95 DROUGHT SEVERITY INDEX

USACE CLIMATE PREPAREDNESS AND RESILIENCE

Background

- Drought severity is estimated using the Thornthwaite (1948) method,[1] which takes into account the moisture content of the soil and climate in a region and is calculated using precipitation, evapotranspiration, soil moisture deficit, and runoff data.
- Both this indicator and the Palmer drought severity index build on Thornwaite's efforts, though the Palmer index is a meteorological descriptor of drought conditions.
- Higher values suggest higher vulnerability relative to other watersheds.

THIS INDICATOR MEASURES THE GREATEST PRECIPITATION DEFICIT, I.E., THE MOST NEGATIVE VALUE CALCULATED BY SUBTRACTING POTENTIAL EVAPOTRANSPIRATION FROM PRECIPITATION OVER ANY 1-, 3-, 6-, OR 12-MONTH PERIOD.

Data Sources

Data Source	Description	Spatial Resolution	Temporal Resolution
Coupled Model Intercomparison Project (CMIP-5) output[2]	Temperature and precipitation within 4-digit hydrologic code (HUC-4) watersheds	HUC-4 watersheds	2035-2064 and 2070-2099

This Indicator Was Used to Assess the Vulnerability of Five of USACE's Eight Business Lines

Business Line	Importance Weight (Varies from 1 to 2 for USACE)
Navigation	2
Hydropower	2
Recreation	2
Water Supply	2
Emergency Managment	1

Calculation

- Use temperature and precipitation values from 47 CMIP-5 climate model traces specific to each future scenario.[3]
- Calculate the potential evapotranspiration (PET) for each month using Thornthwaite's equation.[1] This equation calculates PET as a function of temperature, the average day length in a month, and the number of days in a month.
- Calculate the monthly precipitation deficit as precipitation minus PET.
- Find each model trace's drought severity index, which is the smallest precipitation deficit over a 1-, 3-, 6-, or 12-month period. The drought severity index may be negative.
- Rank climate model traces' drought severity indexes from low to high, and select the 6th value. This value is the drought severity for a specific future scenario.
- Calculate the rate of change in drought severity from the base period to the specific future scenario to determine the indicator value.

[1] Thornthwaite, C. W. 1948. An Approach toward a Rational Classification of Climate. Geographical Review. 38(1): 55-94.
[2] CMIP-5 output is available for download online at: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
[3] Indicator values were calculated for two scenarios (a wet and a dry future) and two time periods (2035-2064 and 2070-2099).

Flathead National Forest, MT - Courtesy of USFS

LOW INDICATOR VALUE
Montana forests receive sufficient rainfall to offset potential evapotranspiration.

HIGH INDICATOR VALUE
California watersheds experience drought due to high temperatures and low precipitation.

California - Courtesy of NOAA