Ministry of Water Resources

Bangladesh Water Development Board

Coastal Embankment Improvement Project, Phase-I (CEIP-I)

Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)

Storm Surge and Wave Modelling Present and Future Conditions

June 2022

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June 2022

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Memo No: CEIP/LTMRA/0622/182 22 June 2022

Project Management Unit
Coastal Embankment Improvement Project, Phase-I (CEIP-I)
Pani Bhaban, Level-10
72, Green Road, Dhaka-1205

Attn: Mr. Syed Hasan Imam, Project Director

Dear Mr Imam,

Subject: Submission of Storm Surge and Wave Modelling - Present and future Conditions (D-4D)

It is our pleasure to submit herewith five copies of other special purpose model (D-4D) Report titled ***"Storm Surge and Wave Modelling Present and Future Conditions"***.

This report describes the development of an improved Bay of Bengal storm surge model, the data basis for this development, calibration and validation of the developed model and application of the model for estimating the effects of cyclones on extreme storm surges and waves propagation during present and future conditions impacted by climate change.

Thanking you,

Yours sincerely,

Dr Ranjit Galappatti
Team Leader

Copies: Engineer Fazlur Rashid, Director General, BWDB
Dr. Zia Uddin Baig, ADG (Planning), BWDB
Dr Kim Wium Olesen, Project Manager, DHI
Ms. Sonja Pans, Deltares Project Manager
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Mr AKM Bodruddoza, Procurement Specialist
Swarna Kazi, Sr. Disaster Risk Management Specialist, World Bank

Contents

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ASLR	Absolute Sea Level Rise
AMS	Annual maximum series
BoB	Bay of Bengal
BWDB	Bangladesh Water Development Board
CDMP	Comprehensive Disaster Management Program
CEIP	Coastal Embankment Improvement Project
CEP	Coastal Embankment Project
CERP	Coastal Embankment Rehabilitation Project
CSPS	Cyclone Shelter Preparatory Study
DEM	Digital Elevation Model
EHRM	Eastern Hilly Region Model
EVA	Extreme Value Analysis
FM	Flexible Mesh
HD	Hydrodynamic
IPCC	Intergovernmental Panel on Climate Change
IWM	Institute of Water Modelling
LTRM	Long-Term Research and Monitoring Project
POT	Peak over threshold
PDS	Partial duration series
RCP	Representative Concentration Pathways
SLR	Sea Level Rise
SROCC	Special Report on the Ocean and Cryosphere in a Changing Climate
SWRM	Southwest Region Model
WL	Water Level

1 INTRODUCTION

1.1 Background

The coastal region of Bangladesh is vulnerable to cyclone-induced storm surge, saline water intrusion and tidal flooding. Cyclones hit this coastal region almost every year, in pre-monsoon (April-May) or in post-monsoon (October-November). About 42 tropical cyclones (classified from Cyclonic Storm Surge to Severe Cyclonic Storm Surge) hit the Bay of Bengal Coast from the 9-10 October 1960 cyclone to the 26 May 2021 cyclone (cyclone Yaas). Among these 24 severe cyclones had directly landfall at the Bangladesh coast (south-west, south-central, south-east, and eastern coastal zones). 3 of these cyclones are defined as Cyclonic Storms (CS) 18 cyclones are defined as Severe Cyclonic Storms (SCS) and 3 cyclones are defined as Severe Cyclonic Storms with a core of Hurricane winds (SCSH). This statistic indicates the whole coastal area of Bangladesh is vulnerable to cyclonic storm surge and evidence of sea level rise and increase in cyclonic wind speed due to climate change makes the Bay of Bengal more vulnerable.

In earlier decades when polders were not constructed, low-lying areas of the Bangladesh coastal zone were frequently flooded by salt water during high tides. In order to increase agricultural production by preventing the land of coastal areas from frequent tidal flooding and salinity intrusion the Coastal Embankment Project (CEP) was implemented in accordance with the Master Plan adopted in 1964. Under this program Bangladesh Water Development Board (BWDB) has built a series of polders enclosing the low-lying coastal areas. During that period, the crest levels of the embankments of the coastal polders were designed based on extreme tide level/ monsoon flood level with some added free board (*Islam et. Al., 2013*). In CEIP (2013), the crest levels were designed based on the combined action of cyclonic storm surge and wave action considering climate change for 17 polders (P14/1, P15, P16, P17/1, P17/2, P23, P32, P33, P34/3, P35/1, P35/3, P39/2C, P40/2, P41/1 P43/2C, P47/2 and P48.) In CEIP (2013), a Bay of Bengal (BoB) storm surge model was developed based on the numerical model MIKE 21 using a Classic (rectangular) model grid system with a minimum grid resolution of 200m.

Later in the Coastal Embankment Improvement Project CEIP-1 (2015-2018), the crest levels were revisited and finalized for all 17 selected polders and construction started of the 4 Polders 32, 33, 35/1 and 35/3 while the remaining 13 polders are under process to implementation. During the CEIP-1, the storm surge model grid system was transferred from MIKE 21 Classic to MIKE 21 FM (Flexible Mesh) system where both rectangular and triangular grid systems were used for a more accurate description of the meandering river system and estuary.

In the present Long-Term Research and Monitoring Project (LTRM), the storm surge model has been developed using the MIKE 21 FM system with an optimized flexible mesh that has reduced the runtime of the storm surge model simulations. In the new grid system, important river banklines and shorelines have been defined very carefully on the basis of resent satellite images and water depths have been updated with most recent available bathymetry data.

1.2 Improvements of the Bay of Bengal Storm Surge Model

A summary of new developments and updates of the Bay of Bengal Storm Surge Model implemented under the Long-Term Research and Monitoring Project is presented in Table 1-1**.**

Table 1-1 : New developments and updates of the Bay of Bengal Storm Surge Model under the Long-Term Research and Monitoring Project.

Task	Item under Task	CEIP-1 (2015-2018)	LTRM (2019-2022)
Bathymetry	Pussur, Shibsha, Baleswar, Bishkhali, Buriswar, Payra, Tentulia Channel and its upstream branches, Padma River, Upper Meghna and Lower Meghna	2010 and 2012	2016, 2017, 2018, 2019 and 2020
	South-West other upstream river system	2000 to 2012	2012 to 2018
	Sandwip Channel, Hatiya Channel, Karnaphuli River, Halda River, Kutubdia Channel	2000, 2010	2018, 2019, 2020
	Moheskhali Channel	Not included	Included
Model Grid	River bankline and estuary shoreline	2010 satellite image	2019 satellite image
	Bay of Bengal model grid generation	Using MIKE 21 FM (rectangular and triangular)	Using MIKE 21 FM (mostly rectangular and triangular)
	Bathymetry generation	MIKE 21 FM grid generation	MIKE 21 FM grid generation with the support of Delft 3D and MATLAB 2015a
Calibration and Validation	Calibration of the Bay of Bengal Hydrodynamic Model	Water level for 2015	Water level and discharge for 2019
	Validation of the Bay of Bengal Hydrodynamic Model	Predicted tide for the Global Tide Station	CEIP-1 observed water level and discharge for 2015
Climate Change Projection	Sea Level Rise	50cm from IPCC 5th Assessment Report	Sea Level Rise determined under this project (20cm for 2050 and 92cm for 2100)
	Land Subsidence	30cm	Land subsidence rate calculated in this project for the whole coastal zone.
	Wind Speed	8% increase in 2100 based on IPCC 5th Assessment Report	8% increase in 2100 based on IPCC 5th Assessment Report
Cyclone wind model	Development of cyclone wind model	19 cyclones up to 2009	23 cyclones up to 2019. New 4 Cyclones- i) cyclone Roanu (May 2016), ii) Cyclone Mora (May 2017), iii) Cyclone Bulbul (Oct 2019) and iv) Cyclone Amphan (May 2020). However, these new four

Task	Item under Task	CEIP-1 (2015-2018)	LTRM (2019-2022)
			cyclones are not considered for the development of the storm surge model as the cyclone data is under review.
	Calibration of cyclone wind model	Carried out for major cyclones at 9 locations	Calibration of the cyclone model was done for the major cyclones at 9 locations.
Storm Surge Model Development, Calibration and Statistical Analysis for both Baseline condition and Climate Change Condition (2050)	Storm Surge Model (19 severe cyclones, 1960-2009)	38 storm surge simulations for 19 severe cyclones (at time of original landfall and "opposite" tide)	54 storm surge simulations for 19 Severe cyclones [considered only severe cyclones from 1960 to 2009] (at time of low tide, high tide and original landfall)
	Calibration of Storm Surge Model	Storm surge model of SIDR (2007) and AILA (2009) were calibrated	Model calibration using SIDR (2007), AILA (2009) and Amphan (2020).
	Statistical Analysis (based on 19 severe cyclones, 1960-2009)	125 locations using Exponential Statistical Method both Baseline and Climate Change Condition	141 locations covering selected polders using Exponential Statistical Method both Baseline and Climate Change Condition

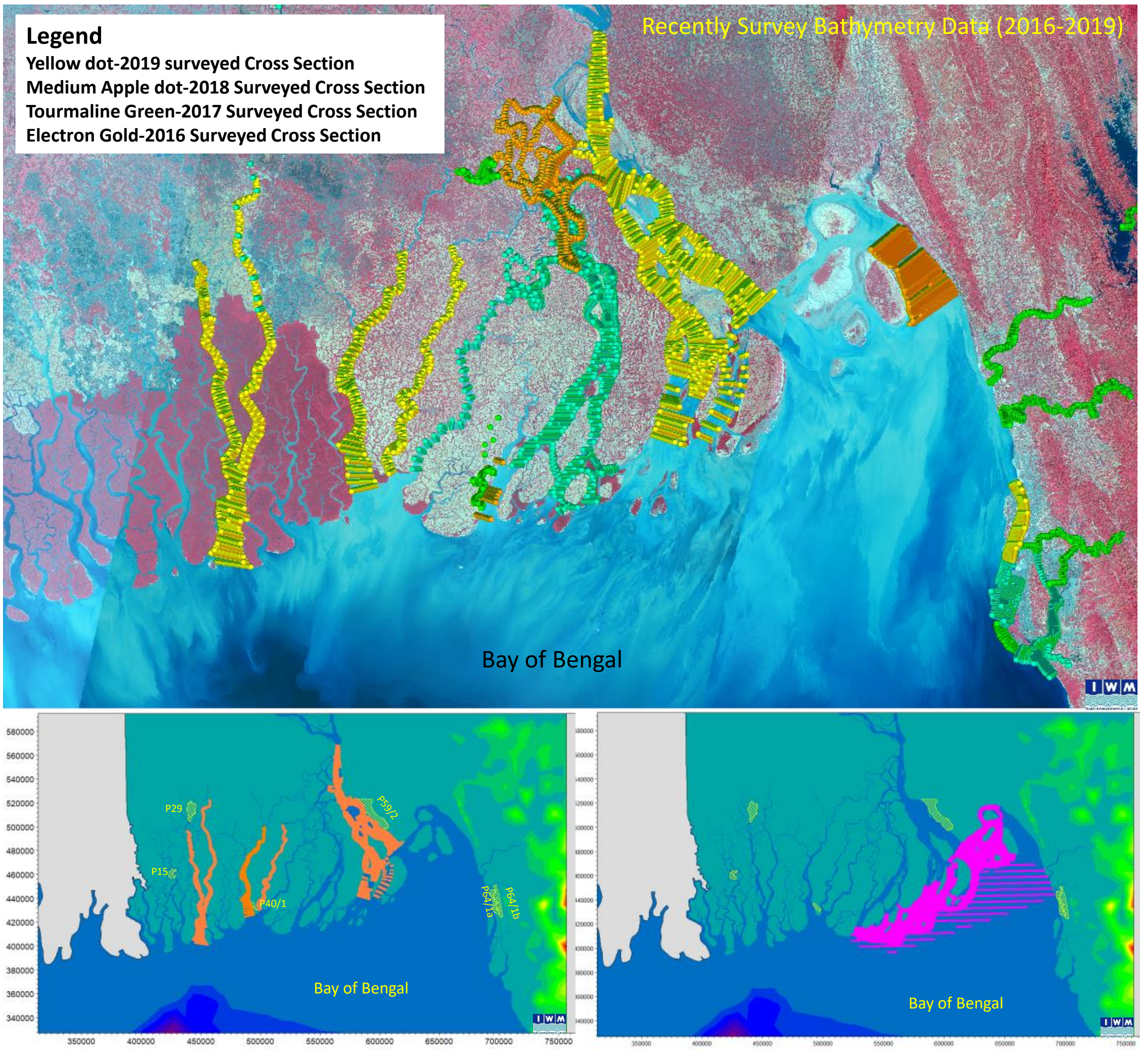
This report describes the development of an improved Bay of Bengal storm surge model, the data basis for this development, calibration and validation of the developed model and application of the model for estimating the effects of cyclones on storm surges during present and future conditions impacted by climate change.

2 Data Collection and Climate Change Projection

The sections below describe the data collected for developing the updated Bay of Bengal storm surge model.

2.1 Bathymetry data

The bathymetry of the Bay of Bengal (BoB) hydrodynamic model has been developed under different studies including the Long-Term Research and Monitoring Program over the recent years. The bathymetry of Pussur-Shibsha River network, Baleswar, Lower Meghna and Sangu River systems has been surveyed under the Long-Term Research and Monitoring Program and most of the major river system's bathymetry has been updated with recent cross sections data. Figure 2-1 shows an overview of recently collected bathymetry data.



Collected Bathymetry under Long Term Research and Monitoring Project

Collected Bathymetry under CDSP Project

Figure 2-1: Recently collected bathymetry data in different river systems

Note: In the top figure, yellow dots indicate 2019 bathymetry, Medium Apple dots indicate 2018 bathymetry, Tourmaline Green dots indicate 2017 bathymetry and Electron Gold dots indicate 2016 bathymetry. Bottom left figure presents the bathymetry collected under the LTRM Project and bottom right figure indicates the bathymetry of 2020 collected under the CDSP Project.

Offshore bathymetry data has been collected from the digital navigational sea charts, C-Map from DHI.

2.2 Hydrographic data

A hydrographic data collection plan was collected based on the requirements of the modelling team. Details of the data collection plan is described in the following sections.

2.2.1 Water level data

Water level measurements have been carried out at seven locations under the Long-Term Research and Monitoring project[1] for calibration of the updated Bay of Bengal (BoB) hydrodynamic model. The locations are presented in Figure 2-2**.** The locations are i) Khaikhali in the transboundary Ichamoti River, ii) Nalian in the Shibsa River, iii) Joymoni in the Pussur River, iv) Char Doani in the Baleswar River, v) Taltoli in the Bishkhali River, vi) Dhulasar in the downstream of Rabnabad Channel, vii) Dasmina in the Tentulia River.

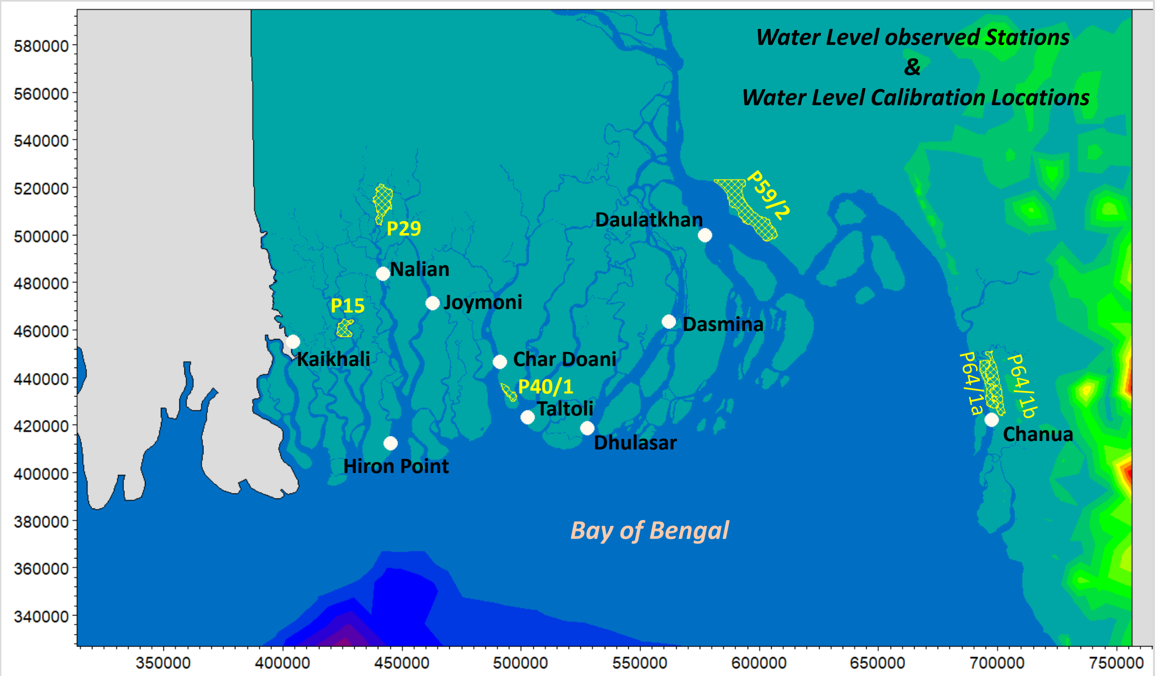


Figure 2-2: Water level observation locations including locations of polders of specific interest for the present study

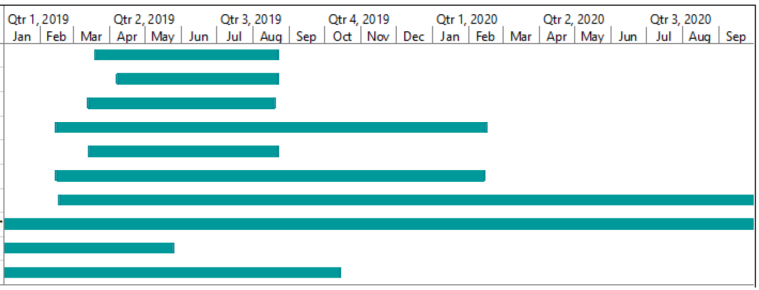
Additionally, water level data from the three locations i) Hiron Point in the downstream of Pussur-Shibsha River ii) Daulatkhan in the Lower Meghna River and iii) Chanua in the Kutubdia Channel have been applied for calibrating of the surge model along the coastal zone of Bangladesh. Observed water level data at Hiron Point was collected from the Bangladesh Inland Water Transport Authority (BIWTA), water level at Daulatkhan has

[1] Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics), Coastal Embankment Improvement Project, Phase-I (CEIP-I), between Bangladesh Water Development Board and Joint Venture of DHI and Deltares in partnership with, IWM, University of Colorado, Boulder and Columbia University

been measured by IWM since 2012[2] and water level at Chanua has been collected from another IWM ongoing project[3] . The water level collection periods are indicated in the following Table 2-1.

Table 2-1 : Overview of water level data (stations and time period) available for the BoB storm surge model calibration

ID	Station Name	River Name
1	Char Doani	Baleswar
2	Hazirhat (Dasmina)	Tentulia
3	Joymoni	Pussur
4	Khaikhali	Ichamoti
5	Nalian	Shibsha
6	Taltoli	Bishkhali
7	Dhulashar	Downstream of Rabnabad
8	Hiron Point	Downstream of Pussur-Shibsh
9	Chanua	Kutubdia Channel
10	Daulatkhan	Lower Meghna



Note: column 2 lists the water level stations and column 3 lists the river names

The developed BoB model was validated against selected water level data from 2015 collected as part of the CEIP-1 project. During CEIP-1, water levels were measured at the peripheral river systems at 17 selected polders **(**Figure 2-3).

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[2] Calibration and validation of the Regional Modelswas carried out by Flood Management Division, Institute of Water Modelling, Dhaka, Bangladesh

[3] Hydrographic survey for construction of the Coal-fired Power Plant at Matarbari in Maheshkhali Upazial, Cox's Bazar, Bangladesh

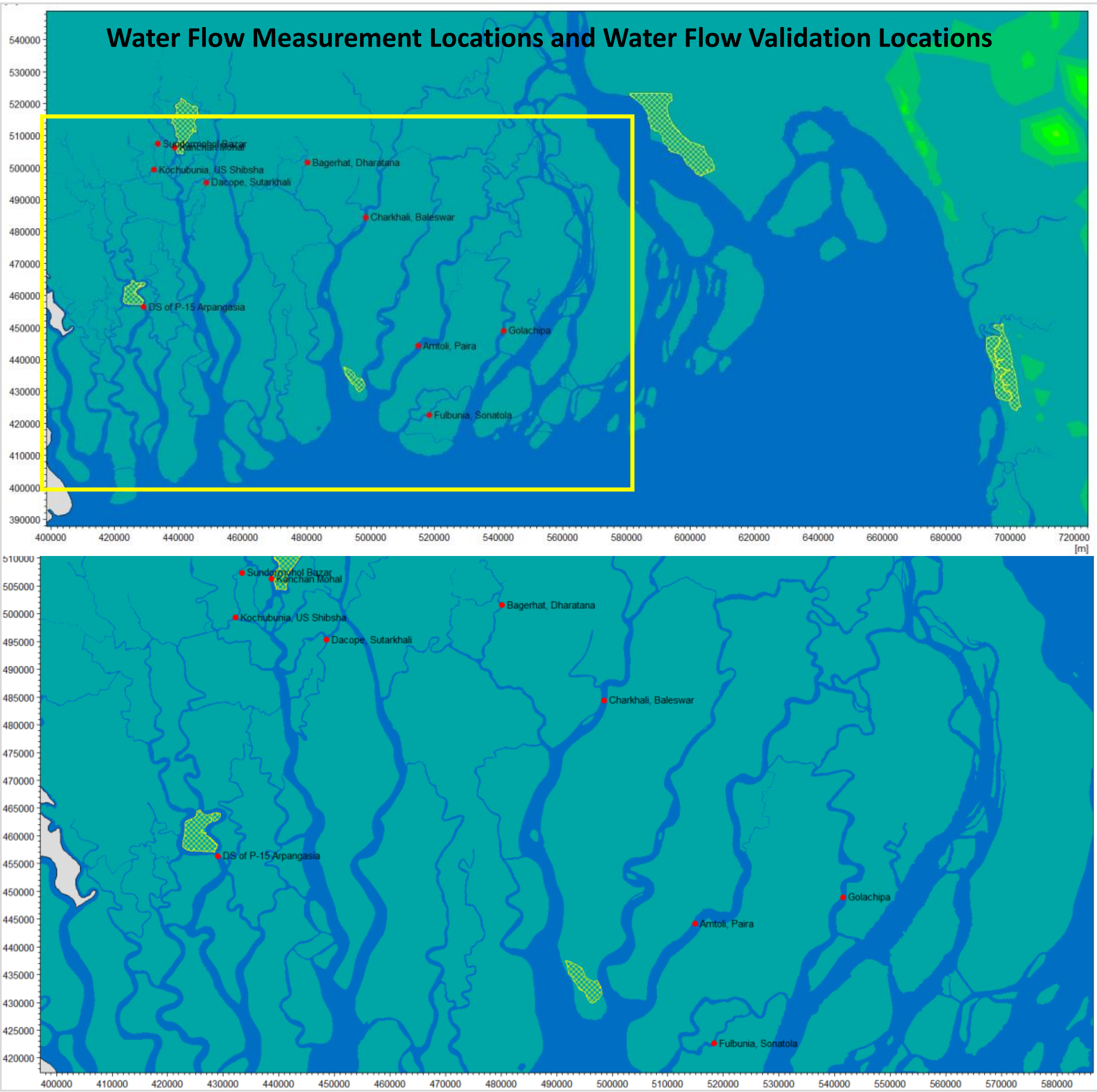

Figure 2-3: Locations of water level measurement collected during CEIP-1 (2015)

Table 2-2 presents the stations and time periods where CEIP-1 water level data is available. The updated BoB model was validated against data at selected stations near relevant polders and major river systems.

Table 2-2: Overview of CEIP-1 water level data (stations and time period) available for the BoB storm surge model validation

ID	Task Name	Text1	Half 1, 2015 (J F M A M J)	Half 2, 2015 (J A S O N D)
1	Fakirghat	confluence of Baleswar-Bishkhali-Buriswar		
2	Kawar Char (Asakhali, Kuakata, Kalapara)	Kuakata Beach		
3	Kalapara	Andharmanik		
4	Tafalbari Lanchghat	Baleswar		
5	Tele Khali Bazir,Bhandaria	Baleswar		
6	Char Doani	Baleswar		
7	Kamarkhula (Dacop, Khulna)	Sutakhali		
8	Noliyan (Khulna)	Shibsa		
9	Joynagor (Dacop, Khulna)	Dhaki		
10	Baniasanta (Dacop, Khulna)	Pussur		
11	Sannasi Bazar (Rumpal, Bagerhat)	Poylahara, Gasiakhali		
12	Khagraghat, Hedayetpur, Bagerhat	Bishnu		
13	Sonatala (Sarankhola)	Bhola River		
14	Haridebpur Ferry Ghat,Galachipa	Lohalia River		
15	Fultala,Patuakhali	Paira-Buriswar		
16	Purakata,Barguna	Paira-Buriswar		
17	Patharghata	(Bishkhali)		

Note: column 2 lists the water level stations and column 3 lists the river names

2.2.2 Discharge data

Discharge measurement is available from 12 locations within the coastal area of Bangladesh: These data has been used for calibration of the updated Bay of Bengal storm surge model (Figure 2-4).

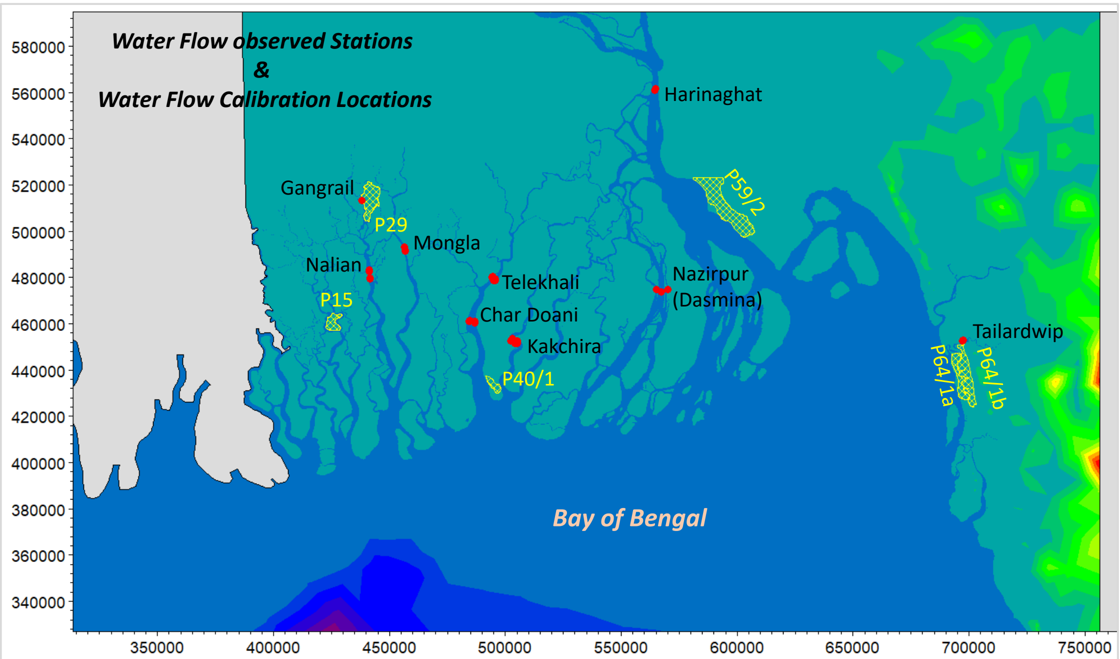

Figure 2-4: Water flow observation and calibration locations

Data from 11 of the discharge locations have been collected as part of the present LTMR Project covering the dry, monsoon and late monsoon periods as well as spring and neap tidal conditions for the year 2019. Data from one station at Tailardwip in the Sangu River have been collected from an ongoing IWM project[4]. A summary of the available discharge data is listed in **Table 2-3**.

Table 2-3 : Overview of discharge data (stations and time period) available for the BoB storm surge model calibration

ID	Station Name	River Name
1	Katalia	Gangrail River
2	Charduani Left	Baleswar River
3	Charduani Right	Baleswar River
4	Horina Ghat	Lower Meghna
5	Kakchira Left	Bishkhali River
6	Kakchira Right	Bishkhali River
7	Nazirpur, Dasmina	Tentulia River
8	Mongla	Pussur River
9	Nalian	Shibsa River
10	Tailardwip	Sangu River
11	Telekhali Left	Baleswar River
12	Telekhali Right	Baleswar River

Note: column 2 lists the water level stations and column 3 lists the river names

During CEIP-1 (2015), discharge measurements were conducted at 14 locations covering monsoon periods and both spring and neap tidal conditions in 2015. Table 2-4 presents the discharge observations available for model validation.

Table 2-4 : Overview of discharge data (stations and time period) available for the BoB storm surge model validation

ID	Text1	Task Name
1	Amtali	Paira
2	Bagerhat	Dharatana
3	Charkhali	Baleswar
4	Dacope	Dhaki
5	Dacope	Sutarkhali
6	DS of P15	Arpangasia
7	Gabura (P15)	Kobadak
8	Fulbunia	Sonatala
9	Galachipa	Lohalia
10	Kanchanmohal	Bhadra
11	Kochubunia	Haria
12	Polder 23, North	Shibsa
13	Polder 23, West	Shibsa
14	Sundarmohal Bazar	Bhadra

Note: column 2 lists the water level stations and column 3 lists the river names

2.2.3 Offshore boundary conditions

Tidal data from DHI's Global Tide Model has been used to generate the offshore (downstream) boundary condition of the updated Bay of Bengal storm surge model.

The tidal data refer to mean sea level and data has been converted to the model datum, mPWD by adding 46cm.

2.2.4 Upstream boundary conditions

The calibrated and validated South-West Regional Model (developed by IWM) has been used to generate discharges at the open upstream open boundaries of the updated Bay of Bengal storm surge model.

[4] Feasibility Study for Restoration of Sangu and Matamuhuri River Basin (2019-2021), between IWM (P52152) and Bangladesh Water Development Board (BWDB)

2.3 Meteorological data

The meteorological forcing of the storm surge model consists of:

- Wind and pressure maps – used for non-cyclone model simulations
- Cyclone track data

For model calibration and validation simulations of non-cyclone periods maps of wind and air pressure data from the Climate Forecast System Reanalysis (CFSR) atmospheric model, which is established by National Centers for Environmental Prediction, USA (NCEP)[5] was used.

2.3.1 Historical Cyclones

42 tropical cyclones (classified from Cyclonic Storm Surge to Severe Cyclonic Storm Surge) hit the Bay of Bengal Coast from the 9-10 October 1960 cyclone to the 26 May 2021 cyclone (cyclone Yaas)[6].

Among them 24 severe cyclones (Figure 2-5 and Table 2-5) had directly landfall at the Bangladesh coast (south-west, south-central, south-east, and eastern coastal zones). 3 of these cyclones are defined as Cyclonic Storms (CS) 18 cyclones are defined as Severe Cyclonic Storms (SCS CS) and 3 cyclones are defined as Severe Cyclonic Storms with a core of Hurricane winds (SCSH CS). Cyclonic storm surges were not considered in this study. Only severe cyclonic storm surges or stronger cyclones were considered in this study. Only 19 number severe cyclones were selected in this study and selection criteria explained in the section 5.3.1.

For modelling of periods impacted by cyclones, maps of cyclone wind and air pressure were generated using a Cyclone Wind Model (CYWIND), which is part of DHI's MIKEZero software package. The primarily input to the applied cyclone parametric model by Holland consist of historical cyclone data like cyclone track, radius to maximum wind speed, maximum wind speed and central and neutral pressure, c.c. Section 5.1

Track data for Cyclones 1 to 19 in below table was collected from the Bangladesh Meteorological Department as part of CEIP (2013) and CEIP-1 (2018) and used in these projects. Track data for Cyclones 20 to 24 are available from Bloemendaal, N. et al. (2019)[7] collected by the Joint Typhoon Warning Center (JTWC).

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[5] CFSR: https://rda.ucar.edu/

[6] List of Tropical Cyclones in the Bangladesh [https://en.wikipedia.org/wiki/List_of_Bangladesh_tropical_cyclones]

[7] https://climatedataguide.ucar.edu/climate-data/ibtracs-tropical-cyclone-best-track-data

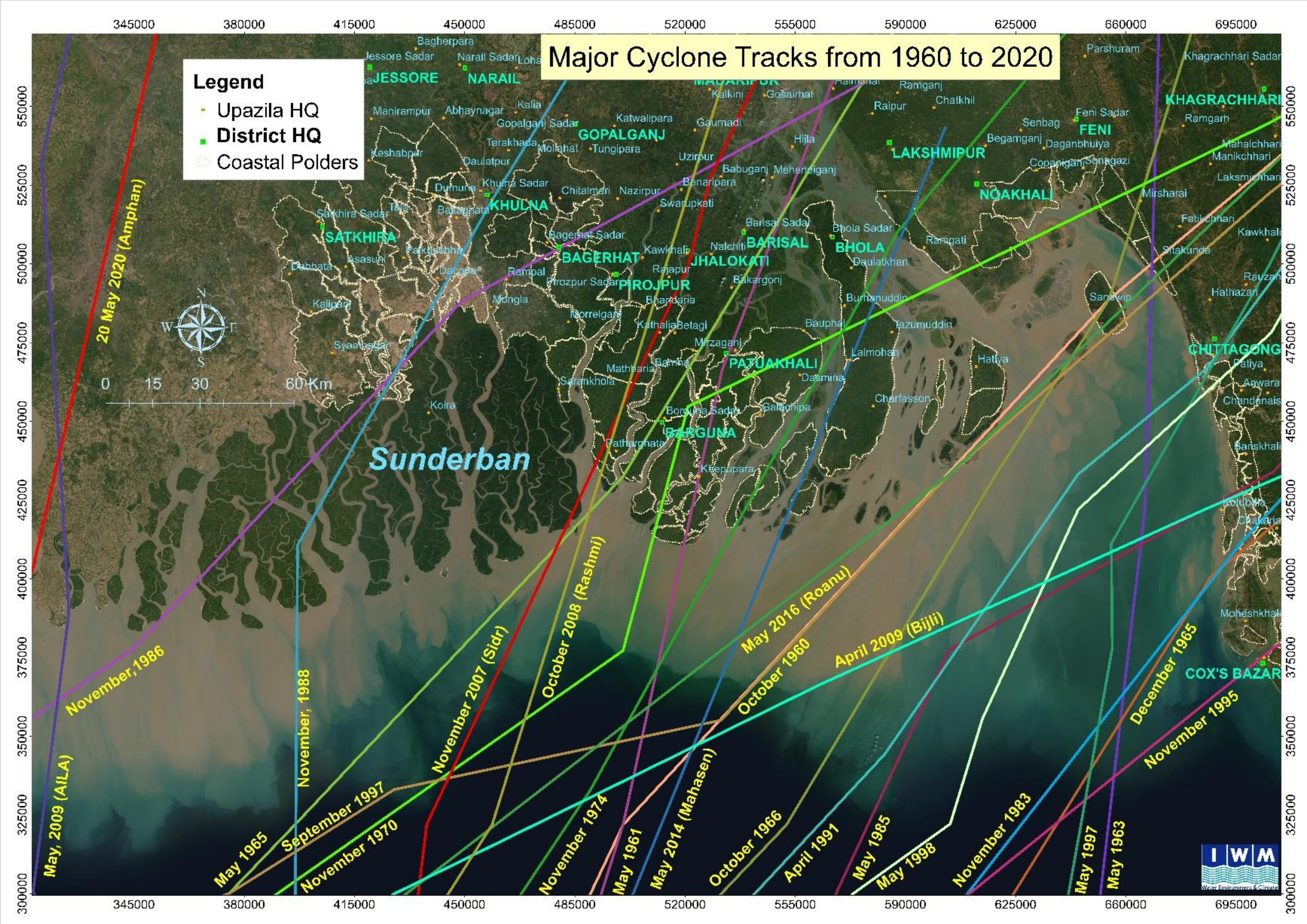

Figure 2-5: Historical severe cyclone tracks in the Bay of Bengal covering the Bangladesh Coast since 1960 to May 2020

Table 2-5 : The 24 severe cyclones with directly landfall at the Bangladesh coast between 1960 and 2017.

SL No.	Cyclone Name	Zone	Cyclone Types
1	8–9 November 1986	South-West	SCS
2	24–30 November 1988	South-West	SCS
3	27–29 May 2009, Cyclone Aila	South-West	SCS
4	9 May 1961	South Central	SCS
5	1–12 May 1965	South Central	SCS
6	7–13 November 1970, Bhola cyclone	South Central	SCSH
7	24–28 November 1974	South Central	SCS
8	15 November 2007: Cyclone Sidr	South Central	SCSH
9	9–10 October 1960	South-East	SCS
10	28–29 May 1963	South-East	SCS
11	1 October 1966	South-East	SCS
12	29–30 April 1991	South-East	SCS
13	16–19 May 1997	South-East	SCS
14	25–27 September 1997	South-East	SCS
15	16–20 May 1998	South-East	SCS
16	14–15 December 1965	East and Hill	SCS
17	5–9 November 1983	East and Hill	SCS
18	24–25 May 1985	East and Hill	SCS
19	21–25 November 1995	East and Hill	SCS
20	19–21 April 2009: Cyclone Bijli	East and Hill	CS
21	16–17 May 2013: Cyclone Viyaru (Mahasen)	East and Hill	CS
22	29 July 2015: Cyclone Komen	South-East	CS
23	21 May 2016: Cyclone Roanu	East and Hill	SCS
24	29–31 May 2017: Cyclone Mora	East and Hill	SCSH

There are additionally three cyclones that recently made landfall outside of the Bangladeshi coast but affected the whole Bangladeshi coast severely (Table 2-6). Cyclone Fani landed in Odisha and Cyclone Bulbul and Cyclone Amphan landed in the West Bengal. These cyclones are all classified as Severe Cyclonic Storm with a core of Hurricane (SCSH) winds. Cyclone data for these cyclones are also available from **Bloemendaal, N. et al. (2019)**.

Table 2-6 : List of recent cyclones with landfall outside but still severely affecting Bangladesh Coast (2019-2020)

SL No.	Cyclone	Zone	Cyclone Type
1	4 May 2019: Cyclone Fani	Odisha	SCSH
2	9 November 2019: Cyclone Bulbul	West Bengal	SCSH
3	20 May 2020: Cyclone Amphan	West Bengal	SCSH

2.4 Climate Change Projection

For modelling of future storm surges the impact of climate changes must be considered in the BoB storm surge modelling.

The effect of climate change has been included in the BoB storm surge model through inclusion of climate change projections up to year 2100 of the following parameters.

- Sea level rise
- Cyclonic wind speed
- Land Subsidence

Upstream discharge boundary conditions of the BoB model have not been considered because cyclones are formed during the pre-monsoon and post-monsoon periods when the upstream river flow is small compared to the tidal flows.

2.4.1 Sea Level Rise

As part of the present LTRM Project climate change scenarios have been developed, c.f. Deliverable 4C: Meteorology, June 2021, Final Report[8].

Regional Absolute Sea Level Rise (ASLR) projections were extracted at five locations close to the Bangladesh coast based on SROCC (Special Report on the Ocean and Cryosphere in a Changing Climate) regional projections (IPCC, 2019; Oppenheimer et al. 2019) (Figure 2-6).

[8] Climate Change Scenarios, Deliverable 4C: Meteorology (June 2021), “Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)”, Coastal Embankment Improvement Project, Phase-I (CEIP-I), Bangladesh Water Development Board

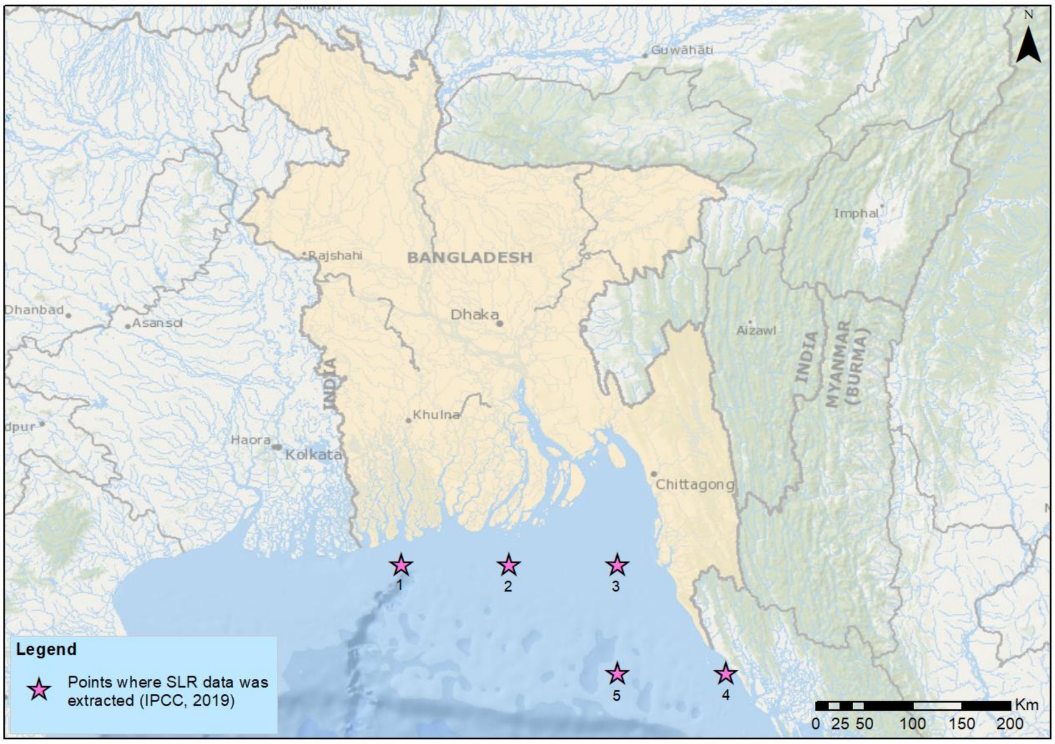

Figure 2-6: Location of extraction of Sea level rise time series in the Bay of Bengal

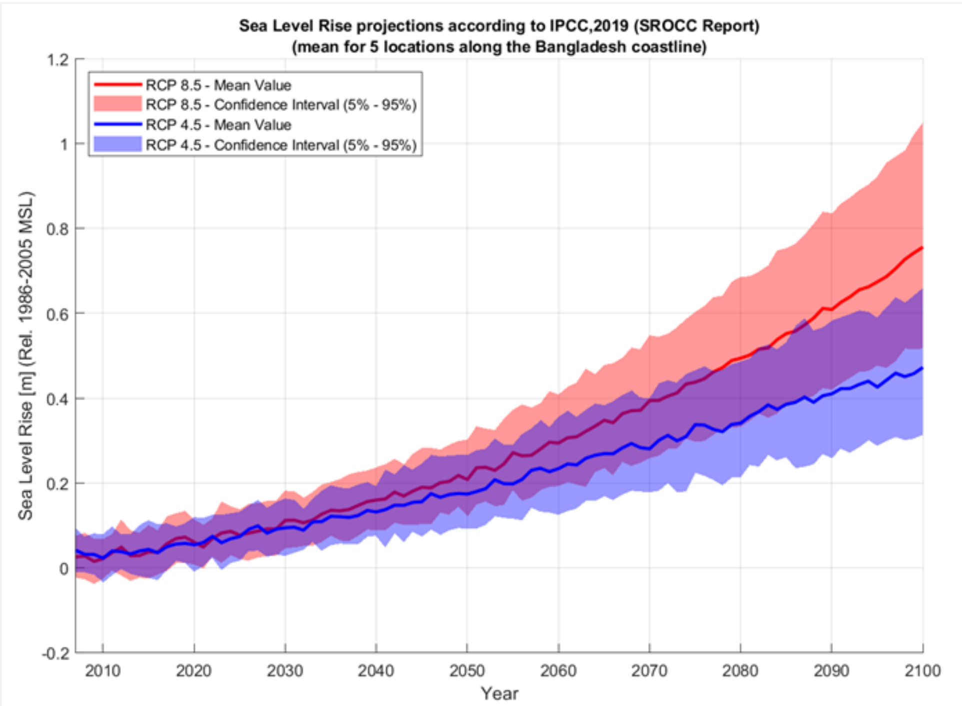

Figure 2-7: Averaged SLR projections for the 21st century and associated uncertainties (Source: Long Term Monitoring Report, 2021)

Averaged ASLR values close the Bangladesh coastline in the Bay of Bengal are shown in the Figure 2-7, both for moderate RCP 4.5 and extreme RCP 8.5 scenarios together with 5%-95% confidence intervals. Predicted values at the five locations (Figure 2-6) are shown in the **Table 2-7** for the RCP 4.5 and RCP 8.5 scenario, respectively, and show only minor differences at the five locations.

Mean values are provided in bold and associated uncertainties (5% and 95%) are included in brackets. Therefore, mean values among the different stations have been recommended for future use.

Table 2-7 : Average regional and global ASLR projections for the 21st century at the five closest locations along the Bangladesh coast in the Bay of Bengal

Time	Total Sea Level Rise – RCP 8.5 [m] (Rel. to 1986 to 2005)					
	1	2	3	4	5	MEAN
2050	**0.216**	**0.213**	**0.197**	**0.206**	**0.209**	**0.208**
	(0.117 to 0.325)	(0.112 to 0.325)	(0.115 to 0.287)	(0.135 to 0.284)	(0.133 to 0.295)	(0.122 to 0.303)
2100	**0.764**	**0.764**	**0.741**	**0.750**	**0.760**	**0.756**
	(0.506 to 1.081)	(0.509 to 1.078)	(0.514 to 1.021)	(0.521 to 1.028)	(0.532 to 1.037)	(0.516 to 1.049)

The above sea level rise values are considering 1986-2005 as the base years. The present modelling refers to year 2019 and therefore the sea level rise values must be adjusted, c.f. Figure 2-8 shows the upper limit (conservative approach) of sea level rise for RCP 8.5 from Figure 2-7.

Relative to year 2019, the global sea level rise value at year 2050 is 20 cm and at year 2100 it is 92 cm. These sea level rise values have been used for the simulation of storm surges for the years 2050 and 2100.

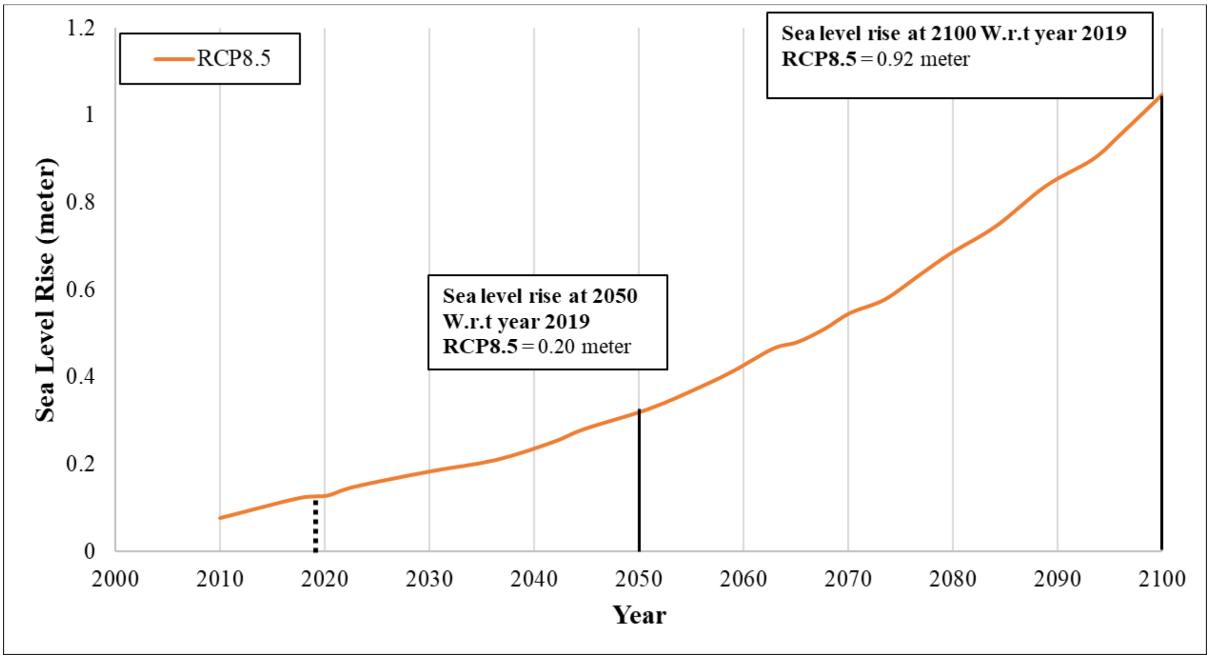

Figure 2-8: Sea level rise graph (95 percentile line in Figure 2-7)

2.4.2 Cyclonic Wind Speed

Future changes to tropical cyclones arising from climate change are likely to vary by region. This is because there is medium confidence that for certain regions, shorter-term forcing by natural and anthropogenic aerosols has had a measurable effect on tropical cyclones. Knutson et al. (2010) concluded that it is likely that the global frequency of tropical cyclones will either decrease or remain essentially unchanged while mean intensity (as measured by maximum wind speed) increases by +2 to +11%. Examples of tropical cyclone intensity change projections considering the percent change in maximum wind speed are presented in the Table 2-8.

Reviewing and analysing of different literature, it can be concluded that cyclonic wind speed will be increased in between +0.2 to +11% in the North Indian Ocean as well as Bay of Bengal and globally. Considering the findings from different research, in this study it is assume that cyclonic wind speed will be increased by 8% in 2100 [considered from Table 2-8]. While, projections are developed for 2100, it is assumed that similar changes can be happened in 2050. Then, the changes of wind speed by 8% have been used to generate the cyclonic wind field for 2050 and 2100 and include into the hydrodynamic model to simulate the storm surge models for future. Similar changes in the wind speed also used in the CEIP-1.

Table 2-8 : Projected cyclonic wind speed for tropical cyclone intensity for 2100 (summarized from IPCC 5th Assessment report)

Reference	Technique/Model	Resolution/Metric Type	Climate Change Scenario	Increase of Wind Speed (%)	
				Global	North India
Emanuel et al., 2008	Statistical /Dynamic Model	Max Wind speed (%)	CMIP3 (7-models)	1.7	0.2
Murakami et al., 2013	JMA/MRI global AGCM time slice	Avg. max winds over lifetime of all TCs V3.1 20 km	Downscale CMIP3 multi-model	11	5
Vecchi and Soden, 2007b	Emanuel PI, reversible w/ diss. heating	Max Wind speed (%)	CMIP3 18-model (100-year trend)	2.6	4.4
Yu et al., 2010a	Emanuel PI modified by vertical wind shear	Max Wind speed (%)	CMIP3 18 model ensemble 1% per yr CO2 70-year trend	2.6	3.3

[Source: IPCC Working Group 1 Report, Chapter 14SM, Table 14. SM.4c]

2.4.3 Land Subsidence

The land level in the coastal zone of Bangladesh is subsiding due to land compaction, anthropogenic activities and tectonic plate movement (***Steckler et. Al., 2021***). Due to land subsidence effect, sea level rise problem will become more severe, as the low-lying areas become vulnerable in the future. Information of land subsidence is obtained from the “Interim Subsidence Report (2021)” which is published under the “Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)” project. In this report, the land subsidence rate along the entire coastal zone of Bangladesh is provided. The subsidence rate is varying throughout the coastal region as indicated by the values provided in Table 2-9.

Table 2-9 : Land subsidence rate in the coastal zone of Bangladesh

Polder	Region	Land Subsidence (mm/year)
15	South-West	5
29	South-West	4
40/1	South-West	6
59/2	South-East	4.7
64/1a	Eastern Hilly	2
64/1b	Eastern Hilly	2

Source: Interim Subsidence Report (2021), LTM project

The land subsidence rate for the whole coastal area of Bangladesh has been developed in this project [9]and has been applied to the BoB model bathymetry to predict model bathymetries for the years for 2050 and 2100 (CEIP-1, Climate Change Scenario (2021), see Figure 2-9.

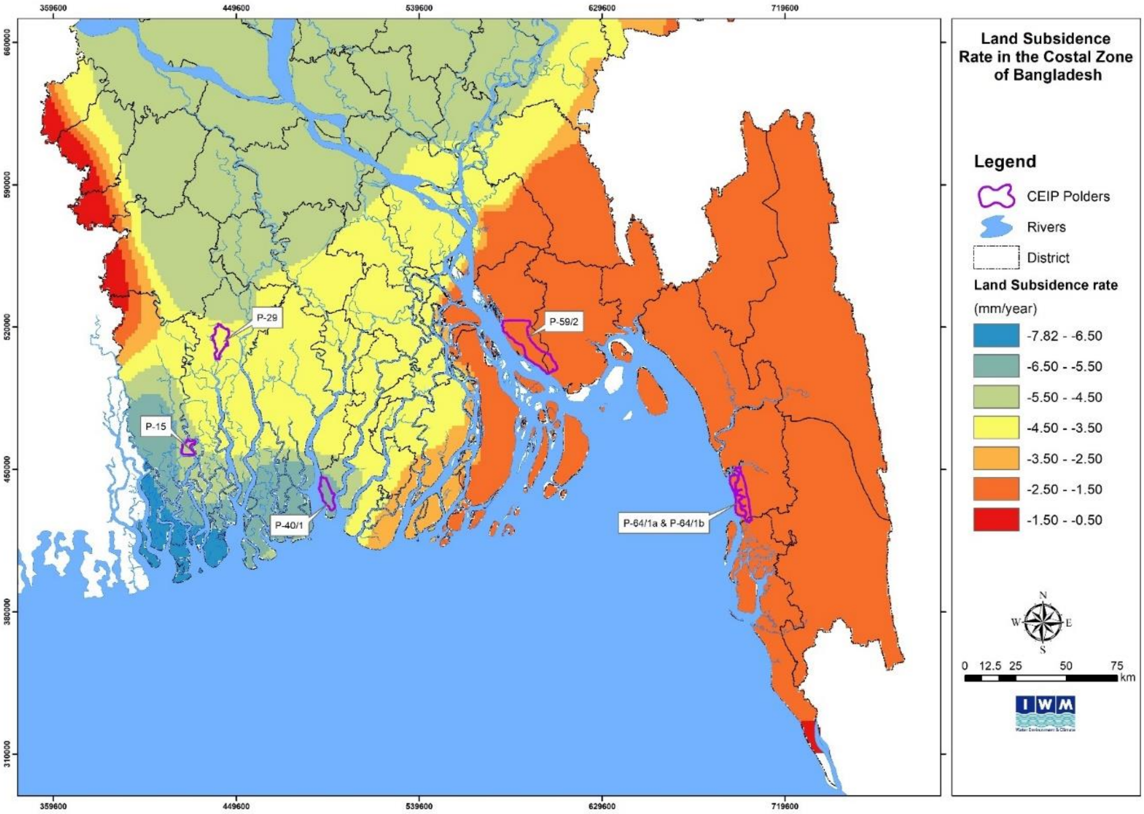

Figure 2-9 Estimated subsidence rate for year 2100

[9] Climate Change Scenarios, Deliverable 4C: Meteorology (June 2021), "Long Term Monitoring, Research and Analysis of Bangladesh Coastal Zone (Sustainable Polders Adapted to Coastal Dynamics)", Coastal Embankment Improvement Project, Phase-I (CEIP-I), Bangladesh Water Development Board

2.4.4 Upstream discharge boundary conditions

Projection on the upstream discharge is not applied to the upstream boundary conditions (Baruria in the Padma River and Bhairab Bazar in the Upper Meghna). In this study prrojection on the upstream discharge is prepared considering the base year 2020. However, cyclones are considererd from 1960 to 2009. Moreover, during the cyclonic period, the tidal flood dominant the river systems and all cyclones landfall were during the pre-monsoon and post-monsoon period.

3 Bay of Bengal Storm Surge Model Setup

3.1 Development of the Bay of Bengal Model

IWM has developed and maintained the two-dimensional Bay of Bengal (BoB) storm surge model since 1991 using DHI's software MIKE 21 HD (Hydrodynamic Module).

The first version of the model (the so-called classic version using a rectangular model calculation grid) was applied in the Cyclone Protection Project (CPP, 1991) and was further developed as a part of the Cyclone Shelter Preparatory Study (CSPS, 1998). The model was further updated as part of the 2nd Coastal Embankment Rehabilitation Project (2nd CERP, 2000). In the Cyclone Shelter Preparatory study and 2nd CERP study, the model was applied for the simulation of cyclones and cyclone related storm surges for several past major cyclones to generate the high-risk zoning map for the planning and management of cyclone shelters. This updated storm surge model was applied under the CDMP (Comprehensive Disaster Management Program) study in 2008-2009 and the World Bank study in 2009. Again, the model was further updated with additional bathymetric data in 2011-2012 under the CEIP first phase study.

In the CEIP-1 (2015)[10], the existing Bay of Bengal Model was further updated and upgraded to using the software MIKE 21 FM HD using a so-called Flexible Mesh. This upgrade included conversion of the earlier structured computational (classical) grid to a flexible mesh allowing for a better representation of the river, coastal and estuarine system.

The developed MIKE 21 FM model grid uses triangular and quadrangular mesh cells to improve the boundary description and increase grid resolution e.g. around Islands, along the coastline, along interior rivers as well as in other areas of interest. The updated model bathymetry also included incorporation of more and recent bathymetric data into the surge model.

3.2 Improved Bathymetry and Calculation Grid

As part of the present LTRM Project, the existing Bay of Bengal model grid has been widely updated by inclusion of new areas of quadrangular cells and adding recent bathymetry data to the bathymetry. This update has improved the bathymetry description and at the same time resulted in lower execution time of model simulations as compared to the earlier model setup.

In below sections the main improvements are described.

3.2.1 Calculation Grid improvements

The existing Bay of Bengal model grid has been updated as follows:

i) Updates of bank lines

ii) Updates of char lands

iii) Updates of flow paths and

[10] Technical Report on Storm Surge, Wave, Hydrodynamic Modelling and Design Parameters on Drainage System and Embankment Crest Level, Coastal Embankment Improvement Project, Phase–I (CEIP-I) Volume III: Package-3, March 2018, Institute of Water Modelling (IWM), Dhaka, Bangladesh

iv) Updates of the connection between two river systems

Riverbank lines, islands and shorelines have been delineated based on recent Google Images from 2019. A dry season (Feb. 2019) image has been selected to identify the bank lines properly. A typical example is presented in Figure 3-1.

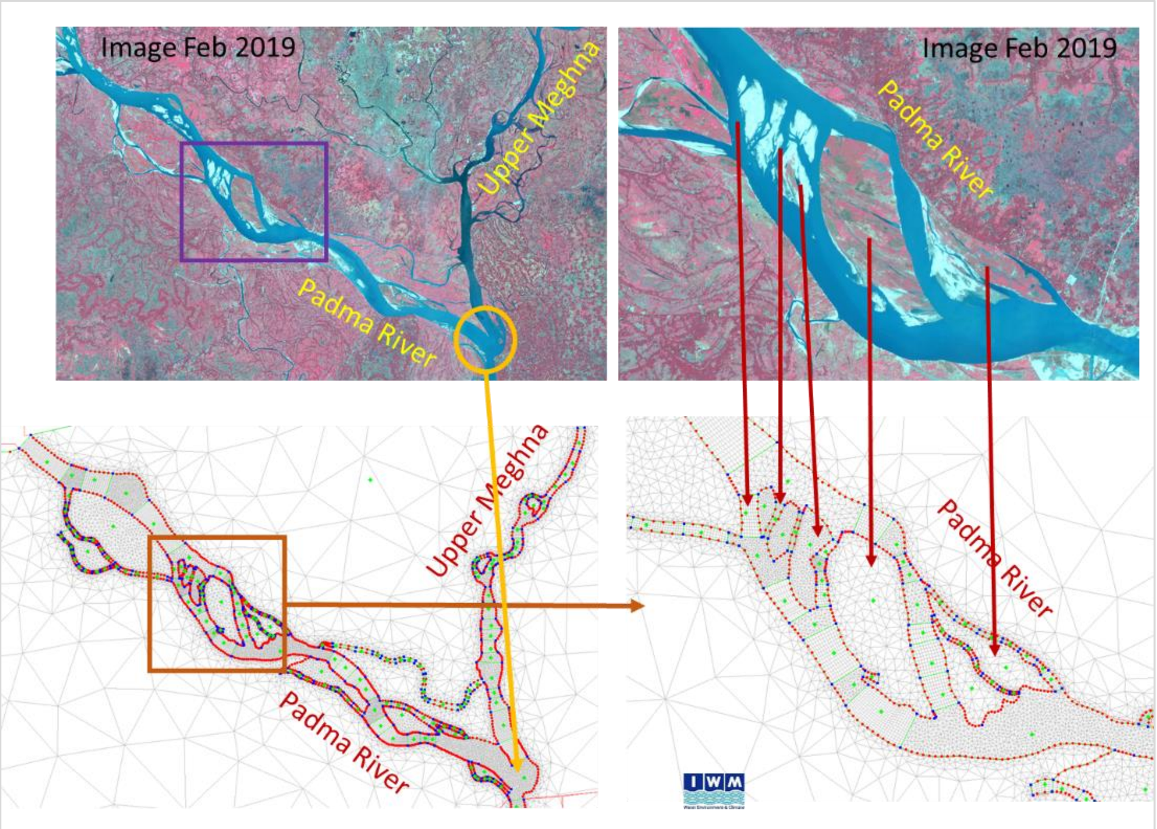

Figure 3-1: Improvement of the Bay of Bengal model mesh (Upper: Google images, lower: representation in the model mesh)

Both triangular and quadrangular elements have been generated with different mesh resolution to ensure a correct geometry of the channels and estuary. Another example is presented in Figure 3-2.

A highest-level accuracy has been used to define the river system because a suitable mesh is essential for obtaining reliable model results. Figure 3-3 presents the mesh system for the whole Bay of Bengal and the coastal area of Bangladesh.

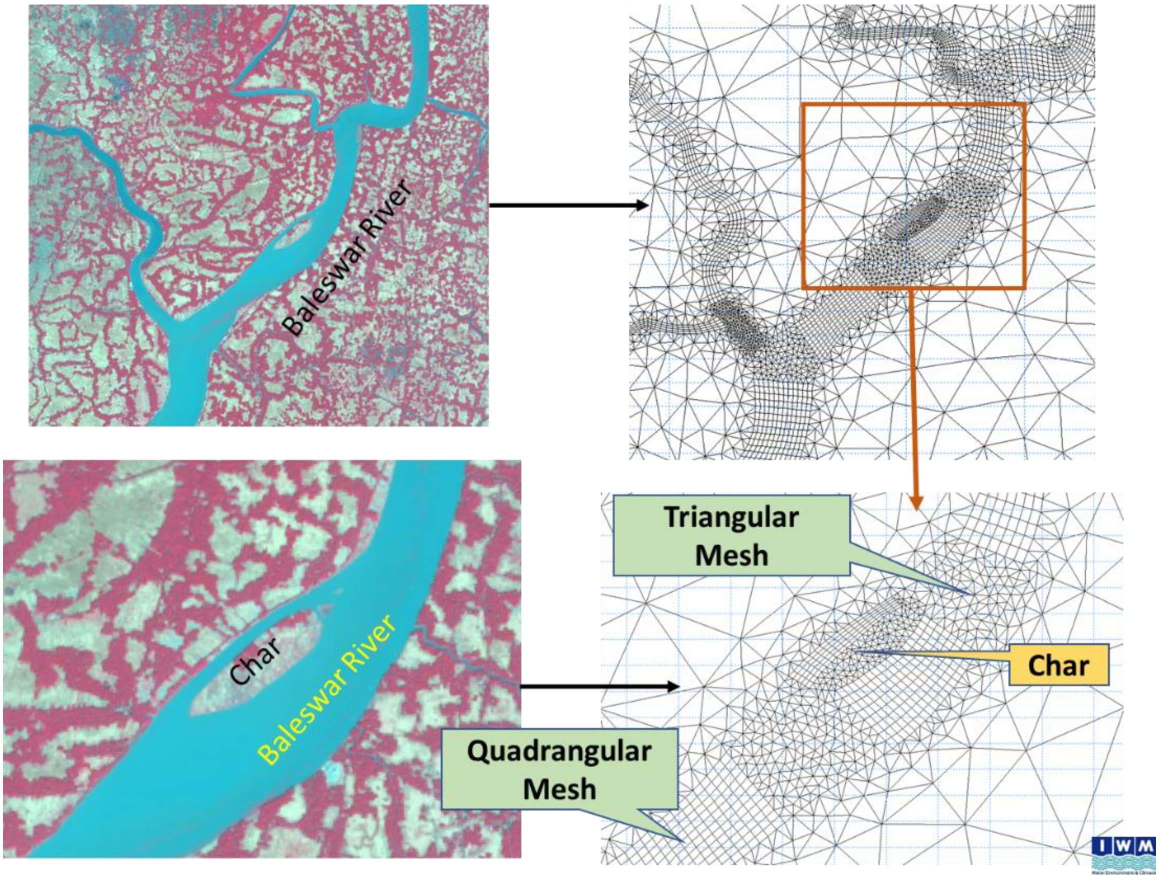

Figure 3-2: Improvements of coastal river bank lines and char islands with the Flexible Mesh system

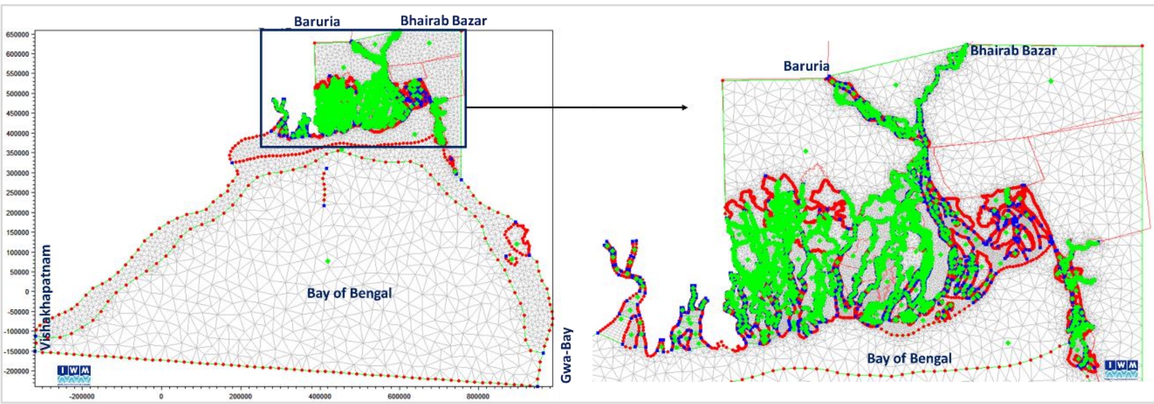

Figure 3-3: Flexible mesh system for the Bay of Bengal and the coastal area of Bangladesh

To reduce the number of calculation cells and thereby simulation run time, most of the river systems have been developed by quadrangular elements. Only confluences of different river systems and sharp river bends have been defined by triangular elements. As an example, part of the improved mesh using a combination of triangular and quadrangular elements is presented in Figure 3-4.

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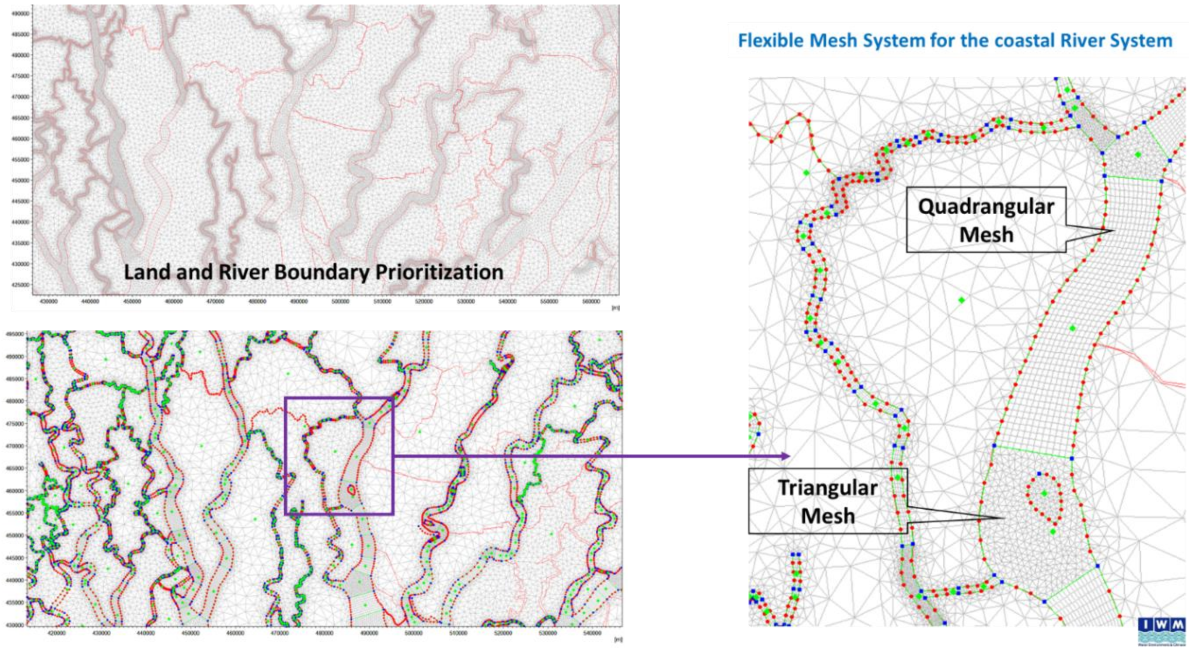

Figure 3-4: Combination of quadrangular and triangular elements of different resolution in the model mesh

3.2.2 Inclusion of river cross-section depth data

River cross section depth data from the period 2015 to 2020 were collected by the IWM Survey and Data Division. The data were processed, quality checked and included in the depth data set used for the bathymetry generation.

The data consists of cross section depth data from the Pussur, Shibsa, Baleswar, the Lower Meghna and Sangu River that were surveyed as part of the present LTMR project, as well as data from other major coastal rivers like Bishkhali, Buriswar and Tentulia channels that were recently surveyed under other projects.

Figure 3-5 shows the cross-section depth data that was added to the Bay of Bengal model bathymetry.

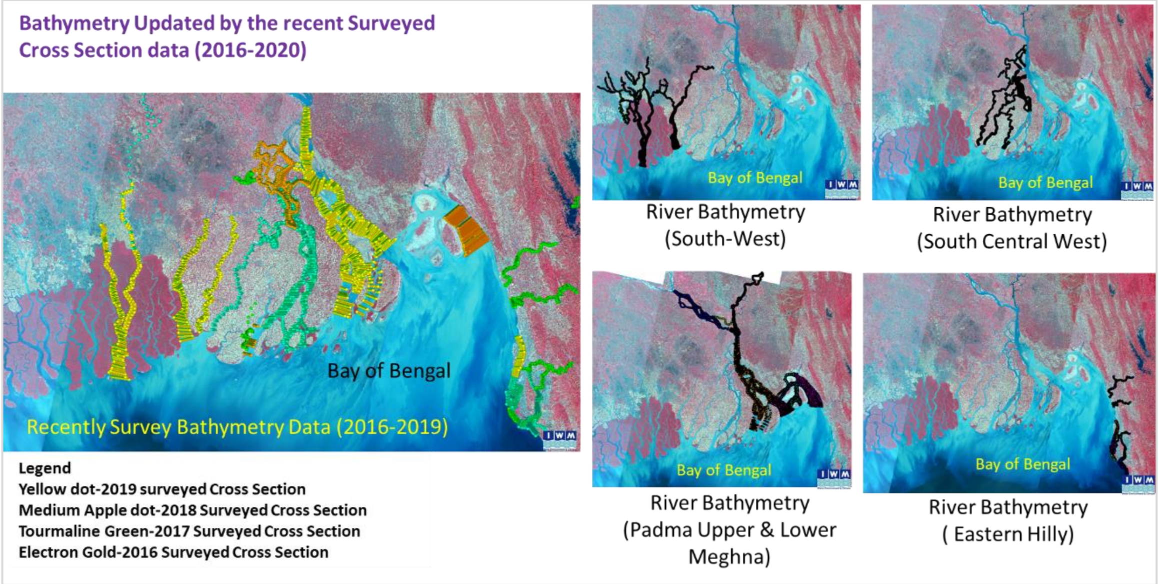

Figure 3-5: Surveyed cross section bathymetry data from 2016 to 2020

For rivers with a meandering or bending shape, it is difficult and rather time consuming to correctly represent the thalweg or connectivity of the bathymetry. The measured depth data are normally spaced by 500 to 1,000m (in some places 2,000 m) and in a meandering river, such large spacing between cross sectional data does not produce a good bathymetry by the use of simple interpolation.

Different tools developed by DHI and Deltares together with MATLAB and open earth tools were used to implement thalweg movements and depth connectivity in bending sections properly. An example illustrating the applied procedure for establishing local quality bathymetry data for a meandering river stretch in the Kobadak river system is given in Figure 3-6. The methodology involved generation of splines from the bank line data and generation of local very high-resolution grids. Error! Reference source not found.Figure 3-7 shows the final processed bathymetry data.

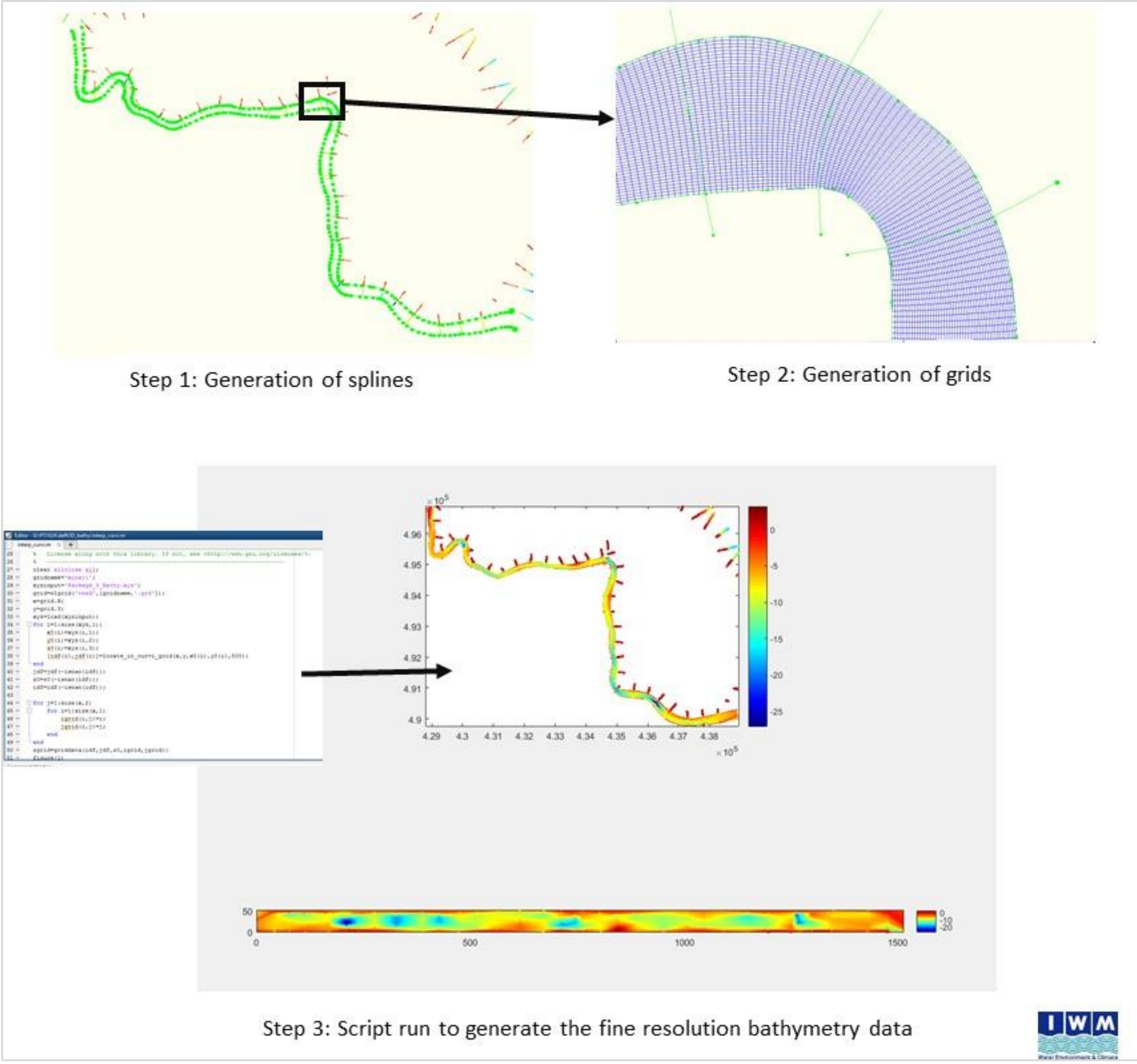

Figure 3-6: Illustration of methodology developed for generation of high resolution bathymetry in meandering or bending rivers

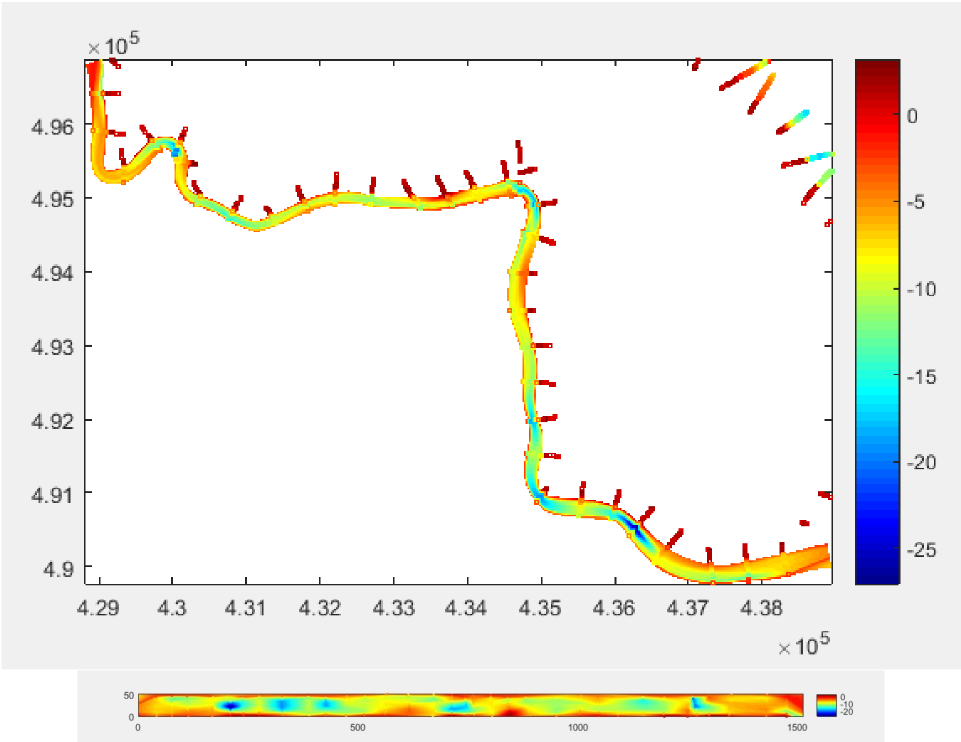

Figure 3-7: New bathymetry generation technique using the Delft 3D Flexible Mesh System

The established bathymetry data set of the river system is presented in Figure 3-8.

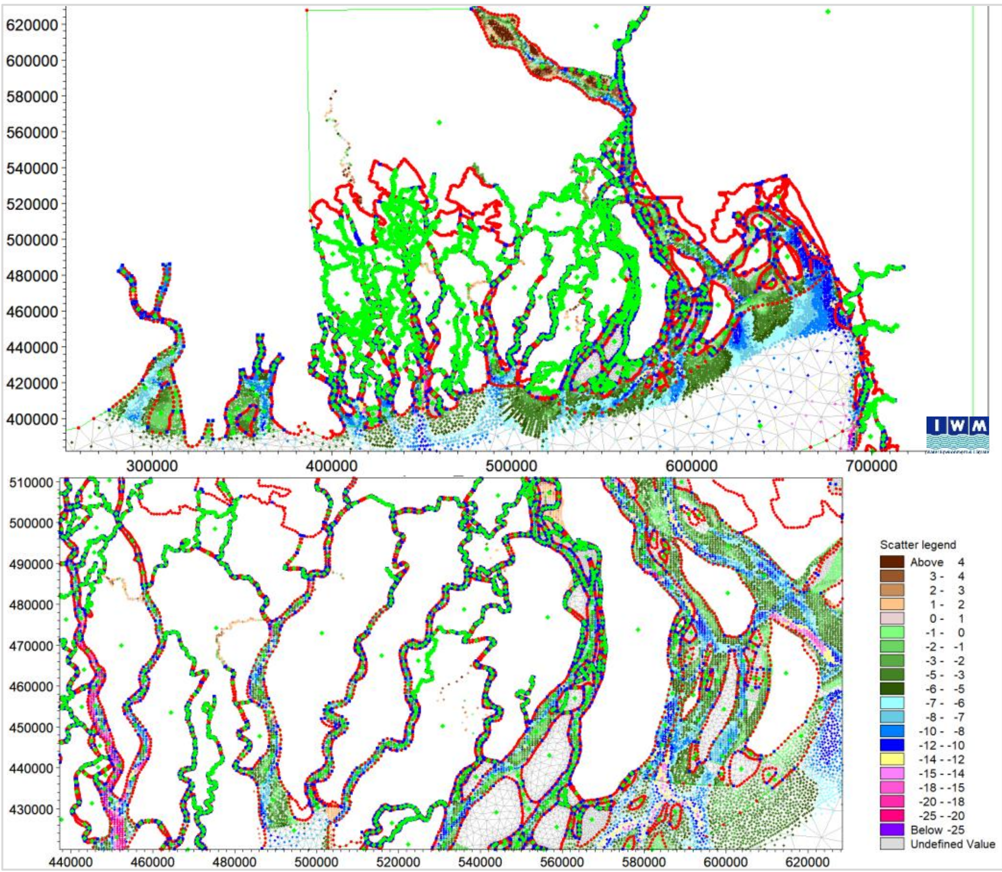

Figure 3-8: River depth data applied for the generation of the model bathymetry

3.2.3 Inclusion of Polder and Land Levels

Land level data for polders and sea islands have been added to the bathymetry data set to improve the effects of propagation of tides and cyclone generated surges.

Most of the polders land levels were collected from Survey of Bangladesh (SOB) and earlier used in the 2nd CERP (2000) project[11]. Additional land levels data have been collected by the IWM Survey and Data Division.

Figure 3-9 presents the density of collected land data and levels inside the polders. The resolution of the SOB land levels is 300m x 300m.

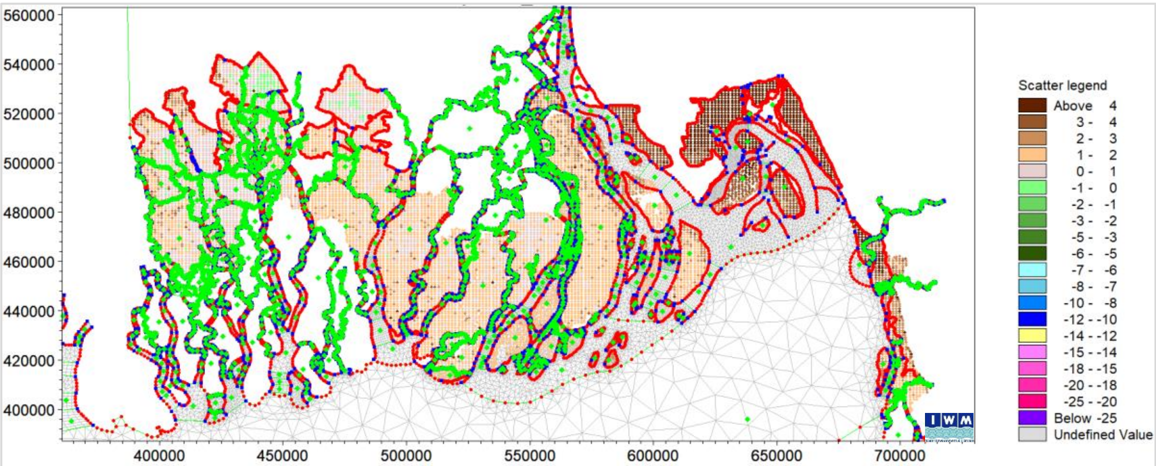

Figure 3-9: Inclusion of land level data in the developed Bay of Bengal model bathymetry

Extra care has been applied during the interpolation of river bathymetry and land level data by carefully defining the boundary between riverbank lines and the tidal flood plain or polder land. The following Figure 3-10 presents the interpolated bathymetry of the Bay of Bengal model.

[11] 2nd CERP, IWM/DHI. (2000). "Coastal Embankment Rehabilitation Project-Hydraulic modelling study, The Government of the People's Republic of Bangladesh, Ministry of Water Resources, Bangladesh Water Devlopment Board

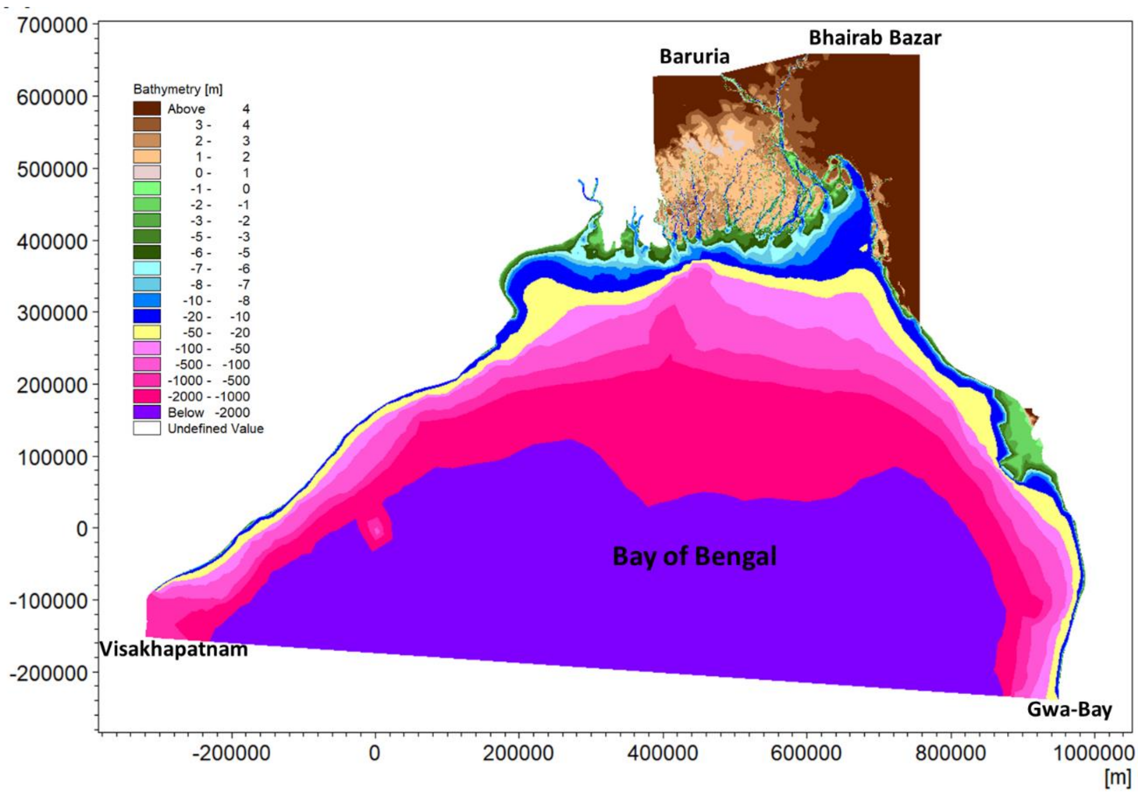

Figure 3-10:: Geographic extent and updated bathymetry of the Bay of Bengal model

3.3 Incorporation of Coastal Polders

The effect of coastal polders has been implemented in the Bay of Bengal surge model using a similar procedure as applied in CEIP-1 (2018).

Because the horizontal dimension (width) of the polder dikes is much smaller than the cell sizes used in the computational grid, all coastal polders have been included in the storm surge model as so-called dike structures using sub grid modelling.

Error! Reference source not found. shows examples of coastal polders included in the model as coastal dikes.

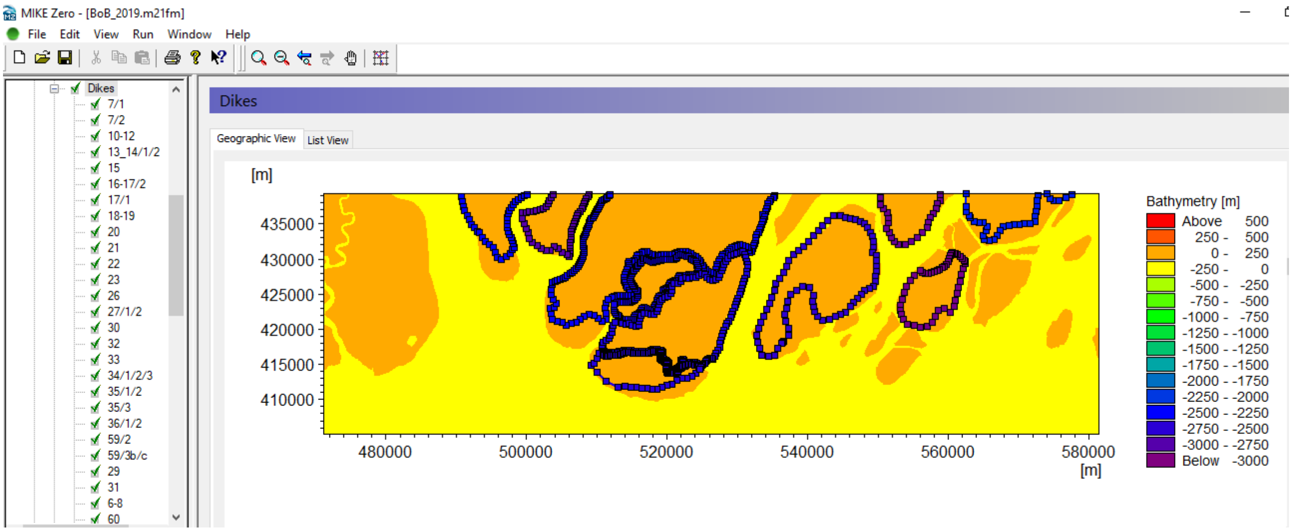

Figure 3-11: Inclusion of coastal polders as a dike structure in the storm surge model

The discharge, *Q*, over a section of the dike corresponding to an element face with the length (width), *W*, is based on a standard weir expression according to the Villemonte formula (***Villemonte, J. R., 1947***):

$$Q = w * C\,(H_{us} - H_w)^{\frac{3}{2}} * \left[1 - \left(\frac{H_{ds-H_w}}{H_{us} - H_w}\right)^{\frac{3}{2}}\right]^{\frac{3}{2}} \quad for\ H_{us} > H_{ds} > H_w$$

$$Q = w * C\,(H_{us} - H_w)^{\frac{3}{2}} \quad for\ H_{us} > H_w > H_{ds}$$

$$Q = 0 \quad for\ H_w > H_{us} > H_{ds}$$

where *Q* is discharge through the structure, *W* is width, *C* is a weir coefficient, *k* is the weir exponential coefficient, H_{us} is upstream water level, H_{ds} is downstream water level and H_w is the weir level taken with respect to the vertical datum, c.f. Figure 3-12**.** The value of the weir exponent is set to 1.5, the value of the weir coefficient is set to 1.838.

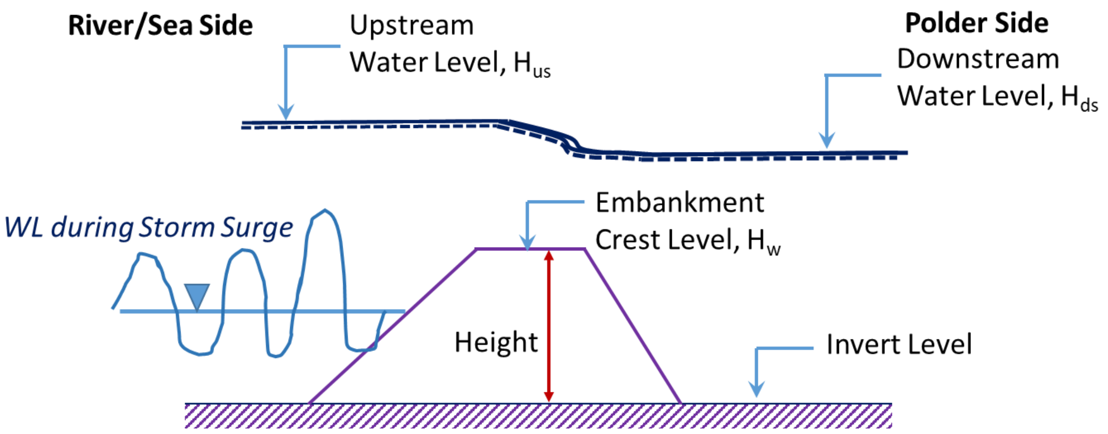

Figure 3-12: Definition of embankment for polder modelling

The horizontal location of a polder is specified by coordinates as polylines. The polyline defines the width of the structure perpendicular to the flow direction as well as the crest level.

3.4 Open Boundary conditions

There are twenty-seven open boundaries in the updated Bay of Bengal hydrodynamic model, see Figure 3-13. Twenty-six open boundaries are located upstream of the river delta, and one is located offshore in the Bay of Bengal at 16° latitude between Vishakhapatnam and Gwa Bay.

One upstream boundary is located in the north of the Upper Meghna River at Bhairab Bazar, and another is in the Padma River at Baruria.

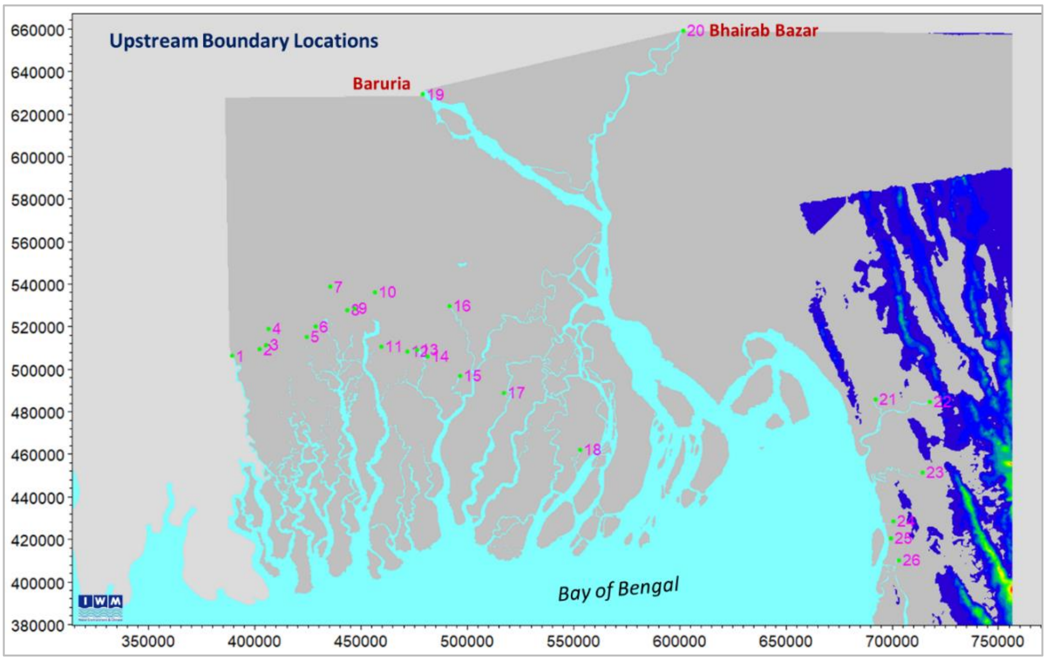

Figure 3-13: Open upstream boundaries in the Bay of Bengal model

The upstream boundary at Baruria is showing non-tidal characteristics and here the discharge[12] is specified as boundary condition through a rating curve (relation between water level and discharge). An example of a typical relation between level and discharge in the Padma River at Baruria for the year 2019 is presented in Figure 3-14.

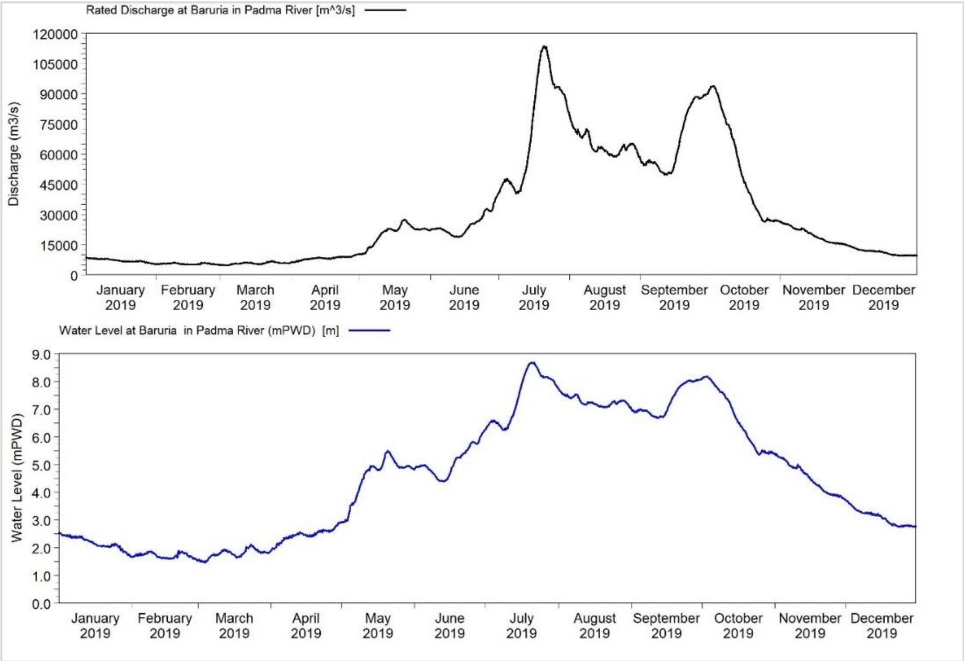

Figure 3-14: Time series of water level and rating discharge at Baruria in the Padma River

At the Bhairab Bazar in the Upper Meghna River tidal effects are observed. Here BWDB is maintaining a water level gauge[13] that provides observed water levels a 3-hours interval. However, to secure model reliability, time series of tidal discharge generated from the available North-Central Region Model (NCRM)[14] are used as the open boundary condition at this location, see Figure 3-15.

[12] BWDB maintains a water level gauge at Baruria Transit (Gauge ID 91.9L) and collects 3-hours interval data. BWDB also collects discharge at Baruria Transit. Using this water level data, stage-discharge relationship has been prepared.

[13] BWDB maintains a water level gauge and discharge (Gauge ID: 273)

[14] IWM maintains six regional models where North-Central Region Model (NCRM) is one of them.

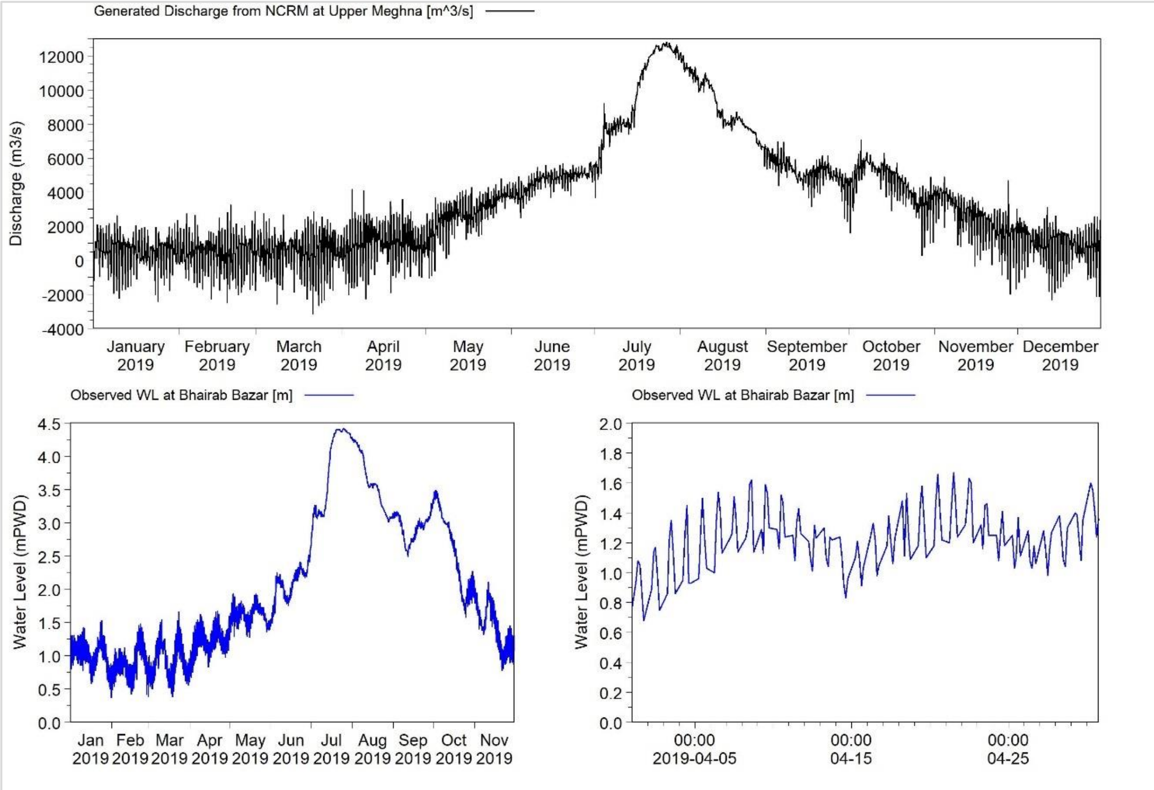

Figure 3-15: Time series of discharge (from the NCRM model) and observed water level at Bhairab Bazar in the Upper Meghna River

At the remaining 24 upstream open boundaries discharge data generated from calibrated and validated regional models (South-West and Eastern Hilly Regional Model) is applied as boundary conditions. Both regional models[15] are available at IWM. An example of the modelled discharge used as open boundary condition (at upstream boundary number 15) is presented in Figure 3-16.

[15] Six regional calibrated and validated hydrological and hydrodynamic models covering the whole Bangladesh are available at IWM.

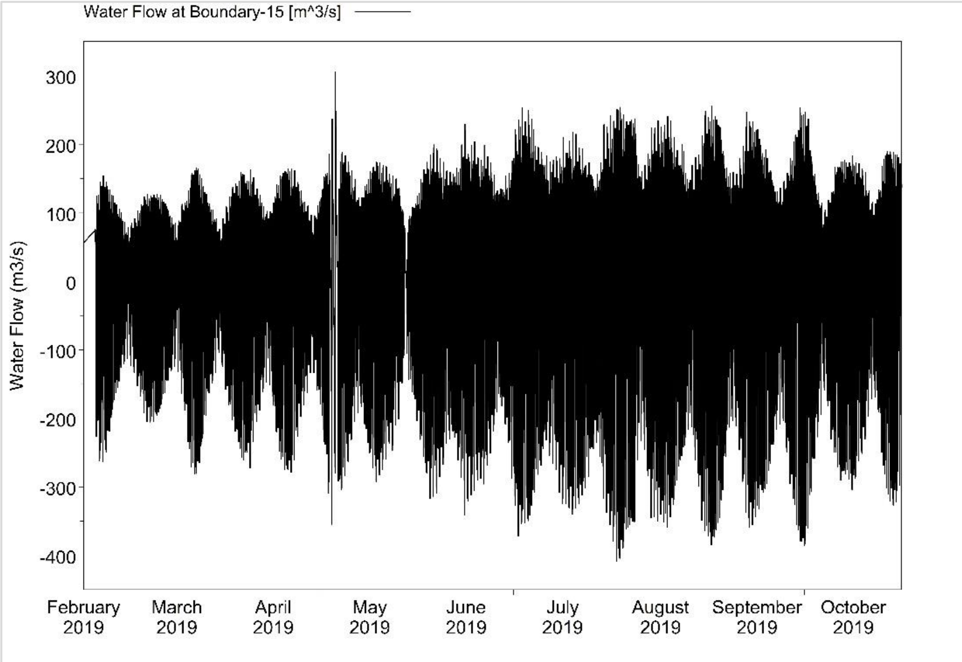

Figure 3-16: Example of modelled discharge used as boundary condition at upstream boundary location 15

The downstream (offshore) boundary condition consists of astronomical tidal water levels along the open boundary. The tidal data is generated from the Global Tide Model which is part of the DHI MIKE Zero software.

3.5 Other Model Parameters

Other relevant model parameters determined as part of the model calibration are described below.

Flood & Dry

In the model simulations three depths: the drying, flooding and wetting depth must be specified for handling the dynamic flooding and drying of individual calculation cells as a consequence of the water level variations. In the Bay of Bengal storm surge model these depths are specified as 0.005m, 0.05m and 0.1m, respectively.

Bed Resistance

The bed resistance in the model is described through specification of the Manning number.

The relation between the Manning number, M and the bed roughness length, Ks can be estimated using the formula:

$$M = \frac{25.4}{Ks^{1/6}}$$

The Manning number, M is the reciprocal value of Manning's n.

The spatial distribution of the Manning number as shown in Figure 3-17 was determined as a result of the model calibration. The applied Manning numbers are related to the local water depths as listed in Table 3-1.

Table 3-1: Manning number distribution

Areas with depths	Manning number ($m^{1/3}/s$)
Below -20 m	32
-20 to -15 m	60
-15 to -10 m	65
-10 to -5 m	90
Above -5 m	100
Mangrove Forrest	15
Settlement & Rice field	25

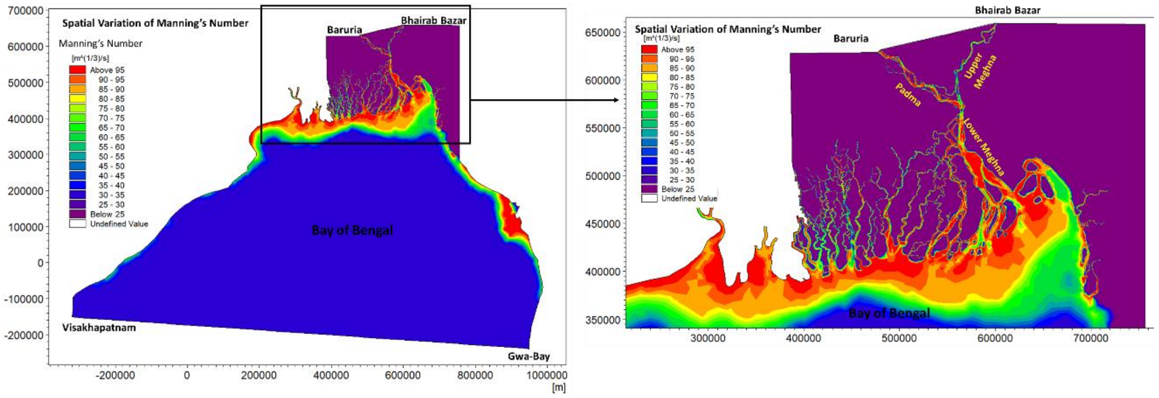

Figure 3-17: Bed resistance (Manning number) as applied in the Bay of Bengal storm surge model

Eddy Viscosity

The applied eddy viscosity is described using the Smagorinsky formulation with a constant Smagorinsky coefficient of 0.28.

Wind Forcing

The drag coefficient can either be a constant value or depend on the wind speed. The empirical formulae proposed by Wu (1980, 1994) is used for the parameterization of the drag coefficient. For calculation of the wind friction, the following wind speed and wind friction relation is used:

$$C_d = C_a \ \ when \ \ W_{10} < W_a$$

$$C_d = C_a + \frac{C_b - C_a}{W_b - W_a} * (W_{10} - W_{a)} \ \ when \ W_a \leq W_{10} \leq W_b$$

$$C_d = C_b \ \ when \ W_{10} > W_b$$

Where C_a, C_b, W_a and W_b are empirical factors and W_{10} is the wind speed 10m above the sea surface. The parameter values given in Table 3-2 were determined through model calibration.

Table 3-2: Model parameters for description of the model wind drag coefficient

	Wind Speed, W (m/s)	Wind Friction, C
a	0	0.0016
b	24	0.0026

4 Bay of Bengal Storm Surge Model Calibration and Validation

4.1 Calibration of the Upgraded Bay of Bengal Model

The upgraded Bay of Bengal storm surge model has been calibrated against tidal water levels, observed water levels, and observed discharges.

4.1.1 Calibration against astronomical tidal water levels

The updated Bay of Bengal storm surge model has been simulated for the period 15th February 2019 to 13th October 2019. This period covers both monsoon and non-monsoon conditions.

The model was forced with astronomical tide at the open offshore boundary without meteorological and upstream forcing and therefore simulates the propagation of the astronomical tide only.

Model results has been compared with astronomical tides derived (or separated) from time series of observed water levels (see Section 2.2.1). The astronomical tides were calculated using the tidal analysis tool (TIDHAC) which is part of the DHI MIKE Zero software package.

The comparison is presented at 8 locations, see Figure 4-1 , are presented in Figure 4-2 to Figure 4-5. The black curves show model results and the red curves the deducted tides.

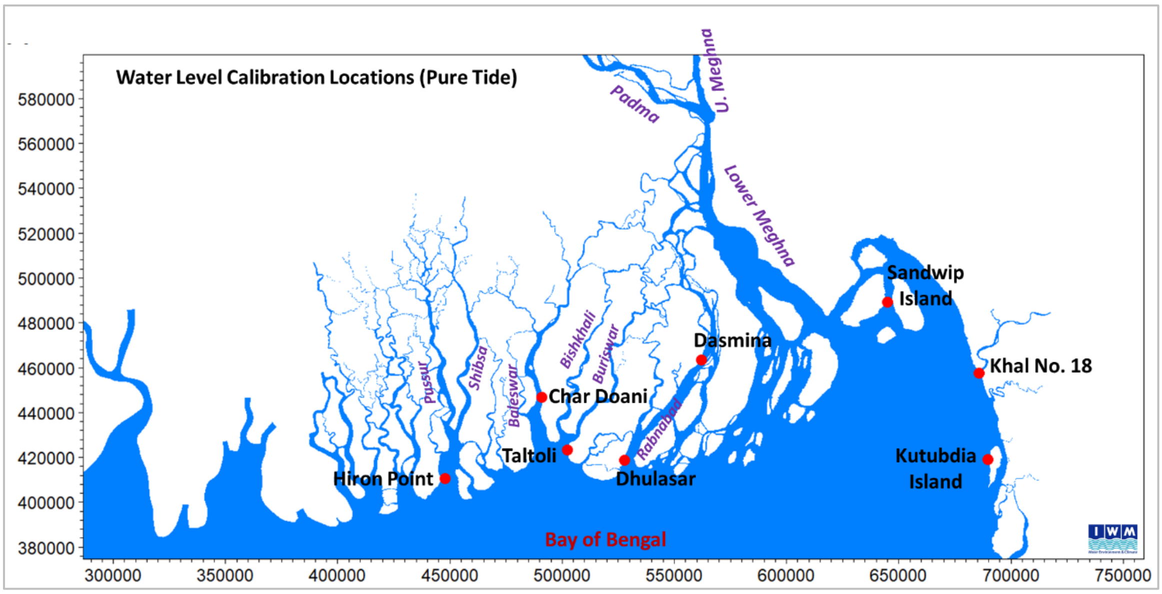

Figure 4-1: Location of the 8 stations used for the comparison of modelled and observed astronomical tides. Polders of specific interest for the present study are also indicated

Overall, the comparison of the astronomical tides is seen to be very good both with respect to tidal phase and tidal amplitude – both during spring and neap tidal periods.

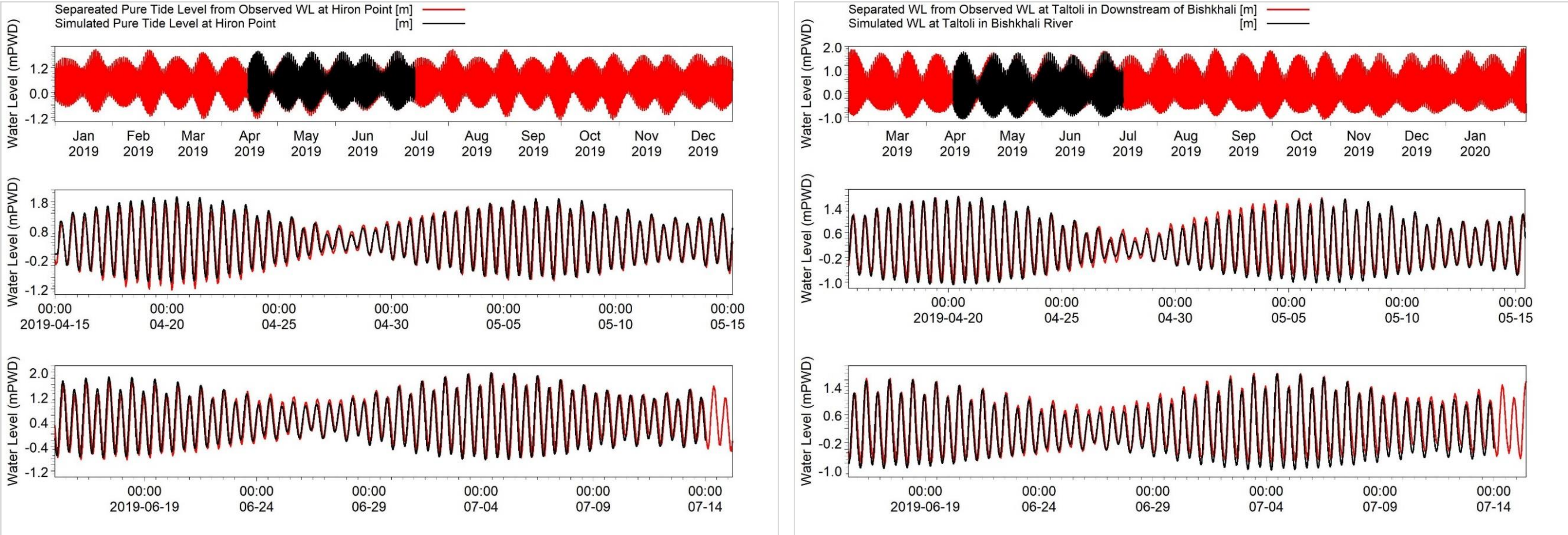

Figure 4-2: Comparison of simulated tide and tide derived from observations. Left: **Hiron Point,** right**: Taltoli** in downstream of Bishkhali and Buriswar River.
Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon)

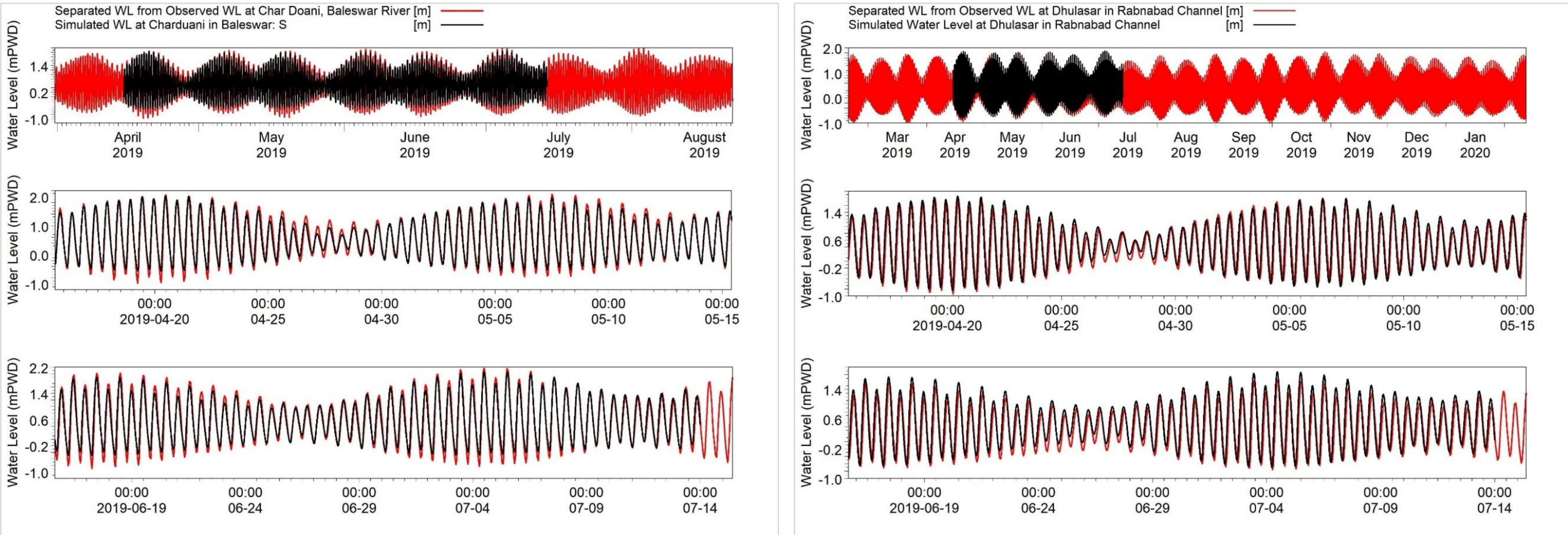

Figure 4-3: Comparison of simulated tide and tide derived from observations. Left: **Char Doani** in the Baleswar River**,** right**:** Dhulasar downstream of Rabnabad Channel.
Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon)

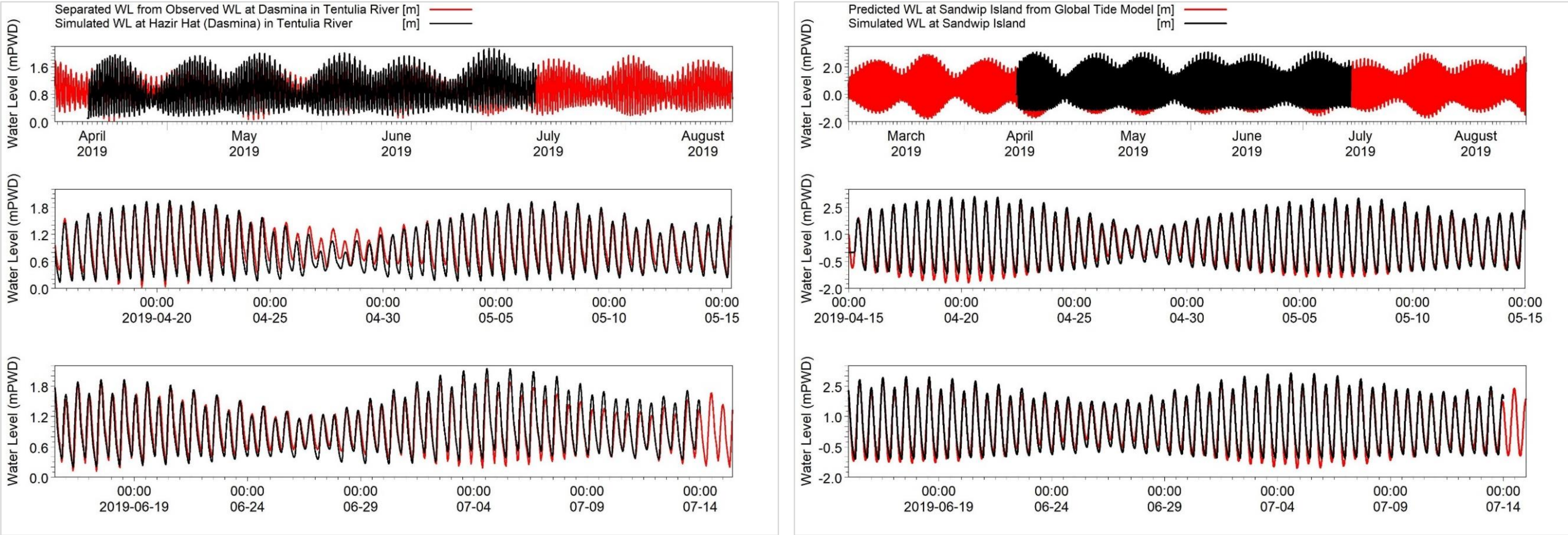

Figure 4-4: Comparison of simulated tide and tide derived from observations. Left: **Dasmina** in the Tentulia Channel**,** right**:** Sandwip Island.
Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon)

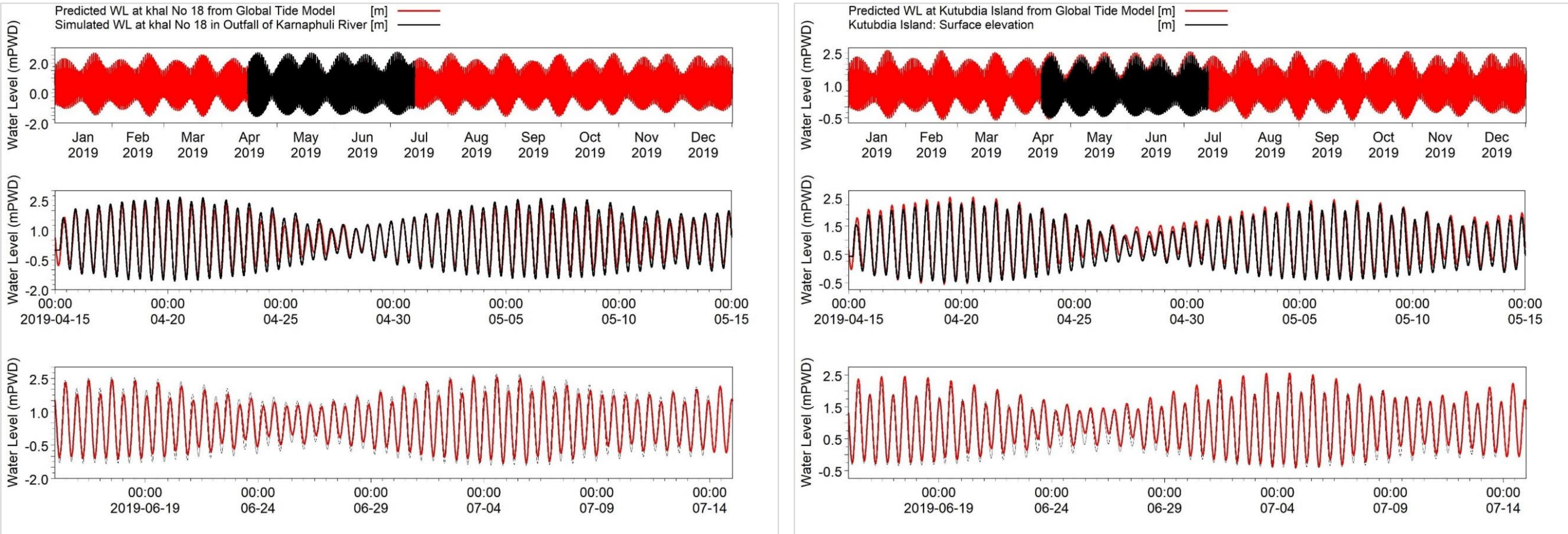

Figure 4-5: Comparison of simulated tide and tide derived from observations. Left: Khal No. 18 downstream of the Karnaphuli River**,** right**:** Western side of the Kutubdia Island.
Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon)

4.1.2 Calibration against observed water levels

The updated Bay of Bengal storm surge model has been simulated for the period 15th February 2019 to 13th October 2019. This period is the same as simulated for the tide only conditions and covers both monsoon and non-monsoon conditions.

The model was forced with astronomical tide at the open offshore boundary, metrological forcing (wind and air pressure) at the water surface and river discharges at the upstream river boundaries. The model therefore simulates the full water levels that can be compared to the available observed water levels as described in Section 2.2.1.

Model results are compared with observed water levels at the seven stations shown in Figure 4-6

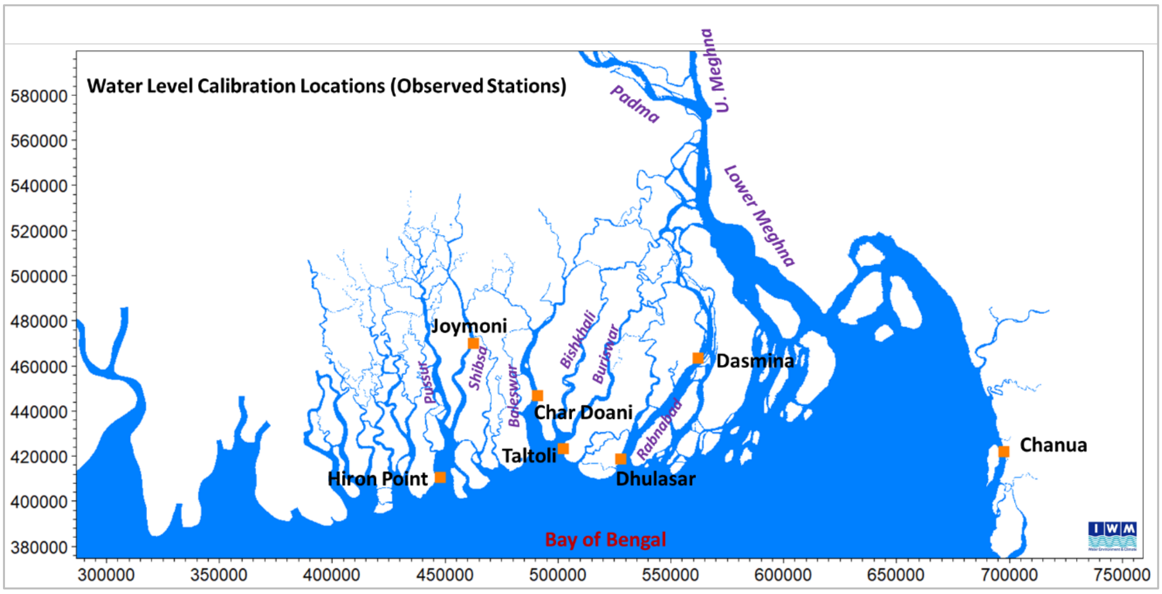

Figure 4-6: Location of the 7 stations (white bullets) used for the comparison of modelled and observed water levels tides. Polders of specific interest for the present study are also indicated

The comparison is presented in Figure 4-7 to Figure 4-11. The black curves show model results and the red curves the observations.

As for the previous tidal calibration the comparison of water levels is seen to be very good both with respect to phase and amplitude –both during spring/neap tide and during dry/monsoon seasons.

Water level for monsoon at Chanua in the Kutbubdia (Figure 4-11) channel are not available. However, model result behaves very well at dry season with the observed water level data.

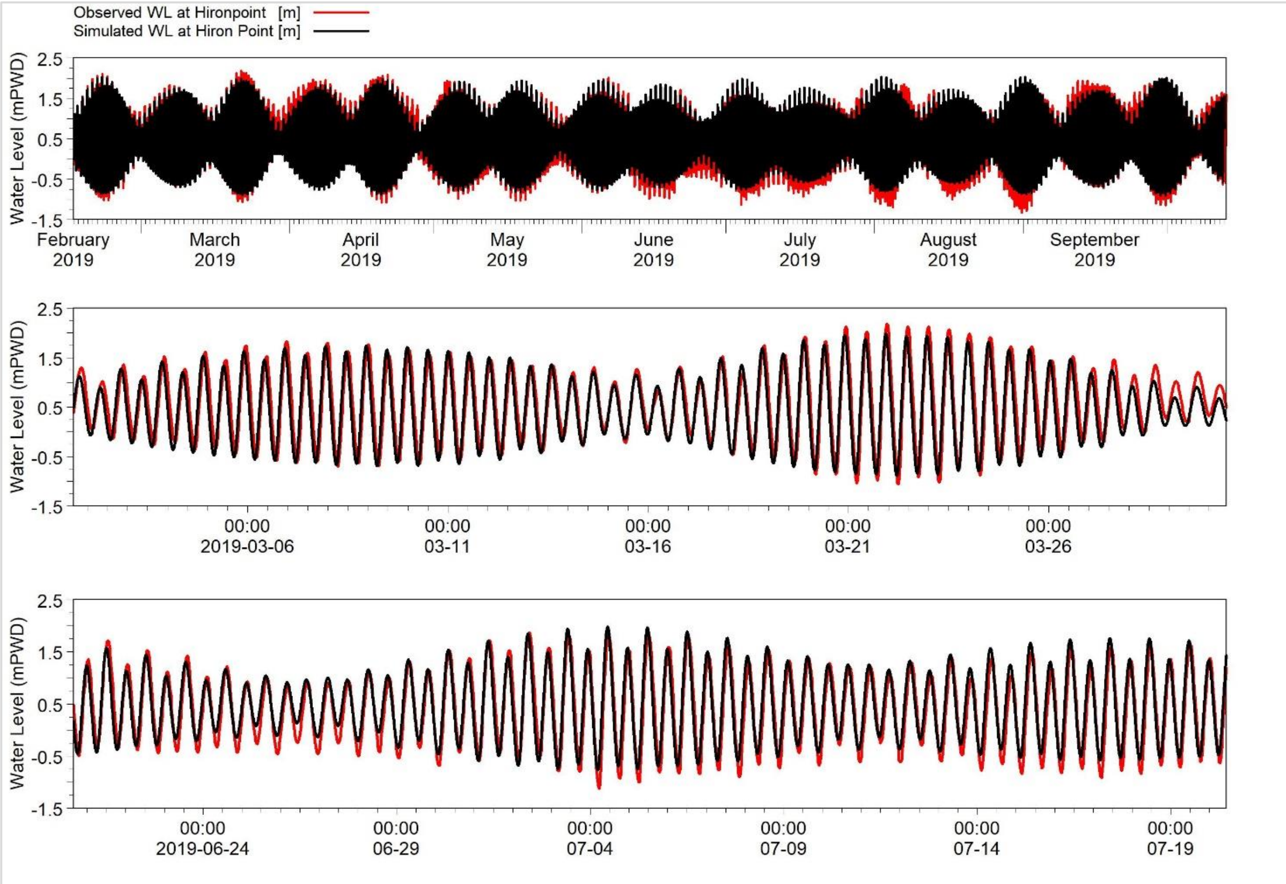

Figure 4-7: Comparison of simulated and observed water levels at **Hiron Point** in the downstream of Pussur-Shibsa River. Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

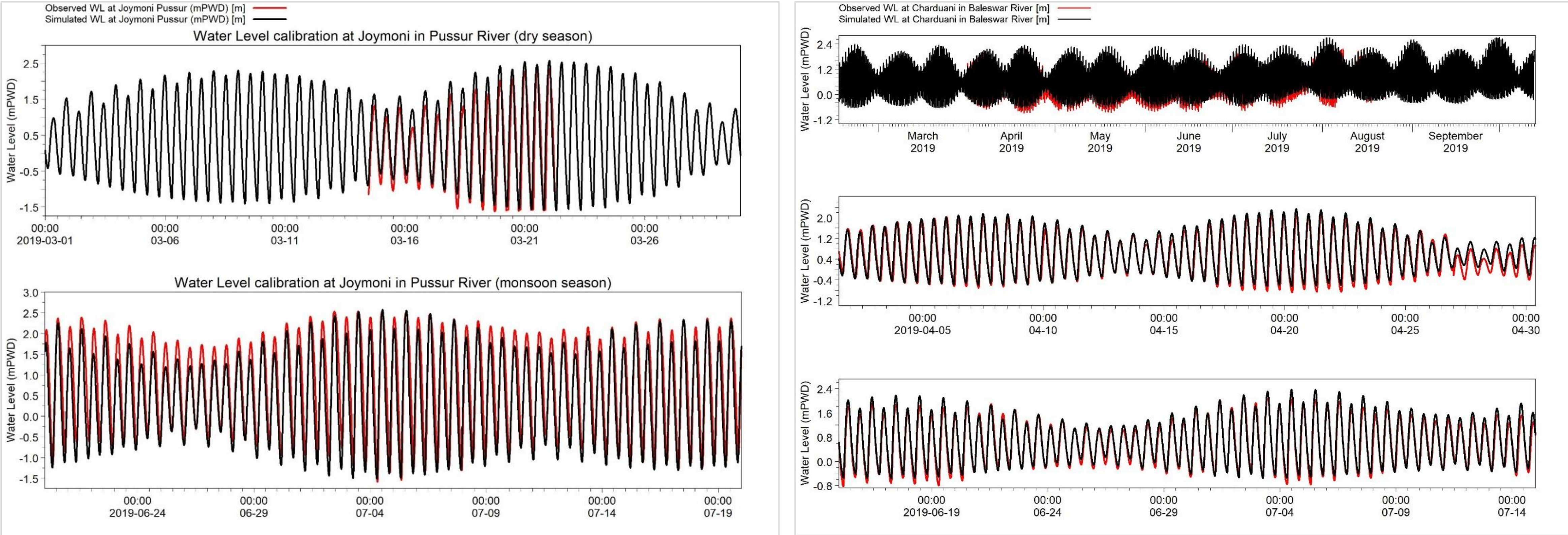

Figure 4-8: Comparison of simulated and observed water levels. Left: **Joymoni** in the Pussur River**,** Right**: Char Doani** in the Baleswar River.Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

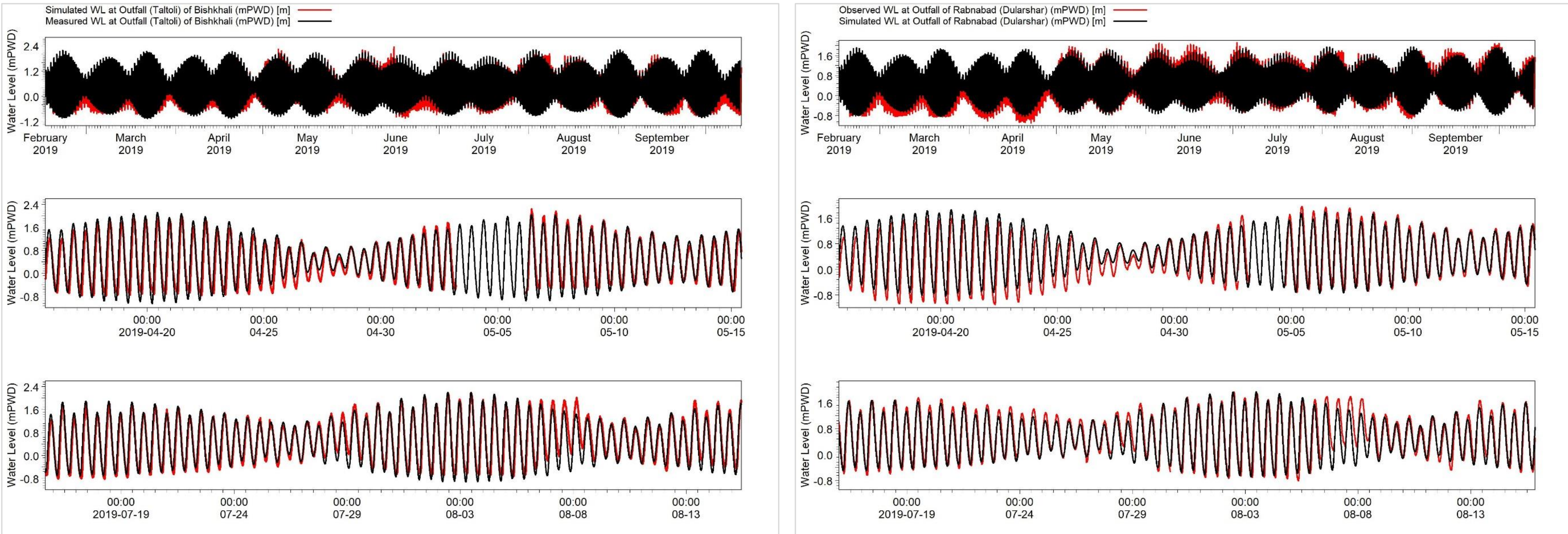

Figure 4-9: Comparison of simulated and observed water levels. Left: **Taltoli** in the outfall of Bishkhali and Buriswar**,** Right**:** Dhulasar outfall of the Rabnabad Channel. Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

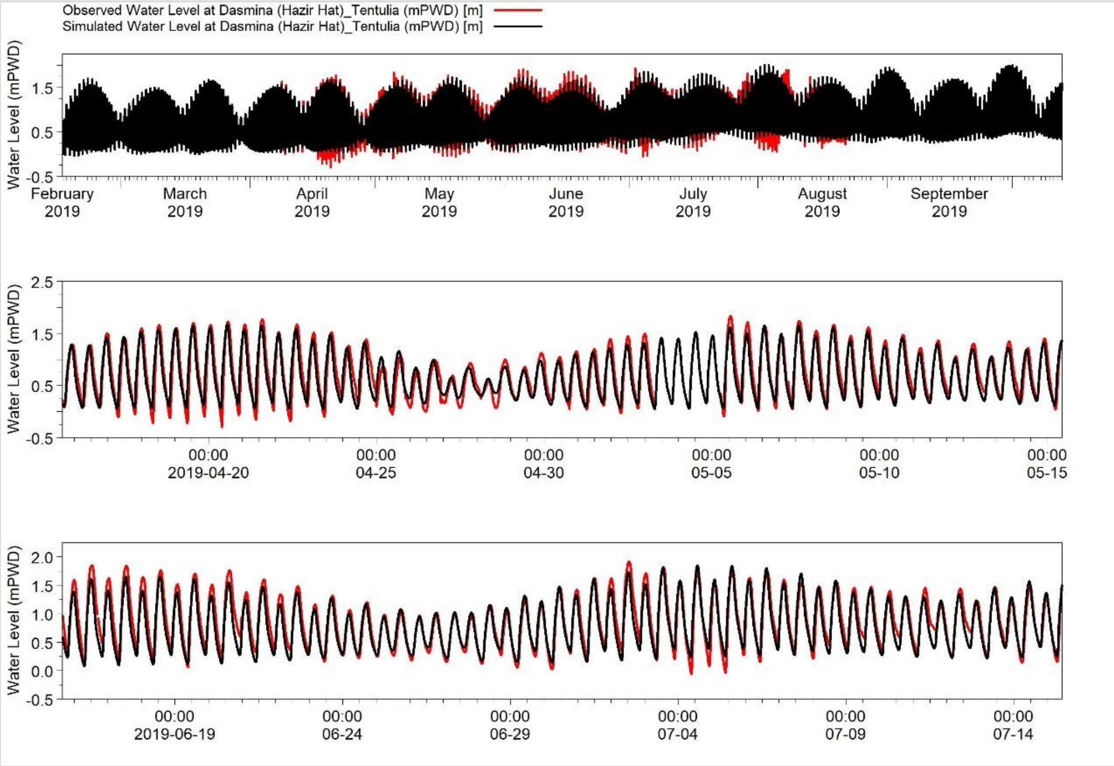

Figure 4-10: Comparison of simulated and observed water levels at **Dasmina** in the Tentulia Channel.Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

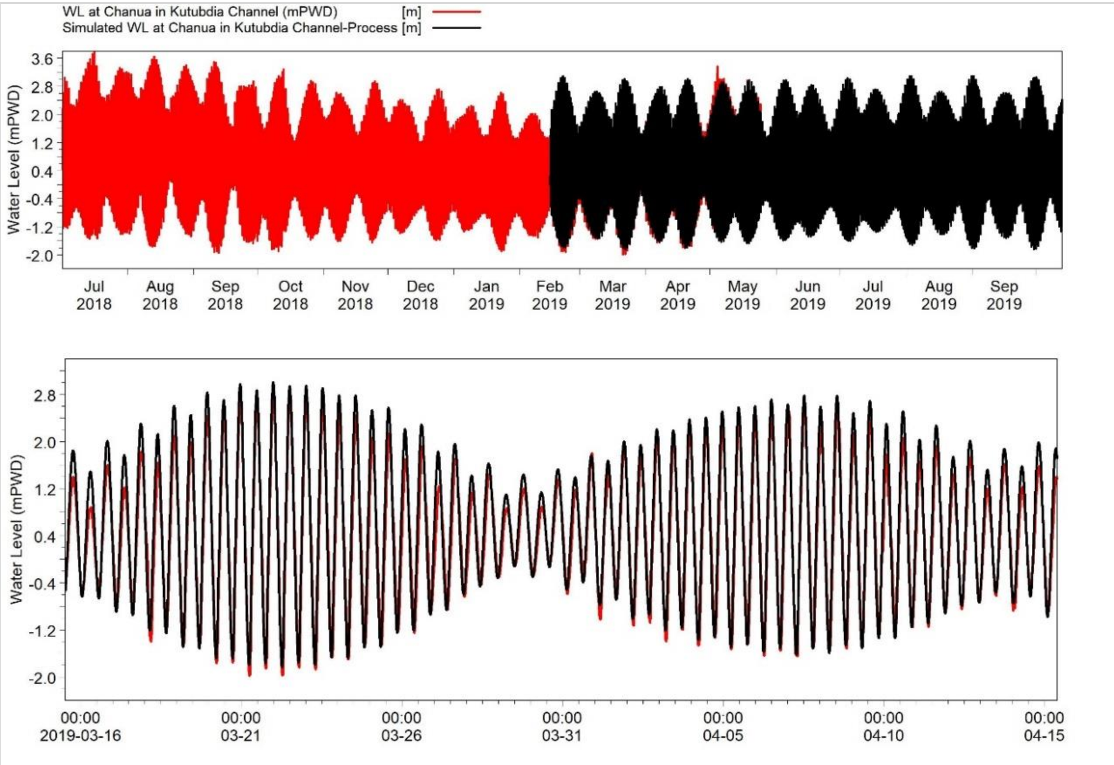

Figure 4-11: Comparison of simulated and observed water levels at **Chanua** in the Kutubdia Channel. Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

4.1.3 Calibration against observed river discharges

The updated Bay of Bengal storm surge model has been simulated for the period 15th February 2019 to 13th October 2019. This simulation is identical to the above-described simulation that simulated the full physical conditions including meteorological and upstream river forcing. The model results can therefore be compared to the available observed river discharges as described in Section 2.2.2.

Model results are compared with observed river discharges at the eight stations (cross-sections) shown in Figure 4-12.

The comparisons represent cross-sections at Katalia Bazar in the Gangrail River, Nalian in the Shibsha River, Mongla in the Pussur River, Char Doani left bank of Baleswar River, Char Doani right bank of Baleswar River, Nazirpur (Dasmina) in the Tentulia River, Harina Ghat in the Lower Meghna River and Tailardwip in the Sangu River and cover observations during both dry and monsoon seasons and during spring and neap tide conditions.

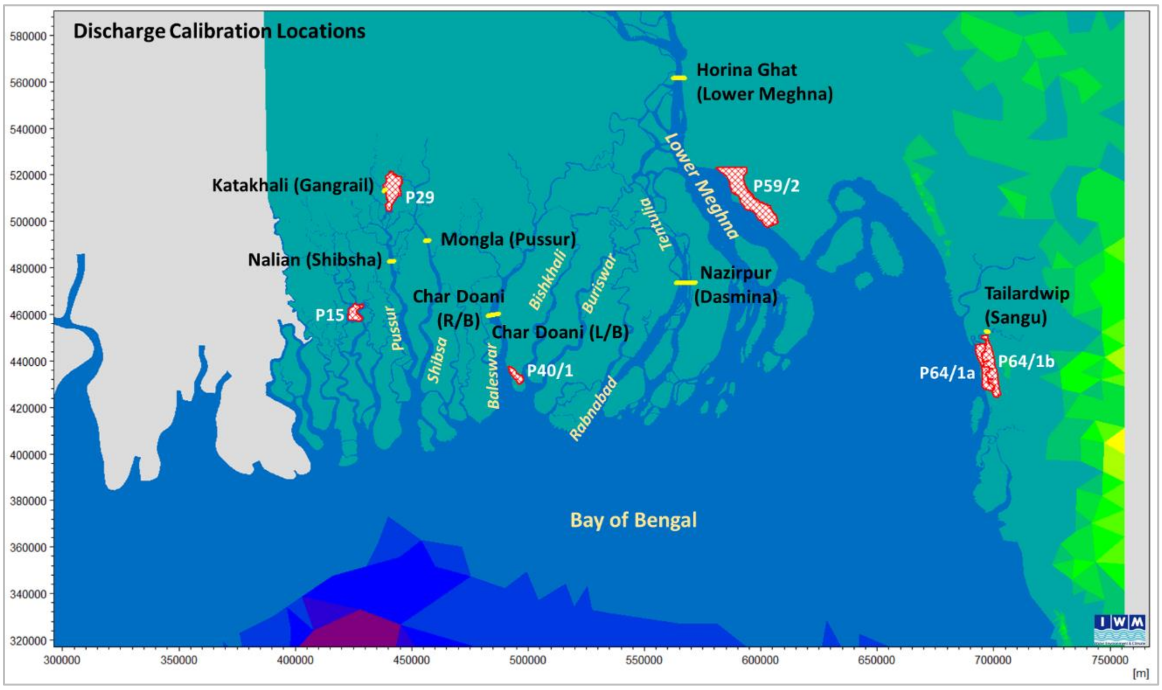

Figure 4-12: Location of the 8 stations/cross-sections (yellow lines) used for the comparison of modelled and observed river discharges. Polders of specific interest for the present study are also indicated

The comparison is presented in Figure 4-13 to Figure 4-19. The black curves show model results and the red curves the observations.

As for the above presented tide/water level comparison the comparison of modelled and observed river discharges is in general very good during all periods both with respect to phase and amplitude – and both during spring/neap tide and during dry/monsoon seasons.

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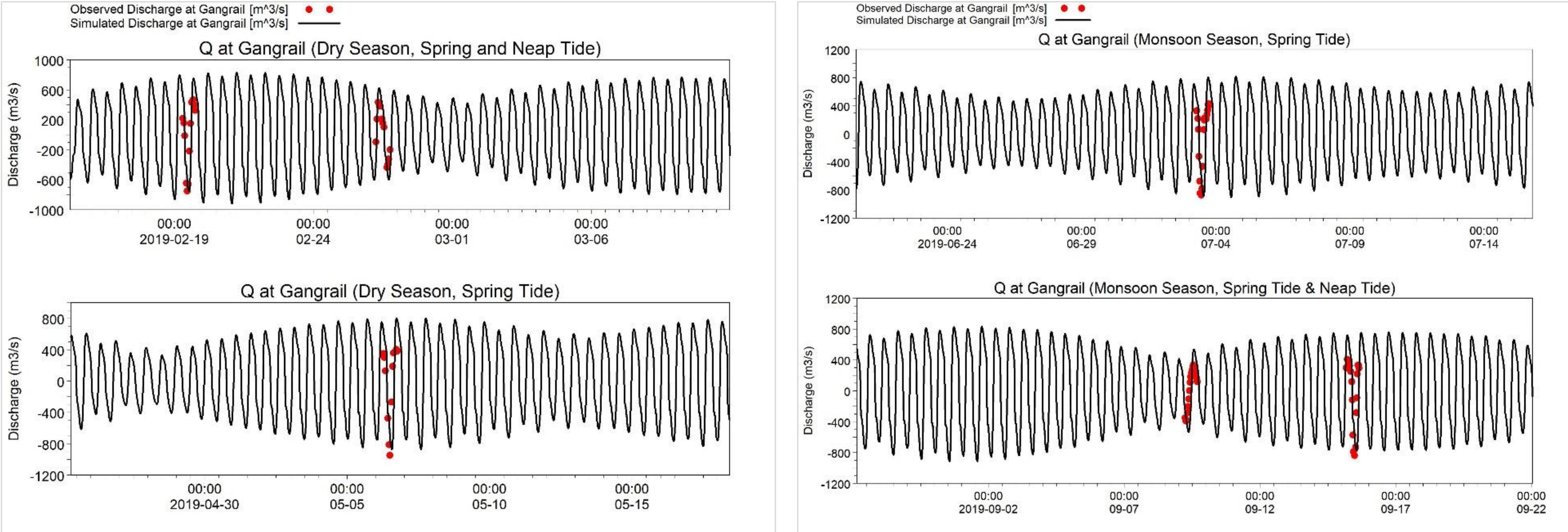


Figure 4-13: Comparison of simulated and observed discharge at Katalia Bazar in the Gangrail River

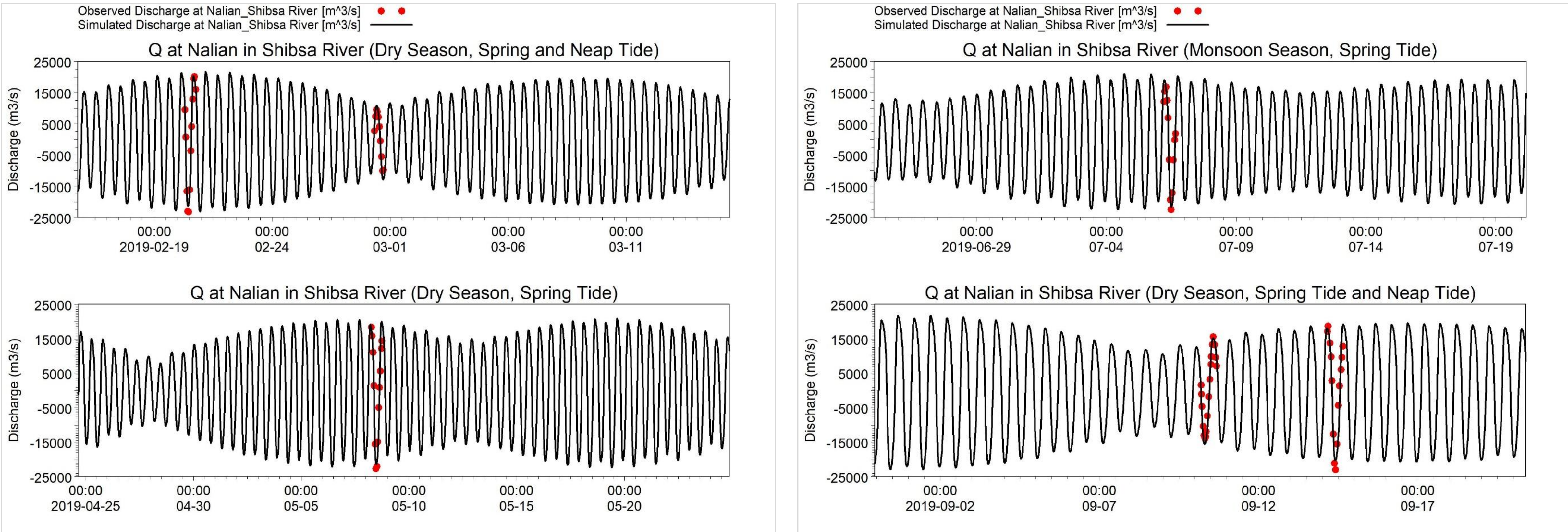


Figure 4-14: Comparison of simulated and observed discharge at Nalian in the Shibsha River

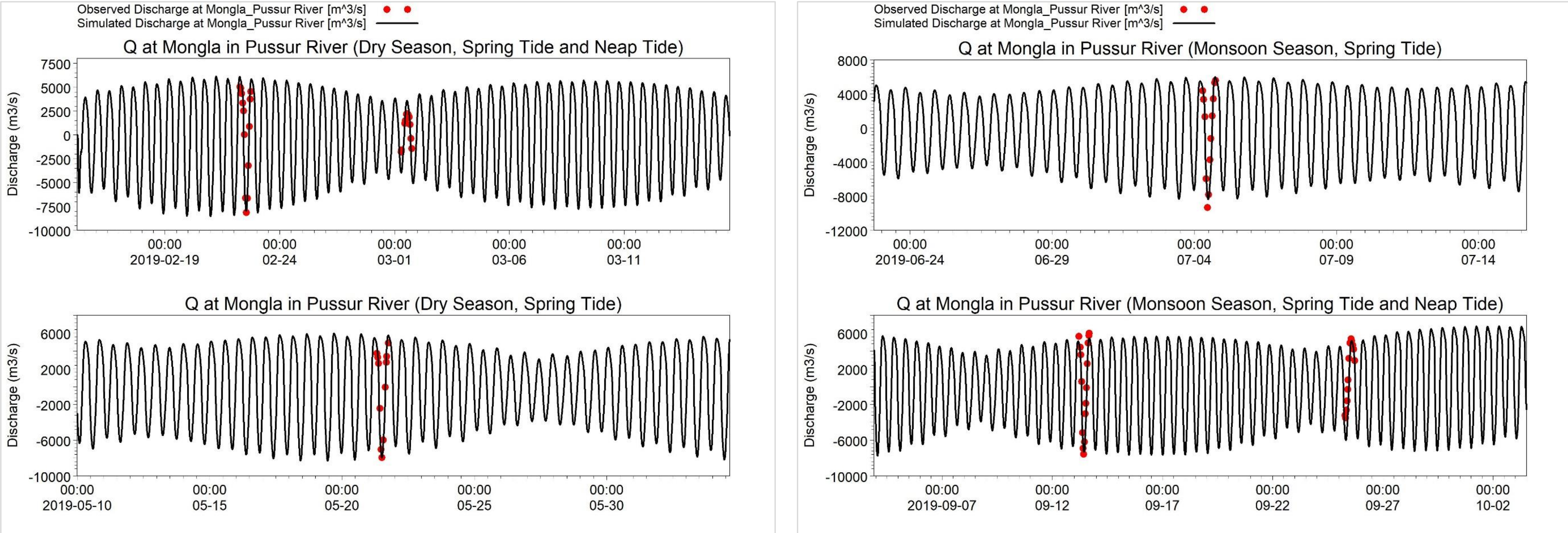


Figure 4-15: Comparison of simulated and observed discharge at Mongla in the Pussur

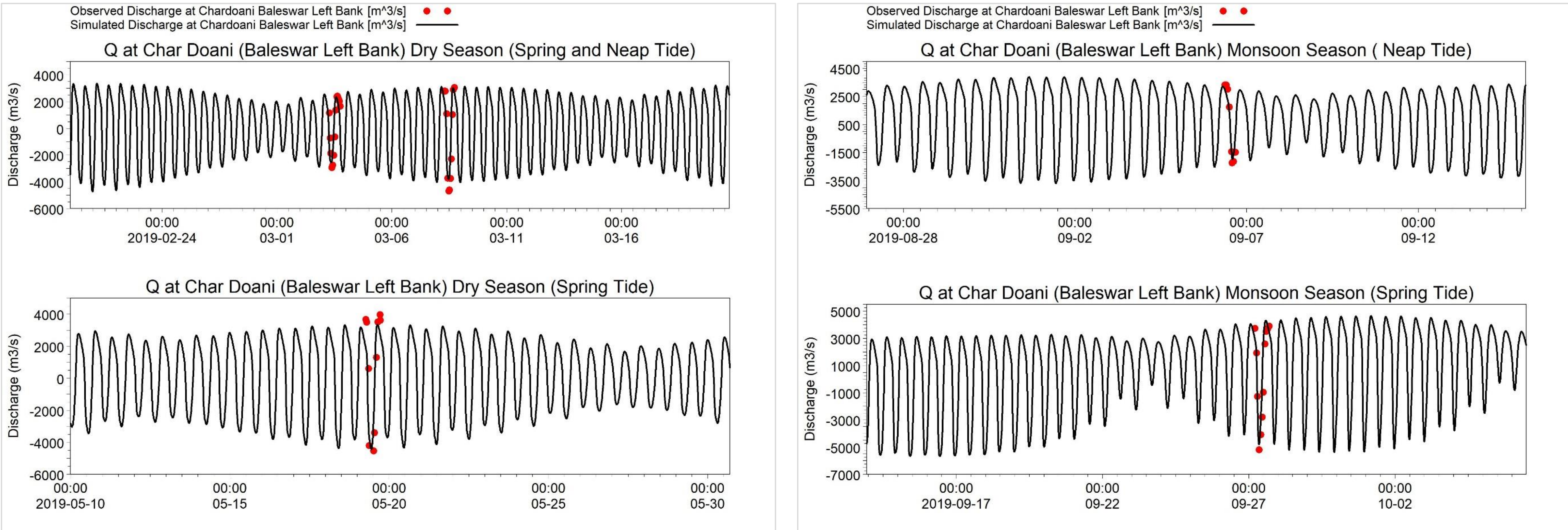


Figure 4-16: Comparison of simulated and observed discharge at Char Doani in the Baleswar River, left bank

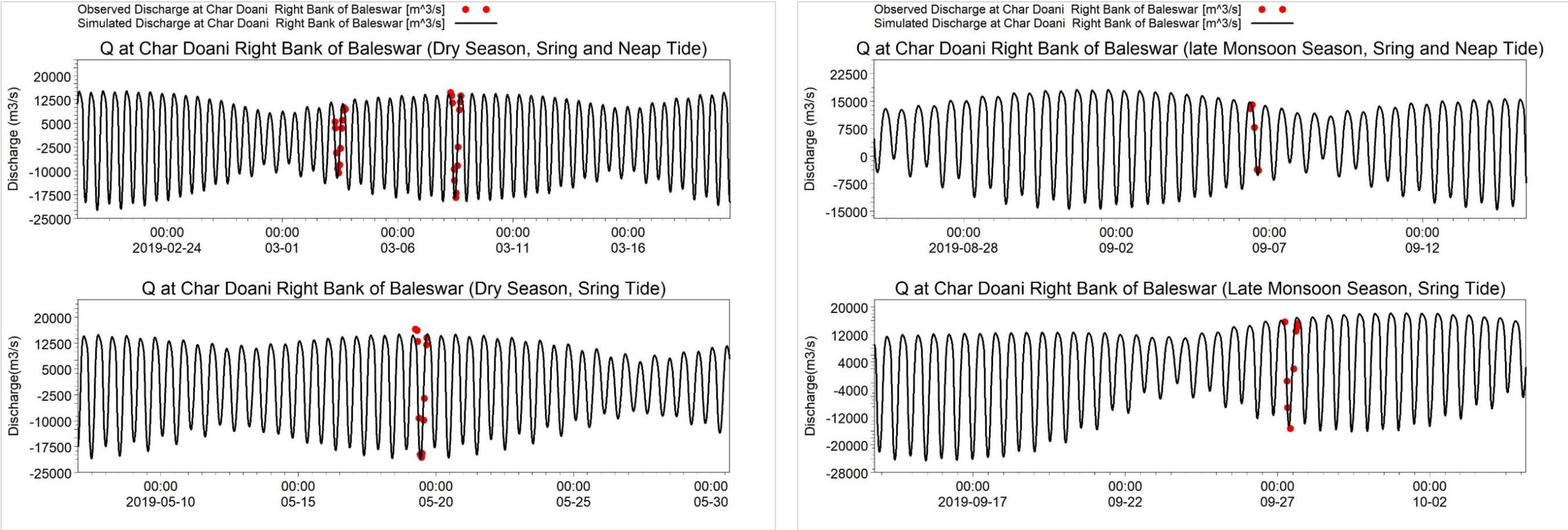


Figure 4-17: Comparison of simulated and observed discharge at Char Doani in the Baleswar River, right bank

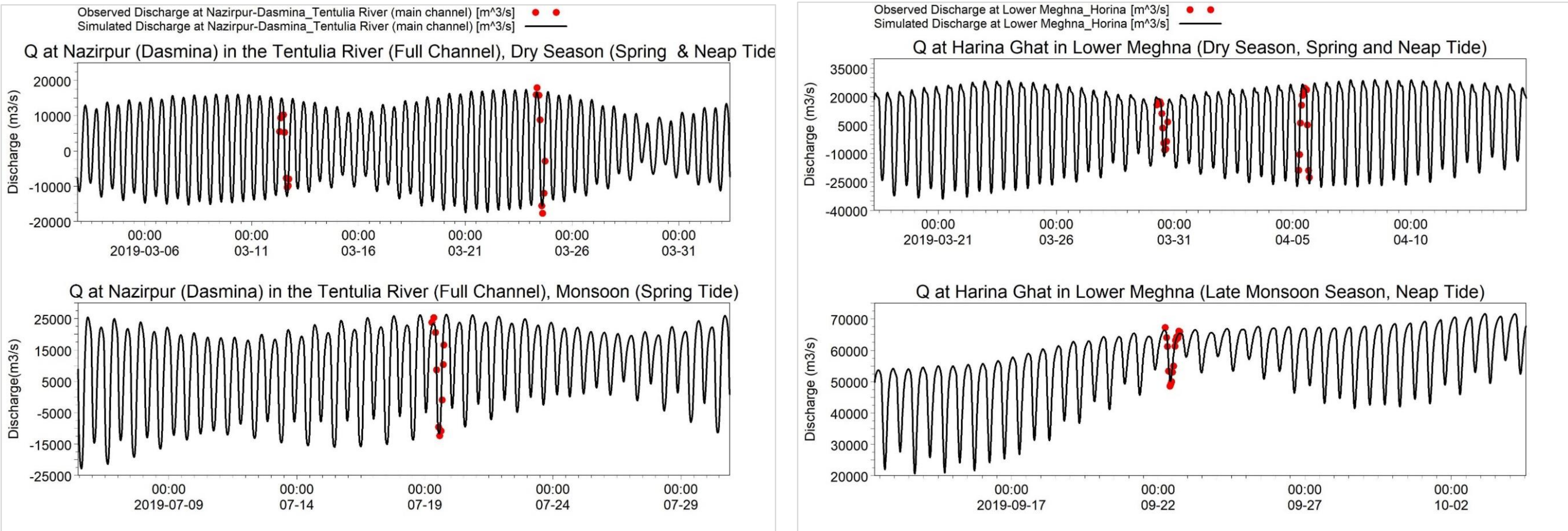


Figure 4-18: Comparison of simulated and observed discharge at Nazirpur (Dasmina) in the Tentulia River full channel (left) and at Harina Ghat in the Lower Meghna River (right)

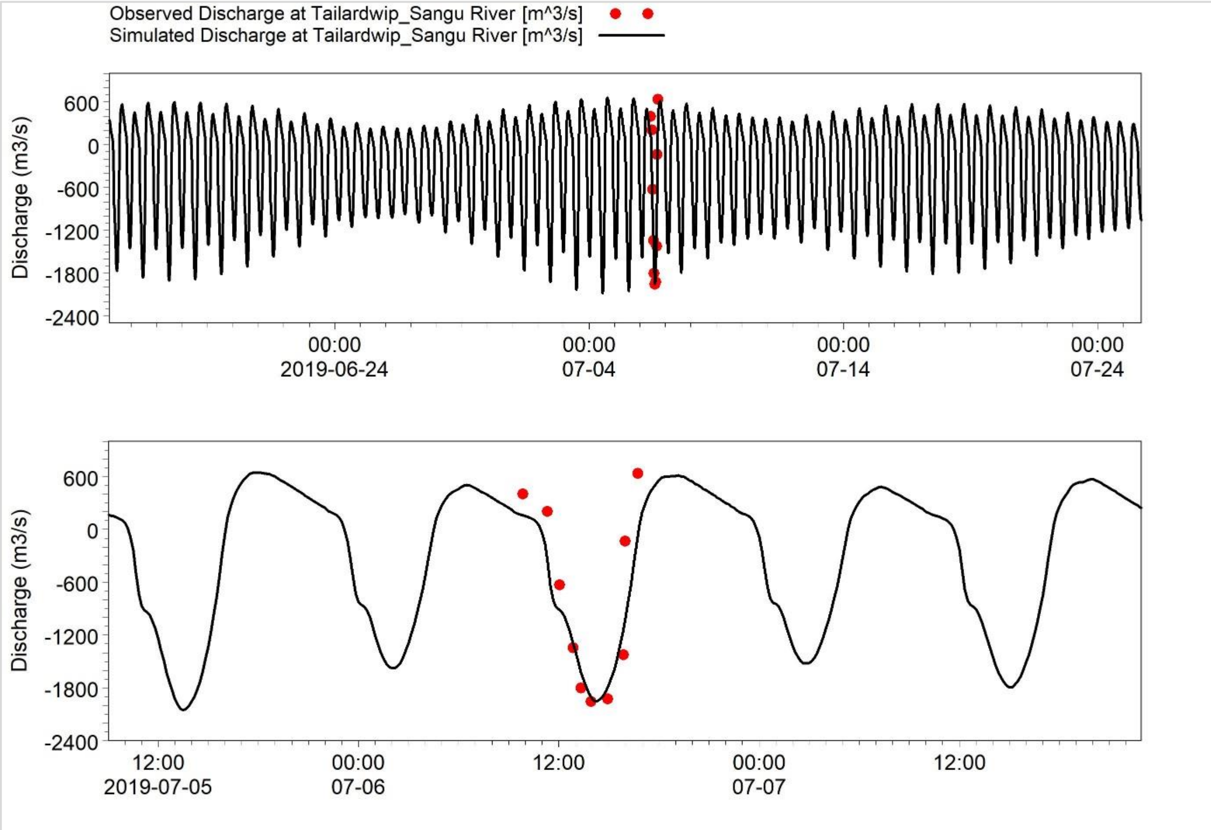


Figure 4-19: Comparison of simulated and observed discharge at Tailardwip in the Sangu River during the monsoon covering spring tide (top) and with a zoom view (bottom)

4.2 Validation of the Upgraded Bay of Bengal Model

The upgraded Bay of Bengal storm surge model has been validated against observed water levels and observed discharges using the model setup and parameters determined through the model calibration.

The model was simulated for the year 2015 including the monsoon period (June to September). During this period observations of water levels and discharges were collected at the peripheral river systems of the 17 polders investigated as part of the CEIP-1 project, c.f. Figure 2-3 and Figure 2-4.

The model was forced with astronomical tide at the open offshore boundary, metrological forcing (wind and air pressure) at the water surface and river discharges at the upstream river boundaries. The model therefore simulates the full water levels that can be compared to the available observed water levels and discharges as described in Sections 2.2.1

The comparison is presented at four water level stations (white bullets) and four discharge locations (yellow lines), see **Error! Reference source not found.**.

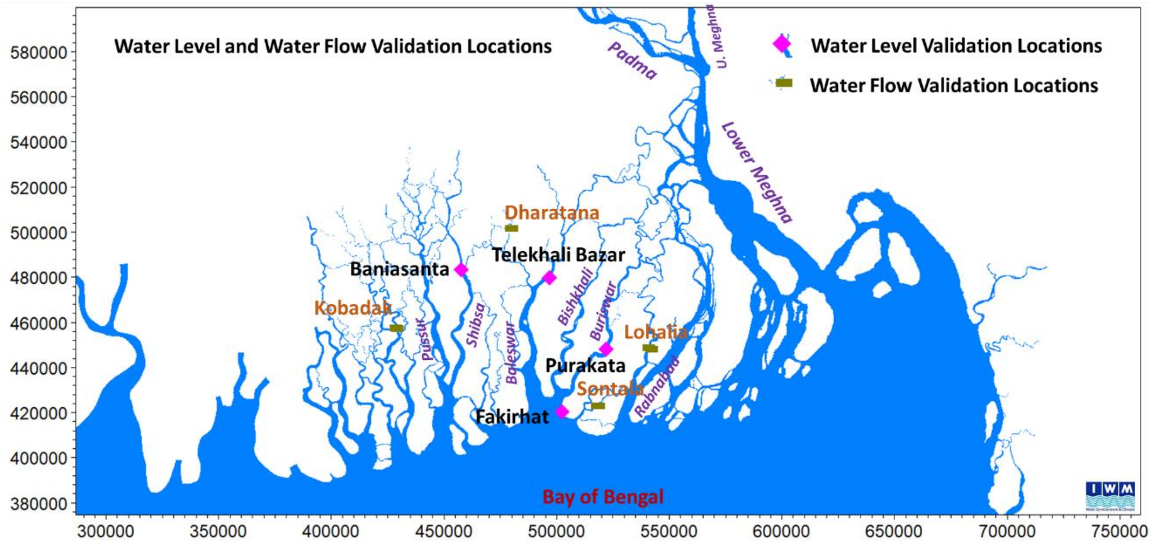


Figure 4-20: Location of the four water levels stations and four discharge cross-sections used for the model validation

4.2.1 Validation against observed water levels

The water level comparison at the four stations is presented in Figure 4-21 (stations covering the major river systems Shibsa River and Baleswar River) and Figure 4-22 (downstream of the Bishkhali-Buriswar River and the Payra River). The black curves show model results and the red curves the deducted tides.

Please note, that the observed water levels include a few shifts in vertical datum due to instrument maintenance or replacement which impact the model comparison.

From the Figure 4-21 and Figure 4-22, it is seen that the accuracy of the model results is very similar to the accuracy obtained for the model calibration.

4.2.2 Validation against observed discharges

Discharges were collected at 14 cross-sections as part of the CEIP-1 project at selected polders in the Pussur, Shibsa, Baleswar, Bishkhali, Buriswar River and Lohalia River catchments. The discharge measurements were conducted during the monsoon considering spring and neap tidal conditions (Figure 2-3 and Table 2-4).

Comparison between modelled and observed discharges are presented for cross-sections at Dharatana River (peripheral river of Polder 32), Kobadak River (peripheral river of Polder 15) at Fulbunia in the Sunatola River (peripheral river of Polder 47/2) and at Galachipa in the Lohalia River (peripheral river of Polder 43/2C). The comparison is presented below in Figure 4-23 and Figure 4-24.

The results show the model behaves well at the presented cross-sections.

Based on the above presented model calibration and validation results for water levels and discharge, it is concluded that the model satisfactory represents the water level and flow conditions in the coastal area as well as in the presented river sections. Model results in un-calibrated/validated rivers where data has not been available will be related with some uncertainty mainly related to the accuracy of the depth data available for constructing the model bathymetry.

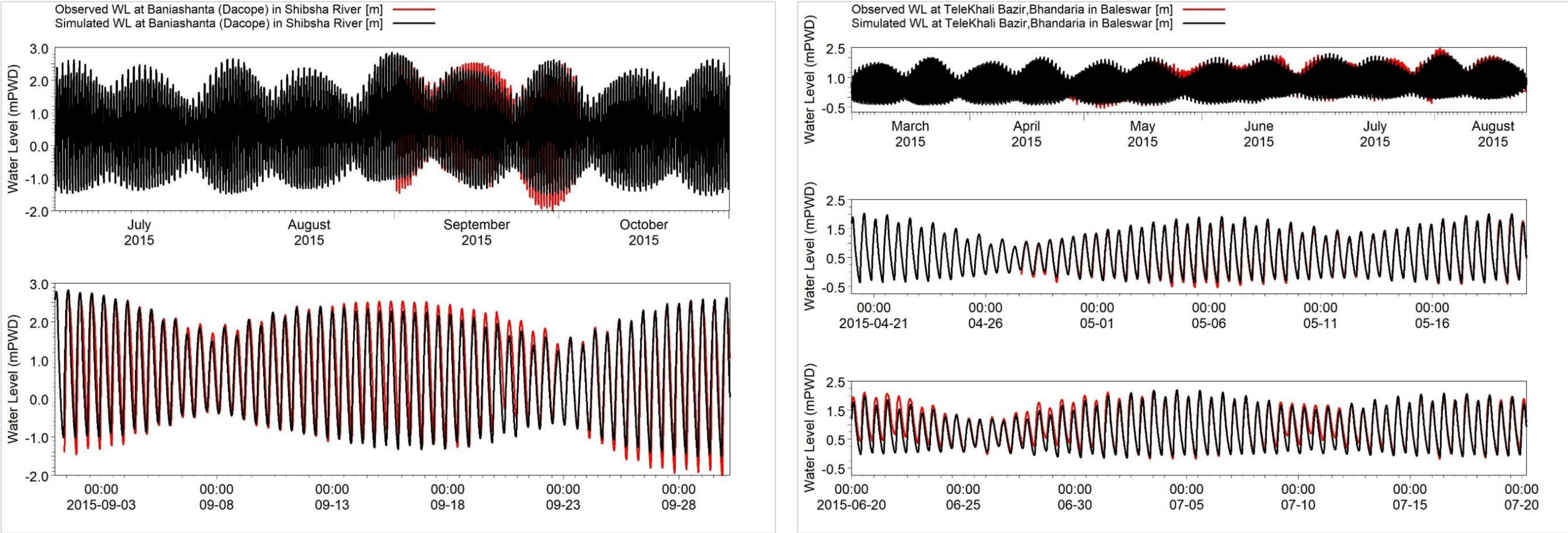


Figure 4-21: Comparison of simulated and observed water levels. Left: **Baniashanta** in the Shibsa River , Right; **Telekhali Bazar** in the Baleswar River.Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

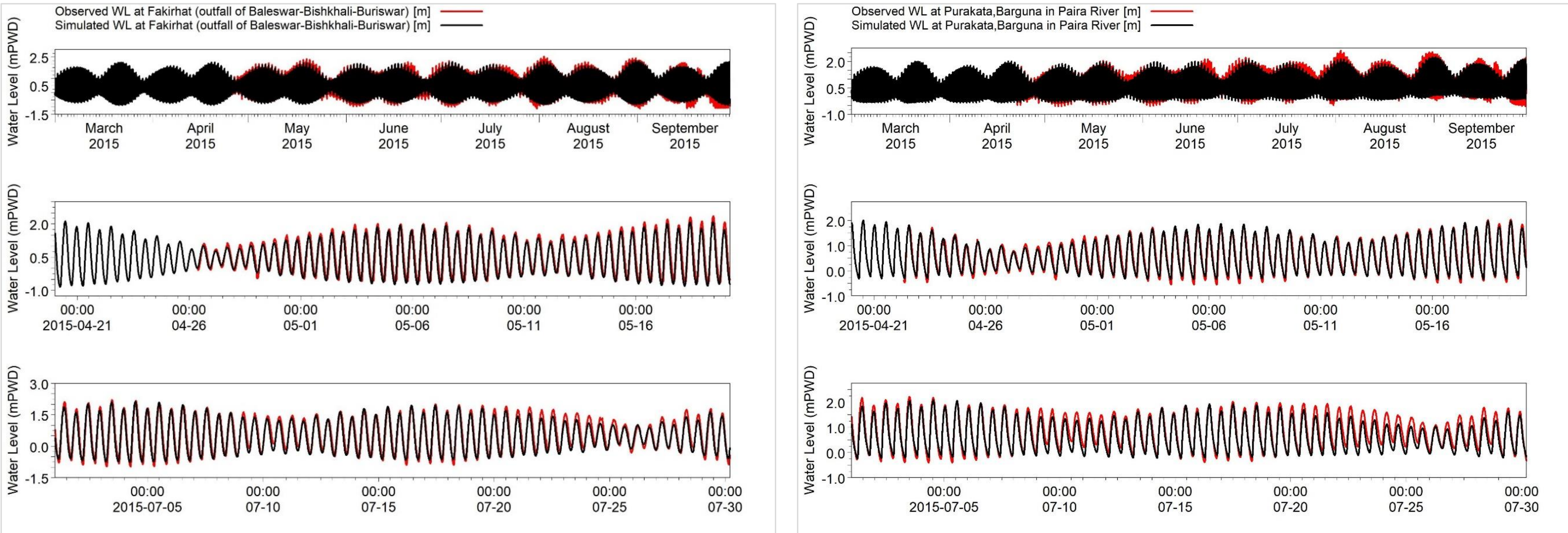


Figure 4-22: Comparison of simulated and observed water levels. Left: **Fakirhat** in the outfall of Baleswar River, Right: **Purakata** (Barguna) Bazar in the Paira River. Top panel: full simulation period, middle panel: dry season, bottom panel: monsoon

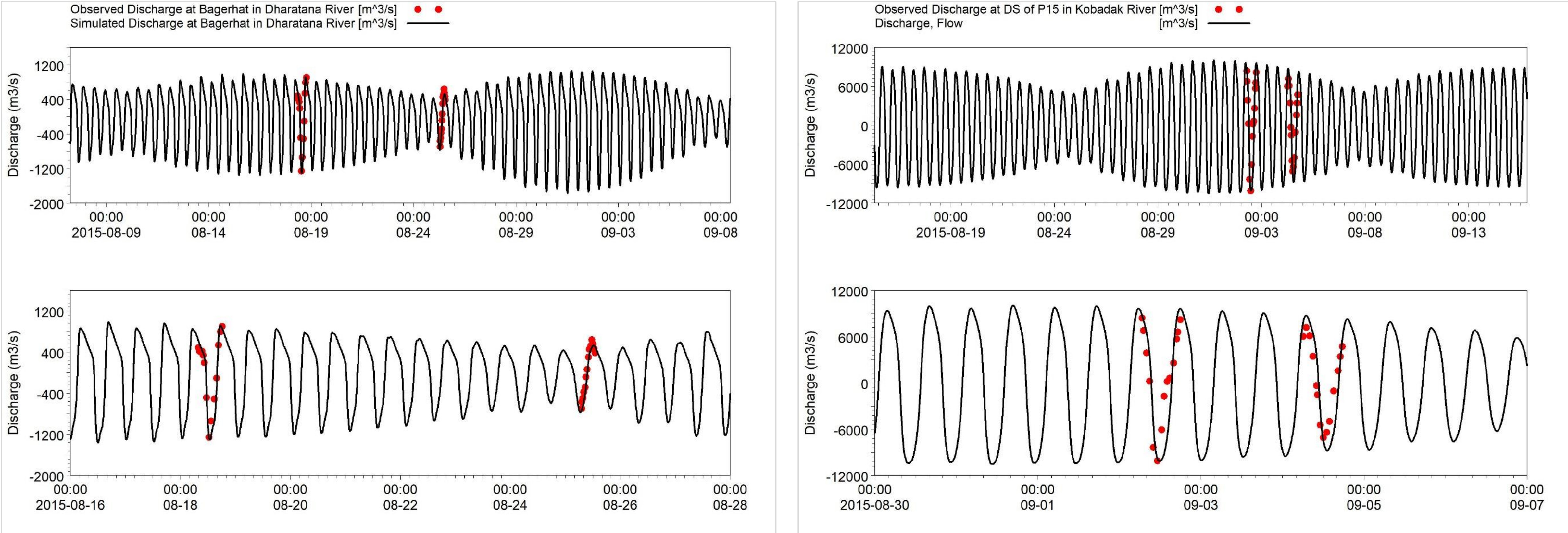


Figure 4-23: Comparison of simulated and observed discharge at the **Bagerhat** in the Dharatana River (left) and at the downstream of Polder 15 in the **Arpangasia River** (right)

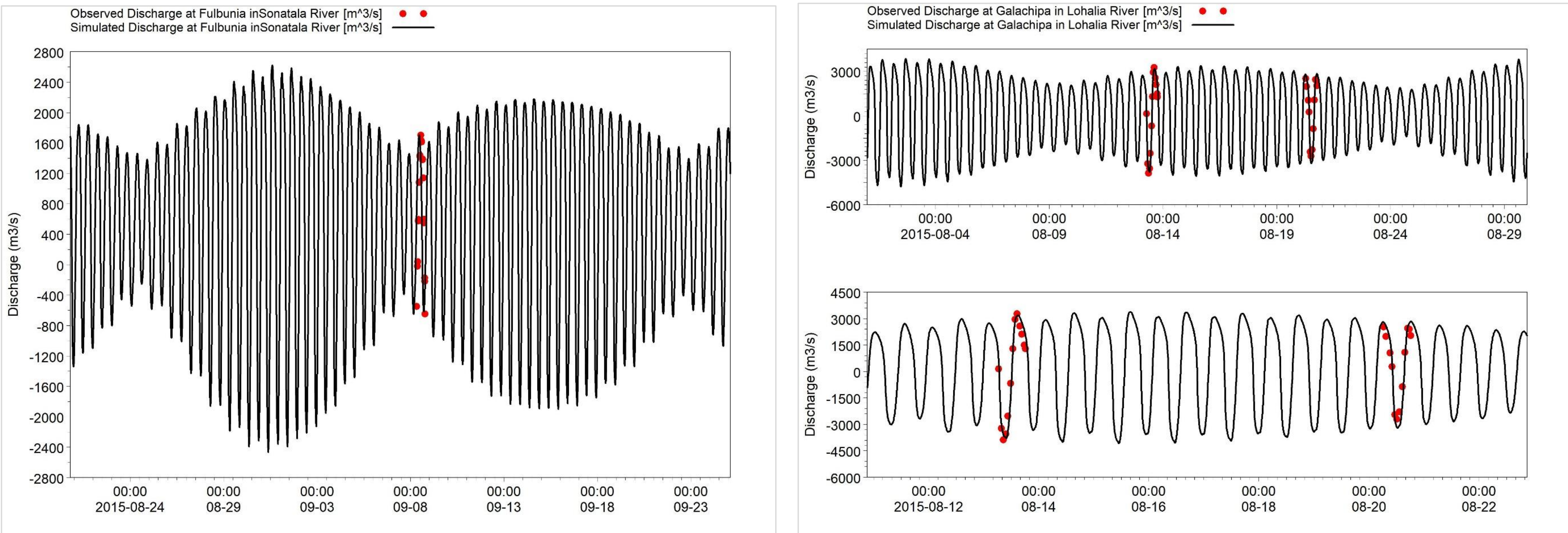


Figure 4-24: Comparison of simulated and observed discharge at **Fulbunia** in the Sonatala River (left) and at Galachipa in the Lohalia River (right)

5 Cyclone Modelling

The modelling of impact from severe cyclones on storm surges follows the methodology used in CEIP, 2013 and CEIP-1, 2018 to ensure consistency with the CEIP-1 results. The methodology is described below.

5.1 Development of Cyclone Model Forcing

On the basis of the available cyclone track data (see Section 2.3.1) cyclone model forcing, consisting of maps of wind and air pressure, were developed using the Holland Single Vortex cyclone model. This model is available from the Cyclone Wind Model (CYWIND), which is part of DHI's MIKEZero software package.

The Holland-Single Vortex cyclone model requires the following data/ for the generation of the model forcing:

- Track position, longitude and latitude as function of time
- Radius to maximum wind speed, R_{max}
- Maximum wind speed, V_{max}
- Cyclone track forward speed V_f and direction
- Central pressure, P_c
- Neutral pressure, P_n
- Holland Parameter, $B=2.0-(P_c-90)/160$

In order to obtain surface winds, a boundary layer wind speed correction has been applied to the gradient wind, V_g. The near-surface wind (10 m above the sea surface) is usually obtained by the following relation (Harper et al., 2001):

$$V_{10}(r) = K_m \cdot V_g(r)$$

Where, V_g is the rotational wind gradient speed at a distance r from the centre of the cyclone.

A speed-dependent formulation for K_m as proposed by Harper et al. (2001) is applied:

$$K_m = \begin{cases} 0.81 & for\ \ V_g < 6\,m/s \\ 0.81 - 2.96\ 10^{-3}(V_g - 6) & for\ \ 6 \le V_g < 19.5 \\ 0.77 - 4.31\ 10^{-3}(V_g - 19.5) & for\ \ 19.5 \le V_g < 45 \\ 0.66 & for\ \ V_g > 45\,m/s \end{cases}$$

Figure 5-1 presents an example of the 2D of cyclone wind vectors for cyclone SIDR (2007). The wind was generated on the basis of the cyclone track data shown in Table 5.1

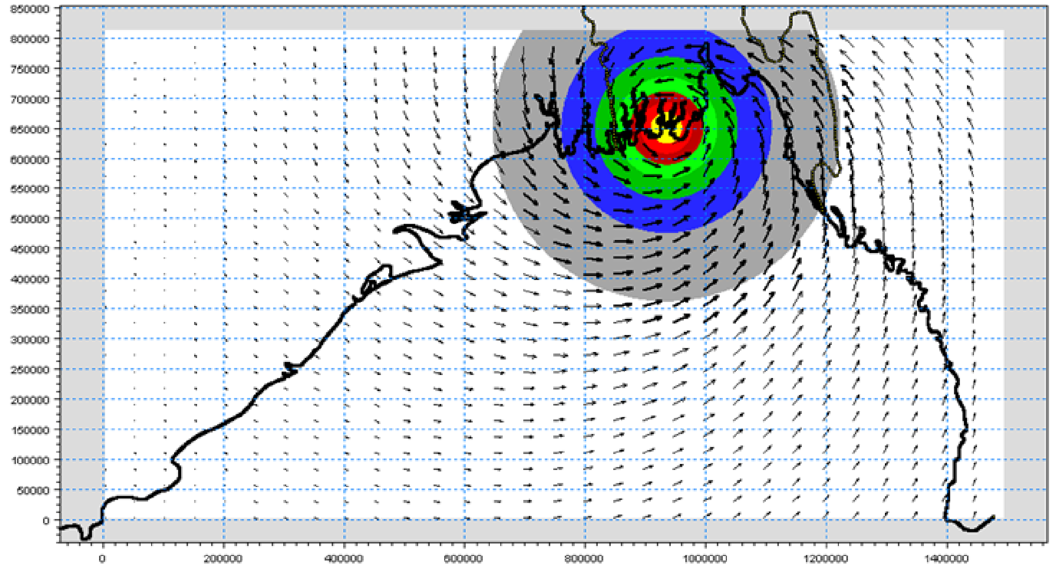


Figure 5-1: Example of 2D wind vectors for cyclone SIDR (2007)

Table 5-1: Cyclone track data used for generation of the cyclone wind fields during SIDR

SIDR (2007) Track Time	Longitude	Latitude	Maximum Radius (km)	Central Pressure (KPa)	Normal Pressure (KPa)	Holland Parameter (B)
11/13/07 12:00 PM	89.20	13.00	44	932	1008	1.800
11/14/07 12:00 AM	89.20	14.00	44	932	1008	1.800
11/14/07 6:00 AM	89.20	15.00	48	932	1008	1.800
11/14/07 12:00 PM	89.20	16.00	54	932	1009	1.800
11/14/07 6:00 PM	89.20	16.50	54	928	1009	1.825
11/15/07 12:00 AM	89.20	18.00	64	928	1009	1.825
11/15/07 6:00 AM	89.20	19.30	64	923	1009	1.856
11/15/07 12:00 PM	89.30	21.00	64	923	1009	1.856
11/15/07 6:00 PM	89.60	22.00	40	979	1009	1.506
11/16/07 12:00 AM	90.00	24.00	40	991	1009	1.431
11/16/07 6:00 AM	91.00	25.50	40	1009	1009	1.319

5.2 Verification of Cyclone Wind Generation

In the CEIP-1 project, the cyclone generation model was calibrated against observed wind data from the Bangladesh Metrological Department (BMD) at nine meteorological stations (Figure 5-2Error! Reference source not found.). Cyclone information (cyclone track, wind speed, maximum radius, central pressure etc.) also collected from BMD and verified with available information of Indian Meteorological Department (IMD) and Joint Typhoon Warning Centre (JTWC).

In this study, geotropic correction factor was adjusted for calibrating the generated cyclonic wind speed and direction with the observed wind speed and direction. For verification of wind speed and wind direction in the present project, the wind field for the 1991 cyclone was generated and compared to observations at the two stations, Barisal and Kutubdia, see Figure 5-3. The generated wind speed and wind direction during cyclone SIDR (2007) is verified at Khepupara and Hatiya (Figure 5-4) and cyclone AILA (2009) is calibrated at Khepupara and Mongla (Figure 5-5) to ensure the reliability of the cyclone models parameters.

The results show a reasonably good agreement with the obtained (extreme) wind speed whereas the modelled wind direction shows less fluctuations, which is expected due to the relatively simple model describing the cyclone movements and related wind/pressure.

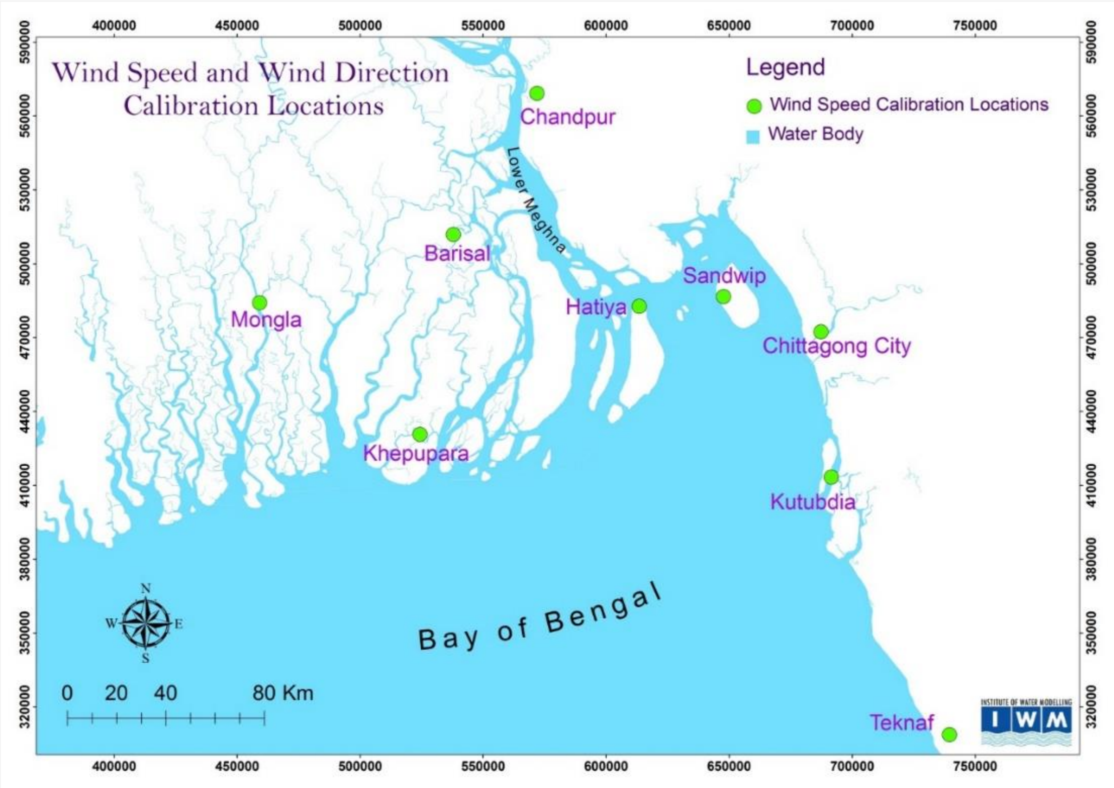


Figure 5-2: Meteorological stations used for model validation in CEIP-1

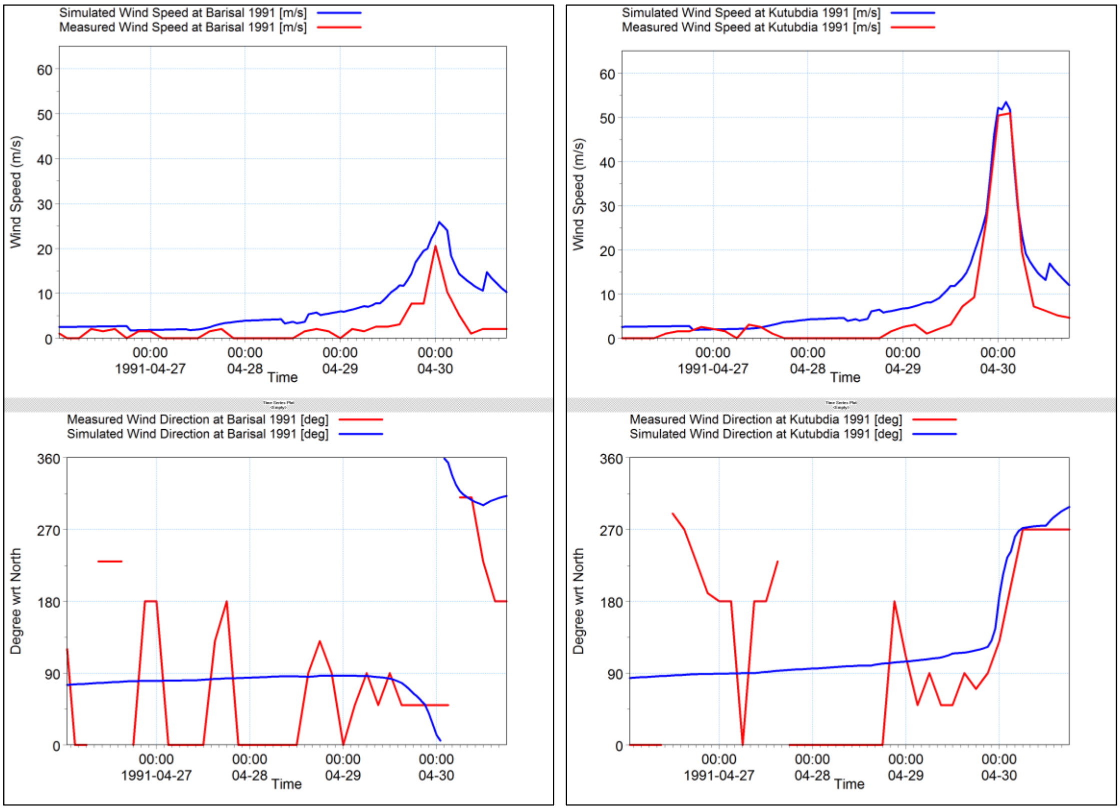


Figure 5-3: Wind speed validation at Barisal and Kutubdia during the 1991 cyclone (source: CEIP-1)

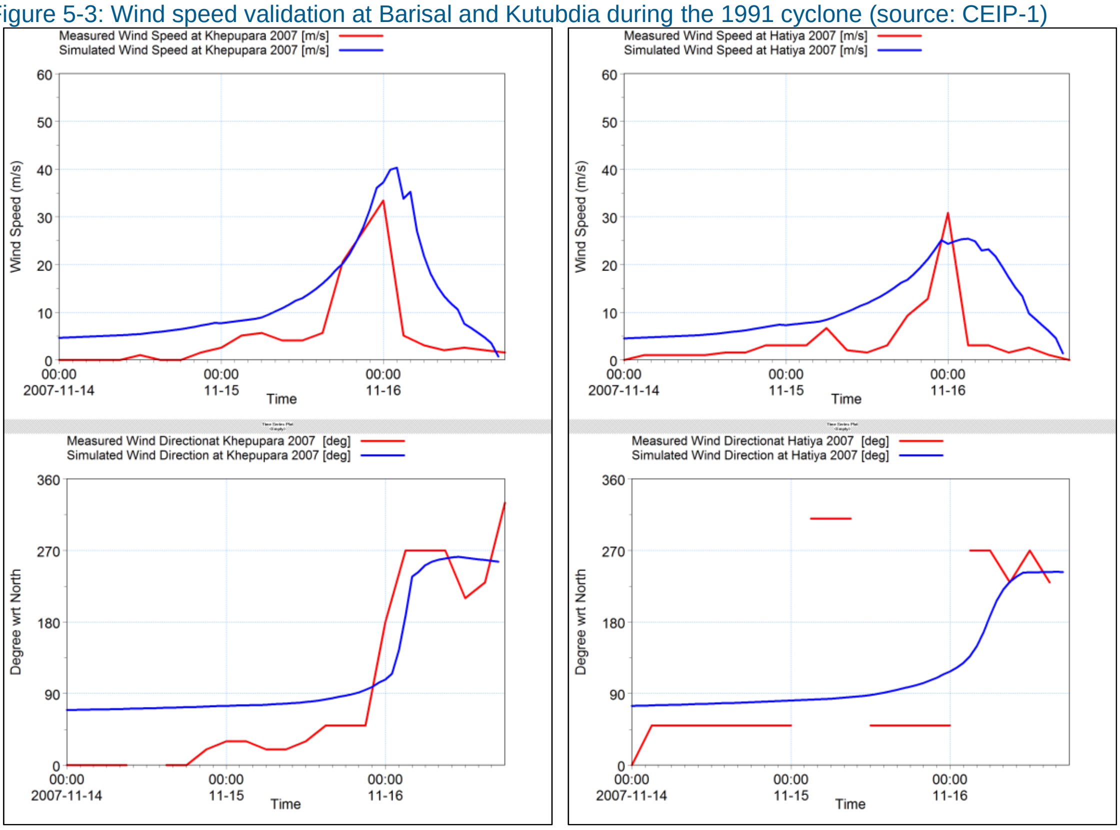


Figure 5-4: Wind Speed calibration at Khepupara and Hatiya during cyclone SIDR (2007)

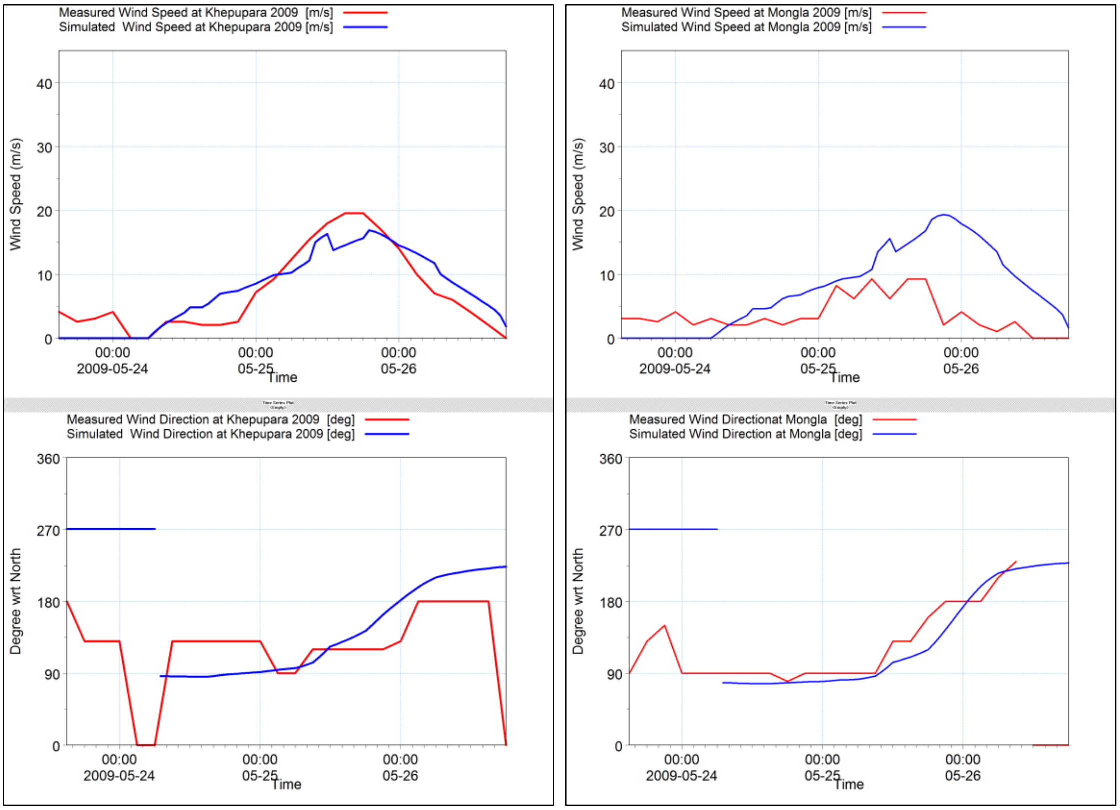


Figure 5-5: Wind Speed calibration at Khepupara and Mongla during cyclone AILA (2009)

5.3 Cyclone Model Simulations

5.3.1 Selection of Historical Cyclones

In Section 2.3, the list of cyclones that hit the Bangladesh coast (Table 2-5) and neighbour Indian Coast (Table 2-6) are mentioned. Amon them, 19 Severe Cyclonic Storms (SCS) have been considered to develop the mathematical model using the upgraded and updated Bay of Bengal surge model. In this regard, severe cyclonic storms from 1960 to 2009 have been chosen though there were two (2) severe cyclones [Cyclone Roanu (May 2016, Easter Hilly-Chittagong coast, Cyclone Mora (May 2017, Easter Hilly-Teknaf coast) that hit in the Bangladesh coast after 2009. However, these two cyclones were not considered for the mode simulations as the Cyclone Mora landfall was almost in the Myanmar coast (most effects were in the Myanmar coast) and due to lack of reliable cyclone information of cyclone Roanu. The rest of the three SCSH cyclones' landfall were in the Indian Coast and three cyclones were classified as Cyclonic Storms (CS) and therefore not included.

5.3.2 Validation of the Storm Surge Model during Cyclone Conditions

Historical water level observations during cyclone conditions are rather limited, but data is available from three cyclones.

In Bangladesh, the Survey of Bangladesh (SOB) is maintaining an automated tide gauge at Hiron Point in the Sundarbans (located at 21.78° latitude, 89.47° longitude).

Below (Figure 5-6 and Figure 5-7) modelled water levels (red line) are compared to observations (blue dots) at Hiron Point during the cyclones SIDR (2007) and AILA (2009).

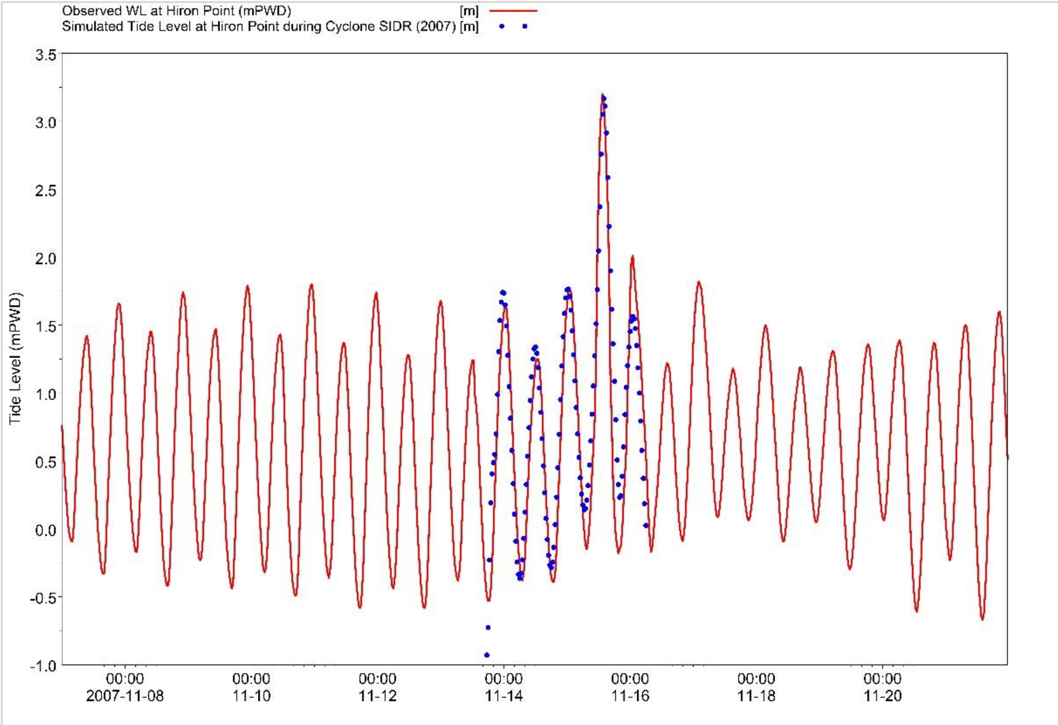


Figure 5-6: Comparison of modelled and measured level comparison at Hiron Point during the cyclone SIDR in 2007

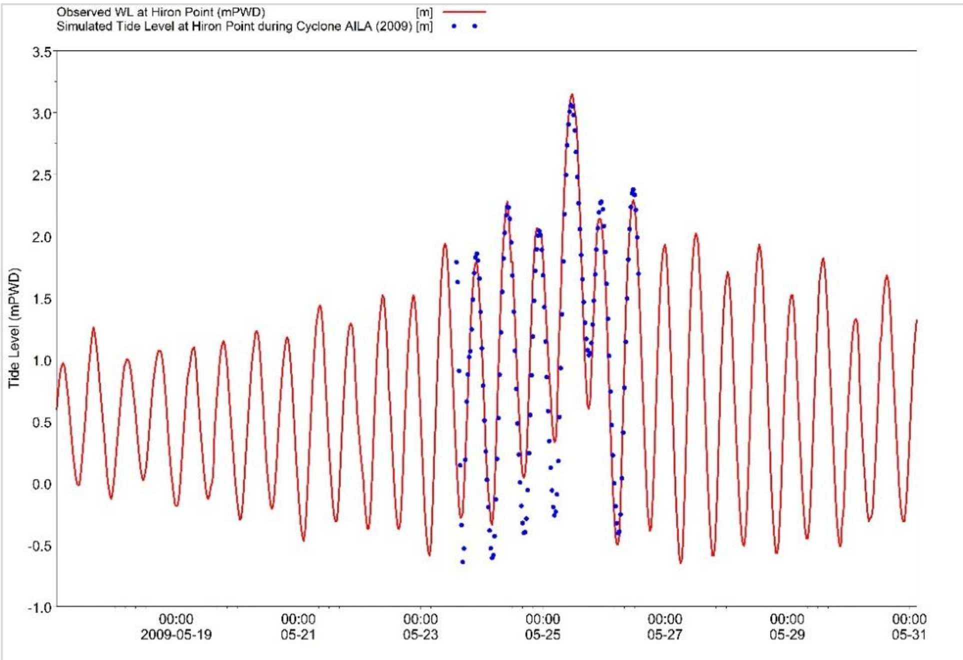


Figure 5-7: Comparison of modelled and measured level comparison at Hiron Point during the cyclone AILA in 2009

Cyclone Amphan was calibrated against data at one location even though this cyclone is not included into storm surge analysis as it had landfall at the Indian coast. During the cyclone Amphan (2020), a Multiflexmeter was installed outside of the Polder 43/2B in the Galachipa River under the Water Management Knowledge and Innovation Program (WMKIP) [https://mybangladelta.wordpress.com/], funded by the Embassy of the Kingdom of the

Netherlands in Bangladesh. The observed water level by Multiflexmeter was processed and used for comparison with the cyclone Amphan model results (Figure 5-8).

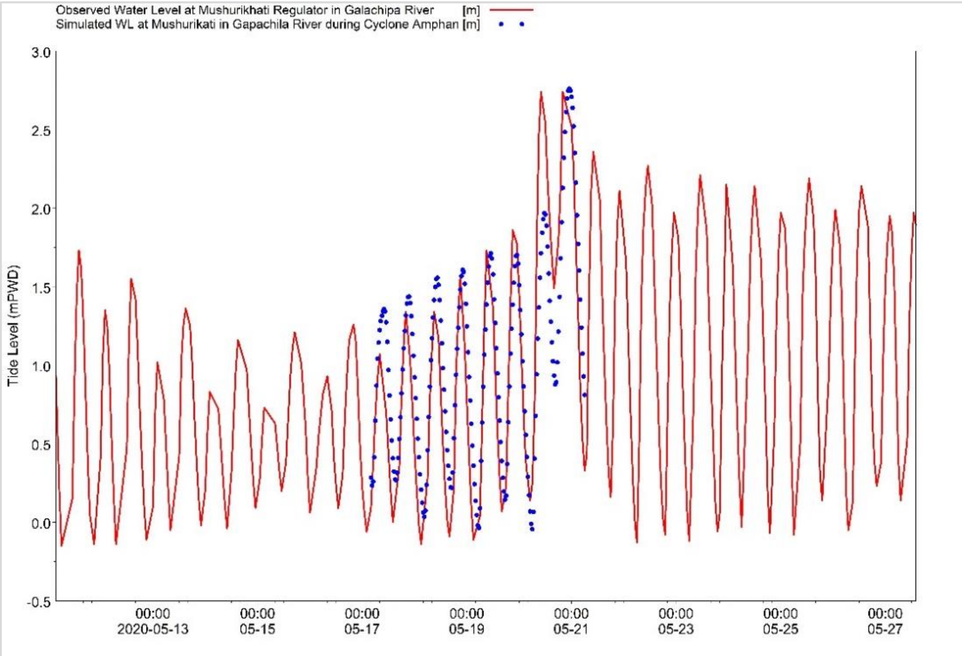


Figure 5-8: Comparison of modelled and measured level comparison at Mushurikhati in the Galachipa River during cyclone Amphan in 2020

It is seen that the model satisfactory captures the extreme water levels during all three historical cyclones.

5.3.3 Cyclone Model Simulations

The selected 19 historical severe cyclones made landfall at different tidal phases (i.e., at the time of either low tide, high tide or at a time in between). For the present modelling the cyclones have been modelled for the actual historical (or original) phase as well as for the time corresponding to the following low and high tide.

The tidal phase of the landfall was determined using a tide predicted by the global tide model (which was also used for preparing the open offshore boundary conditions to the surge model).

As an example, the 1960 cyclone crossed over the Hatiya Island and made landfall on 31st October at 3 PM at Hatiya Island (Figure 5-9) which does not coincide with low (LT) or high tidal (HT) conditions. The following low tide was at 5 PM and high tide at 11 PM.

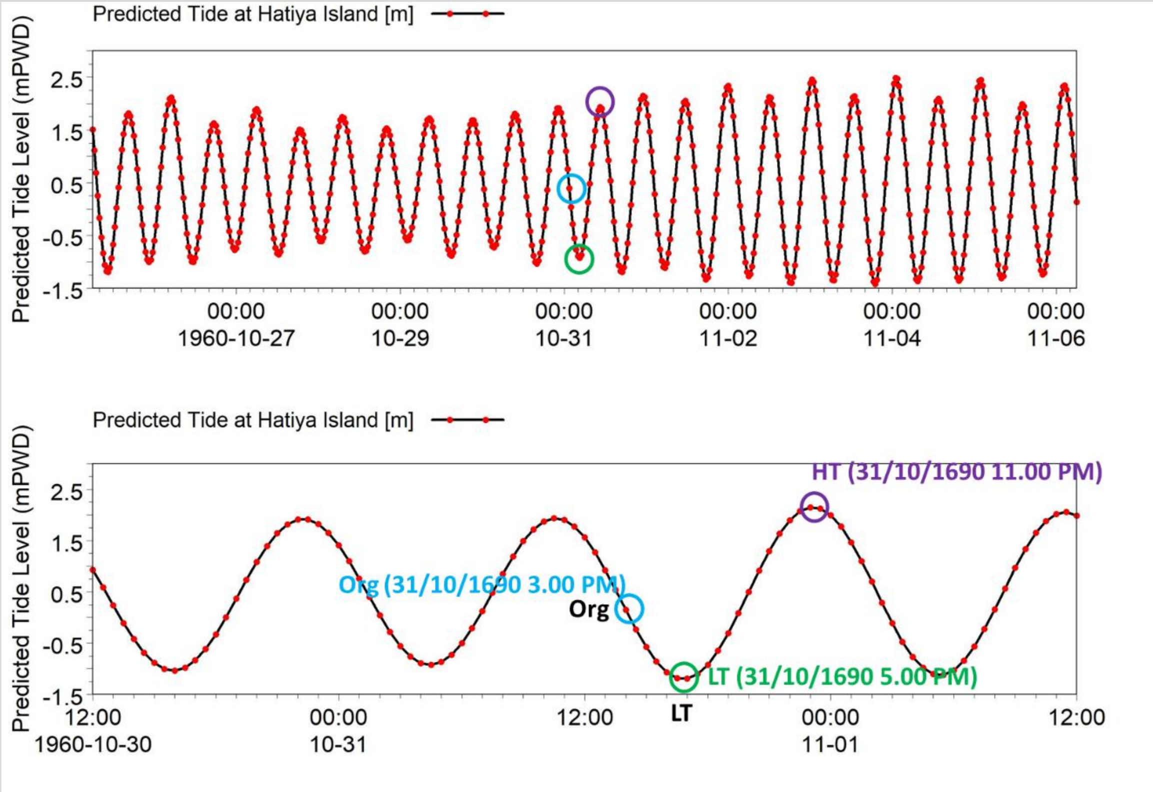


Figure 5-9: Concept for definition of simulated cyclones (example for the 1960 cyclone)

For this cyclone three model simulations were completed: For the original tidal phase, for the low tidal phase and for the high tidal phase.

If a cyclone made landfall at either high water (two cyclones) or low water (one cyclone) only two simulations were completed.

Following this procedure, a total of 54 (= 3 x 19 – 3) cyclone model simulations were conducted.

All simulations were completed for both present (baseline conditions) and future (climate change) conditions corresponding to year 2050.

For modelling of baseline conditions, the above described calibrated and validated storm surge model setup was used.

For modelling of climate change conditions, the baseline model was changed as follows:

- **Sea level rise**: Mean Sea level increased by 20 cm (year 2050) and 92cm (year 2100), c.f. Section 2.4.1
- **Cyclonic wind speed**: Cyclone wind speed was increased by 8%, c.f. Section 2.4.2
- **Land Subsidence**: The established model bathymetry representing year 2019 was adjusted by land subsidence representative for years 2050 and 2100, respectively, c.f. Section 2.4.3

Below Table 5-2 lists the cyclone and tidal conditions for the 54 model simulations completed for the two types of situations corresponding to present conditions and year 2050 including climate change.

Table 5-2 : Overview of conducted cyclone model simulations for baseline (present conditions) and climate change conditions representing year 2050. The circles indicate that the historical cyclone made landfall at this tidal condition.

Cyclone number	Cyclone year	Tidal phase		
		Historical	Low Tide	High Tide
1	1960	x	x	x
2	1961	x	x	x
3	1963	x	x	x
4	1965 (Dec)	x	x	O
5	1965 (May)	x	x	x
6	1966	x	x	x
7	1970	x	x	x
8	1974	x	x	x
9	1983	x	x	x
10	1985	x	x	x
11	1986	x	x	x
12	1988	x	x	x
13	1991	x	x	x
14	1995	x	x	x
15	1997 (May)	x	x	O
16	1997 (Sep)	x	x	x
17	1998	x	O	x
18	2007	x	x	x
19	2009	x	x	x

5.3.4 Results of the cyclone modelling

141 locations (Figure 5-10**Error! Reference source not found.**) have been selected for analysing the results of the cyclone storm surge model results. The locations are selected at the five polders of specific interest for the present study, at the polders of specific interest for the CEIP-1 project and along the coast of Bangladesh in general.

Figure 5-10: Strom surge analysis locations for baseline and climate change conditions

The modelled storm water levels at the 141 locations under base condition (without climate change) and with climate change conditions (2050) are presented in **Appendix-E & Appendix-F respectively**.

It should be noted that the model results obtained under the present project differs from the result obtained under the previous CEIP-1 project. This is explained by the improved storm surge model bathymetry and related calculation grid developed under the present project.

As an example, the modelled water level during the cyclone SIDR (2007) at the location number 106 (left bank of Baleswar) is presented in Figure 5-11. It is seen that the water level from the improved model (red line) in general is higher than obtained under the CEIP-1 modelling (black line).

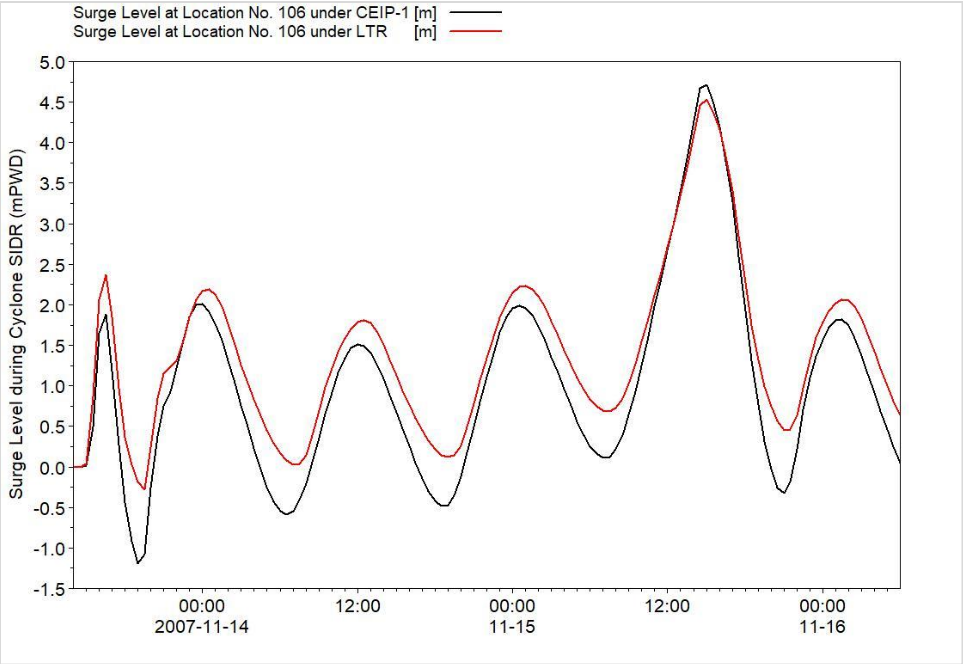


Figure 5-11: Comparison of water levels during cyclone SIDR at location no. 106 (north-west corner of the Polder 40/1) in the Baleswar River (baseline conditions)

5.4 Extreme Value Analysis of Storm Water Levels for Baseline and Climate Change Conditions (2050)

The maximum water levels at the selected 141 locations (Figure 5-10) modelled during the defined 54 cyclone simulations (Table 5-2) under baseline and climate change conditions have been used as input to a statistical frequency analysis.

The modelled extreme water levels that form the input to the statistical analysis are listed in **Appendix-E & Appendix-F respectively**.

Under the present study, the same statistical methodology followed as applied in the previous CEIP-2013 and CEIP-1, 2018. The statistical frequency analysis has been carried out to determine the storm water level for different return periods at the selected locations.

A parametric frequency analysis approach is adopted. This implies that an extreme value model is formulated based on fitting a theoretical probability distribution to the observed extreme value series. For the present Extreme Value Analysis (EVA) the partial duration series (PDS) method, also known as the peak over threshold (POT) method has been applied as the cyclones are unevenly distributed within the years of the considered 50 years period from 1960 to 2009.

In the partial duration series (PDS) method, all events above a threshold are extracted from the time series. The PDS can be defined in two different ways. Using type-I sampling, where all events above a predefined threshold value are considered, implying that the number of exceedance n becomes a random variable or Type-II sampling, where the n largest events are extracted, implying that the threshold level becomes a random variable. Here the Type-I sampling has been applied for analysis. When the Type-I sampling (fixed threshold level) is chosen, the corresponding number of exceedances is calculated. If a fixed threshold level is used to define the extreme value series (Type-I sampling), the PDS model includes two stochastic modelling components, respectively, the occurrence of extreme events and the exceedance magnitudes. It is assumed that the occurrence of exceedance can be described by a Poisson process with constant or one-year periodic intensity, implying that the number of exceedance n is Poisson distributed with probability function:

$$P\{N(t) = n\} = \frac{(\lambda t)^n}{n!} * \exp(-\lambda t)$$

where, t is the recording period. The Poisson parameter equals the expected number of exceedances per year and is estimated from the record as

$$\hat{\lambda} = \frac{n}{t}$$

For estimation of the parameters of the probability distribution, the method of momentum has been used. In this study, the exponential distribution function has been used after checking the other statistical methods like Log Normal, Log Pearson Type 3 and Gumbel statistical distribution methods.

For the probability distribution, it has been assumed that the modelled 54 cyclones occurred over a period of 142 years, corresponding to the 19 historical cyclones occurring over a period of 50 years corresponding to an average annual number of exceedances of 0.38. Each location has 54 water levels for estimating the design water level where the lowest water level is considered being the threshold water level. As an example, 54 water levels (computed from 54 cyclones) were considered at the location 106 where the threshold value was estimated to 1.752 m. The design water level was estimated for four different return periods: 1 in 10, 1 in 25, 1 in 50 and 1 in 100 years (see Figure 5-12).

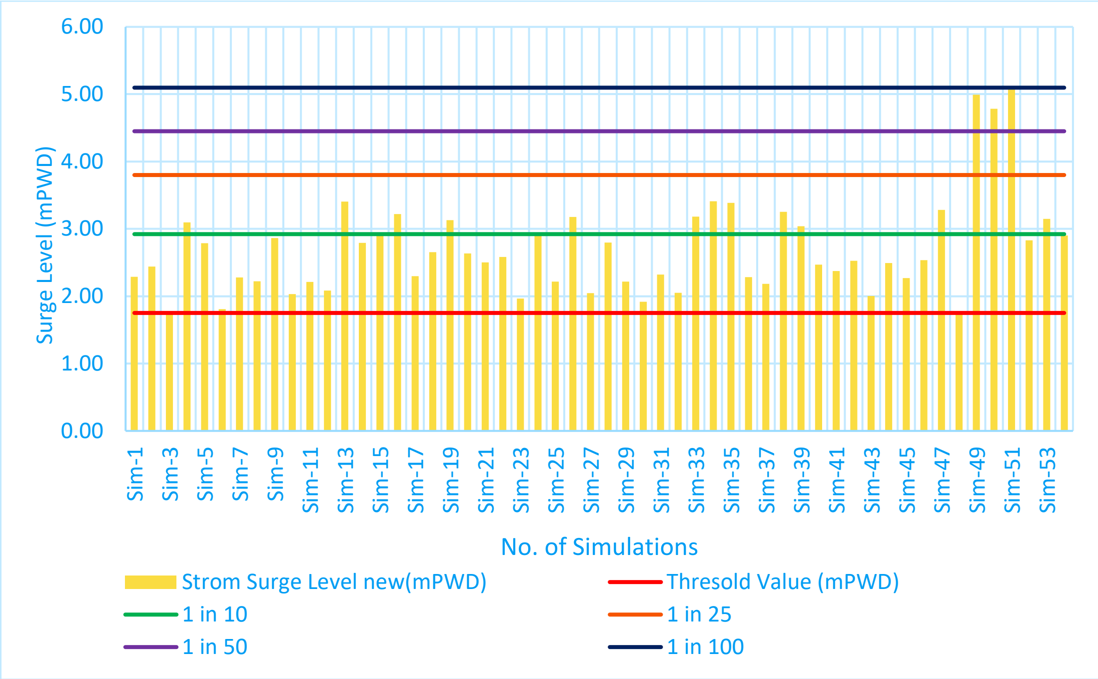


Figure 5-12: Estimated storm water levels during 54 number cyclones at location no. 106 (north-west corner of the Polder 40/1) in the Baleswar River and design water level under climate change conditions

As an example, the frequency distribution curve for the year 2050 at Char Doani in the Baleswar River, North-West side of the Polder 40/1 (Location 106) and the design water level was computed from the following Figure 5-13.

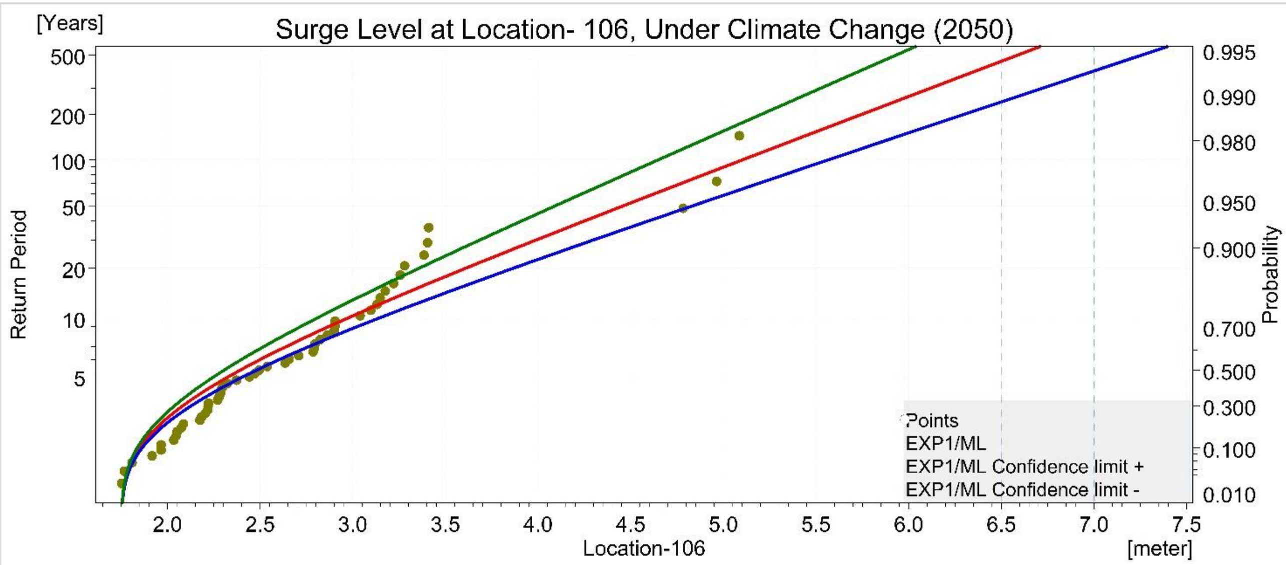


Figure 5-13: Frequency analysis of storm water level at location no. 106 (north-west corner of the Polder 40/1) in the Baleswar River under climate change conditions in year 2050

6 Main Results of the Storm Surge Modelling

6.1 Determination of Design Storm Surge Levels

The storm water level at the target locations was calculated using a storm surge model that was constructed using various cyclone combinations (54 model simulations based on19 selected severe cyclones). For the specified locations, the design water level was estimated using an exponential statistical technique for different return periods. Estimated extreme storm water levels for 10, 25, 50 and 100 years return periods with and without climate change effects at selected locations (around Polder 15, Polder 29, Polder 40/1, Polder 59/2, and Polder 64/1a & Polder 64/1b) are presented in Table 6-1.

Estimated extreme storm water levels for all 141 selected points are given in Appendix G.

Table 6-1: Estimated extreme water levels near selected polders for baseline and climate change conditions

Polder Name	Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
		10	25	50	100	10	25	50	100	
Polder 15	1	1.99	2.47	2.82	3.17	2.16	2.77	3.21	3.66	Kholpetua River
	2	2.03	2.52	2.88	3.24	2.27	3.06	3.66	4.24	Kholpetua River
	3	2.01	2.48	2.84	3.19	2.24	2.98	3.53	4.07	Kobadak River
	132	1.99	2.46	2.81	3.16	2.15	2.72	3.14	3.56	Kobadak River
Polder 29	10	1.99	2.48	2.85	3.21	2.13	2.72	3.16	3.60	Shibsa River
	11	2.05	2.55	2.92	3.28	2.16	2.74	3.16	3.59	Shibsa River
	31	2.35	3.05	3.58	4.10	2.93	4.05	4.88	5.71	Bhadra River
	127	1.96	2.53	2.96	3.38	2.14	2.84	3.36	3.88	Shibsa River
	128	1.96	2.49	2.88	3.26	2.08	2.61	3.00	3.39	Gangrail River
	129	2.05	2.52	2.87	3.22	2.13	2.68	3.09	3.50	Bhadra River
	130	2.07	2.57	2.94	3.31	2.18	2.66	3.02	3.38	Bhadra River
Polder 40/1	105	2.18	2.61	2.94	3.26	2.87	3.71	4.34	4.96	Baleswar River
	35	2.71	3.57	4.20	4.83	3.01	3.92	4.60	5.27	Baleswar River
	37	2.74	3.61	4.26	4.90	3.11	4.10	4.84	5.58	Bishkhali River
	106	2.64	3.47	4.08	4.69	2.92	3.80	4.45	5.10	Baleswar River
	107	2.72	3.56	4.19	4.81	3.08	4.05	4.76	5.47	Bishkhali River
Polder 59/2	136	2.64	3.59	4.30	5.00	2.99	4.09	4.90	5.71	Lower Meghna
	137	3.45	4.66	5.55	6.44	3.72	4.97	5.90	6.82	Lower Meghna
	138	3.54	4.74	5.63	6.51	3.81	5.06	5.98	6.90	Lower Meghna
	139	3.54	4.71	5.59	6.45	3.81	5.02	5.92	6.81	Lower Meghna
Polder 64/1a and Polder 64/1b	140	3.82	4.91	5.72	6.52	4.20	5.47	6.41	7.34	Sangu River
	89	3.72	4.76	5.53	6.30	4.09	5.30	6.19	7.08	Bashkhali River

Polder Name	Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
		10	25	50	100	10	25	50	100	
	90	3.57	4.55	5.29	6.01	3.94	5.10	5.95	6.80	Bashkhali River
	141	3.49	4.50	5.25	5.99	3.82	4.91	5.71	6.52	Bashkhali River

Storm water inundation depth maps were prepared on the basis of 54 cyclonic storm surge model simulations for base (without future projection) and climate change condition (with future projection).

6.2 Storm Surge Inundation Maps for Present and Future Climate

Inundation depth maps were prepared for the baseline climate condition and future climate condition. Future climate condition defines the highest emission scenarios RCP 8.5 and the climate year 2050. In this regards, the largest water depths in the model domain were extracted from the results of the 54 storm surge model simulations conducted both with and without the effect of climate change. Figure 6-1 presents the extent and inundation depth due to the modelled historical cyclones along the coast of Bangladesh.

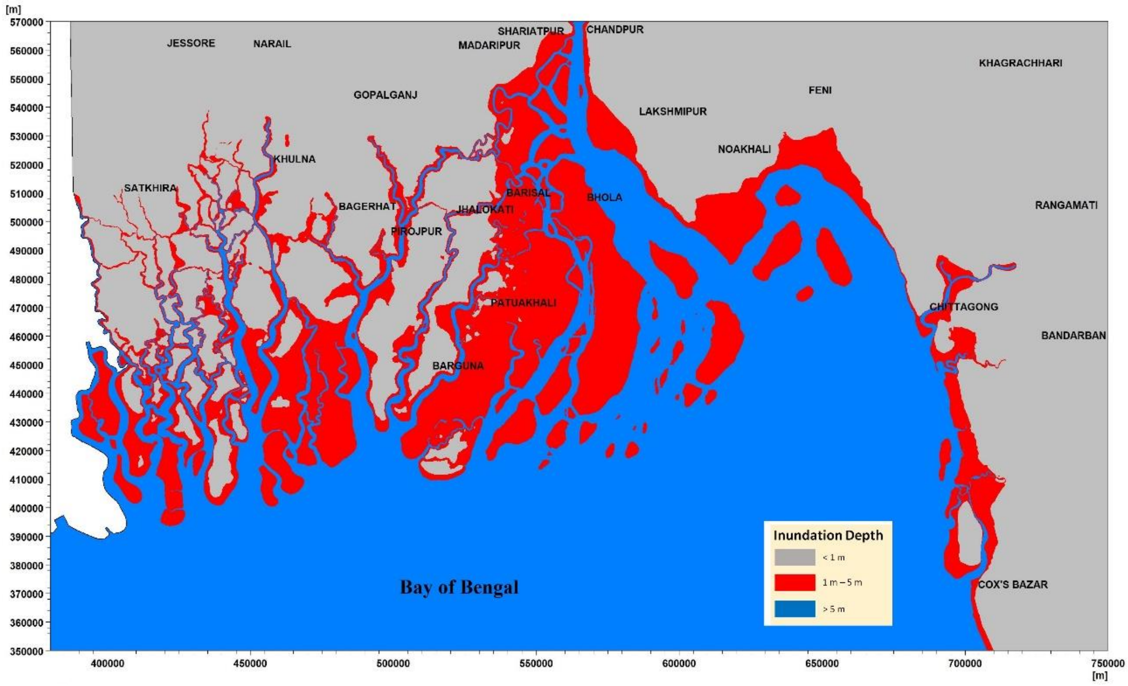


Figure 6-1: Storm surge inundation depth along the coast of Bangladesh considering present climate conditions

It is observed that the southern part of Lower part of Baerhat and Barguna, Patuakhali, Barisal, Bhola, lower part of Laxmipur and Noakhali, Chattogram and Cox's Bazar districts including the offshore islands like Hatiya, Sandwip, Kutubdia etc. were deeply inundated (inundation depth >1.0m) and other coastal districts like Pirojpur, Jhalakhati, Satkhira, Khulna were moderately inundated (inundation depth <1.0m) during the different cyclone occurrence periods. However, the extent and magnitude of the inundation will be increased in 2050 as observed from the Figure 6-2**.**

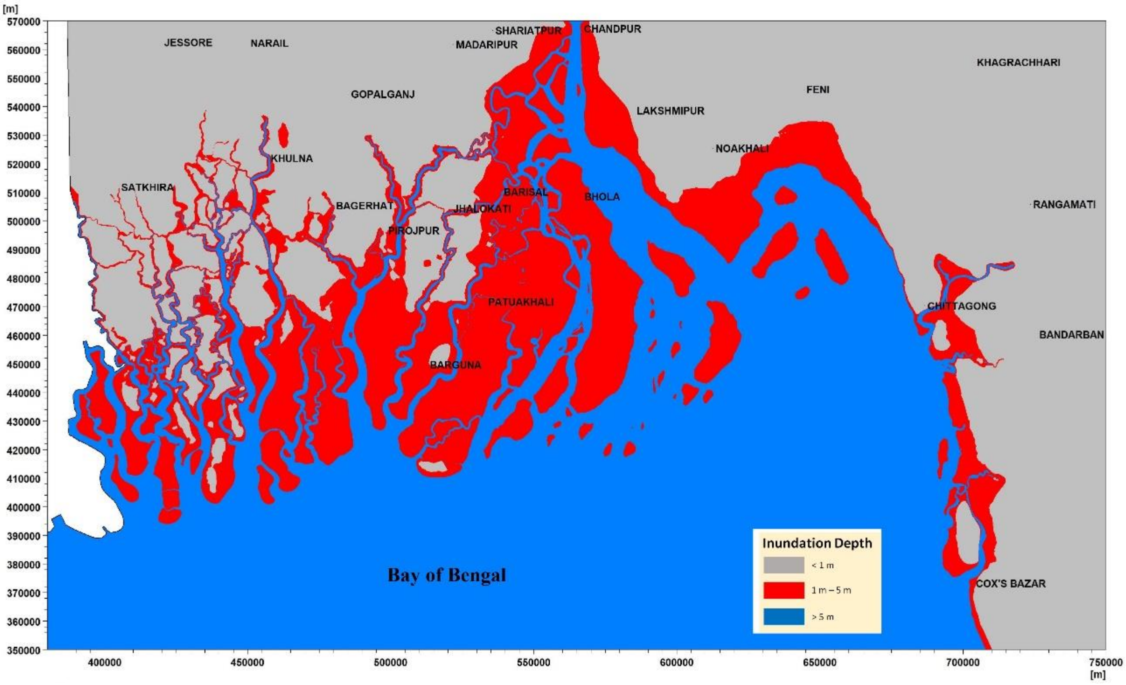


Figure 6-2: Storm surge inundation depth along the coast of Bangladesh coast considering future climate (2050) for RCP 8.5 scenario.

The percentage of the polder area inundated by cyclonic storm surges are presented in Table 6-2. It is estimated that 45% of the polder area have been inundated by surges due to historical cyclones and it is estimated that this area will increase by 15% to 60% of the polder area for the future conditions in 2050 including the effect of climate change.

Table 6-2: Percentage of inundation of polder area due to modelled historical cyclones for present conditions and future (2050) conditions including the effect of climate change

Storm Surge Inundation Condition	Inundation Area [%]
Without Climate Change (Baseline)	45
With Climate Change (2050)	60

The increase in inundation depth, calculated as the difference between the above two maps, is presented in Figure 6-3.

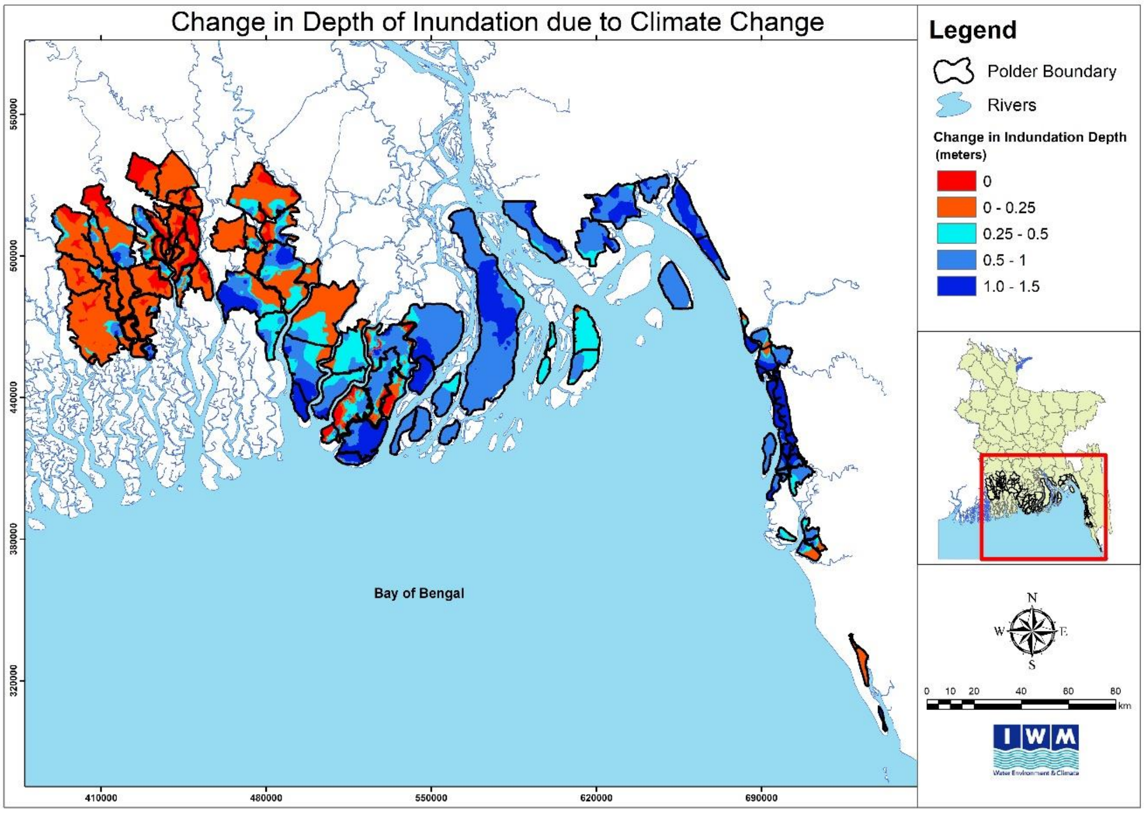


Figure 6-3: Increase of inundation depth due to climate changes (2050)

7 Summary and Conclusions of Storm Surge Model

The established improved Bay of Bengal storm surge model has been used to model 19 historical severe cyclones that exclusively affected the Bangladesh coast.

The original tidal conditions, as well as additional high and low tidal conditions, were used to develop in total 54 severe cyclone conditions as applied for the surge modelling.

The modelled extreme water levels during the cyclone periods were used as input to an Extreme Value Analysis (EVA) to construct extreme water levels at different return periods for the existing climate as well as for the future climate conditions.

Extreme water levels have been estimated at 141 locations covering the whole coast of Bangladesh.

The presence of prior cyclones is estimated to have flooded 45% of the polder area. Due to future climate change (year 2050) the flooded area is estimated to increase by 15% and cover 60% of the polder area.

8 Bay of Bengal Wave Modelling

8.1 Introduction

Understanding the wave dynamics in the coastal region of Bangladesh is important for designing hydraulic loads on the coastal protection. Especially the south-eastern coast is subject to noticeable waves attacks during the monsoon period where cyclones may generate significant waves. Under the present study, cyclonic wave fields across the coast of Bangladesh during severe cyclones as well as during normal monsoon conditions are modelled. The spectral wave model, MIKE 21 SW is applied for the modelling. The model simulates growth, decay and transformation of wind-generated waves and swells in the offshore and coastal areas.

8.2 Data basis for the modelling

Below, the data applied for the wave modelling are described.

8.2.1 Bathymetry data

The wave model follows the model bathymetry of the Bay of Bengal hydrodynamic (HD) model which has been developed under different studies including the Long-Term Research and Monitoring Program over the recent years (refer to Section 2.1). For the wave modelling, however, the model domain was extended towards south until latitude 4°N covering the entire Bay of Bengal and Andaman sea. Depth data for the extended area was extracted from the digital navigational sea charges of C-MAP.

8.2.2 Hydrographic data

Data are very important for understanding the physical environment of the study area and for calibration and validation of the wave model. No wave data have been collected under the Long-Term Research and Monitoring Program. Available wave data were collected from secondary sources (c.f /14//13/) and include significant wave height, maximum wave height, peak wave period, mean wave period, peak wave direction and mean wave direction. Out of eight data locations, three are inshore locations (Loc – 3, Loc – 5 & Loc – 7) **Error! Reference source not found.**and five are offshore locations (Loc – 1, Loc – 2, Loc – 4, Loc – 6 & Loc – 8), c.f. **Error! Reference source not found.Error! Reference source not found.**. The inshore locations are situated in the river/channel mouths and the wave heights are typically small. The offshore locations have relatively higher waves than the inshore locations. The years 2012, 2013 and 2017 have wave data during the monsoon period and the years 2018 and 2020 have wave data for the dry period.

The locations at which the measurements were collected are presented in **Error! Reference source not found.**.

Table 8-1: Details of available wave data

Serial No	Station name	Longitude	Latitude	Period covered		Parameters
1	Loc - 1	92° 0'31.94"E	21°21'6.41"N	Sep 28, 2012	Oct 11, 2012	Sign. Wave Height Peak Wave Period Mean Wave Direction
2	Loc - 2	92° 0'56.64"E	21°21'18.11"N	Jul 7, 2013	Aug 5, 2013	Sign. Wave Height Peak Wave Period Mean Wave Direction
3	Loc - 3	91°57'26.35"E	21°29'1.53"N	Jul 23, 2017	Jul 29, 2017	Sign. Wave Height Peak Wave Period
4	Loc - 4	91°56'28.40"E	21°27'28.96"N	Aug 1, 2017	Aug 13, 2017	Sign. Wave Height Peak Wave Period
5	Loc - 5	90°16'36.97"E	21°51'57.60"N	Mar 7, 2018	Apr 5, 2018	Sign. Wave Height Peak Wave Period
6	Loc - 6	90°14'59.99"E	21°36'29.98"N	Mar 7, 2018	Apr 2, 2018	Sign. Wave Height Peak Wave Period
7	Loc - 7	90°16'16.80"E	21°51'51.32"N	Feb 21, 2020	Mar 1, 2020	Sign. Wave Height Peak Wave Period
8	Loc - 8	90°03'33.818"E	21°20'00.3049"N	Feb 21, 2020	Mar 2, 2020	Sign. Wave Height Peak Wave Period

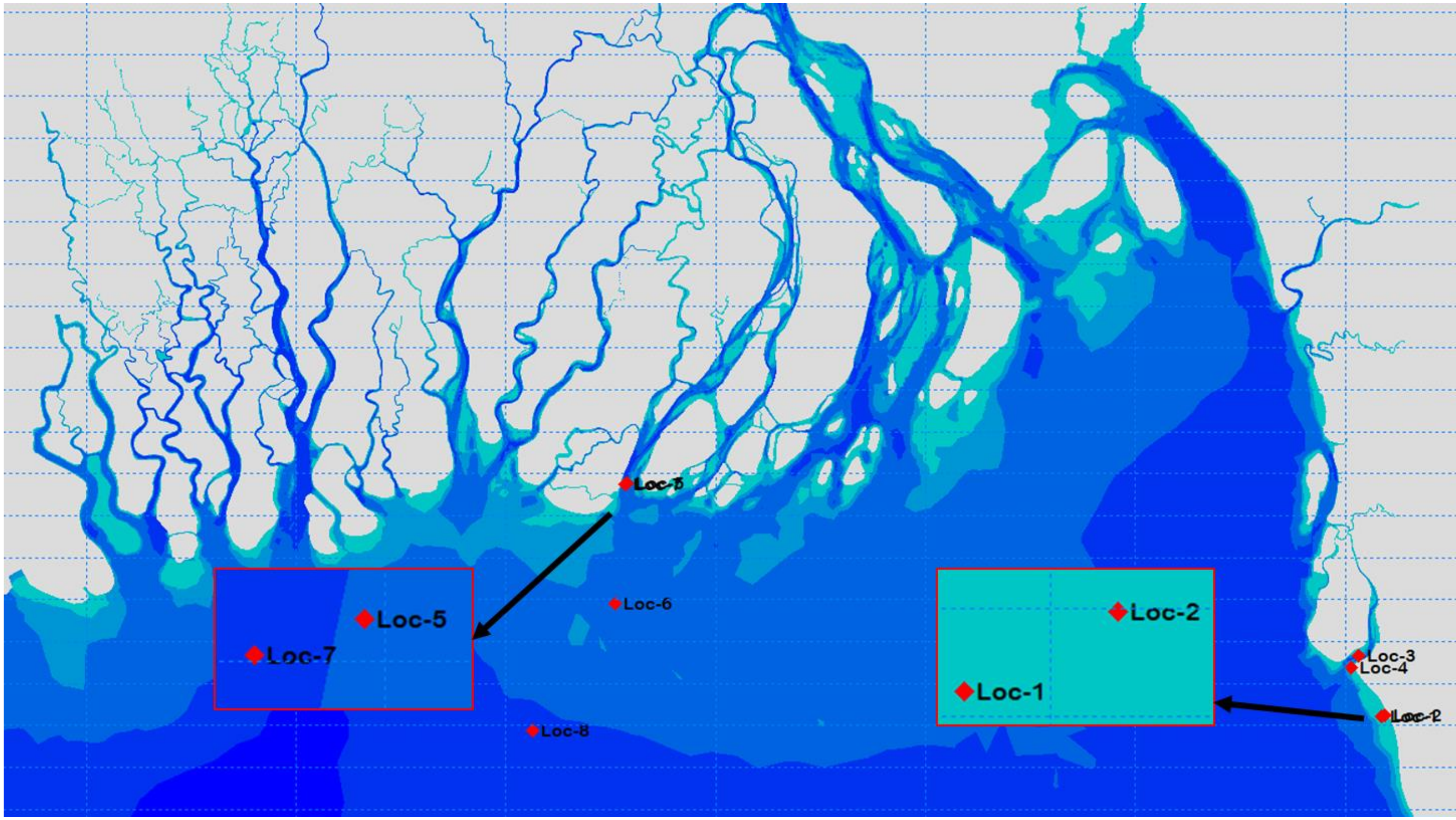


Figure 8-1: Location of the available wave data

Measured significant wave height and peak wave period at Cox's Bazar (Loc – 4) in August 2017 are presented in Figure 8-2.

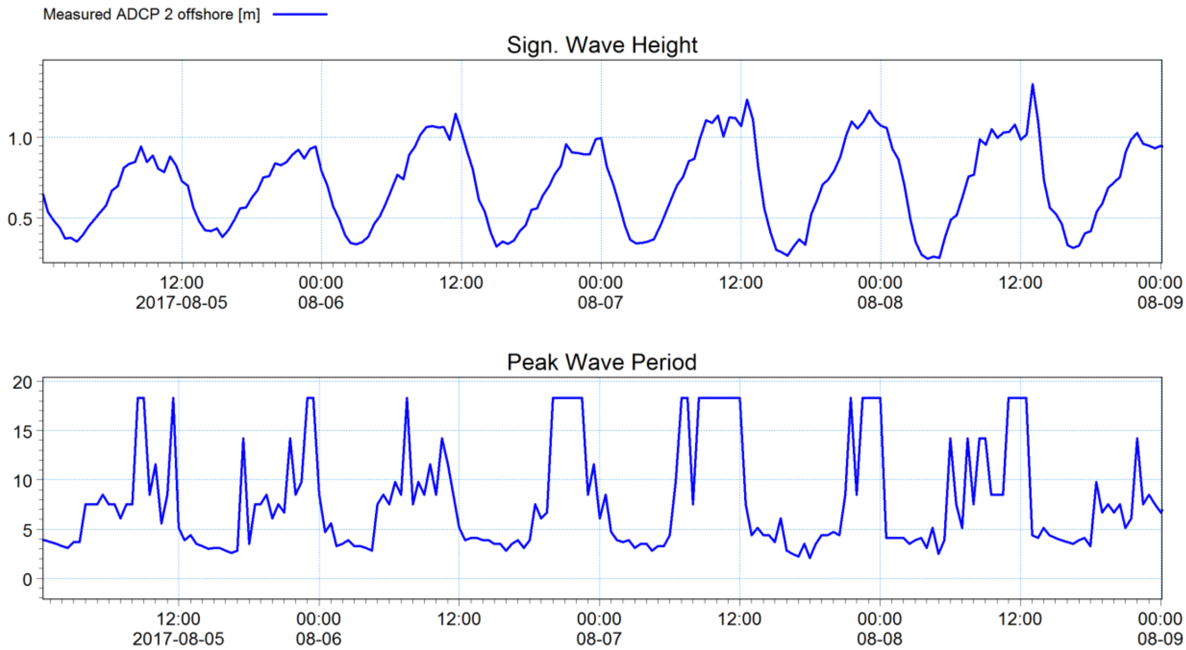


Figure 8-2: Significant Wave height [m] and peak wave period [s] offshore of Cox's Bazar (Loc – 4) for four days in 2017

The coastline of Bangladesh has a predominant wave direction from southwest as shown in Figure 8-3.

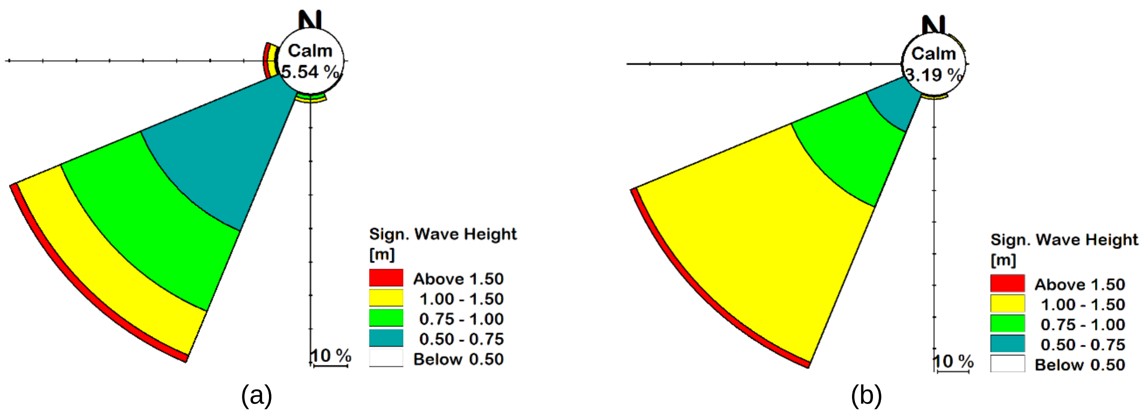


Figure 8-3: Wave rose near Cox's Bazar for (a) Sep-Oct, 2012 (Loc – 1) & (b) Sep, 2013 (Loc – 2)

8.2.3 Meteorological data

The meteorological forcing data as established for the surge model have been used for forcing of the wave model during cyclone conditions. These data consist of wind and pressure maps developed on basis of cyclone track data. Reference is given to Section 2.3 for further details.

For non-cyclone periods, maps of wind and air pressure data from the Climate Forecast System Reanalysis (CFSRv2) atmospheric model were used, which is established by National Centers for Environmental Prediction, USA (NCEP).

8.2.4 Morphology and Subsidence data

The wave model considers the effect of subsidence indirectly through the impact on water level from the storm surge model. Please see also Section 2.4.3 for more details on subsidence. The wave model was forced by water level conditions that are generated in the storm surge model, so the effect of subsidence is incorporated in the wave model.

8.3 Model setup

The Spectral Wave model, MIKE 21 SW has been applied for the study. MIKE 21 SW is a new generation spectral wind-wave model based on an unstructured flexible mesh. The model simulates the growth, decay and transformation of wind-generated waves and swells in the offshore and coastal areas. MIKE 21 SW includes the following physical phenomena:

- Wave growth by the action of wind
- Non-linear wave-wave interaction
- Dissipation due to white capping
- Dissipation due to bottom friction
- Dissipation due to depth-induced wave breaking
- Refraction and shoaling due to depth variation
- Wave-current interaction
- Effect of time-varying water depth.

8.3.1 Model bathymetry and calculation grid

The model domain is about 14,600 km x 2,800 km with a maximum water depth of approximately 4,400 m. The bathymetry of the wave model is the same as established for the storm surge model as shown in Section 3.2 (sub-sections 3.2.1, 3.2.2, and 3.2.3) except that the coastal polders and related land level were not included. Besides, the model domain was extended towards south until latitude 4°N using depth data from the digital navigational sea charts of C-MAP. The overall bathymetry and computational mesh are shown in Figure 8-4 and Figure 8-5 respectively. A local refinement with a higher spatial resolution down to 150 metres has been made along the coast and the islands for more accurate description of the coastal zone. The lowest spatial resolution is about 14 km in the deep sea.

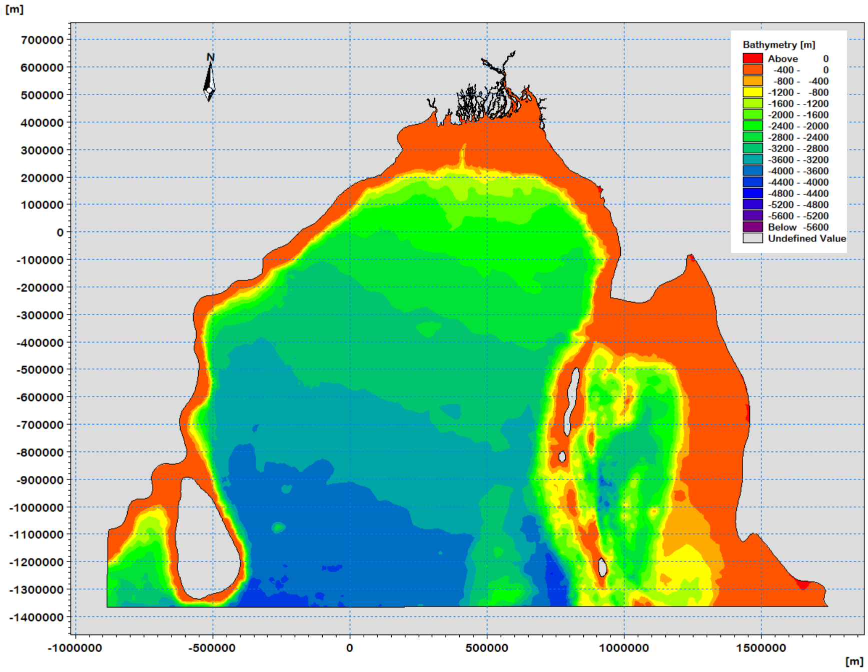


Figure 8-4: Updated bathymetry of the BoB wave model

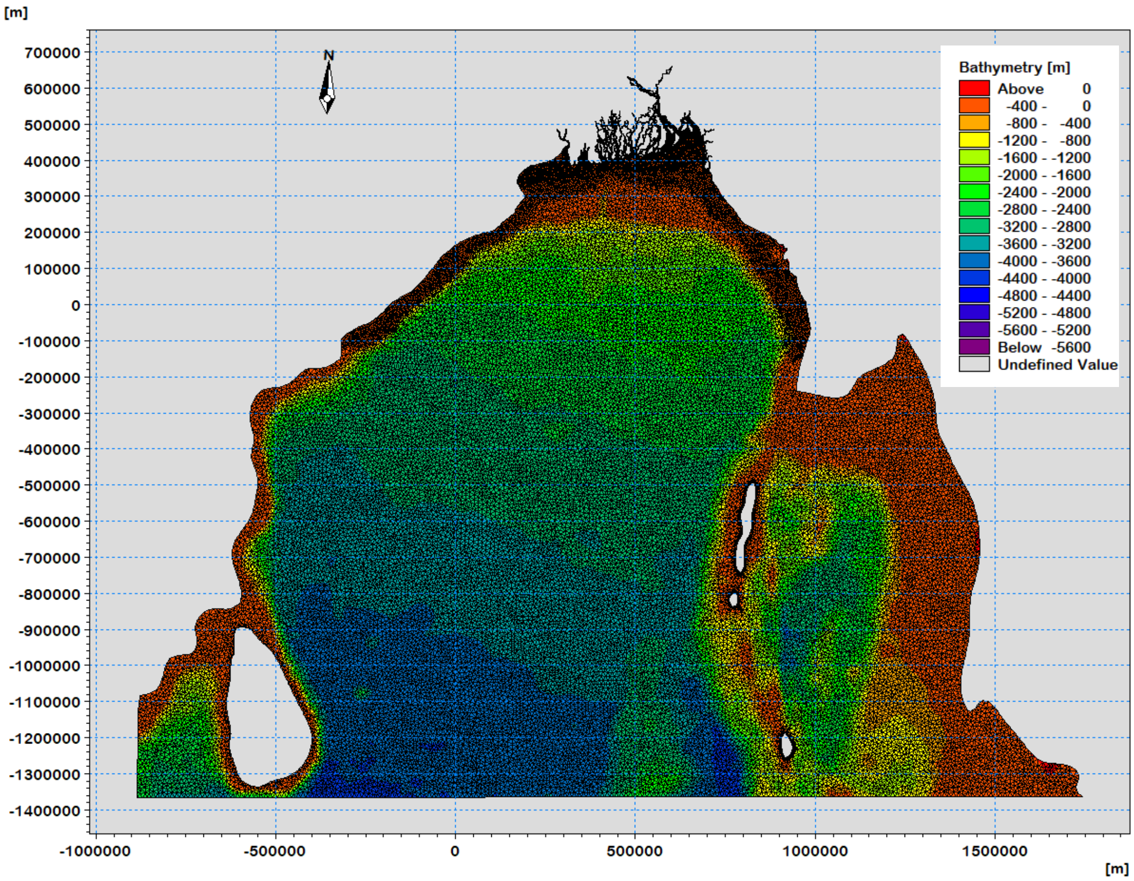


Figure 8-5: Overall computational mesh of the updated BoB wave model

8.3.2 Boundary conditions

Boundary conditions applied at the open boundaries of the wave model are described below:

Offshore conditions

Different types of offshore boundary conditions were for the wave model during cyclone periods and non-cyclone periods. Wave parameters like significant wave height, peak wave period, mean wave direction and directional standard deviation were collected from the European Centre for Medium-Range Weather Forecasts (ECMWF) model and used as open boundary conditions at the southern offshore boundary during non-cyclone periods. During simulations of cyclonic periods, the southern boundary was closed.

Upstream conditions

No wave forcing was used in the upstream boundaries of the BoB wave model.

8.3.3 Model parameters

The wave model parameters used during the simulation of the wave conditions are shown in Table 8-2.

Table 8-2: List of wave model parameters used during the simulation of wave conditions

Model Parameter	Value
Basic equations	Fully spectral formulation Instationary time formulation
Spectral discretization	36 directions
Solution technique	Max. number of levels in transport calculation = 32 No of steps in source calculation = 1 Minimum time step = 0.01 sec Maximum time step = 600 sec
Water level conditions	Calculated using HD model/ storm surge model
Wind forcing	For calibration & validation, U and V wind fields from CFSv2 Wind generation formula: SPM84 For cyclone periods, wind-generated from the cyclone model (same as for the surge model)
Wave breaking	Specified gamma, Gamma = 0.8 Alpha = 1 Gamma (wave steepness) = 1 Effect on mean frequency not included
Bottom friction	Nikuradse roughness height. K_n = 0.005 m Effect on mean wave frequency was included
Current conditions, ice coverage, diffraction	Excluded

8.4 Bay of Bengal wave model calibration and validation

Wave datasets like the significant wave height, peak wave period and mean wave direction are available at several locations around Cox’s Bazar and Kuakata for different years as shown in Table 8-1. The data from the years 2012, 2013 and 2017 are used for calibration whereas data for 2018 is used for validation.

8.4.1 Calibration against 2012 data

The results of the wave model calibration covering a 15-days period in September-October 2012 is shown in Figure 8-6.

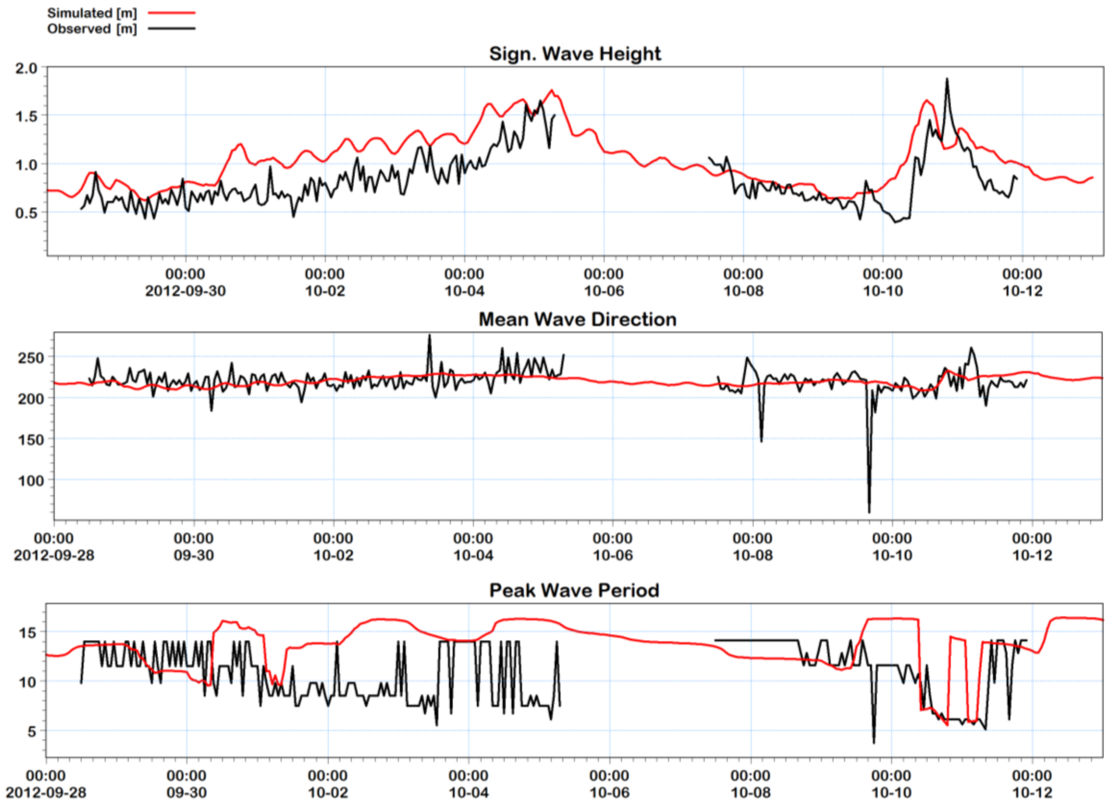


Figure 8-6: Calibration results offshore of Cox's Bazar for the wave model simulation in 2012

8.4.2 Calibration against 2013 data

The results of the wave model calibration covering a 30-days period in July-August 2013 is shown below in Figure 8-7.

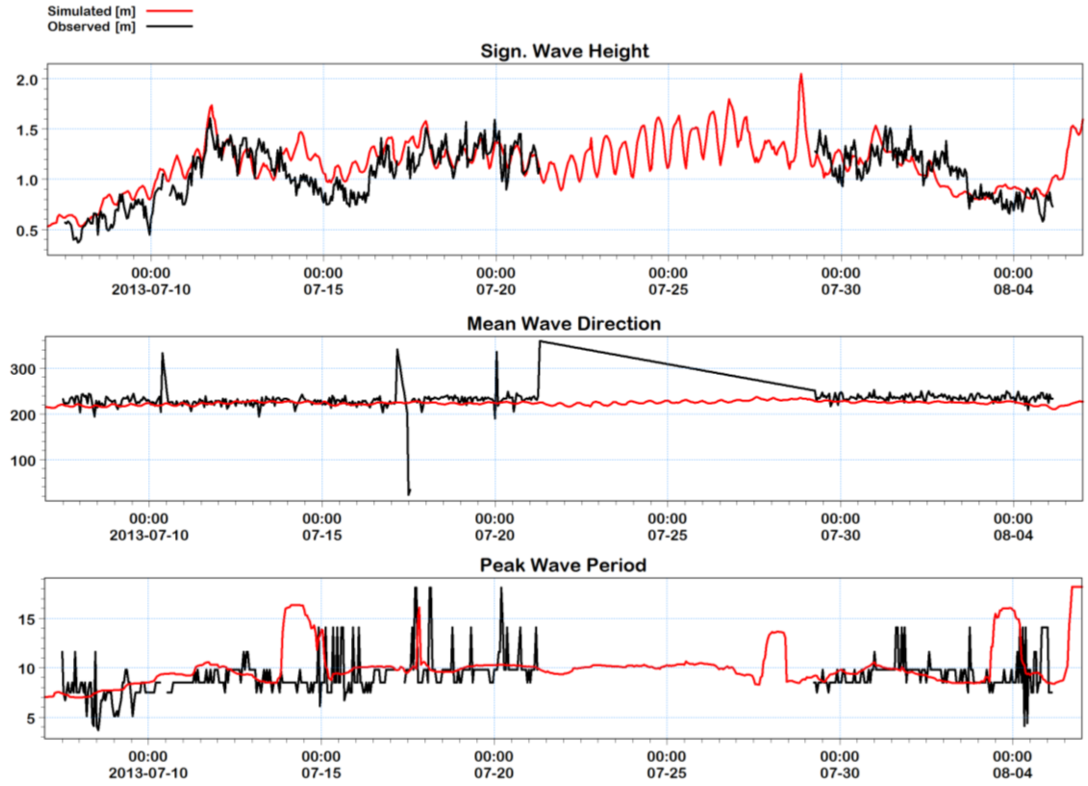


Figure 8-7: Calibration results offshore of Cox's Bazar for the wave model simulation in 2013

8.4.3 Calibration against 2017 data

The results of the wave model calibration covering a 4-days period in August 2017 is shown in Figure 8-8.

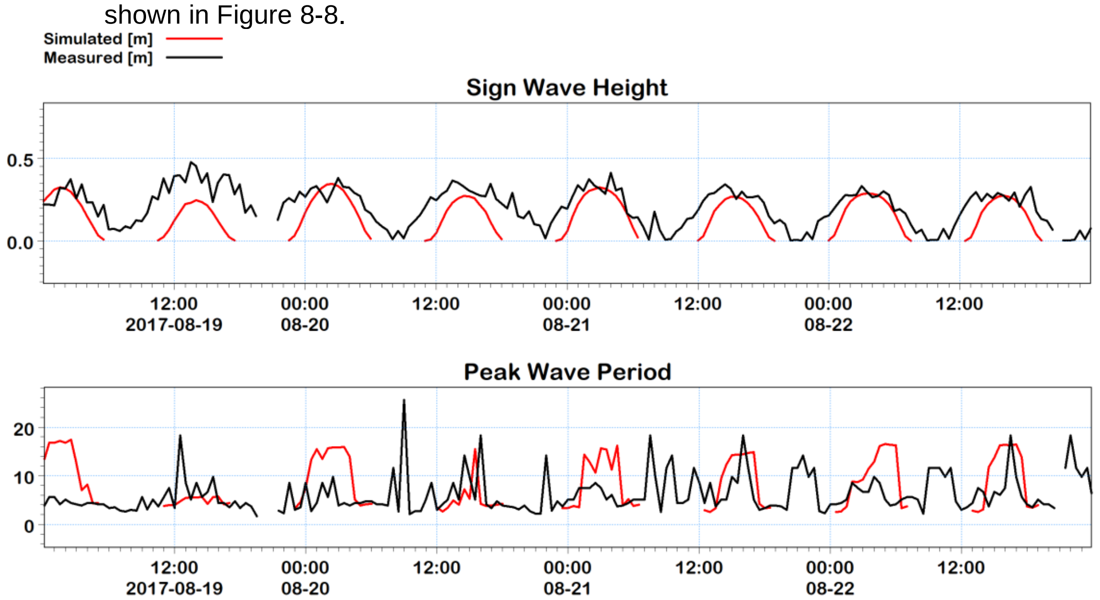


Figure 8-8: Calibration results at the Bakkhali river mouth in Cox's Bazar for the wave model simulation in 2017

8.4.4 Validation against 2018 data

After completion of the model calibration a model validation simulation was conducted using the same set of model parameters as achieved during the model calibration. The results of the validation simulation covering about one month in March-April 2018 are shown below in Figure 8-9 and Figure 8-10.

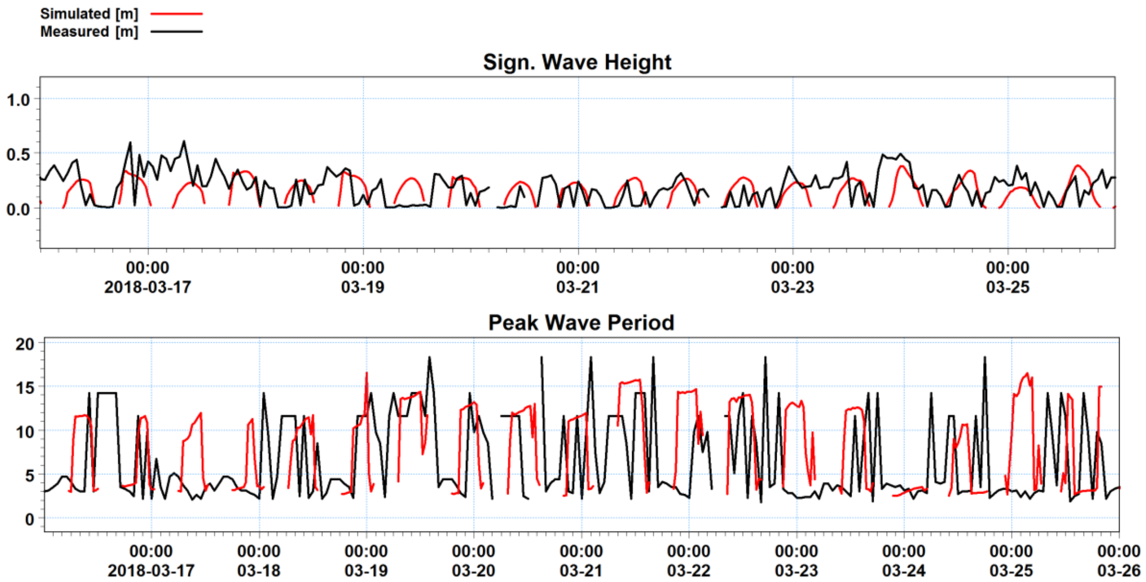


Figure 8-9: Validation results of significant wave height and peak wave period in Rabnabad channel for the wave model simulation in 2018

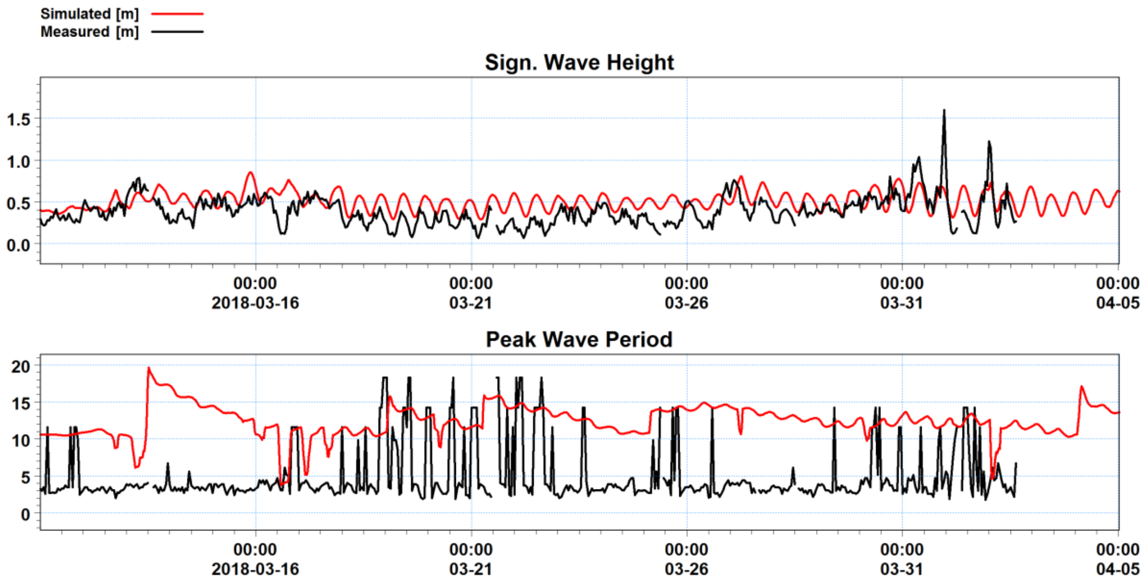


Figure 8-10: Validation results of significant wave height and peak wave period 20 km offshore of Kuakata beach for the wave model simulation in 2018

In general, the wave model resolves the long period swell waves well whereas the shorter wind generated waves sometimes are less accurately described. This is expected to be a consequence of a relatively low resolution of the wind forcing data.

The above presented calibration and validation results show, however, that the overall variability and magnitude of the wave parameters are well described.

8.5 Results of the Bay of Bengal wave model

8.5.1 Wave model results during cyclone wind conditions

Swell waves are negligible compared to wind generated waves during cyclone periods and therefore, the wave model was forced by generated cyclone wind only.

Nineteen wave simulations were carried out using the cyclonic wind and pressure field generated for the nineteen selected historical cyclones as part of the surge modelling.

Table 8-3 presents the maximum significant wave height obtained for each of the model simulation at selected locations. All simulations correspond to present conditions i.e. without considering climate change.

Future conditions were modelled representing the year 2050 including the effect of climate change (“CC"). The impact of climate changes was considered as described in Section 2.4 for the surge modelling. Water levels applied in the wave modelling were modelled by the surge model representing 2050 mean sea level and cyclone wind forcing.

Table 8-4 presents the maximum sign. wave height results for the nineteen cyclones including the effect of climate change (2050).

Table 8-3: Max. sign. wave height (m) without climate change for selected locations around the polders considered in the Long-Term Monitoring project

Cyclonic Event	Polder 40/1					Polder 59/2				Polder 64/1a & 64/1b			
	35	37	105	106	107	136	137	138	139	89	90	140	141
1960	0.73	0.90	1.20	0.98	0.71	0.70	1.79	0.86	1.60	4.84	4.88	3.60	4.04
1961	0.92	1.16	1.58	1.38	1.00	2.49	2.54	2.24	2.98	2.05	2.27	1.25	1.12
1963	0.62	0.13	0.63	0.59	0.04	0.69	0.87	0.42	0.94	3.89	4.00	2.66	3.12
1965_Dec	0.63	0.42	0.69	0.71	0.27	0.18	0.70	0.15	0.47	2.57	3.09	0.80	3.03
1965_May	1.15	0.89	1.36	1.42	0.77	2.36	2.54	1.98	2.82	2.46	2.54	1.67	1.40
1966	0.67	0.18	0.64	0.64	0.07	0.54	1.18	0.76	1.50	3.56	3.69	2.26	2.53
1970	1.48	2.13	2.11	1.89	1.79	1.97	2.62	2.83	3.87	3.55	3.64	2.25	2.70
1974	1.08	1.32	1.64	1.45	1.15	1.88	2.70	2.23	3.40	2.82	3.02	1.63	1.76
1983	0.17	0.08	0.05	0.11	0.03	0.05	0.19	0.06	0.40	1.82	2.17	0.70	2.14
1985	0.51	0.22	0.63	0.61	0.13	0.13	0.51	0.19	0.39	2.41	2.80	0.70	2.71
1986	0.96	0.62	1.04	1.09	0.68	1.39	1.20	0.75	1.31	2.42	2.48	1.63	1.64
1988	1.92	1.69	2.12	2.37	1.75	1.76	1.60	1.36	1.68	1.93	2.04	1.28	0.98
1991	0.34	0.90	1.13	0.95	0.76	0.55	1.67	0.68	1.24	4.23	4.65	3.15	4.08

Cyclonic Event	Polder 40/1					Polder 59/2				Polder 64/1a & 64/1b			
	35	37	105	106	107	136	137	138	139	89	90	140	141
1995	0.31	0.16	0.09	0.20	0.07	0.00	0.01	0.02	0.06	0.74	0.79	0.45	0.28
1997_May	0.74	0.86	1.24	1.09	0.65	0.49	1.26	0.43	0.87	3.41	3.54	1.68	3.09
1997_Sep	0.65	0.98	1.37	1.15	0.84	0.44	1.14	0.64	1.35	4.18	4.29	2.84	3.42
1998	0.67	0.71	0.95	0.89	0.56	0.09	0.21	0.20	0.53	1.94	2.47	0.98	1.81
2007	1.82	2.32	1.09	1.97	2.08	2.67	2.50	2.38	2.78	2.36	2.63	1.50	1.37
2009	1.48	1.04	1.07	1.49	0.99	0.72	0.67	0.63	0.86	1.17	1.27	0.80	0.62

Table 8-4: Max. sign. wave height (m) with climate change (2050) for selected locations around the polders considered in the Long-Term Monitoring project

Cyclonic Event	Polder 40/1					Polder 59/2				Polder 64/1a & 64/1b			
	35	37	105	106	107	136	137	138	139	89	90	140	141
1960_CC2050	0.72	0.99	1.34	1.07	0.80	0.76	1.89	0.97	1.69	5.01	5.02	3.78	4.14
1961_CC2050	1.03	1.36	1.78	1.53	1.16	2.74	2.72	2.43	3.28	2.22	2.46	1.38	1.24
1963_CC2050	0.64	0.32	0.67	0.66	0.13	0.80	1.02	0.51	1.07	4.08	4.16	2.90	3.28
1965_May_CC2050	1.36	1.12	1.62	1.68	0.91	2.52	2.68	2.15	2.98	2.65	2.73	1.83	1.52
1965_Dec_CC2050	0.65	0.60	0.80	0.79	0.42	0.27	0.76	0.18	0.51	2.65	3.19	0.86	3.14
1966_CC2050	0.68	0.46	0.68	0.70	0.28	0.60	1.40	0.87	1.71	3.71	3.82	2.43	2.72
1970_CC2050	1.64	2.31	2.26	2.03	1.95	2.16	2.70	2.99	4.10	3.71	3.82	2.42	2.91
1974_CC2050	1.21	1.50	1.85	1.61	1.31	2.10	2.89	2.48	3.56	3.00	3.22	1.79	1.93
1983_CC2050	0.21	0.10	0.06	0.14	0.04	0.27	0.60	0.21	0.44	2.02	2.38	0.77	2.34
1985_CC2050	0.59	0.45	0.69	0.70	0.31	0.14	0.63	0.22	0.46	2.56	2.96	0.76	2.86
1986_CC2050	1.26	1.02	1.32	1.49	1.13	1.79	1.60	1.15	1.63	2.60	2.75	1.83	1.82
1988_CC2050	2.20	2.04	2.34	2.62	2.13	2.21	2.01	1.70	2.08	2.22	2.35	1.49	1.17
1991_CC2050	0.38	0.95	1.21	1.02	0.81	0.59	1.75	0.74	1.33	4.32	4.78	3.30	4.26
1995_CC2050	0.35	0.19	0.11	0.23	0.08	0.02	0.02	0.04	0.09	0.78	0.84	0.49	0.30
1997_May_CC2050	0.74	0.96	1.38	1.17	0.72	0.52	1.42	0.51	0.99	3.58	3.70	1.90	3.26
1997_Sep_CC2050	0.75	1.14	1.54	1.29	0.99	0.53	1.49	0.76	1.56	4.36	4.47	3.05	3.64
1998_CC2050	0.66	0.78	1.03	0.95	0.61	0.20	0.33	0.22	0.61	2.10	2.65	1.12	2.04
2007_CC2050	2.15	2.77	1.57	2.31	2.44	3.16	3.00	2.81	3.41	2.67	3.00	1.75	1.63
2009_CC2050	1.53	1.12	1.15	1.57	1.07	0.78	0.72	0.70	0.95	1.24	1.35	0.86	0.66

As an example, Figure 8-11 describes the maximum sign. wave height without climate change for polders 64/1a & 64/1b. Figure 8-12 describes the sign. wave height with climate change (2050). Similar figures for polders 40/1 & 59/2 are included in Appendix D.

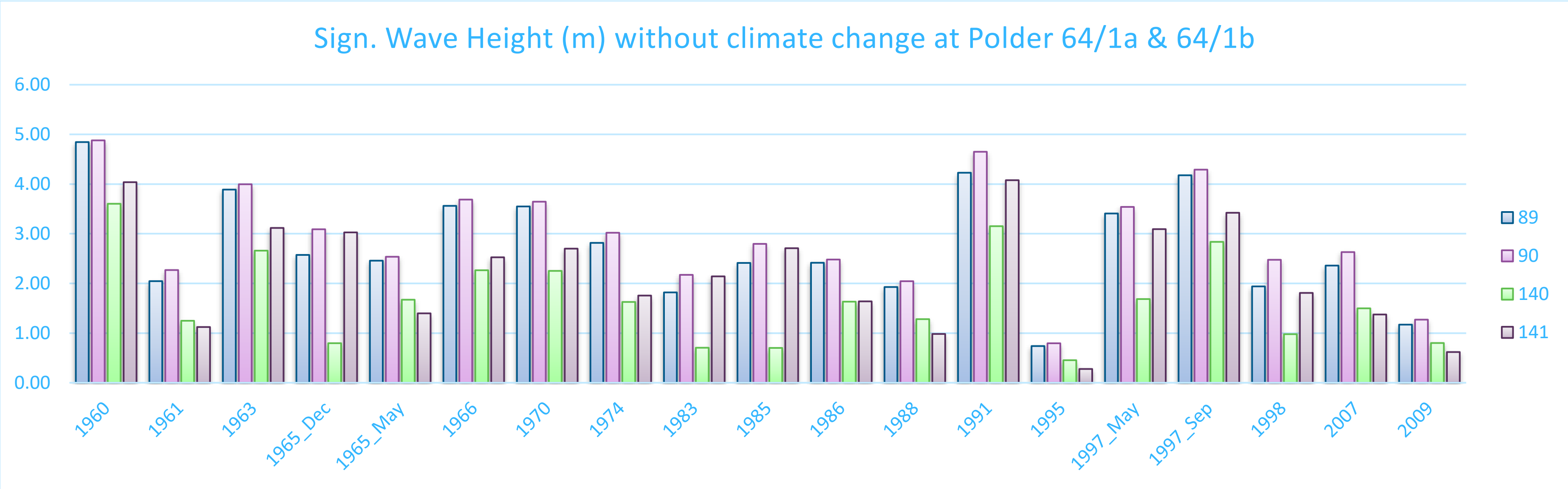


Figure 8-11: Maximum sign. wave height without climate change for polder 64/1a & 64/1b (the legend represents the four locations around polder 64/1a & 64/1b)

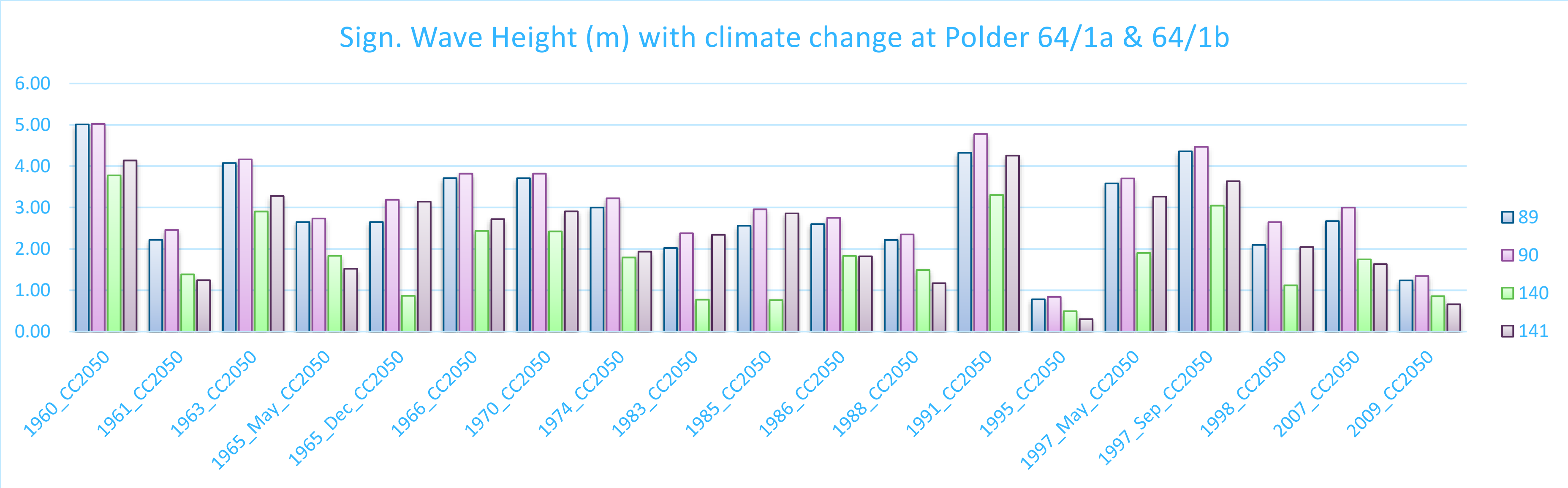


Figure 8-12: Maximum Sign. wave height with climate change (2050) for polder 64/1a & 64/1b (the legend represents the four locations around polder 64/1a & 64/1b described in **Error! Reference source not found.**)

Estimated extreme sign. wave heights without climate change for 141 selected points are given in Appendix A. Estimated extreme sign. wave heights with climate change (2050) for the 141 selected points are given in Appendix B.

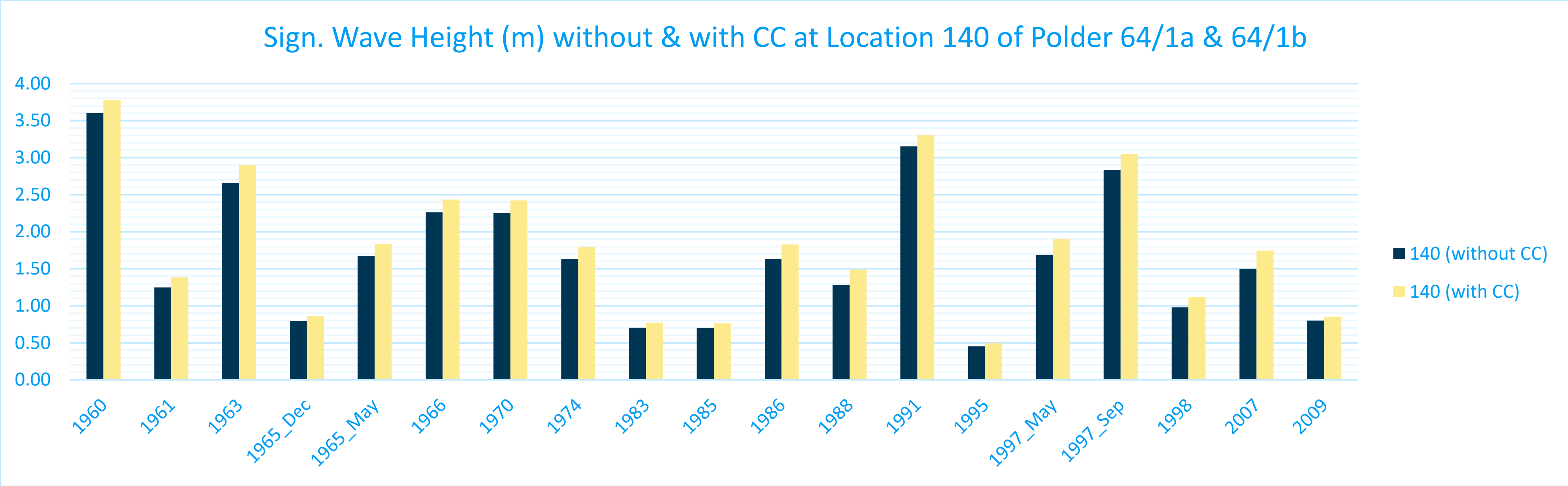


Figure 8-13: Maximum Sign. wave height without & with climate change (2050) for location 140 of polder 64/1a & 64/1b (the legend represents the location 140 without climate change and with climate change around polder 64/1a & 64/1b described in Figure 5-10.

Figure 8-13 describes the sign. wave height for the same location (location 140 c.f. Figure 5-10) comparing between without climate change and with climate change scenarios. It is evident from the figure that the sign. wave height increases with climate scenarios when compared with the present scenario.

8.5.2 Statistical analysis of wave model results

The maximum significant wave height was obtained from the pre-selected locations (as shown in **Error! Reference source not found.**) , for each of the 19 wave simulations. The 19 values obtained for each location were then analysed to obtain the 10, 25, 50, and 100 years return period significant wave height. The statistical analysis of significant wave height is carried out using the Extreme Value Analysis (EVA) tool in the software package MIKE Zero. The same procedure is applied to determine the extreme value for waves as applied in determining surge levels (c.f. Section 5.4) but for the wave heights a Weibull distribution function has been used. The statistical analysis was done for the wave heights results both without climate change and with climate change.

The modelled significant wave heights in locations around polders 40/1, 59/2, 64/1a and 64/1b that form the input to the statistical analysis are listed in Table 8-3 (without climate change) and Table 8-4 (with climate change), respectively. After processing the simulated data, it was found that the rivers around Polder 29 do not have waves generated by most of the cyclones with & without climate change.

Estimated wave heights for 10, 25, 50, and 100 years return periods with and without climate change effects at selected locations are presented in Table 8-5 describes the results of the statistical analysis of sign. wave heights for 10, 25, 50, and 100 years return periods with and without climate change effects (in 2050) at selected locations near polders 15, 40/1, 59/2, 64/1a and 64/1b. The sign. wave heights for different return periods for all 141 locations are given in Appendix C.

5.

In below figures, examples of obtained results are presented. Figure 8-14 presents the frequency distribution curve of significant wave height without climate change and with climate change at Char Doani in the Baleswar River, north-West side of the Polder 40/1.

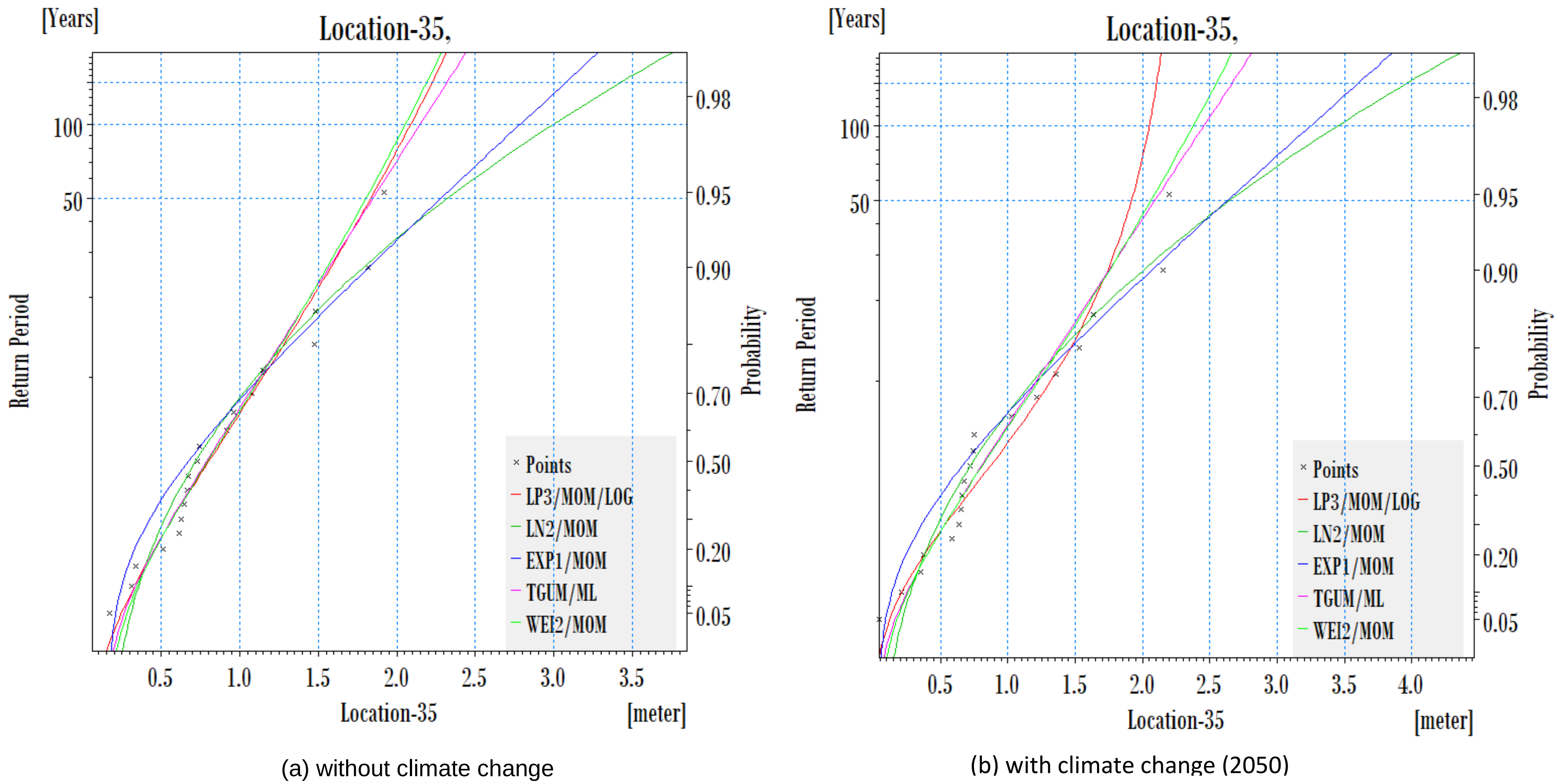


Figure 8-14: Statistical analysis of the significant wave height in Baleswar river northwest of Polder 40/1

Figure 8-15 presents the frequency distribution curve of significant wave height without climate change and with climate change at northwest corner of the Polder 59/2 in the Lower Meghna River.

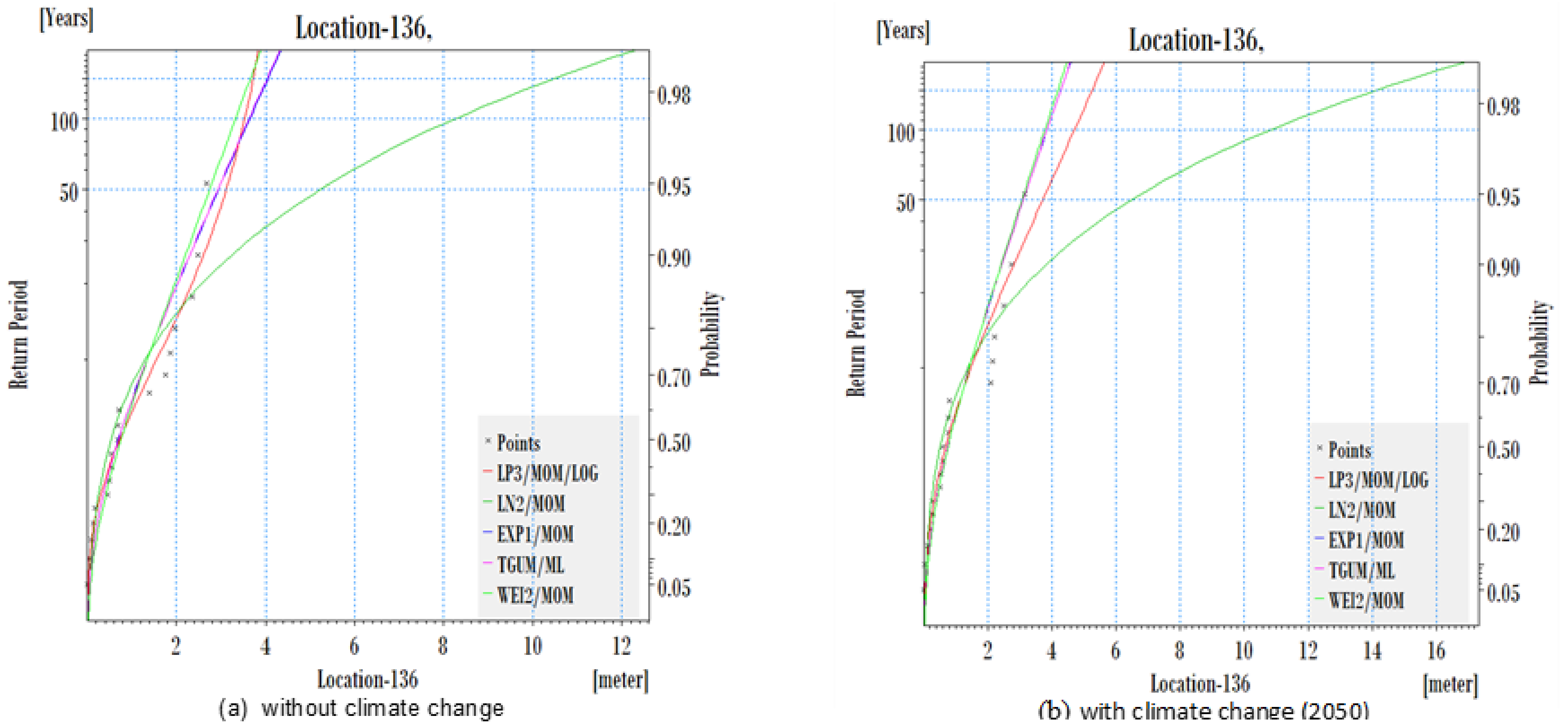
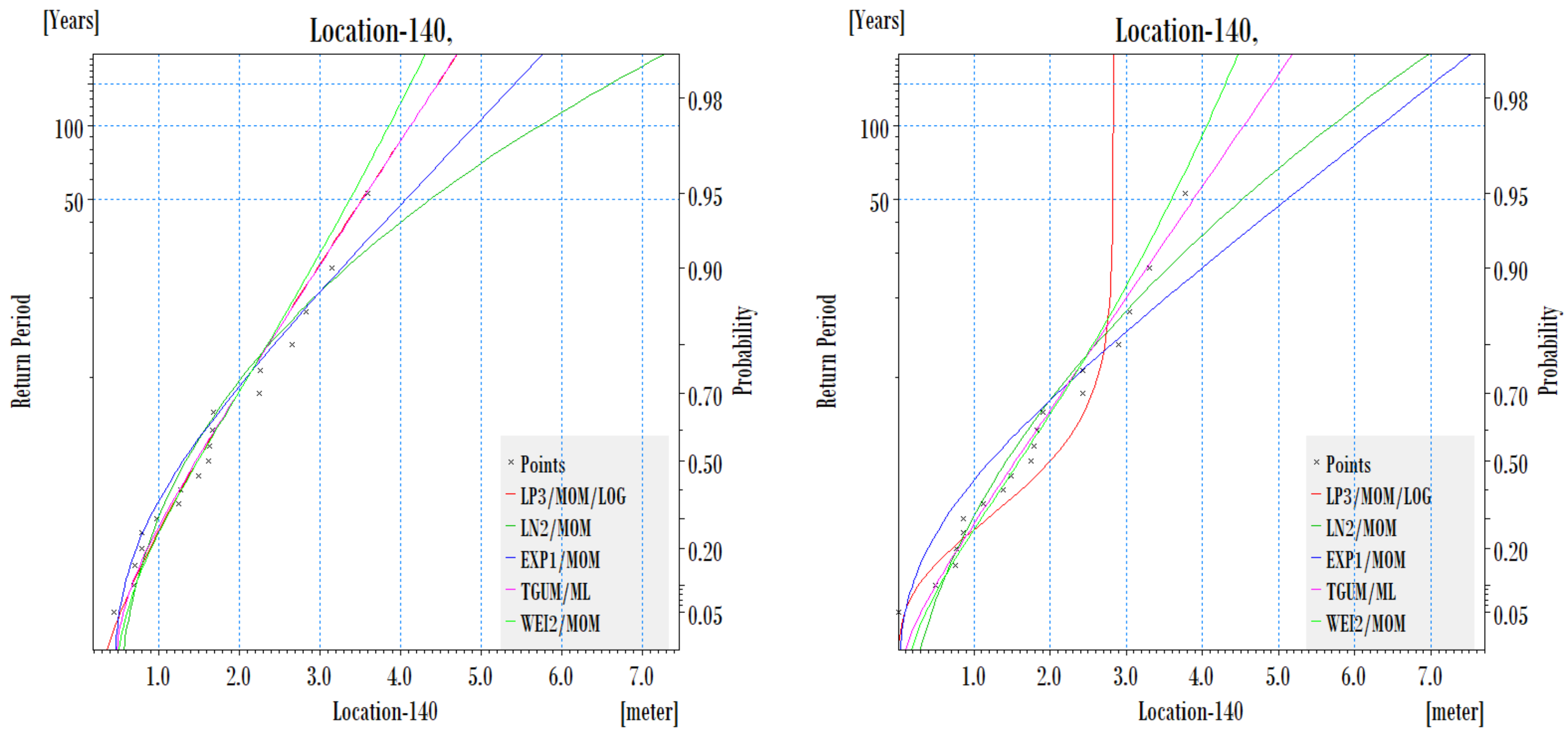


Figure 8-15: Statistical analysis of the wave heights in the Lower Meghna River west side of polder 59/2 (a) without climate change; (b) with climate change (2050)

Figure 8-16presents the frequency distribution curve of significant wave height without climate change and with climate change at northwest of the Polder 64/1a & 64/1b in the estuary of the Sangu river.



(a) without climate change

(b) with climate change (2050)

Figure 8-16: Statistical analysis of the wave heights in the Sangu river mouth north of polder 64/1a & 64/1b

Table 8-5 describes the results of the statistical analysis of sign. wave heights for 10, 25, 50, and 100 years return periods with and without climate change effects (in 2050) at selected locations near polders 15, 40/1, 59/2, 64/1a and 64/1b. The sign. wave heights for different return periods for all 141 locations are given in Appendix C.

Table 8-5: Result of statistical analysis of sign. Wave height for polder 40/1, 59/2, 64/1a and 64/1b without climate change and with climate change (2050)

Polder Name	Location ID	Geographical Location		Sign. Wave height during different Return Periods (Without CC)				Sign. Wave height Level during different Return Periods (With CC)				River Name
		BTM Easting	BTM Northing	10	25	50	100	10	25	50	100	
Polder 15	**1**	424820	456897	–	0.48	0.59	0.67	–	0.51	0.75	0.97	Kholpetua
	2	423114	463204	–	0.44	0.53	0.59	–	0.63	0.76	0.84	Kholpetua
	3	429031	462439	–	0.36	0.62	0.88	–	0.64	0.80	0.92	Kobadak
	132	429571	458014	–	0.52	0.71	0.88	–	0.70	0.94	1.14	Kobadak
Polder 40/1	**105**	489915	441799	1.38	1.83	2.10	2.34	1.50	2.07	2.42	2.74	Baleswar
	35	491282	434133	1.11	1.53	1.80	2.05	1.20	1.72	2.06	2.37	Baleswar
	37	499050	430095	1.13	1.71	2.12	2.50	1.32	1.98	2.43	2.84	Bishkhali Estuary
	106	489198	437761	1.40	1.87	2.17	2.43	1.50	2.09	2.47	2.81	Baleswar
	107	497799	434293	0.98	1.54	1.93	2.31	1.10	1.76	2.22	2.66	Bishkhali
Polder 59/2	**136**	581298	521746	1.31	2.15	2.75	3.33	1.38	2.35	3.07	3.78	Lower Meghna
	137	587002	509780	1.78	2.53	3.01	3.45	1.93	2.78	3.33	3.84	Lower Meghna
	138	596373	503609	1.28	2.12	2.72	3.30	1.39	2.33	3.02	3.70	Lower Meghna
	139	602907	497041	2.00	2.98	3.64	4.26	2.11	3.25	4.04	4.79	Lower Meghna
Polder 64/1a & 64/1b	**140**	692350	446695	2.06	2.85	3.37	3.86	2.25	3.08	3.59	4.05	Sangu Estuary
	89	690915	444710	3.33	4.17	4.68	5.12	3.51	4.42	4.95	5.41	Open sea
	90	691378	436743	3.55	4.35	4.83	5.24	3.73	4.63	5.15	5.59	Open sea
	141	694972	426985	2.77	3.65	4.19	4.68	2.92	3.89	4.49	5.03	Kutubdia channel

8.5.3 Wave characteristics during cyclonic wind

Tropical cyclones are possibly the most damaging natural phenomena in their combination of devastation, duration and size of the area affected. Cyclones are low-pressure systems around which the air circulates in an anti-clockwise direction in the northern hemisphere. The rotating mass of warm humid air is normally between 300 km and 1,500 km in diameter. The strong wind, which may approach 250 km/hr or more, blows around the eye of a cyclone, which can range from a few kilometres to more than 100 km in diameter.

Pre-monsoon, monsoon, and post-monsoon periods are the three seasons when cyclones and depressions form in the Bay of Bengal. Cyclones, which form during pre-monsoon and post-monsoon periods, are the most destructive due to the great instability of the atmosphere and the weak vertical winds. They generally form over the Andaman Sea or the southeast Bay of Bengal. They initially move west/north-westwards then northwards, and finally in a north-easterly direction, and cross Bangladesh.

As the cyclone generated far and travel over the Bay of Bengal and finally hit Bangladesh, during this period wave height generated by cyclonic wind is quite considerable along the sea-facing polders and the polders along the wide estuaries in the south. To know the wave characteristics during cyclone, 19 wave model simulations were conducted using the cyclonic wind field and storm surge as input for each of the 19 naturally occurring cyclones.

The waves created during nineteen cyclones have been simulated by the established waves model. The wind and pressure field for the entire Bay of Bengal have been generated using the Holland single vortex theory as also applied for the surge modelling. The model simulates the development and movement of the wave field towards the Bangladeshi coastline. Maximum significant wave heights were calculated corresponding to individual major cyclones as shown in Figure 8-17, Figure 8-18, Figure 8-19, and Figure 8-20 of November 2007, April 1991, May 2009, and November 1970, respectively.

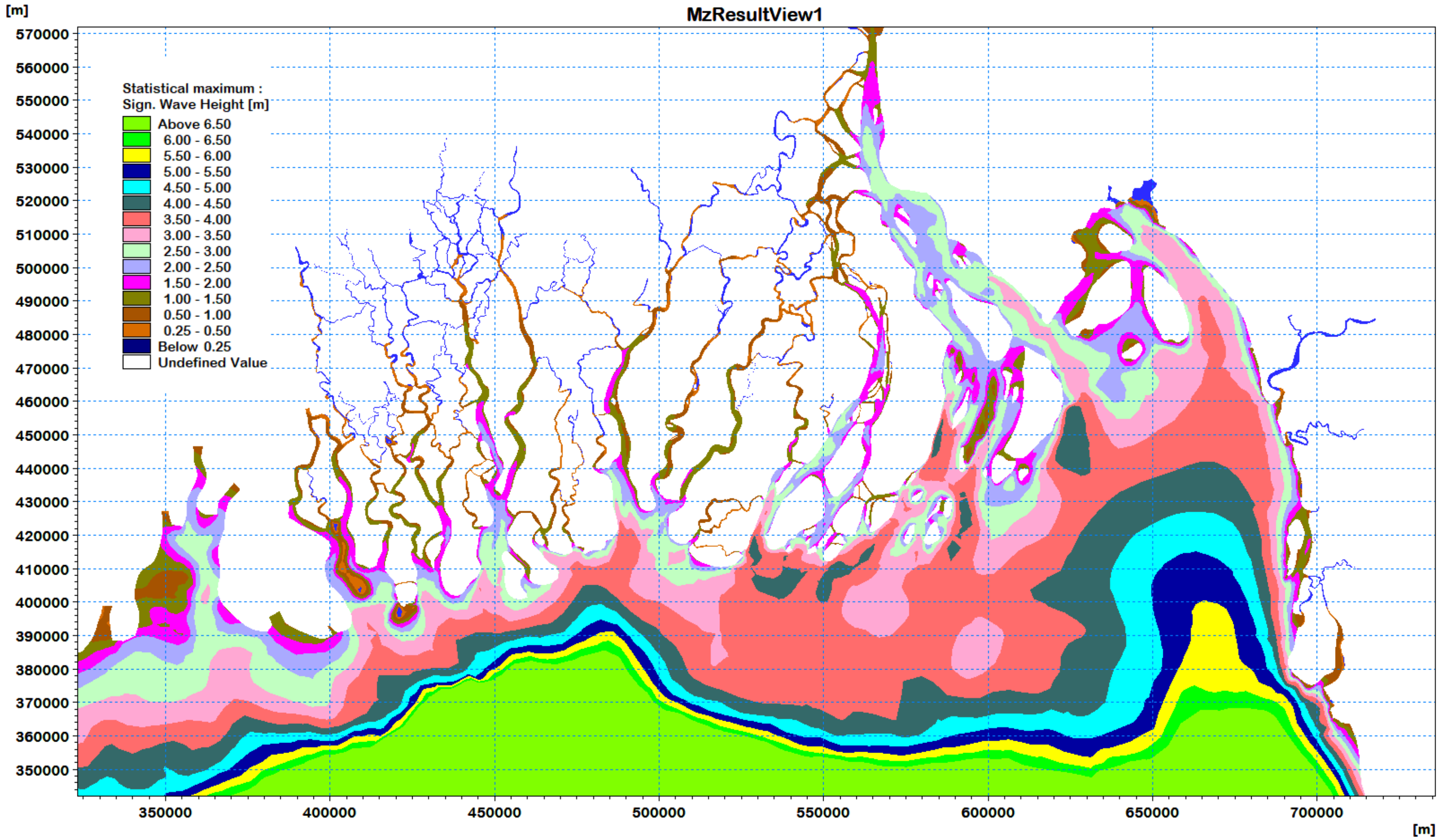


Figure 8-17: Maximum significant wave height during cyclone Sidr in 2007

The maximum significant wave height for cyclone Sidr is found in the mouth of the Baleswar river and along Bhola Island near Char Fashion and these vary from 3.50 to 4.50 m. On the eastern coast the maximum significant wave height varies from 2.50m to 3.00m.

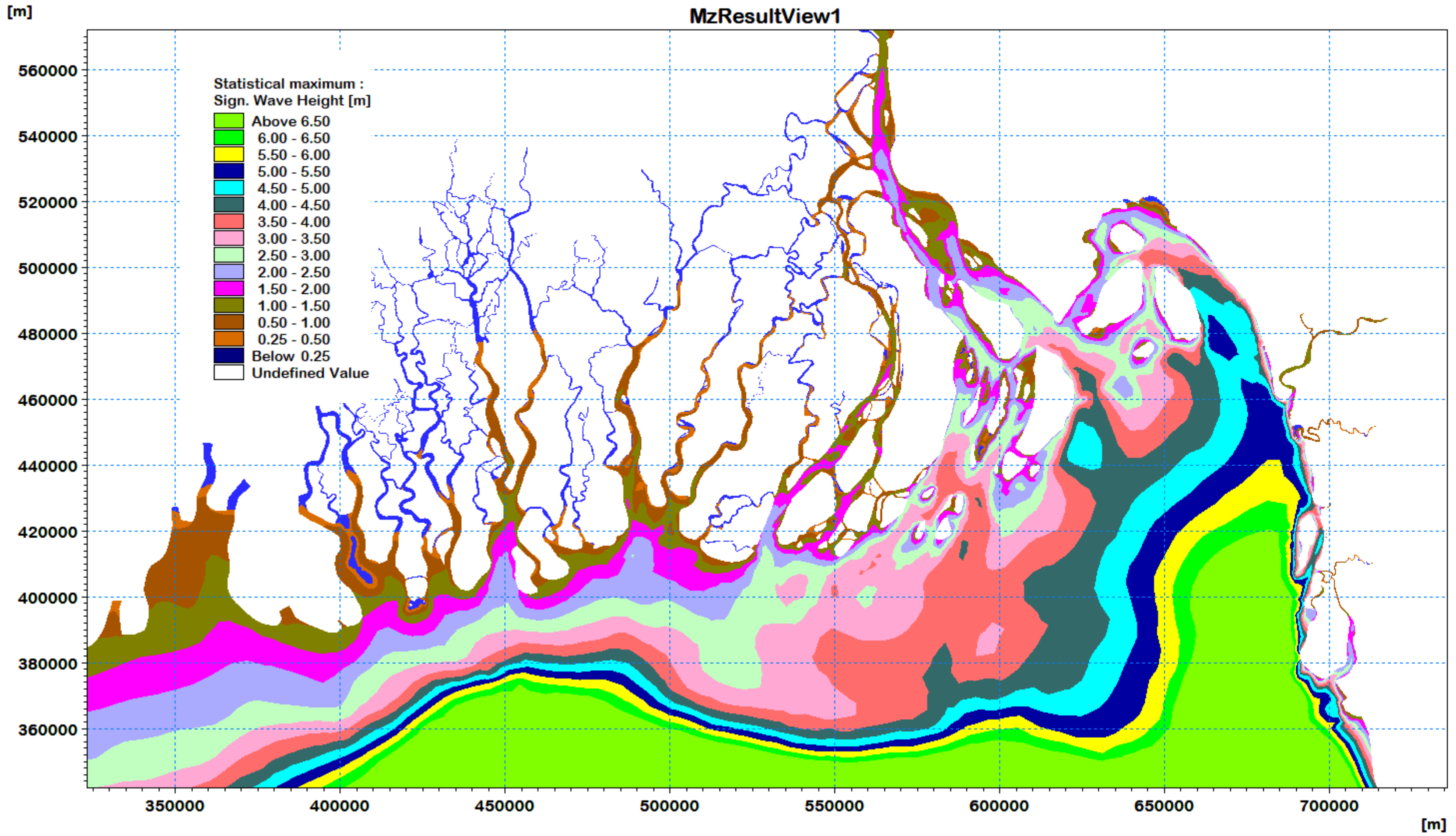


Figure 8-18: Maximum significant wave height during April 1991 cyclone

For the 1991 cyclone, significant wave height was observed to be maximum along the east coast of Bangladesh and it varies from 1.50m-5.00m. In the Sandwip channel, significant wave height varies from 3.00 m – 5.50m.

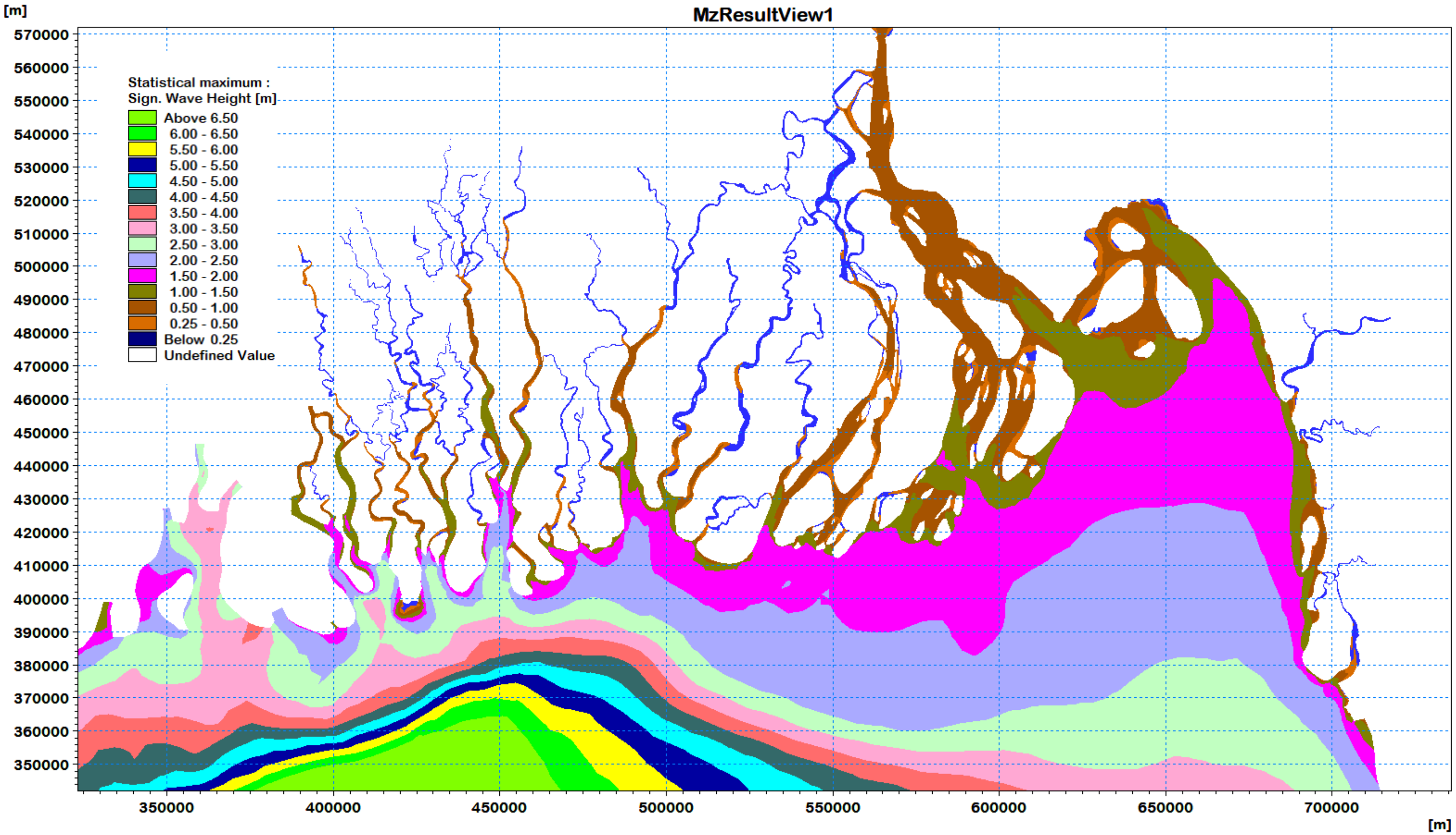


Figure 8-19: Maximum significant wave height during cyclone Aila in 2009

Figure 8-19 shows the maximum significant wave height for cyclone Aila. As Aila hit West Bengal, the wave produced by Aila along the Bangladeshi coast was not so high. All the peripheral rivers of all polders are included in the wave model for predicting wave characteristics during cyclones.

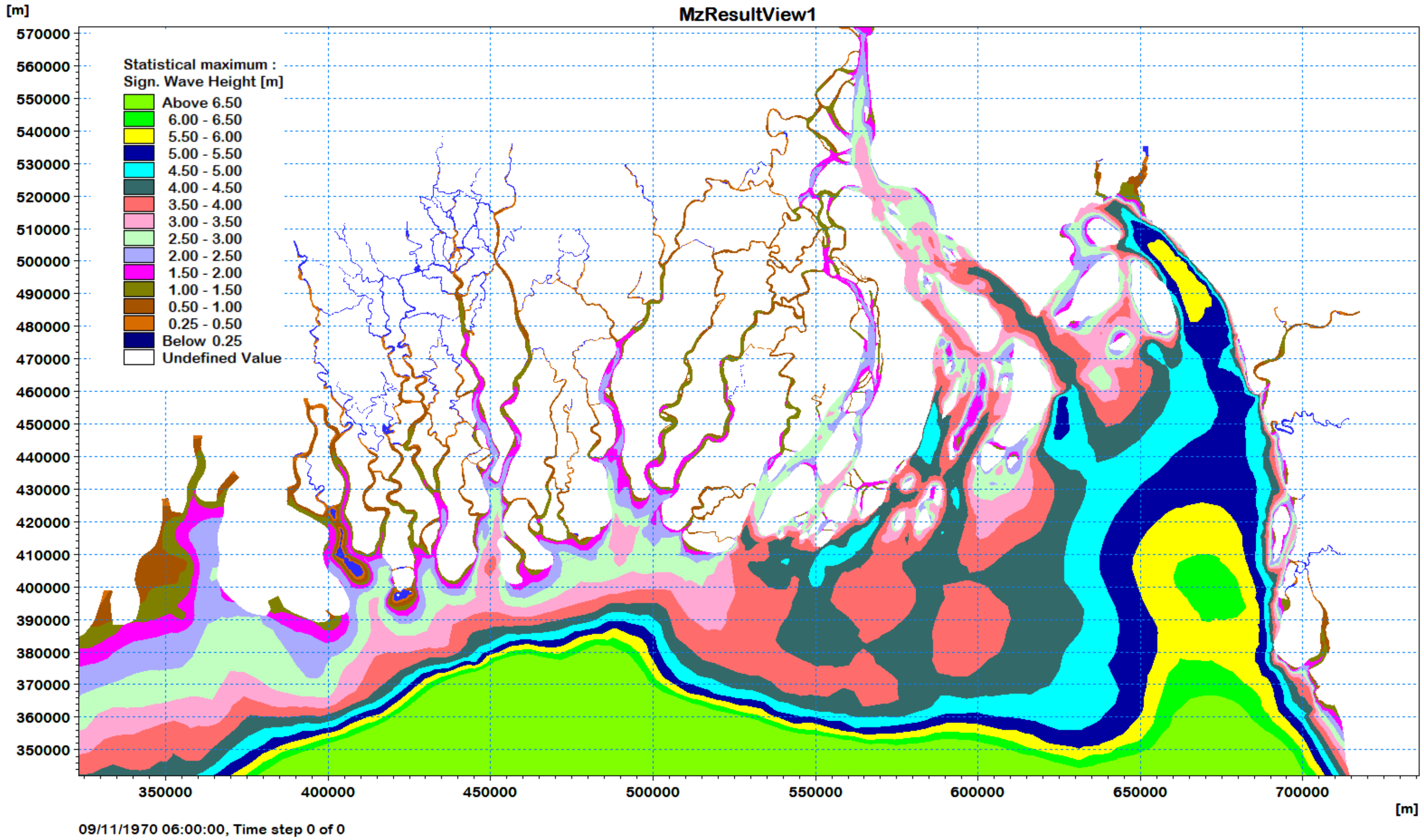


Figure 8-20: Maximum significant wave height during the cyclone in 1970

Figure 8-20 shows the maximum significant wave height during the cyclone in 1970. As the 1970 cyclone made landfall along Bhola Island, the maximum sign. Wave height varies from 1.50 m to 4.50 m on Lower Meghna river west side of polder 59/2. The maximum sign. wave height in the Sandwip channel varies from 1.50 m to 6.00 m.

8.6 Conclusions of Wave Model

The development of the Bay of Bengal wave model aimed to assess the wave characteristics for the coastal zone of Bangladesh. The wave model has been calibrated and validated with the measured data for non-cyclone periods as wave data for cyclone periods were not available. The measured wave data comprises both dry and monsoon periods and the model was calibrated for both periods.

The wave model has been simulated for nineteen cyclonic events and it is evident from Table 8-3 that the sea-facing polders of the eastern region i.e. Polder 64/1a and 64/1b are exposed to larger waves up to 4.88 m than the polders of the south-west region i.e. Polder 40/1 without climate change. Polder 59/2 is exposed to sign. wave heights up to 3.87 m without climate change. Table 8-4 shows the sign. wave height increases for all locations with climate change (2050), where the respective wave heights are seen to be 5.02m for Polder 64/1a and 64/1b m and 4.10 m for Polder 40/1.

The maximum significant wave height for the nineteen severe cyclones has been used for statistical analysis. Extreme wave analyses have been carried out for 10, 25, 50, and 100-year return periods using the Weibull distribution for 141 locations dispersed in the whole coastal zone of Bangladesh as shown in Figure 5-10. Significant wave height for the 100-year return period in Baleswar river at the northwest of Polder 40/1 is 2.05 m and west of Polder 64/1a and 64/1b it is 5.59 m using the Weibull distribution.

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A Maximum significant wave heights

A.1 Maximum Significant Wave Height without Climate Change

The simulated max. significant wave height without climate change for all 141 locations along the Bangladesh coastlines is listed below in **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.** & **Error! Reference source not found.**A-4.

Table A- 1: The simulated max. significant wave heights without climate change for locations 1 -35

Location / Cyclonic Event	Significant Wave Height (m) at Base Condition																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1960_Base(org)_LT	0.08	0.06	0.04	0.02	0.01	0.00	0.17	0.00	0.00	0.00	0.01	0.00	0.10	0.00	0.00	0.00	0.01	0.03	0.06	0.17	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.11	0.43	0.48	0.85	0.91	1.23	0.73
1961_Base(org)_LT	0.00	0.00	0.00	0.01	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.22	0.32	0.40	0.03	0.07	0.00	0.07	0.01	0.01	0.14	0.01	0.51	0.88	0.76	1.38	1.41	1.60	0.92
1963_Base(org)_HT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05	0.41	0.66	0.62
1965_Dec_Base(org)_HT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.11	0.53	0.68	0.63
1965_May_Base(org)_LT	0.12	0.01	0.01	0.04	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.14	0.30	0.43	0.49	0.00	0.00	0.01	0.00	0.00	0.04	0.20	0.01	0.44	0.89	0.94	1.45	1.36	1.51	1.15
1966_Base(org)_LT	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.03	0.38	0.65	0.67
1970_Base_HT_(ORG)	0.48	0.48	0.56	0.49	0.19	0.14	1.17	0.16	0.05	0.15	0.32	0.13	0.77	0.15	0.18	0.19	0.32	0.70	0.64	0.93	0.28	0.19	0.41	0.23	0.10	0.29	0.44	0.26	1.44	1.58	1.62	2.10	2.36	2.16	1.48
1974_Base_LT(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.07	0.21	0.25	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.30	0.71	0.70	1.21	1.34	1.60	1.08
1983_Base(org)_LT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.17
1985_Base(org)_HT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.42	0.63	0.51
1986_Base(org)_HT	0.01	0.00	0.00	0.01	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.80	0.46	0.88	0.38	1.10	0.96
1988_Base(org)_LT	0.63	0.36	0.45	0.58	0.20	0.00	0.91	0.15	0.20	0.27	0.18	0.33	0.76	0.19	0.10	0.12	0.37	0.81	0.72	1.39	0.28	0.26	0.32	0.04	0.18	0.44	0.44	0.36	1.32	1.84	1.86	2.18	1.84	2.26	1.92
1991_Base(org)_HT	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.07	0.20	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.44	0.56	0.83	0.98	1.09	0.34
1995_Base_(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.31
1997_May_Base(org)_LT	0.01	0.00	0.00	0.01	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04	0.09	0.25	0.35	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.14	0.55	0.49	0.87	0.88	1.23	0.74
1997_Sep_Base(org)_LT	0.01	0.00	0.01	0.01	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.13	0.23	0.31	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.29	0.70	0.69	1.12	1.27	1.32	0.65
1998-LT-original	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.20	0.25	0.61	0.68	0.82	0.67
2007_Sidr_Base_HT	0.56	0.60	0.63	0.32	0.21	0.06	0.97	0.01	0.01	0.00	0.04	0.14	0.60	0.09	0.07	0.14	0.25	0.34	0.50	0.64	0.22	0.10	0.08	0.01	0.01	0.31	0.29	0.14	0.79	1.14	1.59	1.28	1.79	1.02	1.82
2009_Base_Org_New	0.06	0.33	0.15	0.01	0.05	0.00	0.86	0.00	0.00	0.16	0.26	0.00	0.87	0.00	0.00	0.00	0.00	0.46	0.42	0.67	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.36	0.48	0.63	0.67	0.82	1.01	1.48

Table A- 2: The simulated max. significant wave heights without climate change for locations 36 - 70

Location / Cyclonic Event	Significant Wave Height (m) at Base Condition																																	
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1960_Base(org)_LT	0.80	0.90	0.91	1.04	0.70	0.53	0.39	0.42	0.17	0.54	1.05	0.42	1.16	1.45	0.52	0.13	1.50	2.11	2.08	0.56	0.25	2.53	2.48	1.69	1.66	2.23	1.25	1.48	0.61	2.29	0.53	2.78	2.43	2.09	1.94
1961_Base(org)_LT	1.37	1.16	1.21	1.07	0.92	0.72	0.51	0.55	0.23	0.73	0.76	0.85	1.86	1.92	0.82	0.19	2.47	3.14	1.64	0.91	0.38	3.04	3.27	1.59	1.56	3.32	2.20	2.26	0.62	2.63	1.37	2.71	3.91	2.83	3.12
1963_Base(org)_HT	0.52	0.13	0.18	0.12	0.19	0.01	0.01	0.01	0.00	0.01	0.47	0.05	0.85	0.95	0.13	0.00	0.53	0.84	0.78	0.21	0.01	1.29	1.00	0.66	0.65	1.46	0.66	0.84	0.28	1.53	0.25	2.09	1.91	1.50	2.30
1965_Dec_Base(org)_HT	0.75	0.42	0.43	0.53	0.23	0.01	0.01	0.01	0.00	0.01	0.37	0.07	0.83	0.81	0.10	0.00	0.94	1.31	1.08	0.14	0.00	1.69	1.51	0.84	0.83	1.81	0.82	0.92	0.09	1.01	0.02	1.46	1.87	1.79	2.30
1965_May_Base(org)_LT	1.48	0.89	1.36	0.69	1.09	0.88	0.15	0.27	0.01	0.55	0.88	1.00	2.16	2.29	1.24	0.27	2.30	2.62	2.77	1.44	0.43	3.03	2.85	2.01	1.99	3.06	2.18	2.25	0.65	2.46	1.43	2.55	3.64	2.78	3.17
1966_Base(org)_LT	0.86	0.18	0.25	0.41	0.14	0.01	0.00	0.01	0.00	0.01	0.42	0.05	0.85	0.90	0.12	0.00	1.11	1.32	1.12	0.12	0.01	1.70	2.00	0.94	0.93	1.78	0.69	1.10	0.41	1.92	0.19	2.31	1.35	1.62	2.06
1970_Base_HT_(ORG)	2.09	2.13	1.90	1.68	1.50	1.41	1.23	1.12	0.74	1.58	1.63	1.60	2.38	2.46	1.49	0.57	3.40	4.06	3.05	1.29	1.01	3.93	4.25	2.37	2.37	4.26	2.99	2.70	1.25	3.43	1.38	3.65	4.77	3.84	4.28
1974_Base_LT(org)	1.62	1.32	1.38	1.51	1.08	0.74	0.60	0.60	0.33	0.77	1.15	0.90	1.85	1.85	0.55	0.18	2.62	3.17	1.78	0.48	0.39	3.19	3.40	1.77	1.77	3.45	1.51	1.85	0.81	2.61	0.48	2.92	4.11	3.31	3.75
1983_Base(org)_LT	0.41	0.08	0.14	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.37	0.05	0.00	0.53	0.45	0.14	0.00	0.00	0.57	0.65	0.02	0.02	0.44	0.00	0.01	0.00	0.46	0.00	0.50	0.23	0.44	0.56
1985_Base(org)_HT	0.64	0.22	0.16	0.46	0.10	0.00	0.00	0.00	0.00	0.00	0.16	0.04	0.72	0.65	0.06	0.00	0.77	1.29	1.13	0.02	0.00	1.66	1.69	0.90	0.89	1.97	0.80	0.84	0.01	0.88	0.00	0.98	1.60	1.60	1.92
1986_Base(org)_HT	1.08	0.62	1.26	0.64	0.63	0.61	0.22	0.11	0.15	0.24	0.59	0.78	1.54	1.43	0.64	0.00	1.34	1.36	1.31	0.50	0.00	1.74	1.47	0.93	0.91	1.14	0.90	1.18	0.15	0.75	0.54	0.76	1.36	1.78	1.68
1988_Base(org)_LT	1.71	1.69	2.32	1.30	1.07	1.07	0.74	0.75	0.52	1.10	1.22	1.42	2.41	2.07	1.06	0.01	2.08	2.26	2.22	0.95	0.24	2.53	2.18	1.49	1.48	1.85	1.27	1.53	0.79	1.46	0.98	1.36	2.22	2.00	1.95
1991_Base(org)_HT	1.04	0.90	0.84	1.20	0.61	0.43	0.38	0.38	0.10	0.53	0.83	0.56	1.22	1.32	0.57	0.05	1.49	2.36	2.27	0.50	0.17	2.65	2.58	1.72	1.70	2.75	1.25	1.24	0.53	2.23	0.46	2.70	2.79	2.58	3.10
1995_Base_(org)	0.74	0.16	0.29	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.85	0.14	0.00	0.85	0.67	0.28	0.00	0.00	0.94	0.62	0.04	0.04	0.17	0.01	0.01	0.00	0.01	0.00	0.01	0.14	0.09	0.16
1997_May_Base(org)_LT	1.14	0.86	0.91	0.81	0.76	0.45	0.33	0.38	0.14	0.42	0.91	0.21	1.36	1.39	0.30	0.01	1.53	1.65	1.40	0.40	0.15	2.15	1.73	1.04	1.02	2.04	0.96	1.08	0.47	1.76	0.35	2.37	2.42	2.02	2.62
1997_Sep_Base(org)_LT	1.46	0.98	0.85	1.26	0.73	0.49	0.51	0.53	0.18	0.64	0.93	0.64	1.19	1.20	0.50	0.07	1.92	2.13	1.97	0.45	0.22	2.28	2.43	1.71	1.70	2.16	0.83	1.14	0.50	2.01	0.22	1.92	2.08	1.24	1.62
1998-LT-original	0.84	0.71	0.65	0.76	0.57	0.08	0.25	0.18	0.01	0.31	0.62	0.22	1.05	1.01	0.16	0.00	0.93	1.56	1.45	0.34	0.03	2.08	1.94	1.08	1.07	2.44	1.09	0.94	0.18	1.15	0.05	1.12	2.33	2.19	2.59
2007_Sidr_Base_HT	2.85	2.32	2.11	1.32	1.02	0.79	0.66	0.66	0.10	1.22	1.07	1.39	2.74	2.75	1.62	0.40	3.54	3.95	3.48	1.74	0.64	3.96	3.65	2.38	2.36	3.50	2.18	2.39	0.88	2.53	1.39	2.66	4.06	2.98	3.15
2009_Base_Org_New	1.59	1.04	1.36	0.50	0.18	0.32	0.00	0.00	0.00	0.34	0.22	0.50	1.75	1.47	0.46	0.00	1.82	1.88	1.32	0.28	0.00	1.93	1.77	0.59	0.59	1.03	0.52	0.53	0.19	0.74	0.40	0.73	1.29	0.90	0.97

Table A- 3: The simulated max. significant wave heights without climate change for locations 71 - 105

Location / Cyclonic Event	Significant Wave Height (m) at Base Condition																																	
	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
1960_Base(org)_LT	2.33	2.16	1.53	3.12	3.08	2.07	1.81	1.84	3.05	2.61	2.69	4.37	3.90	1.35	6.16	6.23	6.01	1.67	4.84	4.88	4.43	5.30	3.21	5.53	4.45	5.04	5.33	2.75	5.16	8.15	0.02	0.94	0.76	0.06	1.20
1961_Base(org)_LT	1.76	1.97	1.64	2.97	2.29	2.47	1.40	1.46	2.99	1.55	1.87	2.92	2.92	0.01	3.00	2.55	2.74	0.48	2.05	2.27	1.36	2.40	1.22	2.56	1.77	2.29	3.14	1.06	3.00	4.15	0.18	1.45	1.20	0.30	1.58
1963_Base(org)_HT	1.20	1.57	0.37	2.76	2.24	1.71	1.02	1.00	2.76	1.54	2.33	3.02	3.24	1.04	5.12	5.18	4.97	0.96	3.89	4.00	3.49	4.57	3.04	4.85	4.12	4.39	4.82	2.62	4.95	7.70	0.00	0.39	0.07	0.00	0.63
1965_Dec_Base(org)_HT	1.69	1.47	0.35	3.00	2.09	1.07	1.14	0.92	0.77	1.29	1.15	2.64	3.20	0.83	3.89	3.44	4.00	0.41	2.57	3.09	3.50	4.30	1.45	4.58	2.59	4.44	4.68	2.86	5.15	8.42	0.00	0.54	0.26	0.00	0.69
1965_May_Base(org)_LT	1.83	1.84	1.58	2.42	1.92	1.98	0.94	1.45	3.21	1.65	1.70	2.98	2.70	0.01	3.11	2.87	2.94	0.42	2.46	2.54	1.72	2.62	1.38	2.77	2.09	2.45	3.02	1.25	3.02	3.91	0.15	1.45	1.28	0.58	1.36
1966_Base(org)_LT	1.79	1.36	0.76	3.23	2.59	2.58	1.58	1.74	3.64	1.87	2.17	3.86	3.43	0.68	4.74	4.68	4.54	0.68	3.56	3.69	2.91	3.69	1.75	3.82	2.94	3.13	3.26	1.51	3.03	3.90	0.00	0.35	0.07	0.00	0.64
1970_Base_HT_(ORG)	3.13	2.95	2.71	4.16	3.49	3.64	2.95	3.19	5.15	3.03	3.26	5.46	4.86	0.93	5.08	5.00	4.88	1.04	3.55	3.64	3.10	4.11	2.64	4.41	3.38	3.64	4.23	1.77	4.01	6.32	0.40	2.36	2.07	1.21	2.11
1974_Base_LT(org)	2.47	2.33	2.16	3.61	2.98	3.03	2.38	2.64	4.69	2.68	2.75	4.66	4.04	0.44	4.22	3.91	3.91	0.69	2.82	3.02	2.10	3.27	1.87	3.51	2.53	2.77	3.42	1.37	3.27	4.89	0.02	1.37	1.15	0.10	1.64
1983_Base(org)_LT	0.68	0.43	0.08	0.92	0.66	0.44	0.01	0.01	0.13	0.24	0.42	0.77	0.78	0.16	1.61	1.63	1.84	0.06	1.82	2.17	2.30	2.87	0.52	3.04	1.51	3.00	3.29	1.69	3.89	5.91	0.00	0.00	0.00	0.00	0.05
1985_Base(org)_HT	1.54	1.23	0.44	2.58	1.86	1.35	0.91	0.78	0.86	0.96	0.78	1.77	2.59	0.53	3.13	2.87	3.37	0.45	2.41	2.80	3.00	3.91	2.34	4.19	3.21	4.10	4.37	2.16	4.39	6.95	0.00	0.39	0.10	0.00	0.63
1986_Base(org)_HT	1.24	0.68	0.61	1.23	1.14	1.46	0.24	0.74	1.69	0.81	1.60	1.60	2.24	0.08	2.73	2.71	2.70	0.30	2.42	2.48	1.91	2.49	1.00	2.56	2.00	2.27	2.60	1.13	2.43	2.72	0.00	0.39	0.68	0.03	1.04
1988_Base(org)_LT	1.18	1.07	0.90	1.89	1.15	1.80	0.85	1.06	2.04	1.21	1.41	2.04	2.25	0.00	2.43	2.21	2.30	0.38	1.93	2.04	1.26	2.12	1.04	2.22	1.69	2.10	2.72	1.03	2.61	3.69	0.40	1.85	2.32	0.79	2.12
1991_Base(org)_HT	2.53	2.41	0.87	4.20	3.53	2.40	2.46	2.18	2.48	2.91	2.39	4.69	4.91	1.25	5.20	5.21	5.17	1.83	4.23	4.65	4.46	5.60	3.90	5.89	4.93	5.12	5.32	2.71	5.27	8.38	0.07	0.96	0.83	0.06	1.13
1995_Base_(org)	0.04	0.01	0.01	0.46	0.11	0.31	0.01	0.01	0.15	0.04	0.20	0.32	0.65	0.00	0.75	0.61	0.71	0.08	0.74	0.79	0.47	1.13	0.30	1.19	1.03	1.56	2.42	0.91	2.47	3.72	0.00	0.00	0.00	0.00	0.09
1997_May_Base(org)_LT	1.66	1.88	0.38	3.22	2.83	1.61	1.99	1.69	1.91	1.98	1.61	3.60	3.89	0.76	4.47	4.50	4.51	0.80	3.41	3.54	3.38	4.34	2.26	4.63	3.75	4.30	4.71	2.49	4.95	7.75	0.02	0.92	0.69	0.20	1.24
1997_Sep_Base(org)_LT	1.48	1.28	0.91	3.13	2.70	2.23	1.58	1.74	2.99	1.24	1.82	4.20	4.02	0.72	4.88	5.18	5.13	1.07	4.18	4.29	3.81	4.79	3.00	5.07	4.08	4.47	4.80	2.30	4.69	7.44	0.01	1.27	1.10	0.18	1.37
1998-LT-original	1.61	1.69	0.57	3.30	2.66	1.97	1.24	1.33	1.39	0.82	1.16	2.55	3.34	0.07	2.67	2.12	2.57	0.60	1.94	2.47	1.99	3.31	2.00	3.67	2.89	3.26	4.25	1.45	4.33	7.53	0.00	0.69	0.66	0.01	0.95
2007_Sidr_Base_HT	1.84	2.03	1.63	3.32	2.60	2.70	1.47	1.60	3.08	1.67	2.08	3.37	3.39	0.00	3.45	2.90	3.22	0.63	2.36	2.63	1.63	2.80	1.28	3.04	1.89	2.64	3.81	1.17	4.23	7.10	0.02	1.68	1.80	0.93	1.09
2009_Base_Org_New	0.50	0.56	0.47	1.46	1.06	1.16	0.59	0.61	1.23	0.58	0.84	1.34	1.59	0.00	1.65	1.46	1.55	0.27	1.17	1.27	0.76	1.44	0.68	1.53	1.26	1.55	2.08	0.82	2.13	2.67	0.01	0.81	0.86	0.89	1.07

Table A- 4: The simulated max. significant wave heights without climate change for locations 106 - 141

Location / Cyclonic Event	Significant Wave Height (m) at Base Condition																																			
	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
1960_Base(org)_LT	0.98	0.71	0.67	0.62	0.84	0.84	0.37	0.51	0.49	0.09	0.21	0.12	0.17	0.00	0.06	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.70	1.79	0.86	1.60	3.60	4.04
1961_Base(org)_LT	1.38	1.00	1.15	0.84	0.57	0.57	0.62	0.88	0.45	0.29	0.35	0.25	0.10	0.00	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	2.49	2.54	2.24	2.98	1.25	1.12
1963_Base(org)_HT	0.59	0.04	0.04	0.02	0.34	0.34	0.03	0.17	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.69	0.87	0.42	0.94	2.66	3.12
1965_Dec_Base(org)_HT	0.71	0.27	0.19	0.06	0.32	0.32	0.03	0.11	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.70	0.15	0.47	0.80	3.03
1965_May_Base(org)_LT	1.42	0.77	0.32	0.87	0.70	0.70	1.07	1.13	0.59	0.47	0.46	0.40	0.31	0.00	0.19	0.06	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	2.36	2.54	1.98	2.82	1.67	1.40
1966_Base(org)_LT	0.64	0.07	0.04	0.04	0.31	0.31	0.04	0.30	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	1.18	0.76	1.50	2.26	2.53
1970_Base_HT_(ORG)	1.89	1.79	1.88	1.55	1.26	1.26	1.45	1.36	1.21	0.80	0.87	0.62	1.42	0.16	0.71	0.36	0.19	0.05	0.14	0.16	0.02	0.23	0.11	0.22	0.20	0.12	0.70	0.16	0.26	0.19	1.97	2.62	2.83	3.87	2.25	2.70
1974_Base_LT(org)	1.45	1.15	1.21	0.99	0.88	0.88	0.54	0.81	0.67	0.28	0.32	0.20	0.17	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	1.88	2.70	2.23	3.40	1.63	1.76
1983_Base(org)_LT	0.11	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.19	0.06	0.40	0.70	2.14
1985_Base(org)_HT	0.61	0.13	0.08	0.04	0.20	0.20	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.51	0.19	0.39	0.70	2.71
1986_Base(org)_HT	1.09	0.68	0.59	0.73	0.43	0.43	0.36	0.36	0.03	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	1.39	1.20	0.75	1.31	1.63	1.64
1988_Base(org)_LT	2.37	1.75	1.49	1.35	1.02	1.02	0.75	0.59	0.28	0.18	0.13	0.19	0.59	0.13	0.31	0.56	0.37	0.28	0.20	0.18	0.14	0.02	0.02	0.06	0.08	0.38	0.77	0.43	0.10	0.13	1.76	1.60	1.36	1.68	1.28	0.98
1991_Base(org)_HT	0.95	0.76	0.71	0.68	0.77	0.77	0.34	0.41	0.37	0.17	0.23	0.15	0.17	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.55	1.67	0.68	1.24	3.15	4.08
1995_Base_(org)	0.20	0.07	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.45	0.28
1997_May_Base(org)_LT	1.09	0.65	0.57	0.37	0.78	0.78	0.23	0.39	0.34	0.01	0.02	0.00	0.12	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.49	1.26	0.43	0.87	1.68	3.09
1997_Sep_Base(org)_LT	1.15	0.84	0.88	0.76	0.86	0.86	0.46	0.32	0.38	0.15	0.21	0.13	0.31	0.00	0.05	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.44	1.14	0.64	1.35	2.84	3.42
1998-LT-original	0.89	0.56	0.60	0.38	0.60	0.60	0.23	0.19	0.21	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.21	0.20	0.53	0.98	1.81
2007_Sidr_Base_HT	1.97	2.08	1.57	1.24	1.01	1.01	1.36	1.13	0.84	0.57	0.45	0.45	1.58	0.10	0.77	0.42	0.24	0.15	0.11	0.08	0.00	0.19	0.06	0.01	0.09	0.15	0.61	0.35	0.23	0.03	2.67	2.50	2.38	2.78	1.50	1.37
2009_Base_Org_New	1.49	0.99	0.71	0.50	0.11	0.11	0.25	0.10	0.02	0.01	0.00	0.00	0.28	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.15	0.26	0.36	0.02	0.00	0.72	0.67	0.63	0.86	0.80	0.62

A.2 Maximum Significant Wave Height with Climate Change

The significant wave height with climate change for all 141 locations along the Bangladesh coastlines are listed below in Table A-5, Table A-6, Table A-7 & Table A-8.

Table A- 5: The simulated significant wave heights with climate change for locations 1 -35

Cyclonic Event	Significant Wave Height (m) at CC Condition																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1960_CC2050(org)	0.01	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.05	0.19	0.22	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.14	0.57	0.57	0.99	1.06	1.38	0.72
1961_CC2050(org)	0.02	0.00	0.00	0.01	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.02	0.29	0.38	0.48	0.07	0.08	0.01	0.08	0.01	0.03	0.18	0.03	0.62	1.02	0.90	1.60	1.61	1.79	1.03
1963_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.15	0.51	0.71	0.64
1965_May_CC2050(org)_LT	0.20	0.03	0.03	0.13	0.00	0.00	0.80	0.00	0.00	0.00	0.01	0.00	0.32	0.03	0.00	0.04	0.18	0.38	0.52	0.60	0.04	0.01	0.04	0.01	0.02	0.15	0.26	0.07	0.63	1.10	1.18	1.71	1.64	1.78	1.36
1965_Dec_HT_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.32	0.61	0.76	0.65
1966_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.52	0.69	0.68
1970_CC2050(org)	0.50	0.55	0.66	0.53	0.23	0.17	1.20	0.18	0.08	0.18	0.35	0.15	0.87	0.18	0.22	0.23	0.37	0.80	0.75	1.02	0.30	0.20	0.47	0.26	0.15	0.35	0.51	0.29	1.56	1.70	1.75	2.24	2.54	2.31	1.64
1974_CC2050(org)	0.01	0.00	0.00	0.01	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.20	0.29	0.35	0.02	0.00	0.00	0.04	0.01	0.01	0.02	0.00	0.42	0.86	0.79	1.41	1.55	1.80	1.21
1983_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.12	0.04	0.21
1985_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.13	0.55	0.66	0.59
1986_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.74	1.20	0.86	1.28	0.78	1.50	1.26
1988_CC_org_2050 (New)	0.94	0.66	0.75	0.88	0.36	0.15	1.20	0.33	0.29	0.41	0.33	0.50	1.09	0.32	0.25	0.29	0.55	1.08	0.93	1.72	0.40	0.36	0.56	0.20	0.26	0.57	0.58	0.46	1.43	1.97	2.00	2.34	2.15	2.46	2.20
1991_CC2050(org)	0.00	0.00	0.00	0.01	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.16	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.53	0.63	0.89	1.08	1.17	0.38
1995_CC2050(org)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05	0.11	0.07	0.35
1997_May_CC2050(org)	0.02	0.00	0.00	0.02	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.06	0.21	0.35	0.44	0.02	0.03	0.00	0.06	0.01	0.00	0.01	0.01	0.20	0.60	0.52	1.01	0.99	1.37	0.74
1997_Sep_CC2050(org)	0.05	0.01	0.01	0.03	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.11	0.21	0.30	0.40	0.01	0.00	0.00	0.01	0.00	0.00	0.03	0.01	0.42	0.85	0.79	1.32	1.46	1.48	0.75
1998_CC2050(org)	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.33	0.40	0.73	0.78	0.91	0.66
2007_CC2050(org)	0.76	0.86	0.86	0.55	0.30	0.19	1.29	0.16	0.13	0.02	0.27	0.20	0.88	0.19	0.20	0.21	0.34	0.50	0.69	0.95	0.34	0.26	0.24	0.09	0.21	0.46	0.45	0.25	1.14	1.43	1.82	1.61	2.15	1.45	2.15
2009_AilaCC2050(org)	0.16	0.45	0.18	0.02	0.17	0.00	0.96	0.00	0.00	0.20	0.32		0.98					0.52	0.47	0.73			0.45				0.01	0.00	0.41	0.52	0.70	0.72	0.91	1.08	1.53

Table A- 6: The simulated significant wave heights with climate change for locations 36 - 70

Cyclonic Event	Significant Wave Height (m) at CC Condition																																		
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1960_CC2050(org)	0.90	0.99	0.95	1.21	0.76	0.62	0.49	0.51	0.25	0.63	1.12	0.55	1.19	1.46	0.61	0.18	1.58	2.31	2.22	0.63	0.27	2.59	2.56	1.81	1.79	2.44	1.32	1.47	0.70	2.38	0.59	2.91	2.57	2.22	2.08
1961_CC2050(org)	1.51	1.36	1.40	1.24	1.06	0.88	0.62	0.64	0.31	0.86	0.86	1.02	2.01	2.06	0.96	0.23	2.68	3.36	1.87	1.04	0.55	3.27	3.43	1.79	1.80	3.44	2.28	2.37	0.73	2.83	1.52	2.94	4.05	3.01	3.41
1963_CC2050(org)	0.57	0.32	0.39	0.38	0.37	0.04	0.03	0.01	0.01	0.02	0.58	0.07	0.92	1.12	0.15	0.00	0.61	0.98	0.89	0.26	0.02	1.48	1.15	0.73	0.72	1.64	0.75	0.96	0.36	1.72	0.30	2.27	2.10	1.63	2.41
1965_May_CC2050(org)_LT	1.69	1.12	1.53	0.78	1.28	1.06	0.26	0.42	0.07	0.75	1.00	1.16	2.32	2.46	1.38	0.33	2.47	2.78	2.91	1.66	0.56	3.20	3.02	2.14	2.11	3.19	2.28	2.38	0.75	2.60	1.56	2.70	3.80	2.94	3.42
1965_Dec_HT_CC2050(org)	0.85	0.60	0.61	0.67	0.42	0.02	0.04	0.02	0.00	0.04	0.53	0.13	0.97	0.98	0.11	0.00	1.04	1.51	1.32	0.27	0.00	1.93	1.70	1.00	0.98	2.01	0.92	1.02	0.19	1.12	0.05	1.68	2.10	1.98	2.52
1966_CC2050(org)	1.00	0.46	0.51	0.60	0.32	0.01	0.02	0.01	0.01	0.03	0.60	0.09	0.98	1.13	0.14	0.00	1.23	1.54	1.42	0.28	0.03	1.97	2.24	1.16	1.15	2.06	0.80	1.37	0.51	2.23	0.37	2.57	1.61	1.87	2.31
1970_CC2050(org)	2.32	2.31	2.05	1.84	1.66	1.55	1.37	1.22	0.84	1.74	1.77	1.74	2.51	2.61	1.63	0.65	3.61	4.29	3.29	1.43	1.29	4.13	4.50	2.60	2.61	4.57	3.26	2.80	1.34	3.64	1.51	3.95	5.11	4.04	4.53
1974_CC2050(org)	1.81	1.50	1.56	1.66	1.21	0.87	0.72	0.70	0.40	0.89	1.32	1.08	1.98	1.96	0.66	0.22	2.78	3.39	2.02	0.58	0.58	3.34	3.57	2.05	2.05	3.58	1.65	1.96	0.96	2.82	0.60	3.06	4.22	3.45	3.88
1983_CC2050(org)	0.49	0.10	0.18	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.42	0.43	0.06	0.00	0.60	0.50	0.16	0.00	0.00	0.65	0.73	0.16	0.16	0.53	0.02	0.05	0.00	0.53	0.00	0.63	0.57	0.62	0.68
1985_CC2050(org)	0.68	0.45	0.43	0.63	0.25	0.00	0.00	0.01	0.00	0.01	0.25	0.11	0.80	0.76	0.06	0.00	0.86	1.49	1.35	0.09	0.00	1.90	1.91	1.06	1.04	2.22	0.90	0.94	0.03	0.93	0.01	1.24	1.87	1.85	2.21
1986_CC2050(org)	1.48	1.02	1.66	1.04	1.03	1.01	0.62	0.51	0.55	0.64	0.99	1.18	1.94	1.83	1.04	0.40	1.74	1.76	1.71	0.90	0.40	2.14	1.87	1.33	1.31	1.54	1.30	1.58	0.55	1.15	0.94	1.16	1.76	2.18	2.08
1988_CC_org_2050 (New)	2.06	2.04	2.64	1.61	1.34	1.31	0.98	0.98	0.65	1.35	1.55	1.78	2.75	2.38	1.31	0.06	2.37	2.62	2.64	1.25	0.38	2.86	2.48	1.79	1.77	2.24	1.57	1.84	1.02	1.82	1.25	1.72	2.67	2.35	2.36
1991_CC2050(org)	1.10	0.95	0.88	1.29	0.66	0.38	0.41	0.44	0.16	0.60	0.86	0.59	1.24	1.32	0.63	0.02	1.56	2.38	2.31	0.54	0.17	2.68	2.64	1.79	1.78	2.82	1.30	1.26	0.61	2.33	0.49	2.75	2.88	2.63	3.24
1995_CC2050(org)	0.82	0.19	0.33	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.87	1.01	0.17	0.00	1.01	0.80	0.34	0.00	0.00	1.14	0.69	0.16	0.16	0.21	0.02	0.05	0.00	0.07	0.00	0.09	0.19	0.11	0.22
1997_May_CC2050(org)	1.30	0.96	1.03	0.91	0.83	0.54	0.37	0.45	0.20	0.51	1.01	0.31	1.48	1.48	0.40	0.02	1.65	1.83	1.63	0.45	0.17	2.32	1.90	1.19	1.17	2.25	1.05	1.14	0.57	1.97	0.42	2.51	2.49	2.08	2.69
1997_Sep_CC2050(org)	1.69	1.14	0.96	1.44	0.84	0.60	0.61	0.63	0.29	0.76	1.07	0.75	1.37	1.28	0.59	0.13	2.10	2.40	2.25	0.57	0.30	2.52	2.70	1.96	1.94	2.49	0.97	1.32	0.62	2.36	0.33	2.26	2.41	1.43	1.90
1998_CC2050(org)	0.89	0.78	0.70	0.83	0.64	0.20	0.29	0.28	0.02	0.38	0.65	0.25	1.14	1.10	0.28	0.01	1.07	1.70	1.61	0.37	0.08	2.21	2.02	1.19	1.17	2.46	1.02	0.95	0.25	1.26	0.12	1.29	2.54	2.25	2.69
2007_CC2050(org)	3.50	2.77	2.48	1.63	1.37	1.11	1.00	0.86	0.36	1.52	1.38	1.66	3.06	3.06	1.79	0.55	4.05	4.49	3.95	1.91	0.98	4.49	4.02	2.68	2.66	3.74	2.44	2.64	1.16	2.97	1.67	3.13	4.29	3.40	3.66
2009_AilaCC2050(org)	1.67	1.12	1.45	0.56	0.22	0.37	0.01	0.00	0.00	0.47	0.25	0.53	1.79	1.53	0.51		1.88	1.96	1.41	0.34	0.00	2.01	1.83	0.64	0.64	1.11	0.55	0.57	0.28	0.81	0.43	0.77	1.37	0.97	1.04

Table A- 7: The simulated significant wave heights with climate change for locations 71 - 105

Cyclonic Event	Significant Wave Height (m) at CC Condition																																	
	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
1960_CC2050(org)	2.45	2.29	1.64	3.21	3.24	2.15	1.97	1.99	3.19	2.81	2.85	4.53	4.06	1.44	6.42	6.51	6.24	1.82	5.01	5.02	4.55	5.41	3.32	5.64	4.53	5.16	5.40	2.76	5.16	8.30	0.07	1.10	0.85	0.08	1.34
1961_CC2050(org)	1.96	2.19	1.83	3.23	2.54	2.69	1.63	1.70	3.34	1.75	2.07	3.20	3.16	0.01	3.26	2.78	2.98	0.56	2.22	2.46	1.50	2.59	1.34	2.77	1.91	2.43	3.34	1.14	3.18	4.47	0.17	1.66	1.36	0.53	1.78
1963_CC2050(org)	1.28	1.68	0.47	2.86	2.31	1.85	1.16	1.13	2.94	1.72	2.48	3.22	3.37	1.13	5.28	5.35	5.15	1.10	4.08	4.16	3.65	4.77	3.24	5.05	4.34	4.56	4.97	2.81	5.16	7.82	0.00	0.51	0.21	0.00	0.67
1965_May_CC2050(org)_LT	2.02	2.02	1.76	2.64	2.12	2.17	1.26	1.76	3.57	1.88	1.90	3.29	2.96	0.02	3.39	3.12	3.21	0.48	2.65	2.73	1.86	2.82	1.51	2.99	2.26	2.60	3.21	1.34	3.18	4.21	0.21	1.75	1.60	0.78	1.62
1965_Dec_HT_CC2050(org)	1.84	1.70	0.39	3.13	2.37	1.21	1.30	1.05	0.88	1.37	1.23	2.92	3.34	0.93	3.93	3.50	4.05	0.48	2.65	3.19	3.62	4.44	1.56	4.72	2.74	4.66	4.93	3.02	5.35	8.50	0.00	0.63	0.51	0.01	0.80
1966_CC2050(org)	2.04	1.57	0.94	3.54	2.88	2.82	1.87	2.05	4.05	2.14	2.45	4.32	3.75	0.76	5.06	5.01	4.83	0.79	3.71	3.82	3.15	4.06	1.98	4.21	3.18	3.38	3.54	1.67	3.29	4.29	0.00	0.54	0.27	0.01	0.68
1970_CC2050(org)	3.32	3.16	2.92	4.33	3.69	3.83	3.11	3.35	5.26	3.19	3.46	5.61	5.01	1.04	5.22	5.14	5.00	1.14	3.71	3.82	3.32	4.33	2.81	4.60	3.59	3.94	4.40	1.90	4.19	6.60	0.47	2.55	2.21	1.26	2.26
1974_CC2050(org)	2.60	2.47	2.29	3.77	3.12	3.19	2.53	2.82	4.87	2.82	2.93	4.99	4.35	0.53	4.50	4.20	4.19	0.80	3.00	3.22	2.30	3.50	2.04	3.76	2.72	2.99	3.64	1.47	3.42	5.23	0.08	1.59	1.35	0.22	1.85
1983_CC2050(org)	0.74	0.56	0.14	1.06	0.76	0.57	0.05	0.09	0.14	0.21	0.48	0.84	0.86	0.25	1.88	1.88	2.11	0.07	2.02	2.38	2.55	3.24	0.59	3.44	1.70	3.39	3.64	1.90	4.14	6.58	0.00	0.08	0.04	0.00	0.06
1985_CC2050(org)	1.77	1.40	0.57	2.91	2.17	1.56	1.07	0.91	1.00	1.15	0.93	2.05	2.95	0.64	3.52	3.22	3.78	0.56	2.56	2.96	3.15	4.04	2.59	4.33	3.46	4.24	4.47	2.26	4.50	7.27	0.00	0.55	0.29	0.00	1.32
1986_CC2050(org)	1.64	1.08	1.01	1.63	1.54	1.86	0.64	1.14	2.09	1.21	2.00	2.00	2.64	0.48	3.13	3.11	3.10	0.70	2.60	2.75	2.31	2.89	1.40	2.96	2.40	2.67	3.00	1.53	2.83	3.12	0.40	0.79	1.08	0.43	1.44
1988_CC_org_2050 (New)	1.47	1.32	1.17	2.22	1.43	2.10	1.16	1.45	2.54	1.53	1.73	2.48	2.65	0.01	2.82	2.58	2.65	0.48	2.22	2.35	1.47	2.42	1.25	2.55	1.91	2.38	3.06	1.18	2.93	4.17	0.55	2.16	2.50	1.09	2.34
1991_CC2050(org)	2.66	2.52	0.99	4.37	3.67	2.55	2.56	2.26	2.51	3.04	2.46	4.80	5.00	1.35	5.23	5.27	5.23	1.98	4.32	4.78	4.64	5.81	4.04	6.09	5.13	5.37	5.49	2.79	5.36	8.28	0.00	1.05	0.90	0.10	1.21
1995_CC2050(org)	0.07	0.09	0.01	0.50	0.26	0.34	0.05	0.09	0.16	0.07	0.22	0.34	0.69	0.01	0.79	0.65	0.75	0.09	0.78	0.84	0.50	1.19	0.32	1.25	1.09	1.65	2.57	1.01	2.70	3.99	0.00	0.08	0.04	0.00	0.11
1997_May_CC2050(org)	1.70	1.97	0.39	3.32	2.94	1.73	2.09	1.84	2.09	2.09	1.70	3.71	4.00	0.91	4.62	4.64	4.67	0.91	3.58	3.70	3.57	4.49	2.48	4.77	3.90	4.46	4.88	2.65	5.09	7.84	0.07	1.05	0.76	0.43	1.38
1997_Sep_CC2050(org)	1.74	1.50	1.18	3.41	3.00	2.52	1.94	2.08	3.45	1.52	2.12	4.67	4.26	0.83	5.13	5.38	5.31	1.25	4.36	4.47	4.04	5.00	3.09	5.26	4.23	4.69	5.00	2.48	4.86	7.79	0.05	1.47	1.30	0.47	1.54
1998_CC2050(org)	1.76	1.86	0.54	3.41	2.80	1.97	1.57	1.46	1.51	0.88	1.16	2.76	3.56	0.20	2.91	2.31	2.80	0.63	2.10	2.65	2.26	3.50	2.22	3.88	3.12	3.42	4.26	1.64	4.45	7.78	0.00	0.77	0.69	0.04	1.03
2007_CC2050(org)	2.26	2.57	2.07	3.81	3.09	3.11	1.91	2.10	3.74	2.10	2.48	4.02	3.94	0.02	3.95	3.33	3.65	0.80	2.67	3.00	1.92	3.23	1.58	3.50	2.16	2.96	4.14	1.34	4.63	7.64	0.22	2.03	2.14	1.29	1.57
2009_AilaCC2050(org)	0.54	0.62	0.52	1.54	1.15	1.22	0.60	0.66	1.30	0.63	0.90	1.41	1.64	0.01	1.73	1.53	1.63	0.31	1.24	1.35	0.82	1.52	0.72	1.61	1.31	1.61	2.18	0.86	2.22	2.86	0.03	0.90	0.96	0.98	1.15

Table A- 8: The simulated significant wave heights with climate change for locations 106 - 141

Cyclonic Event	Significant Wave Height (m) at CC Condition																																		
	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
1960_CC2050(org)	1.07	0.80	0.77	0.73	0.96	0.96	0.43	0.52	0.52	0.16	0.27	0.15	0.08	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.76	1.89	0.97	1.69	3.78	4.14
1961_CC2050(org)	1.53	1.16	1.34	0.99	0.74	0.74	0.72	1.01	0.62	0.38	0.42	0.31	0.24	0.00	0.07	0.02	0.00	0.00	0.00	0.03	0.00	0.03	0.04	0.00	0.00	0.00	0.04	0.00	0.00	0.02	2.74	2.72	2.43	3.28	1.38	1.24
1963_CC2050(org)	0.66	0.13	0.10	0.04	0.43	0.43	0.09	0.22	0.24	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	1.02	0.51	1.07	2.90	3.28
1965_May_CC2050(org)_LT	1.68	0.91	0.51	0.99	0.79	0.79	1.28	1.30	0.72	0.57	0.53	0.47	0.58	0.00	0.35	0.18	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.30	0.01	0.00	0.00	2.52	2.68	2.15	2.98	1.83	1.52
1965_Dec_HT_CC2050(org)	0.79	0.42	0.40	0.21	0.46	0.46	0.13	0.27	0.26	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.76	0.18	0.51	0.86	3.14
1966_CC2050(org)	0.70	0.28	0.20	0.18	0.45	0.45	0.15	0.37	0.35	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	1.40	0.87	1.71	2.43	2.72
1970_CC2050(org)	2.03	1.95	2.04	1.70	1.40	1.40	1.63	1.46	1.34	0.89	0.95	0.70	1.53	0.20	0.80	0.41	0.22	0.11	0.19	0.17	0.02	0.25	0.11	0.25	0.25	0.13	0.78	0.22	0.30	0.20	2.16	2.70	2.99	4.10	2.42	2.91
1974_CC2050(org)	1.61	1.31	1.42	1.16	1.04	1.04	0.72	0.90	0.79	0.34	0.38	0.25	0.33	0.00	0.06	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.00	0.00	0.00	2.10	2.89	2.48	3.56	1.79	1.93
1983_CC2050(org)	0.14	0.04	0.03	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.60	0.21	0.44	0.77	2.34
1985_CC2050(org)	0.70	0.31	0.27	0.18	0.28	0.28	0.02	0.03	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.63	0.22	0.46	0.76	2.86
1986_CC2050(org)	1.49	1.13	0.99	1.13	0.83	0.83	0.76	0.76	0.43	0.44	0.43	0.41	0.41	0.35	0.40	0.70	0.40	0.38	0.40	0.40	0.45	0.40	0.25	0.40	0.27	0.40	0.42	0.40	0.40	0.40	1.79	1.60	1.15	1.63	1.83	1.82
1988_CC_org_2050 (New)	2.62	2.13	1.76	1.66	1.33	1.33	1.01	0.79	0.45	0.28	0.22	0.29	0.85	0.34	0.47	0.88	0.51	0.39	0.35	0.30	0.21	0.23	0.19	0.25	0.29	0.65	1.09	0.57	0.31	0.31	2.21	2.01	1.70	2.08	1.49	1.17
1991_CC2050(org)	1.02	0.81	0.76	0.73	0.83	0.83	0.36	0.37	0.35	0.21	0.27	0.18	0.28	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.59	1.75	0.74	1.33	3.30	4.26
1995_CC2050(org)	0.23	0.08	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.09	0.49	0.30
1997_May_CC2050(org)	1.17	0.72	0.61	0.47	0.87	0.87	0.28	0.43	0.35	0.02	0.11	0.01	0.27	0.00	0.03	0.03	0.00	0.00	0.00	0.01	0.00	0.01	0.04	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.52	1.42	0.51	0.99	1.90	3.26
1997_Sep_CC2050(org)	1.29	0.99	1.04	0.90	1.01	1.01	0.58	0.41	0.45	0.21	0.26	0.17	0.64	0.00	0.13	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.03	0.53	1.49	0.76	1.56	3.05	3.64
1998_CC2050(org)	0.95	0.61	0.64	0.42	0.66	0.66	0.25	0.17	0.23	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.20	0.33	0.22	0.61	1.12	2.04
2007_CC2050(org)	2.31	2.44	1.90	1.49	1.30	1.30	1.52	1.38	1.11	0.79	0.62	0.61	1.76	0.25	1.01	0.57	0.36	0.25	0.22	0.18	0.01	0.25	0.07	0.13	0.19	0.21	0.83	0.51	0.45	0.11	3.16	3.00	2.81	3.41	1.75	1.63
2009_AilaCC2050(org)	1.57	1.07	0.79	0.53	0.14	0.14	0.31	0.14	0.03	0.01	0.00	0.00	0.37	0.00	0.00	0.50			0.00	0.00	0.00	0.00		0.00	0.10	0.20	0.31	0.39	0.03	0.00	0.78	0.72	0.70	0.95	0.86	0.66

B Estimated Significant Wave Heights for Different Return Periods

The significant wave height for 10, 25, 50 & 100 year return periods without climate change (in 2050) and with climate change for all 141 locations along the Bangladesh coastlines are listed below in **Error! Reference source not found.**B-1, **Error! Reference source not found.**B-2, B-3 & **Error! Reference source not found.**B-4. For locations 7-31, 41-46, 64, 66, 84, 104, 110-120 waves were not generated for most of the cyclones without climate change

Table B- 1: The significant wave heights for different return periods from locations 1 - 35

Location ID	Geographical Location		Sign. Wave height during different Return Periods (Without CC)				Sign. Wave height Level during different Return Periods (With CC)				River Name
	BTM Easting	BTM Northing	10	25	50	100	10	25	50	100	
1	424820	456897		0.48	0.59	0.67		0.51	0.75	0.97	Kholpetua
2	423114	463204		0.44	0.53	0.59		0.63	0.76	0.84	Kholpetua
3	429031	462439		0.36	0.62	0.88		0.64	0.80	0.92	Kobadak
7	442770	478297	0.59	0.90	1.09	1.27	0.75	1.08	1.28	1.45	Sibsa
13	439653	490660	0.23	0.61	0.85	1.05	0.37	0.84	1.08	1.28	Sibsa
19	456925	491152	0.36	0.54	0.65	0.74	0.44	0.67	0.81	0.94	Pussur
20	457810	482411	0.47	0.81	1.05	1.28	0.59	1.01	1.29	1.56	Pussur
30	493730	477828	0.88	1.29	1.56	1.79	0.99	1.45	1.73	1.98	Baleswar
31	488904	475025	0.90	1.36	1.66	1.93	1.03	1.53	1.84	2.11	Fanguchi
32	489090	469684	1.08	1.70	2.13	2.54	1.19	1.89	2.37	2.84	Baleswar
33	483717	458446	1.22	1.78	2.14	2.47	1.39	2.03	2.45	2.85	Baleswar
34	490695	444495	1.39	1.87	2.16	2.42	1.50	2.09	2.47	2.80	Baleswar
35	491282	434133	1.11	1.53	1.80	2.05	1.20	1.72	2.06	2.37	Baleswar

Table B- 2: The significant wave heights for different return periods from locations 36 - 70

Location ID	Geographical Location		Sign. Wave height during different Return Periods (Without CC)				Sign. Wave height Level during different Return Periods (With CC)				River Name
	BTM Easting	BTM Northing	10	25	50	100	10	25	50	100	
36	484850	415770	1.46	1.99	2.35	2.68	1.64	2.32	2.78	3.21	Baleswar Estuary
37	499050	430095	1.13	1.71	2.12	2.50	1.32	1.98	2.43	2.84	Bishkhali Estuary
38	501178	429630	1.24	1.84	2.25	2.64	1.38	2.04	2.47	2.87	Bishkhali Estuary
39	507050	433730	1.05	1.46	1.73	1.97	1.18	1.67	1.99	2.27	Buriswar
40	502938	438491	0.79	1.18	1.44	1.68	0.91	1.37	1.67	1.95	Bishkhali
41	506979	449410	0.74	1.01	1.16	1.30	0.82	1.19	1.41	1.61	Bishkhali
43	512000	473000	0.51	0.75	0.91	1.06	0.65	0.90	1.05	1.17	Bishkhali
45	520519	468376	0.74	1.09	1.31	1.52	0.91	1.29	1.53	1.73	Buriswar
46	524186	453741	0.96	1.27	1.46	1.64	1.11	1.45	1.67	1.86	Buriswar
47	516555	445681	0.73	1.22	1.57	1.91	0.80	1.38	1.81	2.24	Buriswar
48	502080	418228	1.75	2.29	2.64	2.94	1.88	2.51	2.90	3.24	Baleswar Estuary
49	508629	412651	1.75	2.28	2.60	2.90	1.89	2.48	2.84	3.15	west of kuakata beach
50	510981	419166	0.70	1.16	1.50	1.83	0.78	1.30	1.68	2.05	andharmanik
52	523350	410170	2.02	2.82	3.37	3.89	2.22	3.10	3.68	4.21	east of kuakata beach
53	527483	414192	2.49	3.35	3.91	4.41	2.70	3.68	4.30	4.86	east of kuakata beach
54	531124	425088	2.09	2.79	3.22	3.61	2.27	3.12	3.65	4.13	Rabnabad channel
55	541285	448331	0.71	1.18	1.52	1.85	0.80	1.33	1.72	2.10	Galachipa
57	529200	409900	2.74	3.44	3.87	4.24	2.94	3.76	4.26	4.69	Open Sea
58	561277	417213	2.66	3.49	4.02	4.49	2.86	3.75	4.30	4.79	Open Sea
59	540208	436190	1.61	2.15	2.49	2.79	1.74	2.40	2.82	3.20	Rabnabad channel
60	540205	436265	1.59	2.14	2.47	2.77	1.73	2.39	2.81	3.19	Rabnabad channel
61	573800	430450	2.71	3.54	4.05	4.49	2.88	3.83	4.42	4.95	Meghna estuary
62	561266	438207	1.52	2.18	2.60	2.98	1.59	2.36	2.87	3.34	Tetulia
63	554201	446788	1.65	2.26	2.65	2.99	1.72	2.43	2.89	3.31	Tetulia
64	550585	513745	0.64	0.90	1.07	1.22	0.77	1.06	1.23	1.39	arial Khan
65	578100	501467	2.16	2.84	3.25	3.61	2.33	3.15	3.67	4.13	shahbazpur channel
66	567929	487153	0.78	1.22	1.52	1.80	0.88	1.38	1.73	2.05	Tetulia
67	590079	479293	2.40	3.15	3.61	4.01	2.59	3.46	4.00	4.48	Meghna estuary
68	585590	452060	2.99	4.03	4.68	5.26	3.16	4.30	5.01	5.65	Meghna estuary
69	592482	451587	2.50	3.20	3.63	4.00	2.62	3.48	4.02	4.49	Meghna estuary
70	599100	444400	2.85	3.62	4.08	4.49	3.02	3.97	4.55	5.06	Meghna estuary

Table B- 3: The significant wave heights for different return periods from locations 71 - 105

Location ID	Geographical Location		Sign. Wave height during different Return Periods (Without CC)				Sign. Wave height Level during different Return Periods (With CC)				River Name
	BTM Easting	BTM Northing	10	25	50	100	10	25	50	100	
71	605840	450215	2.02	2.53	2.84	3.10	2.16	2.83	3.24	3.60	Meghna estuary
72	597475	465243	1.93	2.48	2.81	3.09	2.11	2.77	3.18	3.53	Meghna estuary
73	609280	467071	1.24	1.90	2.34	2.76	1.37	2.12	2.64	3.13	Meghna estuary
74	626425	463625	3.27	4.02	4.47	4.85	3.47	4.35	4.87	5.33	Meghna estuary
75	616745	476120	2.69	3.37	3.77	4.11	2.87	3.69	4.19	4.63	Meghna estuary
76	628198	476860	2.34	2.99	3.38	3.73	2.51	3.27	3.74	4.15	Meghna estuary
77	629763	511565	1.68	2.35	2.78	3.17	1.89	2.61	3.06	3.47	Meghna estuary
78	632032	514964	1.77	2.43	2.84	3.21	1.95	2.70	3.18	3.61	Meghna estuary
79	650068	511375	2.99	4.16	4.91	5.59	3.18	4.52	5.39	6.19	Sandwip channel
80	645960	495665	1.95	2.64	3.07	3.45	2.10	2.90	3.40	3.86	Meghna estuary
81	648770	482662	2.13	2.76	3.14	3.48	2.26	3.03	3.50	3.92	Meghna estuary
82	661910	490315	3.71	4.79	5.45	6.03	3.94	5.21	5.99	6.69	Sandwip channel
83	663400	475480	3.70	4.59	5.13	5.59	3.90	4.93	5.55	6.09	Sandwip channel
84	691564	469562	0.81	1.10	1.27	1.42	0.87	1.21	1.41	1.59	Karnafuli
85	681420	459780	4.38	5.44	6.08	6.63	4.61	5.81	6.53	7.14	Open sea
86	685050	456725	4.25	5.43	6.15	6.78	4.45	5.77	6.56	7.26	Open sea
87	684922	453740	4.31	5.36	5.98	6.53	4.52	5.71	6.41	7.02	Open sea
88	690757	448663	0.87	1.29	1.58	1.85	0.98	1.45	1.76	2.05	Sangu
89	690915	444710	3.33	4.17	4.68	5.12	3.51	4.42	4.95	5.41	Open sea
90	691378	436743	3.55	4.35	4.83	5.24	3.73	4.63	5.15	5.59	Open sea
91	692906	426518	3.10	4.04	4.63	5.14	3.29	4.31	4.92	5.46	Kutubdia channel
92	688363	417300	4.08	5.05	5.64	6.17	4.35	5.35	5.93	6.43	Open sea
93	696050	417270	2.31	3.14	3.67	4.15	2.50	3.37	3.91	4.39	Kutubdia channel
94	687413	416597	4.33	5.35	5.97	6.52	4.60	5.66	6.26	6.78	Open sea
95	693389	406450	3.28	4.24	4.86	5.43	3.55	4.48	5.04	5.52	Kutubdia channel
96	690547	395308	3.82	4.78	5.40	5.96	4.16	5.05	5.55	5.98	Open sea
97	690063	377881	4.32	5.12	5.61	6.05	4.62	5.35	5.76	6.10	Open sea
98	702377	375510	2.03	2.65	3.06	3.45	2.26	2.81	3.14	3.41	Bakkhali
99	698362	368264	4.36	5.22	5.76	6.25	4.67	5.43	5.86	6.21	Open sea
100	691696	355110	6.82	8.53	9.61	10.9	7.32	8.76	9.58	10.8	Open sea
102	484142	458126	1.23	1.78	2.14	2.48	1.40	2.04	2.46	2.85	Baleswar
103	485487	465258	1.10	1.73	2.17	2.59	1.23	1.93	2.42	2.88	Baleswar
104	441606	484078	0.45	0.84	1.08	1.30	0.68	1.06	1.29	1.48	Sibsa
105	489915	441799	1.38	1.83	2.10	2.34	1.50	2.07	2.42	2.74	Baleswar

Table B- 4: The significant wave heights for different return periods from locations 106 - 141

Location ID	Geographical Location		Sign. Wave height during different Return Periods (Without CC)				Sign. Wave height Level during different Return Periods (With CC)				River Name
	BTM Easting	BTM Northing	10	25	50	100	10	25	50	100	
106	489198	437761	1.40	1.87	2.17	2.43	1.50	2.09	2.47	2.81	Baleswar
107	497799	434293	0.98	1.54	1.93	2.31	1.10	1.76	2.22	2.66	Bishkhali
108	498869	436925	0.87	1.40	1.77	2.12	1.00	1.60	2.02	2.43	Bishkhali
109	514789	443907	0.76	1.21	1.52	1.81	0.85	1.37	1.74	2.10	Buriswar
110	522926	451287	0.79	1.05	1.21	1.36	0.95	1.24	1.43	1.59	Buriswar
111	522926	451287	0.79	1.05	1.21	1.36	0.95	1.24	1.43	1.59	Buriswar
112	541746	451668	0.64	1.02	1.29	1.55	0.71	1.18	1.51	1.83	Galachipa
118	425115	446178	0.32	0.74	1.12	1.55	0.53	1.04	1.41	1.77	Arpangachia
120	439406	459130		0.44	0.65	0.84		0.59	0.82	1.02	Sibsa
132	429571	458014		0.52	0.71	0.88		0.70	0.94	1.14	Kobadak
136	581298	521746	1.31	2.15	2.75	3.33	1.38	2.35	3.07	3.78	Lower Meghna
137	587002	509780	1.78	2.53	3.01	3.45	1.93	2.78	3.33	3.84	Lower Meghna
138	596373	503609	1.28	2.12	2.72	3.30	1.39	2.33	3.02	3.70	Lower Meghna
139	602907	497041	2.00	2.98	3.64	4.26	2.11	3.25	4.04	4.79	Lower Meghna
140	692350	446695	2.06	2.85	3.37	3.86	2.25	3.08	3.59	4.05	Sangu Estuary
141	694972	426985	2.77	3.65	4.19	4.68	2.92	3.89	4.49	5.03	Kutubdia channel

C Plots of Max. significat wave height with and without climate change

The maximum sign. wave height with and without climate change, respectively, from the nineteen cyclone simulations of wave model in the pre-selected locations around Polder 40/1 & 59/2 are presented below. The legend of Figure C- 1 & Figure C- 3 describes the different locations around polder 40/1 shown in Figure 5-10. The legend of Figure C-2 & Figure C-4 describes the different locations around polder 59/2 shown in Figure 5-10.

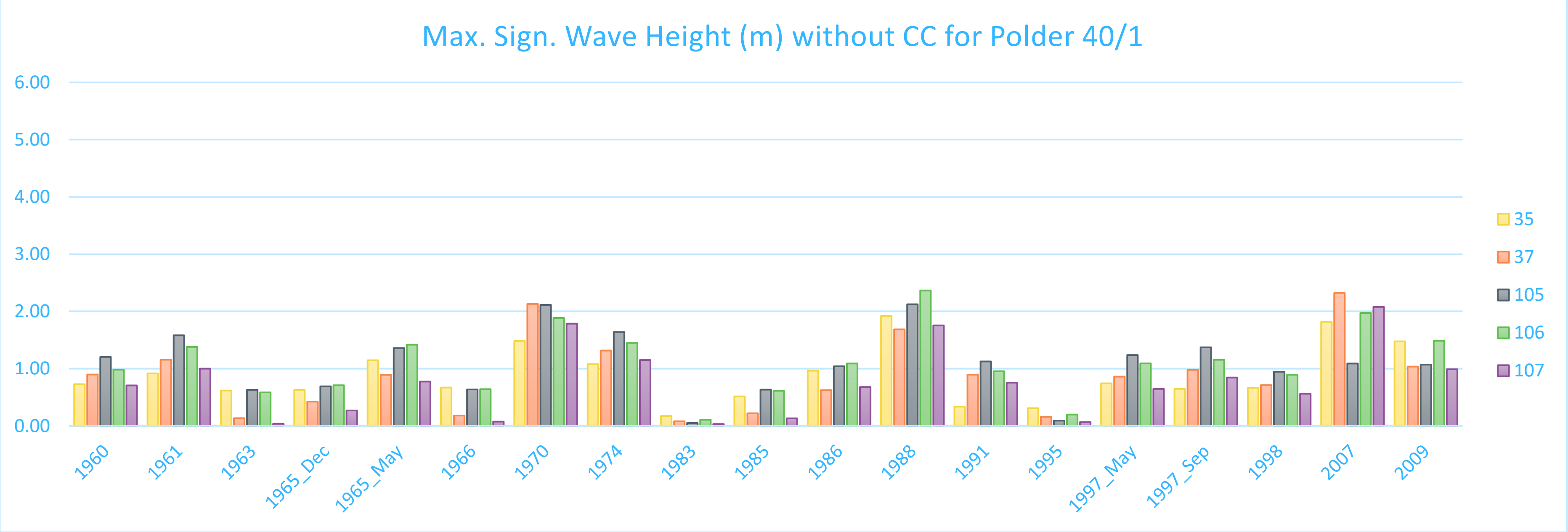

Figure C- 1: Maximum Sign. wave height for 19 cyclones from wave model without climate change for polder 40/1

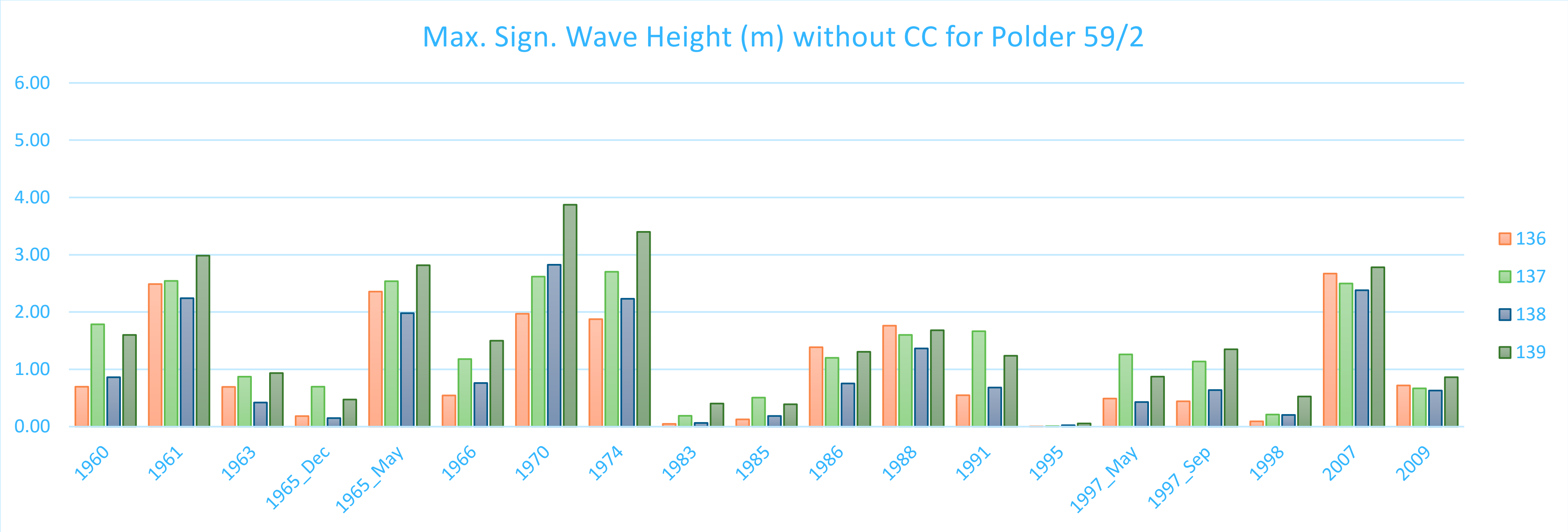

Figure C- 2: Maximum Sign. wave height for 19 cyclones from wave model without climate change for polder 59/2

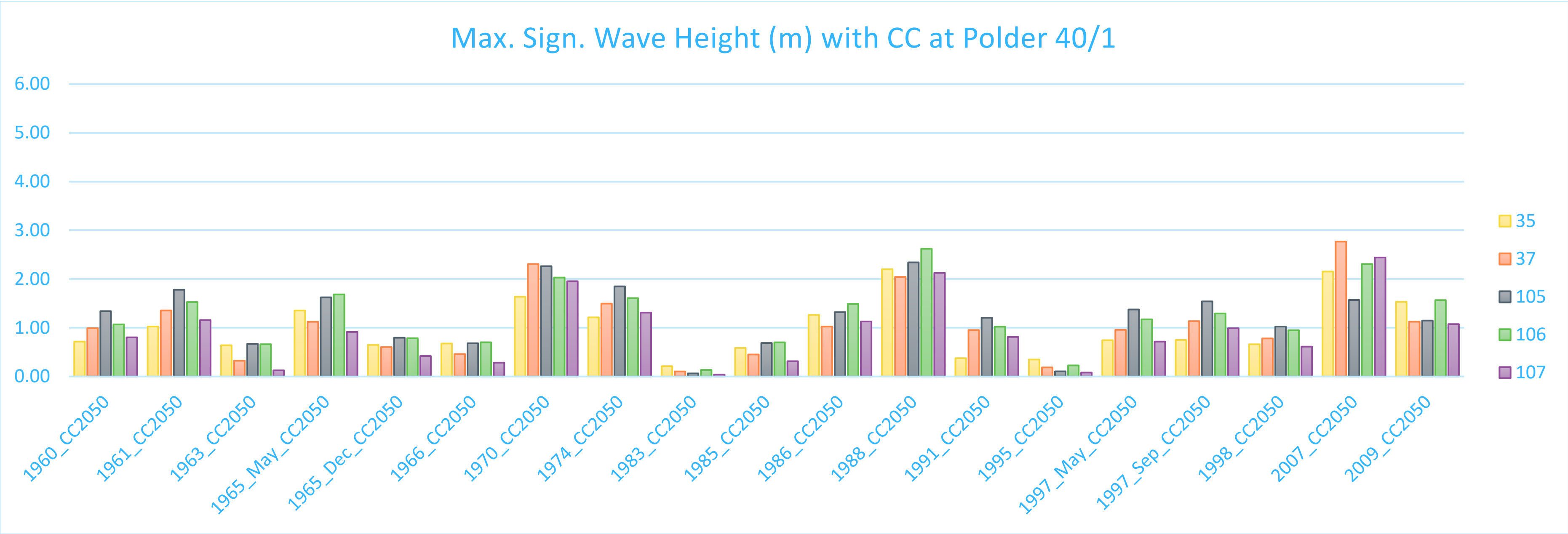

Figure C- 3: Maximum Sign. wave height for 19 cyclones from wave model with climate change for polder 40/1

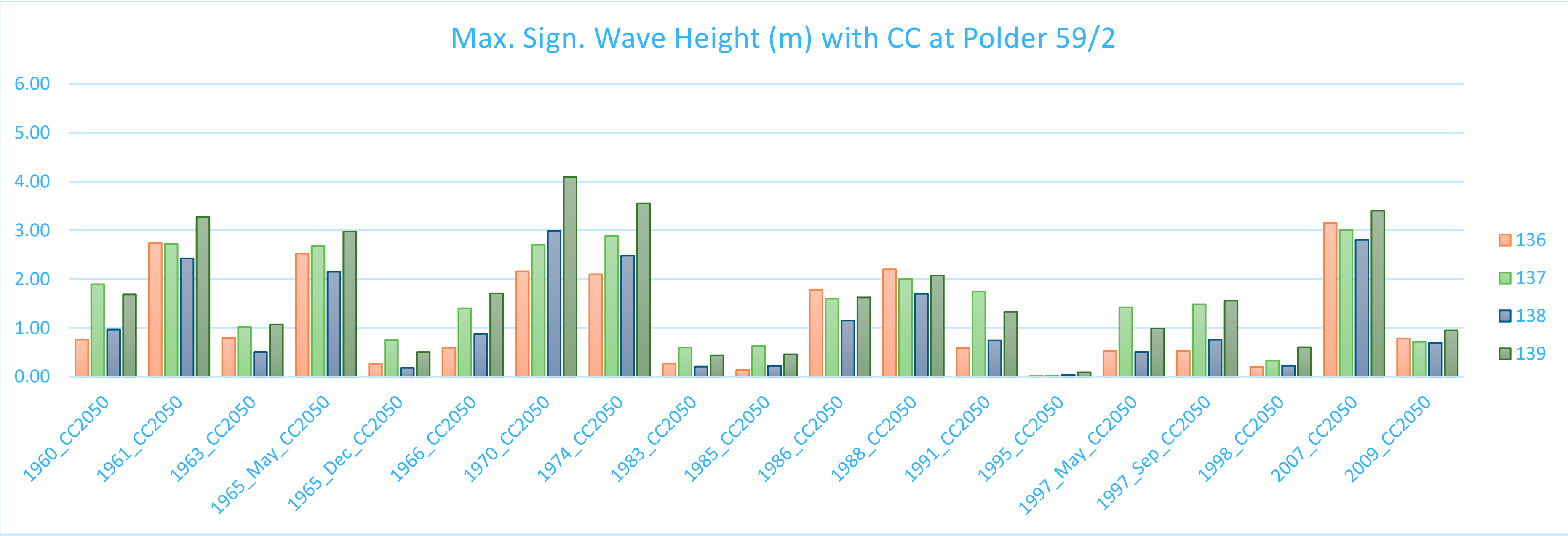

Figure C- 1: Maximum Sign. wave height for 19 cyclones from wave model with climate change

D Crest Level Calculation of Polder 15, 29, 40/1, 59/2, and 64/1a & 1b with climate change

The embankment crest level of polder 15, 29, 40/1, 59/2, and 64/1a & 1b were calculated for 25-year return period and 50 year return period. The calculated crest levels are presented below in Table D- 1 to Table D- 10.

Table D- 1: Crest level calculation for polder 15 (25-year return period)

					wave computation									Monsoon Levels			
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std		25 year maximu in June-Sept period	Max wind wave height in June -Sept period	Free board w/o roughness	Rqd crest Level w/o roughness with subsidence and freeboard
1	Kholpetua	4.10	2.77	0.19	1:7	0.20	0.16	0.15	3.12	3.31	3.08	3.27		3.94	0.25	0.07	4.16
2	Kholpetua	4.10	3.06	0.20	1:7	0.27	0.22	0.15	3.48	3.68	3.43	3.62		4.04	0.29	0.08	4.27
3	Kobadak	4.10	2.98	0.19	1:7	0.28	0.22	0.15	3.41	3.60	3.35	3.54		3.99	0.26	0.07	4.21
132	Kobadak	4.10	2.72	0.18	1:7	0.32	0.25	0.15	3.19	3.37	3.12	3.31		3.90	0.25	0.07	4.12
1	Kholpetua	4.10	2.77	0.19	1:5	0.30	0.24	0.15	3.22	3.41	3.16	3.35		3.94	0.25	0.10	4.19
2	Kholpetua	4.10	3.06	0.20	1:5	0.40	0.32	0.15	3.61	3.81	3.53	3.73		4.04	0.29	0.12	4.31
3	Kobadak	4.10	2.98	0.19	1:5	0.41	0.33	0.15	3.54	3.73	3.46	3.65		3.99	0.26	0.11	4.25
132	Kobadak	4.10	2.72	0.18	1:5	0.47	0.37	0.15	3.34	3.52	3.24	3.42		3.90	0.25	0.10	4.15

Table D- 2: Crest level calculation for polder 15 (50 year return period)

					wave computation								Monsoon Levels			
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std	50 year maximu in June-Sept period	Max wind wave height in June -Sept period	Free board w/o roughness	Rqd crest Level w/o roughness with subsidence and freeboard
1	Kholpetua	4.10	3.21	0.25	1:7	0.35	0.28	0.15	3.71	3.96	3.64	3.89	4.06	0.25	0.07	4.27
2	Kholpetua	4.10	3.66	0.26	1:7	0.36	0.29	0.15	4.17	4.42	4.10	4.35	4.15	0.29	0.08	4.38
3	Kobadak	4.10	3.53	0.25	1:7	0.38	0.31	0.15	4.06	4.31	3.99	4.23	4.10	0.26	0.07	4.32
132	Kobadak	4.10	3.14	0.24	1:7	0.48	0.38	0.15	3.77	4.01	3.67	3.91	4.01	0.25	0.07	4.22
1	Kholpetua	4.10	3.21	0.25	1:5	0.51	0.41	0.15	3.87	4.12	3.77	4.02	4.06	0.25	0.10	4.31
2	Kholpetua	4.10	3.66	0.26	1:5	0.52	0.42	0.15	4.33	4.59	4.23	4.49	4.15	0.29	0.12	4.42
3	Kobadak	4.10	3.53	0.25	1:5	0.56	0.45	0.15	4.24	4.49	4.13	4.37	4.10	0.26	0.11	4.35
132	Kobadak	4.10	3.14	0.24	1:5	0.70	0.56	0.15	3.99	4.23	3.85	4.09	4.01	0.25	0.10	4.26

Table D- 3: Crest level calculation for polder 29 (25 year return period)

					wave computation									Monsoon Levels			
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std		25 year maximu in June-Sept period	Max wind wave height in June -Sept period	Free board w/o roughness	Rqd crest Level w/o roughness with subsidence and freeboard
11	Gengreil	4.41	2.74	0.15	1:7			0.15	3.17	3.32	3.15	3.30		3.99	0.17	0.03	4.17
130	Lower Bhadra	4.24	2.66	0.18	1:7			0.15	3.11	3.29	3.06	3.24		4.02	0.17	0.03	4.20
11	Gengreil	4.41	2.74	0.16	1:5			0.15	3.21	3.37	3.18	3.34		3.99	0.17	0.05	4.19
130	Lower Bhadra	4.24	2.66	0.17	1:5			0.15	3.16	3.33	3.11	3.28		4.02	0.17	0.05	4.22

Table D- 4: Crest level calculation for polder 29 (50 year return period)

					wave computation									Monsoon Levels			
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std		25 year maximu in June-Sept period	Max wind wave height in June -Sept period	Free board w/o roughness	Rqd crest Level w/o roughness with subsidence and freeboard
11	Gengreil	4.41	3.16	0.18	1:7			0.15	3.62	3.80	3.60	3.78		4.10	0.17	0.03	4.28
130	Lower Bhadra	4.24	3.02	0.21	1:7			0.15	3.50	3.71	3.45	3.66		4.12	0.17	0.03	4.31
11	Gengreil	4.41	3.16	0.19	1:5			0.15	3.66	3.85	3.63	3.82		4.10	0.17	0.05	4.30
130	Lower Bhadra	4.24	3.02	0.20	1:5			0.15	3.55	3.75	3.50	3.70		4.12	0.17	0.05	4.32

Table D- 5: Crest level calculation for polder 40/1 (25 year return period)

					wave computation							
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
34	Patharghata,Baleswar	4.50	3.62	0.26	1:7	1.38	1.11	0.18	5.18	5.44	4.91	5.17
105	Patharghata,Baleswar	4.50	3.71	0.35	1:7	1.37	1.09	0.18	5.26	5.61	4.98	5.33
106	Patharghata,Baleswar	4.50	3.80	0.28	1:7	1.38	1.11	0.18	5.36	5.64	5.09	5.37
107	Patharghata,Bishkhali	4.50	4.05	0.31	1:7	1.11	0.88	0.18	5.34	5.65	5.11	5.42
108	Patharghata,Bishkhali	4.50	3.80	0.28	1:7	0.98	0.78	0.18	4.96	5.24	4.76	5.04
34	Patharghata,Baleswar	4.50	3.62	0.26	1:5	2.00	1.60	0.18	5.80	6.06	5.40	5.66
105	Patharghata,Baleswar	4.50	3.71	0.35	1:5	1.98	1.58	0.18	5.87	6.22	5.47	5.82
106	Patharghata,Baleswar	4.50	3.80	0.28	1:5	2.00	1.60	0.18	5.98	6.26	5.58	5.86
107	Patharghata,Bishkhali	4.50	4.05	0.31	1:5	1.60	1.28	0.18	5.83	6.14	5.51	5.82
108	Patharghata,Bishkhali	4.50	3.80	0.28	1:5	1.42	1.13	0.18	5.40	5.68	5.11	5.39

Table D- 6: Crest level calculation for polder 40/1 (50 year return period)

						wave computation						
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
34	Patharghata,Baleswar	4.50	4.21	0.34	1:7	1.71	1.37	0.18	6.10	6.44	5.76	6.10
105	Patharghata,Baleswar	4.50	4.34	0.35	1:7	1.67	1.34	0.18	6.19	6.54	5.86	6.21
106	Patharghata,Baleswar	4.50	4.45	0.37	1:7	1.71	1.37	0.18	6.34	6.71	6.00	6.37
107	Patharghata,Bishkhali	4.50	4.76	0.41	1:7	1.50	1.20	0.18	6.44	6.85	6.14	6.55
108	Patharghata,Bishkhali	4.50	4.45	0.37	1:7	1.32	1.06	0.18	5.95	6.32	5.69	6.06
34	Patharghata,Baleswar	4.50	4.21	0.34	1:5	2.47	1.98	0.18	6.86	7.20	6.37	6.71
105	Patharghata,Baleswar	4.50	4.34	0.35	1:5	2.41	1.93	0.18	6.93	7.28	6.45	6.80
106	Patharghata,Baleswar	4.50	4.45	0.37	1:5	2.47	1.98	0.18	7.10	7.47	6.61	6.98
107	Patharghata,Bishkhali	4.50	4.76	0.41	1:5	2.16	1.73	0.18	7.10	7.51	6.67	7.08
108	Patharghata,Bishkhali	4.50	4.45	0.37	1:5	1.91	1.53	0.18	6.54	6.91	6.16	6.53

Table D- 7: Crest level calculation for polder 59/2 (25 year return period)

Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
								wave computation				
136	Lower Meghna	6.40	4.09	0.35	1:7	1.61	1.29	0.06	5.76	6.11	5.44	5.79
137	Lower Meghna	6.40	4.97	0.43	1:7	1.99	1.59	0.06	7.02	7.45	6.62	7.05
138	Lower Meghna	6.40	5.06	0.45	1:7	1.59	1.27	0.06	6.71	7.16	6.39	6.84
139	Lower Meghna	6.40	5.02	0.45	1:7	2.42	1.94	0.06	7.50	7.95	7.02	7.47
136	Lower Meghna	6.40	4.09	0.35	1:5	2.32	1.86	0.06	6.47	6.82	6.01	6.36
137	Lower Meghna	6.40	4.97	0.43	1:5	2.87	2.29	0.06	7.90	8.33	7.32	7.75
138	Lower Meghna	6.40	5.06	0.45	1:5	2.29	1.84	0.06	7.41	7.86	6.96	7.41
139	Lower Meghna	6.40	5.02	0.45	1:5	3.49	2.79	0.06	8.57	9.02	7.87	8.32

Table D- 8: Crest level calculation for polder 59/2 (50 year return period)

								wave computation				
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
136	Lower Meghna	6.40	4.90	0.46	1:7	2.25	1.80	0.06	7.21	7.67	6.76	7.22
137	Lower Meghna	6.40	5.90	0.57	1:7	2.50	2.00	0.06	8.46	9.03	7.96	8.53
138	Lower Meghna	6.40	5.98	0.60	1:7	2.21	1.77	0.06	8.25	8.85	7.81	8.41
139	Lower Meghna	6.40	5.92	0.59	1:7	3.18	2.54	0.06	9.16	9.75	8.52	9.11
136	Lower Meghna	6.40	4.90	0.46	1:5	3.24	2.60	0.06	8.20	8.66	7.56	8.02
137	Lower Meghna	6.40	5.90	0.57	1:5	3.59	2.87	0.06	9.55	10.12	8.83	9.40
138	Lower Meghna	6.40	5.98	0.60	1:5	3.18	2.54	0.06	9.22	9.82	8.58	9.18
139	Lower Meghna	6.40	5.92	0.59	1:5	4.56	3.65	0.06	10.54	11.13	9.63	10.22

Table D- 9: Crest level calculation for polder 64/1a & 1b (25 year return period)

									wave computation			
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
140	Sangu Estuary	5.28	5.47	0.41	1:7	2.26	1.81	0.06	7.79	8.20	7.34	7.75
89	Sangu	5.28	5.30	0.39	1:7	3.55	2.84	0.06	8.91	9.30	8.20	8.59
90	Open sea	5.28	5.10	0.36	1:7	3.76	3.01	0.06	8.92	9.28	8.17	8.53
141	Kutubdia channel	5.28	4.91	0.35	1:7	3.03	2.42	0.06	8.00	8.35	7.39	7.74
140	Sangu Estuary	4.50	5.47	0.41	1:5	3.26	2.61	0.06	8.79	9.20	8.14	8.55
89	Sangu	4.50	5.30	0.39	1:5	5.10	4.08	0.06	10.46	10.85	9.44	9.83
90	Open sea	4.50	5.10	0.36	1:5	5.40	4.32	0.06	10.56	10.92	9.48	9.84
141	Kutubdia channel	4.50	4.91	0.35	1:5	4.36	3.49	0.06	9.33	9.68	8.46	8.81

Table D- 10: Crest level calculation for polder 64/1a & 1b (50 year return period)

								wave computation				
Point_No.	Location	Exisiting Ave. Crest Level (mNewPWD)	Modelled Storm Surge level (mNewPWD)	Standard Deviation (m)	Recommended Slope	Free board for Grass or Smooth paved Roughness 1.0	Free board for Slope Roughness 0.8	Allowance for Subsidence	Rqd crest Level w/o roughness no std	Rqd crest Level w/o roughness + std	Rqd crest Level w roughness & no std	Rqd crest Level w roughness + std
140	Sangu Estuary	5.28	6.41	0.53	1:7	2.74	2.19	0.06	9.21	9.74	8.66	9.19
89	Sangu	5.28	6.19	0.51	1:7	4.08	3.27	0.06	10.33	10.84	9.52	10.03
90	Open sea	5.28	5.95	0.47	1:7	4.29	3.43	0.06	10.30	10.77	9.44	9.91
141	Kutubdia channel	5.28	5.71	0.46	1:7	3.62	2.90	0.06	9.39	9.85	8.67	9.13
140	Sangu Estuary	4.50	6.41	0.53	1:5	3.95	3.16	0.06	10.42	10.95	9.63	10.16
89	Sangu	4.50	6.19	0.51	1:5	5.87	4.69	0.06	12.12	12.63	10.94	11.45
90	Open sea	4.50	5.95	0.47	1:5	6.15	4.92	0.06	12.16	12.63	10.93	11.40
141	Kutubdia channel	4.50	5.71	0.46	1:5	5.20	4.16	0.06	10.97	11.43	9.93	10.39

E Maximum water level for different cyclones without climate change

The simulated maximum water level without climate change for all 141 locations along the Bangladesh coastlines is listed below from Table E-1 to Table E-4.

Table E- 1: The simulated maximum water level without climate change for locations 1 -35

Location / Cyclonic Event	Strom Surge Level new(mPWD) at Base Condition																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1960_Base_Org	1.55	1.58	1.56	1.60	1.64	1.63	1.66	1.46	1.38	1.56	1.61	1.64	1.69	1.70	1.70	1.72	1.70	1.68	1.66	1.65	1.57	1.64	1.69	1.51	1.55	1.55	1.54	1.52	1.59	1.55	1.53	1.53	1.51	1.53	1.58
1960_Base_HT	1.55	1.58	1.57	1.61	1.64	1.64	1.66	1.48	1.42	1.57	1.62	1.63	1.69	1.70	1.70	1.72	1.70	1.69	1.67	1.66	1.58	1.63	1.70	1.53	1.56	1.55	1.54	1.55	1.61	1.55	1.53	1.53	1.55	1.59	1.68
1960_Base_LT	1.55	1.58	1.56	1.61	1.64	1.63	1.66	1.48	1.41	1.57	1.62	1.63	1.69	1.70	1.70	1.72	1.70	1.68	1.67	1.65	1.58	1.63	1.70	1.53	1.55	1.55	1.54	1.55	1.61	1.55	1.53	1.53	1.50	1.52	1.58
1961_Base_Org	1.63	1.67	1.65	1.69	1.72	1.73	1.77	1.56	1.49	1.64	1.70	1.71	1.80	1.80	1.79	1.82	1.79	1.77	1.75	1.76	1.68	1.71	1.76	1.62	1.63	1.63	1.62	1.62	1.69	1.63	1.61	1.61	1.59	1.61	1.67
1961_Base_HT	1.52	1.55	1.53	1.57	1.60	1.60	1.62	1.47	1.42	1.54	1.59	1.59	1.65	1.65	1.65	1.68	1.66	1.65	1.62	1.61	1.56	1.59	1.66	1.51	1.52	1.52	1.51	1.51	1.55	1.50	1.48	1.47	1.45	1.45	1.49
1961_Base_LT	1.61	1.64	1.62	1.66	1.70	1.71	1.73	1.54	1.48	1.62	1.68	1.70	1.78	1.78	1.77	1.80	1.77	1.75	1.73	1.74	1.65	1.68	1.74	1.58	1.60	1.60	1.59	1.59	1.65	1.59	1.58	1.57	1.52	1.46	1.51
1963_Base_Org	1.86	1.89	1.88	1.92	1.96	1.96	2.04	1.75	1.66	1.83	1.90	1.95	2.05	2.04	2.03	2.05	2.01	1.98	1.97	2.01	1.88	1.95	1.91	1.86	1.86	1.87	1.87	1.87	1.97	1.94	1.91	1.92	1.91	1.95	2.03
1963_Base_HT	1.88	1.91	1.90	1.94	1.97	1.98	2.06	1.76	1.67	1.85	1.92	1.96	2.07	2.06	2.05	2.06	2.02	1.99	1.99	2.03	1.89	1.96	1.92	1.88	1.88	1.89	1.89	1.89	1.99	1.96	1.94	1.95	1.93	1.97	2.05
1963_Base_LT	1.86	1.89	1.88	1.92	1.96	1.96	2.04	1.75	1.66	1.83	1.90	1.95	2.05	2.04	2.03	2.05	2.01	1.98	1.97	2.01	1.88	1.95	1.92	1.87	1.86	1.87	1.87	1.87	1.97	1.94	1.91	1.92	1.91	1.95	2.03
1965_Dec_Base_Org	1.74	1.77	1.75	1.80	1.84	1.84	1.88	1.65	1.57	1.72	1.78	1.82	1.90	1.91	1.89	1.90	1.87	1.85	1.83	1.85	1.77	1.85	1.83	1.78	1.78	1.77	1.77	1.77	1.84	1.80	1.78	1.78	1.77	1.78	1.84
1965_Dec_Base_LT	1.51	1.53	1.52	1.55	1.57	1.60	1.65	1.38	1.30	1.51	1.56	1.58	1.66	1.67	1.67	1.69	1.67	1.65	1.63	1.62	1.48	1.45	1.66	1.21	1.30	1.35	1.34	1.35	1.43	1.36	1.34	1.35	1.34	1.40	1.49
1965_May_Base_Org	1.77	1.80	1.76	1.80	1.84	1.84	1.88	1.66	1.55	1.72	1.78	1.85	1.90	1.89	1.88	1.89	1.84	1.82	1.80	1.83	1.81	1.96	1.80	1.87	1.93	1.96	1.95	1.89	1.96	1.97	1.97	1.95	1.95	1.90	1.92
1965_May_Base_HT	1.59	1.62	1.59	1.64	1.69	1.67	1.76	1.53	1.47	1.60	1.65	1.68	1.73	1.73	1.74	1.76	1.73	1.71	1.70	1.68	1.63	1.72	1.72	1.66	1.66	2.07	2.01	1.69	2.34	2.51	2.59	2.70	2.91	2.98	3.09
1965_May_Base_LT	1.59	1.62	1.59	1.64	1.69	1.67	1.76	1.53	1.47	1.60	1.65	1.68	1.73	1.73	1.74	1.76	1.73	1.71	1.70	1.68	1.63	1.72	1.72	1.66	1.66	2.07	2.01	1.69	2.34	2.51	2.59	2.70	2.91	2.98	3.09
1966_Base_Org	1.84	1.88	1.84	1.88	1.92	1.93	2.02	1.72	1.62	1.80	1.88	1.93	2.03	2.02	2.00	2.02	1.98	1.94	1.93	1.97	1.88	1.98	1.89	1.90	1.90	1.93	1.94	1.92	2.04	2.03	2.02	2.02	2.03	2.07	2.15
1966_Base_HT	1.84	1.88	1.85	1.89	1.93	1.93	2.03	1.72	1.63	1.81	1.88	1.93	2.04	2.03	2.00	2.03	1.98	1.95	1.94	1.97	1.88	1.98	1.89	1.91	1.90	1.93	1.94	1.92	2.04	2.03	2.02	2.02	2.03	2.07	2.14
1966_Base_LT	1.82	1.85	1.82	1.86	1.89	1.91	2.00	1.69	1.60	1.78	1.85	1.91	2.01	2.00	1.97	2.00	1.96	1.94	1.92	1.95	1.86	1.97	1.88	1.89	1.90	1.92	1.93	1.91	2.03	2.02	2.02	2.03	2.04	2.08	2.16
1970_Base_Org	1.81	1.85	1.83	1.87	1.91	1.91	1.98	1.72	1.63	1.80	1.86	1.90	2.00	2.00	1.97	2.00	1.96	1.93	1.93	1.94	1.84	1.91	1.89	1.89	1.86	1.85	1.84	1.84	1.94	1.89	1.88	1.87	1.87	1.93	2.49
1970_Base_HT	1.81	1.85	1.83	1.87	1.91	1.91	1.98	1.72	1.63	1.79	1.86	1.89	2.00	2.00	1.97	1.99	1.96	1.93	1.92	1.94	1.84	1.91	1.89	1.86	1.83	1.84	1.84	1.84	1.94	1.89	1.88	1.87	2.16	2.38	2.86
1970_Base_LT	2.07	2.09	2.02	2.07	2.08	2.10	2.27	1.85	1.63	1.96	2.05	2.19	2.27	2.21	2.20	2.20	2.11	2.07	2.07	2.14	2.02	2.28	1.96	1.98	2.08	2.26	2.25	2.12	2.30	2.36	2.40	2.40	2.44	2.39	2.45
1974_Base_Org	1.70	1.74	1.71	1.75	1.80	1.80	1.84	1.62	1.54	1.69	1.75	1.79	1.87	1.86	1.85	1.87	1.83	1.81	1.79	1.81	1.75	1.84	1.79	1.77	1.77	1.77	1.75	1.76	1.82	1.79	1.78	1.76	1.76	1.77	1.83
1974_Base_HT	1.67	1.70	1.68	1.72	1.76	1.77	1.81	1.58	1.52	1.67	1.73	1.75	1.83	1.83	1.83	1.84	1.81	1.79	1.78	1.79	1.71	1.76	1.78	1.67	1.68	1.68	1.67	1.68	1.74	1.69	1.67	1.66	1.65	1.67	1.88
1974_Base_LT	1.68	1.71	1.69	1.74	1.78	1.78	1.82	1.60	1.53	1.68	1.74	1.77	1.85	1.84	1.84	1.85	1.82	1.80	1.78	1.80	1.72	1.79	1.79	1.71	1.71	1.71	1.69	1.71	1.77	1.72	1.73	1.73	1.75	1.73	1.78
1983_Base_Org	1.84	1.88	1.86	1.90	1.94	1.95	2.03	1.72	1.63	1.81	1.89	1.94	2.04	2.03	2.02	2.04	2.00	1.97	1.96	2.00	1.85	1.93	1.91	1.83	1.84	1.85	1.85	1.85	1.95	1.92	1.90	1.91	1.90	1.96	2.04
1983_Base_HT	1.87	1.91	1.90	1.94	1.97	1.98	2.06	1.75	1.66	1.84	1.92	1.96	2.07	2.06	2.05	2.06	2.02	2.00	1.99	2.03	1.89	1.96	1.92	1.88	1.87	1.89	1.89	1.89	2.00	1.97	1.95	1.95	1.95	1.99	2.08
1983_Base_LT	1.87	1.90	1.89	1.93	1.96	1.97	2.05	1.74	1.65	1.83	1.91	1.95	2.06	2.05	2.04	2.05	2.01	1.99	1.98	2.02	1.88	1.95	1.92	1.86	1.86	1.88	1.88	1.88	1.98	1.95	1.93	1.94	1.93	1.98	2.06
1985_Base_Org	1.79	1.82	1.80	1.84	1.88	1.88	1.94	1.70	1.61	1.77	1.83	1.87	1.96	1.97	1.94	1.96	1.93	1.91	1.90	1.91	1.81	1.88	1.87	1.81	1.80	1.81	1.80	1.80	1.89	1.84	1.82	1.82	1.81	1.83	1.90
1985_Base_HT	1.80	1.83	1.81	1.86	1.89	1.90	1.96	1.71	1.62	1.78	1.85	1.88	1.98	1.98	1.96	1.98	1.95	1.93	1.92	1.94	1.82	1.89	1.88	1.83	1.81	1.82	1.81	1.82	1.90	1.86	1.84	1.83	1.82	1.86	1.93
1985_Base_LT	1.80	1.83	1.81	1.86	1.89	1.90	1.96	1.71	1.62	1.78	1.85	1.88	1.98	1.98	1.96	1.98	1.95	1.92	1.91	1.94	1.82	1.89	1.88	1.81	1.80	1.81	1.81	1.81	1.90	1.86	1.84	1.83	1.82	1.86	1.93
1986_Base_Org	1.61	1.63	1.62	1.67	1.70	1.70	1.73	1.54	1.50	1.62	1.68	1.70	1.76	1.77	1.76	1.78	1.75	1.74	1.73	1.73	1.65	1.70	1.74	1.63	1.62	1.61	1.60	1.62	1.67	1.61	1.59	1.58	1.56	1.57	1.63
1986_Base_HT	1.83	1.81	1.89	1.86	1.80	1.81	1.89	1.62	1.54	1.73	1.77	1.83	1.90	1.99	1.88	1.95	1.95	1.96	2.04	2.10	1.99	1.90	1.82	1.74	1.85	2.00	2.03	2.07	2.18	2.09	2.01	1.98	1.79	1.73	1.78
1986_Base_LT	1.60	1.63	1.62	1.66	1.69	1.70	1.73	1.54	1.47	1.61	1.67	1.69	1.75	1.76	1.76	1.77	1.75	1.73	1.72	1.72	1.64	1.69	1.74	1.59	1.61	1.60	1.59	1.61	1.69	1.60	1.58	1.57	1.55	1.56	1.62
1988_Base_Org	2.67	2.70	2.73	2.77	2.75	2.65	2.97	2.68	2.44	2.97	2.96	2.99	3.01	2.82	2.95	2.85	2.82	2.79	2.85	2.99	2.94	2.64	2.49	3.06	2.93	2.91	2.93	3.04	3.06	3.14	3.18	3.16	3.04	2.91	2.72
1988_Base_HT	3.08	3.09	3.19	3.18	3.07	3.01	3.31	2.84	2.51	3.15	3.16	3.19	3.33	3.06	3.22	3.06	3.01	2.96	3.01	3.22	3.04	2.69	2.60	3.06	2.94	2.92	2.94	3.03	3.15	3.31	3.40	3.42	3.50	3.37	3.27
1988_Base_LT	2.65	2.65	2.78	2.76	2.68	2.61	3.05	2.62	2.37	2.98	2.97	2.99	3.05	2.86	2.96	2.88	2.86	2.81	2.89	3.07	2.99	2.66	2.49	3.05	2.93	2.92	2.95	3.05	3.14	3.26	3.32	3.33	3.28	3.22	3.08
1991_Base_Org	1.87	1.90	1.86	1.91	1.96	1.95	2.04	1.74	1.62	1.82	1.89	1.97	2.05	2.05	2.02	2.04	1.98	1.95	1.94	1.96	1.89	1.98	1.89	1.93	1.92	1.97	1.96	1.93	2.05	2.04	2.05	2.04	2.06	2.08	2.15
1991_Base_HT	1.84	1.88	1.85	1.90	1.94	1.94	2.01	1.74	1.64	1.81	1.88	1.93	2.03	2.02	2.00	2.02	1.98	1.95	1.94	1.96	1.85	1.95	1.90	1.88	1.86	1.88	1.88	1.87	1.98	1.94	1.93	1.93	1.93	1.96	2.03
1991_Base_LT	1.87	1.90	1.88	1.93	1.97	1.96	2.03	1.76	1.66	1.83	1.90	1.96	2.05	2.05	2.03	2.04	2.00	1.96	1.96	1.98	1.88	1.98	1.91	1.92	1.89	1.93	1.92	1.91	2.02	2.00	1.99	1.99	1.99	2.02	2.09
1995_Base_Org	1.99	2.03	2.00	2.05	2.08	2.07	2.18	1.86	1.74	1.93	2.00	2.06	2.19	2.17	2.15	2.16	2.11	2.07	2.08	2.12	1.97	2.05	1.98	1.99	1.95	2.00	2.01	1.99	2.13	2.10	2.10	2.10	2.09	2.14	2.23
1995_Base_HT	1.99	2.02	2.00	2.05	2.08	2.07	2.18	1.85	1.74	1.93	2.00	2.06	2.19	2.17	2.15	2.16	2.11	2.07	2.08	2.12	1.97	2.04	1.98	1.98	1.94	1.99	1.99	1.98	2.11	2.09	2.08	2.08	2.07	2.14	2.23
1995_Base_LT	2.00	2.04	2.01	2.06	2.08	2.07	2.19	1.86	1.75	1.94	2.01	2.07	2.19	2.18	2.15	2.16	2.11	2.08	2.09	2.13	1.97	2.05	1.98	1.99	1.96	2.01	2.01	2.00	2.13	2.11	2.10	2.10	2.10	2.16	2.25
1997_May_Base_Org	1.36	1.38	1.34	1.38	1.42	1.41	1.42	1.28	1.21	1.33	1.38	1.43	1.46	1.44	1.43	1.45	1.42	1.40	1.36	1.37	1.35	1.39	1.44	1.24	1.32	1.35	1.33	1.30	1.34	1.31	1.32	1.31	1.32	1.33	1.38
1997_May_Base_LT	1.33	1.35	1.30	1.33	1.35	1.35	1.38	1.22	1.12	1.23	1.29	1.38	1.40	1.40	1.36	1.39	1.32	1.31	1.29	1.28	1.23	1.33	1.37	1.17	1.29	1.33	1.30	1.25	1.31	1.31	1.32	1.33	1.36	1.34	1.39
1997_Sep_Base_Org	1.68	1.69	1.62	1.64	1.65	1.66	1.72	1.57	1.48	1.60	1.64	1.74	1.75	1.72	1.70	1.71	1.64	1.61	1.59	1.62	1.60	1.94	1.59	1.94	2.00	2.04	2.03	1.96	2.00	2.04	2.08	2.10	2.16	2.04	1.99
1997_Sep_Base_HT	1.39	1.44	1.37	1.44	1.49	1.46	1.44	1.41	1.36	1.44	1.45	1.49	1.48	1.44	1.48	1.50	1.48	1.48	1.45	1.43	1.45	1.57	1.50	1.66	1.62	1.57	1.53	1.51	1.48	1.46	1.46	1.44	1.43	1.35	1.34
1997_Sep_Base_LT	1.61	1.59	1.55	1.57	1.54	1.58	1.69	1.44	1.31	1.47	1.55	1.65	1.68	1.67	1.61	1.63	1.53	1.50	1.48	1.54	1.53	1.90	1.49	1.83	1.94	2.02	2.01	1.90	2.03	2.09	2.13	2.15	2.23	2.14	2.17
1998_Base_Org	1.50	1.54	1.52	1.56	1.59	1.59	1.60	1.46	1.41	1.54	1.58	1.59	1.64	1.64	1.64	1.67	1.65	1.64	1.62	1.60	1.55	1.57	1.65	1.50	1.51	1.51	1.50	1.50	1.53	1.48	1.46	1.45	1.43	1.43	1.47
1998_Base_HT	1.44	1.46	1.45	1.49	1.52	1.52	1.55	1.40	1.36	1.48	1.51	1.51	1.56	1.56	1.57	1.59	1.58	1.56	1.54	1.52	1.48	1.52	1.60	1.43	1.45	1.45	1.44	1.45	1.47	1.42	1.40	1.39	1.44	1.54	1.60
2007_Sidr_Base_Org	1.85	1.79	1.73	1.77	1.81	1.89	2.35	1.88	1.68	1.75	1.89	2.20	2.26	2.14	2.07	2.07	1.87	1.83	1.82	1.97	1.94	2.57	1.80	2.72	2.74	2.81	2.87	2.94	3.22	3.46	3.63	3.79	4.22	4.33	4.44
2007_Sidr_Base_HT	1.70	1.73	1.70	1.74	1.79	1.78	1.83	1.61	1.52	1.67	1.73	1.79	1.85	1.84	1.83	1.85	1.84	1.93	2.03	2.10	2.22	2.59	1.83	2.74	2.76	2.85	2.93	2.96	3.26	3.50	3.64	3.80	4.19	4.30	4.35
2007_Sidr_Base_LT	1.82	1.77	1.72	1.76	1.82	1.92	2.41	1.83	1.64	1.76	1.92	2.18	2.29	2.21	2.12	2.13	1.99	1.98	2.01	2.12	2.14	2.55	1.85	2.72	2.74	2.82	2.89	2.95	3.27	3.52	3.71	3.89	4.37	4.55	4.74
2009_Base_Org	2.63	2.71	2.70	2.78	2.83	2.66	2.63	2.82	2.86	2.87	2.83	2.77	2.74	2.59	2.70	2.63	2.59	2.50	2.46	2.51	2.32	2.45	2.43	2.65	2.50	2.52	2.60	2.59	2.65	2.74	2.78	2.79	2.78	2.73	2.70
2009_Base_HT	2.66	2.78	2.68	2.79	2.95	2.68	2.68	2.67	2.67	2.66	2.67	2.69	2.71	2.60	2.64	2.61	2.51	2.42	2.39	2.48	2.27	2.36	2.34	2.51	2.37	2.48	2.54	2.48	2.63	2.74	2.81	2.83	2.89	2.85	2.90
2009_Base_LT	2.73	2.83	2.81	2.90	2.95	2.74	2.71	2.88	2.88	2.90	2.87	2.82	2.81	2.65	2.76	2.69	2.63	2.53	2.48	2.55	2.33	2.45	2.46	2.65	2.49	2.53	2.61	2.60	2.69	2.79	2.84	2.85	2.85	2.80	2.78

Table E- 2: The simulated maximum water level without climate change for locations 36 -70

Location / Cyclonic Event	Strom Surge Level new(mPWD) at Base Condition																																	
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1960_Base_Org	1.49	1.57	1.58	1.54	1.54	1.55	1.46	1.48	1.44	1.40	1.44	1.52	1.56	1.53	1.58	1.57	1.41	1.39	1.37	1.37	1.36	1.41	1.86	1.31	1.31	2.24	1.39	1.32	1.62	2.01	1.27	2.15	2.27	2.35	2.15
1960_Base_HT	1.77	1.63	1.61	1.54	1.53	1.55	1.46	1.48	1.46	1.39	1.44	1.52	1.62	1.60	1.60	1.56	2.13	2.42	2.20	1.49	1.34	2.30	3.07	1.91	1.91	3.34	1.67	1.52	1.53	3.44	1.31	3.72	3.48	3.48	3.45
1960_Base_LT	1.49	1.57	1.58	1.54	1.53	1.55	1.46	1.48	1.45	1.39	1.44	1.52	1.55	1.53	1.57	1.56	1.40	1.39	1.37	1.37	1.34	1.41	2.24	1.30	1.30	2.48	1.39	1.32	1.58	1.85	1.30	2.38	2.44	2.53	2.32
1961_Base_Org	1.58	1.67	1.68	1.62	1.62	1.63	1.56	1.61	1.67	1.65	1.63	1.60	1.65	1.64	1.67	1.79	2.84	3.18	2.83	2.50	2.17	2.97	3.42	2.65	2.65	3.48	3.55	2.55	3.54	4.15	3.57	3.71	3.61	3.54	3.39
1961_Base_HT	1.62	1.49	1.50	1.46	1.46	1.47	1.53	1.58	1.64	1.65	1.62	1.54	1.51	1.59	1.69	1.95	3.04	3.38	3.01	2.61	2.21	3.17	3.57	2.80	2.80	3.60	3.64	2.66	3.58	4.27	3.57	3.83	3.72	3.66	3.49
1961_Base_LT	1.45	1.51	1.51	1.47	1.47	1.48	1.49	1.49	1.56	1.61	1.79	1.67	1.48	1.47	1.60	1.74	2.18	2.65	2.48	2.34	2.09	2.40	3.00	2.32	2.32	2.99	3.24	2.38	3.49	3.44	3.72	2.92	3.02	2.92	2.71
1963_Base_Org	1.93	2.02	2.04	1.97	1.96	1.97	1.84	1.84	1.79	1.73	1.80	1.92	2.01	1.99	2.03	2.00	1.79	1.77	1.72	1.70	1.60	1.81	1.73	1.62	1.62	1.71	1.75	1.63	1.84	2.19	1.58	1.97	1.75	1.79	1.84
1963_Base_HT	1.96	2.05	2.06	2.00	1.99	2.00	1.86	1.86	1.81	1.75	1.83	1.95	2.04	2.02	2.06	2.02	1.83	1.80	1.75	1.72	1.63	1.84	1.76	1.65	1.65	1.74	1.78	1.65	1.86	2.21	1.60	2.00	1.77	1.81	1.86
1963_Base_LT	1.93	2.02	2.04	1.98	1.96	1.98	1.84	1.84	1.79	1.73	1.81	1.92	2.01	1.99	2.03	2.00	1.79	1.77	1.73	1.70	1.61	1.81	1.73	1.62	1.62	1.71	1.75	1.63	1.84	2.19	1.58	1.97	1.75	1.79	1.84
1965_Dec_Base_Org	1.77	1.82	1.84	1.78	1.78	1.79	1.68	1.69	1.65	1.58	1.64	1.74	1.81	1.78	1.82	1.80	1.65	1.63	1.60	1.57	1.51	1.65	1.58	1.51	1.51	1.58	1.60	1.51	1.75	2.06	1.45	1.86	1.61	1.64	1.68
1965_Dec_Base_LT	1.41	1.50	1.52	1.47	1.44	1.44	1.31	1.31	1.28	1.26	1.33	1.42	1.52	1.51	1.54	1.54	1.29	1.28	1.26	1.23	1.17	1.32	1.25	1.16	1.16	1.24	1.28	1.19	1.31	1.74	1.14	1.76	1.28	1.34	1.49
1965_May_Base_Org	1.85	1.87	1.86	1.97	1.84	1.86	1.83	1.84	1.90	1.99	2.37	2.19	1.96	2.30	2.34	2.48	2.38	2.36	2.35	2.81	2.48	2.33	2.45	2.35	2.35	2.47	3.39	2.48	3.15	2.87	3.72	2.75	2.66	2.70	2.39
1965_May_Base_HT	2.91	3.12	3.17	2.86	3.02	2.92	2.44	2.26	2.21	2.26	2.60	2.78	3.18	3.46	3.37	3.56	3.47	3.40	3.07	3.32	2.72	3.44	3.47	3.04	3.04	3.42	4.22	3.08	3.31	3.74	3.94	3.32	3.45	3.53	3.34
1965_May_Base_LT	2.91	3.12	3.17	2.86	3.02	2.92	2.44	2.26	2.21	2.26	2.60	2.78	3.18	3.46	3.37	3.56	3.47	3.40	3.07	3.32	2.72	3.44	3.47	3.04	3.04	3.42	4.22	3.08	3.31	3.74	3.94	3.32	3.45	3.53	3.34
1966_Base_Org	2.10	2.11	2.12	2.03	2.04	2.03	1.90	1.88	1.83	1.76	1.83	1.96	2.09	2.06	2.09	2.08	1.99	2.03	1.88	1.82	1.70	2.03	2.50	1.77	1.77	2.73	1.87	1.73	1.98	3.50	1.64	3.13	2.81	2.76	2.92
1966_Base_HT	2.09	2.11	2.12	2.03	2.04	2.03	1.90	1.88	1.83	1.76	1.83	1.96	2.09	2.06	2.09	2.08	1.99	2.02	1.87	1.82	1.70	2.01	2.42	1.77	1.77	2.65	1.87	1.73	1.98	3.40	1.64	3.09	2.80	2.74	2.83
1966_Base_LT	2.13	2.13	2.13	2.04	2.05	2.03	1.90	1.88	1.82	1.76	1.83	1.96	2.11	2.07	2.10	2.09	2.05	2.02	1.92	1.84	1.71	2.04	1.96	1.81	1.81	1.95	1.91	1.76	2.02	2.74	1.65	2.74	1.98	2.15	2.21
1970_Base_Org	2.82	2.73	2.72	2.53	2.39	2.24	1.94	1.84	1.75	2.11	2.21	2.29	2.73	2.64	2.71	3.23	5.10	5.61	4.59	4.03	3.05	5.19	5.71	4.47	4.47	5.63	5.70	4.32	4.49	6.39	4.33	5.96	5.66	5.52	5.12
1970_Base_HT	3.22	3.05	2.94	2.72	2.55	2.26	1.89	1.79	1.75	2.16	2.27	2.33	3.01	2.95	2.94	3.41	5.37	5.85	4.83	4.00	3.06	5.45	5.84	4.58	4.59	5.68	5.67	4.21	4.54	6.33	4.29	5.88	5.66	5.50	5.11
1970_Base_LT	2.39	2.39	2.38	2.25	2.32	2.30	2.12	2.08	1.97	1.92	2.15	2.17	2.31	2.25	2.27	2.51	4.22	4.98	4.40	3.56	2.89	4.46	4.98	3.99	3.99	4.87	5.09	3.89	4.37	5.77	4.34	5.27	4.89	4.68	4.23
1974_Base_Org	1.90	1.80	1.81	1.73	1.75	1.74	1.64	1.65	1.61	1.63	1.67	1.69	1.77	1.75	1.78	1.87	3.25	3.54	3.14	2.58	1.88	3.34	3.86	2.91	2.91	4.03	3.51	2.66	2.89	4.75	2.93	4.25	4.16	4.11	3.97
1974_Base_HT	2.36	1.83	1.82	1.70	1.67	1.68	1.58	1.58	1.55	1.49	1.54	1.64	2.01	1.91	1.84	2.14	3.58	3.82	3.36	2.74	1.97	3.62	4.13	3.11	3.11	4.30	3.77	2.88	3.03	4.97	3.05	4.51	4.43	4.31	4.15
1974_Base_LT	1.78	1.75	1.76	1.69	1.70	1.70	1.60	1.61	1.58	1.51	1.56	1.66	1.73	1.70	1.74	1.72	1.86	2.37	2.27	1.86	1.57	2.13	3.08	1.99	1.99	3.26	2.51	2.01	2.51	3.74	2.74	3.41	3.39	3.39	3.18
1983_Base_Org	1.95	2.03	2.05	1.98	1.97	1.97	1.82	1.82	1.77	1.72	1.80	1.92	2.03	2.01	2.05	2.02	1.81	1.79	1.73	1.70	1.59	1.83	1.75	1.62	1.62	1.72	1.77	1.62	1.82	2.17	1.56	1.94	1.76	1.80	1.85
1983_Base_HT	1.98	2.07	2.09	2.02	2.01	2.02	1.88	1.87	1.82	1.76	1.85	1.97	2.07	2.05	2.08	2.05	1.85	1.82	1.77	1.73	1.63	1.86	1.78	1.65	1.65	1.75	1.80	1.66	1.86	2.22	1.61	1.98	1.79	1.83	1.88
1983_Base_LT	1.96	2.05	2.07	2.01	2.00	2.00	1.86	1.86	1.81	1.75	1.83	1.95	2.05	2.03	2.07	2.04	1.82	1.80	1.75	1.72	1.62	1.84	1.76	1.64	1.64	1.73	1.78	1.65	1.84	2.20	1.59	1.96	1.77	1.81	1.86
1985_Base_Org	1.81	1.89	1.91	1.84	1.84	1.85	1.74	1.74	1.70	1.64	1.70	1.81	1.88	1.86	1.90	1.87	1.69	1.66	1.63	1.61	1.54	1.69	1.62	1.54	1.54	1.70	1.66	1.55	1.78	2.11	1.51	1.92	1.73	1.70	1.75
1985_Base_HT	1.84	1.92	1.94	1.87	1.87	1.88	1.76	1.76	1.72	1.66	1.72	1.84	1.91	1.89	1.93	1.90	1.71	1.68	1.64	1.63	1.55	1.71	1.64	1.56	1.56	1.63	1.68	1.57	1.80	2.13	1.53	1.92	1.68	1.71	1.75
1985_Base_LT	1.84	1.93	1.94	1.87	1.88	1.88	1.76	1.75	1.71	1.66	1.72	1.84	1.91	1.90	1.93	1.90	1.76	1.76	1.64	1.63	1.54	1.76	1.87	1.56	1.56	1.95	1.68	1.56	1.79	2.43	1.52	2.20	2.03	1.94	2.01
1986_Base_Org	1.54	1.62	1.63	1.58	1.58	1.58	1.50	1.51	1.49	1.42	1.47	1.56	1.60	1.58	1.62	1.60	1.43	1.41	1.40	1.40	1.36	1.44	1.37	1.33	1.33	1.37	1.42	1.35	1.59	1.92	1.75	1.70	1.42	1.45	1.49
1986_Base_HT	1.61	1.77	1.77	1.74	1.74	1.80	1.78	1.86	2.01	1.72	1.75	1.72	1.68	1.63	1.71	1.72	1.50	1.53	1.53	1.56	1.63	1.54	1.54	1.45	1.45	1.53	1.57	1.45	1.87	1.99	2.06	1.83	1.58	1.61	1.66
1986_Base_LT	1.53	1.61	1.62	1.57	1.57	1.59	1.53	1.59	1.65	1.45	1.59	1.62	1.59	1.57	1.61	1.59	1.42	1.41	1.39	1.39	1.37	1.43	1.36	1.33	1.33	1.37	1.44	1.34	1.59	1.86	1.80	1.70	1.41	1.45	1.49
1988_Base_Org	2.08	2.57	2.60	2.52	2.62	2.78	2.39	2.42	2.47	2.50	2.44	2.64	2.30	2.18	2.33	2.27	1.82	1.81	1.92	2.42	2.47	1.78	1.69	2.04	2.04	1.68	2.30	2.27	2.54	2.61	2.97	2.30	1.84	1.85	1.84
1988_Base_HT	2.99	3.09	3.08	2.89	3.01	2.96	2.47	2.47	2.47	2.61	2.52	2.85	2.79	2.58	2.66	2.56	2.50	2.47	2.39	2.53	2.46	2.40	2.20	2.35	2.35	2.22	2.46	2.36	2.88	2.90	2.82	2.69	2.38	2.38	2.33
1988_Base_LT	2.45	2.94	2.98	2.81	2.94	3.02	2.48	2.47	2.50	2.59	2.59	2.88	2.69	2.56	2.66	2.59	2.15	2.11	2.18	2.58	2.52	2.09	1.93	2.26	2.26	1.86	2.51	2.43	2.64	2.72	3.05	2.41	2.01	2.07	2.04
1991_Base_Org	2.10	2.12	2.13	2.04	2.06	2.05	1.91	1.88	1.82	1.78	1.82	1.96	2.08	2.06	2.08	2.07	2.00	1.98	1.90	1.82	1.72	1.99	2.37	1.79	1.79	2.66	1.88	1.74	2.04	2.50	1.60	2.24	2.37	2.31	2.65
1991_Base_HT	1.95	2.02	2.03	1.95	1.96	1.97	1.83	1.82	1.78	1.72	1.78	1.90	1.99	1.98	2.01	1.99	1.84	1.81	1.75	1.72	1.62	1.83	2.28	1.66	1.66	2.60	1.77	1.64	1.89	2.29	1.58	2.01	2.28	2.26	2.57
1991_Base_LT	2.02	2.07	2.08	2.00	2.01	2.01	1.88	1.86	1.81	1.76	1.82	1.94	2.04	2.02	2.05	2.04	2.04	2.15	1.99	1.77	1.67	2.07	2.33	1.81	1.81	2.60	1.82	1.69	1.94	2.94	1.61	2.52	2.57	2.31	2.44
1995_Base_Org	2.14	2.23	2.24	2.16	2.16	2.16	1.99	1.97	1.92	1.84	1.95	2.09	2.22	2.20	2.22	2.20	2.00	1.97	1.90	1.85	1.73	2.01	1.93	1.78	1.78	1.90	1.93	1.78	1.99	2.36	1.73	2.13	1.93	1.98	2.03
1995_Base_HT	2.14	2.23	2.25	2.16	2.17	2.16	1.99	1.96	1.91	1.83	1.96	2.09	2.23	2.21	2.23	2.20	2.00	1.96	1.89	1.84	1.73	2.01	1.93	1.78	1.78	1.89	1.94	1.78	1.98	2.36	1.72	2.12	1.93	1.97	2.03
1995_Base_LT	2.16	2.25	2.26	2.17	2.18	2.18	2.01	1.97	1.93	1.85	1.96	2.11	2.24	2.22	2.24	2.21	2.02	1.98	1.91	1.85	1.74	2.03	1.95	1.79	1.79	1.91	1.95	1.79	1.98	2.37	1.73	2.14	1.94	1.99	2.04
1997_May_Base_Org	1.43	1.35	1.38	1.28	1.28	1.25	1.16	1.15	1.10	1.09	1.10	1.21	1.41	1.41	1.44	1.39	1.57	1.66	1.54	1.24	1.11	1.60	1.69	1.39	1.38	1.69	1.15	1.12	1.41	1.96	0.91	1.80	1.68	1.62	1.60
1997_May_Base_LT	1.48	1.35	1.34	1.25	1.26	1.21	1.13	1.11	1.04	1.07	1.07	1.15	1.34	1.30	1.31	1.28	1.52	1.56	1.46	1.29	1.14	1.53	1.66	1.36	1.36	1.67	1.26	1.22	1.52	1.98	0.95	1.79	1.62	1.58	1.57
1997_Sep_Base_Org	1.98	1.83	1.78	1.69	1.75	1.75	1.71	1.72	1.66	1.56	1.51	1.58	1.66	1.54	1.60	1.49	1.83	1.89	1.88	1.79	1.71	1.78	2.11	1.79	1.79	2.54	1.69	1.65	2.09	3.02	1.50	2.70	2.70	2.51	2.50
1997_Sep_Base_HT	1.41	1.30	1.29	1.27	1.28	1.28	1.28	1.31	1.28	1.24	1.21	1.26	1.25	1.23	1.25	1.22	1.59	1.81	1.77	1.34	1.29	1.67	2.21	1.64	1.64	2.52	1.34	1.31	1.66	3.36	1.17	3.07	2.68	2.58	2.63
1997_Sep_Base_LT	2.24	2.02	1.98	1.87	1.92	1.87	1.79	1.76	1.68	1.61	1.61	1.75	1.91	1.76	1.82	1.73	2.16	2.21	2.17	1.88	1.73	2.13	2.38	2.03	2.03	2.84	1.82	1.79	2.10	3.54	1.44	3.24	3.11	2.93	2.91
1998_Base_Org	1.40	1.47	1.48	1.44	1.43	1.44	1.37	1.38	1.36	1.30	1.35	1.42	1.45	1.44	1.46	1.46	1.33	1.32	1.30	1.31	1.28	1.33	1.28	1.24	1.24	1.32	1.33	1.26	1.47	1.85	1.24	1.65	1.36	1.36	1.39
1998_Base_HT	1.50	1.60	1.61	1.56	1.55	1.53	1.32	1.33	1.32	1.26	1.36	1.51	1.58	1.57	1.60	1.59	1.44	1.42	1.39	1.31	1.23	1.44	1.41	1.30	1.30	1.48	1.40	1.21	1.44	1.94	1.19	1.73	1.54	1.50	1.50
2007_Sidr_Base_Org	4.63	4.09	4.05	3.69	3.72	3.43	2.68	2.60	2.54	2.98	3.08	3.55	3.68	3.08	3.20	3.05	4.38	4.49	3.91	3.38	2.94	4.23	3.95	3.62	3.63	3.86	3.80	3.40	3.52	4.10	3.35	3.92	3.85	3.78	3.67
2007_Sidr_Base_HT	4.11	4.09	4.11	3.75	3.77	3.55	2.74	2.60	2.55	2.97	3.17	3.71	3.73	3.38	3.46	3.41	3.66	3.80	3.48	3.36	3.07	3.53	3.36	3.35	3.35	3.37	3.32	3.28	3.38	3.68	3.60	3.55	3.47	3.36	3.18
2007_Sidr_Base_LT	4.90	4.40	4.40	3.96	3.95	3.61	2.73	2.62	2.55	3.05	3.22	3.77	4.07	3.52	3.56	3.45	4.51	4.56	3.96	3.47	3.00	4.32	3.92	3.72	3.72	3.80	3.92	3.53	3.55	4.03	3.47	3.85	3.76	3.72	3.61
2009_Base_Org	2.56	2.63	2.64	2.54	2.63	2.64	2.34	2.30	2.25	2.25	2.32	2.52	2.47	2.39	2.43	2.37	2.43	2.42	2.28	2.22	2.10	2.40	2.37	2.16	2.16	2.42	2.32	2.16	2.48	2.89	2.29	2.67	2.45	2.48	2.50
2009_Base_HT	2.82	2.84	2.85	2.66	2.77	2.69	2.32	2.25	2.18	2.18	2.27	2.54	2.74	2.67	2.64	2.61	2.60	2.56	2.41	2.32	2.07	2.55	2.43	2.30	2.30	2.44	2.47	2.27	2.61	3.01	2.23	2.77	2.47	2.49	2.54
2009_Base_LT	2.51	2.71	2.72	2.60	2.70	2.69	2.36	2.30	2.25	2.25	2.33	2.56	2.55	2.45	2.50	2.44	2.33	2.31	2.19	2.26	2.11	2.31	2.27	2.14	2.14	2.33	2.26	2.17	2.50	2.85	2.30	2.65	2.38	2.39	2.43

Table E- 3: The simulated maximum water level without climate change for locations 71 -105

Location / Cyclonic Event	Strom Surge Level (mPWD) at Base Condition																																	
	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
1960_Base_Org	2.30	2.44	2.39	3.11	2.50	2.87	5.41	5.37	5.81	5.18	4.34	6.17	5.67	4.31	6.17	6.29	6.11	6.28	6.09	5.77	5.48	4.84	5.29	4.77	4.55	4.02	3.38	3.57	3.21	2.69	1.60	1.51	1.52	1.67	1.54
1960_Base_HT	3.62	3.67	3.77	4.34	4.07	4.45	5.90	5.83	6.24	5.86	4.93	6.26	5.86	4.33	6.11	6.17	5.99	6.06	5.80	5.34	4.81	4.04	4.33	3.96	3.55	2.86	1.94	2.06	1.83	1.73	1.60	1.55	1.52	1.68	1.63
1960_Base_LT	2.59	2.67	2.64	3.46	2.87	3.23	6.18	6.14	6.61	6.04	5.18	6.83	6.36	4.55	6.82	6.88	6.71	6.71	6.64	6.32	5.99	5.32	5.83	5.25	5.11	4.47	3.68	3.86	3.49	2.91	1.60	1.50	1.52	1.67	1.53
1961_Base_Org	3.43	3.54	3.71	3.41	3.69	3.75	4.68	4.67	4.27	4.11	3.80	3.80	3.50	2.99	3.09	3.01	2.96	2.83	2.77	2.63	2.46	2.31	2.29	2.29	2.12	1.96	1.72	1.85	1.74	1.67	1.69	1.59	1.60	1.77	1.63
1961_Base_HT	3.52	3.65	3.78	3.48	3.74	3.79	4.66	4.65	4.26	4.11	3.82	3.81	3.52	3.01	3.12	3.04	2.98	2.86	2.80	2.66	2.50	2.36	2.34	2.35	2.20	2.05	1.84	1.99	1.85	1.71	1.52	1.44	1.46	1.63	1.46
1961_Base_LT	2.73	2.79	3.06	3.03	3.31	3.46	4.75	4.79	4.43	4.15	3.76	3.88	3.52	3.02	3.12	3.04	2.99	2.90	2.83	2.69	2.54	2.39	2.41	2.37	2.25	2.10	1.90	1.95	1.81	1.68	1.62	1.51	1.55	1.76	1.48
1963_Base_Org	1.88	1.83	1.93	2.39	2.48	2.59	3.77	3.81	4.18	3.45	2.90	3.85	3.34	3.30	3.48	3.64	3.43	4.14	3.80	3.48	3.25	2.88	3.22	2.84	3.03	2.69	2.42	3.64	2.96	2.28	2.03	1.90	1.91	2.03	1.96
1963_Base_HT	1.90	1.86	1.96	2.42	2.51	2.62	3.80	3.75	3.74	3.28	2.84	3.49	3.04	3.21	3.22	3.57	3.35	3.99	3.65	3.34	3.14	2.87	3.14	2.81	3.02	2.71	2.37	3.89	3.19	2.65	2.05	1.93	1.94	2.05	1.99
1963_Base_LT	1.88	1.83	1.93	2.39	2.48	2.59	3.77	3.73	3.92	3.25	2.84	3.59	3.16	3.13	3.18	3.37	3.17	3.83	3.47	3.15	2.93	2.59	2.90	2.54	2.72	2.40	2.10	3.27	2.55	2.00	2.03	1.90	1.91	2.03	1.96
1965_Dec_Base_Org	1.71	1.72	1.78	2.21	2.28	2.38	3.42	3.39	3.14	2.95	2.57	2.78	2.52	2.31	2.34	2.31	2.27	2.22	2.21	2.14	2.09	2.16	2.38	2.14	2.56	2.48	2.39	3.86	3.22	2.70	1.88	1.76	1.77	1.89	1.80
1965_Dec_Base_LT	1.76	1.63	1.96	2.68	2.55	2.90	4.87	4.87	4.69	4.18	3.66	4.25	3.83	3.48	3.76	3.86	3.76	4.06	3.94	3.91	3.92	3.57	4.33	3.51	4.28	3.79	3.38	4.77	3.95	2.59	1.43	1.34	1.35	1.65	1.42
1965_May_Base_Org	2.56	2.62	2.98	2.53	2.48	2.64	3.38	3.35	3.20	3.02	3.02	3.15	3.06	2.95	2.97	2.95	2.92	2.90	2.84	2.74	2.64	2.48	2.54	2.47	2.37	2.19	1.96	1.98	1.87	1.74	2.04	1.96	1.96	1.88	1.91
1965_May_Base_HT	3.48	3.39	3.86	3.31	3.63	3.81	5.04	5.07	4.65	4.38	4.01	4.02	3.66	3.06	3.20	3.11	3.04	2.91	2.84	2.67	2.47	2.29	2.27	2.27	2.12	2.00	1.84	2.02	1.89	1.77	2.17	2.92	2.75	1.71	3.01
1965_May_Base_LT	3.48	3.39	3.86	3.31	3.63	3.81	5.04	5.07	4.65	4.38	4.01	4.02	3.66	3.06	3.20	3.11	3.04	2.91	2.84	2.67	2.47	2.29	2.27	2.27	2.12	2.00	1.84	2.02	1.89	1.77	2.17	2.92	2.75	1.71	3.01
1966_Base_Org	2.89	2.89	3.03	3.63	3.58	3.83	4.59	4.54	4.15	4.06	3.80	3.73	3.48	3.11	3.18	3.20	3.14	3.23	3.11	2.94	2.77	2.49	2.62	2.46	2.33	2.19	2.04	2.35	2.20	2.07	2.12	2.02	2.03	2.01	2.09
1966_Base_HT	2.83	2.83	2.85	3.36	3.32	3.43	4.19	4.14	3.91	3.65	3.38	3.78	3.34	3.23	3.40	3.40	3.32	3.34	3.21	3.00	2.78	2.50	2.59	2.47	2.34	2.13	1.99	2.27	2.14	2.02	2.12	2.02	2.03	2.02	2.08
1966_Base_LT	2.63	2.73	2.94	3.55	3.63	3.94	6.26	6.25	5.76	5.37	4.71	5.04	4.53	3.53	3.99	3.92	3.84	3.73	3.65	3.47	3.28	3.07	3.11	3.05	2.93	2.73	2.45	2.60	2.42	2.22	2.11	2.03	2.03	1.99	2.10
1970_Base_Org	5.03	5.71	6.09	5.41	6.04	6.07	7.72	7.70	6.97	6.63	6.03	6.11	5.64	4.02	4.98	4.87	4.78	4.62	4.50	4.28	4.03	3.78	3.76	3.76	3.52	3.25	2.78	2.94	2.70	2.47	2.00	1.86	1.87	1.98	2.10
1970_Base_HT	4.95	5.63	5.86	5.22	5.77	5.81	7.48	7.45	6.73	6.40	5.79	5.86	5.40	3.92	4.77	4.65	4.56	4.42	4.31	4.09	3.82	3.57	3.54	3.55	3.28	3.00	2.55	2.93	2.69	2.48	1.99	2.16	1.88	1.98	2.54
1970_Base_LT	4.58	4.92	5.49	5.07	5.74	6.04	8.08	8.14	7.87	7.36	6.79	7.12	6.33	4.24	5.53	5.37	5.24	5.04	4.86	4.54	4.21	3.86	3.92	3.82	3.53	3.19	2.71	2.71	2.49	2.20	2.40	2.43	2.43	2.25	2.41
1974_Base_Org	3.95	4.07	4.41	3.80	4.23	4.35	5.87	5.90	5.08	4.77	4.41	4.31	3.93	3.17	3.37	3.26	3.18	3.03	2.92	2.72	2.50	2.31	2.28	2.30	2.12	1.98	1.94	2.10	1.97	1.87	1.88	1.76	1.77	1.84	1.78
1974_Base_HT	4.11	4.35	4.57	4.04	4.39	4.46	5.59	5.59	4.86	4.71	4.41	4.28	3.98	3.23	3.44	3.34	3.28	3.14	3.06	2.89	2.71	2.56	2.54	2.55	2.43	2.30	2.11	2.39	2.22	2.08	1.76	1.64	1.66	1.81	1.74
1974_Base_LT	3.33	3.28	3.89	3.90	4.25	4.51	6.77	6.92	6.85	6.20	5.38	5.91	5.16	3.82	4.57	4.45	4.35	4.18	4.08	3.85	3.60	3.34	3.40	3.32	3.16	2.93	2.63	2.73	2.55	2.32	1.84	1.75	1.74	1.82	1.75
1983_Base_Org	1.89	1.81	1.93	2.39	2.49	2.60	3.82	3.77	3.52	3.29	2.84	3.09	2.81	2.53	2.62	2.60	2.56	2.52	2.50	2.45	2.39	2.32	2.35	2.31	2.29	2.18	2.05	2.23	2.12	2.03	2.04	1.90	1.91	2.03	1.97
1983_Base_HT	1.92	1.85	1.95	2.41	2.52	2.63	3.84	3.80	3.54	3.31	2.86	3.11	2.83	2.55	2.64	2.62	2.58	2.54	2.53	2.47	2.41	2.34	2.37	2.33	2.31	2.25	2.16	2.58	2.38	2.19	2.07	1.94	1.95	2.06	2.01
1983_Base_LT	1.90	1.82	1.93	2.39	2.50	2.61	3.83	3.78	3.52	3.29	2.84	3.10	2.82	2.54	2.63	2.61	2.56	2.52	2.51	2.46	2.39	2.32	2.36	2.31	2.30	2.18	2.05	2.23	2.12	2.03	2.06	1.92	1.93	2.05	1.99
1985_Base_Org	1.78	1.78	1.85	2.78	2.54	2.62	3.58	3.53	3.32	3.10	2.70	2.92	2.67	2.43	2.48	2.46	2.41	2.37	2.36	2.29	2.24	2.17	2.19	2.16	2.13	2.05	1.92	2.06	1.98	1.88	1.93	1.80	1.81	1.94	1.85
1985_Base_HT	1.79	1.79	1.86	2.93	2.54	2.65	3.61	3.56	3.34	3.12	2.84	3.06	2.98	2.67	2.77	2.79	2.76	2.88	2.80	2.77	2.77	2.84	2.93	2.84	3.02	2.88	2.67	3.02	2.72	2.38	1.95	1.82	1.83	1.96	1.88
1985_Base_LT	1.96	1.97	1.85	2.71	2.62	2.73	3.60	3.56	3.34	3.13	2.77	2.94	2.69	2.45	2.51	2.48	2.44	2.39	2.38	2.31	2.26	2.19	2.21	2.18	2.15	2.07	1.94	2.40	2.00	1.90	1.95	1.82	1.84	1.96	1.88
1986_Base_Org	1.53	1.56	1.61	2.03	2.07	2.19	3.16	3.13	3.10	2.88	2.52	2.94	2.68	2.61	2.55	2.52	2.48	2.41	2.37	2.25	2.11	1.92	1.99	1.90	1.84	1.76	1.65	1.75	1.68	1.59	1.65	1.55	1.57	1.74	1.58
1986_Base_HT	1.70	1.74	1.81	2.22	2.28	2.39	3.47	3.43	3.22	3.00	2.63	2.84	2.59	2.37	2.41	2.39	2.35	2.29	2.28	2.22	2.15	2.09	2.11	2.08	2.06	1.98	1.82	1.86	1.75	1.63	2.18	1.79	1.89	1.90	1.74
1986_Base_LT	1.53	1.56	1.61	2.03	2.10	2.21	3.32	3.33	3.52	3.23	2.80	3.27	2.89	2.67	2.64	2.59	2.53	2.45	2.40	2.26	2.11	1.92	1.98	1.90	1.84	1.76	1.64	1.74	1.67	1.59	1.64	1.54	1.57	1.74	1.57
1988_Base_Org	1.99	2.08	2.24	2.49	2.68	2.79	3.92	3.95	3.75	3.48	3.10	3.30	2.96	2.70	2.66	2.60	2.55	2.49	2.43	2.31	2.21	2.16	2.17	2.15	2.11	2.04	1.90	2.05	1.96	1.87	3.81	3.03	3.16	2.99	2.85
1988_Base_HT	2.42	2.53	2.54	2.68	2.81	2.88	3.73	3.72	3.45	3.29	3.02	3.09	2.85	2.58	2.55	2.50	2.46	2.38	2.34	2.24	2.13	2.02	2.03	2.01	1.97	1.89	1.76	1.88	1.81	1.73	4.08	3.49	3.53	3.31	3.34
1988_Base_LT	2.17	2.21	2.47	2.59	2.80	2.91	4.02	4.05	3.81	3.55	3.18	3.36	3.04	2.73	2.72	2.66	2.61	2.53	2.48	2.36	2.23	2.15	2.17	2.14	2.11	2.03	1.89	2.04	1.95	1.86	3.91	3.27	3.36	3.04	3.17
1991_Base_Org	2.25	2.08	2.10	4.48	3.95	3.90	5.95	5.70	5.34	4.86	4.39	5.44	5.37	4.30	5.19	5.55	5.33	6.15	5.84	5.69	5.66	5.20	5.56	5.13	4.96	4.46	3.58	4.12	3.59	2.91	2.13	2.06	2.05	2.04	2.10
1991_Base_HT	2.20	1.97	1.92	4.51	3.90	3.84	6.18	5.90	5.59	5.10	4.60	5.68	5.63	4.40	5.51	5.88	5.66	6.48	6.22	6.09	6.03	5.67	5.98	5.61	5.47	4.95	4.09	4.59	4.14	3.44	2.04	1.92	1.93	2.01	1.98
1991_Base_LT	2.13	2.17	1.99	3.87	3.48	3.12	4.49	4.15	3.72	3.53	2.86	3.98	3.93	3.86	4.01	4.32	4.12	5.15	4.79	4.68	4.81	4.42	4.92	4.35	4.34	3.88	3.14	3.46	2.92	2.39	2.09	1.98	1.99	2.04	2.04
1995_Base_Org	2.07	2.00	2.11	2.59	2.69	2.81	4.05	4.00	3.74	3.50	3.03	3.30	3.01	2.70	2.82	2.80	2.75	2.71	2.69	2.64	2.58	2.50	2.53	2.49	2.48	2.37	2.23	2.41	2.31	2.21	2.18	2.09	2.09	2.17	2.16
1995_Base_HT	2.07	1.99	2.10	2.59	2.69	2.81	4.04	4.00	3.75	3.51	3.03	3.30	3.01	2.70	2.83	2.80	2.75	2.72	2.70	2.64	2.59	2.50	2.54	2.49	2.49	2.38	2.24	2.42	2.32	2.21	2.18	2.07	2.08	2.17	2.16
1995_Base_LT	2.09	2.01	2.12	2.60	2.70	2.82	4.06	4.02	3.75	3.52	3.05	3.31	3.02	2.71	2.83	2.81	2.76	2.72	2.71	2.65	2.59	2.52	2.55	2.51	2.50	2.38	2.24	2.44	2.33	2.23	2.19	2.09	2.10	2.17	2.17
1997_May_Base_Org	1.58	1.64	1.46	2.08	1.92	1.93	3.45	3.23	2.74	2.48	2.00	2.60	2.45	2.34	2.30	2.39	2.32	2.46	2.40	2.34	2.31	2.26	2.47	2.25	2.45	2.31	2.27	3.44	2.98	2.64	1.39	1.32	1.32	1.43	1.34
1997_May_Base_LT	1.58	1.65	1.50	2.00	1.97	2.03	2.67	2.63	2.36	2.26	2.06	2.34	2.49	3.21	3.13	3.33	3.28	3.61	3.61	3.55	3.51	3.18	3.51	3.13	3.24	2.95	2.69	3.28	2.86	2.37	1.35	1.36	1.34	1.38	1.37
1997_Sep_Base_Org	2.32	2.47	2.17	3.00	3.08	3.09	4.73	4.68	4.64	4.29	3.82	4.56	4.32	3.87	4.41	4.46	4.37	4.58	4.48	4.32	4.11	3.73	3.88	3.68	3.52	3.12	2.55	2.70	2.34	1.93	2.17	2.15	2.14	1.73	2.04
1997_Sep_Base_HT	2.60	2.73	2.66	3.78	3.68	3.95	5.40	5.33	5.20	4.83	4.40	4.86	4.53	3.85	4.45	4.50	4.42	4.56	4.45	4.24	3.98	3.50	3.69	3.44	3.18	2.67	2.17	2.38	2.09	1.78	1.48	1.42	1.44	1.46	1.36
1997_Sep_Base_LT	2.79	2.95	2.60	3.03	3.11	3.19	4.13	4.09	4.04	3.70	3.26	3.87	3.66	3.59	3.81	3.88	3.80	4.04	3.93	3.77	3.59	3.22	3.43	3.17	3.05	2.66	2.19	2.38	2.04	1.66	2.17	2.22	2.19	1.69	2.16
1998_Base_Org	1.42	1.48	1.51	3.14	2.69	2.77	3.17	3.08	2.78	2.74	2.64	2.62	2.58	2.10	2.16	2.12	2.07	2.06	1.97	1.86	1.79	1.80	1.79	1.81	1.86	1.74	1.70	2.41	2.07	1.85	1.51	1.43	1.44	1.62	1.44
1998_Base_HT	1.51	1.56	1.44	3.05	2.63	2.72	3.47	3.41	3.14	3.00	2.83	2.93	2.85	2.51	2.50	2.50	2.44	2.49	2.40	2.29	2.17	2.20	2.23	2.20	2.30	2.17	2.08	2.81	2.45	2.13	1.53	1.44	1.39	1.54	1.56
2007_Sidr_Base_Org	3.66	3.77	3.80	3.73	3.93	3.98	4.75	4.74	4.45	4.32	4.01	4.03	3.77	3.15	3.36	3.28	3.23	3.08	3.02	2.88	2.70	2.53	2.50	2.51	2.32	2.12	1.81	2.19	1.94	1.77	4.14	4.21	4.03	2.29	4.38
2007_Sidr_Base_HT	3.14	3.38	3.23	3.00	3.12	3.14	3.88	3.84	3.34	3.25	2.99	2.94	2.73	2.58	2.55	2.51	2.49	2.46	2.39	2.31	2.22	2.12	2.14	2.11	2.05	1.96	1.86	1.95	1.83	1.72	4.22	4.17	4.02	1.83	4.32
2007_Sidr_Base_LT	3.61	3.70	3.75	3.74	3.93	3.99	4.80	4.79	4.56	4.41	4.08	4.16	3.88	3.25	3.52	3.44	3.39	3.24	3.20	3.06	2.89	2.72	2.68	2.70	2.52	2.34	2.02	2.27	2.06	1.87	4.22	4.35	4.14	2.34	4.61
2009_Base_Org	2.54	2.54	2.63	2.96	3.09	3.19	4.40	4.37	4.05	3.83	3.38	3.61	3.27	2.85	3.01	2.95	2.90	2.81	2.78	2.69	2.62	2.52	2.56	2.51	2.49	2.37	2.22	2.44	2.31	2.22	2.86	2.77	2.81	2.68	2.72
2009_Base_HT	2.59	2.61	2.74	3.09	3.17	3.32	4.55	4.53	4.21	3.98	3.53	3.75	3.41	2.98	3.15	3.12	3.07	2.98	2.95	2.87	2.77	2.68	2.69	2.67	2.61	2.51	2.33	2.53	2.41	2.29	2.81	2.88	2.88	2.68	2.86
2009_Base_LT	2.46	2.50	2.56	2.93	3.04	3.16	4.37	4.34	4.01	3.79	3.34	3.53	3.20	2.82	2.92	2.89	2.85	2.79	2.77	2.71	2.64	2.54	2.57	2.53	2.50	2.38	2.23	2.42	2.29	2.20	2.90	2.84	2.87	2.74	2.79

Table E- 4: The simulated maximum water level without climate change for locations 106 -141

Location / Cyclonic Event	Strom Surge Level (mPWD) at Base Condition																																		
	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
1960_Base_Org	1.54	1.58	1.54	1.54	1.43	1.43	1.38	1.36	1.35	1.60	1.55	1.56	1.51	1.67	1.67	1.69	1.65	1.52	1.60	1.62	1.53	1.46	1.52	1.68	1.65	1.65	1.54	1.55	1.57	1.60	1.48	1.98	2.04	2.04	6.25	5.61
1960_Base_HT	1.67	1.62	1.58	1.54	1.43	1.43	1.42	1.37	1.35	1.61	1.59	1.58	1.51	1.66	1.67	1.69	1.65	1.51	1.59	1.62	1.58	1.52	1.57	1.70	1.66	1.65	1.54	1.56	1.57	1.61	1.60	2.99	3.22	3.61	6.00	4.92
1960_Base_LT	1.54	1.58	1.54	1.54	1.43	1.43	1.38	1.37	1.35	1.60	1.55	1.55	1.51	1.66	1.66	1.69	1.65	1.51	1.59	1.61	1.57	1.51	1.56	1.70	1.66	1.65	1.54	1.55	1.57	1.61	1.42	1.90	1.97	2.08	6.75	6.11
1961_Base_Org	1.63	1.66	1.63	1.61	1.61	1.61	2.50	2.66	2.50	1.69	1.75	1.83	1.60	1.77	1.77	1.78	1.74	1.59	1.68	1.71	1.66	1.61	1.64	1.76	1.73	1.73	1.63	1.64	1.67	1.69	3.58	4.42	4.34	4.10	2.80	2.45
1961_Base_HT	1.46	1.49	1.46	1.52	1.60	1.60	2.55	2.67	2.53	1.73	1.85	1.91	1.48	1.61	1.60	1.64	1.60	1.48	1.56	1.59	1.54	1.50	1.54	1.66	1.62	1.61	1.51	1.52	1.54	1.56	3.58	4.45	4.34	4.13	2.83	2.50
1961_Base_LT	1.47	1.50	1.48	1.64	1.74	1.74	2.43	2.62	2.44	1.73	1.70	1.73	1.57	1.62	1.65	1.76	1.72	1.57	1.66	1.69	1.63	1.58	1.61	1.75	1.71	1.72	1.61	1.62	1.65	1.67	3.25	4.07	4.06	3.83	2.87	2.54
1963_Base_Org	1.97	2.03	1.98	1.95	1.79	1.79	1.70	1.67	1.63	2.05	1.97	1.97	1.84	2.06	2.05	2.02	1.99	1.81	1.89	1.93	1.89	1.83	1.85	1.93	1.93	1.95	1.86	1.87	1.90	1.92	1.71	2.30	2.40	2.42	4.07	3.38
1963_Base_HT	2.00	2.06	2.01	1.98	1.82	1.82	1.72	1.70	1.66	2.07	1.99	1.99	1.86	2.08	2.07	2.03	2.00	1.82	1.90	1.94	1.91	1.84	1.87	1.94	1.94	1.96	1.88	1.89	1.92	1.93	1.73	2.33	2.42	2.45	3.92	3.32
1963_Base_LT	1.97	2.03	1.98	1.95	1.80	1.80	1.70	1.68	1.64	2.05	1.97	1.97	1.84	2.06	2.05	2.02	1.99	1.81	1.89	1.93	1.89	1.83	1.85	1.93	1.93	1.95	1.86	1.87	1.90	1.92	1.71	2.30	2.40	2.42	3.76	3.08
1965_Dec_Base_Org	1.80	1.83	1.80	1.76	1.62	1.62	1.58	1.55	1.52	1.85	1.79	1.80	1.71	1.89	1.89	1.89	1.85	1.70	1.78	1.81	1.79	1.70	1.72	1.83	1.81	1.83	1.73	1.74	1.76	1.79	1.61	2.15	2.23	2.25	2.22	2.12
1965_Dec_Base_LT	1.43	1.50	1.45	1.45	1.32	1.32	1.23	1.22	1.19	1.56	1.50	1.50	1.48	1.65	1.66	1.66	1.61	1.46	1.52	1.55	1.37	1.42	1.49	1.64	1.61	1.61	1.50	1.52	1.54	1.56	1.41	1.98	2.21	2.32	4.15	4.14
1965_May_Base_Org	1.90	1.89	1.85	2.16	2.30	2.30	2.88	3.11	2.81	2.41	2.16	2.23	1.76	1.90	1.89	1.89	1.87	1.74	1.83	1.85	1.85	1.60	1.63	1.79	1.80	1.83	1.74	1.75	1.76	1.79	2.94	3.50	3.34	2.80	2.89	2.65
1965_May_Base_HT	3.01	3.12	3.05	2.84	2.54	2.54	3.34	3.53	3.20	3.04	2.72	2.68	1.60	1.80	1.91	1.73	1.69	1.56	1.64	1.67	1.66	1.56	1.60	1.72	1.69	1.69	1.57	1.59	1.60	1.64	3.59	4.57	4.57	4.24	2.88	2.47
1965_May_Base_LT	3.01	3.12	3.05	2.84	2.54	2.54	3.34	3.53	3.20	3.04	2.72	2.68	1.60	1.80	1.91	1.73	1.69	1.56	1.64	1.67	1.66	1.56	1.60	1.72	1.69	1.69	1.57	1.59	1.60	1.64	3.59	4.57	4.57	4.24	2.88	2.47
1966_Base_Org	2.10	2.12	2.07	1.99	1.82	1.82	1.80	1.77	1.73	2.09	2.04	2.04	1.83	2.07	2.06	1.99	1.98	1.80	1.88	1.92	1.93	1.76	1.79	1.89	1.89	1.92	1.84	1.85	1.87	1.89	2.32	3.31	3.46	3.59	3.23	2.81
1966_Base_HT	2.09	2.12	2.06	1.99	1.82	1.82	1.80	1.77	1.73	2.09	2.00	2.04	1.83	2.07	2.06	2.00	1.98	1.80	1.89	1.93	1.93	1.77	1.79	1.90	1.90	1.92	1.84	1.85	1.87	1.89	2.24	3.18	3.27	3.36	3.32	2.82
1966_Base_LT	2.11	2.13	2.08	1.99	1.82	1.82	1.82	1.78	1.75	2.10	2.06	2.06	1.81	2.05	2.04	1.97	1.95	1.77	1.86	1.90	1.91	1.76	1.79	1.89	1.87	1.90	1.81	1.83	1.85	1.86	1.86	2.51	2.89	3.28	3.71	3.29
1970_Base_Org	2.36	2.68	2.53	2.30	2.21	2.21	3.95	4.04	3.77	2.78	2.88	2.97	1.78	1.99	1.98	1.97	1.93	1.76	1.85	1.89	1.87	1.78	1.81	1.90	1.89	1.90	1.81	1.83	1.85	1.87	5.56	6.37	6.64	6.60	4.55	4.03
1970_Base_HT	2.80	3.00	2.79	2.35	2.27	2.27	3.92	3.93	3.70	2.78	2.78	2.91	1.78	1.99	1.98	1.97	1.93	1.76	1.85	1.88	1.87	1.78	1.81	1.90	1.88	1.90	1.81	1.83	1.85	1.87	5.56	6.31	6.48	6.37	4.36	3.82
1970_Base_LT	2.42	2.41	2.36	2.20	2.16	2.16	3.53	3.76	3.53	2.51	2.50	2.60	2.11	2.35	2.33	2.22	2.23	2.05	2.17	2.20	2.02	1.79	1.81	1.94	2.03	2.10	2.03	2.05	2.05	2.08	4.46	5.67	5.94	5.98	4.97	4.24
1974_Base_Org	1.78	1.80	1.76	1.71	1.65	1.65	2.48	2.42	2.28	1.80	1.77	1.77	1.68	1.86	1.85	1.85	1.82	1.67	1.76	1.79	1.77	1.64	1.66	1.80	1.77	1.79	1.69	1.70	1.72	1.75	3.60	4.86	5.07	5.07	2.97	2.50
1974_Base_HT	1.85	1.77	1.68	1.66	1.52	1.52	2.63	2.55	2.40	1.86	1.90	1.91	1.64	1.81	1.81	1.81	1.78	1.63	1.71	1.74	1.71	1.64	1.66	1.79	1.75	1.76	1.66	1.67	1.70	1.72	3.78	5.05	5.25	5.21	3.09	2.70
1974_Base_LT	1.77	1.75	1.71	1.68	1.54	1.54	1.82	1.80	1.77	1.73	1.76	1.72	1.72	1.65	1.83	1.82	1.83	1.79	1.64	1.73	1.76	1.73	1.65	1.67	1.79	1.76	1.77	1.68	1.68	1.71	1.73	2.90	3.97	4.40	4.48	4.15	3.62
1983_Base_Org	1.99	2.04	1.99	1.96	1.78	1.78	1.69	1.67	1.62	2.06	1.98	1.98	1.82	2.06	2.06	2.01	1.98	1.79	1.87	1.91	1.87	1.79	1.82	1.92	1.91	1.94	1.84	1.86	1.88	1.90	1.70	2.29	2.40	2.42	2.52	2.40
1983_Base_HT	2.02	2.08	2.03	2.00	1.83	1.83	1.73	1.71	1.66	2.09	2.01	2.01	1.85	2.09	2.08	2.04	2.01	1.82	1.90	1.94	1.91	1.83	1.86	1.94	1.94	1.96	1.88	1.89	1.91	1.93	1.73	2.33	2.43	2.45	2.54	2.42
1983_Base_LT	2.01	2.06	2.02	1.98	1.82	1.82	1.71	1.69	1.65	2.08	1.97	2.00	1.84	2.08	2.07	2.03	2.00	1.81	1.89	1.93	1.90	1.82	1.85	1.94	1.93	1.96	1.87	1.88	1.90	1.92	1.72	2.31	2.42	2.44	2.53	2.40
1985_Base_Org	1.85	1.89	1.85	1.82	1.68	1.68	1.61	1.60	1.56	1.92	1.86	1.85	1.75	1.95	1.95	1.93	1.90	1.74	1.82	1.86	1.83	1.76	1.78	1.88	1.86	1.87	1.78	1.80	1.82	1.84	1.64	2.21	2.30	2.32	2.38	2.25
1985_Base_HT	1.87	1.92	1.88	1.85	1.71	1.71	1.63	1.61	1.58	1.94	1.88	1.88	1.77	1.98	1.97	1.95	1.92	1.75	1.83	1.87	1.85	1.77	1.80	1.89	1.87	1.89	1.80	1.81	1.84	1.86	1.66	2.23	2.32	2.34	2.78	2.80
1985_Base_LT	1.87	1.93	1.88	1.85	1.71	1.71	1.62	1.61	1.57	1.95	1.89	1.88	1.77	1.98	1.97	1.95	1.92	1.74	1.83	1.87	1.84	1.77	1.79	1.88	1.87	1.89	1.80	1.81	1.84	1.86	1.70	2.34	2.44	2.53	2.40	2.26
1986_Base_Org	1.58	1.62	1.59	1.57	1.45	1.45	1.40	1.40	1.37	1.64	1.59	1.59	1.57	1.73	1.73	1.75	1.71	1.57	1.65	1.68	1.65	1.59	1.62	1.74	1.71	1.71	1.60	1.61	1.64	1.67	1.51	2.04	2.09	2.06	2.42	2.13
1986_Base_HT	1.74	1.78	1.75	1.73	1.68	1.68	1.61	1.68	1.61	1.77	1.75	1.76	1.76	1.88	1.87	1.89	1.83	1.71	1.76	1.78	2.07	1.67	1.70	1.82	1.79	1.84	1.90	1.91	1.91	1.87	2.05	2.42	2.40	2.24	2.30	2.16
1986_Base_LT	1.57	1.62	1.58	1.63	1.54	1.54	1.40	1.50	1.42	1.63	1.58	1.58	1.57	1.72	1.72	1.74	1.70	1.57	1.65	1.68	1.64	1.58	1.62	1.74	1.71	1.70	1.59	1.61	1.63	1.66	1.46	1.96	2.04	2.06	2.46	2.13
1988_Base_Org	2.73	2.63	2.62	2.68	2.37	2.37	2.48	2.54	2.45	2.34	2.18	2.21	2.57	2.83	2.78	2.99	3.01	2.88	2.95	2.98	3.12	2.74	2.63	2.75	2.92	2.95	2.69	2.68	2.67	2.56	2.38	2.97	2.99	2.90	2.47	2.22
1988_Base_HT	3.28	3.14	3.10	2.90	2.47	2.47	2.55	2.53	2.44	2.55	2.37	2.40	3.02	3.26	3.25	3.27	3.28	3.09	3.13	3.11	3.13	2.88	2.77	2.91	3.13	3.17	3.14	3.10	3.06	2.88	2.54	3.12	3.10	2.97	2.36	2.13
1988_Base_LT	3.07	2.99	2.96	2.93	2.52	2.52	2.62	2.67	2.56	2.58	2.37	2.38	2.56	2.86	2.84	3.01	3.00	2.89	2.95	2.96	3.13	2.70	2.60	2.64	2.89	2.97	2.72	2.69	2.73	2.56	2.56	3.14	3.16	3.04	2.51	2.24
1991_Base_Org	2.11	2.12	2.08	1.99	1.82	1.82	1.81	1.76	1.73	2.10	2.03	2.03	1.86	2.09	2.08	2.03	2.00	1.83	1.92	1.96	1.93	1.78	1.81	1.90	1.91	1.94	1.85	1.87	1.88	1.91	1.90	2.53	2.60	2.65	5.98	5.85
1991_Base_HT	1.98	2.01	1.97	1.93	1.77	1.77	1.71	1.69	1.65	2.02	1.96	1.96	1.81	2.03	2.02	2.00	1.96	1.79	1.88	1.92	1.90	1.80	1.82	1.91	1.90	1.93	1.83	1.85	1.87	1.90	1.74	2.32	2.41	2.58	6.33	6.21
1991_Base_LT	2.04	2.06	2.03	1.96	1.81	1.81	1.76	1.73	1.70	2.06	1.97	2.00	1.85	2.07	2.06	2.02	1.99	1.82	1.90	1.94	1.93	1.81	1.83	1.93	1.93	1.95	1.86	1.88	1.89	1.92	1.79	2.53	2.59	2.72	4.98	5.05
1995_Base_Org	2.17	2.23	2.18	2.13	1.94	1.94	1.85	1.82	1.78	2.22	2.12	2.11	1.97	2.22	2.20	2.13	2.11	1.91	2.00	2.04	2.02	1.94	1.95	2.02	2.04	2.05	1.99	2.01	2.03	2.04	1.84	2.47	2.58	2.61	2.71	2.59
1995_Base_HT	2.16	2.23	2.18	2.13	1.94	1.94	1.84	1.81	1.77	2.21	2.12	2.11	1.96	2.22	2.20	2.13	2.11	1.91	2.00	2.04	2.01	1.93	1.95	2.02	2.04	2.05	1.99	2.01	2.03	2.04	1.84	2.47	2.58	2.62	2.72	2.60
1995_Base_LT	2.18	2.25	2.20	2.14	1.95	1.95	1.85	1.82	1.78	2.22	2.13	2.11	1.98	2.23	2.21	2.14	2.12	1.92	2.01	2.05	2.02	1.95	1.96	2.02	2.05	2.06	2.00	2.02	2.04	2.05	1.85	2.48	2.59	2.62	2.72	2.60
1997_May_Base_Org	1.35	1.35	1.31	1.23	1.10	1.10	1.20	1.11	1.11	1.43	1.38	1.38	1.34	1.42	1.43	1.46	1.43	1.34	1.42	1.43	1.28	1.20	1.26	1.43	1.41	1.41	1.33	1.34	1.35	1.38	1.39	1.90	1.91	1.94	2.44	2.36
1997_May_Base_LT	1.39	1.34	1.31	1.17	1.07	1.07	1.27	1.20	1.20	1.30	1.31	1.31	1.33	1.41	1.42	1.39	1.39	1.30	1.37	1.37	1.21	1.08	1.17	1.32	1.30	1.33	1.29	1.30	1.30	1.32	1.40	1.91	1.94	1.97	3.74	3.63
1997_Sep_Base_Org	2.03	1.86	1.83	1.61	1.51	1.51	1.79	1.70	1.70	1.58	1.60	1.61	1.69	1.79	1.79	1.75	1.76	1.65	1.74	1.74	1.94	1.48	1.47	1.60	1.62	1.66	1.63	1.62	1.61	1.62	1.87	2.70	2.70	2.81	4.62	4.19
1997_Sep_Base_HT	1.37	1.31	1.30	1.27	1.20	1.20	1.27	1.21	1.22	1.25	1.24	1.25	1.36	1.41	1.42	1.50	1.48	1.42	1.52	1.53	1.50	1.34	1.36	1.53	1.47	1.47	1.36	1.36	1.37	1.41	2.14	3.15	3.29	3.48	4.58	4.05
1997_Sep_Base_LT	2.18	2.03	1.99	1.78	1.62	1.62	1.85	1.74	1.73	1.78	1.81	1.80	1.65	1.75	1.76	1.65	1.66	1.57	1.65	1.66	1.84	1.28	1.33	1.45	1.52	1.58	1.58	1.58	1.56	1.55	2.16	3.11	3.12	3.20	4.08	3.68
1998_Base_Org	1.44	1.47	1.44	1.43	1.34	1.34	1.32	1.31	1.30	1.49	1.47	1.45	1.47	1.59	1.59	1.64	1.59	1.48	1.55	1.58	1.53	1.49	1.53	1.66	1.62	1.61	1.50	1.51	1.53	1.56	1.37	1.84	2.01	2.25	1.96	1.80
1998_Base_HT	1.56	1.59	1.56	1.54	1.35	1.35	1.27	1.25	1.23	1.62	1.58	1.58	1.40	1.64	1.62	1.56	1.52	1.41	1.49	1.51	1.47	1.43	1.47	1.59	1.55	1.53	1.43	1.44	1.45	1.48	1.33	1.81	2.00	2.21	2.41	2.20
2007_Sidr_Base_Org	4.44	4.12	3.98	3.62	3.08	3.08	3.28	3.14	3.06	2.98	2.75	2.83	2.08	2.68	2.67	2.18	2.30	2.12	2.20	2.20	2.90	1.66	1.69	1.81	1.81	1.97	1.74	1.76	1.72	1.77	3.17	4.20	4.21	4.14	3.05	2.69
2007_Sidr_Base_HT	4.33	4.10	3.98	3.77	3.15	3.15	3.37	3.39	3.30	3.20	2.97	3.03	1.68	1.98	2.04	1.83	1.80	1.66	1.75	1.78	2.91	1.59	1.62	1.77	1.75	1.77	1.69	1.70	1.71	1.74	2.84	3.70	3.62	3.47	2.43	2.23
2007_Sidr_Base_LT	4.69	4.39	4.22	3.84	3.22	3.22	3.37	3.29	3.19	3.21	2.95	3.04	2.03	2.74	2.73	2.20	2.31	2.10	2.17	2.17	2.90	1.61	1.66	1.80	1.85	2.00	1.76	1.78	1.72	1.77	3.22	4.15	4.18	4.12	3.22	2.88
2009_Base_Org	2.68	2.67	2.64	2.56	2.30	2.30	2.23	2.21	2.14	2.39	2.25	2.25	2.49	2.55	2.51	2.75	2.73	2.71	2.76	2.76	2.60	2.98	2.86	2.67	2.88	2.80	2.64	2.63	2.64	2.55	2.27	3.00	3.06	3.07	2.80	2.63
2009_Base_HT	2.87	2.87	2.82	2.59	2.27	2.27	2.30	2.24	2.16	2.53	2.38	2.38	2.63	2.76	2.70	2.69	2.70	2.58	2.69	2.71	2.46	2.66	2.52	2.56	2.72	2.65	2.64	2.63	2.63	2.63	2.41	3.14	3.18	3.18	2.97	2.77
2009_Base_LT	2.76	2.74	2.72	2.59	2.31	2.31	2.25	2.23	2.16	2.43	2.29	2.28	2.60	2.65	2.59	2.81	2.80	2.75	2.82	2.80	2.60	3.01	2.88	2.70	2.93	2.85	2.75	2.73	2.74	2.63	2.24	2.96	3.02	3.02	2.80	2.64

F Maximum water level for different cyclones with climate change

The simulated maximum water level with climate change for all 141 locations along the Bangladesh coastlines is listed below in Table F- 1 to Table F- 4.

Table F- 1: The simulated maximum water level with climate change for locations 1 -35

Location / Cyclonic Event	Strom Surge Level (mPWD) at Climate Change Condition																																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
1960_CC2050_Org	1.70	1.72	1.71	1.75	1.79	1.79	1.82	1.62	1.53	1.68	1.73	1.78	1.84	1.84	1.83	1.84	1.81	1.80	1.78	1.90	1.74	1.82	1.75	1.76	1.75	1.76	1.75	1.73	1.80	1.78	1.77	1.80	1.88	2.19	2.34
1960_CC2050_HT	1.70	1.73	1.72	1.77	1.79	1.79	1.99	1.64	1.58	1.70	1.74	1.78	1.93	1.93	1.92	1.93	1.82	1.81	1.84	2.04	1.74	1.82	1.75	1.79	1.76	1.76	1.76	1.75	1.82	1.92	1.97	2.00	2.11	2.33	2.59
1960_CC2050_LT	1.70	1.73	1.72	1.76	1.79	1.79	1.82	1.64	1.56	1.70	1.74	1.78	1.84	1.85	1.83	1.84	1.82	1.80	1.79	1.81	1.74	1.82	1.75	1.78	1.76	1.76	1.76	1.75	1.81	1.79	1.77	1.77	1.74	1.74	1.79
1961_CC2050_Org	1.82	1.87	1.86	1.88	1.87	1.93	2.27	1.72	1.64	1.77	1.81	1.87	2.21	2.15	2.15	2.12	1.97	1.93	2.04	2.23	1.81	1.89	1.79	1.83	1.80	1.82	1.81	1.82	2.18	2.32	2.39	2.41	2.57	2.88	3.27
1961_CC2050_HT	1.77	1.80	1.79	1.83	1.85	1.86	2.14	1.70	1.62	1.74	1.79	1.84	2.07	2.03	2.04	2.03	1.89	1.86	1.93	2.14	1.79	1.86	1.79	1.80	1.78	1.80	1.79	1.80	1.98	2.12	2.17	2.17	2.33	2.60	2.92
1961_CC2050_LT	1.76	1.79	1.78	1.82	1.85	1.84	1.89	1.69	1.62	1.74	1.78	1.83	1.91	1.91	1.89	1.90	1.87	1.84	1.84	1.87	1.78	1.85	1.78	1.79	1.78	1.78	1.78	1.78	1.83	1.82	1.81	1.80	1.78	1.80	1.85
1963_CC2050_Org	2.06	2.10	2.07	2.11	2.12	2.10	2.23	1.93	1.81	2.00	2.04	2.11	2.22	2.19	2.17	2.17	2.10	2.05	2.07	2.14	1.97	2.05	1.92	2.00	1.96	2.05	2.06	2.03	2.15	2.18	2.18	2.20	2.19	2.25	2.35
1963_CC2050_HT	2.02	2.06	2.04	2.08	2.10	2.07	2.19	1.91	1.80	1.99	2.01	2.06	2.18	2.16	2.14	2.14	2.08	2.04	2.06	2.11	1.97	2.05	1.93	2.01	1.97	2.03	2.04	2.02	2.13	2.14	2.15	2.16	2.14	2.19	2.27
1963_CC2050_LT	2.04	2.08	2.06	2.10	2.12	2.09	2.23	1.90	1.78	1.97	2.00	2.08	2.21	2.18	2.16	2.16	2.09	2.05	2.07	2.13	1.96	2.05	1.92	2.00	1.96	2.04	2.06	2.03	2.17	2.21	2.21	2.22	2.37	2.75	2.89
1965_Dec_CC2050_Org	1.91	1.93	1.92	1.97	1.99	1.97	2.05	1.80	1.72	1.87	1.90	1.96	2.06	2.05	2.03	2.03	1.98	1.95	1.96	2.00	1.89	1.97	1.85	1.93	1.90	1.94	1.94	1.92	2.00	2.00	2.00	2.00	1.99	2.02	2.09
1965_Dec_CC2050_LT	1.95	1.97	1.96	2.01	2.03	2.01	2.11	1.85	1.75	1.91	1.94	2.01	2.12	2.10	2.07	2.07	2.01	1.97	1.99	2.05	1.90	1.99	1.87	1.94	1.90	1.97	1.98	1.96	2.07	2.09	2.08	2.07	2.07	2.13	2.22
1965_May_CC2050_Org	1.91	1.94	1.89	1.94	1.96	1.95	2.02	1.80	1.67	1.88	1.91	1.98	2.03	2.00	2.00	1.99	1.94	1.91	1.91	1.95	1.91	2.05	1.83	1.96	2.00	2.06	2.06	2.00	2.08	2.12	2.14	2.14	2.13	2.09	2.11
1965_May_CC2050_HT	1.74	1.78	1.75	1.81	1.85	1.83	1.88	1.70	1.63	1.75	1.78	1.83	1.88	1.88	1.87	1.88	1.85	1.83	1.81	1.84	1.78	1.91	1.78	1.88	1.83	2.25	2.17	1.82	2.44	2.69	2.82	2.98	3.28	3.40	3.50
1965_May_CC2050_LT	1.76	1.79	1.76	1.81	1.86	1.83	2.10	1.72	1.66	1.77	1.79	1.83	2.02	1.93	2.03	1.99	1.87	1.83	1.88	2.12	1.80	1.90	1.77	1.91	1.87	1.88	1.88	1.87	1.91	2.08	2.10	2.16	2.27	2.65	2.88
1966_CC2050_Org	1.99	2.01	1.99	2.04	2.06	2.04	2.18	1.87	1.75	1.94	1.97	2.04	2.15	2.13	2.10	2.11	2.04	2.01	2.02	2.17	1.97	2.06	1.90	2.01	1.98	2.07	2.08	2.04	2.16	2.21	2.26	2.28	2.43	2.70	3.06
1966_CC2050_HT	1.99	2.02	2.00	2.04	2.07	2.04	2.29	1.87	1.75	1.95	1.98	2.04	2.22	2.13	2.16	2.11	2.05	2.01	2.03	2.24	1.97	2.06	1.90	2.02	1.98	2.07	2.08	2.04	2.18	2.35	2.40	2.46	2.59	3.03	3.33
1966_CC2050_LT	1.96	1.99	1.97	2.01	2.03	2.01	2.13	1.85	1.74	1.91	1.95	2.02	2.13	2.11	2.08	2.09	2.03	1.99	2.01	2.05	1.96	2.05	1.89	2.00	1.98	2.06	2.08	2.03	2.16	2.20	2.21	2.23	2.23	2.27	2.35
1970_CC2050_Org	1.96	1.99	1.98	2.02	2.05	2.02	2.10	1.87	1.75	1.94	1.96	2.01	2.11	2.10	2.08	2.08	2.03	1.99	2.01	2.05	1.94	2.01	1.89	2.00	1.95	2.00	2.00	1.98	2.07	2.09	2.09	2.09	2.19	2.54	2.77
1970_CC2050_HT	1.96	2.00	1.98	2.03	2.05	2.02	2.11	1.88	1.76	1.95	1.97	2.02	2.12	2.11	2.08	2.09	2.03	2.00	2.01	2.05	1.94	2.02	1.90	2.00	1.95	2.00	2.01	1.99	2.09	2.11	2.10	2.10	2.38	2.64	3.20
1970_CC2050_LT	2.19	2.20	2.12	2.18	2.19	2.16	2.39	1.97	1.76	2.12	2.18	2.33	2.38	2.31	2.29	2.28	2.17	2.12	2.13	2.22	2.08	2.38	1.98	2.00	2.12	2.34	2.34	2.19	2.37	2.48	2.55	2.57	2.65	2.61	2.67
1974_CC2050_Org	1.83	1.87	1.84	1.89	1.91	1.90	1.96	1.76	1.68	1.81	1.85	1.89	1.98	1.96	1.95	1.96	1.92	1.89	1.89	1.93	1.84	1.92	1.82	1.89	1.85	1.89	1.89	1.87	1.94	1.94	1.95	1.94	1.97	1.93	1.97
1974_CC2050_HT	1.67	1.70	1.68	1.72	1.76	1.77	1.83	1.58	1.52	1.67	1.73	1.75	1.83	1.83	1.83	1.84	1.81	1.79	1.78	1.90	1.71	1.76	1.78	1.67	1.68	1.68	1.67	1.68	1.74	1.69	1.69	1.70	1.82	2.05	2.26
1974_CC2050_LT	1.83	1.87	1.84	1.89	1.91	1.90	1.96	1.76	1.68	1.81	1.85	1.89	1.98	1.96	1.95	1.96	1.92	1.89	1.89	1.93	1.84	1.92	1.82	1.89	1.85	1.89	1.89	1.87	1.94	1.94	1.95	1.94	1.97	1.93	1.97
1983_CC2050_Org	1.98	2.02	2.00	2.04	2.06	2.04	2.24	1.87	1.76	1.94	1.98	2.04	2.20	2.14	2.12	2.11	2.06	2.02	2.04	2.19	1.95	2.02	1.91	1.98	1.94	2.00	2.01	1.99	2.14	2.24	2.31	2.36	2.49	2.78	3.08
1983_CC2050_HT	2.02	2.05	2.04	2.08	2.09	2.07	2.18	1.91	1.79	1.98	2.01	2.07	2.18	2.16	2.14	2.14	2.08	2.04	2.06	2.11	1.97	2.05	1.93	2.00	1.96	2.04	2.05	2.02	2.14	2.15	2.16	2.17	2.16	2.19	2.27
1983_CC2050_LT	2.01	2.04	2.02	2.07	2.08	2.07	2.26	1.89	1.78	1.97	2.00	2.06	2.17	2.15	2.14	2.13	2.07	2.04	2.05	2.22	1.97	2.04	1.92	2.00	1.96	2.03	2.03	2.01	2.14	2.27	2.34	2.44	2.61	3.04	3.23
1985_CC2050_Org	1.93	1.96	1.95	2.00	2.02	2.00	2.07	1.85	1.75	1.92	1.94	1.99	2.08	2.08	2.05	2.06	2.00	1.97	1.99	2.03	1.92	1.99	1.88	1.95	1.91	1.96	1.97	1.96	2.03	2.05	2.04	2.03	2.02	2.03	2.09
1985_CC2050_HT	1.95	1.98	1.97	2.01	2.03	2.01	2.09	1.86	1.76	1.93	1.95	2.00	2.10	2.09	2.06	2.07	2.02	1.99	2.00	2.09	1.93	2.01	1.89	1.97	1.93	1.98	1.99	1.97	2.05	2.07	2.10	2.18	2.32	2.69	2.82
1985_CC2050_LT	1.95	1.97	1.97	2.01	2.03	2.01	2.09	1.85	1.75	1.92	1.94	1.99	2.10	2.09	2.06	2.07	2.01	1.98	2.00	2.04	1.92	2.00	1.88	1.96	1.91	1.97	1.98	1.96	2.05	2.06	2.05	2.05	2.04	2.11	2.28
1986_CC2050_Org	1.83	1.86	1.85	1.89	1.92	1.91	1.98	1.75	1.65	1.80	1.84	1.90	1.99	1.99	1.96	1.98	1.93	1.90	1.91	1.94	1.83	1.90	1.82	1.85	1.81	1.85	1.84	1.84	1.91	1.90	1.89	1.88	1.87	1.90	1.96
1986_CC2050_HT	2.08	2.04	2.15	2.11	1.95	1.98	2.15	1.77	1.68	1.91	1.97	2.03	2.12	2.19	2.07	2.10	2.09	2.10	2.20	2.28	2.17	2.09	1.87	1.96	2.08	2.23	2.26	2.30	2.37	2.33	2.29	2.29	2.10	2.25	2.32
1986_CC2050_LT	1.83	1.86	1.85	1.90	1.92	1.91	1.97	1.74	1.65	1.79	1.84	1.89	1.99	1.99	1.96	1.97	1.93	1.90	1.91	1.94	1.82	1.89	1.82	1.84	1.81	1.84	1.84	1.84	2.06	1.96	1.89	1.88	1.87	1.92	2.14
1988_CC2050_Org	2.09	2.12	2.11	2.15	2.16	2.12	2.21	1.99	1.88	2.07	2.07	2.11	2.21	2.19	2.16	2.16	2.10	2.06	2.08	2.13	2.01	2.07	1.95	2.05	2.00	2.08	2.09	2.06	2.16	2.19	2.20	2.21	2.31	2.57	2.81
1988_CC2050_HT	3.16	3.16	3.30	3.26	3.10	3.09	3.33	2.83	2.52	3.13	3.15	3.17	3.33	3.07	3.21	3.04	3.00	2.94	2.99	3.24	2.99	2.63	2.55	2.96	2.85	2.84	2.84	2.93	3.10	3.27	3.37	3.41	3.55	3.47	3.41
1988_CC2050_LT	2.72	2.72	2.89	2.84	2.73	2.66	3.07	2.66	2.41	2.98	2.98	3.00	3.07	2.86	2.96	2.88	2.86	2.80	2.89	3.09	2.95	2.62	2.44	2.96	2.84	2.84	2.85	2.94	3.08	3.23	3.30	3.34	3.34	3.34	3.54
1991_CC2050_Org	2.00	2.03	2.00	2.05	2.08	2.05	2.16	1.88	1.75	1.97	2.00	2.08	2.16	2.14	2.12	2.12	2.05	2.01	2.02	2.07	1.98	2.06	1.91	2.01	1.99	2.08	2.10	2.04	2.16	2.21	2.22	2.23	2.25	2.26	2.32
1991_CC2050_HT	1.99	2.02	2.00	2.05	2.08	2.04	2.14	1.89	1.77	1.97	1.99	2.05	2.14	2.13	2.10	2.11	2.05	2.01	2.03	2.07	1.96	2.04	1.91	2.00	1.96	2.03	2.04	2.01	2.12	2.15	2.15	2.15	2.15	2.17	2.23
1991_CC2050_LT	2.01	2.06	2.03	2.08	2.11	2.06	2.32	1.91	1.79	1.99	2.02	2.08	2.25	2.17	2.19	2.13	2.06	2.03	2.05	2.26	1.99	2.06	1.93	2.02	1.99	2.07	2.08	2.04	2.20	2.37	2.43	2.48	2.62	3.05	3.38
1995_CC2050_Org	2.13	2.16	2.15	2.19	2.20	2.16	2.28	2.00	1.86	2.08	2.10	2.15	2.27	2.25	2.22	2.21	2.14	2.10	2.13	2.22	2.04	2.10	1.98	2.06	2.02	2.11	2.13	2.10	2.22	2.28	2.33	2.34	2.51	2.83	3.20
1995_CC2050_HT	2.13	2.15	2.15	2.19	2.20	2.15	2.28	1.99	1.86	2.08	2.10	2.15	2.27	2.25	2.22	2.21	2.14	2.10	2.13	2.18	2.04	2.10	1.99	2.06	2.02	2.11	2.13	2.09	2.22	2.26	2.27	2.29	2.29	2.39	2.48
1995_CC2050_LT	2.14	2.16	2.16	2.20	2.21	2.16	2.29	2.01	1.86	2.08	2.11	2.16	2.28	2.25	2.23	2.22	2.15	2.11	2.13	2.19	2.05	2.11	1.99	2.07	2.03	2.12	2.15	2.11	2.23	2.28	2.30	2.31	2.31	2.35	2.44
1997_May_CC2050_Org	1.36	1.38	1.39	1.38	1.42	1.60	1.79	1.28	1.21	1.34	1.40	1.45	1.70	1.66	1.72	1.78	1.63	1.59	1.62	1.85	1.40	1.39	1.44	1.24	1.32	1.35	1.33	1.30	1.52	1.61	1.65	1.69	1.79	1.98	2.20
1997_May_CC2050_LT	1.33	1.35	1.30	1.33	1.35	1.35	1.38	1.22	1.12	1.23	1.29	1.38	1.40	1.40	1.36	1.39	1.32	1.31	1.30	1.44	1.23	1.33	1.37	1.17	1.29	1.33	1.30	1.25	1.31	1.31	1.32	1.33	1.36	1.41	1.54
1997_Sep_CC2050_Org	1.82	1.82	1.76	1.78	1.78	1.79	1.93	1.70	1.60	1.76	1.79	1.88	2.02	1.86	2.01	1.87	1.80	1.75	1.83	2.11	1.72	2.03	1.67	1.99	2.06	2.13	2.13	2.05	2.07	2.17	2.22	2.24	2.31	2.47	2.47
1997_Sep_CC2050_HT	1.61	1.64	1.57	1.63	1.71	1.66	1.95	1.63	1.57	1.62	1.65	1.70	1.91	1.81	1.95	1.90	1.83	1.76	1.84	2.05	1.65	1.80	1.62	1.88	1.86	1.82	1.78	1.75	1.83	1.97	1.98	1.93	2.16	2.27	2.55
1997_Sep_CC2050_LT	1.79	1.77	1.72	1.73	1.68	1.75	1.91	1.60	1.45	1.63	1.71	1.84	1.89	1.86	1.79	1.79	1.67	1.62	1.62	1.70	1.67	2.10	1.57	1.96	2.07	2.21	2.21	2.10	2.21	2.33	2.40	2.44	2.56	2.49	2.53
1998_CC2050_Org	1.77	1.83	1.84	1.81	1.76	1.89	2.32	1.62	1.56	1.66	1.74	1.86	2.23	2.13	2.19	2.12	1.99	1.94	2.03	2.25	1.76	1.85	1.71	1.74	1.71	1.77	1.77	1.72	2.19	2.35	2.40	2.51	2.67	3.12	3.35
1998_CC2050_HT	1.63	1.65	1.64	1.68	1.71	1.71	1.73	1.59	1.53	1.63	1.66	1.70	1.76	1.76	1.74	1.76	1.73	1.72	1.70	1.72	1.67	1.72	1.69	1.70	1.68	1.66	1.65	1.66	1.68	1.65	1.64	1.63	1.67	1.76	1.80
2007_Sidr_CC2050_Org	1.86	1.90	1.87	1.91	1.95	1.93	2.01	1.78	1.69	1.83	1.87	1.94	2.02	2.02	1.99	2.00	1.94	1.90	1.91	1.96	1.86	2.55	1.82	2.01	2.29	2.68	2.64	2.44	3.04	3.39	3.64	3.87	4.46	4.72	5.13
2007_Sidr_CC2050_HT	1.85	1.88	1.85	1.90	1.94	1.91	2.09	1.76	1.66	1.81	1.84	1.92	1.98	2.09	1.95	1.96	2.00	2.10	2.23	2.29	2.42	2.56	1.89	2.67	2.68	2.80	2.87	2.89	3.28	3.55	3.70	3.90	4.43	4.68	4.86
2007_Sidr_CC2050_LT	1.99	1.91	1.88	1.91	1.96	2.09	2.64	2.00	1.78	1.98	2.08	2.38	2.49	2.38	2.30	2.30	2.17	2.20	2.29	2.42	2.47	2.52	1.93	2.66	2.67	2.79	2.86	2.89	3.29	3.58	3.75	3.97	4.57	4.86	5.19
2009_CC2050_Org	2.78	2.85	2.84	2.91	2.94	2.77	2.72	2.90	2.94	2.91	2.88	2.84	2.83	2.67	2.76	2.69	2.63	2.53	2.49	2.53	2.35	2.43	2.43	2.61	2.47	2.49	2.56	2.55	2.64	2.75	2.81	2.84	2.87	2.87	2.85
2009_CC2050_HT	2.99	3.13	2.98	3.15	3.32	3.03	2.88	2.91	2.99	2.84	2.88	2.89	2.93	2.75	2.83	2.78	2.66	2.54	2.50	2.56	2.31	2.40	2.44	2.58	2.48	2.48	2.57	2.51	2.69	2.86	2.95	3.01	3.13	3.13	3.19
2009_CC2050_LT	2.86	2.94	2.92	2.99	3.03	2.83	2.78	2.93	2.94	2.93	2.91	2.87	2.88	2.71	2.81	2.73	2.66	2.54	2.50	2.56	2.34	2.42	2.44	2.61	2.45	2.49	2.57	2.55	2.67	2.80	2.87	2.90	2.94	2.93	2.93

Table F- 2: The simulated maximum water level with climate change for locations 36 -70

Location / Cyclonic Event	Strom Surge Level (mPWD) at Climate Change Condition																																		
	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
1960_CC2050_Org	2.12	2.48	2.62	2.19	2.22	2.17	1.70	1.69	1.65	1.60	1.71	2.06	2.50	2.81	2.57	2.43	2.44	2.25	1.91	1.61	1.57	2.29	2.36	1.51	1.51	2.49	2.27	1.52	1.82	2.21	1.45	2.38	2.52	2.61	2.39
1960_CC2050_HT	2.37	2.68	2.75	2.38	2.35	2.34	1.71	1.70	1.66	1.69	1.94	2.26	2.71	2.83	2.76	2.73	2.53	2.85	2.59	1.76	1.57	2.71	3.60	2.23	2.23	3.89	2.37	1.74	1.74	3.90	1.49	4.21	4.04	4.01	3.97
1960_CC2050_LT	1.70	1.78	1.79	1.76	1.76	1.79	1.70	1.69	1.66	1.60	1.67	1.75	1.76	1.73	1.78	1.75	1.60	1.81	1.57	1.61	1.56	1.76	2.77	1.50	1.50	3.02	1.59	1.52	1.79	2.09	1.48	2.91	2.96	3.07	2.81
1961_CC2050_Org	3.05	3.40	3.52	3.07	3.10	2.93	2.00	1.88	1.81	1.97	2.46	2.89	3.51	3.70	3.47	3.57	3.25	3.42	3.13	3.20	2.90	3.30	3.63	3.00	3.00	3.69	3.75	2.82	3.62	4.34	3.65	3.90	3.80	3.73	3.56
1961_CC2050_HT	2.68	3.00	3.13	2.73	2.75	2.66	1.86	1.78	1.82	1.77	2.18	2.56	3.09	3.32	3.12	3.12	3.53	3.96	3.64	3.61	3.24	3.70	4.11	3.42	3.43	4.15	4.16	3.18	3.91	4.76	3.93	4.30	4.21	4.10	3.92
1961_CC2050_LT	1.77	1.85	1.87	1.81	1.81	1.82	1.70	1.70	1.75	1.74	2.09	1.96	1.83	1.82	1.86	1.95	2.73	3.26	3.09	3.08	2.90	2.97	3.58	2.92	2.92	3.56	3.76	2.77	3.89	3.84	4.10	3.45	3.57	3.46	3.21
1963_CC2050_Org	2.25	2.35	2.37	2.28	2.29	2.27	2.00	1.94	1.88	1.85	2.05	2.23	2.35	2.34	2.35	2.35	2.17	2.13	2.00	2.00	1.87	2.17	2.07	1.86	1.86	2.08	2.05	1.85	2.02	2.40	1.75	2.29	2.07	2.11	2.20
1963_CC2050_HT	2.19	2.29	2.32	2.24	2.24	2.22	1.99	1.95	1.89	1.87	2.02	2.19	2.28	2.27	2.29	2.25	2.06	2.02	1.95	1.98	1.87	2.06	1.99	1.85	1.85	1.97	1.99	1.85	2.05	2.43	1.77	2.23	2.00	2.05	2.11
1963_CC2050_LT	2.82	3.28	3.44	2.78	2.85	2.64	2.03	1.94	1.88	1.90	2.22	2.60	3.35	3.71	3.17	3.01	3.24	2.95	2.45	2.04	1.92	3.11	3.09	1.92	1.92	2.51	2.78	1.90	2.03	2.40	1.79	2.21	2.14	2.30	2.23
1965_Dec_CC2050_Org	2.01	2.09	2.10	2.04	2.04	2.03	1.87	1.85	1.81	1.74	1.85	1.99	2.08	2.06	2.09	2.05	1.89	1.85	1.80	1.82	1.74	1.89	1.82	1.71	1.71	1.81	1.82	1.71	1.94	2.28	1.63	2.10	1.84	1.88	1.94
1965_Dec_CC2050_LT	2.10	2.43	2.55	2.12	2.14	2.13	1.94	1.88	1.81	1.76	1.94	2.09	2.48	2.75	2.46	2.28	2.39	2.14	1.88	1.87	1.77	2.28	2.31	1.75	1.75	2.02	2.20	1.74	1.91	2.25	1.65	2.14	1.96	2.00	2.05
1965_May_CC2050_Org	2.04	2.06	2.08	2.23	2.09	2.09	2.02	1.97	1.97	2.25	2.58	2.46	2.17	2.51	2.52	2.74	2.60	2.58	2.62	3.45	3.20	2.54	2.66	2.70	2.71	2.69	3.61	2.73	3.26	3.03	3.84	2.91	2.85	2.88	2.57
1965_May_CC2050_HT	3.30	3.61	3.68	3.51	3.42	3.13	2.49	2.26	2.19	2.70	3.18	3.49	3.66	3.96	4.01	4.14	3.97	3.91	3.69	4.34	3.45	3.95	3.95	3.77	3.77	3.90	4.70	3.56	3.61	4.13	4.32	3.66	3.87	3.94	3.73
1965_May_CC2050_LT	2.65	3.06	3.25	2.72	2.76	2.63	2.11	1.99	1.95	2.30	2.76	2.75	3.08	3.47	3.11	3.13	3.01	2.87	2.70	3.45	3.06	2.94	2.99	2.76	2.76	2.73	3.79	2.73	2.91	3.30	3.79	3.02	2.72	2.84	2.63
1966_CC2050_Org	2.84	3.16	3.25	2.85	2.87	2.76	2.01	1.96	1.89	1.88	2.29	2.68	3.24	3.40	3.23	3.30	3.07	3.02	2.43	2.08	1.96	3.11	2.99	1.98	1.98	2.96	2.82	1.93	2.15	3.71	1.80	3.36	3.05	2.99	3.15
1966_CC2050_HT	3.11	3.57	3.79	3.18	3.23	2.96	2.01	1.96	1.89	1.97	2.46	2.94	3.57	3.99	3.60	3.64	3.56	3.31	2.70	2.24	1.96	3.40	3.42	2.12	2.12	2.84	3.14	1.93	2.15	3.58	1.80	3.29	3.00	2.94	3.04
1966_CC2050_LT	2.32	2.33	2.33	2.27	2.26	2.24	2.02	1.96	1.89	1.88	2.02	2.20	2.30	2.27	2.31	2.28	2.24	2.21	2.12	2.11	1.98	2.22	2.15	2.02	2.02	2.14	2.09	1.96	2.18	2.92	1.81	2.94	2.16	2.36	2.40
1970_CC2050_Org	3.08	3.06	3.12	2.87	2.72	2.49	2.14	1.96	1.86	2.32	2.40	2.60	3.03	3.35	3.18	3.46	5.34	5.84	5.17	4.76	3.88	5.42	5.88	4.88	4.88	5.76	5.83	4.44	4.54	6.44	4.42	6.06	5.77	5.61	5.23
1970_CC2050_HT	3.66	3.48	3.35	3.13	2.90	2.49	2.04	1.92	1.87	2.38	2.40	2.64	3.41	3.27	3.42	3.76	5.97	6.53	5.73	4.98	4.00	6.06	6.50	5.36	5.37	6.26	6.29	4.76	5.10	6.68	5.01	6.32	6.16	5.98	5.57
1970_CC2050_LT	2.62	2.63	2.62	2.52	2.55	2.46	2.14	2.08	2.01	2.07	2.54	2.42	2.53	2.47	2.51	2.85	4.94	5.79	5.28	4.76	3.99	5.21	5.69	4.84	4.85	5.50	5.67	4.33	4.78	6.26	4.77	5.78	5.51	5.27	4.76
1974_CC2050_Org	1.97	1.95	1.96	1.91	1.92	1.93	1.82	1.80	1.75	1.70	1.78	1.89	1.93	1.90	1.94	1.90	2.04	2.55	2.46	2.13	1.79	2.32	3.25	2.21	2.21	3.42	2.69	2.17	2.59	3.88	2.87	3.52	3.53	3.51	3.32
1974_CC2050_HT	2.36	2.27	2.35	2.04	2.03	2.00	1.58	1.58	1.55	1.49	1.61	1.94	2.35	2.55	2.46	2.33	3.58	3.82	3.36	2.74	1.97	3.62	4.13	3.11	3.11	4.30	3.77	2.88	3.03	4.97	3.05	4.51	4.43	4.31	4.15
1974_CC2050_LT	1.97	1.95	1.96	1.91	1.92	1.93	1.82	1.80	1.75	1.70	1.78	1.89	1.93	1.90	1.94	1.90	2.04	2.55	2.46	2.13	1.79	2.32	3.25	2.21	2.21	3.42	2.69	2.17	2.59	3.88	2.87	3.52	3.53	3.51	3.32
1983_CC2050_Org	2.90	3.27	3.38	2.87	2.87	2.77	1.97	1.92	1.87	1.88	2.34	2.71	3.28	3.48	3.22	3.30	3.11	2.96	2.47	2.10	1.84	3.10	3.07	1.97	1.97	2.58	2.78	1.82	2.00	2.38	1.73	2.17	2.31	2.42	2.40
1983_CC2050_HT	2.18	2.28	2.30	2.24	2.24	2.24	2.00	1.95	1.89	1.88	2.04	2.20	2.26	2.25	2.28	2.23	2.04	2.02	1.96	1.99	1.89	2.05	1.97	1.86	1.86	1.94	1.99	1.86	2.05	2.43	1.77	2.22	1.98	2.02	2.07
1983_CC2050_LT	3.17	3.70	3.89	3.13	3.18	2.95	1.99	1.94	1.88	1.97	2.49	2.92	3.76	4.16	3.61	3.37	3.65	3.32	2.73	2.22	1.89	3.50	3.49	2.06	2.06	2.80	3.10	1.87	2.03	2.41	1.76	2.19	2.35	2.55	2.32
1985_CC2050_Org	2.01	2.10	2.11	2.05	2.06	2.07	1.91	1.88	1.83	1.77	1.90	2.03	2.08	2.07	2.11	2.07	1.89	1.87	1.81	1.86	1.78	1.90	1.94	1.74	1.74	1.91	1.86	1.75	1.97	2.32	1.69	2.15	1.96	2.01	2.04
1985_CC2050_HT	2.74	3.20	3.36	2.71	2.77	2.59	1.93	1.89	1.85	1.79	2.16	2.54	3.28	3.62	3.09	2.92	3.16	2.87	2.39	1.96	1.80	3.03	3.01	1.77	1.77	2.45	2.72	1.77	1.99	2.35	1.71	2.17	2.06	2.24	2.02
1985_CC2050_LT	2.07	2.37	2.45	2.12	2.10	2.10	1.93	1.89	1.84	1.78	1.93	2.06	2.36	2.54	2.36	2.28	2.23	2.12	1.84	1.87	1.79	2.22	2.21	1.75	1.75	2.15	2.14	1.76	1.97	2.64	1.69	2.42	2.24	2.16	2.23
1986_CC2050_Org	1.88	1.97	1.98	1.92	1.92	1.92	1.78	1.75	1.71	1.67	1.76	1.89	1.95	1.94	1.97	1.93	1.75	1.73	1.68	1.71	1.63	1.75	1.69	1.59	1.59	1.69	1.71	1.59	1.80	2.16	1.52	2.01	1.73	1.78	1.83
1986_CC2050_HT	2.23	2.61	2.74	2.21	2.27	2.19	1.98	2.01	2.09	1.95	2.04	2.11	2.69	2.96	2.58	2.37	2.57	2.34	1.99	1.90	1.99	2.47	2.46	1.64	1.64	2.05	2.31	1.67	2.08	2.21	2.39	2.09	1.81	1.87	1.86
1986_CC2050_LT	1.90	2.12	2.21	1.96	1.91	1.98	1.85	1.87	1.91	1.72	1.98	2.01	2.11	2.29	2.14	2.17	2.00	1.89	1.67	1.70	1.76	1.97	1.99	1.57	1.57	1.76	1.99	1.57	1.79	2.15	2.13	2.01	1.73	1.78	1.83
1988_CC2050_Org	2.61	2.95	3.06	2.65	2.63	2.54	2.02	1.96	1.90	1.90	2.13	2.50	2.93	3.16	2.89	2.92	2.79	2.63	2.25	2.04	1.93	2.77	2.76	1.92	1.92	2.35	2.57	1.91	2.10	2.50	1.82	2.36	2.16	2.26	2.27
1988_CC2050_HT	3.15	3.25	3.25	3.11	3.10	2.99	2.41	2.38	2.39	2.72	2.69	3.03	2.97	2.76	2.90	2.78	2.68	2.66	2.64	3.00	2.90	2.58	2.39	2.63	2.63	2.40	2.65	2.61	2.95	3.07	2.90	2.87	2.57	2.58	2.53
1988_CC2050_LT	3.34	3.71	3.96	3.39	3.40	3.11	2.42	2.38	2.42	2.82	2.88	3.17	3.85	4.16	3.83	3.94	3.63	3.48	2.78	3.01	2.92	3.62	3.51	2.51	2.51	2.91	3.28	2.63	2.75	2.88	3.15	2.58	2.57	2.74	2.63
1991_CC2050_Org	2.28	2.32	2.32	2.24	2.26	2.23	2.02	1.96	1.89	1.88	2.02	2.19	2.27	2.25	2.28	2.25	2.18	2.16	2.09	2.10	1.98	2.16	2.57	1.99	1.99	2.87	2.06	1.94	2.19	2.68	1.77	2.45	2.57	2.53	2.88
1991_CC2050_HT	2.16	2.23	2.24	2.18	2.19	2.17	1.98	1.94	1.88	1.85	1.99	2.14	2.20	2.18	2.21	2.17	2.05	2.02	1.96	1.99	1.89	2.04	2.67	1.88	1.88	3.08	1.97	1.85	2.10	2.54	1.75	2.28	2.68	2.62	3.02
1991_CC2050_LT	3.13	3.60	3.83	3.24	3.27	3.00	2.01	1.96	1.89	2.00	2.51	3.00	3.65	4.05	3.67	3.71	3.54	3.32	2.69	2.27	1.94	3.43	3.41	2.15	2.15	3.11	3.15	1.93	2.13	3.27	1.78	2.85	3.00	2.69	2.93
1995_CC2050_Org	2.96	3.30	3.47	3.01	3.04	2.87	2.07	2.00	1.94	1.97	2.40	2.81	3.42	3.66	3.40	3.47	3.17	3.11	2.50	2.15	2.00	3.22	3.07	1.99	1.99	2.59	2.92	1.96	2.15	2.57	1.88	2.36	2.30	2.46	2.34
1995_CC2050_HT	2.38	2.78	2.92	2.39	2.42	2.35	2.07	2.00	1.93	1.97	2.15	2.34	2.85	3.15	2.73	2.55	2.74	2.49	2.11	2.12	2.00	2.63	2.62	1.99	1.99	2.17	2.43	1.97	2.16	2.57	1.88	2.37	2.12	2.16	2.22
1995_CC2050_LT	2.35	2.45	2.47	2.41	2.40	2.37	2.08	2.01	1.94	1.99	2.16	2.35	2.44	2.42	2.44	2.39	2.21	2.18	2.10	2.14	2.02	2.22	2.13	2.01	2.01	2.10	2.14	1.99	2.16	2.58	1.90	2.37	2.13	2.18	2.24
1997_May_CC2050_Org	1.99	2.23	2.28	1.95	1.91	1.88	1.40	1.35	1.30	1.33	1.53	1.84	2.28	2.36	2.35	2.19	2.15	2.17	1.78	1.45	1.11	2.21	2.12	1.39	1.38	1.84	2.06	1.25	1.41	1.96	1.10	1.80	1.68	1.78	1.63
1997_May_CC2050_LT	1.48	1.54	1.63	1.44	1.40	1.37	1.13	1.11	1.06	1.07	1.12	1.34	1.58	1.72	1.73	1.45	1.59	1.57	1.46	1.29	1.14	1.54	1.66	1.36	1.36	1.67	1.59	1.22	1.52	1.98	1.01	1.79	1.62	1.58	1.57
1997_Sep_CC2050_Org	2.55	2.77	2.96	2.40	2.44	2.55	1.89	1.85	1.79	1.71	1.91	2.44	2.94	3.01	2.98	2.24	2.71	2.70	2.13	2.04	1.96	2.78	2.64	1.99	1.99	2.77	2.57	1.85	2.23	3.21	1.67	2.88	2.91	2.72	2.72
1997_Sep_CC2050_HT	2.33	2.89	3.05	2.32	2.20	2.47	1.70	1.65	1.53	1.70	1.97	2.34	2.78	2.70	2.91	2.38	2.45	2.59	2.26	1.81	1.68	2.61	2.74	2.10	2.10	3.10	2.55	1.71	2.03	3.99	1.51	3.66	3.30	3.12	3.22
1997_Sep_CC2050_LT	2.64	2.38	2.33	2.19	2.26	2.16	2.02	1.94	1.81	1.81	1.84	2.02	2.24	2.06	2.11	2.03	2.62	2.72	2.67	2.36	2.16	2.58	2.94	2.48	2.48	3.45	2.17	2.17	2.40	4.17	1.69	3.84	3.73	3.52	3.47
1998_CC2050_Org	3.25	3.78	3.99	3.26	3.29	2.99	1.99	1.87	1.73	2.01	2.56	2.98	3.81	4.25	3.75	3.57	3.72	3.32	2.78	2.27	1.70	3.53	3.56	2.15	2.15	2.87	3.20	1.94	1.67	2.06	1.55	1.91	2.40	2.60	2.39
1998_CC2050_HT	1.72	1.81	1.82	1.77	1.78	1.77	1.55	1.56	1.54	1.46	1.62	1.75	1.78	1.77	1.80	1.77	1.64	1.62	1.59	1.55	1.43	1.64	1.69	1.50	1.50	1.77	1.59	1.41	1.65	2.22	1.37	2.00	1.86	1.80	1.82
2007_Sidr_CC2050_Org	5.46	4.93	5.06	4.55	4.17	3.69	2.82	2.51	2.43	3.06	3.44	4.12	4.88	4.43	4.62	4.59	6.09	6.10	5.45	4.95	3.72	5.80	5.24	5.05	5.06	5.08	5.20	4.37	4.17	5.09	4.52	4.95	5.04	4.99	4.69
2007_Sidr_CC2050_HT	4.79	4.57	4.64	4.32	4.05	3.73	2.81	2.63	2.59	3.28	3.44	4.02	4.27	3.91	4.11	3.99	4.27	4.45	4.22	4.20	3.44	4.14	3.87	4.00	4.00	3.84	3.83	3.74	3.64	4.05	3.89	3.94	3.90	3.78	3.57
2007_Sidr_CC2050_LT	5.56	4.81	4.87	4.45	4.19	3.76	2.85	2.64	2.60	3.26	3.34	4.02	4.58	4.03	4.22	4.04	5.07	5.16	4.69	4.45	3.50	4.88	4.40	4.37	4.37	4.25	4.35	3.95	3.79	4.40	3.73	4.25	4.15	4.09	3.96
2009_CC2050_Org	2.73	2.82	2.83	2.79	2.77	2.70	2.31	2.24	2.16	2.39	2.52	2.75	2.66	2.58	2.64	2.57	2.62	2.62	2.52	2.60	2.50	2.59	2.55	2.41	2.41	2.62	2.52	2.37	2.58	3.07	2.44	2.88	2.64	2.67	2.69
2009_CC2050_HT	3.13	3.16	3.17	3.05	3.01	2.84	2.33	2.23	2.18	2.38	2.56	2.91	3.04	2.94	2.96	2.92	2.91	2.88	2.77	2.90	2.70	2.85	2.71	2.68	2.68	2.73	2.77	2.63	2.79	3.31	2.49	3.09	2.78	2.79	2.84
2009_CC2050_LT	2.68	2.90	2.91	2.84	2.82	2.75	2.32	2.24	2.16	2.41	2.55	2.81	2.74	2.63	2.70	2.63	2.52	2.51	2.42	2.64	2.54	2.50	2.45	2.37	2.37	2.53	2.45	2.40	2.59	3.04	2.45	2.85	2.57	2.58	2.63

Table F- 3: The simulated maximum water level with climate change for locations 71 -105

Location / Cyclonic Event	Strom Surge Level (mPWD) at Climate Change Condition																																		
	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
1960_CC2050_Org	2.54	2.68	2.65	3.33	2.72	3.09	5.63	5.58	6.03	5.44	4.59	6.40	5.88	4.39	6.39	6.50	6.32	6.42	6.28	5.97	5.71	5.06	5.62	4.98	4.81	4.21	3.56	3.73	3.39	2.87	2.21	1.87	1.84	1.83	2.25
1960_CC2050_HT	4.05	4.13	4.18	4.86	4.54	4.99	6.70	6.59	6.99	6.63	5.65	7.01	6.62	4.61	6.92	6.97	6.77	6.70	6.53	6.06	5.56	4.68	5.17	4.59	4.14	3.42	2.68	3.20	3.28	3.11	2.30	2.10	2.02	1.92	2.37
1960_CC2050_LT	3.04	3.24	3.17	3.76	3.30	3.54	6.66	6.59	7.17	6.63	5.73	7.41	6.99	4.91	7.60	7.69	7.51	7.42	7.39	6.98	6.58	5.94	6.33	5.86	5.59	4.98	4.11	4.25	3.88	3.25	1.82	1.74	1.76	1.83	1.75
1961_CC2050_Org	3.59	3.71	3.86	3.60	3.86	3.93	4.87	4.83	4.44	4.28	3.98	3.98	3.69	3.13	3.30	3.25	3.17	3.37	3.28	3.27	3.23	3.16	3.39	3.16	3.44	3.35	3.46	4.12	4.26	4.08	2.49	2.56	2.48	2.21	2.98
1961_CC2050_HT	3.90	4.08	4.18	3.90	4.16	4.23	5.13	5.11	4.69	4.53	4.24	4.22	3.93	3.28	3.52	3.44	3.38	3.25	3.18	3.03	2.85	2.81	3.03	2.80	3.02	2.99	3.11	3.61	3.80	3.56	2.40	2.31	2.25	2.03	2.69
1961_CC2050_LT	3.21	3.31	3.51	3.40	3.70	3.85	5.17	5.22	4.83	4.53	4.15	4.27	3.89	3.26	3.46	3.39	3.33	3.23	3.15	3.00	2.85	2.68	2.70	2.67	2.54	2.37	2.15	2.19	2.06	1.91	1.86	1.78	1.79	1.90	1.81
1963_CC2050_Org	2.22	2.19	2.31	2.78	2.78	2.98	4.04	4.05	4.43	3.67	3.34	4.09	3.55	3.44	3.71	3.89	3.66	4.37	4.03	3.70	3.46	3.10	3.43	3.06	3.24	2.91	2.63	3.84	3.18	2.56	2.24	2.18	2.20	2.21	2.27
1963_CC2050_HT	2.16	2.10	2.21	2.71	2.77	2.90	4.13	4.08	4.25	3.60	3.17	3.97	3.48	3.50	3.71	4.10	3.84	4.59	4.21	3.85	3.63	3.32	3.59	3.26	3.48	3.16	2.77	4.36	3.66	3.04	2.20	2.14	2.16	2.18	2.21
1963_CC2050_LT	2.30	2.16	2.35	2.65	2.76	2.83	4.29	4.23	4.38	3.59	3.17	4.08	3.56	3.45	3.71	3.90	3.67	4.45	4.06	3.70	3.45	3.03	3.39	2.98	3.20	2.96	3.27	3.79	3.88	3.73	2.40	2.35	2.24	2.21	2.82
1965_Dec_CC2050_Org	1.98	1.96	2.06	2.54	2.56	2.72	3.80	3.76	3.54	3.33	2.94	3.14	2.89	2.63	2.71	2.68	2.63	2.58	2.57	2.50	2.44	2.37	2.56	2.36	2.74	2.66	2.57	4.00	3.39	2.90	2.05	1.98	1.99	2.05	2.03
1965_Dec_CC2050_LT	2.11	2.07	2.18	2.53	2.58	2.72	3.93	3.87	3.55	3.34	3.06	3.15	2.87	2.66	2.74	2.73	2.68	2.57	2.57	2.48	2.47	2.50	2.60	2.49	2.60	2.52	2.42	3.81	3.15	2.71	2.17	2.07	2.07	2.11	2.19
1965_May_CC2050_Org	2.73	2.80	3.12	2.73	2.69	2.84	3.60	3.57	3.37	3.21	3.21	3.34	3.24	3.09	3.15	3.14	3.11	3.08	3.03	2.94	2.84	2.68	2.74	2.67	2.57	2.39	2.16	2.18	2.07	1.94	2.18	2.13	2.15	2.02	2.09
1965_May_CC2050_HT	3.84	3.78	4.19	3.67	4.00	4.21	5.56	5.60	5.11	4.81	4.43	4.46	4.09	3.33	3.59	3.50	3.44	3.28	3.20	3.01	2.81	2.58	2.56	2.57	2.37	2.23	2.06	2.24	2.11	1.98	2.29	3.29	3.08	1.87	3.39
1965_May_CC2050_LT	2.86	2.71	3.23	3.39	3.69	3.87	5.71	5.81	5.61	5.09	4.44	4.82	4.26	3.42	3.80	3.74	3.67	3.57	3.49	3.34	3.19	2.99	3.06	2.98	2.93	2.95	3.16	3.54	3.78	3.43	2.39	2.26	2.22	2.01	2.73
1966_CC2050_Org	3.12	3.12	3.27	3.84	3.77	4.03	4.76	4.71	4.33	4.25	3.99	3.94	3.70	3.25	3.41	3.44	3.37	3.45	3.34	3.16	2.99	2.84	3.07	2.83	3.10	3.00	3.10	3.71	3.85	3.66	2.44	2.42	2.34	2.14	2.80
1966_CC2050_HT	3.04	3.03	3.07	3.55	3.49	3.61	4.69	4.59	4.10	3.85	3.59	3.98	3.53	3.35	3.60	3.59	3.52	3.53	3.40	3.20	3.15	3.14	3.35	3.13	3.31	3.35	3.55	4.02	4.34	4.03	2.51	2.57	2.52	2.17	3.13
1966_CC2050_LT	2.82	2.92	3.14	3.75	3.82	4.14	6.42	6.41	5.92	5.54	4.89	5.23	4.72	3.64	4.19	4.11	4.03	3.93	3.85	3.67	3.48	3.27	3.30	3.25	3.13	2.93	2.64	2.79	2.62	2.42	2.25	2.23	2.24	2.12	2.29
1970_CC2050_Org	5.17	5.84	6.21	5.52	6.14	6.17	7.75	7.73	7.04	6.71	6.12	6.18	5.74	4.07	5.11	5.00	4.92	4.74	4.64	4.44	4.19	3.94	3.92	3.92	3.68	3.43	2.97	3.41	3.52	3.31	2.34	2.17	2.10	2.10	2.62
1970_CC2050_HT	5.44	6.18	6.45	5.72	6.28	6.35	7.90	7.89	7.18	6.84	6.25	6.28	5.82	4.09	5.19	5.06	4.97	4.82	4.71	4.48	4.20	3.93	3.90	3.92	3.62	3.32	2.81	3.18	2.94	2.72	2.16	2.37	2.11	2.11	2.83
1970_CC2050_LT	5.07	5.48	6.12	5.61	6.34	6.69	8.63	8.71	8.46	7.97	7.44	7.81	6.96	4.51	6.06	5.90	5.75	5.49	5.31	4.97	4.61	4.22	4.29	4.19	3.86	3.51	3.01	2.99	2.76	2.45	2.47	2.64	2.63	2.38	2.63
1974_CC2050_Org	3.44	3.40	3.96	4.09	4.42	4.69	6.95	7.08	7.00	6.34	5.57	6.05	5.33	3.90	4.75	4.63	4.54	4.36	4.27	4.04	3.79	3.54	3.59	3.51	3.36	3.13	2.83	2.91	2.75	2.52	1.99	1.96	1.95	1.96	1.95
1974_CC2050_HT	4.11	4.35	4.57	4.04	4.39	4.46	5.59	5.59	4.86	4.71	4.41	4.28	3.98	3.23	3.44	3.34	3.28	3.14	3.06	2.89	2.71	2.56	2.54	2.55	2.43	2.30	2.37	2.65	2.85	2.57	2.21	1.81	1.78	1.81	2.12
1974_CC2050_LT	3.44	3.40	3.96	4.09	4.42	4.69	6.95	7.08	7.00	6.34	5.57	6.05	5.33	3.90	4.75	4.63	4.54	4.36	4.27	4.04	3.79	3.54	3.59	3.51	3.36	3.13	2.83	2.91	2.75	2.52	1.99	1.96	1.95	1.96	1.95
1983_CC2050_Org	2.57	2.25	2.56	2.62	2.71	2.88	4.86	4.75	4.14	3.73	3.38	3.38	3.33	2.85	3.22	3.23	3.14	3.34	3.23	3.12	3.14	3.09	3.20	3.07	3.31	3.22	3.36	3.91	3.92	3.83	2.47	2.48	2.41	2.17	2.85
1983_CC2050_HT	2.12	2.08	2.17	2.64	2.74	2.86	4.07	4.03	3.76	3.53	3.09	3.35	3.06	2.75	2.86	2.84	2.80	2.75	2.74	2.68	2.61	2.56	2.59	2.55	2.53	2.47	2.38	2.82	2.62	2.43	2.21	2.15	2.17	2.17	2.21
1983_CC2050_LT	2.40	2.16	2.58	2.62	2.72	2.84	4.68	4.54	3.91	3.52	3.12	3.33	3.13	2.74	2.97	3.14	3.07	3.40	3.23	3.22	3.25	3.11	3.50	3.09	3.47	3.37	3.69	4.23	4.35	4.19	2.50	2.59	2.46	2.17	3.12
1985_CC2050_Org	2.10	2.00	2.06	3.00	2.74	2.85	3.79	3.76	3.54	3.33	2.92	3.14	2.88	2.64	2.70	2.67	2.63	2.58	2.57	2.50	2.44	2.38	2.40	2.37	2.34	2.25	2.12	2.31	2.18	2.08	2.08	2.02	2.04	2.07	2.05
1985_CC2050_HT	2.08	2.02	2.30	3.37	2.90	3.02	4.21	4.07	3.57	3.35	3.15	3.35	3.31	2.92	3.05	3.07	3.04	3.20	3.10	3.08	3.10	3.19	3.31	3.19	3.43	3.29	3.17	3.68	3.78	3.62	2.38	2.30	2.19	2.09	2.76
1985_CC2050_LT	2.20	2.19	2.07	2.92	2.82	2.94	3.92	3.84	3.57	3.35	2.99	3.16	2.90	2.66	2.72	2.70	2.65	2.60	2.59	2.52	2.46	2.39	2.41	2.38	2.43	2.37	2.45	2.83	2.81	2.70	2.21	2.04	2.06	2.09	2.17
1986_CC2050_Org	1.88	1.88	1.97	2.43	2.46	2.60	3.66	3.62	3.42	3.21	2.84	3.05	2.79	2.57	2.61	2.59	2.55	2.48	2.48	2.41	2.34	2.29	2.31	2.28	2.24	2.17	2.04	2.16	2.08	1.99	1.95	1.87	1.88	1.98	1.92
1986_CC2050_HT	1.93	2.03	2.10	2.46	2.49	2.63	3.69	3.65	3.44	3.24	2.85	3.06	2.81	2.58	2.63	2.61	2.56	2.50	2.49	2.43	2.36	2.29	2.55	2.28	2.46	2.33	2.55	3.03	3.14	2.92	2.45	2.11	2.21	2.15	2.31
1986_CC2050_LT	1.89	1.89	1.98	2.44	2.46	2.61	3.75	3.71	3.96	3.63	3.18	3.70	3.29	2.95	3.01	2.95	2.88	2.79	2.74	2.59	2.42	2.28	2.30	2.27	2.25	2.19	2.24	2.56	2.58	2.39	2.15	1.87	1.88	1.98	1.99
1988_CC2050_Org	2.44	2.20	2.40	2.76	2.78	2.94	4.62	4.54	3.94	3.57	3.23	3.37	3.14	2.84	3.06	3.04	2.97	3.08	3.01	2.94	2.88	2.88	2.93	2.87	3.00	2.98	3.07	3.51	3.54	3.42	2.40	2.30	2.28	2.20	2.64
1988_CC2050_HT	2.62	2.73	2.78	2.88	3.00	3.08	3.91	3.90	3.64	3.49	3.22	3.30	3.06	2.75	2.75	2.70	2.66	2.58	2.54	2.46	2.40	2.34	2.35	2.33	2.30	2.23	2.10	2.23	2.16	2.07	4.14	3.53	3.54	3.32	3.46
1988_CC2050_LT	2.72	2.44	2.82	2.79	2.98	3.10	5.05	4.92	4.32	3.87	3.61	3.57	3.59	2.99	3.43	3.49	3.40	3.61	3.56	3.52	3.46	3.44	3.64	3.43	3.69	3.67	3.82	4.47	4.70	4.48	4.00	3.33	3.39	3.07	3.29
1991_CC2050_Org	2.50	2.28	2.29	4.71	4.14	4.12	6.09	5.84	5.49	5.01	4.61	5.63	5.61	4.38	5.43	5.79	5.56	6.36	6.08	5.93	5.85	5.45	5.79	5.38	5.20	4.66	3.77	4.27	3.78	3.10	2.25	2.24	2.25	2.16	2.28
1991_CC2050_HT	2.54	2.26	2.15	5.08	4.40	4.34	6.60	6.33	5.96	5.49	5.02	6.14	6.14	4.62	6.03	6.46	6.19	7.05	6.78	6.65	6.59	6.28	6.50	6.21	6.13	5.53	4.58	5.04	4.59	3.82	2.20	2.14	2.16	2.14	2.19
1991_CC2050_LT	2.54	2.49	2.66	4.56	4.04	3.69	5.09	4.75	4.32	4.07	3.41	4.58	4.59	4.14	4.58	5.00	4.74	5.86	5.49	5.42	5.49	5.13	5.64	5.05	5.08	4.50	3.70	4.20	4.51	4.22	2.52	2.60	2.55	2.22	3.15
1995_CC2050_Org	2.44	2.23	2.51	2.82	2.90	3.03	4.72	4.57	3.96	3.73	3.28	3.53	3.23	2.89	3.08	3.14	3.06	3.24	3.20	3.17	3.11	3.09	3.31	3.08	3.33	3.28	3.41	4.00	4.19	3.97	2.47	2.50	2.43	2.26	2.93
1995_CC2050_HT	2.27	2.22	2.33	2.82	2.90	3.04	4.27	4.23	3.97	3.73	3.26	3.53	3.23	2.89	3.05	3.01	2.97	2.92	2.91	2.85	2.79	2.71	2.74	2.70	2.75	2.68	2.75	3.24	3.34	3.14	2.31	2.28	2.30	2.27	2.45
1995_CC2050_LT	2.29	2.24	2.34	2.82	2.91	3.04	4.29	4.25	3.97	3.74	3.27	3.54	3.24	2.90	3.05	3.02	2.98	2.92	2.91	2.86	2.79	2.72	2.75	2.71	2.70	2.59	2.45	2.64	2.53	2.43	2.32	2.31	2.31	2.27	2.36
1997_May_CC2050_Org	1.70	1.64	1.86	2.08	1.92	1.93	3.53	3.41	2.77	2.48	2.17	2.60	2.45	2.34	2.30	2.39	2.32	2.46	2.40	2.34	2.31	2.26	2.47	2.25	2.45	2.31	2.27	3.44	2.98	2.64	2.15	1.79	1.71	1.69	2.02
1997_May_CC2050_LT	1.58	1.65	1.50	2.00	1.97	2.03	2.67	2.63	2.36	2.26	2.06	2.34	2.49	3.21	3.13	3.33	3.28	3.61	3.61	3.55	3.51	3.18	3.51	3.13	3.24	2.95	2.69	3.28	2.86	2.37	1.68	1.36	1.34	1.38	1.47
1997_Sep_CC2050_Org	2.54	2.67	2.35	3.24	3.30	3.35	4.93	4.88	4.87	4.52	4.08	4.79	4.55	3.97	4.64	4.68	4.60	4.82	4.72	4.55	4.33	3.95	4.06	3.90	3.72	3.34	2.82	3.42	3.04	3.01	2.37	2.31	2.28	1.98	2.51
1997_Sep_CC2050_HT	3.12	3.29	3.20	4.35	4.22	4.56	6.07	5.99	5.83	5.46	4.99	5.46	5.12	4.11	5.05	5.11	5.02	5.19	5.07	4.85	4.56	4.05	4.21	3.99	3.70	3.15	2.56	3.06	3.32	3.20	2.34	2.15	1.97	1.76	2.27
1997_Sep_CC2050_LT	3.32	3.52	3.21	3.71	3.73	3.89	4.94	4.87	4.81	4.46	3.98	4.61	4.35	3.94	4.45	4.56	4.47	4.77	4.64	4.46	4.24	3.82	3.98	3.77	3.60	3.18	2.62	2.79	2.43	2.00	2.33	2.55	2.50	1.90	2.51
1998_CC2050_Org	2.49	2.24	2.66	3.35	2.87	2.97	4.84	4.71	4.09	3.60	3.30	3.25	3.32	2.73	3.14	3.24	3.17	3.53	3.39	3.29	3.35	3.27	3.52	3.25	3.54	3.53	3.81	4.29	4.54	4.22	2.52	2.65	2.54	2.21	3.21
1998_CC2050_HT	1.79	1.84	1.73	3.54	3.04	3.13	3.88	3.80	3.49	3.36	3.19	3.28	3.21	2.78	2.81	2.82	2.76	2.84	2.73	2.60	2.48	2.51	2.56	2.51	2.64	2.49	2.40	3.20	2.82	2.47	1.74	1.67	1.63	1.74	1.77
2007_Sidr_CC2050_Org	4.69	4.95	5.05	4.50	4.92	4.89	5.81	5.81	5.41	5.22	4.90	4.87	4.57	3.62	4.08	3.98	3.92	3.76	3.68	3.49	3.25	3.01	2.97	2.99	2.71	2.46	2.26	2.45	2.45	2.27	3.45	4.44	4.19	2.02	4.82
2007_Sidr_CC2050_HT	3.52	3.78	3.61	3.31	3.46	3.45	4.15	4.11	3.61	3.52	3.26	3.25	3.04	2.83	2.85	2.81	2.78	2.76	2.69	2.60	2.51	2.40	2.42	2.40	2.33	2.24	2.13	2.19	2.07	1.96	4.44	4.41	4.19	2.04	4.72
2007_Sidr_CC2050_LT	3.93	4.10	4.10	4.11	4.31	4.37	5.18	5.16	4.93	4.78	4.45	4.53	4.27	3.49	3.89	3.81	3.76	3.60	3.55	3.41	3.23	3.05	3.02	3.03	2.92	2.91	3.14	3.55	3.76	3.47	4.43	4.54	4.27	2.55	4.95
2009_CC2050_Org	2.74	2.74	2.88	3.18	3.27	3.40	4.59	4.56	4.26	4.04	3.60	3.83	3.49	3.03	3.22	3.16	3.11	3.02	2.99	2.89	2.82	2.73	2.76	2.72	2.69	2.58	2.43	2.63	2.51	2.42	2.88	2.86	2.87	2.76	2.86
2009_CC2050_HT	2.89	2.93	3.06	3.39	3.45	3.62	4.80	4.78	4.51	4.28	3.85	4.04	3.70	3.19	3.43	3.40	3.35	3.25	3.22	3.12	3.02	2.92	2.92	2.91	2.85	2.74	2.55	2.75	2.63	2.51	2.90	3.12	3.09	2.88	3.14
2009_CC2050_LT	2.67	2.70	2.83	3.15	3.23	3.36	4.56	4.54	4.21	4.00	3.56	3.75	3.42	3.00	3.13	3.11	3.06	2.99	2.98	2.91	2.84	2.74	2.78	2.73	2.70	2.59	2.44	2.61	2.49	2.40	2.91	2.93	2.94	2.82	2.93

Table F- 4: The simulated maximum water level with climate change for locations 106 -141

Location / Cyclonic Event	Strom Surge Level (mPWD) at Climate Change Condition																																		
	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141
1960_CC2050_Org	2.29	2.38	2.30	2.14	1.68	1.68	1.61	1.61	1.59	2.34	1.86	1.95	1.67	2.12	2.01	1.83	1.80	1.66	1.75	1.77	1.74	1.65	1.66	1.76	1.75	1.77	1.69	1.70	1.71	1.74	1.64	2.20	2.25	2.26	6.42	5.84
1960_CC2050_HT	2.44	2.69	2.53	2.38	1.92	1.92	1.71	1.67	1.60	2.36	2.11	2.22	1.67	2.23	2.14	1.85	1.84	1.66	1.74	1.77	1.78	1.72	1.72	1.77	1.76	1.78	1.70	1.70	1.73	1.74	1.79	3.33	3.58	3.99	6.69	5.70
1960_CC2050_LT	1.75	1.79	1.76	1.76	1.66	1.66	1.61	1.62	1.59	1.80	1.75	1.75	1.67	1.83	1.82	1.83	1.79	1.66	1.74	1.77	1.78	1.70	1.70	1.77	1.76	1.77	1.70	1.70	1.72	1.74	1.60	2.12	2.19	2.45	7.54	6.72
1961_CC2050_Org	3.10	3.44	3.27	3.00	2.44	2.44	3.19	2.99	3.00	2.77	2.43	2.56	1.94	2.54	2.44	2.10	2.13	1.81	1.81	1.84	1.83	1.79	1.79	1.83	1.83	1.89	1.87	1.97	1.98	1.94	3.72	4.57	4.51	4.28	3.33	3.25
1961_CC2050_HT	2.79	3.05	2.90	2.66	2.16	2.16	3.62	3.40	3.39	2.58	2.18	2.38	1.78	2.37	2.28	1.93	1.95	1.72	1.80	1.83	1.82	1.76	1.76	1.82	1.83	1.83	1.77	1.78	1.83	1.82	4.11	4.94	4.84	4.61	3.21	2.85
1961_CC2050_LT	1.81	1.85	1.81	1.92	2.03	2.03	3.09	2.88	2.91	1.97	1.94	1.98	1.73	1.89	1.89	1.88	1.85	1.71	1.79	1.82	1.80	1.76	1.76	1.81	1.81	1.82	1.75	1.77	1.78	1.81	3.68	4.56	4.55	4.28	3.20	2.85
1963_CC2050_Org	2.28	2.36	2.30	2.26	2.05	2.05	2.00	2.00	1.94	2.35	2.25	2.24	2.04	2.27	2.24	2.17	2.16	1.98	2.06	2.09	2.02	1.98	1.95	1.98	2.08	2.08	2.06	2.08	2.09	2.08	1.87	2.52	2.63	2.69	4.30	3.60
1963_CC2050_HT	2.22	2.29	2.25	2.21	2.02	2.02	1.98	1.98	1.94	2.30	2.19	2.19	2.01	2.22	2.20	2.14	2.12	1.94	2.02	2.05	2.01	1.99	1.96	1.98	2.06	2.05	2.03	2.04	2.05	2.05	1.89	2.54	2.64	2.69	4.50	3.81
1963_CC2050_LT	2.86	3.23	2.96	2.81	2.22	2.22	2.05	2.04	1.99	2.71	2.27	2.33	2.03	2.42	2.30	2.16	2.14	1.94	2.02	2.06	2.02	1.97	1.95	1.97	2.06	2.05	2.05	2.07	2.08	2.07	1.87	2.52	2.62	2.68	4.37	3.60
1965_Dec_CC2050_Org	2.03	2.09	2.05	2.02	1.84	1.84	1.82	1.81	1.79	2.11	2.03	2.03	1.88	2.08	2.06	2.02	2.00	1.83	1.91	1.95	1.93	1.87	1.85	1.90	1.94	1.94	1.90	1.92	1.93	1.94	1.77	2.37	2.46	2.51	2.58	2.45
1965_Dec_CC2050_LT	2.20	2.35	2.19	2.13	1.93	1.93	1.87	1.86	1.82	2.30	2.15	2.14	1.92	2.13	2.11	2.07	2.05	1.89	1.96	2.00	1.95	1.91	1.89	1.93	1.98	1.99	1.94	1.95	1.96	1.98	1.76	2.37	2.47	2.51	2.58	2.50
1965_May_CC2050_Org	2.09	2.09	2.06	2.46	2.54	2.54	3.56	3.72	3.55	2.54	2.34	2.54	1.90	2.05	2.04	2.01	2.00	1.87	1.96	1.98	1.96	1.78	1.76	1.86	1.91	1.93	1.89	1.89	1.90	1.91	3.05	3.64	3.47	2.94	3.08	2.85
1965_May_CC2050_HT	3.40	3.58	3.48	3.56	3.16	3.16	4.34	4.32	4.00	3.43	3.12	3.22	1.74	1.96	2.05	1.87	1.84	1.72	1.80	1.82	1.84	1.77	1.76	1.81	1.81	1.81	1.73	1.74	1.76	1.78	4.00	5.02	5.05	4.69	3.25	2.80
1965_May_CC2050_LT	2.79	2.96	2.86	2.75	2.70	2.70	3.56	3.71	3.50	2.79	2.63	2.72	1.73	2.36	2.24	1.89	1.94	1.73	1.81	1.83	1.87	1.78	1.76	1.81	1.81	1.81	1.74	1.75	1.76	1.79	2.96	3.90	4.05	4.00	3.55	3.20
1966_CC2050_Org	2.90	3.20	3.04	2.79	2.26	2.26	2.09	2.06	2.02	2.63	2.30	2.46	1.97	2.43	2.33	2.10	2.09	1.92	2.00	2.04	2.01	1.93	1.90	1.96	2.02	2.02	1.97	1.99	1.99	2.01	2.48	3.52	3.67	3.78	3.45	3.03
1966_CC2050_HT	3.22	3.46	3.34	3.06	2.45	2.45	2.23	2.14	2.02	2.85	2.44	2.59	1.97	2.53	2.41	2.10	2.10	1.92	2.00	2.04	2.01	1.93	1.90	1.96	2.02	2.02	1.98	1.99	2.00	2.02	2.39	3.37	3.45	3.53	3.51	3.21
1966_CC2050_LT	2.30	2.34	2.29	2.22	2.02	2.02	2.12	2.09	2.05	2.30	2.24	2.24	1.95	2.18	2.16	2.08	2.07	1.89	1.98	2.01	2.01	1.92	1.90	1.94	1.99	1.99	1.95	1.97	1.97	1.99	2.02	2.70	3.07	3.45	3.90	3.49
1970_CC2050_Org	2.66	2.99	2.86	2.62	2.42	2.42	4.69	4.31	4.09	3.09	3.09	3.19	1.93	2.31	2.20	2.08	2.05	1.89	1.97	2.00	1.98	1.94	1.91	1.96	2.00	2.00	1.95	1.96	1.98	1.99	5.68	6.42	6.69	6.66	4.68	4.18
1970_CC2050_HT	3.13	3.44	3.21	2.68	2.42	2.42	4.88	4.62	4.37	3.36	3.68	3.81	1.94	2.13	2.12	2.08	2.06	1.90	1.97	2.01	1.98	1.95	1.92	1.96	2.01	2.00	1.96	1.97	1.98	1.99	6.19	6.64	6.88	6.81	4.75	4.20
1970_CC2050_LT	2.63	2.65	2.60	2.46	2.56	2.56	4.70	4.20	4.08	2.78	2.80	2.88	2.26	2.50	2.47	2.33	2.35	2.18	2.31	2.34	2.04	1.95	1.92	1.99	2.13	2.21	2.14	2.15	2.14	2.17	5.25	6.16	6.50	6.59	5.43	4.65
1974_CC2050_Org	1.97	1.96	1.92	1.91	1.77	1.77	2.07	2.02	1.98	1.96	1.90	1.90	1.80	1.98	1.96	1.94	1.92	1.78	1.86	1.89	1.88	1.83	1.82	1.86	1.89	1.88	1.83	1.84	1.85	1.87	3.00	4.10	4.53	4.63	4.34	3.81
1974_CC2050_HT	2.17	2.30	2.18	2.04	1.59	1.59	2.63	2.55	2.40	2.22	1.90	1.91	1.64	2.07	1.97	1.81	1.78	1.63	1.71	1.74	1.71	1.64	1.66	1.79	1.75	1.76	1.66	1.67	1.70	1.72	3.78	5.05	5.25	5.21	3.09	2.70
1974_CC2050_LT	1.97	1.96	1.92	1.91	1.77	1.77	2.07	2.02	1.98	1.96	1.90	1.90	1.80	1.98	1.96	1.94	1.92	1.78	1.86	1.89	1.88	1.83	1.82	1.86	1.89	1.88	1.83	1.84	1.85	1.87	3.00	4.10	4.53	4.63	4.34	3.81
1983_CC2050_Org	2.90	3.25	3.04	2.86	2.34	2.34	2.08	2.02	1.90	2.67	2.42	2.52	1.96	2.49	2.39	2.10	2.13	1.90	1.99	2.02	1.99	1.94	1.92	1.96	2.02	2.02	1.99	2.00	2.01	2.02	1.86	2.50	2.60	2.62	3.31	3.17
1983_CC2050_HT	2.22	2.29	2.25	2.22	2.04	2.04	1.99	1.99	1.95	2.28	2.19	2.18	1.99	2.21	2.19	2.13	2.11	1.94	2.02	2.05	2.01	1.98	1.95	1.98	2.06	2.05	2.02	2.03	2.04	2.05	1.90	2.55	2.65	2.67	2.76	2.62
1983_CC2050_LT	3.18	3.65	3.35	3.15	2.51	2.51	2.16	2.11	1.95	2.91	2.38	2.51	1.99	2.54	2.42	2.12	2.10	1.93	2.01	2.04	2.01	1.97	1.94	1.98	2.05	2.04	2.01	2.02	2.04	2.04	1.88	2.53	2.63	2.64	3.34	3.29
1985_CC2050_Org	2.05	2.10	2.06	2.05	1.90	1.90	1.87	1.86	1.82	2.15	2.07	2.07	1.91	2.09	2.08	2.05	2.02	1.87	1.94	1.98	1.96	1.92	1.90	1.94	1.98	1.97	1.93	1.94	1.95	1.96	1.80	2.42	2.51	2.54	2.58	2.45
1985_CC2050_HT	2.80	3.15	2.88	2.74	2.17	2.17	1.90	1.88	1.85	2.68	2.12	2.30	1.92	2.40	2.28	2.06	2.03	1.88	1.96	1.99	1.97	1.93	1.91	1.95	1.99	1.99	1.94	1.96	1.97	1.98	1.83	2.45	2.54	2.56	3.07	3.14
1985_CC2050_LT	2.22	2.33	2.15	2.10	1.92	1.92	1.88	1.87	1.84	2.18	2.06	2.06	1.92	2.11	2.09	2.06	2.03	1.88	1.95	1.98	1.96	1.93	1.90	1.94	1.98	1.98	1.94	1.96	1.96	1.98	1.87	2.56	2.65	2.73	2.60	2.47
1986_CC2050_Org	1.92	1.97	1.92	1.91	1.75	1.75	1.71	1.70	1.68	1.99	1.93	1.92	1.80	1.99	1.98	1.96	1.92	1.77	1.85	1.88	1.86	1.81	1.81	1.86	1.87	1.89	1.82	1.84	1.85	1.87	1.68	2.28	2.38	2.41	2.49	2.35
1986_CC2050_HT	2.32	2.55	2.32	2.27	1.99	1.99	1.96	2.05	1.98	2.40	1.95	2.04	2.01	2.16	2.05	2.11	2.03	1.89	1.94	1.96	2.29	1.85	1.84	1.88	1.90	2.04	2.14	2.16	2.17	2.08	2.31	2.75	2.74	2.48	2.51	2.37
1986_CC2050_LT	2.05	2.08	1.99	2.02	1.92	1.92	1.76	1.87	1.81	2.00	1.93	1.97	1.81	1.99	1.98	1.96	1.92	1.77	1.84	1.88	1.85	1.80	1.80	1.86	1.87	1.89	1.83	1.84	1.86	1.88	1.67	2.27	2.37	2.41	2.80	2.44
1988_CC2050_Org	2.71	2.91	2.70	2.59	2.11	2.11	2.04	2.03	1.99	2.51	2.30	2.42	2.07	2.37	2.27	2.17	2.15	2.00	2.08	2.10	2.04	2.05	2.00	2.01	2.10	2.10	2.09	2.09	2.11	2.10	1.95	2.61	2.70	2.74	3.07	2.92
1988_CC2050_HT	3.41	3.28	3.21	3.10	2.66	2.66	3.04	3.00	2.95	2.82	2.68	2.75	3.09	3.31	3.29	3.27	3.26	3.09	3.11	3.05	3.01	2.87	2.79	2.89	3.12	3.17	3.23	3.16	3.10	2.93	2.64	3.28	3.27	3.15	2.57	2.40
1988_CC2050_LT	3.38	3.72	3.56	3.24	2.84	2.84	3.08	3.10	3.02	2.93	2.65	2.73	2.62	2.88	2.88	3.03	3.01	2.91	2.95	2.95	3.01	2.70	2.64	2.67	2.91	2.99	2.84	2.79	2.80	2.59	2.66	3.29	3.32	3.20	3.63	3.48
1991_CC2050_Org	2.29	2.32	2.28	2.22	2.02	2.02	2.09	2.05	2.03	2.29	2.21	2.21	2.00	2.22	2.20	2.13	2.12	1.95	2.04	2.07	2.00	1.94	1.91	1.97	2.03	2.04	1.98	1.99	2.00	2.02	2.03	2.72	2.79	2.81	6.20	6.03
1991_CC2050_HT	2.18	2.24	2.19	2.16	1.99	1.99	1.99	1.97	1.94	2.22	2.15	2.14	1.97	2.17	2.16	2.11	2.09	1.93	2.00	2.03	2.00	1.96	1.93	1.98	2.03	2.03	1.98	1.99	2.00	2.01	1.92	2.55	2.63	2.89	6.91	6.80
1991_CC2050_LT	3.26	3.53	3.40	3.09	2.48	2.48	2.25	2.15	2.00	2.87	2.47	2.61	2.00	2.57	2.45	2.13	2.13	1.95	2.03	2.06	2.01	1.97	1.93	1.99	2.05	2.05	2.01	2.01	2.03	2.04	1.99	2.79	2.83	2.96	5.67	5.75
1995_CC2050_Org	3.04	3.35	3.19	2.92	2.37	2.37	2.12	2.11	2.07	2.72	2.37	2.52	2.11	2.50	2.40	2.22	2.20	2.03	2.10	2.14	2.08	2.06	2.02	2.05	2.14	2.14	2.12	2.14	2.14	2.14	2.00	2.68	2.79	2.81	3.26	3.14
1995_CC2050_HT	2.47	2.72	2.47	2.41	2.15	2.15	2.12	2.11	2.07	2.48	2.26	2.28	2.11	2.31	2.29	2.21	2.20	2.03	2.10	2.13	2.07	2.06	2.02	2.05	2.13	2.14	2.12	2.14	2.14	2.14	2.01	2.69	2.78	2.82	2.92	2.80
1995_CC2050_LT	2.37	2.46	2.42	2.38	2.16	2.16	2.14	2.12	2.09	2.41	2.30	2.29	2.11	2.32	2.30	2.22	2.21	2.04	2.11	2.14	2.09	2.07	2.03	2.05	2.15	2.15	2.13	2.15	2.15	2.14	2.00	2.70	2.80	2.82	2.93	2.80
1997_May_CC2050_Org	2.08	2.23	2.09	1.95	1.52	1.52	1.40	1.35	1.22	2.09	1.67	1.81	1.45	1.99	1.88	1.60	1.63	1.40	1.42	1.43	1.34	1.20	1.26	1.43	1.41	1.42	1.39	1.46	1.50	1.53	1.39	1.90	1.91	1.94	2.44	2.36
1997_May_CC2050_LT	1.50	1.59	1.51	1.40	1.10	1.10	1.27	1.20	1.20	1.62	1.31	1.31	1.33	1.62	1.52	1.39	1.39	1.30	1.37	1.37	1.21	1.14	1.17	1.32	1.30	1.33	1.29	1.30	1.30	1.32	1.40	1.91	1.94	1.97	3.74	3.63
1997_Sep_CC2050_Org	2.49	2.62	2.37	2.54	1.92	1.92	2.03	1.96	1.98	2.51	2.05	2.32	1.84	2.26	2.15	1.89	1.91	1.79	1.88	1.89	1.97	1.67	1.63	1.68	1.75	1.80	1.77	1.77	1.78	1.76	2.01	2.89	2.89	3.02	4.85	4.41
1997_Sep_CC2050_HT	2.27	2.80	2.52	2.38	1.97	1.97	1.71	1.60	1.64	2.54	1.96	2.15	1.64	2.29	2.18	1.83	1.86	1.64	1.74	1.74	1.74	1.58	1.55	1.66	1.64	1.64	1.56	1.55	1.61	1.67	2.56	3.73	3.84	4.01	5.21	4.64
1997_Sep_CC2050_LT	2.54	2.40	2.35	2.06	1.86	1.86	2.33	2.21	2.24	2.05	2.07	2.05	1.86	2.00	2.01	1.85	1.87	1.76	1.84	1.85	1.98	1.48	1.49	1.57	1.65	1.74	1.75	1.76	1.72	1.71	2.57	3.69	3.70	3.80	4.80	4.33
1998_CC2050_Org	3.28	3.71	3.39	3.22	2.58	2.58	2.24	2.17	1.96	2.95	2.43	2.59	1.93	2.57	2.45	2.08	2.14	1.80	1.76	1.74	1.76	1.68	1.68	1.73	1.72	1.86	1.81	1.95	1.97	1.88	1.53	2.06	2.31	2.42	3.49	3.40
1998_CC2050_HT	1.77	1.81	1.77	1.77	1.61	1.61	1.52	1.48	1.46	1.82	1.78	1.78	1.59	1.78	1.76	1.74	1.71	1.59	1.67	1.69	1.68	1.63	1.64	1.70	1.69	1.70	1.62	1.63	1.64	1.67	1.51	2.06	2.30	2.54	2.73	2.50
2007_Sidr_CC2050_Org	4.96	4.84	4.56	4.29	3.40	3.40	4.82	4.58	4.17	3.84	3.87	4.06	1.86	2.16	2.28	1.99	1.96	1.82	1.91	1.94	2.33	1.84	1.83	1.87	1.89	1.91	1.84	1.86	1.87	1.89	4.74	5.52	5.55	5.40	3.72	3.24
2007_Sidr_CC2050_HT	4.78	4.52	4.32	4.14	3.42	3.42	4.17	4.00	3.83	3.67	3.58	3.68	1.83	2.46	2.46	1.96	2.02	1.90	1.95	1.91	2.83	1.79	1.77	1.85	1.87	1.88	1.83	1.84	1.85	1.88	3.13	4.09	4.01	3.87	2.73	2.51
2007_Sidr_CC2050_LT	5.09	4.76	4.54	4.16	3.37	3.37	4.38	4.16	3.96	3.78	3.68	3.79	2.23	3.00	3.00	2.39	2.50	2.28	2.36	2.37	2.83	1.77	1.78	1.85	1.97	2.15	1.95	1.98	1.94	1.96	3.55	4.54	4.57	4.52	3.58	3.22
2009_CC2050_Org	2.82	2.84	2.80	2.79	2.51	2.51	2.61	2.60	2.56	2.59	2.47	2.49	2.63	2.63	2.59	2.83	2.83	2.80	2.83	2.79	2.54	3.03	2.88	2.67	2.91	2.86	2.78	2.75	2.74	2.63	2.40	3.18	3.24	3.24	3.01	2.83
2009_CC2050_HT	3.15	3.17	3.10	2.97	2.56	2.56	2.91	2.87	2.82	2.84	2.69	2.72	2.89	2.96	2.91	2.91	2.94	2.82	2.89	2.84	2.52	2.89	2.73	2.70	2.94	2.87	2.91	2.90	2.92	2.98	2.63	3.44	3.47	3.45	3.24	3.02
2009_CC2050_LT	2.90	2.91	2.86	2.85	2.54	2.54	2.66	2.64	2.61	2.64	2.51	2.53	2.71	2.70	2.66	2.88	2.87	2.83	2.87	2.82	2.54	3.04	2.89	2.70	2.95	2.90	2.85	2.83	2.81	2.68	2.37	3.14	3.20	3.20	3.00	2.84

G Estimated Water level for different return periods without & with climate change

The estimated maximum water level for different return periods are shown in Table G- 1.

Table G- 1: The estimated extreme water levels without and with climate change for locations 1 -141

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
1	1.975	2.439	2.783	3.125	2.161	2.765	3.213	3.658	Polder-15, Shyamnagar, Kholpetua River
2	2.006	2.478	2.828	3.175	2.192	2.804	3.257	3.707	Polder-15, Polder-5; Shyamnagar, Kholpetua River
3	1.991	2.476	2.836	3.194	2.169	2.751	3.182	3.61	Polder-15, Polder-13-14/1-2: Shyamnagar, Kholpetua
4	2.035	2.527	2.891	3.253	2.223	2.856	3.325	3.79	Polder-13-14/1-2, Polder-07/1; Koyra; Kapotakshi River
5	2.063	2.546	2.904	3.26	2.233	2.843	3.296	3.746	Polder-13-14/1-2, Polder-07/2; Koyra; Kapotakshi River
6	2.052	2.537	2.896	3.253	2.16	2.581	2.894	3.205	Polder-13-14/1-2; Koyra; Kapotakshi River
7	2.16	2.713	3.123	3.53	2.3	2.731	3.05	3.368	Polder-32; Dacope; Sibsa
8	1.894	2.355	2.697	3.037	2.062	2.649	3.085	3.518	Polder-16; Kapotakshi
9	1.791	2.224	2.546	2.865	1.948	2.499	2.908	3.314	Polder-16, Tala; Kapotakshi
10	1.983	2.472	2.835	3.196	2.13	2.721	3.16	3.595	Polder-29, Polder-17/1, Khulna Metro; Ghengrail River
11	2.041	2.544	2.917	3.288	2.159	2.735	3.162	3.587	Polder-29,17/1,20; Teliganga, Ghengrail River
12	2.085	2.575	2.939	3.299	2.219	2.799	3.229	3.655	Polder-18-19,23; Sibsa
13	2.172	2.709	3.107	3.503	2.295	2.744	3.076	3.407	Polder-31,23,10-12; Dacope, Sibsa
14	2.143	2.678	3.074	3.468	2.252	2.693	3.02	3.345	Polder32,33; Sutarkhali, Sibsa
15	2.138	2.667	3.058	3.447	2.233	2.62	2.906	3.191	Polder-32,31; Dhaki River
16	2.143	2.662	3.047	3.429	2.208	2.547	2.799	3.048	Polder-33,32; Sutarkhali River
17	2.097	2.606	2.984	3.359	2.158	2.553	2.845	3.136	Polder-31,33; Chunkuri River
18	2.069	2.569	2.939	3.307	2.125	2.53	2.831	3.129	Polder-33; Rampal; Pussur River
19	2.073	2.606	3.001	3.393	2.147	2.542	2.836	3.127	Polder-33; Mongla; Pussur

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
20	2.116	2.674	3.088	3.499	2.25	2.664	2.97	3.275	Polder-33,35/2; Mongla; Pussur
21	2.01	2.504	2.87	3.233	2.118	2.655	3.053	3.449	Polder-35/2; Mongla; Mongla River
22	2.103	2.637	3.032	3.425	2.231	2.862	3.329	3.793	Polder-35/2; Rampal; Daudkhali River
23	1.991	2.403	2.709	3.013	2.021	2.457	2.78	3.1	Polder-30; Rupsa River
24	2.116	2.796	3.3	3.8	2.235	2.98	3.533	4.081	Polder-34/1&34/3; Bishnu-Kumarkhali River
25	2.085	2.672	3.107	3.539	2.187	2.835	3.316	3.793	Polder-35/3; Bishnu-Kumarkhal River
26	2.122	2.702	3.132	3.559	2.265	2.952	3.462	3.968	Polder-35/3,35/2; Rampal, Katakhali River
27	2.131	2.735	3.184	3.629	2.283	3.001	3.534	4.063	Polder-35/3,37; Morrelganj; Ghasiakhali River
28	2.123	2.74	3.198	3.653	2.252	2.967	3.497	4.023	Polder-35/3,37; Dalatana, Poylahara River
29	2.263	2.953	3.465	3.973	2.381	3.027	3.507	3.983	Polder37,38,39/2; Bhandaria; Kocha River
30	2.279	3.002	3.538	4.071	2.45	3.077	3.542	4.003	Polder-37,39/2; Baleswar River
31	2.288	3.012	3.549	4.083	2.487	3.125	3.599	4.069	Polder-35/1,37,39/2; Morrelganj, Fanguchhi River
32	2.304	3.038	3.583	4.123	2.532	3.208	3.709	4.207	Polder-35/1,39/2; Mathbaria; Baleswar
33	2.341	3.089	3.644	4.195	2.648	3.381	3.925	4.465	Polder-35/1,39/1; Sharankhola; Baleswar
34	2.363	3.131	3.7	4.265	2.816	3.621	4.219	4.812	Polder-40/1,40/2; Patharghata, Baleswar
35	2.443	3.239	3.829	4.415	3.005	3.918	4.595	5.268	Polder-40/1,40/2; Patharghata, Baleswar
36	2.362	3.079	3.611	4.139	2.92	3.833	4.51	5.182	No Polder
37	2.403	3.195	3.782	4.365	3.109	4.104	4.842	5.575	Polder-40/1,40/2; Patharghata; Buriswar
38	2.415	3.223	3.823	4.418	3.203	4.265	5.052	5.833	Polder-40/1& 40/2,41&42,45; Buriswar
39	2.295	3.062	3.63	4.195	2.833	3.635	4.231	4.822	Polder-41&42,44; Borguna; Buriswar
40	2.311	3.082	3.654	4.222	2.808	3.597	4.183	4.764	Polder-41&42,39/1; Borguna; Bishkhali
41	2.289	3.07	3.65	4.226	2.678	3.357	3.861	4.361	Polder-41&42,39/1,41/6&41/7; Borguna; Bishkhali
42	2.057	2.728	3.225	3.719	2.188	2.782	3.223	3.661	Polder-41/6&41/7,39/2; Betagi; Bishkhali
43	2.038	2.703	3.196	3.685	2.117	2.692	3.118	3.541	Polder-39/2; Kathalia; Bishkhali
44	2.015	2.699	3.206	3.71	2.071	2.652	3.082	3.51	Polder-39/2; Kirtonkhola, Biskhali River
45	2.022	2.72	3.238	3.752	2.19	2.839	3.32	3.798	Polder41/6&41/7,43/2; Mirjaganj; Buriswar

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
46	2.121	2.884	3.45	4.011	2.432	3.112	3.616	4.116	Polder41/6&41/7,43/2; Amtali; Buriswar
47	2.255	3.046	3.633	4.215	2.698	3.408	3.935	4.459	Polder41&42,44; Amtali; Buriswar
48	2.338	3.085	3.639	4.19	3.102	4.108	4.855	5.596	Polder-45; Amtali; Bishkhali; Andharmanik
49	2.29	3.031	3.58	4.126	3.22	4.335	5.163	5.984	Polder-48; Kalapara
50	2.333	3.102	3.672	4.238	3.22	4.335	5.163	5.984	Polder-46&47; Kalapara; Andharmanik
51	2.368	3.182	3.785	4.385	3.086	4.067	4.795	5.518	Polder-46&47,48; Kalapara; Khaprabanga Don
52	2.597	3.551	4.259	4.961	3.308	4.592	5.545	6.49	Polder-48; Kalapara; Tentulia
53	2.705	3.745	4.517	5.283	3.334	4.622	5.577	6.525	Polder-46&47,48; Kalapara; Tentulia
54	2.493	3.388	4.053	4.712	2.968	4.019	4.8	5.574	Polder-46&47,50&51; Kalapara; Tentulia
55	2.346	3.177	3.793	4.405	2.84	3.88	4.652	5.418	Polder-55/1,43/2,54; Galachipa; Lohalia
56	2.1	2.818	3.35	3.879	2.574	3.647	4.443	5.233	Polder-43/2,55/2; Galachipa; Lohalia
57	2.616	3.577	4.29	4.998	3.294	4.538	5.461	6.376	Polder-48 & Polder-50/51; Galachipa, Tentulia
58	2.815	3.963	4.814	5.66	3.42	4.716	5.677	6.631	Polder-52/53; Galachipa, Mouth of the Ganges
59	2.356	3.189	3.807	4.421	2.716	3.714	4.454	5.189	Polder-52/53; Tetulia River
60	2.356	3.19	3.808	4.422	2.717	3.716	4.457	5.193	Polder-50/51 & Polder-54 & Polder-55/1; .Galachipa, Tentulia
61	2.887	4.061	4.933	5.797	3.296	4.497	5.388	6.272	Polder-56/57; Char Fassion, Shabazpur
62	2.698	3.774	4.571	5.363	3.275	4.536	5.472	6.4	Polder-55/3 & Polder-56/57; Near at Galatia& Char Faison
63	2.303	3.137	3.756	4.37	2.592	3.597	4.343	5.084	Polder-55/3; near at Galachipa & Dasmina, Tetulia River
64	2.628	3.539	4.215	4.886	2.823	3.803	4.531	5.253	no polder; Arial khan, Barisal
65	3.329	4.44	5.265	6.084	3.579	4.776	5.663	6.545	Polder-56/57 & Polder-59/2; Daulatkhan, Shabazpur
66	2.583	3.804	4.71	5.609	2.785	4.055	4.998	5.934	Polder-56/57; Burhanuddin, Tentulia
67	3.068	4.097	4.86	5.618	3.367	4.543	5.416	6.283	Polder-56/57; Tajumuddin, Shabazpur
68	2.939	4.12	4.996	5.866	3.253	4.434	5.31	6.179	Polder-56/57; Char Fassion, Shabazpur
69	2.914	4.081	4.946	5.805	3.228	4.316	5.124	5.926	Polder-58/2; Monpura, Shabazpur

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
70	2.837	3.85	4.602	5.348	3.187	4.353	5.219	6.078	Polder-58/2; Monpura, Shabazpur
71	2.868	3.89	4.648	5.4	3.204	4.332	5.168	5.998	Polder-73/2;. Hatiya, Shabazpur
72	2.925	3.952	4.714	5.47	3.256	4.463	5.359	6.248	Polder-58/1; Monpura, Shabazpur
73	3.084	4.303	5.208	6.105	3.425	4.699	5.644	6.583	Polder-73/1; Hatiya, Hatiya
74	3.47	4.552	5.354	6.151	3.837	5.153	6.129	7.098	Polder-73/1& Polder73/2; Hatiya, Hatiya
75	3.535	4.706	5.574	6.436	3.899	5.343	6.413	7.476	Polder-73/1; Hatiya, Hatiya
76	3.674	4.908	5.823	6.732	4.055	5.575	6.703	7.822	Polder-73/1; Hatiya,
77	5.013	6.41	7.446	8.474	5.447	6.883	7.949	9.006	Polder-59/3c; Companiganj
78	4.984	6.42	7.484	8.541	5.412	6.91	8.022	9.125	Polder-59/3c; Companiganj
79	4.776	6.306	7.442	8.568	5.238	7.086	8.457	9.818	Polder-61/2; Companiganj,
80	4.471	5.961	7.067	8.164	4.9	6.711	8.055	9.388	Polder-72; Sandwip
81	4.038	5.524	6.626	7.72	4.438	6.138	7.4	8.652	Polder-72; Sandwip,
82	4.359	5.675	6.652	7.621	4.783	6.417	7.629	8.833	Polder-72& Polder-61/1; Near at Sandwip & Sitakunda, Sandwip Channel
83	3.993	5.12	5.957	6.786	4.425	5.875	6.951	8.019	Polder-72; Sandwip, Sandwip Channel
84	3.388	4.199	4.801	5.399	3.568	4.319	4.876	5.429	Polder-63/2; Patia, Karnaphuli River
85	3.793	4.909	5.738	6.56	4.15	5.302	6.156	7.004	Polder-62; Karnaphuli River
86	3.806	4.93	5.763	6.591	4.185	5.382	6.27	7.152	Polder63/1a-Raipur; Anwara, Karnaphuli River
87	3.71	4.79	5.59	6.385	4.079	5.228	6.079	6.925	63/1a; Raipur, Anwara, Karnaphuli
88	3.807	4.996	5.878	6.753	4.214	5.511	6.473	7.428	63/1a; Raipur, Anwara, Sangu River
89	3.687	4.797	5.62	6.437	4.087	5.296	6.192	7.081	Polder 64/1a&Polder-64/1b; Bashkhali
90	3.517	4.547	5.312	6.071	3.915	5.041	5.876	6.705	Polder 64/1b&Polder 64/1a; Bashkhali
91	3.351	4.299	5.003	5.702	3.76	4.822	5.61	6.392	Polder-71; Kutubdia Channel
92	3.126	4.03	4.7	5.366	3.528	4.46	5.153	5.84	Polder-71; Kutubdia Channel
93	3.259	4.215	4.924	5.627	3.706	4.755	5.533	6.305	Polder-71; Chakaria, Kutubdia Channel
94	3.098	3.996	4.661	5.322	3.498	4.417	5.099	5.775	Polder-71; Kutubdia Channel

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
95	3.053	3.971	4.651	5.326	3.51	4.459	5.163	5.861	Polder-70; Moheshkhali
96	2.791	3.566	4.141	4.711	3.272	4.091	4.698	5.301	Polder-70; Moheskhali
97	2.462	3.074	3.527	3.977	3.081	3.843	4.408	4.97	Polder-69; Moheshkhali
98	2.892	3.75	4.386	5.018	3.624	4.705	5.506	6.302	Polder-66/1; Ramu, Moheshkhali Channel
99	2.578	3.254	3.756	4.254	3.531	4.625	5.437	6.243	Polder-66/1; Ramu, Moheshkhali Channel
100	2.264	2.767	3.14	3.511	3.236	4.206	4.926	5.64	Polder-66/1
101	2.427	3.201	3.776	4.347	2.662	3.35	3.861	4.369	Polder-35/1,39/1; Sharankhola, Bhola River
102	2.335	3.08	3.632	4.181	2.638	3.364	3.904	4.439	Polder-35/1,39/1; Sharankhola; Baleswar River
103	2.324	3.06	3.607	4.15	2.59	3.311	3.847	4.378	Polder-40/2; Patharghata; Baleswar River
104	2.155	2.696	3.097	3.495	2.279	2.72	3.047	3.372	Polder-32, Sibsa River
105	2.384	3.155	3.727	4.295	2.872	3.712	4.336	4.955	Polder-40/1&40/2; Patharghata, Baleswar River
106	2.4	3.18	3.758	4.332	2.922	3.8	4.45	5.097	Polder-40/1&40/2; Patharghata; Baleswar River
107	2.41	3.21	3.803	4.393	3.08	4.046	4.762	5.473	Polder-40/1 & 40/2; Patharghata; Bishkhali River
108	2.354	3.14	3.724	4.303	2.926	3.798	4.446	5.088	Polder-40/1 & 40/2; Patharghata; Bishkhali River
109	2.28	3.064	3.646	4.224	2.785	3.55	4.118	4.682	Polder-41/1&43/1; Barguna Sadar; Buriswar
110	2.123	2.964	3.588	4.208	2.42	3.094	3.595	4.091	Polder-41/6 & Polder-41/7; Buriswar River
111	2.1	2.857	3.418	3.975	2.42	3.094	3.595	4.091	Polder-41/6 & Polder-41/7; Buriswar River
112	2.333	3.163	3.779	4.391	2.841	3.925	4.729	5.527	Polder-43/2C&55/1; Galachipa; Lohalia
113	2.346	3.209	3.848	4.483	2.776	3.847	4.641	5.429	Polder-43/2C,43/2&55/2; Galachipa; Lohalia
114	2.245	3.036	3.622	4.205	2.711	3.831	4.662	5.487	Polder-55/2; Lohalia River
115	2.309	3.064	3.624	4.18	2.753	3.467	3.997	4.523	Polder-46 & 47; Andharmanik River
116	2.205	2.873	3.368	3.86	2.534	3.18	3.659	4.134	Polder-46 & 47; Andharmanik River
117	2.227	2.917	3.429	3.937	2.606	3.246	3.721	4.192	Polder-46 & 47; Andharmanik River
118	1.953	2.416	2.758	3.099	2.119	2.621	2.994	3.363	Polder-13-14-1/2; Arpangasia River
119	2.191	2.773	3.205	3.634	2.441	2.939	3.308	3.675	Polder-13-14-1/2; Sibsa River
120	2.185	2.756	3.179	3.6	2.385	2.851	3.197	3.539	Polder-13-14-1/2; Sibsa River

Location No.	Water Level (mPWD) in different Return Period (years) without Climate Change				Water Level (mPWD) in different Return Period (years) with Climate Change [2050]				Peripheral River Name
	10	25	50	100	10	25	50	100	
121	2.141	2.653	3.034	3.411	2.256	2.752	3.12	3.485	Polder-23; Sibsa River
122	2.12	2.636	3.018	3.397	2.239	2.698	3.039	3.378	Polder-23; Karulia River
123	1.958	2.424	2.769	3.112	2.096	2.621	3.01	3.396	Polder-23; Karulia River
124	2.04	2.507	2.853	3.197	2.181	2.754	3.178	3.6	Polder-23; Sibsa River
125	2.07	2.55	2.906	3.26	2.201	2.78	3.209	3.635	Polder-18-19; Haria River
126	2.142	2.785	3.262	3.735	2.229	2.896	3.39	3.881	Polder-34/1 & 34/3; Poylahara river
127	1.949	2.512	2.929	3.343	2.137	2.84	3.362	3.88	Polder-29; Sibsa River
128	1.949	2.466	2.849	3.229	2.089	2.71	3.171	3.629	Polder-29; Salta River
129	2.031	2.483	2.818	3.15	2.1	2.609	2.987	3.362	Polder-29; Salta River
130	2.056	2.541	2.901	3.259	2.18	2.758	3.187	3.613	Polder-29; Bhadra River
131	2.077	2.58	2.953	3.323	2.196	2.775	3.205	3.632	Polder-29; Bhadra River
132	1.974	2.455	2.813	3.168	2.147	2.718	3.141	3.561	Polder-15; Kobadak River
133	1.982	2.463	2.82	3.174	2.142	2.652	3.031	3.406	Polder-13 & 14/1-2; Sakbaria River
134	1.996	2.482	2.842	3.2	2.143	2.622	2.978	3.33	Polder-13 & 14/1-2; Sakbaria River
135	2	2.468	2.815	3.159	2.132	2.585	2.922	3.255	Polder-13 & 14/1-2; Sakbaria River
136	2.636	3.588	4.295	4.996	2.873	3.974	4.792	5.603	Polder-59/2; Lower Meghna
137	3.444	4.649	5.544	6.431	3.709	5.062	6.066	7.062	Polder-59/2; Lower Meghna
138	3.526	4.716	5.599	6.475	3.829	5.245	6.296	7.339	Polder-59/2; Lower Meghna
139	3.521	4.683	5.545	6.401	3.839	5.24	6.279	7.311	Polder-59/2; Lower Meghna
140	3.78	4.956	5.829	6.696	4.181	5.447	6.386	7.318	Polder-64/1a; Sangu River
141	3.4	4.362	5.075	5.783	3.816	4.905	5.713	6.515	Polder-64/1a; Kutubdia/ Kutubdia Channel