Range Cattle Research and Education Center January 2019

Research Report RC-2019-1

CLIMATOLOGICAL REPORT 2018
Range Cattle Research and Education Center

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Weather conditions strongly influence agricultural operations from planting through harvesting. Knowledge of annual rainfall and temperature cycles, along with their extremes, help producers determine optimum times to prepare and plant seedbeds, fertilize pastures, apply herbicides, control water, and supplement cattle on pasture or range. Weather conditions influence forage seed germination, growth and development, palatability, and nutritive value.

This research report presents a summary of weather conditions observed during 2018 at the Range Cattle Research and Education Center (RCREC), Ona, Florida. The center is located 81° 56.406' W and 27° 23.733' N in south central Florida approximately 45 miles (72 km) east of the Gulf of Mexico and 100 miles (160 km) west of the Atlantic Ocean. Weather observations were collected with a Weather Watch 2000 (Campbell Scientific, Inc.) from 1997 until 2005. Beginning in 2006, observations were collected using the Florida Automated Weather Network (FAWN). Measurements reported prior to 2006 were recorded at 0900 h; thus, data on a given day represented the previous 24-hour period. Beginning in 2006, measurements were recorded for an entire 24-h period beginning at midnight.

Daily observations of rainfall, temperature, and solar radiation are summarized in Table 1. These data are then compared to a 77-year summary of rainfall data and a 75-year summary of temperature data collected at this location. In addition, monthly evapotranspiration and freeze hazard information are reported.

Table 1. Daily maximum and minimum temperature, precipitation, and solar radiation for 2017, Range Cattle REC.

	January				February				March				April			
Day	Max oF	Min oF	Rain inch	S Rad MJ/m2	Max oF	Min oF	Rain inch	S Rad MJ/m2	Max oF	Min oF	Rain inch	S Rad MJ/m2	Max oF	Min oF	Rain inch	S Rad MJ/m2
1	67.86	42.81	0.02	3.490	76.50	45.97	0.00	17.37	84.36	61.56	0.00	20.35	88.27	61.16	0.02	22.18
2	57.78	42.16	0.01	7.490	79.93	48.67	0.00	17.74	81.59	65.44	0.00	15.76	90.10	63.55	0.01	23.22
3	55.87	37.28	0.32	8.170	73.72	54.54	0.00	14.42	77.88	41.22	0.00	25.80	89.80	60.21	0.00	23.38
4	56.55	27.91	0.00	17.61	81.39	53.92	0.47	14.21	75.61	36.11	0.00	25.59	88.74	55.24	0.00	25.34
5	58.86	30.13	0.00	17.01	77.36	60.69	0.01	12.53	78.12	38.06	0.00	24.19	85.41	55.83	0.00	28.20
6	61.52	34.43	0.00	13.80	82.29	52.47	0.00	16.65	79.34	40.08	0.05	24.93	88.65	51.94	0.00	28.38
7	66.92	40.75	0.00	15.91	83.46	57.42	0.00	16.44	74.93	63.70	0.06	20.45	85.37	59.25	0.21	19.91
8	73.51	49.68	0.00	7.420	86.65	60.78	0.00	18.33	65.16	42.12	0.00	23.42	80.53	62.19	0.03	14.01
9	79.47	61.48	0.37	11.70	82.89	63.36	0.00	13.60	72.77	34.78	0.00	26.33	89.82	68.05	0.00	23.73
10	80.94	61.92	0.01	13.88	85.91	62.71	0.00	17.59	76.48	37.58	0.12	11.09	82.42	66.58	1.48	7.750
11	81.68	61.57	0.13	10.37	86.29	62.46	0.00	16.04	81.63	58.95	0.00	16.69	79.95	56.07	0.00	26.67
12	80.73	59.85	0.00	7.000	87.35	66.31	0.02	16.76	70.84	66.65	0.01	12.45	83.82	50.77	0.00	29.08
13	64.38	54.97	0.00	8.920	84.47	67.84	0.00	14.37	70.50	35.24	0.00	27.16	86.04	60.03	0.00	26.04
14	63.88	36.52	0.00	18.61	83.03	66.88	0.00	13.71	69.22	33.45	0.00	26.90	90.82	57.11	0.00	28.04
15	69.78	42.34	0.00	17.49	82.96	63.21	0.00	16.62	74.03	29.98	0.00	27.58	87.82	58.51	0.19	13.23
16	74.37	45.00	0.00	16.17	81.64	56.01	0.00	18.18	80.33	30.13	0.00	25.88	70.09	59.50	0.00	30.11
17	72.01	41.43	0.00	16.13	83.77	53.87	0.01	20.46	82.69	42.43	0.00	25.15	81.52	43.59	0.00	30.91
18	57.11	25.61	0.00	19.45	86.34	51.85	0.00	22.58	86.13	47.19	0.00	23.98	89.60	44.78	0.00	30.49
19	69.37	33.25	0.00	13.55	85.12	59.23	0.00	19.95	84.83	58.03	0.01	16.60	84.58	50.49	0.00	27.81
20	67.21	42.94	0.00	5.330	86.29	66.20	0.00	18.54	85.64	69.31	0.21	12.00	87.39	51.13	0.00	26.72
21	80.89	53.62	0.00	16.30	85.19	65.93	0.00	17.56	69.37	54.09	0.01	26.64	89.76	66.02	0.00	26.25
22	84.60	56.08	0.00	15.39	84.94	61.65	0.00	18.02	70.72	40.29	0.00	28.01	87.82	67.06	0.27	20.87
23	80.42	66.40	0.21	11.32	84.88	61.21	0.00	17.29	76.10	36.19	0.00	27.82	86.18	66.22	0.08	18.38
24	75.70	48.94	0.00	18.30	86.43	60.48	0.00	18.55	81.88	39.46	0.00	27.04	83.39	69.73	0.10	21.53
25	72.07	48.18	0.00	16.75	87.40	60.85	0.00	21.29	82.89	48.27	0.00	25.69	81.23	54.81	0.10	27.62
26	77.56	47.73	0.00	17.89	86.70	59.97	0.02	21.01	85.15	51.24	0.00	20.66	83.48	52.56	0.00	29.84
27	77.14	54.88	0.00	9.230	84.51	59.85	0.00	17.78	80.92	56.35	0.00	26.81	85.46	56.93	0.00	27.79
28	80.98	60.39	1.48	8.640	85.06	57.49	0.00	17.37	83.21	51.33	0.00	24.84	84.20	53.46	0.00	30.76
29	74.77	68.27	0.16	10.66					86.88	57.51	0.00	26.21	88.39	52.75	0.00	26.04
30	65.05	47.91	0.00	18.16					86.40	57.33	0.00	21.45	85.98	58.84	0.00	27.08
31	71.87	40.90	0.00	19.52					75.74	68.25	0.00	6.970				
Avg	71.00	47.27	0.09	13.28	84.00	59.40	0.02	17.32	78.43	48.14	0.02	22.43	88.60	57.81	0.08	24.71
Max	84.60	68.27	1.48	19.51	87.40	67.84	0.47	22.0	86.88	69.31	0.21	28.00	90.82	69.73	1.48	30.91
Min	55.87	25.61	0.00	3.48	73.72	45.97	0.00	12.53	65.16	29.98	0.00	6.960	70.09	43.59	0.00	7.75
Total			2.71	411.64			0.53	484.93			0.47	695.41			2.49	741.36

Table 1. Continued.

	May				June				July				August			
Day	Max °F	Min °F	Rain inch	S Rad MJ/m^2	Max °F	Min °F	Rain inch	S Rad MJ/m^2	Max °F	Min °F	Rain inch	S Rad MJ/m^2	Max °F	Min °F	Rain inch	S Rad MJ/m^2
1	87.40	56.34	0.00	25.73	89.47	70.79	0.01	21.70	91.87	73.11	0.01	23.31	91.67	73.98	0.00	22.00
2	87.01	54.32	0.00	25.69	90.77	70.90	0.00	29.53	94.96	72.10	0.00	30.24	92.93	74.86	0.84	27.33
3	88.88	58.15	0.00	29.25	89.42	72.00	0.00	26.47	92.77	72.16	0.49	19.25	92.91	72.72	0.25	24.91
4	90.18	60.53	0.00	29.27	90.00	75.22	0.00	25.92	90.23	69.89	0.69	18.60	92.64	74.52	0.07	27.17
5	86.54	61.27	0.07	18.38	89.46	73.62	0.00	24.98	92.07	69.08	1.80	24.82	92.46	74.28	0.00	21.84
6	75.51	68.79	1.24	12.54	88.75	73.45	0.00	22.11	90.90	71.51	0.00	18.10	91.35	74.01	0.00	25.47
7	90.23	64.99	0.00	25.29	91.11	68.61	0.77	27.14	90.43	71.29	0.05	19.83	93.79	74.75	0.00	27.68
8	88.88	59.70	0.00	29.68	89.40	68.77	0.06	22.62	91.98	70.77	0.01	23.49	93.13	72.30	0.01	23.83
9	89.31	57.13	0.00	30.62	92.19	67.87	0.00	28.80	93.07	72.93	0.03	28.62	92.82	70.65	0.01	24.80
10	85.41	59.22	0.04	20.15	91.29	68.88	0.01	28.98	93.67	72.90	0.00	25.48	87.35	74.19	1.10	16.61
11	90.82	57.72	0.00	24.86	90.09	69.03	0.45	20.63	92.64	73.13	0.01	23.48	86.41	73.85	0.54	18.20
12	82.92	67.75	0.00	9.69	90.82	67.69	0.00	22.61	91.63	71.85	0.26	19.50	85.44	73.13	0.21	17.70
13	81.41	61.86	0.53	7.640	92.64	70.09	0.19	25.86	93.09	72.07	0.00	25.22	90.50	73.20	0.00	23.33
14	77.20	69.28	3.04	7.570	89.55	70.32	0.54	20.06	93.58	72.19	0.00	23.07	91.51	71.64	0.00	19.55
15	88.21	69.66	1.44	23.87	90.59	71.80	0.23	19.75	94.32	71.15	0.83	24.97	91.40	71.78	0.31	19.79
16	86.83	68.11	0.08	22.50	90.57	70.21	0.01	21.93	95.07	73.83	0.49	24.68	91.47	72.18	0.03	23.90
17	82.71	69.04	0.86	9.810	93.16	71.40	0.00	27.20	91.33	74.71	0.15	19.34	93.31	73.96	0.00	27.55
18	87.69	66.34	0.01	25.26	92.73	74.26	0.05	24.96	89.28	74.98	0.20	16.18	95.09	72.95	0.00	28.86
19	83.39	67.05	0.26	13.41	92.19	71.02	0.01	30.48	87.71	75.36	0.29	14.69	95.00	72.77	0.01	22.83
20	73.06	68.43	1.68	4.680	93.16	72.18	0.11	22.04	89.47	75.07	0.30	18.96	91.49	72.79	0.03	22.02
21	82.81	69.93	0.18	18.97	92.14	73.44	0.05	23.78	86.74	75.78	0.30	9.790	93.60	70.57	0.01	23.71
22	83.57	70.75	0.12	14.26	91.56	73.47	0.06	23.29	91.49	76.64	1.10	24.61	89.74	73.13	0.00	25.92
23	89.26	68.13	0.00	24.62	93.13	74.14	0.00	26.17	91.36	68.79	0.52	23.96	88.72	73.51	0.01	18.37
24	89.85	69.04	0.01	23.96	93.56	72.61	1.93	25.80	90.16	73.54	0.15	23.33	92.28	73.44	0.57	18.14
25	85.71	70.88	0.46	12.79	92.59	71.13	0.00	27.13	90.57	74.97	0.00	22.28	92.89	71.28	0.47	20.11
26	78.71	67.93	0.33	9.530	93.04	72.75	0.22	25.76	92.05	74.23	0.00	26.81	91.45	71.85	0.44	21.47
27	85.12	70.16	0.46	13.55	0.000	0.000	0.00	0.000	93.36	74.52	0.00	26.41	93.22	72.18	0.04	18.34
28	86.09	74.37	0.13	19.35	91.31	73.81	0.08	13.75	94.77	72.12	1.73	24.64	91.56	72.09	0.00	19.60
29	85.53	72.25	0.00	17.80	89.15	73.22	0.18	13.11	91.87	72.82	1.65	16.88	88.66	68.61	1.36	12.31
30	81.37	72.61	2.58	8.840	83.57	74.84	0.01	14.28	86.47	72.90	1.98	13.60	88.63	70.65	0.03	13.91
31	86.50	72.45	0.03	16.57					88.68	72.27	0.01	16.94	89.19	72.30	0.29	12.92
Avg	85.10	65.94	0.44	18.58	90.95	71.64	0.16	23.68	91.54	72.86	0.42	21.65	91.37	72.71	0.21	21.62
Max	90.82	73.06	3.04	30.62	93.56	83.57	1.93	30.47	95.07	86.47	1.98	30.23	95.09	74.86	1.36	28.86
Min	74.37	54.32	0.00	4.670	75.22	67.69	0.00	13.11	86.47	68.79	0.00	9.780	85.44	68.61	0.00	12.31
Total			13.55	576.09			4.97	686.88			13.05	671.08			6.63	670.16

Table 1. Continued.

	September				October				November				December			
Day	Max ºF	Min ºF	Rain inch	S Rad MJ/m^2	Max ºF	Min ºF	Rain inch	S Rad MJ/m^2	Max ºF	Min ºF	Rain inch	S Rad MJ/m^2	Max ºF	Min ºF	Rain inch	S Rad MJ/m^2
1	91.15	73.80	0.00	24.55	90.39	72.10	0.00	17.02	86.25	59.65	0.00	15.21	84.51	62.87	0.00	11.97
2	89.92	73.29	0.21	18.39	89.04	73.85	0.27	17.93	85.78	64.85	0.42	11.35	85.80	69.15	0.00	13.25
3	84.13	73.63	0.34	13.06	89.42	70.14	0.01	21.12	75.69	60.21	0.00	17.59	85.50	68.45	0.02	11.60
4	90.23	74.26	0.01	20.73	90.70	69.69	0.00	19.20	85.42	64.96	0.18	8.660	83.21	70.70	0.00	12.56
5	92.28	74.55	0.19	22.04	91.58	71.11	0.00	23.17	85.91	67.69	0.00	16.25	64.99	50.67	0.00	17.43
6	86.38	74.62	0.46	16.11	90.09	70.61	0.07	19.44	87.89	66.00	0.00	17.83	72.72	38.32	0.00	17.09
7	90.73	72.73	0.04	18.92	88.23	69.21	0.03	18.16	89.69	65.79	0.00	17.85	77.29	49.59	0.00	15.00
8	91.78	71.74	0.45	23.28	85.33	72.39	0.06	9.230	88.27	67.26	0.60	14.96	81.93	54.32	0.00	13.97
9	90.03	70.38	0.00	20.11	91.40	74.43	0.00	15.88	88.39	68.76	0.01	15.12	73.22	63.27	0.41	3.038
10	89.67	72.79	0.01	18.04	88.50	75.76	0.62	12.73	85.80	68.25	0.00	14.71	63.07	44.04	0.00	7.800
11	91.78	72.68	0.00	20.56	85.26	75.51	0.47	7.300	86.59	63.39	0.00	15.23	60.39	40.08	0.00	15.39
12	94.01	76.26	0.00	21.46	86.85	75.07	0.00	12.64	89.26	67.69	0.00	14.42	69.75	37.30	0.01	14.61
13	93.63	74.77	0.91	21.76	88.41	65.32	0.00	22.92	87.12	66.74	0.00	13.74	79.21	52.95	0.00	11.57
14	93.60	72.45	0.01	21.40	92.64	69.30	0.00	19.35	87.55	65.16	0.26	14.03	83.23	62.56	0.14	3.980
15	92.23	74.50	0.00	22.64	91.92	72.59	0.00	21.23	76.55	65.37	0.01	7.840	73.45	59.00	1.12	6.680
16	92.48	74.80	0.00	23.61	91.62	71.73	0.02	18.41	72.09	47.80	0.00	19.13	75.96	52.95	0.00	13.31
17	93.15	73.22	0.01	21.99	92.52	70.30	0.00	20.38	77.27	46.99	0.00	18.87	68.07	46.15	0.01	14.14
18	94.32	73.65	0.00	24.72	91.78	70.23	0.00	20.18	82.31	56.26	0.01	13.23	73.89	43.06	0.00	16.42
19	95.20	73.65	0.54	23.71	91.04	71.10	0.01	21.47	83.21	66.24	0.00	10.99	73.06	46.49	0.08	7.220
20	94.80	72.93	0.02	23.21	91.47	69.01	0.00	21.02	77.77	63.97	0.32	8.810	64.81	60.64	4.33	1.090
21	91.81	72.45	0.01	20.02	86.83	68.27	0.00	19.44	78.51	60.39	0.01	17.36	63.46	57.60	0.27	10.26
22	91.27	72.86	0.01	21.42	85.57	63.61	0.00	19.13	72.66	55.15	0.00	12.06	63.91	47.30	0.01	13.96
23	92.59	72.75	0.00	22.39	87.49	61.99	0.00	20.40	81.81	59.16	0.00	14.86	70.70	40.35	0.00	17.31
24	93.63	72.79	0.76	18.98	86.34	69.42	0.00	14.41	83.34	63.27	0.00	14.82	72.95	42.24	0.00	16.78
25	91.65	73.18	0.00	22.03	88.36	64.67	0.00	19.31	81.77	63.93	0.01	15.25	75.06	49.03	0.00	13.20
26	95.07	73.96	0.27	21.61	86.49	67.77	0.00	13.65	83.73	61.48	0.42	11.96	77.83	57.69	0.00	16.26
27	93.78	72.36	0.06	19.77	81.86	65.01	0.00	16.12	66.18	43.57	0.02	13.39	81.66	59.70	0.01	10.38
28	92.77	71.89	0.16	23.97	77.50	54.12	0.00	21.31	59.63	36.10	0.00	16.93	85.19	67.69	0.00	11.73
29	92.68	72.72	0.00	22.55	84.63	49.48	0.00	20.75	67.78	43.13	0.00	16.27	85.57	65.21	0.00	11.62
30	91.96	72.75	0.00	23.28	85.50	56.23	0.01	20.31	79.09	49.50	0.00	13.82	85.35	63.32	0.01	12.81
31					84.96	57.99	0.00	18.81					83.01	61.02	0.00	13.29
Avg	91.96	73.28	0.15	21.21	88.18	68.00	0.05	18.14	81.11	59.96	0.07	14.42	75.44	54.31	0.21	12.15
Max	95.20	84.13	0.91	24.71	92.64	77.50	0.62	23.17	89.69	68.76	0.60	19.12	85.80	70.70	4.33	17.42
Min	76.26	70.38	0.00	13.06	75.76	49.48	0.00	7.290	59.63	36.10	0.00	7.840	60.39	37.30	0.00	1.080
Total			4.47	636.26			1.57	562.40			2.27	432.53			6.42	376.73

Rainfall

Daily rainfall equaled or exceeded 1 inch on 17 separate occasions, with a daily total rainfall maximum of 4.33 inches on 20 December (Table 1). Annual rainfall for 2018 totaled 59.13 inches, which was 6 inches greater than the 77-year average of 53.13 inches (Table 2). The lowest annual total on record was observed in 2000 when 32.02 inches were measured, and the greatest annual rainfall total observed was in 1959 when 78.82 inches were recorded. Record rainfall was recorded during the month of May in 2018 with 13.55 inches recorded. Six months of rainfall was below normal. Monthly rainfall during 2018 is graphically compared to historical mean, median, maximum, and minimum rainfall in Figure 1.

Table 2. Summary of rainfall by months. Range Cattle REC, 2018.

Month	1942 to 2018 Maximum / month	1942 to 2018 Minimum / month	77-year average†	2018 Total	Difference from 77-year average
	----------	----------	inches*	----------	----------
January	8.45	0.03	2.15	2.71	0.56
February	9.59	0.02	2.45	0.53	- 1.92
March	12.34	0.13	2.98	0.47	- 2.51
April	11.91	0.00	2.42	2.49	0.07
May	13.55	0.00	3.80	13.55	9.75
June	18.99	2.79	8.62	4.97	- 3.65
July	19.74	1.87	8.33	13.05	4.72
August	16.10	3.13	8.36	6.63	- 1.73
September	20.11	1.14	7.33	4.47	- 2.86
October	11.23	0.00	2.88	1.57	- 1.31
November	11.22	0.07	1.85	2.27	0.42
December	8.61	0.07	1.96	6.42	4.46
Year total			*53.13*	*59.13*	*6.00*

*Inches x 2.54 = cm.

† Since rainfall records began in July 1942, means for January to June are 76-year means.

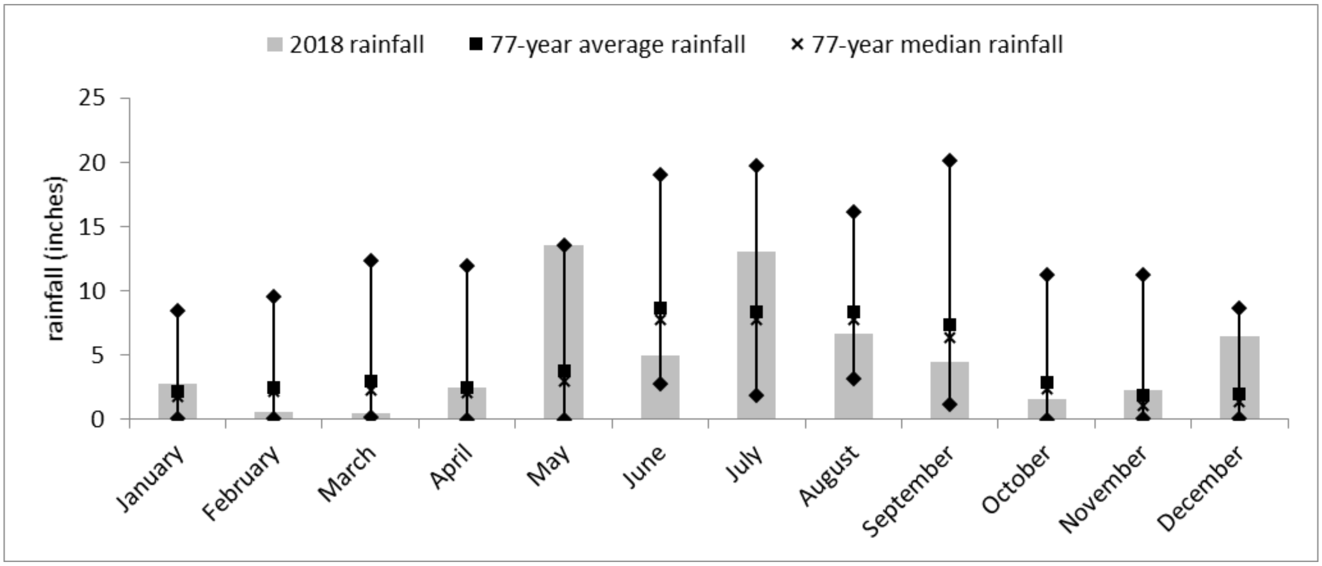

Figure 1. Monthly rainfall at the Range Cattle REC during 2018 relative to historical average, median, minimum, and maximum monthly rainfall. Current rainfall is indicated by the gray bars, historical average and median rainfall are indicated by squares (■) and "X's" (x), respectively. Historical high and low rainfall are indicated by diamonds (♦).

Evapotranspiration

Evapotranspiration is the total amount of water transferred from the earth to the atmosphere. Monthly evaporation in 2018 was 2.56 inches greater than the 13-year average (Table 3). Evapotranspiration exceeded rainfall in February through April, June, and October through November in 2018 (Figure 2). It is quite normal for evapotranspiration to exceed rainfall in January and December, but above average rainfall prevented this occurrence. Rainfall exceeded evapotranspiration by 14.24 inches for the year.

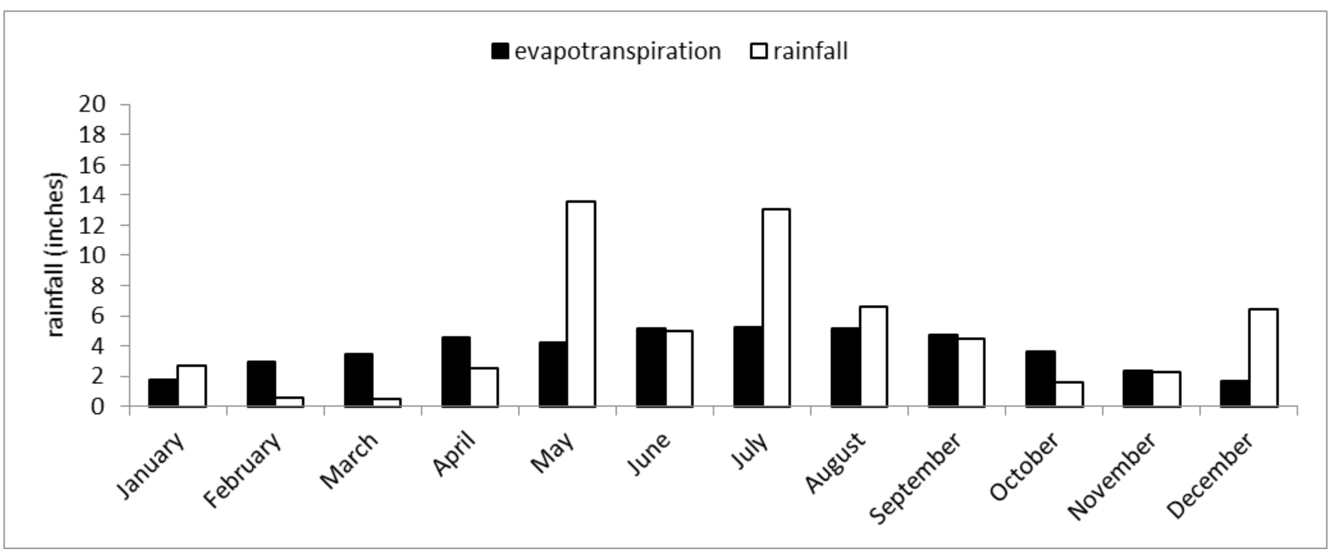

Figure 2. Comparison of monthly evapotranspiration and rainfall at the Range Cattle REC during 2018.

Solar Radiation. Total solar radiation for 2018 was 6945.47 MJ. Daily solar radiation is shown in Table 1, and 2018 total monthly solar radiation can be seen in Table 3. If soil water, temperature, and fertility are not limiting and vegetative cover is complete, 1 MJ results in about 14.3 lb/A of plant dry matter. Theoretically, enough solar radiation was received in April 2018 (709.80 MJ) to produce approximately 10,150 lb/A of plant dry matter.

Table 3. Monthly solar radiation and evapotranspiration at the Range Cattle REC in 2018.

	2006-2018	2018	2006-2018	2018
Month	Evapotranspiration		Solar radiation	
	--------inches--------		--------MJ/m^2--------	
January	1.89	1.77	412.43	411.64
February	2.46	2.93	458.91	484.93
March	3.38	3.45	647.04	695.41
April	4.37	4.54	709.80	741.36
May	5.20	4.25	768.55	576.09
June	4.90	5.13	664.09	686.88
July	4.91	5.27	647.88	671.08
August	4.58	5.15	589.06	670.16
September	3.93	4.75	525.54	636.26
October	3.16	3.63	500.08	562.40
November	2.00	2.32	398.01	432.53
December	1.55	1.70	373.20	376.73
Total	*42.33*	*44.89*	*6694.59*	*6945.47*

Temperature

The highest temperature observed during 2018 was 95.20 °F on 19 September (Table 1). Monthly average-high temperatures exceeded the 75-year average in all months except January, March, May, and July (Table 4). Monthly average low temperatures were above the 75-year average in all months except January and March (Table 5). Daily average low temperatures at or below 32 °F were recorded five times between January and March, with the extreme low of 25.6 °F occurring on 18 January (Table 1). Scattered frost begins to occur when air temperature drops to 35 °F. Air temperatures at or below 35°F occurred ten times, resulting in widespread or scattered frost across the landscape (data not shown). Overall, mean low temperature for 2018 was 1.5 degrees greater than the 75-year mean.

Table 4. Summary of maximum temperature* during 2018 by month, Range Cattle REC.

	Shelter†					Ground level‡	
	1944-2018	2018	1944-2018		2018	2018	
Month	Avg. high	Avg. high	Extreme high	Year	Extreme high	Avg. high	Extreme high
	--°F--					----------°F----------	
January	73.2	71.0	90.0	1982	84.6	64.0	70.4
February	75.2	83.7	91.0	1962	87.4	66.5	77.2
March	79.1	78.4	94.0	1946	86.9	74.0	80.0
April	83.6	85.6	97.0	1945	90.8	81.1	84.5
May	88.1	85.1	103.0	1945	90.8	81.0	85.9
June	90.1	90.9	103.0	1945	93.6	85.7	88.0
July	90.9	91.5	101.0	1972	95.1	84.7	87.6
August	91.1	91.4	98.0	several	95.1	84.0	85.9
September	89.6	92.0	96.2	several	95.2	82.5	83.8
October	85.0	88.2	96.5	2015	92.6	79.5	81.5
November	79.3	81.1	94.0	1990	89.7	74.1	78.9
December	74.6	75.4	89.0	1945	85.8	67.9	75.6
Average	*83.3*	*84.5*				*77.1*	

*°C = (°F – 32) x 0.555

† Prior to 2006, air temperature is measured using a thermometer in an instrument shelter designed to protect meteorological equipment from exposure to direct sunlight, precipitation, and condensations, while allowing for adequate ventilation so that the instruments measure environmental parameters accurately.

‡ Ground level temperature is measured with a soil probe, which measures the temperature 4 inches below the soil surface.

Table 5. Summary of minimum temperature* for 2018 by month, Range Cattle REC.

	Shelter†					Ground level‡	
	1944-2018	2018	1944-2018		2018	2018	
Month	Avg. low	Avg. low	Extreme low	Year	Extreme low	Avg. low	Extreme low
	-----------------------------------°F-----------------------------------					----------°F----------	
January	49.1	47.3	18.0	1981	25.6	58.4	50.7
February	50.7	59.4	23.8	2009	46.0	66.5	56.5
March	54.2	48.1	26.0	1980	30.0	64.7	58.3
April	58.1	57.8	34.0	1971	43.6	71.0	64.5
May	63.3	65.9	43.0	1945	54.3	73.8	71.7
June	69.1	71.6	52.0	1984	67.7	79.5	76.7
July	71.3	72.9	62.0	several	68.8	80.4	78.8
August	72.0	72.7	61.0	1977	68.6	80.6	78.4
September	71.2	73.3	51.0	1962	70.4	79.5	70.8
October	64.8	68.0	37.5	2008	49.5	76.5	69.7
November	56.9	60.0	25.0	1970	36.1	69.8	59.9
December	51.6	52.5	20.0	1962	37.3	63.2	56.1
Average	*61.0*	*62.5*				*72.0*	

*°C = (°F – 32) x 0.555

† Prior to 2006, air temperature is measured using a thermometer in an instrument shelter designed to protect meteorological equipment from exposure to direct sunlight, precipitation, and condensations, while allowing for adequate ventilation so that the instruments measure environmental parameters accurately.

‡ Ground level temperature is measured with a soil probe, which measures the temperature 4 inches below the soil surface.

Freeze hazard

The fall and spring freeze hazards for the Range Cattle REC are shown in Figure 3. The spring freeze hazard estimates the likelihood of temperatures reaching below the critical temperature after a selected date, while the fall freeze hazard estimates the likelihood of experiencing the first attainment of a critical temperature before a selected date. Based on records from 1964 to 2017, these data will not predict what will occur in a given year, but what can be expected over a period of years. In an example using the spring freeze hazard, one should expect approximately a 30% chance of a frost (assuming 35 °F) occurring before the 1st of March (Figure 4C). A grower has a significant likelihood of experiencing three frosts over ten years after the 1st of March; however, the likelihood drops to approximately 10% by March 20th.

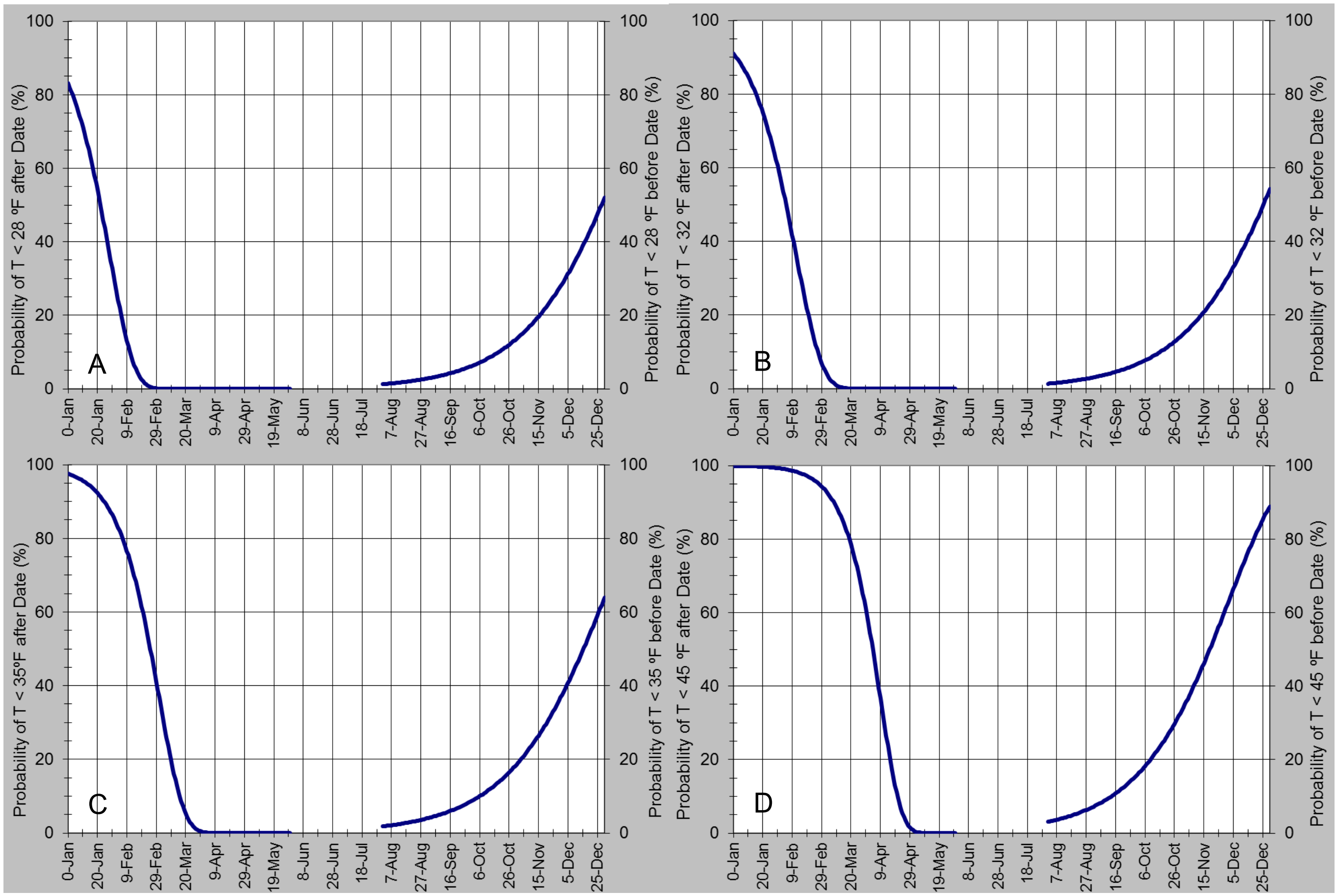

Figure 3. Spring and fall freeze hazard showing temperature probabilities after a given spring date and before a given fall date. Trend lines for temperature probabilities <28 ºF (A), <32 ºF (B), <35 ºF (C), and <45 ºF (D). Graphs were constructed using minimum temperature data from 1960 – 2010 using FRISKNH as developed by R. Snyder and J. Paulo de Melo-Abreu.