



Weather of Fredericksburg and Spotsylvania National Military Park

Mid-Atlantic Network Summary Report for 2016

Natural Resource Data Series NPS/MIDN/NRDS—2017/1102



ON THE COVER

“Foggy Sunrise in Chancellorsville” – Fredericksburg and Spotsylvania National Military Park

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Natural Resource Data Series NPS/MIDN/NRDS—2017/1102

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Abstract

The Mid-Atlantic Network (MIDN) weather and climate monitoring protocol supports the documentation of current status and long-term trends in air temperature and precipitation at multiple temporal and spatial scales in MIDN parks. The purpose of this report is to provide a concise weather and climate summary for Fredericksburg and Spotsylvania National Military Park (FRSP) for the time period of January 1 to December 31, 2016. FRSP is located in the Eastern Piedmont Climate Division of Virginia. In 2016, a total of seven weather stations were selected to report park weather and climate conditions, and a large suite of precipitation and temperature metrics were summarized. Ultimately, 2016 was a very warm year and tied as the 5th warmest on record for the Eastern Piedmont. With the exception of a cool spring, all seasons were warmer than normal, particularly the summer and autumn (2nd warmest and 14th warmest since 1895, respectively). In terms of precipitation, most seasons were near normal. The exception was the spring season which was the 7th wettest spring since 1895. In total, the year was only slightly wetter than normal, being the 41st wettest out of 122 years of records. No drought conditions were reported in Virginia during 2016.

List of Acronyms

ASOS	Automated Surface Observation System
CASTNET	Clean Air Status and Trends Network
COOP	National Weather Service Cooperative Observer Program
FRSP	Fredericksburg and Spotsylvania National Military Park
MIDN	Mid-Atlantic Network
NCDC	National Climatic Data Center
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
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
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, 2016, and to place current patterns and trends in an appropriate historical and regional 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 2016's climate summary.

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 (for the most recent trend report, see Knight et al. 2016). These key indicators are further described in the protocol (Marshall et al. 2012) and are summarized in this report.

Methods

Observing Stations

A total of seven weather observing stations comprising three weather observing networks were selected as the most representative weather stations around FRSP (Figure 1, Table 1). 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.

Fredericksburg and Spotsylvania National Military Park (NMP) lies in VA Climate Division 2 (Eastern 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>).

Climate Indicators and Climatological Normals

A suite of indicators were identified to provide a summary of weather and climate conditions (Marshall et al. 2012). The following are the climate indicators selected for each of the parks:

- Average Annual Mean Temperature – A measure of the composite mean temperature (averaging the maximum and minimum on a daily basis) for an entire year
- Average Annual Maximum Temperature – A measure of the average of the daily maximum temperature for an entire year
- Highest Annual Maximum Temperature – A measure of the individual highest maximum temperature each year
- Annual Number of Hot Days (maximum temperature equal to or exceeding 90°F (32°C) – A measure of warm season heat using a threshold of days with a 90°F (32°C) maxima
- Average Annual Minimum Temperature – A measure of the average of the daily minimum temperature for an entire year
- Lowest Annual Minimum Temperature – A measure of the individual lowest minimum temperature each year
- Annual Number of Cold Days (maximum temperature less than or equal to 32°F (0°C)) – A measure of cold season chill using a threshold of days with a 32°F (0°C) maxima
- Annual Number of Subfreezing Days (minimum temperature less than or equal to 32°F (0°C)) – A measure of cold season chill using a threshold of days with a 32°F (0°C) minima
- Annual Number of Subzero Days (minimum temperature less than or equal to 0°F (-17.8°C)) – A measure of cold season chill using a threshold of days with a 0°F (-17.8°C) minima
- Growing Season Length (number of days between last freeze in spring and first freeze in fall) – A measure of the local growing season as tallied by the total number of days between the last 32°F (0°C) in the spring and the first 32°F (0°C) in the fall
- Annual Precipitation – A measure of total liquid (and its equivalent melted snow) for all days
- Autumn Precipitation (October 1 – December 31) - The three month total precipitation including rain and melted snow
- Annual Number of Heavy Precipitation Days (liquid equal to or greater than 1.0 in (25mm) – A measure of the frequency of heavy precipitation events during each year

- Annual Number of Extreme Precipitation Days (liquid equal to or greater than 2.0 in (50mm)) – A measure of frequency of extreme precipitation events during each year
- Annual Number of Micro-droughts – A measure of micro-droughts for the year as the number of periods of 7+ days without rain
- Annual Snowfall – A measure of total solid precipitation (includes sleet and hail; does not include freezing rain)
- Annual Number of Measureable Snow Days – A measure of the severity of winter precipitation as the number of days receiving more than or equal to 0.1 in (0.3 cm) of solid precipitation (includes sleet and hail; does not include freezing rain)
- Annual Number of Moderate Snow Days– A measure of the severity of winter precipitation as the number of days receiving more than or equal to 3 in (7.6 cm) of solid precipitation (includes sleet and hail; does not include freezing rain)
- Annual Number of Heavy Snow Days– A measure of the severity of winter precipitation as the number of days receiving more than or equal to 5 in (12.7 cm) of solid precipitation (includes sleet and hail; does not include freezing rain)

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 2016) 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.

For two stations, Piedmont Research Station and Louisa, all of the temperature indicators for 2016 are calculated and compared to normals, while precipitation indicators are compared for only one station (Louisa). All seven stations are used to provide monthly summaries for temperature, and four are used to show departures from normal temperatures. Fredericksburg Sewage Plant has a shorter reporting period, but departures from normal are compared to the longer term record for that station (1995–2007). For precipitation, Corbin, Fredericksburg Sewage Plant, Louisa, Piedmont Research Station and Fredericksburg Battlefield are used to calculate monthly summaries. These stations, with the exception of Fredericksburg Battlefield due to a short Period of Record, are used to calculate monthly departures from normal.

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). Positive values indicate periods of above normal precipitation (0 to 2: near normal; 2 to 3: moderate moisture; >3 : very moist) and negative values indicate periods of drought (0 to -2: near normal; -2 to -3: moderate drought; <-3 : severe to extreme drought).

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 2017). 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).

Data Processing and Quality Assurance

Data from selected stations are downloaded from relevant data streams (ASOS, RAWS, CASTNET, etc). Variables are calculated using simple statistics (e.g. mean, minimum, maximum, etc.).

Each data stream has varying levels of associated quality assurance (from none to extensive). ASOS, RAWS, and CASTNet data have rigorous and extensive quality assurance beginning at the point of gather (data-logger on site) and at additional levels as described in the respective user's manuals and specification documents. The COOP data quality control is now much more extensive in real-time as the electronically submitted data passes through several levels of quality assurance and is in a final format within a few days of submission. Quality assurance of USGS and NPS data is performed manually by comparing values with nearby stations.

Data management procedures are fully outlined in Marshal, et al (2012).

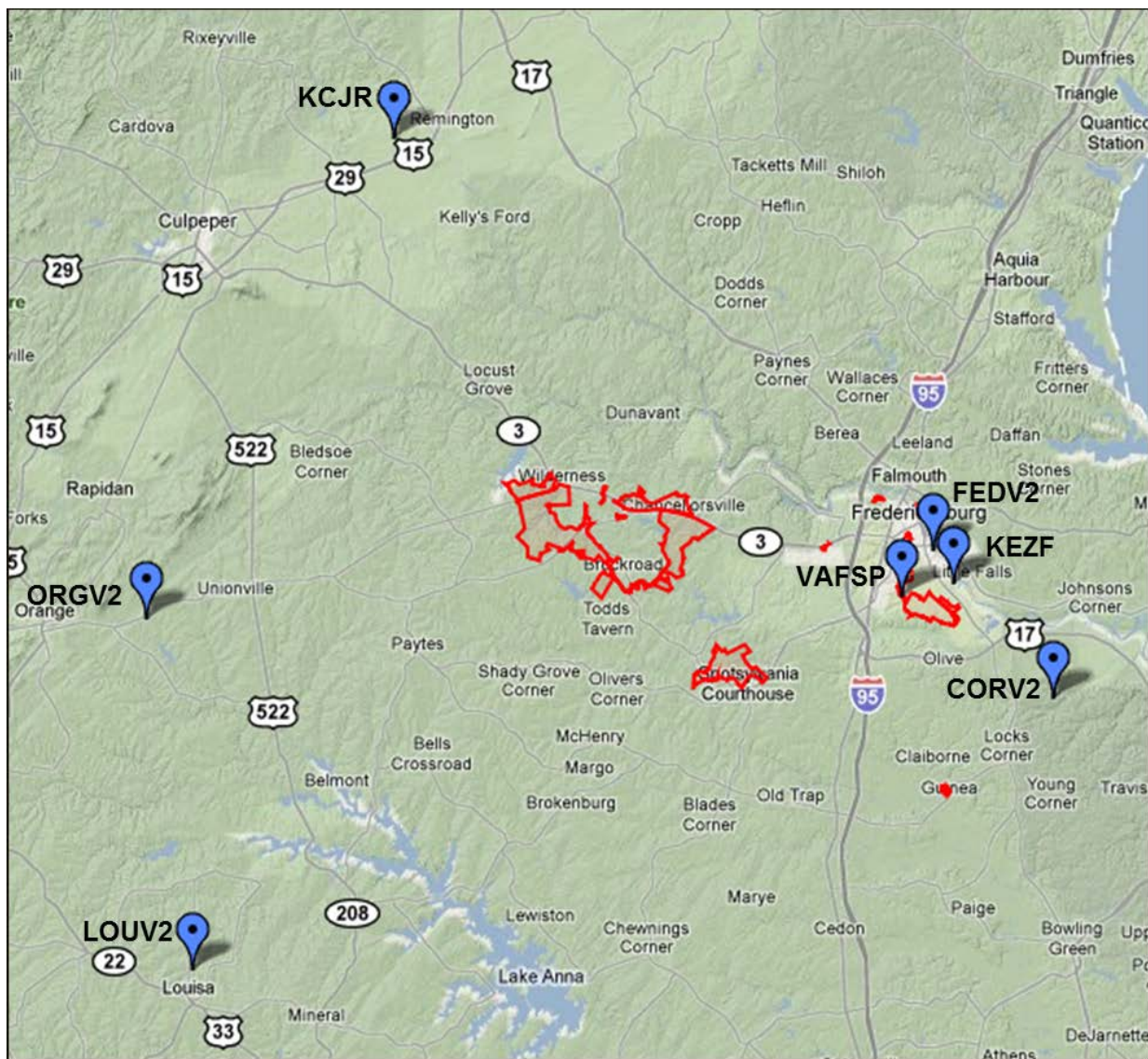


Figure 1. Location of weather observing stations around Fredericksburg and Spotsylvania National Military Park selected as most representative of the park in 2016. See Table 1 for station names. Park boundary is outlined in red.

Table 1. List of weather observing stations around Fredericksburg and Spotsylvania National Military Park selected as most representative of the parks in 2016.

Station	Observing Network ^A	Station Name	Period of Record (POR)	Percentage of Time Reporting Temperature for 2016	Percentage of Time Reporting Precipitation for 2016	Percentage of Time Reporting Temperature for entire POR	Percentage of Time Reporting Precipitation for entire POR
CORV2	COOP	Corbin	01/01/1959 - Present	89.3	97.5	97.7	98.4
KCJR	ASOS	Culpepper Regional Airport	05/11/1998 - Present	100.0	100.0	97.6	42.0
VAFSP ^B	NPS	Fredericksburg Battlefield	01/01/2009 - Present	100.0	100.0	99.6	99.7
FEDV2	COOP	Fredericksburg Sewage Plant	01/01/1995 - Present	95.1	96.2	95.7	95.4
LOUV2	COOP	Louisa	05/01/1916 - Present	100.0	100.0	97.9	97.1
ORGV2	COOP	Piedmont Research Station	11/01/1946 - Present	99.5	95.9	99.8	99.5
KEZF	ASOS	Shannon Airport	01/01/1996 - Present	100.0	100.0	93.0	30.5

^A Observing networks are: ASOS — Automated Surface Observation System, COOP — National Weather Service Cooperative Observer Program, NPS — National Park Service.

^B Station code was NAD83 in some previous reports.

Results

Temperature Summary

Almost all of the temperature metrics calculated from stations around FRSP indicate that 2016 was a warm year. Throughout the year, most months had higher than average temperatures (Figures 2 and 3, Table 2 and 3). Average annual temperatures were also above normal at all of the reporting stations (Tables 2 and 3). In addition, the number of hot days, average annual maximum temperatures, and average annual minimum temperatures were all above average (Table 4). Growing season lengths were approximately one week longer than average (Table 4). With the exception of spring, all of the seasons ranked warmer than average, and the summer of 2016 was a near record season as the 2nd warmest on record (Table 5). In all, 2016 tied as the 5th warmest since the year 1895 (Table 5).

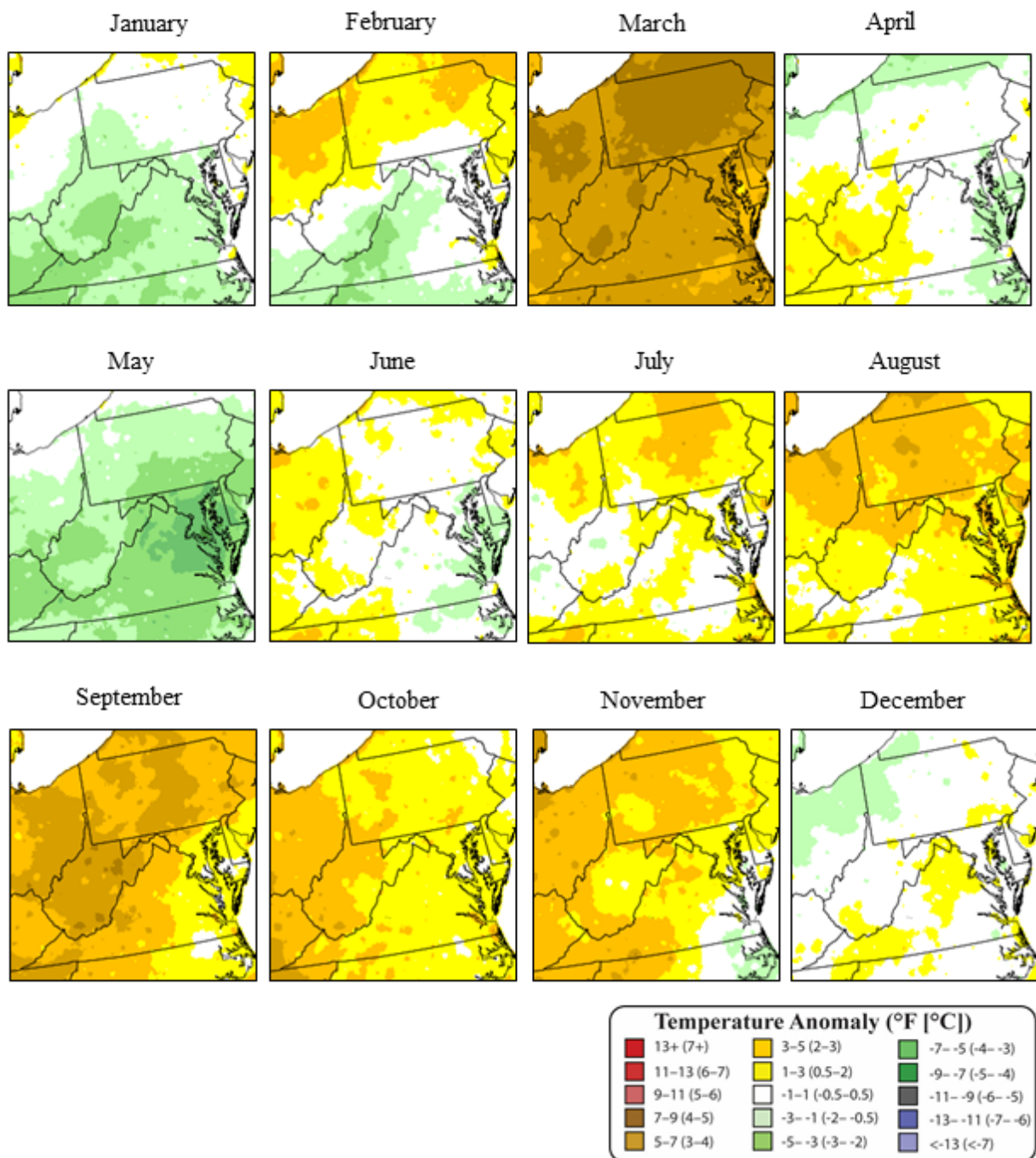


Figure 2. Maps showing departure from average monthly maximum temperature in 2016 compared to the 30-year normal (1981–2010).

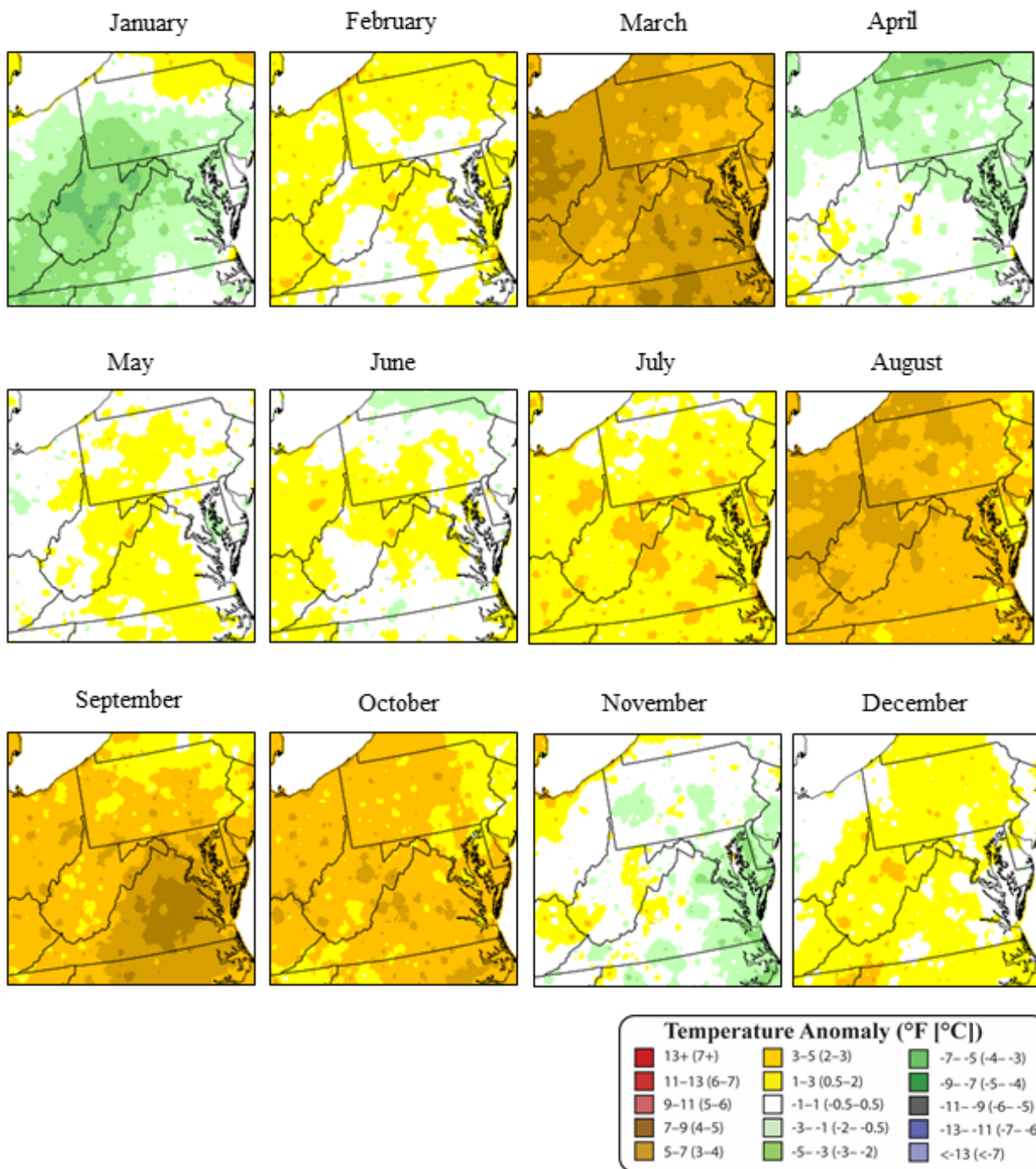


Figure 3. Maps showing departure from average monthly minimum temperature in 2016 compared to the 30-year normal (1981–2010).

Table 2. Summary of 2016 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
Corbin	CORV2	0.5°F	2.4°F	8.3°F	0.8°F	-1.3°F	1.1°F	2.2°F	M	M	3.2°F	0.9°F	1.1°F	M
		0.3°C	1.3°C	4.6°C	0.4°C	-0.8°C	0.6°C	1.2°C	M	M	1.8°C	0.5°C	0.6°C	M
Fredericksburg Sewage Plant*	FEDV2	-2.2°F	1.2°F	7.0°F	0.9°F	-3.3°F	0.9°F	2.0°F	3.3°F	4.5°F	2.1°F	M	2.2°F	M
		-1.3°C	0.7°C	3.9°C	0.5°C	-1.8°C	0.5°C	1.1°C	1.8°C	2.5°C	1.2°C	M	1.3°C	M
Louisa	LOUV2	-2.6°F	0.6°F	6.3°F	-0.4°F	-2.3°F	-0.5°F	0.5°F	1.9°F	3.9°F	1.9°F	-0.5°F	0.3°F	0.7°F
		-1.4°C	0.4°C	3.5°C	-0.3°C	-1.3°C	-0.3°C	0.2°C	1.0°C	2.2°C	1.1°C	-0.3°C	0.1°C	0.4°C
Piedmont Research Station	ORGV2	-2.2°F	0.3°F	6.3°F	-0.8°F	-2.2°F	0.1°F	1.4°F	3.0°F	5.2°F	2.8°F	0.8°F	1.3°F	1.4°F
		-1.2°C	0.2°C	3.5°C	-0.4°C	-1.2°C	0.0°C	0.7°C	1.7°C	2.9°C	1.6°C	0.5°C	0.7°C	0.8°C

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

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

Table 3. Summary of 2016 monthly average temperatures for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Corbin	CORV2	35.2°F	40.3°F	53.8°F	56.3°F	62.5°F	73.8°F	79.0°F	M	M	60.4°F	48.8°F	39.4°F	M
		1.8°C	4.6°C	12.1°C	13.5°C	16.9°C	23.2°C	26.1°C	M	M	15.8°C	9.3°C	4.1°C	M
Culpepper Regional Airport	KCJR	31.1°F	36.6°F	50.6°F	55°F	62.3°F	73.3°F	77.9°F	77.6°F	72°F	59.2°F	46.5°F	38.6°F	56.8°F
		-0.5°C	2.6°C	10.3°C	12.8°C	16.8°C	22.9°C	25.5°C	25.3°C	22.2°C	15.1°C	8.1°C	3.7°C	13.8°C
Fredericksburg Battlefield	VAFSP	34.7°F	39.8°F	54.0°F	56.8°F	62.4°F	74.2°F	79.0°F	78.3°F	72.4°F	60.0°F	48.5°F	40.0°F	58.4°F
		1.5°C	4.3°C	12.2°C	13.8°C	16.9°C	23.4°C	26.1°C	25.7°C	22.4°C	15.6°C	9.2°C	4.4°C	14.7°C
Fredericksburg Sewage Plant	FEDV2	32.6°F	38.6°F	52°F	56.1°F	60.9°F	74.4°F	79.4°F	79.4°F	73.5°F	59.5°F	M	40.4°F	M
		0.3°C	3.7°C	11.1°C	13.4°C	16.1°C	23.6°C	26.3°C	26.3°C	23.1°C	15.3°C	M	4.7°C	M
Louisa	LOUV2	33.4°F	39.7°F	53.0°F	56.2°F	62.5°F	72.7°F	77.6°F	77.4°F	72.3°F	59.3°F	47.2°F	38.7°F	57.5°F
		0.8°C	4.3°C	11.7°C	13.4°C	16.9°C	22.6°C	25.3°C	25.2°C	22.4°C	15.2°C	8.4°C	3.7°C	14.2°C
Piedmont Research Station	ORGV2	32.1°F	37.6°F	51.3°F	54.5°F	61.5°F	72.7°F	77.8°F	77.9°F	73.2°F	59.5°F	48.3°F	38.8°F	57.2°F
		0.1°C	3.1°C	10.7°C	12.5°C	16.4°C	22.6°C	25.4°C	25.5°C	22.9°C	15.3°C	9.1°C	3.8°C	14.0°C
Shannon Airport	KEZF	34.3°F	39.5°F	53.1°F	56.7°F	62.6°F	74.7°F	79.7°F	79.2°F	73.2°F	60.7°F	48.5°F	40.4°F	58.6°F
		1.3°C	4.2°C	11.7°C	13.7°C	17.0°C	23.7°C	26.5°C	26.2°C	22.9°C	15.9°C	9.2°C	4.7°C	14.8°C

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

Table 4. Status of 2016 temperature indicators compared to the 30-year normal (1981–2010) for selected stations.

Temperature Indicator	Louisa, VA 2016	Louisa, VA 1981–2010	Piedmont Research Station, VA 2016	Piedmont Research Station, VA 1981–2010
Average Annual Temperature	57.5°F 14.2°C	56.8°F 13.8°C	57.2°F 14.0°C	55.8°F 13.2°C
Average Annual Maximum Temperature	69.1°F 20.6°C	68.7°F 20.4°C	67.3°F 19.6°C	66.2°F 19.0°C
Maximum Temperature	95.0°F 35.0°C	96.5°F 35.8°C	96.0°F 35.6°C	97.0°F 36.1°C
Hot Days (days with Tmax≥90°F/32°C)	35	31	32	22
Average Annual Minimum Temperature	46.0°F 7.8°C	44.9°F 7.2°C	47.1°F 8.4°C	45.5°F 7.5°C
Minimum Temperature	4.0°F -15.6 °C	0.5°F -17.5°C	5.0°F -15.0°C	3.5°F -15.8°C
Cold Days (days with Tmax≤32°F/0°C)	10	5	13	9
Sub-freezing Days (days with Tmin≤32°F/0°C)	100	100	85	92
Sub-zero Days (days with Tmin≤0°F/-18°C)	0	1	0	0
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	177	169	216	210

Table 5. Seasonal and annual temperature and precipitation rankings for 2016 over 122 years for the Eastern Piedmont (NOAA 2017).

Parameter	VA Climate Division 2 Rankings — Eastern Piedmont				
	Jan–Feb–Mar WINTER	Apr–May–Jun SPRING	Jul–Aug–Sep SUMMER	Oct–Nov–Dec AUTUMN	Jan–Dec YEAR
Temperature-2016	20-T	72-T	2	14	5-T
Precipitation-2016	67	7	51	83	41

1 = warmest/wettest year and 122 = coldest/driest year. T = Tie between multiple year

Precipitation Summary

Although monthly precipitation totals were variable, annual totals were below normal (Figure 4 and Table 6). At Louisa, annual precipitation was 8.5 inches (216 mm) below average (Table 7). Monthly totals ranged from a low of 0.7 inches (18 mm) at Corbin in August and November to a high of 9.6 inches (244 mm) at Corbin in May (Table 8). The wettest day occurred on September 29th when 3.6 inches (91 mm) of rain was recorded (Table 9). There are some variations in the 2016 precipitation data. At the spatial scale of the climate division (Climate Division 2, Eastern Piedmont of Virginia), the year was the 41st wettest on record which is slightly wetter than average (the average would rank at 62). Nevertheless, the Louisa station documented below average precipitation conditions for the year (Figure 4, Tables 6 and 7). Other stations generally documented above average rainfall, though annual totals and deviations weren't available due to missing data (Tables 6 and 8). Though droughts did occur at larger scales, no drought conditions were observed in the Eastern Piedmont in 2016 (Figures 5, 6, and 7).

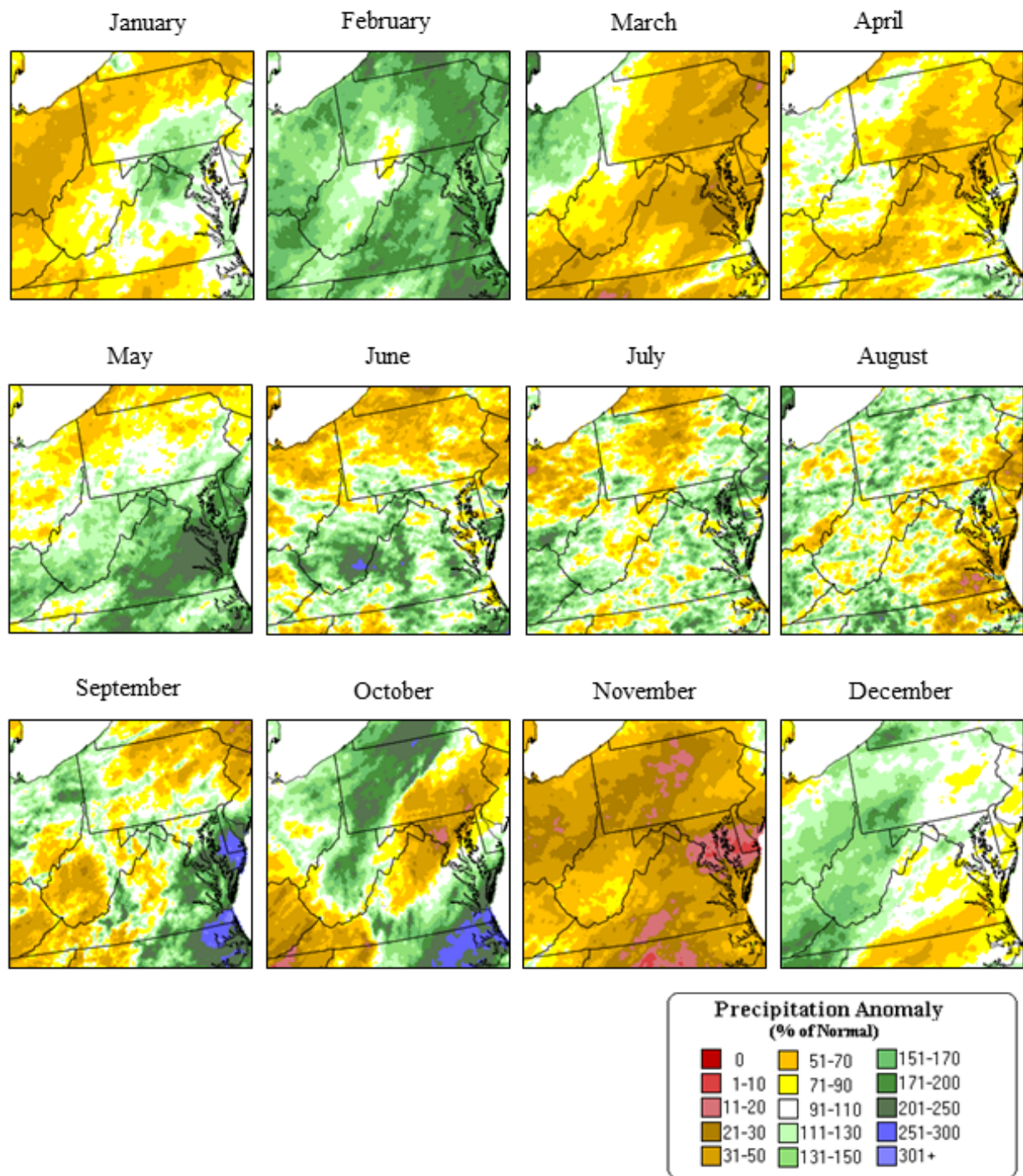


Figure 4. Maps showing percent of average monthly precipitation in 2016 compared to the 30-year normal (1981–2010).

Table 6. Summary of 2016 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
Corbin	CORV2	100	103	35	66	240	119	145	21	161	111	19	M	M
Fredericksburg Sewage Plant*	FEDV2	117	120	20	44	207	105	60	106	193	94	M	66	M
Louisa	LOUV2	97	107	37	47	168	94	106	69	90	47	22	78	81
Piedmont Research Station	ORGV2	100	157	49	76	M	138	119	84	80	35	42	68	M

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

*Indicates a station's Period of Record does not cover the period of 1981-2010 but is five years or more. In this case, the departures from normal values were calculated with normals derived from data spanning the length of the station's Period of Record.

Table 7. Status of 2016 precipitation indicators compared to the 30-year normal (1981–2010) at for a selected station.

Precipitation Indicator	Louisa, VA 1981–2010	Louisa, VA 1981–2010
Annual Precipitation	35.7 in 907 mm	44.2 in 1,123 mm
Autumn (Oct, Nov, Dec) Precipitation	5.1 in 130 mm	10.9 in 277 mm
Heavy Precipitation Days (days with ≥ 1.0 in (25 mm) rain)	10	12
Extreme Precipitation Days (days with ≥ 2.0 in (51 mm) rain)	1	2
Micro-drought (periods of 7+ days without rain)	15	8
Annual Snowfall	20.0 in 50.8 cm	17.7 in 45.0 cm
Measurable Snow Days (days with ≥ 0.1 in (0.3 cm) snow)	3	6
Moderate Snow Days (days with ≥ 3.0 in (7.6 cm) snow)	3	2
Heavy Snow Days (days with ≥ 5.0 in (12.7 cm) snow)	1	1

Table 8. Summary of 2016 monthly total precipitation for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Corbin	CORV2	3.1 in	3.2 in	1.4 in	2.1 in	9.6 in	4.4 in	5.8 in	0.7 in	6.6 in	4.1 in	0.7 in	M	M
		79 mm	81 mm	36 mm	53 mm	244 mm	112 mm	147 mm	18 mm	168 mm	104 mm	18 mm	M	M
Fredericksburg Battlefield	VAFSP	3.9 in	2.6 in	0.8 in	1.3 in	6.6 in	4.0 in	1.9 in	3.1 in	6.6 in	2.3 in	1.1 in	2.2 in	36.4 in
		99 mm	66 mm	20 mm	33 mm	168 mm	102 mm	48 mm	79 mm	168 mm	58 mm	28 mm	56 mm	925 mm
Fredericksburg Sewage Plant	FEDV2	3.4 in	3.0 in	0.8 in	1.5 in	8.5 in	4.2 in	2.7 in	3.6 in	8.3 in	3.2 in	M	2.1 in	M
		86 mm	76 mm	20 mm	38 mm	216 mm	107 mm	69 mm	91 mm	211 mm	81 mm	M	53 mm	M
Louisa	LOUV2	3.0 in	3.1 in	1.4 in	1.5 in	6.9 in	3.4 in	5.0 in	2.5 in	3.8 in	1.7 in	0.9 in	2.5 in	35.7 in
		76 mm	79 mm	36 mm	38 mm	175 mm	86 mm	127 mm	64 mm	97 mm	43 mm	23 mm	64 mm	907 mm
Piedmont Research Station	ORGV2	2.8 in	4.4 in	1.7 in	2.6 in	M	5.8 in	5.6 in	2.7 in	3.2 in	1.2 in	1.6 in	2.1 in	M
		71 mm	112 mm	43 mm	66 mm	M	147 mm	142 mm	69 mm	81 mm	30 mm	41 mm	53 mm	M

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

Table 9. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2016 from weather observing stations at Fredericksburg Battlefield (VAFSP) and Louisa (LOUV2).

Wettest Days in 2016	Dry Spells in 2016
Sept. 29: 3.6 in (91 mm)	April 8 - 21
August 16: 2.3 in (58 mm)	Nov. 16 - 28
July 19: 2.2 in (56 mm)	Oct. 9 - 20
Oct. 9: 1.9 in (48 mm)	March 3 - 13
May 21: 1.6 in (41 mm)	Sept. 9 - 18

Drought Status

The monthly Palmer Drought Severity Index (PDSI) indicates that 2016 began somewhat wet but ended the year closer to normal conditions (Figure 5). Similarly, the far majority of locations in Virginia never entered drought conditions during 2016 as determined by the Drought Intensity Index (Figure 6). In contrast, a number of states across the Southeast did experience drought conditions including exceptional droughts in parts of Georgia and Alabama (Figure 7).

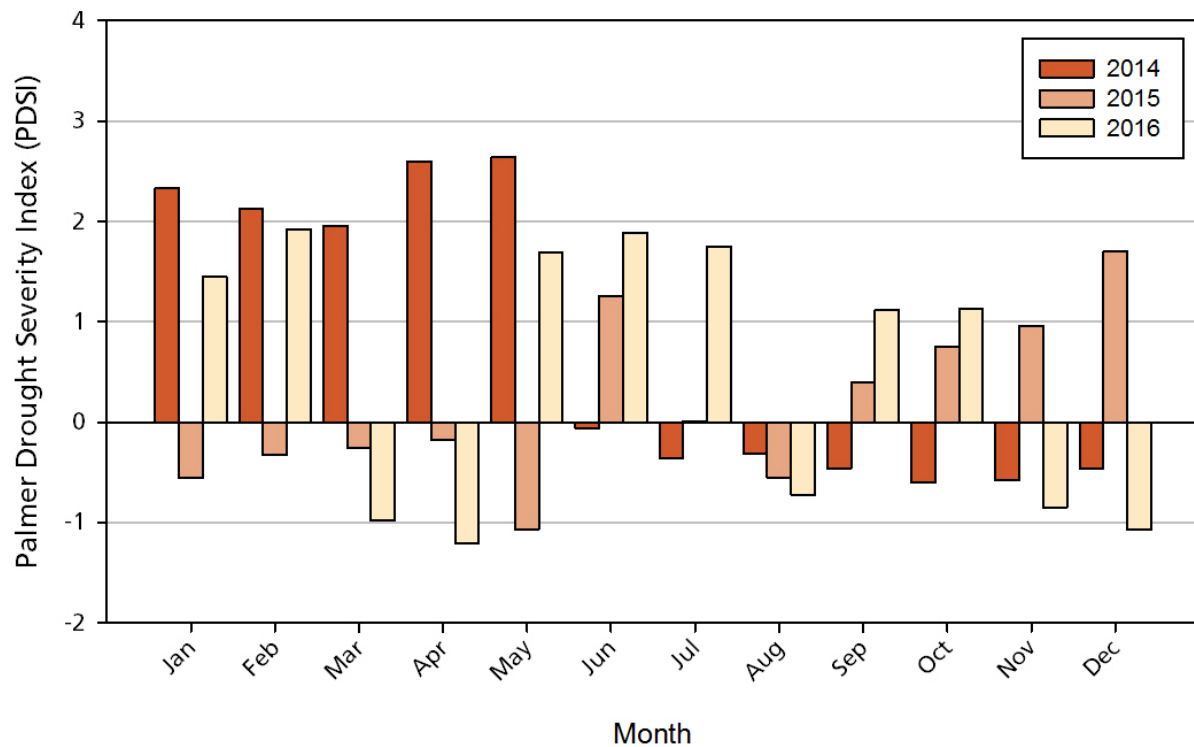


Figure 5. Palmer Drought Severity Index (PDSI) for the Eastern Piedmont, 2014–2016. Positive values indicate periods of above normal precipitation (0 to 2: near normal; 2 to 3: moderate moisture; >3: very moist) and negative values indicate periods of drought (0 to -2: near normal; -2 to -3: moderate drought; <-3: severe to extreme drought).

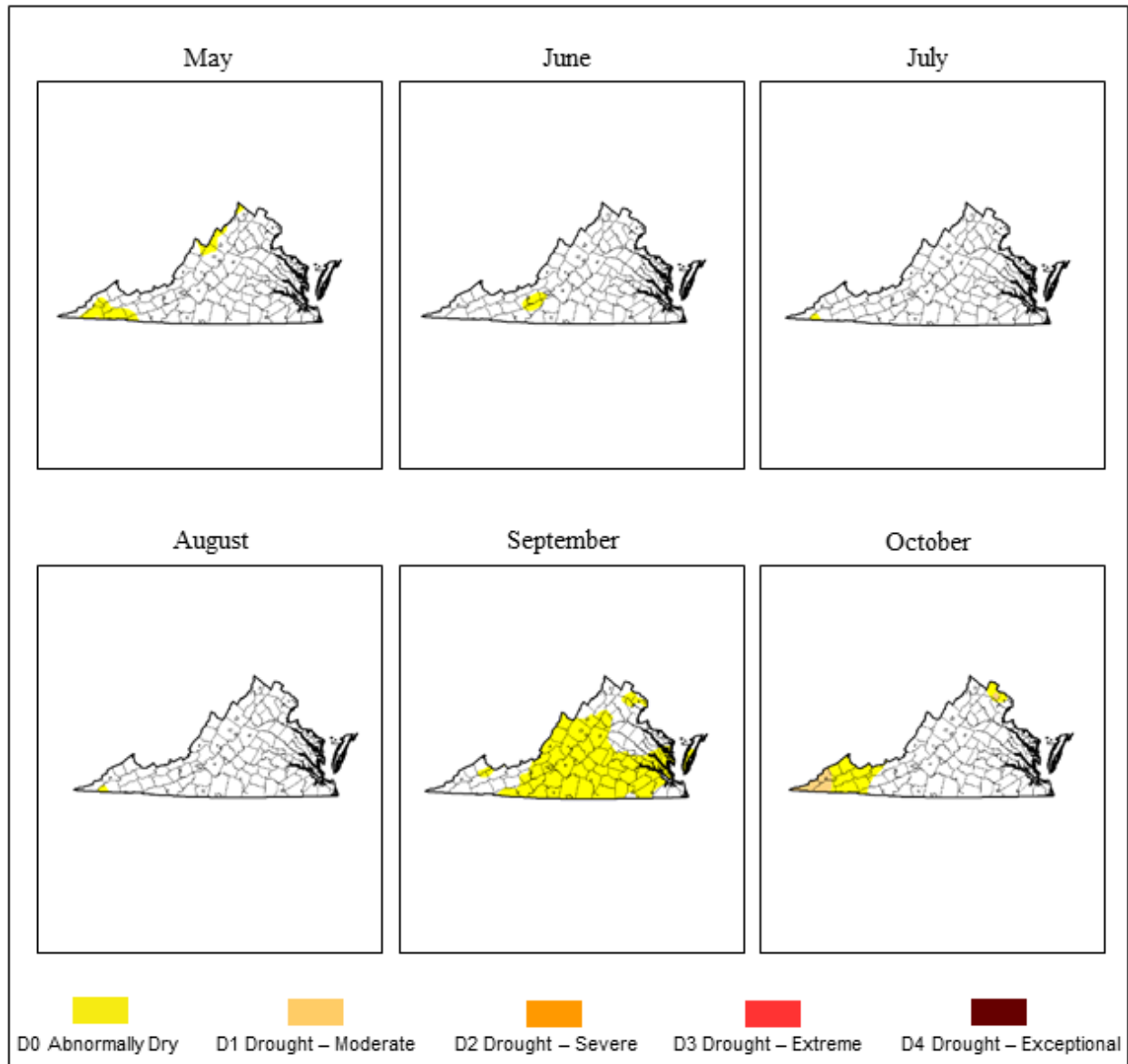


Figure 6. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Virginia in 2016.

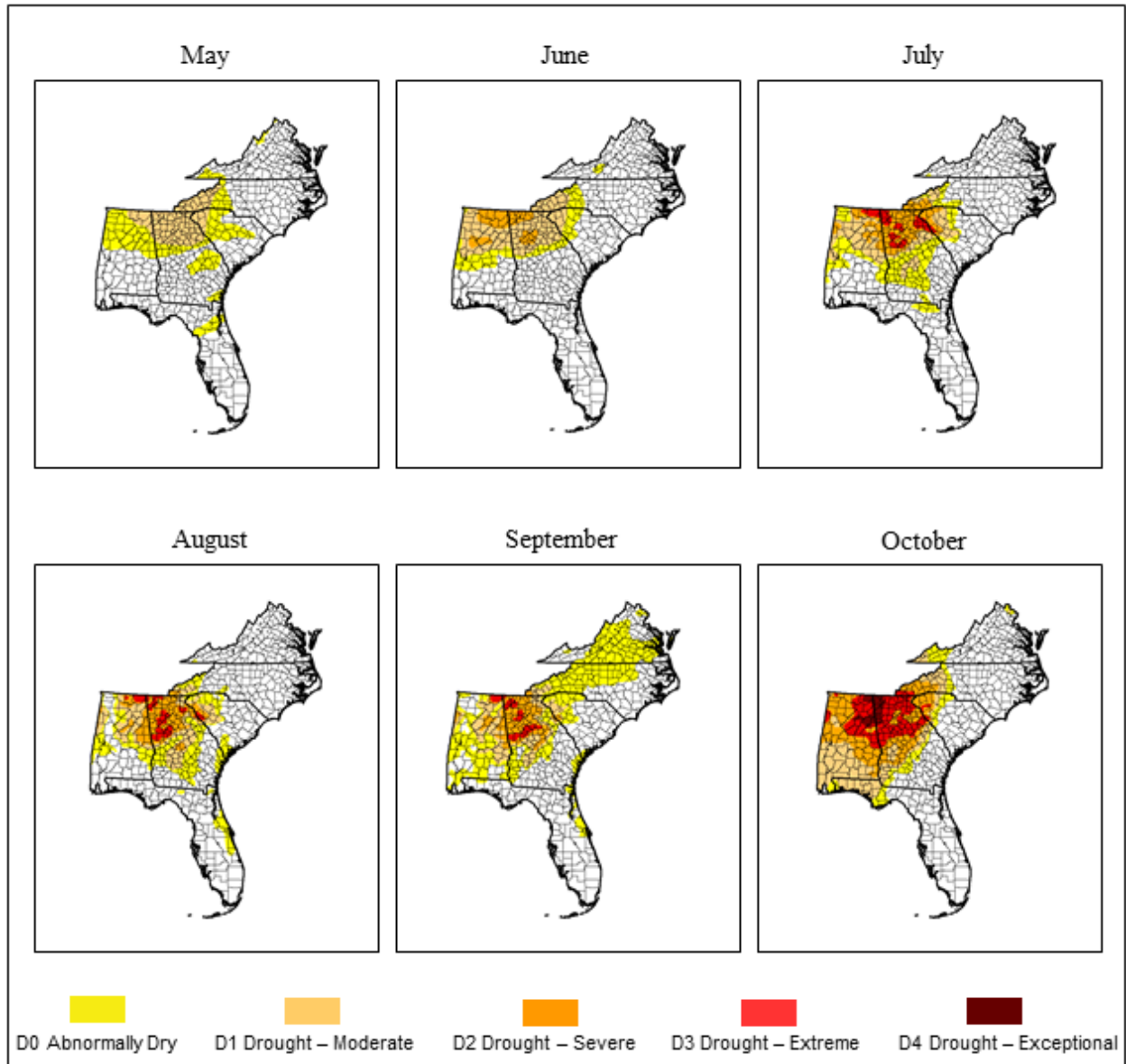


Figure 7. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Southeast in 2016.

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