



Weather of Appomattox Court House National Historical Park and Booker T. Washington National Monument

Mid-Atlantic Network Summary Report for 2013

Natural Resource Data Series NPS/MIDN/NRDS—2014/721



ON THE COVER

Foggy Morning at Booker T Washington National Monument.
Photograph by: Bill Tucker.

Weather of Appomattox Court House National Historical Park and Booker T. Washington National Monument

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Natural Resource Data Series NPS/MIDN/NRDS—2014/721

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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List of Key Acronyms

APCO	Appomattox Court House National Historical Park
ASOS	Automated Surface Observation System
BOWA	Booker T. Washington National Monument
CASTNet	Clean Air Status and Trends Network
COOP	National Weather Service Cooperative Observer Program
CWOP	Citizen Weather Observer Program
FAA	Federal Aviation Administration
IFLOWS	Integrated Flood Observing and Warning System
MIDN	Mid-Atlantic Network
NADP	National Atmospheric Deposition Program
NARR	North American Regional Reanalysis
NCDC	National Climatic Data Center
NHP	National Historical Park
NM	National Monument
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PASC	Pennsylvania State Climatologist
PDSI	Palmer Drought Severity Index
POR	Period of Record
PRISM	Parameter-elevation Regressions on Independent Slopes Model
RAWS	Remote Automated Weather Stations
USDM	United States Drought Monitor
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Introduction

Weather and climate are widely recognized as key drivers of terrestrial and aquatic ecosystems, affecting biotic as well as abiotic ecosystem characteristics and processes. Global and regional scale climatic patterns, trends, and variations are critical to the cycling of elements, nutrients, and minerals through ecosystems and can deliver pollutants from regional and even global sources (National Assessment Synthesis Team 2001). These variations and trends influence the fundamental properties of ecologic systems such as soil-water relationships and plant-soil processes and their disturbance rates and intensity. Information obtained from meteorological monitoring will be useful to interpreting and understanding changes in species composition, community structure, water and soil chemistry, and related landscape processes (Comiskey and Callahan 2008).

The purpose of this report is to provide a concise weather and climate summary for January 1 to December 31, 2013, and to place current patterns and trends in an appropriate historical, regional, and global context (Marshall et al. 2012). It is our intention that this report will satisfy an inherent interest in meteorological phenomena and meet the Mid-Atlantic Network (MIDN) Weather and Climate Monitoring objective:

- Document current status and long-term trends in air temperature and precipitation at multiple temporal scales (e.g., daily, monthly, seasonal, annual, and decadal) and spatial scales (e.g., individual stations and aggregated stations such as climate divisions) utilizing existing weather and climate monitoring programs and datasets.

To accomplish this objective, a variety of atmospheric data streams were evaluated for their quality, longevity, and applicability to the MIDN parks. Since no single weather observing network contains all the pertinent measures of atmospheric phenomena to assess ecosystem health, an objective analysis of the data networks was developed and outlined in the Weather and Climate Monitoring Protocol for the Eastern Rivers and Mountains Network and Mid-Atlantic Network of the National Park Service (Marshall et al. 2012). Through this analysis, a select number of weather/climate observing stations were chosen as representative of each park; these are the primary data sources used in the profile of 2013's climate summary and trends.

In addition to a suite of summary tables, graphs, and narratives, we specifically identify a series of key weather indicators to report status and trends on an annual basis and periodically in separate and more thorough reports. These key indicators are further described in the protocol (Marshall et al. 2012) and summarized in this report.

Climate of the Western Piedmont Region of Virginia

Appomattox Court House National Historical Park (NHP) and Booker T. Washington National Monument (NHP) lie in Virginia Climate Division 3, known as the “Western Piedmont.” A climate division is a region that is reasonably homogenous with respect to climatic and hydrologic characteristics and is frequently used for compiling climate statistics (<http://www.esrl.noaa.gov/psd/data/usclimdivs/data/map.html>). Virginia is divided into six climate divisions. This division is generally considered to have a humid, continental type of climate, but the varied physiographic features have a marked effect on the weather and climate of the various parts of this region. The prevailing westerly winds carry most of the weather disturbances that affect the region from the interior of the continent through the Ohio Valley, so that the Atlantic Ocean has only some influence on the climate of the area (Davey et al. 2006, Gawtry and Stenger 2007). Coastal storms do, at times, affect the day-to-day weather, especially in the winter. Infrequently, storms of tropical origin can have a significant effect, causing severe floods in some instances.

Temperatures are moderately continental, with the tempering effects of the nearby mountains contributing to cloud production in the winter and mountain-valley circulation clouds reducing the heat at times during the summer. The lowest readings in the winter occur with polar air masses of Canadian origin settling over the region after a fresh snowfall. On average, Appomattox Court House NHP tends to have a greater number of sub-freezing days than Booker T. Washington NM (~92 to ~75). The highest readings of the summer happen when the subtropical fair weather system, the Bermuda high, pushes westward into the Carolinas; its clockwise circulation will direct hot, humid air from the Gulf region into the area. The humid southwest winds descending the crest of the Appalachians will raise the temperature several more degrees. The last freeze and first frost typically occur in mid-April and late October, respectively.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 36–52 in (914–1,321 mm), while the majority of places receive 38–44 in (965–1,118 mm). Greatest amounts usually occur in the late spring and summer months, while February is the driest month, having about 2 in (51 mm) less than the wettest months. Precipitation is somewhat greater in the mountains. During the warm season, the uneven heating over the irregular terrain leads to thunderstorms which typically form over the mountains and dissipate as they reach the Piedmont.

Surface winds blow from the west and northwest in the cold season and from the southwest during the warm half of the year. Thunderstorms follow a frequency that matches the solar cycle, occurring between the equinoxes and reaching a peak near the solstice. Hail is relatively infrequent, but flash floods and damaging thunderstorm winds affect parts of the region each summer. On average, tornadoes pass through the area about once every three years. The direct effects of an Atlantic hurricane are uncommon, though remnant rains from hurricanes and tropical storms occur most years and some have contributed to the region’s worst floods. Ice storms, which can cause significant disruption, occur at irregular intervals but are primarily confined to the months between December and March (Kocin and Uccellini 2004).

Observing Stations

A total of five weather observing stations comprising two weather observing networks were selected around Appomattox Court House NHP and Booker T. Washington NM. Representative stations within a 100-km range of each park were chosen based on several criteria, which include proximity to the park, the representativeness of the station to the park elevation profile, the type and frequency of observations, the period of record of the data, and data availability (Marshall et al. 2012). Moreover, the percentage of time a station reports a particular parameter (e.g., temperature) can influence data inclusion. A total of five stations were ultimately used for this 2013 report: Lynchburg, Roanoke, Rocky Mt., Appomattox, and Huddleston (Figure 1, Table 1).

The average value of a climate element over 30 years is defined as a climatological normal, which is calculated and established by NOAA's National Climatic Data Center (NCDC). Every ten years, NCDC computes new thirty-year climate normals for selected temperature and precipitation elements for a large number of U.S. climate and weather stations. The current (as of 2013) normals cover the period 1981–2010. In this report, the 30-year normals established by NCDC are used as the baseline for comparisons (e.g., departures from normal). In cases where data for the 30-year normal period are not available, we use alternative comparisons such as the new pseudo-normal from NCDC or a recent 10-year period. In some cases, sufficient data may simply not be available to calculate normals. For metrics that NCDC may not routinely calculate a normal, such as the number of days with more than 2 in (55 mm) of rain or liquid equivalent, normals are calculated using the same time period (e.g., 1981–2010) as the current NCDC standard. Throughout the report, descriptions of a station's values as compared to the normals are described as a difference from the "average", "mean", "typical", "long-term value", as well as "normal", to improve the readability of the document. However, all of these terms are comparing a value from one year at that station to that station's normal, whether it be the 30-year normal or the pseudo-normal calculated on a shorter time frame.

All five stations have a Period of Record (POR) sufficiently long for a 30-year normal (1981–2010); however, Huddleston lacks temperature data. Monthly averages and deviations from normal are presented for all five stations for precipitation, and for all except Huddleston for temperature.

In addition to the summary information available in this report, a near real-time data stream has been made available to the MIDN through a Web interface for the weather observing stations, along with monthly, seasonal, and annual summaries. The Web interface is accessible through the following link: <http://climate.met.psu.edu/NPS/interface.php>.

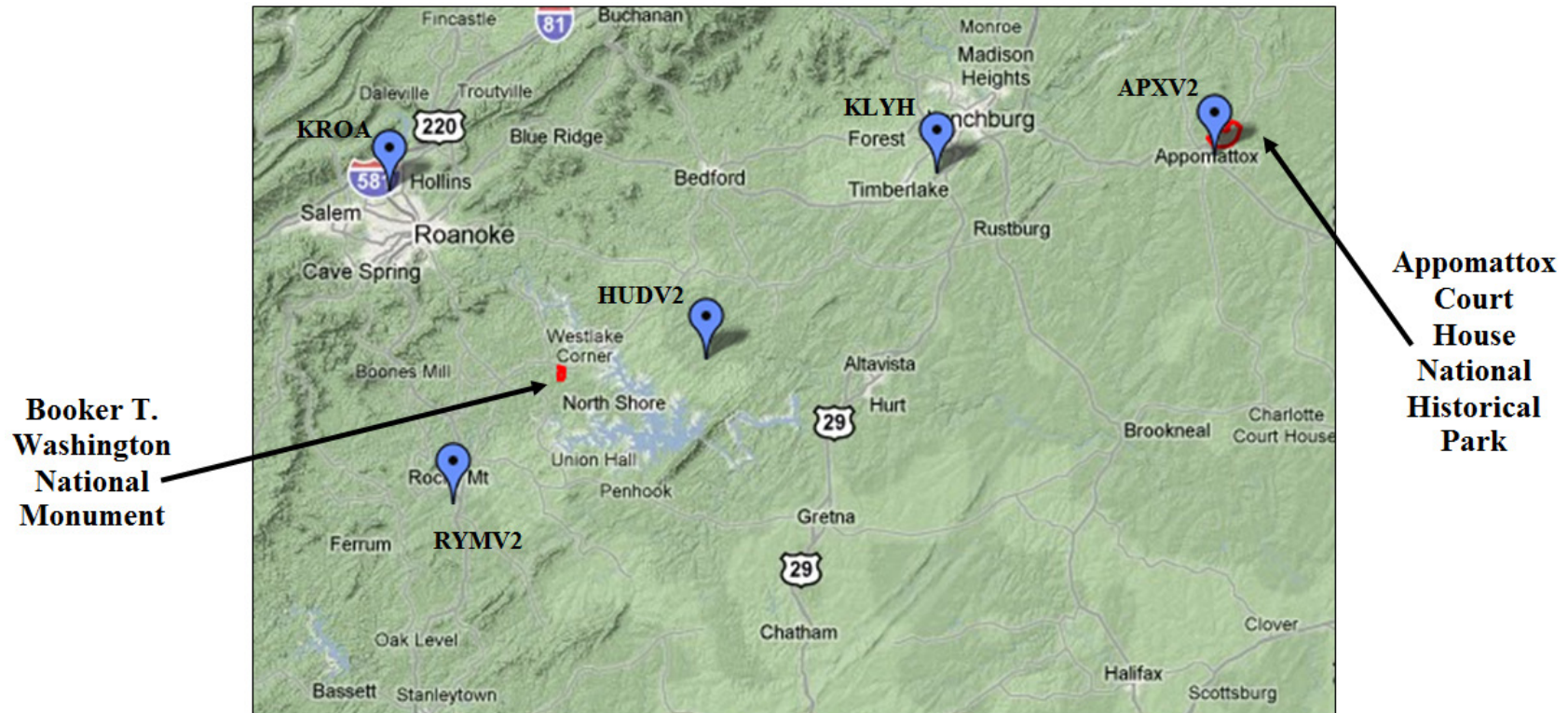


Figure 1. Location of weather observing stations around Appomattox Court House National Historical Park and Booker T. Washington National Monument selected as most representative of the parks in 2013. See Table 1 for station names.

Table 1. List of weather observing stations around Appomattox Court House National Historical Park and Booker T. Washington National Monument selected as most representative of the parks in 2013.

Station	Observing Network ¹	Station Name	Period of Record (POR)	Percentage of Time Reporting Temperature for 2013	Percentage of Time Reporting Precipitation for 2013	Percentage of Time Reporting Temperature for entire POR	Percentage of Time Reporting Precipitation for entire POR
KLYH	ASOS	Lynchburg Regional Airport/Preston Glenn Field	02/01/1948 Present	100.0	100.0	96.2	96.2
KROA	ASOS	Roanoke Regional Airport/Woodrum Field	02/01/1948 Present	100.0	100.0	95.9	95.9
RYMV2	COOP	Rocky Mt.	01/01/1951 Present	99.2	100.0	94.5	94.4
APXV2	COOP	Appomattox	11/01/1937 Present	97.3	99.7	94.5 ²	95.9
HUDV2	COOP	Huddleston 4 SW	01/01/1960 Present	-	100.0	-	99.2

¹ Observing networks are: ASOS — Automated Surface Observation System, COOP — National Weather Service Cooperative Observer Program.

² Percentage of time reporting temperature for Appomattox Court House NHP is based upon a Period of Record beginning on 11/01/1961. The station did not report temperature prior to this date.

Temperature Summary

Average annual temperatures in 2013 were a bit below the 30-year normal for the area around Appomattox Court House NHP and Booker T. Washington NM (Table 2) despite a warm January, April, October and December, the remainder of the months were cooler than average (Tables 3 and 4). Average monthly temperatures were chilliest (largest negative departures from normal) in March, August and November (Figures 2 and 3)¹. This resulted in a year with near normal temperatures (Table 5).

January was warmer than average, with mean temperatures ranging from 3.4 to 5.1°F (1.9 to 2.8°C) above normal from the long-term values (Tables 3 and 4). The lowest readings of the year occurred on January 23-24th with values as low as 12.0°F (-11.1°C), higher than the typical annual minimums (Table 2). February was colder with mean temperatures varying from 37.0°F (2.8°C) at Rocky Mt. to 39.2°F (4.2°C) at Roanoke (Table 3). There was a surge very cold air in March, leading to a winter that ranked the 53rd coolest in 119 years for the Western Piedmont (Table 5; 59 is the mid-point). There were also a near normal number of cold days during the winter (Table 2).

Spring was milder than normal, as April noted significant positive anomalies at each of the representative weather stations including a 1.8°F (1.0°C) at Lynchburg positive departure from normal at Lynchburg Airport (Table 4). Very mild nights were the reason why daily averages were higher than normal, particularly during June (Figure 3), but daytime readings in May and June turned cooler than average. Overall, this spring season ranked as the 43rd warmest on record for the Western Piedmont (Table 5).

The summer months featured warmer-than-average weather in July and then below-normal readings from August through much of September. In fact, the positive anomalies ranged from 0.4 to 0.9°F (0.2 to 0.5°C) above normal during July (Table 4). The number of hot days was notably below normal. Between 15 and 20 days reached or exceeded 90°F (32.2°C) compared with normal numbers around 25 days (Table 2). Accordingly, the highest readings of 2013 did not attain the normal values of around 96°F (36.5°C), topping out at 94°F (34.4°C) (Table 2). The summer of 2013 ranked as the 42nd coolest in the last 119 years for the Western Piedmont (Table 5).

A chilly November was spliced between two autumn months that had mainly positive departures from normal. The number of sub-freezing days were close to the normal (Table 2). December's departure from normal varied from 3.3°F (1.9°C) at Roanoke to 2.8°F (1.7°C) at Lynchburg (Table 4). The autumn ranked as the 34th warmest in 119 years for the Western Piedmont (Table 5). The length of the growing season was about a week longer when compared to the 1981–2010 average and first freeze of the autumn occurred on October 25th, very close to the average date (Table 2).

¹ The maps in Figures 2 and 3 were created using estimates from the Parameter-elevation Regressions on Independent Slopes Model (PRISM). PRISM uses an interpolation scheme for temperature between actual observations and corrects these estimates for changes in topography across the region (Daly et al. 2002). More information can be found at <http://www.prism.oregonstate.edu/>.

Table 2. Status of 2013 temperature indicators compared to the 30-year normal (1981–2010) at the Lynchburg Airport (KLYH), Roanoke Airport (KROA), and Appomattox (APXV2) weather observing stations.

Temperature Indicator	Lynchburg Airport 2013	Lynchburg Airport 1981–2000	Roanoke Airport 2013	Roanoke Airport 1981–2010	Appomattox 2013	Appomattox 1981–2010
Average Annual Temperature	56.1°F 13.4°C	55.6°F 13.1°C	57.0°F 13.9°C	57.0°F 13.9°C	55.6°F 13.1°C	56.0°F 13.3°C
Average Annual Maximum Temperature	66.8°F 19.3°C	67.1°F 19.5°C	66.5°F 19.2°C	67.3°F 19.6°C	65.6°F 18.7°C	67.4°F 19.7°C
Maximum Temperature	93.0°F 33.9°C	95.9°F 35.5°C	94.0°F 34.4°C	96.7°F 35.9°C	92.0°F 33.3°C	96.0°F 35.6°C
Hot Days (days with Tmax≥90°F/32°C)	20	22	17	25	15	23
Average Annual Minimum Temperature	45.5°F 7.5°C	44.1°F 6.7°C	47.5°F 8.6°C	46.6°F 8.1°C	45.5°F 7.5°C	44.5°F 6.9°C
Minimum Temperature	12.0°F -11.1°C	3.7°F -15.7°C	15.0°F -9.4°C	6.0°F -14.4°C	14.0°F -10.0°C	4.4°F -15.3°C
Cold Days (days with Tmax≤32°F/0°C)	3	6	3	7	8	6
Sub-freezing Days (days with Tmin≤32°F/0°C)	105	99	82	78	106	95
Sub-zero Days (days with Tmin≤0°F/-18°C)	0	0	0	0	0	1
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	209	201	212	208	207	199

Table 3. Summary of 2013 monthly average temperatures for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	39.4°F	37.9°F	41.6°F	57.9°F	63.0°F	73.3°F	76.9°F	73.0°F	67.4°F	58.4°F	43.5°F	41.1°F	56.1°F
		4.1°C	3.3°C	5.3°C	14.4°C	17.2°C	22.9°C	24.9°C	22.8°C	19.7°C	14.7°C	6.4°C	5.1°C	13.4°C
Roanoke Airport	KROA	41.7°F	39.2°F	42.2°F	58.2°F	64.4°F	73.6°F	77.0°F	74.0°F	67.8°F	59.1°F	44.1°F	42.3°F	57.0°F
		5.4°C	4°C	5.7°C	14.6°C	18.0°C	23.1°C	25.0°C	23.3°C	19.9°C	15.1°C	6.7°C	5.7°C	13.9°C
Rocky Mt	RYMV2	39.3°F	37.0°F	40.8°F	56.1°F	62.6°F	72.4°F	75.2°F	72.0°F	66.5°F	57.7°F	43.6°F	41.0°F	55.4°F
		4.1°C	2.8°C	4.9°C	13.4°C	17.0°C	22.4°C	24.0°C	22.2°C	19.2°C	14.3°C	6.4°C	5.0°C	13.0°C
Appomattox	APXV2	38.3°F	35.8°F	40.2°F	56.7°F	62.9°F	73.2°F	76.5°F	72.4°F	67.1°F	58.0°F	44.3°F	41.4°F	55.6°F
		3.5°C	2.1°C	4.6°C	13.7°C	17.2°C	22.9°C	24.7°C	22.4°C	19.5°C	14.4°C	6.8°C	5.2°C	13.1°C

Table 4. Summary of 2013 departure from normal temperature based on the 30-year normal (1981–2010) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	3.5°F	-1.0°F	-5.0°F	1.8°F	-1.0°F	0.9°F	0.9°F	-1.9°F	-0.3°F	1.4°F	-4.0°F	2.8°F	-0.2°F
		1.9°C	-0.5°C	-2.8°C	1.0°C	-0.6°C	0.5°C	0.5°C	-1.0°C	-0.1°C	0.8°C	-2.2°C	1.6°C	-0.1°C
Roanoke Airport	KROA	5.1°F	-0.3°F	-5.1°F	1.5°F	-0.1°F	0.7°F	0.4°F	-1.5°F	-0.3°F	1.4°F	-4.1°F	3.3°F	0.1°F
		2.8°C	-0.2°C	-2.8°C	0.9°C	-0.1°C	0.4°C	0.2°C	-0.9°C	-0.2°C	0.8°C	-2.3°C	1.8°C	0.1°C
Rocky Mt ¹	RYMV2	3.5°F	-1.4°F	-4.8°F	1.1°F	-0.3°F	0.6°F	-0.2°F	-2.0°F	-0.5°F	1.3°F	-3.2°F	3.0°F	-0.1°F
		2.0°C	-0.8°C	-2.7°C	0.6°C	-0.2°C	0.3°C	-0.1°C	-1.1°C	-0.2°C	0.7°C	-1.8°C	1.7°C	-0.1°C
Appomattox	APXV2	3.4°F	-2.9°F	-5.6°F	1.4°F	-0.8°F	0.8°F	0.4°F	-2.5°F	-0.9°F	1.5°F	-3.0°F	2.9°F	0.1°F
		1.9°C	-1.6°C	-3.1°C	0.8°C	-0.4°C	0.5°C	0.2°C	-1.4°C	-0.5°C	0.8°C	-1.7°C	1.6°C	0.0°C

¹Indicates a station's Period of Record does not cover the period of 1981-2010 but is five or more years. In these cases the departure from normal values were calculated with normals derived from data spanning the length of the station's Period of Record.

Table 5. Seasonal and annual temperature and precipitation rankings for 2013 over 119 years for the Western Piedmont (NOAA 2013).

Climate Division 3 Rankings — Western Piedmont					
	Jan–Feb–Mar WINTER	Apr–May–Jun SPRING	Jul–Aug–Sep SUMMER	Oct–Nov–Dec AUTUMN	Jan–Dec YEAR
Temperature-2013	67	43-T	78-T	34-T	53
Precipitation-2013	21	6	52	33	10

1 = warmest/wettest year and 119 = coldest/driest year. T = Tie between two years.

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Departure from Average Monthly Maximum Temperature
2013 vs. 1981–2010

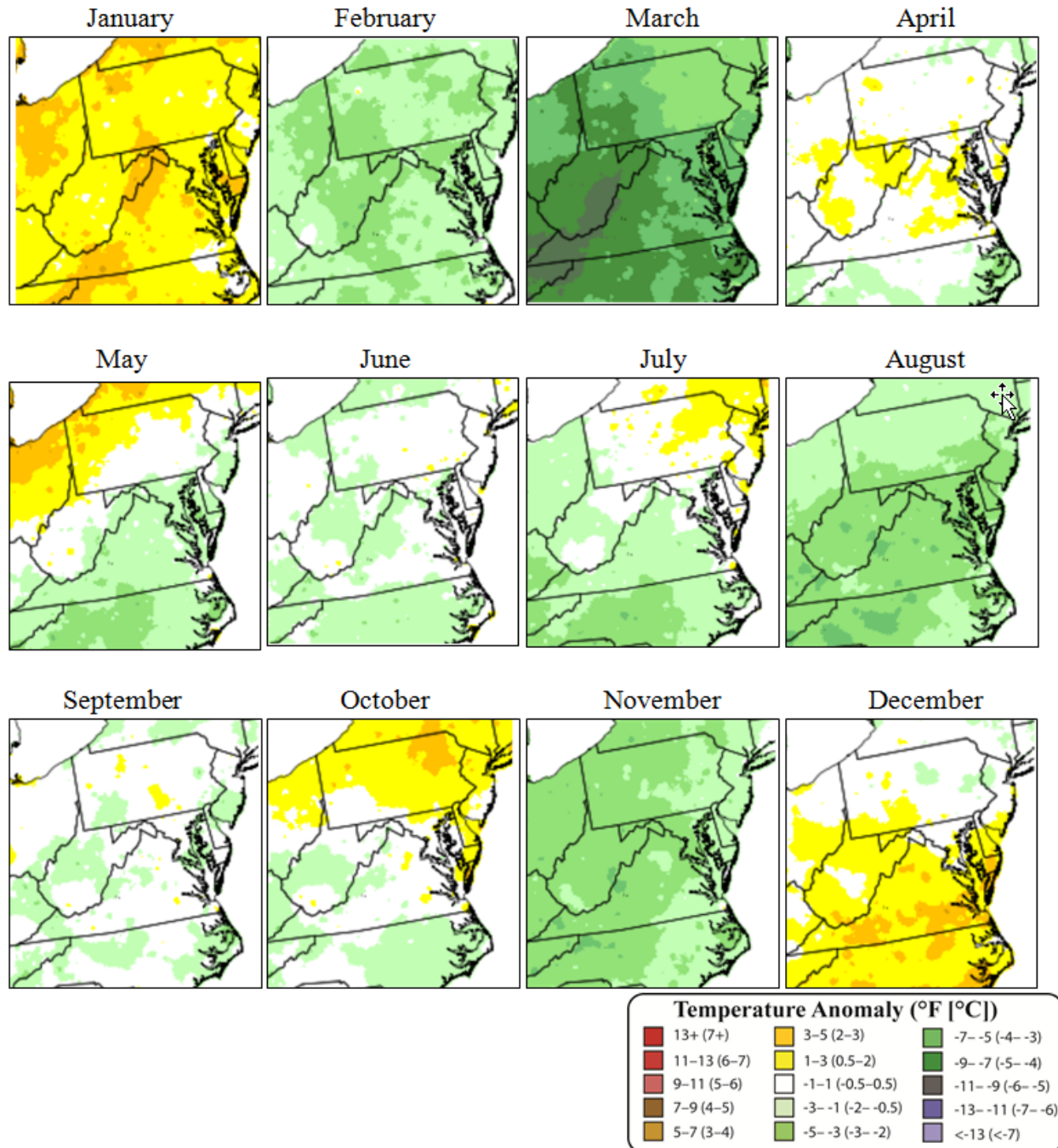


Figure 2. Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Departure from Average Monthly Minimum Temperature
2013 vs. 1981–2010

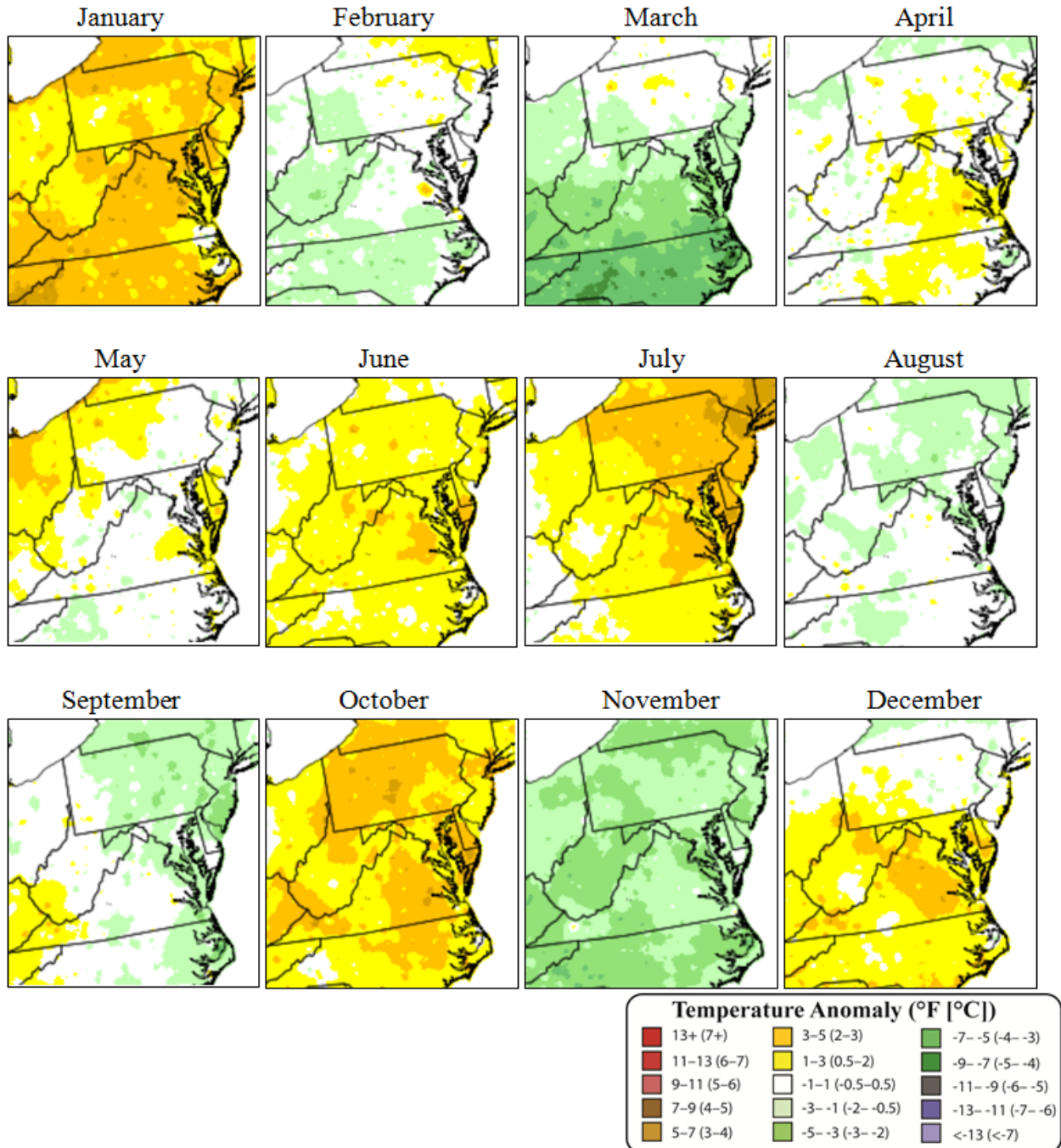


Figure 3. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

Precipitation Summary

The year began wet and was followed with two dry months at Appomattox Court House NHP and Booker T. Washington NM. Unlike previous years, all of the seasons were moister than average (Table 5). Annual precipitation ranged from 4.0 in (100 mm) above normal precipitation, or about a month's of rain and snow at Lynchburg, to 11.8 in (300 mm) above normal at Roanoke (Table 6). The number of heavy precipitation days was slightly above the long-term average at two of the four stations (Table 6). The high rainfall resulted in the 10th wettest year on record.

January was noted by heavy precipitation: a total of 9.1 in (230 mm) fell the entire month at Rocky Mt., about 267% above normal (Tables 7 and 8). It was dry in February followed by another dry March (Figure 4). Precipitation in February was measured at 54-89 percent of normal (Tables 8 and 9). March brought closer to average precipitation, as 3.3 in (84 mm) was tallied at Lynchburg and 2.8 in (72 mm) was measured at Huddleston. (Table 8). Overall, the winter months (January, February and March) were the 21st wettest in the Western Piedmont since 1895 (Table 5).

The spring months of April, May and June were even wetter, aided by an anomalously moist June, with 6.3 in (161 mm) in Lynchburg, 175 percent of normal precipitation for the month (Tables 8 and 9). One long dry spell was noted from May 24 to June 1, during which no measurable precipitation was reported (Table 7). Overall, the spring in the Western Piedmont ranked as the 6th wettest in 119 years of records (Table 5).

Summer rainfall varied across the region, as evidenced by the range of precipitation during July. This month brought only 3.4 in (87 mm) at Lynchburg to 12.7 in (323 mm) at Roanoke (Table 8). There were no effects from hurricanes or tropical storms this season. Overall, this season averaged the closest to normal and ranked as the 52nd wettest in 119 years for the Western Piedmont (Table 5). Two of the notably wet days occurred during this season with 3.90 in (99 mm) on July 10 (Table 7).

The last quarter of the year was wetter than the summer. All stations reported near normal precipitation during two of the three months. October had relatively low precipitation totals ranging from 70 to 88 percent of normal (Table 9). November was increasingly moist at all of weather stations (Table 9) with as much as 95 percent of average at Appomattox. The autumn precipitation totals were around 120 percent of the 1981–2010 normal amounts (Table 6) resulting in the 33rd wettest on record. Snowfall was above normal, with all stations measuring more than 12 in (30 cm), comparable with long-term averages of 12 in (30 cm) (Table 6). Much of the snow for 2013 fell in December and the number of snowy days at Appomattox was three times of the normal (Table 6).

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Percent of Average Monthly Precipitation
2013 vs. 1981–2010

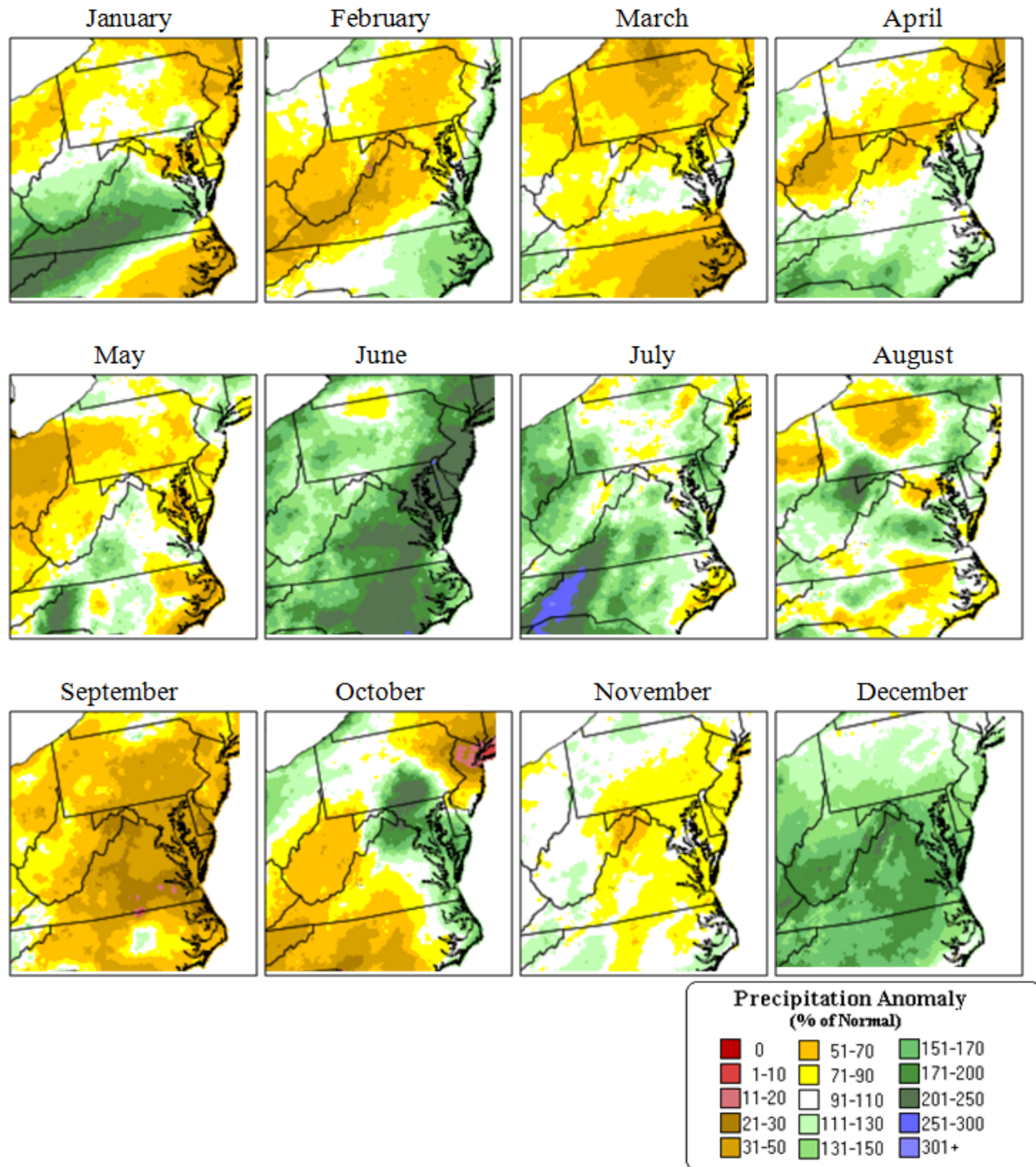


Figure 4. Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).

Table 6. Status of 2013 precipitation indicators compared to the 30-year normal (1981–2010) at the Lynchburg Airport (KLYH), Roanoke Airport (KROA), Appomattox (APXV2), and Huddleston 4 SW (HUDV2) weather observing stations.

Precipitation Indicator	Lynchburg Airport 2013	Lynchburg Airport 1981–2010	Roanoke Airport 2013	Roanoke Airport 1981–2010	Appomattox 2013	Appomattox 1981–2010	Huddleston 4 SW 2013	Huddleston 4 SW 1981–2010
Annual Precipitation	45.6 in 1,158 mm	41.6 in 1,057 mm	53.1 in 1,349 mm	41.3 in 1,049 mm	50.6 in 1,285 mm	46.6 in 1,184 mm	50.2 in 1,275 mm	42.5 in 1,080 mm
Autumn (Oct, Nov, Dec) Precipitation	11.4 in 290 mm	9.8 in 249 mm	9.7 in 246 mm	9.2 in 234 mm	12.1 in 307 mm	11.2 in 284 mm	11.8 in 300 mm	10.3 in 262 mm
Heavy Precipitation Days (days with ≥ 1.0 in (25 mm) rain)	8	10	14	10	11	13	13	11
Extreme Precipitation Days (days with ≥ 2.0 in (51 mm) rain)	2	1	5	2	2	1	3	2
Micro-drought (strings of 7+ days without rain)	7	7	9	5	9	11	9	10
Annual Snowfall	13 in 33 cm	16.2 in 16.3 cm	18 in 46 cm	18.5 in 47.0 cm	19.3 in 49 cm	8.5 in 21.6 cm	12.8 in 33 cm	2.0 in 5.1 cm
Measurable Snow Days (days with ≥ 0.1 in (0.3 cm) snow)	10	8	11	9	8	3	5	1
Moderate Snow Days (days with ≥ 3.0 in (7.6 cm) snow)	1	2	2	2	3	1	2	0
Heavy Snow Days (days with ≥ 5.0 in (12.7 cm) snow)	1	1	1	1	1	1	1	0

Table 7. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2013 from weather observing stations at Lynchburg (KLYH), Roanoke (KROA), Rocky Mt (RYMV2), Appomattox (APXV2) and Huddleston (HUDV2).

Wettest Days in 2013	Dry Spells in 2013
Jul. 10: 3.9 in (99 mm)	Sept. 1–19
Jun. 6: 3.4 in (86 mm)	Sept. 22–Oct. 6
Jul. 2: 2.8 in (71 mm)	Nov. 2–14
Jan. 30: 2.7 in (69 mm)	May. 24–Jun. 1

Table 8. Summary of 2013 monthly total precipitation for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	6.1 in	1.6 in	3.3 in	3.4 in	6.1 in	6.3 in	3.4 in	3.6 in	0.5 in	2.3 in	3.4 in	5.7 in	45.6 in
		154 mm	40 mm	84 mm	86 mm	155 mm	161 mm	87 mm	90 mm	12 mm	59 mm	85 mm	145 mm	1158 mm
Roanoke Airport	KROA	7.2 in	2.1 in	3.4 in	2.9 in	4.9 in	6.5 in	12.7 in	2.6 in	1.1 in	2.5 in	2.7 in	4.4 in	53.1 in
		183 mm	53 mm	86 mm	75 mm	125 mm	165 mm	323 mm	65 mm	29 mm	65 mm	70 mm	111 mm	1349 mm
Rocky Mt	RYMV2	9.1 in	2.4 in	3.4 in	4.3 in	6.1 in	6.2 in	6.6 in	3.6 in	2.4 in	2.5 in	3.1 in	5.4 in	55.1 in
		230 mm	62 mm	87 mm	109 mm	154 mm	158 mm	167 mm	92 mm	62 mm	62 mm	78 mm	137 mm	1400 mm
Appomattox	APXV2	6.0 in	2.4 in	3.3 in	4.2 in	5.7 in	6.1 in	7.0 in	3.1 in	0.9 in	2.6 in	3.8 in	5.7 in	50.6 in
		152 mm	61 mm	84 mm	106 mm	144 mm	154 mm	177 mm	77 mm	23 mm	65 mm	96 mm	146 mm	1285 mm
Huddleston 4 SW	HUDV2	7.2 in	1.9 in	2.8 in	3.2 in	7.0 in	5.4 in	4.4 in	4.6 in	1.8 in	2.6 in	3.3 in	5.9 in	50.2 in
		184 mm	48 mm	72 mm	82 mm	178 mm	137 mm	111 mm	118 mm	45 mm	66 mm	84 mm	149 mm	1274 mm

M = missing data (Monthly statistics are reported as 'M' if more than 4 days of data are missing).

Table 9. Summary of 2013 percent of normal precipitation based on the 30-year normal (1981–2010) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	194	54	92	102	165	175	78	109	12	75	98	176	110
Roanoke Airport	KROA	247	72	98	87	121	169	315	72	29	88	81	149	129
Rocky Mt ¹	RYMV2	267	80	81	112	155	149	129	85	53	77	85	157	119
Appomattox	APXV2	191	89	83	119	129	187	154	77	21	70	95	178	117
Huddleston 4 SW	HUDV2	224	65	76	96	192	153	112	131	45	76	93	179	120

¹Indicates a station's Period of Record does not cover the period of 1981-2010 but is five years or more. In these cases the departure from normal values were calculated with normals derived from data spanning the length of the station's Period of Record.

Drought Status

There are a number of drought indices used to estimate the severity of drought in an area using algorithms that incorporate recent temperatures, rainfall, soil moisture, and other information (<http://www.drought.gov>). The main indices we report are the Palmer Drought Severity Index (PDSI) and the United States Drought Monitor (DM) – Drought Intensity Index. While both indices provide excellent summary information on broad-scale conditions, local conditions (such as at the park scale) may vary.

The PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions and is calculated on a monthly basis using precipitation and temperature data, as well as the water content of the soil. The values vary between extremely moist (>4.0) and extreme drought (<-4.0) with “normal” values ranging between -1.9 and 1.9. The long-term average is “zero”. Monthly PDSI values for the Western Piedmont in 2013 are shown in Figure 5.

The DM – Drought Intensity Index is a synthesis of multiple indices (including the PDSI) and impacts, which represents a consensus of federal and academic scientists (NIDIS 2013). The DM produces a summary map of drought intensity for the nation and all states each week. It is on a scale ranging from abnormally dry (D0) to exceptional drought (D4). Mid-month (i.e., the second or third week) values for Virginia (Figure 6) and the Southeast (Figure 7) are shown for 2013.

According to the PDSI, 2013 in the Western Piedmont started with near normal conditions that stayed the same during spring. Wetter weather returned in the summer and persisted until December (Figure 5). As a result of the persistent wet conditions, the PDSI remained at positive values throughout the year. Compared with the previous two years, 2013 was much wetter than 2011 during the winter and notably moister than 2012 during the autumn.

The DM – Drought Severity Index for Virginia (Figure 6) and the Southeast (Figure 7) shows a pattern similar to the PDSI for the growing season (May through October); no drought in the region during the warm season in the Western Piedmont.

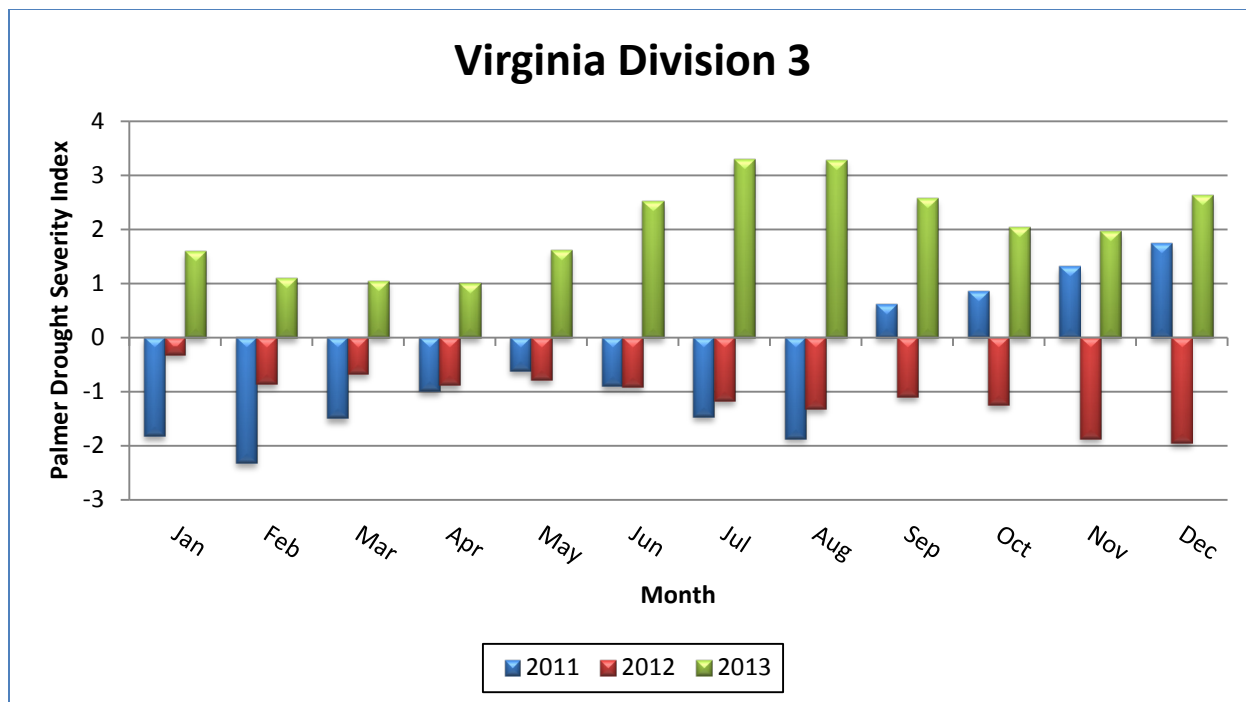


Figure 5. Palmer Drought Severity Index (PDSI) for the Western Piedmont, 2011–2013.

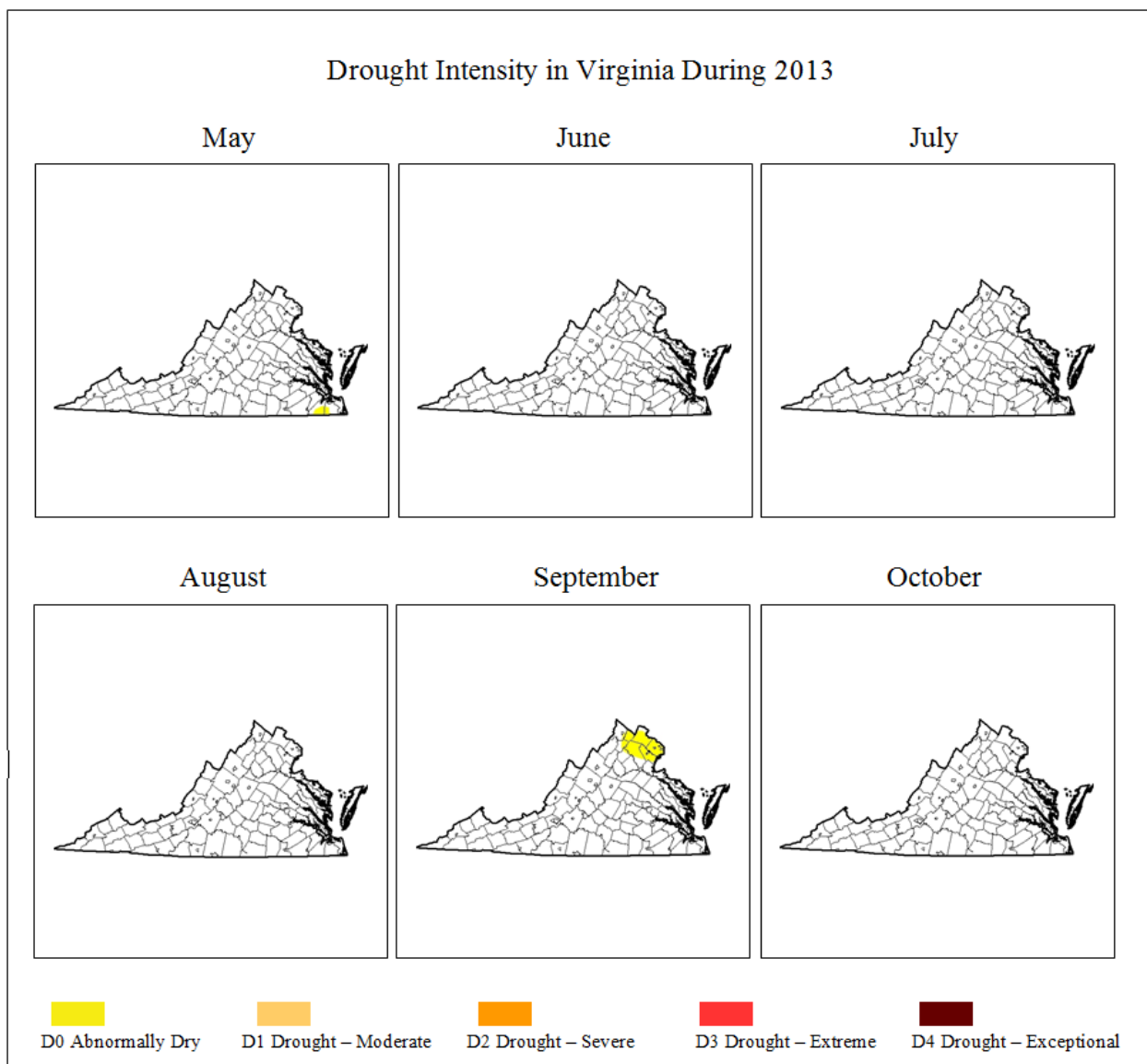


Figure 6. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Virginia in 2013.

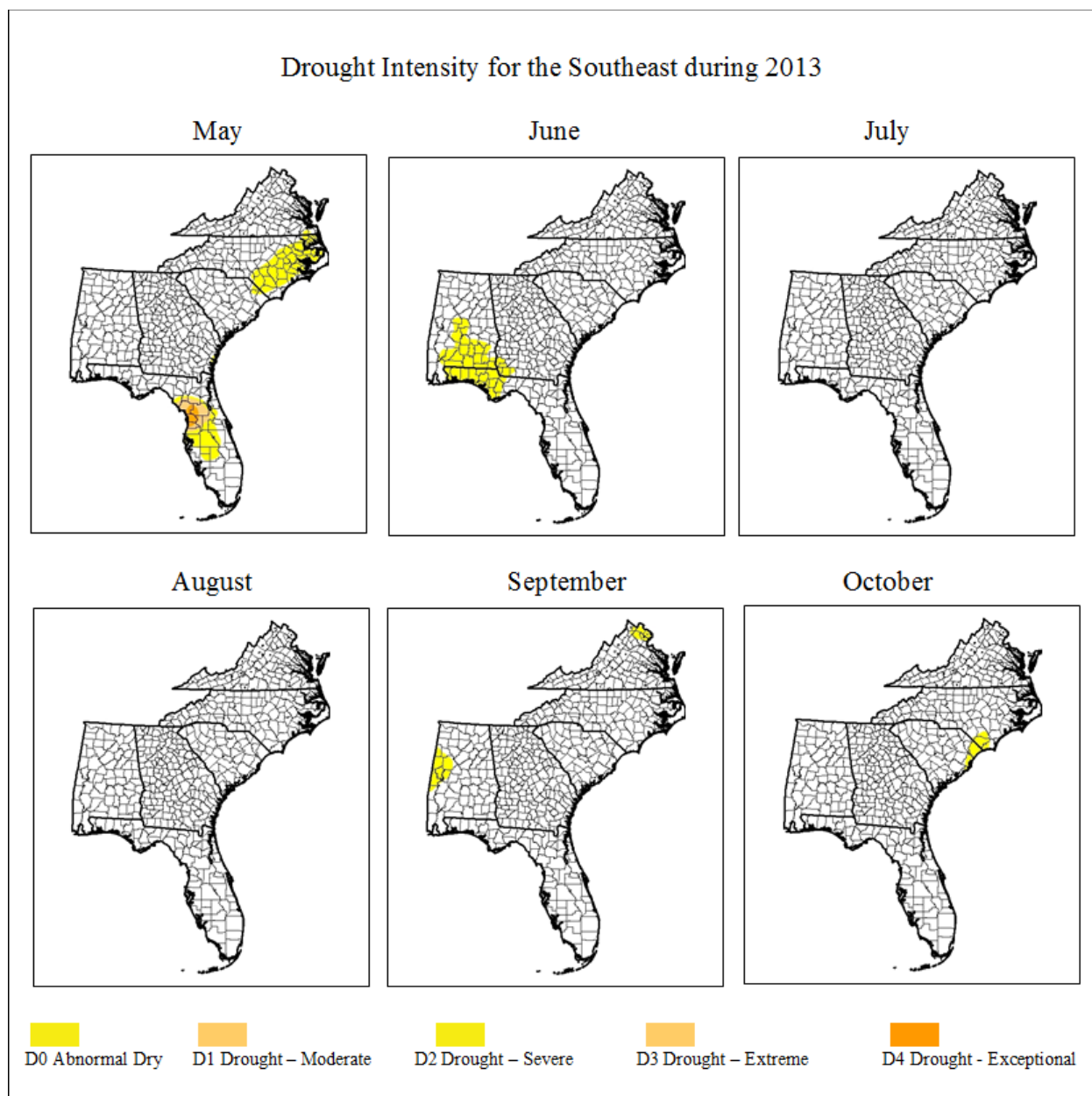


Figure 7. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Southeast in 2013.

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