Marine and coastal wetland management using Geographic Information System and Remote Sensing Technolgy

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Policy Director of Korea Weland Conservation Alliance

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Introduction of Presenter

Career Portfolio

- **Managing Director of TaeYoung Union Inc. (2021.9.~present)**
- **Professor of DongA University, S.Korea (1997.3.~2021.8.)**
- **Professor of Mokpo University, S.Korea (1993.3.~1997.2.)**
- **Visiting Professor of University of Pennsylvania, USA(2010.3.~2010.10)**
- **Visiting Professor of University of Singapore University(2002.3.~2002.2)**
- **Ph.D in Environment Science(1992), Master in LA(1987) at Ohio State U.**
- **Master in LA(1983), Bachelor in Horticulture(1981) at Kyungpook Nat. U.**
- **Policy Director of Korea Wetland conservation alliance(2021.9.~present)**
- **Published books and papers (a few examples)**

  Wetland(습지학) by Korea wetland society(한국습지학회) in 2016

  Multiple Utilization of a Satellite Image for Wetland Assessment Mapping in 1993

  Creation, Value and Use of Ohio's GIS-based Wetlands Inventory in 1992(Journal of Soil and Water Conservation)

BCS(Blue Carbon by Seaweed)

- We focuses on developing models that blend advanced information technologies with fields like forest, agriculture, wetland and environmental management. Specifically, the **Blue Carbon by Seaweed (BCS)** project is designed to create a business model centered on seaweed's ability to sequester carbon.

This initiative utilizes **Remote Sensing and GIS** technology, such as satellite and drone imagery, combined with analytical systems to accurately measure and analyze seaweed's carbon absorption, showcasing a pioneering approach in leveraging technology for environmental sustainability.

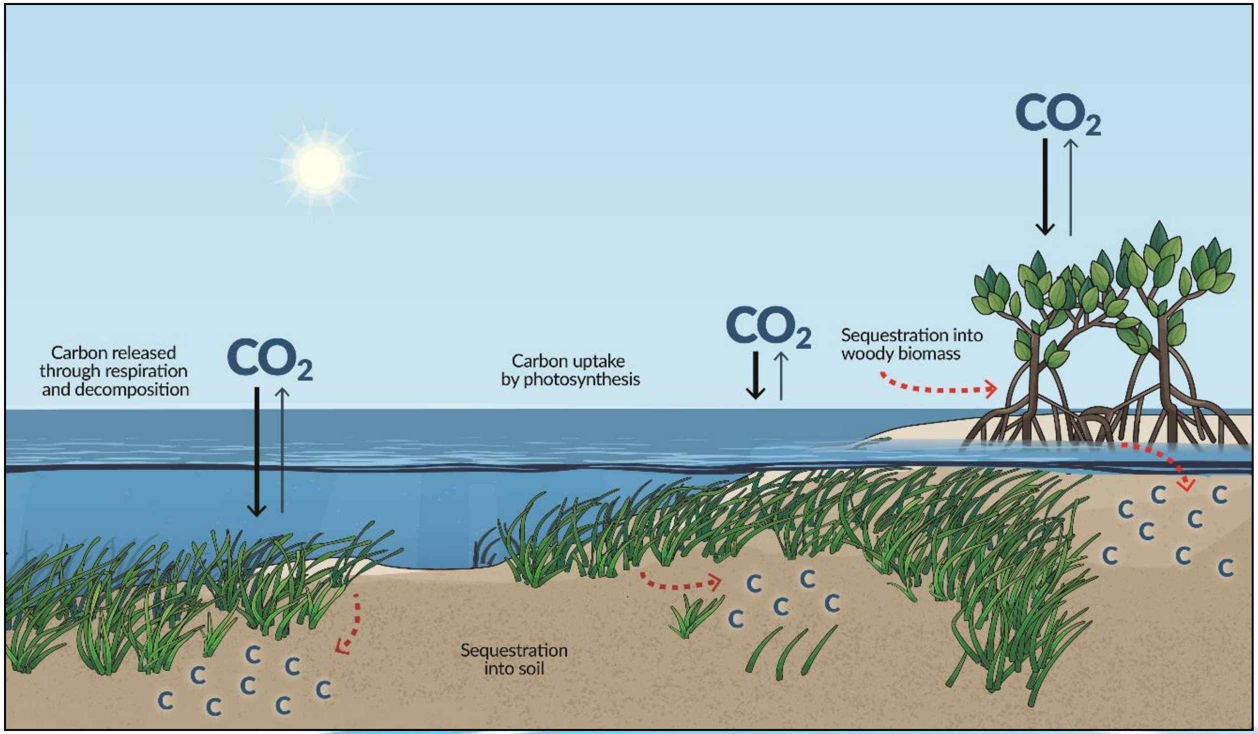
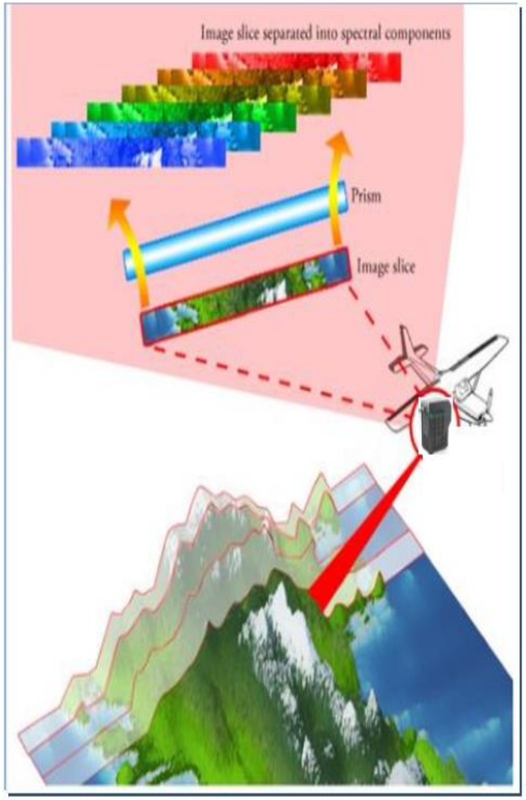


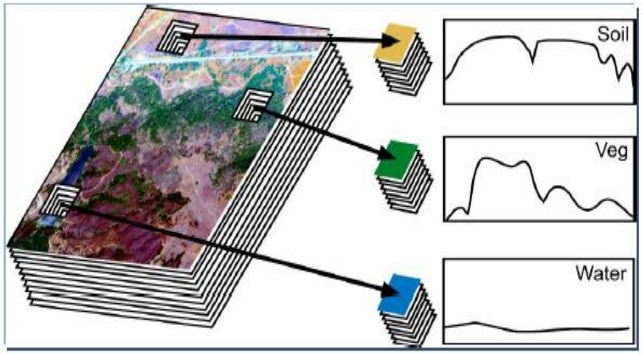
Image source: https://www.pewtrusts.org/en/trend/archive/winter-2022/coastal-blue-carbon

Hyper spectal Image Analysis

▶하이퍼 스펙트럴 영상의 정의(Definition of Hyper spectral Image(H/I))

- 각 채널의 파장 대역폭(bandwidth)가 대략 10nm인 다수 채널의 영상센서(Sensor)로 취득한 영상이며, 각 화소는 대상체의 완전한 분광정보를 포함하고 있음

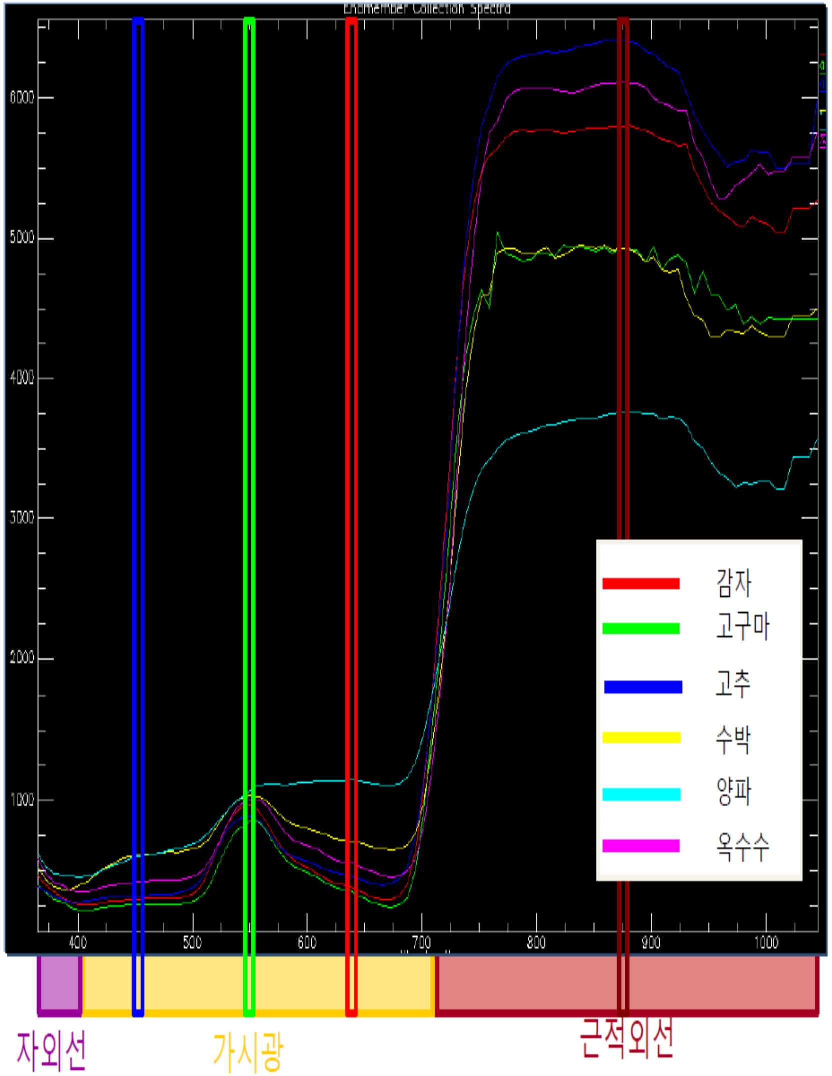




▶ 분광밴드가 많고 ,연속적이며, 측정 파장간격이 좁음

▶ 분광데이터 데이터를 이용하여 물질의 다양한 정보 식별 가능

- 매질의 특성　　식생 분류　　식생 스트레스
- 피복분류　　지질 및 광물탐사　　target detection
- 수질, etc.



Data Processing Procedure

데이터 처리 흐름도 (방사·기하보정, 대기보정)

항공초분광 영상

항공 초분광 영상자료

초분광 항공영상 입력

방사보정

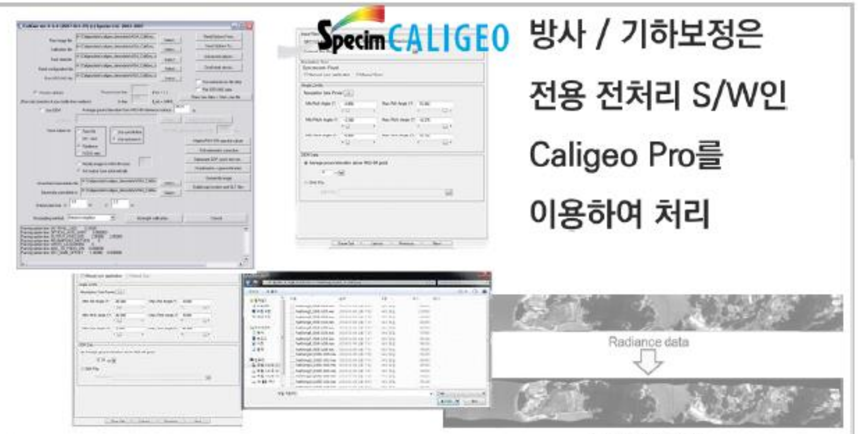
기하보정

대기보정

완료

방사/기하보정
Caligeo Pro

대기보정
ATCOR-4

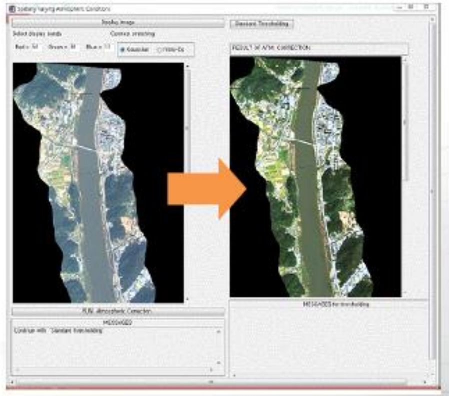


Specim CALIGEO

방사 / 기하보정은 전용 전처리 S/W인 Caligeo Pro를 이용하여 처리

ReSe Applications Schläpfer

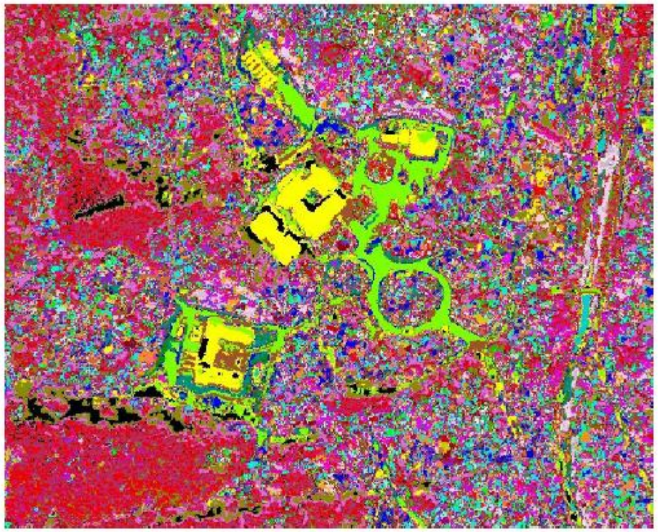
ATCOR® 4



대기보정은 ReSe의 MODTRAN®5 대기모델 기반의 ATCOR-4 S/W를 이용하여 처리

Outcome example on forest analysis

수종분포도 제작



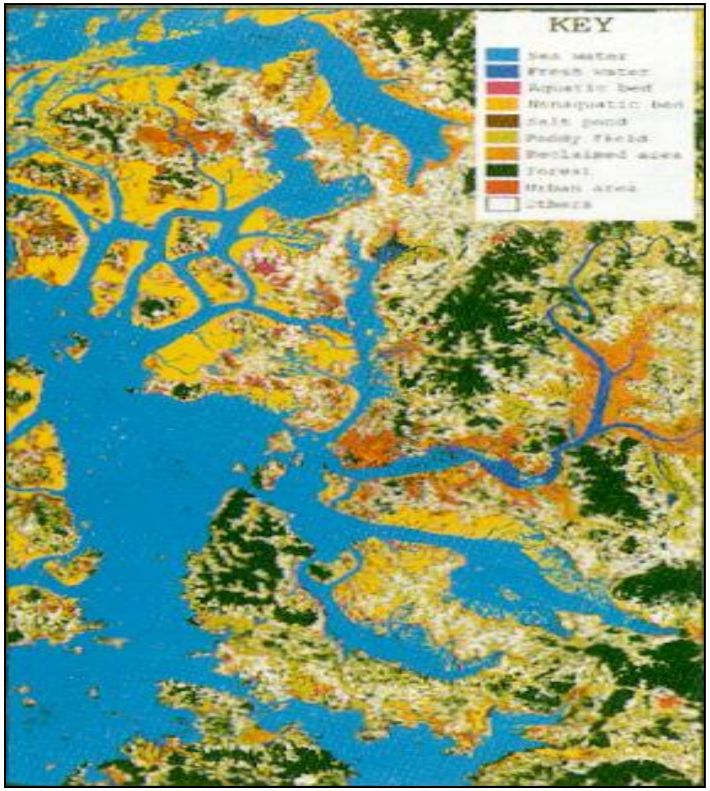
흰산철쭉	버드나무
회향목	반호
향나무	반송
침엽수	물프레나무
집	물
주목	무궁화
주목	메타세콰이어
잣나무	만첩조합나무
음나무	때죽나무
은행나무	돌배나무
왕벚나무	독일가문비
오리나무	단풍나무
양멍자나무	다행송
아스팔트	느티나무
시멘트	눈향나무
수양버들	낙우송
소나무	나무수국
서양측백	금화비
산철쭉	금측백
산수국	구창나무
산골쪽	괴불나무
사무나무	관상수원
비술나무	계수나무
복자기	갈침나무
별목련	갈대

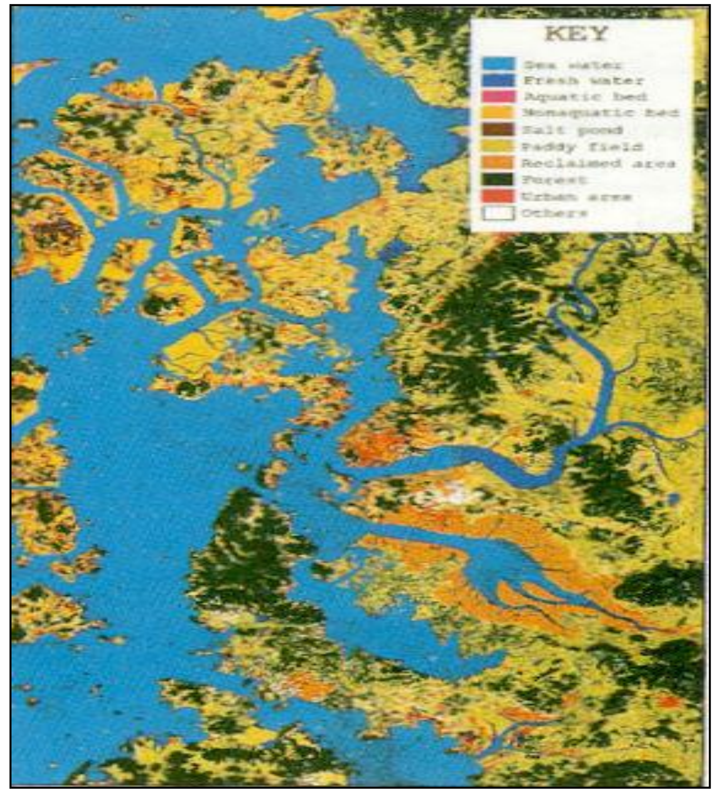
구분	비율	구분	비율	구분	비율
흰산철쭉	2.02	왕벚나무	0.64	산골쪽	2.23
회향목	0.36	오리나무	2.24	사무나무	0.48
은행나무	2.16	산수국	0.03	물	0.14
...	...	...	...	...	...
메타세콰이어	5.24	나무수국	0.88	만첩조합나무	2.78
금화비	0.45	낙우송	1.27	무궁화	1.14

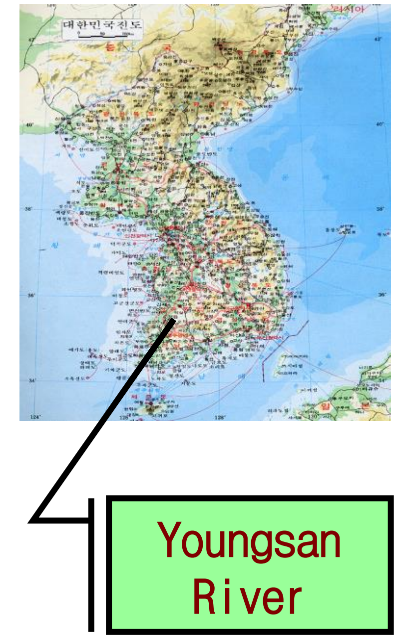
내용	임상도면적	분류 면적	비율
잣나무림	360,998	392,183	92%
낙엽송림	69,476	76,230	91%
침엽수	165,027	145,320	88%
활엽수림	390,091	420,623	92%

Example on spatotemporal analysis

- The loss of coastal wetlands of Southwest region of Korea between the year of 1984 and 1992 by Landsat TM is over 120㎢







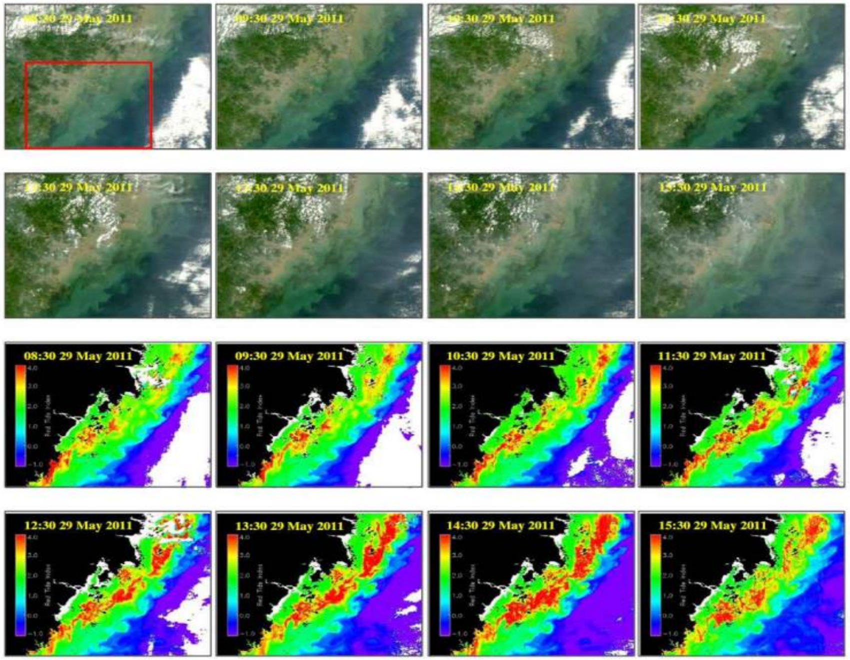
Yi, Gi Chul. A spatiotemporal analysis of southwest region of Korea by Landsat TM, Environment Impact Analysis 6(1). 1997.

Key Technologies and Methodologies

- **Image Analysis and GIS-Based Data Collection**
  - ✓ **Use GIS technology to collect and document spatial data related to seaweed habitats and carbon sequestration in mangrove forests**
- **3D Scanning for Spatial Information**
  - ✓ **Implement 3D scanning technologies to create detailed spatial maps of the targeted regions for a more accurate assessment of the biomass and carbon capture potential**
- **Predictive Modeling via Seaweed Composition Simulation**
  - ✓ **Develop simulation models to predict the growth and carbon sequestration of targeted seaweed and microalgae species, aiding in the planning of cultivation efforts**
- **Research on Seaweed and Microalgae**
  - ✓ **Conduct comprehensive studies on the chosen species for their viability as a source of feed, bioenergy, food and cosmetic ingredients**

Image Analysis and GIS-Based Data Collection

- **Image Analysis**
  - ✓ **The project utilizes advanced satellite and drone imagery to capture detailed visuals of seaweed cultivation areas. This high-resolution imaging allows for precise monitoring of seaweed growth patterns, health, and distribution across vast marine areas.**
- **Algal Bloom Index Development**
  - ✓ **Develop or adopt an Algal Bloom Index (ABI) or Red Tide Index (RI) like the one used by Lou and Hu to quantify the concentration of algal pigments in the water.**
- **Data Integration and GIS Mapping**
  - ✓ **Integrate satellite-derived algal indices with Geographic Information System (GIS) platforms to create comprehensive maps of bloom intensities and affected areas.**



The temporal variation of the Red Tide (Source: Lou and Hu, 2014)

Hyperspectral imaging & Data Analysis

- **Hyperspectral Imaging for Blue Carbon Assessment**
  - ✓ **The project utilizes advanced satellite and drone imagery to capture detailed visuals of seaweed cultivation areas. This high-resolution imaging allows for precise monitoring of seaweed growth patterns, health, and distribution across vast marine areas.**

- **Integrated Data Analysis System**
  - ✓ **Develop a sophisticated data analysis system that can process the hyperspectral data to extract meaningful information about the water quality, presence of phytoplankton, and suspended solids, all of which are indicators of the health of blue carbon habitats.**

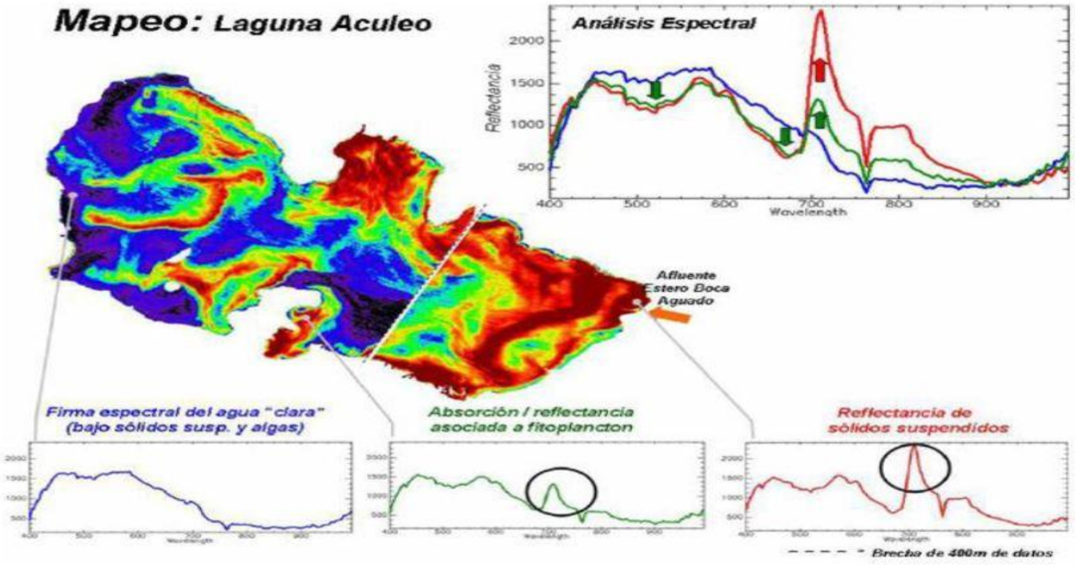


Image source: Hyperspectral image analysis (Kim, Y.S. 2021)

Predictive Modeling via Seaweed Simulation

- **Development of Simulation Models**
  - **Complex Ecosystem Modeling: By creating simulation models that replicate the complex marine ecosystems where seaweed and microalgae grow.**
- **Predicting Growth and Carbon Sequestration**
  - **Using the simulation models to estimate the growth rates of seaweed and microalgae under various scenarios, enabling the prediction of biomass production over time.**
- **Aiding Cultivation Planning**
  - **Leveraging the simulation outcomes to optimize cultivation strategies, such as selecting the most suitable species for a given region, determining the optimal planting densities and scheduling harvest cycles.**
- **Adaptive Management and Continuous Improvement**
  - **Establishing a feedback loop where real-world data from ongoing cultivation projects is used to continually refine and improve the simulation models.**

Conclusion

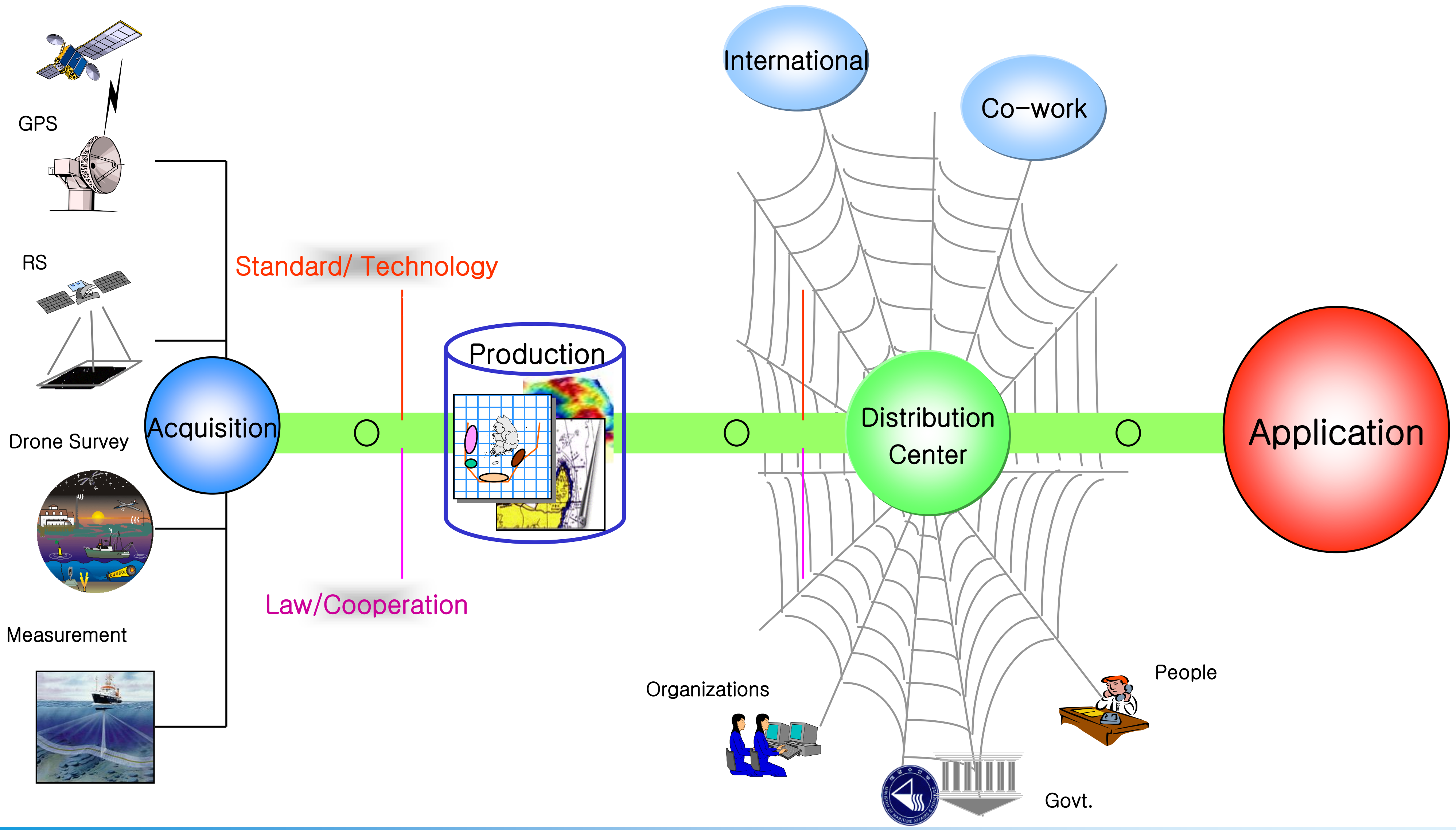
- The BCS (Blue Carbon by Seaweed) project presents a visionary approach to environmental sustainability and economic development.

- ✓ Throughout its phases, from pilot projects to large-scale cultivation and integration into a comprehensive business model, the project emphasizes the importance of balance between ecological preservation and commercial viability.

- ✓ The research findings from this project have the potential to revolutionize the blue carbon sector, setting new benchmarks for environmental conservation practices intertwined with economic growth.

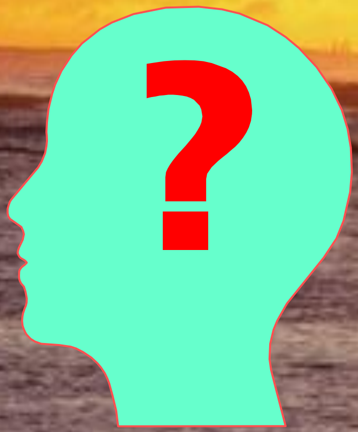
- ✓ As the project moves forward, it remains essential to maintain a focus on continuous innovation and adaptive management, ensuring that the BCS initiative stays at the forefront of sustainable development.

Overall Image for Data Management



Thank you

Questions & Discussion



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