BOD-DO modeling and water quality analysis of Karnaphuli River

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Introduction

Bangladesh is a land of about 230 big and small rivers and The Karnaphuli is the most important riv
the south-eastern part of Bangladesh. (Afroz & Rahman, 2013)

The River originates from the Lusai Hills of Mizoram, India and then enters Chittagong from the nor
corner of Chittagong Hill Tracts at latitude 25.49^{O} N and longitude 92.45^{O}E and falls into the Bay of
Bengal at 22.23^{O}N and 91.78^{O}E at Patenga. (Rahman, M.M. 2008)

There are 30 tributaries related to the river from Kaptai Dam to the river mouth (85.5-km course) a
they contain both solid and liquid waste of about 300 industries, -98% of which have no effluent
treatment plant visible. Moreover, a part of solid and liquid wastes from about 6 million people of
city dumps into the river continuously. (Hossain 2004)

These industrial wastes and effluents contain heavy metals such as Cd, Pb, Cu, Cr, As, Hg, Ni, and Zn
of which are toxic for terrestrial and aquatic environment. (Ali, Ali, & Islam, 2016).

This thesis work is designed to determine the levels of Biological Oxygen Demand (BOD), Dissolve O
(DO), Ammonia (NH_4), Phosphate (PO_4) and Nitrate (NO_3) of the Karnaphuli Rive.

Objectives

To develop a ecological model for analyzing water quality at the Karnaphuli River.

To generate an accurate hydrodynamic model that can be used as the base for future models of the impounded Karnaphuli River.

To generate accurate boundary conditions at the Karnaphuli River based on tidal height.

Materials and Methods

Study Area

The study area is situated near Shah Amanat Bridge (previously known as the Third Karnaphuli Bridge) and extended to mouth of the Karnaphuli River and it covers about 19 kilometers area.

The site was divided into seven stations they are mainly confluent of the sewage and effluent water from oil refinery, fertilizer small scale chemical and agro based industry, food, textile and salt industries.

Satellite view of study area(Google Map)

Water Sampling Method

ples were collected in white color plastic
le previously washed with distilled water.

e parameters namely temperature and
were measured in situ using electrode DO
er.

lly Biological Oxygen Demand (BOD) were
yzed at the laboratory with maintain the
dard method.

Station	Temperature	DO Initial	DO Final
S1	30.5^0c	1.09	0.89
S2	31.8^0c	0.4	0.03
S3	28.3^0c	0.17	0.08
S4	28.6^0c	1.38	0.56
S5	30.1^0c	1.57	0.06
S6	30.9^0c	0.74	0.02
S7	30.8^0c	0.09	0.01
Average-	31.64	1.93	0.24

Physical and biological variables of different station

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Physical and biological variables of different station

Modeling method

MIKE 3 model software developed by DHI (Denmark Hydraulic Institute)

- Mike 3 Flow Model Flexible Mesh (Hydrodynamic Model)
- ECO Lab (Ecological Model)

Time and Module setup

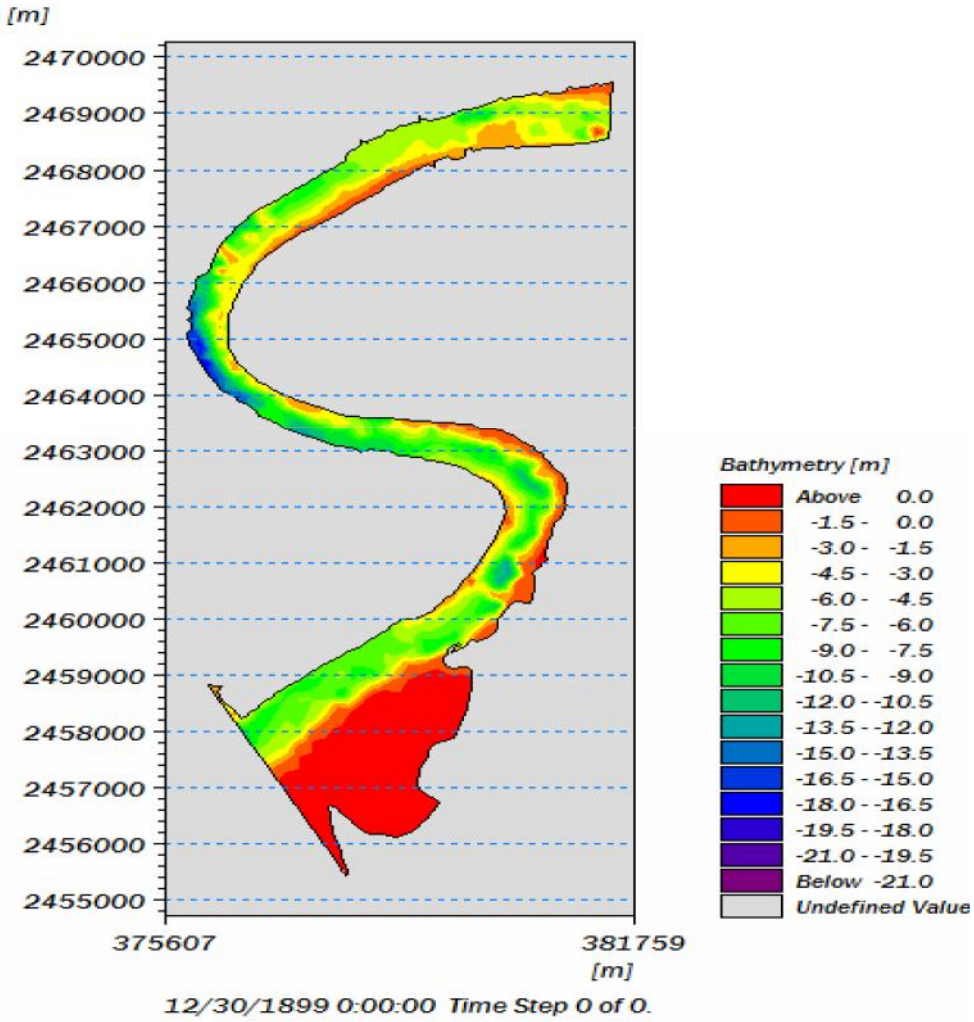
Bathymetry: Bathymetry of the Karnaphuli River system was generated by digitizing the Naval Hydrographic Charts, Chart No. 3021.

Time series: time series were created by using **Mike Zero tool box** based on Tidal data from the 13^{th} - 18^{th} March 2016. (Chittagong Port Authority)

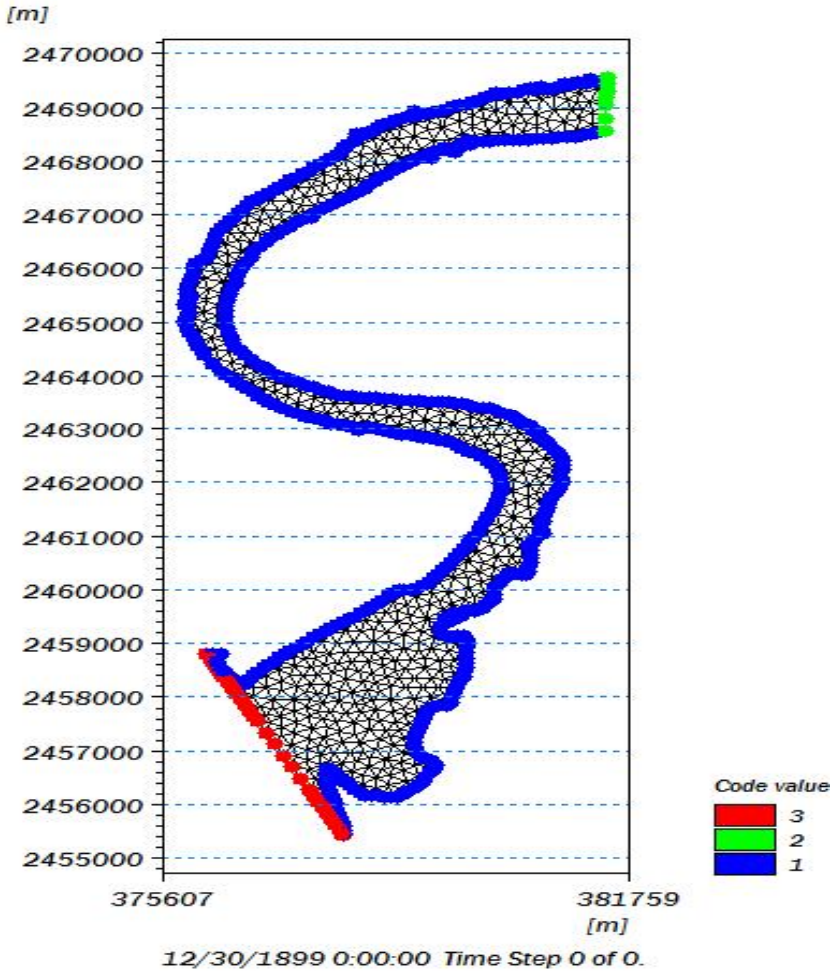
Simulation period

Real time model: [13/March/2016 12 am to 18/March/2016 12 am]

Domain Area



Karnaphuli River Bathymetry (Depth in m)



Mesh file with boundary code

External forces

Wind direction

- March – 247 deg (west-southwest)

Precipitation

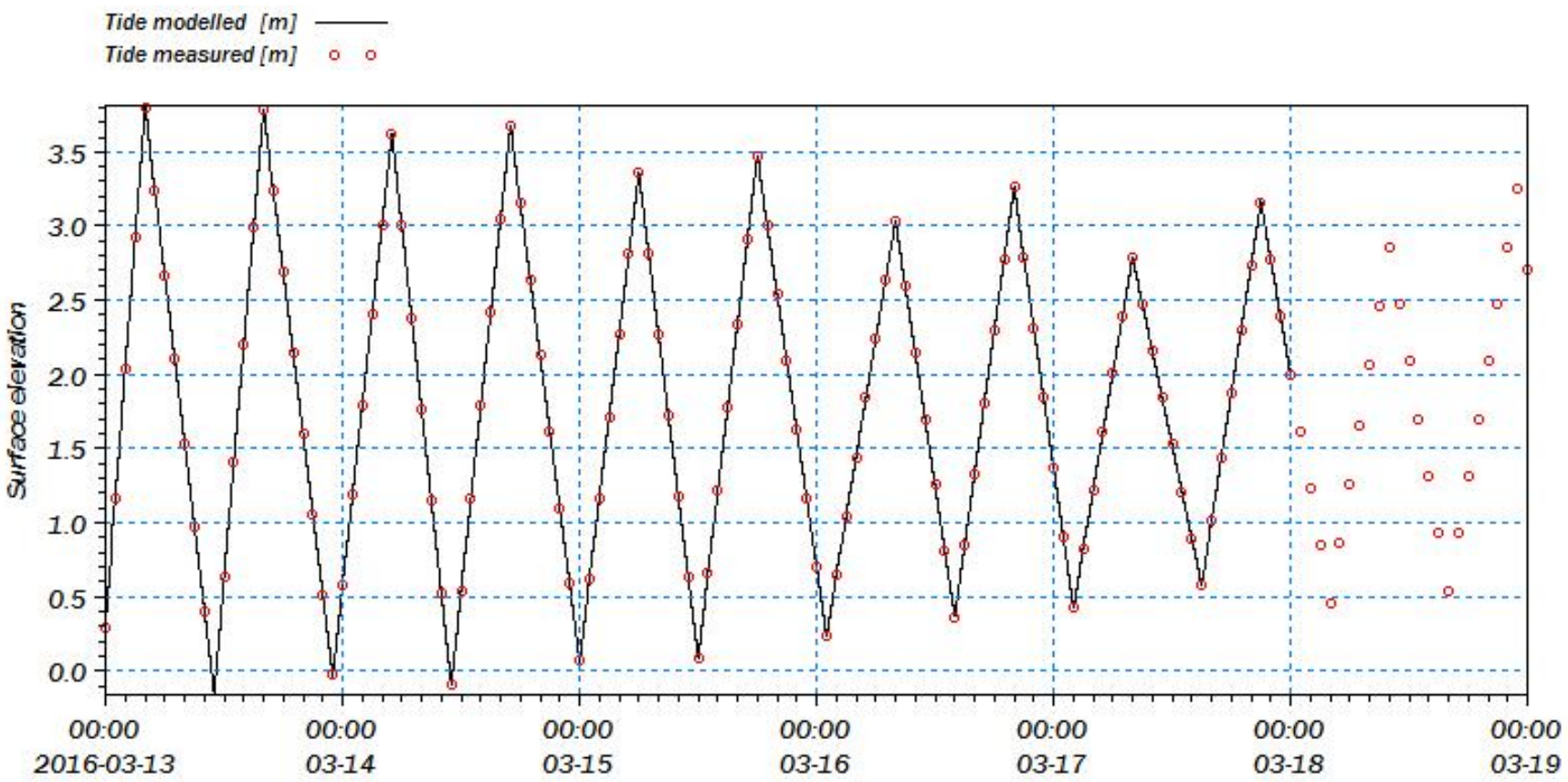
- March – no rainfall observed

Evaporation- 1.83 mm/day

Source – Shah Amanat Air port and Bangladesh Meteorological Department (BMD)

Result and Discussion

Hydrodynamic Model Result



Comparison between measure and modelled surface elevation March 2016

Ecological Model Result

Vertical distribution of Dissolved Oxygen(DO)

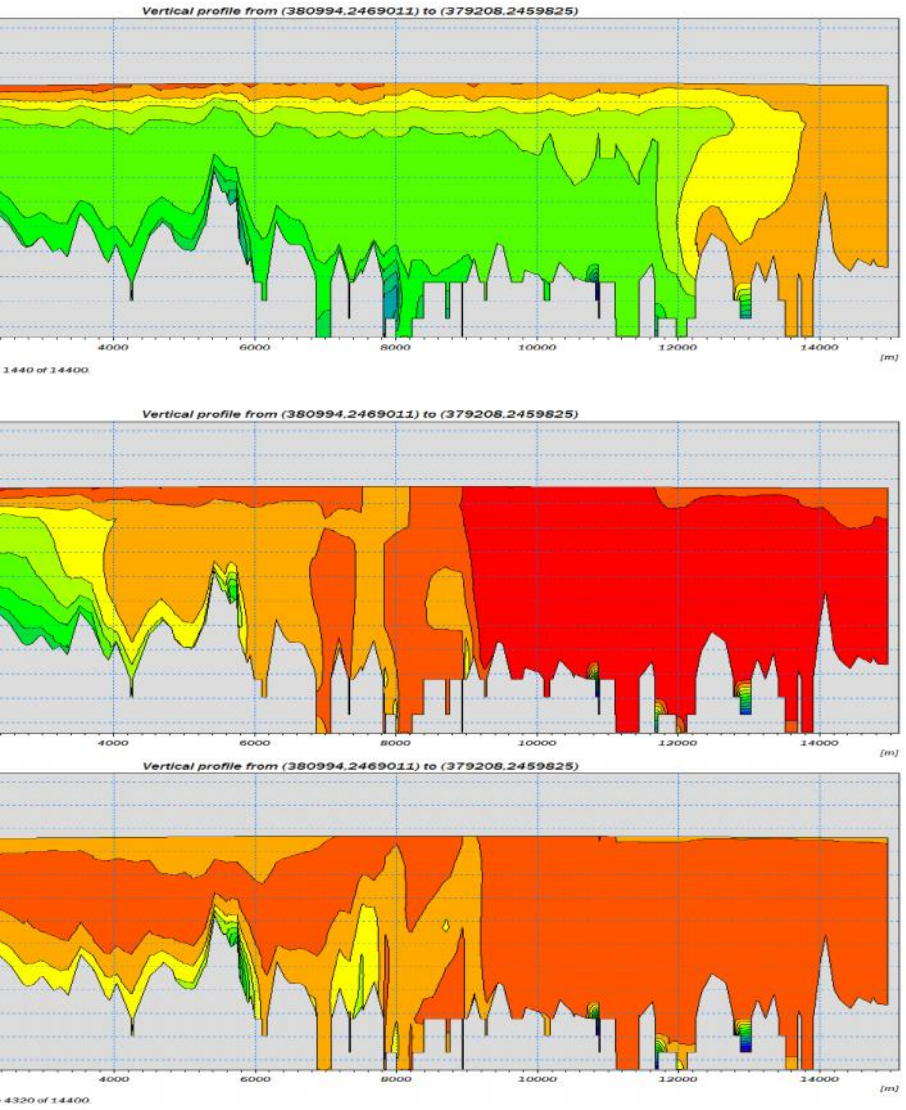
distribution of DO during Low and High Tide, March 2016

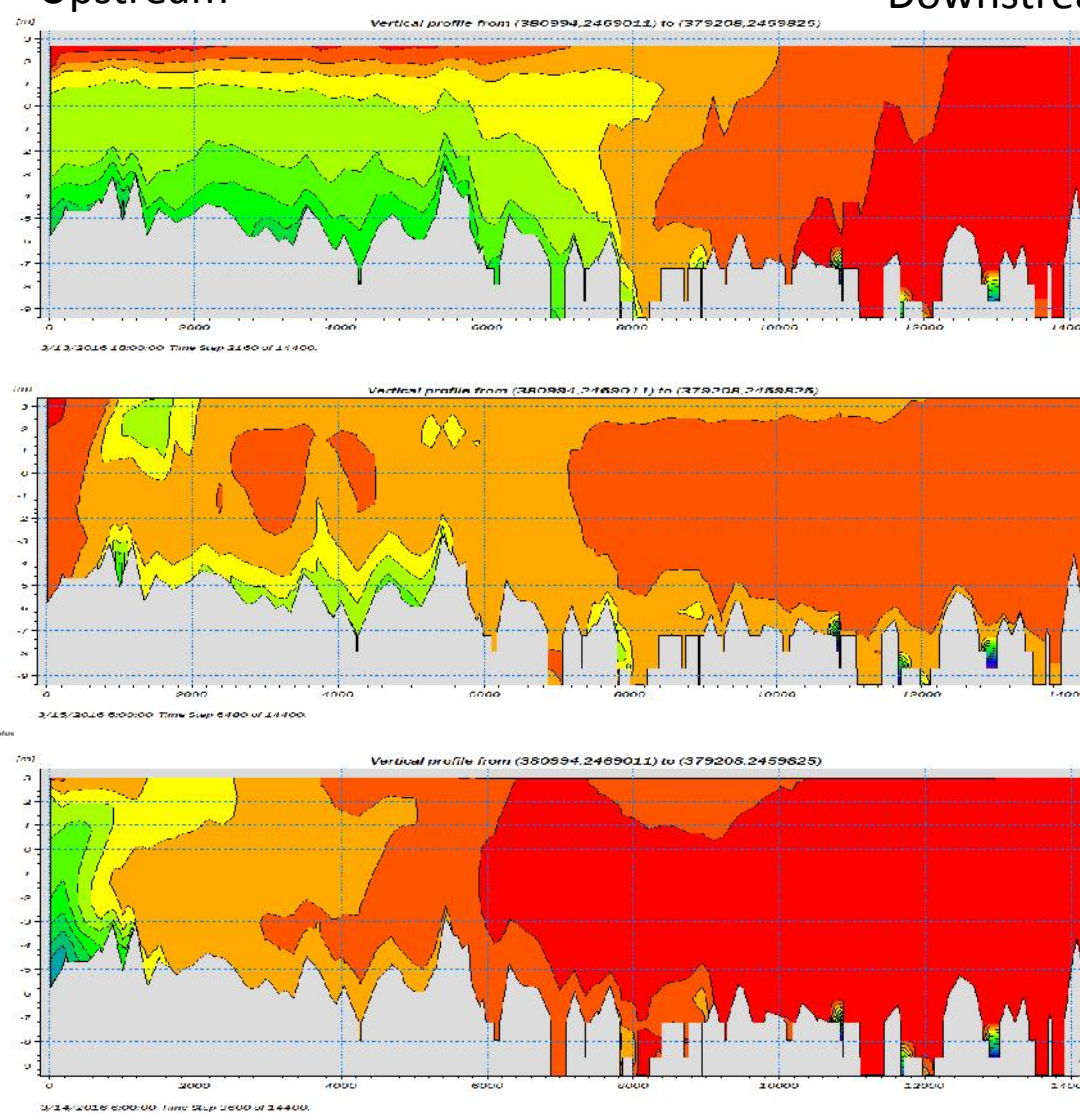
m

Downstream

Upstream

Downstrea





Vertical distribution of Biological Oxygen Demand(BOD)

Vertical distribution of BOD during Low and High Tide, March 2016

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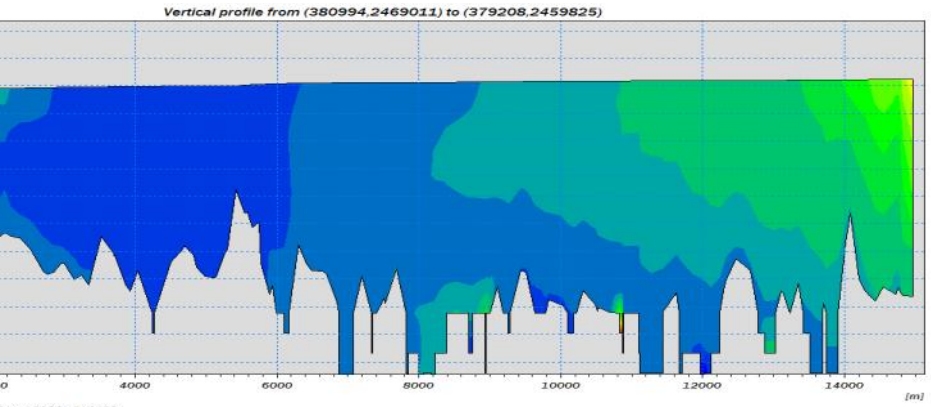
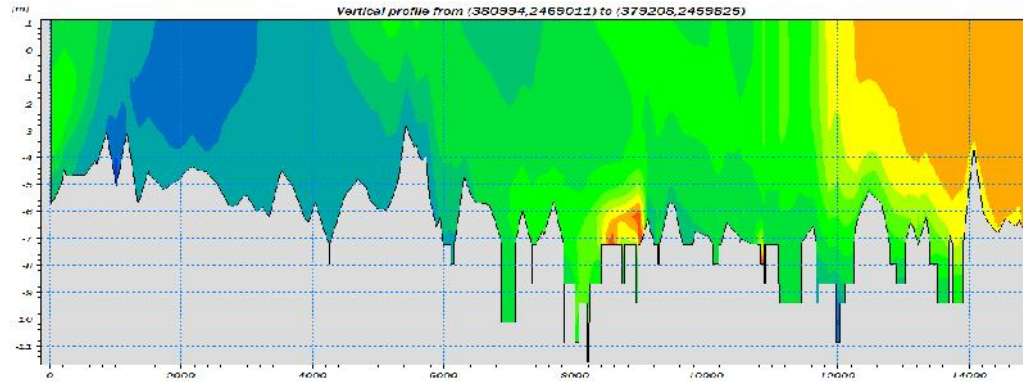
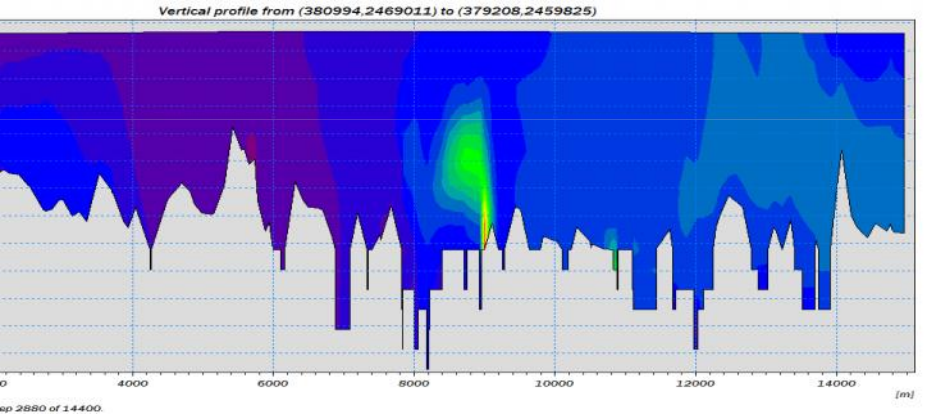
Downstream

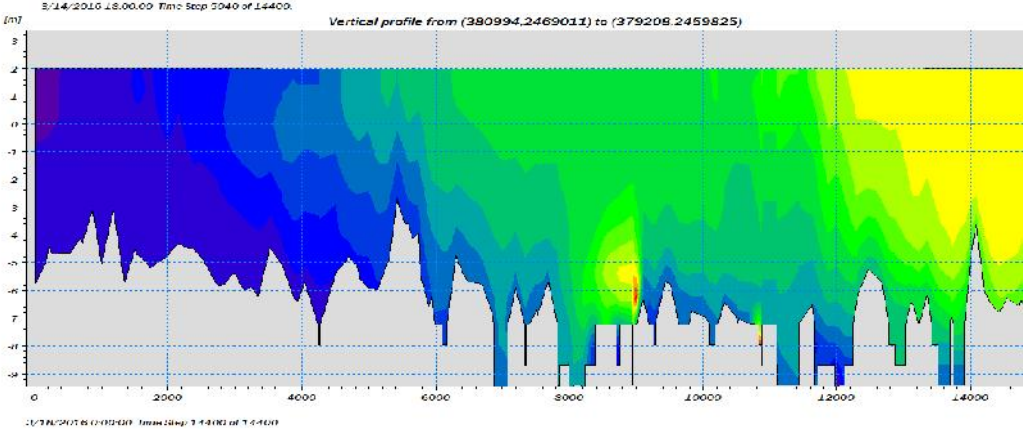
Upstream

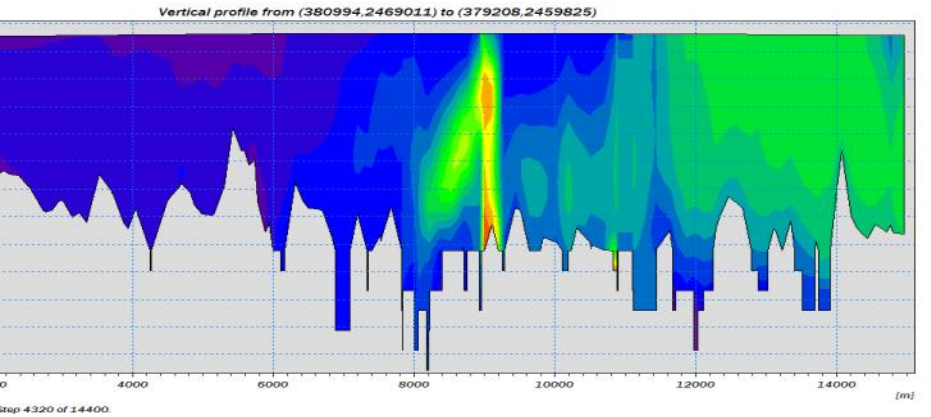
Downstre

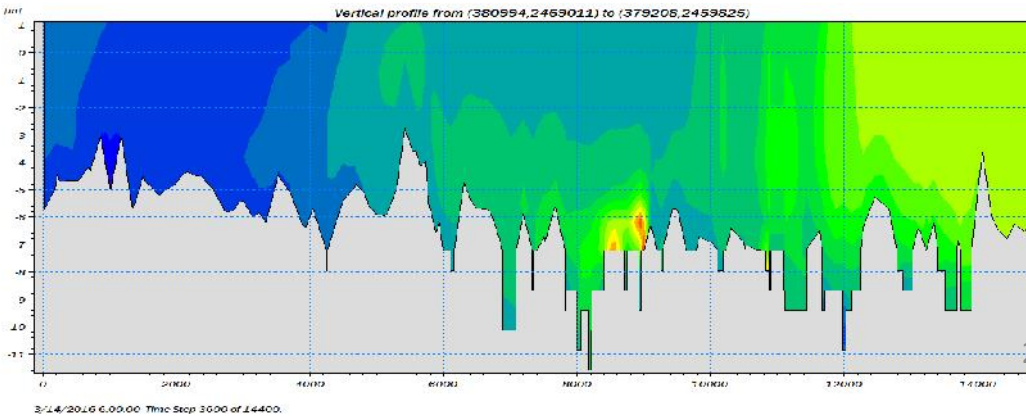


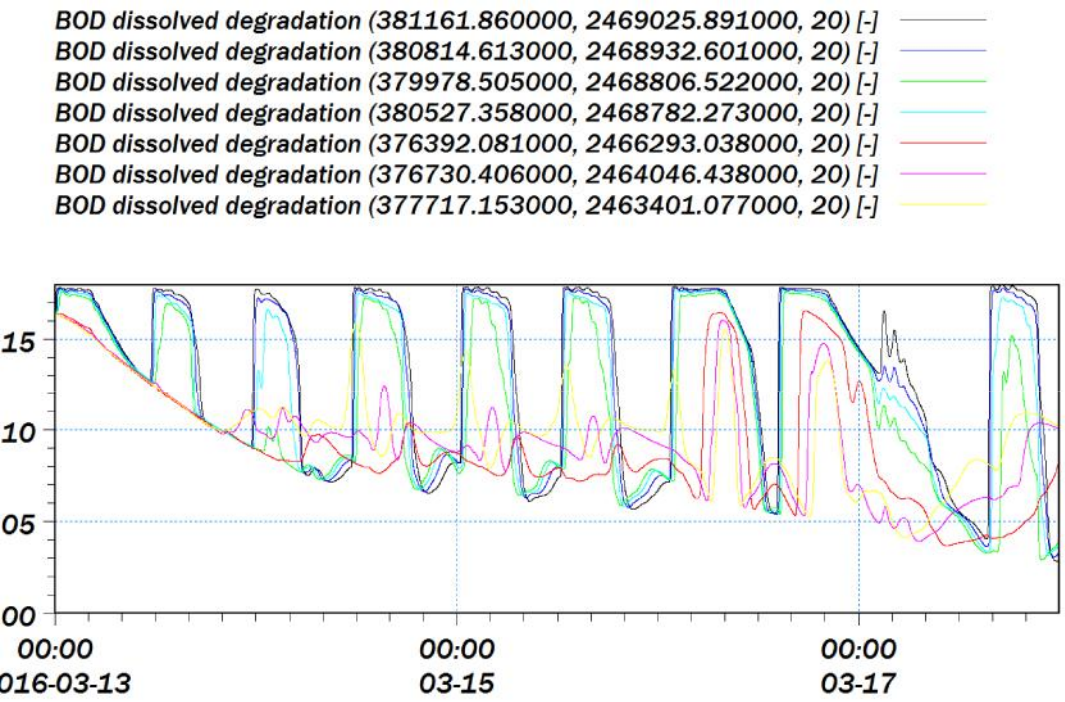


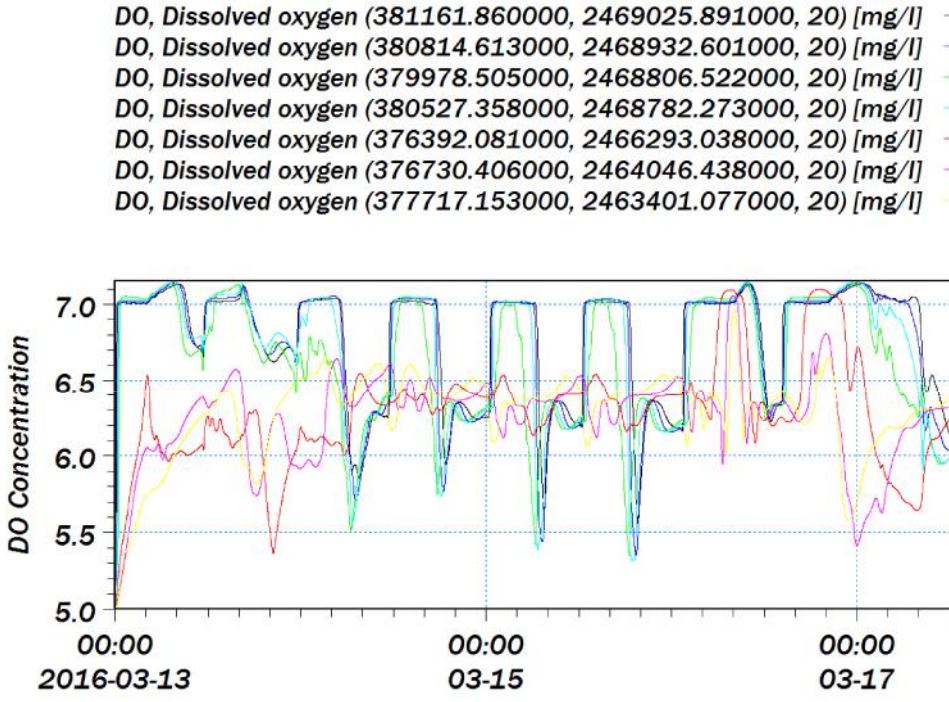












Variation of BOD and DO with tide of different sources

Conclusion

- The calibration and validation of the hydrodynamic model shows th
the model manages to capture the physical processes occurring in t
Karnaphuli River.
- The organic matter in the waste water settles down in the River duri
slack water, thereby causing eutrophication in the backwaters.
- The model result suggested slightly higher assimilative capacity for Riv
water during the monsoon relative to winter and spring.
- The model results could act as a guide to help the limits for polluti
load that can be released at any location.

Thank You