7th Joint Project Team Meeting of Sentinel Asia STEP3 (JPTM2019)

Training Workshop

Flood Mapping and Damage Assessment

Please download data from the google drive

https://tinyurl.com/wguwma8

Kabir Uddin
GIS and Remote Sensing Specialist, Geospatial Solutions
Email: Kabir.Uddin@icimod.org

International Centre for Integrated Mountain Development

Kathmandu, Nepal

FOR MOUNTAINS AND PEOPLE

Dhaka Tribune

TODAY'S PAPER NEWS BUSINESS SPO

Home / Bangladesh / Nation

300,000 hectares of cropland d

Ahmed Alam

The Daily Star

Monday, September 23, 2019
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NEWSPAPER BUSINESS OPINION SPORTS

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2:00 AM, July 29, 2019 / LAST MODIFIED: 04:11 AM, July 29, 2019

Flood Damage in
destroyed

Star Report

Around 6.77 lakh hectares of croplands have been damaged by the recent flood that affected about 61 lakh people in 28 districts, says the government statistics.

Crops on 5.32 lakh hectares were destroyed and the rest damaged.

Besides, 5.66 lakh houses were affected -- 33,635 destroyed and 5,32,643 damaged.

The remains of homesteads in Diga
Around 2,000 people from nearby fl

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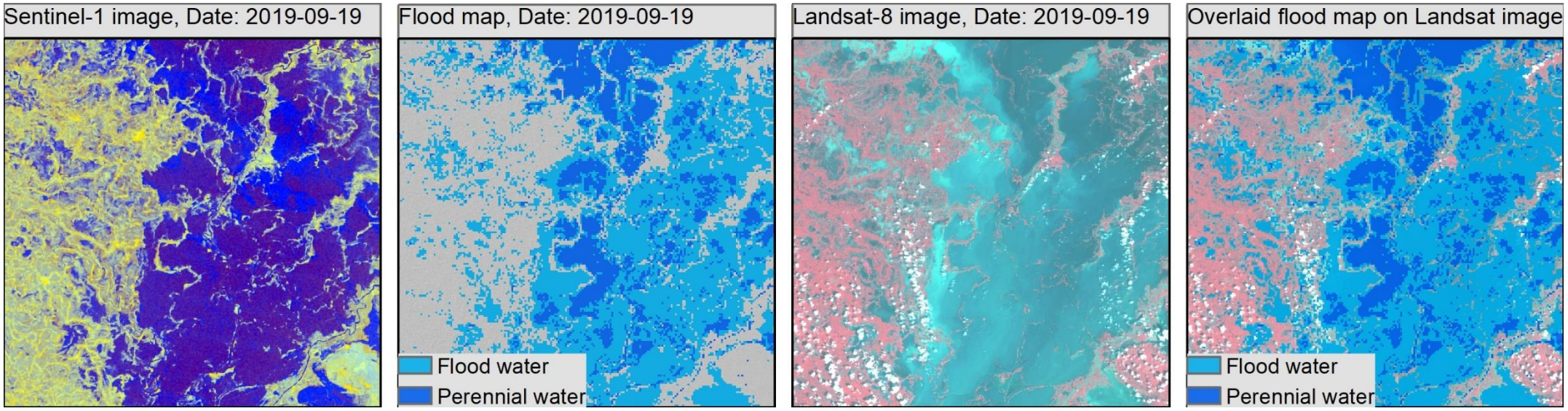
Copernicus EMS
@CopernicusEMS

Great to see #Sentinel1 being used in #Bangladesh to develop operational methodologies for rapid flood inundation and potential flood damaged area mapping to support a quick and effective event response
#Monsoon2019 #monsoon
Paper: mdpi.com/2072-4292/11/1...

ICIMOD

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

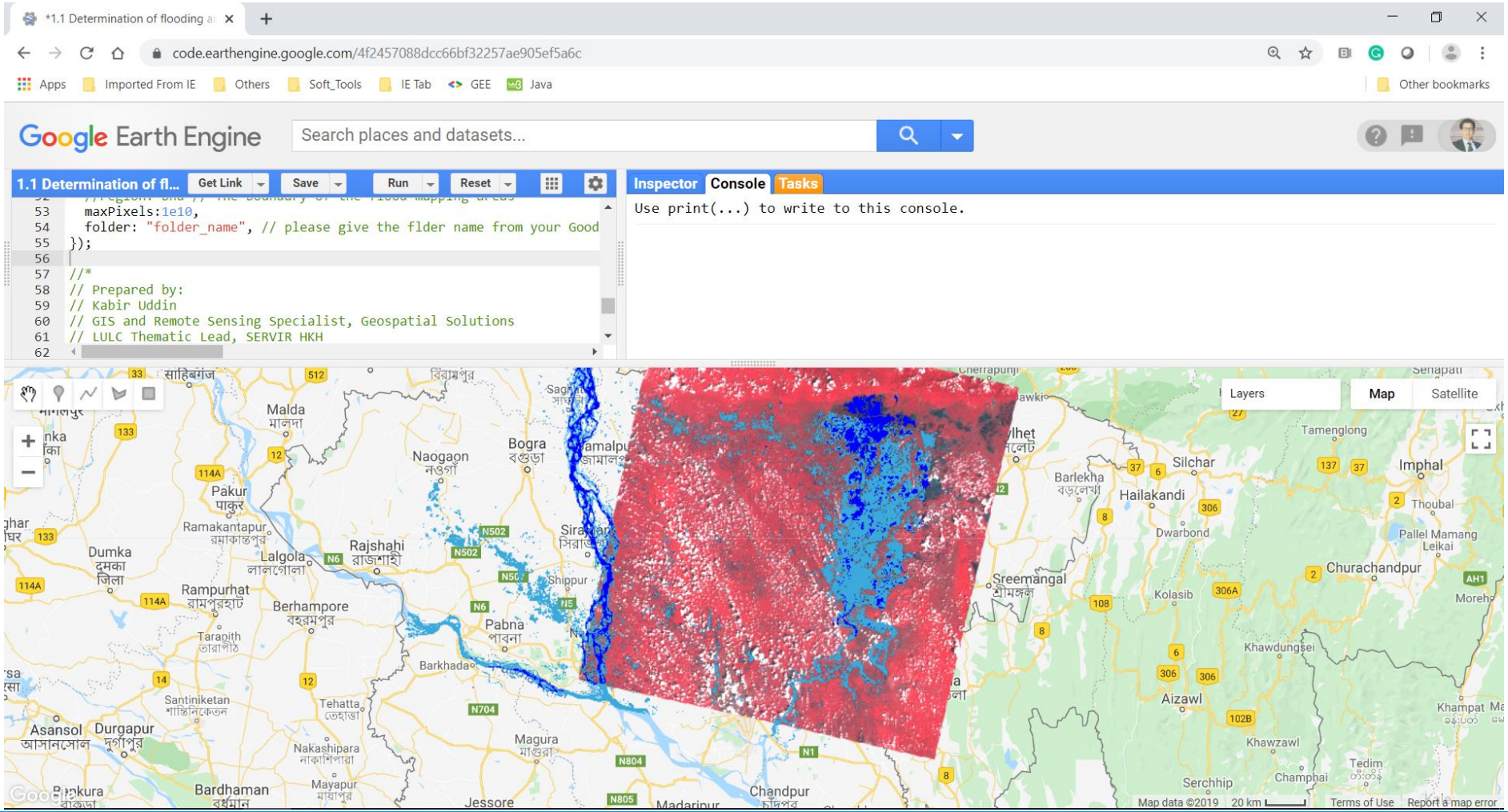
```
1  //Pre-monsoon or pre-flood Copernicus Sentinel-1 Date: 2019-05-20
2  //Data available (https://scihub.copernicus.eu/dhus/#/home)
3  var S1pre = ee.Image('COPERNICUS/S1_GRD/S1A_IW_GRDH_1SDV_20190520T120441_20190520T120506_027311_031480_43CA');
4
5  //Flood inundation periods Copernicus Sentinel-1 Date: 2019-09-19
6  var S1 = ee.Image('COPERNICUS/S1_GRD/S1A_IW_GRDH_1SDV_20190919T235547_20190919T235612_029097_034D72_B042');
7

28 //Flood inundation periods Landsat Image to comparison with sentinel based inundation results Date: 2019-09-19
29 var landsat = ee.Image('LANDSAT/LC08/C01/T1_RT/LC08_137043_20190920');
30 Map.addLayer(landsat,{  bands: ['B5', 'B4', 'B3'],  min: 2164, max: 20205 },'Landsat', false)
31

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.

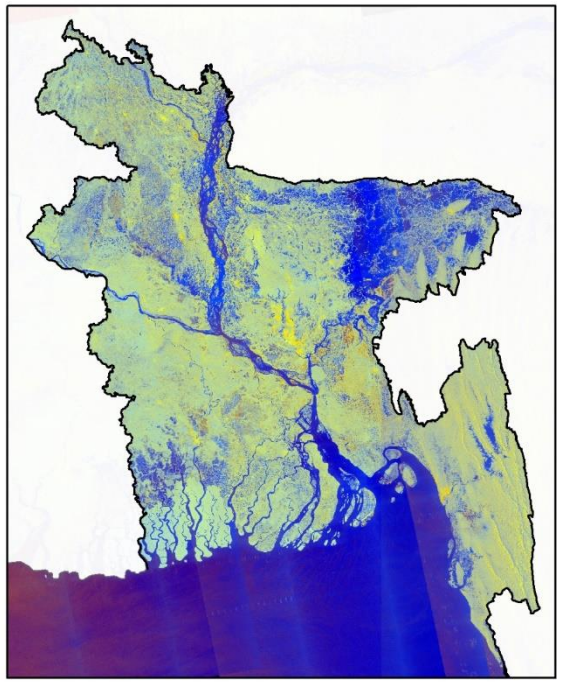
Exercise - 1



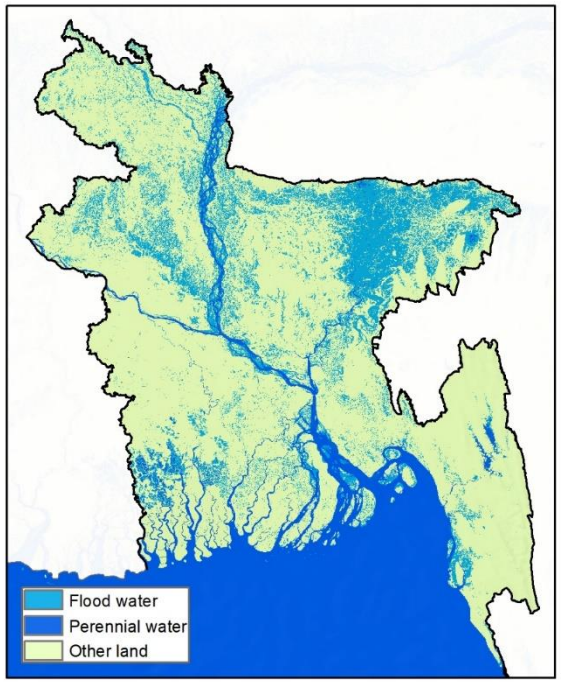
ICIMOD

Exercise - 2

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



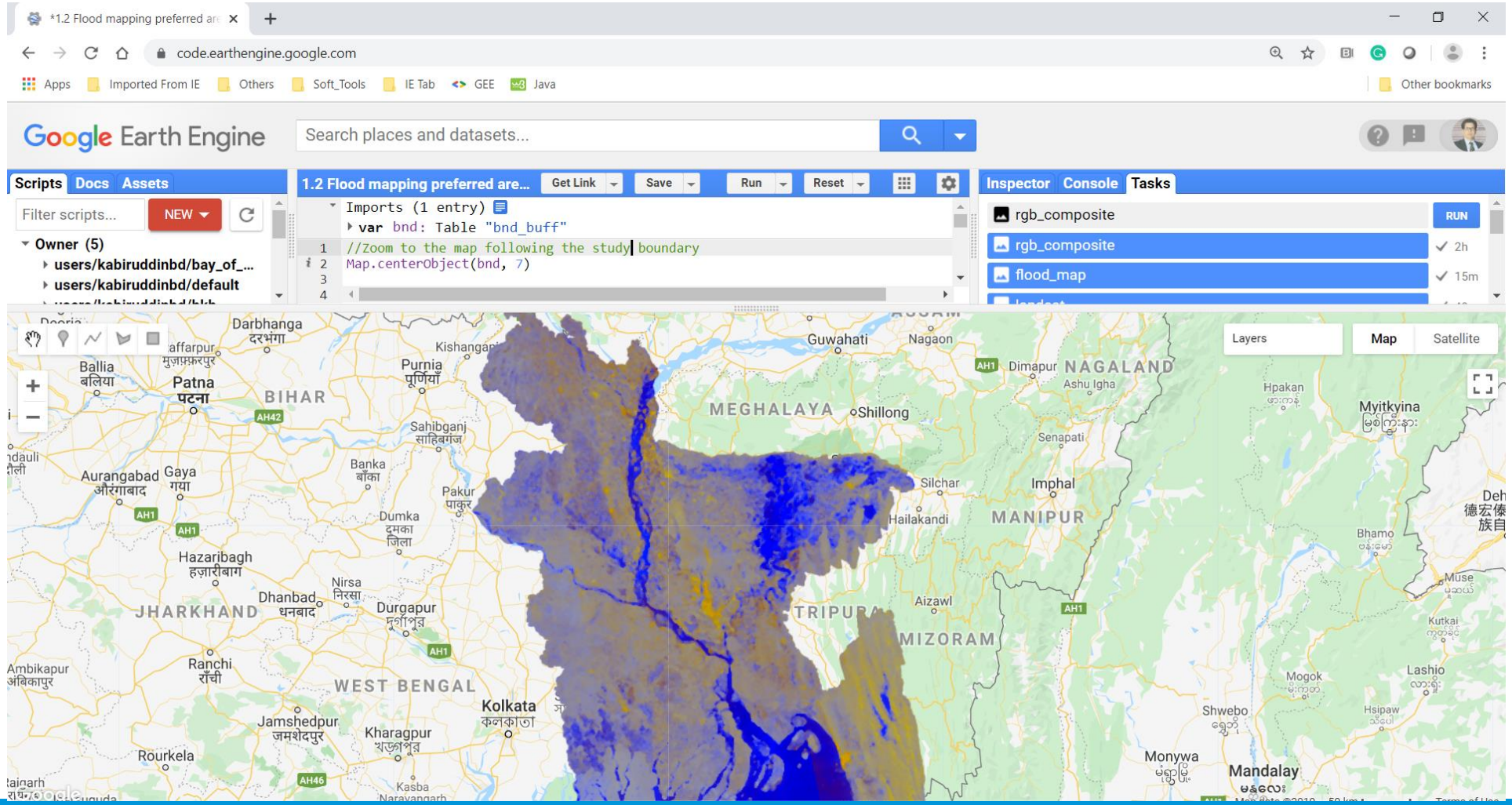
Sentinel-1 RGB composite
Date: ('2019-07-10‘ to '2019-7-20')



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

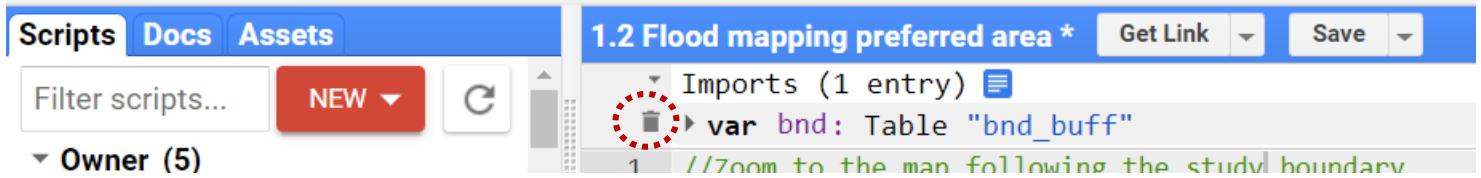
Open the link: https://tinyurl.com/y55hoa2m

Exercise - 2

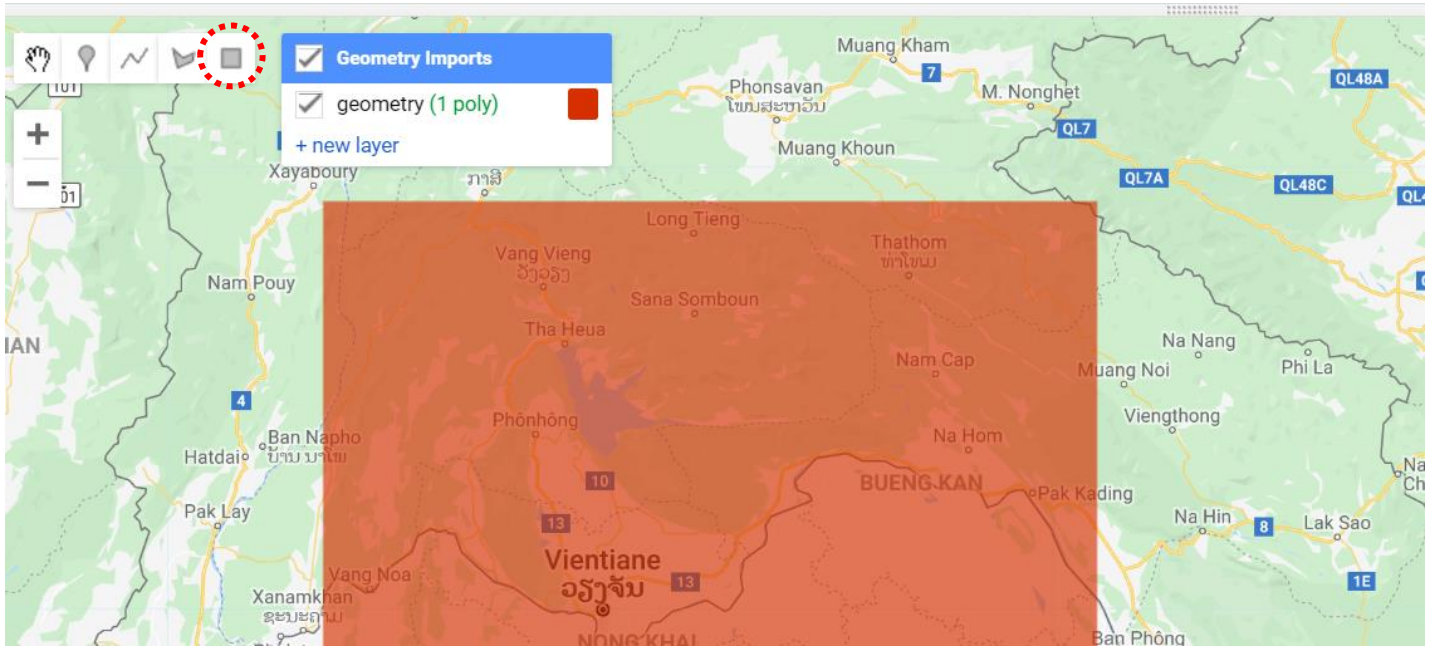

*1.2 Flood mapping preferred ar
code.earthengine.google.com
Apps
Imported From IE
Others
Soft_Tools
IE Tab
GEE
Java
Other bookmarks
Google Earth Engine
Search places and datasets...
Scripts
Docs
Assets
Filter scripts...
NEW
Owner (5)
users/kabiruddinbd/bay_of_...
users/kabiruddinbd/default
1.2 Flood mapping preferred are...
Get Link
Save
Run
Reset
Imports (1 entry)
var bnd: Table "bnd_buff"
1 //Zoom to the map following the study boundary
2 Map.centerObject(bnd, 7)
3
4
Inspector
Console
Tasks
rgb_composite
RUN
rgb_composite
2h
flood_map
15m
Layers
Map
Satellite
Darbhanga
दरभंगा
Kishanganj
Purnia
पूर्णिया
Guwahati
Nagaon
Ballia
बलिया
Patna
पटना
BIHAR
AH42
MEGHALAYA
Shillong
AH1
Dimapur
NAGALAND
Ashu Igha
Hpakan
Myitkyina
Sahibganj
साहिबगंज
Senapati
Aurangabad
औरंगाबाद
Gaya
गया
Banka
बाँका
Pakur
पाकुर
Silchar
Imphal
Hailakandi
MANIPUR
Dumka
दुमका
जिला
Bhamo
Hazaribagh
हज़ारीबाग
Nirsa
निरसा
Dhanbad
धनबाद
Durgapur
दुर्गापुर
JHARKHAND
Aizawl
TRIPURA
MIZORAM
Muse
Kutkai
Ambikapur
अंबिकापुर
Ranchi
राँची
WEST BENGAL
Kolkata
कलकाता
Mogok
Lashio
Shwebo
Hsipaw
Jamshedpur
जमशेदपुर
Kharagpur
खड़गपुर
Monywa
Mandalay
Rourkela
AH46
Kasba
Narayangarh

Exercise - 2

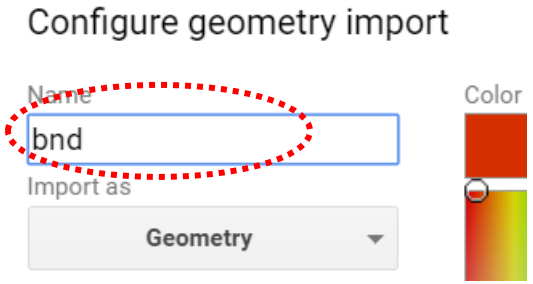
Task Delete the existing boundary and digitized a new study boundary



Task Digitized a new study boundary



Task Rename default name “geometry” to “bnd”



Task Run the code with new boundary

Exercise - 2

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

```
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

```
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(-26)).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 flder name from your Goodle drive
});
```

Exercise - 3

Google Earth Engine

Sentinel-1 Preprocessing

Imagery in the Earth Engine `'COPERNICUS/S1_GRD'` Sentinel-1 `ImageCollection` is consists of Level-1 Ground Range Detected (GRD) scenes processed to backscatter coefficient (σ°) in decibels (dB). The backscatter coefficient represents target backscattering area (radar cross-section) per unit ground area. Because it can vary by several orders of magnitude, it is converted to dB as $10*\log_{10}\sigma°$. It measures whether the radiated terrain scatters the incident microwave radiation preferentially away from the SAR sensor dB < 0) or towards the SAR sensor dB > 0). This scattering behavior depends on the physical characteristics of the terrain, primarily the geometry of the terrain elements and their electromagnetic characteristics.

Earth Engine uses the following preprocessing steps (as implemented by the Sentinel-1 Toolbox) to derive the backscatter coefficient in each pixel:

1. **Apply orbit file**
   - Updates orbit metadata with a restituted orbit file.
2. **GRD border noise removal**
   - Removes low intensity noise and invalid data on scene edges. (As of January 12, 2018)
3. **Thermal noise removal**
   - Removes additive noise in sub-swaths to help reduce discontinuities between sub-swaths for scenes in multi-swath acquisition modes. (This operation cannot be applied to images produced before July 2015)
4. **Radiometric calibration**
   - Computes backscatter intensity using sensor calibration parameters in the GRD metadata.
5. **Terrain correction** (orthorectification)
   - Converts data from ground range geometry, which does not take terrain into account, to σ° using the SRTM 30 meter DEM or the ASTER DEM for high latitudes (greater than 60°

GEE data availability (time)
Oct 3, 2014- Nov 8, 2019

Today date
Nov 13, 2019

5 backlog

Need to process

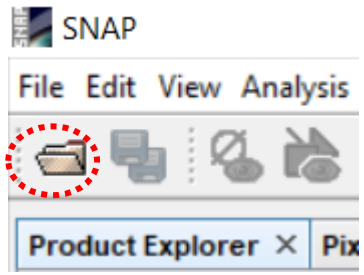
Sentinel Asia

Constellation

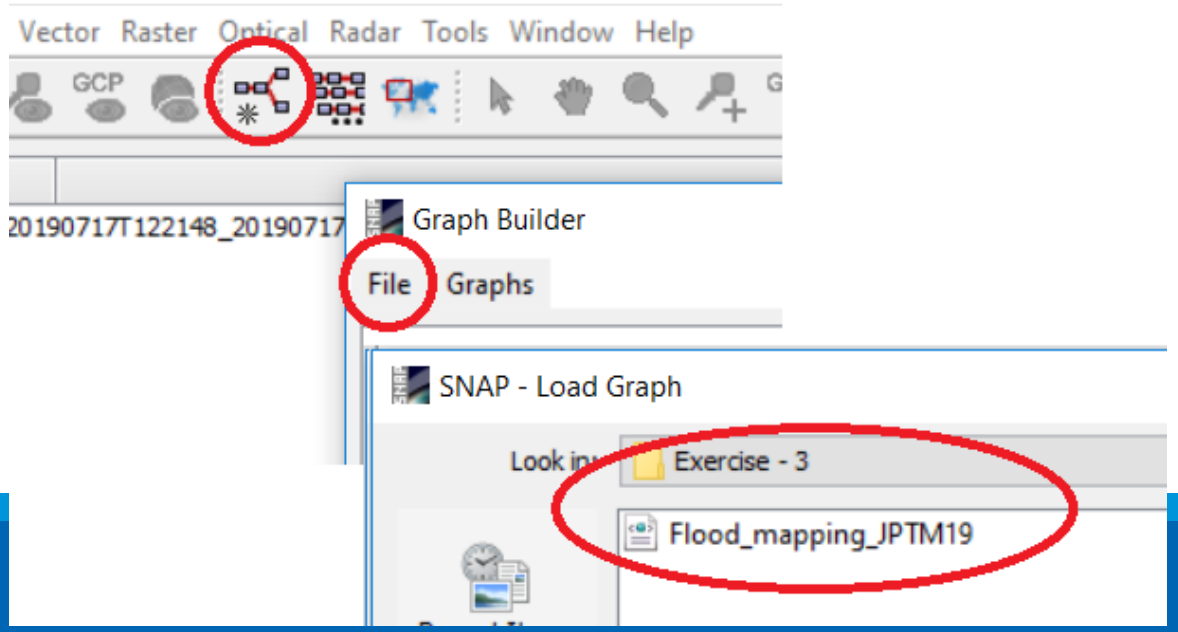
Exercise - 3

Task Open the SNAP tools

Task Open the Sentinel image

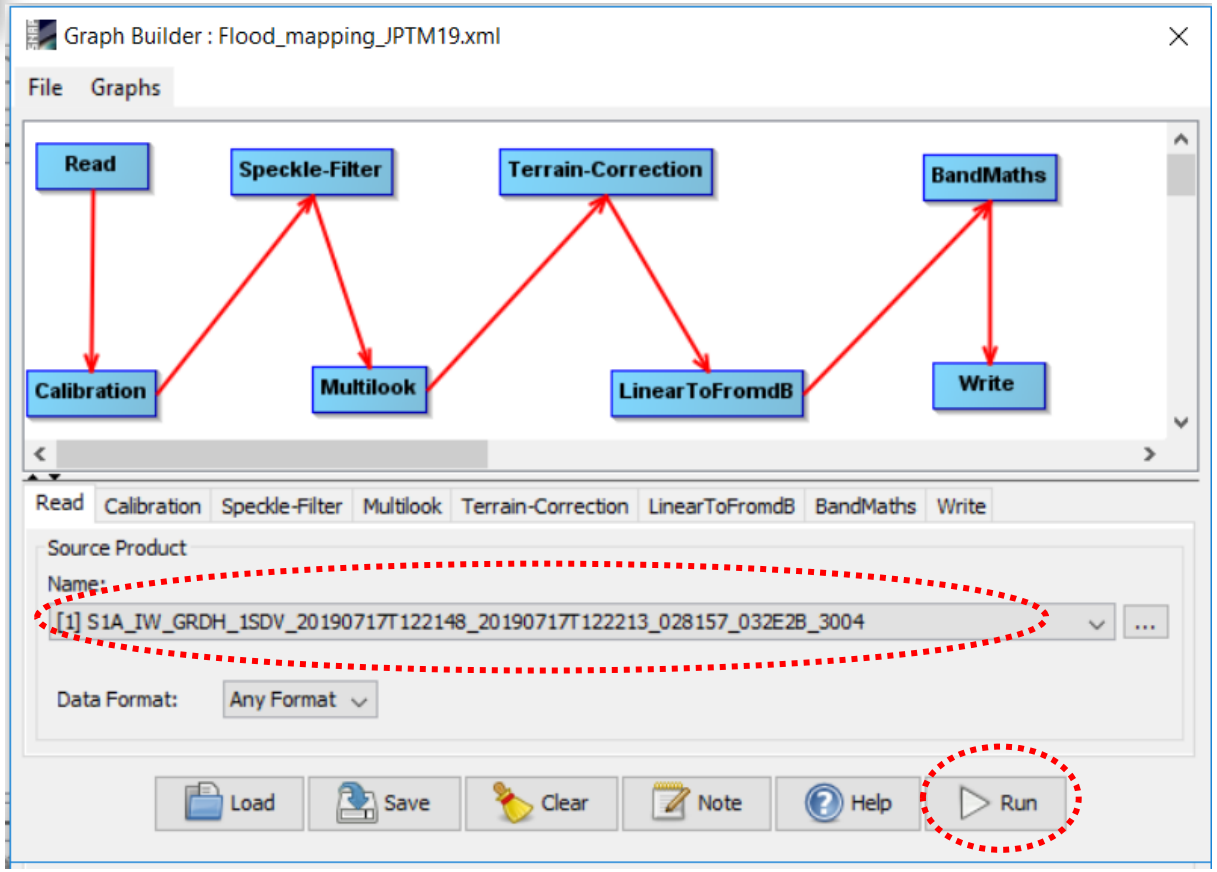


Task Load the graph “Flood_mapping_JPTM19”



Exercise - 3

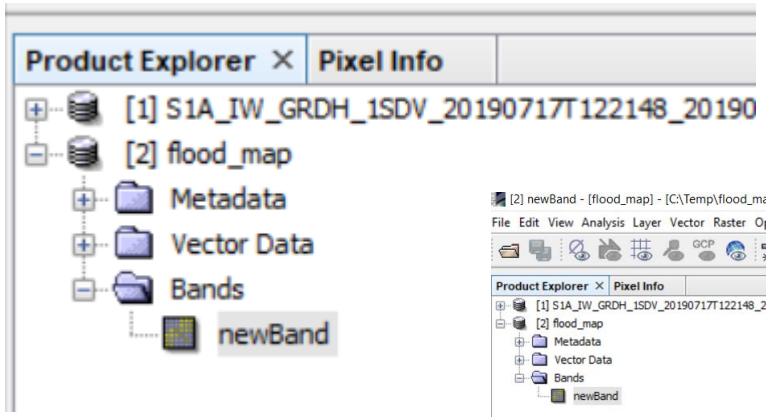
Task Provides the source of the image and run graphs



it might take 15 minutes to produce flood map

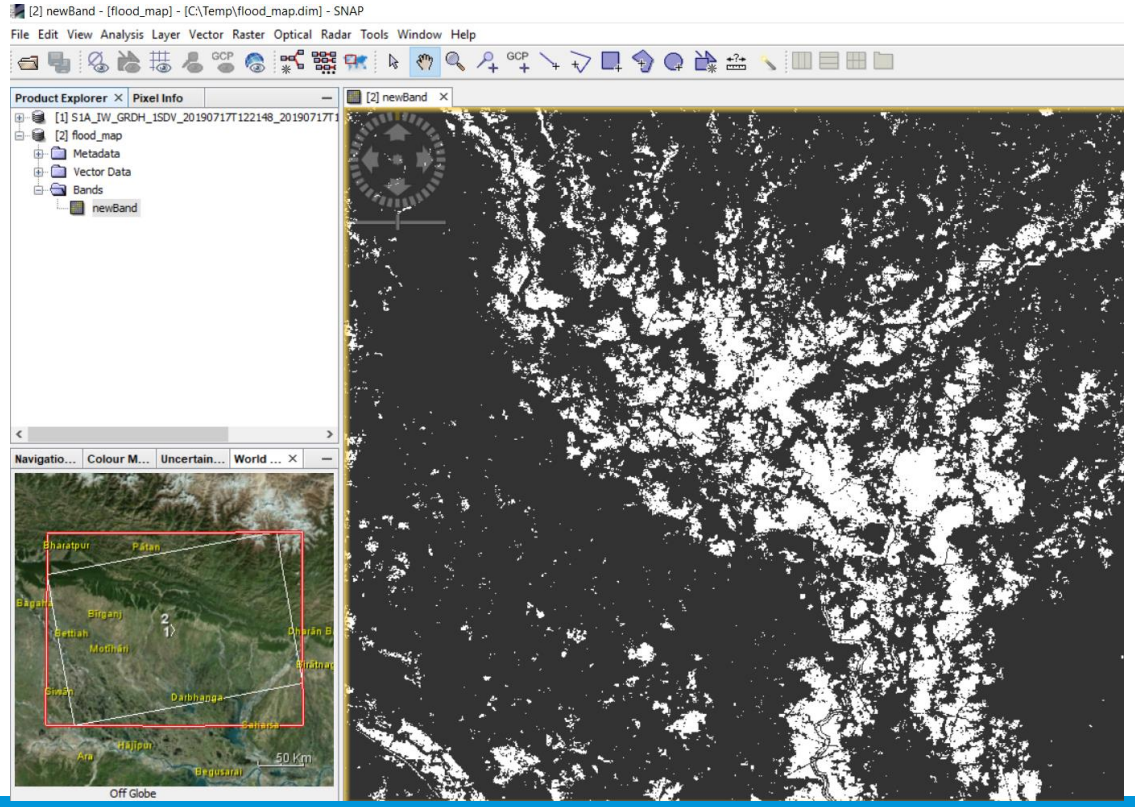
Exercise - 3

Task View the inundation map



Task Export the inundation map

Click on the File>Export> GeoTIFF/BigTIFF



Exercise - 4

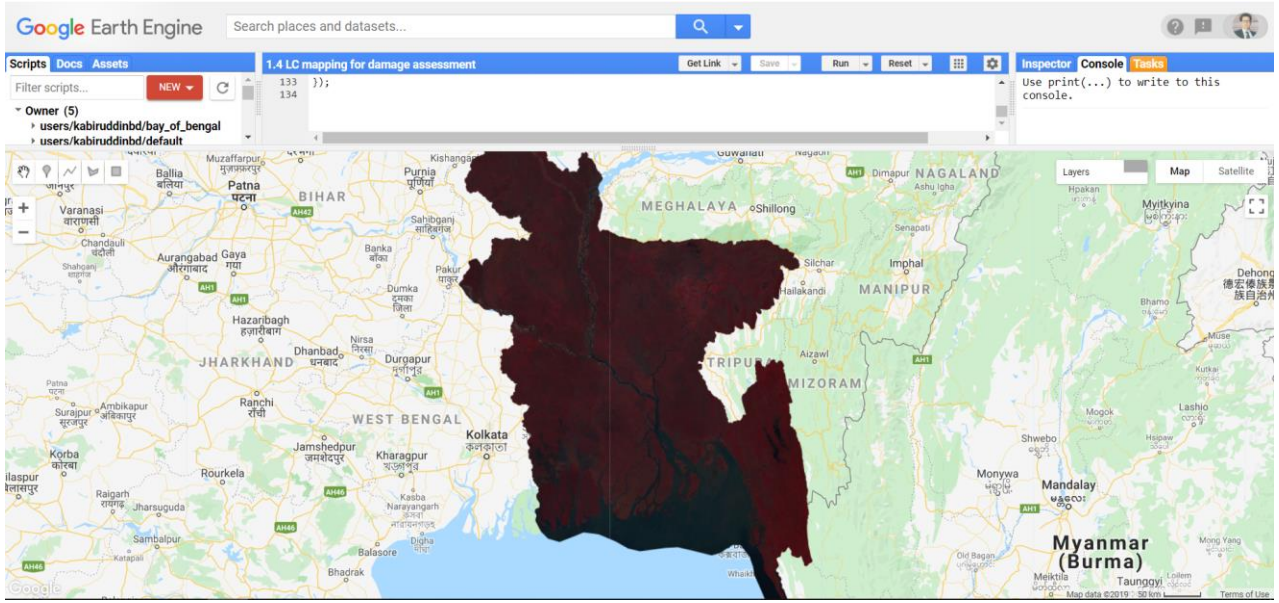
Flood damage assessment-pre-flood land cover mapping using GEE

Exercise - 4

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

Open the link:

https://tinyurl.com/utr6fte



Thank you

Reference:

Uddin, Kabir, Mir A. Matin, and Franz J. Meyer. "Operational flood mapping using multi-temporal sentinel-1 SAR images: a case study from Bangladesh." Remote Sensing 11, no. 13 (2019): 1581.