UST21
Underwater Survey Technology21

2025 Second half

UST21
Introduction

Hydrographic Survey │ Ocean Support │ Geophysical survey
Observation and Modeling Resource Exploration │ Topograhic Survey
Nautical chart & Thematic map production │ MGIS and Mapping Systems

Contents

JUST21
Underwater Survey Technology21

UST21
Underwater Survey Technology 21

UST21 is a specialized company in marine survey and research.

We lead technological innovation in fields such as Marine survey, Marine forecasting, Monitoring, Marine SI, and Simulation.
We continually strive to deliver the highest quality and differentiated value in the Marine research and Technical service sector.

CEO	Kim Jong-Wook
Established	December 28, 1999
Employees	199(As of June 2025)
Major Industries	Service, Wholesale and Retail, R&D
Location	Incheon(Headquarter), Busan(Office)

Major Milestones

2024
· Fugro UST21 Co., Ltd. (JV) Establishment

2023
· Memorandum of Understanding (MOU) with sgma Inc.
· Sign a business agreement with National Korea Maritime &Ocean University
· Registered as Weather Consulting Service

2022
· Memorandum of Understanding (MOU) with Blue Coconut Inc
· Memorandum of Understanding (MOU) with Industry-University Institute Collaboration of Inha University
· Memorandum of Understanding (MOU) with AEMLLP

2021
· Registered as Facilities Support Management Services of private navigational aids
· Registered as Ocean Survey Business
· Selected as one of Inno-Biz by Ministry of SMEs and Startups

2018
· Establishes a business agreement on developing human resources and employing youth with Korea Institute of Science Technology Information.
· Registered as Underground Facility Survey in National Geographic Information Institute
· Registered as Weather Service

2019
· MOU with Fugro Singapore Marine. LTD
· Establishes a technology transfer agreement related to satellite-based severe visibility analysis, sea fog detection / display technique with KIOST
· Registered as Cadastral survey field under engineering business.

2020
· Registered as Underwater Works
· Registered as Construction Technical Service
· Certificated as one of Vision Companies
· Certificated as a Venture corporation by Korea Technology Finance Corporation

2016
· Registered as Video Processing business in National Geographic Information Institute Memorandum of Understanding (MOU) on long-term field study (IPP-Industry Professional Practice) with Inha University

2011
· Registered as Surface surveying business in National Geographic Information Institute
· Registered as Digital Mapping Business in National Geographic Information Institute
· Registered as Coastal Survey Business in National Geographic Information

2008
· Registered as hydrographic survey business

1999
· Established UST21 Co., Ltd

Mission & Core Value

Mission

Through obtaining deeper and broader understanding of dynamic ocean data, we aim to create a safer, more prosperous ocean and grow alongside our customers.

Core Value

Success of Customers

Contributing to the advancement of ocean science and technology, and success of our customers with the high-quality maritime data.

Responsibility

A responsible attitude toward challenges from the present to the future.

Innovation

Pioneering new paths with cutting-edge technology and an unstoppable spirit of challenge

Respect

Recognize and accept that 'different' does not mean 'wrong', but rather 'diverse'.

UST21

Chairman

CEO

SHE

Sales Strategy Team

Planning & Coordination Office

New Business Development

Software Development

Management Support Headquarters	**BLUE Headquarters**	**DATA Headquarters**	**Marine Convergence Department**	**R & D**
Accounting Team	Operation Support & Planning	Support & Planning	Support & Planning	
Human Resources Team	Hydrographic Service	Geospatial Information	Satellite Applications Division	
Public Affairs Team	Geophysical Service	Nautical Chart		
	MetOcean Service	Information Utilization		
	Marine SI	Artificial Intelligence		
	Geotechnical, Operation & Maintenance Service	Marine Development		
	Busan Branch Office	Numerical Forecast		

Workforce Status

Expertise Level

- Special — 43
- Advanced — 12
- Intermediate — 11
- Beginner — 64
- etc — 69

(Unit: number of people)

Degree

- P.E — 7
- Ph. D. — 17
- High School & etc — 9
- Associate — 18
- Master — 47
- Bachelor — 108
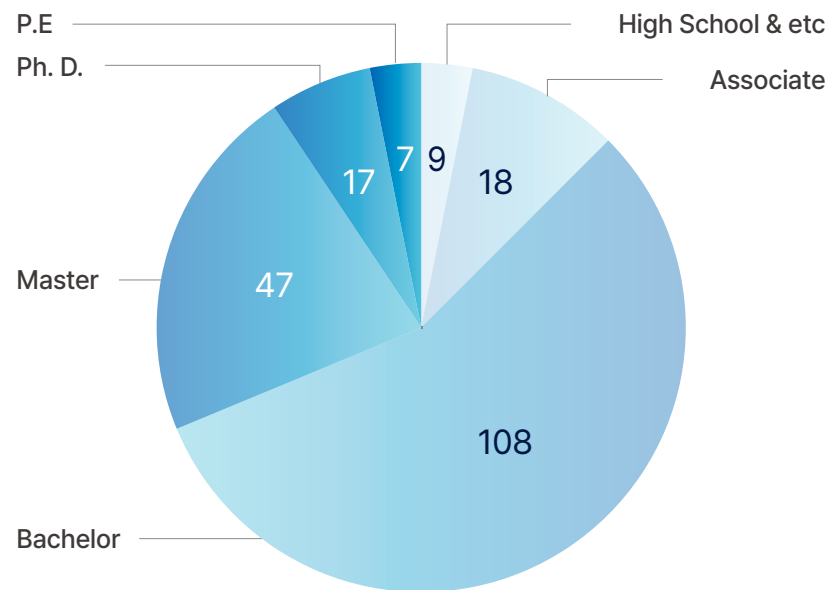
(Unit: number of people)

Total: 199 (As of June 2025)

Clients

UST21 is working with various clients

We contribute to the improvement of scientific technology on the ocean data and the success of our clients.

Major Industries & Certifications

1 Major Industries

Environmental Engineering Services	Natural Science Research & Development	Software Development & Consulting	Maritime Information Service

Non-specialized Wholesale trade	Information Processing service	Hydrographic Surveying	Vessel Leasing Service	Nautical Chart Production	Maritime Observation

2 Certifications

Affiliated Institute Certification

Engineering Business

Software Business

Construction Engineering Service

Hydrographic Business

Cartography Business

Maritime Survey

Maritime Information Service

3 Accreditation

QMS: Quality Management System

EMS: Environmental ManagementSystem

Occupational Health & Safety Assessment Series

Youth-freindly Hidden Champion

Innovation Business

Venture Business

Member of Korea International Trade Association

Family Members in Inha University

Equipments

1 Survey Vessel

105 Haegumho	Hanbadaho	UST 21(18t)	Haegum 2(1.3t)	Blueho

2 Marine Survey and Exploraion, etc.

computer numerical control	AIS	Hyperspectral Radiance and Irradiance Sensors	3D Print	Hyper Spectral Camera	Niskin Water Sampler	LEVEL	Laser cutter	ADCP	GYRO	Sparker	USV
SVP	Sub-Bottom Profiler	Spectro-RadioMeter	Single Beam Echo Sounder	Multi Beam Echo Sounder	Multi-Spectral Sensor	Core	CTD	Motion Sensor	Tide Gauge	Side Scan Sonar	USBL System
Acoustic Release	GNSS	Geometric	DRONE	Wave Gauge	Total Station						

⬢3 S.V. IDABONN

The IDABONN, operated by UST21, is a specialized survey vessel built to meet the highest standards required for nearshore marine deployment.

8.0 m

24.9 m

IDABONN Specifications

· MMSI : 250006524
· Maximum Capacity : 19 persons
· Engine : Diesel 405 kW (x2)
· Gross Tonnage: 149 tons
· Vessel Type: Marine Survey Vessel

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Service

Marine Information Solutions

Maritime Data Analysis

Development of Marine Technology

Ocean Engineering

Global Expansion of Scientific and Technological Excellence

With a dedicated research institute, substantial R&D investments, and proven real-world applications, our cutting-edge technology is gaining international recognition and being adopted as global standards.

Comprehensive Marine Data Solutions

Equipped with Korea's most advanced and extensive marine exploration technology, cutting-edge analysis software, and a team of 161 dedicated professionals, we collaborate with global leading marine exploration companies to provide tailored solutions for any challenge.

Proven Expertise You Can Trust

With 35 years of experience, we ensure the safe, cost-effective, and efficient completion of marine survey, exploration, and development projects-while proactively addressing future challenges with confidence and reliability.

| Overseas Countries | 10 | Highly Skilled Technical Experts | 80 |
| Patents & Utility Models | 40 | Research Papers & Projects | 47 |

Blue Economy, Ocean Wind Farm

Renewable Energy Market	+	Local Geophysical Survey Export	+	International Expert

Offshore wind power has higher wind speeds and better consistency compared to onshore, resulting in superior energy efficiency. It is one of the fastest-growing sectors in renewable energy. Offshore wind projects follow a series of life cycle stages, including site selection, development, construction, operation, and decommissioning, all of which require significant capital and collaboration among various companies.

UST21, with 25 years of experience in domestic and international marine research and services, is conducting marine surveys, meteorological and oceanic observations, soil investigations, geological surveys, and environmental impact assessments for offshore wind farm site selection in collaboration with Fugro. To lead the global renewable energy industry in the future, we are advancing our digital capabilities across all stages, from site selection to development, construction, operation and decommissioning. This includes advanced marine survey technologies, remote sensing, numerical modeling, artificial intelligence, edge computing, open robotics, and low-power IT.

Offshore Wind Farm Site Evaluation

To evaluate the safety and sustainability of offshore wind farms and wind turbines, we conduct precise surveying to provide critical information for site selection, including seabed topography, geological characteristics, detailed geological structures, and hazardous material assessments.

Unexploded Ordnance (UXO) Survey

At specific sites where offshore construction projects are planned, we evaluate the potential presence of unexploded ordnance (UXO) and assess the likelihood of potential UXO (pUXO) based on site conditions.

Ultra-High-Resolution Seismic Survey

Using ultra-high-resolution multi-channel seismic equipment (MC-UHRS), we acquire data to map ultra-high-resolution geological structures. This allows us to conduct geological risk assessments and detailed stratigraphic investigations.

FUGRO·UST21

UST21 has partnered with Fugro to establish the "Fugro UST21" joint venture in Incheon. Since signing a Memorandum of Understanding (MOU) in 2019, UST21 has worked closely with Fugro to deliver advanced geodata solutions, supporting the growth of South Korea's offshore renewable energy sector.

MOU Signing + **Joint Venture Establishment**

UST21
Underwater Survey Technology21
Integration of Complementary Expertise & Technologies

Enhancement of Global Competitiveness

Maximization of Synergy Through Extensive Global Experience
FUGRO

Delivering Reliable, High-Quality Marine Data

We acquire, process, analyze, and predict high-quality marine data seamlessly, based on international quality standards. By leveraging a global SHE system and state-of-the-art equipment, we ensure a comprehensive and consistent approach to marine data collection, processing, and analysis. Additionally, through numerical modeling and artificial intelligence, we provide deep insights into future possibilities.

ISO 9001	ISO 45001	ISO 14001	IMCA

Certified Quality Management System

Certified Environmental Management System

Certificated as Occupational Health and Safety Assessment Series

Vessel 'UST21' certificated by the International Marine Contractors Association (IMCA)

BLUE Headquarters

S-102

· Research bathymetric surface in grid format with uncertainty application
· Provide standards for TPU reporting suitable for domestic states
· Conducting studies on uncertainties in the creation of bathymetric surfaces
· Providing procedures for bathymetric surface creation and the application of the SEP model

HAE (Hight Above Ellipsoid)

· Study of uncertainties in HAE surveying methods and acquired data
· Forge coherent geoid data with HAE survey
· Comparison of uncertainties between HAE surveying and DL-standard depth surveying
· Comparison of data from 2-frequency GNSS equipment and POS/MV equipment Forge coherent geoid data with HAE survey

Unmanned Survey(The Polar Regions)

· Reducing operational risks through unmanned surveying equipment, and conducting surveys and nautical chart production around the Jangbogo Station and King Sejong Station in the polar regions.

Offshore Wind Power

· Preliminary survey for offshore wind farm construction
· International certification for vessel safety management system (eCMID) for collaboration with overseas companies

Tide/Tidal Current Observation

· Conducting long-term and short-term tidal observations tailored to sea area characteristics, integrating leveling surveys and GNSS observations to produce land and sea vertical datum information. Additionally, producing stratified ocean current data and wave characteristics.

LiDAR Buoy

· Designing and maintaining various floating marine observation systems for the acquisition of ocean properties and meteorological information.

Tomography

Research on methods for observing oceanic physical properties using signal processing results of acoustic data collected from multiple points.

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Hydrographic Survey

1 Marine Survey and Nautical Chart Production

Antarctic Marine Survey and Nautical Chart Production

Jangbogo Antarctic Research Station

Near King Sejong Antarctic Research Station

2 ODA (Official Development Assistance)

Economic development and social welfare enhancement in developing countries

Georgia (Anaklia/ Poti/ Batumi)

Projects through Official Development Assistance (ODA)

On-the-Job training on marine observations

3 IHO Capacity Building Program

Support for conducting hydrographic survey and nautical chart production courses for IHO member states

4 S-102

Application of International Hydrographic Organization (IHO) standards

Creation and management of bathymetric surfaces
- Support for marine navigation services
- Pilot survey based on ellipsoidal height
- Development of IHO standards (S-44, S-102)
- Analysis for practical application
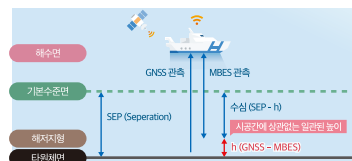
Pilot Survey Based on Ellipsoidal Height
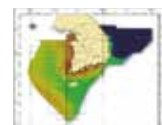
Seafloor Surface Production
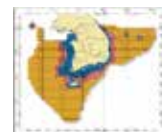
Standard Depth Inspection and Update

5 Engineering Services

Conduct various surveys based on service characteristics Analyze results and produce optimal outputs
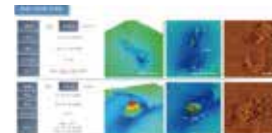
6 Unmanned Surveying

Conduct marine and land surveys using unmanned vehicles Perform topographic and depth surveys through hydrographic and photogrammetric surveying

⬤ Geophysical Survey
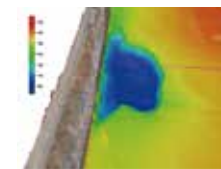
We specialize in conducting a wide range of marine surveys and exploration projects to enhance our understanding of the Earth's ocean environment. Using advanced technologies and equipment, we analyze marine geology, topography, seabed conditions, and various physical characteristics. Our work supports the sustainable use of marine resources and contributes to environmental conservation.

1 Marine Construction Design and Support Survey
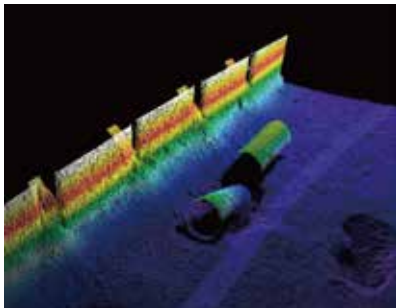
Seafloor Hazard Investigation
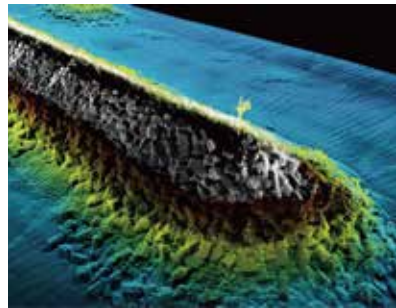
Port Design Survey
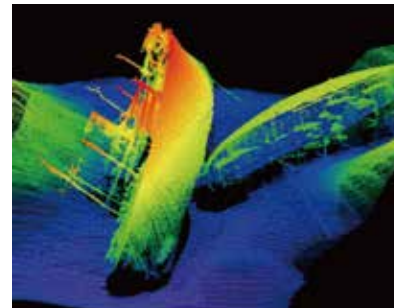
Shipwreck Detailed Survey
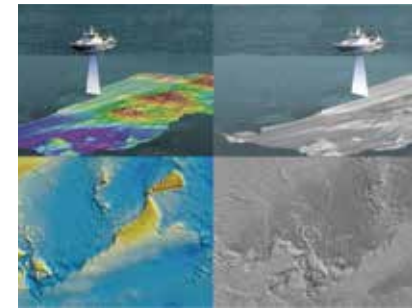
Seafloor Imaging Survey
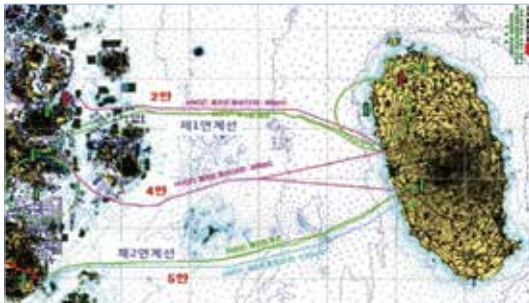
Cable Route Investigation
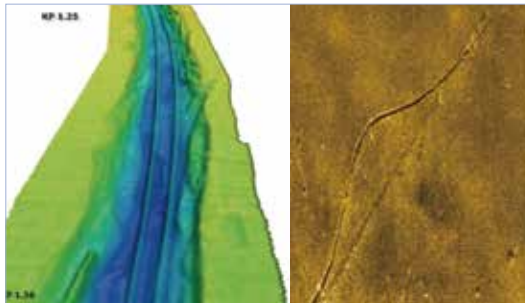
Marine Survey for Cable Maintenance
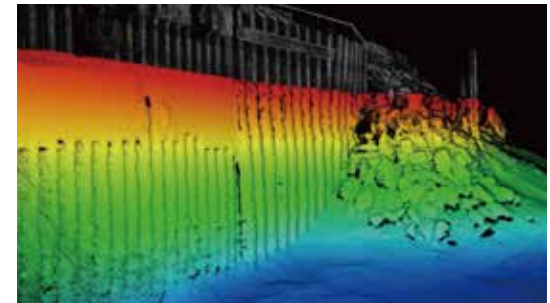
Support for Overseas Port Construction Projects

Unexploded Ordnance(UXO) Survey

The Unexploded Ordnance(UXO) survey is a critical process in ensuring the safety of wind farmconstruction. It involves identifying potential Unexploded Ordnance(pUXO) based on the possibility of its presence.

We utilize four cesium vapor magnetometers(G-882) and Remotely Operated Towed Vehicle(ROTV) to detect potential Unexploded Ordnance(pUXO) containing iron by maintaining a stable depth. In parallel, we conduct high-frequency sub-bottom profiling, Bathymetry, Side scan sonar survey and analyze the specifications of the detected objects.

1 **High-precision / High-Resolution Magnetic Survey**
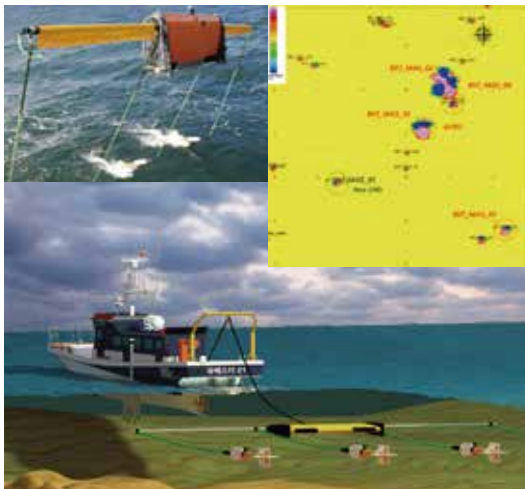
2 **Bathymetry, Side scan sonar survey**
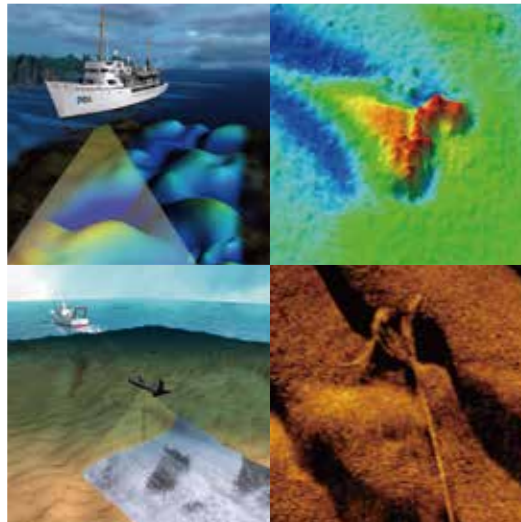
3 **High-Frequency Sub-Bottom Profiling**

Marine Survey
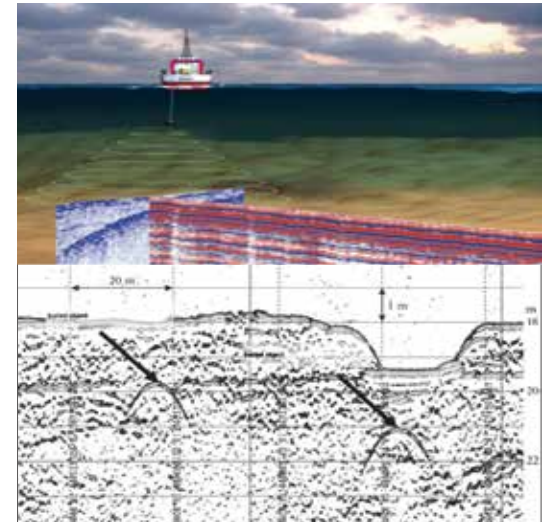
1 Tidal Observation / Marine Vertical Datum

· Providing tidal characteristics of the sea area through short-term (1 month) and long-term tide observations
· Equipped with various observation instruments, including pressure-type and radar-type tide gauges
· Providing marine vertical datum information by integrating leveling surveys, tide pole observations, and GNSS observations
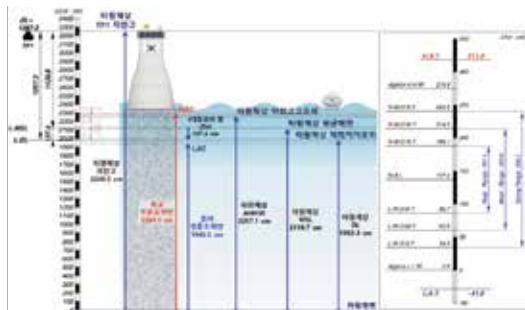

Harmonic Analysis and Determination of Marine Vertical Datum

2 Ocean Currents / Wave Observation
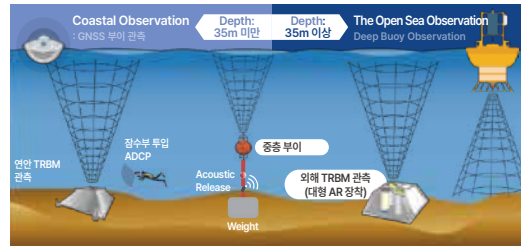
· Providing ocean current and wave data
· Measuring multi-layer current speed and direction using an Acoustic Doppler Current Profiler(ADCP)
· Providing wave information at the sea surface using a wave gauge
· Investigating coastal currents and nearshore water movement characteristics using GNSS buoys
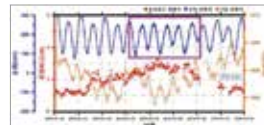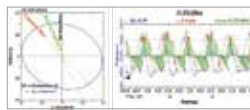

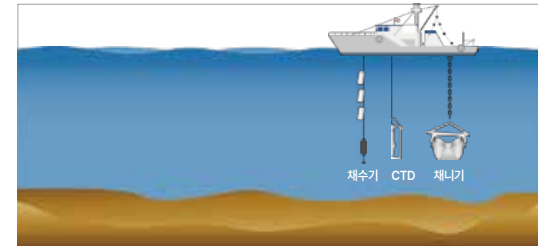Time-Series Analysis of Wave Data

Characteristics of Ocean Currents
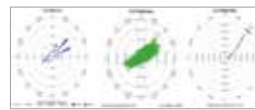
Current Speed and Direction Occurrence Chart, Scatter Plot and Progressive Vector Diagram


Tide-Currents

3 Ocean Properties and Marine Sediments

· Providing information on water temperature, salinity, and suspended sediments, analyzing the distribution characteristics of suspended solids
· Conducts CTD vertical profiling to offer spatial distribution data on ocean properties
· Analyzes sediment characteristics and transport pathways
· Examines sediment transport environments using data on seabed boundary layer flow and sediments
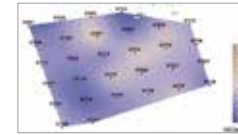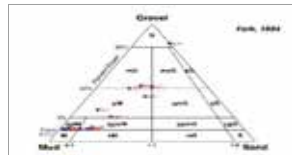

Distribution of Suspended Sediments
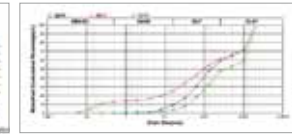
Cumulative Distribution Curve of Marine Sediments
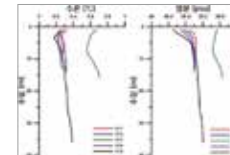
Vertical Distribution of Ocean Properties

Sedimentary Facies of Marine Sediments

Marine Survey

1 Tidal Observation / Marine Vertical Reference

Tidal Level Observation

Level Surveying

Staff Gauge Observation

GNSS Observation

2 Water Flow / Wave Observation

Velocity Observation
(Seafloor Installation)

Velocity Observation
(Sea Surface Installation)

GNSS Buoy Observation

Diver Submersion
Replacement

3 Marine Properties and Marine Sediments

CTD Observation

Water Sampling and Filtering

Core Sampling

Particle Size Analysis

Underwater Acoustics

We observe and analyze underwater noise from various sources, including offshore wind farms, vessels and marine life. We are developing technologies to estimate and analyze the physical and chemical properties of targets using various acoustic devices in the marine environment.
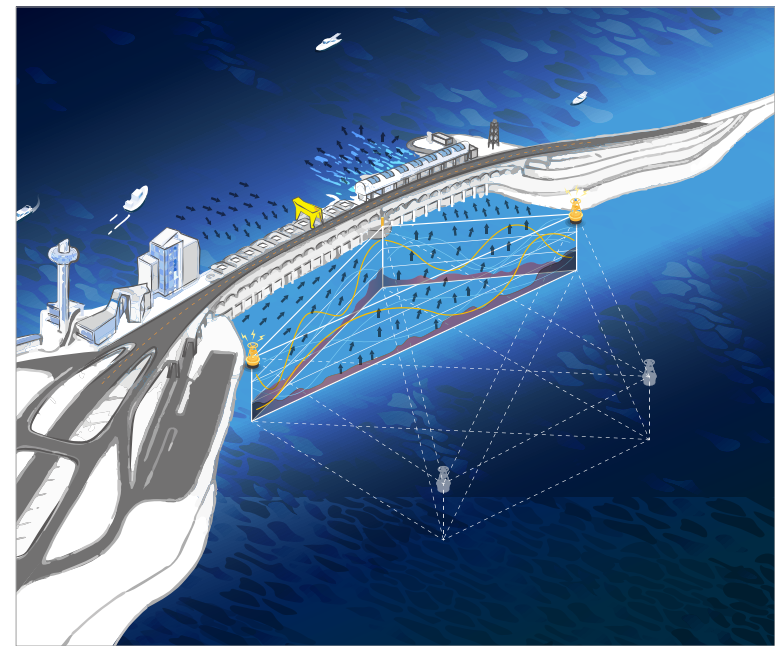
1 Observe and analyze underwater noise

2 Analysis of Marine Characteristics Using Acoustic Signals
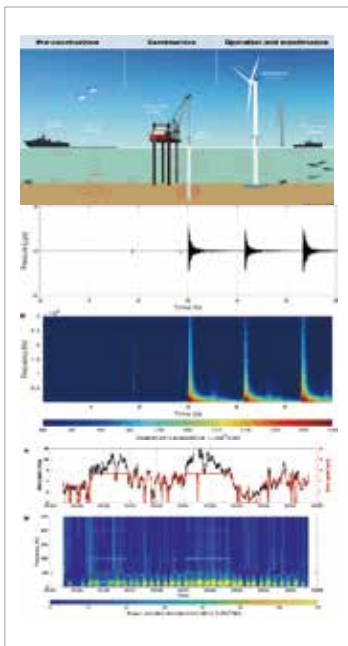
Underwater Noise Related to Offshore Wind Farms
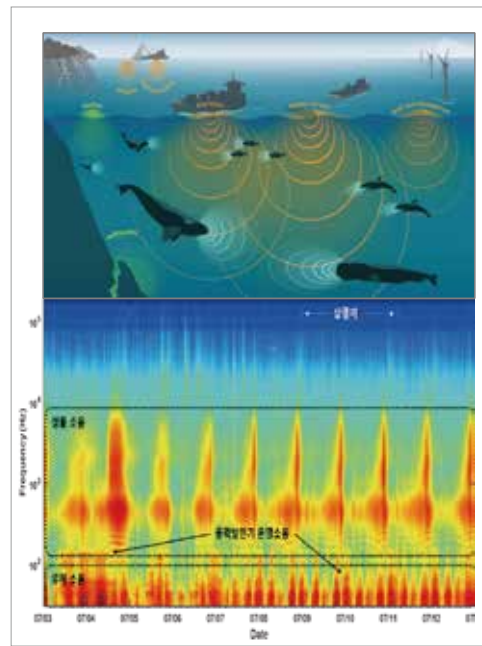
Analysis of Underwater Noise from Various Sources

Acoustic Tomography Technology

Geotechnical Survey

Geotechnical surveys are one of the key processes that form the foundation for underwater construction and power plant development. Using various equipment, the characteristics of the ground are analyzed, and the stability of the ground is evaluated. This helps identify the conditions and potential risks of the target area, providing data that can be used to develop foundation designs.

1 Cone Penetration Test (CPT)

2 Vibro Core (VC)
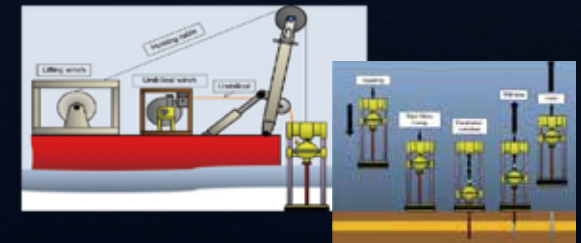
3 Downhole (Borehole) Sampling

Cone penetration test

Borehole sampling

Marine SI

Marine SI visualizes various marine data, supports real-time monitoring, and provides services to the public.

1 Public Services

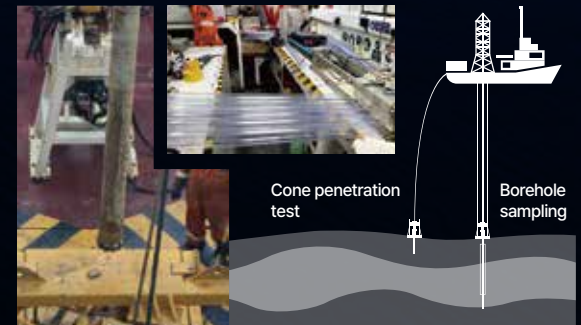Offshore wind environmental spatial analysis platform

2 Visualizes Marine Data

Corstal Flooding Monitoring
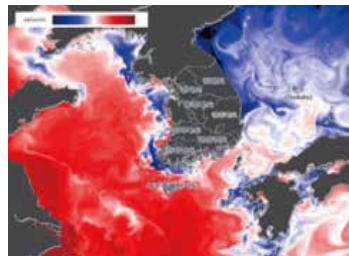
Satellite Sea Surface Temperature Monitoring

ROV

We conduct visual inspections of offshore structures and hazardous materials, providing location and imaging information.

1 Marine Hazardous Material Visual Inspection

Visual Inspection of Hazardous Materials Using Underwater Drones

2 Production of Marine Topography and Hazardous Material Information

3D Terrain Generation Using Photos Taken by Underwater Drones

Ocean Data Analysis

We conduct monitoring and analysis of the National Oceanographic Observation Network, and develop real-time, near-real-time, and non-real-time quality control technologies for marine physical observation data. Additionally, we conduct research on sea area characteristics and phenomena by utilizing various marine data.
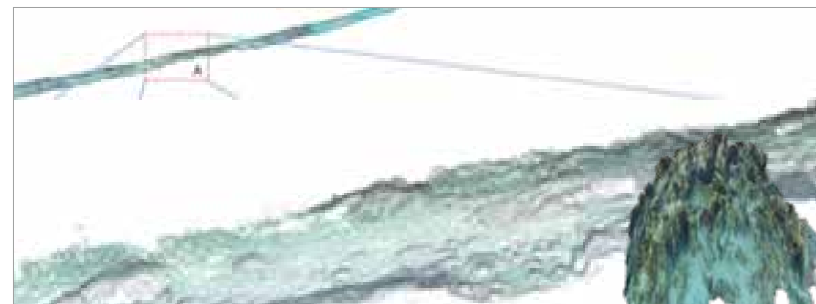
1 Marine Observation Data Monitoring and Quality Management
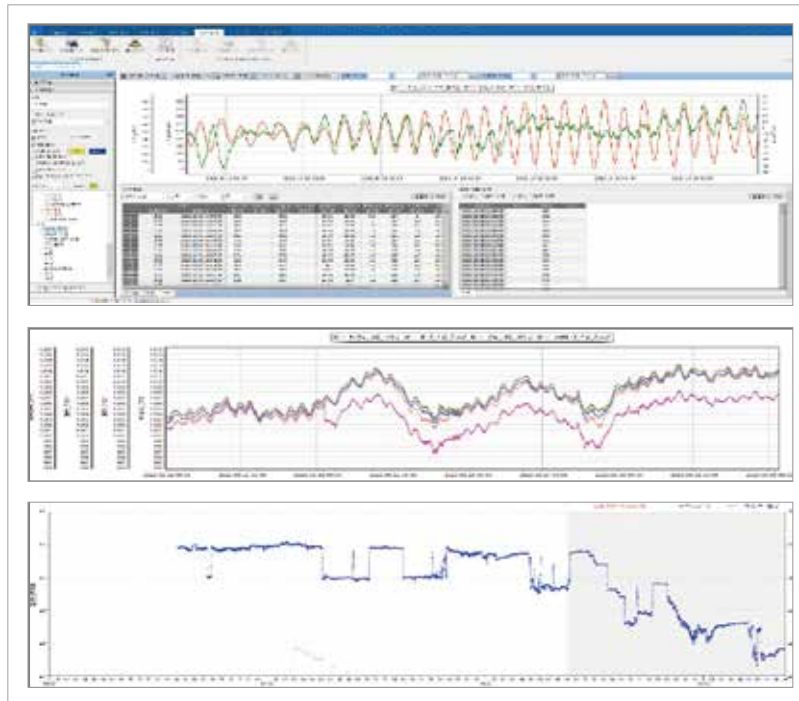
Monitoring and Quality Control of Marine Data

2 Utilization of Marine Information
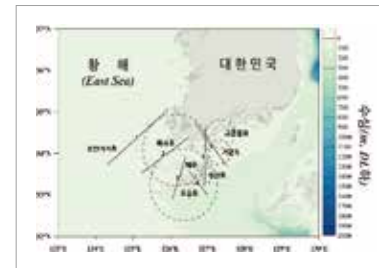
Analysis of the Characteristics of Korean Sea Areas
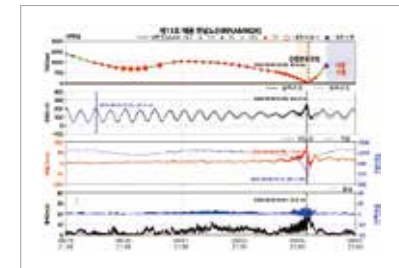
Analysis of Marine Phenomena such as Typhoons

Incheon	Sokcho	Busan

Use of Marine Data for Flood Prediction Maps

Marine Environmental Monitoring

1 Public Services

Offshore Wind Environmental Information Platform

Real-Time High Tide Information Service

Estuarine and Coastal Environmental Information Platform
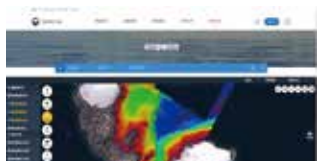
Polar Navigation Safety

2 Visualizes Marine Data
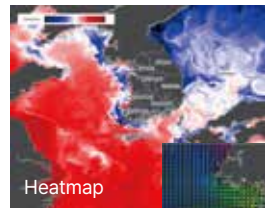
Heatmap

Vector map

Corstal Flooding
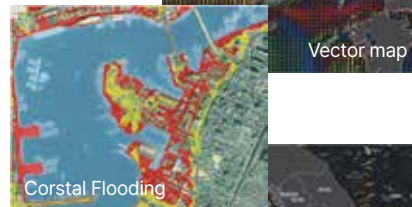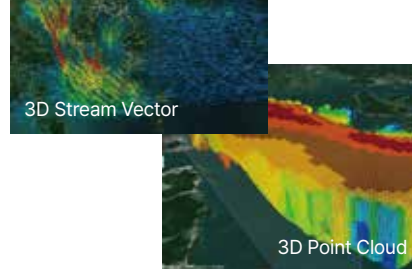
Stream Vector

3D Stream Vector

3D Point Cloud

3 IoT Monitoring

Coastal Communication

Satellite Communication

Current and Tide Data Editing

Location Tracking

Marine Observation Equipment

Data Logger

Real-time Monitoring
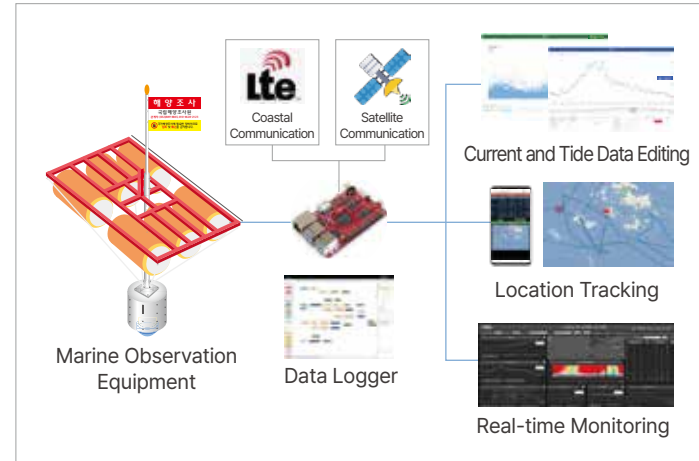
Real-Time Data Transmission and Monitoring System

King Sejong Station, Antarctic

Long-Term Current Measurements at the Horizontal Water Intake

Anomaly Signal

Server Failure

Risk Information

Fault Notification Management System

Jaeun Island

Georgia

Push Queue

Naver Band

Real-Time Monitoring and Alert Service

DATA Headquarters

Nautical Charts Production

· Starting from the high-quality nautical chart production service project in 2010, we have been carrying out services for new and revised editions of digital nautical charts and electronic nautical charts to the present day.

Marine Thematical Maps Production

· Fishing Spot Survey and Database Construction
· Production of Marine Safety Maps
· Creation of National Marine Atlas
· Updating of Nautical Charts and Publications

Artificial Intelligence

· AI-based time series forecasting, AI-based image classification and detection
· AI-driven fog occurrence and dissipation prediction, AI-based fog CCTV image classification

Sea Area Utilization Consultation & Environmental Impact Assessment on Utilization of Sea Area

· Analyzing and predicting the environmental impacts of usage and development in the marine environment, and proposing measures to minimize the impact on the ocean.

Research related with S-100 Standards

· Conducting standard-related research, such as IHO MSDI trend analysis, e-Navi studies, efficiency improvements in integrated management of navigation aids and the establishment of a standardized marine information collection and management system.

Spatial Information Visualization

· Displaying marine prediction model data an observation data
· Accuracy analysis of prediction data and comparison with current status
· Development of a marine spatial information visualization system, including typhoon report generation

Numerical Models, Data Assimilation(4D Variational Method)

· Improving initial conditions in numerical models to enhance prediction accuracy

Visualize the spatial information

· Display the maritime prediction numerical mode data & observation data
· Analyzing the accuracy of prediction data & comparative analysis of current state
· Develop the system to visualize the maritime spatial information including writing typhoon reports, etc.

UST21
Underwater Survey Technology 21

Geospatial Information

We carry out a wide range of projects related to geospatial information, including the production of various thematic maps and publications through the convergence and integration of diverse types of spatial data. Based on the analysis of related standards for geospatial data standardization, we establish management systems to support the collection, management, and utilization of geospatial information in line with client requirements.

Geospatial Data Integration and Convergence

· Expertise in processing various types of spatial data (database construction, spatial data conversion)
· Possess automated geospatial data processing technologies (using SQL, Python, GDAL)
· Structuring of geospatial information based on raw data interpretation
· Production of geospatial publications and various thematic maps

Standards Analysis

· Extensive experience in research on domestic and international standard specifications, related laws, policies, and systems
· Proficient in analyzing geospatial stadards such as ISO and IHO, with experience applying them in domestic projects
· Participation in international meetings related to standard development activities, with experience presenting agendas

Information Management Systems

· Capability to design and implement logical and physical structures based on geospatial data exchange policies
· Ability to establish standardized data history management systems
· Experience in developing production systems considering the transition from analog to digital processes

QGIS   python™   IHO International Hydrographic Organization   S-100 | Universal Hydrographic Data Model   PostGIS PostgreSQL

Marine Base Map Production

We leverage spatial information databases for data analysis and processing to produce national basic marine charts, essential for the marine sector. Additionally, we conduct research on establishing marine information standards and systems for efficient collection and management, adhering to international standards (IHO, ISO).

Marine Information Collection and Management System

Participation in international meetings (UN-GGIM)

EAHC-MSDIWG (IHO)

Hosting of marine information utilization seminar

Necessity and applications of marine base maps

Marine Base Map Production

1 Establishing Institutional Foundations for the Production of Marine Information Publications

Analysis of existing laws and regulations:	Establishment of production standards and addition of administrative rules:
Act on Marine Research and the Use of Marine Information (Ministry of Oceans and Fisheries)	
Act on the Establishment and Management of Spatial Data(Ministry of Land, Infrastructure and Transport)	
Regulations on the Production and Results of Digital Topographic Maps (National Geographic Information Institute)	Regulations on the Standards for the Production of Marine Information Publications (KHOA Notification No. 2023-6) — Guidelines for Marine Base Map Production

Development of a Marine Spatial Analysis Platform for Offshore Wind Power

2 Object Identification and Spatial Data Extraction from Raw Point Cloud Data

Piers /revetments · Breakwaters · TTP · Shipwrecks · Artificial reefs

Obstacles · Shipwrecks · Submarine pipelines · Man-made structures

Enhancement of Marine Information Collection and Management System
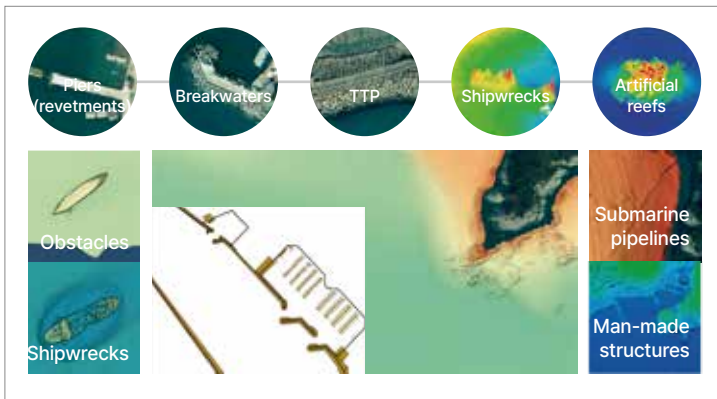
Adoption of the IHO S-100 Data Model

Real World · Digital World (S-100)

Fishing Ground Authority — Feature

Area Of Zone Category... Method : — Attribute

객체 사진
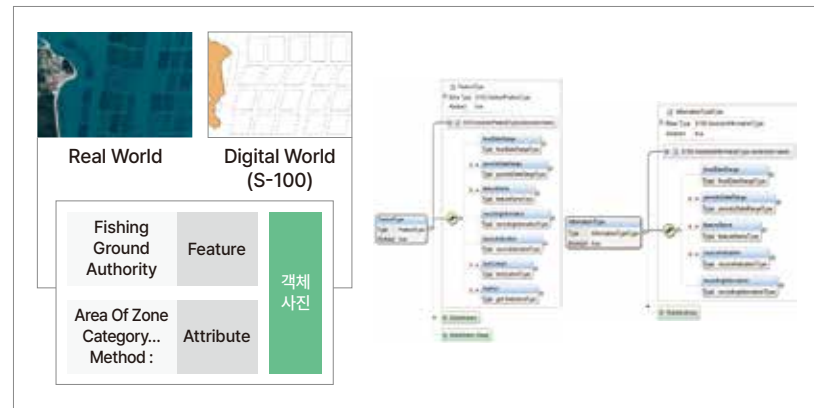
Object-based data structuring

1 What is Generative AI (Large Language Model, LLM)?

· An artificial intelligence model trained on large-scale language data to generate human-like natural language
· Commonly used for tasks such as conversation, text generation, summarization, and translation

2 Building Training Data for Generative AI Services

· Selection of relevant internal and external documents such as reports, press releases, policies, and regulations for use in generative AI services
· The scope of detailed training data is determined after consultation
· Collaboration with data-providing institutions for data collection, integration, and additional support
· Data preprocessing and training to improve data quality and model performance

Diagram of Generative AI-Based Marine Industry Information Service

3 Model Development and Tuning Strategy Based on Training Data for Generative AI Services

· Selection of data from reports, press releases, policies, and regulations for generative AI service use
· Application of techniques to address limitations of generative AI, such as RAG, fine- tuning, Reinforcement Learning from Human Feedback(RLHF), and Machine Reading Comprehension (MRC)
· Development of a multilingual system supporting communication in Korean, English, and other languages
· Enhancements for model quality, including reducing hallucinations and minimizing bias
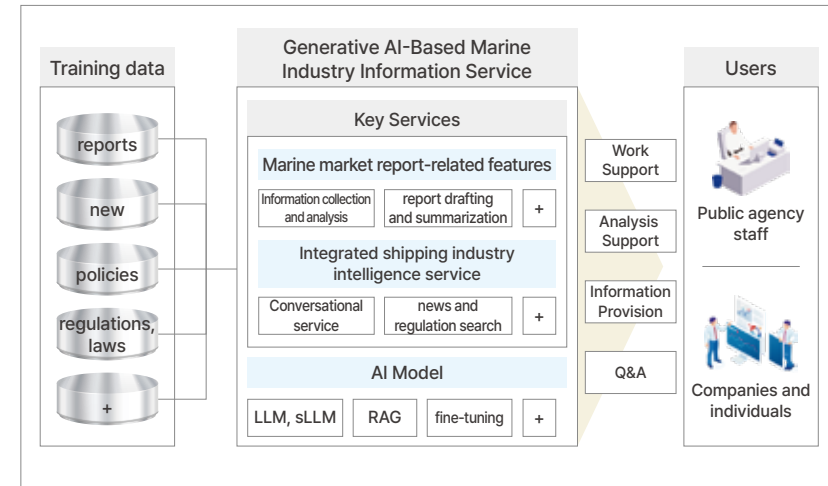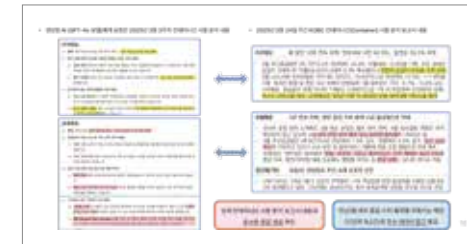

List of Reports from Korea Ocean Business Corporation

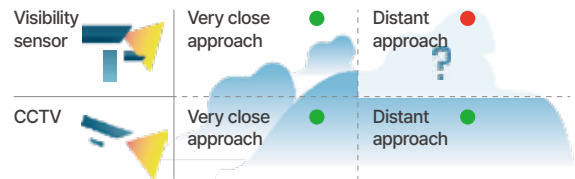Development of Questioning Strategies for Report Analysis and Drafting Using Generative AI
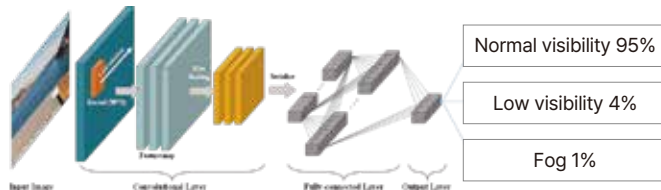
1 Fog Detection

Fog detection: assessing current fog conditions

· Fog detection is commonly performed mechanically using visibility sensors
· Visibility sensors have difficulty detecting fog from a distance, so CCTV is used for fog detection

CNN model optimized for image data processing for fog detection

· Effectively extracts the optical features of fog from images
· Classifies images into appropriate categories (normal visibility, low visibility, fog)


| Normal visibility 95% |
| Low visibility 4% |
| Fog 1% |

Performance of the fog detection model

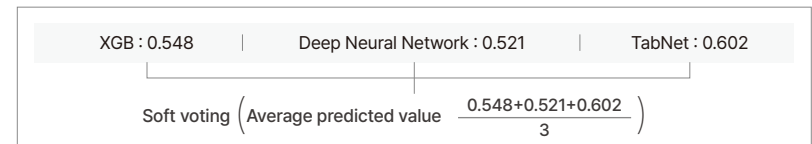| Nationally Managed Trade Ports	ACC(%)	PAG(%)	POD(%)	F1 score(%)
Daesan Port	94.3	90.2	91.3	91.2
Yeosu Port	96.4	84.3	77.5	79.6
Incheon Port	95.5	90.4	84.1	87.0

2 Fog Forecasting

Fog forecasting: predicting the timing of fog formation and clearance

· Fog is difficult to predict due to its complex dependence on sea state and weather conditions
· Using AI models based on observational data to forecast fog quickly and accurately
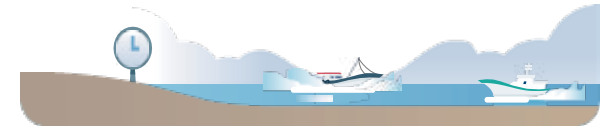
An ensemble model is used to reduce uncertainty in fog forecasting.

· Results from XGB models, artificial neural networks, and TabNet models are combined to produce the final fog forecast
· The final prediction is calculated by taking the arithmetic mean (soft voting) of the prediction probabilities from each model

| XGB : 0.548 | Deep Neural Network : 0.521 | TabNet : 0.602 |

$$\text{Soft voting} \left(\text{Average predicted value} \quad \frac{0.548+0.521+0.602}{3} \right)$$

AI-Based Ensemble Fog Forecasting Model

Hour Ahead Fog Prediction Model Performance Metrics

Nationally Managed Trade Ports	ACC(%)	PAG(%)	POD(%)	F1 score(%)
Daesan Port	96.6	79.2	81.7	80.4
Yeosu Port	99.5	79.2	79.5	79.3
Incheon Port	98.8	79.7	75.9	77.7

# Construction of Marine Big Data for AI Training

1 Fog/Mist CCTV Data

· Prevention of accidents and proactive response through early prediction of visibility restrictions and risk due to fog
· Development of fog detection and forecasting model application services
· Data includes 369,640 fog CCTV images, 2,587,480 observation data points, and 369,640 annotation JSON files
· Achieved an F1 score of 77.41% with a multimodal fog detection model using both observation data and images
· Machine learning-based ensemble fog forecasting model achieved an F1 score of 73.44% for 1-hour ahead prediction

2 Rip Current CCTV Data

· Rip currents are narrow, fast-moving flows of seawater moving away from the shore
· Detection and forecasting systems are needed to prevent drowning accidents among beachgoers
· First-ever construction of big data combining CCTV images and observational data from Haeundae, Songjeong, Daecheon, Jungmun, and Naksan with a total of 310,181 records
· Trained CCTV images and observational data simultaneously by using a Mask R-CNN model with a Swin Transformer as the backbone and an additional DNN for training observational data
· Achieved high rip current detection performance (AP 77.2%)

3 Fishing Vessel Operation Pattern and Track Data
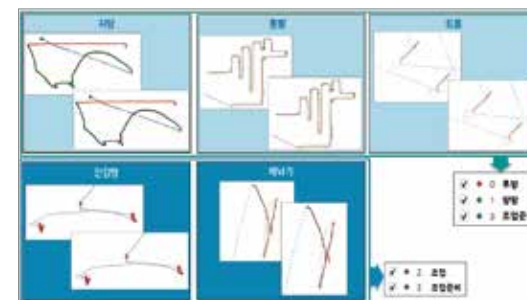
· Automatic Identification System (AIS) is an automatic identification device installed on vessels that includes position, speed, and identification information
· Basis for developing a system for identifying fishing behavior and monitoring illegal fishing vessels for the Jeju marine environment monitoring system
· Built AIS track data and on-site fishing information CCTV dataset with 100,000 records
· Fishing types include gillnet, set net, jigging, longline, trap, trawl, purse seine; fishing behavior includes casting, hauling, fishing, and non-fishing
· Developed models using 1D CNN and Transformer architectures

· Developing a coupled model combining a data-assimilative (4DVAR) ocean circulation model (ROMS) and a lower trophic ecosystem model(NPZDFennel)

· A strong coupling method that simultaneously assimilates physical and biogeochemical models is applied to improve forecast accuracy.

· The predictive results are used for monitoring marine climate change (marine environment and ecosystem) and for evaluating the performance of the analysis field production model.

Initial & Boundary Condition

Salinity NO3 Chl-a

Temperature

Performance Evaluation
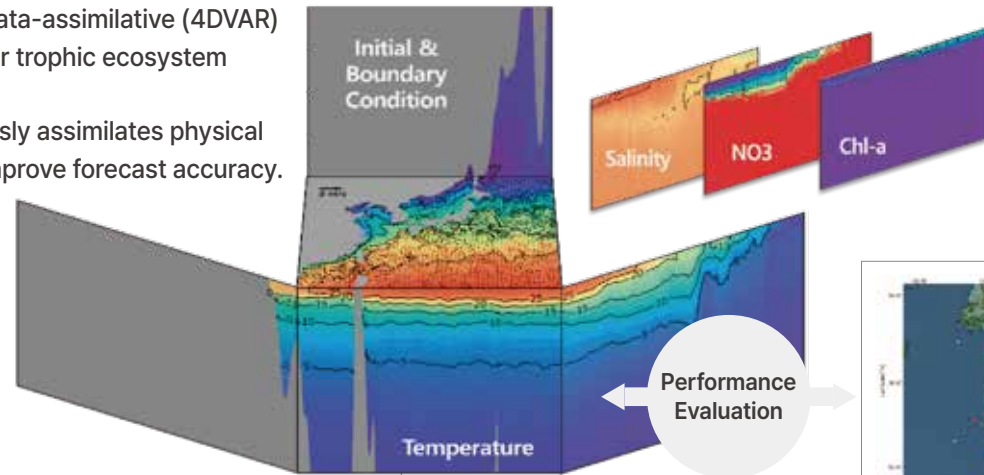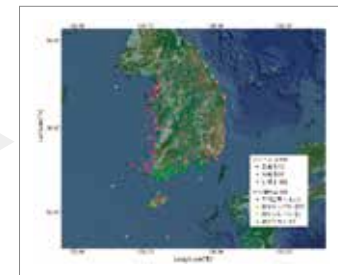
National Observation Network Station Map

Data Assimilation (4DVAR)
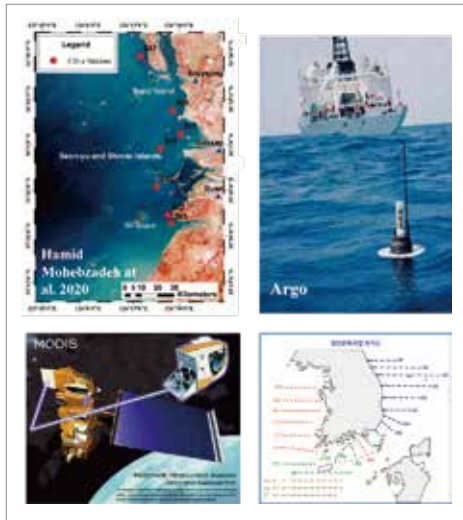
Observation
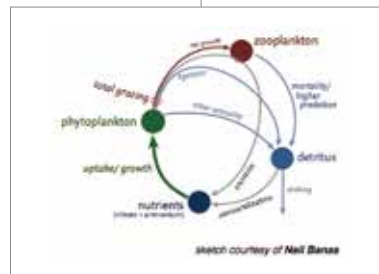
Biogeochemistry Model
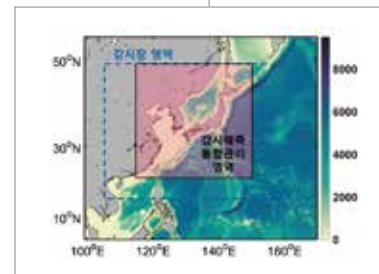
Physical Oceanic Model
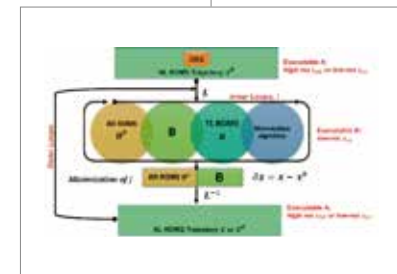
4DVAR Algorithm
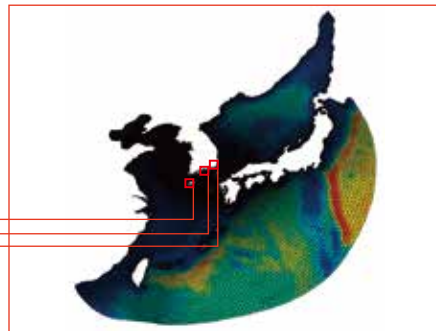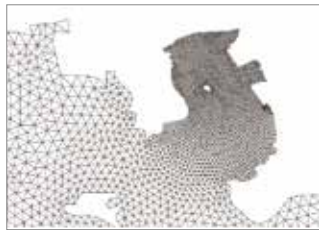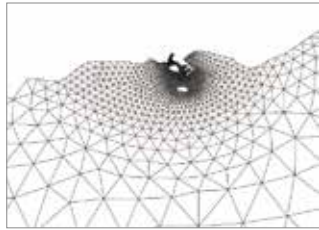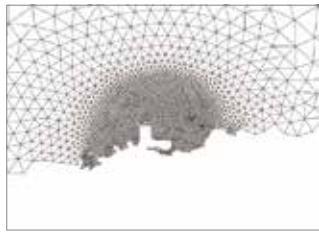
Unstructured Mesh and Domain
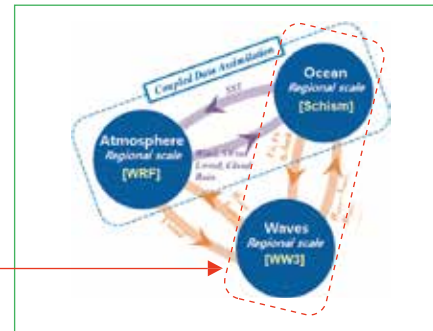
Coupled Model
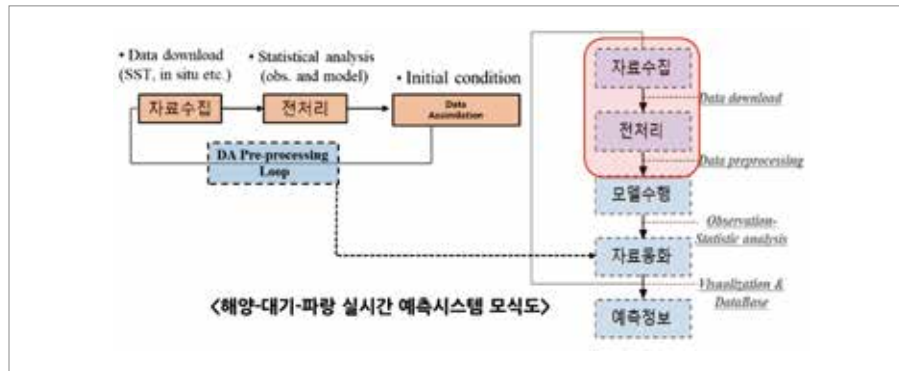
· Development of a real-time coupled ocean-atmosphere-wave model
· Optimization of model initial conditions through data assimilation
· Improved forecast accuracy in coastal areas using unstructured grids
· Real-time prediction of coastal disasters such as low salinity, high water
  temperature, and meteorological tsunamis

Salinity (SSS)

Temperature (SST)

Storm Surge

Real-Time Prediction

Chart Production Field
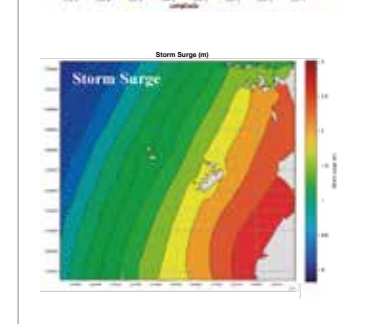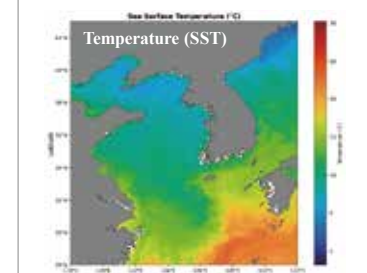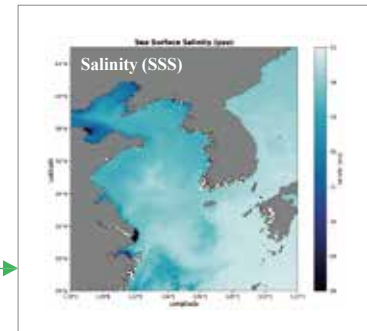
1 Paper Chart

Charts printed on paper after editing

Classification of paper charts

Step	Navigational purpose	Scale level(1:)
1 Step	General chart	Smaller scale than (1:4,000,000)
2 Step	Sailing chart	Smaller scale than (1:1,000,000)
3 Step	General chart of coast	Smaller scale than (1:300,000)
4 Step	Coast chart	Smaller scale than (1:30,000)
5 Step	Harbour chart	1/3만 이상의 대축척

2 Electronic Navigational Chart (ENC)

Digital charts created from edited navigation information such as depths, rocks, coastlines, aids to navigation, and navigation hazards, produced according to international standards for use in electronic chart display systems.

Classification of electronic charts

Step	Navigational purpose	Scale level(1:)	Standard scale for electronic charts(1:)
1 Step	General chart	≥ 2,000,000	2,000,000
2 Step	General	500,000~1,999,999	500,000
3 Step	Coastal	250,000~499,999	250,000
4 Step	Approach	75,000~249,999	75,000
5 Step	Harbour	25,000~74,999	25,000
6 Step	Berthing	≤ 24,999	5,000

3 Chart Maintenance and Management

New Chart	Revised Chart	Reprinted Chart	Correction Chart	Withdrawn Chart
An initial edition chart created to include new chart areas different from existing charts.	A chart newly produced to update existing content such as depths and coastline changes based on new hydrographic surveys.	A chart reissued when paper chart stock runs out, reprinted with updates such as navigation warnings reflected on the chart plates.	A small-sized partial chart produced as a correction map for changes in small areas on already published charts.	A chart that has been discontinued when new editions or revised charts are published, making the previous chart obsolete.

Chart Production and Navigation Notice

Nautical charts include the production of electronic and paper charts, as well as thematic charts, along with chart maintenance, navigational warnings, and alerts.

1 Nautical Chart Production and Maintenance

Paper Nautical Chart Production

Electronic Nautical Chart (ENC) Production
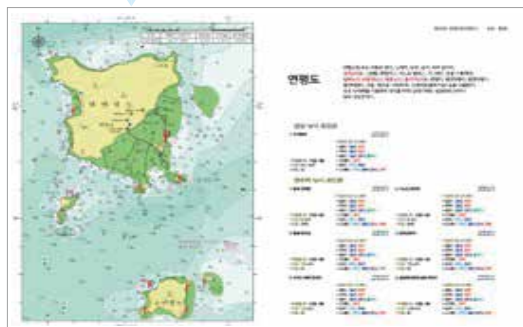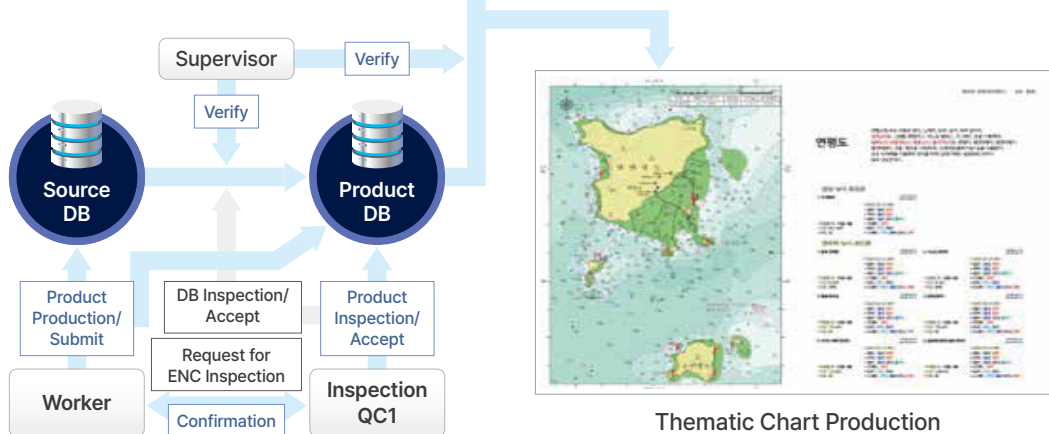
Thematic Chart Production

2 Navigational Warnings and Alerts

Navigational Warnings

Information essential for navigation, including warnings related to maritime traffic safety, provided to navigators and relevant stakeholders.

Navigational Alerts

Urgent information that cannot wait for standard navigational warnings, delivered via wired and wireless communication channels.

System Development

① Integrated Marine Information Management Development

Sediment

Dashboard

Lighthouse List

Restricted Data Request Management

Viewing Status of Restricted Data

General Hydrographic Survey Metadata

② Development of Marine Data Visualization Software

A support system has been developed to visualize and analyze marine environmental data. Based on marine numerical model data, the system enables visualization of forecast and observation data, as well as accuracy analysis of forecast data based on observations.

· System Architecture

User	MSA Core Service		Front-end Service	
External User	Gateway (Spring Cloud)	Service Configuration and Status Check (Consul)	KOOS GIS	Admin Page
			Homepage	OpenDAP

User	Monitoring		Back-end Service		
Related Organization User	Data Collection (Prometheus)	Visualization (Grafana)	API-User Authentication API	Marine Data Collection API(Observation Stations, Etc.)	Typhoon Information API (Collection, Reports)
			Accuracy API (Model Accuracy)	Typhoon Information API (Collection, Reports)	System Management API(User Management, Etc.)

User	DataBase		Data Collection Batch Service(Model Data Integration & Management)		
Internal User	GeoServer	PostgreSQL	Forecast Model Deployment (MOHID, OPEM, Etc.)	Observation Data Deployment (KIOST, KHOA, Etc.)	
			Accuracy Deployment	Typhoon Data Deployment	External Linked Collection

Development of Visualization and Management of Marine Environmental and Ecological Data

We primarily focus on developing GIS-based programs and systems for collecting and managing marine-related information. Additionally, we conduct spatial data visualization and marine ecological data visualization. Various development efforts related to the marine field are being pursued and expanded.

1 Marine Ecological Data Visualization

2 GIS Development for the National Marine Biodiversity Institute of Korea
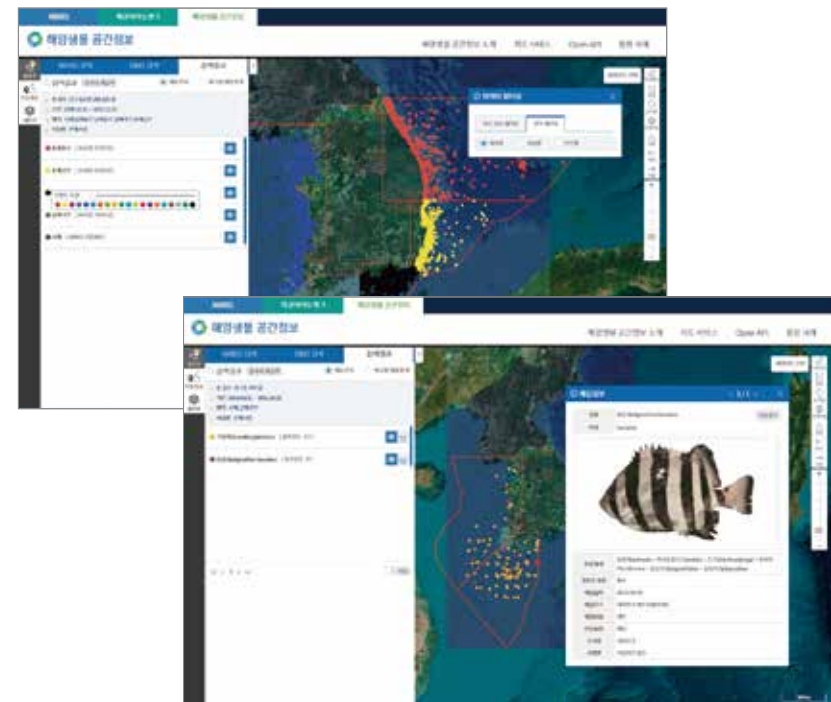
Consultation on Utilization of Sea Areas

We conduct Sea Area Utilization Impact Assessment, general and simplified Consultations on the Utilization of Sea Area in accordance with the Marine Environment Management Act.

Private Aids to Navigation Permit	Consultation on Utilization of Sea Areas / Permit for Occupation and Use of Public Waters	Environmental Impact Assessment
A person who needs to establish aids to navigation to use them for their business or duty may do so after obtaining permission from the Minister of Oceans and Fisheries, as prescribed by Presidential Decree.	The head of the administrative agency that intends to utilize or occupy public waters must consult with the Minister of Oceans and Fisheries in advance regarding the appropriateness of sea area use and its impact on the marine environment.	Anyone intending to implement energy resource development projects, including offshore wind power projects of various scales, must conduct an environmental impact assessment.
Aids To Navigation Act / Article9	Marine Environment Management Act / Article84	Environmental Impact Assessment Act / Article 4

Permit and Approval Related

We carry out permits and approvals for the occupation and use of public waters for the installation of LiDAR buoys and ground investigations(e.g., Installation of wind direction measuring devices and Subsurface explorations for Offshore Wind Farms)

Permit & Approval Process

1 Installation of LiDAR Buoys

- ① Simplified consultation on utilization of sea areas
- ② Permit for Occupation and Use of Public Waters
- ③ Private Aids to Navigation permit

Ministry of Oceans and Fisheries

Generation Facility Capacity Less than 50MW	Generation Facility Capacity More than 50MW
▼	▼
General Consultation on Utilization of Sea Areas	Sea area utilization impact assessment

2 Subsurface exploration

- ① Simplified and General consultation on utilization of sea areas
- ② Permit for Occupation and Use of Public Waters

Ministry of Environment

Generation Facility Capacity More than 100MW
▼
Sea Area Environmental Impact Assessment

3 Offshore Wind Power Project

Marine Convergence Department

We conduct monitoring and analysis of the National Oceanographic Observation Network, and develop real-time, near-real-time, and non-real-time quality control technologies for marine physical observation data. Additionally, we conduct research on sea area characteristics and phenomena by utilizing various marine data.

Marine Environment

· Climate Change and Carbon Absorption
· Environmental DNA and Toxic Substances
· Marine Aquaculture Changes and Environmental Monitoring

Satellite Research

· Remote Sensing Image Preprocessing and Calibration/ Correction
· Quality Verification and Statistical Analysis
· Research on Ocean Color and Inherent Optical Properties

Image Utilization

· Development of Multi-Satellite Utilization Business Models
· AI-Based Object and Change Detection
· Satellite Data Integration and Information Production

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Underwater Survey Technology21

Satellite Remote Sensing

Providing high-quality, user-customized marine information based on remote sensing technology.

Geostationary Ocean / Meteorological Observation Satellites
: Ocean color sensors

Polar-Orbiting Earth Observation Satellites
: Optical, radar, and hyperspectral sensors

Miniature (Cube) Cluster Earth Observation Satellites
: Optical and radar sensors
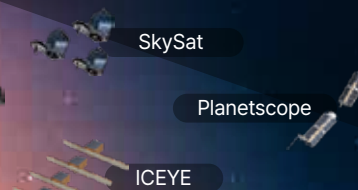
Low-Altitude Remote Sensing (Optical & Hyperspectral) Platforms

Himawari-8

Geo-Kompsat 2A

Geo-Kompsat 2B

Kompsat-3/5

Rapideye

CAS500-1/2

Worldview

Sentinel-1/2/3

Landsat-8/9

SkySat

Planetscope

ICEYE

Data

BIG DATA

Monitoring

Base Station

Open Ocean

Sea Surface Temperature

Sea Surface Salinity

Chlorophyll-a

Coastal Areas

Underwater Aquaculture Farms
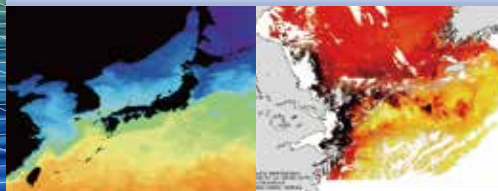
Sargassum Horneri | Marine Debris
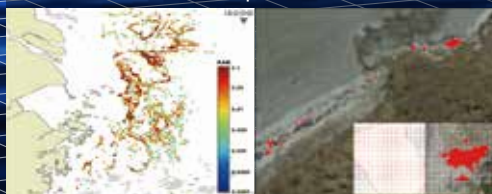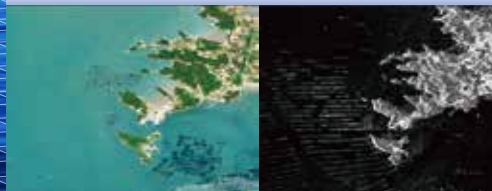
Ports and Coastal Land Areas

Ship Detection | Tidal Flat Distribution
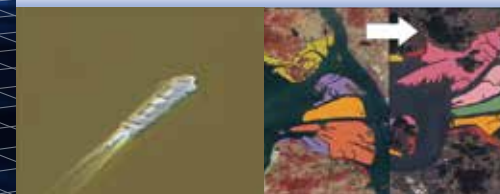
Operation of the Marine Convergence Environmental Analysis Lab

· Various systems are being established for ocean color satellite calibration and ocean environment analysis, including a seawater optical property analyzer, water quality analyzer, organic carbon analyzer, and organic compound analysis equipment.

· Professional analysis is possible through skilled analysts in the fields of marine chemistry and marine biology.

· Through ocean color satellite calibration and utilization, as well as ocean environment analysis, various research and development (R&D) and service projects are being carried out, with plans to expand the analysis field in the future.

Comprehensive Equipment

for Secure Sample Storage and Precise Quantitative Analysis

Measurement of Marine Nutrients and Dissolved Oxygen Levels	Phytoplankton Biomass Measurement
Measurement of Inorganic/ Organic Carbon Concentrations	Primary Productivity Measurement
Pigment Analysis and Amino Acid Composition Analysis	Analysis of Marine Optical Properties
	Environmenta Genetic Analysis

Preparation Room

Seawater Analysis Room

Instrument Analysis Room II

Instrument Analysis Room I
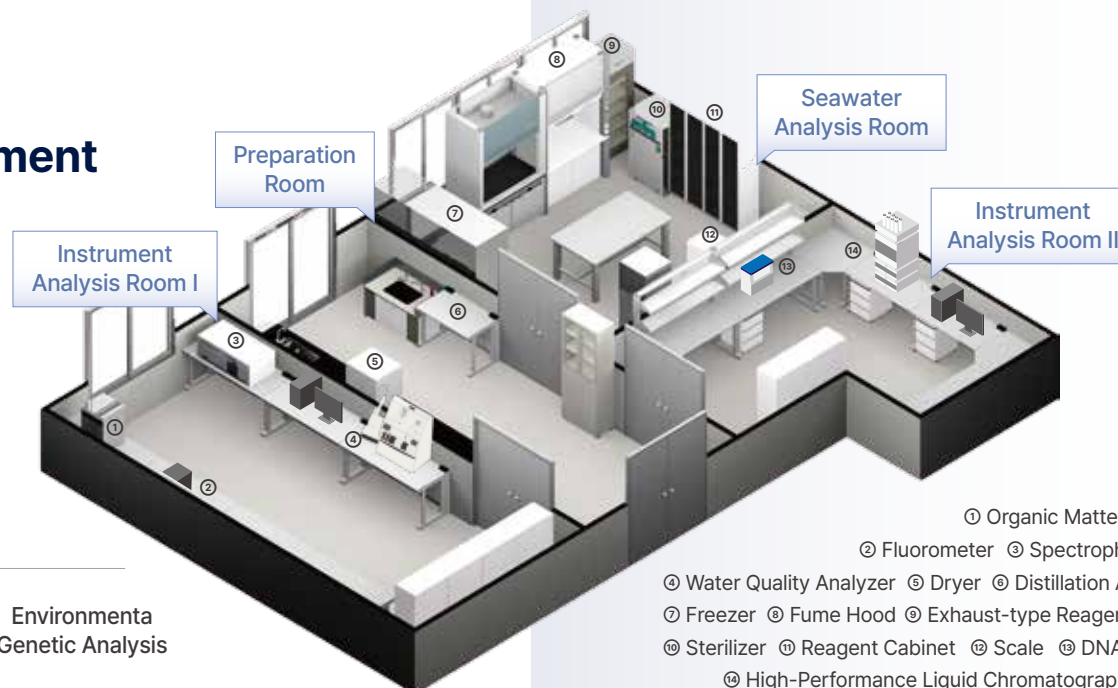
① Organic Matter Analyzer
② Fluorometer ③ Spectrophotometer
④ Water Quality Analyzer ⑤ Dryer ⑥ Distillation Apparatus
⑦ Freezer ⑧ Fume Hood ⑨ Exhaust-type Reagent Cabinet
⑩ Sterilizer ⑪ Reagent Cabinet ⑫ Scale ⑬ DNA Amplifier
⑭ High-Performance Liquid Chromatography (HPLC)

Diagram of Remote Sensing Research and Development Process

Geostationary Satellites
[Ocean Color, Thermal]

Small Satellites
[SkySat, WorldView]

Polar-Orbiting Satellites
[SAR, Optic, Multi-Band]

Unmanned Aerial Vehicles
[Drone, Hyperspectral,
EO/IR, Multi-Band]

**Remote Sensing
Data Collection**

Cloud Platform

OpenAPI Services

API

Service Platform

Geometric Correction

Radiometric Correction

Atmospheric Correction

Quality Processing, etc.

**Image Preprocessing and
Quality Verification**

Marine Debris

Maritime Vessels

Offshore Aquaculture

Blue Carbon

Port Logistics

Tidal Flats, etc.

**Information Production
and Utilization**

XGBoost

Deep Learning

Long Short-Term Memory

Transformer

**Image Preprocessing and
Quality Verification**

1 **Development of Atmospheric Correction Algorithms for Satellite Imagery**

· Development of atmospheric correction algorithms based on medium-to-high-resolution and optical satellite imagery
· Collecting Landsat-8 and SkySat data → Compared and validated results using atmospheric correction techniques such as DOS, COST, and DCP
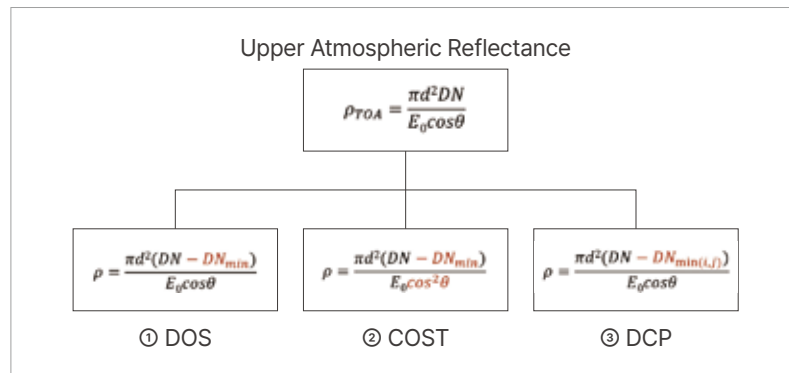
Types of Atmospheric Correction Methods

Upper Atmospheric Reflectance

$$\rho_{TOA} = \frac{\pi d^2 DN}{E_0 \cos\theta}$$

$$\rho = \frac{\pi d^2 (DN - DN_{min})}{E_0 \cos\theta}$$

$$\rho = \frac{\pi d^2 (DN - DN_{min})}{E_0 \cos^2\theta}$$

$$\rho = \frac{\pi d^2 (DN - DN_{min(i,j)})}{E_0 \cos\theta}$$

① DOS   ② COST   ③ DCP

Comparison of Atmospheric Correction Results

Original

DOS
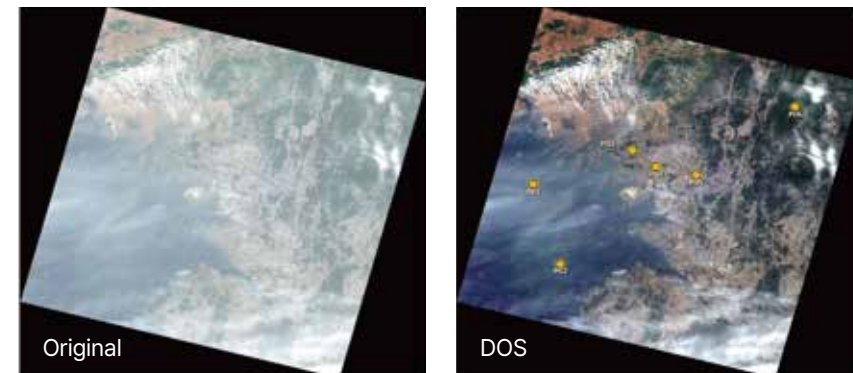
Dark Map Calculation Process (Example of DCP)

[Window]

COST

DCP
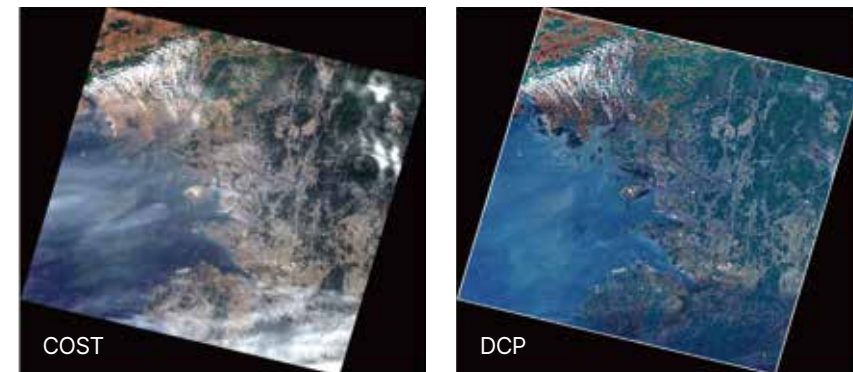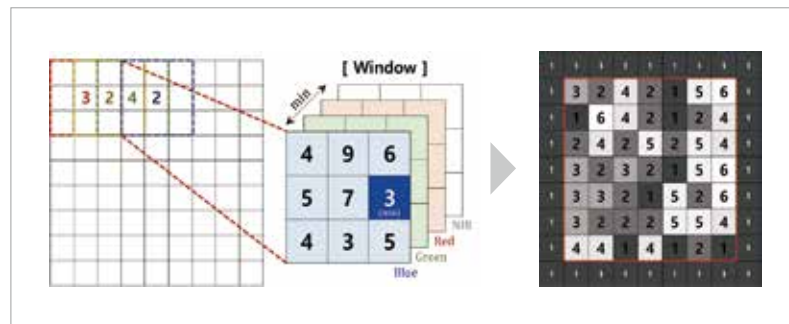
2 Enhancing Inherent Optical Property Prediction Technology: Quasi-Analytic Algorithm and Machine Learning Techniques

· We have refined the Quasi-Analytic Algorithm (QAA) and evaluated the accuracy of inherent optical property predictions using advanced machine learning techniques.
· Moving forward, we will identify and prioritize the key factors influencing predictions, enabling continuous updates to the QAA algorithm for improved prediction performance.

Quasi-Analytic Algorithm (QAA)

· A quasi-analytic and empirical approach consisting of a total of 10 stages
· Estimation of absorption coefficients from remote reflectance of seawater
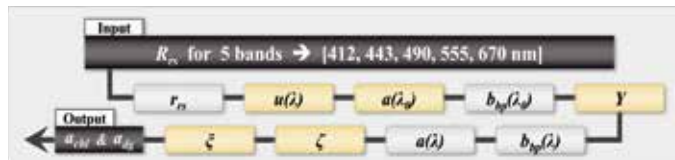
Random Forest (RF) model

· A type of ensemble learning method used for classification and regression analysis
· Outputs the average prediction from multiple decision trees
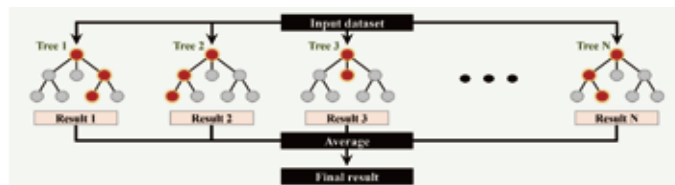
Evaluation of Prediction Performance (Absorption Coefficients of Chlorophyll and Suspended Substances)

Prediction Results for Chlorophyll Absorption Coefficient (a_{chl})
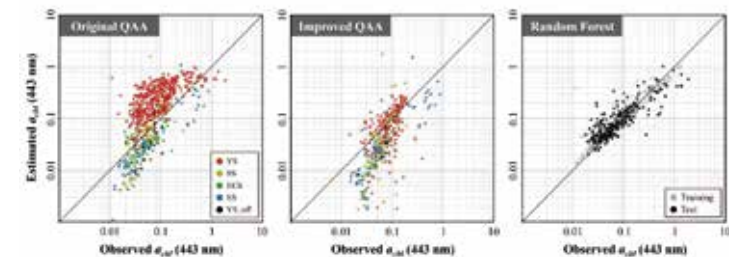
Prediction Results for Absorption Coefficient of Dissolved Organic Matter and Suspended Substances (a_{dg})
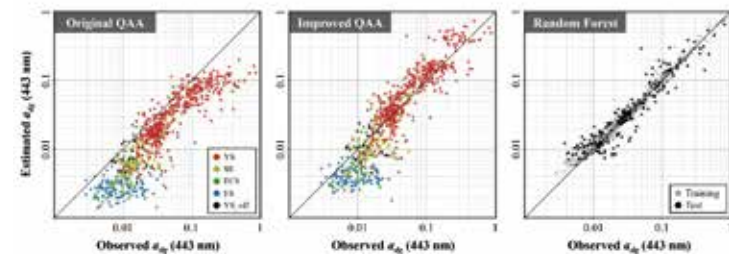
1 Monitoring of Floating Macroalgae (Sargassum horneri) Using Multi-Satellite Imagery

· Coastal influx of Sargassum horneri negatively impacts navigation, aquaculture, and tourism, necessitating the monitoring of floating macroalgae.
· Monitoring Sargassum horneri enables an objective assessment of its origin and scale, while analyzing its relationship with climate and various factors allows for predicting the influx scale.

Multi-Satellite-Based Sargassum horneri Monitoring Results
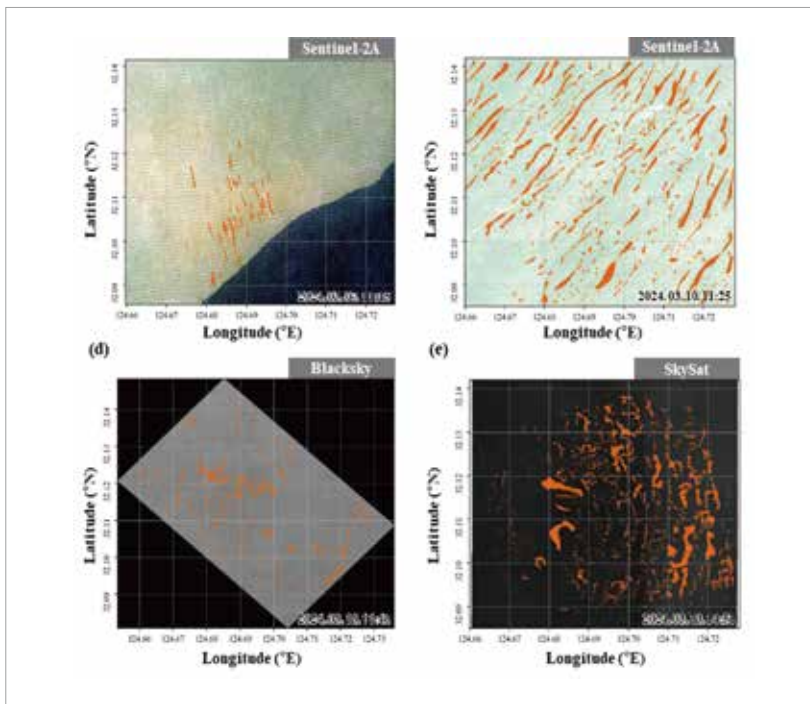
Spectral Characteristic-Based Sargassum horneri Detection Results
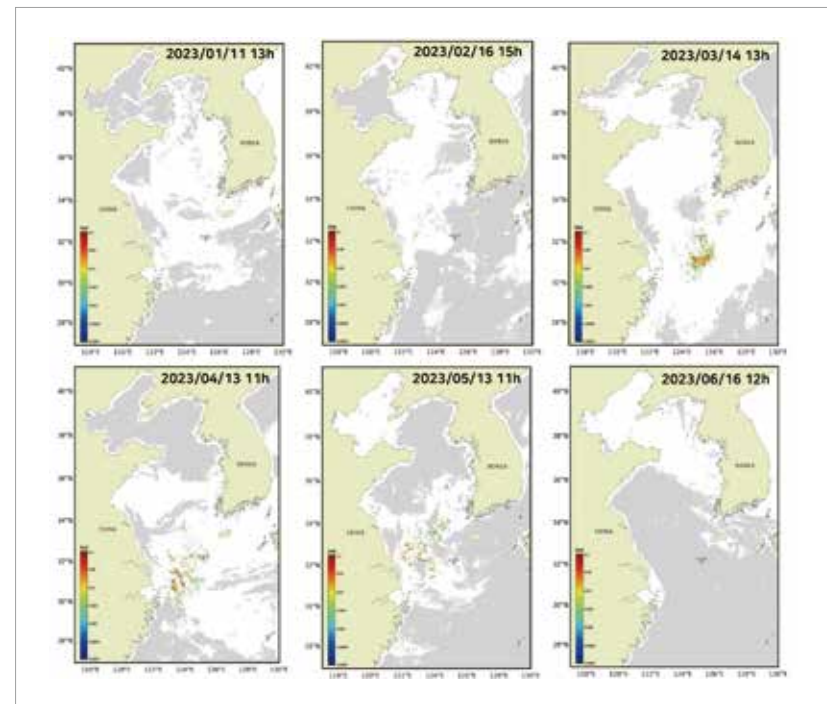
1 Depth Estimation Using Machine Learning Algorithms

· Depth estimation using machine learning algorithms with medium-resolution satellite imagery (Sentinel-2)
· Atmospheric and Sun-glint corrected satellite imagery → Application of the Random Forest model → Optimal random selection of key variables to prevent overestimation → Depth estimation and validation

Depth Estimation Process Using Machine Learning Algorithms

Manual Operation

Clear sky, sufficient light & less than 5% cloud cover, close to the lowest tidal level

Automated Depth Extraction

Selection of target candidate sites

Selection of optimal satellite imagery

Satellite image preprocessing

NDWI Index

Sun-glint correction

Median filter

2020 Electronic Nautical Chart

Metadata extraction

Collection of tidal data at satellite imaging time

Depth Data Tidal correction performed

Tide-corrected depth

Application of Depth Estimation Algorithm

Depth correction based on DL (approximate lowest low water level) Generation of SDB map

Depth accuracy validation

Depth Estimation Results and Comparison (Samcheok Port Waters)

Samcheok Port – November 30, 2020, 11:16 (KST)

Real depth

SDB model

(m)
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
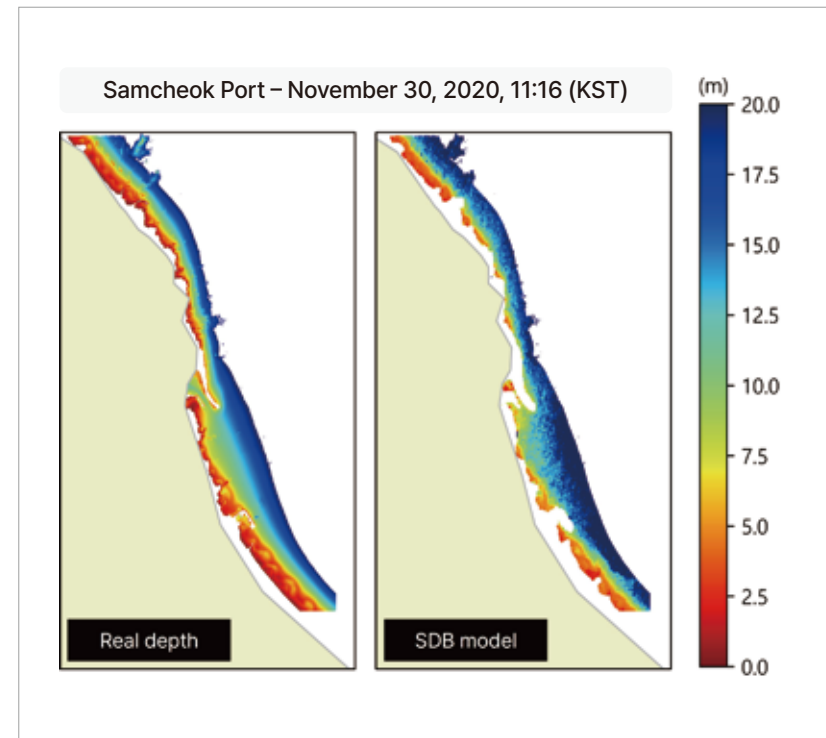
Service Platform Construction

1 Business model design - Demand-based information sales

Who

Marine leisure-related industries and institutions

Korea Hydrographic and Oceanographic Agency

Dabeeo | SGMA

필시
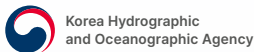
AI-based sea surface temperature forecasting service system tailored for marine leisure activities

1 registered patent / 2 pending patents

What

Sea surface temperature (SST) production and forecast information
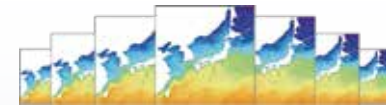
East Asia region │ 1km grid │ 8-hour intervals │ Production and forecast
※ Based on Enterprise account

Profit

Product grades and permanent built-in features

Grade 3 Basic, Pro, Enterprise	Permanent Built in service
B2C, B2B	B2B, B2G

Point

R&D product differentiation points

Accurate	Fast future information provision	As much as desired anywhere
RMSE: 0.5℃, Acc. 80%	within 2 hours, 10-day prediction	in East Asia, selectable area

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How to

High-speed parallel computing OpenAPI service

API

CTE 9

Service Platform Construction

1 By application

| Spatial data collection and mapping | Disaster management | Surveillance and security | Urban planning and development | Energy and natural resource management | Defense and intelligence | Others |

Anomaly detection in mineral mining volume → Shipping port → unloading port → End-To-End → Energy and natural resource management

10-day sea surface temperature (SST) prediction and tide/depth/seabed information detection
→ Satellite image-based secondary processing (Level 3) information service

2 By user

| Government | Military and defense | Forestry and agriculture | Energy |
| Civil engineering and archaeology | Transportation and logistics | Others | |

Information service sales for port logistics and transportation-related companies

Business — Remote sensing applications
to
Business — Web service companies
to
Consumer — Transportation & logistics

Information service sales for fishermen

Business — Remote sensing applications
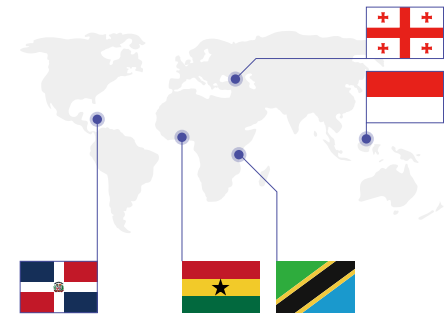to
Business — Web service companies
to
Consumer — Public

3 By region

| Georgia | Pacific Island nations |
| Indonesia | |

Cross-border business

1 **Remote Reflectance (Underwater)**

· Repeating vertical profiling at the measured Secchi depth 5 or more times after measuring the Secchi depth.
  - It is recommended to perform vertical profiling down to a depth with at least 10% light intensity.
  - To describe the optical characteristics of the water mass, vertical profiling should be performed down to the depth with 1% light intensity or maximum chlorophyll concentration.

· Introduction of new underwater remote reflectance observation equipment due to the discontinuation of existing underwater remote reflectance measurement equipment.

  - A compact optical profiling system (C-OPS) is planned for introduction (April).
  - A new system with a propeller will be introduced to minimize the effects of ship shadow and surrounding structures and improve observation efficiency.
  - After moving to a location free of optical interference, vertical profiling will be performed using a free-fall method (5-75 cm/s).
  - Manufacturer training for operating the new equipment and creation of practical manuals will be conducted.
  - Remote reflectance observations in the range of 320 nm to 780 nm will be possible.
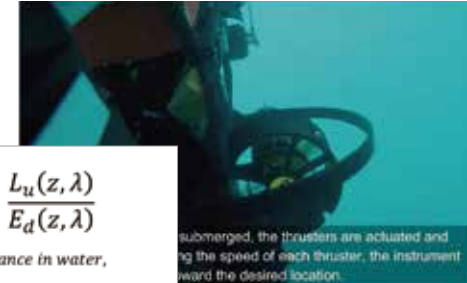
C-OPS Propeller

$$R_{rs} = (z, \lambda) = \frac{L_u(z, \lambda)}{E_d(z, \lambda)}$$

R_{rs}: remote sensing reflectance in water,
L_u: Upwelling radiance

$$K_d = -\frac{1}{(z_2 - z_1)} \ln\left[\frac{E_d(z_2)}{E_d(z_1)}\right]$$

K_d: Diffuse attenuation coefficient,
z_1: Surface depth, z_1: Light penetration depth

Underwater remote reflectance, downward diffusion attenuation coefficient calculation formula

HyperPro-II (discontinued)

C-OPS (newly planned for introduction)

UST21
Underwater Survey Technology21

Major Performance

1 Sewol tragedy

Investigating lost cargo on the seabed near the sinking of the Sewol ferry
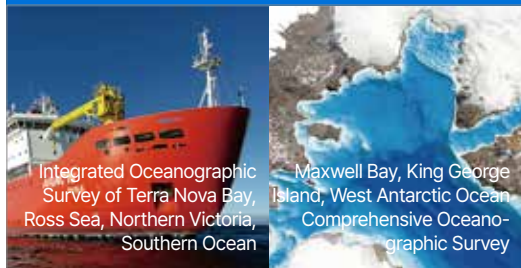
The sinking Sewol ferry

The sunken Sewol ferry

2018. 1. 5 ~ 2018. 3. 5

On April 16, 2014, the passenger ferry Sewol capsized, resulting in the loss of 304 lives. UST21 led a group of private companies in conducting seabed surveys to identify the number, location, and size of lost cargo and anomalous objects on the seabed during the sinking and salvage of the Sewol.

2 Antarctic

Antarctic Hydrographic Survey and Chart making

Integrated Oceanographic Survey of Terra Nova Bay, Ross Sea, Northern Victoria, Southern Ocean

Maxwell Bay, King George Island, West Antarctic Ocean Comprehensive Oceanographic Survey

Ice walls and seabed terrain

2018 ~ 2024

UST21 has been conducting hydrographic surveys, oceanographic observations, and nautical charts of the waters surrounding Jangbogo and Sejong bases for seven years to provide reliable information on polar navigation around polar science bases, major shipping lanes, and unexplored waters.

3 ODA

Building Oceanographic Survey Infrastructure In Georgia

ODA(Official development assistance)

Georgia Poti Comprehensive Ocean Survey

2020 ~ 2024

UST21 contributes to strengthening Georgia's maritime capabilities by establishing real-time ocean observation stations, providing marine survey equipment (including oceanographic tools and survey vessels), conducting hydrographic surveys, and transferring maritime observation technology. These efforts promote safer navigation and the effective collection and use of maritime information in Georgia.

Domestic Performance

Year	Client	Title
2019	Korea Hydrographic and Oceanographic Agency (KHOA)	Bathymetric Surface Production (S-102) & Hydrographic Survey System Verification
		Bathymetric Survey of Ulsan Port
	Ulsan Port Authority	Nautical Chart Production of South Sea
2018	Korea Hydrographic and Oceanographic Agency (KHOA)	Geophysical Survey of South West Sea (West Jeju Island)
		Nautical Chart Production of South East Sea
2017	Hanwha E&C	Marine Geophysical Survey for SHINAN UI OWF Project
	Hyundai Oil Bank	Exterior Integrity Survey for Submarine Pipeline of SPM Buoy
	Samsung Heavy Industries	Under-keel Clearance Survey for Float On/Off of Appomattox, Korea
2016	POSCO Engineering	Marine Geophysical Survey for Submarine Cable Laying
	Hyundai Oil Bank	Exterior Integrity Survey for Submarine Pipeline of SPM Buoy
2015	Royal Boskalis	Dredging Survey for shipping channel
	KT Submarine	Shallow Water Survey for the submarine cable laying between Ulleung and land
2014	Hyundai Heavy Industries	Under-keel Clearance Survey for Mipo Shipyard, Ulsan, Korea
	KT Submarine	Desktop Survey for Submarine Cable between Land and Ulleung Island
2013	Hyundai Oil Bank	Exterior Integrity Survey for Submarine Pipeline of SPM Buoy
	CDS Industries, Co. Ltd.	Geophysical Survey for Submarine Cable for Offshore Wind Farm
2012	HaeJin Construction Company	As-built Survey for Submarine Cable Construction
	KT Submarine(KTS)	Marine Geophysical Survey for Submarine Cable Construction
	POSCO E&C	Construction Supervision for Submarine Pipeline between Jinhae and Geoje
	KT Submarine(KTS)	As-laid Survey for Submarine Cable between Daemo and Chungsan
2011	Hyundai Heavy Industries Co., Ltd.(HHI)	Seabed Clearance Survey for Mipo Shipyard Pier
	KNOC	Submarine Pipeline Survey for Donghae-1 Gas Field
	KOGAS	Seabed Morphology Survey for Submarine Pipeline of SPM Buoy
2010	KT Submarine Co., Ltd	Marine Survey for Submarine Cable Construction between Daemodo and Chungsando, Wando
	LS Cable Co., Ltd	Additional Marine Survey for HVDC Link Project between Jeju and Jindo
	Junil Technology Group, Inc.	Major Superintendence Service for HVDC Link Construction Project
2009	SK Energy	SBP Survey for SK NO. 3 Anchors Position
	Haecheon Co., Ltd	Marine Survey for Submarine Cable Construction between Jangsan and Jara
	KT Submarine Corporation	Marine Survey for Submarine Light Cable Transfer between Uleung and Land

Domestic Performance

Year	Client	Title
2009	HaeChun Co., Ltd	Marine Survey for Submarine Cable between Yangdo myon ~ Samsan myon
	HaeChun Co., Ltd	Marine Survey for Submarine Cable Construction for Nosan Park, Sacheon City
	HaeChun Co., Ltd	Marine Survey for Submarine Cable Construction for Sokuri Island, Jinhae City
	Korea Ocean Research & Development Institute (KORDI)	Marine Survey for HVDC Link Construction between Jeju and Jindo
	S-Oil Co., Ltd	Bathymetry and SBP Survey for S-Oil 42″ Submarine Pipeline
	Korea Institute of Geoscience and Mineral Resources (KIGAM)	Deep Sea Mineral Resources Development Project (Control and Measuring System Design)
2008	HyunDai Heavy Industry co. Ltd (HHI)	SK Crude Oil Unloading System Relocation Project
	Hyundai Oilbank Co., Ltd	Subsea Topographical Survey for SPM Submarine Pipeline
	KT Submarine (KTS)	Marine Survey for Donghae 1 Gas Maintenance
	Korea Institute of Geoscience and Mineral Resources (KIGAM)	Deep Sea Mineral Resources Buffer and Pipeline Design Monitoring Research
2007	KT Submarine (KTS)	Maritime Survey Service for Gangwon Deep Sea Water Project
	Korea Institute of Geoscience and Mineral Resources (KIGAM)	Deep Sea Mineral Resources Buffer and Pipeline Design Monitoring Research
	S-Oil Co., Ltd	Barge Surface Positioning and Monitoring for Rock Dumping on Subsea Pipeline of S-Oil
	Jeong Suk Marine Construction (JS)	Maritime Survey for Deep Sea Mineral Resources Pipeline Installation
	SK Energy	SK Crude Unloading System #1, 2, 3 Buoy Relocation Engineering & Survey
	KMA (Korea Meteorology Agency)	Submarine Seismometer Installation

Year	Client	Title
2023	Korea Hydrographic and Oceanographic Agency	Hydrographic Surveying of South Antarctic and making nautical chart (near King Sejong Station)
	Korea Hydrographic and Oceanographic Agency	Matarbari Ultra Super Critical Coal-Fired Power Plant Project HYDROGRAPHIC SURVEY
	HYUNDAI Engineering & Construction Co.,Ltd. (HDEC)	Hydrographic Survey for the Matarbari Power Plant Construction in Bangladesh
	Korea Hydrographic and Oceanographic Agency	Hydrographic Survey on the Waters around the Antarctic Research Station of Korea
	Korea Hydrographic and Oceanographic Agency	Strengthening of Oceanographic and Hydrographic Infrastructure to Support Maritime Safety and to Mitigate Effects of Natural Di
	Korea Hydrographic and Oceanographic Agency	Strengthening of Oceanographic and Hydrographic Infrastructure to Support Maritime Safety and to Mitigate Effects of Natural Di
	Geotech System Inc.	Shipwreck Inspection Survey
	Hyundai Engineering & Construction Co., Ltd (HDEC)	Seismic Survey for As-built Survey of Submarine Pipeline Route - Colombo Port Expansion Project
	Hyundai Engineering & Construction Co., Ltd (HDEC)	Pre-Lay and Pipeline Route Survey -Colombo Port Expansion Project
	Hyundai Engineering & Construction Co., Ltd (HDEC)	Colombo Port Expansion Project
	Hyundai Heavy Industry co. Ltd (HHI)	PTT Third Transmission Pipeline Project
	Hyundai Heavy Industry co. Ltd (HHI)	TTPP Pre-Drill Site Survey
	National Information Service (NIS)	KAL 858 Debris Search

Overseas Performance

Georgia ❶

· Hydrographic Survey for Infrastructure Establishment of Georgia in 2022
· Hydrographic Survey for Infrastructure Establishment of Georgia in 2021
· Hydrographic Survey for Infrastructure Establishment of Georgia

Oman ❷

· Shipwreck Inspection Survey

Bangladesh ❸

· Matarbari Ultra Super Critical Coal-Fired Power Plant Project HYDROGRAPHIC SURVEY
· Hydrographic Survey for the Matarbari Power Plant Construction in Bangladesh

SriLanka ❹

· Seismic Survey for As-built Survey of Submarine Pipeline Route -
  Colombo Port Expansion Project
· Pre-Lay and Pipeline Route Survey - Colombo Port Expansion Project
  Colombo Port Expansion Project

Myanmar ❺

· KAL 858 Debris Search

Thailand ❻

· TTPP Pre-Drill Site Survey
· PTT Third Transimission Pipeline Project

Philippines ❼

· Strengthening of Oceanographic and Hydrographic Infrastructure to
  Support Maritime Safety and to Mitigate Effects of Natural Disasters
  in the Philippines

Antarctica ❽

· Hydrographic Survey and Charting for Antartica in 2022 (King Sejong Station area)
· Hydrographic Survey and Charting for Antartica in 2021 (King Sejong Station area)
· Hydrographic Surveying of South Antarctic and making nautical chart(near King Sejong Station)
· Hydrographic Survey on the Waters around the Antarctic Research Station of Korea

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