# Week 11 Assignment Answers

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Links
The folder including all files:
https://code.earthengine.google.com/?accept_repo=users/yoshiyasukawamura/DevEng203

The Required Problem 1:
https://code.earthengine.google.com/cbe304eda633f3d44bfee168d81680f8

The Required Problem 2
https://code.earthengine.google.com/1fb5966975ef81e9b1c498d899c99960

The Challenge Problem 1
https://code.earthengine.google.com/519616f81e31d8ba111b55b9bc785bc6

The Challenge Problem 2
https://code.earthengine.google.com/eb1faa6e0380cd16d98a7a7b25596177

(The Codes and Results)

The Required Problem 1
Codes
==========

```
// 1-1
Map.setCenter(-111.2, 37.4, 9);

// 1-2
var ls9Collection = ee.ImageCollection('LANDSAT/LC09/C02/T1_TOA');

// 1-3
var ls9_2023 = ls9Collection
    .filterBounds(ee.Geometry.Point(-111.2, 37.4))
    .filterDate('2023-01-01', '2023-04-05')
    .sort('CLOUD_COVER')
    .first();

// 1-4
var red_2023 = ls9_2023.select('B4');
Map.addLayer(red_2023, {bands: ['B4'], min: 0, max: 0.3}, 'Red 2023');

// 1-5
```

```
var water_2023 = red_2023.lt(0.055);
Map.addLayer(water_2023, {}, 'Water 2023');

// 1-6
var ls7Collection = ee.ImageCollection('LANDSAT/LE07/C02/T1_TOA');

// 1-7
var ls7_2000 = ls7Collection
    .filterBounds(ee.Geometry.Point(-111.2, 37.4))
    .filterDate('2000-01-01', '2000-04-30')
    .sort('CLOUD_COVER')
    .first();

var red_2000 = ls7_2000.select('B3');
var water_2000 = red_2000.lt(0.055);
Map.addLayer(red_2000, {bands: ['B3'], min: 0, max: 0.3}, 'Red 2000');
Map.addLayer(water_2000, {}, 'Water 2000');

// 1-8
var water_change = water_2000.subtract(water_2023);
Map.addLayer(water_change, {palette: ['blue', 'white', 'red']}, 'Water Change 2000 - 2023');

// 1.9
var water_decrease = water_change.gt(0).selfMask().visualize({palette: ['red']});
var water_increase = water_change.lt(0).selfMask().visualize({palette: ['blue']});
Map.addLayer(water_decrease, {}, 'Water Decrease');
Map.addLayer(water_increase, {}, 'Water Increase');
```

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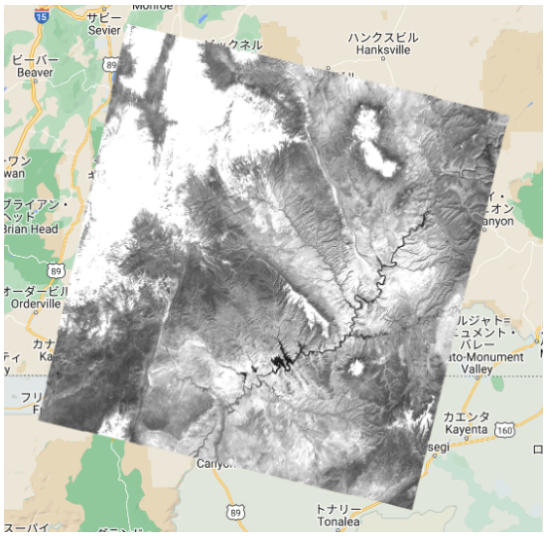
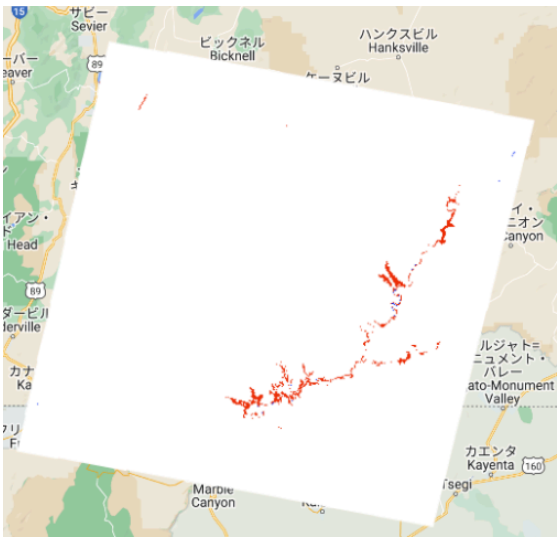
Images

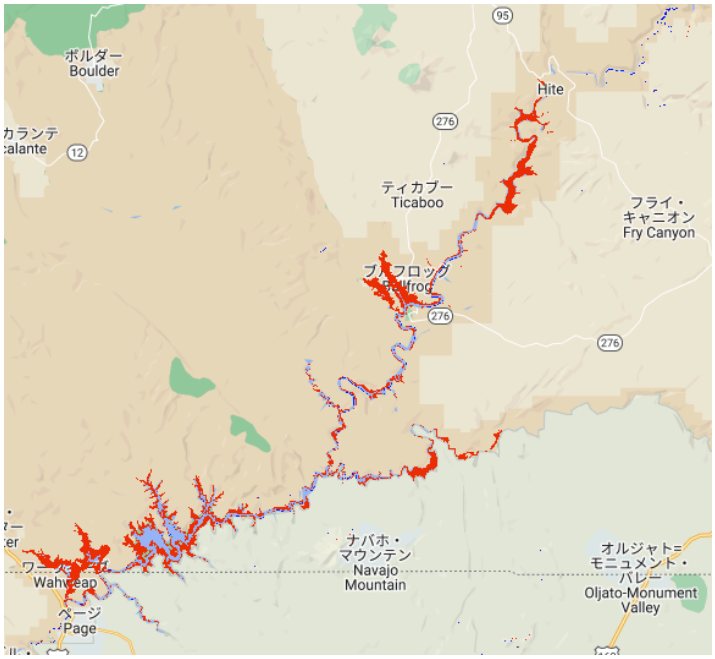
Red 2023




Water Change 2000 - 2023



Water Increase and Water Decrease




The Required Problem 2

Codes

==========

```
// 2-1
Map.setCenter(-115.15, 36.15, 9);

// 2-3
var nlcd_2001 = ee.Image("USGS/NLCD_RELEASES/2019_REL/NLCD/2001");
var nlcd_2019 = ee.Image("USGS/NLCD_RELEASES/2019_REL/NLCD/2019");
print(nlcd_2001)

// 2-4
var Clark_County_Bounds =
ee.FeatureCollection('projects/ee-yoshiyasukawamura/assets/Clark_County_Bounds');
var nlcd_2001_clip = nlcd_2001.clip(Clark_County_Bounds);
var nlcd_2019_clip = nlcd_2019.clip(Clark_County_Bounds);

// 2-5
var impervious_2001 = nlcd_2001_clip.select('impervious');
var impervious_2019 = nlcd_2019_clip.select('impervious');

// 2-6
Map.addLayer(impervious_2001, {min: 0, max: 100, palette: ['black', 'white']}, '2001 Impervious');
Map.addLayer(impervious_2019, {min: 0, max: 100, palette: ['black', 'white']}, '2019 Impervious');
```

```
// 2-7 most urban areas have over 50 points in impervious, so use 50 as the threshold
var urban_2001 = impervious_2001.gt(50);
var urban_2019 = impervious_2019.gt(50);

// 2-8
var urb_growth = urban_2019.subtract(urban_2001);
var urban_growth_increase = urb_growth.gt(0).selfMask().visualize({palette: ['blue']});
var urban_growth_decrease = urb_growth.lt(0).selfMask().visualize({palette: ['red']});

Map.addLayer(urban_growth_increase, {}, 'Urban Growth Increase');
Map.addLayer(urban_growth_decrease, {}, 'Urban Growth Decrease');
```

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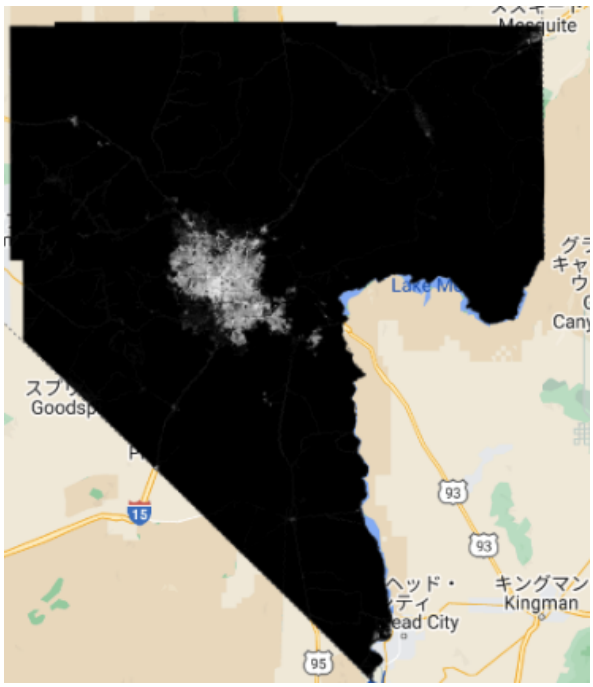
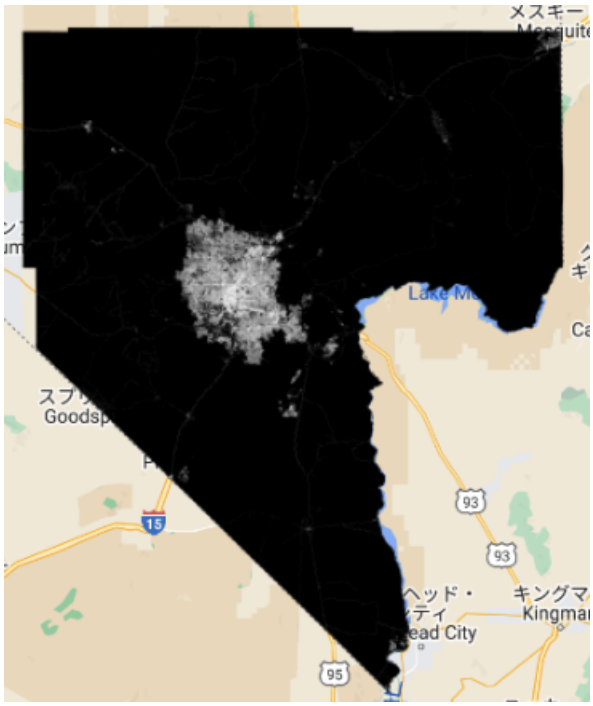
Images

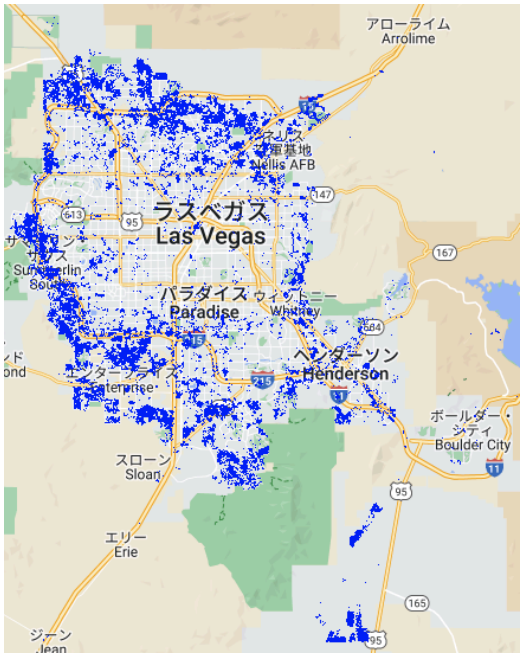
2010 Impervious




2019 Impervious



Urban Growth Increase and Urban Growth Decrease




Challenge Problem 1

Codes

==========

```
// Set the center point and zoom level
Map.setCenter(-115.15, 36.15, 9);

// Import Clark_County_Bounds
var Clark_County_Bounds =
ee.FeatureCollection('projects/ee-yoshiyasukawamura/assets/Clark_County_Bounds');

// Import LANDSAT7 in 2000 summer
var ls7_2000 = ee.ImageCollection('LANDSAT/LE07/C02/T1_TOA')
  .filterDate('2000-05-01', '2000-09-01')
  .filterBounds(Clark_County_Bounds)
  .median()
  .clip(Clark_County_Bounds);

// Import LANDSAT7 in 2022 summer
var ls7_2022 = ee.ImageCollection('LANDSAT/LE07/C02/T1_TOA')
  .filterDate('2022-05-01', '2022-09-01')
  .filterBounds(Clark_County_Bounds)
  .median()
  .clip(Clark_County_Bounds);

// Calculate the NDVI in 2000 and 2022
```

```
var ndvi_2000 = ls7_2000.select('B3').rename('NDVI');
var ndvi_2022 = ls7_2022.select('B3').rename('NDVI');

// Add the layer of NDVI
Map.addLayer(ndvi_2000, {min: -1, max: 1, palette: ['blue', 'white', 'green']}, 'NDVI 2000');
Map.addLayer(ndvi_2022, {min: -1, max: 1, palette: ['blue', 'white', 'green']}, 'NDVI 2022');

// Subtract 2000 NVDI value from 2022 one and show the difference
var ndvi_change = ndvi_2000.subtract(ndvi_2022);
Map.addLayer(ndvi_change, {min: -1, max: 1, palette: ['red', 'white', 'blue']}, 'NDVI Change');
```

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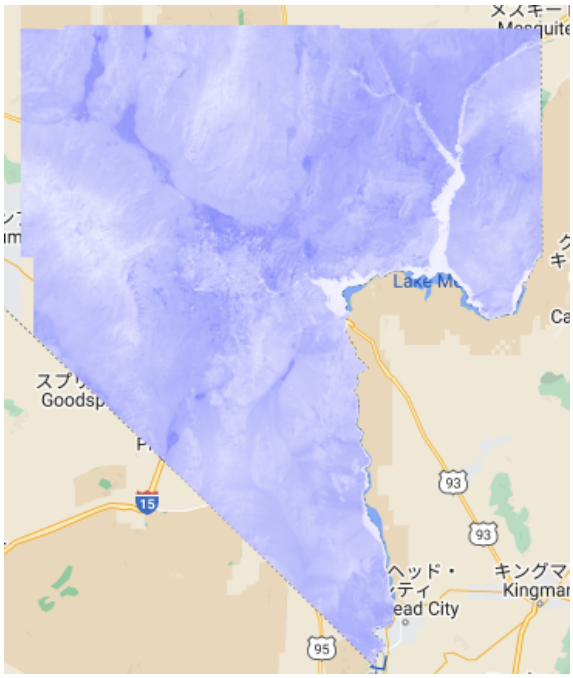
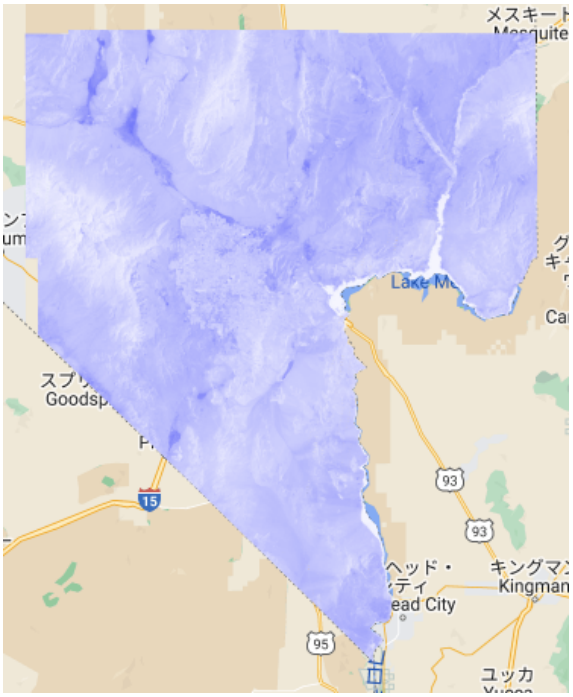
Images

NVDI 2000




NVDI 2022



NVDI Change


This figure shows that irrigation is becoming more prevalent in urban areas, as the red areas are decreasing, especially in urban areas.

Challenge Problem 2

Codes

==========

```
// Set the center point and zoom level
Map.setCenter(-119.6534, 35.9181, 10);

// Import Sentinel-1 image and filter by the date
var s1Collection = ee.ImageCollection('COPERNICUS/S1_GRD')
    .filterDate('2023-03-26', '2023-03-27')
    .filter(ee.Filter.eq('instrumentMode', 'IW'))
    .filter(ee.Filter.listContains('transmitterReceiverPolarisation', 'VV'));

// Import Tulare Lake data
var tulareLake = ee.FeatureCollection('projects/ee-yoshiyasukawamura/assets/tularelake');

// Select 'VV' and clip with the tularelake area
var vvImage = s1Collection.mean().select('VV').clip(tulareLake);

// Show the layer of the lake
```

```
Map.addLayer(vvImage, {min: -25, max: 0}, 'VV Image');

// Show the area flooded
var flooded = vvImage.lt(-18); // use 18 as the threshold since the black zone has ordinally under 18
Map.addLayer(flooded.selfMask(), {palette: ['blue']}, 'Flooded Areas');
```

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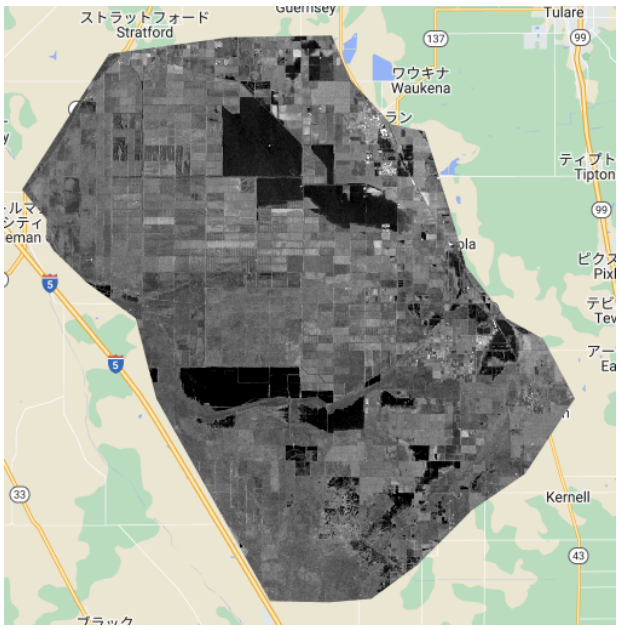
Images

VV Image




Flooded Areas