

# Access Landsat-Based Evapotranspiration

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# Objectives

By the end of this exercise, you will be able to subset and download evapotranspiration (ET) data over the Sao Francisco Verdadeiro (SFV) watershed using a Goggle Google Earth portal and import to QGIS

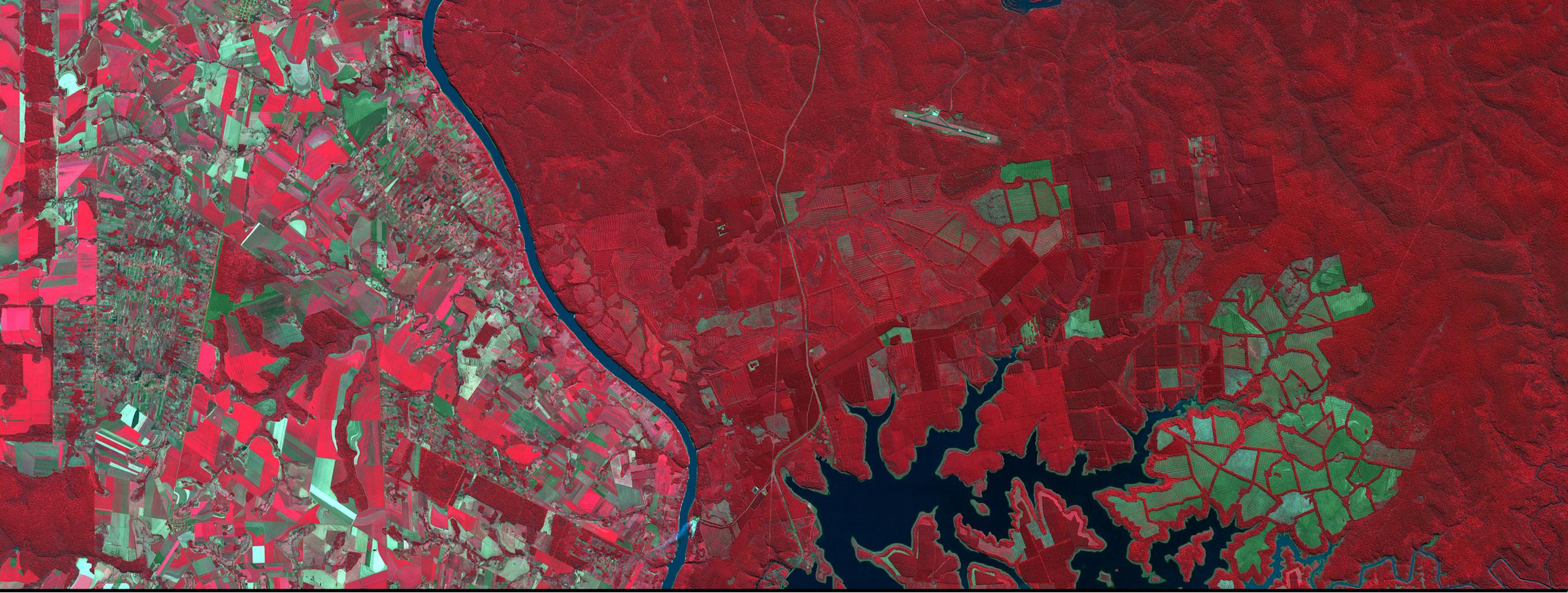
## Requirements

- QGIS installed on your computer
  - <https://arset.gsfc.nasa.gov/sites/default/files/water/drought/Introduction%20to%20QGIS.pdf>
- A shapefile for the Sao Francisco Verdadeiro watershed saved on your computer
  - <http://arset.gsfc.nasa.gov/>



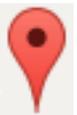
# Outline

- Part 1: Select Landsat Images and Calculate METRIC ET
- Part 2: QGIS analysis of the ET data for January & February 2016 and 2017



# Part 1: Select Landsat Images and Calculate METRIC ET

# Select Landsat Images and Calculate METRIC ET

1. Go to <http://eeflux-level1.appspot.com/>
2. On the EEFlux page you will see the following options:
  - **Instruction:** provides information about the ET data and directions on how to use the EEFlux website
  - **FAQ:** provides frequently asked questions
  - **Date Information:** allows for date range selection
  - **Location Information:** allows spatial selection by moving the orange marker on the world map. In the window the latitude and longitude values appear in decimal degrees as you move the marker. 
  - **Search for Images:** starts the search for images for the selected date range and spatial location



# Select Landsat Images and Calculate METRIC ET

3. Enter the following options:
  - **Date Information:** Using the calendar, select 1 to 29 February 2016.
  - **Location:** Drag the marker on the map to the latitude and longitude close to  $-24.47^{\circ}$  and  $-54.01^{\circ}$
  - Click on **Search for Images**. You will get a list of images with dates and percent cloud cover of the image

**Date Information**

Please change the date range

2016-01-01 to 2016-02-29

**Location Information**

Please drag the marker on the map to select your coordinates.  
Latitude and Longitude values are in decimal degrees. Latitude and longitude -->

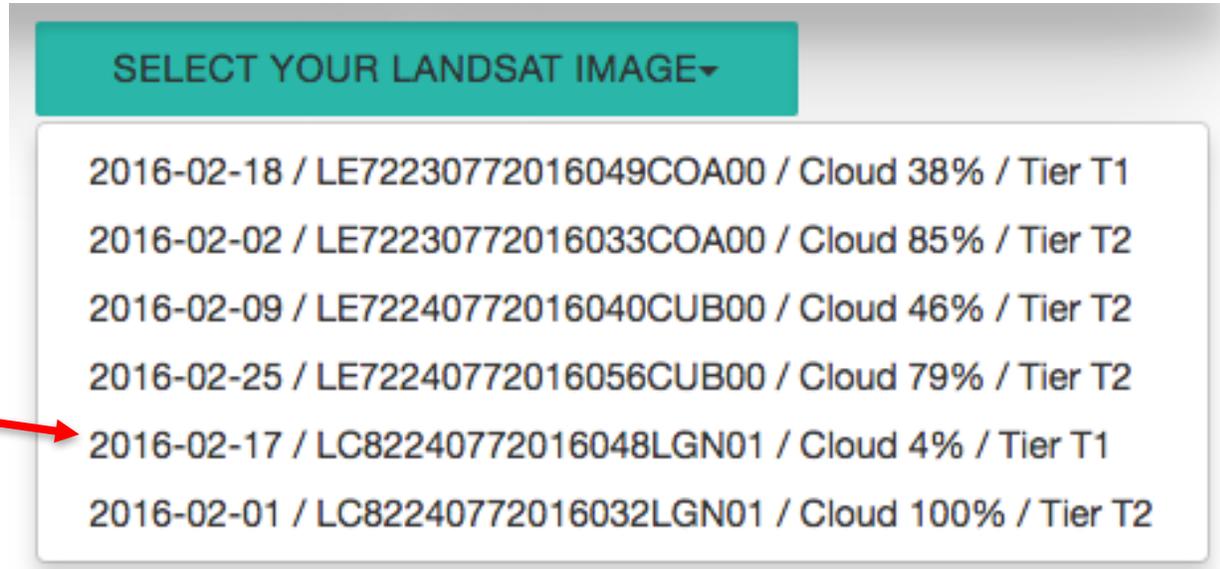
-24.47167988604899

-54.017737582325935



# Select Landsat Images and Calculate METRIC ET

- In filenames LE7 is Landsat ETM+ (Landsat 7) and LC8 is OLI/TIRS combined from Landsat 8
- In the image on the right:  
LC82240772016032LGN01
  - 224 and 077 are path and row of the image
  - 2016 is the year
  - 032 is the Julian Day
  - the last five digits are for the ground station ID



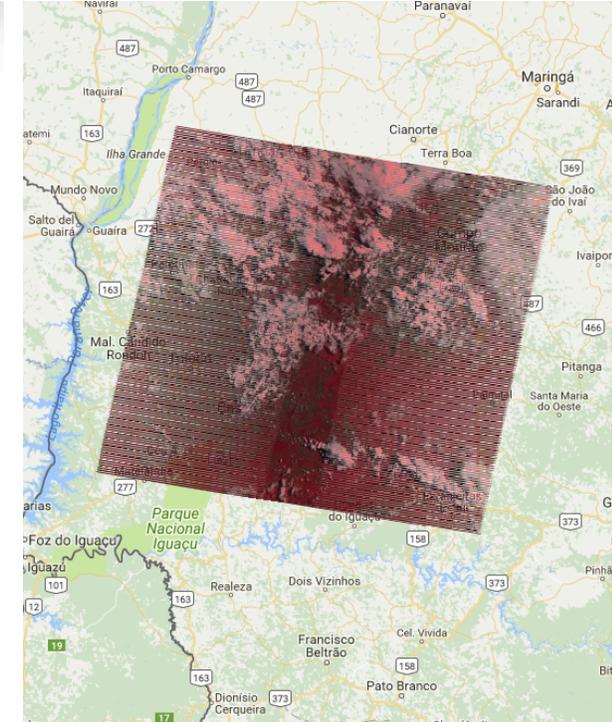
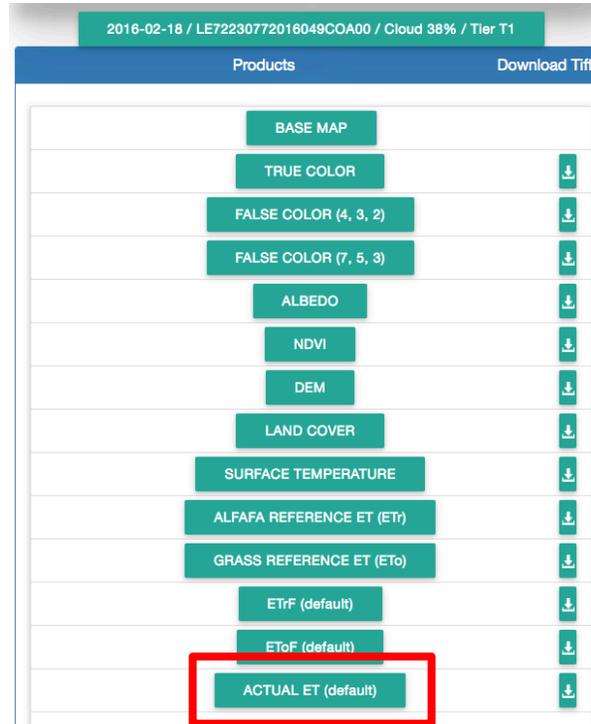
SELECT YOUR LANDSAT IMAGE ▾

- 2016-02-18 / LE72230772016049COA00 / Cloud 38% / Tier T1
- 2016-02-02 / LE72230772016033COA00 / Cloud 85% / Tier T2
- 2016-02-09 / LE72240772016040CUB00 / Cloud 46% / Tier T2
- 2016-02-25 / LE72240772016056CUB00 / Cloud 79% / Tier T2
- 2016-02-17 / LC82240772016048LGN01 / Cloud 4% / Tier T1
- 2016-02-01 / LC82240772016032LGN01 / Cloud 100% / Tier T2



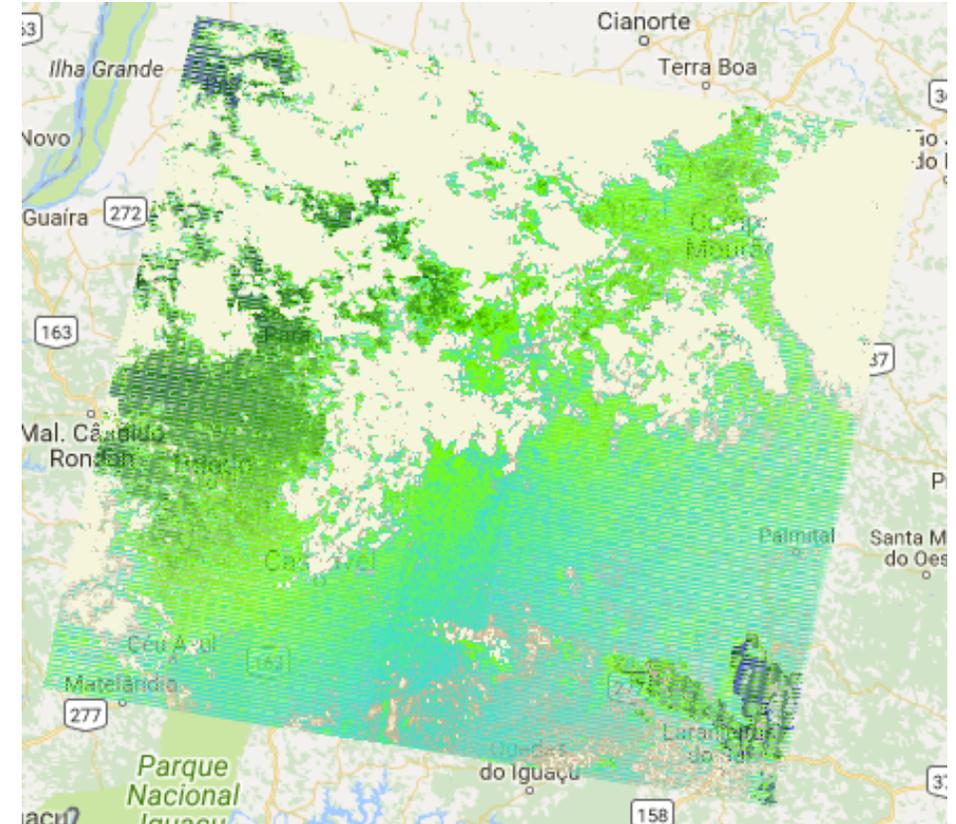
# Select Landsat Images and Calculate METRIC ET

- Click on the first image and you will see the Landsat image displayed on the map, along with a list of parameters derived from the image
- Note the list of parameters available for this image:
  - The reference ET for Alfalfa ( $ET_r$ ) and grass ( $ET_o$ ) surfaces are available
  - $ET_rF$  is the ratio of actual ET ( $ET_c$ ) to  $ET_r$
  - $ET_oF$  is the ratio of  $ET_c$  and  $ET_o$



# Select Landsat Images and Calculate METRIC ET

6. Examine each image in the list one by one and write down the cloud cover for each
  - **Note: the browser back arrow may not work.** Click on the date and image window to go to the next image
7. Select the images one by one and click on Actual ET (Default)
  - You will get the ET map on the right
  - Look at the color bar on the left below the parameter list. Zoom in on the ET map to examine it closely.



# Select Landsat Images and Calculate METRIC ET

8. Download and save ET as a GeoTIFF file by clicking on the down arrow next to the Actual ET. You will get the files in .zip format. Unzip the files to get the ET data in GeoTIFF format.
9. Repeat the above steps for 1 to 28 February 2017 and save a GeoTIFF file for each day.



# Questions

1. Visually compare the ET maps for Landsat 7 images to that from Landsat 8 and comment on the difference you see in the quality of the data.
2. What is the unit of ET?
3. Compare the ET for images with different cloud cover. What happens when an image has large (>50%) cloud cover?





## Part 2: QGIS Analysis of ET Data for February 2016 & 2017

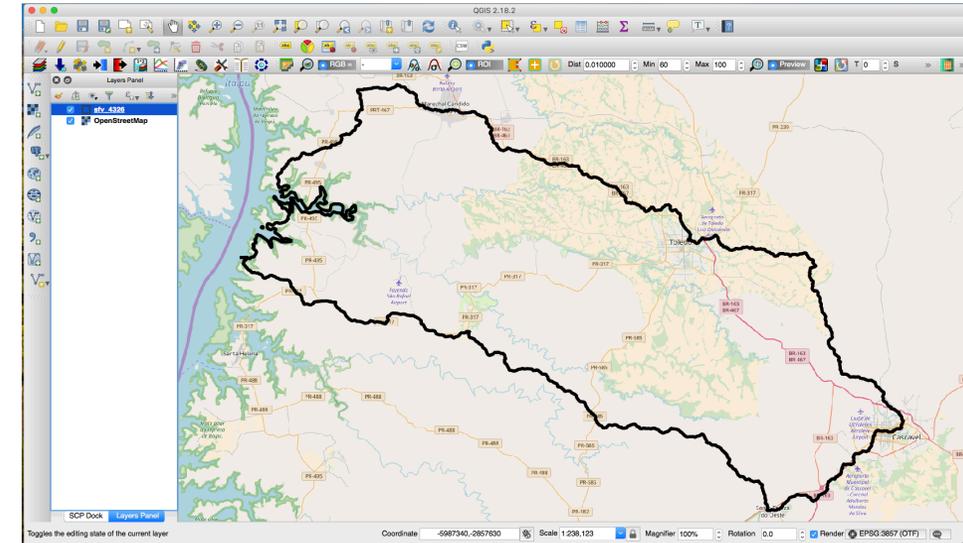
# QGIS Analysis of ET Data for February 2016 & 2017

1. Open QGIS and start a new project
2. From the top menu bar, click on **Web**, select **Open Layer Plugin** and select a background map
3. Click on the menu on the left bar and click **Add Vector**  to add the SFW shapefile: sfv\_4326.shp



# QGIS Analysis of ET Data for February 2016 & 2017

4. Make the shapefile layer transparent with only the boundary outlined on the map
  - Right click on the layer file and go to **Properties > Style**
  - Click on the down arrow in the **Fill** window and select **Transparent fill**
  - Click on the down arrow in the **Outline** window and choose a color of the shapefile boundary (The example uses black)
  - Choose **outline width** to be 2.0
  - Click **Apply** and **OK** to get the result in the QGIS window

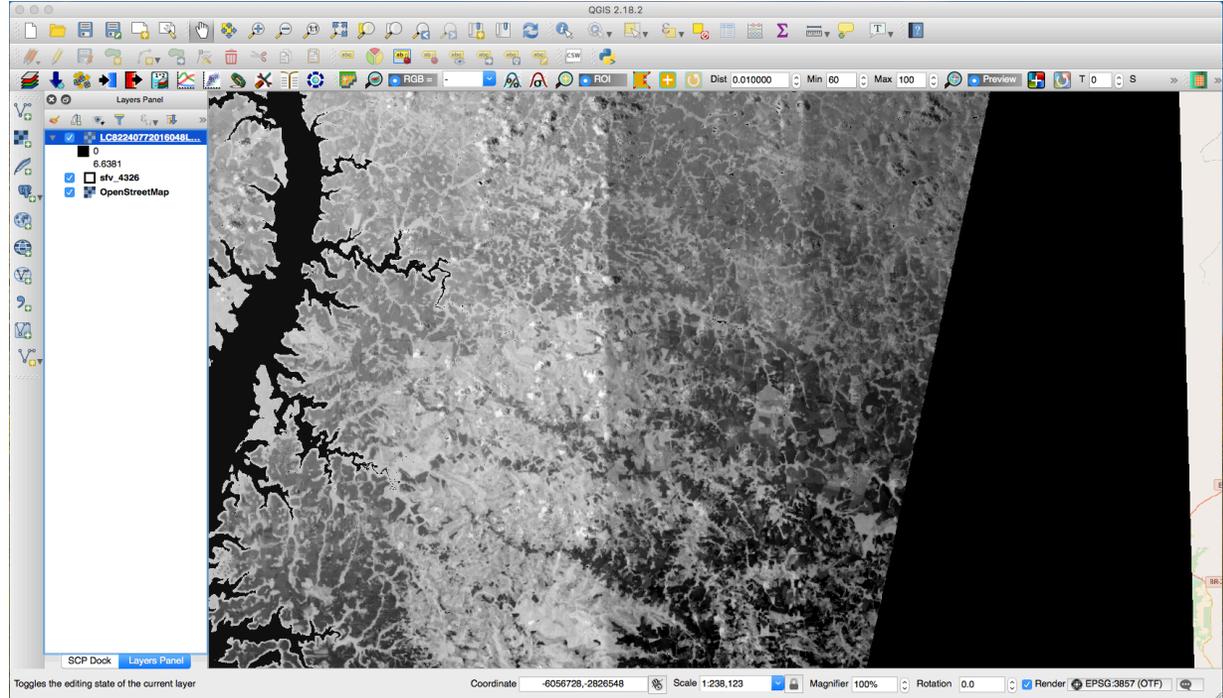


# QGIS Analysis of ET Data for February 2016 & 2017

5. Next click on the **Add Raster** function on the left



- Navigate to your saved ET files and click on **Open** to add the Landsat 8 data file:  
LC82240772016048LGN01\_ETa.ET  
r.tif for February 17, 2016 and  
LC82240772017050LGN00\_ETa.ET  
r.tif for February 19, 2017
- You will see the GeoTIFF images appear in grayscale



# QGIS Analysis of ET Data for February 2016 & 2017

6. Now clip the interpolated ET layers to the SFW shapefile
  - On the top bar go to **Raster** > **Extraction** > **Clipper** to open the Clipper options window
  - In the Input File (raster) window select:  
LC82240772016048LGN01\_ETa.ETr.tif.
  - In the Output file window, select the output folder and enter the file name  
(Suggestion: ET17Feb2016\_Clipped)
  - Check the **Mask Layer** and in the **Mask Layer** window select the shapefile named sfv\_4326
  - Click **OK** on at the bottom right
  - You should see the data clipped by the shapefile boundary



# QGIS Analysis of ET Data for February 2016 & 2017

7. Repeat Step 6 for LC82240772017050LGN00\_ETa.ETr.tif
  - Suggestion: save the clipped file as ET19Feb2017\_Clipped
  - You can also remove the original 'unclipped' ET layers from the QGIS if you choose



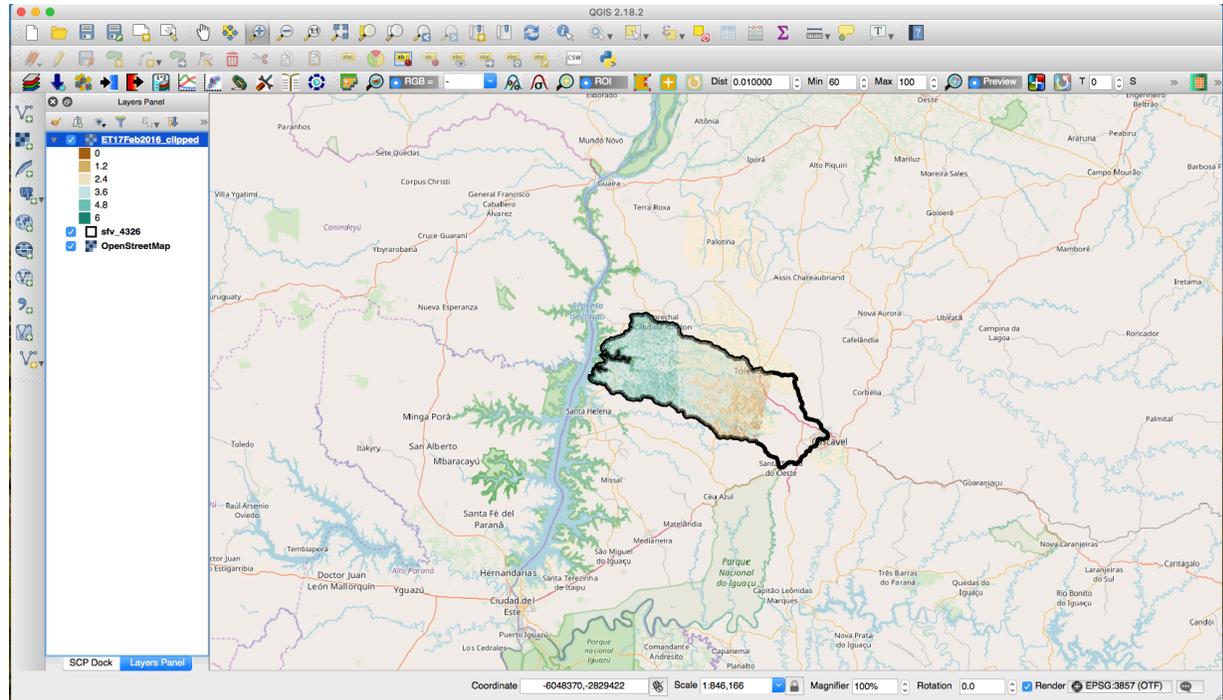
# QGIS Analysis of ET Data for February 2016 & 2017

8. Right click on the clipped raster layers one at a time and follow the steps to get colored ET maps:
  - Go to **Properties > Style**
  - Select the **Render Type** as **Singleband Pseudocolor**
  - Next to **Color**, make sure the color palette is Brown-Green by selecting **(BrBG)**
  - Select **Min** value to be 0 mm/day and **Max** value to be 6 mm/day
  - Below the color display, change the **Mode** to **Equal Interval** and **Classes** to 7. Click **Classify**, then click **Apply**
  - Click **OK** to close the Change Color box



# QGIS Analysis of ET Data for February 2016 & 2017

9. Make the clipped ET layers transparent to see the map underneath
  - Right click on the layer file and go to **Properties > Transparency**
  - Set the **Transparency** level to 50%
  - Under **No data value** set **Additional no data value** to 0
  - Click **Apply** and then **OK**



# Questions

1. Which days show larger ET?
2. Which image has more cloud cover? Do you think the cloud cover has impact on the ET data?
3. Which factors decide what the ET values for any location or time will be?
4. What are the challenges with using Landsat ET for water budget analysis?

