A Review of the Record-Breaking Snow and Persistent Cold of February and March 1960 in the Western Carolinas and Extreme Northeast Georgia

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1. Introduction

February and March 2010 marked the 50th anniversary of one of the most severe periods of winter weather on record in the western Carolinas and extreme northeast Georgia. Beginning in February 1960, a series of winter storms and a prolonged period of below normal temperatures disrupted commerce, schools, and life in general across the region.

The severe winter weather was not confined to the southern Appalachians and nearby areas. The entire eastern United States was affected. According to narratives at the time (Ludlum 1960a,b), the month of March 1960 had more records for snow and cold in the eastern states than any previous March. The coldest March on record at Asheville, Charlotte, and Greenville-Spartanburg occurred in 1960. The average temperature departure was nearly 12°F below normal for the month (Fig. 1). The monthly snowfall for March 1960 was greater than 500% of the mean monthly snowfall (Fig. 2). The general nature of the snowfall map does not depict details and extremes in the southern Appalachians.

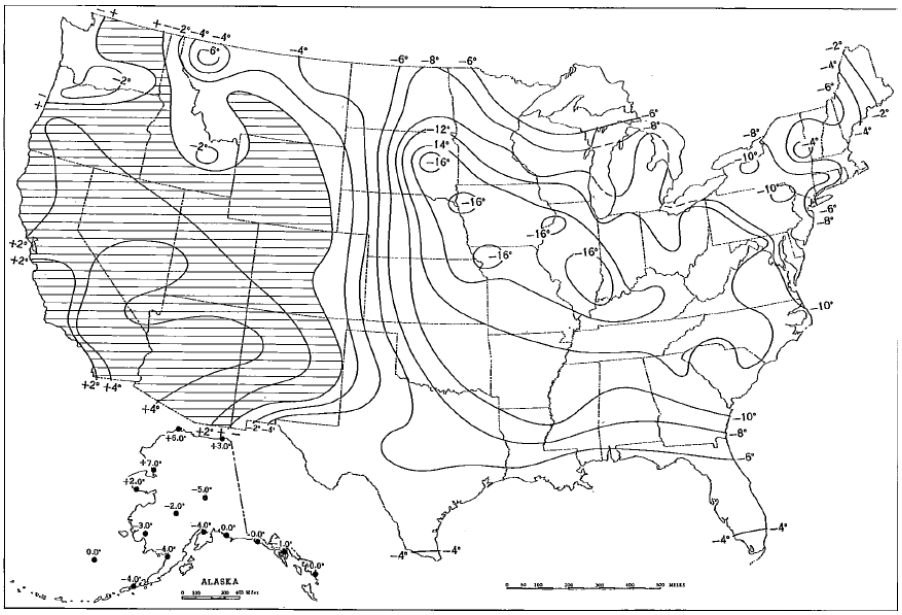

Fig. 1. Departure of average temperature from normal for March 1960. (U.S. Department of Commerce, 1960d)

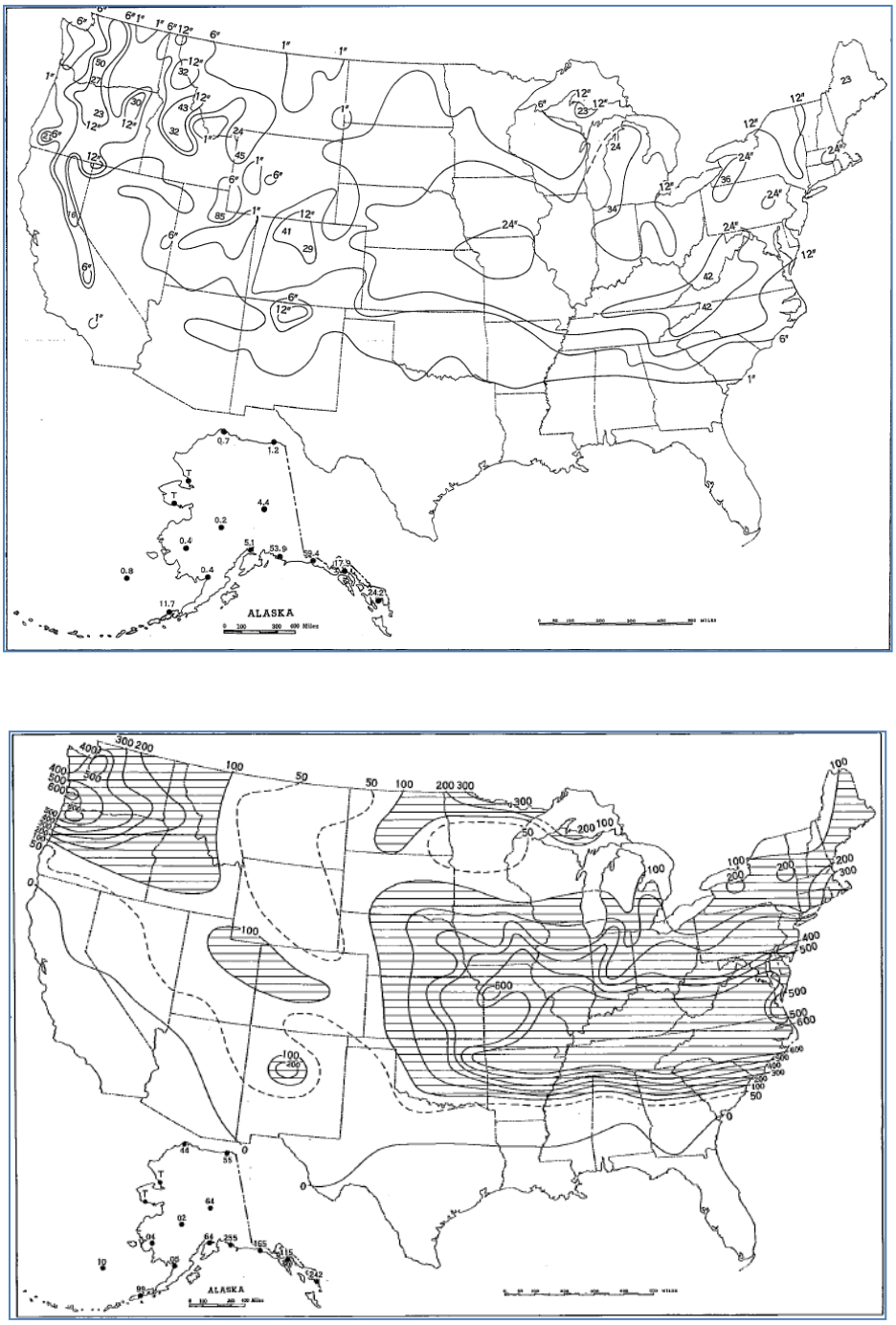

Fig 2. Monthly snowfall (top) percentage of mean monthly snowfall (bottom) for March 1960. (U.S. Department of Commerce, 1960d)

Following December 1959 and January 1960 with near or slightly above normal temperatures in the Southeast, the flow pattern across North America changed abruptly to a configuration that favored cold weather for the eastern United States. One of the most significant features in the mean mid-tropospheric flow pattern for the first half and second half February (Stark 1960) was the retrogression of the Aleutian low to the vicinity of the Kamchatka Peninsula in eastern Russia (Fig. 3). In its place, the mean ridge over western North America during the first half of the month drifted westward and increased in amplitude. The resulting flow pattern directed

cold air from western Canada into the Lower 48. The tables in Figs. 5 and 6 show the daily high, low, and average temperatures at Asheville, Charlotte, and Greenville for both February and March. Of particular interest was the nearly continuous period of below normal daily average temperatures from the 12th of February until the 27th of March.

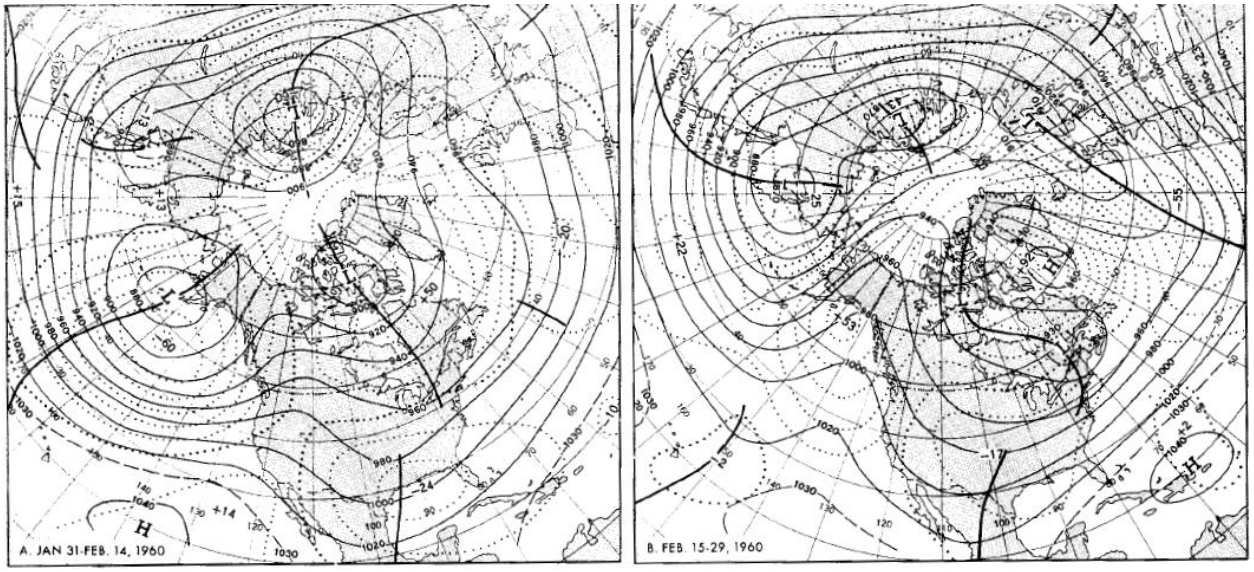

Fig. 3. Mean 700 mb height contours (solid) and height departures from normal (dotted) in tens of feet for 31 January – 14 February 1960 (left) and 15 February – 29 February 1960. Heights over the Gulf of Alaska increased as much as 1,020 feet. From Stark (1960).

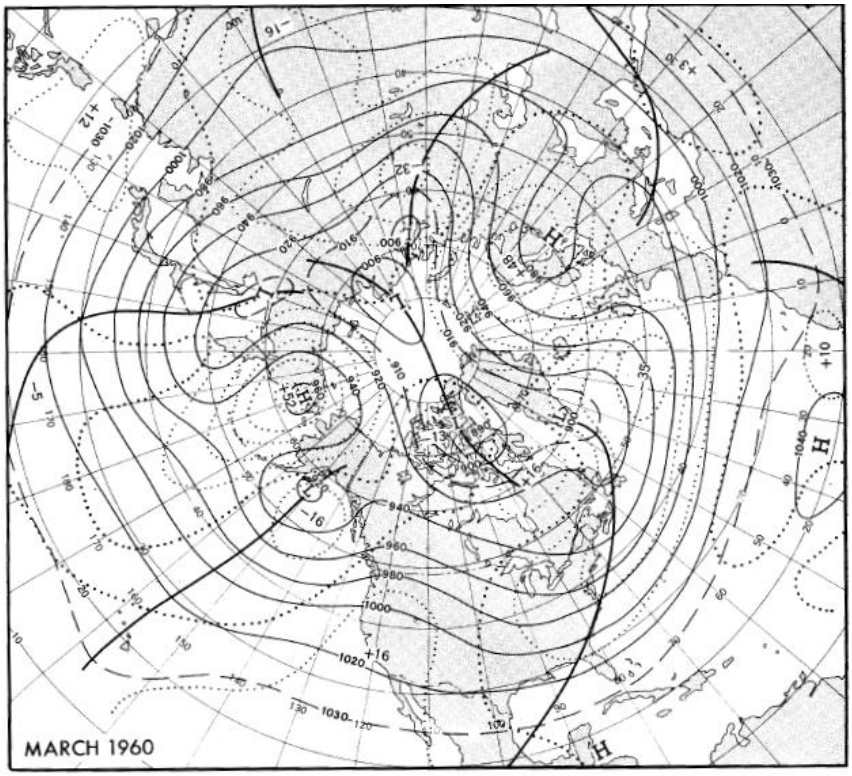

Fig 4. As in Fig. 3 except for March 1960. From Dunn (1960)

Asheville - February 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7 a.m. (In.)
1	2	3	4	5	6	7	8	9
1	60	30	45	+ 5	20	0	0	0
2	61	34	48	+ 8	17	0	0	0
3	44	36	40	0	25	T	0	0
4	41	31	36	- 4	29	0.10	T	0
5	49	38	44	+ 4	21	1.54	0	0
6	49	36	43	+ 3	22	T	0	0
7	37	27	32	- 8	33	0	0	0
8	54	21	38	- 2	27	0	0	0
9	60	34	47	+ 7	18	T	0	0
10	58	48	53	+13	12	0.57	0	0
11	55	29	42	+ 2	23	0	0	0
12	46	25	36	- 4	29	0	0	0
13	37	22	30	-10	35	1.04	6.5	3
14	26	16	21	-19	44	T	T	5
15	42	11	27	-14	38	0	0	3
16	49	21	35	- 6	30	0	0	1
17	55	29	42	+ 1	23	0	0	1
18	44	24	34	- 7	31	0.61	2.0	0
19	31	19	25	-16	40	T	T	1
20	40	17	29	-13	36	0	0	T
21	37	31	34	- 8	31	0.09	T	0
22	38	27	33	- 9	32	T	T	0
23	48	22	35	- 7	30	0	0	0
24	54	25	40	- 2	25	0.08	0	0
25	43	36	40	- 2	25	0.16	0	0
26	36	26	31	-12	34	T	T	0
27	40	23	32	-11	33	0	0	0
28	53	30	42	- 1	23	T	T	0
29	40	26	33	-10	32	0	0	0
30								
31								
Sum	1327	794				4.19	8.5	
Avg	45.8	27.4						

Asheville - March 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7 a.m. (In.)
1	2	3	4	5	6	7	8	9
1	39	18	29	-14	36	0	0	0
2	31	19	25	-18	40	1.69	9.3	1
3	32	19	26	-17	39	0.08	0.8	8
4	23	9	16	-28	49	0.02	0.6	5
5	20	5	13	-31	52	T	T	5
6	28	5	17	-27	48	0	0	5
7	31	15	23	-22	42	0.03	0.6	5
8	35	14	25	-20	40	T	T	4
9	28	19	24	-21	41	0.79	11.0	7
10	38	21	30	-15	35	T	T	13
11	33	25	29	-17	36	0.21	3.4	8
12	28	21	25	-21	40	0.03	0.6	9
13	40	14	27	-19	38	0	0	7
14	45	15	30	-17	35	T	T	5
15	37	31	34	-13	31	0.02	0.4	2
16	34	28	31	-16	34	0.44	0.9	2
17	53	31	42	- 5	23	0	0	2
18	38	27	33	-15	32	T	T	T
19	43	23	33	-15	32	T	T	T
20	37	26	32	-16	33	T	0.1	T
21	34	21	28	-20	37	0.04	1.2	1
22	44	24	34	-14	31	0	0	T
23	51	21	36	-13	29	0	0	1
24	57	28	43	- 6	22	0	0	0
25	49	25	37	-12	28	0	0	0
26	60	33	47	- 3	18	T	T	0
27	71	30	51	+ 1	14	0	0	0
28	70	40	55	+ 5	10	0	0	0
29	62	55	59	+ 9	6	0.24	0	0
30	69	50	60	+ 9	5	0.38	0	0
31	58	45	52	+ 1	13	T	0	0
Sum	1318	757				3.97	28.9	
Avg	42.5	24.4						

Charlotte - February 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7 AM (In.)
1	2	3	4	5	6	7	8	9
1	62	34	48	+ 5	17	0	0	0
2	63	36	50	+ 7	15	0	0	0
3	47	35	41	- 2	24	0	0	0
4	46	33	40	- 3	25	.28	?	0
5	54	39	47	+ 4	18	1.47	0	0
6	61	41	51	+ 8	14	0	0	0
7	51	30	41	- 2	24	0	0	0
8	57	24	41	- 3	24	0	0	0
9	64	40	52	+8	13	0	0	0
10	68	54	61	+17	4	1.02	0	0
11	58	35	47	+ 3	18	T	0	0
12	58	27	43	- 1	22	0	0	0
13	47	28	38	- 6	27	1.88	3.0	2
14	35	23	29	-15	36	0.04	0.3	2
15	41	16	29	-15	36	0	0	1
16	53	28	41	- 4	24	0	0	0
17	59	35	47	+ 2	18	0	0	0
18	53	35	44	- 1	21	.90	0	0
19	46	27	37	- 8	28	0	0	0
20	49	21	35	-10	30	0	0	0
21	48	35	42	- 3	23	.06	0	0
22	51	35	43	- 3	22	0	0	0
23	54	28	41	- 5	24	0	0	0
24	59	26	43	- 3	22	.08	0	0
25	45	37	41	- 5	24	.58	0	0
26	52	32	42	- 4	23	0	0	0
27	49	24	37	-10	28	0	0	0
28	55	33	44	- 3	21	T	0	0
29	56	35	46	- 1	19	0	0	0
30								
31								
Sum	1342	926				6.31	3.3	
Avg	53.2	32.0						

Charlotte - March 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7 AM (In.)
1	2	3	4	5	6	7	8	9
1	44	27	36	-11	29	0	0	0
2	32	22	27	-21	38	1.59	8.0	0
3	41	23	32	-16	33	.33	1.5	8
4	34	21	28	-20	37	0	0	6
5	31	12	22	-26	43	0	0	6
6	36	10	23	-26	42	0	0	6
7	42	18	30	-19	35	0	0	6
8	38	21	30	-19	35	0	0	5
9	30	21	26	-23	39	.48	7.6	4
10	46	19	32	-18	33	0	0	8
11	37	26	32	-18	33	.10	2.2	4
12	41	27	34	-16	31	.01	T	4
13	47	18	33	-17	32	0	0	2
14	50	27	39	-12	26	0	0	1
15	49	36	43	- 8	22	T	T	T
16	38	30	34	-17	31	.77	T	T
17	62	31	47	- 5	18	0	0	T
18	51	34	43	- 9	22	T	0	T
19	48	26	37	-15	28	T	0	0
20	47	30	39	-13	26	0	0	0
21	44	23	34	-19	31	0	0	0
22	60	28	44	- 9	21	0	0	0
23	52	25	39	-14	26	0	0	0
24	69	31	50	- 3	15	0	0	0
25	54	35	45	- 9	20	0	0	0
26	67	36	52	- 2	13	0	0	0
27	76	40	58	+ 4	7	0	0	0
28	82	46	64	+10	1	0	0	0
29	71	56	64	+ 9	1	.87	0	0
30	69	54	62	+ 7	3	.78	0	0
31	72	47	60	+ 5	5	0	0	0
Sum	1559	900				4.93	19.3	
Avg	50.3	29.0						

Fig. 5. Daily temperature and precipitation data at Asheville (top), Charlotte (bottom), for February and March 1960. Tables extracted from U.S. Department of Commerce, Weather Bureau, Local Climatological Data for each station (U.S. Department of Commerce 1960 e,f,h,i).

Greenville - February 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7:00 a.m. (In.)
1	63	41	52	+ 8	13	0	0	0
2	65	45	55	+11	10	0	0	0
3	51	36	44	0	21	T	0	0
4	39	33	36	- 8	29	.26	T	0
5	51	37	44	0	21	1.59	0	0
6	57	39	48	+ 4	17	T	0	0
7	53	31	42	- 2	23	0	0	0
8	57	26	42	- 2	23	0	0	0
9	58	37	48	+ 3	17	T	0	0
10	60	51	56	+11	9	.39	0	0
11	57	34	46	+ 1	19	0	0	0
12	55	32	44	- 1	21	0	0	0
13	45	28	37	- 8	28	1.44	1.4	1
14	39	22	31	-14	34	.04	.4	1
15	42	19	31	-14	34	0	0	1
16	53	30	42	- 3	23	0	0	T
17	60	36	48	+ 3	17	0	0	0
18	48	32	40	- 6	25	.85	0	0
19	47	25	36	-10	29	0	0	0
20	51	25	38	- 8	27	0	0	0
21	42	34	38	- 8	27	.19	.4	0
22	51	34	43	- 3	22	T	0	0
23	54	29	42	- 5	23	0	0	0
24	57	34	46	- 1	19	.20	0	0
25	42	37	40	- 7	25	.69	0	0
26	50	29	40	- 7	25	0	0	0
27	47	25	36	-12	29	0	0	0
28	55	36	46	- 2	19	0	0	0
29	60	36	48	0	17	0	0	0
30								
31								
Sum	1509	953	—	—	—	5.65	2.2	—
Avg	52.0	32.9	—	—	—	—	—	—

Greenville - March 1960

Date	Temperature (°F) Maximum	Minimum	Average	Departure from normal	Degree days (base 65°)	Precipitation Total (Water equivalent) (In.)	Snow, Sleet (In.)	Snow, Sleet, or Ice on ground at 7:00 a.m. (In.)
1	40	28	34	-14	31	0	0	0
2	31	23	27	-21	38	1.80	4.7	T
3	42	24	33	-16	32	.20	.5	5
4	37	19	28	-21	37	0	0	5
5	31	12	22	-27	43	0	0	4
6	39	16	28	-21	37	0	0	4
7	39	25	32	-17	33	0	0	3
8	40	22	31	-19	34	0	0	1
9	29	23	26	-24	39	.40	4.1	1
10	46	24	35	-15	30	0	0	5
11	34	27	31	-19	34	.56	6.0	2
12	38	25	32	-19	33	T	T	5
13	46	25	36	-15	29	0	0	2
14	47	28	38	-13	27	.01	T	T
15	41	33	37	-14	28	.04	T	T
16	33	32	33	-18	32	.58	T	T
17	60	32	46	- 6	19	0	0	0
18	52	33	43	- 9	22	T	0	0
19	50	26	38	-14	27	T	T	0
20	46	29	38	-15	27	0	0	0
21	47	26	37	-16	28	0	0	0
22	62	29	46	- 7	19	0	0	0
23	53	26	40	-14	25	0	0	0
24	69	33	51	- 3	14	0	0	0
25	56	34	45	- 9	20	0	0	0
26	69	45	56	+ 1	9	0	0	0
27	74	46	60	+ 5	5	0	0	0
28	77	55	66	+11	0	0	0	0
29	66	57	62	+ 6	3	.90	0	0
30	72	54	63	+ 7	2	1.16	0	0
31	70	47	59	+ 3	6	0	0	0
Sum	1536	956	—	—	—	5.65	15.3	—
Avg	49.5	30.8	—	—	—	—	—	—

Fig. 6. Same as Fig. 5 except for Greenville. (U.S. Department of Commerce 1960g,j)

2. February Snow and Below Normal Temperatures

Accompanying the change to persistently cold weather for the second half of February, an area of low pressure developed on the 13th (Fig. 7) and traveled from the northern Gulf of Mexico across north Florida and southeast Georgia to a position along the Carolina coast on the 14th. Snow fell across nearly all of the western Carolinas and extreme northeast Georgia, as summarized in Table 1.

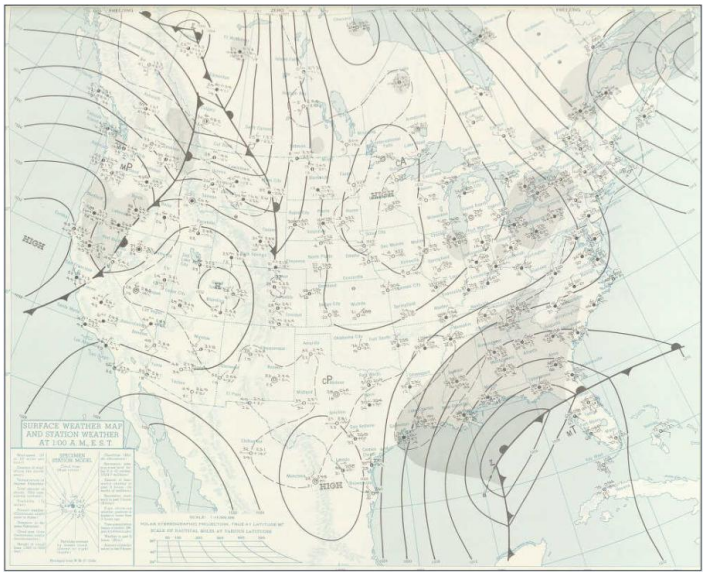

Fig. 7. Surface analysis at 1:00 am EST on 13 February 1960. (Credit: NOAA Central Library Data Imaging Project.) http://docs.lib.noaa.gov/rescue/dwm/data_rescue_daily_weather_maps.html

Another low pressure system moved northeast from the Gulf of Mexico on the 17th and 18th (not shown). This storm followed a track from the Mississippi coast through the western Carolinas which allowed warmer air to move far inland. As a result, significant snowfall was confined to the mountains where Asheville measured 2.0 inches, Banner Elk received 8.0 inches, and Mount Mitchell 2 SSW had 10.0 inches.

Following the passage of the low pressure system**,** high pressure moved southward from Canada and spread cold air over most of the country east of the Rockies. Even though the pattern was altered by the passage of low pressure systems on the 21st-22nd and 24th-25th, below normal temperatures prevailed across the southern Appalachians and nearby Piedmont for most of the remainder of the month. For example, Spartanburg had below normal average daily temperatures for 16 of the last 18 days of February.

3. Repetitive March Snow and Persistently Cold Weather

A. General Circulation and Temperature Characteristics

A change in the mean circulation of the mid and upper troposphere occurred from February to March 1960. The most significant feature was the weakening of blocking and above normal heights (e.g., 700 mb) over Greenland and eastern Canada (Dunn 1960). The greatest weakening occurred over southern Greenland. However, nearly all of Canada experienced decreasing heights. Height rises in the western United States in conjunction with falling heights in the east combined to strengthen the northwest flow through a deep layer from the Great Plains to the Atlantic coast (Fig. 4). The resulting flow pattern caused frequent incursions of very cold air into the central and eastern portion of the country. Among the key factors that contributed to cold temperatures in the United States were the unusually low temperatures in the air mass source region in Canada. Temperatures across nearly all of Canada averaged below normal. Several high pressure systems that moved into the United States during March came from the MacKenzie River Basin in northwest Canada where average temperatures were about 8°F below normal.

B. General Precipitation Characteristics

The mid and upper level flow pattern that existed during March was favorable for significant precipitation across the southeastern states. The mean trough was over the region, and the jet stream was depressed southward. The frontal systems that moved toward the Gulf of Mexico provided the temperature contrasts necessary for storm development, and the proximity of the jet stream resulted in favorable upper level support for the formation of low pressure systems.

C. Significant Events

i. First Week of March – A Wednesday Winter Storm

March 1960 began with a large and cold high pressure system centered over the middle Mississippi River valley. By the morning of the 2nd, a reinforcing surge of cold air was moving southeast from Canada, and a developing low pressure system was centered off the Texas coast. The low pressure system moved northeast into Mississippi during the day as cold air damming (Bell and Bosart 1988) strengthened east of the Appalachians. Precipitation spread rapidly across the western Carolinas and extreme northeast Georgia. Snow was the predominant form of precipitation across northern portions of the WFO Greenville-Spartanburg

County Warning Area (Table 2), but it was mixed with some sleet. A mixture of snow, sleet, and freezing rain occurred across the south. Even though the surface air temperature was near or below freezing, the complex temperature advection patterns aloft caused enough warming to produce a variety of precipitation types. A number of studies have addressed the issue of forecasting multiple precipitation types during winter storms in the western Carolinas (e.g., Keeter and Green 1989; Keeter and Cline 1991; Keeter et al. 1995; Moyer 2001).

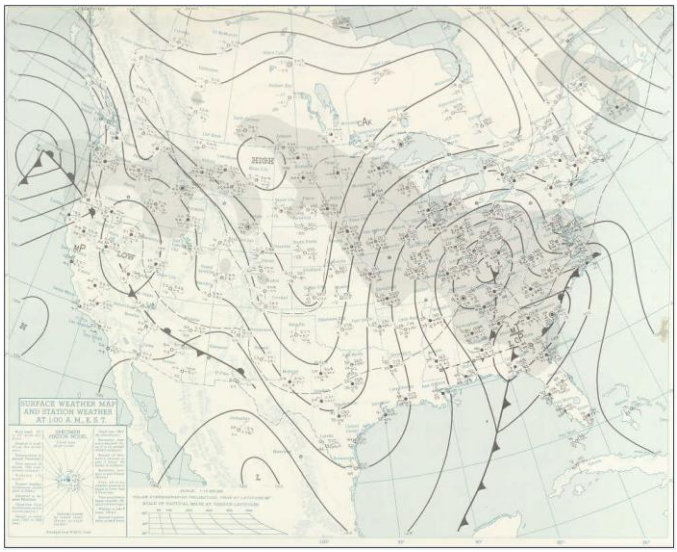

Fig. 6. Surface analysis at 1:00 am on 3 March 1960.

The overall complexity of the weather pattern was due in large part to the development of a second low pressure system along the southeast coast while the primary low moved from Mississippi northeast into eastern Kentucky (Fig. 6). On the 3rd of March, the coastal low had become the dominant system as it moved toward the Gulf of Maine. The storm was a major snow producer for the mid-Atlantic region and New England. The meteorology of the event is described in detail by Kocin and Uccellini (2004a,b).

Cold air surged into the southeastern United States on the heels of the coastal low. Enough moisture remained in the cold air sweeping across the mountains to produce northwest flow snow (Keighton et al. 2009) that added to the accumulation that piled up during the passage of the surface low pressure systems.

The cold air that spread across the region was responsible for temperatures that were far below normal for early March. For example, the high on the 5th of March was +13°F at Banner Elk, and the low was -2°F. The high at Asheville was +20°F, and the low was +5°F. In South Carolina, the high and low temperatures at Caesars Head were +22°F and +1°F, respectively. Clayton, Georgia reported a low of +3°F on the 5th.

Temperatures remained well below normal during the week following the snow and sleet that occurred on the 2nd and 3rd of March. As a matter of fact, at Asheville, Charlotte, Greenville, and Spartanburg, the daily average temperatures were approximately 20 degrees below normal for the entire week. The temperature did not climb above the freezing mark at Asheville

between the 1st and the 8th. Banner Elk's temperatures did not inch above 32°F from the 1st until the 10th.

ii. Second Week of March – Two Winter Storms (Wednesday and Friday)

The frigid air mass remained firmly planted over the eastern United States on the 9th of March while another low pressure system approached the Southeast from the southern Plains (Fig. 7). The center of low pressure moved from northeast Texas on the morning of the 9th to eastern Kentucky on the 10th. As was the case with the storm the previous week, another low pressure system developed off the Carolina coast. Once again snow and sleet spread across the southern Appalachians and nearby Piedmont. Snow and sleet totals were quite substantial in many areas (Table 3).

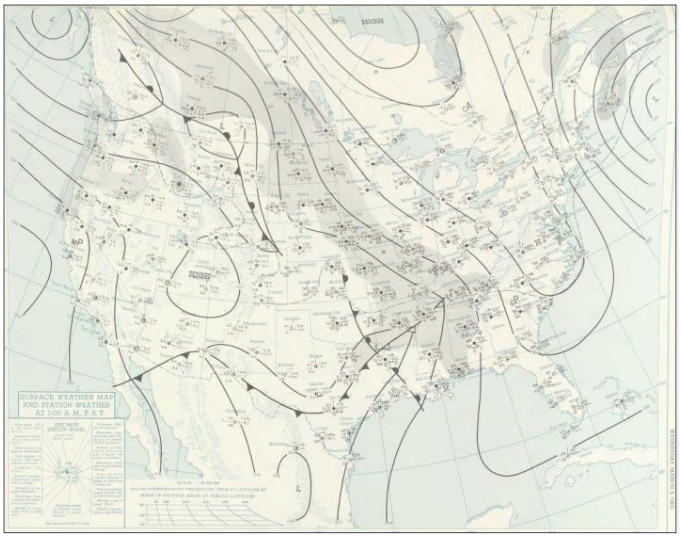

Fig. 7. Surface analysis at 1:00 am EST on 9 March 1960.

On the heels of the storm of the 9th and 10th of March, yet another low pressure system – this one rather weak - traveled across the Gulf Coast states into the Southeast on the 11th and 12th of March (Fig. 8) . Temperatures remained 15 to 20 degrees below normal, so snow and sleet were once again the predominant form of precipitation. Snowfall totals included the following: Asheville, 4.0 inches; Charlotte, 2.2 inches; Greenville, 6.0 inches; and Spartanburg, 3.8 inches (Table 4).

Following the snowfall of Friday, the 11th of March, daily temperatures averaged about 15 degrees below normal for the next week. The upper level flow pattern across North America continued to favor cold high pressure over the central and eastern states. Only very gradual melting occurred, so snow remained on the ground in many locations in the western Carolinas and extreme northeast Georgia. For example, Spartanburg had a five inch snow depth on the 12th, and snow several inches deep had been on the ground since the first storm of the month on the 2nd. Asheville's maximum depth during the month was 13 inches on the 10th. Charlotte reported eight inches on the ground on the 10th. Hendersonville's greatest snow depth was 19 inches on the 9th. In the northern mountains of North Carolina, the snow depth at Banner Elk was 29 inches on the 12th (to be repeated on the 21st and 22nd).

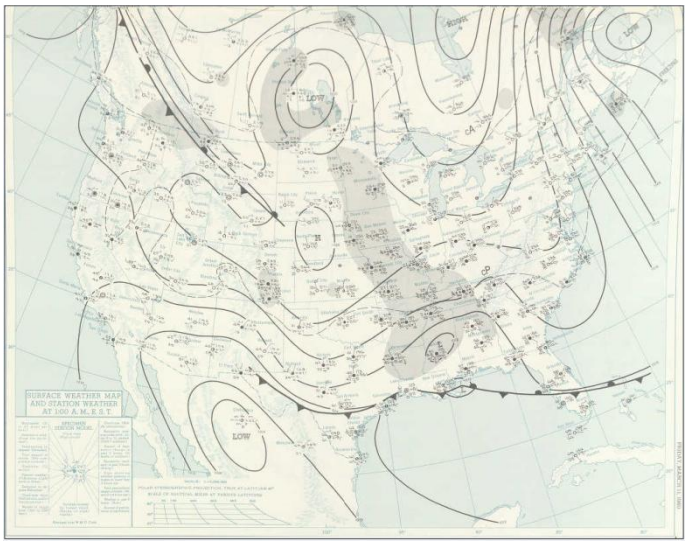

Fig. 8. Surface analysis at 1:00 am EST on 11 March 1960.

iii. Third Week of March – Another Wednesday Winter Storm

By the middle of the next week, the weather map presented another ominous pattern for the snow- and cold-weary residents of the region. Late on Tuesday and during Wednesday, the 15th and 16th, cold high pressure was centered over eastern Canada with a ridge of high pressure extending southward east of the Appalachians. At the same time, an area of low pressure over Missouri and a weak low pressure system near the Gulf Coast were spreading precipitation into the Southeast (Fig. 9). Surface temperatures were still rather cold, but enough warm air aloft moved across the area to diminish the snow and sleet totals. Much of the precipitation outside the mountains fell as rain or freezing rain. Ice accumulation in the Charlotte area caused "considerable damage to trees, shrubs, and overhead wires" (U.S. Department of Commerce, 1960i). Freezing rain fell at Greenville from around midnight until noon. *The Greenville-News* reported, "A glistening coat of ice remained on many trees throughout the day." Table 5 lists snow totals for this event – the third Wednesday in succession with wintery precipitation.

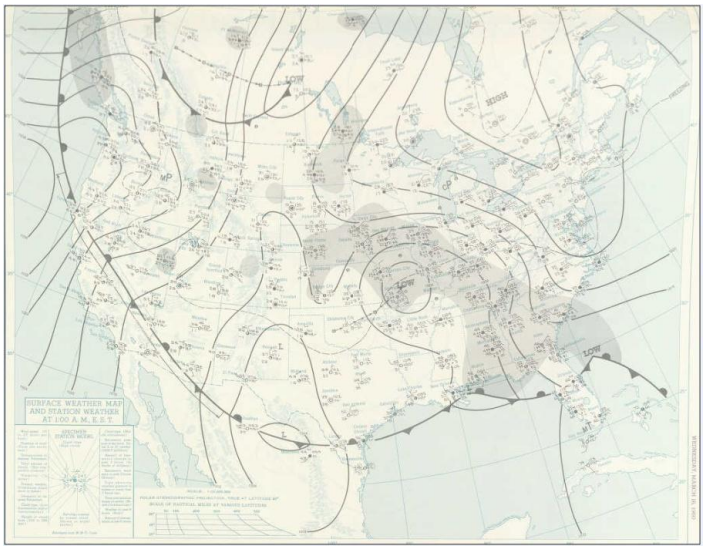

Fig. 9. Surface analysis at 1:00 am EST on 16 March 1960

In the wake of the snow and freezing rain that occurred on the 15th and 16th, below normal temperatures persisted. A weak low pressure system embedded in the cold, northwest flow crossed the region from the 19th to the 21st (not shown) and produced several inches of snow in the mountains. Selected snow totals from that event included Asheville, 1.3 inches; Banner Elk, 11.5 inches; Celo, 2.0 inches; Hendersonville, 0.3 inch; and Highlands, 4.6 inches. Several northwest flow snow events during the course of the month were responsible for contributing to the impressive snowfall totals in the mountains.

The persistent mid and upper level flow pattern characterized by a ridge over the western states and a trough in the east finally gave way to a different pattern during the last week of the month. An upper level ridge in the east and trough in the west produced a west and southwest wind flow that brought warmer air into the Southeast, thus bringing to an end the record-breaking period of snow and cold.

4. Summary of Highlights and Impacts

A review of the synoptic weather patterns associated with the events of February and March 1960 was conducted by Perry and Konrad (2006). They note that, on average, snow was observed every other day in the higher elevations in the southern Appalachians from mid February until late March. The frequent mountain snow can be attributed to the northwest flow snow events that occurred in the intervals between the synoptic scale low pressure systems that traveled across the Southeast. Temperatures during the period extending from mid February to late March were nearly eleven degrees below normal. The repetitive snow and sleet events and persistently cold weather resulted in some locations experiencing snow accumulations on a scale rarely documented in the southern Appalachian region. For example, Boone, North Carolina reported a snow depth of 44 inches on the 13th and 14th of March. The total snowfall at Boone during February and March 1960 was 82.8 inches.

The highest elevation U.S. Weather Bureau cooperative observation sites in North Carolina during the winter of 1959-1960 were at Grandfather Mountain (5500 ft MSL) and Mount Mitchell 2 SSW (Clingman's Peak; 6525 ft MSL). The deep, drifting snow prevented the Grandfather Mountain observer from reaching the observation site during much of February and March, so a continuous record of daily weather for that period is not available. Even though the observer was not able to reach the equipment, he made notations of the general conditions in the area. For example, he stated that most roads in Avery County were blocked with snow from the 13th to the 23rd of February. During March he was not able to reach the observation site for most of the month; however, he did record observations at Linville. The snow depth at Linville on the 11th of March was 42 inches.

The heavy snow, occasional sleet, bitter cold, and strong winds at Mount Mitchell 2 SSW created very difficult observing conditions, particularly during March. The low temperature was zero or below on four days. The coldest day of the month was the 5th when the high was +5°F and the low was -13°F. The greatest snow depth was 34 inches on the 9th. Measureable snow remained on the ground at Mount Mitchell 2 SSW until the 7th of April. A trace of snow on the ground was observed until the 21st of May.

News reports documented extreme hardship for residents of the area, particularly in the mountains. The deep, drifting snow closed highways and stranded people in their homes. Airlifts were necessary to transport fuel and food into the affected areas for both people and animals (e.g., Associated Press, *The Greenville News*, 14 March 1960).

Following are comments extracted from the March 1960 **Climatological Data** publications (U.S. Department of Commerce 1960a,b,c) for North Carolina, South Carolina, and Georgia:

North Carolina

"March broke all records for severe and persistent wintry weather in North Carolina."

"This was by far the coldest March on record in North Carolina. Every one of the first 26 days of the month was below normal in temperature, some days as much as twenty to thirty degrees below normal."

"This period, along with the last several days of February, was the longest unbroken period of sub-normal temperatures in over seventy years of weather records."

"The unprecedented quantity of snowfall and duration of heavy snow cover in western North Carolina caused widespread hardship and considerable economic loss."

South Carolina

"The month of March 1960 was characterized by a notable number of weather and allied events which disturbed the equilibrium and comfort of life in South Carolina."

"There were three unusually heavy and probably record-breaking snowfalls for so late in the season, one on the 2nd, another on the 9th, and still another on the 11th."

"Those snowstorms were accompanied by glaze and freezing rains."

"Many roofs collapsed, cars skidded into accidents, trees and wires were covered with ice, roads were closed and essential services were interrupted in most of the northern half of the state for days following the three snow and ice storms."

Georgia

"March 1960 was the coldest month of the winter in Georgia and the coldest March since statewide records were begun more than 70 years ago."

"The ice and snow storms that hit north Georgia during the first half of March were of much greater importance, economically, than the cold weather."

"Clayton measured 22 inches during the month and the observer at Hartwell reported snow on his housetop from the 2nd to the 29th of the month."

Perhaps the best commentary on the latter part of the winter of 1959-1960 is the following remark on the March 1960 U.S. Weather Bureau *Record of River and Climatological Observations* at Tryon, North Carolina:

"This is by far the worst March ever experienced here. Most snow, most cold, most everything bad. Ground hog could do better."

Table 1

Snowfall --- 13-15 February 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville	6.5	**Banner Elk**	17.0	**Charlotte**	3.3
Cullowhee	5.0	**Hickory**	9.0	**Highlands 2 S**	4.0
Salisbury	7.0	**Shelby 3 N**	5.5	**Hendersonville**	7.0
Mount Mitchell 2 SSW	11.0				
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Anderson FAA Airport	Trace	**Greenville**	2.8	**Landrum 5 ENE**	4.8
Long Creek 1 N	1.5	**Pelzer**	2.0	**Spartanburg**	3.4
Union 7 SW	2.0				
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	3.0				

Table 2

Snowfall -- 2-5 March 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville WB City	10.7	**Banner Elk**	14.0	**Celo 2 S**	7.2
Charlotte WB Airport	9.5	**Cullowhee**	4.0	**Hickory FAA Airport**	8.8
Hendersonville	12.0	**Highlands 2 S**	6.0	**Lenoir**	7.0
Salisbury	10.0*	**Shelby**	10.0	Tryon	8.5
*Salisbury reported "snow on ground." "Snowfall" not available.					
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Anderson	2.0	**Anderson FAA Airport**	3.3	**Caesars Head**	8.5
Calhoun Falls	1.0	**Chester 2 WSW**	5.5	**Clemson College**	3.5
Greenville WB Airport	5.2	**Greenwood**	2.0	**Landrum 5 ENE**	11.0
Laurens	3.0	**Pelzer**	4.0	**Pickens 5 SE**	5.8
Rainbow Lake	8.0	**Santuck 4 SE**	2.0	**Spartanburg WB Airport**	5.8
Union 7 SW	2.5	**Walhalla**	4.0	**Winthrop College**	4.6
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	6.5	**Hartwell***	3.0		
*Hartwell report "snow on ground." "Snowfall" not available.					

Table 3

Snowfall -- 9-10 March 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville WB City	11.0	**Banner Elk**	10.0	**Celo 2 S**	7.7
Charlotte WB Airport	7.6	**Cullowhee**	7.0	**Hickory FAA Airport**	9.0
Hendersonville	1.0	**Highlands 2 S**	5.5	**Lenoir**	11.5
Salisbury	11.0*	**Shelby**	8.0	**Tryon**	7.0
*Salisbury reported "snow on ground." "Snowfall" not available.					
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Anderson	4.0	**Anderson FAA Airport**	4.0	**Caesars Head**	6.0
Calhoun Falls	3.5	**Chester 2 WSW**	5.0	**Clemson College**	5.8
Greenville WB Airport	4.1	**Greenwood**	3.5	**Landrum 5 ENE**	7.0
Laurens	3.5	**Pelzer**	5.5	**Pickens 5 SE**	5.8
Rainbow Lake	4.5	**Santuck 4 SE**	4.5	**Spartanburg WB Airport**	4.0
Union 7 SW	3.8	**Walhalla**	5.0	**Winthrop College**	4.0
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	16.0	**Hartwell***	5.0		
*Hartwell reported "snow on ground." "Snowfall" not available.					

Table 4

Snowfall -- 11-13 March 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville WB City	4.0	**Banner Elk**	6.0	**Celo 2 S**	2.8
Charlotte WB Airport	2.2	**Cullowhee**	3.0	**Hickory FAA Airport**	Trace
Hendersonville	5.5	**Highlands 2 S**	5.0	**Lenoir**	Missing
Salisbury	1.0*	**Shelby**	3.8	**Tryon**	4.0
*Salisbury reported "snow on ground." "Snowfall" not available.					
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Anderson	Missing	**Anderson FAA Airport**	2.5	**Caesars Head**	5.0
Calhoun Falls	1.8	**Chester 2 WSW**	6.0	**Clemson College**	6.0
Greenville WB Airport	6.0	**Greenwood**	4.5	**Landrum 5 ENE**	8.0
Laurens	5.0	**Pelzer**	5.5	**Pickens 5 SE**	5.8
Rainbow Lake	4.5	**Santuck 4 SE**	5.5	**Spartanburg WB Airport**	3.8
Union 7 SW	5.8	**Walhalla**	4.0	**Winthrop College**	3.0
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	Missing	**Hartwell**	Missing		

Table 5

Snowfall -- 15-16 March 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville WB City	1.3	**Banner Elk**	2.0	**Celo 2 S**	2.7
Charlotte WB Airport	Trace	**Cullowhee**	1.0	**Hickory FAA Airport**	2.0
Hendersonville	2.0	**Highlands 2 S**	1.0	**Lenoir**	1.5
Salisbury	2.0*	**Shelby**	N/A	**Tryon**	1.0
*Salisbury reported "snow on ground." "Snowfall" not available.					
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Caesars Head	1.8	**Greenville WB Airport**	Trace	**Landrum 5 ENE**	2.2
Rainbow Lake	Trace	**Spartanburg WB Airport**	Trace	**Pickens 5 SE**	0.5
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	1.5				

Table 6

Snowfall -- February and March 1960					
North Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Asheville WB City	37.4	**Banner Elk**	74.5	**Celo 2 S**	32.6
Charlotte WB Airport	22.6	**Cullowhee**	26.3	**Hickory FAA Airport**	28.8
Hendersonville	36.8	**Highlands 2 S**	32.6	**Lenoir**	N/A
Salisbury	29.5*	**Shelby**	27.3	**Tryon**	24.5
*Salisbury estimated. Some events recorded as "snow on ground" – not "snowall."					
South Carolina					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Anderson	6.0	**Anderson FAA Airport**	9.8	**Caesars Head**	29.3
Greenville WB Airport	17.5	**Greenwood**	10.0	**Landrum 5 ENE**	33.0
Laurens	11.5	**Pelzer**	15.5	**Pickens 5 SE**	13.1*
Calhoun Falls	6.3	**Chester**	16.5	**Clemson College**	15.3
Rainbow Lake	16.5*	**Santuck 4 SE**	12.0*	**Spartanburg WB Airport**	17.0
Union 7 SW	14.1	**Walhalla**	14.0	**Winthrop College**	11.6*
*Feb 60 data N/A					
Georgia					
Station	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**	**Station**	**Snowfall (Inches)**
Clayton	30.0				
Two-month totals in Table 6 might not match totals from Tables 1-5 at some sites because smaller snowfalls (e.g., northwest flow snow events) were not included.					

Appendix I

U.S. Weather Bureau (National Weather Service) Station Locations

The U.S. Weather Bureau became the National Weather Service in 1970.

The Weather Bureau Office at Asheville during the winter of 1959-1960 was in the U.S. Post Office and Court House Building at the corner of Otis and Post Streets.

The Weather Bureau Office at Charlotte during the winter of 1959-1960 was in what was called the New Terminal Building at Douglas Municipal Airport (now Charlotte-Douglas International Airport).

The Weather Bureau Office at Greenville during the winter of 1959-1960 was in what was called the New Administration Building at Municipal Airport (now Greenville Downtown Airport).

The Weather Bureau Office at Spartanburg during the winter of 1959-1960 was in the Administration Building at Memorial Airport (now Spartanburg Downtown Memorial Airport).

Appendix II

Circulation Anomalies

The NOAA/National Weather Service Climate Prediction Center uses the Oceanic Niño Index (ONI) in ascertaining whether or not El Niño or La Niña conditions exist. The ONI is derived from a dataset described in Smith et al. (2008). The ONI was slightly negative during the winter of 1959-1960. The index did not meet the criteria required for classification as either a warm (El Niño) or a cold (La Niña) episode. For more information, refer to: http://www.cpc.noaa.gov/products/precip/CWlink/MJO/enso.shtml

The North Atlantic Oscillation (NAO; Barnston and Livezey 1987) incorporates the distribution of surface pressure and heights between high and low latitudes in the North Atlantic to identify large scale circulation patterns that affect basin-wide weather. The NAO was negative during January, February, and March 1960. For more information refer to: http://www.cpc.noaa.gov/data/teledoc/nao.shtml

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