



Usefulness of Google Earth Engine in Geoscience Studies

The 143th GIS Seminar
GONG Hao
2016.07.14

Acknowledgement

Some of contents, pictures or resources are borrowed from the Google Earth Engine official website.

The logo for Google Earth Engine, featuring the word "Google" in its multi-colored font followed by "Earth Engine" in a grey sans-serif font.

<https://earthengine.google.com/>



Usefulness of Google Earth Engine in Geoscience Studies

01

INTRODUCTION

- ✓ What is Google Earth Engine?
- ✓ How is Earth Engine different from Google Earth?
- ✓ Objective

02

TOPICS

- ✓ Datasets
(public data catalog)
- ✓ Platform
(cloud-based)
- ✓ Analysis
(code editor and explorer)

03

FINAL

- ✓ Get started
- ✓ Case studies

Google Earth Engine

What is Google Earth Engine?

a cloud-based computing platform that allows users to run geospatial analysis

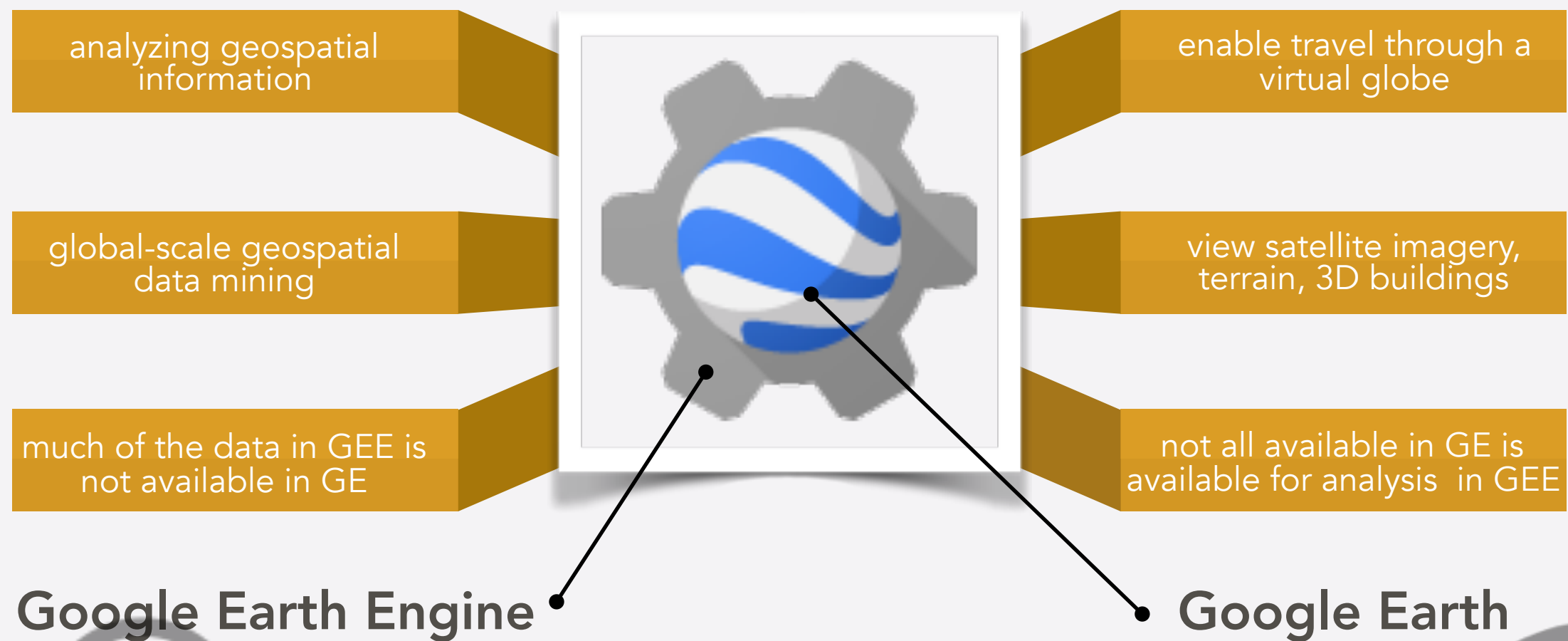
a platform for petabyte-scale scientific analysis and visualization of geospatial datasets, and makes it available for global-scale data mining

a tool provides simple and powerful APIs in JavaScript and Python, to enable the analysis of large datasets

Google Earth Engine combines a multi-petabyte catalog of satellite imagery and geospatial datasets with planetary-scale analysis capabilities and makes it available for scientists, researchers, and developers to detect changes, map trends, and quantify differences on the Earth's surface.

Google Earth Engine

How is Earth Engine different from Google Earth?





OBJECTIVE

UNDERSTANDING GOOGLE EARTH ENGINE

a cloud-based computing platform that allows users to run geospatial analysis

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TOPICS

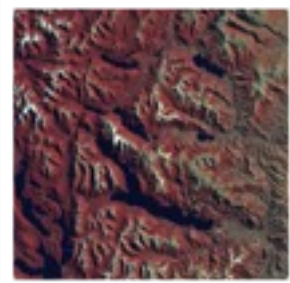
- ✓ Datasets
(public data catalog)
- ✓ Platform
(cloud-based)
- ✓ Geospatial analysis
(code editor and explorer)

03

FINAL

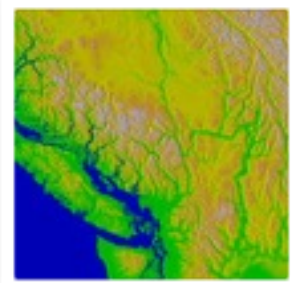
- ✓ Get started
- ✓ Case studies

DATASETS



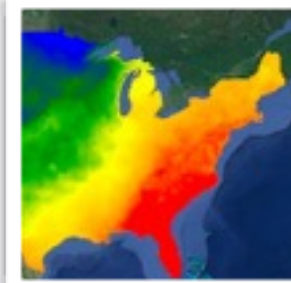
IMAGERY

Landsat
MODIS
High-Resolution
Sentinel
Other (nightlight)



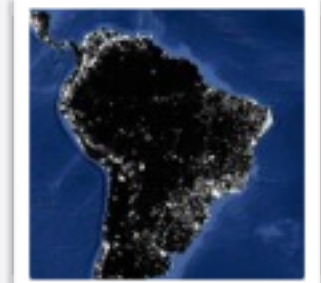
GEOPHYSICAL

Terrain
Land Cover
Cropland
Surface Temperature
Other (FIRMS)



CLIMATE

Atmospheric data
Weather
Climate



DEMOGRAPHIC

World Pop
Malaria data

...

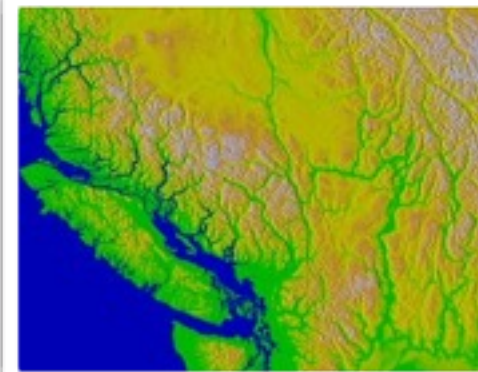
You can also upload your own raster data or vector data.

DATASETS



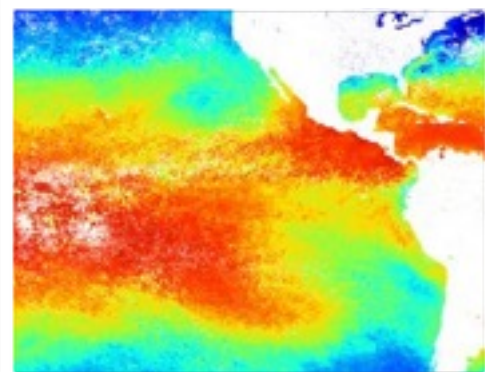
LANDSAT

1972 ~ now
30m resolution
once every 2 weeks
NDVI, EVI...



TERRAIN

SRTM 30m
ASTER 100m
WWF's HydroSHEDS
hydrology database



SURFACE TEMP

MODIS, ASTER, and
AVHRR
Landsat thermal data



NIGHT LIGHT

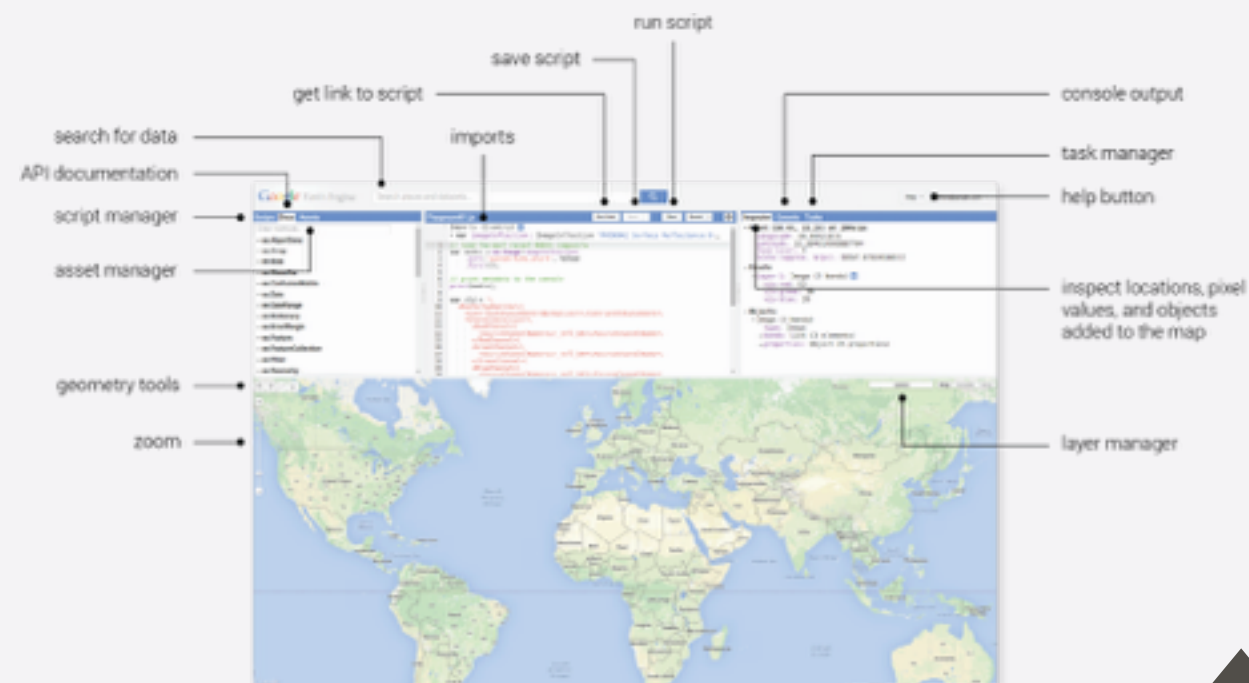
DMSP-OLS

<https://code.earthengine.google.com/datasets>

PLATFORM

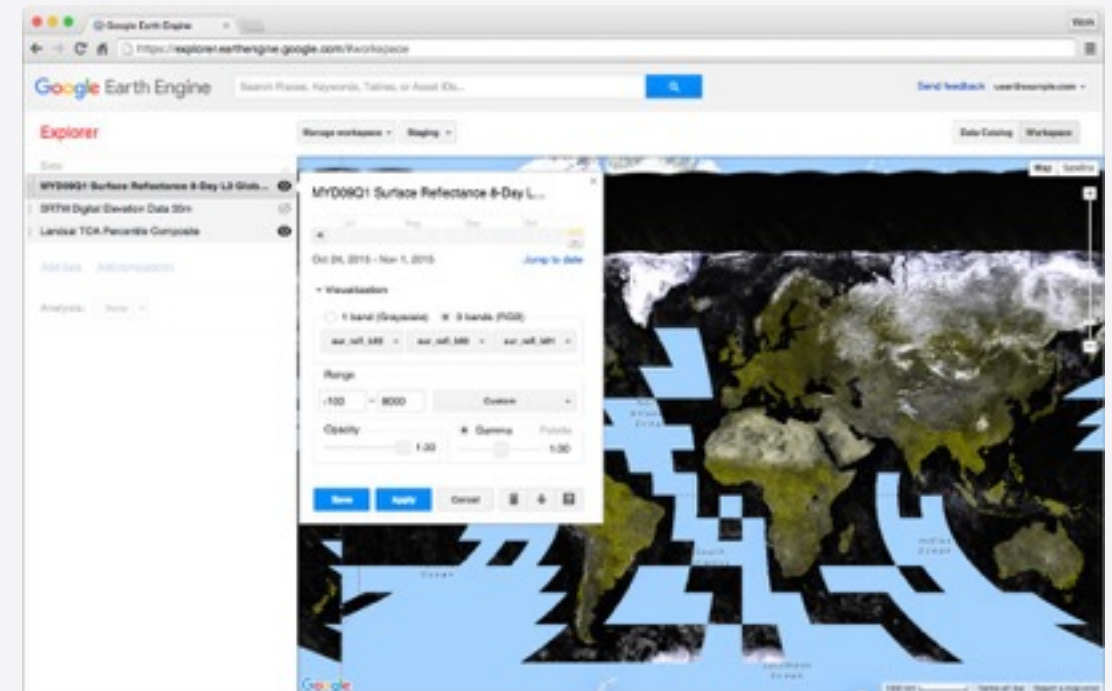
CODE EDITOR

a web-based IDE for the Earth Engine JavaScript API
<https://code.earthengine.google.com/>



EXPLORER

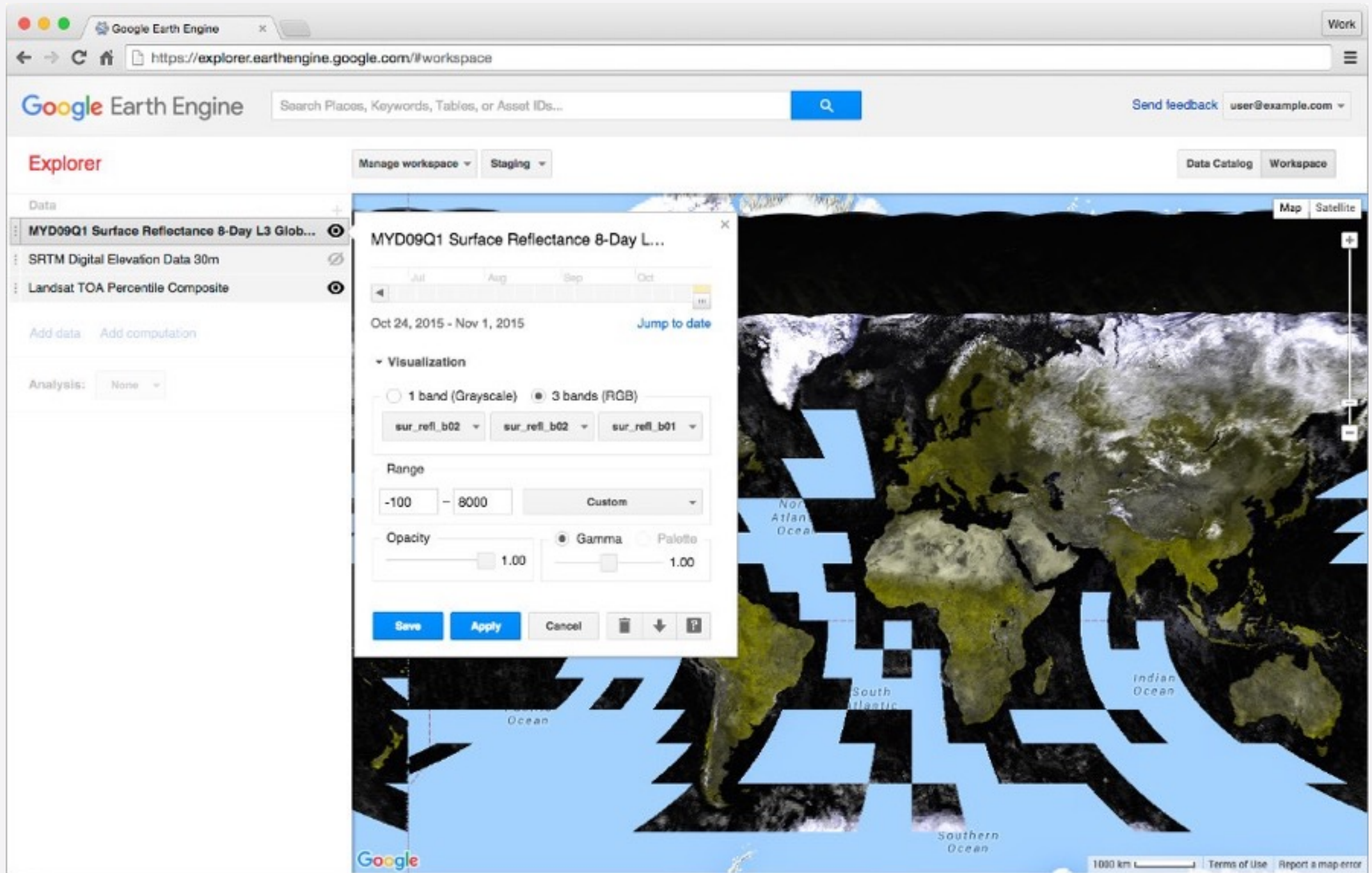
a simple web interface to the Earth Engine API
<https://explorer.earthengine.google.com/#workspace>



EXPLORER

a simple web interface to the Earth Engine API

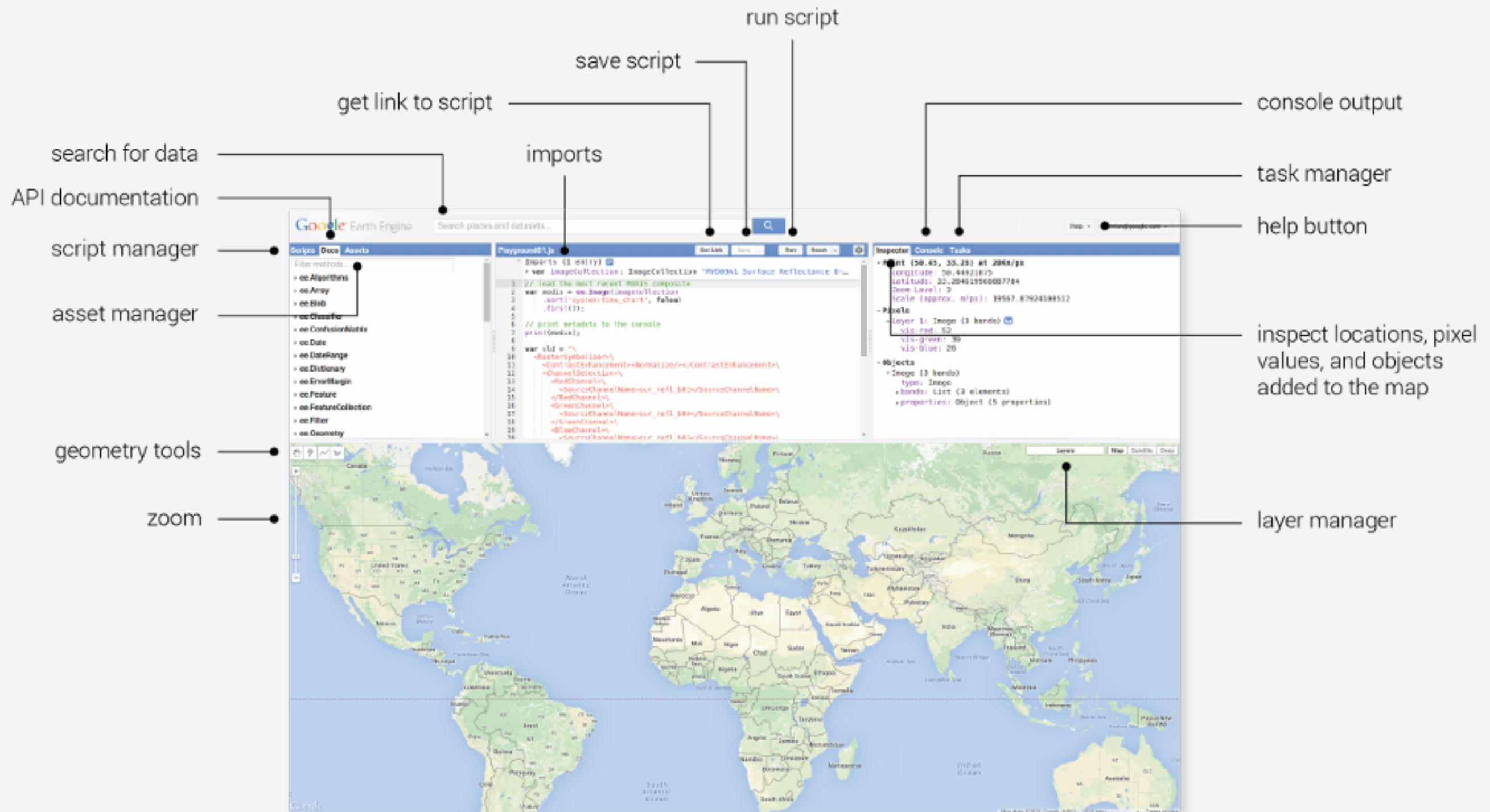
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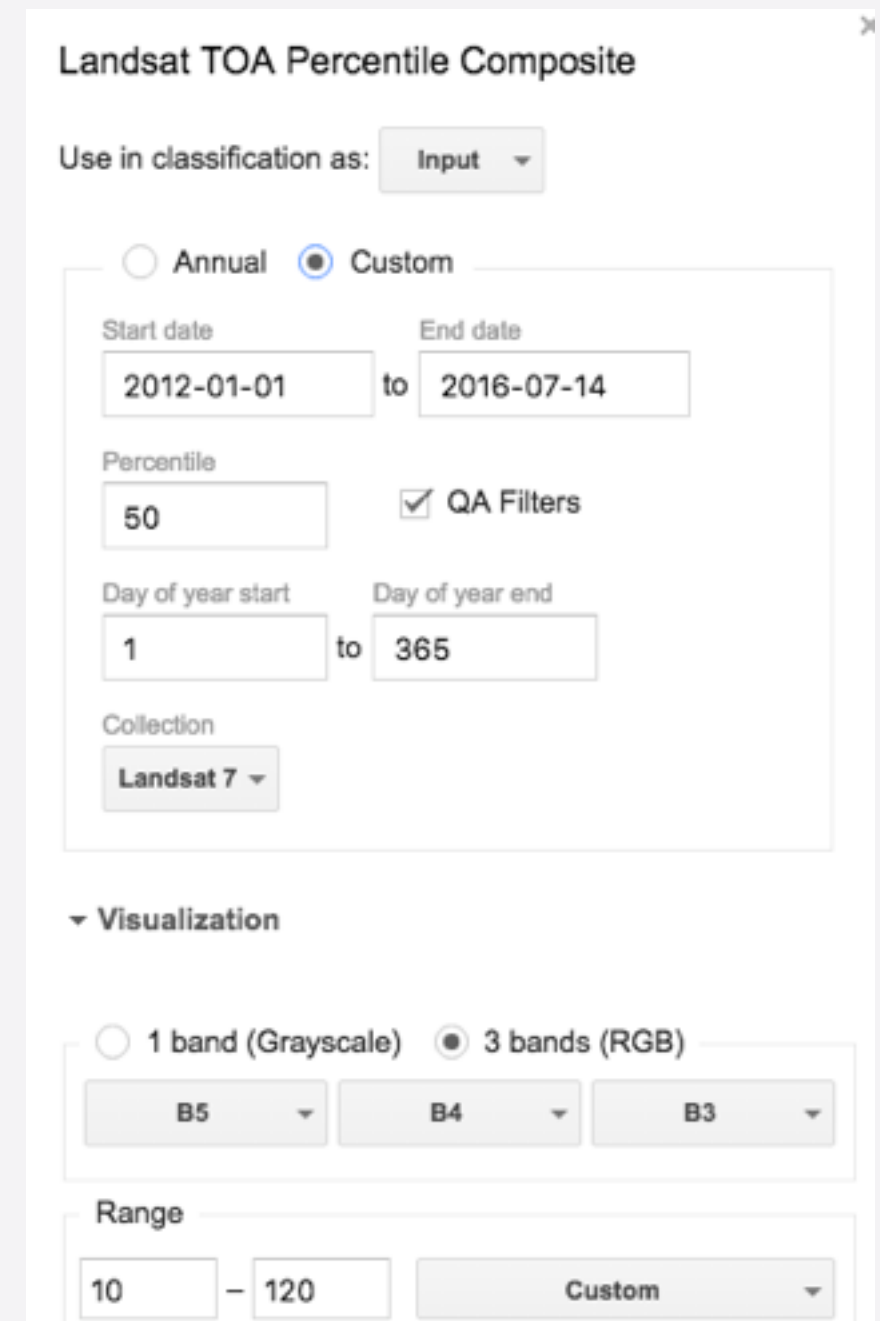
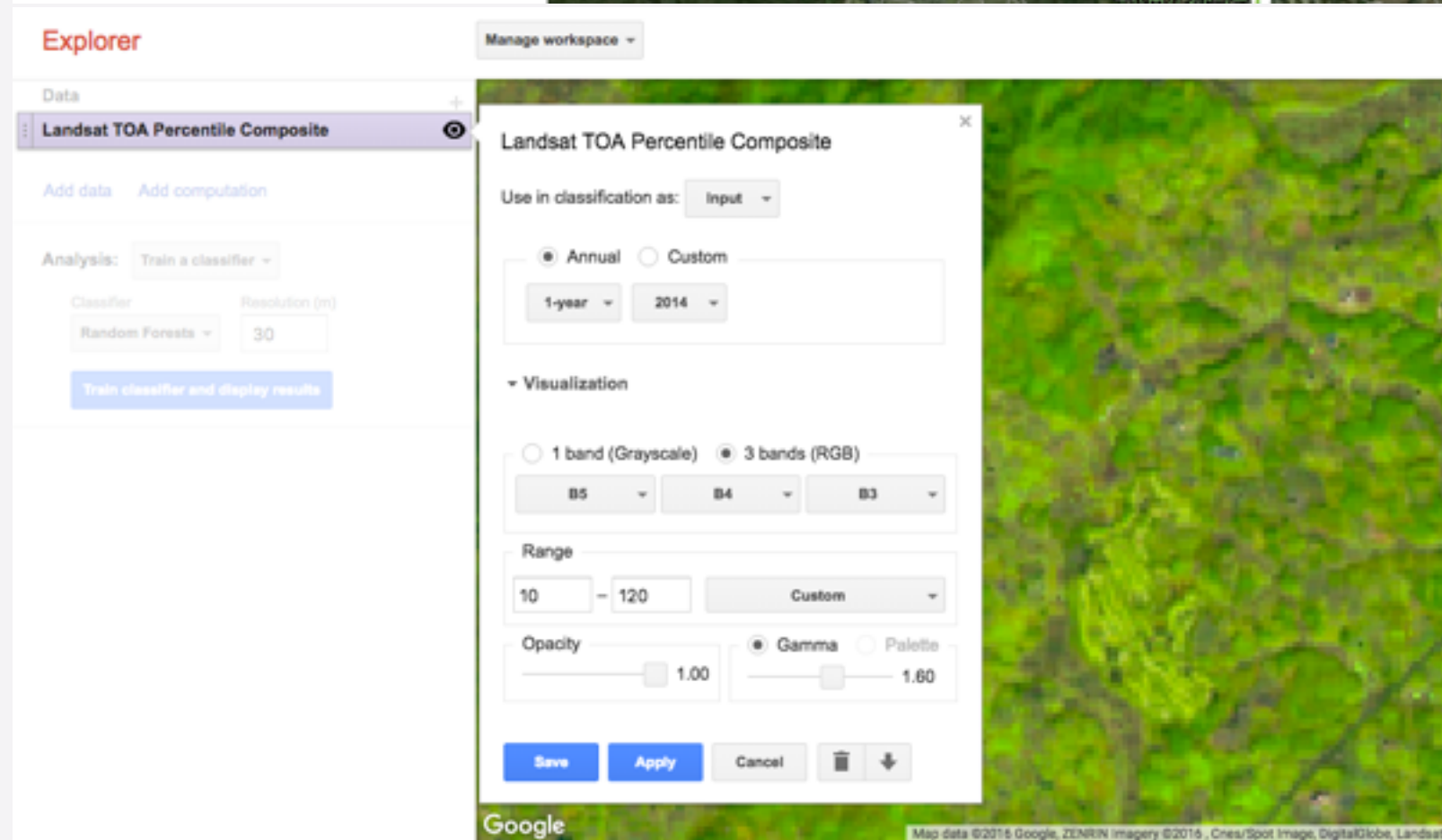
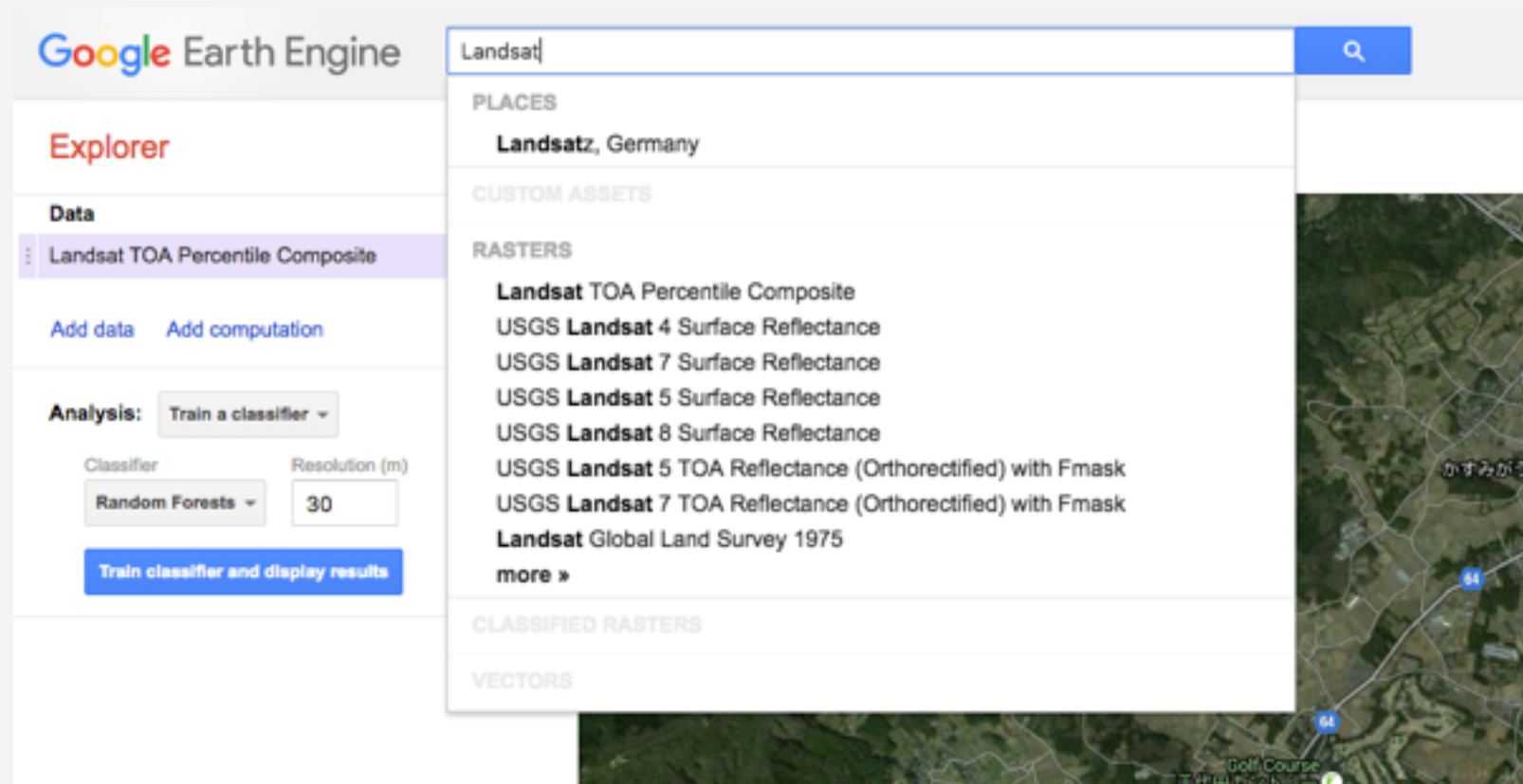


GEOSPATIAL ANALYSIS

- Case 1 | Visualizing Images and Image Bands
(image regions charts, cloud mask)
- Case 2 | Statistics of Image Neighborhoods
- Case 3 | Vector to Raster Interpolation (Kriging)
- Case 4 | Raster to Vector Conversion
- Case 5 | Supervised Classification
- Case 6 | Importing Raster/Vector Data, Exporting Data



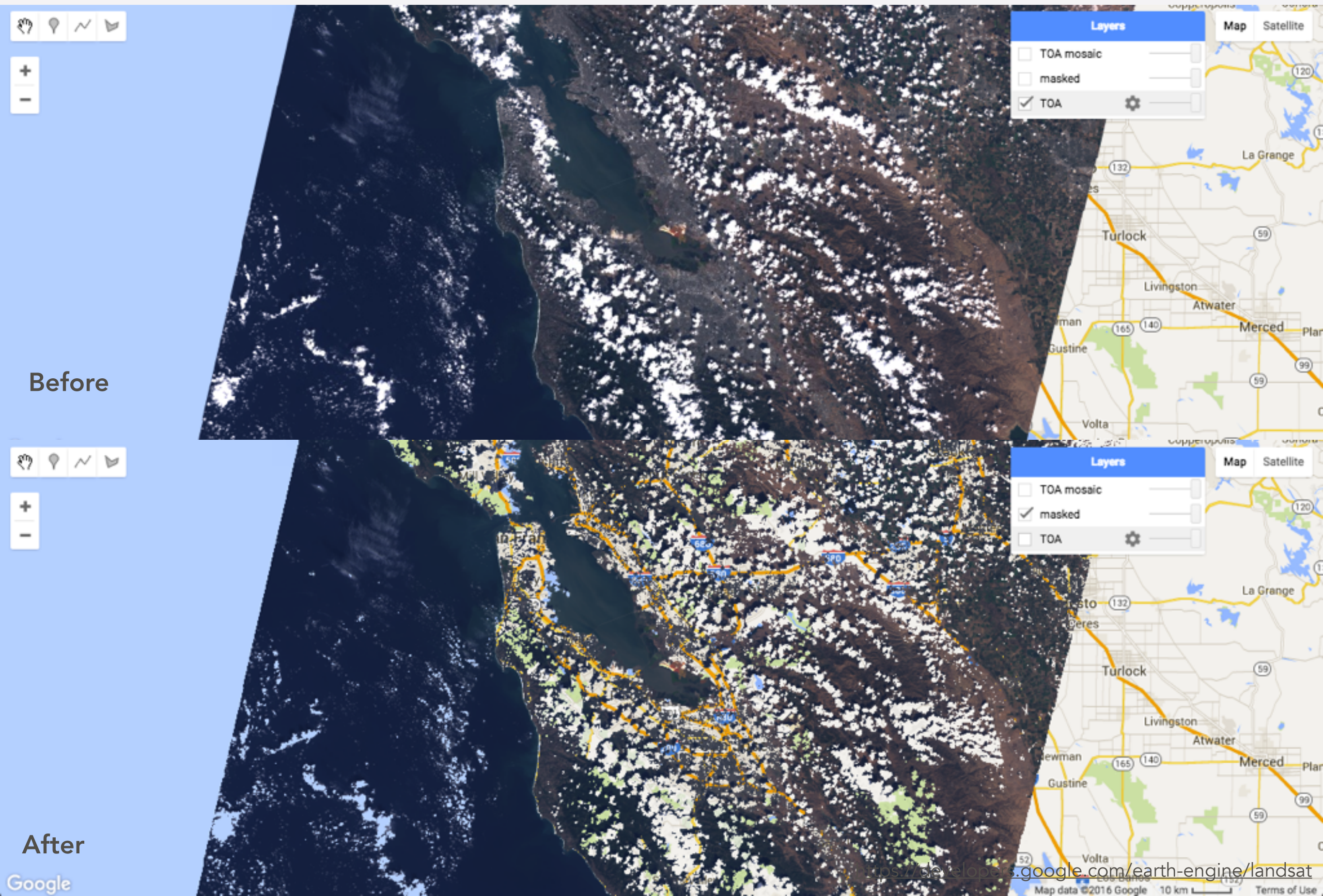
Case 1 | Visualizing Images and Image Bands (Explorer)



Case 1 | Visualizing Images and Image Bands (cloud mask)

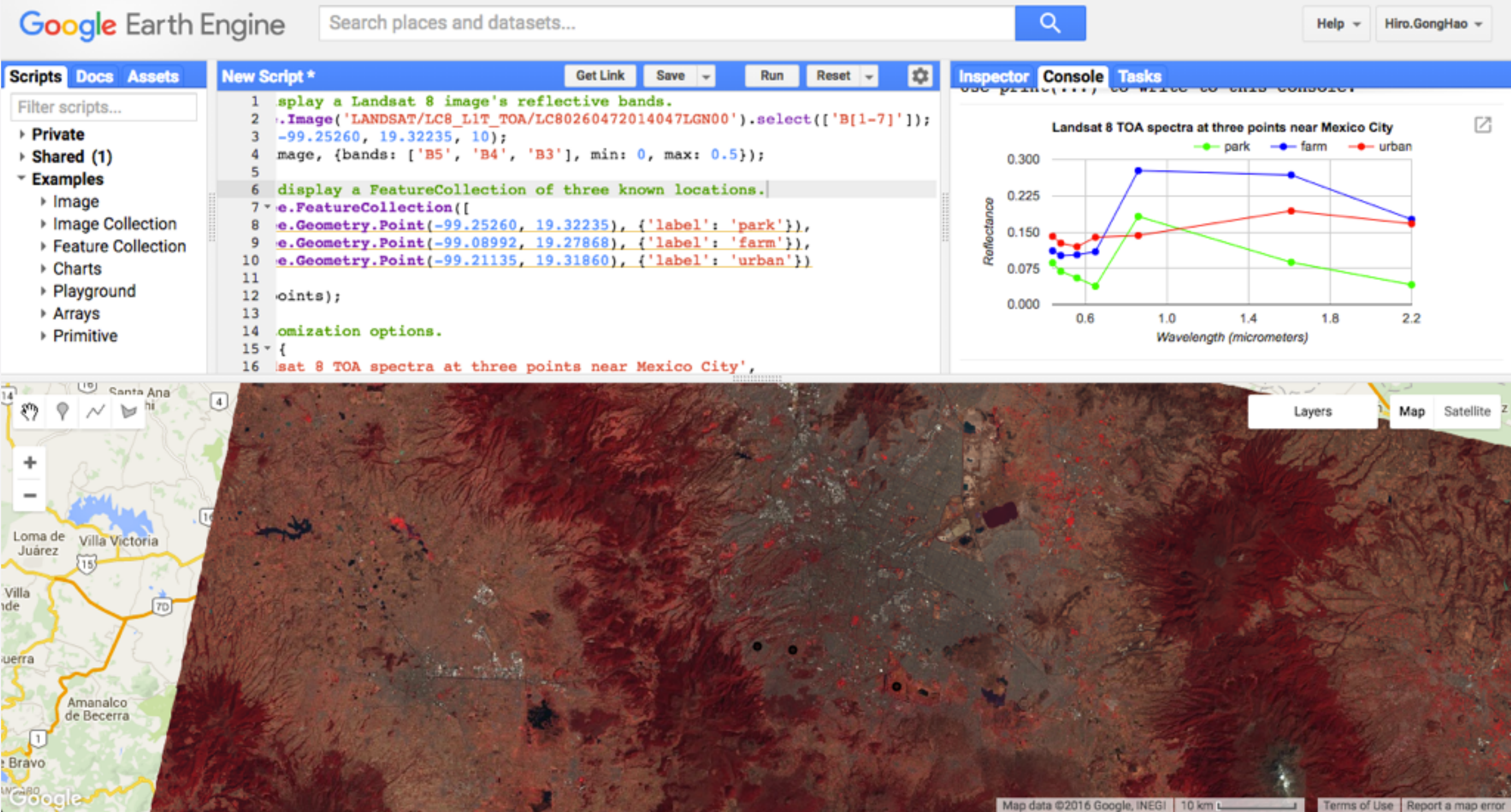
Before

After



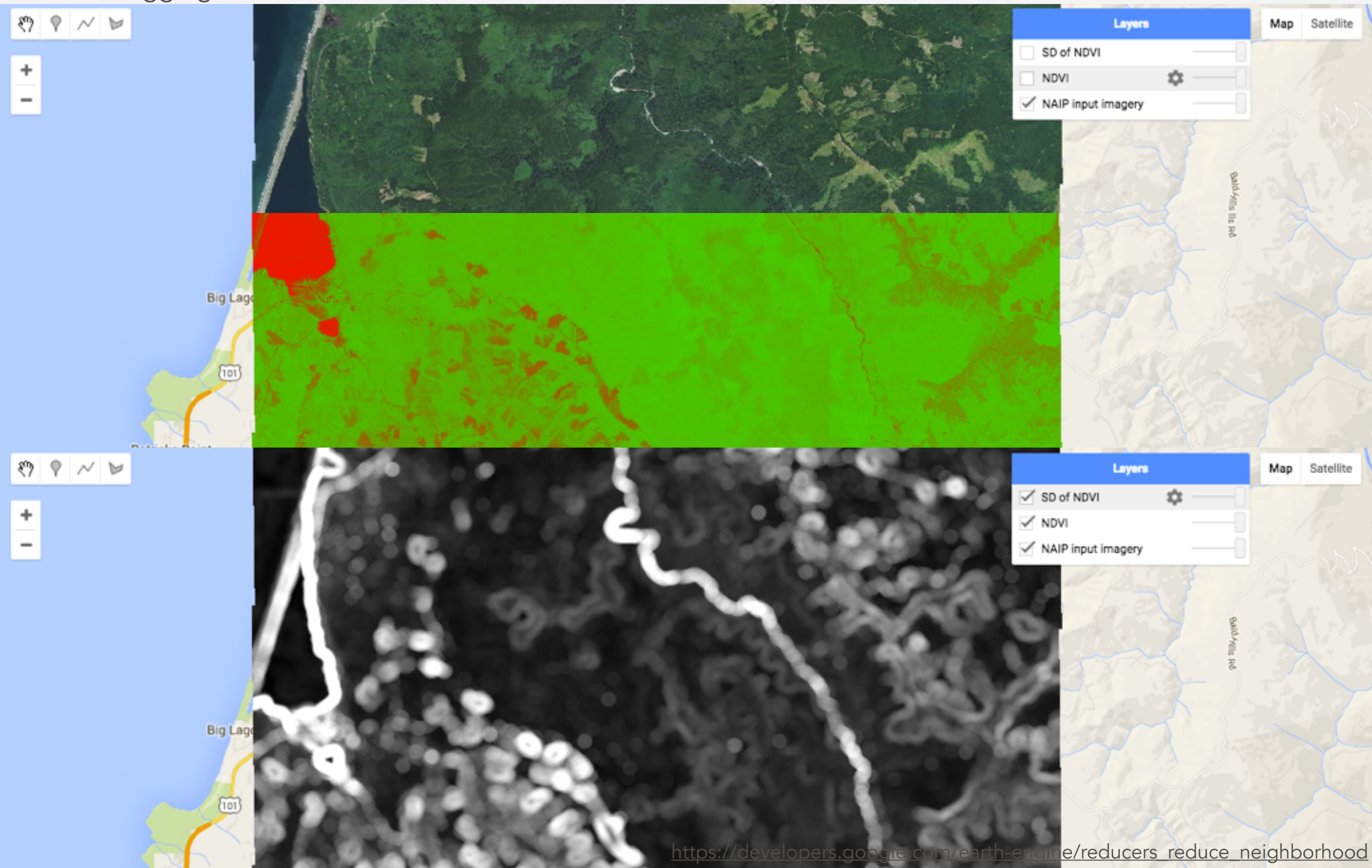
Case 1 | Visualizing Images and Image Bands (image regions charts)

The following example illustrates this method by getting image spectra from three land cover types at locations in Mexico



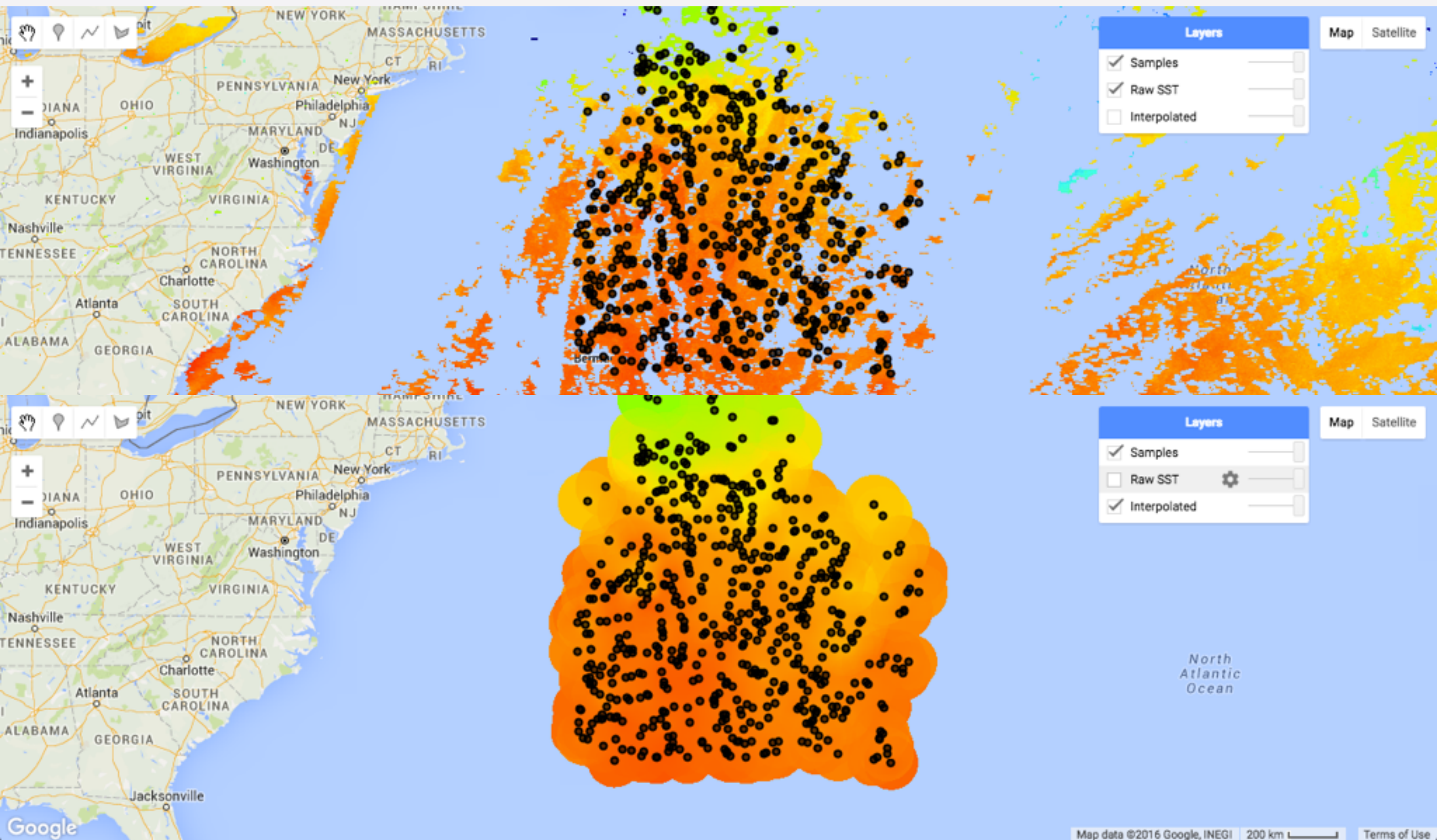
Case 2 | Statistics of Image Neighborhoods (Code Editor)

Using National Agriculture Imagery Program (NAIP) imagery to quantify landscape differences resulting from logging in the California redwood forests.



Case 3 | Vector to Raster Interpolation (Kriging)

The following example samples a sea surface temperature (SST) image at random locations, then interpolates SST from the sample using Kriging.



Case 4 | Raster to Vector Conversion (Code Editor)

Night-lights digital number serve as a proxy for development intensity of Japan, 2012

The screenshot displays the Google Earth Engine web interface. The top navigation bar includes the Google Earth Engine logo, a search bar, and user controls. The left sidebar shows a 'Scripts' panel with a 'New Script' button and a list of scripts. The main area is a code editor with a script that processes night-light data. The script defines a geometry type as 'polygon', sets a reducer to 'ee.Reducer.mean()', and adds a layer to the map. The map itself shows a visualization of the data, with a large red area in the center and green and blue areas around it. The right sidebar contains an 'Inspector' panel and a 'Layers' panel. The 'Layers' panel shows two layers: 'vectors' and 'raster', both of which are checked. The map data is attributed to Google and ZENRIN, with a 10 km scale bar and a 'Terms of Use' link.

Google Earth Engine

Search places and datasets...

Help Hiro.GongHao

Scripts Docs Assets

Filter scripts...

Private Shared (1) Examples

Image Image Collection Feature Collection Charts Playground Arrays Primitive

New Script *

Get Link Save Run Reset

```
19 geometryType: 'polygon',
20 eightConnected: false,
21 labelProperty: 'zone',
22 reducer: ee.Reducer.mean()
23 });
24
25 // Display the thresholds.
26 Map.setCenter(139.6225, 35.712, 9);
27 Map.addLayer(zones, {min: 1, max: 3, palette: ['0000FF', '00FF00', 'FF0000']}, 'zones');
28
29 // Make a display image for the vectors, add it to the map.
30 var display = ee.Image(0).updateMask(0).paint(vectors, '000000', 3);
31 Map.addLayer(display, {palette: '000000'}, 'vectors');
32
```

Inspector Console Tasks

Click on the map to inspect the layers.

Layers

Map Satellite

☒ vectors

☒ raster

Map data ©2016 Google, ZENRIN 10 km Terms of Use

Case 5 | Supervised Classification (Explorer)

Google Earth Engine Explorer

Search Places, Keywords, Tables, or Asset IDs...

Send feedback Hiro.GongHao@gmail.com

Manage workspace

Data Catalog Workspace

Data

- Hand-drawn points and polygons
- Model, trained Jul 13, 2016 at 3:13am (100%)
- Landsat TOA Percentile Composite

Add data Add computation

Classes

- BU - 3 points
- NBU - 3 points

Add class Get palette

Analysis: Train a classifier

Classifier: Random Forests Resolution (m): 30

Train classifier and display results

Map Satellite

Point drawing. Exit

Google Earth Engine Explorer

Search Places, Keywords, Tables, or Asset IDs...

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Explorer

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Train classifier and display results

Fast Naive Bayes

GMO Max Entropy

Winnow

Perceptron

Pegasos

CART

Random Forests

IKPamir

Voting SVM

Margin SVM

Case 5 | Supervised Classification (Code Editor)

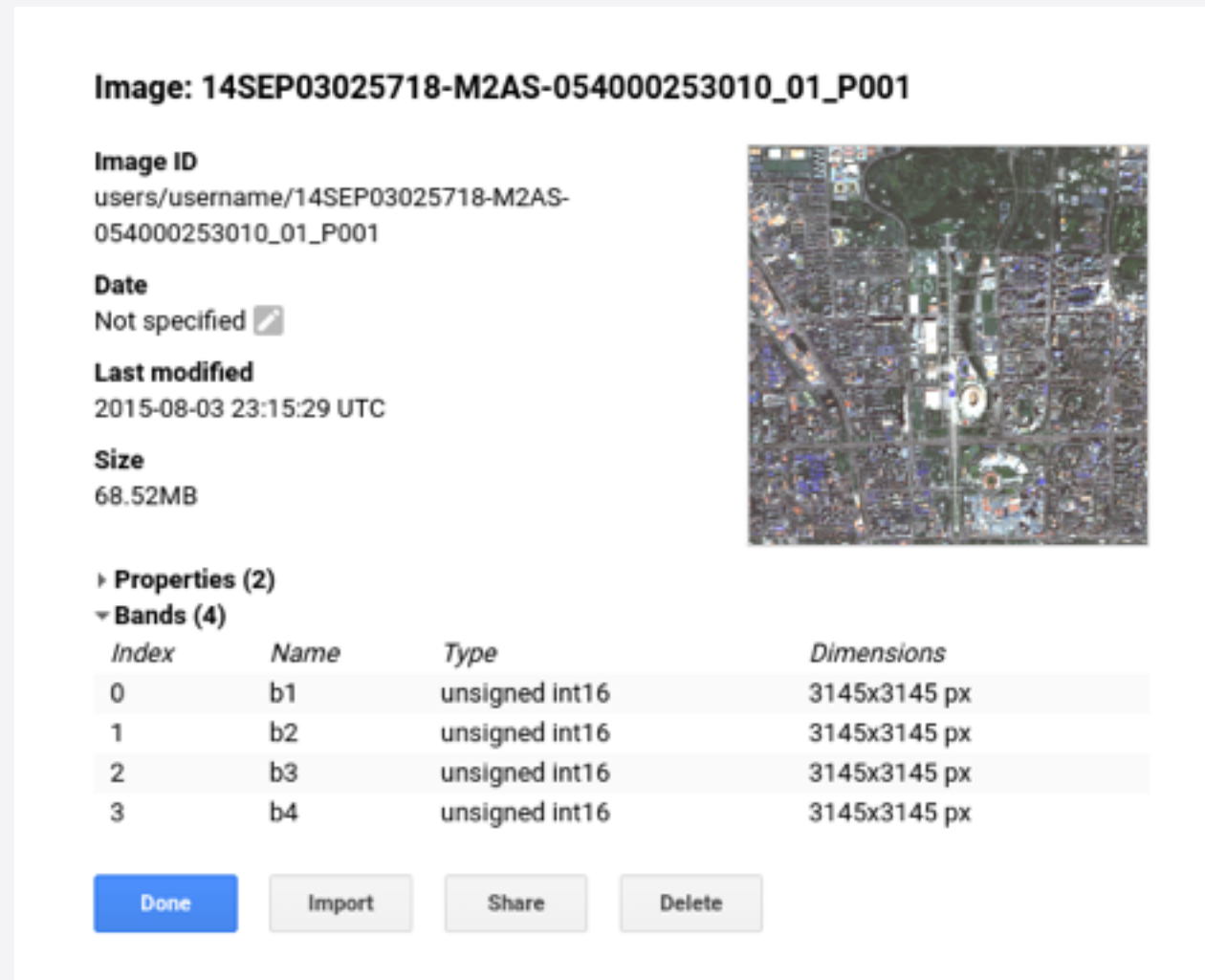
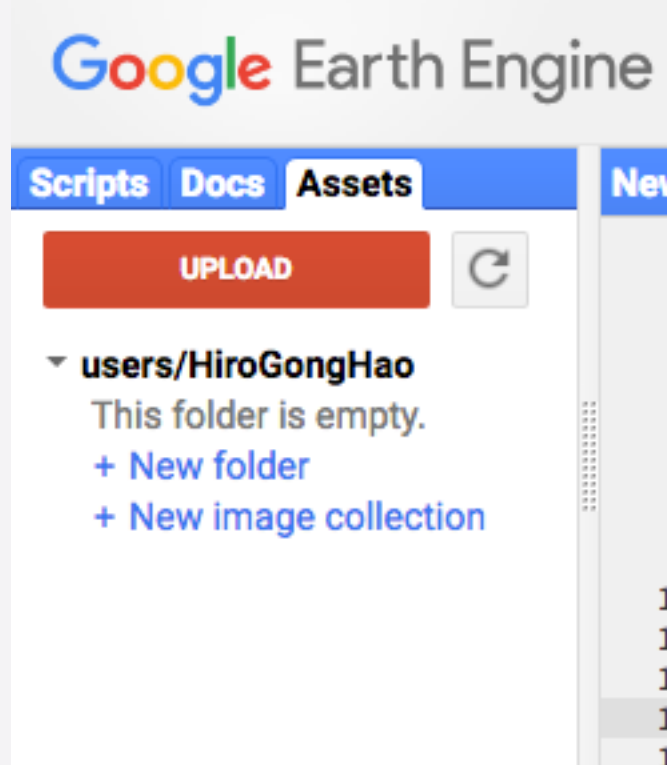
The screenshot displays the Google Earth Engine Code Editor interface. At the top, the Google Earth Engine logo is on the left, a search bar in the center, and 'Help' and 'Hiro.GongHao' on the right. Below the header, the 'Scripts' tab is active, showing a 'New Script' editor with the following code:

```
1 // Use these bands for prediction.
2 var bands = ['B2', 'B3', 'B4', 'B5', 'B6', 'B7', 'B10', 'B11'];
3
4 // Load a Landsat 8 image to be used for prediction.
5 var image = ee.Image('LANDSAT/LC8_L1T_TOA/LC82320672013207LGN00').select(bands);
6
7 // Load training points. The numeric property 'class' stores known labels.
8 var points = ee.FeatureCollection('ft:10X7SUjDTiFJDyIA58zLcptK8pwBwj1BV12SQOgJ')
9   .remap([1, 2], [0, 1], 'class');
10
11 // Overlay the points on the imagery to get training.
12 var training = image.sampleRegions(points, ['class'], 30);
13
14 // Train a CART classifier with default parameters.
```

On the right, the 'Inspector' tab is active, displaying the instruction: 'Click on the map to inspect the layers.' Below the code editor, a map is shown with a red and green supervised classification result. The map includes a 'Layers' panel, 'Map' and 'Satellite' view toggles, and a scale bar at the bottom right indicating 10 km. The Google logo is visible in the bottom left corner of the map area.

Case 6 | Importing Raster/Vector Data, Exporting Data

Importing raster data (<10 GB)



Importing vector data

Google Fusion Tables

```
// Load a Fusion Table from the ID using the FeatureCollection constructor.  
var fc = ee.FeatureCollection('ft:11SfWB6oBS1iWGiQxE0qF_wUgBJL7Bux-pWU-mqd5');
```

Exporting data

The exports can be sent to your Google Drive account or to Google Cloud Storage.

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A planetary-scale platform for Earth science data & analysis

Powered by Google's cloud infrastructure

▶ WATCH VIDEO

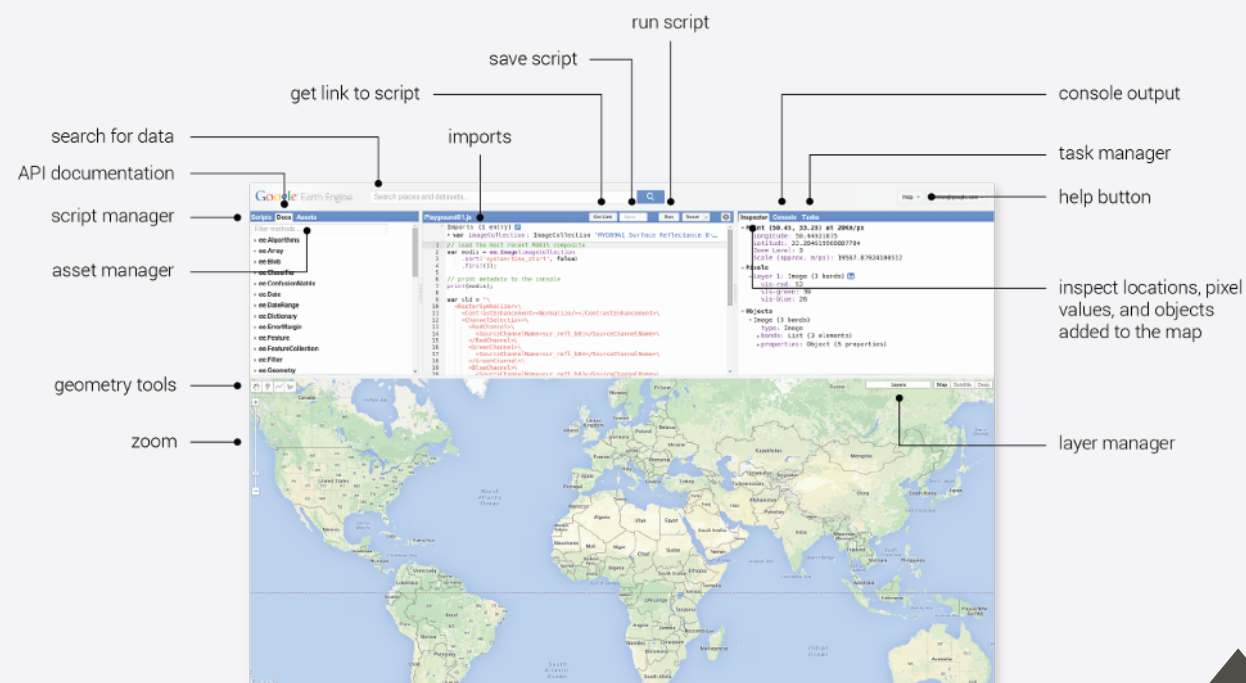
GET STARTED

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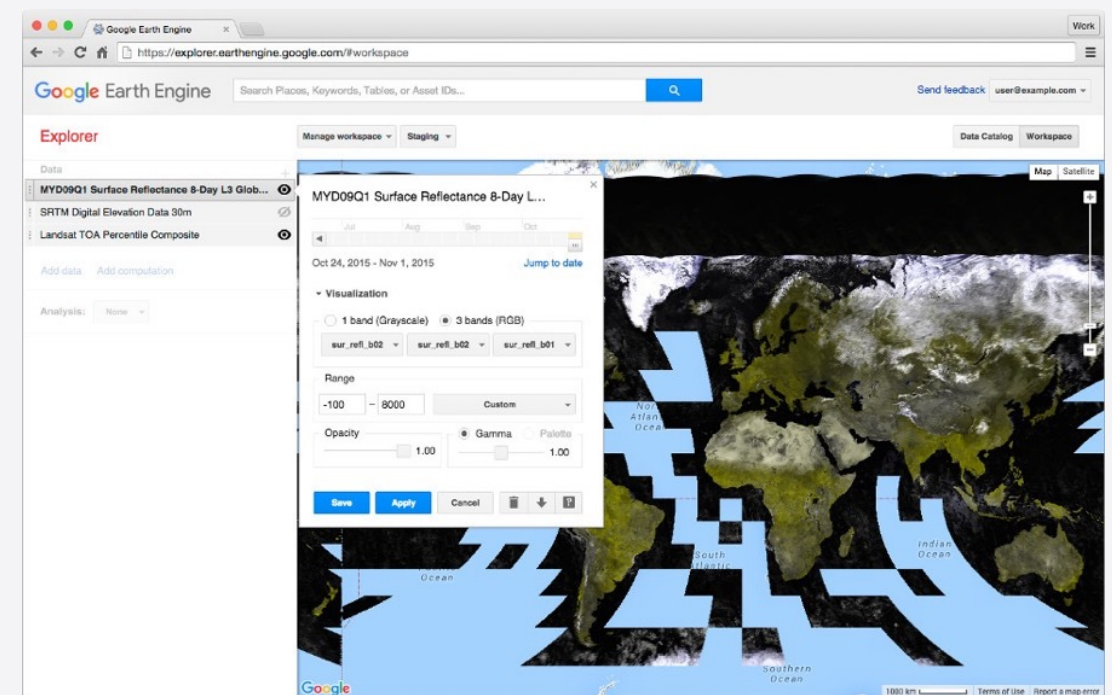
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CASE STUDIES

https://earthengine.google.com/case_studies/

Case 1 | Global Forest Cover Change

Case 2 | Map Of Life

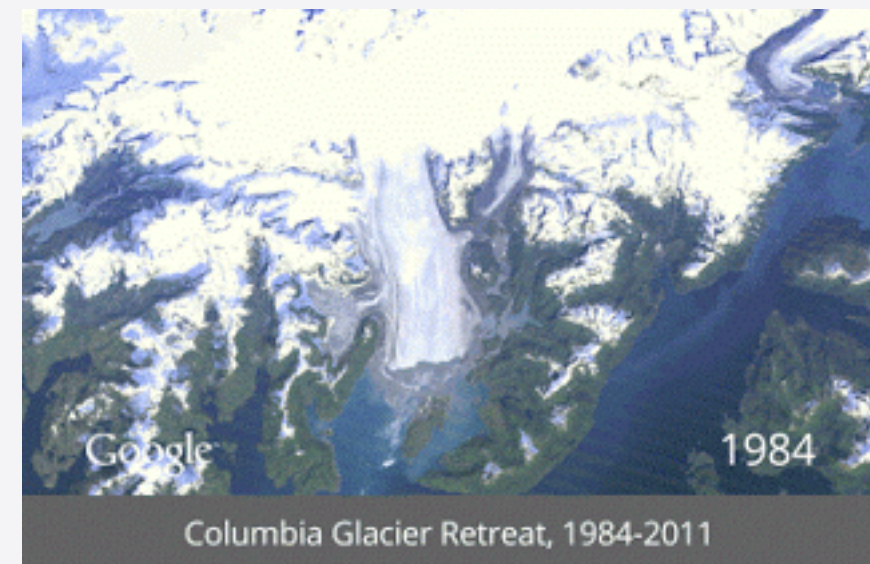
Case 3 | Global Forest Watch

Case 4 | Tiger Habitat Monitoring

Case 5 | Malaria Risk Mapping

Case 6 | Global Surface Water





Google Earth Engine