# A Comparison of the National Drought Monitoring Index with New Drought Indices Based on Remotely Sensed SMAP Data and In Situ COSMOS Observations

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## Motivation

- Timely **monitoring of** hydrological **drought** is **critical** for agriculture, insurance, and government applications
- National Drought Mitigation Center publishes **weekly drought monitor reports authored by experts** who integrate data and observations from multiple sources
- **More frequent data at higher spatial resolution** could further help mitigate socio-economic effects of drought
- NASA's **SMAP** (Soil Moisture Active Passive) satellite delivers **9km x 9km global soil moisture every ~3 days**
- **COSMOS sensors** use cosmogenic neutrons to estimate **meso-scale** (600m diameter) area-averaged **soil moisture** and can be used to cross-validate remotely sensed data

## Approach

- Develop new drought index using SMAP and cross-validate using COSMOS sensors
- Compute drought category percentiles as follows:
  - For each date, select all available SMAP data (since 2015-04-13) within a 45-day window
  - Divide by porosity to get a value in [0, 1]
  - Fit beta distribution using maximum likelihood estimation
  - Assign D0 to D4 categories percentiles, converting to volumetric soil moisture by multiplying by porosity
- Convert SMAP volumetric soil moisture to drought categories by thresholding using the D0-D4 values
- Perform cloud-based data ingestion, harmonization, analysis, and web-based dissemination using open-source PODPAC library and its serverless cloud architecture:
  - http://creare-com.github.io/podpac-drought-monitor/

## Open Source Development

- The Drought Monitor is built using PODPAC, which is open-source software available at https://podpac.org
- SMAP vs. COSMOS compared via open-source SoilMAP software

## Acknowledgments

- US Army support: SBIR Phase II Contract W9132V19C0002
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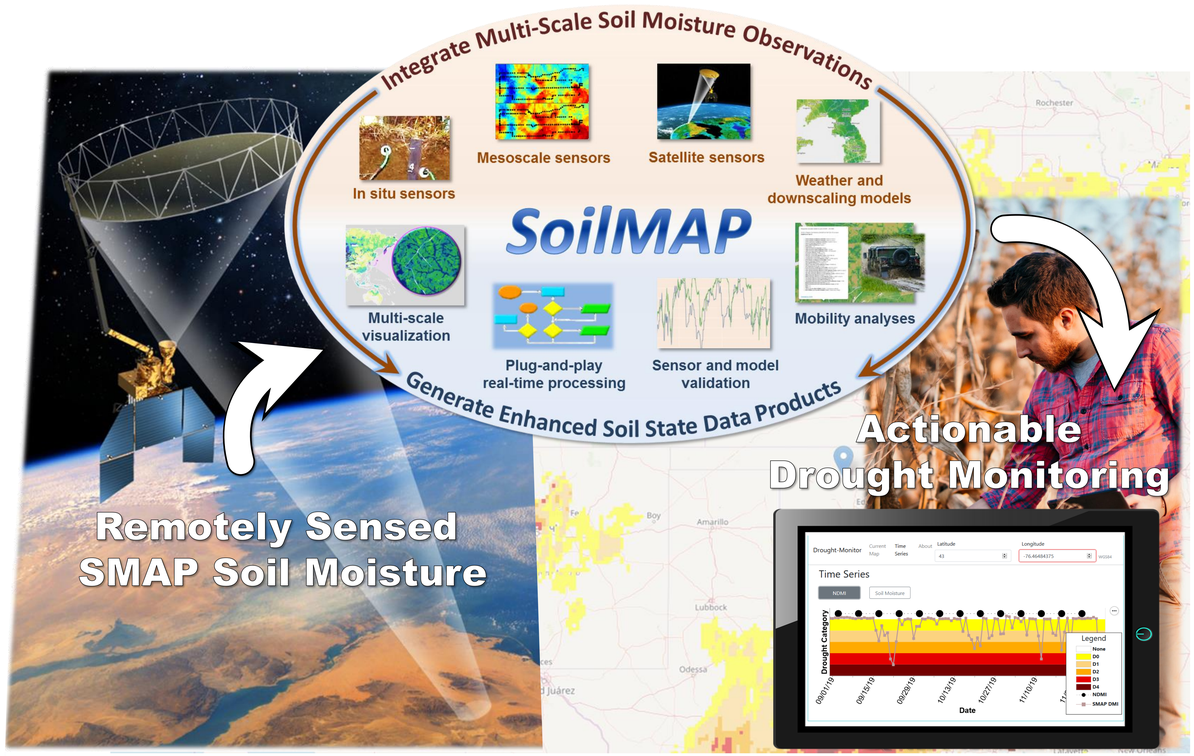
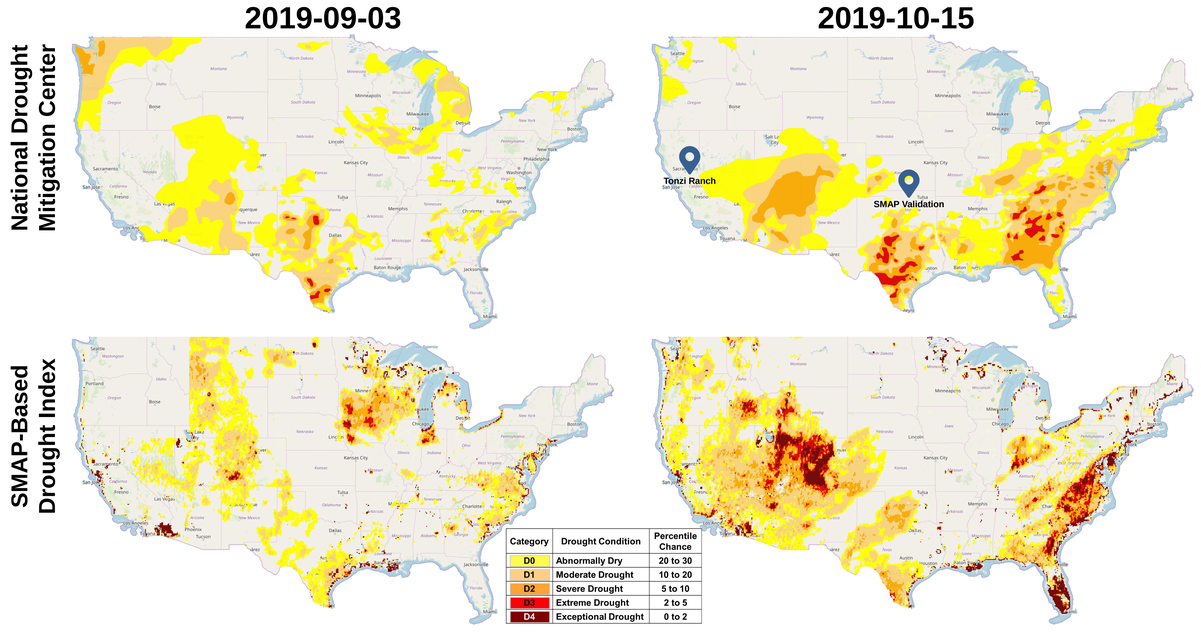
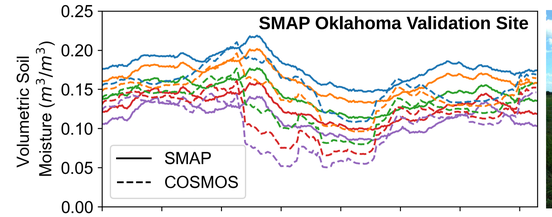


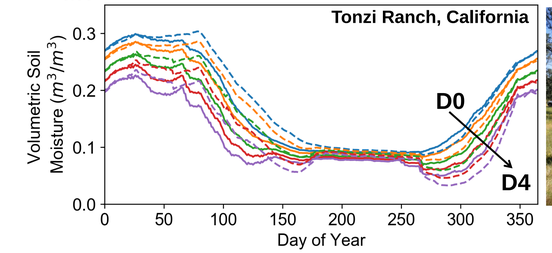

## Drought Index Comparison




| Category | Drought Condition | Percentile Chance |
|---|---|---|
| D0 | Abnormally Dry | 20 to 30 |
| D1 | Moderate Drought | 10 to 20 |
| D2 | Severe Drought | 5 to 10 |
| D3 | Extreme Drought | 2 to 5 |
| D4 | Exceptional Drought | 0 to 2 |

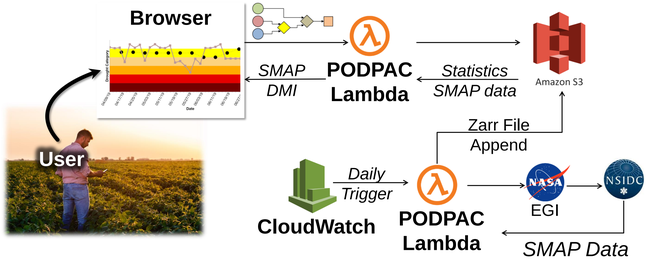
## Comparison of Drought Category Computed from SMAP vs. COSMOS




## Cloud Computing Infrastructure

- **On-demand processing of raw data**
  - No pre-processing reduces overall storage (and cost…)
  - Rapid subsetting in space/time with cloud-optimized storage
- **Inexpensive to host and maintain**
  - Uses serverless cloud technology (AWS Lambda)
- **Easy to setup**
  - Uses PODPAC's cloud-ready workflow




***Scientific data from satellite measurements (SMAP) can be made accessible and available to the public and decision makers with low effort and cost***