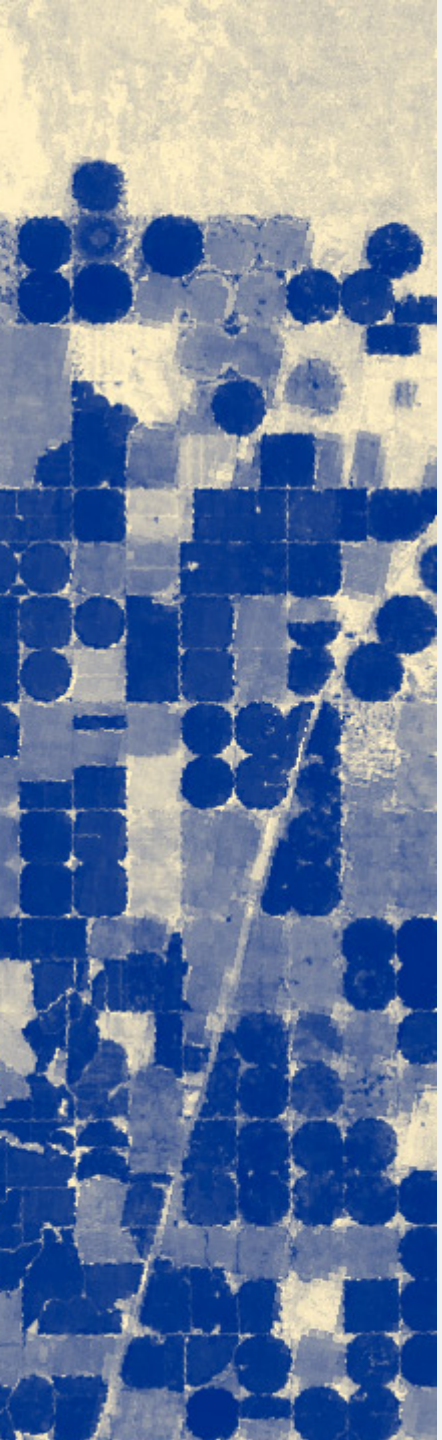


National Aeronautics and
Space Administration

ARSET

Applied Remote Sensing Training

http://arset.gsfc.nasa.gov

@NASAARSET

Applications of Remote Sensing to Soil Moisture and Evapotranspiration

Speakers:

Erika Podest

Amita Mehta

Guest Speaker:

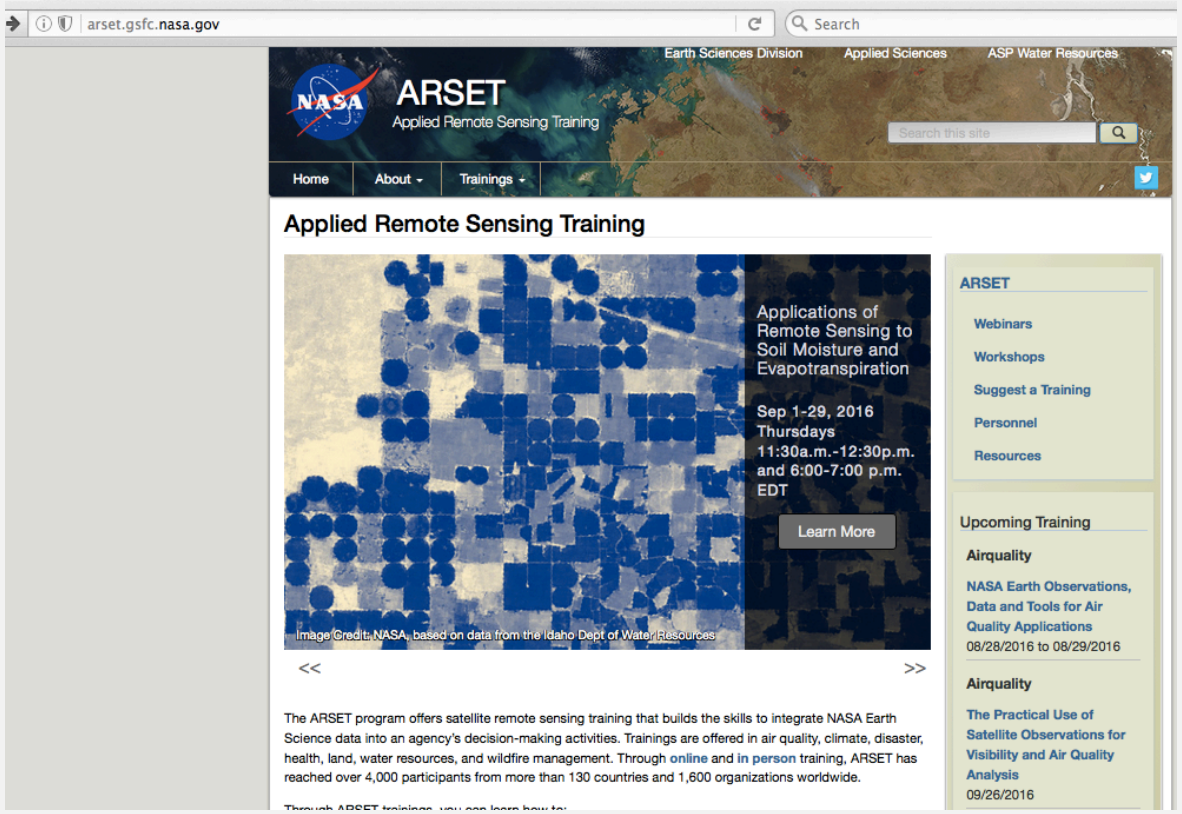
Christopher Hain, NOAA, chris.hain@noaa.gov

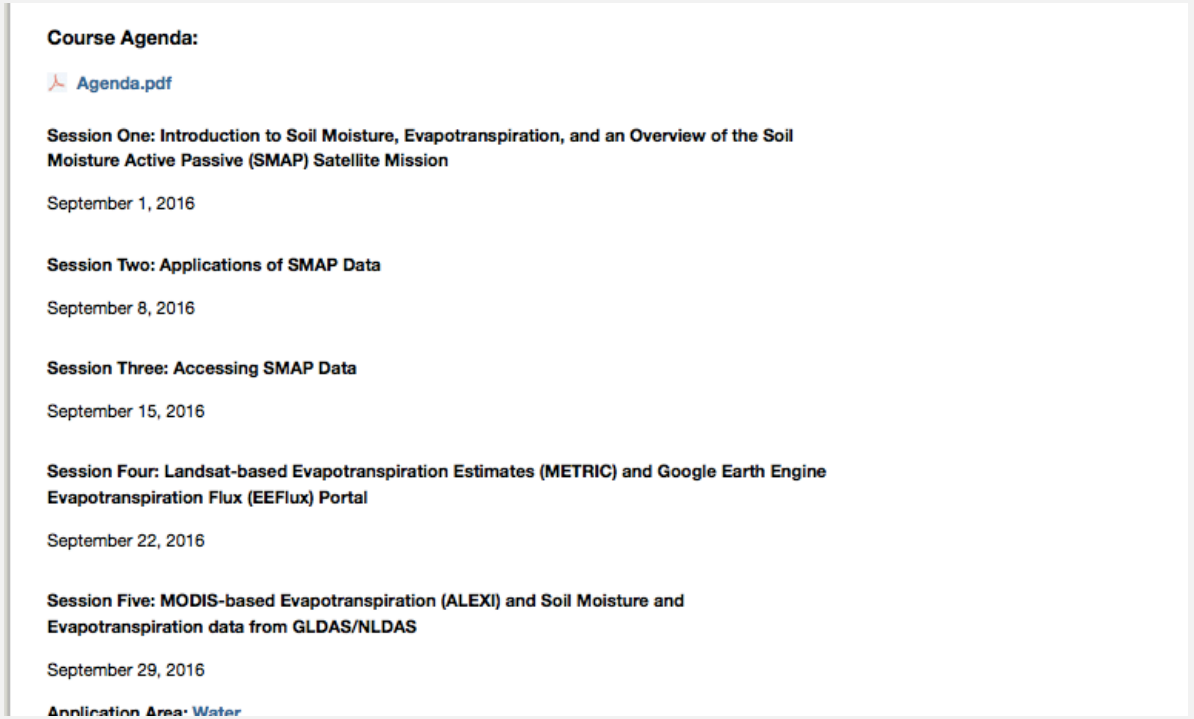
Homework and Certificate

- **Homework**
  - Answers to homework questions via Google form
  - will be Available at http://arset.gsfc.nasa.gov/water/webinars/apps-et-smap
- **Certificate of Completion**
  - Attend all 5 webinar sessions
  - Complete both homework assignments
  - Certificates will be emailed approx. 2 months after the course finishes by Marines Martins (marines.martins@ssaihq.com)

Course Material

http://arset.gsfc.nasa.gov/water/webinars/apps-et-smap





Agenda: Week 5

- ALEXI ET and Applications

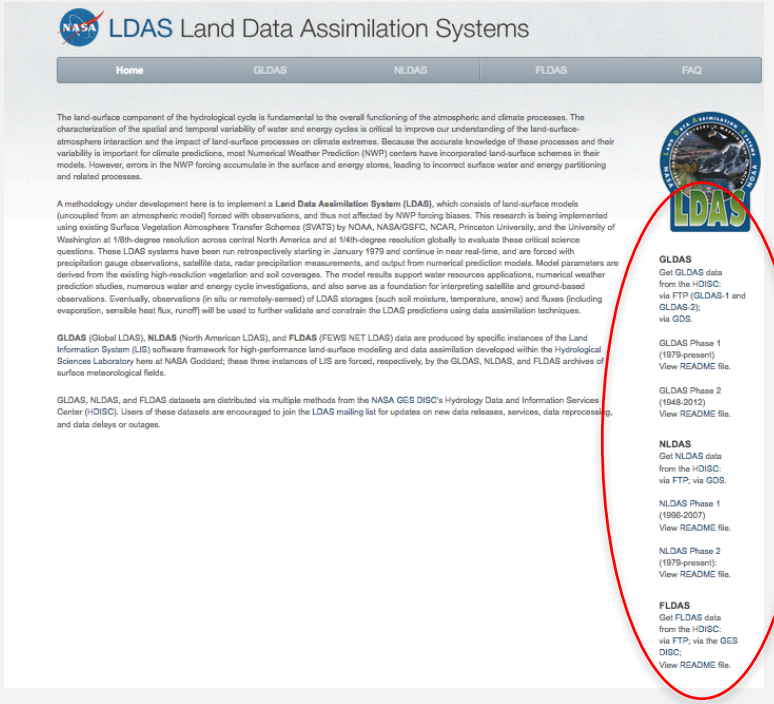
- ET and Soil Moisture Data from Global and North American Land Data Assimilation Systems (GLDAS and NLDAS): Data Access and QGIS Analysis

ET and Soil Moisture Data from GLDAS and NLDAS: Data Access and QGIS Analysis

ET and Soil Moisture from Land Surface Models

Land Data Assimilation System (LDAS): http://ldas.gsfc.nasa.gov

- Integrate satellite and ground observations within sophisticated numerical models with water and energy balance



GLDAS
Get GLDAS data from the HDISC: via FTP (GLDAS-1 and GLDAS-2); via GDS.

GLDAS Phase 1 (1979-present) View README file.

GLDAS Phase 2 (1948-2012) View README file.

NLDAS
Get NLDAS data from the HDISC: via FTP; via GDS.

NLDAS Phase 1 (1996-2007) View README file.

NLDAS Phase 2 (1979-present): View README file.

FLDAS
Get FLDAS data from the HDISC: via FTP; via the GES DISC; View README file.

North American Land Data Assimilation System-2 (NLDAS-2)

http://ldas.gsfc.nasa.gov/nldas

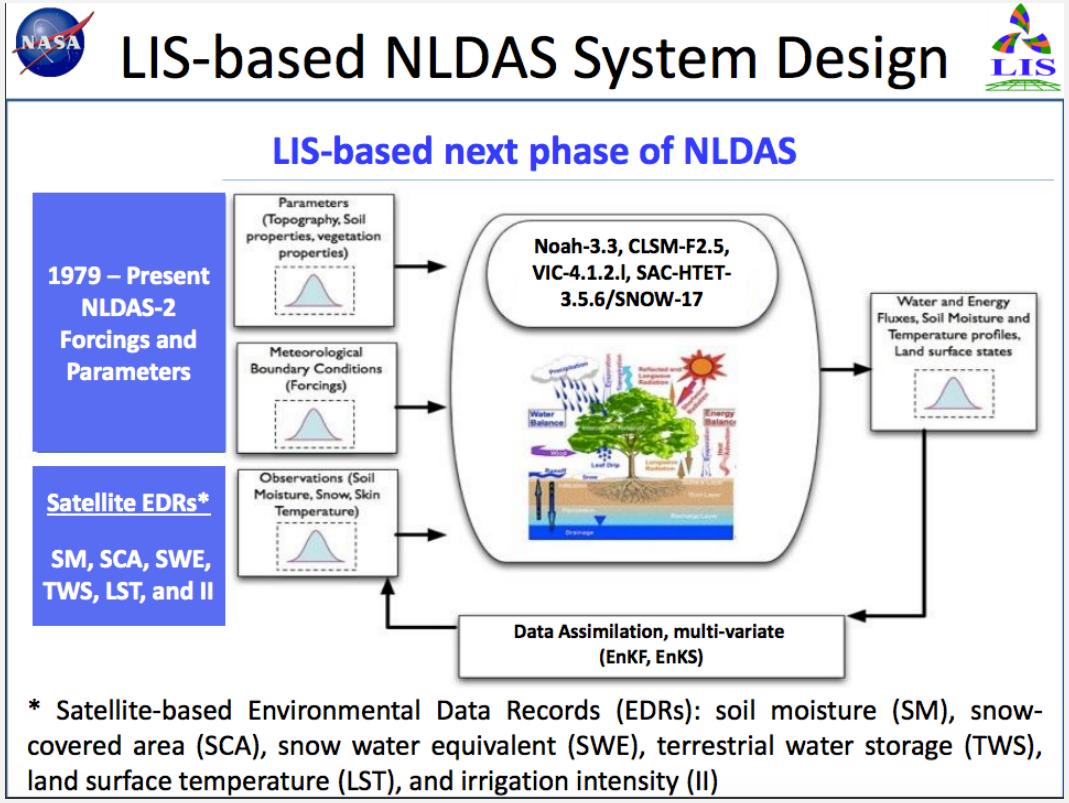
Four Land Surface Model Versions: NLDAS-2 Mosaic, Noah, SAC, and VIC

Inputs:

- Precipitation: NOAA-CPC rain gauges
- Meteorological: North American Regional Reanalysis (NARR)
- Surface Shortwave Radiation Data: NARR with GOES satellite bias-correction

Integrated Outputs Include:

- **Soil Moisture**
- **Evapotranspiration**
- Surface/Sub-Surface Runoff
- Snow Water Equivalent



Courtesy of David Mocko, NASA GSFC

http://ldas.gsfc.nasa.gov/nldas/presentations/NLDAS-LIS-status-future_2015-03-11.pdf

Global Land Data Assimilation System (GLDAS)

http://ldas.gsfc.nasa.gov/gldas/

Four Land Surface Model Versions: Noah, CLM2, Mosaic, and VIC

Inputs:

- Rainfall: TRMM and Multi-Satellite Based Data
- Meteorological Data: Global reanalysis and observations-based data from Princeton
- Vegetation Mask, Land/Water Mask, Leaf Area Index: MODIS (GLDAS-2)
- Clouds and Snow (for surface radiation); NOAA and DMSP satellites

Integrated Output Include

- **Soil Moisture**
- **Evapotranspiration**
- Surface/Sub-Surface Runoff
- Snow Water Equivalent

Rodell, M., P. R. Houser, U. Jambor, J. Gottschalck, K. Mitchell, C.-J. Meng, K. Arsenault, B. Cosgrove, J. Radakovich, M. Bosilovich, J. K. Entin, J. P. Walker, D. Lohmann, and D. Toll, 2004. The Global Land Data Assimilation System. Bulletin of the American Meteorological Society, 85(3):381–394.

LDAS Soil Moisture and ET Data Access

Model	Spatial/Temporal Resolutions	Data Source
GLDAS (NOAH)	• 1/4th – 1 degree (global) • 3 hour, monthly • 1948 – 2010	Giovanni: http://giovanni.gsfc.nasa.gov/giovanni Mirador: http://mirador.gsfc.nasa.gov/
NOAH (v 2.1)	• 2000 – present	
VIC	• 1979 – present	
NLDAS (NOAH, VIC)	• 1/8th – 1 degree (global) • 1 hour, monthly • 1979 - present	

Original data files are in GRIB format

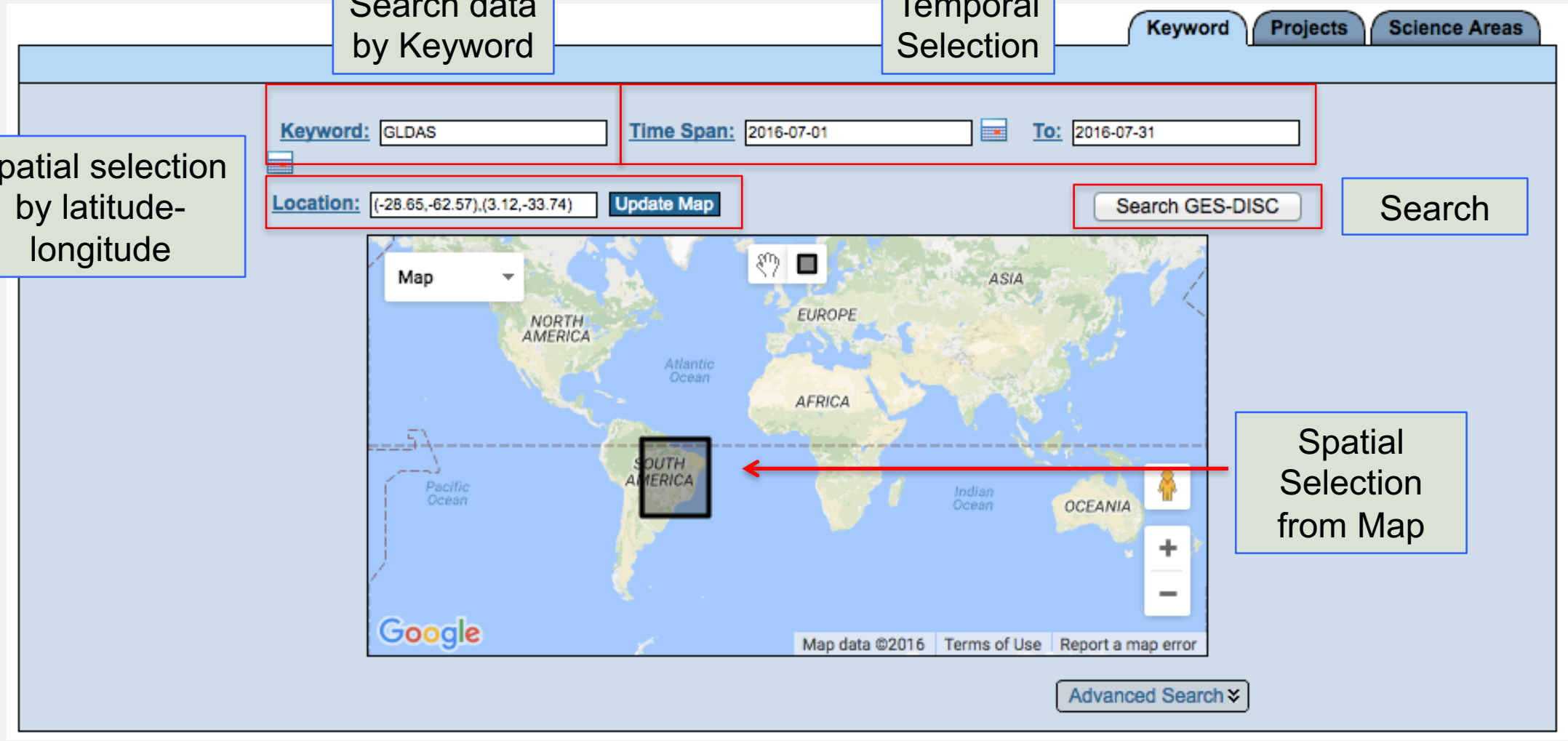
Soil Moisture and Evapotranspiration Data Access

- Demonstration

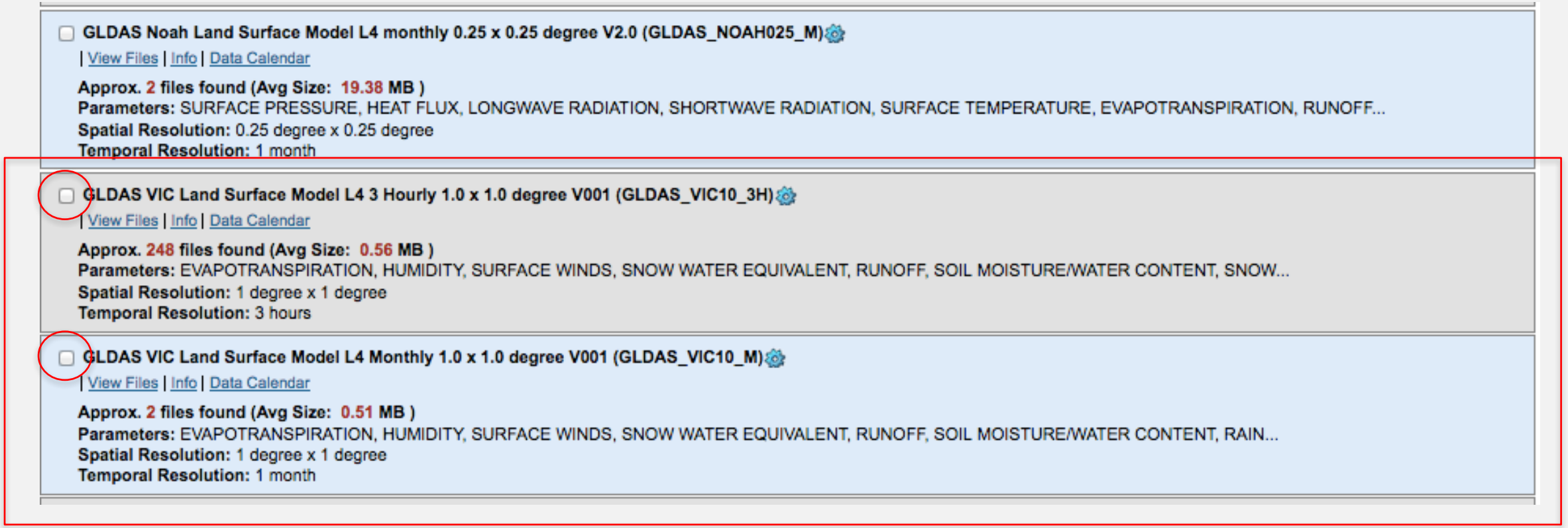
- Examples: Access and Download:
  1) GLDAS VIC data using Mirador
  2) NLDAS VIC data using Giovanni and import into QGIS

Search, Select, and Download Data from Mirador

http://mirador.gsfc.nasa.gov/

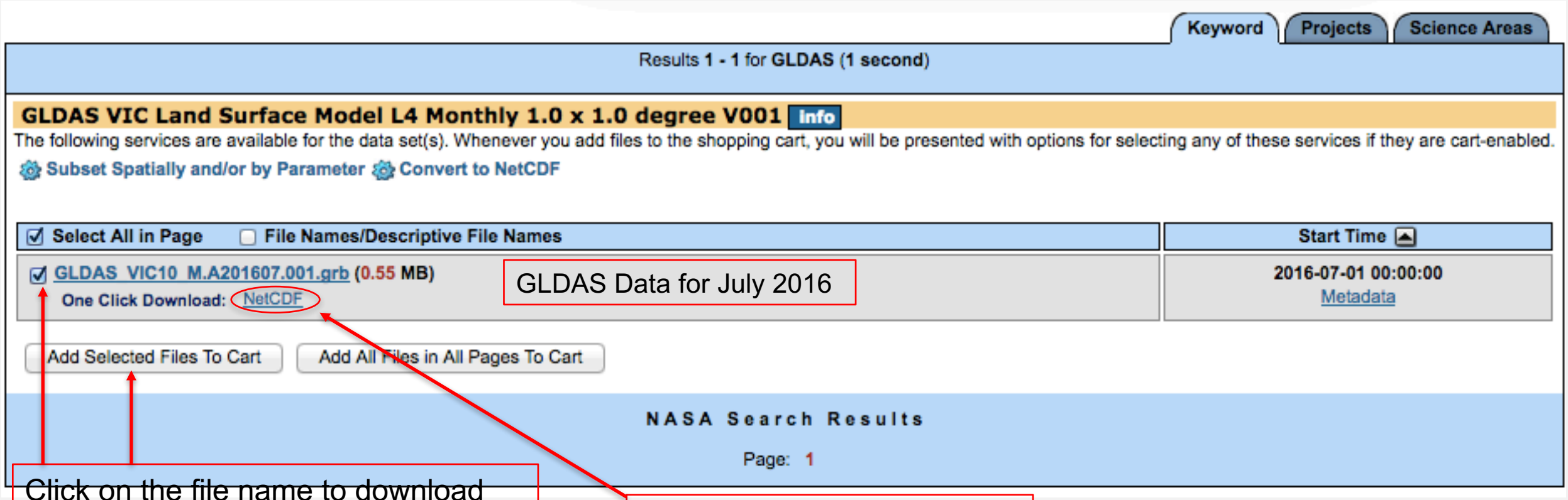


Search, Select, and Download Data from Mirador



Choose

Search, Select, and Download Data from Mirador

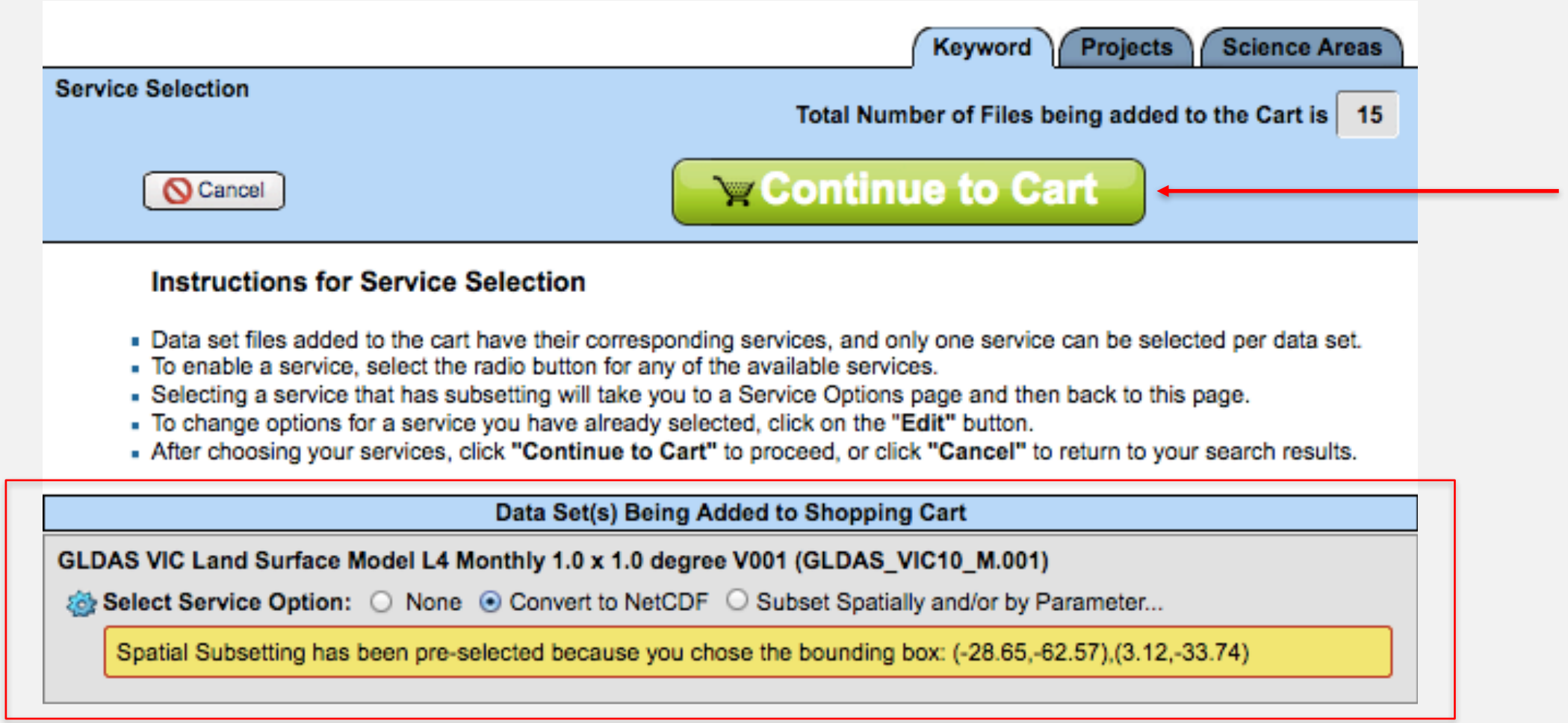


GLDAS Data for July 2016

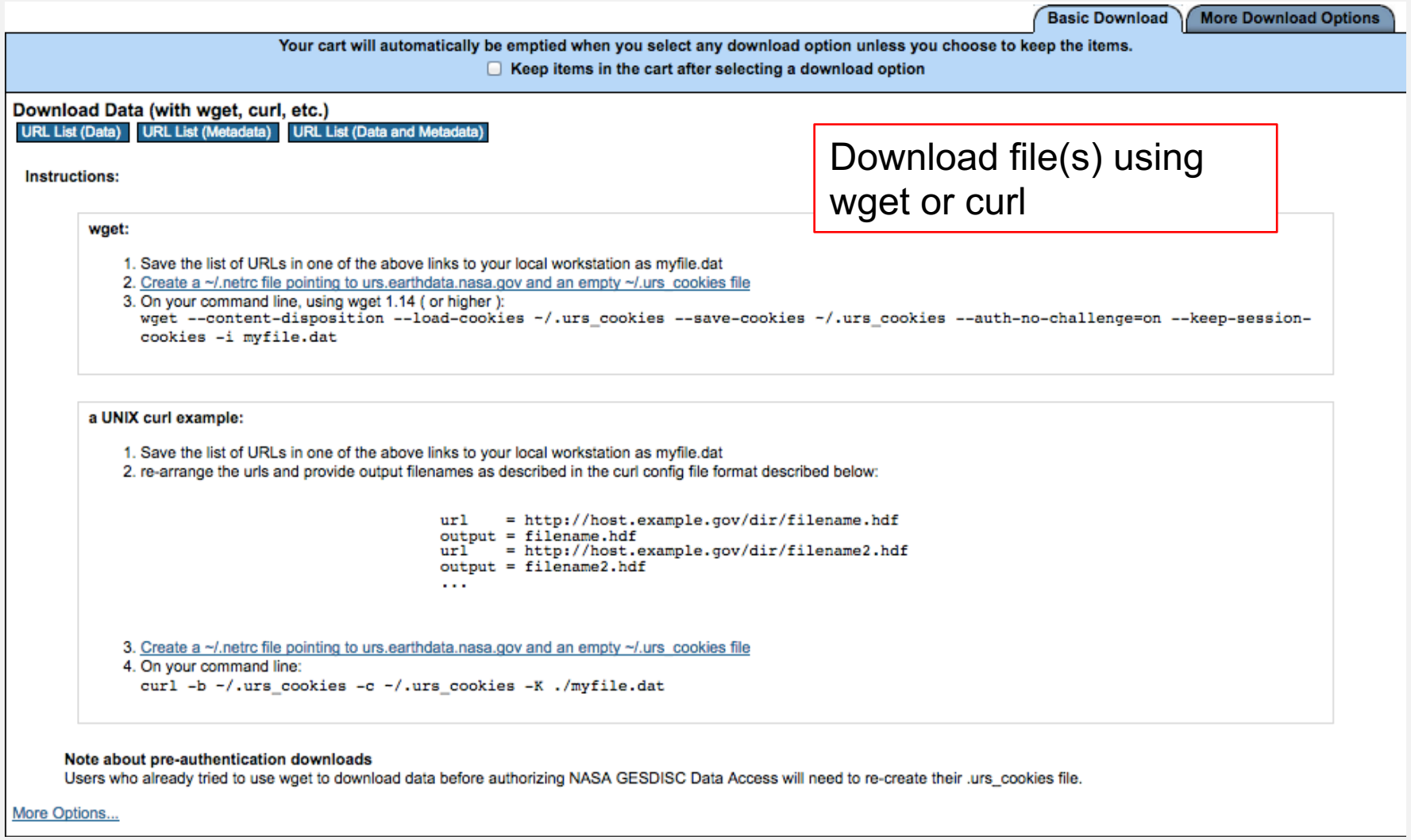
Click on the file name to download
Or select and 'Add to Cart' for multiple file download

Save Data in NetCDF Format

Search, Select, and Download Data from Mirador

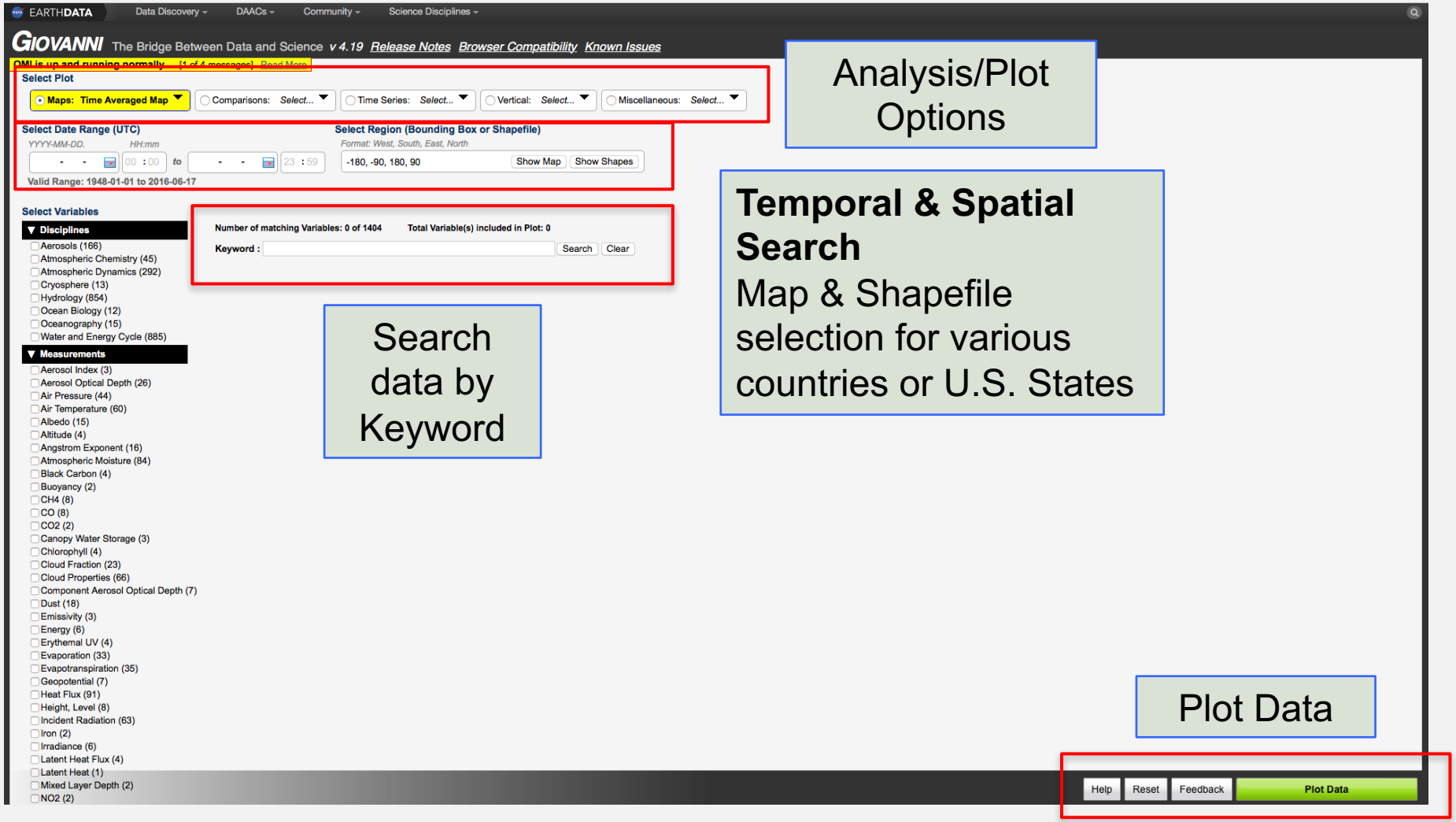


Search, Select, and Download Data from Mirador

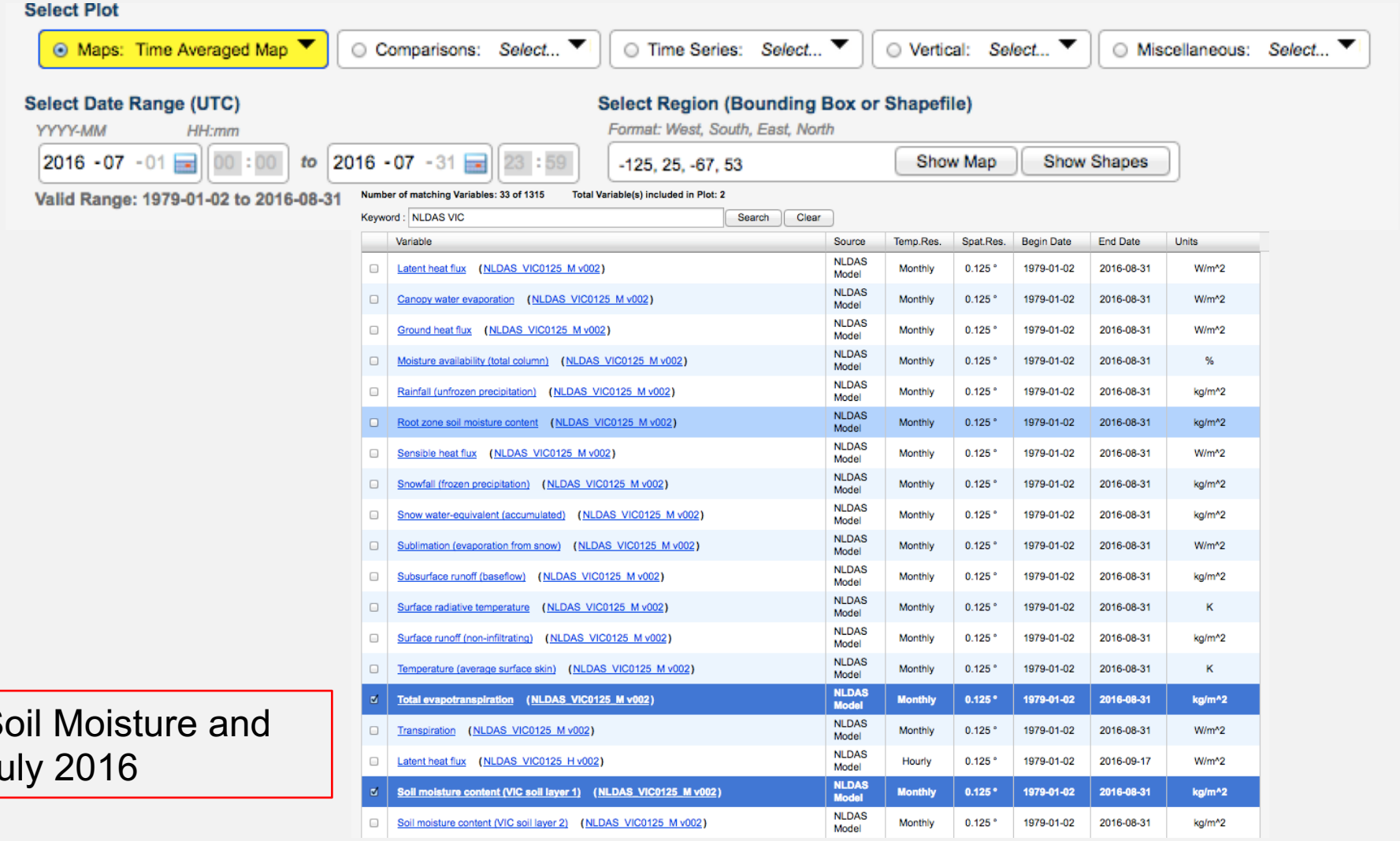


Search, Select, and Download Data from Giovanni

http://giovanni.gsfc.nasa.gov/giovanni/



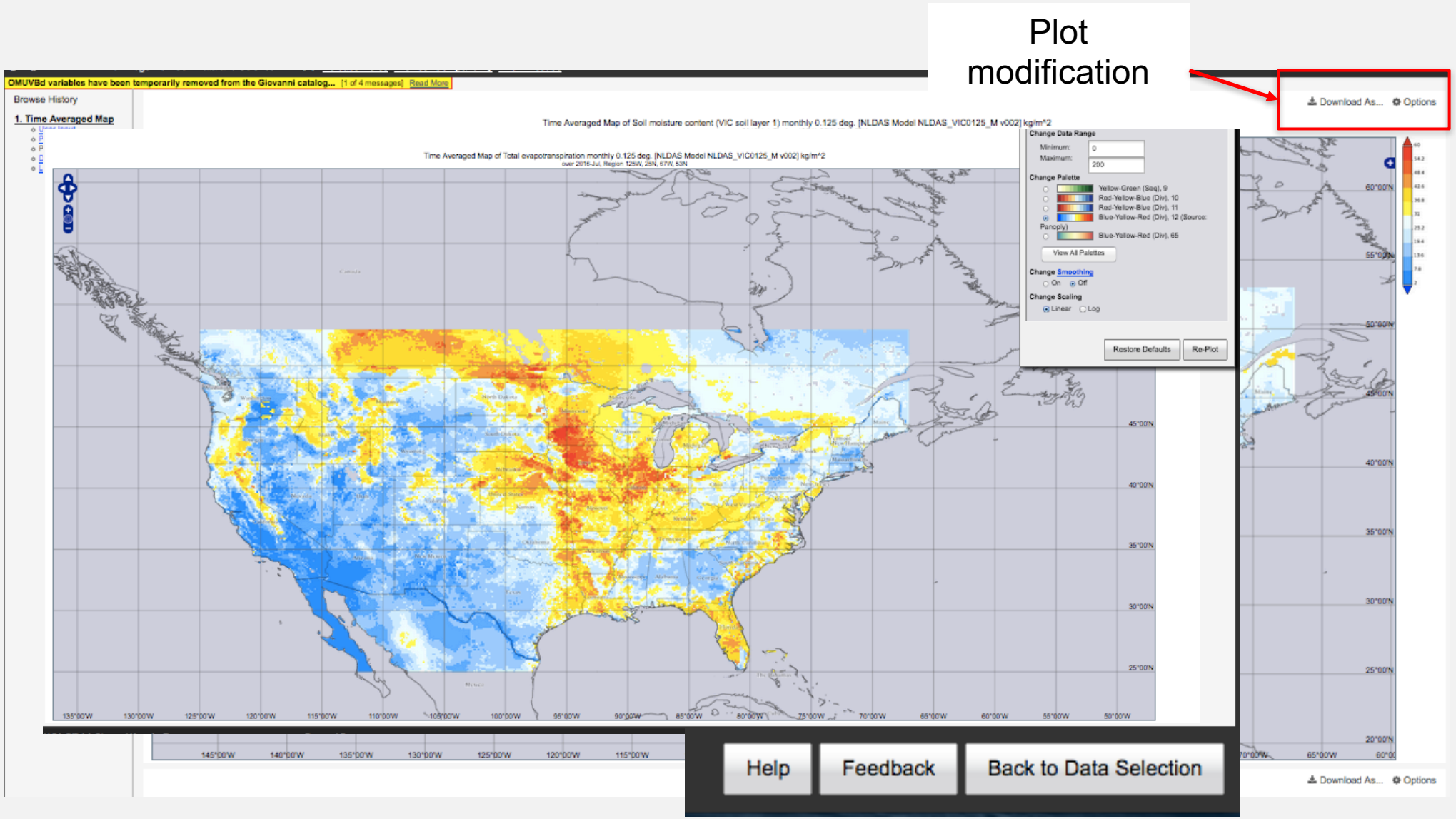
Search, Select, and Download Data from Giovanni



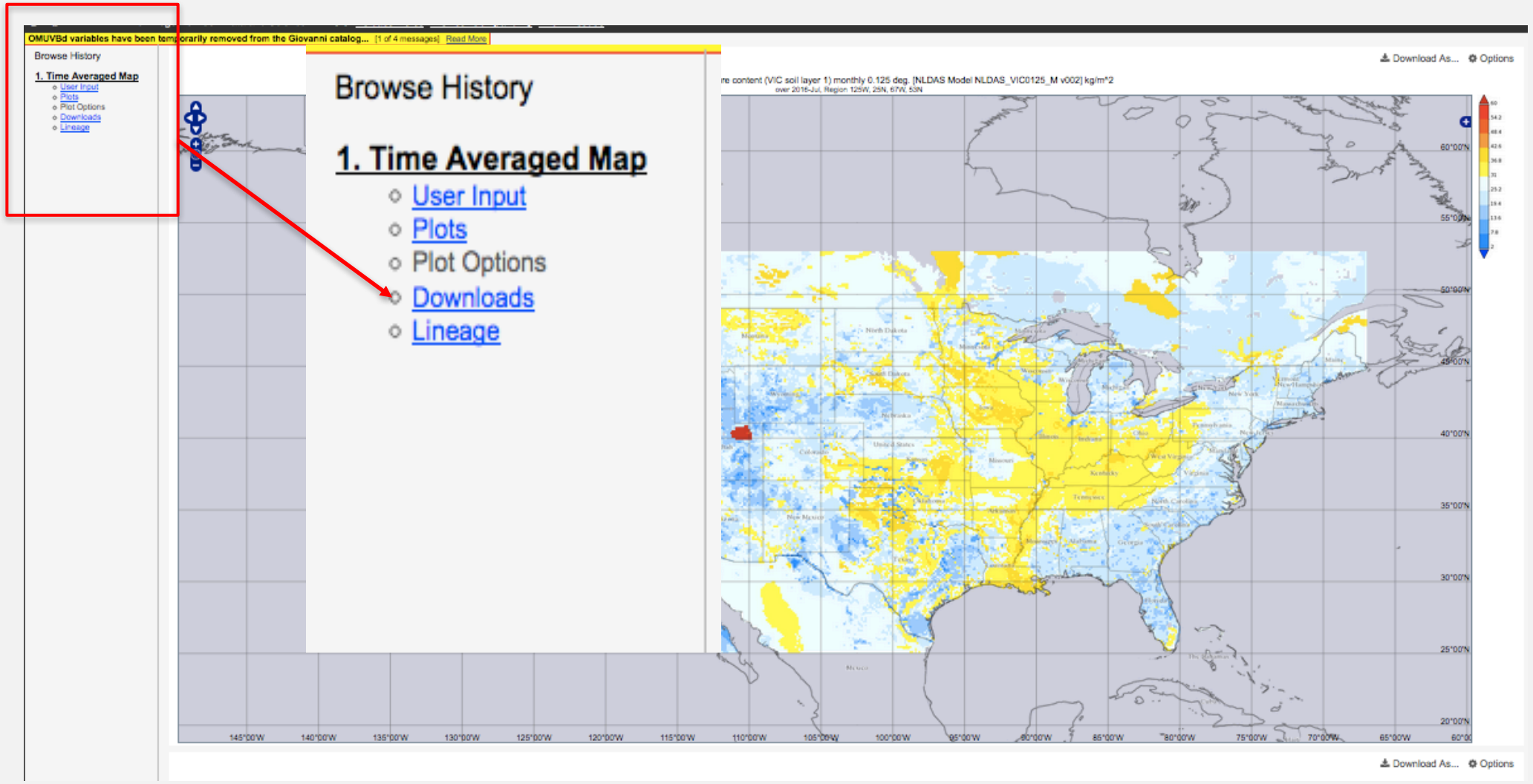
	Variable	Source	Temp.Res.	Spat.Res.	Begin Date	End Date	Units
☐	Latent heat flux (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Canopy water evaporation (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Ground heat flux (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Moisture availability (total column) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	%
☐	Rainfall (unfrozen precipitation) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Root zone soil moisture content (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Sensible heat flux (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Snowfall (frozen precipitation) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Snow water-equivalent (accumulated) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Sublimation (evaporation from snow) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Subsurface runoff (baseflow) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Surface radiative temperature (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	K
☐	Surface runoff (non-infiltrating) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2
☐	Temperature (average surface skin) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	K
☑	**Total evapotranspiration (NLDAS_VIC0125_M v002)**	**NLDAS Model**	**Monthly**	**0.125 °**	**1979-01-02**	**2016-08-31**	**kg/m^2**
☐	Transpiration (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	W/m^2
☐	Latent heat flux (NLDAS_VIC0125_H v002)	NLDAS Model	Hourly	0.125 °	1979-01-02	2016-09-17	W/m^2
☑	**Soil moisture content (VIC soil layer 1) (NLDAS_VIC0125_M v002)**	**NLDAS Model**	**Monthly**	**0.125 °**	**1979-01-02**	**2016-08-31**	**kg/m^2**
☐	Soil moisture content (VIC soil layer 2) (NLDAS_VIC0125_M v002)	NLDAS Model	Monthly	0.125 °	1979-01-02	2016-08-31	kg/m^2

Select Soil Moisture and ET for July 2016

Plot Data in Giovanni



Plot Data in Giovanni



Download Data Using Giovanni

Browse History

1. Time Averaged Map
   - User Input
   - Plots
   - Plot Options
   - **Downloads**
   - Lineage

Click on file links to download. Files contain data portrayed in the plot images.

NetCDF:

g4.timeAvgMap.NLDAS_VIC0125_M_002_soilmlyr1.20160701-20160731.125W_25N_67W_53N.nc
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PNG:

g4.timeAvgMap.NLDAS_VIC0125_M_002_soilmlyr1.20160701-20160731.125W_25N_67W_53N.png
g4.timeAvgMap.NLDAS_VIC0125_M_002_evpsfc.20160701-20160731.125W_25N_67W_53N.png

GEOTIFF:

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KMZ:

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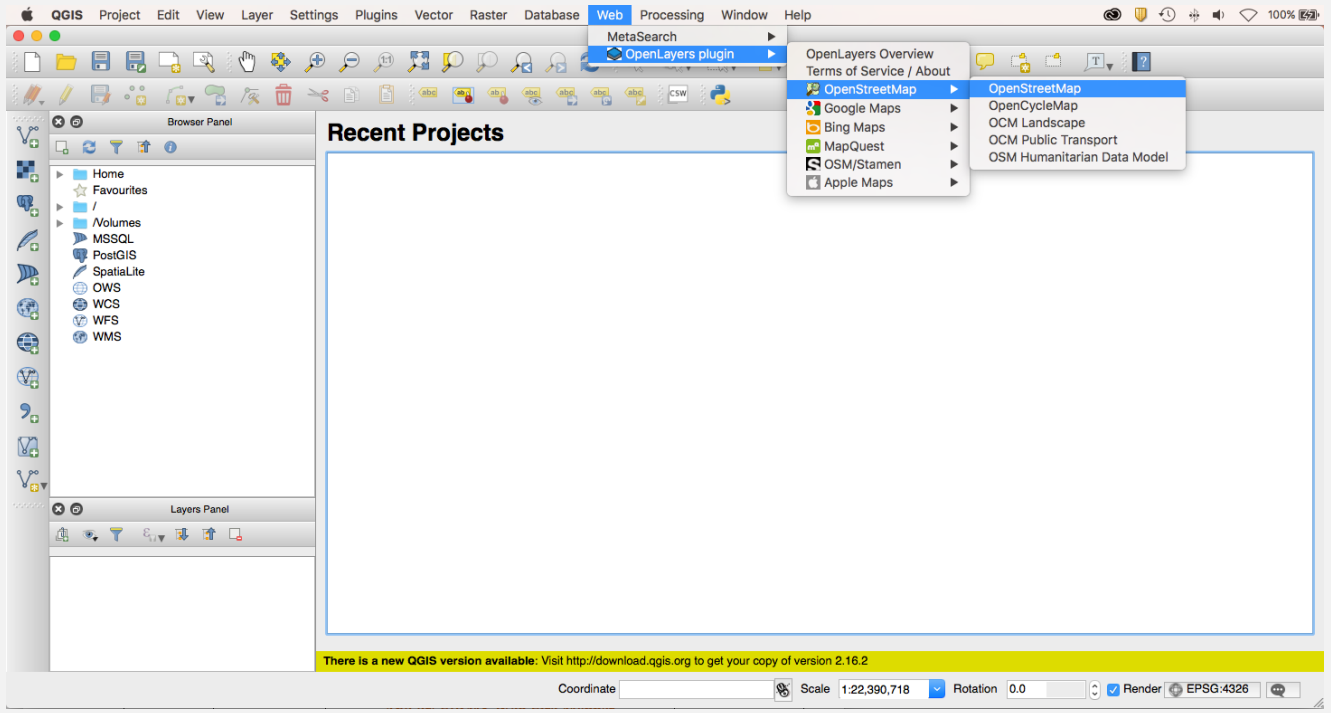
g4.timeAvgMap.NLDAS_VIC0125_M_002_evpsfc.20160701-20160731.125W_25N_67W_53N.kmz

NetCDF, Geotiff, kmz, and png files

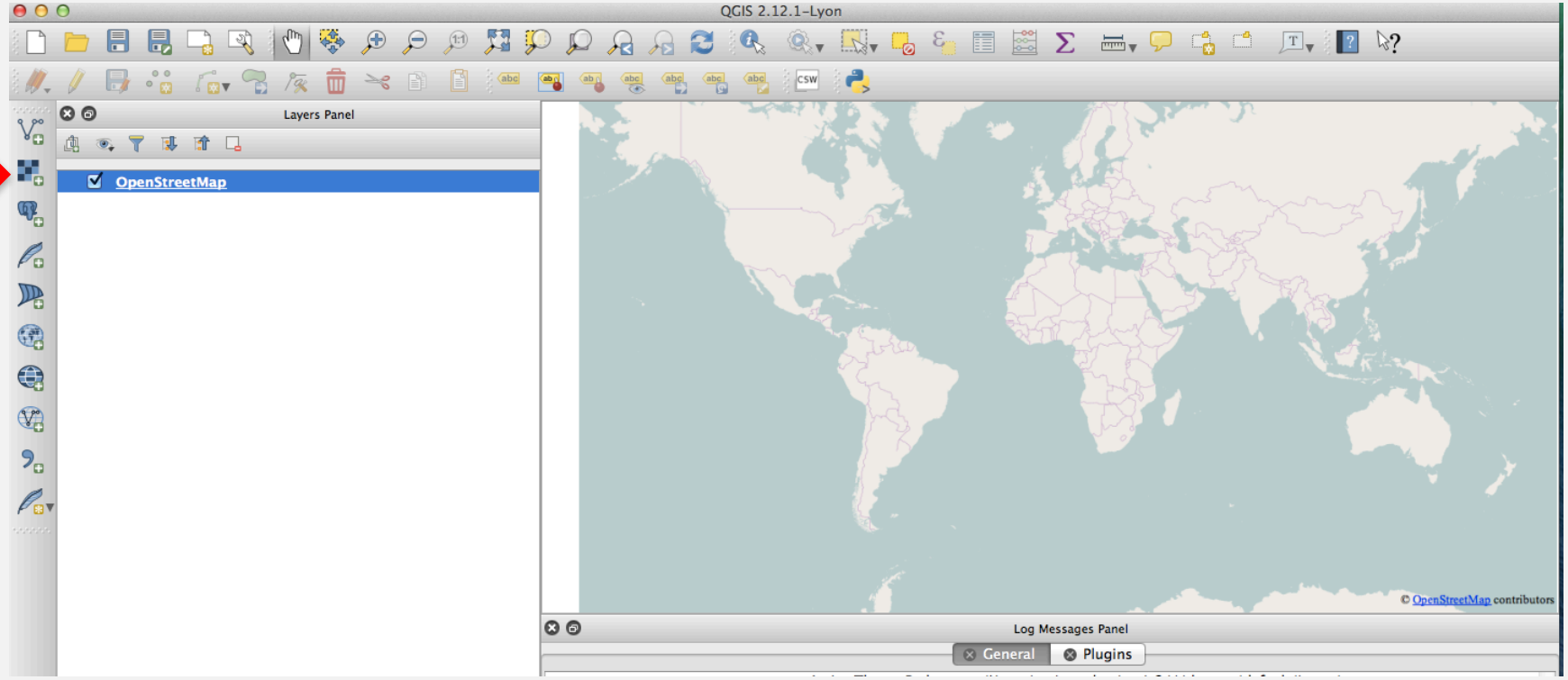
Import NLDAS ET and Soil Moisture NetCDF Files in QGIS

- Install QGIS on your computer:
  - http://bit.ly/ARSET_QGIS_Download_and_Install
- Open QGIS and OpenStreetMap
  - From top bar click on ‘Web’
  - Select ‘OpenLayers Plugin’
  - Select a background map (our exercise uses ‘OpenStreetMap’)



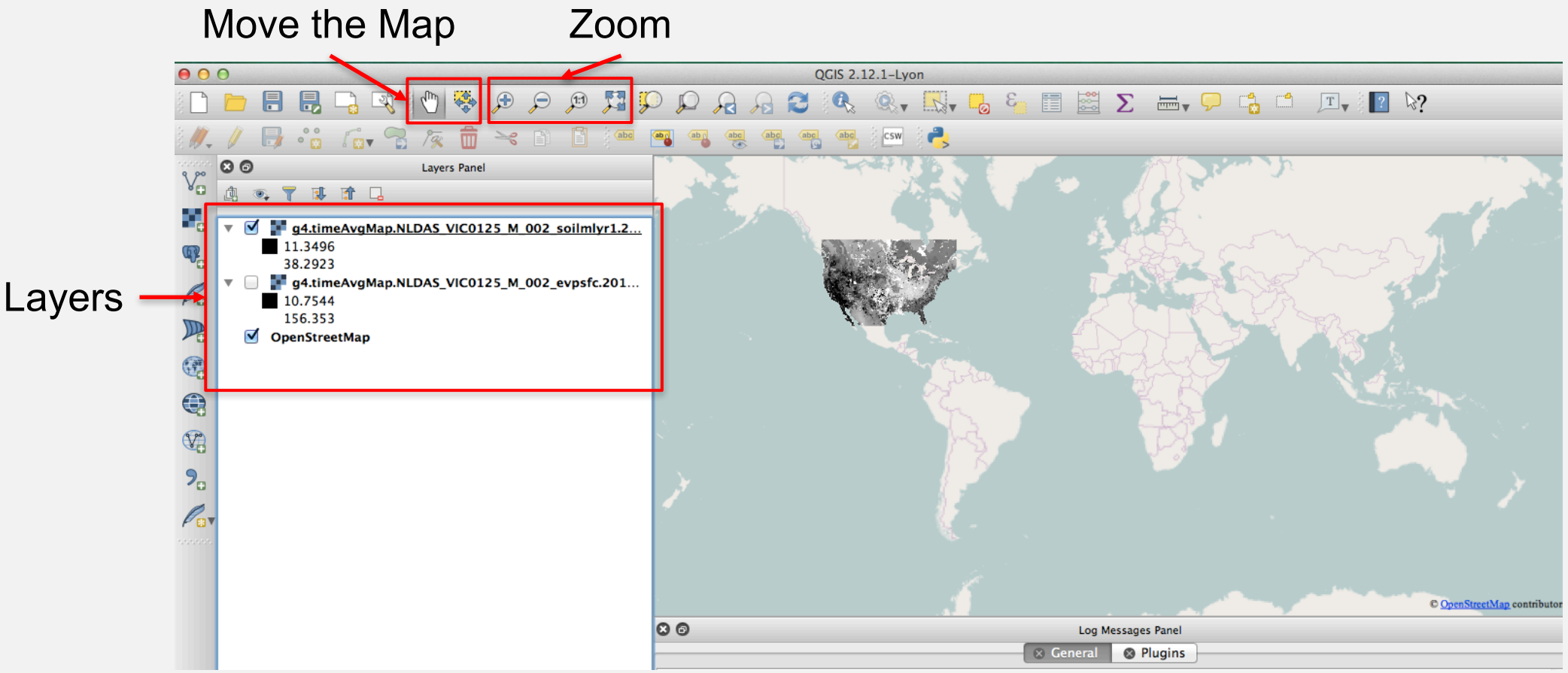
Import NLDAS ET and Soil Moisture NetCDF Files in QGIS

- Select ‘Add Raster’
- Load the NLDAS ET and soil moisture NetCDF data files one by one



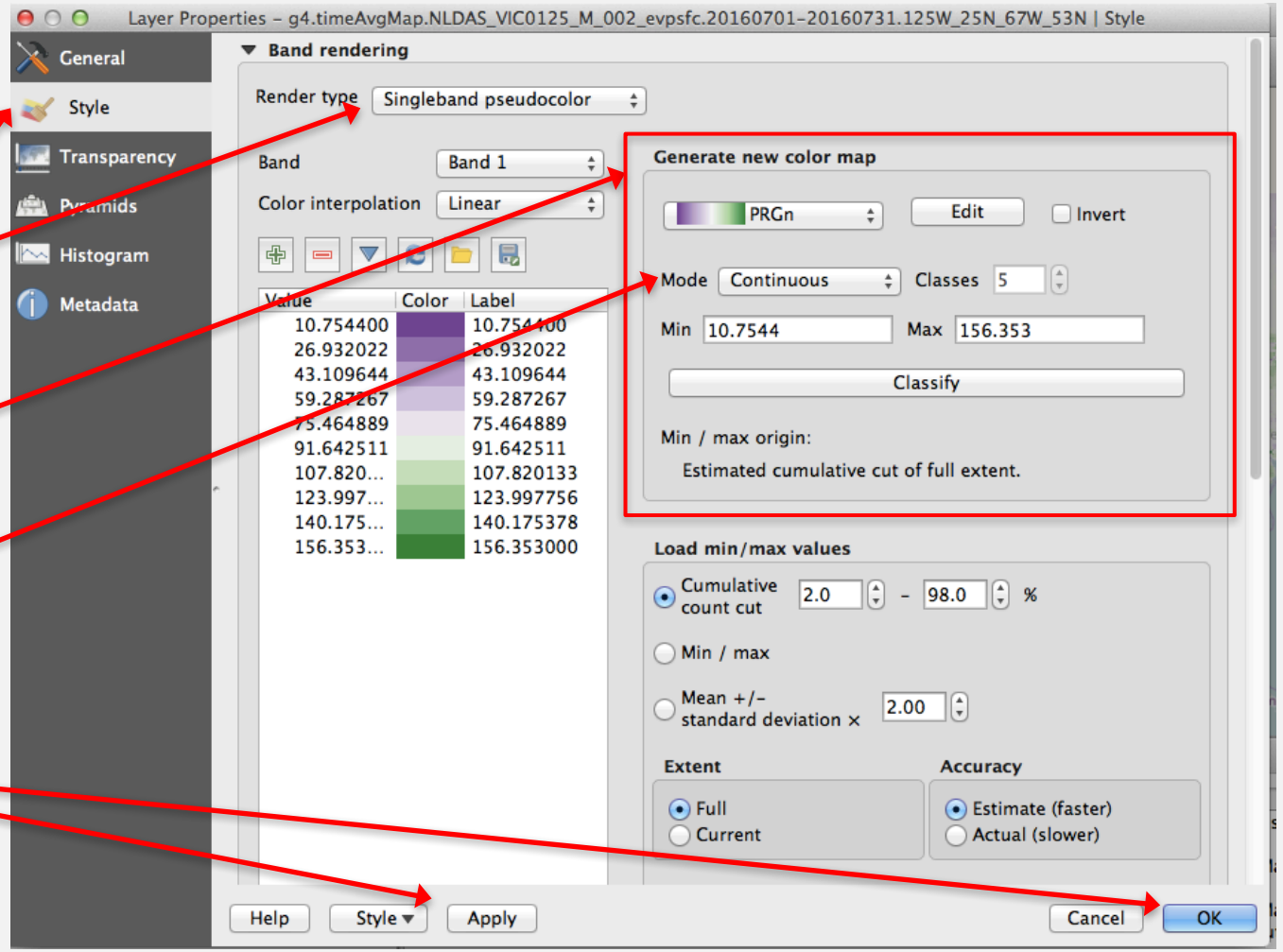
Import NLDAS ET and Soil Moisture NetCDF Files in QGIS

- You will get a black & white image of the data



Change Data Layer Properties

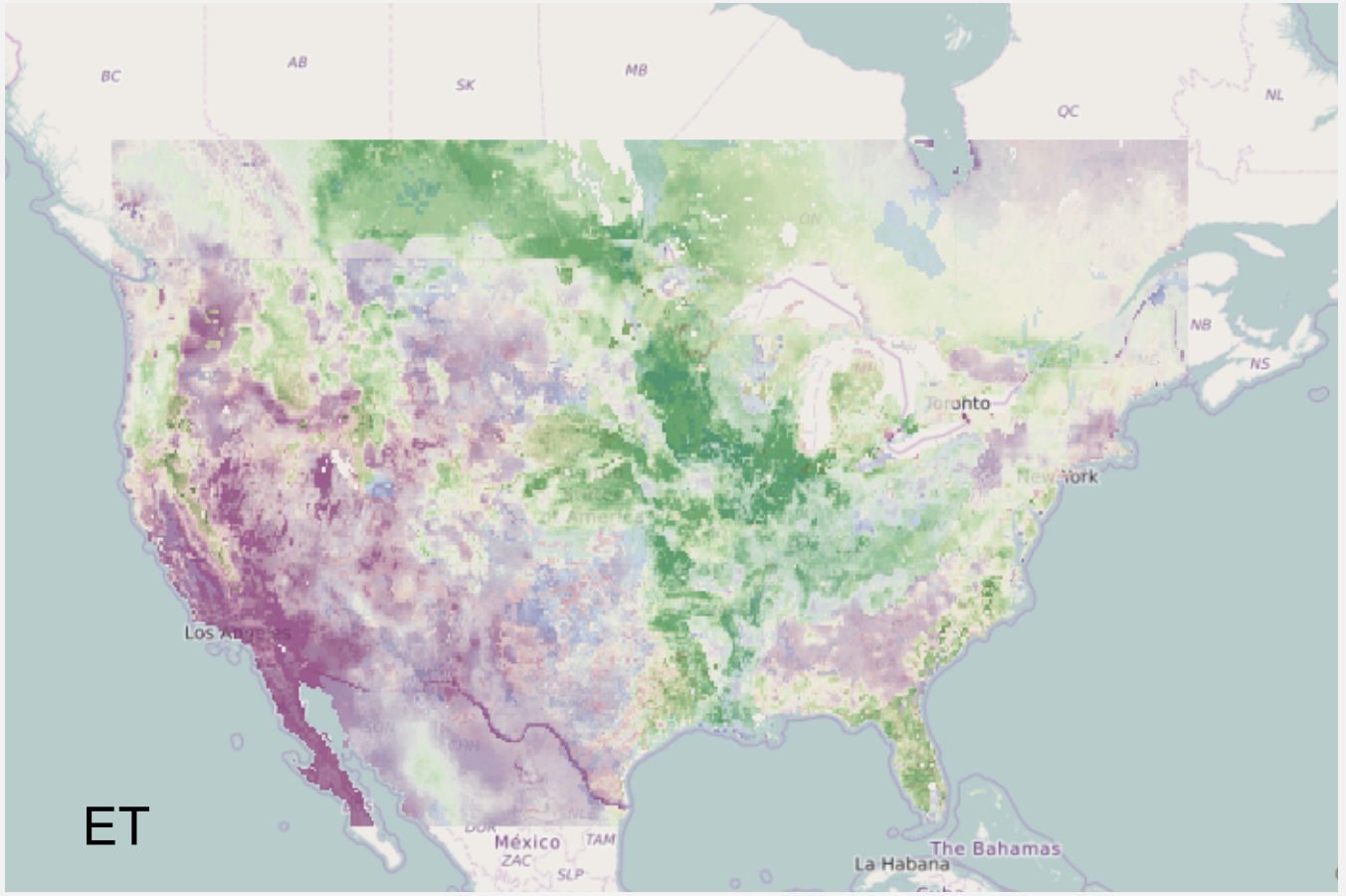
- Click on ‘layer’ on the top bar and select ‘properties’ to edit the map visualization & analysis
- Select ‘Style’ in ‘Render Type’ and select ‘Singleband pseudocolor’
- Choose color table from ‘Generate new color map’
- Choose ‘mode’ as continuous or ’Equal Interval’
- Click on ‘Apply’ and ‘OK’



Change Data Layer Properties

Value	Color	Label
10.754400		10.754400
26.932022		26.932022
43.109644		43.109644
59.287267		59.287267
75.464889		75.464889
91.642511		91.642511
107.820...		107.820133
123.997...		123.997756
140.175...		140.175378
156.353...		156.353000

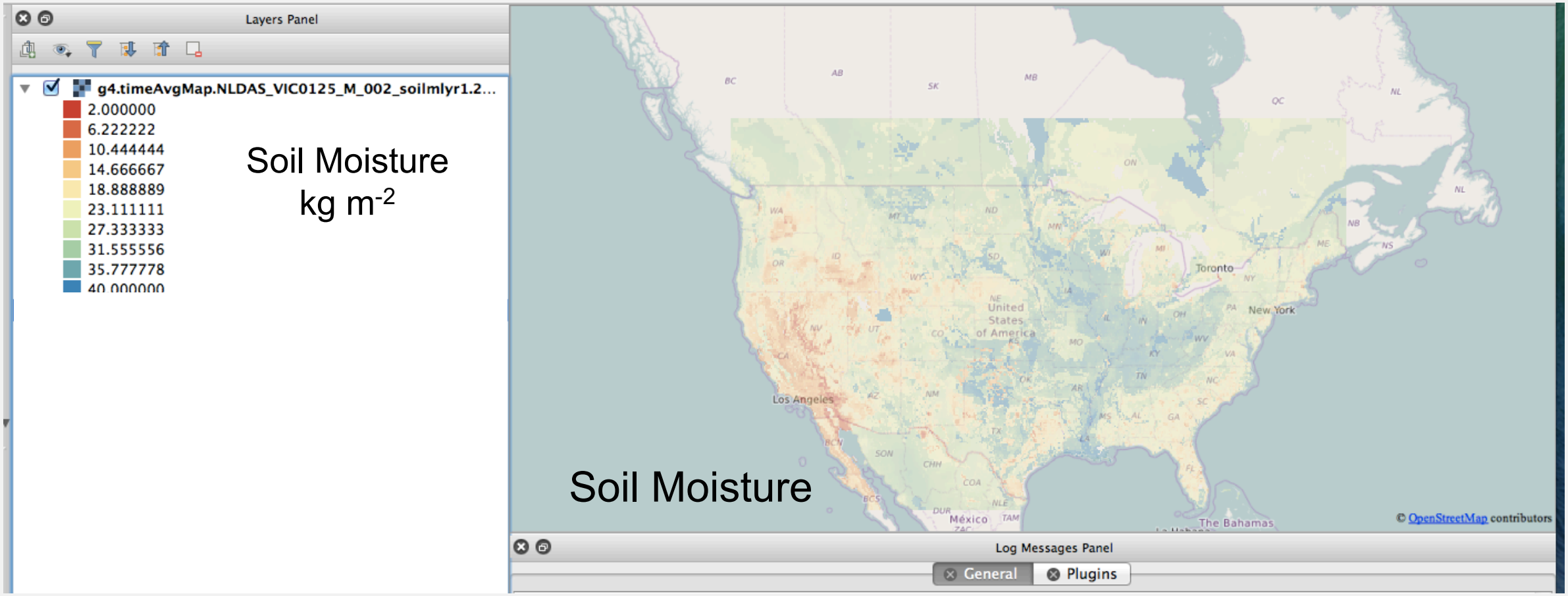
ET
kg m^{-2}



- From ‘Layer’ in the top bar, select ‘properties’
- From the left side menu, select ‘Transparency’
- Choose the appropriate % value to see the OpenStreetMap under the ET layer

ET and Soil Moisture Layers

- Repeat for the ‘Layer,’ ‘Properties’ steps for the soil moisture layer



Course Summary

This course provided information about:

- NASA's Soil Moisture Active Passive (SMAP) mission, soil moisture data from SPAM and its applications in the fields of agriculture, flood and drought monitoring, weather and climate forecasting, and human health
- SMAP data access from NASA's National Snow & Ice Data Center (NSIDC): http://nsidc.org
- Evapotranspiration estimates based on Landsat (METRIC) and its access from EEFLUX: http://eeflux-level1.appspot.com
- Evapotranspiration estimates from MODIS/GOES (ALEXI) and its access from NOAA: http://www.ospo.noaa.gov/Products/land/getd
- Evapotranspiration estimates based on Land Data Assimilation Models and its access from:
  - Mirador: http://mirador.gsfc.nasa.gov
  - Giovanni: http://giovanni.gsfc.nasa.gov/giovanni

Thank You

Sign up to receive updates on future ARSET trainings:
http://lists.nasa.gov/mailman/listinfo/arset