

Introduction to Google Earth Engine and Satellite Image Analysis

1. Introduction

1.1 What is Google Earth Engine?

Google Earth Engine (GEE) is a cloud-based geoprocessing platform, launched in 2010, that enables access to a wide variety of satellite remote sensing datasets, including the Landsat series, Sentinels-1, 2 and 3, and MODIS, for analysis either within Earth Engine or to download and analyse externally with other software. It is a code-based platform, utilising a JavaScript application programming interface designed to make developing complex geospatial workflows fast and easy. It is free and open, allowing researchers increased access to geospatial and remotely sensed data.

To access Google Earth Engine, you need to have a Gmail account and then register for a Google Earth Engine Account. If you have not done so yet, you can check how to get these following the instructions under “Assignment 2: Registration” in the section “Workshop Resources and Assignments” at the bottom of the official workshop webpage:

<https://www.agl-acare.org/rit-project-2022>.

1.2 How do I get help?

There are multiple resources available to help get you started with Google Earth Engine. The GEE User Guide can be accessed here: <https://developers.google.com/earth-engine>. If you're stuck this is a good place to get help with the basics. After following this link, you can use the search bar at the top to type in the topic you need help with. Alternatively, you can scroll down the left-hand bar to find the sections that relate to what you need help with.

However, the User Guide does not have all the answers. If you are stuck, a Google search is your friend. Other people may have had similar problems to you and posted their question online where other people may have responded with the answer. GIS stack exchange (<https://gis.stackexchange.com/>) and Google Groups (<https://groups.google.com/forum/#!forum/google-earth-engine-developers>) are also good places to look for answers to your problems. You can also post your own questions and wait for people to respond. However, you should note that Google Earth Engine is still relatively new, and you may not find answers to all your questions. Posting on these platforms can be a good way of getting your answers and engaging with the GEE community. But because users are still low compared to other software, it may take time for questions to be answered, and they may not be answered at all, so don't be disheartened if you don't get a reply (particularly on Google Groups).

2. Introduction to GEE interface

To access the Earth Engine Code Editor (see Figure 1), go to: code.earthengine.google.com. The code editor is an integrated development environment that allows the user to interact and access information stored on the Earth Engine Cloud platform.

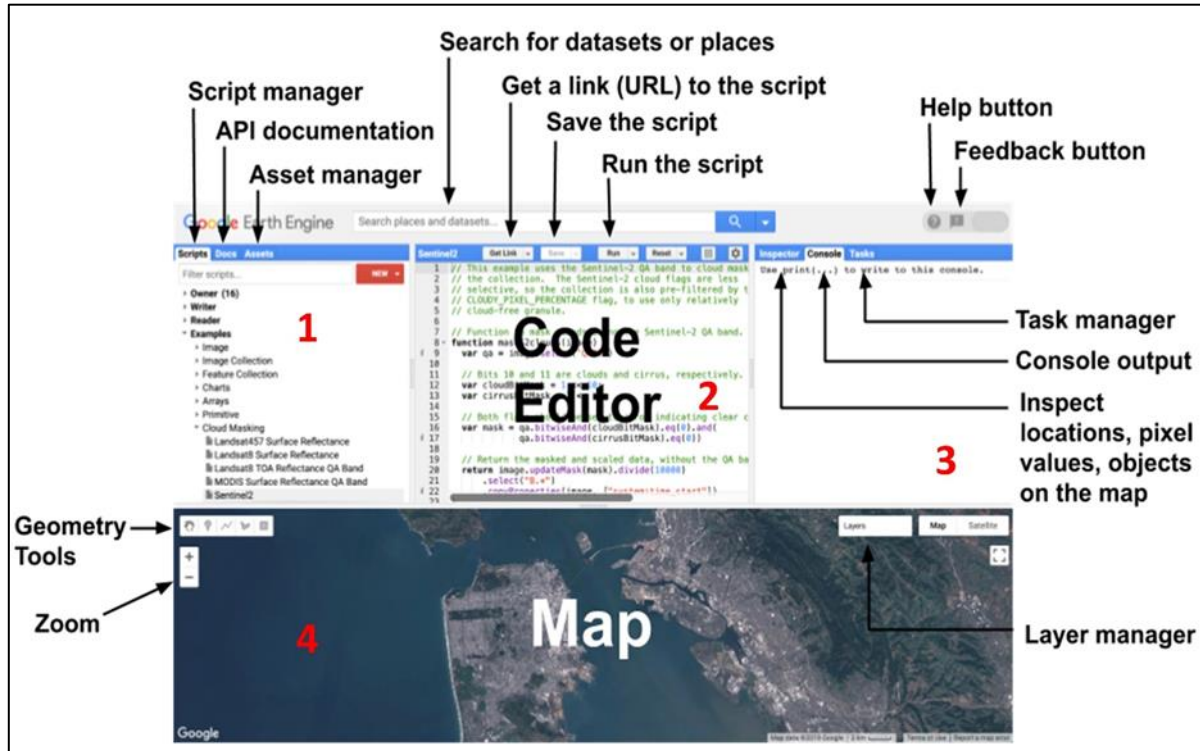


Figure 1 Diagram of components of the Earth Engine Code Editor at code.earthengine.google.com

The Code Editor is made up of four sections (Figure 1). These sections are:

1. Documentation
 - a. Script manager – where you save your scripts and repositories, linked to your google account
 - b. API documentation – information and documentation for all GEE based functions
 - c. Asset manager – where you import or save assets (such as polygons and geometries, and data tables) for use in your scripts.
2. Code editor – where you write your code
3. Outputs
 - a. Inspector – search your layers and investigate values from mapped information e.g. pixel values
 - b. Console – where the outputs from your script are printed
 - c. Task manager – where outputs just as csv, images, or assets are placed for you to save to your google drive, or to your asset manager.
4. Map – where the outputs of your scripts are visualised

3. Getting started

Now let's have a quick look at some of the basics you can do in Google Earth Engine.

Sign in to Earth Engine and navigate to the code editor (code.earthengine.google.com). First, you will need to have a Google account and Google Drive and register with Google Earth Engine (see section 1).

Let's start by outputting something to the console using the print function. Type the following into the code editor

```
print('Hello');
```

as shown below in Figure 2 2.

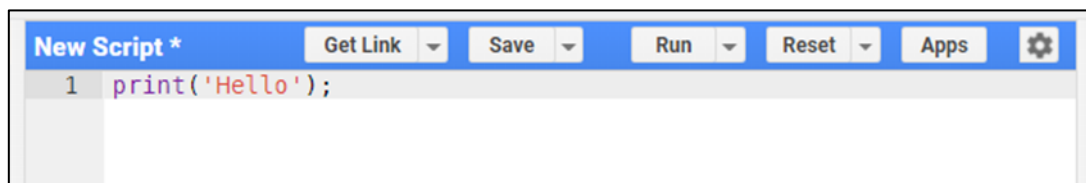


Figure 2. Using the print function.

and then click 'Run' to run the script. What do you see in the console window?

Next, we will select a Sentinel image and print its details to the console. Copy and paste the following code into the code editor and then click 'Run' (tip: you can also use the shortcut Ctrl + Enter to run your script).

```
print( ee.Image('COPERNICUS/S2_SR_HARMONIZED/20220923T074641_20220923T080500_T36MXE') );
```

This should print details of the image to the console as shown in Figure 3. Click on the little arrow to the left of the word 'Image' in the Console window to expand and see more information about the image. Notice that the image ID that appears in the console is the same as the text that appears in quote marks in the code that you entered. You can also expand 'bands' and 'properties' to find out more details of the image bands and image properties.

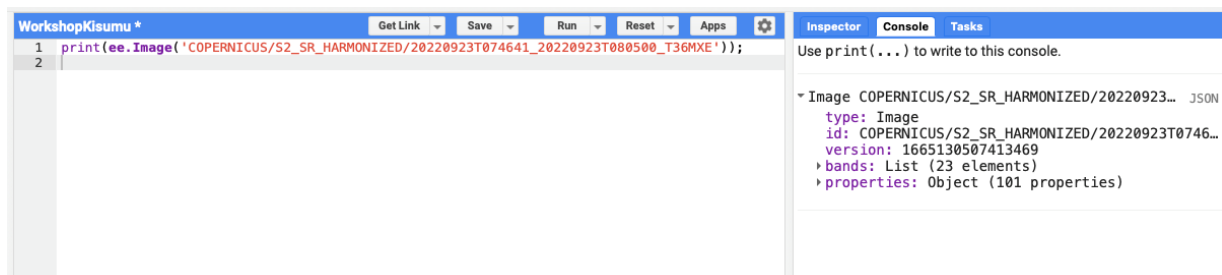


Figure 3. Print image details.

We can also visualise images in the map window. To do this, copy and paste the following code into the code editor and then hit 'Run'.

```
// Select Sentinel image
var image =
ee.Image('COPERNICUS/S2_SR_HARMONIZED/20220923T074641_20220923
T080500_T36MXE');

// Center the map on the image.
Map.centerObject(image, 9);

// Display the image.
Map.addLayer(image, {bands: ['B4', 'B3', 'B2'], min: 0, max:
3000, gamma: 1.3}, 'image');
```

The result is shown in Figure 4. The block of code you have just entered can be broken into three commands (i.e. instructions given to the computer application). First, a Landsat image is selected, using its ID and the ee.Image() function, and assigned to the variable 'image'. Secondly, the map view is centred on the image using the Map.centerObject() function. Thirdly, the image is displayed in the in the map window using the Map.addLayer() function.

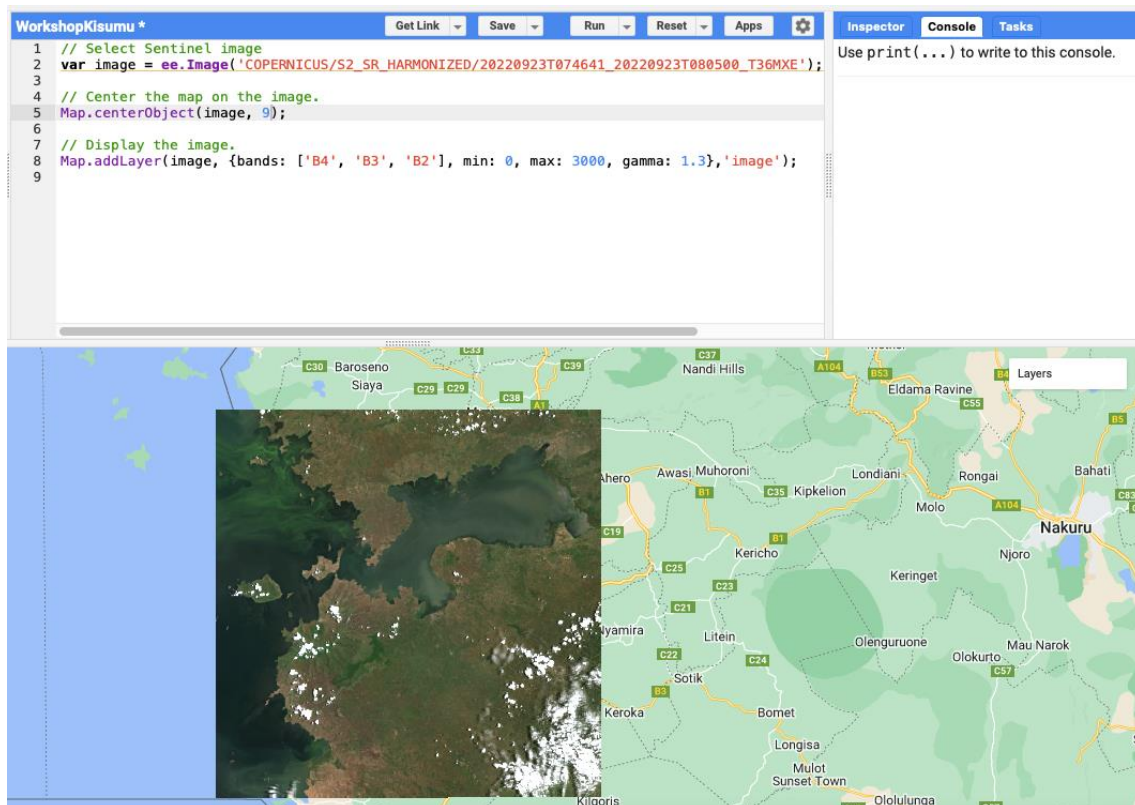


Figure 4. Displaying an image.

4. Extra

The above is just an initial walkthrough. Don't worry if some things feel a bit confusing, this is completely normal. Give yourself some time to go through the steps, and once you're comfortable with them, please take a look at some examples of code from the Google Earth Engine Library.

You will just need to open the links listed below, scroll down to the 'Explore in Earth Engine' section, and click on the button 'Open in Code Editor' right at the bottom. This will open the code in Google Earth Engine code editor.

Without changing the code, click on 'Run' (like you've done previously) and look at the output. Go through the code to see if you understand what is happening and note any potential questions that you might have that you will be able to ask during the workshop.

Feel free to modify the code if you feel up to the task and note that you can save the scripts on your directory for future use if you want! Don't worry about the different names of the products for now, we will discuss about this during the workshop. These are just some examples to show you how easy it is to just copy simple scripts from the Google Earth Engine Library and get some cool maps.

Note that we will only use **Sentinel-2 Level-2A** during the workshop.

Sentinel-2 Level-1C

https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2

Sentinel-2 Level-2A

https://developers.google.com/earth-engine/datasets/catalog/COPERNICUS_S2_SR_HARMONIZED

Landsat 8 Level 2, Collection 2, Tier 1

https://developers.google.com/earth-engine/datasets/catalog/LANDSAT_LC08_C02_T1_L2

NOAA CDR AVHRR NDVI: Normalized Difference Vegetation Index, Version 5

https://developers.google.com/earth-engine/datasets/catalog/NOAA_CDR_AVHRR_NDVI_V5

NASADEM: NASA NASADEM Digital Elevation 30m

https://developers.google.com/earth-engine/datasets/catalog/NASA_NASADEM_HGT_001

MOD11A1.061 Terra Land Surface Temperature and Emissivity Daily Global 1km

https://developers.google.com/earth-engine/datasets/catalog/MODIS_061_MOD11A1

CHIRPS Daily: Climate Hazards Group InfraRed Precipitation With Station Data (Version 2.0 Final)

https://developers.google.com/earth-engine/datasets/catalog/UCSB-CHG_CHIRPS_DAILY