



ARSET

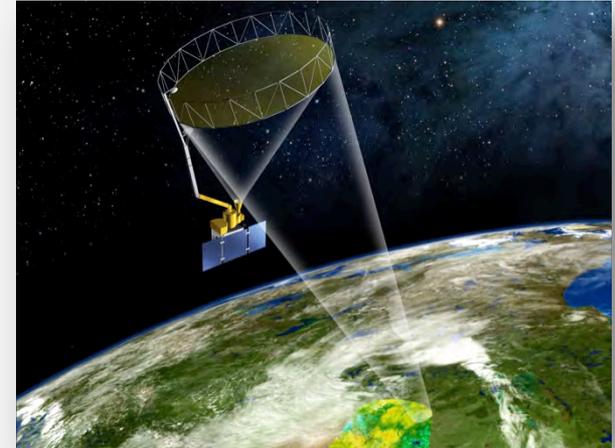
Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

Ejercicios con SMAP

Jul. 20, 2016



Resumen General

1. Resumen de los Productos
2. Descubriendo y Bajando los Datos
3. Visualización de los Datos
4. Análisis de los Datos

A satellite dish antenna is shown in space, pointing towards the Earth. The dish is a large, white, parabolic structure with a metal frame. It is mounted on a satellite platform. The Earth is visible in the background, showing a mix of green land, blue oceans, and white clouds. A semi-transparent white box is overlaid on the image, containing the text "Resumen de los Productos".

Resumen de los Productos

Producto y Nombre Resumido	Descripción	Resolución	Extensión
L1A_Radar	Telemetría del radar		Mitad de Orbita
L1A_Radiometer	Telemetría del radiómetro		Mitad de Orbita
L1B_S0_LoRes	Datos del radar en baja resolución	5x30 km (10 tiras)	Mitad de Orbita
L1C_S0_HiRes	Datos del radar en alta resolución	1 km	Mitad de Orbita
L1B_TB	Datos del radiómetro de acuerdo a la hora adquirido	39x47 km	Mitad de Orbita
L1C_TB	Datos del radiómetro T _B	36 km	Mitad de Orbita
L2_SM_A	Humedad del suelo derivado del radar (incluye estado congelado/descongelado de la superficie)	3 km	Mitad de Orbita
L2_SM_P	Humedad del suelo derivado del radiómetro	36 km	Mitad de Orbita
L2_SM_AP	Humedad del suelo derivado del radar y radiómetro	9 km	Mitad de Orbita
L3_FT_A	Mosaico global diario del estado congelado/descongelado de la superficie	3 km	Al Norte de 45° N
L3_SM_A	Mosaico global diario de la humedad del suelo utilizando el radar	3 km	Global
L3_SM_P	Mosaico global diario de la humedad del suelo utilizando el radiómetro	36 km	Global
L3_SM_AP	Mosaico global diario de la humedad del suelo utilizando el radar y el radiómetro	9 km	Global
L4_SM	Humedad del suelo en la superficie y en las raíces	9 km	Global
L4_C	Intercambio neto de carbono en el ecosistema	9 km	Al Norte de 45° N

Configuración de los Productos

- Todos los Productos Están en Formato HDF
 - Cada archivo HDF contiene los datos primarios (ej. humedad del suelo, estado congelado/descongelado de la superficie, datos de radar) y todos los archivos utilizados en la producción del producto primario.
 - Estos archivos contienen metadata, datos sobre los instrumentos, señalizaciones o mascararas, etc.
- Proyección: EASE2 Grid
 - Proyección de igual área
 - Los productos L2, 3, y 4 y los datos del radiómetro L1C se encuentran en esta proyección

Configuración de los Productos

- Valores
 - Los datos del radiómetro (temperatura de brillo) están en Kelvin
 - Los datos del radar están en sigma cero
 - La humedad del suelo es una medición volumétrica expresada como cm^3/cm^3
 - El estado congelado/descongelado de la superficie es una medida binaria
 - Intercambio neto de carbono en el ecosistema es una medición de gramos de carbono por metro cuadrado por día

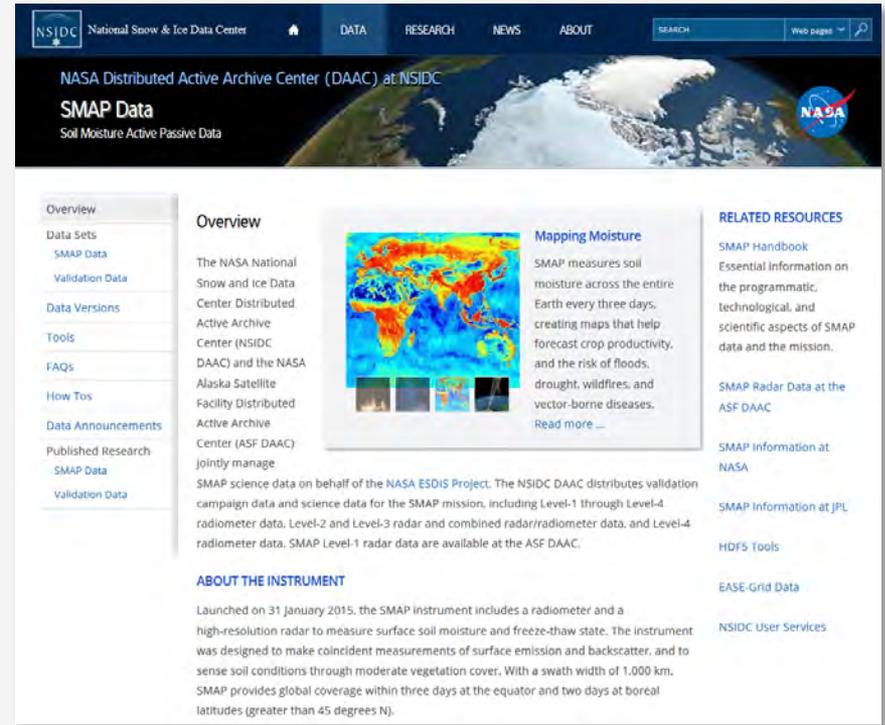
A satellite dish antenna is shown in space, pointing towards Earth. The dish is a large, white, parabolic structure with a metal frame. A beam of light or data is projected from the dish onto the Earth's surface. The Earth is shown in a curved perspective, with a green and yellow data visualization overlay on the landmasses. The background is a starry space with a bright star. The text "Descubriendo y Bajando los Datos" is centered on a semi-transparent white rectangular background.

Descubriendo y Bajando los Datos

Acceso a los Datos: NSIDC

NSIDC DAAC: <http://nsidc.org/data/smap>

- Acceso a los datos L1 del radiómetro y todos los datos L2, L3, y L4
- Acceso a los datos, documentos sobre los diferentes productos, herramientas, noticias, publicaciones, preguntas y respuestas y muchos recursos más



The screenshot shows the NSIDC DAAC website for SMAP Data. The header includes the NSIDC logo, the text "National Snow & Ice Data Center", and navigation links for DATA, RESEARCH, NEWS, and ABOUT. A search bar and a "Web pages" dropdown are also present. The main banner features a satellite image of Earth with the text "NASA Distributed Active Archive Center (DAAC) at NSIDC" and "SMAP Data Soil Moisture Active Passive Data".

The left sidebar contains a navigation menu with the following items: Overview, Data Sets (SMAP Data, Validation Data), Data Versions, Tools, FAQs, How Tos, Data Announcements, Published Research (SMAP Data, Validation Data).

The main content area is titled "Overview" and contains the following text:

The NASA National Snow and Ice Data Center Distributed Active Archive (NSIDC DAAC) and the NASA Alaska Satellite Facility Distributed Active Archive Center (ASF DAAC) jointly manage SMAP science data on behalf of the NASA ESDIS Project. The NSIDC DAAC distributes validation campaign data and science data for the SMAP mission, including Level-1 through Level-4 radiometer data, Level-2 and Level-3 radar and combined radar/radiometer data, and Level-4 radiometer data. SMAP Level-1 radar data are available at the ASF DAAC.

Below the overview text is a section titled "ABOUT THE INSTRUMENT" which states: "Launched on 31 January 2015, the SMAP instrument includes a radiometer and a high-resolution radar to measure surface soil moisture and freeze-thaw state. The instrument was designed to make coincident measurements of surface emission and backscatter, and to sense soil conditions through moderate vegetation cover. With a swath width of 1,000 km, SMAP provides global coverage within three days at the equator and two days at boreal latitudes (greater than 45 degrees N)."

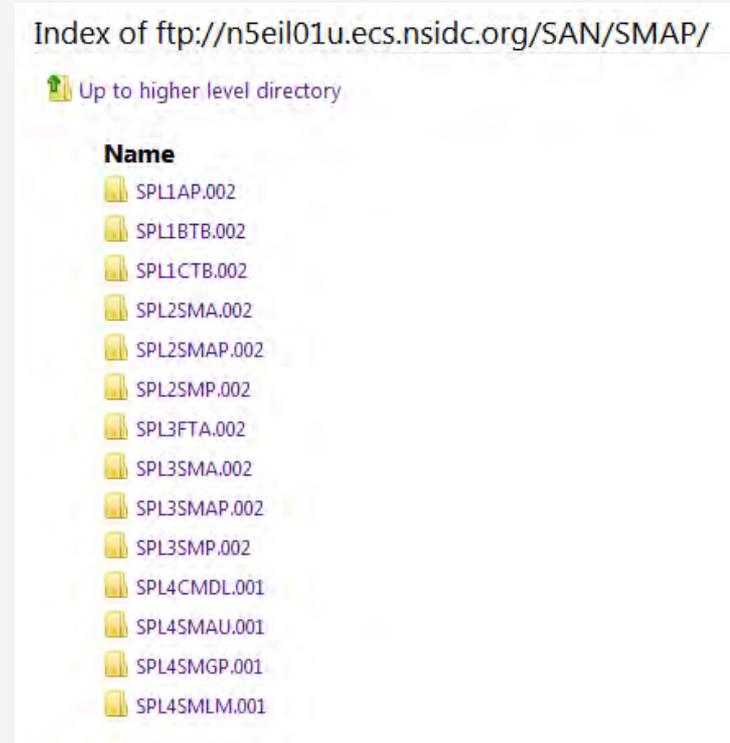
On the right side of the main content area, there is a "Mapping Moisture" section with a world map showing soil moisture data. The text next to the map reads: "SMAP measures soil moisture across the entire Earth every three days, creating maps that help forecast crop productivity, and the risk of floods, drought, wildfires, and vector-borne diseases. Read more ..."

At the bottom right, there is a "RELATED RESOURCES" section with links to: SMAP Handbook, SMAP Radar Data at the ASF DAAC, SMAP information at NASA, SMAP information at JPL, HDF5 Tools, EASE-Grid Data, and NSIDC User Services.

Acceso a los Datos: NSIDC

NSIDC DAAC: <http://nsidc.org/data/smap>

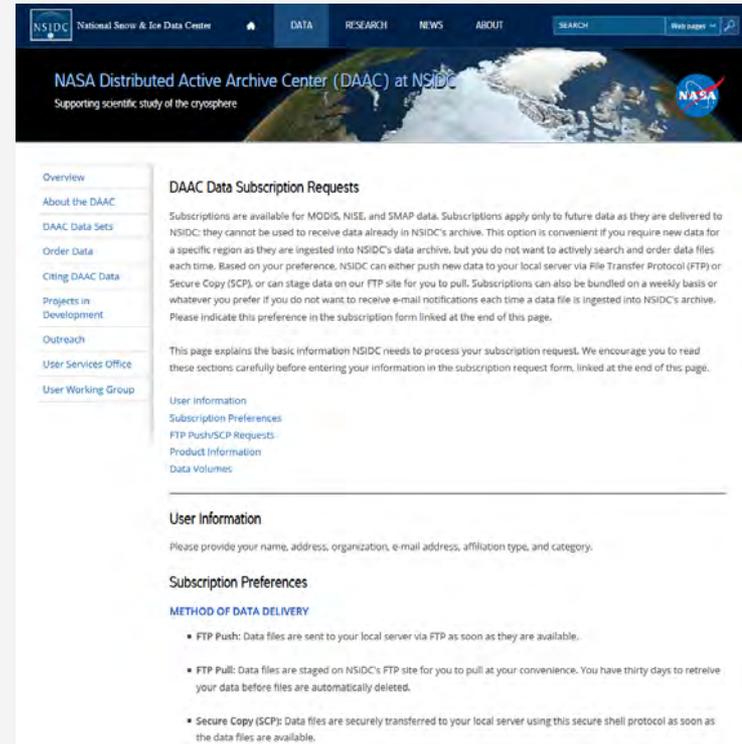
- HTTPS
 - <https://n5eil01u.ecs.nsidc.org/SMAP/>
- FTP
 - <ftp://n5eil01u.ecs.nsidc.org/SAN/SMAP>
- Acceso directo a todos los archivos de SMAP



Acceso a los Datos: NSIDC

Suscripción: <http://nsidc.org/daac/subscriptions.html>

- Entrega automática de los datos a medida que se vuelven disponibles



The screenshot shows the NSIDC (National Snow & Ice Data Center) website. The header includes the NSIDC logo, navigation links for DATA, RESEARCH, NEWS, and ABOUT, a search bar, and a 'Web page' dropdown. Below the header is a banner for the NASA Distributed Active Archive Center (DAAC) at NSIDC, with the tagline 'Supporting scientific study of the cryosphere' and a NASA logo. The main content area is titled 'DAAC Data Subscription Requests'. It contains a left sidebar with navigation links: Overview, About the DAAC, DAAC Data Sets, Order Data, Citing DAAC Data, Projects in Development, Outreach, User Services Office, and User Working Group. The main text explains that subscriptions are available for MODIS, NISE, and SMAP data, but only for future data. It details three options: FTP Push, FTP Pull, and Secure Copy (SCP). The 'User Information' section asks for name, address, organization, e-mail address, affiliation type, and category. The 'Subscription Preferences' section is titled 'METHOD OF DATA DELIVERY' and lists the three options with their respective details.

DAAC Data Subscription Requests

Subscriptions are available for MODIS, NISE, and SMAP data. Subscriptions apply only to future data as they are delivered to NSIDC; they cannot be used to receive data already in NSIDC's archive. This option is convenient if you require new data for a specific region as they are ingested into NSIDC's data archive, but you do not want to actively search and order data files each time. Based on your preference, NSIDC can either push new data to your local server via File Transfer Protocol (FTP) or Secure Copy (SCP), or can stage data on our FTP site for you to pull. Subscriptions can also be bundled on a weekly basis or whatever you prefer if you do not want to receive e-mail notifications each time a data file is ingested into NSIDC's archive. Please indicate this preference in the subscription form linked at the end of this page.

This page explains the basic information NSIDC needs to process your subscription request. We encourage you to read these sections carefully before entering your information in the subscription request form, linked at the end of this page.

User Information
Subscription Preferences
FTP Push/SCP Requests
Product Information
Data Volumes

User Information

Please provide your name, address, organization, e-mail address, affiliation type, and category.

Subscription Preferences

METHOD OF DATA DELIVERY

- **FTP Push:** Data files are sent to your local server via FTP as soon as they are available.
- **FTP Pull:** Data files are staged on NSIDC's FTP site for you to pull at your convenience. You have thirty days to retrieve your data before files are automatically deleted.
- **Secure Copy (SCP):** Data files are securely transferred to your local server using this secure shell protocol as soon as the data files are available.

Acceso a los Datos: ASF

ASF DAAC: <http://asf.alaska.edu/smap>

- Acceso a los datos de radar L1 solamente
- Acceso a los datos, documentos sobre los diferentes productos, herramientas, noticias, publicaciones, preguntas y respuestas y muchos recursos más



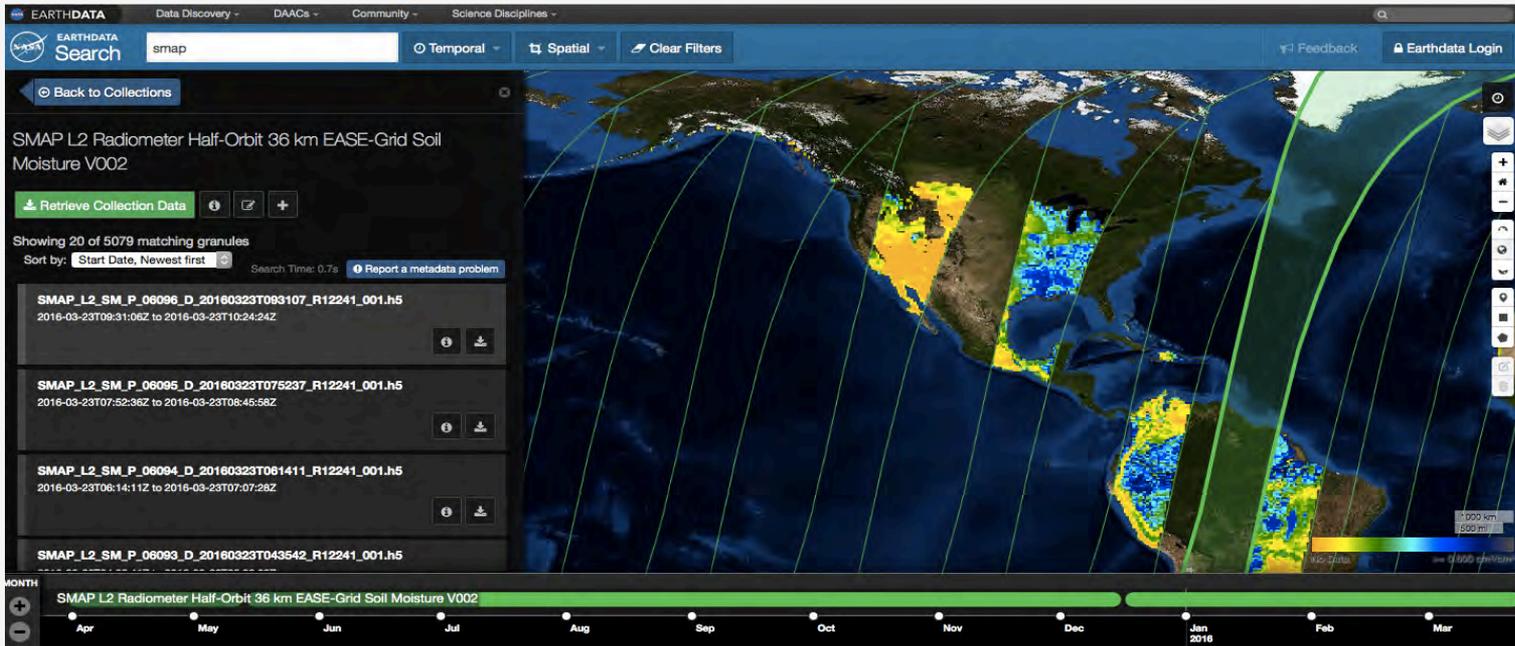
A satellite dish antenna is shown in space, pointing towards Earth. The dish is white with a green interior and a white frame. A large, semi-transparent white rectangular area is overlaid on the image, containing the text 'Visualización de los Datos'. Below the text is a horizontal black line. The background shows the Earth's surface with green land, blue oceans, and white clouds, set against a starry space background.

Visualización de los Datos

Visualización de los Datos con Worldview

<https://earthdata.nasa.gov/worldview>

- Permite interactivamente visualizar y descargar los datos originales



A satellite dish antenna is shown in space, pointing towards Earth. The dish is a large, white, parabolic structure with a metal frame. It is mounted on a satellite platform. The Earth is visible in the background, showing a mix of green land, blue oceans, and white clouds. A semi-transparent white rectangular box is overlaid on the image, containing the text 'Análisis de los Datos' and a horizontal line below it. The background is a starry space with a bright star visible in the upper right.

Análisis de los Datos

Herramientas Disponibles Para Leer los Archivos de SMAP

- Herramientas HDF5

- http://www.hdfgroup.org/products/hdf5_tools/index.html

- Código para leer los archivos en Python, MATLAB, IDL, y NCL

- http://hdfeos.org/zoo/index_openNSIDC_Examples.php#SMAP

- Panoply

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

SOFTWARE USING HDF5

CONTENTS:

- [HDF5 Tools and Software](#)
- [HDF5 Tools by Category](#) (view, edit, export, convert, import)
- [Table \(Summary\) of Software Using HDF5](#)
- [HDF5 Command-line Tools](#)
- [Archived](#)

HDF5 Tools and Software:

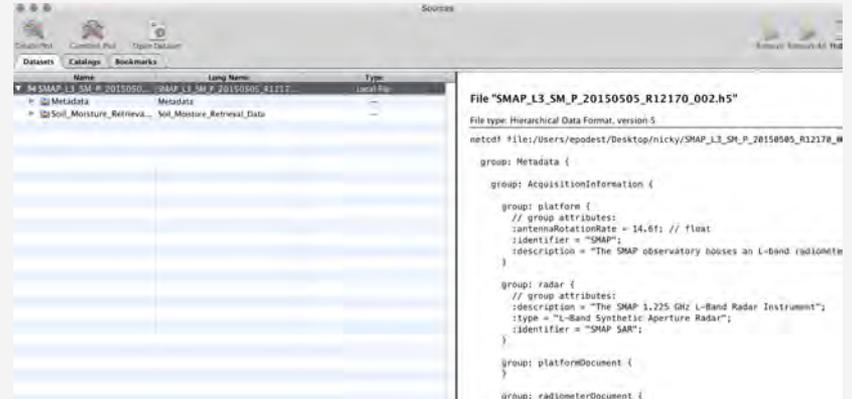
- [HDF-Java Products and HDFView](#): HDFView Java browser for HDF4 and HDF5 and HDF Java wrappers
- [HDF5 Command-line Tools](#): Tools included with the HDF5 distribution
- [HDF5 and .NET](#)
- [H4toH5 Conversion Library and Tools](#): A library and tools for converting to and from HDF4 and HDF5.
- [h5check](#): A tool to check the validity of an HDF5 file.
- [h5edit](#): A tool for editing an HDF5 file. The current (first) release only supports commands for the creation and deletion of attributes of datasets and groups. More commands will be implemented in the future. This software is sponsored by the JPSS project. **NEW**
- [HDF5 XML Information Page](#): DTD and tools for using HDF5 with XML.

See the [Downloads](#) page to access this tool:

- [h5fix_obj_nmgs](#): Corrects corrupt object header (rare problem prior to 1.6.6). Search on [Miscounted](#) [here](#).

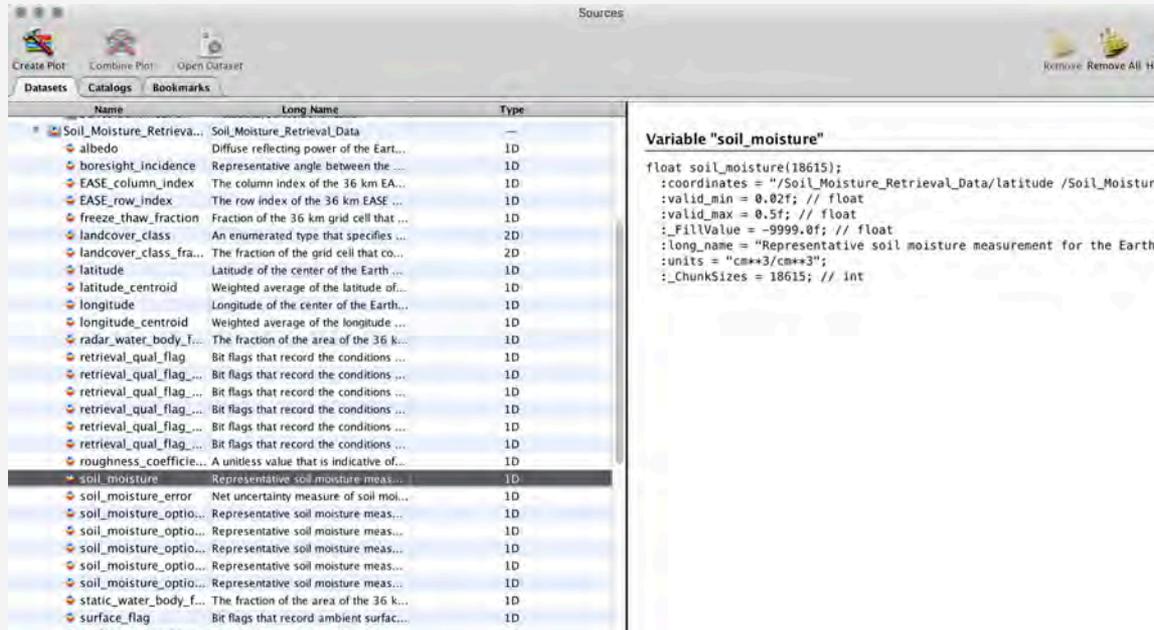
Abrir un Archivo con Panoply: L3 SM_P

1. Abrir Panoply
2. Ir a File-Open y abrir el archivo
3. “SMAP_L3_SM_P_20150505_R12170_02.h5” La ventana a la izquierda muestra la estructura del archivo el cual contiene 2 folderes: Metadata y Humedad del Suelo.
4. Haga doble clic en un grupo para ver los datos dentro de ese grupo



Abrir un Archivo con Panoply: L3 SM_P

- Haga clic sobre soil moisture para ver las características del archivo en el panel derecho.



The screenshot shows the Panoply software interface. The 'Sources' panel on the left displays a list of datasets. The 'soil_moisture' dataset is selected, and its metadata is shown in the right panel.

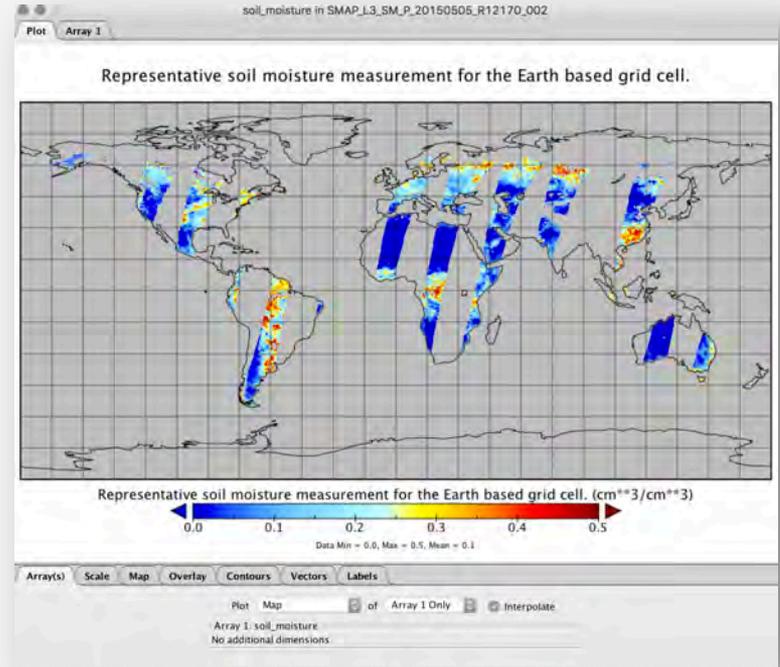
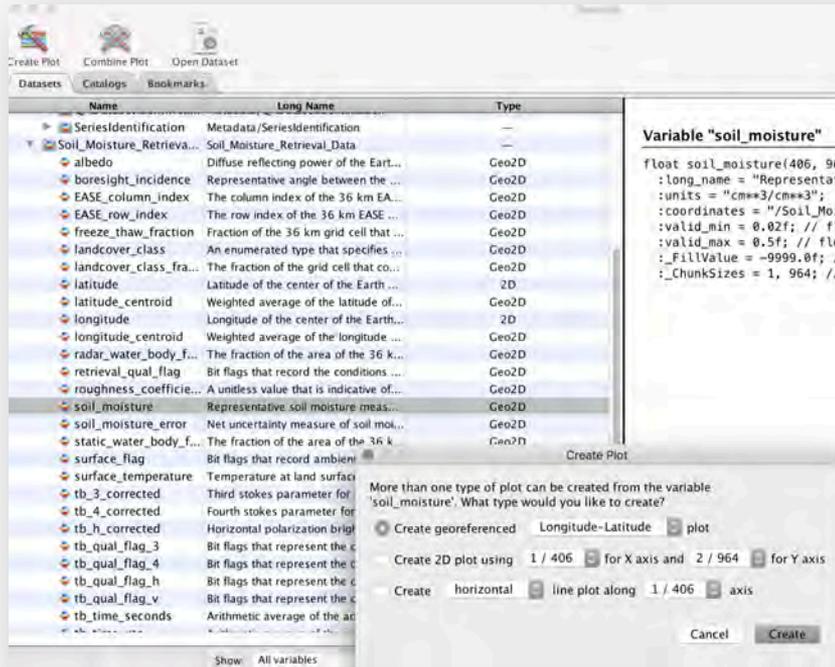
Name	Long Name	Type
Soil_Moisture_Retrieval...	Soil_Moisture_Retrieval_Data	—
albedo	Diffuse reflecting power of the Earth...	1D
boresight_incidence	Representative angle between the ...	1D
EASE_column_index	The column index of the 36 km EA...	1D
EASE_row_index	The row index of the 36 km EASE...	1D
freeze_thaw_fraction	Fraction of the 36 km grid cell that ...	1D
landcover_class	An enumerated type that specifies ...	2D
landcover_class_fra...	The fraction of the grid cell that co...	2D
latitude	Latitude of the center of the Earth...	1D
latitude_centroid	Weighted average of the latitude of...	1D
longitude	Longitude of the center of the Earth...	1D
longitude_centroid	Weighted average of the longitude...	1D
radar_water_body_f...	The fraction of the area of the 36 k...	1D
retrieval_qual_flag	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
retrieval_qual_flag_...	Bit flags that record the conditions ...	1D
roughness_coefficie...	A unitless value that is indicative of...	1D
soil_moisture	Representative soil moisture meas...	1D
soil_moisture_error	Net uncertainty measure of soil moi...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
soil_moisture_optio...	Representative soil moisture meas...	1D
static_water_body_f...	The fraction of the area of the 36 k...	1D
surface_flag	Bit flags that record ambient surfac...	1D

Variable "soil_moisture"

```
float soil_moisture(18615);
:coordinates = "/Soil_Moisture_Retrieval_Data/latitude /Soil_Moisture_
:valid_min = 0.02f; // float
:valid_max = 0.5f; // float
:_FillValue = -9999.0f; // float
:long_name = "Representative soil moisture measurement for the Earth t
:units = "cm**3/cm**3";
:_ChunkSizes = 18615; // int
```

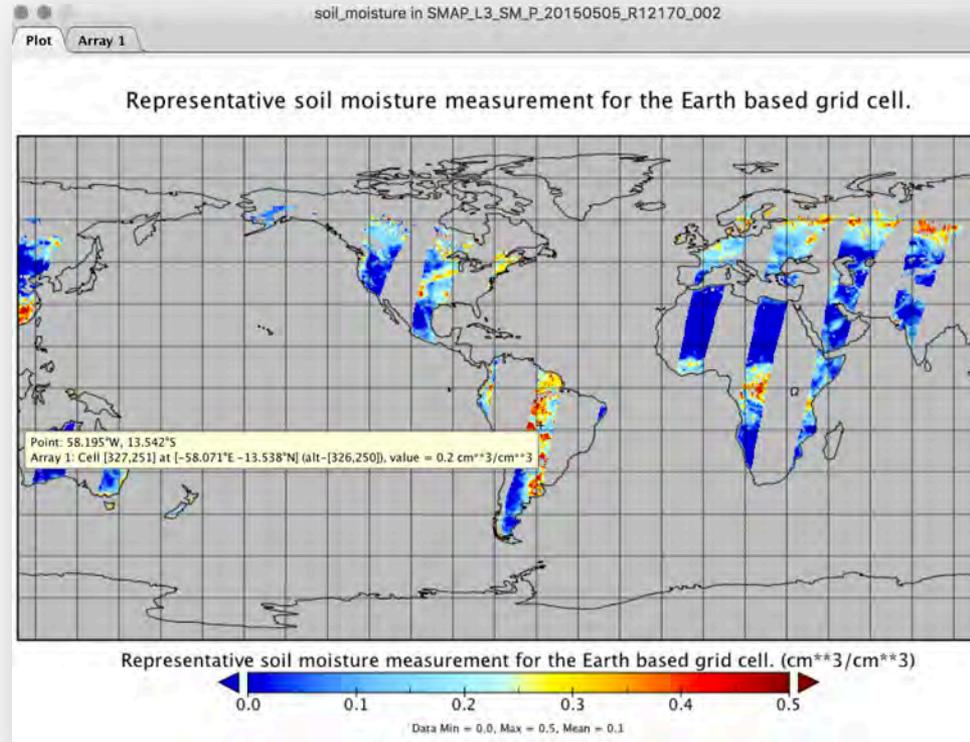
Abrir un Archivo con Panoply: L3 SM_P

5. Abra el archivo en formato mapa haciendo doble clic en soil moisture



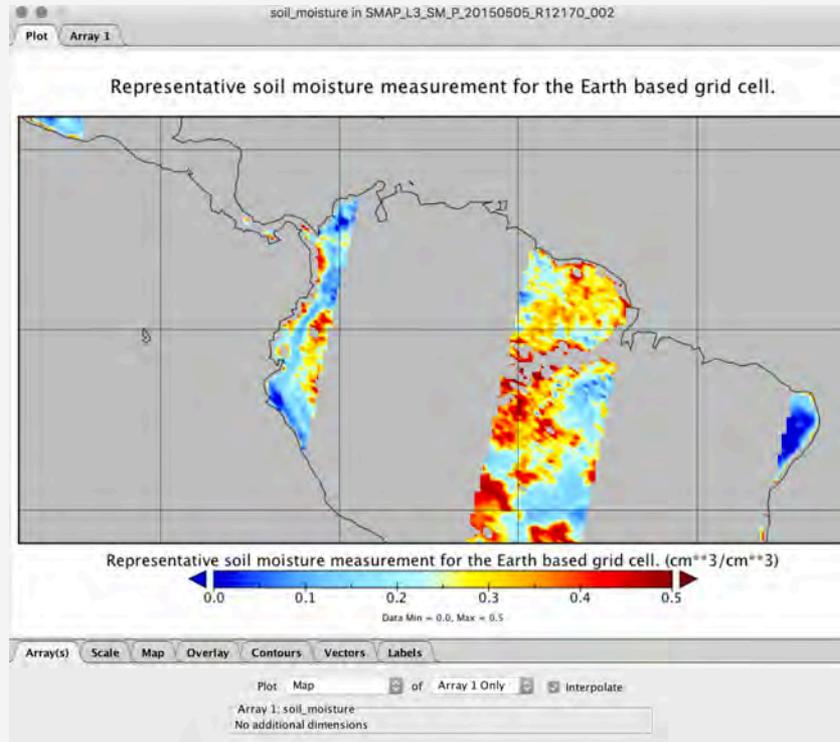
Valor de un Pixel en el Mapa: L3 SM_P

6. Para ver el valor de un pixel haga clic y botón “Alt” sobre el punto de interés



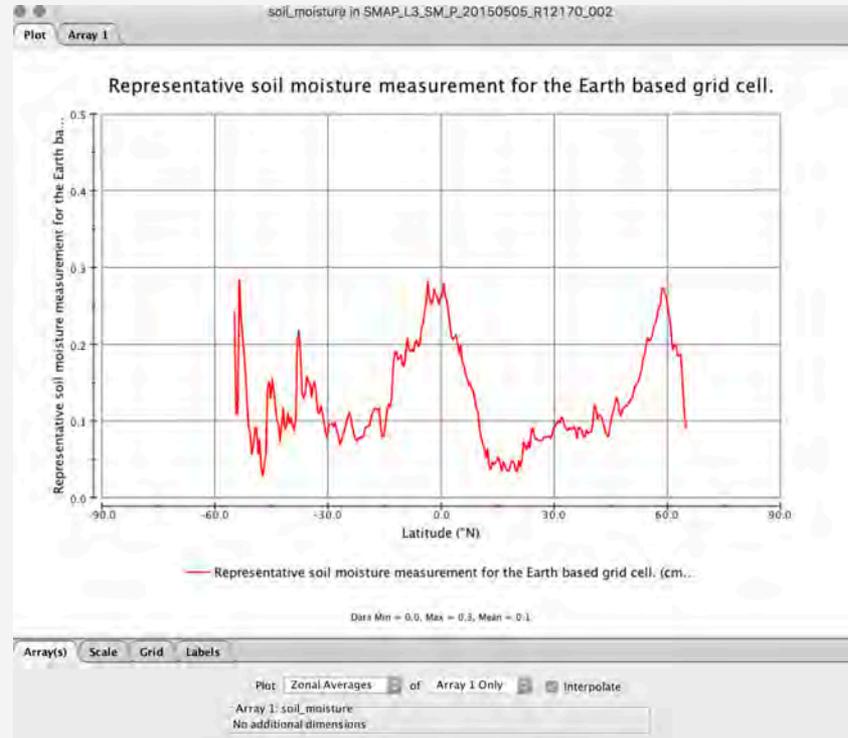
Zoom de la Imagen: L3 SM_P

7. Para hacer zoom sobre un área en especifica vaya al menú de arriba “Plot-Zoom In”



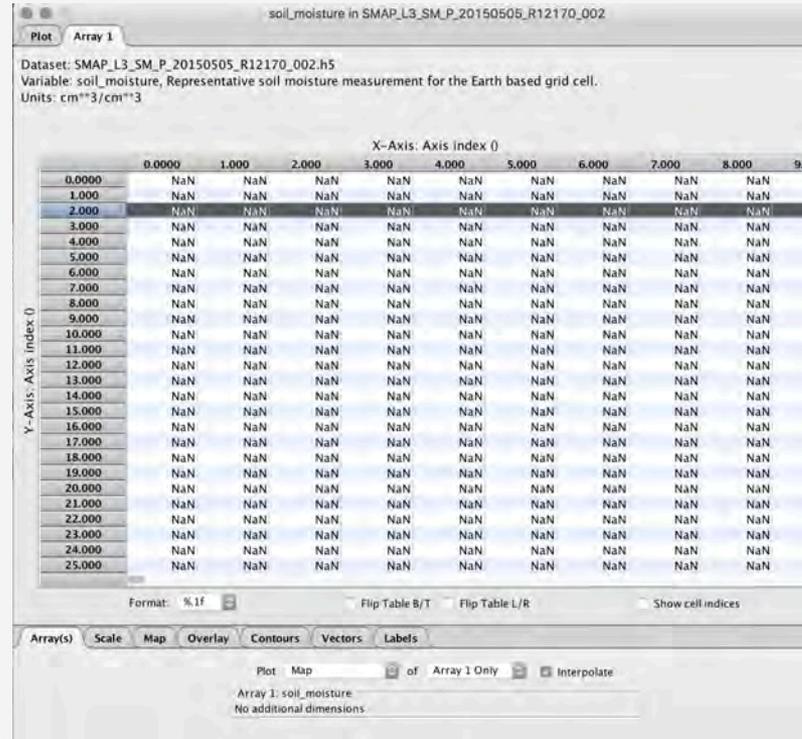
Plotear los Datos: L3 SM_P

8. En la ventana inferior seleccione Array-Plot para crear un diagrama de la humedad del suelo de acuerdo a latitud



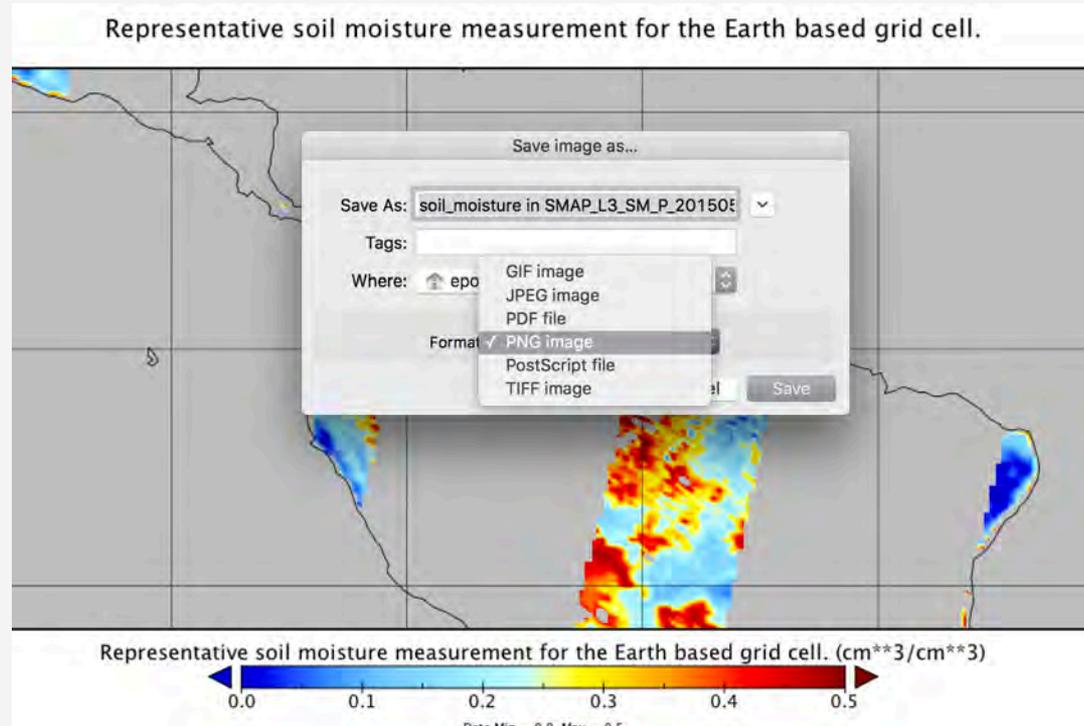
Los Valores del Archivo: L3 SM_P

9. Ahora haga clic en la pestaña de arriba que dice “Array” para ver la cuadrícula y sus valores



Guardar un Archivo: L3 SM_P

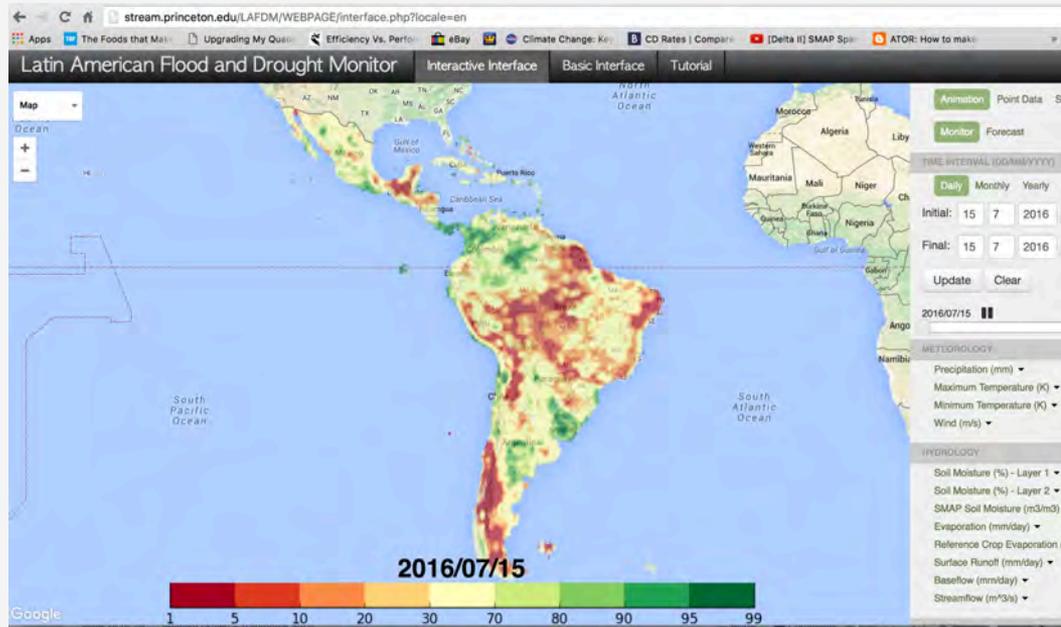
10. Para guardar la imagen en un formato diferente (e.g. Png, tiff, pdf) seleccionar "File-Save Image As"



Extraer Valores de Humedad del Suelo de SMAP

12. La forma mas directa de extraer valores de humedad del suelo de SMAP es por medio de la herramienta "Latin American Flood and Drought Monitor" de la Universidad de Princeton:

<http://stream.princeton.edu/LAFDM/WEBPAGE/interface.php?locale=en>



Extraer Valores de Humedad del Suelo de SMAP

13. Extraiga datos de humedad del suelo de SMAP

-En la ventana derecha seleccione “Point Data” en la parte de arriba.

-En la siguiente sección “Time Interval” especifique el periodo de interés. Recuerde que los datos de SMAP comenzaron a mediados de abril del 2015.

-En la parte de abajo seleccione SMAP soil moisture y haga clic en el mapa sobre su punto de interés o introduzca sus coordenadas manualmente con la opción “Manual Entry”

-En la ultima parte “Create Corresponding Data File” seleccionar “yes”

-Hacer clic sobre “Download Data”

Animation **Point Data** Spatial Data

TIME INTERVAL (DD/MM/YYYY)

Daily Monthly Yearly

Initial: 22 6 2016 - +

Final: 22 7 2016 - +

Update Clear

POINT DATA SELECTION

Map Click Manual Entry

Latitude: -17.309
Longitude: -52.910

Indices
 Water Balance
 Surface Fluxes
 Streamflow
 Soil Moisture (Layer 1)
 Soil Moisture (Layer 2)
 SMAP Soil Moisture
 Reference Crop Evaporation
 Vegetation
 Meteorology

Create Corresponding Data File?

Yes
 No

Download Data Only the last 1000 timesteps from the selected final date will be displayed

Extraer Valores de Humedad del Suelo de SMAP

14. Los datos bajan directamente a su computadora en formato text

```
year,month,day,SMAP Soil Moisture - 1 day composite (m3/m3)
2016,6,22,-999.000
2016,6,23,0.110
2016,6,24,-999.000
2016,6,25,-999.000
2016,6,26,0.119
2016,6,27,-999.000
2016,6,28,-999.000
2016,6,29,0.123
2016,6,30,-999.000
2016,7,1,0.112
2016,7,2,-999.000
2016,7,3,-999.000
2016,7,4,0.120
2016,7,5,-999.000
2016,7,6,-999.000
2016,7,7,0.097
2016,7,8,-999.000
2016,7,9,0.112
2016,7,10,-999.000
2016,7,11,-999.000
2016,7,12,0.111
2016,7,13,-999.000
2016,7,14,-999.000
2016,7,15,-999.000
2016,7,16,-999.000
2016,7,17,-999.000
2016,7,18,-999.000
```

Ejercicio

15. Bajar los datos de humedad del suelo de SMAP y de vegetación y/o meteorología de la misma página y crear una gráfica de todas las variables para explorar correlaciones entre ellas.