東京大学
THE UNIVERSITY OF TOKYO

EGU General Assembly 2022
Session NH1.2

EGU22-5110: Generalizing flood damage mechanism processes of MC Type houses by developing comprehensive flood damage estimation method for Teesta River Basin, Bangladesh

Presented by

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Date: May 23, 2022

Introduction

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4 types of Residential Houses

BB type: This house has brick base with brick wall.

BC type: This house has brick base with cast iron (tin) sheet wall

MC type: This house has mud base with cast iron (tin) sheet wall**.** This type of house is affected mostly in flood and the number of this type is larger than other.

New BC type (BBC): This house has brick base with brick and cast iron sheet wall.

- The **depth damage curve** developed from historical data and questionnaire survey can provide the **estimation of damages** for different elements **(mostly for houses and agriculture)** considering the statistical analysis only. e.g. Pistrika, A. (2010), Dias et al. (2018), Komolafe et al. (2019), Win et al. (2018), Thepa et al. (2020).

- However, mechanism of damage of structure due to flood were not considered

Research Objective and Novelty

Research Objective

- To consider various flood parameters such as flood depth, flood duration, and flood velocity in development of flood damage functions for residential houses.

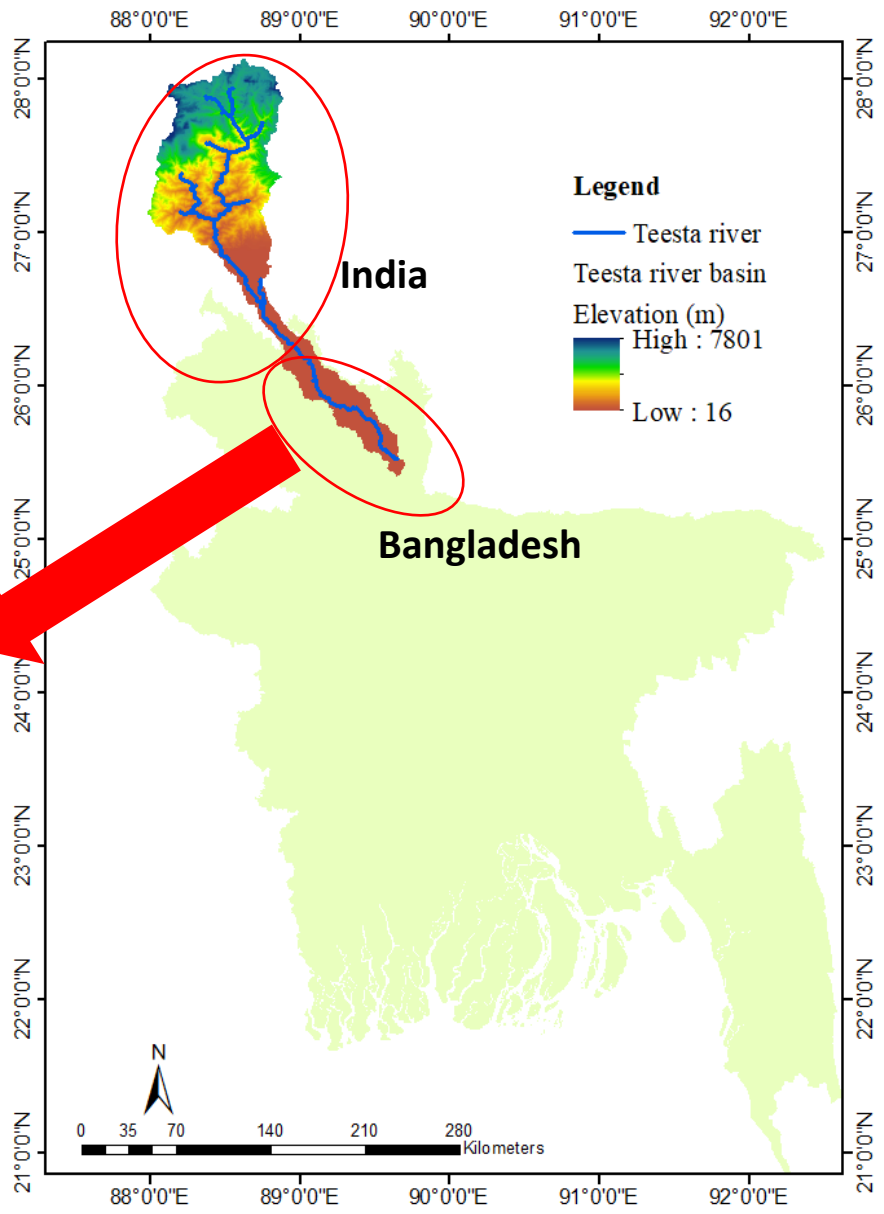
Novelty of this study

- The consideration of flood damage mechanism of MC type of houses in development of damage function/ table is a new thing in flood damage assessment.
- In Bangladesh, questionnaire survey for understanding damage mechanism for residential houses is necessary because it was not done before.

Study Area

- **Teesta river basin**
- Higher elevation in Indian part
- Lower elevation (almost floodplain) in Bangladesh part
- Teesta river and it's surrounding area receives the flood water very frequently almost in every year due to this greater elevation difference.

Flood 2017, (Talukdar et al., 2020)



Specific Research Methods

Necessary data

Method 1: Field survey	• Flood Depth in basin area • Flood Duration, velocity (approx.) • Damage mechanism for house	**Output 1:** Damage function/ table
Method 2: RRI and iRIC model simulation	• DEM (SRTM) • Observed water level and discharge in river (BWDB) • Observed water depth in flood plain (field survey) • Observed flood velocity (if possible) • Identification of flood area extent for specific flood year	**Output 2:** A calibrated and validated RRI and iRIC model
Method 3: Estimate flood damage using damage table/ function from method 1	• Damage information from previous flood events • House damage information for the Teesta river basin area • Identification of flood area extent for specific flood year	**Output 3:** Validation of new damage function / table that considers flood damage mechanics

Method 1: Field Survey

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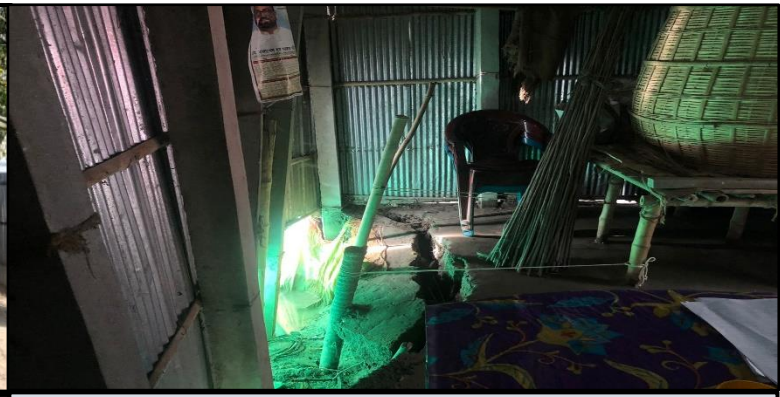
Field Visit: March, 2021 to March 2022; Number of Samples: 198; Flood Year: 2017 and 2019
Selected sub-district for field visit: Lalmonirhat Sadar, Aditmari, Kaliganj, Hatibandha and Gangachara

MC Type House damage:

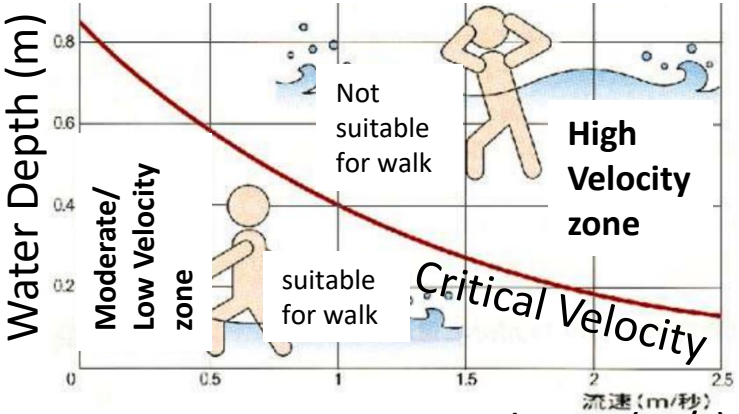
Type A: Removal of Soil from base

Type B: Removal of Soil from base + Side wall Damage



Type C: Removal of Soil from base + Side wall Damage and Displacement + full structure instability

Area where you can walk underwater during Flood evacuation



Velocity Type	Definition
High velocity	People unable to walk
Moderate/ Low velocity	It is tough to walk, but people can evacuate; People can walk stably even if there is some flow velocity
No velocity	No velocity

Reference:
https://www.kkr.mlit.go.jp/wakayama/ryuiki_iinkai/ryuiki/comm11/pdf/data1_11.pdf

Result 1: Field Survey

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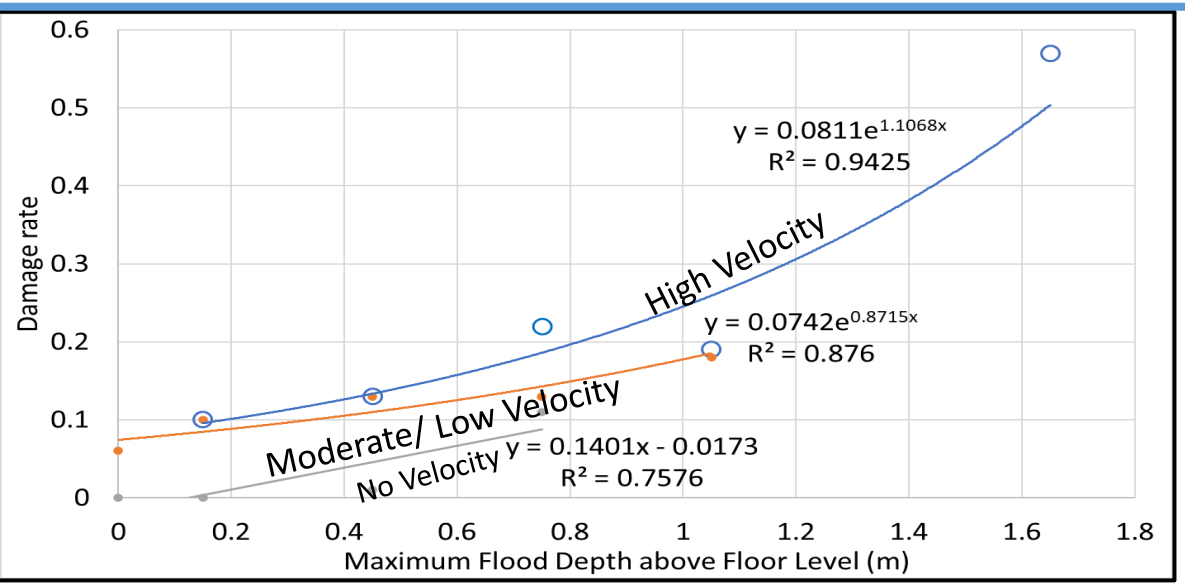

Figure: Damage rate curve for maximum flood depth and velocity combination

Table 1: Flood Damage Rate for MC type of House

Duration (day)						
	Less than 7 Days			Equal or more than 7 days		
Velocity Effect / Flood Depth (m)	High	Moderate/Low	No	High	Moderate/Low	No
0.0-0.3	0.139	0.052	0	0.11	0.06	0.04
0.3-0.6	0.145	0.071	0.045	0.14	0.08	0.07
0.6-0.9	0.152	0.09	0.09	0.20	0.11	0.10
0.9-1.2	0.161	0.135		0.26	0.15	0.12
1.2-1.5		0.178		0.35		

Method 2: Calibration status of RRI model

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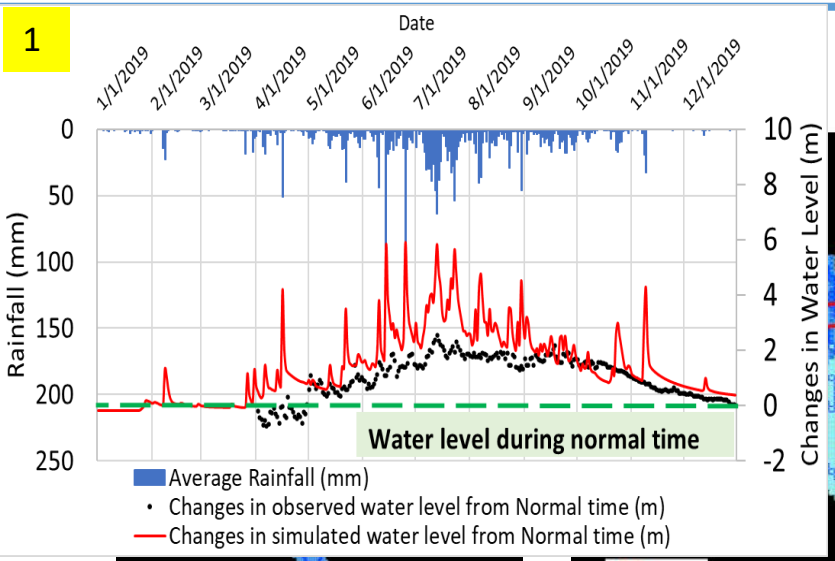

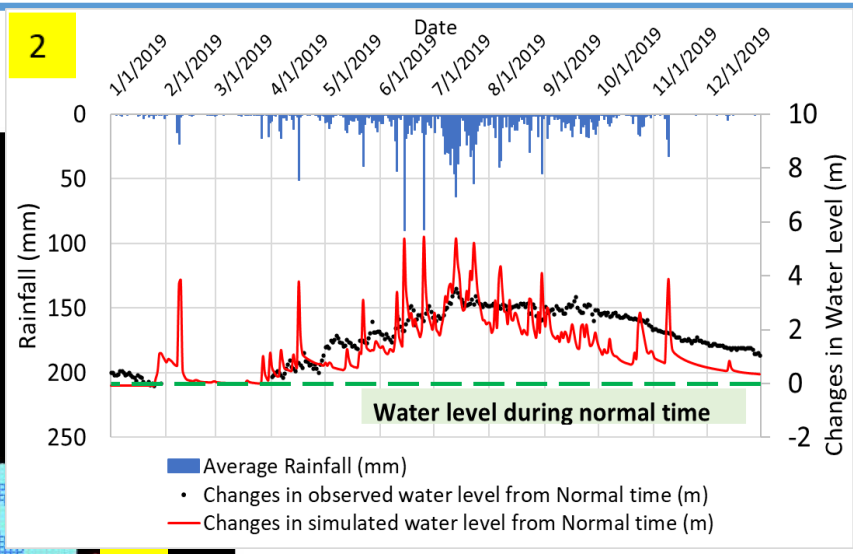

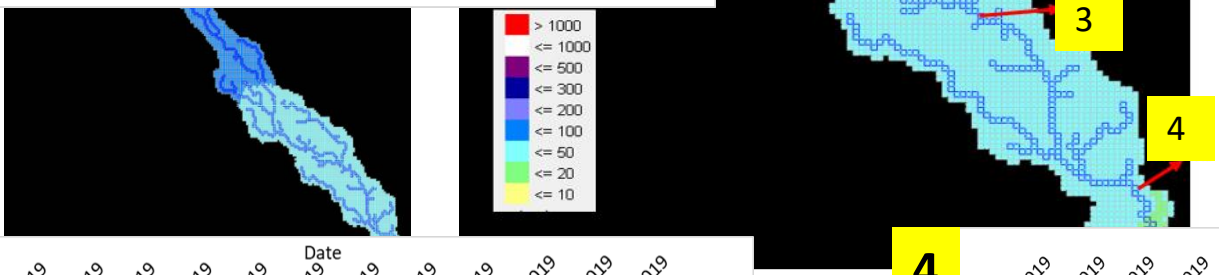

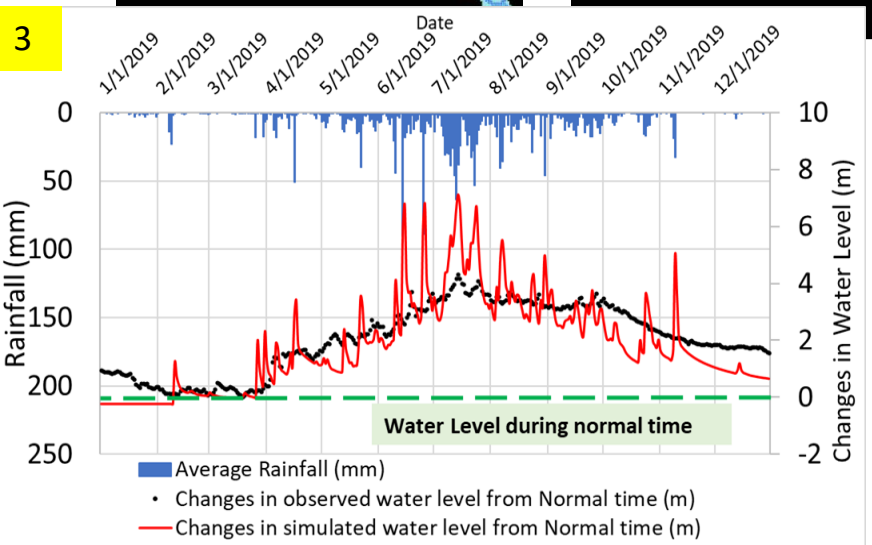

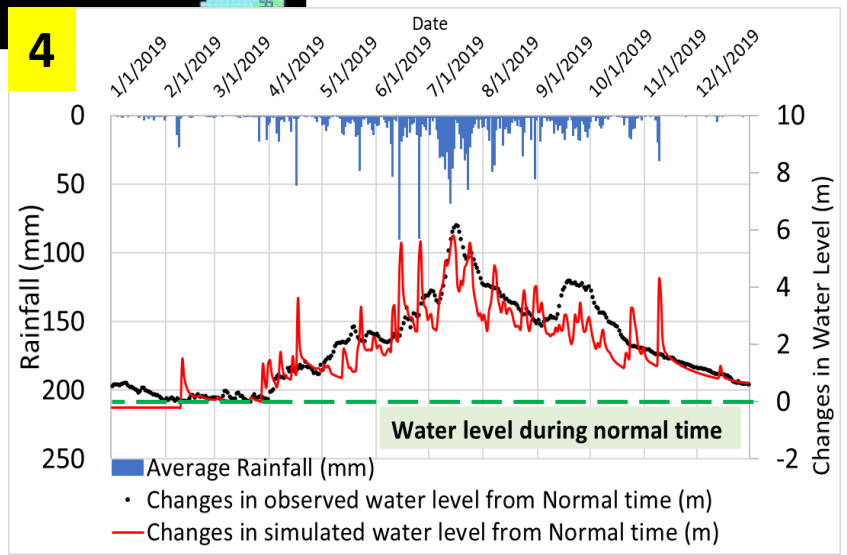

Result 2: Calibration status of RRI model

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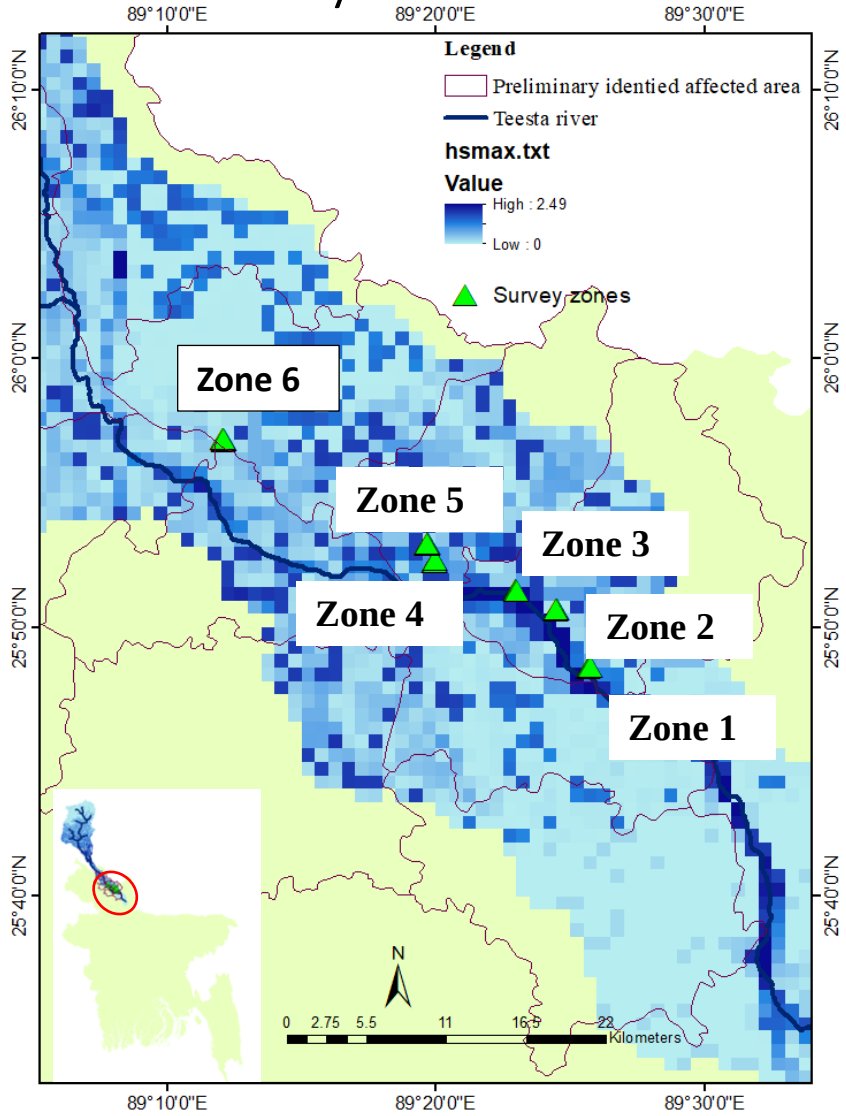
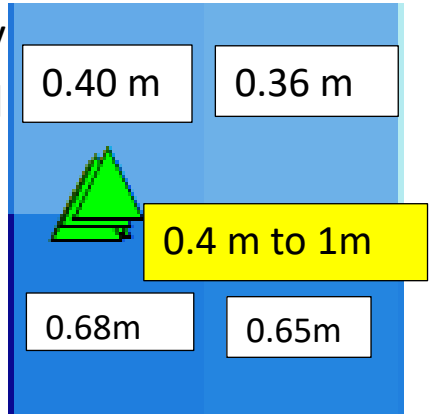
Comparison of 2019 flood depth from Maximum Water Depth simulation with the field survey data for 6 zones

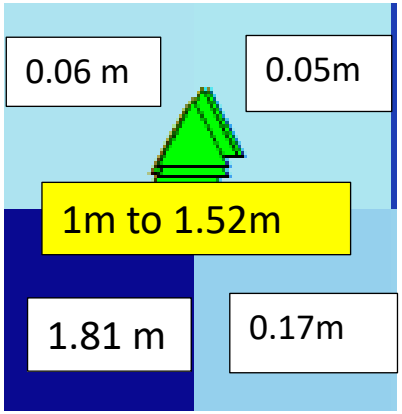
Survey

Model





Zone 1



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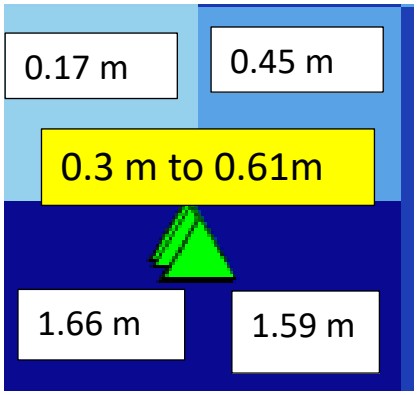
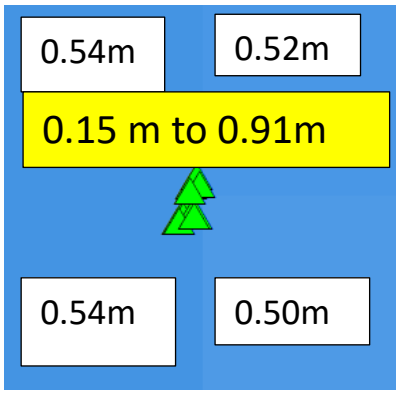
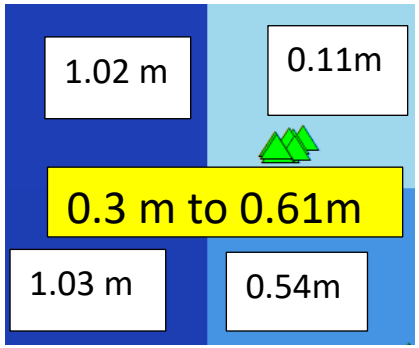


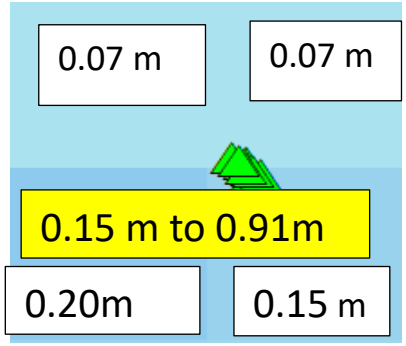
Zone 3



Zone 4



Zone 5



Zone 6

Result 2: iRIC Nays2D Flood model

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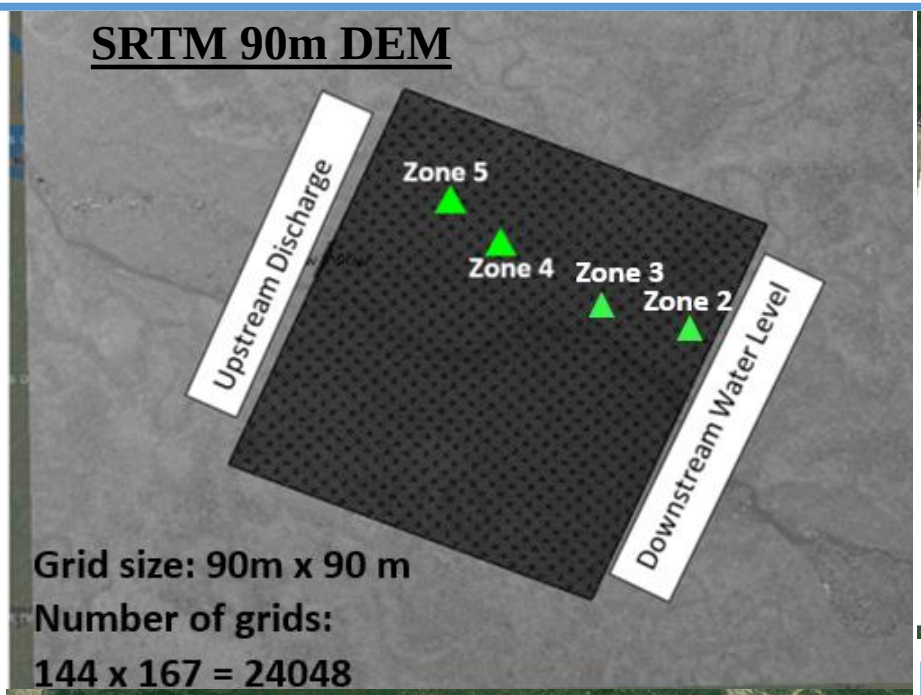

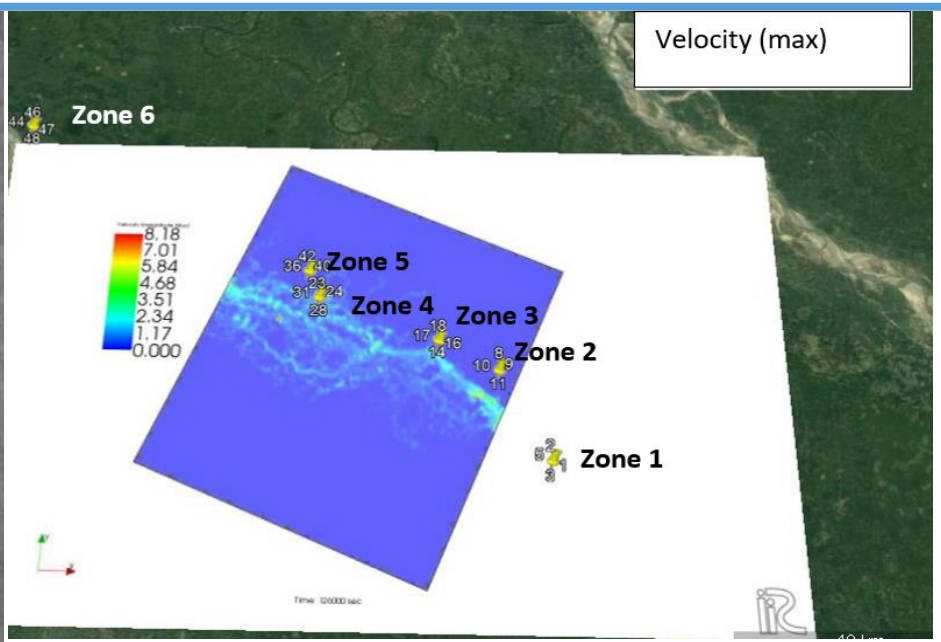

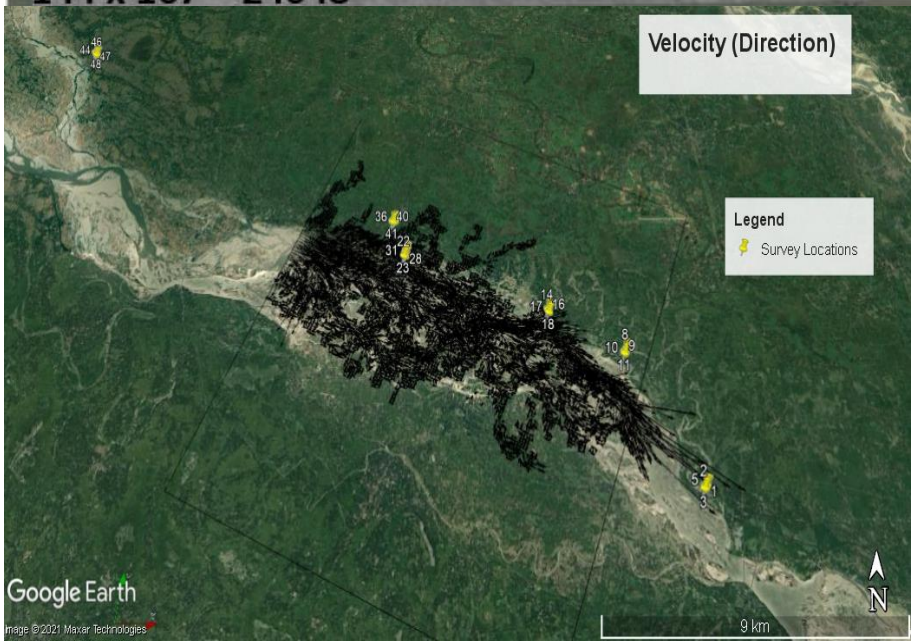

Criteria	Type	Verification
Model velocity≥ Critical velocity	High velocity	It has been validated in field survey based on velocity information from the local people
Model velocity< Critical velocity	Moderate/ Low velocity	
Model Velocity = 0	No velocity	

This verification will lead to provide a specific range for three types of velocity that are related with the flood depth.

Method 3: Flood damage Calculation

- The population distribution per household has been estimated using Total Household and total population of surveyed village area (3 examples are in below).

Administrative Unit		Total Household	Population	Population distribution per Household
Upazilla	**Village name**			
Lalmonirhat sadar	Shekh Para	479	1971	4.1
Lalmonirhat sadar	Kamar Para	230	881	3.8
Aditmari	Gobordhan	407	1624	4.0

- The flood depth in each grid from calibrated RRI model can be identified (Ongoing)
- The velocity (high, moderate/low and no) from the iRIC can also be idenfied

- Damage in each grid = (percentage of MC type of house in this grid) **x** (total number of residential houses in this grid) **x** (the total rebuilding cost of MC type of house in this grid**)** **x** (Damage ratio considering flood depth and velocity for this grid)
- Therefore, Total Damage = sum of damage from all grids

This process can be able to estimate the total flood damage for MC type houses in flood-affected areas.

Ongoing Works

1. This is the ongoing work for doctoral thesis and these outputs are still under modification.

2. The Identification of specific damage mechanism for MC type of house (ranges of flood depth, flood duration and flood velocity) considering zero to maximum structural damage is still under developing stage.

3. The **specific threshold points of** flood depth, flood duration and flood velocity for different damage types of MC type of house is in developing stage.

Thank you for your time and attention. Any Questions?