

A photograph of a flooded area. In the foreground, a large tree trunk is partially submerged in murky brown water. In the background, a building with a corrugated metal roof is partially submerged. The sky is overcast and grey. A large white stylized 'M' shape is overlaid on the left side of the image.

Introduction to flood inundation mapping and damage assessment using remote sensing

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Photo : Shakil Ahamed

Background of flood inundation mapping and damage assessment



Photo subject to copyright



Photo subject to copyright

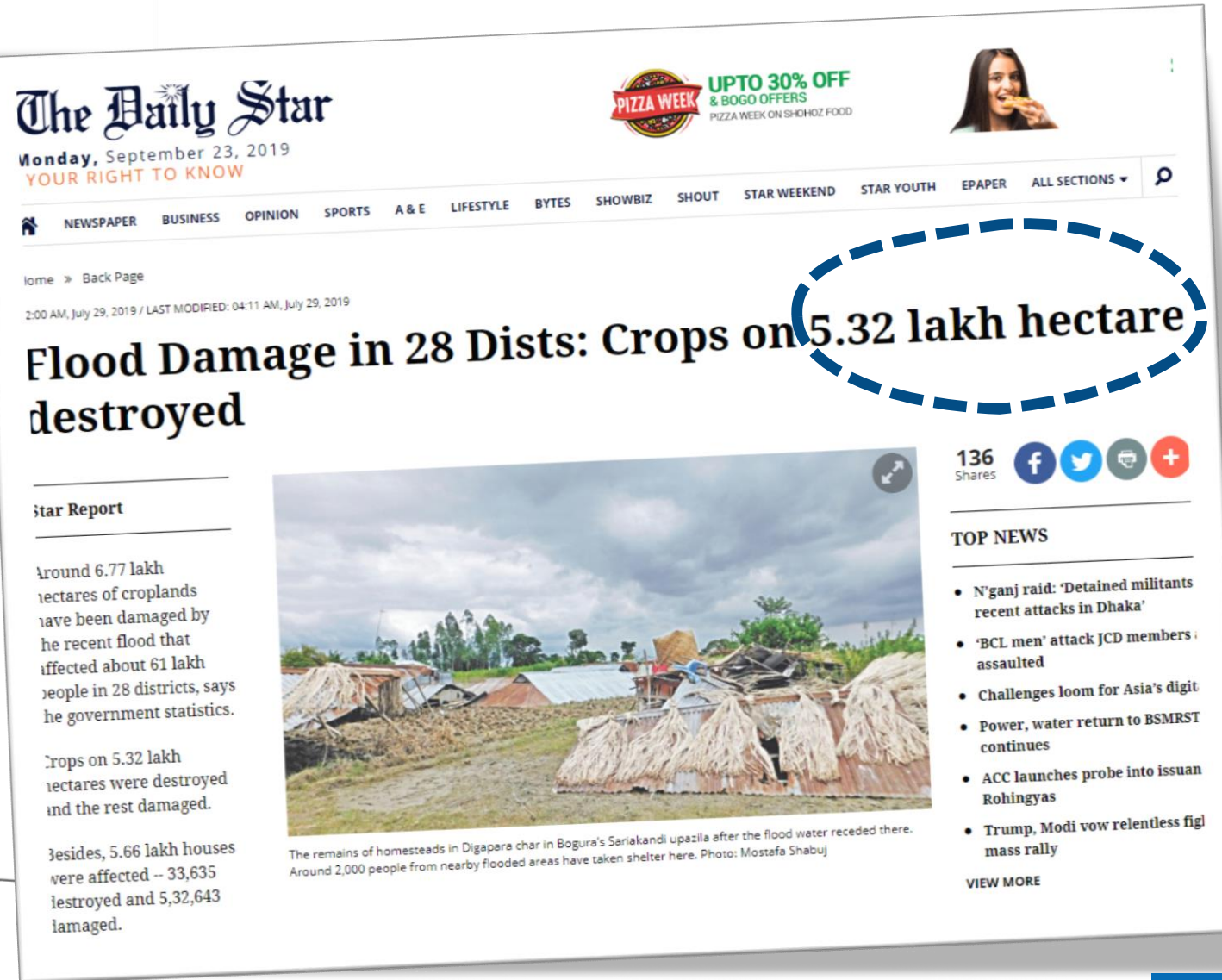


Photo subject to copyright

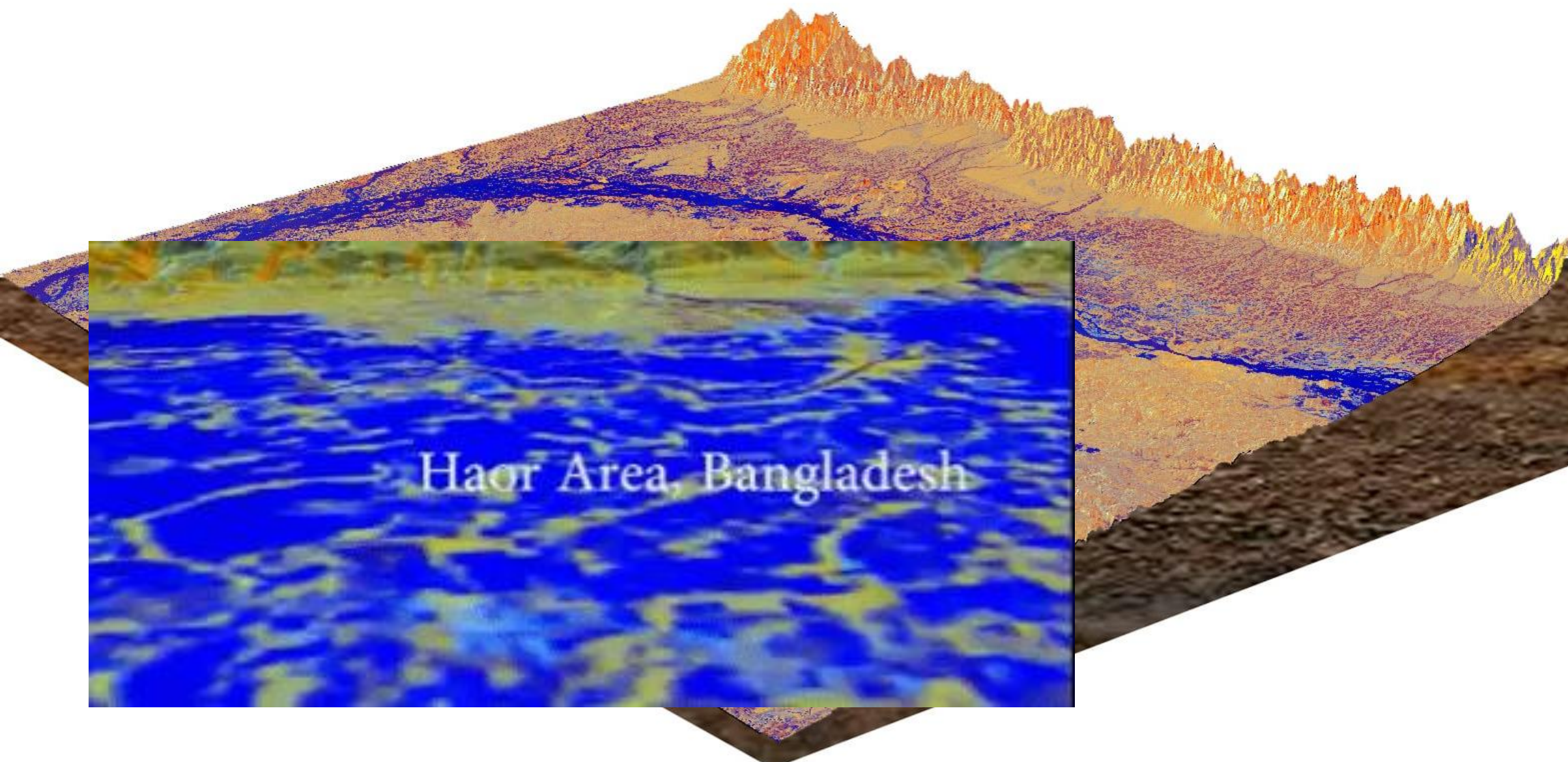


Photo subject to copyright

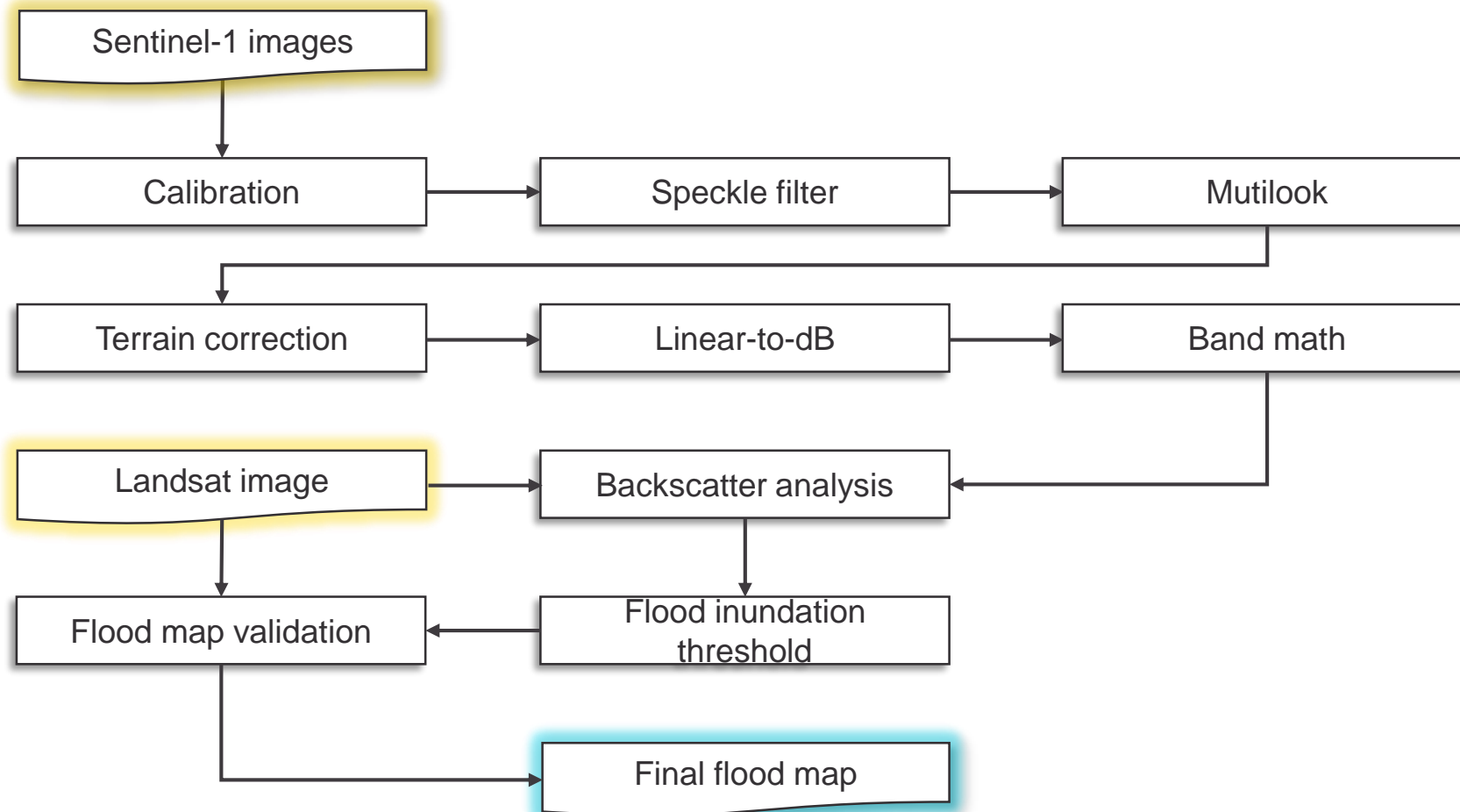
Background of flood inundation mapping and damage assessment



Background of flood inundation mapping and damage assessment

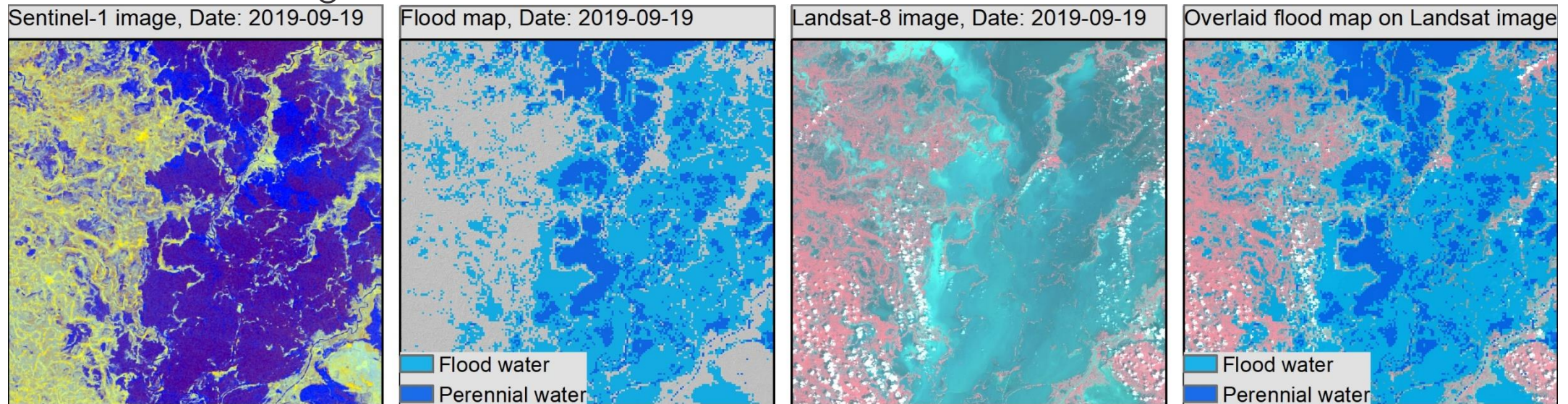


Methods: flood inundation mapping



Exercise - 1

Determination of Copernicus sentinel-1 backscatter threshold to automatically flood inundation mapping in GEE and comparison of sentinel-1 based flood inundation map with Landsat-8 image



Open the link: <https://tinyurl.com/yy4kddek>

Exercise - 1

1.1 Determination of flooding area Get Link Save Run Reset

```
1 //Pre-monsoon or pre-flood Copernicus Sentinel-1 Date: 2019-05-20
2 //Data available (https://scihub.copernicus.eu/dhus/#/home)
3 var S1pre = ee.Image('COPERNICUS/S1_GRD/S1A_IW_GRDH_1SDV_20190520T120441_20190520T120506_027311_031480_43CA');
4
5 //Flood inundation periods Copernicus Sentinel-1 Date: 2019-09-19
6 var S1 = ee.Image('COPERNICUS/S1_GRD/S1A_IW_GRDH_1SDV_20190919T235547_20190919T235612_029097_034D72_B042');
7
8
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17
18 //Flood inundation periods Landsat Image to comparison with sentinel based inundation results Date: 2019-09-19
19 var landsat = ee.Image('LANDSAT/LC08/C01/T1_RT/LC08_137043_20190920');
20 Map.addLayer(landsat,{ bands: ['B5', 'B4', 'B3'], min: 2164, max: 20205 }, 'Landsat', false)
21
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37
38 // Flood masking and mosaicking the Sentinel 1 image.
39 var FloodMap = ee.ImageCollection([
40   vv_smoothed.updateMask(vv_smoothed.lt(-16)).visualize(floodViz),
41   vh_smoothed.updateMask(vh_smoothed.lt(-20)).visualize(floodViz),
42   Sprevv_smoothedmask.visualize({palette: ['BLUE']})),
43   ]).mosaic();
44 Map.addLayer(FloodMap, {}, 'Flood Map');
45
```

Task Please change the backscatter value from line 40 and 41, and run code. Visually compare the results with Landsat image.

Exercise - 1

1.1 Determination of flooding ar

code.earthengine.google.com/4f2457088dcc66bf32257ae905ef5a6c

Apps Imported From IE Others Soft_Tools IE Tab GEE Java Other bookmarks

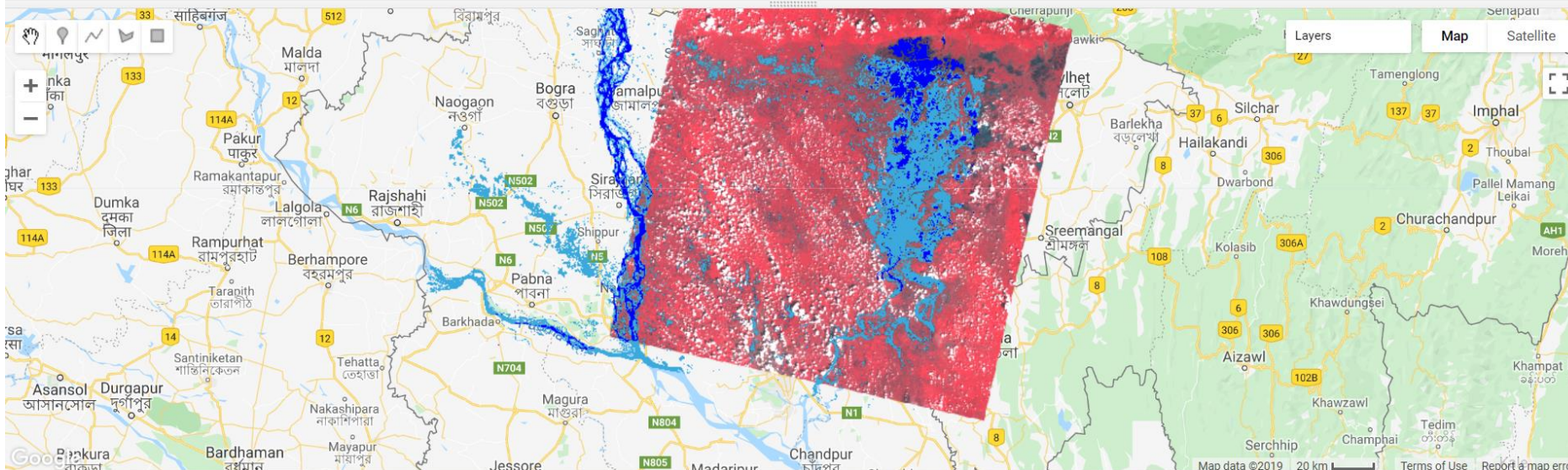
Google Earth Engine Search places and datasets...

1.1 Determination of fl... Get Link Save Run Reset

```
52 // region and // the boundary of the flood mapping areas
53 maxPixels:1e10,
54 folder: "folder_name", // please give the folder name from your Good
55 });
56
57 /**
58 // Prepared by:
59 // Kabir Uddin
60 // GIS and Remote Sensing Specialist, Geospatial Solutions
61 // LULC Thematic Lead, SERVIR HKH
62
```

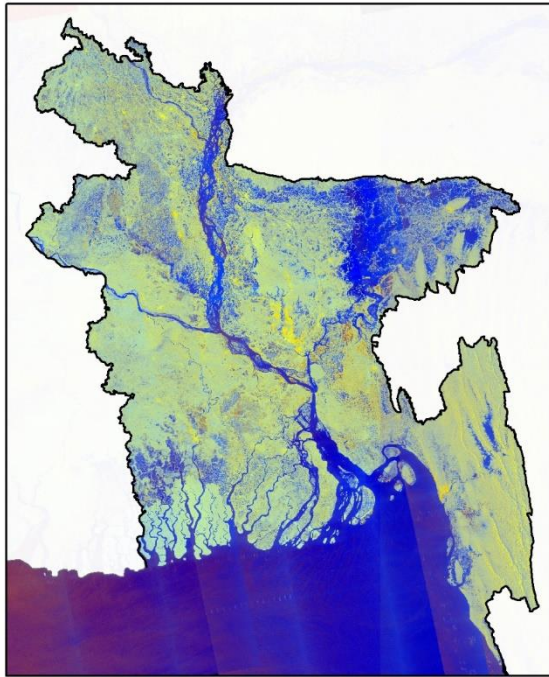
Inspector Console Tasks

Use print(...) to write to this console.

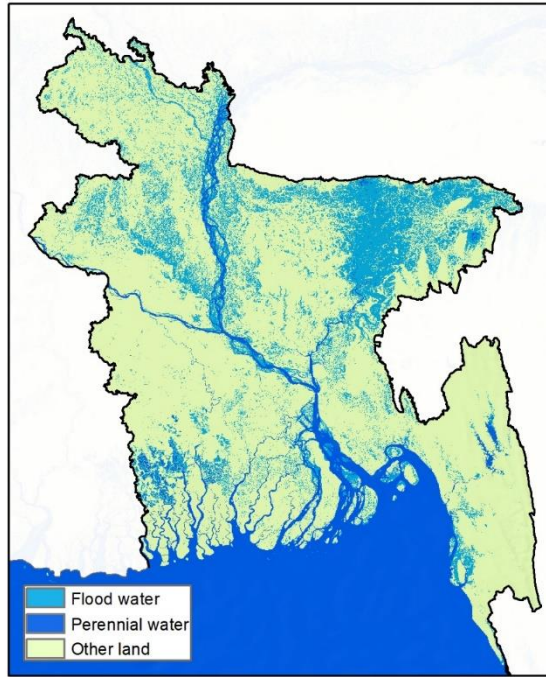


Exercise - 2

Flood inundation mapping using sentinel-1 for any chosen site/**boundary** and date



Sentinel-1 RGB composite
Date: ('2019-07-10' to '2019-7-20')



Flood Inundation Map
Date: ('2019-07-10' to '2019-7-20')

Open the link: <https://tinyurl.com/y55hoa2m>

Exercise - 2

The screenshot displays the Google Earth Engine web interface. The top navigation bar includes the Google Earth Engine logo, a search bar, and user profile icons. Below the navigation bar, the 'Scripts' tab is active, showing a script titled '1.2 Flood mapping preferred are...'. The script code is as follows:

```
Imports (1 entry)
var bnd: Table "bnd_buff"

1 //Zoom to the map following the study boundary
2 Map.centerObject(bnd, 7)
3
4
```

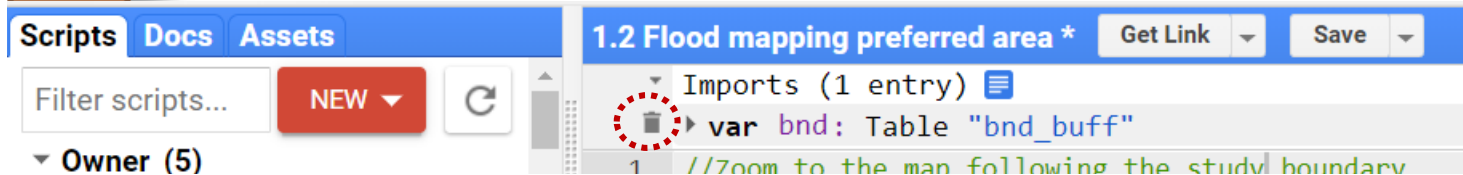
The right sidebar contains the 'Inspector' tab, which lists the following layers:

- rgb_composite (RUN button)
- rgb_composite (checked, 2h)
- flood_map (checked, 15m)
- landuse

The main map area shows a satellite view of India, with a blue-shaded region indicating the flood mapping area. The map includes labels for various states and cities, such as Patna, Ranchi, Kolkata, and Guwahati. The map controls on the right include 'Layers', 'Map', and 'Satellite' buttons.

Exercise - 2

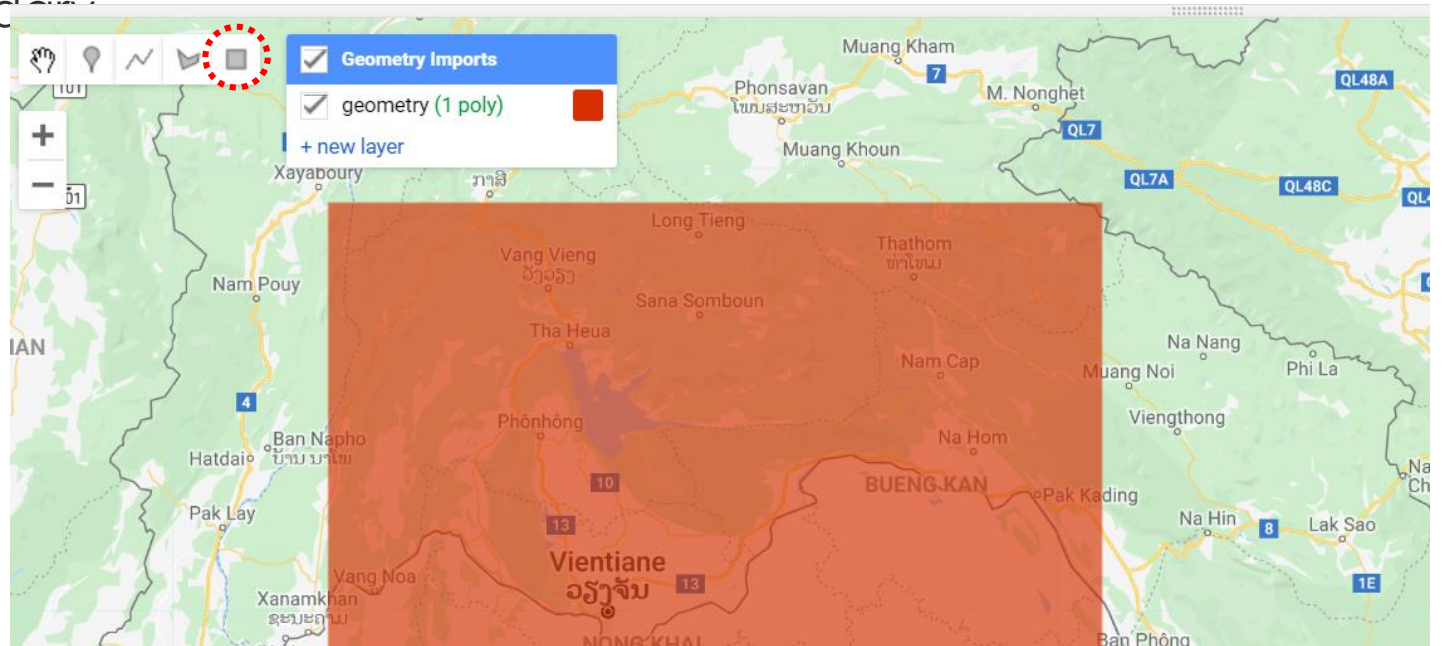
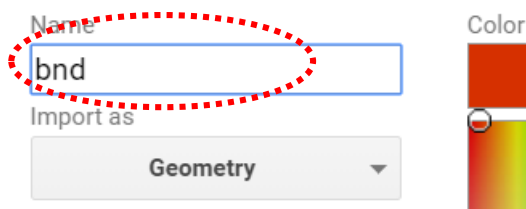
Task Delete the existing boundary and digitized a new study boundary



Task Digitized a new study boundary

Task Rename default name "geometry" to "bnd"

Configure geometry import



Task Run the code with new boundary

Exercise - 2

Task //Select the pre-flood Copernicus Sentinel-1 imagery

```
3
4 //Selecting the pre-monsoon or pre-flood Copernicus Sentinel-1
5 //Sentinel-1 Data available also at https://scihub.copernicus.eu/dhus/#/home
6 var sentinel1p = ee.ImageCollection('COPERNICUS/S1_GRD')
7   .filterDate('2019-01-01', '2019-5-30') // Please change perineal water date
8   .filterBounds(bnd); // Within the boundary selecting the satellite imagery
9
```

Task //Select the flooding time Copernicus Sentinel-1 imagery

```
30
31 //Selecting the flood Copernicus Sentinel-1
32 var sentinel1 = ee.ImageCollection('COPERNICUS/S1_GRD')
33   .filterDate('2019-07-10', '2019-7-20')
34   .filterBounds(bnd);
35
```


Exercise - 2

Task //If needed adjust the sentinel-1 backscatter threshold

```
75  
76 // Flood masking and mosaicking the Sentinel 1 image.  
77 var FloodMap = ee.ImageCollection([  
78   vv_smoothed.updateMask(vv_smoothed.lt(-17)).visualize(floodViz),  
79   vh_smoothed.updateMask(vh_smoothed.lt(-20)).visualize(floodViz),  
80   vvp_watermask.visualize({palette: ['BLUE']})),  
81   ]).mosaic();  
82 Map.addLayer(FloodMap.clip(bnd), {}, 'Flood Map');  
83
```

Exercise - 2

Task Export the generated flood map

```
// Export the flood map.  
Export.image.toDrive({  
  image: FloodMap, //Generated flood map  
  description: 'Flood_Map', //Export file name  
  scale: 90 //Map resolution, here we used 300 to minimized the google drive  
  //region: bnd // The boundary of the flood mapping areas  
  maxPixels: 1e10,  
  folder: "folder_name", // please give the folder name from your Google drive  
});
```


Exercise - 4

Flood damage assessment-pre-flood land cover mapping using GEE

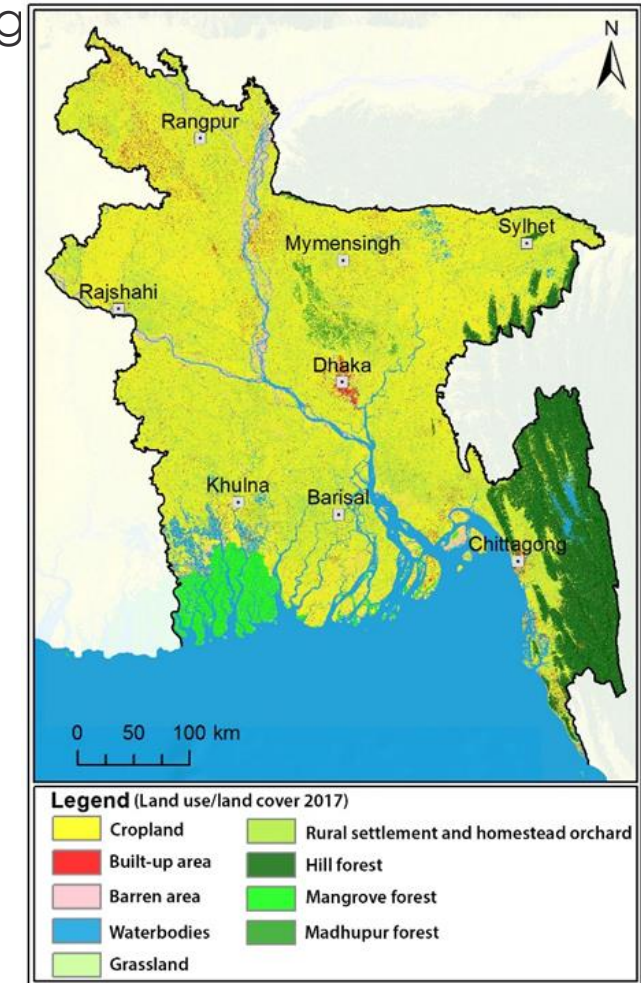
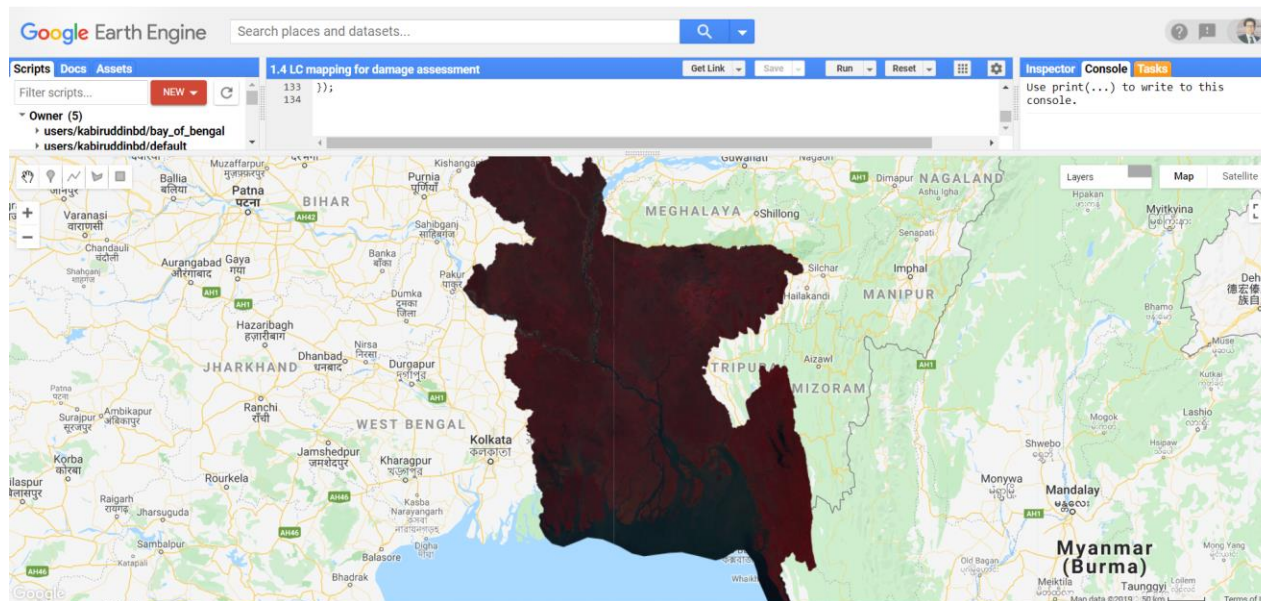


Exercise - 4

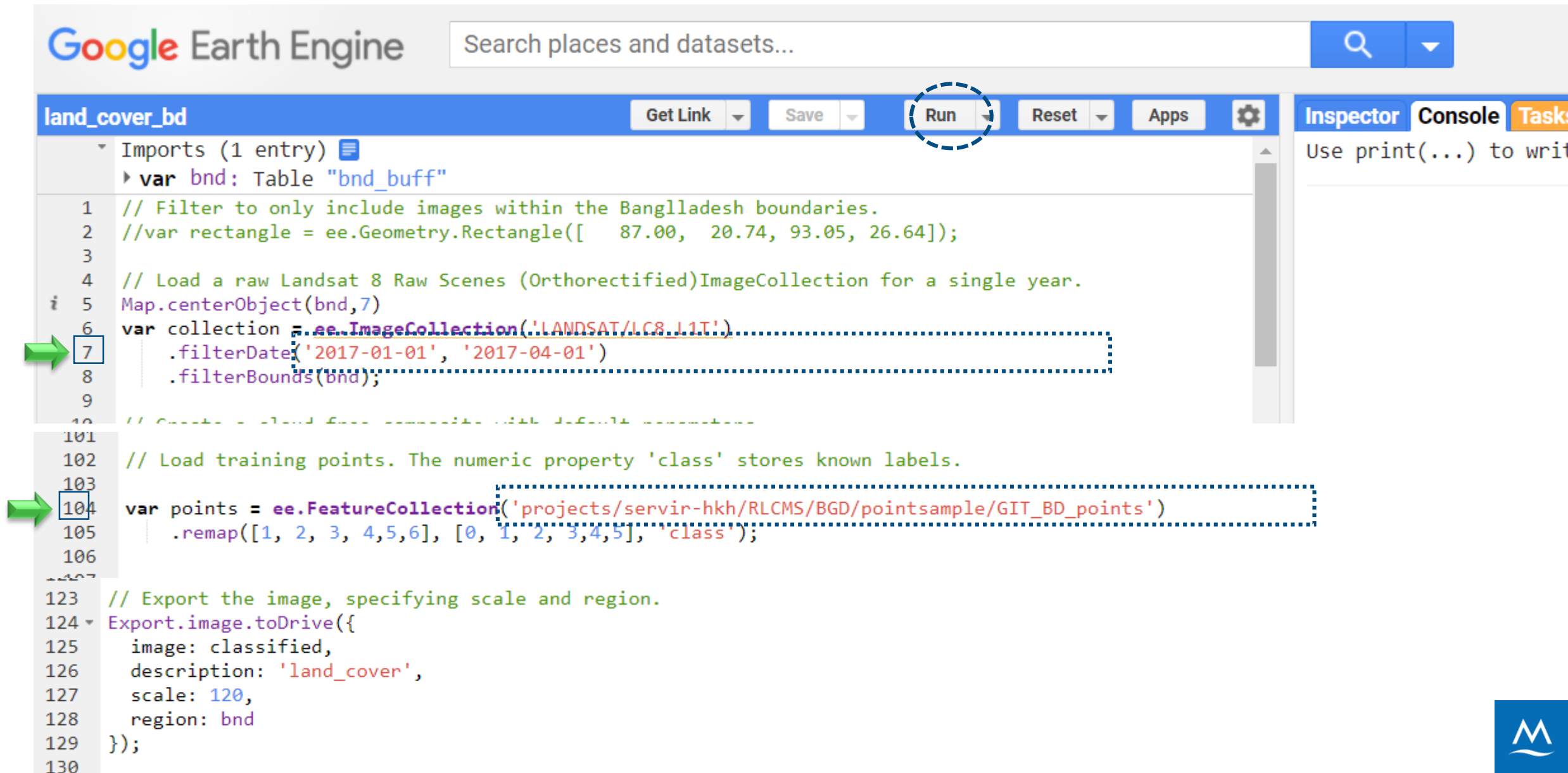
Flood damage assessment-pre-flood land cover mapping using

Open the link:

<https://tinyurl.com/4d3ze2k9>



Exercise - 4



The screenshot shows the Google Earth Engine interface. The top bar includes the Google Earth Engine logo, a search bar, and buttons for 'Get Link', 'Save', 'Run' (circled), 'Reset', 'Apps', and a settings gear. The main area displays a script for land cover classification in Bangladesh. The script is titled 'land_cover_bd' and includes the following code:

```
land_cover_bd
Imports (1 entry)
  ▶ var bnd: Table "bnd_buff"
1 // Filter to only include images within the Bangladesh boundaries.
2 //var rectangle = ee.Geometry.Rectangle([ 87.00, 20.74, 93.05, 26.64]);
3
4 // Load a raw Landsat 8 Raw Scenes (Orthorectified)ImageCollection for a single year.
5 Map.centerObject(bnd,7)
6 var collection = ee.ImageCollection('LANDSAT/LC8_L1T')
7   .filterDate('2017-01-01', '2017-04-01')
8   .filterBounds(bnd);
9
10 // Create a cloud free composite with default parameters
101
102 // Load training points. The numeric property 'class' stores known labels.
103
104 var points = ee.FeatureCollection('projects/servir-hkh/RLCMS/BGD/pointsample/GIT_BD_points')
105   .remap([1, 2, 3, 4,5,6], [0, 1, 2, 3,4,5], 'class');
106
107
123 // Export the image, specifying scale and region.
124 Export.image.toDrive({
125   image: classified,
126   description: 'land_cover',
127   scale: 120,
128   region: bnd
129 });
130
```

Two green arrows point to specific lines of code: one to line 7 and another to line 104. The 'Run' button is circled in blue. The right sidebar shows the 'Inspector', 'Console', and 'Tasks' tabs, with the 'Console' tab active and displaying the text 'Use print(...) to write'.

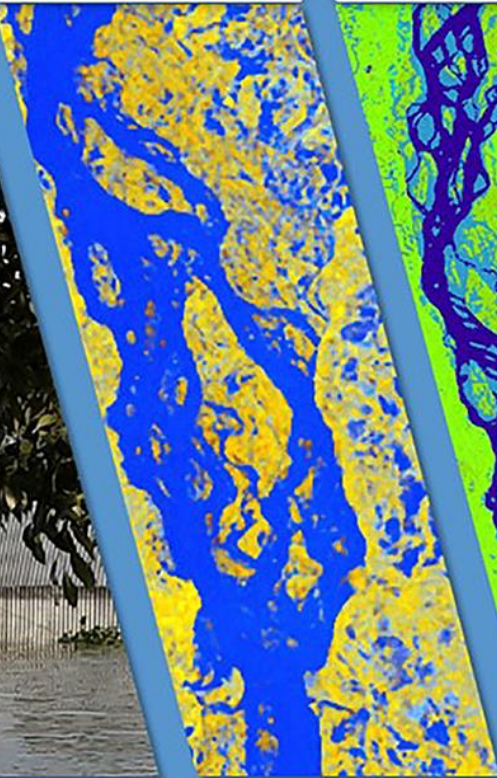
Homework

Find a flood shelter suitability

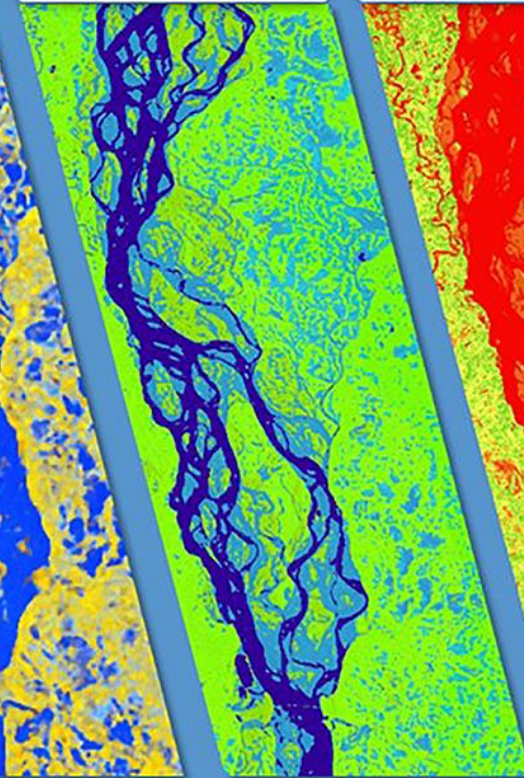
Flood
inundation



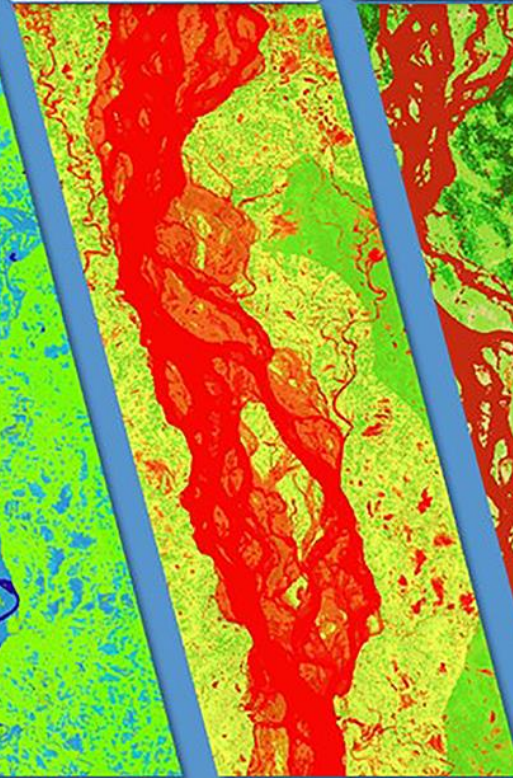
Sentinel -1
image



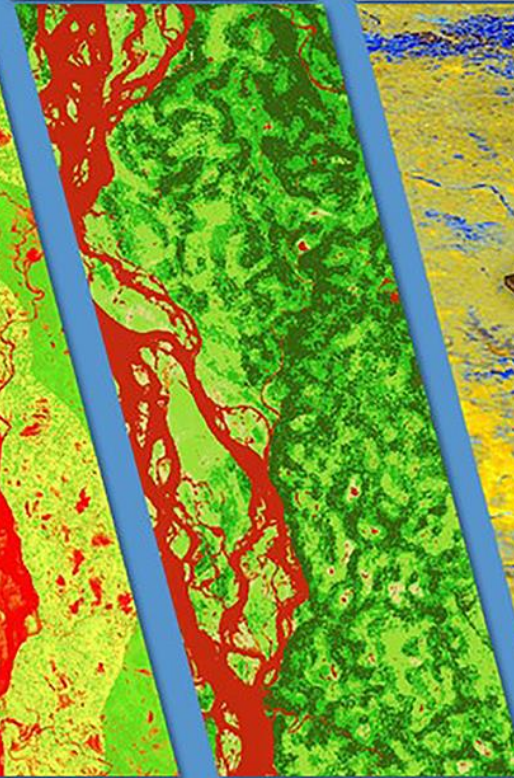
Flood map



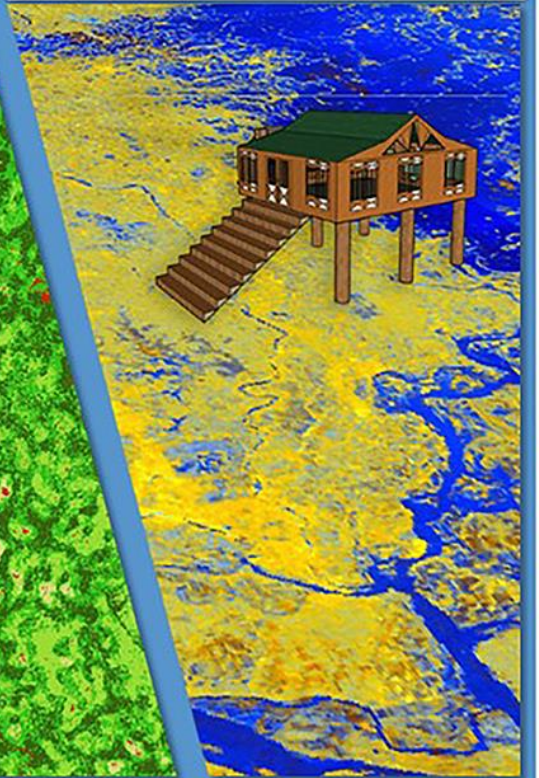
Flood hazard
area



Shelter
suitability



Flood shelter



Thank you

Let's protect
the pulse.