The BlueCARES Project and the EAS Initiative

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Blue Carbon: Biological carbon captured by coastal-marine organisms through photosynthetic process in mangroves, seagrass, salt marsh, etc.

Main components of “Blue carbon ecosystem”

- Mangroves
- Seagrass beds
- Tidal marsh

55% of total organic carbon stock on the globe is owned by marine organisms. However, annually its 0.5-3% has been lost due to degradation of coastal environment and others (Pendleton et al. 2012).

Rapid declining of coastal ecosystems

Carbon release back to atmosphere

Coral Triangle as world richest area in biodiversity
BlueCARES Project

‘Comprehensive Assessment and Conservation of Blue Carbon Ecosystems and their Services in the Coral Triangle’

- **Period:** 5 years from April 2017 to March 2022
- **Joint scheme:** Trilateral joint project among Philippines, Indonesia and Japan

**Funding:** SATREPS Program jointly established by JST (Japan Science and Technology Agency) and JICA
Key questions on Blue Carbon:

- How to precisely assess blue carbon?
- Blue carbon has been well preserved or degraded?
- If degraded, what are causal relationships behind?
- What will happen if no action will be taken?
- How to properly conserve blue carbon?
- How do we link blue carbon with coastal ecosystem conservation efforts?

Needs of “Blue Carbon Strategy” for implementing effective actions based on proper scientific knowledge.
BlueCARES project aims at establishing and proposing ‘Blue Carbon Strategy’ as an effective scheme for enhancing local efforts to conserve coastal ecosystem and improve its resilience and thereby for contributing to mitigation of global warming.
### Expected Outputs of BlueCARES Project:

1. **Innovative integrated system of monitoring and modeling methodology** on the blue carbon dynamics is developed.

2. Blue carbon dynamics and associated ecosystem processes are **elucidated**, based on the monitoring and modeling methodology.

3. **Framework for effective conservation** of blue carbon ecosystems is developed, based on comprehensive ecosystem service assessment.

4. "**Core-and-Network“ System is operationalized** for nationwide monitoring, implementation of Blue Carbon Strategy, and capacity building.

5. **Blue Carbon Strategy is proposed** for policy making bodies in national and local levels.
1) ‘Flux (flow) + stock-based’ assessment
2) ‘Ecosystem-based’ assessment instead of ‘element-based’ assessment
   Blue carbon assessment of a coastal ecosystem as a whole, characterized as a ‘mangrove-seagrass beds-coral’ linkage system
3) ‘Local + sub-regional + regional’ multi-scale assessment
   A coastal ecosystem should be treated as an open system having import from and export to the surrounding systems (watersheds, outer seas). Blue carbon therefore should be evaluated in an integrated Land-Coast-Ocean scheme. In this regard, ‘green carbon’ should be properly linked for blue carbon assessment. Advanced RS method like LiDAR should be introduced in a regional scale mapping.
4) Future predictions for scenario analyses
   Needs of developing an integrated model system for coastal ecosystems under combined local and global environmental threats
5) Effective scheme for properly conserving multiple ecosystem services including blue carbon
Major pathways of blue-carbon sequestration to the outer ocean

More extensive scope is needed for accurate understanding of blue carbon dynamics!
Indonesian seas: mostly releasing CO$_2$, especially in Java Sea
BlueCARES Project Sites

- Bolinao
- Busuanga & Coron Islands
- Berau-Derawan
- Northern Java coast & Karimunjawa Islands
- Northern & eastern Panay coast
- Samar & Leyte
- Northern Sulawesi
- Yaeyama Islands
- Nusa Penida Island
Multi-scale mapping of blue carbon ecosystems

LiDAR system

Multi-scale mapping by sensor fusion

Satellite remote sensing: MSS, SAR, etc. for large-scale mapping

Airborne remote sensing: LiDAR, etc.
→ Detailed 3D mapping of selected local areas

Drone:
→ Fine-scale mapping at selected sites

Target area to cover: More than 80% of the total area of blue carbon ecosystems in the Coral Triangle in each country
How to do mapping of below-ground parts like root system and SOM?
Points:

How to do nation-wide mapping of below-ground parts?

"Core-and-Network" System

How to analyze and predict blue carbon dynamics under various environmental impacts?

Integrated multi-scale model system
1. A platform for **sustainable periodical nation-wide monitoring** as a basis for **updating Blue Carbon Strategy**

2. Selected communities among the network members may act as the implementation bodies of Blue Carbon Strategy

(More than 20 partners)

(More than 15 partners)
Core-and-Network System in the Philippines

3 Clusters:
- Luzon Cluster
- Visayas Cluster
- Mindanao Cluster

Compositions:

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(by M.D. Fortes)
Integrated multi-scale model system

Local-scale blue carbon dynamics model
- Seagrass model
- Mangrove model

Coral model
- Coral diagram

Local-scale hydrodynamic model

Watershed green carbon dynamics model
- Characteristics of organic matter/nutrients discharge are affected by land use or ‘green carbon’ dynamics.

Simplified coastal export model for regional & sub-regional scale analysis

Multi-nested 3D ocean circulation model

Export

Discharge

Horizontal transport

Sinking

Export

Transport

Sediment model

Characteristics of organic matter/nutrients discharge are affected by land use or ‘green carbon’ dynamics.
Blue carbon dynamics model

Model coupling of mangrove vegetation dynamics model, soil dynamics model and hydrodynamics model.
Study site and field survey

**Study site**

Estuarine mangrove of Fukido River in the northern part of Ishigaki Island, Japan

**Field survey**

Seven times (Aug, 2014 ~ Sep, 2016)

**Intake**

Observation of water level and velocity

**River mouth**

Observation of resuspension and settlement

**Mangrove**

Soil core sampling for estimating soil organic matter and root biomass
Hydrodynamic model for mangrove area

RMSE = 4.59

Middle of creek

Simulation

Observation

Velocity

Soil salinity

Deposition – erosion rate
As a result, it was found that the litter which is supplied from above ground tree accounted for 65% of total organic matter in the soil. SOM content and bulk density were simulated well. As a result, it was found that the litter which is supplied from above ground tree accounted for 65% of total organic matter in the soil.
Simulation result of spatio-temporal mangrove change dynamics

Bird-eye view

- **Rhizophora stylosa**
  - Salinity tolerant species.

- **Bruguiera gymnorrhiza**
  - Faster growth rate, salinity tolerance is weaker.
Simulation results for three different salinity conditions

High soil salinity (S=33)
*Rhizophora* forest

Low soil salinity (S=27)
*Bruguiera* forest

Middle soil salinity (S=29)
Mixed forest

10m
Coupling of local and regional scale models

Chasing test case of DOC produced by corals on the Shiraho reef domain
Scenario Analysis for various threats in future

➢ Climate changes
  • Air and water temperature rise
  • Ocean acidification
  • SLR

➢ Stronger & more frequent typhoon
  • Intensified terrestrial runoff
  • Stronger winds → fallen trees increase
  • Larger waves → increase in resuspension and blowout of bottom sediments

➢ Deforestation (↔ afforestation/reforestation)
  • Change in runoff of sediment, etc.
Sustainable Development Strategy for the Seas of East Asia (SDS-SEA)

“The SDS-SEA embodies the shared vision of the countries and other stakeholders for the Seas of East Asia, and the ways by which they will achieve that shared vision.”

BlueCARES Project is aiming at developing and implementing Blue Carbon Strategy, which is in line with SDS-SEA. We are willing to link and collaborate with relevant regional programs to extend our scope to cover wider area in and around Coral Triangle.
Thank you!