UNOSD Workshop : From Lisbon to Nice: Implementing SDG 14 with the Communities of Ocean Action

Review And Sharing of Best Practice and Lessons Learned on Access and Collection of Ocean data

Korea's Marine Spatial Management based on Ocean data for a sustainable future

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Ministry of Oceans and Fisheries

KIOST KOREA INSTITUTE OF OCEAN SCIENCE & TECHNOLOGY

Korea Institute of Ocean Science & Technology

Ahreum Jang

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1. Marine Spatial Planning for Sustainability

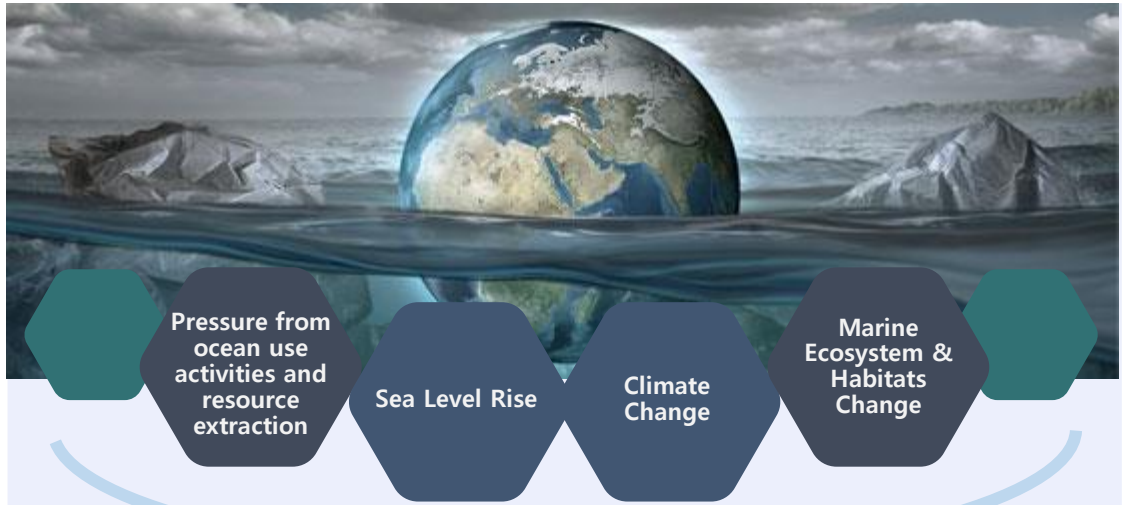
① Marine issues and policy tool

Marine space faces various problems due to increased demand for use for multiple activities, climate change, rising sea levels, and changes in the marine ecosystem.

To respond to this, the UN Sustainable Development Goal 14 (UN SDG 14) seeks to ensure sustainability below water by 2020(Skovgaard, 2021)

Marine Spatial Planning can be one way of achieving the UN SDG 14. The objective of MSP is to promote the sustainable growth of maritime economies, the sustainable development of marine areas, and the sustainable use of marine resources" (European Commission, 2014).

Korea's Ministry of Oceans and Fisheries adopted marine spatial planning as a policy tool to manage its water sustainably.

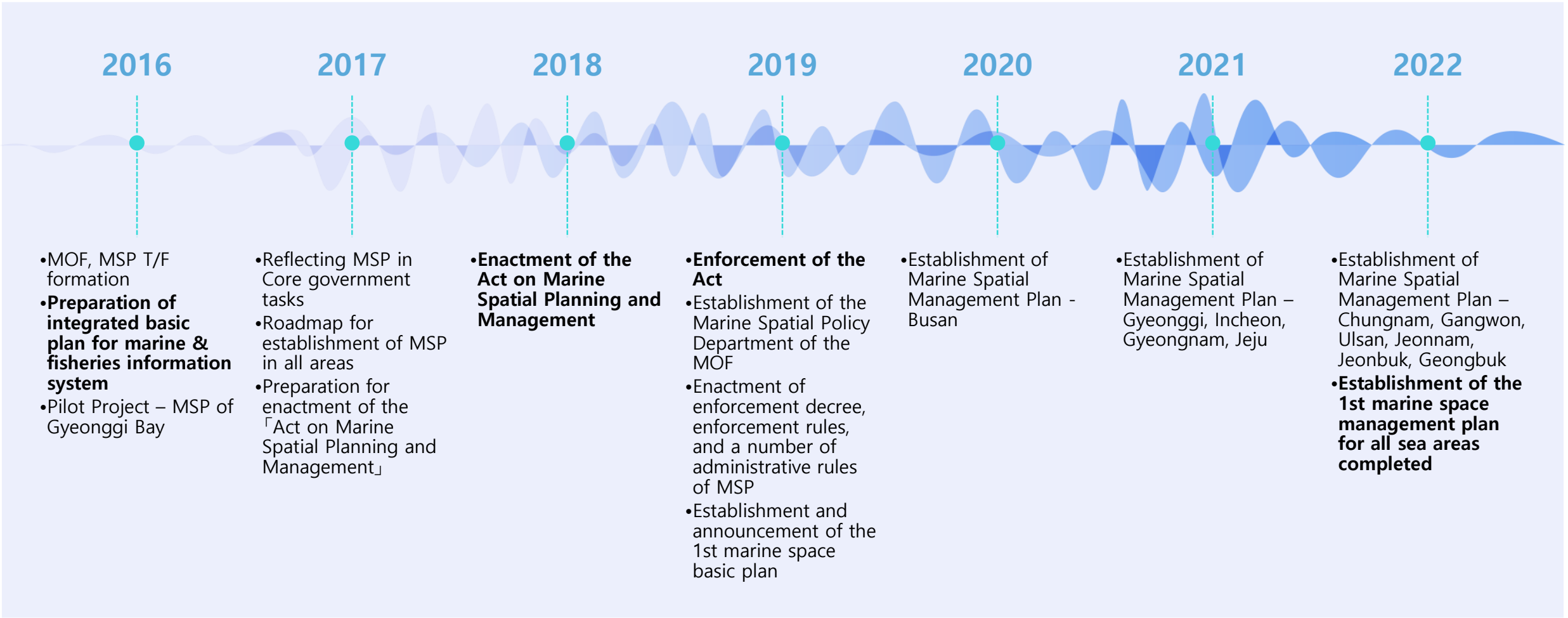


- Kirkfeldt Trine Skovgaard, Frazão Santos Catarina(2021), A Review of Sustainability Concepts in Marine Spatial Planning and the Potential to Supporting the UN Sustainable Development Goal 14, Frontiers in Marine Science, vol.8.
- European Commission (2014). Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014, Establishing a Framework for Maritime Spatial Planning. Brussels: Official Journal of the European Union.

Ⅰ. Challenges to Ocean, **How to Respond?**

1. Marine Spatial Planning for Sustainability

② Progress in the establishment of the MSP policy system in Korea



Ⅰ. Challenges to Ocean, **How to Respond?**

2. Act on Marine Spatial Planning and Management (2018)

① Main Contents of the Act on MSP

After the enactment of Act on Marine Spatial Planning and Management(2019), the establishment of Marine Spatial Management Plans(MSMP) for the entire sea area is completed (2022)

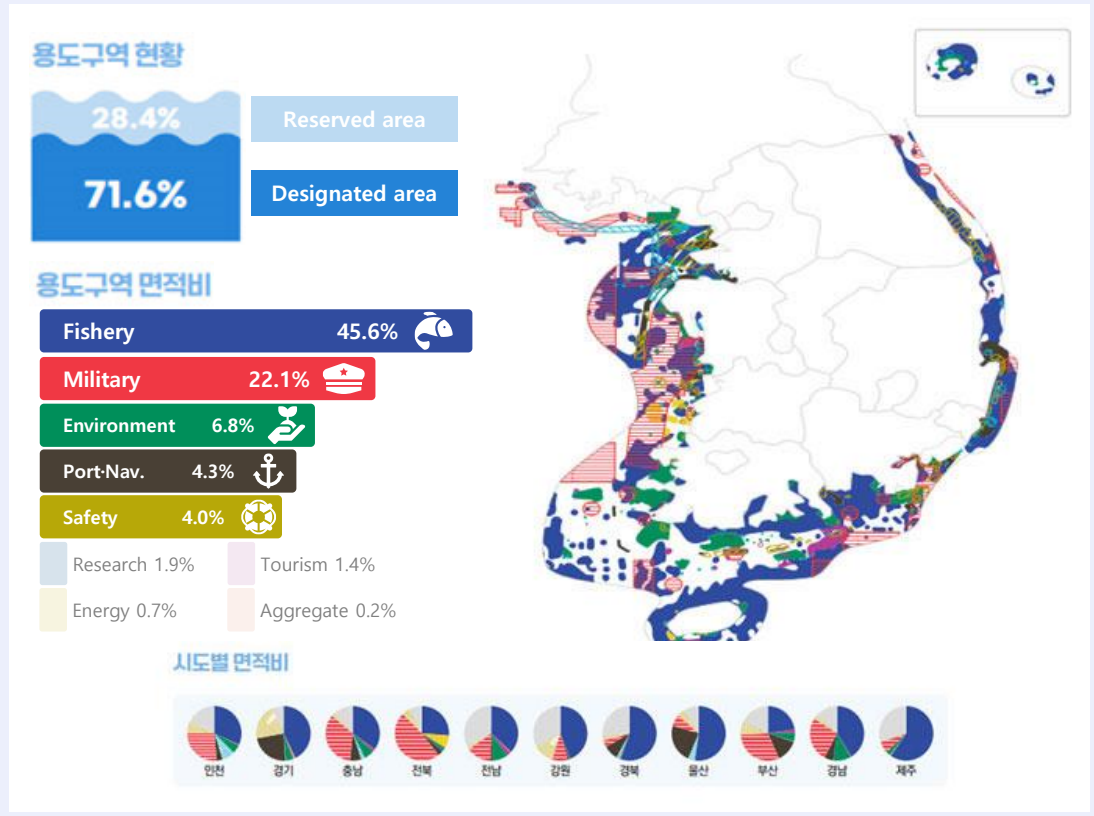
MSMP's designation of 9 marine use zones
Fishery activity protection zones, Aggregate and mineral resource development zones:, Energy development zones, Marine tourism zones, Environment and ecosystem management zones, Research and education conservation zones, Port and navigation zones, Military action zones, Safety management zones

Establishment of **Integrated Marine Spatial Information System >> Data platform**

Marine Spatial Suitability Assessment

Evaluate whether new plans to use marine space are sustainable and appropriate for the characteristics of the target maritime area (about 300 cases per year)

Marine Use Zoning Plan



Korea Marine Spatial Management Plan (Except EEZ area)

Ⅰ. Challenges to Ocean, **How to Respond?**

2. Act on Marine Spatial Planning and Management (2018)

② Ocean Data for MSP

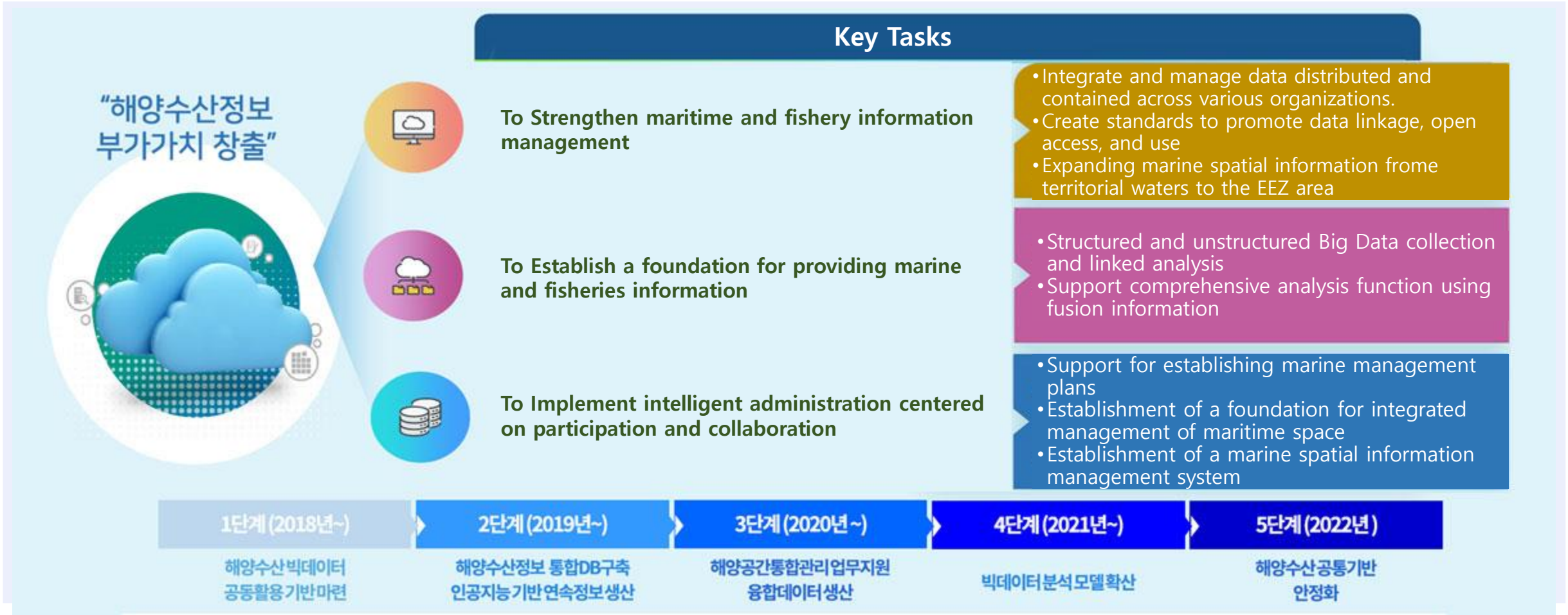
- Korea's MSP system is an evolution of the Integrated Coastal Zone Management system
- The difference is that the level of spatial analysis based on the marine data platform has improved

Before **2018**		**After**
COAST MANAGEMENT ACT	Legal Basis	ACT ON MARINE SPATIAL PLANNING AND MANAGEMENT
Coastal area(in 12NM water, 500m from coastline Land)	Coverage Area	Territorial water, including EEZ, CS
Plans for Coastal Management Areas	Name of plan	Marine Spatial Management Plan
heads of City, County, District (Lower-level local government)	Planning authority	The Minister of Oceans and Fisheries and Metropolitan city Mayors, Province Governors
Planner collected data by individually verifying its location and production organization	Data Collecting	Information collection, integration(API, EAI, sFTP, search, and use through integrated marine spatial information system(Platform)
Limited information (difficulty using spatial information, Non-spatialized data, past information not updated) Simple overlay Reflect already designated areas(port, farm, MPA..) Setting Priority to overlapped marine zones	Data Analysis	Improved analysis techniques, data periodically updated from production organizations through database. Identify the actual space usage status(e.g., ship movement information) and reflect it in zoning. Designate a management zone when overlapped uses by conflict analysis.

Ⅱ. Marine Data for **MSP**

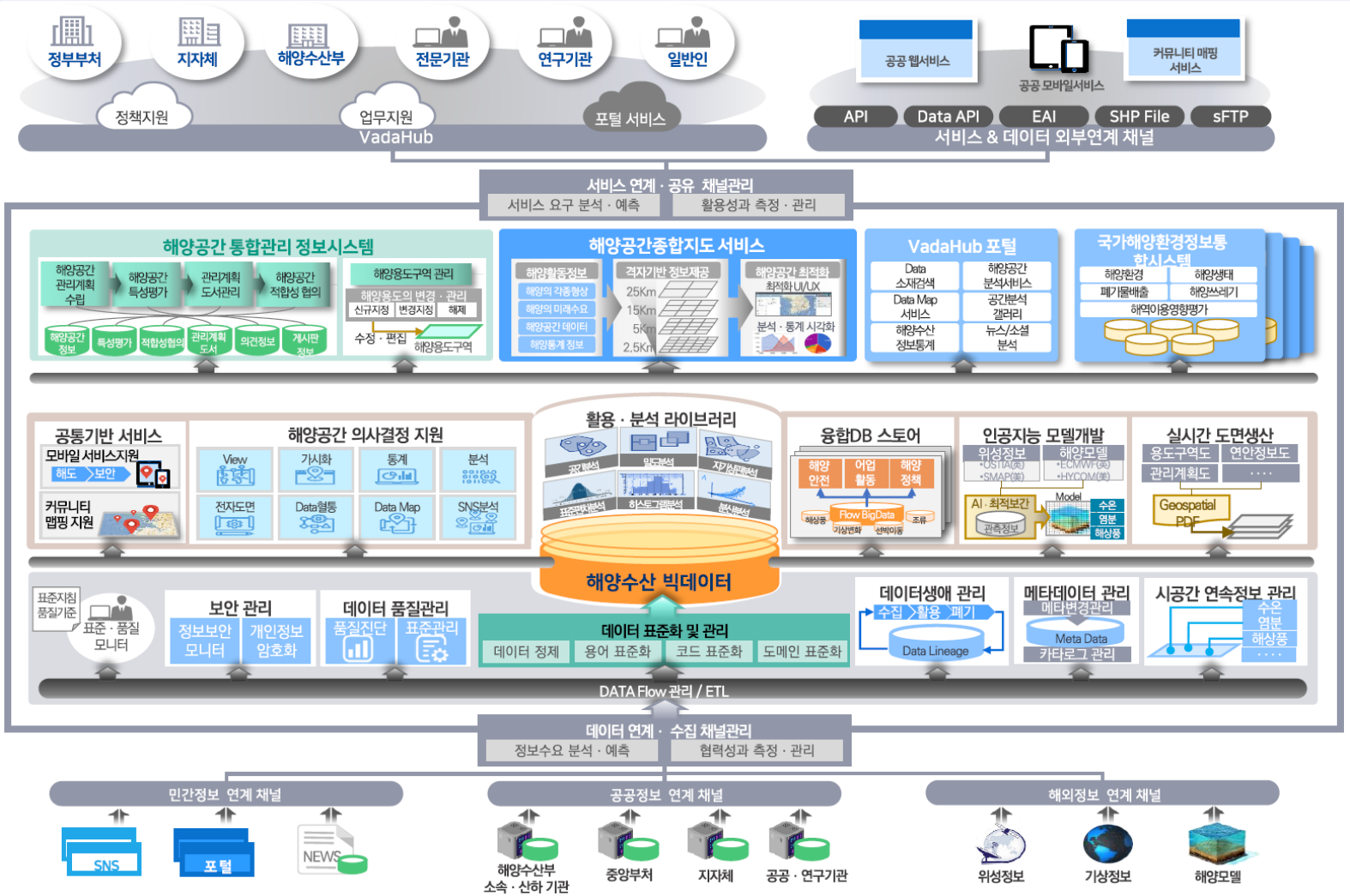
1. The Marine Data System Development

Establishment of a foundation for integrated maritime and fishery information (big data) and supporting services for marine spatial planning and management through analysis of maritime and fishery information (`18~`22)



Ⅱ. Marine Data for **MSP**

2. Marine Data System Concept



Ⅱ. Marine Data for **MSP**

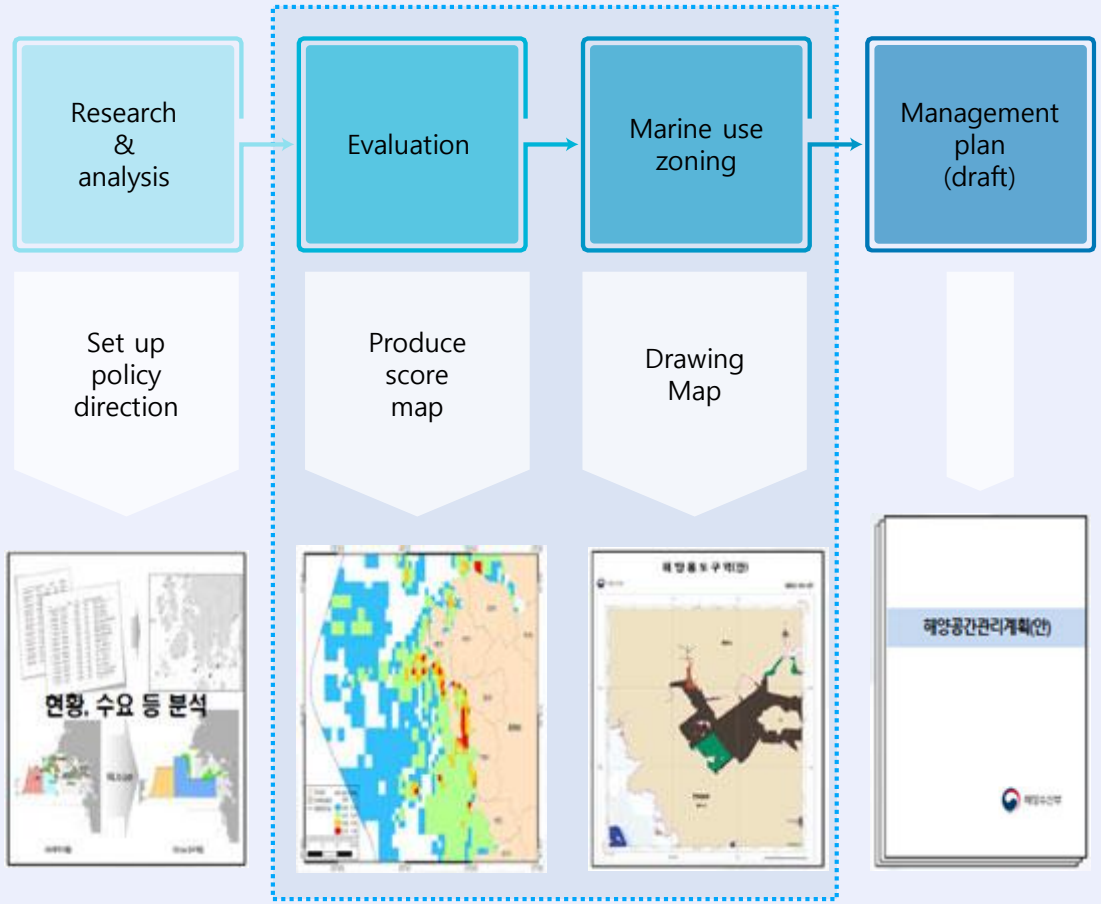
3. Dataset of the Marine Data System

Field	Key Information		Amount	Note
Ocean	Marine industry	Marina, trails, festivals, observatories, government offices, ticket offices, museums, arboretum, showers, recreational fishing grounds, etc.	241	※ 283 types of core information and 487 types of general information to support integrated marine space management
	Marine environment	Marine ecology map, marine debris, marine environment theme map, marine protected organisms, use of public water points, public water reclamation, beach environment information, etc.	75	
	Deep-sea fishery	deep-sea fishing information, deep-sea fishing operation status	2	
Fishery	Marine fisheries	Comprehensive information by fish species, marine product processing, fishing performance report, production area commission information, fishery direct payment system information, sea salt history information, marine product history tracking management information, etc.	12	
	Fishing resources	Sea forest, coastal fishing resources, fishing industry, sea forest seaweed information, sea ranch, protected water, seagrass, etc.	71	
	Fishing & aquaculture	Fish farm, fishing village fishing port information, fishing ground information, red tide news, fishing ground information map, sea fish condition information, jellyfish alarm, national fishing port information, etc.	36	
Shipping & transportation	Shipping logistics	passenger ship, ship information, passenger terminal, shipping business information	4	
	Port operation	Marina vessel information, marina arrival and departure information, port operation information, dry dock, secondary dock, trade port, coastal port, floating bridge, etc.	53	
Maritime safety	Maritime safety	Rocks which covers and uncovers, exposed rock, whirlpool, anchorage, no signal, lighthouse, signal station, Channel, pilot boarding and disembarkation area, etc.	161	
Port	Port construction	Port hinterland complex, new port area, marina port facilities, port underground facility information, etc.	10	
Common administrative	Common administrative	total population, building information, country indicators, real estate statistical information, etc.	105	
Total			**770**	

Ⅱ. Marine Data for **MSP**

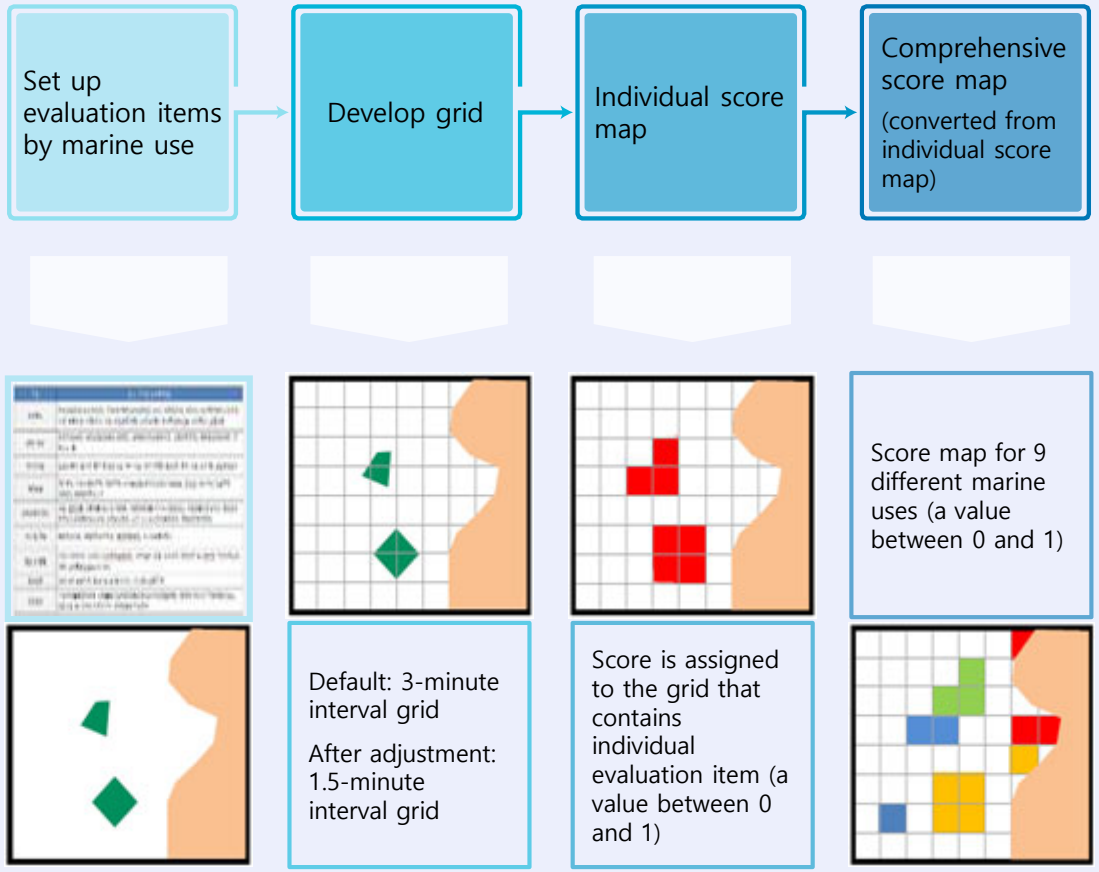
4. Evaluation of marine spatial characteristics and setting of use zones using marine data

Steps to prepare marine space management plan(draft)



Formation and operation of Regional Council on marine space management

Summary of evaluation procedures



Ⅱ. Marine Data for **MSP**

4. Evaluation of marine spatial characteristics and setting of use zones using marine data

Marine use zone procedure (draft)

STEP 1 Identify key marine activity areas for each marine use zone based on the results from evaluating marine spatial characteristics.

STEP 2 Review and reflect Article 3 and 4 of Act on Marine Spatial Planning Addenda(functional areas/statutory zones)

STEP 3 Determine marine use zones, considering designation criteria according to regulations (characteristics, use, status of marine space/statutory areas)

STEP 4 Identify conflicts between activities in marine space and adjust marine use zones (give priority)

STEP 5 Comprehensively consider the steps 1 to 4 results to decide the final draft marine use zone.

Analysis of high-volume and continuous data

Processing of high-volume and continuous data is to identify the distribution of spatial activities of ships using the target area. It collects static and dynamic data for ship movement, fishing activity areas, location-based fishing volume, and dense traffic areas. It develops them into spatial information with unit data, producing various heat maps for characteristic evaluation and analysis.

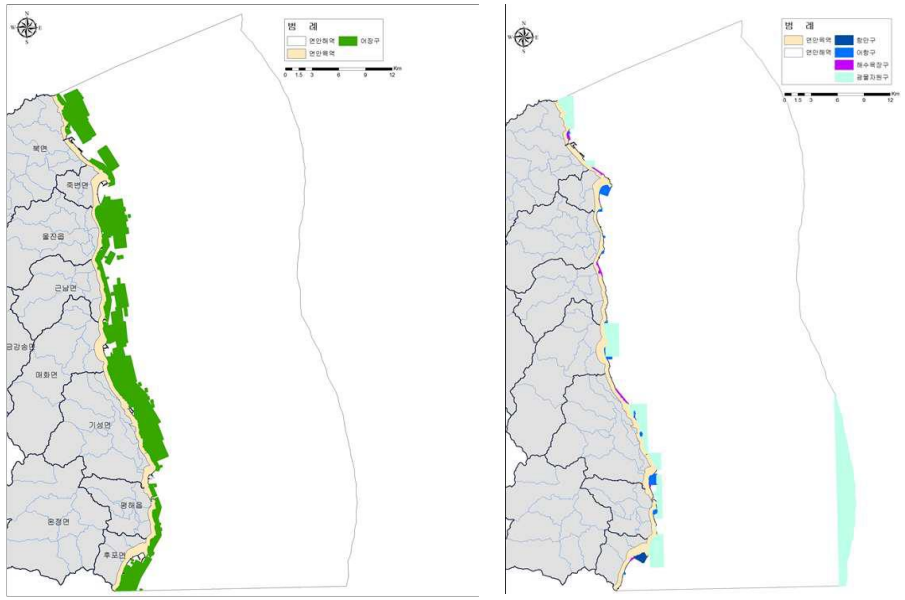
Ⅱ. Marine Data for **MSP**

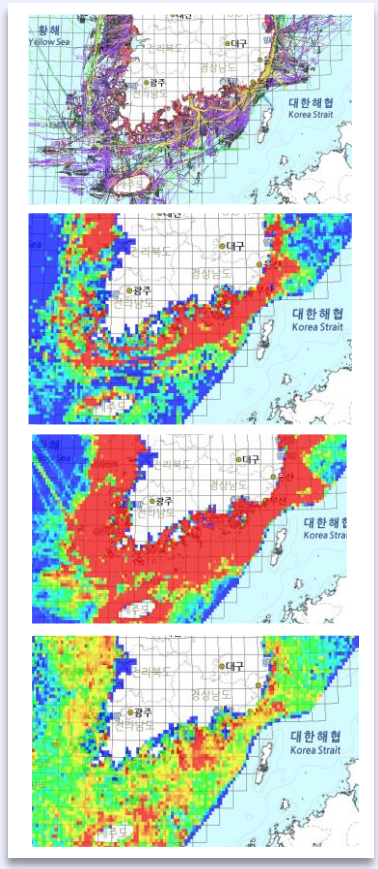
5. Pre-Post Comparison Fishery Activity Protection Zone

Plans for Coastal Management Areas reflects only areas for which **rights** have been **established or permitted under other laws** to determine use (e.g., aquaculture area, fishing port area, fisheries resource protection area, etc.)

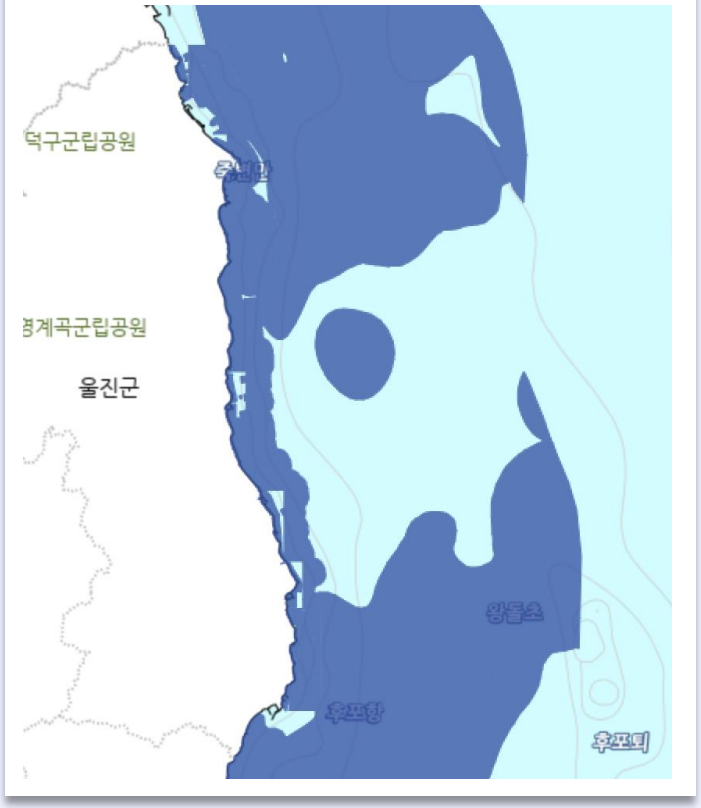
Marine spatial planning decides on marine use zones by **analyzing statutory data and accumulated status information**(Fishing vessel track, Density of traffic volume, Conflict area against other activities, Fish Catch density, etc.).

Aquaculture Zone | **Fishery Port Zone**





Fishery Activity Protection Zone



Ⅲ. Future plans : **Digital twin & Simulator**

1. Limitations of the current system - Lack of key information to reduce uncertainty in decision-making considering future changes

A system for analysis of marine spatial information and scenario-based predictive evaluation is required to support the frequent establishment and implementation of marine spatial management plans (designation and change of marine use zones) of cities/provinces.

•Marine spatial management plans currently under development do not consider various "what if" scenarios to determine marine use zones. (past status data and statutory areas are dominating to other information)

•Suitability is determined based on the report paper prepared by the developer (lack of alternative basis for determination during the review)

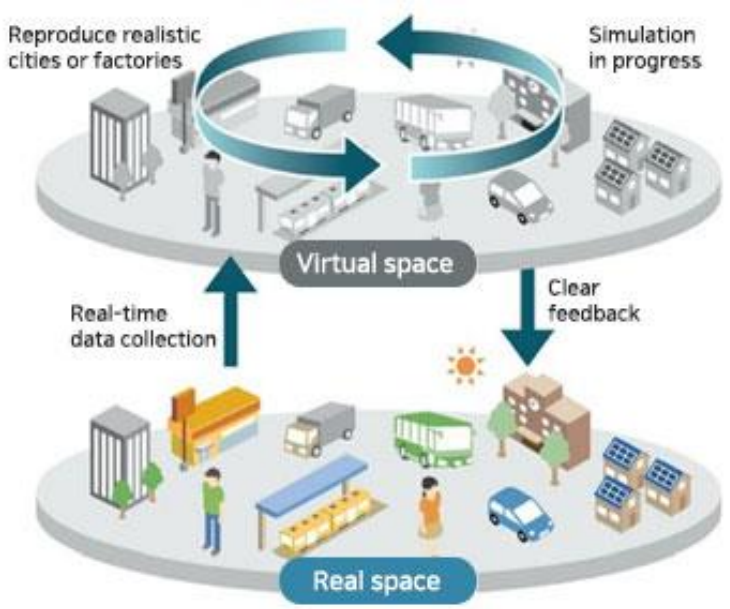
The use of analytical information is still limited, utilizing the spatial density and distribution of activities such as fishing and tourism through VPASS data analysis.

* Though this is data on the past-current status, it can be used as the basis for various predictive evaluations using big data. Therefore, it is essential to build a system to utilize such data

Ⅲ. Future plans : **Digital twin & Simulator**

2. Marine Digital Twin?

Concept of Digital Twin

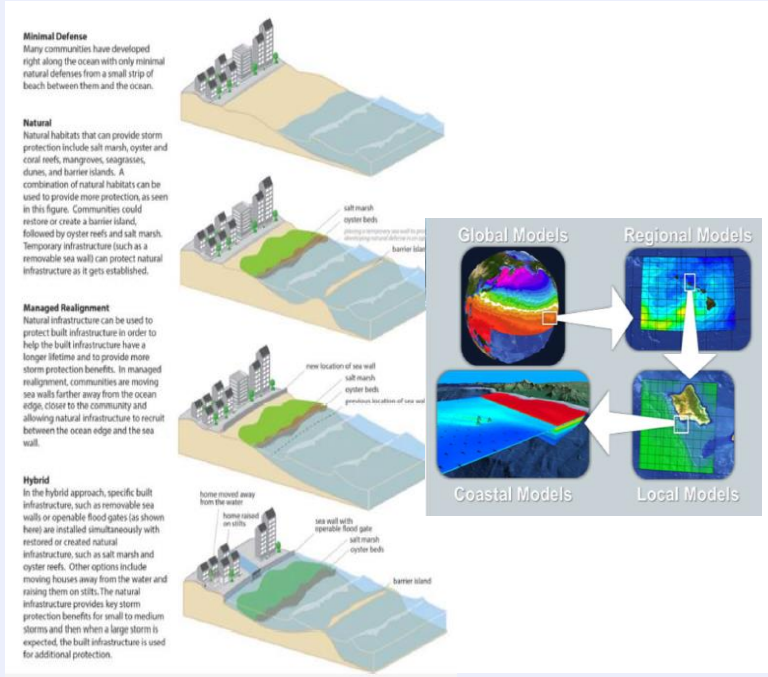


Benefits?

- ✓ Reducing Cost & Time for Policy Decision making
- ✓ Testing for risk management

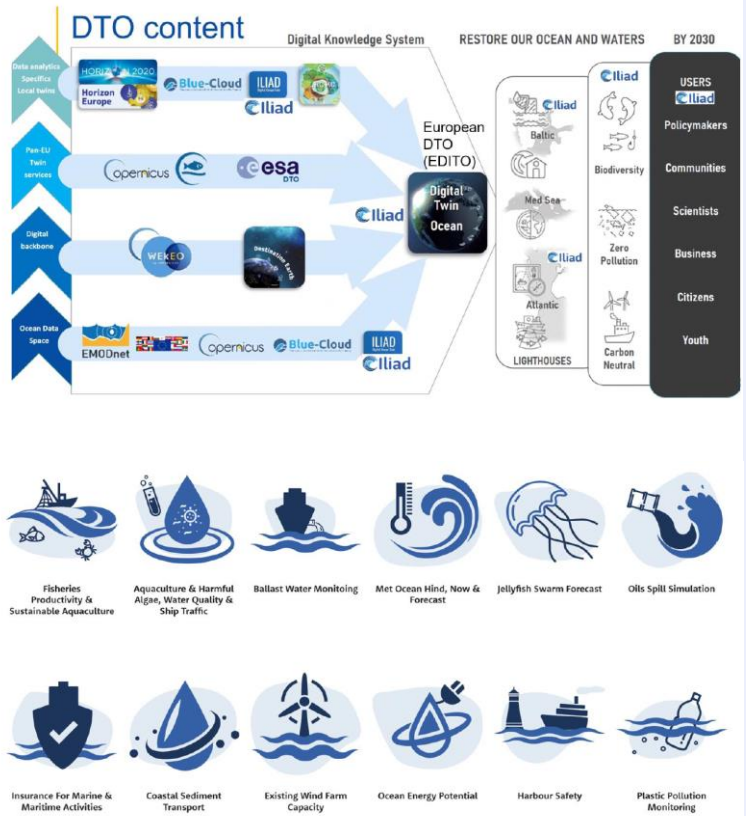
Digital Twin of the Ocean Project (DITTO)

What is the most cost effective option to mitigate the costal impact of sea level rise?



EU has built prototype for marine digital twin focusing on DITTO

DTO content



Ⅲ. Future plans : **Digital twin & Simulator**

3. Marine Spatial Policy Simulator based on digital twin platform (2022-2026)

Ultimate goal	Development of intelligent marine-space policy simulation technology based on the marine digital platform for maritime activity prediction and analysis of spatial changes and policies according to scenarios and development of plans to improve technology to support policies
Focal points of research	▪ Present directions for development/use of analysis on requirements for digital twin-based policy simulator ▪ Development and pilot use of sectoral marine policy scenarios and evaluation indicators ▪ Development and validation of a digital twin-based policy simulator

Segment 1	Segment 2	Segment 3
Analysis of needs for MSP simulator by police officers and related experts; Case studies	Development of policy support toolkit and policy simulator validation and utilization technology	Development of policy support scenario and its utilization technology

	Phase 1			Phase 2	
	1st year	2nd year	3rd year	4th year	5th year
Current direction	Establish agendas and development direction	Develop scenarios and analysis engine, etc.		Promote simulator development and pilot research	
New	**Setting the direction for development of policy support functions**	**Develop technology to support spatial plan changes** (automation of GIS-based analysis for characteristic evaluation and use zone designation)		**Develop analysis technology for spatial planning evaluation** (develop a simulator to evaluate use suitability and demand for changes)	
	Implementation on integrated marine space management information system for immediate use			Implementation on digital twin system	

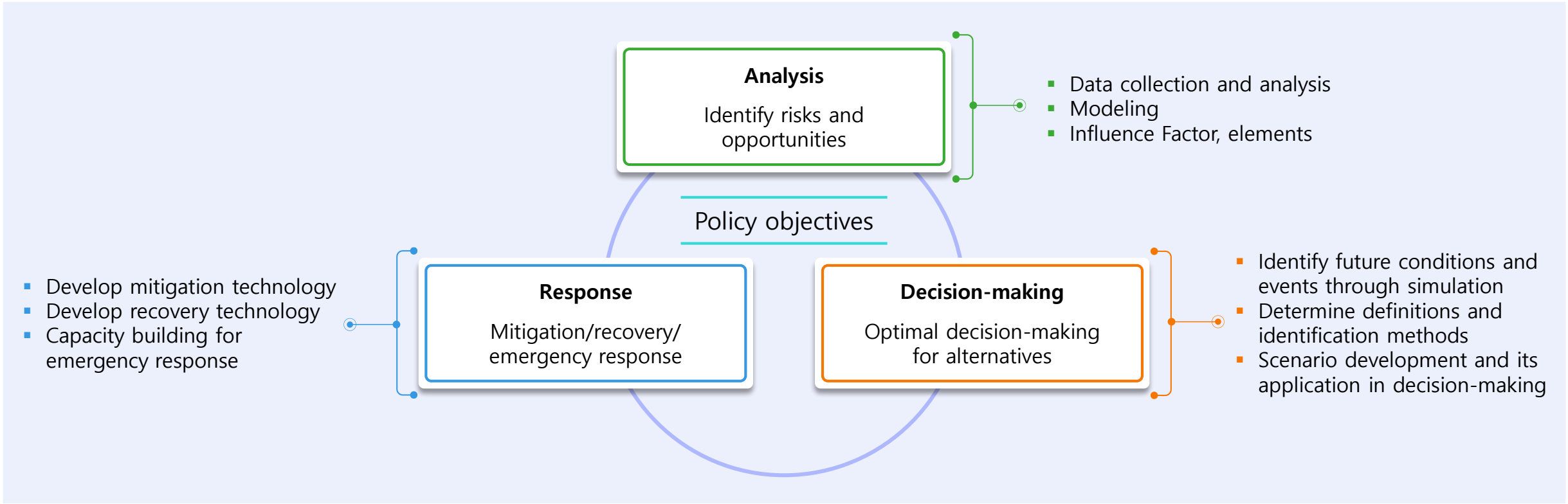
Ⅲ. Future plans : **Digital twin & Simulator**

3. Marine Spatial Policy Simulator based on digital twin platform (2022-2026)

Objectives

Support optimal decision-making through scientific prediction and simulation before making decision on marine-space policies

Prepare for uncertainties in marine spaces and reduce conflicts regarding use and development of marine spaces



Ⅲ. Future plans : Digital twin & Simulator

Ⅲ. Future plans : **Digital twin & Simulator**

Marine Spatial Policy Simulator Example

Simulator to analyze prospective needs and conflicts caused by vessel activities

Demant for analysis of traffic characteristics and conflicts with other activities to be caused by vessel activities using big data

- Identify detailed navigation characteristics and determine navigation zones based on the latest information by ship type/season (periodical updates of GICOM data)
- Analyze conflicts with other activities to be caused by vessel activities and coordinate scenario-based zones using navigation information
- Identify prospective navigation areas through big data-based prediction of future traffic changes

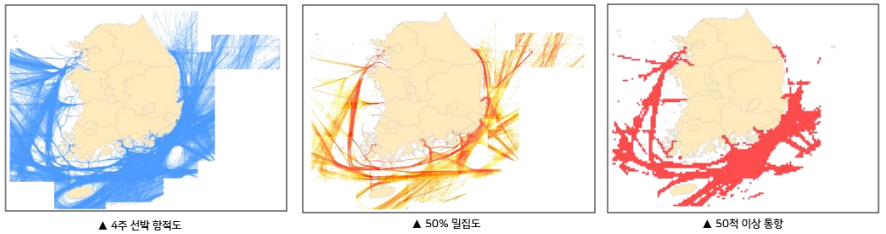
Density analysis using wake data and quantitative evaluation of navigation characteristics

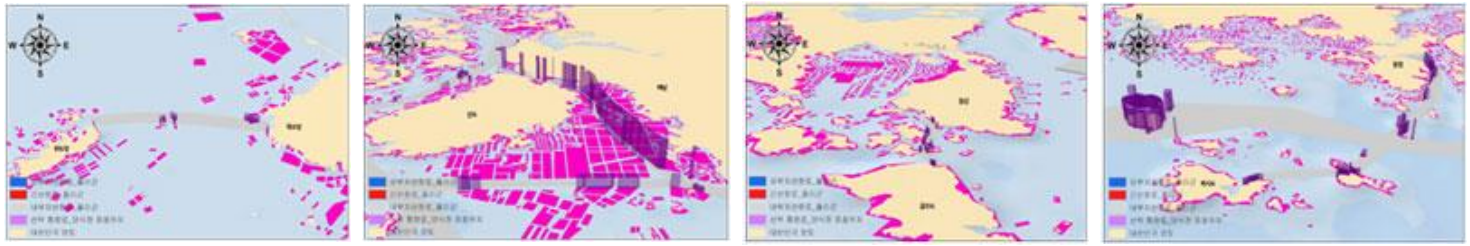
- Traffic characteristics of main/branch lines
- Traffic density grade by vessel type

  * Various criteria/methods for density analysis

Analyze and coordinate conflicts based on scenarios

Predict potential traffic changes using big data





Gyeokpo Port ↔ Wido Port route

Nearby Yuldo Island and Byeokpa Port

Geumodo Island ↔ Dolsando Island route

Dumido Island, Tongyeong ↔ Yokjido Island route

Ⅲ. Future plans : **Digital twin & Simulator**

Marine Spatial Policy Simulator Example

Simulator to assess impact on physical environment from use and development (What if)

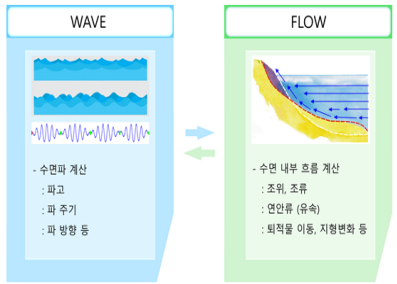
For coastal environment/safety, It is critical to conduct predictive analysis of environmental impact from use and development due to sea level rise and climate change

- Assess the impact on the physical environment according to the scenario depending on characteristics of sea area and development type in conjunction with a geosystem prediction model for quasi-real-time wave observation information and sea level rise.
- Provide standards for optimal model application by comparing related sediment movement, Suspended Solids Diffusion models.

Configuration of coastal numerical modeling

Composition and outline of predictive numerical model

- Numerical models typically consist of Wave and Flow modules
- Prediction from Flow module enables prediction of sediment movement (floating sand diffusion)



1. Set up the model grid
2. Bathymetric data
3. Physical factors
   - Fluid density
   - Floor friction coefficient
   - Sediment size/density

   Sediment movement coefficient
4. Numerical factors
5. Boundary conditions
   - Water level
   - Harmonic constant
   - Fluid outflow, etc...

Suspended Solids Diffusion and sediment prediction model system

Short-term area model

Short-term prediction of floating sand/sediment from typhoon and storm, and prediction of terrain changes

Xbeach model

Mid-term area model

Prediction of seasonal and year-round floating sand diffusion and prediction of terrain changes

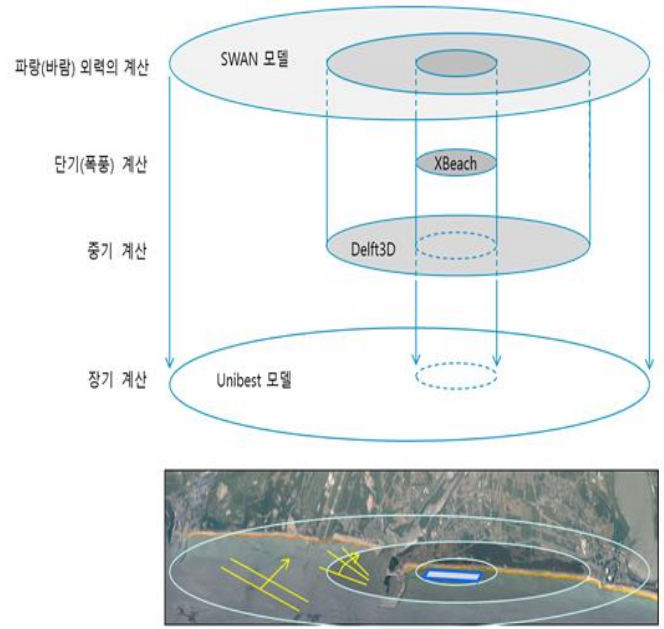
Delft3D model

Long-term coastline model

Long-term prediction of floating sand/sediment diffusion and prediction of coastline changes

Unibest-CL+ model

Coastal diffusion and sediment change prediction package



Ⅲ. Future plans : **Digital twin & Simulator**

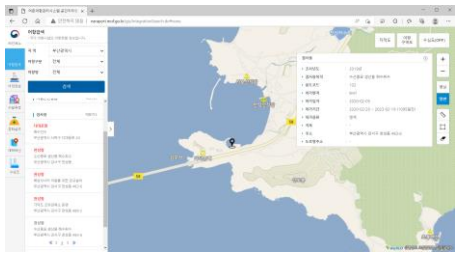
Marine Spatial Policy Simulator Example

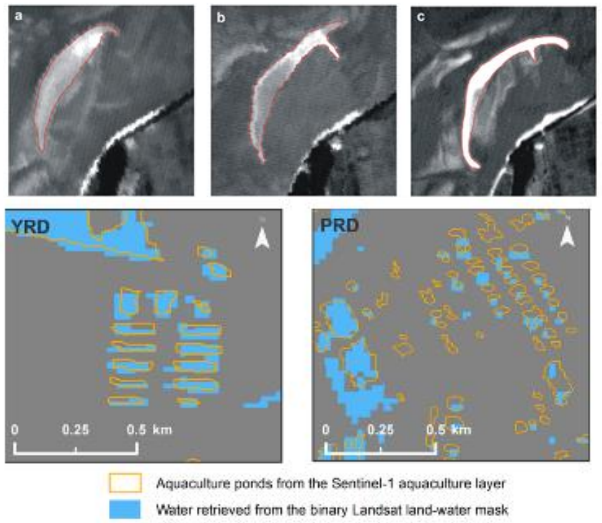
Marine space monitoring and management simulator (Detecting changes in coastline and fishfarm)

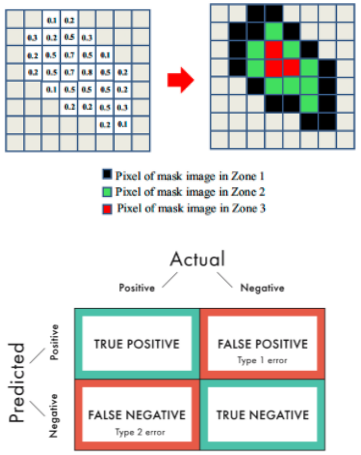
It is difficult to check whether actual activities in marine spaces are under appropriate statutory plans, consultation, evaluation, and permission.

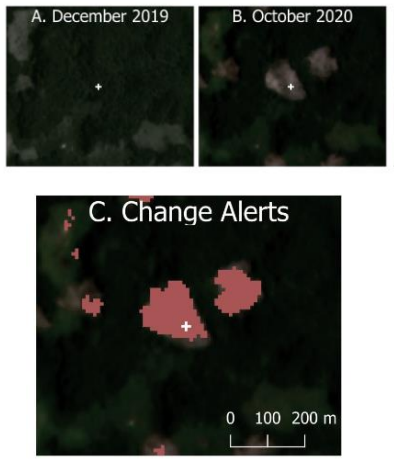
Monitoring and managing whether marine activities occur under marine spatial policy is necessary.

- Monitor and analyze maritime activity state through quasi-rea-time image data (satellite, aviation) analysis technology.
- Determine the appropriateness of marine space use and development under the initial plan and monitor illegal activities and changes in the surrounding environment resulting from marine space use and development.









Ahreum Jang: arjang@kiost.ac.kr
Dr. Moonsuk Lee(PI): leems@kiost.ac.kr

해양수산부

KIOST 한국해양과학기술원