NS21B-0814

AGU100 ADVANCING EARTH AND SPACE SCIENCE

SoilMAP: An Open Source Python Library for Developing Algorithms and Specialized User Interfaces to Streamline Analysis and Remote Monitoring of Experiments

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Motivation

- **COSMOS sensors** use cosmogenic neutrons to estimate **meso-scale** area-averaged **soil moisture**
- **Roving COSMOS sensors** can cover large areas, and present a unique opportunity for **validating** remotely-sensed soil moisture data from satellites platforms such as **SMAP**
- **COSMOS** sensors **require site-specific calibrations**
- When **collecting soil state data** using roving COSMOS sensors, it can take **hours to days** before the data can be:
  - **Visualized**
  - **Compared** to other data sources
  - **Integrated** into an analysis or derived product
- **Automated harmonization** of varying observational input datasets is needed to rapidly **integrate and validate** new sensor data
- **Near-real-time analysis** of field data is needed to **monitor** and **improve data quality**
- **Customized user interfaces (UIs)** are needed for **rapid analysis** while operating **in the field**

Project Objectives

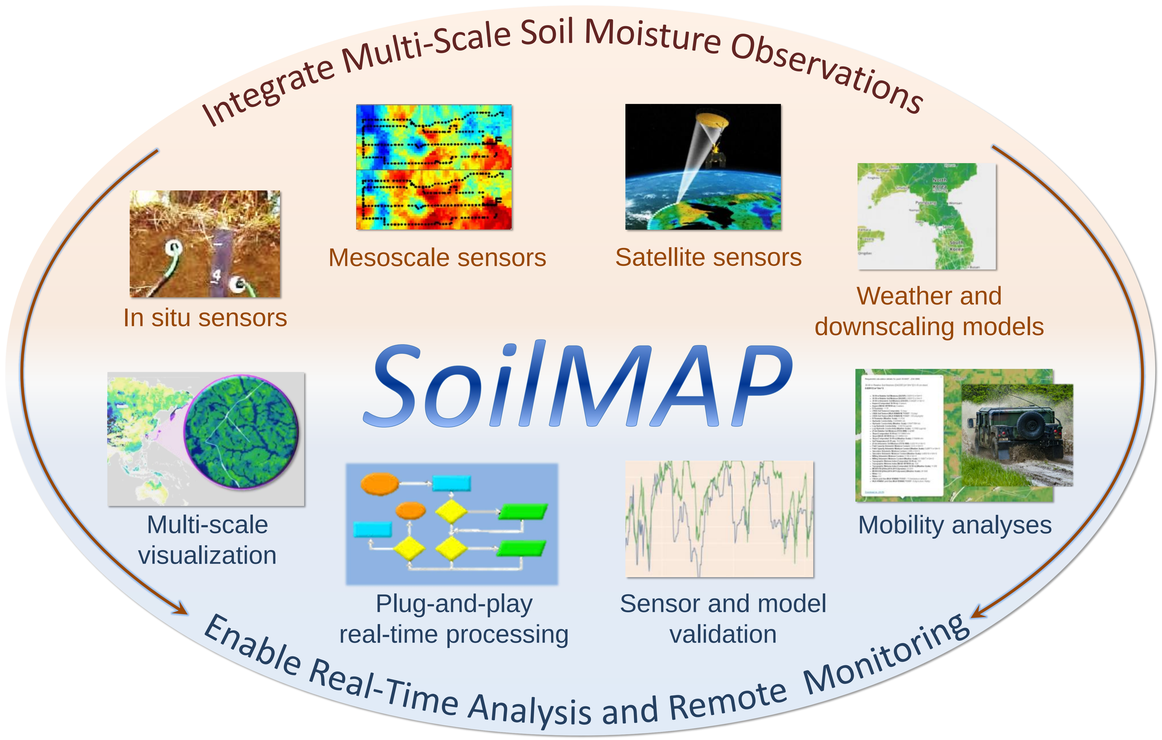
- Develop SoilMAP software with specialized analysis application for COSMOS and SMAP soil moisture data
- Create customizable UI for rapid, near-real-time visualization and analysis for COSMOS and SMAP data
- Develop unified data access and automated data harmonization to facilitate comparison of roving COSMOS measurements and SMAP L3 data
- Create streamlined UI for developing customized COSMOS sensor calibrations with uncertainty estimates
- Generalize UI development framework allowing users to customize and build UIs using high-level schemas

Open Source Development

- SoilMAP is built using PODPAC, which is open-source software available at https://podpac.org

Acknowledgment

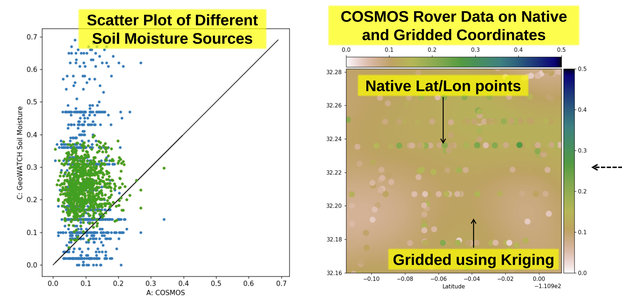
- This research is supported by the US Army ERDC under SBIR Phase II Contract No. W9132V19C0002



Technology

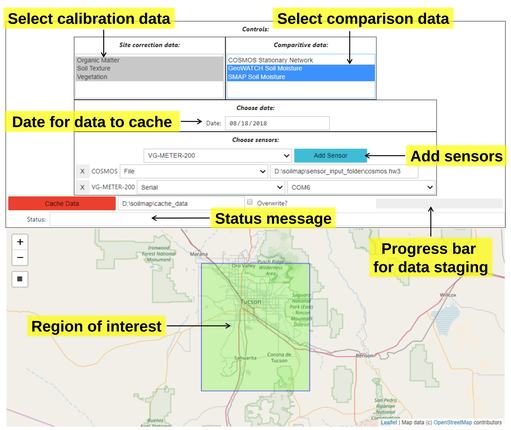
- Leverages Jupyterlab framework to build interactive, customizable UIs
- Uses open source scientific Python stack

ipyleaflet
Traitlets
Rasterio
PODPAC
[ipy]widgets
PROJ
xarray
Leaflet
jupyterlab
SciPy
matplotlib
NumPy



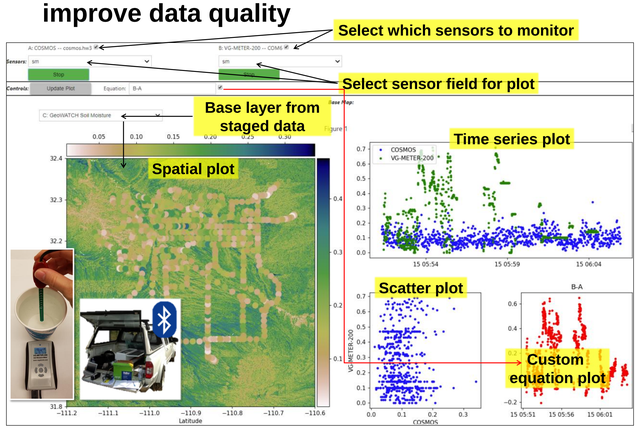
COSMOS Use Case Application

1. **Field Data Collection. Experimentalist wants to store data for offline access in the field**



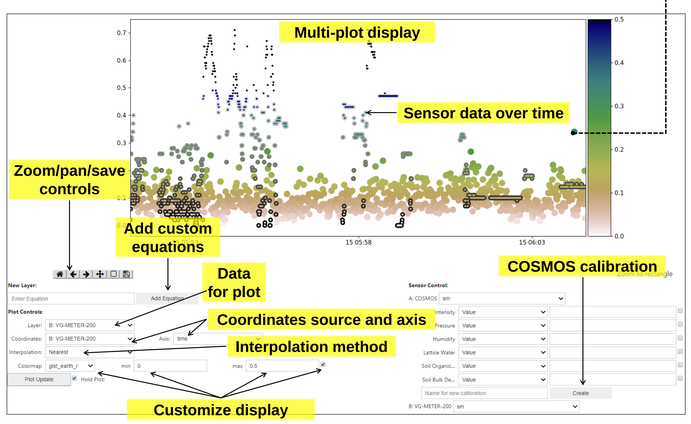
SoilMAP UI stages data

2. **Remote Monitoring. PI wants to monitor experiment to direct resources and improve data quality**



SoilMAP ingests sensor data and plots in near-real-time

3. **Post Analysis. Researcher wants to analyze experimental results to improve COSMOS calibration**



SoilMAP allows rapid plotting, data harmonization, and creation of custom COSMOS calibrations