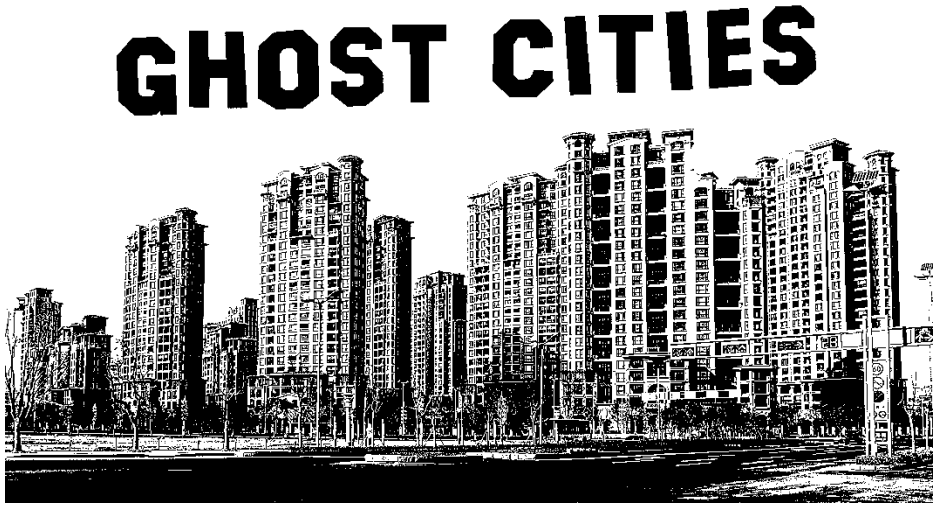
Assignment 03 Kefan Long

Tracking Global "Ghost" Urbanization

There is an interesting word called "ghost city", which mainly refers to the built-up settlements that are not filled with residents in a long time after they are built up. Lots of such settlements can be found in China, but I am also interested in tracking these "ghost" urbanization phenomena all over the world using google Earth Engine.



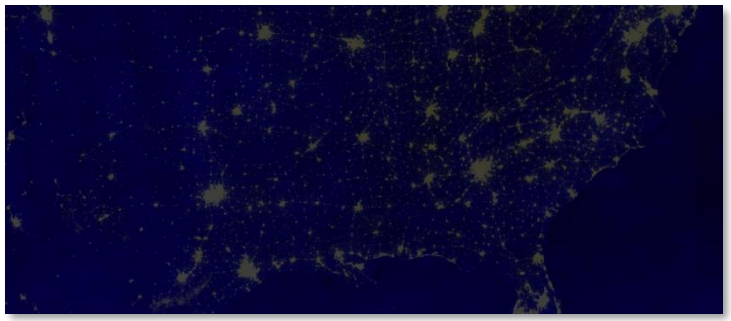
Method:

1. Find settlements that experience built-up activity
2. Use the night light image to test if the stable light has changed between two time of period
3. Exclude the pixels that have larger change in stable lights because these pixels have already 'urbanized'
4. Exclude the city core
5. Mask the built-up settlement layer with the mask of city core and exclude the 'urbanized pixels'
6. The rest of the pixels will be settlements that are built up but less 'urbanized'. They are much more likely to be 'ghost' settlement.
7. We can also see the global 'ghost' settlements and have a better understanding.

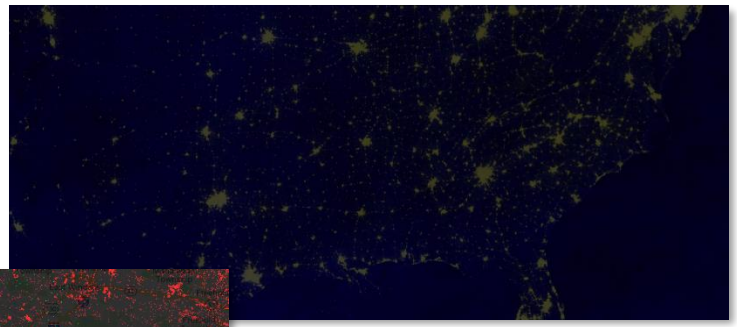
Code:

```
// Load all the image we need, including night light in two period of time and settlement data
var settlement = ee.Image('JRC/GHSL/P2016/BUILT_LDSMT_GLOBE_V1');
var nightlight = ee.ImageCollection('NOAA/DMSP-OLS/NIGHTTIME_LIGHTS');
var nightlight2013 = ee.Image('NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/F182013'); // Night light in
2014
```

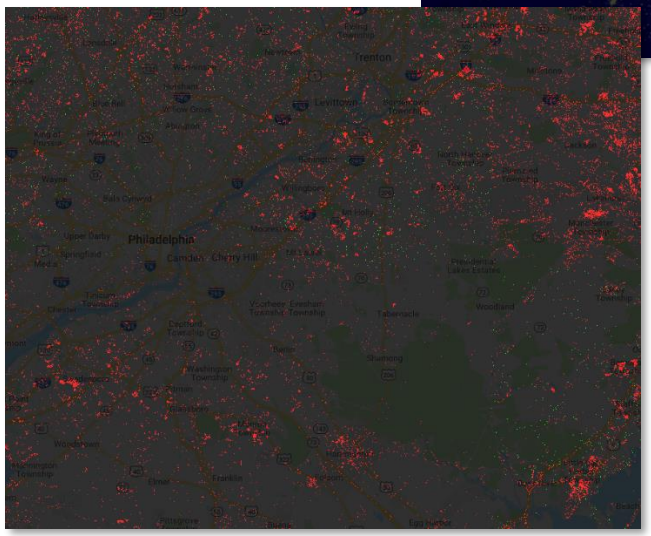
```
var nightlight1998 = ee.Image('NOAA/DMSP-OLS/NIGHTTIME_LIGHTS/F141998'); // Night light in 1998
// Print the settlement image so that we know how to use its infomation
print(settlement);   // Value 3 equals the built-up from 2000 to 2014
```



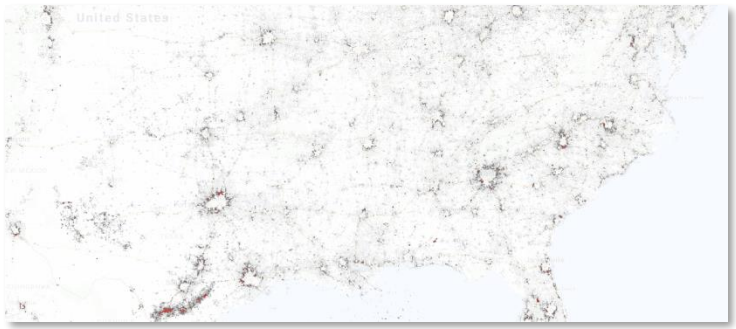
```
Map.addLayer(nightlight2013, {}, 'NightLight2013');
Map.addLayer(nightlight1998, {}, 'NightLight1998');

// First, we should look at built-up from 2000 to 2014

var builtup = settlement.eq(3);
Map.addLayer(builtup, {}, 'Built_up from 2000 to 2014');
```



```
// Select useful band of two periods for the calculation

var stable2013 = nightlight2013.expression('b(1)');
var all2013 = nightlight2013.expression('b(0)');

var stable1998 = nightlight1998.expression('b(1)');
var all1998 = nightlight1998.expression('b(0)');
```




```
// Finding the stable light changes from 1998 to 2013 and Unit scale to see which pixels have higher change in stable light

var store = ee.Image(0);

var transition = store.expression('A-B',{A:stable2013, B:stable1998}).clamp(0,63).unitScale(0,63);
```



// Here I overlooked the condition of A < B, because I want to focus only on the condition where urbanization expands slower than construction

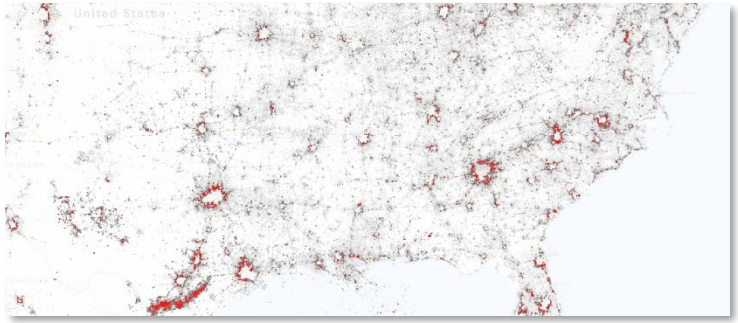
```
Map.addLayer(transition,{min: 0, max: 1, palette: ['ffffff','777777','ff0000'], opacity:0.9},
'Transition');
```

// Also, we need to exclude the city core which already has a typical urbanized life

```
var core = transition.gt(0.2);
```

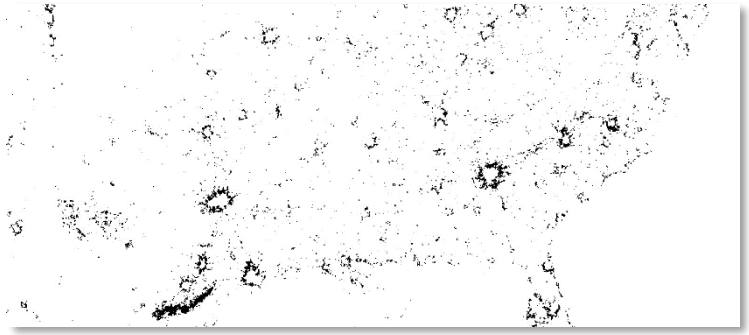
// Now identify pixels that have the largest change of stable lights from 1998 to 2013.

```
var urbanizedExtent = transition.unitScale(0,0.5);
Map.addLayer(urbanizedExtent,{min: 0, max: 1, palette: ['ffffff','777777','ff0000'], opacity:0.9},
'urbanizedExtent');
```



// We should exclude these pixels that are drastically changed from 1998 to 2013, because they are also considered as well-urbanized

```
var exclusion = urbanizedExtent.lt(0.4);

Map.addLayer(exclusion,{}, 'Less Urbanized');
```



// Now we need a layer to know where we could search possible 'ghost' places in 2013

```
var diff2013 = nightlight2013.expression('b(0) - b(1)').clamp(0,15).unitScale(0,15);
Map.addLayer(diff2013,{min: 0, max: 1, palette: ['ffffff','777777','ff0000'], opacity:0.9}, 'Possible Places');
```

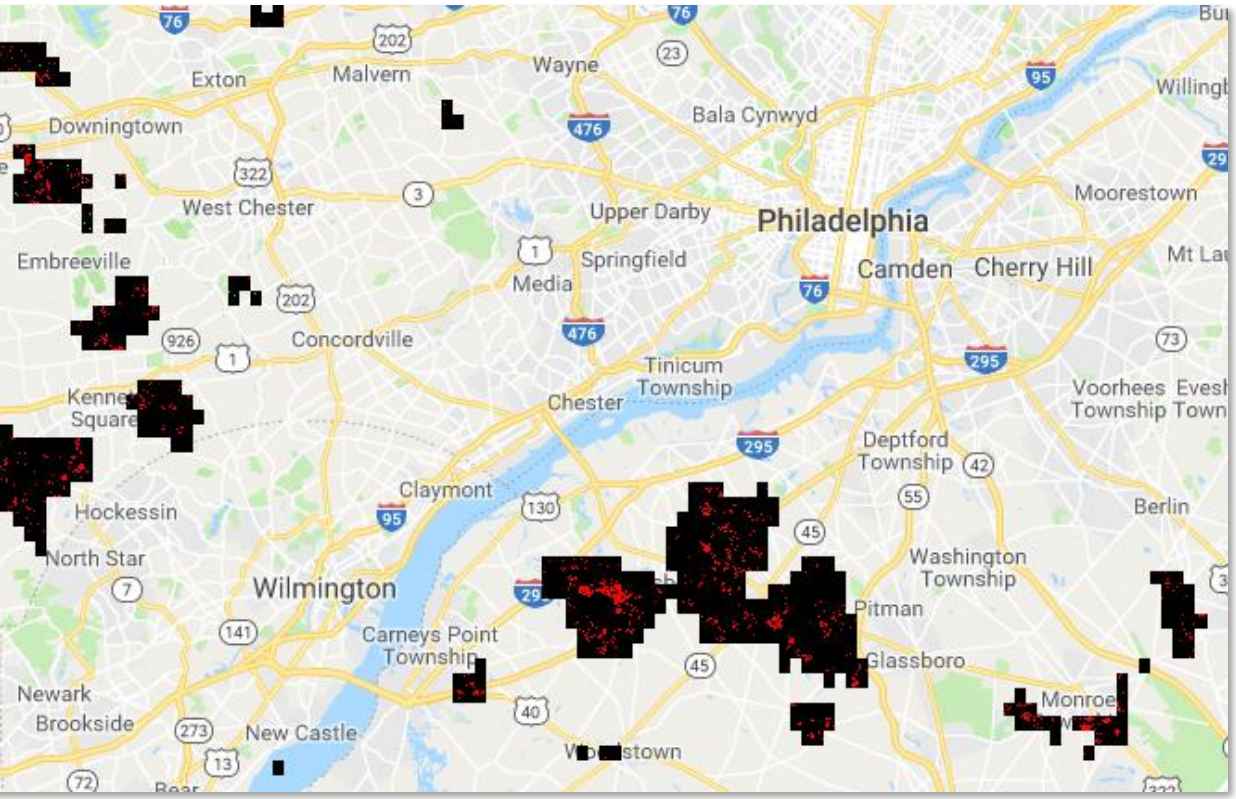
// create a mask layer

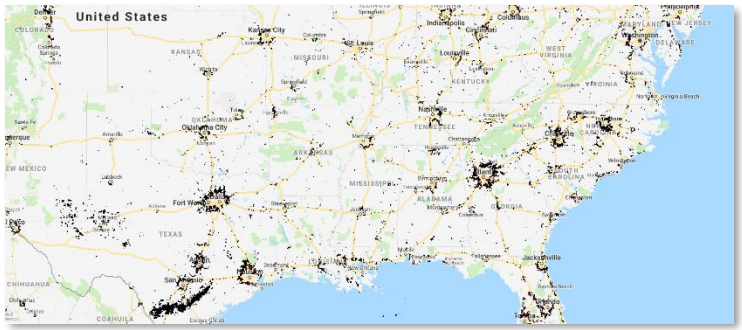
```
var searchPlace = diff2013.eq(0);
Map.addLayer(searchPlace,{},'Possible Places');
```

// Now mask the bult layer with two masks

```
var possibleBuiltup = builtup.mask(searchPlace).mask(core);
Map.addLayer(possibleBuiltup,{},'Target Place With 2000-2014 Built Up pixels');
```

//The color pixels within the black area are the settlements that have higher possibility of being a 'ghost'settlement





Result:

From the global picture, we can see that, more black pixels fall in Asia than America and Europe. When we zoom in, it is much more obvious that China and South Korea has much more black pixels than other countries. This means that probably between 1998 and 2013, China and South Korea experienced a lot of constructions that go faster than a substantia l urban life, and this may cause many built settlements to become a ‘ghost’ settlement.