International Conference on Aquatic Science & Technology

Handbook

27th~29th October
Shilla Stay Haeundae, Busan

i-CoAST
BUSAN 2020


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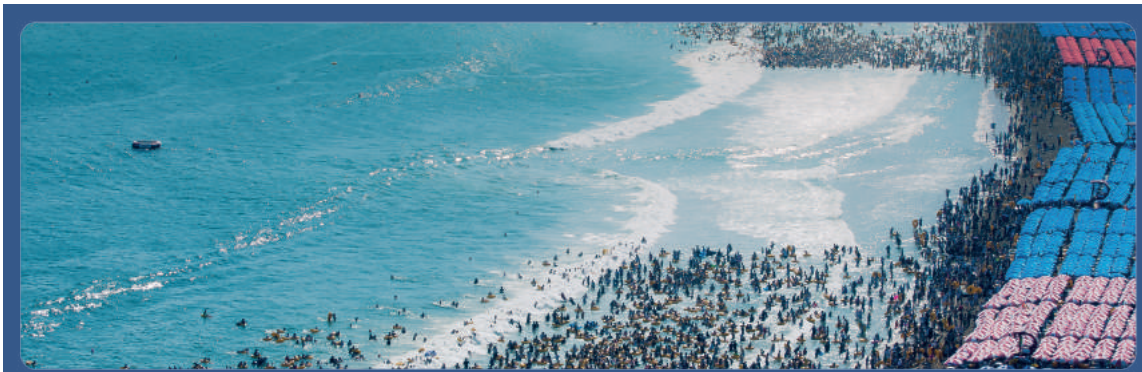
Introduction



i-CoAST 2020

i-CoAST 2020 is organized by the legacy of the successful symposium in Busan 2014 (3rd International Rip Current Symposium), Incheon 2016 and 2018 (2nd & 3rd International Water Safety Symposium).

i-CoAST 2020 was founded in 2019 with a greater focus on engineering, policy, tourism and the environment in coastal space.

At i-CoAST 2020, various studies will be presented on Coastal engineering, Coastal management, Coastal policy approach, Coastal pollution, and Geo-spatial approach in coastal area.

The 2nd International Symposium on Beach Erosion Management in Asia hosted by Beach & Shore Management Center (BSMC) in Sungkyunkwan University will be held in the form of special session.

The overview of i-CoAST 2020 is as follow :

Title	international Conference on Aquatic Science & Technology (i-CoAST 2020)
Date	27th ~29th October 2020
Venue	Shilla Stay Haeundae, Busan, Korea
Theme	Key themes include coastal engineering, coastal management, coastal policy approach, coastal pollution, and geo-spatial application in coastal environment
Programs	Plenary Sessions, Technical Sessions
Social Events	Welcome Reception, Official Banquet, Award Ceremony
Offical Language	English
Secretariat	international Conference on Aquatic Science & Technology (i-CoAST 2020) - Address : 509, Centum Dong-ro 99, Haeundae-gu, Busan, Republic of Korea - Telephone : +82-51-747-6188 - Fax : +82-51-747-6187 - E-mail : info@i-coast.org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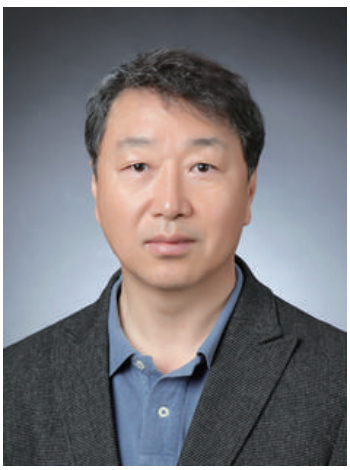
Welcome Messages



SUNG KYUN KWAN UNIVERSITY(SKKU)

I am very pleased to host the international Conference on Aquatic Science & Technology (i-CoAST 2020) in Busan, the ocean capital of South Korea, and I would like to give you a warm welcome. It is difficult for the people around the world to travel and meet face to face in the midst of the COVID-19 pandemic. However, I thank you to the speakers, the moderators of each session, and all the participants for attending this academic conference online and offline as scheduled.

The i-CoAST 2020 is an academic conference to discuss the issues in engineering, policy, tourism and environment in coastal spaces such as coastal engineering, coastal management, coastal policy, coastal pollution and geo-spatial approach in coastal areas. The coast is undergoing a process of change due to either natural or artificial environmental changes. I hope that this conference will be a great opportunity for creating synergies by sharing knowledge from active research activities in various coastal spaces, and by incorporating and creating new ideas.

I wish this i-CoAST to become a valuable academic conference that combines various research fields to mitigate coastal disasters and manage coastal environments. Once again, I sincerely thank all of you for taking your precious time to attend this event.

Thank you

Prof. Jung Lyul Lee

Professor, Sungkyunkwan University
President of Beach & Shore Management Center

사단법인 한국측량학회

It is a great pleasure to welcome distinguished researchers and guests to the i-CoAST2020 in Busan, South Korea. This conference will play a key role in sharing knowledge, information, and technology in Coastal engineering, Coastal management, Coastal policy approach, Coastal pollution, and Geo-spatial engineering.

This year, the world faces an unprecedented crisis due to COVID-19. The economy crumbled and normal daily life is significantly changed. It seriously draws people's attention to the importance of safety and make their best efforts to prevent the spread of the virus and find a cure.

In these times, the role and responsibility of science and engineering become increasingly important. The themes in this conference deal with various aspects of development and safety issues in the coastal area. On the one hand, what we are doing is not much different from what they are doing in the COVID-19 case. Our efforts will finally lead to a prosperous and safer society.

Serving as President of the Korean Society of Survey, Geodesy, Photogrammetry, and Cartography, I am very glad to co-organize this conference and hope to bear much fruition through impassioned discussion. Especially, we can generate a significant synergy effect using geoinformatics in the field of coastal engineering and scien-ce.

Once again, I appreciate your enthusiasm and efforts and wish you good health.
Thank you.

Prof. Jay Hyoun Kwon

President of Korea Society of
Surveying, Geodesy, Photogrammetry and Cartography

Welcome Messages

I heartily congratulate the hosting of the I-CoAST 2020 and deeply appropriate the staff members who have prepared for the conference despite the difficulties aroused by COVID-19, as well as various coastal engineers for providing help.

Ever since the foundation in 1908, Korea Rural Community Corporation has worked on large-scale land reclamation projects to expand the grain production base and secure water resources. Especially in 2010, Saemangeum Sea dike was successfully constructed as the world's longest Sea dike in the Guinness Book of Records. However, reclaimed lands in coastal areas are suffering flood and shore erosion damages every year due to the rise of sea level, increased scale of typhoons, and frequent localized heavy rains caused by the recent climate change. Many typhoons pass through the Korean peninsula during this year, and the number of heavy rainfall days hit a record high (54 days) after 2013. Disaster damages are becoming increasingly frequent in coastal areas.

Facing this reality, the i-CoAST 2020 is taking place at an appropriate time to resolve the problems at stake and promote the advancement of practical coastal engineering technologies. We hope to better predict damages and come up with countermeasures against the shore erosion problem, large-scale typhoons, and rising sea levels.

I want to close by expressing my gratitude to many experts who have devoted to developing the field of coastal engineering and wishing for the success of the i-CoAST.

Thank you.

Dr. Jeon-yong Ryu

Director General of Rural Research Institute,
Korea Rural Community Corporation

서울YMCA

I would like to extend my heartfelt congratulations on the i-CoAST 2020.

I also want to express my appreciation to Dr. Jooyong Lee for your effort to prepare carefully for this conference in this difficult situation of that social activities are very limited due to the COVID-19, and researchers for your passion for this conference. Moreover, I can't help thinking that hosting this conference in Busan which is the international marine city is the proud of South Korea as a small country but one of the world-famous maritime powers.

I used to be interested in aerospace. However, as much as aerospace, I truly understand the ocean and coast have a lot of meanings and significance. In order to be supported by laws, systems and policies, endless researches and discussions are necessary to present a solution for various problems related to coastal resources, coastal management, coastal pollution, water safety etc. I believe that i-CoAST 2020 is the most authoritative conference to play an important role for endless researches and discussions of it.

Especially, it's the honor of the Seoul YMCA to have an opportunity to take part in this conference with the new area of coastal water safety as received high praise on the experience and expertise of the YMCA which has carried out the Civil Safety Movement in private sector. As considered this era which the disaster and safety becomes a social issue more than ever before, it's well-timed to discuss about the water safety and i-CoAST have the potential to have it. I hope the Seoul YMCA's efforts to nurture the life-guard and safety leaders, operate the CPCR etc. can be projected to this conference.

Lastly, I wish this conference becomes the touchstone of all conferences under the circumstances of COVID-19, and raises its reputation by presenting solutions regarding the coastal areas at the end.

Dr. Gyu Tae Cho

President of Seoul YMCA

Welcome Messages

Korea Atomic Energy Research Institute

It is my great pleasure to welcome you to the International Conference on Aquatic Science & Technology (i-CoAST) 2020 in Busan, South Korea. We welcome all speakers and participants to share knowledge, information, and skills in the field of water safety. The i-CoAST 2020 brings leading international researchers and experts together to share their knowledge of scientific approaches to the various fields in the water environment. I anticipate that all participants will actively join in the various professional sessions, and discuss many issues that will lead to fruitful outcomes and applications. Even though many researchers don't attend in the conference venue of Busan due to the COVID-19 pandemic, I expect to join in on-line conference.

I am working at the Korea Atomic Energy Research Institute (KAERI) as a member of the environmental safety assessment research division, and I would like to shortly introduce my institute to you. KAERI is a government supported research organization that aims to promote the peaceful application of atomic energy. One of the main missions of KAERI is to protect the public against unexpected nuclear incidents like the Fukushima accident that affect the water environment. KAERI will spearhead efforts to help Korea achieve its national agenda of sustainable development and low carbon, green growth by reducing the environmental degradation and resource depletion that face us in the 21st century.

By the way, I am sure that i-CoAST 2020 will be a very valuable conference at which to derive optimal solutions to control water pollution and to integrate various scientific fields related to managing the aquatic environment. I would like to express my gratitude again for all participants.

Dr. Kyung-Suk Suh

Research Division Director
Environmental Safety Research Division
Korea Atomic Energy Research Institute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Committee

Committee

Chairperson	Sungkyunkwan University | **Prof. Jung Lyul Lee** University of Seoul | **Prof. Jay Hyoun Kwon** Seoul YMCA | **Dr. Gyu Tae Cho**
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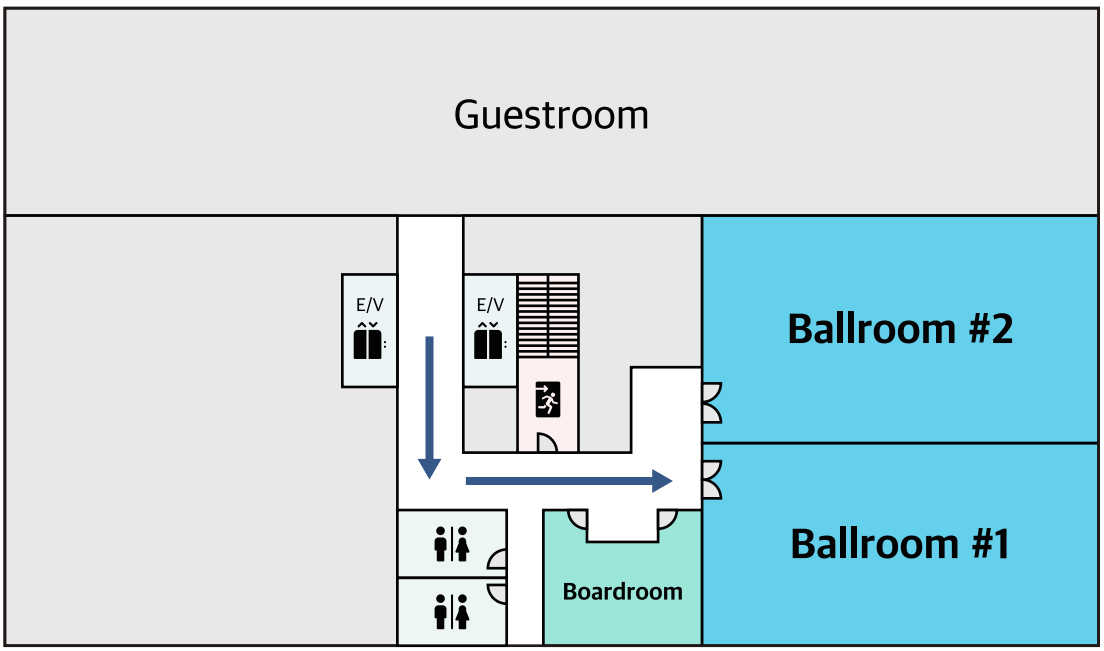
Seoul YMCA | **Dr. Jihan Ryu**
Seoul YMCA | **Dr. Sunggil Kim**
Ulsan Coast Guard Station | **Mr. Young-Ha Kim**

Venue

Shilla Stay Haeundae 3F

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Program Overview

	27th (Tue) Day 1			28th (Wed) Day 2			29th (Thr) Day 3		
	Ballroom#1 (3F)	Ballroom#2 (3F)	Boardroom (3F)	Ballroom#1 (3F)	Ballroom#2 (3F)	Boardroom (3F)	Ballroom#1 (3F)	Ballroom#2 (3F)	Boardroom (3F)
10:00~10:30				Session #1-1 (CE/CP)		Session #1-2 (CM)	Session #4-1 (SS#1)		Session #4-2 (SS#2)
10:30~11:00					Poster Session #1			Poster Session #3	
11:00~11:30									
11:30~12:00									
12:00~12:30				LUNCH		LUNCH	LUNCH		LUNCH
12:30~13:00									
13:00~13:30				Session #2-1 (CE)		Session #2-2 (CM/CPA)	Session #5-1 (SS#1)		Session #5-2 (SS#2)
13:30~14:00									
14:00~14:30					Poster Session #2			Poster Session #4	
14:30~15:00									
15:00~15:30	Registration #Shilla Stay Haeundae 3F			Coffee		Coffee	Coffee		Coffee
15:30~16:00				Session #3-1 (GA)		Session #3-2 (GA/SS#3)	Session #6-1 (SS#1)		Session #6-2
16:00~16:30									
16:30~17:00									
17:00~17:30									
17:30~18:00									
18:00~18:30							Official Banquet #2F, Cafe		
18:30~19:00	Welcome Reception #Shilla Stay Haeundae 3F								
19:00~19:30									
19:30~20:00									
20:00~20:30									
20:30~21:00									


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Oral Sessions

Session 1

Session #1-1

Coastal Engineering (Online)
Coastal Pollution (Online)

Unsteady Flow Characteristics at Gate of Overtopping-type Submerged Breakwater

Shinwoong KIM, Seong-Dae LEE

A Study on the Application Method of Textiles-RC Composite Structures in Coastal Environment

Jongho PARK, Jungbhin YOU, Sungnam HONG, Seong-Chan RYU, Sun-Kyu PARK

Wave Overtopping Rate on Vertical Seawall with Deformed Wave Dissipating Work

Susumu ARAKI, Yasuo KOTAKE, Shin-Ichi KUBOTA, Yoko SHIBUTANI, Yuka KAWAUCHI, Fumika YAMAMOTO

Ocean Modeling in the Makassar Strait and Balikpapan Bay Using Online Nesting Method

Ashadi Arifin NUR, Totok SUPRIJO, Idris MANDANG, Ivonne Milichristi RADJAWANE, Hansan PARK, Faruq KHADAMI

Hydrodynamic modeling of Seasonal circulation at Bandon bay, Surat Thani province, Thailand

Narongrit LUANGDILOK, Kachapond CHETTANAWANIT, Watin THANATHANPHON, Piyamarn SISOMPHON, Tanuspong POKAVANICH

Long-Term Investigation of Radiological Impacts on the Economic Marine Species in Thailand caused by 137Cs released from the Fukushima Dai-ichi Nuclear Power Plant Accident

Yutthana TUMNOI, Wanwiwa TUMNOI, Nattchakarn NAKKAEW, Chitsanupong KHRAUTONGKIEO, Rungsuk SUWANKLANG

Session #1-2

Coastal Management (Online)

Legal Review of 'Precautionary Approach' in 'Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean'

Minsu KIM

ANTHROPOGENIC CARBON AND CO_2 FLUX ANALYSIS IN BANGKA STRAIT TO EASTERN LAMPUNG

Avrionesti, Wawan HERMAWAN, Mutiara Rachmat PUTRI, Hanif DIASTOMO, Mochamad Riam BADRIANA, Martin YAHYA SURYA, Umar ABDURRAHMAN, Totok SUPRIJO, Hansan PARK

Multi-data Ensemble Estimation of Wave Energy Potential in Indonesian Seas

Mochamad Riam BADRIANA, Han Soo LEE, Hanif DIASTOMO, AVRIONESTI, Martin Yahya SURYA, Umar ABDURRAHMAN, Totok SUPRIJO, Hansan PARK

Potential Ocean Thermal Energy Conversion in Indonesia Seas Territory

Totok SUPRIJO, Putri Rahmani POERBO, Hansan PARK, Aditya Rakhmat KARTADIKARIA, Mira YOSI

Ocean Energy exploration and its current status in Indonesia: A Review

Ardian RIZAL, Nining NINGSIH, Rima RACHMAYANI, Iqbal ARDIANSYAH, Laela YANI, Aditya KARTADIKARIA, Hansan PARK

Statistical classification of sand beaches in Taean region and its application to disaster prevention

Junbeom BAHK, Chan Woong KIM

Session 2

Session #2-1

Coastal Engineering (Oral)

Experimental and numerical study on the wave, surge, and structure interactions on a coastal residential building.

Dayeon LEE, Hyoungsu PARK, Sungwon SHIN, Daniel COX

Numerical analysis of nonlinear wave characteristics under porous sloped-seabed conditions

Eun-Hong MIN, WeonCheol KOO

Propagation of solitary wave around conical island in level-set finite element framework

Haegyun LEE

Analysis on the Initial Sediment Transport using NWT-DEM Twoway Coupled Model

Yeon-Myeong JEONG, Won-Chul CHO, Woo-Dong LEE, Dong-Soo HUR

On the Probability Density Function of the wave direction data in Korea

Giseop LEE, HongYeon CHO, Uk-Jae LEE

Optimal Smoothing of the Wave Spectrum using HeMOSU-1 Data

Uk-Jae LEE, Gi-Seup LEE, Dong-Hui KO, Hong-Yeon CHO

Session #2-2

Coastal Management (Oral)
Coastal Policy Approach (Oral, Online)

Global warming footprints on the local extreme sea level events in the Eastern Asia

Dong Eun LEE

Shoreline Retreat Prediction using Artificial Intelligence

Aoki SHIN-ICHI, Hyun Dong KIM, Byungsun CHO, Kyu Han KIM, Mu HAJJIR

Composite extreme value analysis using the typhoon-induced annual maxima wave data

Hong Yeon CHO

Exploring trading potential of coastal blue carbon between regional community and individual business entity subject to emission allowances

Dan-Bi UM

The convergence and integration of the MICE and maritime industry: An analysis of the MICE industry of Busan, northeast Asia's maritime capital

Changho OH, Sandy NAM-JO, Kwi Baek KIM

Beaches for everyone? Marine tourism for mobility-impaired visitors for Busan, the first international tourism destination of Korea

Changho OH, Sandy NAM-JO, Kwi Baek KIM

Session 3

Session #3-1

Geo-Spatial Application in Coastal Area (Online)

A morphological approach to seabed Detection from Bathymetric LiDAR point clouds

Jaehoon JUNG, Jaebin LEE, Christopher PARRISH

Evaluating operational potential of UAV imagery in coastal wetland survey according to wetland inventory guideline of Ramsar Convention : A case study on southern coast in South Korea

Seong-Il PARK, Young-Seok HWANG, Jung-Joo LEE, Jung-Sup UM

Comprehensive Analysis of Coastal Dynamics in Cirebon Coastal Area, Indonesia

Umar ABDURRAHMAN, Hanif DIASTOMO, Avrionesti, Martin Yahya SURYA, Mochamad Riam BADRIANA, Totok SUPRIJO, Hansan PARK

Sea surface temperature prediction using long short-term memory recurrent neural network

Haeng-Yeol OH, Myeong-Hun JEONG, Seung-Bae JEON, Tae-Young LEE, Geon KIM

Development of the optimal locations for offshore wind farms using the analytical hierarchy process.

Geon KIM, Myeong-Hun JEONG, Seung-Bae JEON, Tae-Young LEE, Haeng Yeol OH, Chan Sung PARK

Development of evacuation management system in coastal areas using analysis of human behavior in Smart Society

Wanyoung SONG, Junho CHOI, Dongkwan LEE, Jung-Sup UM

Session #3-2

Geo-Spartial Application in Coastal Area (Oral)
SS#3 : Convergence Technology related to Water Safety and Underwater Safety (Oral)

Mapping Red Tide Intensity Using a Multispectral Camera Loaded on a UAV

Wonkook KIM, Sunghoon JUNG, Keungyong KIM, Joo-Hyung RYU, Yongseon MOON

Optimal Rain Gauge Network Based On the Gis-Based Approach Integrated with Spatial Interpolation Technique

Van Men HUYNH, Sung-Hoon HONG, Yong-Ju KWON, Van Ty TRAN, Vuong Thu Minh HUYNH, Soon-Chul KWON

A Study of Buoyancy and Kinematics according to the Survival Swimming Lying down Position

KIM YUN-SUB, LEE HYO-TAEK, RYU JI-HAN

Session 4

Session #4-1

SS#1 : The 2nd International Symposium on Beach Erosion Management in Asia (Online)

Development of a Probabilistic Model for the Transmission Coefficient of Low Crested Breakwater

Yong Jun CHO

RECLAMATION WITH MANGROVE TO PROTECT CLIFF FROM EROSION IN BINTUNI BAY SEDIMENT DISPERSION MODELING USING NON-ORTHOGONAL BOUNDARY FITTED TECHNIQUE

Muslim MUIN

Optimized Evacuation Plan and Decision Support System Development with Agent-Based Modelling (ABM) and GIS Analysis for Tsunami in Pandeglang, Banten, Indonesia

Ricard Diago SAMBUAGA, Han Soo LEE

Session #4-2

SS#2 : Marine Engineering Technology (Online)
Coastal Management (Online)

Comparative study on the ship performance of a twisted rudder with wavy configuration

TAE YOUNG BYUN, JIN WOOK KIM, KYOUNG WAN LEE, MOON CHAN KIM

Study on the effect of the ramp variables on the energy efficiency of overtopping

Sunghwan AN, Jong-Hyun LEE

IDENTIFICATION OF MARINE DEBRIS SOURCES IN KUTA BEACH, BALI, INDONESIA THAT COMES FROM THE RIVER USING NUMERICAL MODEL

I Putu Ranu Fajar MAHARTA, Ivonne Milichristi RADJAWANE, Totok SUPRIJO, Hansan PARK, I Gede HENDRAWAN

Utilization and Linkage of Oceanic Energy in Natuna Island: A Review

Rima RACHMAYANI, Nining S. NINGSIH, Iqbal ARDIANSYAH, Laela F. YANI, Ardian M. RIZAL, Aditya R.KARTADIKARIA, Hansan PARK

A Test for Motion Control and Configuration Effect of Wave Energy Converter on a close structure

Sungsoo KIM, Jong-Hyun LEE, Donghoon KANG, Jae-Chul LEE

Oral Sessions

Session 5

Session #5-1

SS#1 : The 2nd International Symposium on Beach Erosion Management in Asia (Oral)

Analysis of Shoreline Changes in the Nourished Beach by the One Line Shoreline Model

Sahong LEE, Jung Lyul LEE

Beach erosion reduction effect of artificial gravels Technique

Seungho LEE, Hyoseob KIM, Yangwoo LEE

Wave attenuation analysis in artificial coral reef using a physicial modelling

Taeyoon KIM, Yongju KWON, Sunghoon HONG, Jongyeong KIM, Jooyong LEE

Variation characteristics of Irregular wave passing over Artificial Coral Reef

Sunghoon HONG, Taeyoon KIM, Jongyeong KIM, Jooyong LEE

MeePaSoL and MEPBAY: Software tool to support empirical parabolic model for headland-bay beaches

John HSU , Jung Lyul Lee

Session #5-2

SS#2 : Marine Engineering Technology (Oral)

A Simulation of soil dumping problem by using Moving Particle Semiimplicit Method

Kyung Sung KIM, Jong Hyun LEE

A study on the flow analysis of ship scrubber effluent

Kyoung Wan LEE, Moon Chan KIM

WAVE OVERTOPPING PLUNGING ON THE REAR SIDE OF COMPOSITE BREAKWATER

Made Narayana ADIBHUSANA, Jong-In LEE, Yonguk RYU

Session 6

Session #6-1

SS#1 : The 2nd International Symposium on Beach Erosion Management in Asia (Oral)

Shoreline Change Analysis and Erosion Prediction at Kkotji Beach, Korea

Kisu KWAK, Jinwoo JUNG, Hyun Dong KIM

Calibration and assessment of bed evolution model in an embayed beach with submerged breakwaters

Minsang CHO, Hyun-Doug YOON, Kideok DO, In-Ho KIM

Effect of the oblique wave incidence in beach scarp formation

Hoai Xuan VU, Jung Lyul LEE

Session #6-2


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Unsteady Flow Characteristics at Gate of Overtopping-type Submerged Breakwater

Shinwoong KIM, Seong-Dae LEE*

Civil Engineering, Halla University , Korea

The unsteady flow characteristics at the gate of an overtopping-type submerged breakwater were investigated experimentally and numerically. The structure has walls with the crest position equal to the still water level. These walls installed on the land and sea sides of the structure have a role to break the incident waves (Shin and Lee, 2019). The water chamber between walls stores the fluid after breaking and discharges it through the gate of the seaward wall. This flow is caused by the deviation of water level at the front and rear of the gate, breaking wave, and reflected wave. To quantitatively determine the variation mechanism of flow, a 1/20 scale hydraulic experiment for dam breaking was performed and reproduced by the computational fluid dynamic model called FS3M (Nakamura and Mizutani, 2014). The model validation was performed by comparing the variation of water level. Root mean square error (RMSE) and correlation coefficient (R) for the varying elevation were estimated as 0.58 mm and 0.9998 in the vicinity of the gate, and 0.76 mm and 0.9994 in the center of the water chamber. In addition, it was shown that the relationship between the water level flow rate in an unsteady state can be explained using the empirical formula proposed by Itadani and Tesima(1951).
To examine whether this water level-discharge relationship is also applicable even in the environment of wave propagation, the estimated result using the empirical formula under the regular wave was compared with the averaged flow rate at the cross-section of the gate. The estimated results are very similar to the averaged flow rate (R= 0.89~0.97), but that error increases as the breaking effect increases (RMSE= 0.47~0.82 m/s). These results will be used in research for optimizing the size and shape of the gate to develop the wave power generation using submerged

Keyword : Submerged breakwater, Rectangular weir, FS3M

Corresponding Author. : **Seong-Dae LEE** (sdlee@halla.ac.kr)

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A Study on the Application Method of Textiles-RC Composite Structures in Coastal Environment

Jongho PARK[1], Jungbhin YOU[1], Sungnam HONG[2], Seong-Chan RYU[3], Sun-Kyu PARK[*1]

[1] *Department of Civil, Architectural and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[3] *Department of Convergence Engineering for Future City, Sungkyunkwan University, Korea*

Reinforced concrete structures are widely used in bridges, buildings, ports and offshore structures, underground structures, etc. on the basis of economic, construction, and durability advantages. However, reinforced concrete structures located in the coastal environment have a high possibility of corrosion of steel reinforcement due to chloride penetration, and when corrosion of steel occurs, the durability and performance of structures decrease rapidly. The potential for corrosion of steel reinforcement has increased interest in new reinforcements to be applied to concrete composite. Textiles are woven industrial fibers such as carbon, glass, and aramid in two or more directions, and have advantages such as high strength, high strength/weight ratio, high resistance to corrosion, and easy construction. Textiles can be applied as a substitute for steel reinforcement in coastal environments where there is a high possibility of corrosion or as a strengthening material for existing RC structures with reduced performance and durability. The former is TRC (Textile Reinforced Concrete), and the latter can be named TRM (Textile Reinforced Mortar). Textile is composed of numerous filaments, which has a complicated behavior inside the composite, and the construction process and structural performance vary depending on the application method such as TRC and TRM. Therefore, it is necessary to verify the performance as a textile-based composite structure and the ease of practical application according to the construction process. In this paper, the flexural performance, ductility, serviceability, construction stage, etc. of structures applied with TRC and TRM, respectively, were compared and analyzed. Finally, the efficient application method of a textile-RC composite structure in a coastal environment was considered.

Keyword : TRC, TRM, Application method

Corresponding Author. : **Sun-Kyu PARK** (skpark@skku.edu)

Wave Overtopping Rate on Vertical Seawall with Deformed Wave Dissipating Work

Susumu ARAKI[*1], Yasuo KOTAKE[2], Shin-Ichi KUBOTA[3], Yoko SHIBUTANI[2], Yuka KAWAUCHI[4], Fumika YAMAMOTO[2]

[1] *Civil Engineering, Osaka University, Japan*
[2] *Technical Research Institute, Toyo Construction Co., Ltd., Japan*
[3] *Technical Research Institute, Fudo Tetra Corporation, Japan*
[4] *The Kansai Electric Power Company, Incorporated, Japan*

Vertical seawalls with wave dissipating work has a hydraulic function of reducing wave overtopping rate. In general, deformation of wave dissipating work due to high waves is promptly repaired in order to keep the performance of reducing wave overtopping rate. However, slight deformation of wave dissipating work is expected to cause no significant decrease in the performance. In this study, the change in the wave overtopping rate due to the deformation of wave dissipating work was investigated.

First, wave overtopping rate on a vertical seawall with wave dissipating work was measured at the initial profile and several kinds of deformed profiles of the wave dissipating work in a two-dimensional wave flume. The measured data showed that the wave overtopping rate increased at the beginning stage of the deformation and then decreased at the final stage of the deformation. The reason why the wave overtopping rate decreased at the final stage of the deformation may be that a large amount of water mass splashed up vertically due to the vertical face of the seawall exposed by reduction of the crest height of the wave dissipating work.

Next, a simple model for estimating the wave overtopping rate was developed. The model was based on the Bernoulli's theorem and the continuity equation, neglecting the energy loss due to wave breaking and the friction on the surface of the wave dissipating work. This model approximately estimated the measured wave overtopping rate on the initial profile and the final profile of the wave dissipating work. However, the model overestimated the measured wave overtopping rate at the middle stage of the deformation because the interaction between the water mass rushing up and the wave dissipating work was larger at the middle stage of the deformation.

Keyword : Wave overtopping, Wave dissipating work, Deformation

Corresponding Author. : **Susumu ARAKI** (araki@civil.eng.osaka-u.ac.jp)

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Ocean Modeling in the Makassar Strait and Balikpapan Bay Using Online Nesting Method

Ashadi Arifin NUR[*1], Totok SUPRIJO[1, 2], Idris MANDANG[4], Ivonne Milichristi RADJAWANE[1], Hansan PARK[3], Faruq KHADAMI[1]

[1] *Oceanography, Faculty of Earth Sciences and Technology, Bandung Institute of Technology, Indonesia*
[2] *Marine Technology Cooperation Research Center (MTCRC), Bandung Institute of Technology, Indonesia*
[3] *Korea-Indonesia Marine Technology Cooperation Research Center (MTCRC), Korea Institute of Ocean Science and Technology (KIOST), Korea*
[4] *Oceanography, Faculty of Mathematics and Natural Sciences, Mulawarman University, Indonesia*

Our previous study had applied offline nesting method (one-way interaction) by using Regional Ocean Modeling System (ROMS) to simulate currents circulation in the Balikpapan Bay and showing good results with a high agreement between model output and observational measurement for water level data. It proves that even using the offline nesting method is the better option than increasing grid resolution on the entire model domain that will be demanding more computational cost, while the area of our interest is a small-scale application. Therefore, we aim to improve our model solution and using the online nesting method (two-way interaction) with a refinement ratio of 1:5 from the larger domain to a smaller domain. Three domains which include larger domain (L1) with spatial resolution 2.5km that encompasses almost the entire Makassar Strait and acted as parent grid for the model. Coarser model of domain L2 with 500m resolution becomes the buffer zone between the parent model (L1) and smaller domain (L3) in the Balikpapan Bay that has 100m resolution. Initial and boundary conditions (IC/BC) for the L1 domain consisting of water levels, currents, temperature, and salinity were derived from the Hybrid Coordinate Ocean Model (HYCOM) re-analysis dataset. By using this method, there is only IC needs to be prepared for the other domain by interpolating IC data from the L1 domain and the BC would be provided directly from their larger domain during the simulation. Surface forcing for all domains extracted from the European Centre for Medium-Range Weather Forecast (ECMWF) ERA5 hourly dataset. Statistical methods such as Root Mean Square Error (RMSE) and model skill were used to validated model results for each model domains and we found the improvement of the model solution when comparing observational data by model results for the larger and smaller domain at the same location, respectively.

Keyword : Ocean modeling, Nesting method, Grid resolution

Corresponding Author. : **Ashadi Arifin NUR** (ashadi.fis08@gmail.com)

Hydrodynamic modeling of Seasonal circulation at Bandon bay, Surat Thani province, Thailand

Narongrit LUANGDILOK[*1], Kachapond CHETTANAWANIT[1], Watin THANATHANPHON[1], Piyamarn SISOMPHON[1], Tanuspong POKAVANICH[2]

[1] *Hydro-Informatics Innovation Division, Hydro-Informatics Institute, Thailand*
[2] *Department of Marine Science, Faculty of Fisheries, Kasetsart University, Thailand*

Bandon bay in Surat Thani Province is one of the highest productive areas in the southern Thailand. The area is well nourished and there is abundance of aquatic biodiversity especially marine Blue Swimming Crab (BSC). At present the number of the BSC is reducing sharply as they tend to be overfished. Therefore, there is an attempt to conserve the BSC population by artificially nurse and release back to the sea BSC larvae from the female BSC captured in the area by fisheries activities. The larvae is expected to flow and settle with the seawater current. To identify the best suitable location to release the larvae, a Delft3D hydrodynamic model was set up and calibrated in 3 different seasonal periods. Cross-sectional survey using ADCP and Synoptic survey using a CTD, Echo sounder survey and in-situ water sampling were made in January, May, July 2019 to measure hydrographic condition of the bay during Northeast, transition between the monsoons and Southwest monsoon. It was found that the model could simulate the seasonal pattern satisfactory. The flow direction in Bandon Bay was found to be consistency moving toward Northeast and Southwest direction during ebb and flood tides, respectively. Since Bandon Bay is semi-confined area, its seasonal pattern was found to be less significant compared to the outer area. The effect of freshwater released from Tapi river was observed and could be well simulated in the model. Moreover, transport and mixing conditions from the hydrodynamic model were used to run a particle tracking model. The results from the conservative particle tracking confirmed that the larvae is likely to have similar pattern with the seasonal flow direction and mostly remained within the Bandon Bay area during the transition between monsoons period.

Keyword : Hydrodynamics, Seasonal circulation, Thailand

Corresponding Author. : **Narongrit LUANGDILOK** (narongrit@hii.or.th)

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Long-Term Investigation of Radiological Impacts on the Economic Marine Species in Thailand caused by 137Cs released from the Fukushima Dai-ichi Nuclear Power Plant Accident

Yutthana TUMNOI[1], Wanwiwa TUMNOI[*2], Nattchakarn NAKKAEW[1], Chitsanupong KHRAUTONGKIEO[1], Rungsuk SUWANKLANG[1]

[1] *Regulatory Technical Support Division, Office of Atoms for Peace, Thailand*
[2] *Faculty of Science, Silpakorn University, Thailand*

The Fukushima-Dai-ichi Nuclear Accident released a huge amount of artificial radionuclides into the ocean leading to radioactive contamination and concern in several countries. Although it has been more than nine years since the accident, 137Cs still remains in the marine environment with varying degrees of concentration due to its physical half-life of 30 years. Until recently, the long-term investigation of 137Cs radioactivity and radiation dose in seawater and local marine biota in Thailand has been carrying out in order to reveal any possible radiological impacts caused by such radioactive releases on the economically important marine species. Seawater and 3 local marine species including threadfin bream (Nemipterus hexodon), slender lizardfish (Saurida elongata), and squid (Loligo duvauceli) were collected from the Gulf of Thailand (GoT) and the Andaman Sea between 2012 and 2019 followed by 137Cs measurement and radiation dose assessment using ERICA Assessment Tool. The current finding showed that 137Cs concentrations in the Thai seawater ranged from 0.4-2.8 mBq/L. While, ranges of 0.02-0.71, 0.01-1.08, and 0.03-0.33 Bq/kgf.w. were found in threadfin bream, slender lizardfish, and squid, respectively. Those obtained results are in agreement with the 137Cs levels measured in the Thai marine ecosystem before the accident and in the marine environment of several countries in the Asia-Pacific region. Additionally, the radiation dose assessment demonstrated that 137Cs radiation doses received by the studied species were between 6.42x10-4 and 4.56x10-3 μGy/h in threadfin bream, 6.36x10-4 and 4.65x10-3 μGy/h in slender lizardfish, and 6.82x10-4 and 4.81x10-3 μGy/h in squid. Those radiation doses are several orders of magnitude lower than the screening level of 10 μGy/h therefore no radiation impacts on marine biota would be observed. It could be concluded here that the marine ecosystem of Thailand has not been radioactively contaminated by the Fukushima Dai-ichi Nuclear Accident.

Keyword : 137Cs, Fukushima Dai-Ichi, Gulf of Thailand

Corresponding Author. : **Wanwiwa TUMNOI** (tumnoi_w@silpakorn.edu)

Legal Review of 'Precautionary Approach' in 'Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean'

Minsu KIM*

Northern & Polar Regions Research Department, Korea Maritime Institute, Korea

As sea ice-melting in the Arctic region is accelerating, the chance to access marine resources including fisheries is on the rise. Against this backdrop, 'Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean(hereinafter referred as CAOFA)' was signed to manage and use fisheries in a sustainable way. Also, 'Precautionary approach' was introduced in the CAOFA as similar as other fisheries agreement as one of effective ways of regulating unregulated commercial fishing activity . However, CAOFA is different from other fisheries agreement in that 'Central Arctic Ocean' is more risky and vulnerable to marine environment than other high seas. In this regard, this study reviews the difference between 'Precautionary approach' and 'Precautionary Principle' in terms of legal effect and suggests the parties should introduce more strict measures based on 'precautionary principle' in the process of implementing the CAOFA.

Keyword : CAOFA, Precautionary approach, Lex ferenda

Corresponding Author. : **Minsu KIM** (guan72@kmi.re.kr)

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ANTHROPOGENIC CARBON AND CO_2 FLUX ANALYSIS IN BANGKA STRAIT TO EASTERN LAMPUNG

Avrionesti *[1], Wawan HERMAWAN[2], Mutiara Rachmat PUTRI[2], Hanif DIASTOMO[1, 2], Mochamad Riam BADRIANA[1], Martin YAHYA SURYA[1], Umar ABDURRAHMAN[1, 2], Totok SUPRIJO[1, 2], Hansan PARK[1, 3]

[1] *Research and Development, Korea - Indonesia MTCRC, Indonesia*
[2] *Oceanography, Institut Teknologi Bandung, Indonesia*
[3] *KIOST, Korea*

Human activities are increasing production of carbon dioxide which is released into the air, land, or waters. The influence of those activities were analyzed based on parameters such as anthropogenic carbon, ocean pCO2, and CO2 flux. Anthropogenic carbon data were taken from Science for Protection of Indonesian Coastal Marine Ecosystem (SPICE) III cruise along South Sumatra to Eastern Lampung coastal area and analyzed utilizing Tracer combining Oxygen, inorganic Carbon and total Alkalinity (TrOCA) method. The ocean pCO_2 and CO_2 flux was calculate using polynomial regression model based on satellite data of sea surface temperature (SST) and Chlorophyll-a concentration and in situ data. These in situ data were collected during The South China Sea – Indonesian Seas Transpor/Exchange (SITE) cruise.

The anthropogenic carbon variations are related to the presence of large river mouths in the region. It is expected that the dominant southward current in the Bangka Strait causes anthropogenic carbon from the Musi River to be distributed more to the south. Flux analysis showed the Eastern Sumatra was CO_2 source area with the highest flux occur in the east season and the lowest in the 2nd transition season. Both anthropogenic carbon, pCO_2, and CO_2 flux has the highest values in the Bangka Strait. Spatially, almost all locations are identify as CO_2 source area with high variation in the coastal area. The distribution pattern of ocean pCO_2 is quite similar to the CO_2 flux distribution.

Keyword : Anthropogenic Carbon, pCO_2, CO_2 flux

Corresponding Author. : **Avrionesti** (avrionesti@mtcrc.center)

Multi-data Ensemble Estimation of Wave Energy Potential in Indonesian Seas

Mochamad Riam BADRIANA*, Han Soo LEE, Hanif DIASTOMO, AVRIONESTI, Martin Yahya SURYA, Umar ABDURRAHMAN, Totok SUPRIJO, Hansan PARK

Research and Technology, Korea-Indonesia MTCRC (Marine Technology Cooperation Research Center), Indonesia
Graduate School of Advanced Science and Engineering, Hiroshima University, Japan
Faculty of Earth Science and Technology, Bandung Institute of Technology, Indonesia
Korea Institute of Ocean Science and Technology, Korea

Indonesia treasures huge potential for marine renewable energy such as tidal, current, wave and coastal wind energy. Wave as blue energy is promising in Indonesia since it propagates from both Pacific and Indian Oceans directly. Therefore, preliminary study is necessary as a gate of initial development for ocean energy conversion. Currently, a number of wind-wave model results, reanalysis dataset, and satellite data are available and help researchers comprehend deeply ocean behavior and its energy produced. Multi-data ensemble estimation of wave energy with various methods, set-ups and resolutions from those available data would provide better accuracy, consistency, and insight for wave energy potential estimation. This is crucial because wave measurement and buoy are still not enough in Indonesian region.

Indonesia and its surrounding seas in this study are defined as 85° – 155° E and 20° S – 16° N. This vast region is used since buoys for validation typically are located outside Indonesia. The significant wave height and period are obtained from multi-data resources over 8 years (2011 – 2018). Then, each data is spatially interpolated onto a consistent grid of half degree and temporally monthly averaged based on the spatial and temporal resolution of data used. Mean wave energy is then calculated through energy conversion formula. Seasonal and monthly wave energy is also considered since the monsoonal pattern plays a major role in Indonesian seas. Wave energy trends are obtained from monthly time series over the existing period. To investigate further possibility, wave energy potential is analyzed at the locations near the coast with less than 100 m depth.

Averaged wave characteristics and energy potential are demonstrated in spatial map. Higher wave energy potential is found promising off the coast of Southern Java and Western Sumatra.

Keyword : Wave energy, Multi-Wave data, Ensemble estimation

Corresponding Author. : **Mochamad Riam BADRIANA** (riam_badriana@mtcrc.center)

Potential Ocean Thermal Energy Conversion in Indonesia Seas Territory

Totok SUPRIJO[*1, 3], **Putri Rahmani POERBO**[3], Hansan PARK[2], Aditya Rakhmat KARTADIKARIA[3], Mira YOSI[4]

[1] *Marine Technology Cooperation Research Center (MTCRC), Institute of Technology, Bandung, Indonesia*
[2] *Korea-Indonesia Marine Technology Cooperation Research Center (MTCRC), Korea Institute of Ocean Science and Technology (KIOST) , Korea*
[3] *Oceanography, Faculty of Earth Sciences &Technology, Institute of Technology Bandung, Indonesia*
[4] *Marine Geological Institute, Ministry of Energy and Mineral Resources, Indonesia*

This study aims to estimate Ocean Thermal Energy Conversion (OTEC) resources in Indonesian Seas using 6 years (from 2011 to 2016) daily basis data resulted from numerical simulation of high-resolution (1/10°) ocean model, namely Japan Coastal Ocean Predictability Experiment (JCOPE), with covering a wide area (e.g. 9°N to 11°S and 95°E to 141°E). Estimation of thermal power resources in this study was conducted based on temperature differences between surface layer and deep layer with water depth of 20 m and 1000 m from sea surface, respectively . The output power generated from OTEC and also OTEC operation are sensitive to the fluctuation of the temperature differences, therefore we also analysed sea surface temperature variability in Indonesia Seas, in order to identify suitable waters area for OTEC operation. We found that Southern coast of Java, Nusa Tenggara and Banda waters are unsuitable for OTEC deployment area because of high temperature variability on the sea surface that can cause instability of power output from OTEC operation. The area, where is favorable for OTEC operation in Indonesia waters, is estimated about 3,773,552.7 square kilometers with total potential power rate that can be harvested around 451,7 GW per day. Surface temperature in Indonesia Seas is also influenced by global phenomena, such as the El Niño and the La Niña . When the El Niño occurs in 2015 to 2016, potential thermal power resources are decrease into 442 GW. Meanwhile, when the La Niña occurs in 2011 to 2012 , the OTEC power resources are increase to 460 GW.

Keyword : OTEC, Marine Energy, Indonesia Seas

Corresponding Author. : **Totok SUPRIJO** (tsuprijo@gmail.com)

Ocean Energy exploration and its current status in Indonesia: A Review

Ardian RIZAL*, Nining NINGSIH, Rima RACHMAYANI, Iqbal ARDIANSYAH, Laela YANI, Aditya KARTADIKARIA, Hansan PARK

Oceanography, Bandung Institute of Technology, Indonesia
Marine Technology Cooperation Research Center, Indonesia

As an archipelago nation, Indonesia is endowed with a vast repository and sheer number of ocean resources. Employing ocean energy in Indonesia is particularly attractive due to its unique geographic configuration. In this study, an investigation of marine energy resources comprises wave, current, tidal and ocean thermal energy is explored and reviewed across Indonesian Seas. It is found that wave energy is generally prominent along the western coast of Sumatra to the southern coast of Java, ocean thermal resources are abundant in the eastern region of Indonesian seas, while current and tidal energy are highly potential located at numerous straits in Indonesia, notably which is situated in lesser Sunda island chain specifically.

As South Korea formed an agreement with the Indonesian government on ocean energy development cooperation in 2016 until recently. The applicability and state-of-the-art of Korean technology that is likely will be adopted as the future ocean energy project in Indonesia is examined. The plan is aimed to combine the ocean energy system with other non-ocean renewable energy types such as solar, wind, and pumped hydro storage to develop hybrid ocean energy.

Finally, here we propose several selected major candidates based on specific parameters and considerations on each type of ocean energy for future ocean energy installation. A particular type of technology is also addressed for understanding its effectiveness and efficiency in their energy extraction.

Keyword : Marine Renewable Energy, Indonesia, Korea

Corresponding Author. : **Ardian RIZAL** (ardianrizalr@gmail.com)

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Statistical classification of sand beaches in Taean region and its application to disaster prevention

Junbeom BAHK[1], Chan Woong KIM[*2]

[1] *Department of Geography, Seoul National University, Korea*
[2] *Marine Research Division, Korea Maritime Institute, Korea*

This study statistically classifies sand beaches in the Taean region and presents examples of policy application from the perspective of disaster prevention. In this study, twenty sand beaches were analyzed using cluster analysis, multidimensional scale analysis, and ANOVA. A total of thirteen variables, which included geometry, mean sediment size, and external force, were used. Moreover, traditional parameters for this study included surf similarity, surf scaling, dimensionless fall velocity, and relative tidal range. As a result of the cluster analysis, three clusters were identified, while three others remained unidentified of individual types. Furthermore, ANOVA results showed that there was a significant difference between most variables, which was mainly due to the difference between C and other clusters. Cluster A is mostly located in Anmyeondo Island, and among the statistical figures, it maintains a middle range. Cluster B, which has a very long shoreline length, has dikes on a number of shorelines. Finally, cluster C is located in the Taean peninsula and is characterized by its short shoreline length and seepages. The results of the cluster analysis were plotted along the dimensions of the multidimensional scale analysis, which displayed that most were properly clustered. In comparing the statistical classification with the conventional classification, we found that the former was more suitable than the latter in reflecting human intervention. From the perspective of disaster management, we applied these results to the beach risk assessment and the sensitivity evaluation of oil spills and storms. Ranking the order of the need for management from greatest to least, we confirmed that for beach risk assessment, the order is A-B-C; for sensitivity evaluation of oil spills, it is C-A-B; and for storms, it is B-A-C. This study contributes to further knowledge of coastal processes through beach classification and can be utilized as an effective basis for policy.

Keyword : Statistical classification, Disaster prevention, Beach risk assessment

Corresponding Author. : **Chan Woong KIM** (cwkim@kmi.re.kr)

Experimental and numerical study on the wave, surge, and structure interactions on a coastal residential building.

Dayeon LEE[1], Hyoungsu PARK[2], Sungwon SHIN[*1], Daniel COX[3]

[1] *Department of Marine Science and Convergence Engineering, Hanyang University, Korea*
[2] *Department of Civil and Environmental Engineering, University of Hawaii, USA*
[3] *Department of Civil and Construction Engineering, Oregon State University, USA*

Residential structures in the coastal cities have been attacked by extreme waves such as storm and tsunamis. Therefore, it is crucial to understand and predict the damage and failure mechanism of the structures under extreme wave and surge conditions. Most numerical and experimental studies have been performed to investigate the wave impact on rigid structures, where the failure mechanism was not included. Large-scale laboratory experiments of a 1:6 scaled model of a wood-framed residential house were conducted to investigate the wave and surge effect on the structure and the structural failure mechanism. A wood-frames residential house model (slab-on-grade) was installed in the three-dimensional wave basin at Oregon State University. Eight ultrasonic wave gages, five Acoustic Doppler Velocimeters (ADV), and four load cells were installed near and on the structure to measure water surface elevation, wave particle velocities, and vertical wave load. LIDAR scanning was conducted to collect the data of damage states on the structure of each surge level. The tests were conducted by changing surge level, wave period, and wave height. A three-dimensional RANS model, OpenFOAM, was used to verify the model capability and understand the hydrodynamics near the structure. Measured water surface elevation and horizontal wave velocity were used as an input of olaFlow wave generation to compare the results on a wave-by-wave basis. The numerical simulations were performed for all cases before structural failure, including both damaged and undamaged conditions. The numerical model results in damage condition, which is the direct comparison with the experimental setup at each case, showed a good agreement with the experimental results in hydrodynamics and wave loads. However, the numerical simulation results of wave loads in undamaged condition showed twice larger than those in real damaged condition. Therefore, the damaged condition of the structures can affect the wave load on the structures.

Keyword : Wave structure interaction, Large-Scale experiment, OpenFOAM

Corresponding Author. : **Sungwon SHIN** (sungwshin@hanyang.ac.kr)

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Numerical analysis of nonlinear wave characteristics under porous sloped-seabed conditions

Eun-Hong MIN[1], WeonCheol KOO[*1]

[1] *Department of Naval Architecture and Ocean Engineering, INHA University, Korea*

As the incident wave propagates to the coastal region, the nonlinearity of the wave increases, and the permeable seabed affects the attenuation of the wave amplitude at a finite depth. In this study, the characteristics of nonlinear wave attenuation were analyzed under porous sloped-seabed conditions. Nonlinear wave propagation was simulated in the time domain using a two-dimensional fully nonlinear numerical wave tank (NWT). The NWT is based on the boundary element method and consists of two computational domains: a fluid domain and a porous seabed domain. The upper fluid region is assumed to be a potential flow, and the lower porous region satisfies the continuous equation and Darcy's law. The mixed Eulerian-Lagrangian (MEL) method was used to represent instantaneous water particle motions in the time domain, and time integration of free surface boundary conditions was performed using the Runge-Kutta fourth-order scheme. To account for the wave-porous subsea interaction, the boundary value problem was solved in each domain, and the calculated values were exchanged at the interface boundary between the fluid domain and the porous domain at each time step. The calculated wave elevations were confirmed with the results of previous studies. The shoaling coefficients for wave propagation on a sloped-seabed were calculated and the attenuation of the waves due to the porous bottom interaction was investigated.
Waves traveling to the coast were decomposed into each wave frequency component, and the magnitude of each component was compared. It was confirmed that each wave component caused spatial evolution according to the type of incident wave. In addition, each frequency component of the traveling wave was significantly reduced in the porous bottom condition compared to the rigid bottom condition. The characteristics of wave propagation according to various permeability coefficients on the seabed were also investigated.

Keyword : Porous seabed, Nonlinear wave, Numerical wave tank

Corresponding Author. : **WeonCheol KOO** (wckoo@inha.ac.kr)

Propagation of solitary wave around conical island in level-set finite element framework

Haegyun LEE*

Department of Civil & Environmental Engineering, Dankook University, Korea

Though the solitary wave is a single wave, it consists of a complex spectrum of frequencies, which enables in-depth analysis and reliable generation in both the laboratory and the numerical model. For these reasons, solitary waves are known to be a good candidate for the description of waves including tsunami since they effectively model the important effects of the long wave on the coasts very well. In addition, it is supposed to propagate over constant depth without appreciable changes, allowing for consistent referencing of its offshore or incident wave height. In this study, the level-set scheme, which is combined with the incompressible Navier-Stokes solver based on the fractional step algorithm and the finite element method, was applied to the modeling of wave propagation and runup on a circular conical island. Unstructured hexahedral meshes were generated for this purpose and MPI (Message Passing Interface) based parallel algorithms were developed to accelerate the computation. The physical behavior of waves are discussed in detail and the numerical results (e.g., runup heights) are compared with the experimental data. The good agreements were observed.

Keyword : Solitary wave, Level-Set method, Runup

Corresponding Author. : **Haegyun LEE** (haegyun@dankook.ac.kr)

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Analysis on the Initial Sediment Transport using NWT-DEM Two-way Coupled Model

Yeon-Myeong JEONG[1], **Won-Chul CHO**[3], Woo-Dong LEE[2], Dong-Soo HUR[*2]

[1] *Institute of Marine Industry, Gyeongsang National University, Korea*
[2] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[3] *Department of Civil and Environmental Engineering, Chung-Ang University, Korea*

Coastal structures, such as submerged breakwaters, are used to reduce coastal erosion and are installed in coastal areas to protect beaches by reducing the wave energy. The waves that flow into these coastal structures generate reflected waves via interactions between waves and structures, and local scours are generated at the front of the coastal structures due to the reflected waves. These local scours significantly impact on the stability of coastal structures. In this study, we conducted numerical simulations using the fluid–particle coupling analysis method for the initial local scours due to the wave energy at the front of the coastal structures. We used a numerical model that involves bidirectional coupling analysis technique for the wave field model and individual element method. The technique can numerically interpret the behavior characteristics of sediment particles from the wave–structure–ground interaction. The numerical simulation confirmed that as the incoming wave height increases due to the initial surface movement of the waves interacting with the front surface of the coastal structures, the fluid force acting on the sediment particles increases, and this in turn increases the scour depth with the movement of the sediment particles. Additionally, the fluid–particle coupling analysis method can be used to analyze the mechanism of erosion and sedimentation with respect to time by tracking the behavior of sediment particles via the Lagrangian analysis method. This is based on the key parameters, such as incident wave height, incident period, and sediment particle size, which are dominant factors in determining the scour depth.

Keyword : DEM, Sediment transport, Two-Way coupled model

Corresponding Author. : **Dong-Soo HUR** (dshur@gnu.ac.kr)

On the Probability Density Function of the wave direction data in Korea

Giseop LEE, HongYeon CHO*, UkJae LEE

Marine Bigdata Center, Korea Institute of Ocean Science and Technology, Korea

Although wave direction is important information along with wave height and period, distribution estimation studies have been limited to traditional schematic analysis including rose diagram. In addition, studies on the estimation of the distribution function in the wave direction are relatively insufficient compared to the wave height and period distribution. In this study, basic statistical information and distribution function estimation were performed using hourly wave direction data at 16 points in the last 4 years (2016-2019) measured by the KMA(Korea Meteorological Administration) buoy. The von Mises Mixtures(VMM) distribution function was used to estimate the direction data distribution, and the optimal parameters for each order were estimated using the EM algorithm. The optimal order was selected based on BIC, and generally, 2~3 VMM distribution functions were identified as optimal distribution functions(70%). The optimal VMM distribution function was compared with the Histogram and the non-parametric method of Kernel density estimation. In addition, quantitative analysis was performed on the temporal change pattern of the mean and standard deviation of direction data corresponding to a representative statistical measure. As a result of the analysis, it was found that the multi-modal distribution was appropriate for the wave direction according to overall stations and times. Therefore, one representative wave direction and standard deviation information was found to be insufficient for estimating the distribution type, and parameters (weighting coefficient, mean, variance) of the VMM model were found to be more effective for estimating the distribution type. The results of this study can be used in various fields of coastal engineering that require input of wave information (coastal transport, predominance of design wave).

Keyword : Wave Direction, Probability Density Function, Von Mises Mixture

Corresponding Author. : **HongYeon CHO** (hycho@kiost.ac.kr)

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Optimal Smoothing of the Wave Spectrum using HeMOSU-1 Data

Uk-Jae LEE[1], Gi-Seup LEE[1], Dong-Hui KO[2], Hong-Yeon CHO[*1]

[1] *Marine Bigdata Center, Korea Institute of Ocean Science and Technology, Korea*
[2] *Coastal Development and Ocean Energy Research Center, Korea Institute of Ocean Science & Technology, Korea*

The optimal model based on water surface elevation can be considered as the optimal smoothing model, which is the model for estimating the optimal range of smoothing. The optimal model is a process of classifying observation data into a structure that can be statistically analyzed or a signal and noise component that can be given meaning, and the signal component is an optimal estimation model. In general, wave spectral analysis for irregular waves is carried out using water surface elevation data. In this study, errors that occur in the process of smoothing the estimated spectrum were minimized using the statistical estimation method that tracks the optimal bandwidth. For optimal smoothing, a total of 169 data (excluding missing and unobserved data) were used as wave data observed from the HeMOSU-1 observation station near Wido island located in the west sea of Korea from 2013.07 to 2014.07. The extracted spectrum used raw data observed in WaveGuide Rader, and the equipment used standard wave analysis package (SWAP) method to estimate 10 mHz wave energy density spectrum after applying 10% COSINE Tapering, Fast Fourier Transform (FFT). In order to optimize the estimated spectrum, the optimal bandwidth was estimated using the local linear regression function (dpill) in the 'KernSmooth' package included in R, one of the data analysis programs, and the estimated value was plotted by constructing a linear function. Optimal smoothing is based on the theory of bias-variance trade off, and the optimal bandwidth value occupies 50% within the range of 0.0201 to 0.0207.

Keyword : Wave spectrum, Optimal smoothing, Optimal bandwidth value

Corresponding Author. : **Hong-Yeon CHO** (hycho@kiost.ac.kr)

Global warming footprints on the local extreme sea level events in the Eastern Asia

Dong Eun LEE*

Chungnam National University, Korea

With the observed daily maximum anomalous sea level height records, the global warming footprint on the annual frequency of the all-time top 1 and 5% events and the average sea level height of the annual top 5 events are investigated. Warm and cold season events are investigated separately.
In the coastal area around Korean Peninsula, no significant linear increase is detected in the extreme sea level events for the last 30 years or so. Instead, a distinctive decadal scale fluctuation is found in the frequencies and the mean extreme values, implying the impacts of the variability in weather patterns. Associated with the decadal fluctuation, distinct spatial pattern is found dividing the local tidal stations into a few groups, which indicates decadal shifts in the tracks of tropical and extra-tropical cyclones.
The future assessment of the extreme sea level events near Korean Peninsula is revisited with full consideration of the changes in typhoon genesis frequency and locations, winter storm activities, etc., as much as the steric mean sea level rise due to the warmer ocean.

Keyword : Extreme sea level, Climate change, Climate variability

Corresponding Author. : **Dong Eun LEE** (dlee@cnu.ac.kr)

S222

Shoreline Retreat Prediction using Artificial Intelligence

Aoki SHIN-ICHI[1], Hyun Dong KIM[*1], Byungsun CHO[2], Kyu Han KIM[2], Mu HAJJIR[1]

[1] *Department of Civil Engineering, Osaka University, Japan*
[2] *Department of Civil Engineering, Waterfront and Coastal Research Center, Korea*

Gravel beach, located in Shingu City, Wakayama Prefecture in Japan, suffers from a large scale of coastal erosion. The beach is composed of gravel, which is usually stable against regular waves; however, a sudden erosion occurred in this area due to the high storm surge. Under extreme wave conditions, the beach could lose its shoreline massively. Continuous erosion may cause severe local problems such as flooding and cliff collapse. Since there is a JR railroad located on the beach's backshore, revetment was placed in front of the railroad. During two continuous typhoon attacks, there was a large scour occurred behind the revetment. This beach was recovered relatively shortly after the typhoon; however, throughout the survey results, it was challenging to find out the recovering and eroding patterns of the beach. Thus, to determine the correlation of complicated mechanism on this beach, shoreline retreat prediction was analyzed using artificial intelligence using the time series of wave data and survey data as parameters for the Artificial Intelligence models. Among many AI models, Random forests, AdaBoost, and LightGBM models were used in this analysis and compared the accuracy and prediction throughout the study.

Keyword : Shoreline Retreat, Random Forest, Gravel Beach

Corresponding Author. : **Hyun Dong KIM** (hdkim311@gmail.com)

Composite extreme value analysis using the typhoon-induced annual maxima wave data

Hong Yeon CHO*

Marine Bigdata Center, Korea Institute of Ocean Science anf Technology, Korea

An extreme value analysis (EVA) should be done respectively using the separated each data set because the wave height distributions induced by the monsoon and typhoon are not identical. In case of the typhoon-induced wave, the typical EVA methods are AM (annual maxima) and POT (peaks over threshold) methods. The POT method is desirable in terms of using the all available data. The number of the data used in the method, however, is depends on the site and direction and the additional process for the threshold value decision is necessary. AM method have been used in the design wave estimation in Korea because the same number of data are used and produces the consistent confidence-level estimation. But, this method have very low confidence levels in the estimation of the short return period because of the mis-matched fitting in this region. Thus, the new composite EVA method are suggested. In this study, the typhoon-induced AM data from 1959 to 2018 (193 typhoons, 16 directions, 210 grid stations) are used to test the performance. In order to apply this method, the AM data should be separated from the practical no-wave data (Hs < 0.3m) and the other significant data which can be regarded as the discrete and continuous variables, respectively. The candidate extreme value funtions are the typical Gumbel, Frechet and Weibull functions. The method shows the more reasonable estimation of the parameters and makes the fitting accuracy significantly improved. In addition, the short return period estimation show the same results based on the statistical significance in the no-wave data region.

Keyword : Extreme value analysis, Typhoon-Induced wave data, Annual maxima method

Corresponding Author. : **Hong Yeon CHO** (hycho@kiost.ac.kr)

S224

Exploring trading potential of coastal blue carbon between regional community and individual business entity subject to emission allowances

Dan-Bi UM*

Law, Pusan National University, Korea

Blue carbon refers to carbon dioxide removed from the atmosphere by the coastal ecosystems. The price of the carbon credit, which was 8640 won per ton in South Korea in January 2015, has soared more than five times as of 2020. Even if domestic companies participating in the emission trading want to invest in offset trading of blue carbon overflowing the coastal area of South Korea, there is no fundamental governance to trade blue carbon. This article suggests ways to configure carbon rights to coastal village communities; procedural carbon rights (accommodating local residents' opinions) and carbon rights for compensation (carbon benefit sharing). It is anticipated that this research output could be used as a valuable reference on blue carbon trading by proposing interactive linking between local companies and coastal village communities.

Keyword : Coastal blue carbon, Coastal village , Carbon trading

Corresponding Author. : **Dan-Bi UM** (dbulaw@pusan.ac.kr)

The convergence and integration of the MICE and maritime industry: An analysis of the MICE industry of Busan, northeast Asia's maritime capital

Changho OH[*1], Sandy NAM-JO[2], Kwi Baek KIM[3]

[1] *Hotel and Tourism Management, Youngsan University, Korea*
[2] *Hotel and Tourism Management, Kyungsung University, Korea*
[3] *Marine Leisure and Tourism, Youngsan University, Korea*

In 2017, Busan was ranked 8th among global MICE destinations, and in2018, 14th by the UIA (Union of International Associations). The rapid development of the city's MICE industry raised the city's global profile, with various major exhibitions held in the city. Marine Week, one of the recognized maritime industry-related exhibitions since 1980, attracted shipping and maritime business to Busan. The establishment of BEXCO in 2001 aided further growth of the exhibition and flourished the maritime related business in Busan and Korea. It is expected that Busan's exemplary MICE infrastructure can accelerate the development of the maritime industry when convergence and integration occur between the two.
This study examines the current status of the city as a MICE destination and future as a center of maritime industry, a regional industry that may serve as one of the major growth engine of the city's future development. A focus group interview with 11 MICE industry professionals was first conducted to examine and verify the attributes of the MICE destination. Analysis Hierarchy Process (AHP) was then conducted to evaluate Busan's strengths and weaknesses as a MICE destination. The findings revealed that the city's key strengths are its attractive climate and environment, transportation infrastructure, and level of cooperation within the MICE industry. However, the level of cooperation with the MICE industry and maritime industry seems to need much improvement. The local authorities of the two industries should continue to interact to reduce the delays, miscommunication, and fasten the flow of the work process. To improve the city's brand and to expand its recognition as the "maritime capital of northeast Asia," they should foster the growth of the MICE industry and promote trusted exhibitions or events for the region-specific industry for convergence and integration of the two.

Keyword : : Maritime industry, MICE destination, MICE integration

Corresponding Author. : **Changho OH** (och3355@gmail.com)

Beaches for everyone? Marine tourism for mobility-impaired visitors for Busan, the first international tourism destination of Korea

Changho OH*[1], **Sandy NAM-JO**[2], Kwi Baek KIM[3]

[1] *Hotel and Tourism Management, Youngsan University, Korea*
[2] *Hotel and Tourism Management, Kyungsung University, Korea*
[3] *Marine Leisure and Tourism, Youngsan University, Korea*

Busan's new vision statement, "Northeast Asia's maritime capital full of happy citizens," reflects the city's uniqueness and its aim to promote the wellness of its people. In December2019, Busan became the first city to be selected as an official "international tourism destination" by the Korean government and will receive 130 million US dollars over five years to improve tourism standards for international tourists. As an international destination, the needs of all travelers must be accommodated, especially those of mobility-impaired visitors. However, the number of tour agencies that accommodate disable tourists is woefully inadequate, only seven operating in Korea. As senior citizens constitute a growing proportion of the Korean population, the number of wheelchair users will surely increase. For these travelers, the simple activity of a dip at the beach is impossible. However, this challenge can be overcome with the use of technology and an adequate budget for the welfare of both Busan citizens and incoming tourist.
This study is the first study conducted to examine the needs and preferences for marine tourism among the mobility-impaired population in Korea with a beach wheelchair program. The result of the survey conducted among 200 beach wheelchair users revealed that they expressed significantly high level of satisfaction with their tours. They also rated the destination very favorably and expressed great rate of intend to return. These results highlight the need for the development of tourism policy and the tourism environment for physically impaired travelers. Furthermore, a portion of the 130 million-dollar budget should be used to better accommodate mobility-impaired travelers, and to improve the city's standards as an international tourism destination.

Keyword : Beach wheelchair, international tourism destination, Marine tourism

Corresponding Author. : **Changho OH** (och3355@gmail.com)

A morphological approach to seabed Detection from Bathymetric LiDAR point clouds

Jaehoon JUNG[1], **Jaebin LEE**[*2], Christopher PARRISH[1]

[1] *School of Civil and Construction Engineering, Oregon State University, USA*
[2] *Civil Engineering, Mokpo National University, Korea*

Detection of seabed returns in bathymetric lidar data is a prerequisite step for a number of processing and analysis procedures. Conventional seabed detection approaches use return waveforms and are of limited use when return waveforms are not available, due to not being captured by the system or provided to the user. Therefore, there is a need for seabed detection algorithms that operate directly on point clouds. This study proposes a histogram-based morphological clustering approach to seabed detection that solely uses geo-referenced point clouds. The proposed approach does not assume any statistical distributions for the input point cloud. Instead, the approach finds a gap that best separates the seabed and sea surface. First, the input point cloud is organized into a histogram using the z-values. The bins are grouped into clusters using a change-point detection method. To prioritize the clusters, the weights are calculated by dividing the mean number of points by the number of bins, enabling the algorithm to find the cluster that separates the seabed and sea surface as wide as possible with minimal points. Subsequently, the z-values contained in the selected cluster are averaged and used as a threshold to divide the input point cloud into the lower and upper segments, representing the seabed and sea surface, respectively. The proposed approach is evaluated datasets acquired in Miami, Florida with a Riegl VQ-880-G bathymetric lidar system. The parameters are optimized through a sensitivity analysis with point-wise comparison between the extracted seabed and ground truth. With optimized parameters, the proposed approach achieved F1 scores of 99.925 – 99.932 % when tested on the other datasets. Further, we compared seabed points with ones from the Reson 8125 MBES hydrographic surveying. The results indicate that seabed points were detected successfully with RMSE in Z-direction being calculated as 0.143 and 0.178 m, respectively.

Keyword : Seabed Points Detection, Bathymetric lidar Data, Histogram-Based Morphological Clustering

Corresponding Author. : **Jaebin LEE** (lee2009@mokpo.ac.kr)

S312

Evaluating operational potential of UAV imagery in coastal wetland survey according to wetland inventory guideline of Ramsar Convention : A case study on southern coast in South Korea

Seong-Il PARK[1], Young-Seok HWANG[2], Jung-Joo LEE[1], **Jung-Sup UM**[*3]

[1] *Department of Spatial Information, Kyungpook National University, Korea*
[2] *Department of Climate Change, Kyungpook National University, Korea*
[3] *Department of Geography, Kyungpook National University, Korea*

There has been little research regarding area-wide data using UAV (Unmanned Aerial Vehicle) remote sensing in evaluating the halophyte conserving coastal wetland. Acknowledging these constraints, we investigated whether Object-Based Image Analysis derived from UAV imagery could be used effectively as a survey of area-wide land use that distinctively appears according to spectral characteristic of UAV multispectral sensor. This research idea was formulated by incorporating the concept of typical UAV remote sensing into in situ transect techniques. Based on the postulated advantages of UAV transect for area-wide monitoring, we explored the applicability of UAV transect sampling on coastal wetland monitoring. A strong positive correlation (Kappa coefficient, transect 1 : 0.80, transect 2 : 0.88) was observed between UAV imagery samples and the field survey samples in study area. This research can provide the practical alternatives methodologies, which fulfill the requirements of Ramsar wetland surveying standard, of concrete evaluations on the Ramsar wetlands. Especially, the UAV imagery supports the detection of seasonal and yearly variations of spatial distributions of plants with their original reflectivity. This facilitates to establish the zones which have the higher priority in conservations. This study proposes the utility of UAV imagery as the alternatives to investigate subjectively the Ramsar wetlands.

Keyword : Coastal wetland, UAV imagery, Wetland inventory

Corresponding Author. : **Jung-Sup UM** (jsaeom@knu.ac.kr)

Comprehensive Analysis of Coastal Dynamics in Cirebon Coastal Area, Indonesia

Umar ABDURRAHMAN*, Hanif DIASTOMO, Avrionesti, Martin Yahya SURYA, Mochamad Riam BADRIANA, Totok SUPRIJO, Hansan PARK

Research and Technology, Korea-Indonesia, Marine Technology Cooperation Research Center, Indonesia
Faculty of Earth Sciences and Technology, Bandung Institute of Technology, Indonesia
Korea Institute of Ocean Science and Technology, Korea

Cirebon Coastal Area (CCA), which covers Cirebon City and Cirebon District, is an area located in the north coast of Java Island, Indonesia. The area was among one of coastal area with a high-density population in Indonesia. Human activities in this area, which dominated by fisheries and agriculture, strongly influenced the coastal environmental conditions. One of an effective and accurate way to monitor the coastal environmental conditions is to utilize remote sensing technology which has grown significantly in recent years. Although various studies have been conducted, many different results were shown and indicated that the coastal dynamics in CCA were not fully understood yet. This research provides comprehensive analysis with the aim to comprehend the complete pattern of coastal dynamics in CCA. Analysis of coastal dynamics has been carried out by using a combination of Landsat and Google Earth data, as well as field observation data using drone. This robust combination allowed to cover a long-time span (1996-2020), periodic (every East Monsoon), and high resolution (up to 1 m resolution) data analysis. Field observations using drone, which were conducted every 2 hours, were not only utilized as a validation and calibration data but also provided information about shoreline changes due to daily tidal effect. In addition, ground control points were established to maintain the accuracy of drone data. Results indicated that along the CCA shoreline the accretion was dominated rather than the erosion. While on the eastern area showed more dynamic changes rather than western area, especially at Losari and Pangenan sub-districts. The result of this research also showed the limitation of Normalized Difference Vegetation Index (NDVI) algorithm in identifying shoreline based on Landsat data and the limitation of Google Earth data for shoreline changes analysis.

Keyword : Remote Sensing, Coastal Dynamics, Cirebon Coastal Area

Corresponding Author. : **Umar ABDURRAHMAN** (umarabd@mtcrc.center)

S314

Sea surface temperature prediction using long short-term memory recurrent neural network

Haeng-Yeol OH[1], Myeong-Hun JEONG*[1], Seung-Bae JEON[1], Tae-Young LEE[1], Geon KIM[1]

[1] *Civil engineering, Chosun University, Korea*

It is crucial to monitor marine water quality for sustainable marine ecosystems. Sea surface temperature is one of the critical parameters to calculate the marine water quality evaluation index. This research predicts sea surface temperature using long short-term memory (LSTM) recurrent neural network. The experimental data comes from the ocean water quality measurement network for two years, including sea surface temperature, salinity, etc. The proposed model performed better than the state-of-the-art alternative, autoregressive integrated moving average (ARIMA) model. The future direction should extend all parameters of the water quality evaluation index and then predict the water quality.
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Keyword : LSTM, Deep Learning, Sea Surface Temperature, Water Quality

Corresponding Author. : **Myeong-Hun JEONG** (mhjeong@chosun.ac.kr)

Development of the optimal locations for offshore wind farms using the analytical hierarchy process.

Geon KIM[1], Myeong-Hun JEONG[*1], Seung-Bae JEON[1], Tae-Young LEE[1], Haeng Yeol OH[1], Chan Sung PARK[2]

[1] *Civil Engineering , Chosun University, Korea*
[2] *Dohwa Engineering Co., Ltd., Korea,*

The ocean is one of the largest renewable energy sources. The adoption of renewable energy technologies has triggered great excitement about offshore wind energy; thereby, it is vital to locate the most appropriate offshore wind farm sites. This study aims to locate the best optimal sites for offshore wind farms based on the analytical hierarchy process (AHP). This study considered nine criteria: wind, water depth, distance from shore, distance to closet substation, proximity to port, proximity to manufacturing base, ship route density, meteorology and (physical) oceanography, and geology. The feasibility of potential sites for offshore wind farms was evaluated across the Korea peninsula.

Keyword : Offshore wind farm, Analytical Hierarchy Process, Renewable Energy

Corresponding Author. : **Myeong-Hun JEONG** (mhjeong@chosun.ac.kr)

S316

Development of evacuation management system in coastal areas using analysis of human behavior in Smart Society

Wanyoung SONG[1], Junho CHOI[2], Dongkwan LEE[3], Jung-Sup UM[*4]

[1] *Spatial Information Science, Kyungpook National University, Korea*
[2] *Disaster Prevention Research Institute, Kyoto University, Japan*
[3] *Institute of Social Science, Kangwon National University, Korea*
[4] *Geography, Kyungpook National University, Korea*

In recent years, the term, 'smart' has emerged as a major social issue and has been established in disaster management in Korea. In disaster management, it is becoming a trend to reduce disaster damage through smart disaster management as well. This study aims to examine the implications of smart disaster management in the case of Japan, which introduced smart disaster management relatively early. It analyzed cases in coastal areas through human behavior and psychological factors such as normalcy bias and cognitive dissonance. This study focuses on the enormous human casualties that occurred when the Great East Japan Earthquake that occurred in 2011.
The results show that 1) understanding the elements of people who do not evacuate after an earthquake and tsunami warning in coastal areas is important. 2) The decision-making process and the reason why residents do not evacuate should be clarified 3) The rapid accuracy of the information delivery system through smart disaster management needs to be improved.
This study suggests that 1) it will be necessary to develop Geo-Spatial information and communication technologies in consideration of human behavior and psychological factors. 2) Information on the location-based evacuation status of leading evacuees should be shared in real-time in crises to induce rapid evacuation. 3) An evacuation management system using the real-time evacuation monitoring module can be utilized in the coastal area.

Keyword : Human behavior, Smart disaster management, Evacuation management system

Corresponding Author. : **Jung-Sup UM** (jsaeom@knu.ac.kr)

Mapping Red Tide Intensity Using a Multispectral Camera Loaded on a UAV

Wonkook KIM[*1], Sunghoon JUNG[2], Keungyong KIM[3], Joo-Hyung RYU[3], Yongseon MOON[4]

[1] *Department of Civil and Environmental Engineering, Pusan National University, Korea*
[2] *Department of Smart Mobile Convergence System, Chosun University, Korea*
[3] *Korea Ocean Satellite Center, Korea Institute of Ocean Science and Technology, Korea*
[4] *Department of Electric Engineering, Sunchon National University, Korea*

Red tide is a harmful algal bloom that causes economic damages in aquaculture industry over years in the southern coast of Korea. Detection and quantification of red tide play an important role not only for understanding its life cycle and outbreak condition, but also for protecting local aquaculture farms. However, the traditional means based on ship surveying has a critical limitation in the spatial coverage being limited in coastal areas due to the mobility of ships. Remote sensing approach helps overcoming such limitations by providing observation in wide areas.

This study aims to develop algorithms and processes required to produce a red tide intensity map for a coastal area using a multispectral camera on an unmanned aerial vehicle. Although UAV's have clear limitation in the operation duration (typically less than 30 minutes for a rotary wing UAV), and allowed weather condition (limited by rain or strong wind), its operation-readiness, cheap operation cost, and maneuvering flexibility provides unique merits over other platforms such as satellites.

In this study, we conducted a ship-based field campaign in a southern coast of Korea in 2019, where radiometric variables were collected with a hyperspectral sensor and a multispectral camera along with chlorophyll-a concentrations of red tide waters. Radiance and irradiance measured by TriOS RAMSES and RedEdge-M camera were first compared for a closure between the instruments, and a chlorophyll-a retrieval algorithm was developed using the synchronous measurements of RedEdge-M and chlorophyll-a concentration measured by water sampling for the ship.

The results showed that the RedEdge-M camera stably estimate red tide intensity and can be used for wide-area observation in ocean. The algorithm was applied to the RedEdge-M images taken over a few km2 from 200 m altitude, to produce red tide intensity map after performing georeferencing individual pixels in the images using the sensor modeling

Keyword : Red tide, Multispectral, UAV

Corresponding Author. : **Wonkook KIM** (wonkook@pusan.ac.kr)

S322

Optimal Rain Gauge Network Based On the Gis-Based Approach Integrated with Spatial Interpolation Technique

Van Men HUYNH[1], Sung-Hoon HONG[1], Yong-Ju KWON[1], Van Ty TRAN[2], Vuong Thu Minh HUYNH [3], Soon-Chul KWON[*1]

[1] *Civil and Environmental Engineering, Pusan National University, Korea*
[2] *Civil Engineering, Can Tho University, Vietnam*
[3] *Environment and Natural Resources, Can Tho University, Vietnam*

Rainfall data is one of the essential data needed for further hydro-meteorological studies. In the context of climate change has been increasingly complicated, the hydro-meteorological forecast data are necessary and urgent. However, it is always a big challenge to achieve accurate rainfall data for such a minimum observation cost. The study hence was conducted to propose the optimization design of the rain gauge network in southern Vietnam in terms of quantity and spatial distribution. The well-known geostatistics method (variance-reduction method) combined with a spatial interpolation algorithm has applied by using input rainfall data throughout the region over the past 30 years. The selection of the appropriate spatial interpolation method also probably affects the accuracy of the optimization process. The outcomes of the interpolation analysis illustrate the spatial variability of rainfall patterns throughout the basin according to the seasons as well as its geographical location. Meanwhile, the primary underlying criteria for reducing error and uncertainty are also to improve the network density by installing additional rain gauge stations. After the number of optimized stations was determined, a GIS-based approach and multi-layer overlaying technique was applied to achieve rain gauges' optimal spatial positioning map. The conceptual method has described as well as developed in this research is capable to apply in other related research which aims to achieve more accurate rainfall estimation data.

Keyword : Rain gauge, Spatial Interpolation, Semi-Variogram

Corresponding Author. : **Soon-Chul KWON** (sckwon@pusan.ac.kr)

A Study of Buoyancy and Kinematics according to the Survival Swimming Lying down Position

KIM YUN-SUB[1], LEE HYO-TAEK[*1], RYU JI-HAN[2]

[1] *Maritime Rescue & Salvage Association of Korea, Instructor trainer, PhD, Korea*
[2] *Seoul YMCA, Leisure Sports department, Manager, PhD, Korea*

This study was conduct to raise awareness of safety at the ocean, to prepare institutional policy, and to revise the lifeguard education guideline. In detail, the purpose of this study was to analyze the change in floating time and the underwater weight (buoyancy) according to the survival swimming lying down position, we selected 20 men who have been serving as marine police officers. The body segment and mass data for the subject's lying down position was calculate using the 3D video analysis program and the underwater weight test. SPSS One way ANOVA was performed to check the statistical difference between the buoyancy retention time and underwater weight (buoyancy) according to the lying down position (P1;head-up, P2;horizontal, P3;attention), and post-test between groups was Scheffe Post hoc was used. First, the buoyancy retention time according to the change in lying down posture was the longest in P1, and in the order of P2 and P3, and there were statistically significant difference. Second, the change in body weight (buoyancy) according to the change of the lying down position was found to be the heaviest in P3, followed by P2 and P1. Even in the post-test, all groups showed significant differences. Summarizing the results of this study, the best way to maintain the buoyancy according to the change in lying down position during survival swimming is P1 that allows the body to float on the surface for the longest time. It also showed the heaviest underwater weight at P3, so it was found that incorrect upper body stance during survival swimming could affect buoyancy and survival rate. Lastly, even a person who is proficient in swimming has a very limited survival time at low temperatures, so we should considered that the above-mentioned efficient floating method and continuous lifeguarding and application in education are necessary.

Keyword : Survival Swimming, Floating Skill, Kinematic Study

Corresponding Author. : **LEE HYO-TAEK** (take1682@naver.com)


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Development of a Probabilistic Model for the Transmission Coefficient of Low Crested Breakwater

Yong Jun CHO*

Department of civil engineering, University of Seoul, Korea

LCB [Low Crested Breakwater] has been the most preferred structural type among many countermeasures against beach erosion in the coastal zone management project by the Korean Ministry of Ocean. The shore protection performance by LCB depends on the transmission coefficients, which are random due to the variability inherent in the marine environment. However, a probabilistic model for these coefficients is hard to find, indispensable for the reliability-based optimal design of LCB. In this rationale, first, a probabilistic model of transmission coefficients is empirically developed. In doing so, the transmission characteristics of LCB were examined using the situ-wave data measured at the up-wave and down-wave sides of LCB at Bong-Po and Sok-Cho from 2019.8.6 to 2019.8.21 to identify the pertinent random variables affecting LCB transmittance for the development of analytical probability model of LCB transmittance. Sea conditions have a significant influence on the transmission coefficients, and the roughness of sea conditions can be quantified in terms of wave height and its associated wave slope, as can be found in the Wallops wave spectrum. It is also noted that wave height and its associated wave slope are highly correlated in a mild sea, but independently behave, especially as wave heights get significant. These complicated interrelations between wave height and wave slope can precisely be described based on the joint distribution of wave amplitude and its associated period by Longuet-Higgins (1983). Based on these facts, we analytically derived a probabilistic model for transmission coefficients of LCB from d'Angremond et al. (1996)'s model and the joint distribution of wave amplitude and its associated period by Longuet-Higgins(1983) using the standard technique of transformation of random variables. Numerical simulation results show that as sea conditions are getting harsh, non-negligible amount of probability mass shifts toward the low transmission coefficients due to sub-harmonic resonance wave-wave interaction.

Keyword : Low Crested Breakwater, Probability distribution of transmission, Reliability-Based optimal design of LCB

Corresponding Author. : **Yong Jun CHO** (young@uos.ac.kr)

S412

RECLAMATION WITH MANGROVE TO PROTECT CLIFF FROM EROSION IN BINTUNI BAY SEDIMENT DISPERSION MODELING USING NON-ORTHOGONAL BOUNDARY FITTED TECHNIQUE

Muslim MUIN*

Coastal Engineering Research Group, Institut Teknologi Bandung (ITB), Indonesia

Bintuni Bay is semi closed bay, located in West Papua Province, Indonesia. The facility of Tangguh LNG Project was faced serious problem due to erosion along the Cliff. It was decided that reclamation is the best solution. Mangrove trees are planted in the reclamation area to reduce the wave. The reclamation was only conducted until Mean Sea Level to allow seawater to flow in and out through the inlet/outlet. This paper presents and discuss the results of simulations for several option of reclamation layout, inlet/outlet, during and after reclamation. MuSed3D, 3D Ocean Hydrodynamics and Sediment Transport Model Using Non-Orthogonal Boundary Fitted Technique, was employed to conduct the simulation.

Keyword : Mangrove tree, Cliff Erosion, MuSed3D

Corresponding Author. : **Muslim MUIN** (muslimmuin@gmail.com)

Optimized Evacuation Plan and Decision Support System Development with Agent-Based Modelling (ABM) and GIS Analysis for Tsunami in Pandeglang, Banten, Indonesia

Ricard Diago SAMBUAGA[1], Han Soo LEE*[2]

[1] *Graduate School for International Development and Cooperation, Hiroshima University, Japan*
[2] *Transdisciplinary Science and Engineering Program, Hiroshima University, Japan*

On December 22, 2018, a tsunami caused by the eruption of the volcanic mountain and partial collapse of the Mt. Anak Krakatoa “Child of Krakatoa” volcano occurred in the Sunda Strait (a strait between Java and Sumatra island), Indonesia. The tsunami in the Sunda Strait resulted in 430 casualties (January 7th, 2019). The aim of this study is to provide optimum evacuation shelters by reducing evacuation time and casualty number caused by tsunami. Early evacuation is the most significant measure in reducing casualties in tsunami disaster. Panimbang sub-district is chosen as a study area in this research, which it has the highest casualties according to Pandeglang Regional Disaster Management Agency (BPBD Pandeglang). Digital elevation model (DEM), information datasets (road network, hospital, worship facilities, schools, population distribution, etc.), and casualties’ information are used in the analysis. This study conducts two parts; shelter analysis and agent-based modeling. The service area evaluation of proposed shelter is conducted using network analyst tool in ArcGIS. The important variable in the shelter analysis is the nearest accessibility based on the road network from residential area to proposed shelters. Public facilities such as mosque, school, health center, etc. are used as proposed shelters in the analysis. Ages group, walking speed, travel mode (walk or driving car), etc. are used as parameters and scenarios in the agent-based model. It affects the number of total casualties and evacuation time as an output in this model. A comparison of total casualties from model output and real data will be further conducted in this study. It is also needed to validate the proposed shelters are optimum to reduce evacuation time and total casualties.

Keyword : Tsunami, Evacuation, Agent-Based modeling

Corresponding Author. : **Han Soo LEE** (leehs@hiroshima-u.ac.jp)


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Comparative study on the ship performance of a twisted rudder with wavy configuration

TAE YOUNG BYUN[1], JIN WOOK KIM[2], KYOUNG WAN LEE[3], MOON CHAN KIM[*2]

[1] *MECHANICAL ENGINEERING , DONG-EUI INSTITUTE OF TECHNOLOGY, Korea*
[2] *Naval Architecture & Ocean Engineering, Pusan National University, Korea*
[3] *Technology, Blue Marine, Korea*

Due to recent serious human injury and marine pollution caused by ship accidents, interest in maneuverability of ships is increasing. In addition, as IMO mandates EEDI(Energy Efficiency Design Index), the total carbon dioxide regulation system, the demand for eco-friendly ships is also increasing. The energy saving device in the stern direction based on the propeller is called a post device, and most of the post devices are studies on rudders. Various special rudders have been introduced to reflect this interest in eco-friendliness and steering safety.
In this paper, in order to confirm the ship applicability of the twisted rudder with wavy configuration, we reviewed the resistance, self-propulsion and maneuverability. The target ship for analysis and experiment was KCS, and the performance was compared and verified with the existing special rudders(full spade rudder, fish tail rudder). CFD analysis was performed using Star CCM+ ver.11.02, and it was calculated using the RANS (reynolds-averaged Navier-stokes) equation as the governing equation for turbulent flow analysis around the hull.
As a result of the verification, the maneuverability is slightly lower than that of the existing special rudders, but it satisfies the IMO standards sufficiently and shows improved results in terms of efficiency.

Keyword : Rudder, Maneuverability, Wavy Twisted Rudder

Corresponding Author. : **MOON CHAN KIM** (kmcprop@pusan.ac.kr)

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Study on the effect of the ramp variables on the energy efficiency of overtopping

Sunghwan AN, Jong-Hyun LEE*

Naval Architecture and Ocean Engineering, Gyeongsang National University, Korea

The devices which is able to produce electricity by using of the energy of the waves are commonly called Wave Energy Converter(WEC) and Overtopping Wave Energy Converter(OWEC) is one of the type of the WEC. OWEC has the device that utilize the wave energy by leading overtopping water to reservoirs placed at a level higher than the mean water level. Especially in the coastal fixed type of OWEC, the rise of wave height by the ramp of the structure is main phenomenom and the many of research of these is conducted. The research verified the effect on the hydraulic efficiency by the desgin of ramp of OWEC using the Smoothed Particle Hydrodynamics (SPH) particle method. The analysis was conducted by changing the horizontal length, vertical length, and shape of the sloping arm of ramp and studied the effect of each variables. As a result of the analysis, the effect of each variable on the overtopping performance was analyzed according to the shape of the ramp.

Keyword : Wave Energy Converter, Overtopping, Particle method

Corresponding Author. : **Jong-Hyun LEE** (gnujhlee@gnu.ac.kr)

IDENTIFICATION OF MARINE DEBRIS SOURCES IN KUTA BEACH, BALI, INDONESIA THAT COMES FROM THE RIVER USING NUMERICAL MODEL

I Putu Ranu Fajar MAHARTA[*1], Ivonne Milichristi RADJAWANE[1], Totok SUPRIJO[1, 2], Hansan PARK[3], I Gede HENDRAWAN[4]

[1] *Oceanography, Faculty of Earth Sciences and Technology, Bandung Institute of Technology, Indonesia*
[2] *Marine Technology Cooperation Research Center (MTCRC), Bandung Institute of Technology, Indonesia*
[3] *Korea-Indonesia Marine Technology Cooperation Research Center (MTCRC), Korea Institute of Ocean Science and Technology (KIOST), Korea*
[4] *Faculty of Marine Science, Udayana University, Indonesia*

Kuta Beach is one of the beaches with the biggest tourist arrivals in Bali. In recent years Kuta beach has received shipments of marine debris from the Bali Strait. Kuta Beach area gets an average of piles of garbage reaching ± 30 tons/day and the peak occurred in January 2014 which reached ± 1,700 tons. Previous studies only carried out simulations with sources of marine debris from outside the Bali Strait and the coast in Bali. This study aims to determine the marine debris that reaches Kuta Beach with the source of debris from rivers and outside the Bali Strait area in the west season (January 2019). The Finite Volume Coastal Ocean Model (FVCOM) is used to obtain the circulation of current patterns and patterns of movement of particles by using the Lagrangian Particle Tracking module, with the sources of the debris from 8 river and outside the Bali Strait. In general, the pattern of movement of currents in the Bali Strait at west season is dominantly moving towards the east due to the influence of the west monsoon winds. The simulation results show that particles that reach Kuta Beach are dominated by rivers that flow near Kuta Beach, with the river that gives the most debris is the Tukad Penet, which is 54.5% of the total marine debris that reaches Kuta Beach.

Keyword : Kuta Beach, FVCOM, Marine debris

Corresponding Author. : **I Putu Ranu Fajar MAHARTA** (ranufajar123@gmail.com)

Utilization and Linkage of Oceanic Energy in Natuna Island: A Review

Rima RACHMAYANI[*1], Nining S. NINGSIH[1], Iqbal ARDIANSYAH[1], Laela F. YANI[1], Ardian M. RIZAL[1], Aditya R. KARTADIKARIA[1], Hansan PARK[2]

[1] *Faculty of Earth Sciences and Technology, Institut Teknologi Bandung (ITB), Indonesia*
[2] *Marine Technology Cooperation Research Center, Coordinating Ministry for Maritime & Investment Affairs Building, Indonesia*

Natuna Regency is a district of Riau Islands Province and it is known as the northernmost regency in the Karimata Strait. Natuna Regency has abundant fisheries, oil, and gas resources. Moreover, Natuna is famous for aquaculture fisheries of Napoleon (Cheilinus undulatus). Currently, Natuna has been partially improved on distribution services through the sea toll and the establishment of the Marine and Integrated Fisheries (SKPT) of the Lampa Strait. In addition, Natuna waters is traversed by the ALKI (Indonesian Archipelagic Sea Lanes) I; a sea lane that traversed by foreign ship and flights in the territory of Indonesia to implement shipping. Resource development in Natuna is often constrained by infrastructure. However, one of infrastructure of electricity provided by PT PLN to encourage economic growth including the border areas of Indonesia. According to National Mid-term development plan (RPJMN) 2015-2024, the development of Natuna Regency will focus on maritime and fisheries, tourism, oil and gas industry, defense and environment. In the marine science, research on marine renewable energy have been conducted. According to our study, characteristic of ocean wave and ocean current in Natuna is inferior to be developed as the renewable energy concept. Likewise, OTEC is found ineffective in Natuna. However, Natuna is a potential area for wind farm and solar power plant. Other than that, Natuna has its potency to develop a pumped hydro storage system dan energy storage system like in some islands in Natuna. Furthermore, Natuna Island, as Indonesian important for economic and geopolitics role, will be further discussed deeply in regard to its possibility of harnessing ocean energy to make the island as a pilot project for an energy-independent island role model. Additionally, discussion of government current plan and status of local industry and living hood status of local people is also addressed to make a comprehensive discussion.

Keyword : Indonesia, Marine Energy, Natuna

Corresponding Author. : **Rima RACHMAYANI** (rrachmayani@oceanography.itb.ac.id)

A Test for Motion Control and Configuration Effect of Wave Energy Converter on a close structure

Sungsoo KIM[1], Jong-Hyun LEE[*2], Donghoon KANG[2], Jae-Chul LEE[2]

[1] *R&D department, Adialab inc., Korea*
[2] *Naval architecture ocean engineering, Gyeongsang national university, Korea*

Nowadays, the interesting on the renewable energy has been increased because of the environmental issues caused by over-usage of fossil fuels. The representative renewable energies consist of wind energy, solar energy, wave energy, current energy and so on. Among them, the wave energy, which is distributed throughout the worldwide ocean with abundant available energy, is studied in this paper. Wave energy converters can be divided into three categories: Oscillating Water Column(OWC), Overtopping, and Wave Activated Body(WAB) depending on the energy extraction ways. WAB devices have a high efficiency of energy absorption because it has a simpler energy convert mechanism than the other wave energy converters. As WAB uses the motion of structures to make electric energy, if each structures are closely installed, there would be hydrodynamic interaction between them. The hydrodynamic interaction can amplify or attenuate the motion of adjacent structures, and the effect of the hydrodynamic interaction depends on the shape, size, and distance of structures, motion mode, and wave direction. Therefore, in this paper, it is studied through the experiment that the control method, which increases the motion of WAB and decreases the motion of adjacent non-waver energy converters(offshore plant, floating house, mega structures, etc.) at the same time. It is considered as principal factors that motion restrictions, configuration, distance between structures, and wave directions. The motion restriction restricts the pitch motion of WAB because pitch motion is expected to mainly affect other structures. The experiment implemented in the 2D wave generator and 3D motion capture camera is used to measure the movement of structures.

Keyword : Wave energy converter, Wave activated body, Experimental test

Corresponding Author. : **Jong-Hyun LEE** (naoe.lee@gmail.com)


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Analysis of Shoreline Changes in the Nourished Beach by the One Line Shoreline Model

Sahong LEE[1], Jung Lyul LEE*[2]

[1] *School of Civil Architectural and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *Graduate School of Water Resources, Sungkyunkwan University, Korea*

Gwangalli Beach is one of the most representative beaches in South Korea along with Haeundae Beach, and a busy tourist attraction that attracted 10 million visitors in 2006 as the number of visitors had been increasing consistently since the completion of the construction of Gwangan Bridge in 2003. Although the government is carrying out the project of beach nourishment every year, studies on systematic monitoring and beach erosion are rare. In this study, the changes in shorelines were analyzed through consistent monitoring of shorelines since beach nourishment in 2016, and the reaction of beach cross-section investigated through the nourishment data and comparatively analyzed with the monitoring data by application of the One Line Shoreline Model.

Keyword : Beach nourishment, Gwangalli, Shoreline change

Corresponding Author. : **Jung Lyul LEE** (jllee6359@hanmail.net)

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Beach erosion reduction effect of artificial gravels

Seungho LEE*, Hyoseob KIM, Yangwoo LEE

Major in hydraulic engineering, Kookmin University, Korea

There are a number of cases that confirmed the great effect and potential for beach erosion reduction by supplying materials with a larger particle size than sand existing on the beach. The Jinko and Ninomity beaches in Japan and the Riviera beaches in Nice, France, used gravel to regain the width of the beach that had disappeared due to coastal erosion. Also, according to Dean(2003), the diameter of the sand distributed on the beach affects the beach slope, and the larger the diameter, the greater the beach slope.
Here, we put an artificial material larger than the particle size of the sand placed on the existing beach, and conducted a laboratory model miniaturization experiment to directly check the effect. The experiment was conducted by reproducing the target beach on one side using a two-dimensional wave generator and inputting waves by placing materials with different particle sizes, respectively.
When comparing Case 1 and Case 5, Case 1 used sand with an inclination of 8.5 degrees, a depth of 24 cm, a wave height of 10 cm, a cycle of 1.8 seconds, and an average particle diameter of 0.03 mm. Case 5 placed boulder on case1's shoreline.
As a result of the experiment, in case 1, the erosion in the crushed area was large, so that sand escaped into the open sea, and in case 5, the amount of sand that escaped into the open sea was reduced by the boulder moving in the land direction to form a jaw and reducing erosion. The position of the shoreline was also retreated by 5.85 cm for Case 1 and 4.1 cm for Case 5.
Artificial gravels reduces erosion due to external forces near the beach, and the shoreline is maintained or advanced.

Keyword : Beach erosion, Shoreline, Gravel

Corresponding Author. : **Seungho LEE** (stork@kookmin.ac.kr)

Wave attenuation analysis in artificial coral reef using a physicial modelling

Taeyoon KIM[1], Yongju KWON[1], Sunghoon HONG[1], Jongyeong KIM[1], Jooyong LEE[2*]

[1] *Department of civil and environmental engineering, Pusan national university , Korea*
[2] *Research Institute of Industrial Technology, Pusan National University, Korea*

Due to global warming and coastal development, the damages in coastal such as sea level rise and changes in coastline caused by scour and erosion are increasing, Various types of breakwaters are applied to prevent the coastal erosion, however, the problem such as scour around the structure is exacerbated, therefore a fundamental solution is needed. In this study, Two-dimensional laboratory experiments were conducted in the wave flume to investigate the wave transmission phenomena of artificial coral reef. Experiments are conducted by analyzing wave transmission dependents on structure shapes, relative crest height, relative crest width and wave steepness. Wave attenuation appeared to be most dependent on relative crest height and relative crest width. Wave attention increased slightly with wave height while no clear trend with respect to wave period was seen. No significant difference is shown in wave attenuation dependent on the structure shape, however on water level fluctuation, the water level slightly rised a structure with small porosity. As a result, it is judged that calculating wave transmission rate of the artificial coral reef method dependents on the section specifications can be appropriately applied to the detailed design and application.

Keyword : Artificial coral reefs, Wave attenuation, Relative crest width

Corresponding Author. : **Jooyong LEE** (jooyong@gmail.com)

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Variation characteristics of Irregular wave passing over Artificial Coral Reef

Sunghoon HONG[1], Taeyoon KIM[1], Jongyeong KIM[1], Jooyong LEE[2*]

[1] *Department of Civil Engineering, Pusan National University, Korea*
[2] *Research Institute of Industrial Technology, Pusan National University, Korea*

Recently, submerged structure has been paid attention worldwide as the method for preventing coastal erosion. In this study, we reviewed the variation effects of irregular wave propagation over submerged structure on wave height, period and depth. We installed the 'Artificial Coral Reef (ACR)' structure on the flat bed and generated more than 100 irregular waves using JONSWAP spectrum. During wave analysis, we used zero-crossing method and significant wave and energy density spectrum theory with peak energy frequency(fp). The parameters for experiment were set to wave height (4~8 cm), wave period (1.0~2.25 sec), and water depth (20~28 cm). The results showed that wave attenuation mitigated when wave height gets bigger, wave period increase, and water depth increase. It also be assumed that the peak energy of irregular wave can be decreased and the spectrum broadening occurred when passing over the ACR structure. Moreover, the data tendency showed that the wave energy transferred to high frequency domain with increased wave nonlinearity by passing ACR structure. These results are caused by the effect of secondary oscillation due to the long-period. For mitigating these unexpected effect of composed wave, we applied band-pass filtering method. Based on our research, we figured out that filtering high frequency domain more than 3.5fp is reliable. It can be judged that the results on irregular wave deformation over ACR structure can be used for designing various types of submerged structure.

Keyword : Artificial coral reef, Wave energy spectrum, Energy transfer

Corresponding Author. : **Jooyong LEE** (jooyong@gamil.com)

MeePaSoL and MEPBAY: Software tool to support empirical parabolic model for headland-bay beaches

John HSU[*1] , Jung Lyul Lee[2]

[1] *School of Civil, Environmental & Mining Engineering, The University of Western Australia, Australia*
[2] *Department of Civil and Environmental Engineering, Sungkyunkwan University, Korea*

Headland-bay beaches (HBBs) in various shapes, sizes and stability stand out as the most recognizable coastal landforms on the world's coast, having connected for human activities. They have existed naturally as part of geological inheritance or as by-product of engineering works arising from harbor and protective structures. A few mathematical functions to describe their planform have emerged since 1944, in which the parabolic bay shape equation (PBSE) for a HBB in static equilibrium planform (SEP; Hsu and Evans, 1989) has become the most popular and trustworthy for engineering applications among coastal fraternity, with the support of software tools (e.g., MEBAY by Klein et al, 2003; SMC by González et al., 2010) developed specifically for its application. Overall, the former is a simple tool to operate for most users, but may find uncertainty at attempting a downdrift control point, whereas the latter is a complex numerical modeling system for researchers and the like.

Recent research at the Sungkyunkwan University (SKKU) has developed a versatile MATLAB-based GUI package called 'MeePaSoL', aiming to lessen/eliminate this uncertainty. This is achieved by (1) introducing a new concept of 'wave phase potential' for the SEP and nearshore contours, (2) transforming a shoreline segment to a fitted circle in polar coordinates and determining the predominant wave direction for the beach, thus enabling subsequent calculation for the PBSE, and (3) assessing planform stability visually for prototype HBBs and demonstrating how to mitigate potential beach erosion.

In this paper, comparison between MEPBAY and MeePaSoL will be made on operation procedure and results of applications, as well as on locating control points (updrift and downdrift). General guidelines are also explained to assist the users on digitizing shoreline data and locating control points, showing cases with proper and with proper and imperfect arrangements.

Keyword : Headland-Bay beaches, Parabolic model, MeePaSoL

Corresponding Author. : **John HSU** (jrchsu@iinet.net.au)


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A Simulation of soil dumping problem by using Moving Particle Semi-implicit Method

Kyung Sung KIM[1], Jong Hyun LEE*[2]

[1] *School of Naval Arcitecture and Ocean Engineering, Tongmyong University, Korea*
[2] *Department of Naval Architecture and Ocean Engineering, Gyeongsang National University, Korea*

The soil dumping problem is one of the most important problems on the coastal and ocean construction project. In general, the computational fluid dynamics method used grid system to simulate soil particle under flow with concentrated condition. It can be useful for fast calculation, however, it is restricted to demonstrate particle movement. The Moving particle semi-implicit (MPS) method follows fully Lagragian approach, thus it can simulate soil particle behavior via tracking each particle. In this study, the newly developed MPS method modified for solid particle was used to simulate soil dumping problem. For the solid particle interaction, drag force and friction force term were implemented instead of viscosity term in the governing equation. The friction force is generated by friction between soil particles, and the drag force can be calculated by relative velocity around center particle within effective range. All the solid particle interaction models were validated by corresponding physical phenomena. The numerical results were compared to the corresponding experimental results and they show good agreement.

Keyword : Moving paritlcle semi-Implicit, Gravel, Dumping

Corresponding Author. : **Jong Hyun LEE** (gnujhlee@gnu.ac.kr)

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A study on the flow analysis of ship scrubber effluent

Kyoung Wan LEE[1], Moon Chan KIM[*2]

[1] *Technology, Blue Marine, Korea*
[2] *Department of Naval Architecture & Ocean Engineering , Pusan National University, Korea*

As of January 1, 2020, the International Maritime Organization (UN) under the UN decided to significantly strengthen the sulfur content standards for marine fuel oil.
The allowable sulfur content for ship oil will be limited to less than 0.5% from 2020 from the existing 3.5%. As an alternative, it is trying to reduce sulfur oxides by installing a scrubber on an existing ship or LNG fuel propulsion ship. When the engine exhaust gas is cleaned using a scrubber, sulfur oxides are included in the washing water to become acidic. This washing water is discharged to the sea, and since it may affect marine organisms, the MEPC259 (68) regulation limits the acidity (pH) of the discharged water.
The purpose of this study is to find out how well the effluent dilutes depending on the size, angle, and presence of the diffuser.

Keyword : Scrubber, Diffuser, CFD

Corresponding Author. : **Moon Chan KIM** (kmcprop@pusan.ac.kr)

WAVE OVERTOPPING PLUNGING ON THE REAR SIDE OF COMPOSITE BREAKWATER

Made Narayana ADIBHUSANA[1], Jong-In LEE[2], Yonguk RYU*[2]

[1] *Ocean Engineering Department, Pukyong National University, Korea*
[2] *Civil Engineering Department, Chonnam National University, Korea*

Large wave overtopping not only damages the front slope of a breakwater, but also does the crest and rear slope of a breakwater. In this study, the behavior of overtopping waves falling on the rear side of composite breakwater were investigated through physical experiments. A series of regular waves with various wave periods and wave heights were used as wave parameters while plunging location, velocity and angle were used as the parameters of wave overtopping behavior on the rear side of a composite breakwater. The geometry of the composite breakwater were kept constant through the experiments. The Bubble Image Velocimetry (BIV) and digital image analysis were applied to measure the velocity in the aerated region of overtopping water falling on the rear side of breakwater and the plunging location. The increment value of plunging location shows a logarithmic trend as wave period and wave height increased. The front velocity of overtopping flows right before plunging the rear water surface shows a linear trend with those wave parameters. Moreover, the angle of overtopping flows plunging the rear water surface shows an exponential trend as the wave parameters changed.

Keyword : Wave overtopping, Overtopping jet, Rear slope

Corresponding Author. : **Yonguk RYU** (yuryu@jnu.ac.kr)


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Shoreline Change Analysis and Erosion Prediction at Kkotji Beach, Korea

Kisu KWAK, Jinwoo JUNG, Hyun Dong KIM*

R&D Center, Mirae Ocean Corporation, Korea

The west coast of Korea has a low water depth, and in the form of a bay facing the east coast of China, a tide wave enters the bay, and there is a considerable resonance between the reflected wave and the incident wave from the bay, which cause substantial tide differences. Among many beaches on the west coast of Korea, Kkotji beach is one of the representative coastal tourist locations on the west coast of Korea. This beach has been specified as a coastal erosion management beach by the Korean government because of continuous severe coastal erosion. Sandy beach has been graveled, and the number of tourists has decreased over the years, causing significant economic loss. To countermeasure the erosion problem, a field survey was conducted since the early 2000s. With ten years of collected field survey data, coastal erosion has been analyzed and verified using Numerical simulation, Mike 21, powered by DHI. Spectral wave module, hydrodynamic module, and sand transport module were used simultaneously to calculate the shoreline changes and were compared with the field measured data to analyze the cause of the coastal erosion in Kkotji beach, and possible location-oriented countermeasures for this beach were proposed throughout the study.

Keyword : Kkotji Beach, Historical Survey Data, Shoreline Changes

Corresponding Author. : **Hyun Dong KIM** (hdkim311@gmail.com)

S612

Calibration and assessment of bed evolution model in an embayed beach with submerged breakwaters

Minsang CHO[1], Hyun-Doug YOON[*1], Kideok DO[2], In-Ho KIM[3]

[1] *Department of Civil and Environmental Engineering, Myongji University, Korea*
[2] *Department of Convergence Study on the Ocean Science and Technology, Korea Maritime and Ocean University, Korea*
[3] *Department of Earth and Environmental Engineering, Kangwon National University, Korea*

Coastal erosion is caused by high-energy waves induced by extreme condition such as typhoon. A submerged breakwater is a coastal structure which is used not only to reduce coastal erosion but also to prevent loss of sand. XBeach, process-based model, has been used to simulate nearshore hydrodynamics and morphological response to storms. A variety of parameters is included in XBeach, which provides default setting. However, parameter calibration is a process that must be performed to apply to a specific-site. Parameter calibration has been carried out depending on the researchers' experience or through traditional trial-and-error, but more rigorous and systematic methods are required. In this study, parameter calibration in XBeach is performed for an embayed beach with submerged breakwaters under storm conditions. Also, we analyze the relationship between parameters and morphological changes and finally propose the optimal parameters that can be applied to the target beach.

Keyword : Embayed beach, Submerged breakwaters, XBeach

Corresponding Author. : **Hyun-Doug YOON** (hdyoon@mju.ac.kr)

Effect of the oblique wave incidence in beach scarp formation

Hoai Xuan VU, Jung Lyul LEE *

Graduate School of Water Resources, Sungkyunkwan University, Korea

Beach scarps are common morphological features that frequently occur under the stormy wave condition. However, the knowledge on beach scarp formation and their morphodynamics is far from being complete. These features are reported to be often observed on the nourished beaches or under the oblique incidence of stormy waves, leading to serious hazards to beach users and negatively impacting local ecosystems.

Numerical study conducted to quantify the morphodynamic response of the beach scarp to onshore or longshore action of waves. The non-linear wave model was used to simulate the uprush and backwash swash dynamics in the foreshore face. Numerical simulation shows that the dispersive motion in the swash zone induced by the periodic wave motion are important to destruct the berm and to form the beach scarp.

The phase speed simulated by numerical model is compared with that obtained by the concept of wave phase potential. The theoretical phase speed was derived on a planar surface. Furthermore, in order to examine the model performance, the numerical results are compared with beach scarp creation experiments conducted by Bemmelen (2018).

Keyword : Beach scarp, Swash zone, Numerical Modelling

Corresponding Author. : **Jung Lyul LEE** (jllee6359@hanmail.net)


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Model tests for the bearing pressure evaluation of harbor structures using open cell caisson method

Byeong Wook LEE[1], Deokhee WON[2], Dong Hyawn KIM[3], Woo-Sun PARK*[4]

[1] *International Hybrid Hydraulic Research Center, Rural Research Institute, Korea Rural Community Corporation, Korea*
[2] *Maritime ICT R&D Center, Korea Institute of Ocean Science and Technology, Korea*
[3] *School of Architecture and Coastal Construction Engineering, Kunsan National University, Korea*
[4] *Coastal Development and Ocean Energy Research Center, Korea Institute of Ocean Science and Technology, Korea*

Recently, it has been attempted to interlock adjacent caissons to secure the stability
dispersing the external force concentrating at a specific point throughout the structure. Among interlocking methods, the open cell caisson method interlocking adjacent caissons by crushed stone fillers in open cells facing each other is getting attention.
In this study, model tests were carried out for evaluating the bearing pressure of harbor structures using open cell caissons. For the convenience of the experiment, it was used one open cell caisson model filled with crushed stones in the open cells, in which the facing caissons were simplified by separated acrylic plates at both sides. Using four load cells installed at each corner of the caisson bottom verti
measured according to varying horizontal forces. The experiments were conducted on major design parameters affecting the bearing pressure of an open cell caisson, which are the frictional coefficient of the inner wall of the open cell, the compaction degree of fillers, and the overload on fillers. For the comparisons, numerical analyses were performed by using ABAQUS.
As a result of the experiment, it was found that fillers in the open cell share 20% of the maximum bearing pressure for the flat surface of the inner wall with the frictional coefficient of 0.47 and 30% for the uneven surface of the inner wall with frictional coefficient of 0.787. This means that the bearing pressure of the open cell caisson is reduced to at least 20% compared to the bearing pressure of the typi
the unevenness of the inner wall of the open cell. In addition, the sharing ratio increased, as the compaction degree of fillers and the overload on fillers increased. Also, numerical results by ABAQUS showed similar trends as model tests.

Keyword : Harbor structure, Open cell caisson, Bearing pressure

Corresponding Author. : **Woo-Sun PARK** (wspark@kiost.ac.kr)

P102

Experimental comparison of hydrodynamic characteristics of submerged floating tunnel with different cross-sectional shape

Sang-Ho OH*

Coastal Development and Ocean Energy Research Center, Korea Institute of Ocean Science and Technology, Korea

The submerged floating tunnel (SFT) is an innovative method of crossing over two shore areas separated by deep sea strait or lakes, where it is not feasible to build a conventional tunnel or bridge. The hydrodynamic stability of SFT is maintained by a balance of buoyancy and tethering of the structure. Because little experience exists for an actual construction of this unique structure, it is required to establish design technologies a elements of the SFT, such as the main tube, tethering lines, anchors on the seabed, and shore connections. Assessment of hydrodynamic performance of SFT under wave loading is one of important factor in the design of a SFT structure. In this study, physical experiments were conducted in a two-dimensional wave flume to investigate hydrodynamic characteristics of two different SFT models under the action of regular waves having different heights and periods. The cross-sectional shape of the two SFT models were either rectangular or rounded-rectangular. By analyzing the experimental data, the performance of the two SFT models were compared with that of the conventional SFT model of circular cross-section, which already reported by a previous study. The experimental results showed that the three-degree motions of the SFT and the associated tensile forces on the tension legs significantly vary according to the change of the cross-sectional shape of the model. It was found that rectangular or rounded-rectangular SFT models are less effective for suppressing the horizontal and vertical motions of the SFT body.

Keyword : Submerged floating tunnel, Hydrodynamic response, Tension leg

Corresponding Author. : **Sang-Ho OH** (ohsangho@kiost.ac.kr)

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Experimental Study on Hydraulic Performance of Tiecell Caisson Breakwater with Wave Chambers

Inchul KIM, Kichul PARK*, Taewook KANG

Civil & Environmental Engineering Department, Dongseo University, Korea

Generally, most coastal structures in Korea are covered with wave-dissipating concrete blocks such as tetrapods for the purpose of preventing beach erosion and protecting harbor facilities. The tetrapod is not difficult to be constructed and is used as an armoured layer of breakwaters in various locations as coastal protection structures, and an interior space among the blocks has various advantages such as being a habitat of aquatic life.
However, because of the public safety problems caused by empty spaces among tetrapods that are interlocked with one another at a rubble mound breakwaters, it is urgent to suggest an alternative to the wave-dissipating blocks such as tetrapods. It has been reported that more than 100 falling accidents occurred in Korea in the past few decades. This is due to the geometrical problems of tetrapod which is not flat but round and the subsidiary problems of exposure to environments in which seaweeds live as well.
Therefore, the tiecell caisson of interlocking-blocks type optimized for breakwaters has been developed to improve these various drawbacks. The tiecell caisson breakwater is not a simple installation of blocks, but an integral type that each layer-built block is interlocked by columns existing inside its block.
In this study, hydraulic model tests are performed to examine the hydraulic performance of a non-porous caisson and the tiecell caisson breakwater with perforated blocks attacking wave against a small fishery harbor near Busan. The model test results show that the tiecell caisson is more effective in dissipating wave energy under normal wave conditions and in reducing wave overtopping rates under design wave conditions than the non-porous caisson and the horizontal wave forces acting on tiecell caisson show slightly larger than the non-porous caisson due to impulsive forces on the caisson with the perforated blocks.

Keyword : Tetrapods, Tiecell caisson, Hydraulic model tests

Corresponding Author. : **Kichul PARK** (dongseo94@gmail.com)

P104

The limited installation ranges of silt curtain in ocean physical environment

Sukzun YOUN[*2], Byungsoon JUNG[1]

[1] *Port and harbor, Coastal Simulation Technology Inc., Korea*
[2] *Department of Land, Water, and Environment Research, Korea Institute of Civil Engineering and Building Technology, Korea*

A silt curtain is a flexible ocean structure and is applied to control the diffusion of suspended sediment and pollution materials in the whole world. The silt curtain is the only way to control the diffusion of suspended sediment and pollution materials at most construction fields around ocean in Republic of Korea. But this flexible ocean structure has the limitation to install and to maintain in rough ocean physical condition due to wave, tidal current, and wind. In this study, limitations of installation range of silt curtain in countries, where has the rule of installation guides of silt curtain, were reviewed for making a decision about available installation of silt curtain. Also, designing methods of silt curtain was reviewed. The applied designing methods in this study was studied in 'Research to increase the effectiveness of silt curtain (2018)'. To check the designing methods, various wave, tidal current, and wind conditions was applied to designing methods. When tidal current and wave height is over specific wave height and the speed of tidal current, no more installation of silt curtain was available to use based on the result of this study. Based on the result, the installation ranges of silt curtain due to ocean physical conditions in Republic of Korea is required for safety and protecting ocean environment around coastal area.

Keyword : Silt curtain, Flexible ocean structure, Ocean physical condition

Corresponding Author. : **Sukzun YOUN** (newl74@hanmail.net)

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Improvements in unconfined compressive strength of kaolinite due to controlled-pH fluorogypsum and quicklime

Junbong JANG[1], Jungyeon JANG[2], Jongwon JUNG*[3]

[1] *Department of Civil Engineering, Dong-A University, Korea*
[2] *Department of Civil and Environmental Engineering, Texas A&M University, USA*
[3] *School of Civil Engineering, Chungbuk National University, Korea*

Coastal areas have weak, soft ground, which is inappropriate for coastal constructions such as ports. We need to modify the soft ground, which contains clays, using soil improvement techniques. One of the ways is to inject soil-binders that can enhance the soil strength. We can find the binders from industrial wastes instead of commercial products such as cements and limes to reduce construction costs and environmental disturbance. Reusing industrial wastes would mitigate environmental pollutes and cost of waste managements. Construction materials such as sands and cements can be replaced with industrial wastes if the wastes are granular and induce cementation effects. The cementation effects are applied to enhance the strength of construction materials. Fluorogypsum, a byproduct in the process of hydrofluoric acid, satisfies the conditions. It is capable to bind granular materials and produced approximately 90,000 metric tons annually in the United States. However, no data is available in mechanical strength of clay-fluorogypsum mixtures. For use of the fluorogypsum as a binder, we conducted unconfined compressive strength tests to show mechanical behavior of kaolinite, which represents a clay in soft ground, at different contents with fluorogypsum and quicklime. The effects of fluorogypsum in the compressive strength of kaolinite-flurogypsum-quicklime mixtures depend on the curing time and the weight ratios of raw materials. The composition of the mixture for highest compressive strength was at 30% fluorogypsum, 5% lime and 65% kaolinite. We infer that the chemical reactions for cementation control changes in the weight ratios of the mixtures of the greatest compressive strength at different quicklime contents based on the series of compressive tests.

Keyword : Fluorogypsum, Soft ground improvement, Clay

Corresponding Author. : **Jongwon JUNG** (jjung@chungbuk.ac.kr)

P106

Study on the test wave condition for the coastal and harbor experiments

IL RO BAE[1], YOUNG TAEK KIM[2], JONG IN LEE*[3]

[1] *Experimental Center for Coastal and Harbor Engineering, Chonnam National University, Korea*
[2] *Department of Land, Water and Environment Research, Korea Institute of Civil Engineering and Building Technology , Korea*
[3] *Department of Architecture and Civil Engineering, Chonnam National University, Korea*

Numerical modeling and hydraulic experiments are representative methods for solving problems in the port and coastal structures. Numerical models have evolved remarkably in terms of analytical techniques and computational capabilities in complex domains, along with computer performance. Also, hydraulic model experiments have been improved, such as the development of wave generators and advanced measuring equipment.
The hydraulic experiments have the advantage that it can be observed more intuitively than numerical modelings such as structure and amour stability and hydraulic characteristics. However, different experimental results can be drawn depending on the scale of the facility or the experimenter. This may be one of the reasons for lowering the reliability of the experimental results. In this study, two-dimensional hydraulic experiments were performed to propose the decision guidance of test wave conditions, which is the most basic and important factor for hydraulic model experiments. In the experiments, the occurrence of wave breaking and the effects of measurement location and wave duration were considered to propose the test wave generation's decision guidance.
Capacitance-type wave gages were used to measure the water surface elevation with the sampling rate of 100 Hz. Incident/reflected wave separation analysis was performed based on Goda and Suzuki (1976).
The experimental results showed that the target wave condition varies with the cross-shore location of the wave gages in breaking wave conditions and the wave generation duration. Through this study, we suggest that waves should be generated more than 200 waves, and the test wave spectrum as an input of the wave generator should be decided in a non-breaking region for statistical reliability.
It is expected that the proposed guidance to decide the test wave condition established through this study will contribute to enhancing the reliability of the hydraulic experimental results in the port and coastal engineering.

Keyword : Hydraulic experiment, Wave condition, Wave flume

Corresponding Author. : **JONG IN LEE** (jilee@jnu.ac.kr)

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Changes in power generation at Sihwa Lake Tidal Power Plant with the installation of submerged breakwaters

Tae Woo KIM, Jong Sung YOON, Yeon Joong KIM*

Inje University, Civil and Urban Engineering, Korea

Tidal power generation uses potential energy generated by vertical movements of the sea level to run a hydro turbine to produce electricity; thus, it is suitable for areas with large differences between t idal waves. The Sihwa Lake Tidal Power Plant situated on the west coast of South Korea is located at the center of the 11.2 -km-long Sihwa Seawall. It generates power by using the increased water level in the outer region during ebb, and it discharges the seawater inflow caused by power generation during flood.
In this study, the EFDC(Environmental Fluid Dynamics Code) model, which can reproduce the operation patterns of the Sihwa sluice gate and considers permeable structures, was applied to predict the ef fect of changes in seawater flow resulting from the installation of impact reduction facilities on the nearby offshore of the Sihwa Lake Tidal Power Plant.
To calculate the amount of power generated using a numerical model, a year -long daily operation record of the tidal power plant in 2013 was analyzed and used as input conditions (sluice gate operation, runoff) of the numerical model. In addition, a relational expression was derived using the data —inner/outer water-level difference (ΔH), hydro turbine wat er flowrate (Q), and power generated (W)—and the power output was calculated using the inflow rate calculated by the numerical model.

Keyword : Sihwa Lake Tidal Power Plant, Submerged breakwaters, EFDC Model

Corresponding Author:Yeon Joong KIM(anyseason@inje.ac.kr)

P108

Reflection of irregular waves from perforated-wall structures when the chamber is filled with rock

Young-Taek KIM[1], Jong-In LEE[*2]

[1] *Department of Land, Water and Environment Research, Korea Institute of Civil Engineering and Building Technology, Korea*
[2] *Department of Civil Engineering, Chonnam National University, Korea*

In general, the perforated-walls were designed and applied to the vertical structures in order to improve the hydraulic characteristics. The perforated-wall could reduce the wave reflection, wave pressure and wave overtopping comparing with the simple vertical wall.
The perforated-wall was normally applied to the quay walls to reduce the reflected waves and the chamber of perforated-wall was generally designed empty, that is, the chambers were filled with the only sea water. However the perforated-wall was could be designed to the breakwaters. The breakwater that was constructed against the high waves should be satisfied with the safety. The total weight of structures should be heavy enough to satisfy the wave forces. The chamber of perforated-wall was filled with rock armor to increase the total weight of structures. In this study, the reflection from perforated-wall was investigated with the hydraulic model experiments. The perforated-wall had the shape of vertical slits. The number of chambers and the size of the rock was changed to investigate the effects of them to the reflection from perforated wall.

Keyword : Perforated wall, Wave reflection, Rock

Corresponding Author. : **Jong-In LEE** (jilee@chonnam.ac.kr)

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Exploring the combined risk of sea level rise and storm surges using a Bayesian network model: Application to Saemangeum seawall

Min-Kyu JUNG[1], Baeg LEE[2], Hyun-Han KWON[*1]

[1] *Civil and Environmental Engineering Department, Sejong University, Korea*
[2] *Rural Community & Infrastructure Research Group, Rural Research Institute, Korea Rural Community Corporation, Korea*

In terms of natural hazards, typhoon-induced storm surge along with heavy rainfall has been recognized as the most frequently reported hazard among water-related disasters at the coastal areas in South Korea. Moreover, it has been widely acknowledged that the frequency and intensity of typhoons (or abnormal low-pressure system) are likely to increase over time due to the potential impact of climate change. In these contexts, a risk analysis covering different loading conditions has been a tool for flood risk management. We propose a Bayesian network based generic risk analysis tool for flood defense systems such as a levee, dike, and seawall. On the other hand, this study explores various failure modes of flood defense structures for the use of risk analysis. In our study, three different loading conditions such as wave loading, lateral flow, and water level difference are mainly considered, and a set of limit state equations for the failure modes are introduced. The proposed modeling framework is applied to Saemangeum seawall in South Korea. Based on the review, various failure modes for Saemangeum seawall was identified, and the failure modes are then translated into nodes in the Bayesian network framework. The failure probabilities of each node were estimated quantitatively by integrating limit state equations which are composed of a set of random variables. Moreover, we investigated an integrated Bayesian network model to estimate overtopping risk from sea level rise informed by climate change scenarios. A further discussion on the role of the uncertainty for overall risk is provided.

Acknowledgement:
This work is supported by the Rural Research Institute, Korea Rural Community Corporation(KRC) through Research of Risk Assessment for Saemanguem Sea Dike, funded by the Korea Ministry of Agriculture, Food and Rural Affairs

Keyword : Risk analysis, Flood defence structure, Bayesian network

Corresponding Author. : **Hyun-Han KWON** (hkwon@sejong.ac.kr)

P110

An integrated risk assessment for Saemangeum seawall using a Bayesian network model

Min-Kyu JUNG[1], Baeg LEE[2], Hyun-Han KWON[*1]

[1] *Civil and Environmental Engineering Department, Sejong University, Korea*
[2] *Rural Community & Infrastructure Research Group, Rural Research Institute, Korea Rural Community Corporation, Korea*

A seawall is a representative coastal structure to protect the coasts and residential shorelines from wave action. It has been widely acknowledged that the risk of structures is likely to increase due to rising sea levels and increased in typhoon frequency and intensity under climate change. A recent increase in climate variability is causing damage to Saemangeum seawall, and risk analysis is required to reflect the changes in climate variability and internal characteristics of the seawall. This study aims to develop a novel approach for assessing the impact of compounding risk associated with internal erosion of the seawall and sea-level rise in a changing climate. In these contexts, A Bayesian Network (BN) model is introduced and constructed to explore the changes in risk with a set of variables needed to understand the failure mechanisms under different climate change scenarios. The proposed BN model can offer an integrated way to consider the spatio-temporal dependence between internal erosion factors as well as the dependence between changes in wave action and coastal interactions to generate a set of potential failure scenarios. The results obtained here are expected to not only provide a comprehensive way to alleviate risk (e.g., damage cost) but also facilitate to determine investment priority. A simulation model is demonstrated with an example of Saemanguem seawall within a fully Bayesian modeling framework.

Acknowledgement:
This work is supported by the Rural Research Institute, Korea Rural Community Corporation(KRC) through Research of Risk Assessment for Saemanguem Sea Dike, funded by the Korea Ministry of Agriculture, Food and Rural Affairs

Keyword : Seawall, Bayesian network, Risk assessment

Corresponding Author. : **Hyun-Han KWON** (hkwon@sejong.ac.kr)

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Development of Caisson-Type of Submerged Breakwater for Reducing Mean Water Level behind Structure

Dong-Soo HUR[3], Woo-Dong LEE[3], Sang-Yeop LEE[2], Yeon-Myeong JEONG[*1]

[1] *Institute of Marine Industry, Gyeongsang National University, Korea*
[2] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[3] *Disaster Information Research Division, National Disaster Management Research Institute, Korea*

To reduce coastal erosion and protect coastlines, submerged breakwaters are installed in the target coastal area, which reduce the wave energy by breaking the incoming waves at the submerged floor. However, the rise in the water level behind submerged breakwaters due to wave breaking generates a strong flow in the openings between the submerged breakwaters. This eventually undermines their original function and affects the stability of the submerged breakwaters. Therefore, in this study, hydraulic model experiments were performed for four types of cross sections depending on the presence or absence of pipeline of caisson-type submerged breakwaters, in which slit-upper pipeline and slit-lower pipeline are installed to lower the water level behind the submerged breakwaters. Additionally, based on the measured water level data, we compared the changes in the average water level behind the submerged breakers for cases with or without pipeline with a solid caisson that has no slit-upper and slit-lower pipelines. Hence, in submerged breakwaters with a slit-upper pipeline, the rear water level was reduced by 52.5% compared to that with solid caisson, and it was reduced by 43.4% and 64.2%, in the case of lower pipeline and the combined case, respectively. Therefore, lowering of water level behind the submerged breakwaters is better using the slit-lower pipeline than with the slit-upper pipeline. Moreover, its effect is excellent when both are used. The caisson-type submerged breakwater proposed herein was found to be effective in reducing the rear water level and the flow in the openings, thereby securing the stability of the submerged breakwaters.

Keyword : Caisson-Type, Mean water level, Submerged breakwater

Corresponding Author. : **Yeon-Myeong JEONG** (jym3803@gmail.com)

P112

Yawing Behavior Analysis of Large Ocean Observation Buoy with Vane based on Wave Flume Experiments

Jae-Seol SHIM[1], Dongha KIM[*1], SeungHwan JIN[1], Jeseon YOO[1], Seonjeong KIM[1], Insik CHUN[2]

[1] *Marine Disaster Research Center, Korea Institute of Ocean Science and Technology, Korea*
[2] *Department of Civil Engineering, Konkuk University, Korea*

Recently, a new large ocean observation buoy (LOOB) is required from various marine data demands. In addition, the new LOOB is equipped with a function to measure the water layer while sending observation equipment such as a CTD along a separate cable. Thus, in this LOOB, cables for observation equipment and mooring lines should not be twisted. In other words, LOOB should not rotate about the z-axis (yawing) while the observation equipment is reciprocating the cable. To do this, the vane was attached to the hull of a LOOB to control the behavior. In this study, the relationship between the vane length attached to the hull and the z-axis rotational motion of the LOOB was analyzed through wave flume experiments. The experiments were carried out in a 2-dimension wave flume with a 1:20 scale, and the vane length scenarios were no-vane, 0, 4, 8, and 10cm, and JONSWAP irregular waves, and current velocities are 0, 5, and 9cm/s. The vane length refers to the length of the portion protruding out of the LOOB when viewed from the z-axis. In the case of no-vane, the yawing angular velocity was ±20 dps (degree per second) after waves incident. On the other hand, when the vane was attached, it was about ±10 dps. The correlation between vane length and yawing angular velocity was difficult to find. In other words, in all cases where vanes are attached, they represent similar behavior based on yawing rotation. In conclusion, when the vane is attached on the LOOB hull, it is possible to control the yawing behavior in the current and waves environment, and vane length size of 0cm is sufficient. On the contrary, if the vane protrudes out of the diameter of the LOOB, it may cause fatal damage to the small boat approaching the LOOB.

Keyword : Yawing behavior, Large ocean observation buoy, Wave flume experiment

Corresponding Author. : **Dongha KIM** (kimdh@kiost.ac.kr)

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A study of applicability in repairing the pore inside breakwater corresponding initial temperature of inflow sand mastic

Hyo Jun JUNG[1], Sung lyn YANG[2], Seung Yeon LEE[1], Seung Oh LEE[*1]

[1] *Civil engineering, Hongik Univ., Korea*
[2] *Future Infrastructure Research Center, Korea Institute of Civil Engineering and Building Technology, Korea*

Due to the occurrence of coastal erosion, an empty space inside a breakwater is created, and mortar is generally used to refill the empty space. However, mortar leaks to the sea by waves and ocean currents during the curing, which is potentially fatal to marine life. In order to compensate for this shortcoming, the sand mastic(SM) method, which can be quickly solidified to control the environmental issues, is emerging as an alternative. In this study, the behavior of the SM is reviewed through FLOW-3D, a three-dimensional numerical model, and its applicability is examined. There is a built-in function in the model to alter viscosity according to simulated temperature which is used to characterize SM behaviors of varying viscosity with temperature and solidified upon reaching a certain temperature. A previous study on an experiment is used to establish the relationship between SM's viscosity and sea water temperature. It is assumed that SM of 100 L is applied at varying temperature from 50℃ to 200℃ with an interval of 10℃ to test SM's behaviors of spreading to a cone shape once it's poured. Its performance is measured using spreading diameter and used for most effective applying temperature. In general when high temperature SM comes into contact with sea water, it potentially causes difficulties in the construction process such as space visibility due to steam generated and flow reflux back to its outlet. Therefore the lowest temperature that reaches required diameter to cover the pore at the cone bottom is assumed to be more efficient and effective application temperature. Numerical results has been analyzed to develop a relationship between the required diameter and initial SM temperature. it can be useful to standardize its application process.

Keyword : Sand mastic, FLOW-3D, Temperature dependence of viscosity

Corresponding Author. : **Seung Oh LEE** (seungoh.lee@hongik.ac.kr)

P114

A Study on Divergent Vibration of a Circular Cylinder in the Flow-Induced Vibration Characteristics Occurred when the Control Cylinder Exists at Rear the Circular Cylinder Approximately

Sang-Il KIM[1], Dong-Seob SONG[2], Bo-Kyu KWON*[3]

[1] *Department of Mechanical engineering, Kangwon national university, Korea*
[2] *Department of Earth and Environmental Engineering, Kangwon national university, Korea*
[3] *Division of Electrical, Control & Instrumentation Engineering, Kangwon national university, Korea*

Since many components of coastal and offshore plants contain elements with cylindrical shape such as stacks and pipelines, many researches with the vibration of circular cylinder have been carried out in the coastal engineering field. It is therefore necessary to study on divergent vibration of circular cylinder in the flow-induced vibration characteristics. This paper presents experimental investigation of the divergent vibration in the flow-induced vibration characteristics of a circular cylinder when the control cylinder is located behind the test cylinder approximately having half diameter of test cylinder. Concretely, the characteristics of flow-induced vibration of the test cylinder and the characteristics of wake flow of the test cylinder are investigated with changing position of control cylinder and velocity of main stream. As a result, we have concluded as followings; i) divergent vibrations are divided into three patterns based on the vibration amplitude characteristics when the control cylinder is existed behind the test cylinder approximately. ii) divergent vibrations are divided into three patterns based on the velocity that flow-induced vibration is generated on the test cylinder. The position of control cylinder with three vibration patterns is closely associated with vortex efflux frequency from the test cylinder. But this regime that three vibration patterns are happened is not same to the aforementioned regime of three vibration patterns. iii) Through the investigation of the hysteresis phenomenon, it is clarified that one of the causes of the divergent vibration of test cylinder is vibration inertia.

Keyword : Coastal plants , Flow-Induced vibration, Circular cylinder

Corresponding Author. : **Bo-Kyu KWON** (bkkwon@kangwon.ac.kr)

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Characteristics of seawater intrusion in coastal aquifers due to seawater flooding

Yeong Han JEONG[1], Dong Soo HUR[2], Sang Yeop LEE[1, 3], Woo Dong LEE[*2, 4]

[1] *Disaster Information Research Division, National Disaster Management Research Institute, Korea*
[2] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*

Dense seawater penetrates into coastal aquifers and forms wedge-shaped intrusions under freshwater. However, in a flood caused by storm surges and tsunamis, the dense seawater on the surface penetrates deep into the earth. Little is known about such characteristics of seawater penetration in coastal aquifers. This study simulates seawater intrusion by seawater flooding using the Navier?Stokes (N-S) solver based on the porous body model (PBM). The flow of seawater penetrating the upper part of a coastal aquifer was analyzed using the results of numerical analysis. When the difference between the sea and ground levels was small, the seawater from the upper and lower layers converged. However, when the difference between the sea and ground levels was large, the seawater that penetrated into the upper part was released into the sea.

Keyword : Seawater intrusion, Coastal aquifer, Porous body model

Corresponding Author. : **Woo Dong LEE** (leewoodong@gmai.com)

P116

PIV and BIV measurements of roller in hydraulic jumps

Moonhyung PARK[2], **Hyung Suk KIM**[*1], Seohye CHOI[2], Yonguk RYU[3]

[1] *Department of Civil Engineering, Kunsan National University, Korea*
[2] *Department of Land, Water Environment Research, Korea Institute of Civil Engineering and Building Technology, Korea*
[3] *Department of Civil Engineering, Chonnam National University, Korea*

For engineering and scientific aspects, study on hydraulic jumps has been sustained over last several decades in coastal areas and open channels. The roller in hydraulic jumps is caused by breaking wave and tidal bore in the coastal zone. In particular, the tidal bore is a phenomenon that the water flow from the river into the ocean reverses due to pushing water toward the river. Vortex flows occur at the frontal face of the tidal bore because of reverse flows of the river. Such phenomenon is similar to a hydraulic jump downstream of the river-crossing hydraulic structure. That induces high turbulent flow and energy dissipation, which can result in the oscillation on the bed. Even though the understanding of turbulent flow fields is essential for the design of the coastal zone, they have been not considered so far.
This study carried out an experimental investigation on turbulent velocity fields of the hydraulic jump roller using an image technique with particle image velocimetry and bubble image velocimetry. Four aerated hydraulic jumps varying downstream water levels and Froude numbers of 7.3 and 8.6 were tested. The measured mean and turbulence statics were obtained by ensemble averaging the instantaneous velocity measurements. In addition, water surface profiles in both aerated and non- aerated regions were acquired using the image technique. It was observed that the maximum horizontal and vertical turbulence intensities occurred near the toe of hydraulic jumps and they showed a decrease with horizontal distance. However, the water surface fluctuation along the hydraulic jump tended to converge to a specific value less than 10 mm.

Keyword : Hydraulic jump, Image technique, Turbulence

Corresponding Author. : **Hyung Suk KIM** (hskim0824@kunsan.ac.kr)

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Development of a technique to predict the mean water level rise behind the low-crested coastal structure

Won-Chul CHO*[2], **Ki-Jae LEE**[1], Dal Soo LEE[1]

[1] *HYEIN E&C Co., Ltd., Korea*
[2] *Dept. of Civil and Environmental Engineering, Chung-Ang University, Korea*

Recently, breakwater, jetty, and detached breakwater have been installed to reduce beach erosion and damages of coastal area due to weather and wave climate changes. Among these coastal structures, the detached breakwater is installed with low crest and allow large overflow, which increases mean water level behind the structure and subsequently influences structure stability.
The mean water level rise behind the low-crested coastal structure is determined by wave conditions, water depth, structure shape, etc. Because the mean water level rise behind the structure affects the overflow, wave run-up, wave pressure, and structure stability, it is important to accurately predict the mean water level rise behind the structure at the design stage of the low-crested coastal structure.
In this study, we suggested a technique determining the mean water level rise behind the low-crested coastal structure and provided its application to the field site. In order to estimate the mean water level rise behind the low-crested coastal structure, we applied a hybrid technique that combined the results of two-dimensional hydraulic model tests and hydrodynamic numerical simulations based on the relationship between the mean water level behind the structure and discharge moving offshore at the end of the structure. Using this technique, the mean water level rise and flow field can be obtained almost at the same time. In addition, this technique can provide the outflow velocity moving offshore at the end of the structure, which is useful in selecting appropriate planar configuration of the low-crested coastal structure.

Keyword : Low-Crested structure, Water level rise, Outflow velocity

Corresponding Author. : **Won-Chul CHO** (chowc@cau.ac.kr)

P118

Assessment of the Degree of Contamination in Marine Sediments in Cheonsu-Bay, West Coast of Korea

Jong-Joo YOON*, Young-Kwan YOON, LEE SANG-WOO

Climate Change Research Center, ChungNam Institute, Korea

Eutrophication-related items for heavy metals and persistent toxic substances were measured to calculate the contamination-cleanup index in Marine sediments of Cheonsu-Bay, West coast of Korea. Cheonsu-Bay area is one of Korea's leading fisheries production sites on the west coast. Four large estuary lakes made by reclamation are located in Cheonsu-Bay. Samples were taken to a depth of 1m using gravity core. Marine sediment pollution purification purify index of eutrophication index (EI index) was calculated as three items of eutrophication-related COD, AVS, IL, purification of hazardous chemicals, to restore index (CI index) heavy metals and persistent toxic substances 8 big-items, 21 detail-items (polycyclic aromatic hydrocarbons: PAHs 16 items) was calculated by the analysis.
EI index in the sea of Cheonsuman Bay showed up to 7, and CI index was analyzed to be less than 1. Items on the highest impact on the EI index is COD and IL, CI index was analyzed that the biggest impact of the heavy metals of Cu. In Cheonsu-Bay, eutrophication pollution is more serious than hazardous chemicals. Investigation by vertical layer of contaminants in Cheonsu-Bay showed an eutrophication content of up to 60cm depth. An analysis of C/N ratio shows that the origin of organic matter in sediments originated from land(estuary lake). In addition to the high temperature phenomenon in summer, hypoxic conditions due to deterioration of water quality are occurring at the same time around this research site, which adversely affects the surrounding areas. It was analyzed that the water quality of the estuary lake located in Cheonsu-Bay needs to be improved, along with dredging and other cleanup efforts for some polluted bottom sediment.

Keyword : Marine Sediments Contamination, Cheonsu-Bay, Estuary eco-System restoration

Corresponding Author. : **Jong-Joo YOON** (jjyoon@cni.re.kr)

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Characteristics of Wind Distribution in the Doyo-deung Barrier Islands off the Coast of the Nakdong River Estuary based on Marine Environmental Information System–Automatic Weather Station Data, Busan, South Korea

Jun-Ho LEE, Han Jun WOO, Hoi-Soo JUNG, Ha Neul PARK, Eui-Yong JEONG, Joo Bong JEONG*

Korean Seas Geosystem Research Unit, Korea Institute of Ocean Science & Technology, Korea

In this study, we developed a Nakdong-marine environmental information system (N-MEIS) using automatic weather station (AWS) data to elucidate the characteristics of wind distribution and land/sea breezes in the Doyo-deung barrier islands located in the brackish water zone off the coast of the Nakdong River Estuary (NRE), Busan, South Korea. From May 2015 to the present day, the N-MEIS was run in real-time with sampling intervals of 10 second using long-term evolution communication, anoperation rate of approximately 98% in AWS, and periodic marine observations recorded 1–4 times per year. From April 2016 to October 2019, the average annual wind speed in the Doyo-deung barrier islands was 3.8 m/s (range, 2.11–5.1 m/s) and the maximum wind speed, recorded in February 2019, was 46.8 m/s. These values are usually influenced by low-pressure blasts or instantaneous wind speed. However, the maximum monthly mean velocity is also influenced by typhoons occurring in early autumn from August to September. Based on the percentages of wind directions recorded, the prevailing winds blow in ESE'ly and SSW'ly directions. The distribution of wind directions in summer was similar to that in spring, and the distribution in autumn tended to be similar to that in winter. The mean wind velocities at Yeongdo and Gadeokdo islands approximately 9–12 km west, were two times higher than those at Haeundae beach approximately over 20 km east of the study area. Research on the dynamic wind distribution is necessary tomanage erosion and sedimentation around the barrier islands, beach pollution from floating materials transported overland, coastal sand dune activity, changes in migratory bird habitats, and impacts on ecosystem health more effectively. The evolution and developments of the N-MEIS facilitates this process understand. Further studies should integrate real-time/periodic marine observations and predictions with environmental sensitivity index (ESI) maps.

Keyword : Marine environmental information system, Nakdong river estuary, Wind distribution

Corresponding Author. : **Joo Bong JEONG** (jjbongeo@kisot.ac.kr)

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Field Application of SSC Monitoring System Using Image Analysis of UAV

Seung-Bae CHOI, Gyu-Seok HAN, Dong-Ho KIM, Tai-Gyun KIM, Sun-Sin KIM*

Affiliated Research Institute, Hydrobot tech & research, Korea

The suspended sediments flowing into rivers or oceans can be water quality and ecological problems. Therefore, monitoring of suspended sediment concentration (SSC) is a highly important factor that may play a key role in environmental quality assessment and help to evaluate the extent of potential adverse. Monitoring with optical sensors that can provide a continuous time series of SSC has been widely used in many marine and estuarine studies. However, the main disadvantage of this monitoring is that it is difficult to determine the spatial distribution of the SSC: since it requires a large number of sensors to be deployed. In this study, a new technique of monitoring SSC based on the unmanned aerial vehicle (UAV) was developed to improve the problem. This technique converts the pixel intensity of a video image measured from a UAV into SSC and visualizes the spatial and temporal distribution of SSC in the surface waters. The pixels of the orthoimage acquired from the UAV was visualized as a 2D color map through image processing technology. At the same time, real-time buoys equipped with a turbidity sensor for calibrating the pixel intensity of a video image were evenly placed on the testbed. The correlation analysis between the pixel intensity and the SSC showed a relatively strong positive linear correlation (R-squares: 0.84). As a result, the spatial and temporal changes in the SSC at the site were calculated and visualized. In addition, the diffusion range and diffusion rate were quantitatively estimated from the results of the SSC. The wide application of new monitoring technologies for SSC is expected to contribute to the river, the sea, and estuary observations.

Keyword : SSC, 2D Visualize of SSC, Diffusion Monitoring of SSC

Corresponding Author. : **Sun-Sin KIM** (enter1122@hanmail.net)

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Tidal creek mapping from airborne LiDAR data using multi-resolution cloth simulation filtering

Hyejin KIM[1], Jaebin LEE[*2], Yongil KIM[3]

[1] *Institute of Engineering Research, Seoul National University, Korea*
[2] *Department of Civil Engineering, Mokpo National University, Korea*
[3] *Department of Civil and Environmental Engineering, Seoul National University, Korea*

For the conservation and restoration of tidal flats, which play a variety of economic, ecological, and environmental roles, it is essential to monitor their topographic changes. Tidal creeks are transitional waterways promoting evolution and expansion of tidal flats. Delineating tidal creeks precisely and objectively is critical to monitor characteristics, formation, and evolution of tidal flats. Airborne light detection and ranging (LiDAR) data is the most widely used to extract tidal topography because it can acquire precise terrain information over a wide area. However, existing tidal creek extraction methods using airborne LiDAR data have limitations such as excessive user intervention and lack of adaptability to various shapes and widths of tidal creeks. Tidal creeks' morphological irregularity, complexity, and diverse widths (from a few centimeters to several kilometers) make it difficult to extract them automatically or even manually. This study aims to propose an effective and practical mapping method of tidal creeks with a range of sizes and shapes. We adopted and modified cloth simulation filtering (CSF), one of the verified ground filtering techniques that filter off-ground objects from point cloud data in land LiDAR surveys. The proposed multi-resolution CSF can extract very wide tidal creeks without compromising the details of the narrow creeks, by sequentially filtering creek points with increasing grid resolution of simulated cloth. The sequential filtering uses local thresholds calculated using the creek points extracted in the previous filtering and does not require empirical parameter adjustment. An experimental evaluation using airborne LiDAR data collected on the west coast of South Korea indicated that the accuracy of the proposed method was Kappa > 0.8 and superior to that of the results with the user parameter. Lastly, we calculated the depth of the extracted tidal creeks and generated a tidal creek map.

Keyword : Tidal creek mapping, Multi-Resolution filtering, Airborne LiDAR data

Corresponding Author. : **Jaebin LEE** (lee2009@mokpo.ac.kr)

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Intensive Monitoring for Establishing Measures to Prevent Erosion in Gyeokpo Beach

Sun-Sin KIM[1], Seung-Chul SEO[1], Yun-Woong CHOI[2], Jae-Hyuk HYUN[1], Hong-Ryul RYU[*1]

[1] *Affiliated Research Institute, Hydrobot Tech & Research , Korea*
[2] *Dept. of Civil Engineering, Chosun College of Science & Technology, Korea*

Recently, damages to coastal areas such as beach erosion have increased rapidly due to rising sea levels, increased typhoon strength, and construction of artificial structures on the coastal. This study area, Gyeokpo beach is a representative tourist destination of Jeonbuk in Korea. Recently, it was reported that the vertical wall and commercial structure might collapse due to local scour at the beach hinterland. In this study, intensive monitoring was performed from May 2018 to April 2019 to identify the phenomenon occurring and cause of erosion in the Gyeokpo beach. The monitoring items included oceanographic surveys (wave, current, hydrographic survey, etc.) and video monitoring (variation of beach area). As a result of the investigation, the erosion mechanism of Gyeokpo beach were largely divided into three categories: 1) When high waves are generated during high tide, the reflection waves by the vertical walls increase, resulting in scour and beach erosion; 2) the longshore current was blocked by the commercial structure protruding from the center of the hinterland, indicating that the amount of sand on the north side was insufficient; 3) fine sand particles cannot be returned due to the wall after moving over the hinterland by wind, resulting in beach erosion. In conclusion, through intensive monitoring, it was found that the main cause of erosion in the Gyeokpo beach is an artificial structure built on the hinterland. In addition, it is considered that long-term continuous monitoring is necessary to establishing measures to effectively prevent erosion.

Keyword : Beach erosion, Coastal monitoring, Gyeokpo beach

Corresponding Author. : **Hong-Ryul RYU** (ryu1543@gamail.com)

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Measurement of Erosional Parameters using ASERA, Automated Sediment Erosion Rate Apparatus

Dong-Ho KIM[1], Hong-Ryul RYU[1], Su-Hyun YANG[2], Kyu-Nam HWANG[*2]

[1] *Affiliated Research Institute, Hydrobot Tech & Research, Korea*
[2] *Dept. of Civil Engineering, Jeonbuk National University, Korea*

The stability of tidal flats along the west coast of Korea is a matter of national interest due to their significant role as protectors of the shoreline against erosion by storm surge and waves. Depending on the location of these flats the material ranges from gravel to clay, and flat stability against currents and waves is highly sensitive to material properties. Stability related parameters of immediate interest are the critical shear stress and the sediment load for coarse particles and the shear strength against erosion as well as erosion flux for cohesive sediment. Since in situ determination of these parameters is cumbersome during storm events, it is customary to collect cores of the top layer and analyze them in the laboratory under simulated severe flows. To that end, in recent years the Automated Sediment Erosion Rate Apparatus (ASERA) has been developed. The apparatus consists of a rectangular duct through which water erodes the surface of the bed extruded from a practically undisturbed core at a controlled rate. Also, it is equipped with a laser system along with a high-quality CCD camera for accuracy and consistency in the detection and tracking of the eroding bed. In this study, the ASERA has been evaluated on a preliminary basis through a series of tests to verify its effectiveness with coarse and cohesive sediments. Fifteen coarse sediments ranging from very-fine gravel to very-fine sand were used to determine the critical shear stress and the sediment load. For cohesive sediment the bed shear strength and the erosion flux of uniform density bed of commercial clays were measured. The results for both types of sediment yielded values consistent with available data and formulas, and indicate that ASERA has a promising potential for the characterizing mudflat sediments.

Keyword : Critical shear stress , Sediment load , ASERA

Corresponding Author. : **Kyu-Nam HWANG** (khwag@jbnu.ac.kr)

P124

EOF Analysis for Wind-Driven Cross-Shelf Exchange around a Sandbank in Inner Continental Shelf

Hong-Ryul RYU[1], Sun-Sin KIM[1], Dong-Ho KIM[1], Won-Seok JANG[1], Seung-Oh LEE[*2]

[1] *Affiliated Research Institute, Hydrobot tech & research, Korea*
[2] *School of Urban and Civil Engineering, Hongik University, Korea*

Since the inner-shelf is an important zone located between the surf-zone and the continental shelf in terms of the heat exchange, the transport of terrigenous sediment, and so on, it is essential to understand the shelf circulation dynamics. In this study, from the combined results of current velocity profiles measured by the moored ADCP and wind observations obtained by KMA(Korea Meteorological Administration) over the Daesan inner-shelf located in Yellow Sea, Korea we found that the inner-shelf circulation was mainly driven by a combination of wind stress, pressure gradient, Coriolis force and submarine topography. Empirical Orthogonal Function (EOF) analyses were used to comprehend the shelf circulation dynamics induced by the wind stress and the wavelet coherence was used to analyze the time-frequency distribution of the coherence between currents reconstructed by EOF method and channel-aligned winds. The thickness of the surface and bottom frictional layers mainly depended on wind forcing and seabed topography. As the results, the subtidal currents were strongly dominated along-channel due to the complex seabed topography such as a sandbank. The vertical structure of the along-channel currents was mostly uniform regardless of water depth. In mode 2 of EOF analysis, it was shown that the cross-channel currents were polarized into two layers. In general, wind in the ocean causes down-welling or up-welling along the direction, but in the study area, variation of wind-induced current and the Ekman layer are not clearly distinguishable. Additionally, it is resulted that the cross-channel exchange caused by the wind was not significant because of complex seabed topography including a sandbank and tidal force even though the Ekman depth was changed by the wind forcing in the Daesan inner-shelf. Finally, as a result of wavelet coherence analysis, the correlation between wind and currents was also insignificant according to channel-aligned U, V directions and water depths.

Keyword : Daesan inner-Shelf, EOF (Empirical Orthogonal Function), Wavelet coherence

Corresponding Author. : **Seung-Oh LEE** (seungoh.lee@hongik.ac.kr)

Poster Sessions

P125

Typhoon-induced vertical mixing and subsequent intrusion of Yangtze fresh waters in the southern Yellow Sea: Observations with an underwater glider and GOCI ocean color imagery

Hak Soo LIM[1] Dongha KIM[1], Hee Jun LEE[2*], Minwoo KIM[3], Seunghwan JIN[1], Travis N. MILES[4] Scott GLENN[4]

[1] *Marine Disaster Research Center, Korea institute of Ocean Science and Technology, Korea*
[2]*Marine Active Fault Research Unit, Korea institute of Ocean Science and Technology, Korea*
[3]*Ocean Circulation and Climate Research, Korea institute of Ocean Science and Technology, Korea*
[4]*Department of Marine and Coastal Sciences, Rutgers University, USA*

Typhoons have been regarded as an important forcing to control oceanographic phenomena, particularly in the Yellow and East China seas. The influences of typhoons have become increasingly severe due to global warming. An autonomous underwater glider was deployed west of Jeju Island for 10 days from 15th to 25th August, 2018 to observe changes in physical environments induced by typhoon Soulik. The glider data show that the stratified water masses were destroyed by the typhoon into a fully mixed stage of the entire 100-m-thick water column. The mixing duration was evaluated at about 12 hours. This de-stratification is manifested by many environmental parameters including temperature, salinity, chlorophyll-a and suspended sediment concentrations. Accordingly, calculated parameters, density and Richardson number, indicate de-stratification. The water column displayed, however, a rapid return to the stratification stage immediately after the Typhoon passage. In addition, the GOCI ocean color imagery was analyzed that were obtained during and after the passage of Soulik between 21-26 August 2018. These satellite images suggest that the discharge of the Yangtze freshwater so increased during the typhoon that the intensified freshwater plume could move toward Jeju Island. As a result, observations with an autonomous glider may provide a promising means to analyzing oceanic processes occurring during the peak of typhoons.

Keyword : Ocean destratification, Typhoon Soulik, Underwater glider

Corresponding Author. : **Hee Jun LEE** (hslim@kiost.ac.kr)

P126

Rip Current monitoring based on photogrammetry using UAV

Bumshick SHIN*

Civil Engineering, Catholic Kwandong University, Korea

In recent years, due to the development of hardware and video image processing, analysis technique and it make it possible to analyze the shoreline change, wave runup, swash, current phenomenon and so on. In order to obtain the information of a large area requires high-resolution imaging at a high position, however, to the recording technique used in the past, there is a limit of height and resolution.
This research investigates the development of wave-induced currents using images processing technology with fixed-wing and Rotary Wing UAV on the East coast of Korea. In this study sediment transport in the major external wave-induced current to the direct observation of advection-diffusion dye to trace a direct approach was adopted, study area on the maritime distress for the sea dye maker.
Using the low-altitude high-resolution image data obtained in order to produce the orthophoto and DSM (Digital Surface Model) can be modelled high-resolution orthophoto and detailed DSM and model body and correction of the picture. After the shooting order of processing is divided into picture elements using an external, GCP matching, photo location optimization step of separating the dye diffusion range and interpretation.
Rip current recorded by UAV when the significant wave height was 1,9m and the period was 6.0sec. The average velocity was 25cm/s. These remote sensing observations provide a more synoptic picture of the rip current flow field and allow the identification of several rip events that were not captured by the in situ sensors and times of alongshore deflection of the rip flow outside the surf zone.
This study was conducted as part of the preliminary research for developing a method that can precisely measure the wave-induced current. These research will contribute to reducing the hazards of swimmers and shoreline changes by prediction and warning of the rip current generation.

Keyword : Rip current, Image processing, UAV

Corresponding Author. : **Bumshick SHIN** (bs.shin@gmail.com)

Assessment of Tropical Cyclones Trajectories and Synoptic Pattern based on Probabilistic Clustering Approach over East Asia

Jae Ung YU, Hyun-Han KWON*

Civil and Environmental Engineering, Sejong University, Korea

The risk posed by extreme events associated with tropical cyclones has been an issue in the coastal areas over South Korea. More frequent tropical cyclones have caused the extensive flood and wind damage in the coastal region during the summer season. Moreover, there is evidence that climate change may lead to an increase in the frequency and intensity of tropical cyclones, and the rapid coastal development can even exacerbate the associated risk. The primary objectives of this study are to categorize the historical tropical cyclones over East Asia and to explore further spatio-temporal evolutions of the synoptic flow patterns associated with the tropical cyclones. In this respect, this study develops a probabilistic clustering model that can classify the historical tropical cyclones in terms of their trajectories and geneses. In this study, we used the best track data provided by the Regional Specialized Meteorological Center (RSMC) from 1951 to 2018 and climate state variables obtained from the NCEP/NCAR Reanalysis data set. The proposed clustering model is based on a finite mixture distribution-based approach to effectively describe the tropical cyclones trajectories. More specifically, a probabilistic curve aligned clustering (PCAC) approach is introduced to categorize the tropical cyclones trajectories with different lengths. It was found that the PCAC model can be an effective way of dealing with a relatively small number of tropical cyclones trajectories and can simultaneously account for the spatio-temporal evolution of the trajectory. Furthermore, we evaluate the performance of the proposed clustering model through a simulation study based on synthetic tropical cyclones trajectories.

Acknowledgement : This work is supported by the Korea Agency for Infrastructure Technology Advancement(KAIA) grant funded by the Ministry of Land, Infrastructure and Transport (Grant 20AWMP-B121100-05).

Keyword : Tropical cyclone, Synoptic flow pattern, Probabilistic clustering

Corresponding Author. : **Hyun-Han KWON** (hkwon@sejong.ac.kr)

P128

Correlation Analysis between Color and Grain Size of Sand using a Colorimeter

Jungmin NAM, Sungjun HONG, Yongjae LEE, Inho KIM*

Dept. of Earth and Environmental Engineering, Kangwon National University, Samcheok, Korea

In order to determine the cause of coastline change, various monitoring items such as wave information, depth change, sea currents, seabed topography change and seabed quality change are required. This study aims to derive a correlation between the sand grain size and the color of sand on coastal erosion in Namae 3-ri~Sodol beach. Therefore, for 5 years from 2013 to 2017, the depth zones of the foam zone, the breaking band, and beyond are divided for each cross-base line (DL(±)0.00m, DL(-)3.00m, DL(-)6.00, respectively) m and DL(-)9.00m), seabed was collected from a total of four vertices, and the median particle size and sand color characteristic values were calculated. As a result, the average median particle size of DL(±)0.00m was 0.793mm, 0.315mm of DL(-)3.00m, 0.277mm of DL(-)6.00m, and median particle size of DL(-)9.00m 0.228mm. In addition, the color of the sand through the colorimeter is represented by L* (white-black), a* (green-red), and b* ((yellow-blue)), and the sand color is expressed as a number to present a unique value. DL(±)0.00m means L* = 61.30915, a* = 6.337094, b* = 18.64009, DL(-)3.00m means L* = 62.44956, a* = 4.615, b* = 16.14032, DL(-) At 6m, L* = 62.2794, a* = 4.525067, b* = 15.9862, and at DL(-)9m, L* = 62.15851, a* = 4.256348, and b* = 15.53418. In addition, the sand color values a* and b* were coordinated, distributed on the beach, and presented with a color range, which was converted to the radius value of polar coordinates (r) and compared with the particle size. In order to compare the a* value and the b* value with the sand particle size again, the radius value, r, is expressed as a first-order function. The R2 of the first order function was 0.9395, which was found to be highly reliable, and the exponential function was analyzed.

Keyword : Colorimeter, Grain size, Sand color

Corresponding Author. : **Inho KIM** (kimih@kangwon.ac.kr)

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Application of Optimal Interpolation with FVCOM in tidally dominated Gyeonggi Bay, South Korea

Bon-Ho GU[1], Seung-Buhm WOO*[1], Sangil KIM[2]

[1] *Oceanography, INHA University, Korea*
[2] *Mathematics, Pusan National University, Korea*

The purpose of this study is to find out the effect of the data assimilation using mooring tidal current observation in macro-tidal estuary such as the Gyeonggi Bay (GGB), South Korea. The tidal current observation for this study is Acoustic Doppler Current Profiler (ADCP) mooring data in the GGB. GGB is located at the Yellow Sea of South Korea, and it is macro-tidal dominated semi-closed estuary that has a tidal range of over 6.8 m. To consider the numerical model including irregular coastline in GGB, we used the Finite Volume Coastal Ocean Model (FVCOM), which has the advantage of using triangular grid flexibility and parallel processing. When applying data assimilation into the coastal model, parameters in data assimilation such as scaling factor and correlation length are adjusted to find optimized with observation. An empirical result with the Taylor diagram showed that influencing factors are different required to be optimized at each location. It means that parameters in the data assimilation depend on the physical dynamic system via complicated geometry such as GGB. Although the optimized parameter in saltwater and the freshwater mixed layer is smaller than others, the effect radius is larger than because of the complex between strong fresh discharge and high tide. Base on this study, we expect the various application of data assimilation research could be possible in the estuary.

Keyword : Tidal current, Data assimilation, Coastal model

Corresponding Author. : **Seung-Buhm WOO** (sbwoo@inha.ac.kr)

P130

Estimation of sediment budgets for integrated coastal erosion management

Yeon-Joong KIM[1], Myong-Kyu KIM[2], Jong-Sung YOON[1], Tae-Woo KIM[*1]

[1] *Department of Civil and Urban Engineering, Inje University, Korea*
[2] *HTI Korea, R&D Center, Korea*

The sediment transport mechanism in coastal areas is complex, and accurate prediction of coastal sediment budgets is a difficult task. Sediment entering and exiting the coast is extremely sensitive to natural and anthropogenic changes in the surroundings. In particular, in coastal areas with rivers nearby, the sediment is also affected by the sediment yield from upstream. However, thus far, the sediment in coastal areas has been managed by measures devised for each different area, such as mountains, dams, rivers, and coasts upstream; hence, mutual feedback has been cut off, making it difficult to identify the exact cause for coastal erosion. In addition, to estimate accurately the sediment budgets in coastal areas, it is necessary to establish a mixed particle size model that can consider the characteristics of the sediment that composes the waters and the sediment emerging from rivers. Therefore, to perform integrated coastal erosion management, it is crucial to estimate sediment budgets following shoreline changes caused by waves and to calculate accurately the amount of sediment based on the identification of the transport mechanism of sediment flowing into the coastal area. In this study, to analyze the transport mechanism of sediment entering coastal areas from the mountains through rivers, a model of sediment yield from mountains to calculate the amount of sediment generated in each area and another model of riverbed change were developed. The amount of sediment transported was estimated. In addition, a one-line model with mixed particle size considering waves and the amount of sediment entering and exiting was established to calculate accurate sediment budgets for coastal areas. It was compared with long-term observations to examine the model verification and measures for coastal erosion management.

Keyword : Coastal erosion, Sediment budget, Mixed particle size

Corresponding Author. : **Tae-Woo KIM** (burningwoo@gmail.com)

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The Numerical Simulation of Rip Current Generation on a macro-tidal beach - Case of Malipo beach, the west coast of Korea

Jong-Joo YOON*

Climate Change Research Center, ChungNam Institute, Korea

Malipo beach is one of the most popular places in the west coast of Korea. Every summer, a million tourists visit Malipo Beach. Recently, it has become famous as a surfing experience site, and many surfers are visiting the country throughout the year. However, the irregular occurrence of rip currents threatens the swimmers during every summer season. There are repeated nearshore accidents every year in which some surfers are swept away by the fast moving rip currents. Such accidents occur even during the season when beach rescue teams are not active, so it is urgent to come up with countermeasures.
To investigate the dominant mechanism of rip currents in this region, a numerical simulation was carried out using the non-hydrostatic model Surface WAves till SHore (SWASH), with observed wave and topographical data. In this study, the applicability of SWASH for modeling the wave transformation and rip current circulation near the shallow foreshore is investigated. Assuming that rip current dynamics are controlled by combination of variations in wave dissipation, tidal currents and morphological flow constriction, we tested the effects of wave parameters, such as wave heights, wave periods, wave directions, and changes in tidal conditions, on rip current generation. Rip currents were simulated when longshore currents flowed out through a channel with very small wave energy in the seaward direction.
The occurrence of rip currents was increased under conditions of higher waves and longer wave periods. In the case of wave direction, we tested cases from NW to SW, and present the spatial characteristics of the simulation results. The locations of rip channels that generate rip current are significantly affected by incident wave conditions and topographic features. We expect that the results of this study will help prevent the repeated rip-current accidents.

Keyword : Rip-Current, Numerical Simulation, SWASH

Corresponding Author. : **Jong-Joo YOON** (jjyoon@cni.re.kr)

P132

Non-linear Kernal Convolutional Neural Network to Find Median Sand Particle Size

Hyoseob KIM[1], **Hojun YOO**[*1], Jung Lyul LEE[2]

[1] *Civil and Environmental Engineering, Kookmin University, Korea*
[3] *Civil Architectural Engineering, Sungkyunkwan University, Korea*

Convolutional Neural Network have successfully been used in various areas. Kim et al`s convolutional neural network with a non-linear kernel is adopted here to obtain the medium sand particle size from gray images. The Non-linear kernal involves a bias and negative square of subtraction between input image pixel numbers and the kernel coefficients and summation. The convolution layer conforms new feature map in convolutional neural network. While using gradient descent method to train relevant coefficients and biases, the gradient of the square of subtraction term appears in the whole gradient over each kernel coefficient.

First, the network was examined on regular-sized sands, i.e. 2000, 1000, 500, 250, 125 and 63 micrometer. The network was trained by using 5 images for each size. It was validated against 2 new images of size 500 and 250 micrometer, and the absolute error was less than 30 micrometer, respectively, which is satisfactory. Second, the network was applied by using 5 images to sands with size distribution. It was trained, and validated against 2 new images of size. It was also well validated and made satisfactory predictions. In the course of study, several numbers of kernels, kernel sizes, pooling sizes were tried and the optimum architecture for this work was chosen.

It is expected that the present network will reduce time and effort in obtaining median sand size in many field projects. The size distribution of sand particles could also be obtained with the present network in the near future.

Keyword : Non-Linear Kernal, CNN, Image-Recognition

Corresponding Author. : **Hojun YOO** (yoohj@geosr.com)

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P133

Asymmetry between accretional advance and erosional retreat of shoreline position in on-offshore direction

Hojun YOO[1], Hyoseob KIM[1*], Jung Lyul LEE[2]

[1] *Civil and Environmental Engineering, Kookmin University, Korea*
[2] *Civil Architectural Engineering, Sungkyunkwan University, Korea*

Episodic shoreline retreat often slowed recovery in low frequency periods (weeks or months). The asymmetry between wave energy rise and collapse is closely related to the asymmetry of shoreline advancement and retreat, but the latter is more pronounced due to the different profile adjustment processes.

Long-term wave time series data and shoreline time series data were analyzed at Wonpyeong beach located on the east coast of Korea. Assume beach, almost parallel and straight, so that the wave direction and the following alongshore sediment transport would not affect the beach profiles of the entire beach center between the North and South Capes. Analyze of the correlation between erosion period and recovery period of wave and average shoreline data during 2016, 2018 of storm event, and Winter of 2020. When waves such as storms into the beach, the shoreline quickly retreated, and in relatively quiet times, the beach slowly recovered to it's original position. Also, the asymmetry of the shoreline position with respect to time is stronger than that of the wave height. A methodology is proposed here, and the envelope rope curve can be used to predict profile and average shoreline changes in the reference section for erosion steps such as storms.

The proposed equation was good agreement for shoreline asymmetry position, and is satisfactory. Empirical formular are slightly different in a relatively calm period, this is an artificial change formed by external pressure conditions such as artificial nourishment. Several variables are used as correction factors. It`s important for future research to propose standardized correction factors and ranges by applying them at various sites. Through this study, it is possible to suggest whether any beach steep slope occurs in a given section.

Keyword : Shoreline position, Wonpyeong beach, Shoreline prediction

Corresponding Author. : **Hyoseob KIM** (hkim@kookmin.ac.kr)

P134

Monsoon-influenced deposition systems in a rhodolith beach on Udo Island, Korea

Joo Bong JEONG[1], Han Jun WOO[1], Hoi-Soo JUNG[1], Ha Neul PARK[1], Tae-Joung KIM[2], Jun-Ho LEE[*1]

[1] *Korea Seas Geosystem Research Unit, Korea Institute of Oceanscience & Technology, Korea*
[2] *Jeju Special Self-Governing Province , Ocean and Fisheries Research Institute, Korea*

The Seogwangri Beach of Udo Island, off Jeju Island, Korea, is formed almost entirely by long-term deposition of rhodoliths, which is an extremely rare sedimentological phenomenon. In 2004, this beach was designated a natural monument with significant geoheritage value. To date, no geological studies have been conducted to explore the sedimentary mechanisms and properties of beach, despite the potential for erosion due to recent development and climate change. Therefore, the objective of this study was to study beach evolution on Udo Island. We examined aerial photographs taken during the past several decades and conducted seasonal beach surveys to determine its sedimentation characteristics.
Geomorphological characteristics of the beach were divided into to the northern (Reef area), with high altitudes and rocky coastlines, and to the southern (Sandy beach), with low altitudes and geomorphology controlled by waves. Gravel is distributed along the coastline, and particle size decreases toward the upper parts of the beach. Sediments in the north increased in size from spring to autumn, approaching the size of coarse sand.
Sedimentary processes exhibited seasonal variation, dominated by erosion in the north and deposition in the south in spring. Also, beach received more sediment deposits in autumn than in any other season. Due to the influence of the East Asian monsoon climate, Udo Island is dominated by typhoons in summer and by tidal currents and winds from the north-northwest in autumn and winter. The beach area of Udo Island increased from 1985 to 2003, and continually decreased thereafter. And during the past three years, beach erosion has accelerated due to a decrease in the volume of sediments on the southern beaches. Topographical causes of sediment erosion are lack of berm area in the south. The results of this study will increase understanding of Rhodolith beach system elsewhere in the world.

Keyword : Rhodolith beach, Morphology variation, Beach processes

Corresponding Author. : **Jun-Ho LEE** (leejh@kiost.ac.kr)

Poster Sessions

P135

Economic Sediment Transport Control with Sediment Flushing Curves for Sea Dike Gate Operation: Case Study - Saemangeum Basin, Korea

HYUNGJU YOO, DONGHYUN KIM, SEUNGOH LEE*

Civil Engineering, Hongik University, Korea

The gates of a sea dike were constructed to prevent the salt-water intrusion and simultaneously control the water level inside the dike for flood defense during rainy season. In Saemangeum basin, however, the sedimentation occurring near the gates because of the decrease of flow velocity might induce calamitous problems such as the deterioration of water quality and drainage retardation due to geomorphological bed changes. The dredging approach was one of the alleviation on these problems, but it could not be a fundamental solution since it should be requested periodically with excessive budget. Therefore, it is necessary to suggest the Best Management Practice (BMP) on gate operation based on the combination of tidal undulation and sediment flushing curves for mitigating the sedimentation problem. In this study, SCHISM which can simulate the gate operation was used to derive the BMP on gate operation. First, terrain data measured by Ministry of Oceans and Fisheries were utilized to verify the SCHISM and showed good agreement with less than 10.0 % error. And we confirmed that it could be reflected almost exactly the gate operation when comparing with the gate operation log (Ryu, 2018). Thus, we examined various scenarios about gate operations considering the tidal undulation and sediment flushing effectiveness for the substantial possibility as an alternative measure to replace the dredging approach. The occurrence of local scour inducing a catastrophic problem in the structural stability was also analyzed with SCHISM results. Finally, we assessed the feasibility of sediment flushing by gate operations compared with the annual dredging volume in Saemangeum basin and determined the practically optimal conditions of gate operation. When versatile field cases will be considered to deduce relationship between sediment flushing and gate operation, it would be meaningfully serviceable in terms of structural safety and economic sediment transport control in near future.

Keyword : Gate Operation, Best Management Practice, Sediment Flushing

Corresponding Author. : **SEUNGOH LEE** (seungoh.lee@hongik.ac.kr)

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Prediction of Long Term Bed Changes due to Saemangeum Reclamation Project

Jae-Seon YOON[1], Hyun-Gu SONG[1], Taemin HA[2], Jae-Sang JUNG[1*]

[1] *Regional Community & Infrastructure Research Group, International Hybrid Hydraulic Research Center, Rural Research Institute, Korea Rural Community Corporation, Korea*
[2] *Department of Civil Engineering, Kangwon National University samcheok, Korea, Korea*

Saemangeum reclamation project was started in 1989 and tidal barrier was completed in 2010. Now land development inside Saemangeum tidal barrier is being implemented following Saemangeum Master Plan of Korea Government. It is very important to know long term bed changes for effective maintenance of Saemangeum area because flood level inside Saemangeum tidal barrier is affected by bed level changes of upstream rivers (Dongjin and Mankyong Rivers) and Saemangeum lake. In this study, long term bed changes of Saemangeum area was investigated with quasi 3D numerical simulation and field observations. The results of numerical simulation agree well with field observation results. The period 2031 to 2040 was set simulation period after the completion of Saemangeum Reclamation Project. Maximum accumulation height of Saemangeum area was predicted as 2.46 m for 10 years and total accumulation rate for 10 years was calculated as 8.3 million m3. Flood level inside Saemangeum tidal barrier was investigated by reflecting long term bed changes of Saemangeum area. The maximum flood levels corresponding to 200-year frequency flood increase 6 cm and 80 cm in Dongjin and Mankyong Rivers when reflecting bed changes.

Keyword : Long-Term bed change, Saemangeum reclamation project, Numerical simulation

Corresponding Author. : **Jae-Sang JUNG** (fingon@ekr.or.kr)

Poster Sessions

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The characteristics of storm surge based on the forward speed of the storm

Young Hyun PARK[1], Daeok YOUN*[2]

[1] *Coastal Development and Ocean Energy, Korea Institute of Ocean Science and Technology, Korea*
[2] *College of Education, Chungbuk National University, Korea*

Storm surge is one of the most dangerous natural disasters directly cause to threaten coastal areas. It is determined by the characteristics of the storm and various factors. In general, the major factors are maximum wind speed, central pressure, forward speed, and geography. The forward speed of the storm is known to increase the wave height, but the effect on the storm surge has not yet been founded completely. The study focused on the forwards speed of storms around the Korea peninsula and it was getting slower due to climate change. The typhoon in this region travels northward and then change their directions northeastward. In addition, the forward speed continues to change along the track of storm until extinction. For this reason, it is not easy to study the effects of forward speed on the storm surge and the study was conducted by the ADCIRC numerical model. The variation of storm surge by the forward speed was also studied by simplifying the other factors including virtual and real storms. Many tests were simulated under conditions such as various steady and accelerated forwarding speeds, and routes along an artificial straight track of the storm. The results were analyzed to find the characteristics of storm surge in terms of the forward speed. Some of them were compared with the actual cases. Based on this study, it was found that the forward speed of the storm was inversely proportional to the duration of the storm, and their ratios produced the different forms of storm surge. The maximum storm surge was determined by the balance between forwarding speed and duration.

Keyword : Forward speed, Storm surge, Numerical model

Corresponding Author. : **Daeok YOUN** (dyoun@chungbuk.ac.kr)

P138

Development of a tsunami-tide interaction model with simulation of tsunami wave propagation to Korea coasts

Kyeong Ok KIM[*1], Kyung Tae JUNG[2], Tae Min HA[3]

[1] *Marine Environmental Research Center, Korea Institute of Ocean Science and Technology, Korea*
[2] *Research and Development Center, Oceanic Consulting & Trading, Korea*
[3] *Department of Civil Engineering, Kangwon National University, Korea*

Simulation studies of historic and prognostic tsunamis have been performed with focus on tsunami-tide interaction. For that, a modeling system has been developed which is composed of a global tsunami model and a regional multi-nesting tide and tide-tsunami model covering the Northwest Pacific region. The tsunami generation point can be located at any point inside or outside of the regional model domain. Initially tide propagation is simulated on the regional domain until tidal motion becomes stable enough, specifying open boundary conditions based on NAO's tidal prediction verification of the model results are made comparing with tidal information around the Korean coasts. In parallel with the tide model simulation, tsunami propagation is then simulated on the global domain. Superposition of tsunami and tide information at the open boundary of the regional tide-tsunami model leads to the simulation of tsunami-tide interaction on the regional domain.
Two historic tsunami cases, 2010 Chilean and 2011 Tohoku tsunami, are simulated to estimate the tsunami-tide interaction by calculating the difference of tsunami only and tsunami-tide simulations. The tsunami waves propagated across the Pacific and swept around the main islands of Japan. It has been found that the gravity wave transformed traveling a long distance affected by the phase of tidal currents. The prognostic tsunami propagation caused by the Nankai earthquake was also tested. The most impact scenario on Korean coasts was selected among the scenarios proposed by Central Disaster Management Council, Japan. Calculations show that tsunami waves reach Cheju Island and the southern coast of Korea in approximately 3.5 and 4 hours, respectively. The arrival time lag of tsunami was generated by the tsunami-tide interaction. Also smaller wave height of the first tsunami wave was calculated depending local tidal and current conditions.

Keyword : Tsunami-Tide interaction, Tsunami model, Tsunami wave propagation

Corresponding Author. : **Kyeong Ok KIM** (kokim@kiost.ac.kr)

2010 Chile Earthquake Tsunami modeling with adaptive mesh refinement

Han Soo LEE[*1], Taemin HA[2], Kyeong Ok KIM[3]

[1] *Transdisciplinary Science and Engineering Program, Graduate School of Advanced Science and Engineering, Hiroshima University, Japan*
[2] *Department of Civil Engineering, Kangwon National University, Korea*
[3] *Marine Environmental Research Center, Korea Institute of Ocean Science and Technology, Korea*

In numerical modelling of tsunami, direct calculation of tsunami propagation and run-up from source regions to the coastal zones with a single model domain results in low accuracy. Therefore, nested calculation with varying grid intervals from open sea to coastal zone are generally applied. High level accuracy for tsunami run-up in coastal zones requires small grid intervals in the order of 10 meters or even less, resulting in the significant increase of computing times. As a result, numerical models with nesting method are difficult to apply in operational practice.
In this study, we illustrate the 2010 Chile earthquake tsunami propagation and run-up modeling using non-linear shallow water equation solver with adaptive mesh refinement (AMR) method. In the tsunami modelling, we investigate the efficiency of AMR in terms of computation time and accuracy. GEBCO 30 arc-sec is used for bathymetry and the model results are validated with NOAA DART buoy and coastal sea level measurements. Numerical experiments using a non-linear shallow water equation solver with AMR method have been carried out in three categories, (a) adaptive mesh (66023.4 m $\leq$ resolution $\leq$ 2063.2 m), (b) non-adaptive with low resolution (constant grid interval of 16505.9 m) and (c) non-adaptive in high resolution (2063.2 m). In addition, four experiments to investigate the effect of tide on tsunami propagation are tested. The quadratic bottom friction is used with the friction coefficient, Cd, of 0.003. Therefore, in total, 7 numerical experiments are performed. The level of adaptive meshes varies from 7 to 12 which are equivalent to approximately 66023.4 m and 2063.2 m in distance, respectively. The results of numerical experiments illustrate that the experiments with AMR applied show averagely 50 times faster in computational time than those required in non-adaptive high-resolution runs, while keeping the comparable accuracy with the non-adaptive high-resolution runs.

Keyword : 2010 Chile tsunami, Adaptive mesh refinement, Tsunami-Tide interaction

Corresponding Author. : **Han Soo LEE** (leehs@hiroshima-u.ac.jp)


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Poster Sessions

P201

A Climate Informed Wind Frequency Model and Prediction over South Korea: In the context of Nonstationary Bayesian Mixture Distribution Model

Ho Jun KIM, Hyun-Han KWON*

Department of Civil & Environmental Engineering, Sejong University, Korea

It has been well recognized that extreme wind process often features a nonstationary behavior, which may not be effectively modeled within a stationary frequency modeling framework. Furthermore, univariate Gumbel distribution has been commonly used for wind frequency analysis in Korea. However, the distributional changes in extreme wind have been globally observed including Korea. More specifically, the univariate Gumbel distribution based wind frequency analysis often failed to describe multimodal behaviors which are mainly influenced by distinct climate conditions. In this perspective, this study explores a mixture distribution based nonstationary frequency (MDNF) model in a changing climate within a Bayesian framework. It was found that the MDNF model can effectively account for the time-varying moments (i.e. mean and variance) as well as the time-varying mixing ratio in a two-component mixture distribution. Moreover, this study will further investigate the role of climate variables (e.g., sea surface temperature and sea level pressure) on the extreme wind as inputs in the MDNF model. The MDNF model showed more robust results for describing the upper tail of the distribution which plays a crucial role in estimating the design wind.

Acknowledgments

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Keyword : Extreme wind, Mixture distribution, Nonstationary and Bayesian Model

Corresponding Author. : **Hyun-Han KWON** (hkwon@sejong.ac.kr)

P202

Storm surge analysis method considering wave effect

Myong-Kyu KIM[1], Tea-Woo KIM[2], Jong-Sung YOON[2], Yeon-Joong KIM*[2]

[1] *HTI Korea, R&D Center, Korea*
[2] *Department of Civil and Urban Engineering, Inje University, Korea*

To accurately analyze storm surges occurring in coastal areas, the wave effect caused by high waves should be considered. In general, there are two major factors involved when a storm surge is caused by wave developments: the wave radiation stress and wave-induced surface drag coefficient. The radiation stress of a wave can be seen as a wave setup phenomenon in which the energy gradient occurs spatially because of the physical change process (breaking wave) that occurs when a wave entering shallow water from the deep sea advances to the shallow coastal region. Because of the topographical characteristics of rias on Korea's west and south coasts, the waves generated by a typhoon are significantly attenuated when a typhoon hits because of the topographic characteristics of rias; thus, the rise in water levels caused by radiation stress does not have much impact. However, in places where the influence of waves is significant, such as Busan and the east coast of Korea, there is a risk of rising water levels caused by radiation stress resulting from the characteristics of local topography; therefore, radiation stress should be considered. The surface drag coefficient should also be considered. Currently, most studies use drag coefficients for the sea surface where the wave is not considered as a sea surface resistance coefficient. However, because the actual storm surge shows rough surface movements caused by wind rather than a calm state, it is necessary to use the sea-level resistance factor considering the wave effect. Therefore, in this study, the aim was to evaluate the sensitivity of the coastal area around the South Sea in Korea, particularly Tongyeong, Masan, Gadeok, and Busan, where significant storm surge inundation damage occurs, by applying the above-mentioned key factors, including radiation stress and the sea resistance coefficient.

Keyword : Storm surge, Wave, Radiation Stress

Corresponding Author. : **Yeon-Joong KIM** (anyseason@inje.ac.kr)

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P203

A Study on the Characteristic of Tsunamis in the Southwest Coast of Korea Using a Hypothetical Scenario

Dong-Seak KIM, Yeong-Han JEONG, Dong-Hwan KIM, Sang-Yeop LEE, Hyeon-Jeong KIM*, Sung-Jin HONG

Disaster Information Research Division, National Disaster Management Research Institute, Korea

In recent years, the frequency of large-scale earthquakes has been increasing worldwide. In particular, the crust of earth around the East Asia has been in a state of stress since the 2011 Great East Japan Earthquake, with mounting concerns and uncertainty of future seismic activities. Earthquakes that may impact the southwest coast of Korea mostly occur from the slope of continental shelf of the Ryukyu Island. Tsunami records from the past also suggest that there is always the likelihood of incursive tsunamis in the southwest coast. Therefore, a study for advance preparation of tsunami response plans is required.
In a preceding study, a hypothetical tsunami was presumed to be generated from the Ryukyu Island and the Korea Strait. The impact and risk levels of the hypothetical tsunami were analyzed through a numerical analysis. Further, tsunami propagation characteristics were examined by location of wave force in Korea Strait. Distributional characteristics of the hypothetical tsunami in the southwest coast were also explored. In the study of Tsunami Hazard Mapping Through Characteristic Analysis of Inundation, tsunamis in the eastern coast were studied using numerical simulation. However, the southwest coast has a spring range that can cause considerable tidal influences. Therefore, it is necessary to analyze the impact of tide on tsunami propagation characteristics. Furthermore, the location of earthquakes occurring in fault zones of the Ryukyu Island may affect the trend of tsunami propagation reaching Korean coasts. Hence, this study postulated a hypothetical tsunami scenario that could possibly induce impacts on the southwest coast to simulate tsunamis. Additionally, this study intended to analyze tidal wave propagation characteristics appearing by interaction of tides and tsunamis in the coast. The findings of this study can be used to prepare for future tsunamis that may occur in the southwest coast after conducting risk assessment on the coast.

Keyword : Tsunami, Scenario, Risk assessment

Corresponding Author. : **Hyeon-Jeong KIM** (liswjd@korea.kr)

P204

Estimation of Relations between Representative Wave Heights using Measured Wave Data in the West Sea of Korea

Dong-Hui KO[1], Uk-Jae LEE[2], Hongyeon CHO[2], Byeong Wook LEE[*3]

[1] *Coastal development and ocean energy research center, Korea Institute of Ocean Science and Technology, Korea*
[2] *Marine big data center, Korea Institute of Ocean Science and Technology, Korea*
[3] *International Hybrid Hydraulic Research Center, Rural Research Institute, Korea Rural Community Corporation, Korea*

As the distribution of individual wave heights for irregular waves, the Rayleigh distribution was first introduced by Longuet-Higgins. The relations between representative wave heights were proposed by manipulating the probability density function of the Rayleigh distribution. However, since the Rayleigh distribution is based on the linear wave theory assumption for narrow-band spectra, it is necessary to examine the applicability in the shallow water with the nonlinearity. Thus in this study, individual wave heights were calculated using the water level data (2013.08.01-31) obtained from the HeMOSU-1 offshore met-mast. The zero-up crossing method was used to define individual waves, and the Kolmogorov-Smirnov (K-S) test was used for Goodness-of-Fit of the Rayleigh distribution for the individual wave heights. Besides representative wave heights such as the highest wave, the significant wave, the highest one-tenth wave, the mean wave, and the root mean square wave were calculated using the individual waves for 20 minutes. Relations between representative wave heights were estimated and compared with the theoretical relations. As a result, about 68.6% of the 2016 data sets were found to follow the Rayleigh distribution. Notably, it was shown that the measured data during typhoon Kong-rey (Typhoon no. 201315) did not follow the Rayleigh distribution because the typhoon invasion from August 30 to 31 caused the wavelength to become longer and the relative water depth to become shallow. Meanwhile, as a result of comparing the theoretical relations with the estimated relations ($y = \alpha \times x$), the error range was from 1.68% to 13.25%. In the future, it was judged that it is necessary to estimate the optimal distribution for the shallow water waves and to properly estimate the relations between representative wave heights using the measured data on the Korean coast.

Keyword : Rayleigh distribution, Representative wave height, HeMOSU-1 offshore met mast

Corresponding Author. : **Byeong Wook LEE (bwlee20@ekr.or.kr)**

Poster Sessions

P205

Application of data assimilation for spectral wave model in coastal regions of South Korea

Hanna KIM[1], Kyeong Ok KIM*[1], Young Ho KIM[2]

[1] *Marine Environmental Research Center, KIOST, Korea*
[2] *College of Environmental and Marine Sciences and Technology, Pukyong National Yniversity, Korea*

The most important factor on the accuracy of the wave simulation is the accuracy of the wind data, which is a major force to wave generation. And it also depends on the performance of the parameterization for the development and dissipation of wave energy and on the nonlinear energy transmission between wave components. Wave model has limitations due to errors of wind fields and lack of understanding of wave dynamics like white capping dissipation, wave-bottom interaction processes and long-term wave propagation. To compensate and improve for this uncertainty of wave estimates, this paper investigates the performance of a wave model based on WAVEWATCH III version 5.16 with spectral wave data assimilation using the OI (optimal interpolation) method. The spectral wave energy computed by wave model was modified by OI as the observed significant wave height considering spatial distribution. Data assimilation was applied for the coastal region of Korea using near real-time global satellite wave observation data provided by CMEMS (Copernicus Marine environment monitoring service) and the buoy data of KMA (Korea Meteorological Administration). It was verified by calculating the bias and Root Mean Square Error (RMSE) between simulation results and observational buoys of KMA and it was shown to contribute to improving the accuracy of numerical model.

Keyword : Wave, Data assimilation, OI

Corresponding Author. : **Kyeong Ok KIM** (kokim@kiost.ac.kr)

P206

A study on the prevention of wave overtopping according to the type of breakwater at the Busan Marine City during a typhoon Chaba (1618)

Jin-Hee YUK[1], Junghyun PARK[*2], Min-Ho SUH[2], Ki-Seok CHOI[1]

[1] *Convergence Research Center for Data Driven Solutions, Korea Institute of Science and Technology Information, Korea*
[2] *Data-Centric Problem Solving Research, Korea Institute of Science and Technology Information, Korea*

Busan Marine City, one of the largest coastal cities and expensive areas in South Korea, was greatly damaged by the typhoon during the typhoon Chaba in 2016. To prevent this, the construction of a sea breakwater or the redesign of revetment height has been proposed, but no research has been conducted on it.
In this study, by using the three-dimensional fluid dynamics model (GERRIS), the two types of breakwater described above were reproduced to simulate the effect of preventing wave overtopping. In addition, Adaptive Mesh Refinement (AMR) was applied to the major dangerous regions using sensitivity tests the effect of wave reduction according to the height of the breakwater.
As a result, in the first case of a sea breakwater, no flooding occurred in Marine City. In the second case of the redesign of revetment height, wave overtopping occurred in the central area of Marine City (points = 10~12), but this is significantly reduced compared to the actual case. Also, when the height of the breakwater was 1.0 m or more, the wave overtopping tended to decrease rapidly, and this could be suggested as a major design factor when designing a revetment height.

Keyword : Wave overtopping, Typhoon Chaba, Busan Marine City

Corresponding Author. : **Junghyun PARK** (pjh@kisti.re.kr)

Poster Sessions

P207

Comparative analysis on wave field using wave measurement data and wave analysis data applying Meso-scale Model

Hyeong Jun KIM[1], Won Chul CHO[*2], Yong MOON[1]

[1] *Coastal & Ocean Engineering Laboratory, DY Engineering Co. Ltd., Korea*
[2] *Dept. of Civil and Environmental Engineering, Chung-Ang University, Korea*

Waves are the most important factor to perform the numerical analysis on morphological variation analysis in coastal area. Wave condition in coastal area is varied with time and space and derived from on-site wave measurement or numerical wave analysis. Actually, acquisition of spatial wave measurement data in a specific coastal area is limited, therefore spatial wave data generally acquired by accurate numerical simulation, which required accurate boundary conditions generally derived from global prediction model data. Global prediction model data is the reanalyzed data using data assimilation approaches produced by ECMWF, NOAA, JMA, etc. In the present study, we perform the comparative analysis on wave field in a coastal area in South Korea using wave measurement data and wave analysis data applying Meso-scale Model. The highest resolution meteorological data in 2018 were used for the wave field numerical simulation and the measurement data provided by WINK(Wave Information Network of Korea) were used for the comparative analysis. In addition, the variation of the wave field resulting from the measurement data and the numerical analysis are compared and analyzed.

Keyword : Wave field, Numerical anaysis, Meso-Scale Model

Corresponding Author. : **Won Chul CHO** (chowc@cau.ac.kr)

P208

Predictability of Extreme Wave Heights in the Coast of South Korea Within A Nonstationary Hierarchical Bayesian Model Framework: The role of the Madden-Julian Oscillation (MJO)

Yong-Tak KIM, Hyun-Han KWON*

Department of Civil and Environmental Engineering, Sejong University, Korea

The increasing frequency of extreme wave heights has been observed in many parts of the world due to the recent global warming. Especially, the variability of extreme wave heights in the summer season has increased during the last three decades over the coast of South Korea that is partially attributable to the increase of the climate variability, leading to the changes in frequency and intensity of the extreme wave heights. Further, coastal areas are particularly vulnerable to the increased climate variability, and the associated risk can be exacerbated by the rapid coastal development over South Korea. Most of the extreme wave heights in South Korea are largely caused by a typhoon during the summer season. Recent studies revealed that the typhoon frequency and intensity in the Asian monsoon region are modulated by Madden-Julian Oscillation (MJO) during the summer season from May to November. Traditional frequency analysis methods do not consider the year to year shifts in wave heights risk distributions that are attributed to changes in climate variability that affect the causal structure of coastal inundation risk. In this perspective, a climate-informed nonstationary frequency analysis model is proposed to predict the extreme wave heights and explore the role of the MJO in a Bayesian regression framework. The parameters of the nonstationary frequency model are obtained using a Markov Chain Monte Carlo algorithm. The proposed model shows strong potential for predicting the extreme wave heights by linking large-scale climate patterns, providing motivation for developing dynamic coastal flood risk management strategies.

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Keyword : Bayesian model, Climate information, Extreme wave heights

Corresponding Author. : **Hyun-Han KWON** (hkwon@sejong.ac.kr)

Poster Sessions

P209

Development of a new computation module using the SRIAM method in WAVEWATCH III®

Jae-Seon YOON[1], Hoki BAN[2], **Taemin HA**[*2]

[1] *Rural Research Institute, Korea Rural Community Corporation, Korea*
[2] *Department of Civil Engineering, Kangwon National University, Korea*

Because of the rapid development of computer technology in recent years, wave models can utilize parallel calculations for the high-resolution prediction of open sea and coastal areas with high accuracy. Parallel calculations also allow national agencies in the relevant sectors to produce marine forecasting data through massive parallel calculations. Meanwhile, the eastern coast of the Korean Peninsula has been increasingly damaged by swell-like high waves, and many researchers and scientists are continuing their efforts to anticipate and reduce the damage. In general, the short-term transformation of swell-like high waves can be reproduced relatively well in the third generation wave models, but the transformation of relatively long period waves needs to be simulated with higher accuracy in terms of the nonlinear wave interactions to gain a better understanding of the low-frequency wave generation and development mechanisms. In this study, we developed a calculation module to improve the calculation of the nonlinear energy transfer in the 3rd generation wave model and integrated it into the wave model to effectively consider the nonlinear wave interaction. First, the nonlinear energy transfer calculation module and third generation model were combined. Then, the combined model was used to reproduce the wave transformation due to the nonlinear interaction, and the performance of the developed operation module was verified.

Keyword : Nonlinear energy transfer, WAVEWATCHIII, SRIAM

Corresponding Author. : **Taemin HA** (tmha@kangwon.ac.kr)

P210

Assessing the Applicability of Disaster Scale Criteria for Swell-Like Waves Based on Predictions of Wave Overtopping

Sang-Yeop LEE[1], Hwa-Young LEE[*2], Sung-Jin HONG[1, 3], Dong-Seag KIM[1, 4], Hyeon-Jeong KIM[1, 5], Dong-Hwan KIM[1, 6], Yeong-Han JEONG[1, 7]

[1] *Disaster Information Research Division, National Disaster Management Research Institute, Korea*
[2] *Ocean Research Division, Korea Hydrographic and Oceanographic Agency , Korea*

Recently, people' leisure time has increased, coastal areas are increasingly being utilized for leisure activities. However, safety measures against storm surges and tidal waves are still insufficient. The purpose of this study is to predict wave overtopping caused by swell-like waves on the eastern coast of South Korea and thereby minimize economic losses and fatalities caused by disasters. It also develops warning systems and information updates to alert citizens of a disaster in advance of its occurrence. Wave overtopping was predicted by applying the recently revised EurOtop (2018) empirical formulas on vertical- and slope-type structures, which includes the results of research on wave overtopping in Europe. Real-time results from a tide-wave model coupled with the ADCIRC-UNSWAN model were used to estimate the wave height and time period required to predict wave overtopping. Swell-like waves were characterized as having a significant wave height of 2 m and a time period of 8 s; the wave overtopping hazard criterion was set at a wave overtopping rate of 0.01 m3/ms-1. These criteria were applied to artificial structures along major ports on the eastern coast of South Korea and verified via a field survey. Scale criteria for swell-like wave disasters, with different attention, notice, caution, and hazard stages, were developed and proposed to support decision-making by policy makers. In addition, the results of the study can also aid the development of disaster mitigation plans. It is expected that this study will provide data by which the wave overtopping hazard faced by major artificial structures along the eastern coast of South Korea can be predicted.

Keyword : Disaster, Swell-Like Wave, Wave Overtopping

Corresponding Author. : **Hwa-Young LEE** (hylee81@korea.kr)

Improvement of numerical simulation applied statistical Properties of Directional wave by Typhoon

Dong-Hwan KIM[1], Chang-Ill YOO[*2], Yeong-Han JEONG[1], Sang-Yeop LEE[1], Hyeon-Jeong KIM[1], Dong-Seog KIM[1], Seong-Jin HONG[1]

[1] *Disaster Information Research Division, National Disaster Management Research Institute, Korea*
[2] *CEO, C3D, Korea*

Typhoon-generated wave fields are of importance both scientifically for understanding for coastal zone protection and operationally for predicting potentially hazardous conditions for coastal regions. However, no matter how affect directional wave to wave characteristics near the bay and estuary during the typhoon due to a strong lack of wave field data. To determination of more accurate design wave height, the objective of this paper is to investigate high accurate numerical simulation using statistical properties of directional wave. In this paper, directional wave data collected using MIDAS-DWR (Directional Wave Recorder) and used of Geoje and Haeundae floating buoy, Gwangan light beacon on typhoon Ma-on and Muifa in July and August of 2011. In addition, the results of Numerical simulation with STWAVE base on wave action balance equation is compared with significant wave heights and periods of collected data at in-situ measurements. The model input parameters are significant wave height, peak period and wave direction in Case1 on observed from 4 wave gauges and statistical properties of wave direction instead in Case 2, Case 3. The numerical simulations using the mean and standard deviation of the long wave observation data of mode ±45° for the longest wave of wave height (Case 3) showed very good agreement respectively. From the above results, it can be concluded that the accurate wave characteristics can be analyzed by using statistical analysis technique of wave direction rather than using the input value as the actual wave direction which is highly fluctuated in the outer sea, and the numerical experiment considering the influence of the local wind and flow is performed and the influence of these factors on the wave characteristics during the typhoons may be able to be studied continuously.

Keyword : Directional wave measurement, Typhoon wave, STWAVE

Corresponding Author. : **Chang-Ill YOO** (ciy@coast3d.com)

P212

Study of Wave Transmission Reduction by Floating Breakwater using Physical Model Experiment

Martin YAHYA SURYA*, Totok SUPRIJO, Hanif DIASTOMO, Mochamad Riam BADRIANA, Avrionesti, Umar ABDURRAHMAN, Hansan PARK

Research and Technology, Korea-Indonesia MTCRC (Marine Technology Corperation Research Center), Indonesia
Faculty of Earth Science and Technology, Bandung Institute of Technology, Indonesia
Korea Institute of Ocean Science and Technology, Korea

Floating breakwater structure can prevent the damage caused by ocean waves in coastal area. In this study, physical model experiment was done to test the efficiency of floating breakwater in reducing wave transmission. The influenced of structure designs and incident wave characteristics were examined. The experiment was conducted in 3D waves flume under regular waves varied on amplitude and period. The floating breakwater is constructed with rectangular shaped blocks with several designs based on sise adjusment of length and width.

The effect of incident wave on floating breakwater structure responses and its effectiveness are presented and analyzed. The experimental results show that there are trends where the wave steepness increasing, the wave transmission reduction will become more effective. The structures width increment is more effective on damping the incident wave, while the structure length changes not really significant to reduce the wave transmission. In some cases, the structures will ineffective to reduce the wave transmission. The structures movement caused by waves motion will make random difraction pattern. These cases happened due to wave length longer than the structures width. When the waves height higher than the structures height, it will caused the waves run up and resulting wave amplification. The experiment results show that floating breakwater can dissipate the wave energy more than amplified it.

Keyword : Floating Breakwater, Physical Experiment, Wave Transmission Coefficient

Corresponding Author. : **Martin YAHYA SURYA** (martinyahya@mtcrc.center)

Poster Sessions

P213

ASSESSING THE ENVIRONMENTAL IMPACTS OF THE ARTIFICAL NAVIGATION CHANNEL IN SOUTHERN VIETNAM

Tin HUYNH TRUNG*

Dept of Earth Resource and Environment, Ho Chi Minh City University of Technology, Vietnam

Several years ago, government has kicked off the project of artificial navigation channel in Tra Vinh province with aim to increase the availability of Hau's entrance navigation. The improvement project includes with existing channel and 8 km of artificial channel was 1st launched in 2017. After years of operation, project has taken its effects on the waterway traffic. However, with immense biological risks identified, riverbank erosion coupled with the risk of deposition have raised questions to governments and scientists about its viability. This paper analyses the environmental impacts of the navigation channel in context of bank stability and sedimentation discharge. It was shown that, digging of new canal has significantly affected the current velocity at the river mouths. It is also found that, increasing of the movement through navigation channel is expected to increase the risk of bank erosion and sediment deposition with simulated volume of sediment discharged is 691,483.22 m3/year.

Keyword : Artificial canal, Hau river, Sediment transportation

Corresponding Author. : **Tin HUYNH TRUNG** (httinvn@gmail.com)

P214

Correlation Analysis between Beach-Face Slope and Sand Size along Eastern Coast in South Korea

Dongseob SONG[1], Jinhoon KIM[2], Hyungseok LEE[1], Inho KIM[*1]

[1] *Earth and Environmental Engineering, Kangwon National University, Korea*
[2] *Environmental Technique Research Institute, Kangwon National University, Korea*

The beach-face slope represents an active portion of shoreline, where wave run-up and run-down flow interactions with a littoral zone. The grain size is a significant variable when predicting beach morphology change related to coastal erosion. Nevertheless, there is a dearth of information on grain size, sorting, skewness and beach-face slope of the Gangwon coast, eastern area of South Korea, to understand its coastal environment. In the present paper, the relationship between the mean grain size and the beach-face slope has been investigated. In order to obtain accurate estimates of grain size parameters, sand samples were taken from 35 beaches based on traditional sieving method. The beach profile data, including beach-face slope, was collected, using a VRS GNSS system mounted on either a quad bike or a surveyor's backpack. The several times campaigns to acquire field data accomplished from August 2010 to October 2017. Three results can be stated: (1) Averages of mean grain size d50 in the Gangwon coast are within the range from 0.5 to 1.5mm, and can be classified as fine uniform sand. (2) The range of beach-face slope is 6° to 14° in study sites. (3) An increase in mean grain size correlates with a decrease in beach-face slope (r2=0.005) on all campaign cases. The correlation coefficients between the mean grain size and the beach- face slope is revealed from -0.20 to -0.05. It can be concluded that these results might efficiently used to comprehend Gangwon coastal environments for beach management, such as littoral zone conservation projects, construction of beach nourishment, and coastal engineering. Additionally, the estimation of ranges with the quantitative meaning of morphodynamic parameters, namely sediment grain size, will improve the confidence in the numerical analysis of coastal evolution in South Korea.

Keyword : Beach-Face slope, Mean grain size, Littoral drift cell

Corresponding Author. : **Inho KIM** (kimih@kangwon.ac.kr)

Analysis of long-term beach change in Wonpyeong Beach using Video Image

Jaegab CHO[1], **Hojun YOO**[1*], Jinyoung PARK[2], Jongbeom KIM[2]

[1] *Affiliated Research Institute, Geosystem research, Korea*
[2] *Coastal Management, Geosystem research, Korea*

Numerous coastal developments have led to the development of human life, but it has created the inconvenience of reducing the available space. The artificial structure changed the sea condition and artificially manipulated the beach sedimentation system. If the construction of the structure has reached an unavoidable situation, it is necessary to continuously review the beach sedimentation status. Starting with Holman's research in 1981, video monitoring for sea&beach research has been actively conducted using the development of various techniques. Currently, video monitoring are installed in the erosion-predominant grade (D grade or serious area) area of the East Coast of Korea to perform real-time analysis.

In this study, we analyzed the shoreline changes during 6 years using video monitoring data in the Won-Pyong Beach, east coast of South Korea. In the past 6 years, various changes have been made, constructing a marine protection facility such as submerged structure, groyne. The coastal development and long-term wave condition data were reviewed for a long period of time, beaches were identified, and changes were analyzed. The target area has been performing littoral nourishment steadily on the beach since monitoring in 2015, and littoral nourishment (9,750 square meter) was performed in autumn 2017 to significantly increase the beach area. In the spring of 2018, the wave height of more than 1 meter and the wave period about 8 second during 8days, and the beach area decreased by 8%(4,960 square meter) and gradually recovered. In addition, in Feb 2020, the leisure facility located on the back of the beach was damaged by the high-frequency invasion of the winter. We reviewed these post facts using our data.

To protect the shoreline, we need to keep a close eye on the changes. It`s judged that this data will contribute effectively to coastline protection and crisis response.

Keyword : Video monitoring, Beach erosion, Won-Pyeong beach

Corresponding Author. : **Hojun YOO** (yoohj@geosr.com)

P216

Detection of Wave Parameters using CCTV Images-based on Deep Learning Algorithm

Jongchul YOON[1], Yechan KIM[1], Sangil KIM[2], Inho KIM[3], Dongseob SONG[3*]

[1] *Dept. of Software and Media Technology, Kangwon National University, Korea*
[2] *Dept. of Mechanical Engineering , Kangwon National University, Korea*
[3] *Dept. of Earth and Environmental Engineering, Kangwon National University, Korea*

The closed-circuit television (CCTV) systems have been used on the various applications of oceanic research fields, that is an effective installation method of offshore monitoring and can be conveniently and continuously observe the coastal region using the visible or infrared light in the electromagnetic spectrum. However, in the case of the wave observing CCTV images, there is a problem in that it is difficult to extract the corresponding feature points between the video frames, and it is the cause of inaccurate measurement of wave parameters. Recently, in the field of the machine learning technology, deep learning-based video analysis that does not require the detection of feature points have been proposed. In this paper, we analyzed the wave observing CCTV images with three kinds of deep learning method, especially 2D/3D convolution neural network (CNN), recurrent neural network (RNN) and deep residual network (DRN), and find the optimal method of wave observing CCTV through bench marking of three methods. For the data learning, we use the CCTV data at the Samcheok Beach in Republic of Korea and wave observation data, which were used on the machine learning, were collected by an acoustic wave and current profiler (AWAC). Also, in case of insufficient observation data, we examined with the data augmentation to enhance the prediction model by the deep learning. The results of this study confirmed that the deep learning algorithm is applicable to detect the wave period and the wave height. Consequently, the continuous CCTV images-based on deep learning algorithm can be clarified the complex characteristics of wave distribution and its temporal change.

Keyword : Closed-Circuit television, Wave parameter, Deep learning

Corresponding Author. : **Dongseob SONG** (sds@kangwon.ac.kr)

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Analysis of Beach Changes after Construction of Submerged Breakwaters

Jaejoong JIN, Inho KIM, Jinhoon KIM, Hyungseok LEE*

Dept. of Earth and Environmental Engineering, Kangwon National University, Samcheok, Korea

This study shows seasonal investigations of the submerged breakwaters constructed in 2013 –2014, monitoring and analyzing tendencies of sand transport in Munam Beach. Wave-induced current, wave height, beach profile, and shoreline change, were throughly investigated. The littoral drift cell includes Gungchon Beach, Wonpyeong Beach, and Munam Beach, located in Samcheok-si, South Korea, and it extends from the northern Gungchon harbor to the southern Chogok harbor. Owing to the construction of the Gungchon harbor in 2006, sand from the southern Wonpyeong Beach was moved to the northern Gungchon Beach, which resulted in a retreat of the shoreline by an average exceeding 50 m. Even though the government has implemented an erosion prevention project via submerged breakwaters, beach erosion continues to occur in nearby areas. After construction of the submerged breakwaters, a tombolo was generated behind the submerged breakwaters, causing beach erosion. Rip currents has mainly occurred near submerged breakwaters, which play a role in the transportation of sand in the offshore direction. Numerical analysis was conducted to analyze the sand movement, indicating that a strong rip current is generated near the submerged breakwaters. Thus, Wonpyeong Beach eroded due to the construction of Gungchon harbor in 2006, whereas Gungchon Beach was accreted. Despite the government's countermeasures with submerged breakwaters, newly generated erosions are still observed near the construction area. Therefore, this study shows that detailed monitoring during and after construction of the breakwaters is inevitable to predict possible second erosion and to comprehend the erosion mechanism for design purposes.

Keyword : Submerged breakwater, Coastal monitoring, Beach erosion

Corresponding Author. : **Hyungseok LEE** (LHS0815@empal.com)

P218

Climate Change: Characteristic of Storm around Korea

Daeok YOUN[1], Young Hyun PARK*[2]

[1] *Dept. of Earth Science Education, Chungbuk National Univ., Korea*
[2] *Coastal Development and Ocean Energy, Korea Institute of Ocean Science and Technology, Korea*

A Tropical storm is a massive and severe natural disaster that repeats every year and it becomes a major threat to coastal areas. Many researches show that the intensity and frequency of storm are increasing due to global warming. Because storm is affected by many factors from climate and sea, the characteristic of storm is difficult to analyze with complexity. Though their relationship of some factors was found, its characteristics still need to be studied for better understanding. Most of the recent storm studies have been focused on increasing the accuracy of simulation using a numerical model, but this study was based on statistical methods to find the correlation between factors that determined the characteristics of storm. In this study, correlation analysis was conducted by some factors in the ocean and atmosphere. The analysis was conducted using R is a software for statistical computing. In this study, the analysis was conducted on the selected storms passing around the Korean Peninsula considering the difficulty of storm study. The typhoons that occurred in the last 20 years, were analyzed considering the existence of marine observational data. The available observational data were limited, and some of them were lost during the typhoon. The number of typhoons heading for Korea has been increased for last 30 years, but the increment of their intensity was not apparent in the observational data. In the region between 30 and 35 degrees north latitude where the direction of typhoon changed to the northeast by the westerlies, the forward speed of the typhoon was inversely proportional to the water temperature of the southern sea, and it affected the characteristic of storm surge in coastal areas.

Keyword : Climate Change, Typhoon, Statistical analysis

Corresponding Author. : **Young Hyun PARK** (yhpark@kiost.ac.kr)

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Analysis of atmospheric stability in the coastal area for the evaluation of offshore wind turbine stability

Hyunsu KIM[1], Chaejoo MOON[2], Younggon KIM[2], Kyung-Hee CHON[1], Geonhwa RYU*[2]

[1] *National Electric Control Center, Korea Power Exchange, Korea*
[2] *Wind energy research center, Energy Valley Industry-University Convergence Agency, Korea*

The ground friction force in coastal and marine areas is lower than that of land and the frequency of strong winds is relatively high, which greatly affects the life and stability of wind turbines. In particular, the strong wind at the bottom of the atmospheric boundary layer is generated by a combination of thermal and mechanical factors, so it always carries a risk due to vertical wind shear and strong turbulent gusts. Therefore, in order to prevent physical loss of the wind turbine located in the atmospheric boundary layer, it is necessary to grasp the wind condition through more accurate atmospheric stability analysis. In this study, the observation data of the Boseong Standard Meteorological Tower is used to select strong wind cases in the lower atmospheric boundary layer and analyzed the vertical distribution characteristics of wind resources according to the Monin-Obukhov length. As a result, it was confirmed that vertical wind velocity gradient caused by atmospheric stability mainly changes when the atmosphere is in the neutral state at night in winter.

Keyword : Atmospheric stability, Wind shear, Monin-Obukhov length

Corresponding Author. : **Geonhwa RYU** (geonhwa@eiuca.or.kr)

P220

A study on the site analysis of the optimal offshore wind farm considering the coastal disaster

Geonhwa RYU[2], Chaejoo MOON[2], Younggon KIM[2], Kyung-Hee CHON[1], Hyunsu KIM[*1]

[1] *National Electric Control Center, Korea Power Exchange, Korea*
[2] *Wind energy research center, Energy Valley Industry-University Convergence Agency, Korea*

The horizontal force transmitted to the turbine and the substructure of the wind power system is a very important factor in terms of system safety, and is particularly vulnerable to large-scale coastal disasters such as earthquakes and typhoons. Wind power system built on the coast and offshore are more disadvantageous in terms of economic efficiency due to the increase in initial investment costs because they require a more robust design when installed in areas vulnerable to coastal disasters. The west and south seas of Korea have a relatively shallow water depth, which is advantageous for the construction of offshore wind farms. However, since it is close to the Pacific Rim, the probability of an earthquake is relatively high compared to other regions, and the frequency of typhoons is higher, so more detailed site analysis is necessary. In this study, the GIS technique was used to select the optimal site for wind farms in terms of reducing the risk of coastal disasters. The current state of earthquakes in the western and southern seas of Korea and the movement path and intensity of typhoons affecting or passing through the western and southern seas were also analyzed in a complex way. As a result, the site of the optimal offshore wind farm with the lowest risk in coastal disasters was analyzed.

Keyword : Coastal disaster, Wind turbine, Site analysis

Corresponding Author. : **Hyunsu KIM** (hyunsu@kpx.or.kr)

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P222

A Study on Terrain Conditions for Survival of Coastal Vegetation in Estuary barrier Island

Junghyun PARK[1], Seung-Hyun EEM[*2], Han-Sam YOON[3]

[1] *Data-Centric Problem Solving Research, Korea Institute of Science and Technology Information, Korea*
[2] *School of Convergence & Fusion System Engineering, Kyungpook National University, Korea*
[3] *Ecological Engieering, Pukyong National University, Korea*

Most natural sandy beaches surrounding an estuary barrier island are backed by vegetated sandy ridges known as sand dunes. This study was carried out to investigate long-term changes in the vegetation line resulting from the position of sand dunes within large-scale and small-scale regions. In addition, the stability of the area covered by sand dunes was also considered for large-scale regions. Sand dunes play an important role on an estuary barrier island in that they stabilize ground elevation and the development of the vegetation zone. A comparison between stable/unstable sand dune areas indicates that these two situations have a different effect on changes in the vegetation line. Moreover, the vegetation line is shown to depend on the shape of coastal sand dunes in the ocean. This led us to suggest a reasonable sand dune shape (by defining the ground level and position) based on the field vegetation line and beach profile data. The result has suggests designed sand dune feature advantageous condition of vegetation. Beach-dune gradient is upper than 1/40 and beach-dune cross-shore distance is 40 ~ 60 m, Sand dune height is upper than 2.3 m based on A.H.H.W.. This type of sandy terrain provides a better environment for coastal plants to survive.

Keyword : Estuary barrier island, Coastal sand dune, Coastal vegetation

Corresponding Author. : **Seung-Hyun EEM** (eemsh@knu.ac.kr)

P223

Flow Analysis of the Drainage Gate Operation at Dong-Sam Seawater Small Stream based on Computational Fluid Dynamics

Dongha KIM[1], Hak Soo LIM[*1], SeungHwan JIN[1], Hee Jun LEE[2], Youn-Ho LEE[3], Hong-Yeon CHO[4]

[1] *Marine Disaster Research Center, Korea Institute of Ocean Science and Technology, Korea*
[2] *Marine Active Fault Research Unit, Korea Institute of Ocean Science and Technology, Korea*
[3] *Marine Ecosystem Research Center, Korea Institute of Ocean Science and Technology, Korea*
[4] *Marine Bigdata Center, Korea Institute of Ocean Science and Technology, Korea*

Dong-Sam Seawater Small Stream (hereafter DSS) is a small seawater stream located in Yeongdo-gu, Busan, and was created artificially by reclaiming the coast. Unlike normal revers, DSS flows from the difference between the tides in the open sea. Due to these flow characteristics, a low-velocity region was developed in the central part of DSS. In order to improve this problem, drainage gates are installed at both ends, and in this study, the effects are analyzed through computational fluid dynamics (CFD). The results of the analysis were extracted from four vertices (P1, P2, P3, and P4) that can represent DSS. First, when one drainage gate is installed, the flow direction of the ebb is determined according to the installation location, and the flow velocity development pattern of the entire DSS is significantly different according to the flow direction of the ebb. When drainage gate is installed in the direction of the Korea Maritime and Ocean University (KMOU) and the gate is closed at low tide to flow the low tide in the direction of the Cruise terminal, the flow velocity at the P4 is almost stagnant, and the flow velocity around 0.1m/s occurs at P3. On the other hand, the flow velocity increase rate of the Cruise terminal region is up to 170%. Second, when two drainage gates are installed, dramatic flow velocity development can be expected by utilizing only the inner and outer tides of DSS. In case of the inner water level of DSS is high tide, both drainage gates are closed, and when the open sea is at low tide, opening the drainage gate toward the Cruise terminal, the seawater quickly flows in the direction of the Cruise terminal. At this time, the flow velocity increases significantly in all sections except the P4.

Keyword : Flow analysis, Drainage gate, Dong-Sam seawater small stream

Corresponding Author. : **Hak Soo LIM** (hslim@kiost.ac.kr)

Development of Surface Reinforcement Technique of Levee using Bio-soil

DONGWOO KO[*1], JOONGU KANG[2]

[1] *Civil Engineering , Chonnam National University , Korea*
[2] *Department of Land, Water and Environment Research, Korea Institute of Civil Engineering and Building Technology, Korea*

Conventional levees are easy to construct at low cost, but they are vulnerable to overtopping and infiltration in the event of heavy rain, typhoon and wave. Therefore, this study applied bio-soil, a mixture of eco-friendly biopolymers and soil, to the surface of the levee to verify the physical stability through hydraulic tests. In other words, we reproduced an overtopping flow in a channel to compare and analyze the effect of delaying the levee breach according to the distribution of levee surface velocity, the failure mechanism, and new material reinforcement through image analysis. The experiment was performed at the River Experiment Center in Andong and the dimensions of the levee were: height (1 m), levee crest width (3 m), levee crest length (1 m), slope (1:2), and total length (5 m). As a result of analyzing the distribution of velocity, erosion developed in the joints and the direction of the flow immediately after overtopping occurred at the levee (control case), and the velocity increased from 1.1 m/s to 1.8 m/s for 30 seconds immediately after overtopping. In terms of the levee reinforced with the new material, the distribution of velocity was maintained for a certain period and the maximum velocity (3.3 m/s) was measured at the toe of the levee. Although the pattern of failure was the same as vertical erosion developed due to strong tractive force, the overtopping breach mechanism at the same time of flow was different. Moreover, the slope loss rate of levee reinforced with the new material was retarded about 12 times over times as compared to control case. In the future, we will continue to conduct eco-friendly protection studies to prevent erosion of natural levees along the coastal and river areas through full-scale experiments.

Keyword : Eco-Friendly, Levee experiment, Surface reinforcement

Corresponding Author. : **DONGWOO KO** (rhehddn84@gmail.com)

P226

Segmentation of the marine forecast zone in Korea by using wave observation and model data: Based on k-mean clustering algorithm

Myung-Seok KIM[1], Doyoun KIM[2], Hyunmin EOM[3], Sung Hyup YOO[3], Seung-Buhm WOO[*1]

[1] *Department of Oceanography, Inha University, Korea*
[2] *Oceanography Division, Ara Consulting & Technology, Korea*
[3] *Marine Meteorology Division, Korea Meteorological Administration, Korea*

- The Korea Meteorological Administration (KMA) classified the forecast zone based on the administrative districts, weather characteristics, civil complaints, and location of observation points. In order to check the validity of the current forecast zone for the wave forecast, a clustering analysis was performed using the wave observation and model data. The clustering analysis is a method used to group areas with common characteristics. In this study, a set of n objects was decomposed into k clusters and a distance-based method, k-means clustering algorithm, was used. As the data structure of the clustering analysis, the mean and standard deviation of the significant wave height and wave period from 2014 to 2016 were selected.
- When performing clustering analysis with wave heights and wave periods observed at ocean buoys, 10-12 cluster conditions have a relatively significant internal evaluation index suggesting the distance and variance ratio between points and points within a cluster or between distinct clusters. However, there were not only a few points to perform the segmentation of the marine forecast zone using only the observation data, but also a problem in that clusters concentrated in a specific area were distributed. Therefore, it is necessary to perform statistical analysis and clustering analysis by using the verified KMA wave prediction model for the segmentation of the marine forecast zone. As a result, 11-12 cluster conditions showed the best internal evaluation index. Although the results of this clustering analysis did not differ significantly from the existing forecast zone, the segmentation of zones was made in more detail. Based on these results, further consideration of the subdivision of the marine forecast zone is required when predicting waves.

Keyword : Marine forecast zone, Wave observation and model data, Clustering analysis

Corresponding Author. : **Seung-Buhm WOO** (sbwoo@inha.ac.kr)

Poster Sessions

P227

A Study on Parameter Optimization of Conceptual Rainfall-Runoff Model in the Coastal Urban Region

Woo Yeon SUNWOO, Kyung Soo JUN*, Gyu Min LEE

Graduate School of Water Resources, Sungkyunkwan University, Korea

The rainfall-runoff simulation based on the local conditions is important for flood disaster management. This study aims to simulate the conceptual rainfall-runoff model by applying two optimization techniques to the parameter calibration in the coastal urban region. Although the rainfall- runoff model, which conceptualizes the moisture state of the soil, can reflect soil moisture into the runoff using probability distribution, few studied have been applied in South Korea. The reason is that it is difficult to calculate the representative values of the parameters of the model, and it is known that the peak flooding is overestimated due to extreme rainfall events. In this study, the non-linear programming, which is one of traditional optimization techniques, and metaheuristics algorithm, which has been actively applied recently are used. The conceptual rainfall-runoff model, which use the calibrated parameter with a flood events. Study area is Hongseong, a coastal urban region located to the west of South Korea. The rainfall-runoff results simulated from the parameters obtained using metaheuristics algorithm showed closer results to the actual runoff values. Each of the parameters obtained by metaheuristics algorithm and non-linear programming showed some differences. The method of this study can provide more improved rainfall-runoff simulation results for flood management.

Keyword : Conceptual rainfall-Runoff model, Parameter calibration, Flood disaster management

Corresponding Author. : **Kyung Soo JUN** (ksjun@skku.edu)

P228

Analyze the Impact of Building Wind on the Coastal Area : 3D modelling study

Yongju KWON[1], Taeyoon KIM[1], Jongyeong KIM[1], Jooyong LEE[2*]

[1] *Dept. of Civil Engineering, Pusan National University, Korea*
[2] *Research Institute of Industrial Technology, Pusan National University, Korea*

Recently, high buildings have been constructed numerously in the city near ocean. However, in densely populated area with high building, wind velocity can increase and vortex can occur due to the 'Venturi effect', causing various secondary problems. The Target area, 'marine city' has a highest density of high building in Busan, the biggest port city of Korea. In addition, marine city is surrounded by three sides of the sea, thus the winds from the sea become complicated and threatening in the building forest, accordingly, the solution for estimating and analyzing building wind in the city is required to find the dangerous areas and to prevent serious damages from typhoon. Herein, we simulated building wind using computational fluid dynamic program to numerically analyze the wind environment in target area dependents on wind directions. (East, West, and South directions). Utilizing CAD (Computer aided design), we imported 2D plane, added building height data, set the flow field to conducted 3D modelling. As a result, maximum wind speed increased 31%, 72% and 40% compared to input wind speed data for south, east and west direction, respectively, to let us know that the wind speed can significantly increase when the wind flows in east direction. The increased wind speed is caused by generated low pressure in the building forest. In addition, vortex was generated not only when input wind speed was high but also low, which is judged that the vortex is mostly effected by the shape, location and vertical gap of the buildings. Based on the study, we confirmed that the numerical analysis of building wind environment using 3D modelling is capable, therefore it is judged that this method can be applicable for finding dangerous location from enhanced wind by typhoon to protect the safety in the marine city.

Keyword : Building wind, CFD, 3D modeling

Corresponding Author. : **Jooyong LEE** (jooyong@gmail.com)

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An approach to assess typhoon vulnerability for coastal cities

Gyumin LEE[5], Changwoo LEE[3], Hyungjin SHIN[2], Wooyeon SUNWOO[1], Sungnam HONG[4], Kyung Soo JUN*[1]

[1] *Graduate School of Water Resources, Sungkyunkwan University, Korea*
[2] *Rural Research Institute, Korea Rural Community, Korea*
[3] *Institute of Technology, Wesmart Co., Korea*
[4] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[5] *Construction and Environmental Research Center, Sungkyunkwan University, Korea*

This study aims at providing typhoon vulnerability assessment of Busan which is a coastal city. Busan is the second largest city in South Korea with over 3.4 million people, and average 2 million people per year visit the city for seaside vacation. Also, port-container volume of 20 million TEU per year are exchanged at the port in Busan. Disasters such as extreme wind, storm surge and inundation occur every year due to the effects of typhoons. Typhoons affect Korean peninsula more than three times a year and most of them pass through Busan. Therefore, we need to construct a regionally dynamic damage mitigation plan based on disaster vulnerability assessment by reflecting variable characteristics of Busan as a metropolitan city with developed tourism and port. Multiple-criteria decision making technique is applied in vulnerability assessment and assessment framework is formed through expert forum. Disaster damage mitigation plan will be proposed based on mapping using priorities for management to reduce damage. These priorities are estimated by area based on the assessment indicators composed of spatial characteristics.

Keyword : Typhoon vulnerability, MCDM, Busan

Corresponding Author. : **Kyung Soo JUN** (ksjun@skku.edu)

P230

Study on the Mechanism of Rip Current Generation in Deoksan Beach

Sungyeol CHANG, Jinhoon KIM, Hyungseok LEE, Inho KIM*

Dept. of Earth and Environmental Engineering, Kangwon National University, Samcheok, Korea

The coast serves as a buffering function to reduce high-wave energy and a leisure space for people. The east coast of Gangwon is mostly used as a beach in summer, but it is also an area that has recently been spotlighted as an optimal spot for surfing. In addition, most beaches are consist of sand, and they have been well developed crescentic bars by exposure to high water waves. The site of study, Deoksan Beach, had an accident where two college students died by rip current from 5 to 6 pm on July 13, 2019. In this study, the flow velocity and flow direction were identified using CCTV at the time of the death of Deoksan Beach, and the causes of rip current were analyzed by using the data observed 5 times since 2017. At the time of the accident, the significant wave height was 0.6m, the period was about 7.5s, and the wave direction was invaded to 46°. As a result of the water depth survey, it has been analyzed that the environment for rip current generation has been created. The numerical model experiment was used to reproduce the occurrence of rip current at the time of the accident, and it was found that the flow (0.3m/s) on the offshore side of the accident occurred. The purpose of this study is to prepare a safety map for rip current when opening a beach in summer and provide it as a basic data for enjoying a safe sea bathing.

Keyword : Rip current, Numerical model experiment, Water depth survey

Corresponding Author. : **Inho KIM** (kimih@kangwon.ac.kr)

Suggestions on the Expansion of Studies Involving Development Projects for Marina Port in Korea

Seung Hyun JANG[1], **Ji Sun KIM**[*2]

[1] *Physical education, Pusan National University, Korea*
[2] *BK21PLUS, Pusan National University, Korea*

Marina port development projects includes a long-term planning for developing marina port business model by establishing related industrial cluster through developing marina ports across the whole country starting from 2010. This project which involves plans to develop shore fishing villages across Korea into hubs of leisure industry became the marine leisure project with the largest scale as it led to the establishment of the 2nd Marina Port Basic Agenda in 2020 backed by vigorous governmental support. However, in reality, many marina ports across Korea is faced with variety of problems. Thus, this study seeks to propose a new direction for the study related to marina port development to take as a means to offer academic support to better resolve issues related to the development of marina ports. To achieve such goal, 1) 'the study looks into the 'beginning and current status of marina port development project' to discuss the characteristics and the issues of the projects 2) and proceeded to have a discussion to 'expand the studies on marina port expansion projects.' the study goes in to details to suggests the importance of 'studies to investigate the fundamentals of the issues involving the project,' which have been seeing failures, and proposed the necessity for 'cultural approach on participants or potential participants.' Lastly, the study emphasizes the needs for 'studies on the governance of local society' as a practical and long-term resolution. Expansion on such studies will act as a guide to help marina port development project to overcome difficulties it is faced with at the moment.

Keyword : Marina, Marina Port in Korea, Marina port development projects

Corresponding Author. : **Ji Sun KIM** (loligsun@hanmail.net)

P232

Importance analysis of the environmental management according to the beach use characteristics in the Gangwon area

Hyo Min KANG, Wonseok OH*

Dept. of Leisure sport, Kangwon National University, Korea

There are 92 officially designated beaches in the eastern coast of Gangwon-do. This amount is shown as twice times as the second largest number of Jeonnam (55 locations) in Korea. The management for the beach is performed by not only central and local governments but also private organizations for various purposes. Nevertheless, with the increasing demand for diverse marine tourism activities based on beaches, a multifaceted and systematic management planing is urgently needed. The purpose of this study is to analysis the importance of safety accidents, facilities, user rules, and natural conditions accordance with the use characteristics of the beach located in the eastern coast of Gangwon. Likewise, some data was collected through a questionnaire survey targeted on 221 beach workers (related facility workers, safety guards, etc.). Additionally, the characteristics of beach use were analyzed with regard to the scale of customer accommodation, the perceived crowding, and the environmental management significance by using stepwise multiple regression analysis. As a result of the points of views, it appeared that the use characteristics of the beach in the eastern coast of Gangwon-do was highly related to the facility and equipment factors, natural environment factors, human resources factors, and user factors. These results will be the foundation for the safer and more comfortable operation in Korean beaches surrounded by three sides of the sea as well as Gangwon-do.

Keyword : environmental management , Characteristics of beach use , Gangwon area

Corresponding Author. : **Wonseok OH** (poiuy1005@naver.com)

Poster Sessions

P233

A Study on the Improvement Plan for Disabled People` Marine Tourism Activities

Kwi-Baek KIM*, **Chang-Ho OH**, Jin-Gu JI, Sandy Kyunghwa NAM-JO

Marine Leisure and Tourism, Youngsan University, Korea

Marine Tourism is regarded as one of the most important aspect in modern life and one`s happiness and becomes core part in improving the quality of life. However disable people have a limitation in enjoying Marine tourism due to the mobility problem and limited access although they have every right to participate and take actions. It is the time to increase the possibility for disabled people to have an access to core parts of Marine tourism, namely sea and marine facility with barrier free environments so that they become much aware of the betterment in Marine tourism activities and are led to the positive behavioral intention

Keyword : Marine Tourism , Disabled People, Improvement Plan

Corresponding Author. : **Kwi-Baek KIM** (demi100@ysu.ac.kr)

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A Study on the Overseas Practice Experience of Marine Sports Instructors

CHANG BEOM PARK*

Dept. of Physical Education, SANGJI UNIVERSITY, Korea

This study aims at how marine sports instructors understand, overcome, and adapt to unfamiliar environments, languages, people, and cultures experienced in the process of practicing in overseas resort environments or related companies. It is a study to find out the core categories by grasping whether it works as a meaning. Participants of the study are 9 marine sports instructors on the beaches of the Gangwon region, who have been practicing overseas within the last three years. Overseas training sites were relatively diverse, including Hawaii, Clark, Philippines, Thailand, and Malaysia. The training period ranged from the case of going out as an educational practice during the vacation to the field practice for one semester, or there were cases where they chose overseas sites for about two years after graduation.
As a result of analyzing the data collected through reminiscence diaries, document data, and in-depth interviews on the subject presented by the researcher, 10 themes and 5 paradigms were derived. These themes and paradigms were sub-categorized as 6 core categories. The paradigm of marine sports instructors who experience overseas practice constructs 'Expectations and fears of overseas life' in the first category. The second category is 'the continuation of unfamiliarity and awkwardness (excitement)', and the third category is 'acknowledge and accept differences'. Category 4 is 'Active and Continuous Challenge', Category 5 is 'Recognize the reward and value of on-site education, and Category 6 is 'Looking at my future'. This study will provide empirical information for prospective sports instructors, practical knowledge leading to more professional field instructors, and useful data for seeking directions for sports field practice.

Keyword : Marine sports instructor, Overseas Practice Experience, Sports field

Corresponding Author. : **CHANG BEOM PARK** (spopark71@gmail.com)

Poster Sessions

P235

Assessment of Sustainable Development Goal 14 around the Korean Peninsula:Focusing on the inter-Korean Cooperation

In Joo YOON*

General Policy Research Department, Korea Maritime Institute, Korea

This study aims to assess the implementation levels and trends of United Nations' Sustainable Development Goal (SDG) 14 around the Korean Peninsula. The scope of research includes ROK, DPRK, PRC, and Japan, but mostly focusing on both Koreas. As the marine ecosystem has no boundaries in spite of jurisdictional separation, it is necessary that the surrounding neighbours cooperate to achieve SDG 14. In order to prove such necessities and suggest ways of further improvement, this study examines current implementation levels of SDG 14 of these countries. A quantitative comparative case study of four countries and another qualitative comparative case study of ROK and DPRK will be conducted. ROK, DPRK, Japan share the east sea of the Peninsula while ROK, DPRK, and PRC share the west sea of the Peninsula. ROK and Japan are included in the OECD Countries group while DPRK and PRC in the East and South Asia group. Therefore, the result of comparative cases will demonstrate not only the current assessment of SDG 14 around Korean Peninsula but also regional implications in terms of socio-economic institutions. Based on the results and further discussion on them, this study will draw out suggestions for achieving SDG 14 around the Korean Peninsula, especially focusing on inter-Korean cooperation.

Keyword : SDG, Life below Water, DPRK

Corresponding Author. : **In Joo YOON** (mouthpiece@kmi.re.kr)

P236

A Review of Ocean Economy of North Korea:Focusing on the Relationship between its Economic Status and Fisheries Policy

In Joo YOON*, **Huikwon JIN**

General Policy Research Department, Korea Maritime Institute, Korea

This study aims to review the ocean economy of North Korea, more specifically the relationship between North Korean economy and its fisheries policy as fisheries holds a dominant position in the ocean economy, comparing to other sectors. In order to achieve the purpose of this study, North Korean economy and fisheries sector are respectively analysed in terms of policy and performance from 1945 to 2020. Most of materials rely on literature review generated by the North and estimated or statistical figures provided by South Korea and international organizations. Main hypothesis of this study is that the North tends to emphasize fishing when its economic status is relatively fine while it moves its policy focus from fishing to aquaculture when the economy goes down. Based on the analysis of the history of North Korean economy and fisheries policy, this hypothesis will be tested and examined. If there is a significance between them, the result of this study will help to prospect the future policy of North Korea.

Keyword : : North Korean Economy, Fisheries Policy, North Korea

Corresponding Author. : **In Joo YOON** (mouthpiece@kmi.re.kr)

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The Marine Environment and the Problem of Resource Recycling of Oyster Shell:Comparison between Korea and Japan

Eun Young BAEK*

Fisheries Policy Implementation Division, KMI, Korea

Oysters, which rank first among Korean and Japanese shellfish production, are as important as the oyster shell problem. In particular, if the oyster shell, a by-product generated from oyster, is left untreated, it can cause serious damage to the marine environment such as environmental pollution on the coast, ills and odors caused by leachate, natural landscape damage, and marine tourism industry. The annual amount of oyster shell in Korea is about 300,000 tons, accounting for about 90% of the production of oysters, and it also takes considerable cost to process oyster shelling. If oyster shells are recycled, it is important not only for coastal management, but also for creating new added value and efficient use of resources. Although the effectiveness of oyster shell has already been proven in many cases, the issue of oyster shell has emerged as a social issue in Korea, even though it has not settled down as a resource. On the other hand, Japan is less than half of Korea's oyster production, but resources of oyster shells are being made in various forms. Therefore, this study aimed to compare the differences between Korea and Japan, and to make suggestions on how to use reasonable oyster shells and make policy recommendations for domestic situations.

Keyword : Oyster Shell, Resource Recycling, Policy

Corresponding Author. : **Eun Young BAEK** (eybake@kmi.re.kr)

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Utilization of de-regulation-oriented beaches policy

Jaehyung LEE[1], Chanryong KIM*[2]

[1] *Department of Ocean Physical Education, KOREA MARITIME AND OCEAN UNIVERSITY, Korea*
[2] *Department of Leisure & Sport Science, DONGEUI UNIVERSITY, Korea*

In summer, most beaches in Korea limit the scope of sea bathers' activities excessively on the ground of safety in preparation for situations such as rip current and broad wave. What is the cause of that? In the event of a rip current, how would sea bathers play in the water? Why the use of equipment that can ensure safe playing in the water is not recommended while riding tubes, swimming naked or playing in the water? Various questions can be guessed.
Accordingly, in order to solve these questions, this study analyzes unnecessary regulations on domestic beaches from various perspectives on the ground of safety and suggests improvement measures, thereby improving the satisfaction, convenience and safety of beach users. A literature study and a fact-revealing analysis are conducted as a research method to carry out the purpose of this study to analyze the actual conditions and related regulations of domestic beaches. In addition, in-depth interviews are conducted with marine leisure experts to find ways to ease and improve unnecessary regulations on domestic beaches, and the following conclusion are derived.
First, when considering the environment of domestic beaches in vacance seasons, the criteria of safeline should be re-established and expand swimming areas in order to secure wider space for sea bathers, and permit the use of facilities in swimming areas.
Second, the use of various auxiliary equipment, such as surfboards and SUPs used by swimmers, should be permitted in dangerous places or the place of rip current in order to promote the use of rescue auxiliary equipment in case of safety accident.
Third, the area using auxiliary equipment should be divided into beaches in order to satisfy various needs of sea bathers due to the increase in the number of people using auxiliary equipment, and to increase satisfaction through leisure activities.

Keyword : Deregulation, Beach, Utilization policy

Corresponding Author. : **Chanryong KIM** (cksfyd@deu.ac.kr)

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The strategies to introduce fishing education certification system to reduce marine safety accidents, protect marine resources, and reduce marine debris

Chanryong KIM[1], Jaehyung LEE*[2]

[1] *Leisure & Sport Science, Dongeui University, Korea*
[2] *Ocean Physical Education, Korea Maritime and Ocean University, Korea*

As of 2019, the population of leisure fishing has exceeded 8 million, and it has become a new leisure culture that can be enjoyed by families of all ages. The increasing number of leisure fishing populations and the lack of systematic fishing education are increasing new social problems such as reduced marine resources, pollution of the marine environment, and increased safety accidents.
Accordingly, the government has enacted the Fishing Management and Promotion Act to manage and control fishing activities in order to spread the sustainable fishing culture of the people and develop the fishing industry. In accordance with the law, the government provides regular fishing expert training to fishing fishermen and fishermen to protect marine safety accidents and marine resources.
However fishing education for leisure anglers is rarely developed, and marine safety accidents and marine debris are still a social problem due to the wrong fishing culture. The government tried to introduce a fishing license system as a way to solve the social problems caused by fishing, but the introduction of the system was not successful due to strong opposition from leisure anglers.
Therefore this study was conducted to establish a strategy for the introduction of an effective fishing education certification system to understand the right fishing culture and to induce participation of leisure-anglers into self-directed fishing education. And the ultimate goal of this study is to provide basic data for establishing social systems such as leisure fishermen's perception change and fishing license system.
This study was conducted as a qualitative study. Research participants conducted in-depth interviews with 10 research participants such as fishing experts, leisure anglers, fishing fishermen, and fishing managers. In-depth interviews were conducted through rapport formation after obtaining research consent. It was conducted by using a mixed questionnaire with semi-structured and unstructured about 60-90 once.

Keyword : Leisure fishing, Fishing education certification system, Strategy

Corresponding Author. : **Jaehyung LEE** (jhlee3416@kmou.ac.kr)


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Poster Sessions

P301

Economic efficiency of the Freight Forwarding Industry in Korea

Na Young Hwan CHOI[*1], **Seok Woo CHOI**[2], Hanna KIM[2]

[1] *General Policy Research Division, Korea Maritime Institute, Korea*
[2] *Maritime Industry & Logistics Division, Korea Maritime Institute, Korea*

In Korea, under ‘Framework Act on Logistics Policies', international logistics brokerage business means business mediating logistics of importing and exporting goods by making use of logistics facilities, equipment, etc. of others in his/her own name and by his/her calculation at the request of others.

As of March 2020, there are 4,277 freight forwarders in Korea. Among them, businesses with capital of 500 million or less account for 90.4%. Hereupon, freight forwarding industry experiences surge of small and medium sized forwarders, shortages in volume caused by limited domestic business networks and intense price competition. Moreover, 1PLs(First Party Logistics) of leading conglomerates account for considerable proportion of freight forwarding industry so that difficulties in Korean freight forwarding industry persist.

Under these circumstances, financial analysis and operational efficiency analysis are required for the industry to enhance competitiveness. Therefore, this study intends to examine the current status of Korean freight forwarding industry and analyze economic efficiency using the stochastic frontier approach, while the results obtained is compared to those from a data envelopment analysis model. In addition, estimated efficiencies are analyzed to find determinants affecting the efficiency by utilizing the Tobit regression model.

Keyword : Economic efficiency, Freight Forwarding Industry, Tobit model

Corresponding Author. : **Na Young Hwan CHOI** (chnayoung@kmi.re.kr)

P302

A Study on Development for Safety Practice Competency on the Beach: Focusing on Life-Respect and Participation in Survival Swimming Program of Elementary School Students.

Hyo Min KANG*

Department of Leisure Sports, Kangwon National University, Korea

The purpose of the study was to development for safety practice competency on the beach through survival swimming program to elementary school students. These factors are affecting various accidents on the beach. Therefore, it is necessary to identify, control and handle the accident on the beach by analyzing these factors. In order to achieve this purpose, 248 elementary school students were selected from registered in Kangwon-do area by the cluster sampling method.
In this paper, this study analysis That factors is safety practice competency, life-respect and participation in survival swimming program assessment model. This study apply multiple linear regression for effect the between each factors. And this study conduct experiments to development for safety practice competency on the beach calculate the factors affecting the there factors. Therefore, various approaches to survival swimming program are needed from the perspective of interdisciplinary fusion research. And A framework is established to investigate the competency of safety practice in different situation.

Keyword : Beach, Safety practice competency , elementary school students

Corresponding Author. : **Hyo Min KANG** (riverhm@kangwon.ac.kr)

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P303

Assessing the Marine Spatial Planning in terms of Ecosystem services: a case of Busan, South Korea

Chan Woong KIM, Jae Young PARK*, Hee-Jung CHOI, Jungho NAM

Marine Research Division, Korea Maritime Institute, Korea

The various types of MSP have been attempted to obtain a Good Environment Status globally. Based on the zoning system, South Korea established MSP for the seas of Busan in January 2020. MSP in South Korea considered both the existing legal area (National park, etc.) and the result of marine spatial characteristics evaluation based on scientific data. This study evaluates marine zoned area in Busan in terms of ecosystem services. The result of marine zoned area in Busan and ecosystem services evaluation were collected and overlapped, thus identifying the value of ecosystem services for each grid (1km x 1km). A total of five marine zoned areas were analyzed: the fishing activity zone, the aggregate/mineral resource zone, the tourism zone, the environment/ecosystem zone, and the port/navigation zone. In Busan, the area designated for marine zoned area was 2681.7 ㎢, and the value of ecosystem services was totally found to be 322.1 billion won. The value of ecosystem services of each grid are 730 million won in the marine tourism zone, 580 million won in the environment/ecosystem zone, 200 million won in the port/navigation zone, 50 million won in the fishing activity zone, and 10 million won in the aggregate/mineral resource zone. This is consistent with the characteristics of the marine area in Busan, where the tourism industry is active. Even when considered for each ecosystem services, the value of cultural service was high in most marine zoned areas. The value of cultural service is three times higher than the value of supply service in the fishing activity area raises questions about how it is appropriate to connect the marine zoned area with the ecosystem service. These results indicate that the marine zoning system in the Busan area shows the characteristics of the region well and has been properly designated except some cases.

Keyword : MSP, GES, Valuation

Corresponding Author. : **Jae Young PARK** (jay.park@kmi.re.kr)

P304

Cumulative Impact Assessment for Marine Spatial Planning: A Case of Gyeonggi Bay in Korea

Hee-Jung CHOI[1], Chul-Sue HWANG[*2], Sung-Jin CHO[1], Taekeon HWANG[2]

[1] *Marine Research Division, Korea Maritime Institute, Korea*
[2] *Department of Geography, Kyung Hee University, Korea*

CIA (Cumulative Impact Assessment) techniques have been developed for MSP (Marine Spatial Planning) in Europe and North America. Effective MSP requires a process of evaluating the effect of human activities on the marine ecosystem, i.e. to perform CIA. Korea has been establishing MSP in all waters in succession since it enacted a MSP law in 2019. This study aims to carry out the CIA that has never been attempted in Korea before and discuss the limitations and alternatives of the CIA method in terms of operative MSP. The related literature was first reviewed and the cumulative impact of human activities on the marine ecosystem was then measured on Gyeonggi bay, Korea. Information on the marine ecosystem and activities were collected, and the concept of the relationship between activity-pressure-ecosystem was adopted in this study. The results showed the cumulative impact score is typically high on the coast where human activities are concentrated, and fishing activities account for the largest portion of the total cumulative impact among marine activities. Moreover, it was confirmed that the degree of cumulative impact varies by activity depending on whether the weight of the marine ecosystem is applied. We have learned the lessons from the case study. It first gives an overview of how cumulative impacts of marine activities can be quantified in a spatial context. Second, it is necessary to consider how to collect and process data before the CIA process. Moreover, the linkage system of activity-pressure-ecosystem suitable for the actual conditions of the study area should be deliberated to improve the accuracy and reliability of the CIA result. Above all, the analysis and mapping techniques for the CIA should be advanced. We hope this study will provide a guideline for developing and utilizing the CIA tool in countries and regions that plan to adopt MSP.

Keyword : Cumulative Impact Assessment, Marine Spatial Planning, CIA

Corresponding Author. : **Chul-Sue HWANG** (hcs@khu.ac.kr)

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P305

Assessment of long-term effects on coastal seabed sediments due to inflow of suspended load through rivers

Byung Il MIN, Kyung-Suk SUH*

Environmental Safety Assessment Research Division, Korea Atomic Energy Research Institute, Korea

The rainfall erodes land soil and it flows into the river, which travels along the river to the coast. Due to the 2011 Fukushima nuclear power plant accident, a large amount of radioactive isotopes were deposited on Japan's land. The radioactive material that has deposite on the land strongly attached the mineral and organic matter of the soil. The radioactive isotope, which has fallen on land, travels to the coast through rivers with sediment. In this paper, the above phenomena are reproduced by a simple mathematical expression to reproduce the long-term effects on the rivers and coasts of Fukushima, and compare the results with observation datas. The compartmental models also represent the exchange between the water column and the bed sediment. Due to the relatively low computational demand of these models, more complex processes can be simulated, such as the migration of contaminants in bed sediment by burial or bioturbation, or a full representation of radionuclide decay chains. This paper describes a semi-dynamic compartment model to assess the radioactivity concentration of coastal sediments as a result of a nuclear accident.

Keyword : Seabed Sediments, River discharge, Fukushima Nuclear Power Plant

Corresponding Author. : **Kyung-Suk SUH** (kssuh@kaeri.re.kr)

P306

Comparison study of Scan MDC for field and under waste measurement condition for final status survey in decommissioning site

Sang Bum HONG*, Jun Ha KIM, Byungchae LEE, Unjoong LEE, Bum Kyoung SEO

Decommissioning technology development , KAERI, Korea

The final status survey is to identify and verify that the residual contamination levels should satisfy the release criteria after decommissioning. The radiation survey and evaluation technology are required to ensure the reliability of the results, and the process must be easily applied during field measurements. Scanning is the process by which the technician uses portable radiation detection instruments to detect the presence of any locations of elevated contamination on surface soil and sediments. The scan MDC requires the appropriate detection efficiency values based on user selected parameter of detector type and height, scan speed, source diameter, and radionuclides. In this study, the scan MDC was compared with two different survey condition on the ground and underwater. The evaluation result of a scan MDC of 3 inch by 3 inch NaI(Tl) detector was calculated by MCNP simulation and field measurement. The Scan MDC on underwater measurement condition was around 35% lower than ground measurement condition by shielding background radiation of water layer. In addition, the sensitivity of survey conditions such as a scan speed and detector height was evaluated and compared with field and under water measurement condition

Keyword : Final status survey, Scan MDC, Sediment

Corresponding Author. : **Sang Bum HONG** (sbhong@kaeri.re.kr)

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P307

Application of Food Chain Model in Lake Environment after the Fukushima Accident

Kyung-Suk SUH*, Byung-Il MIN, Sora KIM, Kihyun PARK, Jiyoon KIM

Environmental Safety Assessment Research Division, KAERI, Korea

From the Fukushima nuclear accident, a large amount of radioactive materials were released into the environment. Long-lived radionuclide 137Cs released into the air had been deposited in the soil surface, and it moved to the shallow soil, river and lake due to the precipitation. In the long-term environmental assessment, it is important to estimate the transport of the radionuclide in freshwater environment.
In this study, food chain model has been developed to evaluate the process of the transport and accumulation of radionuclide in aquatic organism by radioactive materials entered into freshwater environment from the nuclear accident. Simulations were compared with concentrations of organism in lake which was measured from the Fukushima accident. Some results agreed well with measurements and the others showed a little discrepancy due to the coarse box size in the model and lack of the observations. Developed food chain model will be used to assess the dose which is affected human by ingestion of contaminated products in terrestrial and aquatic environment.

Keyword : Fukushima accident, Food chain model, Radionuclide

Corresponding Author. : **Kyung-Suk SUH** (kssuh@kaeri.re.kr)

P308

Development of scan survey adjust method for radioactively contaminated sediment in water using MCNP simulation

Junha KIM[1, 2], Gyuseong CHO[1], Sangbum HONG[*2], Eunjung LEE[2], Byungchae LEE[2], BumKyung SEO[2]

[1] *Nuclear & Quantum Engineering, Korea Advanced Insitute of Science and Technology, Korea*
[2] *Decontamination & Decommissioning Research Division, Korea Atomic Energy Research Institute, Korea*

The nuclear power plants located near the coast and river to supply the cooling water. Therefore, unexpected radioactive materials leakage can contaminate the sediment on the coast, river, and lake. In FDNPP(Fukushima Daiichi Nuclear Power Plant), Cs-137concentration in coastal sediment was 1~500 Bq/kg [1] and the Cs-137concentration in lake sediment has a range from not detected to 1580 Bq/kg [2]. This result shows that contaminated sediment has various radioactivity levels due to the different absorption coefficient by sediment particle size [3]. The conventional estimation methods of radioactivity distribution are sampling and scan survey. The sampling method has limitations due to the sample representation, while the scan survey method is an easy way to assess radioactivity distribution. However, the scan survey method can overestimate or underestimate the contaminated area depending on the radioactivity concentration in the area, because this method determines the area is contaminated when the measured count rate or dose rate exceeds the criteria level [4]. In this study, an adjusting method to solve the limitation of the scan survey for sediment has developed. To this, the distribution of spatial dose rate was assessed using MCNP(Monte Carlo N-Particle) simulation. Also, the over-estimation factor, which is the ratio of the actual contamination area size and estimated contamination area size was calculated using the MCNP simulation. The adjusting method for the scan survey was devised using the over-estimation factor, maximum dose, and dose increase rate. Using this method, the scan survey results of Co-60and Cs-137sources were adjusted. As a result, accuracy of the estimation results of the source size improved 19.35~42.59 % compared to before adjusting. Therefore, the accuracy of the scan survey result was improved using the adjusting method, and accurate data of the contaminated area can be contributed to efficient environmental impact assessment.

Keyword : Scan survey, Underwater sediment, Radioactivity contamination

Corresponding Author. : **Sangbum HONG** (sbhong@kaeri.re.kr)

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P309

The Development and Performance of Underwater Gamma-Ray Spectrometry for the Riverbed Monitoring

Young-Yong JI*, Byung Il MIN, Kyung-Suk SUH

Environmental Safety Assessment Research Division, Korea Atomic Energy Research Institute, Korea

The atmospheric release and fallouts of radionuclides have produced the radioactive contamination over wide area in the accident at the Fukushima Daiichi nuclear power plant (FDNPP). They still affect the environment around the Fukushima Prefecture, such as resident area, fields, mountainous area, river and stream, and reservoir. In JAEA (Japan Atomic Energy Agency), diverse monitoring platforms have been developing and successfully applying to the assessment of environmental radiation and deposited nuclides. Especially, there are about 3,700 irrigation reservoirs around the Fukushima Prefecture, which can be effected from direct fallouts in reservoirs as well as dispersions of the contamination in the other sites, depending on weather conditions. Underwater survey system is an important tool to assess the radioactive contamination in the river, stream and reservoir, including the bottom sediments. In this study, underwater gamma-ray spectrometry, named as MARK-U1, was developed to rapidly estimate the underwater radioactivity for the emergency preparedness, according to the lesson learned from the nuclear accident of FDNPP. A 3”φx3” NaI(Tl) detector is equipped in this underwater system and the lateral shielding around a detector was also designed using lead with a thickness of 1 cm to confine the field of view. Finally, its performance test was conducted by evaluating the natural radioactivity of 214Bi, 208Tl, and 40K in the sediment of the lake.

Keyword : Underwater gamma-Ray spectrometry, Riverbed monitoring, Radionuclide

Corresponding Author. : **Young-Yong JI** (yyji@kaeri.re.kr)

P310

A report on field tour to Fukushima in October 2019

Ji-Yoon KIM*

Environmental Safety Assessment Research Division, Korea Atomic Energy Research Institute, Korea

It has been nine years since the accident at Fukushima nuclear power plant, from 1st October to 5th October 2019, we went to Fukushima prefecture to visit JAEA FESC (Minamisoma) in collaboration with JAEA for environmental radiation around Fukushima. We made a presentation on the current subject of Korean-Japanese research, and had a time for questions and answers. After that, we inspected experimental equipment for exploration related to measuring the surroundings of Ukedo, Odaka and Tomioka River. KAERI and JAEA conducted a joint environmental radiation survey experiment around rivers. On the way to the site, there was a sign saying "Don't enter" at each entrance of district, and there were no traces of people in the town. Also, there were signs of "no-traffic" and defensive walls all over the national highways. The measured value of radioactivity each time we moved from place to place, the value was different for each position, and was high up to 10 μ Sv/h. Radioactive cesium was evaluated through fixed surface surveys and mobile surveys using vehicles and backpacks, and unmanned aerial survey using JAEA's UAV was also conducted at multiple sites near rivers. There are many changes in the natural environment where humans cannot be seen. I realized how big an accident the nuclear accident was, and how much time, effort and cost it would take to recover. In addition, it has been proved how important it is to prioritize the safety of nuclear power plants, and prepare for this by fully considering natural disasters and external factors that cannot be expected.

Keyword : Fukushima, Nuclear Power Plants, Radioactivity measurement

Corresponding Author. : **Ji-Yoon KIM** (kjy0817@kaeri.re.kr)

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P311

Impact of extreme typhoon events on fluvial discharge of particulate radiocesium in Fukushima

Takahiro NAKANISHI[*1], Takuya OHYAMA[2], Hiroki HAGIWARA[1], Kazuyuki SAKUMA[1]

[1] *Fukushima Environmental Monitoring Division, Japan Atomic Energy Agency, Japan*
[2] *Collaborative Laboratories for Advanced Decommissioning Science, Japan Atomic Energy Agency, Japan*

The two huge typhoons in October 2019, Hagibis and Bualoi, caused enormous flood damage to Fukushima Prefecture. There is concern about radiocesium discharge to the coastal area due to such flood events. In this study, on the basis of field observations over 6 years in Ukedo River near the Fukushima nuclear power plant, sediment and Cs-137 discharges from the river catchment were quantitatively evaluated. Approximately 90% of annual sediment and Cs-137 discharges in 2019 was occupied during the typhoons Hagibis and Bualoi events. This sediment discharge was almost twice than the discharge during the largest ever flood event since the Fukushima nuclear accident, caused by typhoon Etau in September 2015. However, Cs-137 discharge during Hagibis and Bualoi events was two-thirds that of Etau event, because the particulate Cs-137 concentration in river water decreased during the observation period with the effective half-life of 2.2–3.9 years. Moreover, Cs-137 discharge during two typhoon events in 2019 accounted for only 0.1% of the catchment Cs-137 deposition and the impact of radiocesium to the coastal area was extremely limited. As the particulate Cs-137 concentration in river water steadily decreases, the concern about radiocesium discharge from river catchment would be resolved.

Keyword : Radiocesium, River discharge, Typhoon event

Corresponding Author. : **Takahiro NAKANISHI** (nakanishi.takahiro@jaea.go.jp)

P312

Dynamics of radioactive cesium in coastal area linked with river discharge

Toshiharu MISONOU[*1], Tadahiko TSURUTA[1], Takehiko SHIRIBIKI[1], Takahiro NAKANISHI[1], Seiya NAGAO[2], Shinya OCHIAI[2], Yukihisa SANADA[1]

[1] *Remote Monitoring Research Group, Japan Atomic Energy Agency, Japan*
[2] *Institute of Nature and Environmental Technology, Kanazawa University, Japan*

For understanding future radioactive Cs dynamics and its distribution in the coastal area of Fukushima Prefecture, it is important to evaluate the supply of radioactive Cs from river discharge. Especially particulate radioactive Cs supplied in floods might have a significant impact on the coastal area. However, there are few studies on the dynamics of particulate radioactive Cs at the coastal area linked with rivers at the flood event. Therefore, to clarify the effect of particulate radioactive Cs supplied from the river, mooring systems (sediment trap and water quality meters) were installed five times at four points (water depths of St.1:10 m, St.2:27 m, St.3:60 m, and St.4:30 m) in the coastal area of Fukushima Prefecture from October to December 2019. During the observation period, a typhoon (Bualoi) accompanied by torrential rain struck Fukushima Prefecture. As a result of measuring the Cs-137 concentration of the sinking particles collected by the sediment trap, at the observation point installed in front of the river, the Cs-137 concentration collected immediately after the typhoon Bualoi (October 25th) was about three times higher than before the typhoon. However, the Cs-137 concentration of the sinking particles collected two days after the typhoon (October 27th) was almost the same as before the typhoon. The stable carbon isotope ratio ($\delta^{13}C$) of the sinking particles during typhoon were -27 to -24‰ at measurement points (St.2 and St.4). The value of $\delta^{13}C$ is about -27 ‰ for land plants and -20‰ for phytoplankton in the sea. It was assumed that there was an influence of inflow from the river on St.1, St.2 and St.4 after precipitation. The impact of rivers on coastal areas during torrential rain stuck is extremely limited.

Keyword : Sinking particle, Typhoon

Corresponding Author. : **Toshiharu MISONOU** (misono.toshiharu@jaea.go.jp)

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A Study of the Radiological Impact Assessment for Jordan Research & Training Reactor

Mohammad TALAFHA[1], Kyung-Suk SUH[*2]

[1] *Nuclear and Radiation Safety, University of Science and Technology, Korea*
[2] *Environmental Safety Assessment Research Division , Korea Atomic Energy Research Institute, Korea*

In the case of radioactive materials released to the environment due to a severe nuclear accident, the estimation of the radiological impact is of high importance. A study of the radiological impact due to a design basis accident expected to release the largest radiation source to the environment in Jordan Research & Training Reactor (JRTR); a 10 MWth MTR open pool-type research reactor was conducted. In this study, the radiological impact was estimated by the HYSPLIT modeling system. HYSPLIT atmospheric transport and dispersion modeling system is a hybrid calculation method between the Lagrangian approach and the Eulerian methodology developed by the National Oceanic and Atmospheric Administration (NOAA) Air Resources Laboratory (ARL). The results were compared with the JRTR Safety Analysis Report (SAR) radiological impact assessment, which was done using PAVAN computer program; a Gaussian dispersion model developed by U.S. Nuclear Regulatory Commission (U.S.NRC), to study the magnitude and importance of the effect using different atmospheric dispersion models on the outcomes of the radiological impact assessment.

Keyword : Radiological impact assessment, JRTR, HYSPLIT

Corresponding Author. : **Kyung-Suk SUH** (kssuh@kaeri.re.kr)

P314

Mapping of coastal zones in UAV video sequences

Dongyeob HAN*, Changguen LEE

Department of architectural and civil engineering, Chonnam national university, Korea

Collecting accurate and detailed geological and dynamic information of coastal processes is required for coastal erosion and coastal facility monitoring. Over the past decades, video monitoring systems have demonstrated to be a cost-effective method. Nevertheless, video processing is difficult to extract information with a consistent accuracy in the coast due to the limitation of geometric field of view on the top of tower. In this work we apply a framework for geographic mapping in coastal videos from UAV. Specifically, we address the coast modeling using multiple videos. The system is designed to be deployed in inexpensive, off-the-shelf hardware, in a way such that the results can be easily replicated by other applications.

Keyword : UAV, Video, Coast

Corresponding Author. : **Dongyeob HAN** (hozilla@chonnam.ac.kr)

Application of Unmanned Aerial Vehicle and Eco-sounder to Investigate Coastline Changes

Joon Kyu PARK[1], Kap Yong JUNG*[2]

[1] *Civil Engineering, Seoil University, Korea*
[2] *Construction Engineering Education, Chungnam National University, Korea*

The coastline is a baseline that defines the shape of the national territory or defines the borders of the seas between countries, and it is important geospatial information to be managed by the nation for international and legal responses. In addition, importance is increasing day by day as a guideline for various laws that determine the spatial scope of the land, coast, and ocean, and closely related to people's lives. In this study, geospatial information was constructed using UAV (Unmanned Aerial Vehicle) and eco-sounder to investigate coastline changes. UAV was used to survey the coastal area during ebb tide, and eco-sounder was used to measure areas where UAV is not applicable and to integrate with UAV data. The data surveyed by UAV was processed to create a DSM(Digital Surface Model) and ortho image. And eco-sounder was used for depth measurement during high tide, and was used to construct geospatial information for coastal areas by integrating with UAV data. As a result of the study, geospatial information about the study area could be constructed. The UAV results showed X, Y, and H deviations within 10cm compared to the check point survey results using GNSS and it suggesting the possibility of using the results. The shoreline variation survey should be conducted from the existing “line concept” survey to the “plane concept” survey. In this regard, the result of integrating UAV and eco-sounder will be a way to effectively build plane data through data processing. Coastline change survey using UAV and eco-sounder can be used to establish and manage standardized coastline data and establish predictable mid- and long-term national maritime policies through continuous coastline survey. In addition, it will help effective business execution as data for the execution of major marine policies such as coastal management and marine safety.

Keyword : Coastline Change, Eco-Sounders, Unmanned Aerial Vehicle

Corresponding Author. : **Kap Yong JUNG** (jungjusa@hanmail.net)

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Tidal Flat UAV-DEM Correction Using Tandem-X DEM

Hyoseong LEE[2], Jaehong OH[*1]

[1] *Dep. Of Civil Engineering, Korea Maritime and Ocean University, Korea*
[2] *Dep. Of Civil Engineering, Sunchon National University, Korea*

The tidal flats are unusual landscapes that are submerged in seawater during high tide and are exposed like land during low tide twice a day. The Korean intertidal flat is one of the largest tidal flats in the world that are shelters for endangered migratory birds and the prosperous ecosystems inhabited by various species living in clusters. In order to recognize the topographical and environmental characteristics and systematically manage the tidal flat, it is essential to obtain topographic maps of the geographical and environmental characteristics of tidal flats to systemically manage and monitor them. In particular, height information of the tidal flat is critically important for monitoring and forecasting the tidal-flat ecosystem changes caused by either the natural or artificial influences. Recently unmanned aerial vehicles (UAV) show their potentials for accurate digital elevation models (DEMs) of the tidal flats. But a major problem is that it is almost impossible to conduct a field survey for ground control points (GCPs) because tidal flat areas are not easy to approach where the proportion of silt and clay content is very high. Without GCPs, the DEM produced from the UAV images and photogrammetric software tend to show a bowl-shape distortion due to the aerial triangulation errors. Therefore we propose a least-squares height-difference DEM matching called LHD-PM with a polynomial model using a worldwide Tandem-X DEM to correct the location error and the aforementioned bowl-shape distortion. Experimental results showed that the decent DEM error modeling was possible with curvilinear translation and constant rotation parameters along the UAV's flight direction to significantly reduce the location errors and eliminated the bowl-shape distortion of the UAV-derived DEM.

Keyword : Tidal flat, UAV-DEM, Tandem-X DEM

Corresponding Author. : **Jaehong OH** (jhoh@kmou.ac.kr)

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Estimation of Submerged Coastlines using Photogrammetric Technique

Chang-Kyung LEE[1], Konghyun YUN[*2], Guangtao HE[1], Byung Wook PARK[3]

[1] *Department of Civil Engineering, Kunsan National University, Korea*
[2] *Geospatial Research Group , Institute of Engineering Research, Yonsei University, Korea*
[3] *School of Civil & Environmental Engineering, Hankyong National University , Korea*

Understanding the complex causes on coastal transformation related to the management remains very challengeable in spite of numerous research programs for the fully recognition behavior. The practical problem of understanding the coastal behavior is the scarcity of multi decadal datasets being a major obstacle to the accurate quantitative analysis and trends in shoreline environments. In this study, approximately during 20 years for the coastal study digital aerial photos were used. In the process of it, the photogrammetric principles were applied. We follow the steps for the acquisition of shorelines in each collected aerial image pair. First, we delineated the shoreline derived existing map in the year 2013. It contains only two dimensional position. There is no height information for Approximately highest high ester level(AHHWL) Second, we use stereo pair of scanned images in the year 1986. After photogrammetric orientation process is accomplished using carefully selected GCPs. We can obtain accurate three dimensional positional information. Last we can trace the two dimensional position on the AHHWL in the year of 1986 and 2016. As a comparison, the submerged land area during 20 years due to the erosion could be calculated.

Keyword : Coastlines, Submergent, Erosion

Corresponding Author. : **Konghyun YUN** (ykh1207@yonsei.ac.kr)

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Development of Coastal Safety Mapping System by Vulnerability Assessment of Tidal Creeks

Jung Ok KIM[1], Jae Kang LEE*[2]

[1] *AICT, Advanced Institute of Convergence Technology, Korea*
[2] *Department of Future Technology and Convergence Research, KICT, Korea*

Most coastal accidents occur in coastal areas with heavy traffic and beaches and tidal flats visited by many people. In Korea, various leisure activities have been conducted all year round on the beach. As the number of workers in the coastal area increases significantly, the risk of accidents is gradually increasing, and countermeasures are required. The coastal safety map is a map that integrates spatial information with dangerous areas and dangerous information to prevent accidents occurring in the ocean. In addition to the expansion of coast leisure activities, it can be used in coastal safety areas such as accidents and disaster prevention caused by sea conditions such as tidal creeks, heavy swells, and rip current. In this study, a tidal creek map is created by using UAV (Unmanned Aerial Vehicle) to express the shape of a tidal creek in three dimensions. Next, we design and implement a mapping system that informs to places where there is a high potential for human accidents in tidal flats. It uses computer vision technology to identify the shape and location of the tibia and extract areas with high probability of accidents, contributing to the preparation of comprehensive safety measures.

Keyword : Tidal Channels, Watershed Segmentation, Drone Photogrammetry

Corresponding Author. : **Jae Kang LEE** (geostar1@snu.ac.kr)

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Monitoring of Shoreline Changes at Chollipo Beach in South Korea

Konghyun YUN[1], Chang-Kyung LEE[*2], Guangtao HE[2], Byung Wook PARK[3]

[1] *Geospatial Research Group, Institute of Engineering Research, Yonsei University, Korea*
[2] *Department of Civil Engineering, Kunsan National University, Korea*
[3] *School of Civil & Environmental Engineering, Hankyong National University , Korea*

Natural coastal shoreline changes constantly due to the various phenomena such as tides, waves, and weather. Shoreline change data are used as important data for coastal management which deals with coastal erosion and sedimentation trends, setbacks etc. Unlike serious beach erosion phenomena, it has been reported that Chollipo Beach in Taeangun, Chungnamdo, in the western part of South Korea, has been progressively sedimentated over past years. In this study, photogrmmetric process was conducted to analyze and determine the shorelines during twenty years. In the process, photogrammetric aerial triangulation using old digital aerial images in the year of 1986, UVA(Unmanned Aerial Vehicle) images in the of 2020 was implemented respectively. Also network-GPS surveying for the acquisition of GCP(Ground Control Points) in the stage of bundle adjustments was done. Finally DSM(digital Surface Model) and mosaicked orthoimages were generated. For the analysis, contour lines and beach profile were extracted. In the conclusion, this study shows that shorelines moved into the west direction with maximum 30m long distance during 20 years. Sands are accumulated with average 0.74m height in the 34,053 m^2 area

Keyword : Chollipo, Shorelines, Sedimentation

Corresponding Author. : **Chang-Kyung LEE** (leeck@kunsan.ac.kr)

P320

On the difficulties in reconstructing 3D models of glass-reflective high-rise buildings in strong wind areas

Seungil BAEK, Wonkook KIM*

Civil and Environmental Engineering, Pusan national university, Korea

Haeundae in Busan has suffered from increasing damage to people and property caused by the “building wind”, which is produced by sea breeze and high-rise buildings. To reduce and prevent the building wind damage, typically the wind tunnel test and hydrodynamic simulation (e.g. computational fluid dynamics (CFD)) are performed, where the 3D models of the target area are essential in the analysis. The study area has high-rise buildings with highly complex structures , and thus precise 3D modeling are critical in the wind field analysis for the Haeundae area. Conventional 3D building modeling approach based on stereo images, however, exhibits significant challenges for the buildings in the study area due to (1) high wind speed, (2) obstacles in radio communication, and (3) reflective building surfaces.

This study discusses the difficulties in reconstructing precise 3D models using drone's optical camera in coastal high-rise
areas. First, the effect of strong wind on the flight mission is addressed, which makes it difficult to control the posture of drones and increases the risk of falls and collisions. Second, discussion is presented for the obstacles that cause communication problems between
the drone and the control in the case of or high-rise buildings taller than 200 meters. Finally, failure in matching stereo image pairs is analyzed for glassy building surfaces, which causes reflected scenes to vary with the looking angles.

Keyword : Coastal high_rise area, 3D reconstruction, Building winds

Corresponding Author. : **Wonkook KIM** (wonkook@pusan.ac.kr)

Poster Sessions

P321

Coastal Mapping from Ny-Ålesund of the Arctic Using Inception-V3 Model and Sentinel-2

Seung-Min LEE, Jong-Chul JEONG*

Geoinformatics, Namseoul University., Korea

In recent years, the Arctic has shortened the ice-covered cycle due to the thawing of the permafrost. In addition, the world's interest in the Arctic is increasing for reasons such as climate change and resource exploration. Under the circumstances of the world, Korea's National Geographic Information Service provides polar spatial information by establishing a digital map and DEM(Digital Elevation Model) of the polar regions. However, few of the methods tried utilizing the Sentinel-2 imagery and deep learning for coastal mapping in the Arctic. In addition, it is difficult to build data through field survey because the Arctic is dangerous area for humans to access. This study used the Inception-V3 deep learning model to evaluate the coastal mapping of the Svalbard, Ny-Ålesund region in the Arctic. The data used for coastal mapping were Sentinel-2 images, utilizing false color composites with NIR-Red-Blue of 10m spatial resolution among multi-spectral bands. The learning model was used on August 2, 2016 Sentinel-2 image, and the classification items were selected as vegetation, land, water, and snow. The size of the images used for learning was 150X150, and a total of 3,416 were used, including 648 vegetation images, 861 lands, 1,747 waters, and 161 ices. The accuracy evaluation of the deep learning model was conducted through the accuracy and loss rate according to the epoch, and the number of epochs was set at 500 times. The accuracy assessment of the model showed 93% for training data and 92% for verification data. The loss rate assessment was 0.1808 for training data and 0.1950 for verification data. The performance evaluation of the deep learning model used a total of 78 images for Sentinel-2 images on July 27, 2019, with 87% overall classification accuracy.

Keyword : Coastal classification, Inception-V3, Sentinel-2

Corresponding Author. : **Jong-Chul JEONG** (jjc1017@gmail.com)

P322

High Resolution Bathymetry in Shallow Waters of South Sea of Korea from Satellite Altimetry and Remote Sensed Imagery

Kwang Bae KIM, Hong Sik YUN*

School of Civil, Architectural, and Environmental System Engineering, Sungkyunkwan University, Korea

Bathymetry in shallow waters of coastal areas has been measured by using conventional methods such as single-beam and multi-beam echo-sounders installed on the ship. However, shipborne depth data are spatially limited and uneven distribution over shallow waters of coastal areas. In this study, various methods by using satellite altimetry-derived gravity anomalies and high resolution remote sensed imagery were explored for recovering high resolution bathymetry over shallow waters of Gwangyang Bay between Yeosu Peninsula and Namhae Island of South Sea of Korea. Satellite altimetry-derived gravity anomalies derived from Cryosat-2, Envisat, and Jason-1; and high resolution remote sensed imagery obtained from Sentinel-2 were utilized to predict bathymetry in shallow waters of Gwangyang Bay. Estimated high resolution bathymetry from satellite altimetry-derived gravity anomalies and remote sensed imagery was compared with shipborne depth measurements to validate the accuracy in shallow waters.

Acknowledgement
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Keyword : High resolution bathymetry, Satellite altimetry, Remote sensed imagery

Corresponding Author. : **Hong Sik YUN** (yoonhs@skku.edu)

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P323

The Development of Korean Precise Geoid Model (KNGeoid18) and Its Application

Jisun LEE[1], Jay Hyoun KWON[*1], Yong LEE[1], Hungkyu LEE[2]

[1] *Geoinformatics, University of Seoul, Korea*
[2] *Civil Engineering, Changwon National University, Korea*

The low density and precision of land gravity data have been pointed out as a problem of degrading the precision of the Korean geoid model. To overcome the problem, new land gravity data showing the homogeneous distribution and high precision are being obtained since 2008. In 2009, airborne gravity data were also collected to cover relatively lower distribution in the mountainous as well as the spatial gap in the coastal areas. Especially, a variety of new global geopotential models (e.g. EIGEN-6C4, XGM2016) based on GOCE were published so that it supports to improve the overall precision in the local geoid modeling. Thus, gravimetric geoid has been newly developed by the "Remove-Restore" technique using XGM2016 geopotential model as well as land, airborne, shipborne and DTU10 altimeter data. Then, as a final product of the study, the hybrid geoid, KNGeoid18, was modeled by fitting gravimetric geoid to a total of 2,791 points of GNSS/Leveling data which are located over whole Korean peninsula. The degree of fit of the KNGeoid18 was calculated to be about 2.3cm and the precision which is calculated to be compared to other 1,701 points of GNSS/Leveling data was 2.46cm. The one of main necessity of a local geoid model is to determine the orthometric height by time and cost-efficiently. To examine the applicability of the KNGeoid in the surveying field, GNSS surveying has been conducted on the 12 points located in the mountainous area and the orthometric height has been determined by GNSS-orthometric height determination technique. When comparing orthometric heights from various GNSS post-processing software, TBC, LGO, and GIODIS, all points showed smaller than 5cm of difference. Thus, it was concluded that the precise orthometric height would be determined by GNSS surveying and the local geoid model when the target precision is about 3~5cm level.

Keyword : Geoid, Preicision, GNSS-Orthometric Height Determination

Corresponding Author. : **Jay Hyoun KWON** (jkwon@uos.ac.kr)

P324

Comparison of machine and deep learning methods for classifying the coastal land covers using the high-resolution satellite image

Yun-Jae CHOUNG*

Geospatial Research Center, Geo C&I Co., Ltd., Korea

Coastal land cover classification is the necessary task for protecting coastal properties, preventing coastal disasters and etc. The utilization of the artificial intelligence techniques such as the machine and deep learning methods is efficient for automatically identifying the significant land covers in coastal areas. This research compared the support vector machine (SVM), a widely used machine learning method, and the deep neural network (DNN), a famous deep learning method for identifying the various land covers in coastal areas using the KOMPSAT image acquired in the east coast of South Korea through the following steps. First, the SVM and DNN algorithms were separately employed for generating the land cover maps (water, vegetation and land) in the selected coastal areas using the given KOMPSAT image. Then, the accuracy of both land cover maps was assessed using the ground truths. This research contributes to select the most appropriate artificial intelligence approach for identifying various land covers in coastal areas using a high-resolution satellite image.

Keyword : Land Covers, Machine Learning, Deep Learning

Corresponding Author. : **Yun-Jae CHOUNG** (chyj@geocni.com)

Poster Sessions

P325

A Case Study on Detecting Whitening in Coralline Flats using Airborne Hyperspectral Imagery

Wonkook KIM[1], Jaehong OH[*2], HyunKyum KIM[3], Sung Hak KIM[4], Seungil BAEK[1]

[1] *Department of Civil and Environmental Engineering, Pusan National University, Korea*
[2] *Department of Civil Engineering, Korea Maritime and Ocean University , Korea*
[3] *Department of Resources Enhancement, Korea Fisheries Resources Agency, Korea*
[4] *Technical Research Center, GEOSTORY, Korea*

Whitening in coralline flats refers to phenomena in the shallow subtidal zone that leads to the replacement of seaweeds by coralline algae that contains calcium carbonate, which results in the destruction of coastal ecosystem and the fishery resources. Traditionally, the spatial distribution of whitening has been mapped through manual benthic identification by divers, thereby significantly limiting the spatial coverage of its detection despite the intensive man power, time, and cost invested to the survey. Optical remote sensing provides an efficient alternative for observing benthic conditions in shallow coastal areas when combined with aerial platforms such as aircraft or unmanned aerial vehicle. This study presents a case study for detecting whitening occurring in coralline flats in eastern and southern coast of Korea, using airborne hyperspectral imagery collected in 2019. The hyperspectral image data acquired over the sea surface contain radiometric signals from the seabed and the water column in a subtidal zone for the wavelength interval of roughly 400 ~ 2500 nm. A series of preprocessing procedures including the geometric correction, the atmospheric correction, the removal of surface reflectance, and the water column correction were conducted prior to performing classification of seabed cover types based on the spectral library collected in the field. The classification results were then validated based on diver's photographs of the seabed captured synchronously with the aerial hyperspectral images.

Keyword : Whitening , Coralline flats, Hyperspectral

Corresponding Author. : **Jaehong OH** (jhoh@kmou.ac.kr)

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Estimation of microalgae abundance in mudflat surfaces of Geunso bay using optical remote sensing

Soo Yoon KOH[1, 2], Seung Il BAEK [1], Jae Hoon NOH[2], Sung Min AN[2], Myung Jin HYUN [3], Won Kook KIM [*1]

[1] *Civil and Environmental Engineering, Pusan National University, Korea*
[2] *Marine Ecosystem Research Center, Korea Institute of Ocean Science and Technology , Korea*
[3] *KIOST School, Korea University of Science and Technology, Korea Institute of Ocean Science and Technology, Korea*

Mudflats are crucial for understanding the ecological structure and biological function of coastal ecosystem because of high primary production by microalgae. However, the observation of primary productivity with field instruments is limited for large areas due to the intensive human resource and time required for the survey. Using a drone equipped with a multispectral camera, it is possible to remotely estimate the concentration of chlorophyll in the surface layer in wide areas of mudflats.
In this study, an algorithm is developed to estimate the spatial distribution of microalgae present on the surface of the Geunso bay mudflat, South Korea. As the seawater exchanges between the bay and the sea at this 30 km2 half-closed bay, it is a suitable place for observing the prosperity of various microalgae dynamics. To assess the chlorophyll concentration of microalgae from the multispectral image, the reflectance of the mudflat surface layer is measured with both a hyperspectral radiometer (TriOS Ramses) and a multispectral camera (RedEdge-MX). The changes in reflectance by the chlorophyll concentration variation is analyzed firstly for hyperspectral sensor, and an algorithm that estimate chlorophyll concentration is derived for the reflectance of the multispectral camera. In-situ chlorophyll concentration of the mudflat surface layer is measured by the fluorescence method and high-performance liquid chromatography (HPLC). The measurements from the two methods are cross-validated, and are used for algorithm development and performance validation. The developed algorithm is applied to the multispectral images to produce a map of chlorophyll concentration for an area of about 2 km2 in the mudflats of Geunso bay.

Keyword : Mudflat, Microalgae, Multispectral camera

Corresponding Author. : **Won Kook KIM** (wonkook@pusan.ac.kr)

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Generation of orthophoto and 3D models for monitoring breakwaters in coastal areas using unmanned aerial vehicle

Ki Rim LEE[1], Ji Hoon SEONG[1], You Kyung HAN[2], Won Hee LEE*[2]

[1] *Department of spatial Information, Kyungpook National University, Korea*
[2] *School of Convergence & Fusion System Engineering, Kyungpook National University, Korea*

Breakwaters can be weakened, damaged, and moved by typhoons or strong waves, and severe coastal damage can occur when breakwaters are damaged. To prevent such damage, evaluating the safety and functionality of the breakwater, and monitoring system for estimating the damage are important. Existing breakwater monitoring is conducted by visual detection. However, UAV, which is capable of producing high-resolution images since the development of technology, is one of the great ways to replace the visual detection method.
In this study, the orthophoto and three-dimensional data were generated and evaluated for accuracy by using UAV in the breakwater of the Pohang area, which was recently damaged by earthquakes and typhoons. First, GPS surveying was performed to improve the accuracy of the position of the drone image. The GCPs and the check points for evaluating the accuracy of the produced orthophoto were measured, and the GPS points for evaluating the three-dimensional data accuracy was separately measured. Afterwards, images data around the breakwater at the study site was acquired using Inspire 2, and the camera was photographed at a 45-degree angle for produce three-dimensional data. Orthophoto and three-dimensional data were produced using PhotoScan pro. Based on the aerial surveying work rules, the accuracy of orthophoto produced using GCPs and check points was evaluated, and the accuracy of the three-dimensional data was evaluated by comparing the DEM value with the GPS value corresponding to the location.
Through this study, it is considered that the time and cost required for the safety inspection of the breakwater can be reduced, and the surveying necessary for the safety inspection can also be economically performed. In the future, we will also study the breakage and movement of the breakwater through continuous monitoring.

Keyword : UAV, Breakwater, Monitoring

Corresponding Author. : **Won Hee LEE** (wlee33@knu.ac.kr)

P328

A Study on How to Increase the Utility of the Coastal Basic Map

Jae-Cheol LEE*

Civil Engineering, Kangwon National University, Korea

Due to the nature of Korea's topography where the three sides are in contact with the sea, the importance of providing information in coastal waters is increasing day by day. accordingly, the National Geographic Information Institute provided a basic survey of coastal waters from 1977 to 2008 in the past for the purpose of securing basic data for design and development for coastal waters(within 50m depth). Since 2010, it has been provided with the results of a detailed survey of coastal waters by the Korea Hydrographic and Oceanographic Agency, and has been using it to provide a basic coastal water map.
However, there has been no continuous construction of information on all coastal waters in Korea, and it is not possible to provide detailed and precise coastal waters for each coastal situation.
In this study, in order to improve the effectiveness of the current coastal basic map, we analyzed and reviewed the current state of map construction and management in Korea to draw problems, and based on the drawn problems, we discussed ways to improve the new coastal basic map. through this study, by providing a continuous and unified coastal basic map of all coastal waters in Korea, it is possible to provide information on coastal waters with high utility that can be widely used not only in coastal construction projects but also in various industries related to spatial development of coastal waters.

Keyword : Coastal basic map, I.M.S.L(Incheon Mean Sea Level), D.L(Datum Level)

Corresponding Author. : **Jae-Cheol LEE** (essentialee@kangwon.ac.kr)

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P329

Urban Flood Inundation Simulation based on High-precision 3D Modeling

Jung Ok KIM[1], Jae Kang LEE*[2]

[1] *AICT, Advanced Institute of Convergence Technology, Korea*
[2] *Department of Future Technology and Convergence Research, Korea Institute of Civil Engineering and Building Technology, Korea*

Flooding is one of frequent climate-related natural disasters and affects many people around the world. In recent years, a large natural disasters have occurred due to unusual weather and damage is increasing by high density population and large buildings in coastal urban areas. The spatial characteristics in urban floods are complex due to the widespread change to the land uses such as buildings, roads and drainage networks. In particular, urban infrastructures that affect urban flood modeling includes the location and geometry of building. Hydrological modeling can adequately simulate both surface and subsurface processes at the watershed level, most of them cannot accurately simulate urban flooding without 3D city modeling. 3D simulation of the computation results is important in practice. In recent years, simulation technology of flood have been used to build 3D virtual environments based on data such as HD (High Definition) map, LiDAR point clouds, drone images. The main objective of the study is to develop and simulate an urban flood inundation based on 3D city modeling. The model is tested for coastal city in Republic of Korea. Our case studies show reasonable match between the observed and modeled flood spatial extents and highlight the importance of considering 3D city model in urban flood simulations.

Keyword : Flood Hazard Map, Flood Damage, Disaster Management System

Corresponding Author. : **Jae Kang LEE** (geostar1@snu.ac.kr)

P330

Analysis of Beach Erosion Changes Using Time Series of Coastal Spatial Data

Hyungseok LEE, Inho KIM, Dongseob SONG*

Dept. of Earth and Environmental Engineering, Kangwon National University, Samcheok, Korea

On the east coast of Gangwon province, a fishing port has been established for fishing activities, and there is a net function of regional economic development, while coastal erosion is occurring as a reverse function. The Yeongjin Port, the site of this study, was constructed in the Yeongok River Estuary, causing problems with the sand budget, resulting in harbor sedimentation and erosion in surrounding areas. Therefore, monitoring data such as shoreline, beach profile, water depth survey, sand characteristic, and aerial photography for the past 10 years (2010~2019) were used to find out the cause of sand movement. In particular, the waves on the east coast of Gangwon province are distinctly different in each season, so acquiring monitoring data on a periodic basis is very important in understanding the change in sea topography. Therefore, in this study, DSM was generated for coastal topography through unmanned aerial image information and water depth survey, and UAV image information captured in time series was analyzed for terrain change through 3D modeling performance. In addition, in order to secure the reliability of the measurement data, survey data through GPS for 10 years and surveying data through UAV observed by period were compared and verified. As a result, the coastal fluctuation from Yeongjin Port to Sacheon Port averaged 15~23%, and the average beach width was analyzed to be 31~42m. Acquiring periodic data through monitoring erosion allows understanding the change in beach topography and comparison with existing results.

Keyword : Monitoring data, Coastal erosion, Coastal topography

Corresponding Author. : **Dongseob SONG** (sds@kangwon.ac.kr)

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Development of automatic detection method of land characteristics based on environmental factors of coast adjacent land

SeungMin JOO[1], JunHyun KIM [*2]

[1] *R&D Office, KOREA APPRAISAL BOARD, Korea*
[2] *Department of Geography, Kyungpook National University, Korea*

The Korean government estimates the land value every year and uses it as a standard for taxation and appraisal. The estimated land value, the appraised land value, is used in various fields such as appraisal of land prices, evaluation of loans and collateral by financial institutions, compensation evaluation according to development, welfare system and administrative standards, etc.
Currently, in the estimation of appraised land value, the value evaluation items are composed of total 35 items, including public regulation, topography, road conditions, and access to hazardous facilities. However, there is nearly no review for disaster, tourism and view that may occur according to coast adjacency.
In the case of coast adjacent areas, the land price of some area may rapidly decrease due to frequent flooding in high tide or sea level rise according to the climate change but the land price of other area such as sand coast and coastal terrace may increase according to excellent view and aesthetic functions.
The purpose of this study is to deviate from the direct survey method and to develop a value evaluation method for coast adjacent land by using remote exploration and GIS spatial analysis methods to accurately evaluate coast adjacent area in the current appraised land value estimation method.
The results of this study can be used for protection of property rights, tax equity, and national land policy through accurate value judgment on coastal adjacent lands. Furthermore, it can be used as basic data for evaluation and compensation of coastal adjacent lands according to the climate change.

Keyword : Appraised land value, Coastal topography, GIS spatial analysis

Corresponding Author. : **JunHyun KIM** (kamcho78@nate.com)

P332

Proactive Monitoring of Sea Wave based on Precision GNSS Positioning

Minho KIM, Tae-Suk BAE*

Geoinformation Engineering, Sejong University, Korea

Since the global warming becomes evident, the sea level is accordingly changing with unprecedented manner. In addition, due to the difficulty of its prediction, it sometimes causes a loss to human life and property, as well as the damages such as oil spills from ship overturn and/or stranding. Therefore, monitoring sea wave is one of the essential factors to deal with the disasters caused by climate change. Ocean vessels generally use the radar to measure the roughness of the sea surface based on the reflected value. Another example of monitoring sea wave is buoy, which measures the height of wave near the coast through Global Navigation Satellite System (GNSS) Real-time Kinematic (RTK) positioning. However, the RTK is known to be reliable within 10 km from a reference station, therefore, it may not be applicable to the vessels off the coasts. We are seeking to develop a strategy to monitor sea wave through accurate positioning of ocean vessels. The primary error source in GNSS is the ionospheric delay, thus accurate modeling of the ionosphere is essential to estimate the position of the vessels, resulting in an accurate determination of the sea wave. This study intends to propose a method to model an ionospheric error in the ocean for monitoring the sea wave using high accuracy GNSS positioning. The Precise Point Positioning (PPP) can be applied for the receiver onboard vessels anywhere on the globe. Assuming every vessel carries the GNSS receiver, we will estimate the ionospheric delay and model its distribution on a regional scale to provide the correction information for better estimation of the sea wave. Once the accurate ionosphere model is provided in the ocean, more precise monitoring of sea wave can prevent the risk of vessel navigation.

Keyword : GNSS, Positioning, Sea Wave

Corresponding Author. : **Tae-Suk BAE** (baezae@sejong.ac.kr)

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Development of Unmanned Surface Vehicle(USV) Combining Unmanned Ship and Wired Unmanned Undersea Vehicle (WUUV)

JongSin KIM[1], **JunHyun KIM**[*2], Kyung Woon PARK[3]

[1] *Representative Director, Marine Research, Korea*
[2] *Department of Geography, Kyungpook National University, Korea*
[3] *Director, Marine Research, Korea*

Currently, domestic and foreign marine water surveys are conducted by measuring the geometric characteristics of the exploration equipment based on the incidence angle of the vessel. In the case of such a ship-based survey, a problem arises in that the resolution decreases as the depth increases due to the geometrical characteristics according to incidence angle of the sensor. Therefore, it is necessary to lower the probe to the seabed. An error in the position of the waters actually measured occurs. In order to solve this problem, the development of an unmanned surface vehicle that combines an unmanned ship and a wired unmanned undersea vehicle is required for safe management of seabed topographic changes, seabed geological survey, and harbor seabed structures and for continuous and precise underwater investigation. Therefore, this study suggests to prepare Unmanned Surface Vehicle (USV) consisting of Unmanned Ship and Unmanned Undersea Vehicle (UUV), Remotely Operated Vehicle (ROV) and Winch System, and to move USV to the measurement position and conduct the underwater observation through Winch System, ROV Launch/Recovery System and ROV. In the case of the position/posture correction system, first, the initial position will be corrected through the GPS of the gull, and the position of ROV will be corrected through USBL (Ultra Short Baseline). Finally, the position/posture errors will be minimized by correcting the yaw angle value through IMU sensor. The accuracy can be improved by measuring at the short distance by mounting the observation sensor on ROV. It is possible to identify the features or changes of the seabed in real time to be observed in the ocean by using the side scan sonar and/or camera system. It is expected that the demand based on USV-ROV Platform technology as shown in this study will increase in order to confirm the precise location of objects.

Keyword : Seabed geological survey, Realtime measurement, USV-ROV Platform technology

Corresponding Author. : **JunHyun KIM** (kamcho78@nate.com)

P334

Analysis of Shoreline Variation by Cross-shore Sediments Transport Resulting from Effects of Duration of Storm Waves

TAEKON KIM[1], JINHWAN JEONG[1], JUNGLYUL LEE*[2]

[1] *School of Civil, Architecture and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *School of Water Resources Engineering, Sungkyunkwan University, Korea*

Coastal erosions, owing to high waves, are mainly as a result of the effects of duration of waves. In particular, the west coast of Korean peninsula exhibiting great tidal range, the coastal erosion, resulted from effects of duration of waves, occupies an absolute portion. The study of Kim and Lee (2018), which was carried out based on results of study conducted by Dean (1977) and Yates et al. (2009), did not take into account the effects of duration of high waves in predicting the range of variation of shoreline resulted from cross-shore transport of sediments, thus, it's regarded that it would render over estimations. The present study therefore presented the methodology to predict the range of shoreline variation by cross-shore transport of sediments through analyses of duration of high waves and dimensionless interpretation of wave data from NOAA. The duration of high wave was analyzed through dimensionless interpretation of the data from NOAA, and the reliability of the methods of analysis was verified through comparison with site observations of the east coast of Korean peninsula.

Keyword : Wave duration, Shoreline variation, Cross-Shore

Corresponding Author. : **JUNGLYUL LEE** (jllee6359@hanmail.net)

Changes to Wave Height and Transmission Ratio at Front and Back Submerged Breakwater

Jinhoon KIM, Inho KIM, Hyungseok LEE*

Dept. of Earth and Environmental Engineering, Kangwon National University, Samcheok, Korea

The topographical characteristics of Gangwon's east coast city are narrow and long. Recently, coastal roads and coastal buildings have been constructed indiscriminately on coastal sand dunes, causing serious coastal erosion. In order to prevent coastal erosion, the submerged breakwaters is often used, but the functional verification often relies only on numerical analysis and small hydraulic model test with large uncertainties. Therefore, in this study, a field measurement was conducted to confirm the functional verification of the transmission wave height of the latent, which was constructed for the purpose of preventing erosion on the beach in Gonghyeonjin, Gangwon-do. Two sites (W-1, W-2) were selected to understand the wave characteristics of the coastal area of Gonghyeonjin Beach. W-1 installed AWAC at EL(-)24.0m at the waterfront of Gonghyeonjin Beach, and W-2 installed a wave gauge at EL(-)3.0m between submerged and the beach. The wave observation was implemented for 26 months. The observed data at vertices W-1 and W-2 were analyzed for the wave height and distribution characteristics of the period by spectral method. It can be seen that the wave height at the W-1 point is relatively larger in winter than in the summer, and the wave direction is predominantly NNE~E in the winter and ENE~ESE in the winter. From the observation results from November 18, 2016 to December 19, 2016, the average wave height at the outside of the submerged (W-1) is approximately 1.2 m, and approximately 0.8 m at the submerged inside (W-2). It showed an attenuation effect of about 32%. From June 10, 2017 to July 25, 2017 after the submerged construction, the average wave height observed from the outside of the submerged (W-1) was approximately 0.9 m, and the average wave height observed from the inside of the submerged (W-2) was observed at about 0.3m, exhibiting an attenuation effect

Keyword : Submerged breakwater, Transmission ratio, Wave height

Corresponding Author. : **Hyungseok LEE** (LHS0815@empal.com)

P336

Establishment of the erosion control line from long-term beach survey data on the macro-tidal coast

Soon-Mi HWANG[1, 2], Jung Lyul LEE[2], Yong-Ho CHOI[1], Ki-Hyun KIM[1], Tae-Soon KANG*[1]

[1] *Coastal management, Geosystem Research Corporation, Korea*
[2] *Water resources, Sungkyunkwan University, Korea*

Due to the indiscriminate development of the coast, the damage caused by coastal erosion on the coast of Korea is increasing, so it is important to establish the erosion control line to preserve the coast.
The west coast of Korea is macro-tidal coast and the sea level is significantly different depending on the tide level. so the establishment of erosion control line is conducted on the macro-tidal coast. Manripo Beach is selected as a study site located in the western coast of Korea. It is one of the three major beaches and regarded as a famous sightseeing spot in Taeanhaean National Park along with northern Cheonnipo Beach. However, due to the reduction of sand on the beach and coastline, on the 2019' Coastal Erosion Monitoring conducted by Ministry of Oceans and Fisheries, Manripo Beach was evaluated the coastal erosion grade as the lowest grade D, and was classified as a serious erosion area.
Since structures affecting erosion have not been constructed from 2009 to present when survey was conducted(Ministry of Maritime Affairs and Fisheries), it is possible to establish erosion control line using long-term beach survey data. Beach survey has been conducted twice a year starting from 4 baselines in 2009 and divided into 15 baselines as of 2020. The beach width and cross-sectional area were calculated based on various tide levels.
It was found that the variation of the beach width has a normal distribution, the sensitivity of the coastline is analyzed using the mean and standard deviation. Thus the erosion control line is estimated for the beach width by return period of 30 years. The results of this study can be the basis for the establishment and coastal management of erosion risk areas.

Keyword : Coastal erosion, Erosion control line, Macro-Tidal coast

Corresponding Author. : **Tae-Soon KANG** (kangts@geosr.com)

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Field Observation and Numerical Modeling for morphological response of the macro-tidal beach

Hyunjung JUN[1], Kideok DO[*1], Tae soo CHANG[2]

[1] *Department of Convergence Study on the Ocean Science and Technology, Korea Maritime & Ocean University, Korea*
[2] *Department of Ocean Science, Korea Maritime & Ocean University, Korea*

Macro-tidal sand beaches with tidal ranges exceeding 4 m are global coastal features but are less understood than micro-tidal sand beaches. This study investigates a Group 1 beach (higher waves, planar, uniform slope) that occurs in a high wave environment with a modal breaker height exceeding 0.5m. Firstly, we measured the water level, current and the bathymetry of Sinduri Beach from Feb, 27th to Dec, 20th, 2017. Sinduri Beach (latitude 36.84° N and longitude 126.19° E) located on the west coast of Korea, which developed the large scale multi-sand bar with a tidal range of 5 to 7 m. This study installed one pulse coherent Acoustic Doppler Velocimeter (ADV) and Current Profiler (ADCP) at one station in a water depth of 1.86 m. Differential Global Positioning System (DGPS) used to measure the beach profile above the water level during low tides. This study analyzed the field data and found that the multi-sand bar disappeared in high-wave conditions (winter) and developed in low-wave conditions (summer), which are different in the general beach process. Nextly, the analyzed field data used to examine the water level fluctuation and current in the coastal area and assess the applicability of the Delft3D model. For the wave condition, a total of 60 representative scenarios selected by analyzing the ERA5 reanalysis data in the offshore area. As a result of the numerical simulation, the sediment transport in Sinduri Beach has predominant onshore direction in the high wave season (Winter). The suspended sand by high wave moved to onshore by the interaction of wave and tide, which caused the multi sand bars to disappear. In the summer, sediment transported offshore by water level change and strong tidal current and developed the multi-sand bar at the water depth of 4 to 7 m.

Keyword : Macro-Tidal Beach, Sediment Transport, Sand Bar

Corresponding Author. : **Kideok DO** (kddo@kmou.ac.kr)

P338

Development of Mathematical Formula of Annual and Seasonal Wave Distributions from NOAA Wave Data

Changbin LIM[1], Junglyul LEE*[2]

[1] *School of Civil, Architecture and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *Graduate School of Water Resources, Sungkyunkwan University, Korea*

The shoreline continues to change due to the influence of climate change such as wave, tidal and wind, as well as the effects of development of coastal structures. Among them, shoreline change is most sensitively affected by wave, particularly wave angle. The littoral drift would form a shoreline wherein the value of the angle between shoreline and wave crest line becomes 0. And the repetitive seasonal effects responded shoreline change due to the littoral drift. Therefore, it is important to accurately analyze the effects of wave directional characteristics. The seasonal wave direction distributes with different characteristics. In addition, it has the asymmetric wave direction distribution. Thus, it is necessary to development the mathematical formula that can reflect these seasonal characteristics. Using cos2s formula, which is Lee et al.(2010) suggested, the present study investigated how applicable to the coast of the Republic of Korea with long-term wave hindcast data, NOAA data. The formula was seen reasonable results that reflect the seasonal wave characteristics. And assuming that wave height and wave direction are independent characteristics and follow each distribution, there was a proportional relationship between the wave energy of each wave direction component and the concentration of the wave direction.

Keyword : Wave Directional Distribution, Rayleigh Distribution, Long-Term Wave Hindcast Data

Corresponding Author. : **Junglyul LEE** (jllee6359@hanmail.net)

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A Study on the Management Coastline at the East Sea in South Korea

Seung Min PARK, **Seon Jung PARK***, Gyeong Sik SEO, Yeoung Ju YU, Heui Jung SEO

Institute of Technology, HYEIN E&C Co., LTD, Korea

Due to recent climate changes, the sea level has been continuously rising, and abnormally high waves such as swell-like high wave are occurring frequently. In South Korea, coastal erosion problems are occurring not only in these environmental impacts but also indiscriminate coastal development.
In this study, the concept of a management coastline for efficient coastal management was established and a management coastline was established for the beaches of Gangwon-do, where severe coastal erosion was occurring.

Keyword : Beach erosion, Mamagement coastline, Wave data

Corresponding Author. : **Seon Jung PARK** (nayana_sj@hanmail.net)


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Poster Sessions

P401

Three-Dimensional experimental study on the wave attenuation characteristics of the Coral Cell

JONGYEONG KIM, TAEYOON KIM, SUNGHOON HONG, SOONCHUL KWON*

Dept. of Civil Engineering, Pusan National University, Korea

Recently, ductile submerged breakwater have been paid attention as the substitute of the rigid structure to mitigate coastal erosion. This study investigated three-dimensional hydraulic model experiment to review the wave attenuation characteristics when the ductile structure, 'Coral Cell' was installed. At first, we generated more than 100 regular waves and measured at 7 points in lateral direction and 4 points in longitudinal direction in order to calculate wave transmission rate. As the control variables, we set the wave height(6~8 cm), wave period(1.75 ~ 2.25 sec) and crest height(2~6 cm) to evaluate their effects. Longitudinally, wave transmission showed the highest rate right in front of the structure and then in 1m section, the transmission rate was 40%, and only 15% transmitted when passing 3m section. Laterally, as the wave propagate over the structure, the transmission rate was low(7~11 %) in the middle part and high(11~19)% at the edge. Moreover, the wave transmission rate was higher as the wave gradient and crest height got increased. Based on the result, potential of the 'Coral Cell' for adopting to submerged breakwater is verified and it is worthy of further research.

Keyword : Wave Attneuation, Submerged breakwater, Artificial Reef

Corresponding Author. : **SOONCHUL KWON** (sckwon@pusan.ac.kr)

P402

Cost comparison between hard and soft approaches adapted as preventive methods of beach erosion

Yoon Jeong YEON[1], Jung Lyul LEE*[2]

[1] *School of Civil Architectural and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *Graduate School of Water Resources, Sungkyunkwan University, Korea*

To protect the property placed behind beaches, either approaches constructing a submerged breakwater or conducting a beach nourishment unit, which are the representative hard and soft approaches, are employed. Submerged breakwater controls the waves to mitigate the beach erosion and to protect background facilities, whereas the beach nourishment provides beach width sufficient to protect background facilities.
In the present study, the cost of building either submerged breakwater or beach nourishment unit, which is required to secure the sufficient buffering zone against the wave impact of the return period of 30 years, will be estimated and compared to each other.
To estimate the cost of developing submerged breakwater, the correlation between wave energy flux and MSL is needed thus the observations of shoreline variation taken four times a year for the period of 10 years were used. And to estimate the cost of beach nourishment, the estimations of the beach losing rate of nourished sand are needed as time goes by since the nourished sands are subject to disappear. By taking the losing rate as a sensitive parameter, the costs of the two approaches will be compared to each other, since its accurate estimation would be difficult.

Keyword : Cost comparison, Preventive methods, Beach nourishment

Corresponding Author. : **Jung Lyul LEE** (jllee6359@hanmail.net)

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Evaluation of Coastal Sediment Budget on East Coast Maeongbang Beach by Wave Changes

Gweonsu KIM*, Hasang RYU, Sanghoon KIM

Port & Coastal Development Institute, SEIL ENGINEERING CO., LTD., Korea

Numerical simulation of the sediment by the Delft3d model was conducted to examine the changes in the sediment budget transport caused by long-term wave changes at the Maengbang beach. Representative waves were generated with input reduction tools using NOAA NCEP wave data for about 40 years, i.e., from January 1979 to May 2019. To determine the adequacy of the model, wave and depth changes were compared and verified using wave and depth data observed for about 23 months beginning in March 2017. As a result of the error analysis, the bias was 0.05 and the root mean square error was 0.23, which indicated that the numerical wave results were satisfactory. Also, the observed change in depth and numerical result were similar. In addition, to examine the effect due to long-term changes in the waves, the NOAA wave data classified into each of the representative wave grades, and then the annual trend of the representative wave was analyzed. After deciding the weight of each wave class considering the changed wave environment in 2100, the amounts of sedimentation, deposition, and the sediment transport budget were reviewed for the same period. The results indicated that the sedimentation pattern did not change significantly compared to the current state, and the amount of the local sediment budget shown in the present state was slightly less. And there has been a local increase in the number of sediment budget transport, but there is no significant difference in the net and amount of sediment movements

Keyword : Sediment budget, Wave change, Input reduction tool

Corresponding Author. : **Gweonsu KIM** (kimknsu@hanmail.net)

P404

Assessment of Geo-Environmental Condition for Development of Mangrove Ecosystem in Coastal Areas, Tra Vinh Province

TRONG VINH BUI*

GEOLOGY AND PETROLEUM ENGINEERING, HO CHI MINH CITY UNIV. OF TECHNOLOGY, VNU-HCMC, Vietnam

Mangroves play important roles in: (1) providing livelihood for people; (2) protecting and preventing natural disaster; (3) reducing erosion and protecting land; (4) reducing pollution; (5) reducing the impact of climate change; (6) providing food and habitat for many animals. Mangrove ecosystem in Tra Vinh also contribute significantly to the national mangrove system. In the economic development process, it has been destroyed heavily. In 1975, the mangrove area in this region was over 19,000 ha. However, according to Tra Vinh Provincial FDP, the whole mangrove area was only 12,400 ha in 1980. It continued to go down to 5,924 ha in 1990 and 5,429 ha in 1992 (Tra Vinh People's Committee, 2010). At present, there are over 8,622 ha of mangroves and to be expected to cover 9,000 ha in 2020 by ODA (VNA, 2016). Therefore, the research team conducted the research to assess the current geoenvironmental condition in Duyen Hai area, Tra Vinh province. The result from 15 samples show that: for surface water, the pH value from 6.39 to 8.11, the salinity varies from 26 to 2 ‰, the Eh value ranging from -2 mV to -91 mV, slightly redox potential; for soil samples, all the pH values of sediment are rather low, they vary from 3.7 to 7.2, the total organic carbon (TOC), total nitrogen (TN) and total phosphorous vary widely (0.5-2.41%, 0.015-0.17% and 0.04-0.07% respectively). Moreover, soil erosion was also observed in the afforestation area.

Keyword : geo-Environment, Mangrove ecosystem, Coastal area n Tra Vinh

Corresponding Author. : **TRONG VINH BUI** (btvinh@hcmut.edu.vn)

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P405

PHYSICAL MODEL TESTS FOR TSUNAMI MITIGATION MEASURES IN PALU BASED ON THE 2018 SULAWESI EARTHQUAKE AND TSUNAMI

Adi PRASETYO*, Leo Eliasta SEMBIRING, Ma'ruf Hadi SUSANTO, Huda BACHTIAR, Daniel FERNANDO

Ministry of Public Works and Housing, Experimental Station for Coastal, Indonesia

Tsunami struck Palu Bay, which is triggered by a 7.4 M on the Righter scale due to the movement of the Palu Koro Fault on September 2018. According to National Disaster Management Agency (BNPB), 4.340 people were dead and missing, around 4.438 people were injured, and more than 172,000 people are evacuated with total economic damage about 1.1 billion USD. Under the circumstances, the Indonesian Government had decided to develop a national panel of Indonesian expert for tsunami, earthquake and liquefaction. Therefore, a series of hydraulic model experiments is already conducted to evaluate the effect of tsunami countermeasures. The characteristics of tsunami due to landslides was a short wave period which is easy to reduce the energy. Therefore, the countermeasures for tsunami mitigation will be the combination of hard and soft structure solution; the solution comprises with coastal protection, elevated road, vegetation and mangrove. The experiments were implemented in the laboratory of experimental station for coastal which is located in Buleleng, Bali. Using a solitary wave, several kinds of cases with and without countermeasures were performed. First scenario using combination of mangrove with particular dimension and area, revetment, inland trees and two different elevated roads with height +5.0 and +6.5 MSL. Second scenario more focused on variation of mangrove, width of inland trees and using elevated road with height +5.0 MSL. Similar with second scenario, third scenario conducted in terms of high water level (+1.4 MSL). Fourth scenario demonstrated in same condition as the second, however the different sea water level applied (+0.7 MSL).
The result achieved from this experiment is the most effective scenario is found in several scenarios which have 5 cm of mangrove density and demonstrated on wave target 11 cm with result of reduction rate behind elevated road is 1.00 (no overtopping found).

Keyword : Tsunami, , Structural and non-Structural measures, Solitary Waves

Corresponding Author. : **Adi PRASETYO** (adi.prasetyo246@yahoo.com)

P406

Numerical study of non-linear wave run-up around a circular cylinder in regular waves

Jong-Hyun LEE[1], **Bonguk KOO**[*2]

[1] *NavalArchitecture & Ocean Engineering, Gyeongsang National University, Korea*
[2] *Naval Architecture and Marine Engineering, Changwon National University, Korea*

In this study, numerical simulations have been carried out to investigate the non-linear wave run-up phenomena of a single cylinder according to wave period and slope. In order to perform numerical analysis on a three-dimensional incompressible viscous turbulent two phase flow, this study used a volume of fluid (VOF) technique and a realizable turbulence model based on the computational fluid dynamics (CFD) commercial code, “STAR-CCM+”. The wave period for the model scale is 1.269 seconds and 1.692 seconds. Each case has a wave slope of 1/30, 1/16. Finally, the wave run-up estimation results for wave slope and period were compared with the related experimental results and they had good agreement. It was confirmed that as the wave steepness increased, the run-up phenomenon appeared largely at the part where the cylinder hit the incident wave.

Keyword : Wave run-Up, Offshore cylindrical structure , CFD

Corresponding Author. : **Bonguk KOO** (bonguk9@changwon.ac.kr)

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P407

Numerical study of flow characteristics around a wedge-shaped bow

Bonguk KOO[1], Yong-Duck KANG[*2]

[1] *Naval Architecture and Marine Engineering, Changown National University, Korea*
[2] *School of Shipbuilding, Automobile, Aircraft & Mechanics, Yonam Institute of Technology, Korea*

Numerical study has been performed to investigate the flow characteristics such as wave breaking mechanism and small scale features of ship bow waves. The geometry of wedge-shaped bow used in the present study is from one of previous studies (Waniewski et al. (2002)) and the condition of calculation is with Re = 1.64×105 and Fr = 2.93. Star CCM+, one of commercial CFD softwares, has been used to carry out the numerical calculations. Results such as overall bow wave profile, plunging jet shape, air entrainment, and wave breaking process have been compared with other experimental and numerical studies and discussed some discrepancies with others.

Keyword : Wedge-Shpaed bow, Wave breaking, CFD

Corresponding Author. : **Yong-Duck KANG** (bonguk9@changwon.ac.kr)

P408

Flow control behind hemisphere in turbulent flow

YONG DUCK KANG[1], Bonguk KOO*[2]

[1] *School of Shipbuilding, Automobile, Aircraft & Mechanics, Yonam Institute of Technology, Korea*
[2] *Department Naval Architect & Marine Engineering, Changwon National University, Korea*

An experimental study on separation control in front of a hemisphere by local wall suction was performed in a circulating water channel. A vortical system engirdling a bluff body in turbulent flow was targeted to mitigate its effect on the wake region where hairpin vortices shed. Local wall suction caused a change in the static pressure distribution over the hemisphere surface, moving the flow separation point upstream. As the flow detached early from the hemisphere surface, the size of the wake region increased indicating that it took longer to generate the vortices. LDV measurement indicated that the frequency of hairpin vortices in the wake region was reduced. The reduction in the vortex shedding frequency was attributed to the weakening of the standing vortices by local wall suction, which resulted in a reduction in the inrush in the wake region.

Keyword : Vortex shedding, Local suction, Turbulent flow

Corresponding Author. : **Bonguk KOO** (bonguk9@changwon.ac.kr)

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P409

Experimental study on the correlation between wave reflection and overtopping in regular waves fields

WOODONG LEE[1], Yeon Myeong JEONG[2], Jong Ryul PARK[3], Dong Soo HUR[*1]

[1] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[2] *Institute of Marine Industry, Gyeongsang National University, Korea*
[3] *Earthquake Hazard Research Division, National Disaster Management Research Institute, Korea*

In this study, hydraulic experiments were conducted to analyze the correlation between wave reflection and overtopping by seawalls under a regular wavefield condition. In a two-dimensional wave flume at a depth of 50 cm, regular waves with a period of 1.2–2 s and a height of 1.0–2.6 cm were generated. For the experimental condition, vertical and absorbing seawalls with tetrapod (TTP) on the base mound were considered separately. The reflection coefficient of the wave was obtained by calculating the water-level fluctuations (measured via a crest meter) using the Goda method, and the overtopping discharge was measured directly in a separate wave flume. As a result, the wave reflection coefficient clearly exhibited a decreasing tendency, as the overtopping discharge increased in the vertical seawall. However, in the absorbing seawalls, not only was the overtopping discharge smaller than that of the vertical seawalls, but the reflection coefficient was also smaller. In addition, the slope of the wave reflection coefficient and the overtopping discharge was gentler in the absorbing seawalls than in the vertical seawalls.

Keyword : Wave reflection , Wave overtopping, Hydraulic experiment

Corresponding Author. : **Dong Soo HUR** (dshur@gnu.ac.kr)

P410

Interaction Analysis between Artificial Reef Blocks under Tidal Current using FSI Method

Choonghyun KANG[1], Woodong LEE[1], Taewan KIM[2], Sungnam HONG[*1]

[1] *Dept. of Ocean Civil Engineering, Gyeongsang National University, Korea*
[2] *Dept. of Civil Engineering, Pusan National University, Korea*

This study discusses a method for estimating the structural stability of a coastal concrete structure with an emphasis on sliding and over turning due to tidal current or waves. Because of the complexity of fluid flow behavior, a coastal structure was assumed to be a rigid body for structural safety reviews. Namely, the safety reviews assume the stress and strain of a structure insignificant and focus only on the fluid analysis. However, structural analysis should be considered especially if the structure is not of a single, large block construction, such as artificial reef blocks, which are stacked on each other. An artificial reef is normally composed of small concrete blocks stacked together. A section of each block is relatively small, and interacts with each other blocks. Macro issues, such as sliding and over turning as well as micro issues such as stress concentration and contact between blocks must be considered. This study emphasizes the micro-structural point of view, such as stress and strain of each artificial block and the interaction between blocks. ABAQUS 2D fluid-structure interaction analysis was performed where simultaneous analysis was completed using computational flow dynamics; in addition, the performance of a structural analysis using finite element modeling.

Keyword : FSI analysis, Contact analysis, Artificial reef blocks

Corresponding Author. : **Sungnam HONG** (snhong@gnu.ac.kr)

Poster Sessions

P411

Simulation Gusan beach morphology changed by using CST3D-WA

Seungho LEE*, Hyoseob KIM, Duhoon PARK

Major in hydraulic engineering, Kookmin University, Korea

Shoreline always moves back and forth on any coast. Its variability has threatened safety of onshore territory and attracted interests from many coastal engineers. Its short or medium term variation around equilibrium position and long-term irrepressible evolution are fundamentally different. The former may threaten stability of coastal facilities or wash out sediment at beaches mainly due to cross-shore sediment transport or seasonal alongshore transport, while the latter induces one-sided morphological change due to mainly steady alongshore sediment transport or circulations around structures.
Korea East shoreline has suffered erosion, and coastal roads have collapsed. Several submerged breakwaters have been built to protect further erosion at the places. It is important to predict the effect of the submerged breakwaters in advance, but not much work has been done about the prediction due to limitations of mathematical formation involved in numerical modelling, or difficulty in scaling bed material in physical modelling. Ranasinghe et al. (2010) proposed a parameterized equation for distinction of a submerged breakwater whether it will cause erosion of siltation. However, they used depth-average flow and morphologic change model, and did not clearly define erosiveness of a shoreline around a structure.
CST3D-WA has recently been refined to be able to simulate shoreline retreat and advance by adopting the beachface controlling method. A submerged breakwater of 100m×40m was built at Gusan beach at the end of 2005. By 2017, eight additional submerged breakwaters were constructed along the shoreline. The tombolo developed significantly behind the two submerged breakwaters. CST3D-WA reproduced the shoreline advance well.

Keyword : Shoreline, CST3D, Submerged breakwater

Corresponding Author. : **Seungho LEE** (stork@kookmin.ac.kr)

P412

Corrosion resistance of passive films formed on low-nickel duplex stainless steel in nitric acid solution containing sodium molybdate

Jeonghyeon YANG[1], JongBeom CHOI[2], KyungHwang LEE[3], Jun KANG[4], MyeongHoon LEE[4], YongSup YUN[*5]

[1] *Department of Mechanical System Engineering, Gyeongsang National University, Korea*
[2] *Department of Mechanical Engineering, Tokyo Institute of Technology, Japan*
[3] *Posco, Posco, Korea*
[4] *Division of Marine Engineering, Korea Maritime and Ocean University, Korea*
[5] *Department of Marine System Engineering, Korea Maritime and Ocean University, Korea*

The effect of sodium molybdate on the passive films on lean duplex stainless steel (STS 329 FLD) was studied. The elemental depth distribution was investigated using glow discharge optical emission spectroscopy, and the passive film capacitance, chemical state of molybdenum, and corrosion resistance were analyzed. The addition of sodium molybdate to the passivation electrolyte reduced the iron content in the iron-rich layer (48% to 38%), increased the chromium content in the enhanced chromium layer (33% to 42%), and left molybdenum on the film surface. The electrical impedance spectroscopy measurements show that the capacitance of the passive film was dramatically increased. Furthermore, molybdenum was detected as molybdate. Electrochemical anodic polarization curves show that the corrosion potential was increased by the addition of sodium molybdate to the nitric acid electrolyte. The corrosion resistance was improved because the molybdate adsorbed on the outermost part of the passive film prevented the adsorption or penetration of chloride. Furthermore, the corrosion current density decreased because of the chromium-rich layer.

Keyword : Chemical Passivation, Passive films , Low-Nickel duplex stainless steel

Corresponding Author. : **YongSup YUN** (ysyun@kmou.ac.kr)

Poster Sessions

P413

Corrosion Resistance of Calcareous Deposit Film on Steel Plate by using Waste Oyster Shell

Jeonghyeon YANG*[1], **Junryul LEE**[1], Heehun KIM[1], Sangdoo YUN[1], Duckhyeon SEO[2], Jungpil NOH[2]

[1] *Department of Mechanical system engineering, Gyeongsang National University, Korea*
[2] *Department of Energy Mechanical Engineering, Gyeongsang National University, Korea*

Enormous amount of oyster-shell(OS) waste has a major disposal problem in coastal regions. OSs have been attracted much attention in last years in order to recycle, because these are mainly composed of calcium carbonate with rare impurities. OSs can be resources of pure calcareous materials. In this study, we demonstrate the calcareous deposit film on steel plate by using OS on the basic of cathodic protection technique that is routinely utilized for the prevention of corrosion. The current density, time of D.C power supply and steel plate surface roughness were tested under various conditions in order to fine the improvement of adhersion of calcareous deposit film. XRF(X-ray Fluorescence Spectrometer) analysis was chemical composition of oyster shell, EDX(Energy Dispersive X-ray Spectroscopy) analysis was performed to analyze the elements of the thin film, and SEM(Scanning electron micro-scope) was used to observe the surface morphology, XRD was performed for the structural analysis of the thin film, and natural immersion and electrochemical polarization tests were carried out for the corrosion resistance evaluation.

Keyword : Corrosion Resistance, Calcareous Deposit , Oyster Shell

Corresponding Author. : **Jeonghyeon YANG** (jh.yagi@gnu.ac.kr)

P414

The Depleted Petroleum Reservoir Quality Evaluation for Compressed Air Energy Storage

Nghiep QUACH[1], Hyung-Mok KIM[*1], Xuan Huy NGUYEN[2], Tuyen VU[3], Thi Thu Trang NGUYEN[2]

[1] *Department of Energy Resources and Geosystems Engineering, Sejong University, Korea*
[2] *Faculty of Geology and Petroleum Engineering, Ho Chi Minh University of Technology, Vietnam*
[3] *Department of Electrical and Computer Engineering, Clarkson University, USA*

The purpose of this study is to investigate the evaluation of the depleted oil and gas reservoir quality for large-scale underground power storage in Vietnam using compressed air energy storage (CAES) technology. CAES system is considered to be the only energy storage technologies at a large scale to leverage intermittent power generation using renewable energy sources such as wind power and solar panel. CAES is utilized as one of the promising energy storage technologies in which off-peak or excess power from renewable energy is taken at low cost and successfully used to compress and store air in the geological formation. When needed, this high-pressure compressed air is then heated and expanded in a gas turbine to produce electricity during peak demand. On the other hand, depleted oil and gas reservoirs are used for power storage, since a significant amount of cost and efforts will be reduced for exploration and obtaining geological information of the storage formation, which is already well understood before and during the production of oil and gas.

The authors first review geological data of the oil and gas fields in Vietnam to screen and select the potential site of applying CAES technology with renewable energy sources. Comprehensive geological data analysis is carried out to construct an appropriate geological and geomechanical model. Based on these models with proper boundary conditions, various design parameters of the CAES system are determined. The safety and stability of the CAES system are investigated numerically. Based on those results, the quality of potential depleted oil and gas reservoirs for CAES is evaluated. In addition to the numerical simulations, laboratory, as well as in-situ measurements, are carried out to calibrate and validate the numerical models from the comparison between different approaches with different scales as further investigation.

Keyword : Depleted oil/gas field, Large-Scale power storage, Renewable energy

Corresponding Author. : **Hyung-Mok KIM** (hmkim@sejong.ac.kr)

Sea Fog Prediction System for Major Port of Korea

Ki-Young HEO*, Jae-Il KWON

Marine Disaster Research Center, Korea Institute of Ocean Science and Technology, Korea

Sea fog is one of the dangerous meteorological phenomenon affecting marine transportation, and accurate prediction is necessary to reduce its impact on human activity. The sea fog-related accidents resulted in 537 ships and 3843 victims in recent five-year period (2015-2019), the Ministry of Ocean and Fishery in Korea needs more accurate means of predicting the formation and dissipation of sea fog. Due to the complexity and interaction of physical processes, it is very difficult to understand the mechanisms of sea fog formation, evolution and dissipation. Consequently, fog predictions represent a great challenge which is generally further amplified by a lack of detailed measurements.
Korea Institute of Ocean Science and Technology has developed sea fog prediction system for major ports of Korea from 2019. The system is based on the use of 3D coupled atmosphere-ocean model and 1D fog model, which consists of Coupled Ocean-Atmosphere-Wave-Sediment Transport (COAWST) model and PArameterized FOG (PAFOG) model, respectively. In order to clarify the modulation of the formation and dissipation of sea fogs by the air-sea temperature difference and the atmospheric stability, numerical experiments for an advection fog event and a steam fog event were carried out. An improved prescriptions of SST simulated in ocean circulation model during atmospheric model integration lead to better simulation of reasonable turbulence flow and boundary layer structure. The PAFOG model is useful for making the vertical level more dense to improve the predictive accuracy of sea fog occurring at low atmospheric levels. Therefore, it is expected to be able to improve sea fog prediction for specific areas of interest, such as major ports or frequent maritime traffic areas.

Keyword : Sea fog prediction, Coupled atmosphere-Ocean model , 1D fog model

Corresponding Author. : **Ki-Young HEO** (kyheo21@kiost.ac.kr)

P416

Impact of Waste and Lost Fishing Gears in Stationary Fishing Boats and Fisheries, and Legislative Improvements to Protect Fishery Resources

Bong Kyu JUNG*, Nam U LEE

Department of Maritime Police and Production System, Gyeongsang National University, Korea

This study sought to analyze and review the current status and problems centered on coastal and inshore fisheries, which have the greatest impact in terms of the continuous use of fishery resources and the protection and management of the marine ecosystem, and to thus provide improvement measures for such.
In particular, among the coastal and inshore stationary fishing boats and fisheries in the southern waters of South Korea, analyzed the current conditions and problems of gill net and fish trap fishery by comparing these with the current fishing regulation system. Using a training ship, the waters where a large amount of fishing work involving coastal and inshore fishing vessels is being done were classified into A (Hongdo fishing ground), B (Geomundo fishing ground), and C (fishing ground between Hongdo and Geomundo), and the waste fishing gears deposited in such waters were investigated in terms of their trawling means. In addition, the marine debris that was collected was directly identified.
Through such practical field surveys and comparative analyses of the relevant information aimed at preventing disputes over fishing in coastal and inshore waters (which have been diverse and continuously occurring) as well as the creation of waste fishing gears caused by deliberate or environmental factors, and its consequent adverse effects on the fishery resources ecosystem, this study aims to present a legislative improvement plan that could achieve the sustainable use of fishery resources and thus that could promote the growth and development of fisheries.

Keyword : Coastal and inshore fishery, Stationary fishing boat and fishery, Waste fishing gear and marine debris

Corresponding Author. : **Bong Kyu JUNG** (bkjung@gnu.ac.kr)

Investigation on the Structure of Scuba Diving Accidents in Korea

Sung gil KIM[1], **Seung Hyun JANG**[*2]

[1] *Marine Sports, Pukyong National University, Korea*
[2] *Physical Education, Pusan National University, Korea*

The purpose of this study is to investigate the structure of scuba diving accidents occurring in Korea to understand the causes and backgrounds for such accidents and propose preventive measures. Thus, diving accident statistics provided Korea Coast Guard and other related documentations of domestic or foreign origin were collected and analyzed, and 8 participants including diving instructor, coast guard, and diver were interviewed. Based on the result, the accidents can be classified into either minor accidents or serious accidents. 1) Minor accidents include injuries resulting from emergency ascent and drifts all of which were caused by 'lack of proper equipment check', 'panic in novice divers', 'drifting apart due to current.' Causes and backgrounds included 'lack of proper education' and 'unfamiliar rental equipment.' while 'lack of safety equipment(SMB, dive alert, etc.) was pointed out as a root cause leading to serious accidents. 2) Serious accidents were those involving death which results from 'going beyond one's limit', 'entrapment by discarded fishing net', and 'missing.' As causes and backgrounds, 'diving culture in Korea(hungting collecting, drinking, groupism, short diving tour)', 'underwater environment in Korea(low visibility, unmaintained underwater environment, no local guide on site)' were pointed out. Based on the information on the structure of accidents gathered in the study, 'planned diving', 'locaL guide system', 'buddy diving system' could be proposed as practical preventive measures.

Keyword : Scuba Diving, Accident, Korea

Corresponding Author. : **Seung Hyun JANG** (5694640@hanmail.net)

P418

Effect of wave load on decompression of underwater workers

WOODONG LEE[1], Jooyong LEE*[2]

[1] *Department of Ocean Civil Engineering, Gyeongsang National University, Korea*
[2] *Research Institute of Industrial Technology, Pusan National University, Korea*

Various physical forces exist in the oceans. Among them, the change in water pressure caused by wave action has the greatest effect on underwater workers. Underwater workers are sensitive to changes in water pressure, as they are exposed to a high-pressure underwater environment, and proper decompression procedures must be followed to prevent the contraction of diving-related diseases. However, most underwater workers do not adopt a decompression plan that considers wave-induced changes in water pressure. In this study, the change in water pressure due to wave action was calculated using computational fluid dynamics (CFD), and virtual diving was performed using this calculation result in the varying permeability model (VPM). As a result, the change in water pressure caused by wave action was identified, but the effect on the decompression of underwater workers was not significant. However, for the safety of divers during decompression (caused by prolonged underwater operations), considering wave-induced changes in water pressure is suggested.

Keyword : Decompression, Water pressure, Varying permeability model

Corresponding Author. : **Jooyong LEE** (jooyong@gmail.com)

Poster Sessions

P419

Numerical Modeling of Tide and Tide-Induced Drifting of Particles Released from the Sunken Ship in the Southeastern Yellow Sea

Sok Kuh KANG[*1,2]

[1] *Ocean Circulation and Climate Change, Korea Institute of Ocean Science & Technology, Korea*
[2] *Ocean Physics, Institute of Ocean Sciences, Canada*

Casualties released from a sunken ship off the southwestern tip of the Korean peninsula on April, 2014 show a particular trend of moving mainly northward around the complicated coastal area, where strong tidal currents prevail. In order to understand how this takes place and to also examine tidal and residual current features in the region, fine grid tidal modeling has been carried out in this sub region of the southeastern Yellow Sea.
A detailed study of the phase and sea level slope differences in the several waterways off the southwestern tip of Korean peninsula suggests that there are noticeable differences in the dominant M2 tidal current speed.
Analyses of tidal currents in terms of the in-phase and quadrature velocity components reveal that both the standing and progressive characters are competitive in this area
It is shown that the M2-driven tidal residual currents are dominated, with the northward residual currents prevailing just near the sunken ship, and generally intensified northward residual currents in the surrounding region. The accuracy of the particle trajectory modeling was validated by showing that the locations of 3 casualties (among 300 persons) found outside the sunken ship off southwestern tip of Korean peninsula on April 16, 2014 were within the predicted locations estimated by the particle trajectory method. In particular, it is shown that the general northward scattering pattern of continuously released particles for 15 days is likely to result from the M2-driven residual currents in this region. This should be useful information for future rescue purposes.

Keyword : Tidal current, residual current, numerical modelng

Corresponding Author. : **Sok Kuh KANG** (skkang@kiost.ac.kr)

P420

A study on the development plan of National Lifeguard Qualification system

Sunggil KIM*

Leisure Sports Department, Seoul YMCA,SE-PDIC ASIA, Korea

In 2014, the “National Lifeguard” system was newly established to cultivate search and rescue experts who can rescue people in the event of a national disaster since the “Sewol ferry”. Starting with the first acquirers in 2017, many acquirers are produced every year, but many problems are everywhere, which is noteworthy. Therefore, this study analyzed problems of National Lifeguard system through the comparative analysis with Lifeguard system, which is private qualification, to suggest the development plan. To this end, the literature analysis and in-depth interviews were conducted with experts to produce the following results. First, it is necessary to nurture lecturers specialized in National Lifeguard education which is differentiated with lecturers specialized in lifeguard education. Second, there is no age limit in national lifeguard system, but when considering many problems are embedded in participating in the actual rescue activities, age limits should be defined to increase the effectiveness of qualifications. Third, when considering the low rescue efficiency at site of National lifeguard system which educates and evaluates by focusing on swimming ability in the pool, diversification of training and evaluation sites should be conducted to provide realistic training. Fourth, the current Lifeguard qualification holders should be recognized as National Lifeguard Grade II and the national Lifeguard qualification should be subdivided into Grade I to enhance the expertise of National Lifeguard qualifications and establish an efficient water safety system.

Keyword : National Lifeguard, Lifeguard, National Lifeguard Qualification system

Corresponding Author. : **Sunggil KIM** (ysafety@daum.net)

Poster Sessions

P421

A study on practical skill evaluation method improvement for lifeguard license acquisition

Namgyu KIM[1], Jaehyung LEE*[2]

[1] *Department of Physical Education, Pusan National University, Korea*
[2] *Department Of Ocean Physical Education, Korea Maritime & Ocean University, Korea*

The purpose of this study is to analyze and improve the practical skill evaluation method for the acquisition of lifeguard license which is domestically conducted now from various point of views, and to improve various rescue abilities that fits the sites in case of accident disasters as well as lifesaving related technology through this.
As a research method to achieve the purpose of this study, practical evaluation methods, standard benchmark, and educational contents for domestic and foreign lifeguards are analyzed through literature research and case studies. In addition, a Delphi analysis and in-depth interviews are conducted to lifeguard experts in order to improve the adequacy of the practical skill evaluation method for the acquisition of qualifications currently being conducted in Korea, the adequacy of the selection of educational institutions for qualifications, and to enhance the credibility of qualifications. Following study results are obtained.
First, when reviewing the practical skill evaluation method for lifeguard license acquisition through the cases of developed countries, Korea should re-establish the evaluation method and standard benchmark using rescue equipment in various situations.
Second, the certain education period should be determined and the evaluation method and standard benchmark focusing on the professional rescue technology should be established based on long-standing physical strength at sea rather than focusing on the predetermined rescue technology.
Third, the educational institutions and practical skill evaluation institutions related to the acquisition of lifeguard license are evaluated annually to select the institutions that grant the license, and the credibility of the license should be enhanced to prevent the cases in which the licenses are abused for the purpose of pursuing profit.
Fourth, it is necessary to increase the evaluation method and standard benchmark to the level of the lifeguard license equivalent to the current water rescuer's license, and to transfer the current issuer.

Keyword : Lifeguard, Lifeguard evaluation method, Lifesaving technology improvement

Corresponding Author. : **Jaehyung LEE** (jhlee3416@kmou.ac.kr)

P422

The Issues of Civilian Lifesaving System and Plans for Improvement

Seami LIM[1], Sung-Gil KIM*[2]

[1] *P.E, Pusan National University, Korea*
[2] *Marine Sports, Pukyong National University, Korea*

The purpose of this study is to investigate issues of civilian lifesaving system and suggest plans to activate civilian lifesaving activities, protect civilian lives, and improve safety issues. for the study, interview were conducted with 10 individual civilian life guards. the results are as below: First one is the Lack of administrative system in government office or local government. Management of civilian life guards at beaches in Korea is currently handled by public service personnel without related professional experience and the temporary administrative system centered around office repeatedly creates unreasonable process. Second issue is the civilian life guards feel discriminated against 119 rescue squad. Despite the fact that civilian life guards are absolutely necessary personnel considering the current status of Korean beaches, majority of the people view them as temporary workforce only required for summer seasons rather than accepting them for their professionalism. The third issue of the topic is the lack of welfare. The civilian life guards who ensure the safety of civilians do not receive proper treatment which results in lowered motivation.
For the improvement of civilian life saving system, this study firstly suggests the establishment of improved understanding between related departments through joint training with 119 squads,' in order to resolve the issues involving lack of communication with 119. Second suggestion in this study is the improvement of training system for civilian life guards. Life saving programs based on the seas in Korea need to be implemented as well as those that can resolve practical incidents occurring at the sea. Thirdly, advertizing efforts to activate civilian life saving activities are required. Considering in long-term perspective, more vigorous advertising is necessary as life saving activities of private organizations need to be activated and continued.

Keyword : Civilian Lifesaving System , Life guard

Corresponding Author. : **Sung-Gil KIM** (ysafety@daum.net)

Poster Sessions

P423

Development of Survival Swimming Programs for Disabled Persons through the case studies of survival swimming in Korea and foreign countries

Kei-Baek KIM*, **Chang-Ho OH**, Sandy Kyunghwa NAM-JO

Marine Leisure and Tourism, Young san University, Korea

The purpose of this study is to develop survival swimming program for disabled people by studying survival swimming cases in Korea and foreign countries
As the memory of the sinking of the Sewolho is still vivid, the importance of safety after the disaster is being highlighted, making it more important to swim for survival in the event of a crisis. Now survival is a necessity, not a choice. It is time to develop the ability to deal with underwater safety accidents in advance. There is a survival swimming program for the public, but very few studies have been done on survival swimming programs for the disabled. Accordingly, people with disabilities can be taught swimming programs to enhance their ability to adapt to water and to protect their lives in times of crisis to enjoy safe leisure activities by instructors.

Keyword : Surivival Swimming Program, Disabled, Scredible education system

Corresponding Author. : **Kei-Baek KIM** (demi100@ysu.ac.kr)

P424

THE PERFORMANCE OF PILE BREAKWATERS AS AN ALTERNATIVE STRUCTURE FOR COASTAL PROTECTION BASED ON FIELD EXPERIMENTS AT PLENTONG BEACH, WEST JAVA-INDONESIA

Rian Mohammad AZHAR*, Huda BACHTIAR, Adi PRASETYO, Leo Eliasta SEMBIRING, Cahyo Nur RAHMAT NUGROHO

Ministry of Public Work, Experimental Station for Coastal, Indonesia

Plentong Beach is one of the iconic tourism object in Indramayu Regency, West Java Province. In this location, erosion problems disrupt tourism activities. Erosion problems are indicated due to the impact of revetments construction protuding into the sea that changes wave transformations and blocking long shore sediment transport. In order to countermeasure the problems, Experimental Station for Coastal constructs pile breakwaters to reduce wave energy and to trap sediment behind the structure. Two segments of pile breakwaters were constructed from August to December 2019. The pile breakwater consist of 4 inch diameter concrete piles with a gap between the piles of 150 mm. The second segment of pile row breakwaters has a length of 15 m and wide of 5 m. The distance gap between two segments is about 3 m. Based on the results of laboratory physical model tests in 2018, the pile row breakwaters have a transmission coefficient around 0.75 - 0.95. According to the monitoring performance there is wave attenuation and changing of the coastline profile behind the structure. The results of observations on the performance of the structure showed that the pile row breakwaters were able to absorb the waves by 10-15%. This result certainly indicates sedimentation behind the structure so that the beach will slowly grow.

Keyword : Pile breakwaters, Beach response, Coastal structures

Corresponding Author. : **Rian Mohammad AZHAR** (rian_mad23@yahoo.co.id)

Poster Sessions

P425

Hydraulic Treatise of Untreated Water Reservoir Design of Indonesia's National Capital Integrated Coastal Development Offshore Dike

Andojo WURJANTO, Julfikhsan Ahmad MUKHTI*

Ocean Engineering, Institut Teknologi Bandung, Indonesia

Jakarta, the current Indonesia's capital, is one of the fastest sinking cities on the northern coast of Java Island. The high rate of land subsidence caused coastal flooding which puts the city at risk. To overcome this problem, the government of Indonesia has started the National Capital Integrated Coastal Development (NCICD) project. The major part of the project is the construction of the coastal and offshore dike. The offshore dike, in addition to coastal flooding protection, will also function as a coastal water reservoir. The reservoir system consists of (i) untreated water reservoir (UWR) to store extreme rainfall flow, (ii) clean water reservoir (CWR) with filtering pond for municipal use and (iii) tidal gate for emergency purposes.
The design of this dual-purpose dike is challenging in terms of engineering. This study aims to elaborate hydraulic characteristics of the UWR part of the NCICD offshore dike. This paper (i) analyzes the flood-retaining capacity of the UWR initial design from the National Development Planning Agency (BAPPENAS), (ii) calculates the required pumping capacity, (iii) designs the flood gate which acts as the entrance to UWR, and (iv) optimizes UWR's layout from the point of view of flood control.
Numerical modeling will be conducted using publicly available data to analyze the UWR's current capacity against flooding. Flood flow will be calculated based on the historic rainfall and catchment area Cisadane River, which flows directly into the reservoir. Iteration will be performed to optimize the pumping capacity as well as the flood gate to efficiently prevent flooding in the protected area. Flooding is indicated by water surface elevation within the reservoir reaching a certain level before the dike is overtopped. The pumping system is essential as the outflow from the reservoir while the flood gate controls when and amount of water flows into the UWR.

Keyword : Coastal Reservoir, Jakarta, Coastal Flooding

Corresponding Author. : **Julfikhsan Ahmad MUKHTI** (andojowurjanto@gmail.com)

P426

Shoreline Linearization of Convex Beach due to Sea Level Rise

Anthony Harlly Sasono PUTRO[1], Anasya Arsita LAKSMI[2], **Jung Lyul LEE**[*3]

[1] *Directorate General of Water Resources, Ministry of Public Works and Housing, Indonesia*
[2] *Military Building Construction Engineering, Indonesia Defense University, Indonesia*
[3] *Graduate School of Water Resources, Sungkyunkwan University, Korea*

Indonesia is the largest archipelago in the world, also the country straddling the longest of the equatorial line across both land and sea. It consists of five major islands and about 30 smaller groups. There are a total number of 17,508 islands with over 81,000 kilometers of coastline. Some economic activities, such as tourism areas are lying in coastal zones. As an archipelago country, Indonesia is also very vulnerable to sea level rise.

The previous monitoring of sea level rise was done in 4 years period (2009-2012). That study reported that the highest rate of sea level rise in Indonesia is 14.1 mm/year in Manokwari, and the lowest is 1.18 mm/year in Ambon. IPCC (2007) released that the sea level has risen by an average of 2.5 mm/year.

The present study estimates the background of beach erosion due to sea level rise, wherein Indonesia related information is available. In particular, the beach of convex feature, which is often formed by the existence of rocky shoal, is much vulnerable to sea level rise. In the present study, the vulnerability on the beach of the convex feature is conducted by a variety of numerical experiments and estimated by the reduction of circle radius fitting a shoreline.

The wave model of mild slope equation type is applied to similar shoals to the shoal conducted by Ito and Tanimoto (1972), changing the sea level. The future vulnerability on convex beaches in Bali, Indonesia, is examined by using a set of data compiled from numerical experiments.

Keyword : Beach erosion, Convex beach, Sea level rise

Corresponding Author. : **Jung Lyul LEE** (jllee6359@hanmail.net)

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Vertical profiles of radioactive Cs distributions and changes in seabed sediments near the river mouth in the coastal area of Fukushima Prefecture

Tadahiko TSURUTA[*1], Takehiko SHIRIBIKI[1], Toshiharu MISONOU[1], Takahiro NAKANISHI[1], Yukihisa SANADA[1], Yoshimi URABE[2]

[1] *Fukushima Environmental Monitoring Division, Japan Atomic Energy Agency, Japan*
[2] *NESI, Inc., , Japan*

Understanding the features of radioactive Cs in seabed sediments at the coastal area linked with rives, which are considered major settlement areas for particulate radioactive Cs, are key issues to evaluate the supply of radioactive Cs from river discharge. The vertical profiles of radioactive Cs distribution in seabed sediments are important factor when studying settlement process of particulate radioactive Cs near the river mouth, because radioactive Cs deposition (Cs inventories) in seabed sediments near the river mouth are relatively lager than those in offshore. Therefore, we conducted seabed sediments sampling using a longer core sampler (vibrocoring; a maximum lengths of the core is approximately 100 cm) to collect deeper seabed sediments and to clarify the vertical profiles of radioactive Cs distributions and changes in seabed sediments near the river mouth in the coastal area of Fukushima Prefecture. As the results of sampling and analysis from 2015 through 2019, increasing trends of the 137Cs concentration along entire vertical profiles and migration of the137Cs toward deeper layer in seabed sediments were not observed. These results suggest that the continuous accumulations of radioactive Cs, which were the supply of radioactive Cs from river discharge, are not major concern near the river mouth in the coastal area.

Keyword : Radioactive Cs, Seabed sediments, Vertical profile

Corresponding Author. : **Tadahiko TSURUTA** (tsuruta.tadahiko@jaea.go.jp)

P428

Unmanned Aerial System (UAS) based Building Damage Monitoring using Artificial Intelligent (AI)

Anjin CHANG[*1], Ahram SONG[2], Jaewan CHOI[3], Jinha JUNG[4], Junho YEOM[5]

[1] *School of Engineering and Computing Sciences, Texas A&M University-Corpus Christi, USA*
[2] *Departmnet of Civil and Environmental Engineering, Seoul National University, Korea*
[3] *School of Civil Engineering, Chungbuk National University, Korea*
[4] *Lyles School of Civil Engineering, Purdue University, USA*
[5] *Department of Civil Engineering, Gyeongsang National University, Korea*

Advances in Unmanned Aerial System (UAS) and sensor technologies have made it possible to collect big remote sensing data with high spatiotemporal resolutions. Although collection of the ultra-high resolution remote sensing data is getting easier and cheaper than ever and now we can accumulate huge database using these platforms, exploiting the big geospatial data is still in early infancy for disaster response and recovery related activities. Hurricane Harvey was a Category 4 hurricanes that made landfall at Rockport, TX on August 25, 2017. It caused catastrophic flooding and many deaths, inflicting $125 billion in damage. In this paper, multi-temporal UAS data collected over Rockport, TX will be used to develop a method to monitor building by hurricane using Artificial Intelligent (AI) techniques. The UAS data were collected after the hurricane with significant overlap at 60~80m flying altitude above ground. Orthomosaic images and Digital Surface Models (DSM) were generated by using a Structure from Motion (SfM) algorithm with Ground Control Points (GCPs). Characteristics of building changes from the processed data are input to the AI models to estimate the building damage. This presentation will demonstrate feasibility of ultra-high resolution UAS data and state-of-the-art AI algorithms to monitor building damages affected by hurricanes.

Keyword : UAS, Buliding Monitoring, AI

Corresponding Author. : **Anjin CHANG** (anjin.chang@tamucc.edu)

Poster Sessions

P429

Analysis of Static and Dynamic Equilibrium Bay Beach in Myanmar, Thailand and Vietnam

Sutat WEESAKUL[*1, 2]

[1] *Hydro Informatics Institute, Thailand*
[2] *Water Engineering and Management, Asian Institute of Technology, Thailand*

Coastal stabilization is a concept to alleviate and control beach erosion. Static Equilibrium Bay (SEB) concept is used as a tool to evolve shoreline gradually approaching natural bay beach planform providing stable bay. This is the case when no sediment supply to bay or littoral drift is negligible. Hsu and Evan (1989) derived Parabolic Bay Shape Equation (PBSE) for static equilibrium planform (SEP). A number of studies worldwide have successfully used PBSE to apply and design for headland-bay beach (HBB) in Singapore, Brazil, Northern Ireland, Maldives, and Portugal.

Tasaduak et al. (2014) revised the C coefficient in PBSE for SEB using 21 bays in Thailand and propose a new equation for Dynamic Equilibrium Bays (DEB). A new set of C Coefficients, which is not a function of wave obliquity as that in SEB, but also sediment supply ratio (SSR), which is a new parameter representing the ratio between the rate of sediment supplied from a river source to the bay and potential longshore sediment transport rate

It is found that the total number of natural SEB and DEB are 79 and 87 respectively while ratios of unstable bays are 31.15 and 10.61 %. Characteristics of bays are systematically summarized. The proposed DEB equation show efficiency index 90%, so that the DEB concept can be successfully verified and applied for dynamic stabilization concept.

Keyword : Dynamic equilibrium bay, Static equilibrium bay, Coastal stabilization

Corresponding Author. : **Sutat WEESAKUL** (sutat@hii.or.th)

P430

Estimation of Variation in Background Erosion Rate of Sub-littoral Cell in Korea

Sahong LEE[1], Jung Lyul LEE*[2]

[1] *School of Civil Architectural and Environmental System Engineering, Sungkyunkwan University, Korea*
[2] *Graduate School of Water Resources, Sungkyunkwan University, Korea*

The beachline is a consequence of the principle of mass conservation wherein the amount of inflow and sediment discharge is in balance. The naturally inflowing sediments are distinguished into types of the sediments of direct inflow from rivers, of those from other littoral cells, and those carried by the waves flowing into beaches. The sediments are then subject to be lost by breaking waves or dispersion of suspended sediments, as well as by the flows of littoral current, tidal current, and drift current etc.
In the present study, the rate of loss of sediments to coastal is calculated through the analyses of sediment budget encompassing three factors such as the loss of sediments to coastal, the rate of decrease in sediment discharge due to development activities, and the loss of sediments due to collection or dredging of marine sands, as well as three factors of the littoral cell, which are selected to identify the supply or loss of sediments from beaches by the law of conservation of matters, such as the length of beaches, depth of sediments, and width of beaches.
The main area, selected for the present study, is the littoral cell of Sanpori, Uljin County, Gyeongsangbuk-do Province, Korea, wherein the collection of marine sands and development activities have been continued since 2000. The main littoral cell was divided into the two sub-littoral cells for the calculation of respective rates of loss of sediments to open sea, to estimate the 'Background Erosion Rate' in 2050 and 2100. This will enable us to predict the time to realization of cumulative effects of beach erosion in the future owing to the reduction in sediment budget, by which the predicted width of eroded beach of the future will be exploited for the provisions against the disastrous coastal erosion.

Keyword : Littoral cell, Sediment budget, Background erosion rate

Corresponding Author. : **Jung Lyul LEE** (jllee6359@hanmail.net)

Hydraulic Characteristics of LCB [Low Crested Breakwater] - Centered on the Transmission Coefficient

In Ho KIM[1], Yong Jun CHO[*2]

[1] *Department of Earth and Environmental Engineering, Kangwon National University, Korea*
[2] *Department of Civil Engineering, University of Seoul, Korea*

The transmission coefficient of LCB [Low Crested Breakwater], preferred structural type among many countermeasures against beach erosion, is regarded as the primary design factor. The models of van der Meer and Daemen (1994) and d'Angremond et al. (1996), the most preferred model in the literature, have been popular since they are developed using the most comprehensive data of hydraulic model test. However, it is worthy of note that humongous tetrapod is preferred as the construction material of LCB to quarry stone due to less adverse environmental impact and workability, and the porosity of LCB built with tetrapod is more significant than that of LCB built with the quarry stone. As a result, the LCB deployed in Korea are designed to rise near the free surface to obtain the target energy dissipation enough to mitigate the beach erosion in rough seas. Based on these facts, it can be easily perceived that these construction environments differ from the one underlying van der Meer and Daemen (1994), d'Angremond et al. (1996) model. In this rationale, we studied the transmission characteristics of LCB at Bong-Po beach using the situ-data of wave height measured from 2019.8.6. to 2019.8.21. In doing so, we also carried out the 3-D numerical simulation to compensate for the limitations of the wave observation system, which often malfunctions in harsh marine environments. It turns out that transmission coefficients by van der Meer and Daemen (1994), d'Angremond et al. (1996) are significantly different from the one from the situ wave data. Several factors are involved in making this difference, and among these factors, the Korean construction environment mentioned above noticeably stands out. Based on this rationale, a modified model of transmission coefficient optimized for the Korean construction environment is also developed, which shows the remarkable agreement with the measured data.

Keyword : Field survey of transmission coefficient, Characteristics of transmission coefficient , Low-Crested breakwater at Bong-Po

Corresponding Author. : **Yong Jun CHO** (young@uos.ac.kr)

P432

Numerical Analysis of sediment transport rate by the rip current formed at the open inlet between LCB [Low Crested Breakwater] - centered on the infra-gravity waves

Jung Lyul LEE[1], Yong Jun CHO[*2]

[1] *School of Civil, Architectural Engineering & Landscape Architecture, Sungkyunkwan University, Korea*
[2] *Department of Civil Engineering, University of Seoul, Korea*

LCB [Low Crested Breakwater], the most preferred structural form in the coastal zone management project by the Korean Ministry of Ocean and Fisheries, has been designed to mitigate the beach erosion by high waves occurring only a few times a year. Now that moderate sea conditions are dramatically different from those in rough seas, these poor design practices interrupt the grand circulation process of natural beaches in a year. As a result, the anticipated beach stabilization effect of LCB often falls short. In this study, in order to test this hypothesis, 3-D numerical simulation was implemented to analyze the rip-current and its associated sediment transport at open inlet between LCB when LCB is subject to infra-gravity waves which play an indispensable role in the beach restoring process in a mild sea with an annual prevalence rate of over 80%. Numerical results show that in the case of LCB of lower crest freeboard, rip current gets increased by 2.6 times when compared to the one before the deployment of LCB since the water mass influx toward the down-wave side of LCB by overflowing LCB in the form of Stokes Drift by the preceding waves is redirected toward the open inlet. Based on these facts, it can be perceived that once the sand leaves the inner zone of LCB through the rip-channel when LCB is deployed, return to the coast seems unlikely. The sediment transport rate is estimated based on Bailard's model, the most referred cross-shore sediment model in the literature. It is shown that the primary sediment transport mode at open inlet between LCB is bed load, and sand of 5.62x10-5m3/m is leaving the inner zone of LCB per unit wave period.

Keyword : Low Crested Breakwater, Rip current at the open inlet, Beach restoration by infra-Gravity waves

Corresponding Author. : **Yong Jun CHO** (young@uos.ac.kr)

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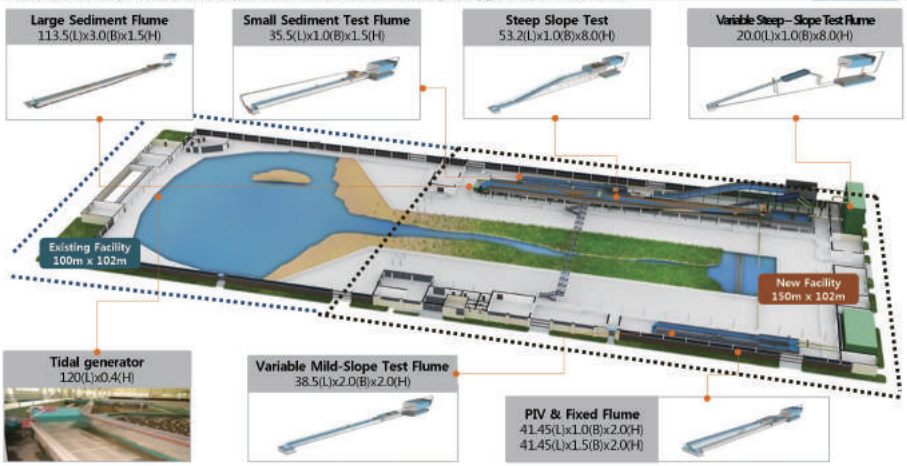
PROJECT OVERVIEW

- **Project Name : Construction of Large Scale Hydraulic Laboratory (250m by 102m)**
- **Purpose of Project : Promoting national competition of water engineering through establishment of world-class hydraulic model testing facility with the infrastructure for simultaneous hydraulic tests at both river and coast**
- **Period : 29 Dec 2014 ~ 28 Dec 2018** (Four years total)
- **Budget : 18.1 million USD(** Building: 13.5 million, Test Flumes : 4.6 million USD)
- **Operation Agency : KRC-RRI**
- **Location : Rural research Institute of KRC, Ansan Citi, Gyeonggi Province, Korea**



OPERATION AND APPLICATION

- To lead technology of the private sector through an unique **open-sharing infrastructure platform**
  - Open to anyone who want to use conveniently
  - Financial support from the government if used by small businesses
- To induce technological development through **performance certification of revetment block**
- Experiment condition **up to 8.5m high and velocity 10m/s**
  -Fixed steep slope test, Variable mild-slope test flume
  -At most 100m long waterway for the large sediment test flume
- Hydraulic model test of large-scale rivers **simultaneously at rivers and coasts**
  -Able to connect the existed coastal test facility with the new river test facility
  -Available for hydraulic tests at large rivers and estuaries with the maximum testing flow rate up to 7㎥/s

CONTACT INFORMATION Dr. J.S Yoon jsun0757@ekr.or.kr Dr. E.C Chang jec1004@ekr.or.kr

Promotion

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