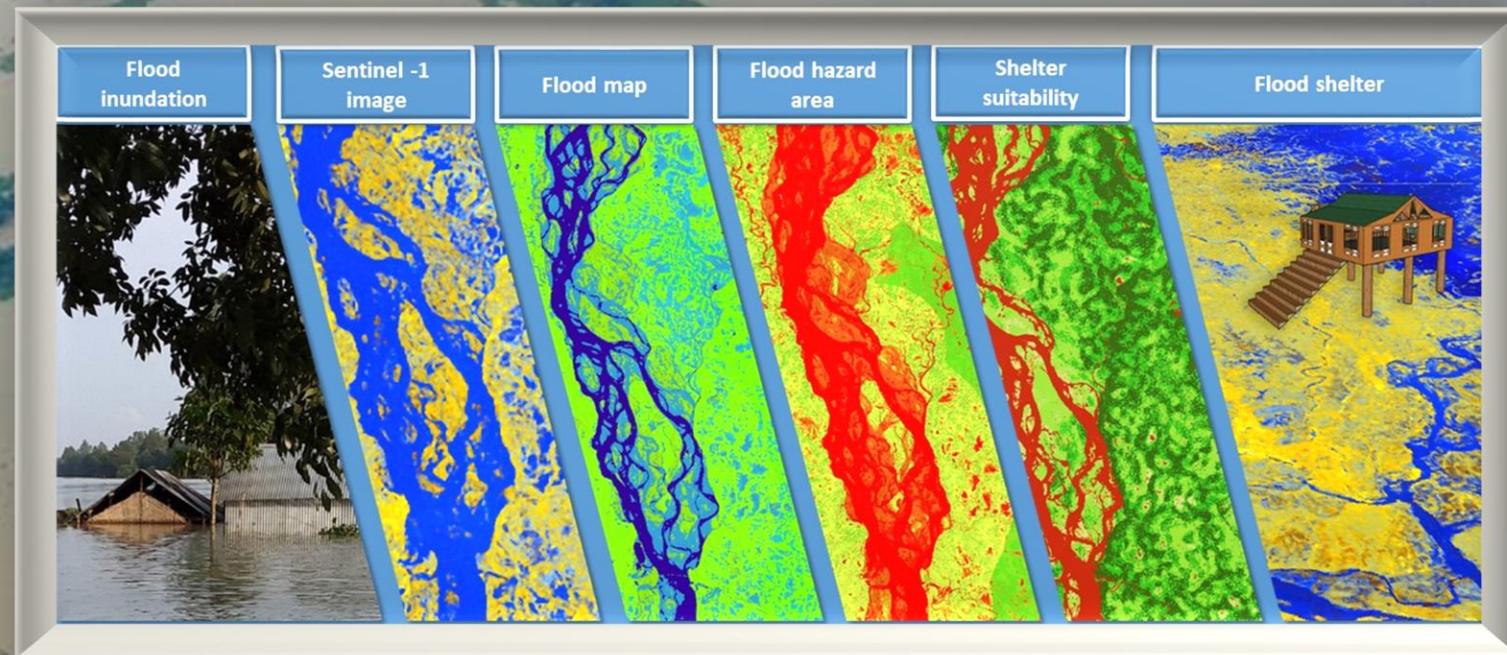


8th Joint Project Team Meeting for Sentinel Asia STEP-3 (JPTM2023)

Potential flood hazard zonation and flood shelter suitability mapping for disaster risk mitigation in Bangladesh using geospatial technology



Kabir Uddin

Email: Kabir.Uddin@icimod.org





Flood hazard, vulnerability and risk mapping

Flood early warning system


Flood inundation area

Flood damage assessment

Flood shelter suitability area

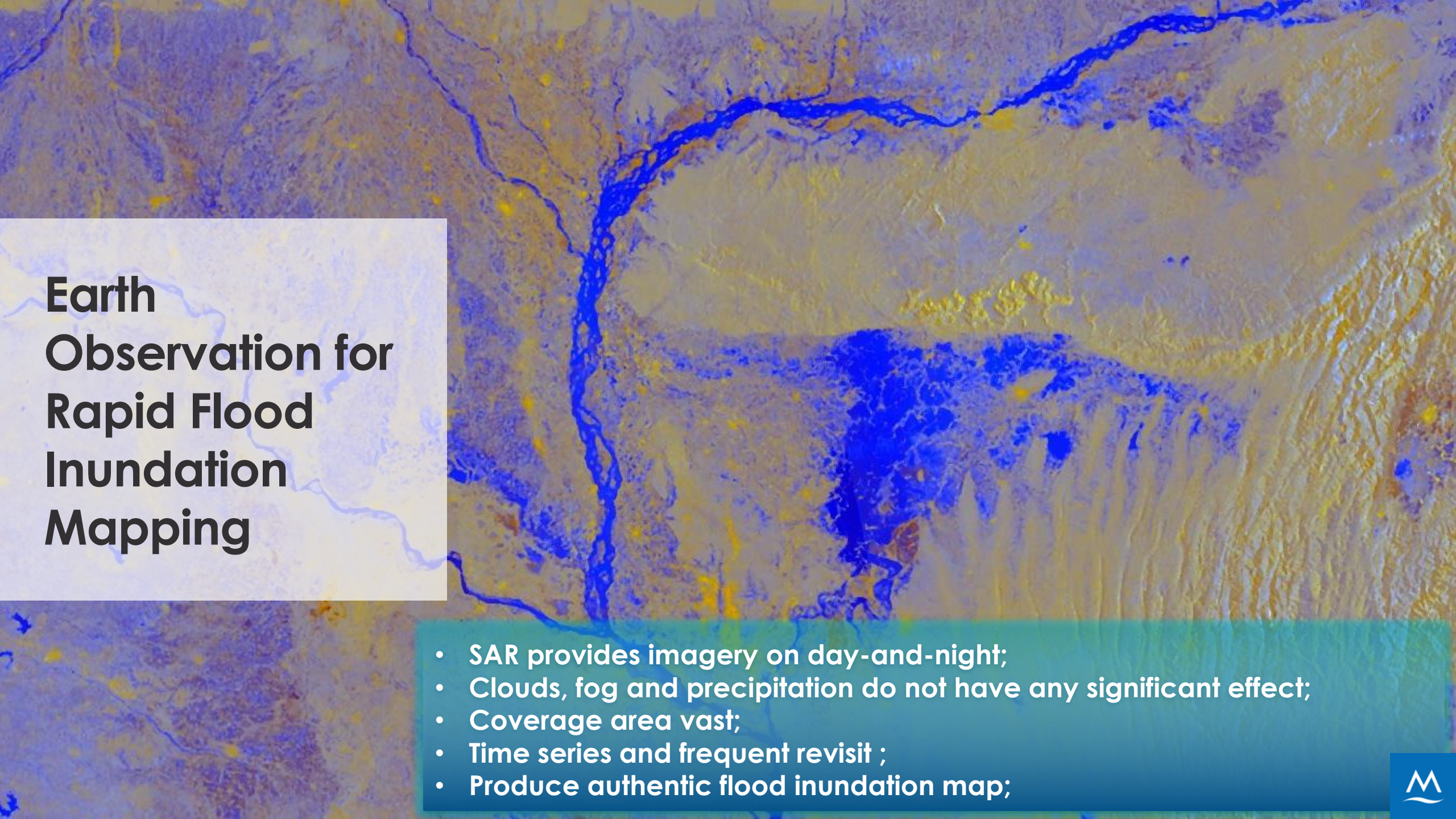
BBC NEWS



The background of the slide is a composite of several aerial satellite images of a river basin. The images are arranged in a grid-like pattern, with some overlapping. The colors are vibrant, showing various shades of green for vegetation and blue for water. A semi-transparent white rectangular box is overlaid on the left side of the image, containing the title text.

Earth Observation for Rapid Flood Inundation Mapping



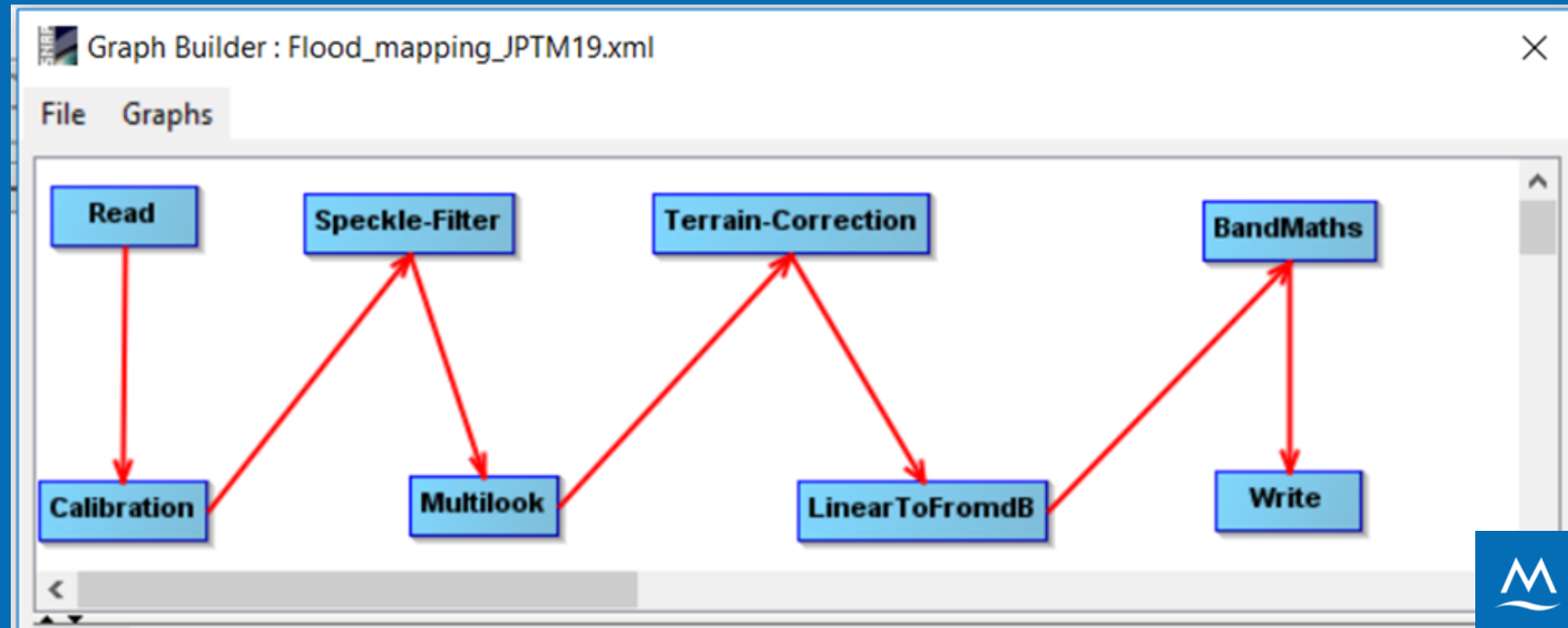
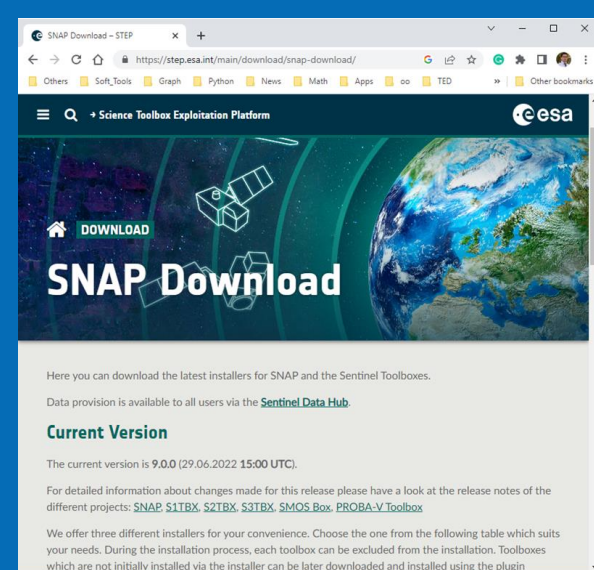
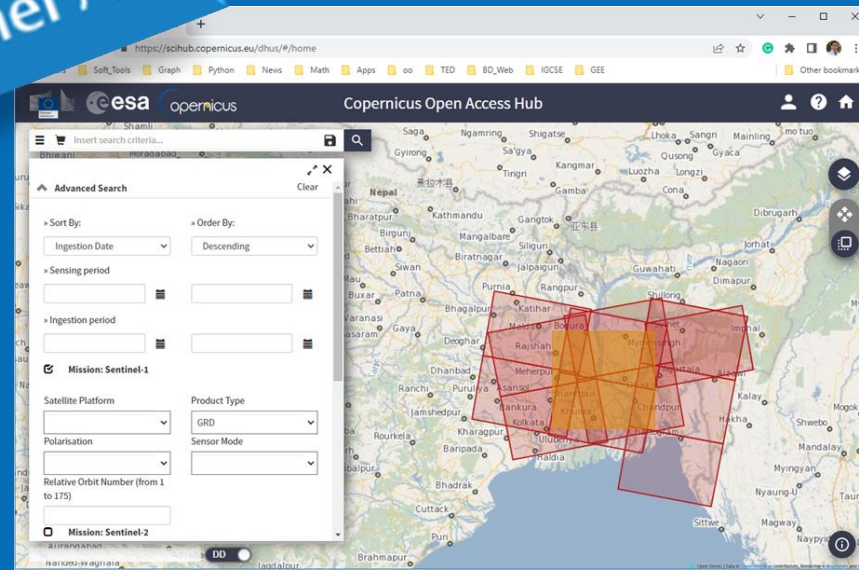
An aerial Synthetic Aperture Radar (SAR) image of a river system. The river channels are shown in a light blue color, while the surrounding land is in shades of yellow and brown. A large, irregularly shaped area in the center-right of the image is highlighted in a darker blue, indicating flood inundation. The background is a textured, grainy surface typical of SAR imagery.

Earth Observation for Rapid Flood Inundation Mapping

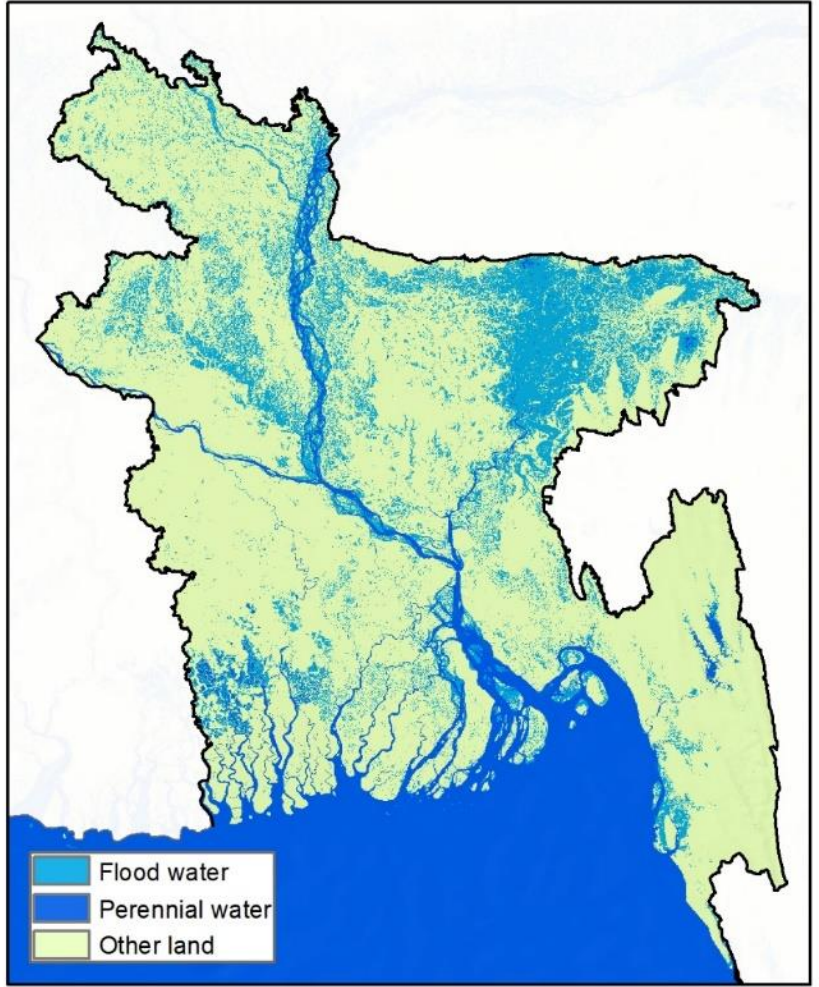
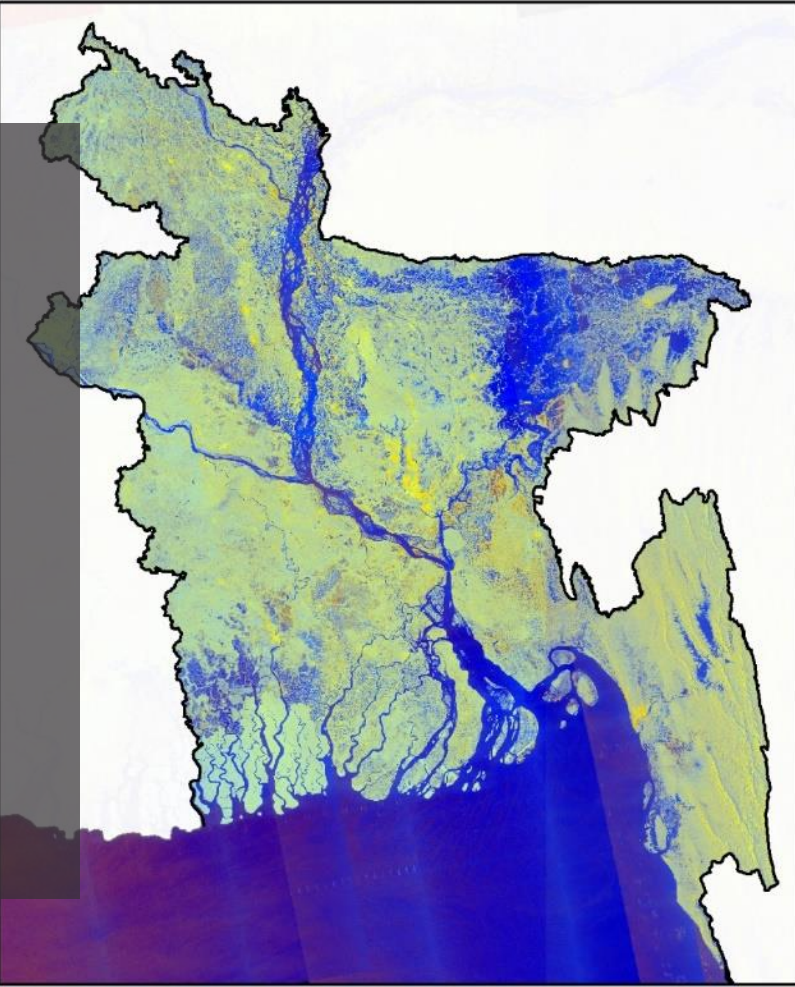
- SAR provides imagery on day-and-night;
- Clouds, fog and precipitation do not have any significant effect;
- Coverage area vast;
- Time series and frequent revisit ;
- Produce authentic flood inundation map;



Tools for Earth Observation for Rapid Flood Inundation Mapping using SAR Imagery



Tools for Earth Observation for Rapid Flood Inundation Mapping using SAR Imagery

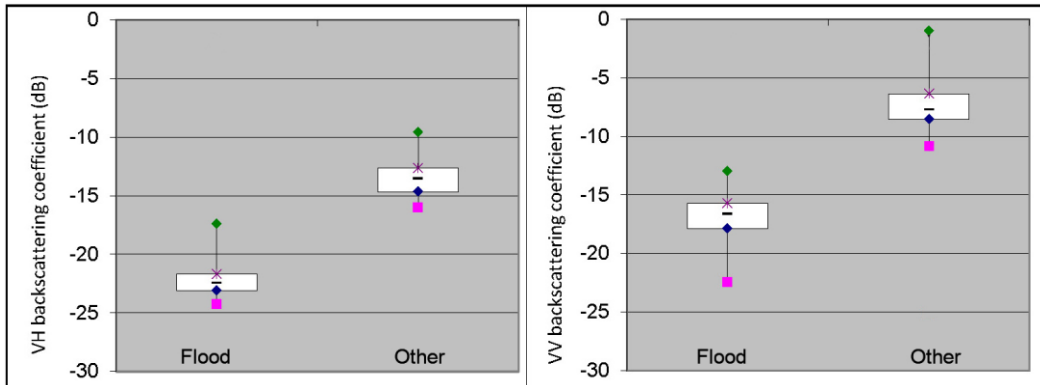


Flood Inundation Map Date: ('2019-07-10' to '2019-7-20')

GEE Code: <https://tinyurl.com/2vfyvfkn>



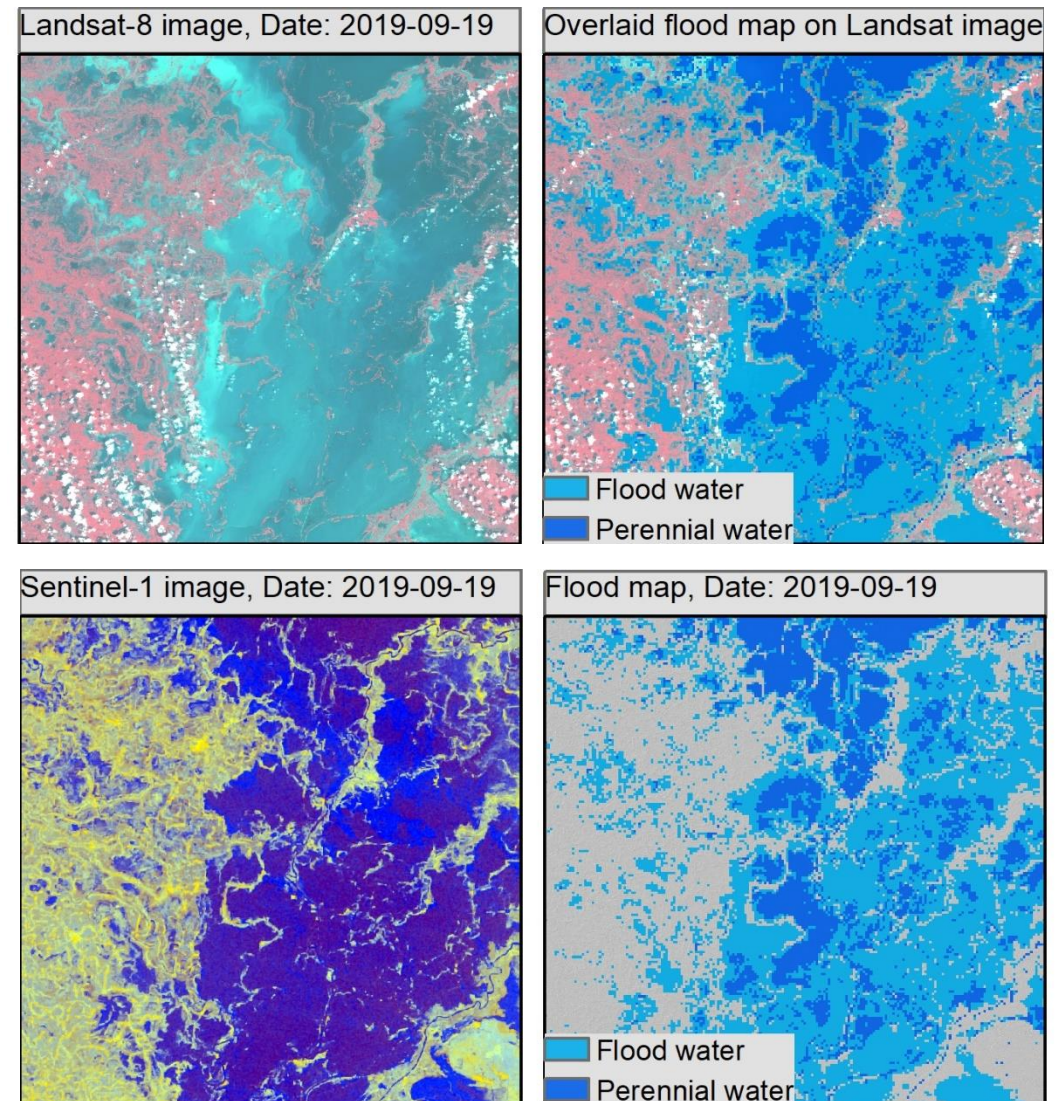
Ensuring the quality of rapid flood inundation map



Box plots of Sentinel-1 VV and VH backscatter value for waterbodies (flood inundation) and other samples

| | | Landsat-8 | | |
|------------|-----------------------|-----------------------|-------|-------|
| Sentinel-1 | Class name | Flood Inundation Area | Other | Total |
| | Flood Inundation Area | 2233 | 231 | 2463 |
| | Other | 139 | 1769 | 1908 |
| | Total | 2372 | 2000 | 4372 |

Omission and commission matrix between Sentinel-1 and Landsat-8 images used for ensuring the quality of the developed maps



Comparison of optical data and SAR-based flood inundation: (a) Landsat-8 image from 19 September 2019; (c) colour-coded Sentinel-1 image from 19 September 2019, showing waterbodies in blue; (b) classification result based on Landsat-8; (d) classification result based on Sentinel-1 data (dark blue: perennial water; light blue: flood inundation areas; green: other areas)

GEE Code: <https://tinyurl.com/4z4hv4m9>



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About KBIS

Base layers

Hydro-Meteorology Stations

Water resources

Land Use

Cryosphere

Vulnerability

Flood Inundation Map of Koshi Basin (2016)

Inundation map as of 1 August 2016

Inundation map as of 19 July 2016

Village boundary

Koshi basin

Sub-basin

Drainage Network

Land cover (2010)

Climate Change Impact

2016 Flood Inundation Mapping using SAR Imagery

Flood Inundation Map of Koshi Basin (2016)

Secure | <https://reliefweb.int/report/india/flood-inundation-map-koshi-basin-2016>

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05 Aug 2016

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Flood Inundation Map of Koshi Basin (2016)

INTERACTIVE from [Government of Australia, International Centre for Integrated Mountain Development](#)

Published on 05 Aug 2016 — [View Original](#)

Click the image(s) below to view the interactive content.

Primary country
India

Other countries
[China](#)
[Nepal](#)

India: Floods - Jun 2016

Other disasters
[Nepal: Floods and Landslides - Jul 2016](#)

Content Format:
Interactive

Language:

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Flood Inundation Map of Koshi Basin (2016)

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Inundation map as of 19 July 2016

Village boundary

Koshi basin

Sub-basin

Drainage Network

Land cover (2010)

Flood Inundation Map of Koshi Basin (2016)

Select district ▾ Please select district first ▾ Please select block first ▾

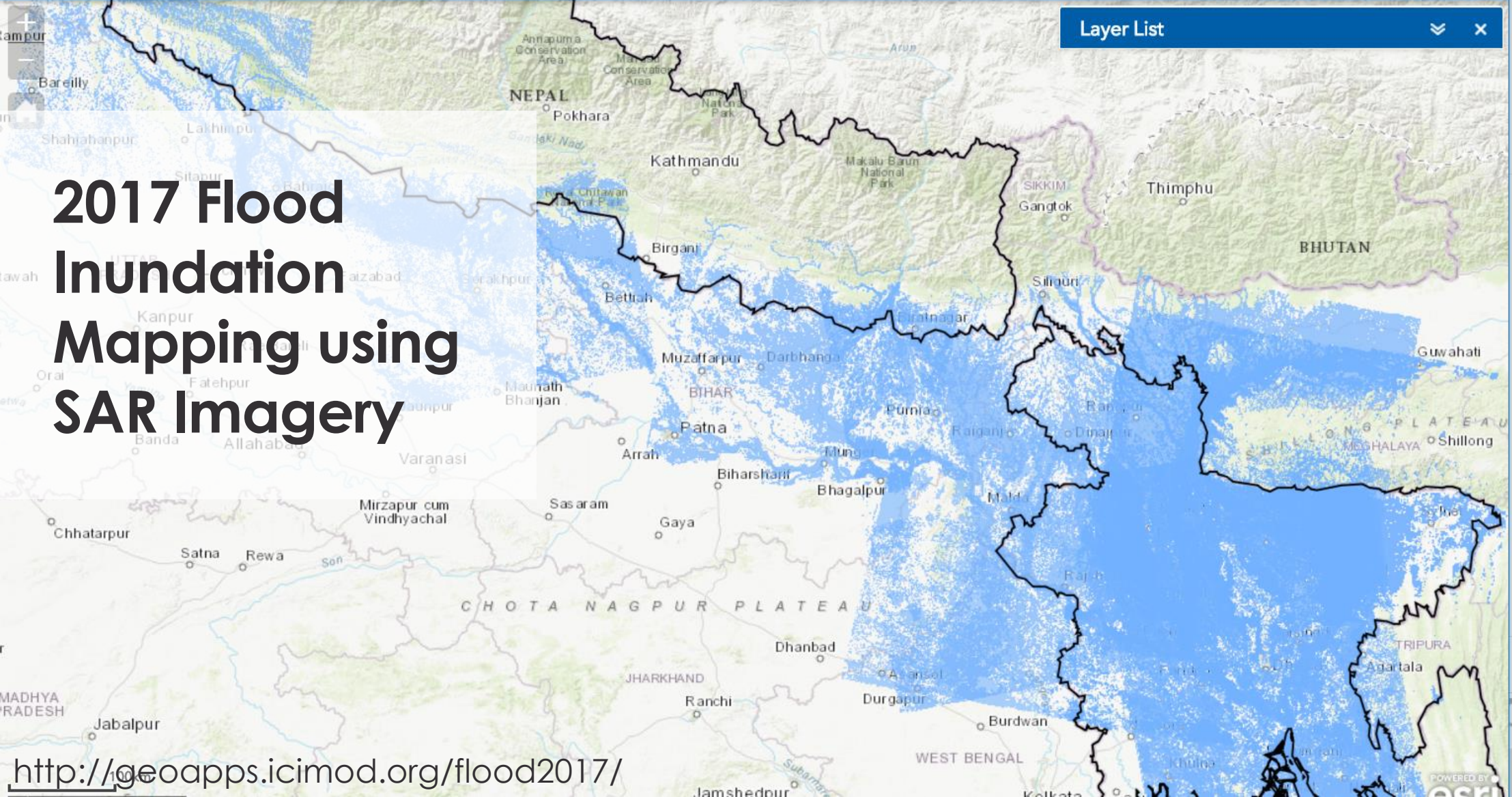
Legend

- Koshi Flood Koshi River Basin
- Inundation map as of 1 Aug 2016
- Permanent water bodies
- Inundated area



Layer List [Dropdown icon] [Close icon]

2017 Flood Inundation Mapping using SAR Imagery



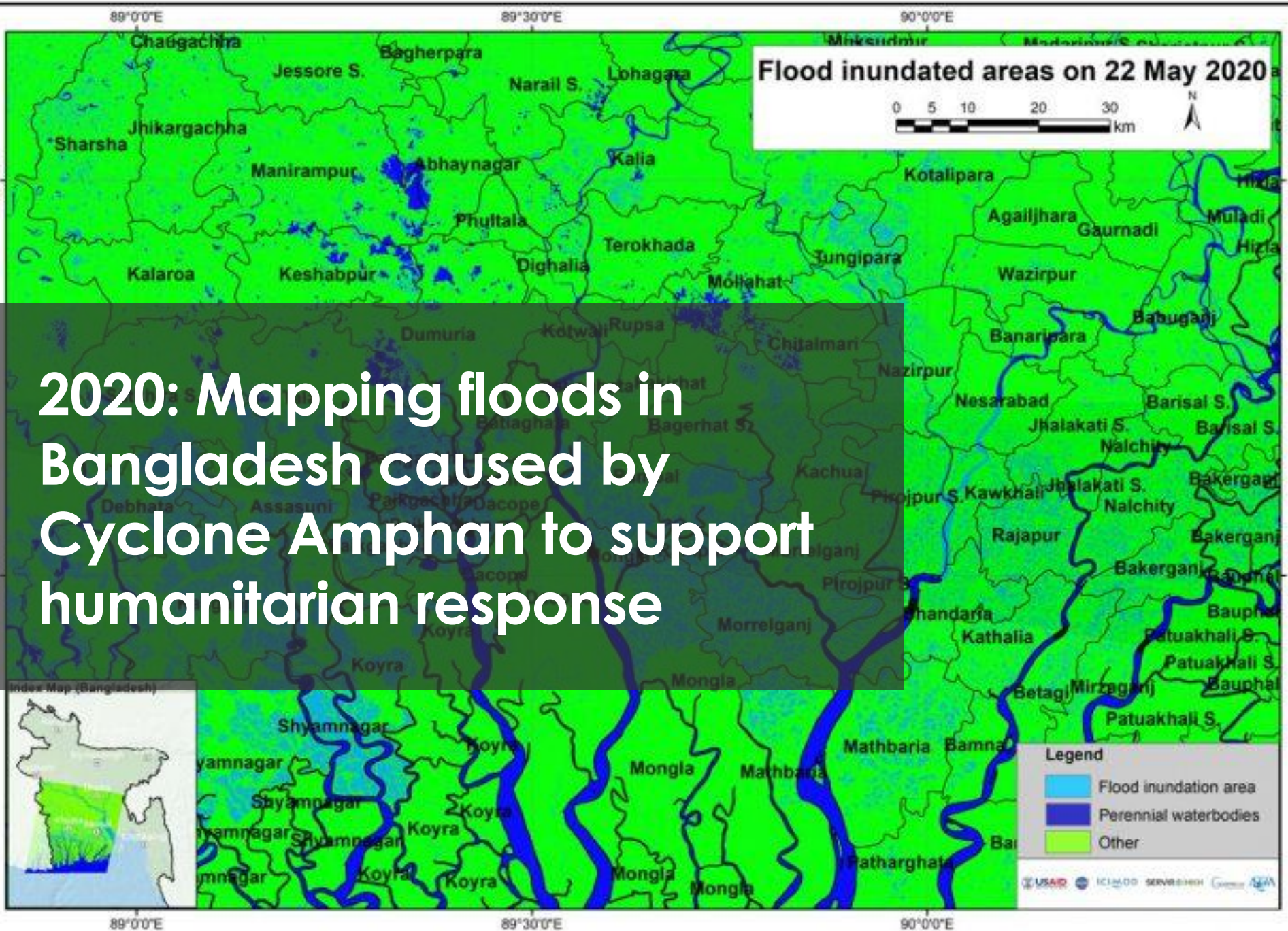
2019 Flood Inundation Mapping using SAR Imagery

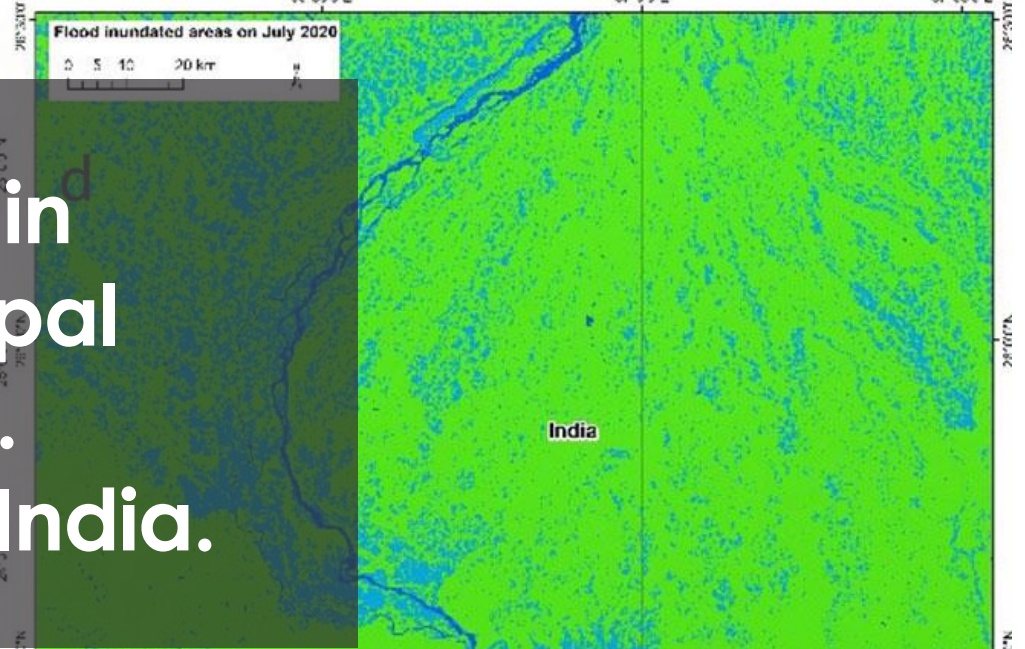
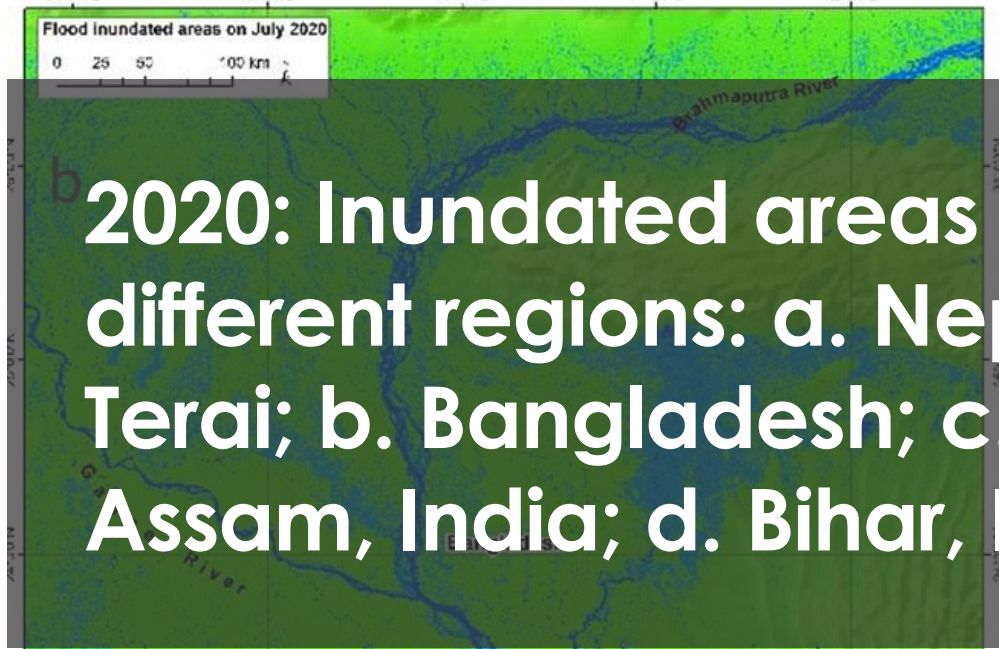
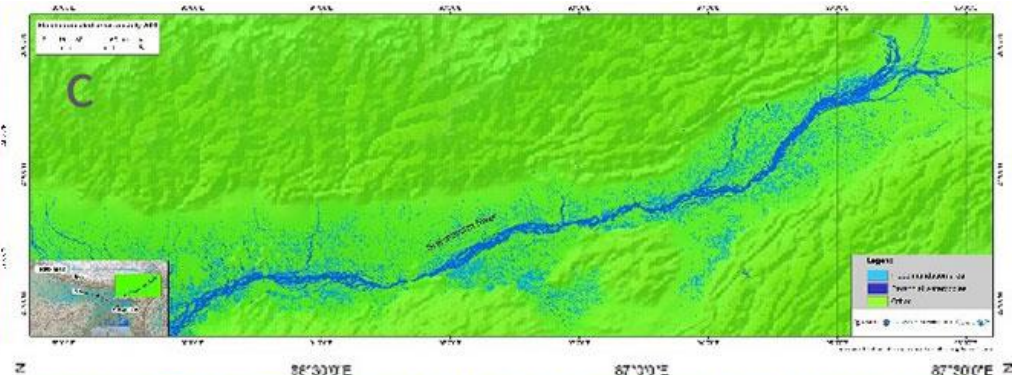
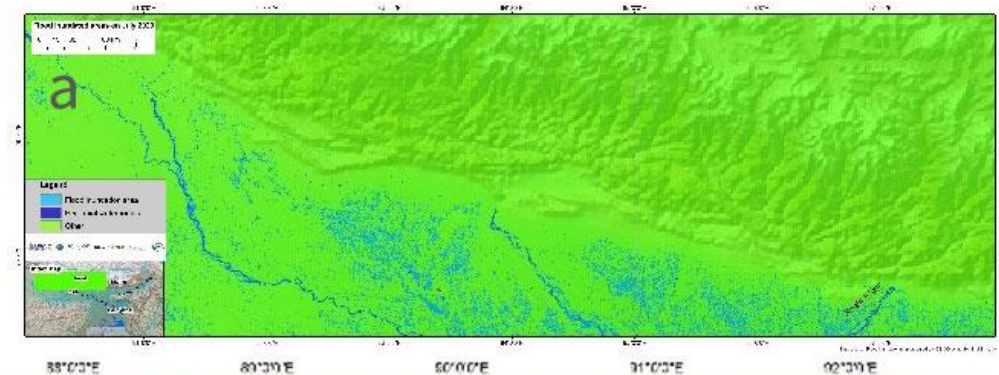


An aerial map of Bangladesh showing flood areas. The map is color-coded, with red and purple areas indicating flooded regions. A network of black lines represents rivers and waterways. The text is overlaid on a dark grey rectangular background on the left side of the map.

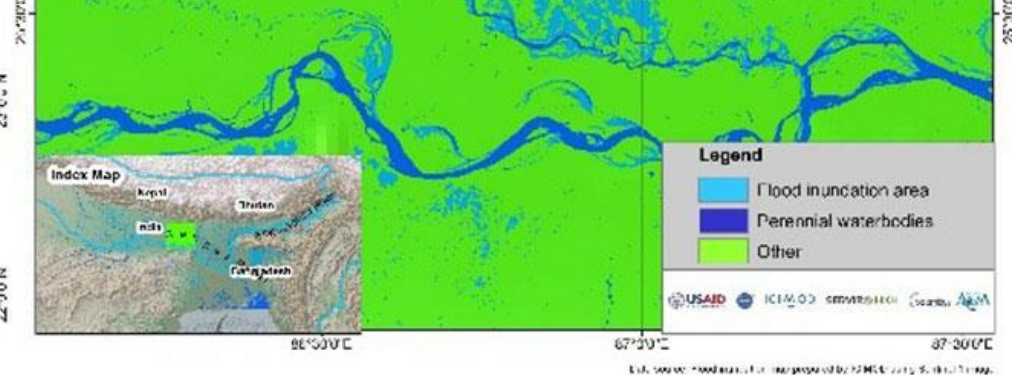
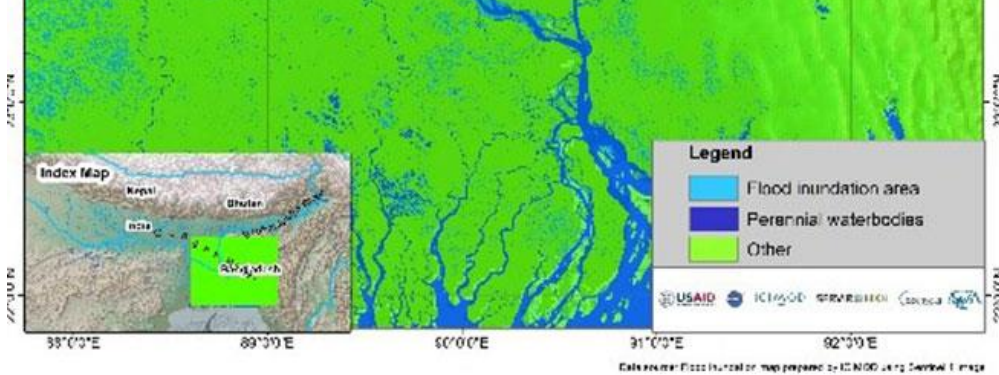
**2020: Mapping floods in
Bangladesh caused by
Cyclone Amphan to support
humanitarian response**

2020: Mapping floods in Bangladesh caused by Cyclone Amphan to support humanitarian response





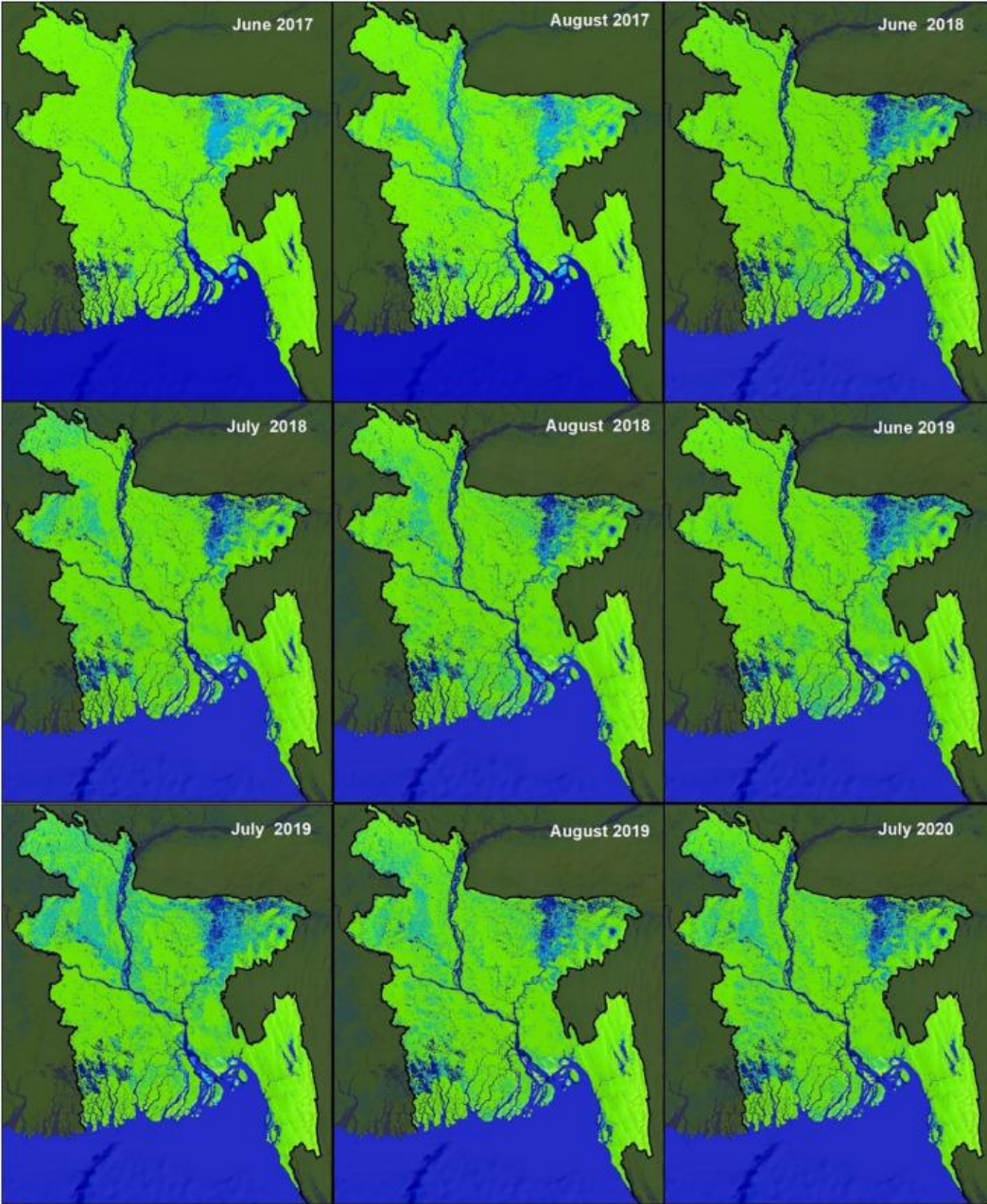
2020: Inundated areas in different regions: a. Nepal Terai; b. Bangladesh; c. Assam, India; d. Bihar, India.



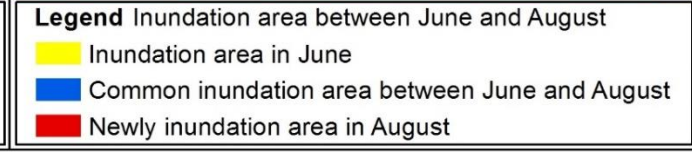
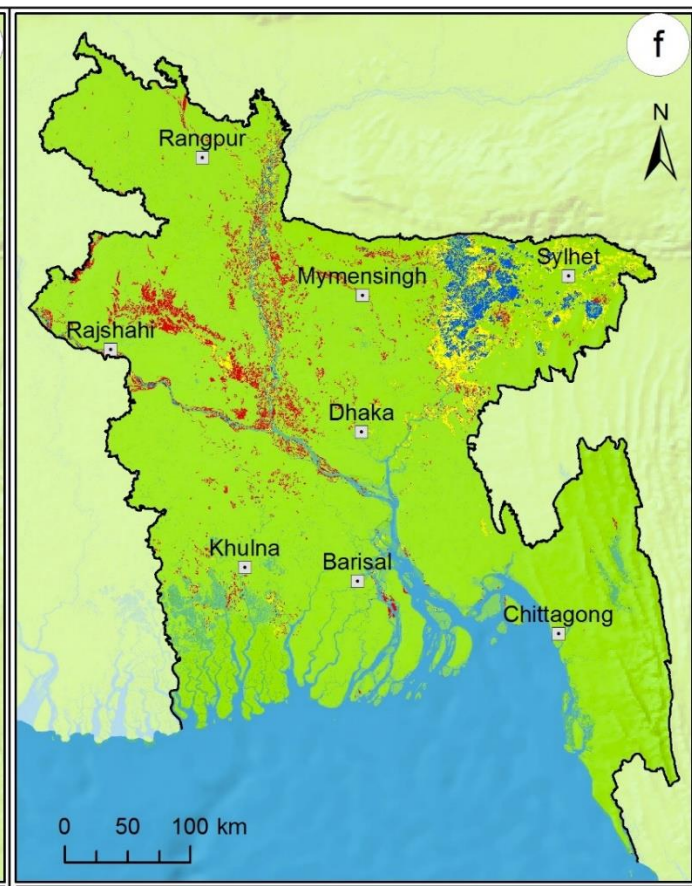
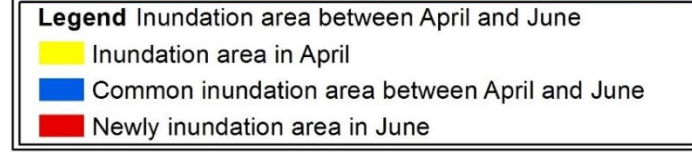
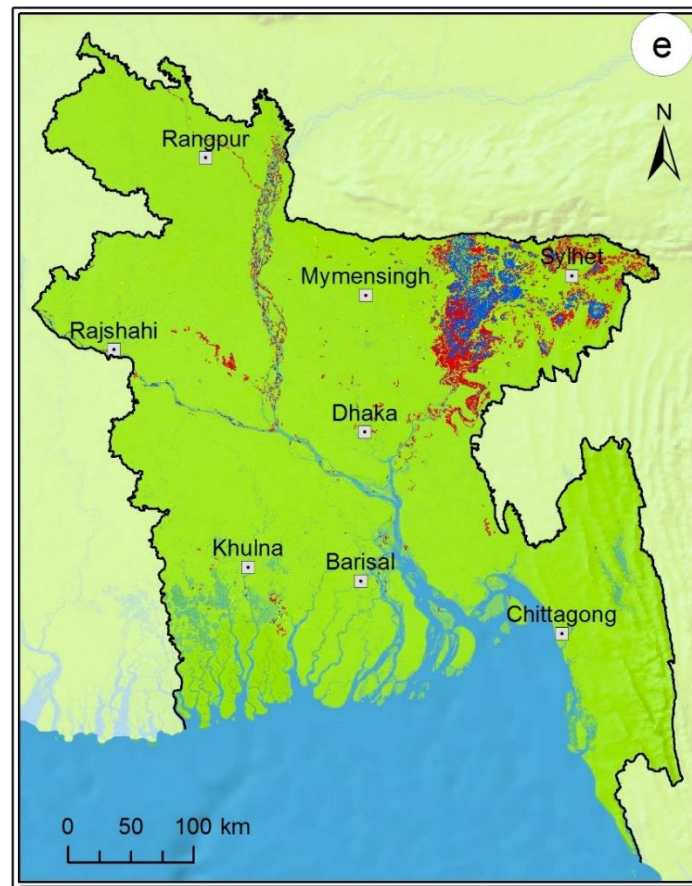
Data source: Flood inundated map prepared by ICIMOD using Sentinel-1 image

URL: www.floodmap.org Map prepared by ICIMOD using Sentinel-1 image





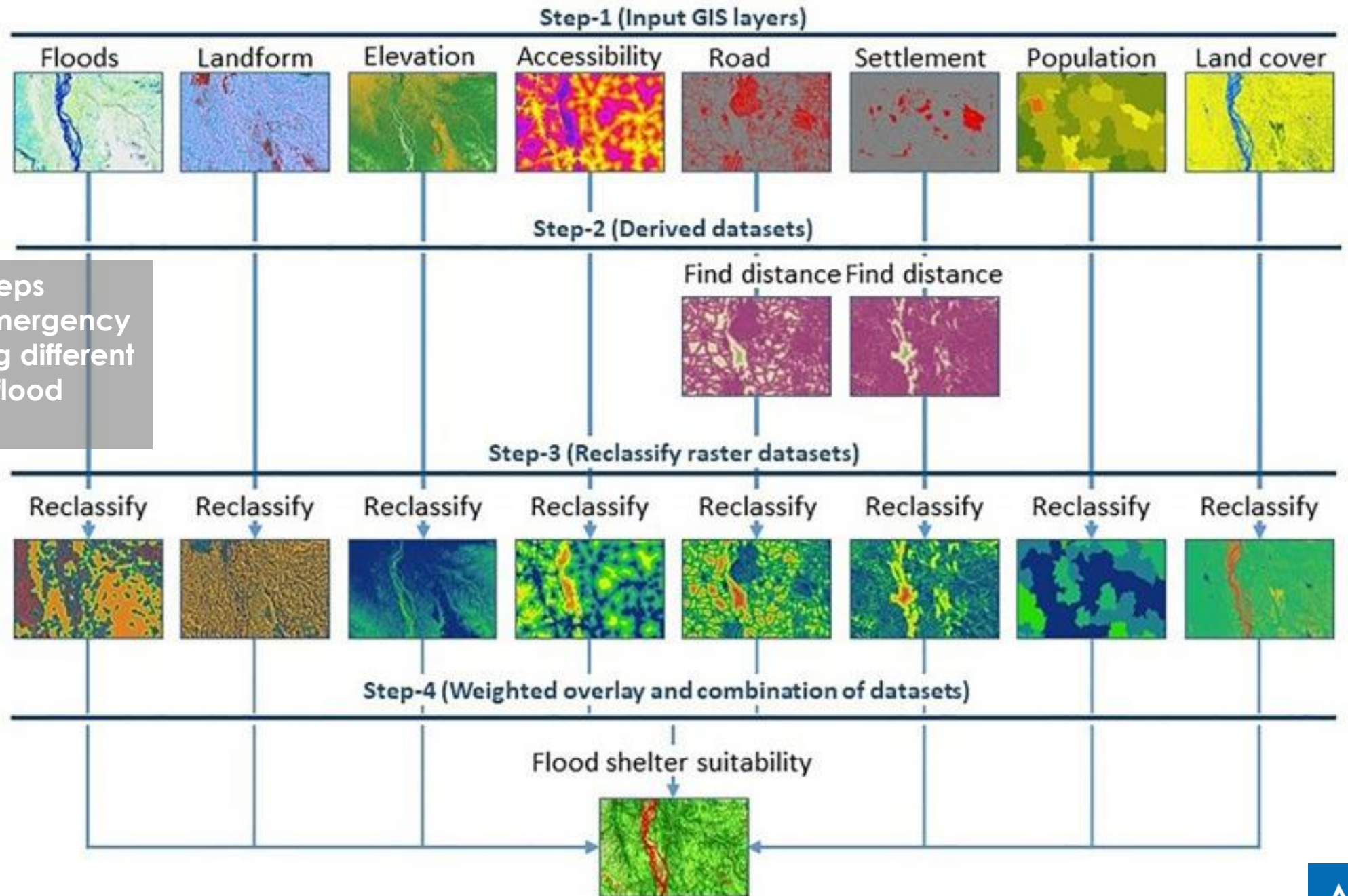
Flood extents of June and August 2017; June, July and August 2018; June, July and August 2019; and July 2020 of Bangladesh.

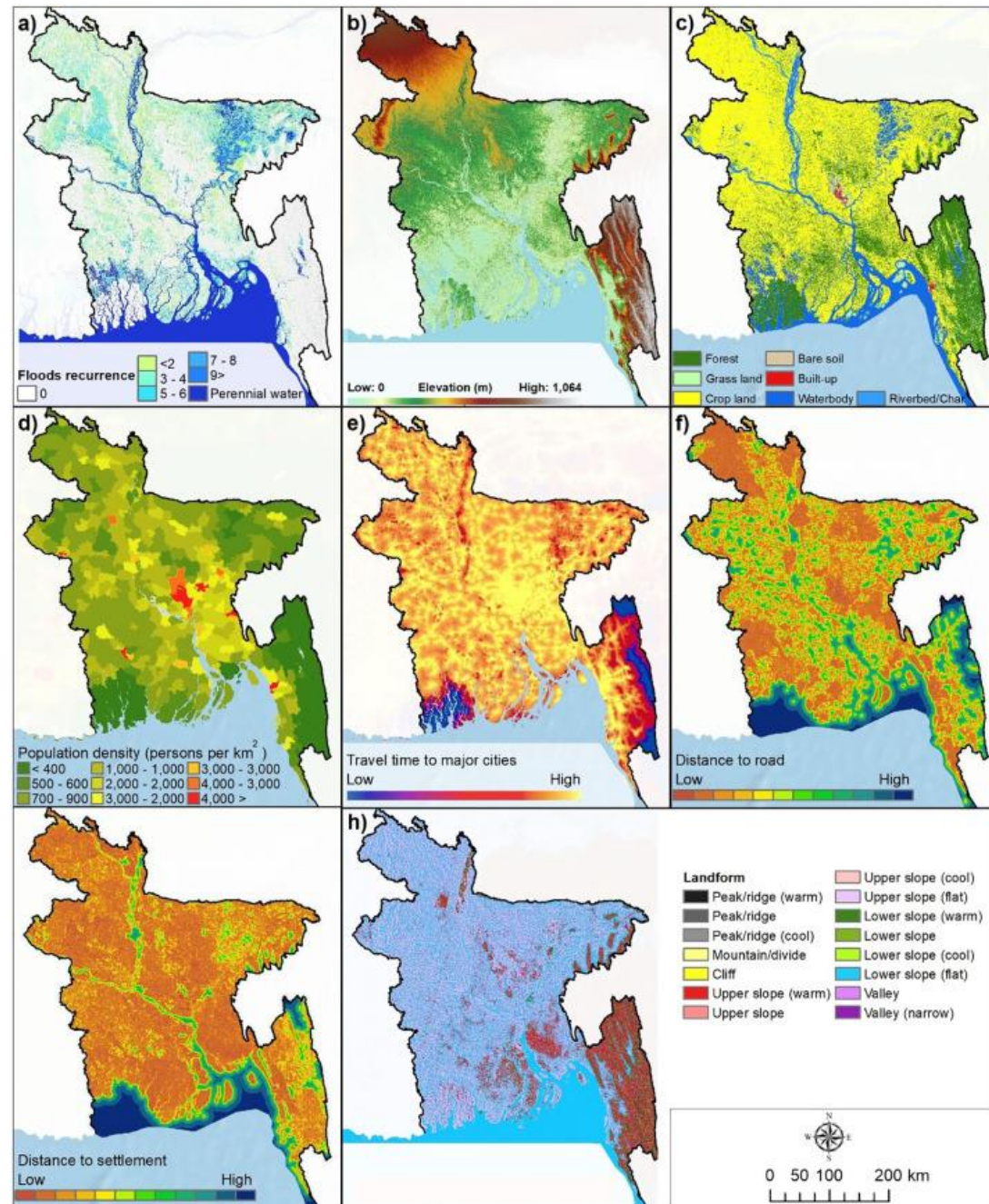


Flood recession and rise areas of Bangladesh between (e) April and June, (f) June and August.



Main methodological steps followed for the flood emergency suitability mapping using different factors associated with flood shelters.

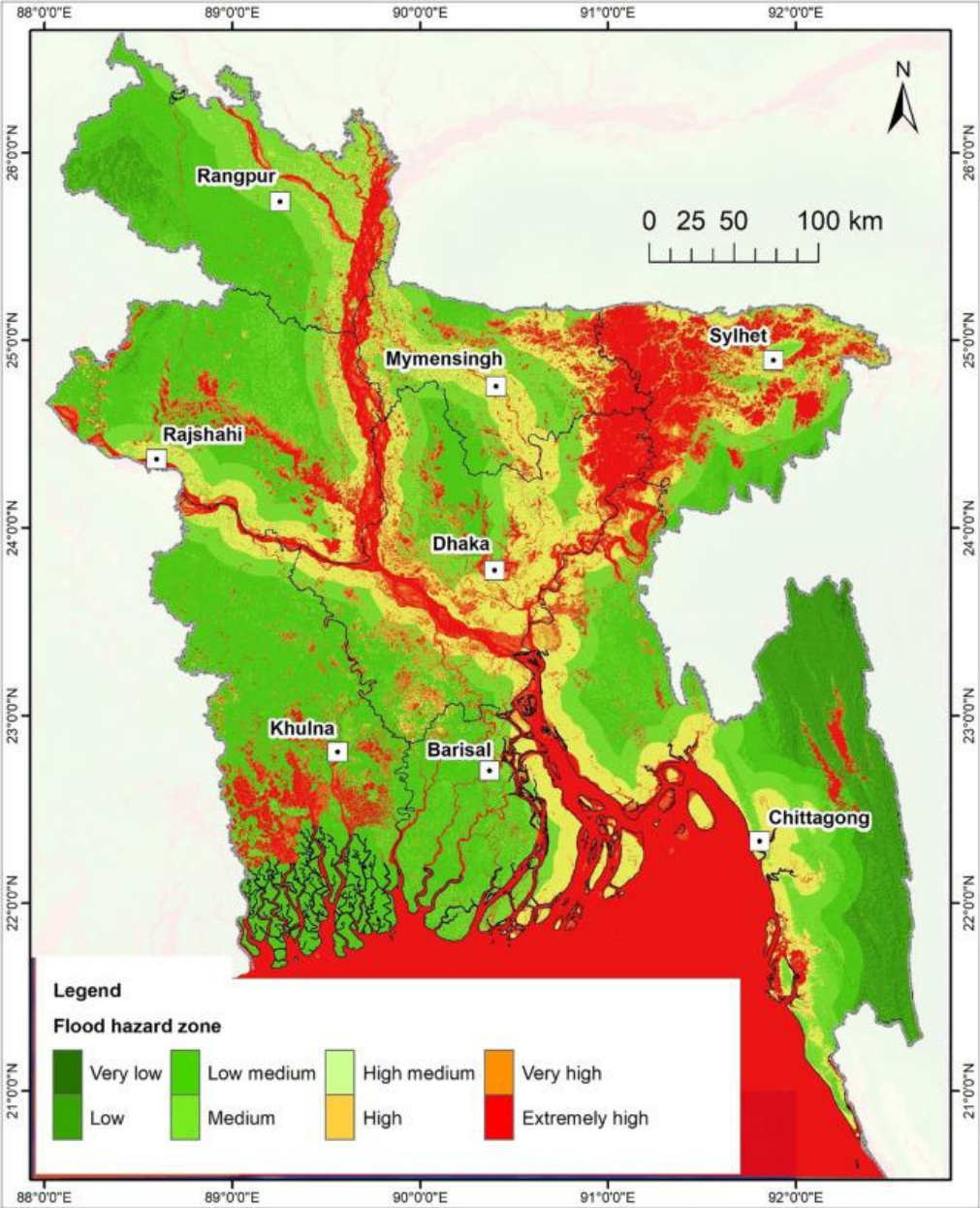




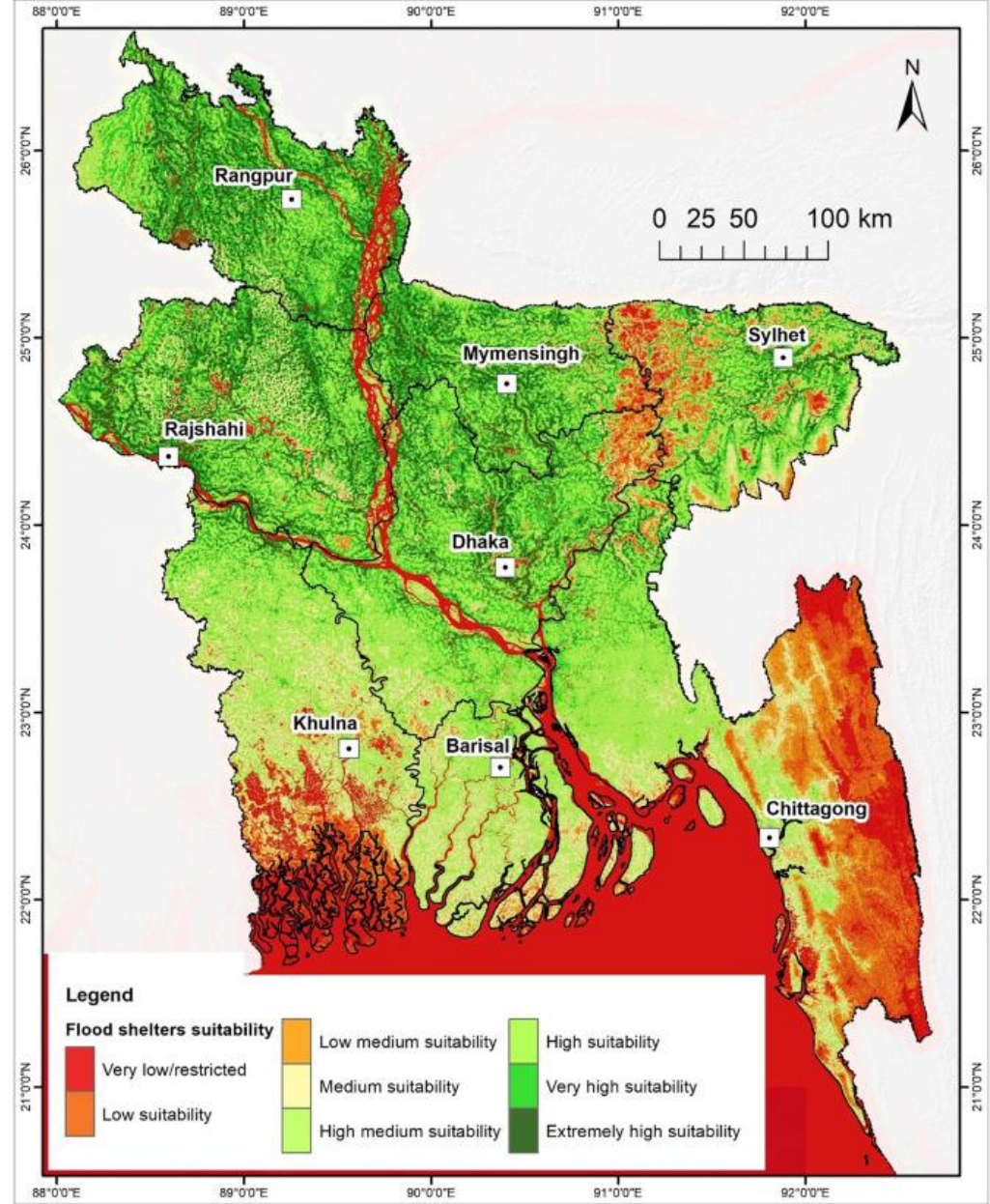
Picture of typical inundation area of Bangladesh, (a, b, c) The village in Jabalpur district inundated by the 2020 floodwaters. d) An aerial photo of rural settlements enclosed by floodwaters during 2017.

GIS layers used for the flood suitability mapping



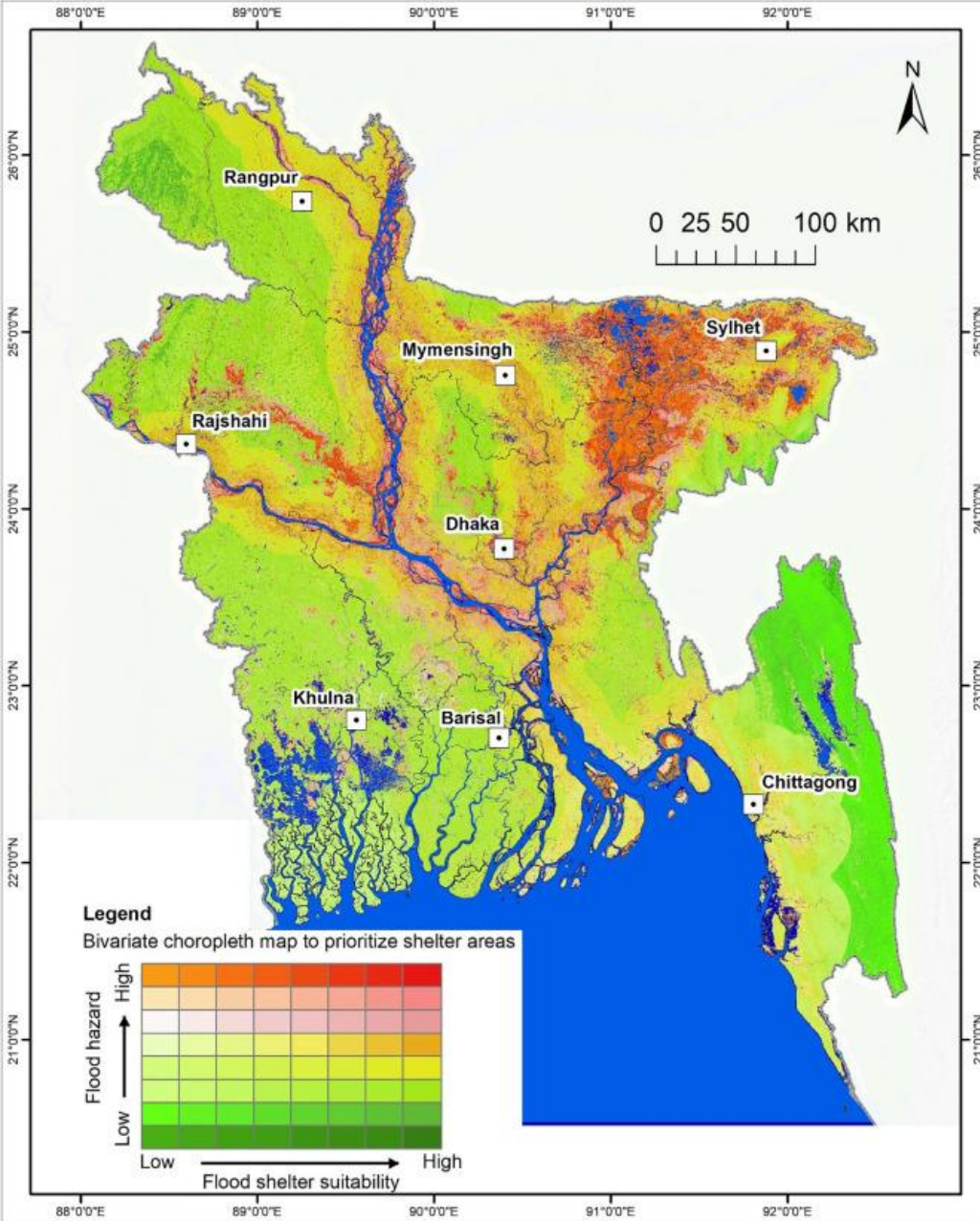


Flood hazard map of Bangladesh



Flood shelter suitability map of Bangladesh





Priority area for flood shelter construction based on the bivariate choropleth analysis using flood hazard and flood shelter suitability maps in Bangladesh



Useful article/reference



Operational Flood Mapping Using Multi-Temporal Sentinel-1 SAR Images: A Case Study from Bangladesh

Kabir Uddin^{1,*}, Mir A. Matin^a

- 1 International Centre for Integrated Mountain Development
- 2 Geophysical Institute
- * Corresponding Author

Received: 1 May 2021

Abstract: Bangladesh is one of the most flood-prone countries in the world. During the last few decades, the frequency, intensity, and duration of floods have increased. To ensure safety and save lives when people's homes submerge because of flooding, it is urgent to relocate them to safe shelters during the flooding. In Bangladesh, the number of designated flood shelters is very less. To plan and prioritise the building of shelters, flood hazard zonation and the identification of suitable locations for shelters are vital for disaster risk mitigation. This study attempted the first and most extensive national flood inundation database and flood dynamics of Bangladesh developed between 2017 and 2020 using public domain Sentinel-1 Synthetic Aperture Radar (SAR) images were processed in the Google Earth Engine (GEE) and replicable methodology. Using a set of analytic hierarchy process (AHP) criteria associated with flood disasters (e.g., floods recurrence areas, elevation, land cover, landform, population density, accessibility, distance to water bodies, etc.) the flood hazard zonation and flood shelter suitability mapping were carried out. The results show that the flood hazard zonation and flood shelter suitability mapping are vital for disaster risk mitigation. This study attempted the first and most extensive national flood inundation database and flood dynamics of Bangladesh developed between 2017 and 2020 using public domain Sentinel-1 Synthetic Aperture Radar (SAR) images were processed in the Google Earth Engine (GEE) and replicable methodology. Using a set of analytic hierarchy process (AHP) criteria associated with flood disasters (e.g., floods recurrence areas, elevation, land cover, landform, population density, accessibility, distance to water bodies, etc.) the flood hazard zonation and flood shelter suitability mapping were carried out.

Potential flood hazard zonation and flood shelter suitability mapping for disaster risk mitigation in Bangladesh using geospatial technology

Kabir Uddin^{a,b,*}, Mir A. Matin^a

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ABSTRACT

Low-lying Bangladesh is known as one of the most flood-prone countries in the world. During the last few decades, the frequency, intensity, and duration of floods have increased. To ensure safety and save lives when people's homes submerge because of flooding, it is urgent to relocate them to safe shelters during the flooding. In Bangladesh, the number of designated flood shelters is very less. To plan and prioritise the building of shelters, flood hazard zonation and the identification of suitable locations for shelters are vital for disaster risk mitigation. This study attempted the first and most extensive national flood inundation database and flood dynamics of Bangladesh developed between 2017 and 2020 using public domain Sentinel-1 Synthetic Aperture Radar (SAR) images were processed in the Google Earth Engine (GEE) and replicable methodology. Using a set of analytic hierarchy process (AHP) criteria associated with flood disasters (e.g., floods recurrence areas, elevation, land cover, landform, population density, accessibility, distance to water bodies, etc.) the flood hazard zonation and flood shelter suitability mapping were carried out.



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Birendra Bajracharya
Rajesh Bahadur Thapa
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