National Park Service
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# Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial

*Weather of 2008*

Natural Resource Data Series NPS/ERMN/NRDS—2010/077

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

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

*Weather of 2008*

Natural Resource Data Series NPS/ERMN/NRDS—2010/077

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## List of Key Acronyms

| | |
|---|---|
| ALPO | Allegheny Portage Railroad National Historic Site |
| COOP | National Weather Service Cooperative Observer Program |
| CWOP | Citizen Weather Observer Program |
| FAA | Federal Aviation Administration |
| 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 |
| NWS | National Weather Service |
| PDSI | Palmer Drought Severity Index |
| PRISM | Parameter-elevation Regressions on Independent Slopes Model |
| RAWS | Remote Automated Weather Stations |
| USDM | United States Drought Monitor |
| USGS | United States Geological Survey |

# 2008 Climate Summary

The year began with a stretch of mild weather in January, when daytime maximums reached into the 60's°F (15.6°C–20.6°C) for three consecutive days (January 7–9), which was 25°F (13.9°C) above normal. A cool down in February and March lead winter temperatures to be near normal. Despite May temperatures being ~1.7°F (0.9°C) below average, the spring also averaged near normal. The second half of 2008 featured cooler-than-average temperatures with four of the six months recording negative monthly temperature departures. Precipitation varied significantly throughout the year. The mid-month values of the Palmer Drought Severity Index showed that drought conditions rarely encroached on the Allegheny Portage Railroad NHS and the Johnstown Flood NMem. Despite this, January was fairly dry with only 50–77% of normal precipitation. February and May, on the other hand, had above-average precipitation. Dry spells were most common in the late summer and early fall, with no rain falling for 11 consecutive days in August. The effects of a wet winter followed by a dry summer were shown in the flow pattern of the Conemaugh River near the Johnstown Flood NMem. The final month of the year was very wet with over 200% of normal precipitation in the region. With the excessive rainfall in December, the year, overall, was slightly above average with regard to precipitation.

### Long-term Trends

Temperatures in 2008 were lower than the 30-year normal (Table 1) and was the chilliest year since 2003. This was reflected by the minimum temperature dipping below 32°F (0°C) on 134–147 occasions, which is well above the average of 124. In addition, maximum temperatures never rose above 90°F (32°C). This cooler regime led to a growing season of 137–159 days, which is below the long-term average. Precipitation as a whole was near average, while more snowfall was observed above the normal. The key factor with precipitation in 2008 was the excessively wet December when more precipitation fell than October and November combined. The largest outbreaks of severe weather occurred on June 22 when 1 inch (25 mm) of hail was reported in Nanty-Glo, PA, and on July 20 when severe storms downed trees and power lines. The lowest temperature recorded in 2008 was -5°F (-20.6°C) on February 21, while the highest maximum temperature occurred on June 10 with a reading of 88°F (31.1°C).

**Table 1**. Summary of 2008 climate indicators for the Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. Data from the COOP station at Ebensburg, PA (EBNP1) and the FAA station at Johnstown, PA (KJST) compared to the 30-year means from Pittsburgh, PA (KPIT).

| Indicator | 2008 Statistics | Comments on Trends |
|---|---|---|
| Average Annual Maximum Temperature | 55.4–58.6°F<br>13.0–14.8°C | Below the 30-year mean of<br>60.4°F<br>15.8°C |
| Average Annual Minimum Temperature | 36.7–39.9°F<br>2.6–4.4°C | Below the 30-year mean of<br>41.5°F<br>5.3°C |
| Hot Days (days with Tmax≥90°F/32°C) | 0 | Below the 30-year mean of 7.4 days |
| Cold Days (days with Tmax≤32°F/0°C) | 41–50 | Above the 30-year mean of 39.1 days |
| Winter Minimum (lowest temperature) | -5 °F<br>-20.6°C | Above the long-term record of<br>-22°F<br>-30°C |
| Sub-freezing Nights (days with Tmin≤32°F/0°C) | 134–147 | Above the long term average of 124 |
| Cold Winter Nights (days with Tmin≤0°F/-17.8°C) | 2–5 | Near the long term mean of 3.5 |
| Growing Season Length<br>(Days between last spring 32°F/0°C and first fall 32°F/0°C) | 137–159 | Below the 30-year mean of 160–180 days |
| Annual Precipitation | 43.6–49.5 in<br>1107–1257 mm | Above the long-term average of<br>37.9 in<br>963 mm |
| Autumn (Oct, Nov, Dec) Precipitation | 9.8–13.5 in<br>249–343 mm | Near the long-term average of<br>10–11 in<br>254–279 mm |
| Moderate Rain (days with ≥ 1.0 in (25 mm) rain) | 5–7 | Near the 30-year mean of 6 days |
| Micro-drought (strings of 7+ days without rain) | 3–3 | Near the long-term mean of 4 |
| Annual Snowfall | 74–87 in<br>188–221 cm | Above the 30-year mean of<br>41 in<br>104 cm |

# 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 the 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–December 31, 2008 and to place current patterns and trends in an appropriate historical and regional context (Knight et al., in preparation). It is our intention that this report will satisfy an inherent interest in meteorological phenomena and meet the Eastern Rivers and Mountains Network (ERMN) Weather and Climate Monitoring objectives:

- Document long-term trends in weather and climate through seasonal and annual summaries of selected parameters (e.g., multiple forms of precipitation, temperature).
- Identify and document extremes and averages of climatic conditions for common parameters (e.g., precipitation, air temperature) and other parameters where sufficient data are available (e.g., wind speed and direction, solar radiation).
- Provide information on near real-time weather parameters, historical climate patterns, and climate station metadata from a single, easy-to-use Internet portal.

To accomplish these objectives 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 (Knight et al., in preparation). 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 climatological 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 (Knight et al., in preparation) and summarized in the body of this report.

## The Climate of the of the South Central Mountains

Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial 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/usclimate/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 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 reaching 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

A total of seven weather observing stations comprised of six observing networks were selected around Allegheny Portage Railroad NHS and Johnstown Flood NMem (Figure 1). Representative stations within a 100-km range of each park were chosen based on several criteria which include proximity to the park, the representativeness of the station to the park elevation profile, the type and frequency of observations, the period of record of the data, and data availability (Knight et al., in preparation). A subset of these observing networks (IFLOWS, GOES, NADP, and CWOP; three total weather observing stations) are not yet utilized for these reports due to limited data availability and/or lack of data quality assurance (Bureau of Land Management 1997). Moreover, the percentage of time a station reports particular parameters (e.g., temperature) can influence its data inclusion. No stations were excluded in 2008 based on this criterion. Therefore, a total of four stations were used for this report (Table 2).

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/gmaps/NPS_DEVELOPMENT/interface.php.

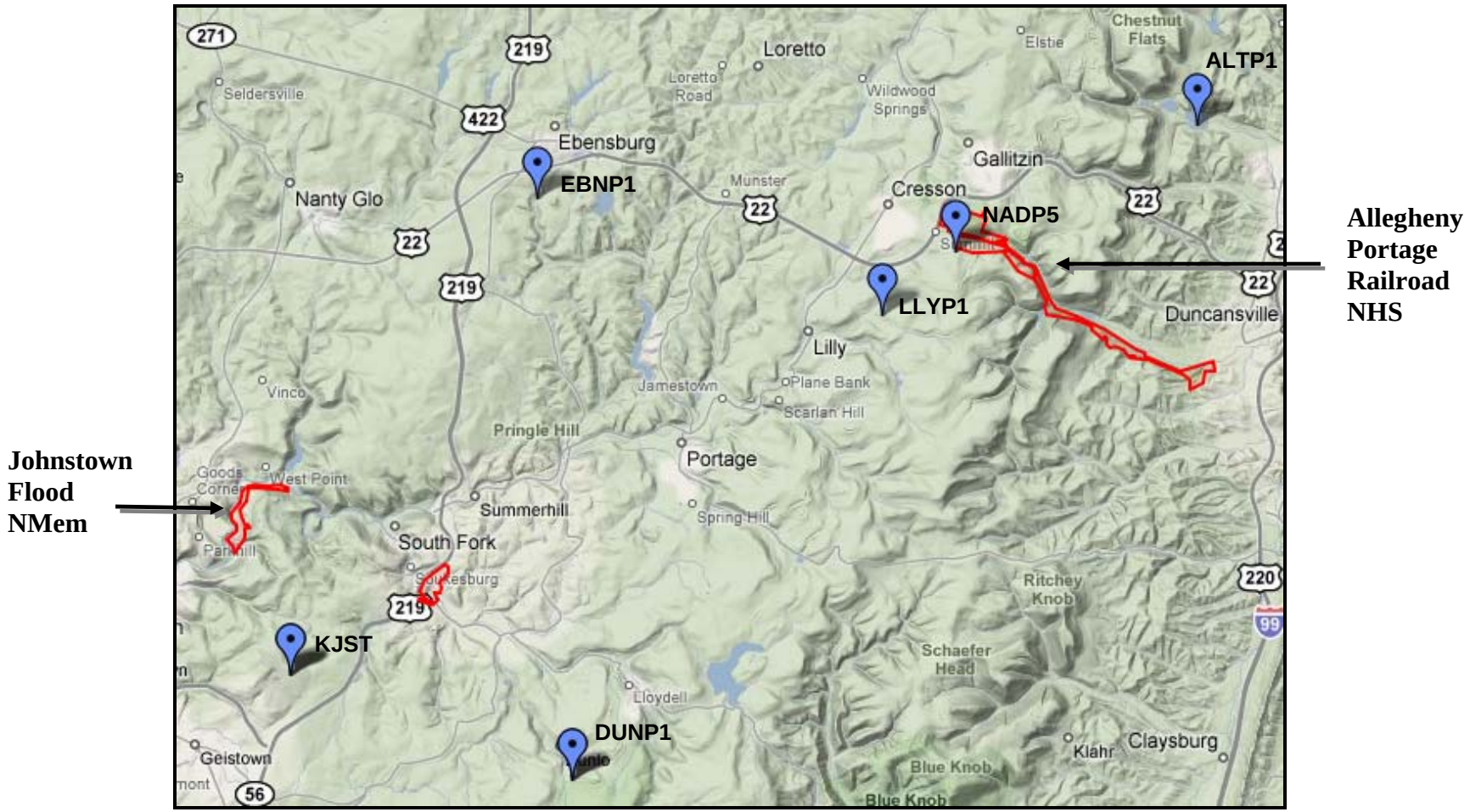


**Figure 1**. Location of weather observing stations around Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. The CASTNET station located at Laurel Hill is not shown.

**Table 2**. List of weather observing stations around Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. These stations have been selected as best representative of the parks in 2008.

| Station | Observing Network | Station Name | Period of Record (POR) | | Percentage of Time Reporting Temperature for 2008 | Percentage of Time Reporting Precipitation for 2008 | Percentage of Time Reporting Temperature for entire POR | Percentage of Time Reporting Precipitation for entire POR |
|---|---|---|---|---|---|---|---|---|
| KJST | FAA | Johnstown | 01/01/1973 | Present | 100.0 | 100.0 | 99.7 | 99.8 |
| DUNP1 | COOP | Dunlo | 05/01/1948 | Present | - | 100.0 | - | 32.9 |
| EBNP1 | COOP | Ebensburg Sewage Plant | 02/01/1964 | Present | 100.0 | 100.0 | 98.5 | 98.7 |
| LRL117 | CASTNET | Laurel Hill | 01/01/1988 | Present | 100.0 | 100.0 | 100.0 | 100.0 |

-No data available.

## Temperature Summary

Large temperature variations were common in calendar year 2008 at Johnstown Flood NMem and Allegheny Portage Railroad NHS. In the end, the year finished slightly cooler than average. The year began with a warmer-than-normal January (Figures 2 and 3). 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/.

The first month was more than 2 degrees Fahrenheit (°F [1.1 degree Celsius {°C}]) above average for Johnstown, PA (Table 3). This positive anomaly was aided by a record high temperature of 66°F (18.9°C) on the January 8 and 9, which was 30°F (16.7°C) above average. Temperatures in February were slightly cooler than normal, with nighttime lows dipping below 0°F (-17.8°C) on three occasions. The lowest temperature recorded was -5°F (-20.1°C) on February 21. Negative temperature anomalies persisted into March, which was the 37th coolest in the South Central Mountain Climate Division of Pennsylvania since records began in 1895.

Spring began with above-normal temperatures in April. The average temperature in Ebensburg, PA, during the month was 50.9°F (10.5°C) which was 3.7°F (2°C) above average (Tables 3 and 4). Cool anomalies returned in May, which was the 6th coldest May on record, with an average temperature about 5°F (2.8°C) below normal. The last 32°F (0°C) reading of the spring occurred on May 23. Very warm weather returned in the beginning of June when 9 consecutive days (June 5–13) saw high temperatures above 80°F (26.7°C). In its entirety, temperatures in the spring were nearly average (Table 5).

Temperature anomalies in the summer varied. Warmer-than-normal readings occurred in July, while August readings were slightly below average. The average temperature in August was 65.4°F (18.6°C) in Ebensburg, PA, which was 1.7°F (0.9°C) below average (Tables 3 and 4). Above-average temperatures returned in September with a +1.0°F (0.6°C) temperature anomaly. Overall, the summer was the 31st coolest on record (Table 5). The highest temperature of the year occurred on June 10 in Ebensburg, PA, with a reading of 88.0°F (31.1°C).

The cooling trend continued into the first two months of fall. The first 32°F (0°C) reading occurred on October 7, which is similar to previous years. More cool weather occurred in November despite a daytime record high temperature of 71°F (21.7°C) on November 7. Near average temperatures occurred in December, which was 0.5°F (0.3°C) below normal in Johnstown, PA (Table 3). It is interesting to note that the nighttime low on December 22 was 0°F (-17.8°C), and just six days later the daytime high was 66°F (18.9°C). Interestingly, 2008 featured a notable increase in the frequency of sub-freezing nights (Table 6). Overall, 2008 was the 37th coolest and the chilliest since 2003. Though there was a drop in surface temperatures in 2008, the 30-year trend for soil temperatures is still on the rise, which is consistent with the overall warming trend noted in the atmosphere during the past 30 years (Figure 4). The total growing season length (days between last spring freeze and first fall freeze) ranged from 137–159 days in 2008.

Allegheny Portage Railroad NHS and Johnstown Flood NMem
Departure from Average Monthly Maximum Temperature
2008 vs. 1971–2000

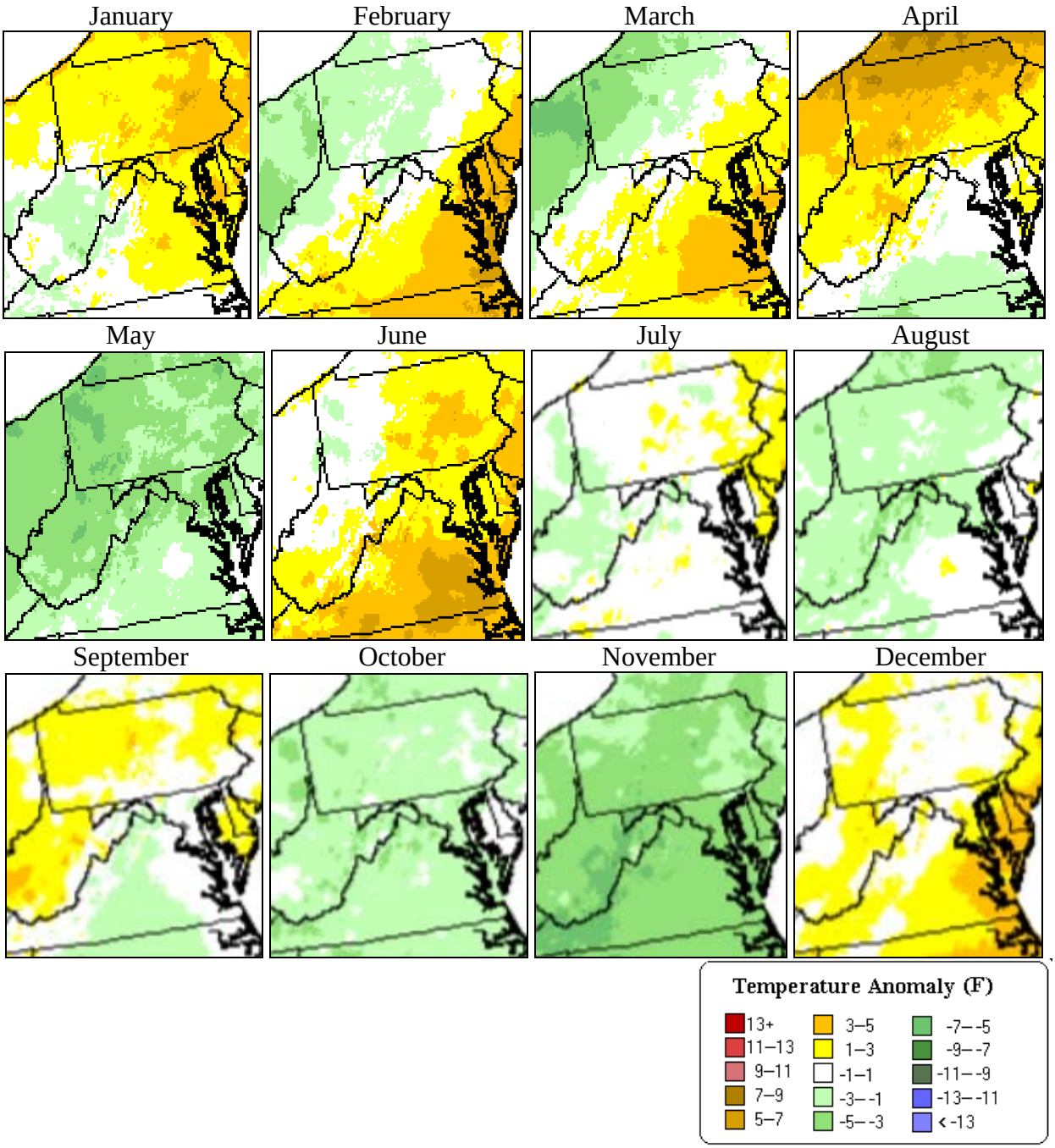


**Figure 2**. Maps showing maximum daily temperature (°F) departure from the 30-year normal (1971–2000) for each month in calendar year 2008.

Allegheny Portage Railroad NHS and Johnstown Flood NMem
Departure from Average Monthly Minimum Temperature
2008 vs. 1971–2000

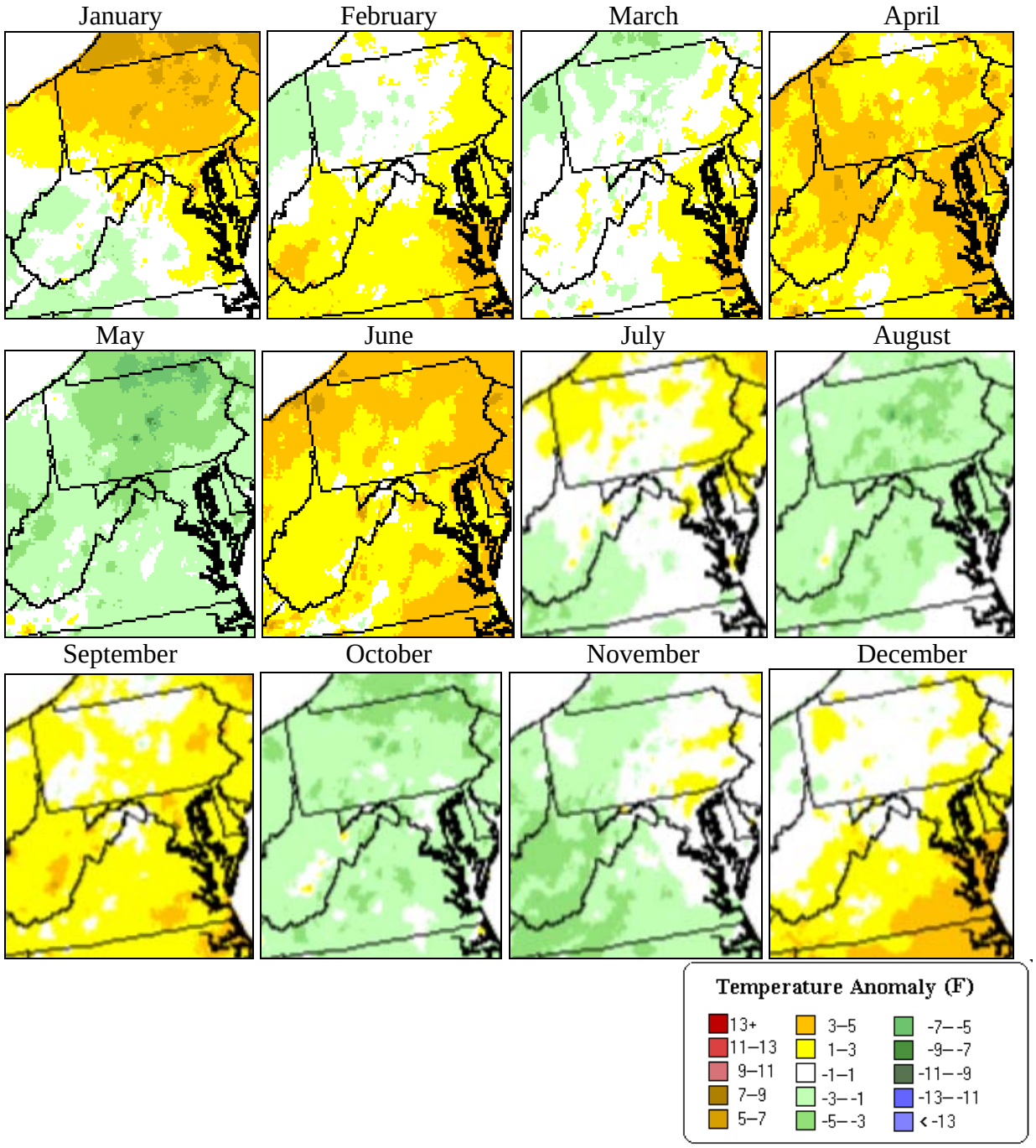


**Figure 3**. Maps showing minimum daily temperature (°F) departure from the 30-year normal (1971–2000) for each month in calendar year 2008.

**Table 3**. Summary of 2008 departure from normal temperature based on 30-year normal (1971–2000) for the selected stations.

| Station Location | ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnstown, PA | KJST | 2.81°F | -1.33°F | -2.41°F | 2.88°F | -3.04°F | 1.93°F | 0.56°F | -1.81°F | 1.31°F | -2.04°F | -3.13°F | -0.49°F |
| | | 1.57°C | -0.74°C | -1.34°C | 1.60°C | -1.69°C | 1.08°C | 0.31°C | -1.01°C | 0.73°C | -1.13°C | -1.74°C | -0.27°C |
| Ebensburg, PA | EBNP1 | 2.00°F | -2.28°F | -1.76°F | 3.73°F | -3.08°F | 2.10°F | 0.44°F | -1.65°F | 1.00°F | -1.71°F | -1.98°F | 0.75°F |
| | | 1.11°C | -1.27°C | -0.98°C | 2.07°C | -1.71°C | 1.17°C | 0.24°C | -0.91°C | 0.56°C | -0.95°C | -1.10°C | 0.42°C |

**Table 4.** Summary of monthly average temperatures for 2008 for the selected stations.

| Station Location | ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnstown, PA | KJST | 28.1°F | 26.5°F | 34.6°F | 50.0°F | 53.7°F | 66.5°F | 69.0°F | 65.3°F | 61.9°F | 47.6°F | 36.4°F | 29.3°F | 47.4°F |
| | | -2.2°C | -3.1°C | 1.4°C | 10.0°C | 12.1°C | 19.2°C | 20.6°C | 18.5°C | 16.6°C | 8.7°C | 2.5°C | -1.5°C | 8.6°C |
| Ebensburg, PA | EBNP1 | 27.3°F | 25.5°F | 35.2°F | 50.9°F | 53.7°F | 66.7°F | 68.9°F | 65.42°F | 61.6°F | 47.9°F | 37.6°F | 30.5°F | 47.6°F |
| | | -2.6°C | -3.6°C | 1.8°C | 10.5°C | 12.1°C | 19.3°C | 20.5°C | 18.6°C | 16.4°C | 8.9°C | 3.1°C | -0.8°C | 8.7°C |
| Laurel Hill, PA | LRL117 | 26.4°F | 27.0°F | 35.6°F | 49.3°F | 52.7°F | 64.4°F | 66.31°F | 68.3°F | 59.1°F | 45.4°F | 35.7°F | 30.0°F | 46.7°F |
| | | -3.1°C | -2.8°C | 2.0°C | 9.6°C | 11.5°C | 18.0°C | 19.1°C | 20.2°C | 15.0°C | 7.4°C | 2.0°C | -1.1°C | 8.2°C |

**Table 5.** Seasonal temperature and precipitation rankings over 114 years for Pennsylvania Climate Division 8. The values indicate a somewhat wet winter followed by an average, relatively wet spring, a dry and cool summer and a cool, moist autumn.

| PA Climate Division 8 Rankings "South Central Mountains" | Jan–Feb–Mar WINTER | Apr–May–Jun SPRING | Jul–Aug–Sep SUMMER | Oct–Nov–Dec AUTUMN |
|---|---|---|---|---|
| Temperature-2008 | 62 | 58 | 83 | 85 |
| Precipitation-2008 | 26 | 41 | 73 | 32 |

1 = Warmest or Wettest 114 = Coldest or Driest

**Table 6**. Status of 2008 temperature indicators using the Ebensburg and Hawley, PA stations compared the 30-year normal at Pittsburgh, PA. While the elevation does vary, the trend in 2008 showed near to slightly above average number of cold winter days, but a notable increase in the frequency of sub-freezing nights. The summer of 2008 brought fewer than average number of hot days and the length of the growing season was shorter than the 30-year average for Pittsburgh.

| Temperature Indicator | Ebensburg, PA EBNP1 2008 | Johnstown, PA KJST 2008 | Pittsburgh, PA KPIT 1971–2000 |
|---|---|---|---|
| Average Annual Maximum Temperature | 58.6°F<br>14.8°C | 55.4°F<br>13.0°C | 60.4°F<br>15.8°C |
| Average Annual Minimum Temperature | 36.7°F<br>2.6°C | 39.9°F<br>4.4°C | 41.5°F<br>5.3°C |
| Cold Days (days with Tmax≤32°F/0°C) | 41 | 50 | 39.1 |
| Sub-freezing Nights (days with Tmin≤32°F/0°C | 147 | 134 | 123.9 |
| Winter Minimum (lowest temperature) | -5.0°F<br>-20.6°C | -2.2°F<br>-19.0°C | -22°F<br>-30.0°C |
| Cold Winter Nights (days with Tmin≤0°F/-17.8°C) | 5 | 2 | 3.5 |
| Hot Days (days with Tmax≥90°F/32°C) | 0 | 0 | 7.4 |
| Growing Season Length: (days between last spring 32°F/0°C and first fall 32°F/0°C) | 137 | 159 | 160–180 |

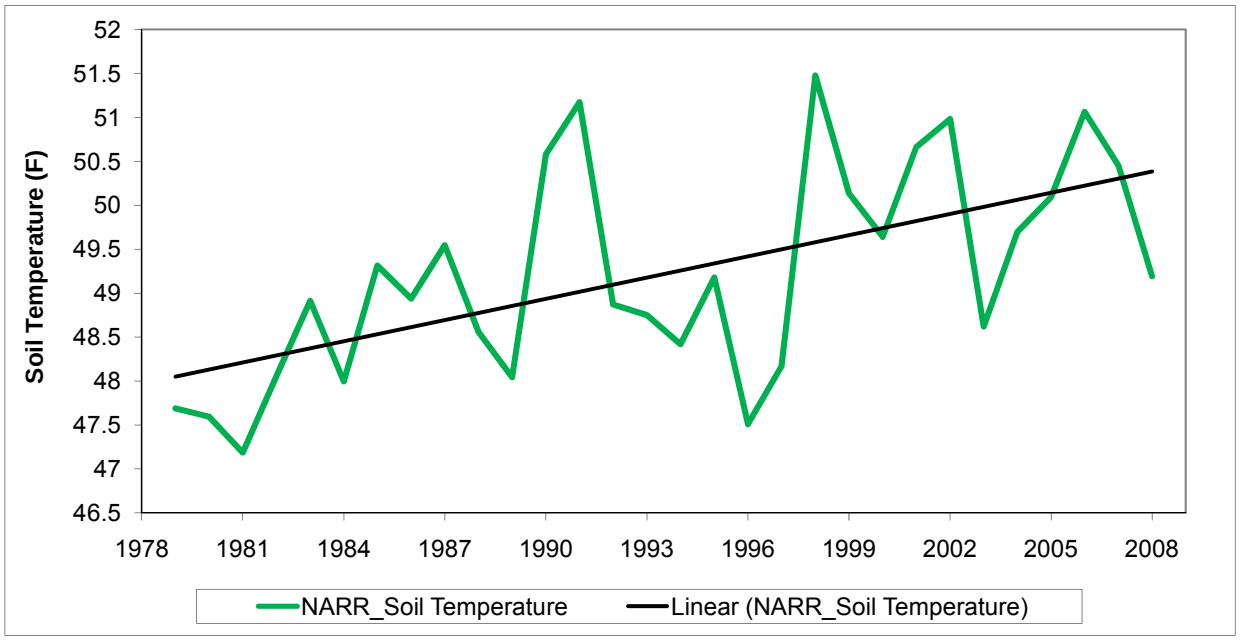


**Figure 4**. Annual soil temperature trends for Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. The black line is the soil temperature trend for a 32-km square box within Allegheny Portage Railroad NHS as derived from the North American Regional Reanalysis (NARR). The steady rise is consistent with the warming trend noted in the atmospheric during the past 30 years.

## Growing Degree Days

The derived quantity, growing degree days – base 55°F (12.8°C), is shown for its accumulation and long-term trend during several important intervals of the annual growing season. The accumulation of growing degree days is directly related to the phenological cycle of the flora and fauna and its related pests and diseases. Trends in the growing degree days can signal changes in the exposure of the region's fauna to native and invasive pests. For the Allegheny Portage Railroad NHS and Johnstown Flood NMem, a small increase is noted in the early spring (Figure 5), but the remainder of the growing season shows no change (Figures 6 and 7). Data in Figures 5–7 are from the Ebensburg Sewage Plant (EBNP1) COOP station.

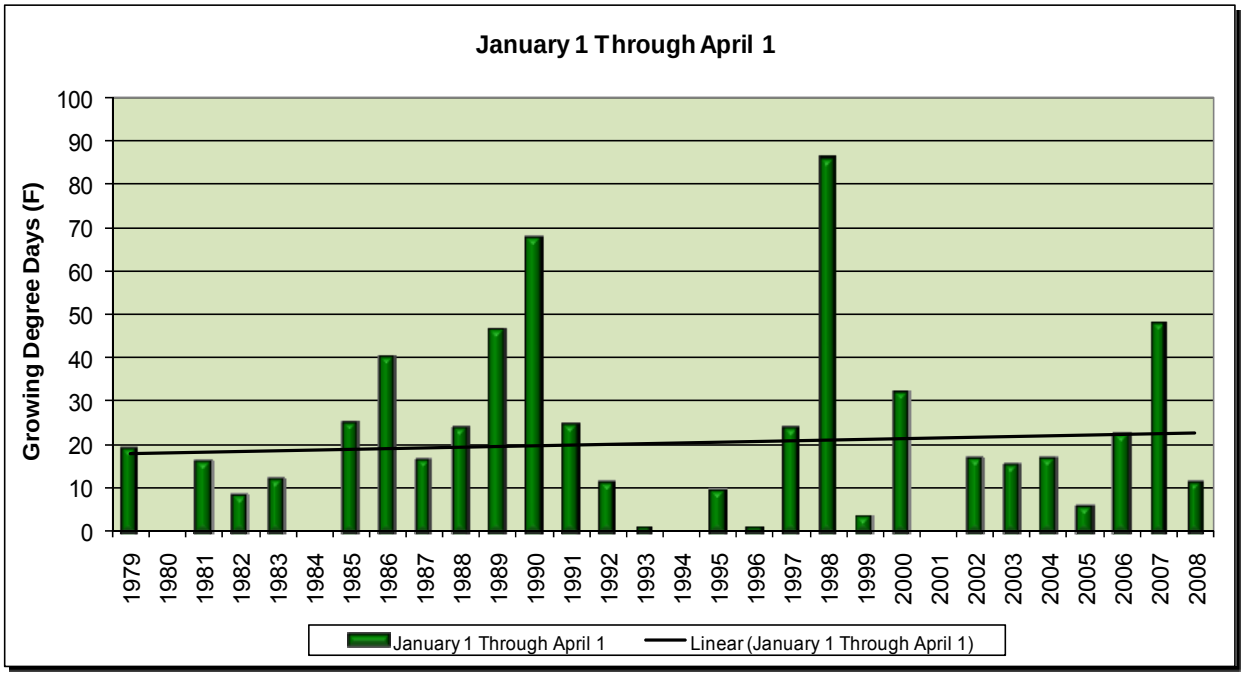


**Figure 5**. Trend in growing degree day accumulation (90 days) for Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial 1979–2008. There is a slight increasing trend indicating an earlier start to the growing season over this time period.

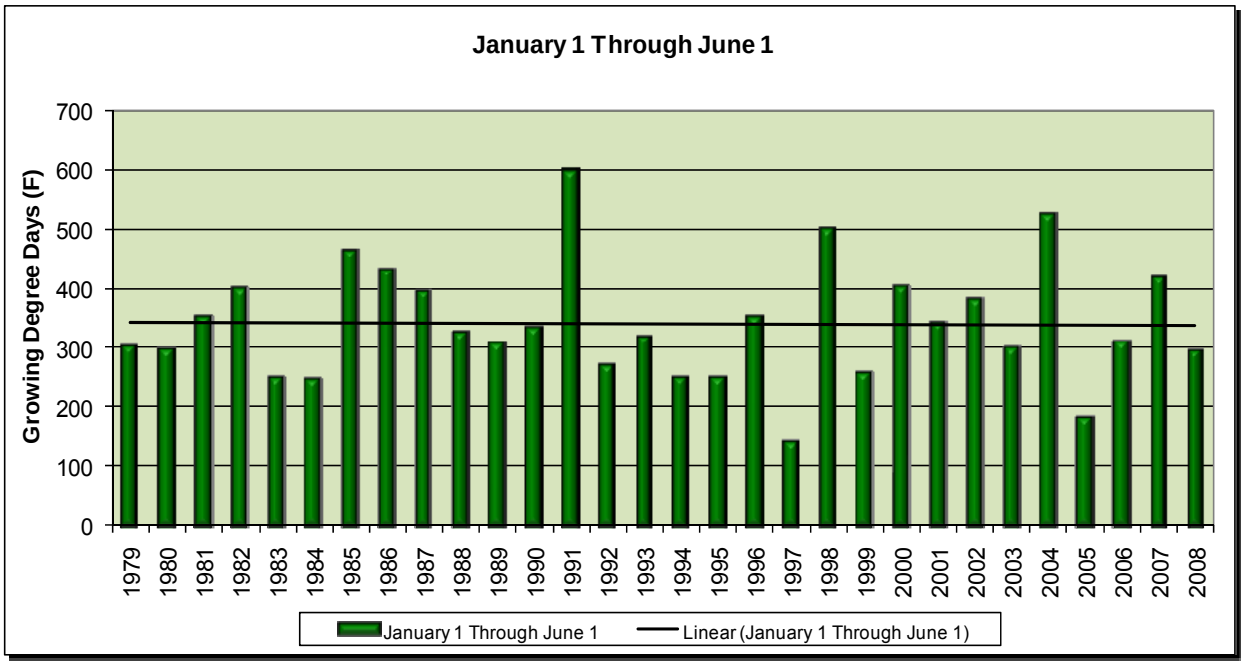


**Figure 6.** Trend in growing degree day accumulation (150 days) for Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial 1979–2008. There is virtually no change during the last 30 years.

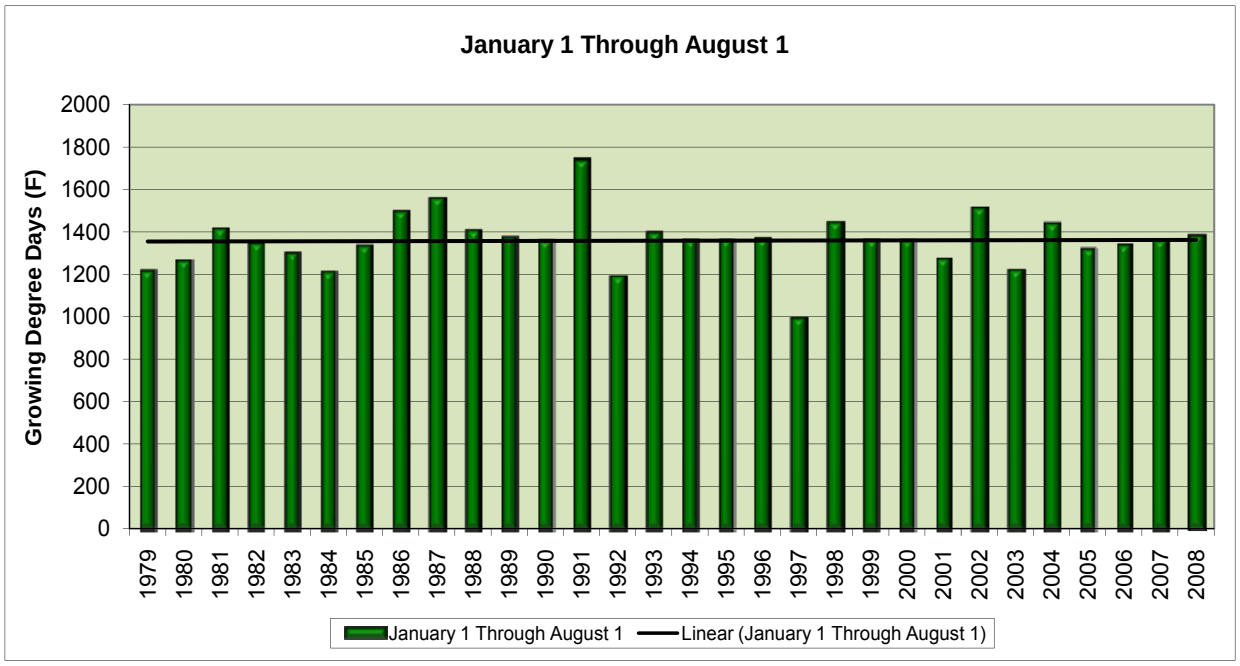


**Figure 7**. Trend in growing degree day accumulation (215 days) for Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial 1979–2008. There is virtually no change during the last 30 years.

## Precipitation Summary

Precipitation throughout 2008 was generally at or above average around the Johnstown Flood NMem and Allegheny Portage Railroad NHS (Figure 8, Tables 7 and 8). The consistently positive precipitation anomalies allowed the year to rank as the 29th wettest in the South Central Mountain Climate Division (8) of Pennsylvania since records began in 1895.

However, the beginning of year featured below-normal precipitation with January ranking as the 24th driest and the lowest amount since 2002. With a total of 1.9 in (49 mm) for the month, only 50 percent of normal precipitation fell in Johnstown during January (Tables 7 and 8). The deficit to start the year was quickly erased in February when 3.9 in (99 mm) of precipitation fell in the climate division. This was the wettest 2nd month of the year since 1998 and 18th wettest on record. March continued the above-average trend with the wettest 3rd month since 1994. The positive anomalies were aided by one of the wettest days of the year on March 5 when 1.6 in (40 mm) fell (Table 9). Overall, the winter was the 26th wettest on record with above normal snowfall (Table 5); 74 in (188 cm) fell in the region while the average is closer to 60 in (152 cm) (Table 10) (Changnon et al. 2008).

Spring began with below-normal precipitation; 3.1 in (77 mm) fell in April in Ebensburg, PA, which was 1.3 in (33 mm) below normal (Tables 7 and 8). May of 2008 was the 20th wettest on record and the wettest since 2003. In June, about 3.7 in (94 mm) of rain fell in the region and precipitation tallied below average for the month.

The summer of 2008 was the driest season of the year and ranked the 41st driest summer (Table 5). Both July and August saw negative precipitation anomalies with 84 and 58 percent of normal, respectively, in Dunlo, PA (Table 8). August was the driest since 2002 and ranked the 38th driest on record. The below-average precipitation was accompanied by the longest dry spell of the year which occurred from August 17–27. Positive anomalies returned in September despite a dry spell from September 15–25 (Table 10).

Precipitation anomalies in the fall varied drastically. October and November were both well below normal, ranking 35th and 38th driest, respectively. They were also the driest such months since 2001. Despite the dry weather in the first two months of fall, the season concluded as the 32nd wettest (Table 5). This was due to record-setting precipitation in December. Two of the wettest days of the year occurred during this month with 1.7 in (42 mm) on the 20th and 1.4 in (35 mm) on Christmas day (Table 10). The month ranked as the wettest December of all time and almost twice as much of the normal precipitation fell during this month (7.8 in [166 mm]) than October and November combined in Ebensburg, PA (Table 7). As a whole, the year 2008 was the wettest since 2004 and similar to 2007. Despite near- to above-normal precipitation in 2008, annual soil moisture trends have been on the decline over the past 30 years (Figure 9), in large part due to rising temperatures causing more evaporation.

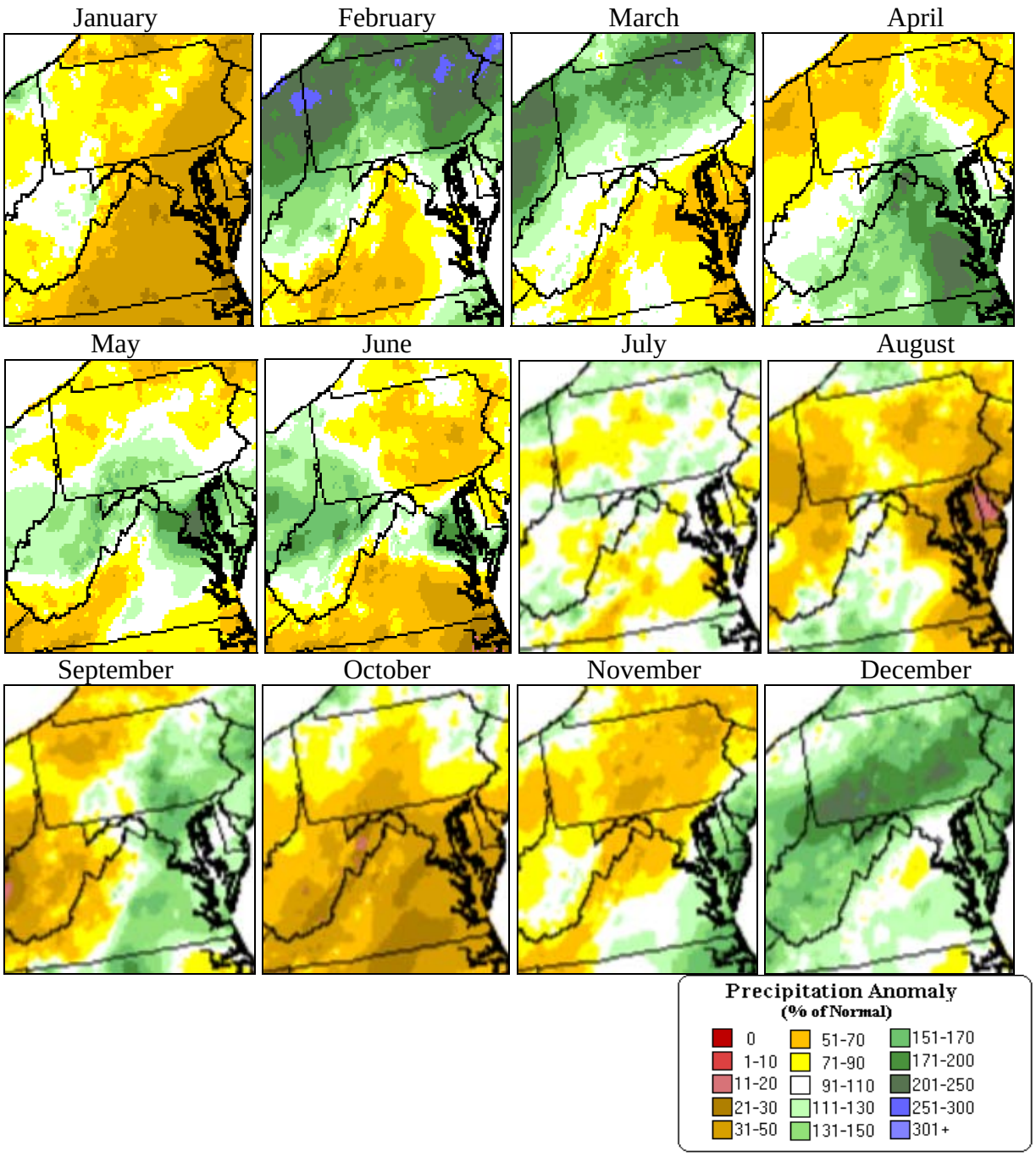


**Figure 8.** Maps showing percent of average precipitation compared to the 30-year normal (1971–2000) for each month in the calendar year 2008.

**Table 7**. Summary of 2008 monthly total rainfall (in/mm) for selected stations.

| Station Location | ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dunlo, PA | DUNP1 | 1.5 in | 7.9 in | 5.9 in | 3.4 in | 3.0 in | 2.9 in | 4.7 in | 1.6 in | 5.7 in | 5.0 in | 2.3 in | 6.8 in | 50.6 in |
| | | 37 mm | 201 mm | 150 mm | 85 mm | 76 mm | 73 mm | 120 mm | 40 mm | 145 mm | 127 mm | 57 mm | 173 mm | 1285 mm |
| Ebensburg, PA | EBNP1 | 3.0 in | 4.4 in | 5.8 in | 3.1 in | 6.1 in | 3.9 in | 2.6 in | 3.0 in | 4.1 in | 2.9 in | 2.8 in | 7.8 in | 49.5 in |
| | | 65 mm | 93 mm | 103 mm | 77 mm | 162 mm | 118 mm | 106 mm | 59 mm | 140 mm | 48 mm | 63 mm | 166 mm | 1200 mm |
| Johnstown, PA | KJST | 1.9 in | 3.0 in | 3.4 in | 2.54 in | 6.5 in | 4.4 in | 3.9 in | 2.3 in | 5.7 in | 1.5 in | 1.9 in | 6.5 in | 43.6 in |
| | | 49 mm | 77 mm | 86 mm | 65 mm | 165 mm | 111 mm | 100 mm | 59 mm | 146 mm | 37 mm | 48 mm | 164 mm | 1106 mm |

**Table 8**. Summary of 2008 percent of normal rainfall based on 30-year normal (1971–2000) for selected stations.

| Station Location | ID | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dunlo, PA | DUNP1 | 66 | 109 | 111 | 69 | 134 | 104 | 84 | 58 | 127 | 56 | 60 | 181 | 97 |
| Ebensburg, PA | EBNP1 | 77 | 130 | 131 | 71 | 128 | 88 | 53 | 74 | 94 | 85 | 68 | 216 | 101 |
| Johnstown, PA | KJST | 50 | 85 | 122 | 66 | 150 | 90 | 77 | 56 | 139 | 55 | 52 | 202 | 95 |



**Table 9**. Top four wettest days and top four dry spells (consecutive days with a trace or less of rainfall) during 2008 (data from the COOP station at Ebensburg, PA).

| Wettest Days in 2008 | Dry Spells in 2008 |
|---|---|
| Dec. 20: 1.7 in (42 mm) | Aug. 17–27 |
| Mar. 5: 1.6 in (40 mm) | Sept. 15–25 |
| Sept. 13: 1.5 in (39 mm) | Oct. 31–Nov. 7 |
| Dec. 25: 1.4 in (35 mm) | Oct. 10–15 |

**Table 10.** Status of 2008 precipitation indicators using the Ebensburg and Johnstown, PA stations compared the 30-year normal at Pittsburgh, PA. While elevation does vary, trends in 2008 showed an increase in annual rainfall and a near average number of excessively wet days.

| Precipitation Indicators | Ebensburg, PA EBNP1 2008 | Johnstown, PA KJST 2008 | Pittsburgh, PA KPIT 1971–2000 |
|---|---|---|---|
| Annual Precipitation | 49.5 in<br>1257 mm | 43.6 in<br>1107 mm | 37.9 in<br>963 mm |
| Autumn (Oct, Nov, Dec) Precipitation | 13.5 in<br>343 mm | 9.8 in<br>249 mm | - |
| Annual Snowfall | 87 in<br>221 cm | 74 in<br>188 cm | 41 in<br>104 cm |
| Micro-drought (strings of 7+ days without rain) | 3 | 3 | - |
| Moderate Rain (days with ≥1.0 in [2.5 cm] rain) | 5 | 7 | 6 |
| Heavy Rain (days with ≥2.0 in [5.1 cm] rain) | 0 | 1 | - |
| Snow (days with ≥0.1 in [0.3 cm] snow) | 46 | 46 | - |

-Data not available.

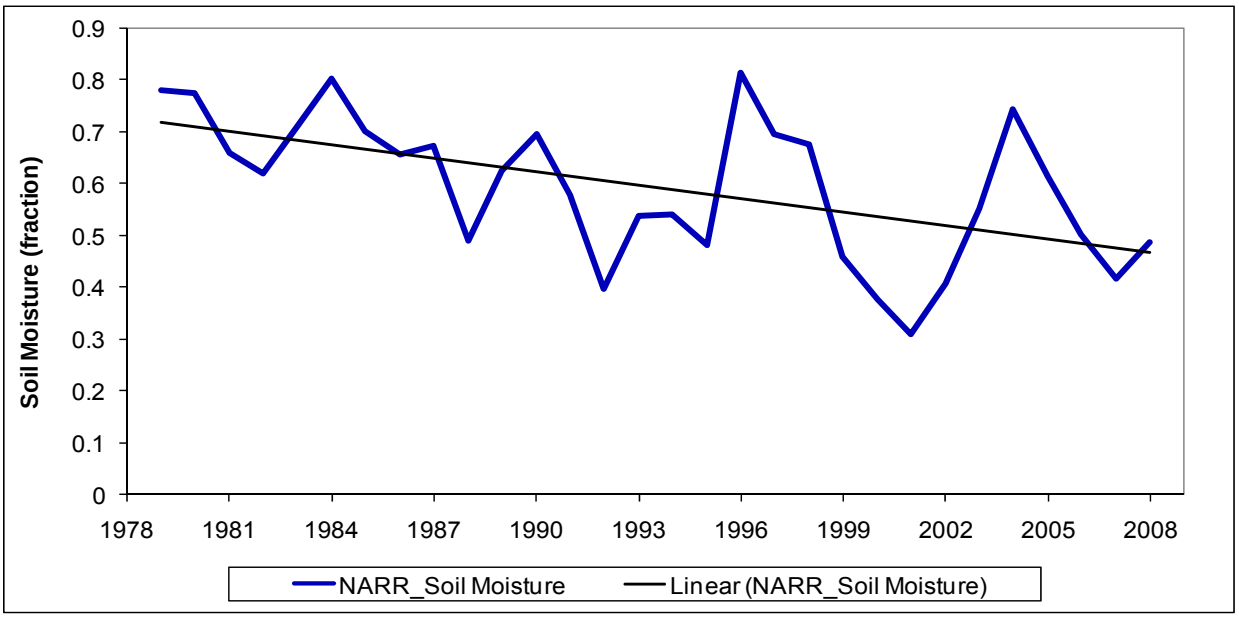


**Figure 9**. Annual soil moisture trends for Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. The black line is the soil moisture trend for a 32-km square box within Allegheny Portage Railroad National Historic Site as derived from the North American Regional Reanalysis (NARR). There has been a steady decline in the soil moisture content during the last 30 years.

## Drought Status

The U.S. Drought Monitor (USDM; http://www.drought.unl.edu/dm/monitor.html) tracks drought conditions across the nation on a weekly basis, and it incorporates data and expert input from a wide variety of state and federal agencies. The USDM is designed to represent a "broad brush," regional perspective (e.g., summarized by climate division, state or region) on drought, and therefore provides an ideal tool for tracking generalized drought conditions across the Delaware River valley parks and surrounding areas. One index used to track drought conditions, the Palmer Drought Severity Index (PDSI), uses temperature and rainfall information to determine dryness (the long-term average is "zero"). Since the PDSI responds to long-term effects, including evaporation, there is usually a lag between both long dry spells and episodes of heavy rain and changes in the index value.

According to the USDM, there was no time during calendar year 2008 when it was drier than normal (Figures 10–12). In fact, despite some dry periods in April, August and November, most of the time, the region was abnormally moist (> +2). When compared with the past few years, 2008 was noticeably moister than 2007 and very similar to 2006.

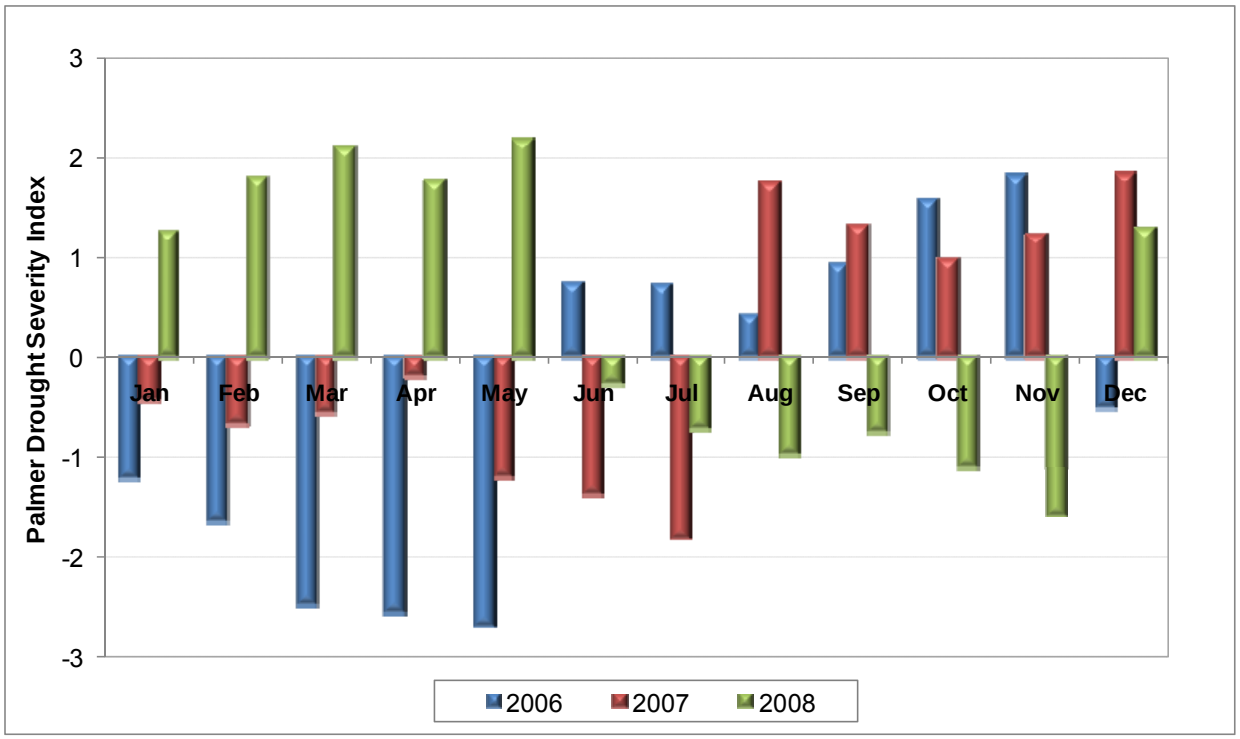


**Figure 10**. Palmer Drought Severity Index (PDSI) for Pennsylvania Climate Division 8, 2006–2008.

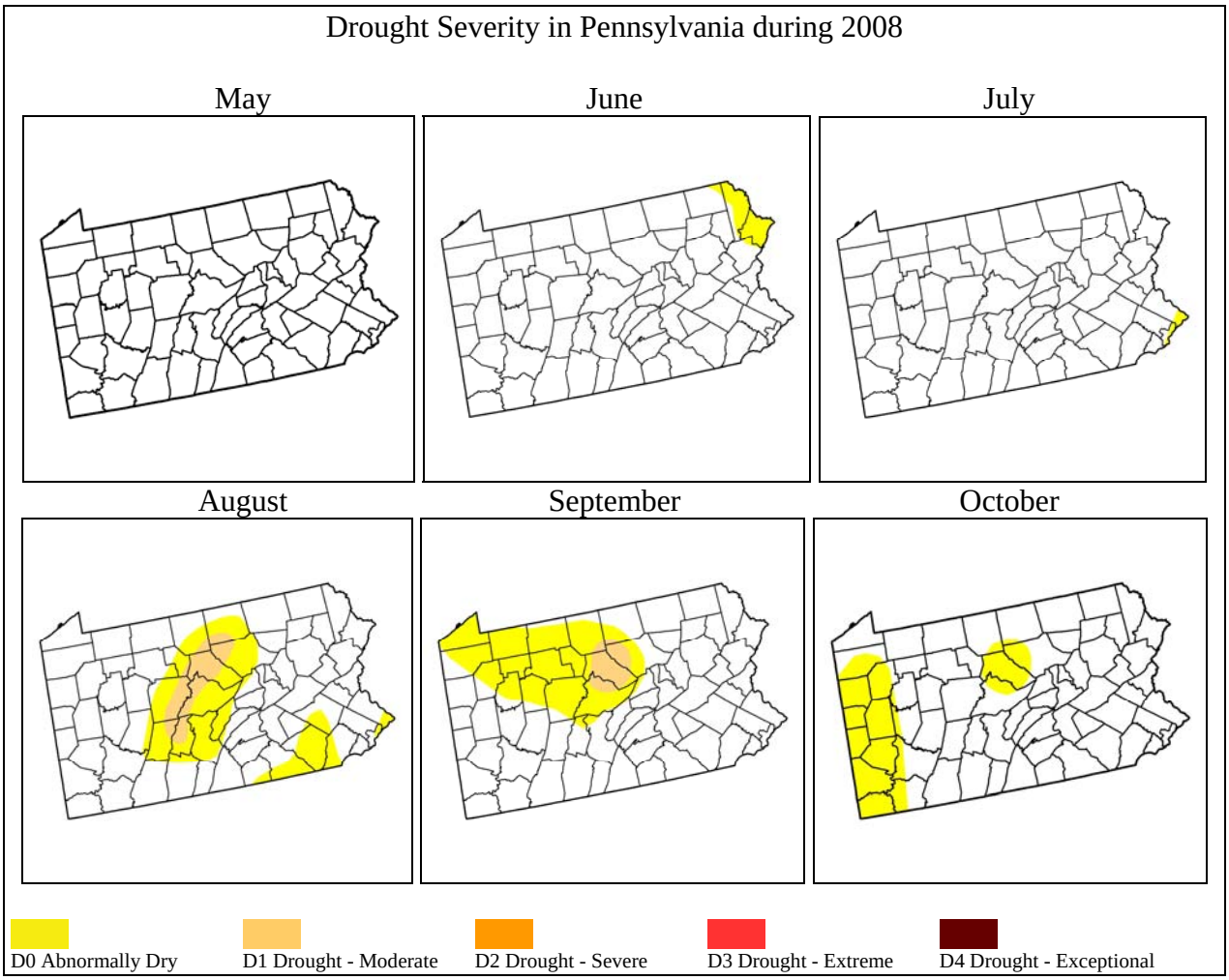


**Figure 11**. Mid-month values of the Palmer Drought Severity Index (PDSI) for Pennsylvania in 2008.

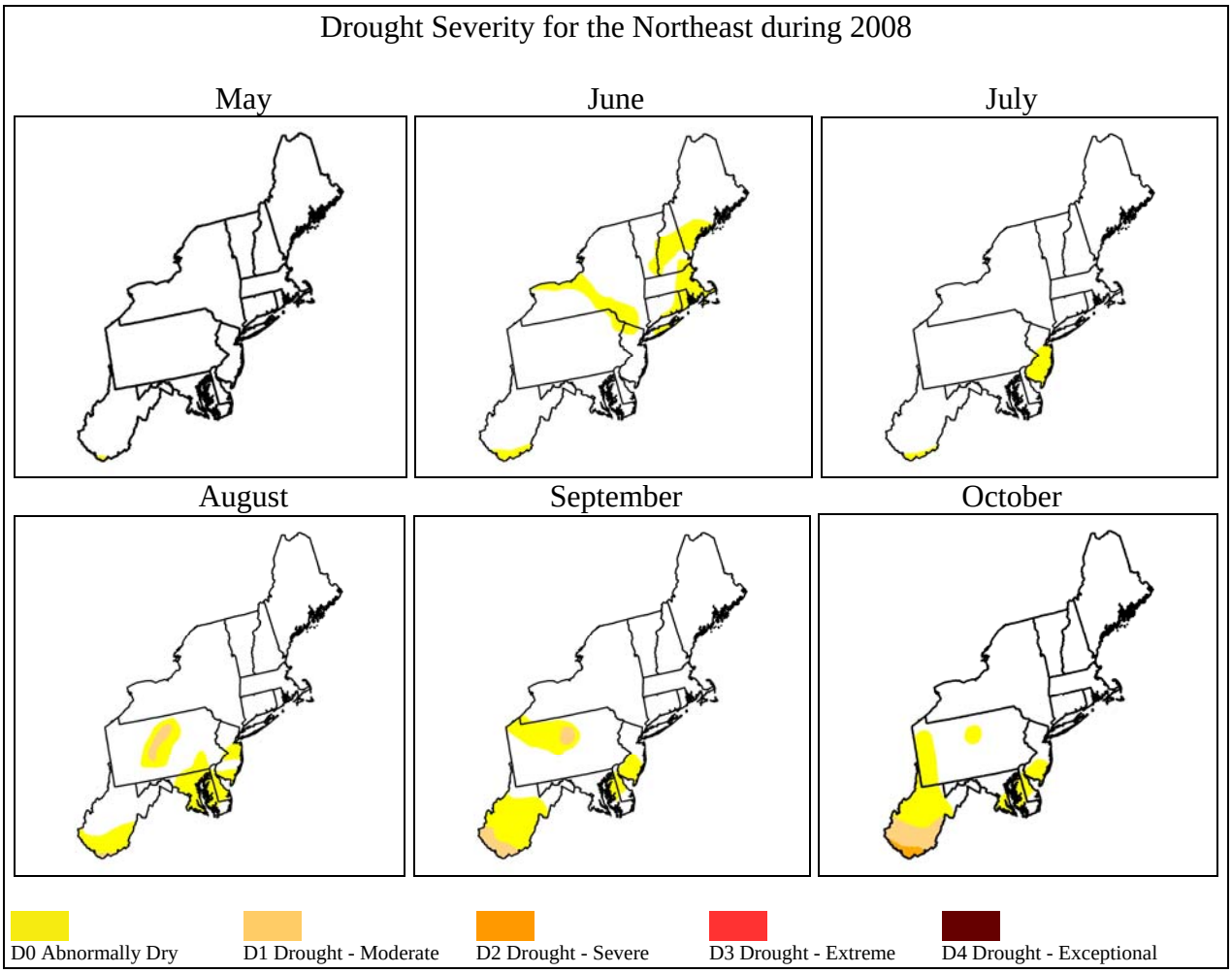


**Figure 12**. Mid-month values of the Palmer Drought Severity Index (PDSI) for the Northeast in 2008.

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# Appendix. Summary of Severe Weather

The following tables are a tally of all reports of severe weather during 2008 in the counties that encompass Allegheny Portage Railroad National Historic Site and Johnstown Flood National Memorial. These storm events were provided by the National Climatic Data Center (NCDC). NCDC receives this storm data from the National Weather Service, who acquires their information from a variety of sources. These sources include, but are not limited to: county, state, and federal emergency management officials, local law enforcement officials, skywarn spotters, NWS damage surveys, newspaper clipping services, the insurance industry, and the general public. This Storm Data is an official publication of the National Oceanic and Atmospheric Administration (NOAA [2008]) which documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. Each table contains the location, date, time, description of the severe event, its magnitude, and number of deaths, injuries, and property/crop damage associated with the event. The property and crop damage should be considered as a broad estimate.

## Blair County

| Location or County | Date | Time | Type | Mag | Dth | Inj | PrD | CrD |
|---|---|---|---|---|---|---|---|---|
| PAZ004>006 - 010>012 - 017>019 - 024>028 - 033>035 - 037 - 041>042 - 045>046 - 049>053 - 058 | 02/01/2008 | 03:00 AM | Winter Storm | N/A | 0 | 0 | 0K | 0K |
| PAZ004 - 010>012 - 017>018 - 024>025 - 033>034 - 037 - 041 | 02/10/2008 | 18:00 PM | Extreme Cold/wind Chill | N/A | 0 | 0 | 0K | 0K |
| PAZ025 | 05/11/2008 | 16:30 PM | High Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Ironville | 06/16/2008 | 15:57 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Newry Arpt | 06/26/2008 | 20:50 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Mill Run | 06/26/2008 | 20:55 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Mill Run | 07/20/2008 | 15:23 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Tyrone | 07/24/2008 | 13:45 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Tyrone | 07/24/2008 | 13:48 PM | Hail | 0.88 in. | 0 | 0 | 0K | 0K |
| Altoona | 07/24/2008 | 14:03 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Williamsburg | 07/24/2008 | 14:10 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| PAZ019 - 025 - 045 | 09/14/2008 | 21:45 PM | High Wind | 50 kts. | 0 | 0 | 0K | 0K |
| PAZ004>006 - 010>012 - 018>019 - 024>025 - 033>034 - 037 - 041>042 - 045>046 - 058 | 12/21/2008 | 23:00 PM | Extreme Cold/wind Chill | N/A | 0 | 0 | 0K | 0K |
| | | | | Totals: | 0 | 0 | 0 | 0 |

Mag: Magnitude; Dth: Deaths; Inj: Injuries; PrD: Property Damage; CrD: Crop Damage

## Cambria County

| Location or County | Date | Time | Type | Mag | Dth | Inj | PrD | CrD |
|---|---|---|---|---|---|---|---|---|
| PAZ024 | 01/09/2008 | 04:00 AM | Strong Wind | 44 kts. | 0 | 0 | 10K | 0K |
| PAZ005 - 010>011 - 024 - 033 | 01/19/2008 | 04:00 AM | Extreme Cold/wind Chill | N/A | 0 | 0 | 0K | 0K |
| PAZ024 | 01/30/2008 | 06:00 AM | High Wind | 50 kts. | 0 | 0 | 0K | 0K |
| PAZ004>006 - 010>012 - 017>019 - 024>028 - 033>035 - 037 - 041>042 - 045>046 - 049>053 - 058 | 02/01/2008 | 03:00 AM | Winter Storm | N/A | 0 | 0 | 0K | 0K |
| PAZ004 - 010>012 - 017>018 - 024>025 - 033>034 - 037 - 041 | 02/10/2008 | 18:00 PM | Extreme Cold/wind Chill | N/A | 0 | 0 | 0K | 0K |
| PAZ010 - 017 - 024 - 033 | 02/29/2008 | 13:00 PM | Heavy Snow | N/A | 0 | 0 | 0K | 0K |
| PAZ024 | 05/11/2008 | 13:30 PM | High Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Nanty Glo | 06/22/2008 | 22:45 PM | Hail | 1.00 in. | 0 | 0 | 0K | 0K |
| Johnstown | 06/26/2008 | 20:20 PM | Thunderstorm Wind | 61 kts. | 0 | 4 | 1K | 0K |
| Johnstown | 06/26/2008 | 20:23 PM | Thunderstorm Wind | 61 kts. | 0 | 0 | 0K | 0K |
| Barnesboro | 07/20/2008 | 14:57 PM | Thunderstorm Wind | 50 kts. | 0 | 0 | 0K | 0K |
| Glasgow | 07/24/2008 | 13:17 PM | Hail | 0.88 in. | 0 | 0 | 0K | 0K |
| PAZ006 - 010>012 - 017>018 - 024 - 037 - 041 | 09/14/2008 | 21:30 PM | High Wind | 50 kts. | 0 | 0 | 0K | 0K |
| PAZ006 - 010>012 - 017>018 - 024 - 037 - 041 | 12/11/2008 | 07:00 AM | Winter Storm | N/A | 0 | 0 | 0K | 0K |
| PAZ004>006 - 010>012 - 018>019 - 024>025 - 033>034 - 037 - 041>042 - 045>046 - 058 | 12/21/2008 | 23:00 PM | Extreme Cold/wind Chill | N/A | 0 | 0 | 0K | 0K |
| | | | | Totals: | 0 | 4 | 11K | 0 |

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 423/105518, 439/105518, September 2010

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