National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

# Weather of
# Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial

*Eastern Rivers and Mountains Network Summary Report for 2015*

Natural Resource Data Series NPS/ERMN/NRDS—2016/1047

**ON THE COVER**
Summer sky at Allegheny Portage Railroad National Historic Site 2009.
Photograph by: Kathy Penrod.

# Weather of Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial

*Eastern Rivers and Mountains Network Summary Report for 2015*

Natural Resource Data Series NPS/ERMN/NRDS—2016/1047

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August 2016

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Imhoff, K., and A. Person. 2016. Weather of Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial: Eastern Rivers and Mountains Network summary report for 2015. Natural Resource Data Series NPS/ERMN/NRDS—2016/1047. National Park Service, Fort Collins, Colorado.

NPS 423/133833, 427/133833, August 2016

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# List of Key Acronyms

| | |
|---|---|
| ALPO | Allegheny Portage Railroad National Historic Site |
| ASOS | Automated Surface Observing System |
| COOP | National Weather Service Cooperative Observer Program |
| CWOP | Citizen Weather Observer Program |
| ERMN | Eastern Rivers and Mountains Network |
| FAA | Federal Aviation Administration |
| GOES | Geostationary Operational Environmental Satellite |
| NHS | National Historic Site |
| IFLOWS | Integrated Flood Observing and Warning System |
| JOFL | Johnstown Flood National Memorial |
| NADP | National Atmospheric Deposition Program |
| NARR | North American Regional Reanalysis |
| NCDC | National Climatic Data Center |
| NOAA | National Oceanic and Atmospheric Administration |
| NMem | National Memorial |
| NPS | National Park Service |
| 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 (Marshall and Piekielek 2007).

The purpose of this report is to provide a concise weather and climate summary for the period from January 1 through December 31, 2015, 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 a portion of the Eastern Rivers and Mountains Network (ERMN) 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 ERMN 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 and these are the primary data sources used to profile 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 the body of this report.

## The Climate of the South Central Mountains

Allegheny Portage Railroad National Historic Site (NHS) and Johnstown Flood National Memorial (NMem) are located in Pennsylvania Climate Division 8, also known as the South Central Mountains. 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 10 climate divisions.

The South Central Mountain region is generally considered to have a humid continental type of climate, but the elevated terrain and rolling mountains keep temperatures lower than surrounding areas. 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). Coastal storms do, at times, affect the day-to-day weather, especially in the winter, though the air circulating southeastward from the Great Lakes dominates in the winter. Seldom do storms of tropical origin have an effect in this part of Pennsylvania, but the rough terrain has led to memorable severe floods in the warm half of the year (Gelber 2002).

Temperatures are moderately continental, with the tempering effects of the Great Lakes contributing to cloud production in the winter and mountain-valley circulation-induced clouds reducing the heat 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 will direct hot, humid air from the Gulf region into the Laurel Highlands. Allegheny Portage Railroad NHS tends to have greater daytime temperatures than Johnstown Flood NMem; however, Johnstown Flood NMem tends to have fewer sub-freezing nights than the Allegheny Portage Railroad NHS. The last freeze for the region typically occurs in May and the first frosts appear in late September or October.

Precipitation is fairly evenly distributed throughout the year. Annual amounts generally range between 36–54 in (914–1,371 mm), while the majority of places receive 40–46 in (1,016–1,168 mm). Greatest amounts usually occur in the 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 higher terrain due to uplift and additional moisture from the Great Lakes. Based upon long-term averages, annual precipitation amounts tend to be greater at Allegheny Portage Railroad NHS than at Johnstown Flood NMem.

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 between the equinoxes and reaches a peak near the summer 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 two years. Ice storms, which can cause significant disruption, occur at irregular intervals and are primarily confined to the months between December and March (Kocin and Uccellini 2004).

## Observing Stations

Five weather observing stations, comprised of two observing networks, were selected around Allegheny Portage Railroad NHS and Johnstown Flood NMem. Representative stations within a 100-km range of each park were chosen based on several criteria, including proximity to the park, representativeness of the station to the park elevation profile, 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 particular parameters (e.g., temperature) can influence its data inclusion. The Dunlo station was excluded in 2015 for all months except January and February based on this criterion; therefore, only four stations were used for the majority of the report (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 2015) 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.

NOAA's National Centers for Environmental Information (NCEI) also calculates and provides climatological ranks for selected temperature and precipitation elements (http://www.ncdc.noaa.gov/temp-and-precip/ranks.php). Data and statistics are as of January 1895 providing a substantial period of record to place the current year in historical context.

In addition to the summary information available in this report, a near real-time data stream has been made available to the ERMN through a Web interface for the selected 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.

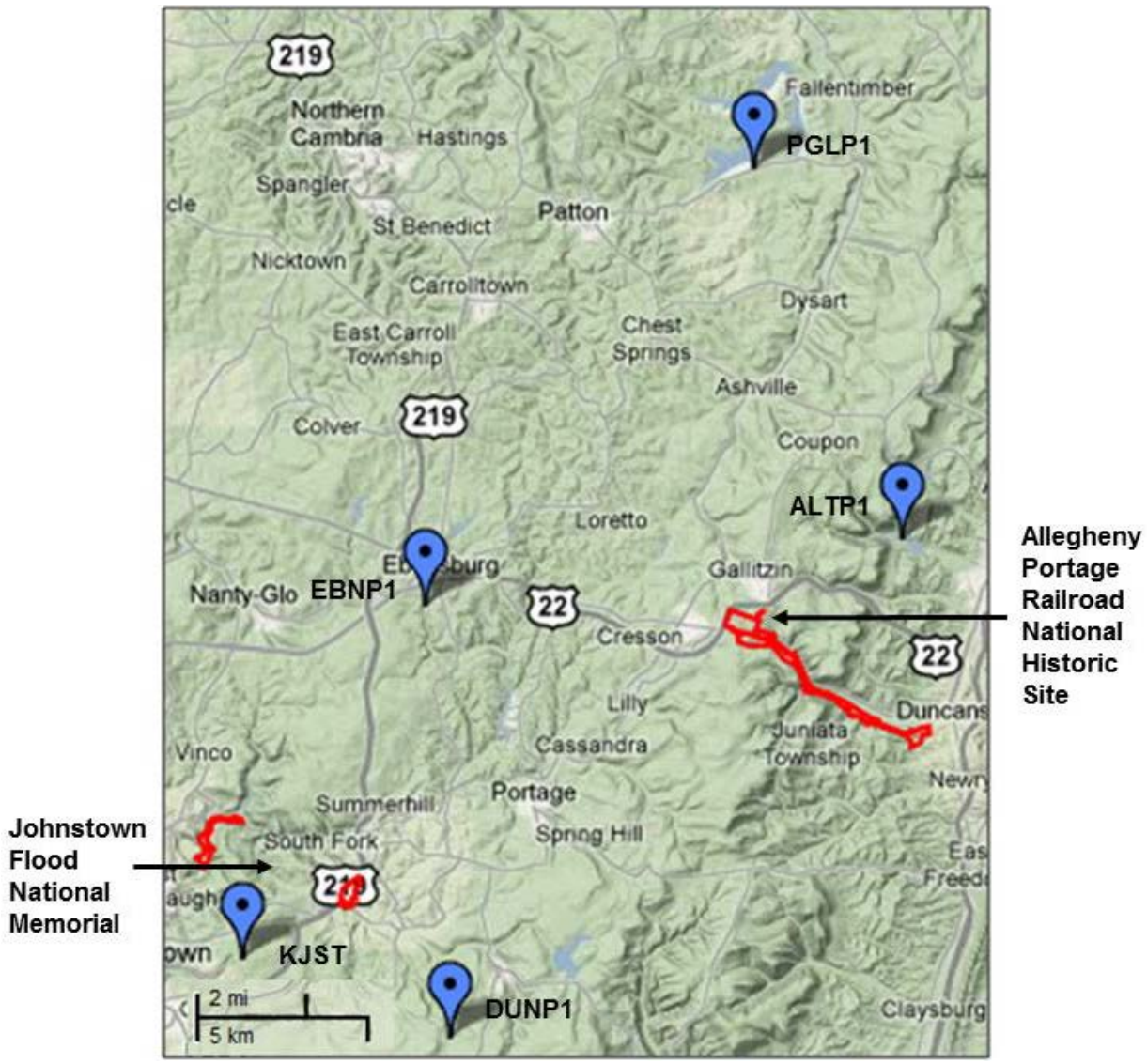


**Figure 1.** Location of weather observing stations around Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. See Table 1 for station names.

**Table 1**. List of weather observing stations around Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial selected as best representative of the parks in 2015.

| Station | Observing Network | Station 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 |
|---|---|---|---|---|---|---|---|---|
| KJST | ASOS | John Murtha Johnstown-Cambria County Airport | 01/01/1973 | Present | 99.7 | 100.0 | 99.6 | 42.8 |
| ALTP1 | COOP | Altoona 3 W | 10/01/1967 | Present | 100.0 | 100.0 | 95.7 | 96.6 |
| EBNP1 | COOP | Ebensburg Sewage Plant | 02/01/1964 | Present | 100.0 | 100.0 | 99.1 | 99.7 |
| PGLP1 | COOP | Prince Gallitzin State Park | 09/01/1982 | Present | 100.0 | 100.0 | 96.0 | 97.7 |
| DUNP1 | COOP | Dunlo | 02/01/1992 | Present | - | 60.0 | - | 90.1 |

## Temperature Summary

Calendar year 2015 had annual average temperatures near, to slightly above, normal for the Allegheny Portage Railroad NHS and Johnstown Flood NMem region, ranging between -0.5 to +1.8 degrees Fahrenheit (°F) (-0.2 to +1.0 degrees Celsius (°C)) from normal. Annual maximum temperatures were between -2.6°F (-1.5°C) to +1.1°F (+0.6°C), but annual minimum temperatures were well below normal, measuring 9.3°F (5.1°C) to 9.7°F (5.4°C) below normal (Figures 2 and 3, Table 2)[1].

The first three months of the year had below normal temperatures, but the most pronounced temperature departures were during February (Figures 2 and 3). In fact, at all observing stations, February average temperatures were several degrees below the historically coldest month of the year, January (Table 3). During the month, temperature anomalies were more than 10 degrees Fahrenheit (6 degrees Celsius) below normal across all observing stations, reaching as low as 13.1°F (7.3°C) below normal at Ebensburg Sewage Plant (Table 2). March was also a relatively cool month, with temperatures averaging between 2.4°F (1.3°C) and 6.1°F (3.4°C) below normal. Due to the persistent chill, the winter months of January–February–March were the 7th coldest in the South Central Mountain Climate Division of Pennsylvania since records began in 1895 (Table 5).

The late winter chill transition to a rather mild Spring as temperatures averaged near to above normal across all stations for the months of May, June, and July (Table 4) Of the three months, May was the warmest with average temperatures ranging from 60.5°F (15.8°C) at Ebensburg Sewage Plant to 63.5°F (17.5°C) (Table 3). These readings led to departures of between 4.3°F (2.4°C) and 7.0°F (3.9°C) above normal during May. The last 32°F (0°C) reading of the spring occurred between April 25th (Johnstown AP) and May 24th (Ebensburg Sewage Plant). In its entirety, temperatures in the spring were the 25th warmest in 119 years of record keeping (Table 5).

Near seasonal temperatures prevailed for July and August, but September was several degrees above normal across all observing stations. This lead to a tie for 31st warmest (Table 5) since records began in 1895 for the summer period, primarily due to the mild September. The highest temperatures of the year occurred on September 8th and 9th, reaching 88.0°F (31.1°C) at Johnstown AP and Ebensburg Sewage Plant (Table 2). The first freeze of the autumn occurred between October 11th and 17th.

The last two months of the calendar year will very mild, especially in December. December anomalies were over 10 degrees Fahrenheit above normal across all reporting stations, reaching as high as 14.3°F (7.9°C) at Johnstown AP. The autumn months of October through December ranked the 2nd warmest on record, with December being the warmest on record in many locations. Calendar year 2015 featured notably more than normal frequency of sub-zero days due to the cold February and a longer growing season as compared to normal (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/.

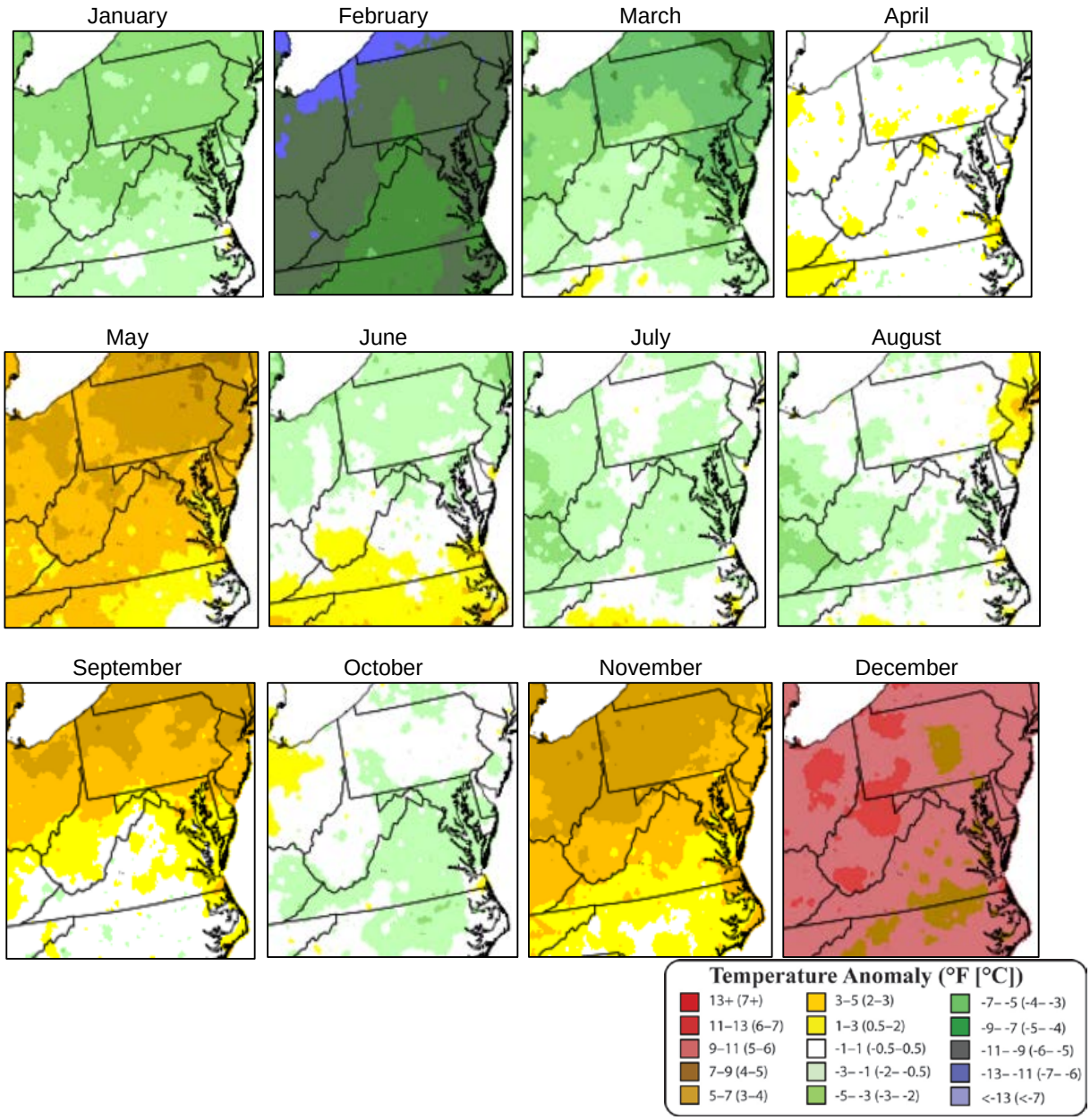


**Figure 2.** Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

Allegheny Portage Railroad National Historic Site
and Johnstown Flood National Memorial
Departure from Average Monthly Minimum Temperature
2015 vs. 1981–2010

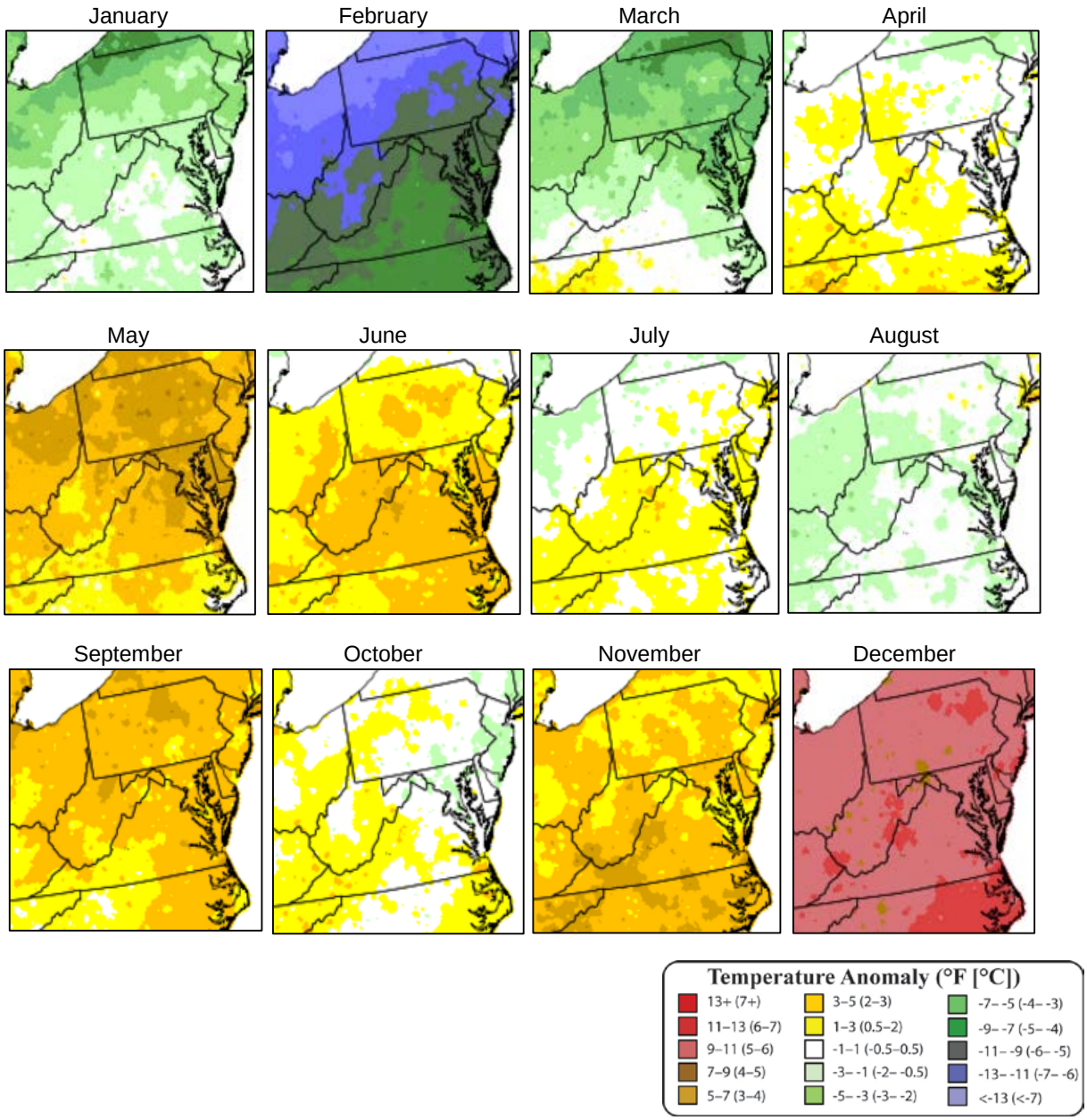


**Figure 3**. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

**Table 2**. Status of 2015 temperature indicators compared to the 30-year normal (1981–2010) at the Ebensburg Sewage Plant (EBNP1) and Johnstown Airport (KJST) stations.

| Temperature Indicator | Ebensburg Sewage Plant, PA 2015 | Ebensburg Sewage Plant, PA 1981–2010 | Johnstown Airport, PA 2015 | Johnstown Airport, PA 1981–2010 |
|---|---|---|---|---|
| Average Annual Temperature | 47.4°F<br>8.6°C | 47.7°F<br>8.7°C | 49.5°F<br>9.7°C | 47.7°F<br>8.7°C |
| Average Annual Maximum Temperature | 58.4°F<br>14.7°C | 58.9°F<br>14.9°C | 57.7°F<br>14.3°C | 55.8°F<br>13.2°C |
| Maximum Temperature | 88.0°F<br>31.1°C | 90.6°F<br>32.6°C | 88.0°F<br>31.1°C | 86.9°F<br>30.5°C |
| Hot Days (days with Tmax≥90°F/32°C) | 0 | 1 | 0 | 3 |
| Average Annual Minimum Temperature | 36.0°F<br>2.2°C | 36.6°F<br>2.6°C | 41.0°F<br>5.0°C | 39.7°F<br>4.3°C |
| Minimum Temperature | -21.0°F<br>-29.4°C | -11.7°F<br>-24.3°C | -11.0°F<br>-23.9°C | -1.3°F<br>-18.5°C |
| Cold Days (days with Tmax≤32°F/0°F) | 45 | 38 | 47 | 50 |
| Sub-freezing Days (days with Tmin≤32°F/0°C) | 147 | 151 | 109 | 127 |
| Sub-zero Days (days with Tmin≤0°F/-17.8°C) | 21 | 7 | 12 | 1 |
| Growing Season Length<br>(days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C) | 139 | 129 | 175 | 166 |

**Table 3**. Summary of monthly average temperatures for 2015 for the selected stations.

| Station Name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altoona 3 W | ALTP1 | 23.6°F | 17.3°F | 33.1°F | 49.5°F | 63.5°F | 66.8°F | 70.4°F | 69.2°F | 66.0°F | 50.6°F | 45.6°F | 41.2°F | 49.9°F |
| | | -4.7°C | -8.2°C | 0.6°C | 9.7°C | 17.5°C | 19.3°C | 21.3 °C | 20.7°C | 18.9°C | 10.3°C | 7.5°C | 5.1°C | 9.9°C |
| Ebensburg Sewage Plant | EBNP1 | 21.0°F | 14.7°F | 29.8°F | 46.7°F | 60.5°F | 65.0°F | 68.1°F | 65.6°F | 64.0°F | 48.0°F | 43.0°F | 40.2°F | 47.4°F |
| | | -6.1°C | -9.6°C | -1.2°C | 8.2°C | 15.8°C | 18.3°C | 20.1°C | 18.7°C | 17.8°C | 8.9°C | 6.1°C | 4.6°C | 8.6°C |
| Prince Gallitzin State Park | PGLP1 | 21.7°F | 15.4°F | 30.7°F | 48.0°F | 62.9°F | 67.4°F | 70.4°F | 68.1°F | 66.9°F | 49.4°F | 45.5°F | 40.5°F | 49.1°F |
| | | -5.7°C | -9.2°C | -0.7°C | 8.9°C | 17.2°C | 19.7°C | 21.3°C | 20.1°C | 19.4°C | 9.7°C | 7.5°C | 4.7C | 9.5°C |
| Johnstown Airport | KJST | 22.4°F | 16.3°F | 33.1°F | 48.9°F | 63.3°F | 65.7°F | 69.6°F | 68.0°F | 65.5°F | 50.5°F | 46.0°F | 43.0°F | 49.5°F |
| | | -5.3°C | -8.7°C | 0.6°C | 9.4°C | 17.4°C | 18.7°C | 20.9C | 20.0°C | 18.6°C | 10.3°C | 7.8°C | 6.1°C | 9.7°C |

**Table 4.** Summary of 2015 departure from normal temperature based on 30-year normal (1981–2010) for the selected stations.

| Station Name | Station | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Altoona 3 W | ALTP1 | -1.8°F | -10.9°F | -3.3°F | 1.2°F | 5.5°F | 0.2°F | -0.3°F | -0.2°F | 4.0°F | -0.3°F | 4.6°F | 11.5°F | 1.0°F |
| | | -1.0°C | -6.1°C | -1.8°C | 0.7°C | 3.1°C | 0.1°C | -0.2°C | -0.1°C | 2.2°C | -0.2°C | 2.6°C | 6.4°C | 0.5°C |
| Ebensburg Sewage Plant | EBNP1 | -4.4°F | -13.1°F | -6.1°F | -0.5°F | 4.3°F | 0.5°F | -0.2°F | -1.5°F | 3.6°F | -1.7°F | 3.0°F | 10.7°F | -0.3°F |
| | | -2.4°C | -7.3°C | -3.4°C | -0.3°C | 2.4°C | 0.3°C | -0.1°C | -0.8°C | 2.0°C | -0.9°C | 1.7°C | 5.9°C | -0.1°C |
| Prince Gallitzin State Park | PGLP1 | -2.6°F | -11.1F | -3.9°F | 1.8°F | 7.0°F | 2.7°F | 1.8°F | 1.0°F | 7.2°F | 1.0°F | 6.3°F | 12.0°F | 2.1°F |
| | | -1.4°C | -6.2°C | -2.2°C | 1.0°C | 3.9°C | 1.5°C | 1.0°C | 0.6°C | 4.0°C | 0.6°C | 3.5C | 6.7°C | 1.2°C |
| Johnstown Airport | KJST | -2.8°F | -10.8°F | -2.4°F | 1.6°F | 6.6°F | 0.9°F | 0.3°F | 0.2°F | 5.7°F | 0.8°F | 6.5°F | 14.3°F | 1.9°F |
| | | -1.6°C | -6.0°C | -1.3°C | 0.9°C | 3.7°C | 0.5°C | 0.2°C | 0.1°C | 3.2°C | 0.4°C | 3.7°C | 7.9°C | 1.0°C |

**Table 5.** Seasonal and annual temperature and precipitation rankings for 2015 over 121 years (1 = warmest/wettest year and 121 = coldest/driest year) for Pennsylvania Climate Division 8. T = “tie”.

| PA Climate Division 8 Rankings “South Central Mountains” | Jan–Feb–Mar WINTER | Apr–May–Jun SPRING | Jul–Aug–Sep SUMMER | Oct–Nov–Dec AUTUMN | Jan-Dec ANNUAL |
|---|---|---|---|---|---|
| Temperature-2015 | 115 | 7 | T31 | 2 | T24 |
| Precipitation-2015 | 110 | 13 | 78 | T62 | 62 |

## Precipitation Summary

Liquid precipitation (rain and melted snow, ice, sleet, etc.; hereafter precipitation) was near normal around Johnstown Flood NMem and Allegheny Portage Railroad NHS (Tables 6 and 9) The first two months of the year and November were rather dry while much of the summer and December were wet; this allowed the year to rank as the 60th driest (61 is the midpoint) in the South Central Mountain Climate Division (8) of Pennsylvania since records began in 1895.

The beginning of the year featured below-normal precipitation for January and February (Figure 4 and Table 9). However, March and April brought some reprieve from the existing precipitation deficits (Tables 8 and 9). Snowfall was well below normal with just 63.1 in (160 cm) measured at Ebensburg Sewage Plant, which is 24.4 in (62 cm) below the long-term mean (Table 6).

Concerns of drought arose during the month of May, when monthly precipitation totals were just 48 to 78 percent of normal (Table 9). A remarkably wet June erased any fears of drought (Figure 4 and Table 8). Johnstown Airport tallied 12.0 in (304 mm) of rain during the month, which is 295 percent of normal (Tables 8 and 9), which is about three months' worth of normal precipitation. The remnants of Tropical Storm Bill, along with a slow-moving frontal boundary, in the middle of the month played a role in the exceptionally wet month. With such a wet June, Spring ranked 78th wettest in the South Central Mountain Climate Division with 121 years of records (Table 5).

The summer of 2015 was quite varied, as it was moist in July but rather dry in August and September (Tables 8 and 9). In its entirety, summer ranked 44th driest in 121 years (Table 5). Two of the longest dry spells of the year occurred in August and early September (Table 7). On the other hand, in late September, heavy rain produced one of the wettest days of the year (2.60 in (66 mm)) on the 30th of the month (Table 7).

Precipitation anomalies in the fall continued to meander between above and below normal levels. While October was near normal, November precipitation totals were at or below 2.0 in (50 mm) across all observing stations (Table 8), which is about half of normal totals (Table 9). The last moth of the year was relatively wet, with Ebensburg Sewage Plant measuring 4.3 in (109 mm) for the month of December, 124 percent of normal (Tables 8 and 9). As a whole, the season concluded near normal levels, ranking as a tie for 62nd wettest over 121 years of records (Table 5). For the calendar year, the number of heavy precipitation days, extreme precipitation days, and micro-droughts were near their long-term averages (Table 6).

**Table 6.** Status of 2015 precipitation indicators compared to the 30-year normal (1981–2010) at the Ebensburg Sewage Plant (EBNP1) and Johnstown Airport (KJST) stations.

| Precipitation Indicator | Ebensburg Sewage Plant, PA 2015 | Ebensburg Sewage Plant, PA 1981-2010 | Johnstown Airport, PA 2015 | Johnstown Airport, PA 1981-2010 |
|---|---|---|---|---|
| Annual Precipitation | 48.9 in<br>2,242 mm | 47.7 in<br>1,212 mm | 45.1 in<br>1,146 mm | 41.1 in<br>1,044 mm |
| Autumn (Oct, Nov, Dec) Precipitation | 9.51 in<br>242 mm | 11.2 in<br>284 mm | 8.4 in<br>213 mm | 9.3 in<br>236 mm |
| Heavy Precipitation Days (days with ≥1.0 in [25 mm] rain) | 8 | 9 | 11 | 7 |
| Extreme Precipitation Days (days with ≥2.0 in [51 mm] rain) | 2 | 1 | 1 | 0 |
| Micro-drought (strings of 7+ days without rain) | 1 | 5 | 4 | 5 |
| Annual Snowfall | 63.1 in<br>160 cm | 87.5 in<br>222 cm | 58.5 in<br>149 cm | 75.6 in*<br>192 cm* |
| Measurable Snow Days (days with ≥0.1 in [0.3 cm] snow) | 42 | 40 | 34 | 39* |
| Moderate Snow Days (days with ≥3.0 in [7.6 cm] snow) | 8 | 11 | 7 | 10* |
| Heavy Snow Days (days with ≥5.0 in [12.7 cm] snow) | 0 | 4 | 0 | 3* |

*Annual normal values and 2015 data were taken from Boswell, PA (BSWP1) due to the lack of reporting snowfall at Johnstown AP (KJST).

**Table 7**. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2015 from stations Ebensburg Sewage Plant (EBNP1) and Johnstown Airport (KJST).

| Wettest Days in 2015 | Dry Spells in 2015 |
|---|---|
| Sep. 30: 2.60 in (66 mm) | Aug. 22–Sep. 4 |
| Mar. 4: 2.20 in (56 mm) | Nov. 20–Nov. 27 |
| Sep. 29: 2.11 in (44 mm) | Oct. 30–Nov. 5 |
| Jun. 15: 1.86 in (47 mm) | Feb. 22–Feb. 28 |
| Sep. 20: 1.67 in (42 mm) | Aug. 12–Aug. 17 |

**Table 8**. 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnstown Airport | KJST | 1.9 in | 1.5 in | 4.1 in | 4.4 in | 2.5 in | 12.0 in | 4.6 in | 2.7 in | 3.1 in | 3.0 in | 1.7 in | 3.7 in | 45.1 in |
| | | 49 mm | 38 mm | 103 mm | 112 mm | 65 mm | 304 mm | 117 mm | 69 mm | 78 mm | 77 mm | 42 mm | 95 mm | 1146 mm |
| Altoona 3 W | ALTP1 | 2.4 in | 1.0 in | 2.5 in | 4.4 in | 2.6 in | 10.1 in | 4.8 in | 1.6 in | 3.4 in | 4.0 in | 1.8 in | 4.2 in | 42.7 in |
| | | 60 mm | 25 mm | 65 mm | 111 mm | 66 mm | 257 mm | 122 mm | 40 mm | 86 mm | 102 mm | 45 mm | 105 mm | 1085 mm |
| Ebensburg Sewage Plant | EBNP1 | 3.1 in | 2.7 in | 5.4 in | 4.0 in | 3.6 in | 9.9 in | 4.7 in | 1.9 in | 4.0 in | 3.3 in | 2.0 in | 4.3 in | 48.9 in |
| | | 78 mm | 68 mm | 137 mm | 103 mm | 91 mm | 252 mm | 118 mm | 48 mm | 103 mm | 83 mm | 50 mm | 109 mm | 1241 mm |
| Prince Gallitzin State Park | PGLP1 | 2.2 in | 1.2 in | 3.7 in | 3.5 in | 1.8 in | 7.2 in | 4.6 in | 3.2 in | 4.4 in | 2.5 in | 1.7 in | 3.0 in | 38.9 in |
| | | 55 mm | 31 mm | 93 mm | 89 mm | 45 mm | 182 mm | 117 mm | 81 mm | 112 mm | 62 mm | 43 mm | 77 mm | 988 mm |
| Dunlo | DUNP1 | M | M | M | M | M | 11.2 in | 5.7 in | 2.2 in | 2.6 in | 3.3 in | 1.7 in | 4.2 in | M |
| | | M | M | M | M | M | 284 mm | 144 mm | 55 mm | 67 mm | 84 mm | 45 mm | 106 mm | M |



**Table 9**. Summary of 2015 percent-of-normal precipitation 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnstown Airport | KJST | 67 | 63 | 123 | 123 | 56 | 295 | 119 | 71 | 90 | 99 | 45 | 145 | 110 |
| Altoona 3 W | ALTP1 | 87 | 39 | 72 | 123 | 59 | 258 | 124 | 44 | 87 | 116 | 46 | 138 | 101 |
| Ebensburg Sewage Plant | EBNP1 | 83 | 92 | 131 | 94 | 78 | 235 | 99 | 47 | 104 | 101 | 47 | 114 | 102 |
| Prince Gallitzin State Park | PGLP1 | 79 | 51 | 110 | 104 | 48 | 189 | 123 | 85 | 121 | 82 | 51 | 124 | 99 |
| Dunlo[1] | DUNP1 | M | M | M | M | M | 269 | 136 | 55 | 68 | 108 | 46 | 145 | M |

[1] Indicates a station's Period of Record is ten 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.

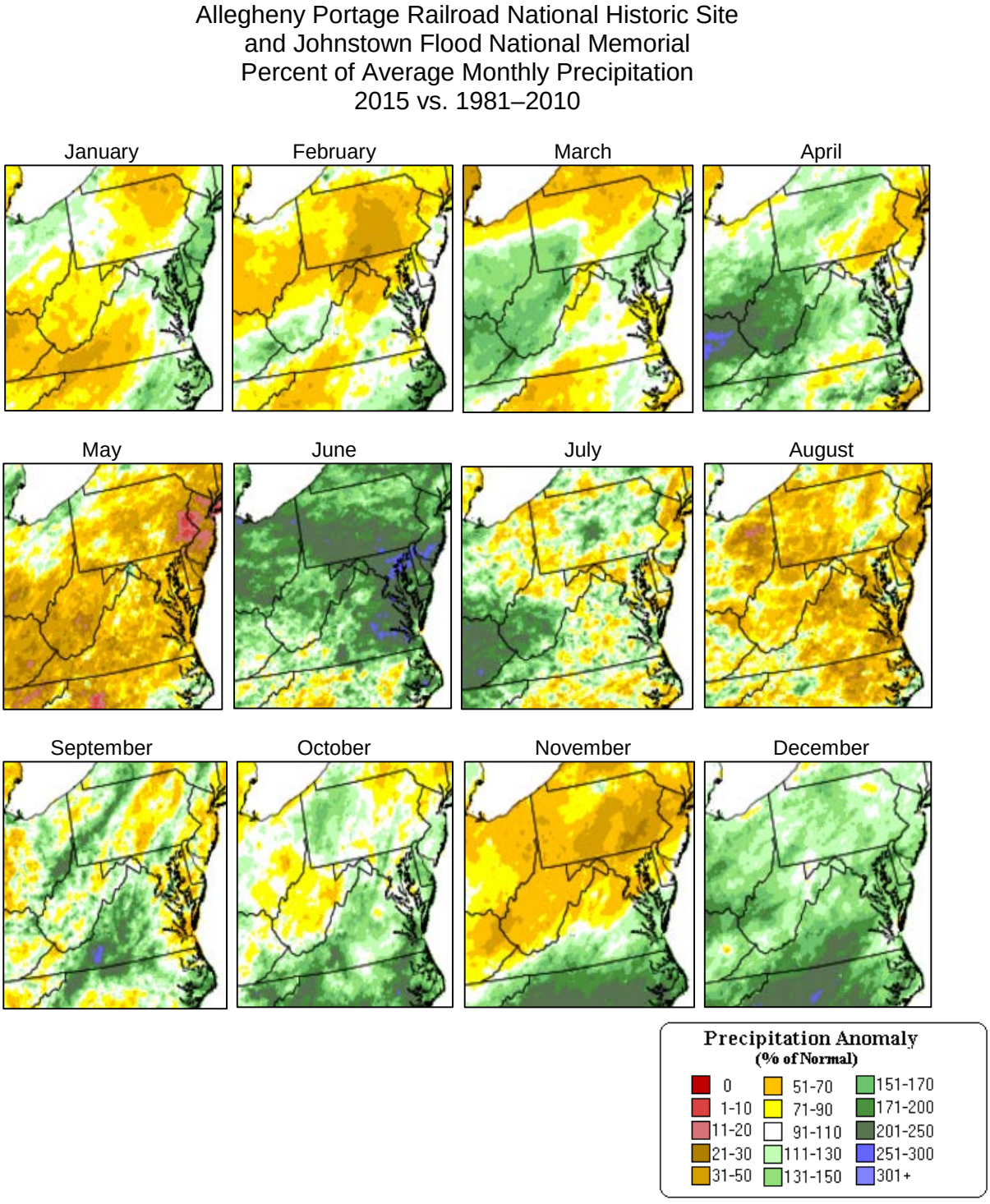


**Figure 4**. Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).

## 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. Monthly PDSI values for Pennsylvania Climate Division 8 in 2015 are shown in Figure 5.

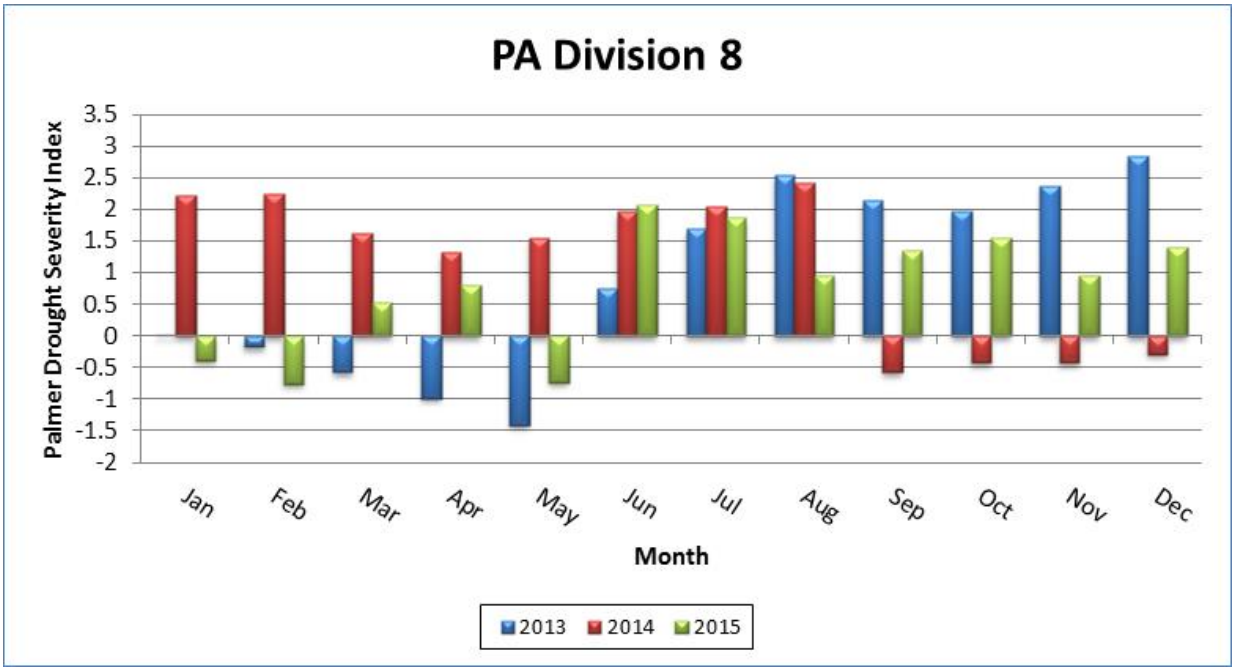


**Figure 5.** Monthly Palmer Drought Severity Index (PDSI) values for Pennsylvania Climate Division 8, 2013–2015.

The DM – Drought Intensity Index is a synthesis of multiple indices (including the PDSI) and impacts and 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 Pennsylvania (Figure 6) and the Northeast (Figure 7) are shown for 2015.

According to the PDSI, the value of this index in Climate Division 8 reflected the near average rainfall that occurred during 2015. The only month that strayed from the "normal" category was the month of June, where PDSI values were just above 2.0 indicating "moderately moist" conditions.

There was no drought noted in the Allegheny Highlands during 2015 (Figure 5). When comparing 2015 with previous years, values of PDSI during the peak of the growing season (June–September) were primarily in the “normal” or “moderately moist” categories.

The DM – Drought Severity Index for Pennsylvania (Figure 6) and the Northeast (Figure 7) show a similar pattern for the growing season (May through October); with no widespread dry (D0) conditions during this period.

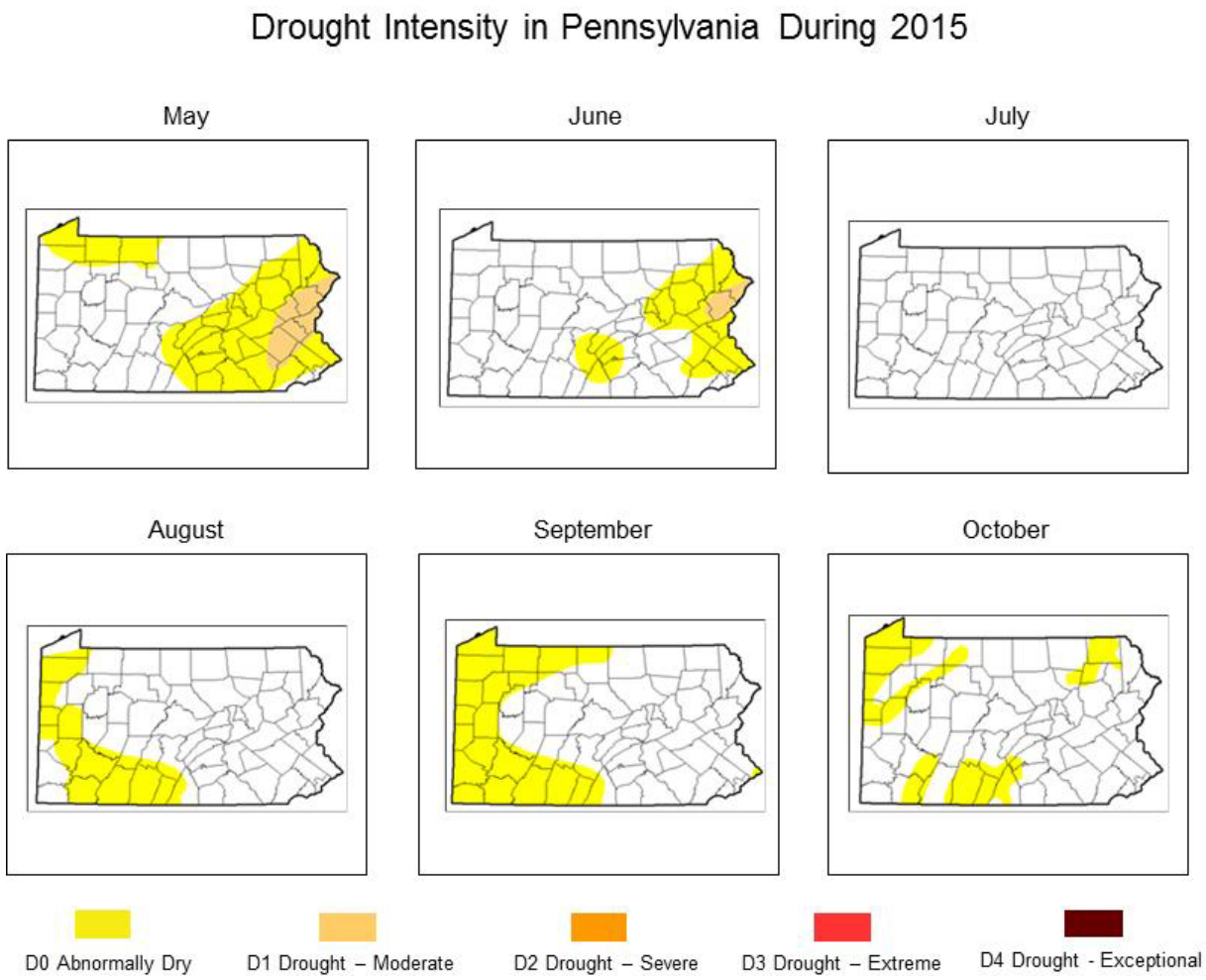


**Figure 6**. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Pennsylvania in 2015.

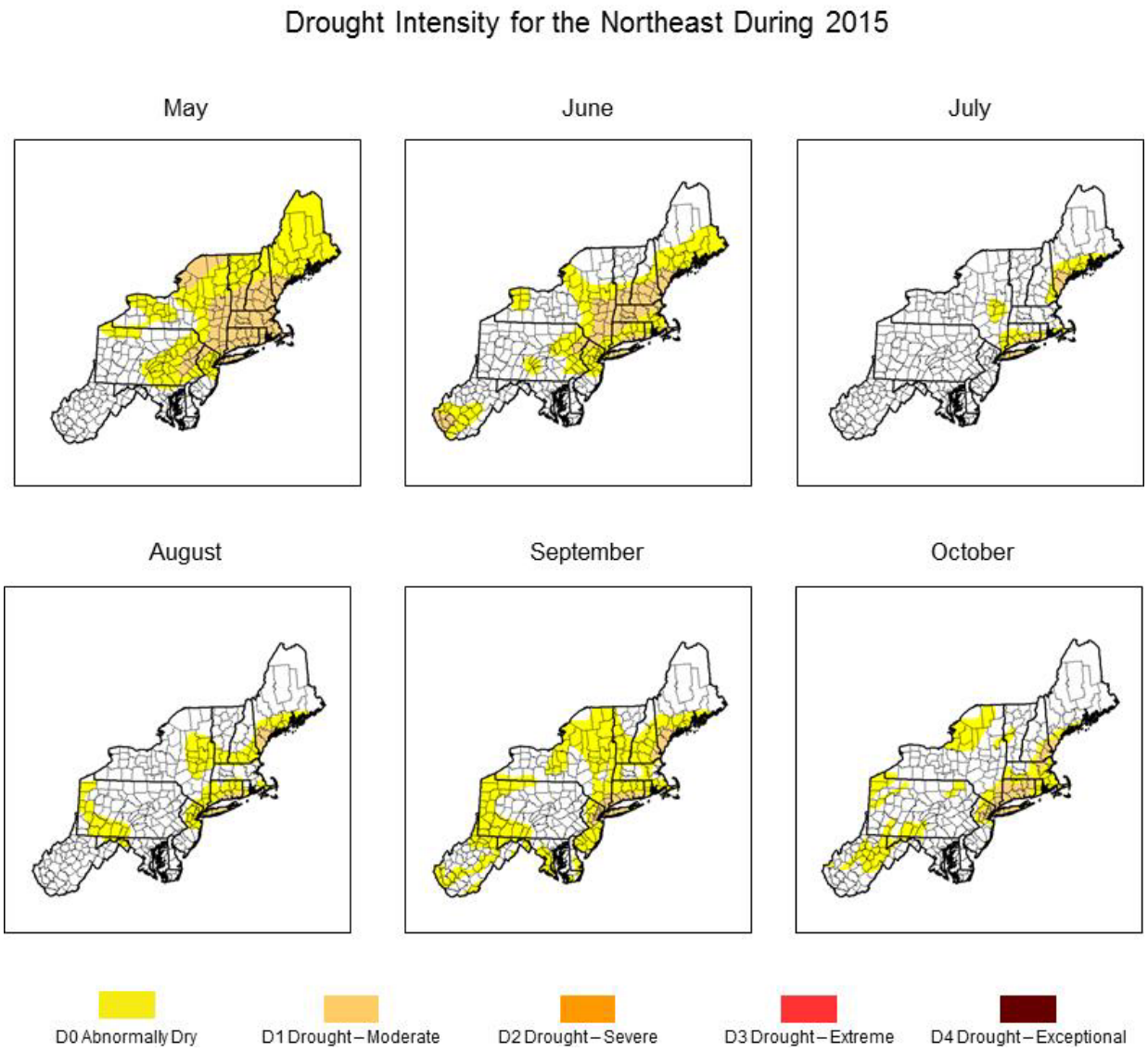


**Figure 7**. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Northeast in 2015.

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NPS 423/133833, 427/133833, August 2016

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