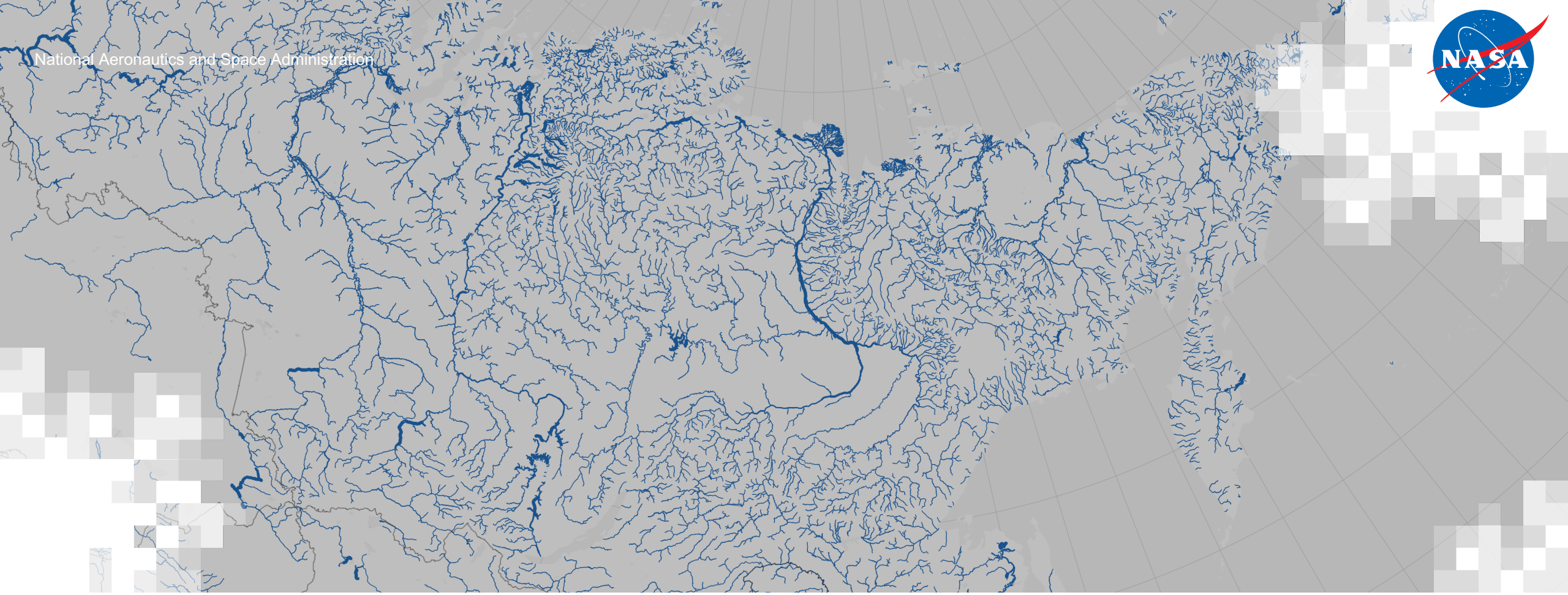


Exercise 1: Using Earth Observations to Monitor Water Budgets for River Basin Management II

Amita Mehta and Sean McCartney

July 21, 2020

Exercise 1

- This exercise focuses on acquiring the data we will use for water budget estimation in sessions 2 & 3.

Objectives

- After participating in this exercise, attendees should be able to replicate the steps for acquiring Earth science data provided from NASA's Earth Observing System Data and Information System (EOSDIS), accessed from:
  - Giovanni for **IMERG* precipitation** data
  - AppEEARS* for **MODIS Evapotranspiration (ET)** data
  - PO.DAAC* for **GRACE-FO Terrestrial Water Storage (TWS)** anomaly data
  - NASA GES DISC* for **GLDAS 2.1** data

*IMERG: Integrated Multi-satellitE Retrievals for GPM

*AppEEARS: Application for Extracting and Exploring Analysis Ready Samples

*PO.DAAC: Physical Oceanography Distributed Active Archive Center

*GES DISC: Goddard Earth Sciences Data and Information Services Center

Requirements

- Account registered with NASA EarthData
- QGIS installed on your computer
- Folder with a shapefile of the Limpopo River Basin saved on your computer (link to access the shapefile is found at the link below).
  - https://arset.gsfc.nasa.gov/water/webinars/water-budgets-river-basin

Note

This is a four-part exercise to save NASA Earth science data to a directory on your computer for analysis in sessions 2 & 3 of the webinar series:

Part 1: Download IMERG precipitation data

Part 2: Download MODIS ET data

Part 3: Download GRACE-FO Terrestrial Water Storage (TWS) anomaly data

Part 4: Download GLDAS 2.1 precipitation, ET, TWS, and runoff data

- Questions based on this exercise will be included in Homework 1

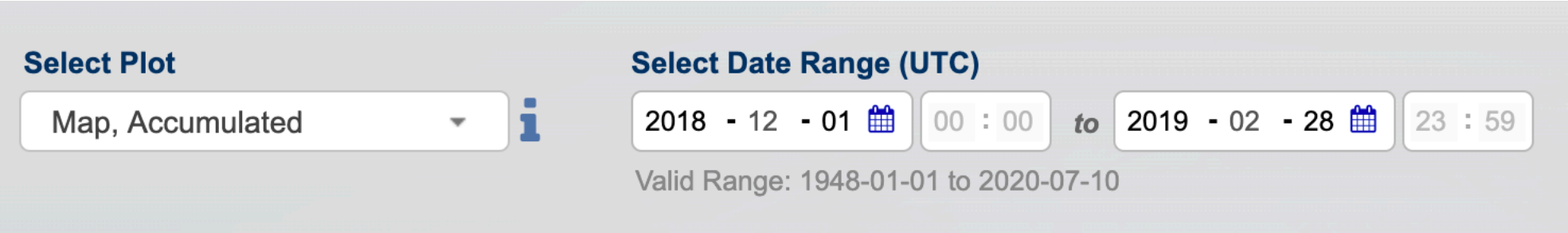
Part 1

Download monthly IMERG precipitation data for the selected months:

1. December (2018), January, February (2019)
2. June, July, August (2019)

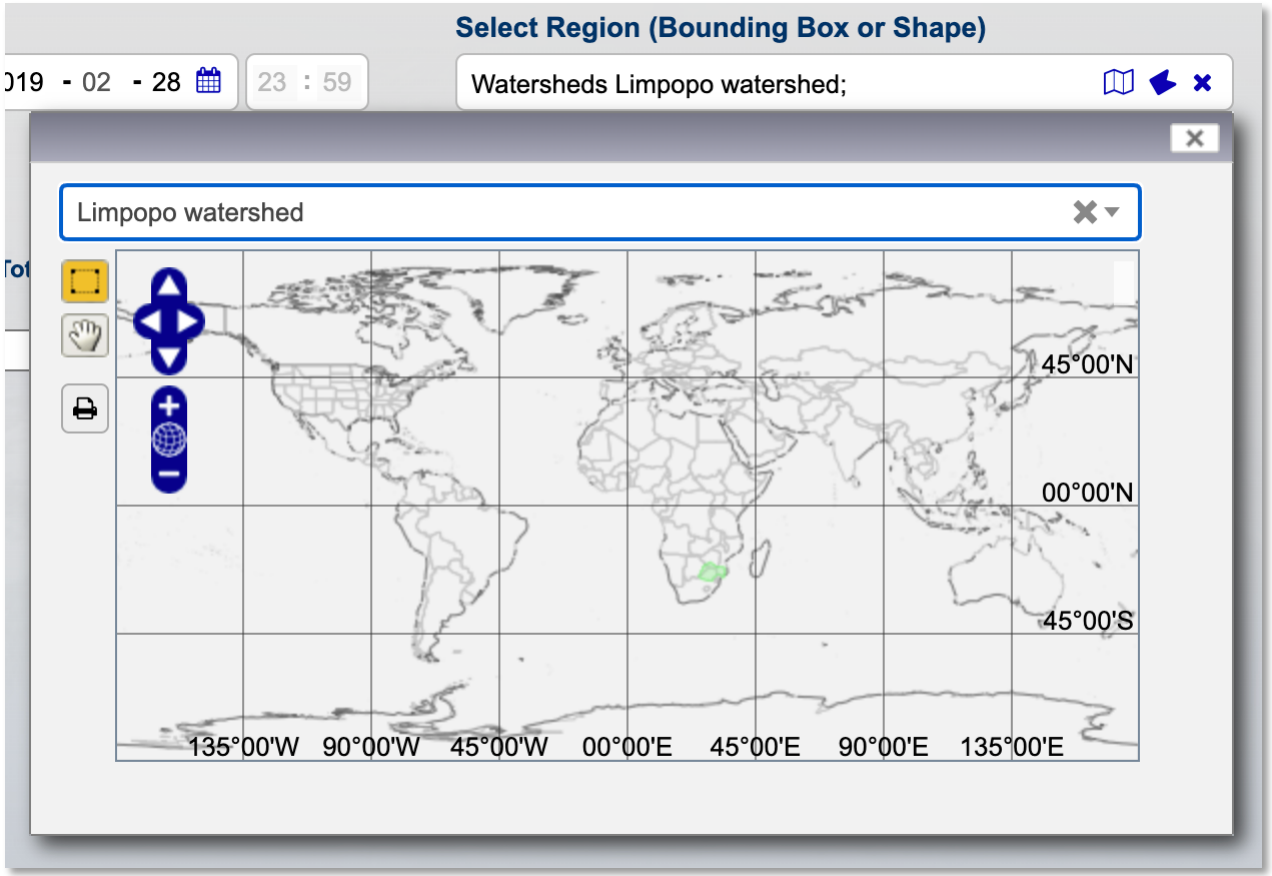
Part 1: Download Monthly IMERG Precipitation Data

1. Go to: https://giovanni.gsfc.nasa.gov/giovanni/
2. Login using your EarthData username and password
3. Select Plot → Map, Accumulated
4. Select Date Range (UTC) → Dec 1, 2018 to Feb 28, 2019



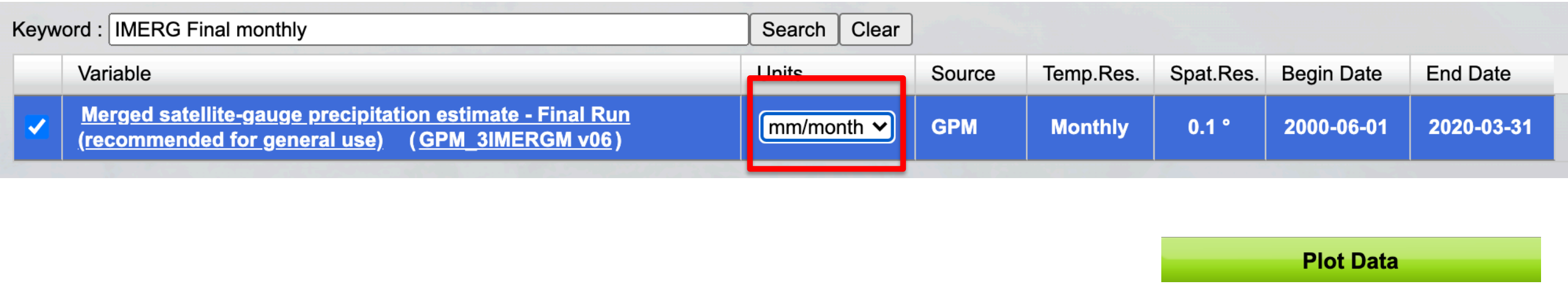
Part 1: Download Monthly IMERG Precipitation Data

5. Select Region (Bounding Box or Shape)
   - Click on the blue icon (Select a shape…).
   - Type "Limpopo watershed" and click on the highlighted text.
   - Once selected, the watershed polygon will be delineated in green on the map.



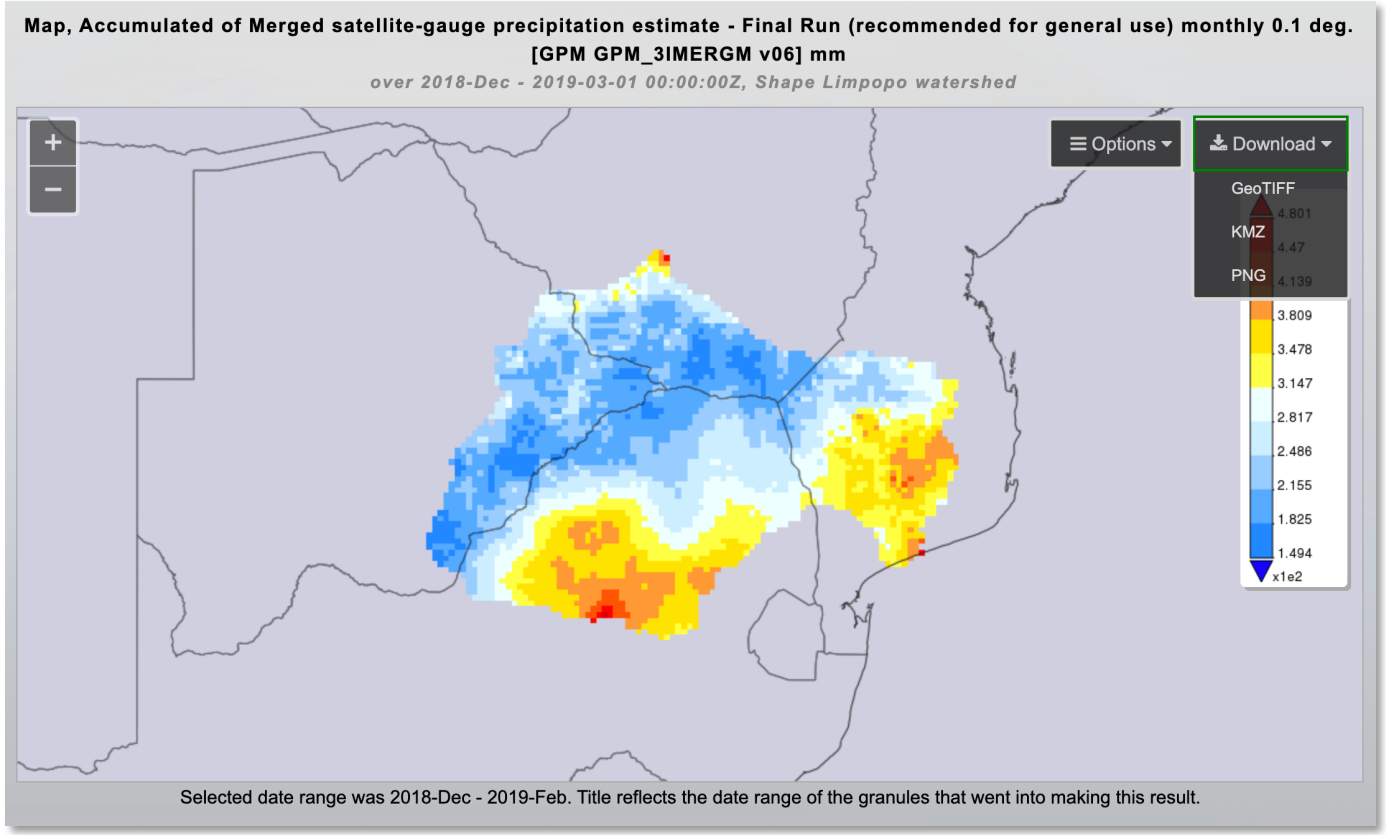
Part 1: Download monthly IMERG Precipitation Data

6. Next to **Keyword** type "IMERG Final monthly" and click **Search**.
7. Select the Variable "Merged satellite-gauge precipitation estimate - Final Run (recommended for general use) (GPM_3IMERGM v06)."
8. Change units to **mm/month**.
9. Click on Plot Data.



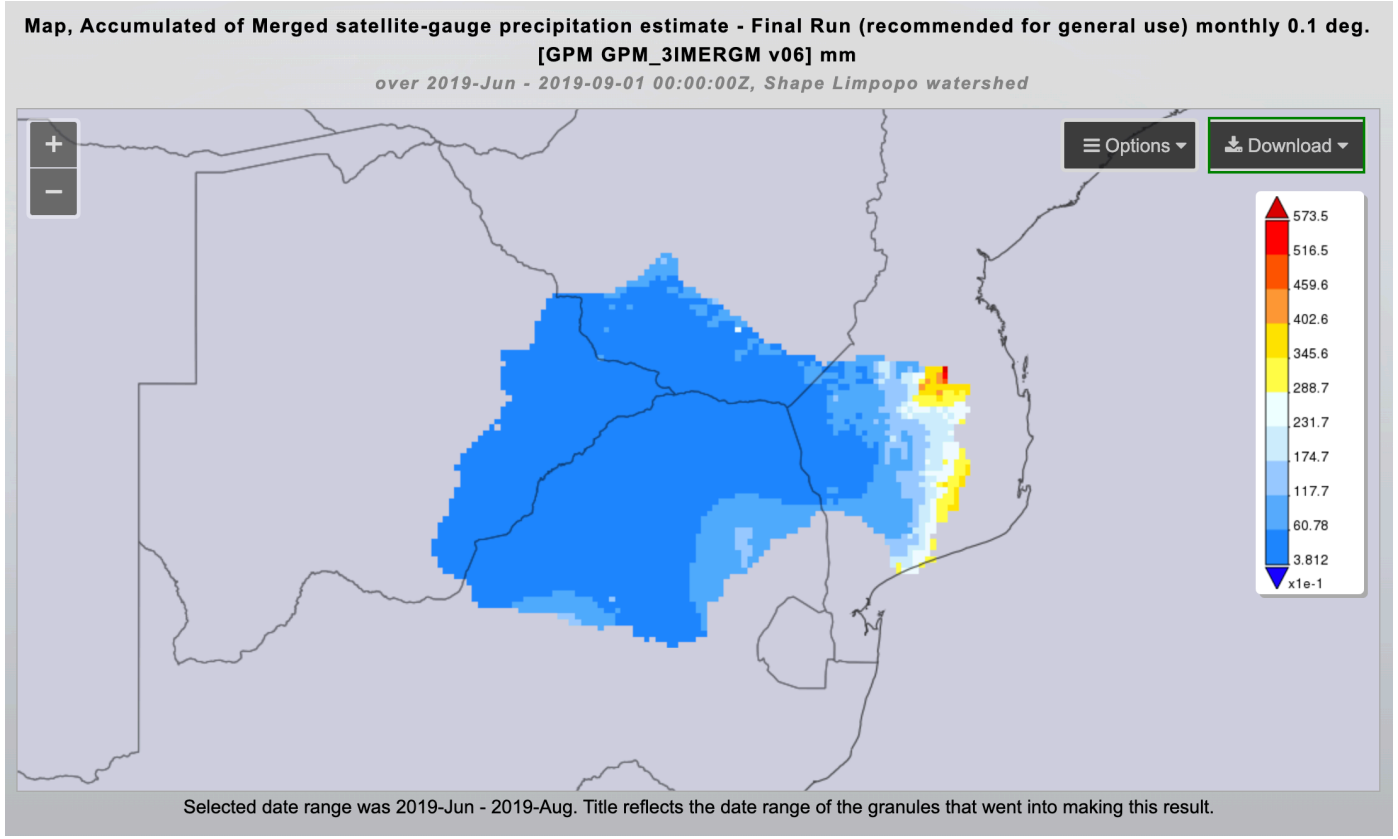
Part 1: Download Monthly IMERG Precipitation Data

10. Click on Download → GeoTIFF.
11. Save the file to a working directory on your computer with a short, descriptive filename (e.g. IMERG_Dec18-Feb19.tif).



Part 1: Download Monthly IMERG Precipitation Data

12. Click on "Back to Data Selection" (lower right button).
13. Repeat steps 4 - 11 for June – August (2019) and save to your working directory with short, descriptive filename (e.g. IMERG_Jun-Aug19.tif).



Part 2

Download 8-day MODIS ET data products (MOD16) for the selected months:

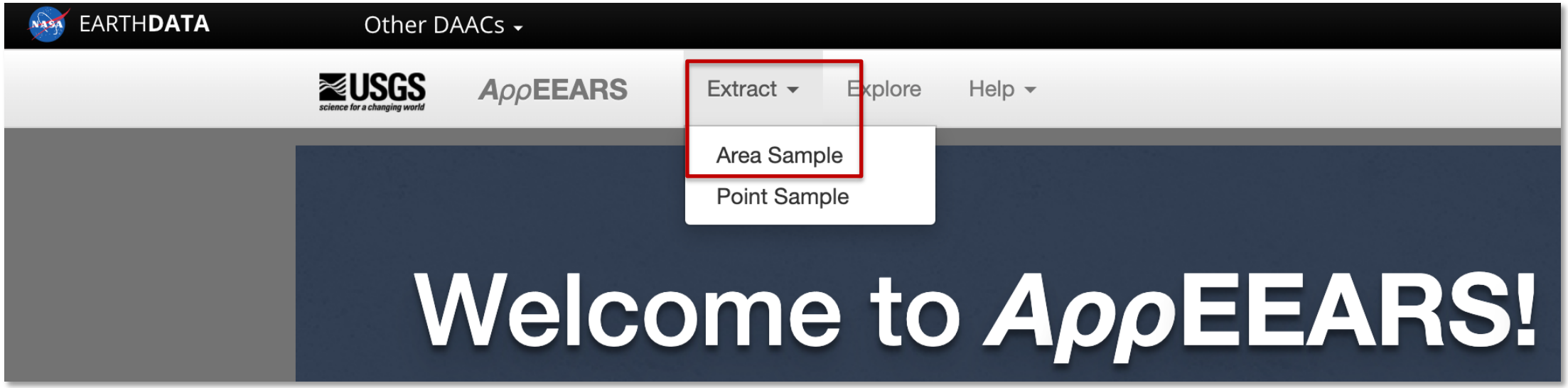
1. December (2018), January, February (2019)
2. June, July, August (2019)

Note:

- The start and end dates are in Julian days.
- The Julian day for each MODIS image represents the first day of the 8-day composite.
- The MOD16 file name has the following naming convention:
  MOD16A2.A2002081.h02v06.105.2010355155223.hdf
  - MOD16A2 - Product Short Name
  - .A2002081 - Julian Date of Data Acquisition (A-YYYYDDD)
  - . h02v06 - Tile Identifier (horizontalXXverticalYY)
  - .105 - Collection Version
  - . 2010355155223 - Julian Date and time of being generated (YYYYDDDHHMMSS)
  - .hdf - Data Format (HDF-EOS)

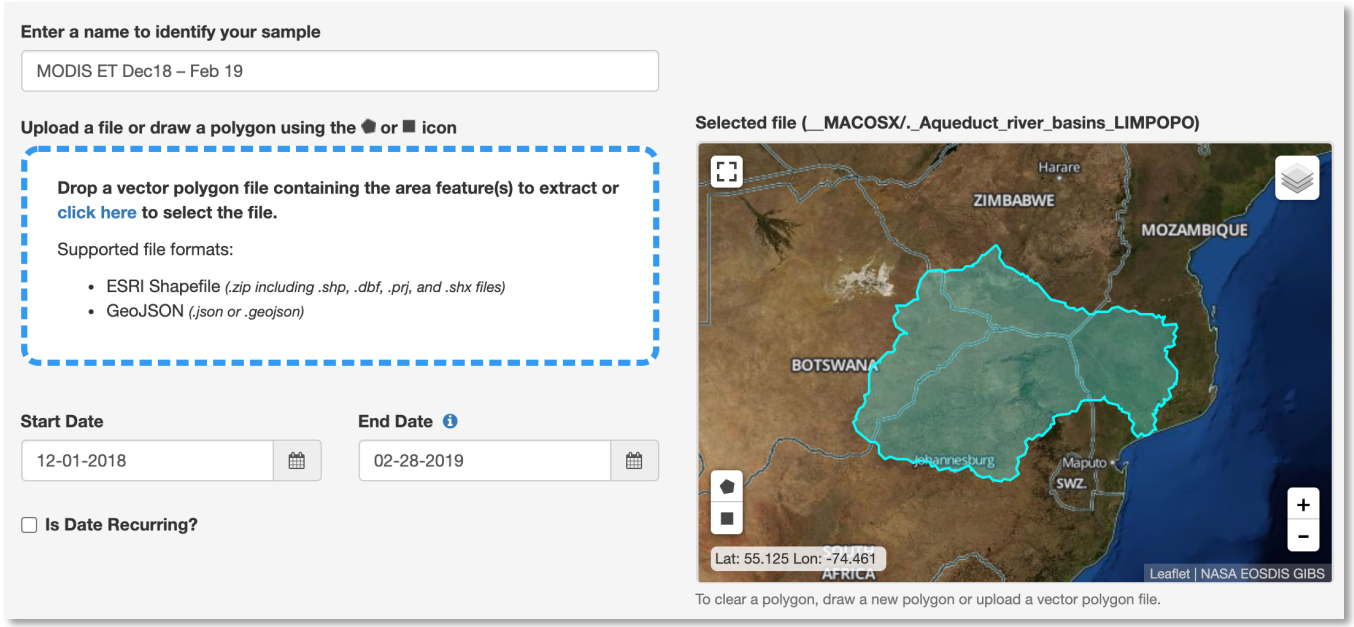
Part 2: Download 8-day MODIS ET Data

1. Go to https://lpdaacsvc.cr.usgs.gov/appeears/.
2. Sign In using your EarthData username and password.
3. From the menu bar select Extract → Area Sample.
4. Click on "Start a new request."



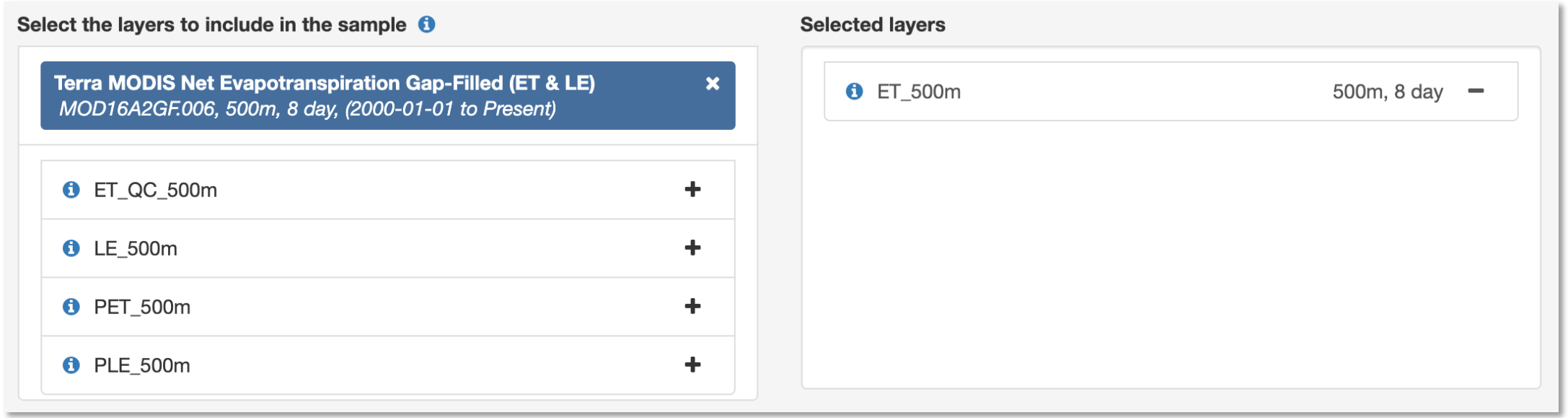
Part 2: Download 8-day MODIS ET Data

5. Enter a name to identify your sample = **MODIS ET Dec18 – Feb 19**
6. Upload a file… → click on the blue **click here** and select the zipped shapefile of the Limpopo River Basin provided from the ARSET website: https://arset.gsfc.nasa.gov/water/webinars/water-budgets-river-basin
   – The basin extent will appear in the window on the right.
7. Start Date 12-01-2018 End Date 02-28-2019



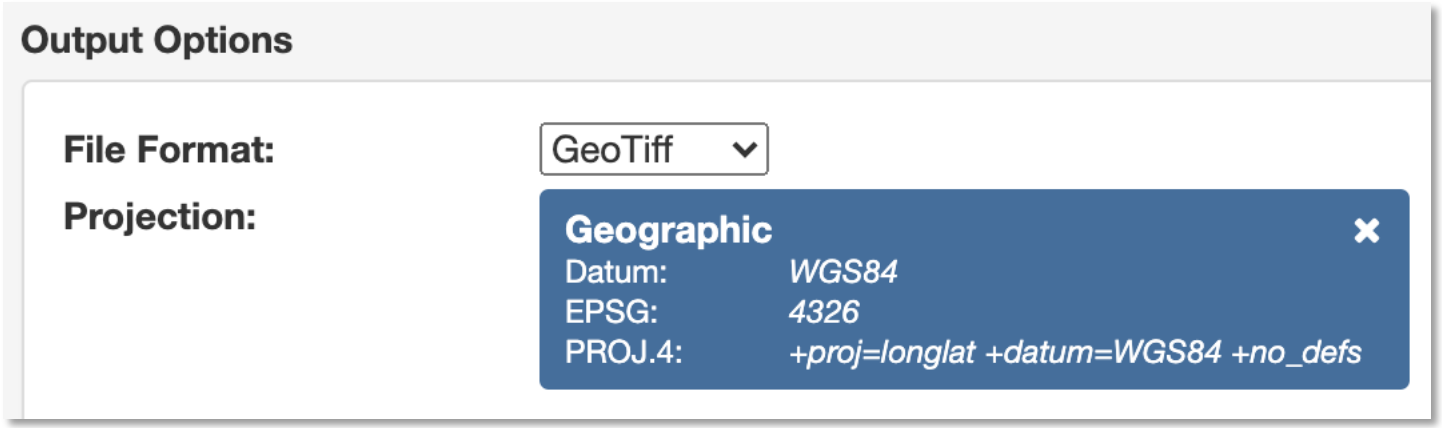
Part 2: Download 8-day MODIS ET Data

8. Select the layers to be included in the sample →
   - Type "mod16" and 3 options will be presented.
   - Click on Terra MODIS Net Evapotranspiration Gap-Filled (ET & LE) **MOD16A2GF.006**.
9. Select ET_500m.



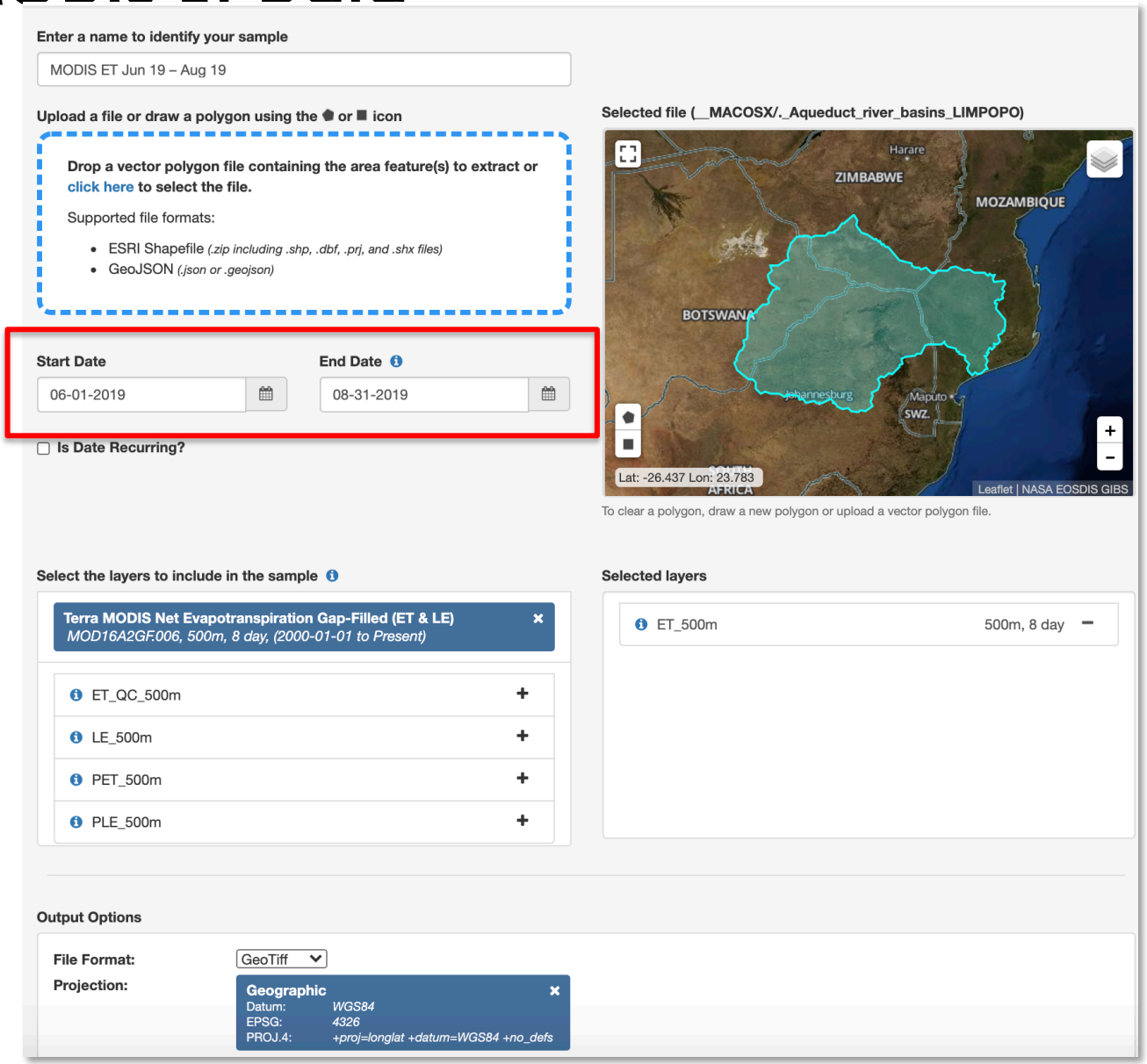
Part 2: Download 8-day MODIS ET Data

10. Output Options → File Format → GeoTiff
11. Projection → Geographic
12. Click Submit.
13. You will receive a link to download the data in an email.



Part 2: Download 8-day MODIS ET Data

10. Repeat steps 7 – 13 for the months June, July, August (2019).



Part 3

Download monthly GRACE-FO TWS data for the selected months:

1. December (2018), January, February, March (2019)
2. June, July, August, September (2019)

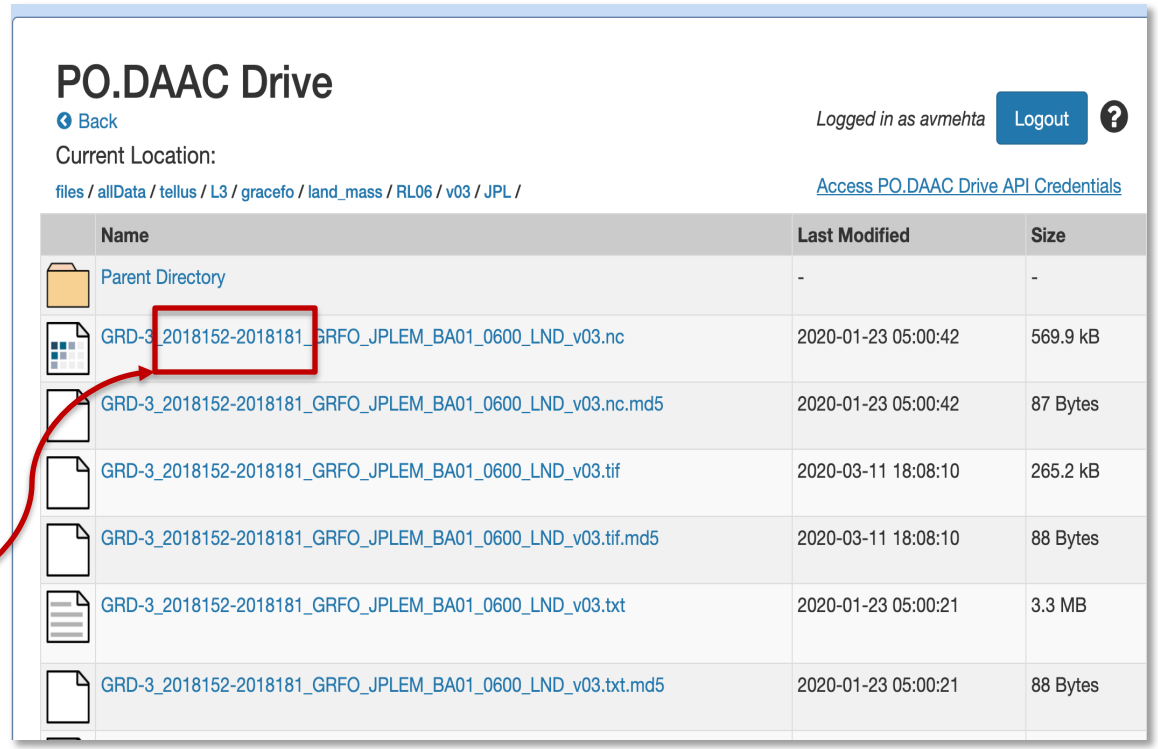
Part 3: Download Monthly GRACE-FO TWS Data

1. Go to https://podaac-tools.jpl.nasa.gov/drive/files/allData/tellus/L3/gracefo/land_mass/RL06/v03/JPL.

2. There will be a list of GRACE-FO monthly TWS files.

Note:

- The start and end dates are in Julian days, available from https://podaac-tools.jpl.nasa.gov/drive/files/allData/tellus/L3/docs/GRACE_GRACE-FO_Months_RL06.pdf, for each year and month
- The files are available in NetCDF (nc), tif, and text formats.



For data search use the following link and type GRACE or GRACE FO in the search window: https://podaac.jpl.nasa.gov/

Part 3: Download Monthly GRACE-FO TWS data

3. Select tif file for December 2018 (Julian day 335-365): GRD-3_**2018335-2018365**_GRFO_JPLEM_BA01_0600_LND_v03.
4. Click on the filename and download to save on your computer.
   Recommendation: Save the file with a short, descriptive filename. For example, in this exercise we will use: **GRFO_TWS_Dec18.tif**.
5. Repeat steps 3 and 4 for January, February, March (2019), & June, July, August, September (2019) and save to a working directory on your computer with short, descriptive filenames (see example above).

Month Sr No	GRACE/GRA	MONTH	YEAR	START DAY	YEAR	END DAY
195	164	JUN	2018	152	2018	181
196	165	JUL	2018	182	2018	212
197	NA	AUG	2018	213	2018	243
198	NA	SEP	2018	244	2018	273
199	166	OCT	2018	274	2018	313
200	167	NOV	2018	305	2018	334
201	168	DEC	2018	335	2018	365
202	169	JAN	2019	1	2019	31
203	170	FEB	2019	26	2019	63
204	171	MAR	2019	60	2019	90
205	172	APR	2019	91	2019	120
206	173	MAY	2019	121	2019	151
207	174	JUN	2019	152	2019	181
208	175	JUL	2019	182	2019	212
209	176	AUG	2019	213	2019	243
210	177	SEP	2019	244	2019	273
211	178	OCT	2019	274	2019	304
212	179	NOV	2019	305	2019	334
213	180	DEC	2019	335	2019	365

From: https://podaac-tools.jpl.nasa.gov/drive/files/allData/tellus/L3/docs/GRACE_GRACE-FO_Months_RL06.pdf

Part 4

Download monthly precipitation, ET, TWS, Runoff, and Baseflow Runoff data from GLDAS 2.1 for the same selected months:

1. December (2018), January, February, March (2019)
2. June, July, August, September (2019)

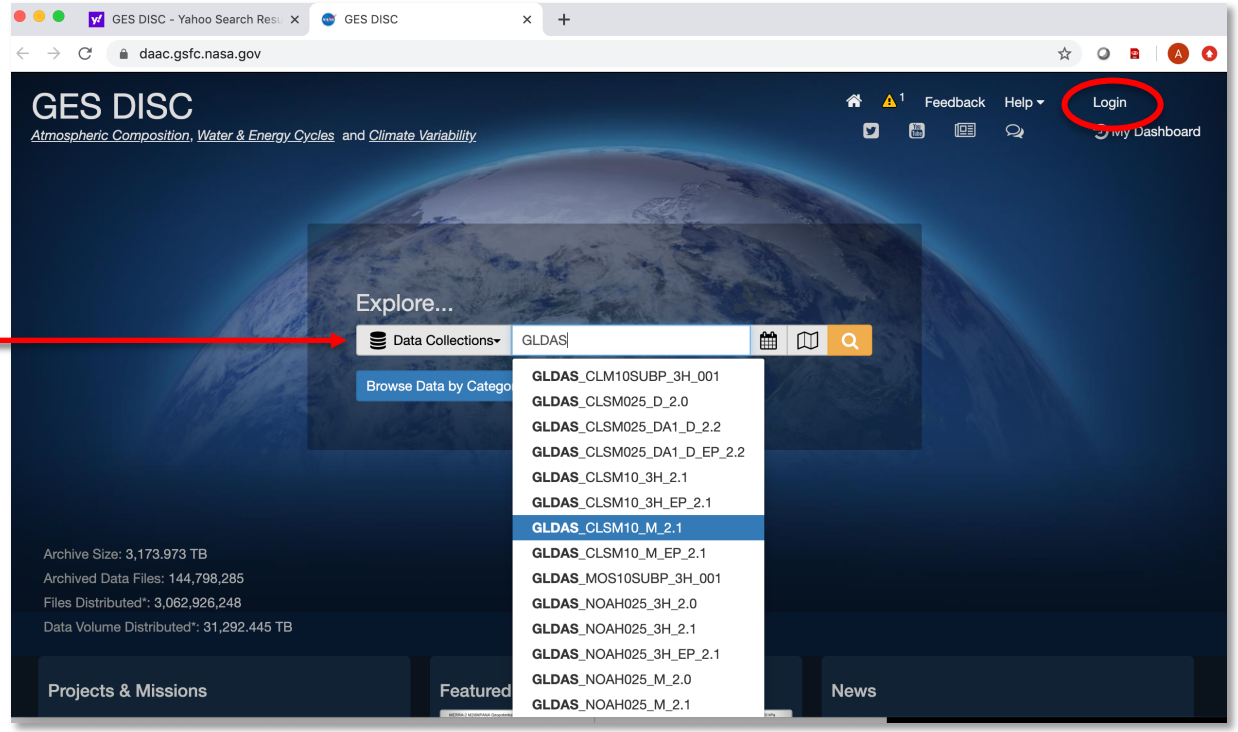
Part 4: Download Monthly GLDAS 2.1 Data

1. Go to GES DISC https://daac.gsfc.nasa.gov/.

2. Login (top right) using your NASA EarthData username and password.

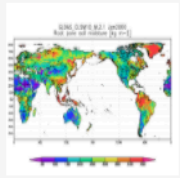
3. In the **Explore…Data Collection** window type GLDAS.

4. Select **GLDAS_CLSM10_M2.1** and click on search.



Part 4: Download Monthly GLDAS 2.1 Data

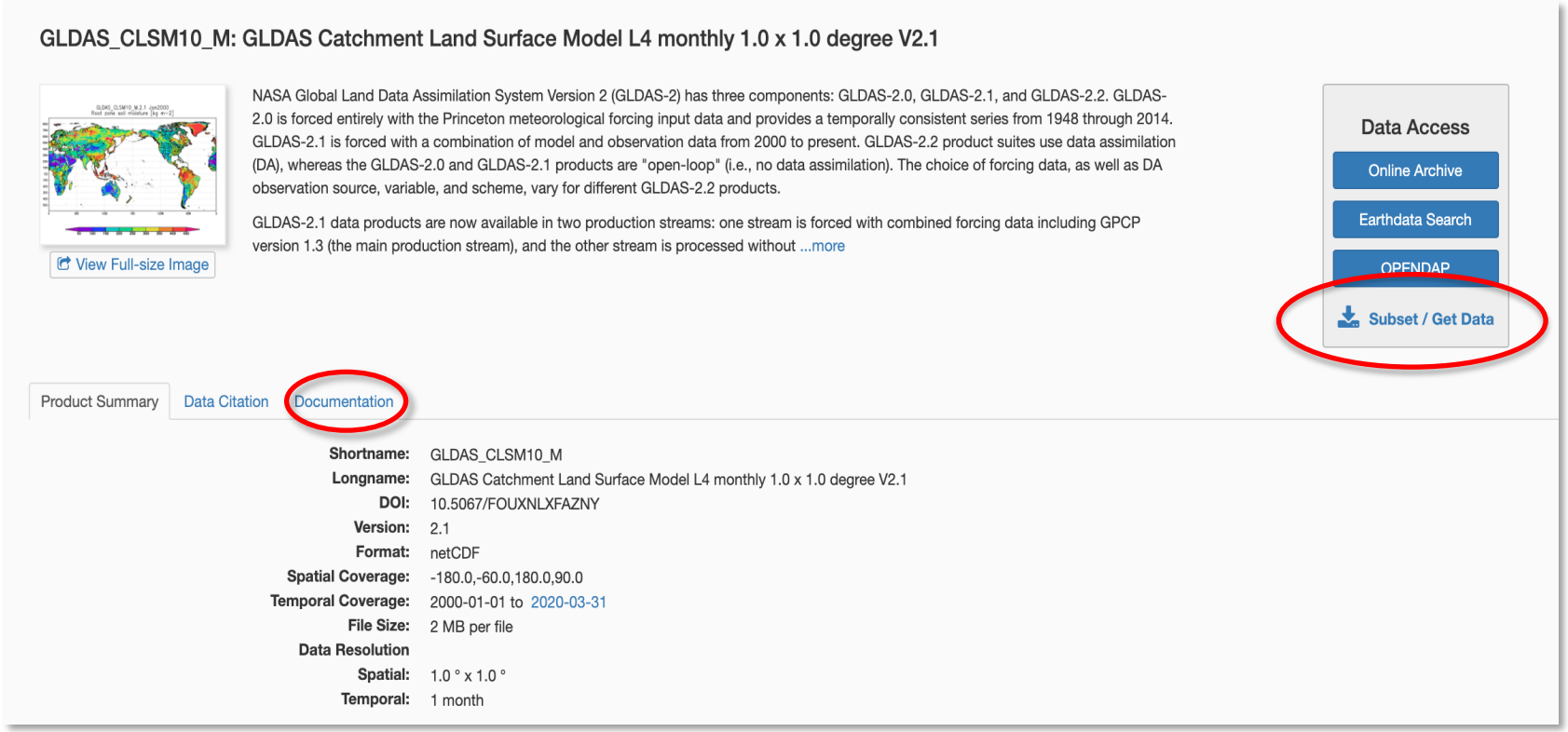
5. You will see the following information along with the link for the dataset:

Image	Dataset	Source	Version	Time Res.	Spatial Res.	Process Level	Begin Date	End Date
 Hover	GLDAS Catchment Land Surface Model L4 monthly 1.0 x 1.0 degree V2.1 (GLDAS_CLSM10_M 2.1) Subset / Get Data	Models/Analyses Catchment-LSM	2.1	1 month	1.0 ° x 1.0 °	4	2000-01-01	2020-03-31

6. Click on the dataset link.

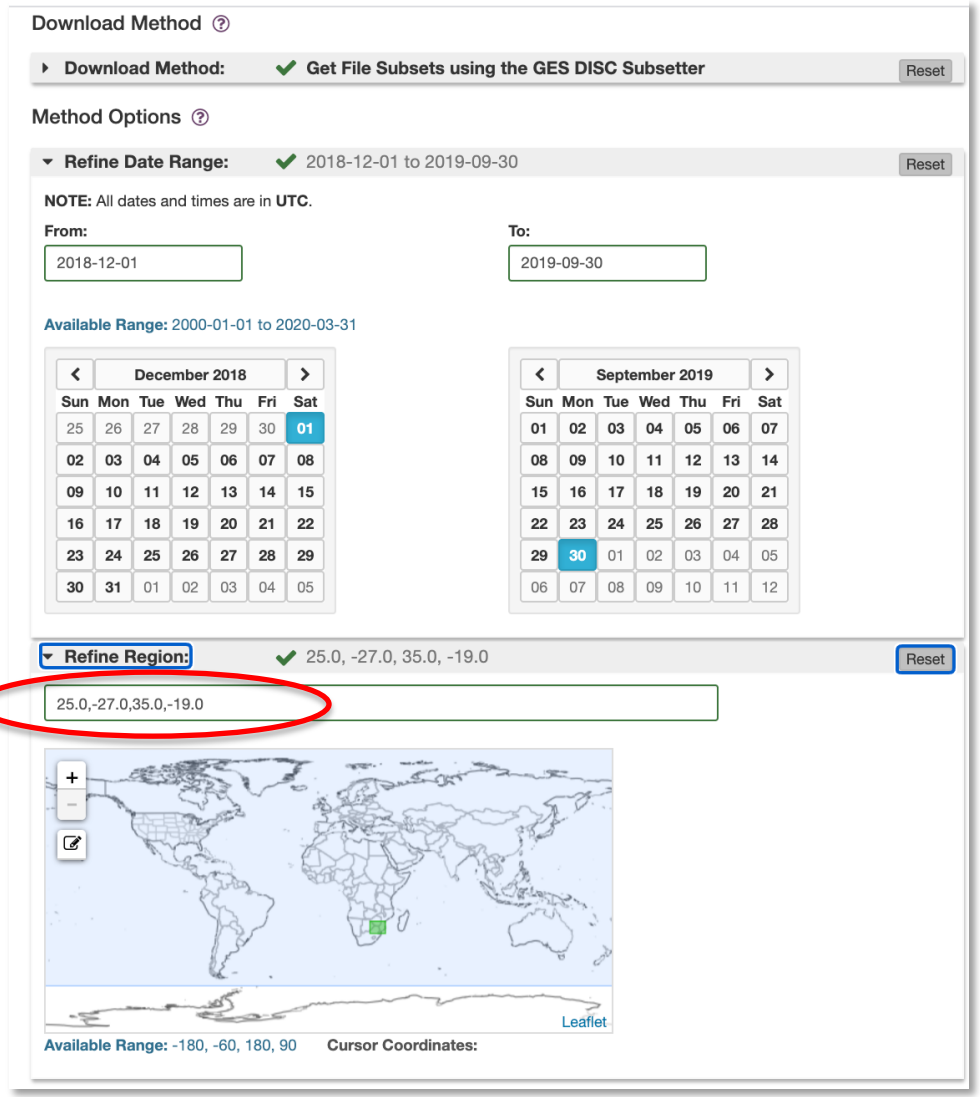
Part 4: Download Monthly GLDAS 2.1 Data

7. You will see description of the dataset and a link to documentation.
8. Click on the **Subset/Get Data** link.



Part 4: Download Monthly GLDAS 2.1 Data

9. Select **Download Method → Get File Subsets using the GES DISC Subsetter**
10. Under **Method Options:**
    - **Refine Date Range -** Choose dates using the drop-down arrow.
    - **From: December 1, 2018**
    - **To: September 30, 2019**
    - **Refine Region -** Use drop-down arrow and enter coordinates encompassing the Limpopo River Basin:
        - West longitude = 25.0
        - South latitude = -27.0
        - East longitude = 35.0
        - North latitude = -19.0

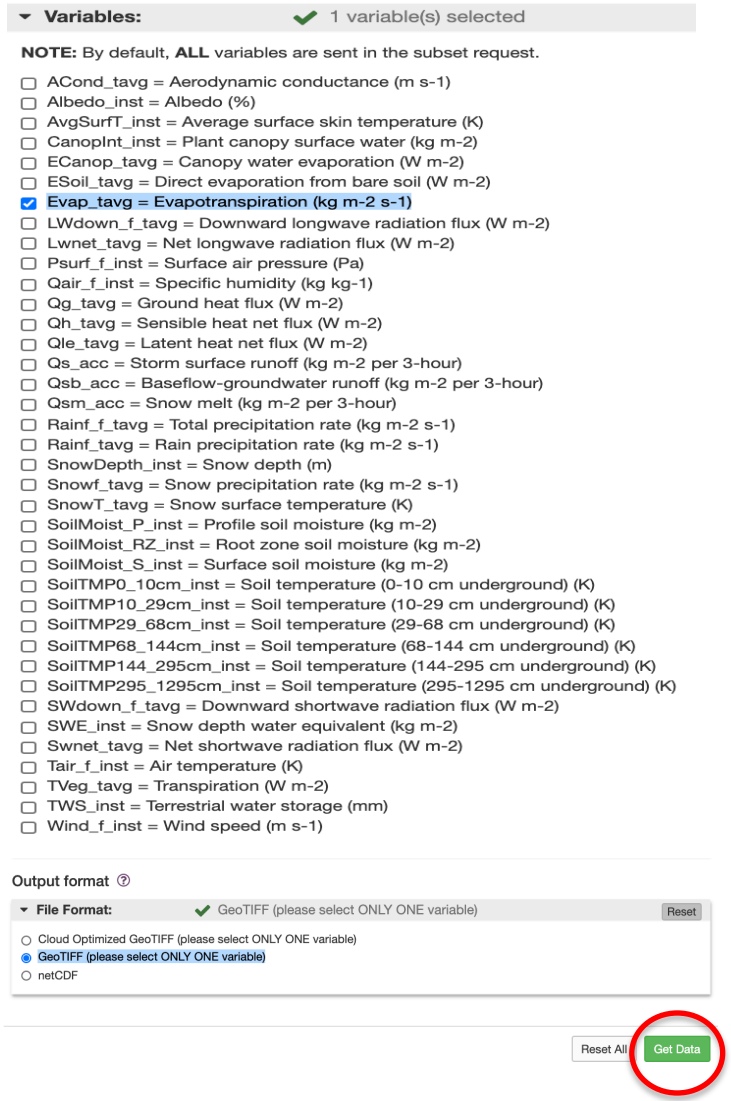


Part 4: Download Monthly GLDAS 2.1 Data

11. Using the drop-down arrow for **Variables**, first choose only **Evap_tavg = Evapotranspiration (kg m-2 s-1)**

12. Scroll down to **Output format** and choose **File Format → GeoTiff (Please select ONLY ONE variable)**.

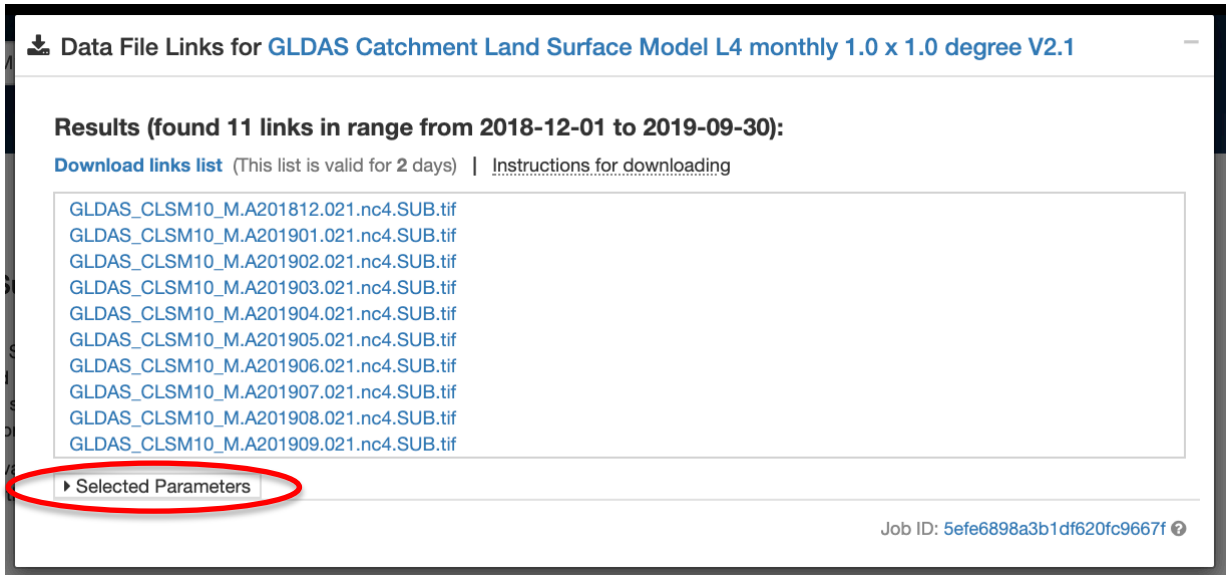
13. Click on **Get Data** (bottom right).



Part 4: Download Monthly GLDAS 2.1 Data

14. You will see the monthly data file list.
15. Click on the file name links for December (2018), January, February, March (2019) & June, July, August, September (2019).

    Recommendation: Save the files with short, descriptive file names.
    We will use **GLDAS2.1-ET-Dec18.tif** for December 2018, **GLDAS2.1-ET-Jan19** for January 2019, and so on for this exercise.
16. Click on **Selected Parameters → Refine Parameters**.
17. You will be navigated back to the data selection page.

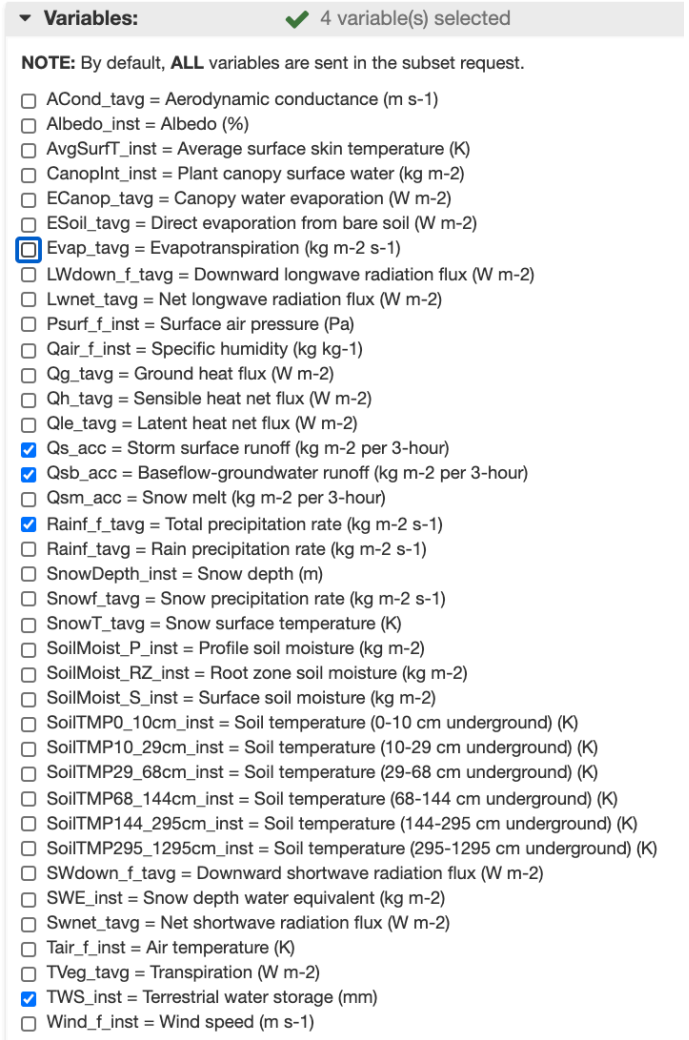


Part 4: Download Monthly GLDAS 2.1 Data

18. Repeat Steps 11-17 for the following variables one at a time:

- Qs_acc = Storm surface runoff (kg m-2 per 3-hour)
- Qsb_acc = Baseflow-groundwater runoff (kg m-2 per 3-hour)
- Rainf_f_tavg = Total precipitation rate (kg m-2 s-1)
- TWS_inst = Terrestrial water storage (mm)

Please refer to the next slide for recommended file names.



Part 4: GLDAS 2.1 Data Files

19. You will have the following files for each month – 40 files total at the end of Part 4:

GLDAS2.1-ET-monyy.tif	For Evapotranspiration
GLDAS2.1-PR-monyy.tif	For Precipitation
GLDAS2.1-RO-monyy.tif	For Storm Surface Runoff
GLDAS2.1-BRO-monyy.tif	For Baseflow Runoff
GLDAS2.1-TWS-monyy.tif	For Terrestrial Water Storage

Where mon = Dec (2018), Jan, Feb, Mar (2019), & Jun, Jul , Aug, Sep (2019)
yy = ‘18 for Dec and ‘19 for all other months