



## **Additional Information on the Antecedent Precipitation Tool (APT)**

What is the APT used for?

The APT was originally developed by the Corps to streamline and automate evaluation of precipitation normalcy and other climatic variables to complete wetland delineations whenever an assessment of the following site-specific conditions is needed: 1) dry season, 2) drought conditions, 3) lower than normal antecedent precipitation, or 4) greater than normal antecedent precipitation.

Can other tools be used to determine normal climate conditions?

The agencies recognize that there may be other accurate and reliable measurements of normal precipitation, as well as other sources of climatic data, relevant to the aquatic resource being evaluated. The agencies may consider data sources such as certain drought indices (e.g., the [Palmer Drought Severity Index \(PDSI\)](#) , which is also reported by the APT separately from the precipitation normalcy score) that incorporate multiple hydrologic inputs and can capture the presence of prolonged drought conditions. The agencies may also consider data on snowpack for certain regions and certain times of the year (e.g., using the National Oceanic and Atmospheric Administration's (NOAA) [National Snow Analyses](#), or the Natural Resources Conservation Services' (NRCS) [Snow Telemetry \(SNOTEL\)](#) data and products).

The APT results should be interpreted in light of all available data. For instance, the APT precipitation normalcy score could be “normal” based on the preceding three 30-day periods, but the precipitation could be extremely high on the day preceding a field sampling data or aerial photograph date, which could affect surface flow conditions. Alternatively, the APT precipitation normalcy score could be “dry” based on rainfall precipitation, but inspection of snow data sources may show that overall precipitation is actually “normal” or “high” for a given period. The agencies will use their best professional judgment to integrate relevant data sources.

How does the APT work?

Selecting weather stations

The APT identifies all weather stations that are located within a 30 mile radius from the point of interest using NOAA's [Daily Global Historical Climatology Network \(GHCN-Daily\)](#), which integrates climate data from over 20 sources. Each weather station is then ranked based on a weighted difference value which incorporates both the distance to the point of interest and the difference in elevation. The weather station with the lowest weighted

difference value, as well as a record that is sufficient to develop the 30-year normal period and the antecedent period, is selected by the tool as the Primary Station used to develop the dataset. Weighted differences for the remaining stations are then recalculated in relation to the Primary Station, rather than the observation point, and the APT attempts to backfill the missing dates from the Primary Station with the resulting Secondary Stations until there are no missing dates in the 30-year record.

#### Calculating precipitation normalcy

The APT determines whether antecedent precipitation is normal by comparing rainfall data from the previous three months to the same three-month period over a rolling 30-year record. Specifically, the APT calculates antecedent precipitation following the "combined method" which uses 30-day rolling totals and weighting factors, as described by [Sprecher and Warne \(2000\) \(PDF\)](#). Using daily rainfall data, the APT calculates 30-day rolling totals for each of the three 30-day periods preceding the observation date. For each period, a weighted condition value is assigned by determining whether the 30-day total falls within, above, or below the 30<sup>th</sup> to 70<sup>th</sup> percentiles of precipitation totals from the same date range over the preceding 30 years. The weighted condition values are then summed across the three 30-day periods to calculate a final precipitation normalcy index score. An index score of 9 or lower indicates antecedent precipitation conditions are drier than normal; a score of 10-14 indicates conditions are normal; and a score of 15 or higher indicates conditions are wetter than normal.

The APT adjusts for changes in climatic conditions by calculating normal precipitation conditions based on a rolling 30-year period. The 30-year period is calculated specifically for the observation date of interest and is adjusted over time if conditions are changing. This method is different than the calculation of normal precipitation in the Natural Resources Conservation Service WETS tables, which use the 30-year climate normals that are maintained by NOAA and adjusted every decade.

#### Supplemental climatic data

In addition to providing users with a rapid, accurate, and repeatable procedure for calculating antecedent precipitation, the APT also provides other relevant information such as drought indices and water-balance metrics, which may be used to inform an evaluation of whether observations of flow and surface water connections are representative of normal climatic conditions. Specifically, the APT displays monthly values from NOAA's Climate Division scale [Palmer Drought Severity Index \(PDSI\)](#) dataset, and water-balance metrics from the [Web-based Water-Budget Interactive Modeling Program \(WebWIMP\)](#).

The PDSI is one drought index that may be used to inform whether the observation location was experiencing drought conditions on the date of the observation. The PDSI integrates not just precipitation data, but also evapotranspiration and soil moisture data into a monthly drought index. The PDSI can capture the presence of prolonged drought conditions rather than assessing precipitation normalcy based on the preceding three 30-day periods. The PDSI is not site-specific, but rather is calculated on a regional scale,

which contrasts with the APT precipitation normalcy score which is calculated based on local weather station data.

The APT also incorporates water-balance metrics from *WebWIMP*, which is a water-budget model that uses interpolated average monthly air temperature and precipitation data to calculate a climatically-averaged, monthly water-balance for a given location. Using the monthly water-balance metrics from *WebWIMP*, the APT determines the approximate dates of the wet and dry seasons for the observation location. In general, the dry season is indicated when potential evapotranspiration exceeds precipitation, resulting in drawdown of soil moisture storage and/or a moisture deficit. The APT then indicates whether the date of observation falls within the wet season or the dry season as estimated by the average monthly water-balance metrics; however, because the metrics calculated in *WebWIMP* are based on interpolated averages, the actual dates for the dry season vary by location and year.

#### Spatial scales

The APT precipitation normalcy results can change by location, based on the weather stations being selected by the tool. Therefore, precipitation normalcy results for one site might not be applicable to a nearby site, and it may be appropriate to re-run the tool for individual sites.

In addition to performing an analysis for a single point, the APT can also be configured to run on a watershed scale. To conduct a watershed scale analysis, the APT generates a series of random sampling points throughout the watershed, and performs an analysis on each individual sampling point, the total number of which is dependent upon watershed size. A detailed description of sampling point generation and selection within watersheds or custom polygons is available in the APT Detailed Methodology (page 3) which can be accessed on the APT's "Help" page. Users can conduct a watershed scale analysis at one of three Hydrologic Unit Code (HUC) levels, either a HUC-8, HUC-10, or HUC-12 scale, or by using a custom defined polygon.

#### Temporal scales

The APT calculates precipitation normalcy based on the observation date entered by the user. The precipitation normalcy calculation applies to the specific observation date, and not necessarily the week, month, or season surrounding that date. It is important to recognize that precipitation normalcy can change over time. For instance, a field observation date in June may have a different precipitation normalcy score than a field observation date in July at the same site. In some cases, precipitation normalcy could even change on short timescales of days to weeks as the preceding three 30-day antecedent periods shift. Thus, running the tool for individual observation dates will increase the accuracy of the results.