

NASA Western Water Applications Office

Smarter Drought Management

Drought Severity Evaluation Tool

WWAO's Drought Severity Evaluation Tool (DSET) is helping the Navajo Nation monitor and respond to drought. DSET, which will be deployed in 2020, is a web application that pulls in Earth observations and in-situ data to produce drought maps for the Navajo Nation Department of Water Resources (NNDWR). This information can help Navajo decision makers improve the way they handle drought emergencies.

The tool is hosted in partnership with the Desert Research Institute (DRI) as a spin-off of the popular Climate Engine platform. It integrates precipitation data from various remote-sensing and in-situ sources. Drought indices, maps and trend analyses of drought indicators are generated for different parts of the Nation. The NNDWR plans to share these outputs with the Navajo Nation's Commission on Emergency Management and resource managers, to help them decide when to declare a drought emergency and disseminate drought-relief funds. They might also help the Navajo manage streamflow, watershed restoration and agricultural activities.



Photo taken from the Navajo Nation. Credit: Erica Gies.

The Bigger Picture

The Navajo Nation is an arid, vast region in the southwest U.S. Managing its water is difficult. With over 200,000 people, it is the largest federally-recognized sovereign U.S. tribe by land area. The Navajo experiences frequent, pervasive droughts, with widely varying precipitation and rising temperatures. Drought emergencies are common. In 2018, millions of drought-relief dollars were needed.

Currently, when a drought emergency is declared, relief funds are divided evenly among the Nation's 110 chapters (akin to U.S. counties). But some chapters, especially in the west, have less water than others and require more help. The community wants to deliver a smart response, and NASA Earth observations can provide detailed measures of drought severity in different locations.

At a Glance

DSET output products

- Maps of drought severity
- Maps, tables of monthly precipitation for administrative and ecological areas
- Precipitation trends (time series)
- Data downloads of precipitation and drought indices

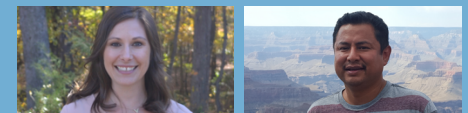
Technical requirements

- Spatial resolution: Approx. 4.25 km
- Latency: 1 month
- Temporal repeat: Monthly (daily also available)

Geographical coverage

- Navajo Nation (Utah, Arizona and New Mexico)

Meet the Team



Project lead: Dr. Amber McCullum (NASA Ames Research Center), Project partners: Carlee McClellan (NNDWR, pictured); Dr. Justin Huntington & Britta Daudert (DRI).

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Project Partners



Navajo Nation Department
of Water Resources



Climate Engine



Desert Research Institute



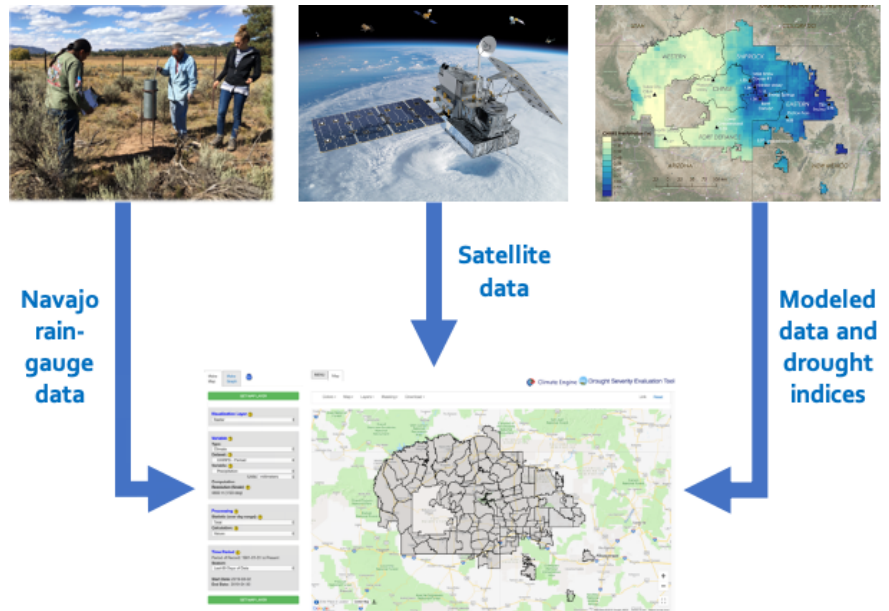
How it Works

Until now, the NNDWR has relied on 85 rain gauges unevenly distributed across the Nation and just three satellite-based calculations from NOAA's Western Regional Climate Center. Rain-gauge monitoring is resource- and time-intensive. The limited data make it hard to monitor precipitation across the Navajo Nation's diverse geography, which ranges from low-lying desert to rain- and snow-prone forests.

By comparing the rain-gauge measurements to remotely-sensed Earth observations such as those made by NASA, we can improve measures of precipitation. The DSET ingests satellite data from the Global Precipitation Measurement (GPM) mission and the Tropical Rainfall Measuring Mission (TRMM). It also takes in modeled data such as the Climate Hazards group InfraRed Precipitation with Stations data (CHIRPS) and gridMET data (a surface meteorological dataset covering the contiguous U.S. from 1979 to yesterday).

DSET generates drought indicators like the Standardized Precipitation Index (SPI) and maps and trends in near-real-time. Water managers can quickly see precipitation over virtually any area of the Navajo Nation (chapters, agencies, grazing districts, watersheds, ecoregions), for any timespan in recent decades.

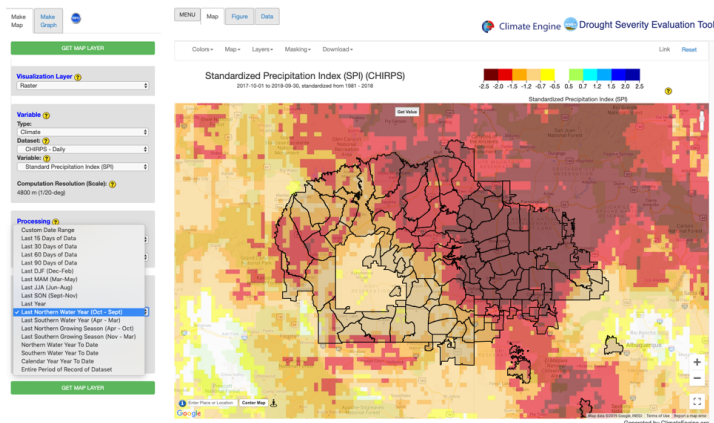
DROUGHT SEVERITY EVALUATION TOOL



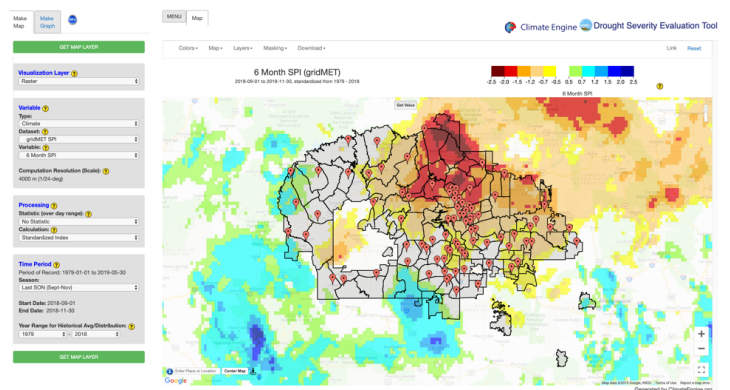
Sample Products

First, the rain gauge and remotely-sensed precipitation data are fed into the tool. Rain gauges with long and consistent records are used. These data are compared to generate monthly maps, data tables and precipitation correlations. Second, monthly maps and time series of the CHIRPS-generated SPI values are produced. Drought reports are created from these maps and trends.

If the SPI value (averaged over 6 months) in a particular area falls below -1.5, a drought emergency is declared and relief funds are distributed by emergency managers. These funds are used for mitigation efforts such as boosting water hauling and hay and water deliveries to farmers and ranchers. DSET can help determine which regions meet the emergency threshold and are most in need of help.



DSET drought map for the last Navajo Northern Water Year (Oct. 2017 to Sept. 2018), which was in extreme drought. Navajo Nation chapter boundaries are overlaid. *Credit: DSET.*



DSET map showing 6-month SPI. We see drought in the north and above-average precipitation in the south, underscoring the variability in precipitation across the Nation, particularly during monsoon season. *Credit: DSET.*

