MDS6212 Fintech Theory and Practice

Assignment 6

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1 Question1

Using the available archived DMSP-OLS Nighttime Lights Time Series data from Google Earth Engine, generate two pictures for all calendar years. One captures the global regions occasionally lighted, and the other captures the global regions continuously lighted. Combine the two pictures with the base map in GEE platform, and discuss its economic meanings.

1.1 Picture that captures the global regions occasionally lighted

Based on Google Earth Engine, we generate the picture that captures the global regions occasionally lighted as Figure 1

1.2 Picture that captures the global regions continuously lighted

Based on Google Earth Engine, we generate the picture that captures the global regions continuously lighted as Figure 2

1.3 Discussion about the economic meanings

As Donaldson and Storeygard (2016) indicated, NightLight Data, compared with traditional data such as GDP, breaks through the limits of administrative boundaries, and can reflect the dynamic changes of economic activity, has been widely used in the fields of development economics, economic history, space and Urban Economics, and has effectively promoted the theoretical and empirical research in related fields.

For these two pictures here, on the one hand, the fisrt picture (occasionally lighted) can reflect the economic activity that once happened during the record time of our dataset around the world. On the other hand, the second picture (continuously lighted) can reflect the region whose economic activities are always flourish.

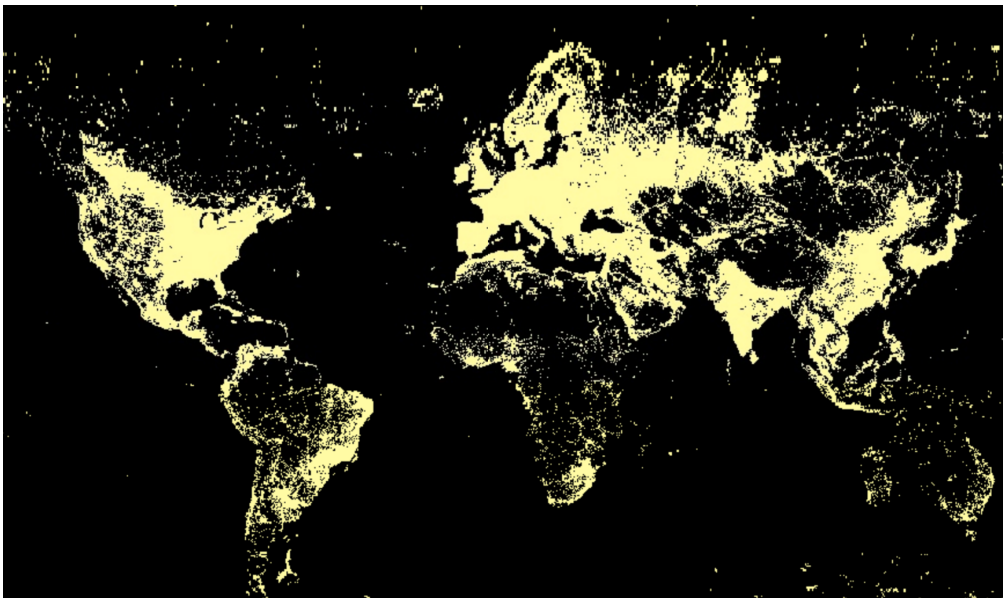

Figure 1: occasionally lighted

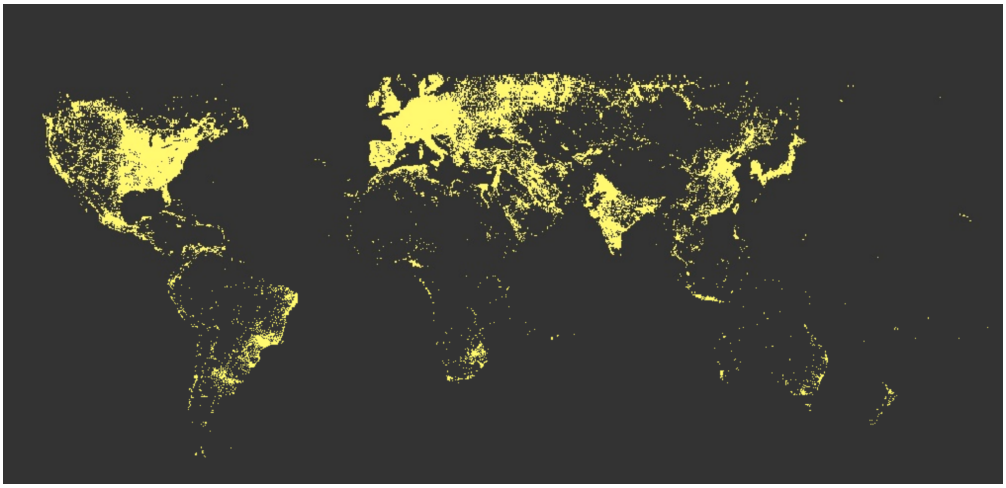

Figure 2: continuously lighted

Table 1: The average value of nighttime lights between Shenzhen and Silicon Valley for all calendar years

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Shenzhen	35.439662	32.285812	41.683090	38.792754	38.782927	40.706170	39.822508	43.701722	48.087574	47.755491	49.550536
Silicon Valley	22.776293	22.323440	22.541117	22.289387	22.604112	20.823703	20.990781	20.738914	23.375442	22.121903	22.107374
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Shenzhen	47.826286	51.932506	47.139096	48.738705	50.607664	51.394430	50.087678	52.279356	54.689053	52.867029	54.470875
Silicon Valley	19.879166	21.168617	19.270026	20.216495	20.902540	20.626117	20.860783	22.907854	21.558780	21.109308	21.157488

2 Question2

Using the available archived DMSP-OLS Nighttime Lights 2013 year data, calculate a yearly average value of nighttime lights between Shenzhen and Silicon Valley (located in Santa Clara county) to compare the degree of economic activities during night time. Likewise, calculate the average value of nighttime lights between Shenzhen and Silicon Valley for all calendar years, draw the variables in a time series diagram, and analyse the differences between the two cities.

2.1 calculate a yearly average value of nighttime lights between Shenzhen and Silicon Valley

Based on Google Earth Engine, we calculate a yearly average value of nighttime lights between Shenzhen and Silicon Valley by using the JavaScript codes (See Appenix A).

And the results are: **Shenzhen -> 54.4708747628905 vs Silicon Valley -> 21.157488046805707**

2.2 To compare the degree of economic activities during night time.

Since for the yearly average value during night time, Shenzhen is twice more than the Silicon Valley, which indicates that the degree of economic activities in Shenzhen during night time is much more flourish than Silicon Valley. Maybe one reason is due to the different culture between these two area, like '996' in Shenzhen and slow-pace life in Silicon Valley.

2.3 Calculate the average value of nighttime lights between Shenzhen and Silicon Valley for all calendar years

For all calendar years, this data set ranges from 1992 to 2013. Then we try to calculate the average value of nighttime lights for those years

By using the JavaScript codes in GEE (See Appendix B), we successfully calculate the average value of nighttime lights for those years

The results are as Table 1

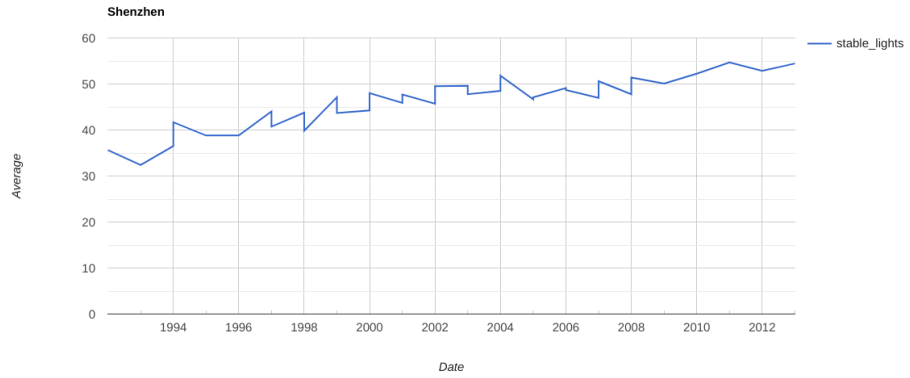

Figure 3: Time Series for Shenzhen

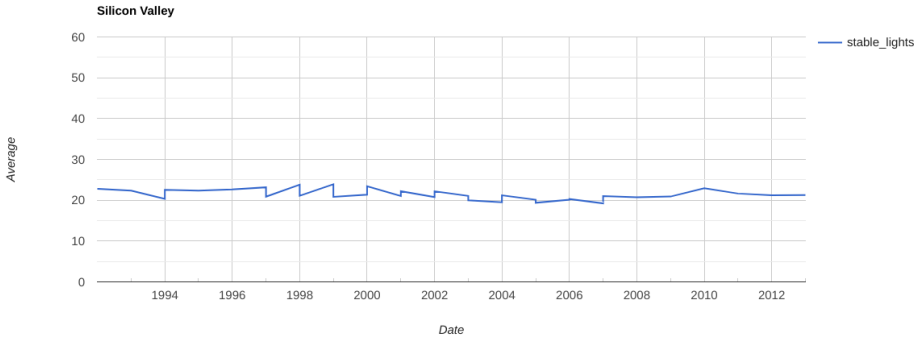

Figure 4: Time Series for Silicon Valley

2.4 draw the variables in a time series diagram, and analyse the differences between the two cities

Also, by using the codes in Appendix C, we successfully draw the variables in a time series diagram as Figure 3 and Figure 4.

The differences between the two cities:

The average value of nighttime lights for Shenzhen among those years are increasing while for Silicon Valley among those years are very stable.

3 Question3

Using the available MOD11A2.006 Terra Land Surface Temperature and Emissivity 8-Day Global 1km data from Google Earth Engine, calculate an 8-Day average value of daytime Land Surface Temperature between Shenzhen and Silicon Valley (located in Santa Clara county) to compare the degree of economic activities from 2020-01-25 to 2020-02-02.

By using the codes in Appendix D, we successfully calculate an 8-Day average value of daytime Land Surface Temperature between Shenzhen and Silicon Valley

The results are: 14538.681009054704 for Shenzhen and 14420.224741655871 for Silicon Valley.

Since these are non-scale data, we need to scale them, and the final results are: 17.62362018109411 for Shenzhen and 15.254494833117462 for Silicon Valley.

To compare the degree of economic activities from 2020-01-25 to 2020-02-02: From the results above, these two area have very close average value of daytime data. However, Shenzhen is slightly higher than Silicon Valley, which indicates that the economic activities in Shenzhen is slightly more flourish than in Silicon Valley

Appendices

A 2.1

```
var nig_values = [];
var cities = ee.FeatureCollection("users/220041006/Cities_F");
var shenzhen = cities.filterMetadata('NAME_2', 'equals', 'Shenzhen');
var valley = cities.filterMetadata('NAME_2', 'equals', 'Santa_Clara');
var sz_nig = ee.Image("NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/F182013").select('
    stable_lights').clip(shenzhen);
var vl_nig = ee.Image("NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/F182013").select('
    stable_lights').clip(valley);
var params1 = {
  reducer:ee.Reducer.mean(),
  geometry:shenzhen.geometry(),
  scale:1000,
  maxPixels:1e9
};
var sz_2013 = sz_nig.reduceRegion(params1);
var params2 = {
  reducer:ee.Reducer.mean(),
  geometry:valley.geometry(),
  scale:1000,
  maxPixels:1e9
};
var vl_2013 = vl_nig.reduceRegion(params2);
var k_1 = sz_2013.get('stable_lights');
var niglight_k = ee.Feature(null, {nig_value:k_1});
nig_values.push(niglight_k);
```

```
var k_2 = vl_2013.get('stable_lights');
var niglight_k = ee.Feature(null, {nig_value:k_2});
nig_values.push(niglight_k);
print(k_1, k_2);
print(nig_values);
```

B 2.3

```
var Shenzhen_values = [];
var Valley_values = [];
var shenzhen = cities.filterMetadata('NAME_2', 'equals', 'Shenzhen');
var valley = cities.filterMetadata('NAME_2', 'equals', 'Santa_Clara');
var calendar = ['F101992', 'F101993', 'F121994', 'F121995',
                'F121996', 'F141997', 'F141998', 'F141999',
                'F152000', 'F152001', 'F152002', 'F152003',
                'F162004', 'F162005', 'F162006', 'F162007',
                'F162008', 'F162009', 'F182010', 'F182011',
                'F182012', 'F182013'];
var x;
for (x in calendar) {
  var sz_nig = ee.Image("NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/"+calendar[x]).select('
      stable_lights').clip(shenzhen);
  var vl_nig = ee.Image("NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/"+calendar[x]).select('
      stable_lights').clip(valley);
  var params1 = {
  reducer:ee.Reducer.mean(),
  geometry:shenzhen.geometry(),
  scale:1000,
  maxPixels:1e9
  };
  var sz_2013 = sz_nig.reduceRegion(params1);
  var params2 = {
    reducer:ee.Reducer.mean(),
    geometry:valley.geometry(),
    scale:1000,
    maxPixels:1e9
  };
  var vl_2013 = vl_nig.reduceRegion(params2);
  var k_1 = sz_2013.get('stable_lights');
  var niglight_k = ee.Feature(null, {nig_value:k_1});
  Shenzhen_values.push(niglight_k);
  var k_2 = vl_2013.get('stable_lights');
```

```
  var niglight_k = ee.Feature(null, {nig_value:k_2});
  Valley_values.push(niglight_k);
  print(k_1, k_2);
}
```

C 2.4

```
var collection = ee.ImageCollection('NOAA/DMSP-OLS/NIGHTTIME_LIGHTS').select('
    stable_lights');
print(ui.Chart.image.series(collection, shenzhen, ee.Reducer.mean(), 30).
    setOptions({
     title: 'Shenzhen',
     vAxis: {title: 'Average', maxValue: 60, minValue: 10},
     hAxis: {title: 'Date', format: 'yyyy', gridlines: {count: 12}},
  }));
print(ui.Chart.image.series(collection, valley, ee.Reducer.mean(), 30).setOptions
    ({
     title: 'Silicon Valley',
     vAxis: {title: 'Average', maxValue: 60, minValue: 10},
     hAxis: {title: 'Date', format: 'yyyy', gridlines: {count: 12}},
  }));
```

D 3

```
var shenzhen = cities.filterMetadata('NAME_2', 'equals', 'Shenzhen');
var valley = cities.filterMetadata('NAME_2', 'equals', 'Santa_Clara');
var LST = ee.ImageCollection("MODIS/006/MOD11A2").select('LST_Day_1km');
var date_rg_1 = ee.DateRange('2020-01-25', '2020-02-02');
var sz_lst = LST.filterDate(date_rg_1).filterBounds(shenzhen).first()
    .clip(shenzhen);
var vl_lst = LST.filterDate(date_rg_1).filterBounds(valley).first()
    .clip(valley);
var sz_20 = sz_lst.clip(shenzhen).reduceRegion({
    reducer:ee.Reducer.mean(),
    geometry:shenzhen,
    scale:1000,
    maxPixels:1e9
});
var vl_20 = vl_lst.clip(valley).reduceRegion({
    reducer:ee.Reducer.mean(),
```

```
    geometry:valley,
    scale:1000,
    maxPixels:1e9
});
print(sz_20, vl_20);
var sz_20_1 = ee.Number(14538.681009054704);
var sz_20_2 = sz_20_1.multiply(0.02).subtract(273.15);
var vl_20_1 = ee.Number(14420.224741655871);
var vl_20_2 = vl_20_1.multiply(0.02).subtract(273.15);
print(sz_20_2, vl_20_2);
```

References

Donaldson, Dave and Adam Storeygard, "The view from above: Applications of satellite data in economics," *Journal of Economic Perspectives*, 2016, *30* (4), 171–98.