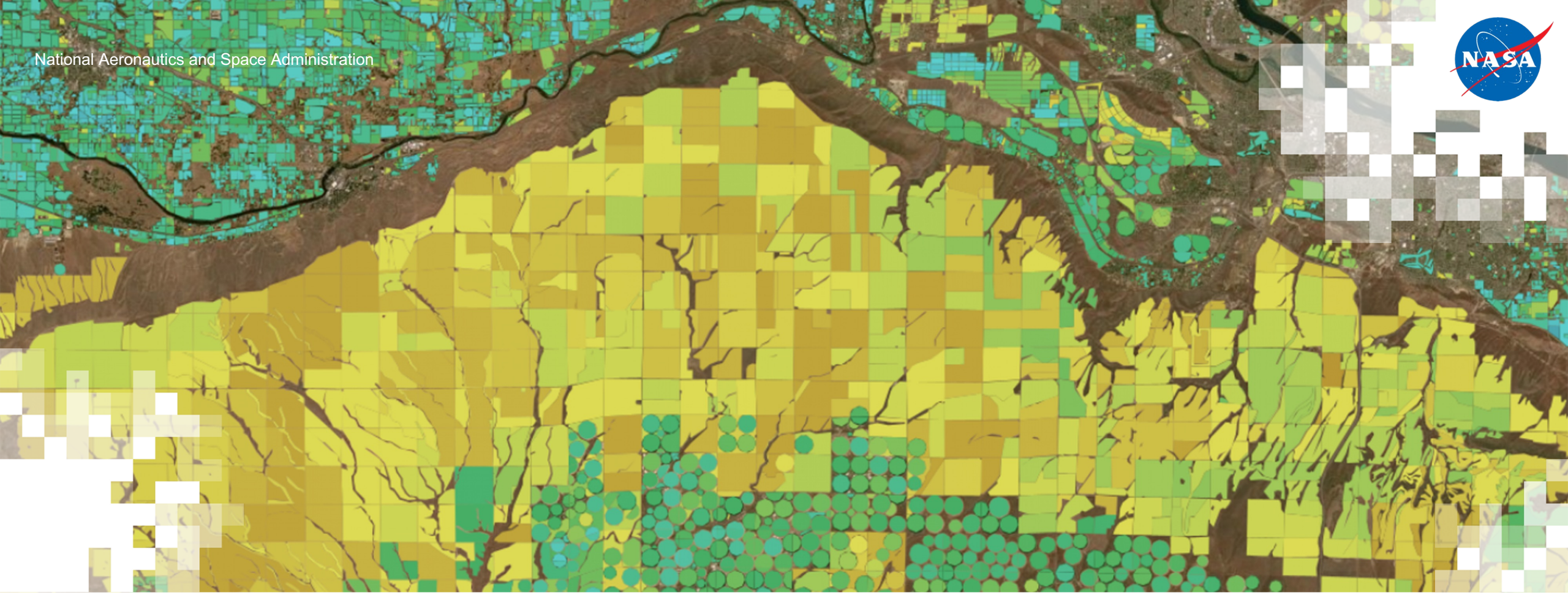


Applications of Remote Sensing-Based Evapotranspiration Data Products for Agricultural and Water Resources Management

Lab Time Exercise

June 15, 2022

Objective

- This exercise is designed to provide hands-on data access and visualization experience for using OpenET and ECOSTRESS ET data.

Outline

There are two parts to this Exercise:

1. Search, visualize, and download field level and regional evapotranspiration (ET) data from the OpenET portal for different crops.
2. Search, download, and examine ECOSTRESS ET.

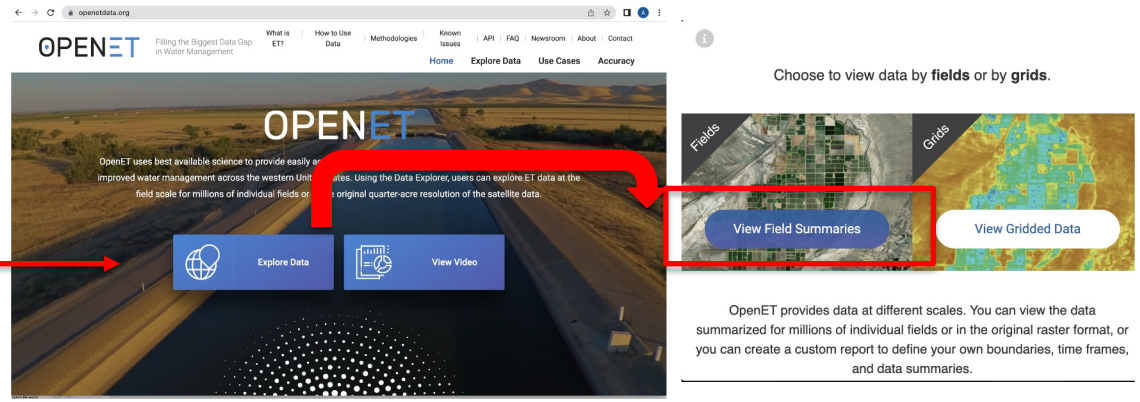
Note: Some of the homework questions will be based on these exercises.

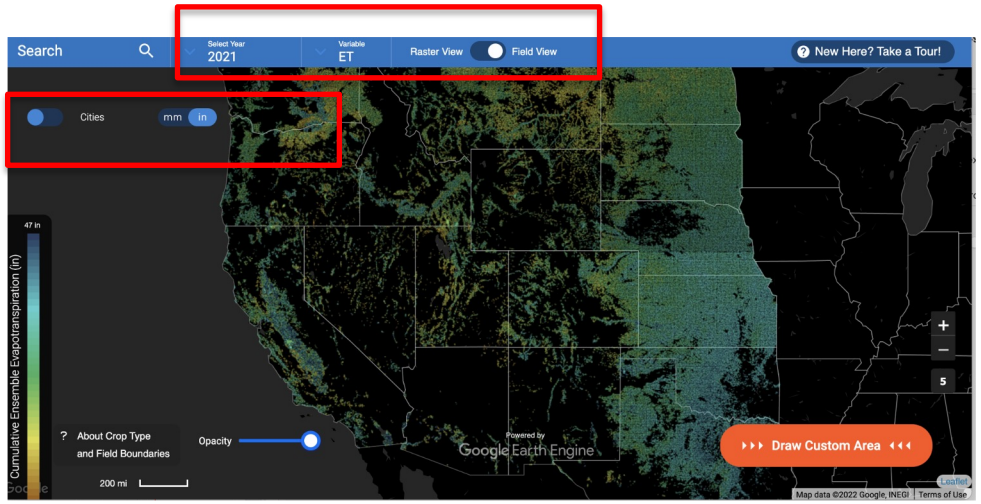
1.0 Search, Visualize, and Download OpenET Data

1a: Explore ET at field level

Go to https://openetdata.org/

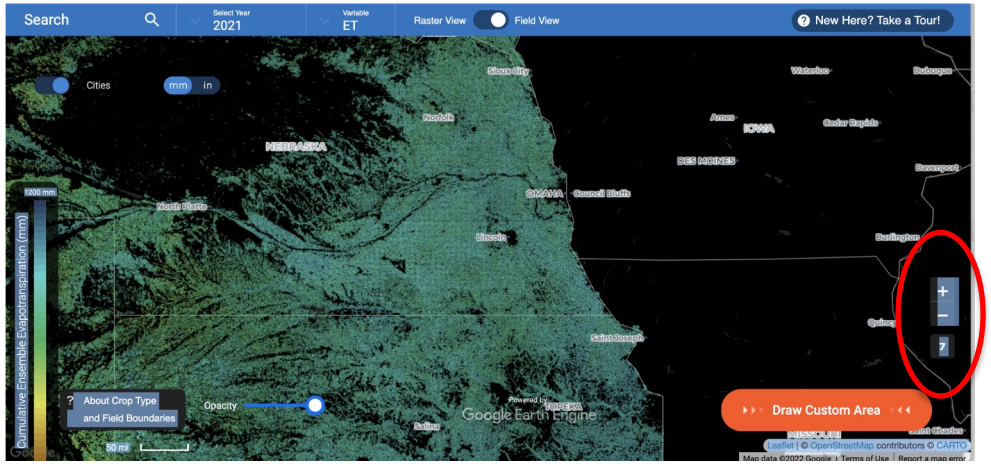
1. Click on **Explore Data.**
2. Select **View Field Summaries:**
   - Keep **Select Year** to **2021.**
   - Make sure **Field View** is selected.
   - Turn on **Cities** display.
   - Change ET units to mm.

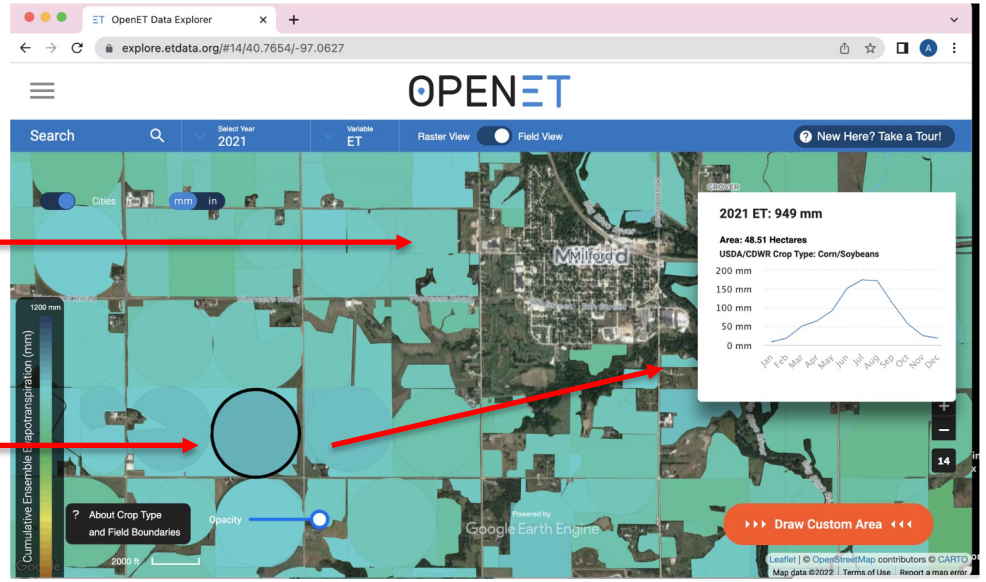




1.0 Search, Visualize, and Download OpenET Data

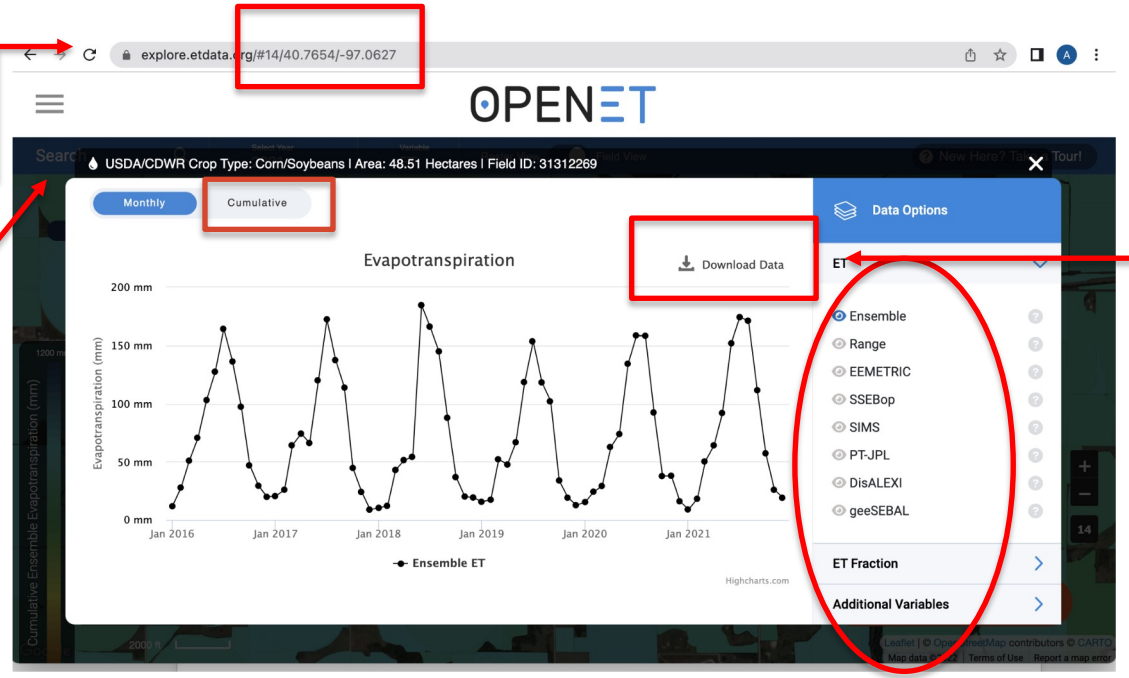
3. Go to zoom level **5 or 6** and locate the U.S. state of **Nebraska.**
4. Zoom in further to level **14** to focus on the **Milford** area **(west of Lincoln).**
   - Select **any field** in this area by moving the cursor over the field. You will see a graph showing monthly ET for 2021.
5. Click on the field to open the time series window.





1.0 Search, Visualize, and Download OpenET Data

- You will get the ensemble mean ET timeseries.
- Note the **latitude-longitude** center of this region (not the field).
- Note the **area** of the field, **crop type**, and **field ID**.
  - Examine the **Range** of ET.
  - Examine ET values by selecting each model.
  - Select and examine **Cumulative** (top left in the timeseries window) ET.



- To download the timeseries data click on **Download Data** and save the ET data in preferred format.

Exercise 1a: Questions

Answer the following questions based on Exercise 1: an ET multi-year time series (Step 5)

i) Write down the latitude – longitude and field ID number.
ii) What was the crop type of the field you chose?
iii) Note the ensemble ET values (with units) for July of 2016 to 2021.
iv) Which year and month had the highest ET for this field?
v) Which year had maximum cumulative ET?

Optional Exercise

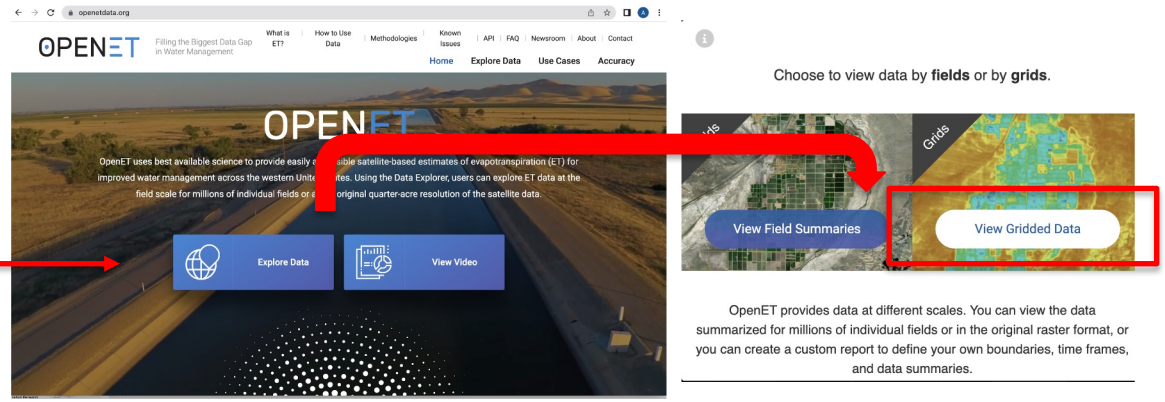
- Repeat all the steps in Exercise 1a but for a field in **California with crop type other than the one you chose in Nebraska.**
- Examine how the annual pattern of ET changes compared to the field/crop chosen in Nebraska.

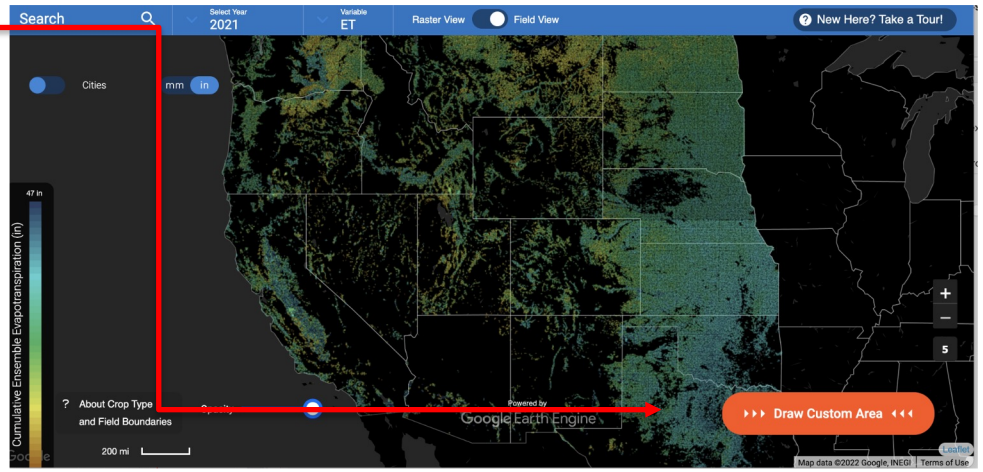
1.0 Search, Visualize, and Download OpenET Data

1b. Explore ET for a Custom Region

Go to https://openetdata.org/

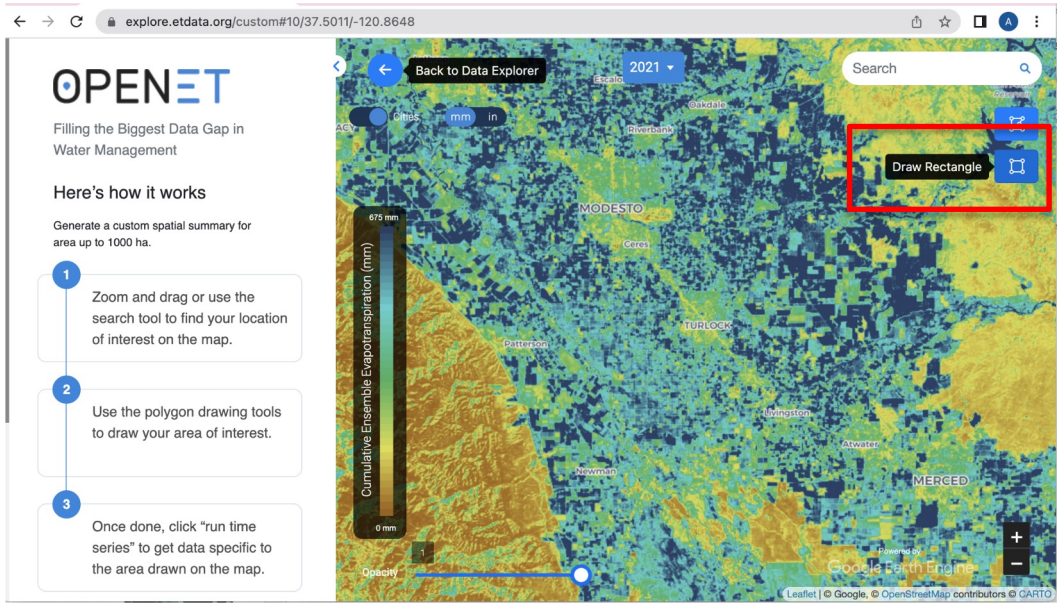
1. Click on **Explore Data**
2. Select **View Gridded Data**
3. Click on **Draw Custom Area**

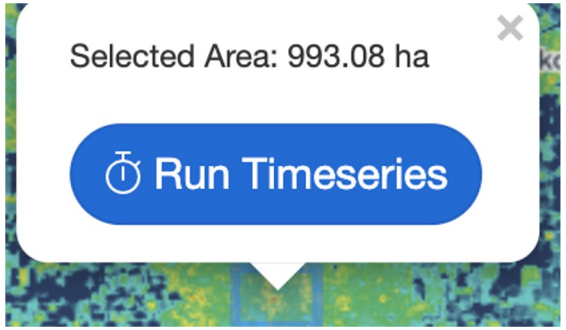




1.0 Search, Visualize, and Download OpenET Data

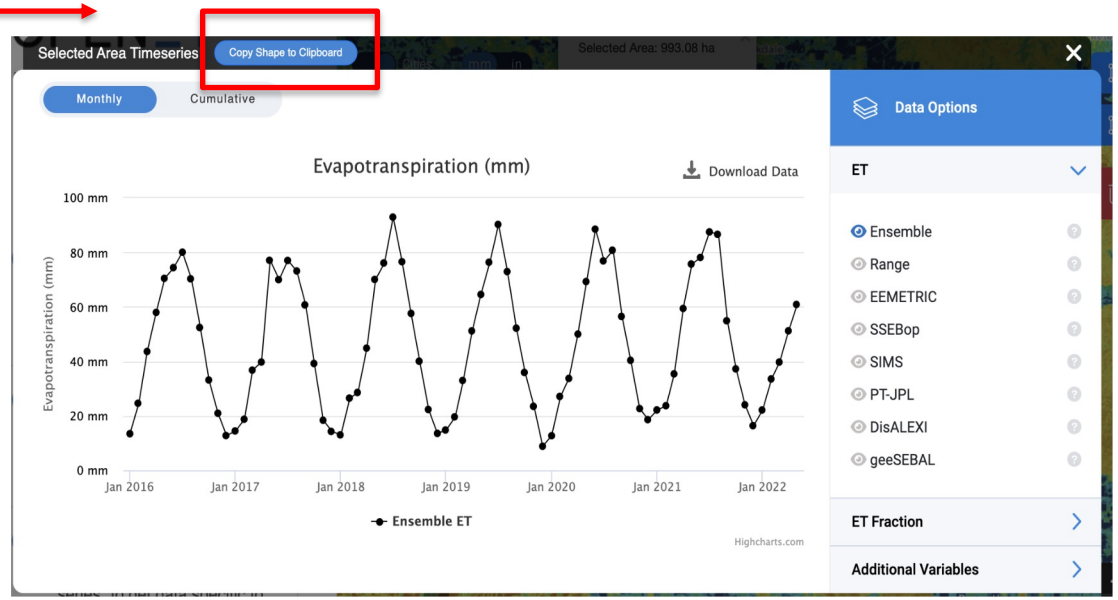
4. Turn on **Cities** display and change ET units to **mm.**
5. Zoom to any area of your choice
   - Select **Draw Rectangle**
   - Draw a rectangle for a custom region. Make sure that the area does not exceed 1000 Ha.
   - Once you draw the rectangle, **Run Timeseries** option will appear. Click and plot timeseries of ET.





1.0 Search, Visualize, and Download OpenET Data

6. **Selected Area Timeseries** for monthly ET time will be plotted
   - Click on **Copy Shape to Clipboard** to save the coordinates of the rectangle.
   - Select **PT-JPL** model (one that is also used for calculating ECOSTRESS ET) from the list of models.
   - On the bottom right select **Additional Variables** and click on **Precip (gridMET).**
   - Select **Download Data** and save the data as **csv** file for further analysis.



Exercise 1b: Questions

Answer the following questions based on Exercise 1a ET multi-year time series (Step 6):

i) Press ⌘ + V (on Mac) **or** right click (Windows) to paste the coordinates of the rectangle saved on the clipboard. You will need these later.

ii) Examine how PT-JPL ET differs from the Ensemble mean ET. Note how they differ.

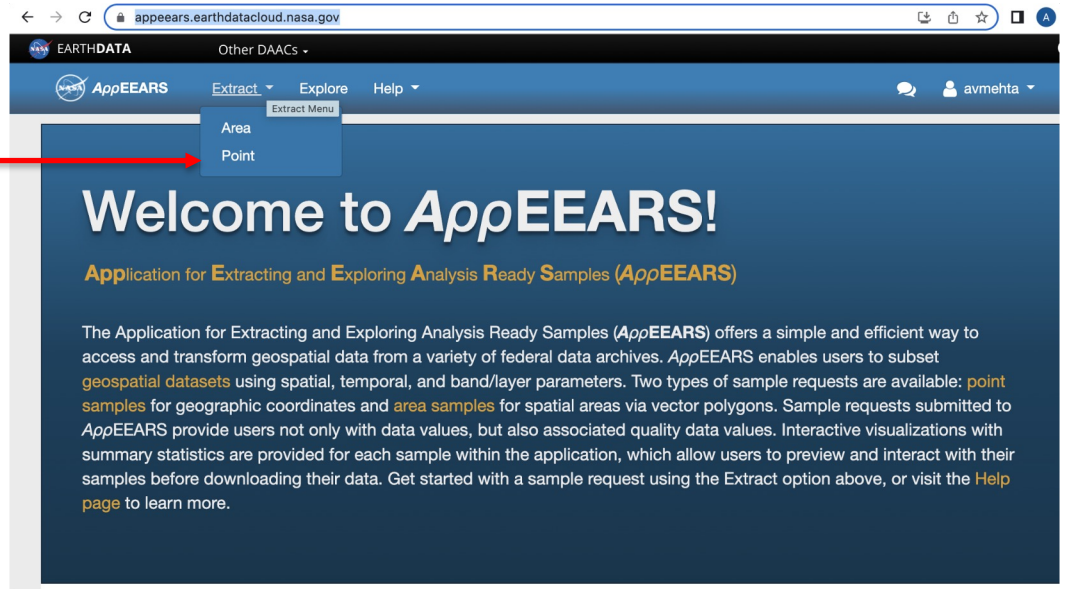
iii) Does the ET maximum occur at the same time as the Precipitation maximum?

What would this mean for water availability in the region you chose over the annual cycle?

2.0 Search, Download, Examine ECOSTRESS ET.

Go to
https://appeears.earthdatacloud.nasa.gov/

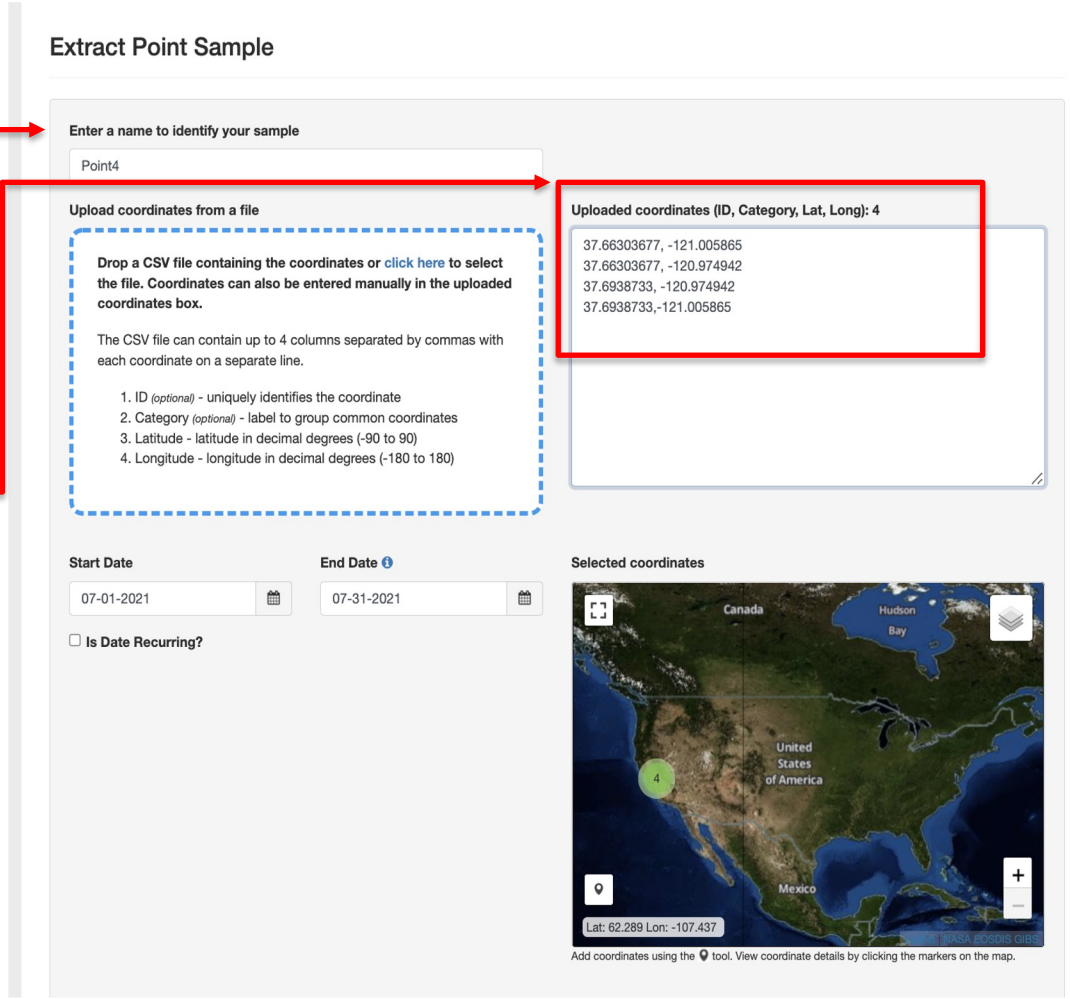
1. Login with NASA EarthData username.
2. Select **Extract** → **Point**



2.0 Search, Download, Examine ECOSTRESS ET.

3. A window will open for data selection.

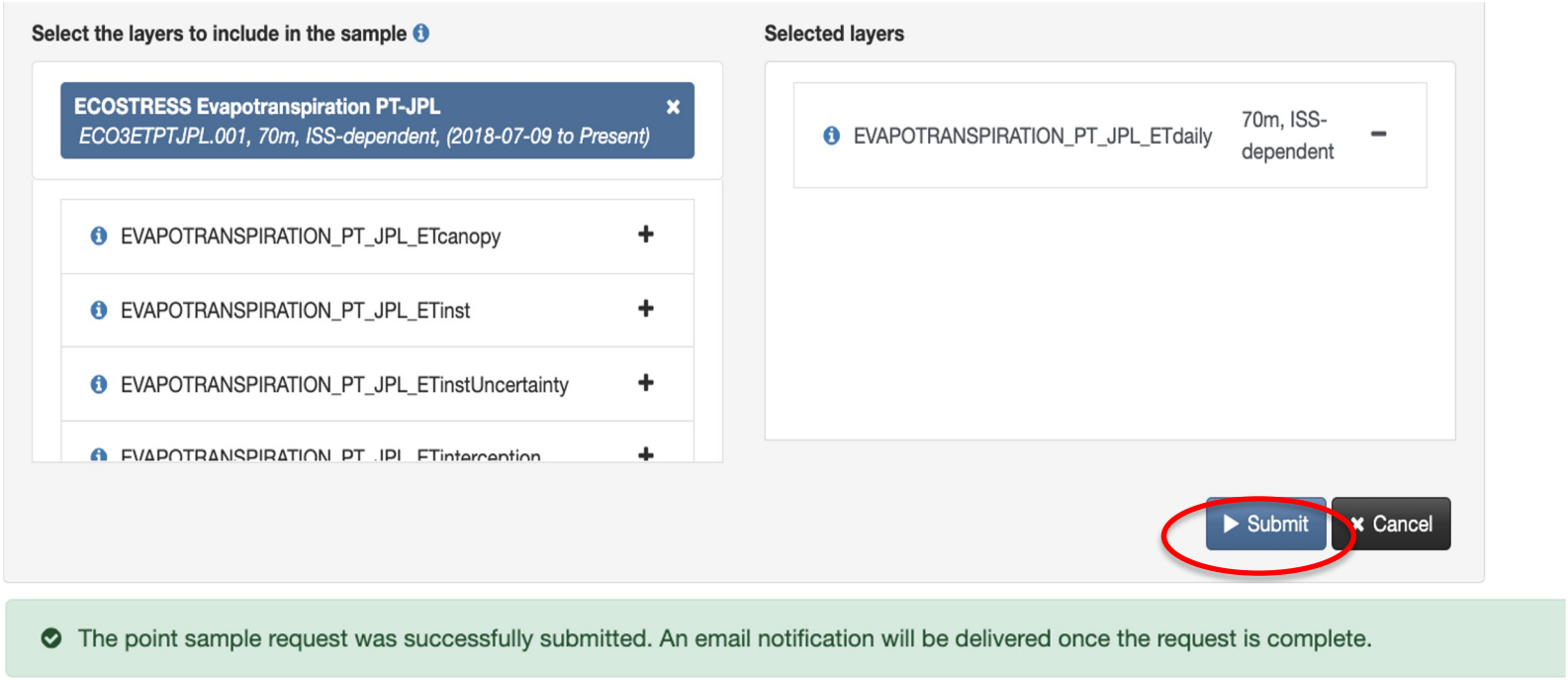
- **Enter a name to identify your sample.**
- In the **Upload coordinates** box, type the coordinates of the box you chose in OpenET (Exercise 1b) and saved on the clipboard.
- Select **Start Date**: 1 July 2021
- Select **End Date**: 31 July 2021



2.0 Search, Download, Examine ECOSTRESS ET.

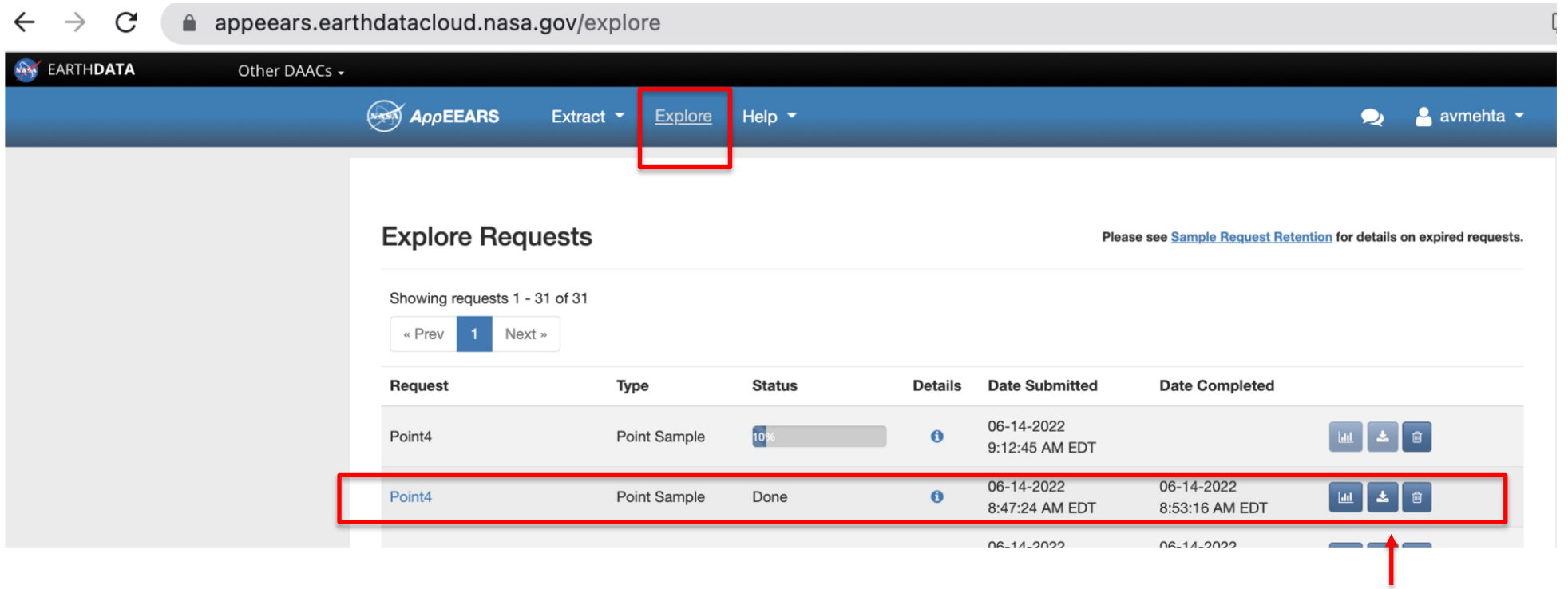
- In **Select layers to include in the sample**, type **ECOSTRESS.**

  Select **ECOSTRESS Evapotranspiration PT-JPL → (use +)** and select **EVAPOTRANSPIRATION_PT_JPL_Etdaily.**
- Click **Submit.**
- You will see a notification at the top of the selection window:



2.0 Search, Download, Examine ECOSTRESS ET.

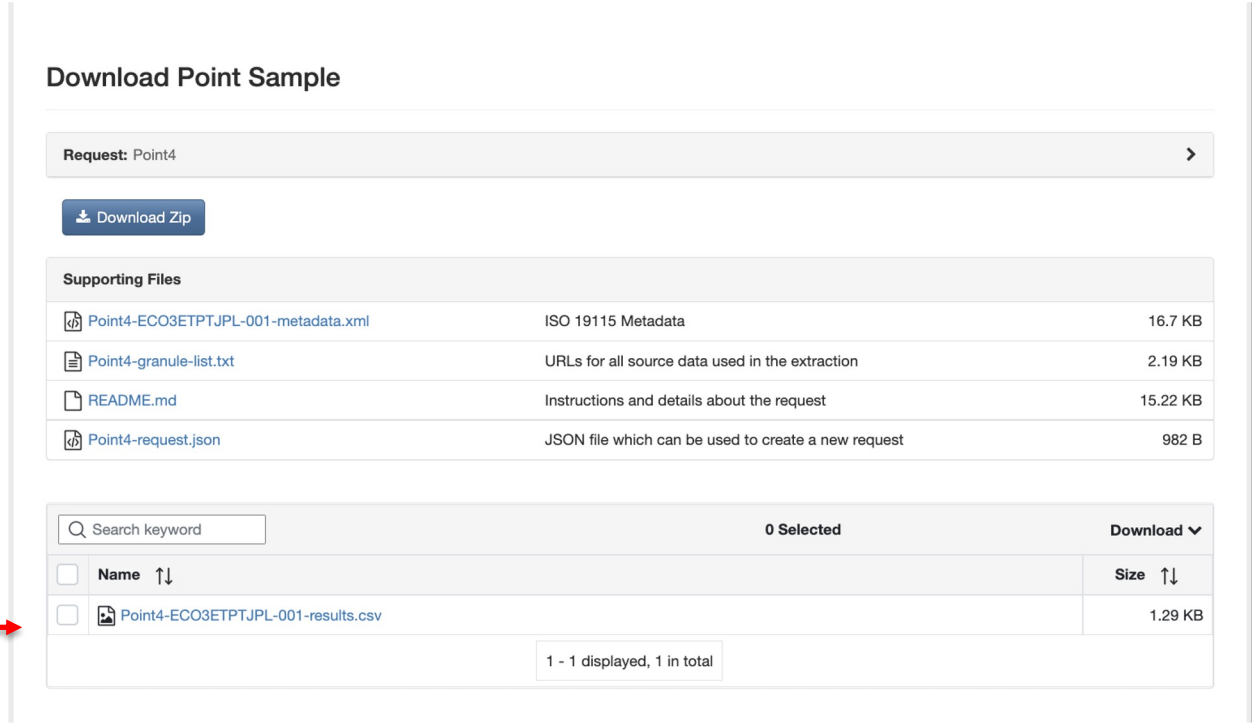
4. Click on **Explore** to check if the sample you requested is **Done.**
    - Once **Done**, click in the down arrow.



Click to Download

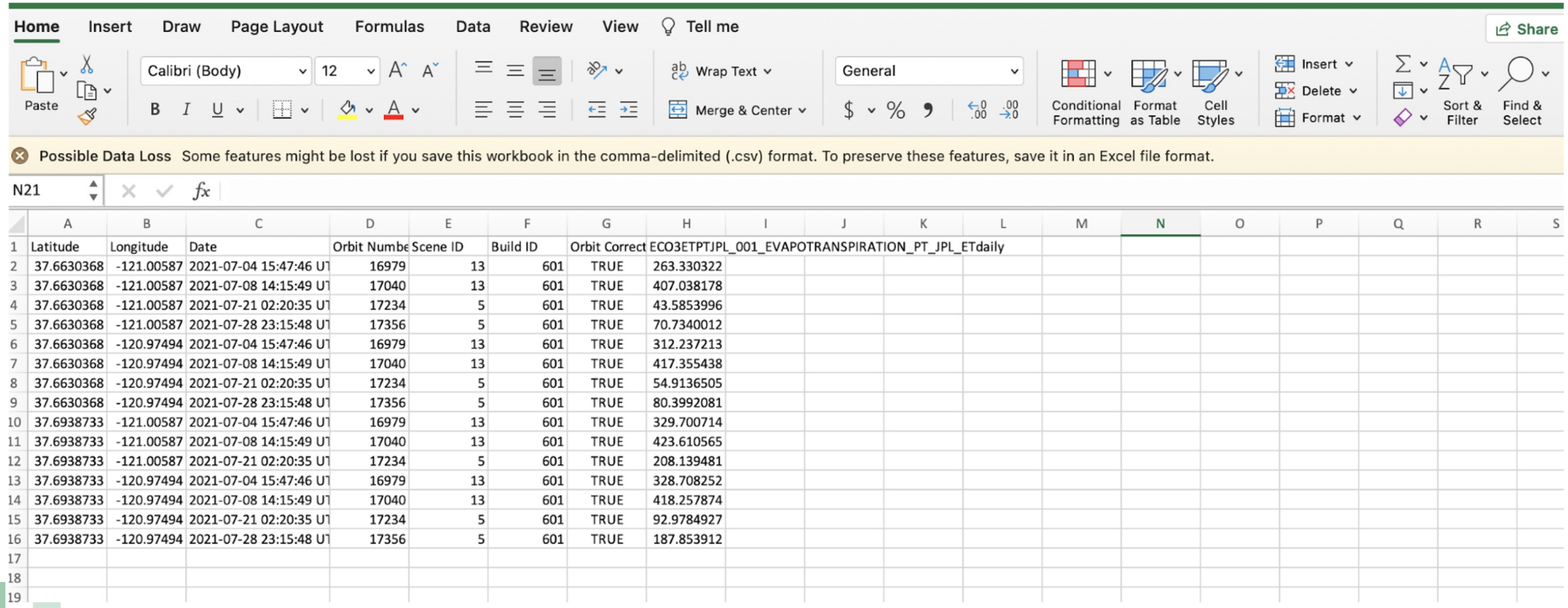
2.0 Search, Download, Examine ECOSTRESS ET.

- The **Download Point Sample** window will open.
- Click on the Point4_ECO3PTJPL_001_reults.csv file and save on your computer:



2.0 Search, Download, Examine ECOSTRESS ET.

5. Open the csv file you just saved.
   - You will see the points you selected and a number of days in July 2021 when the ET data are available.

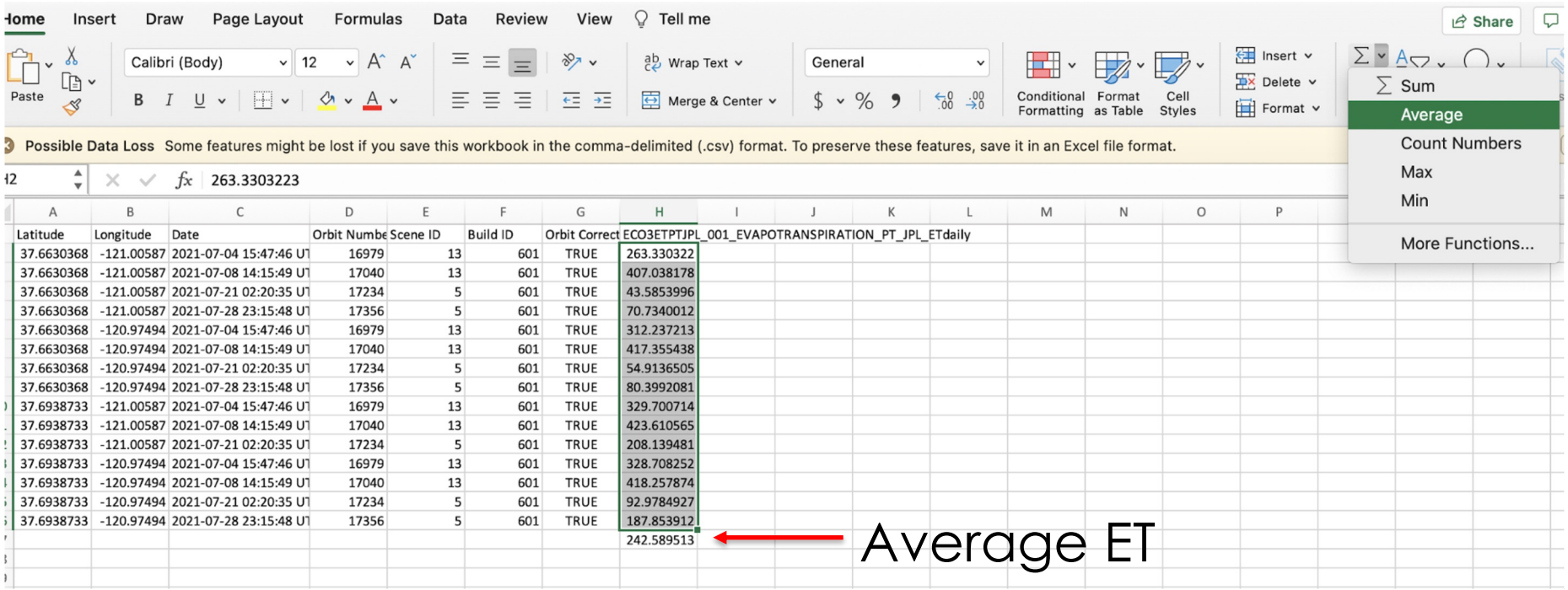


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Latitude	Longitude	Date	Orbit Numbe	Scene ID	Build ID	Orbit Correct	ECO3ETPTJPL_001_EVAPOTRANSPIRATION_PT_JPL_ETdaily											
2	37.6630368	-121.00587	2021-07-04 15:47:46 UT	16979	13	601	TRUE	263.330322											
3	37.6630368	-121.00587	2021-07-08 14:15:49 UT	17040	13	601	TRUE	407.038178											
4	37.6630368	-121.00587	2021-07-21 02:20:35 UT	17234	5	601	TRUE	43.5853996											
5	37.6630368	-121.00587	2021-07-28 23:15:48 UT	17356	5	601	TRUE	70.7340012											
6	37.6630368	-120.97494	2021-07-04 15:47:46 UT	16979	13	601	TRUE	312.237213											
7	37.6630368	-120.97494	2021-07-08 14:15:49 UT	17040	13	601	TRUE	417.355438											
8	37.6630368	-120.97494	2021-07-21 02:20:35 UT	17234	5	601	TRUE	54.9136505											
9	37.6630368	-120.97494	2021-07-28 23:15:48 UT	17356	5	601	TRUE	80.3992081											
10	37.6938733	-121.00587	2021-07-04 15:47:46 UT	16979	13	601	TRUE	329.700714											
11	37.6938733	-121.00587	2021-07-08 14:15:49 UT	17040	13	601	TRUE	423.610565											
12	37.6938733	-121.00587	2021-07-21 02:20:35 UT	17234	5	601	TRUE	208.139481											
13	37.6938733	-120.97494	2021-07-04 15:47:46 UT	16979	13	601	TRUE	328.708252											
14	37.6938733	-120.97494	2021-07-08 14:15:49 UT	17040	13	601	TRUE	418.257874											
15	37.6938733	-120.97494	2021-07-21 02:20:35 UT	17234	5	601	TRUE	92.9784927											
16	37.6938733	-120.97494	2021-07-28 23:15:48 UT	17356	5	601	TRUE	187.853912											
17																			
18																			
19																			

2.0 Search, Download, Examine ECOSTRESS ET.

- Highlight the ET data column and find average ET by using the statistics tool.
- Note the average ET value that is added at the bottom the ET column.

  What are the units of ET ?



Exercise 2 : Questions

Answer the following questions based the ECOSTRESS ET data (Step 5) you downloaded in csv file format:

i) Write the average ET values with unit. What does the average ET value show?
   - average ET per month?
   - average ET for the four points you chose?
   - both of the above?

ii) Using the next slide, convert the average ET to mm/day.

iii) Can you compare this value with the OpenET value for July 2021?

iv) Explain your answer. (hint: what does OpenET value show? Is it daily ET?)

Convert Watts/m^2 to mm/day

- PT-JPL ECOSTRESS ET is the units of energy (Watts/m^2) that is used for evapotranspiration of water.

  Note:

  1 day = 86,400 seconds

  1 Watt = 1 Joule/second ⟶ 1 Watt/m^2 = 1 Joules/(second.m^2)

  = 86,400 Joules/(day.m^2)

  Density of water = 1000 kg/m^3

  Laten heat energy of evaporation = 2.45 x 10^6 Joules/kg

  = energy needed to evaporate 1 kg or 0.001m^3 or 1 mm of water

  ⟶ 2.45 x 10^6 Joules energy is required to evaporate 1 mm of water

  In mm/day per m^2 = (ET * 86400Joules)/ 2.45 x 10^6 Joules

[1]https://academic.uprm.edu/abe/backup2/tomas/fao%2056.pdf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Thank You!