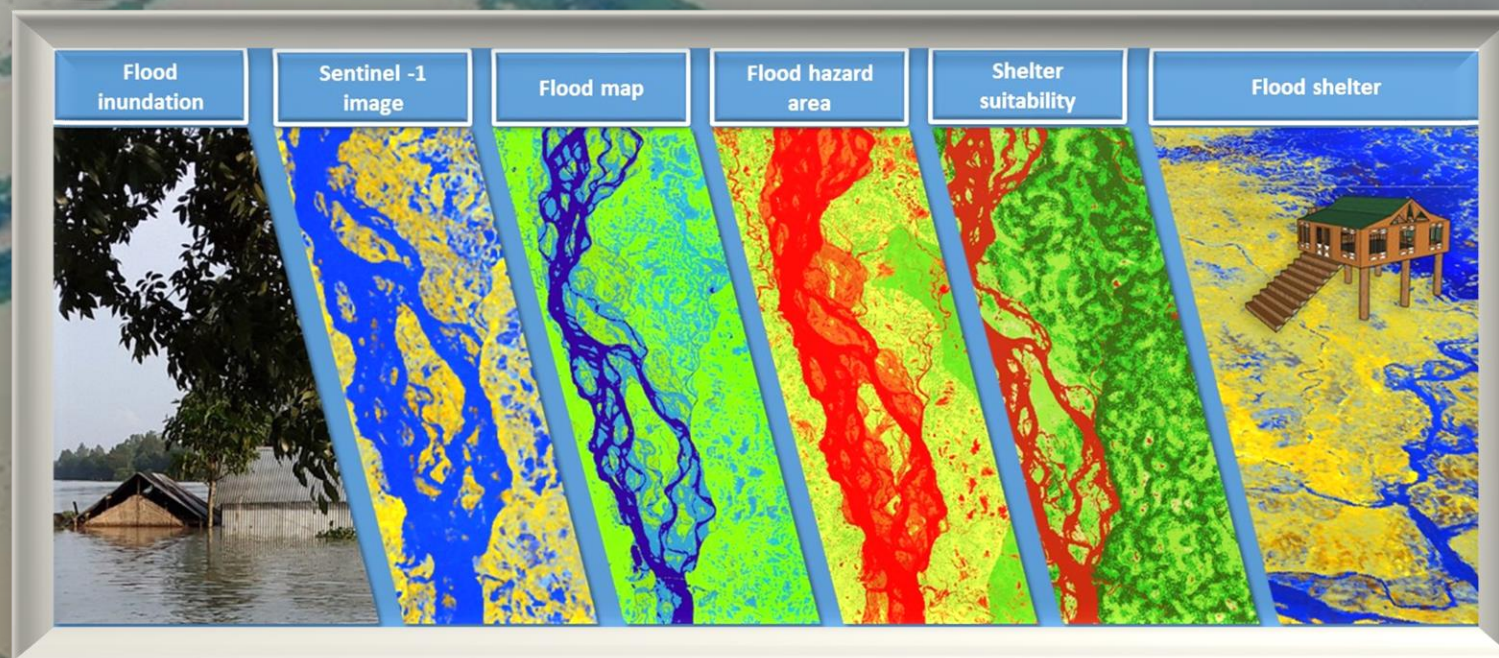


8th Joint Project Team Meeting for Sentinel Asia STEP-3 (JPTM2023)

# 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](mailto:Kabir.Uddin@icimod.org)





Flood hazard, vulnerability and risk mapping

Flood early warning system


Flood inundation area

Flood damage assessment

Flood shelter suitability area

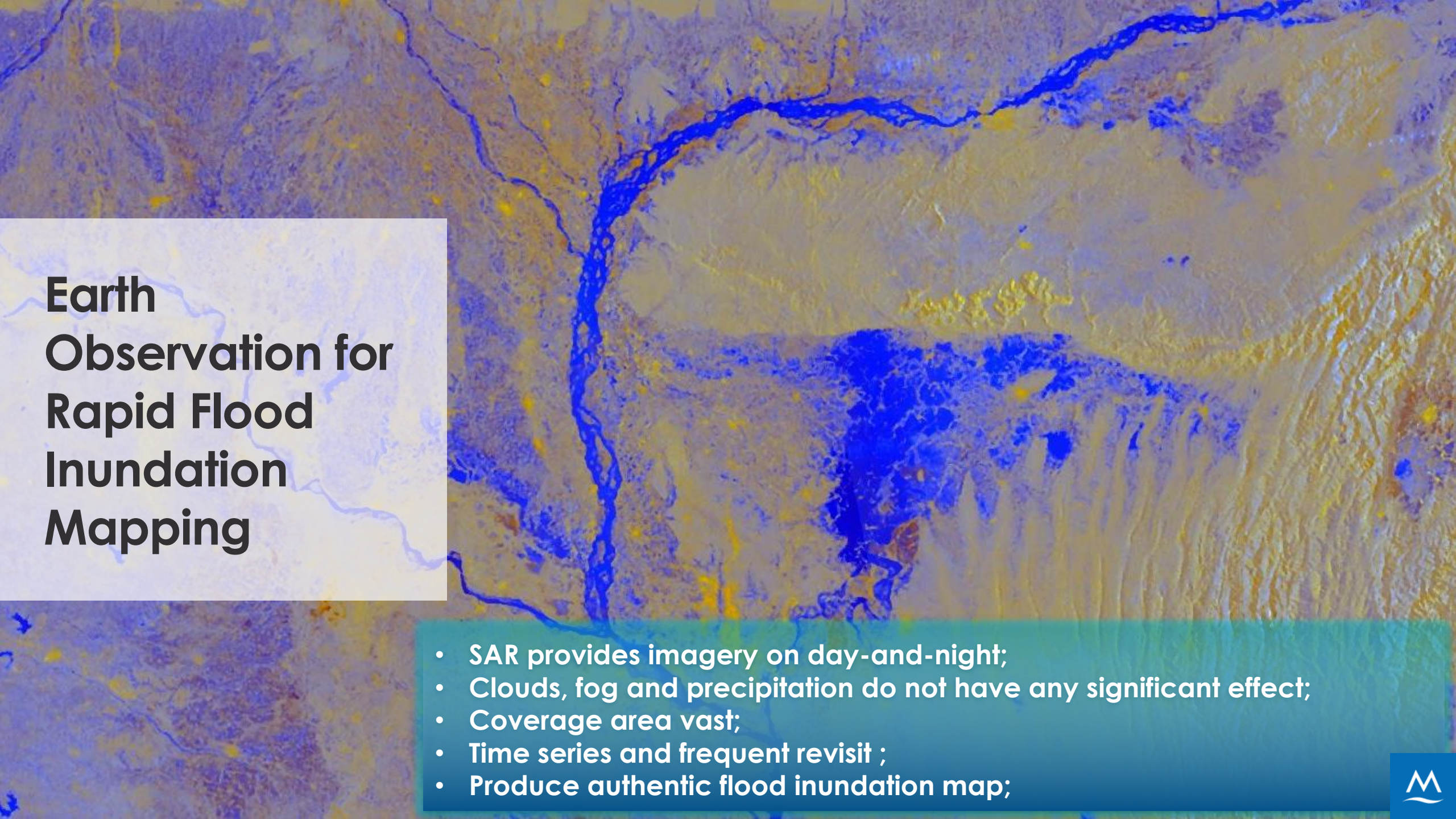
BBC NEWS



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.

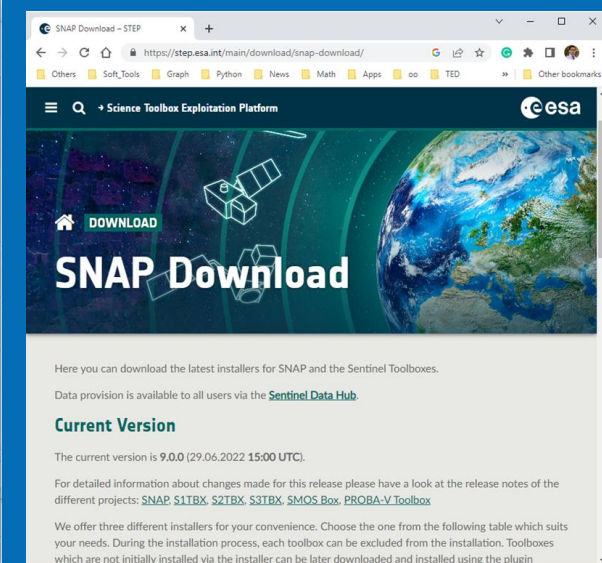
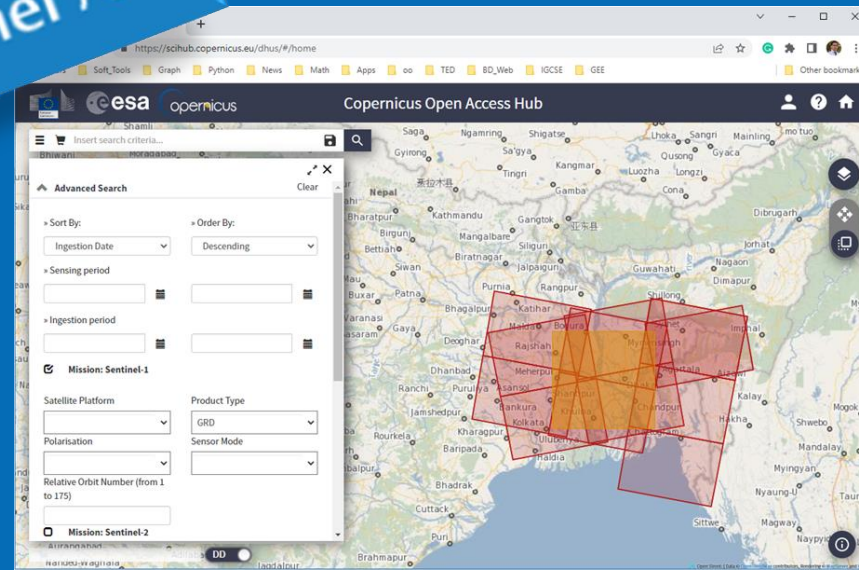
# Earth Observation for Rapid Flood Inundation Mapping



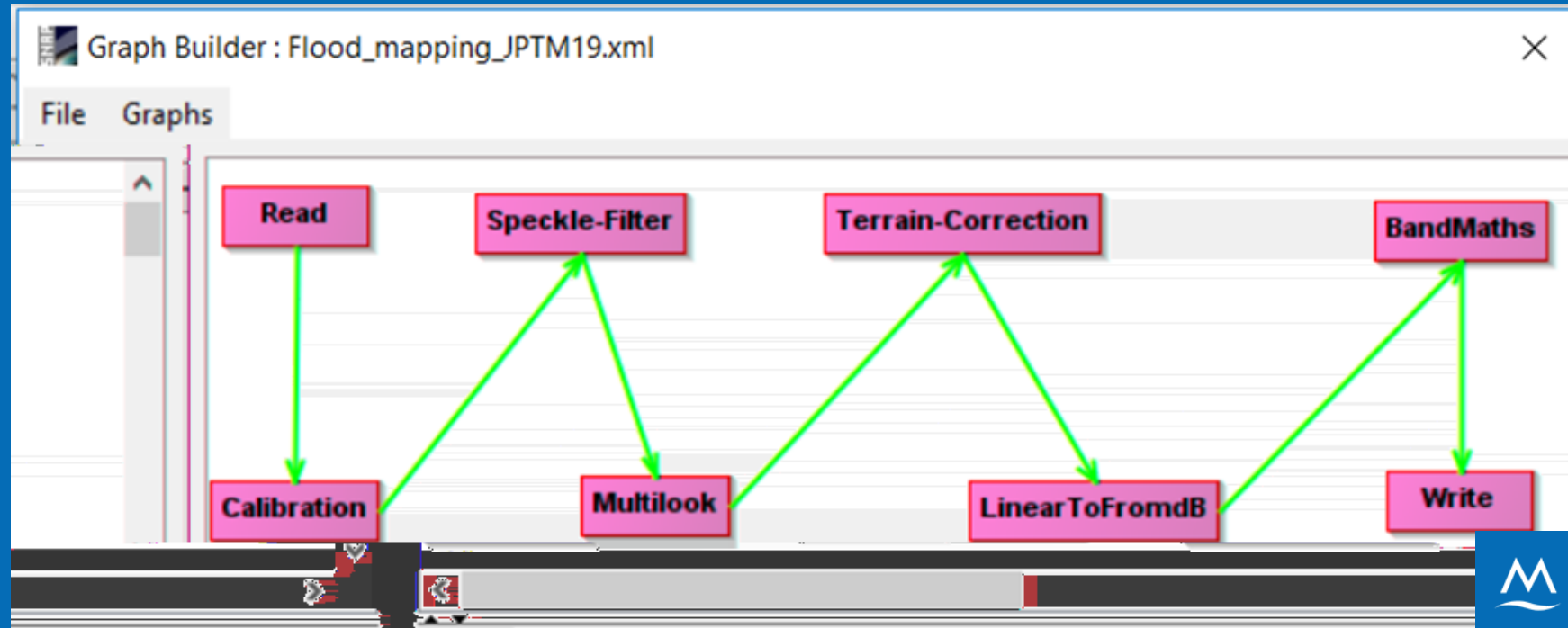
An aerial Synthetic Aperture Radar (SAR) image of a river system. The river channels are shown in a light blue color, while the surrounding land is in shades of yellow and brown. A large, irregularly shaped area in the center-right of the image is highlighted in a darker blue, indicating flood inundation.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

# Earth Observation for Rapid Flood Inundation Mapping

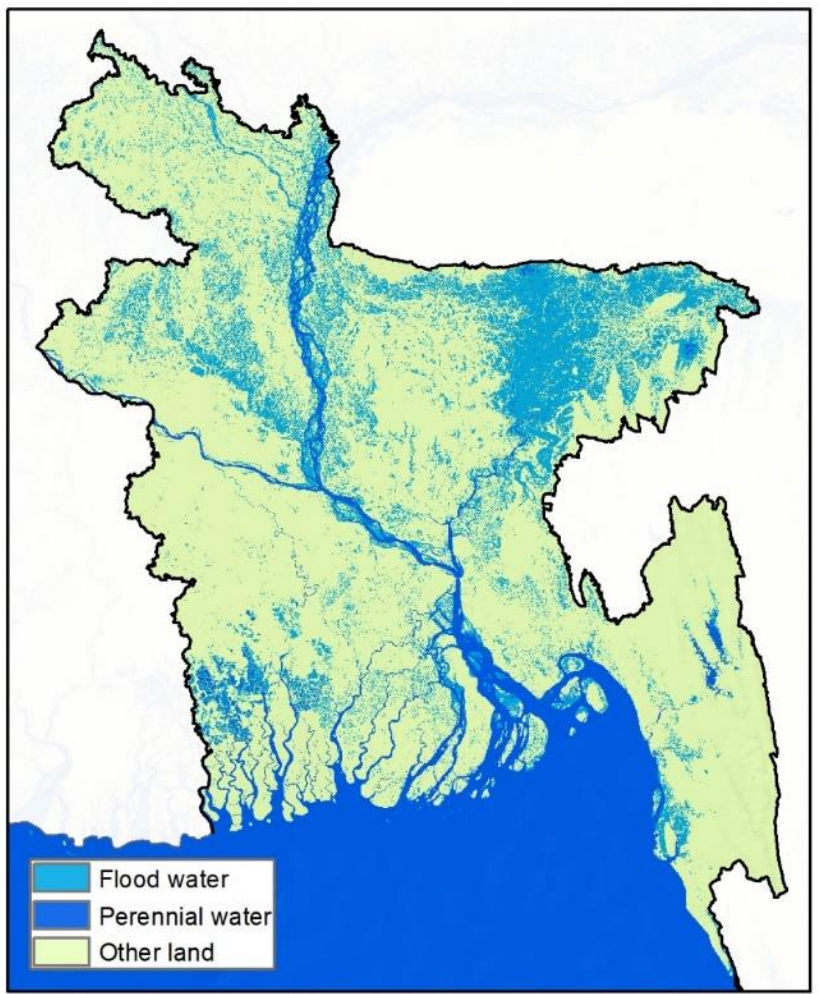
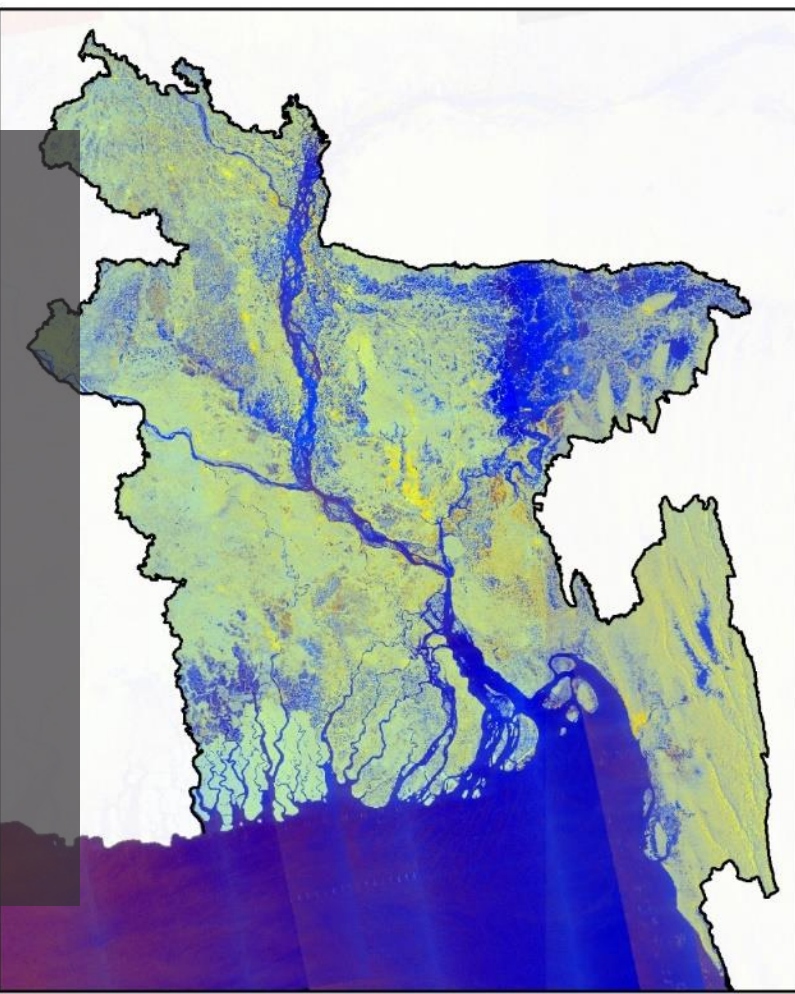
- SAR provides imagery on day-and-night;
- Clouds, fog and precipitation do not have any significant effect;
- Coverage area vast;
- Time series and frequent revisit ;
- Produce authentic flood inundation map;



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



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

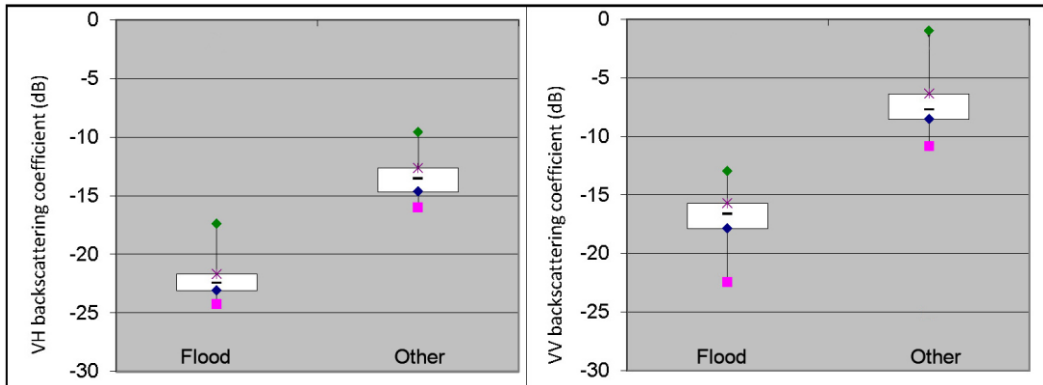


GEE Code: <https://tinyurl.com/2vfyvfkn>

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



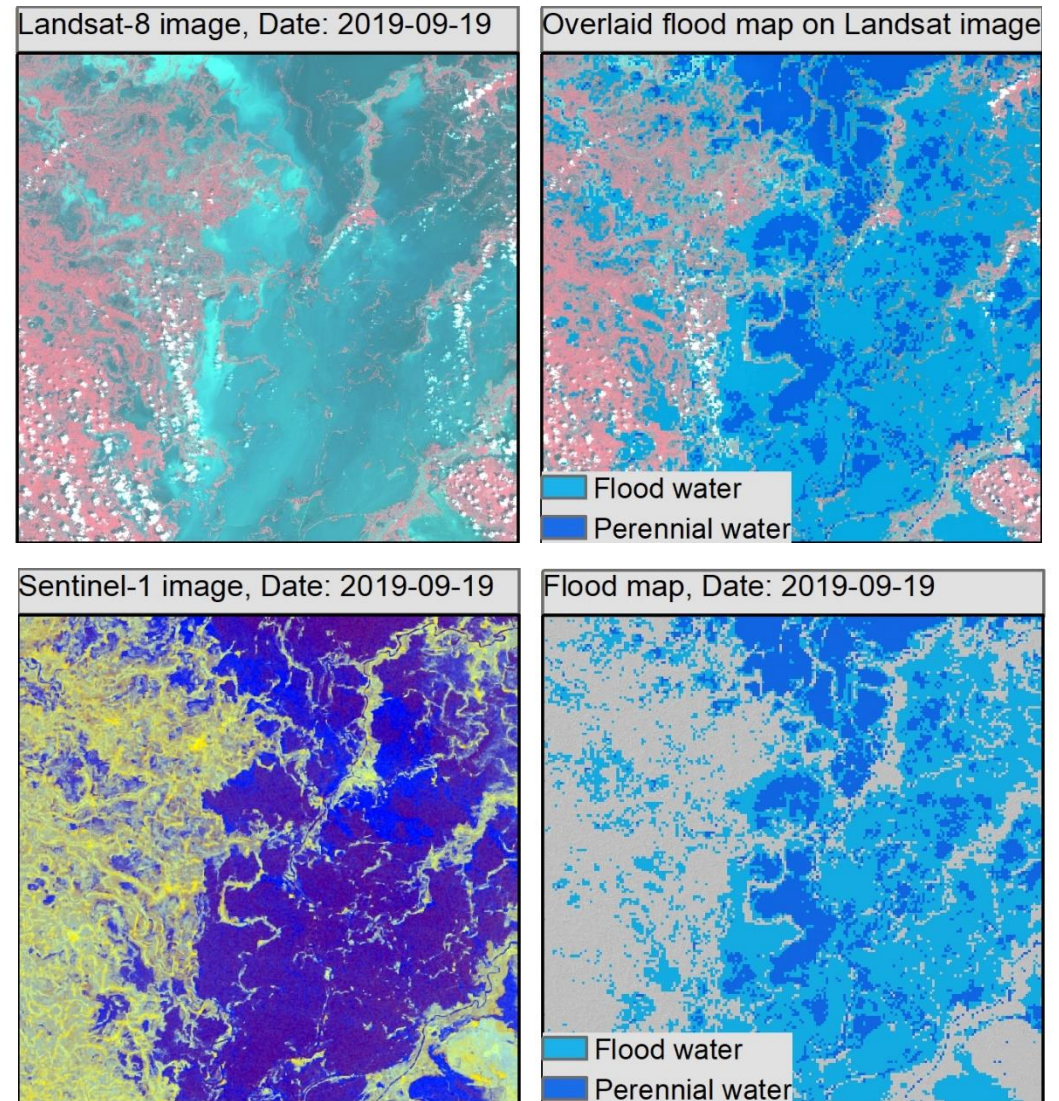
# Ensuring the quality of rapid flood inundation map



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>





About ICIMOD ▾ Programmes ▾ Mountain

Koshi Basin Programme Home

KBIS Home

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

Kabir

Flood Inundation Map of Koshi Basin (2016)

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

Apps Imported From IE Others Soft\_Tools IE Tab

HOME **UPDATES** COUNTRIES DISASTERS TOPICS ORGANIZATIONS JOBS TRAINING

Search ReliefWeb

05 Aug 2016

f t G+ in ✉

## 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:**

Koshi Basin Programme Home

KBIS Home

About KBIS

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)

Flood Inundation Map of Koshi Basin (2016)

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

Legend

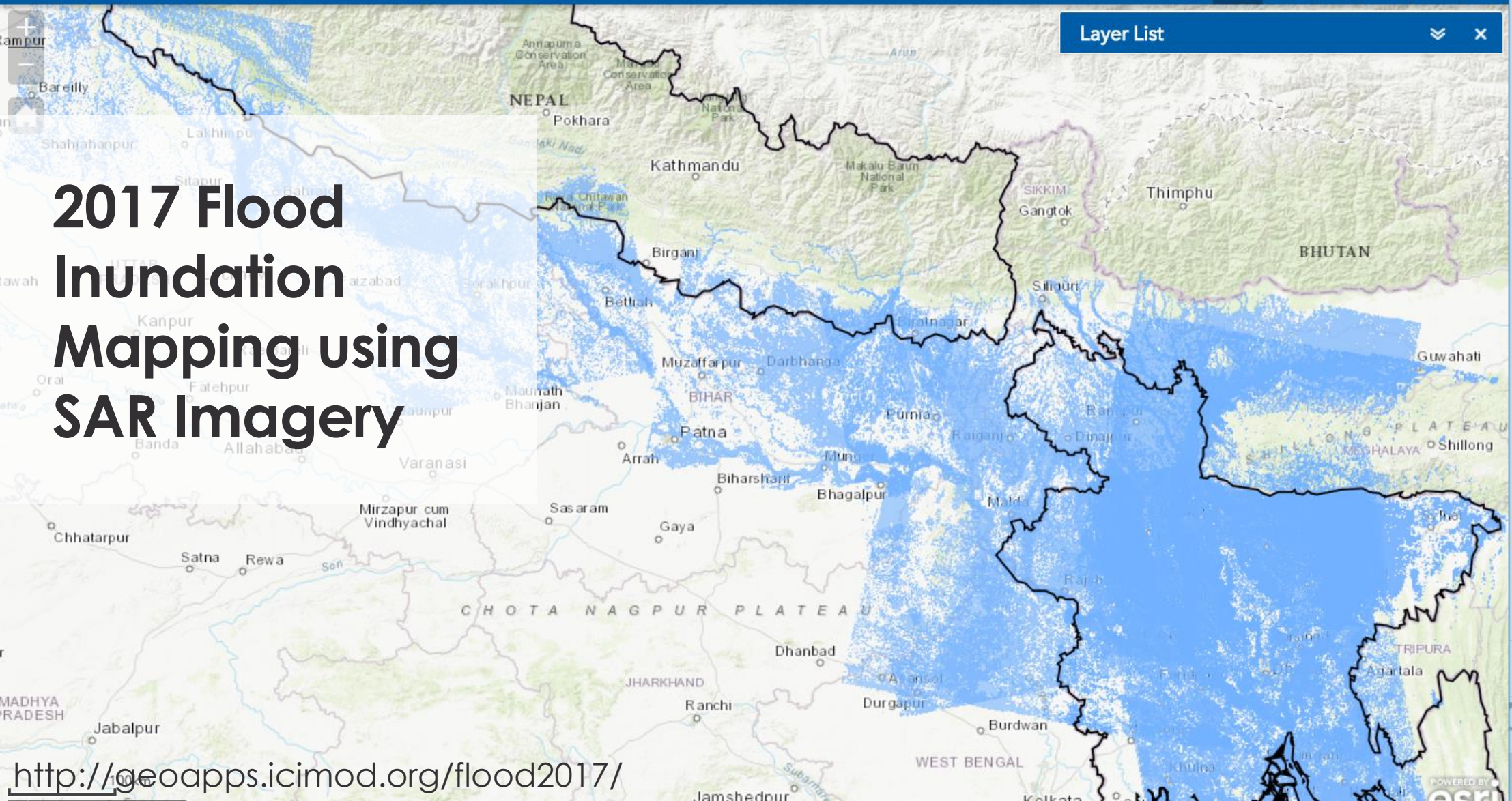
Koshi Flood Koshi River Basin

Inundation map as of 1 Aug 2016

Permanent water bodies

Inundated area





# 2017 Flood Inundation Mapping using SAR Imagery



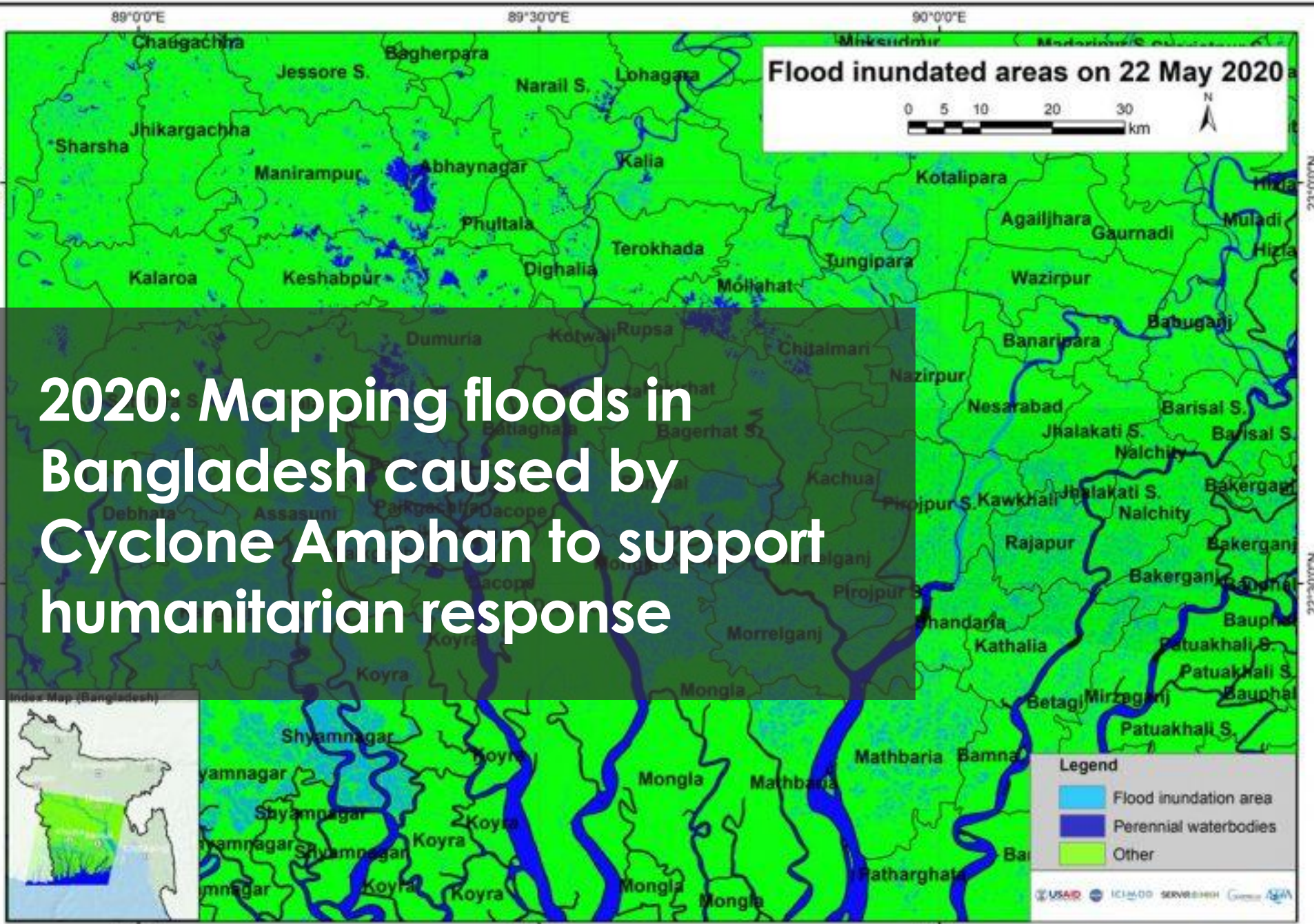
# 2019 Flood Inundation Mapping using SAR Imagery





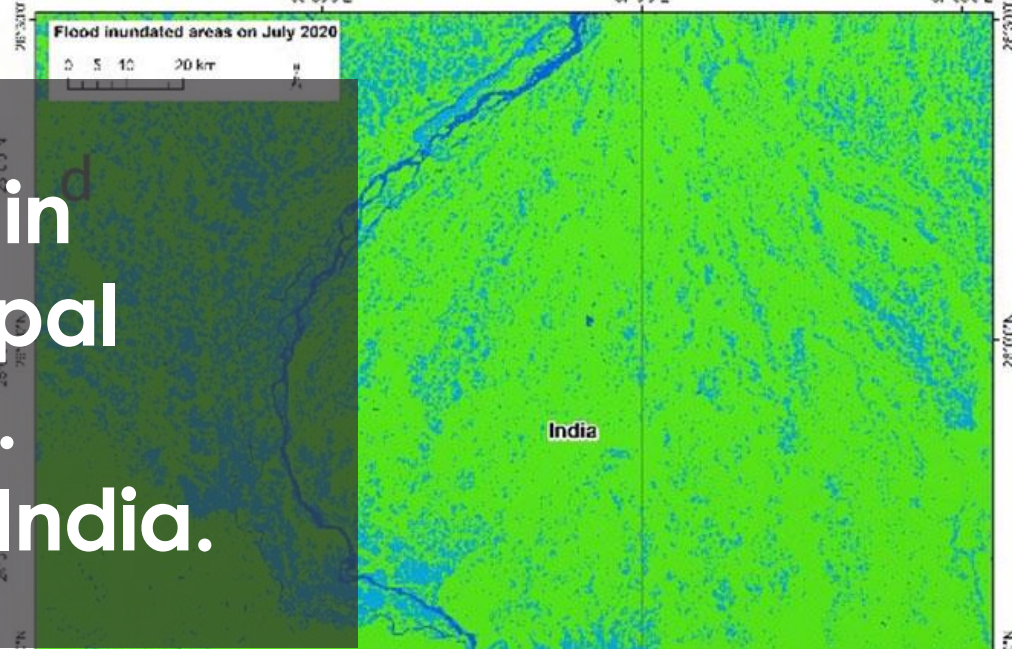
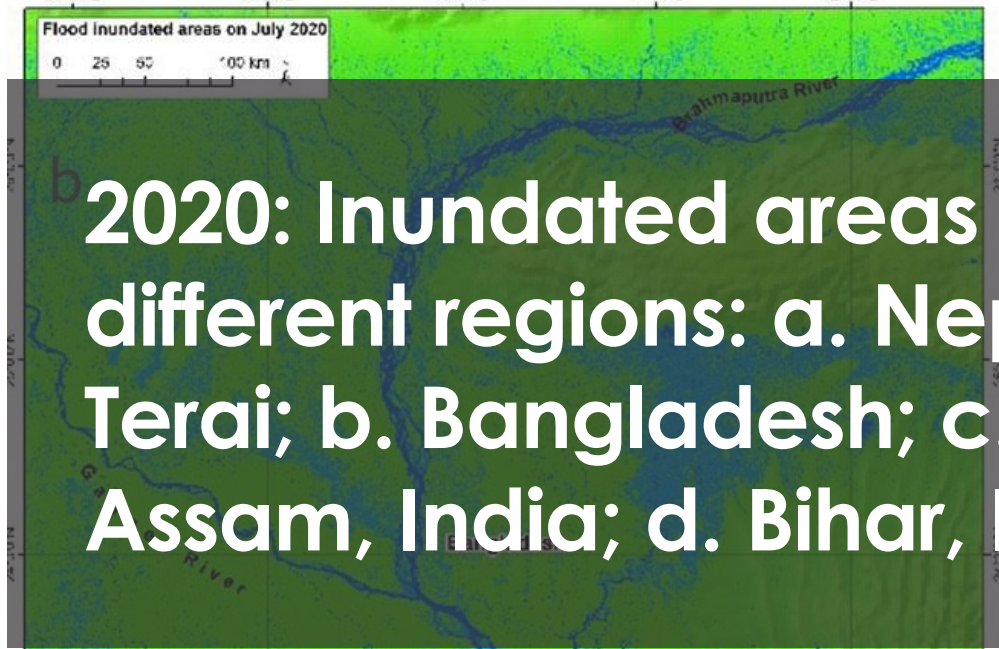
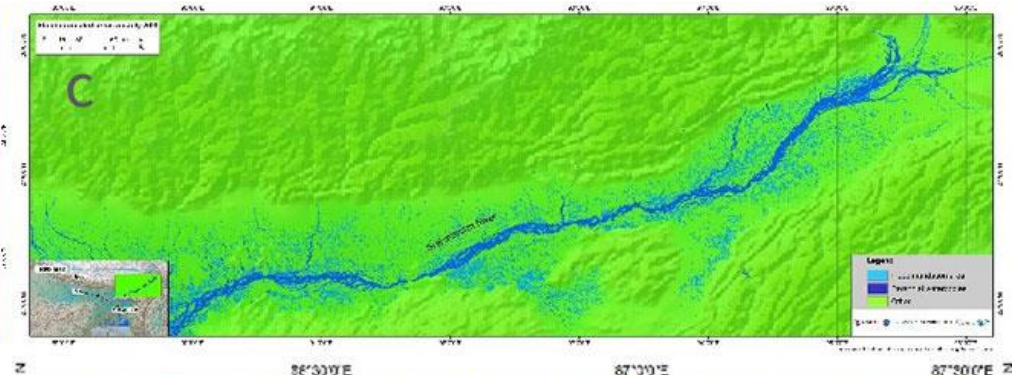
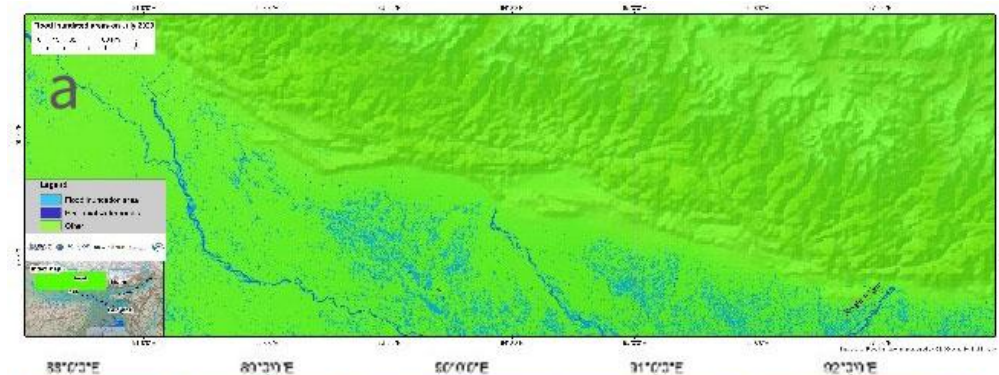
**2020: Mapping floods in Bangladesh caused by Cyclone Amphan to support humanitarian response**

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

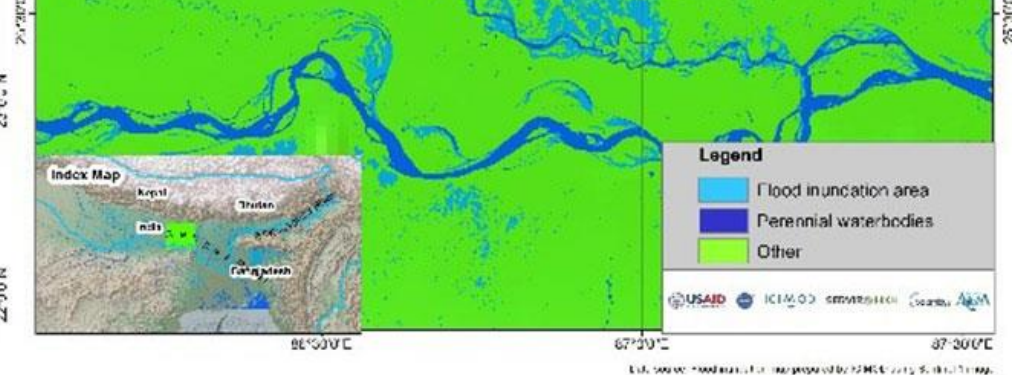
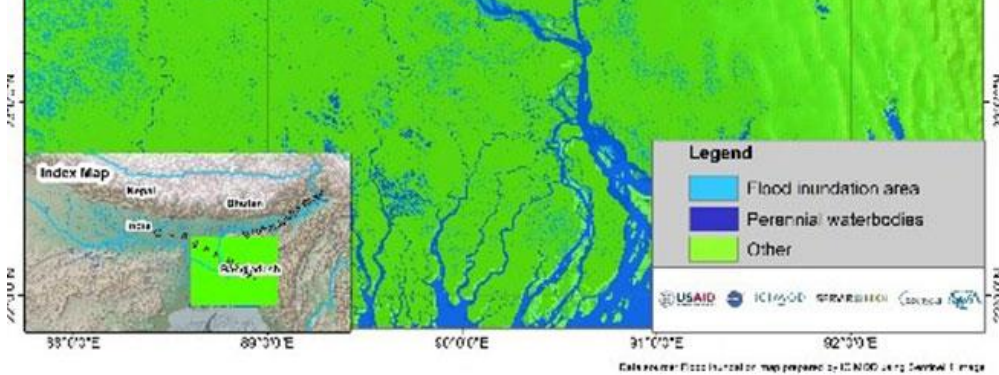


Data source: Flood inundation map prepared by ICI+00 using Sentinel-1 imagery





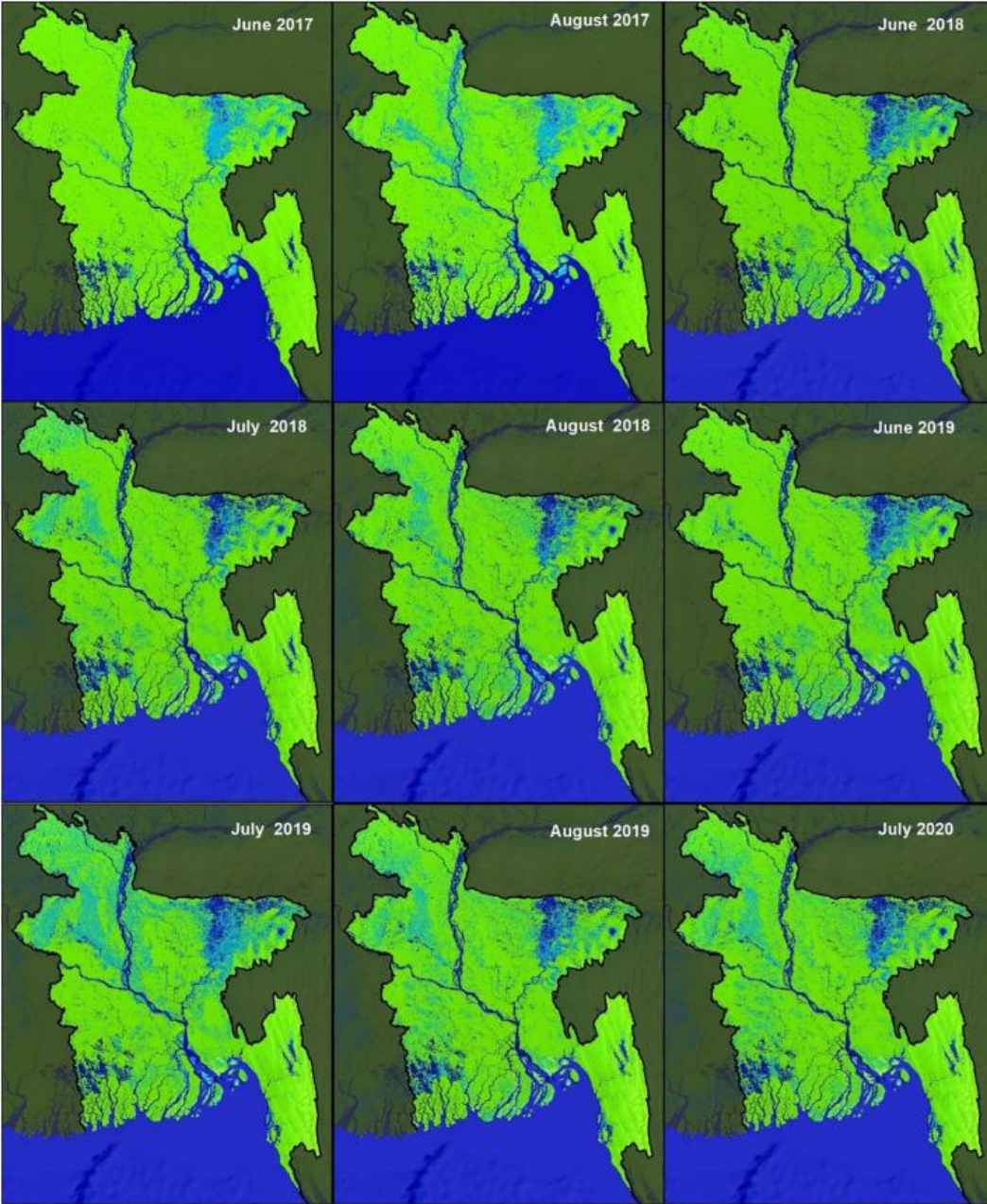
**2020: Inundated areas in different regions: a. Nepal Terai; b. Bangladesh; c. Assam, India; d. Bihar, India.**



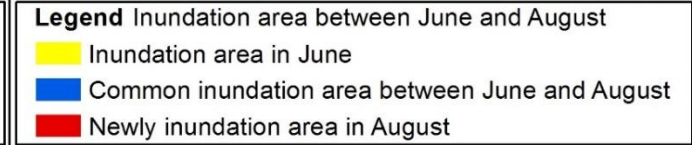
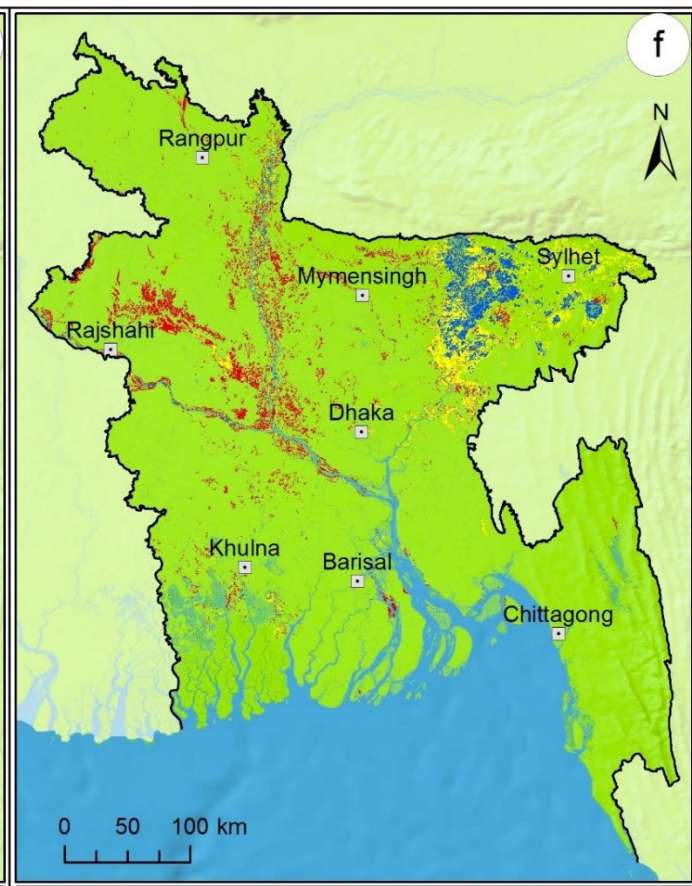
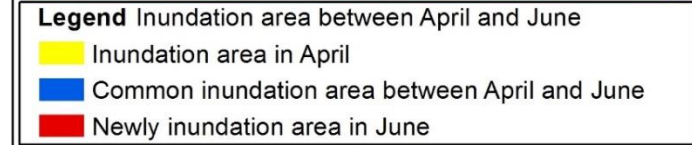
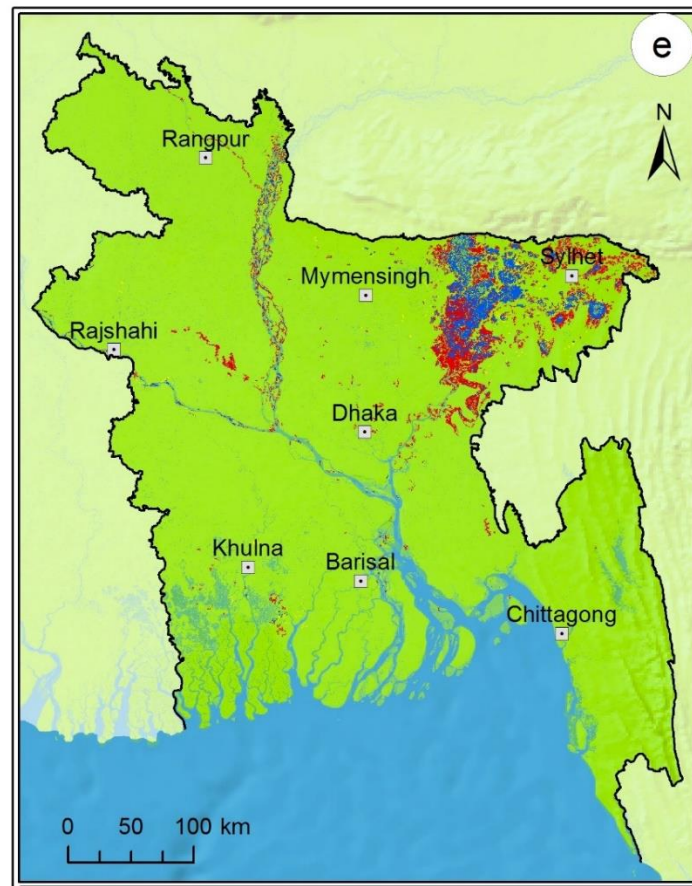
Data source: Flood inundation map prepared by ICIMOD using Sentinel-1 image

URL: [www.floodmap.org](http://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.



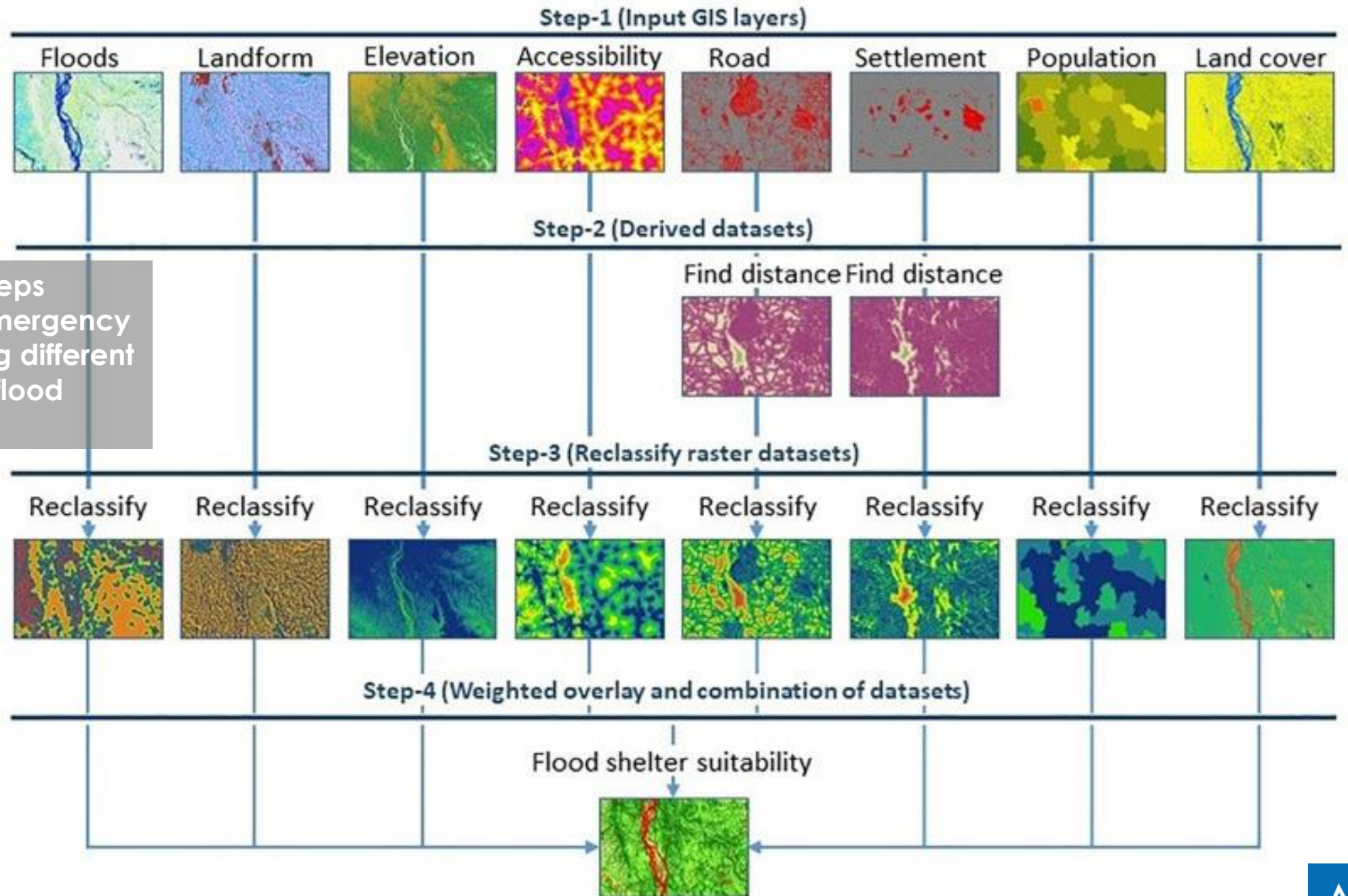
Flood recession and rise areas of Bangladesh between (e) April and June, (f) June and August.



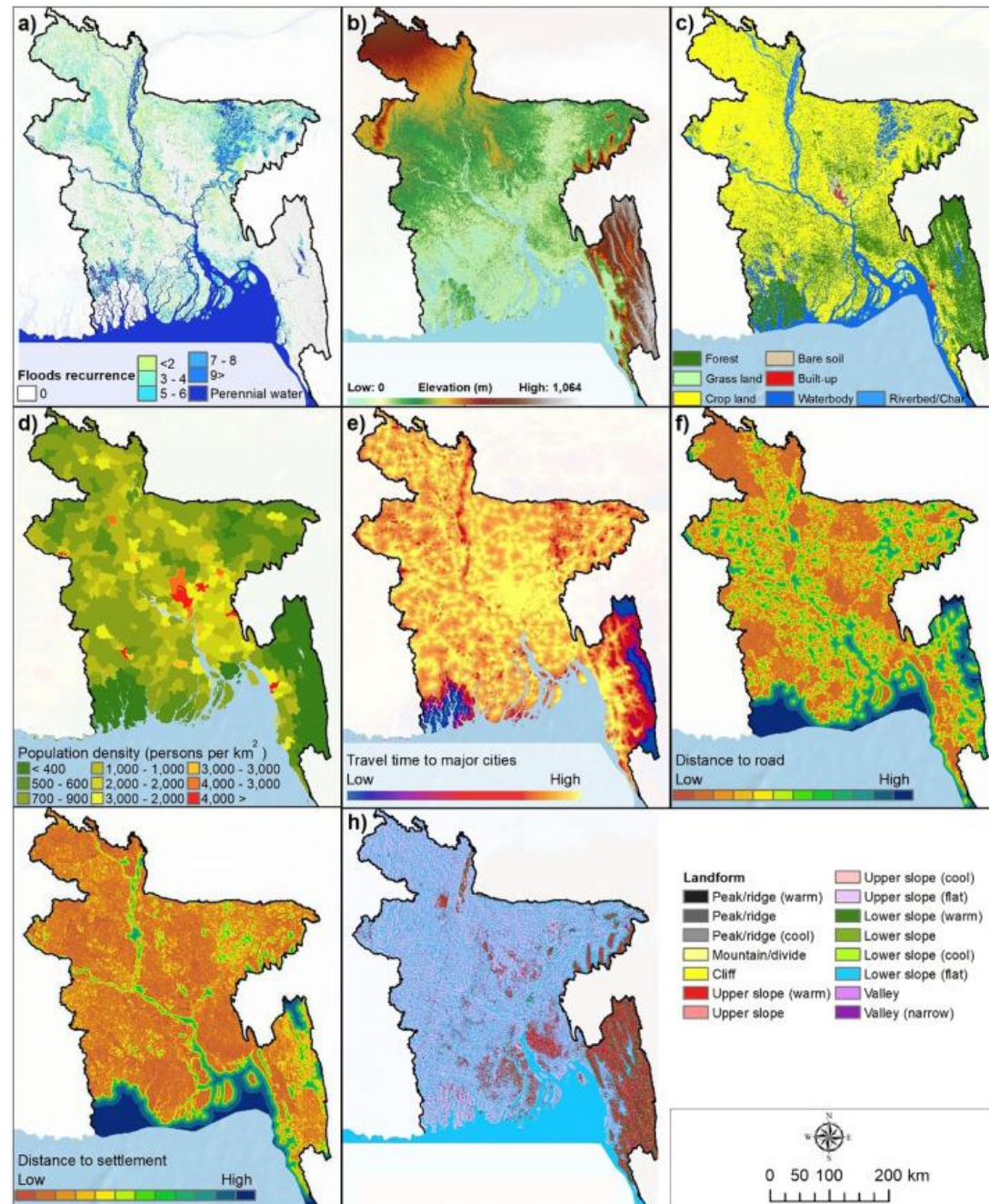
euronews.  
14/08/2017  
DINAJPUR, BANGLADESH



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



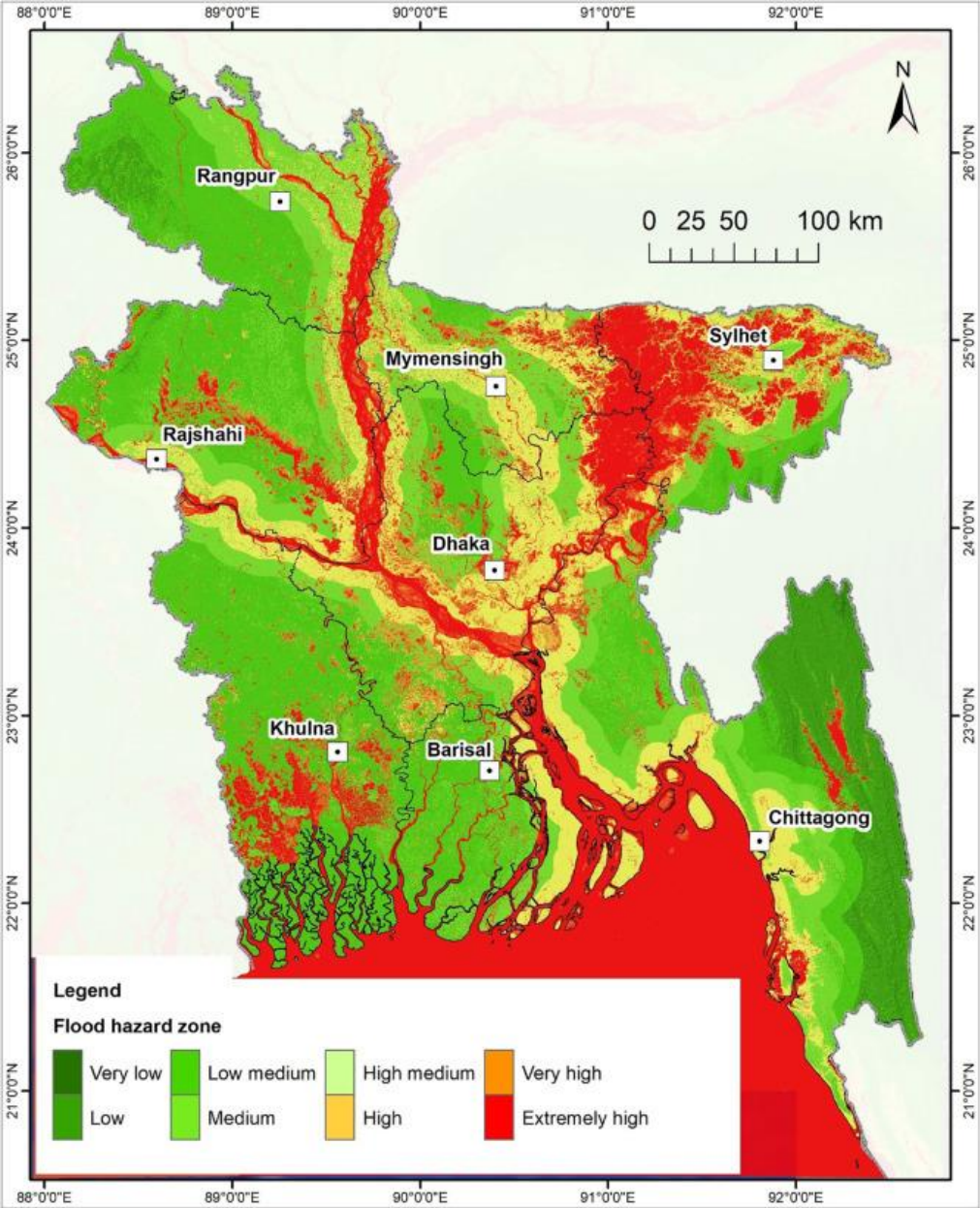




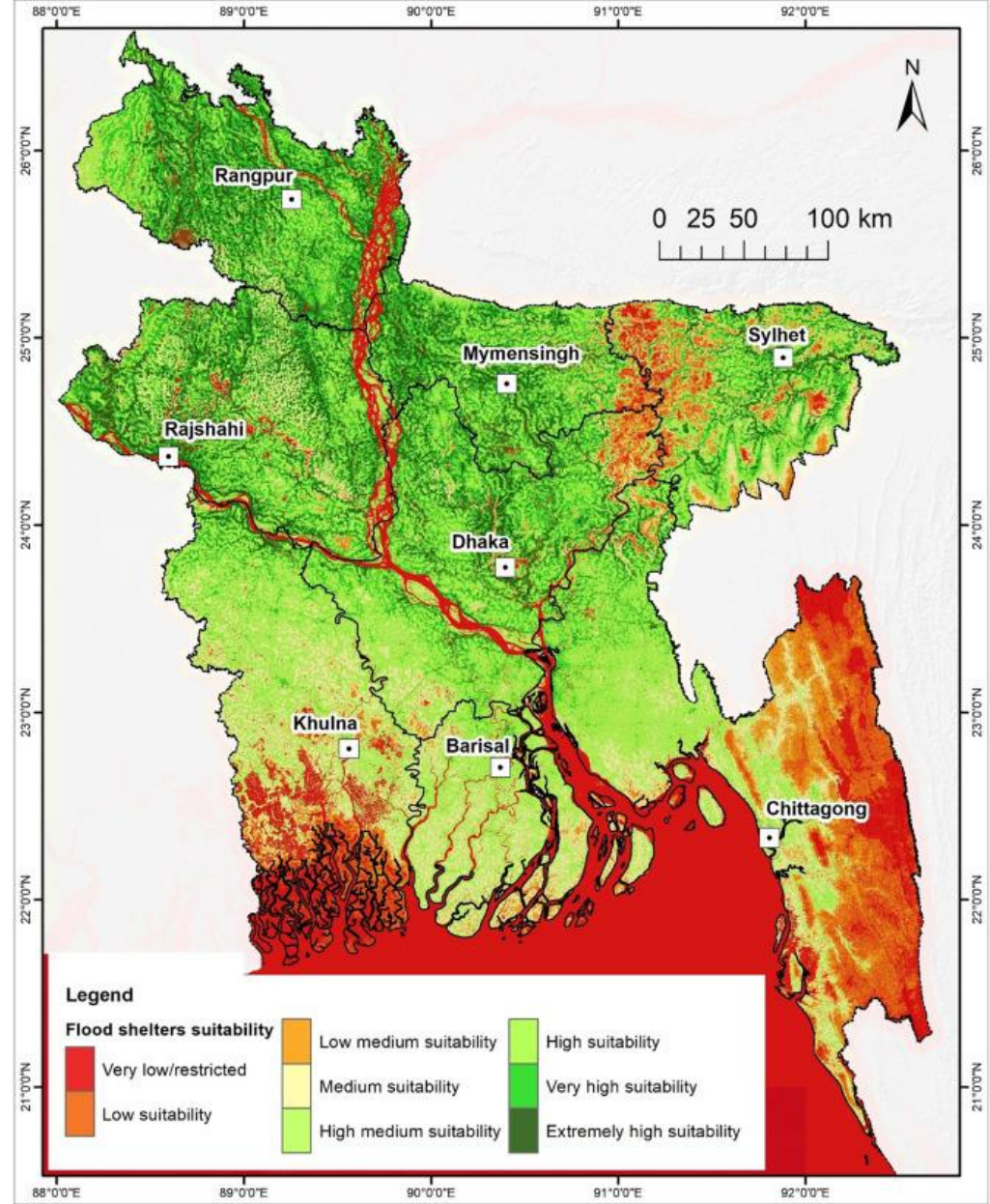
Picture of typical inundation area of Bangladesh, (a, b, c) The village in Jabalpur district inundated by the 2020 floodwaters. d) An aerial photo of rural settlements enclosed by floodwaters during 2017.

GIS layers used for the flood suitability mapping



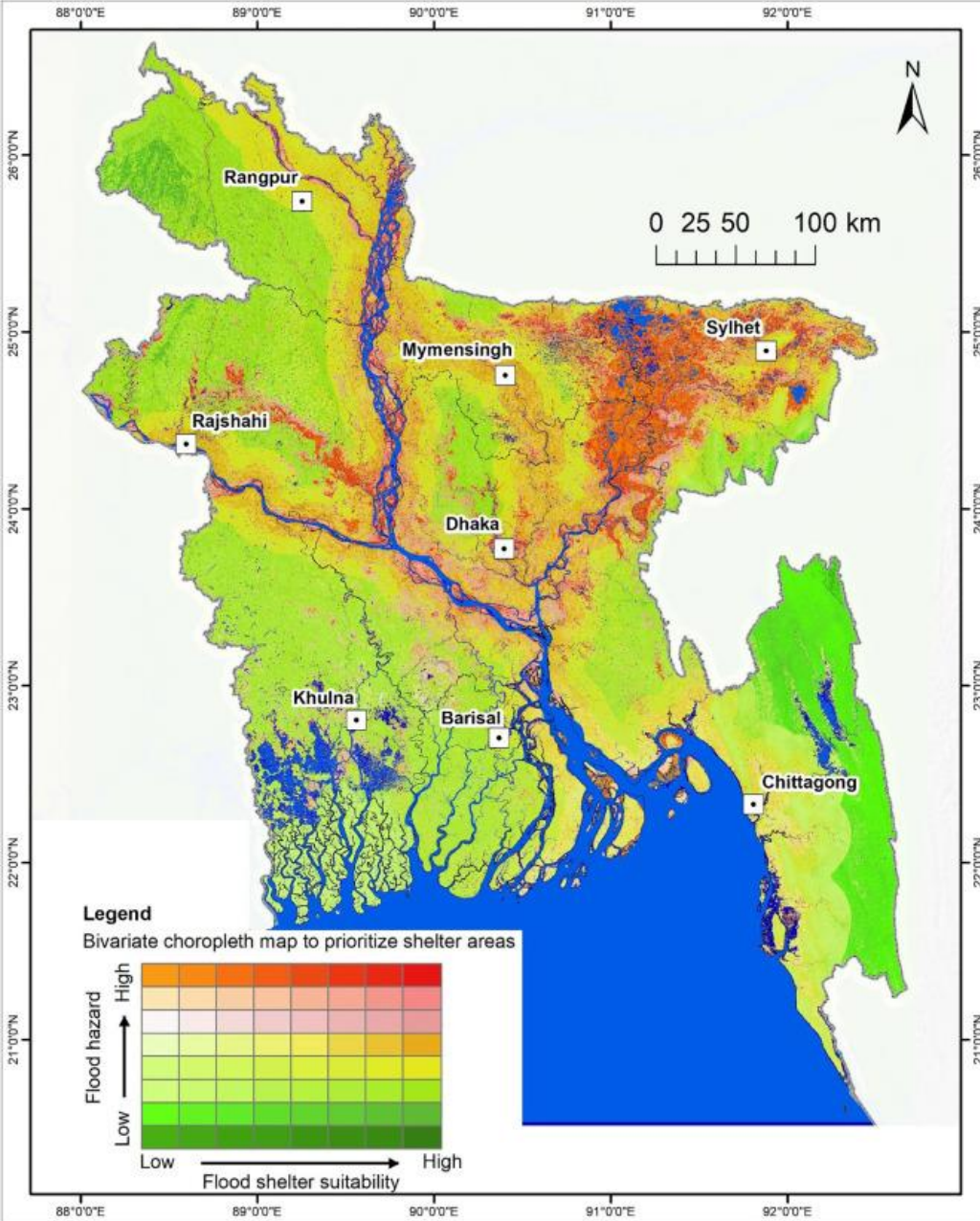


Flood hazard map of Bangladesh



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



Aerial photo shows flood-affected houses in Faridpur, Bangladesh, (Photo credit: Xinhua)



People take shelter at Shialhar Government Primary School in Gowainghat, Sylhet (Photo credit: Dhaka Tribune)



# Useful article/reference



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

Kabir Uddin<sup>1,\*</sup>, M

- 1 International Center for Integrated Mountain Development
  - 2 Geophysical Institute
- \* Correspondence

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

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

Kabir Uddin<sup>a,b,\*</sup>, Mir A. Matin<sup>a</sup>

<sup>a</sup> International Centre for Integrated Mountain Development, GPO Box 3226, Kathmandu, Nepal

### ARTICLE INFO

**Article history:**  
Received 1 February 2021  
Received in revised form 5 June 2021  
Accepted 14 June 2021

Available online 18 June 2021

**Keywords:**  
Automatic flood mapping  
Flood hazard zonation

### 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



journal homepage: [www.elsevier.com/locate/pdisas](http://www.elsevier.com/locate/pdisas)



Birendra Bajracharya  
Rajesh Bahadur Thapa  
Mir A. Matin *Editors*

## Earth Observation Science and Applications for Risk Reduction and Enhanced Resilience in Hindu Kush Himalaya Region

A Decade of Experience from SERVIR

ICIMOD SERVIR HINDU KUSH HIMALAYA

OPEN ACCESS

Springer

[www.mdpi.com/2072-4292/11/13/1581](http://www.mdpi.com/2072-4292/11/13/1581)

[https://link.springer.com/chapter/10.1007/978-3-030-73569-2\\_10](https://link.springer.com/chapter/10.1007/978-3-030-73569-2_10)

[www.sciencedirect.com/science/article/pii/S2590061721000454](http://www.sciencedirect.com/science/article/pii/S2590061721000454)





Thank you



Let's protect  
the pulse.