Ecology Subgroup

Member list

From Japan

M. Nakaoka (subleader), Y. Tanaka, Y. Nakamura, K. Honda, M. Watai (until 2011), M. Sato (since 2012), Venus Leopardas (since 2012)

From the Philippines

Miguel Fortes (leader), Wilfredo L. Campos, Wilfredo H. Uy, Gay Amabelle G. Go, Klenthon Bolisay, Monica Edralin (until 2011), Monica Sarceda (from 2011), Francisco Paciencia Jr., Venus Leopardas (until 2012), Allyn Pantallano, Joshua Regalado (until 2012), Rocille Palla (until 2011), Lucas Felix (until 2012), Ma. Marivic Pepino (since 2012) , Mary Ann Cielo Malingin (from 2012)

Our Missions (written in RD)

(2-1) Investigation of biodiversity, functions and inter-connectivity of local habitats consisting of coral reefs, seagrass beds, tidal flats and mangrove forests and their responses to multiple environmental stresses
(2-2) Investigation of impacts of episodic events like typhoon, flood and oil/coal spill on tropical coastal ecosystems and their recovery processes

Ecology Subgroup

Research Subjects of Ecology Subgroups

1. Establishment of field monitoring systems on species diversity and ecosystem functions of coastal ecosystems under multiple stress (for RD 2-1 and 2-2)

2. Responses of major coastal organisms to multiple stresses analyzed based on ecological observation and experiments (for RD 2-1 and 2-2)

3. Inter-connectivity of reef systems focusing on major consumers (for RD 2-1)

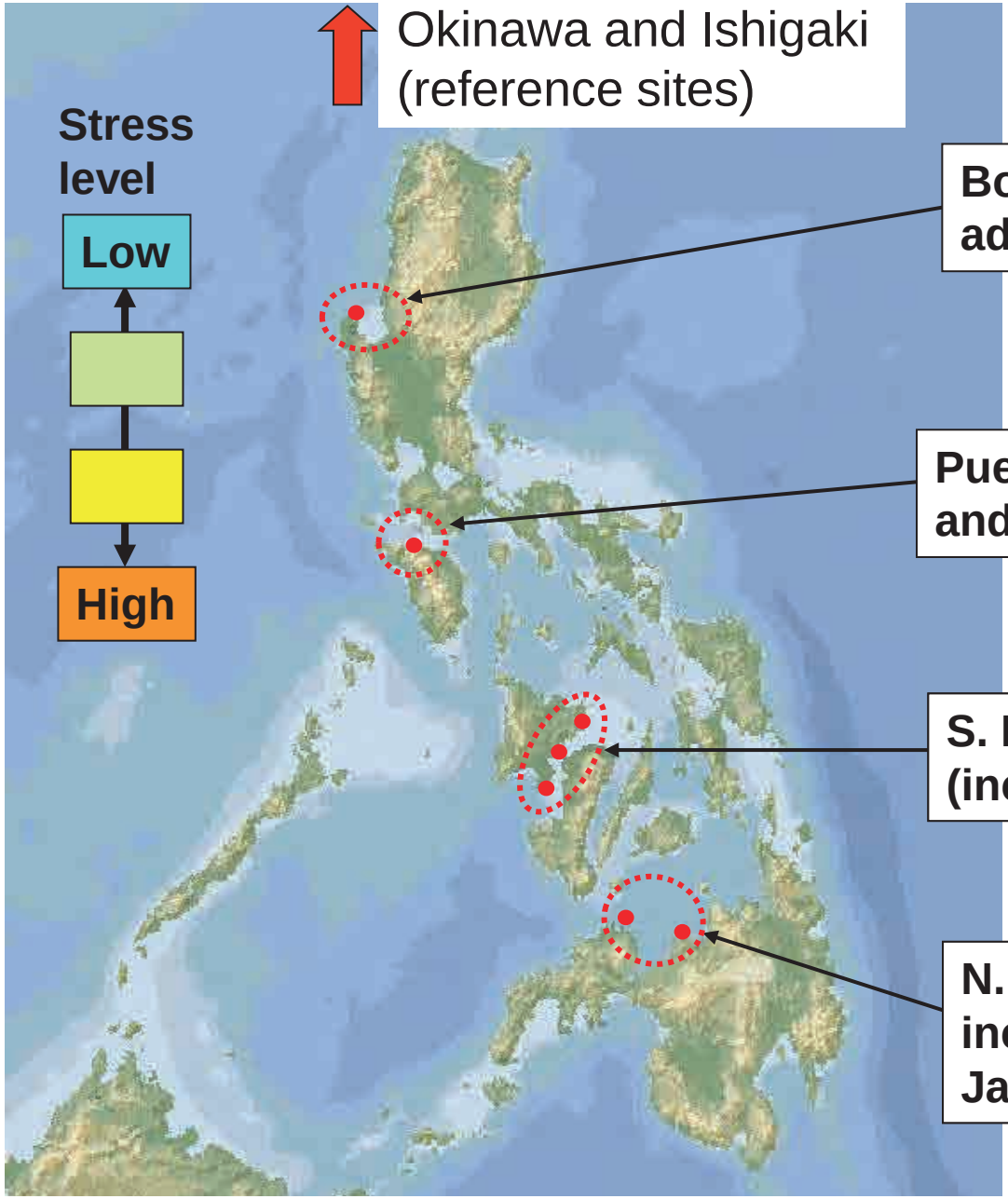
4. Establishment of biological indicators and baseline data to assess impacts of unpredictable episodic events (for RD 2-2)

Ecology Subgroup

Study Sites

Nested, hierarchical design

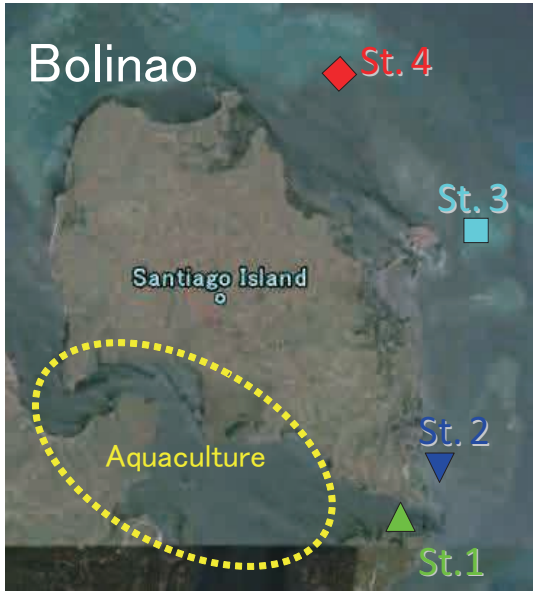
Region > Area (20km) > Site (2km)

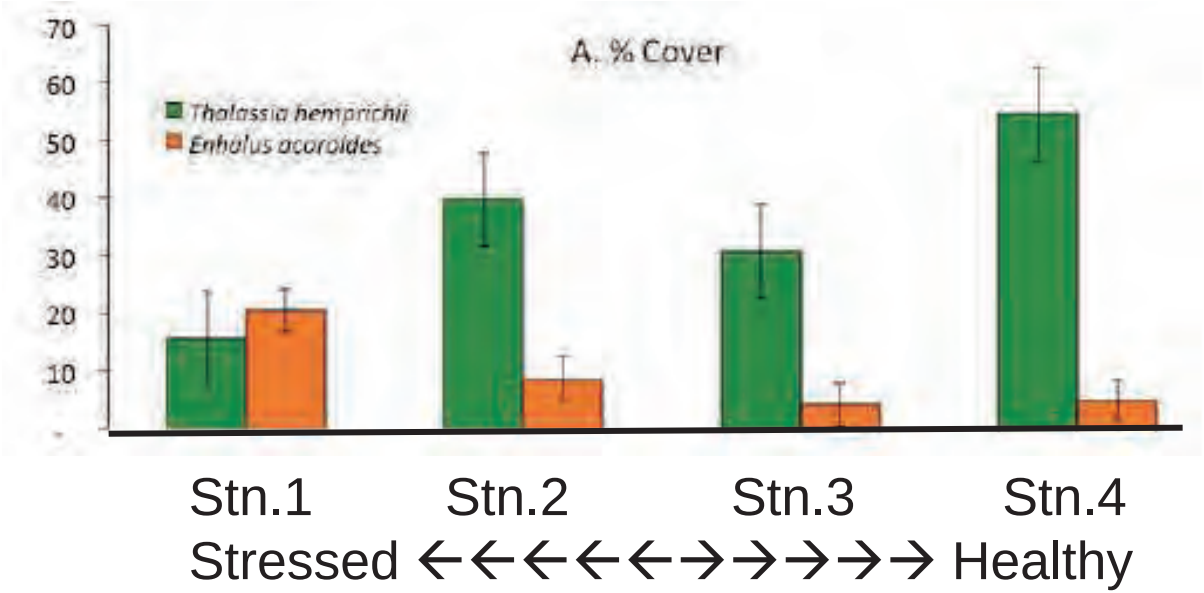


Ecology Subgroup

1. Establishment of biological monitoring methods

10 time-series data on biodiversity and ecosystem functions were collected since September 2010





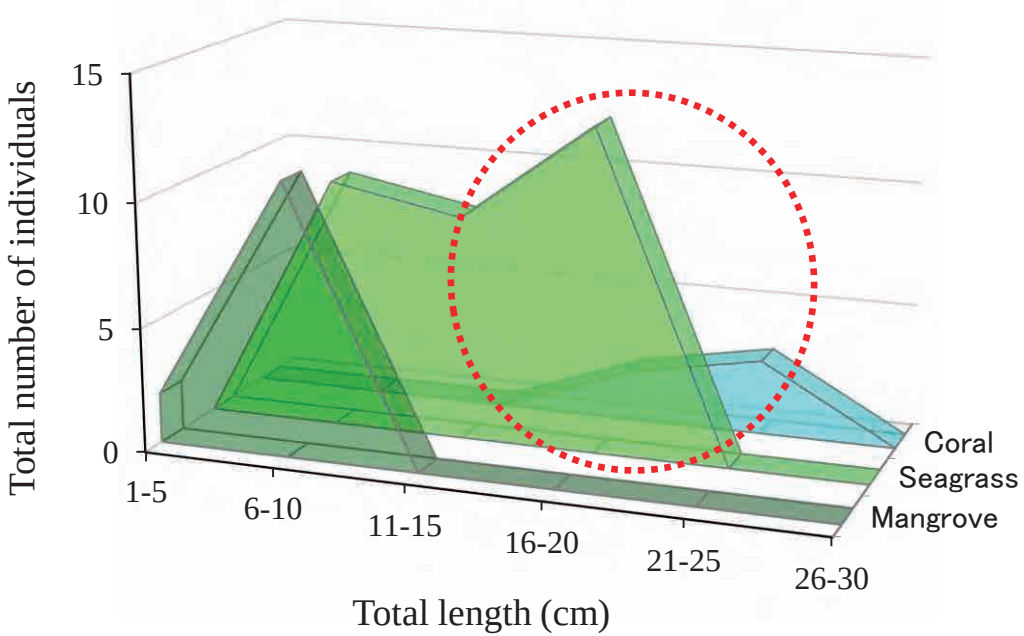
- Different patterns of responses against environmental stressors among seagrass species
- A large seasonal variation in response variables

Fortes et al. (2012)

Ecology Subgroup

2. Local connectivity of fish within reef system

Lethrinus harak

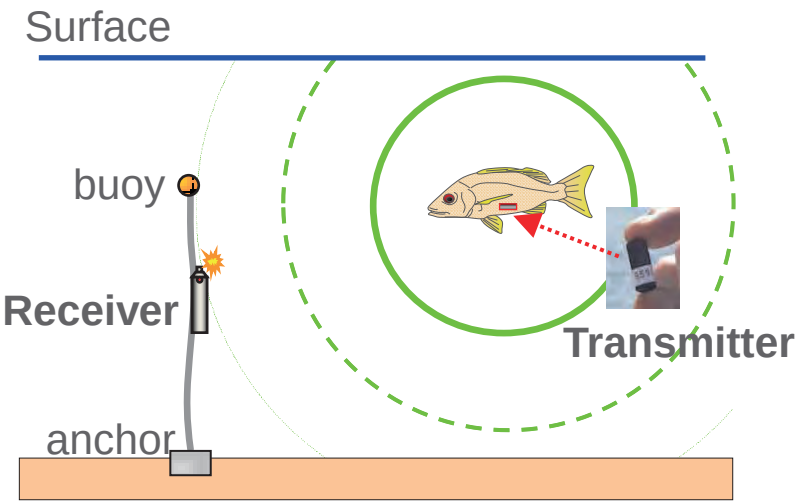


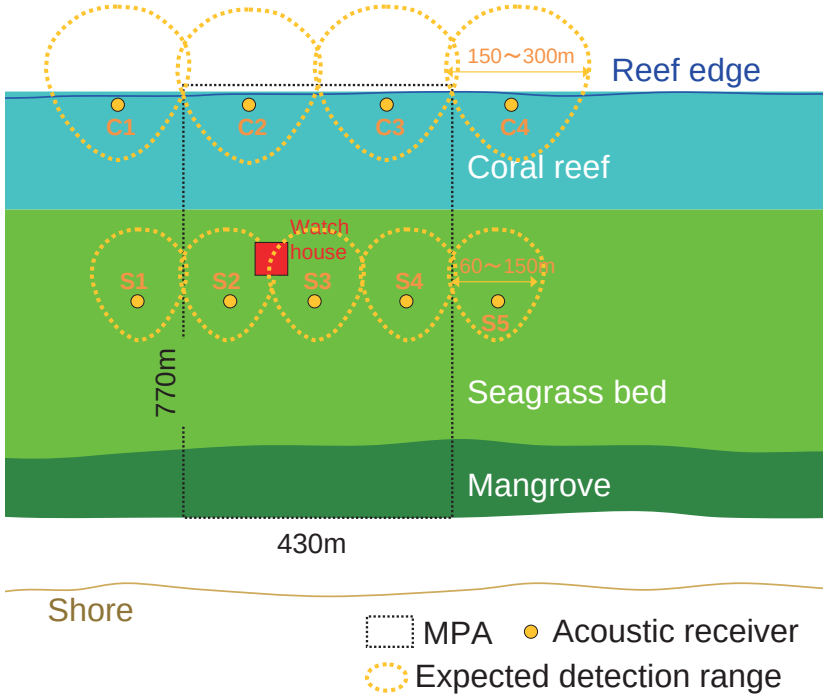
Fish visual census revealed that some fish (such as *Lethrinus harak*) exhibited ontogenetic habitat shift from mangrove and seagrass habitats to coral reef.

For some fishery-important species, MPA should include both seagrass and mangrove areas as their nursery- or feeding ground

Ecology Subgroup

3. Evaluation of effective MPA size based on acoustic telemetry





The current MPA size in Laguindingan is assumed to be wide enough for some fish species (such as *L. monostigma*, and *L. harak*), but may not be enough for other species (such as *L. argentimaculatus*, and *L. atkinsoni*).

Ecology Subgroup

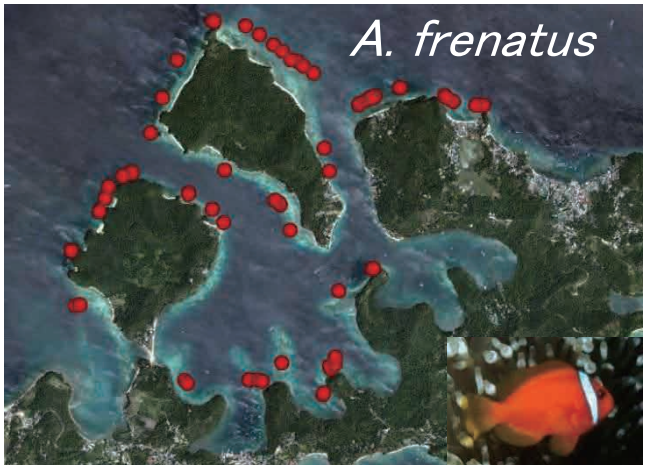
Plans for 2013-2014 (1)

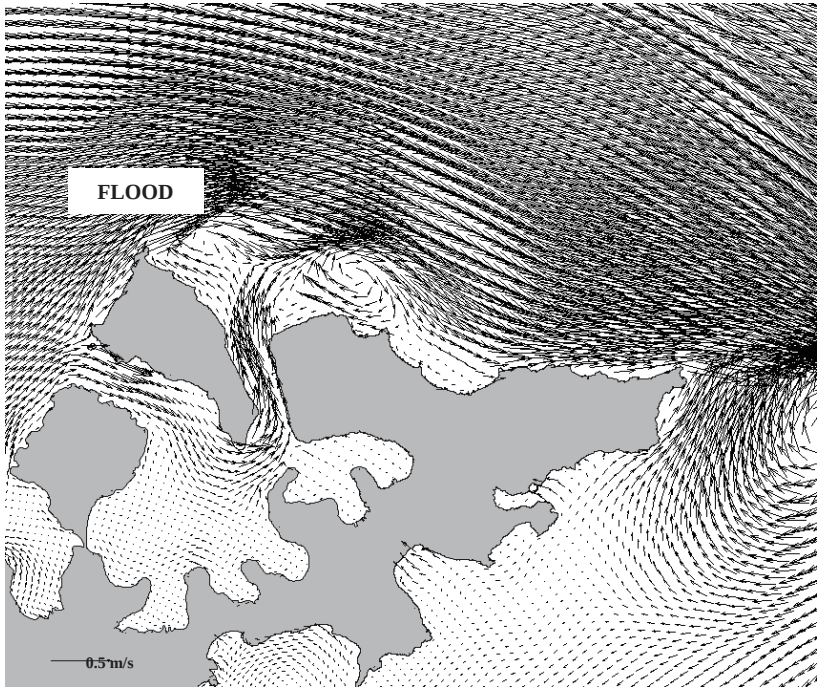
Campbell and Fourqurean (2011)

- Laboratory and field manipulative experiments to examine factors responsible for the observed variation in the field (collaboration with Geochemical Group)
- Estimation of long-term change of seagrass beds since 1990's based on past literature and remote sensing data (collaboration with Modeling Group)
- Evaluation of carbon stock capacity of seagrass beds (collaboration with Geochemical Group)

Ecology Subgroup

Plans for 2013-2014 (2)





- Metapopulation approach to understand local connectivity using reef fish as a model organisms (collaboration with Genetic Subgroup and Modeling Group)
- Extension of target organisms to plankton and non-vegetated benthic habitats for better understanding biodiversity changes at broader spatial scales (collaboration with Geochemical and Modeling Groups)
- Quantitative estimation of ecosystem services of coastal areas based on ISSE framework (to be utilized for IDSS)

Ecology group_Genetics group

Members:

Japan: Chunlan Lian, Yuichi Nakajima, Yu Matsuki, Masahiro Nakaoka , Kazuo Nadaoka

Philippines: Miguel Fortes (leader), Wilfredo L. Campos, Wilfredo H. Uy, Dan Arriesgado

Research subjects

- **Genetic conservation of seagrasses, starfishes, etc**
- **Reef connectivity estimated by genetic information**
- **Reproductive model and recruitment processes of seagrasses**

Missions (written in RD)

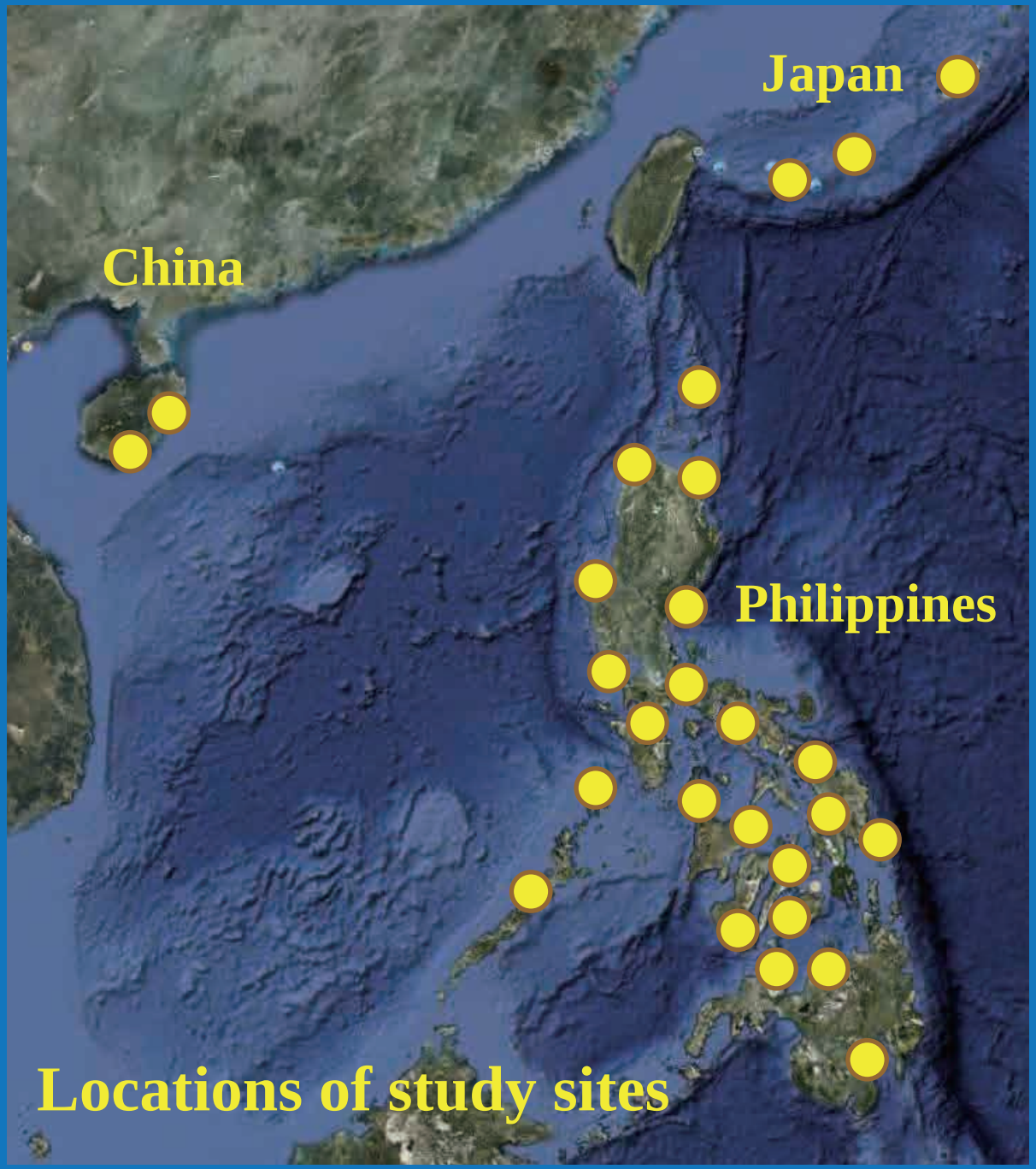
(2-1) Investigation of biodiversity, functions and inter-connectivity of local habitats consisting of coral reefs, seagrass beds, tidal flats and mangrove forests and their responses to multiple environmental stresses

(2-3) Investigation of **reef connectivity** in tropical island-studded sea and environmental influences on larval dispersal and recruitment processes

(4-2) Proposing an effective scheme for improving and maintaining **MPA networks** as a measure to enhance ecosystem resilience by identifying core habitats in local/regional reef connectivity and by assessing environmental stresses on MPA candidates

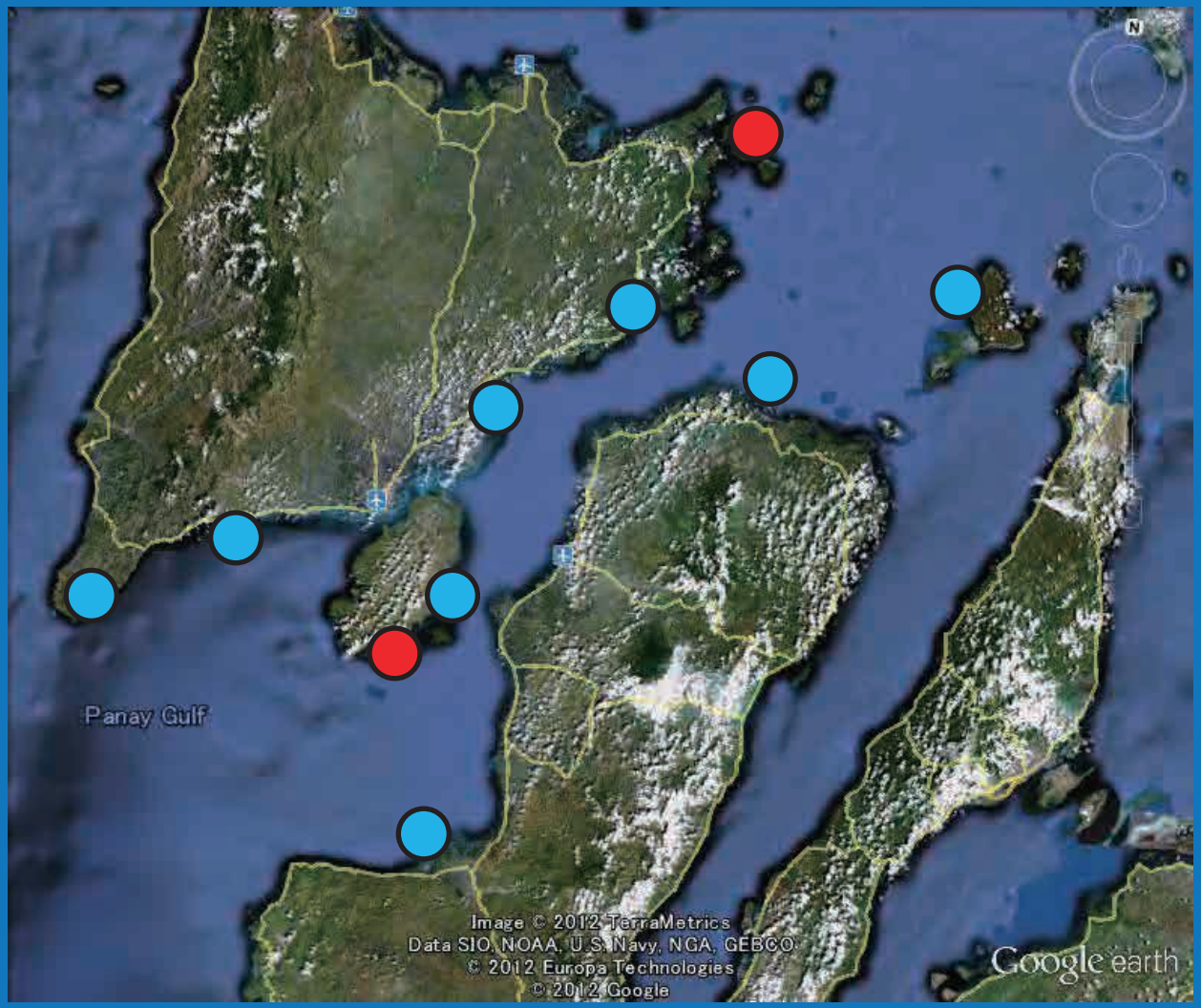
Study sites
-- Large scale

Japan
China
Philippines
Total: 81 sites



Study sites
-- Intermediate scale

Guimaras strait: 200 km



Study sites
-- Small scale (15 km)

Target regions:

1. **Bolinao**
2. **Mindanao**

Locations of study plots in Santiago Is., Bolinao

Results
--Large scale

Genetic diversity and population structure of seagrass, *Thalassia hemprichii* in the Philippines

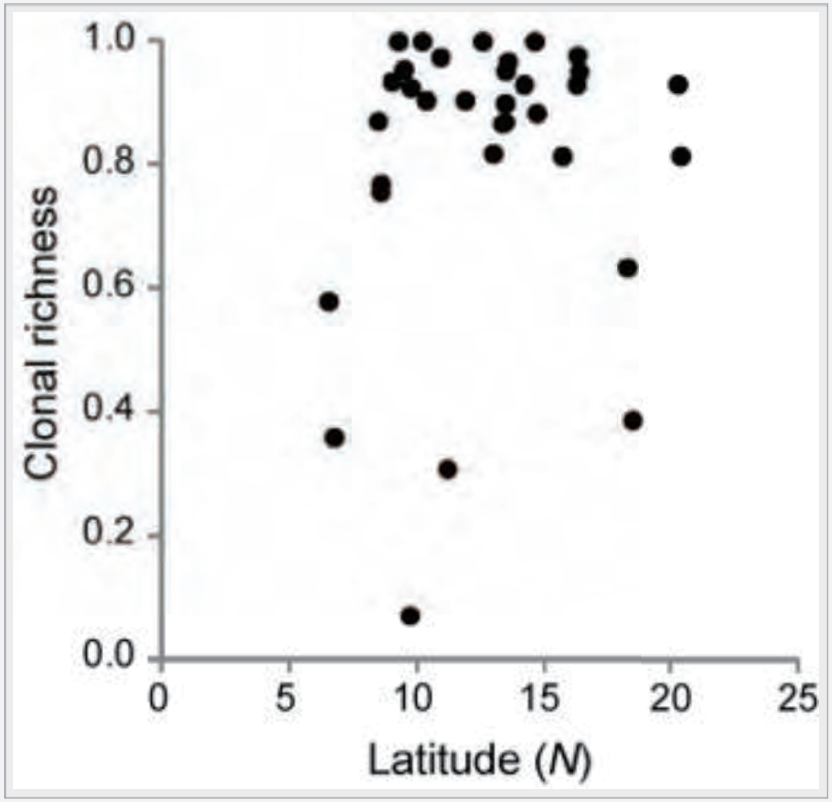
Clonal richness (*R*)

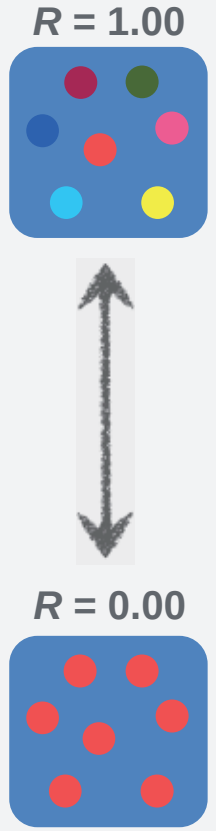
$R = (1\text{-}G)/(1\text{-}N)$

G: # of genotype; N: # of sample

- *R* = 0.07~1.00 (mean : 0.81)
- Most of meadows had high clonal richness
- No clear relationship with latitude

  - High level of sexual reproduction





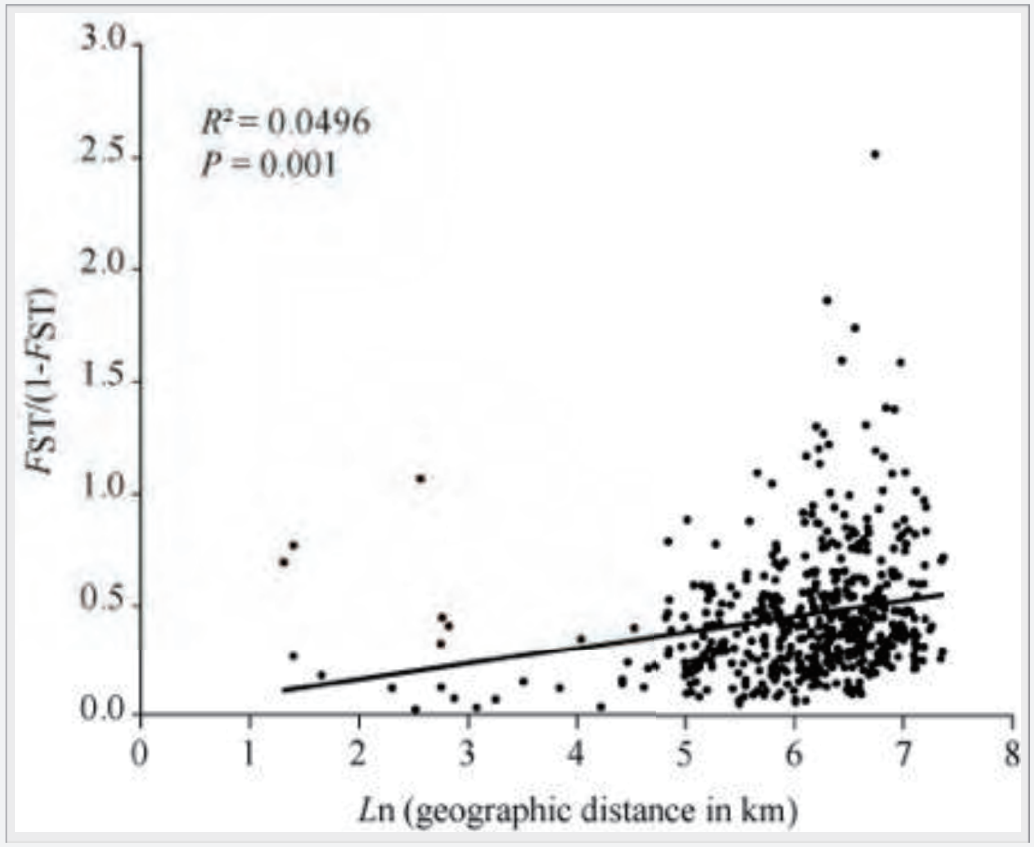
F_{ST} = 0.026-0.715
(mean: 0.28)

High genetic differentiation between different populations

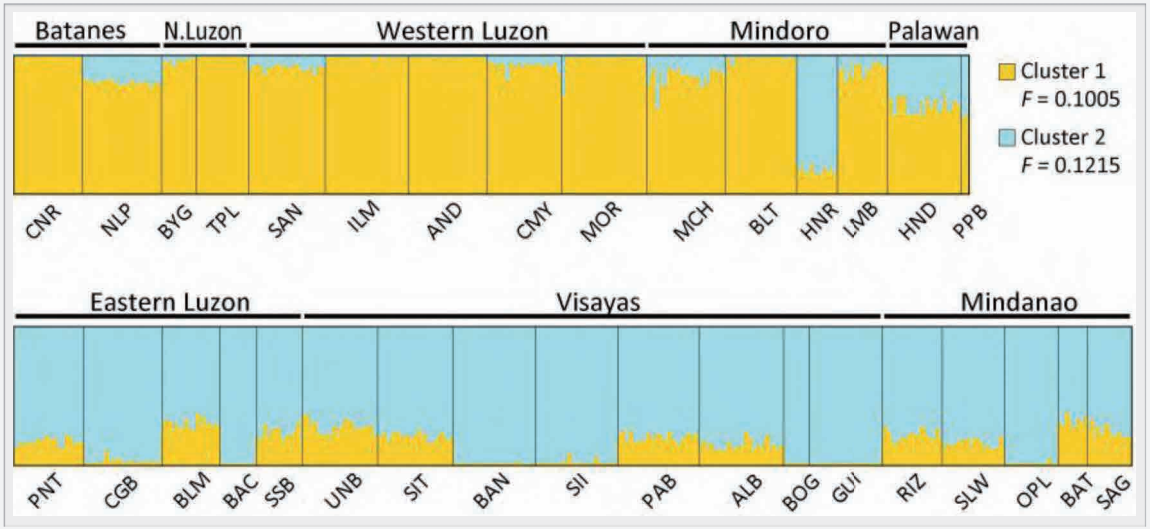
Genetic divergence increased with geographic distance

Gene flow of *T. hemprichii* is restricted at the archipelago scale

Isolation by distance



Genetic structure across the PA



- Divided into NW & SE group
  - HNR (Mindoro Is.): SE group
  - Palawan Island: Intermediate

Genetic structure across the PA

- Gene flow is restricted at the archipelagic scale
- Genetic structure reflects the patterns of sea currents

Results
--Large scale

Genetic diversity and population structure of *Enhalus acoroides* in tropical and subtropical regions

Plans for 2013-2015

- **Continually analyzing genetic diversity and population genetic structure of other seagrasses (*Syringodium isoetifolium*, *Cymodocea rotundata*, *C. serrulata*) and starfish species**

↓

Developing genetic diversity map and conservation units of seagrasses and starfishes in the Philippines

↓

Establishing MPA in the Philippines (for RD 2-3, 4-2)

Plans for 2013-2015

- **Reef connectivity in Guimaras strait estimated by genetic information (collaboration with Modeling Group and Ecology Group)**

Establishing effective MPA size

Plans for 2013-2015

- **Reproductive models and recruitment processes of seagrasses (collaboration with Geochemistry, Modeling and Ecology groups)**

Assessing environmental impacts on conservation of seagrass beds (for RD 4-5)

Geochemistry Subgroup

Member list

From Japan

T. Miyajima (subleader), Y. Umezawa, A. Watanabe, N. Morimoto, H. Kurihara (since 2012)

From the Philippines

Maria Lourdes S.D. McGlone (subleader), Fernando P. Siringan, Cesar L. Villanoy,
Genevieve L. Regino, Charissa M. Ferrera, Danica L. Mancenido (until 2011),
Mikko Garcia (since 2012)

Geochemistry Subgroup

Our Missions (written in RD)

(1-1) Monitoring and analysis of terrestrial environmental loads on tropical coastal ecosystems
(1-2) Investigation of material cycle dynamics in land-ocean integrated zone of tropical coastal ecosystems
(1-3) Analysis of combined impacts by local and global environmental stresses on coastal ecosystems
(1-4) Coastal ecosystem evaluation in terms of CO_2 source/sink
(3-2) Analysis and prediction of dynamic response of tropical coastal ecosystems to multiple environmental stresses based on the development of a coastal ecosystem model
(4-1) Establishing an effective scheme to assess sources and propagation processes of environmental impacts and carrying capacity of coastal ecosystems as a basis for mitigating environmental stresses
(4-3) Damage potential mapping for coastal ecosystems based on multiple environmental stress assessment and prediction

Research Subjects of Geochemistry Subgroup

1. Assessment of nutrient loading through rivers, groundwater, and atmospheric deposition to coastal ecosystems to evaluate local and regional environmental stresses (RD 1-1, 1-3)

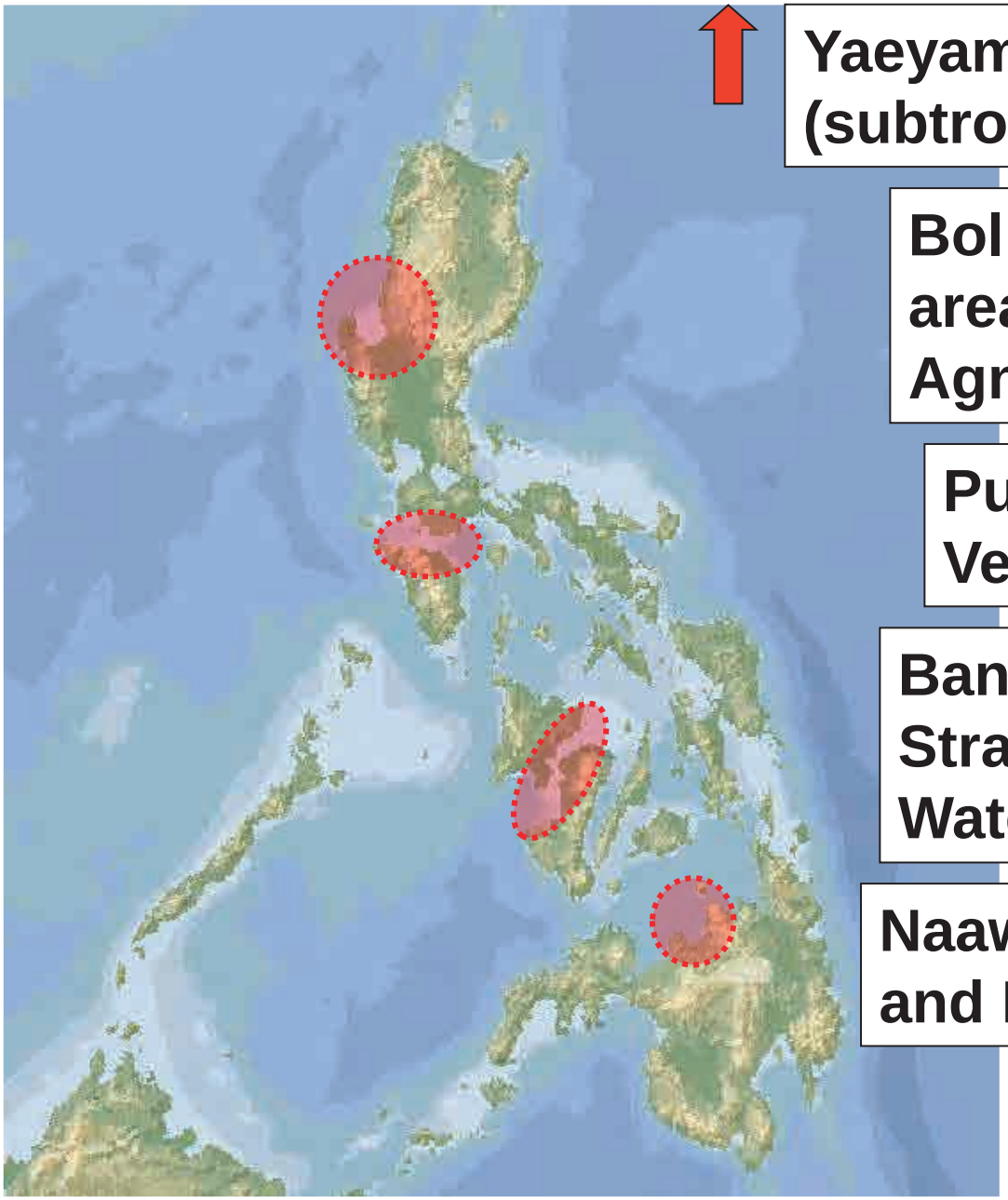
2. Fine-scale spatial and temporal monitoring of water quality and spatial mapping of sediment composition in several pollution-prone coastal areas (for RD 1-2, 1-4, 3-2)

3. Development of biochemical indicators and in-situ experimental methods (deployment of artificial substrates, transplantation) for assessing environmental stresses on corals and other benthic organisms (for RD 1-1, 1-3, 4-3)

4. Investigation of ocean acidification and CO_2 flux through sea surface and assessment of organic carbon storage in sediments to evaluate CO_2 source/sink potential of tropical coastal ecosystems (for RD 1-4, 4-1)

Geochemistry Subgroup

Study Sites



Yaeyama Islands
(subtropical reference sites)

Bolinao/Santiago Island area, Lingayen Gulf, Agno River watershed

Puerto Galera and Verde Island Passage

Banate Bay, Guimaras Strait, Jalaur River Watershed

Naawan, Laguindingan, and Macajalar Bay

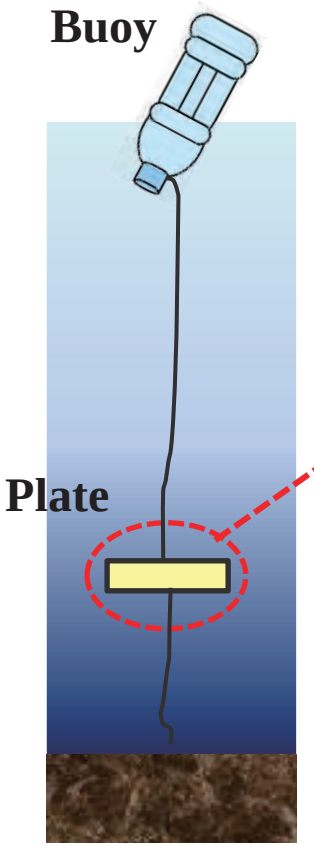
Geochemistry Subgroup

Major environmental stresses to be addressed:

Yaeyama Islands (subtropical reference sites)	• Groundwater discharge • Atmospheric deposition • Global warming
Bolinao/Santiago Island area, Lingayen Gulf, Agno River watershed	• River discharge • Groundwater discharge • Aquacultures/Hypoxia
Puerto Galera and Verde Island Passage	• Wastewater input • Coastal erosion • Ocean acidification
Banate Bay, Guimaras Strait, Jalaur River Watershed	• Siltation by river discharge • Algal blooming • Land subsidence
Naawan, Laguindingan, and Macajalar Bay	• No environmental stresses (Control sites)

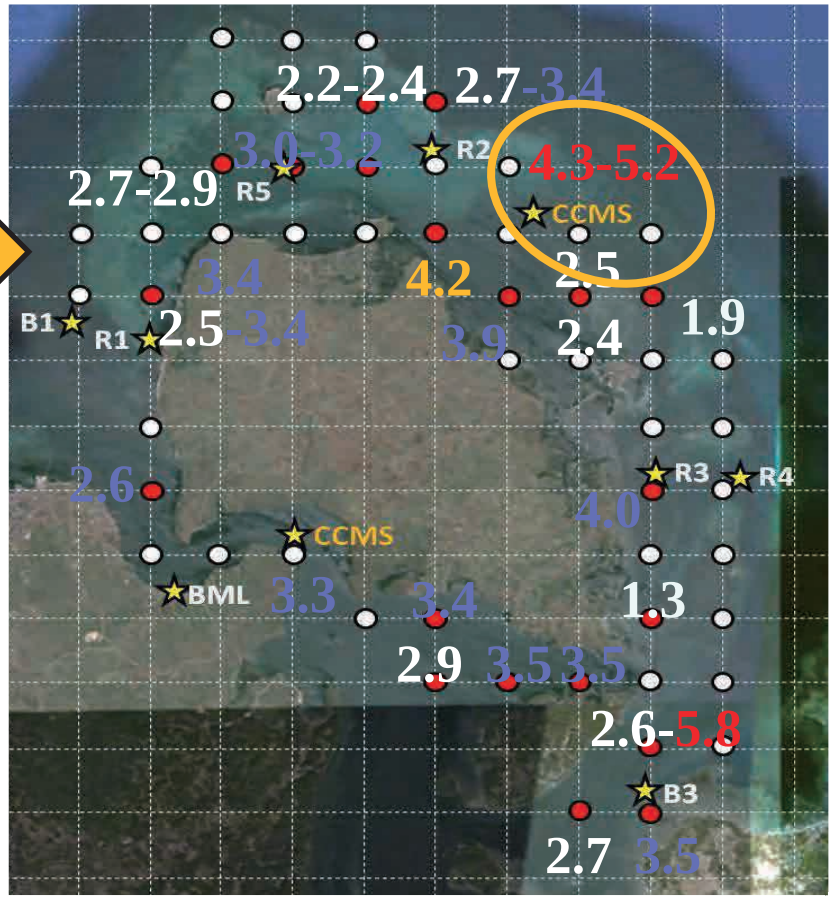
1. Monitoring and analysis of terrestrial environmental loads

Artificial attachment plates were deployed around Bolinao, to get time-integrated information for nutrient sources for primary producers at each area.



$\delta^{15}N$ & N (%) analyses

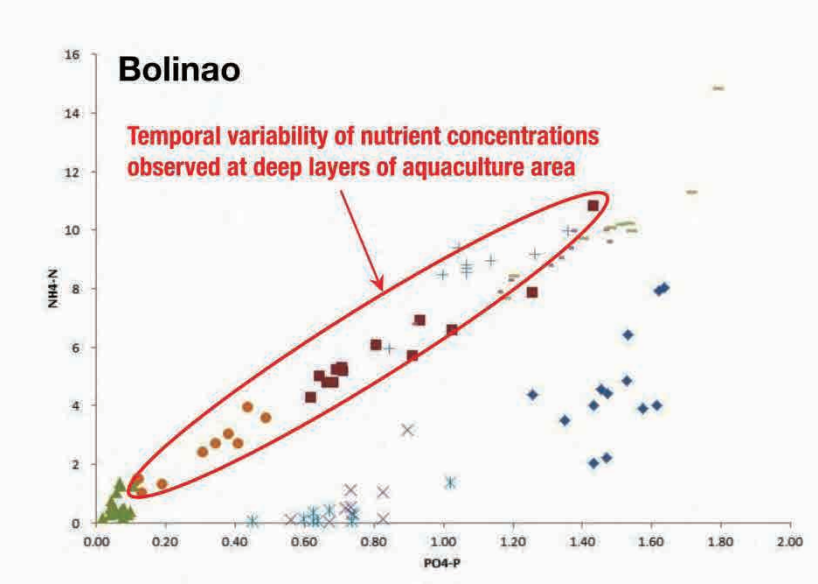
Algal species & biomass



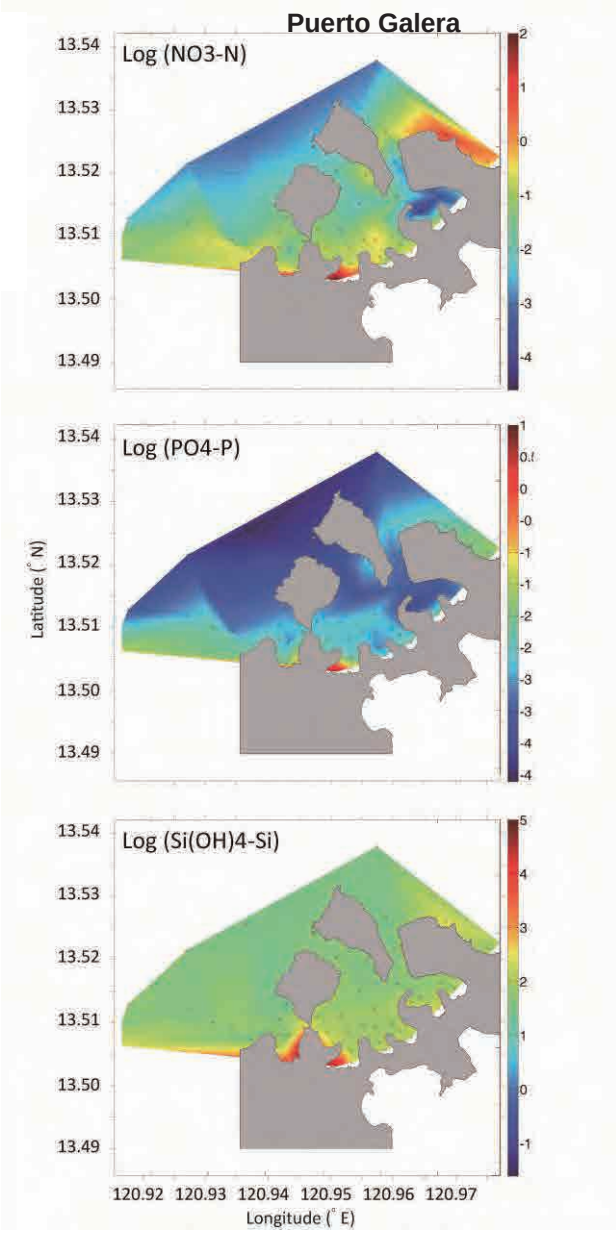
Higher algal $\delta^{15}N$ at offshore reef may be caused by the use of nutrient through the groundwater, which seep out from the faults in the reef, as also suggested by ^{222}Rn & resistivity surveys.

2. Material cycle dynamics in land-ocean integrated zone

Fine-scale spatial mapping and 24-h continuous observation have been conducted in Bolinao, Puerto Galera, and Guimaras Strait, to elucidate detailed dynamics of biogeochemical C, N, and P cycles

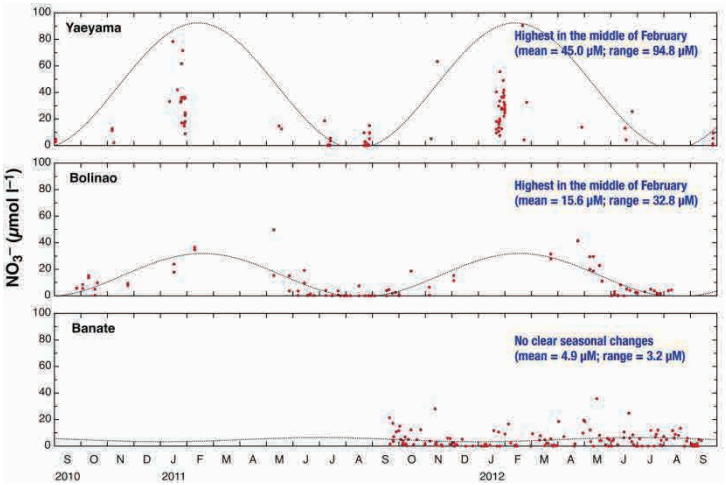


Several point sources (wastewater) with different N:P:Si ratios have been identified in Puerto Galera by fine-scale mapping.



Strong correlation between NH_4^+ and PO_4^{3-} in Bolinao indicates prevalent influence of a single particular nutrient source, i.e. decay of fish feed for aquaculture.

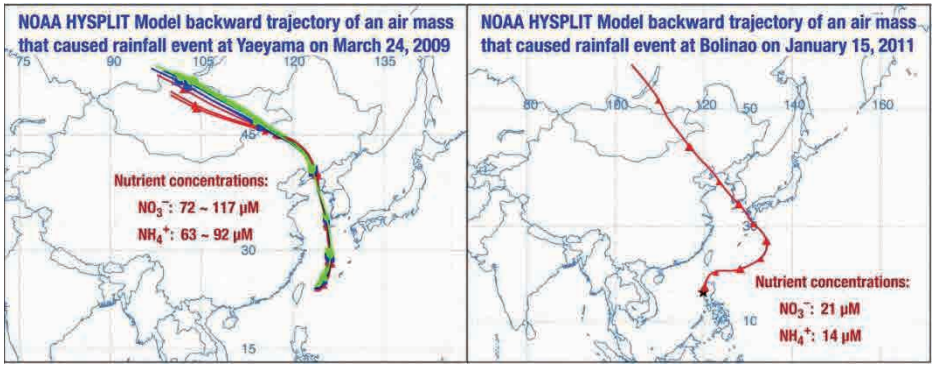
3. Large-scale environmental stresses on coastal ecosystems

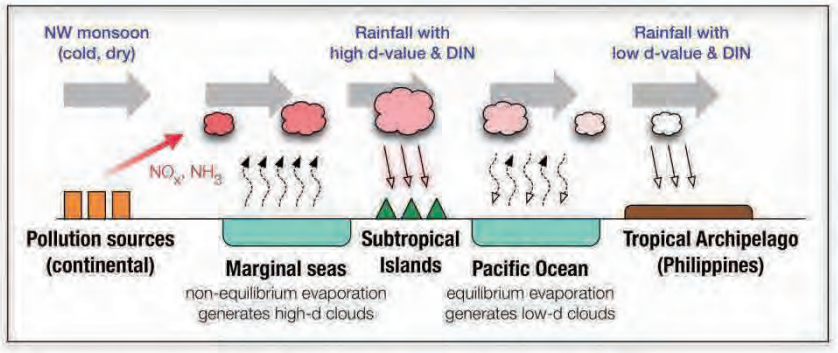


Nutrient loading by atmospheric deposition has been investigated at tropical and subtropical coastal sites.

Atmospheric nutrients generated in temperate industrial zone are transported by monsoon, and affect most strongly the subtropical reference sites (Yaeyama Island).

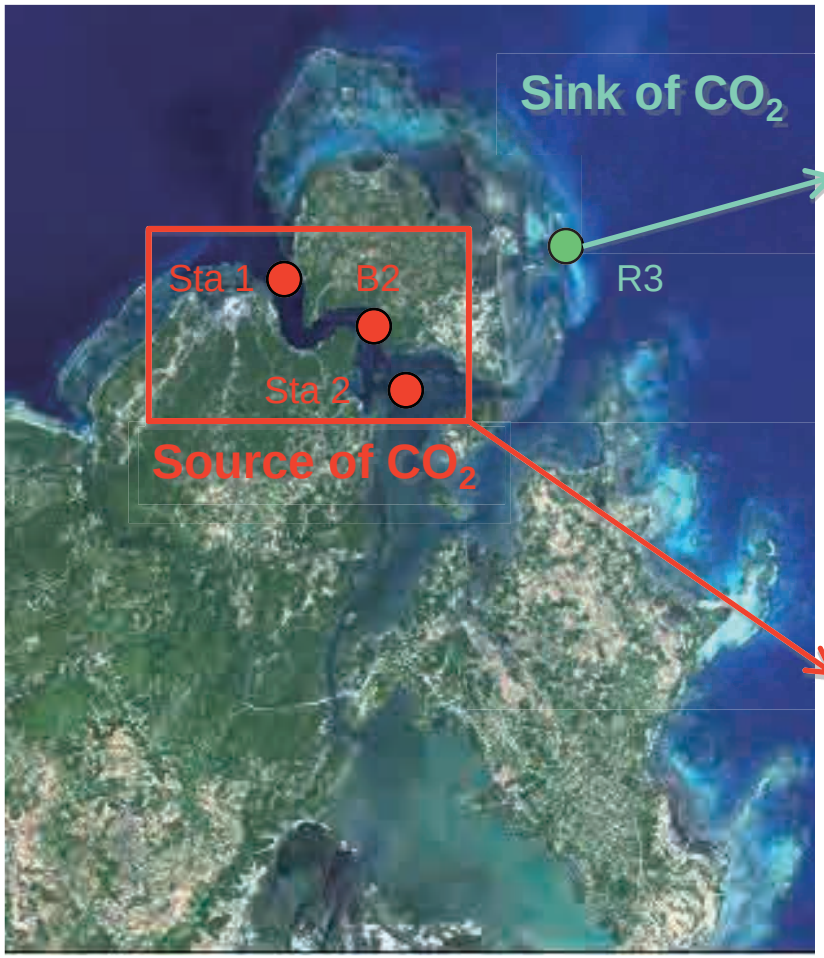
The influence seems to extend over northen Philippines to a lesser extent.

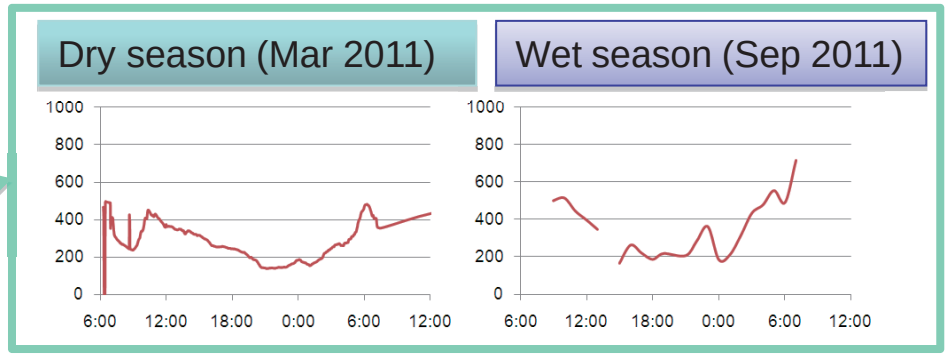


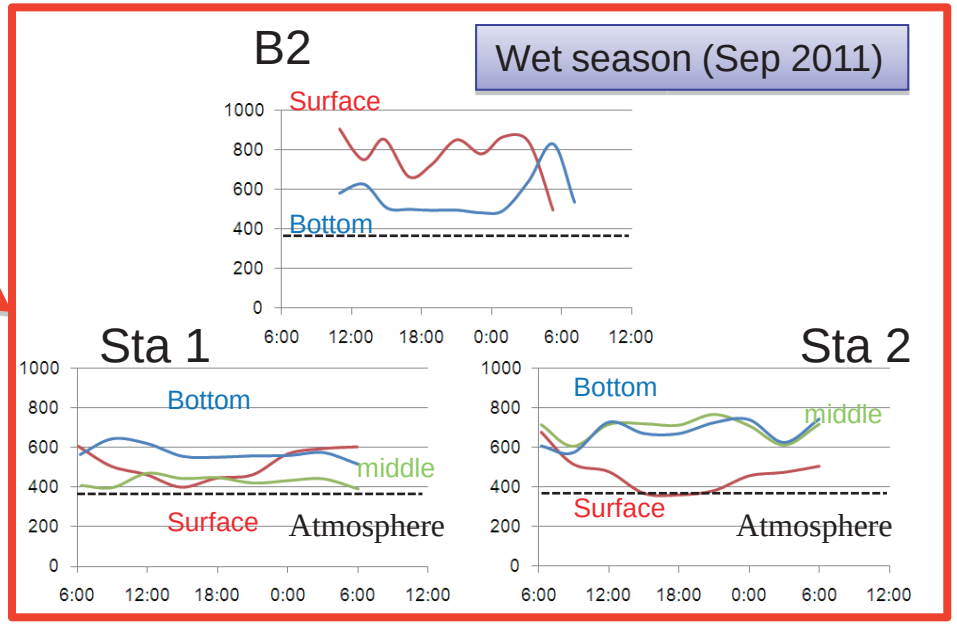


4. CO_2 source/sink potential and blue-carbon production

CO_2 flux has been monitored using pCO_2 loggers and precise carbonate analysis over coastal areas of Bolinao, Banate, and Laguindingan.







Geochemistry Subgroup

Plans for 2013-2014 (1)

Oceanographic investigations

- Precise pCO_2/TA monitoring
- Phosphorus cycle using $\delta^{18}O$-PO_4
- Additional sites (Macajalar Bay, Boracay)

Periodic observation at CCMS

- Long-term trend of water quality
- Hypoxia and HAB alarming
- Collaboration with Ecology group

Sedimentological research

- Historic change in sedimentation
- Evaluation of blue carbon storage
- Collaboration with Ecology group

Plans for 2013-2014 (2)

Internal loading from sediments

- Effect of hypoxia formation
- Impacts on water column N/P/Si balance

In-situ transplantation experiments

- Detection of local/global stresses
- Novel biochemical and isotopic indicators
- Collaboration with Ecology group

Acidification experiments at BML

- Influence on coral calcification
- Seagrass-coral interactions
- Collaboration with Dr. Tanaka's team

Modeling and assessment Subgroup

Member list

From Japan

K. Nadaoka (project reader), A. Watanabe, Y. Kuriyama, T. Yamamoto, T. Tsuchiya, K. Iwai

From the Philippines

Cesar L. Villanoy(subleader), A.C. Blanco, E. Herrera, S. Reyes, E.M. Tomoling, A. Tamondong

Our Missions (written in RD)

(3-1) Quantitative assessment of multiple environmental stresses on tropical coastal ecosystems based on the development of an "atmosphere-land-coast-ocean" coupling model for simulating physical and chemical processes.
(3-2) Analysis and prediction of dynamic response of tropical coastal ecosystems to multiple environmental stresses based on the development of a coastal ecosystem model.
(3-3) Quantitative assessment and prediction of multiple environmental impacts on reef connectivity based on the coupling model and a larval dispersal model.
(3-4) Development of numerical models to assess impacts on coastal ecosystems by episodic events like typhoon and oil/coal spill.

(4-1) Establishing an effective scheme to assess sources and propagation processes of environmental impacts and carrying capacity of coastal ecosystems as a basis for mitigating environmental stresses

(4-2) Proposing an effective scheme for improving and maintaining MPA networks as a measure to enhance ecosystem resilience by identifying core habitats in local/regional reef connectivity and by assessing environmental stresses on MPA candidates

(4-3) Damage potential mapping for coastal ecosystems based on multiple environmental stress assessment and prediction

(4-4) Establishment and implementation of a comprehensive system for continuous monitoring of multiple environmental stresses and coastal ecosystem responses

(4-5) Development and implementation of Integrated Decision Support System (IDSS) and capacity building for its management and effective applications

(4-6) Socio-economic investigation of local communities as sources and solutions of environmental stresses for integrated coastal zone management

Research Subjects of Modeling/Assessment Group

1. Quantitative assessment of multiple environmental stresses on tropical coastal ecosystems (for RD 3-1 to 3-3)

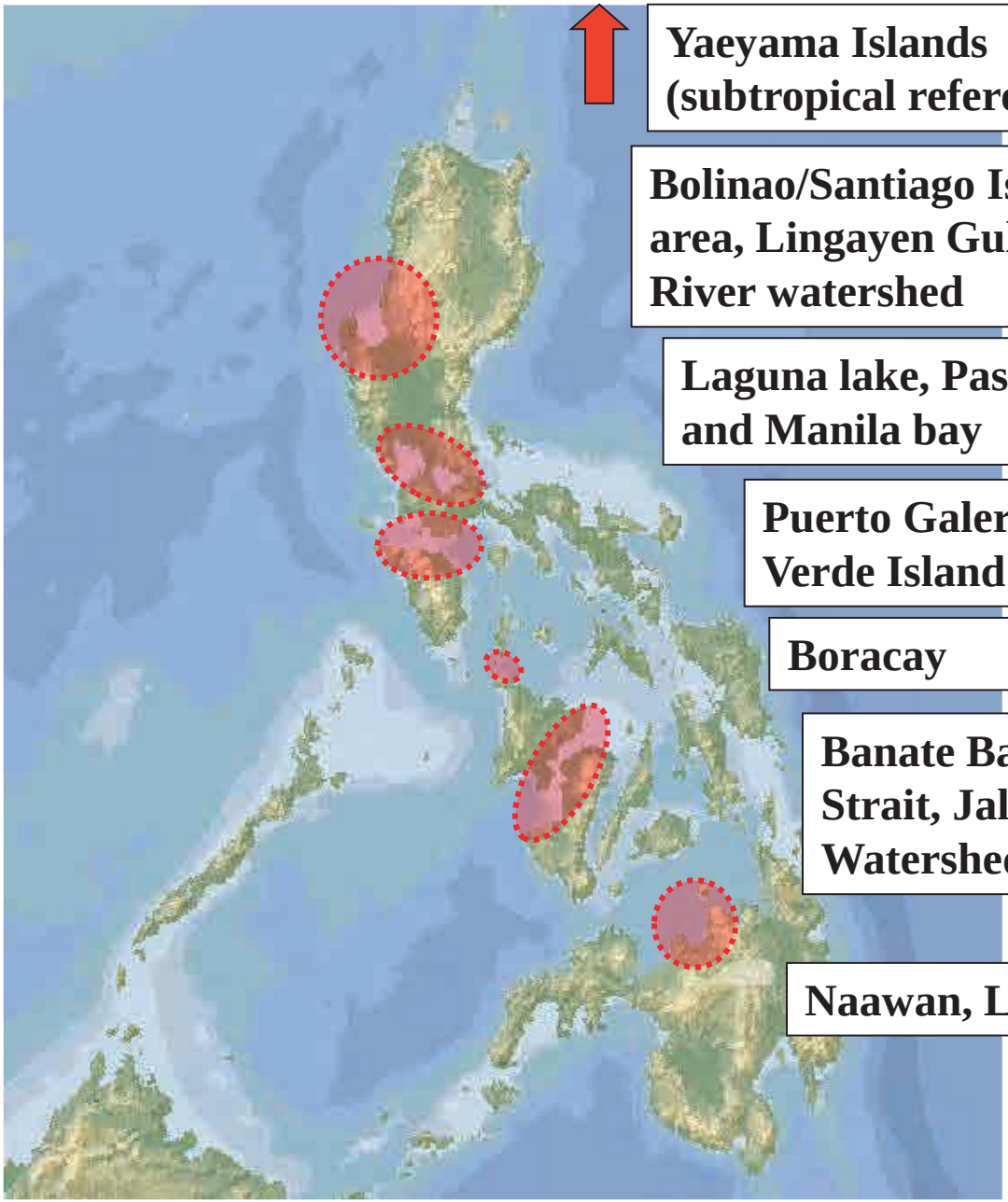
2. Prediction of dynamic response of tropical coastal ecosystems to multiple environmental stresses (for RD 3-1 and 3-2)

3. Development of new simulation models for quantitative assessment and prediction of multiple environmental impacts on coastal ecosystems (for RD 3-1 to 3-4)

4. Quantitative assessment of multiple environmental impacts on reef connectivity (for RD 3-3)

Modeling and Assessment Subgroup

Study Sites



Yaeyama Islands (subtropical reference sites)

Bolinao/Santiago Island area, Lingayen Gulf, Agno River watershed

Laguna lake, Pasig river and Manila bay

Puerto Galera and Verde Island Passage

Boracay

Banate Bay, Guimaras Strait, Jalaur River Watershed

Naawan, Laguindingan

Target environmental issues to be addressed:

- High water temperature
- Sedimentation
- Groundwater discharge

- Aquacultures
- Hypoxia
- River discharge
- Groundwater discharge

- Urbanization
- Aquaculture
- Flooding
- Eutrophication
- Larval connectivity
- Beach erosion

- Beach erosion

- Multiple terrestrial stress connectivity
- Environmental stress gradient

- Prestine (Control sites)

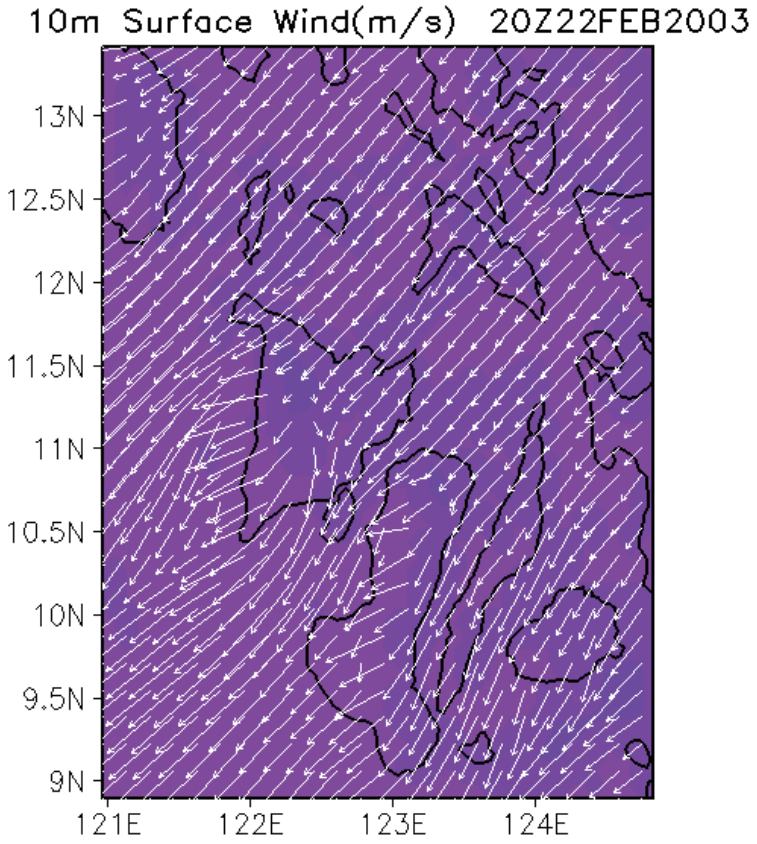
Modeling and Assessment Subgroup

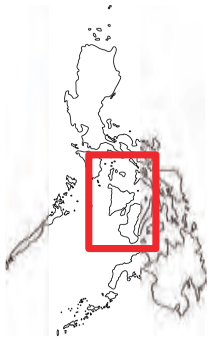
3-1. Development of an atmosphere-land-coast-ocean coupling model

Result of atmospheric simulation by a regional atmospheric model (WRF)

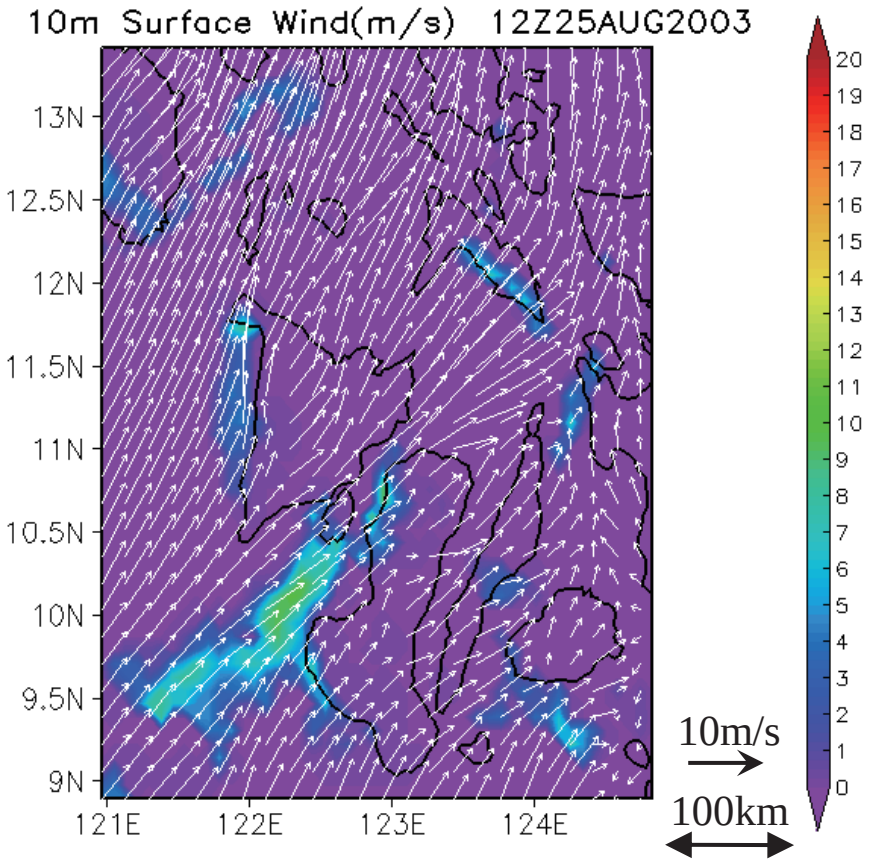
Vector: wind (10m surface), Contour: Precipitation

Dry Season





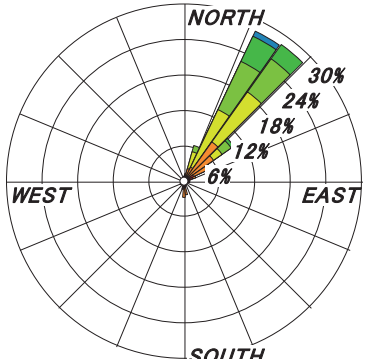
Rainy season

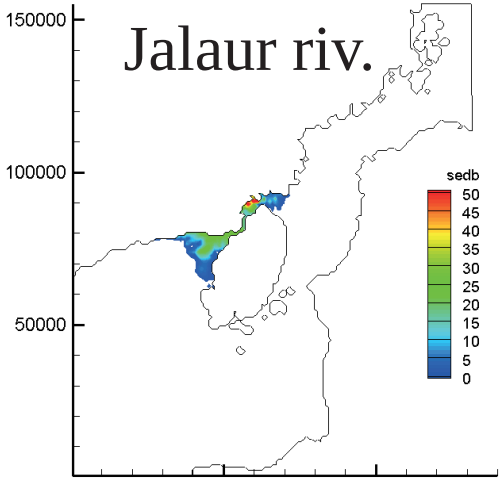


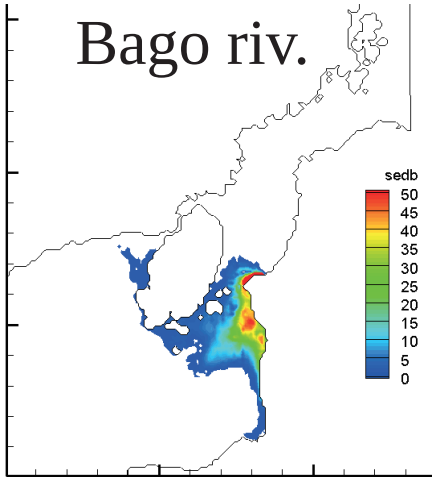
3-1. Development of an atmosphere-land-coast-ocean coupling model

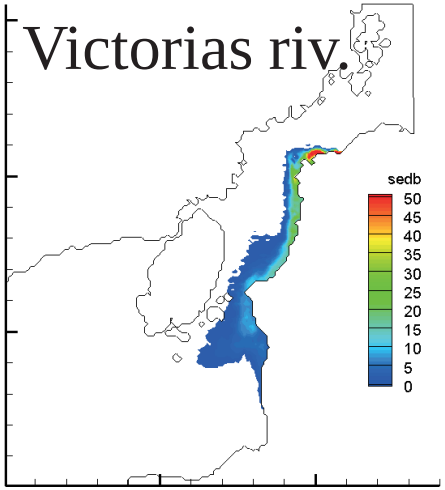
Sediment transport analysis by atmosphere-land-coast coupling model in Guimaras strait

Dry season

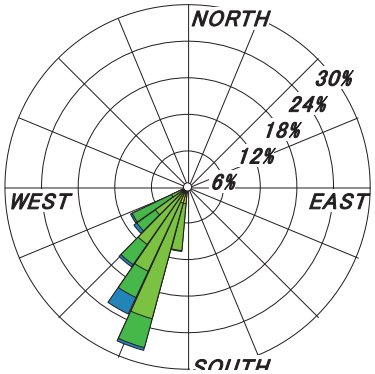


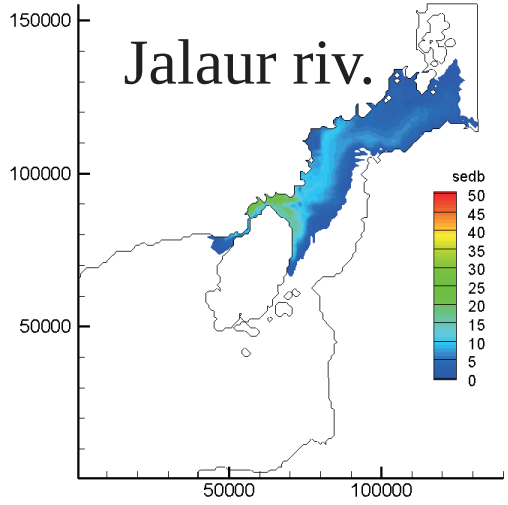


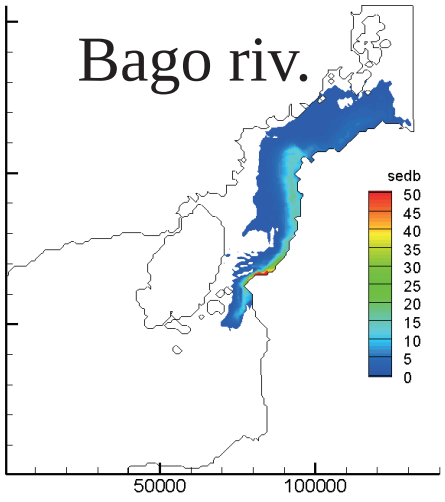


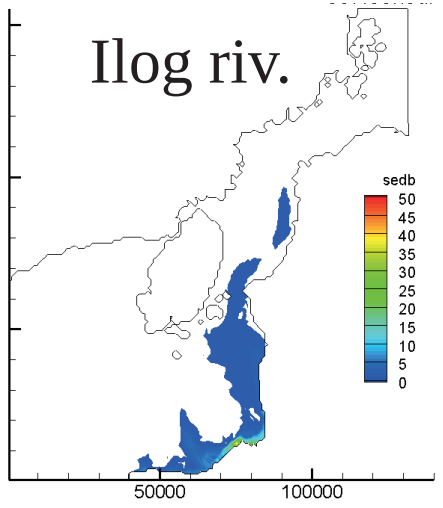


Rainy season









Each riverine influence spreads across a wide area of strait.

→Water quality of the strait seems to be affected by discharge from multiple rivers.

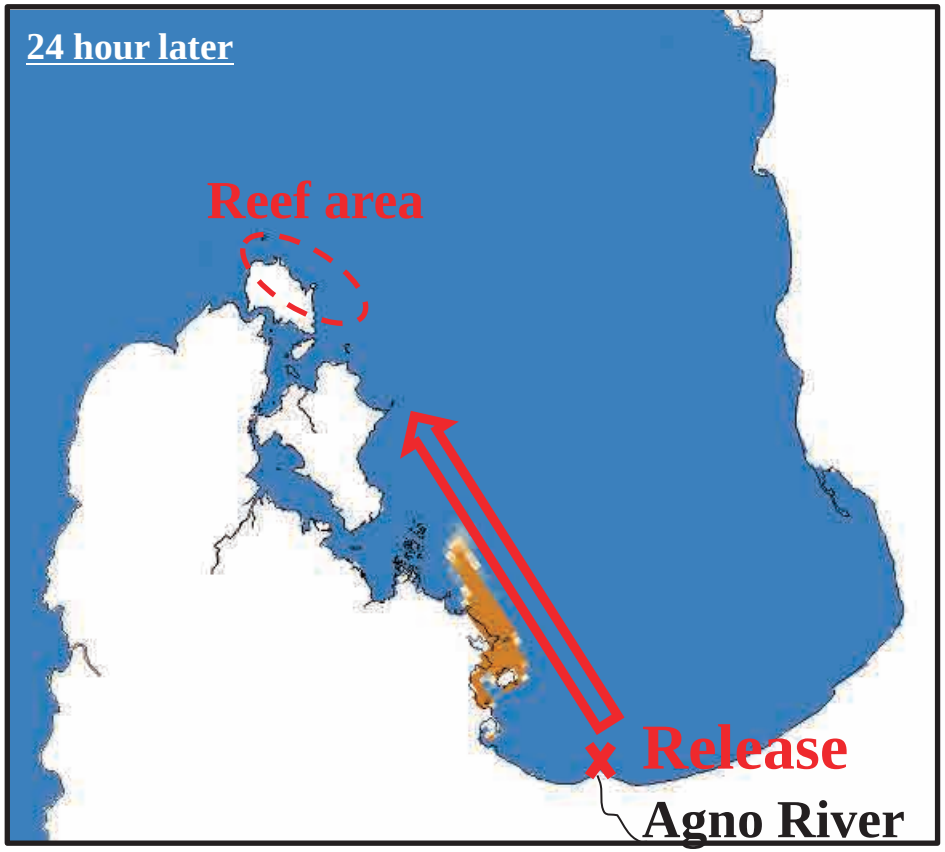
Modeling and Assessment Subgroup

3-3. Quantitative assessment and prediction of multiple environmental impacts on reef connectivity

Gulf-scale connectivity in terms of material transport

Results of particle tracking simulation

Lingayen Gulf



Particles from Agno River mouth

➢ **Gulf-scale connectivity from Agno River to reef area**

Particles released from Agno River mouth were transported along the west coast of the Gulf toward Bolinao area. This current may transport the nutrients and sediments discharged from Agno River toward Bolinao area.

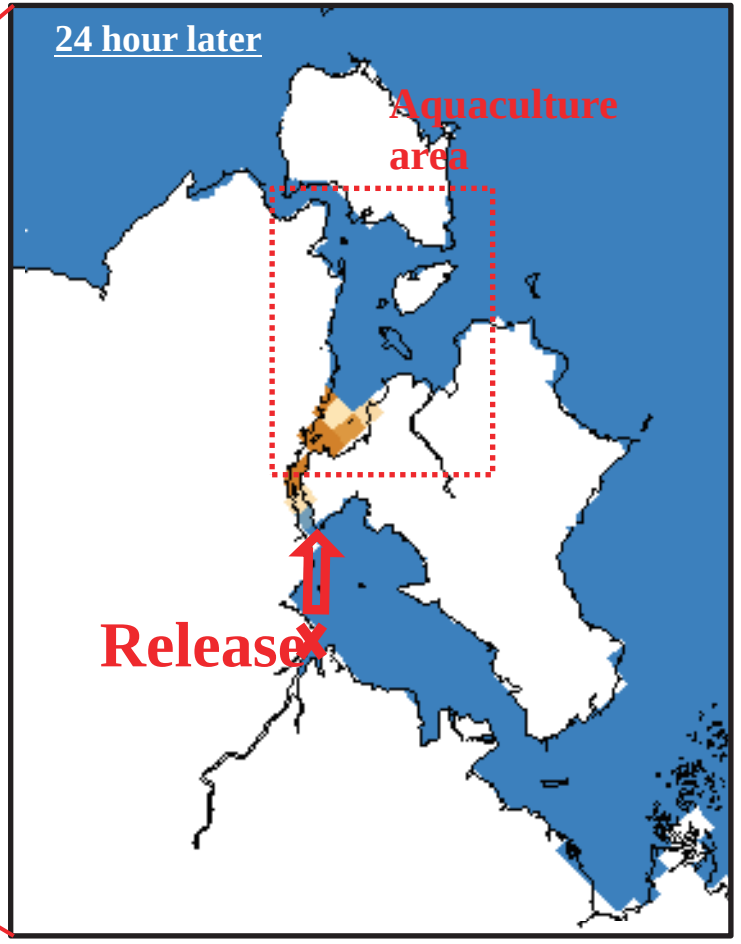
3-3. Quantitative assessment and prediction of multiple environmental impacts on reef connectivity

Local connectivity in terms of material transport

Results of particle tracking simulation

Lingayen Gulf

Particles from adjacent river mouth

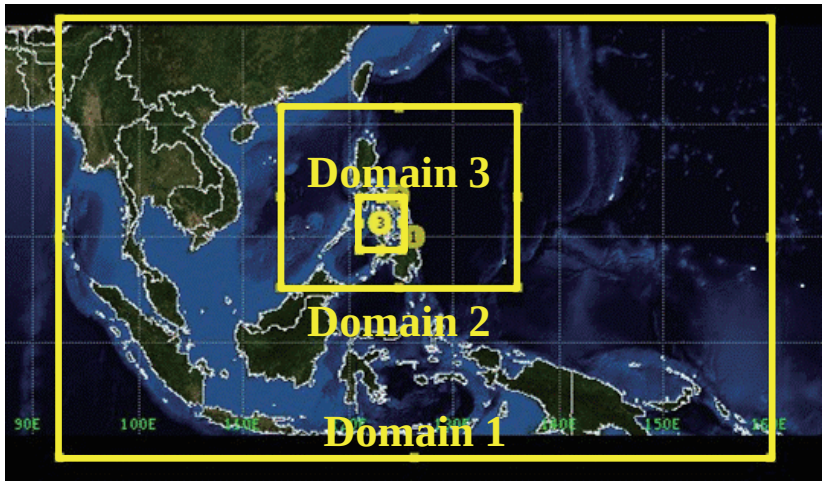


➢ **Local connectivity from adjacent rivers to aquaculture area**

Particles released from adjacent river mouth were spread widely toward the aquaculture area.

Modeling and assessment Subgroup

Plans for 2013-2014 (1)



- To further develop and improve the different scale models with proper linkage among them (closely related with damage potential mapping in 4-2).
- To develop socio-economic system model to assess and predict the generation and control of environmental stresses in relation to the socio-economic activities in local communities (closely related with 4-5 and 4-6).
- To improve the coastal ecosystem model and apply it for several sites.

Modeling and assessment Subgroup

Plans for 2013-2014 (2)

- To improve the larval dispersal models by introducing the biological parameterization for the larval behavior and proper linkage with a primary ecosystem ocean model (collaboration with Biological Group).
- To develop methodology for identifying the MPA candidate sites with the connectivity matrix analysis and environmental stress mapping. The latter will be performed with the models to be developed in (3-1) and (4-3).
- To deploy cctv cameras at five sites in Boracay Island and, if possible, three sites in Puerto Galera for the continuous monitoring of beach deformation and waves acting on the beach.
- To develop numerical simulation models for analyzing the wave deformation in high wave conditions and associated sediment transport processes in the reef in front of the beach of Boracay (will be related with 4-5).

Continuous
Comprehensive
Monitoring
System
COASTAL ECOSYSTEM CONSERVATION
and ADAPTIVE MANAGEMENT under Local
and Global Environmental Impacts in the
Philippines <www.cecam-project.net>
CECAM

BOLINAO
Date Completed:
September 2011
Date Operated:
October2011

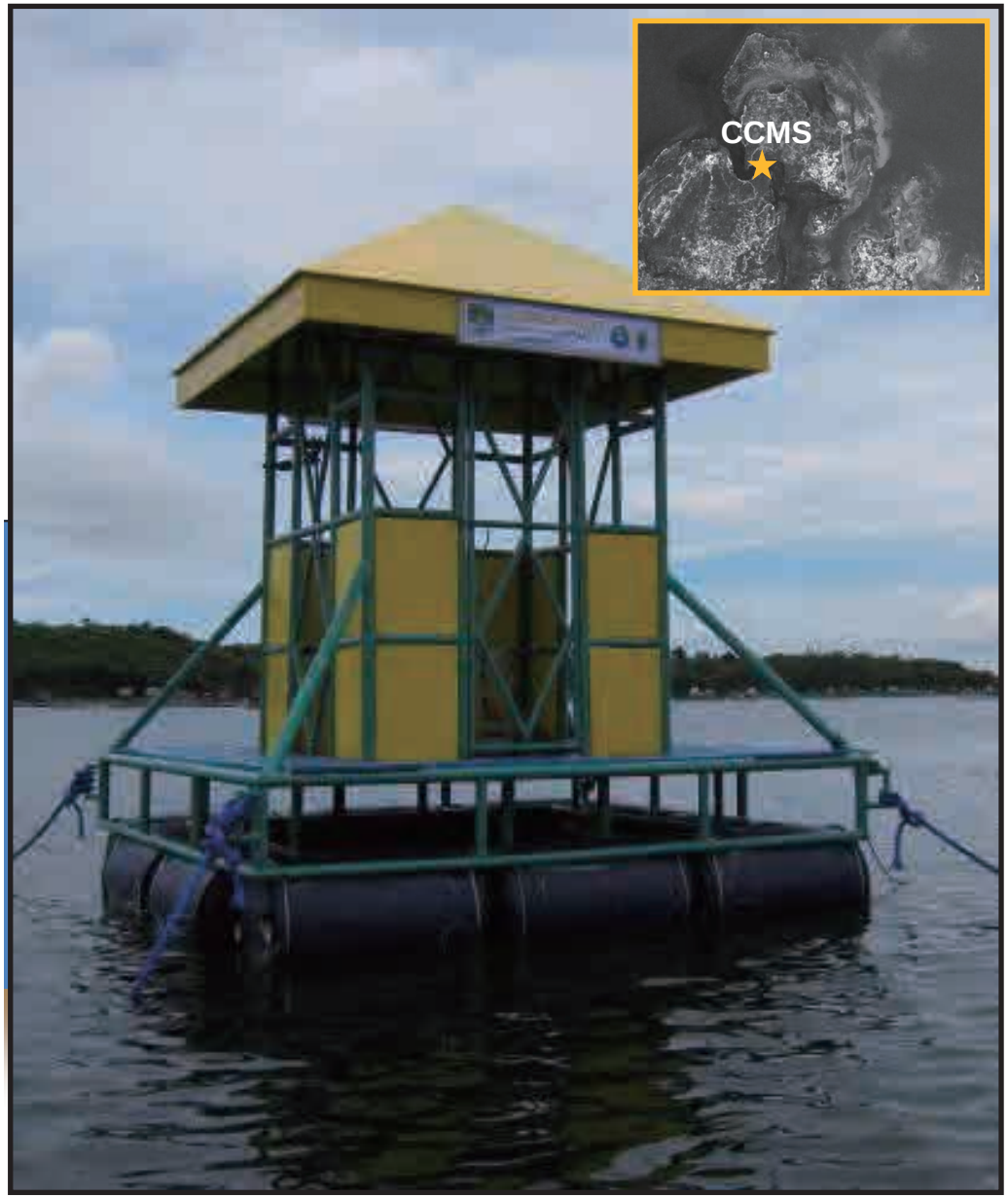
PUERTO GALERA
Date Completed:
January 2012
Date Operated:
February 2012

LAGUNA LAKE
Date Completed:
Temporary: May 2012
Date Operated:
March 2005

LAGUINDINGAN
Date Completed:
Not yet
Date Operated:
Planned in
March 2013

BANATE BAY
Date Completed:
September 2012
Date Operated:
September 2012

BOLINAO CCMS: Aquaculture-side



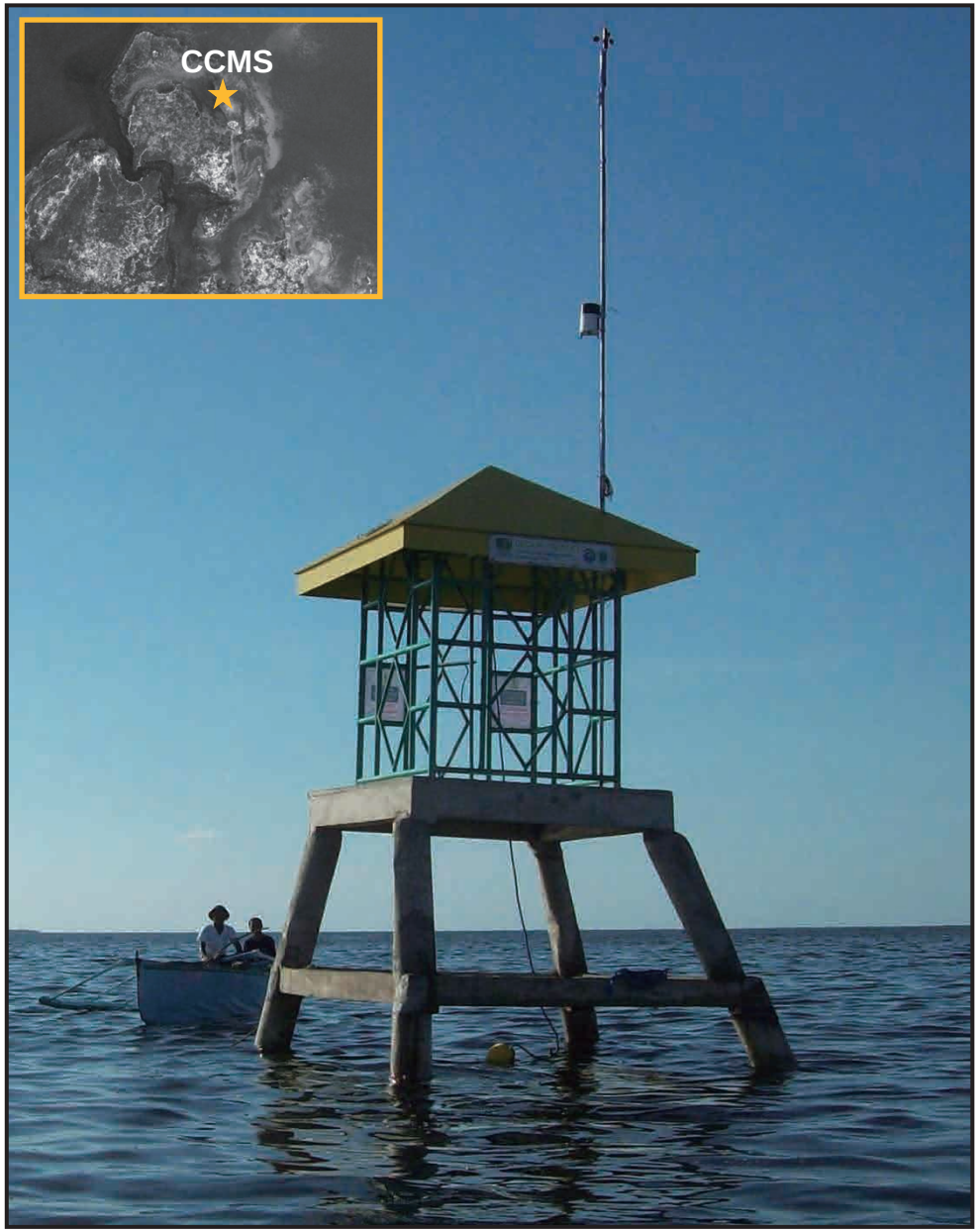
Collaboration:
CECAM Project
and Bolinao LGU

Meteorological

Hydrodynamic ⇔ **Water quality**

Sensor / Instrument	Parameter
Hydrodynamic	
ADCP	Vertical 2D velocity
Water Level Logger	Water depth
Water quality	
Compact-DO	Dissolved oxygen (2)
Infinity CLW	Chlorophyll-a, Turbidity
Infinity-CT	Salinity, Conductivity (2)
Infinity-LW	Light penetration
Water Temp Pros	Water temperature (3)
Meteorological	
Weather station	Rainfall
	Wind speed and direction
	Solar radiation
	Humidity
	Air temperature

BOLINAO CCMS: Reef-side



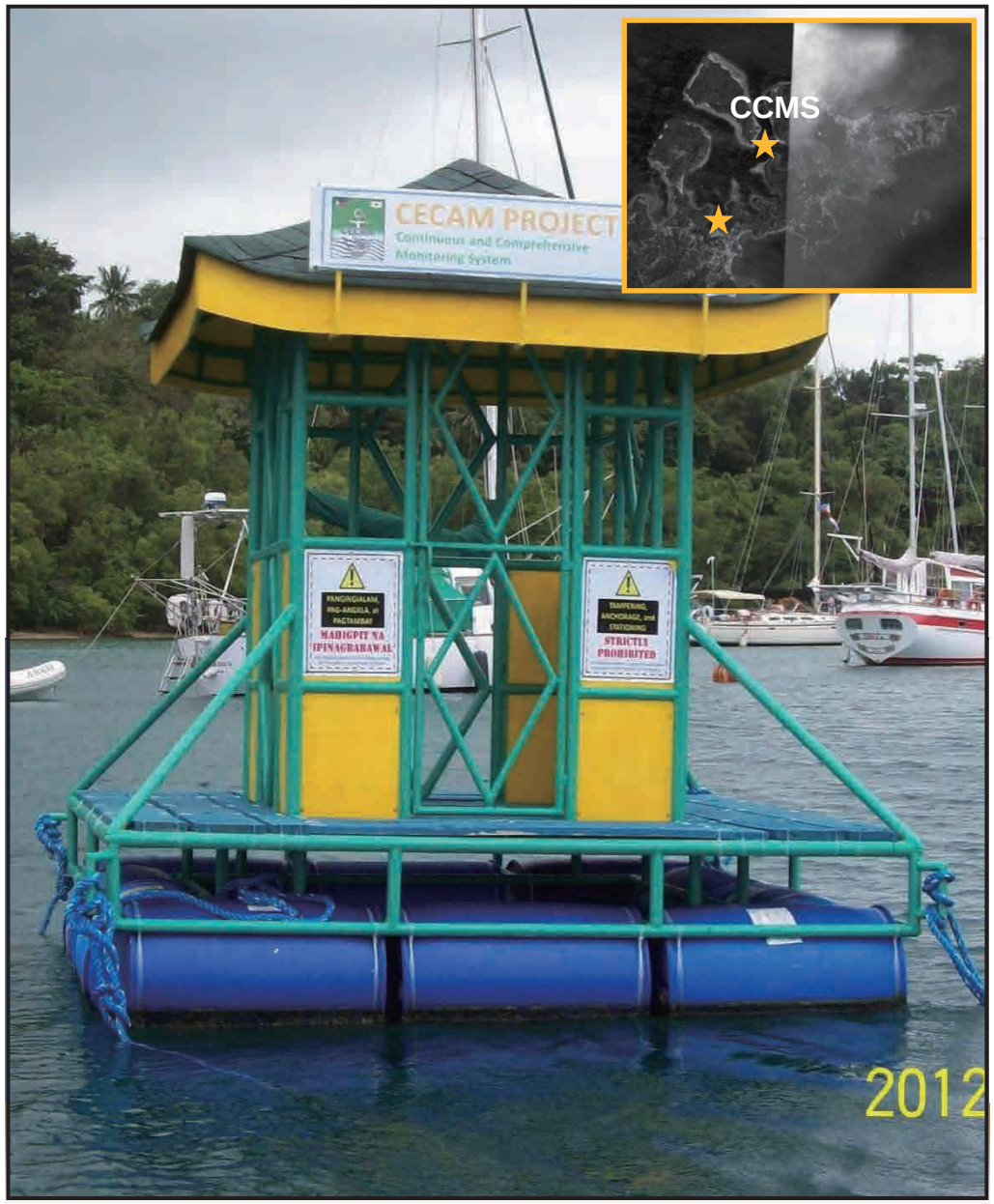
Collaboration:
CECAM Project
and Bolinao LGU

Meteorological

Hydrodynamic ⇔ **Water quality**

Sensor / Instrument	Parameter
Hydrodynamic	
Infinity-EM	2D velocity
Infinity-WH	Water depth, Wave
Water quality	
Compact-DO	Dissolved oxygen
Infinity-CLW	Chlorophyll-a, Turbidity
Infinity-CT	Salinity, Conductivity (2)
Water Temp Pros	Water temperature (2)
Meteorological	
Weather station	Rainfall
	Wind speed and direction
	Solar radiation
	Humidity
	Air temperature

Puerto Galera CCMS: Cove and channel



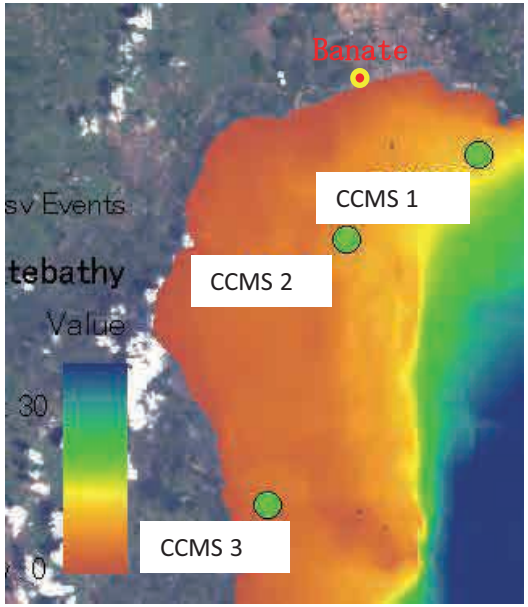
Collaboration: CECAM Project and Puerto Galera LGU

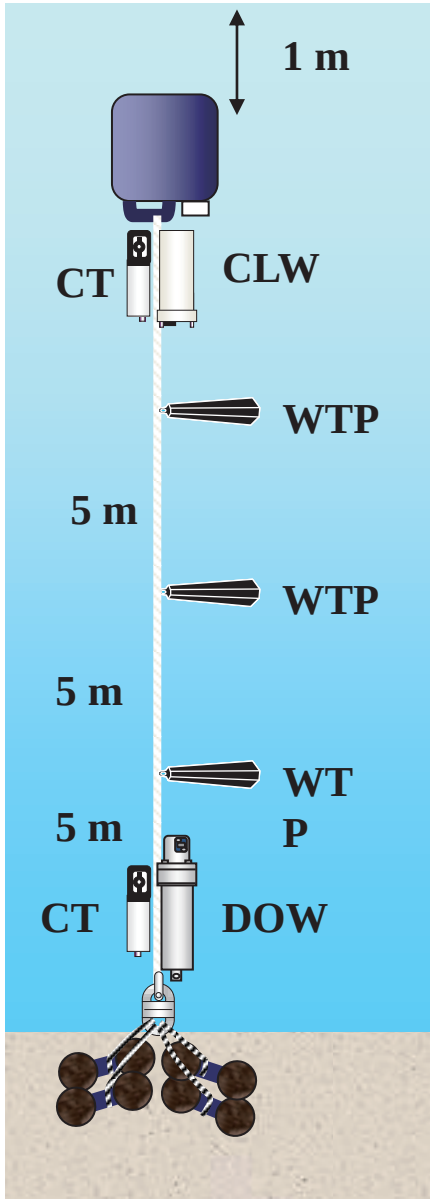
Meteorological

Hydrodynamic ⇔ **Water quality**

Sensor / Instrument	Parameter
Hydrodynamic	
ADCP	Vertical 2D velocity
Water Level Logger	Water depth
Water quality	
Compact-DO	Dissolved oxygen (2)
Infinity CLW	Chlorophyll-a, Turbidity
Infinity-CT	Salinity, Conductivity (2)
Infinity-LW	Light penetration
Water Temp Pros	Water temperature (3)
Meteorological	
Weather station	Rainfall
	Wind speed and direction
	Solar radiation
	Humidity
	Air temperature

Banate Bay CCMS: Moored deployment





Collaboration: CECAM Project and BanateLGU

Meteorological

Hydrodynamic ⇔ **Water quality**

Changed mode of deployment

- Mooring-type deployment of sensors instead of platform-type. Three (3) stations instead of one (1) only.

Sensor status

- Initial set of sensors already procured. Additional set under negotiation with JICA.

Deployment

- September 2012 before the intensive survey. Proper LGU coordination and caretaker selection already conducted.

➡ On-going data collection since Sep. 2012.

Banate Bay CCMS: Moored deployment

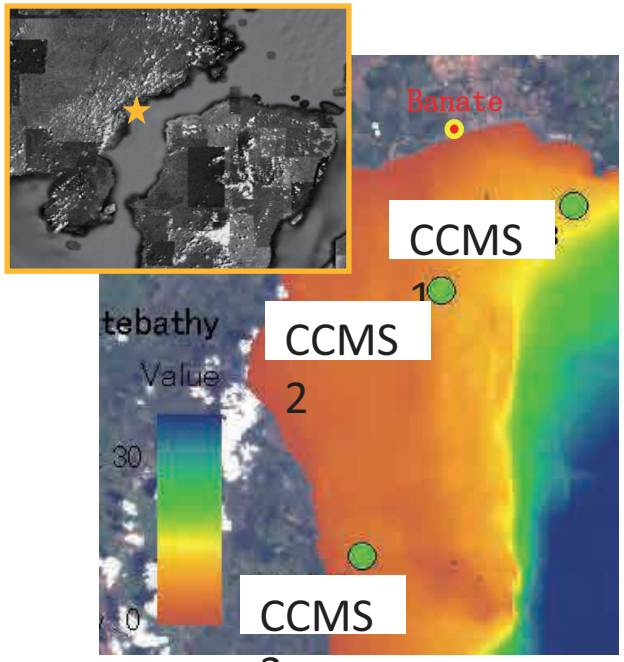
Collaboration:
CECAM Project
and BanateLGU

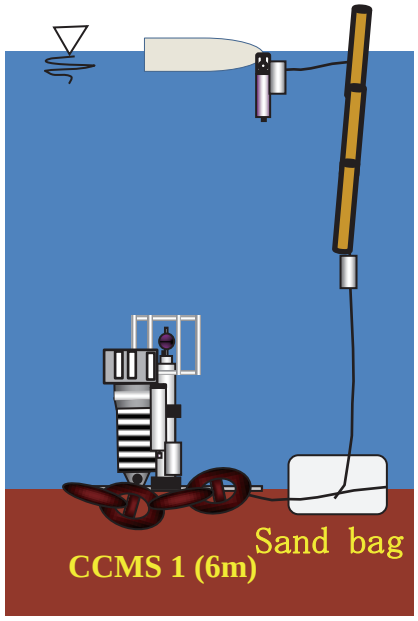
Meteorological

Hydrodynamic ⇔ **Water quality**

Moored deployment

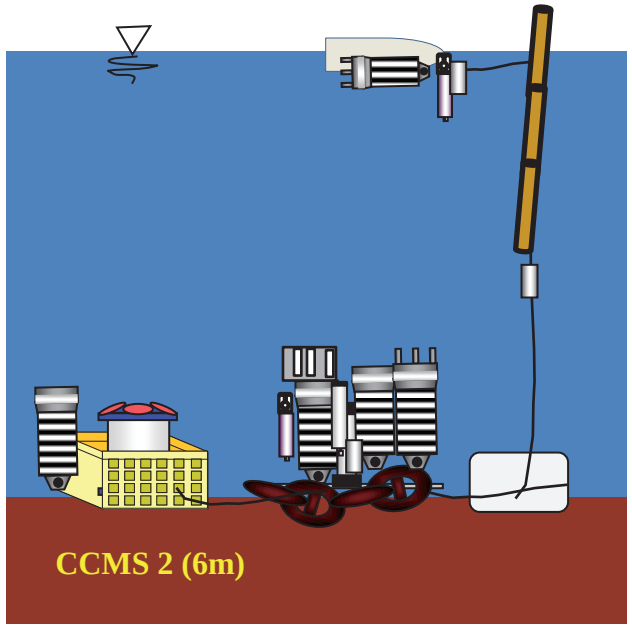
Mooring-type deployment of sensors (3 stations) instead of platform-type to cover wider study area.



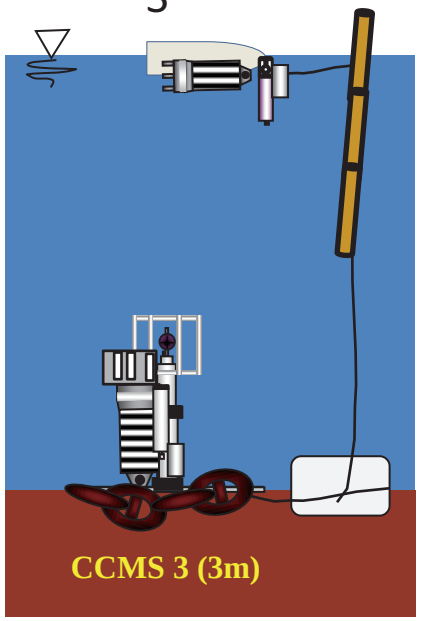


Surface
Salinity
Temp.

Bottom
Temp.
DO
Velocity
Tide



Surface
Salinity
Turbidity
Temp.
Bottom
Salinity
Turbidity
Temp.
DO
Velocity
Light
Wave

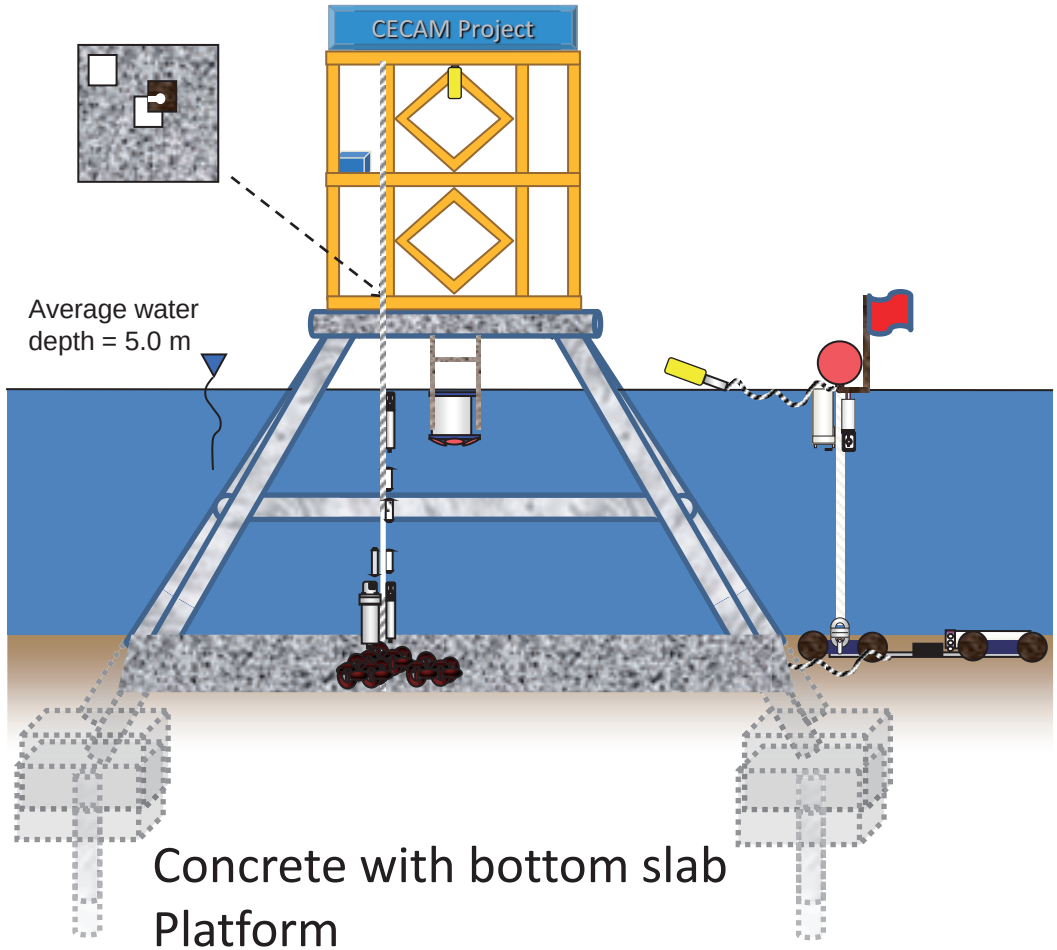


Surface
Salinity
Turbidity
Temp
Bottom
Temp
DO
Velocity
Tide

Laguna Lake CCMS

Proposed ideas

• Concrete platform with a wide slab base for stability



Collaboration: CECAM Project and LLDA

Meteorological

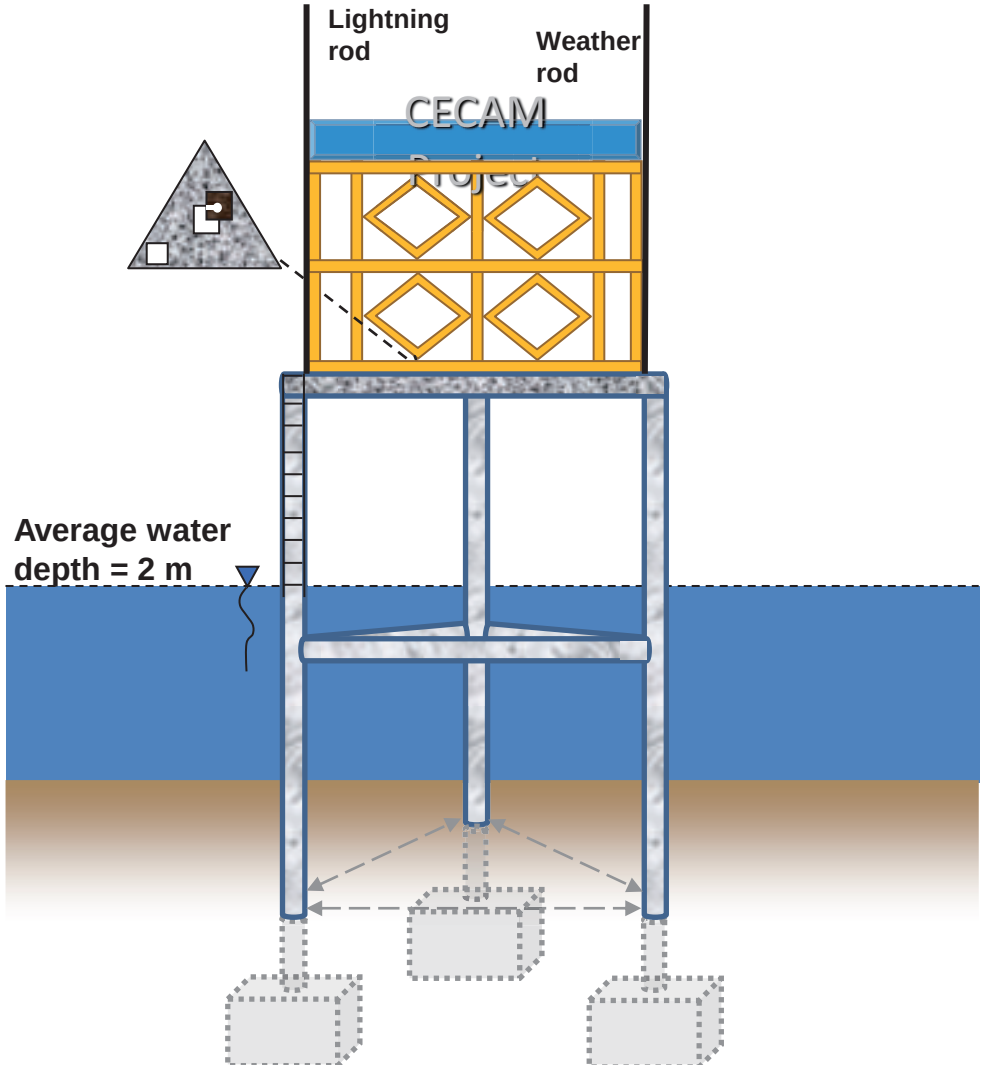
Hydrodynamic ⇔ **Water quality**

Sensor / Instrument	Parameter
Hydrodynamic	
ADCP	2D velocity
Compact-WH	Wave height
Water Level Logger	Water depth
Water quality	
Compact-DO	Dissolved oxygen
Compact-CL	Chlorophyll-a, Turbidity
Compact-CT	Salinity, Conductivity
Water Temp Pros	Water temperature
Meteorological	
Weather station	Rainfall
	Wind speed and direction
	Solar radiation
	Humidity
	Air temperature

Laguindingan CCMS: Fixed, concrete-type

Proposed idea

• 3-column concrete platform in a shallow area (around 2 m)



Collaboration: CECAM Project and Laguindingan LGU

Meteorological

Hydrodynamic ⇔ **Water quality**

Sensor / Instrument	Parameter
Hydrodynamic	
Compact-EM	1D velocity
Water Level Logger	Water depth
Water quality	
Compact-DO	Dissolved oxygen (2)
Infinity CLW	Chlorophyll-a, Turbidity
Infinity-CT	Salinity, Conductivity (2)
Infinity-LW	Light penetration
Water Temp Pros	Water temperature (3)
Meteorological	
Weather station	Rainfall
	Wind speed and direction
	Solar radiation
	Humidity
	Air temperature