NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

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Department of Civil Engineering and

Department of Engineering Sciences.

09.02.2015

- Computational tool is NAMI DANCE which is developed by Profs. Andrey Zaytsev, Ahmet Yalciner, Anton Chernov, Efim Pelinovsky and Andrey Kurkin.
- It solves NLSW and also visualize the results by animations for the assessment, understanding and investigation of tsunami generation, propagation and coastal amplification mechanisms. The model is tested and verified in different Benchmark problems

BM#1

- **Short History**
- Based on TUNAMI N2 developed in Tohoku University, Japan
- Distributed by TIME Project of UNESCO
- Coverted to C++ and additional modules added in NAMI DANCE

- **Acknowledgements**

UNESCO TIME Project,

Prof. Shuto, Prof. Imamura,

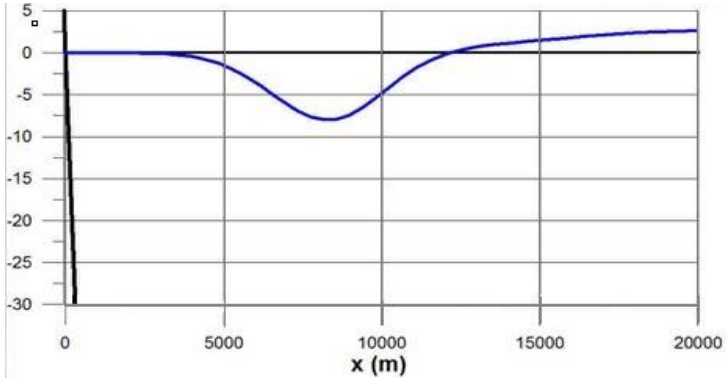
Costas Synolakis, Emile Okal, Efim Pelinovsky

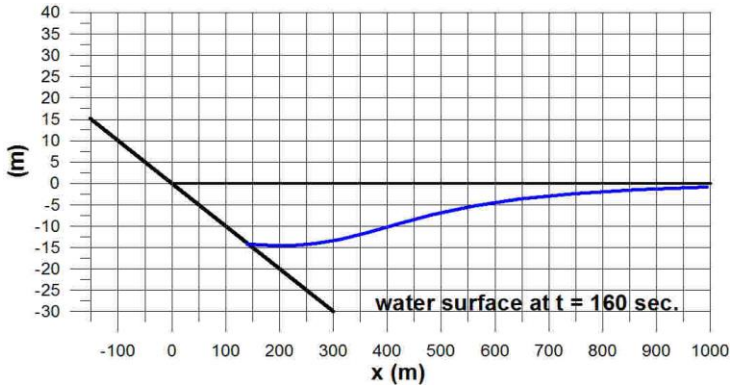
Previous Validations-1

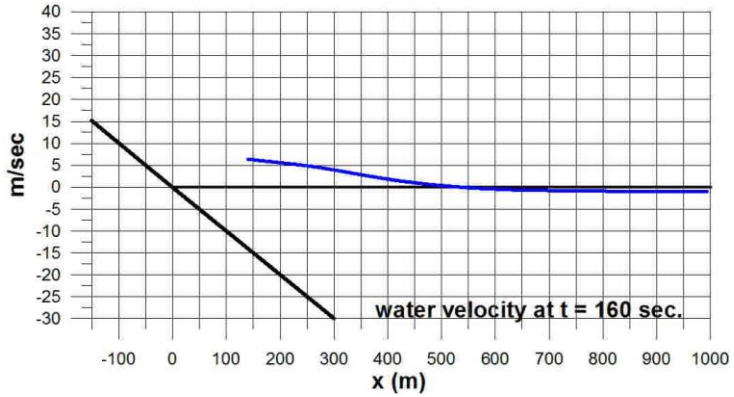
- Catalina Workshop of Long Wave Runup Models
- IAEA Benchmarking of Tsunami Numerical Models

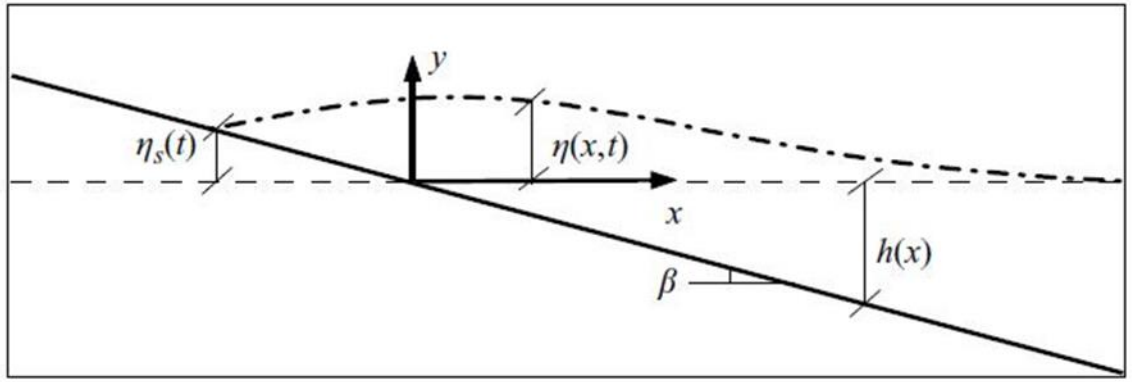
- Benchmark Problems
- Analytical Data
- Experimental Data
- Field Data

Previous Validations-2





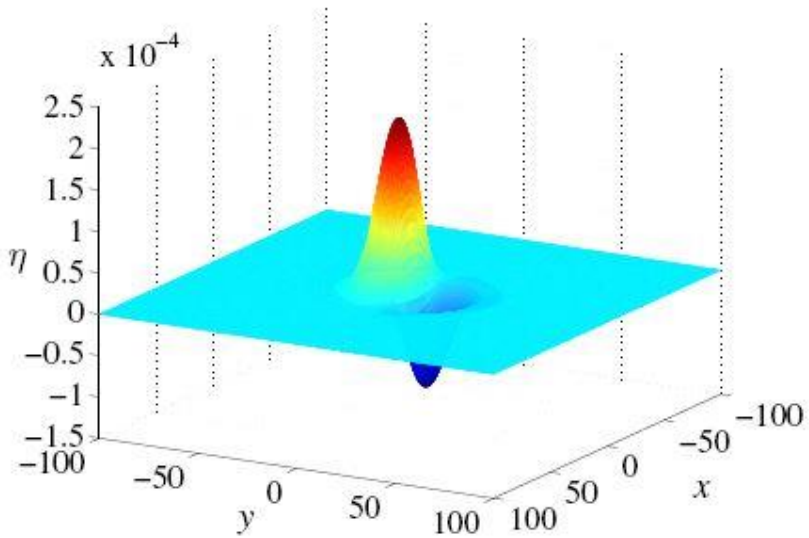


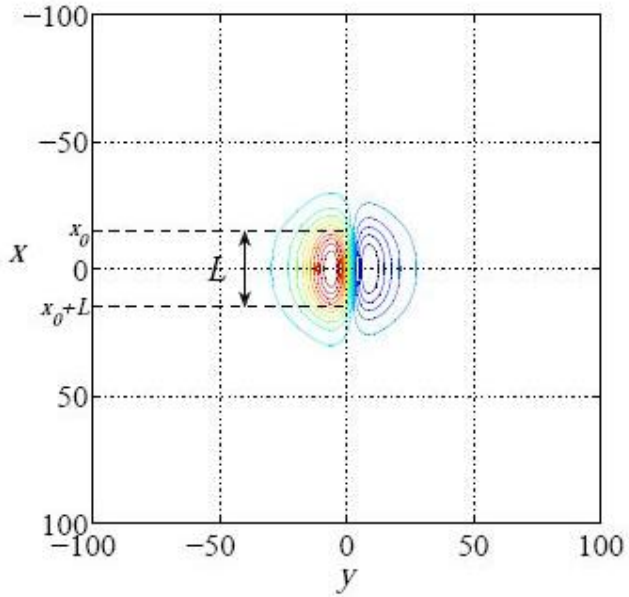


[3-6] Kânoglu, U., (2007): “Theoretical solution of the wave runup on 1/10 sloping beach”, Joint Workshop of Benchmark Problems, Numerical Models, Inundation Maps and Test Sites in EC funded TRANSFER Project, held in Fethiye Turkey on June 12-14, 2007.

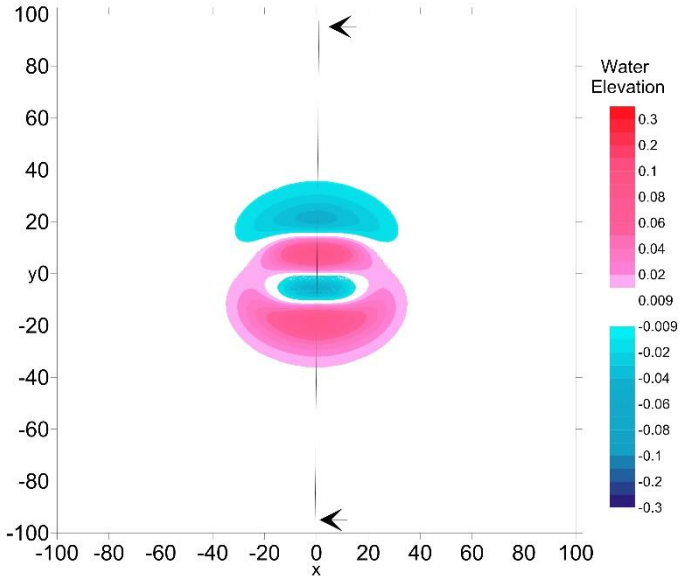
Previous Validations-3

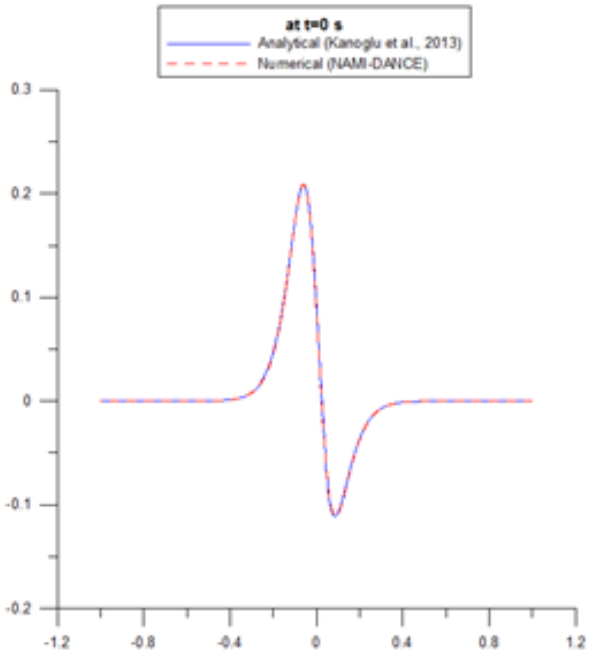
ANALYTICAL BENCHMARK PROBLEM (FOCUSING OF LONG WAVES)



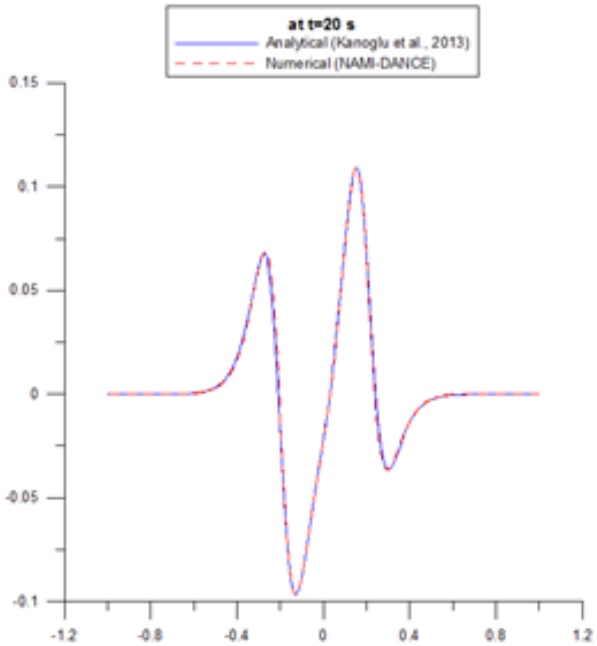


Kânoglu, U., Titov. V., Aydın B., Moore C., Stefanakis S. T., Zhou H., Spillane M., Synolakis C. E.,(2013): "Focusing of long waves with finite crest over constant depth" Proc. R. Soc. A. 2013 469 2153 20130015; doi:10.1098/rspa.2013.0015 (published 27 February 2013) 1471-2946





x=0 and t=0sec



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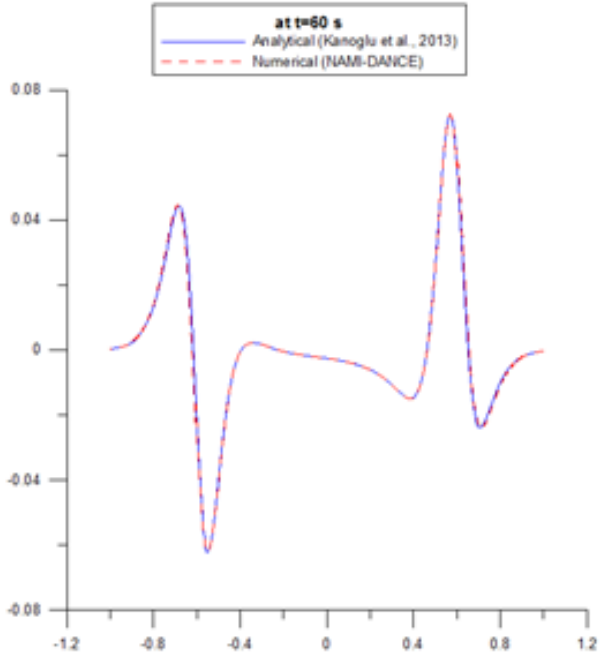
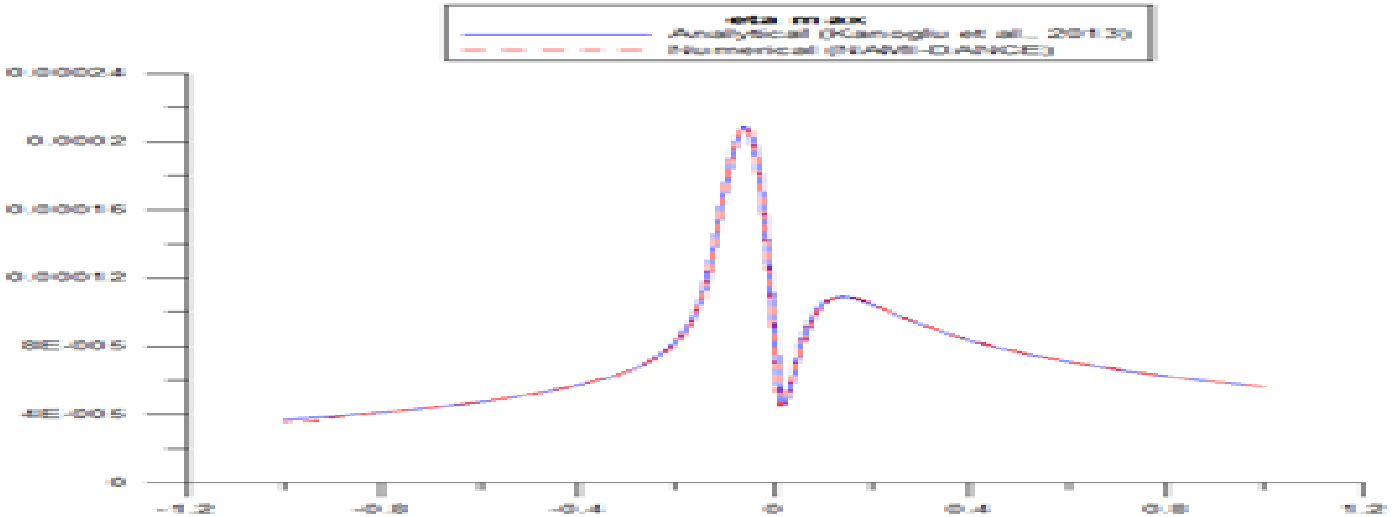
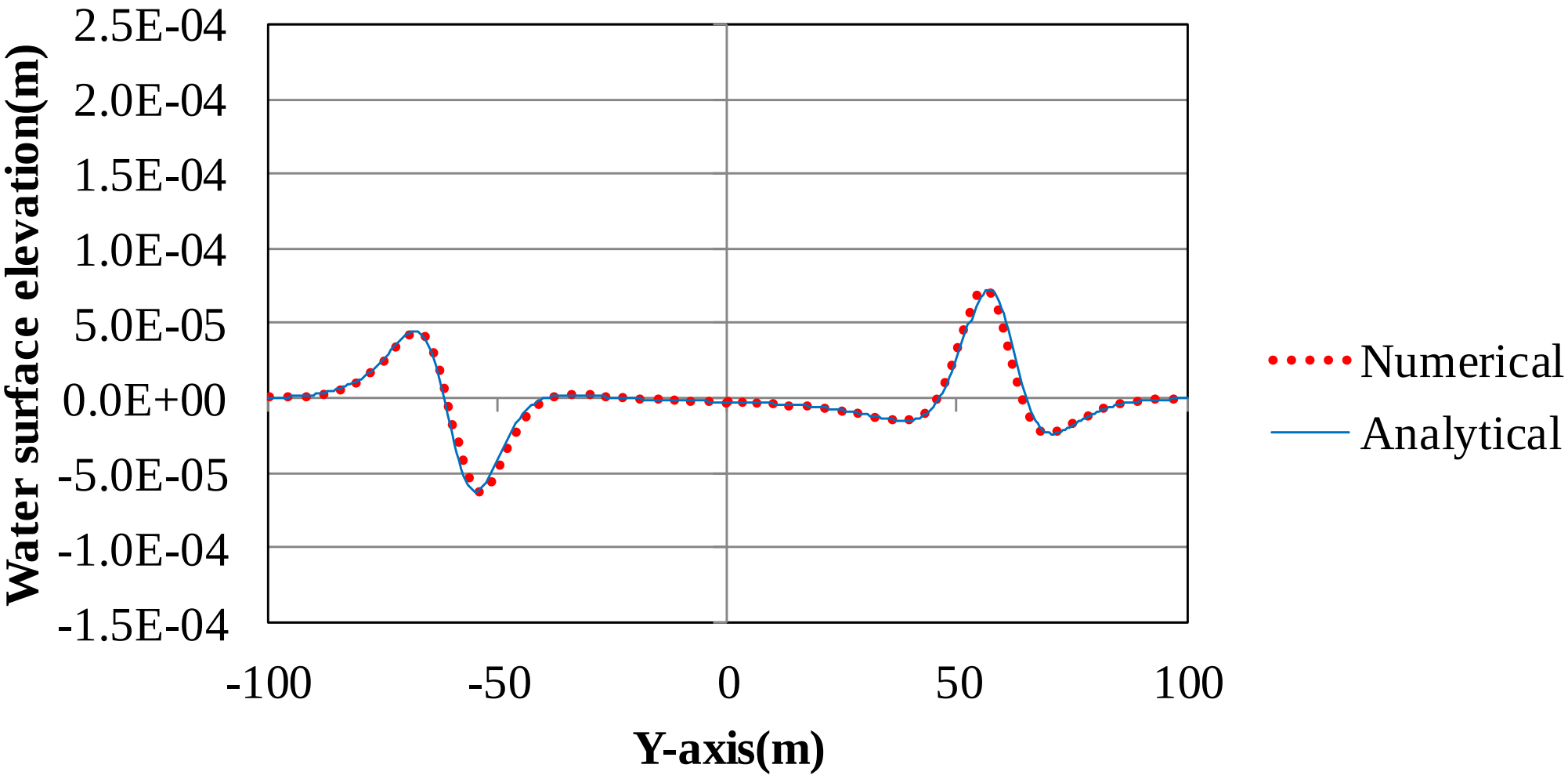




Cross section of water surface elevation of analytical and numerical results

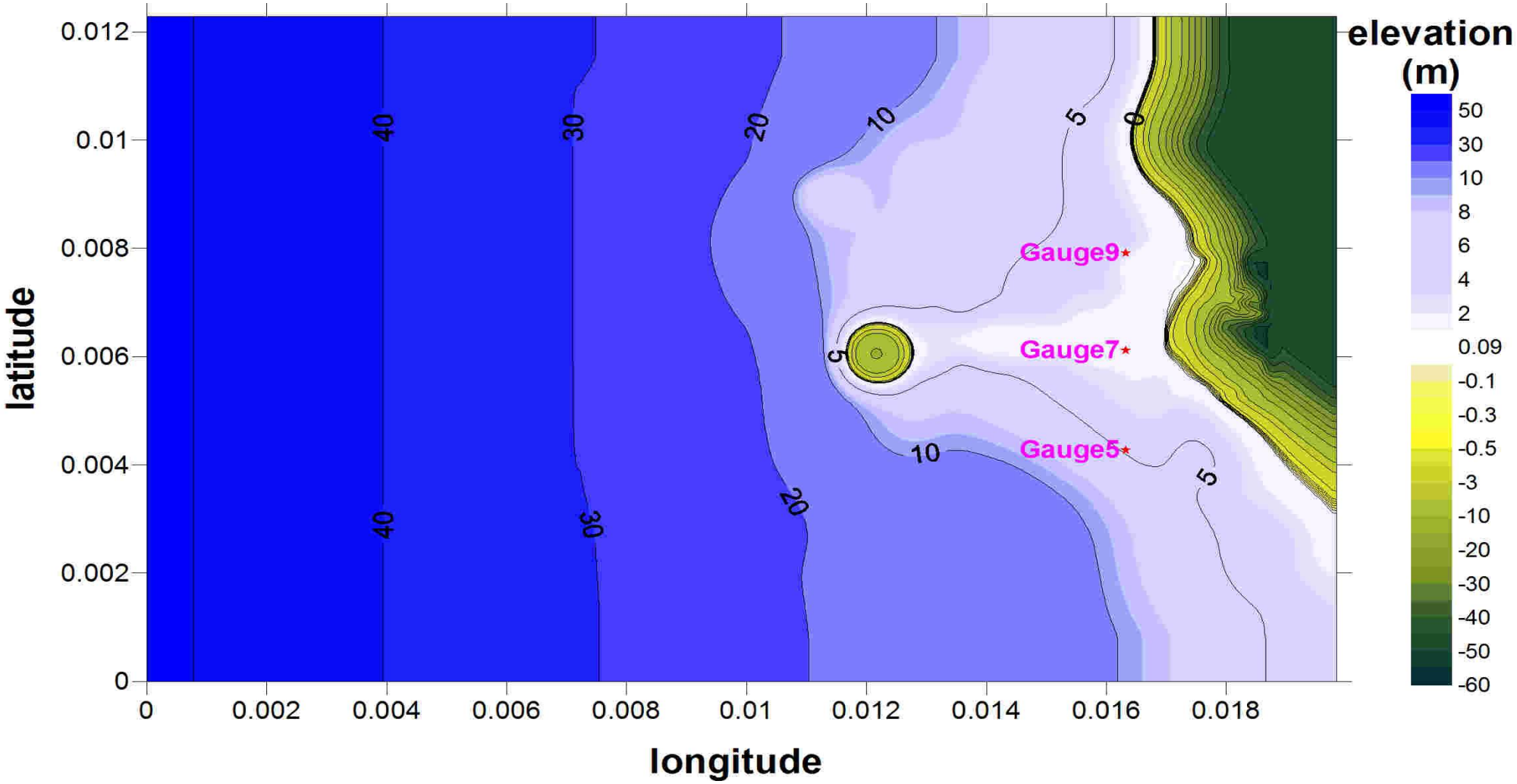
Comparison of maximum water elevations of analytical and numerical results



x = 0 and t = 60 sec

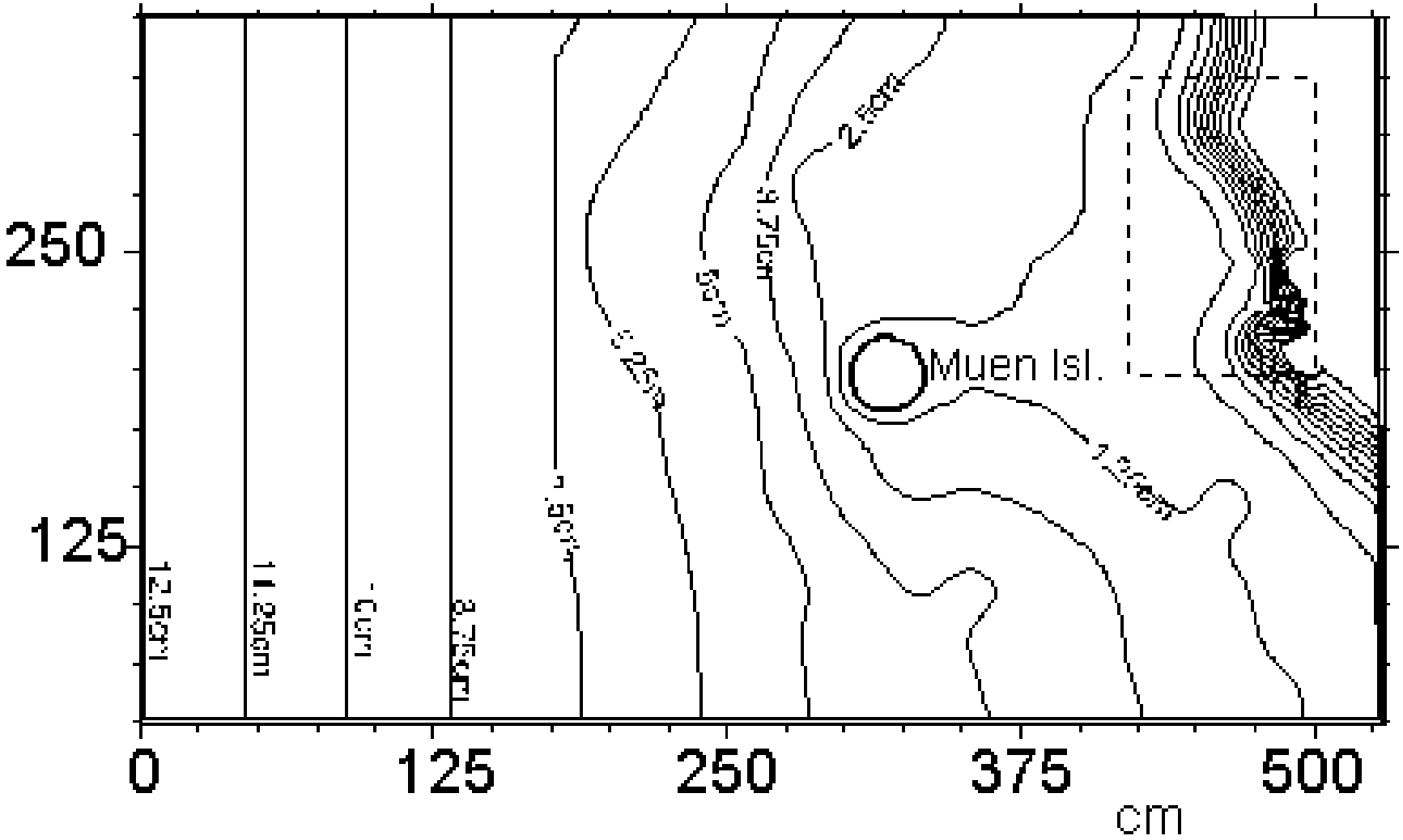
FIG. I-10Cross section of water surface elevation for analytical and numerical results

Previous Validations-4

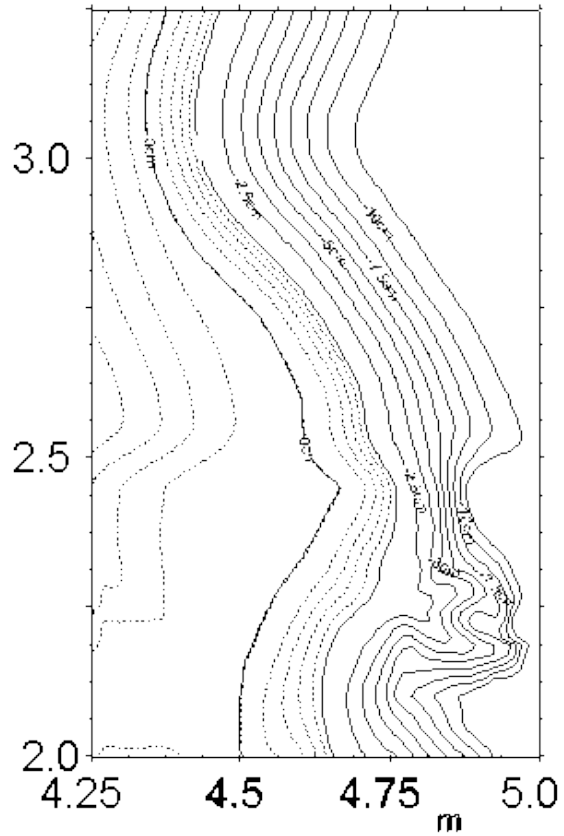


Matsuyama, M., and H. Tanaka (2001), An experimental study of the highest run-up height in the 1993 Hokkaido Nansei-oki earthquake tsunami, U.S. National Tsunami Hazard Mitigation Program Review and International Tsunami Symposium (ITS), Seattle, Washington 7-10 August 2001. U.S. National Tsunami Hazard Mitigation Program, 7(21), 879-889.

Previous Validations-4



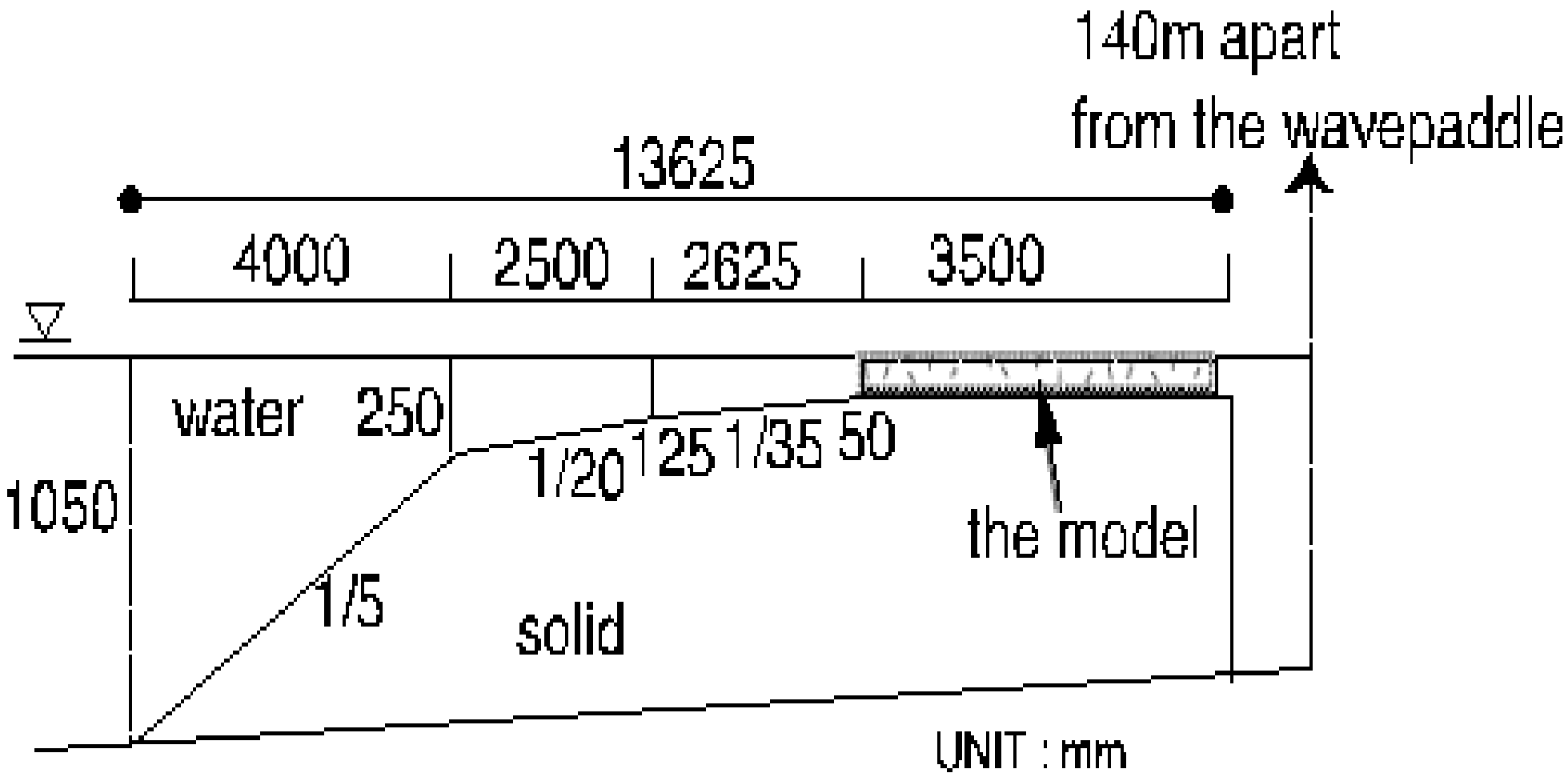
(a) whole model area



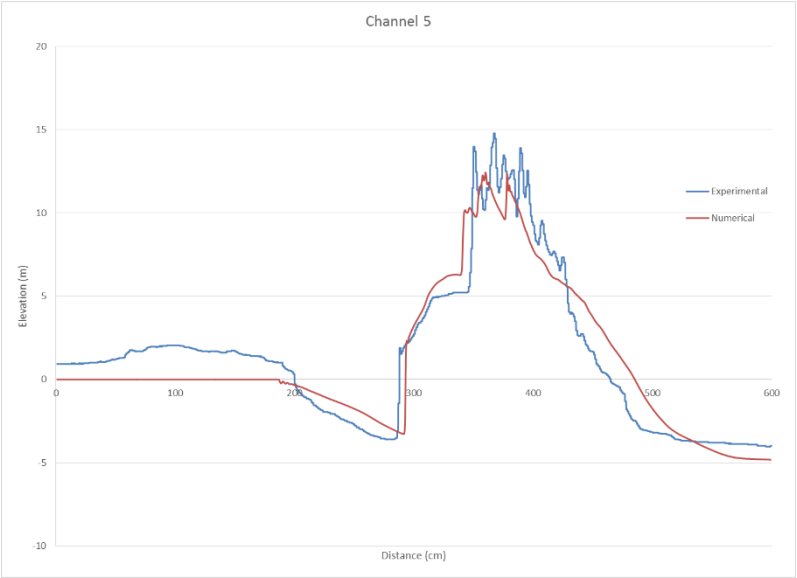
(b) Detailed topography near the maximum runup

Bathymetry and topography near the runup area

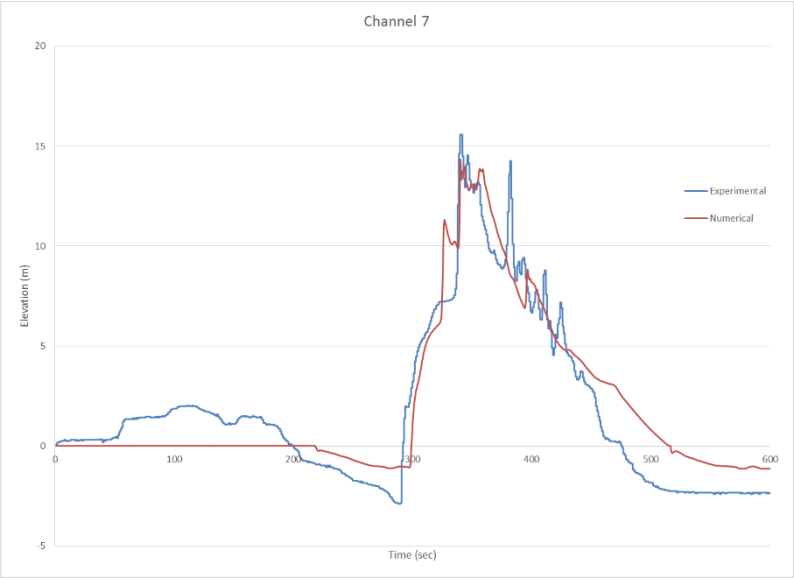
Previous Validations-4



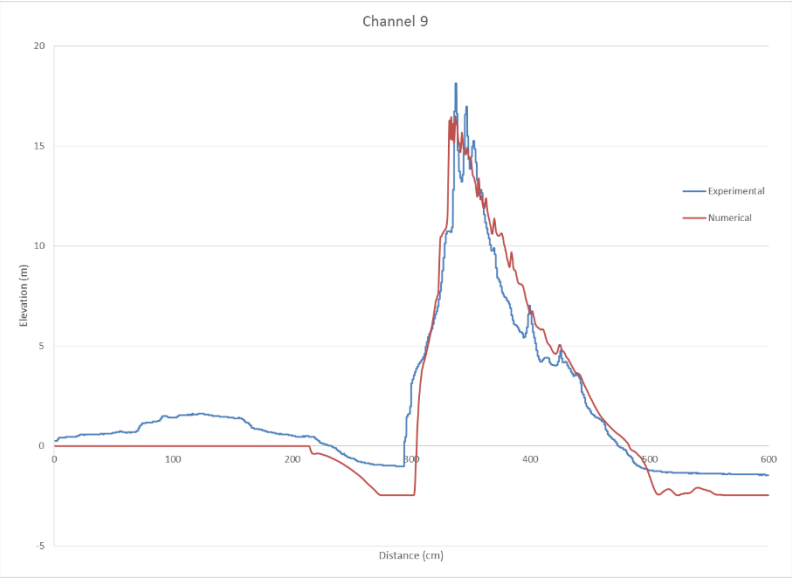
Comparison of the measured and computed water elevations



at channel 5



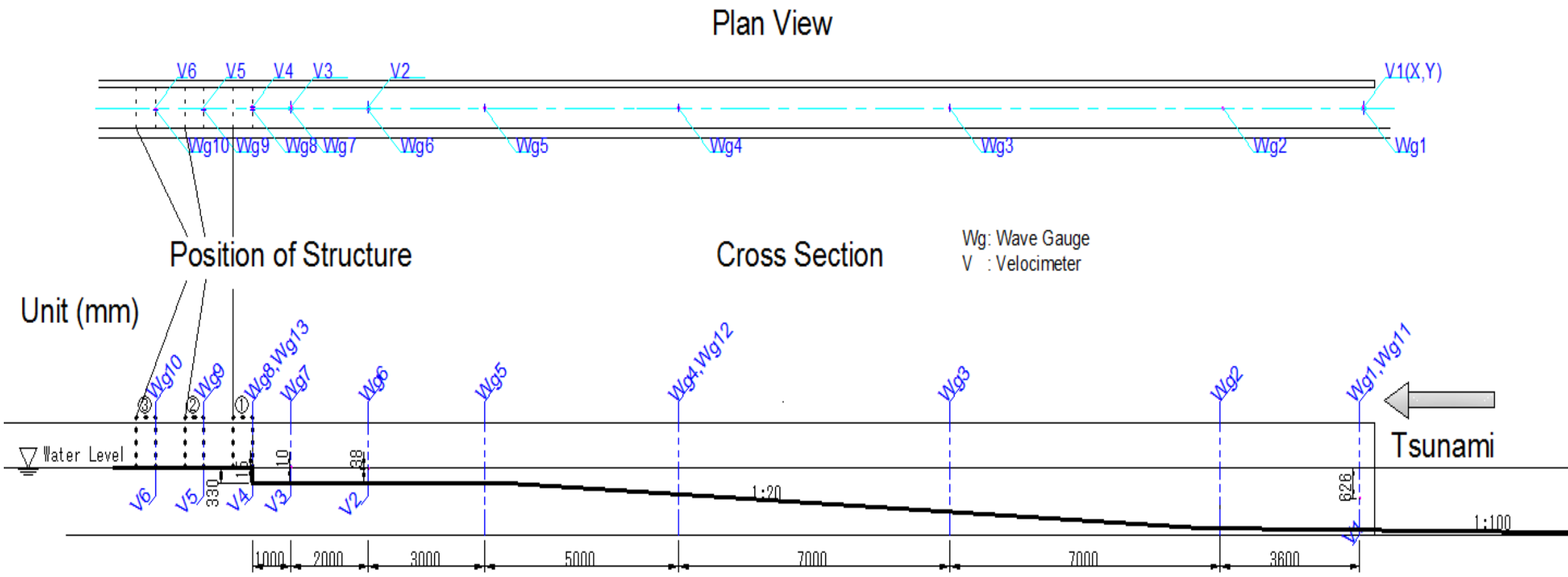
at channel 7

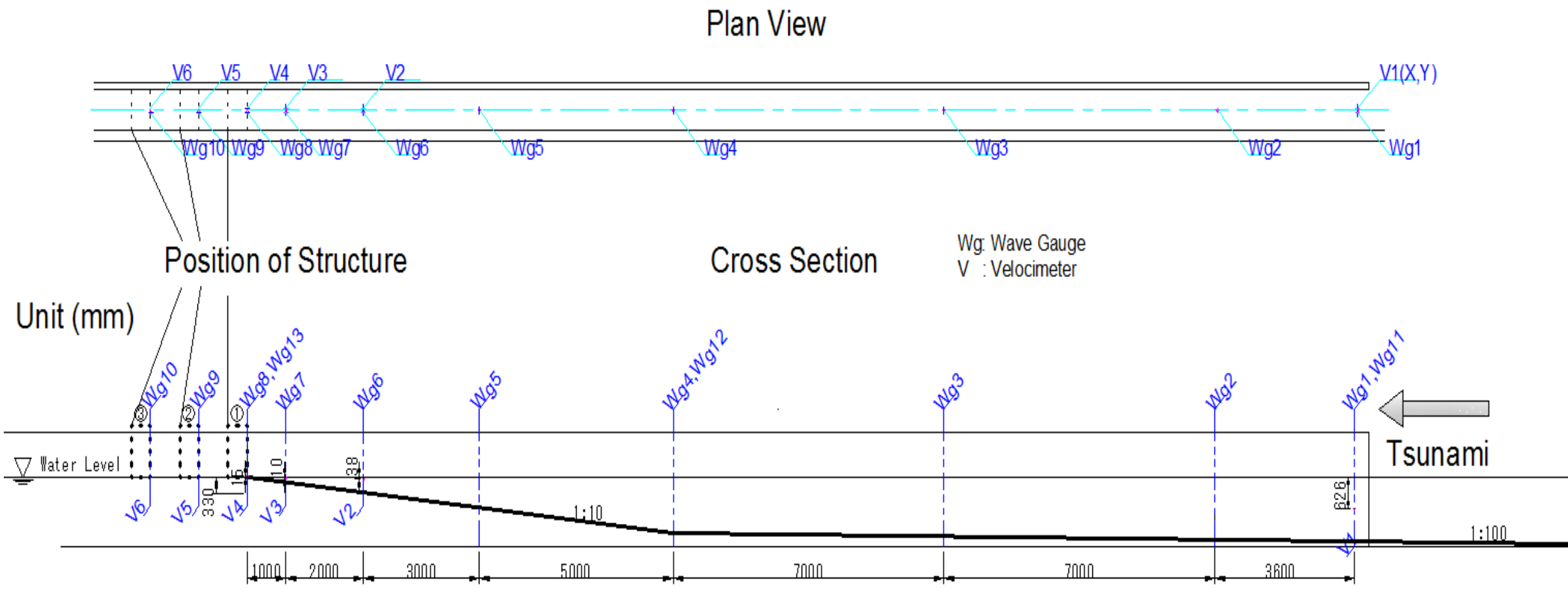


at channel 9

PARI EXPERIMENTS BY DR. ARIKAWA

Port and Airport Research Institute (PARI, Japan) have performed a series of physical model experiments[4-2]. In the experiments the solitary wave climb on different slopes and its impact on vertical wall are tested. Four different channel bottom slopes (near shore slope) are used as i) horizontal, 1:00, ii) 1:10, iii) 1:20, iv) 1:40in front of the block nearest shore line. At the toe of the near shore slope the channel bottom continues with 1:100 slope.In the experiments of each slope, two different heights (large and small) of solitary waves are used. Width of the design structure is 0.80 m in the model. Three identical blocks of wall are located in the shore with 0.50 m width and 1.00 m height.


Plan View
V6
V5
V4
V3
V2
V1(X,Y)
Wg10
Wg9
Wg8
Wg7
Wg6
Wg5
Wg4
Wg3
Wg2
Wg1
Position of Structure
Cross Section
Wg: Wave Gauge
V : Velocimeter
Unit (mm)
Wg10
Wg9
Wg8,Wg13
Wg7
Wg6
Wg5
Wg4,Wg12
Wg3
Wg2
Wg1,Wg11
Tsunami
Water Level
V6
V5
V4
V3
V2
V1
330
15
10
38
826
1:20
1:100
1000
2000
3000
5000
7000
7000
3600


Plan View
V6
V5
V4
V3
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Wg10
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Tsunami
Water Level
330
15
10
38
626
1:10
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V6
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V4
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V2
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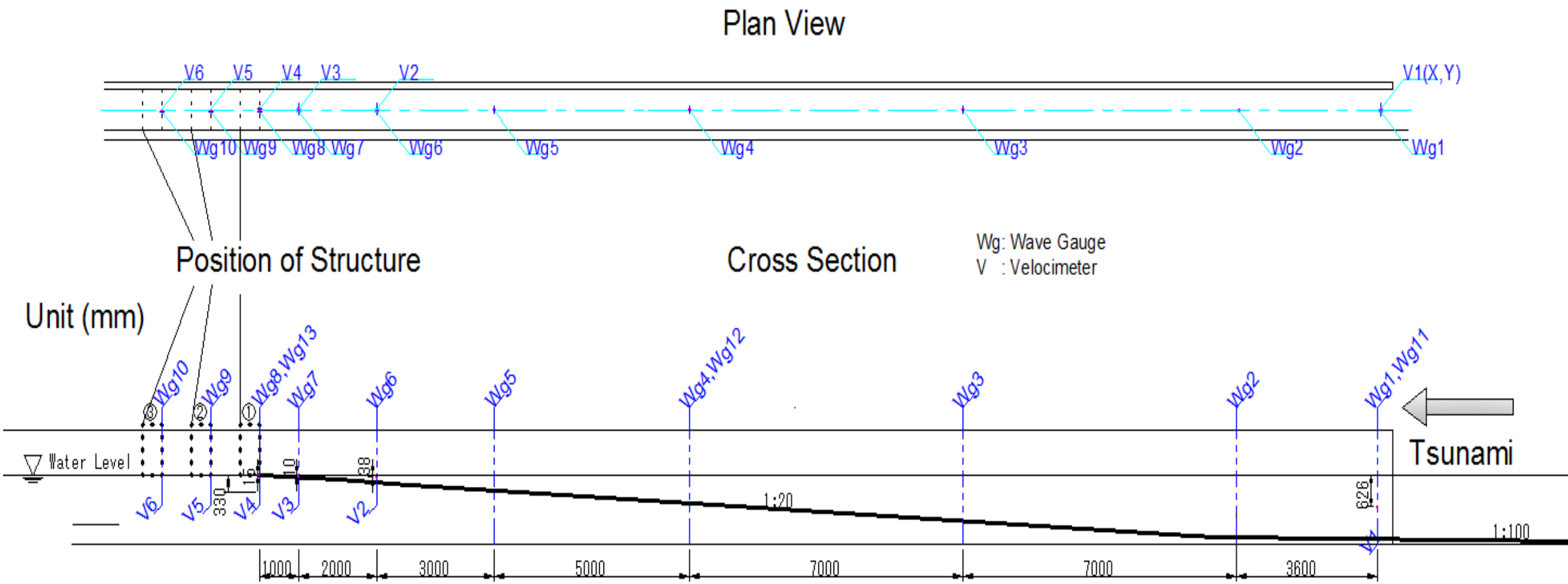
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626
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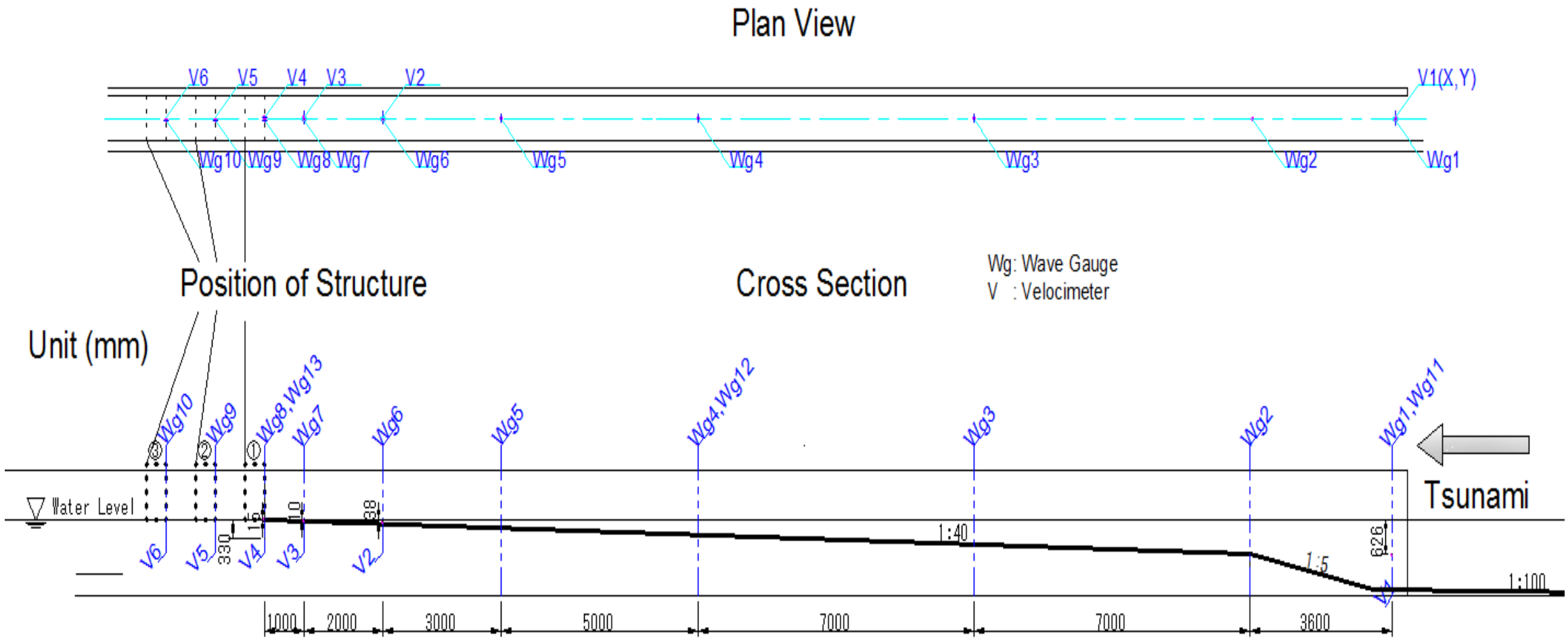
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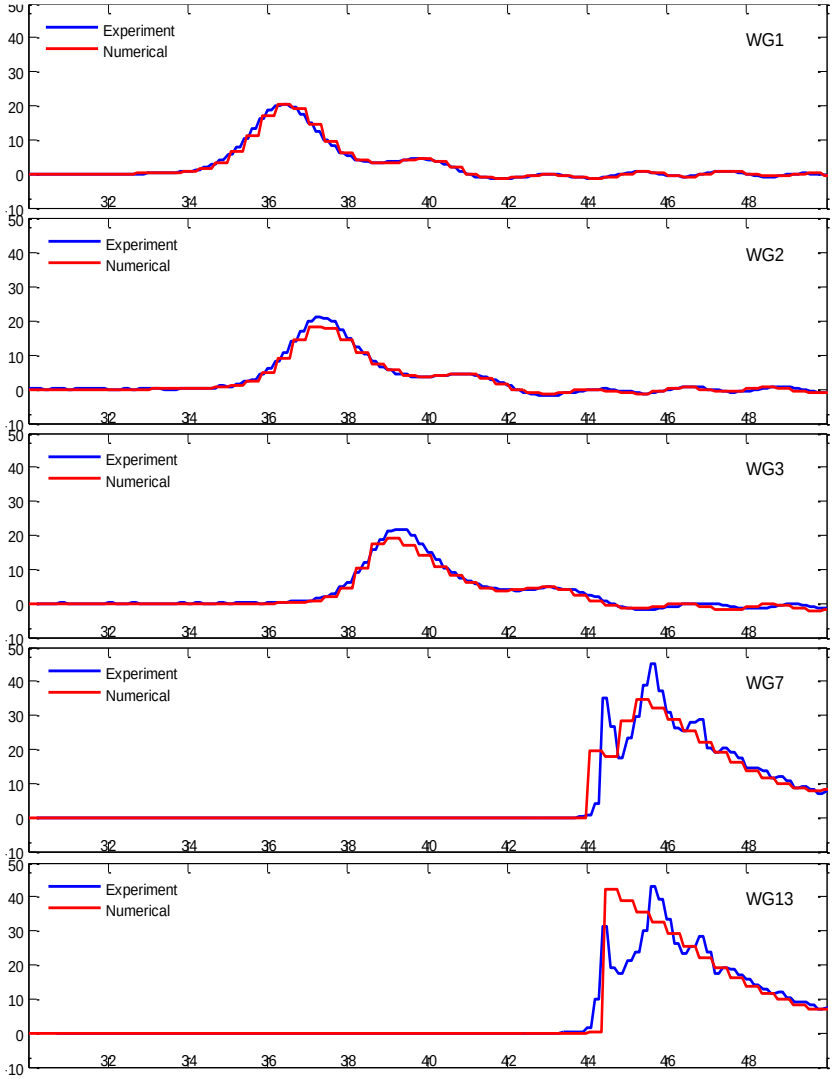
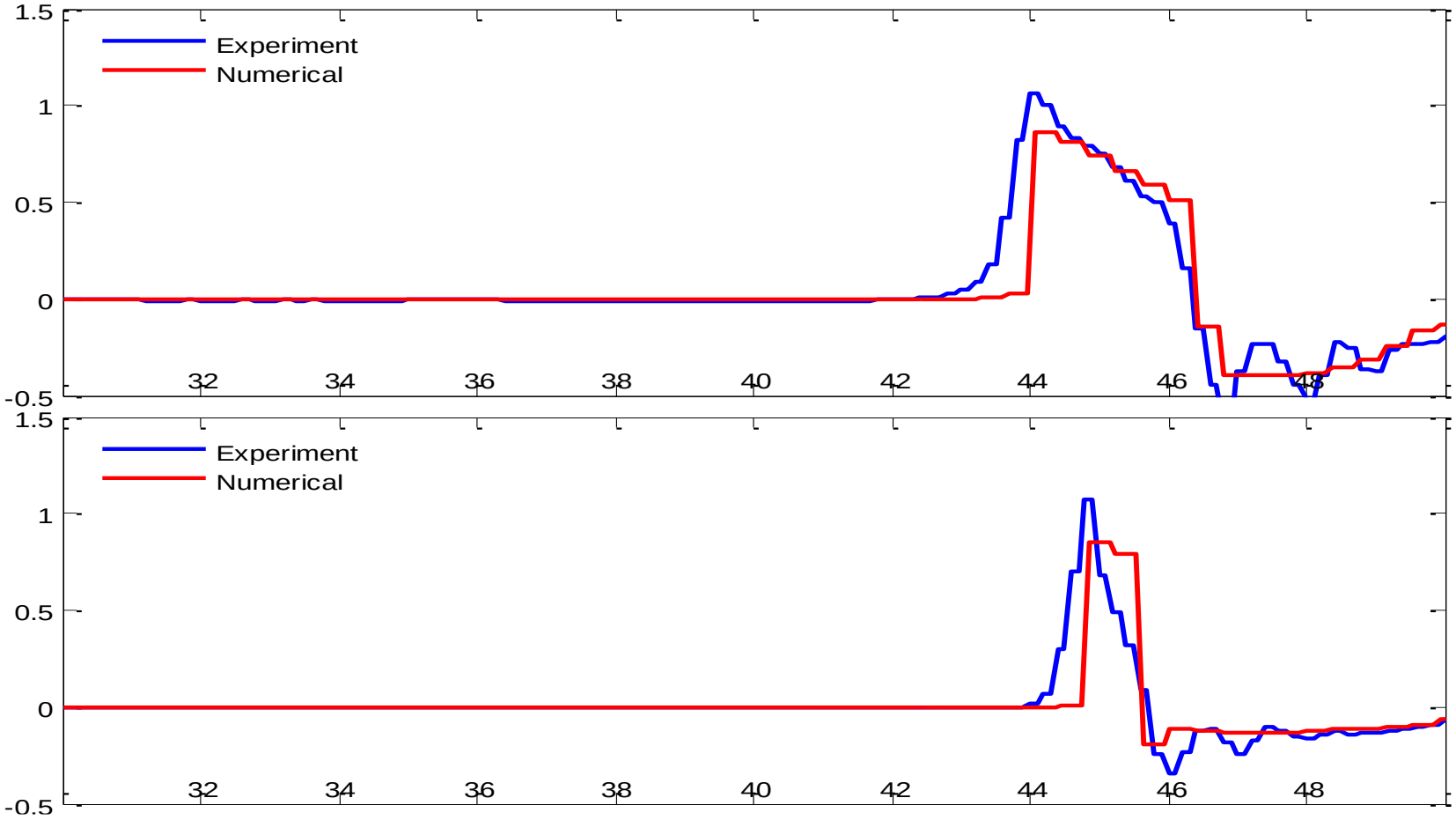
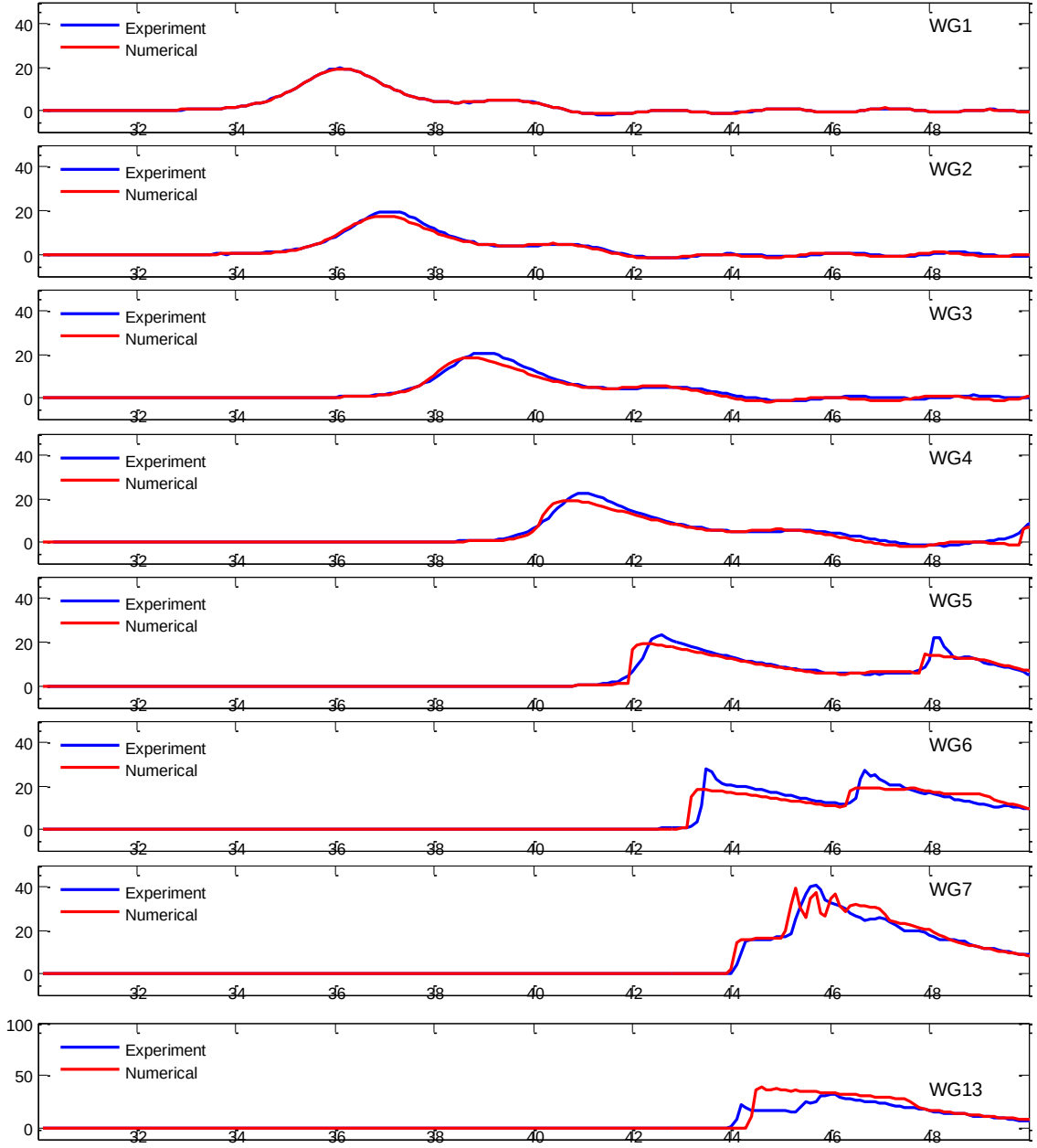


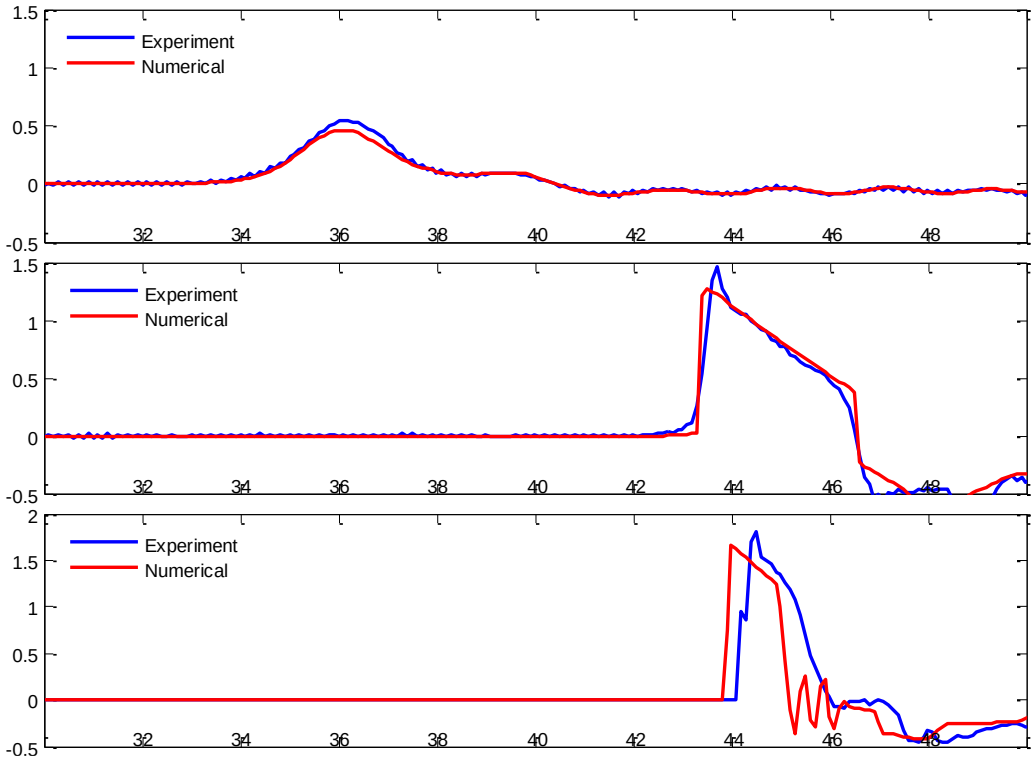
Comparison of the measured and computed water elevations for the front slope of 1-00 horizontal with large input wave at channels WG1, WG2, WG3, WG7 and WG13



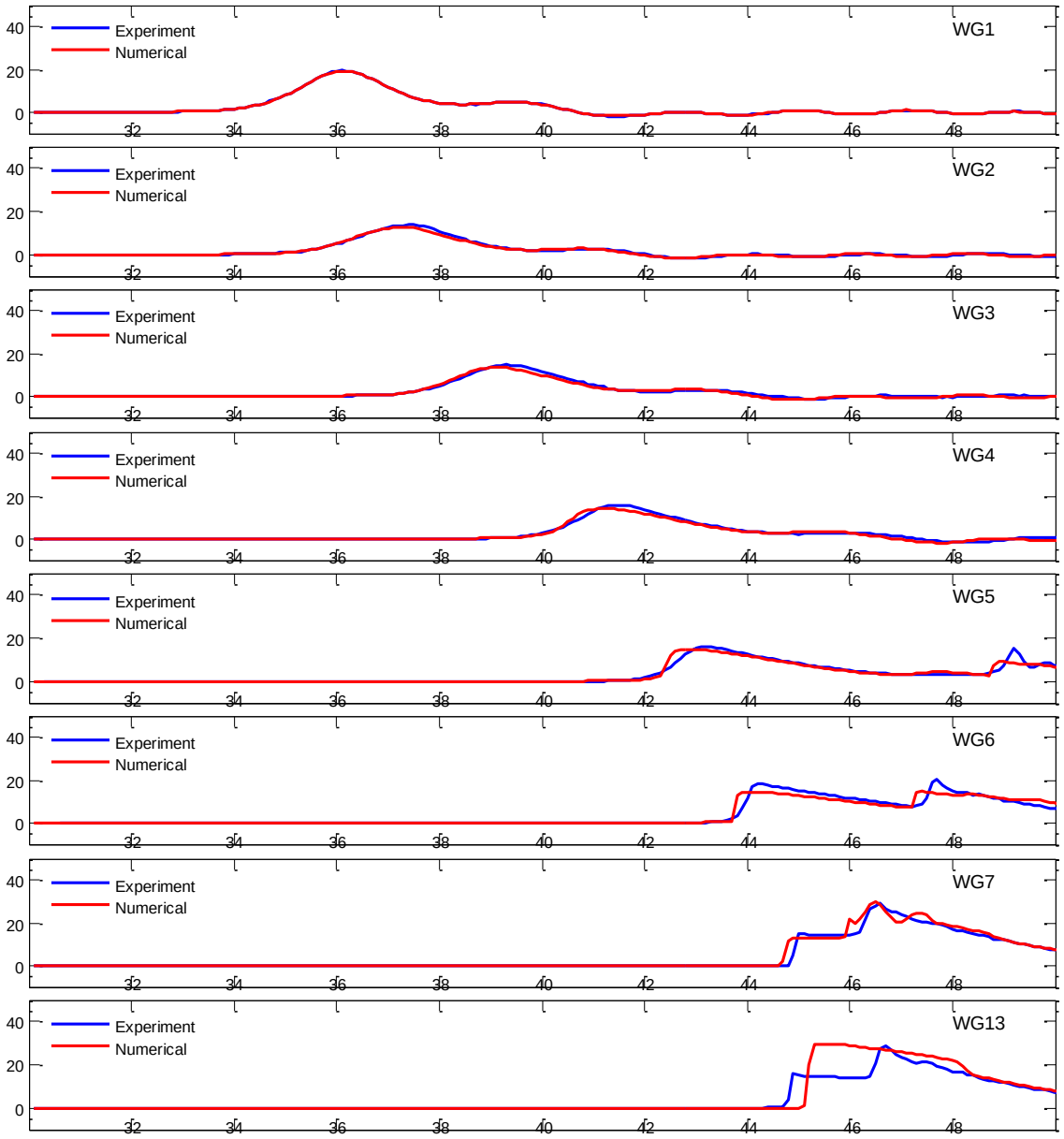
Comparison of the measured and computed water velocity in wave direction for the front slope of 1-00 horizontal with small input wave at channels V2 (top) and V3 (bottom)



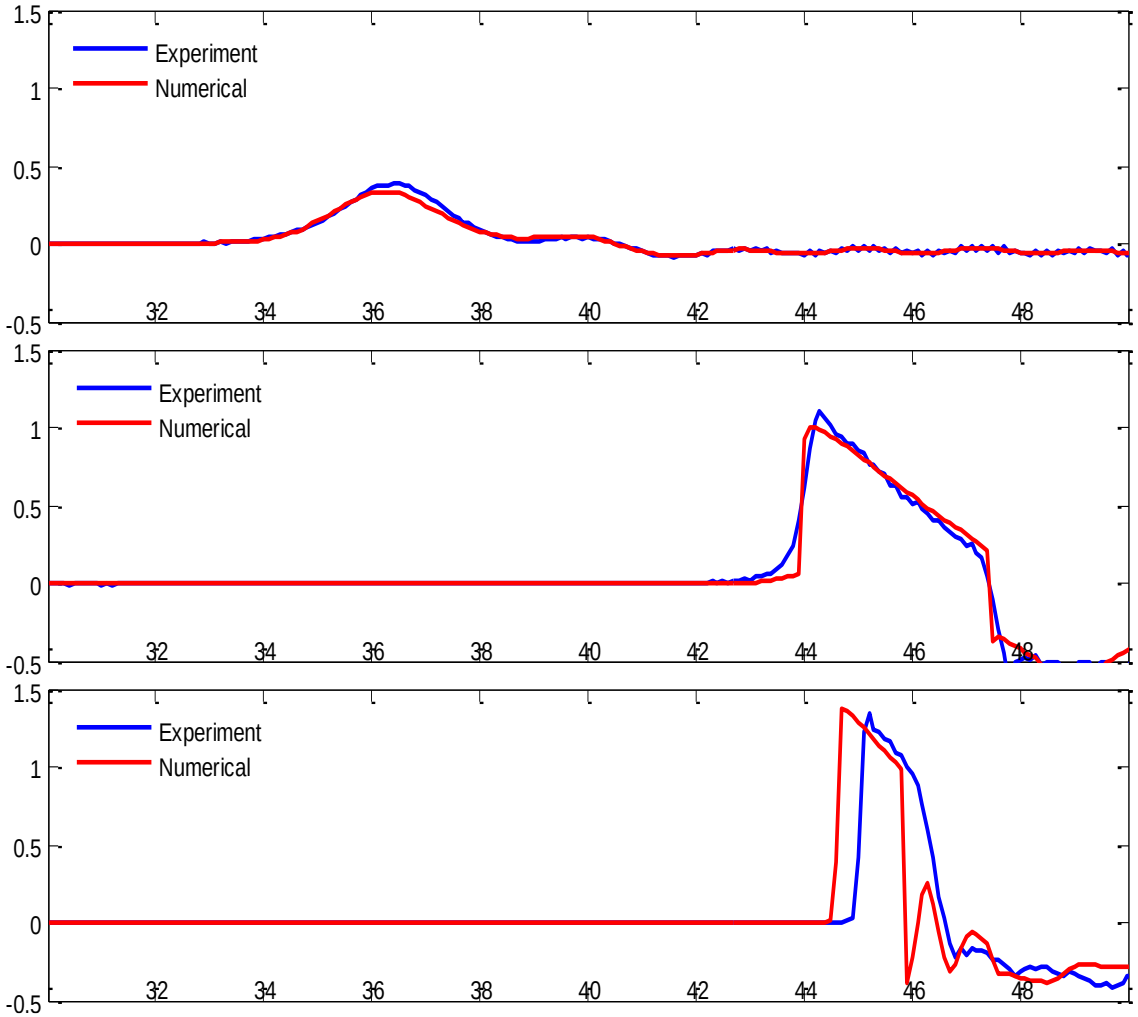
Comparison of the measured and computed water elevations for the front slope of 1-20 with the large input wave at channels WG1, WG2, WG3, WG4, WG5, WG6, WG7 and WG13



Comparison of the measured and computed water velocity in wave direction for the front slope of 1-20 with large input wave at channels V1 (top), V2 (centre), and V3 (bottom)



parison of the measured and computed water elevations for the front slope of 1-20 with the small input wave at channels WG1, WG2, WG3, WG4, WG5, WG6, WG7 and WG13



Comparison of the measured and computed water velocity in wave direction for the front slope of 1-20 with small input wave at channels V1 (top), V2 (centre), and V3 (bottom)

NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

Benchmark Problem #1
Shallow Flow Around A Submerged Conical Island With Small Side Slopes

Ahmet Cevdet Yalciner, Andrey Zaytsev, Utku Kanoğlu

Ph. D. Candidate Deniz Velioğlu

Middle East Technical University

Civil Engineering Department

09.02.2015

BM#1 – Shallow Flow Around A Submerged Conical Island With Small Side Slopes

While there are many experimental datasets looking at the wake behind a cylinder, there are very few that examine the wake behind a sloping obstacle in the context of shallow flow.

A conical island is placed on a flat bottom, where the water depth is 0.054 m
The side slopes of the conical island are 8 degrees,
The height of the island is 0.049 m and
The diameter at the base of the island is 0.75 m

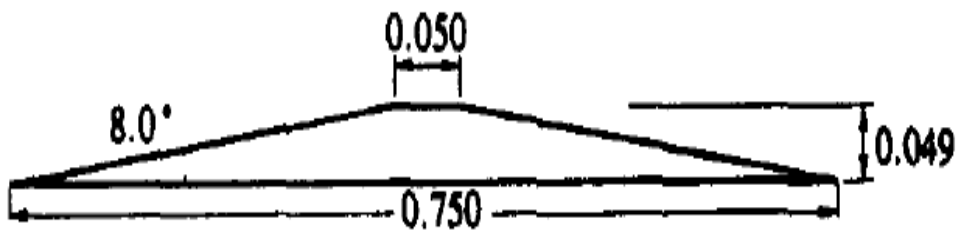


Figure 1. Conical Island

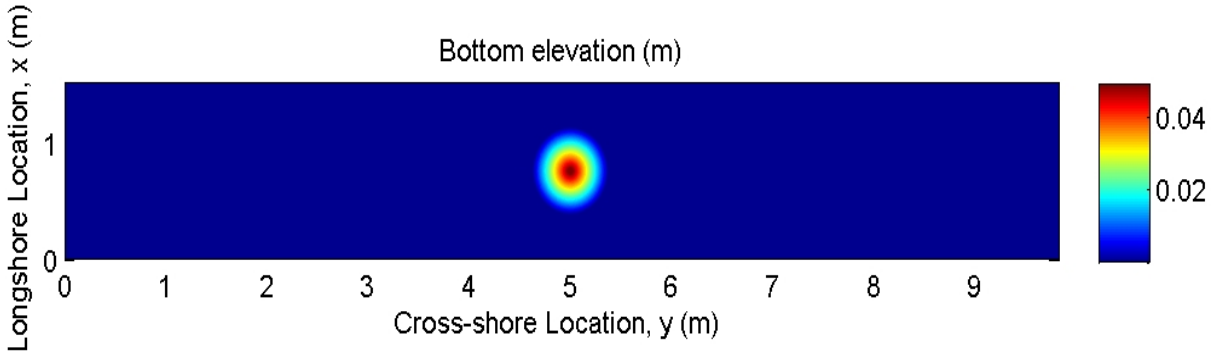


Figure 2. Bathymetry

BM#1

BM#1 – Shallow Flow Around A Submerged Conical Island With Small Side Slopes

In this study, horizontal velocity components located at two different locations behind the island are compared. A plot of the locations is shown in Figure 3. Point (1) is located 1.02 m behind the center of the island. Point (2) is located at the same x-location as Point (1), but 0.27 m offset in the positive (y) direction

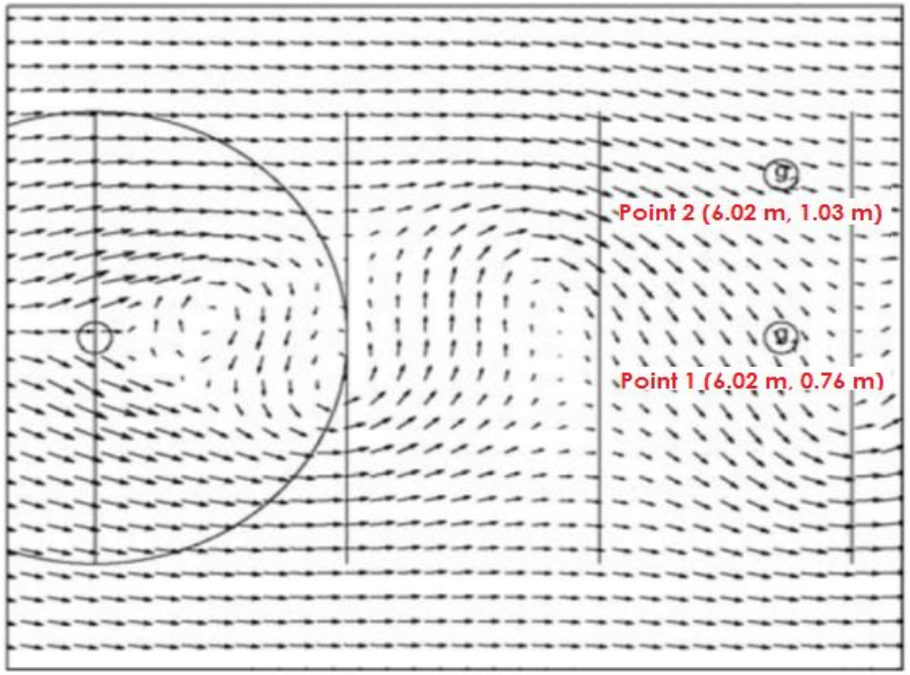


Figure 3. Two gauge points located behind the submerged cone

BM#1 – Shallow Flow Around A Submerged Conical Island With Small Side Slopes

<u>Input Data</u>:

The steady discharge velocity is U = 0.115 m/s

Water depth is h = 0.054 m

Δx = 0.01 m & Δt = 0.001 sec

Manning's Roughness Coefficient, n= 0.01

Simulation Duration: 3 minutes

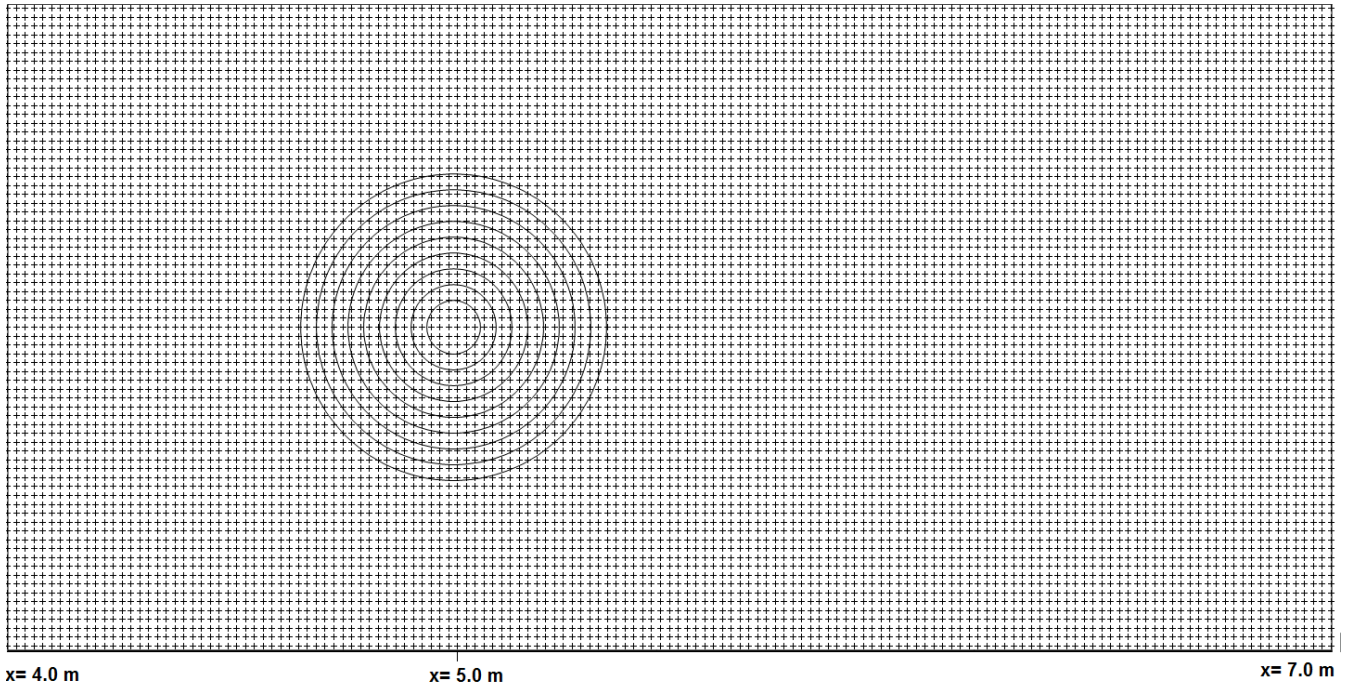
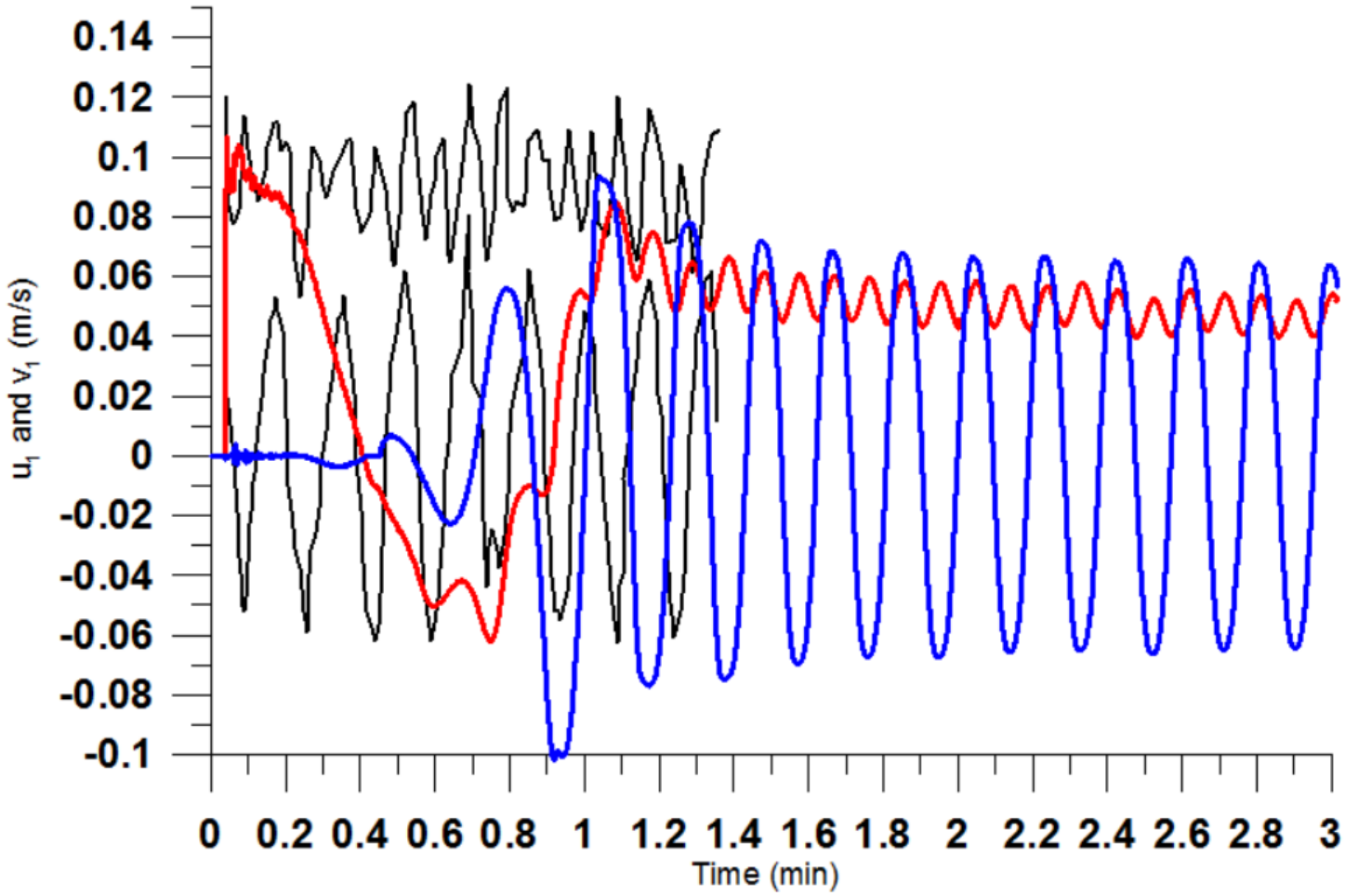


Figure 4. Bathymetry used in the simulations

BM#1

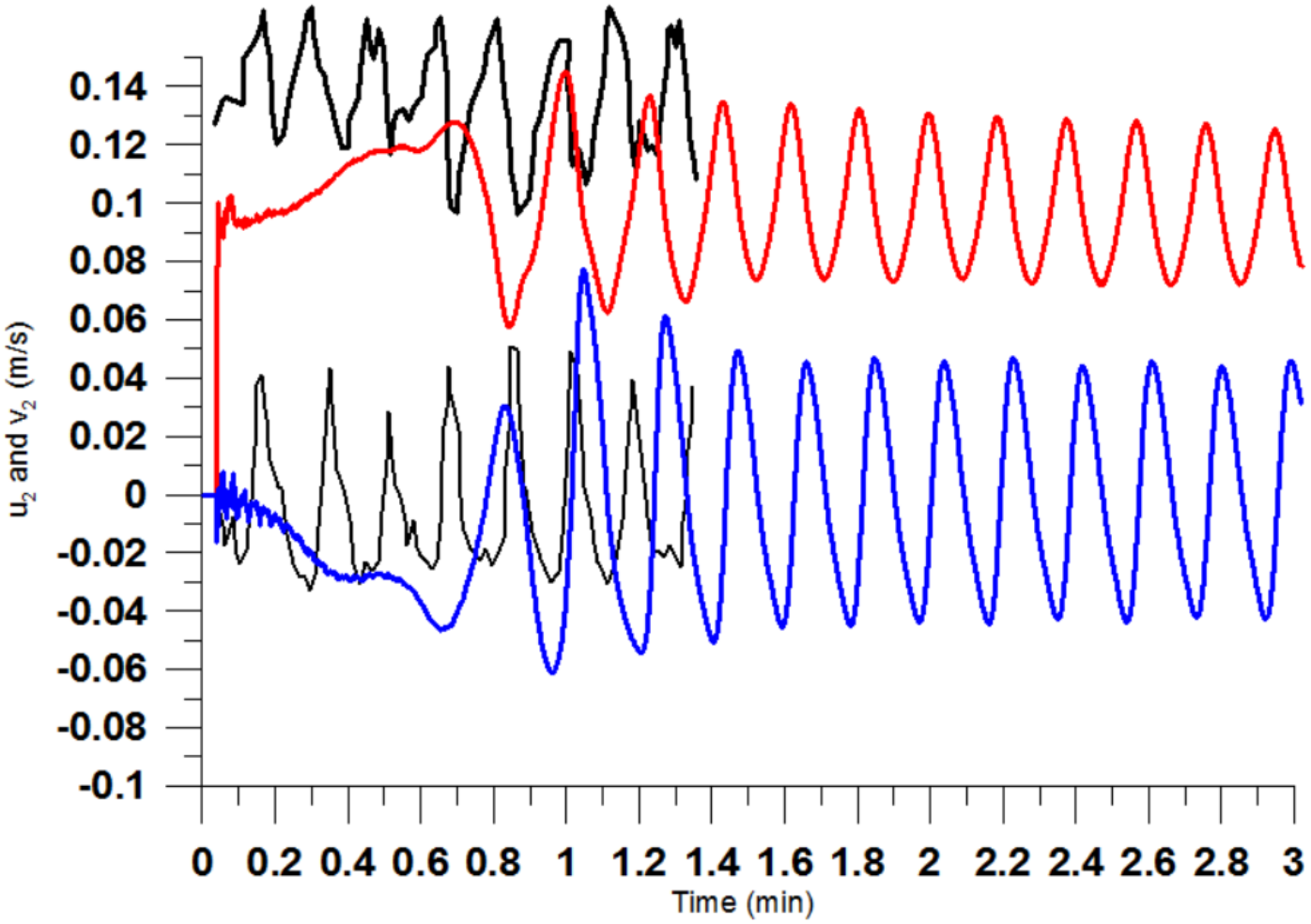
COMPARISON OF RESULTS (Gauge Point 1):



Point 1: U (top) and V (bottom)
Experimental Data: Black Line
Numerical Results: Red Line (U)/Blue Line (V)

BM#1

COMPARISON OF RESULTS (Gauge Point 2):

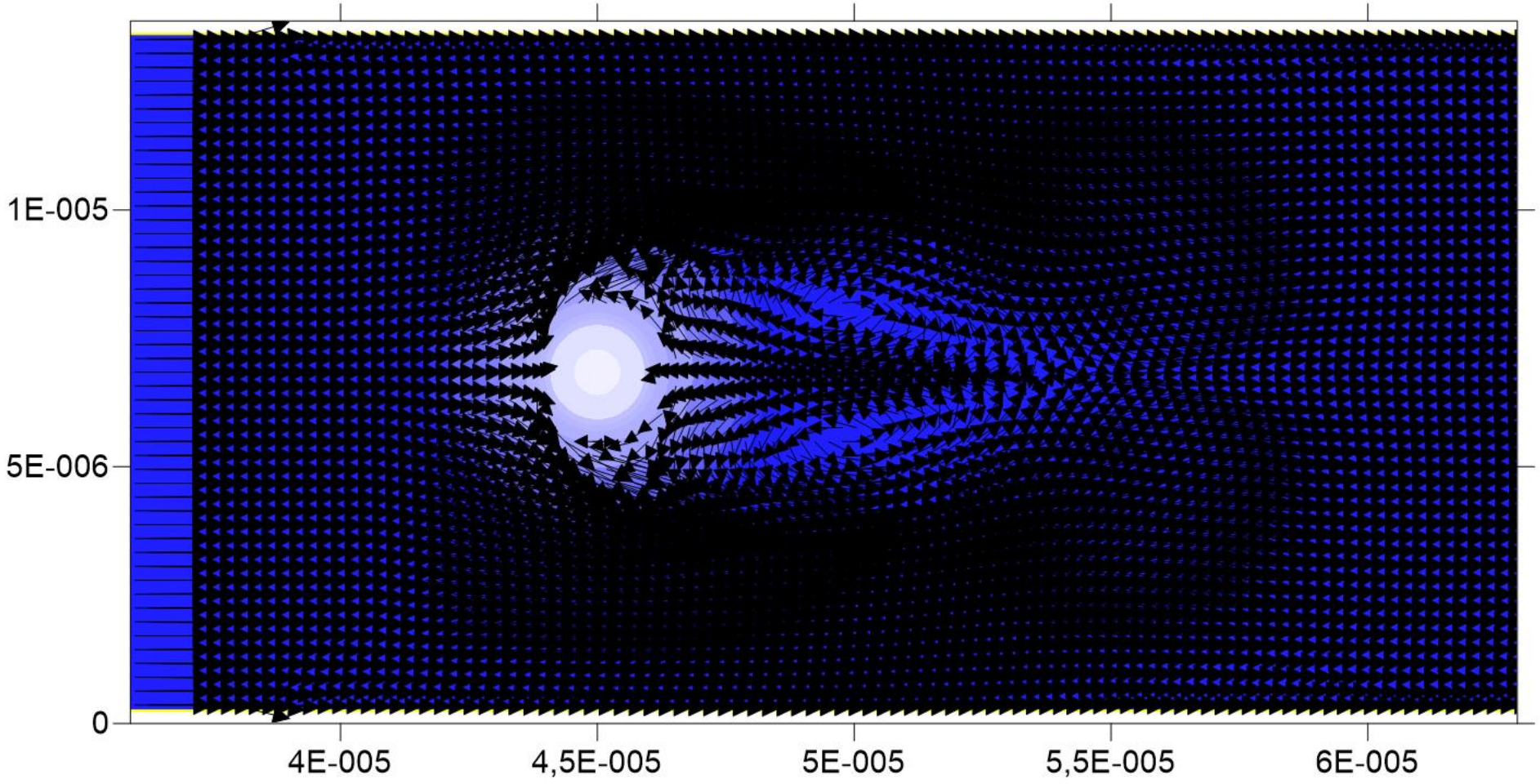


Point 2: U (top) and V (bottom)
Experimental Data: Black Line
Numerical Results: Red Line (U)/Blue Line (V)

BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

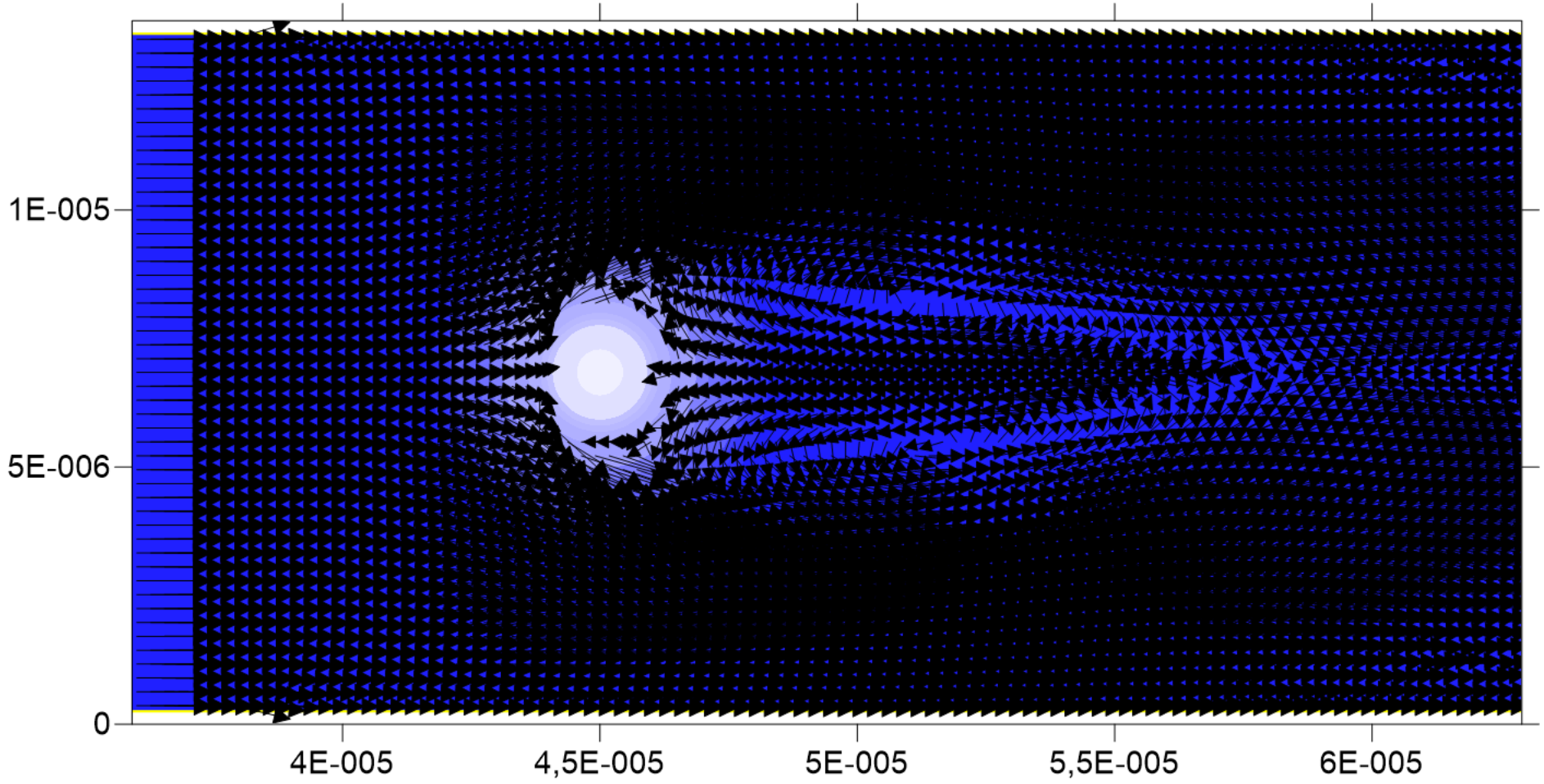
t = 20 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

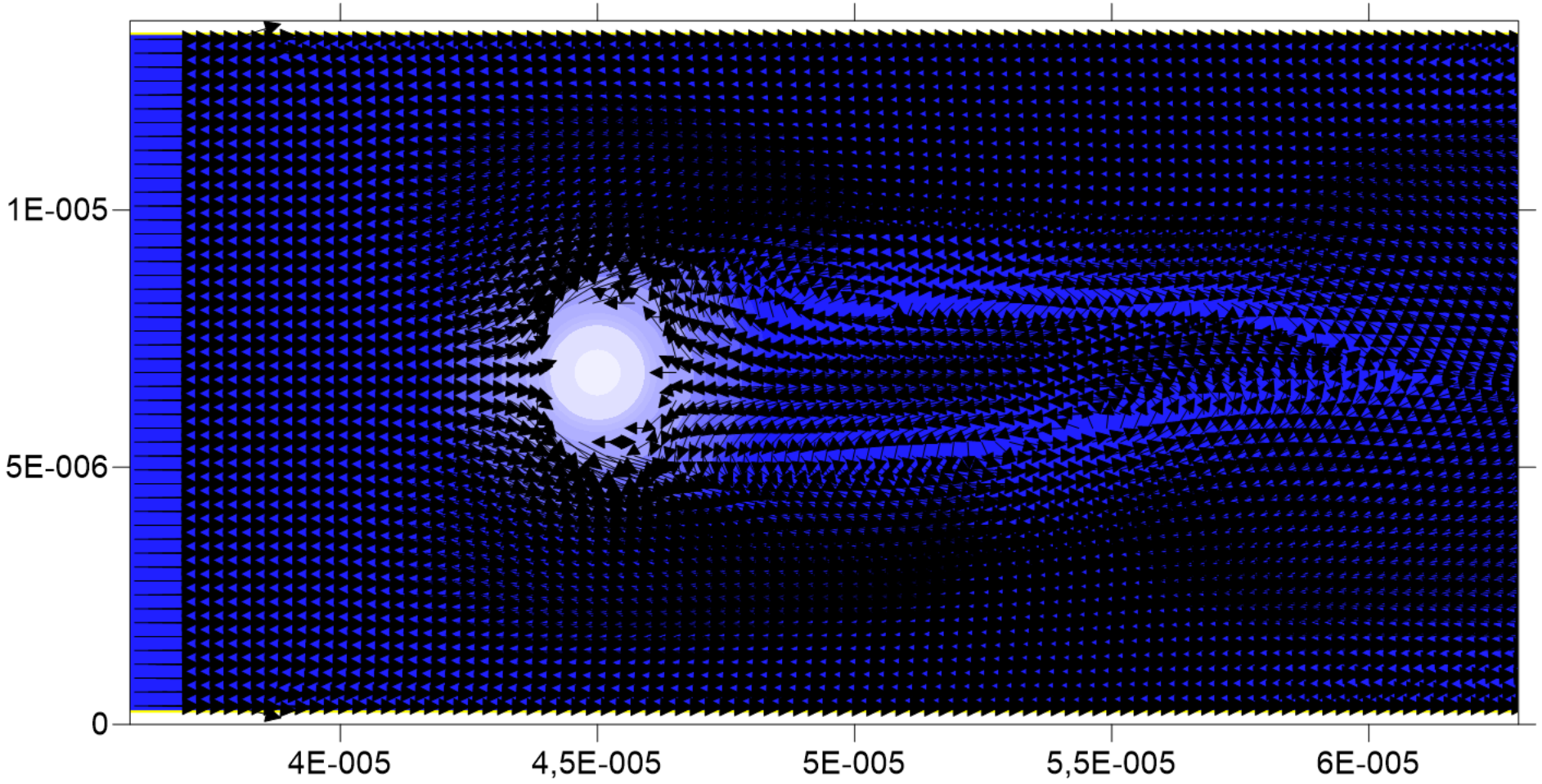
t = 40 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

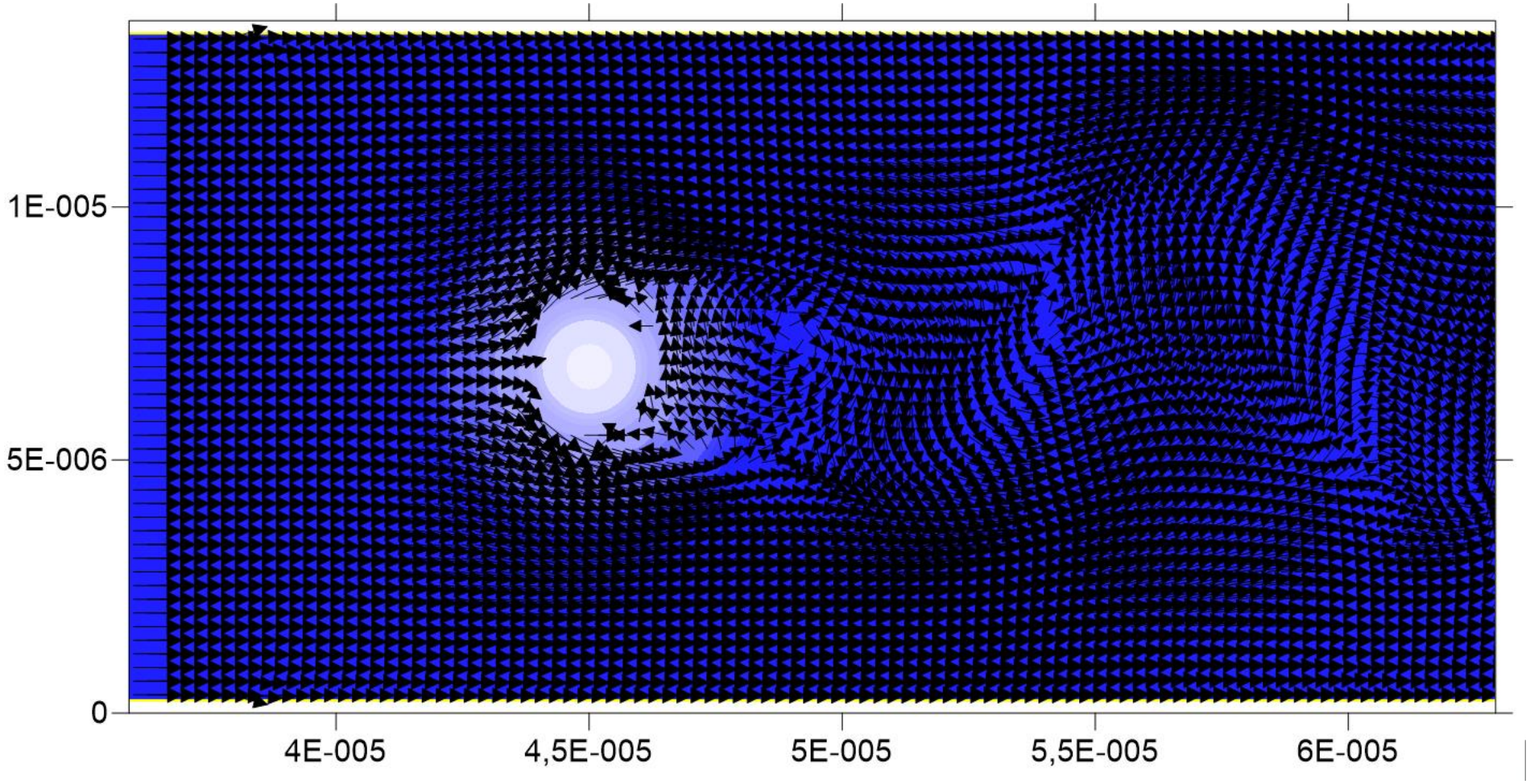
t = 60 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

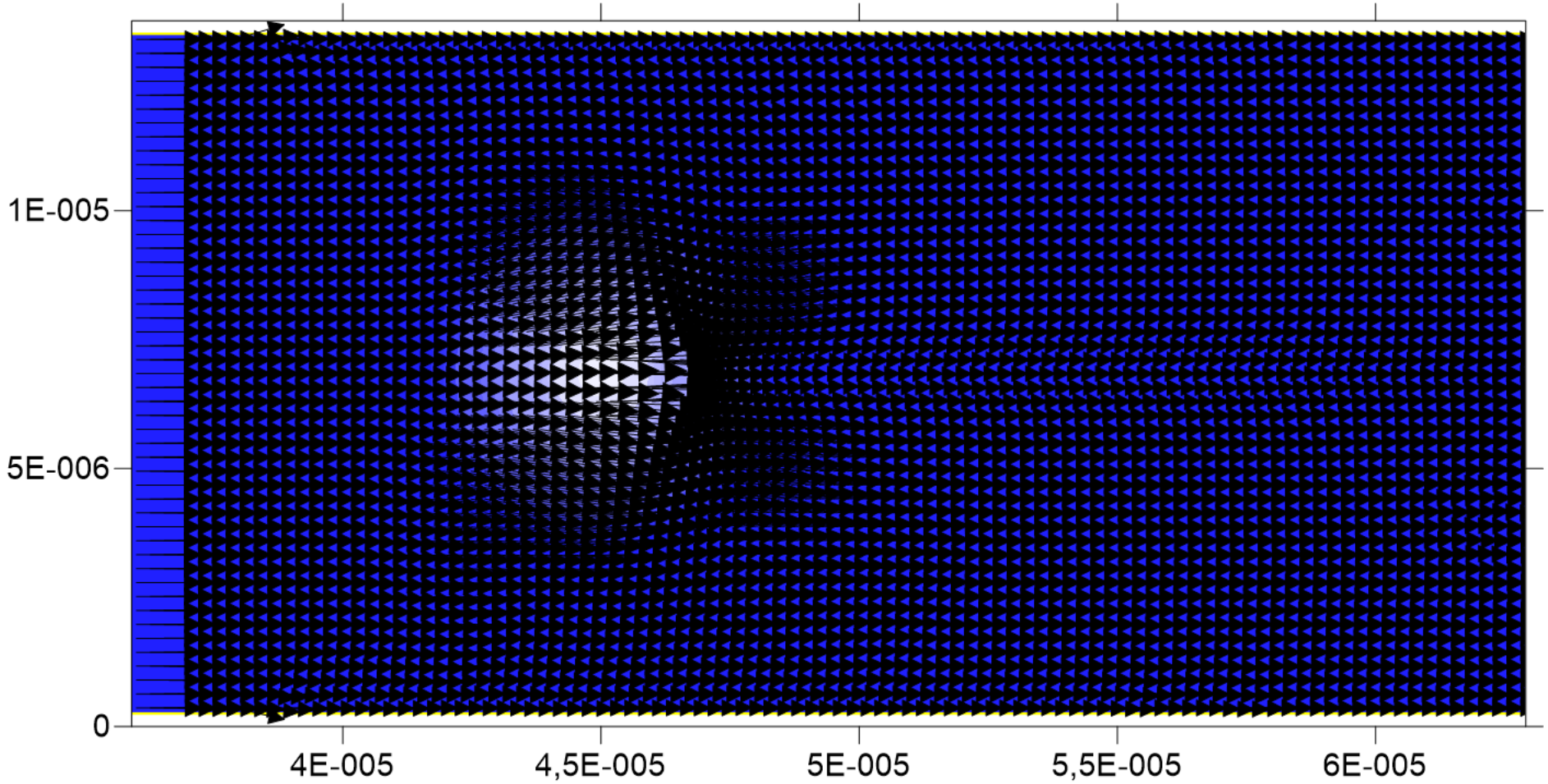
t = 80 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS (Configuration 3)

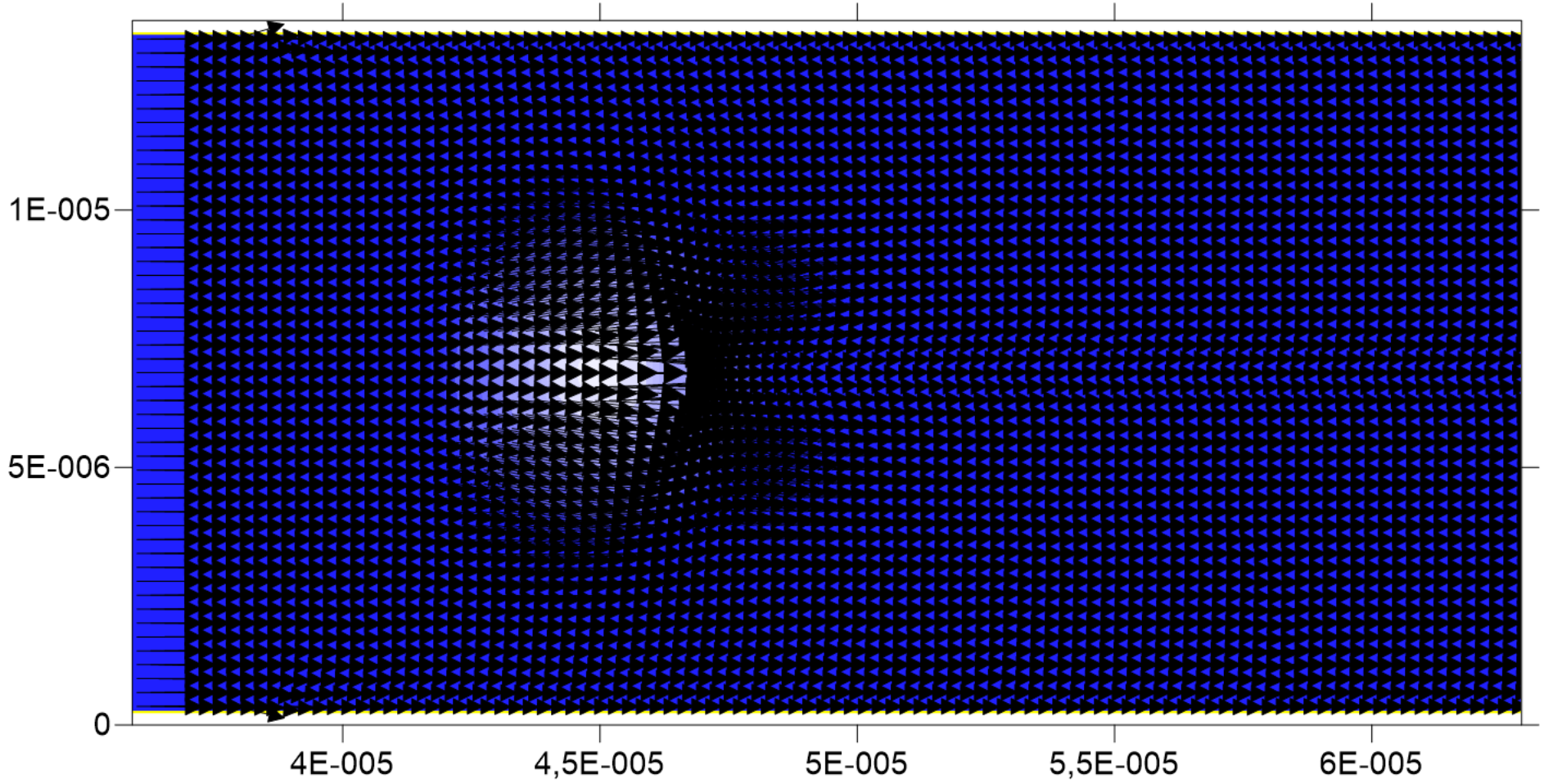
t = 20 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

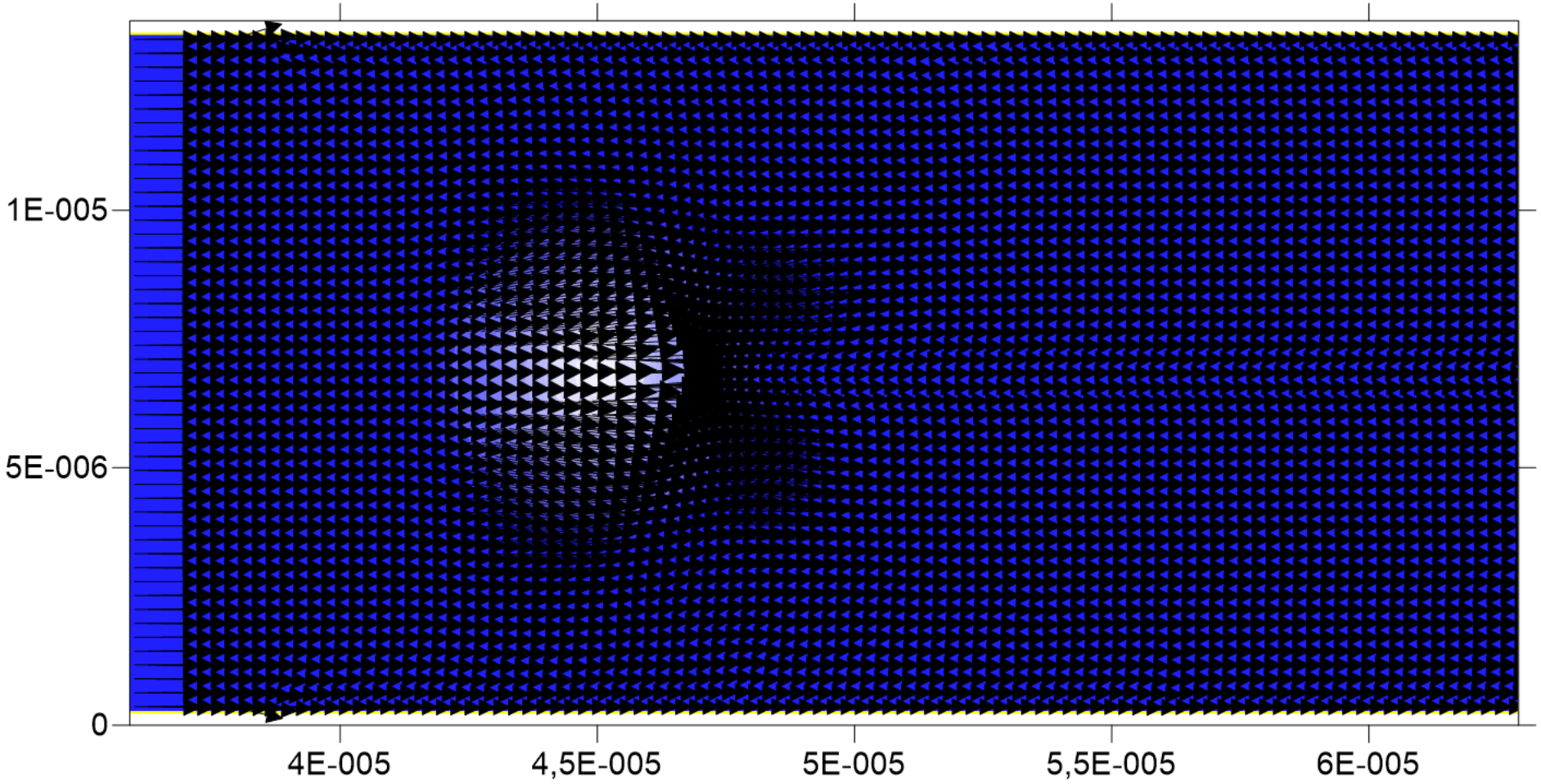
t = 40 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

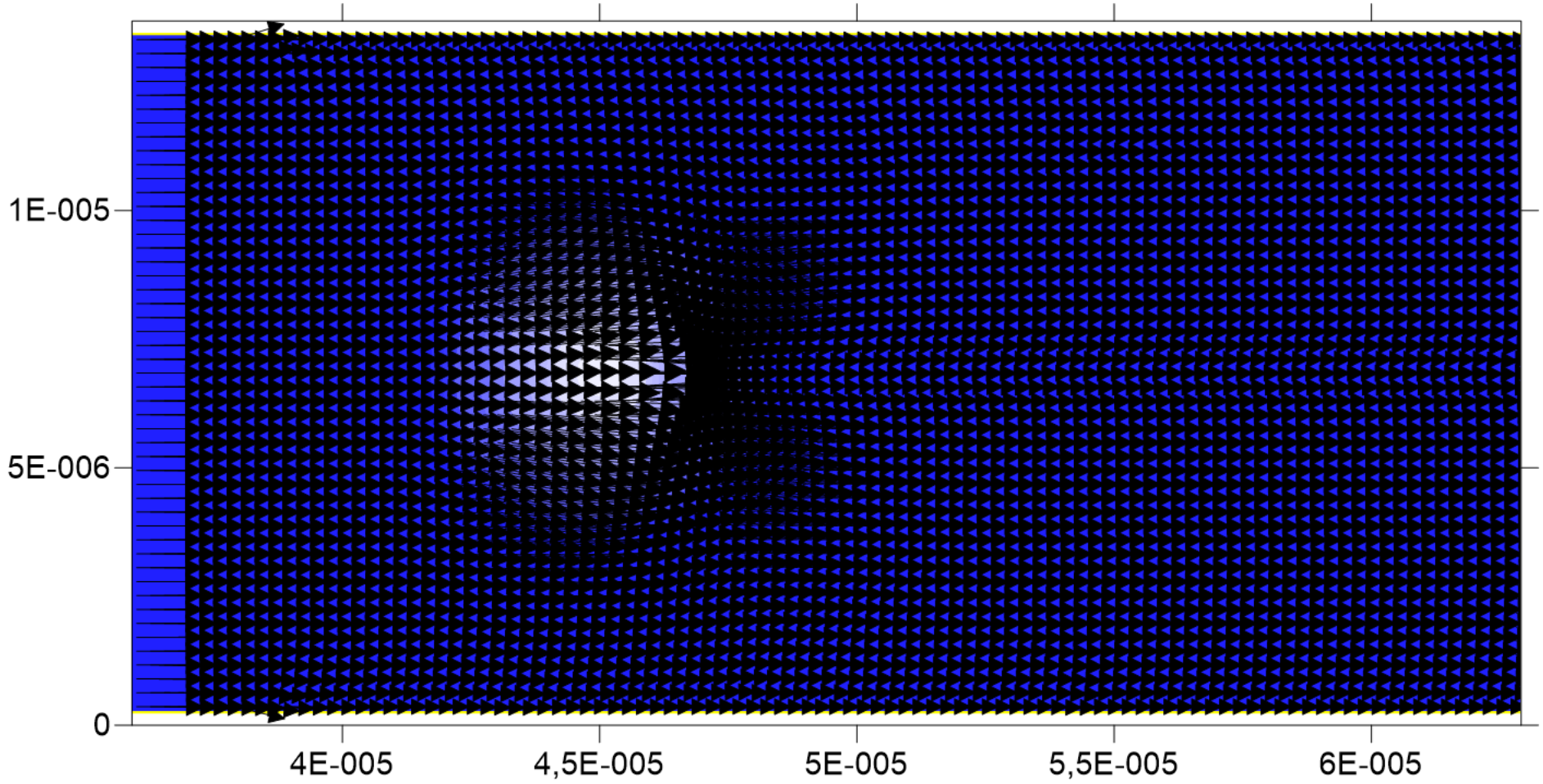
t = 60 sec



BM#1

VELOCITY VECTORS AT DIFFERENT TIME INTERVALS

t = 80 sec



BM#1

NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

Benchmark Problem #2
Japan 2011 tsunami in Hilo Harbor, Hawaii

Ahmet C. Yalciner, Andrey Zaytsev, Utku Kanoglu

Research Assistant Gozde Guney Dogan

METU, Department of Civil Engineering and Department of Engineering Sciences

09.02.2015

BM#2 – Japan 2011 Tsunami in Hilo Harbor, Hawaii

- Several simulations for a comparison of shallow water, tsunami currents aiming to understand the level of precision that can be expected from a model about modelling currents on real bathymetry and to see the convergence of a model with respect to speed predictions and model resolution.
- The results obtained from these simulation studies using NAMI DANCE and the comparisons with the actual data for free surface elevation and current speeds in E-W and N-S directions are provided.

BM#2 – Japan 2011 Tsunami in Hilo Harbor, Hawaii

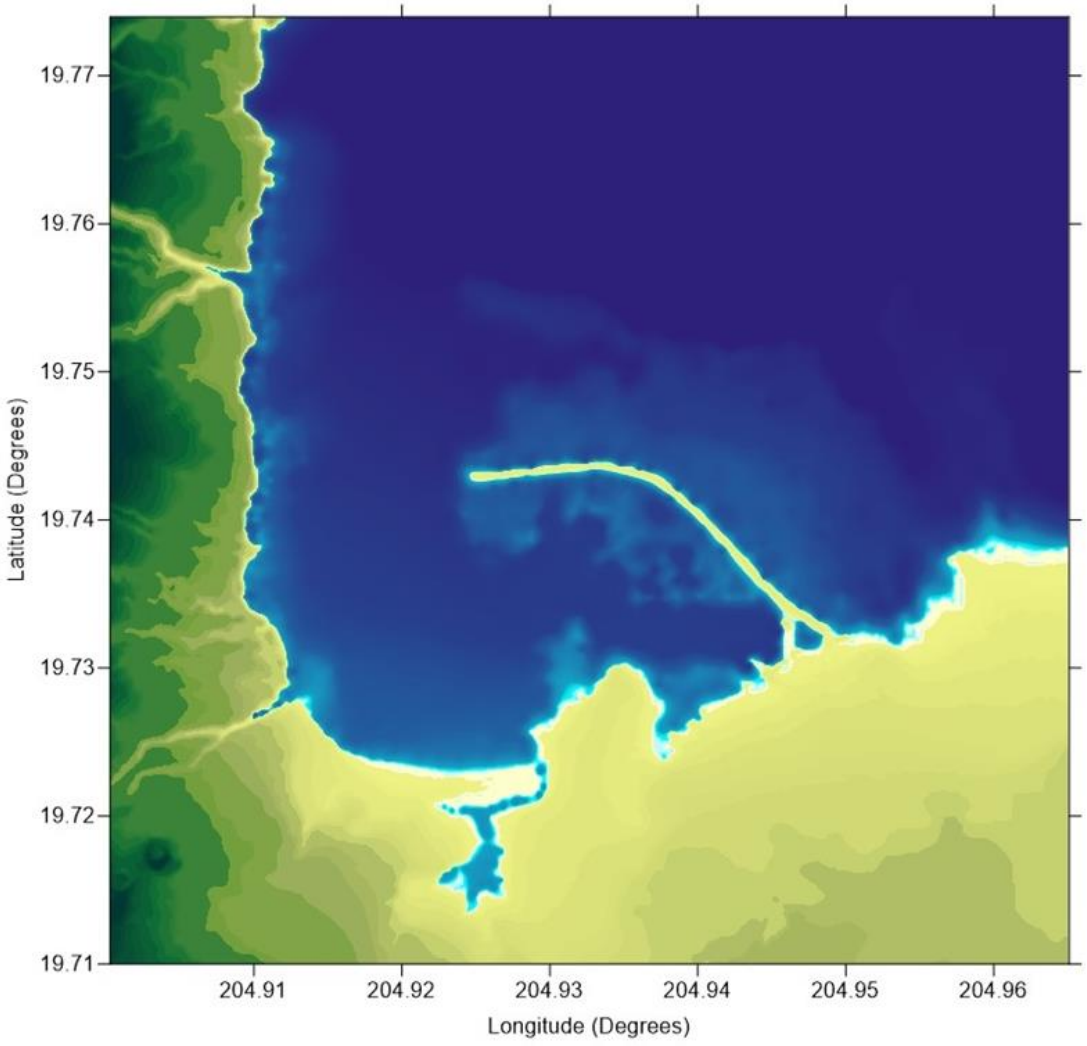
7 Different Configurations

Dx	Incident wave is inputted at:	Input Location	Manning's Roughness Coefficient
5m resolution	X = from 204.90028 to 204.96509, Y = 19.772115	Upper Grid Boundary	n = 0.015
10m resolution	X = from 204.90028 to 204.96509, Y= 19.748311	Northern Part of Domain	n = 0
10m resolution	X = from 204.90028 to 204.96509, Y = 19.757315	Northern Part of Domain–Control Point Level	n = 0
10m resolution	X = from 204.90028 to 204.96509, Y = 19.773118	Upper Grid Boundary	n = 0
10m resolution	X = from 204.90028 to 204.96509, Y = 19.773597	Upper Grid Boundary	n = 0.015
20m resolution	X = from 204.90028 to 204.96509, Y = 19.772064	Upper Grid Boundary	n = 0.015
20m resolution	X = from 204.90028 to 204.96509, Y = 19.772064	Upper Grid Boundary	n = 0.025

BM#2 – Japan 2011 Tsunami in Hilo Harbor, Hawaii

Bathymetry

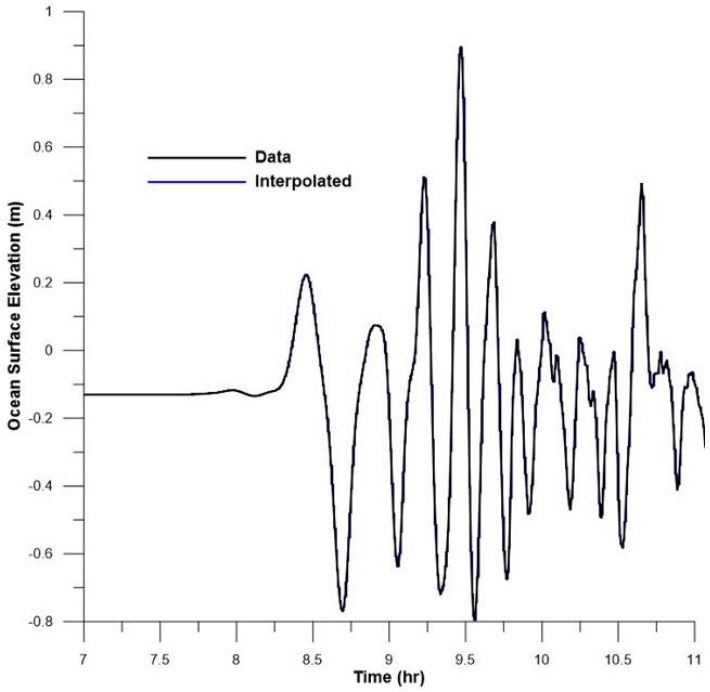
- Bathymetry data is provided (lon,lat) on a 1/3 arcsec grid.
- However, the problem has a flattening of the bathymetry at a depth of 30 meters. Therefore, in the offshore portion of the bathymetry grid, there are no depths greater than 30 m.
- The data is obtained for 20m (2/3 arcsec, the input bathymetry is de-sampled), 10m (1/3 arcsec) and 5m (1/6 arcsec, bi-linear interpolation is used) resolutions.



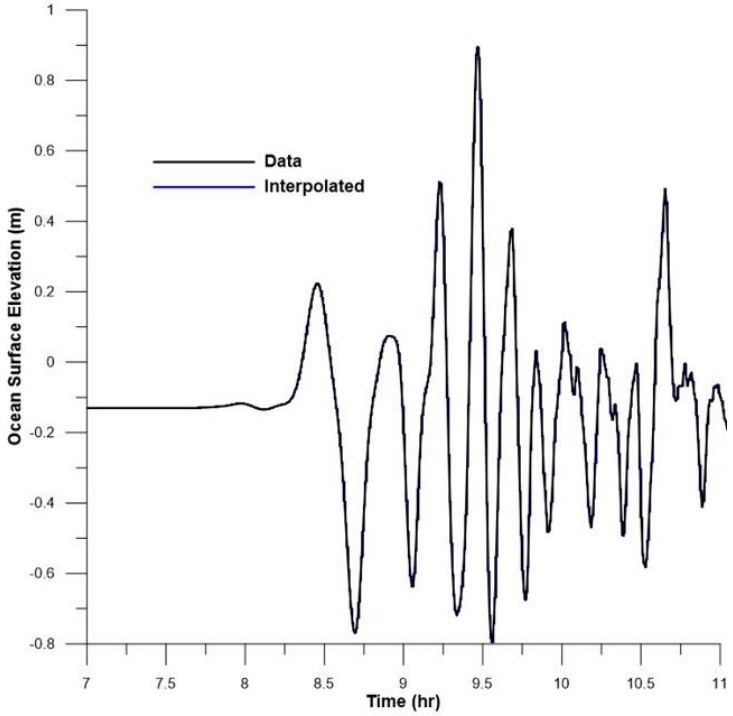
Sample bathymetry used in simulations for 10 m resolution

BM#2 – Japan 2011 Tsunami in Hilo Harbor, Hawaii
Incident Wave

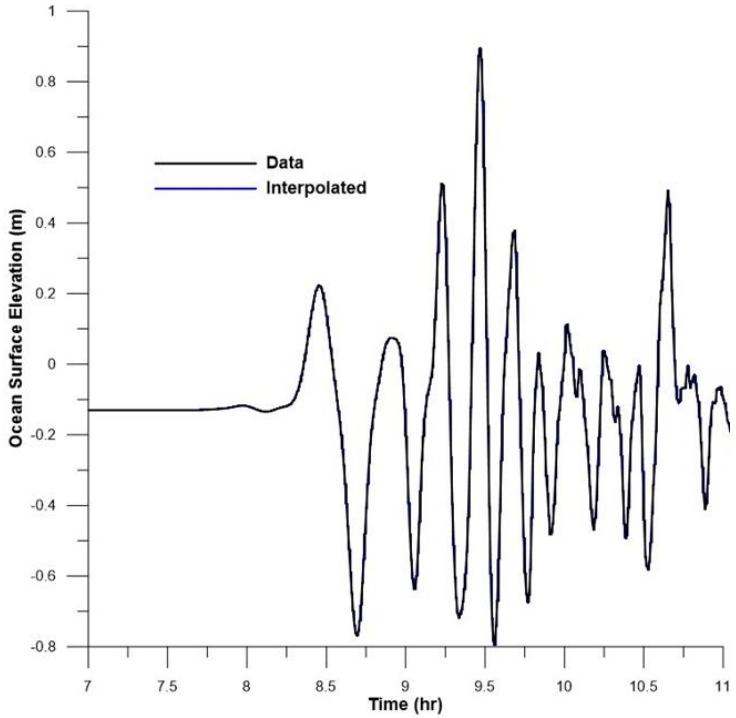
- Since the incident wave data is given with 30 second (0.5 minute) time intervals, the data is obtained again for 0.125 second intervals for 5m resolution case, 0.25 second intervals for 10m resolution and 0.5 second intervals for 20 resolution by making linear interpolation.



Incident Wave Comparison for 5m resolution (Interpolated data dt = 0.125s)

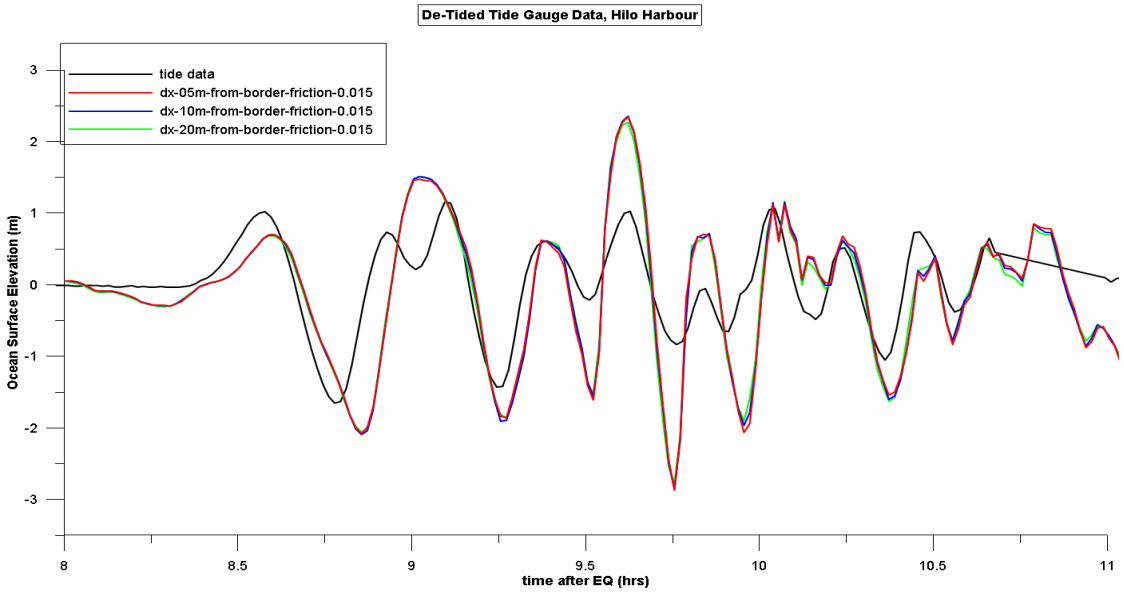


Incident Wave Comparison for 10m resolution (Interpolated data dt = 0.25s)

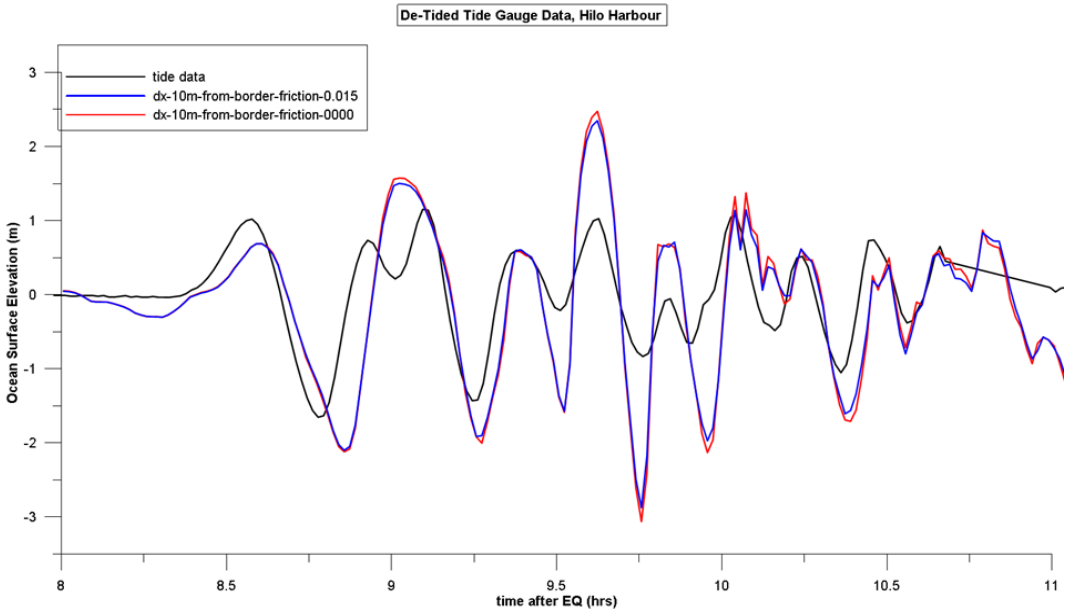


Incident Wave Comparison for 20m resolution Interpolated data dt = 0.5s

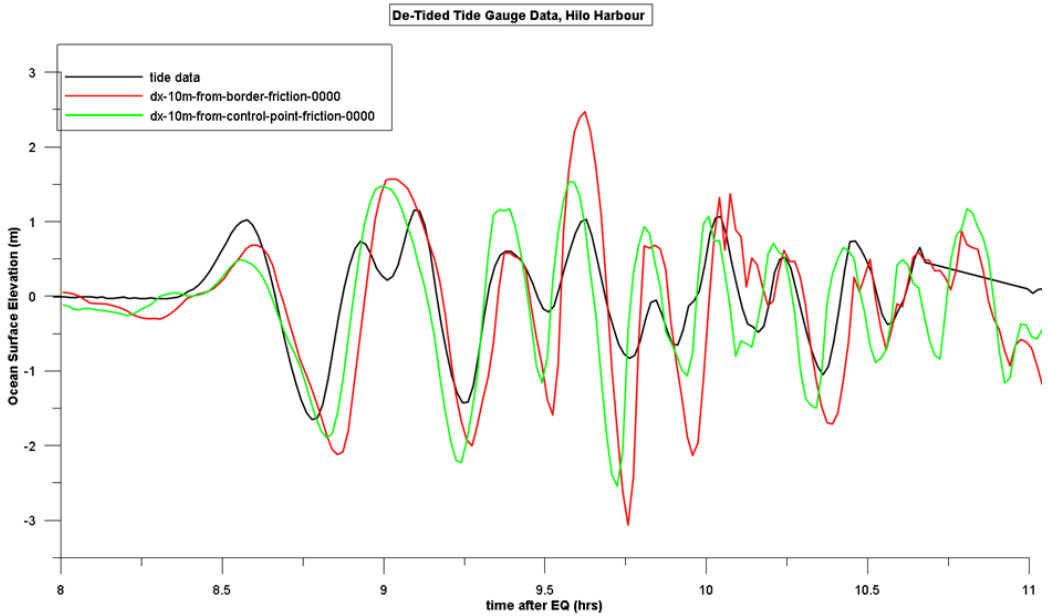
COMPARISON OF RESULTS - De-tided Tide Gauge Data



Comparison of three different resolutions for the tide gauge data (n is 0.015)



Comparison of Manning's coefficients (0.015 and 0 cases) with 10m resolution for the tide gauge data

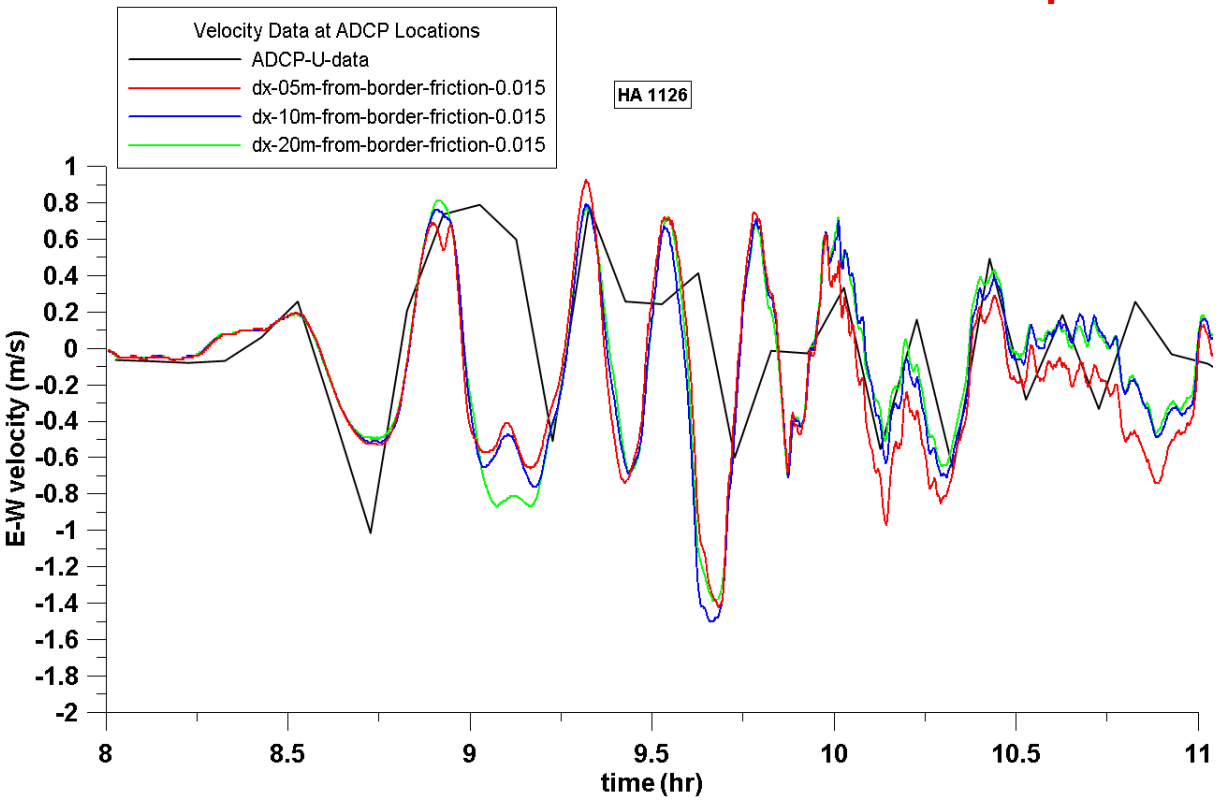


Comparison of the input location (from border or control point) of incident wave with 10m resolution

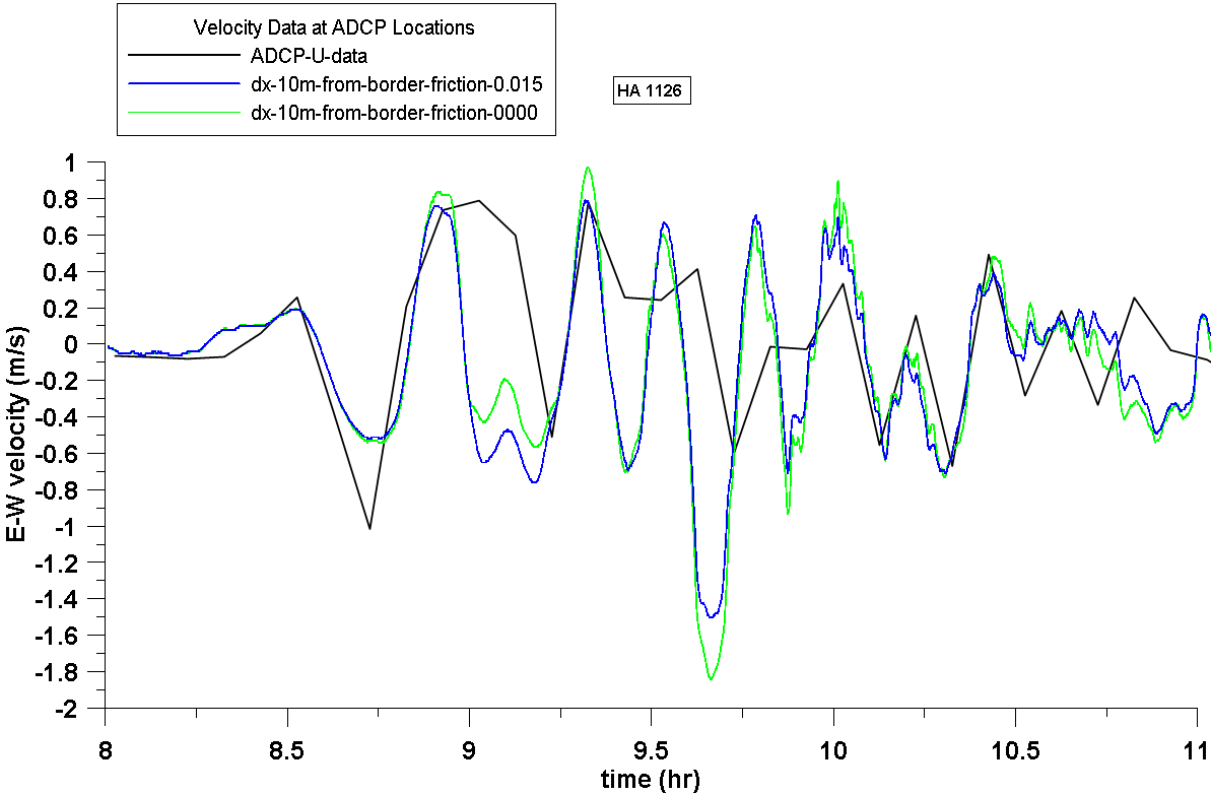
BM#2

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in E-W Direction



HA1126: Hilo Harbor, Comparisons of the E-W current speeds for three different resolutions (Manning's Coefficient is 0.015)



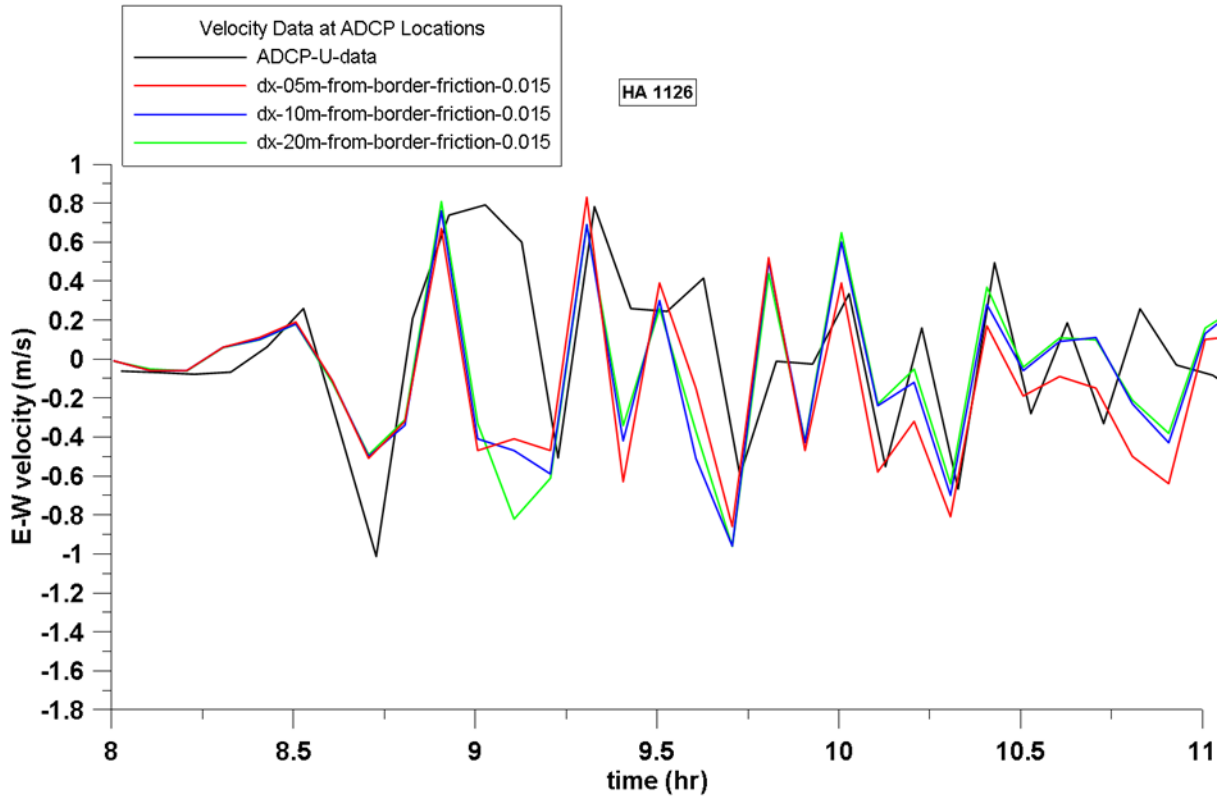
HA1126: Hilo Harbor, Comparisons of the E-W current speeds for 10m resolution with Manning's coefficient 0 and 0.015

BM#2

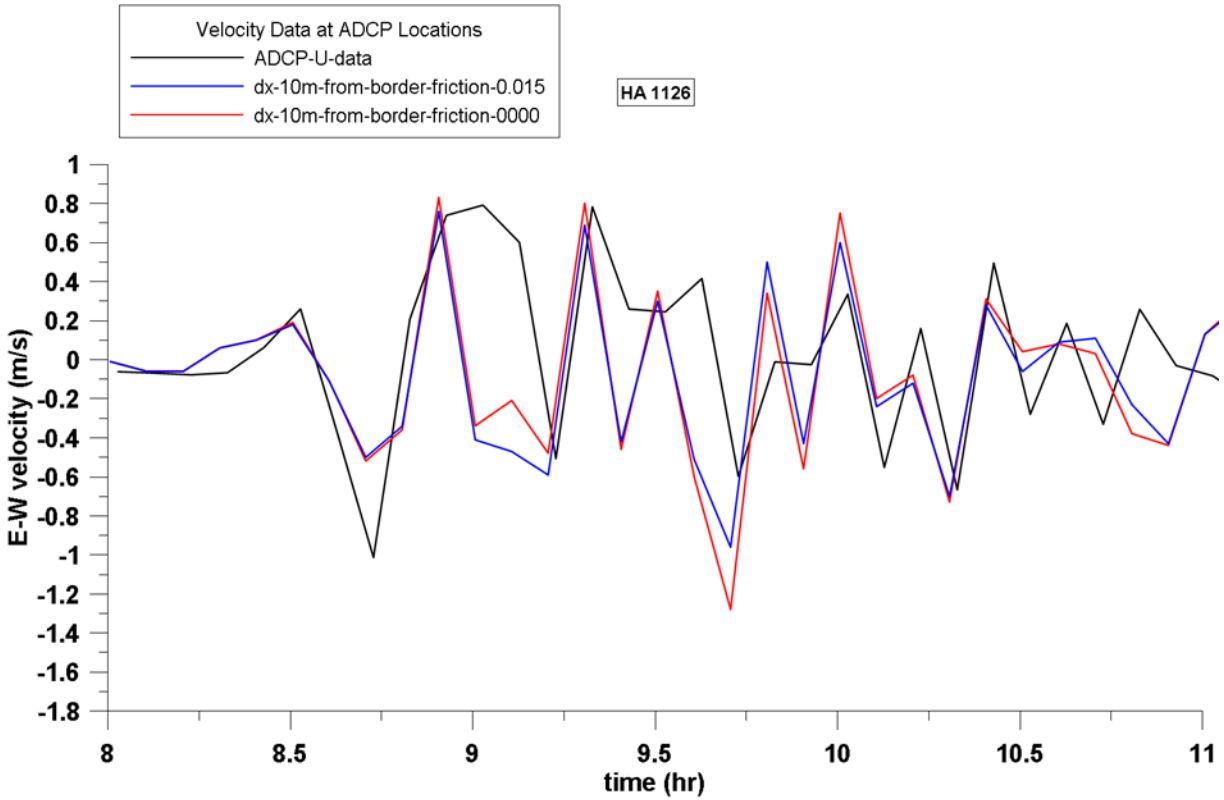
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in E-W Direction



HA1126: Hilo Harbor, Comparisons of the E-W current speeds for three different resolutions (Manning's Coefficient is 0.015)



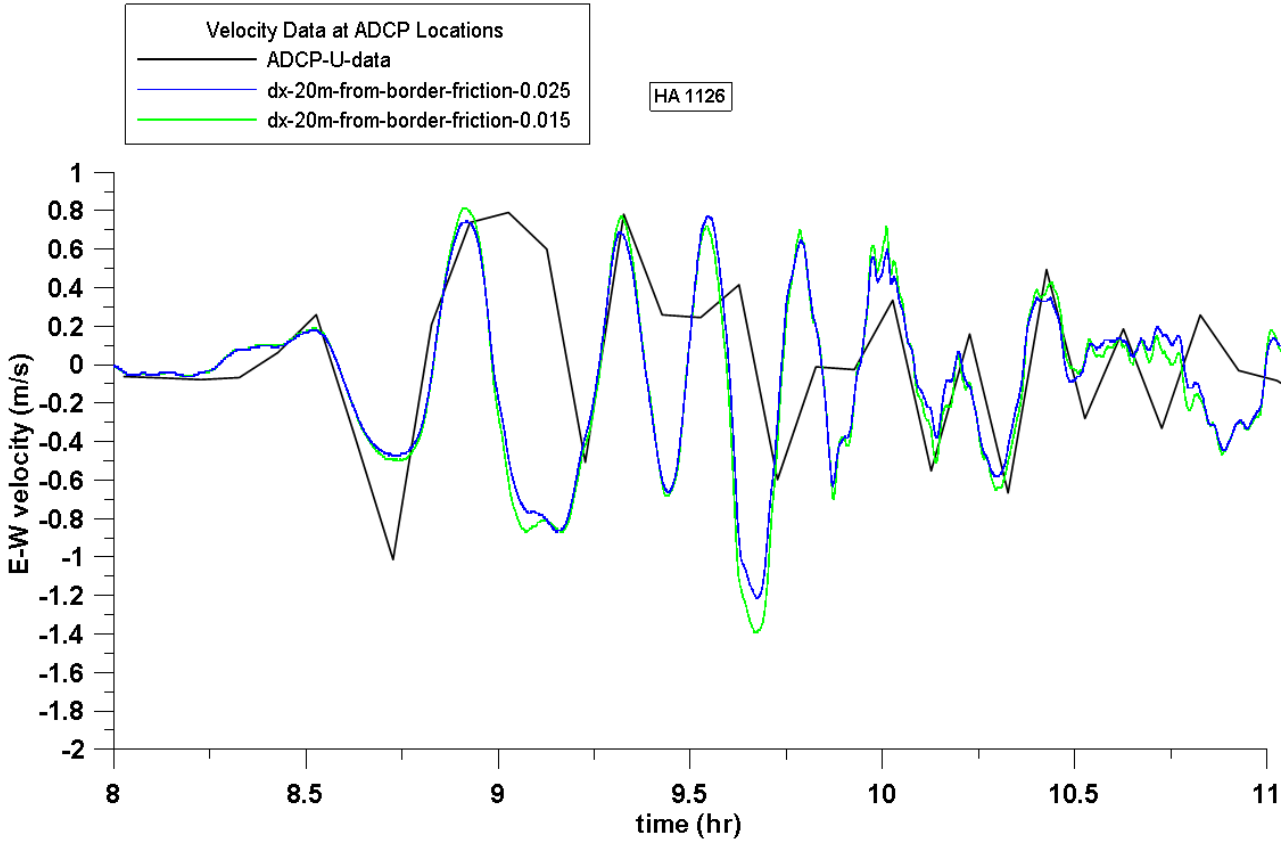
HA1126: Hilo Harbor, Comparisons of the E-W current speeds for 10m resolution with Manning's coefficient 0 and 0.015

BM#2

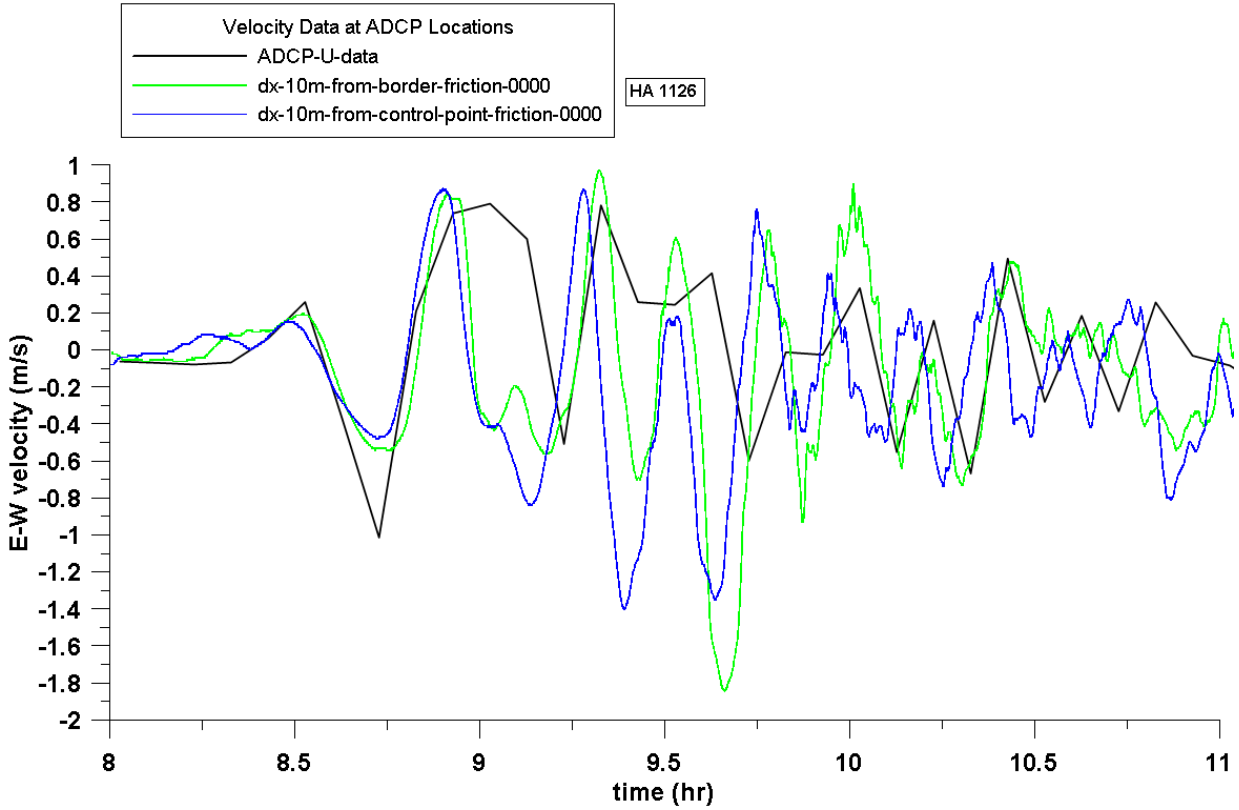
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in E-W Direction



HA1126: Hilo Harbor, Comparisons of the E-W current speeds for 20m resolution with Manning's coefficient 0.015 and 0.025



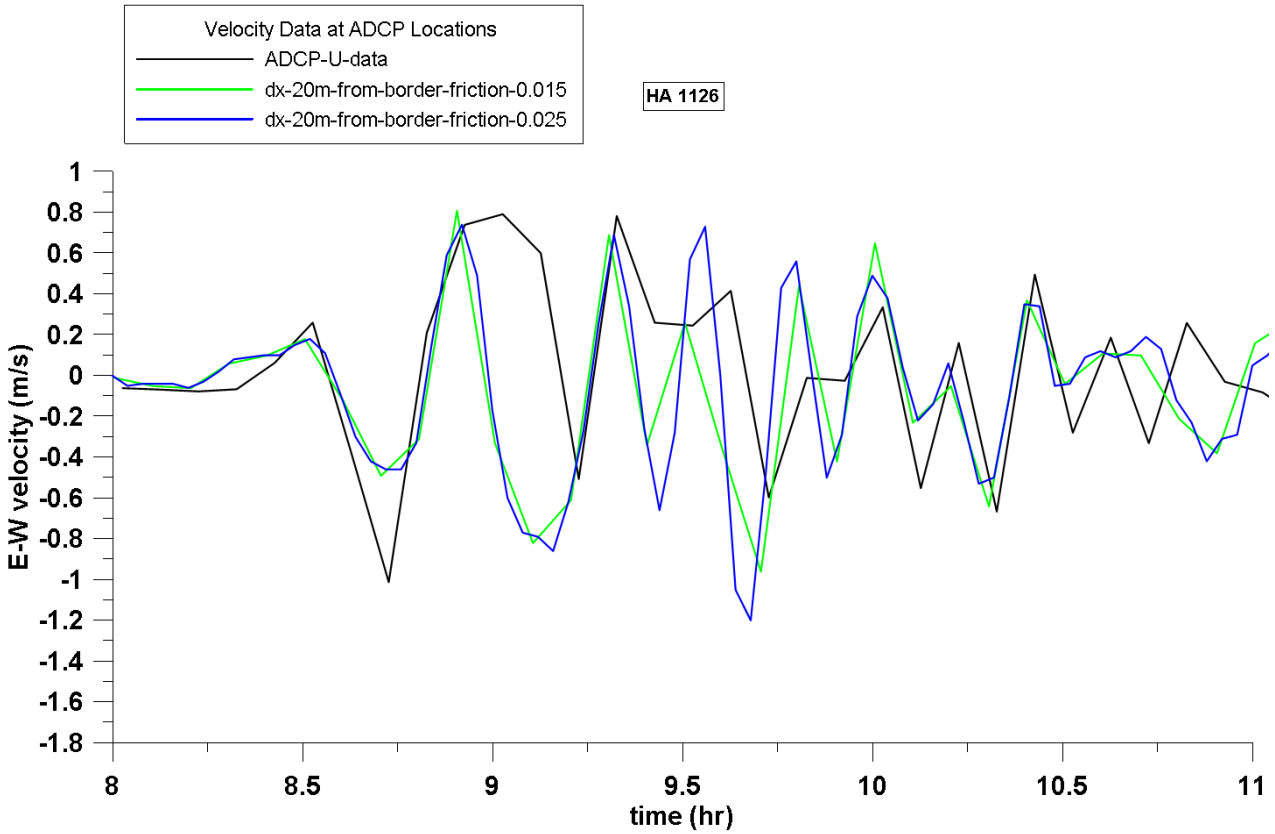
HA1126: Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in E-W direction

BM#2

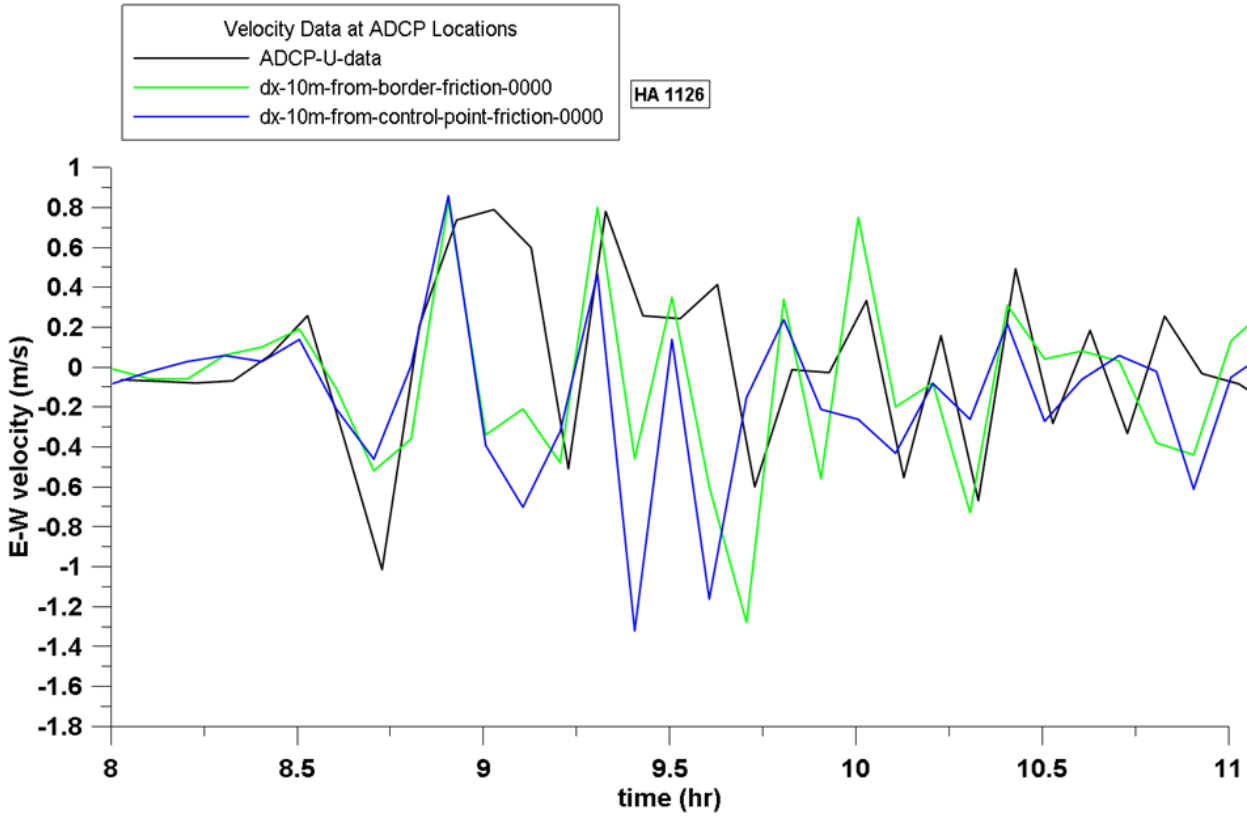
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in E-W Direction



HA1126: Hilo Harbor, Comparisons of the E-W current speeds for 20m resolution with Manning's coefficient 0.015 and 0.025



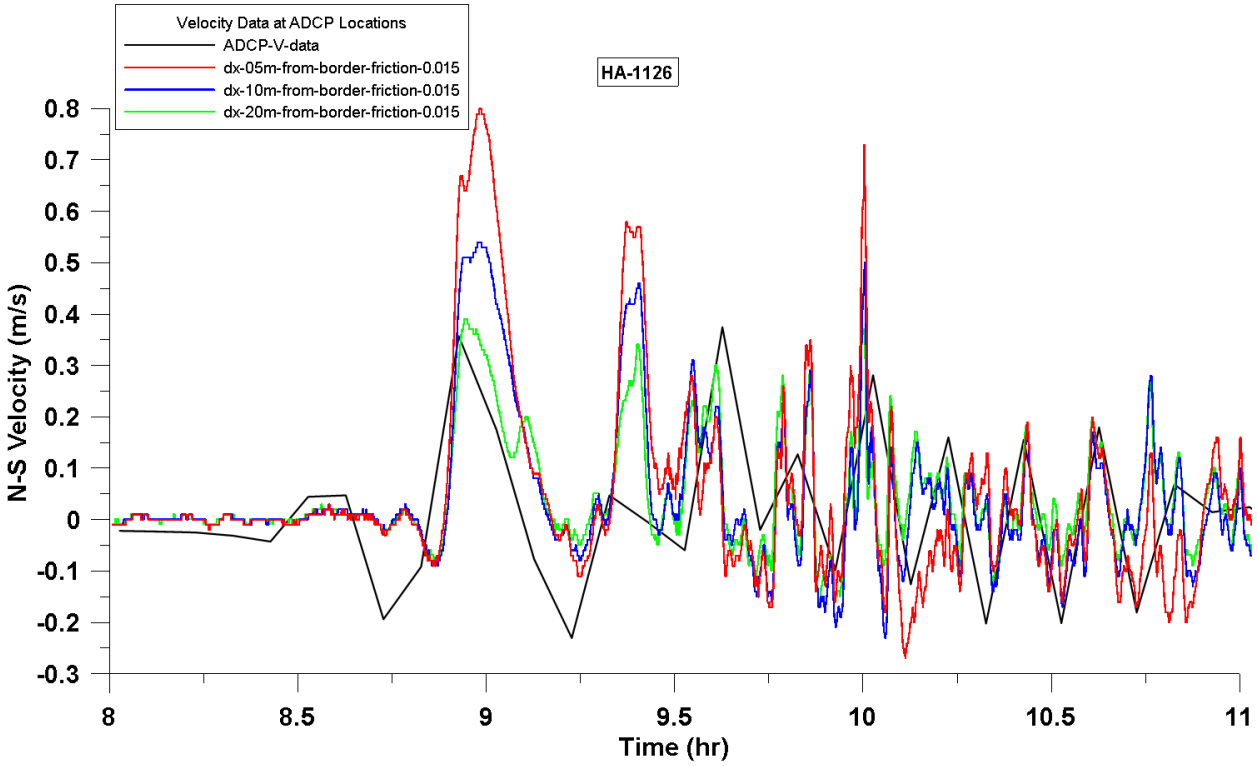
HA1126: Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in E-W direction

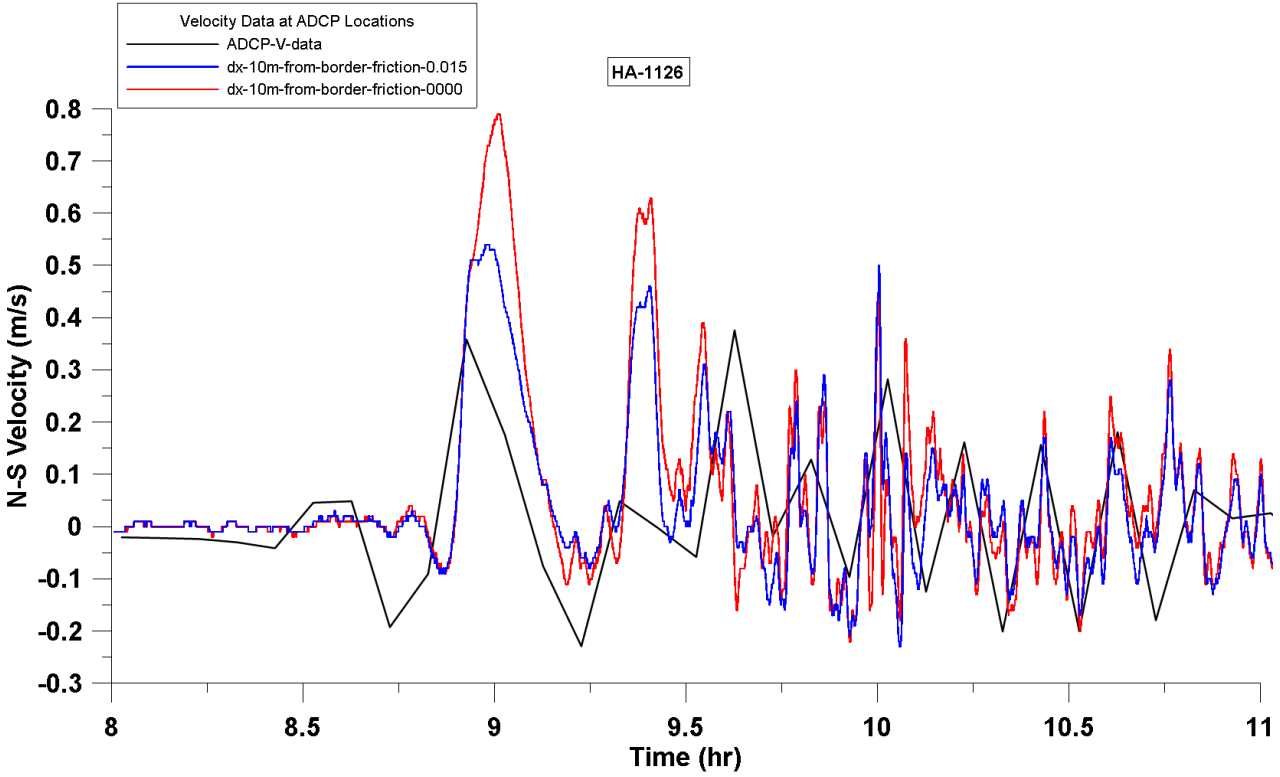
BM#2

Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in N-S Direction





HA1126: Hilo Harbor, Comparisons of the N-S current speeds for three different resolutions (Manning's Coefficient is 0.015)

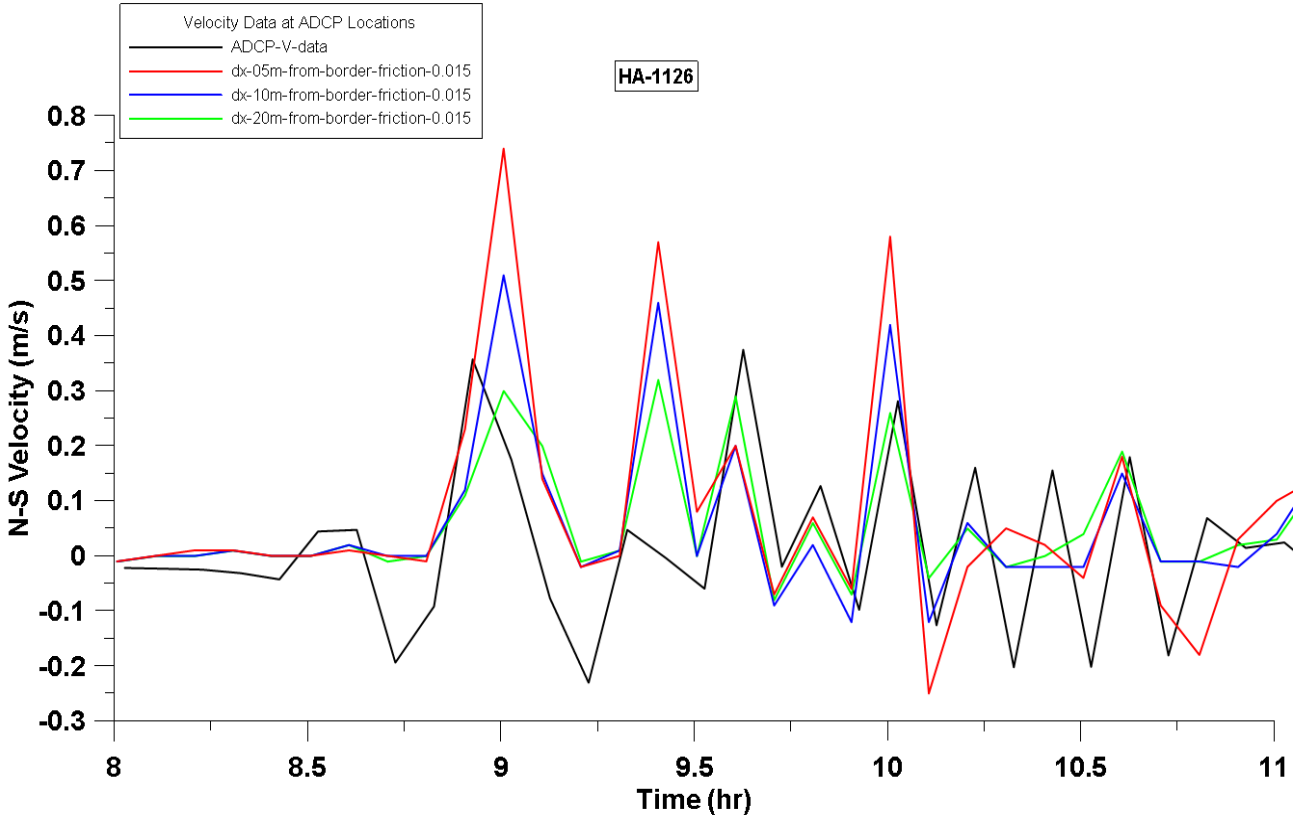
HA1126: Hilo Harbor, Comparisons of the N-S current speeds for 10m resolution with Manning's coefficients 0 and 0.015

BM#2

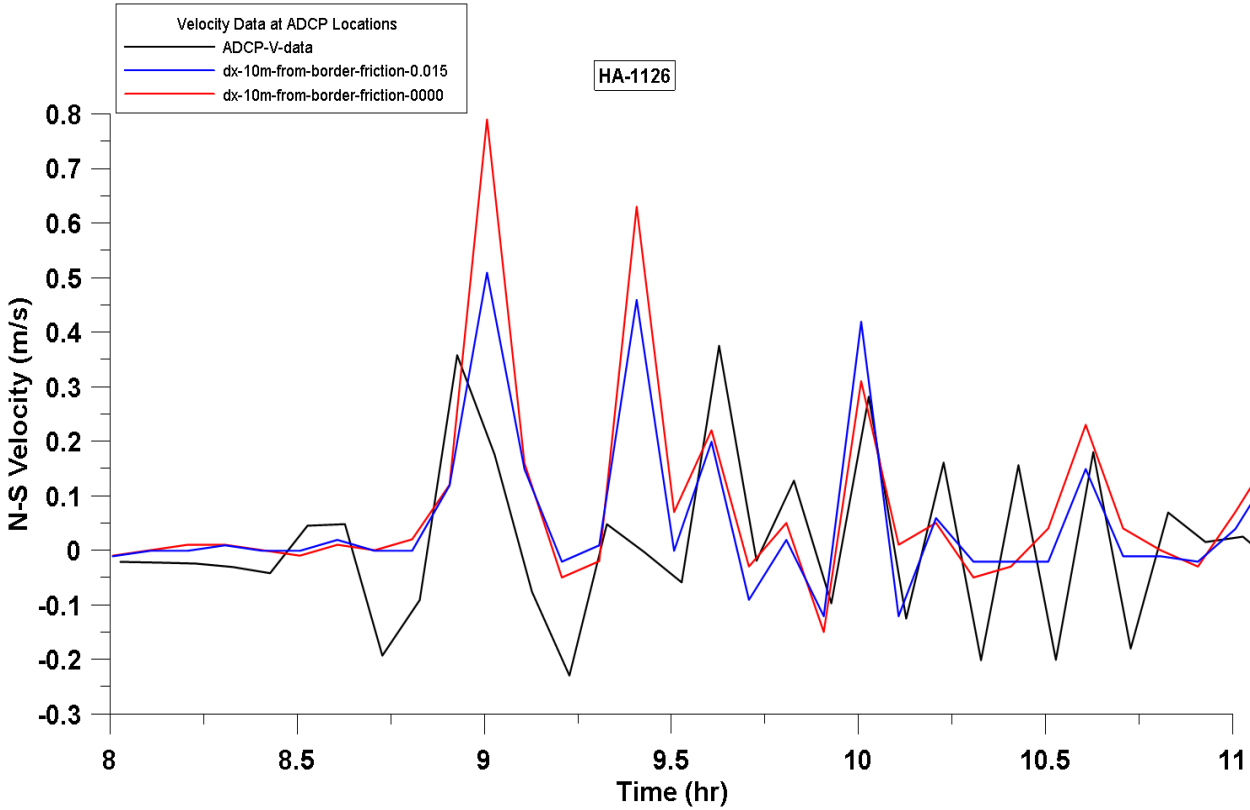
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in N-S Direction



HA1126: Hilo Harbor, Comparisons of the N-S current speeds for three different resolutions (Manning's Coefficient is 0.015)



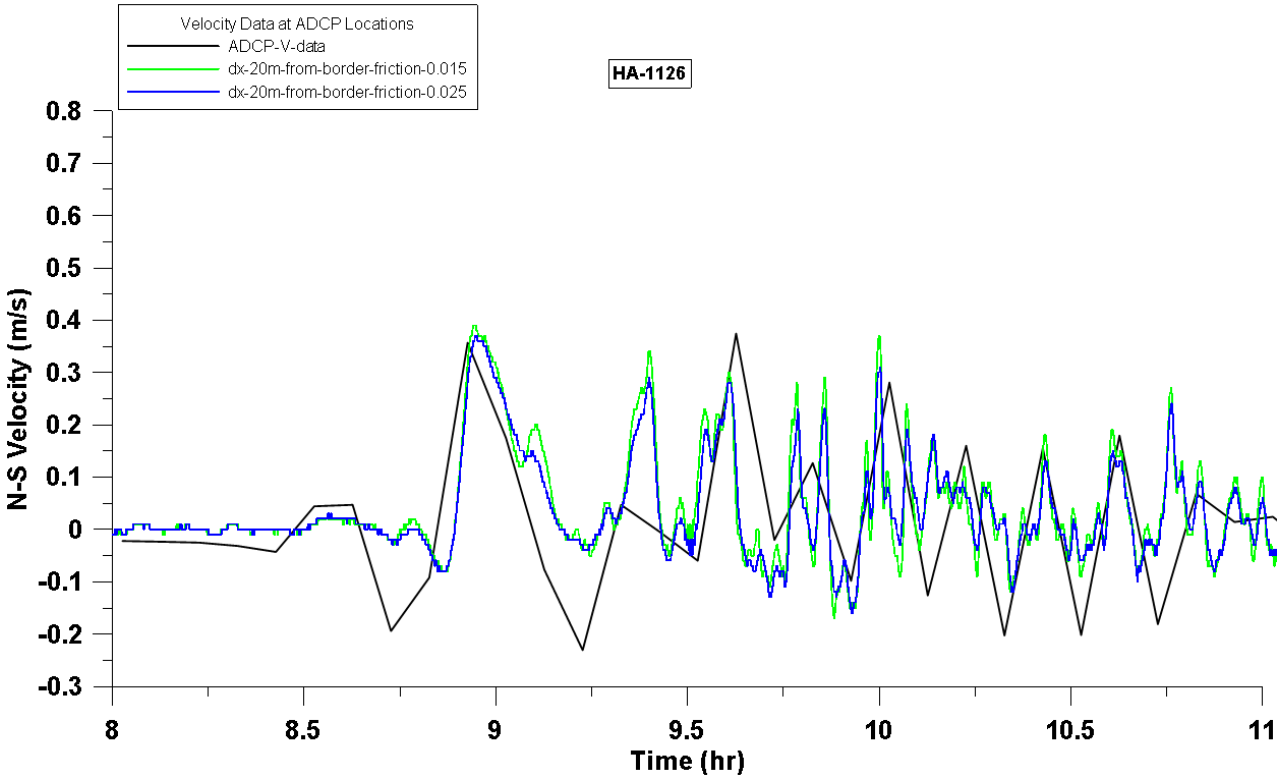
HA1126: Hilo Harbor, Comparisons of the N-S current speeds for 10m resolution with Manning's coefficients 0 and 0.015

BM#2

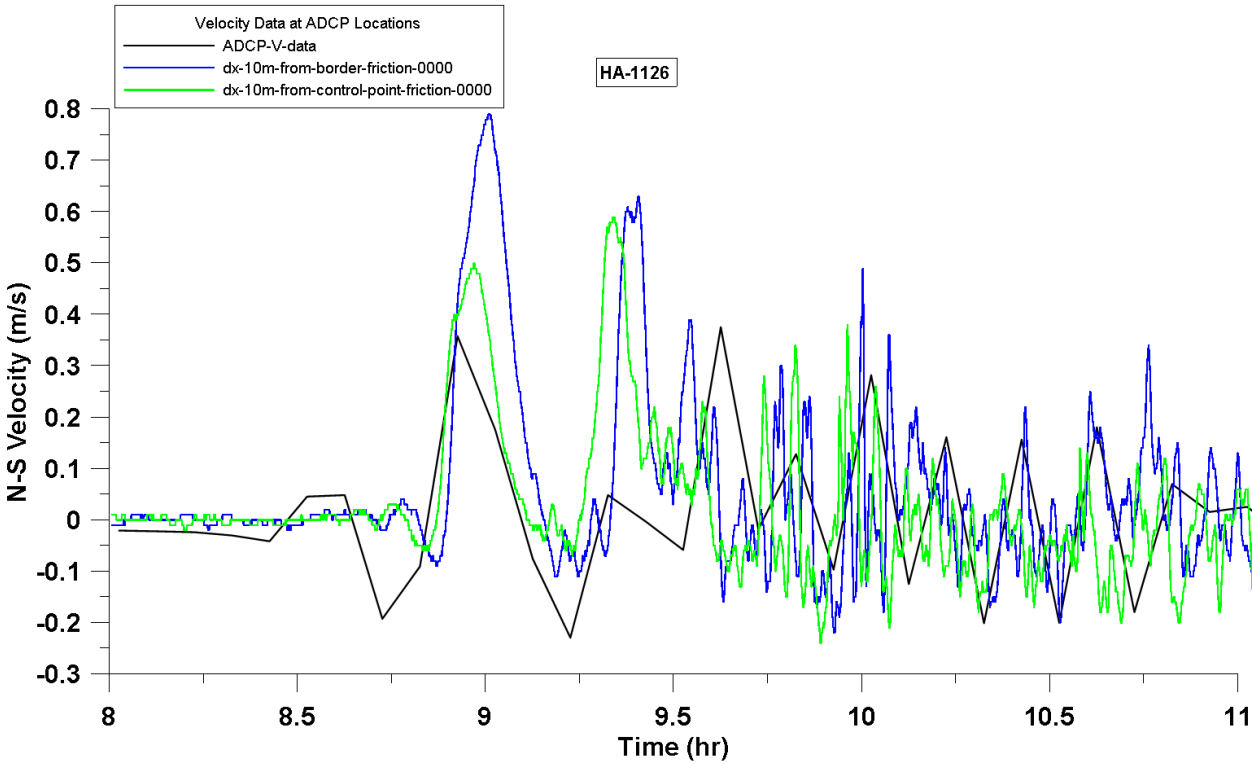
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in N-S Direction



HA1126: Hilo Harbor, Comparisons of the N-S current speeds for 20m resolution with Manning's coefficients 0.015 and 0.025



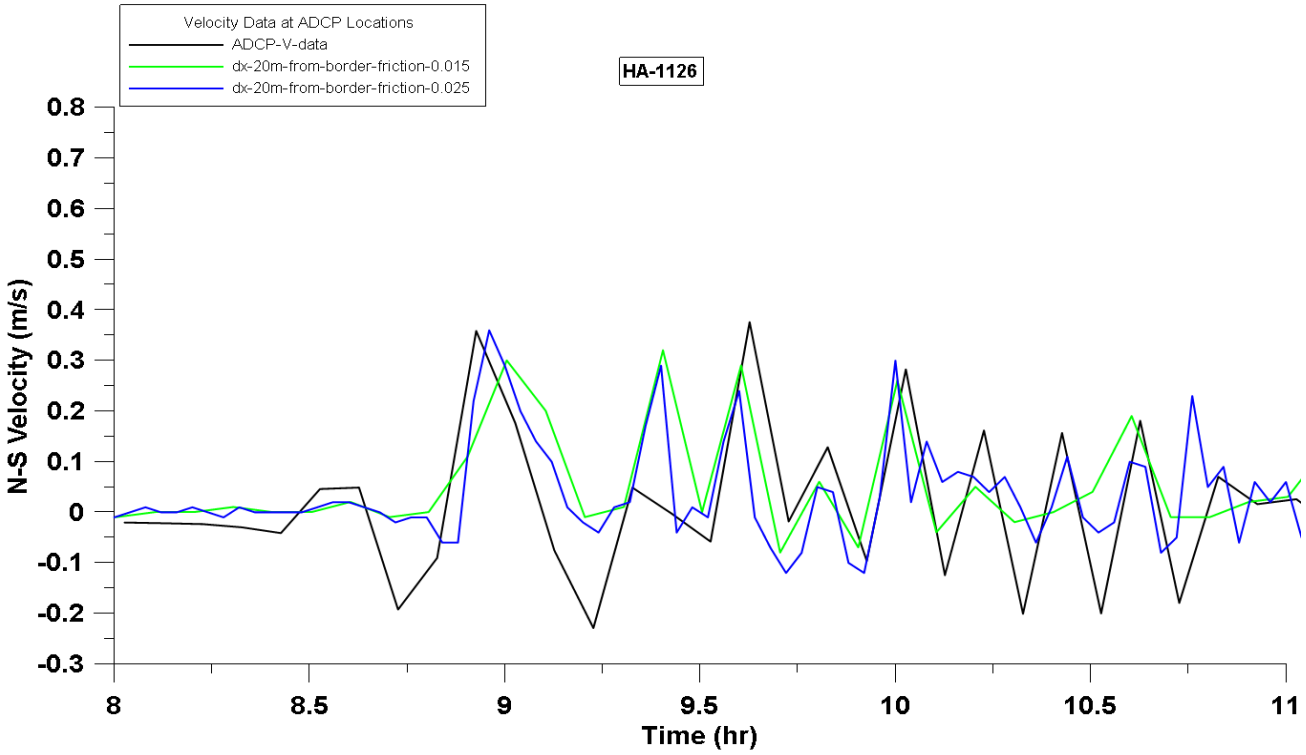
HA1126: Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in N-S direction

BM#2

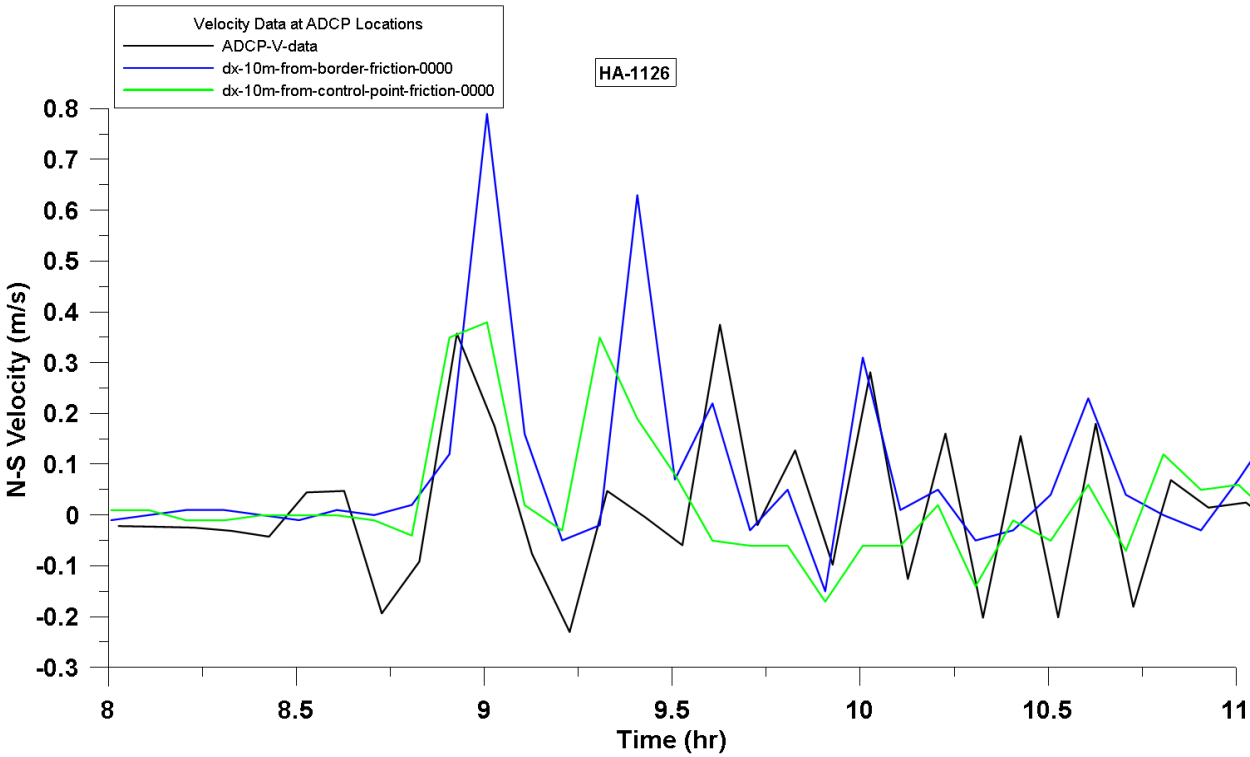
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1126, Inside Harbor

- Current Speeds in N-S Direction



HA1126: Hilo Harbor, Comparisons of the N-S current speeds for 20m resolution with Manning's coefficients 0.015 and 0.025



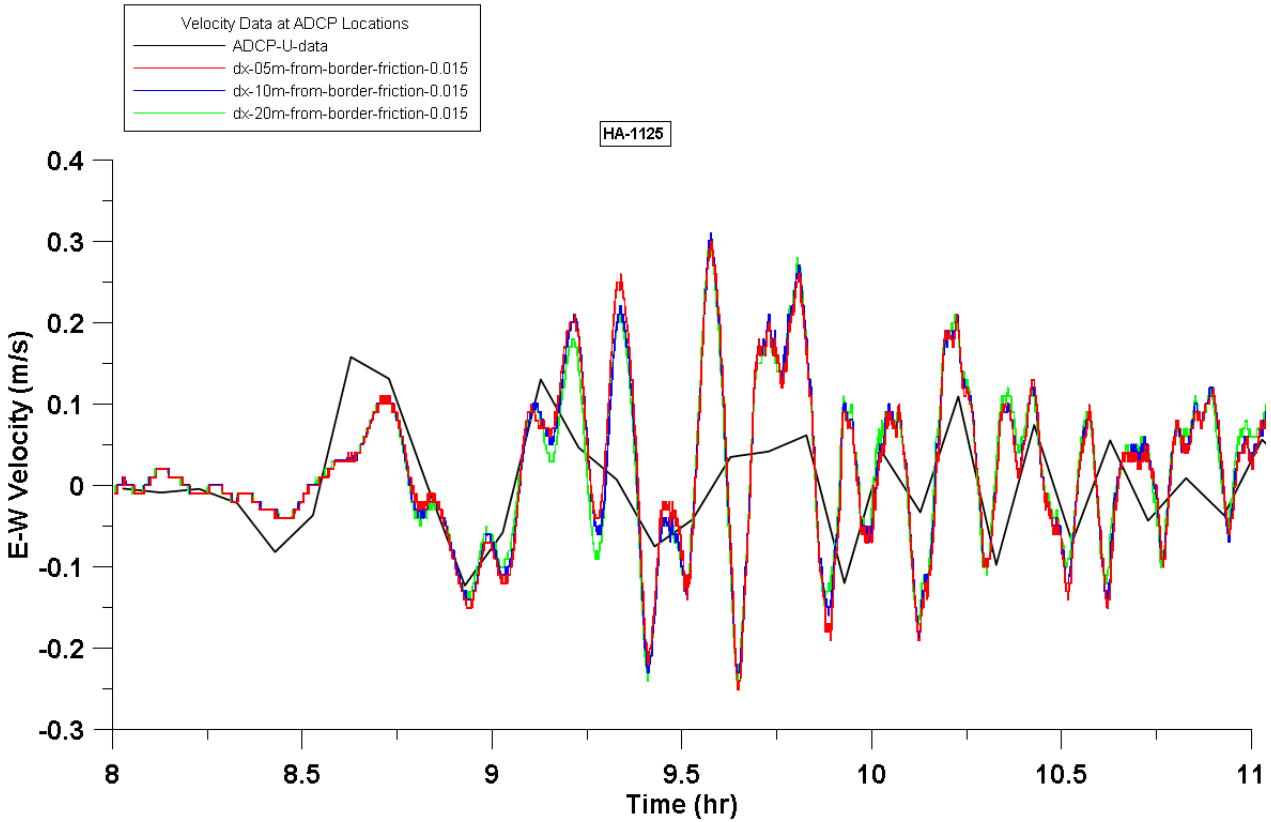
HA1126: Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in N-S direction

BM#2

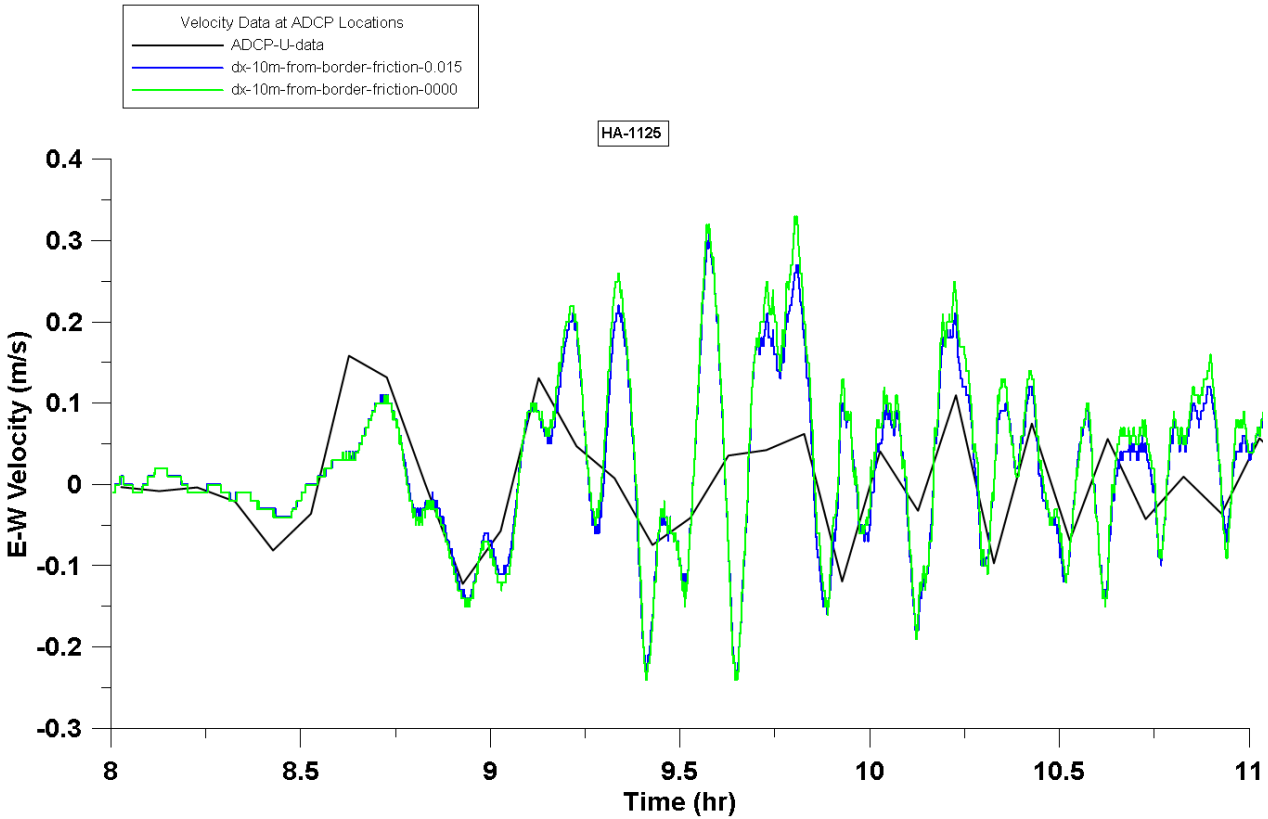
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in E-W Direction



HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for three different resolutions (Manning's Coefficient is 0.015)

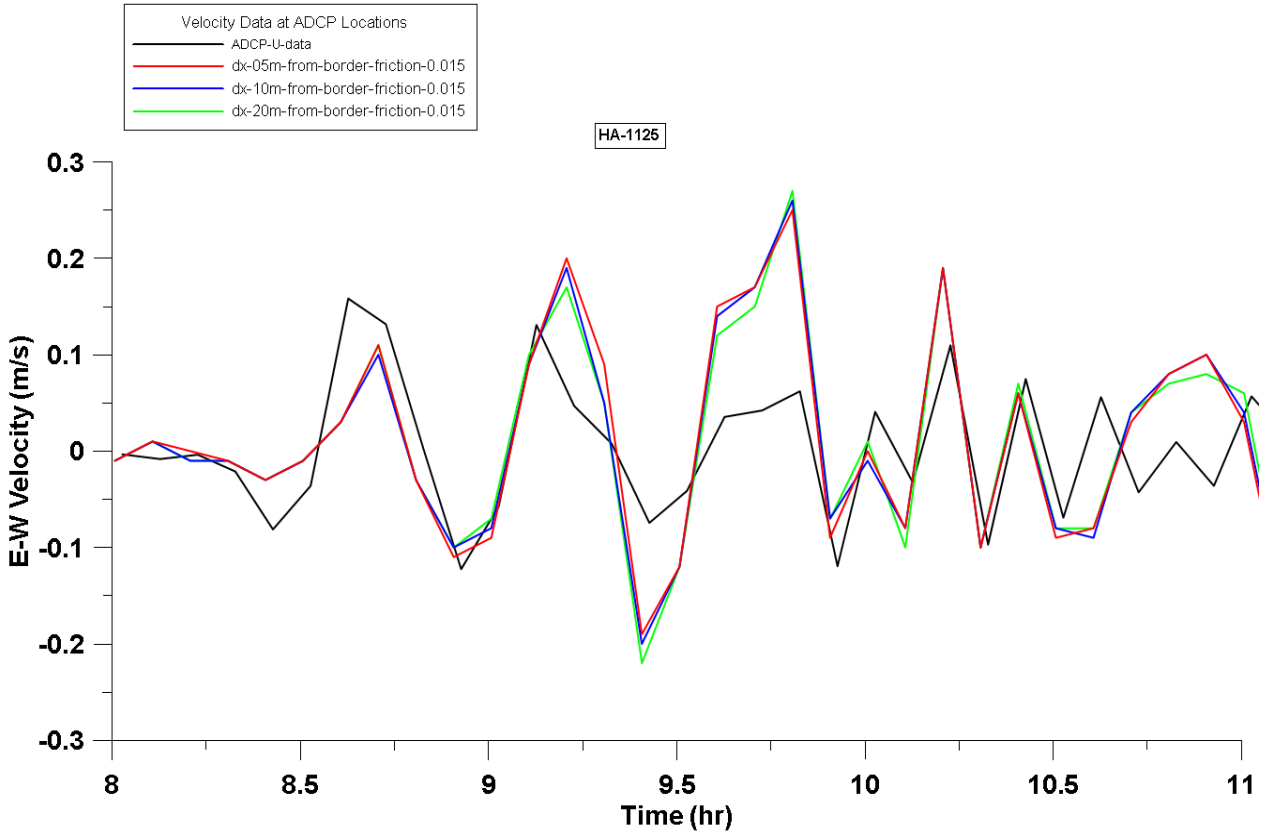


HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for 10m resolution with Manning's coefficient 0 and 0.015

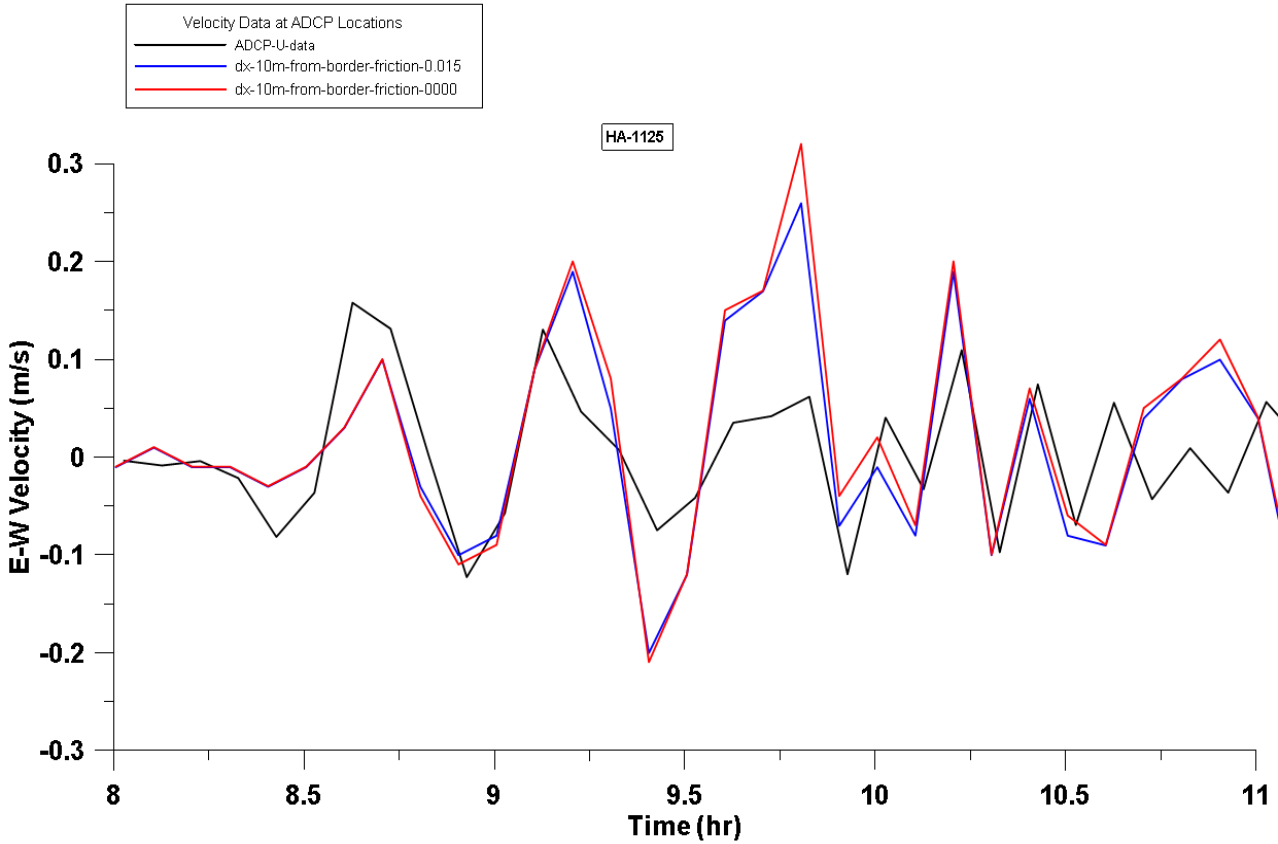
BM#2 **Plot frequency 360 sec (field data), 2.5 sec (numerical data)**

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in E-W Direction



HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for three different resolutions (Manning's Coefficient is 0.015)



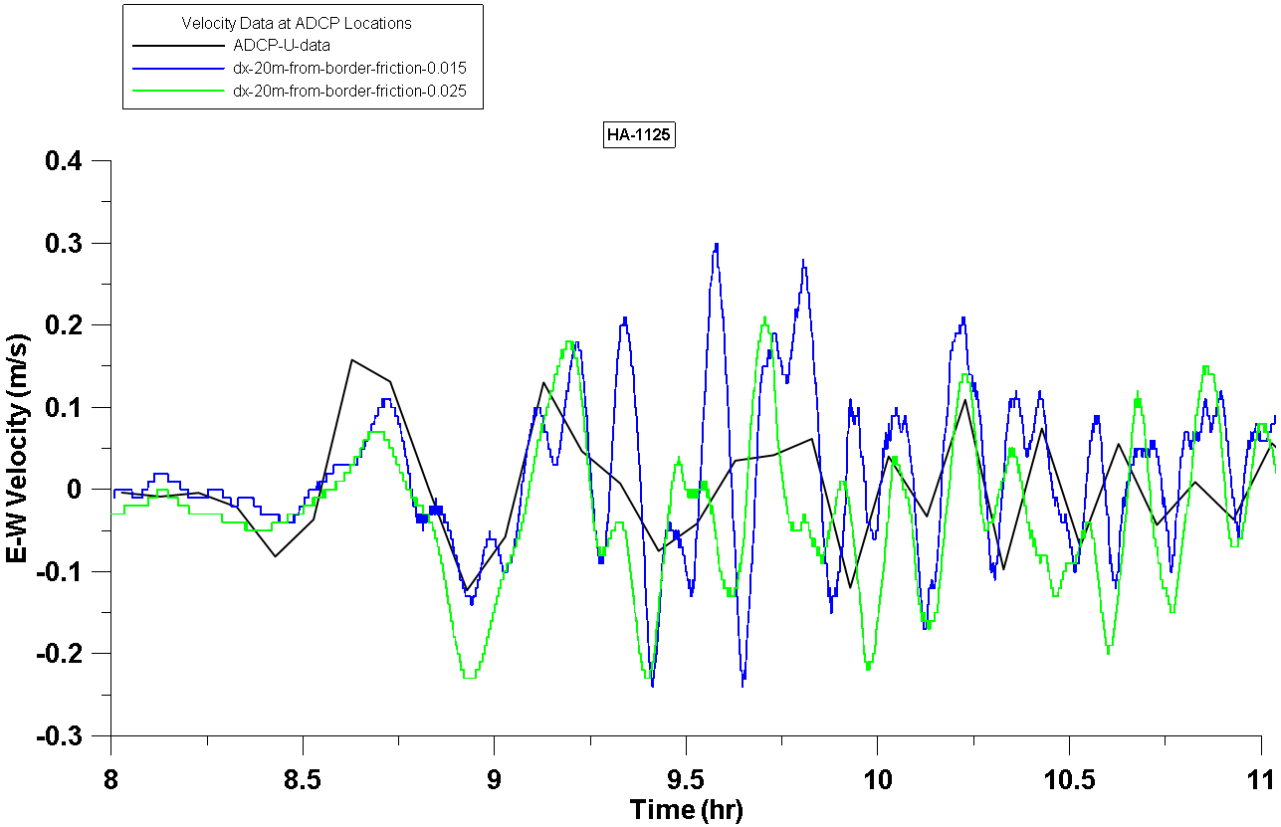
HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for 10m resolution with Manning's coefficient 0 and 0.015

BM#2

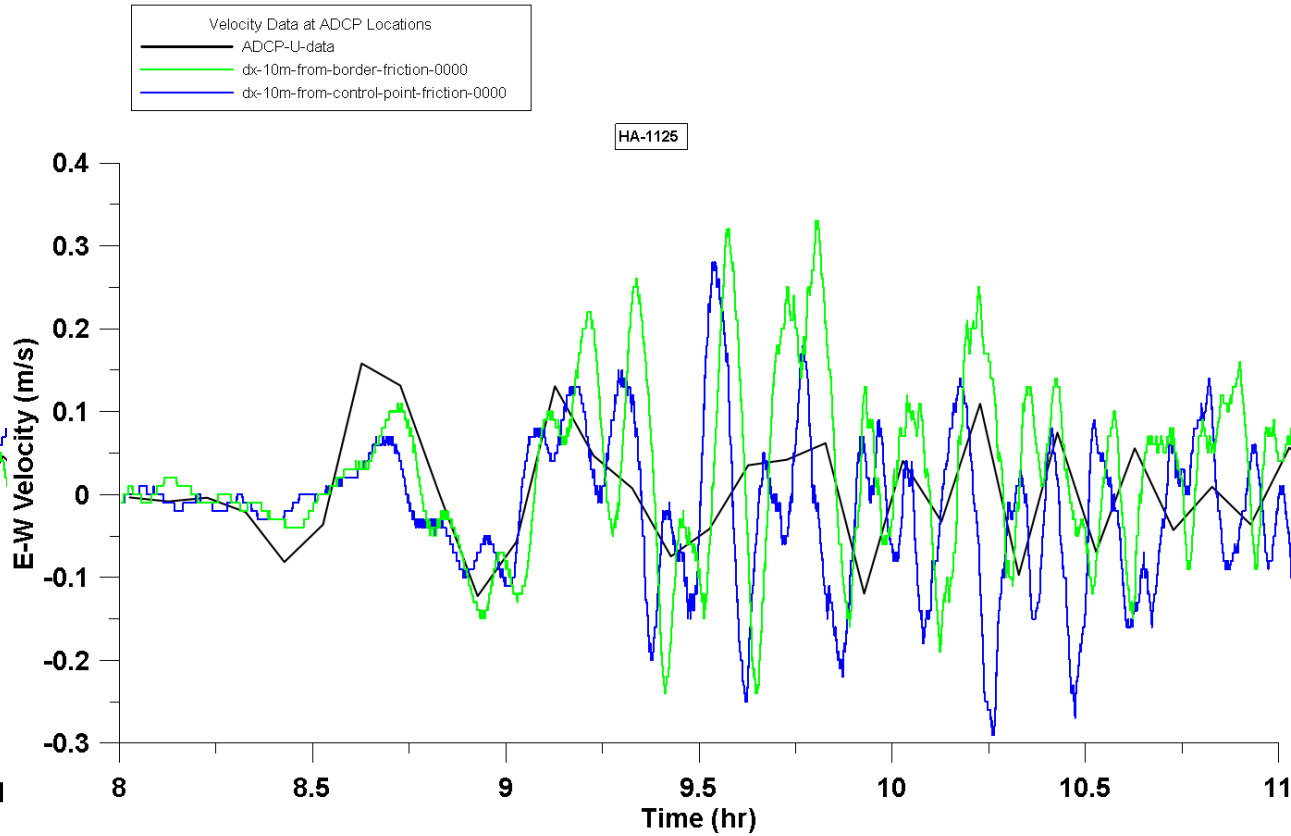
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in E-W Direction



HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for 20m resolution with Manning's coefficient 0.015 and 0.025



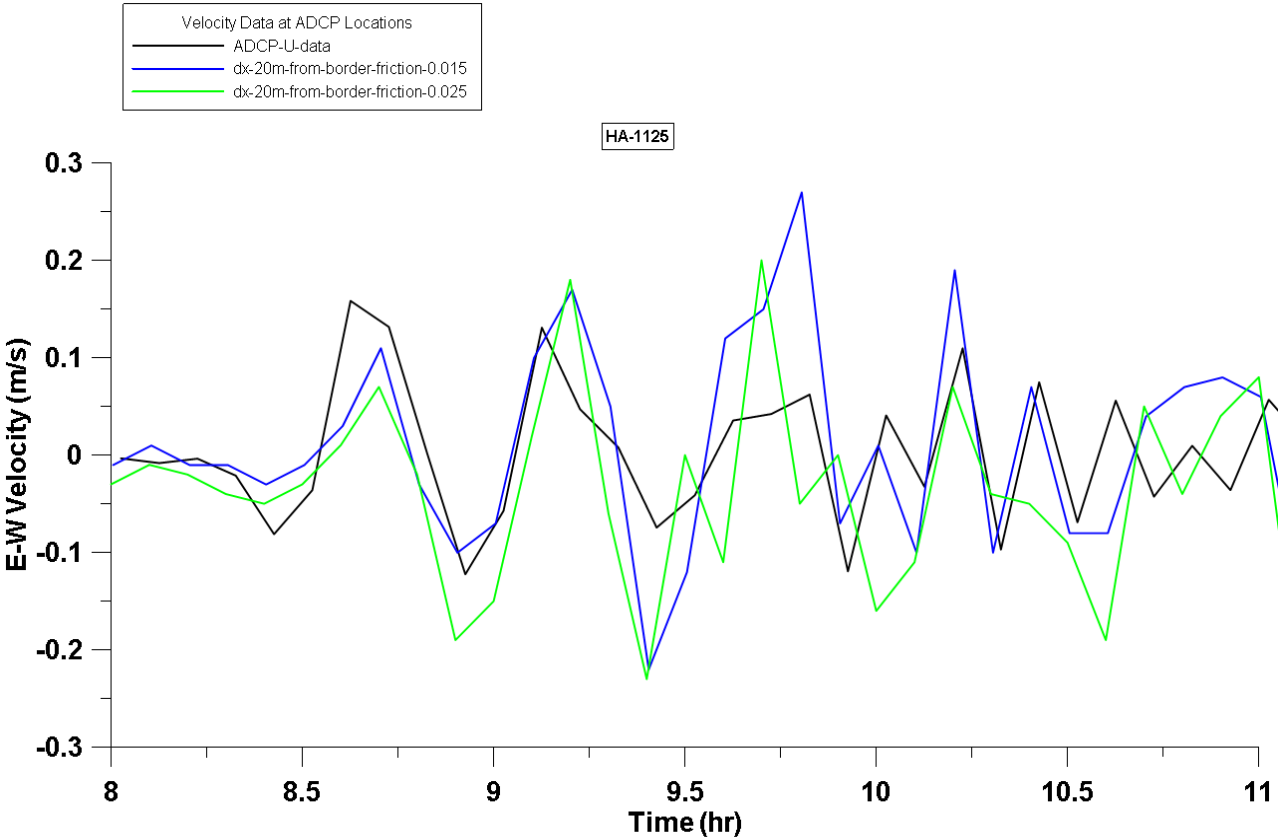
HA1125: Approach to Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in E-W direction

BM#2

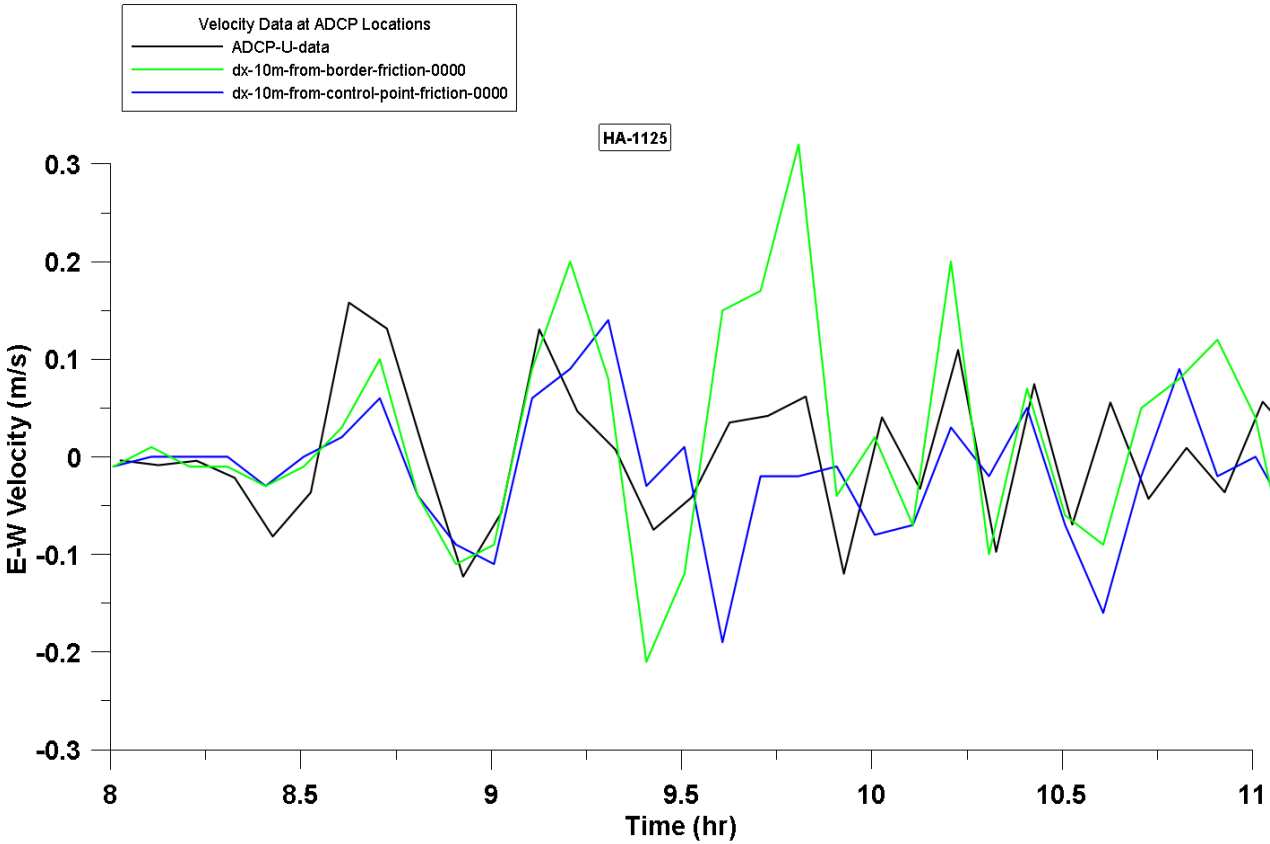
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in E-W Direction



HA1125: Approach to Hilo Harbor, Comparisons of the E-W current speeds for 20m resolution with Manning's coefficient 0.015 and 0.025



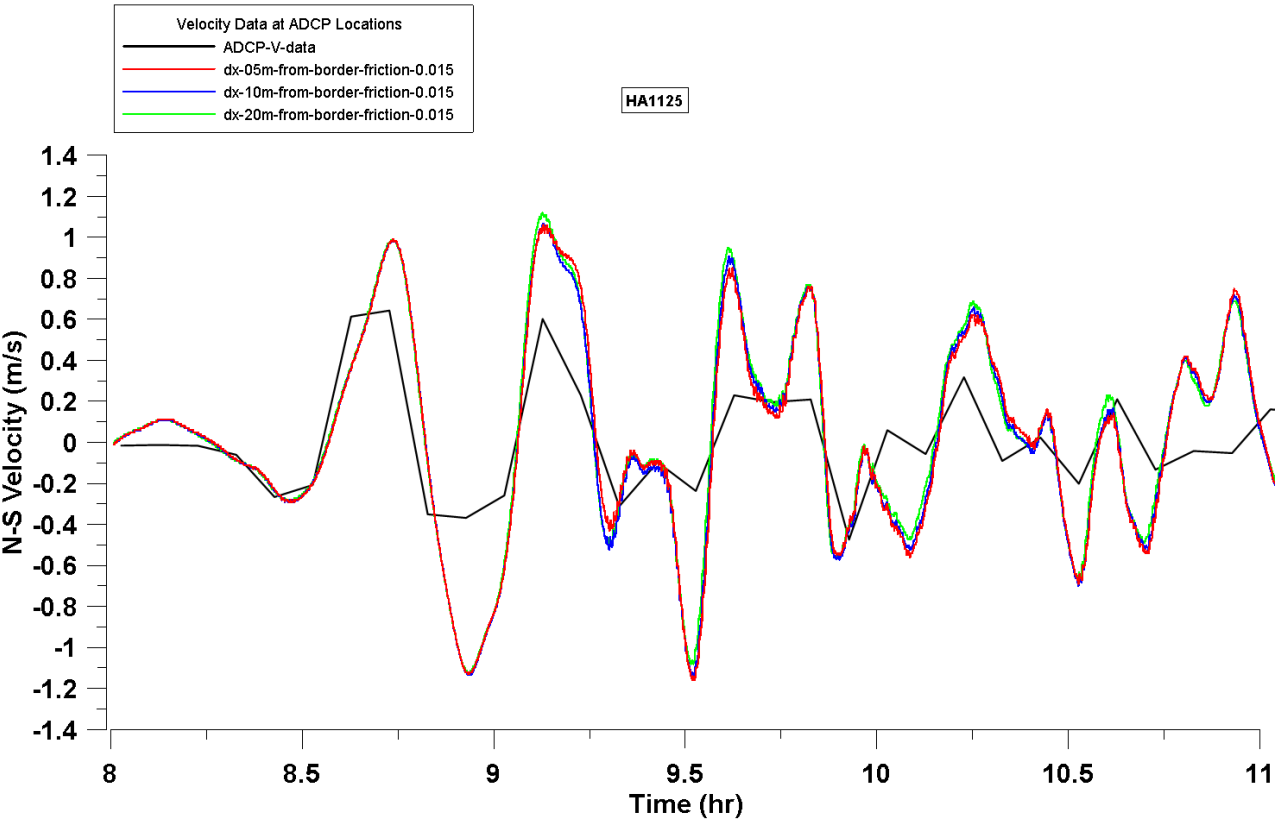
HA1125: Approach to Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in E-W direction

BM#2

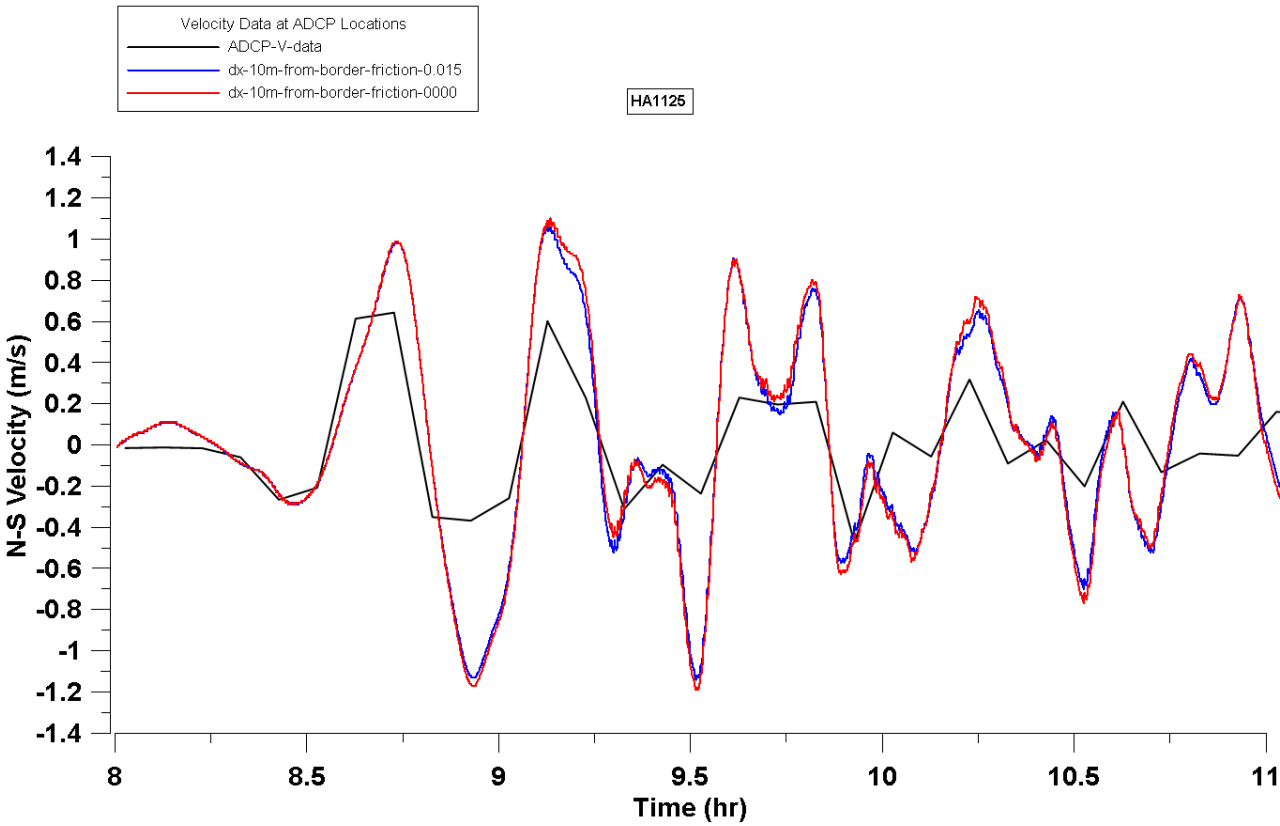
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in N-S Direction



HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for three different resolutions (Manning's Coefficient is 0.015)



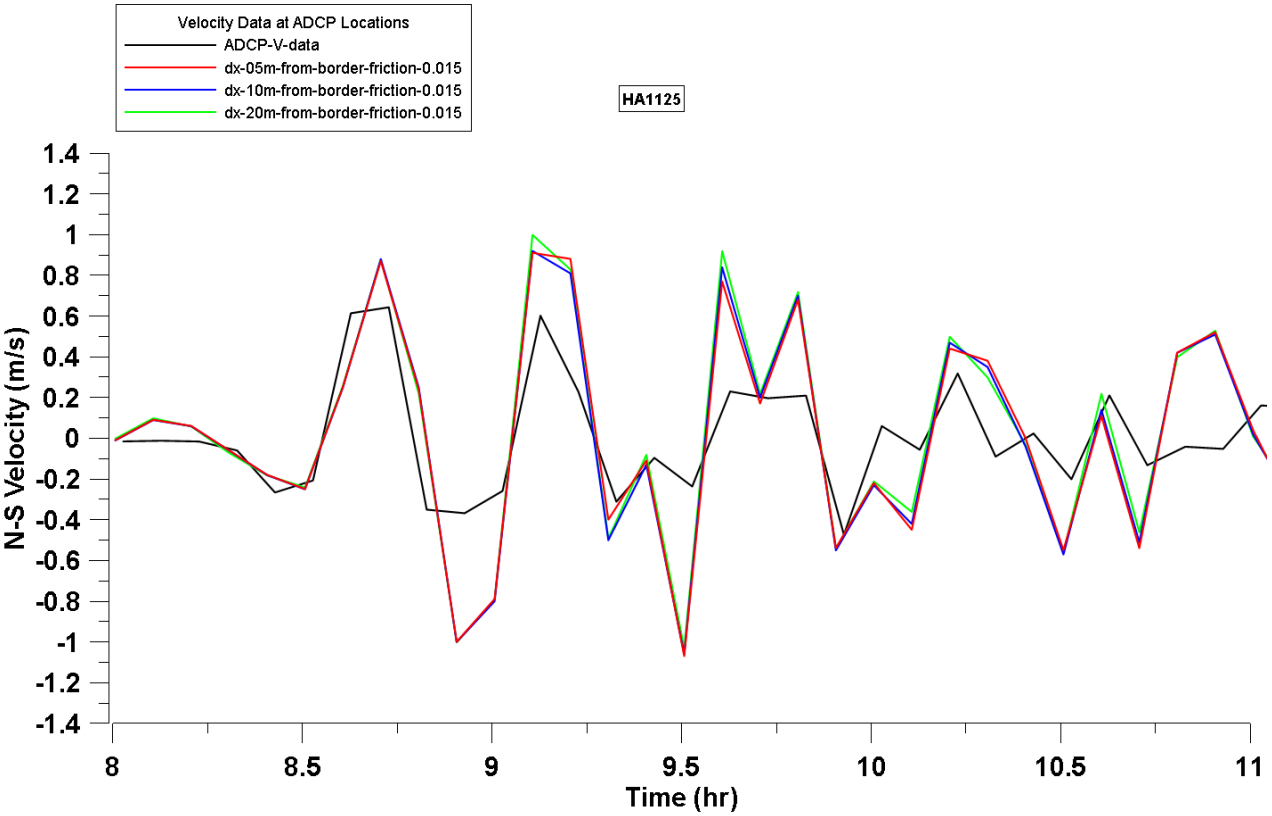
HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for 10m resolution with Manning's coefficients 0 and 0.015

BM#2

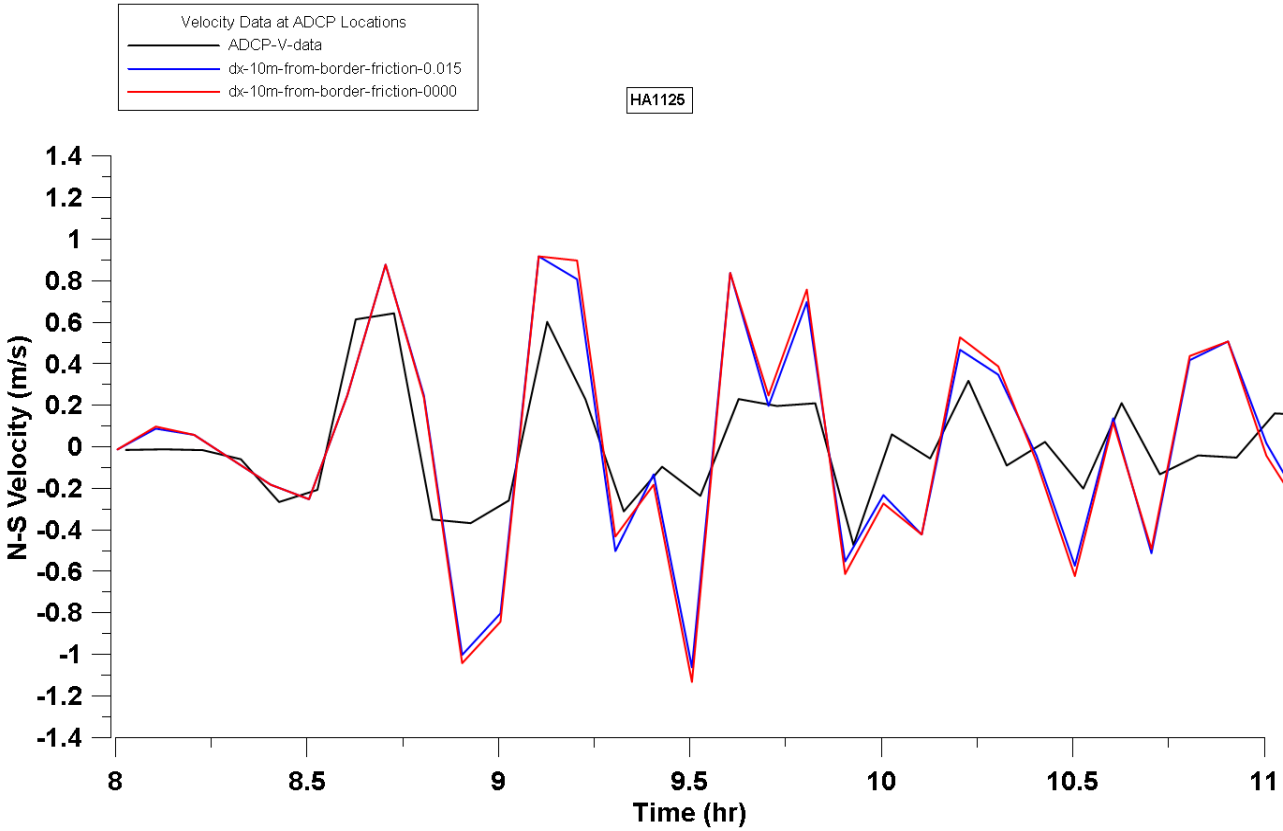
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in N-S Direction



HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for three different resolutions (Manning's Coefficient is 0.015)



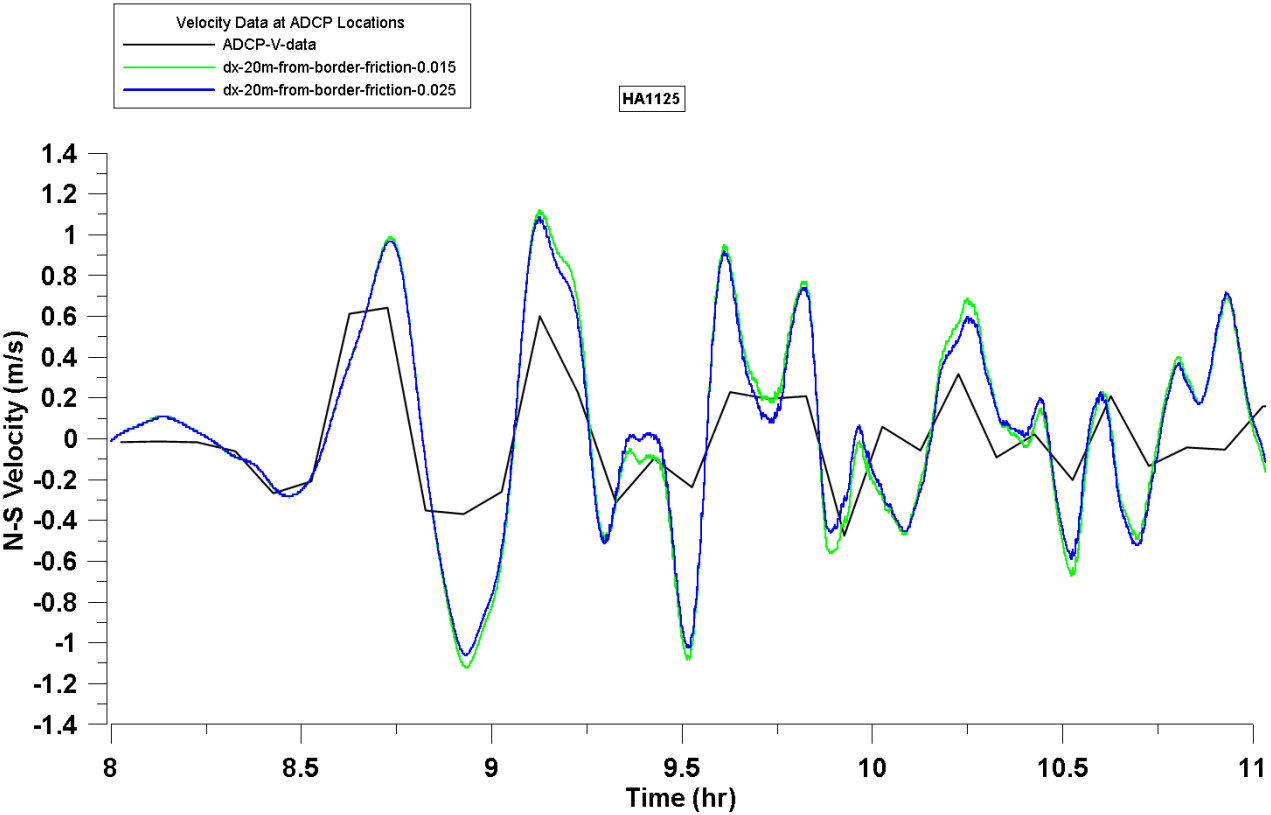
HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for 10m resolution with Manning's coefficients 0 and 0.015

BM#2

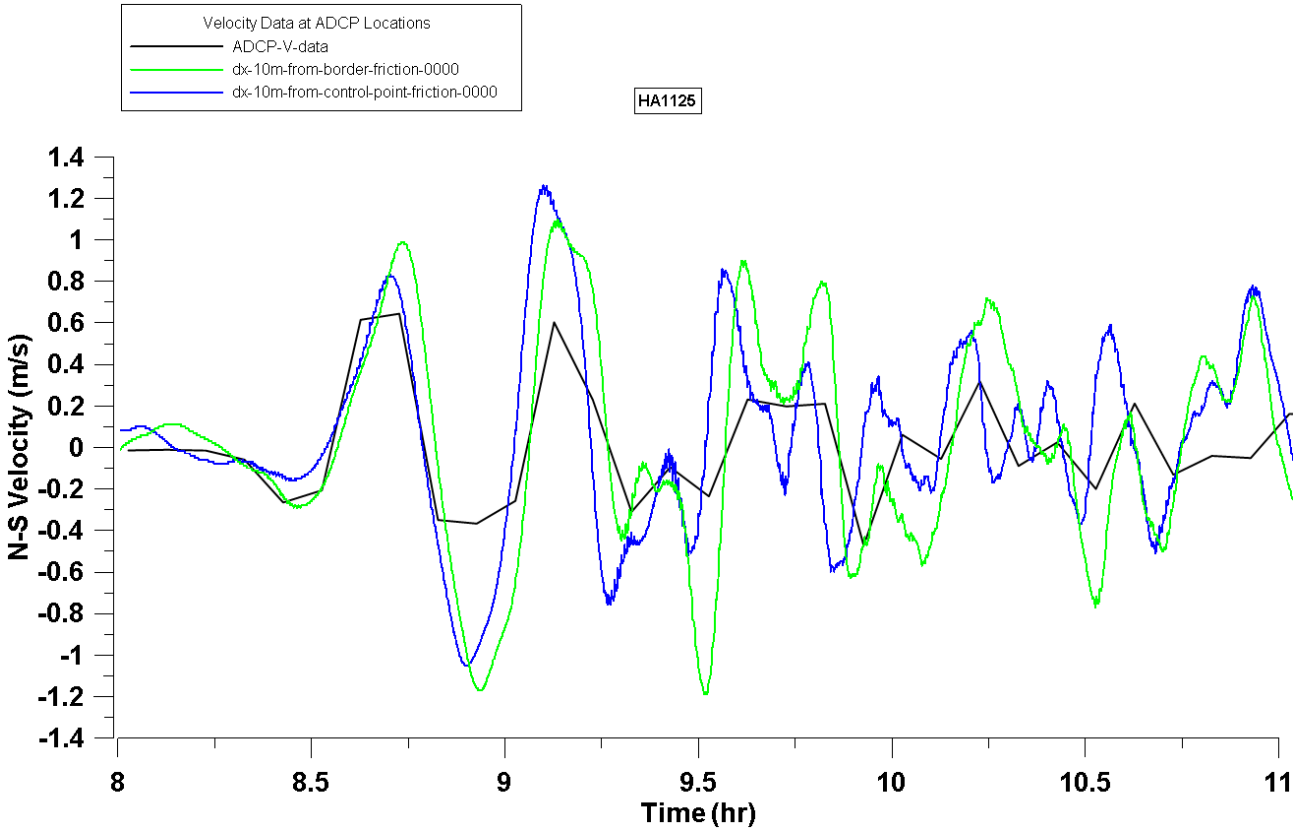
Data plot frequency 360 sec

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in N-S Direction



HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for 20m resolution with Manning's coefficients 0.015 and 0.025



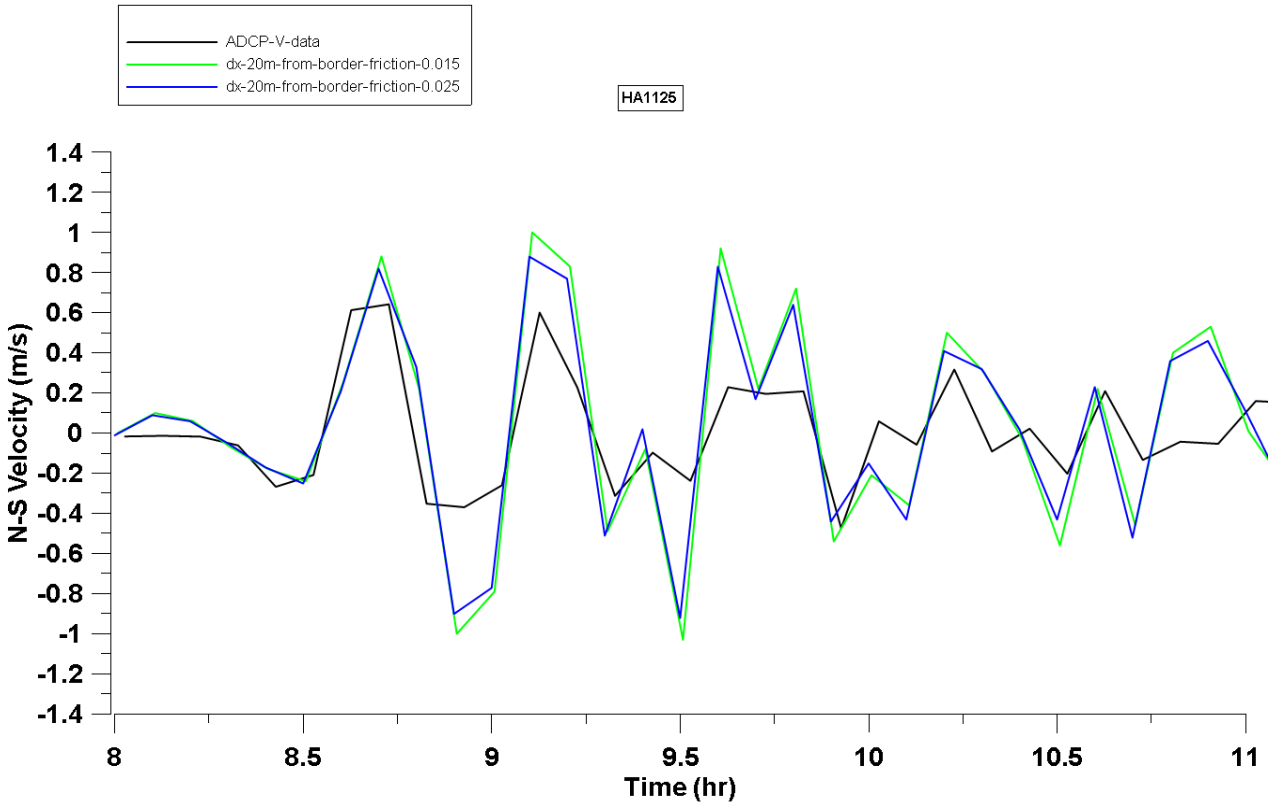
HA1125: Approach to Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in N-S direction

BM#2

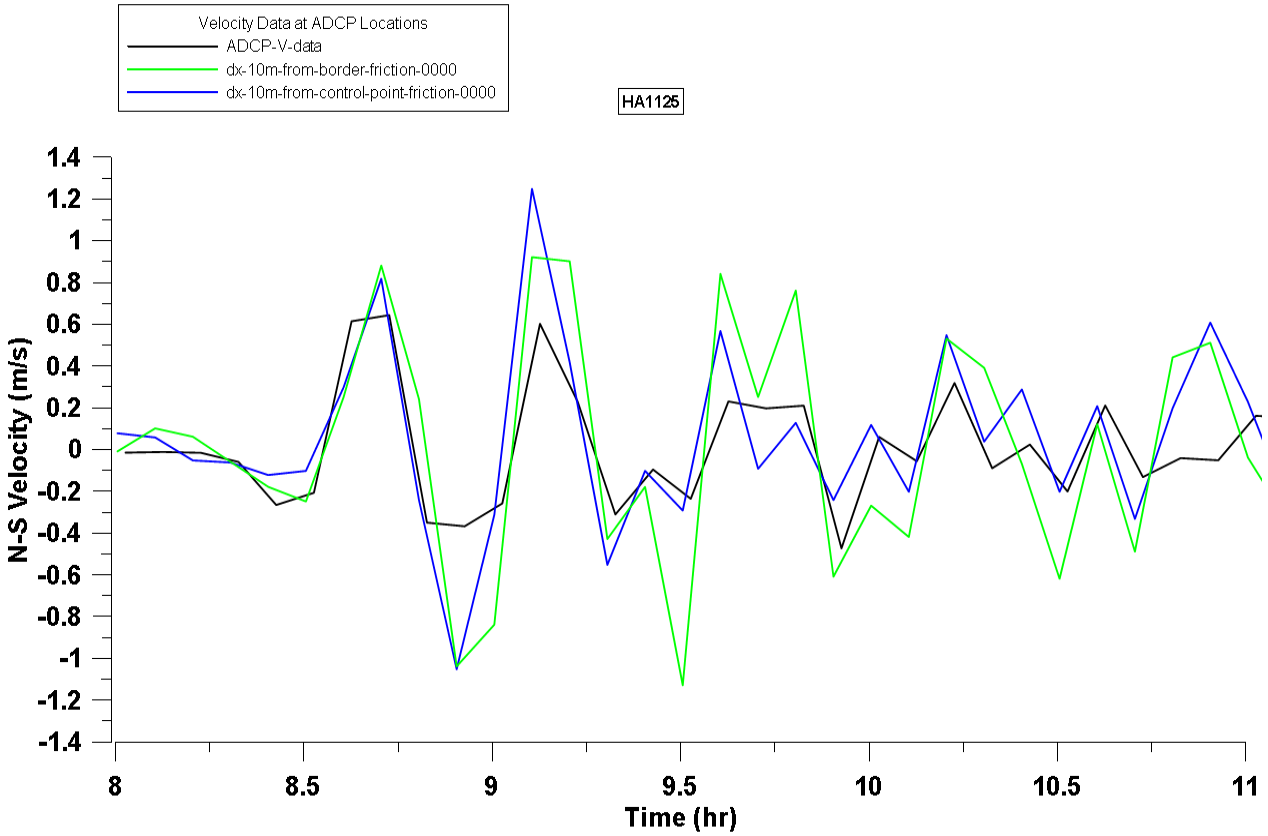
Plot frequency 360 sec (field data), 2.5 sec (numerical data)

COMPARISON OF RESULTS -
Current Speeds at ADCP Locations - HA1125, Harbor Entrance

- Current Speeds in N-S Direction



HA1125: Approach to Hilo Harbor, Comparisons of the N-S current speeds for 20m resolution with Manning's coefficients 0.015 and 0.025

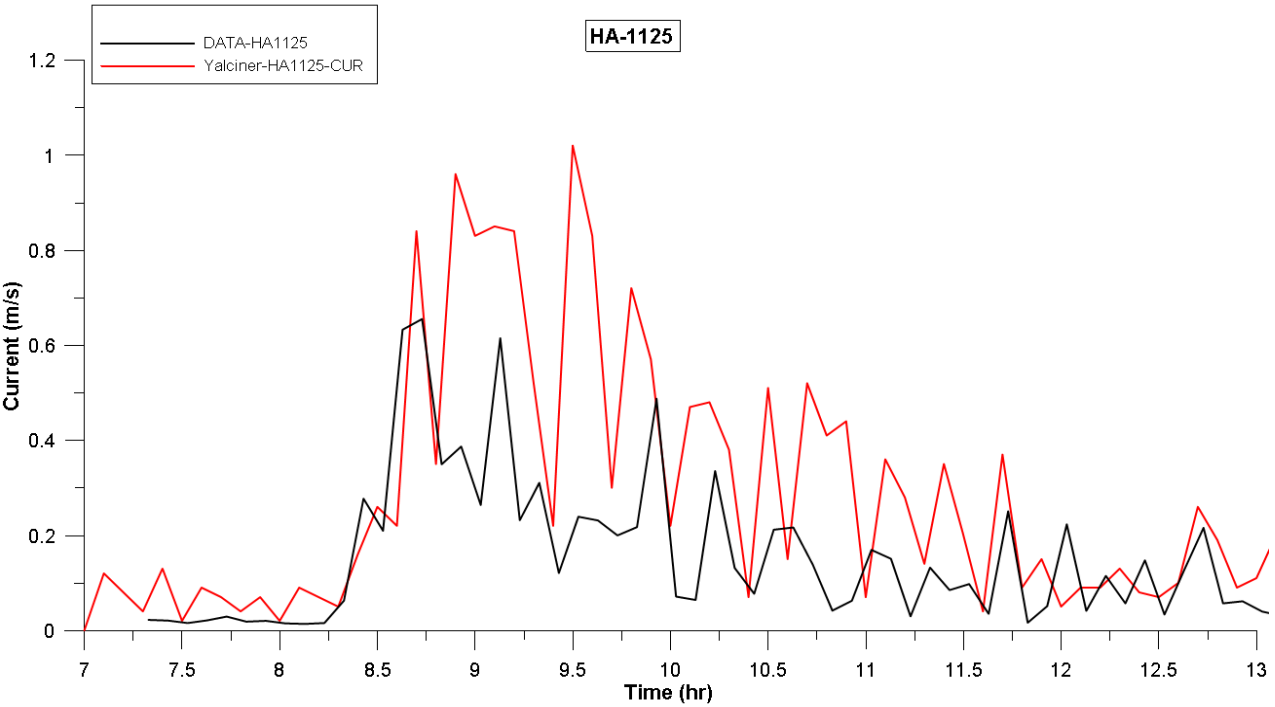


HA1125: Approach to Hilo Harbor, Comparison of the input location of incident wave with 10m resolution for current speeds in N-S direction

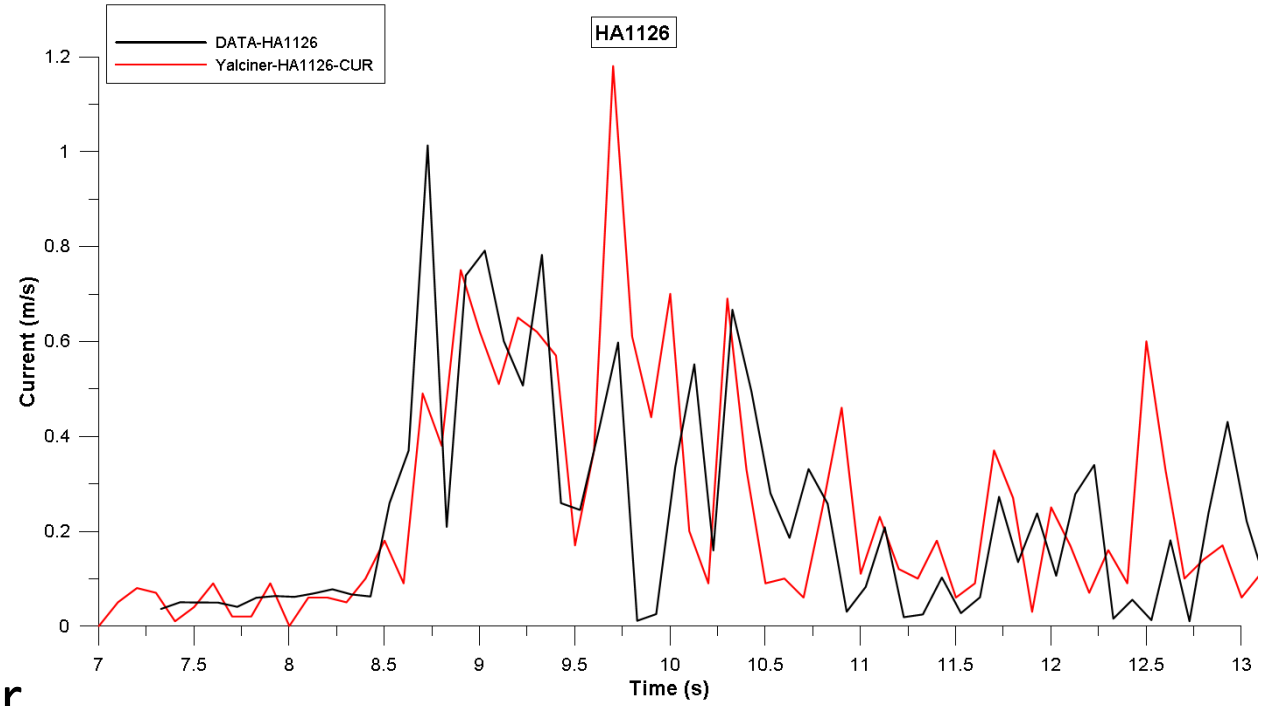
BM#2

Data plot frequency 360 sec

COMPARISON OF RESULTS - Maximum Speeds



Harbor Entrance



Inside Harbor

BM#2

NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

Benchmark Problem #3

Japan 2011 tsunami in Tauranga Harbor, New Zealand

Ahmet C. Yalciner, Andrey Zaytsev, Utku Kanoglu

Project Assistant, Rozita Kian

Middle East Technical University

Department of Civil Engineering Department

Department of Engineering Sciences

09.02.2015

BM#3 –
Japan 2011 Tsunami in Tauranga, New Zealand

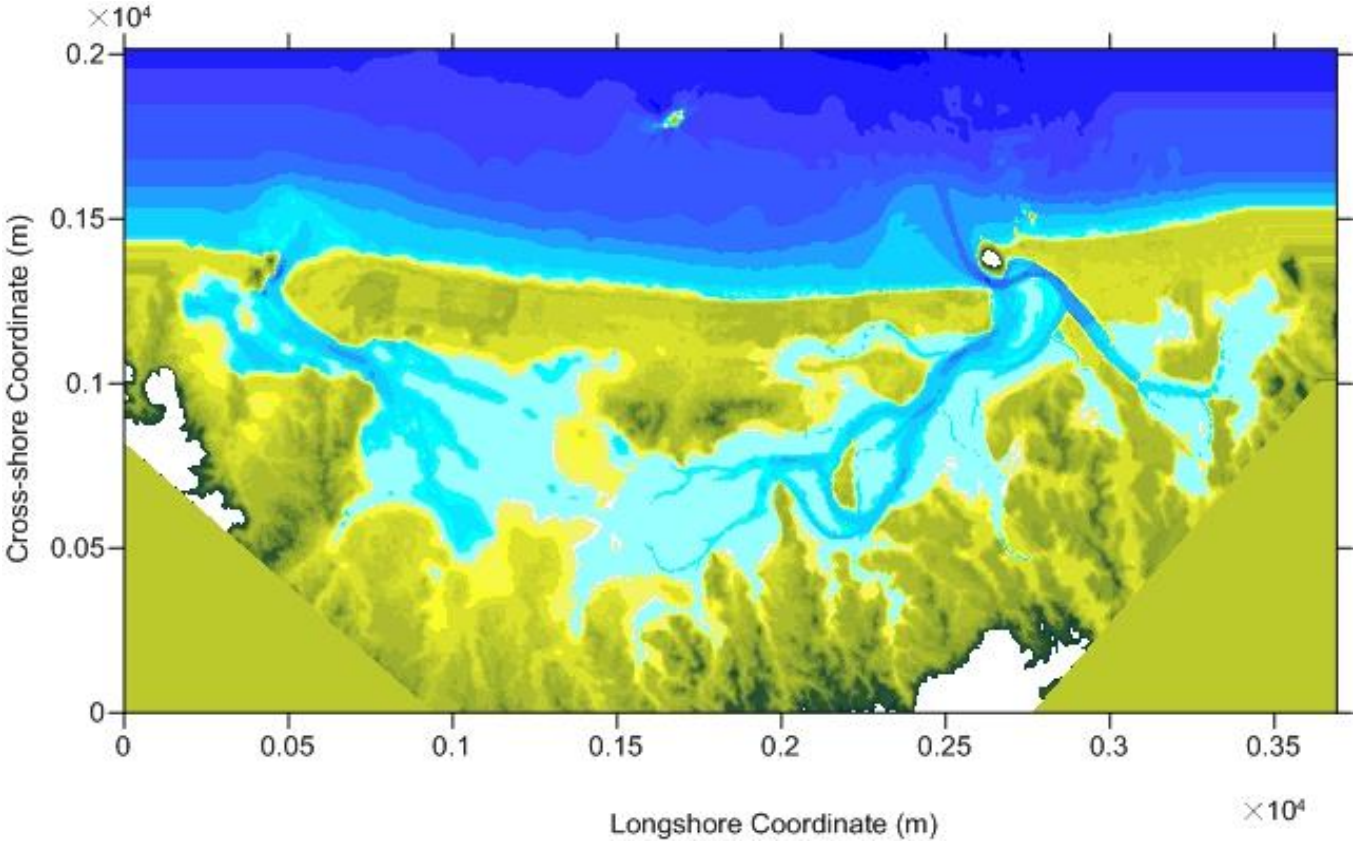
- The unique component of this benchmark test is to attempt to include the effects of the tides and compare free surface elevation (from tide stations) and velocity information (from and ADCP).

- The results obtained from these simulation studies using NAMI DANCE and the comparisons with the actual data for free surface elevation and current speeds are provided.

BM#3 – Japan 2011 Tsunami in Tauranga Harbor, New Zealand
Bathymetry

- Bathymetry data is provided for 30m resolution (1 arcsec grid).

- Maximum Water Depth : 37.6m
- Depth of Input wave in ABeacon: 25m
- Simulation time step: 0.25 sec
- Manning Coeff: 0.025



Bathymetry used in simulations for 30 m resolution

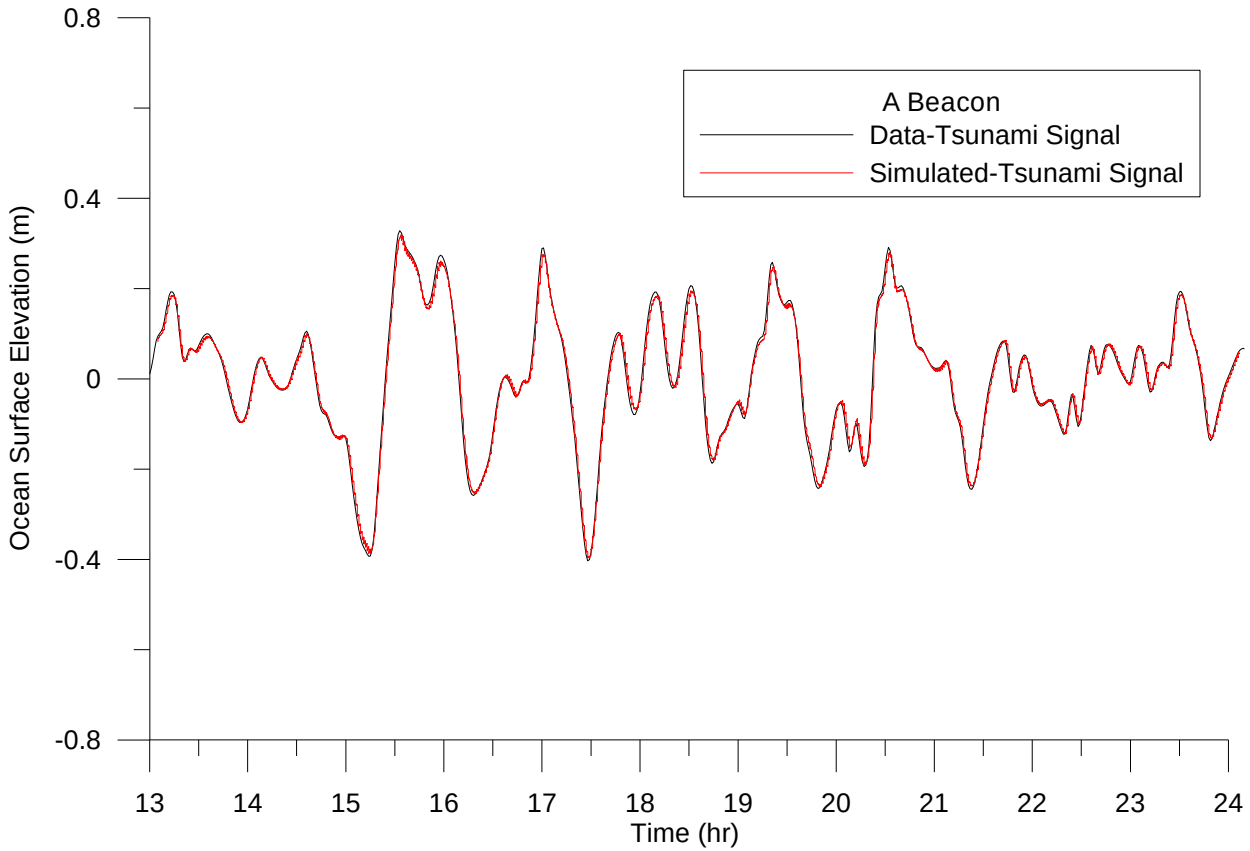
BM#3 – Japan 2011 Tsunami in Tauranga Harbor, New Zealand

Gauge Points

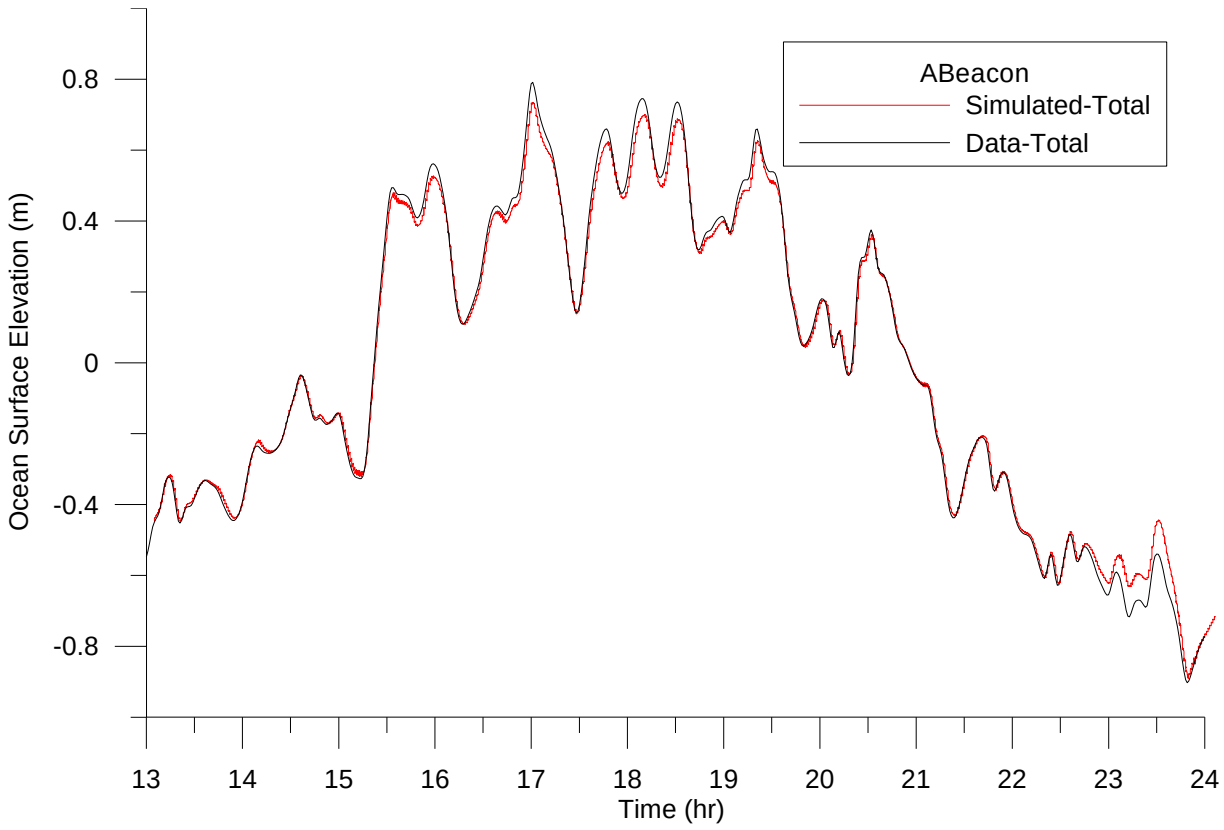
Gauge Point	X Coordinate (m)	Y Coordinate (m)
ABeacon	2.724e4	1.846e4
Tug Berth	3.085e4	1.512e4
Sulfur	3.2e4	1.347e4
Moturiki	3.005e4	1.61e4

BM#3 – Japan 2011 Tsunami in Tauranga Harbor, New Zealand
Incident Wave

- Since the incident wave data is given with 60 second (1 minute) time intervals, the data is obtained again for 0.25 second intervals for 30m resolution by making linear interpolation.

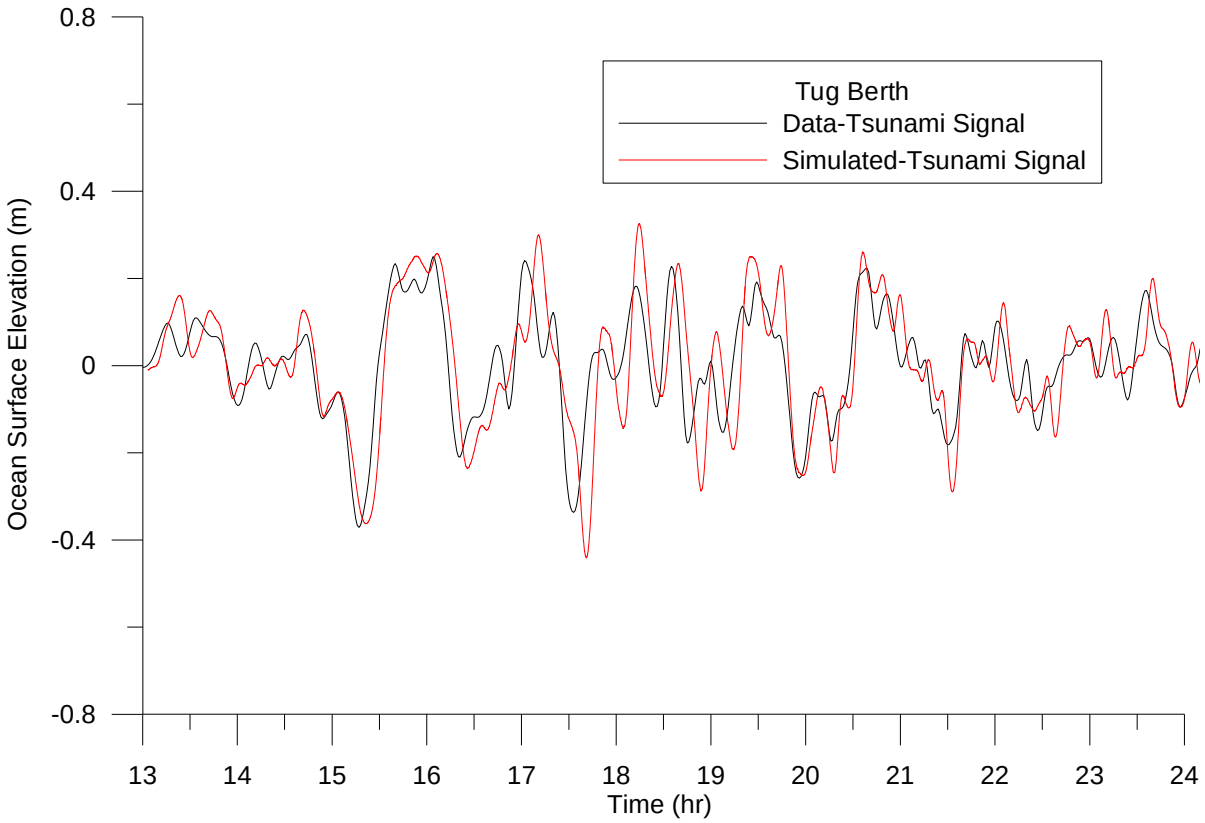


Incident Wave Comparison for tsunami signal in Abeacon (detided)

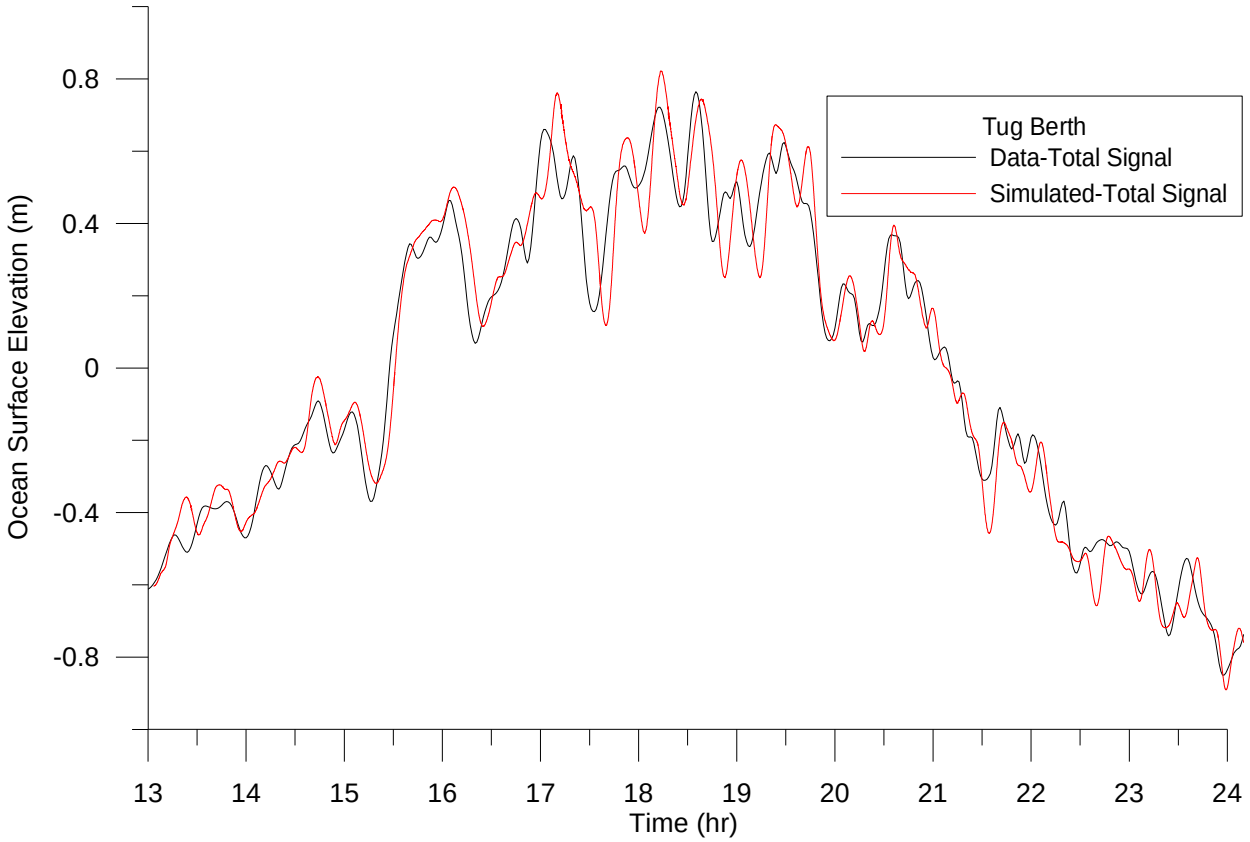


Incident Wave Comparison for tsunami signal in Abeacon (tided)

COMPARISON OF RESULTS – Water Surface Elevation @ Tug Berth



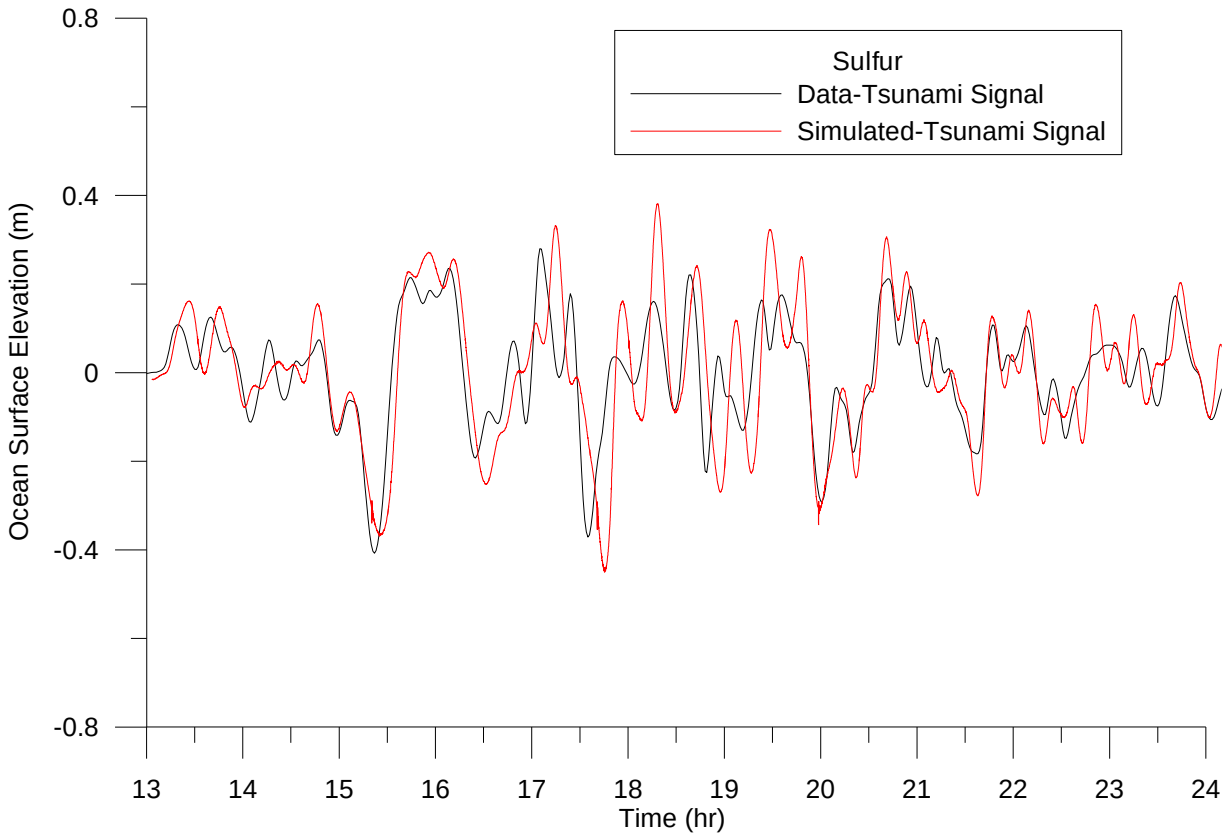
Comparison of water surface elevation at Tug Berth for tsunami signal (detided)



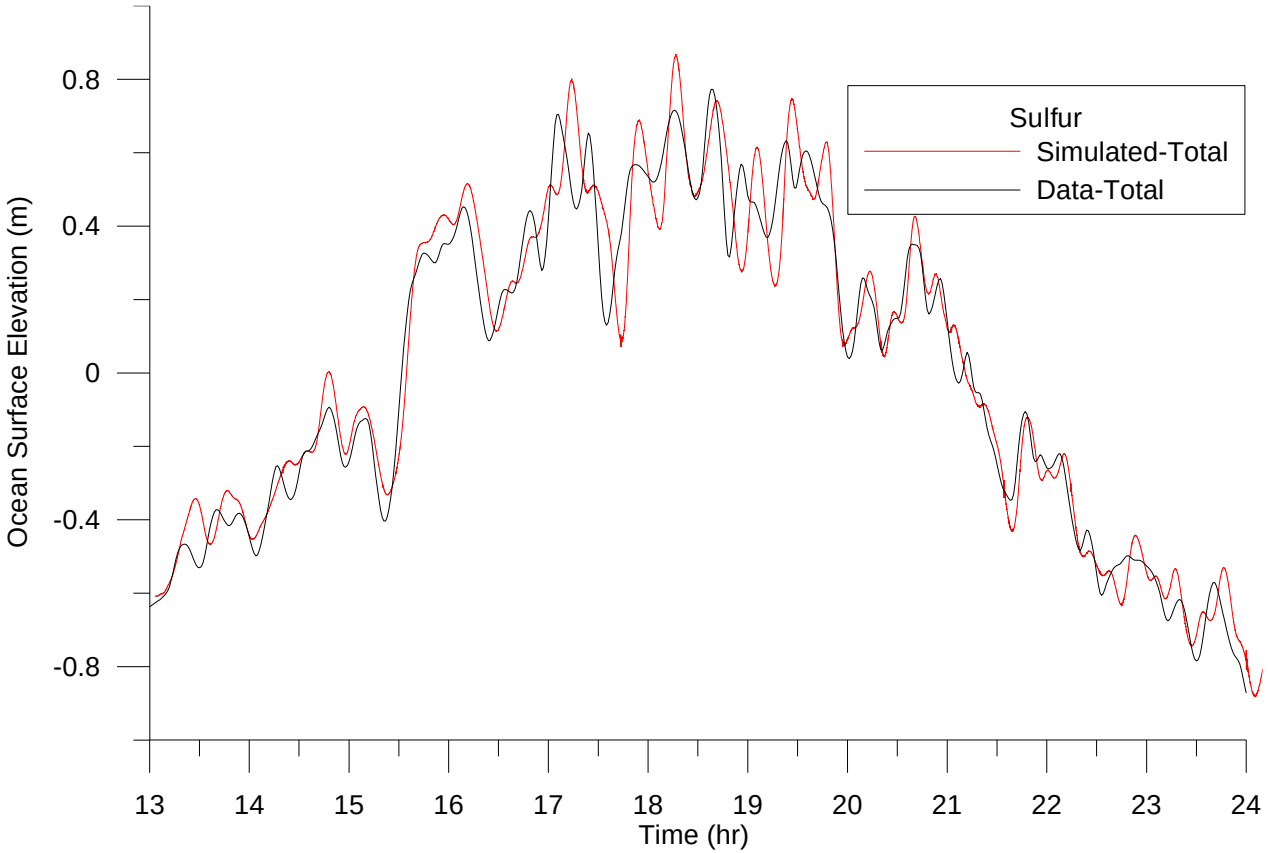
Comparison of water surface elevation at Tug Berth for total signal (tided)

BM#3

COMPARISON OF RESULTS – Water Surface Elevation @ Sulfur



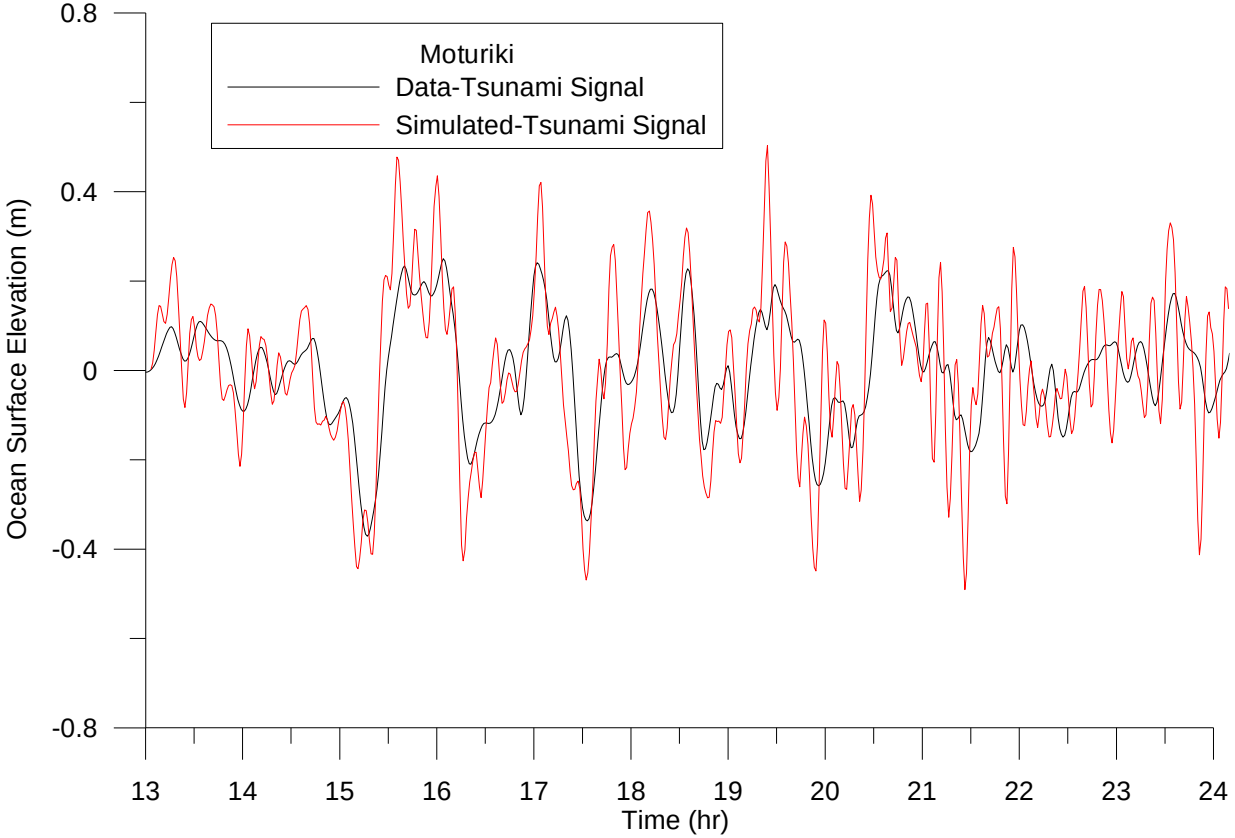
Comparison of water surface elevation at Sulfur for tsunami signal (detided)



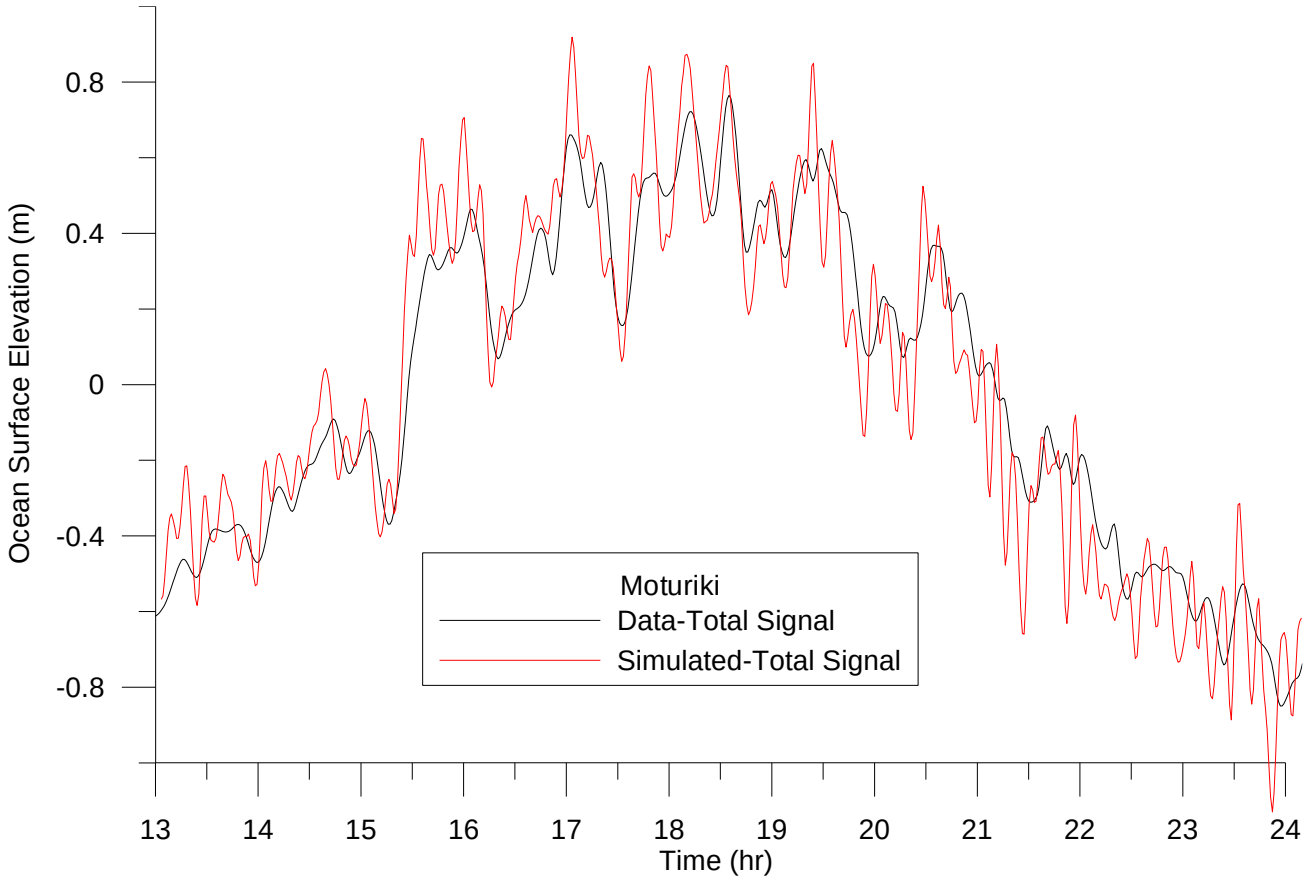
Comparison of water surface elevation at Sulfur for total signal (tided)

BM#3

COMPARISON OF RESULTS – Water Surface Elevation @ Moturiki



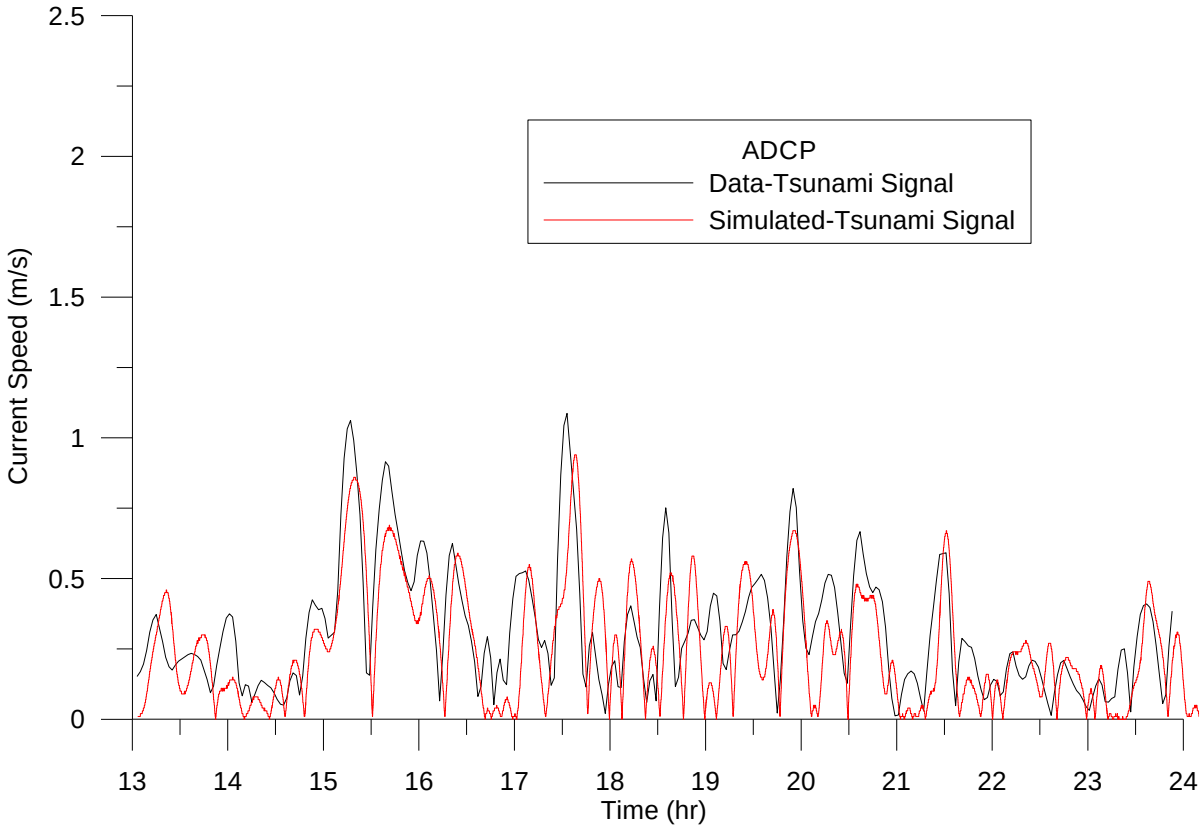
Comparison of water surface elevation at Moturiki for tsunami signal (detided)



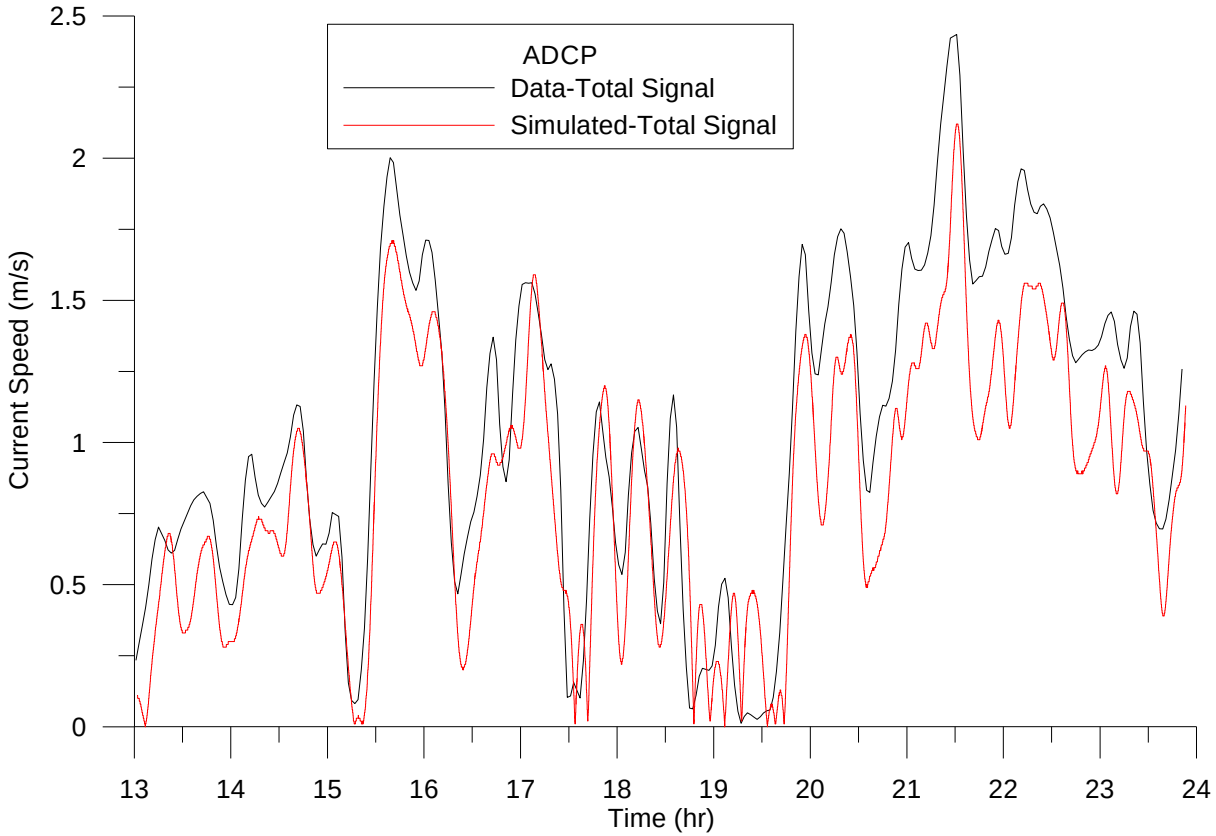
Comparison of water surface elevation at Moturiki for total signal (tided)

BM#3

COMPARISON OF RESULTS – Current Speeds@ ADCP



Comparison of current speed at ADCP for tsunami signal (detided)

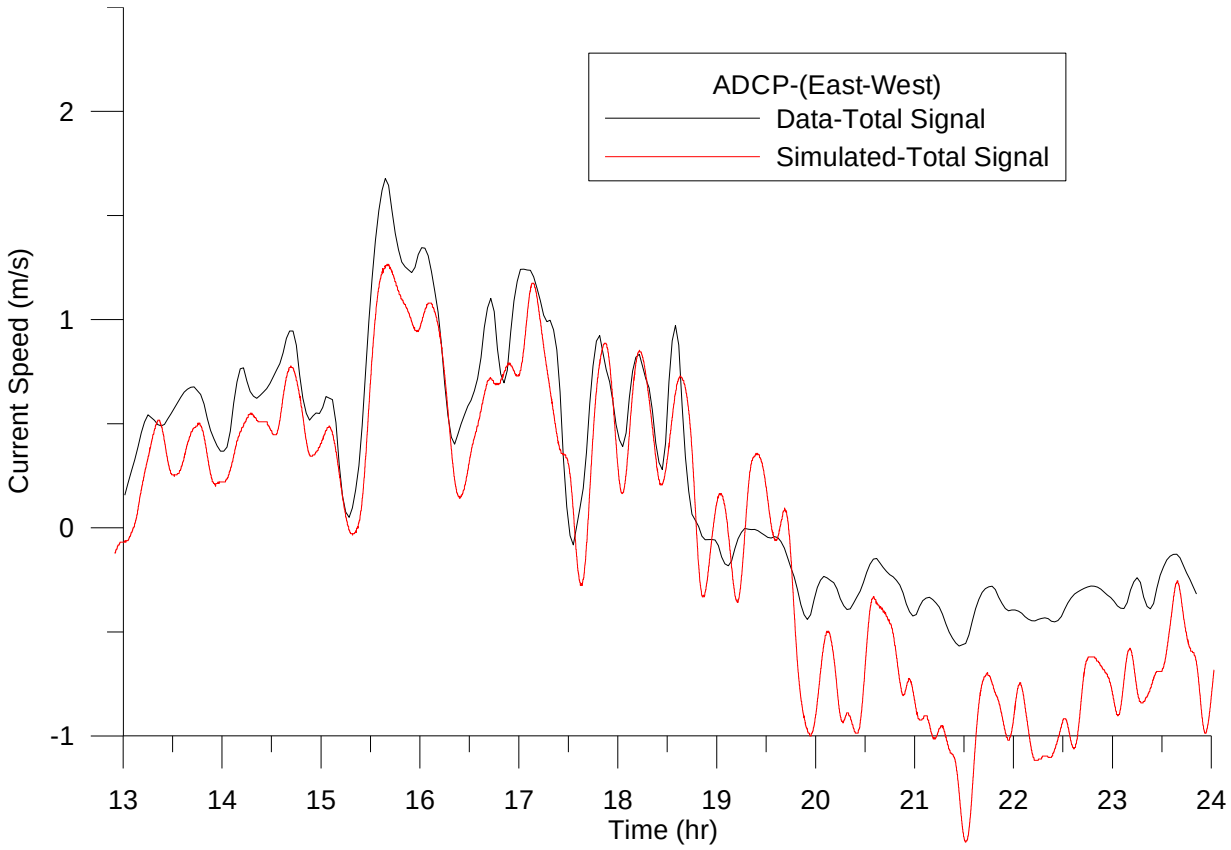


Comparison of current speed at ADCP for tsunami signal (tided)

BM#3

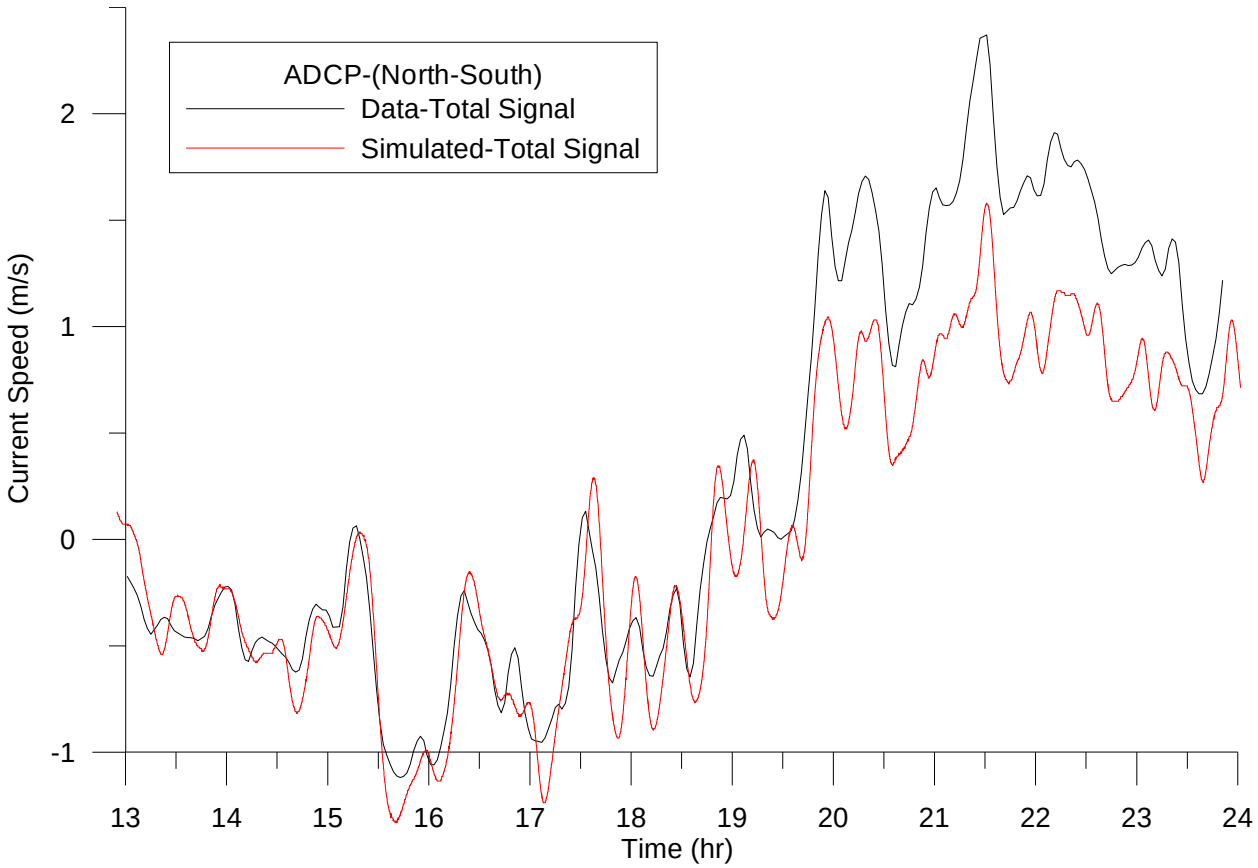
COMPARISON OF RESULTS – Current Speeds@ ADCP (Total Signal-Tided)

(in E-W Direction)



Comparison of current speed in E-W direction at ADCP for totatl signal (tided)

(in N-S Direction)



Comparison of current speed in N-S direction at ADCP for total signal (tided)

BM#3

NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

Benchmark Problem #4

Single long-period wave propagating onto a small-scale model of the town of Seaside, Oregon

Ahmet C. Yalciner, Andrey Zaytsev, Utku Kanoglu

Project Assistants, Rozita Kian, Naeimeh Shaghrivand

Middle East Technical University

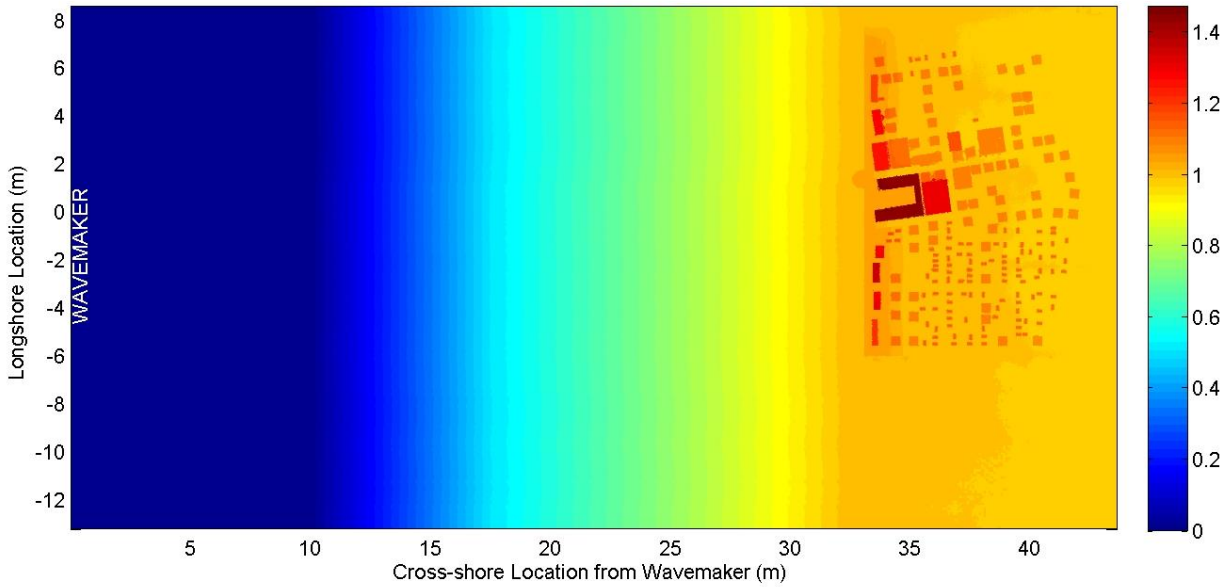
Department of Civil Engineering Department

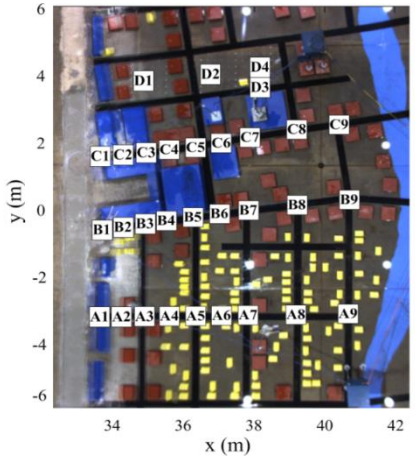
Department of Engineering Sciences

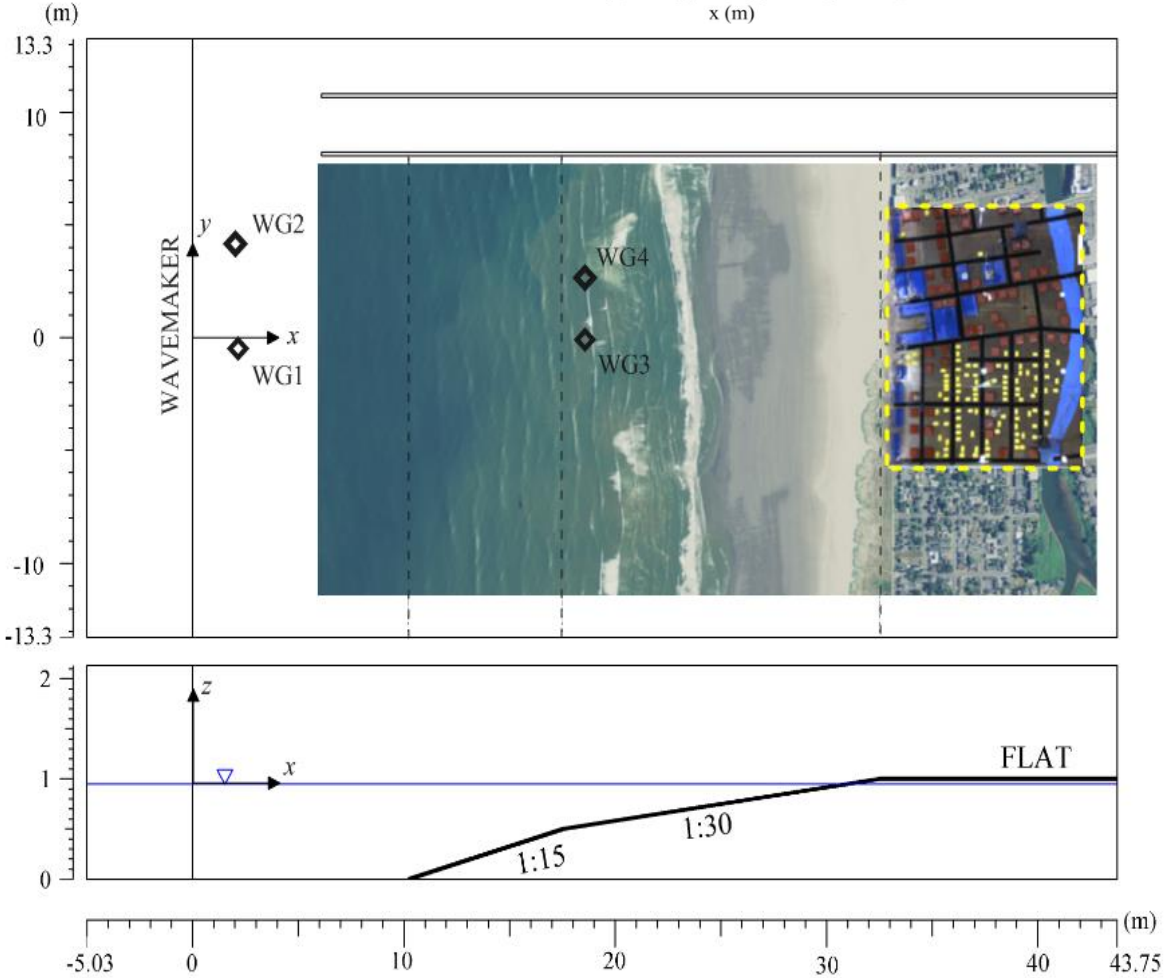
09.02.2015

BM#4 – Bathymetry, Gauges

- For this benchmark, we will compare free surface, velocity, and momentum flux information recorded throughout the tank. (By NAMI DANCE)





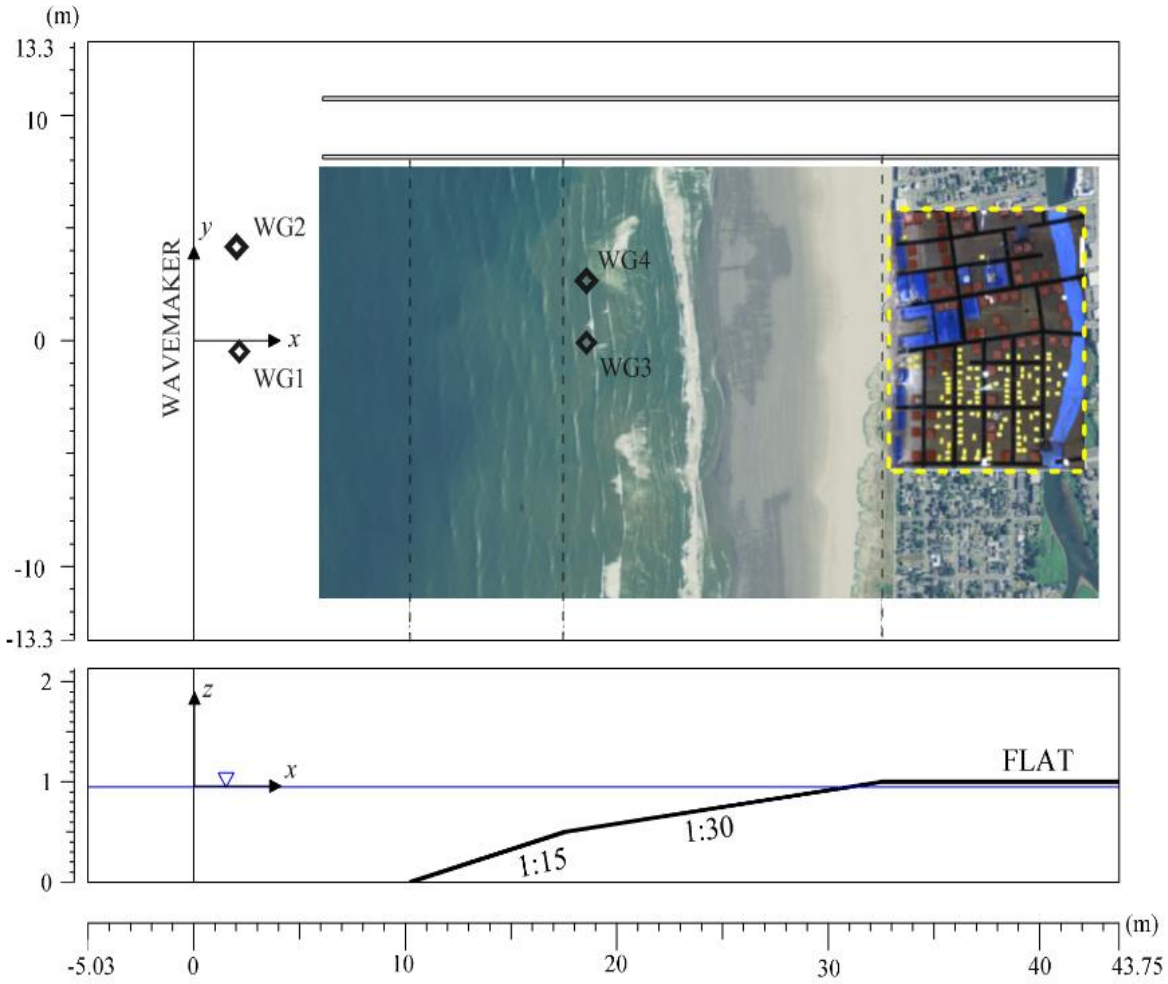


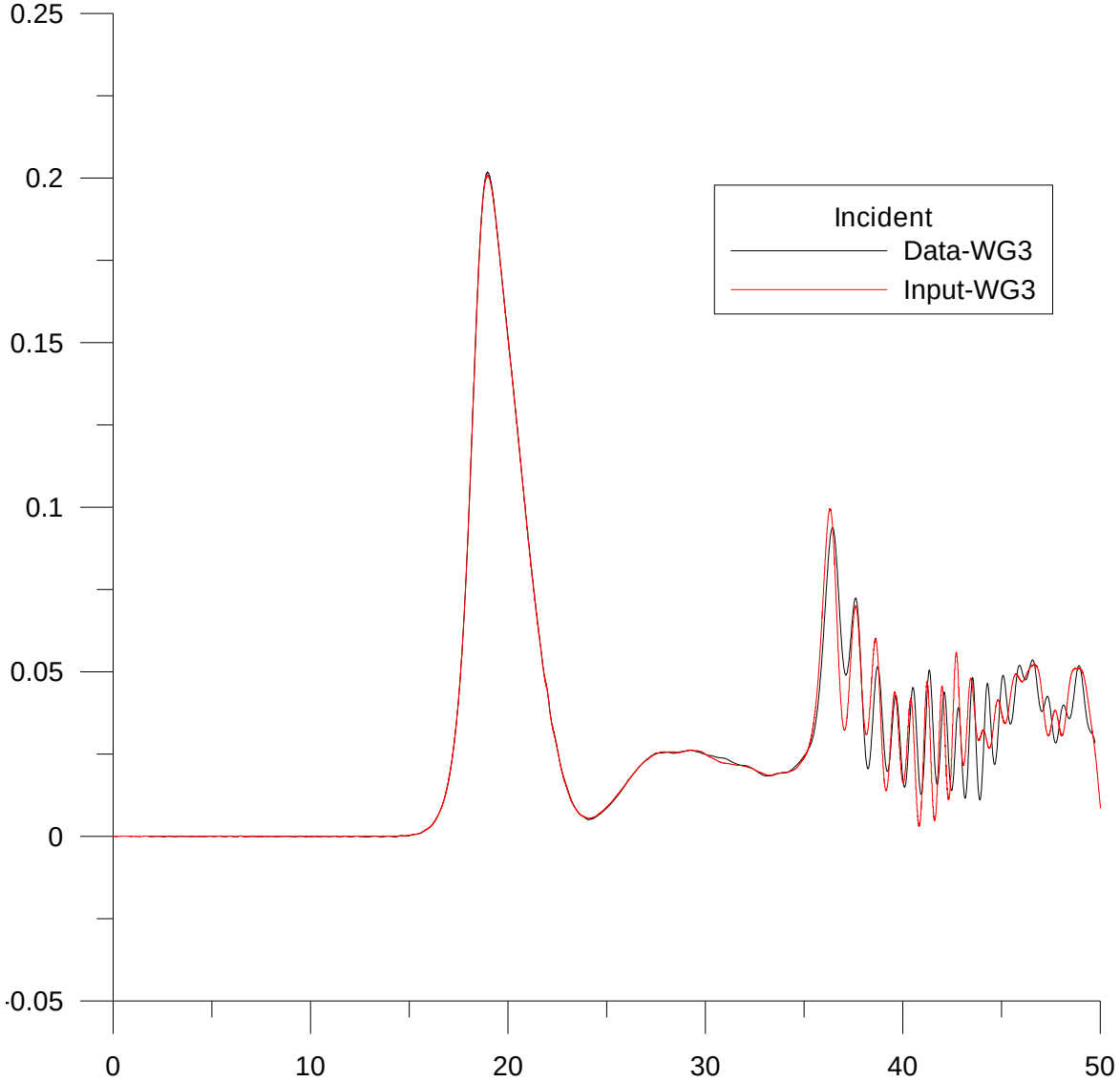
resolution: 0.1 m
Maximum Water Depth : 0.97m
Simulation time step: 0.0005 sec
Manning Coeff: 0.01

BM#4

BM#4 – Incident Wave @ WG3

Since the incident wave data is given with 0.02 second time intervals, the data is obtained again for 0.0005 second intervals for 0.1m resolution by making linear interpolation.





BM#4

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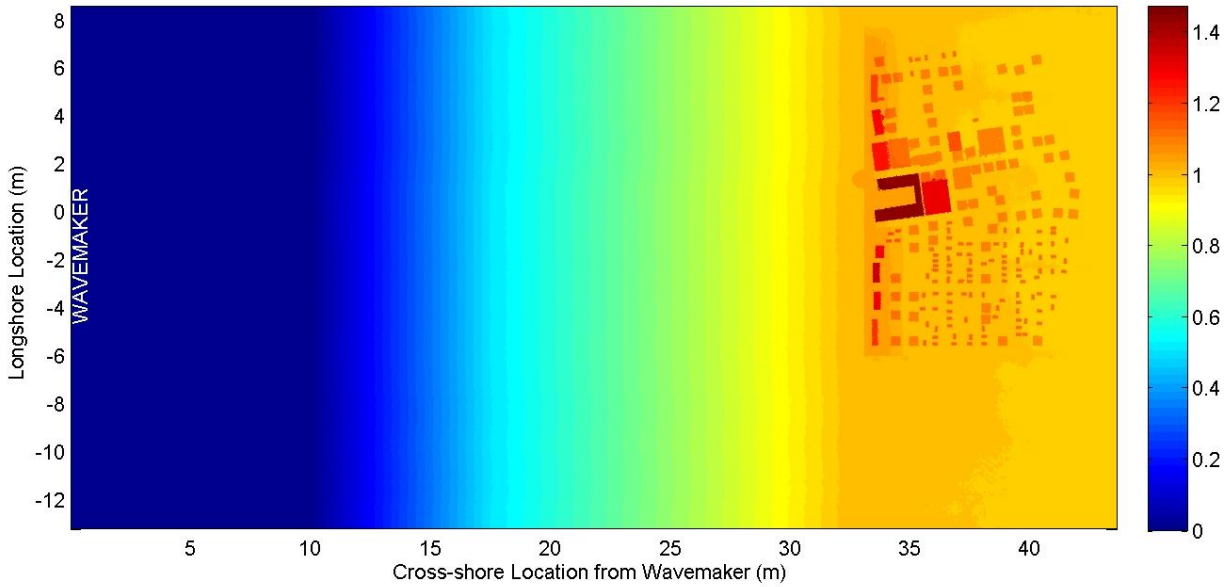

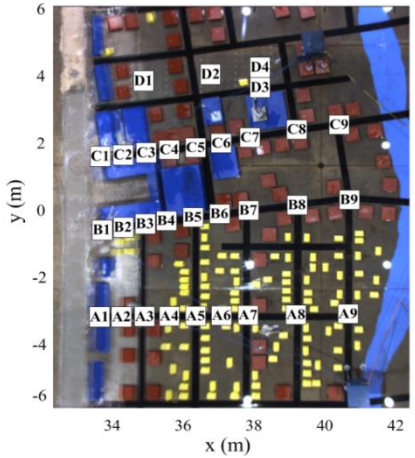

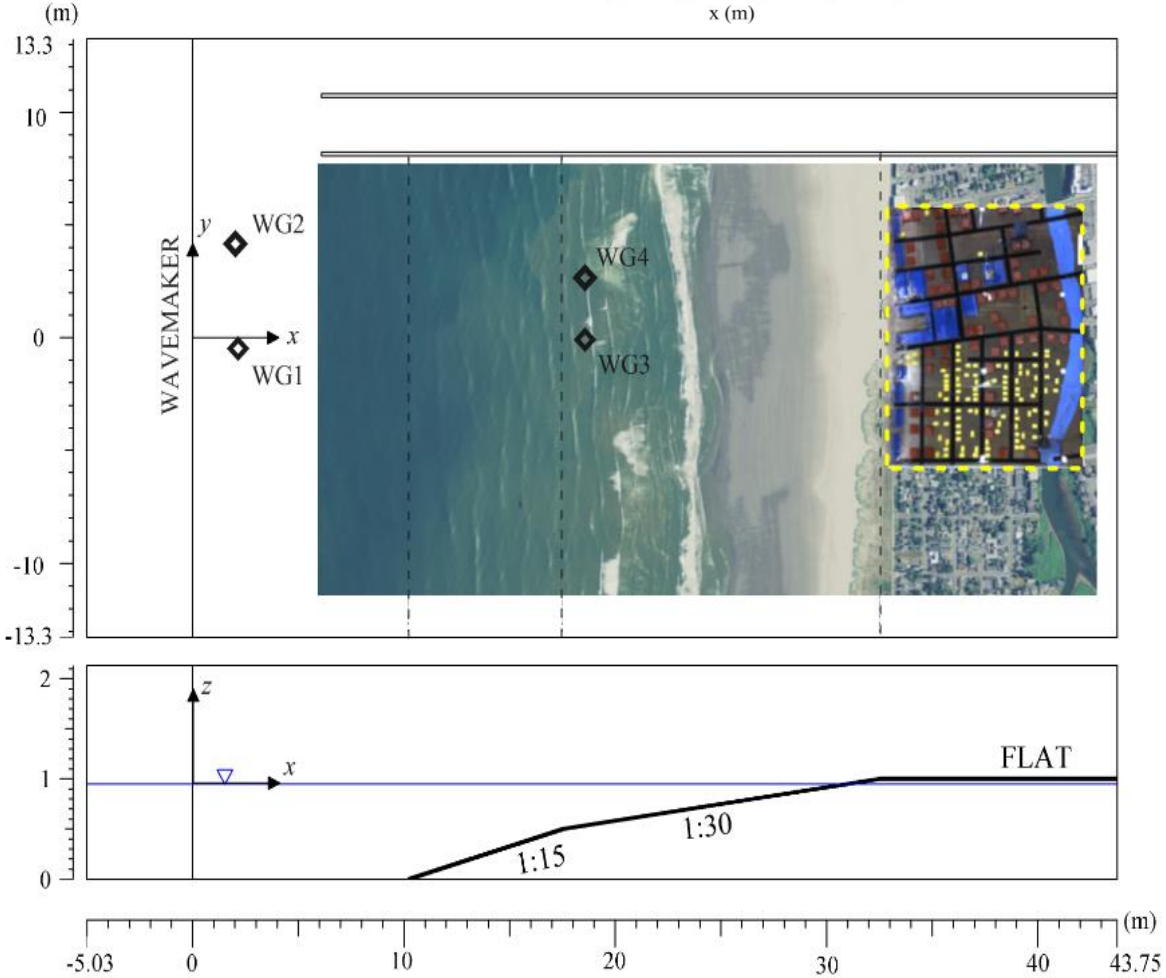

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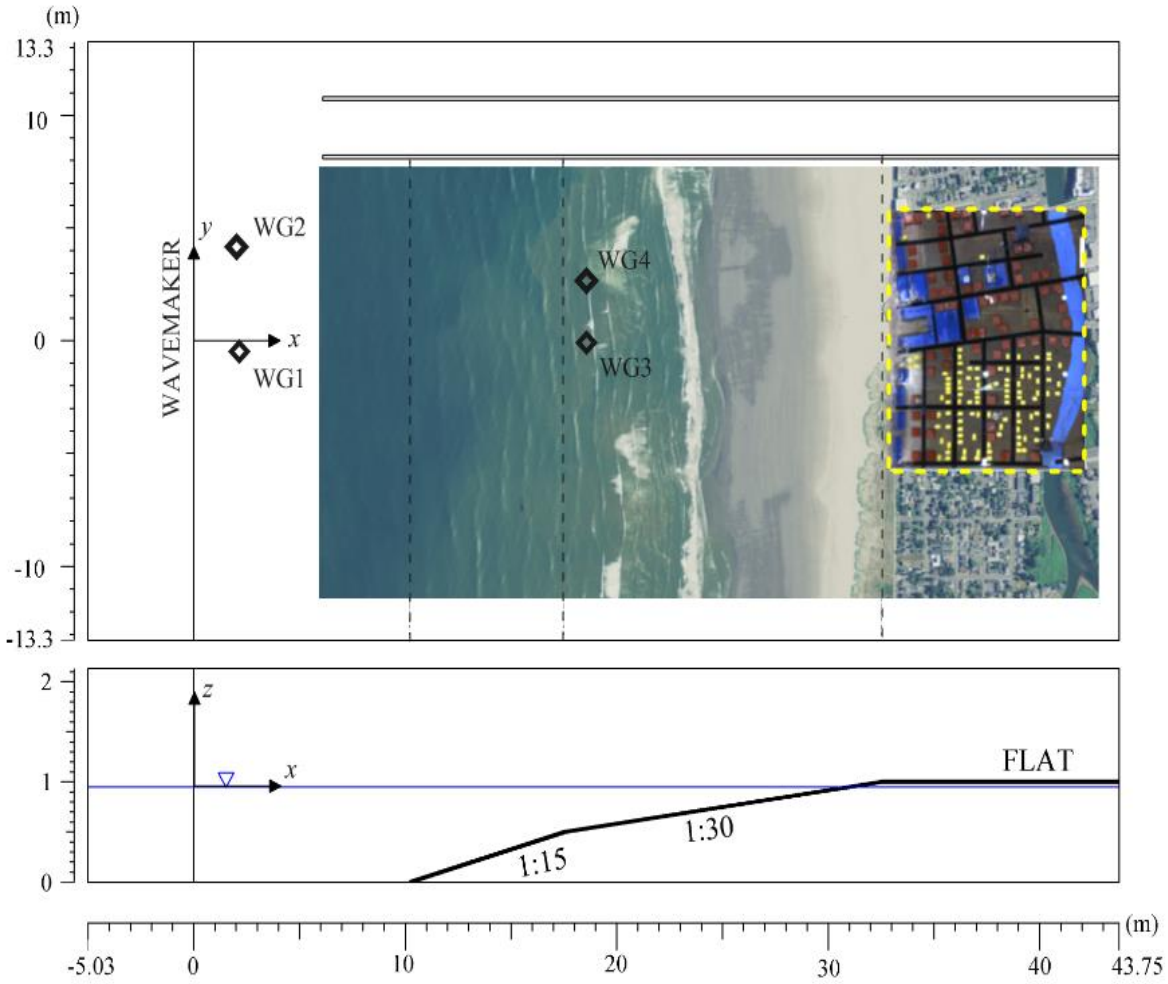
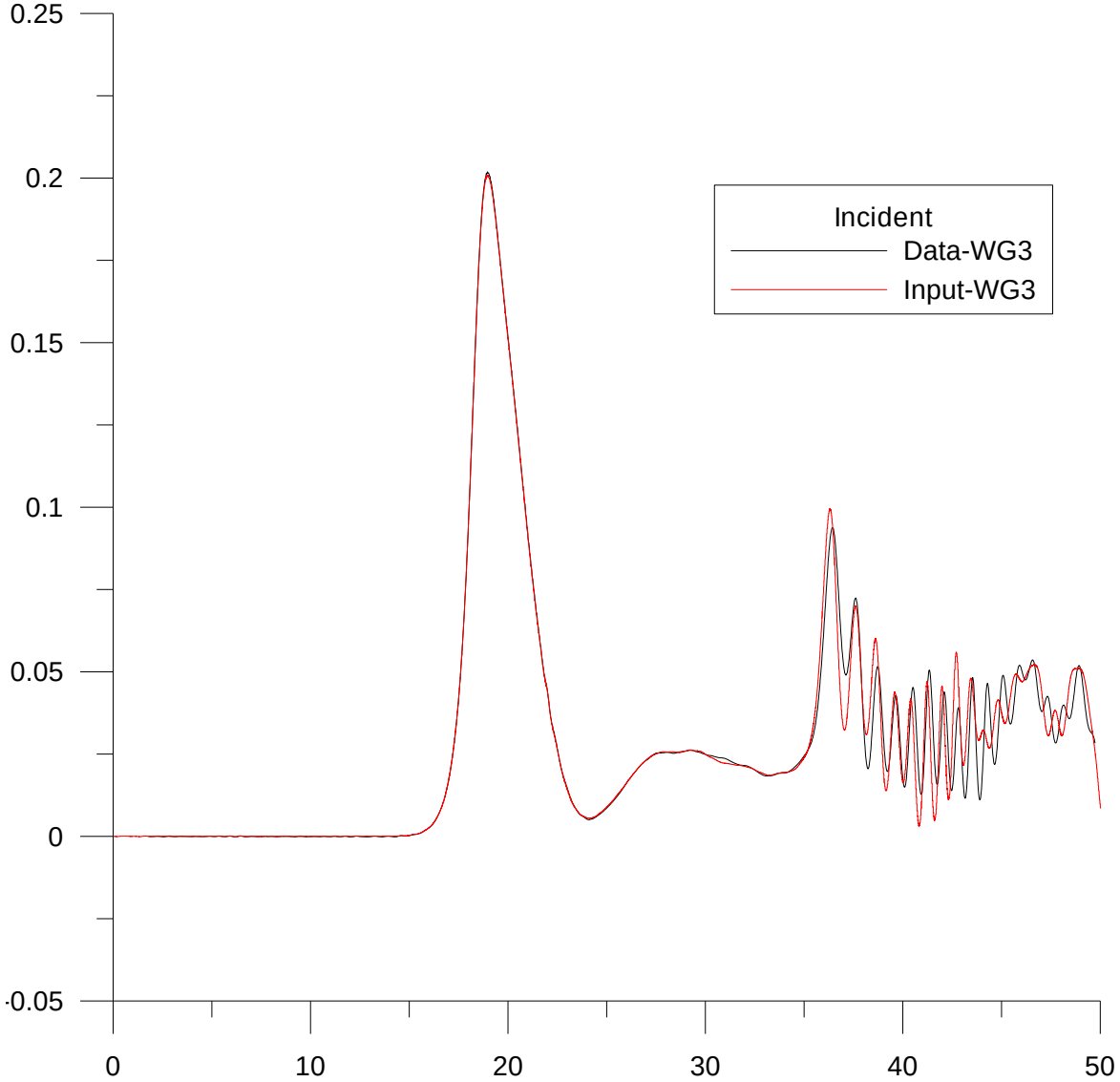
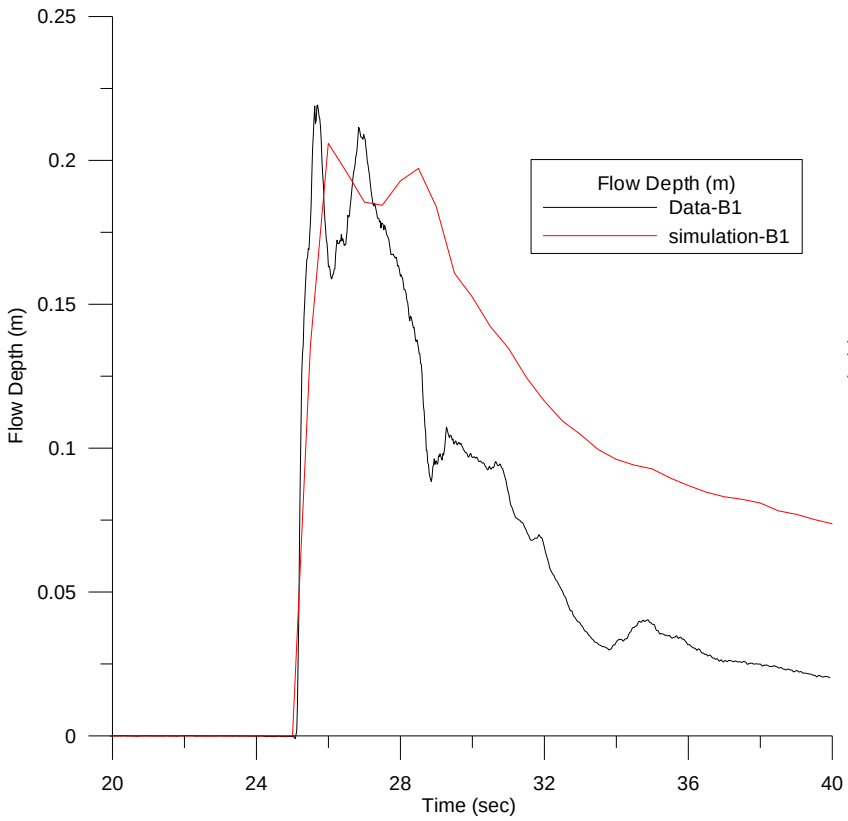


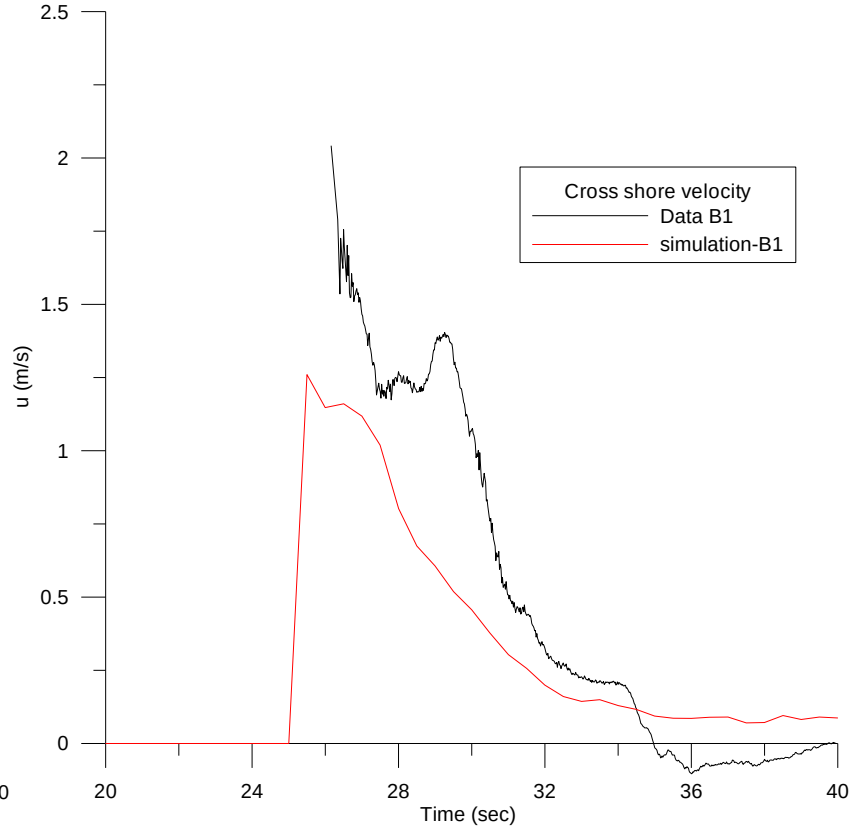


BM#4

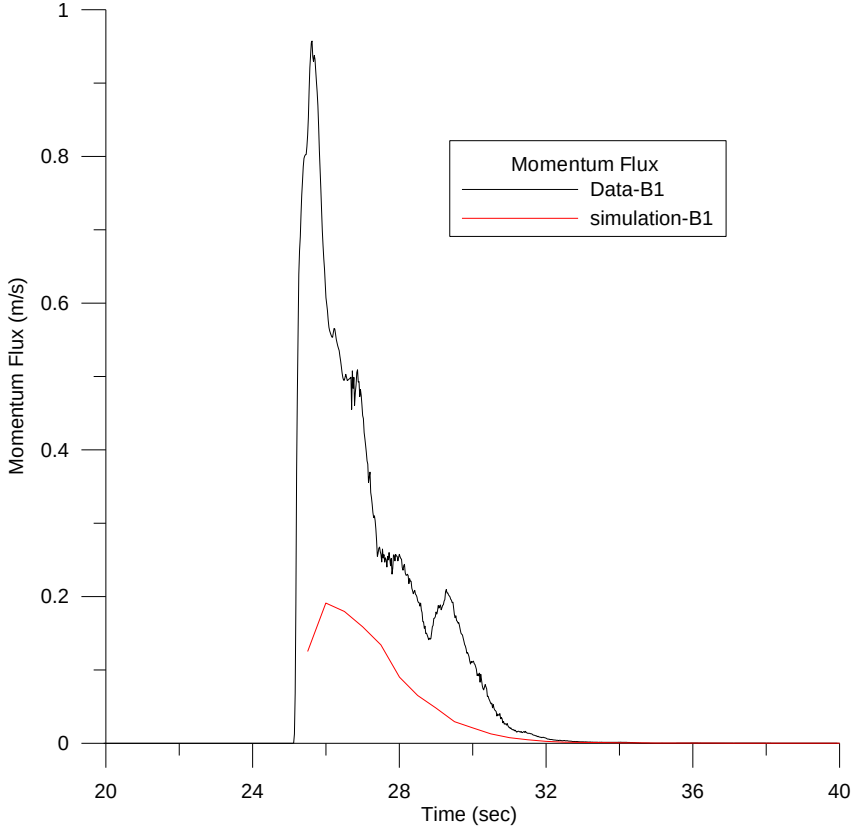
COMPARISON OF RESULTS – @ (B1) Location



Comparison of flow depth



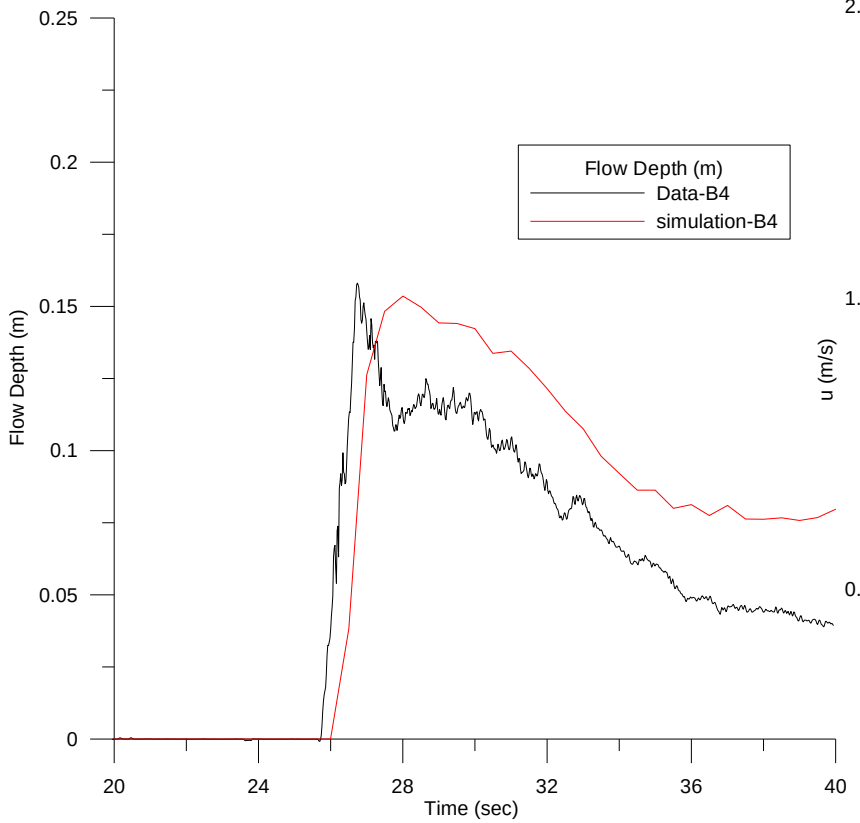
Comparison of cross shore velocity



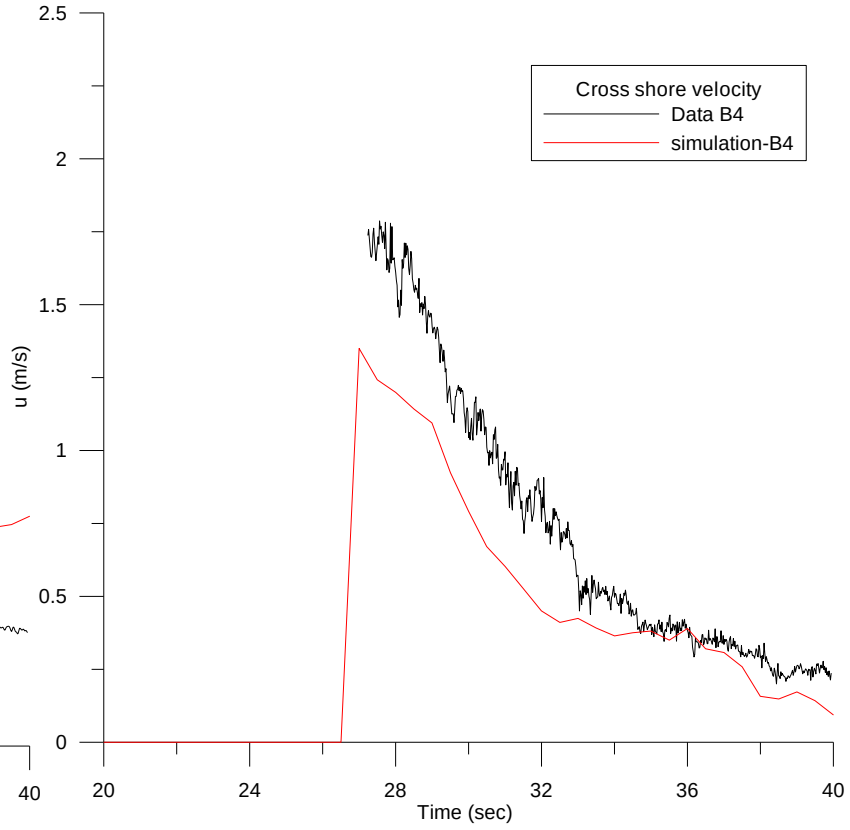
Comparison of momentum flux

BM#4

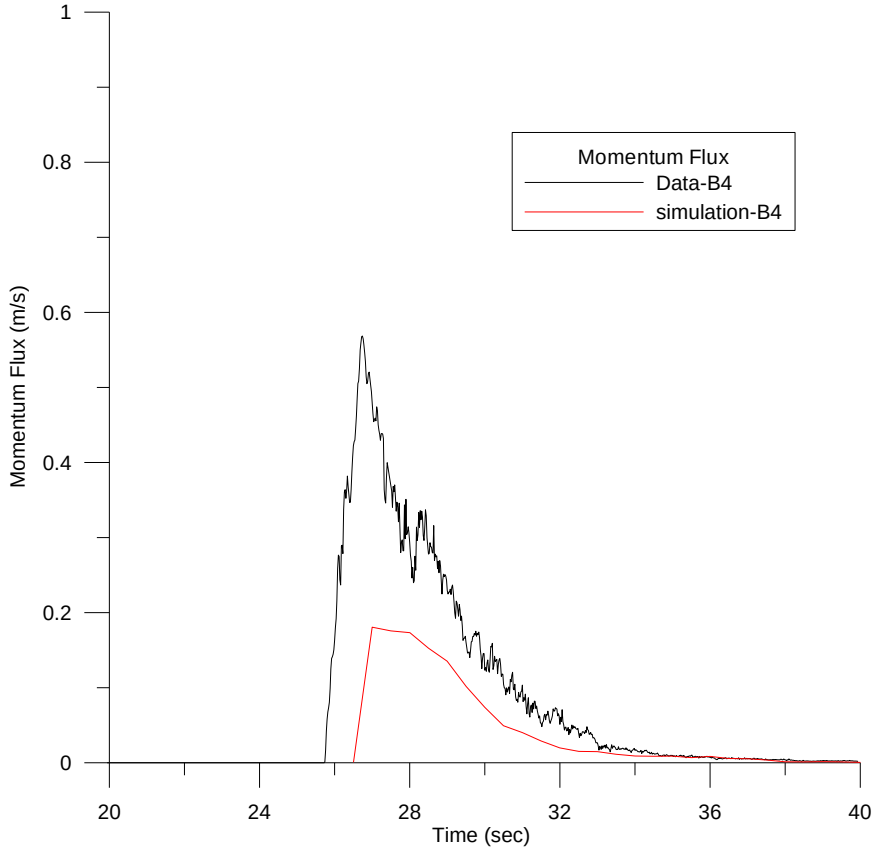
COMPARISON OF RESULTS – @ (B4) Location



Comparison of flow depth



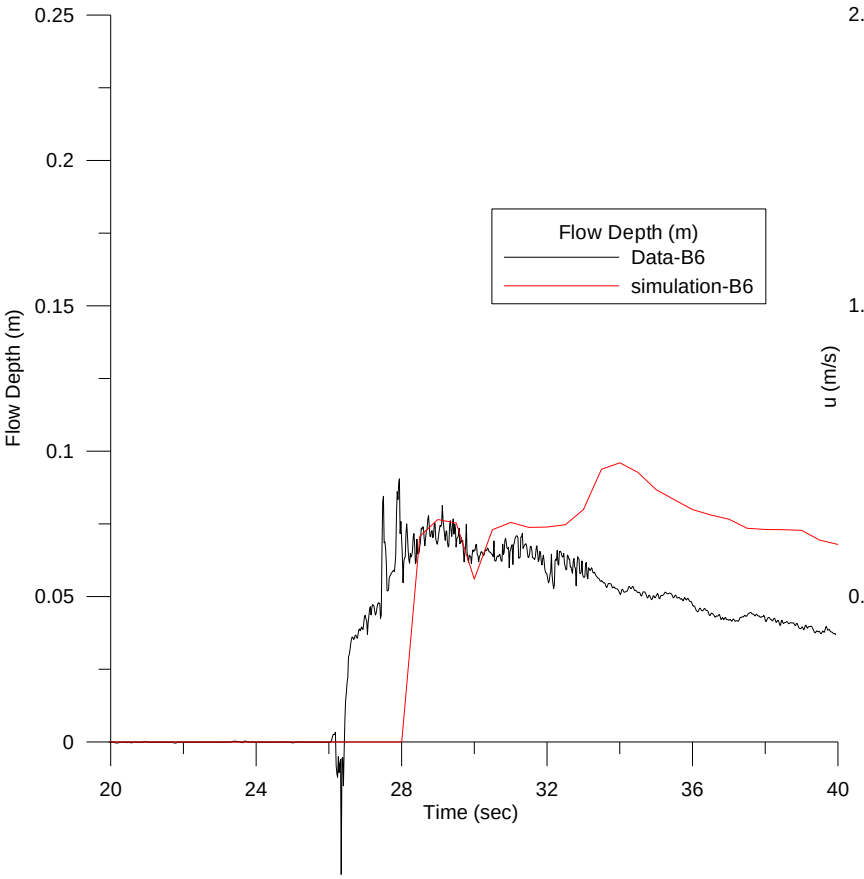
Comparison of cross shore velocity



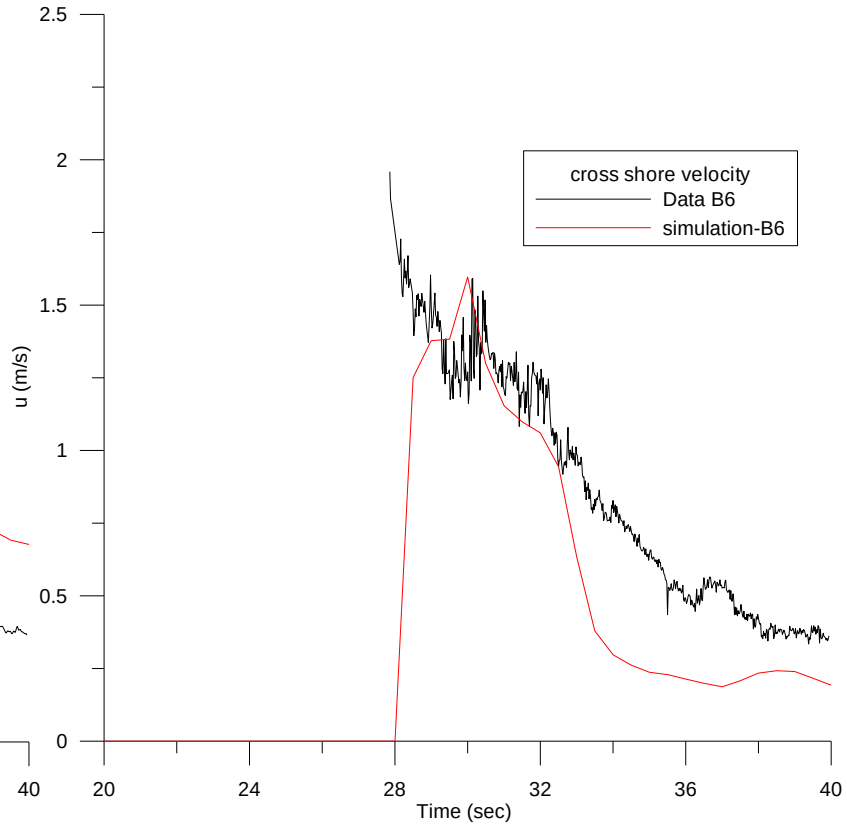
Comparison of momentum flux

BM#4

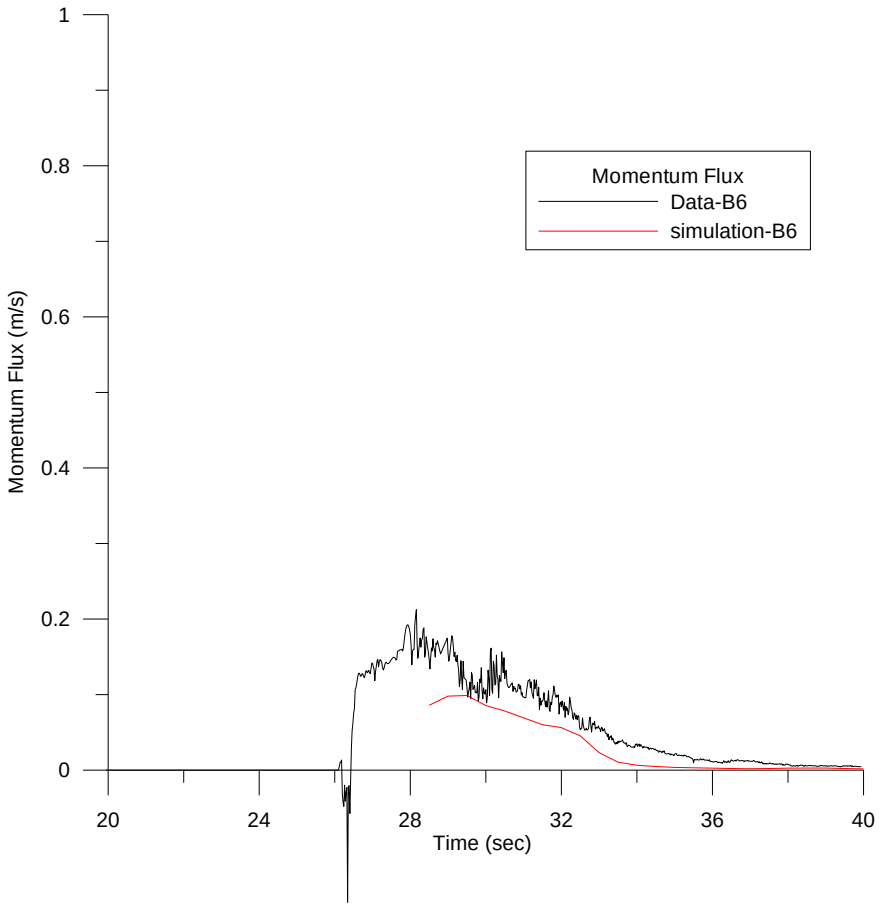
COMPARISON OF RESULTS – @ (B6) Location



Comparison of flow depth



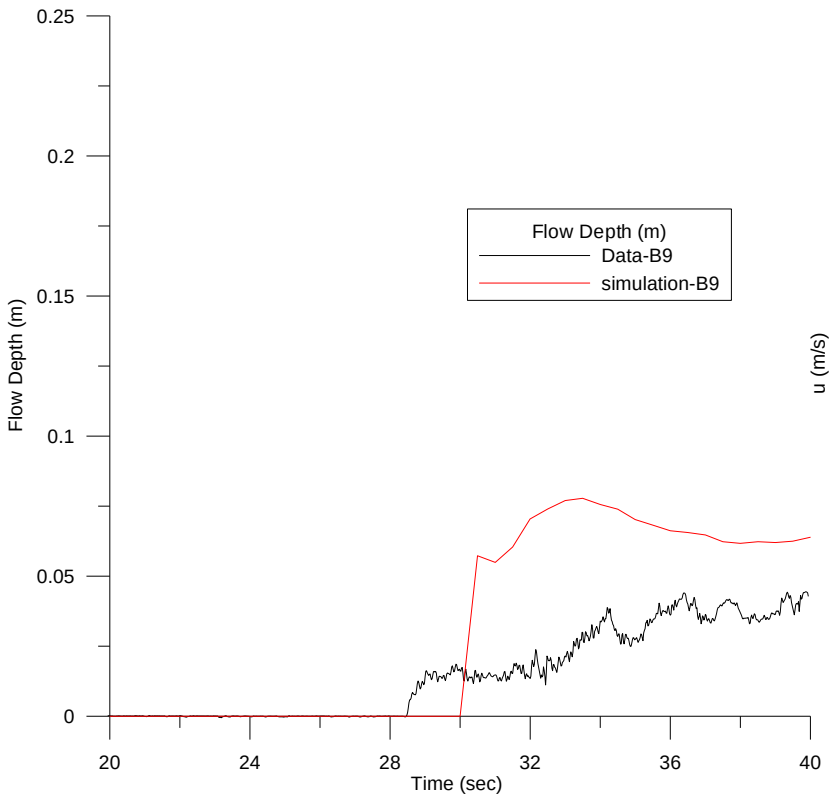
Comparison of cross shore velocity



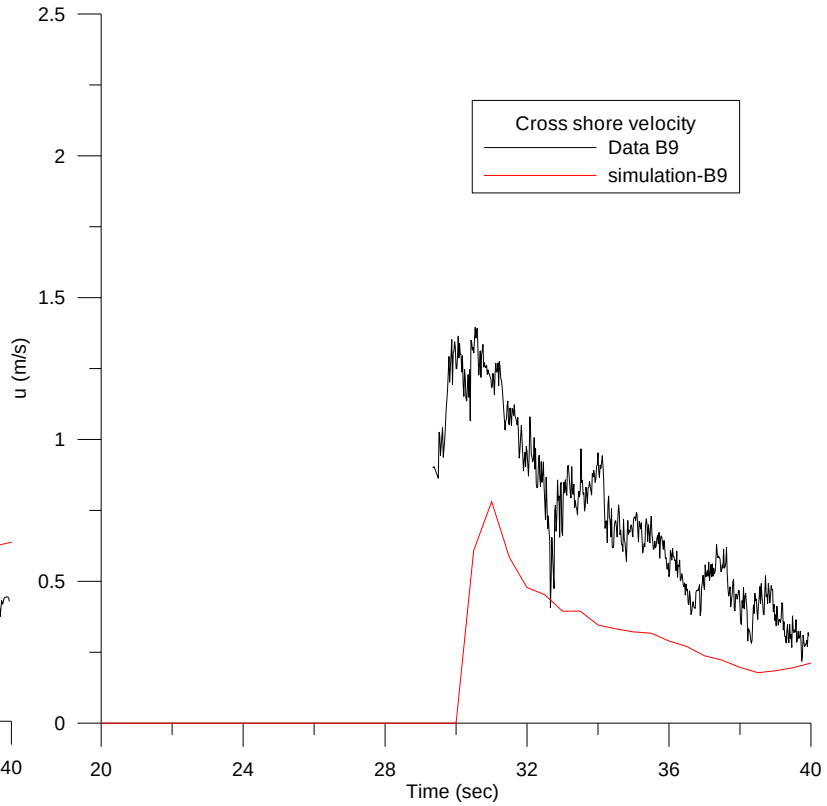
Comparison of momentum flux

BM#4

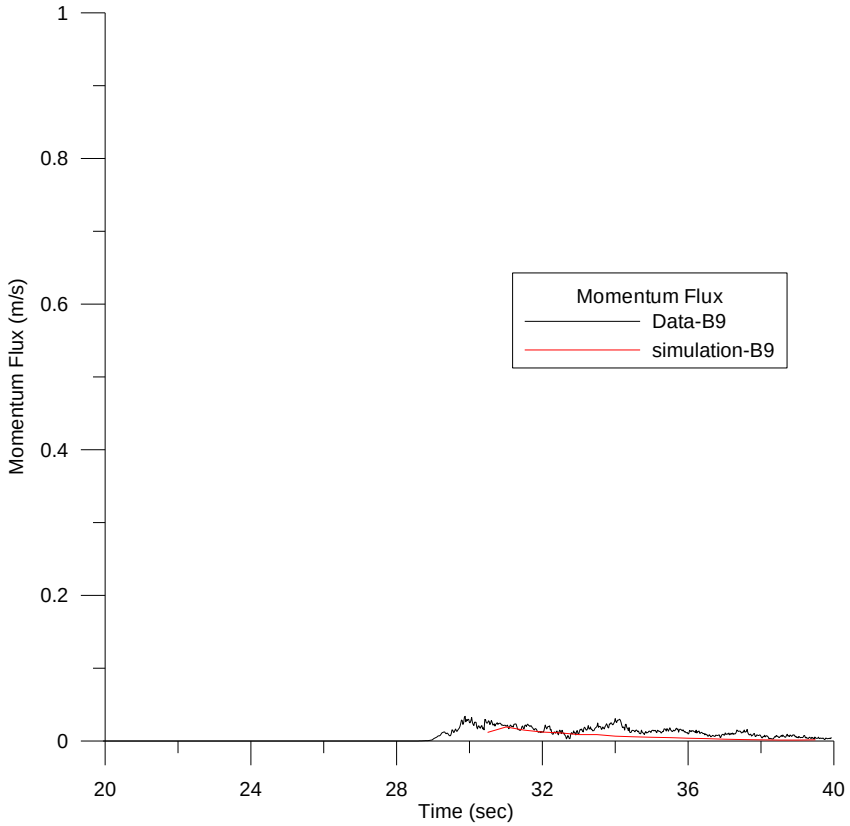
COMPARISON OF RESULTS – @ (B9) Location



Comparison of flow depth



Comparison of cross shore velocity



Comparison of momentum flux

BM#4

NTHMP - Mapping & Modeling Benchmarking Workshop: Tsunami Currents

Benchmark Problem #5
Experiment on a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf

Ahmet C. Yalciner, Andrey Zaytsev, Utku Kanoglu

Research Assistant Betul Aytore

METU, Department of Civil Engineering and Department of Engineering Sciences

09.02.2015

BM#5 – Experiment on a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf

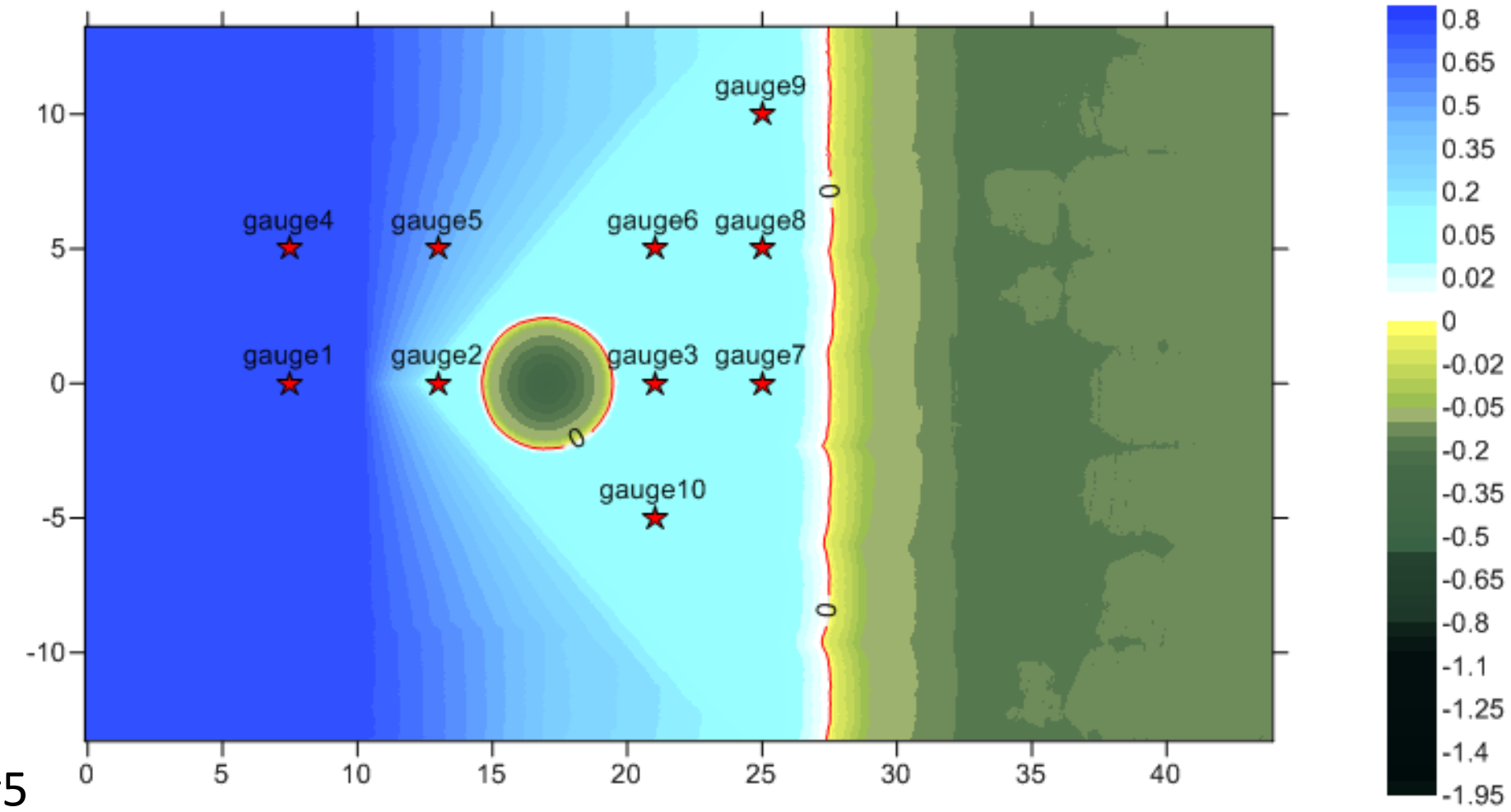
- Simulation studies are carried out by tsunami numerical modelling tool ''NAMI DANCE'' to understand the importance of model resolution and numerics on the prediction of tidal currents.
- NAMI DANCE is a computational tool developed by Profs Andrey Zaytsev, Ahmet Yalciner, Anton Chernov, Efim Pelinovsky and Andrey Kurkin as a collaboration for tsunami modeling.
- It provides direct simulation and efficient visualization of tsunamis to the user and for assessment, understanding and investigation of tsunami generation and propagation mechanisms. The model is tested and verified for research and operational purposes.

BM#5 –
Experiment on a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf

- This experiment has a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf.
- Free surface information was recorded via resistance-type wave gauges and sonic wave gages. Velocity information was recorded via ADV's.
- For this benchmark, we will compare the free surface, velocity, and information recorded throughout the tank.

BM#5 –

Experiment on a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf

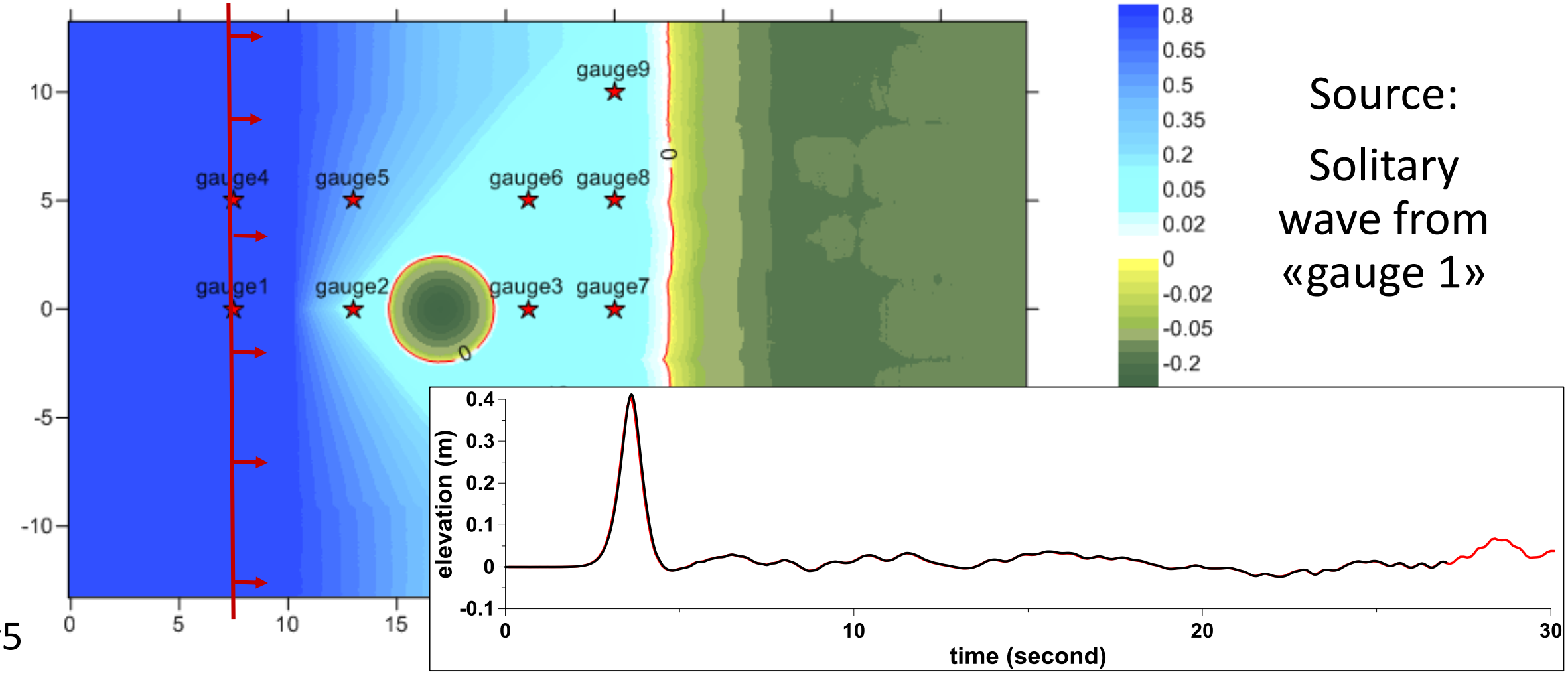


Bathymetry

BM#5

BM#5 –

Experiment on a single solitary wave propagating up a triangular shaped shelf with an island feature located at the offshore point of the shelf

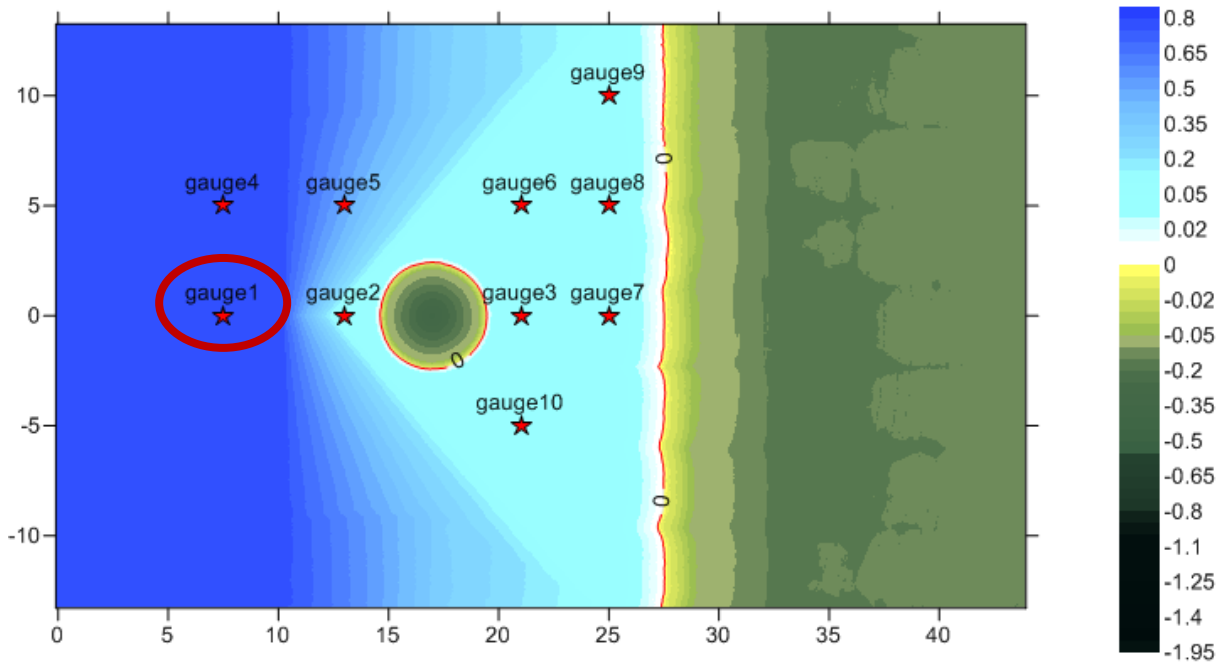


Source:

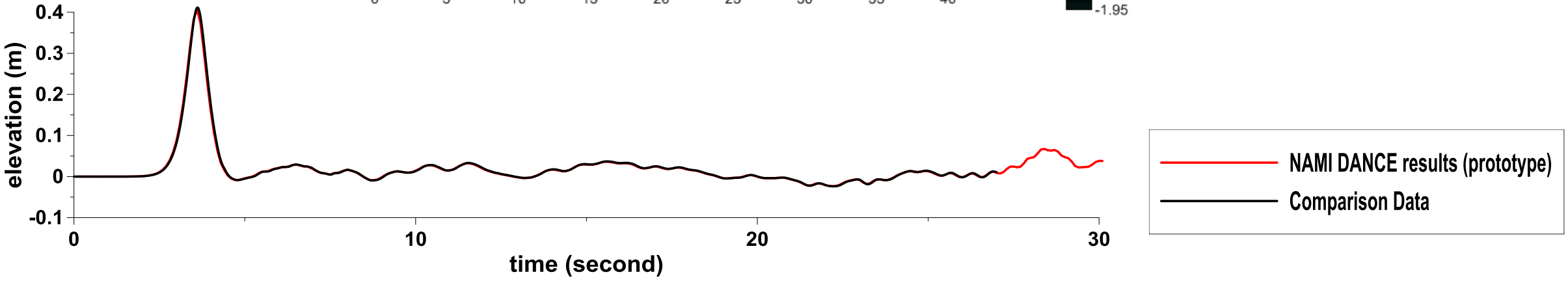
Solitary wave from «gauge 1»

BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

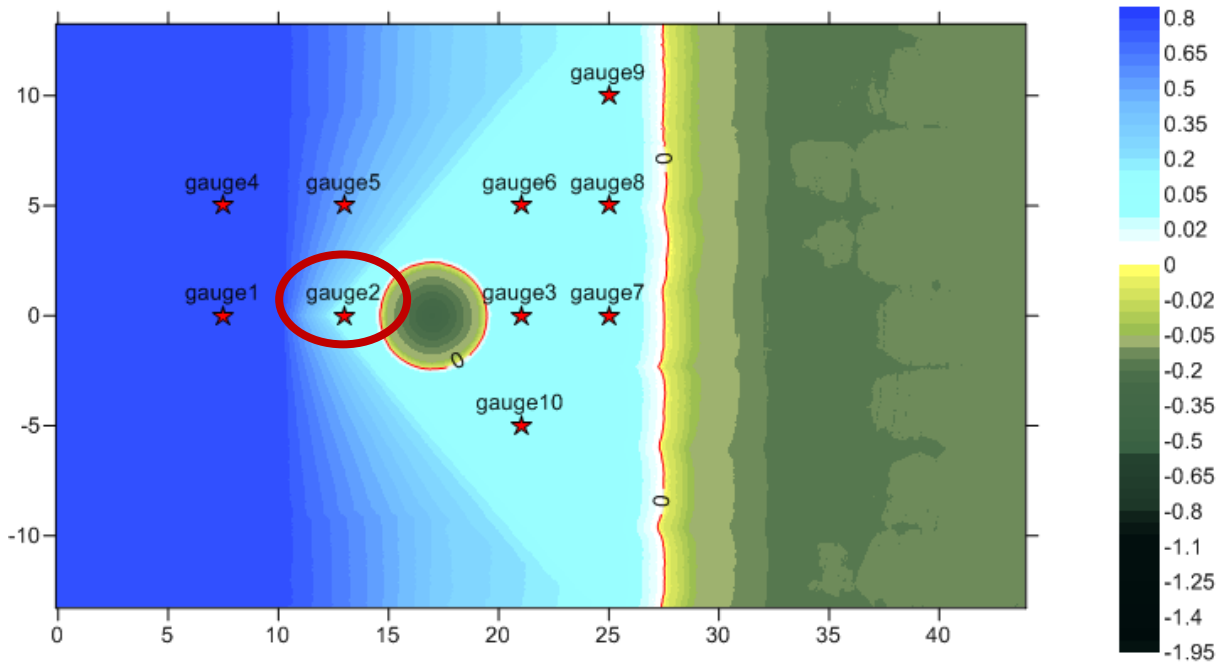


«gauge 1»

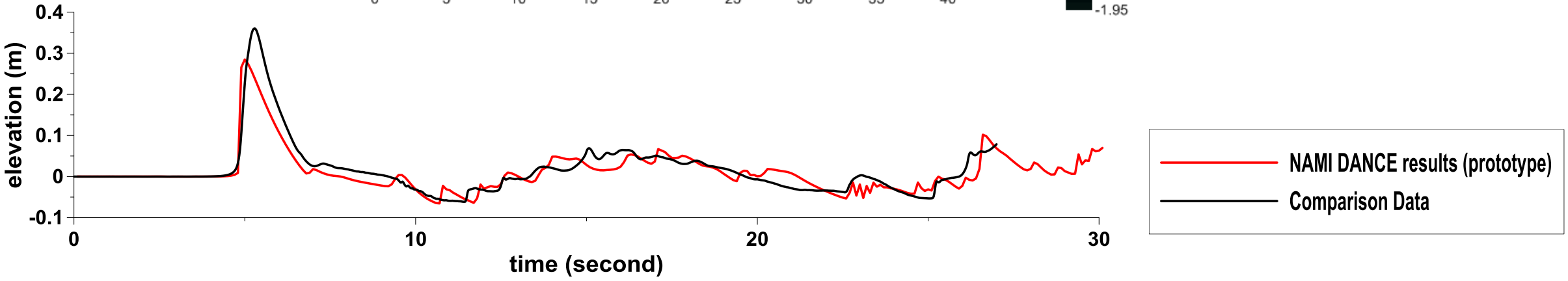


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

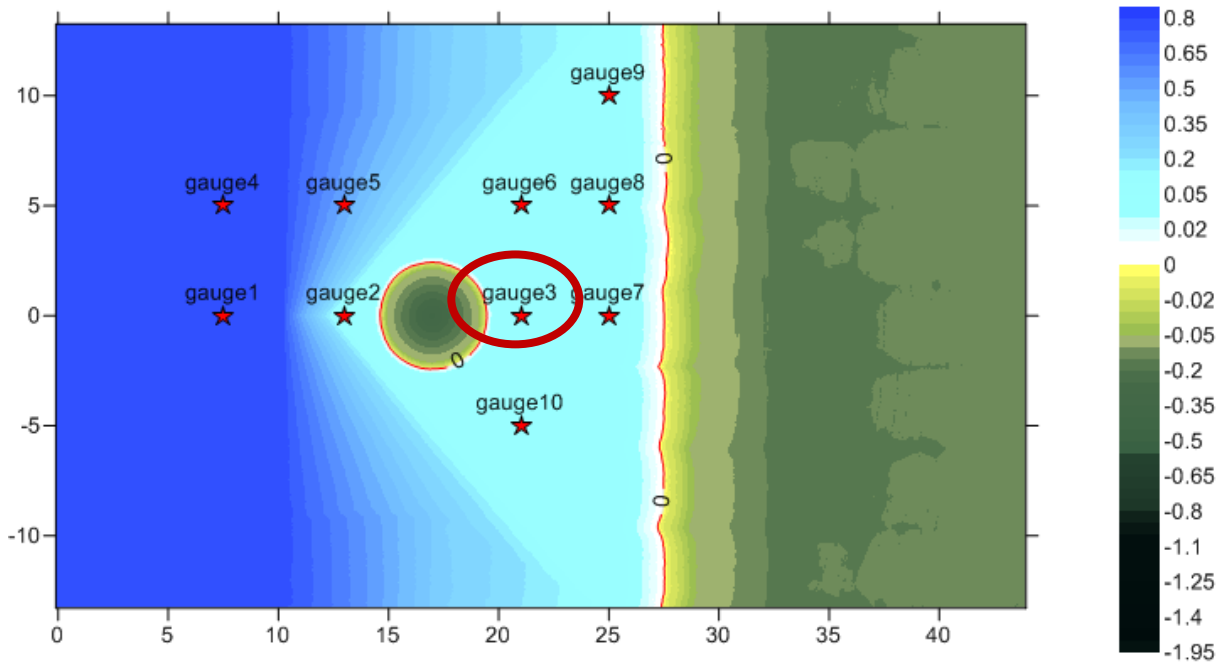


«gauge 2»

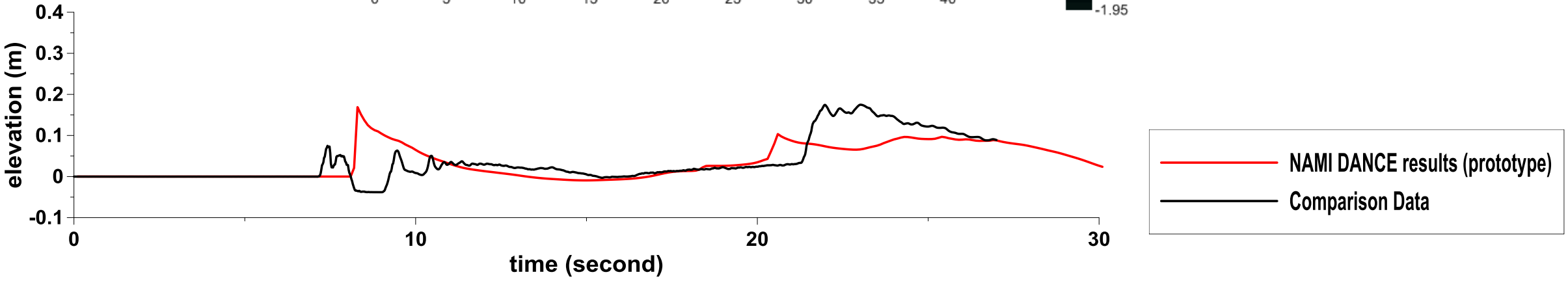


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

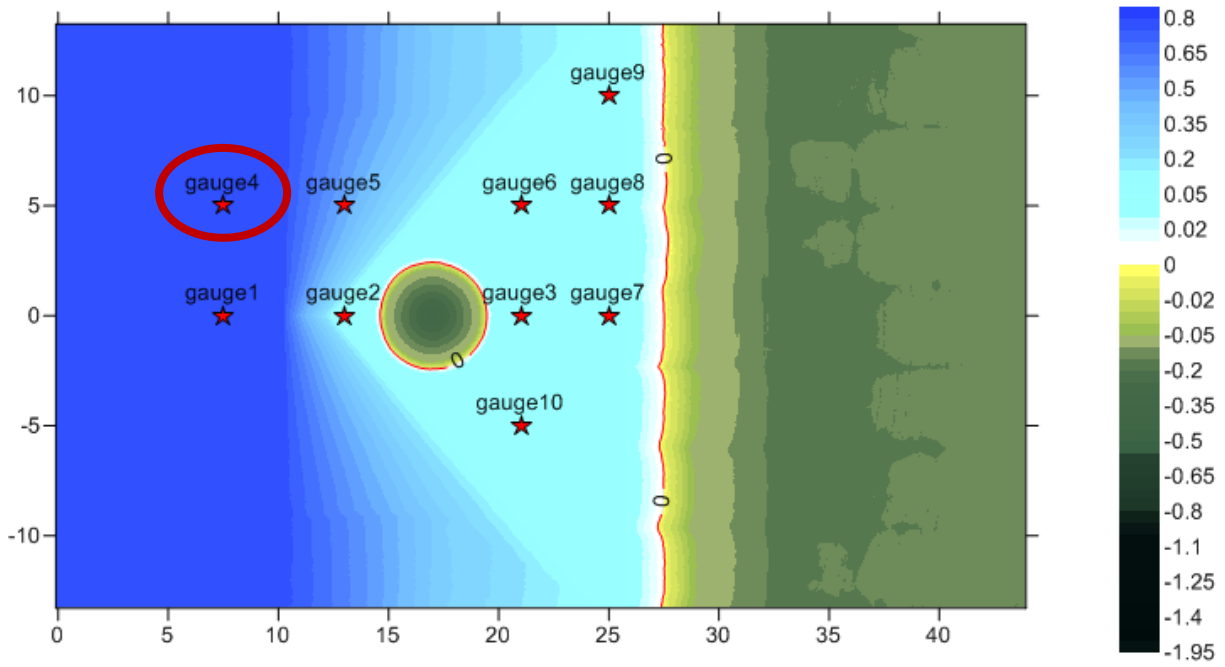


«gauge 3»

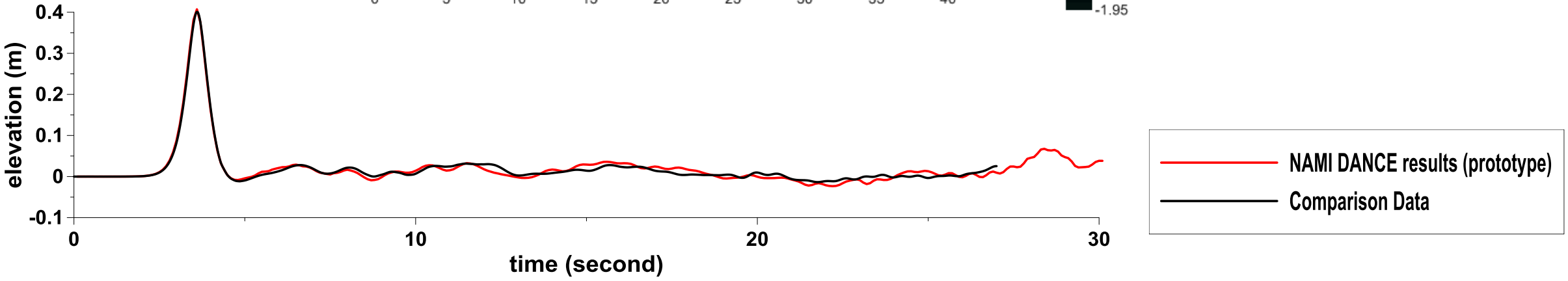


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

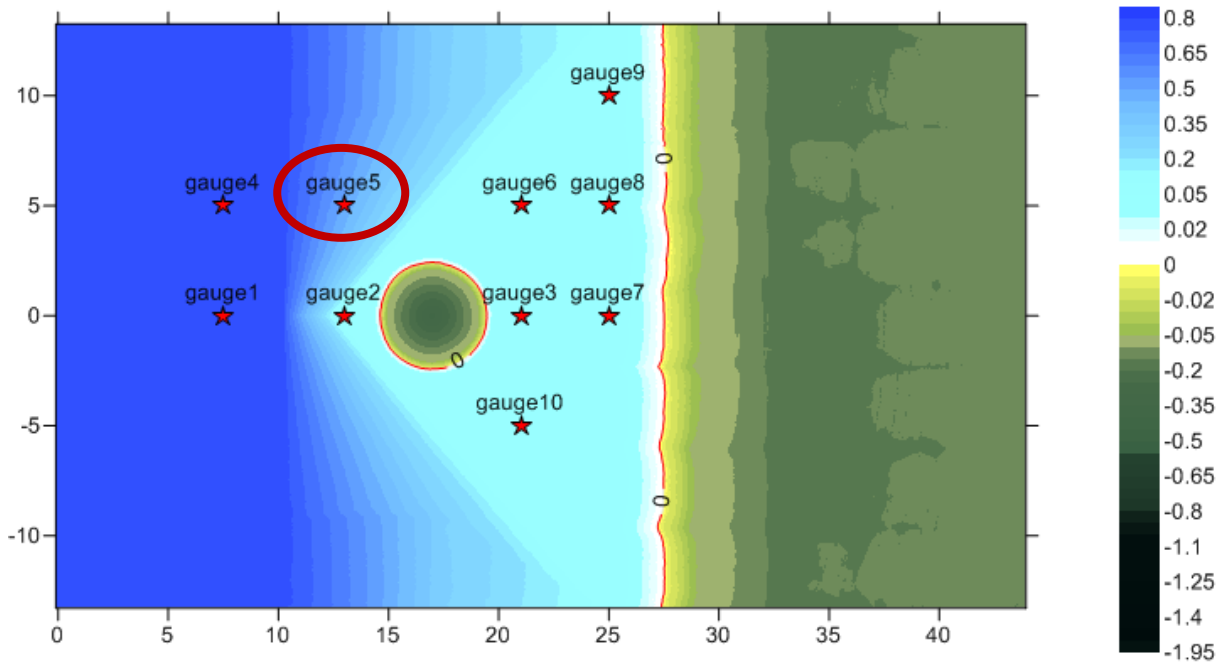


«gauge 4»

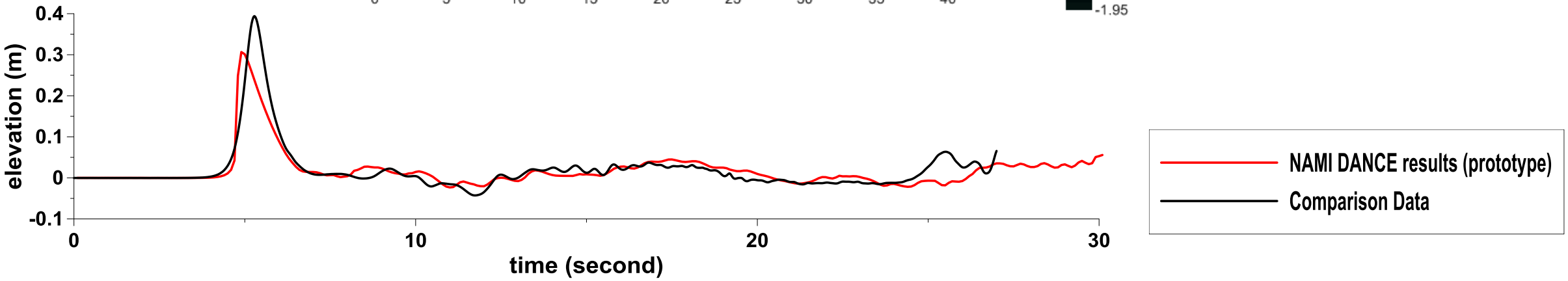


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

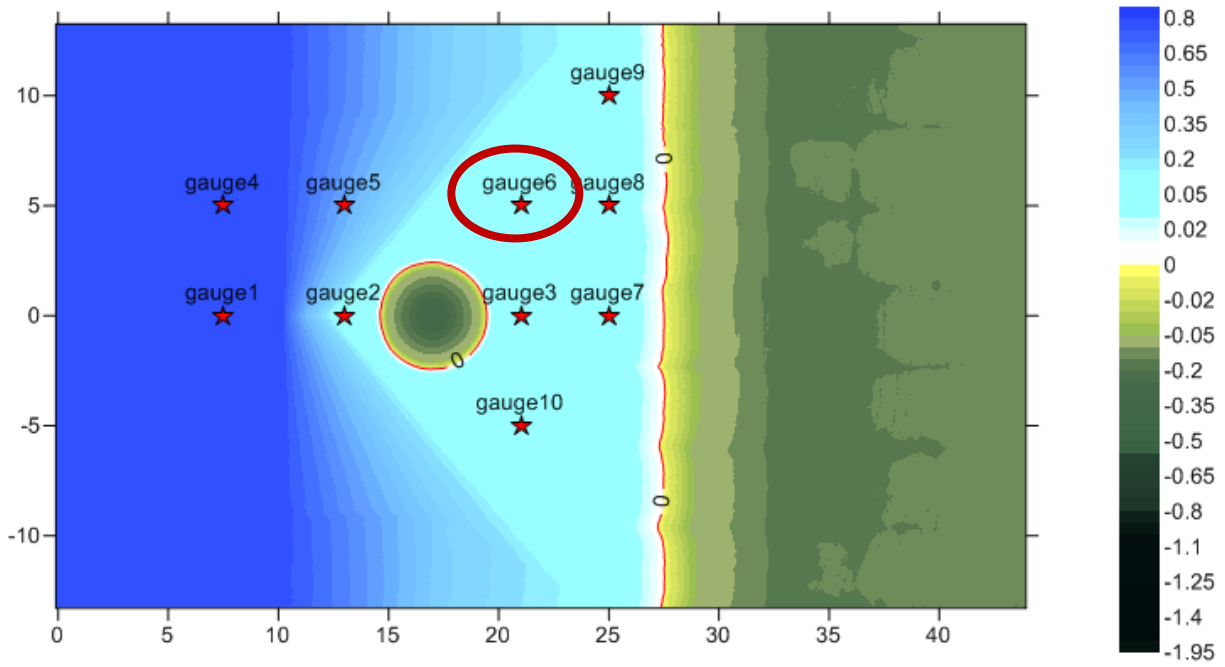


«gauge 5»

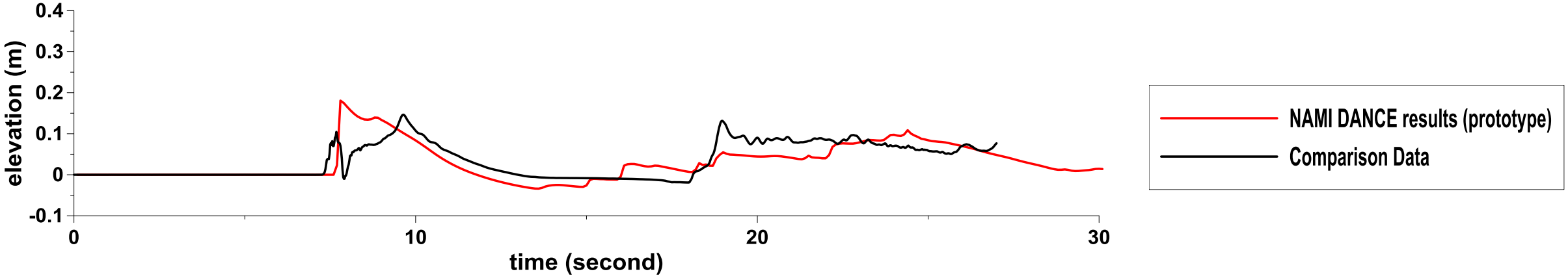


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

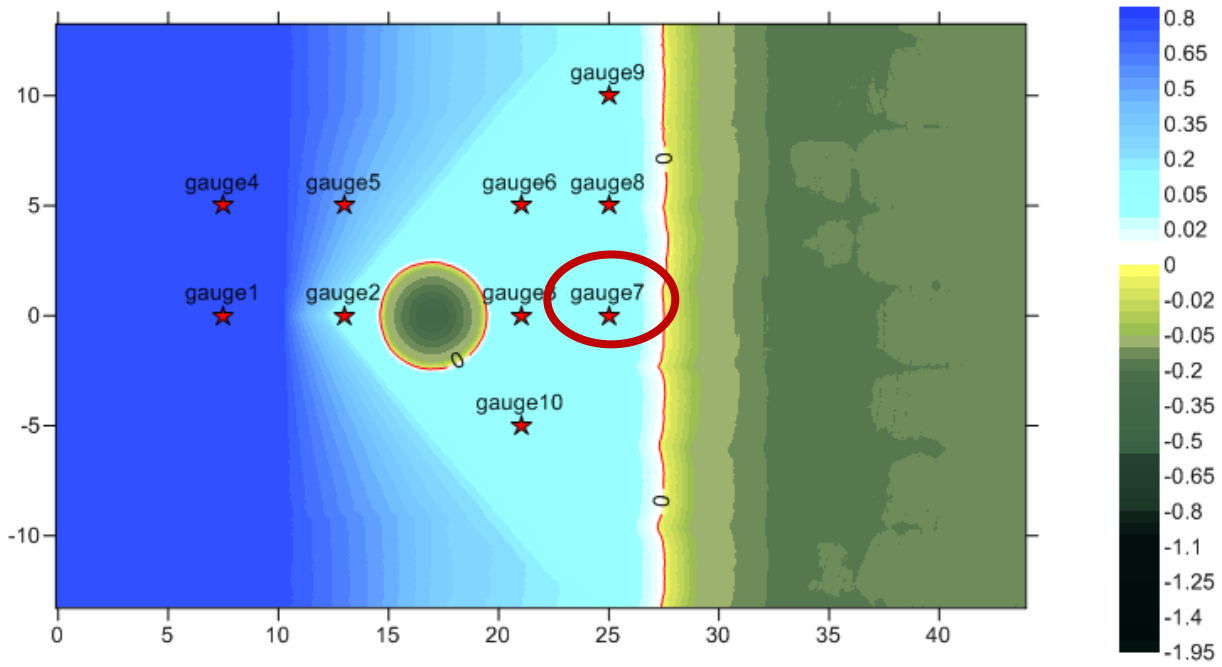


«gauge 6»

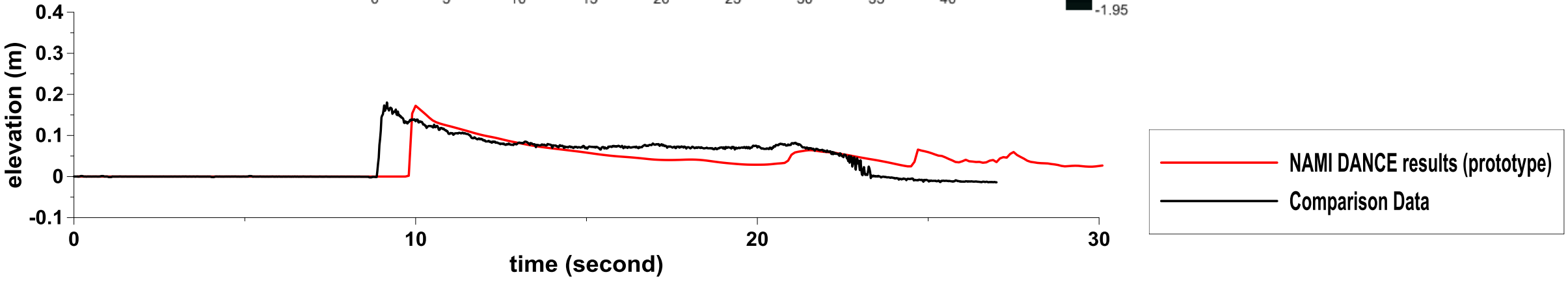


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

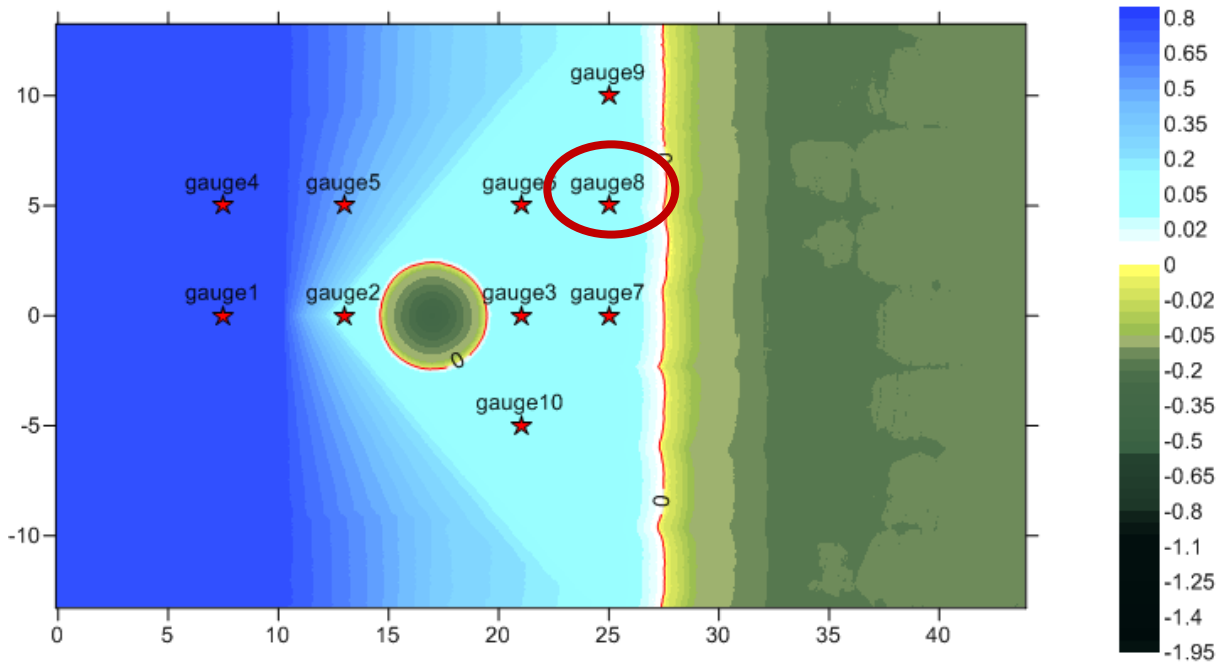


«gauge 7»



BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements



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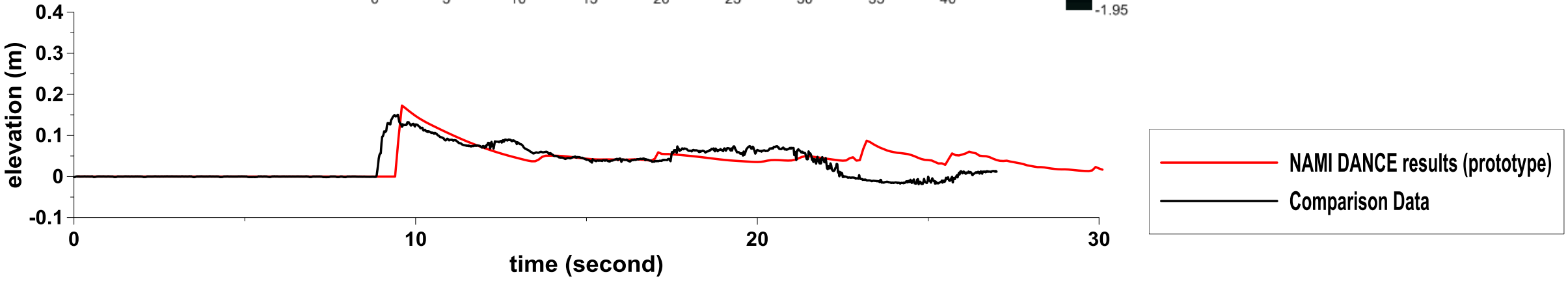
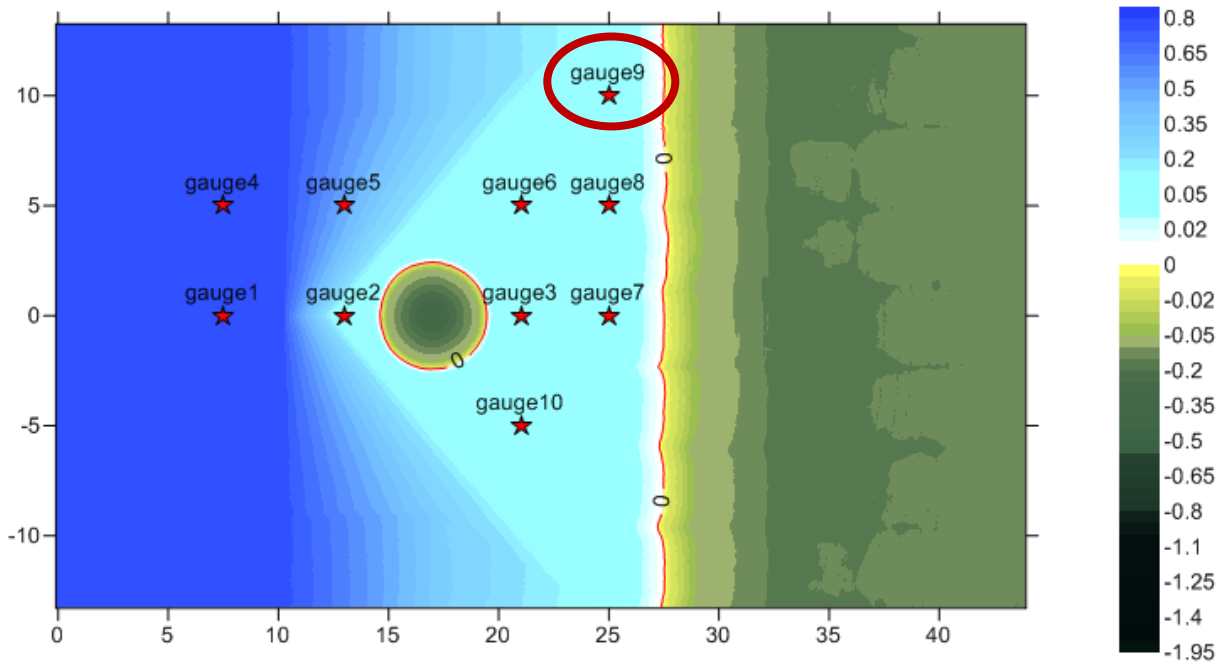
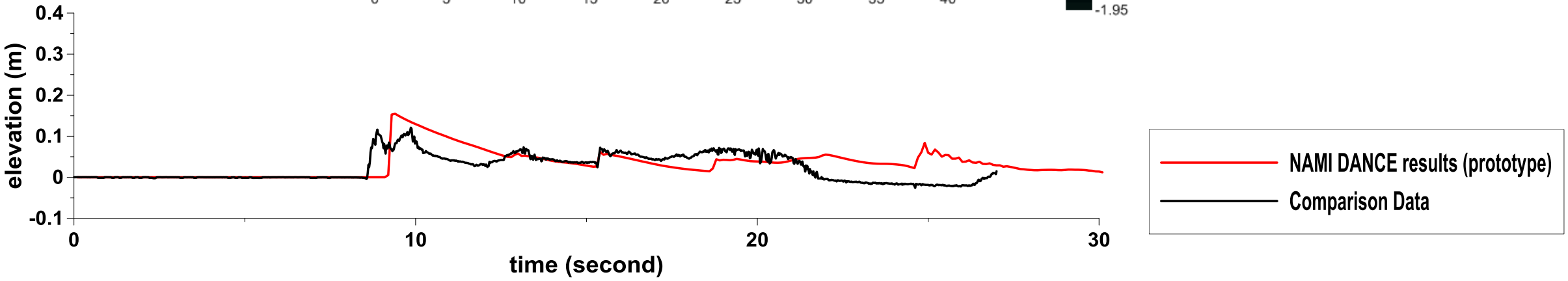


BM#5

COMPARISON OF RESULTS - Free Surface Elevation Measurements

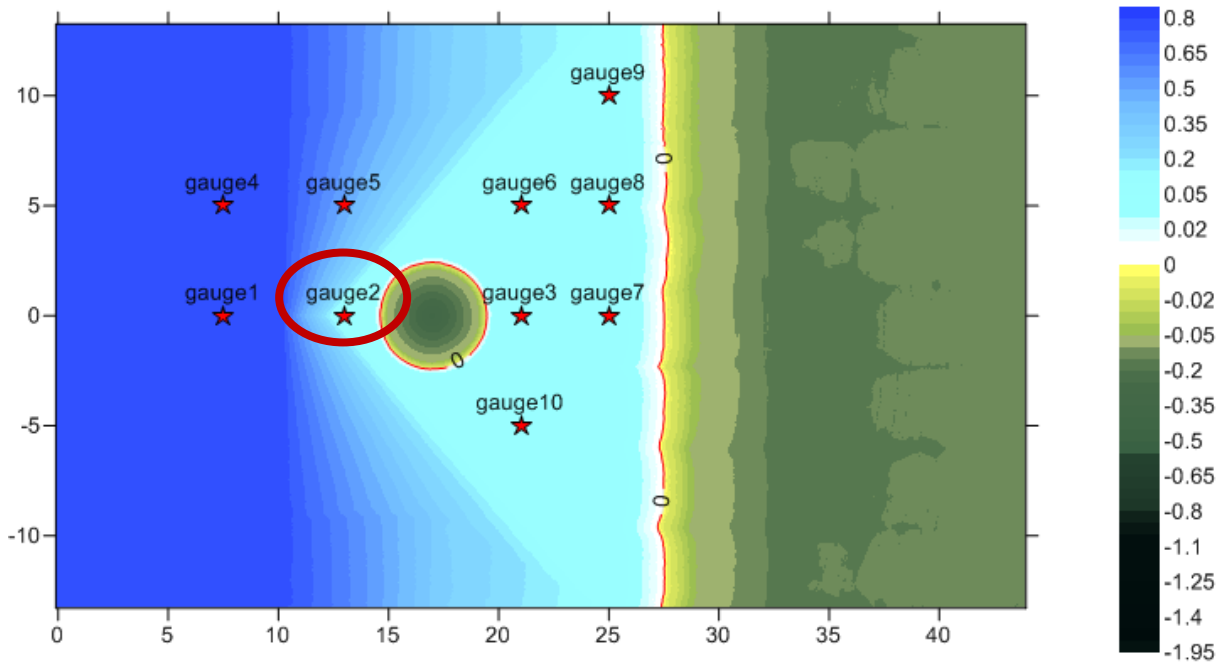


«gauge 9»



BM#5

COMPARISON OF RESULTS - Velocity Measurements (U)



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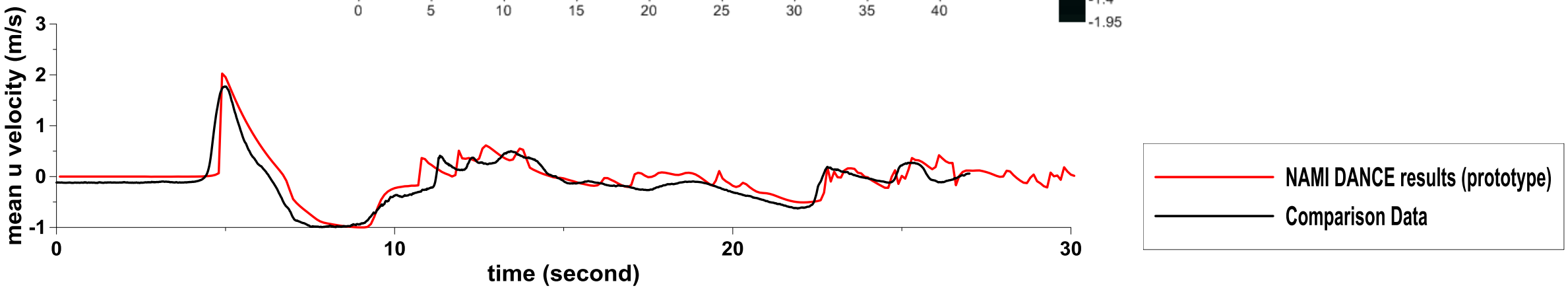
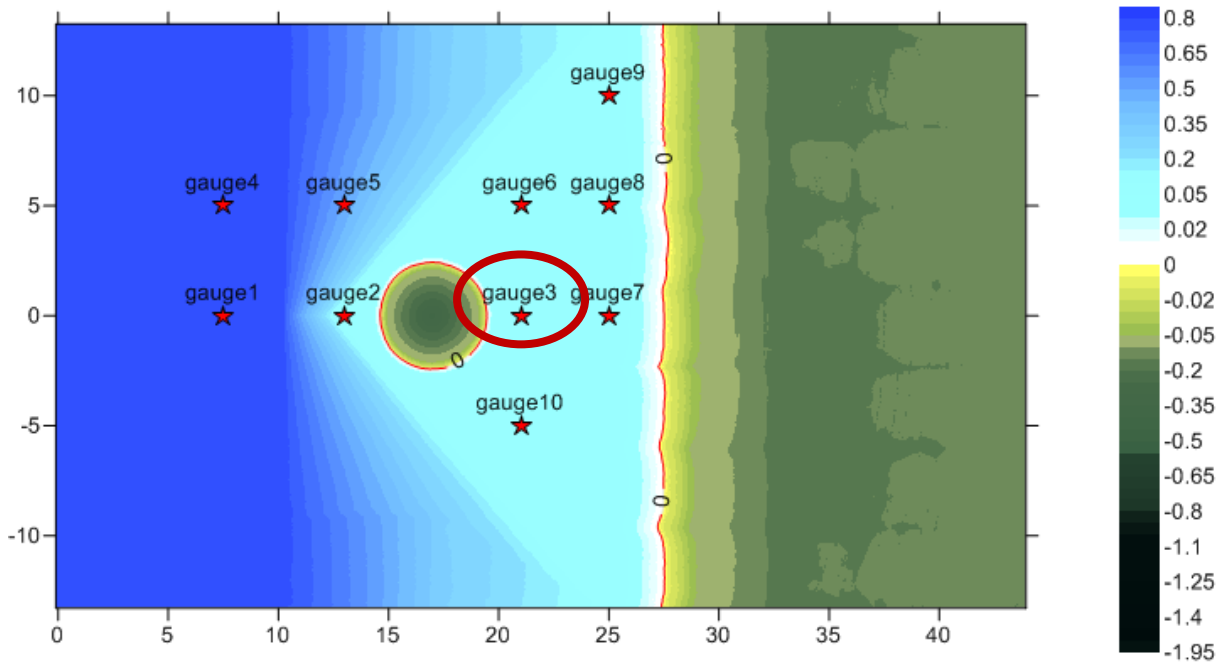
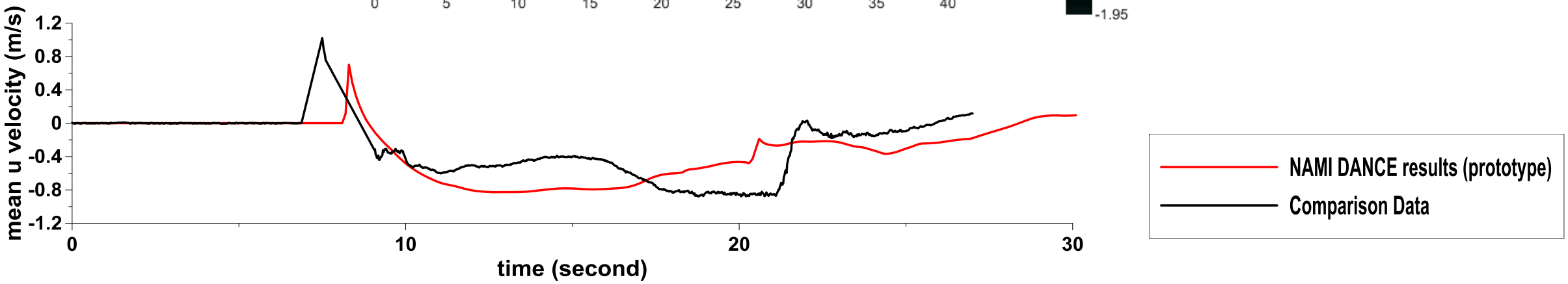


BM#5

COMPARISON OF RESULTS - Velocity Measurements (U)

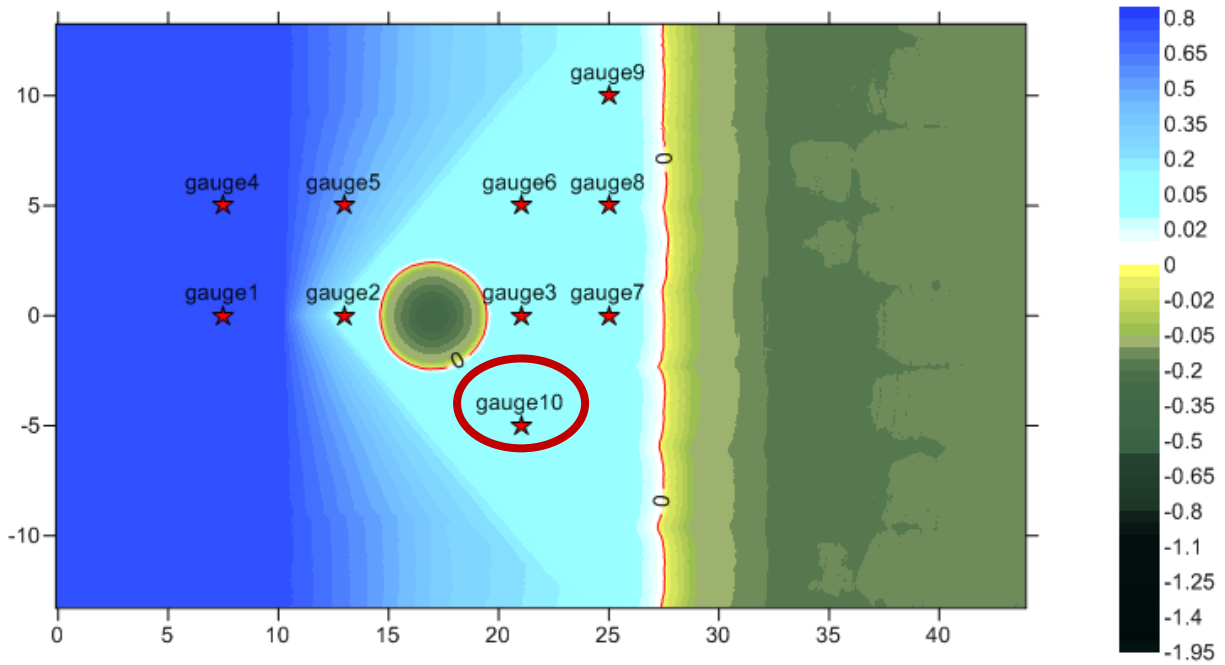


«gauge 3»



BM#5

COMPARISON OF RESULTS - Velocity Measurements (U)



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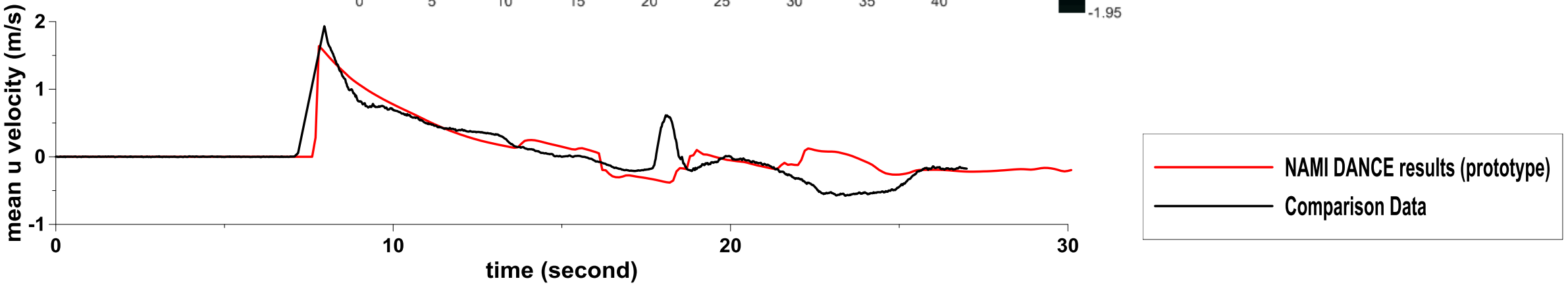
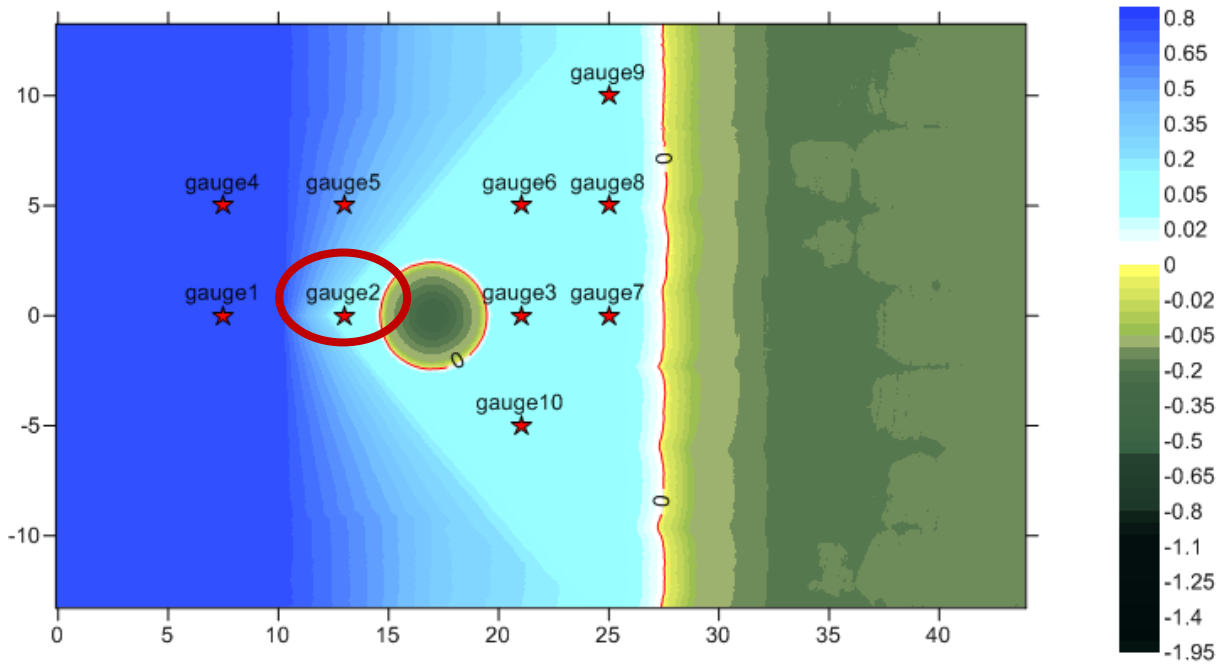
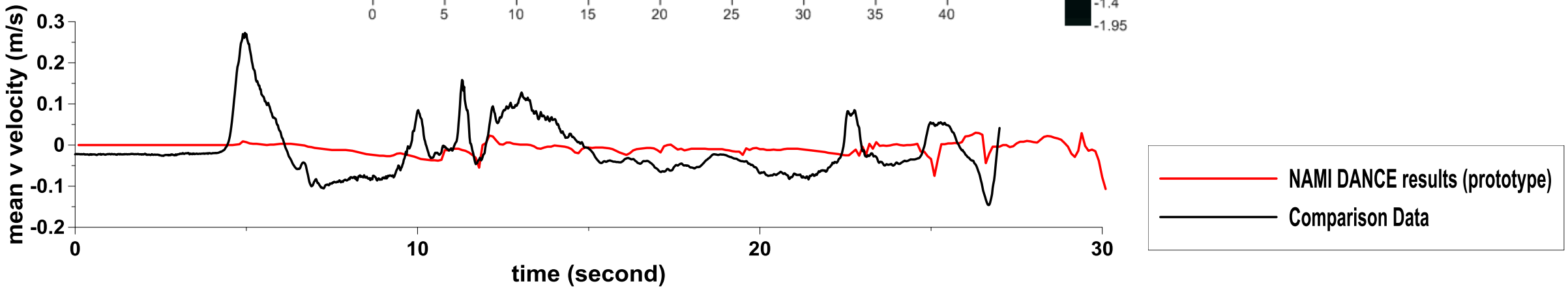


BM#5

COMPARISON OF RESULTS - Velocity Measurements (V)

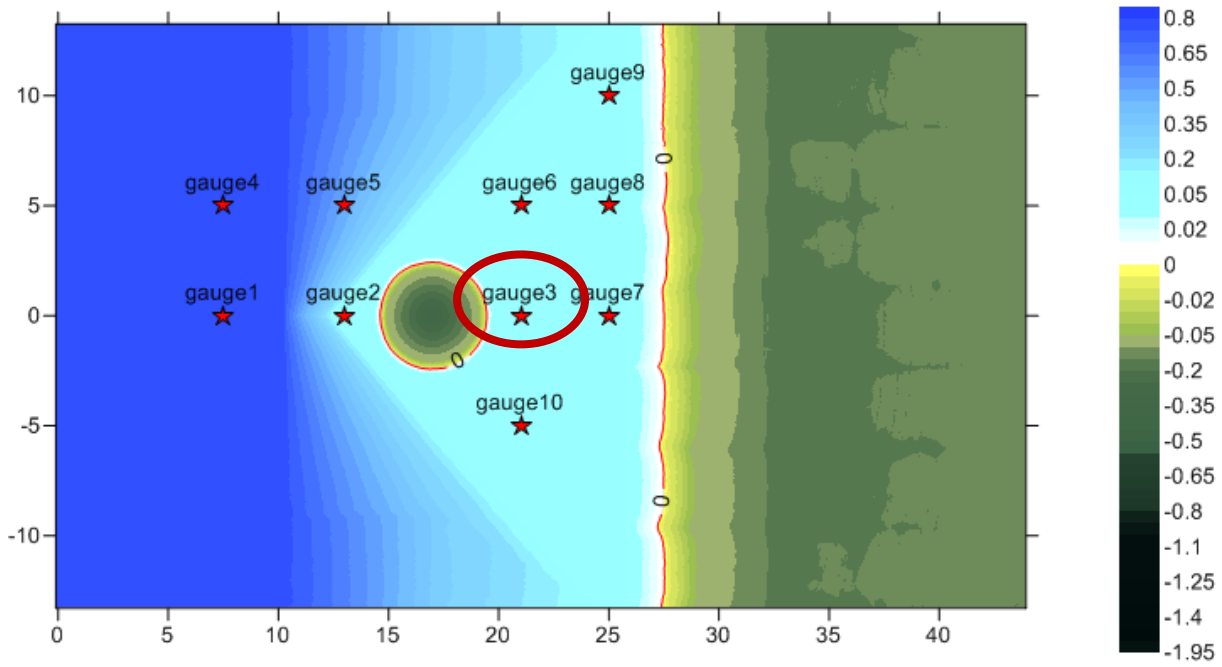


«gauge 2»

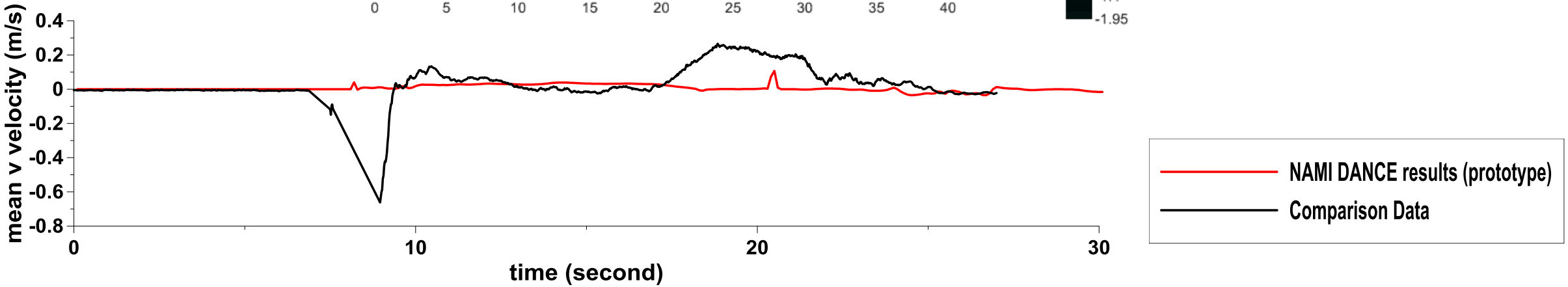


BM#5

COMPARISON OF RESULTS - Velocity Measurements (V)

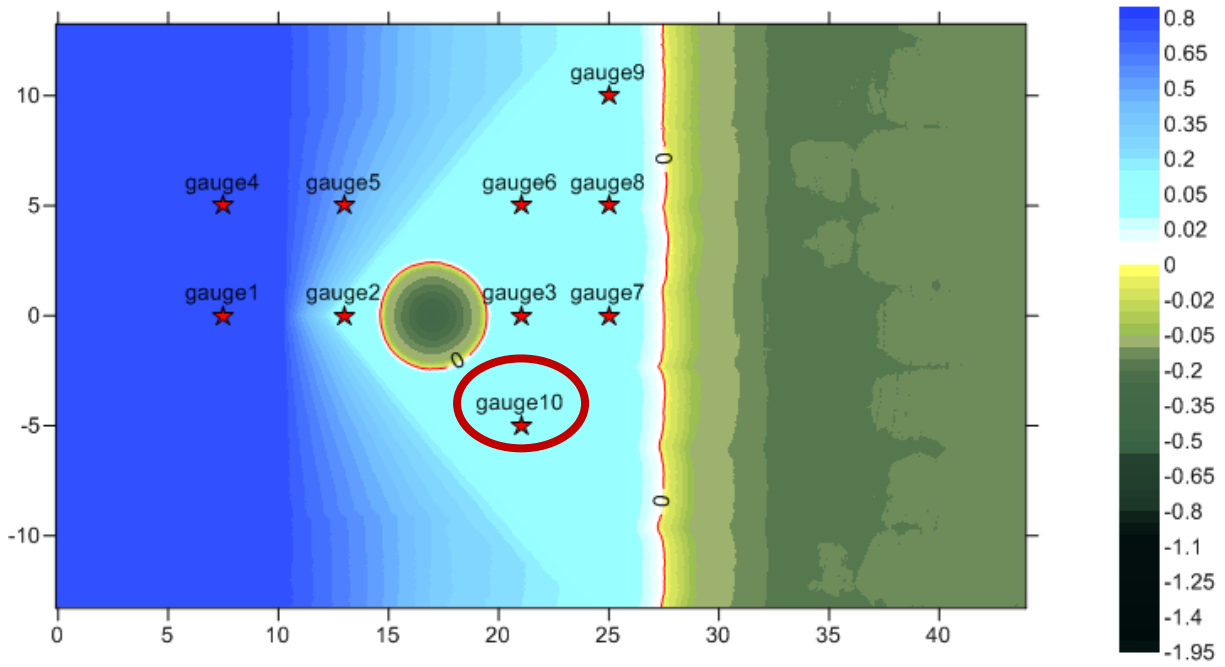


«gauge 3»

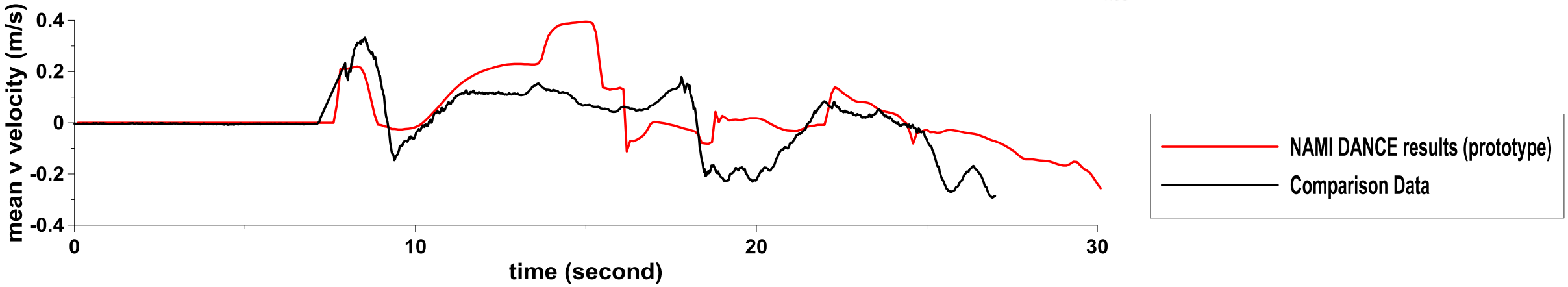


BM#5

COMPARISON OF RESULTS - Velocity Measurements (V)



«gauge 10»

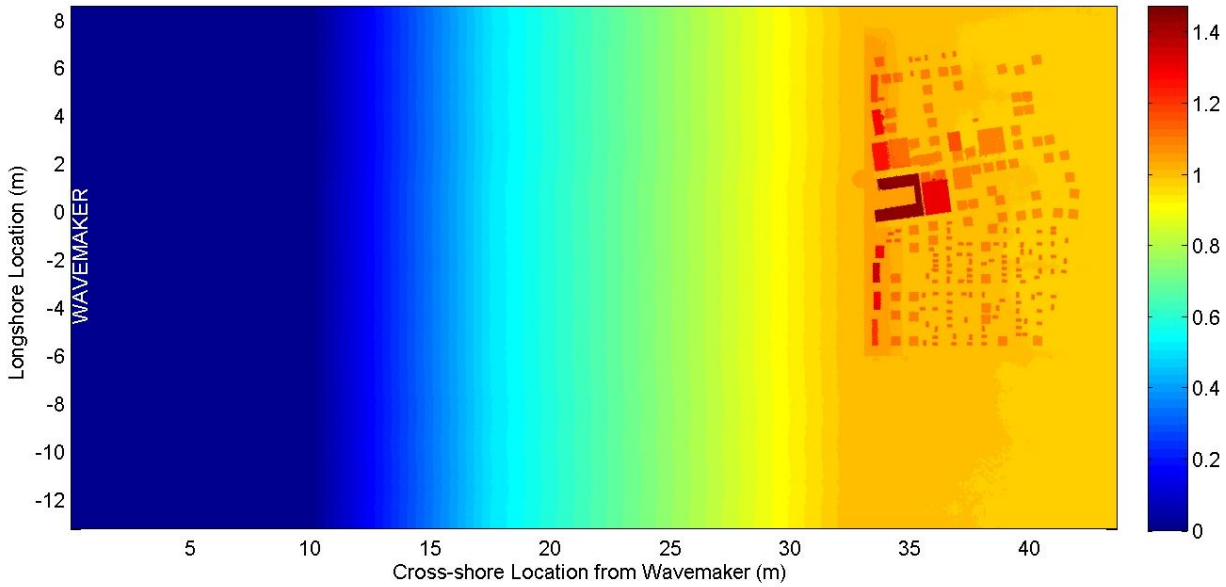


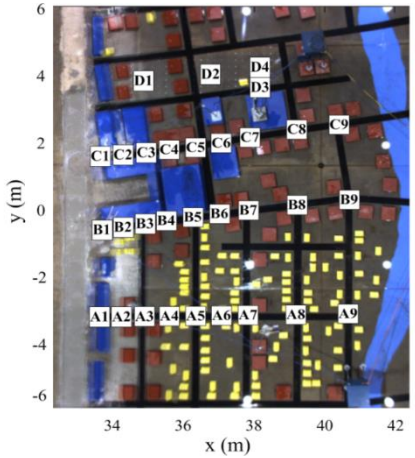
BM#5

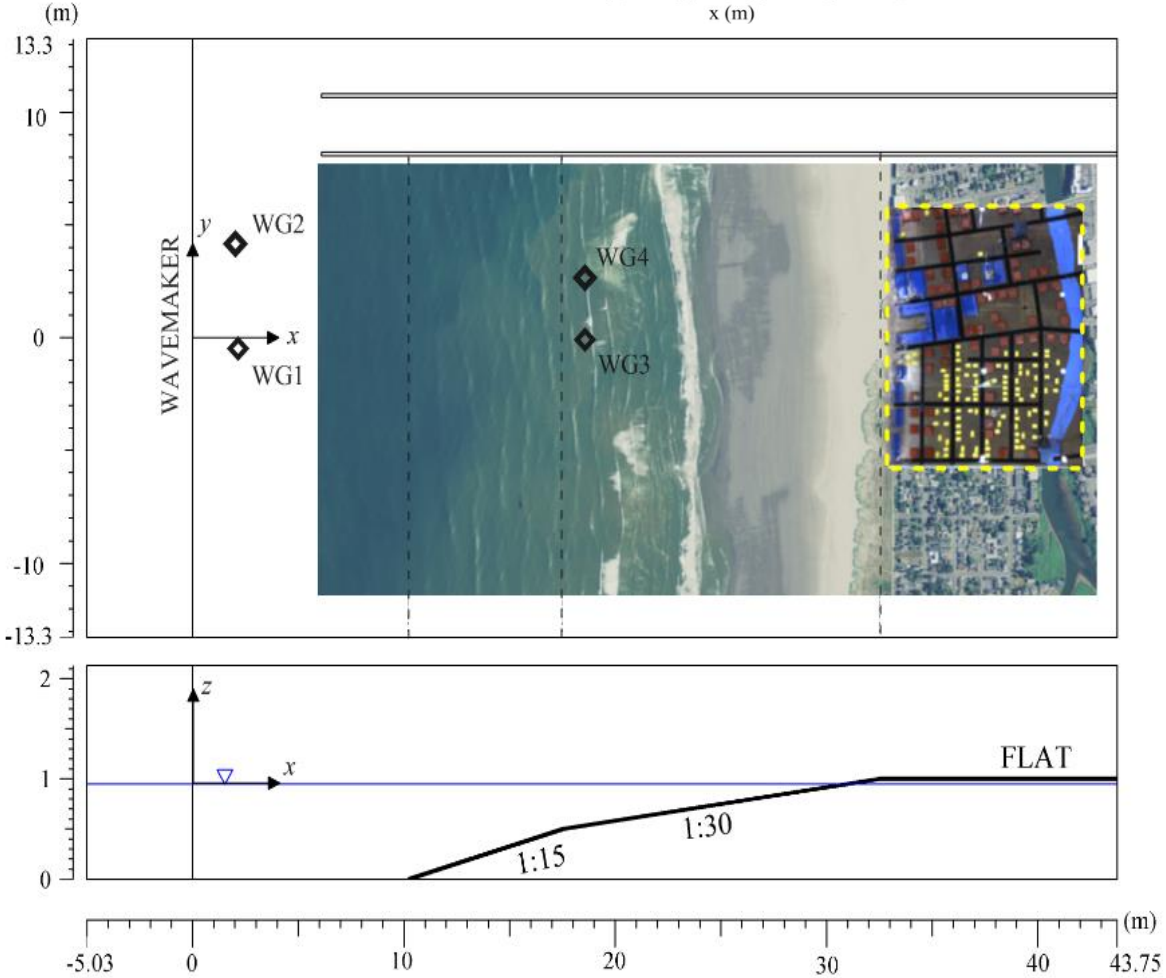
THANKS FOR YOUR ATTENTION

BM#4 – Bathymetry, Gauges

- For this benchmark, we will compare free surface, velocity, and momentum flux information recorded throughout the tank. (By NAMI DANCE)





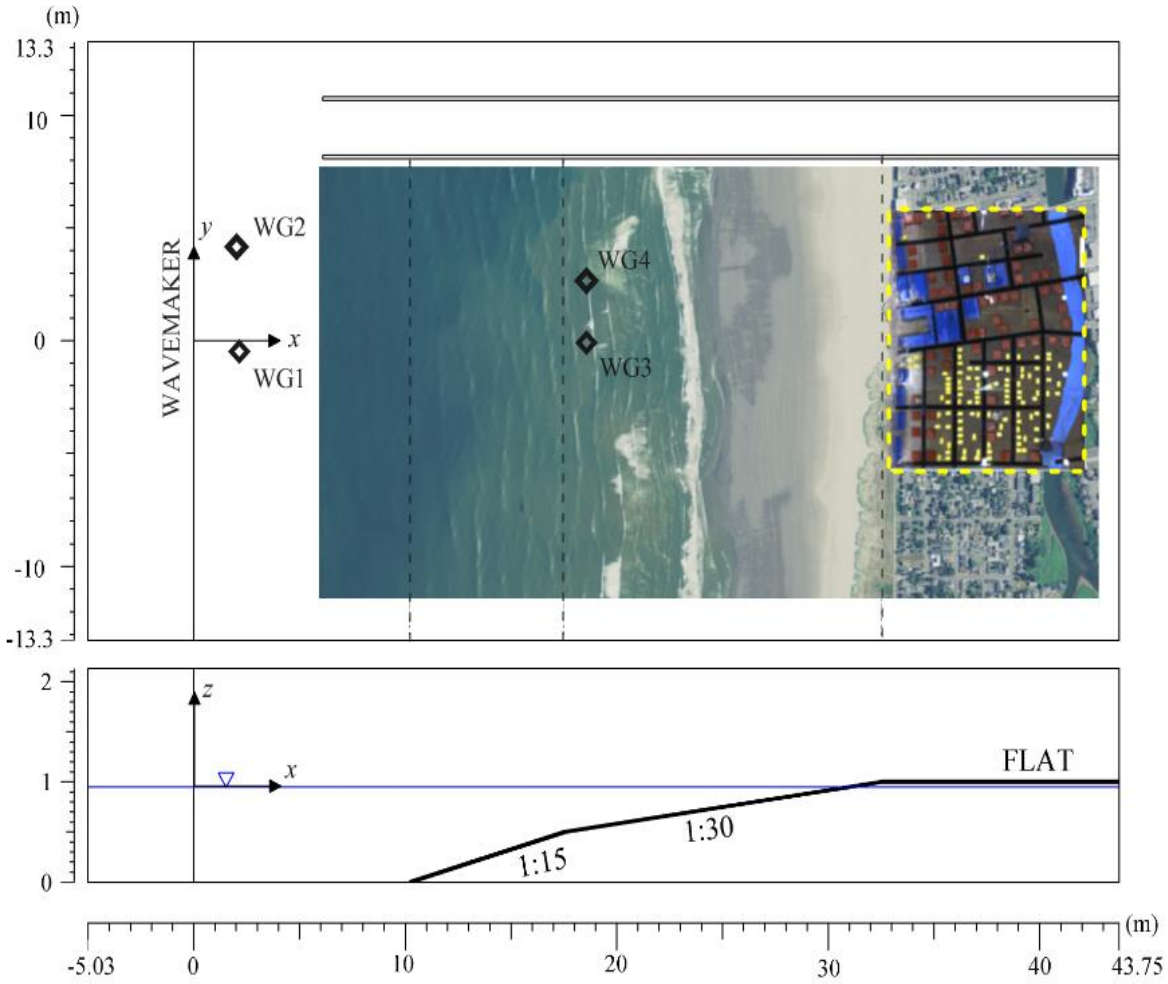


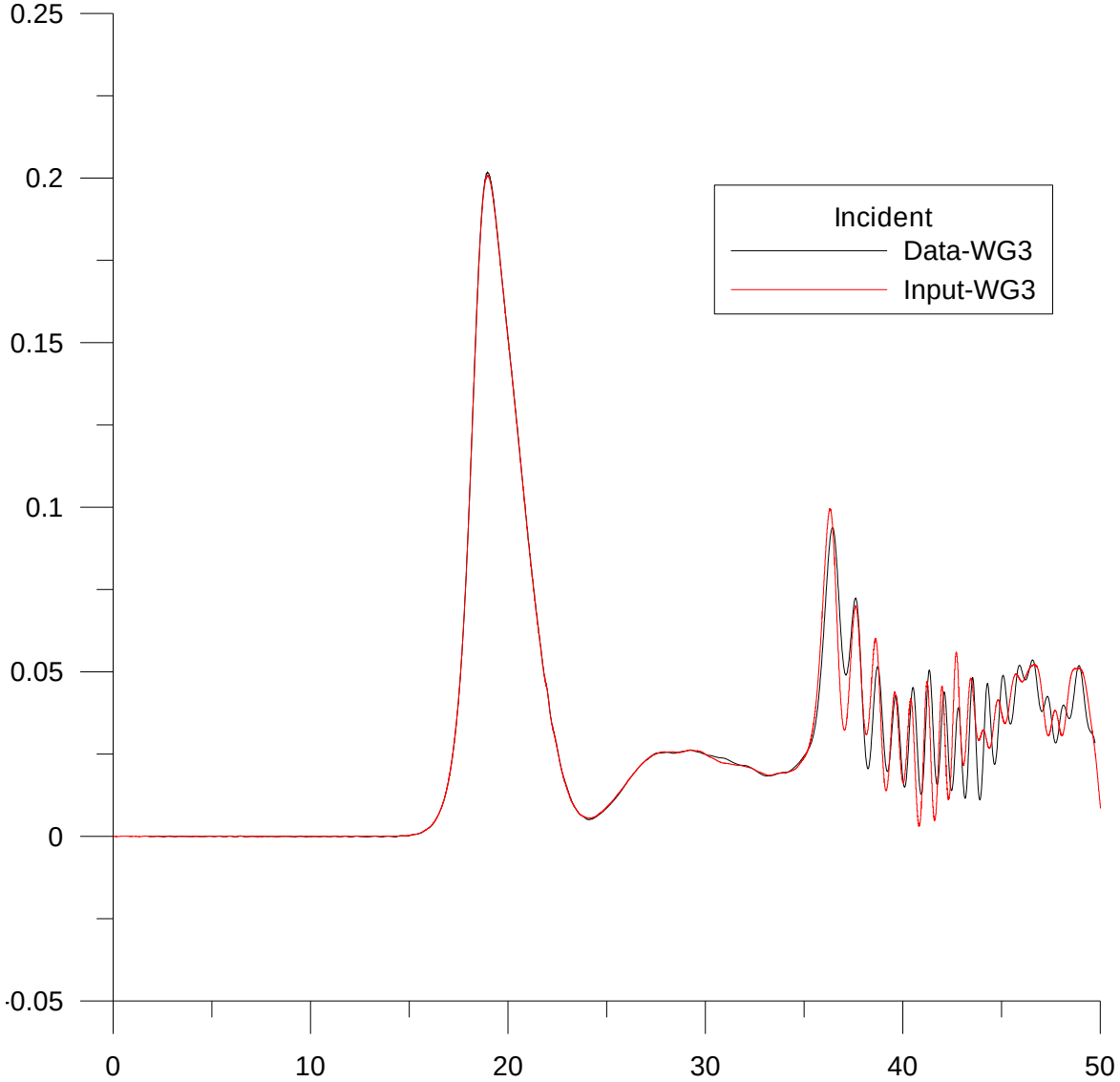
resolution: 0.1 m
Maximum Water Depth : 0.97m
Simulation time step: 0.0005 sec
Manning Coeff: 0.01

BM#4

BM#4 – Incident Wave @ WG3

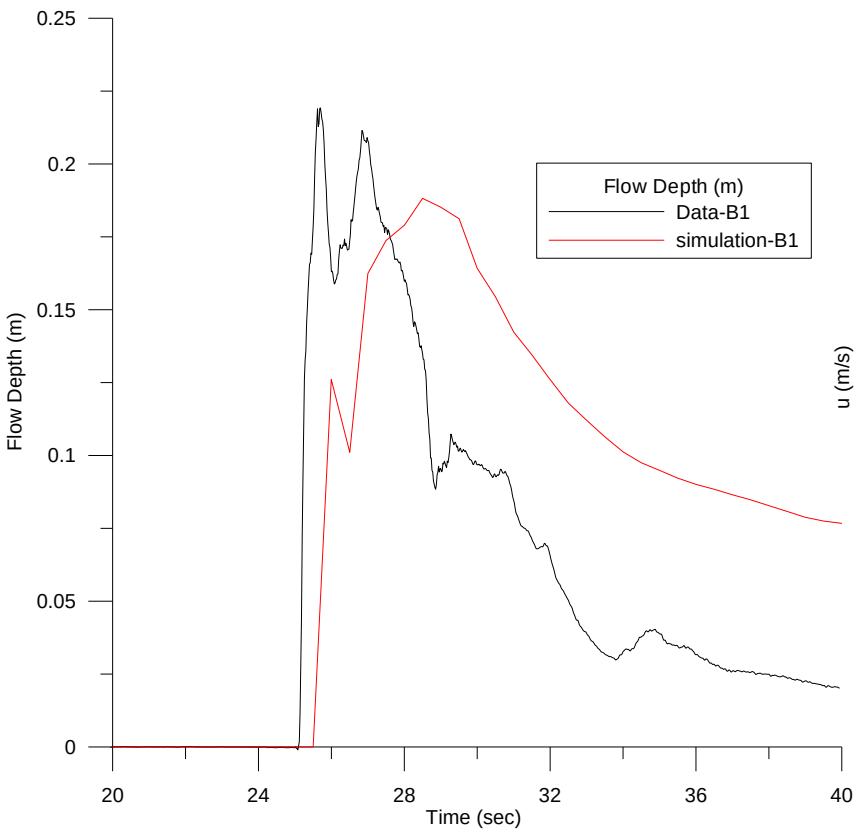
Since the incident wave data is given with 0.02 second time intervals, the data is obtained again for 0.0005 second intervals for 0.1m resolution by making linear interpolation.



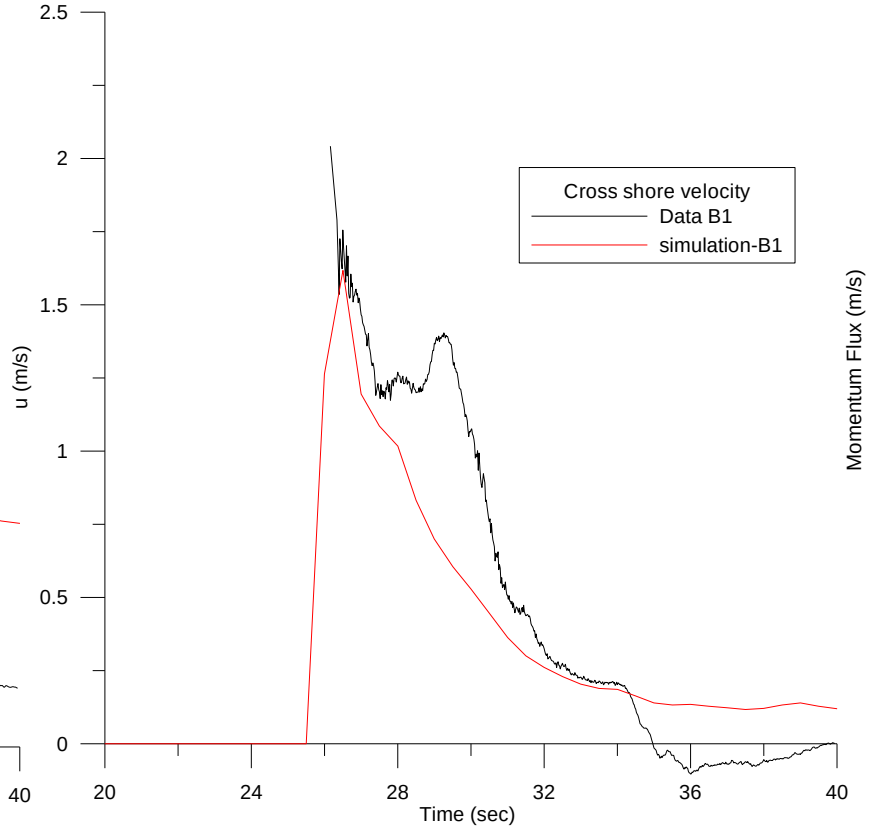


BM#4

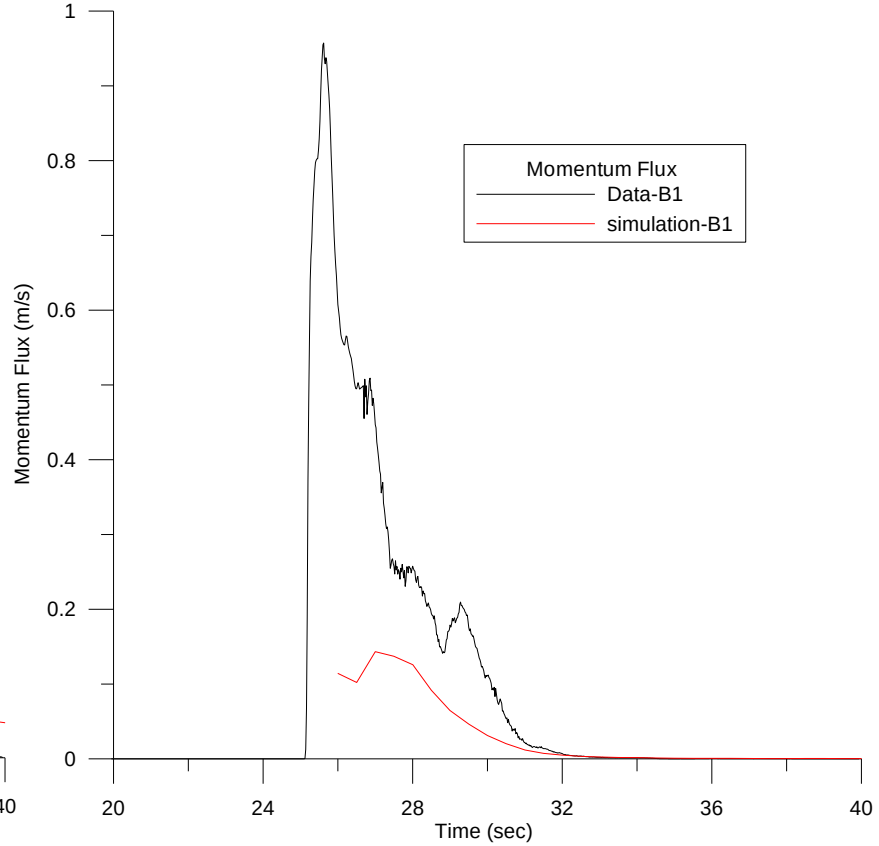
COMPARISON OF RESULTS – @ (B1) Location



Comparison of flow depth



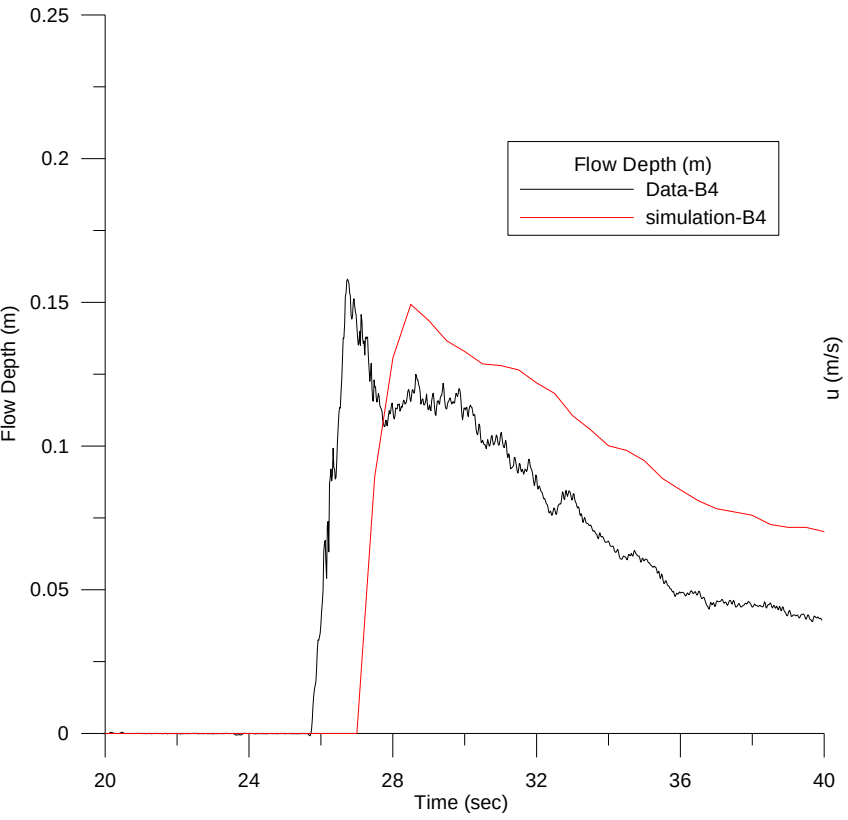
Comparison of cross shore velocity



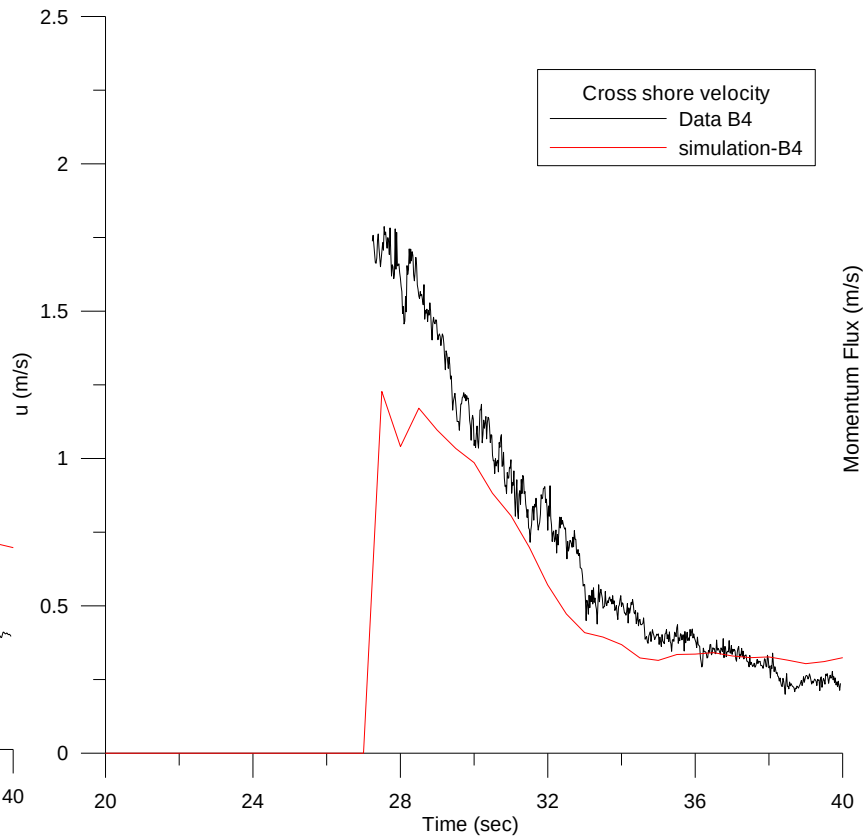
Comparison of momentum flux

BM#4

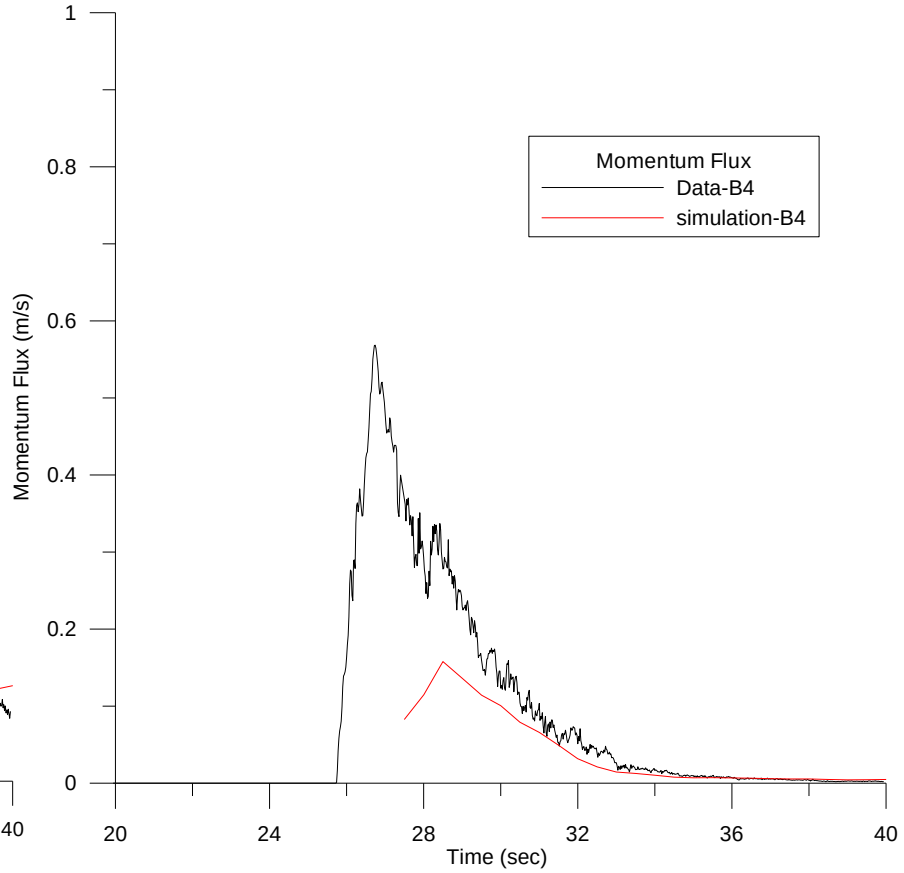
COMPARISON OF RESULTS – @ (B4) Location



Comparison of flow depth



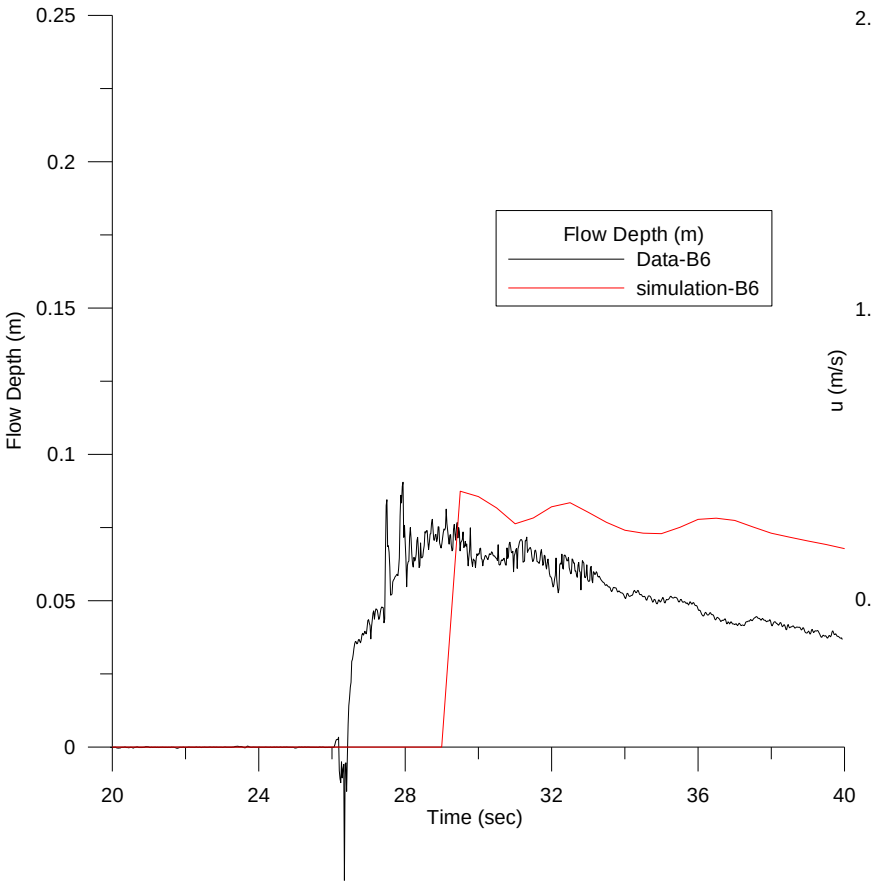
Comparison of cross shore velocity



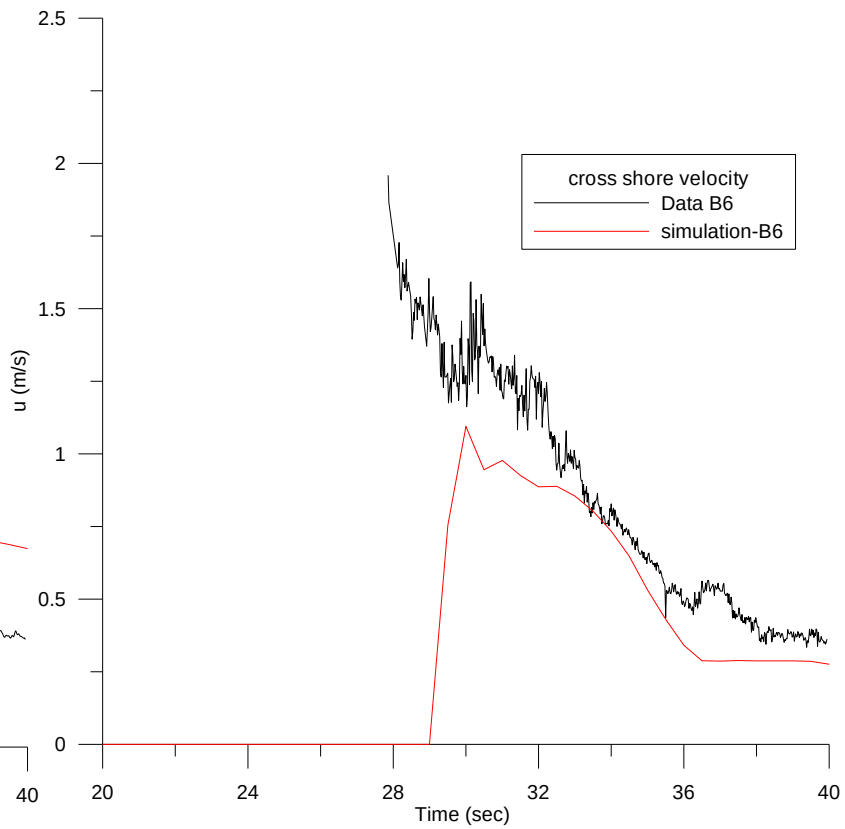
Comparison of momentum flux

BM#4

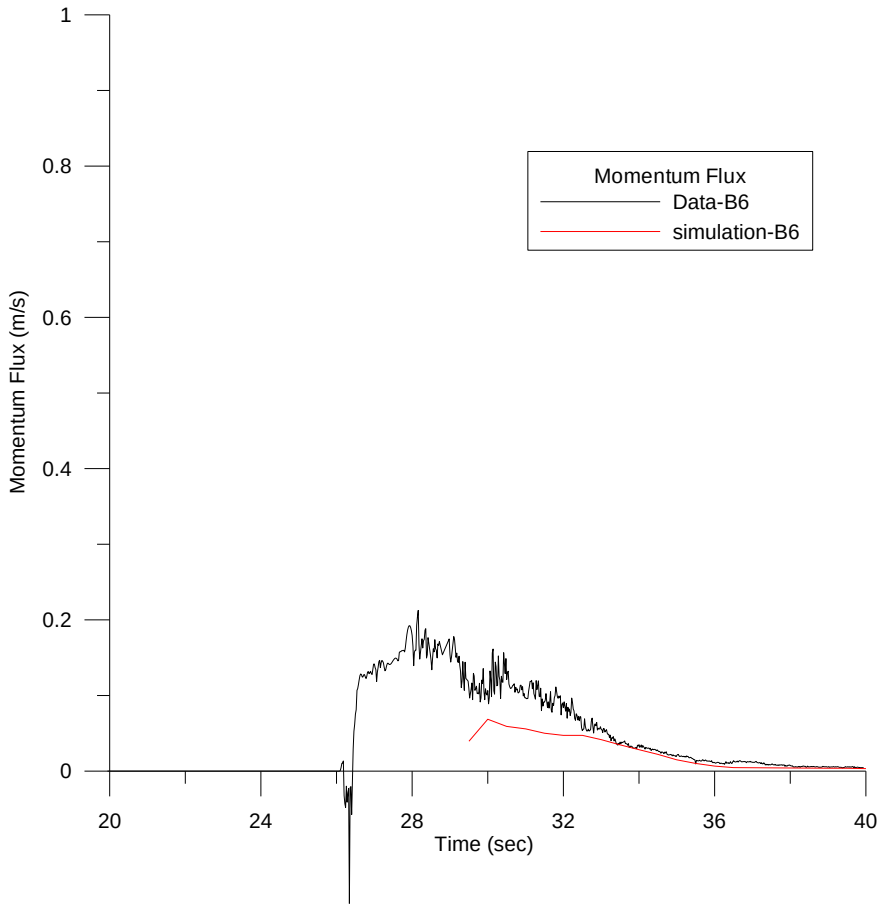
COMPARISON OF RESULTS – @ (B6) Location



Comparison of flow depth



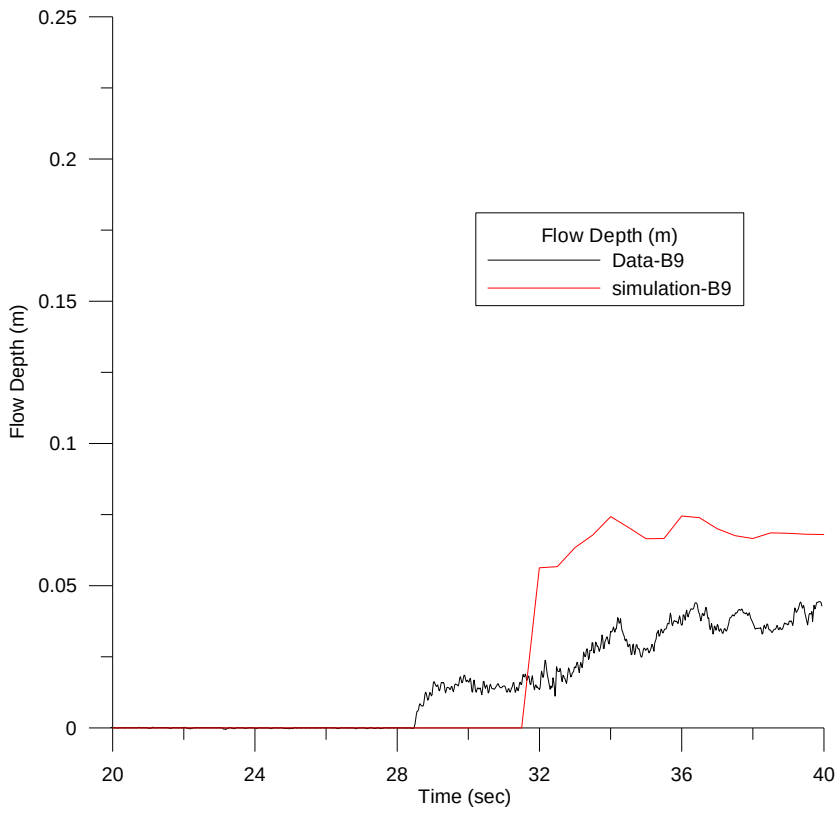
Comparison of cross shore velocity



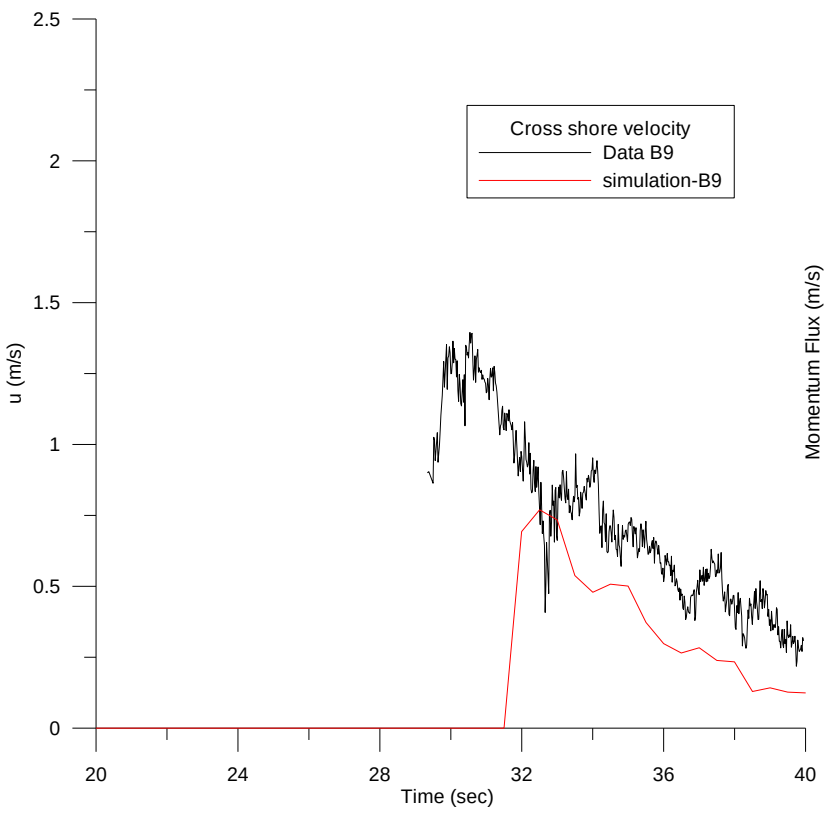
Comparison of momentum flux

BM#4

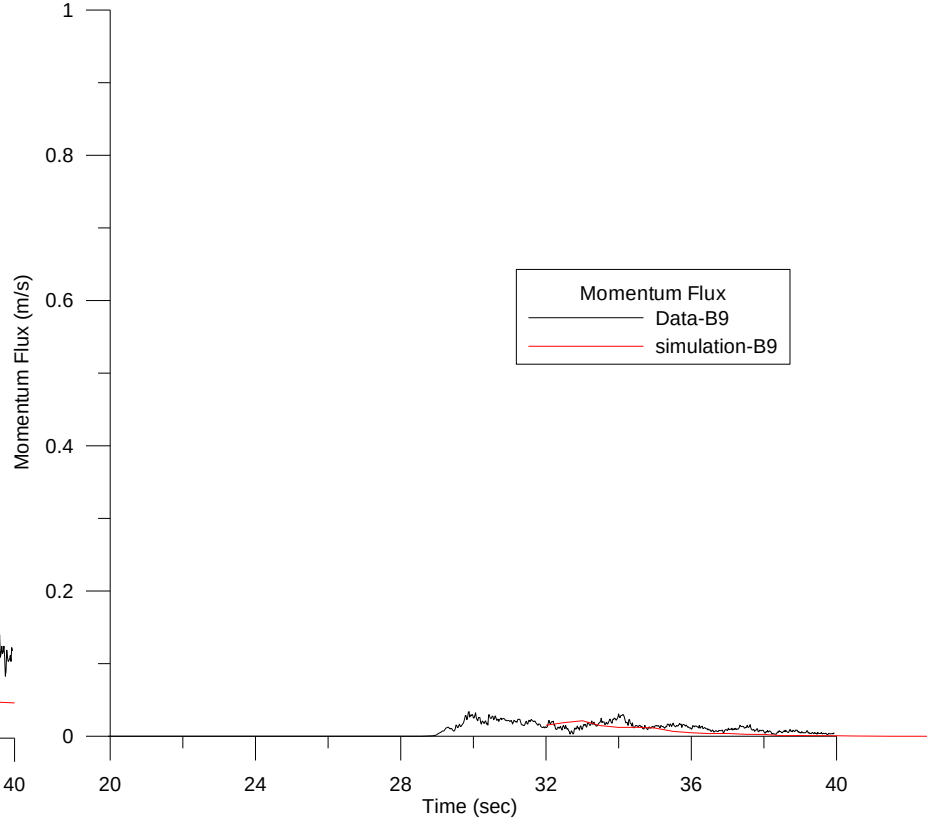
COMPARISON OF RESULTS – @ (B9) Location



Comparison of flow depth



Comparison of cross shore velocity



Comparison of momentum flux

BM#4

- **THANKS FOR KIND ATTENTION**