Introduction: The Navajo Nation

- Largest federally-recognized tribe in the United States in land area: over 70,000 km$^2$
- Population of over 200,000
- 5 Agencies and 110 Chapters
Introduction: Drought

The Navajo Nation: Prone to frequent and pervasive droughts

Drought Impact Types:
- D = Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g., agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g., hydrology, ecology)

Intensity:
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://droughtmonitor.unl.edu/
Introduction: Drought Reporting

- Navajo Nation Department of Water Resources (NNDWR) conducts monthly and annual drought assessments
  - Limited in-situ data
  - Coarse spatial resolution of regional drought indicators

- Reports to the Navajo Nation Commission on Emergency Management (NN CEM)
  - Drought Contingency Plan
    - Declare drought designation
    - Mitigation and action plans to reduce risk in advance of drought
## Introduction: Task Overview

<table>
<thead>
<tr>
<th>Vision</th>
<th>Improve NNDWR drought reporting through Earth Observations and <em>in-situ</em> data within a user-friendly web application</th>
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</table>
| Objectives | • Compare NNDWR in-situ data with remotely sensed and modeled data  
• Create the Drought Severity Evaluation Tool (DSET) as a web-application for the Nation that integrates:  
  (1) integrates precipitation data from multiple sources, (2) generates drought indices, (3) produces maps and time series analyses of drought indicators for administrative boundaries on the Nation |
| Geographic Domain | The Navajo Nation: In the states of Utah, Arizona, and New Mexico |
| Project Partner | The Navajo Nation Department of Water Resources (NNDWR) |
| Decision-Maker(s) | Navajo Nation Commission on Emergency Management (NN CEM), the Navajo Nation Division of Natural Resources (NN DNR), and the Navajo Nation Tribal Council |
| Decision(s) Targeted | Drought emergency declarations and the dissemination of drought relief funding |
Navajo Nation (NN) Drought Report

Navajo Nation Department of Water Resources (NNDWR)

NNDWR presents Drought Reports to the Navajo Nation’s Commission on Emergency Management (NN CEM), the Department of Natural Resources (NN DNR), and the Tribal Council

Drought Emergency Declared if SPI < -1.5

NN CEM, the NN DNR, and Navajo Nation Tribal Council disseminate drought emergency funds evenly to each Agency

Funds distributed to water haulers, farmers, ranchers, the Navajo Nation Departments of Fish and Wildlife, Parks and Recreation, and Forestry for mitigation activities

Provide more detailed Drought Reports that support distribution of funds to regions that are more severely affected by drought

Goal

Data Production, Dissemination, Feedback,

Partner Engagement & Feedback

Decision-making
Introduction: Product Generation

Decision Making
- Drought Report Presented to Emergency Managers

Final Product
- Navajo Nation Drought Report

Product Details
- NN Rain Gauge and Remote Sensing Precipitation Comparisons
- CHIRPS SPI for Entire Nation and Agencies

Data Products
- Map: Monthly Total Precipitation (Rain Gauges)
- Maps: Monthly Total Precipitation (Remotely Sensed)
- Table: Summary Statistics
- Figure: Precipitation Correlations
- Map: 6-Month CHIRPS SPI for NN
- Maps: 6-month CHIRPS SPI for each Agency
- Figures: Long-term SPI time series for each Agency

Data Sources
- NN rain gauges
- Multi-Satellite Precipitation Product: TRMM and GPM
- IMERG Precipitation Product: TRMM and GPM
- CHIRPS: Modeled TRMM and in-situ product

Figures
- TRMM
- GPM
• 11 NNDWR rain gauges
  • Down-selected based on record length, consistency, and location
  • Date Range: January 2011-December 2017

• Monthly total precipitation comparisons:
  • NNDWR rain gauges vs. CHIRPS (pixel location)
  • Agencies vs. CHIRPS (average totals for region)
  • Chapters vs. CHIRPS (average totals for region)
Key Accomplishment Highlight - Technical

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```javascript
// Example code snippet
var clippedIP = interpolatedPrecip.clip(NH);
```

**Map:**
- Visualization of interpolated precipitation
- Marked areas for specific regions
- Color-coded for different levels of precipitation

**Inspector Console Tasks:**
- Point (-109.193, 36.624) at 1Km/px
- Pixels
  - Interpolated Precipitation: Image (1 band)
  - Navajo Nation: Image (1 band)
- Objects
  - Interpolated Precipitation: Image (1 band)
  - Navajo Nation: Image (1 band)
```
Key Accomplishment Highlight - Stakeholder

- 2 visits with NNDWR
  - Examined rain gauge data collection
  - Obtained rain gauge data for comparison with remote sensing sources
    - Discussed current techniques for comparisons and future ideas
  - Created mock outputs and desired features list for DSET
  - Presented at the New Mexico Geographic Information Council Annual meeting in Albuquerque
Key Accomplishment Highlight - Transition

• Currently formalizing partnership with the Desert Research Institute (DRI) to create a spin-off page of the Climate Engine Web Application for DSET
Next Steps and Anticipated Outcomes

• Continue to work with DRI and NNDWR partners
• Continue comparisons of NNDWR rain gauge and remotely-sensed and modeled data
• Integrate NN administrative boundaries and NNDWR rain gauge data into DSET
• Generate 6-month SPI values for NN administrative boundaries using CHIRPS in DSET
• Generate time series of data for drought reporting in DSET
• Beta DSET tool testing and revisions based on partner requests
Thank You

Questions?

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