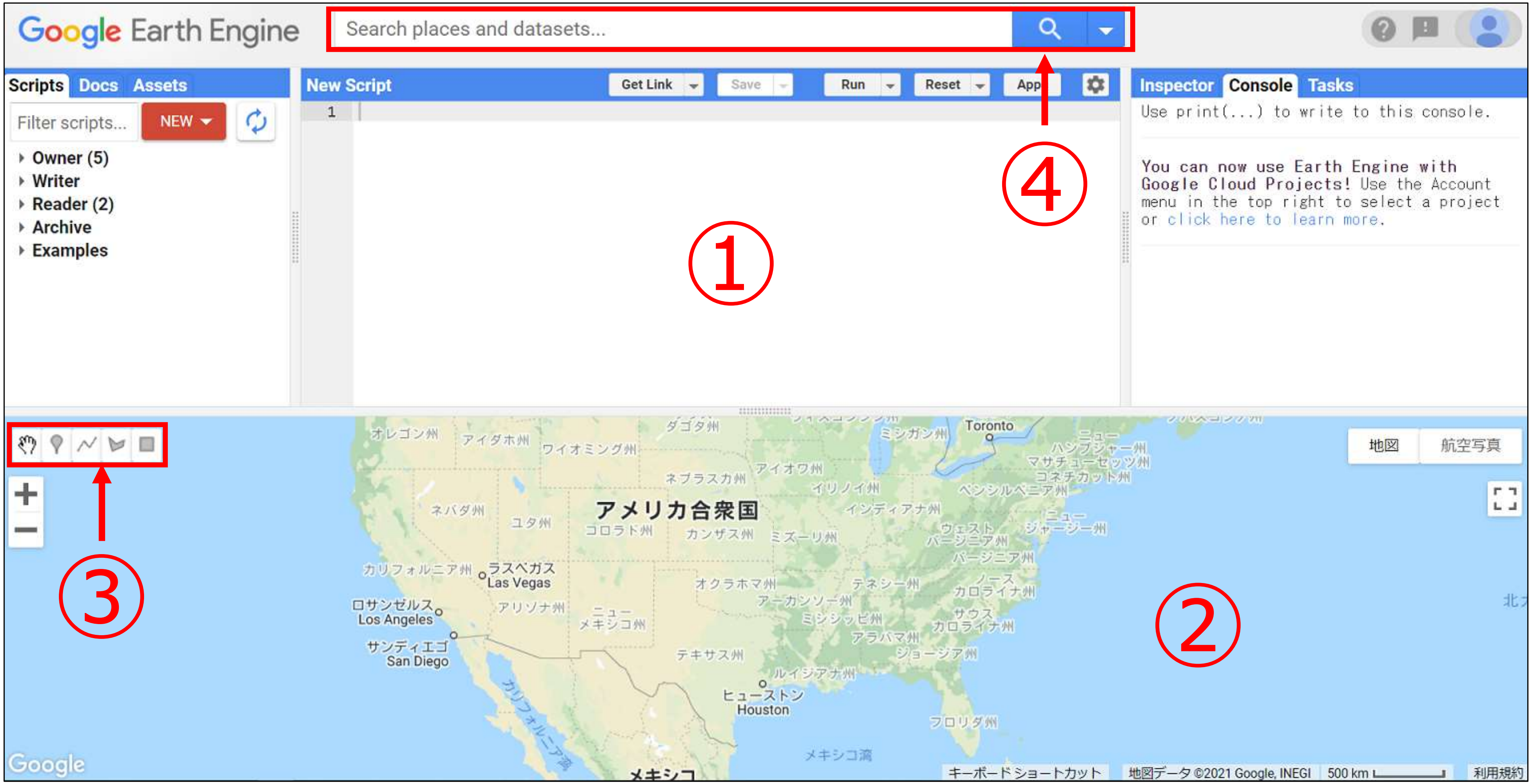
Introduction of the Basic Handling of Satellite Data (Nighttime Light Data)

Section Composition

1. Google Earth Engine (GEE) Main Screen
2. Prerequisite Knowledge for Programming in GEE
3. How to Handle Administrative Boundaries Data
4. How to Handle Nighttime Light Data
5. Additional Tips
6. Reference Materials for Studying Nighttime Light Data

Google Earth Engine Main Screen

Google Earth Engine (GEE) Main Screen 1/2



Use print(...) to write to this console.

You can now use Earth Engine with Google Cloud Projects! Use the Account menu in the top right to select a project or click here to learn more.

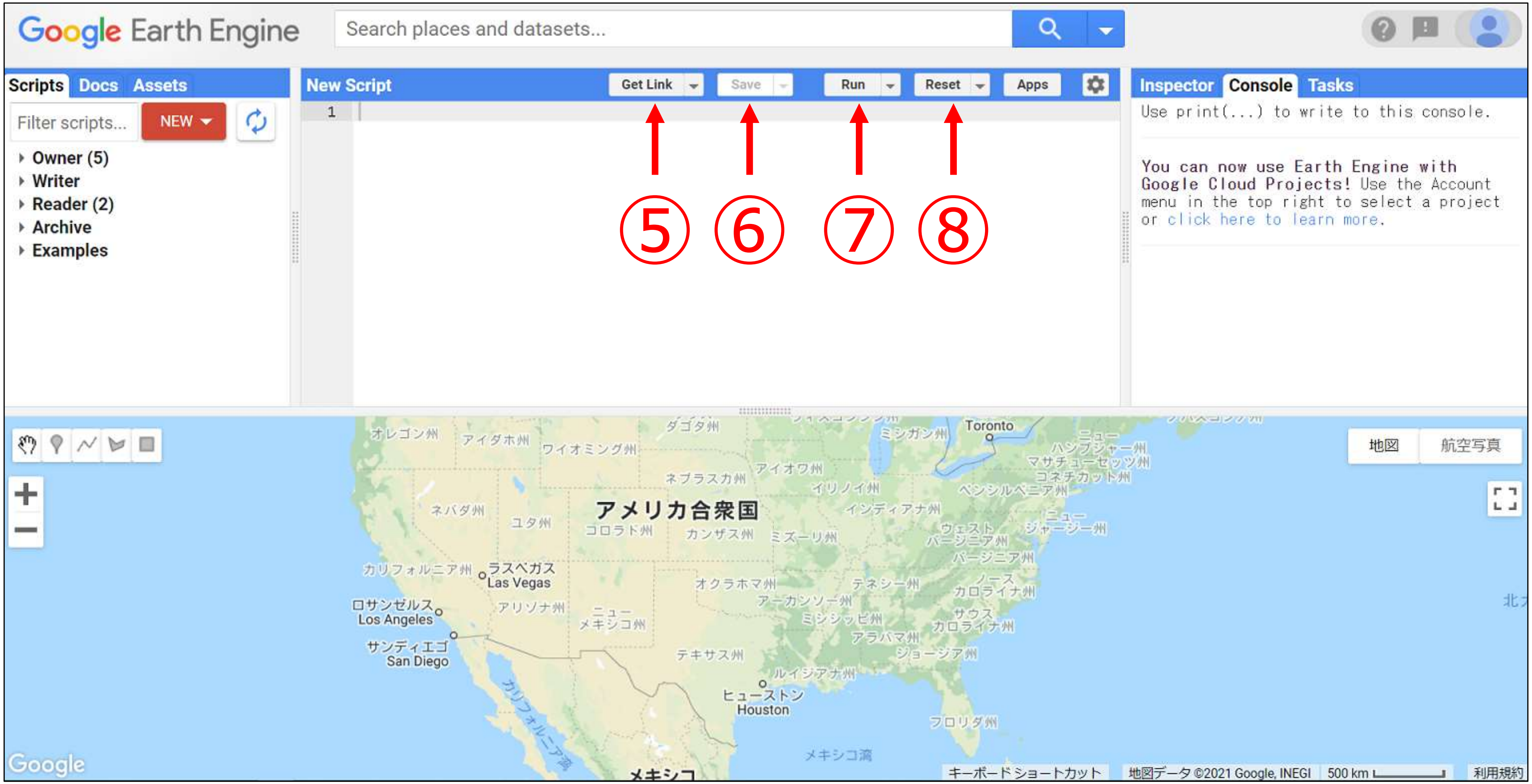
① Code editor: Where you write the code

② Map: Where the satellite data is displayed

③ Geometry tool: Tool used to draw points, lines, and figures on a map

④ Search field: Where you enter text to search to find satellite data stored in GEE

Google Earth Engine (GEE) Main Screen 2/2



Use print(...) to write to this console.

You can now use Earth Engine with Google Cloud Projects! Use the Account menu in the top right to select a project or click here to learn more.

⑤ Get Link: Generates a link for sharing the code with other people

⑥ Save: Saves the program/script written

⑦ Run: Runs the program/script written (alternatively, press Ctrl + Enter.)

⑧ Reset: Deletes the program/script written

Prerequisite Knowledge for Programming in GEE

Programming Language Used in GEE

- JavaScript is adopted as GEE’s programming language. JavaScript is not a statistical programming language like R, but rather a language used to develop websites and web apps.

- On the other hand, JavaScript used in GEE is not exactly the same as JavaScript used in website and web app development. It is important to note that it is only based on JavaScript.

- GEE provides a variety of JavaScript-based GEE-specific codes. One example is **Map.addLayer**, which displays data on a map and is a code introduced in this document.

How to write codes

- The basic description to use for GEE programming is as follows: “var” creates new variables.

```
var variable name = number, data, etc.
```

- For example, if you want to create a variable “abc ” containing numerical data “5,” you would write the code as follows:

```
var abc = 5
```

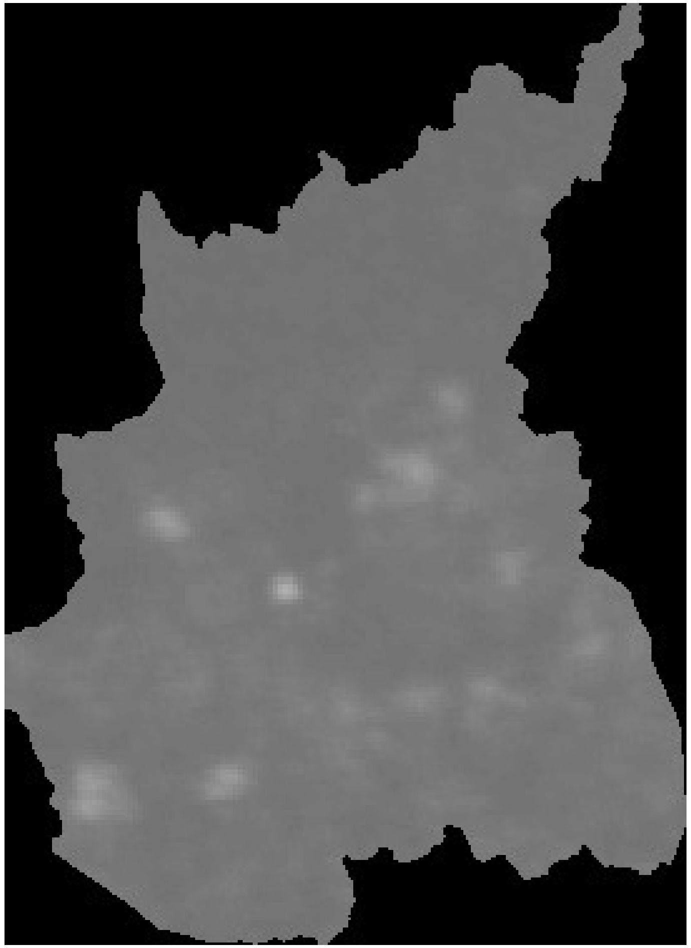
- This document introduces a variety of codes. Bear in mind that a code does not work even if the spelling is incorrect. Particularly beginners often produce errors due to spelling mistakes. Therefore, if an error occurs, it is recommended that you check the spelling first.

How to Handle Administrative Boundaries Data

Necessity for Handling Administrative Boundaries Data

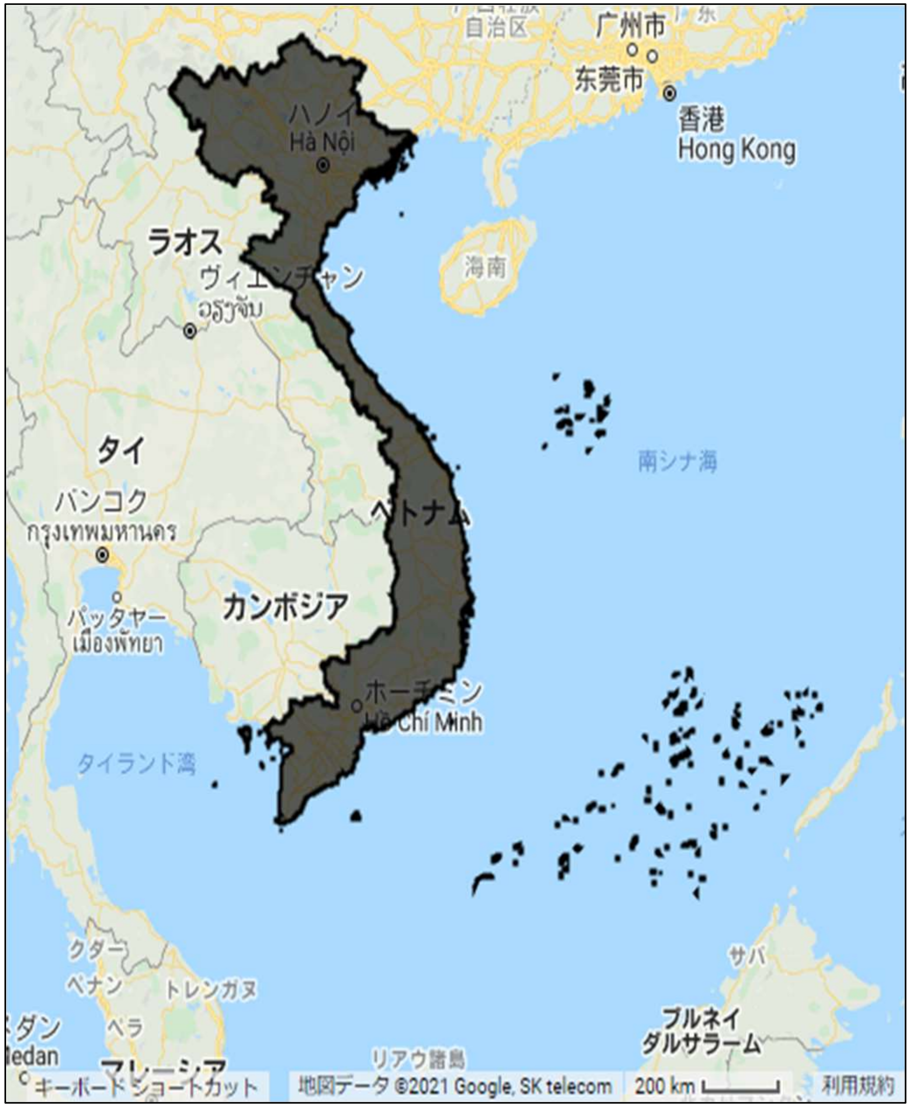
- When analyzing satellite data, it is often the case that you need to handle only a specific country or region. Therefore, it is useful to know how to upload administrative boundaries data to GEE and import the data from GEE, and how to map the data.

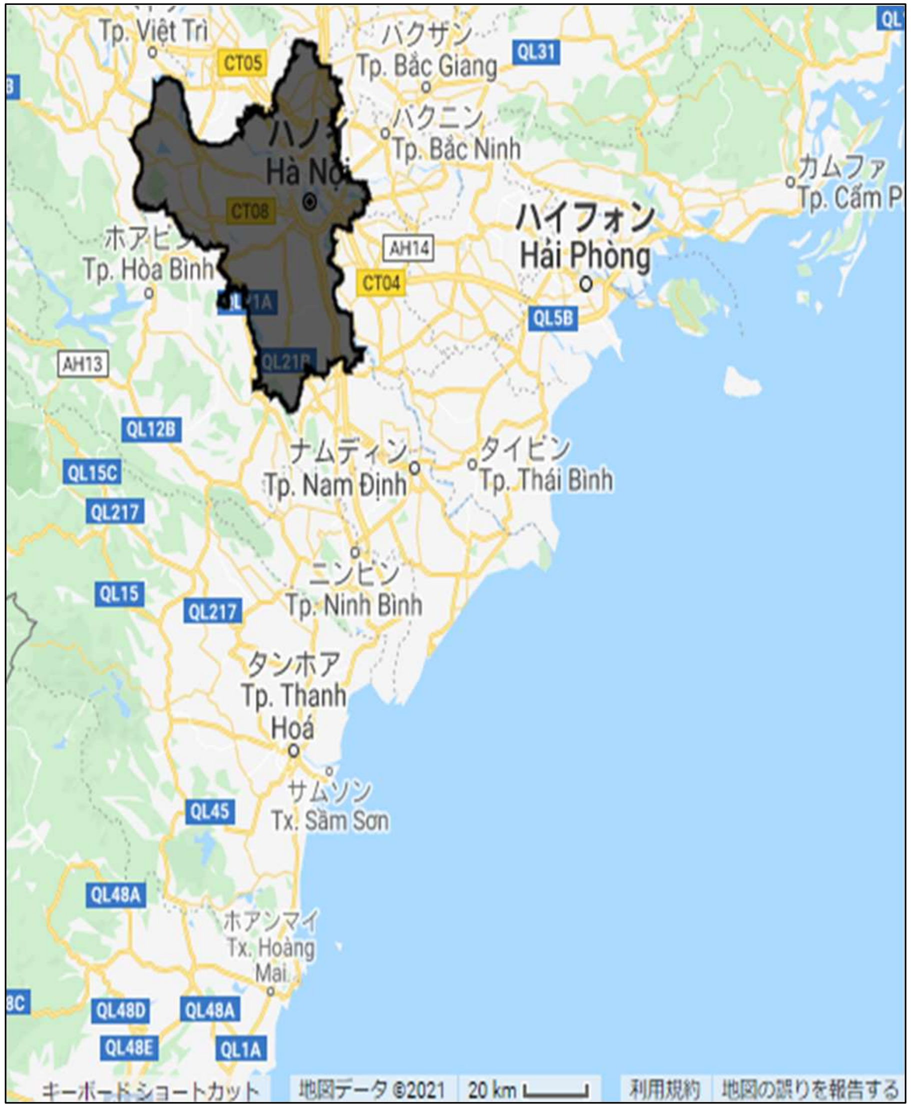
- For instance, one example of satellite data analysis conducted by the JICA Evaluation Department is the analysis of nighttime light data in Rattanakiri Province, Cambodia.



Final Goal of This Section

- Upload the administrative boundaries shapefiles of Vietnam and visualize (1) country level and (2) province level (Hanoi) on the map.





Uploading Administrative Boundaries Data (Country Level) 1/4

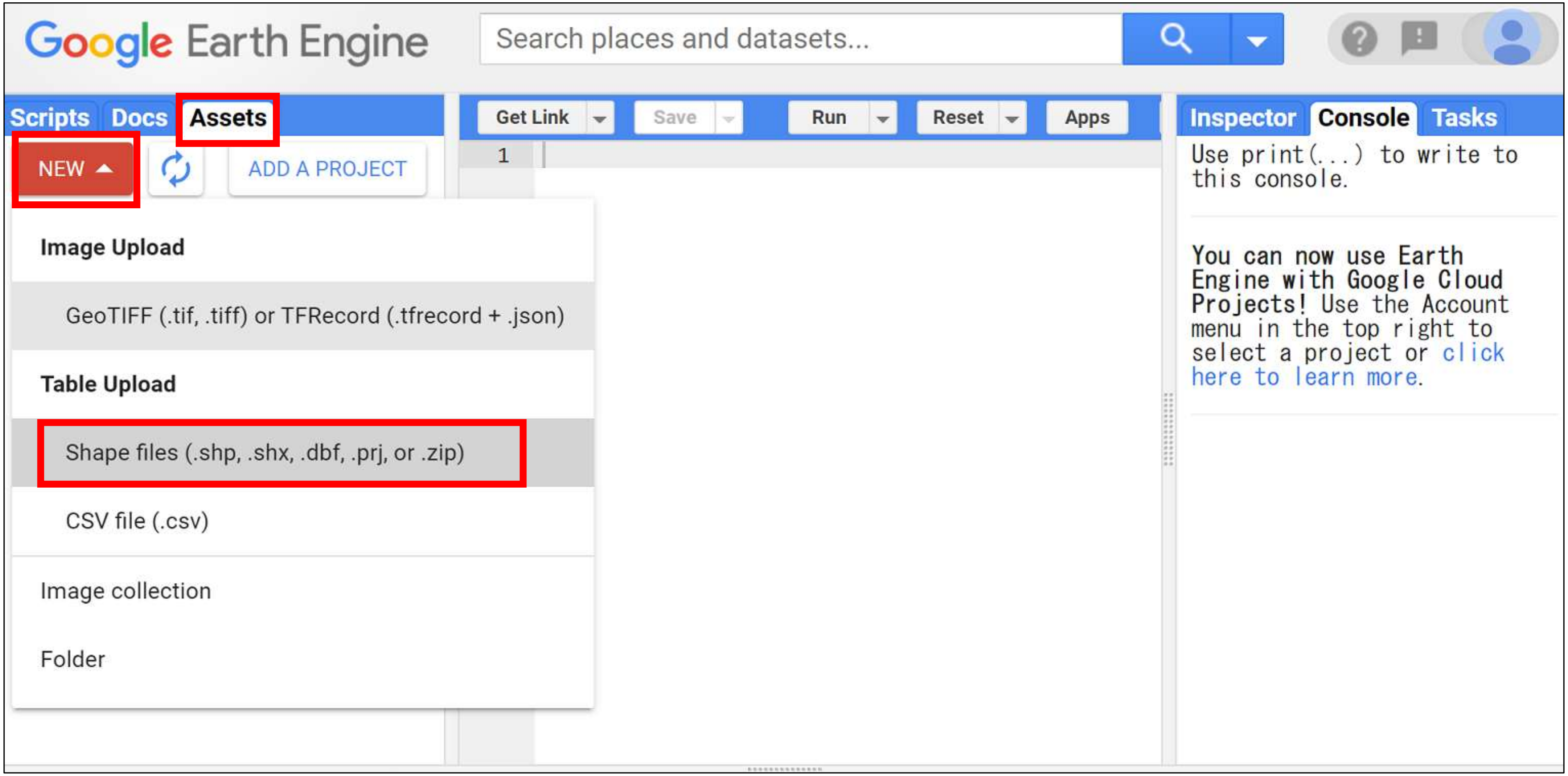
① Download the target administrative boundaries data from the Humanitarian Data Exchange (https://data.humdata.org/), operated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA).

- ➢ For the purpose of this document, download the administrative boundaries data for Vietnam from the following URL (https://data.humdata.org/dataset/viet-nam-administrative-boundaries-polygon-polyline).
- ➢ The file you should download is as follows, containing level 0 (country), level 1 (province), and level 2 (district) shapefiles:

vnm_adm_gov_20201027_shp.zip

Uploading Administrative Boundaries Data (Country Level) 2/4

② Click **Assets** in the left pane of GEE to display the **NEW** button and click it. A drop-down list appears. Click **Shape files** located in the middle.



Use print(...) to write to this console.

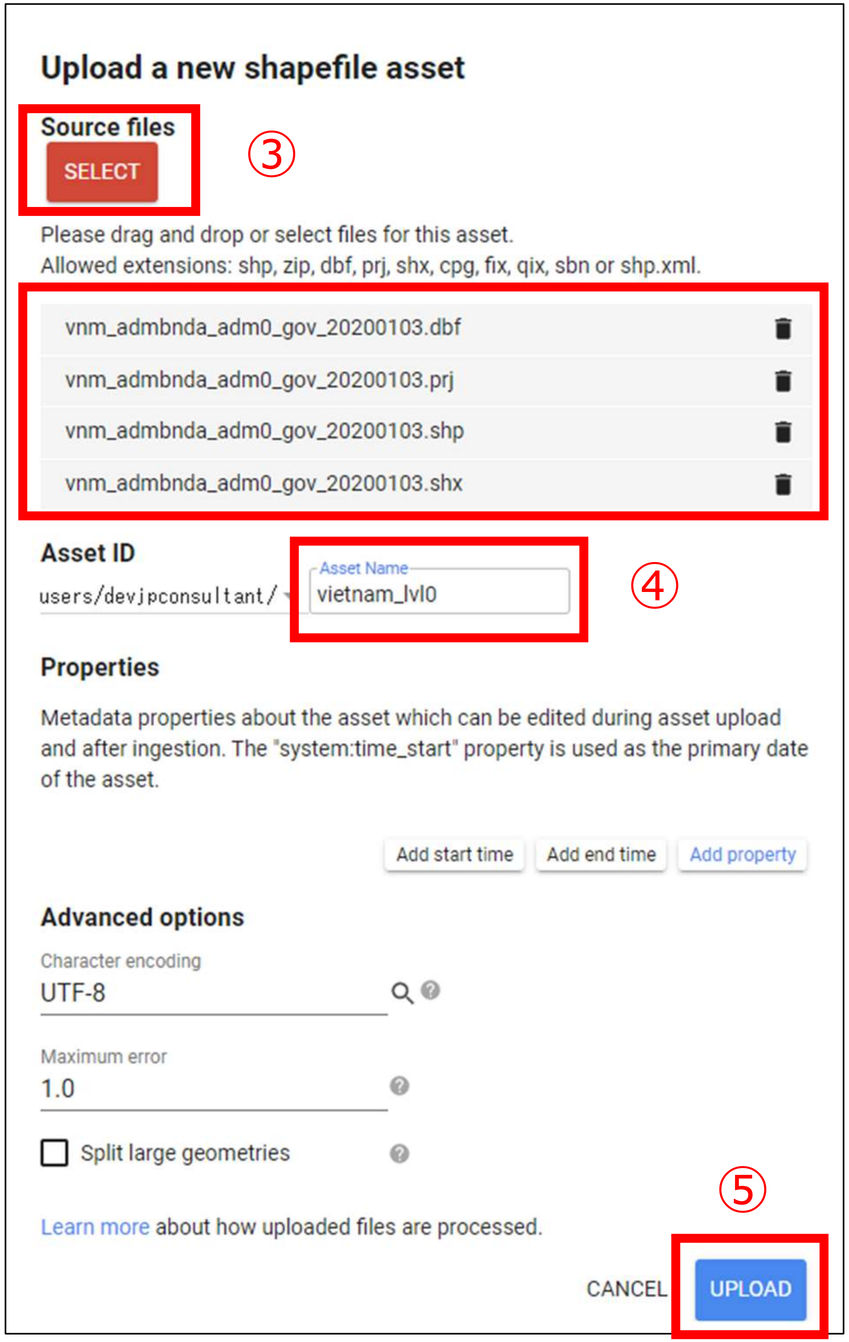
You can now use Earth Engine with Google Cloud Projects! Use the Account menu in the top right to select a project or click here to learn more.

Uploading Administrative Boundaries Data (Country Level) 3/4

③ The figure to the right is displayed in the center pane. Click **SELECT** and select the files you downloaded earlier. You should select four files with the extensions: **.dbf**, **.prj**, **.shp**, and **.shx**.

④ When you select a file, the **Asset Name** is automatically entered. Edit the name to any name you like.

⑤ Click **UPLOAD** button at the bottom to begin uploading administrative boundaries data.



Upload a new shapefile asset

Source files

SELECT

Please drag and drop or select files for this asset.
Allowed extensions: shp, zip, dbf, prj, shx, cpg, fix, qix, sbn or shp.xml.

vnm_admbnda_adm0_gov_20200103.dbf
vnm_admbnda_adm0_gov_20200103.prj
vnm_admbnda_adm0_gov_20200103.shp
vnm_admbnda_adm0_gov_20200103.shx

Asset ID

users/devjpconsultant/

Asset Name: vietnam_lvl0

Properties

Metadata properties about the asset which can be edited during asset upload and after ingestion. The "system:time_start" property is used as the primary date of the asset.

Add start time | Add end time | Add property

Advanced options

Character encoding: UTF-8

Maximum error: 1.0

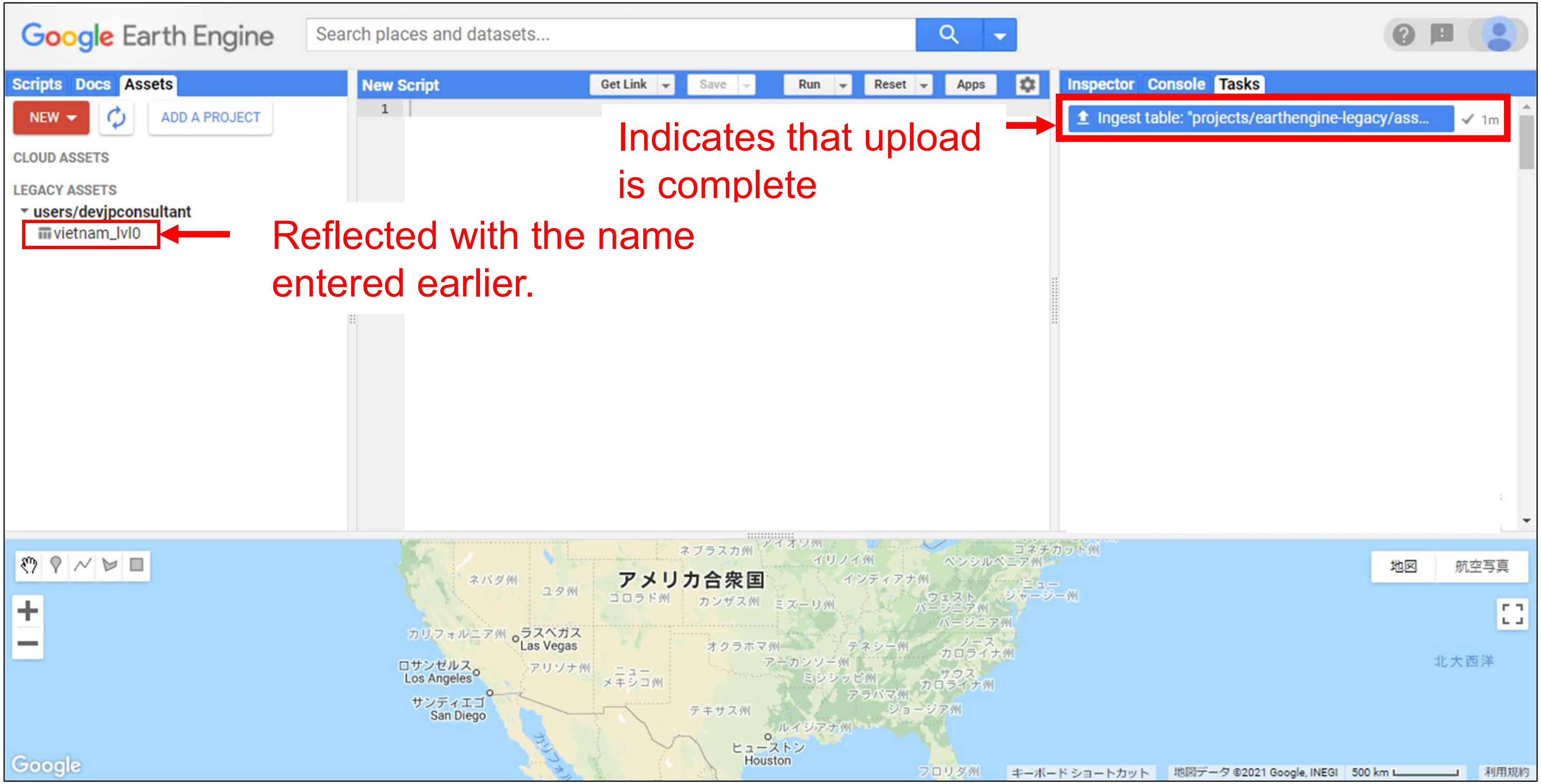
□ Split large geometries

Learn more about how uploaded files are processed.

CANCEL | UPLOAD

Uploading Administrative Boundaries Data (Country Level) 4/4

⑥ You can check the upload status in **Tasks** in the right pane. Once the upload is complete, the data is reflected in **Assets**.



Ingest table: "projects/earthengine-legacy/ass... ✓ 1m

Indicates that upload is complete

Reflected with the name entered earlier.

Importing Administrative Boundaries Data (Country Level) 1/2

① Click the administrative boundaries data uploaded to **Assets** to view its basic information. You can import administrative boundaries data from **IMPORT** at the bottom right of the screen.

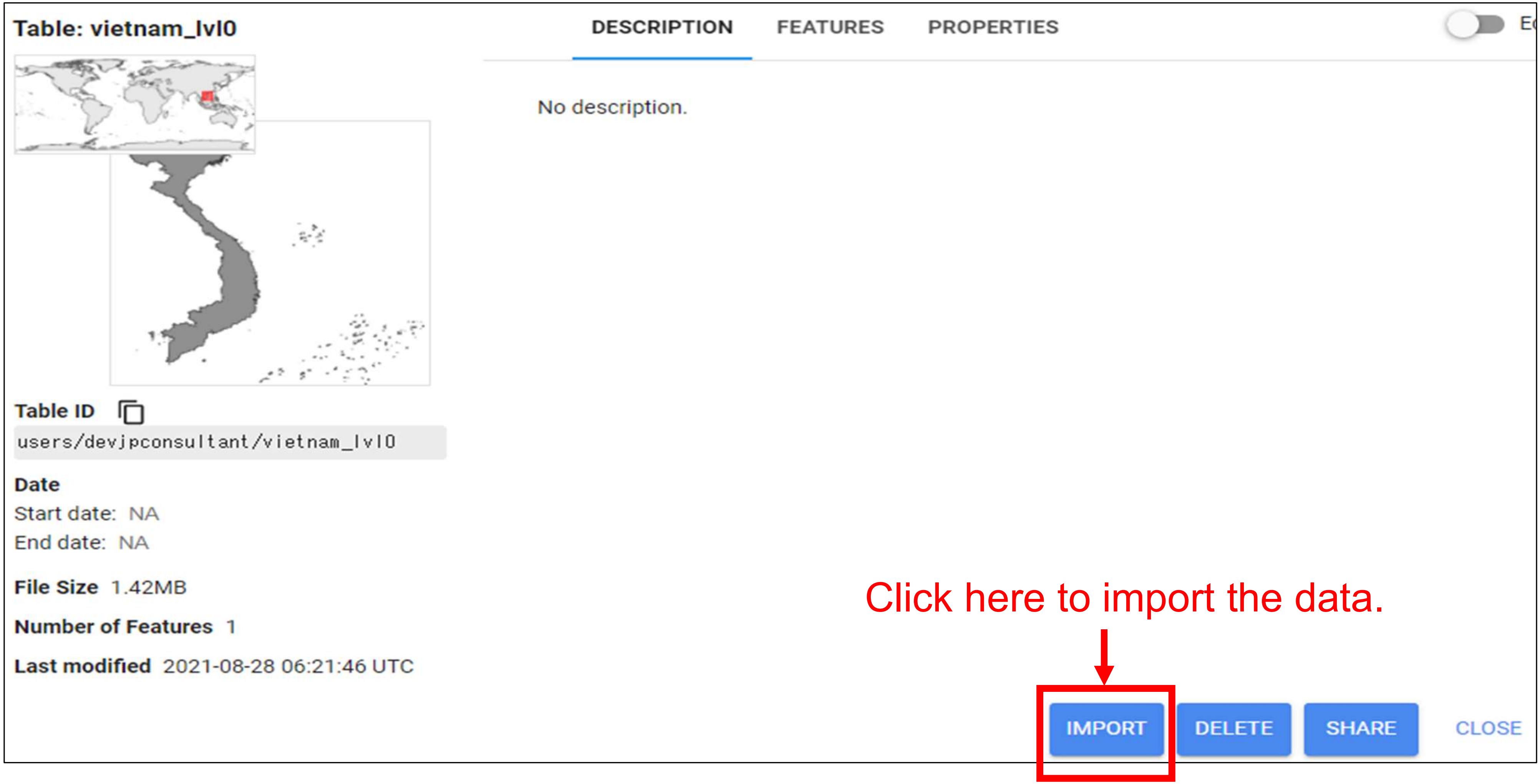


Table: vietnam_lvl0

No description.

Table ID
users/devjpconsultant/vietnam_lvl0

Date
Start date: NA
End date: NA

File Size 1.42MB

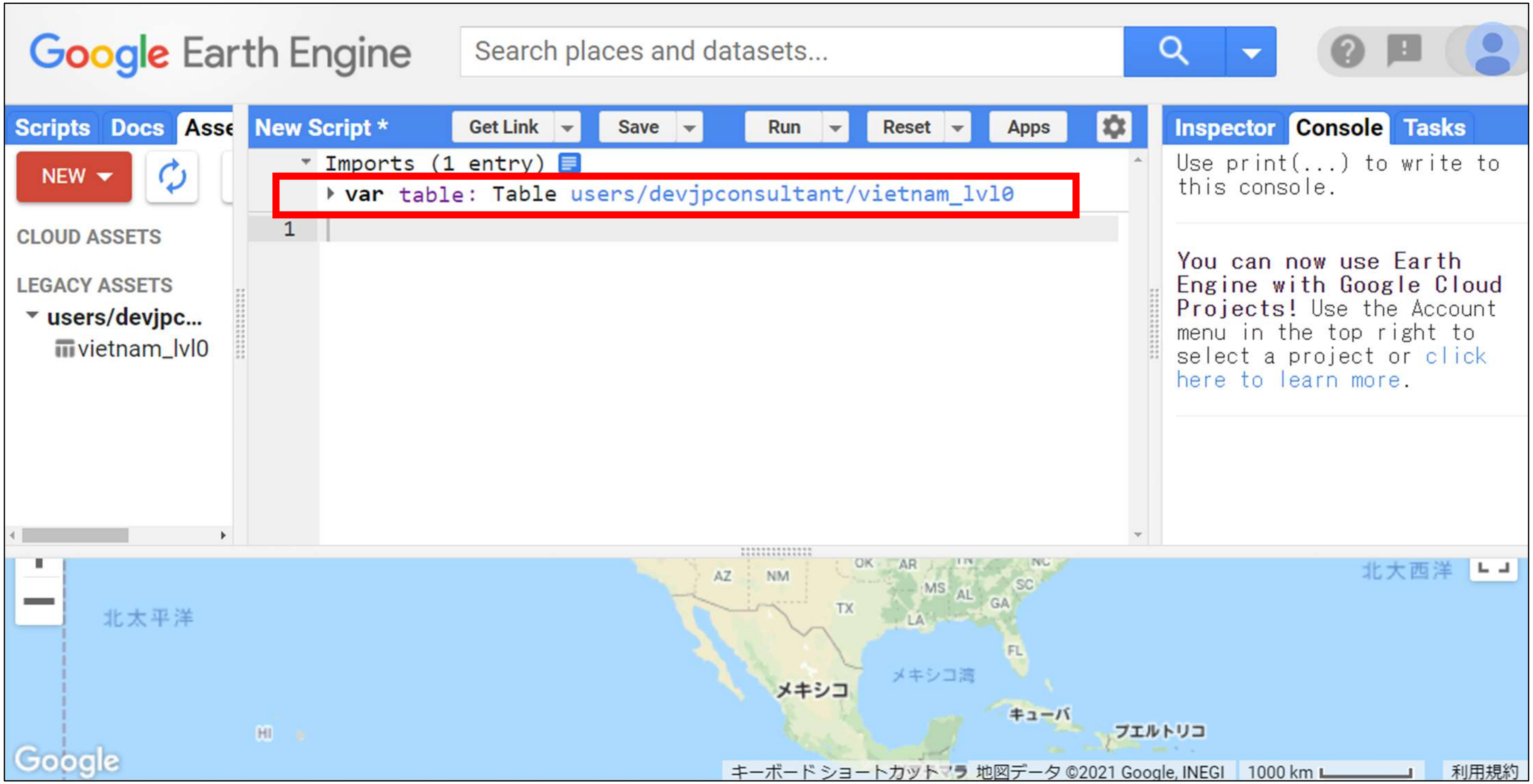
Number of Features 1

Last modified 2021-08-28 06:21:46 UTC

Click here to import the data.

Importing Administrative Boundaries Data (Country Level) 2/2

② The imported administrative boundaries data is displayed in the center pane with the variable **table**. Click **table** if you want to rename the variable. In this document, the variable name is unchanged from “table.”



```
Imports (1 entry)
  var table: Table users/devjpconsultant/vietnam_lvl0
```

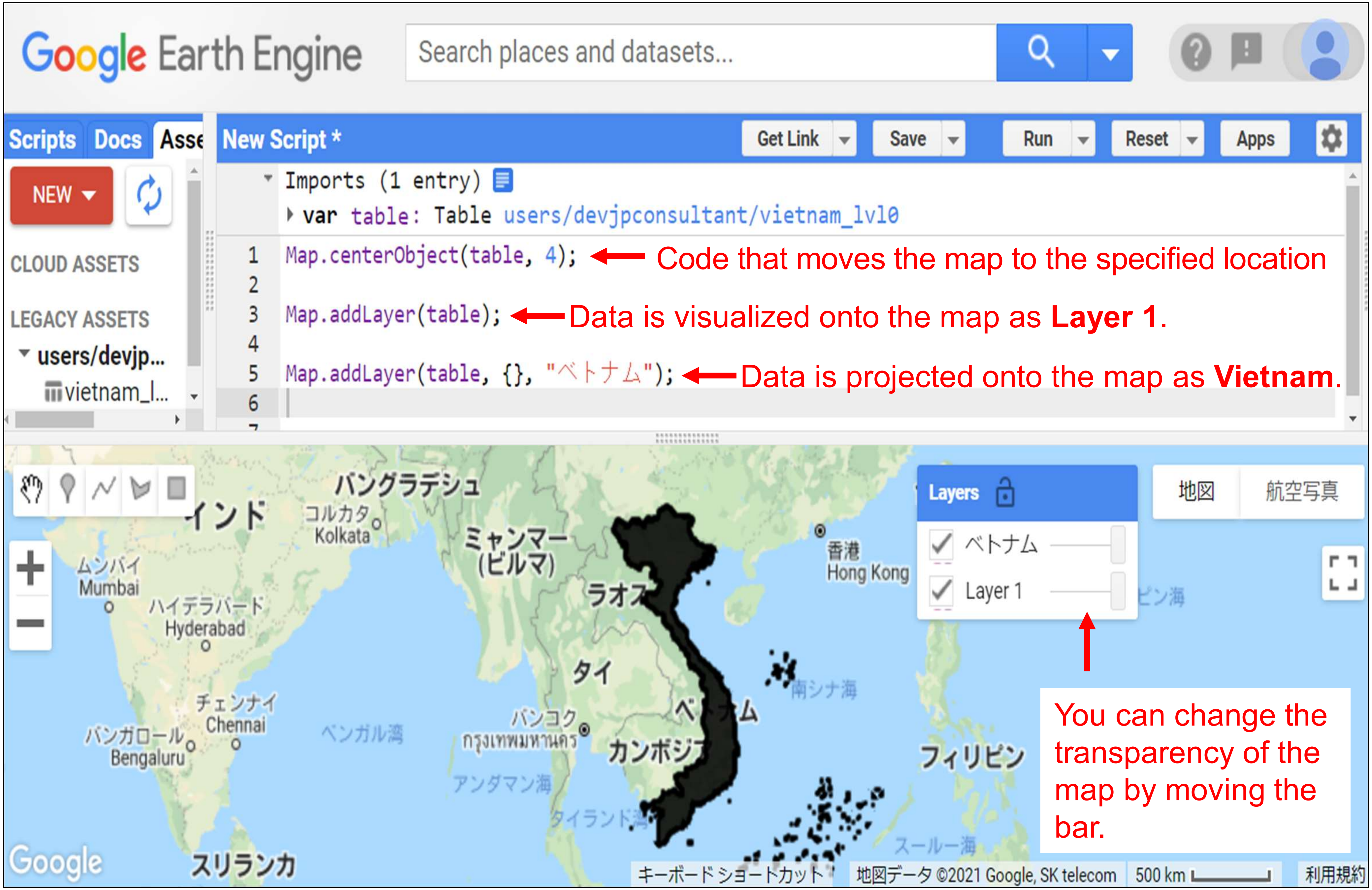
Use print(...) to write to this console.

You can now use Earth Engine with Google Cloud Projects! Use the Account menu in the top right to select a project or click here to learn more.

Visualizing Administrative Boundaries Data (Country Level) onto Map 1/2

- GEE provides **Map.addLayer();** as the code to visualize an image onto the map.
- By using this code, you can visualize the image stored in the specified variable name as a layer on the map.
- Write **Map.addLayer(variable name, {}, “layer name”);** to name the layer projected onto the map. If no layer name is given, a **layer number** is displayed.
  - ➢ The next slide shows the actual code.

Projecting Administrative Boundaries Data (Country Level) onto Map 2/2



```
Imports (1 entry)
var table: Table users/devjpconsultant/vietnam_lvl0
Map.centerObject(table, 4);

Map.addLayer(table);

Map.addLayer(table, {}, "ベトナム");
```

Code that moves the map to the specified location

Data is visualized onto the map as **Layer 1**.

Data is projected onto the map as **Vietnam**.

You can change the transparency of the map by moving the bar.

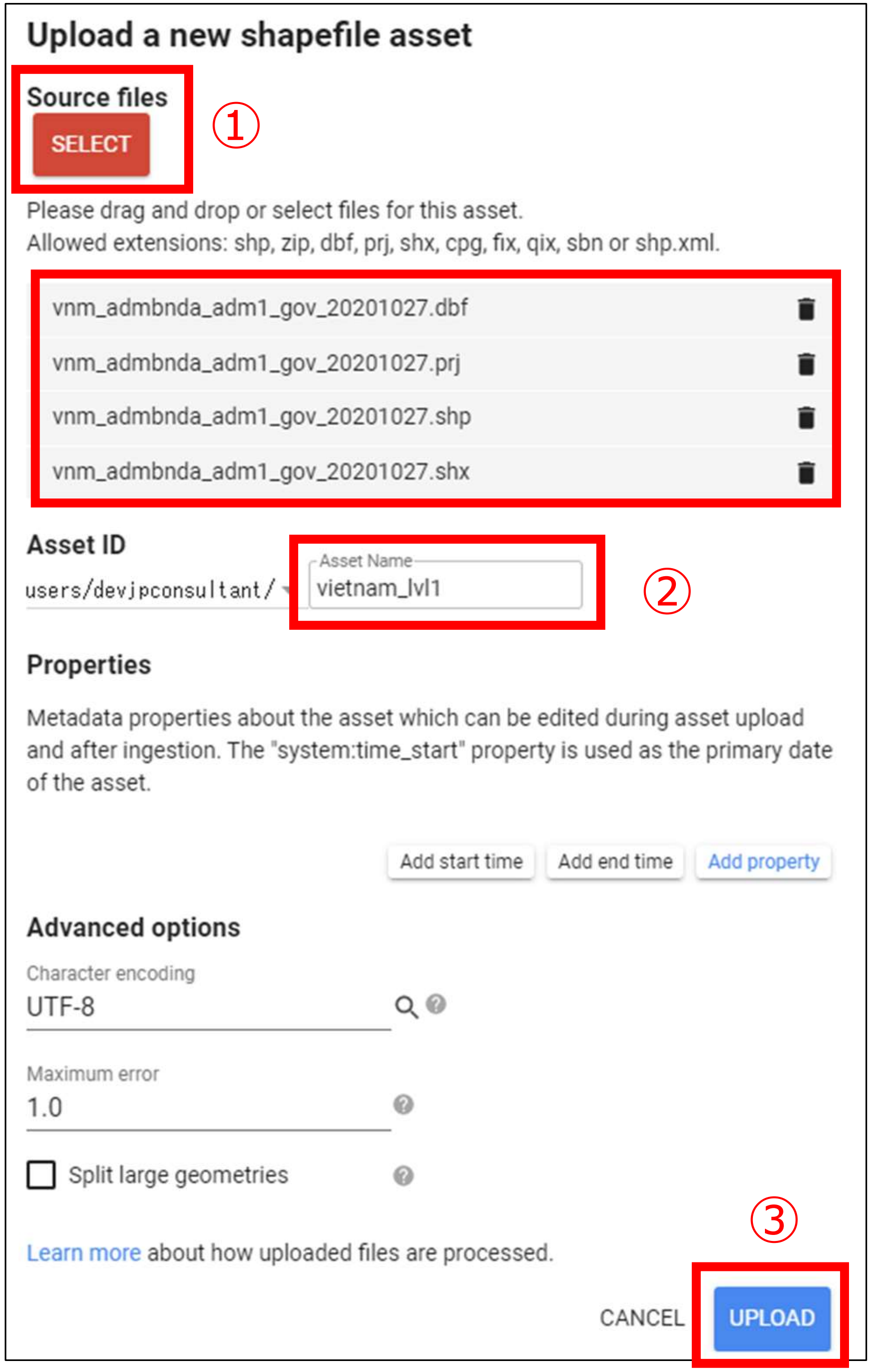
Uploading Administrative Boundaries Data (Province Level) 1/2

- One step needs to be added after the last step of projecting the administrative boundaries data (country level) onto the map.

① In the right pane, change the file to be uploaded from **adm0** to **adm1**.

② When you select a file, the **Asset Name** is automatically entered. Edit the name to any name you like.

③ Click **UPLOAD** button at the bottom to begin uploading administrative boundaries data.



Upload a new shapefile asset

Source files

Please drag and drop or select files for this asset.
Allowed extensions: shp, zip, dbf, prj, shx, cpg, fix, qix, sbn or shp.xml.

vnm_admbnda_adm1_gov_20201027.dbf
vnm_admbnda_adm1_gov_20201027.prj
vnm_admbnda_adm1_gov_20201027.shp
vnm_admbnda_adm1_gov_20201027.shx

Asset ID
users/devjpconsultant/
Asset Name: vietnam_lvl1

Properties

Metadata properties about the asset which can be edited during asset upload and after ingestion. The "system:time_start" property is used as the primary date of the asset.

Advanced options

Character encoding: UTF-8

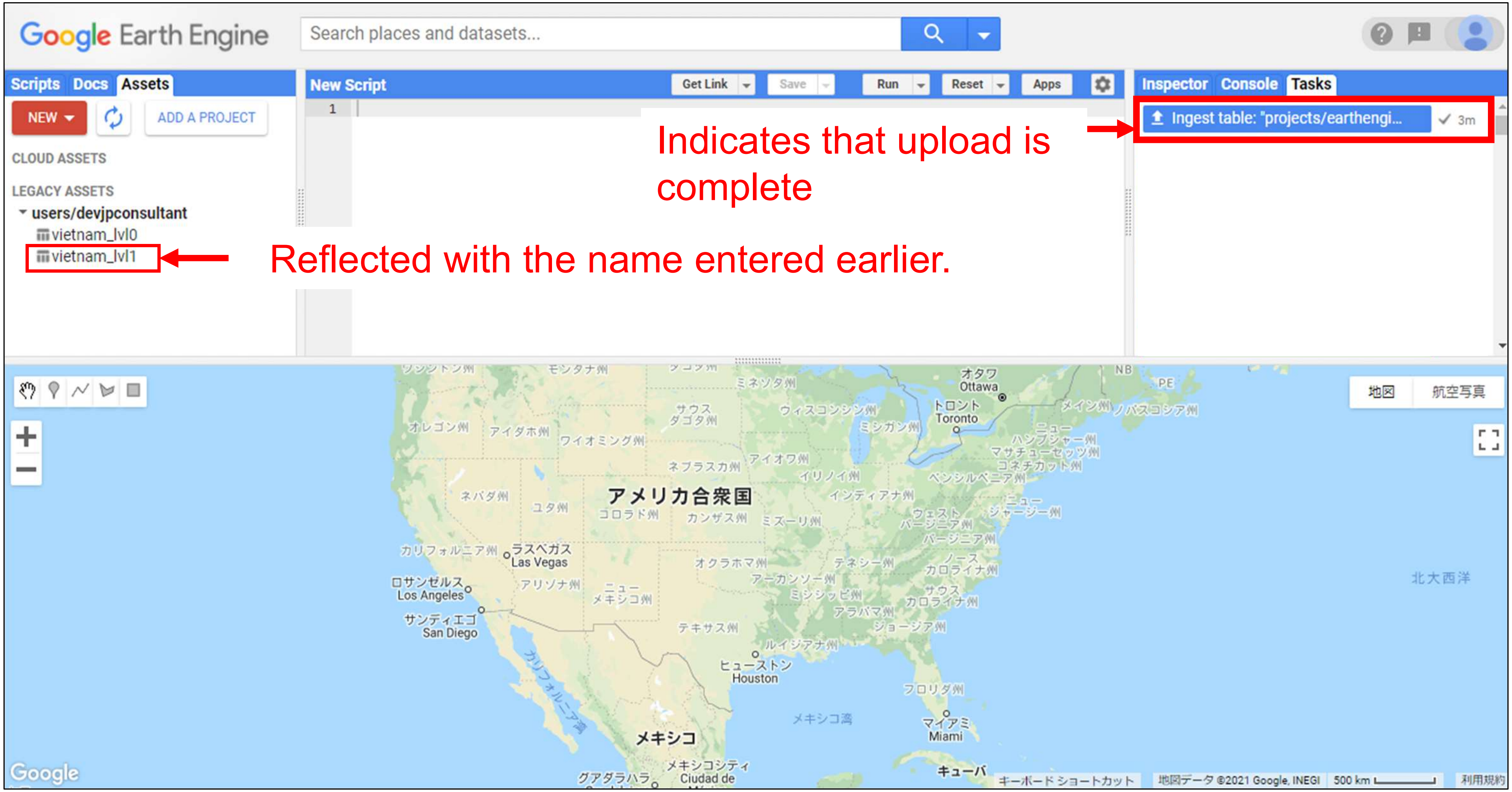
Maximum error: 1.0

☐ Split large geometries

Learn more about how uploaded files are processed.

Uploading Administrative Boundaries Data (Province Level) 2/2

④ You can check the upload status in **Tasks** in the right pane, and once the upload is complete, the data is reflected in **Assets**.



Indicates that upload is complete

Reflected with the name entered earlier.

Importing Administrative Boundaries Data (Province Level) 1/2

① Click the administrative boundaries data uploaded to **Assets** to view its basic information. You can import the administrative boundaries data from **IMPORT** at the bottom right of the screen.

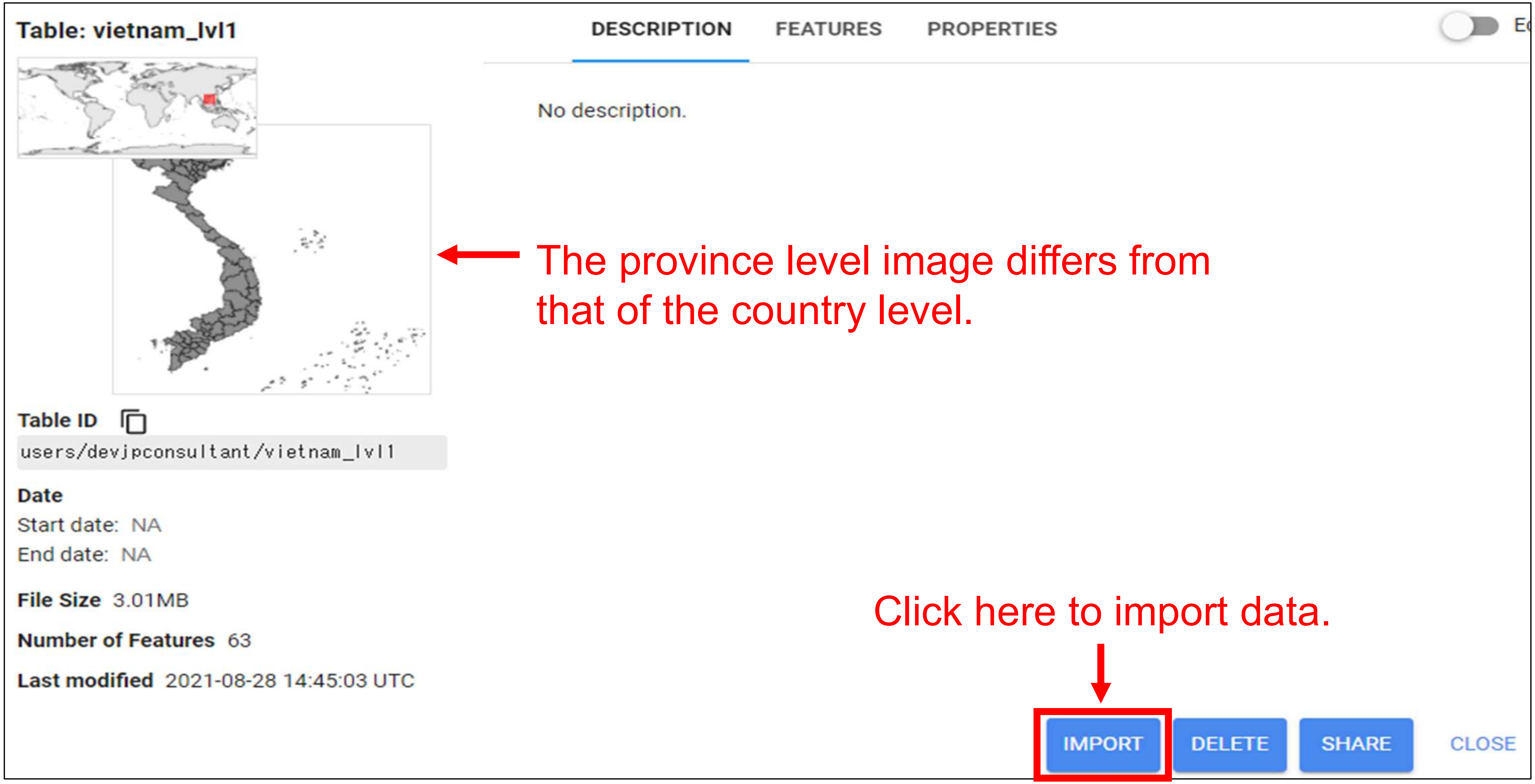


Table: vietnam_lvl1

No description.

Table ID

users/devjpconsultant/vietnam_lvl1

Date

Start date: NA

End date: NA

File Size 3.01MB

Number of Features 63

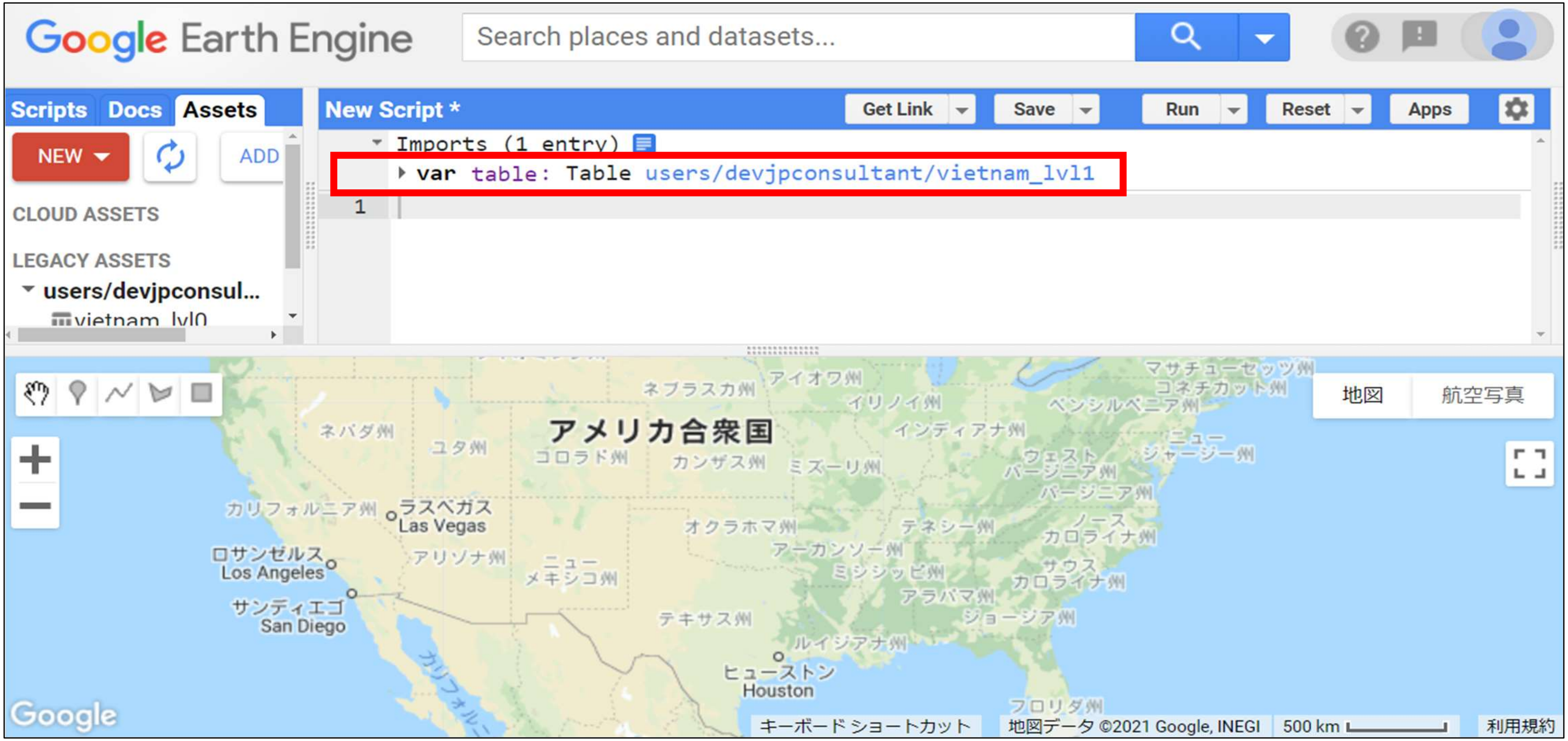
Last modified 2021-08-28 14:45:03 UTC

The province level image differs from that of the country level.

Click here to import data.

Importing Administrative Boundaries Data (Province Level) 2/2

② The imported administrative boundaries data is displayed in the center pane with the variable **table**. Click **table** if you want to rename the variable. In this document, the variable name is unchanged from “table.”



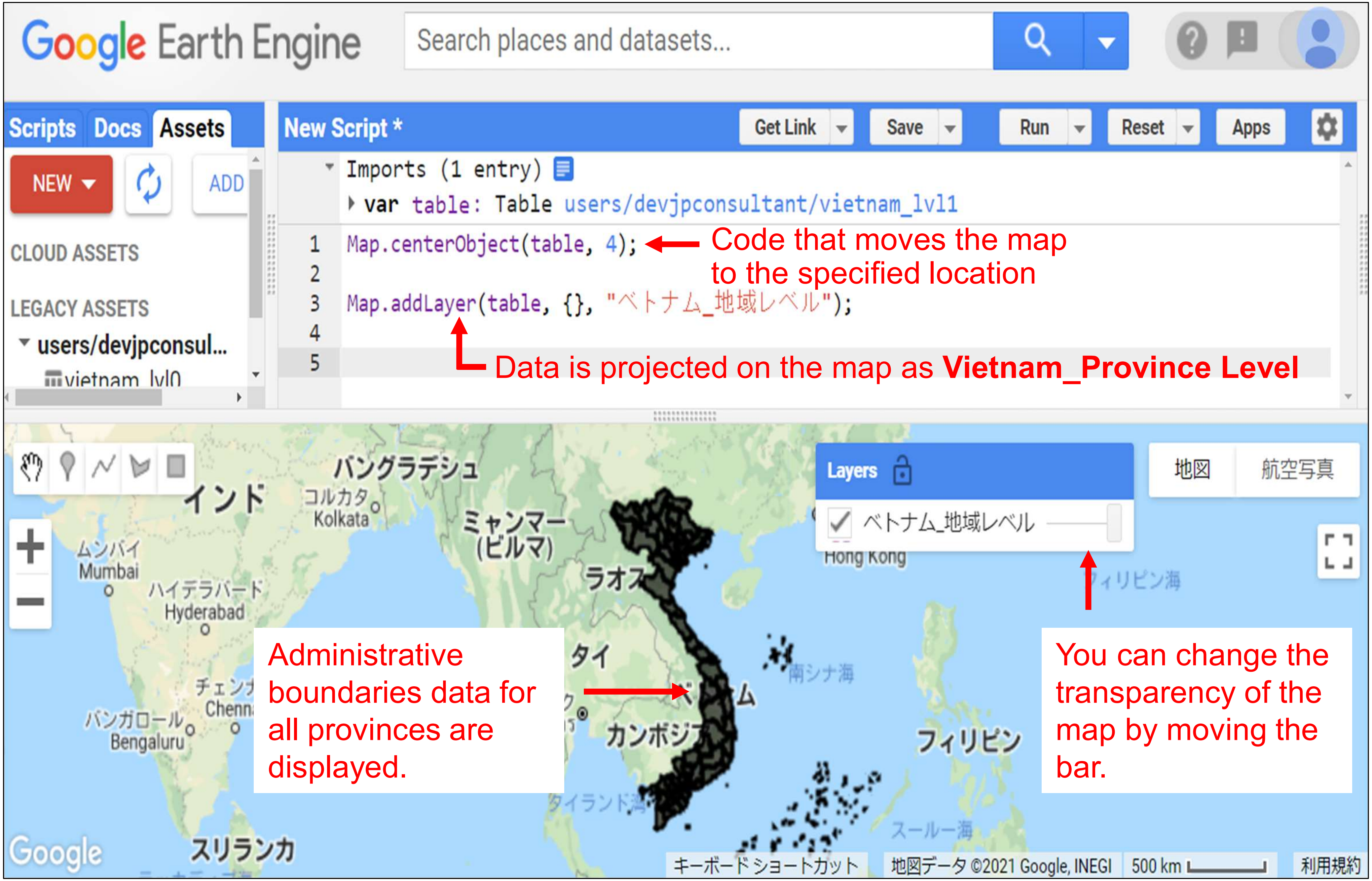
```
▾ Imports (1 entry)
  ▸ var table: Table users/devjpconsultant/vietnam_lvl1
```

Projecting Administrative Boundaries Data (Province Level) onto Map 1/4

- Likewise administrative boundaries data (country level), use the code **Map.addLayer()** to project the image stored in the specified variable.

- However, note that at this stage, all provinces will be displayed on the map due to not having specified or extracted a specific province yet.
  - The result is shown in the next slide.

Projecting Administrative Boundaries Data (Province Level) onto Map 2/4



```
Imports (1 entry)
▸ var table: Table users/devjpconsultant/vietnam_lvl1

Map.centerObject(table, 4);

Map.addLayer(table, {}, "ベトナム_地域レベル");
```

Code that moves the map to the specified location

Data is projected on the map as **Vietnam_Province Level**

Administrative boundaries data for all provinces are displayed.

You can change the transparency of the map by moving the bar.

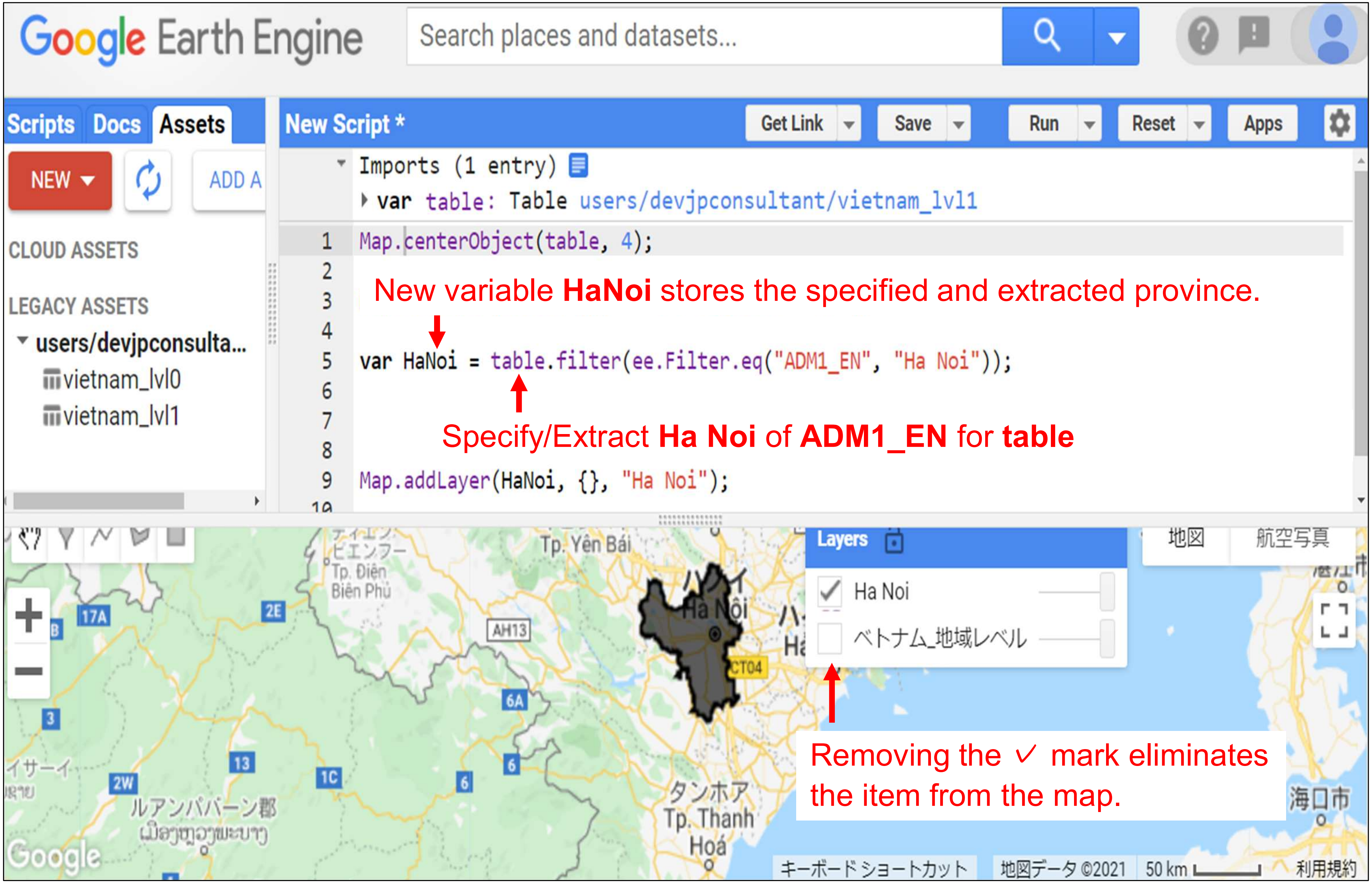
Projecting Administrative Boundaries Data (Province Level) onto Map 3/4

- The result on the previous slide is not sufficient for province level analysis as the target province is not specified/extracted yet.

- Therefore, it is necessary to specify and extract the target province by applying a filter to the variable **table** in which the province level administrative boundaries data is stored, and store it in another variable. This time, you will specify/extract Hanoi (Ha Noi).

- One of the codes for specifying/extracting a province is **variable name.filter(ee.Filter.eq(“attributes”, “target province”));**.
  - The next slide shows the actual code.

Projecting Administrative Boundaries Data (Province Level) onto Map 4/4



```
Imports (1 entry)
var table: Table users/devjpconsultant/vietnam_lvl1
```

```
Map.centerObject(table, 4);



var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));



Map.addLayer(HaNoi, {}, "Ha Noi");
```

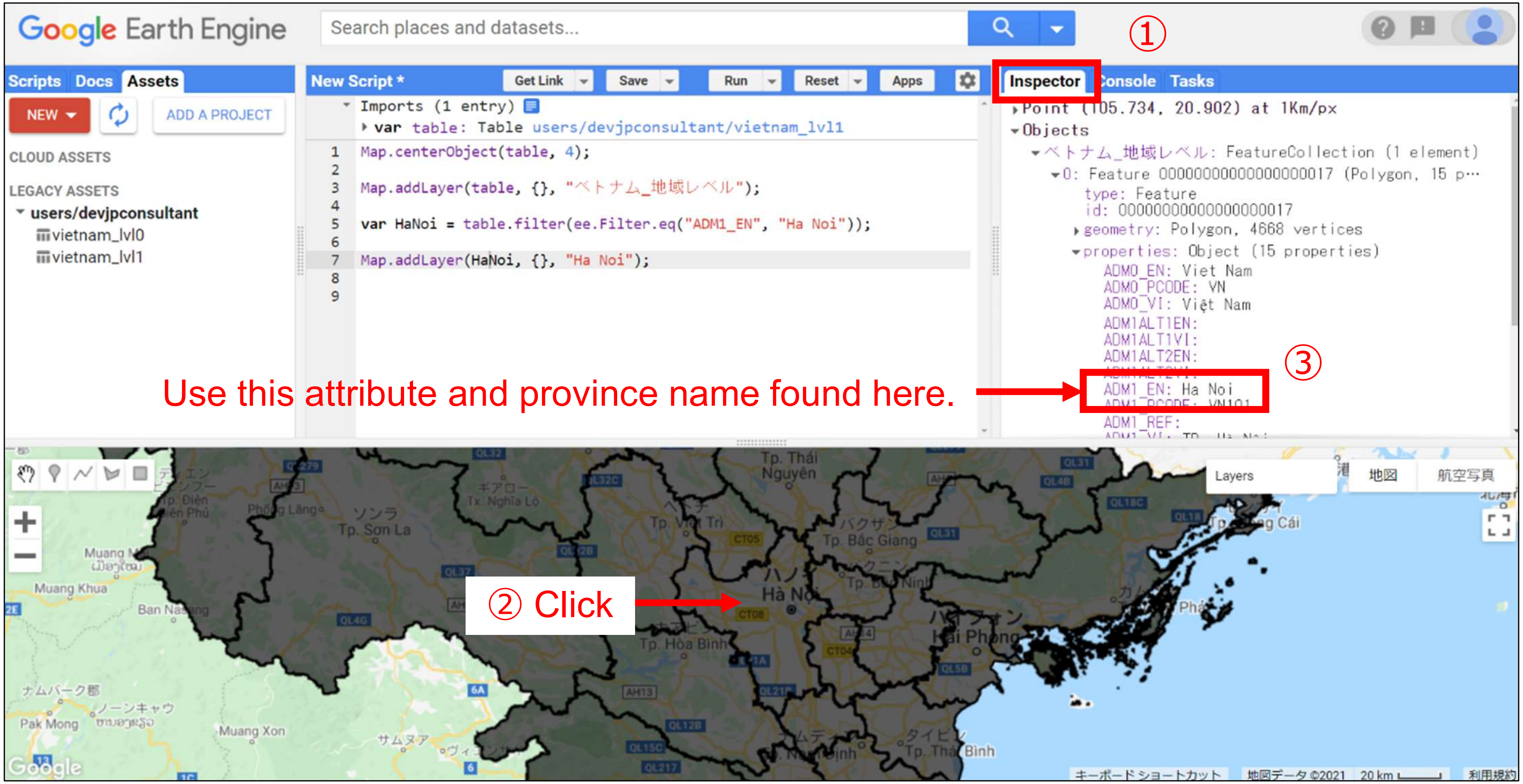
New variable **HaNoi** stores the specified and extracted province.

Specify/Extract **Ha Noi** of **ADM1_EN** for **table**

Removing the ✓ mark eliminates the item from the map.

How to Look for Attribute and Province Name Required for Filtering

- Use the **Inspector** function in the right pane and click the province you want to specify or extract. You will then see the data for the province you clicked. Look for the appropriate column and province names.



①

```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1

Map.centerObject(table, 4);

Map.addLayer(table, {}, "ベトナム_地域レベル");

var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.addLayer(HaNoi, {}, "Ha Noi");
```

```
Point (105.734, 20.902) at 1Km/px
Objects
  ベトナム_地域レベル: FeatureCollection (1 element)
    0: Feature 00000000000000000017 (Polygon, 15 p…
      type: Feature
      id: 00000000000000000017
      geometry: Polygon, 4668 vertices
      properties: Object (15 properties)
        ADM0_EN: Viet Nam
        ADM0_PCODE: VN
        ADM0_VI: Việt Nam
        ADM1ALT1EN:
        ADM1ALT1VI:
        ADM1ALT2EN:
        ADM1ALT2VI:
        ADM1_EN: Ha Noi
        ADM1_PCODE: VN101
        ADM1_REF:
        ADM1_VI: TP. Ha Noi
```

③

Use this attribute and province name found here.

② Click

How to Handle Nighttime Light Data

Nighttime Light Data Stored in GEE

- The third in the list is to be used in future ex-post evaluations.

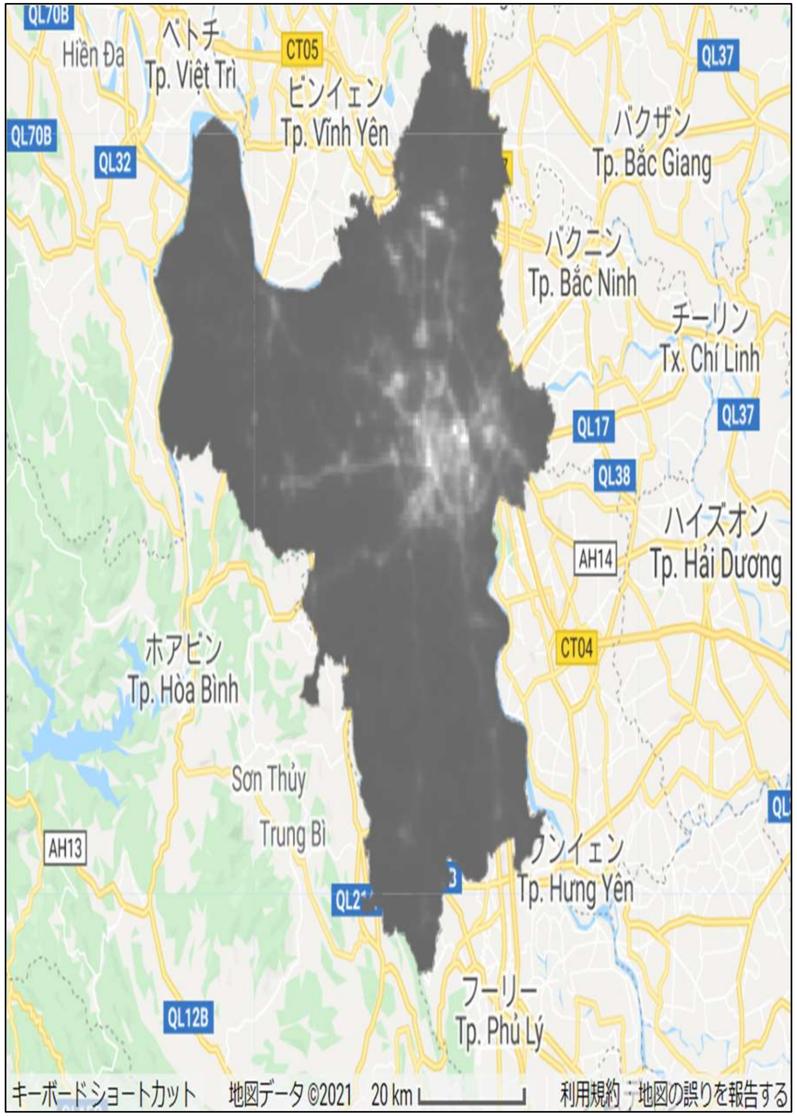
  This document deals with the **third** dataset.

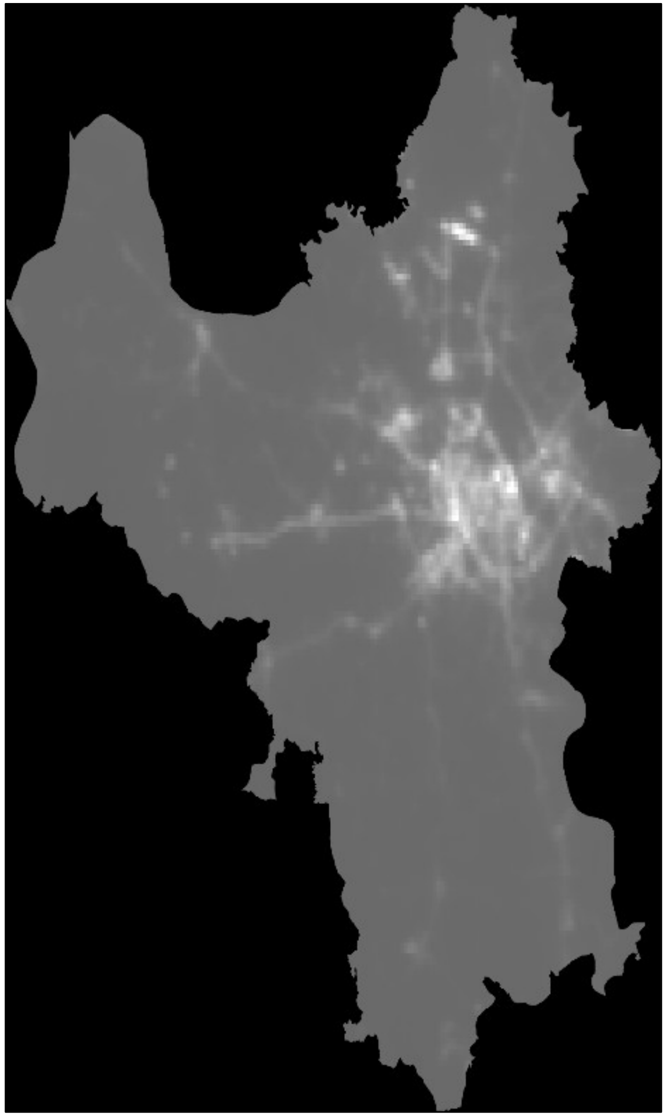
  Please study the other datasets on your own.

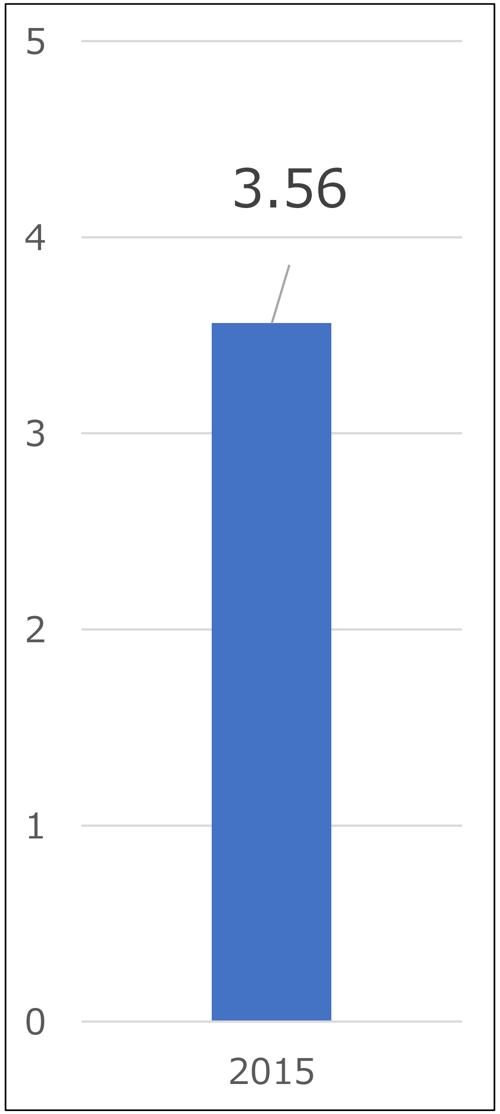
No	Name	Period	Nighttime light intensity range (pt)
1	DMSP OLS: Nighttime Lights Time Series Version 4	1992 - 2014	0-63
2	DMSP OLS: Global Radiance-Calibrated Nighttime Lights Version 4	1996 - 2011	0-6060.6
3	VIIRS Nighttime Day/Night Band Composites Version 1	April 2012 - present	-1.5-340573
4	VIIRS Stray Light Corrected Nighttime Day/Night Band Composites Version 1	2014 - present	-1.5-193565

Final Goal of This Section

- (1) Display of nighttime light data and (2) exported nighttime light data for Hanoi in 2015, as uploaded in the previous section.

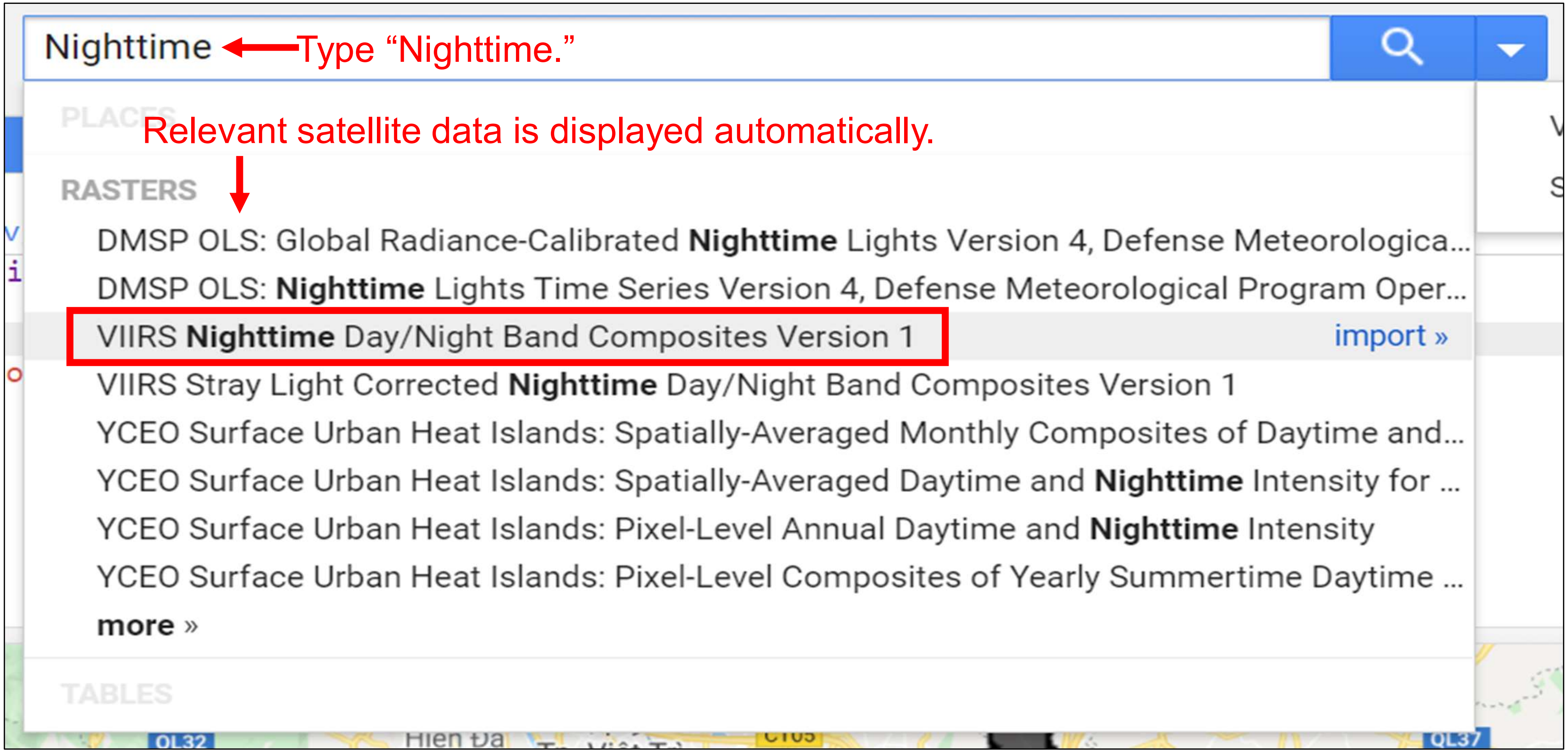






Importing Nighttime Light Data 1/5

- Type “Nighttime” in the search field.
- Click **VIIRS Nighttime Day/Night Band Composites Version 1** from among the displayed satellite data.



Nighttime

Type “Nighttime.”

PLACES

Relevant satellite data is displayed automatically.

RASTERS

DMSP OLS: Global Radiance-Calibrated **Nighttime** Lights Version 4, Defense Meteorologica...

DMSP OLS: **Nighttime** Lights Time Series Version 4, Defense Meteorological Program Oper...

VIIRS **Nighttime** Day/Night Band Composites Version 1 import »

VIIRS Stray Light Corrected **Nighttime** Day/Night Band Composites Version 1

YCEO Surface Urban Heat Islands: Spatially-Averaged Monthly Composites of Daytime and...

YCEO Surface Urban Heat Islands: Spatially-Averaged Daytime and **Nighttime** Intensity for ...

YCEO Surface Urban Heat Islands: Pixel-Level Annual Daytime and **Nighttime** Intensity

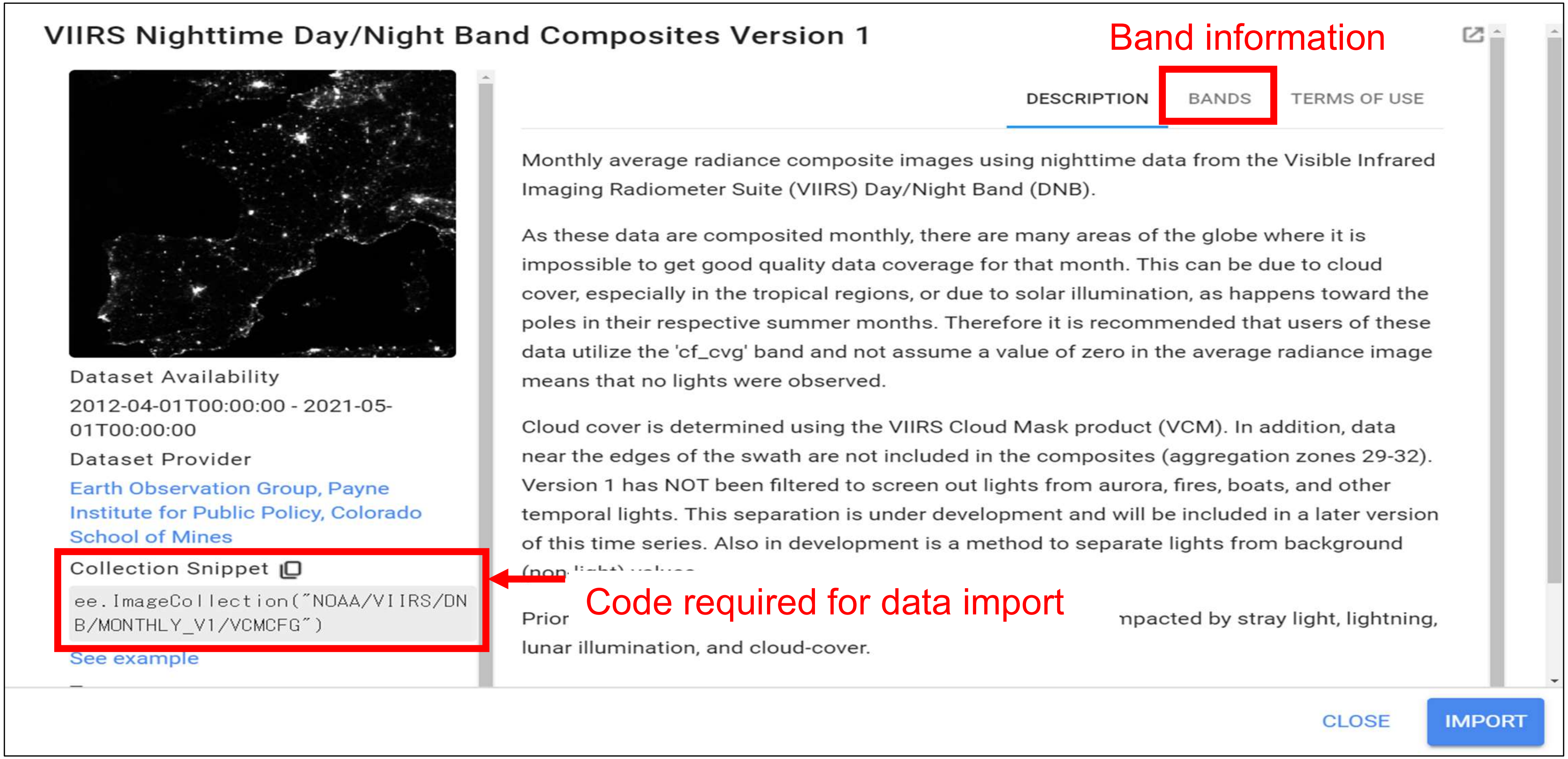
YCEO Surface Urban Heat Islands: Pixel-Level Composites of Yearly Summertime Daytime ...

more »

TABLES

Importing Nighttime Light Data 2/5

- The information of the clicked nighttime light data is displayed.
- Data summary, year of use, band, code required for data import, etc. are provided. What you should check for is the band and the code required for data import.



VIIRS Nighttime Day/Night Band Composites Version 1

Monthly average radiance composite images using nighttime data from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB).

As these data are composited monthly, there are many areas of the globe where it is impossible to get good quality data coverage for that month. This can be due to cloud cover, especially in the tropical regions, or due to solar illumination, as happens toward the poles in their respective summer months. Therefore it is recommended that users of these data utilize the 'cf_cvg' band and not assume a value of zero in the average radiance image means that no lights were observed.

Cloud cover is determined using the VIIRS Cloud Mask product (VCM). In addition, data near the edges of the swath are not included in the composites (aggregation zones 29-32). Version 1 has NOT been filtered to screen out lights from aurora, fires, boats, and other temporal lights. This separation is under development and will be included in a later version of this time series. Also in development is a method to separate lights from background (non-light) values.

Prior npacted by stray light, lightning, lunar illumination, and cloud-cover.

Dataset Availability

2012-04-01T00:00:00 - 2021-05-01T00:00:00

Dataset Provider

Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines

Collection Snippet

```
ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
```

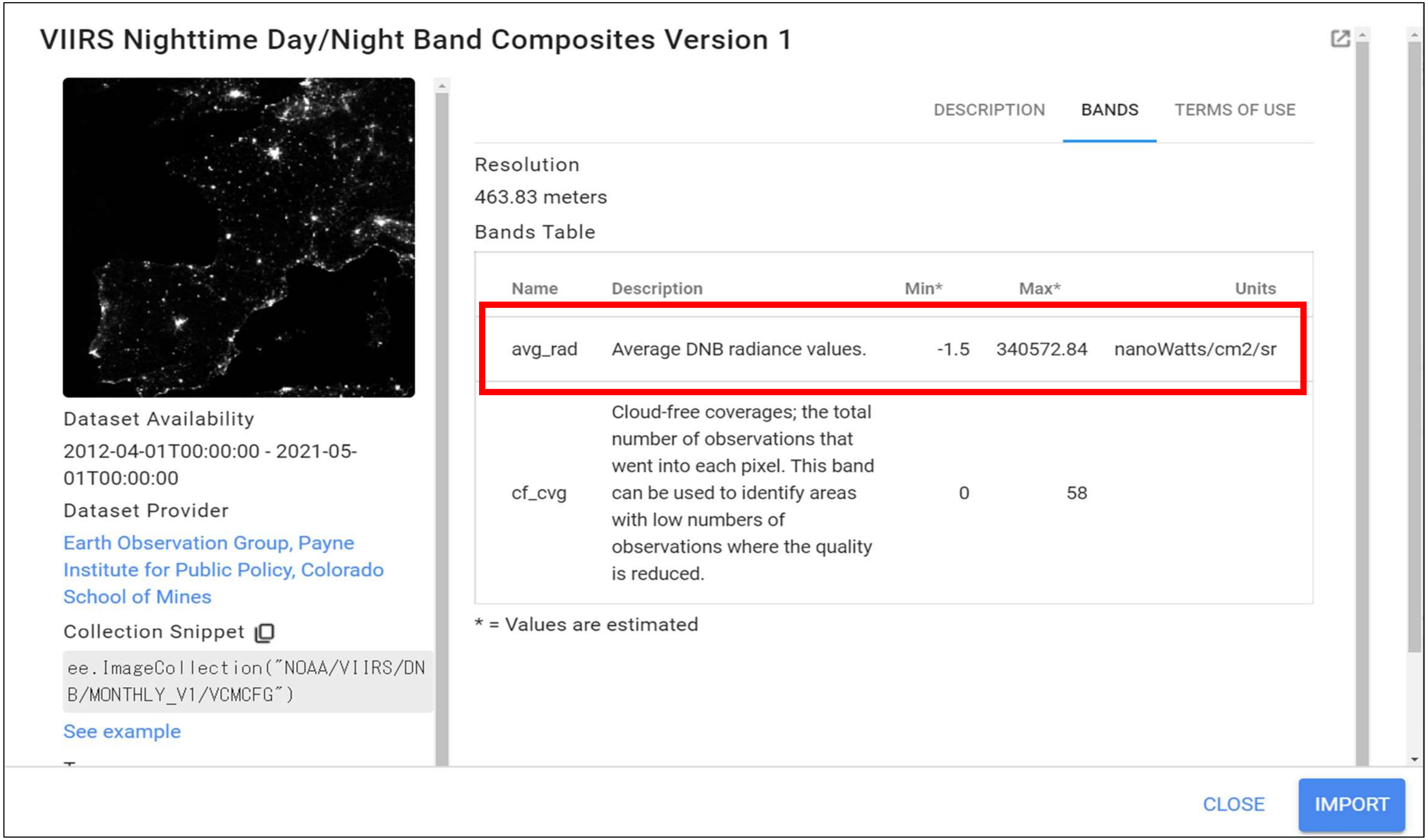
See example

Band information

Code required for data import

Importing Nighttime Light Data 3/5

- The band used in this document is **avg_rad**.



VIIRS Nighttime Day/Night Band Composites Version 1

Resolution

463.83 meters

Bands Table

Name	Description	Min*	Max*	Units
avg_rad	Average DNB radiance values.	-1.5	340572.84	nanoWatts/cm2/sr
cf_cvg	Cloud-free coverages; the total number of observations that went into each pixel. This band can be used to identify areas with low numbers of observations where the quality is reduced.	0	58	

* = Values are estimated

Dataset Availability

2012-04-01T00:00:00 - 2021-05-01T00:00:00

Dataset Provider

Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines

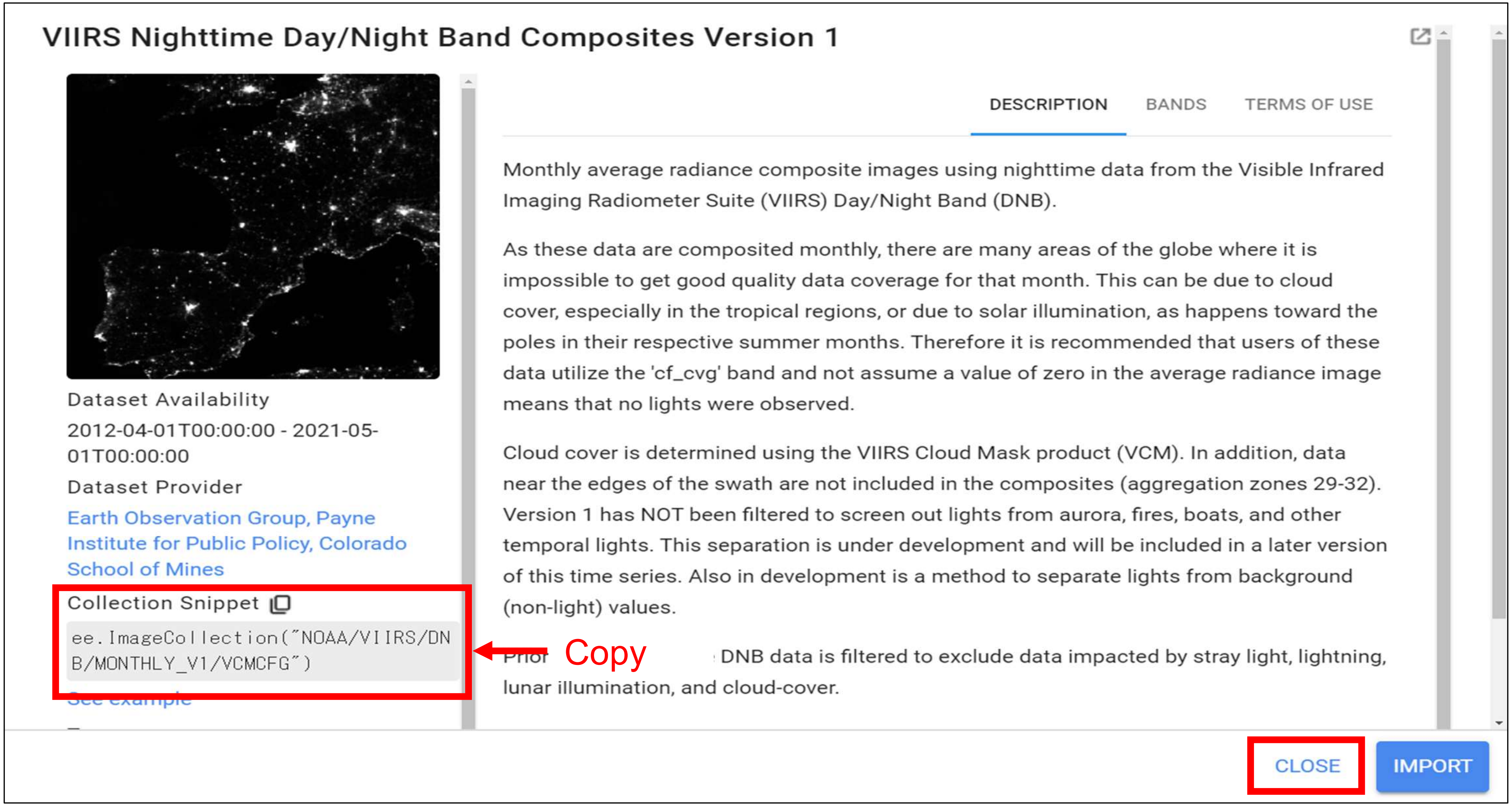
Collection Snippet

```
ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
```

See example

Importing Nighttime Light Data 4/5

- After checking the band, copy the code required for data import.
- Click **CLOSE** after copying.



VIIRS Nighttime Day/Night Band Composites Version 1

Dataset Availability

2012-04-01T00:00:00 - 2021-05-01T00:00:00

Dataset Provider

Earth Observation Group, Payne Institute for Public Policy, Colorado School of Mines

Collection Snippet

```
ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
```

See example

Monthly average radiance composite images using nighttime data from the Visible Infrared Imaging Radiometer Suite (VIIRS) Day/Night Band (DNB).

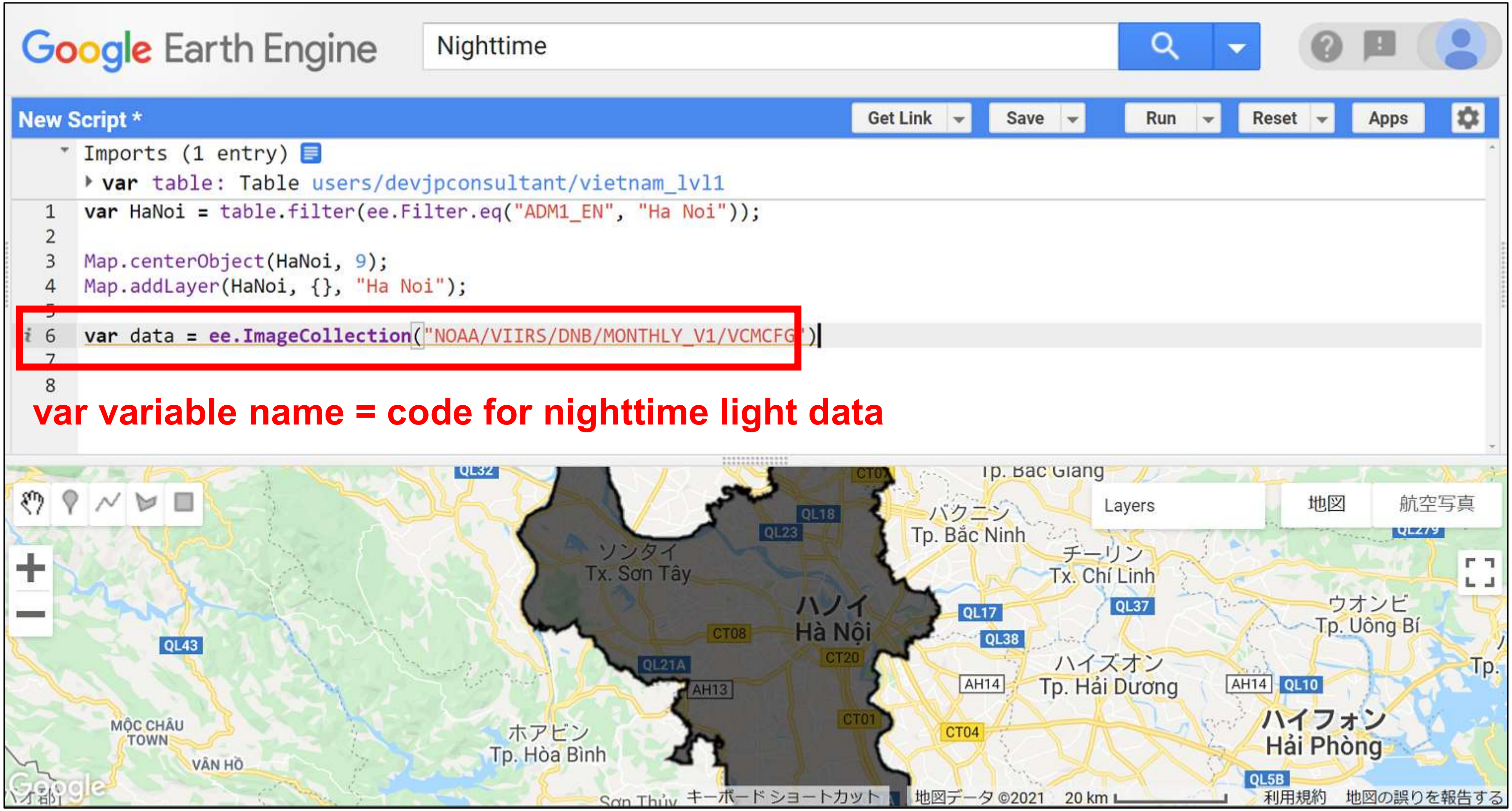
As these data are composited monthly, there are many areas of the globe where it is impossible to get good quality data coverage for that month. This can be due to cloud cover, especially in the tropical regions, or due to solar illumination, as happens toward the poles in their respective summer months. Therefore it is recommended that users of these data utilize the 'cf_cvg' band and not assume a value of zero in the average radiance image means that no lights were observed.

Cloud cover is determined using the VIIRS Cloud Mask product (VCM). In addition, data near the edges of the swath are not included in the composites (aggregation zones 29-32). Version 1 has NOT been filtered to screen out lights from aurora, fires, boats, and other temporal lights. This separation is under development and will be included in a later version of this time series. Also in development is a method to separate lights from background (non-light) values.

Prior DNB data is filtered to exclude data impacted by stray light, lightning, lunar illumination, and cloud-cover.

Importing Nighttime Light Data 5/5

- You will be returned to the main screen. Paste the code into the code editor.
- Define the variable and store the code. In this document, variable name is **data**.

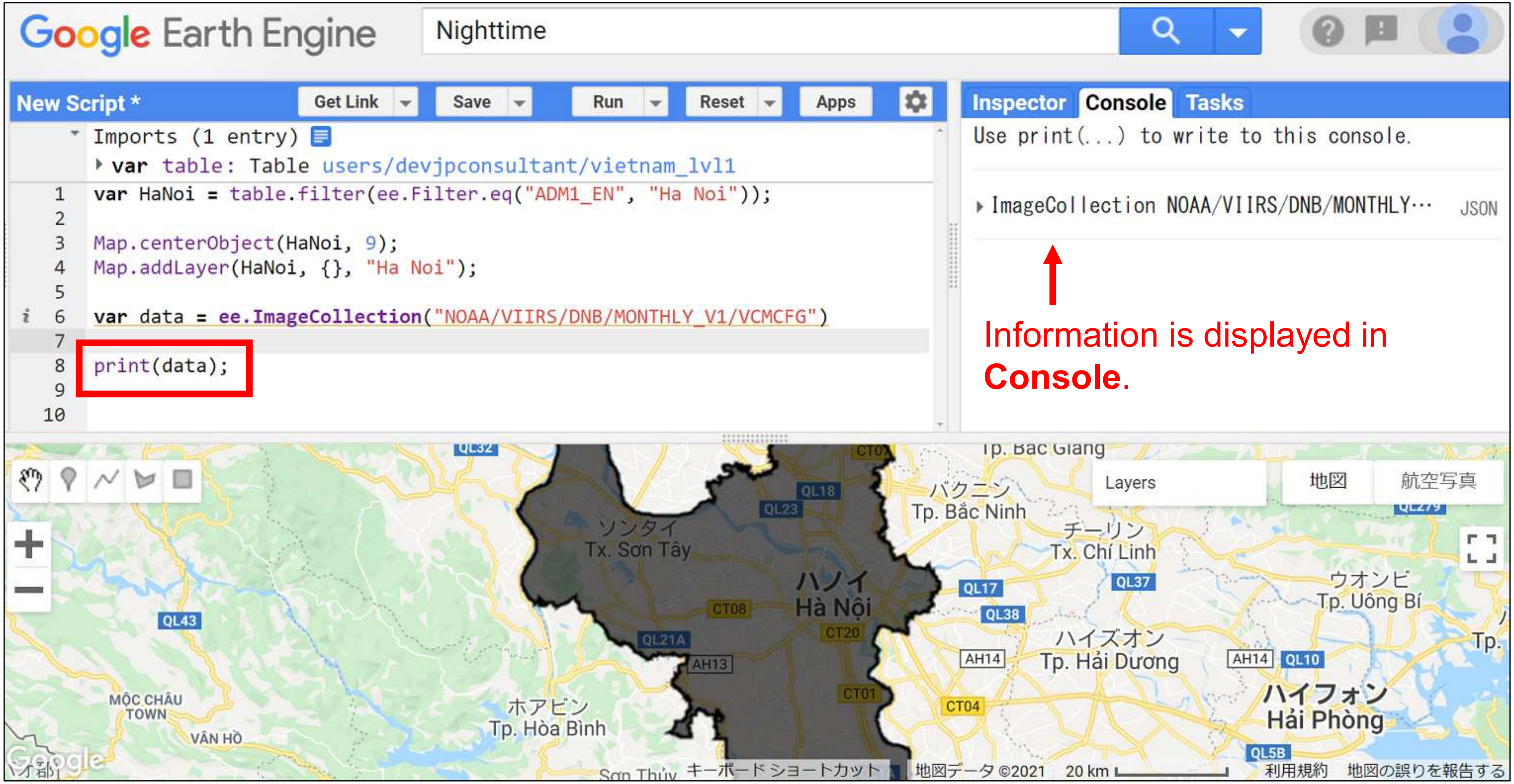


```
Imports (1 entry)
  var table: Table users/devjpconsultant/vietnam_lvl1
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")


```

var variable name = code for nighttime light data

Viewing the Information on Nighttime Light Data 1/2

- You can use **print(variable name)** to view nighttime light data.
- Information is displayed in **Console**.



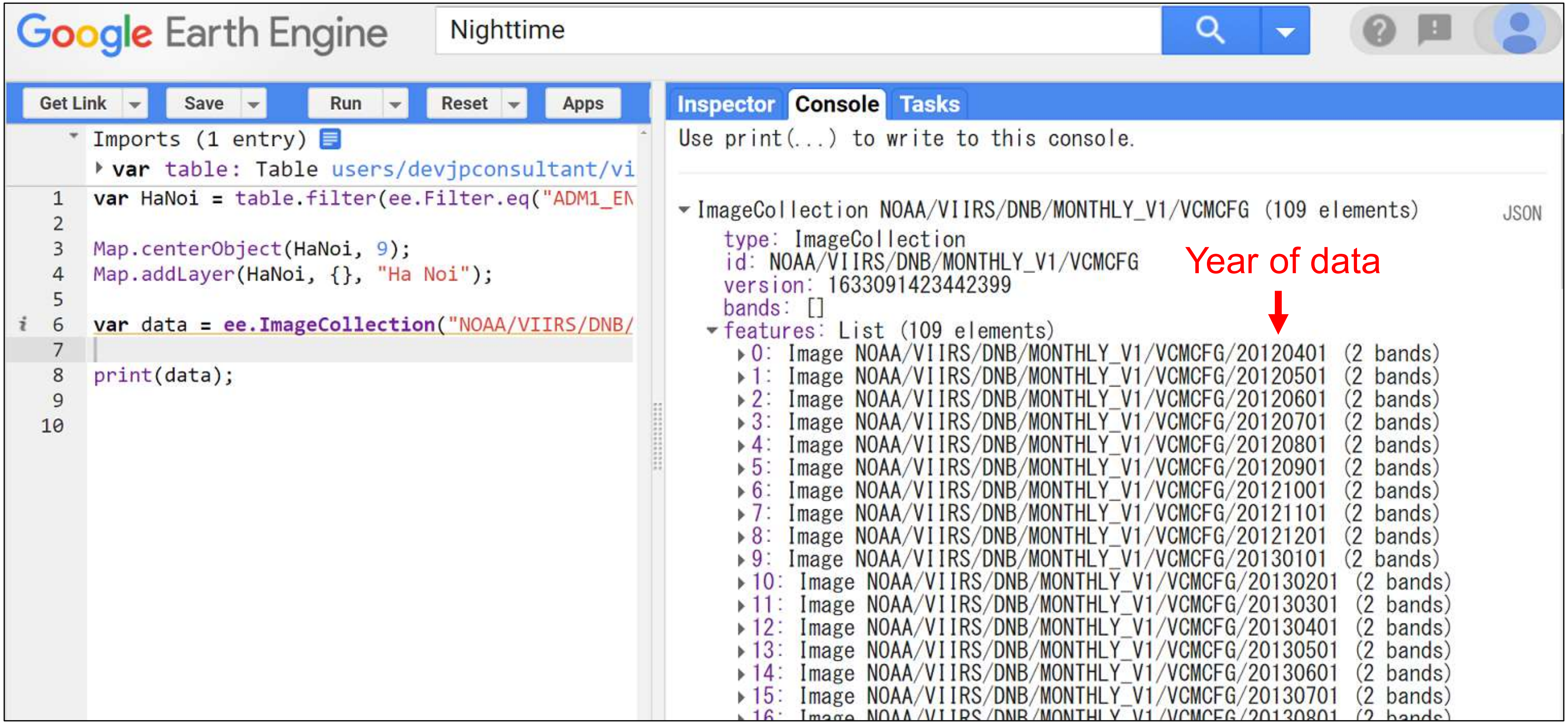
```
Imports (1 entry)
  var table: Table users/devjpconsultant/vietnam_lvl1
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")

print(data);
```

```
Use print(...) to write to this console.

▸ ImageCollection NOAA/VIIRS/DNB/MONTHLY…
```

Information is displayed in **Console**.

Viewing the Information on Nighttime Light Data 2/2

- Click an item to open the information. If you open **features**, you can see that the data from and after April 2012 is stored.
- Only the data from January to December 2015 is used in this document.



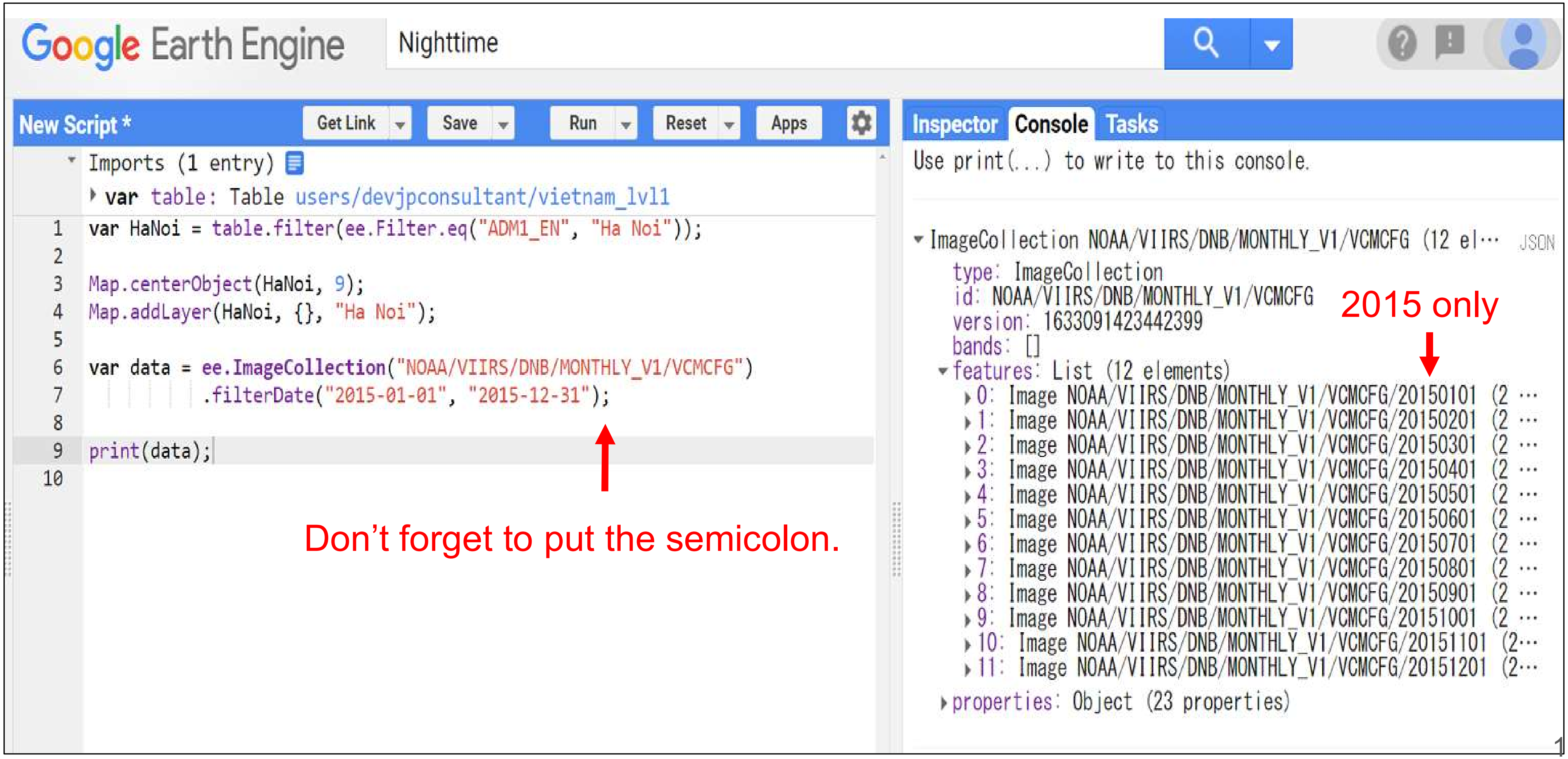
```
Imports (1 entry)
 var table: Table users/devjpconsultant/vi
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/

print(data);
```

```
Use print(...) to write to this console.

ImageCollection NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG (109 elements)
  type: ImageCollection
  id: NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG
  version: 1633091423442399
  bands: []
  features: List (109 elements)
    0: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120401 (2 bands)
    1: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120501 (2 bands)
    2: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120601 (2 bands)
    3: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120701 (2 bands)
    4: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120801 (2 bands)
    5: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20120901 (2 bands)
    6: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20121001 (2 bands)
    7: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20121101 (2 bands)
    8: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20121201 (2 bands)
    9: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130101 (2 bands)
    10: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130201 (2 bands)
    11: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130301 (2 bands)
    12: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130401 (2 bands)
    13: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130501 (2 bands)
    14: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130601 (2 bands)
    15: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130701 (2 bands)
    16: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20130801 (2 bands)
```

Year of data

Extracting Target Year Data

- Apply the date filter **.filterDate("first date", "last date")** to the nighttime light data.
- If you check **print()**, you can see that data only for 2015 is extracted.



```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1

var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
            .filterDate("2015-01-01", "2015-12-31");

print(data);
```

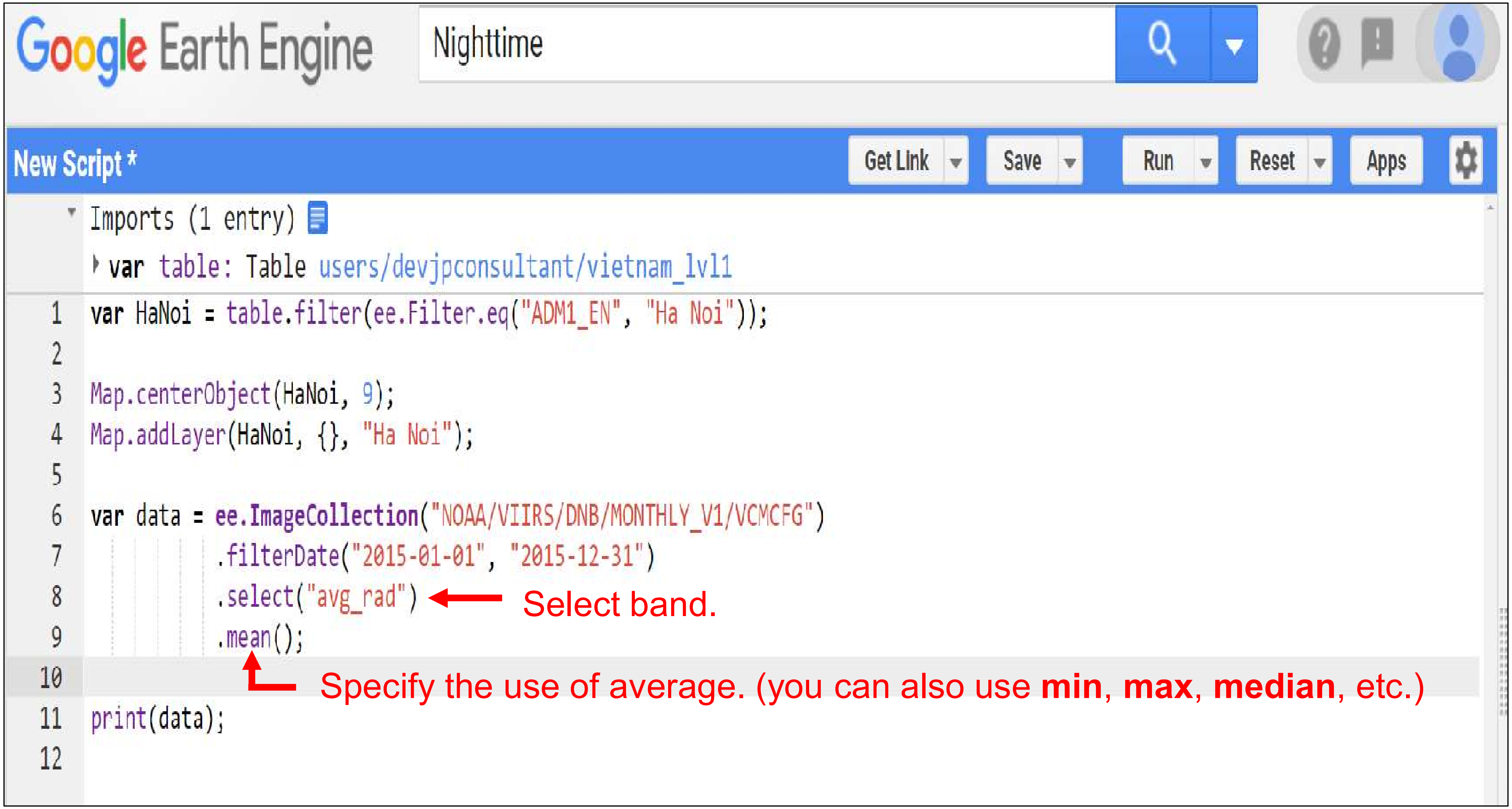
Don't forget to put the semicolon.

```
Use print(...) to write to this console.

ImageCollection NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG (12 el…
  type: ImageCollection
  id: NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG
  version: 1633091423442399
  bands: []
  features: List (12 elements)
    0: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150101 (2 …
    1: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150201 (2 …
    2: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150301 (2 …
    3: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150401 (2 …
    4: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150501 (2 …
    5: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150601 (2 …
    6: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150701 (2 …
    7: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150801 (2 …
    8: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20150901 (2 …
    9: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20151001 (2 …
    10: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20151101 (2…
    11: Image NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG/20151201 (2…
  properties: Object (23 properties)
```

2015 only

Selecting the Target Band and Calculating the Average

- Specify the band to use for the selection filter.
- Specify the use of the 2015 annual average.



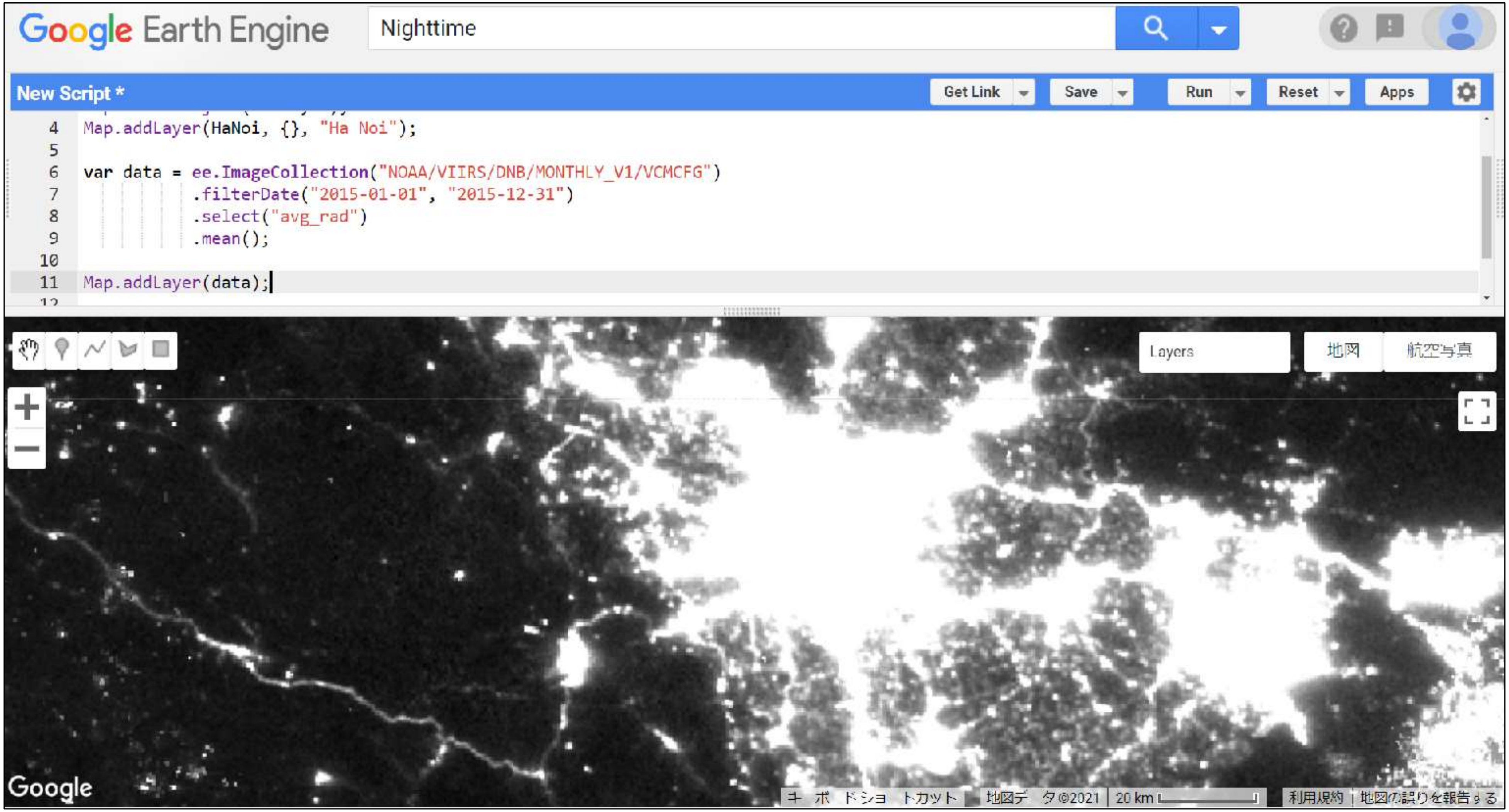
```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
            .filterDate("2015-01-01", "2015-12-31")
            .select("avg_rad")
            .mean();

print(data);
```

Select band.

Specify the use of average. (you can also use **min**, **max**, **median**, etc.)

Projecting Nighttime Light Data onto Map

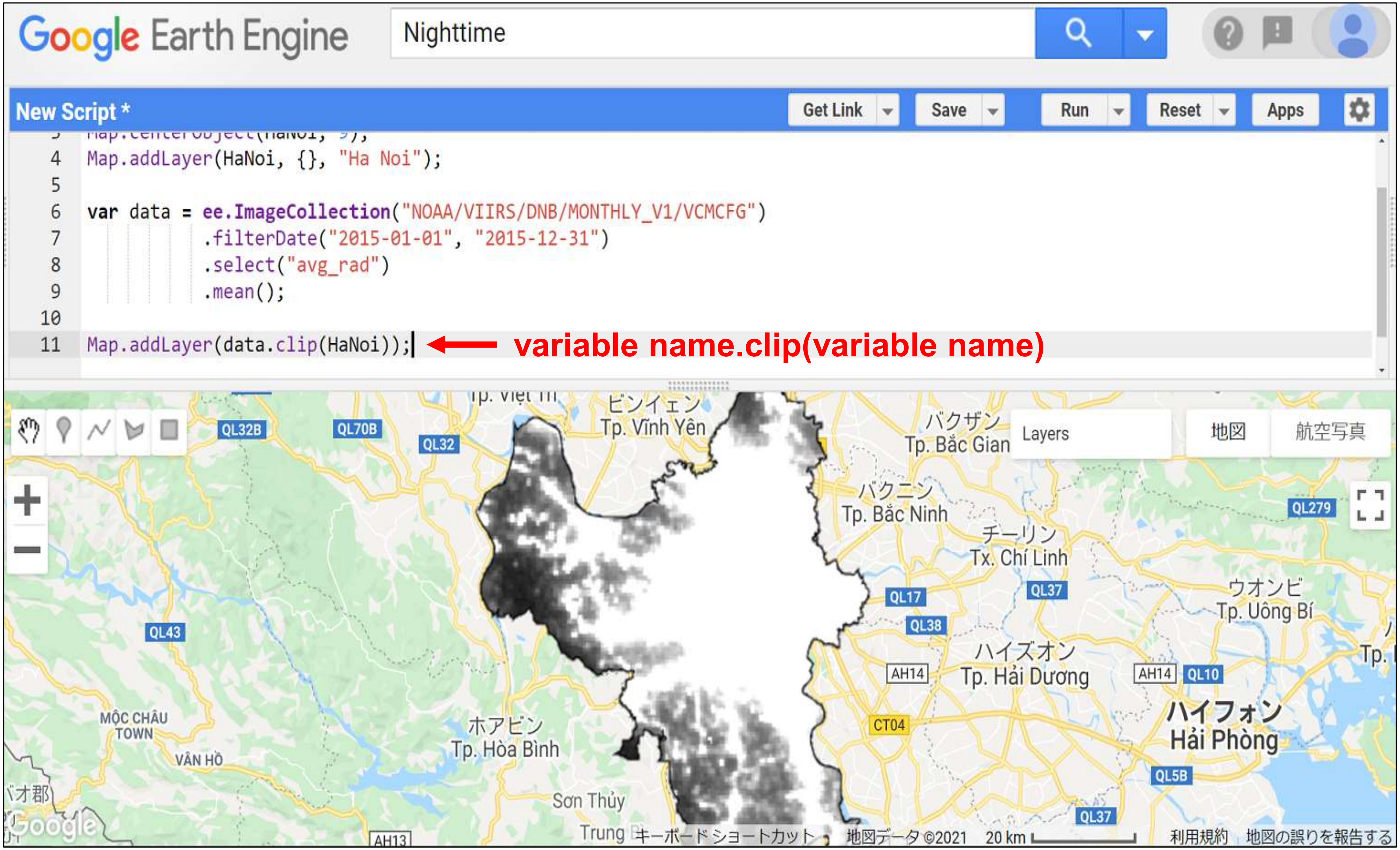
- You can use **Map.addLayer** to project nighttime light data onto the map. However, since the region to be projected is not specified, the nighttime light data of the whole world is projected.



```
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
           .filterDate("2015-01-01", "2015-12-31")
           .select("avg_rad")
           .mean();

Map.addLayer(data);
```

Specifying Projection Regions

- Use **.clip(variable name)** to specify the region to project.

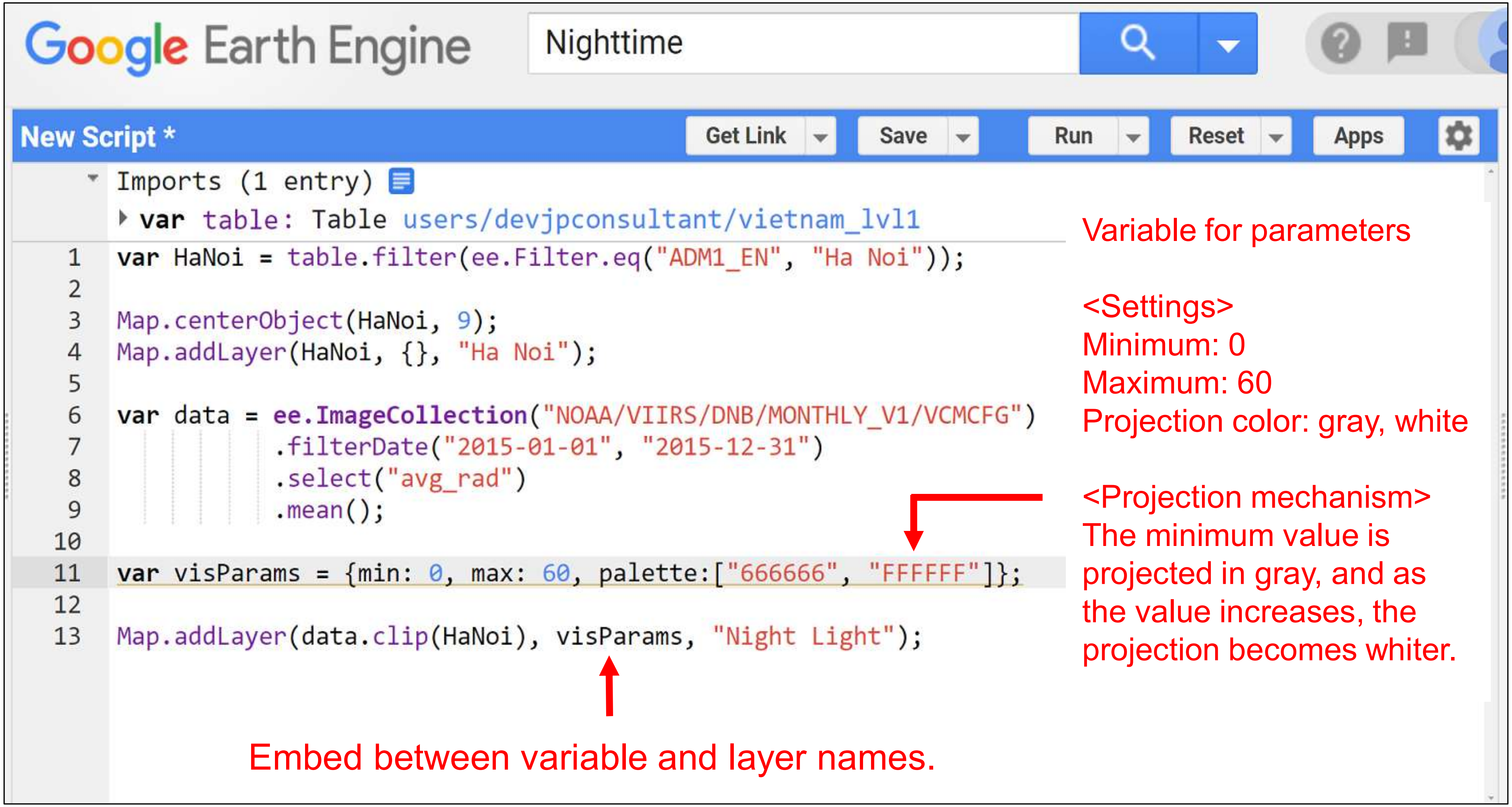


```
Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
             .filterDate("2015-01-01", "2015-12-31")
             .select("avg_rad")
             .mean();

Map.addLayer(data.clip(HaNoi));
```

variable name.clip(variable name)

Setting Projection Parameters

- The reason why the projection view is very bright is because the parameters for the projection are not set yet.
- You must create a variable for the parameters and embed it in **Map.addLayer**.



```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
           .filterDate("2015-01-01", "2015-12-31")
           .select("avg_rad")
           .mean();

var visParams = {min: 0, max: 60, palette:["666666", "FFFFFF"]};

Map.addLayer(data.clip(HaNoi), visParams, "Night Light");
```

Variable for parameters

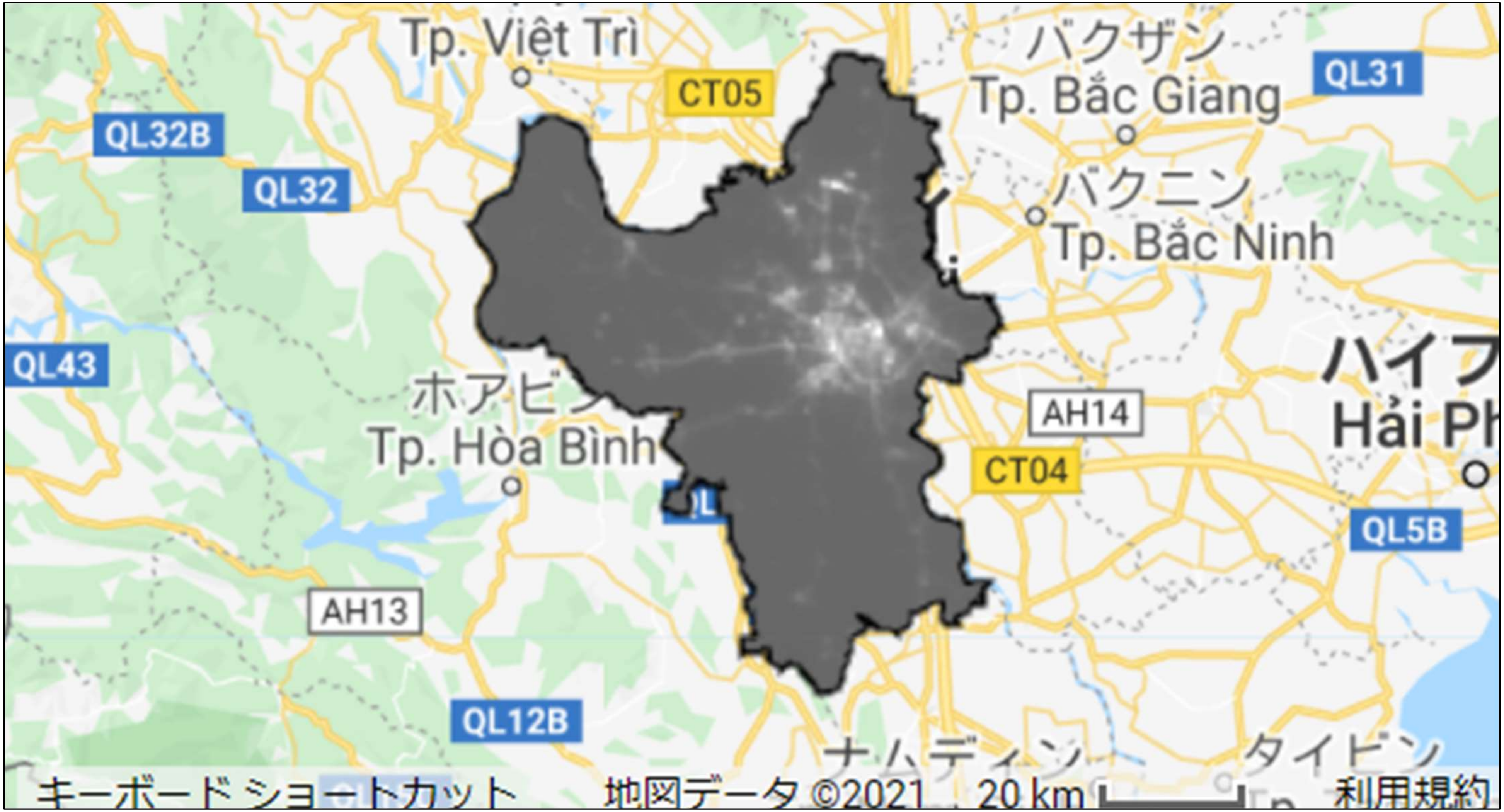
<Settings>
Minimum: 0
Maximum: 60
Projection color: gray, white

<Projection mechanism>
The minimum value is projected in gray, and as the value increases, the projection becomes whiter.

Embed between variable and layer names.

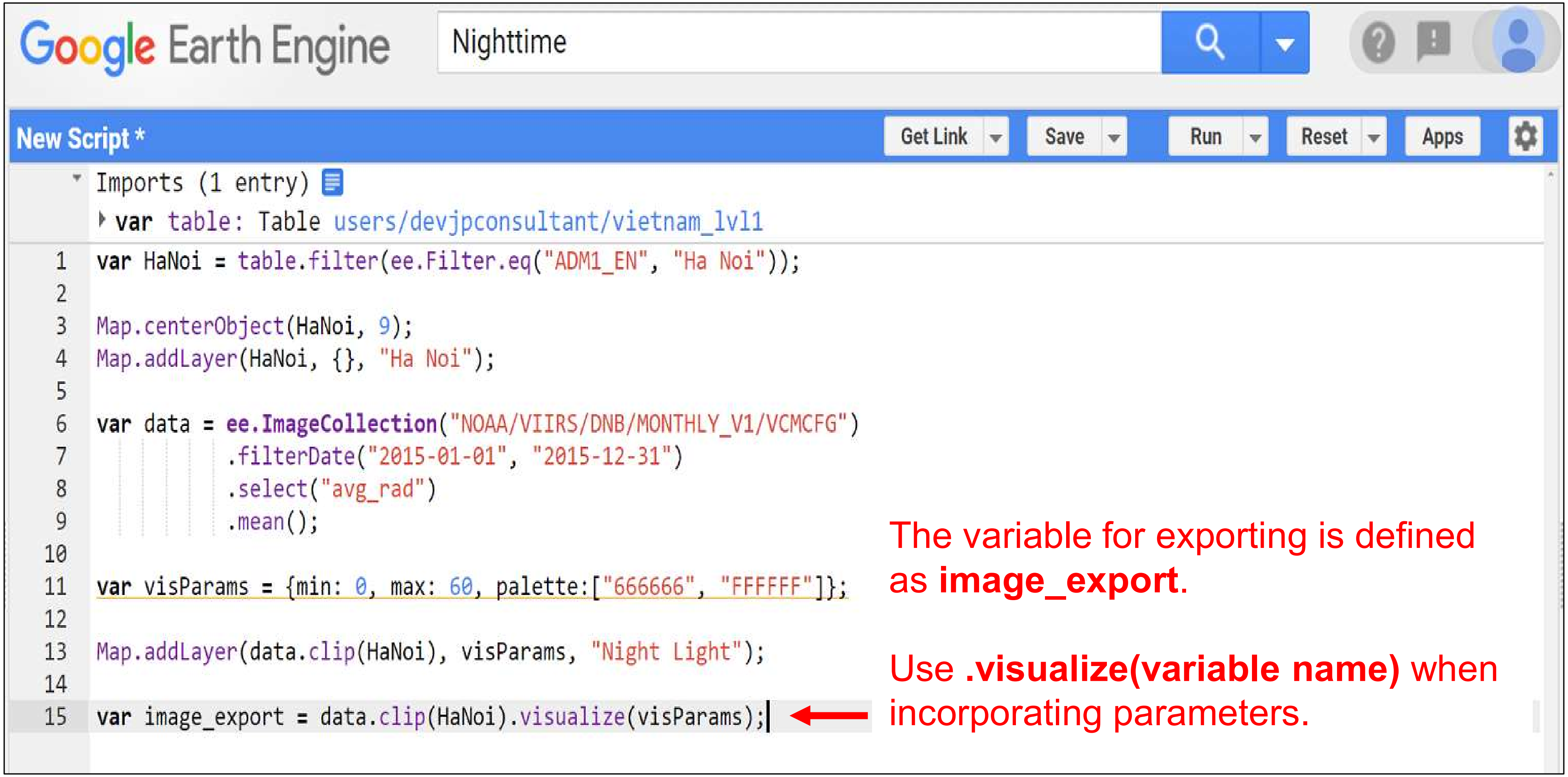
Projection of Nighttime Light Data for 2015 in Hanoi

- The appropriate nighttime light data was projected because the province and parameters were set.
- For the purpose of this document, the maximum value of the parameter is set to 60, but it should be changed accordingly.



Exporting Nighttime Light Data (Image) 1/4

- Export a projection to use for report.
- As a preliminary step, store satellite data incorporating the projection region and parameters in a new variable (for export).



```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1
```

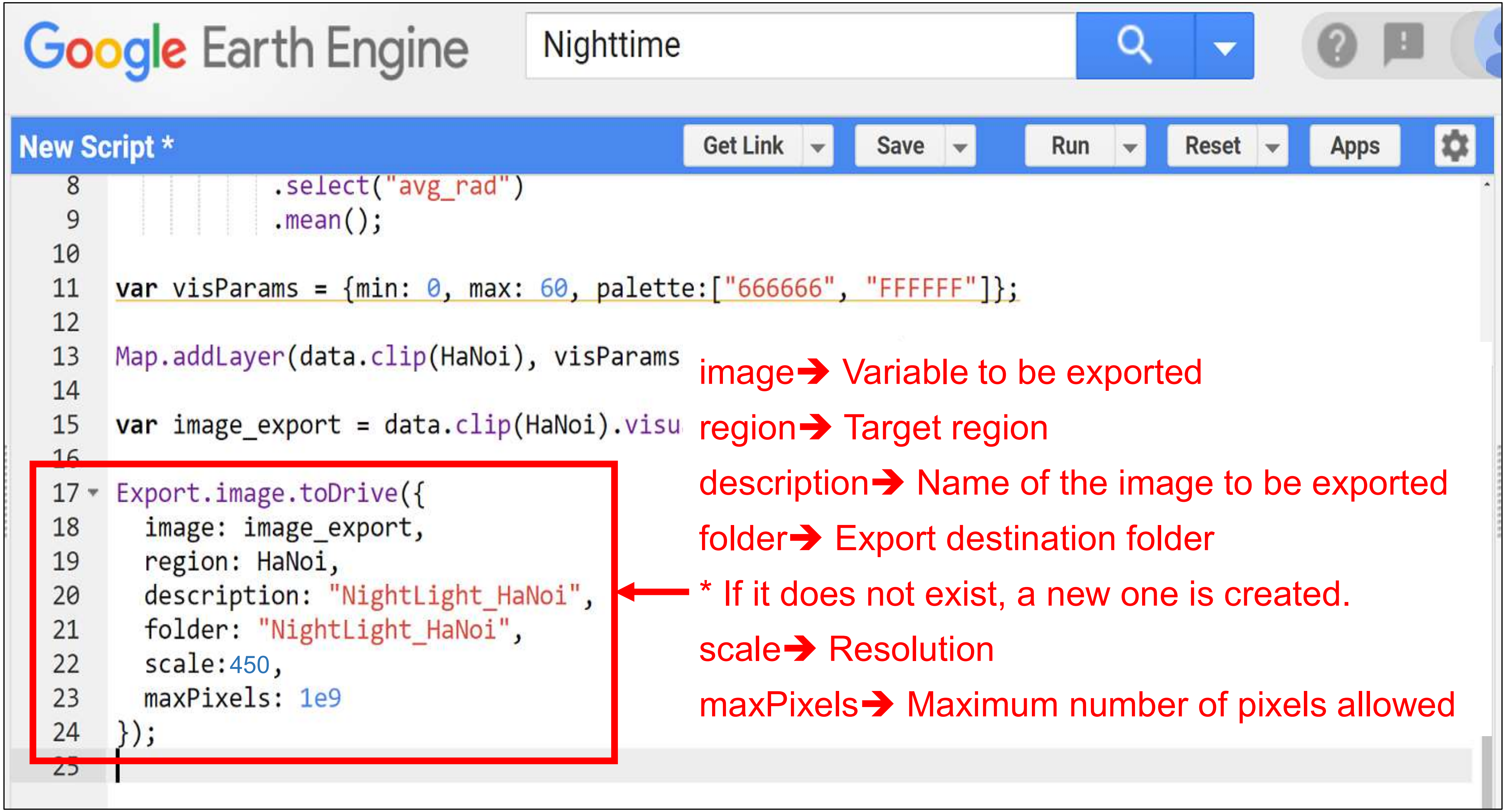
```
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
             .filterDate("2015-01-01", "2015-12-31")
             .select("avg_rad")
             .mean();

var visParams = {min: 0, max: 60, palette:["666666", "FFFFFF"]};

Map.addLayer(data.clip(HaNoi), visParams, "Night Light");

var image_export = data.clip(HaNoi).visualize(visParams);
```

The variable for exporting is defined as **image_export**.

Use **.visualize(variable name)** when incorporating parameters.

Exporting Nighttime Light Data (Image) 2/4

- The code for exporting is shown below.
- The data is exported to Google Drive.



```
            .select("avg_rad")
            .mean();

var visParams = {min: 0, max: 60, palette:["666666", "FFFFFF"]};

Map.addLayer(data.clip(HaNoi), visParams

var image_export = data.clip(HaNoi).visu

Export.image.toDrive({
  image: image_export,
  region: HaNoi,
  description: "NightLight_HaNoi",
  folder: "NightLight_HaNoi",
  scale:450,
  maxPixels: 1e9
});
```

image➔ Variable to be exported

region➔ Target region

description➔ Name of the image to be exported

folder➔ Export destination folder

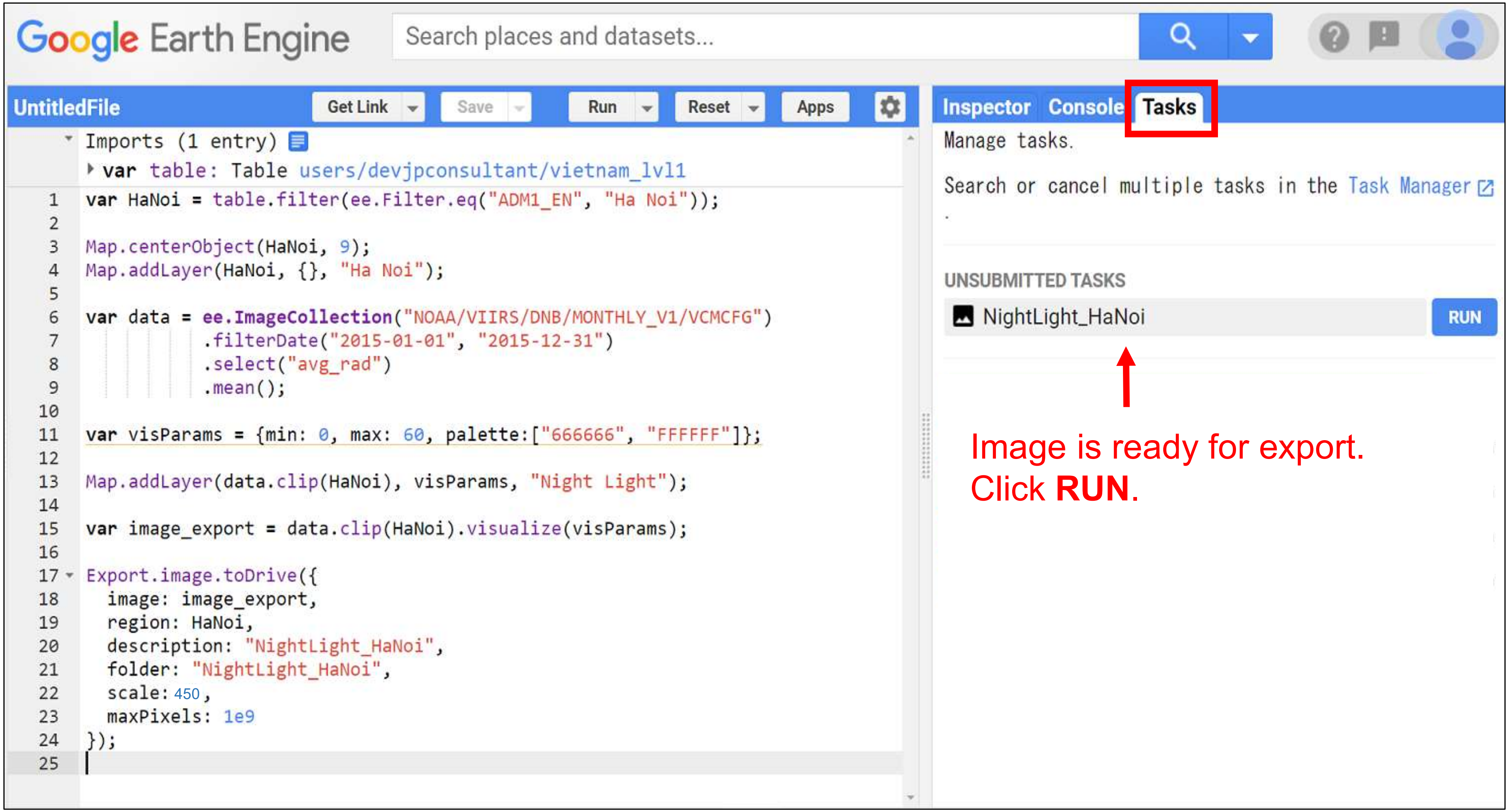
* If it does not exist, a new one is created.

scale➔ Resolution

maxPixels➔ Maximum number of pixels allowed

Exporting Nighttime Light Data (Image) 3/4

- When **Tasks** lights up, click it.
- Image is ready to be exported. Run the export.



```
Imports (1 entry)
 var table: Table users/devjpconsultant/vietnam_lvl1
var HaNoi = table.filter(ee.Filter.eq("ADM1_EN", "Ha Noi"));

Map.centerObject(HaNoi, 9);
Map.addLayer(HaNoi, {}, "Ha Noi");

var data = ee.ImageCollection("NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG")
                .filterDate("2015-01-01", "2015-12-31")
                .select("avg_rad")
                .mean();

var visParams = {min: 0, max: 60, palette:["666666", "FFFFFF"]};

Map.addLayer(data.clip(HaNoi), visParams, "Night Light");

var image_export = data.clip(HaNoi).visualize(visParams);

Export.image.toDrive({
  image: image_export,
  region: HaNoi,
  description: "NightLight_HaNoi",
  folder: "NightLight_HaNoi",
  scale: 450,
  maxPixels: 1e9
});
```

Manage tasks.

Search or cancel multiple tasks in the Task Manager.

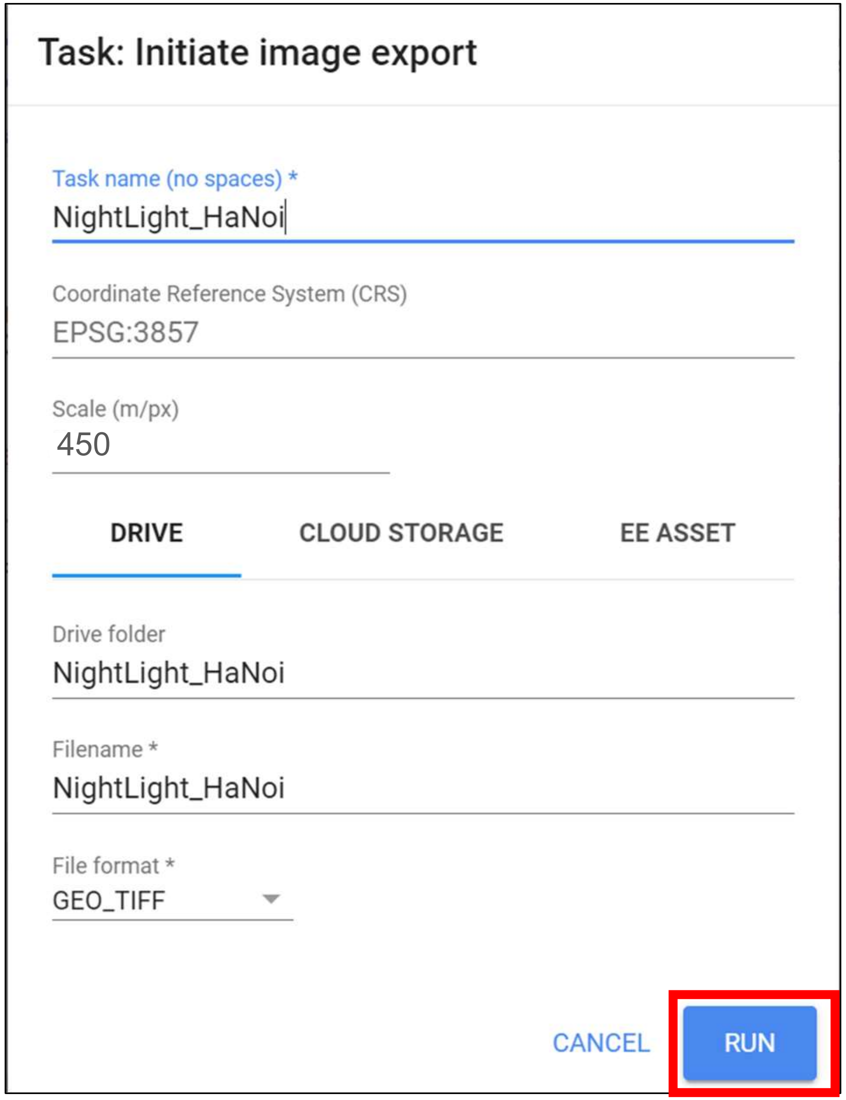
UNSUBMITTED TASKS

NightLight_HaNoi RUN

Image is ready for export.
Click **RUN**.

Exporting Nighttime Light Data (Image) 4/4

- Click **RUN** when the figure to the left appears. Then export starts (shown right) and the file is saved to Google Drive when export is complete.



Task: Initiate image export

Task name (no spaces) *
NightLight_HaNoi

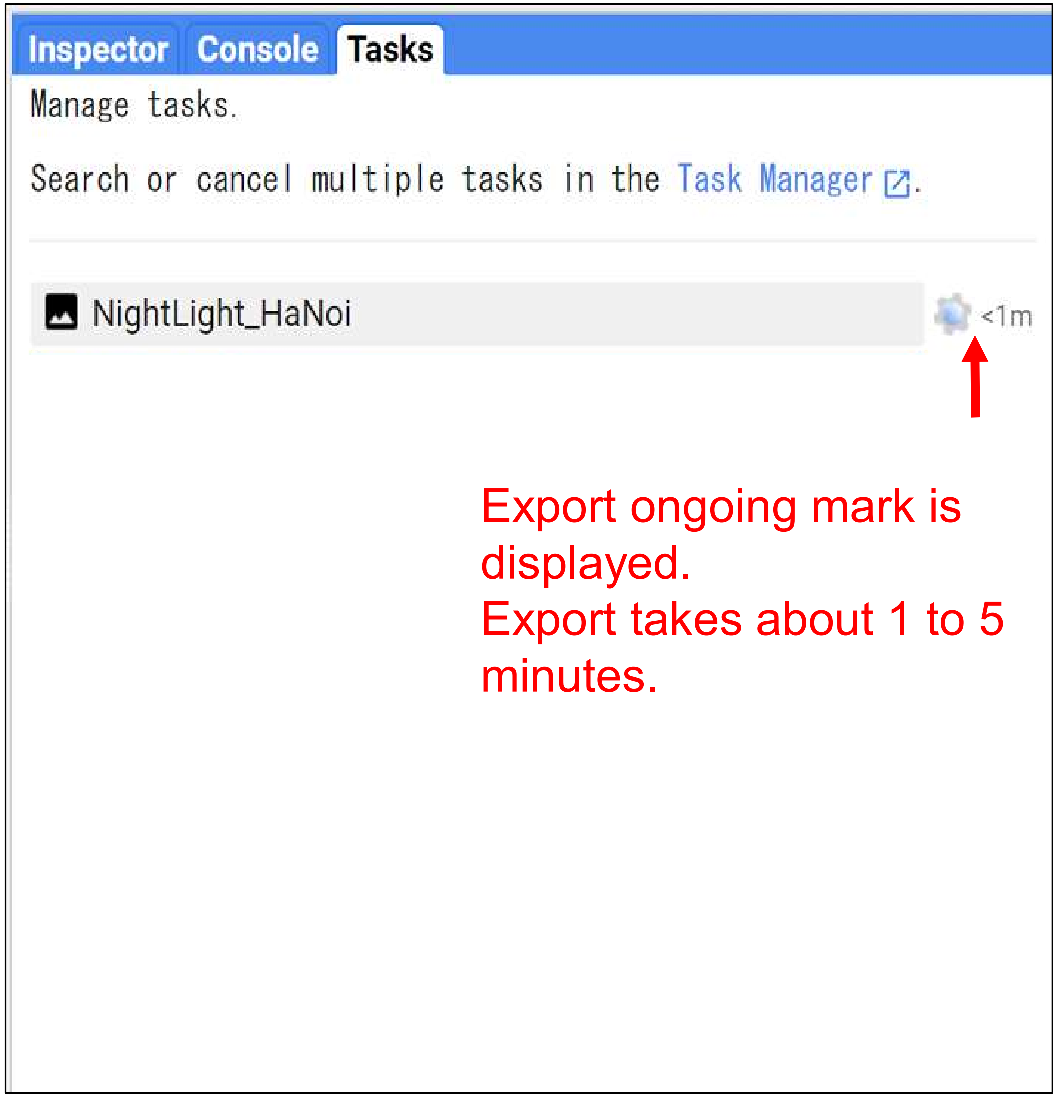
Coordinate Reference System (CRS)
EPSG:3857

Scale (m/px)
450

Drive folder
NightLight_HaNoi

Filename *
NightLight_HaNoi

File format *
GEO_TIFF



Manage tasks.

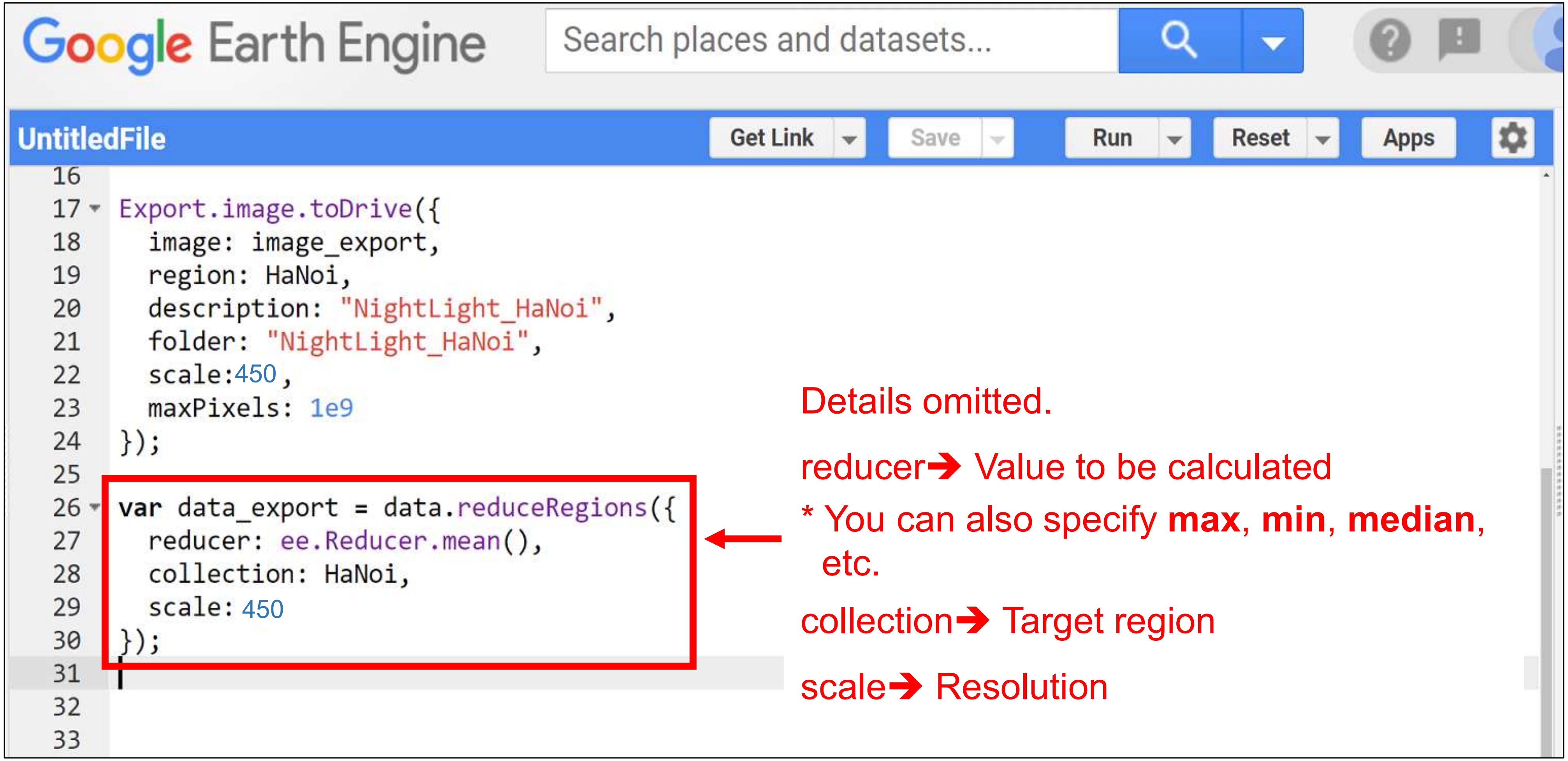
Search or cancel multiple tasks in the Task Manager.

NightLight_HaNoi <1m

Export ongoing mark is displayed.
Export takes about 1 to 5 minutes.

Exporting Nighttime Light Data (Values) 1/4

- Export the nighttime light intensity values for use in the report.
- As a preliminary step, store data obtained by averaging the nighttime light intensity values of entire the target region (Hanoi) in a new variable (for export).



```

Export.image.toDrive({
  image: image_export,
  region: HaNoi,
  description: "NightLight_HaNoi",
  folder: "NightLight_HaNoi",
  scale:450 ,
  maxPixels: 1e9
});

var data_export = data.reduceRegions({
  reducer: ee.Reducer.mean(),
  collection: HaNoi,
  scale: 450
});
```

Details omitted.

reducer→ Value to be calculated

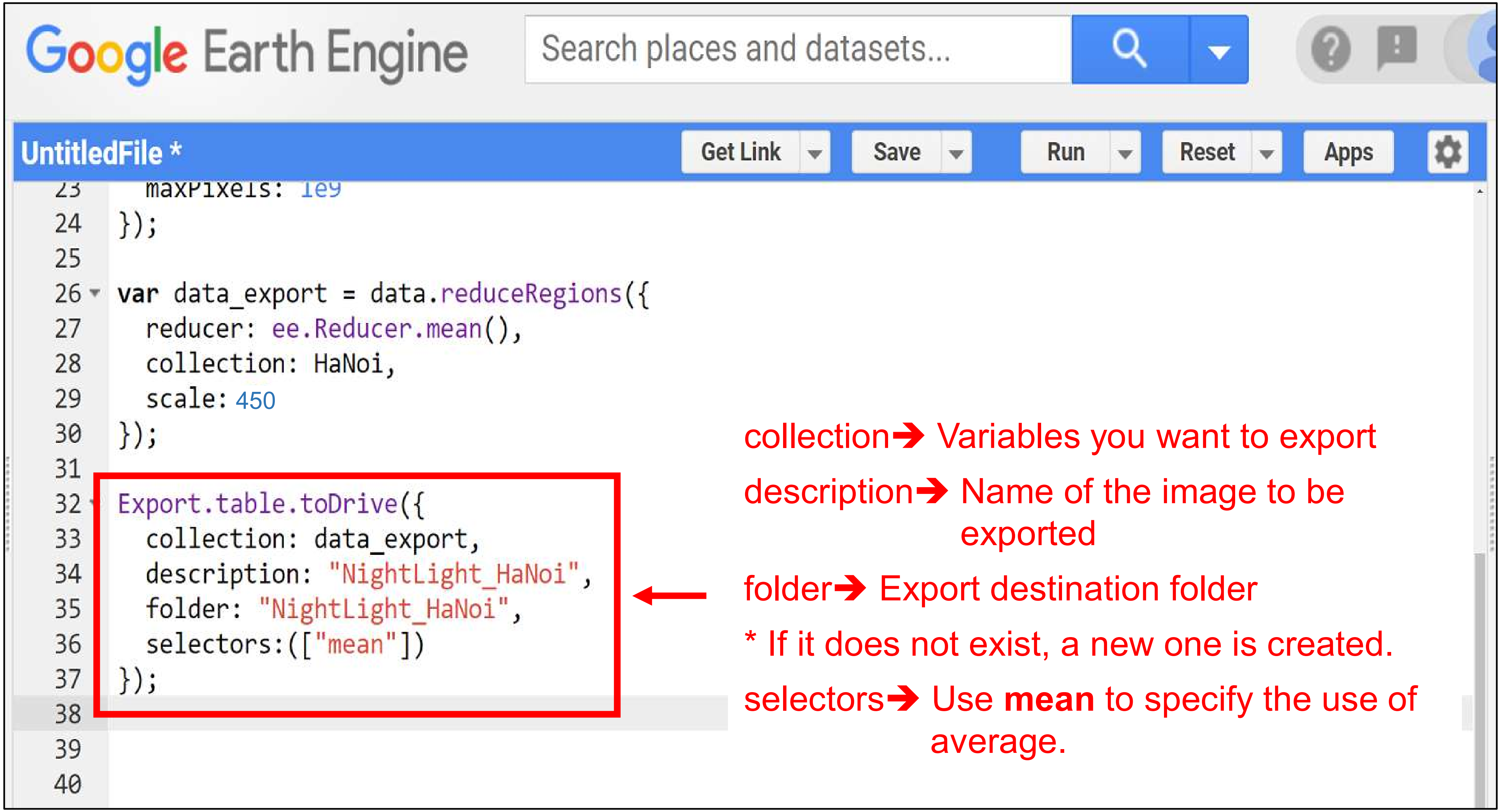
* You can also specify **max**, **min**, **median**, etc.

collection→ Target region

scale→ Resolution

Exporting Nighttime Light Data (Values) 2/4

- The code for exporting is shown below.
- The data is exported to Google Drive.



```
  maxPixels: 1e9
});

var data_export = data.reduceRegions({
  reducer: ee.Reducer.mean(),
  collection: HaNoi,
  scale: 450
});

Export.table.toDrive({
  collection: data_export,
  description: "NightLight_HaNoi",
  folder: "NightLight_HaNoi",
  selectors:(["mean"])
});
```

collection→ Variables you want to export

description→ Name of the image to be exported

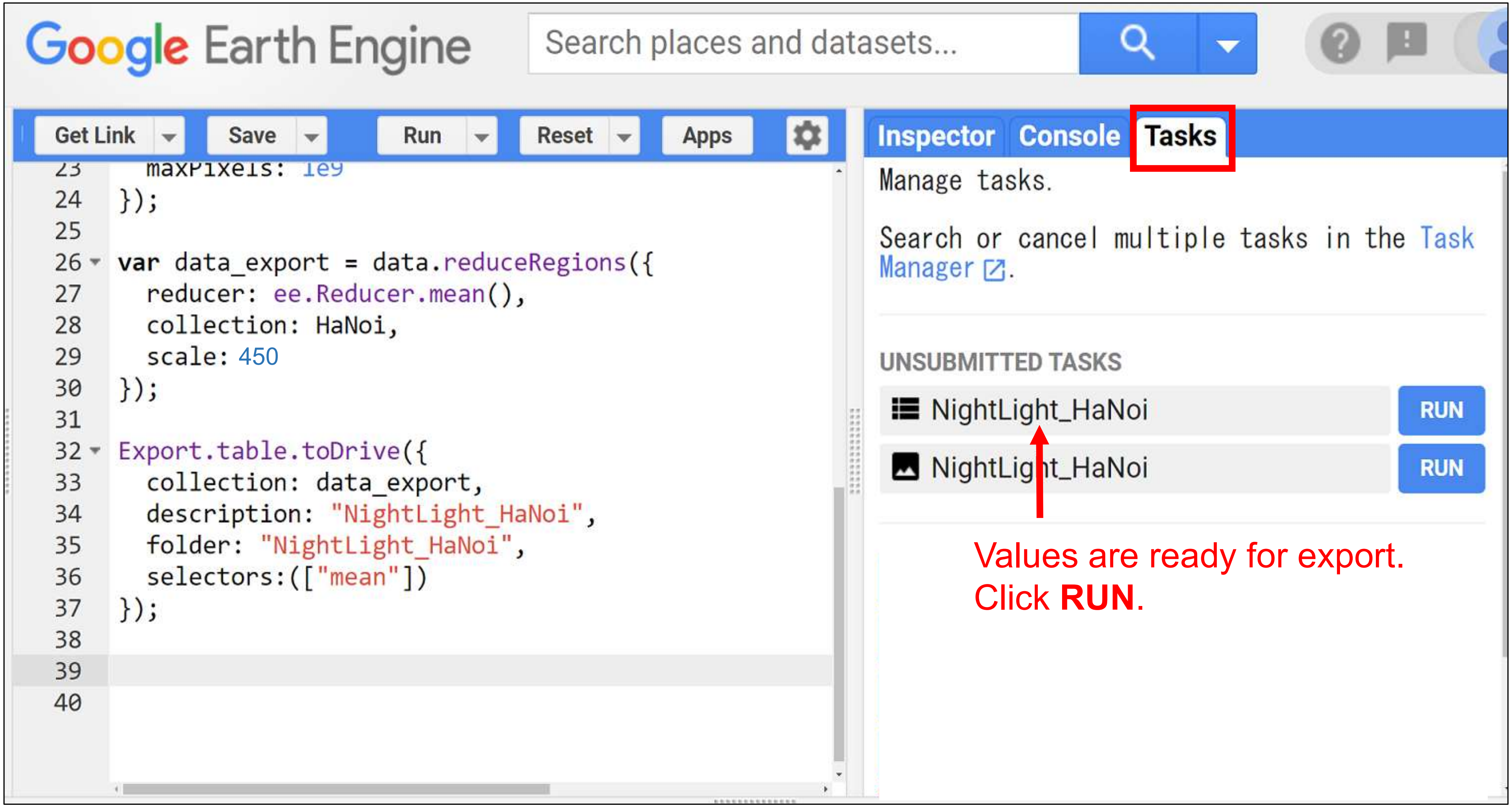
folder→ Export destination folder

* If it does not exist, a new one is created.

selectors→ Use **mean** to specify the use of average.

Exporting Nighttime Light Data (Values) 3/4

- When **Tasks** lights up, click it.
- Image is ready to be exported. Run the export.



```
  maxPixels: 1e9
});

var data_export = data.reduceRegions({
  reducer: ee.Reducer.mean(),
  collection: HaNoi,
  scale: 450
});

Export.table.toDrive({
  collection: data_export,
  description: "NightLight_HaNoi",
  folder: "NightLight_HaNoi",
  selectors:(["mean"])
});
```

Manage tasks.

Search or cancel multiple tasks in the Task Manager.

UNSUBMITTED TASKS

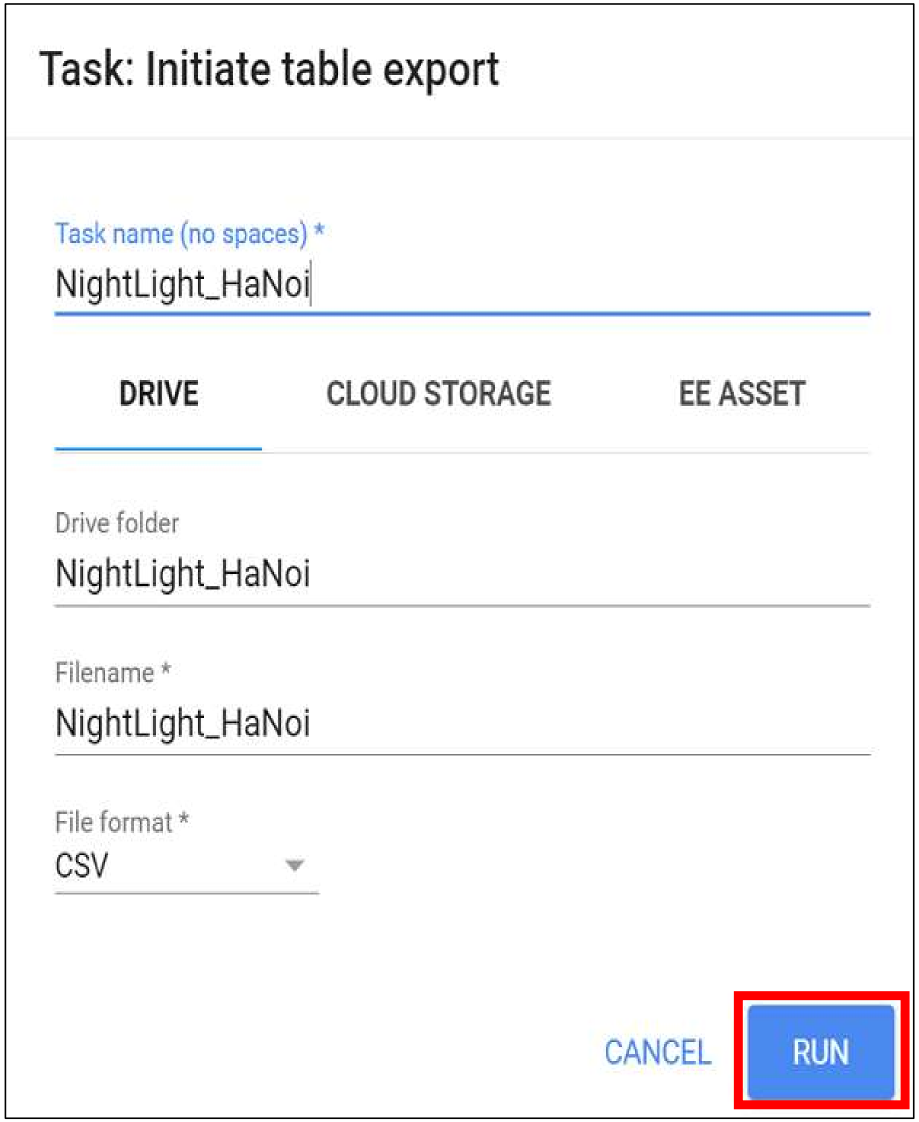
NightLight_HaNoi

NightLight_HaNoi

Values are ready for export.
Click **RUN**.

Exporting Nighttime Light Data (Values) 4/4

- Click **RUN** when the figure to the left appears. Then export starts (shown right) and the file is saved to Google Drive when export is complete.



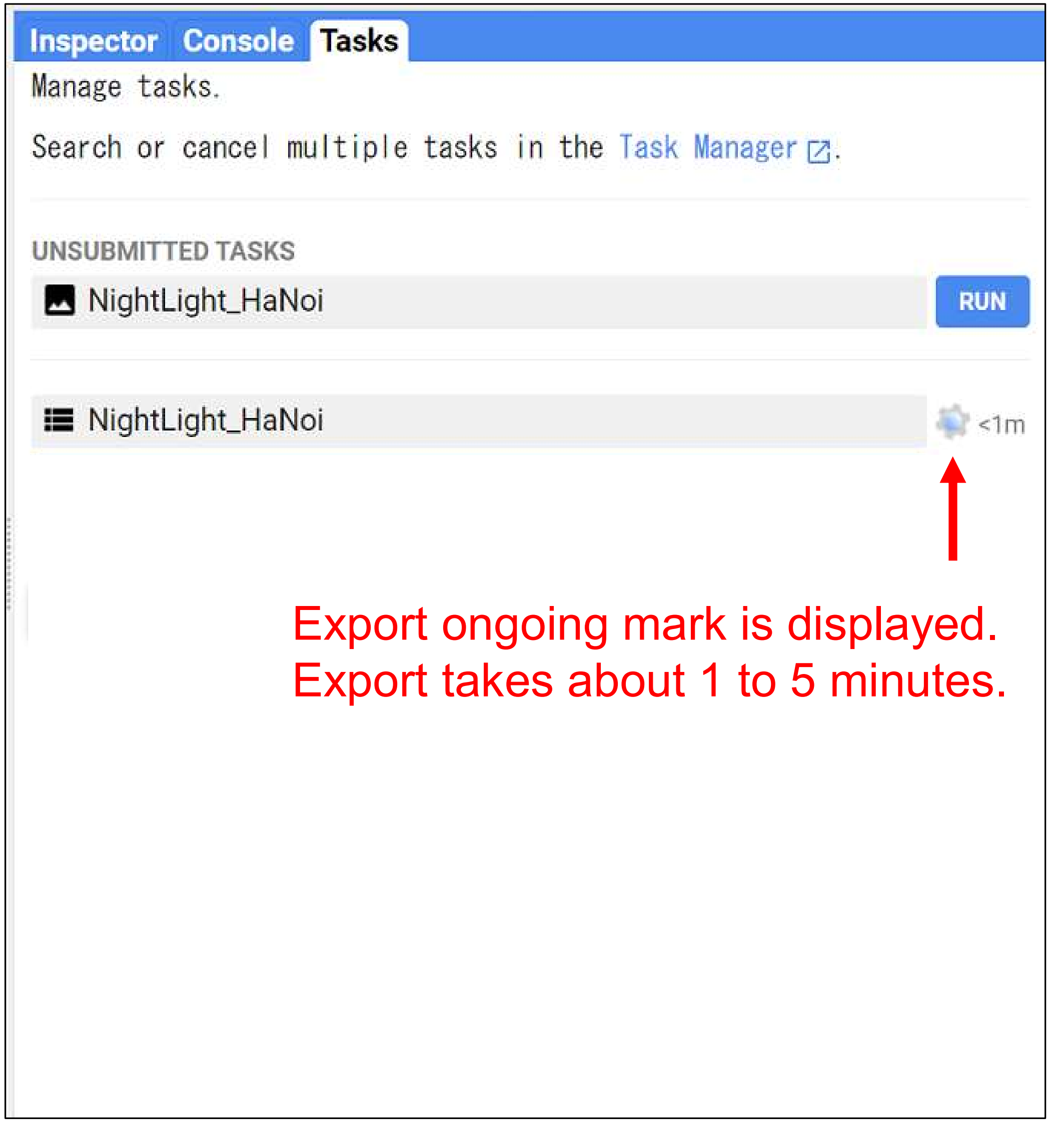
Task: Initiate table export

Task name (no spaces) *
NightLight_HaNoi

Drive folder
NightLight_HaNoi

Filename *
NightLight_HaNoi

File format *
CSV



Manage tasks.

Search or cancel multiple tasks in the Task Manager.

UNSUBMITTED TASKS

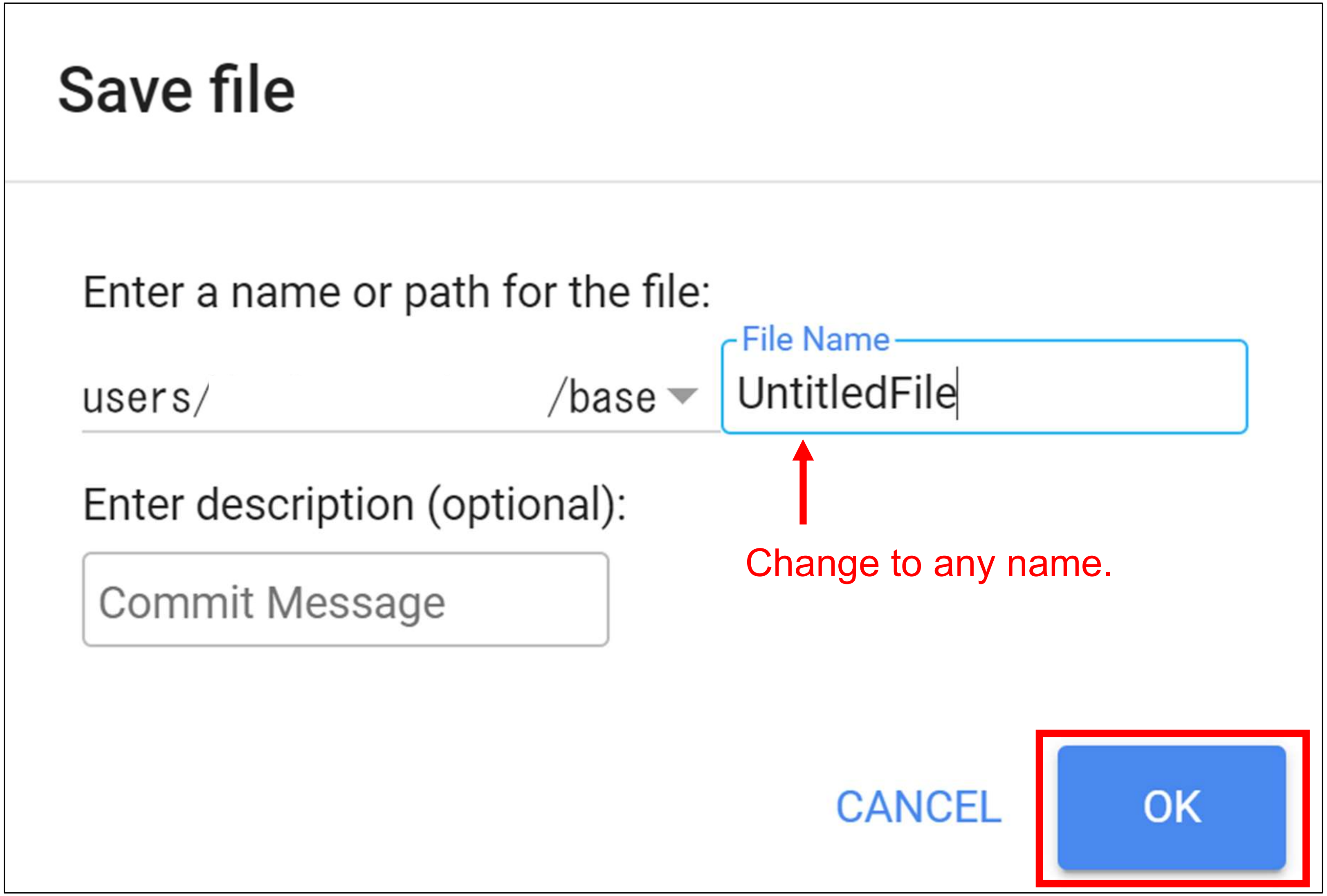
NightLight_HaNoi RUN

NightLight_HaNoi <1m

Export ongoing mark is displayed.
Export takes about 1 to 5 minutes.

Last Step (Saving the Code)

- When you click **Save**, you are prompted to enter a file name.
- Enter a name of your choice and click **OK**.



Save file

Enter a name or path for the file:

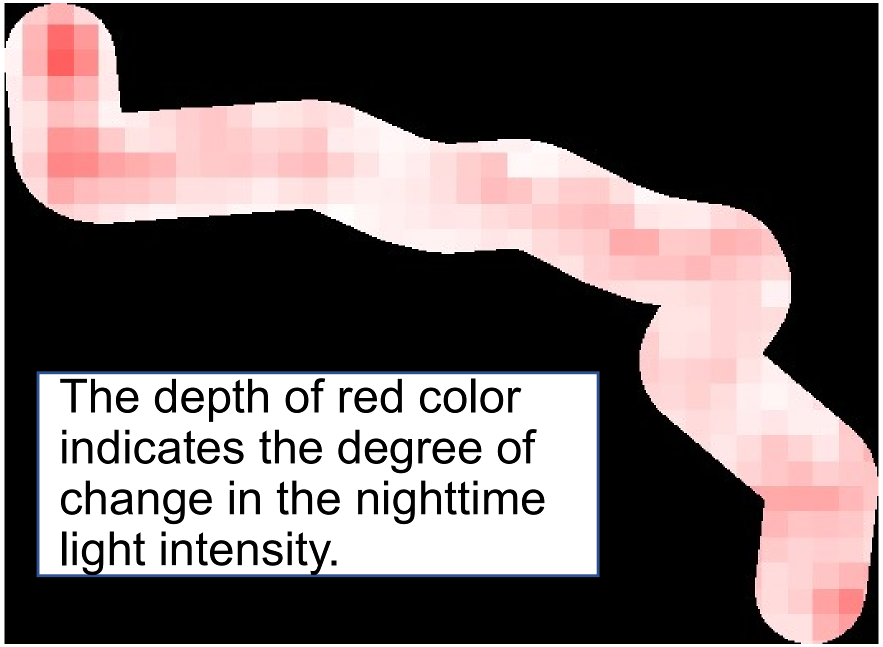
users/ /base ▾ File Name: UntitledFile

Enter description (optional): Commit Message

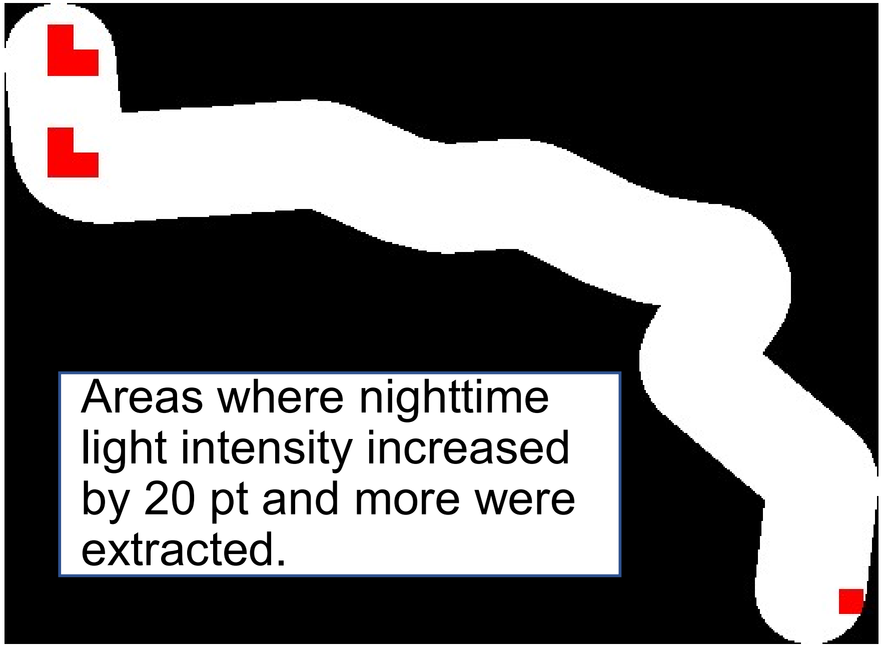
Change to any name.

Tracking the Change between Two Points in Time

- This document deals only with data at one point in time. By handling data at two points in time, you can see the change in the target region.
- This will enable the formulation of (1) detailed evaluation framework and (2) efficient on-site survey plans in the planning stage.
- The figures below show the change in nighttime light intensity along the Purple Line route constructed with JICA Japanese ODA loans between 2013 and 2018.



The depth of red color indicates the degree of change in the nighttime light intensity.



Areas where nighttime light intensity increased by 20 pt and more were extracted.

Reference Materials for Studying Nighttime Light Data

- The World Bank's Open Nighttime Lights covers a comprehensive overview, history, advantages, challenges, and use of nighttime light data.
  - ➢ Welcome — Open Nighttime Lights (worldbank.github.io)
- Cardille et al. (2022) "Cloud-Based Remote Sensing with Google Earth Engine: Fundamentals and Applications"
  - ➢ eefabook.org
- Donaldson etc. (2016) "The View from Above: Applications of Satellite Data in Economics": This well-known paper introduces the history, use cases, and issues of satellite data in general.

・・・etc.