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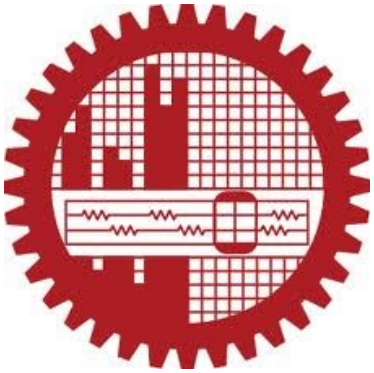

Assignment

Course Code: CMRM 6202

Course Name: Numerical Modelling in Water and Sediment Transport

Submitted to

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Submitted by

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Programme: CMRM

1D and 2D Model Showing Variation of Velocity and Water Level With Respect to Time For a River Reach

1 Introduction

In this assignment, the 1D modelling was done using Python and the 2D Model was by the Delft3D software platform. Due to lack of datasets, the same was data used for the Term Paper was used in this assignment too. The model setups, model outputs and the errors are discussed in the following sections

2 Study Area and Data

The river reach from Panchapukuria to Enayethat of Halda river was taken for assessment. Total river reach was about 45.8km. After Enayethat, the river falls on the Karnaphuli river.

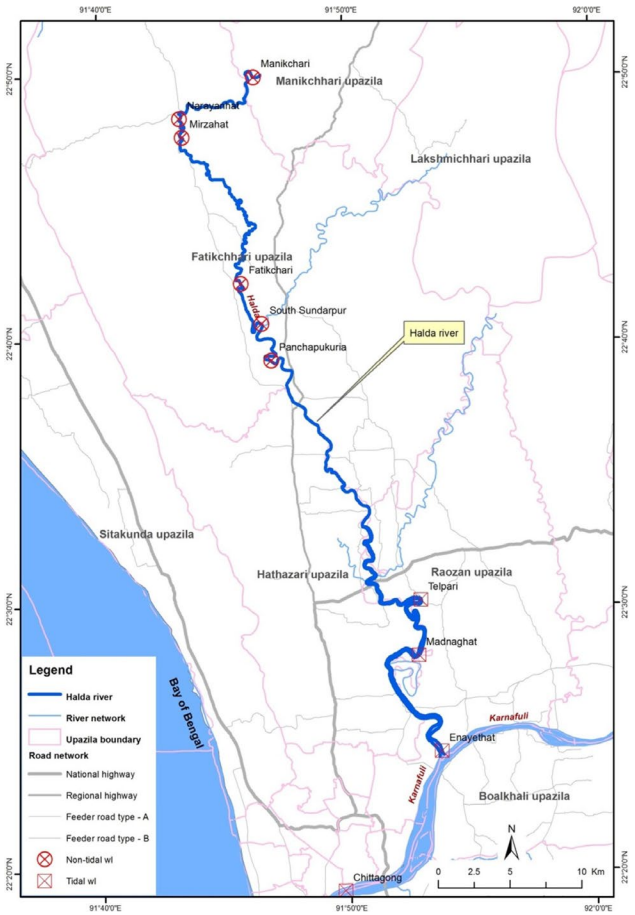

Figure 2.1: Study Area

2.1 Data Collection

The discharge data for the upstream boundary condition was taken on Panchapukuria discharge station. The data was taken from the Bangladesh Water Development Board (BWDB) gauge measurement at Panchapukuria Station from January 1, 2021 to December 31, 2022. The discharge data on the upstream was taken on a daily basis.

Table 3.1: Upstream Discharge Station Information.

Station ID	**SW 119.1**
Station Name	Panchapukuria
River Name	Halda
District Name	Chattogram
Upazila Name	Fatikchari
Latitude	22.667041
Longitude	91.782144
First Receive Date	13-MAR-83
Last Receive Date	17-JUN-25

The water level data for downstream boundary condition was taken from Enayehat water level station. The data was taken from the Bangladesh Water Development Board (BWDB) gauge measurement at Enayethat Station from January 1, 2021 to December 31, 2022. The water level data on the downstream was taken for 3-hour intervals.

Table 3.2: Downstream Water Level Station Information.

Station Id	**SW 121**
Station Name	Enayethat
River Name	Halda
District Name	Chattogram
Upazila Name	Chattogram Sadar
Latitude	22.419666
Longitude	91.882308
First Receive Data	01-JAN-59
Last Receive Data	30-JUN-25

For calibration, the water level data from the Telpari station was taken from January 1, 2021 to December 31, 2022.

Table 3.3: Telpari Water Level Station Information.

Station Id	**SW 120**
Station Name	Telpari
River Name	Halda
District Name	Chattogram
Upazila Name	Hathazari
Latitude	22.557512
Longitude	91.844104
First Receive Data	01-APR-49
Last Receive Data	30-JUN-25

The cross-sectional data to generate the bathymetry of the river were taken at four different locations (RMHLD1, RMHLD4, RMHLD7, RMHLD8) provided by the Bangladesh Water Development Board (BWDB). The DEM data for the study area were taken from Copernicus GLO-30 DEM data source. The bridge data were taken using Google Earth Pro, as raw data weren't available.

3 Bathymetry

The cross-sections data from BWDB were used in HEC-RAS and interpolated to create cross-sections in every 100m distance. Afterwards, a terrain was formed using this bathymetry. That same terrain was used in Delft3D as well.

4 Modelling Approaches:

4.2 1D Modelling by Python

In the 1D modelling, both the Explicit and Semi-implicit approaches were considered. In both cases the depth of the river reach was considered 5m and the width was considered to be 50m. The time range was used from May 2022 to October 2022. The time steps were considered 60seconds each with 10 spatial nodes. The upstream boundary condition location was in Panchpukuiria node and the value of wave celerity was fixed at 7 after many trials. This was considered constant throughout the reach as well.

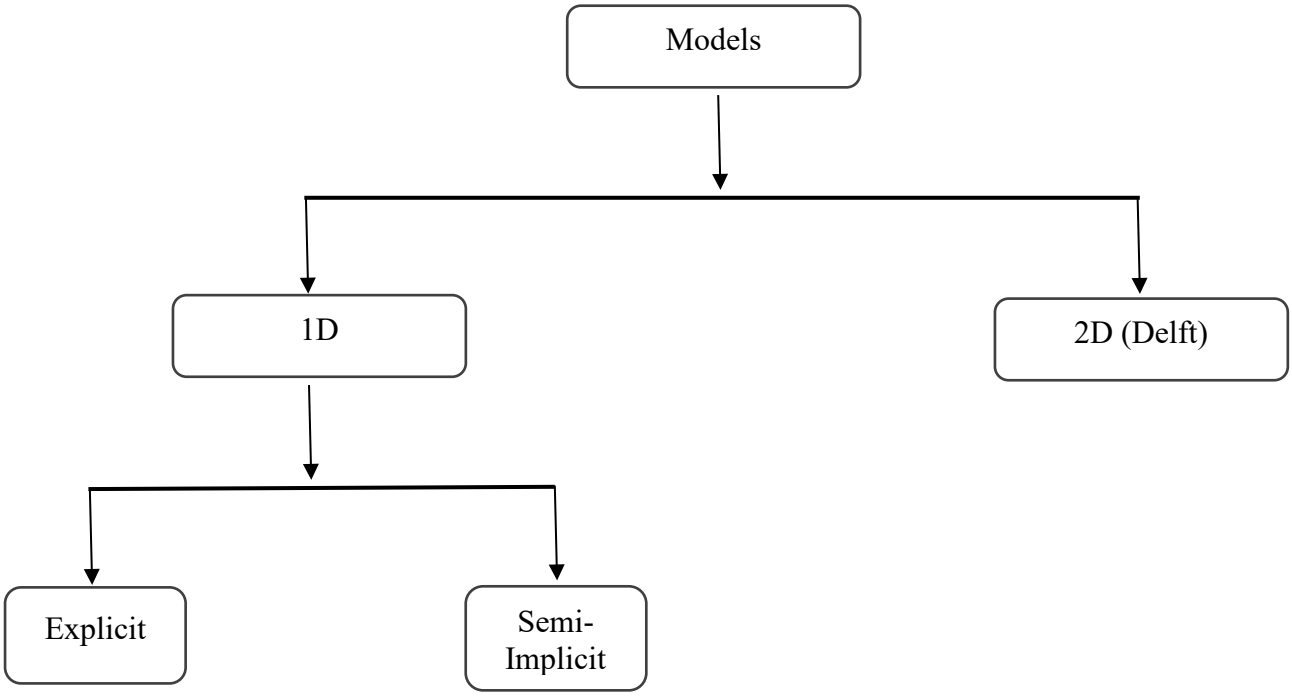

Figure 4.1 Modelling Approaches

From **Figure 4.2**, the velocity and the water level profiles can be seen. In those both figures, the flat lines indicate the boundary conditions that stays same for the entire run-time.

In both models, there was no roughness was considered therefore the wave should propagate throughout the nodes smoothly. But from **Figure 4.2,** it can be seen that the wave propagation for the Explicit model is underperforming.

Here, the main problem is in the so many fluctuations in the output. Moreover, there are extreme values in some nodes that are abnormal. One of the reasons behind this can be the Tidal nature of the river. Although, it's tidal but the Daily

water level doesn't capture the tides. Therefore, the water level plots should've shown oscillations time to time but fails to do so.

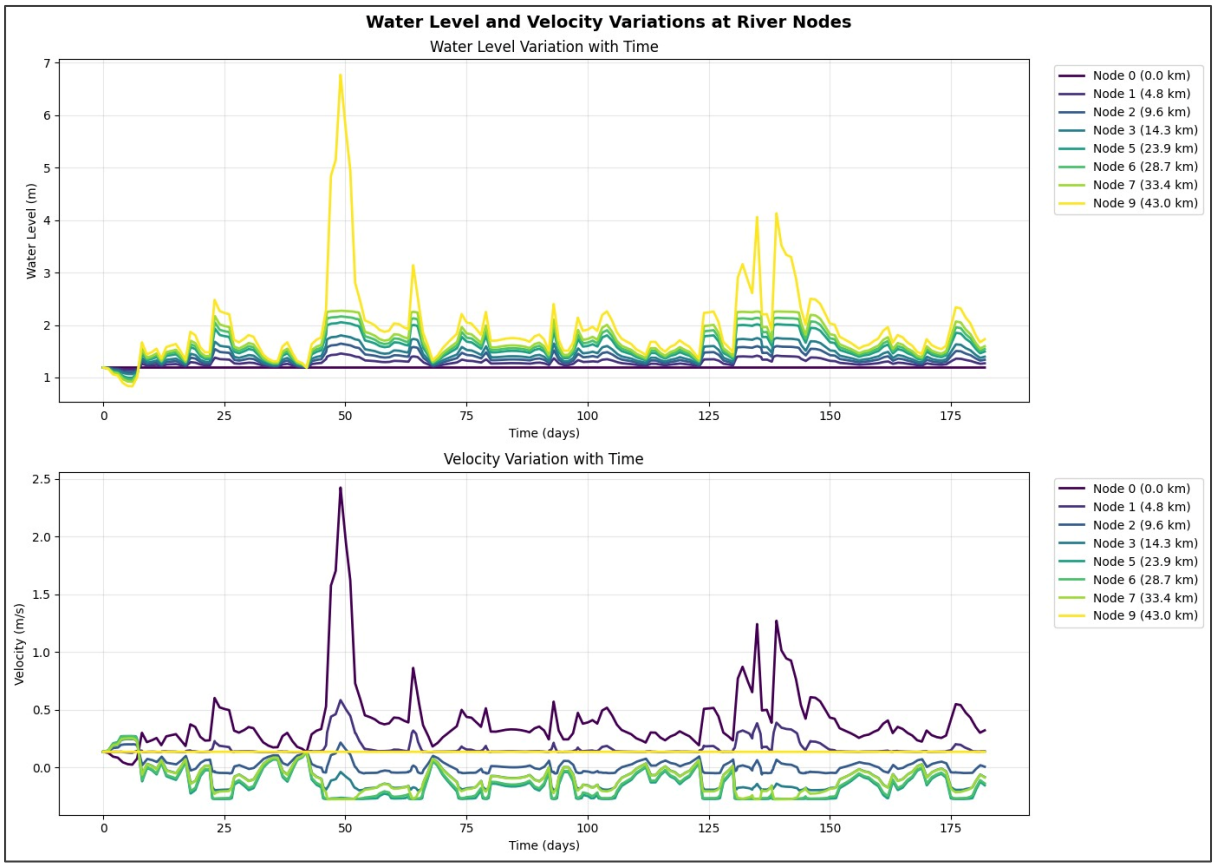

Figure 4.2 Water Level and Velocity Change for Explicit Scheme

In **Figure 4.3,** semi-implicit model is shown. Wave celerity, bathymetry, water depth etc were considered same for this model also. From the figures, it can be seen that, in the semi-implicit model the wave propagation throughout the nodes works pretty well than the previous model. But these models also show the 7m water level extreme case in the 50th time step.

Therefore, it can be concluded that the semi-implicit model shows better wave propagation performance but shows the extreme peaks as before.

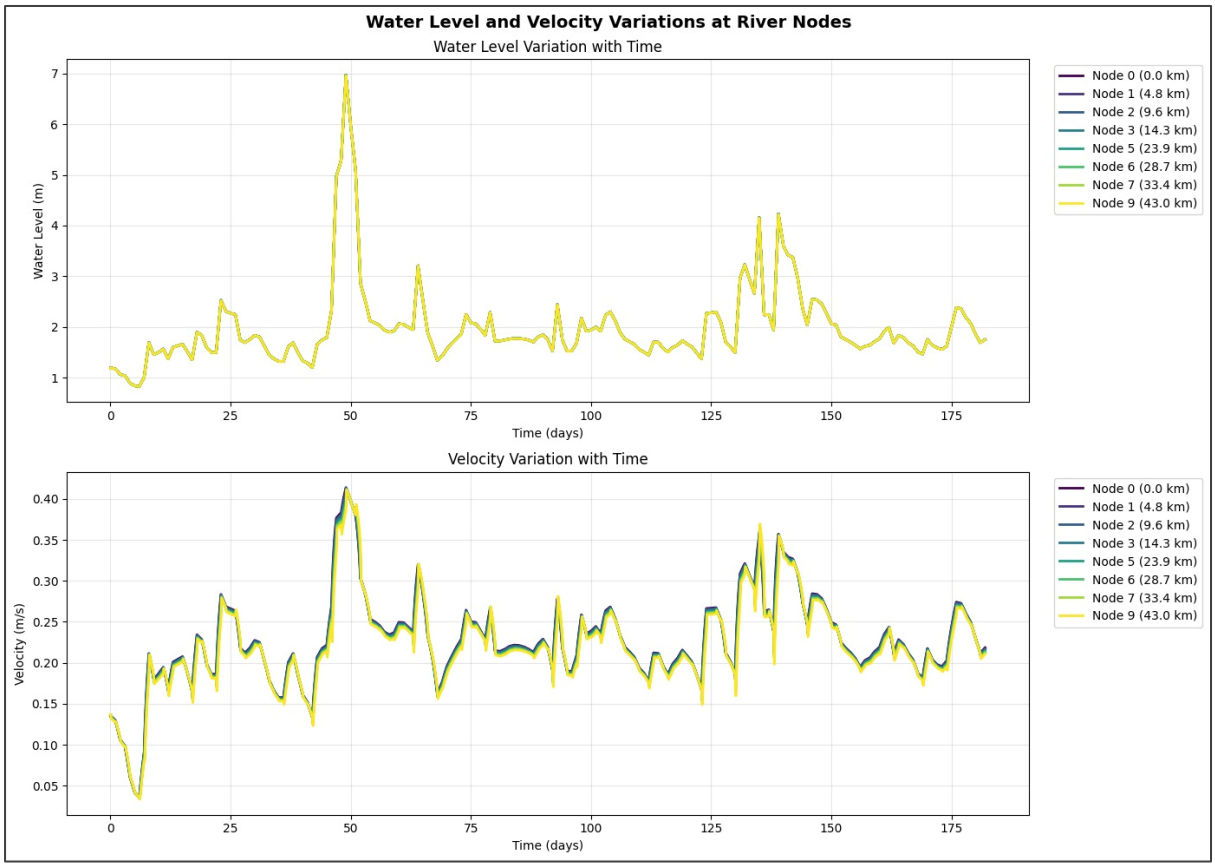

Figure 4.3 Water Level and Velocity Change for Implicit Scheme

5 2D modelling

As stated before the terrain made from bathymetry in HEC-RAS was used in this modelling approach. This terrain can be seen in **Figure 5.1.** The implementation of the upstream and downstream boundary conditions are shown in the **Figure 5.2 .**

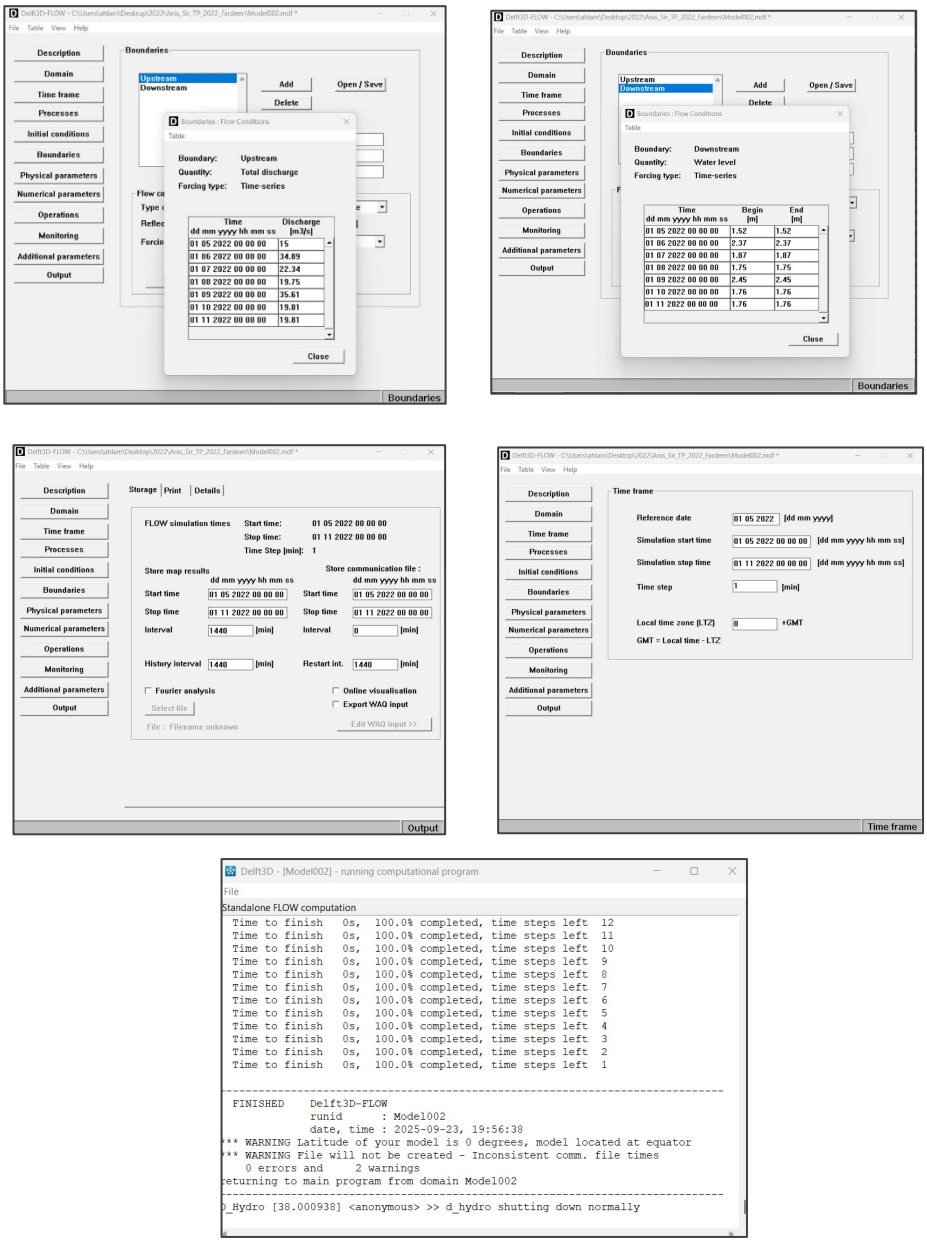

Figure 5-1 Model Preparation

B

However, by observing the water level at those 10 nodes at same interval, it can be clearly seen that the 2D model from the Delft3d needs a complete overhaul. From **Figure 5.2,** we can see there's a significant difference between the boundary condition values at the 10th node and the values of water level at other nodes.

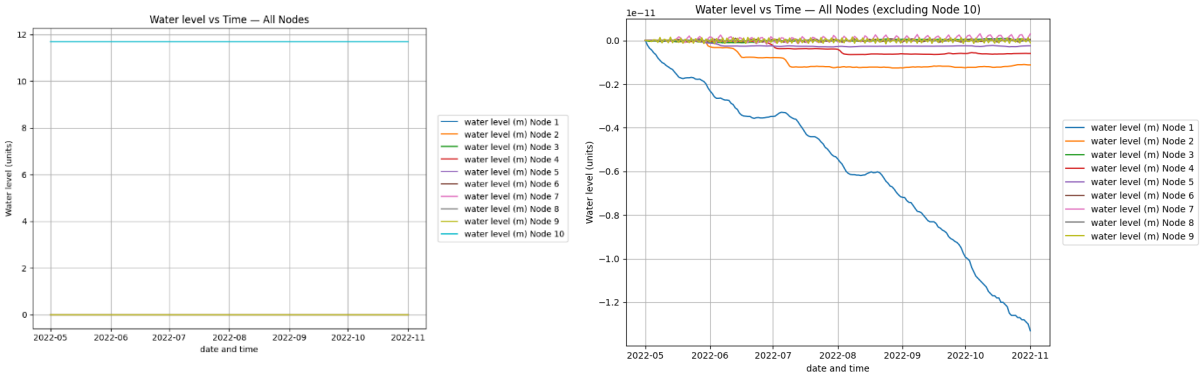

Figure 5-2 Water Level of the nodes

These values are inaccurate and does not resemble the 1D model output at all. Therefore, in this assignment, the 2D model is not set up properly and need further revises