Assignment 4

CPLN 670 - Geospatial Software Design
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"Predicting Los Angeles Summer Wildfires in 2019"

"In Los Angeles, with our population density, a fire is going to be burning houses down right away," said Ralph Terrazas, the chief of the Los Angeles Fire Department. Wildfire has become more and more intense in Los Angeles and a good prediction of where summer wildfires may break out could save lives. Here I created a script using land elevation and land surface temperature to predict locations in the Great Los Angeles Area that wildfire may break out. Then I compared my prediction results with the actual locations where wildfire broke out.

Link to Code: https://code.earthengine.google.com/3b77b0206604b14e785fd11769d85632

I. Establish Boundaries for the Great Los Angeles Area

```
//Set Boundary to Los Angeles;
//Inspired by past submission by He,huiling;
var geo = ee.Geometry.Polygon([[-119.02,35],[-116,35],[ -116,32.71533],[-119.02,32.71533]])
var bound_LA = ee.Geometry.Rectangle(-119.02, 32.71533,-116, 35);
var boundary = ee.Feature(geo, {name:'studyArea'})
Map.addLayer(boundary, {color:'ffffff'}, 'Study Area')
Map.centerObject(boundary,8)

//Display Los Angeles Counties;
var dataset = ee.FeatureCollection('TIGER/2018/Counties');
dataset = dataset.filterBounds(bound_LA);

// Turn the strings into numbers
dataset = dataset.map(function (f) {
  return f.set('STATEFP', ee.Number.parse(f.get('STATEFP')));
});

var image = ee.Image().float().paint(dataset, 'STATEFP');
var countyOutlines = ee.Image().float().paint({
  featureCollection: dataset,
  color: 'black',
  width: 0.8
});

Map.addLayer(countyOutlines, {}, 'county outlines');
Map.addLayer(dataset, null, 'for Inspector', false);
```

Fig 1.1 County Boundaries for the Great Los Angeles Area and its neighborhoods

We first zoom to the Great Los Angeles Area and its neighborhood areas. Then we examine the fire information in 2010 and 2019.

```
//Import the Data; Fire Information for Resource Management System.
var fire19 = ee.ImageCollection('FIRMS').filter(ee.Filter.date('2019-06-01', '2019-09-15'));
var fire10 = ee.ImageCollection('FIRMS').filter(ee.Filter.date('2010-06-01', '2010-09-15'));
var fires19 = fire19.select('T21');
var fires10 = fire10.select('T21');
var fire_median19 = fires19.reduce(ee.Reducer.median());
var fire_median10 = fires10.reduce(ee.Reducer.median());
var fire_LA19 = fire_median19.clip(boundary);
var fire_LA10 = fire_median10.clip(boundary);
var firesVis = {
  min: 325.0,
  max: 400.0,
  palette: ['red', 'orange', 'yellow'],
};
Map.setCenter(-118.243683, 34.052235, 7);
//Map.addLayer(fire_LA19, firesVis, 'Fires');
//Map.addLayer(fire_LA10, firesVis, 'Fires');
```

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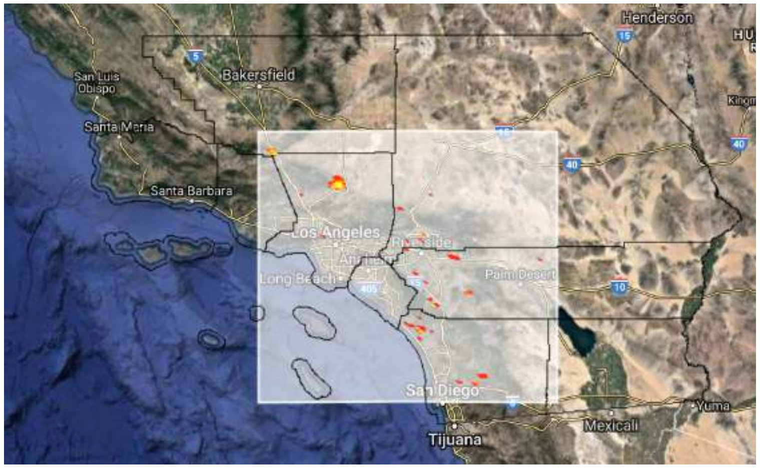

Fig 1.2 Fire Information within study area in 2010.

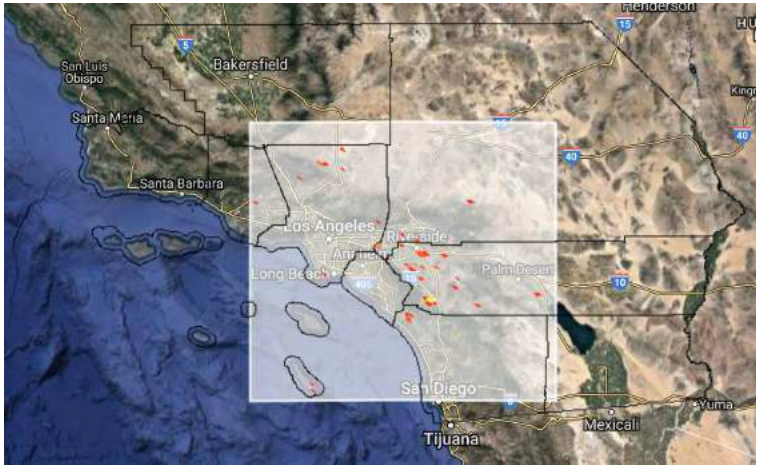

Fig 1.3 Fire Information within study area in 2019.

II. Examine Factors That May Cause a Summer Wildfire

```
//Explore Los Angeles temperature in 2010 and 2019.
var temp10 = ee.ImageCollection('MODIS/006/MOD11A1').filter(ee.Filter.date('2010-06-01', '2010-09-15'));
var temp19 = ee.ImageCollection('MODIS/006/MOD11A1').filter(ee.Filter.date('2019-06-01', '2019-09-15'));
var landSurfaceTemperature10 = temp10.select('LST_Day_1km');
var landSurfaceTemperature19 = temp19.select('LST_Day_1km');
var temp_median10 = landSurfaceTemperature10.reduce(ee.Reducer.median());
var temp_median19 = landSurfaceTemperature19.reduce(ee.Reducer.median());
var temp_LA10 = temp_median10.clip(boundary);
var temp_LA19 = temp_median19.clip(boundary);
var landSurfaceTemperatureVis = {
  min: 13000.0,
  max: 16500.0,
  palette: [
    '040274', '040281', '0502a3', '0502b8', '0502ce', '0502e6',
    '0602ff', '235cb1', '307ef3', '269db1', '30c8e2', '32d3ef',
    '3be285', '3ff38f', '86e26f', '3ae237', 'b5e22e', 'd6e21f',
    'fff705', 'ffd611', 'ffb613', 'ff8b13', 'ff6e08', 'ff500d',
    'ff0000', 'de0101', 'c21301', 'a71001', '911003'
  ],
};

//Map.addLayer(temp_LA10, landSurfaceTemperatureVis,'Land Surface Temperature 2010');
//Map.addLayer(temp_LA19, landSurfaceTemperatureVis,'Land Surface Temperature 2019');
```

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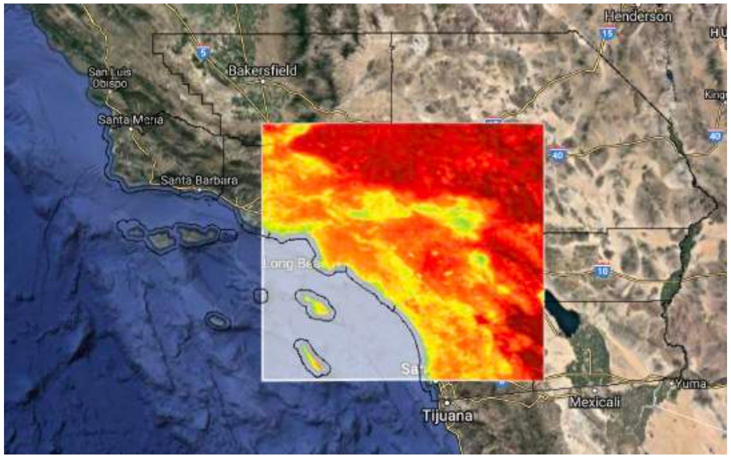

Fig 2.1 Land Surface Temperature within study area in 2010.

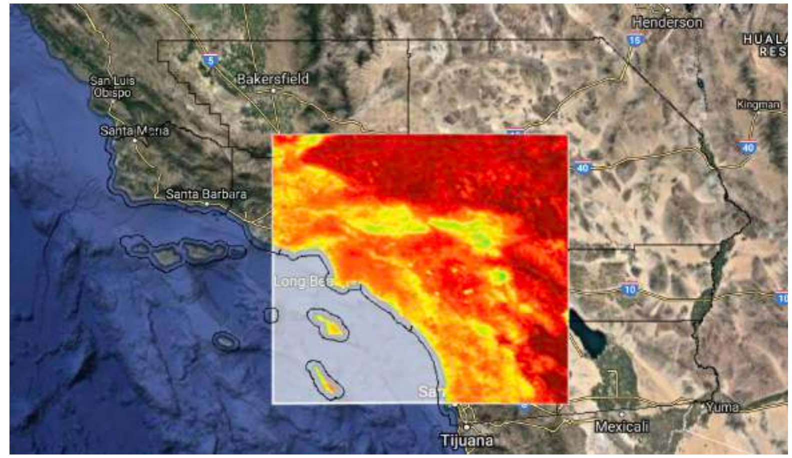

Fig 2.2 Land Surface Temperature within study area in 2019.

```
// Threshold the thermal band to find "hot" objects.
var hotspots10 = temp_LA10.select('LST_Day_1km_median').gt(15500);
var hotspots19 = temp_LA19.select('LST_Day_1km_median').gt(15500);
// Mask "cold" pixels.
hotspots10 = hotspots10.updateMask(hotspots10);
hotspots19 = hotspots19.updateMask(hotspots19);
//Map.addLayer(hotspots10, {palette: 'a42039'}, 'hotspots10');
//Map.addLayer(hotspots19, {palette: 'a42039'}, 'hotspots19');
```

Then we want to find the hot spots within our study area. We set the threshold to 15500 and mask the cold pixels. Here we want to only display the places that have higher land surface temperature.

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Fig 2.3 “Hot” spots within study area in 2010.

Fig 2.2 “Hot” spots within study area in 2019.

```
// Load the SRTM image.
var srtm = ee.Image('USGS/SRTMGL1_003');
// Calculate slope.
var slope = ee.Terrain.slope(srtm);
// Clip the image to the region of interest.
slope = slope.clip(boundary);
// Displaying slope for the region of interest.
var visualization_params = {min: 0, max: 45, palette:'white,red'};
//Map.addLayer(slope, visualization_params, "slope");
```

Fig 2.4 Clip the land elevation image to our study area.

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III. Combine the Factors into a Multi-band Image and Compute an Index to Predict Fire

```
//Combine the image of temp_LA10 and slope.
var image_com10 = ee.Image.cat([temp_LA10, slope]);
print(image_com10);
var image_com19 = ee.Image.cat([temp_LA19, slope]);
print(image_com19);

//Compute an index to predict fire.
var index10 = image_com10.expression(
    '(TEMP / 1000) * SLOPE', {
      'TEMP': image_com10.select('LST_Day_1km_median'),
      'SLOPE': image_com10.select('slope'),
});
print(index10);

var index19 = image_com19.expression(
    '(TEMP / 1000) * SLOPE', {
      'TEMP': image_com19.select('LST_Day_1km_median'),
      'SLOPE': image_com19.select('slope'),
});
print(index19);
```

We use Land Use Temperature / 1000 * Slope as Index, and we predict fire with places with higher index.

```
// Define an SLD style of discrete intervals to apply to the image.
var sld_intervals =
  '<RasterSymbolizer>' +
    '<ColorMap  type="intervals" extended="false" >' +
      '<ColorMapEntry color="#0000ff" quantity="0" label="0"/>' +
      '<ColorMapEntry color="#90e576" quantity="100" label="1-100" />' +
      '<ColorMapEntry color="#007f30" quantity="200" label="101-200" />' +
      '<ColorMapEntry color="#7aa34a" quantity="300" label="201-300" />' +
      '<ColorMapEntry color="#c51f1f" quantity="500" label="301-500" />' +
      '<ColorMapEntry color="#ffff00" quantity="6000" label="501-6000" />' +
    '</ColorMap>' +
  '</RasterSymbolizer>';
//Map.addLayer(index10.sldStyle(sld_intervals), {},'SLD intervals');
//Map.addLayer(index19.sldStyle(sld_intervals), {},'SLD intervals');
```

Fig 3.1 Index within Study Area in 2010.

Fig 3.2 Index within Study Area in 2019

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We finally arrive at areas that wildfire are more likely to break out, which are exemplified as red areas.
We can compare with the fire locations in 2010 and 2019 in our first figure and conclude predicted locations are very close to real fire locations.

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