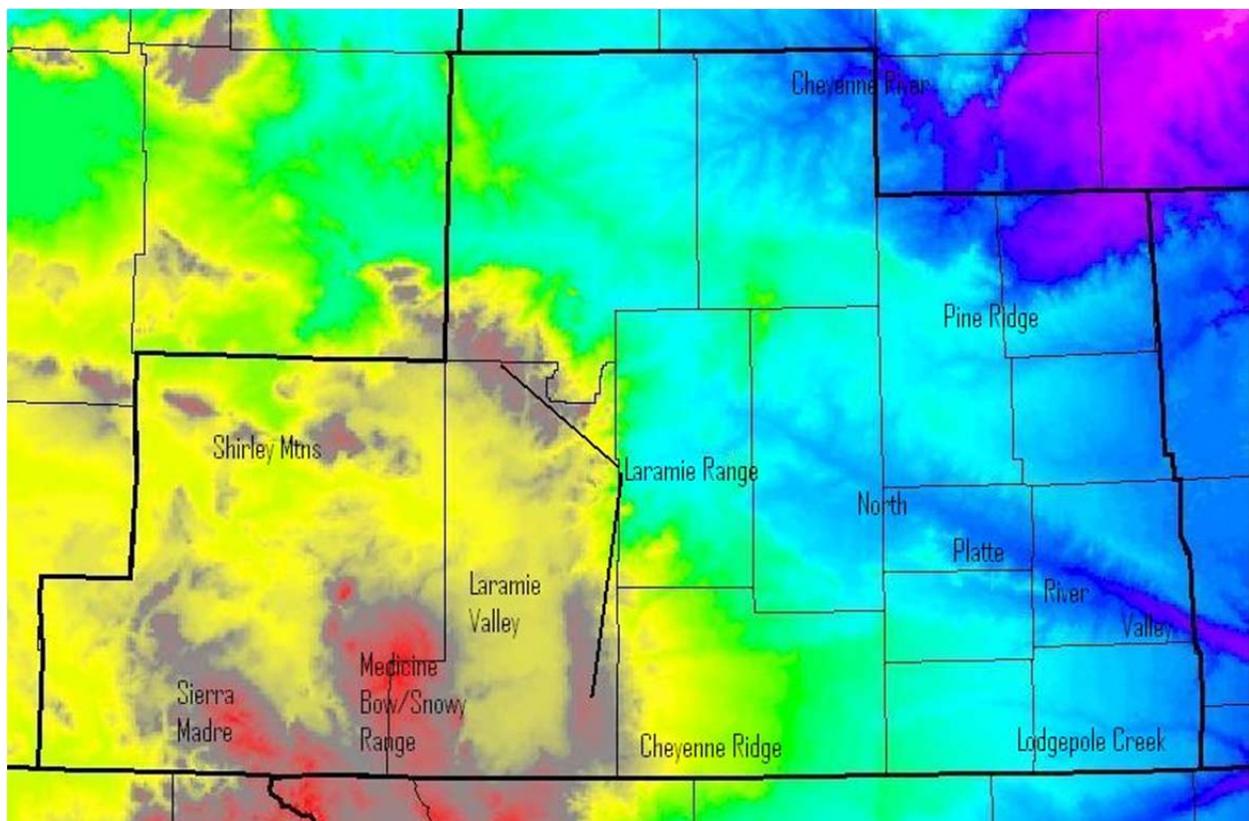


# Climate Orientation and Reference for the Cheyenne NWS CWA

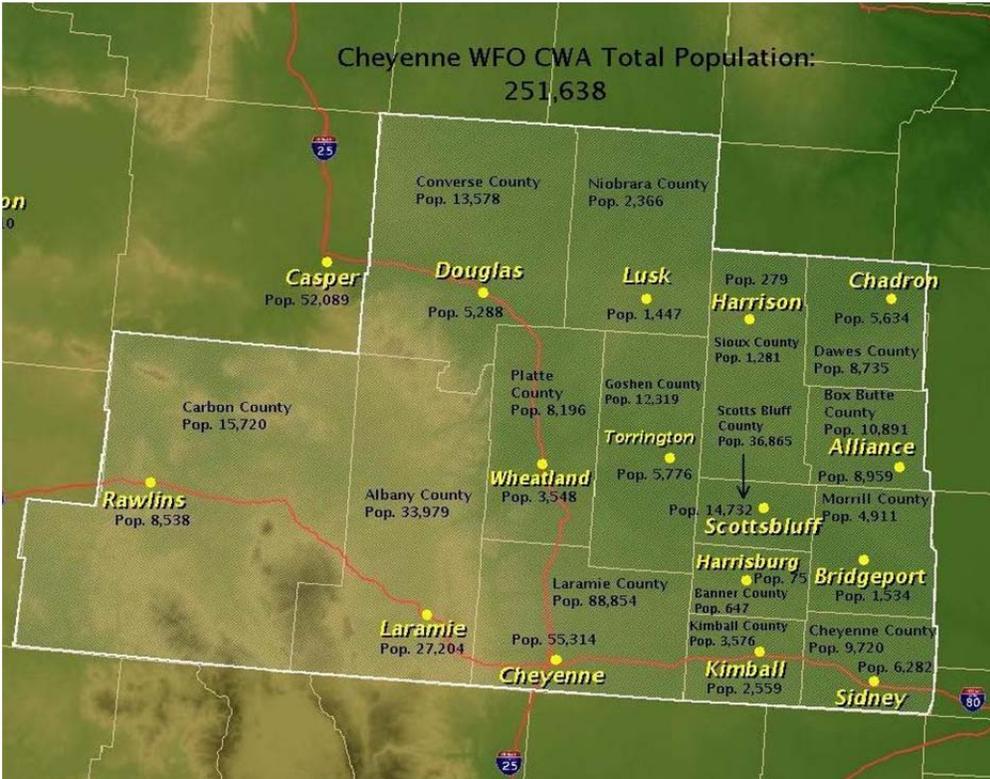
## Introduction:

The climate of this region is typical of an inland continental climate, consisting of a wide variety of weather at varying times of the year. Diurnal and annual temperature changes are normally fairly large and precipitation patterns quite varied as well. The terrain ranges from mountainous over western sections of the CWA to gently sloping plains from far eastern Wyoming into the Nebraska panhandle, interrupted in some areas by low hills and bluffs. Elevations range from 10,000 to 12,000 feet above sea level in the Medicine Bow and Sierra Madre Ranges to about 3000 to 5000 feet ASL over the plains of far eastern Wyoming and the Nebraska panhandle. The map below shows the topography of the area with certain features annotated. The thick dark line indicates the boundary of the Cheyenne NWS CWA:



## Counties and cities:

The population density of the Cheyenne NWS CWA is relatively low with Cheyenne being the largest city. The CWA consists of 8 counties in the Nebraska panhandle and 7 counties in southeast Wyoming. The following map depicts the individual counties and some of the towns and cities in those areas:



The following are the year 2000 populations for the individual counties as well as for some selected cities/towns in those counties:

### Southeast Wyoming

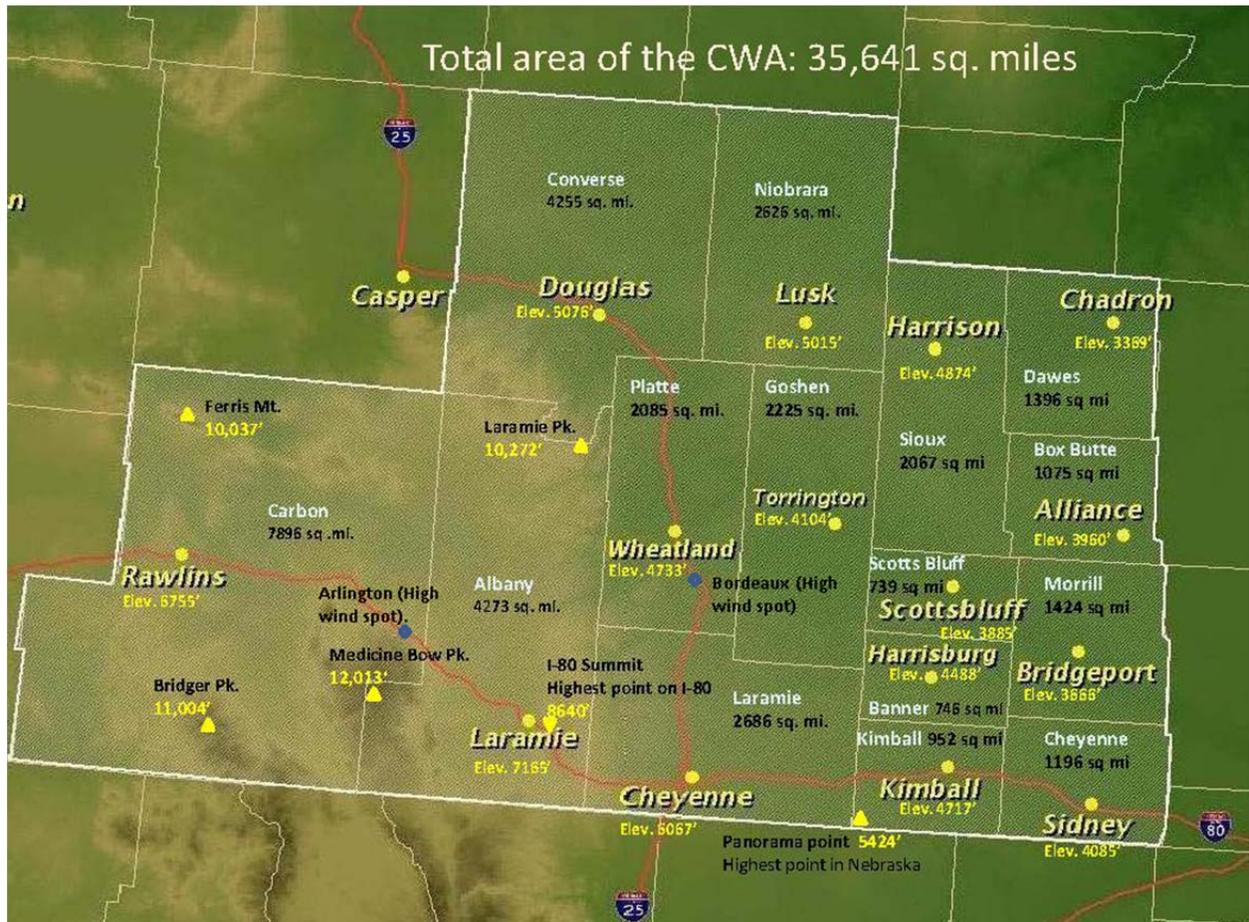
County	County Population	City/Town	City/Town
Laramie	88,854	Cheyenne	55,314
		Pine Bluffs	1142
Albany	33,979	Laramie	27,204
Carbon	15,720	Rawlins	8538
		Saratoga	1737
Converse	13,578	Douglas	5288
		Glenrock	2371
Goshen	12,319	Torrington	5776
		Guernsey	1088
Platte	8196	Wheatland	3548
Niobrara	2366	Lusk	1447

# Nebraska Panhandle

County	County Population	City/Town	City/Town
Scotts Bluff	36,865	Scottsbluff/Gering 22,972	Mitchell 1774
Box Butte	10,891	Alliance 8959	
Cheyenne	9720	Sidney 6282	
Dawes	8735	Chadron 5634	Crawford 1040
Morrill	4911	Bridgeport 1534	
Kimball	3576	Kimball 2559	
Sioux	1281	Harrison 279	
Banner	647	Harrisburg 75	

## Area and Elevations:

This map depicts the areas of all counties in the CWA and elevations of cities and other points:



## **Climate and Weather:**

As stated earlier the climate of the region contains a wide variety of weather. Winters see periods of mainly light snows as well as strong winds. Arctic outbreaks occur on occasion, sending temperatures below zero in some cases. Arctic air normally does not stay more than a couple days as Chinook winds tend to develop off the mountains and bring adiabatically warmed air eastward over the plains. Snows tend to be light but blizzards do occur infrequently. Spring is a transitional time with both significant snowfalls as well as severe thunderstorms occurring. Most of the annual snowfall over the plains tends to occur in March and April while May and June see thunderstorms, some severe with large hail, strong winds and a few tornadoes. Large hail is the most common severe feature from the thunderstorms. Tornadoes tend to be small and short-lived.

Summer times tend to be warm and pleasant though a few short periods of hot temperatures normally occur. Relative humidities tend to be relatively low and hot afternoon temperatures usually cool down nicely in the evenings, especially over southeast Wyoming. Thunderstorm intensity tends to decrease in July into August but some increase in flash flooding potential occurs as monsoonal moisture from the southwestern U.S. advects over this region and combines with slower moving thunderstorms.

Fall is usually the least harsh season as the air mass over the region dries and temperatures cool down with the shortening days. The first freeze of the season normally occurs in the latter part of September, latest over the southern Nebraska panhandle. The first snows of the season usually arrive in October and the winds begin to increase. The last two months of the year see cool temperatures with occasional surges of arctic air.

## Climatic Data:

The following tables provide some temperature data for selected cities over the CWA:

### Average monthly high and low temperatures:

City	Avg.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Cheyenne	Max T	37.1	40.5	46.4	54.4	64.4	75.4	81.9	79.8	70.3	58.2	44.5	38.1	<b>57.6</b>
	Min T	14.8	17.2	22.0	28.7	38.3	47.5	53.4	52.0	42.9	32.5	22.1	16.1	<b>32.3</b>
Laramie	Max T	31.7	35.1	41.9	50.2	60.8	72.6	79.1	77.4	68.3	56.1	40.5	32.6	<b>53.9</b>
	Min T	9.0	11.6	18.1	24.1	33.2	41.6	47.3	46.0	37.4	27.6	16.3	9.9	<b>26.8</b>
Rawlins	Max T	33.4	37.1	45.5	55.1	65.7	77.9	85.3	83.8	73.3	59.8	42.9	34.6	<b>57.9</b>
	Min T	12.5	15.1	22.1	28.0	36.1	44.6	50.5	49.2	40.5	31.1	20.1	13.5	<b>30.3</b>
Chadron	Max T	35.1	40.9	49.3	58.9	69.6	81.0	88.6	87.8	77.2	63.8	46.4	37.8	<b>61.4</b>
	Min T	10.4	15.3	23.0	32.9	43.9	53.4	59.6	58.1	46.1	33.9	21.0	12.4	<b>34.2</b>
Scottsbluff	Max T	38.0	44.3	51.7	61.0	71.1	82.2	88.7	86.8	77.3	64.4	48.2	39.8	<b>62.8</b>
	Min T	11.0	15.8	23.0	31.4	42.4	52.1	57.4	54.9	43.7	31.3	19.7	11.6	<b>32.9</b>
Sidney	Max T	37.3	43.1	49.4	58.6	68.7	80.0	87.4	86.0	76.3	64.1	47.5	39.8	<b>61.5</b>
	Min T	11.6	16.1	21.2	29.1	39.8	50.0	55.9	54.5	44.2	32.1	20.7	13.7	<b>32.4</b>

Note: Temperatures are 1971-2000 Normals.

### Monthly Record Highs and Lows:

City	Record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cheyenne	Highest	66	71	77	83	91	<b>100</b>	<b>100</b>	98	95	85	75	69
	Lowest	<b>-38</b>	-34	-21	-8	8	25	33	25	8	-5	-21	-28
Laramie	Highest	59	63	70	76	87	<b>94</b>	<b>94</b>	<b>94</b>	90	78	70	61
	Lowest	<b>-50</b>	-39	-25	-14	9	22	30	28	-2	-18	-26	-34
Rawlins	Highest	56	58	68	77	88	97	<b>98</b>	<b>98</b>	95	81	70	57
	Lowest	<b>-36</b>	<b>-36</b>	-23	-11	11	21	32	28	8	-7	-23	-35
Chadron	Highest	70	76	85	92	98	108	<b>112</b>	111	104	97	81	74
	Lowest	-29	<b>-33</b>	-20	-11	15	26	38	35	15	-10	-20	-29
Scottsbluff	Highest	74	77	87	93	103	106	<b>110</b>	106	102	93	80	77
	Lowest	-33	<b>-45</b>	-27	-8	12	30	35	30	14	-6	-21	-42
Sidney	Highest	73	76	83	90	96	105	<b>107</b>	104	100	93	81	72
	Lowest	<b>-30</b>	-27	-25	-9	16	28	37	36	13	6	-12	-23

**Bold** numerals indicate all-time record highs and lows.

## Growing season:

The relatively high altitude of this area does act to limit the growing season somewhat. As can be seen by the above table the month of July is the only month that freezing temperatures have not been recorded over most locations outside of the mountains. Freezing temperatures are rare from June through August and even frost is quite unusual during that time. In general the growing season is considered to run from about mid-May into mid-September. The following table shows the average dates of the last freeze in spring and the first freeze in fall, with the length of freeze-free days in between:

City	Avg. date last freeze in spring	Avg. date of first freeze in fall	Avg. freeze-free days
Cheyenne	May 14	September 29	137
Laramie	June 7	September 12	96
Rawlins	June 2	September 16	105
Chadron	May 15	September 25	132
Scottsbluff	May 7	September 30	145
Sidney	May 16	September 26	132

## Precipitation:

The part of this region below about 8000 feet elevation exists in what is known as a semi-arid climate, where the vegetation is dominated by grasses and shrubs. Forested areas are primarily confined to mountainous terrain where a more alpine climate exists. Average annual precipitation over the CWA ranges from around 10 inches over the western valleys to around 18 inches over far eastern sections, over the central Nebraska panhandle. Heavy precipitation is rare with most areas averaging daily precipitation over  $\frac{1}{4}$  inch liquid less than 20 days per year, and over  $\frac{1}{2}$  inch less than 10 days per year. Flooding is uncommon and typically limited and flashy, usually a result of heavy rains from slow-moving thunderstorms in the late spring and summer when atmospheric moisture is highest.

The following table depicts the average annual precipitation for the selected cities:

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Cheyenne	0.45	0.44	1.05	1.55	2.48	2.12	2.26	1.82	1.43	0.75	0.64	0.46	<b>15.45</b>
Laramie	0.38	0.46	0.79	1.06	1.67	1.33	1.56	1.23	0.99	0.80	0.64	0.46	<b>11.37</b>
Rawlins	0.56	0.52	0.65	1.06	1.49	0.93	0.90	0.81	0.82	0.86	0.65	0.49	<b>9.74</b>
Chadron	0.46	0.47	0.91	1.89	3.02	2.62	2.11	1.67	1.44	1.05	0.57	0.42	<b>16.63</b>
Scottsbluff	0.54	0.58	1.16	1.79	2.70	2.65	2.13	1.19	1.22	1.01	0.80	0.56	<b>16.33</b>
Sidney	0.44	0.39	1.57	2.19	3.39	3.00	2.55	2.25	1.07	0.78	0.65	0.50	<b>18.78</b>

May through July tends to be the wettest time of year outside of the mountains with almost ½ of the annual precipitation occurring during that time. The mountains tend to receive the most precipitation during the winter and spring due to orographic enhancement resulting from moist air being lifted up the windward sides. Cold season snowfall is extremely important as it constitutes the major source of water in this region once it melts and runs off for storage in area reservoirs.

### **Snow:**

Snow typically falls from October through early May. It has also fallen on rare occasions in September and June. The number of days with measurable snow over the plains averages about 35 per year, but most snowfalls are light with an average of only about 5 days a year with 3.0 or more inches of snowfall. Gusty winds are not uncommon with the snow and can create significant travel problems. Sometimes the worst problems occur after the snow ends due to a subsequent increase in the winds and associated blowing/drifting snow. Blizzards are rare and tend to be more localized in nature.

This table summarizes average monthly and annual snowfall in inches for selected cities in the CWA:

City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Cheyenne	7.3	6.8	12.5	9.1	2.5	0	0	0	1.6	4.1	8.5	7.9	<b>60.3</b>
Laramie	5.4	5.8	9.2	8.1	3.5	0.4	0	0	0.8	4.0	8.0	7.2	<b>52.4</b>
Rawlins	8.3	7.3	6.0	6.0	1.4	0.3	0	0	1.0	3.9	7.8	7.0	<b>49.0</b>
Chadron	6.8	6.1	8.0	3.8	0.4	0	0	0	0.1	2.4	5.7	7.6	<b>40.9</b>
Scottsbluff	6.9	6.2	8.9	5.0	0.6	0	0	0	0.6	2.3	6.6	7.1	<b>44.2</b>
Sidney	5.9	4.5	10.4	7.6	1.3	0	0	0	0.4	2.3	8.1	5.6	<b>46.1</b>

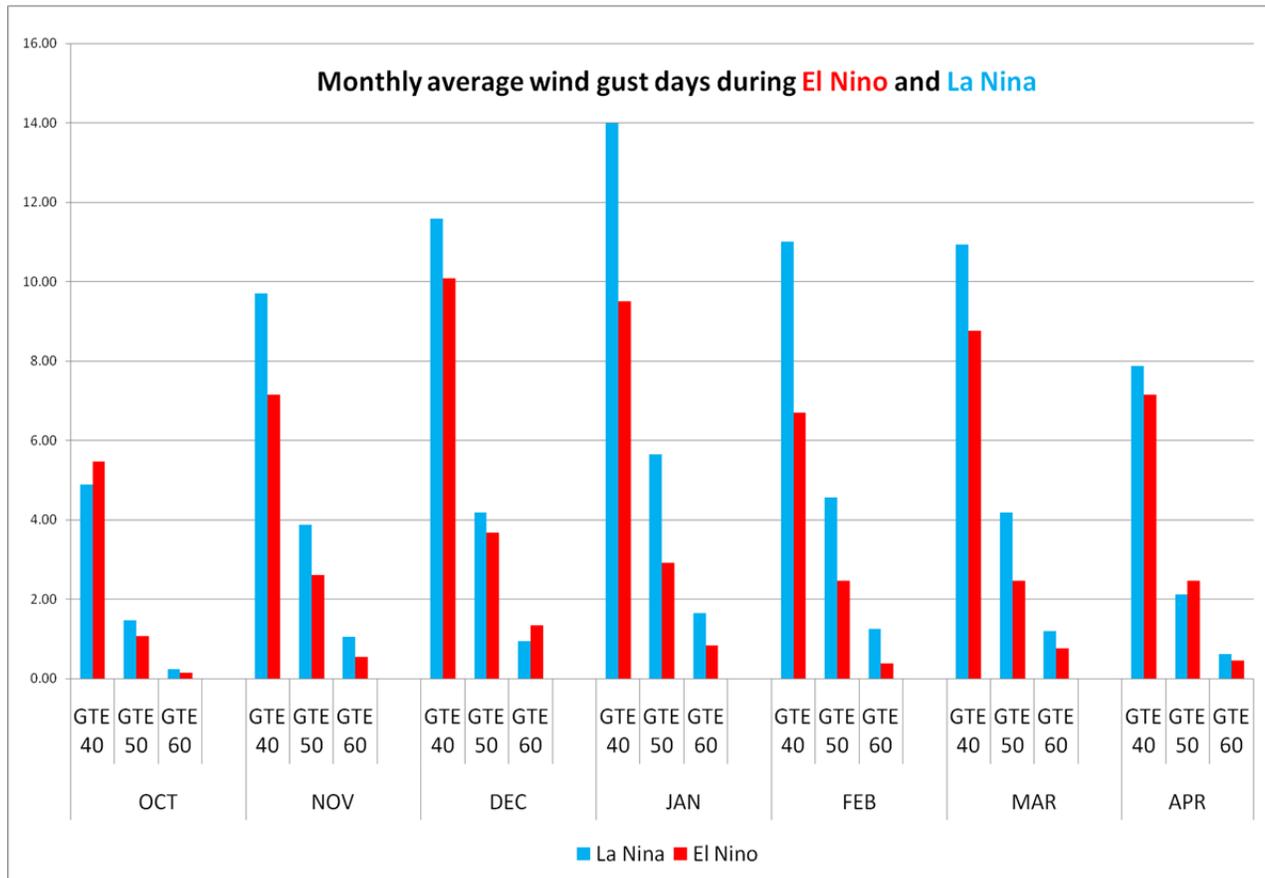
March tends to be the snowiest month across the area, usually due to an increased frequency of lee cyclones that develop over eastern Colorado, putting the CWA in a favorable upslope pattern, combined with better moisture values. Heavy snow can result from such events, most often in spring or fall. This next table shows the heaviest daily snowfalls and dates for selected cities in the CWA:

City	Greatest daily snowfall	Date of occurrence
Cheyenne	19.8 inches	November 20, 1979
Laramie	18.2 inches	December 24, 1982
Rawlins	19.0 inches	January 29, 1980
Chadron	26.7 inches	January 3, 1949
Scottsbluff	17.6 inches	April 25, 1935
Sidney	19.8 inches	November 27, 1983
Kimball	18.0 inches	March 25, 1959

## Effects from El Nino and La Nina

The events known as El Nino and La Nina do seem to have an effect on the general climate of the region, mostly during the fall into spring time. In general El Nino tends to produce milder temperatures, above average precipitation and less wind, while La Nina tends to produce the opposite, with somewhat colder and drier than average conditions and enhanced wind. Warm season effects are more ambiguous with no pronounced correlations. Curiously, La Nina tends to delay the onset of colder temperatures in fall, but then brings cold temperatures for mid-winter into spring.

This first chart shows the number of days with wind gusts equal to or greater than 40, 50 and 60 mph for Cheyenne with blue bars indicating La Nina seasons and red bars indicating El Nino seasons:



As you can see, the effect of wind enhancement during La Nina is most pronounced in January and February.

The next two charts depict temperature and precipitation anomalies for the two events:

## Oct-Mar and Dec-Feb Temperature Anomalies

La Nina Years								
	Cheyenne			Rawlins			Scottsbluff	
	OCT-MAR	DEC-FEB		OCT-MAR	DEC-FEB		OCT-MAR	DEC-FEB
<b>Avg Temp (F)</b>	<b>33.5</b>	<b>28.5</b>		<b>29.1</b>	<b>23.1</b>		<b>34.3</b>	<b>27.8</b>
<b>2008-2009</b>	<b>35.1</b>	29.3		<b>30.5</b>	24.0		<b>35.5</b>	<b>28.8</b>
<b>2007-2008</b>	32.9	<b>25.5</b>		<b>27.0</b>	<b>18.1</b>		32.8	<b>22.7</b>
<b>2000-2001</b>	<b>31.2</b>	26.6		<b>24.7</b>	<b>18.8</b>		32.3	26.2
<b>1999-2000</b>	<b>37.5</b>	<b>32.2</b>		<b>36.4</b>	<b>30.2</b>		<b>38.6</b>	<b>32.9</b>
<b>1998-1999</b>	<b>35.8</b>	<b>30.7</b>		<b>34.2</b>	<b>27.9</b>		<b>37.3</b>	<b>31.8</b>
<b>1988-1989</b>	33.2	<b>25.4</b>		28.6	<b>19.1</b>		33.4	<b>25.6</b>
<b>1984-1985</b>	<b>30.0</b>	<b>23.3</b>		<b>25.3</b>	<b>17.6</b>		32.4	<b>23.7</b>
<b>1975-1976</b>	34.2	<b>30.7</b>		29.0	24.0		<b>36.2</b>	<b>31.3</b>
<b>1974-1975</b>	31.9	<b>25.7</b>		27.6	<b>19.5</b>		33.6	26.7
<b>1973-1974</b>	<b>34.5</b>	28.4		28.9	<b>21.0</b>		34.0	26.4
<b>1970-1971</b>	32.3	28.1		27.9	23.3		32.4	27.0
<b>1964-1965</b>	32.3	29.1		27.3	23.0		32.9	28.1
<b>1955-1956</b>	32.6	27.5		28.7	23.1		32.6	26.0
<b>1954-1955</b>	32.9	26.8		27.4	<b>20.1</b>		32.9	<b>25.3</b>
<b>1950-1951</b>	34.0	28.9		M	M		34.9	<b>29.6</b>

El Nino Years								
	Cheyenne			Rawlins			Scottsbluff	
	OCT-MAR	DEC-FEB		OCT-MAR	DEC-FEB		OCT-MAR	DEC-FEB
<b>Avg Temp (F)</b>	<b>33.5</b>	<b>28.5</b>		<b>29.1</b>	<b>23.1</b>		<b>34.3</b>	<b>27.8</b>
<b>2009-2010</b>	<b>30.9</b>	<b>24.9</b>		<b>27.0</b>	<b>19.6</b>		32.4	24.3
<b>2006-2007</b>	34.0	<b>26.9</b>		29.1	<b>20.8</b>		34.3	26.4
<b>2004-2005</b>	<b>35.9</b>	<b>32.1</b>		<b>31.8</b>	<b>27.2</b>		<b>36.3</b>	<b>31.2</b>
<b>2002-2003</b>	33.9	<b>30.7</b>		29.6	<b>25.6</b>		34.5	<b>29.8</b>
<b>1997-1998</b>	33.3	<b>29.8</b>		<b>31.3</b>	<b>26.9</b>		35.1	<b>31.1</b>
<b>1994-1995</b>	<b>35.8</b>	<b>32.2</b>		<b>32.2</b>	<b>27.9</b>		35.2	<b>29.4</b>
<b>1991-1992</b>	<b>35.9</b>	<b>32.9</b>		<b>30.6</b>	<b>24.3</b>		<b>37.0</b>	<b>33.6</b>
<b>1986-1987</b>	33.5	<b>29.8</b>		28.0	22.6		34.7	30.4
<b>1982-1983</b>	33.8	<b>31.5</b>		29.4	<b>25.1</b>		<b>36.1</b>	<b>32.3</b>
<b>1972-1973</b>	<b>30.2</b>	<b>24.8</b>		<b>24.0</b>	<b>16.0</b>		<b>32.0</b>	<b>24.9</b>
<b>1968-1969</b>	33.9	<b>30.4</b>		28.1	<b>24.4</b>		32.6	26.2
<b>1965-1966</b>	<b>36.0</b>	28.2		<b>30.5</b>	22.1		34.7	<b>24.3</b>
<b>1957-1958</b>	33.3	<b>32.6</b>		29.1	<b>26.6</b>		34.6	<b>31.5</b>

	> 2.0 deg above average
	Between 1 and 2 degrees above average
	Within 1 degree of average
	Between 1 and 2 degrees below average
	> 2.0 deg below average

**October-March Precipitation Anomalies**

**La Nina Years**

	Cheyenne OCT-MAR		Rawlins OCT-MAR		Scottsbluff OCT-MAR
<b>Average Precipitation (inches)</b>	3.99		3.44		3.75
2008-2009	3.04		5.28		3.23
2007-2008	3.54		3.15		3.24
2000-2001	3.04		2.00		4.07
1999-2000	3.13		2.85		2.84
1998-1999	2.98		3.69		6.14
1988-1989	3.06		3.20		2.77
1984-1985	3.21		2.17		2.87
1975-1976	2.56		2.85		3.98
1974-1975	3.24		3.42		3.59
1973-1974	4.12		3.53		6.00
1970-1971	4.12		4.06		4.32
1964-1965	1.92		2.50		1.84
1955-1956	3.13		2.64		2.99
1954-1955	2.07		3.00		2.49
1950-1951	2.85		M		1.42

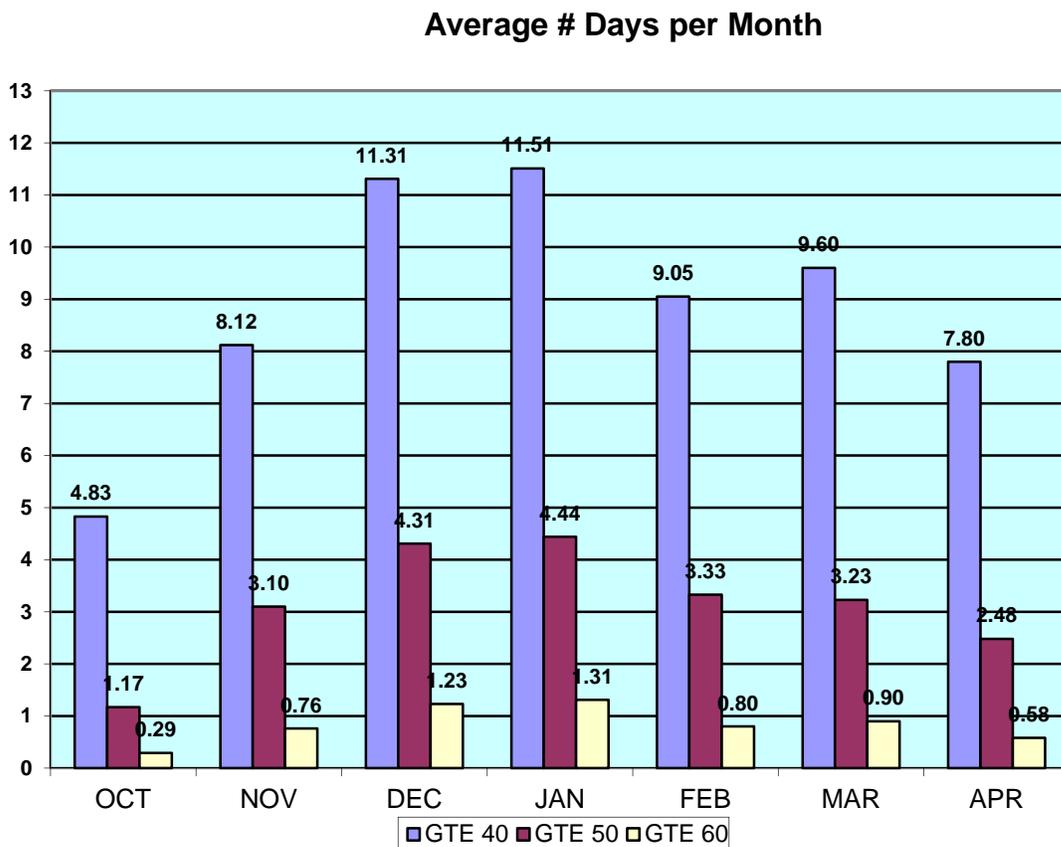
**El Nino Years**

	Cheyenne OCT-MAR		Rawlins OCT-MAR		Scottsbluff OCT-MAR
<b>Avg Precip (inches)</b>	3.99		3.44		3.75
2009-2010	5.67		3.40		4.99
2006-2007	4.26		2.66		3.90
2004-2005	3.95		2.30		4.74
2002-2003	4.46		2.32		3.70
1997-1998	2.93		4.47		4.39
1994-1995	3.79		3.03		6.39
1991-1992	4.48		3.13		4.80
1986-1987	4.86		4.13		6.41
1982-1983	5.44		2.24		4.86
1972-1973	3.56		5.08		6.29
1968-1969	2.60		2.93		3.35
1965-1966	1.42		2.27		2.56
1957-1958	4.66		3.20		3.97

[Dark Green]	> 1.0 inch above average
[Light Green]	Between 0.25 & 1.0 inch above avg
[White]	Within 0.25 inch of avg
[Yellow]	Between 0.25 & 1.0 inch below avg
[Dark Yellow]	> 1.0 inch below average

## Wind:

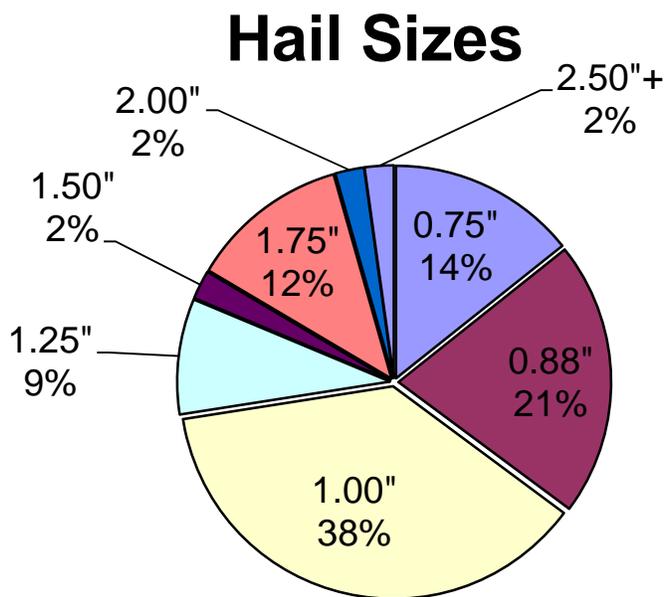
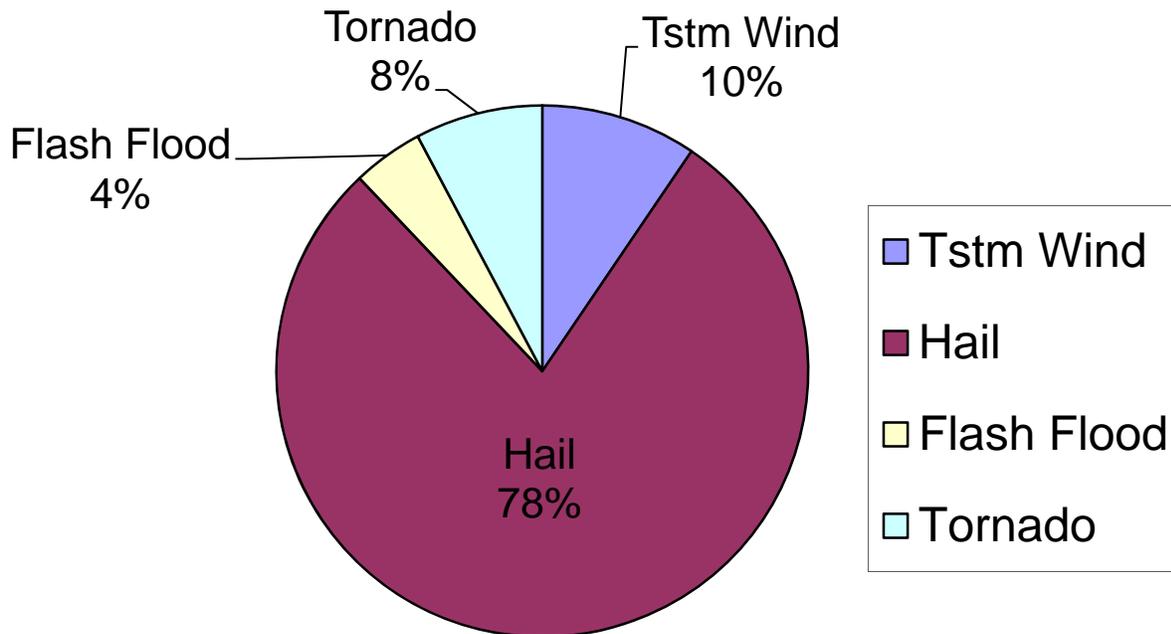
This is one of the windier areas of the country, especially over southeast Wyoming over and close to the mountains. Strong winds are a common occurrence from about November through April and are typically synoptically driven, though a few areas do get strong gap winds. Two notable locations for these particularly strong winds are along Interstate 80 near Arlington and along Interstate 25 at the Bordeaux interchange south of Wheatland (see map on page 3). The following chart shows the average number of days each month with wind gusts of at least 40, 50 and 60 mph in Cheyenne for the period October through April:



## Severe Convective weather:

The convective season runs generally from May into September with the period of highest thunderstorm frequency being about late May to early August. June is normally the most active month and severe thunderstorms are fairly common. Large hail is by far the most prevalent severe event in this area. In general the severe events begin in May with severe downburst winds, then transitions to large hail and some tornadoes in June into July. Flash flooding tends to uptick somewhat in July into early August as monsoonal moisture advects across the region. By late August the air mass typically begins drying and convection becomes increasingly sparse.

The following charts provide a breakdown of events in a typical severe convective season for this area:



As can be seen, about 2/3rds of the hail that falls ranges from  $\frac{3}{4}$  to 1 inch in diameter, with very large hail rare.

**Summary:**

The continental climate and varied elevation of the Cheyenne CWA provides for a wide variety of weather throughout the year and long periods of quiet weather do not occur often. Severe events are normally not widespread outside of winter snows. This climate provides a challenging environment for forecasters but is otherwise generally pleasant with ample sunshine, comfortable temperatures and low humidity.