Disaster Damage Assessment and Recovery Monitoring using Night-time Light on GEE

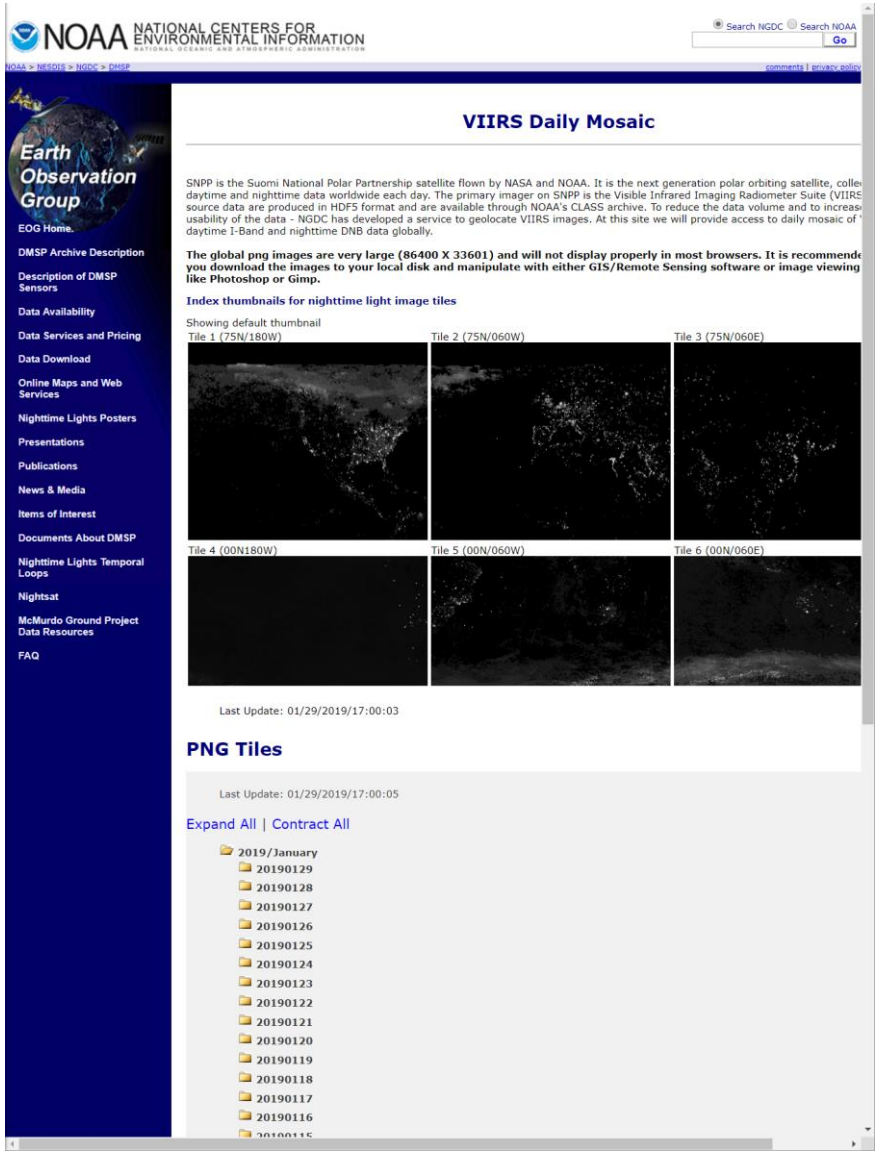
Hiroyuki Miyazaki, Ph.D.

Center for Spatial Information Science, University of Tokyo

heromiya@csis.u-tokyo.ac.jp

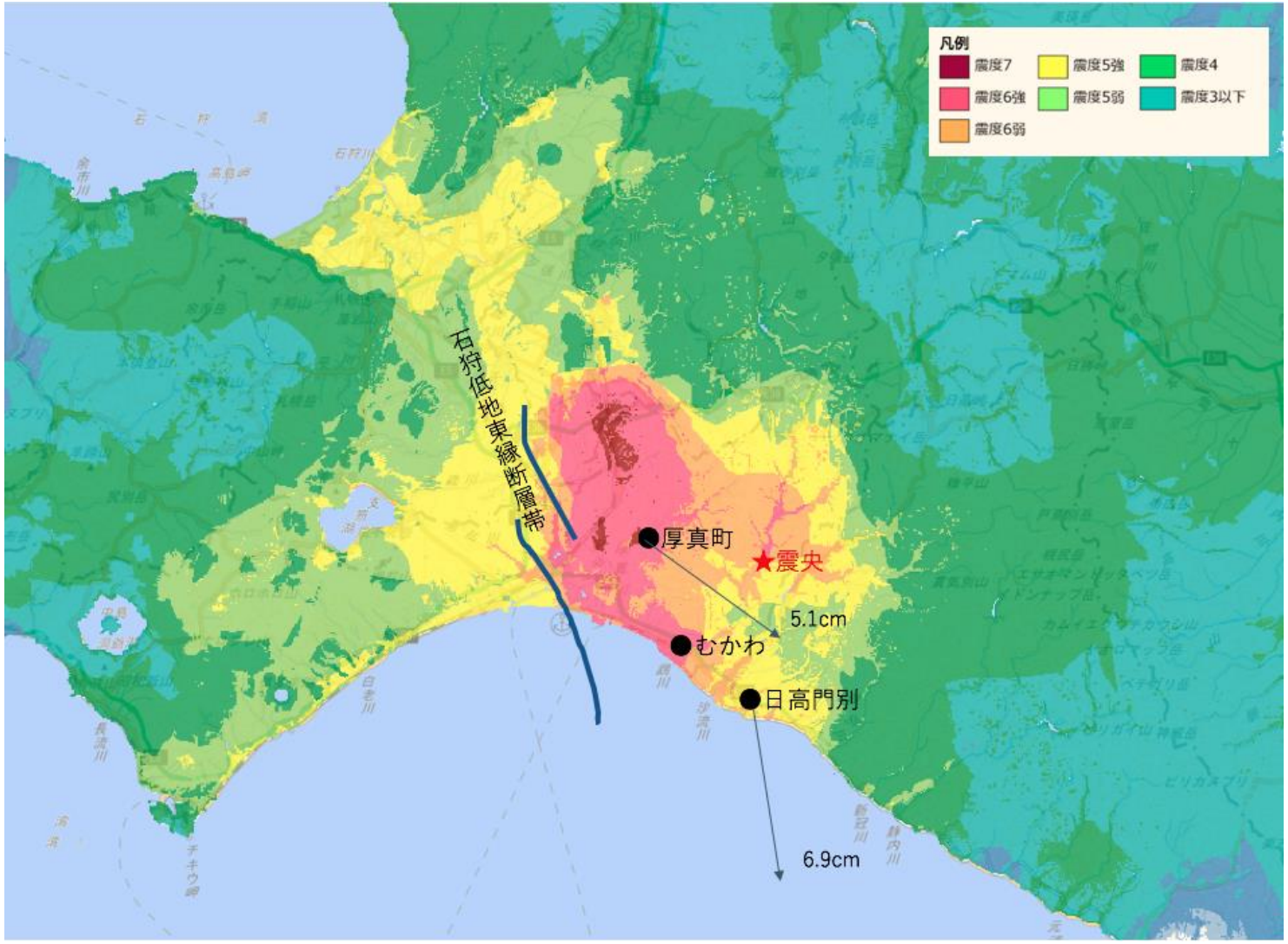
Monthly composite of night-time light data (1-2 month-delay from real-time)

Daily mosaic of night-time light data (real-time)

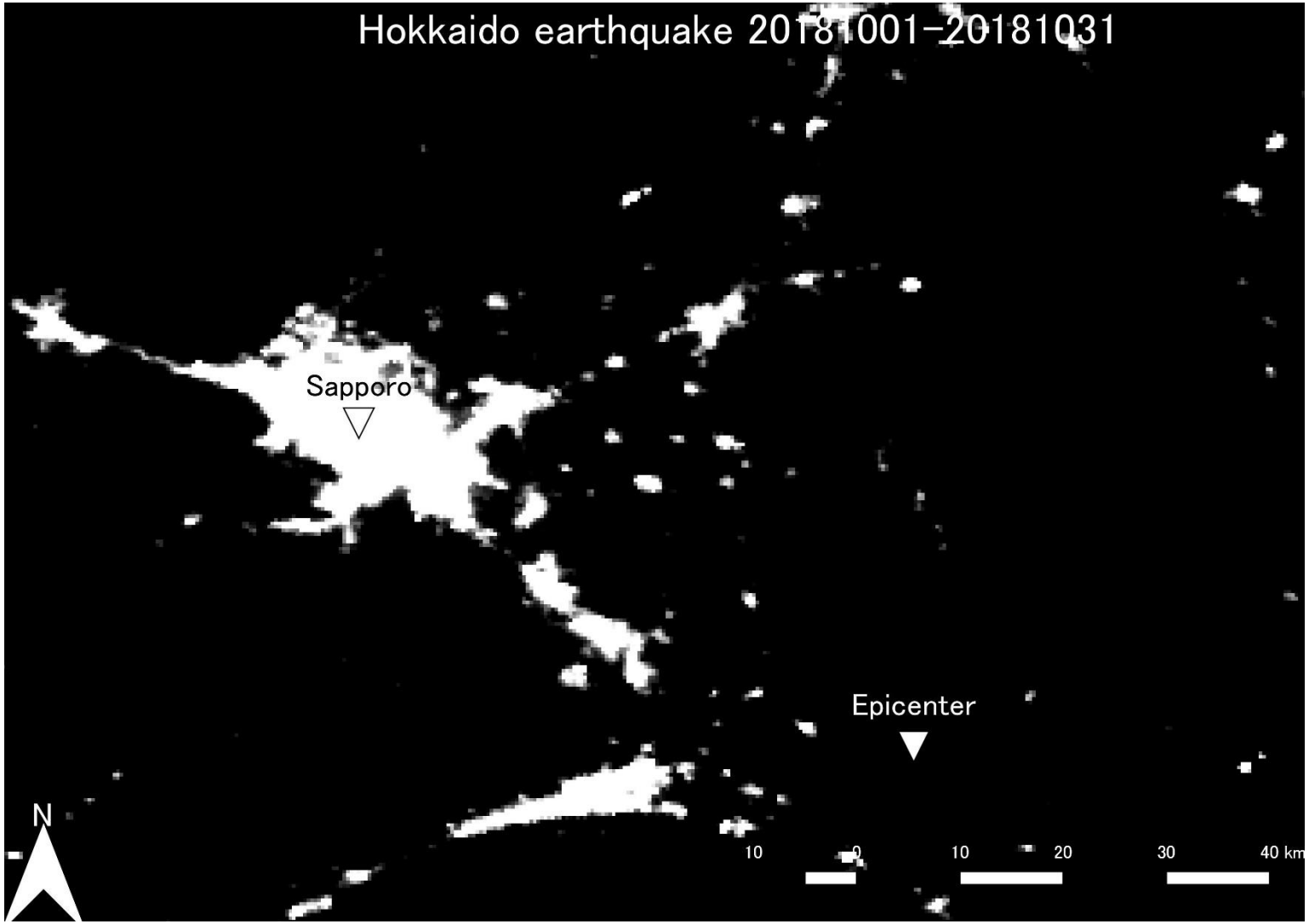


https://www.ngdc.noaa.gov/eog/viirs/download_dnb_composites.html

Earthquake in Hokkaido, Japan, Sept 2018

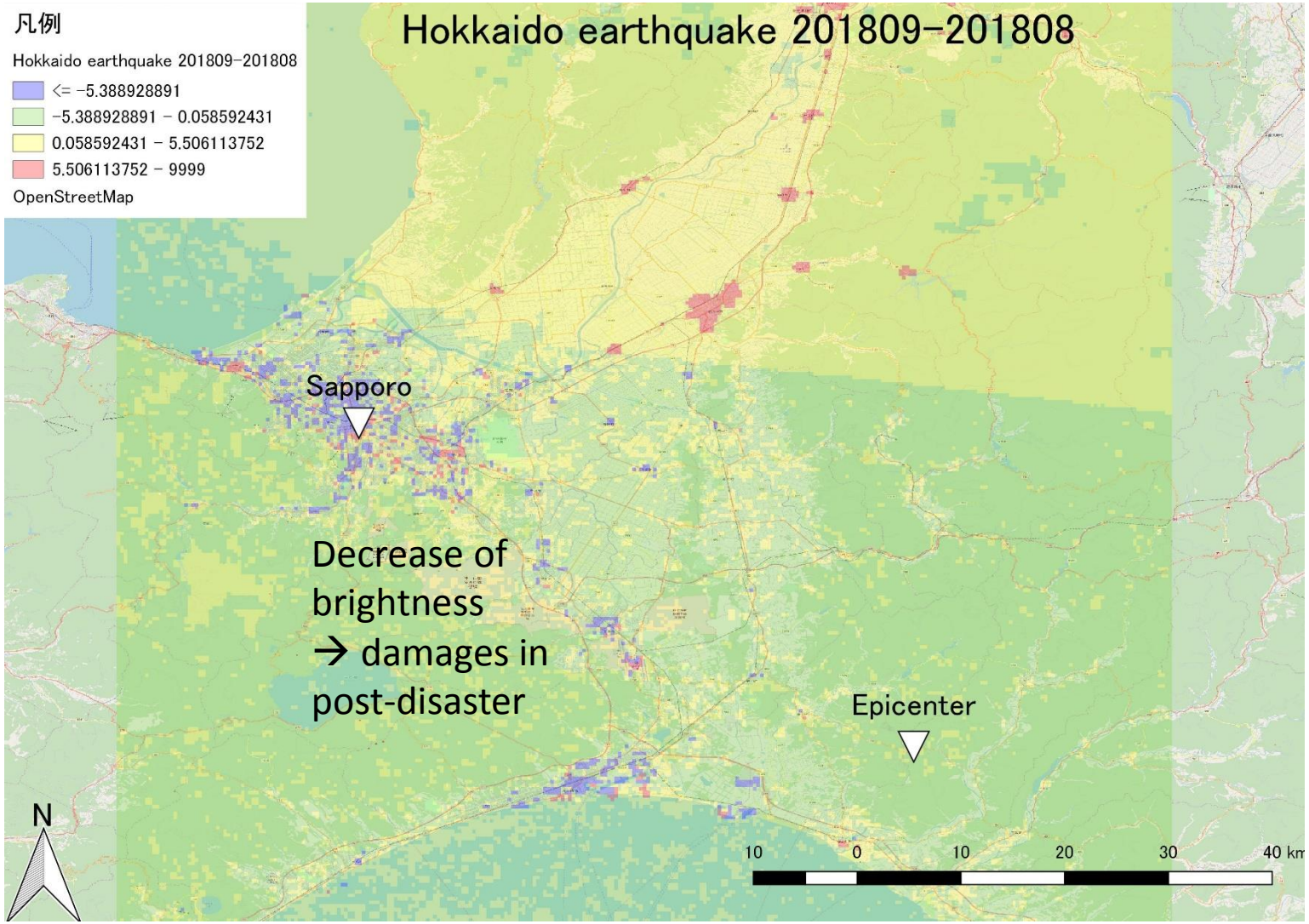


Post-disaster night-time light, Oct 2018



Change detection from monthly composite

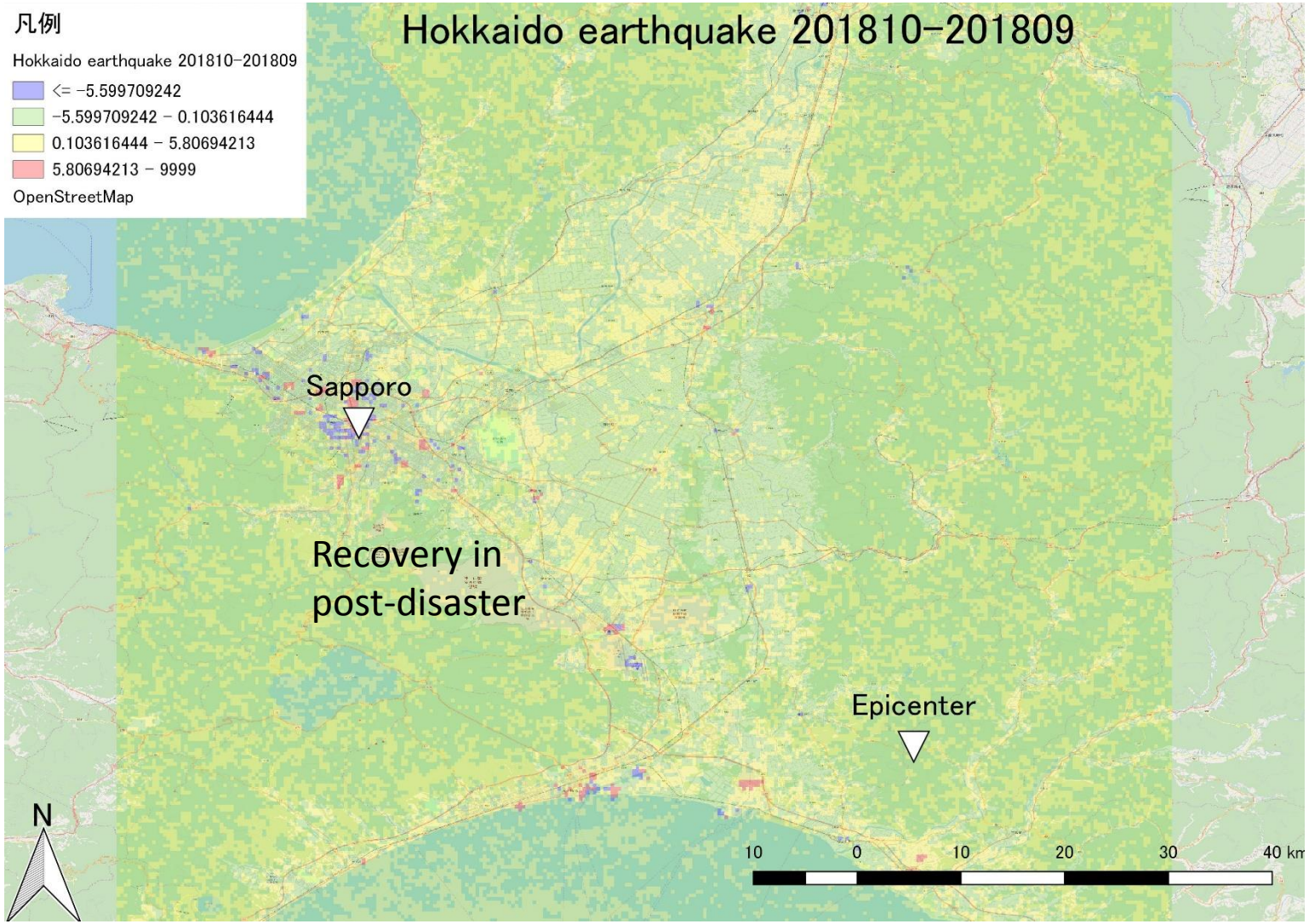
Changes between September – August, 2018



Changes were identified by $\mu \pm 2\sigma$ in the differences.

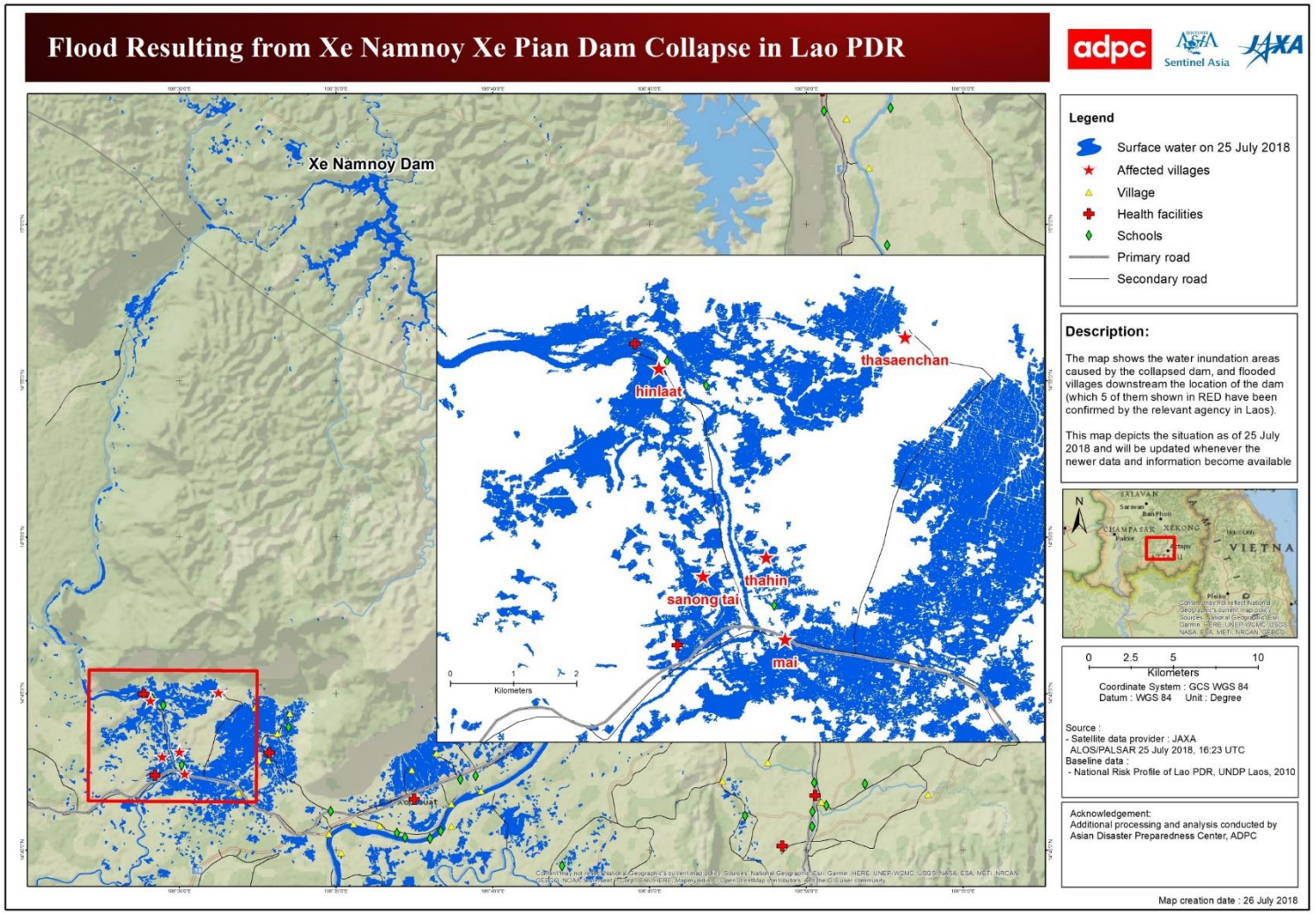
Change detection from monthly composite

Changes between October – September, 2018

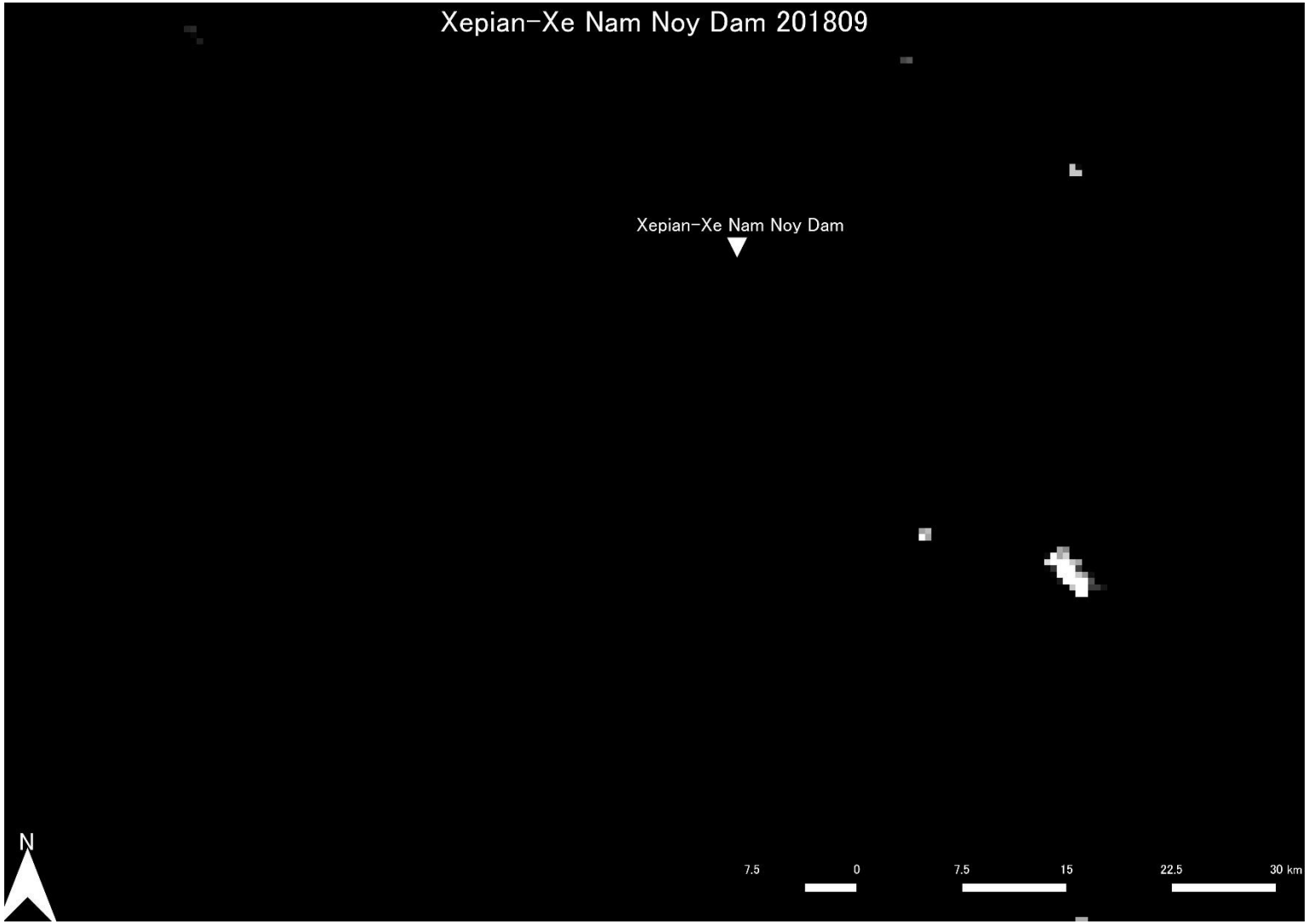


Changes were identified by $\mu \pm 2\sigma$ in the differences.

Impact of dam eruption in Laos, July 2018

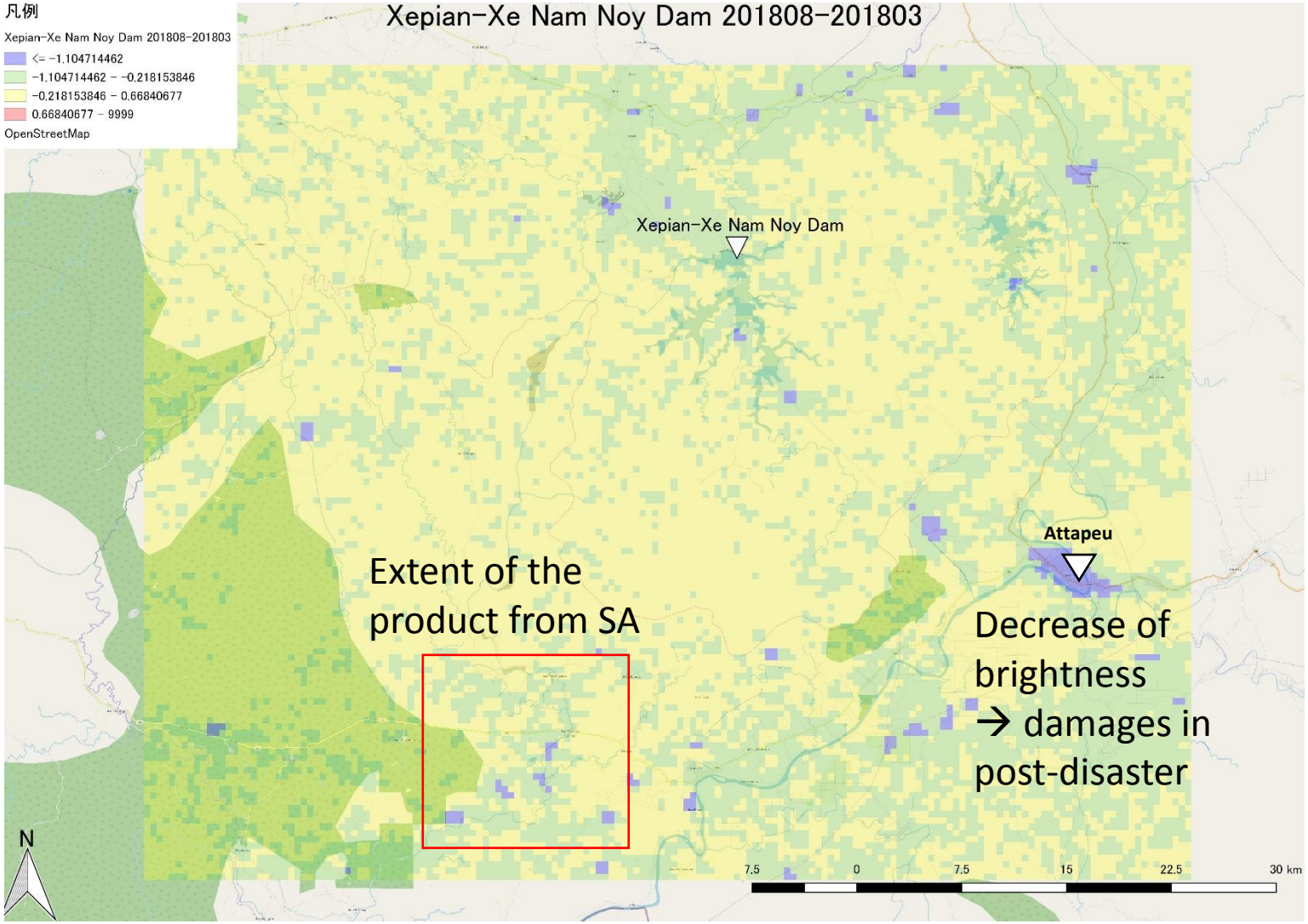


Night-time light in post-disaster, September, 2018



Change detection from monthly composite

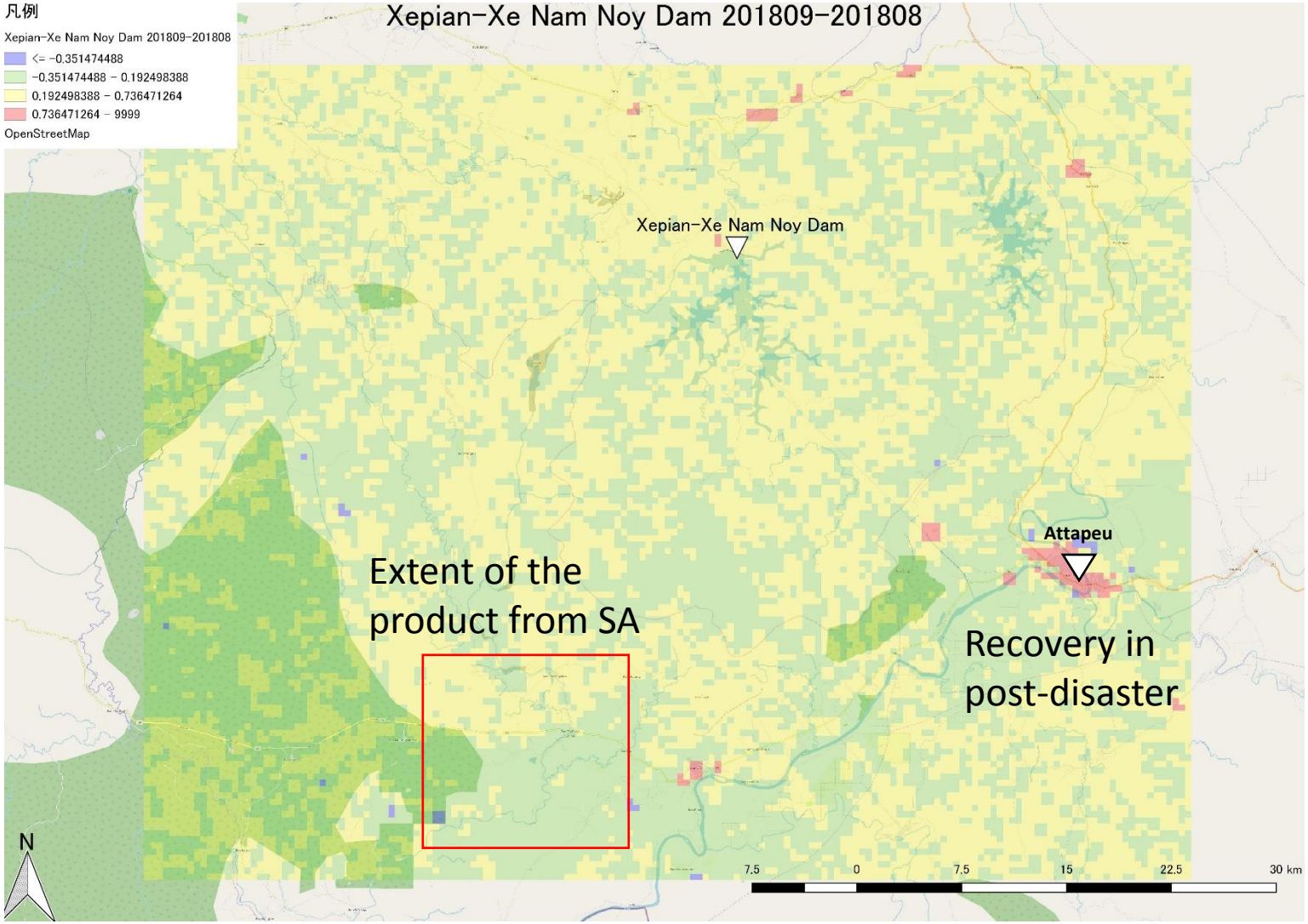
Changes between August – March, 2018



Changes were identified by $\mu \pm 2\sigma$ in the differences.

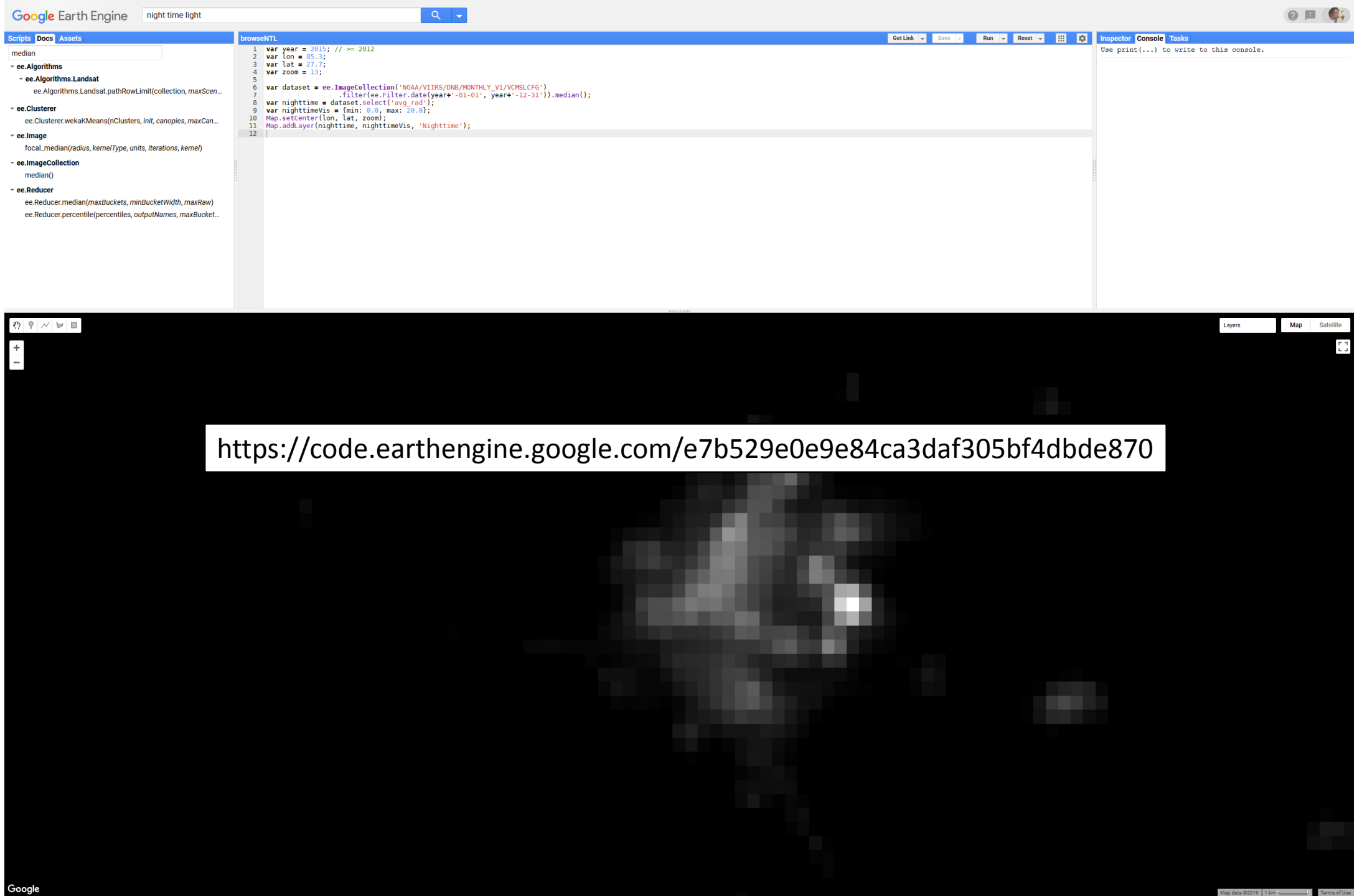
Change detection from monthly composite

Changes between September – August, 2018



Changes were identified by $\mu \pm 2\sigma$ in the differences.

Browse NTL on GEE


Google Earth Engine
night time light
Scripts Docs Assets
median
ee.Algorithms
ee.Algorithms.Landsat
ee.Algorithms.Landsat.pathRowLimit(collection, maxScen...
ee.Clusterer
ee.Clusterer.wekaKMeans(nClusters, init, canopies, maxCan...
ee.Image
focal_median(radius, kernelType, units, iterations, kernel)
ee.ImageCollection
median()
ee.Reducer
ee.Reducer.median(maxBuckets, minBucketWidth, maxRaw)
ee.Reducer.percentile(percentiles, outputNames, maxBucket...
browseNTL
Get Link
Save
Run
Reset
1 var year = 2015; // >= 2012
2 var lon = 85.3;
3 var lat = 27.7;
4 var zoom = 13;
5
6 var dataset = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMSLCFG')
7 .filter(ee.Filter.date(year+'-01-01', year+'-12-31')).median();
8 var nighttime = dataset.select('avg_rad');
9 var nighttimeVis = {min: 0.0, max: 20.0};
10 Map.setCenter(lon, lat, zoom);
11 Map.addLayer(nighttime, nighttimeVis, 'Nighttime');
12
Inspector Console Tasks
Use print(...) to write to this console.
Layers
Map
Satellite
https://code.earthengine.google.com/e7b529e0e9e84ca3daf305bf4dbde870
Google

Google Earth Engine

night time light

Scripts | Docs | Assets

median

- ee.Algorithms
  - ee.Algorithms.Landsat
    - ee.Algorithms.Landsat.pathRowLimit(collection, *maxScen…*
- ee.Clusterer
  - ee.Clusterer.wekaKMeans(nClusters, *init*, *canopies*, *maxCan…*
- ee.Image
  - focal_median(*radius*, *kernelType*, *units*, *iterations*, *kernel*)
- ee.ImageCollection
  - median()
- ee.Reducer
  - ee.Reducer.median(*maxBuckets*, *minBucketWidth*, *maxRaw*)
  - ee.Reducer.percentile(percentiles, *outputNames*, *maxBucket…*

browseNTL

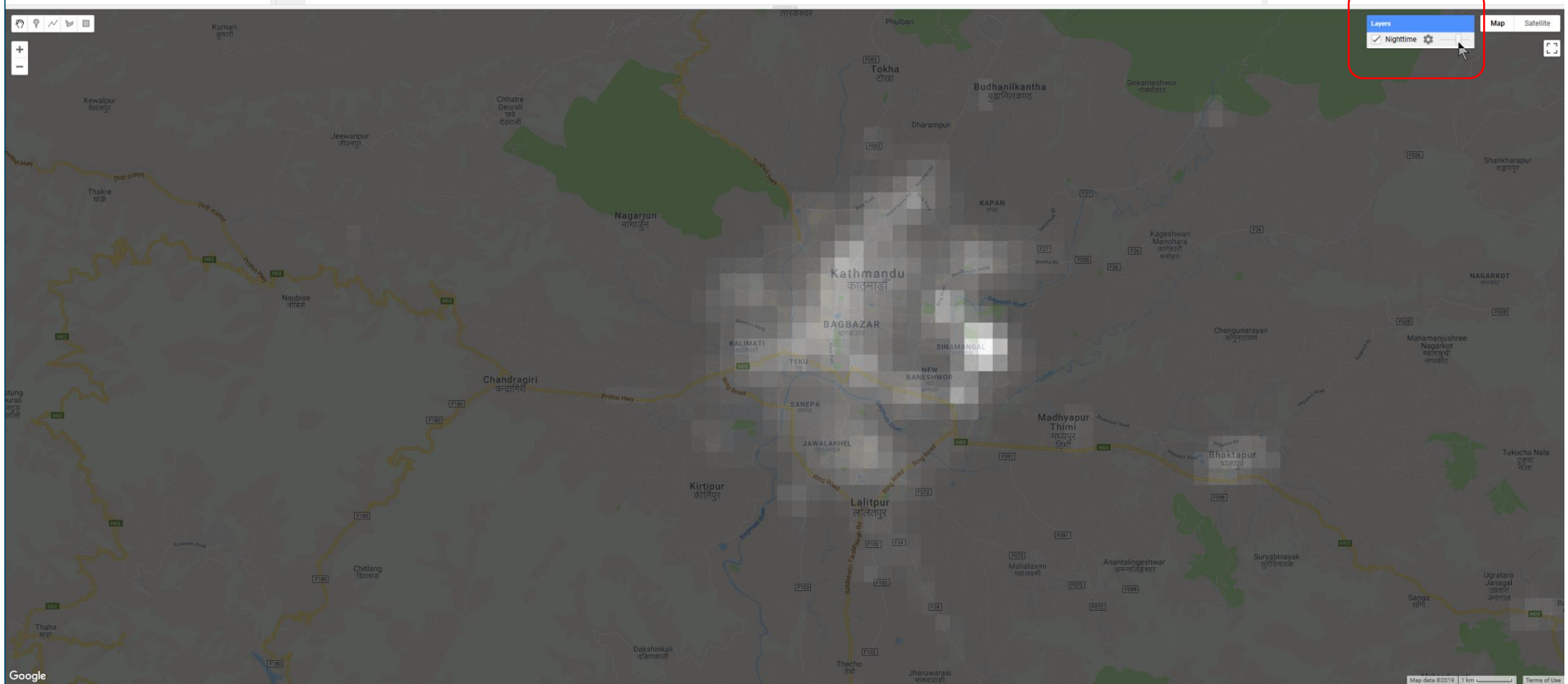
Get Link | Save | Run | Reset

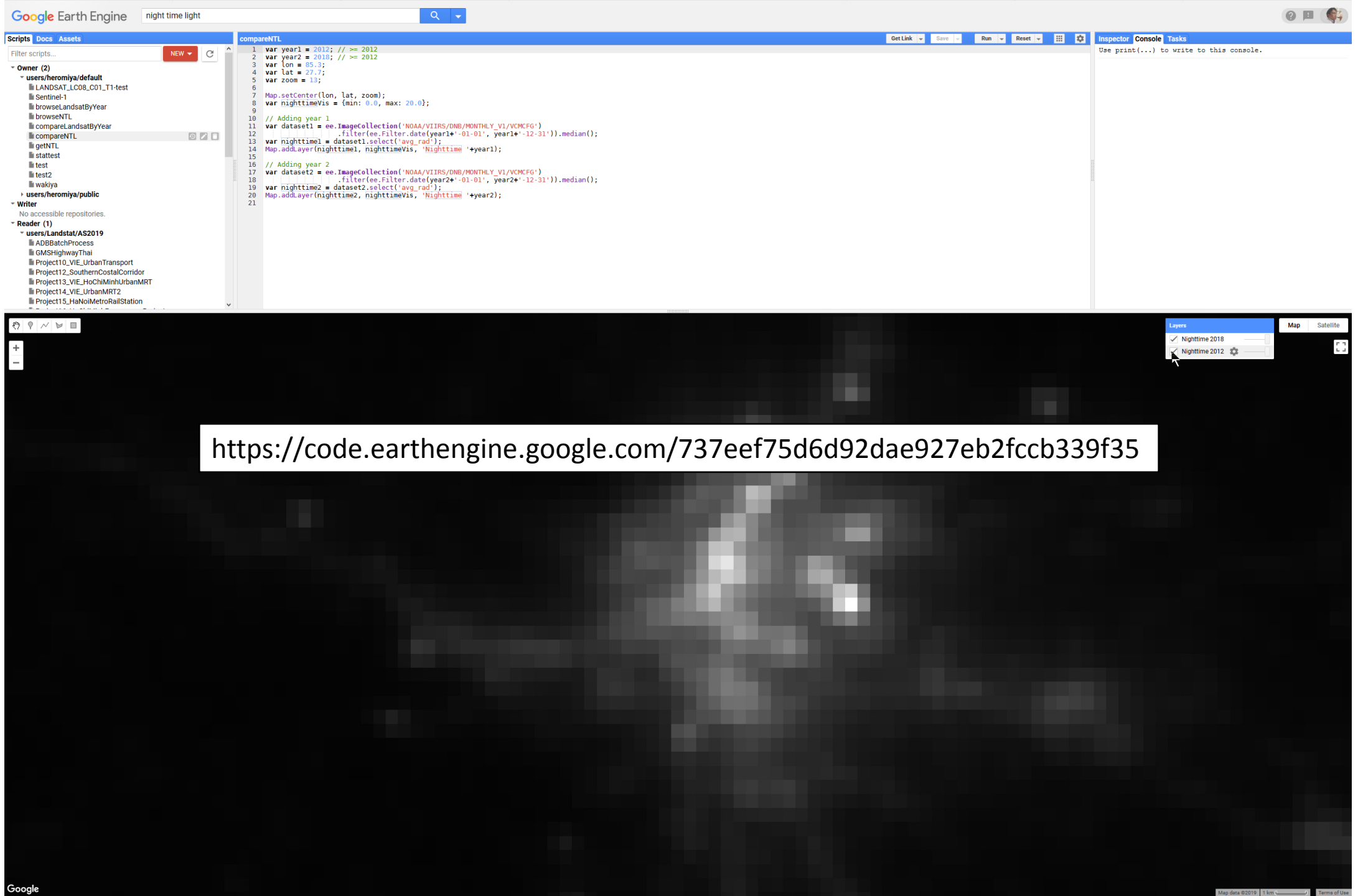
```
var year = 2015; // >= 2012
var lon = 85.3;
var lat = 27.7;
var zoom = 13;

var dataset = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMSLCFG')
                  .filter(ee.Filter.date(year+'-01-01', year+'-12-31')).median();
var nighttime = dataset.select('avg_rad');
var nighttimeVis = {min: 0.0, max: 20.0};
Map.setCenter(lon, lat, zoom);
Map.addLayer(nighttime, nighttimeVis, 'Nighttime');

```

Inspector | Console | Tasks

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

Adjust opacity




Google Earth Engine
night time light
Scripts Docs Assets
Filter scripts...
NEW
Owner (2)
users/heromiya/default
LANDSAT_LC08_C01_T1-test
Sentinel-1
browseLandsatByYear
browseNTL
compareLandsatByYear
compareNTL
getNTL
stattest
test
test2
wakiya
users/heromiya/public
Writer
No accessible repositories.
Reader (1)
users/Landstat/AS2019
ADBBatchProcess
GMSHighwayThai
Project10_VIE_UrbanTransport
Project12_SouthernCostalCorridor
Project13_VIE_HoChiMinhUrbanMRT
Project14_VIE_UrbanMRT2
Project15_HaNoiMetroRailStation
compareNTL
Get Link
Save
Run
Reset
var year1 = 2012; // >= 2012
var year2 = 2018; // >= 2012
var lon = 85.3;
var lat = 27.7;
var zoom = 13;
Map.setCenter(lon, lat, zoom);
var nighttimeVis = {min: 0.0, max: 20.0};
// Adding year 1
var dataset1 = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG')
.filter(ee.Filter.date(year1+'-01-01', year1+'-12-31')).median();
var nighttime1 = dataset1.select('avg_rad');
Map.addLayer(nighttime1, nighttimeVis, 'Nighttime '+year1);
// Adding year 2
var dataset2 = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG')
.filter(ee.Filter.date(year2+'-01-01', year2+'-12-31')).median();
var nighttime2 = dataset2.select('avg_rad');
Map.addLayer(nighttime2, nighttimeVis, 'Nighttime '+year2);
Inspector Console Tasks
Use print(...) to write to this console.
Layers
Nighttime 2018
Nighttime 2012
Map
Satellite
https://code.earthengine.google.com/737eef75d6d92dae927eb2fccb339f35
Google

Google Earth Engine

night time light

Scripts Docs Assets

Filter scripts...

NEW

- Owner (2)
  - users/heromiya/default
    - LANDSAT_LC08_C01_T1-test
    - Sentinel-1
    - browseLandsatByYear
    - browseNTL
    - compareLandsatByYear
    - compareNTL
    - getNTL
    - stattest
    - test
    - test2
    - wakiya
  - users/heromiya/public
- Writer
  - No accessible repositories.
- Reader (1)
  - users/Landstat/AS2019
    - ADBBatchProcess
    - GMSHighwayThai
    - Project10_VIE_UrbanTransport
    - Project12_SouthernCostalCorridor
    - Project13_VIE_HoChiMinhUrbanMRT
    - Project14_VIE_UrbanMRT2
    - Project15_HaNoiMetroRailStation

compareNTL

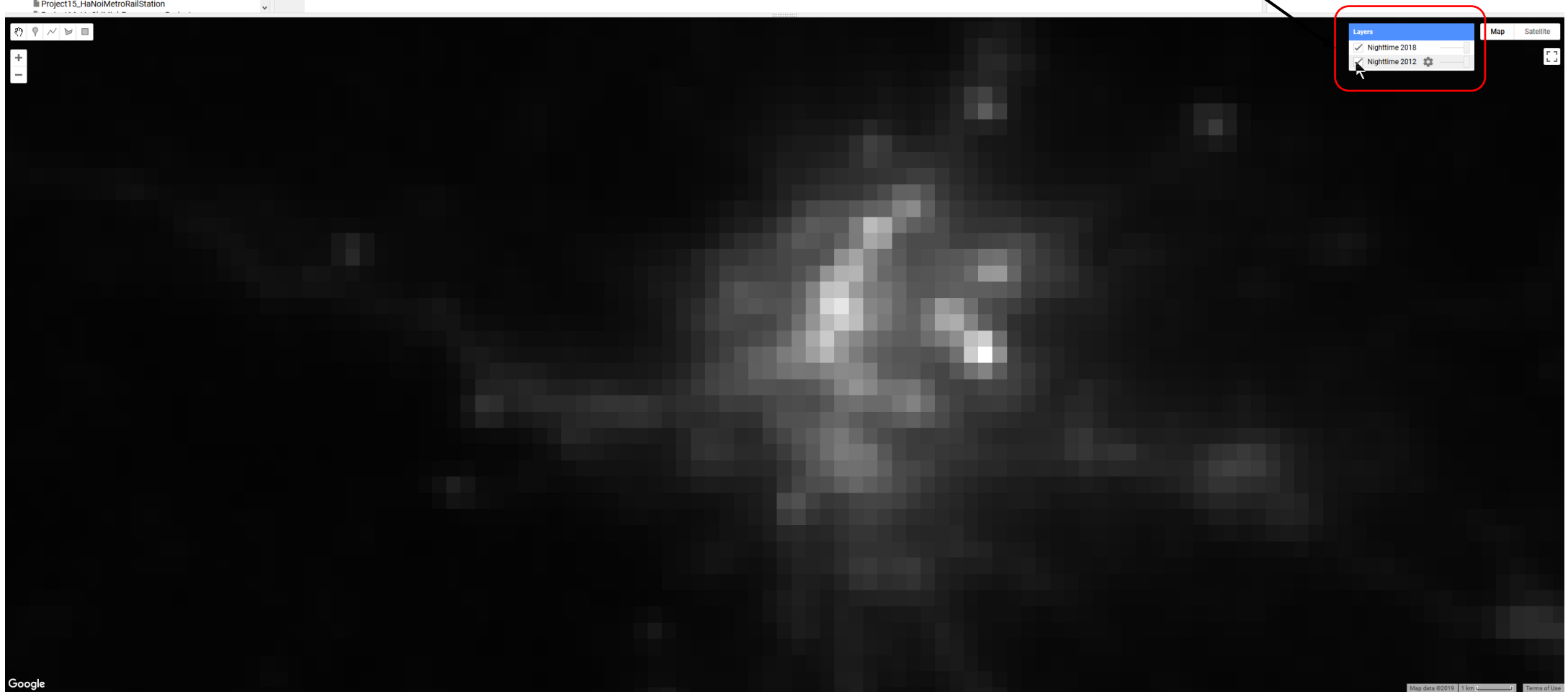
Get Link | Save | Run | Reset

```
var year1 = 2012; // >= 2012
var year2 = 2018; // >= 2012
var lon = 85.3;
var lat = 27.7;
var zoom = 13;

Map.setCenter(lon, lat, zoom);
var nighttimeVis = {min: 0.0, max: 20.0};

// Adding year 1
var dataset1 = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG')
                  .filter(ee.Filter.date(year1+'-01-01', year1+'-12-31')).median();
var nighttime1 = dataset1.select('avg_rad');
Map.addLayer(nighttime1, nighttimeVis, 'Nighttime '+year1);

// Adding year 2
var dataset2 = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG')
                  .filter(ee.Filter.date(year2+'-01-01', year2+'-12-31')).median();
var nighttime2 = dataset2.select('avg_rad');
Map.addLayer(nighttime2, nighttimeVis, 'Nighttime '+year2);

```

Inspector Console Tasks

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

On/off visibility of the images to compare



Night-time light profiling

Google Earth Engine

Search places and datasets...

Scripts Docs Assets

Filter scripts... NEW

- Owner (2)
  - users/heromiya/default
    - _trash
    - LANDSAT_LC08_C01_T1-test
    - NTLprofiling
    - Sentinel-1
    - browseLandsatByYear
    - browseNTL
    - compareLandsatByYear
    - compareNTL
    - getNTL
    - wakiya
  - users/heromiya/public
- Writer
  - No accessible repositories.
- Reader (1)
  - users/Landstat/AS2019
    - ADBBatchProcess
    - GMSHighwayThai
    - Project10_VIE_UrbanTransport
    - Project12_SouthernCostalCorridor
    - Project13_VIE_HoChiMinhUrbanMRT
    - Project14_VIE_UrbanMRT2
    - Project15_HaNoiMetroRailStation
    - Project16_HoChiMinhExpresswayProject

Link d967b2ace56099807041b3fb46b4954b *

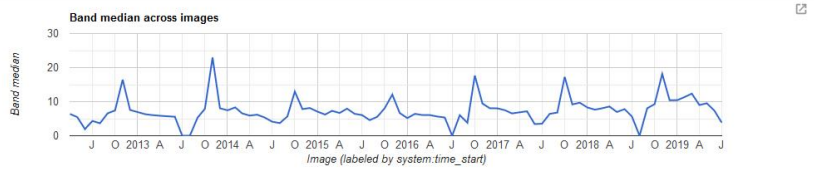
Get Link Save Run Reset

Imports (1 entry)
  var geometry: Polygon, 4 vertices

```
var lon = 85.3;
var lat = 27.7;
var zoom = 13;

var dataset = ee.ImageCollection('NOAA/VIIRS/DNB/MONTHLY_V1/VCMCFG')
                  .filter(ee.Filter.date('2012-01-01', '2019-12-31'));
var nighttime = dataset.select('avg_rad');
var nighttimeVis = {min: 0.0, max: 20.0};
Map.setCenter(lon, lat, zoom);
Map.addLayer(nighttime.median(), nighttimeVis, 'Nighttime', true, 0.7);

print(ui.Chart.image.series(nighttime, geometry, ee.Reducer.median(), 500));
```

Inspector Console Tasks

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

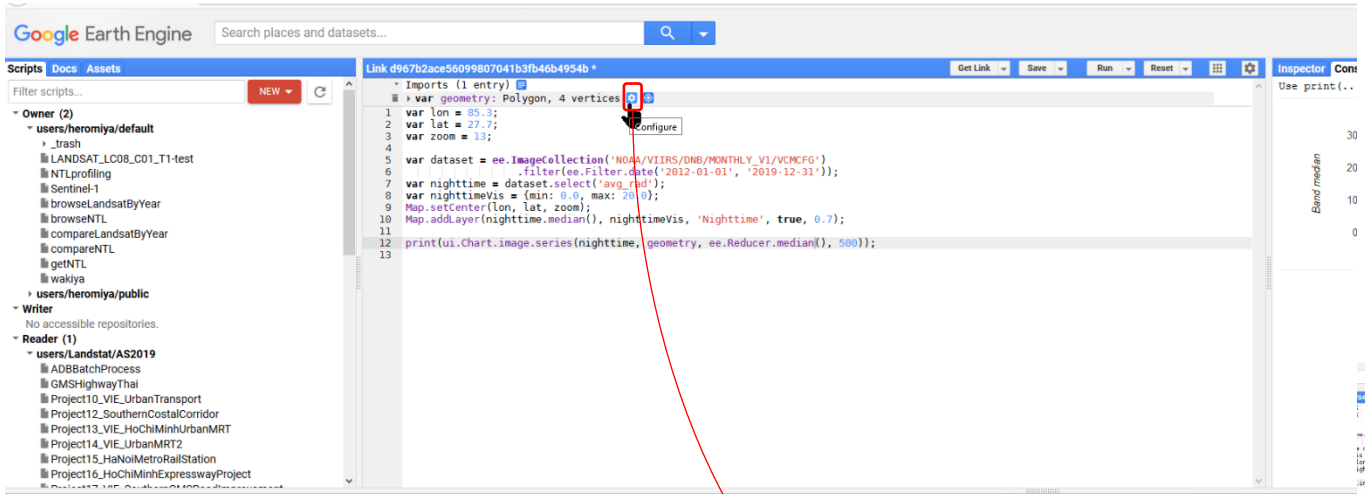


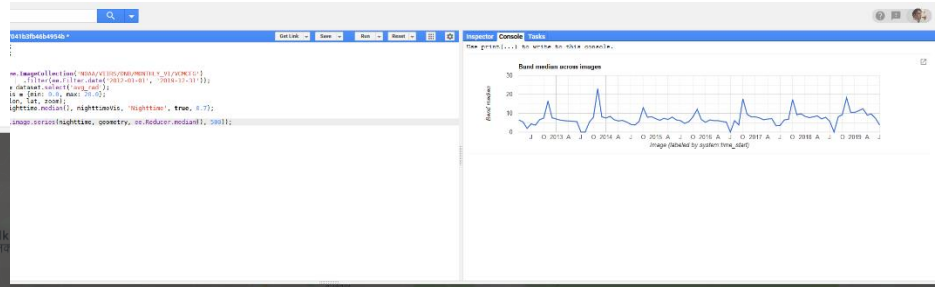
Geometry Imports

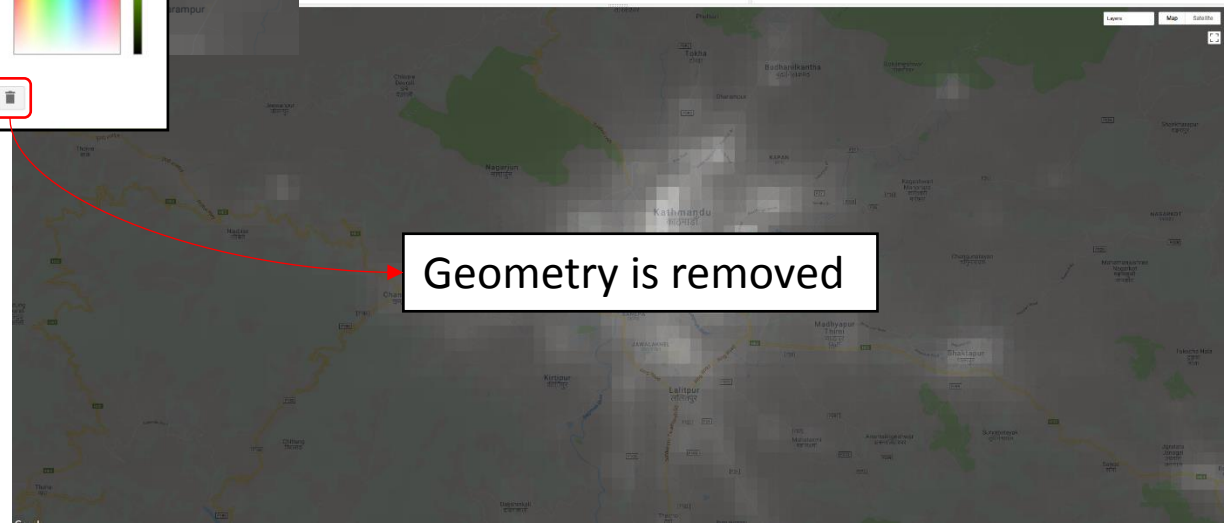
Layers Map Satellite

https://code.earthengine.google.com/a0602ac97ed7a6abf800fda306930d4a

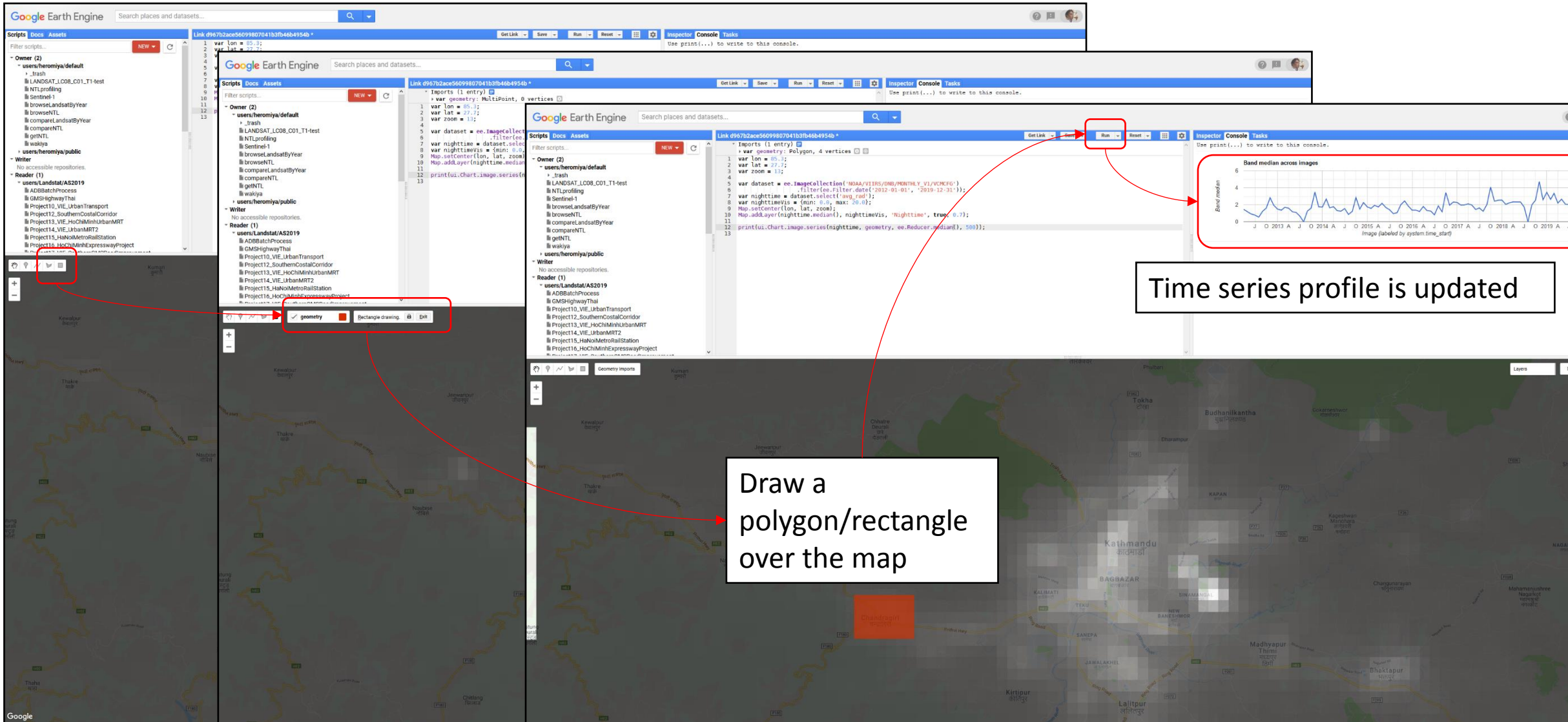
Configure areas to profile night-time light







Configure areas to profile night-time light

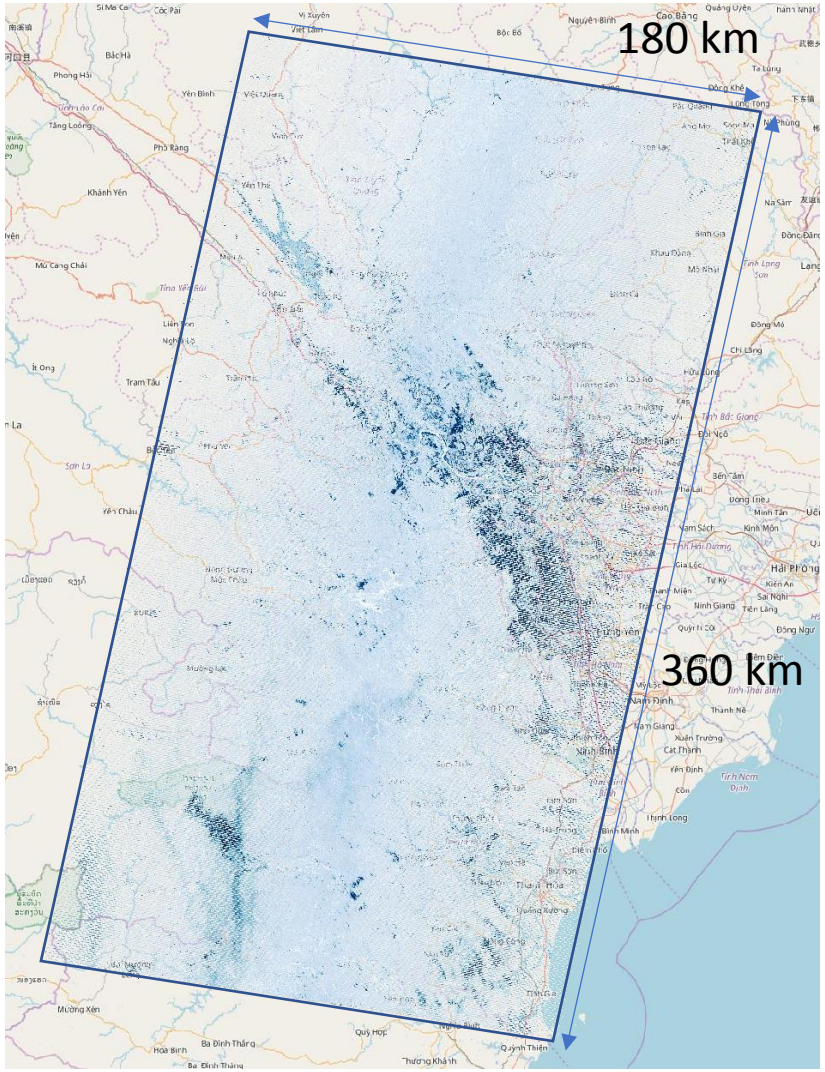


(Not validated very well)
Change detection in Landsat archive

Advantages of Satellite Data in Flood Observations

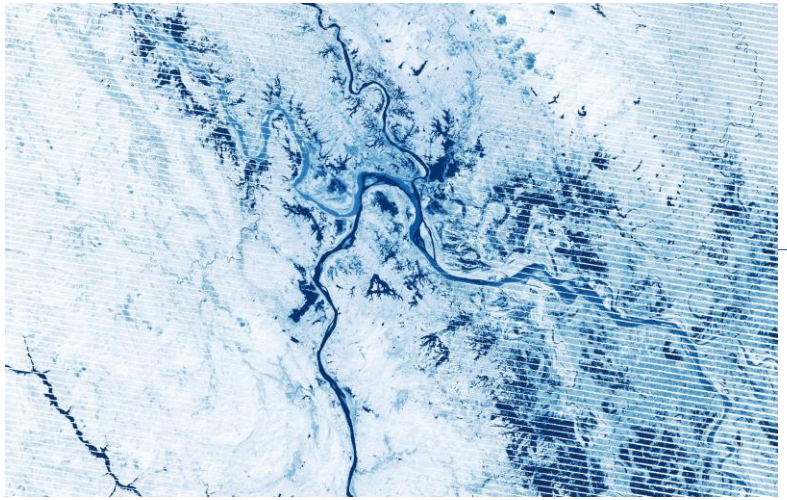
- Simultaneous observation of large extent
- Map-friendly
  - Useful to visualization
  - Overlay with other layers for integration
- Observation of dangerous and remote areas

Observation of a flood, November 2008

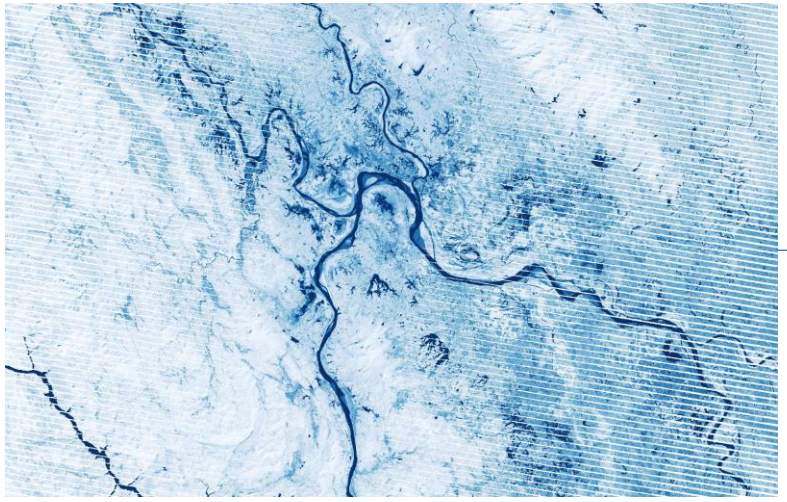


Flood observation from satellites

Waterbody extent (post-flood, 10 Nov 2008)

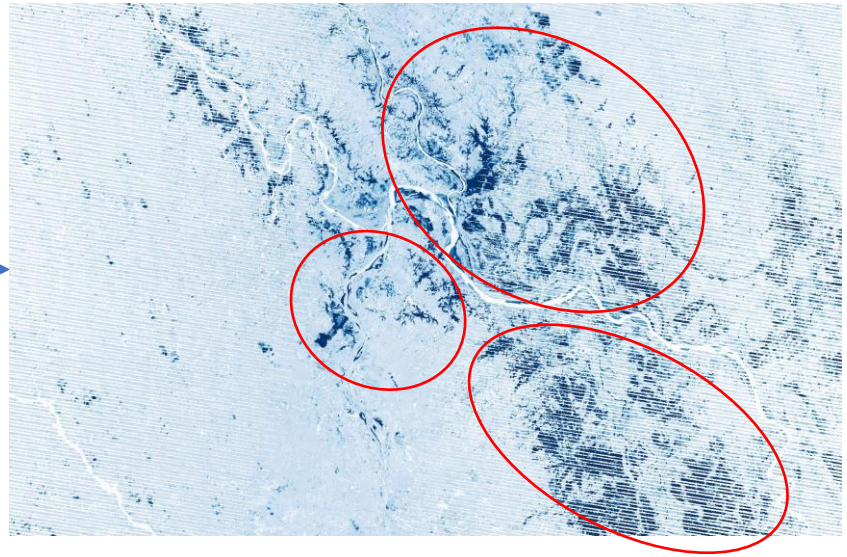


Waterbody extent (pre-flood, 8 Nov 2007)



Change detection

Extent of the flood in November 2008



Concept

- Pre-disaster data → Cloud-free Landsat data with 1-year composite before a disaster using - ee.Algorithms.Landsat.simpleComposite(collection, *percentile*, *cloudScoreRange*, *maxDepth*, *asFloat*)
- Post-disaster data → Cloud-free Landsat data with 1-month or 3-month composite after a disaster using - ee.Algorithms.Landsat.simpleComposite(collection, *percentile*, *cloudScoreRange*, *maxDepth*, *asFloat*)