

1 Climate Report for Carter County

```
Warning: There were 5 warnings in `dplyr::mutate()`.  
The first warning was:  
i In argument: `plots = list(make_historical_plot(df, variable, "Annual") %>%  
  add_logo_to_ggplot(historical = TRUE))`.  
i In row 15.  
Caused by warning:  
! Removed 8 rows containing missing values (`geom_point()`).  
i Run `dplyr::last_dplyr_warnings()` to see the 4 remaining warnings.
```

2 Historical Climate Trends for Carter County

Climate has changed over the last 50 years in Carter County. In this analysis, we use [GridMet](#) meteorology to look at trends in climate in Carter County since 1979. We do this analysis for energy release, reference et, net primary production, vapor pressure deficit, max. temperature, min. temperature, min. relative humidity, max. relative humidity, precipitation, ground cover, potential et, ground cover, ground cover, ground cover, ndvi, evi, et, gross primary production, ground cover, net primary production, reference et, wind speed, net primary production, and net primary production in the section below.

2.1 Historical Trends in Energy Release in Carter County

Between 1979 and 2020, there has been no statistically significant change in energy release in Carter County at an annual timescale. When looking at monthly data, there have been significant changes in energy release in February (-2.05 per decade) and May (-2.36 per decade). Below, annual trends in energy release are plotted for the GridMet period of record.

Trend in Carter County Annual Energy Release

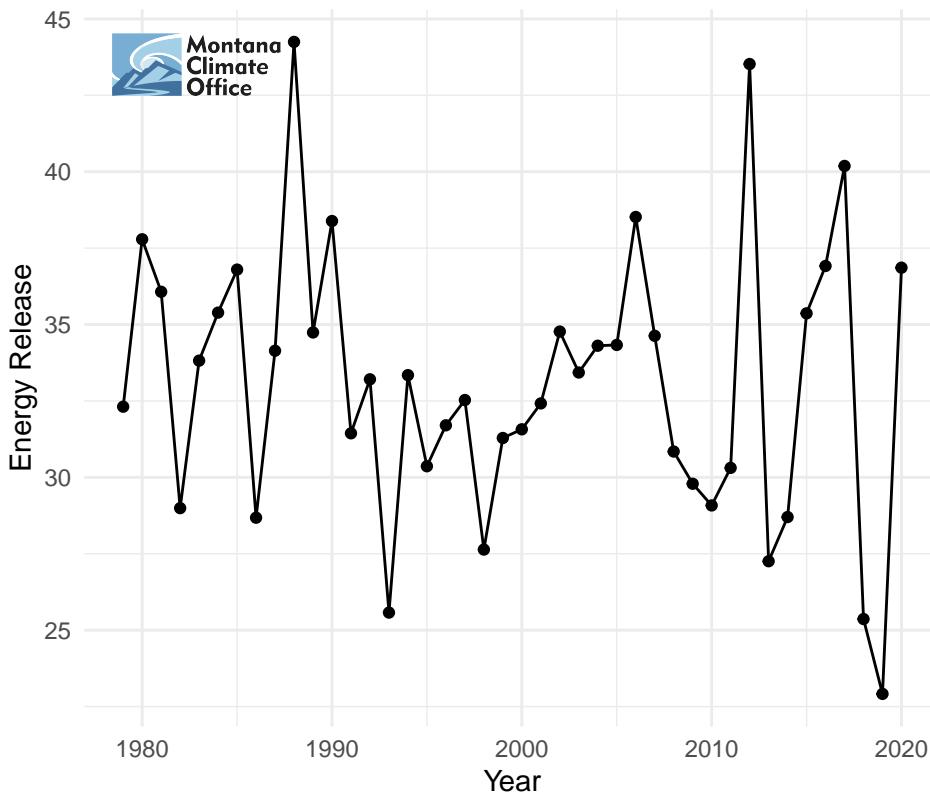


Figure 1: Historical Annual Energy Release Trends Across Carter County

2.2 Historical Trends in Reference ET in Carter County

Between 1979 and 2020, there has been no statistically significant change in reference et in Carter County at an annual timescale. When looking at monthly data, there has also been no significant trend in reference et across the same time period. Below, annual trends in reference et are plotted for the GridMet period of record.

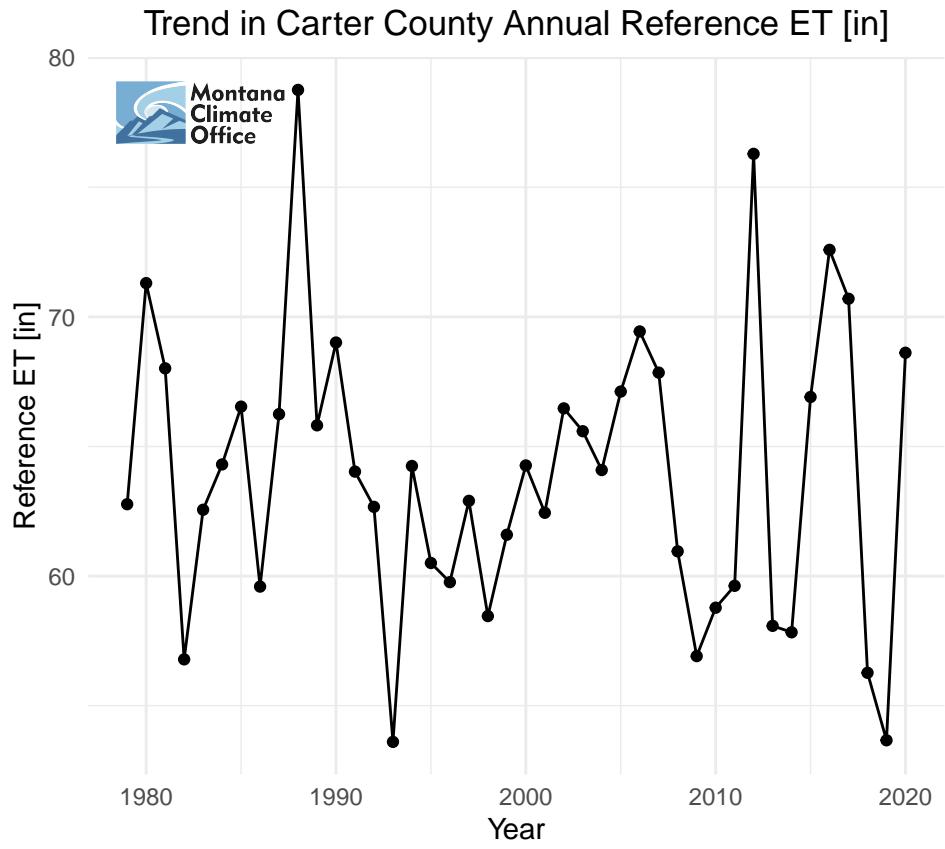


Figure 2: Historical Annual Reference Et Trends Across Carter County

2.3 Historical Trends in Net Primary Production in Carter County

Between 1979 and 2020, there has been a statistically significant change in net primary production of $7.01 \text{ t renpp} = \text{kg m}^{-2}$ per decade at an annual timescale. Below, annual trends in net primary production are plotted for the GridMet period of record.

Trend in Carter County Annual NPP [kg m⁻²] Trend per Decade is Statistically Significant

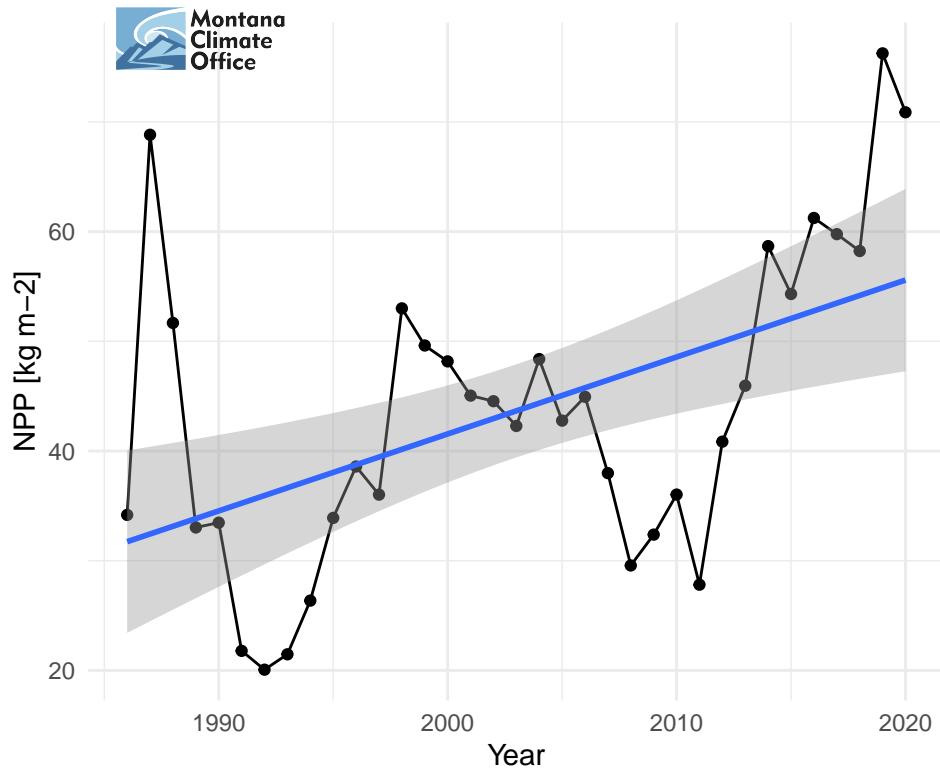


Figure 3: Historical Annual Net Primary Production Trends Across Carter County

2.4 Historical Trends in Vapor Pressure Deficit in Carter County

Between 1979 and 2020, there has been no statistically significant change in vapor pressure deficit in Carter County at an annual timescale. When looking at monthly data, there have been significant changes in vapor pressure deficit in May (-0.49 milibars per decade). Below, annual trends in vapor pressure deficit are plotted for the GridMet period of record.

Trend in Carter County Annual Vapor Pressure Deficit [mba]

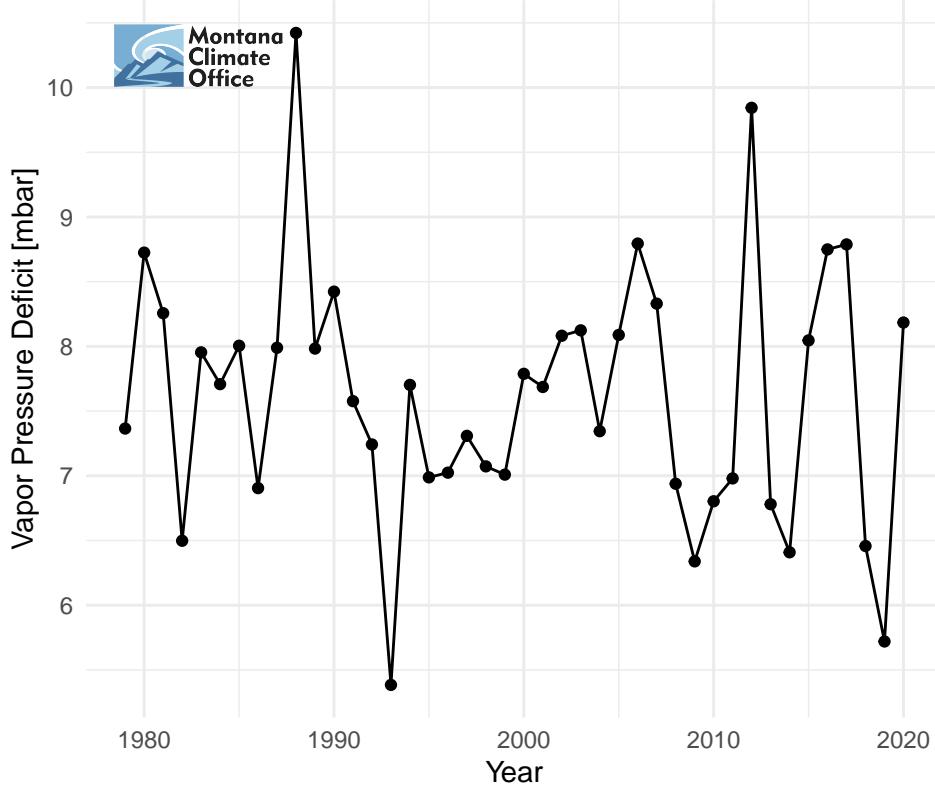


Figure 4: Historical Annual Vapor Pressure Deficit Trends Across Carter County

2.5 Historical Trends in Max. Temperature in Carter County

Between 1979 and 2020, there has been no statistically significant change in max. temperature in Carter County at an annual timescale. When looking at monthly data, there has also been no significant trend in max. temperature across the same time period. Below, annual trends in max. temperature are plotted for the GridMet period of record.

Trend in Carter County Annual Max. Temperature [degF]

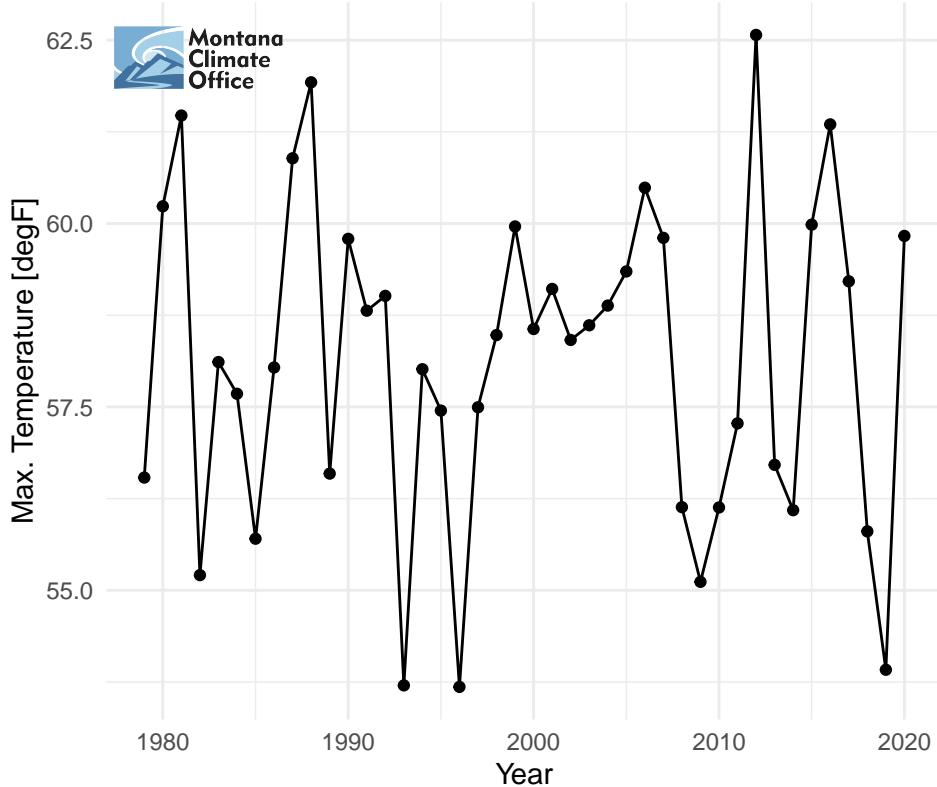


Figure 5: Historical Annual Max. Temperature Trends Across Carter County

2.6 Historical Trends in Min. Temperature in Carter County

Between 1979 and 2020, there has been a statistically significant change in min. temperature of 0.42 degF per decade at an annual timescale. When looking at monthly data, there have been significant changes in min. temperature in September (1.08 degF per decade). Below, annual trends in min. temperature are plotted for the GridMet period of record.

Trend in Carter County Annual Min. Temperature [degF] Trend per Decade is Statistically Significant

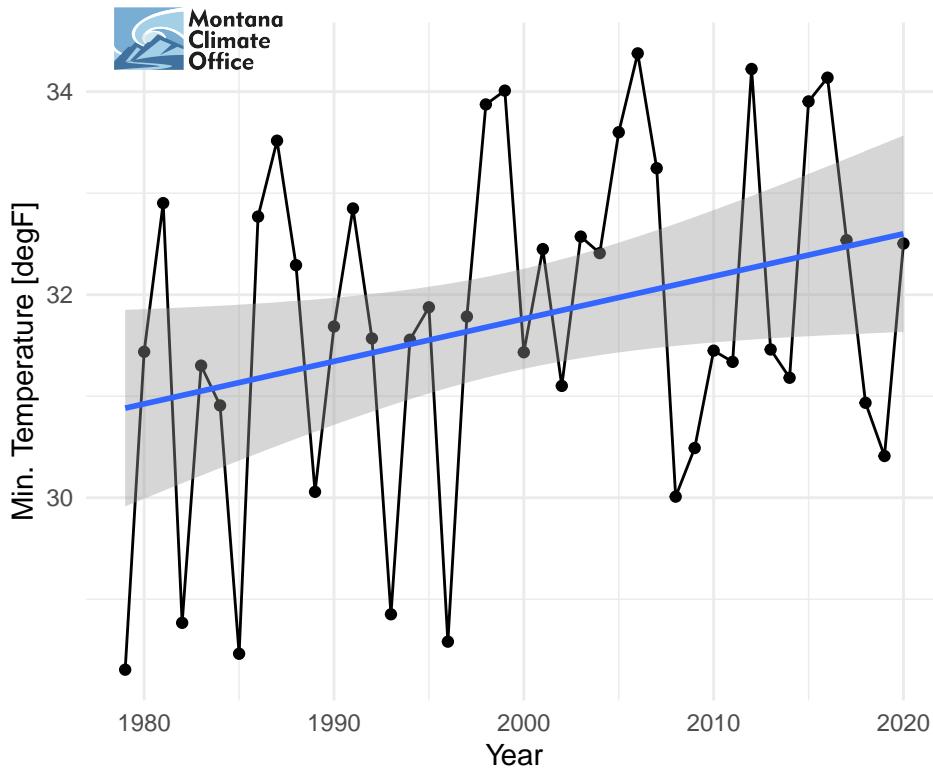


Figure 6: Historical Annual Min. Temperature Trends Across Carter County

2.7 Historical Trends in Min. Relative Humidity in Carter County

Between 1979 and 2020, there has been a statistically significant change in min. relative humidity of 1.31 percent per decade at an annual timescale. When looking at monthly data, there have been significant changes in min. relative humidity in January (1.48 percent per decade), February (2.97 percent per decade), April (2.18 percent per decade), May (2.19 percent per decade), October (1.37 percent per decade), and December (2.23 percent per decade). Below, annual trends in min. relative humidity are plotted for the GridMet period of record.

Trend in Carter County Annual Min. Relative Humidity [%] Trend per Decade is Statistically Significant

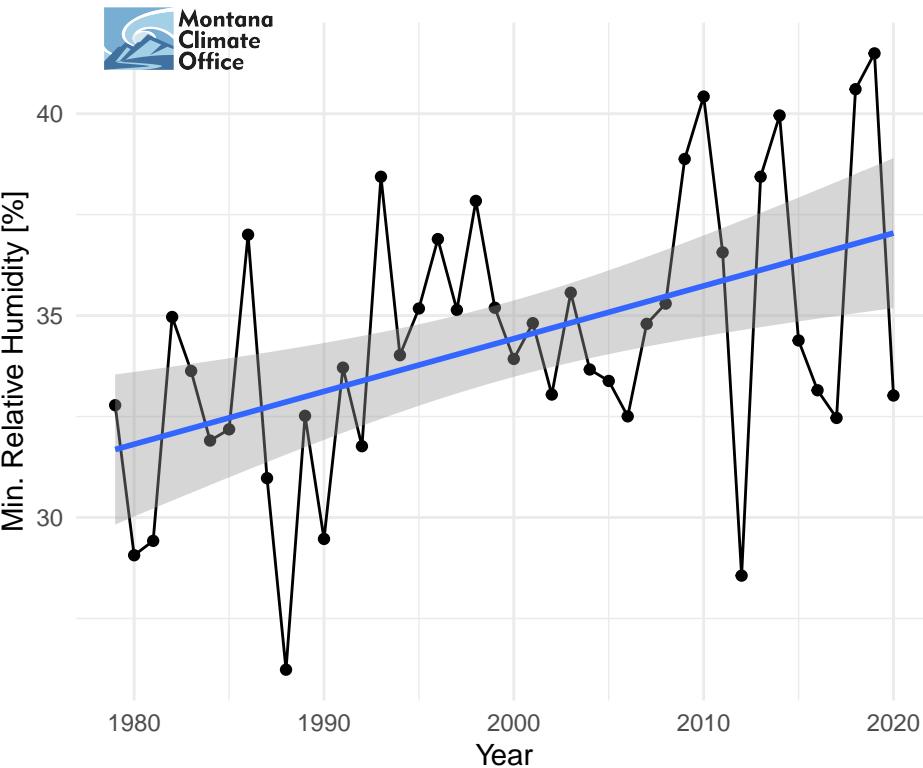


Figure 7: Historical Annual Min. Relative Humidity Trends Across Carter County

2.8 Historical Trends in Max. Relative Humidiy in Carter County

Between 1979 and 2020, there has been no statistically significant change in max. relative humidiy in Carter County at an annual timescale. When looking at monthly data, there have been significant changes in max. relative humidiy in March (-1.49 percent per decade), August (-1.51 percent per decade), and November (-1.1 percent per decade). Below, annual trends in max. relative humidiy are plotted for the GridMet period of record.

Trend in Carter County Annual Max. Relative Humidiy [%]

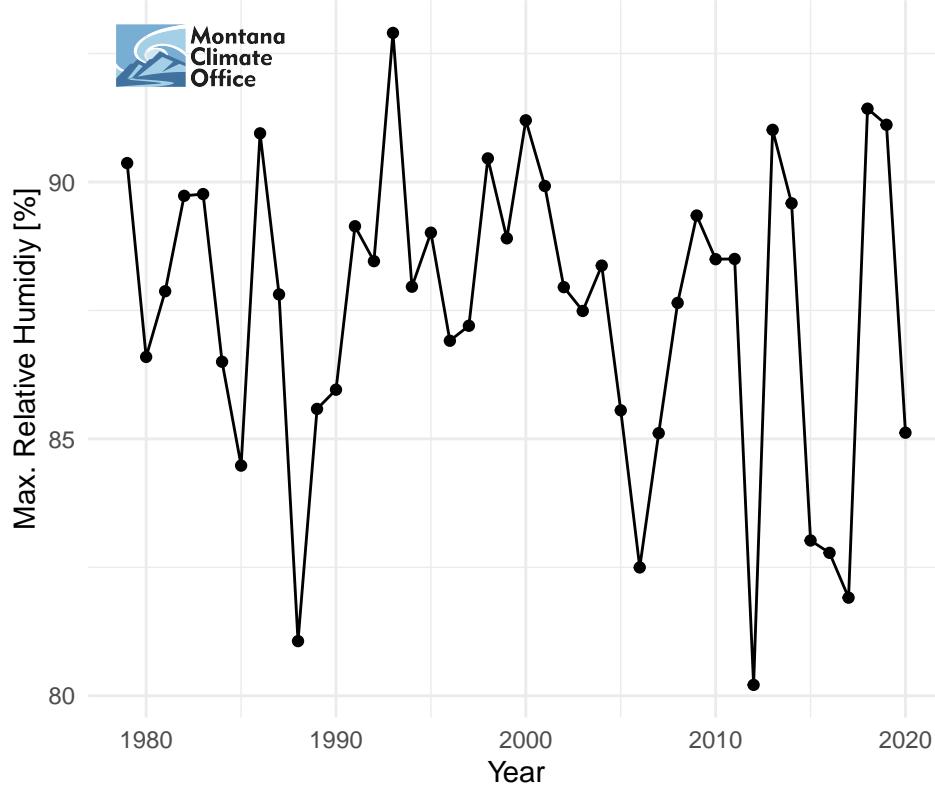


Figure 8: Historical Annual Max. Relative Humidiy Trends Across Carter County

2.9 Historical Trends in Precipitation in Carter County

Between 1979 and 2020, there has been a statistically significant change in precipitation of 1.36 inches per decade at an annual timescale. When looking at monthly data, there have been significant changes in precipitation in February (0.1 inches per decade) and August (0.2 inches per decade). Below, annual trends in precipitation are plotted for the GridMet period of record.

Trend in Carter County Annual Precipitation [in] Trend per Decade is Statistically Significant

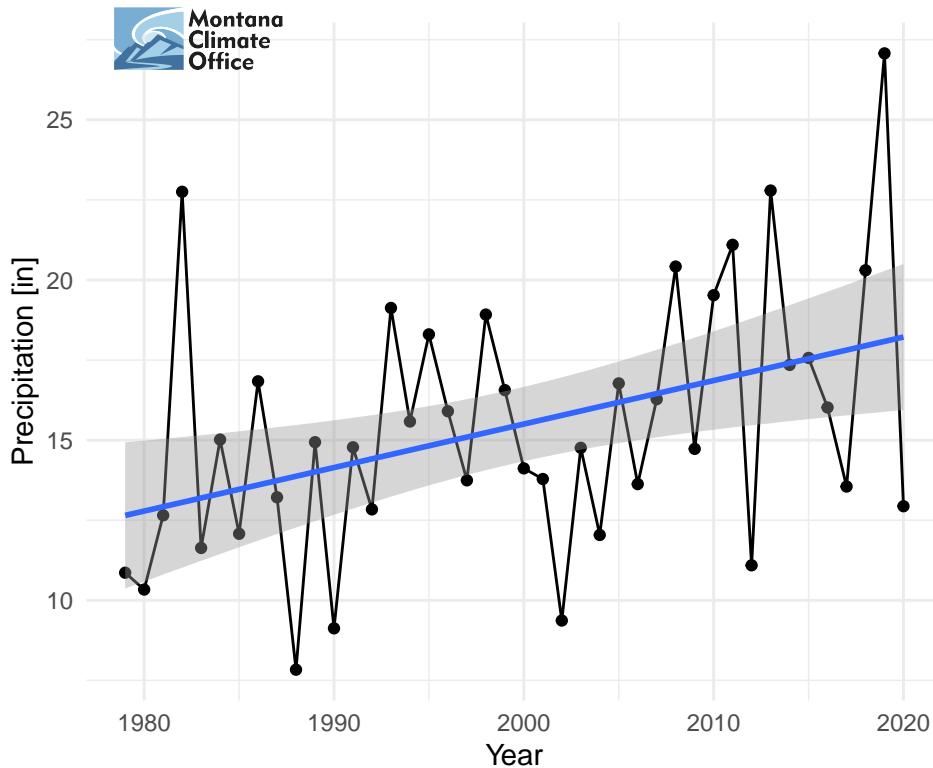


Figure 9: Historical Annual Precipitation Trends Across Carter County

2.10 Historical Trends in Ground Cover in Carter County

Between 1979 and 2020, there has been a statistically significant change in ground cover of 1.54 percent per decade at an annual timescale. Below, annual trends in ground cover are plotted for the GridMet period of record.

Trend in Carter County Annual Ground Cover [%] Trend per Decade is Statistically Significant

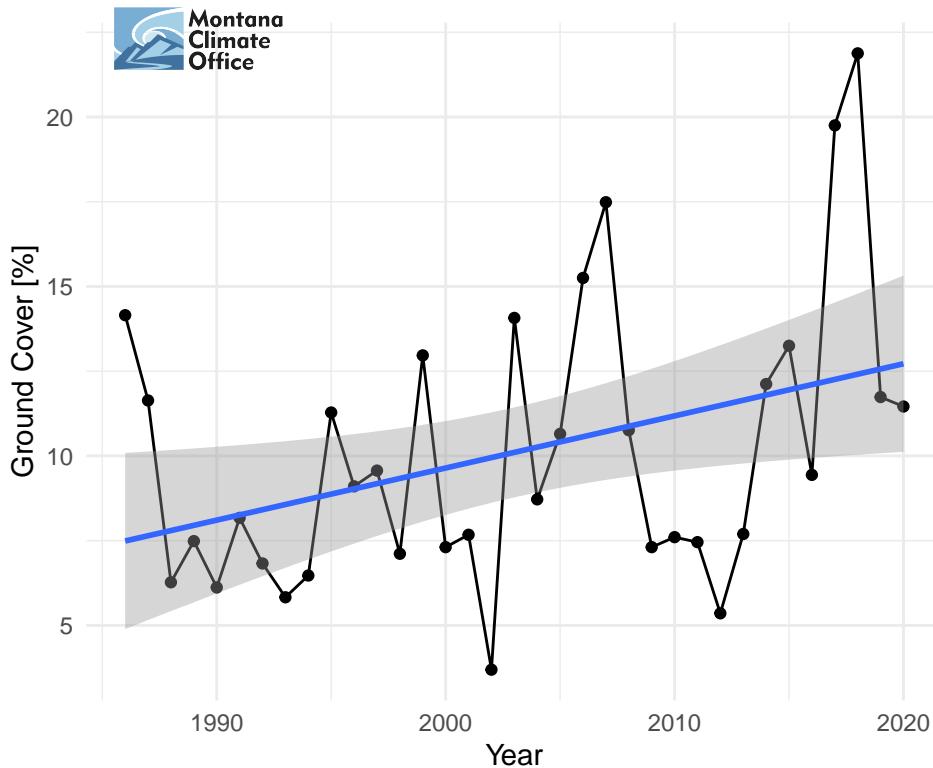


Figure 10: Historical Annual Ground Cover Trends Across Carter County

2.11 Historical Trends in Potential ET in Carter County

Between 1979 and 2020, there has been no statistically significant change in potential et in Carter County at an annual timescale. When looking at monthly data, there have been significant changes in potential et in July (-0.5 in. per decade), August (-0.7 in. per decade), September (-0.54 in. per decade), and November (-0.49 in. per decade). Below, annual trends in potential et are plotted for the GridMet period of record.

Trend in Carter County Annual Potential ET [in]

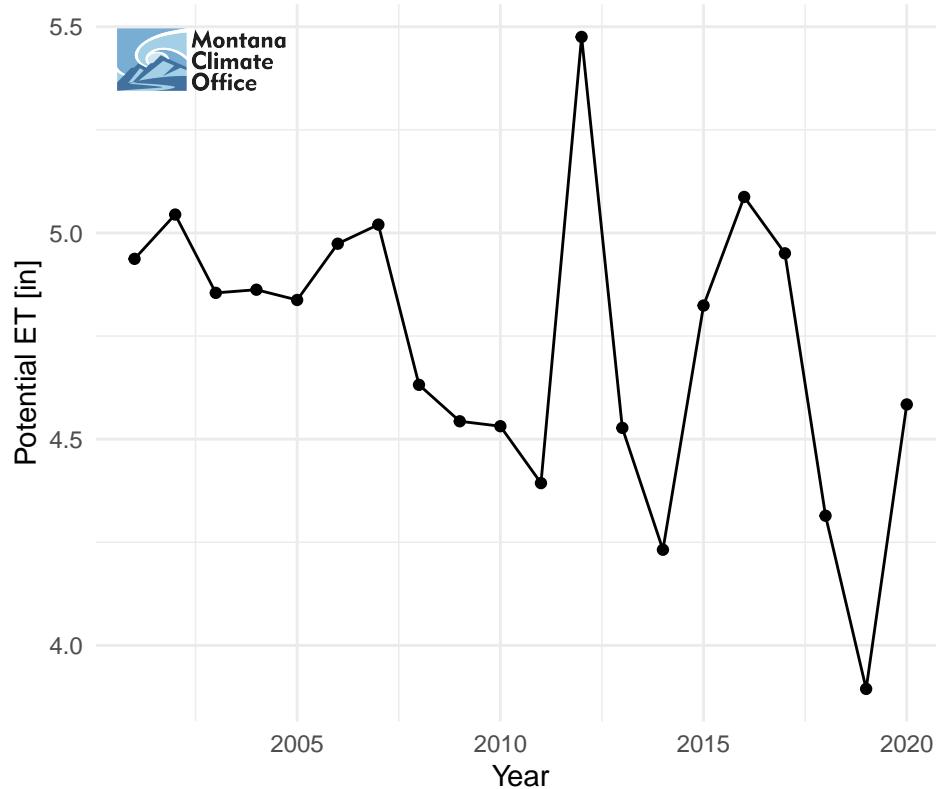


Figure 11: Historical Annual Potential Et Trends Across Carter County

2.12 Historical Trends in Ground Cover in Carter County

Between 1979 and 2020, there has been no statistically significant change in ground cover in Carter County at an annual timescale. Below, annual trends in ground cover are plotted for the GridMet period of record.

Trend in Carter County Annual Ground Cover [%]

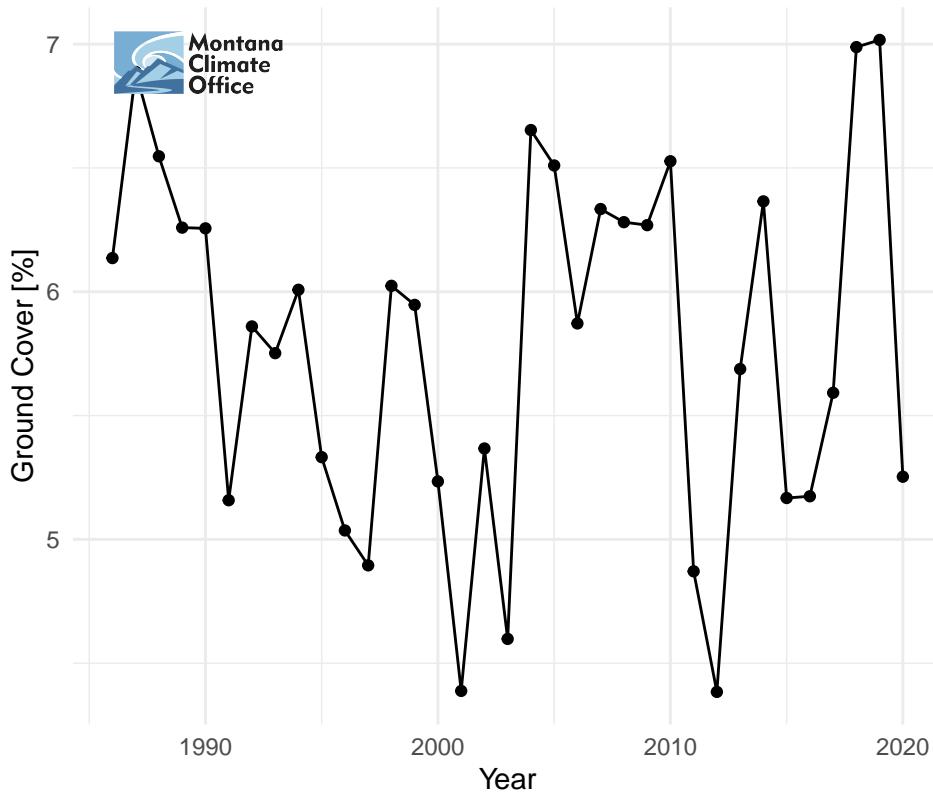


Figure 12: Historical Annual Ground Cover Trends Across Carter County

2.13 Historical Trends in Ground Cover in Carter County

Between 1979 and 2020, there has been a statistically significant change in ground cover of 0.15 percent per decade at an annual timescale. Below, annual trends in ground cover are plotted for the GridMet period of record.

Trend in Carter County Annual Ground Cover [%] Trend per Decade is Statistically Significant

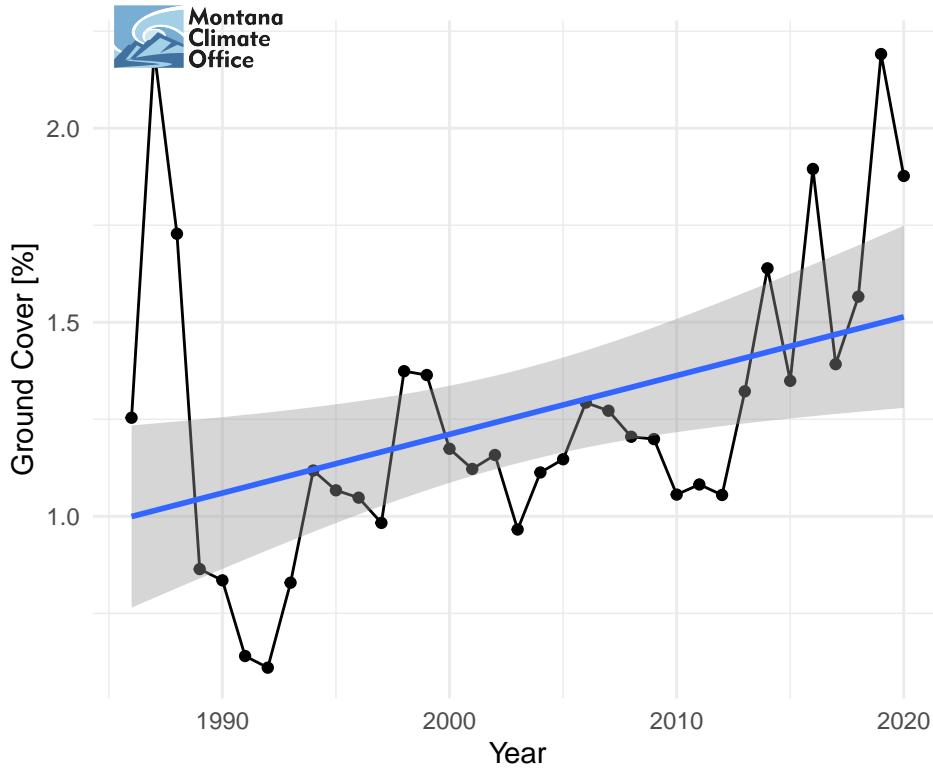


Figure 13: Historical Annual Ground Cover Trends Across Carter County

2.14 Historical Trends in Ground Cover in Carter County

Between 1979 and 2020, there has been no statistically significant change in ground cover in Carter County at an annual timescale. Below, annual trends in ground cover are plotted for the GridMet period of record.

Trend in Carter County Annual Ground Cover [%]

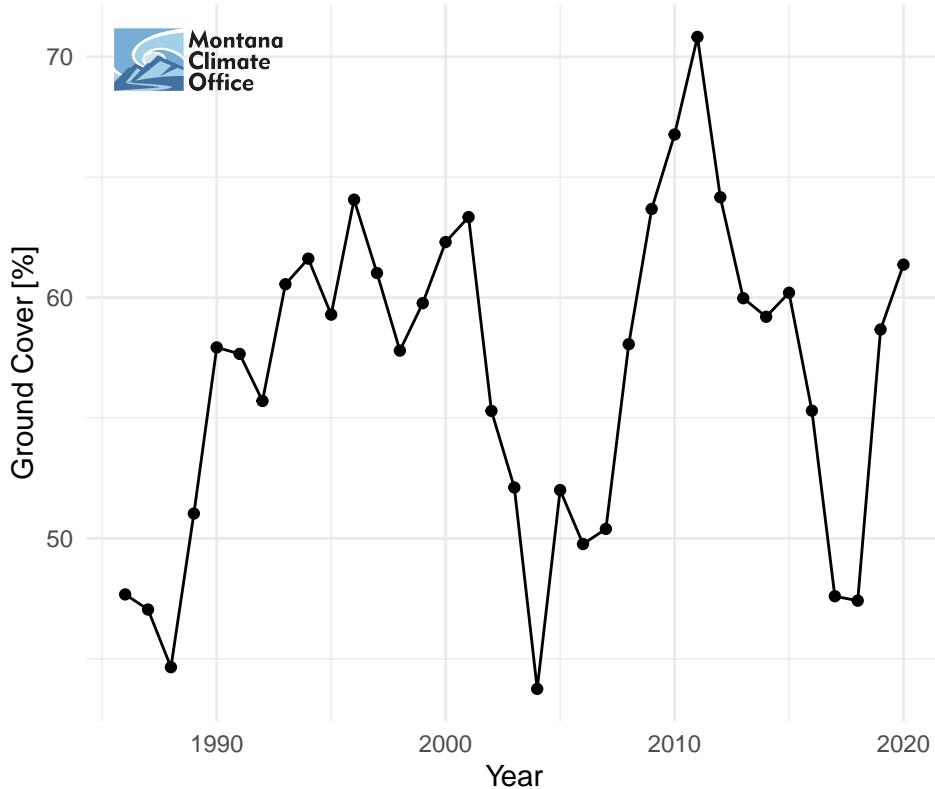


Figure 14: Historical Annual Ground Cover Trends Across Carter County

2.15 Historical Trends in NDVI in Carter County

Between 1979 and 2020, there has been no statistically significant change in ndvi in Carter County at an annual timescale. When looking at monthly data, there have been significant changes in ndvi in February (0.02 per decade), March (0.02 per decade), May (0.05 per decade), September (0.05 per decade), October (0.04 per decade), and November (0.02 per decade). Below, annual trends in ndvi are plotted for the GridMet period of record.

Trend in Carter County Annual NDVI

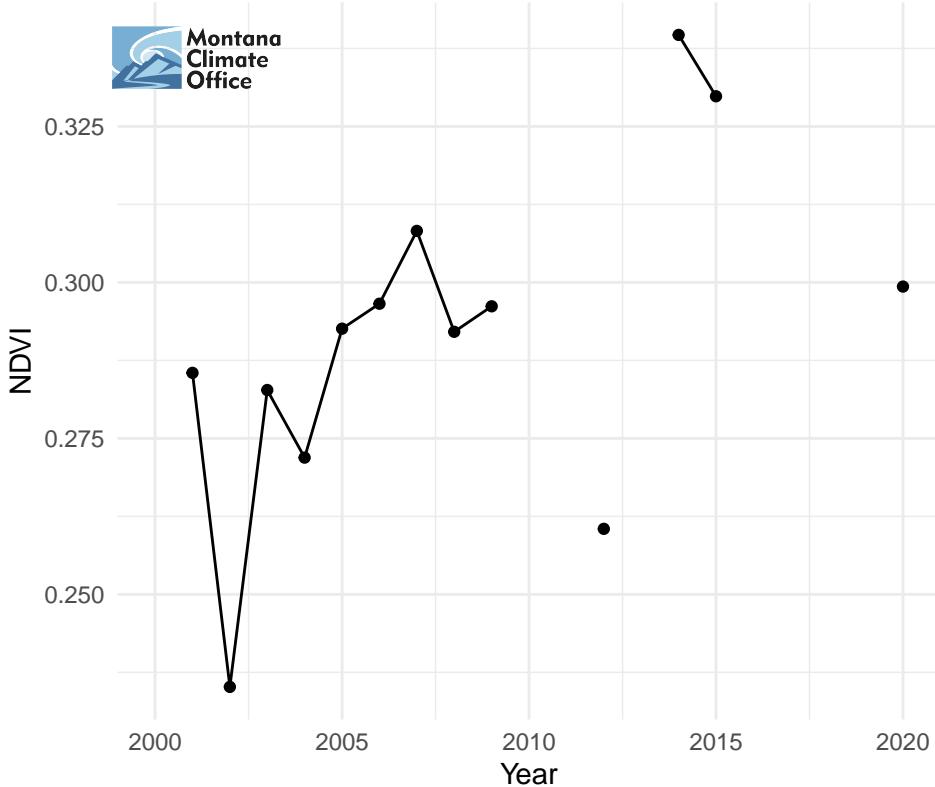


Figure 15: Historical Annual Ndvi Trends Across Carter County

2.16 Historical Trends in EVI in Carter County

Between 1979 and 2020, there has been a statistically significant change in evi of 0.01 per decade at an annual timescale. When looking at monthly data, there have been significant changes in evi in February (0.01 per decade), May (0.03 per decade), September (0.02 per decade), October (0.02 per decade), and November (0.01 per decade). Below, annual trends in evi are plotted for the GridMet period of record.

Trend in Carter County Annual EVI Trend per Decade is Statistically Significant

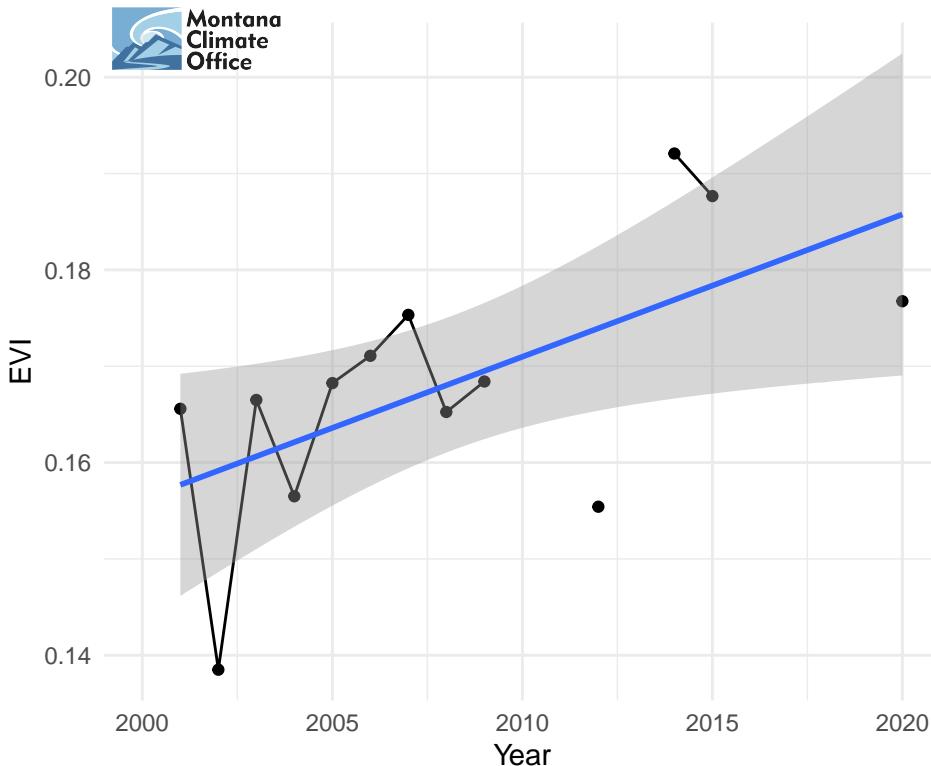


Figure 16: Historical Annual Evi Trends Across Carter County

2.17 Historical Trends in ET in Carter County

Between 1979 and 2020, there has been a statistically significant change in et of 0.16 in. per decade at an annual timescale. When looking at monthly data, there have been significant changes in et in April (0.2 in. per decade), May (0.3 in. per decade), June (0.51 in. per decade), August (0.3 in. per decade), and September (0.23 in. per decade). Below, annual trends in et are plotted for the GridMet period of record.

Trend in Carter County Annual ET [in] Trend per Decade is Statistically Significant

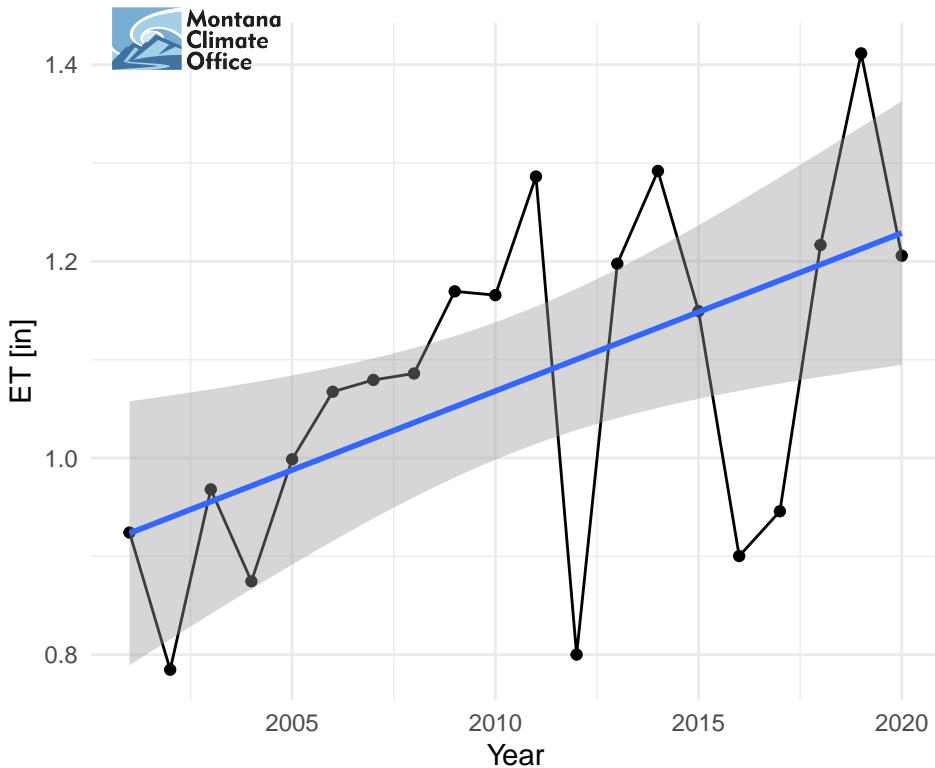


Figure 17: Historical Annual Et Trends Across Carter County

2.18 Historical Trends in Gross Primary Production in Carter County

Between 1979 and 2020, there has been a statistically significant change in gross primary production of 58.55 kg m⁻² per decade at an annual timescale. When looking at monthly data, there have been significant changes in gross primary production in June (226.49 kg m⁻² per decade), August (131.3 kg m⁻² per decade), and September (57.98 kg m⁻² per decade). Below, annual trends in gross primary production are plotted for the GridMet period of record.

Trend in Carter County Annual GPP [kg m⁻²] Trend per Decade is Statistically Significant

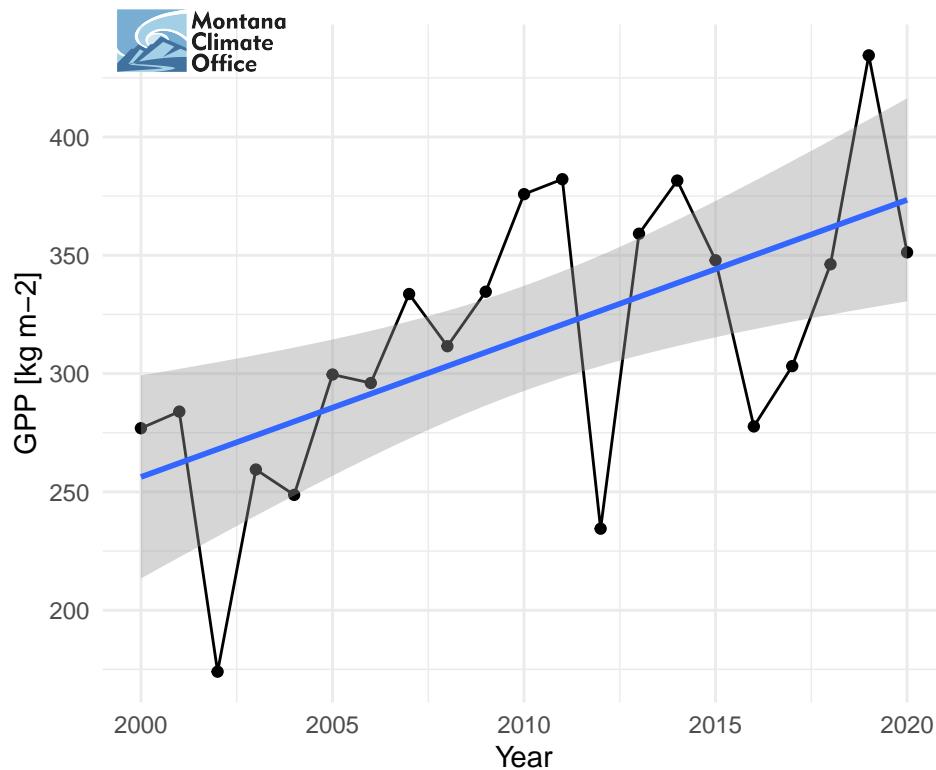


Figure 18: Historical Annual Gross Primary Production Trends Across Carter County

2.19 Historical Trends in Ground Cover in Carter County

Between 1979 and 2020, there has been a statistically significant change in ground cover of -2.79 percent per decade at an annual timescale. Below, annual trends in ground cover are plotted for the GridMet period of record.

Trend in Carter County Annual Ground Cover [%] Trend per Decade is Statistically Significant

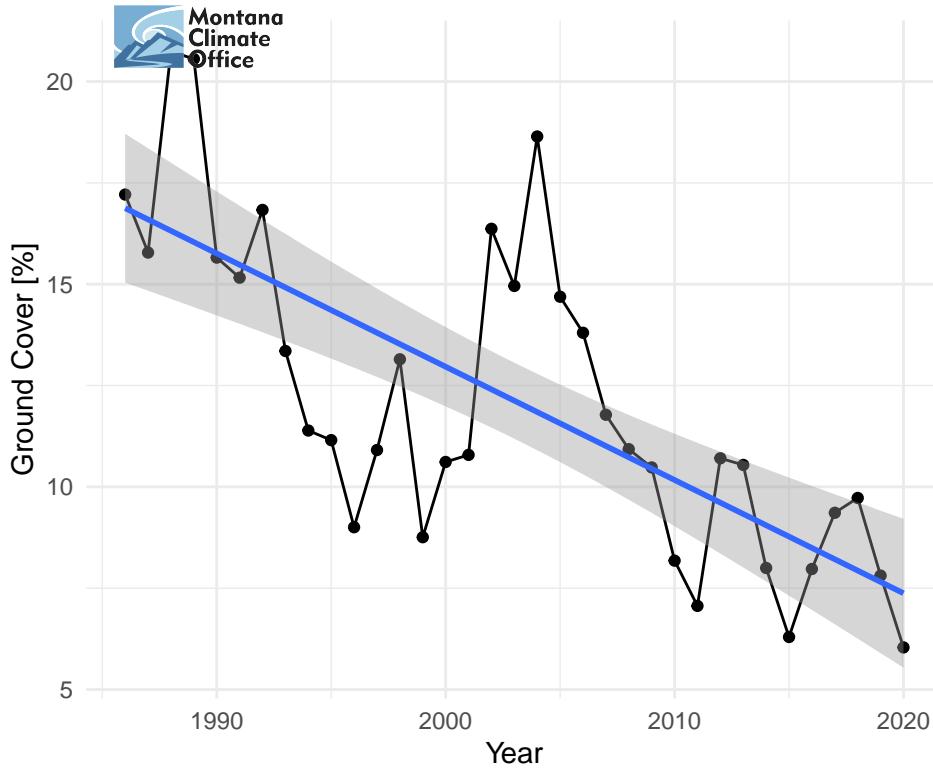


Figure 19: Historical Annual Ground Cover Trends Across Carter County

2.20 Historical Trends in Net Primary Production in Carter County

Between 1979 and 2020, there has been a statistically significant change in net primary production of 45.25 kg m^{-2} per decade at an annual timescale. Below, annual trends in net primary production are plotted for the GridMet period of record.

Trend in Carter County Annual NPP [kg m⁻²] Trend per Decade is Statistically Significant

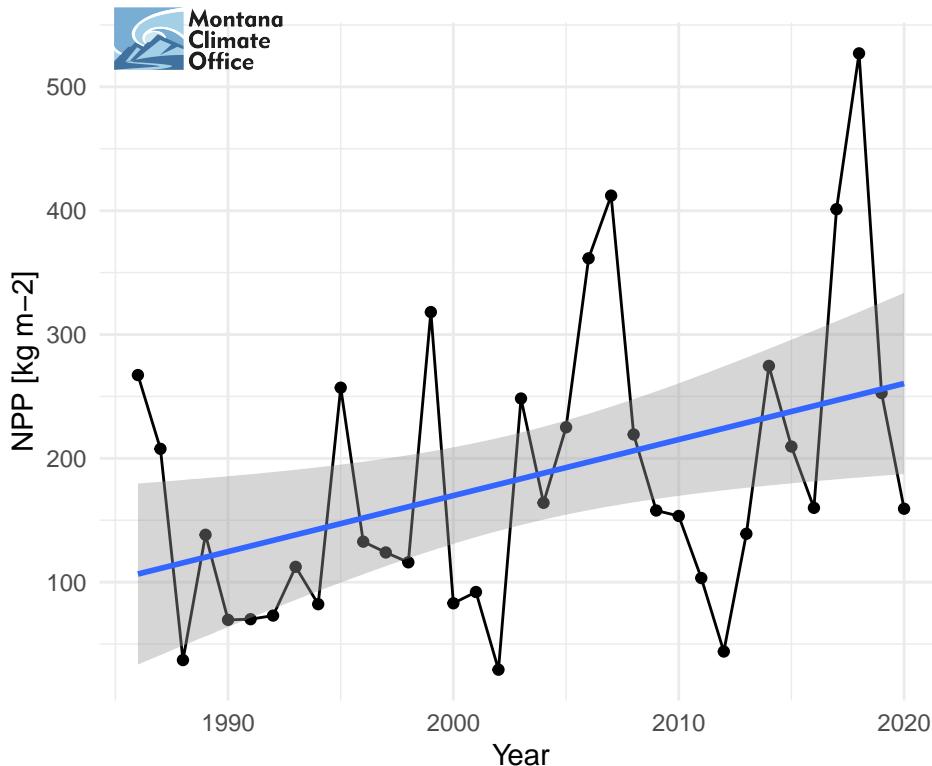


Figure 20: Historical Annual Net Primary Production Trends Across Carter County

2.21 Historical Trends in Reference ET in Carter County

Between 1979 and 2020, there has been no statistically significant change in reference et in Carter County at an annual timescale. When looking at monthly data, there has also been no significant trend in reference et across the same time period. Below, annual trends in reference et are plotted for the GridMet period of record.

Trend in Carter County Annual Reference ET [in]

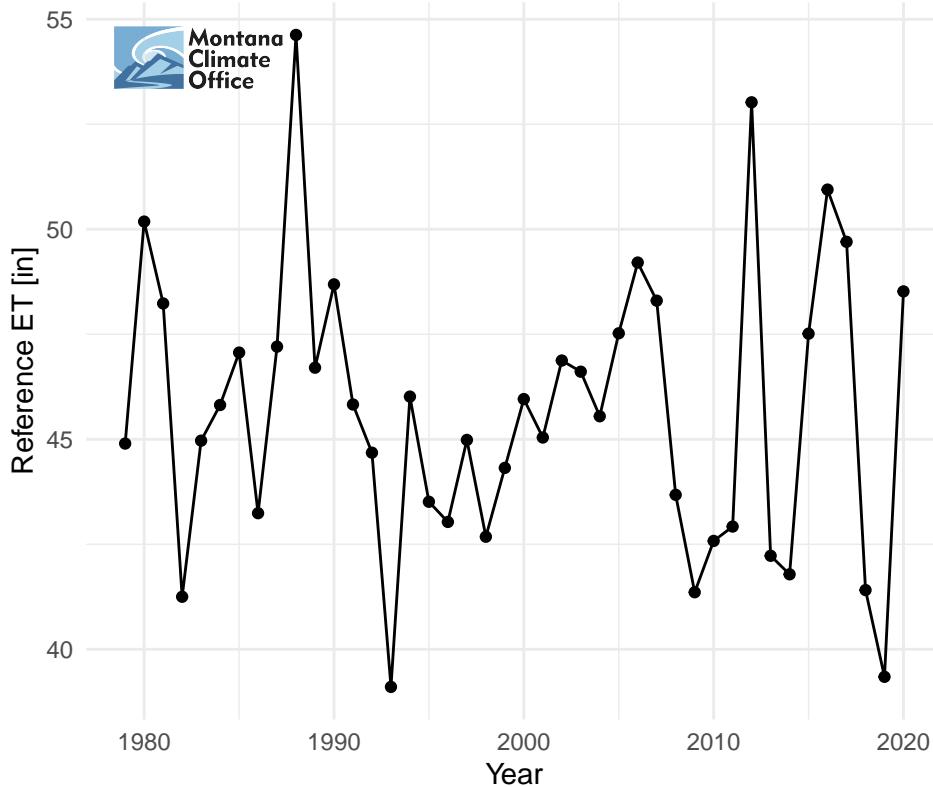


Figure 21: Historical Annual Reference Et Trends Across Carter County

2.22 Historical Trends in Wind Speed in Carter County

Between 1979 and 2020, there has been a statistically significant change in wind speed of 0.15 miles per hour per decade at an annual timescale. When looking at monthly data, there have been significant changes in wind speed in October (0.3 miles per hour per decade) and November (0.35 miles per hour per decade). Below, annual trends in wind speed are plotted for the GridMet period of record.

Trend in Carter County Annual Wind Speed [mph] Trend per Decade is Statistically Significant

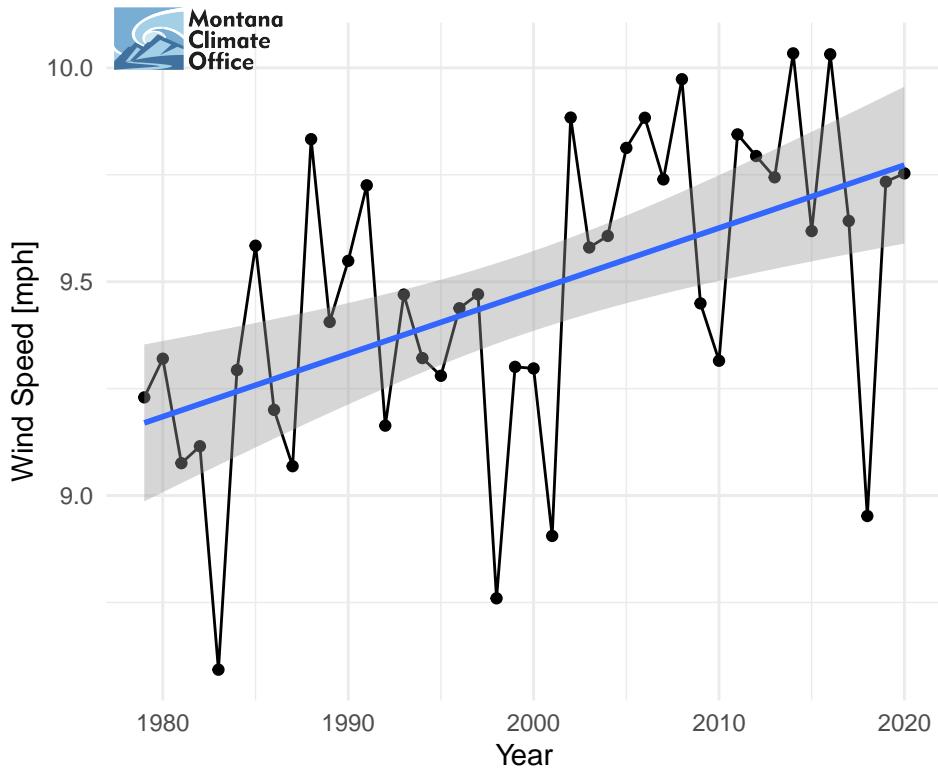


Figure 22: Historical Annual Wind Speed Trends Across Carter County

2.23 Historical Trends in Net Primary Production in Carter County

Between 1979 and 2020, there has been no statistically significant change in net primary production in Carter County at an annual timescale. Below, annual trends in net primary production are plotted for the GridMet period of record.

Trend in Carter County Annual NPP [kg m⁻²]

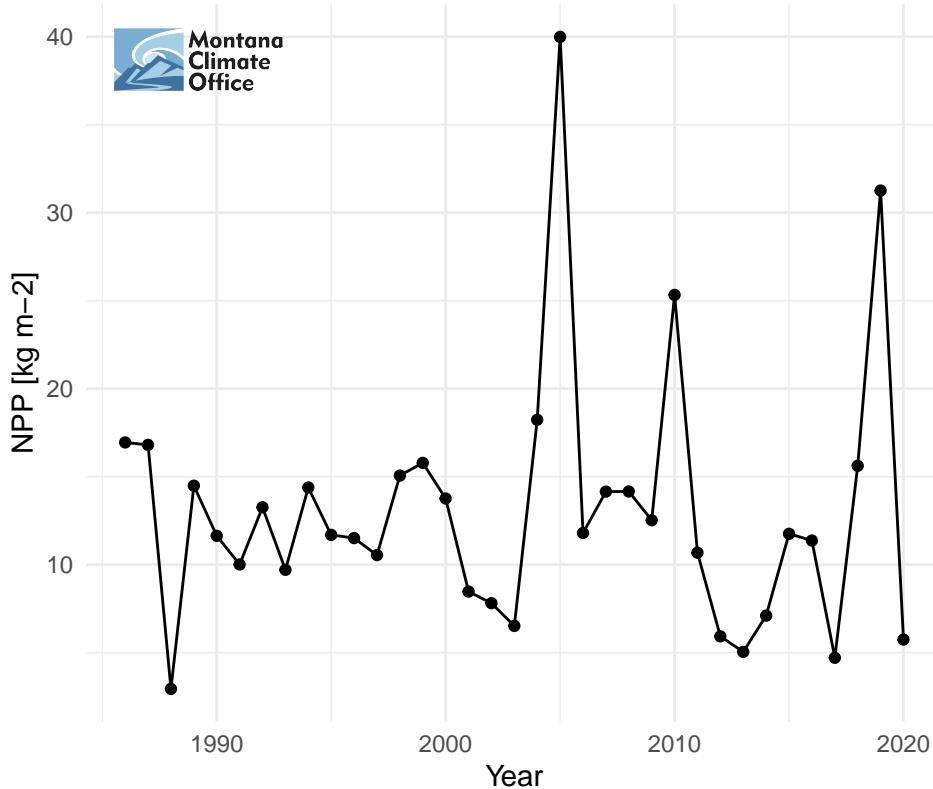


Figure 23: Historical Annual Net Primary Production Trends Across Carter County

2.24 Historical Trends in Net Primary Production in Carter County

Between 1979 and 2020, there has been a statistically significant change in net primary production of 190.38 kg m⁻² per decade at an annual timescale. Below, annual trends in net primary production are plotted for the GridMet period of record.

Trend in Carter County Annual NPP [kg m⁻²] Trend per Decade is Statistically Significant

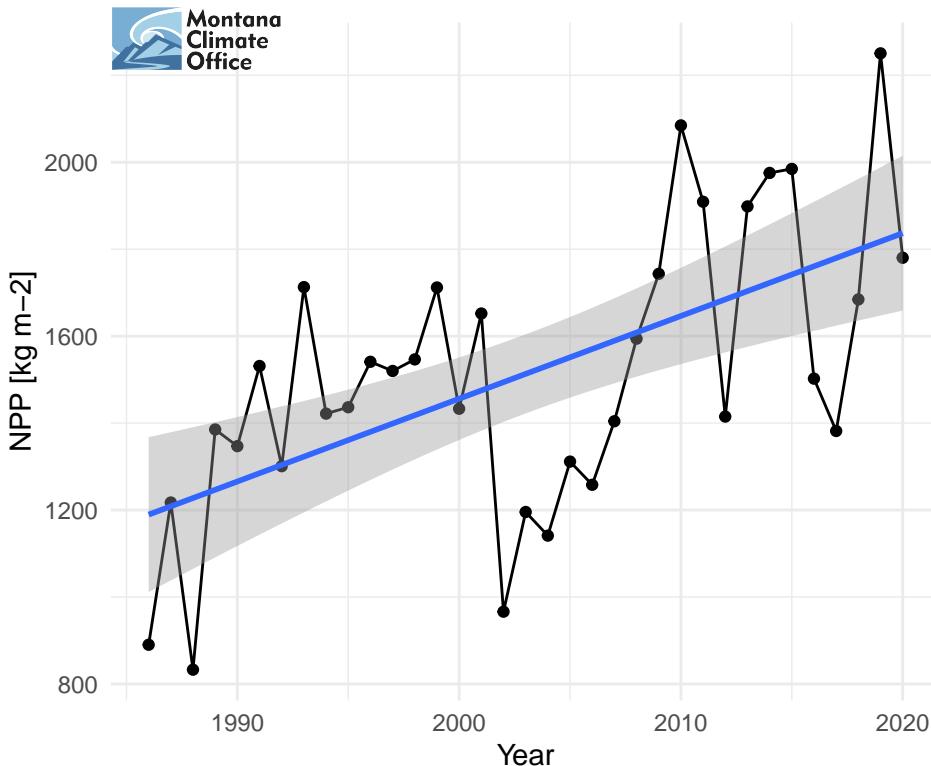


Figure 24: Historical Annual Net Primary Production Trends Across Carter County

3 Future Climate Projection for Carter County

3.1 Projected Annual Changes in Temperature in Carter County

Between 1950 and 2099, it is projected that under the middle of the road emissions scenario, temperature will increase at a rate of 0.36 degF per decade and under the high emissions emissions scenario, temperature will increase at a rate of 0.36 degF per decade. Below, a timeseries plot shows projected changes in temperature under these different emission scenarios.

Climate Projections of Temperature for Carter County

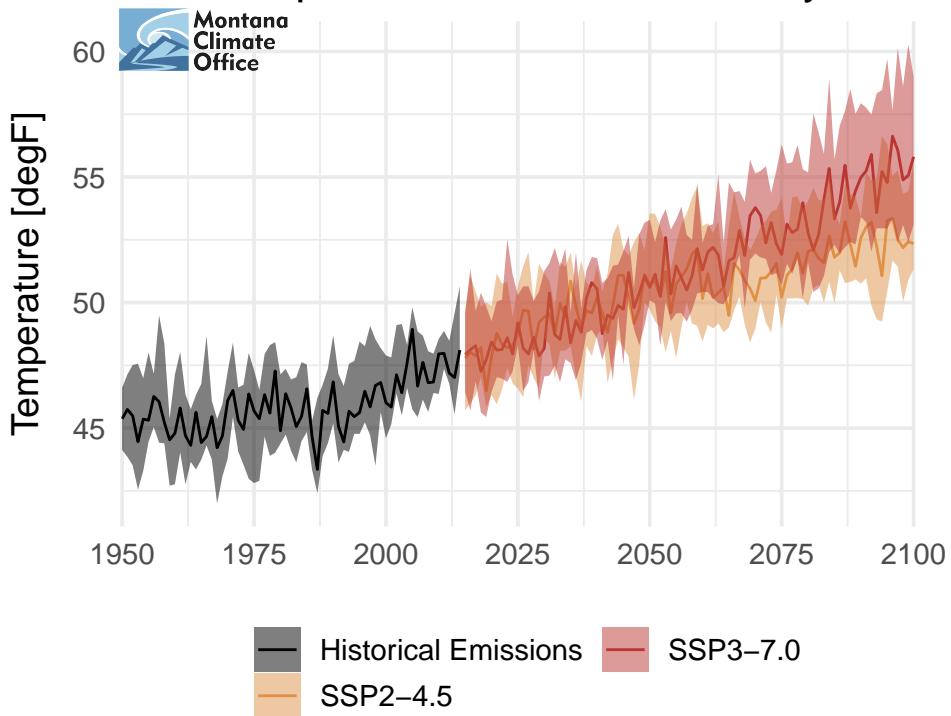


Figure 25: Projected Timeseries Of Annual Temperature In Carter County

3.2 Projected Monthly Changes in Temperature in Carter County

In addition to changing at annual time scales, temperature is also projected to change at the monthly scale. By mid century (2040-2069), Jul is projected to see the largest increase in temperature (4.12 degF) under the ssp2-4.5 scenario relative to the 1991 - 2020 baseline and Aug is projected to see the largest increase in temperature (5.06 degF) under the ssp3-7.0 scenario relative to the 1991 - 2020 baseline. By end-of-century (2070-2099), Sep is projected to see the largest increase in temperature (6.8 degF) under the ssp2-4.5 scenario relative to the 1991 - 2020 baseline and Aug is projected to see the largest increase in temperature (11.9 degF) under the ssp3-7.0 scenario relative to the 1991 - 2020 baseline.. Below, a table and graph showing changes in temperature for the SSP2-4.5 and SSP3-7.0 scenarios is provided to give a monthly breakdown of projected changes.

Table 1: Projected Monthly Temperature Changes In Carter County

Month	SSP2-4.5	SSP3-7.0
Mid Century (2040-2069)		
Jan	3.93	4.43
Feb	3.17	4.64
Mar	2.07	2.67
Apr	2.59	3.05
May	2.63	2.87
Jun	3.02	3.65
Jul	4.12	3.97
Aug	3.94	5.06
Sep	3.70	4.77
Oct	3.64	3.71
Nov	2.93	3.22
Dec	3.11	4.10
End-of-Century (2070-2099)		
Jan	6.25	5.37
Feb	6.34	7.50
Mar	3.99	6.09
Apr	3.00	6.15
May	4.53	7.88
Jun	3.69	7.51
Jul	5.65	9.44
Aug	6.24	11.90
Sep	6.80	11.44
Oct	6.46	7.48
Nov	4.42	6.10
Dec	4.85	8.91

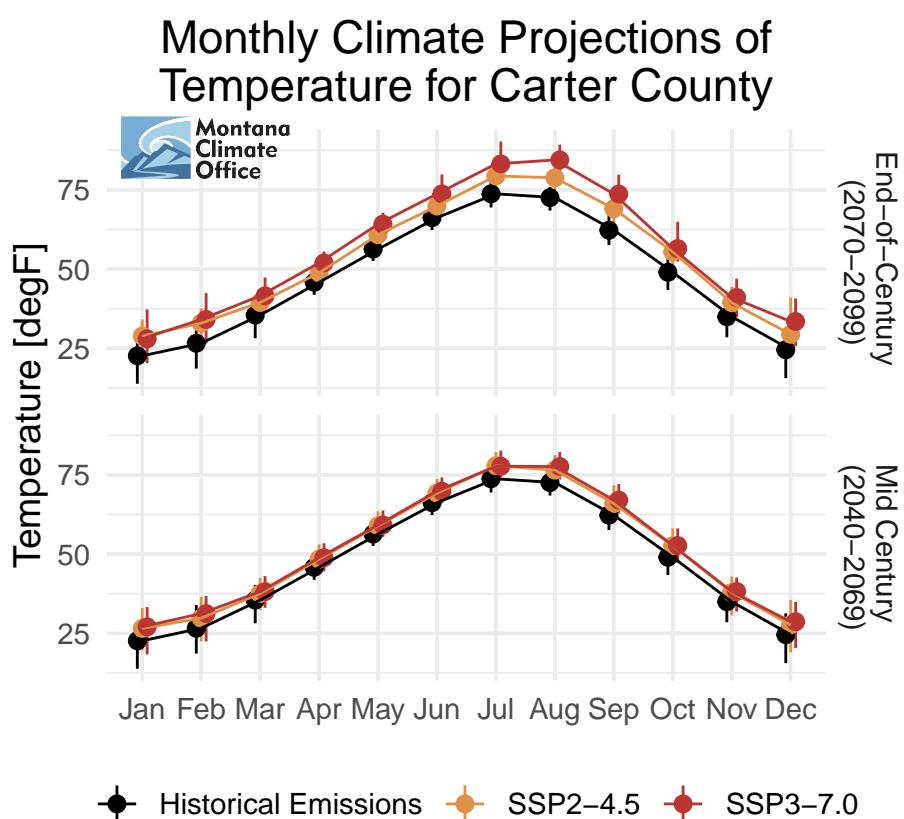


Figure 26: Projected Monthly Temperature Changes In Carter County