



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

Mid-Atlantic Network Summary Report for 2010

Natural Resource Data Series NPS/MIDN/NRDS—2011/184



ON THE COVER

Booker T. Washington National Monument.

Photograph by: Sean Lloyd.

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

Mid-Atlantic Summary Network Summary Report for 2010

Natural Resource Data Series NPS/MIDN/NRDS—2011/184

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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 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.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

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, 2010, and to place current patterns and trends in an appropriate historical, regional, and global context (Marshall et al., in review). 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., in review). 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 2010'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., in review) 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/usclimate/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 nights than Booker T. Washington NM (~92 to ~75). The highest readings of the summer happen when the sub-tropical 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 region. The humid southwest winds descending the crest of the Appalachians will raise the temperature several more degrees. The last freeze typically occurs in mid-April and the first frosts appear in late October.

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., in preparation). 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 2010 report: Lynchburg, Roanoke, Blue Ridge, Appomattox, and Huddleston (Figure 1, Table 1).

Of the five stations four have a Period of Record (POR) sufficiently long for a 30-year normal (1971–2000); however, Huddleston lacks temperature data. The normal for Blue Ridge is based on a POR from 1996–2008. 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/gmaps/NPS_DEVELOPMENT/interface.php.

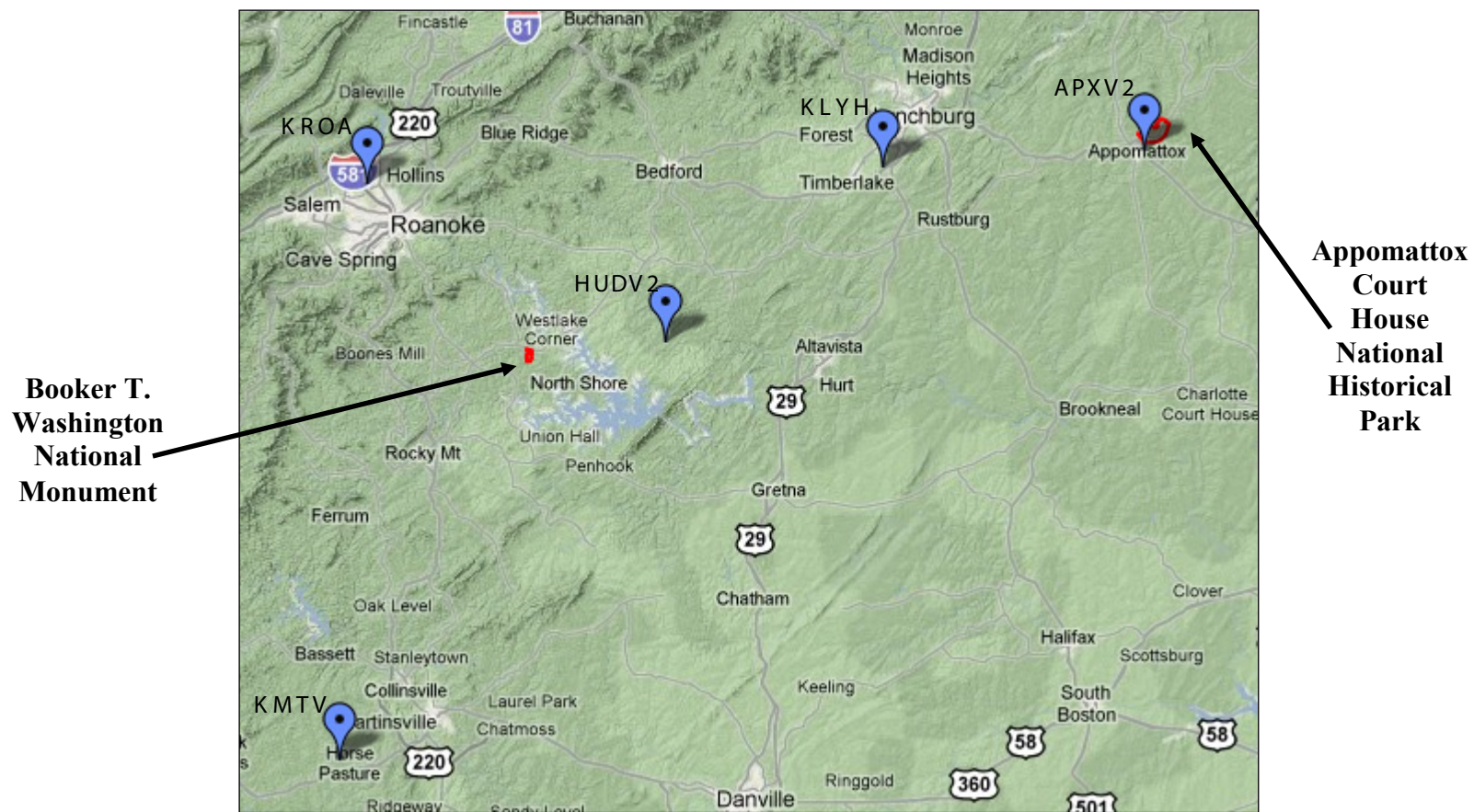


Figure 1. Location of weather observing stations around Appomattox Court House National Historical Park and Booker T. Washington National Monument selected as most representative of the parks in 2010. See Table 1 for station names.

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 2010.

Station	Observing Network ¹	Station Name	Period of Record (POR)	Percentage of Time Reporting Temperature for 2010	Percentage of Time Reporting Precipitation for 2010	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	95.9	95.9
KROA	ASOS	Roanoke Regional Airport/Woodrum Field	02/01/1948 Present	100.0	100.0	95.6	95.6
KMTV	ASOS	Blue Ridge Airport	01/01/1996 Present	99.2	90.7	93.7	34.6
APXV2	COOP	Appomattox	11/01/1937 Present	98.1	98.1	95.4*	96.1
HUDV2	COOP	Huddleston 4 SW	01/01/1960 Present	-	100.0	-	99.2

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

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

Temperature Summary

Temperatures in 2010 were somewhat above average for Appomattox Court House NHP and Booker T. Washington NM (Table 2) despite a very cold February and December (Tables 3 and 4). Temperatures were variable in the colder seasons, but the warmer half of the year had continuous above-average temperatures (Figures 2 and 3)¹.

January was a bit colder than average, with mean temperatures ranging from +1.2 to -2.3°F (0.6 to -1.3°C) from the long-term values (Tables 3 and 4). The lowest readings of the year occurred at end of January with values as low as -2.0°F (-18.9°C), slightly lower than the typical annual minimums (Table 2). February was even colder, with mean temperatures varying from 31.5°F (-0.3°C) at Lynchburg to 36.8°F (2.7°C) at Blue Ridge (Table 3). There was a complete reversal of temperatures in March with very mild weather, leading to a winter which ranked the 32nd coolest in 116 years for the Western Piedmont (Table 5). There were also an above-normal number of cold days during the winter (58 is the mid-point; Table 2).

Spring was much milder than normal, as all three months noted significant positive anomalies at each of the representative weather stations (Table 4). April had the largest positive departures, with Blue Ridge registering 9.4°F (5.2°C) above normal (Table 4). Much of the warmth was due to very mild nights, particularly during May and June (Figure 3). Overall, this season ranked as the second warmest on record for the Western Piedmont (Table 5).

The summer months featured consistently warmer-than-average weather from July through much of September. In fact, the positive anomalies ranged from +2.2 to +4.6°F (1.2 to 2.6°C) (Table 4). The number of hot days was well above normal. Between 48 and 52 days reached or exceeded 90°F (32.2°C) compared with normal numbers around 25 days (Table 2). Accordingly, the highest readings of 2010 exceeded the normal values, topping out at 101°F (38.3°C) compared to 96°F (35.6°C) (Table 2). The summer of 2010 ranked as the 9th warmest in the last 116 years (Table 5).

After a mild October, the next two autumn months had increasingly large negative departures. The number of sub-freezing nights was slightly above normal (Table 2). December's departure from normal varied from -3.7°F (-2.1°C) at Blue Ridge to -7.8°F (-4.3°C) at Lynchburg (Table 4). The autumn ranked as the 9th coolest in 116 years for the Western Piedmont (Table 5). The length of the growing season was virtually normal when compared to the 1971–2000 average and first freeze of the autumn occurred between October 31st and November 7th, very close to the average dates (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 2010 temperature indicators compared to the 30-year normal (1971–2000) at the Lynchburg Airport (KLYH), Roanoke Airport (KROA) and Appomattox (APXV2) weather observing stations.

Temperature Indicator	Lynchburg Airport 2010	Lynchburg Airport 1971–2000	Roanoke Airport 2010	Roanoke Airport 1971–2000	Appomattox 2010	Appomattox 1971–2000
Average Annual Temperature	56.4°F 13.6°C	55.4°F 13.0°C	57.7°F 14.3°C	56.3°F 13.5°C	56.9°F 13.8°C	55.7°F 13.2°C
Average Annual Maximum Temperature	67.8°F 19.9°C	66.9°F 19.4°C	67.6°F 19.8°C	67.3°F 19.6°C	67.9°F 19.9°C	67.4°F 19.7°C
Maximum Temperature	101°F 38.3°C	95.0°F 35.0°C	100°F 37.8°C	95.8°F 35.4°C	101°F 38.3°C	96.1°F 35.6°C
Hot Days (days with Tmax≥90°F/32°C)	50	24	52	27	48	26
Average Annual Minimum Temperature	45.0°F 7.2°C	44.1°F 6.7°C	47.8°F 8.8°C	45.5°F 7.5°C	45.6°F 7.6°C	43.9°F 6.6°C
Minimum Temperature	-2.0°F -18.9°C	4.1°F -15.5°C	10.0°F -12.2°C	4.6°F -15.2°C	5.0°F -15.0°C	3.4°F -15.9°C
Cold Days (days with Tmax≤32°F/0°F)	9	9	18	10	11	8
Sub-freezing Days (days with Tmin≤32°F/0°C)	110	89	88	87	100	98
Sub-zero Days (days with Tmin≤0°F/-18°C)	1	1	0	1	0	1
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	194	206	224	212	223	198

Table 3. Summary of 2010 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	33.4°F	31.5°F	48.7°F	58.7°F	66.7°F	76.3°F	78.6°F	76.2°F	69.7°F	58.6°F	46.4°F	30.4°F	56.3°F
		0.8°C	-0.3°C	9.3°C	14.9°C	19.3°C	24.6°C	25.9°C	24.6°C	20.9°C	14.8°C	8.0°C	-0.9°C	13.5°C
Roanoke Airport	KROA	33.5°F	33.1°F	49.8°F	60.9°F	67.9°F	78.1°F	79.3°F	77.2°F	71.2°F	60.6°F	47.2°F	31.8°F	57.5°F
		0.8°C	0.6°C	9.9°C	16.1°C	19.9°C	25.6°C	26.3°C	25.1°C	21.8°C	15.9°C	8.5°C	-0.1°C	14.2°C
Blue Ridge Airport	KMTV	35.1°F	36.8°F	51.3°F	62.8°F	69.9°F	77.9°F	79.0°F	77.7°F	71.4°F	59.7°F	47.6°F	33.4°F	58.5°F
		1.7°C	2.7°C	10.7°C	17.1°C	21.1°C	25.5°C	26.1°C	25.4°C	21.9°C	15.4°C	8.6°C	0.8°C	14.7°C
Appomattox	APXV2	32.9 °F	31.9 °F	49.0 °F	58.4 °F	66.5 °F	76.6 °F	79.3 °F	76.5 °F	70.9 °F	58.8 °F	47.0 °F	30.7 °F	56.5 °F
		0.5 °C	-0.1 °C	9.4 °C	14.7 °C	19.2 °C	24.8 °C	26.3 °C	24.7 °C	21.6 °C	14.9 °C	8.3 °C	-0.7 °C	13.6 °C

Table 4. Summary of 2010 departure from normal temperature based on 30-year normal (1971–2000) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	-1.1 °F	-6.3 °F	2.7 °F	3.4 °F	3.3 °F	5.3 °F	3.5 °F	2.4 °F	2.6 °F	2.5 °F	-0.2 °F	-7.8 °F	0.9 °F
		-0.6°C	-3.5°C	1.5 °C	1.9 °C	1.8 °C	2.9 °C	1.9 °C	1.3 °C	1.4 °C	1.4 °C	-0.1°C	-4.3°C	0.5 °C
Roanoke Airport	KROA	-2.3°F	-6.0°F	2.6°F	4.8°F	3.8°F	6.2°F	3.1°F	2.5°F	3.5°F	4.0°F	-0.1°F	-7.3°F	1.2°F
		-1.3°C	-3.3°C	1.4°C	2.7°C	2.1°C	3.4°C	1.7°C	1.4°C	1.9°C	2.2°C	-0.1°C	-4.1°C	0.7°C
Blue Ridge Airport*	KMTV	1.2°F	0.5°F	6.9°F	9.4°F	7.5°F	7.3°F	4.0°F	4.4°F	4.6°F	4.5°F	2.0°F	-3.7°F	4.0°F
		0.6°C	0.3°C	3.8°C	5.2°C	4.2°C	4.1°C	2.2°C	2.4°C	2.6°C	2.5°C	1.1°C	-2.1°C	2.2°C
Appomattox	APXV2	-1.4 °F	-5.5 °F	3.6 °F	3.6 °F	3.2 °F	5.0 °F	3.4 °F	2.2 °F	3.2 °F	2.8 °F	0.3 °F	-7.3 °F	1.0 °F
		-0.8 °C	-3.1 °C	2.0 °C	1.9 °C	1.8 °C	2.8 °C	1.9 °C	1.2 °C	1.8°C	1.6 °C	0.2 °C	-4.1°C	0.6 °C

*Indicates a station's Period of Record is five or more years but less than 30 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 temperature and precipitation rankings over 116 years for the Western Piedmont (NOAA 2010).

	Climate Division 3 Rankings — Western Piedmont			
	Jan–Feb–Mar	Apr–May–Jun	Jul–Aug–Sep	Oct–Nov–Dec
	WINTER	SPRING	SUMMER	AUTUMN
Temperature-2010	84	2	9	107
Precipitation-2010	16	99	41	65

1 = warmest/wettest year and 116 = coldest/driest year

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Departure from Average Monthly Maximum Temperature
2010 vs. 1971–2000

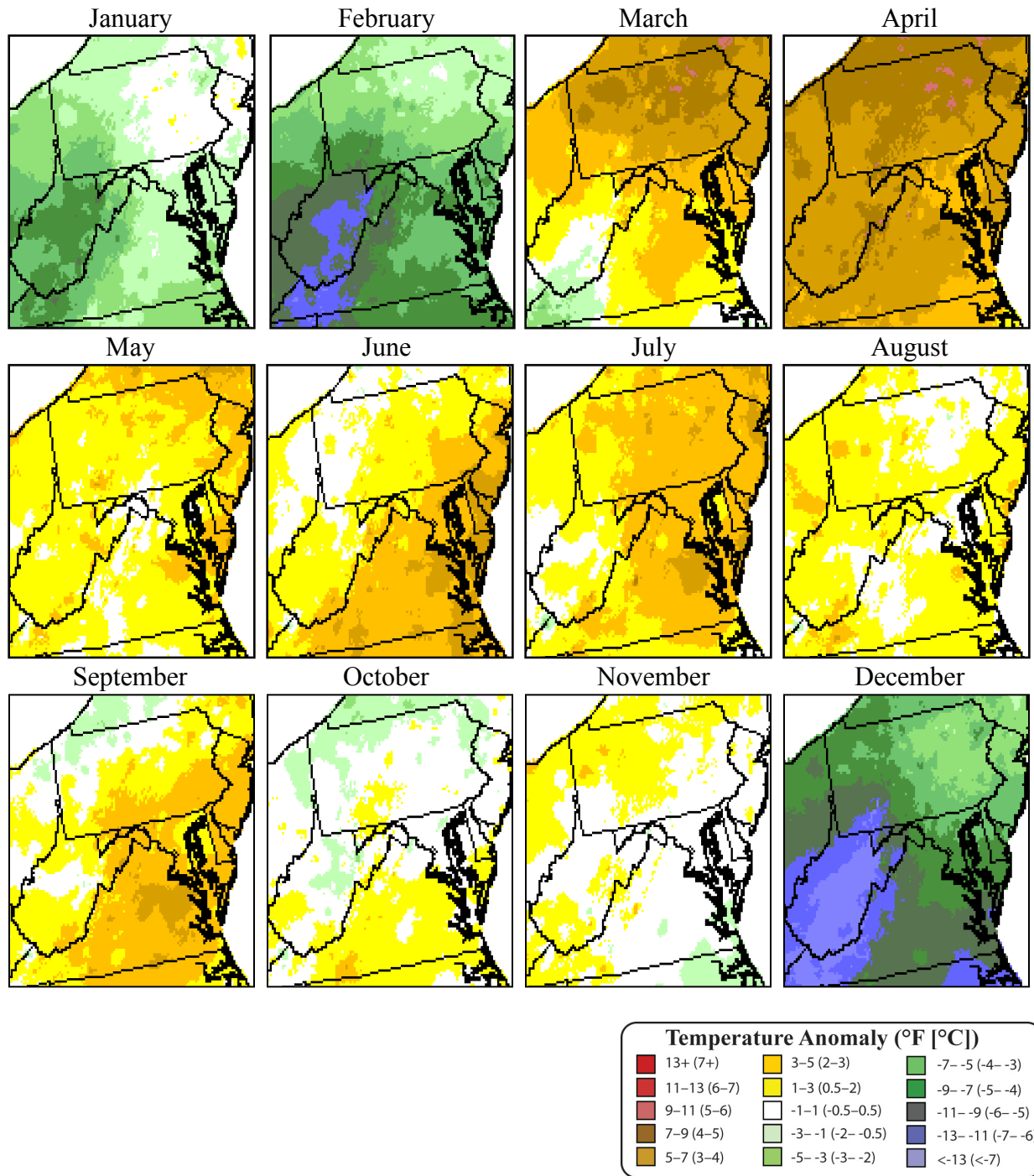


Figure 2. Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1971–2000).

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Departure from Average Monthly Minimum Temperature
2010 vs. 1971–2000

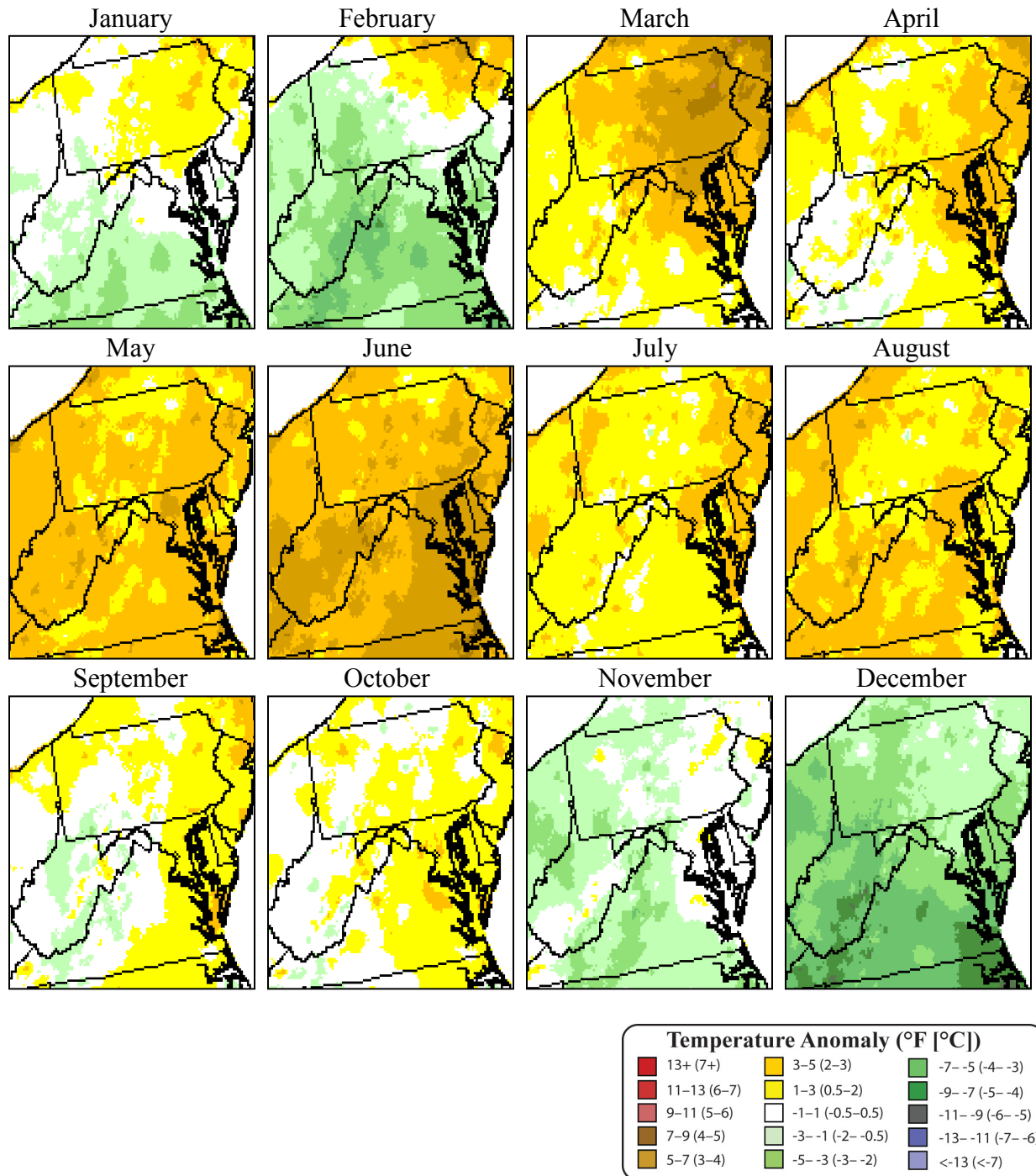


Figure 3. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1971–2000).

Precipitation Summary

The year began with a rather wet month at Appomattox Court House NHP and Booker T. Washington NM. Oddly, the seasons alternated with a wet winter, dry spring, wet summer, and a dry autumn (Table 5). Annual precipitation ranged from 2.4 in (62 mm) above normal precipitation, or about an average month of rain and snow at Lynchburg, to 3.3 in (84 mm) below normal at Appomattox (Table 6). The number of heavy precipitation days was slightly above the long-term average (Table 6).

January was noted by very heavy precipitation, a total of 2.25 in (58 mm) fell on the 25th (Table 7). However, the rest of the month was dry with no measurable precipitation from January 1-16th followed by February which proved to be quite dry (Figure 4). Precipitation in February was measured at 36-74 percent of normal (Tables 8 and 9). March brought closer to average rain and snowfall, as 3.3 in (84 mm) was tallied at Blue Ridge and 5.2 in (132 mm) was measured at Lynchburg (Table 8). Overall, the winter months (January, February and March) were the 16th wettest since 1895 (Table 5).

The spring months of April, May and June were significantly drier, aided by an anomalously dry April, with 1.4 in (36 mm) in Roanoke, 39 percent of normal precipitation for the month (Tables 8 and 9). Another long dry spell was noted from April 10-20 during with no measurable precipitation reported (Table 7). Overall, the spring in the Western Piedmont ranked as the 17th driest in 116 years of records (Table 5).

Summer rainfall varied across the region, as evidenced by the range of precipitation during July. This month brought only 2.5 in (64 mm) at Huddleston and an overabundance of 5.7 in (145 mm) at Roanoke (Table 8). There were indirect effects from tropical storm Nicole in late September. Overall, this season averaged on the wet side, and ranked as the 41st wettest in 116 years for the Western Piedmont (Table 5). Three notably wet days occurred with 2.6 in (66 mm) on July 9, a total of 2.55 in (65mm) on August 24 and 4.1 in (104 mm) falling on September 30 (Table 7).

The last quarter of the year was notably drier. October, though, was highly variable with precipitation totals ranging from 29 to 119 percent of normal (Table 9). In contrast, November and December had less than 100 percent of normal precipitation at the majority of weather stations (Table 9). The autumn precipitation total was less than 80 percent of the 1971–2000 normal amounts (Table 6). Snowfall was well above normal, with most sections measuring more than 25 in (64 cm), compared with long-term averages of less than 12 in (30 cm) (Table 6). Much of the snow for 2010 fell in January, though the number of snowy days was more than double the average (Table 6).

Appomattox Court House National Historical Park
and Booker T. Washington National Monument
Percent of Average Monthly Precipitation
2010 vs. 1971–2000

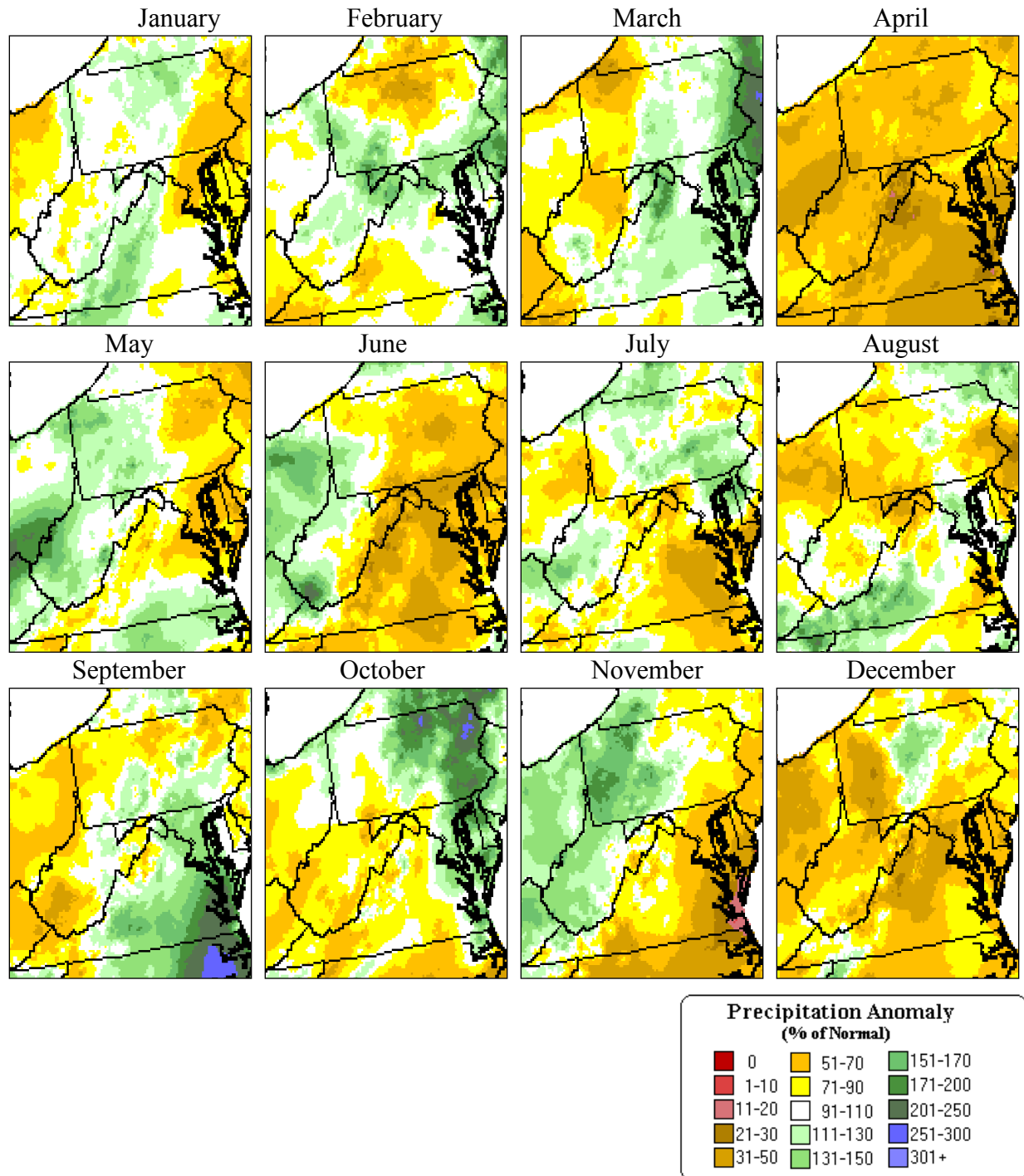


Figure 4. Maps showing percent of average monthly precipitation compared to the 30-year normal (1971–2000).

Table 6. Status of 2010 precipitation indicators compared to the 30-year normal (1971–2000) at the Lynchburg Airport (KLYH), Roanoke Airport (KROA), Appomattox (APXV2) and Huddleston 4 SW (HUDV2) weather observing stations.

Precipitation Indicator	Lynchburg Airport 2010	Lynchburg Airport 1971–2000	Roanoke Airport 2010	Roanoke Airport 1971–2000	Appomattox 2010	Appomattox 1971–2000	Huddleston 4 SW 2010	Huddleston 4 SW 1971–2000
Annual Precipitation	45.7 in 1,161 mm	43.3 in 1,099 mm	43.4 in 1,102 mm	42.5 in 1,080 mm	42.6 in * 1,082 mm*	45.9 in 1,166 mm	44.3 in 1,125 mm	42.9 in 1,090 mm
Autumn (Oct, Nov, Dec) Precipitation	6.6 in 168 mm	9.8 in 249 mm	7.2 in 183 mm	9.2 in 234 mm	9.5 in 241mm	10.5 in 267 mm	7.7 in 196 mm	9.9 in 252 mm
Heavy Precipitation Days (days with ≥ 1.0 in (25 mm) rain)	14	11	12	10	14	12	13	12
Extreme Precipitation Days (days with ≥ 2.0 in (51 mm) rain)	3	1	2	3	2	3	2	3
Micro-drought (strings of 7+ days without rain)	12	8	15	9	11	12	13	12
Annual Snowfall	28.6 in 72.6 cm	11.0 in 27.9 cm	31.3 in 79.5 cm	10.9 in 27.7 cm	4.4 in 112 cm	13.3 in 33.8 cm	25.5 in 64.8 cm	11.2 in 28.4 cm
Measurable Snow Days (days with ≥ 0.1 in (0.3 cm) snow)	15	7	13	7	4	5	9	3
Moderate Snow Days (days with ≥ 2.0 in (5.0 cm) snow)	4	2	5	2	1	3	5	1
Heavy Snow Days (days with ≥ 5.0 in (12.7 cm) snow)	2	0.4	2	1	0	1	2	0.1

*Six days of precipitation measurements were missing during February 2010 for Appomattox. This may be reflected in the annual sum.

Table 7. Top five wettest days and top five dry spells (consecutive days with a trace or less of rainfall) during 2010 from weather observing stations at Lynchburg (KLYH), Roanoke (KROA), Blue Ridge (KMTV), Appomattox (APXV2) and Huddleston (HUDV2).

Wettest Days in 2010	Dry Spells in 2010
Sep. 30: 4.10 in (104 mm)	Jun. 21–Jul. 9
Jul. 9: 2.60 in (66 mm)	Jan. 1–16
Aug. 24: 2.55 in (65 mm)	Aug. 26–Sep. 10
Jan 25: 2.25 in (58 mm)	Apr. 10–20
Jul. 28: 2.10 in (53 mm)	Nov. 5–14

Table 8. Summary of 2010 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	4.8 in	2.3 in	5.2 in	2.9 in	4.6 in	3.1 in	2.9 in	6.5 in	6.8 in	2.5 in	1.9 in	2.2 in	45.7 in
		122 mm	58 mm	132 mm	74 mm	117 mm	79 mm	74 mm	165 mm	173 mm	64 mm	48 mm	56 mm	1,161 mm
Roanoke Airport	KROA	4.6 in	2.1 in	4.0 in	1.4 in	5.4 in	1.3 in	5.7 in	5.0 in	6.9 in	1.7 in	3.5 in	2.0 in	43.6 in
		117 mm	53 mm	102 mm	36 mm	137 mm	33 mm	145 mm	127 mm	175 mm	43 mm	89 mm	51 mm	1,107 mm
Blue Ridge Airport	KMTV	6.5 in	1.2 in	3.3 in	2.1 in	3.0 in	4.0 in	3.5 in	5.2 in	M	1.0 in	1.9 in	2.2 in	M
		165 mm	30 mm	84 mm	53 mm	76 mm	102 mm	89 mm	132 mm	M	25 mm	48 mm	56 mm	M
Appomattox	APXV2	4.7 in	0.5 in**	4.5 in	2.4 in	5.4 in	2.4 in	2.8 in	5.4 in	4.9 in	4.6 in	2.7 in	2.2 in	42.6 in
		119 mm	13 mm**	114 mm	61 mm	137 mm	61 mm	71 mm	137 mm	124 mm	117 mm	69 mm	56 mm	1,082 mm
Huddleston 4 SW	HUDV2	4.8 in	2.3 in	4.0 in	2.6 in	3.2 in	2.7 in	2.5 in	6.5 in	7.9 in	3.1 in	1.6 in	3.0 in	44.2 in
		122 mm	58 mm	102 mm	66 mm	81 mm	69 mm	64 mm	165 mm	201 mm	79 mm	41 mm	76 mm	1123 mm

* M = missing data (Monthly statistics are reported as 'M' if more than 4 days of data are missing). **An exception was made for Appomattox because it is used as an indicator for the parks. Six days of precipitation measurements were missing during February.

Table 9. Summary of 2010 percent of normal precipitation based on 30-year normal (1971–2000) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Lynchburg Airport	KLYH	132	74	136	84	112	82	66	191	175	74	60	68	105
Roanoke Airport	KROA	138	68	104	39	127	35	143	134	179	54	109	70	102
Blue Ridge Airport*	KMTV	166	36	74	56	69	101	79	149	M	29	62	67	M
Appomattox	APXV2	131	15**	107	67	120	68	63	143	110	119	75	72	93
Huddleston 4 SW	HUDV2	130	73	100	73	80	80	67	201	187	88	48	98	103

*Indicates a station's Period of Record is five years or more but less than 30 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.

**Appomattox is missing six days of precipitation measurements during February.

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 2010 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 2010). 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 2010.

According to the PDSI, 2010 started with abnormally wet conditions, with drier conditions returning during February, and persisting for much of the rest of the year (Figure 5). Even wet conditions at the end of September and early December were not able to restore the PDSI to zero values. However, only July was sufficiently dry to send the PDSI outside the normally dry levels. Compared with the previous two years, 2010 was rather similar to 2008. The PDSI value was only above /below ± 2 for two months, unlike seven months in 2008.

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); abnormally dry (D1) in August and early September.

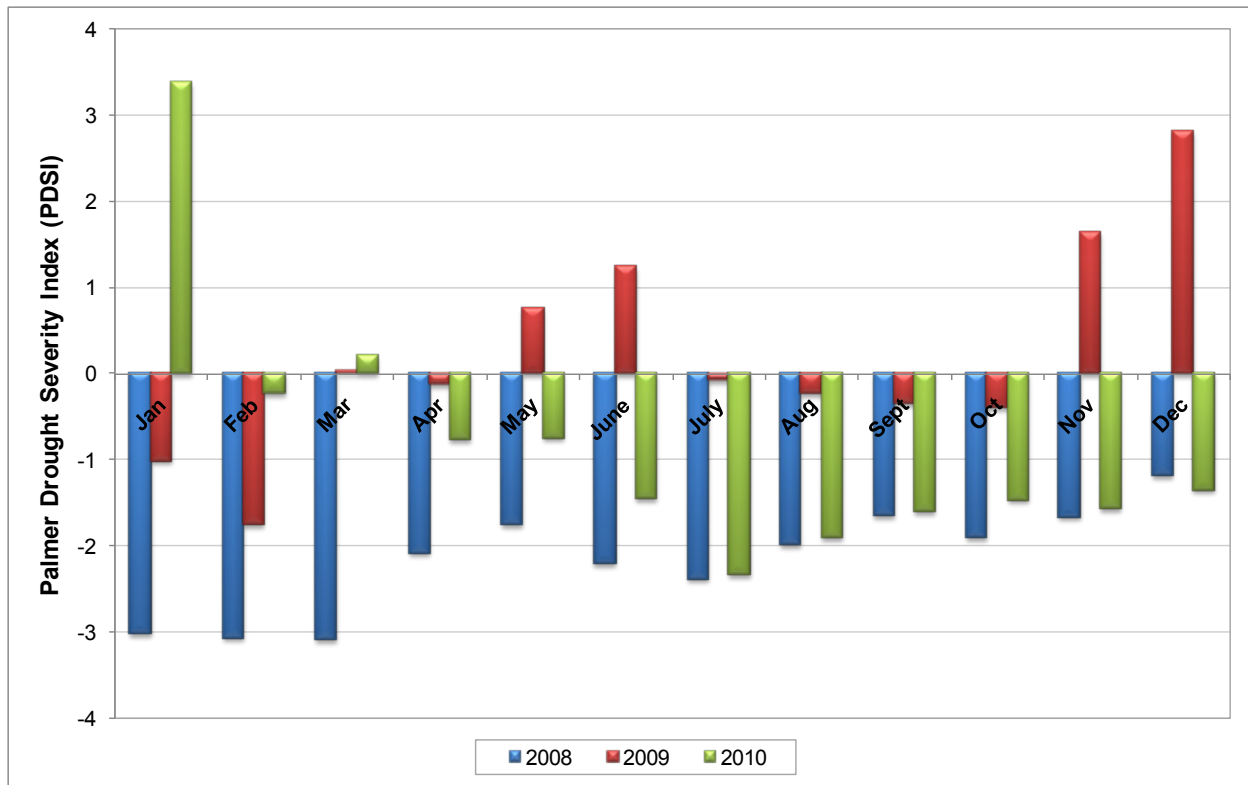


Figure 5. Palmer Drought Severity Index (PDSI) for the Western Piedmont, 2008–2010.

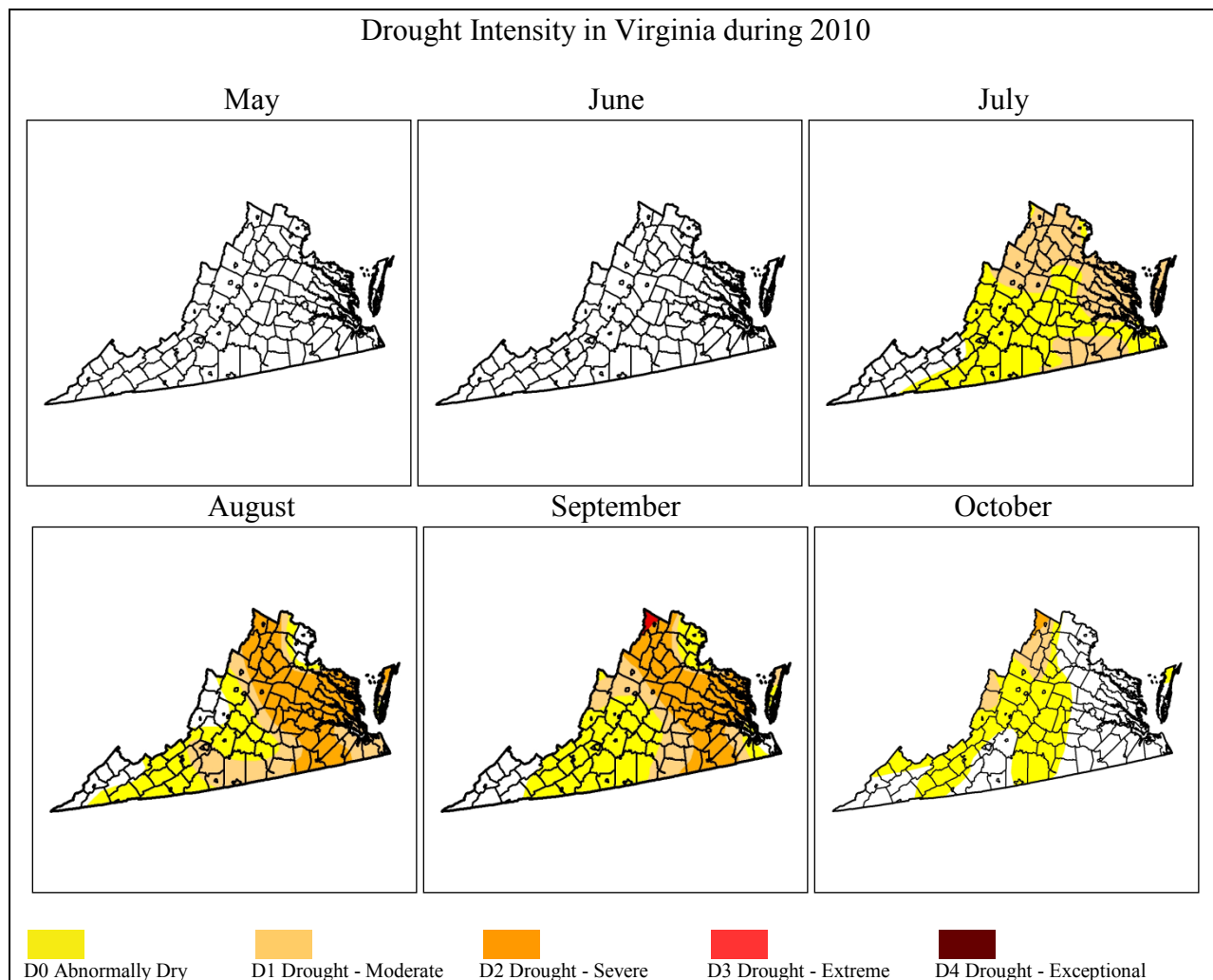


Figure 6. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for Virginia in 2010.

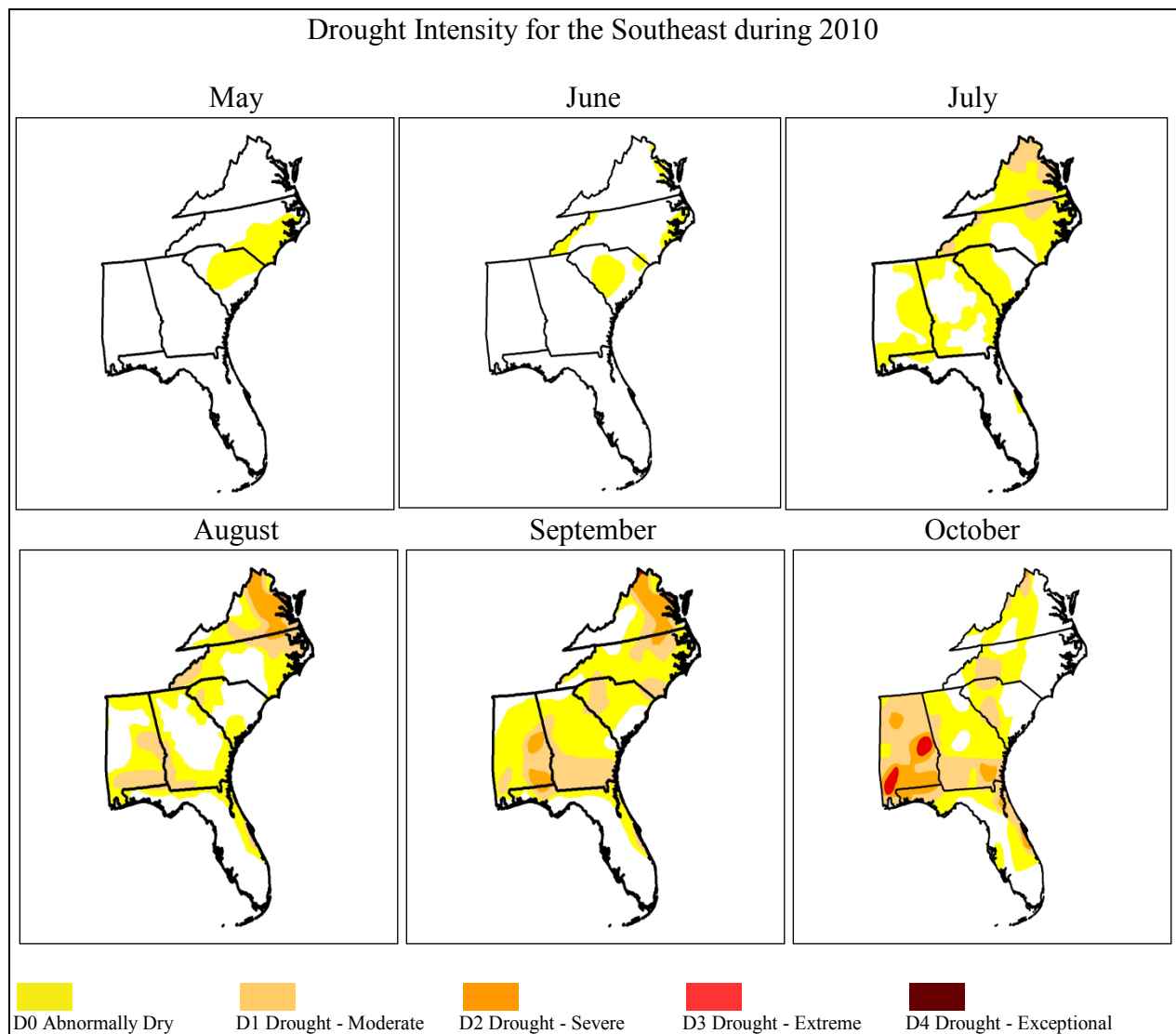


Figure 7. Mid-month values of the United States Drought Monitor (DM) – Drought Intensity Index for the Southeast in 2010.

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