

### Laboratory 3: See the World at Night – Nighttime Lights (NTL) dataset

Remote sensing of nighttime light emissions offers a unique perspective for investigations into some of human behaviors. The Visible Infrared Imaging Radiometer Suite (VIIRS) instruments aboard the joint NASA/NOAA Suomi National Polar-orbiting Partnership (Suomi NPP) and NOAA-20 satellites provide global daily measurements of nocturnal visible and near-infrared (NIR) light (400-900 nanometers) that many human-made light sources provide spectral responses in this range. VIIRS Day/Night Band (DNB) data are used for estimating population, assessing electrification of remote areas, monitoring disasters and conflict, and understanding biological impacts of increased light pollution.

In addition, the NTL data are helping assess progress towards meeting many of the United Nation's Sustainable Development Goals (SDGs), specifically addressing the needs of conflict-affected populations (SDG-1); quantifying the effectiveness of local electrification projects in the developing world (SDG-7); building infrastructure resilient to disasters, promoting inclusive and sustainable industrialization, and fostering innovation (SDG-9); and ensuring that cities and human settlements are inclusive, safe, resilient, and sustainable (SDG-11).

#### 1. Area of interest

Our study focuses on Guangdong Province, China and access our boundary-defining geometry using the GAUL-Level2 layer

```
//Import GAUL administrative boundaries for level 1 and level 2 units.  
// Level 1 units are used to clip the raster nightlight imagery to Guangdong  
// Province. and Level 2 is used for the zonal statistics.  
  
var GAUL1 = ee.FeatureCollection('FAO/GAUL/2015/level1');  
var GAUL2 = ee.FeatureCollection('FAO/GAUL/2015/level2');  
  
var Guangdong1 = GAUL1.filter(ee.Filter.eq('ADM1_NAME', 'Guangdong  
Sheng'));  
var Guangdong2 = GAUL2.filter(ee.Filter.eq('ADM1_NAME', 'Guangdong  
Sheng'));
```

#### 2. Filter the VIIRS Data by Area & Time

```
// Import VIIRS Annual composites for 2014
var dataset2014 = ee.ImageCollection('NOAA/VIIRS/DNB/ANNUAL_V21')
    .filter(ee.Filter.date('YYYY-MM-DD', 'YYYY-MM-DD'))
    .filterBounds(Guangdong1);
var dataset2014_mean = dataset2014.mean()
    .clip(Guangdong1);
var NTL2014 = dataset2014_mean.select('average');
var VIS2014 = {min: 0.0, max: 63.0};

// Import VIIRS Annual composites for 2020
var dataset2020 = ee.ImageCollection('NOAA/VIIRS/DNB/ANNUAL_V21')
    .filter(ee.Filter.date('YYYY-MM-DD', 'YYYY-MM-DD'))
    .filterBounds(Guangdong1);
var dataset2020_mean = dataset2020.mean()
    .clip(Guangdong1);
var NTL2020 = dataset2020_mean.select('average');
var VIS2020 = {min: 0.0, max: 63.0};

// Calculate the difference of "Average DNB radiance values" between 2014 and 2020
var NTLDiff = NTL2014.subtract(NTL2020);
var VISDiff = {min: 0.0, max: 63.0};
Map.addLayer(NTLDiff, VISDiff, 'diff');

print(NTL2014);
print(NTL2020);
print(NTLDiff);
```

**Commented [SC1]:** You have to define the study period based on the worksheet instruction

Click **Run** button in the top menu. The right window will show the results for the year of 2014 and 2020 in selected study area, respectively.

### 3. Zonal statistics

Calculate the mean radiance of each administrative unit in Guangdong province:

```
var means2014 = NTL2014.reduceRegions({
  collection: Guangdong2,
  reducer: ee.Reducer.mean(),
  scale: 30,
});
var means2014 = means2014.select(['ADM2_CODE', 'ADM2_NAME', 'mean']);

var means2020 = NTL2020.reduceRegions({
  collection: Guangdong2,
  reducer: ee.Reducer.mean(),
```

```

    scale: 30,
  });
  var means2020 = means2020.select(['ADM2_CODE', 'ADM2_NAME', 'mean']);

  // Calculate the difference of mean radiance of each administrative unit
  var meansDiff = NTLDiff.reduceRegions({
    collection: Guangdong2,
    reducer: ee.Reducer.mean(),
    scale: 30,
  });
  var meansDiff = meansDiff.select(['ADM2_CODE', 'ADM2_NAME', 'mean']);

  print(means2014);
  print(means2020);
  print(meansDiff);

```

#### 4. Setting style parameters for administrative boundaries and adding map layers

```

var styleParams = {
  fillColor: '00000000',
  color: 'EEB50D',
  width: 1.0,
};
Guangdong2 = Guangdong2.style(styleParams);

Map.setCenter(113.4488, 23.1988, 8);
Map.addLayer(NTL2014, VIS2014, '2014');
Map.addLayer(NTL2020, VIS2020, '2020');
Map.addLayer(Guangdong2, {color: 'FFBE00'}, 'First Level Administrative Units');

```

#### 5. Creating charts

```

var chart2014 =
  ui.Chart.feature
    .byFeature({
      features: means2014.select('mean|ADM2_NAME'),
      xProperty: "ADM2_NAME",
    })
    .setChartType('ColumnChart')
    .setOptions({
      title: 'Average Annual Nighttime Light for Guangdong Province in 2014
using VIIRS Imagery',
      hAxis:
        {title: 'Prefectures', titleTextStyle: {italic: false, bold: true}},

```

```

        vAxis: {
            title: 'Average Radiance',
            titleTextStyle: {italic: false, bold: true}
        },
        colors: [
            '0BC8F7'
        ]
    });
print(chart2014);

var chart2020 =
    ui.Chart.feature
        .byFeature({
            features: means2020.select('mean|ADM2_NAME'),
            xProperty: "ADM2_NAME",
        })
        .setChartType('ColumnChart')
        .setOptions({
            title: 'Average Annual Nighttime Light for Guangdong Province in 2020
using VIIRS Imagery',
            hAxis:
                {title: 'Prefectures', titleTextStyle: {italic: false, bold: true}},
            vAxis: {
                title: 'Average Radiance',
                titleTextStyle: {italic: false, bold: true}
            },
            colors: [
                '0BC8F7'
            ]
        });
print(chart2020);

var chartDiff =
    ui.Chart.feature
        .byFeature({
            features: meansDiff.select('mean|ADM2_NAME'),
            xProperty: "ADM2_NAME",
        })
        .setChartType('ColumnChart')
        .setOptions({
            title: 'Difference in Average Annual Nighttime Light for Guangdong
Province from 2014 to 2020 using VIIRS Imagery',
            hAxis:

```

```
        {title: 'Prefectures', titleTextStyle: {italic: false, bold: true}},  
      vAxis: {  
        title: 'Average Radiance',  
        titleTextStyle: {italic: false, bold: true}  
      },  
      colors: [  
        '0BC8F7'  
      ]  
    });  
print(chartDiff);
```

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