Accessing SMAP Data

Objectives

By the end of this exercise, you will be able to:

- Access SMAP data
- Visualize and analyze SMAP data

Outline

1. SMAP Data Background Information
    a. SMAP Data Products
    b. SMAP Data Product Summary
    c. Product Configuration
    d. Sites to Discover, Download, and Visualize SMAP Data
2. Downloading the Data for this Exercise
3. Analyzing the Data
    a. Opening a SMAP File in Panoply
    b. Extracting SMAP Soil Moisture Values

4. Part 1: SMAP Data Background Information

Part 1A: SMAP Data Products

Data Product Short Name	Description	Grid Resolution	Granule Extent
L1A_Radar*	Parsed Radar Instrument Telemetry		Half Orbit
L1A_Radiometer	Parsed Radiometer Instrument Telemetry		Half Orbit
L1B_S0_LoRes*	Low Resolution Radar σ_o in Time Order	5x30 km (10 slices)	Half Orbit
L1C_S0_HiRes*	High Resolution Radar σ_o on Swath Grid	1 km	Half Orbit
L1B_TB	Radiometer T_B in Time Order	39x47 km	Half Orbit
L1C_TB	Radiometer T_B	36 km	Half Orbit
L2_SM_A*	Radar Soil Moisture (includes Freeze-Thaw)	3 km	Half Orbit
L2_SM_P	Radiometer Soil Moisture	36 km	Half Orbit
L2_SM_AP*	Active-Passive Soil Moisture	9 km	Half Orbit
L3_FT_A*	Daily Global Composite Freeze/Thaw State	3 km	North of 45° N
L3_SM_A*	Daily Global Composite Radar Soil Moisture	3 km	Global
L3_SM_P	Daily Global Composite Radiometer Soil Moisture	36 km	Global
L3_SM_AP*	Daily Global Composite Active-Passive Soil Moisture	9 km	Global
L4_SM	Surface & Root Zone Soil Moisture	9 km	Global
L4_C	Carbon Net Ecosystem Exchange	9 km	North of 45° N

*Only available during the 2.5 months of radar operation (mid-April – July 7, 2015)

Part 1B: SMAP Data Product Summary

Data Product	Description	Grid Resolution	Algorithm Source
L1A_Radiometer	Radiometer Data in Time-Order	-	Mission DA
L1B_TB	Radiometer T_B in Time Order	39x47 km	Mission DA
L1C_TB	Radiometer T_B in Half-Orbits	36 km	Mission DA
L1C_TB_E	Radiometer T_B in Half-Orbits, Enhanced	9 km	Mission DA
L2_SM_P	Soil Moisture (Radiometer)	36 km	Mission DA
L2_SM_P_E	Soil Moisture (Radiometer)	9 km	Mission DA
L2_SM_SP	Soil Moisture (Sentinel Radar + Radiometer)	3 km	Mission DA
L3_FT_P	Soil Moisture (Radiometer)	36 km	Mission DA
L3_SM_P_E	Soil Moisture (Radiometer, Enhanced)	3 km	Mission DA
L3_SM_P	Soil Moisture (Radiometer)	36 km	Mission DA
L3_SM_P_E	Soil Moisture (Radiometer, Enhanced)	9 km	Mission DA
L4_SM	Soil Moisture (Surface and Root Zone)	9 km	Mission DA
L4_C	Carbon Net Ecosystem Exchange (NEE)	9 km	Mission DA

Part 1C: Product Configuration

- All products are in HDF5 format
  - Each SMAP HDF5 file contains the primary data parameters (e.g. soil moisture, freeze/thaw, sensor data) and all data used in the production of those primary parameters. These files also include metadata, geolocation information, quality flags, etc.
- Projection: EASE-Grid 2.0
  - Equal-area projection
  - Level 2, 3, 4, and radiometer L1C are in this projection
- Values
  - Radiometer data (brightness temperature) is in Kelvin
  - Radar data is in sigma naught (σ_o)
  - Soil moisture is a volumetric measurement expressed as cm^3/cm^3
  - Freeze/thaw is a binary measurement, either frozen or thawed
  - Net ecosystem exchange is in grams of carbon/square meter per day

Part 1D: Sites to Discover, Download, and Visualize SMAP Data

National Snow and Ice Data Center (NSIDC): http://nsidc.org/data/smap

- Provides access to L1 radiometer data and all L2, L3, and L4 radiometer products
- Provides data access, dataset user guide documents, tools, news, published research, quality information, FAQs, and many other resources
- Direct access to SMAP data (with logins) through:
  - HTTPS: https://n5eil01u.ecs.nsidc.org/SMAP/
- Subscribe here: http://nsidc.org/daac/subscriptions.html for an automatic delivery of data as it becomes available

Alaska Satellite Facility (ASF): http://www.asf.alaska.edu/smap/

- Only provides L1 radar data
- Provides data access, data set user guide documents, tools, news, published research, quality information, FAQs, and many other resources

Earthdata Search: http://search.earthdata.nasa.gov

- Allows you to search, order, and visualize all SMAP data
- You can perform a keyword, spatial, or temporal search
- Reformats, reprojects, and subsets services for most products

The HDF5 Group Support: http://support.hdfgroup.org/products/hdf5_tools/index.html

Allows you to access and visualize SMAP HDF5 data using Python, NCL, MATLAB®, and IDL®.

- Access HDF5 tools: http://support.hdfgroup.org/products/hdf5_tools/index.html
- Download code in Python, NCL, MATLAB®, and IDL®: http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP

Part 2: Download Data for This Exercise

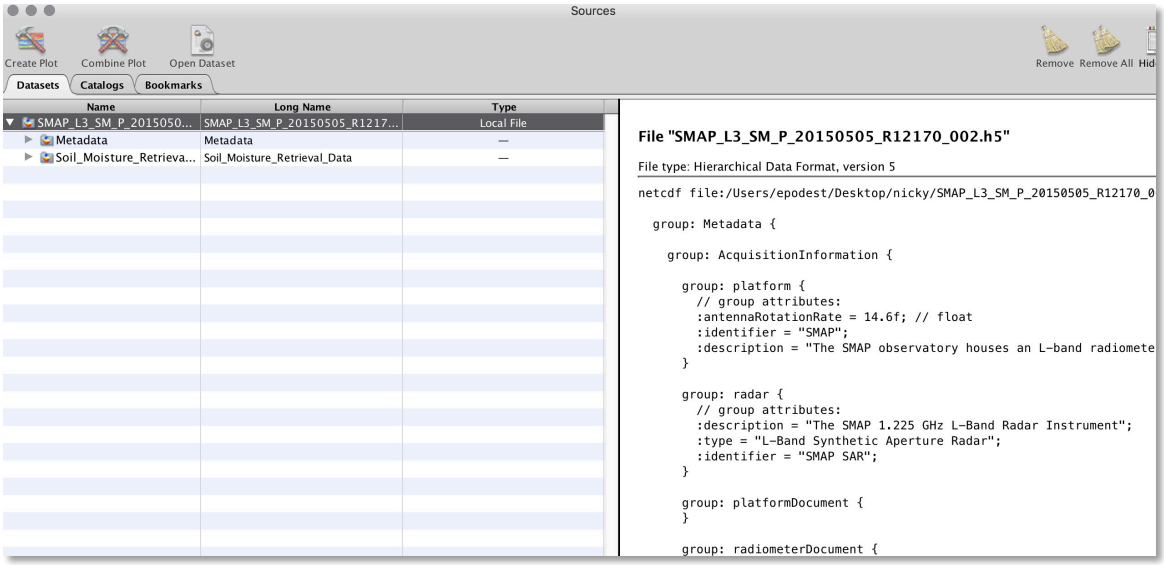
- Go to http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP
- Click on **SMAP_L3_SM_P_20150505_R12170_002.h5** next to Grid

SMAP	Swath	SMAP_L1A_RADIOMETER_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L1B_TB_01367_A_20150505T001706_R11850_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L1C_TB_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
		SMAP_L2_SM_P_03721_D_20151013T000528_R11920_001.h5	Python	NCL	MATLAB	IDL
	Grid	SMAP_L3_SM_P_20151012_R11920_001.h5	Python	NCL	MATLAB	IDL

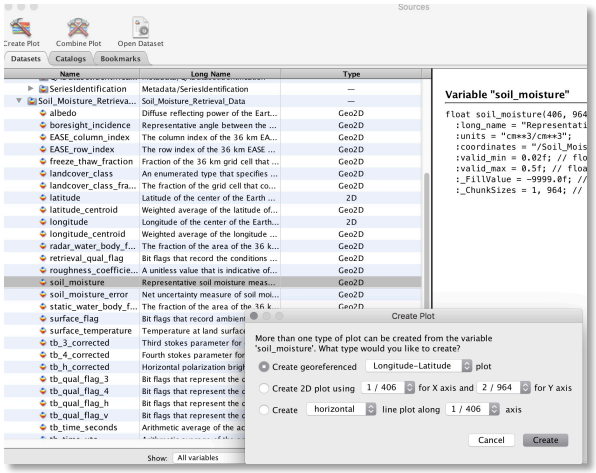
Part 3: Analyzing the Data

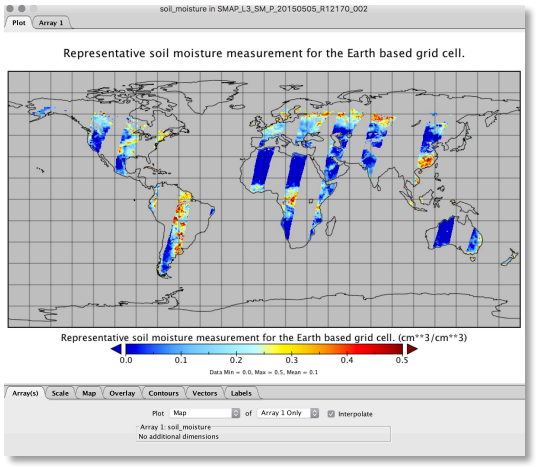
Part 3A: Opening a SMAP File in Panoply

- Open Panoply
- Go to File > Open and open **SMAP_L3_SM_P_20150505_R12170_002.h5**
- The left window shows the archive structure, which has two folders: Metadata and Soil Moisture
- Double click on an archive to see the files within it

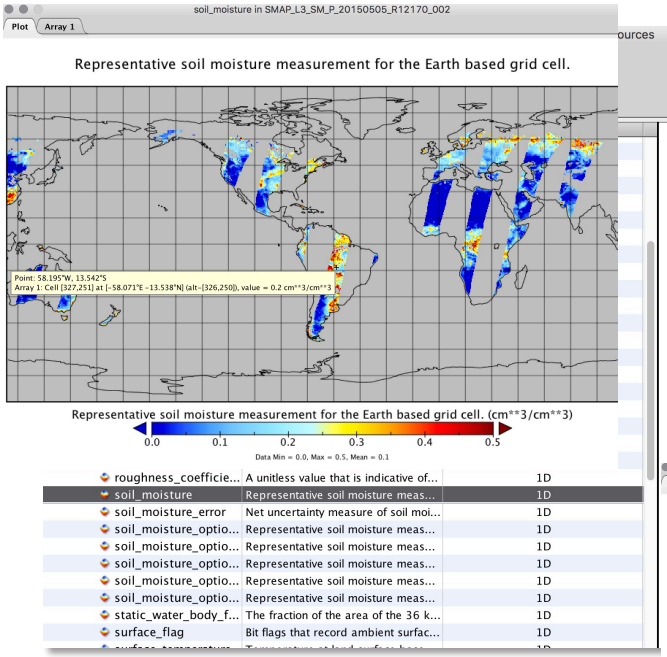


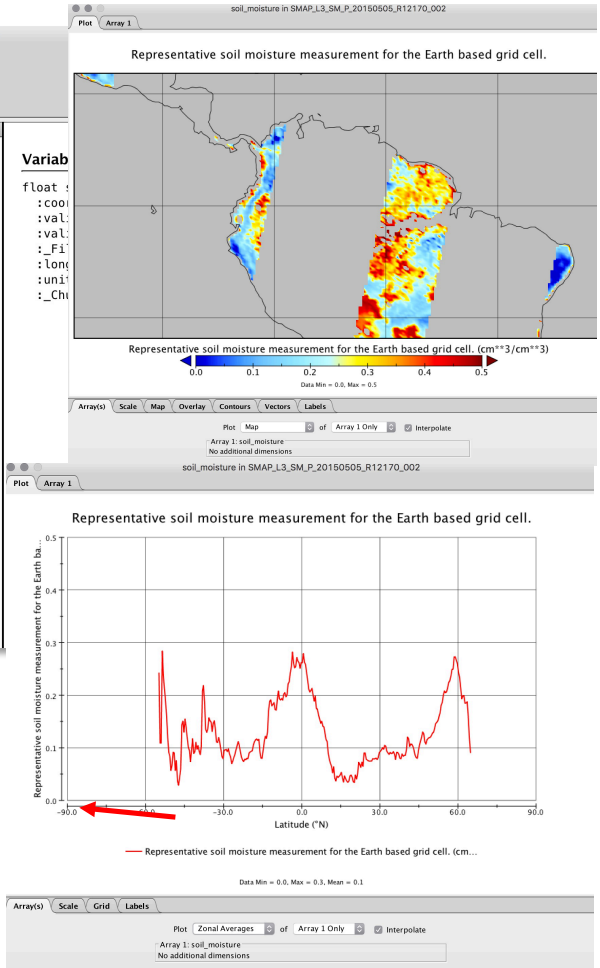
- Click on **soil moisture** to see the characteristics or metadata of the file in the right-hand window
- Open the file as a map by double-clicking on the soil moisture file





- To see the pixel value, place the curser over the point of interest and click **Alt**



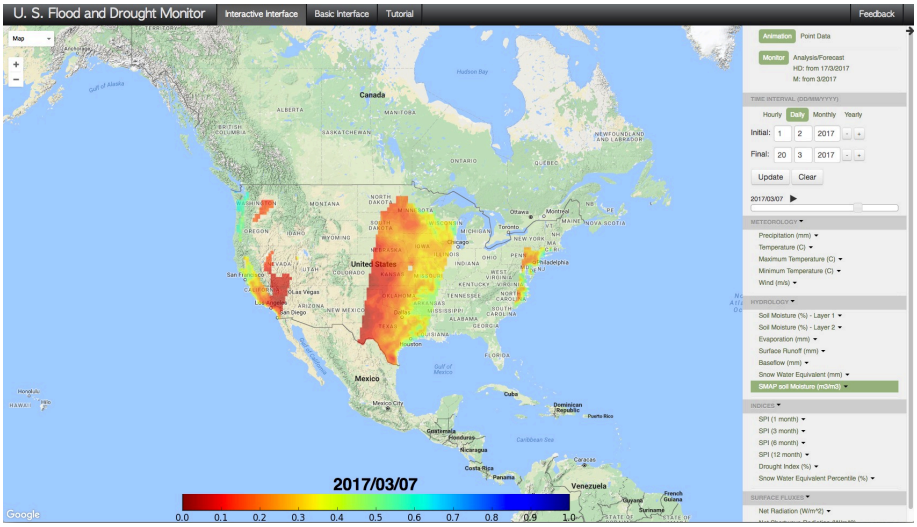


- To zoom in on an area, go to the top menu and select **Plot-Zoom in**
- In the lower window, select **Array-Plot** to create a plot of soil moisture as a function of latitude

- Click on the tab option on the top that says **Array** to see the values in the file
- To save a file in a different format (e.g. .png, .tiff, .pdf), select **File** > **Save As** from the main menu

Part 3B: Extracting SMAP Soil Moisture Values

- Go to the U.S. Flood and Drought Monitor tool from Princeton University: http://stream.princeton.edu/CONUS4FDM/WEBPAGE/interface.php?locale=en
    - This is the most direct way to extract SMAP soil moisture values



- In the upper-right window, select **Point Data**
- In the next section under **Time Interval**, specify the period of interest that you would like: **soil moisture**
    - Note that SMAP soil moisture data is available as of mid-April 2015
- In the next section, select **SMAP soil moisture** and click on the map over your point of interest
    - You may also manually specify your latitude/longitude using the **Manual Entry** option
- Under **Create Corresponding Data File** select **yes**
- Click on **Download Data** at the very bottom
- The data are downloaded directly onto your computer as a text file
- From the same page, download SMAP soil moisture data as well as vegetation and/or meteorological data for the same point
- Plot them and explore any correlations