



Innovative Greenhouse Gas
Reduction through Marine Ecosystem

Blue Carbon



Ministry of Oceans
and Fisheries

Launching a new climate regime!

UNFCCC
1992

Kyoto
Protocol
1997

Paris
Agreement
2015

KOREA's
Action?



The United Nations Framework Convention on Climate Change (UNFCCC) was adopted to combat climate change by international community, but limited under the Kyoto Protocol

Encourages all countries to cut greenhouse gas emissions
by adopting the Paris Agreement in December 2015

01
Goal of
new climate
regime

Global temperature rise
< 2 °C
(effort for <1.5°C)

02
Determined
contributions of
Korea

Reduce by 37% of business-as-usual emission in 2030

25.7% through domestic reduction,
11.3% through international carbon market

03
Role of
the Ocean

Limit to greenhouse gas absorption into the forest

Reduced by more than 50% in 2030

Greenhouse gas reduction strategy considering carbon absorption as well as climate regulatory capacity of marine ecosystem is urgent

Blue Carbon

A shift of marine conservation paradigm for greenhouse gas reduction

Project

Establishment of blue carbon information system and development of evaluation and management methodologies for Blue Carbon in Korea

Goal

Development of climate change response system through blue carbon

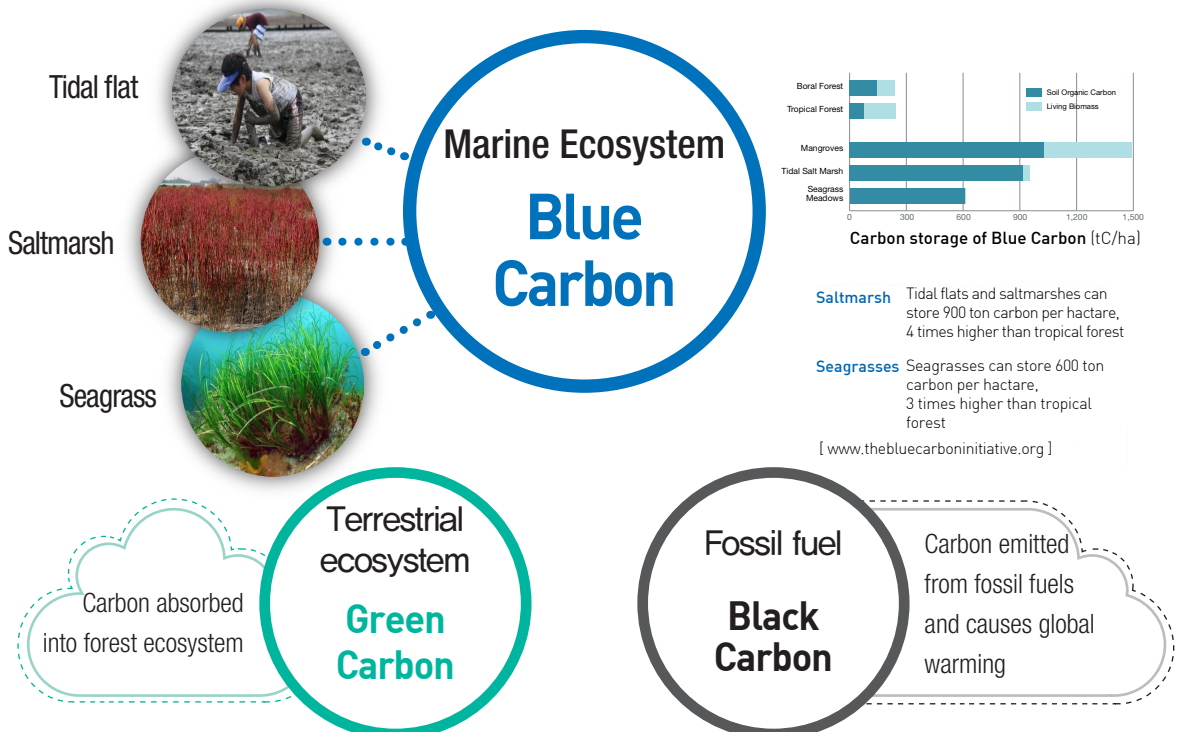
Details

- Establishment of blue carbon database with a national statistical system for marine greenhouse gas
- Identification of the current budget and sequestration processes of blue carbon in Korea, development of carbon budget model
- Development of greenhouse gas MRV(Measuring, Reporting, and Verification) protocol for blue carbon and inventory management system

Carbon storage into marine ecosystem such as coastal vegetations and sediments

Although the area of marine ecosystem is smaller than that of terrestrial, the total storage of carbon is similar
Moreover, its absorption rate is up to 50 times faster

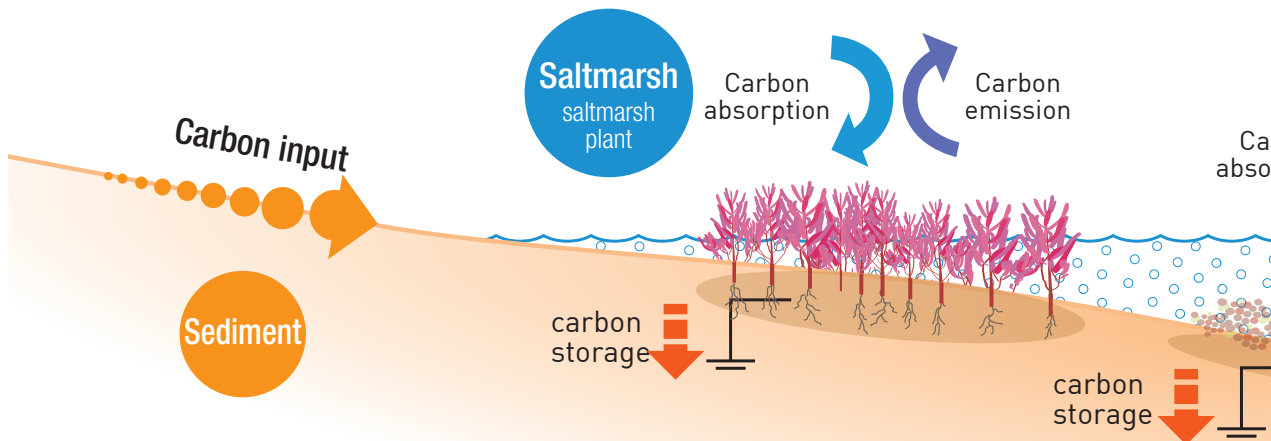
< Mcleod et al. 2011 >



How does the marine ecosystem absorb carbon?

CO₂

Carbon storage schematic plot of marine ecosystem



Blue Carbon can be measured as following methods

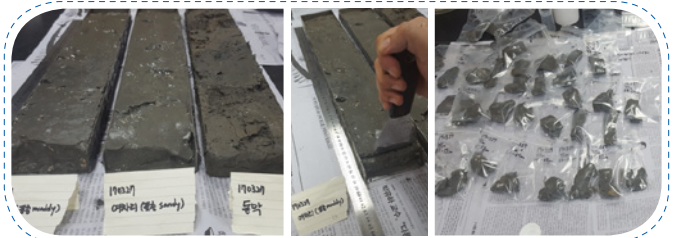
CO₂

Organic carbon measurement flow in sediments



1 Field sampling

1-3 m depth coring
at field site



2 Sample separation by depth

The samples were cut
by depth (1 cm)



3 Oven drying

Measuring **bulk density**
after the oven drying (65 °C, 72 h)

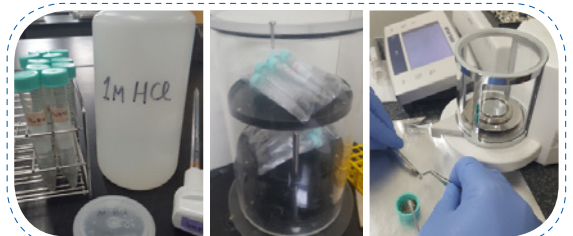


5-1 High temperature drying

Measuring **organic matter(OM)**
after drying at 550 °C, 4 h



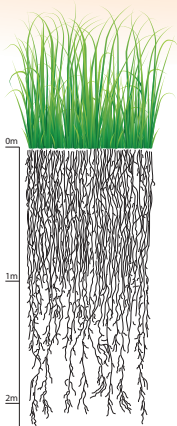
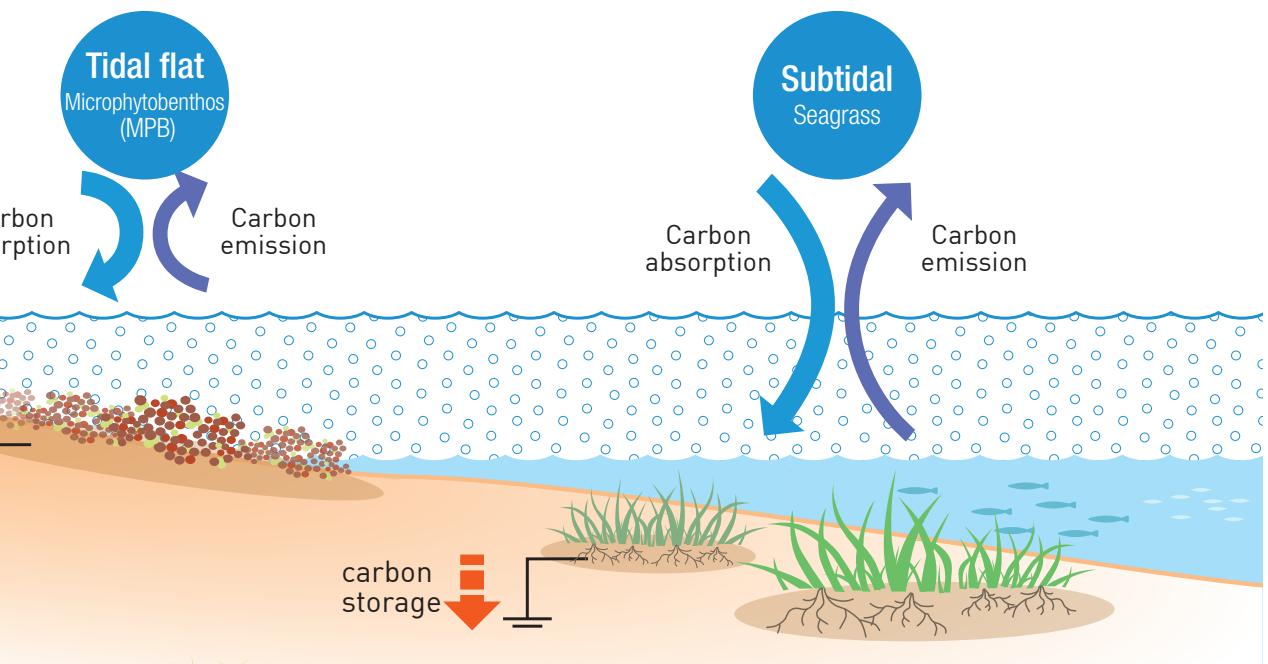
4 Grinding the dried samples



5-2 Freeze-drying

Measuring **total organic carbon(TOC)** content
after 1M-HCl treatment and freeze-drying for about 12-24 h

*Carbon content (%) and carbon stable isotope ratio ($\delta^{13}\text{C}$) in samples



CO₂

Biomass measurement

- Spatiotemporal estimates of blue carbon amounts by habitat with measuring total biomass and carbon content of dominant salt marsh vegetation
- Development of algorithm to estimate productivity of saltmarsh plants and seagrasses species
- Estimation of blue carbon potential within coastal vegetation

CO₂

Application of Machine learning

- Researches on saltmarsh vegetation so far have been emphasised fundametal structure such as distribution and density; no research on species-based biomass or on shore seagrasses to estimate the amounts of blue carbon
- Habitation of saltmarsh vegetation at inaccessible tidal flat will be explored by repeated learning of satellite image complied in-situ data



Field data acquisition system for Blue Carbon measurements

CO₂

Factors influencing on the carbon accumulation/storage of blue carbon

①
Physical
Characteristics

②
Dominant
Vegetation

③
Temperature
Variation

④
Sediment
Type

- Influence of tidal variation
- Influence of wave
- Influence of intermittently closed environments

CO₂

Field survey plan

Establishment of a blue carbon production and its management system through field survey at least 25 sites which is considered having high potential of blue carbon

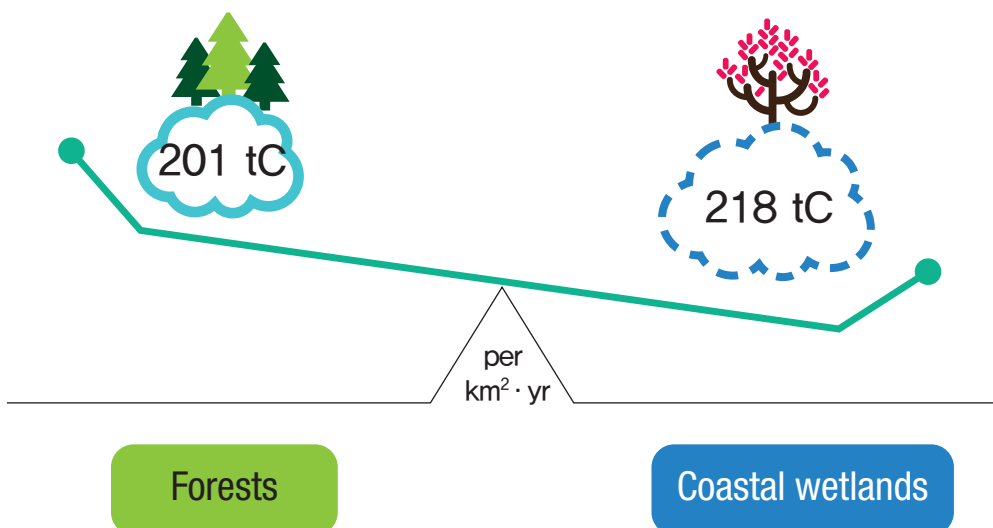
Q Main interest of Korean blue carbon?

Mainly interested in the current amount as well as annual accumulation of domestic blue carbon such as saltmarsh, seagrass, and tidal flat



Blue Carbon is an economic means to reduce greenhouse gas

CO₂ Green carbon vs Blue carbon



Increasing global movements to include the marine ecosystem as a carbon sink beyond the forests

Roadmap on Blue Carbon research project

CO₂

Organization

Ministry of Oceans and Fisheries (MOF)

Korea Marine Environment Management Corporation (KOEM)

Advisory Panel

KOEM

- Development of MRV protocol for blue carbon greenhouse gas
- Establishment of blue carbon greenhouse gas statistical system
- Economic feasibility study of blue carbon
- Proposal of strategies to be included into greenhouse gas inventory

Hallym University

- Development of bluecarbon greenhouse gas measurement and verification guideline
- Development of emission and absorption QA/QC guideline

Seoul National University

- Establishment of analytic methods for carbon cycles through field survey
- Zone (East, West, South, Jeju) and habitat (tidal flat, salt marsh, seagrass) based field study
- Development of guidelines for blue carbon emission/absorption measurement
- Development of country-specific emission factors

Korea Institute of Ocean Science & Technology

- Assessment of blue carbon productivity and proposal of agricultural technologies

KESTI

(Korea Environmental Science & Technology Institute)

- Establishment of blue carbon measurement database
- calculation of marine and fishery greenhouse gas inventory

CO₂

Research plan of Blue Carbon project

Step	Step 1	Step 2		Step 3	
Year budget*	2017 0.3 million USD	2018 2.5 million USD	2019 2.5 million USD	2020 2.5 million USD	2021 2.2 million USD
Information system establishment	Spatial database establishment (Ganghwa island)	Spatial database establishment (Western coast)	Spatial database establishment (Southern coast)	Spatial database establishment (East coast, Jeju island)	Service of Blue Carbon spatial database provision
	saltmarsh plant/sea-grass photosynthesis/biomass measurement	Annual/zonal photosynthesis/biomass measurement for saltmarsh vegetation (17 sites), seagrass (7 sites)			
Identification of carbon cycle	carbon measurement and analysis at a demonstration site	Annual/Zonal carbon measurement for tidal flat (25 sites), saltmarsh vegetation (22 sites), seagrass (7 sites)			
	Development of carbon measurement method and SOP(Standard Operating Procedure)			Seasonal sedimentation rate survey	
Blue Carbon management scheme	Proposal of MRV boundary	Development of greenhouse gas measurement and reporting guideline	Development of greenhouse gas verification methodology	Development of QA/QC, uncertainty estimating methodology	Development of QA/QC, uncertainty estimation guideline
	Marine greenhouse gas statistical system design and establishment				
	Symposium for international blue carbon networking			Establishment of global blue carbon network	

* 10 million USD for 5 years



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