한국연안방재학회
Korean Society of Coastal Disaster Prevention

대천해수욕장에서의 이안류 발생에 대한 수치모의 평가

(Numerical Study of Rip Current Generation at Daecheon Beach)

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Contents

1 Introduction

2 Numerical Simulation

3 Simulation Results

4 Discussion

1 Introduction

Background

Accidental Rip currents

- The social issue at the Haeundae beach
- Rip currents occur repeatedly and sweep away swimmers
- Rip currents are generated due to the longshore variations of wave energy caused by alongshore non-uniformities
- Strong jet-like flow evolves through the lower-energy zone (rip-channel)

Daecheon beach in west coast of Korea

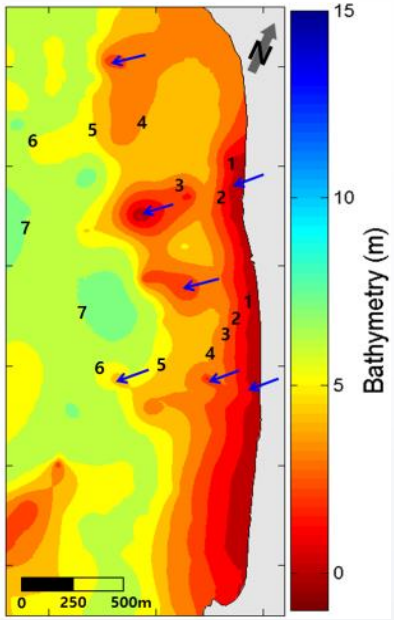
Most famous beach

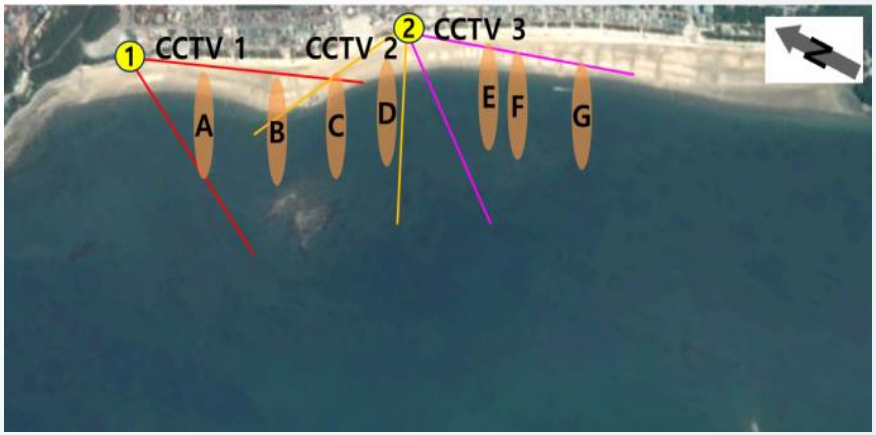
- The biggest beach on the west coast of Korea
- Soft sand composed of tiny bits of eroded shells
- 'Boryeong Mud Festival' attracts visitors from throughout the world in July every year
- Length: 3.5 km / Width: 100 m

Daecheon beach in west coast of Korea

Location , Bathymetry and Observation

- submerged rocks are located near the wave breaking zone
- CCTV monitoring system has been operated since 2013





Rip current at Daecheon beach

- Question whether rip currents can occur at beaches of the west coast of the Korea
- The events of rip current occurred at the Daecheon beach
- The coast characterized by dissipative beach profiles with very gentle slope and macro tides

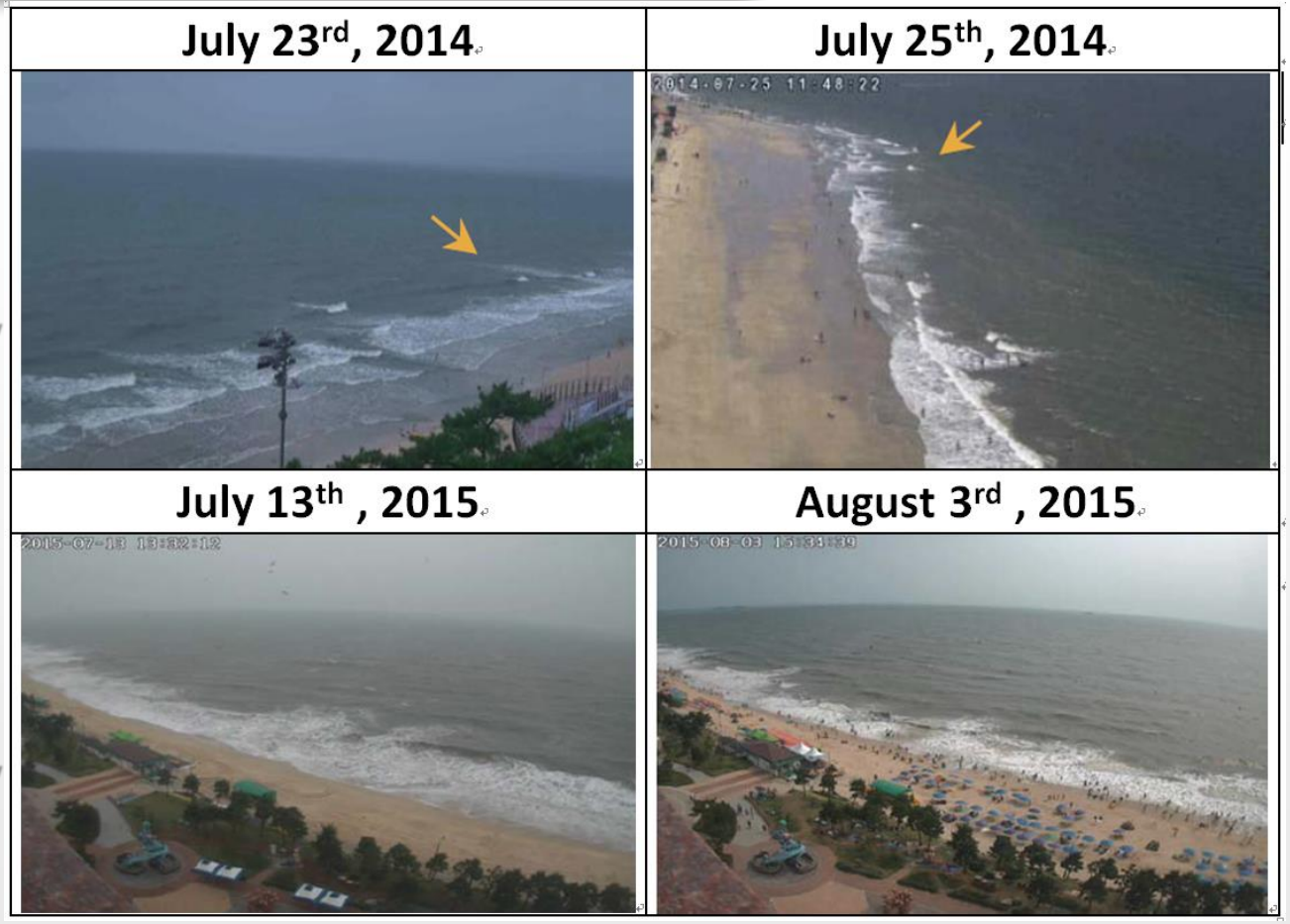
Snapshots of rip current occurrence at the Daecheon beach, 2012 (Choi and Kim, 2016)

Observation

: 0.6m wave height, 6 s wave period, and 4m tidal elevation about MSL

Rip current at Daecheon beach

Hs=1.0m,
Tp=5 s
Dir=SW



Hs=1.0m,
Tp=5 s
Dir=SW

Hs=1.5m,
Tp=8 s
Dir=SW

Hs=1.0m,
Tp=5 s
Dir=SW

Snapshots of rip current occurrence at the Daecheon beach, 2014~2015

Observation

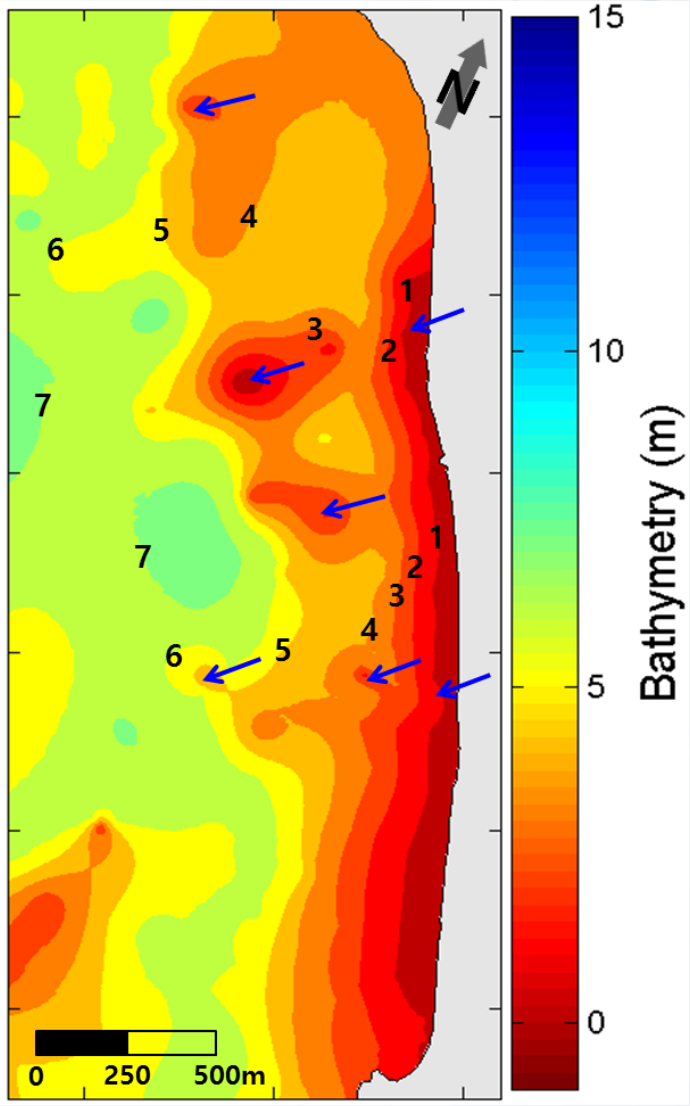
: 0.6~1.5m wave height, 6~10 s wave period, and 3~6m tidal elevation

2 Numerical Simulation

Numerical simulations for rip current generation

SWASH model

- Based on the non-linear shallow water equations with non-hydrostatic pressure model
- SWASH is very likely to be competitive with the Boussinesq-type wave models.
- One of the most advanced model for simulating rapid wave-induced current (i.e., rip current)



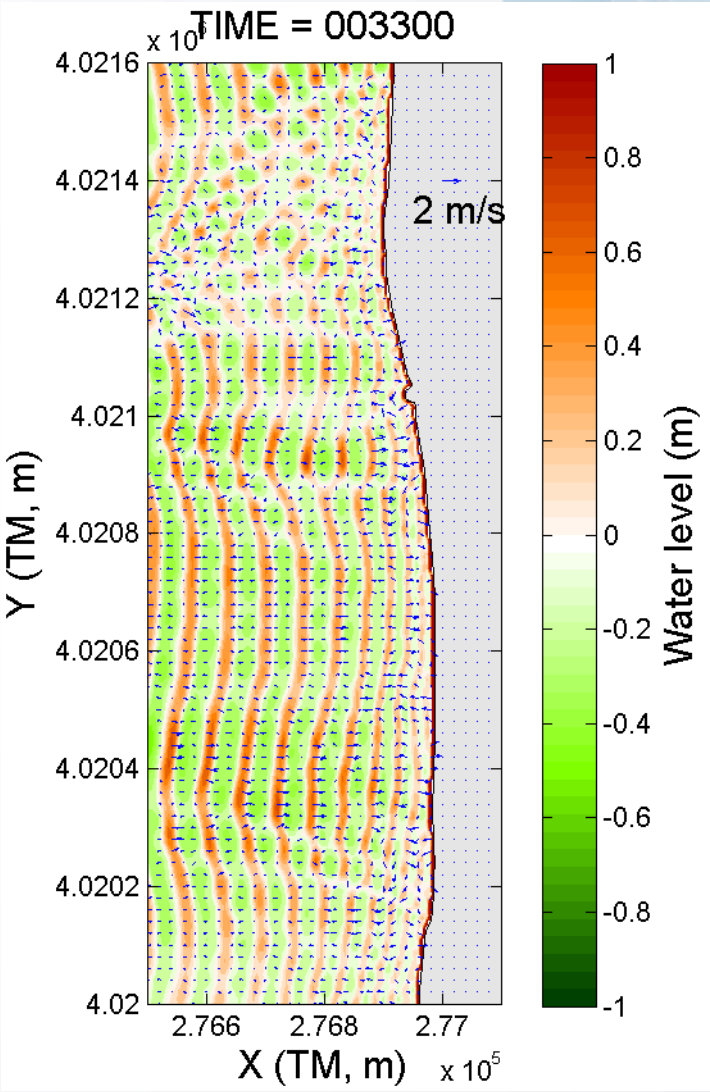
Topography of Daecheon beach at medium tide, which was rotated 25 degree in clockwise direction

Model setup

- dx=dy=5m (grid size)
- nx=261, ny=611 (1300m x 3000m)
- Time step : 0.005 s, run : 60 min
- Friction coefficient n = 0.019
- Mean tide level condition

- Test cases for monochromatic wave conditions
  : wave heights (1.0, 1.5, 2.0m)
  wave periods (8.0, 10.0, 12.0s)
  wave directions (SW, WSW, SSW, WNW)

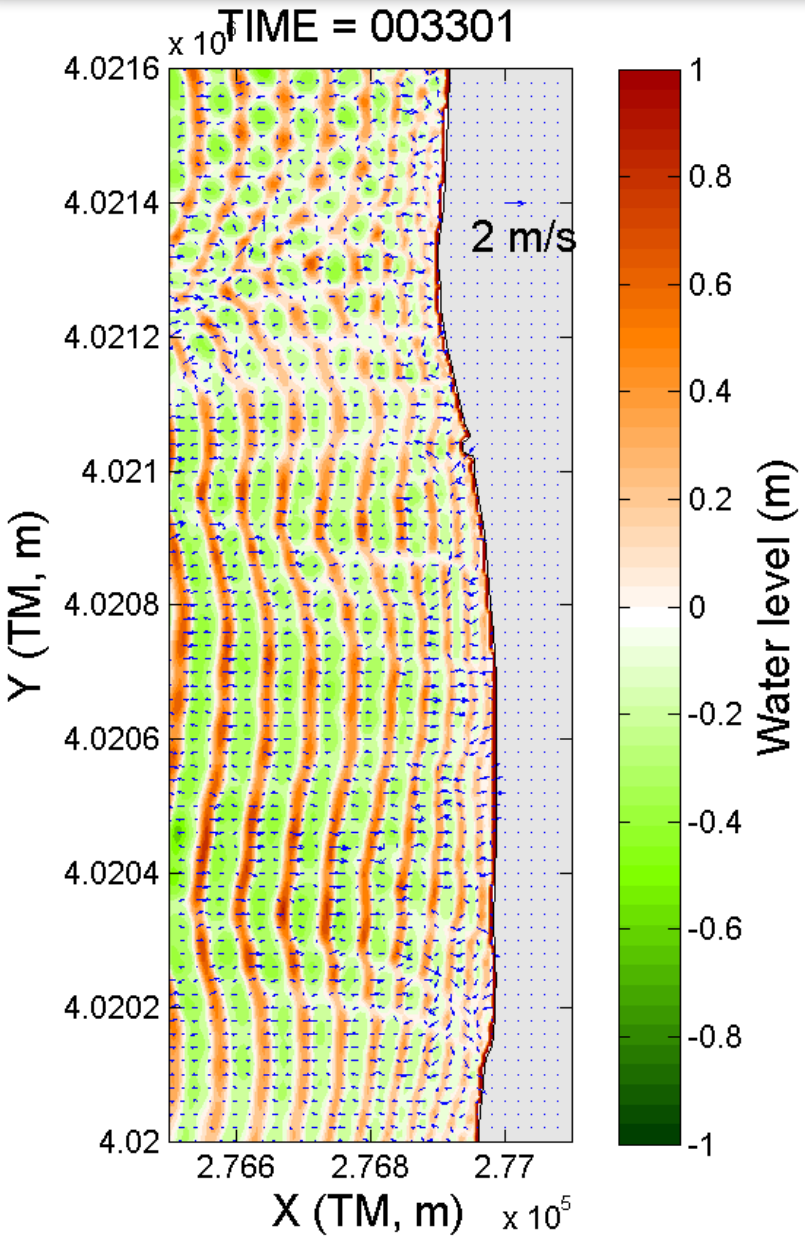
- Wave-induced rip current are computed by averaging velocities for the last six-wave-periods.

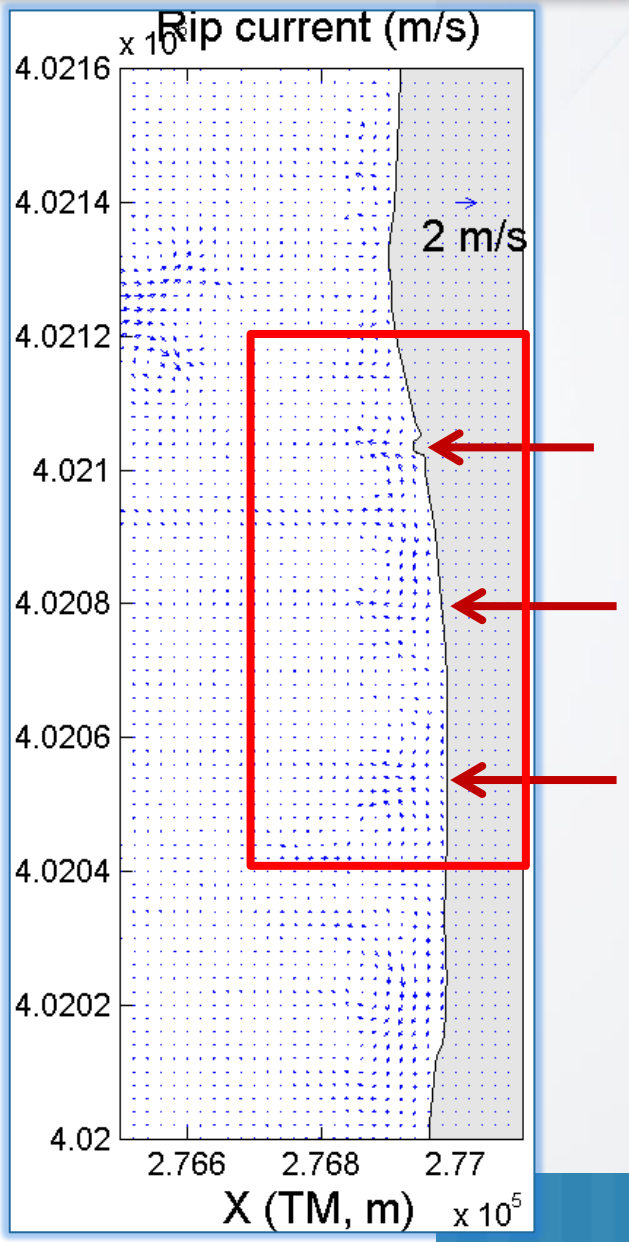


Sample case simulated snap-shot of free surface displacement(shading) and currents

3 Simulation Results

Typical rip current case : H_s=1.5m, T_p=10s, D_p=0°





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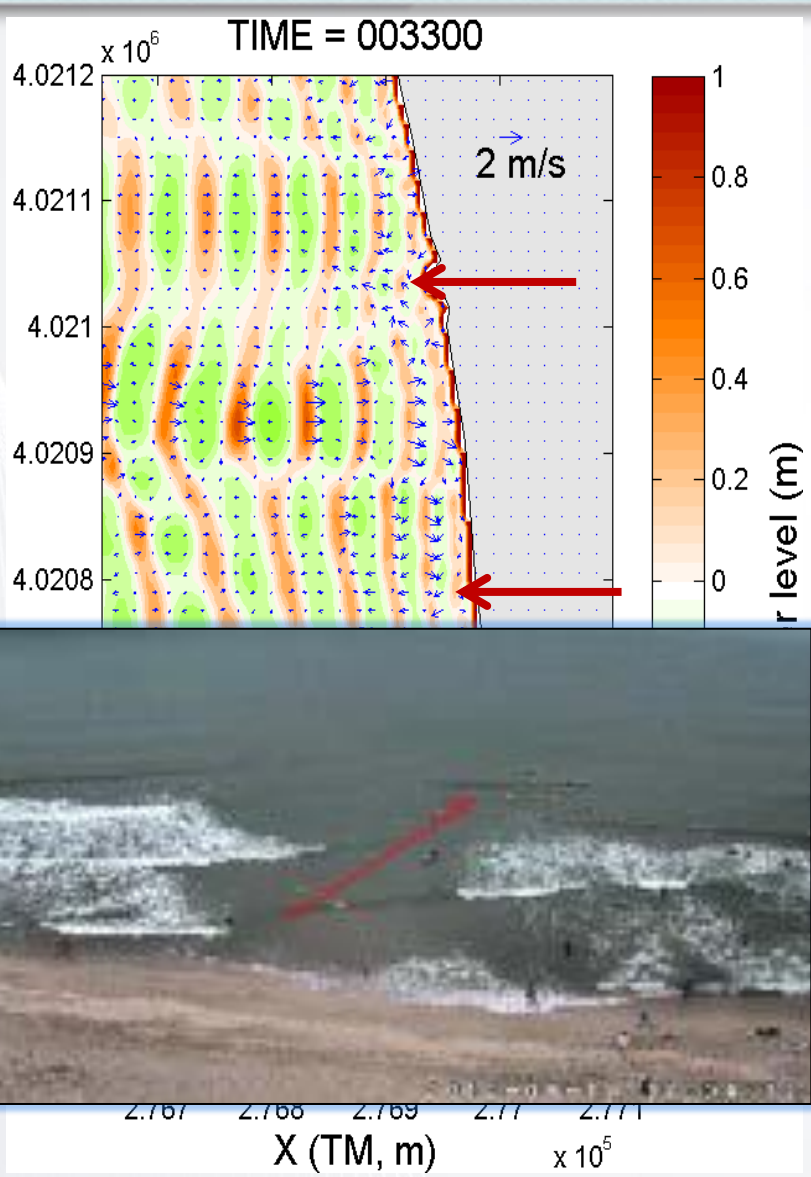
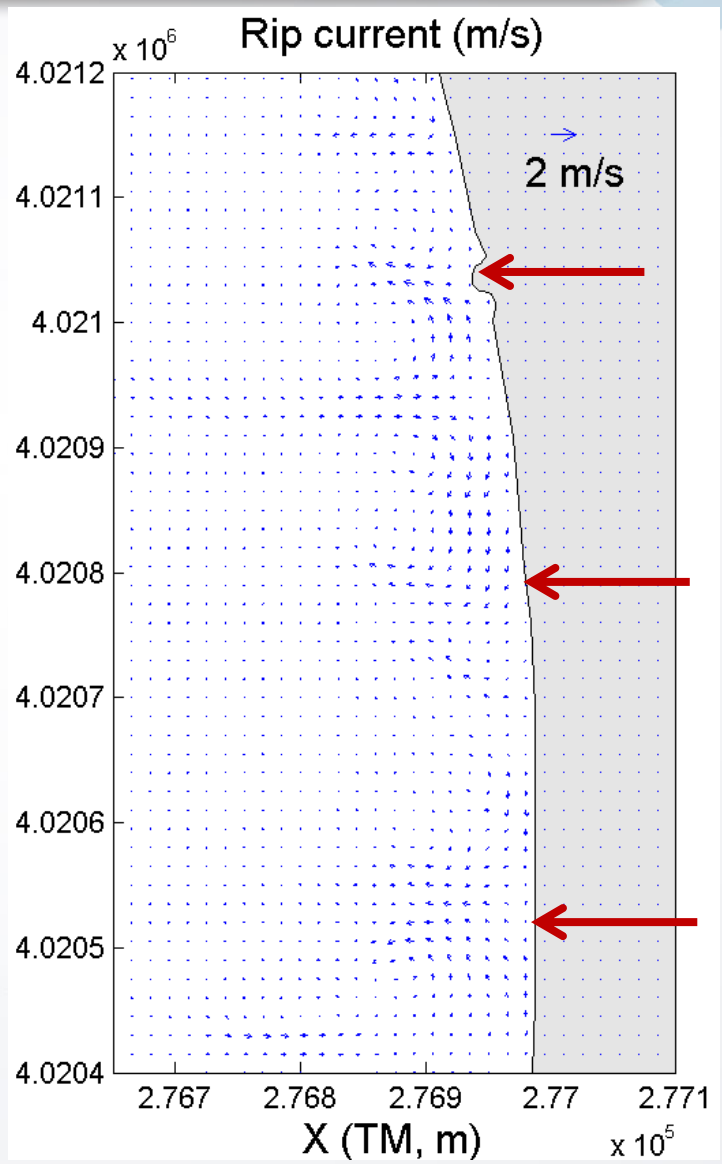
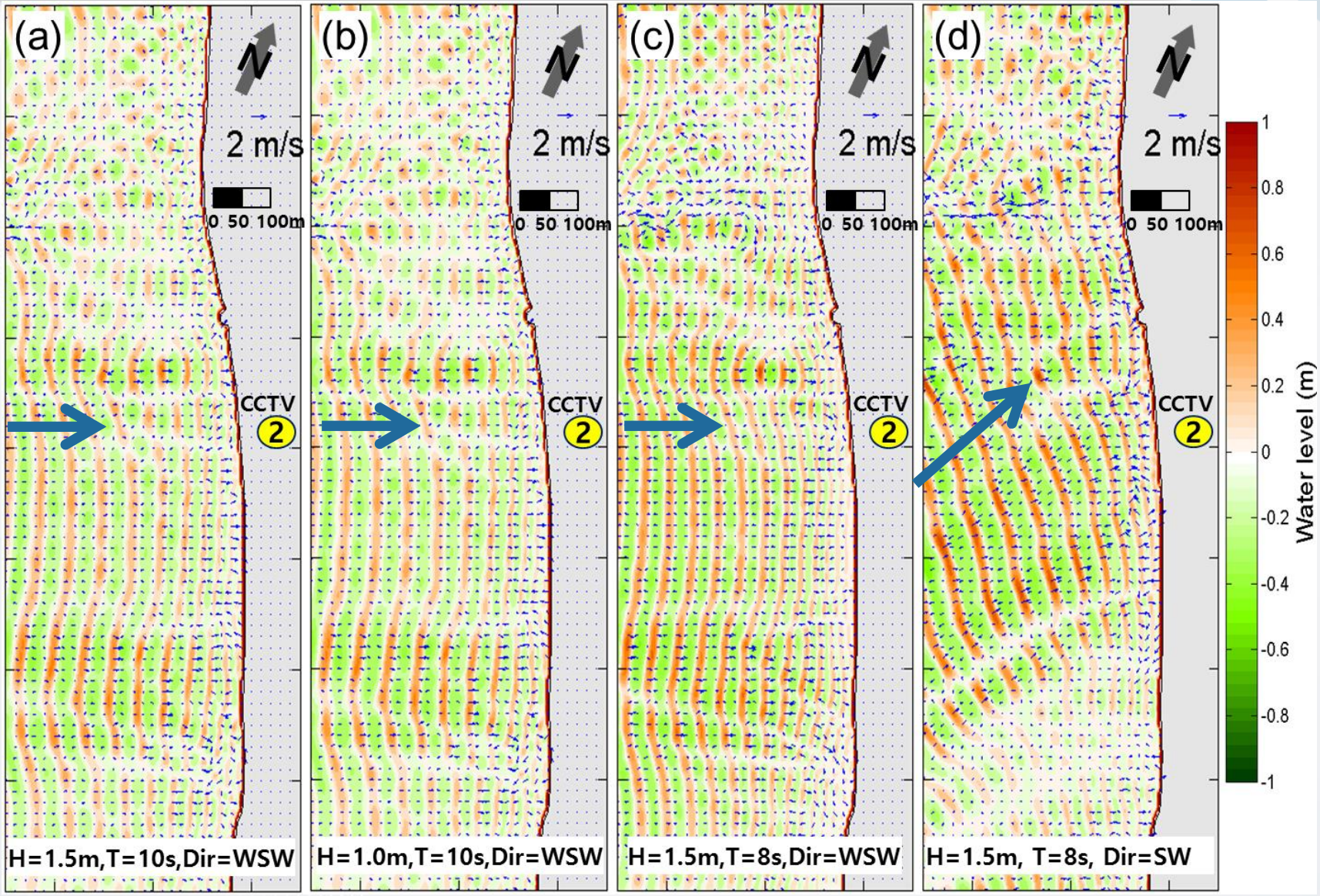
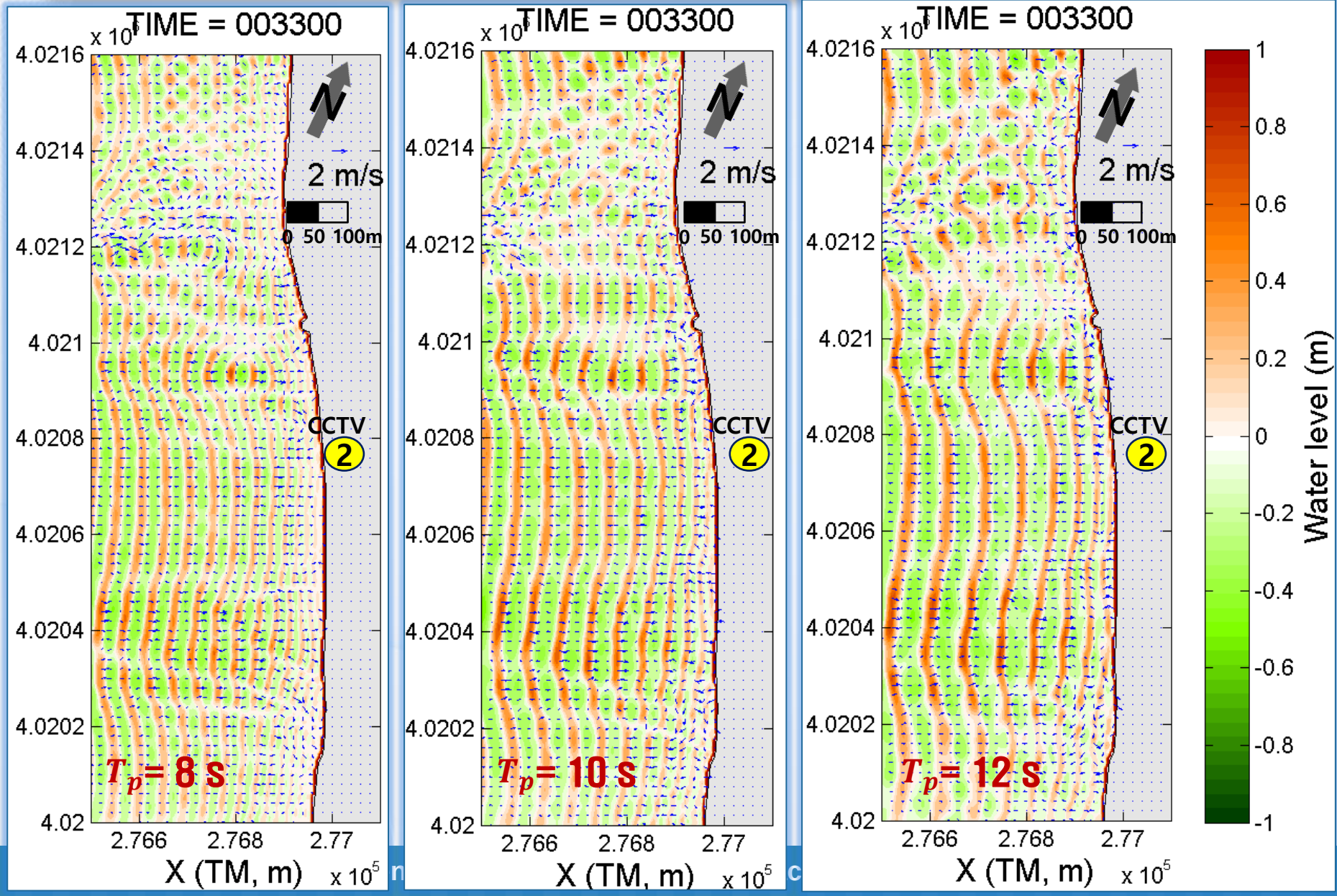




Influence of Incident wave height, period, direction



Influence of Incident wave period : T_p= 8, 10, 12 s



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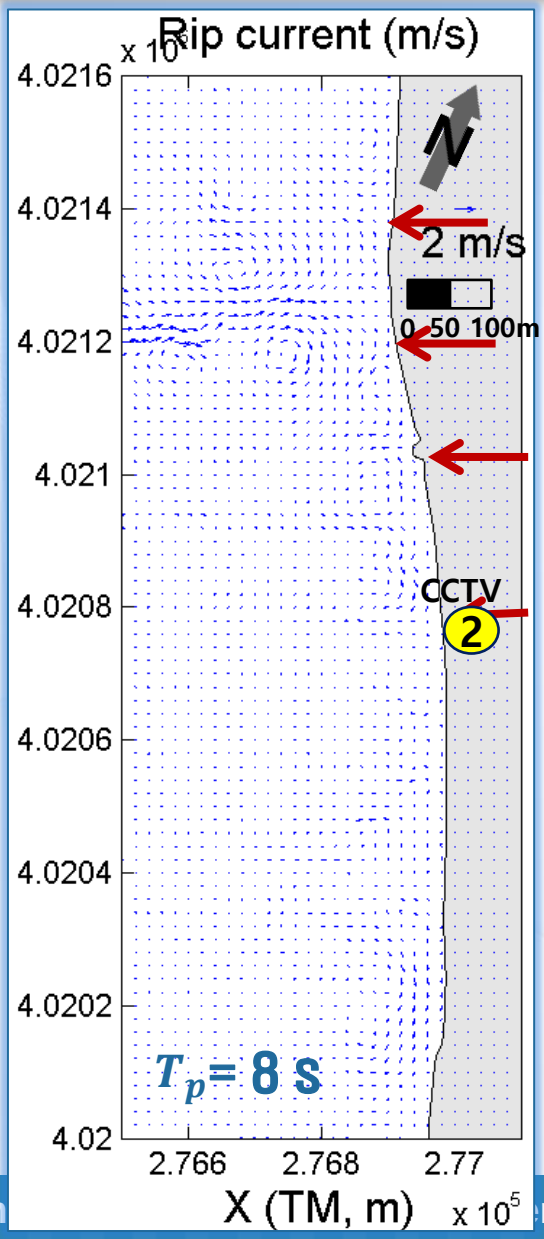
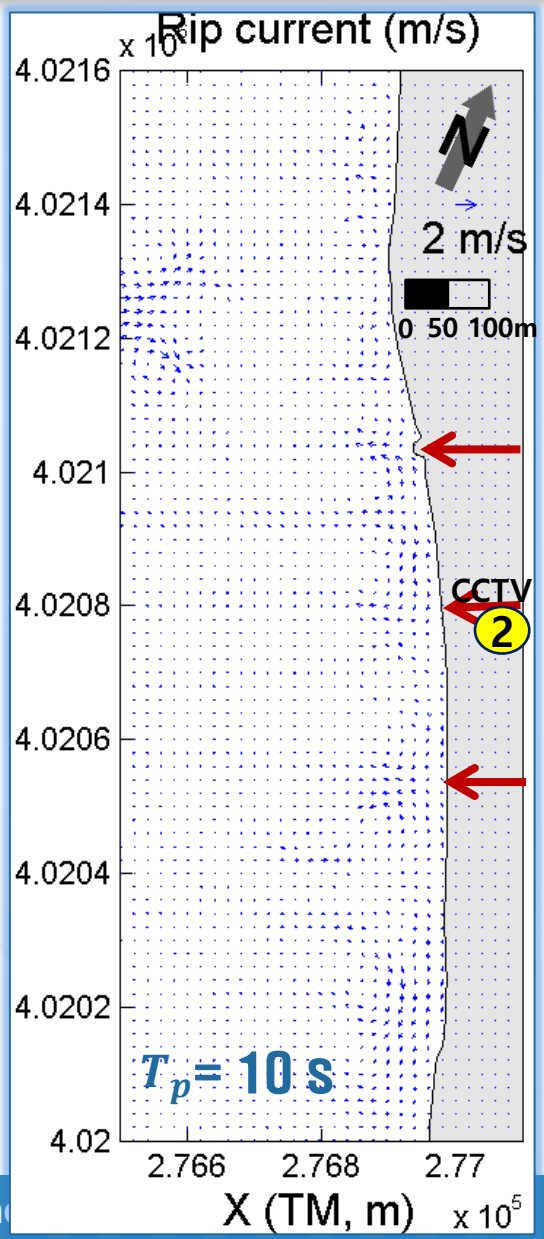
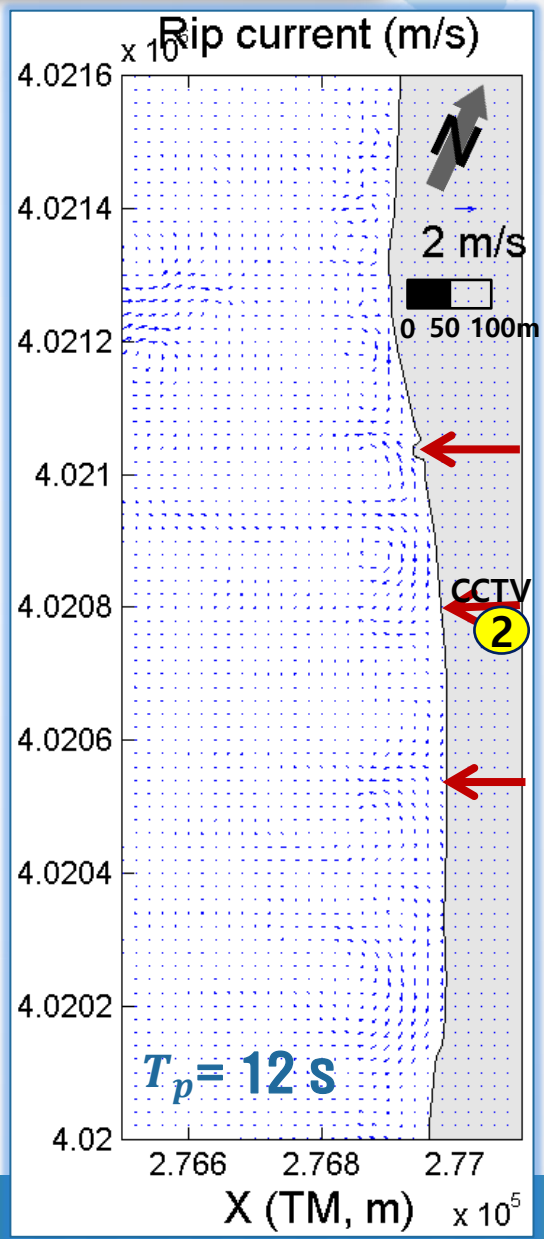
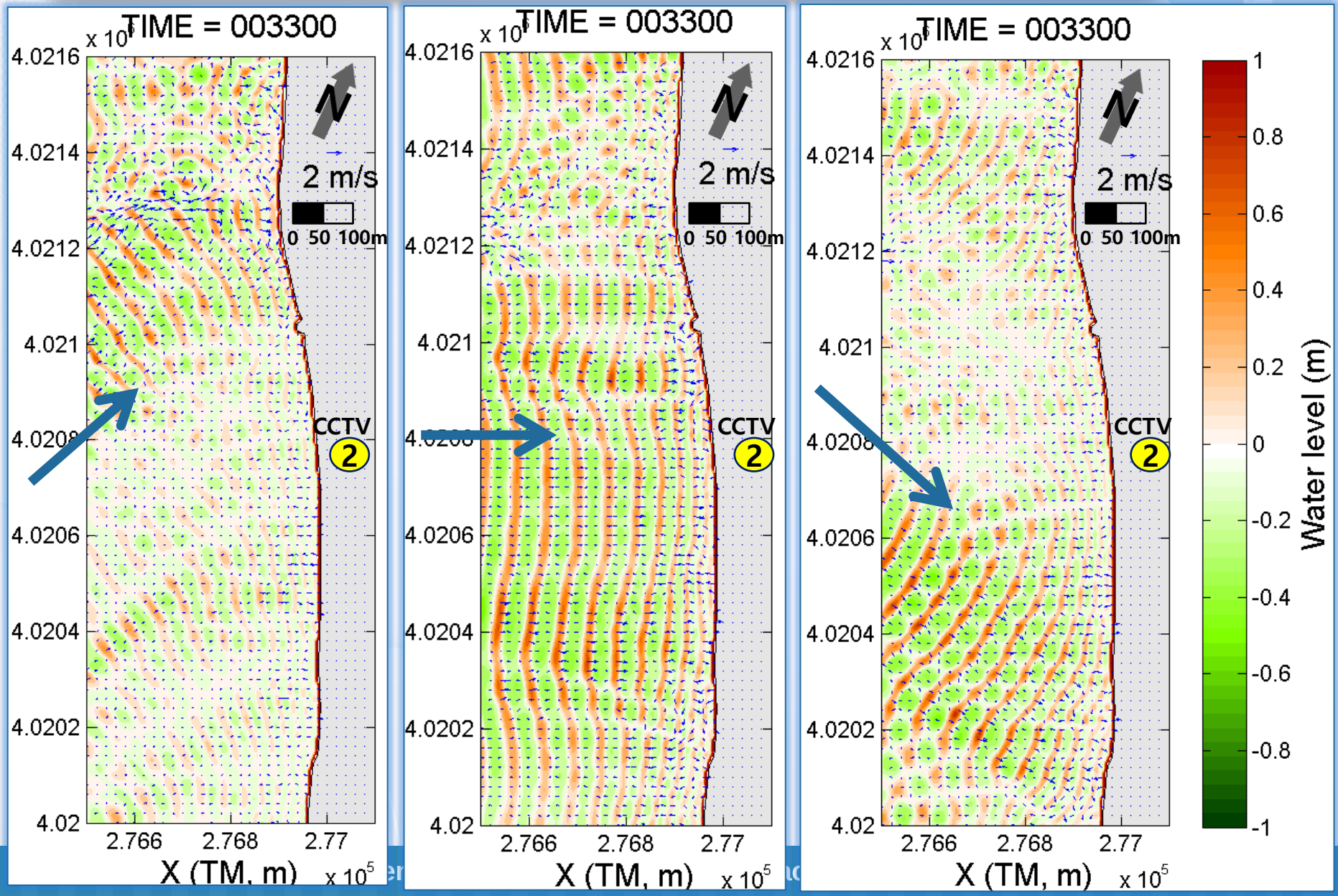






Influence of Incident wave dir. : D_p=45, 0, −45°



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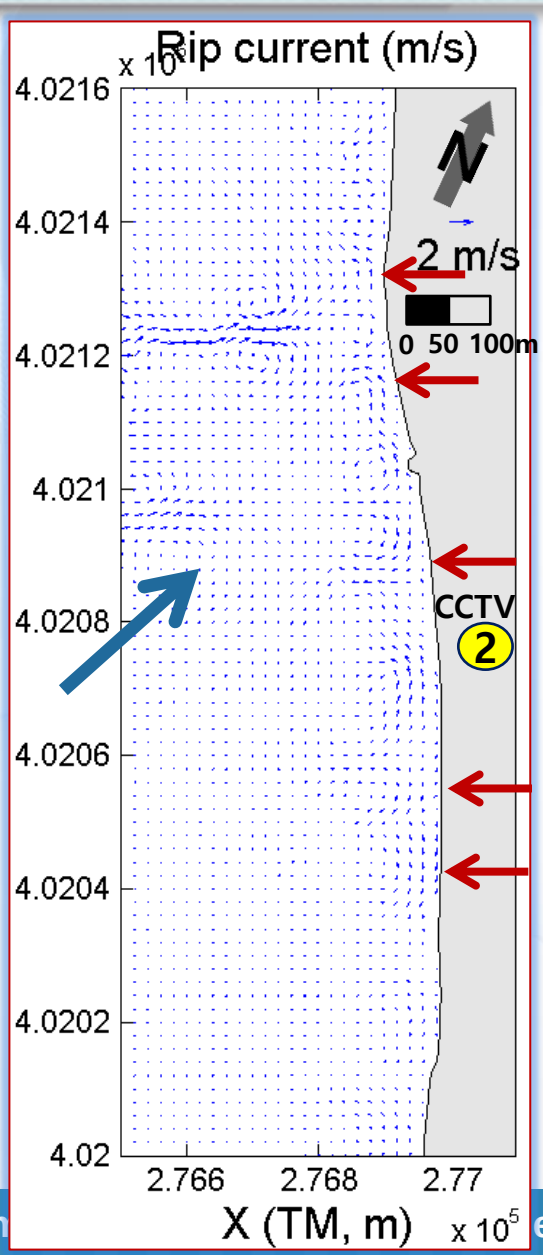

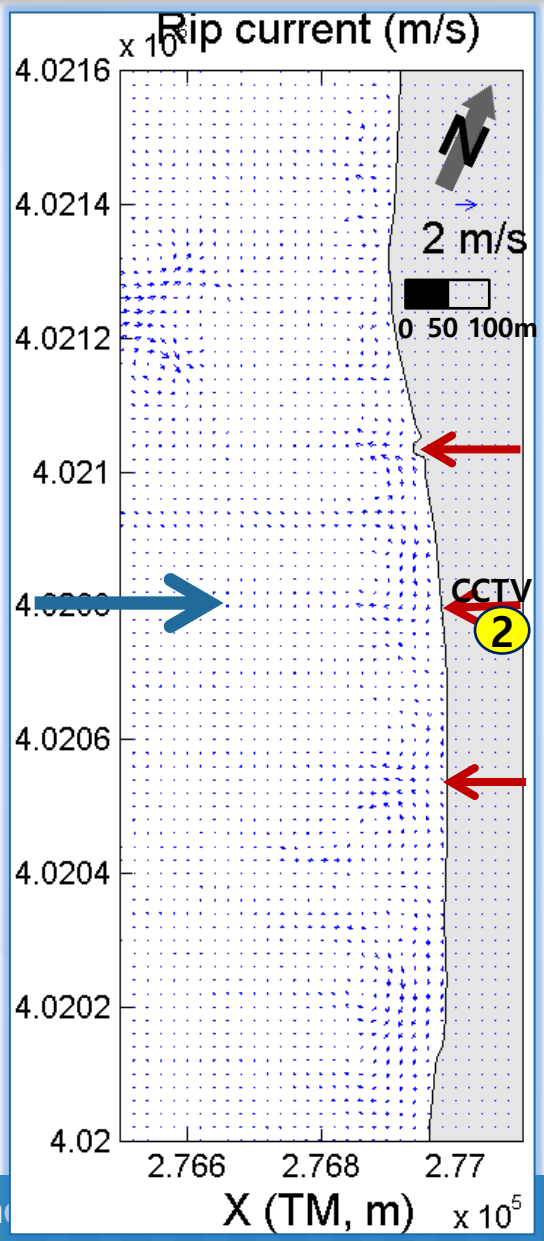

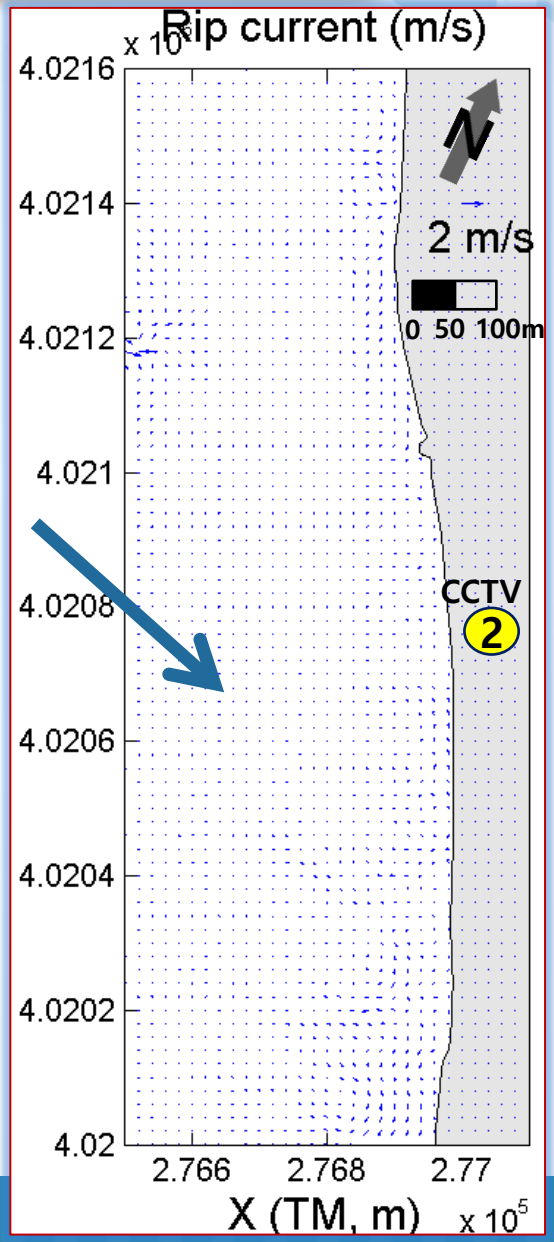

4 Discussion

Discussion

- The model results showed reasonable agreements with previous recorded report in this area.
- In our results, rip currents were increased for the higher wave heights, the longer wave periods conditions. In case of wave directions, rip channels are significantly affected by Incident wave directions.
- Estimation of the statistical likelihood of hazardous rip currents is on going now.
- Many observation data is required to calibrate accuracy of simulation results.
- Further validation and numerical testing to assess possible tuning of model coefficients will continue with the field data.
- For the future works, we can utilize this study's numerical results in a scenario-based rip current prediction system.

THANK YOU