

Prerequisite Introduction to QGIS and Raster Imagery

Introduction

This exercise will provide a brief overview of QGIS elements. It will also show you how to add vector data and modify layer attributes. Additionally, raster data (Landsat imagery) will be acquired and input into QGIS. The Landsat imagery that you download in the prerequisite will be used during the course exercises for generating a land cover classification.

Objectives

- Become familiar with QGIS
- Learn to add vector data and modify layer attributes in QGIS
- Become familiar with the USGS Global Visualization Viewer (GLOVIS) data portal
- Understand how to download Landsat imagery and display it in QGIS
- Learn how to stack raster bands to generate a multilayer raster image

Data Requirements

For this exercise you will need all files from the “Prerequisite_Data” zipped folder on the ARSET website including:

- CA_projected.shp
- CA_Cities_Top10.shp
- Yosemite_boundary.shp

You can download the zipped data files listed above on the [ARSET website](#).

You will need to unzip this folder and save it to a folder on your computer. It is recommended that all data for this webinar be well organized and remain in the same location.

Homework

You must complete the prerequisite homework via Google Forms by January 27, 2017. This homework will test your knowledge of the fundamentals of remote sensing and your completion of this exercise. You will receive an email confirming receipt of your homework by January 31, 2017. [View the homework »](#)

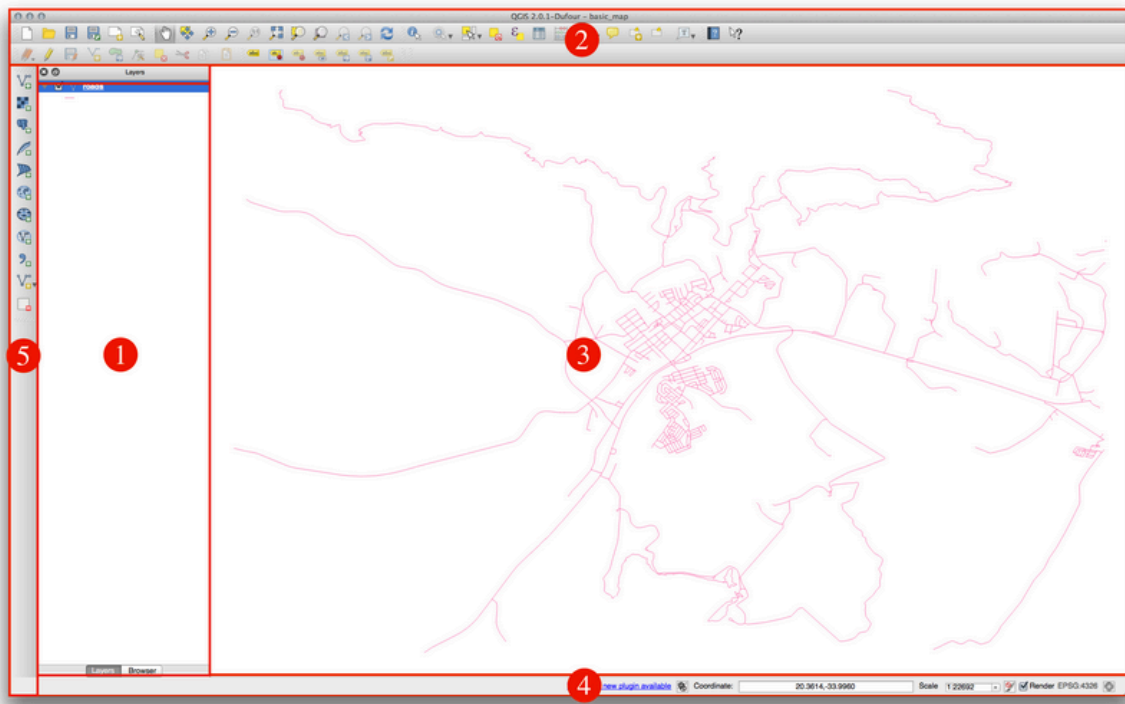
Additional Prerequisite

QGIS and the associated plugins should already be downloaded as part of the prerequisites for this course. This is the first prerequisite we have for this course. If you do not have QGIS installed, please see *Downloading and Installing QGIS* on the ARSET website. This introduction assumes that you have a basic background with geospatial software. If you are not familiar with any geospatial software we suggest spending some time exploring QGIS prior to the webinar. Additionally, QGIS has [very useful user tutorials](#).

Part 1: Getting Started with QGIS

- Open QGIS
 - Mac users: from your Desktop icon or your Applications folder
 - Windows users: from your Desktop icon or your Program start

The QGIS interface has multiple elements outlined here:



1. Layers List/Browser Panel

- a. This will display all the layers you have in the map. You can right click on each layer file for more information and to perform specific functions. You can also expand and collapse items within the panel.

2. Toolbars

- The tools you use most often can be displayed here. You can modify which tools are displayed by clicking on “View” - “Toolbars.” You can also move tools around within this toolbar.

3. Map Canvas

- Where the map is displayed

4. Status Bar

- This shows current information about the map and allows you to adjust the scale

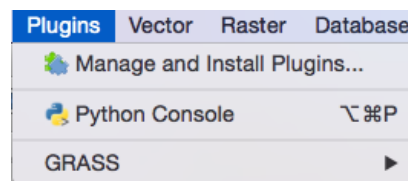
- Here you can add in different types of data layers. Note: if you hover over any of these icons, it will display the function name. Explore the available functions.

Part 2: QGIS Plugins

Plugins are optional tools that you can import into your QGIS for additional functionality. For this training, we will be using the Semi-Automatic Classification Plugin to conduct land cover classifications. You must install this plugin before the first session.

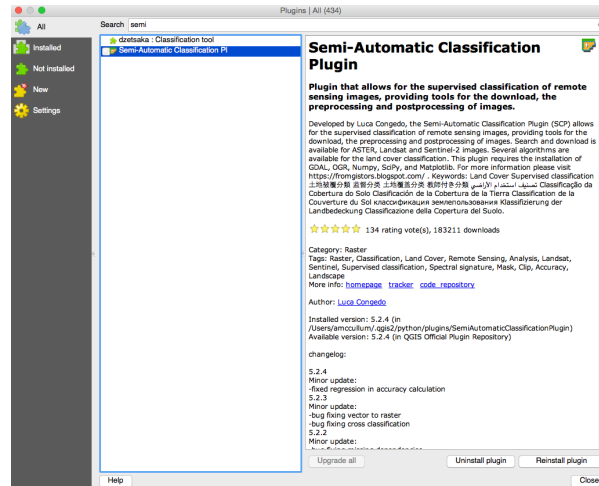
Another useful plugin for QGIS is OpenLayers, which includes Google Maps, OpenStreetmap, and Yahoo Map layers. This is not required for the course, but you will use it for this prerequisite exercise.

- Install the **Semi-Automatic Classification Plugin**. This is a useful plugin for many types of raster operations such as classifications.
- Click on **Plugins** to Manage and
- In the search bar type **Semi**. Then you should see the Semi-Automatic Classification Plugin appear.
- Click on **Install Plugin** in the bottom right corner. This will download the plugin from the repository, install it, and load it into QGIS.

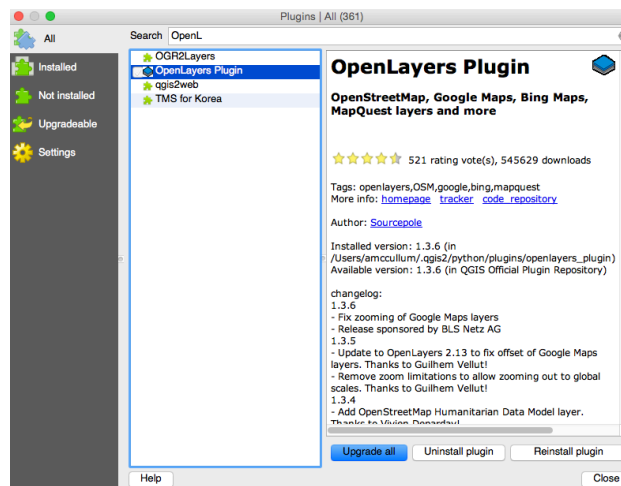


raster operations such

in the top toolbar and go Install Plugins.




- You can also install the OpenLayers Plugin.
- From the Plugins menu in QGIS, choose **Manage and Install Plugins** enter OpenLayers in the search field and select **OpenLayers Plugin** from the list.
- Click the **Install plugin** button. This will download the plugin from the repository, install it, and load it into QGIS.

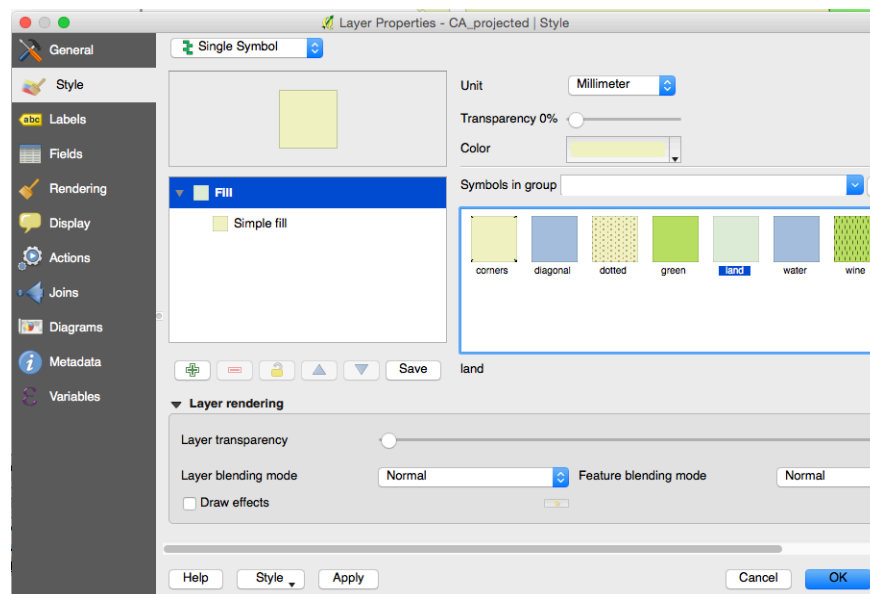


- Another useful plugin is **GRASS** (Geographic Resources Analysis Support System) and can be used through QGIS. GRASS allows for additional abilities to view, edit and create data as well as perform analysis. GRASS 6 plugin is automatically installed as a plugin with the initial download of QGIS 2.0.
- Feel free to explore additional plugins!

Part 3: Adding and Modifying Vector Layers

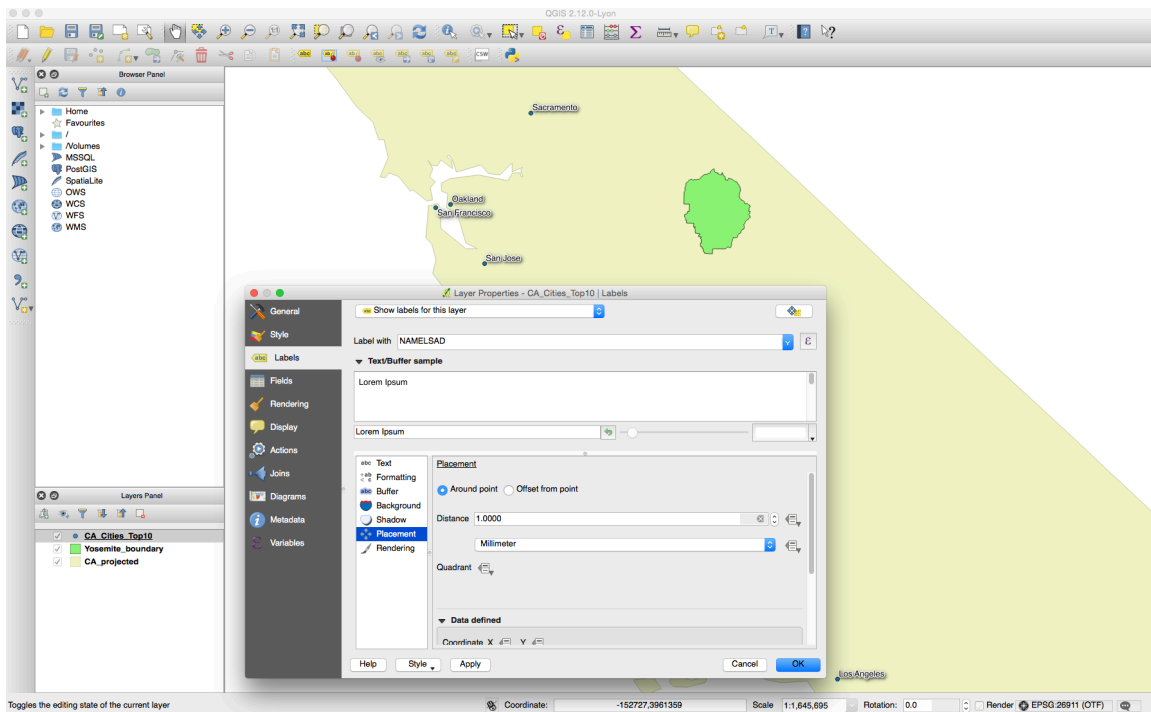
Adding a vector layer

- Click on the **Add Vector Layer** icon 
- Next to Dataset click on the **Browse** button and find the shapefile called CA_projected.shp. Click **Open** to add it to the map. The layer will be added to the map and you should see an outline of the state of California. The color may not be aesthetically pleasing, so we can change that.
- Right click on the CA_projected file in the Layers Panel, then click on **Properties**. This should automatically take you to the **Style** panel and there you can change the color, transparency, etc. You will notice some example symbols and colors on the right side of the Style panel. Click on land. Click **Apply** at the bottom. You will see the fill change colors. Click **OK**.





- Repeat the previous steps to add the CA_Cities_Top10.shp and Yosemite_boundary.shp files. These are a point file of the ten largest cities in California based on population, and the boundary of Yosemite National Park.
- Right click on the CA_Cities_Top10 file in the Layers Panel, then click on **Properties**. In the **Style** tab, change the symbol to the city option in the box on the right. Then, using the dropdown menu next to **Color**, change the fill color to blue.

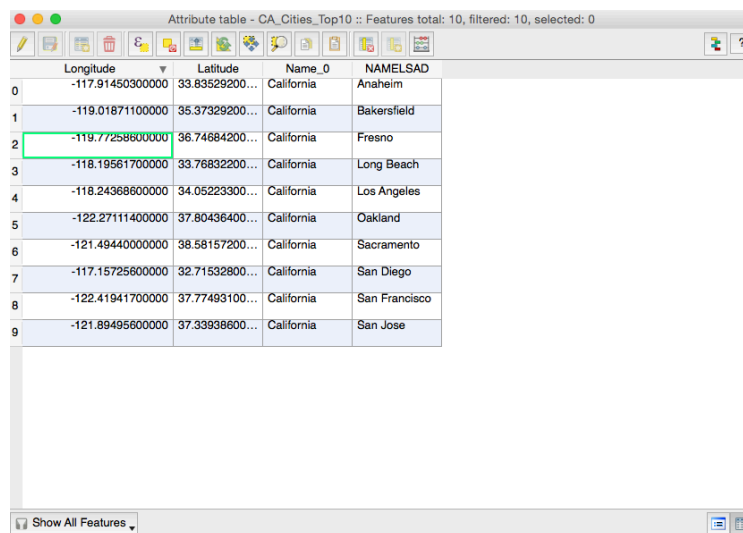
- You can also add labels to a map and modify them based on your specific cartographic needs. Click on the **Labels** tab. In the top drop down menu choose **Show Labels for this Layer**. In the drop down menu next to **Label With** select NAMELSAD. Click Apply.
- Without closing the Properties box, take a look at the city labels in the map. You can also change the formatting of the labels. Click on the **Buffer** option within the **Labels** tab. Check the **Draw text buffer** button and keep everything as default. Click on the **Shadow** option and check the Draw drop shadow. Finally, click on the **Placement** option and increase the distance to 1 millimeter by clicking on the “up” arrow next to **Distance**. Click **Apply** again and close the **Properties** window. Take a look at the labels again in the map. They are now a bit easier to read.



- You can also modify and label the Yosemite layer in the same way. Open the Properties box and change the color to dark green. Click on **Simple Fill** in the fill box on the left side. Then change the Fill color to green and the Border to red.
- Label the layer using the **UNIT_NAME** and give it a white **Buffer** of 0.7 millimeters.


Viewing data and Vector Attributes

- Using some of the tools on the top of your QGIS project panel, you can modify the view of your data. Click on the **Zoom Full**  tool. This should display the full extent of all of your map layers. You can also zoom into specific layers. Click on the Yosemite_boundary layer, then click on the **Zoom to Layer**  tool. This should allow you to view the full extent of the Yosemite NPS boundary. You can also zoom to a specific layer by right clicking on the layer in the Layers Panel and clicking on Zoom to Layer.
- You can obtain more information about the specifics of a vector layer by taking a look at the Attribute table. Right click on the CA_Cities_Top10 layer and click on **Open Attribute Table**. Here you will see the latitude and longitude of each point, the state, and the city name.



| | Longitude | Latitude | Name_0 | NAMELSAD |
|---|-------------------|----------------|------------|---------------|
| 0 | -117.914503000000 | 33.83529200... | California | Anaheim |
| 1 | -119.018711000000 | 35.37329200... | California | Bakersfield |
| 2 | -119.772588000000 | 36.74684200... | California | Fresno |
| 3 | -118.195617000000 | 33.76832200... | California | Long Beach |
| 4 | -118.243686000000 | 34.05223300... | California | Los Angeles |
| 5 | -122.271114000000 | 37.80436400... | California | Oakland |
| 6 | -121.494400000000 | 38.58157200... | California | Sacramento |
| 7 | -117.157256000000 | 32.71532800... | California | San Diego |
| 8 | -122.419417000000 | 37.77493100... | California | San Francisco |
| 9 | -121.894956000000 | 37.33936600... | California | San Jose |

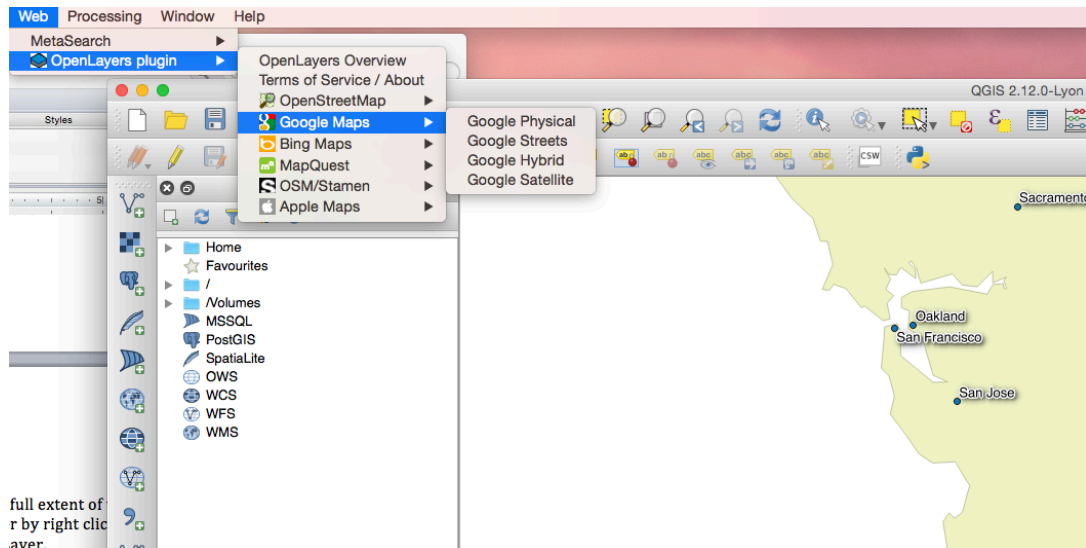
Saving your QGIS Projects

- It is very important to save your QGIS projects along the way so that you do not lose any important processing steps. At the top of your screen click on **Project**, then **Save As**. Navigate to your data folder for this webinar and save the project as Week1 or something similar. We recommend that throughout this exercise and your homework assignments, that you regularly click on the **Save** icon .

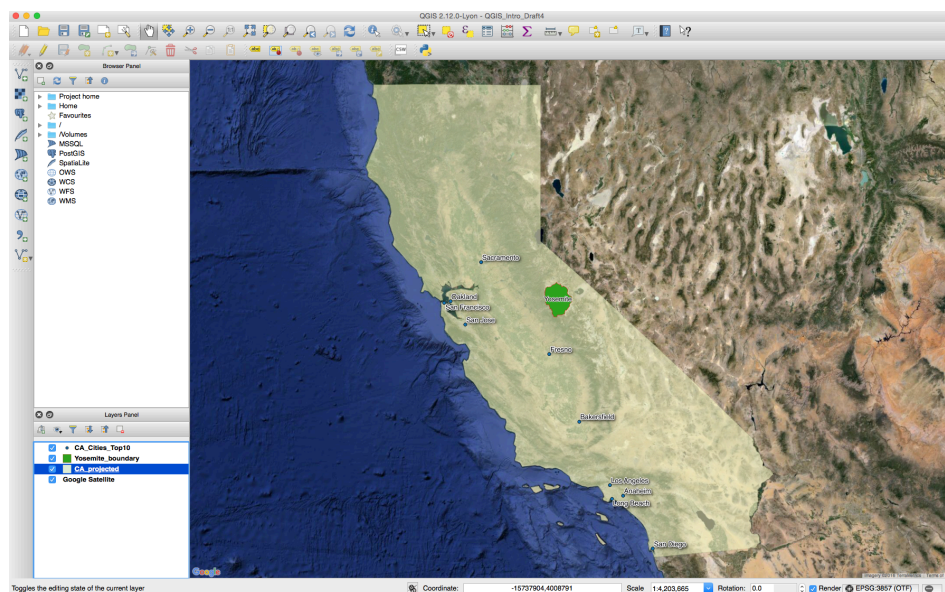
Using Plugins

- You can also add some background imagery to your map using the OpenLayers Plugin. At the top of your screen click on **Web**, then

OpenLayers Plugin, then Google Maps, and Google Satellite. It may take some time to load in your map, so be patient! Then zoom to your CA_Projected layer.



- Move the Google Satellite layer to the bottom of the Layers Panel by clicking on Google Satellite and dragging it down below the other layers.
- You can then adjust the transparency of the California layer. Right click on the CA_Projected layer and go to **Properties**. In the **Style** tab under **Layer rendering** you can adjust the **Layer transparency** by sliding the circle to the right or typing in a specific transparency on the box on the right. Adjust the transparency to 40. Click **Apply** then click **OK**. Now you can see some of the earth features under the California layer.



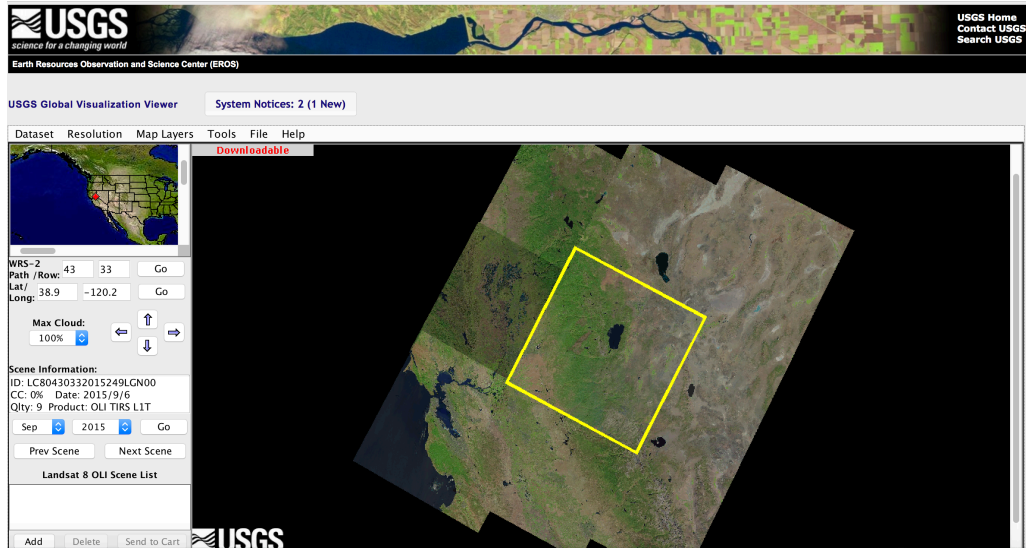
- As you may have noticed, the Google Satellite layer causes QGIS to run quite slow and can sometimes cause it to freeze. Here is where that regular saving comes in handy! So if you are creating a map it is recommended that you add this layer at the very end of your work. Right click on the Google Satellite layer and click on **Remove**.
- Make sure to also **Save** your QGIS project.
- As a final step before you quit QGIS, at the top of your computer, Click on **Project**, then **Project Properties**. Under the General Settings make sure that next to **Save paths** it says **Relative**. This should be the default setting for QGIS, but it is important to check. Relative paths specify the location of the data contained in the map relative to the current location. This means that you should be able to move all the files and the QGIS project to a different folder or computer. However, it is recommended to keep all data in the same location.

Part 4: Downloading Raster Data

For this portion of the exercise we will be downloading and viewing a raster layer. We will step through the process of downloading a Landsat image. This image will also be used in additional exercises and homework assignments.

- Go to the USGS Global Visualization Viewer (GloVis) website here: <http://glovis.usgs.gov/>. Please use Firefox, Safari, or Internet Explorer and make sure you have pop-up blocker off and have the latest version of Java installed.
- Click on the **Dataset** tab, scroll down to **Landsat Archive**, then select **Landsat 8 OLI**. Under the small image on the left, next to WRS-2 Path/Row type in 43 and 33 (path 43, row 33) then click **Go**.

- Under the Scene information change the date to September 2015 then click **Go**. You should see the scene we want highlighted in yellow in the preview pane on the right. At the bottom of the webpage under Landsat 8 OLI Scene list click **Add**. Then click **Send to Cart**.



- A separate tab will then open and ask you to either login to your EROS Registration System or to create an account. If you do not have an account, you must register by clicking on **Create New Account**. This is free and easy to do by creating a username and password. Once you are registered you will receive an email to confirm your account. If you have an account, login now. Once you login, you should see your username on the top right corner of the webpage.
- You will then be taken to your cart. This is like your shopping cart. You will see the Entity ID listed. Click on the ID **LC80430332015249LGN00**. This will take you to another webpage that shows a preview of the image and information. Scroll down to the bottom of the page and click on **Download**. Then click on the last **Download** button next to Level 1 GeoTIFF Data

Product (940.1 MB).

The screenshot shows the USGS Item Basket page. At the top, there's a USGS logo and navigation links. Below that, it says 'Item Basket' and '1 New System Message'. A message states: 'No scenes were automatically added to your item basket. Please select the appropriate order type for each scene and click 'Apply''. Below this, there's a section for 'Pending Scenes' with a table:

| Entity Id | Collection | Order | Bulk Download | Available Products |
|---------------------------------------|-------------|-------------------------------------|--------------------------|--|
| LC80430332015249LGN00 | L8 OLI/TIRS | <input checked="" type="checkbox"/> | <input type="checkbox"/> | Order Products L8 OLI/TIRS L1 WMS ON-DEMAND Bulk Products LandsatLook "Natural Color" Image LandsatLook "Thermal" Image LandsatLook "Quality" Image LandsatLook images with Geographic Reference Level 1 GeoTIFF Data Product |

Below the table are buttons: 'Toggle All Bulk Download', 'Toggle All Orderable', 'Apply', and 'Go to Item Basket'. At the bottom, there are links for 'Accessibility', 'FOIA', 'Privacy', 'Policies and Notices', and 'Google Maps API Disclaimer'. The footer includes 'U.S. Department of the Interior U.S. Geological Survey', 'URL: https://earthexplorer.usgs.gov', 'Page Contact Information: customers@usgs.gov', 'Page Last Modified: 12/07/2016', and the USA.gov logo.

- The image will take a while to download depending on your connection. In my case, the file took about 25 minutes to download.
- Once the file has downloaded, you will receive the file as a .tar.gz file. For most Mac users, this will require using the Archive Utility application. This should be invoked automatically with OS X Yosemite. For Windows users, you can use 7-zip (<http://www.7-zip.org/>). Here is a tutorial on how to download and install 7zip and how to extract files from a .tar file: <https://www.youtube.com/watch?v=QJbXUkM1Us>. Please make sure you

The screenshot shows a list of five items for download, each with a 'Download' button and the item name and size:





- Download** LandsatLook "Natural Color" Image (8.3 MB)
- Download** LandsatLook "Thermal" Image (3.7 MB)
- Download** LandsatLook "Quality" Image (439.7 KB)
- Download** LandsatLook images with Geographic Reference (12.5 MB)
- Download** Level 1 GeoTIFF Data Product (940.1 MB)

have the ability to unzip these files.

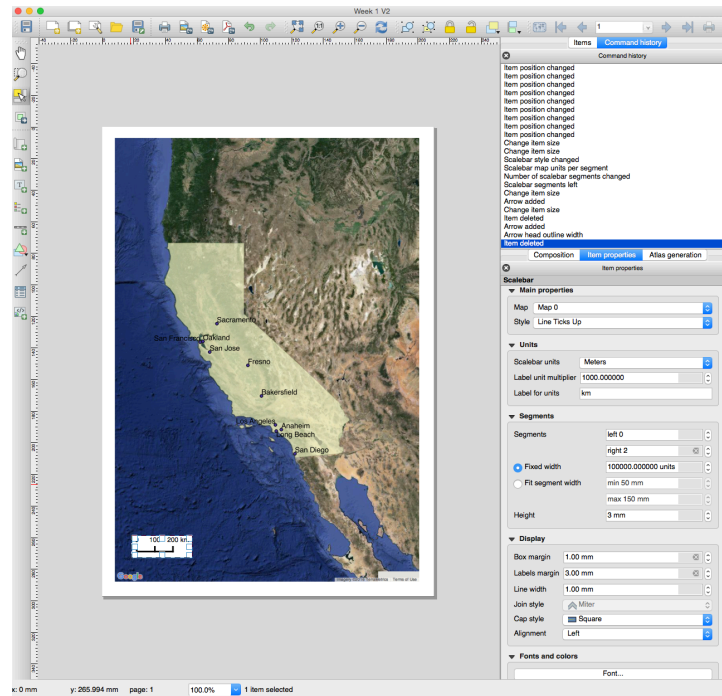
- Once you have downloaded and unzipped the Landsat images, save the folder with your other files for this webinar. Take a look at the files. You will notice that they named using the standard Landsat naming convention, and that there are separate files for each band (e.g. B1, B2, B3).
- Make sure you save all of these files (including the .MTL file) in the same folder on your computer. This will be important when we stack the Landsat bands and display them in our course exercises.

Additional Optional Exercise: Creating a Map with Print Composer

The **Print Composer** function allows you to create a map as a PDF or an image file. You can add all the “pieces” of a map such as adding a legend, scale bar, north arrow, etc. Once you create your first map, you can also save the map template for quick map-making in the future. Let’s briefly explore this tool.

- Turn off the raster layer by unchecking the layer in the **Layers Panel**.
- At the top of your screen click on **Web**, then **OpenLayers Plugin**, then **Google Maps**, and **Google Satellite**. It may take some time to load in your map, so be patient! Then zoom to your **CA_Projected** layer.
- At the top of your screen, click on **Project**, then **New Print Composer**. In the name prompt, type **Week 1 Map**.
- A new window will appear. Under **Page size** on the right side, change the **Orientation** to **Portrait**.
- On the left hand side of the **Print Composer**, click on **Add new map** . Then hover over the blank page and draw a rectangle about the size of your page. This will automatically display your project properties within the new map.
- If California is not centered, click on **Move item content**  or  (depending on QGIS version). Then click on the map to move around the contents.
- Click on **Add scale bar** . Then click on the lower left side of the map. The scale bar will automatically be displayed. On the right side panel click on **Item properties**. In the **Style** option under **Main properties**, choose **Line Ticks Up**. Under **Segments**, decrease the left to 0 and the right to 2. Under **Fonts and colors**, change the fill color to white by clicking on the triangle next to the color box and choosing white. Under **Background**, change the background color to white.

You can then check out all the other features of the **Print Composer**. You can style your maps to fit your cartographic needs. To end this homework, we will save the map as a pdf.



- At the top of your screen, click on **Composer**, then **Export as PDF**. A screen may pop up saying that it is recommended to print as raster, if so, click OK. This will still have the map as a pdf. Navigate to your webinar folder, name your map *Week 1 Map*, and click **Save**. You can then open this file and take a look at the map you created.

For additional fun with Print Composer, here are some helpful websites:

http://docs.qgis.org/1.8/en/docs/user_manual/print_composer/print_composer.html and http://www.qgistutorials.com/en/docs/making_a_map.html