# 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
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   3. Product Configuration
   4. Sites to Discover, Download, and Visualize SMAP Data
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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 σo in Time Order | 5x30 km  (10 slices) | Half Orbit |
| L1C\_S0\_HiRes\* | High Resolution Radar σo on Swath Grid | 1 km | Half Orbit |
| L1B\_TB | Radiometer TB in Time Order | 39x47 km | Half Orbit |
| L1C\_TB | Radiometer TB | 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 TB in Time Order | 39x47 km | Mission DA |
| L1C\_TB | Radiometer TB in Half-Orbits | 36 km | Mission DA |
| L1C\_TB\_E | Radiometer TB 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 (σo)
  + Soil moisture is a volumetric measurement expressed as cm3/cm3
  + 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**](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/**](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**](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®.

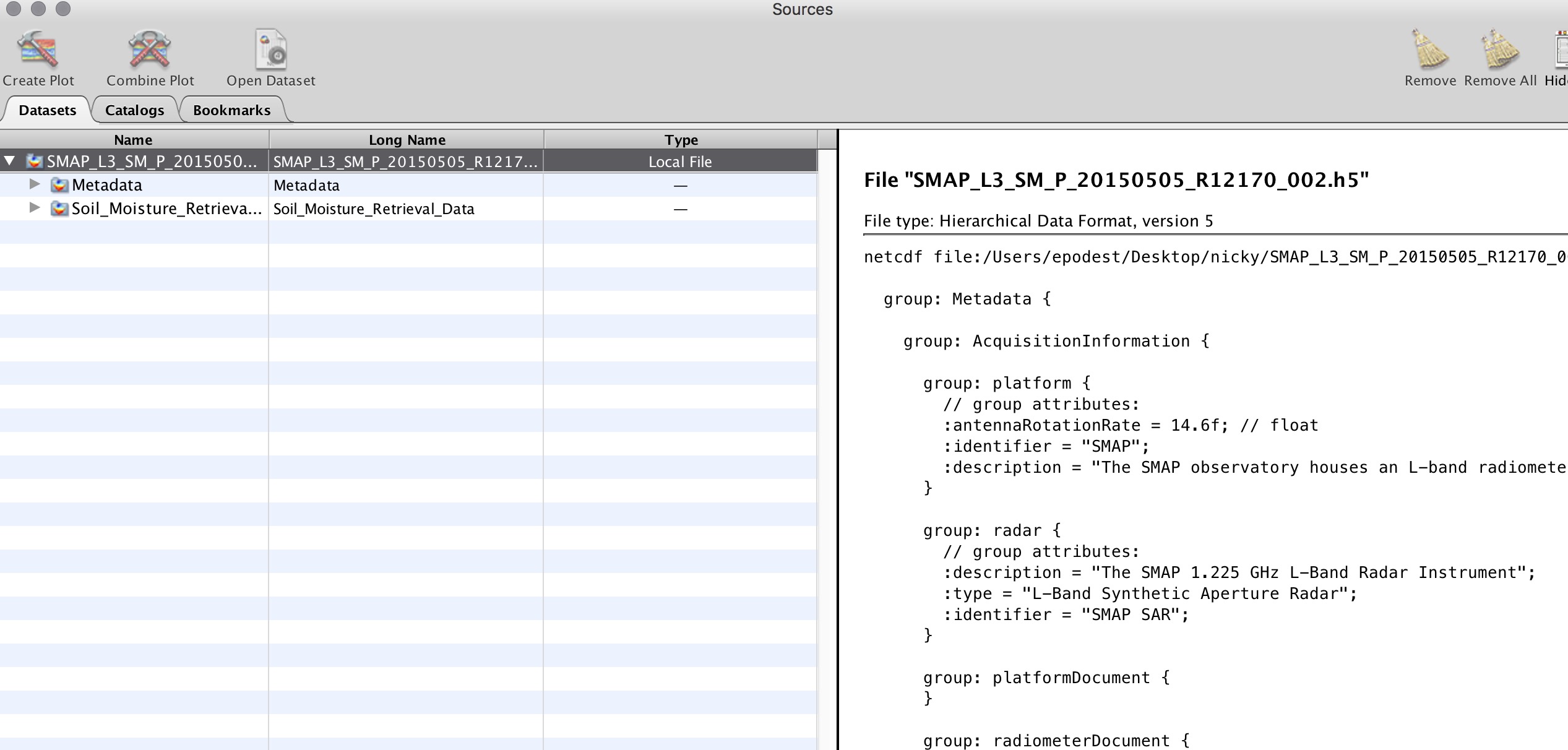
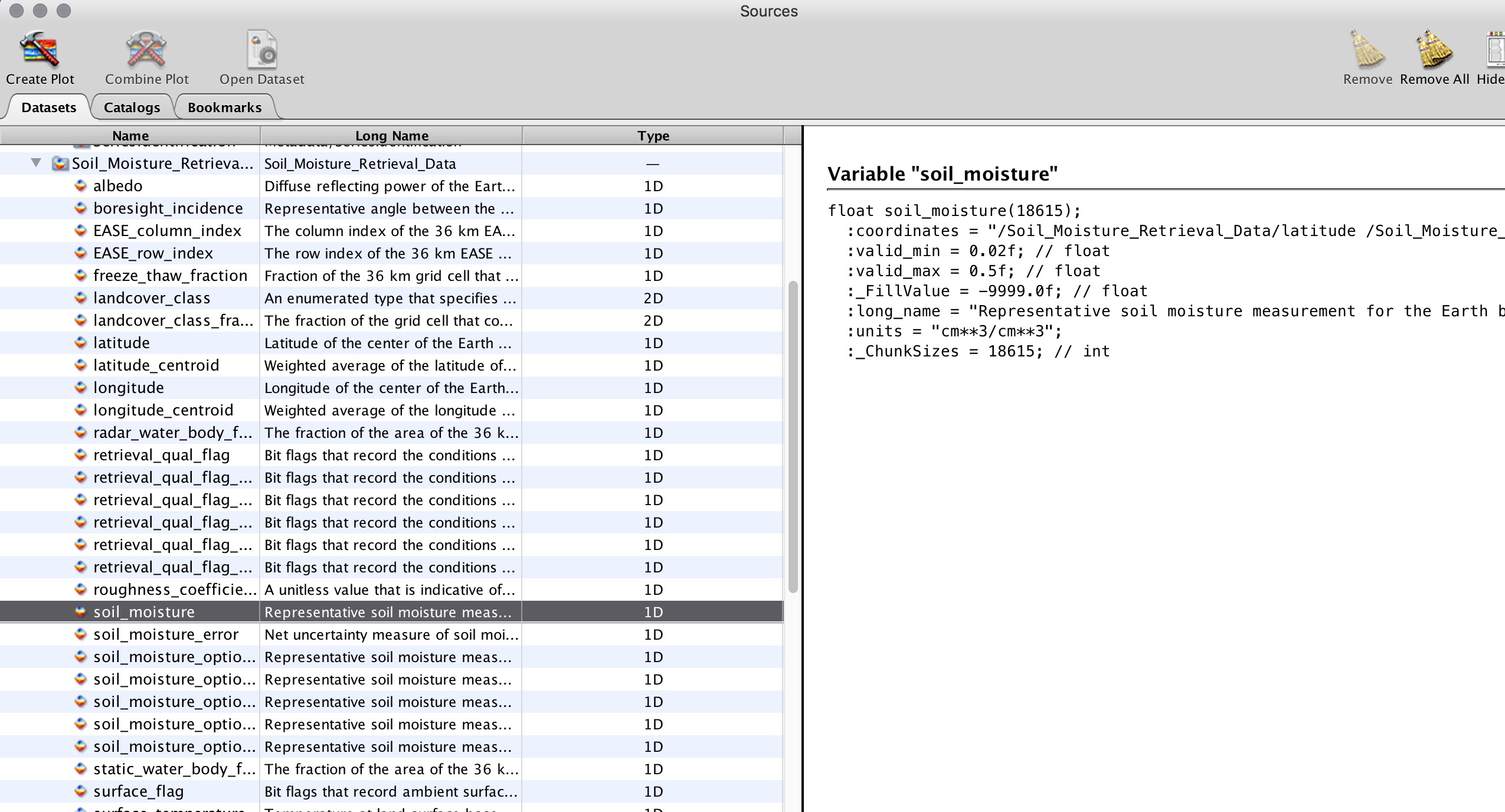
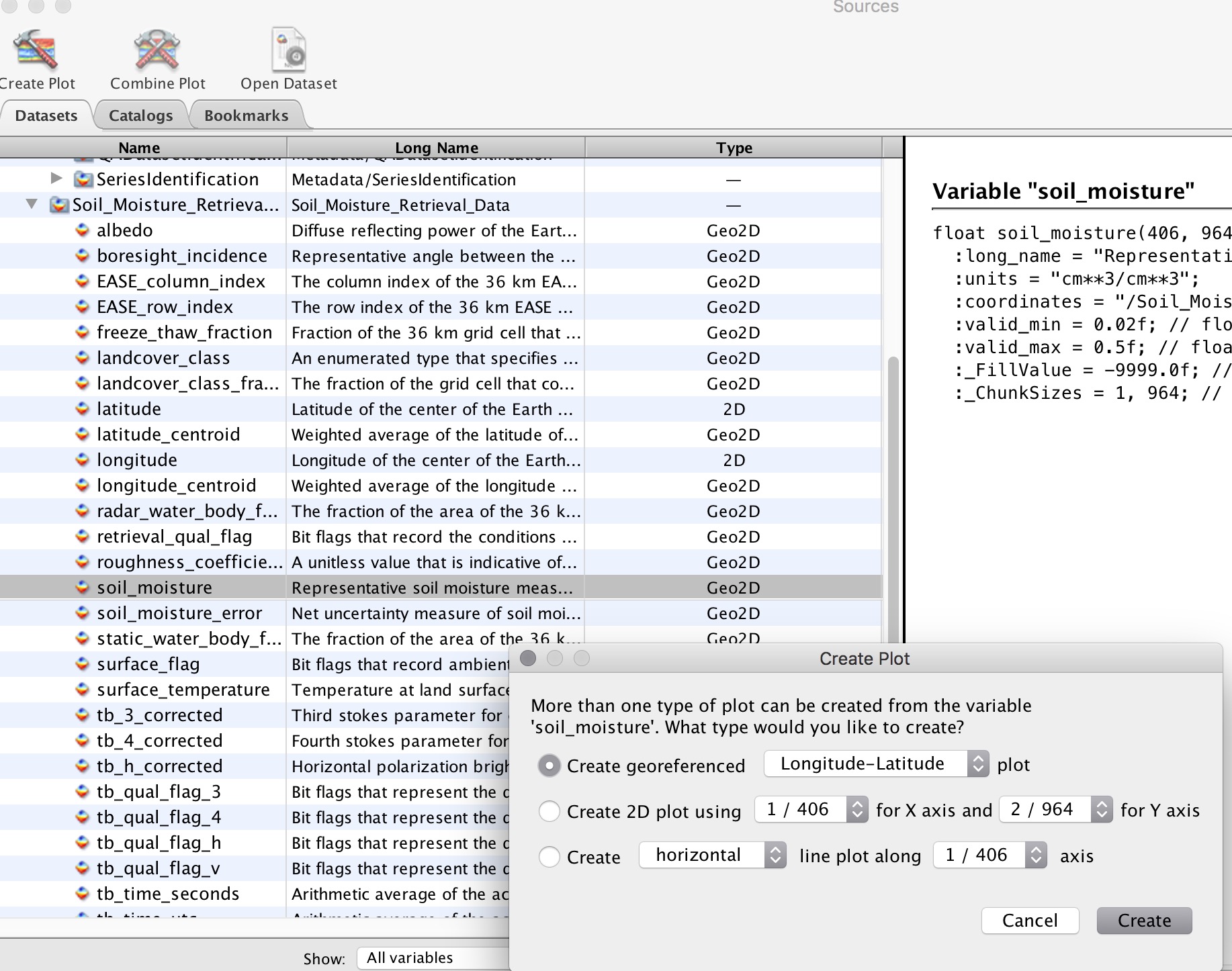
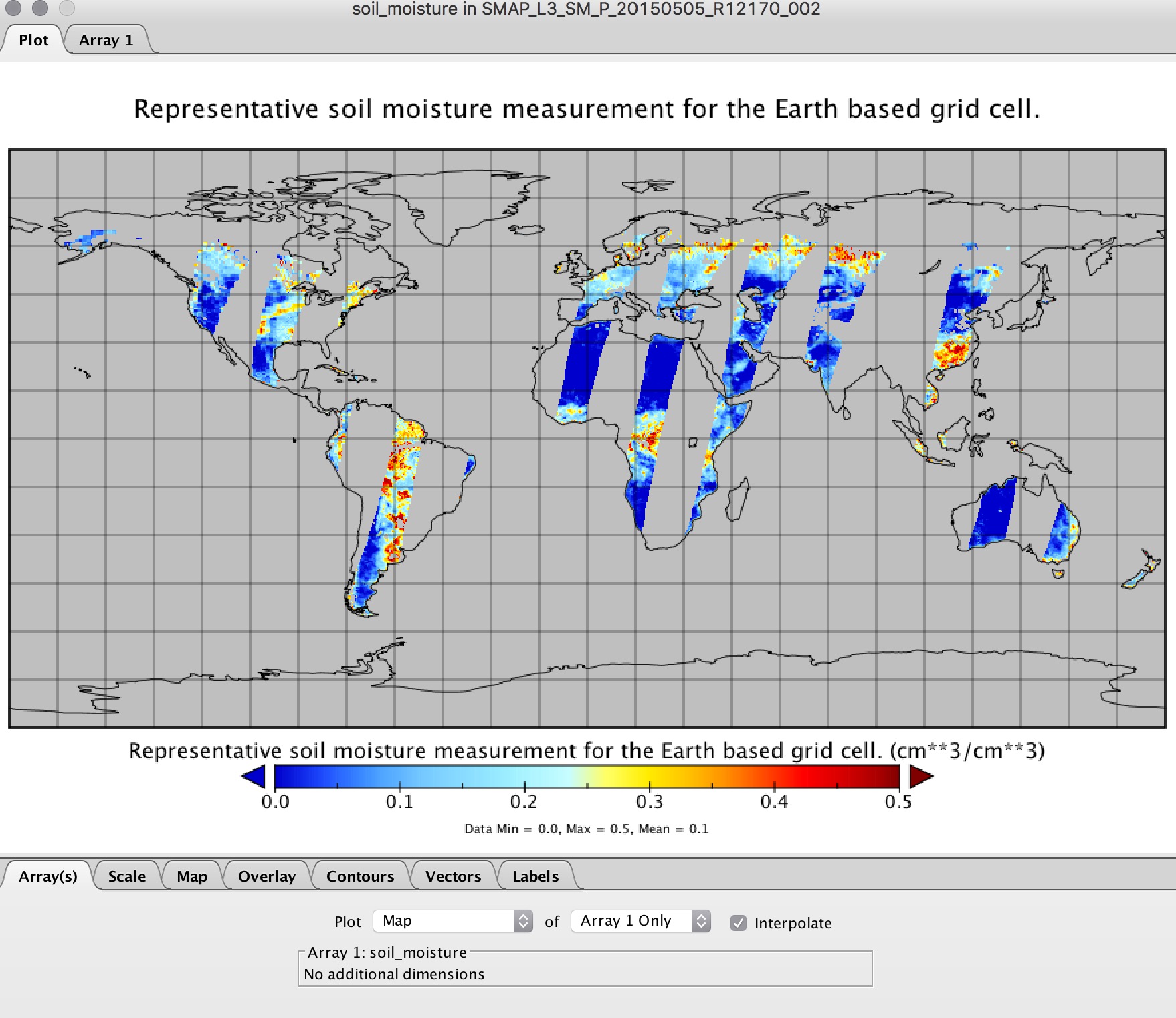
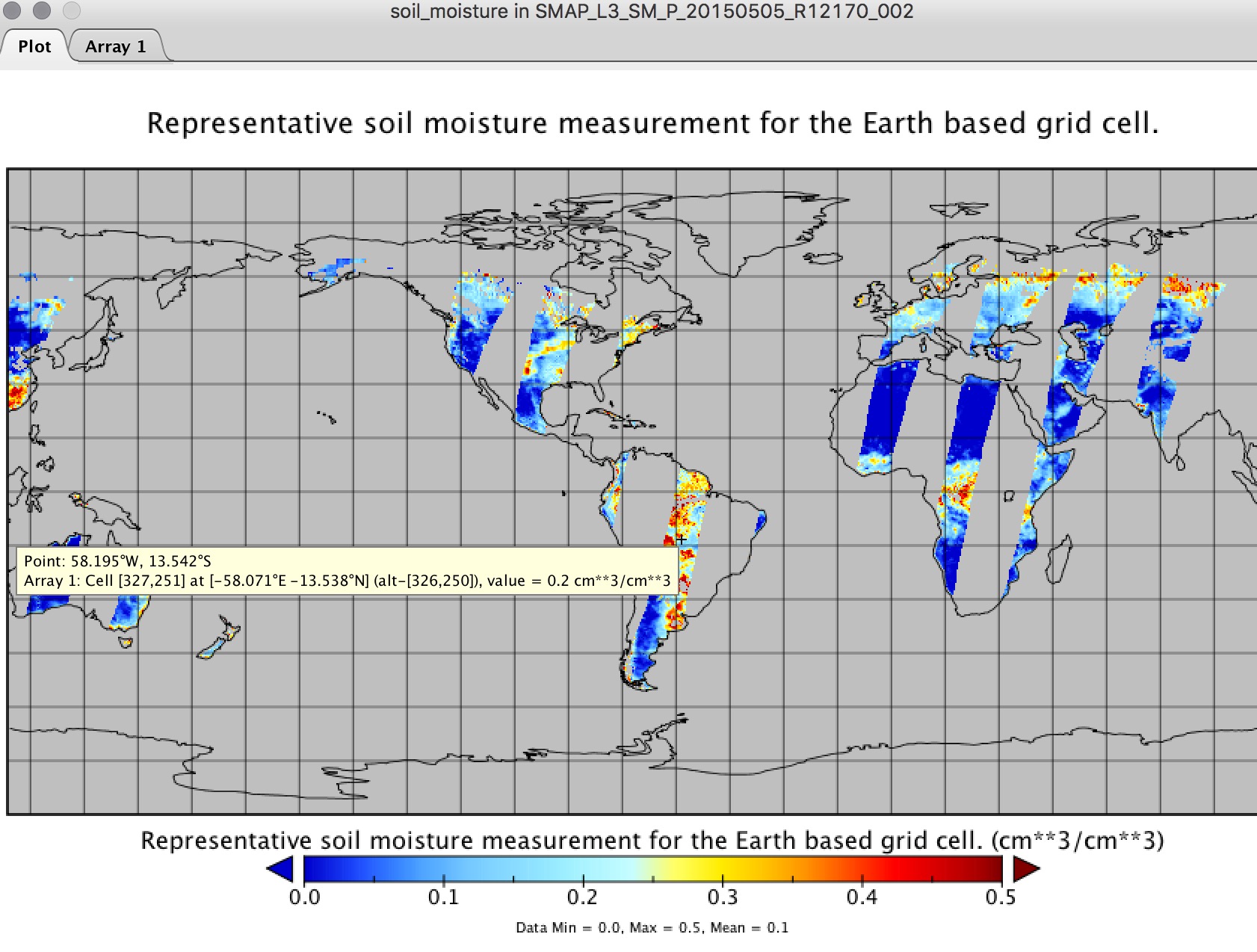
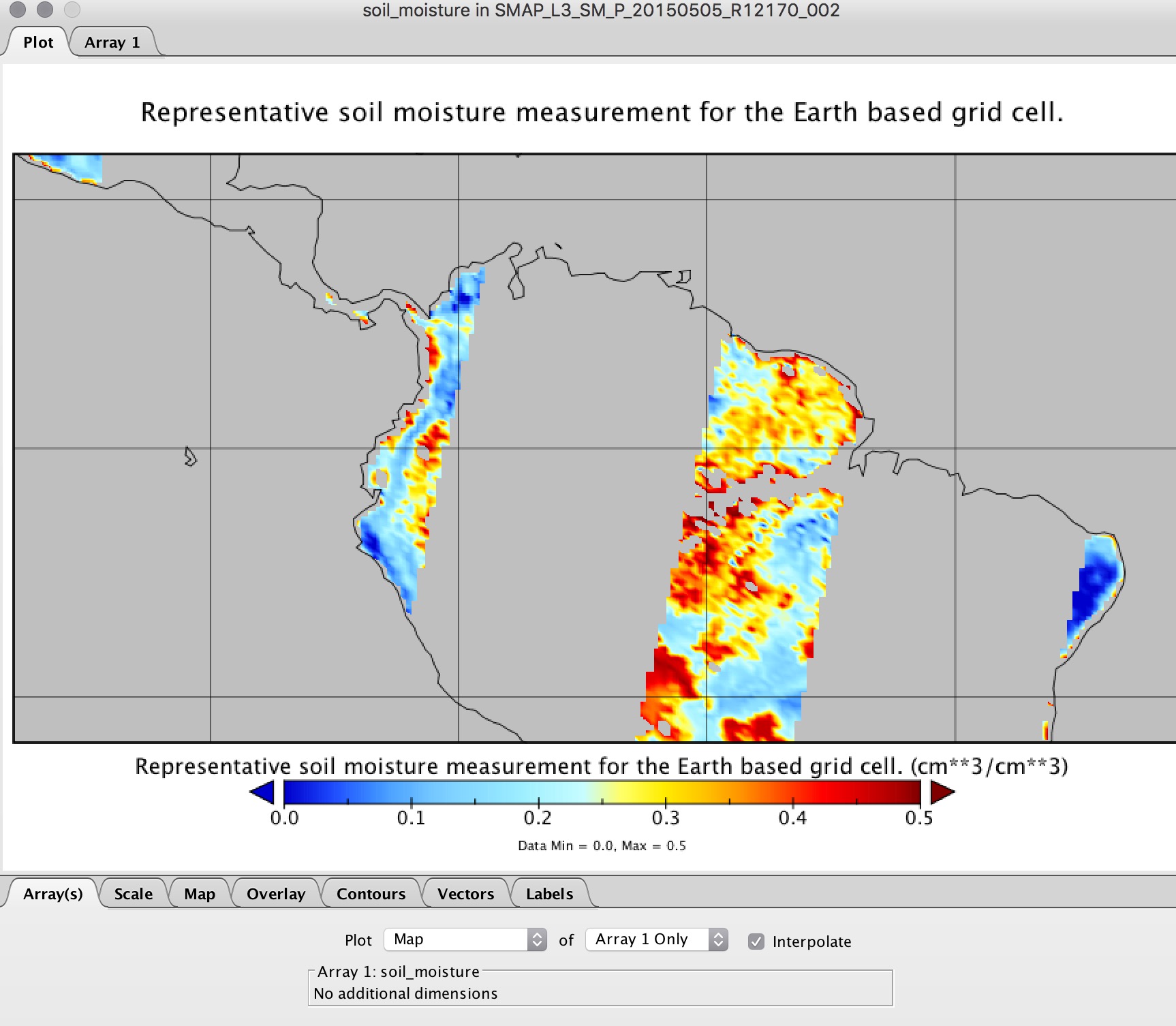
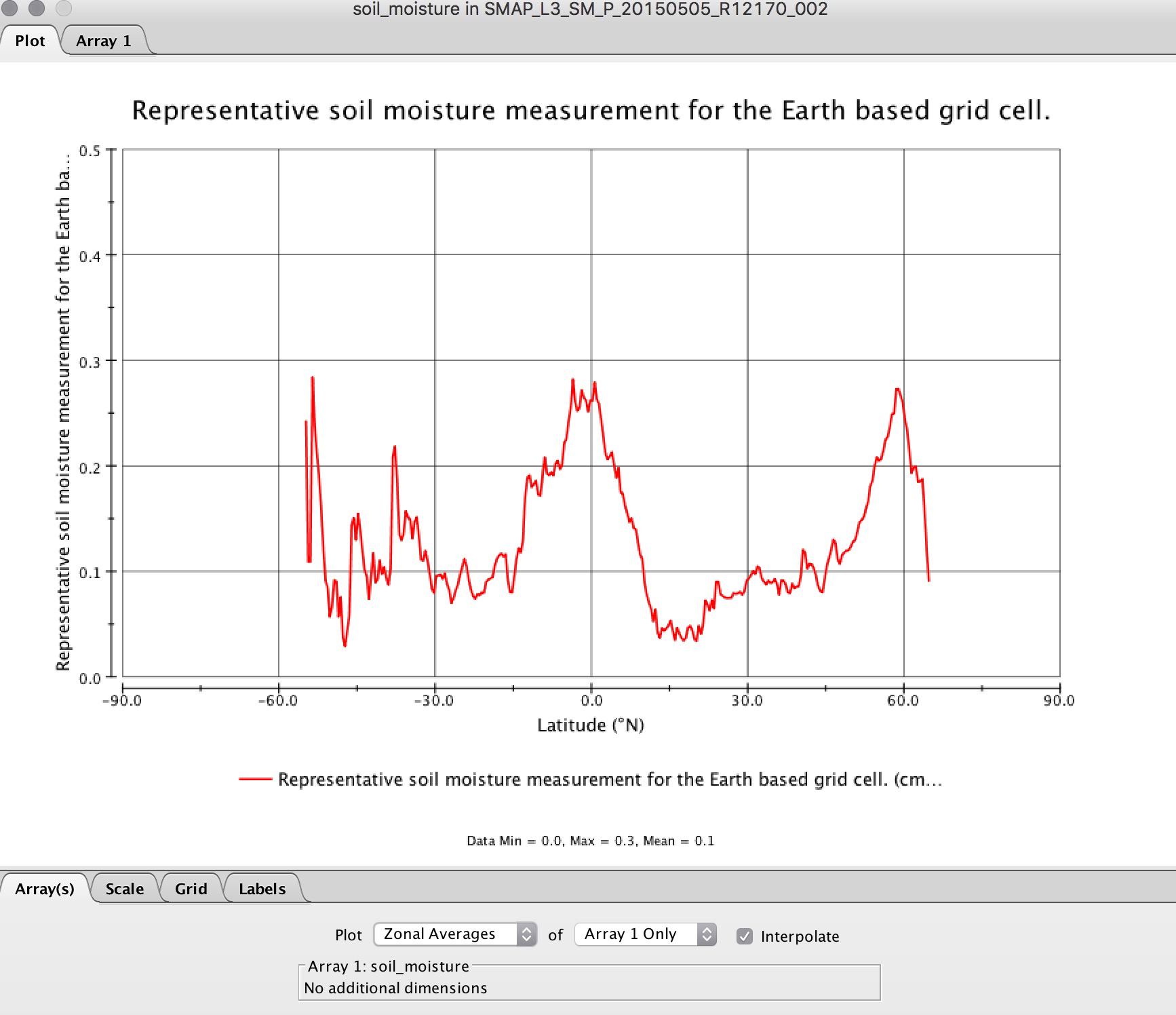
* Access HDF5 tools: <http://support.hdfgroup.org/products/hdf5_tools/index.html>
* Download code in Python, NCL, MATLAB®, and IDL®: <http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP>

## Part 2: Download Data for This Exercise

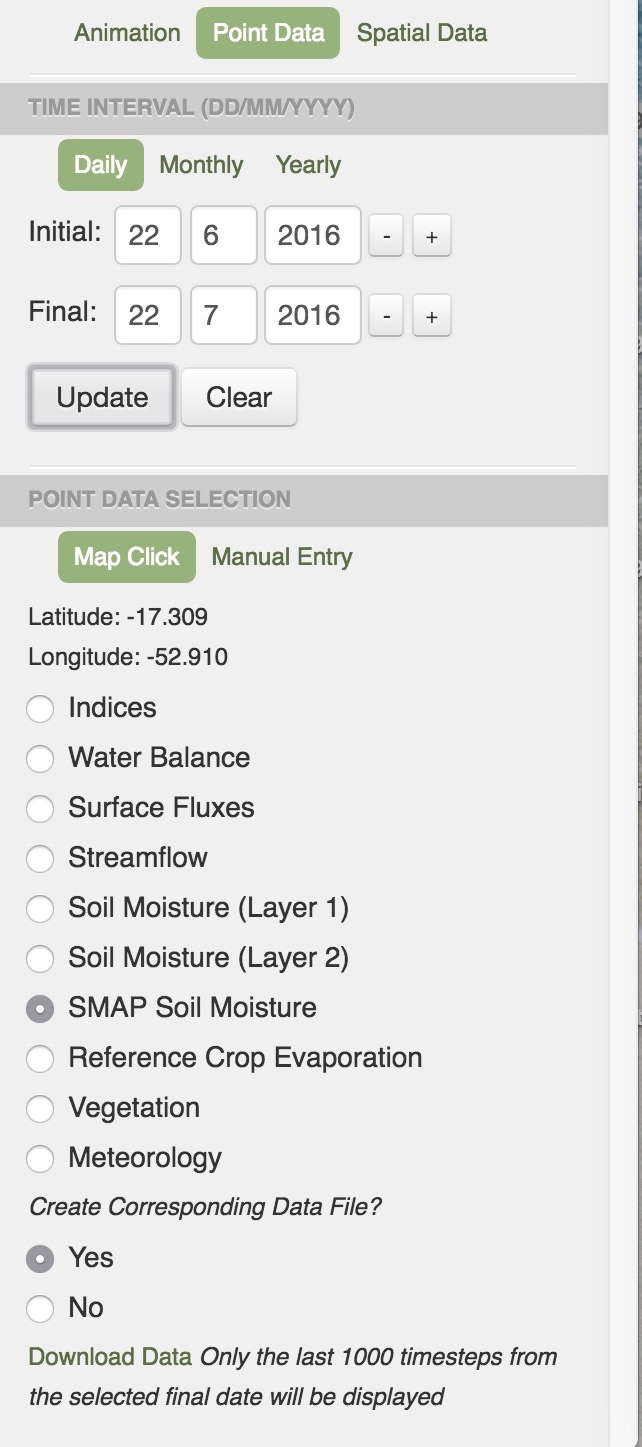
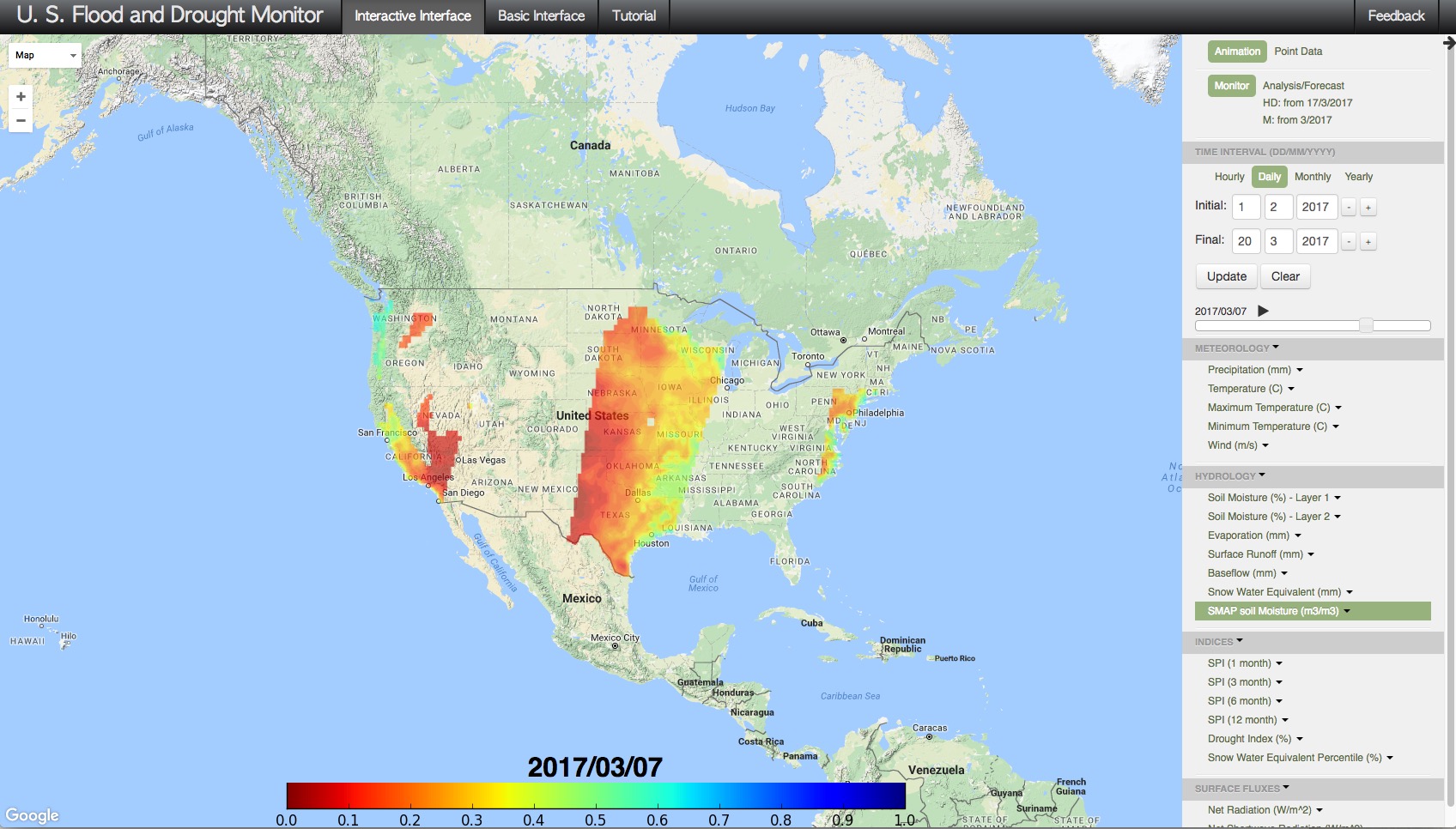
* Go to <http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP>
* HDFeos.tiffClick on **SMAP\_L3\_SM\_P\_20150505\_R12170\_002.h5** next to Grid

## 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