PhenoMap Users Guide

Updated 1 February 2022

Welcome to *PhenoMap*, the weekly vegetation greenness and precipitation tracking web map developed by the USDA Forest Service Western Wildlands Environmental Threat Assessment Center (WWETAC). This is a guide to the features and data in *PhenoMap*.

PhenoMap is a web map, meaning that it functions inside a web browser (no software to install) and all the map layers are delivered with services over the web. This allows us to update the map weekly and you always see the latest data. Updates occur every Friday.

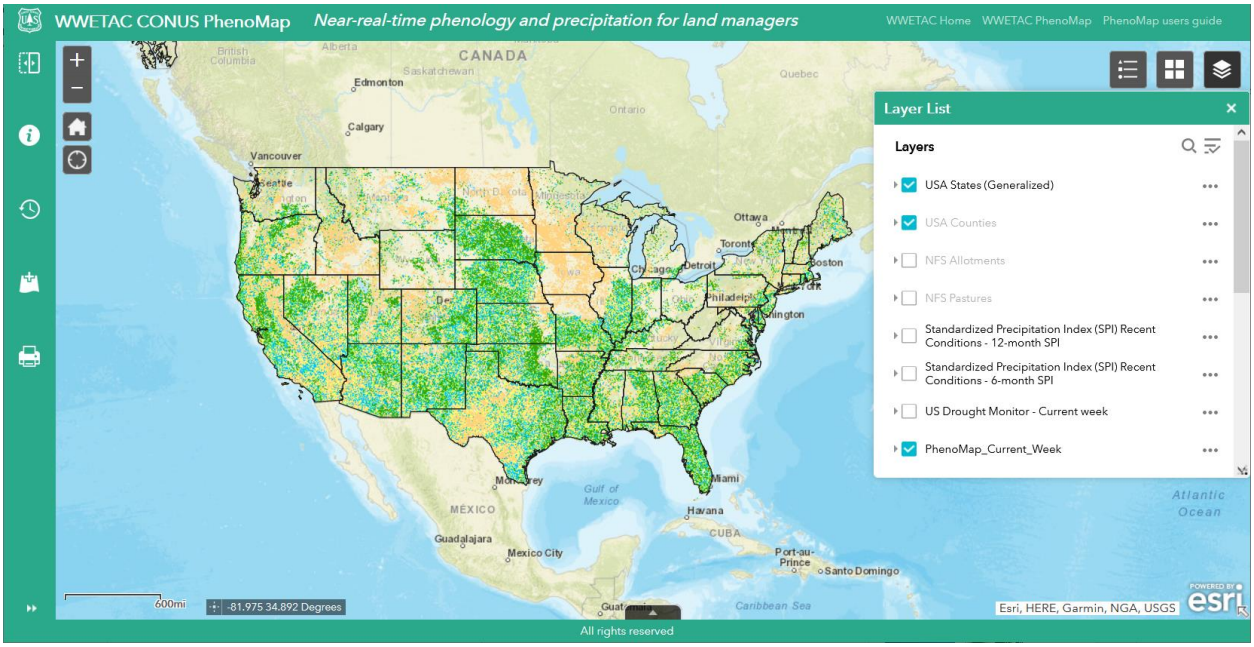
The first step is to load the map. It's linked on this web page:

WWETAC PhenoMap

Here is the link to the map:

TRM-CONUS PhenoMap

Here is what the map looks like when it initially loads in your browser:



The layers in *PhenoMap* may take up to a minute to load so if nothing seems to be happening, look for the spinning icon in the lower right corner. If its spinning, then map data is loading.

Here is what that looks like:

Here are the widgets to interact with the map and brief descriptions of their functions and a link to specific info on the widget. In the linked pages scroll down to the 'Use the widget' section.

Info widget – Displays info about the web map.
Widget link (click here).

Swipe widget– Allows you to swipe between layers that are turned on. Widget link (click here).

Bookmark widget – Save a specific spatial map extent.
Widget link (click here).

Zoom widget – Change the spatial map extent by zooming in or out.
Widget link (click here).

Basemap list – Change the basemap. Select from a variety of image and background maps. Widget link (click here).

Legend widget – Display the legend(s) of the layers that are turned on. Widget link (click here).

Add data widget – Add data to the map. Widget link (click here).

Layer list widget – Displays the layers available and which ones are visible. Widget link (click here).

Print widget – Produce a graphic output file (PDF, JPG, EPS) of the current map. Widget link (click here).

Measurement widget – Measure linear distances and the area of polygons. Widget link (click here).

Attribute table widget – Display attribute data in a table for the visible layers. Widget link (click here).

1. **Layer Display** – Controlling which layers are displayed in the map is done with the layer list. Bring up the layer list by clicking the layer list widget. The layers window has checkboxes to turn the layers on/off:

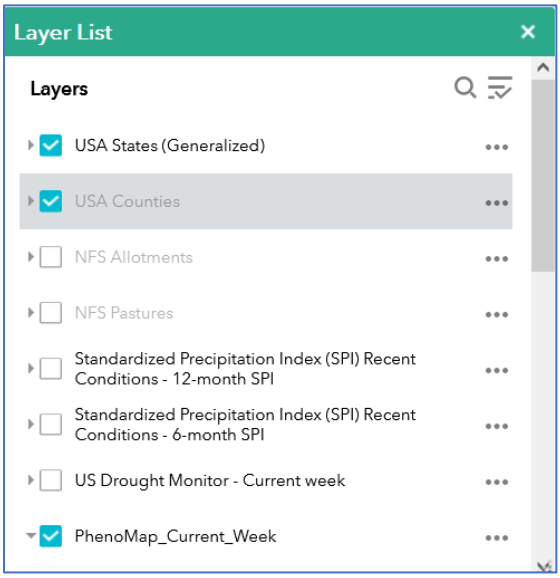


Figure 2. Layer list window.

Notice that some of the layers are greyed out. This means that these layers are not visible at the current extent. These layers only become visible if you zoom in.

Next to the checkboxes, you will see an arrow. . This arrow exposes the sub-layers contained in the layer. For example, clicking the arrow next to the 'PhenoMap_Current_Week' layer reveals the percentile and vegetation greenness sub-layers for the current week (Figure 3).

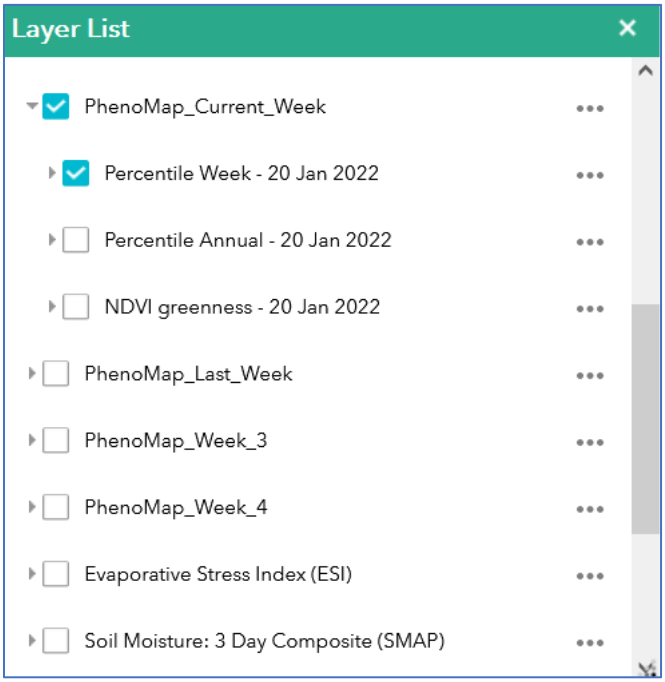


Figure 3. Percentile and NDVI *PhenoMap* sub-layers for the current week.

For the sub-layers to be visible, the parent layer checkbox must be checked as well as the sub-layer checkbox. If a layer contains no sub-layers the layer legend will become visible when the arrow is clicked.

Clicking on the three dots to the right of the layer activates a menu that allows you to move the layer up or down in the layer list (which changes the order of the layers in the display), adjust the transparency of the layer, display the layer table (vector layers only), zoom to the extent of the layer, and display web pages with more information about the layer (Figure 4).

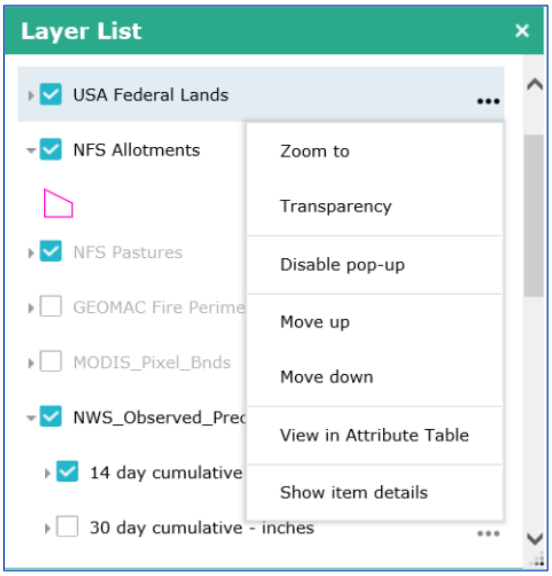


Figure 4. Additional layer controls menu

Attribute data for vector layers (Allotments, pastures) can be displayed in a pop-up by clicking a feature in the sub layer. In figure 5 a pop-up displays attributes for the Red Creek allotment on the San Juan National Forest.

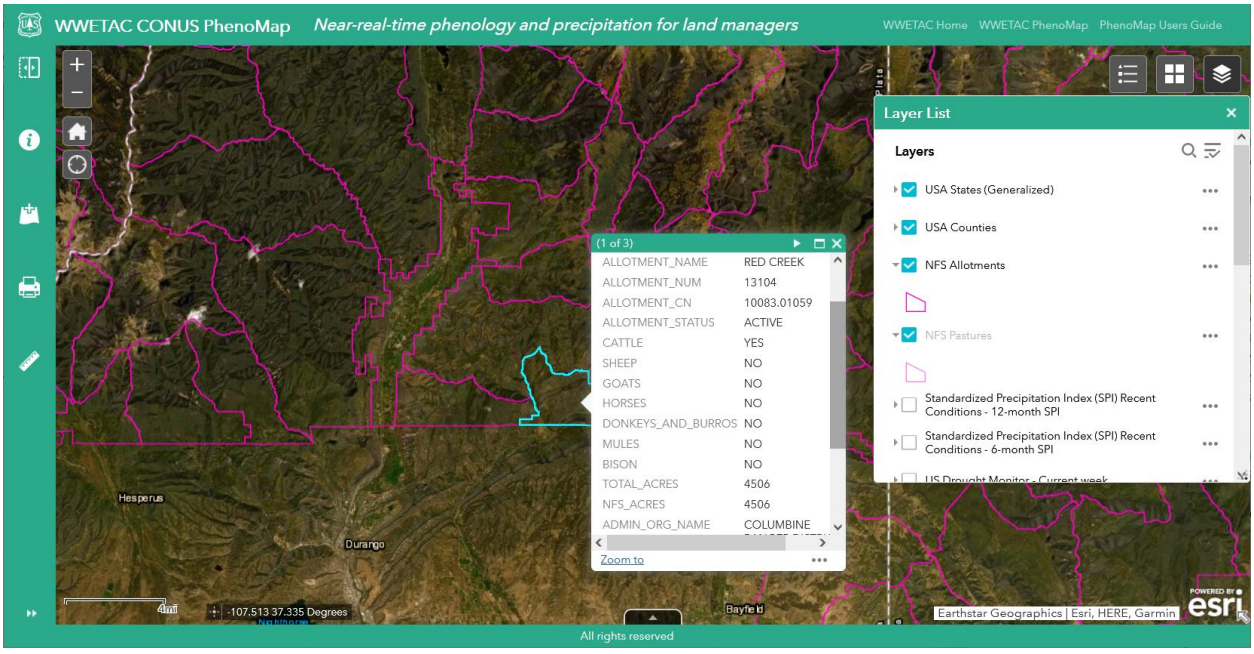


Figure 5. Clicking a vector feature displays a pop-up with attribute information.

The swipe widget is a good way to explore the differences in the phenology layers. The widget produces a slider bar vertically on the map with the swipe layer on the right. As the bar is moved to the right the swipe layer is replaced by the layer underneath:

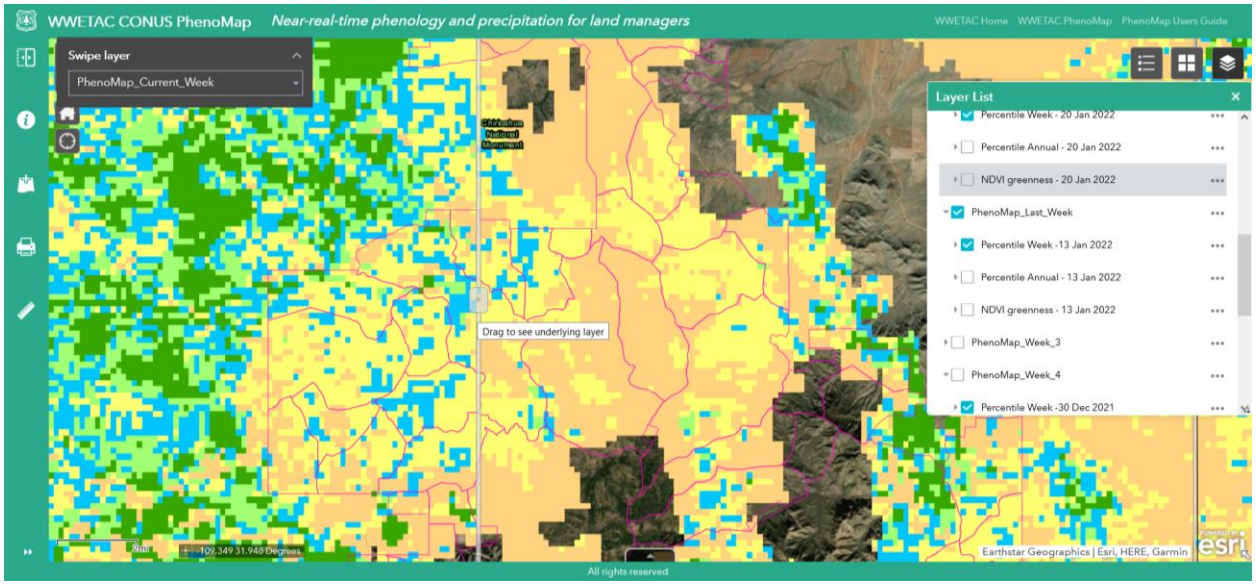


Figure 6. The swipe slider controls the visibility of the current week's greenness (left) and the greenness for the previous week (right).

2. **Layer Information**

The layers in *PhenoMap* may change based on user input (Let us know!) or if new layers become available. The following descriptions are for the layers in *PhenoMap* as of January 2022:

USA State Boundaries

Generalized state boundaries (2017) for all 50 states and the District of Columbia.

USA Counties

US Census 2020 county boundaries in the USA for all 50 states and the District of Columbia.

National Forest System Allotments and Pastures

Area boundaries of USDA Forest Service livestock grazing allotments along with attributes from the Rangeland Infra database that describes those features. At scale less than 250,000 the allotment features are turned off and the pastures

are turned on. Pastures are subsets of allotments. Data are from the USDA Forest Service Enterprise Data Warehouse (4/26/2017).

Standardized Precipitation Index (SPI)

SPI estimates the deviation of precipitation from the long-term probability function at different temporal periods (e.g., 1, 3, 6, 9, or 12 months). SPI only uses monthly precipitation as an input, which can be helpful for characterizing meteorological droughts. These data layers developed using the Climate Hazards Center InfraRed Precipitation with Station data (https://www.chc.ucsb.edu/data/chirps).

US Drought Monitor (USDM)

Weekly drought conditions assessment in the following categories: D0 (abnormally dry), D1 (moderate drought), D2 (severe drought), D3 (extreme drought), and D4 (exceptional drought). Produced by the National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA). http://droughtmonitor.unl.edu/CurrentMap.aspx

NDVI Greenness (NDVI)

The Normalized Differential Vegetation Index is a formula that leverages the red (R) and near-infrared (NIR) bands in remotely sensed to measure vegetation greenness:

$$NDVI = NIR+R/NIR-R$$

NDVI has been well-established as a measure of vegetation greenness. *PhenoMap* uses NDVI from the eMODIS program (https://lta.cr.usgs.gov/emodis). These data are downloaded and processed weekly to produce the greenness (NDVI) and the percentile layers (described below). The previous three weeks greenness layers are included so you can see the latest value if the current value is obscured by clouds.

Percentile – Annual

These layers are the current greenness expressed as a percentile of the baseline (2003-2019) median values for the whole year. In essence it is the level of current greenness relative to the annual range of greenness. For example, a pixel above the 90th percentile is higher than all but 10% of the historical pixel values for the year.

Percentile – Weekly

These layers are the current greenness expressed as a percentile of the baseline (2003-2009) values for that specific week. It is the current greenness relative to

the range of historic values for that week. For example, a pixel above the 90th percentile is higher than all but 10% of the historical values for that week

Evaporative Stress Index (ESI)

The ESI layer displays abnormally high or low rates of water using changes in land surface temperature as a proxy. ESI is useful for detecting early signs of 'flash drought' brought on by extended periods of hot, dry, and windy conditions resulting in rapid soil moisture depletion (https://www.drought.gov/data-maps-tools/evaporative-stress-index-esi)

Soil Moisture - Soil Moisture Active Passive instrument (SMAP)

The Soil Moisture Active Passive satellite radar instrument designed to measure soil moisture every 2-3 days. Surface vegetation is filtered out such that all ground that is not frozen or covered in water can be measured for soil moisture. The current soil moisture values are compared to long-term climatological averages to produce the anomalies layer, which is indicative of agricultural drought. Units are in mm. (https://smap.jpl.nasa.gov/mission/description/)

National Weather Service (NWS) Observed Precipitation

Advanced Hydrological Prediction Service (APHPS - https://water.weather.gov/precip) observed precipitation data are quality-controlled, multi-sensor (radar and rain gauge) precipitation estimates obtained from National Weather Service (NWS) River Forecast Centers (RFCs) and mosaicked by National Centers for Environmental Prediction (NCEP). The original data from NCEP is in GRIB (GRIdded Binary or General Regularly-distributed Information in Binary form) format (files pre-March 22nd, 2017 are in XMRG format) and projected in the Hydrologic Rainfall Analysis Project (HRAP) grid coordinate system, a polar stereographic projection true at 60°N / 105°W. Observed precipitation is a byproduct of National Weather Service (NWS) operations at the 12 CONUS River Forecast Centers (RFCs), and is displayed as a gridded field with a spatial resolution of roughly 4x4 km. Observed precipitation estimates are created in order to simulate streamflow across the CONUS United States. Units are inches.

National Phenology Network (USA NPN) Accumulated Growing Degree-Day

Heat accumulation in the spring is commonly used to predict the timing of phenological transitions in plants and animals. This accumulation is typically reported in Growing Degree Days. The National Phenology Network (USA-NPN https://www.usanpn.org/usa-national-phenology-network) is currently generating daily Accumulated Growing Degree Day (AGDD) maps using a January 1 start date and two base temperatures, 32°F and 50°F.

In many plants and animals, phenological transitions – especially those in spring - happen when enough warmth has accumulated. This warmth is often measured using growing degree days (GDDs). Growing degrees days are defined as the number of degrees the average daily temperature exceeds a base temperature, or the temperature below which the organism will remain in dormancy. Growing Degree Days are calculated as:

$$GDD = ((Tmax + Tmin)/2) – Tbase$$

where Tmax is the 24-hour temperature maximum, Tmin is the 24 hour temperature minimum, and tbase is the base temperature. The mean daily temperature (((Tmax + Tmin)/2)) must be above the base temperature to be recorded as a growing degree day.

3. **Mobile devices**:

Since it is a browser-based app, *PhenoMap* can be used in browser on your iOS/Android device (Figure 7) with no additional software installation.

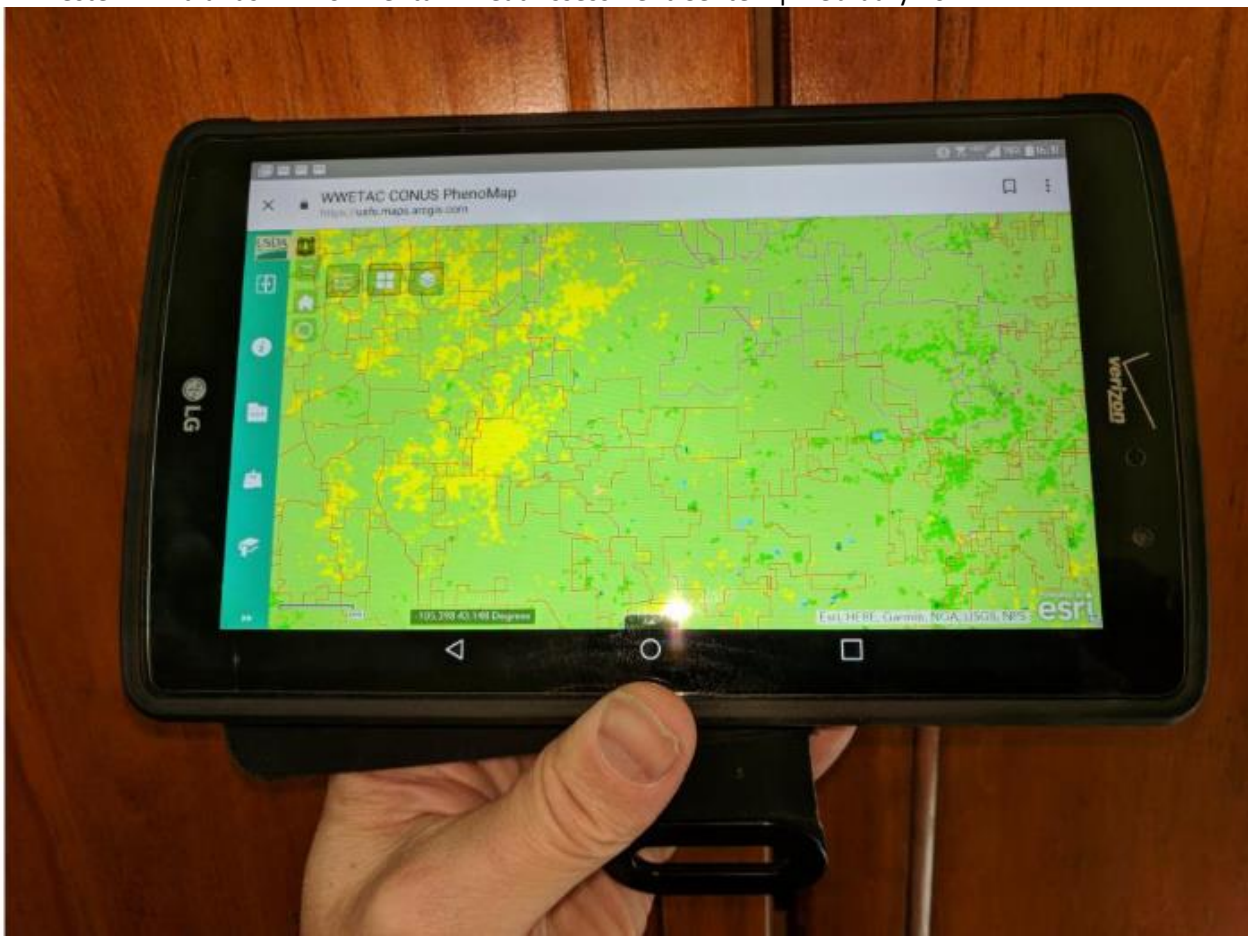


Figure 7. PhenoMap can be used on iOS and Android mobile devices.

However, this requires a data connection – either Wi-Fi or mobile data. Many field locations may be without mobile data service. ESRI ArcGIS Collector and Field Maps applications are options that allow downloading of map data for use off-line. For more info on deploying these ESRI solutions contact Charlie Schrader-Patton (charlie.schrader-patton@usda.gov).

PhenoMap will connect to the GPS in your mobile device and zoom to the location provided (Figure 8).

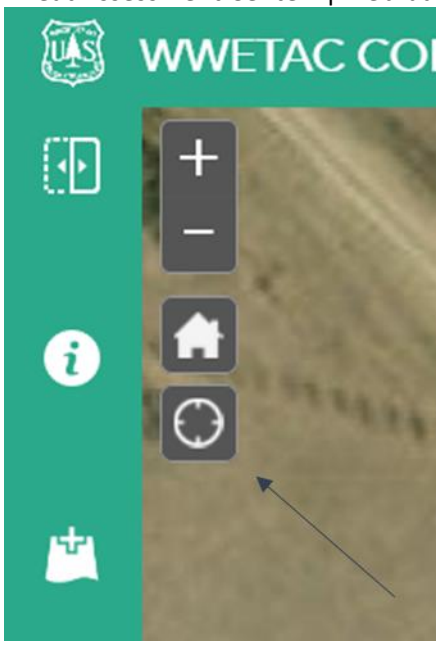


Figure 8. The 'My Location' will connect to the GPS or other location utility (e.g., IP address) on your device and zoom this location.

Thanks for your interest in PhenoMap. If you have suggestions or ideas on how we can modify PhenoMap to meet your needs, please don't hesitate to contact me.

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