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

Eastern Rivers and Mountains Network Summary Report for 2013

Natural Resource Data Series NPS/ERMN/NRDS—2014/685

ON THE COVER
Photo description. 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 2013

Natural Resource Data Series NPS/ERMN/NRDS—2014/685

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This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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List of Key Acronyms

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, 2013, 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 [NOAA 2013]). 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 2013 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 2013) normals cover the period 1981–2010. In this report, the 30-year normals established by NCDC are used as the baseline for comparisons (e.g., departures from normal). In cases where data for the 30-year normal period are not available, we use alternative comparisons such as the new pseudo-normal from NCDC or a recent 10-year period. In some cases, sufficient data may simply not be available to calculate normals. For metrics that NCDC may not routinely calculate a normal, such as the number of days with more than 2 in (55 mm) of rain or liquid equivalent, normals are calculated using the same time period (e.g., 1981−2010) as the current NCDC standard. Throughout the report, descriptions of a station's values as compared to the normals are described as a difference from the "average", "mean", "typical", "long-term value", as well as "normal", to improve the readability of the document. However, all of these terms are comparing a value from one year at that station to that station's normal, whether it be the 30-year normal or the pseudo-normal calculated on a shorter time frame.

The NCDC 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.

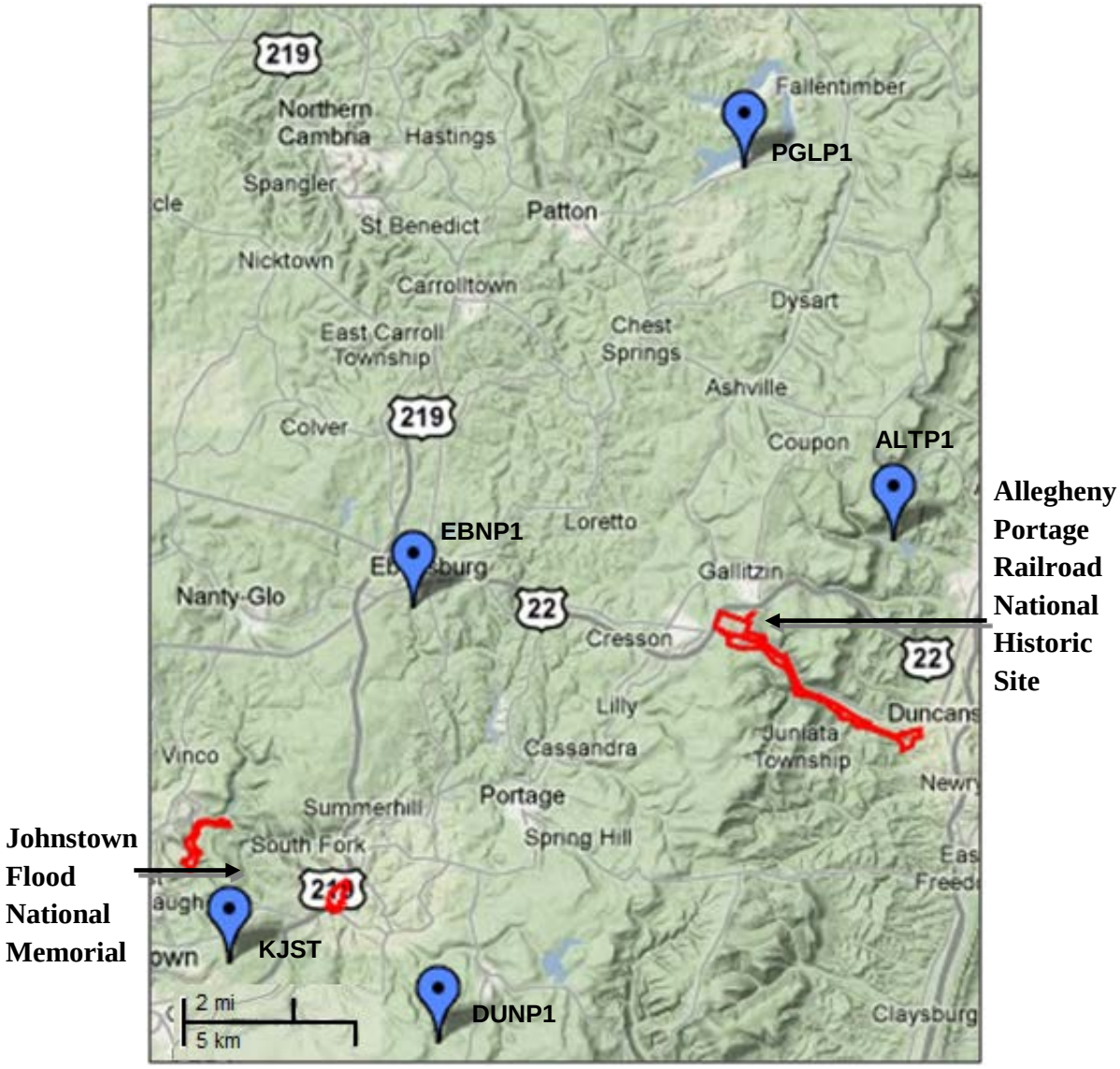

Figure 1. Location of weather observing stations around Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. See Table 1 for station names.

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 2013.

Station	Observing Network	Station Name	Period of Record (POR)		Percentage of Time Reporting Temperature for 2013	Percentage of Time Reporting Precipitation for 2013	Percentage of Time Reporting Temperature for entire POR	Percentage of Time Reporting Precipitation for entire POR
KJST	ASOS	John Murtha Johnstown-Cambria County Airport	01/01/1973	Present	100.0	100.0	99.6	42.4
ALTP1	COOP	Altoona 3 W	10/01/1967	Present	100.0	100.0	96.3	96.4
EBNP1	COOP	Ebensburg Sewage Plant	02/01/1964	Present	100.0	100.0	99.5	99.6
PGLP1	COOP	Prince Gallitzin State Park	09/01/1982	Present	100.0	100.0	95.9	97.6
DUNP1	COOP	Dunlo	02/01/1992	Present	-	12.3	-	91.4

Temperature Summary

Calendar year 2013 was cooler than average for the Allegheny Portage Railroad NHS and Johnstown Flood NMem region, with maximum temperatures averaging consistently between -1.4 to -1.7 degrees Fahrenheit (°F) (-0.8 to -1.0 degrees Celsius (°C)) from normal and minimums were cool too, ranging from -0.2°F (-0.1°C) to -0.5°F (-0.3°C) from normal (Figures 2 and 3, Table 2). 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/.

Negative temperature departures in 2013 were measured during five of the months with March and November most notably chilly. January was quite mild, with readings more than 4.2°F (2.3°C) above average at Prince Gallitzin, PA (Tables 3 and 4). The lowest readings of the year occurred in February (10th) as temperatures dropped to -1°F (-18.3°C) in the Laurel Highlands (Table 2). Mean temperatures in February were colder, with departures of -2.6°F (-1.4°C) at Johnstown (Table 4). Negative temperature anomalies reached their maximum in March as readings averaged as much as 4.7°F (2.6°C) below normal (Table 4). The winter months of January–February–March were the 50th warmest in the South Central Mountain Climate Division of Pennsylvania since records began in 1895 (59 is the mid-point; Table 5).

Spring was noted by above-normal temperatures at all stations in June (Table 4), but near normal temperatures in the other months. The average temperature in Ebensburg, PA, during April was 46.9F (8.3°C); -0.3°F (-0.2°C) below average (Tables 3 and 4). The first hot spell had daytime maxima at 85°F (29.6°C) from May 22-23. The last 32°F (0°C) reading of the spring occurred around May 27 (Table 2). The positive anomalies during May were modest, but somewhat warmer days in June led to a monthly departure of 1.0°F (0.6°C) in Altoona, PA. In its entirety, temperatures in the spring were the 25th warmest in 119 years of record keeping (Table 5).

Warmer-than-average conditions continued into July, but then temperatures averaged below seasonal levels leading to the 41st coolest (Table 5) since records began in 1895, in part due to a rather cool September, ranking the 27th coolest. The average temperature in July was 72.4°F (22.4°C) in Altoona, PA; 1.7°F (0.9°C) above average (Tables 3 and 4). The state experienced below seasonable readings in the late summer and then during October turned milder again with an average +2.3°F (1.3°C) temperature anomaly for the four stations. The highest temperature of the year occurred on July 18-19th in Ebensburg, PA, with a reading of 89.0°F (31.7°C) (Table 2). The first freeze of the autumn occurred on September 24th. November averaged well below normal and the fall of 2013 ranked the 53rd warmest for the South Central Mountain Climate Division. Calendar year 2013 featured notably more than normal frequency of cold days and below normal number of hot days (Table 2). The total growing season length (days between last spring freeze and first fall freeze) ranged from 144-162 days or within two weeks of the long-term average (Table 2).

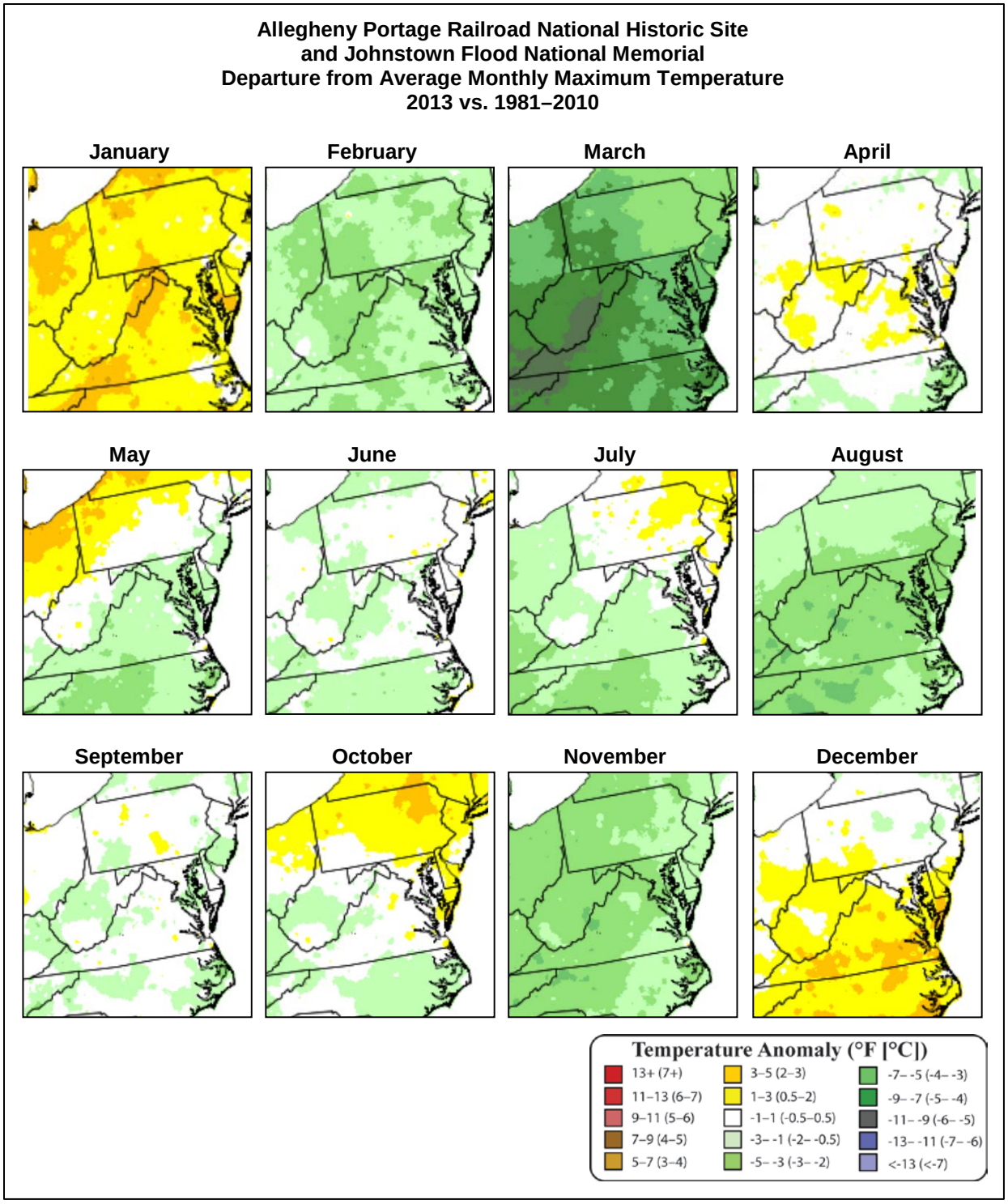

Figure 2. Maps showing departure from average monthly maximum temperature compared to the 30-year normal (1981–2010).

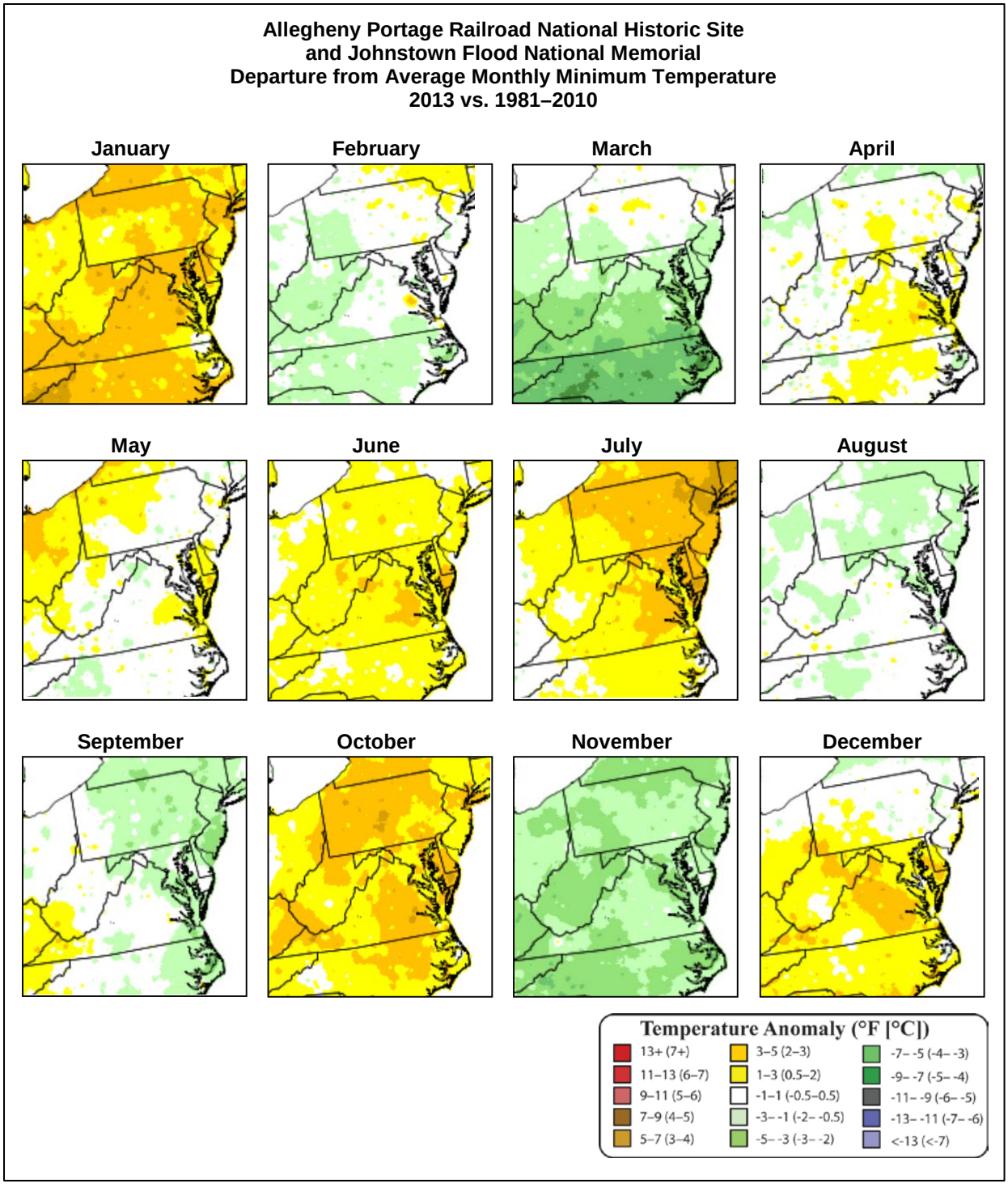

Figure 3. Maps showing departure from average monthly minimum temperature compared to the 30-year normal (1981–2010).

Table 2. Status of 2013 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 2013	Ebensburg Sewage Plant, PA 1981–2010	Johnstown Airport, PA 2013	Johnstown Airport, PA 1981–2010
Average Annual Temperature	46.8°F 8.2°C	47.7°F 8.7°C	46.8°F 8.2°C	47.7°F 8.7°C
Average Annual Maximum Temperature	57.2°F 14.0°C	58.9°F 14.9°C	54.4°F 12.4°C	55.8°F 13.2°C
Maximum Temperature	89.0°F 31.7°C	90.6°F 32.6°C	87.0°F 30.6°C	86.9°F 30.5°C
Hot Days (days with Tmax≥90°F/32°C)	0	1	0	3
Average Annual Minimum Temperature	36.4°F 2.4°C	36.6°F 2.6°C	39.2°F 4.0°C	39.7°F 4.3°C
Minimum Temperature	-1.0°F -18.3°C	-11.7°F -24.3°C	0.0°F -17.8°C	-1.3°F -18.5°C
Cold Days (days with Tmax≤32°F/0°F)	46	38	66	50
Sub-freezing Days (days with Tmin≤32°F/0°C)	167	151	143	127
Sub-zero Days (days with Tmin≤0°F/-17.8°C)	3	7	1	1
Growing Season Length (days between last spring Tmin 32°F/0°C and first fall Tmin 32°F/0°C)	144	129	162	166

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

Station Name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Altoona 3 W	ALTP1	28.7°F	26.8°F	33.0°F	49.4°F	59.4°F	67.6°F	72.4°F	68.7°F	61.4°F	53.4°F	36.7°F	30.3°F	49.0°F
		-1.8°C	-2.9°C	0.5°C	9.7°C	15.2°C	19.8°C	22.4 °C	20.4°C	16.3°C	11.9°C	2.6°C	-0.9°C	9.4°C
Ebensburg Sewage Plant	EBNP1	29.1°F	26.5°F	31.2°F	46.9°F	55.7°F	64.6°F	69.6°F	64.8°F	58.3°F	50.9°F	34.8°F	29.5°F	46.8°F
		-1.6°C	-3.1°C	-0.4°C	8.3°C	13.2°C	18.1°C	20.9°C	18.2°C	14.6°C	10.5°C	1.6°C	-1.4°C	8.2°C
Prince Gallitzin State Park	PGLP1	28.5°F	26.0°F	31.2°F	48.6°F	57.9°F	66.9°F	71.4°F	67.4°F	59.1°F	51.9°F	36.3°F	30.6°F	48.0°F
		-1.9°C	-3.3°C	-0.4°C	9.2°C	14.4°C	19.4°C	21.9°C	19.7°C	15.1°C	11.1°C	2.4°C	-0.8°C	8.9°C
Johnstown Airport	KJST	28.3°F	24.5°F	29.7°F	47.5°F	57.3°F	65.0°F	69.2°F	65.6°F	58.6°F	51.7°F	34.1°F	30.5°F	46.8°F
		-2.1°C	-4.2°C	-1.3°C	8.6°C	14.1°C	18.3°C	20.7°C	18.7°C	14.8°C	10.9°C	1.2°C	-0.8°C	8.2°C

Table 4. Summary of 2013 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	3.3°F	-1.4°F	-3.4°F	1.1°F	1.4°F	1.0°F	1.7°F	-0.7°F	-0.6°F	2.5°F	-4.2°F	0.6°F	0.1°F
		1.9°C	-0.8°C	-1.9°C	0.6°C	0.8°C	0.6°C	0.9°C	-0.4°C	-0.4°C	1.4°C	-2.3°C	0.3°C	0.0°C
Ebensburg Sewage Plant	EBNP1	3.7°F	-1.3°F	-4.7°F	-0.3°F	-0.5°F	0.1°F	1.3°F	-2.3°F	-2.1°F	1.2°F	-5.2°F	0.0°F	-0.9°F
		2.1°C	-0.7°C	-2.6°C	-0.2°C	-0.3°C	0.1°C	0.7°C	-1.3°C	-1.2°C	0.7°C	-2.9°C	0.0°C	-0.5°C
Prince Gallitzin State Park	PGLP1	4.2°F	-0.5°F	-3.4°F	2.4°F	2.0°F	2.2°F	2.8°F	0.3°F	-0.8°F	3.5°F	-2.9°F	2.1°F	1.0°F
		2.3°C	-0.3°C	-1.9°C	1.3°C	1.1°C	1.2°C	1.6°C	0.2°C	-0.4°C	1.9°C	-1.6°C	1.1°C	0.6°C
Johnstown Airport	KJST	3.1°F	-2.6°F	-3.8°F	0.2°F	0.6°F	0.2°F	-0.1°F	-2.2°F	-1.2°F	2.0°F	-5.4°F	1.8°F	-0.8°F
		1.7°C	-1.4°C	-2.1°C	0.1°C	0.3°C	0.1°C	-0.1°C	-1.2°C	-0.7°C	1.1°C	-3.0°C	1.0°C	-0.5°C

Table 5. Seasonal and annual temperature and precipitation rankings for 2013 over 119 years (1 = warmest/wettest year and 119 = 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-2013	T50	T25	T78	T53	T40
Precipitation-2013	99	66	88	37	T85

Precipitation Summary

Liquid precipitation (rain and melted snow, ice, sleet, etc.; hereafter precipitation) was slightly below normal in 2013 around Johnstown Flood NMem and Allegheny Portage Railroad NHS (Table 6) with four of the twelve months averaging below normal for all stations (Tables 8 and 9). The winter and spring were rather dry and the early summer and late autumn were wet; this allowed the year to rank as the 34th driest in the South Central Mountain Climate Division (8) of Pennsylvania since records began in 1895.

The beginning of the year featured progressively below-normal precipitation from February through late May (Figure 4). However, the next seven months of 2013 featured at least a few stations reporting above average precipitation (Table 9). Between 11.1 and 16 in (288-407 mm) was tallied by the end of May (Tables 8 and 9); about 80 percent of normal. The start-of-the-year deficit began to be erased in the early summer when an average of 145 percent of normal precipitation fell in the climate division. Snowfall was near the normal amount (Table 6) with a total of 84.4 in (214.4 cm) at Ebensburg Sewage Plant, which is just 3.1 in (7.9 cm) below the long-term mean.

Spring was virtually normal across the region, with a ranking of 52nd driest in the South Central Mountain Climate Division with 119 years of records (Table 5) [59th is the mean]. June provided the region with above average rainfall at all reporting stations (Table 9). The driest location was Johnstown during April when 2.07 in (53 mm) was measured (Table 8). Overall, May ranked as the 40th driest for the South Central Mountain Climate Division.

The summer of 2013 was quite varied, as it was moist in August and dry in September which ranked 26th driest in 119 years (Table 5). On the other hand in early August, heavy showers developed producing one of the wettest days of the year (2.64 in (67mm)) on August 8th (Tables 7 and 9). The notable dry spells were clustered during July-September (Table 7). September brought well below average rainfall as 1.48 in (38 mm) fell at Altoona (Table 8). There was no direct influence from tropical cyclones during this year. Total rainfall at Ebensburg, PA was 1.60 in (41 mm) on September 12th, one of the wettest days of 2013 at this station (Table 7).

Precipitation anomalies in the fall continued to be largely positive. October and December were both above normal; November brought the least precipitation (Figure 4). Prince Gallitzin tallied only 2.34 in (59 mm) which was 63% of normal (Table 8). Despite the dry weather in November, the season concluded as the 37th wettest (Table 5). As a whole, 2013 had exactly the average number of excessive rain days and well above normal number of snowy days (Table 6).

Table 6. Status of 2013 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 2013	Ebensburg Sewage Plant, PA 1981-2010	Johnstown Airport, PA 2013	Johnstown Airport, PA 1981-2010
Annual Precipitation	46.2 in 1,173 mm	47.7 in 1,212 mm	37.6 in 955 mm	41.1 in 1,044 mm
Autumn (Oct, Nov, Dec) Precipitation	11.7 in 297 mm	11.2 in 284 mm	8.1 in 206 mm	9.3 in 236 mm
Heavy Precipitation Days (days with ≥1.0 in [25 mm] rain)	9	9	7	7
Extreme Precipitation Days (days with ≥2.0 in [51 mm] rain)	0	1	2	0
Micro-drought (strings of 7+ days without rain)	5	5	7	5
Annual Snowfall	84.4 in 214.4 cm	87.5 in 222 cm	84.9 in 215.6 cm	75.6 in* 192.0 cm*
Measurable Snow Days (days with ≥0.1 in [0.3 cm] snow)	57	40	60	39*
Moderate Snow Days (days with ≥3.0 in [7.6 cm] snow)	9	11	5	10*
Heavy Snow Days (days with ≥5.0 in [12.7 cm] snow)	0	4	2	3*

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

Table 7. Top five wettest days and top five dry spells (consecutive days with a trace or less of liquid precipitation) during 2013 from stations Ebensburg Sewage Plant (EBNP1) and Johnstown Airport (KJST).

Wettest Days in 2013	Dry Spells in 2013
Aug. 8: 2.64 in (67 mm)	Sep. 23–Oct. 4
Jun. 27: 2.12 in (54 mm)	Sep. 4–Sep. 11
Sep. 12: 1.60 in (41 mm)	Apr. 2 –Apr. 9
Jan. 31: 1.45 in (37 mm)	Jan. 3–Jan. 10
Sep. 3: 1.31 in (33 mm)	Jul. 12–Jul. 18

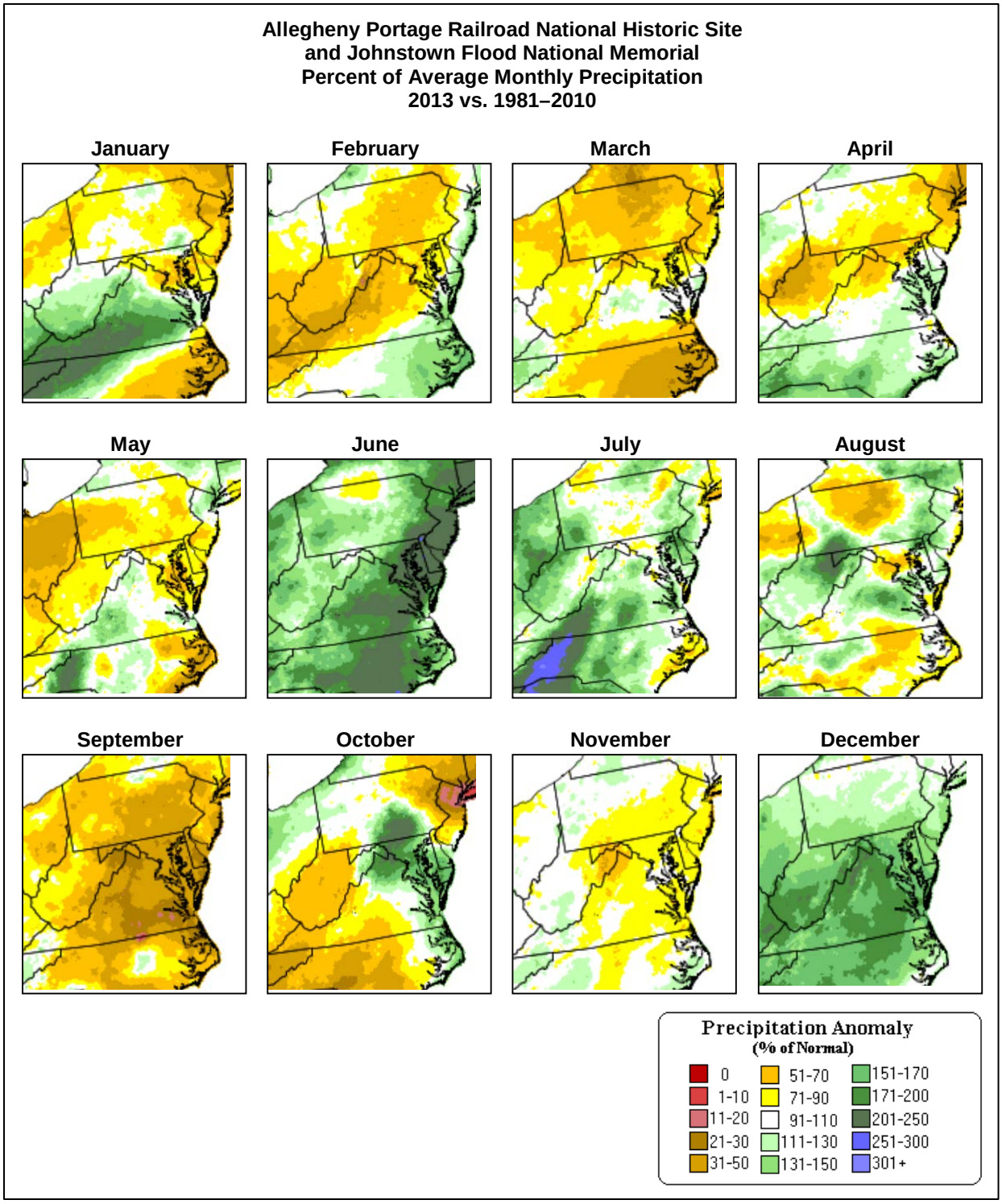

Figure 4. Maps showing percent of average monthly precipitation compared to the 30-year normal (1981–2010).

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

Station Name	Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Johnstown Airport	KJST	2.83 in	1.03 in	2.03 in	2.07 in	3.16 in	5.85 in	2.62 in	5.56 in	4.07 in	2.63 in	2.34 in	3.17 in	37.63 in
		72 mm	26 mm	52 mm	53 mm	80 mm	149 mm	67 mm	141 mm	103 mm	67 mm	59 mm	81 mm	956 mm
Altoona 3 W	ALTP1	3.07 in	1.73 in	2.43 in	2.09 in	3.66 in	5.91 in	2.74 in	1.80 in	1.48 in	4.15 in	2.96 in	4.44 in	36.46 in
		78 mm	44 mm	62 mm	53 mm	93 mm	150 mm	70 mm	46 mm	38 mm	105 mm	75 mm	113 mm	926 mm
Ebensburg Sewage Plant	EBNP1	3.95 in	2.55 in	2.88 in	2.76 in	3.88 in	6.39 in	4.29 in	3.50 in	4.28 in	2.78 in	3.71 in	5.20 in	46.17 in
		100 mm	65 mm	73 mm	70 mm	99 mm	162 mm	109 mm	89 mm	109 mm	71 mm	94 mm	132 mm	1173 mm
Prince Gallitzin State Park	PGLP1	2.54 in	1.54 in	1.56 in	2.28 in	2.63 in	5.36 in	4.83 in	3.29 in	3.12 in	2.50 in	3.85 in	4.15 in	37.65 in
		65 mm	39 mm	40 mm	58 mm	67 mm	136 mm	123 mm	84 mm	79 mm	64 mm	98 mm	105 mm	956 mm
Dunlo	DUNP1	M	M	M	M	M	M	M	2.01 in	M	M	M	M	M
		M	M	M	M	M	M	M	51 mm	M	M	M	M	M

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

Table 9. Summary of 2013 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	98	44	62	58	70	144	68	146	119	86	63	123	92
Altoona 3 W	ALTP1	112	68	69	59	83	151	70	50	38	120	76	148	86
Ebensburg Sewage Plant	EBNP1	106	87	70	64	85	151	91	88	110	85	89	138	97
Prince Gallitzin State Park	PGLP1	93	64	47	67	71	141	129	89	85	83	115	169	96
Dunlo[1]	DUNP1	M	M	M	M	M	M	M	51	M	M	M	M	M

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

[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.

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 2013 are shown in Figure 5.

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 2013.

According to the PDSI, the value of this index in Climate Division 8 reflected the below average rainfall that occurred during 2013. While values were in the normal range during January, the effects of continuing below normal precipitation during the spring and early summer months lowered the PDSI to near "moderate drought" conditions. However, it was seasonably moist during the late summer, allowing the PDSI to stay in the "near normal" range. However, the rain returned during October. Despite a parched November, excessive rain and snow in December brought the PDSI into positive values for the first time in 2013. There was no drought noted in the Allegheny Highlands during 2013 (Figure 5). When comparing 2013 with previous years, values of PDSI during the peak of the growing season (June–September) remained in the below normal range for the first time in this season since 2011. It is interesting to note that December during the last three years, has been wetter than average.

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.

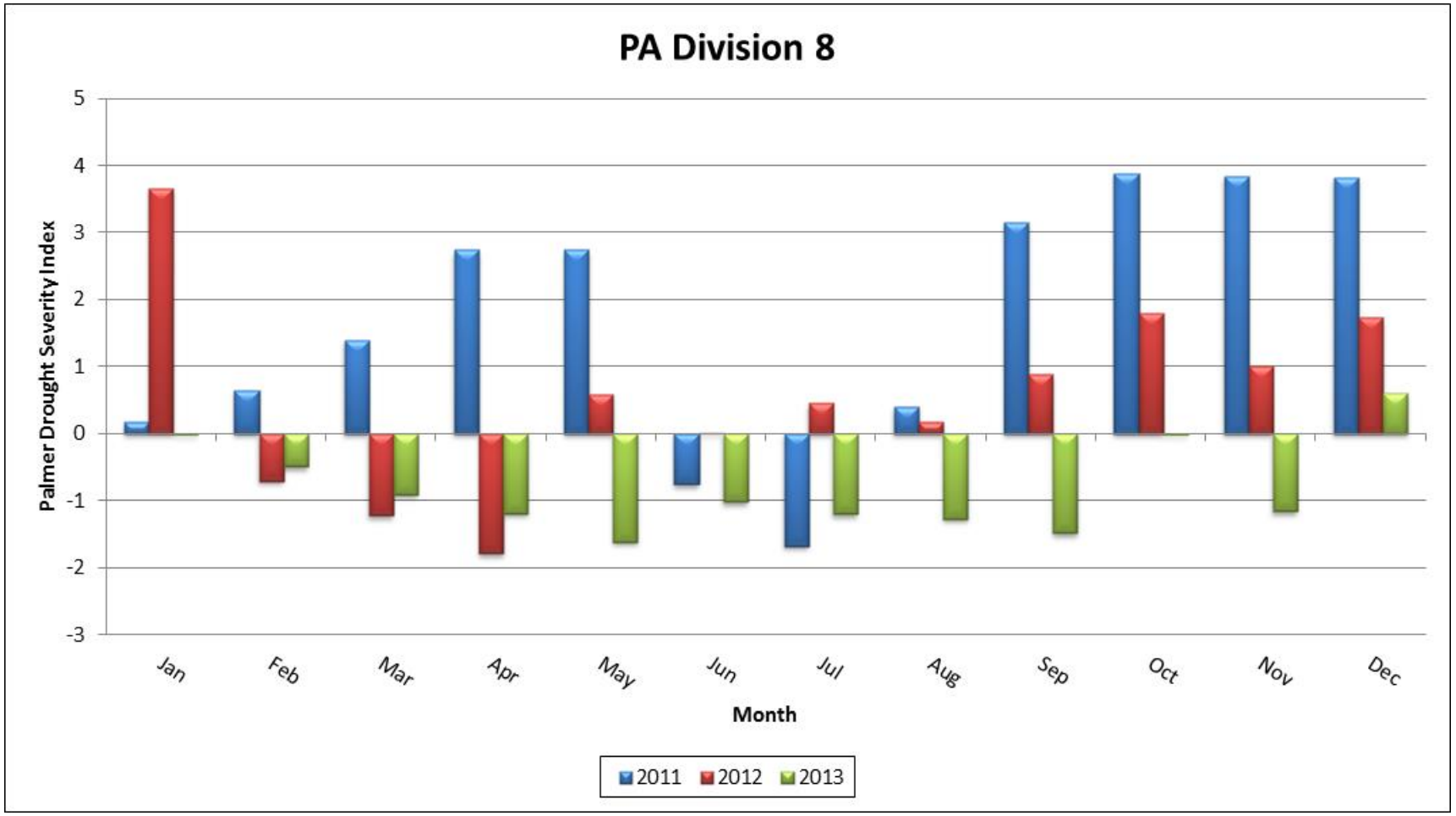

Figure 5. Monthly Palmer Drought Severity Index (PDSI) values for Pennsylvania Climate Division 8, 2011–2013.

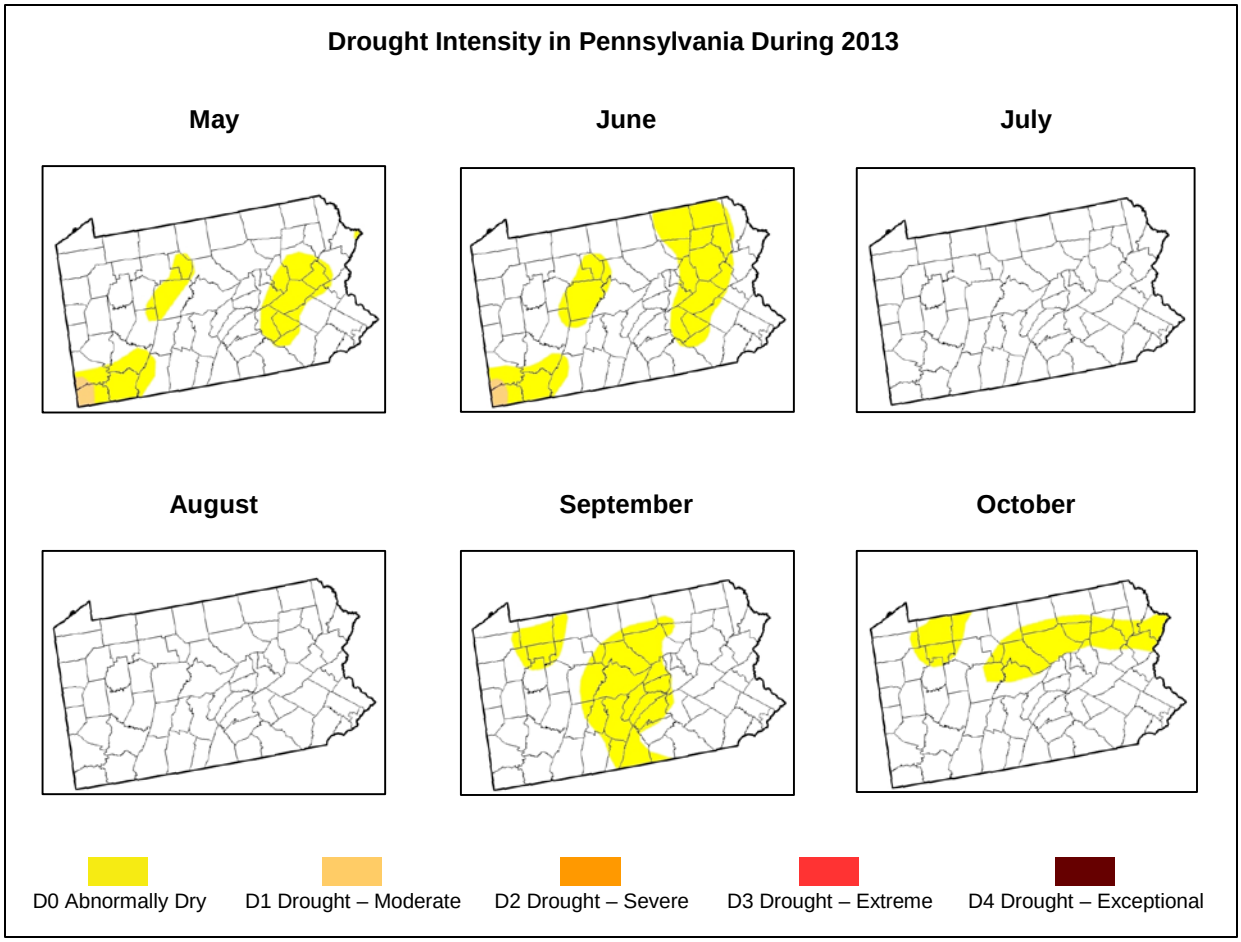

Figure 6. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for Pennsylvania in 2013.

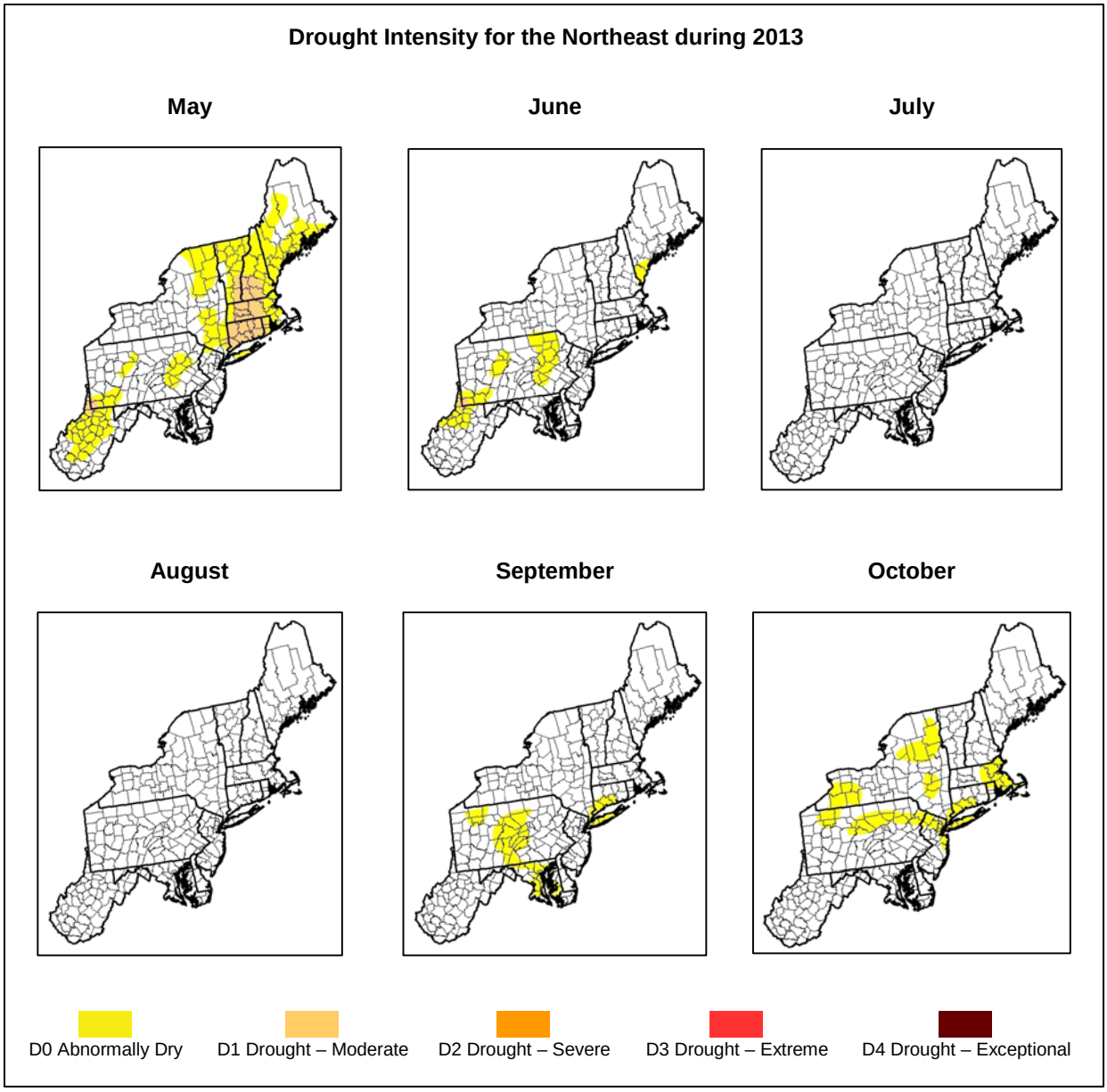

Figure 7. Mid-month values of the United States Drought Monitor (DM) - Drought Intensity Index for the Northeast in 2013.

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