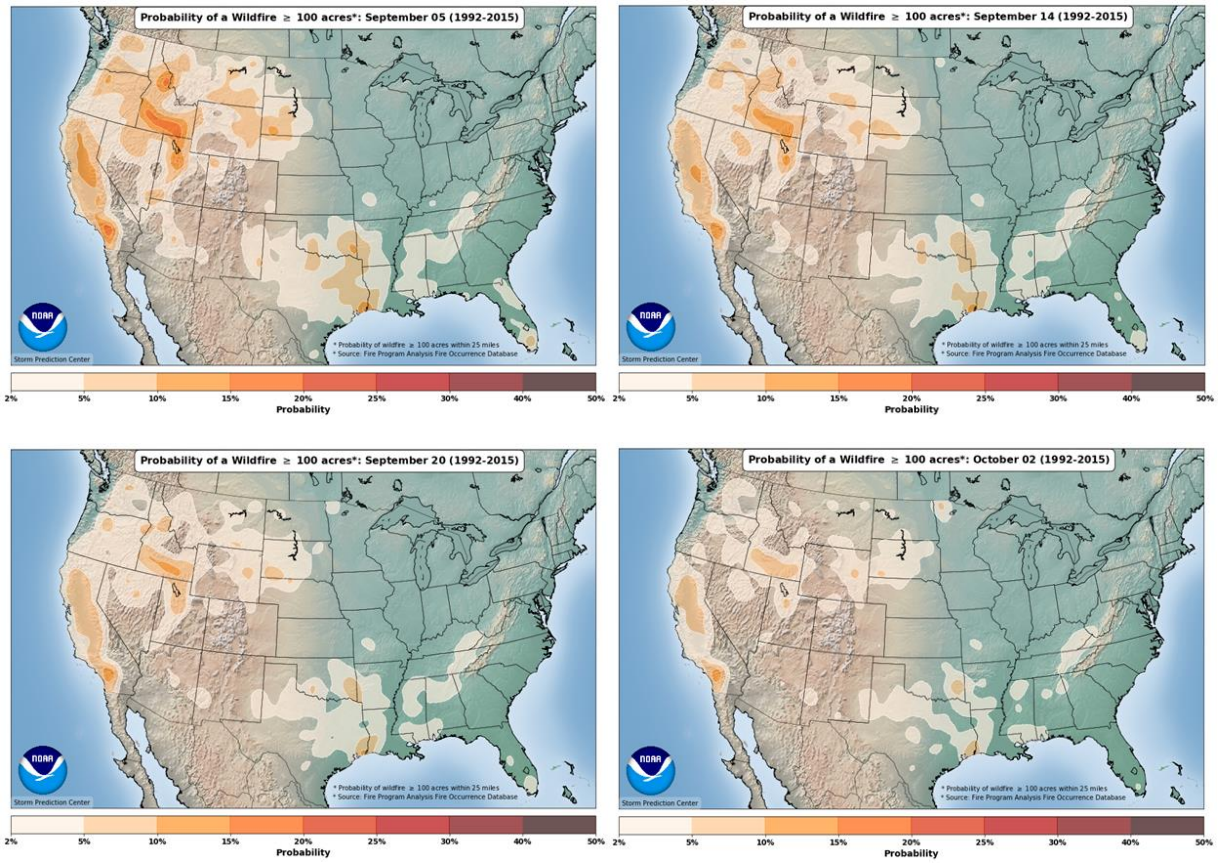


Fig. 19. Probability of Wildfires September-October greater than 100 acres based on historical fire starts from 1992 to 2013 (http://www.spc/noaa.gov/new/FWclimo.php?parm=100ac)

Probability of Wildfires Greater than 100 acres

Historical ignition locations can offer guidance on where future fires may occur. Fig. 19 shows four different time periods where wildfires were most likely to start, with lower probabilities occurring by mid-September.

Highlights

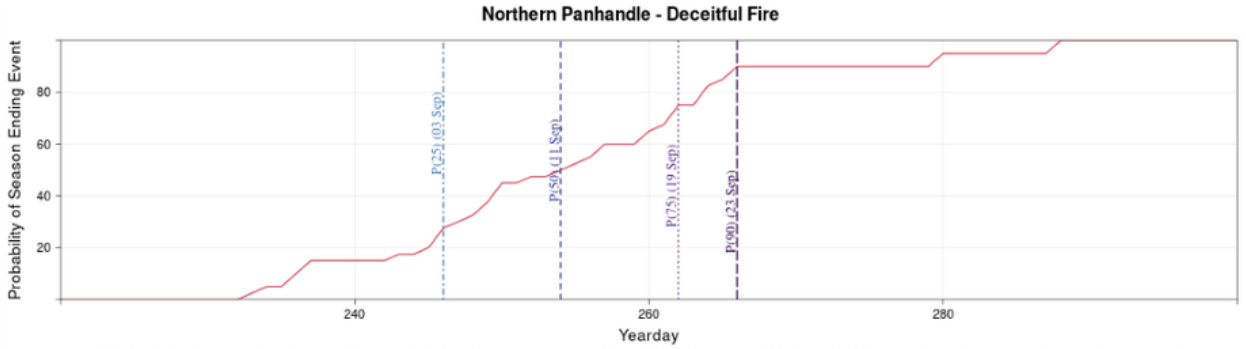
- Mid-September may be a period of gradual decline in the fire-weather risk of thunderstorms followed by dry cold fronts.
- No "season ending" precipitation event is expected in September. Guidance indicates persistence of current conditions to worsening fire weather conditions through mid-September. It is important to mention that there are great uncertainties with middle to long range modeling.
- Longer term model and CPC guidance indicate above average temperatures could continue into the Fall thus extending the fire season and active burning on large wildfires through September.

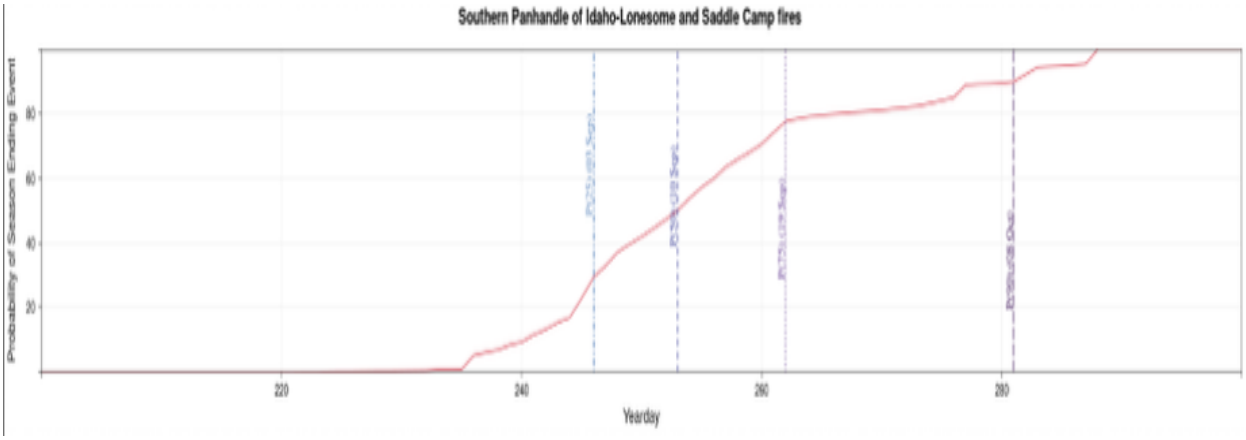
Disclaimer: Confidence in the forecast details decrease going forward through the forecast periods.

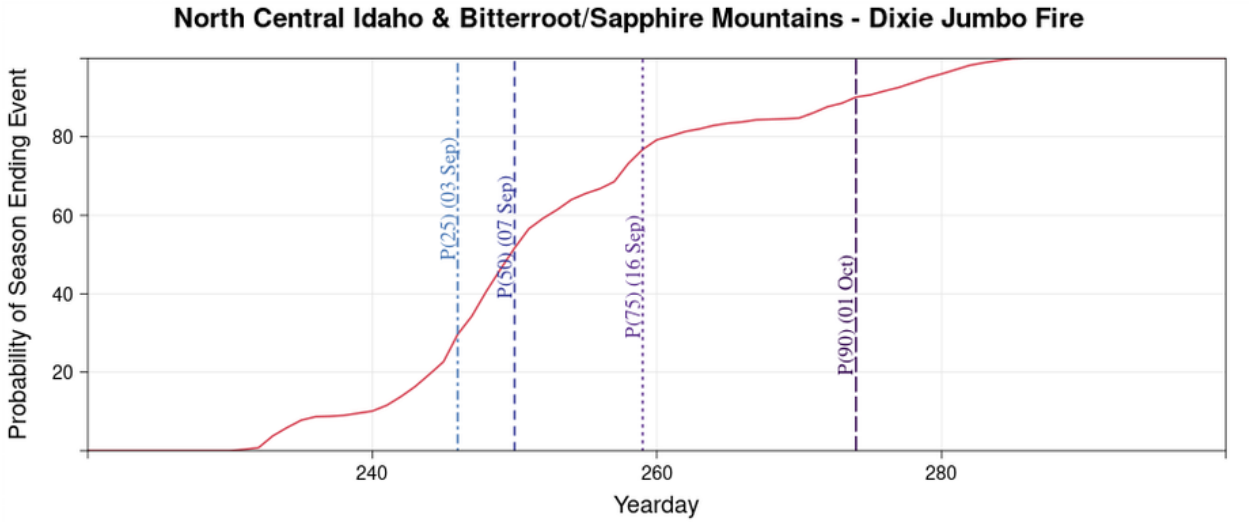
Analysis of Season Ending Events

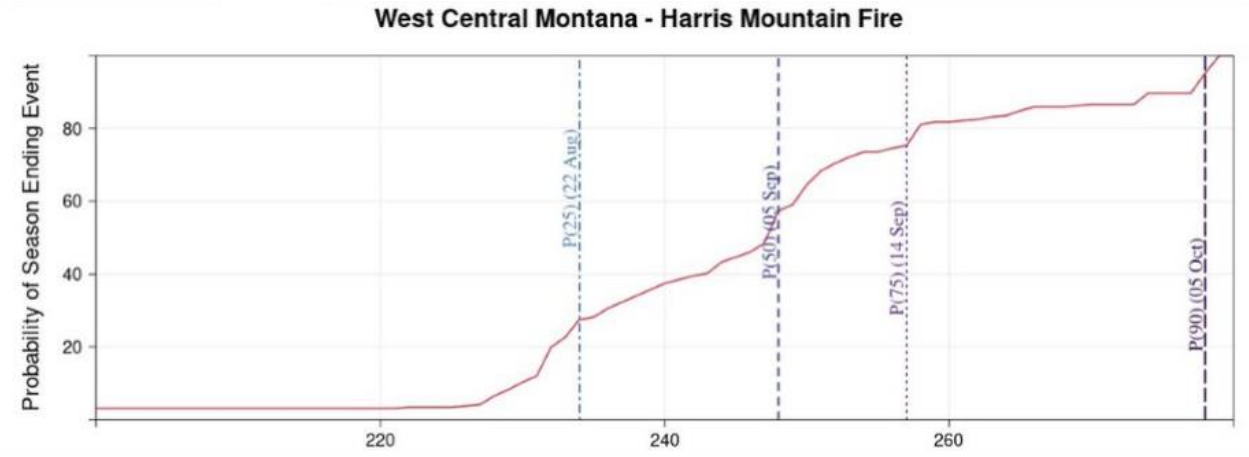
Assessing the history of season ending events provides an understanding of the fire season length based when fires no longer spread more than one burning period. A small sample of fires located in different geographic regions in the NRGA, suggest that the middle of September is a likely time when a season ending event could occur to mitigate significant fire activity. The season-ending tool is under

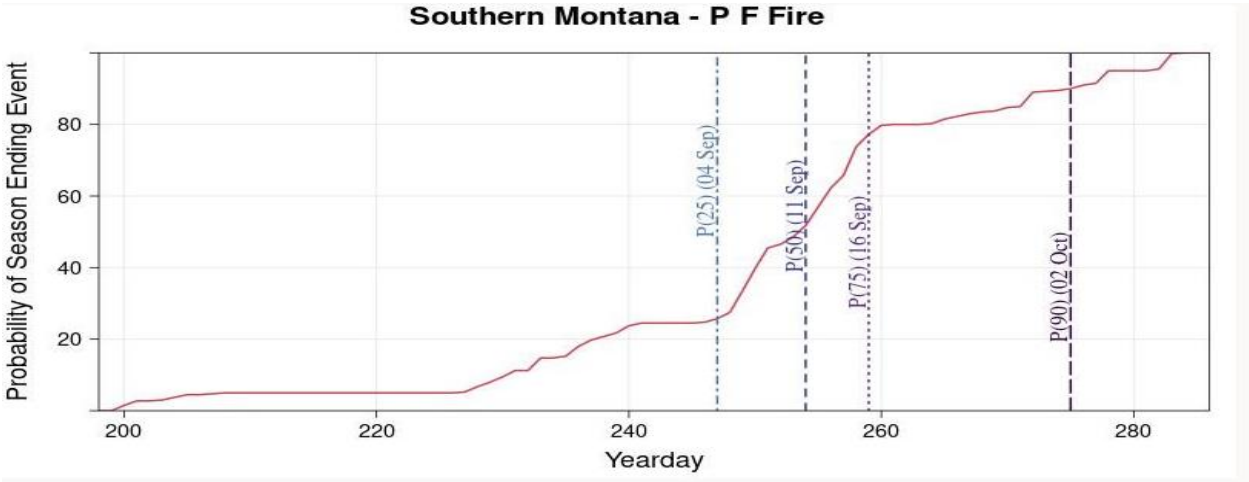
development by Dr. Matthew Jolly of the Fire Sciences Laboratory, Rocky Mountain Research Station and shared on the Risk Management Assistance Dashboard (https://www.arcgis.com/apps/MapSeries/index.html?appid=c5bc811ee22e4da0bde8abec7c20b8b4). The analysis is based on 21 years of gridded weather data (2000-2020), and instead of the nearest Remote Automated Weather Station (RAWS) or a group of RAWS (a Special Interest Group [SIG]), it uses a recent fire perimeter. An annual time series of the energy release component is calculated for each pixel in the fire area and scaled from 0 – 100. If the ERC drops below 75, defined as 25% of the historical maximum, and remains below that threshold for the remainder of the year, the season end date is set. This procedure occurs for all years (2010- 2020).






North Central Idaho & Bitterroot/Sapphire Mountains - Dixie Jumbo Fire
Probability of Season Ending Event
20
40
60
80
240
260
280
Yearday
P(25) (03 Sep)
P(50) (07 Sep)
P(75) (16 Sep)
P(90) (01 Oct)


West Central Montana - Harris Mountain Fire
Probability of Season Ending Event
20
40
60
80
220
240
260
P(25) (22 Aug)
P(50) (05 Sep)
P(75) (14 Sep)
P(90) (05 Oct)


Southern Montana - P F Fire
Probability of Season Ending Event
20
40
60
80
200
220
240
260
280
Yearday
P(25) (04 Sep)
P(50) (11 Sep)
P(75) (16 Sep)
P(90) (02 Oct)

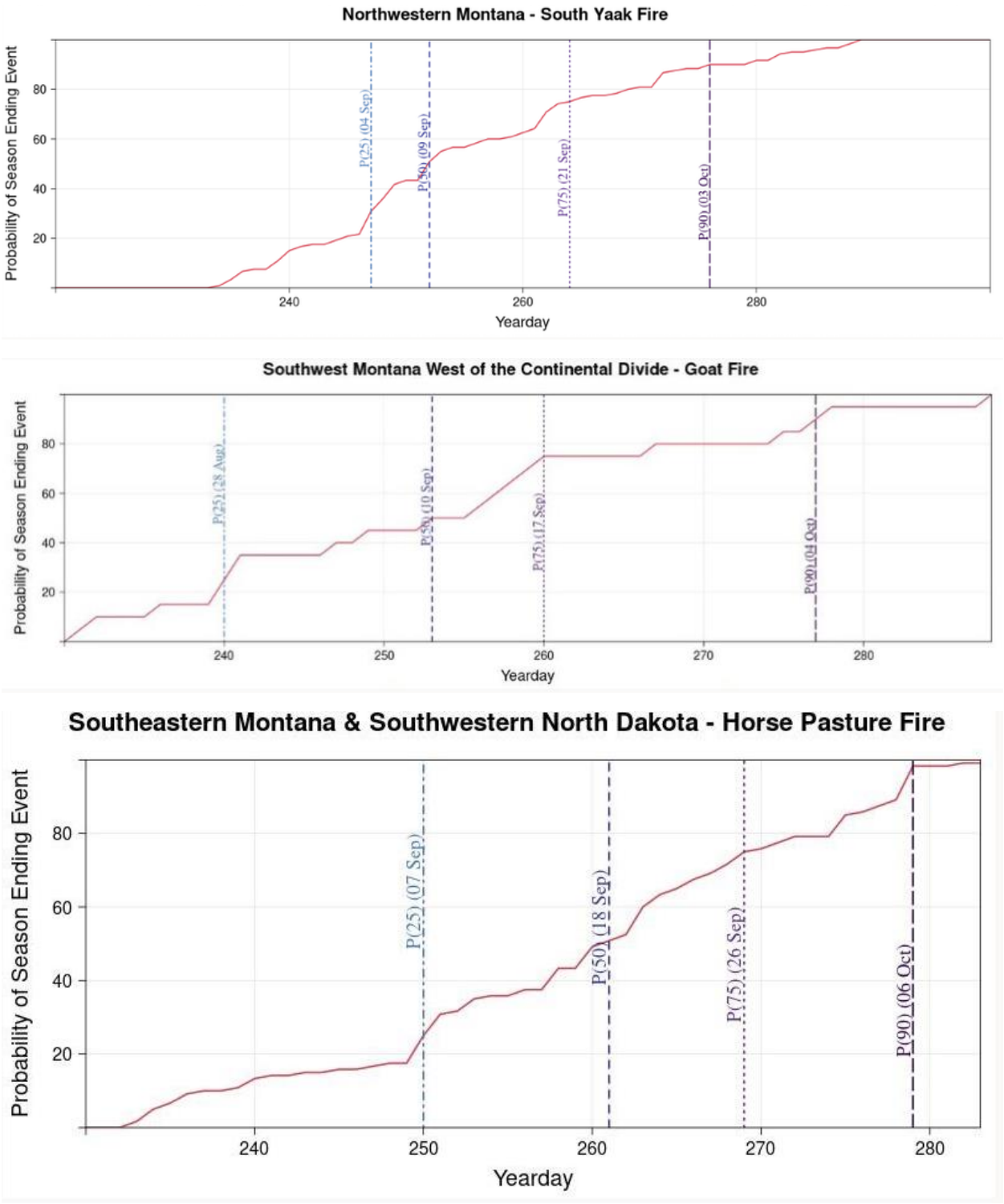


Fig. 20. Season-ending event graphs for a select number of NRGA wildfires as of August 7, 2021.
A Season Slowing Event (SSE, defined as more than 0.5 inches of precipitation that occurred over a 5-day period after August 11th) indicates that areas in the NRGA could expect a SSE by late September/early October.

Hadlow (2009) examined the 90th percentile date for occurrence of a season slowing event (SSE) by extracting and analyzing data for 76 RAWS weather stations in Montana and Idaho (excluding North

Dakota). SSE dates ranged from September 3 to November 28, with an average date of October 2 (Fig 19). Stations with significant autocorrelation for similar SSE dates were located in Montana near Anaconda, and along the Front and in central. This analysis also indicates that "Season slowing events are occurring 15 days later, on average, than they did in 1982, while summer rainfall is decreasing at 97% of stations, with clusters of significant change focused on the central Idaho mountains and in west-central Montana."

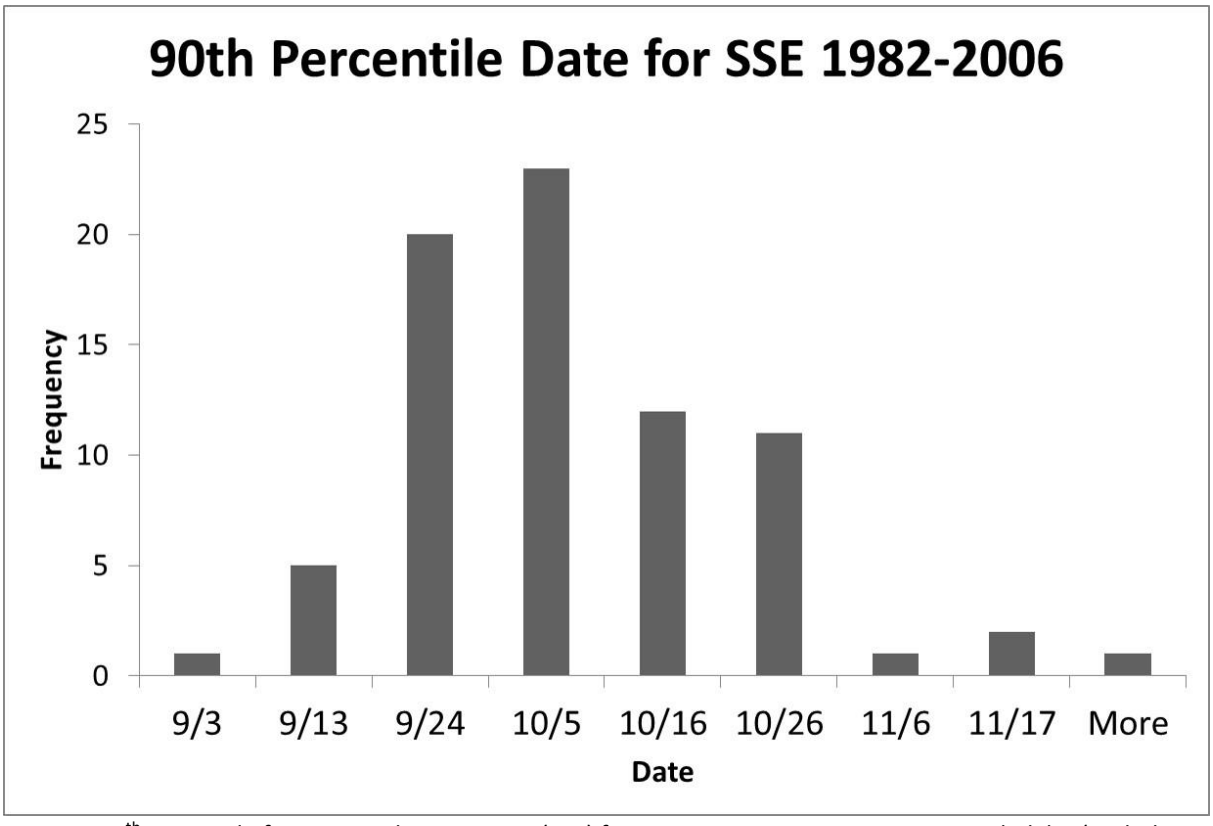


Fig. 21 – 90th percentile for Season Slowing Event (SSE) for 76 RAWS stations in Montana and Idaho (excluding North Dakota)

Hadlow, Ann Marie, "CHANGES IN FIRE SEASON PRECIPITATION IN IDAHO AND MONTANA FROM 1982-2006 " (2009). University of Montana. *Theses, Dissertations, Professional Papers.* Paper 1282. http://scholarworks.umt.edu/etd/1282/

Summary and Findings

- Fire season will likely extend into September for most of the NRGA. The one exception could be eastern North Dakota.
- Historical data suggest mid-September has higher likelihood of experiencing season slowing events.
- Much of the West Coast and the northern Intermountain West will retain above normal significant fire potential into September with portions of the Northern Rockies returning to normal by late September.
- There has been consistency with the model forecasts for the El Niño-Southern Oscillation (ENSO) outlook in bringing about a secondary weak La Niña period this fall. Thus, the expectation is for

fire potential returning to normal for some PSAs east of the Divide in September while remaining above normal elsewhere.

- More updated analysis and forecasts should be used to provide a better synthesis of September and October as they become available. Links to data sources were provided to users to find the most up to date information.

This assessment included portions of the 2017 long term assessment including support and analysis from Bill Bunting, NOAA; Ariel Cohen (NOAA); Lisa Elenz (Ret. USFS); Matt Jolly (USFS); Chuch McHugh (USFS); Nick Nauslar (NOAA); Bob Nester (NWS); Erin Noonan-Wright (USFS); Karin Riley (USFS); Karen Short (USFS), Michael Richmand (Ret. USFS), and Ron Steffens (Ret. NPS). This assessment was updated to reflect 2021 conditions and was authored by Erin Noonan-Wright (USFS), Brianna Schueller (USFS), Jim Riddering (USFS), Todd Rankin (NPS), David Quisenberry (USFS) Chad Pickering (USFS), Coleen Haskell (USFS), Francesca Chavez (USFS), and Rick Mowery (USFS).

References

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Vicente-Serrano, S. M., S. Beguería, and J. I. López-Moreno, 2010: A multiscalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index. *J. Climate*, **23**, 1696-1718.

Riley, K.L., Abatzoglou, J.T., Grenfell, I.C., Klene, A.E. and F.A. Heinsch. The relationship of large fire occurrence with drought and fire danger indices in the western USA, 1984-2008: the role of temporal scale. *Intl J of Wildland Fire* 22: 894-909. http://dx.doi.org/10.1071/WF12149.

Appendices

Wind Analysis

Appendix - Table 1. Weather stations selected for wind gust analysis and Predictive Services Area (PSA) in which they were located.

PSA code	PSA name	Wind station	Station duration
NR04	Western Montana	Point Six	Data to be updated
NR05	North Central Idaho and Bitterroot Mountain	Roundtop	1993-2017 (fire season only)
NR06	Glacier National Park and Wilderness	Spotted Bear LO	1999-2017 (year-round since 2003)
NR12	Southern Plains Missouri Breaks	Fishtail	October 1992-current (year-round)
NR13	Northern Plains Missouri Breaks	Little Bullwacker Creek	1985-2017 (year-round)
NR16	Eastern North Dakota	Devil's Lake	1993-2017 (year-round)

At the representative weather stations used in this analysis, we found that the odds that at least one day during a month will have wind gusts in excess of 30 mph were high, ranging from a low of 46% in October at Roundtop weather station to a high of 100% at multiple stations in multiple months (Table 2). Odds were, of course, lower during two-week periods, ranging from a low of 17% at Roundtop weather station in the second half of October to a high of 100% at Fishtail weather station during multiple two-week periods.

Appendix - Table 2. Based on recent weather records, what are the chances of winds gusting to 30 mph or higher on at least one day during a month?

Weather station	Years in record	August	September	October
Roundtop	24	63%	63%	46%
Spotted Bear Lookout	26	100%	85%	Incomplete data
Little Bullwacker Creek	32	100%	100%	97%
Fishtail	24	100%	100%	100%
Devil's Lake	24	92%	96%	100%
Point Six		Data to be added		

Additional Notes on Wind Analysis

The Thompson Creek Fire of 2003 was examined for thresholds in wind gusts that caused extreme fire growth. The Thompson Creek Fire made a run on 8/19/2003, going from 7,530 acres to 17,410 acres (based on the GeoMAC perimeter data). It appears that the fire may have traveled as much as 10.7 miles on that day. The high temperature was 95 degrees Fahrenheit at the nearby Pardee weather station and winds gusted up to 39 mph at the Roundtop weather station. From this case study, a determination was made to use gusts of 30 mph or greater as a threshold for identifying days prone to extreme fire spread. Additionally, days with 20 and 10 mph winds were examined.

Based on hourly wind records at the selected RAWS, the daily probability of winds was calculated at or greater than 10, 20, and 30 mph for durations at or greater than 2, 3, and 4 hours. These probabilities were calculated for both 10-minute average winds and wind gusts.

10-minute average winds are measured in the ten minutes prior to the weather being recorded and then averaged (for example, if the weather is recorded at 12:00, winds are measured from 11:50-12:00). Winds at a given station are likely to be different from the winds experienced on a fire, as winds can be quite variable across a landscape depending on topography, vegetation, and other factors. However, we expect that the winds measured at these exposed and/or ridgetop stations represent fairly well the frequency of wind speeds and durations that might be expected at exposed locations on the landscape. A spline function was applied to smooth the resulting curves.

This analysis is unlikely to capture occurrence of thunderstorm downdraft winds as they may be localized some distance from the weather station. However, three of these sites display a signature of potential cold-front passage as higher and longer period winds may occur as the front approaches and passes the weather station. Tracking wind gusts and shifts in wind direction (from southwest to southeast as the front approaches, and then clockwise to northwest as the front arrives and passes) can support early alerts for active fires. A weather station furthest to the west of the NRCC zones might be

used to observe an approaching cold front prior to its impact on central and eastern zones, but time constraints prevented this analysis from being presented here.

Daily percent chance of wind gusts greater than or equal to 10 mph for a duration of 2 hours was as high as 100% at Fishtail RAWS. The chance of windy conditions declined as the fire season progressed at some stations and increased at others. While the daily probability of wind gusts greater than 30 mph was low at some stations, fire managers might consider that if the daily chance is 3%/day over the period of a week, the chance that windy conditions will occur on at least one day during the week is approximately 20%. At some stations, the daily chance of wind gusts in excess of 30 mph over a 2-hour period was as high as approximately 40%.

Chance of sustained winds at a given speed and duration was lower than chance of gusts for all five stations. At some stations, such as Roundtop, all estimated daily probabilities for 10-minute average winds were approximately 10% or lower. However, fires in this area have still experienced large daily growth, including the Thompson Fire of 2003, perhaps due to wind gusts. Daily chance of 10-minute average winds over a 2-hour period in excess of 10mph is near 70% at some stations such as Spotted Bear Lookout.

Of the stations, Little Bullwacker Creek Weather Station shows spikes in 20 mph winds in the third week of August and first week of September. Spotted Bear Weather Station shows three potential cold front passages between the third week of August and the early third of September. Fishtail Weather Station shows a different and more regular signature of wind spikes which may represent more local and regular wind events.

All sites except Roundtop Weather Station show a probability greater than 30% of 10 mph wind gusts into October. However, the 10 mph gusts may not be associated as clearly with active fire spread. Of the six sites, Fishtail, Spotted Bear and Point Six showed significant probability (40-60%) of 2-4 hour periods of 20+mph wind gusts, which may indicate a higher probability in such locations of active fire spread. As with other thresholds and watch-outs, these indicators should be adapted to local situations and watch-outs, these indicators should be adapted to local situations and observations, and adapted based on local knowledge and fire experience.