



Weather of Eisenhower National Historic Site and Gettysburg National Military Park

Mid-Atlantic Network Summary Report for 2015

Natural Resource Report NPS/MIDN/NRR—2016/1324



ON THE COVER

Photograph of Gettysburg National Military Park.
Photograph courtesy of Nicolas Raymond.

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Contents

	Page
Figures.....	iv
Tables.....	v
Abstract.....	vi
List of Key Acronyms.....	vii
Introduction.....	1
Climate of the Lower Susquehanna of Pennsylvania.....	2
Observing Stations and Climate Indicators.....	3
Temperature Summary.....	7
Precipitation Summary.....	12
Drought Status	16
References.....	20

Figures

	Page
Figure 1. Location of weather observing stations around Eisenhower National Historic Site and Gettysburg National Military Park selected as most representative of the parks in 2015.....	5
Figure 2. Maps showing departure from average monthly maximum temperature in 2015 compared to the 30-year normal (1981–2010).....	8
Figure 3. Maps showing departure from average monthly minimum temperature in 2015 compared to the 30-year normal (1981–2010).....	9
Figure 4. Maps showing percent of average monthly precipitation in 2015 compared to the 30-year normal (1981–2010).....	13
Figure 5. Palmer Drought Severity Index (PDSI) for the Lower Susquehanna, 2013–2015.....	17
Figure 6. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Pennsylvania in 2015.	18
Figure 7. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Northeast in 2015.	19

Tables

	Page
Table 1. List of weather observing stations around Eisenhower NHS and Gettysburg NMP selected as most representative of the parks in 2015.....	6
Table 2. Summary of 2015 departure from normal temperature based on 30-year normal (1981–2010) for selected stations.	10
Table 3. Status of 2015 temperature indicators compared to the 30-year normal (1981–2010) at the Biglerville (BGLP1) weather observing station.	10
Table 4. Summary of 2015 monthly average temperatures for selected stations.	11
Table 5. Seasonal and annual temperature and precipitation rankings for 2015 over 121 years for the Lower Susquehanna (NOAA 2015).	11
Table 6. Summary of 2015 monthly total precipitation for selected stations.	14
Table 7. Summary of 2015 percent of normal precipitation based on the 30-year normal (1981–2010) for selected stations.	14
Table 8. Status of 2015 precipitation indicators compared to the 30-year normal (1981–2010) at the Biglerville (BGLP1) weather observing station.	15
Table 9. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2015 from the weather observing station at Biglerville (BGLP1).	15

Abstract

The Mid-Atlantic Network (MIDN) Weather and Climate Monitoring protocol supports the objective to document the current status and long-term trends in air temperature and precipitation at multiple temporal and spatial scales. The purpose of this report is to provide a concise weather and climate summary for Eisenhower National Historic Site (NHS) and Gettysburg National Military Park (NMP) for the time period of January 1 to December 31, 2015. The parks are located in the Lower Susquehanna climate division of Pennsylvania. A total of two weather stations were selected as representative of local weather and climate conditions, and a large suite of precipitation and temperature metrics were summarized. Ultimately, 2015 was a warm year and tied as the 17th warmest since records began in 1895. In addition, the autumn of 2015 was the warmest autumn ever recorded in the Lower Susquehanna. The year supported near-normal precipitation, and no drought conditions were reported during 2015.

List of Key Acronyms

ASOS	Automated Surface Observation System
CASTNET	Clean Air Status and Trends Network
COOP	National Weather Service Cooperative Observer Program
CWOP	Citizen Weather Observer Program
EISE	Eisenhower National Historic Site
FAA	Federal Aviation Administration
GETT	Gettysburg National Military Park
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
NHS	National Historic Site
NMP	National Military Park
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, 2015, 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 2015'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.

Climate of the Lower Susquehanna of Pennsylvania

Eisenhower National Historic Site (NHS) and Gettysburg National Military Park (NMP) are located in Pennsylvania Climate Division 4, known as the “Lower Susquehanna.” 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>). Pennsylvania is divided into ten climate divisions. The Lower Susquehanna River Valley 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 the valley. The prevailing westerly winds carry most of the weather disturbances that affect the region from the interior of the continent, with the Atlantic Ocean having only an occasional 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. Also, storms of tropical origin can have the greatest effect within this portion of Pennsylvania, causing severe floods in some instances (Gelber 2002).

Temperatures are moderately continental with the tempering effects of the Great Lakes contributing to some cloud production in the winter and onshore winds 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 Northeast after a fresh snowfall. 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 directs hot, humid air from the Gulf region into the Susquehanna Valley. The southwest winds gain additional warmth when descending the crest of the Appalachians. The last freeze and first frost typically occur in late April and late October, respectively.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 34–52 in (864–1,321 mm), while the majority of places receive 38–46 in (965–1,168 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 tends to be somewhat greater in the mountains, due primarily to coastal storms which occasionally frequent the area. During the warm season these storms can bring heavy rain, and in winter, heavy snow or a mixture of rain and snow may be produced.

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 Valley 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 tropical storms 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 and Climate Indicators

A total of two weather observing stations comprised of two weather observing networks were selected as the most representative around Eisenhower NHS and Gettysburg NMP in 2015 (Figure 1). Representative stations within a 100-km range of each park were chosen based on several criteria, which include proximity to the parks, the representativeness of the station to the park's 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 two stations were ultimately used for this 2015 report: Arendtsville and Biglerville (Table 1, Figure 1).

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 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-normals 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 is the 30-year normal or the pseudo-normal calculated on a shorter time frame

Of the two stations, only Biglerville has a Period of Record (POR) sufficiently long for a 30-year normal (normal calculated from years 1981–2010). However, for Arendtsville, a normal was calculated based on a POR from 1988–2010. Monthly averages and deviations from normal are presented for all stations for precipitation and 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 selected 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>.

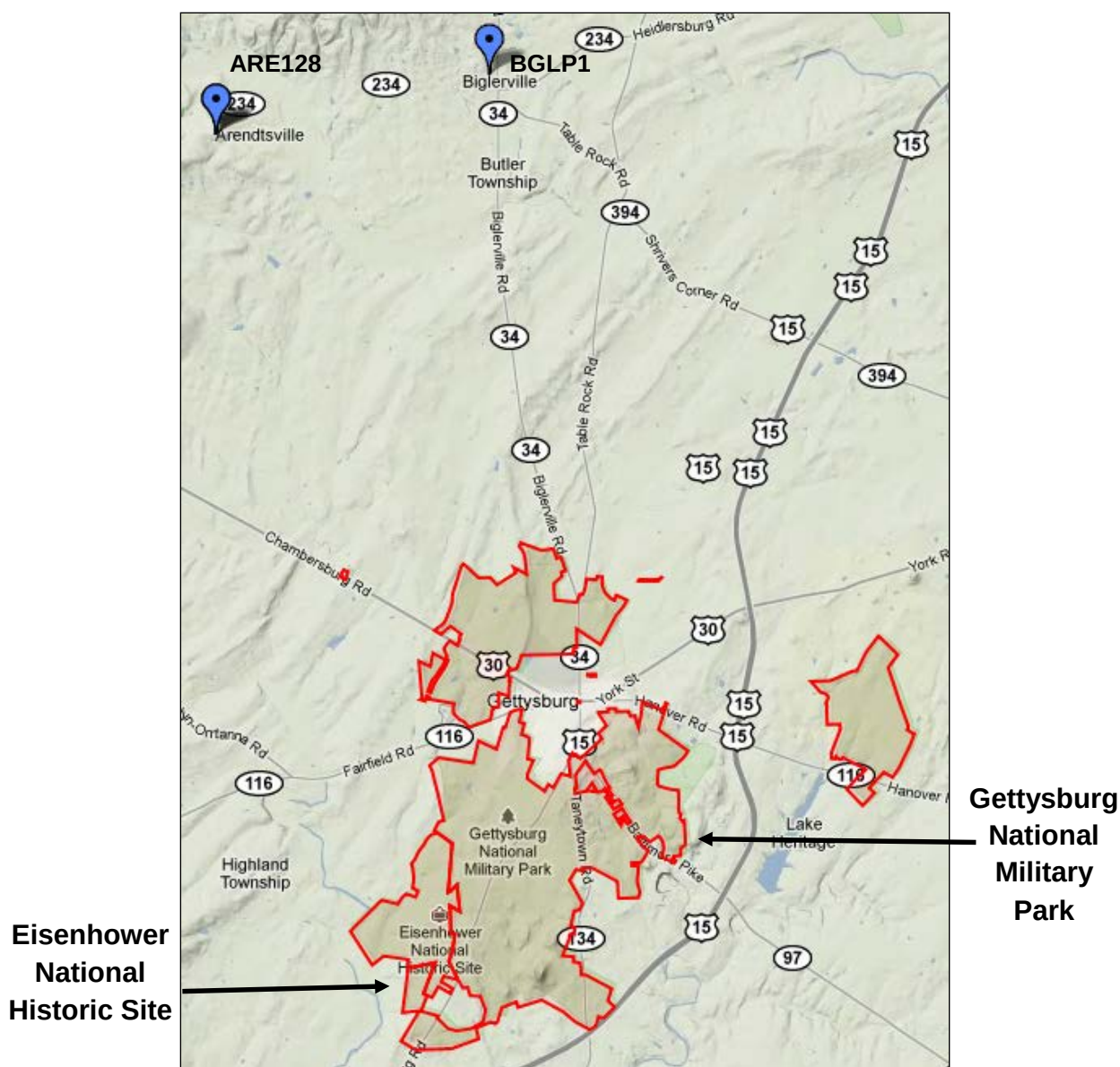


Figure 1. Location of weather observing stations around Eisenhower National Historic Site and Gettysburg National Military Park selected as most representative of the parks in 2015. See Table 1 for station names.

Table 1. List of weather observing stations around Eisenhower NHS and Gettysburg NMP selected as most representative of the parks in 2015.

Station	Observing Network ¹	Name	Period of Record (POR)	Percentage of time reporting temperature for 2015	Percentage of time reporting precipitation for 2015	Percentage of time reporting temperature for entire POR	Percentage of time reporting precipitation for entire POR
ARE128	CASTNET	Arendtsville	07/01/1988 - Present	100.0	89.6	96.3	93.5
BGLP1	COOP	Biglerville	02/02/1972 - Present	100.0	100.0	99.9	99.6

¹ Observing networks are: CASTNET — Clean Air Status and Trends Network, COOP — National Weather Service Cooperative Observer Program.

Temperature Summary

Average annual temperatures were above normal during 2015 for the areas around Eisenhower NHS and Gettysburg NMP (Tables 2 – 4). Temperatures ranged from 0.9°F to 1.2°F (0.5°C to 0.7°C) above the long-term average (Table 2). The length of the growing season was about a week longer than normal (Table 3).

The winter months of January through March were colder than normal, with February being an exceptionally cold month across the region (Figures 2 and 3)¹. Average temperatures during February were colder than those during January, by as much as 6.0°F (3.3°C) at Biglerville (Table 4). The deep chill during February resulted in an unusually high number of sub-zero days, with 5 of the 6 days occurring within the month (Table 3). The winter temperatures, based on the Lower Susquehanna climate division, ranked 6th coldest in 121 years of records (Table 5).

Spring began with mild temperatures but soon became very warm with May temperatures 6.0°F (3.3°C) to 6.4 (3.5°C) above normal (Table 2). With a mild June, the spring season (April – June) ultimately tied as the 3rd warmest on record for the Lower Susquehanna (Table 5).

Summer temperatures began near normal, as both July and August had temperature departures less than 2°F (1.1°C) from the long-term mean (Table 2). The highest readings of the year occurred on August 18th, when Biglerville reported a high temperature of 95.0°F (35.0°C, Table 3). The number of days with maximum temperatures reaching 90°F (32.2°C) tallied 15, compared with a normal of 17 days (Table 3). September brought a mild end to the summer season, with departures from +3.8°F to +4.0°F (+2.1°C to +2.3°C) across the region (Table 2). The season as a whole tied as the 17th warmest for the period of record (Table 5).

Autumn 2015 was notable for the exceptional warmth that arrived for the middle to latter half of the season (Figures 2 and 3)¹. In fact, November was the 3rd warmest in 121 years of records and December was the warmest on record in the Lower Susquehanna. Departures during the month of December were in excess of 11°F (6°C) at both observing stations (Table 2). As a result, the entire season ranked as the warmest winter on record for the Lower Susquehanna climate division (Table 5). While the year started cool, the final three seasons were mild and, as a result, the calendar year ended as tied for the 17th warmest since 1895 (Table 5).

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/>.

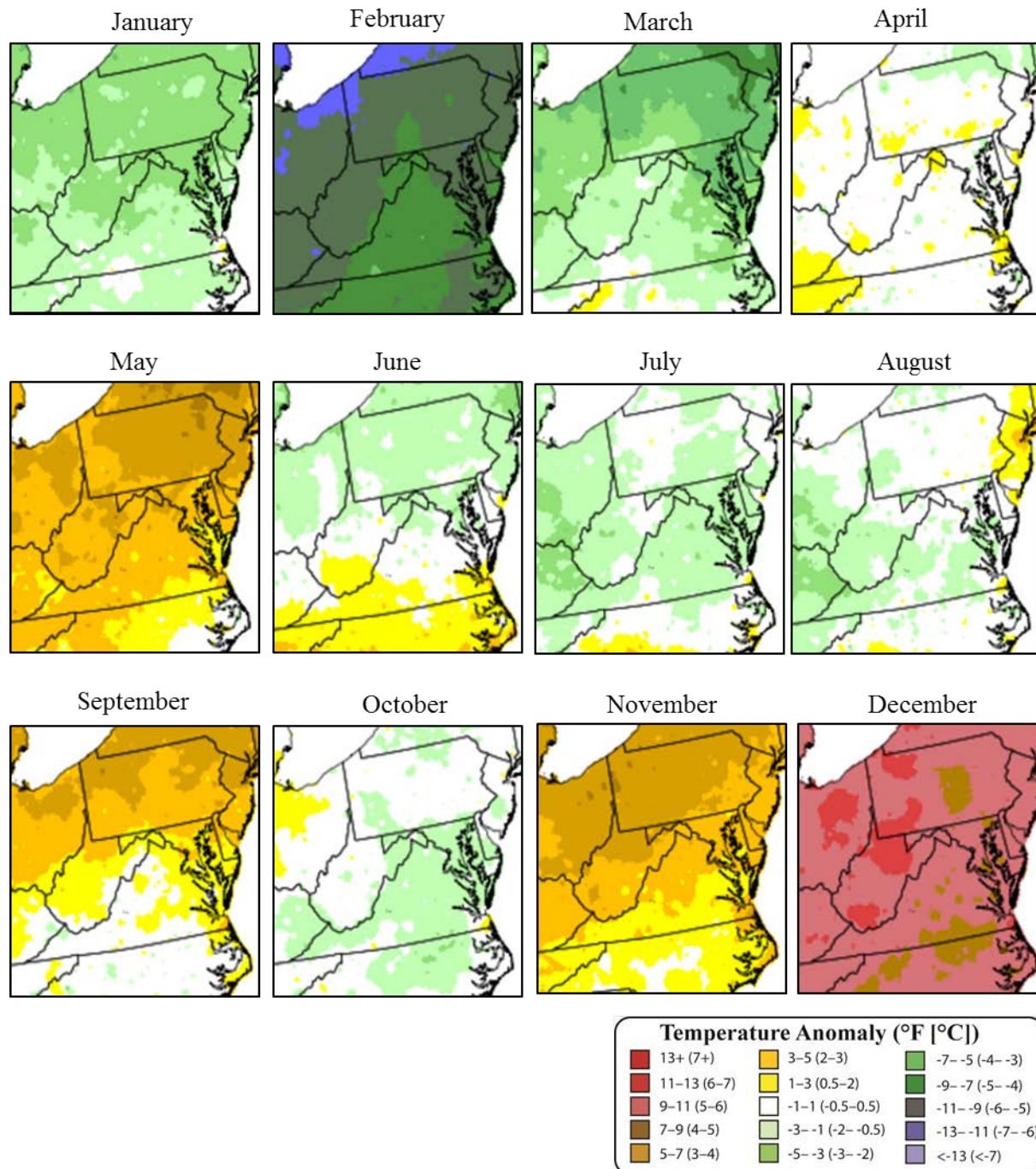


Figure 2. Maps showing departure from average monthly maximum temperature in 2015 compared to the 30-year normal (1981–2010).

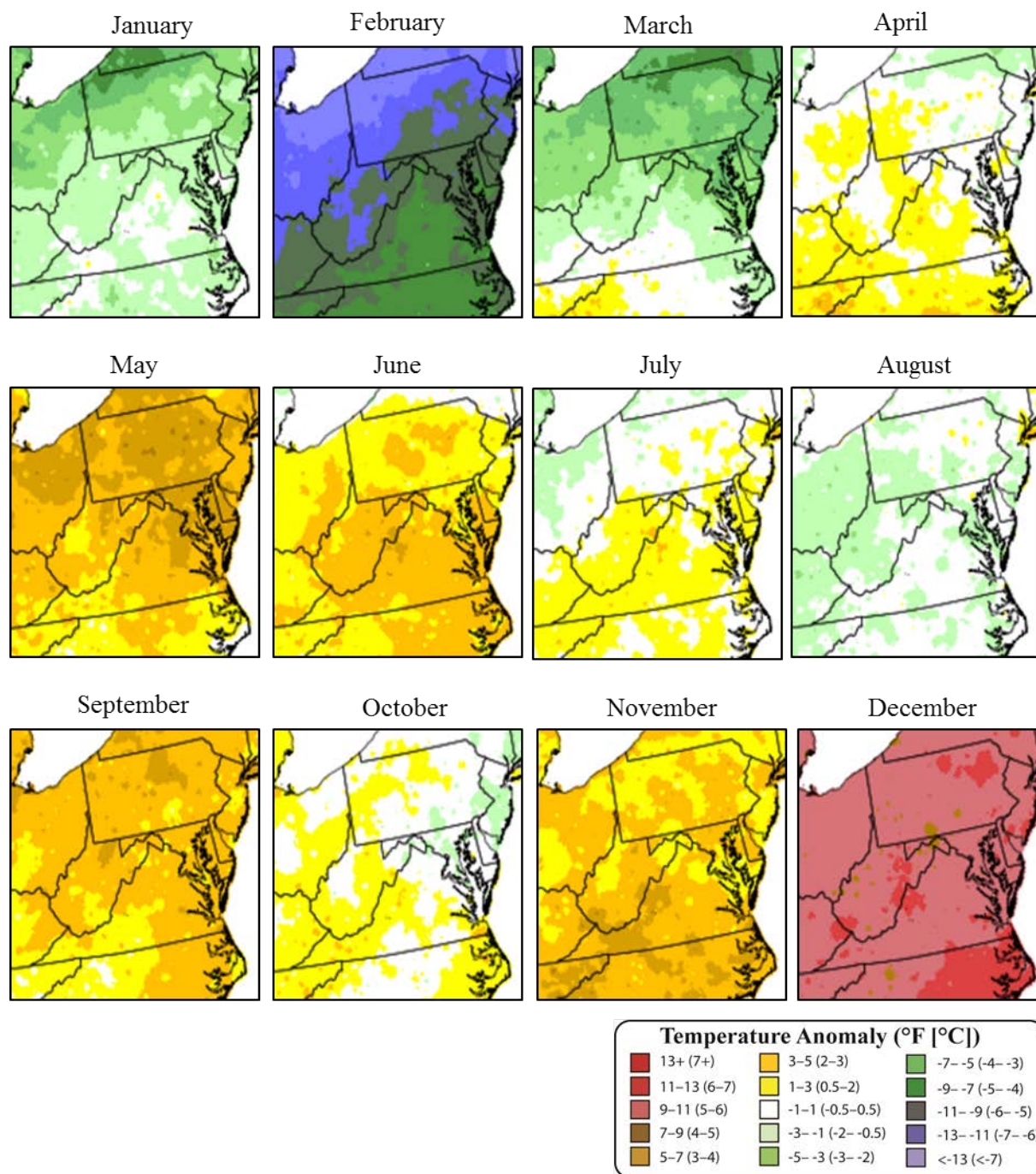


Figure 3. Maps showing departure from average monthly minimum temperature in 2015 compared to the 30-year normal (1981–2010).

Table 2. Summary of 2015 departure from normal temperature based on 30-year normal (1981–2010) for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Biglerville	BGLP1	-3.0°F	-11.6°F	-4.7°F	1.4°F	6.4°F	1.1°F	-0.6°F	-0.5°F	4.0°F	-0.7°F	5.1°F	11.3°F	0.9°F
		-1.6°C	-6.5°C	-2.6°C	0.8°C	3.5°C	0.6°C	-0.3°C	-0.2°C	2.3°C	-0.4°C	2.8°C	6.3°C	0.5°C
Arendstville ¹	ARE128	-3.7°F	-10.5°F	-2.9°F	1.2°F	6.0°F	1.0°F	0.6°F	2.0°F	3.8°F	0.0°F	5.7°F	11.1°F	1.2°F
		-2.0°C	-5.8°C	-1.6°C	0.7°C	3.3°C	0.5°C	0.3°C	1.1°C	2.1°C	0.0°C	3.1°C	6.2°C	0.7°C

¹Indicates a station's Period of Record is five or more years but less than 30 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. Status of 2015 temperature indicators compared to the 30-year normal (1981–2010) at the Biglerville (BGLP1) weather observing station.

Temperature Indicator	Biglerville, PA 2015	Biglerville, PA 1981–2010
Average Annual Temperature	53.1°F 11.7°C	52.3°F 11.3°C
Average Annual Maximum Temperature	62.8°F 17.1°C	62.3°F 17.1°C
Maximum Temperature	95.0°F 35.0°C	97.5°F 36.4°C
Hot Days (days with Tmax≥90°F/32°C)	15	17
Average Annual Minimum Temperature	43.1°F 6.2°C	42.3°F 5.7°C
Winter Minimum (lowest temperature)	-5.0°F -20.6°C	-2.5°F -19.2°C
Cold Days (days with Tmax≤32°F/0°C)	32	21
Sub-freezing Days (days with Tmin≤32°F/0°C)	110	113
Sub-zero Days (days with Tmin≤0°F/-18°C)	6	1
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	188	180

Table 4. Summary of 2015 monthly average temperatures for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Biglerville	BGLP1	26.2°F	20.2°F	35.1°F	52.0°F	67.3°F	71.4°F	74.3°F	72.8°F	69.2°F	52.9°F	48.8°F	44.7°F	53.1°F
		-3.2°C	-6.6°C	1.7°C	11.1°C	19.6°C	21.9°C	23.5°C	22.7°C	20.7°C	11.6°C	9.3°C	7.1°C	11.7°C
Arendstville	ARE128	27.2°F	22.0°F	37.8°F	53.1°F	66.6°F	69.9°F	73.4°F	72.4°F	68.7°F	53.9°F	50.0°F	46.0°F	53.4°F
		-2.7°C	-5.5°C	3.2°C	11.7°C	19.3°C	21.0°C	23.0°C	22.4°C	20.4°C	12.2°C	10.0°C	7.8°C	11.9°C

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

Table 5. Seasonal and annual temperature and precipitation rankings for 2015 over 121 years for the Lower Susquehanna (NOAA 2015).

Parameter	Climate Division 4 Rankings — Lower Susquehanna				
	Jan–Feb–Mar WINTER	Apr–May–Jun SPRING	Jul–Aug–Sep SUMMER	Oct–Nov–Dec AUTUMN	Jan–Dec YEAR
Temperature – 2015	116	3-T	17-T	1	17-T
Precipitation – 2015	106	18	71	65	63-T

1 = warmest/wettest year and 121 = coldest/driest year. T = Tie between multiple years.

Precipitation Summary

The year ending on December 31, 2015, was a year of “feasts and famines” with respect to precipitation for Eisenhower NHS and Gettysburg NMP (Figure 4, Table 6 and 7). When looking at the entire year as a whole, however, precipitation totals were near normal. Biglerville reported a total of 47.0 in (1,194 mm) of precipitation for 2015, 109% of its long-term average (Tables 7 and 8).

Although January averaged near to below normal precipitation (73-107%, Table 7), February turned notably drier, with less than half of the normal rainfall amount tallied at Biglerville (Table 7). March would again turn wetter, with near normal precipitation in the region, but any precipitation deficits that formed in February were not reduced at this point (Tables 6 and 7). The dry February resulted in a winter season that was the 16th driest out of 121 years of records in the Lower Susquehanna (Table 5). Even with the dry winter season, snowfall for the year was 15 in (38 cm) above average, with 41.1 in measured at Biglerville (Table 8). In addition, the number of measurable, moderate, and heavy snow days were all above their respective long-term averages (Table 8).

Spring 2015 had wild swings in precipitation, becoming a microcosm of the ups and downs seen throughout the entire year (Figure 4)¹. While April saw near normal totals, May was an exceptionally dry month with Arendtsville reporting just 22% of their normal monthly precipitation (Table 7). Nevertheless, June was extremely wet and tallied 329% of its normal monthly rainfall (Table 7). Three of the wettest days of the year also occurred during June (Table 9). After all three months concluded, the spring season ranked 18th wettest in 121 years of records, primarily due to the very wet June (Table 5).

After the wild swings in rain over the spring months, summer precipitation remained closer to normal, comparatively (Tables 6 and 7). The wettest month of the season was August, with rainfall tallying 170 to 194% of normal (Table 7). The wettest day of the year occurred on August 21st, when 4.91 in (125 mm) of rain fell at Biglerville. This season ranked as the 71st wettest in 121 years for the Lower Susquehanna (Table 5).

Bucking the recent trend of very wet autumns, October through December 2015 was relatively dry across Eisenhower NHS and Gettysburg NMP (Figure 4, Tables 6 and 7). The wettest month was October, when upwards of 4.3 in (110 mm) was observed at Arendtsville (Table 6). Biglerville measured 7.3 in (184 mm) for the entire season, 3.0 in (78 mm) below the 1981-2010 normal (Table 8). The autumn ranked 65th wettest (i.e. near normal) for the period of record (Table 5).

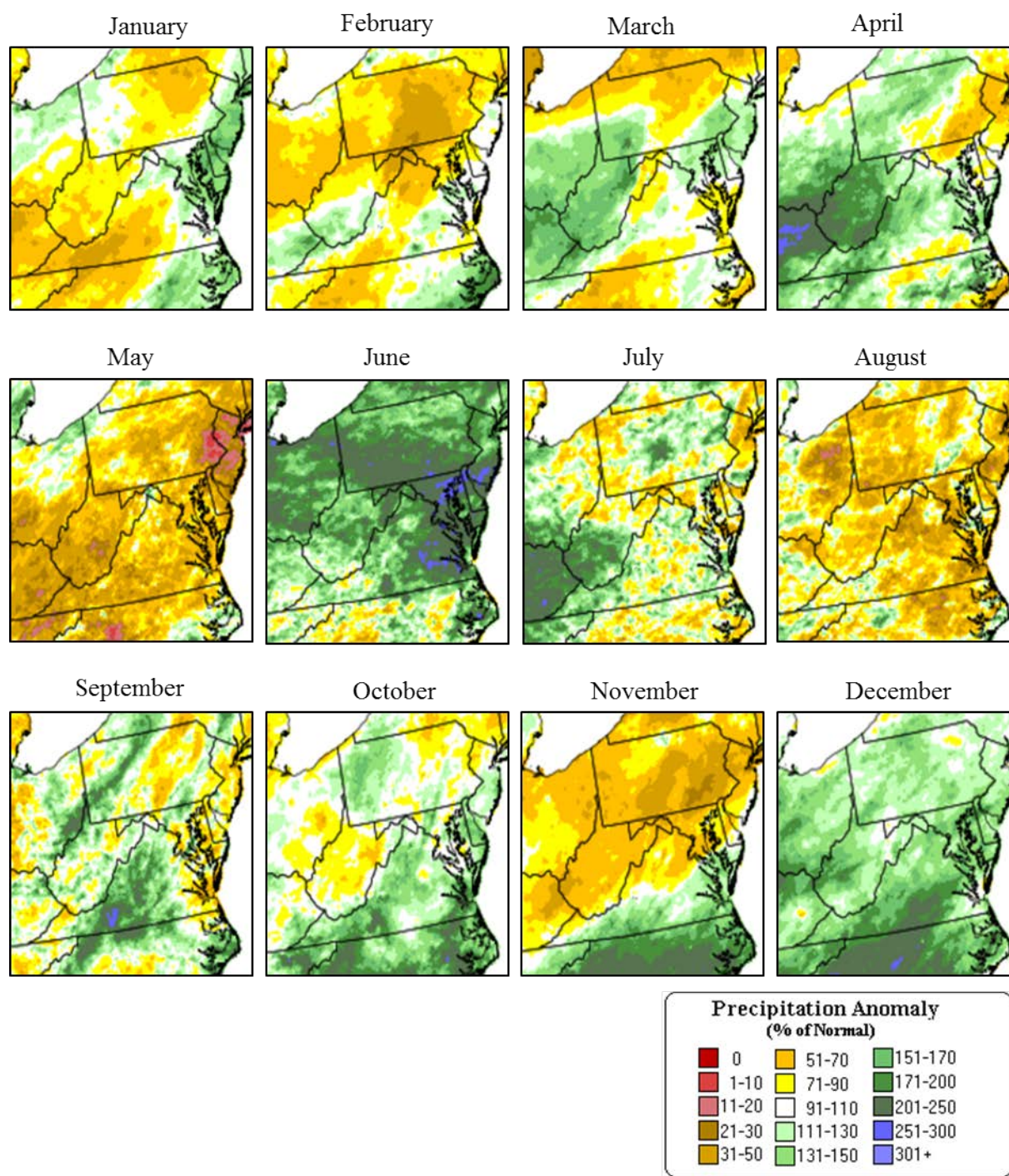


Figure 4. Maps showing percent of average monthly precipitation in 2015 compared to the 30-year normal (1981–2010).

Table 6. Summary of 2015 monthly total precipitation for selected stations.

Station name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Biglerville	BGLP1	2.3 in	1.2 in	3.5 in	3.5 in	2.4 in	12.5 in	3.4 in	6.8 in	4.1 in	3.1 in	1.4 in	2.8 in	47.0 in
		58 mm	31 mm	89 mm	89 mm	60 mm	318 mm	87 mm	173 mm	105 mm	79 mm	35 mm	70 mm	1194 mm
Arendtsville ¹	ARE128	2.7 in	1.0 in	3.4 in	3.6 in	0.9 in	10.9 in	4.2 in	5.5 in	3.5 in	4.3 in	M	M	M
		69 mm	25 mm	87 mm	91 mm	24 mm	276 mm	106 mm	138 mm	88 mm	110 mm	M	M	M

M = missing data (Monthly statistics are reported as ' M' if more than 7 days of data are missing).

¹Arendtsville precipitation data for 2015 was taken from the NADP/NTN site co-located with the CASTNET site.

Table 7. Summary of 2015 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
Biglerville	BGLP1	73	43	98	97	54	319	97	194	93	90	38	83	109
Arendtsville ¹	ARE128	107	55	114	101	22	329	136	170	69	132	M	M	M

M = missing data (Monthly statistics are reported as ' M' if more than 7 days of data are missing).

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 departures from normal values were calculated with normals derived from data spanning the length of the station's Period of Record.

Table 8. Status of 2015 precipitation indicators compared to the 30-year normal (1981–2010) at the Biglerville (BGLP1) weather observing station.

Precipitation indicator	Biglerville, PA 2015	Biglerville, PA 1981–2010
Annual Precipitation	47.0 in 1,194 mm	43.3 in 1,100 mm
Autumn (Oct, Nov, Dec) Precipitation	7.3 in 184 mm	10.3 in 262 mm
Heavy Precipitation Days (days with ≥ 1.0 in (25 mm) rain)	12	11
Extreme Precipitation Days (days with ≥ 2.0 in (51 mm) rain)	3	2
Micro-drought (periods of 7+ days without rain)	10	9
Annual Snowfall	41.1 in 104.4 cm	25.9 in 65.8 cm
Measurable Snow Days (days with ≥ 0.1 in (0.3 cm) snow)	15	11
Moderate Snow Days (days with ≥ 3.0 in (7.6 cm) snow)	4	3
Heavy Snow Days (days with ≥ 5.0 in (12.7 cm) snow)	2	1

Table 9. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2015 from the weather observing station at Biglerville (BGLP1).

Wettest Days in 2015	Dry Spells in 2015
August 21: 4.91 in (125 mm)	May 2-16
June 21: 2.36 in (60 mm)	Oct 15-27
June 28: 2.04 in (52 mm)	Nov 21 – Dec 1
April 20: 1.89 in (48 mm)	Oct 30 – Nov 9
June 19: 1.89 in (48 mm)	Apr 22-30

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 Lower Susquehanna in 2015 are shown in Figure 5.

According to the PDSI, 2015 became increasingly dry until the very wet June flipped index values from below -1.5 to near $+2.0$ in the course of 30 days. The relatively wet conditions, as indicated by the positive PDSI values, did not last as values dipped below 0 starting in August and remained there for the rest of the year (Figure 5). When compared with the last two years, 2015 was noticeably drier for the majority of the year.

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 2015). 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 Pennsylvania (Figure 6) and the Northeast (Figure 7) are shown for 2015.

The DM – Drought Severity Index for Pennsylvania (Figure 6) and the Northeast (Figure 7) shows a pattern similar to the PDSI for the growing season (May through October); with little in the way of widespread abnormal dryness or drought during this period.

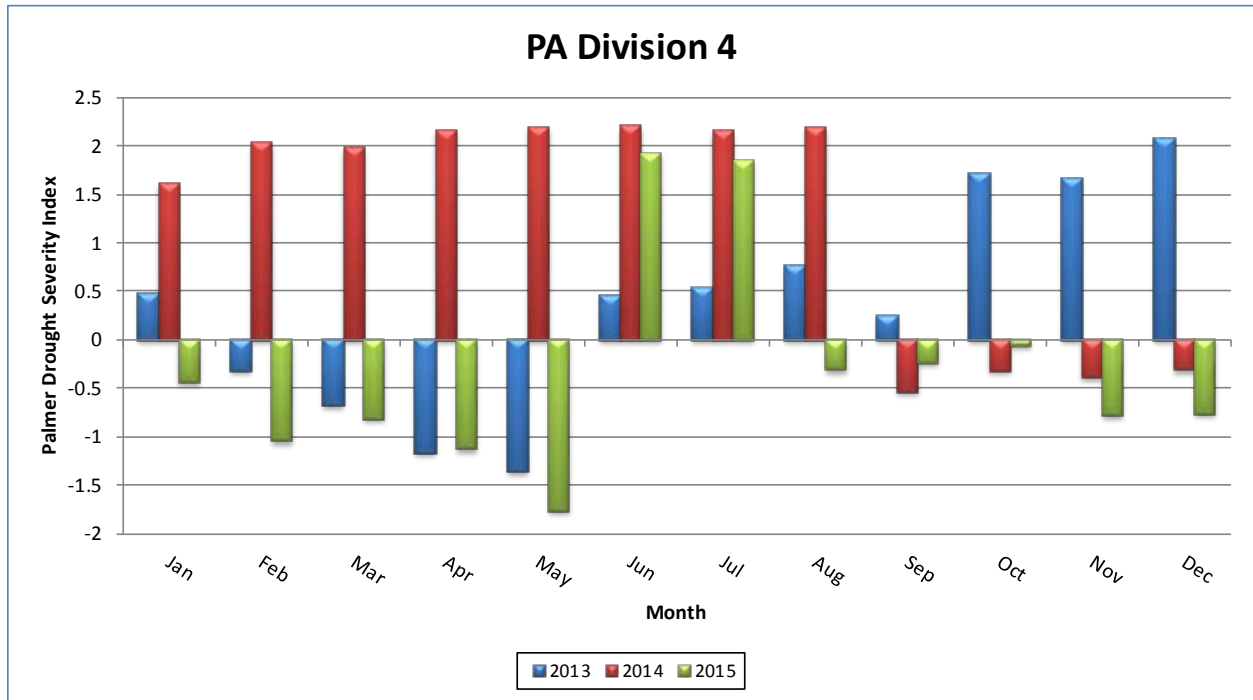


Figure 5. Palmer Drought Severity Index (PDSI) for the Lower Susquehanna, 2013–2015.

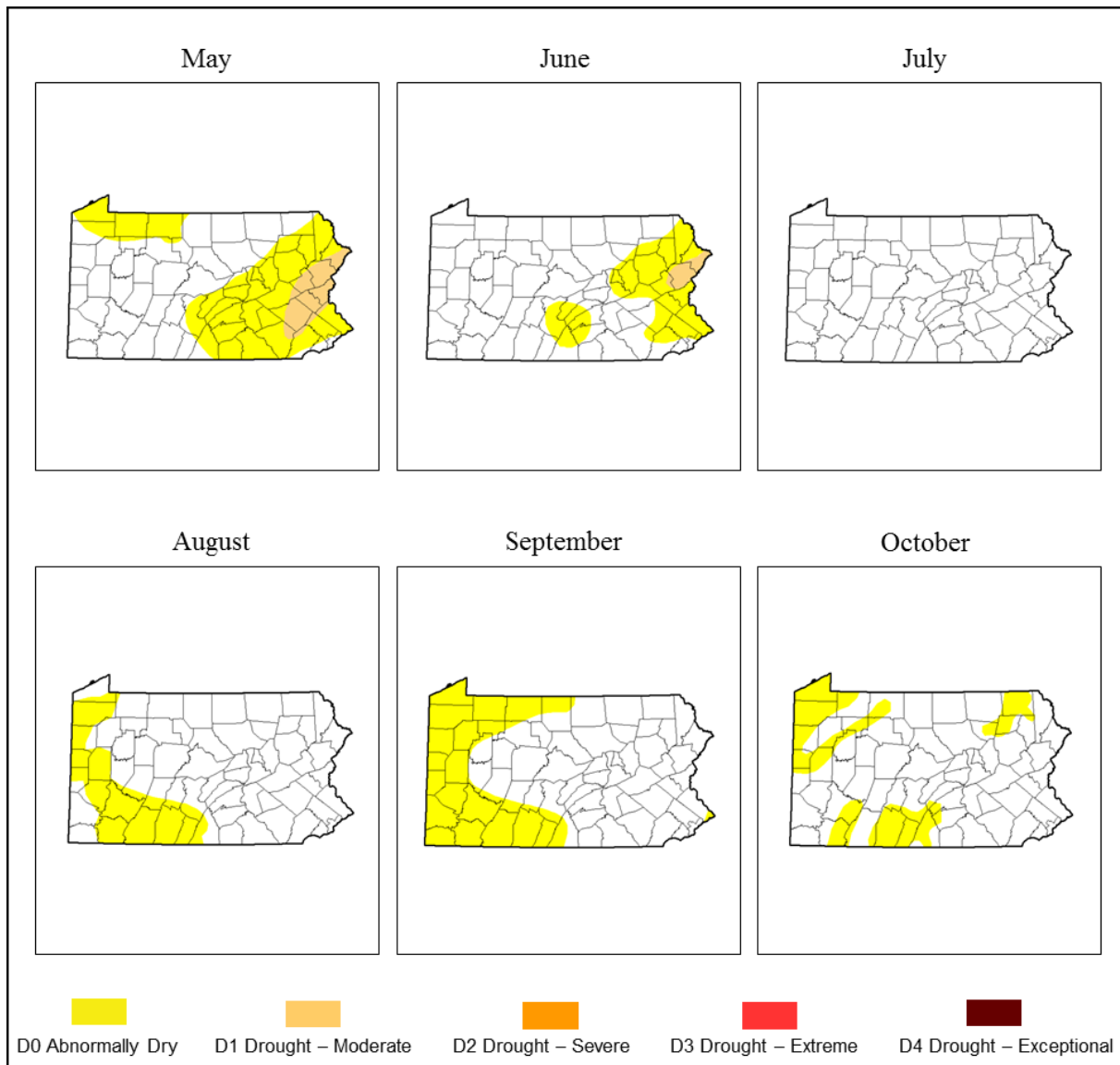


Figure 6. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Pennsylvania in 2015.

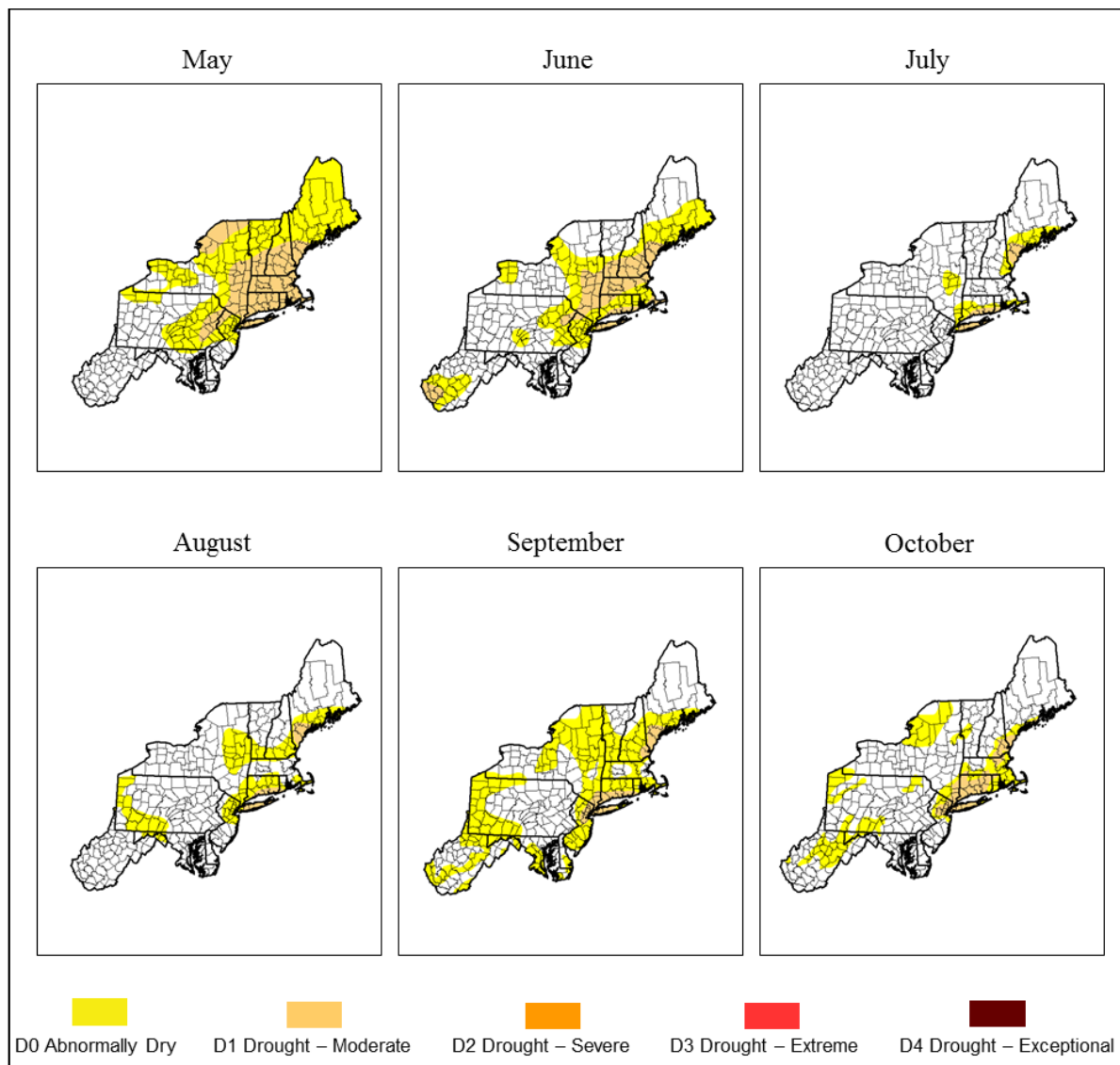


Figure 7. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Northeast in 2015.

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