(EAS Congress 2018, Iloilo, Nov 28, 2018)

KQ2: How do we manage the key factors that influence the blue carbon stock in the East Asian Seas?

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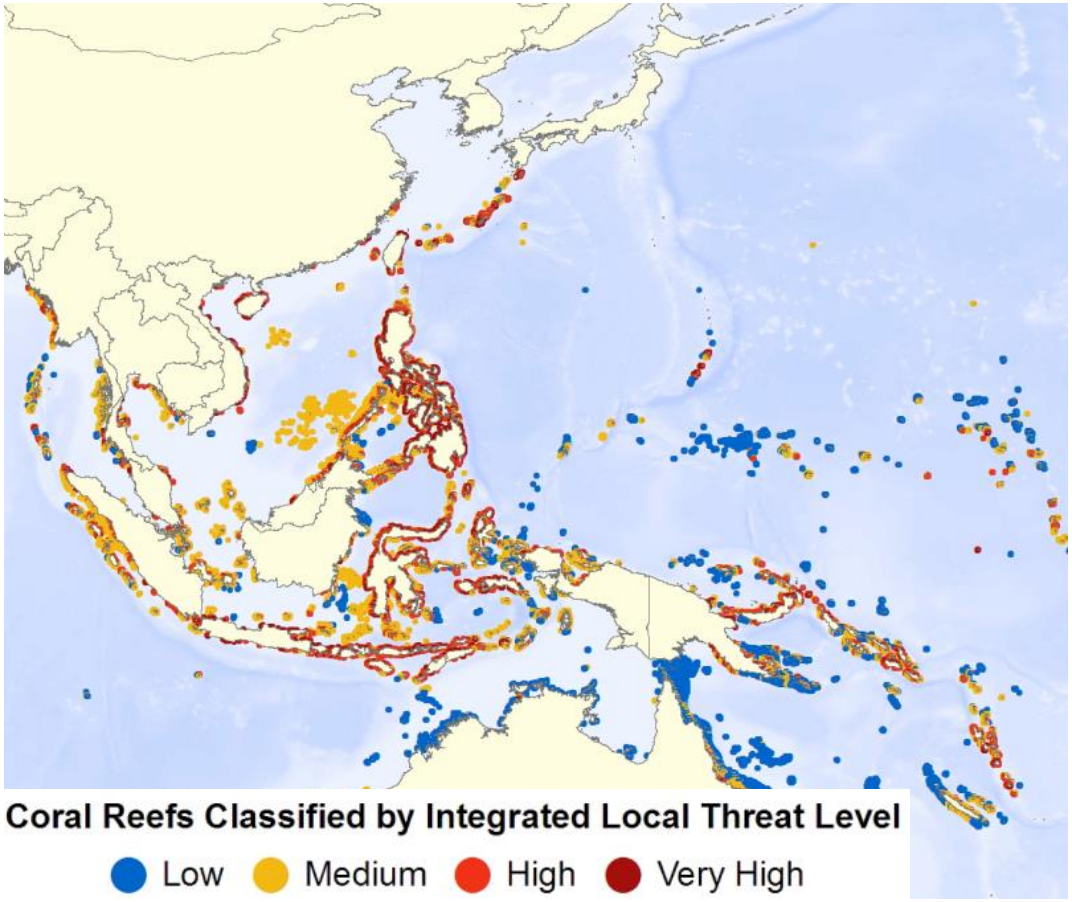
Tokyo Institute of Technology

Coral triangle as highly threatened coastal area



(WRI., 2012, etc.)

High population pressure in coastal zones

local

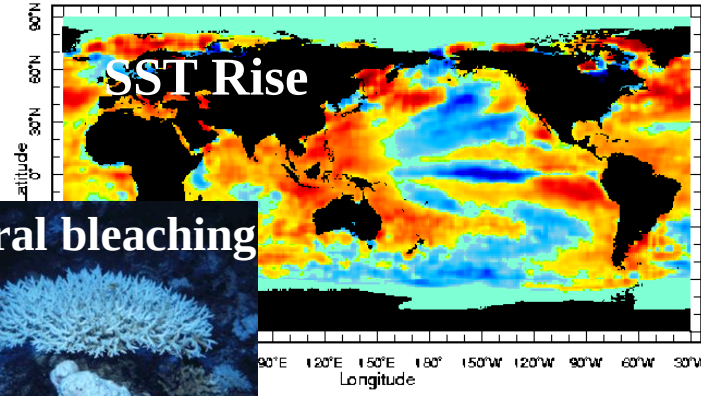
Various land-based loads, unsustainable tourism development, excessive & destructive fisheries, etc.

\+ *global*

Climate change

- **More than 85% of reefs are rated as threatened, with 45% at high or very high risk**
- **Mangroves have lost 70% of their cover in the last 70 years**
- **Seagrass bed loss ranges from 20-60% in the last 50 years**

Multiple Environmental stresses



Watershed

Mangroves

Unsustainable
Tourism development

Ocean
acidification

Over/destructive
fishing

Ocean

SLR

Seagrass Bed

Coral Reef

Outbreak of COTS

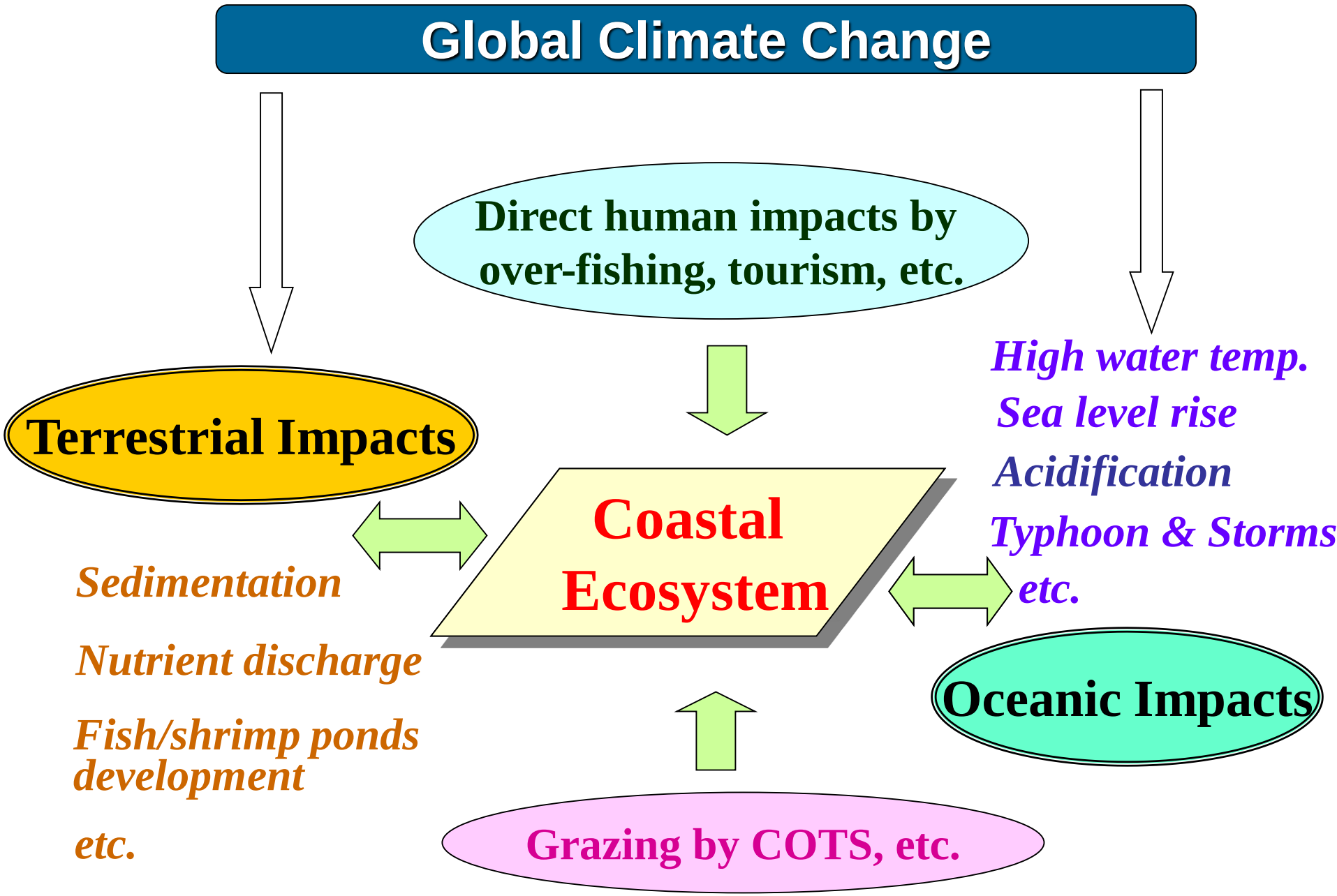
Chronic stresses:

- Sedimentation/ siltation
- Excessive nutrient discharge
- Pesticide/ herbicide/ bacteria
- SLR, water temp increase
- Ocean acidification, *etc*.

Episodic disturbances:

- Massive coral bleaching
- COTS outbreak
- Typhoons/cyclones/hurricanes
- Tsunami, *etc.*

Chronic stresses may exacerbate some episodic disturbances!


Global Climate Change
Direct human impacts by over-fishing, tourism, etc.
Terrestrial Impacts
High water temp.
Sea level rise
Acidification
Typhoon & Storms
etc.
Coastal Ecosystem
Sedimentation
Nutrient discharge
Fish/shrimp ponds development
etc.
Oceanic Impacts
Grazing by COTS, etc.

Mangrove deforestation between 2000 and 2012

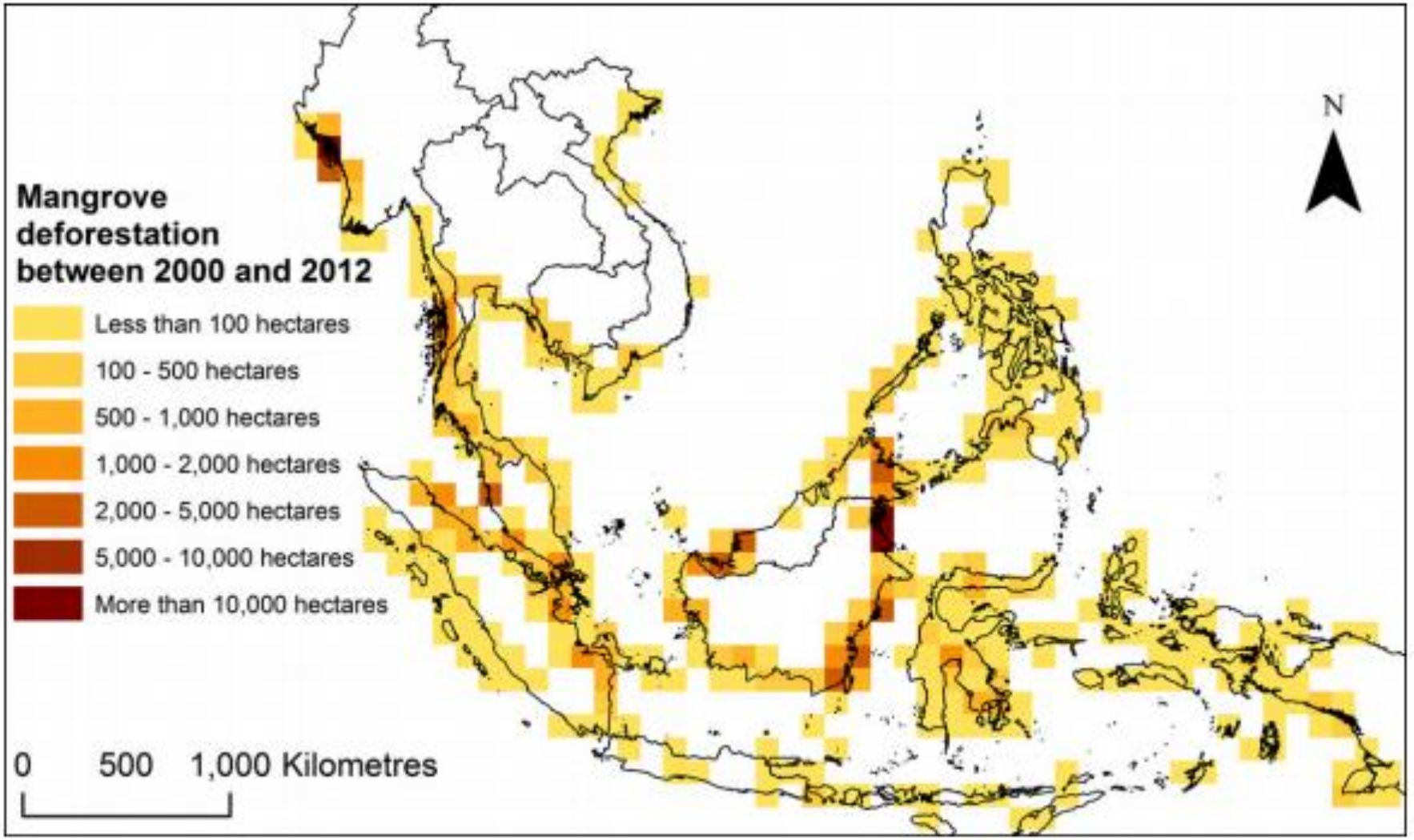


Fig. 1. Mangrove deforestation between 2000 and 2012. Deforestation is summarized within each 1 decimal degree square.

(Richards and Friess, 2016, PNAS)

Dominant land uses of deforested areas in 2012

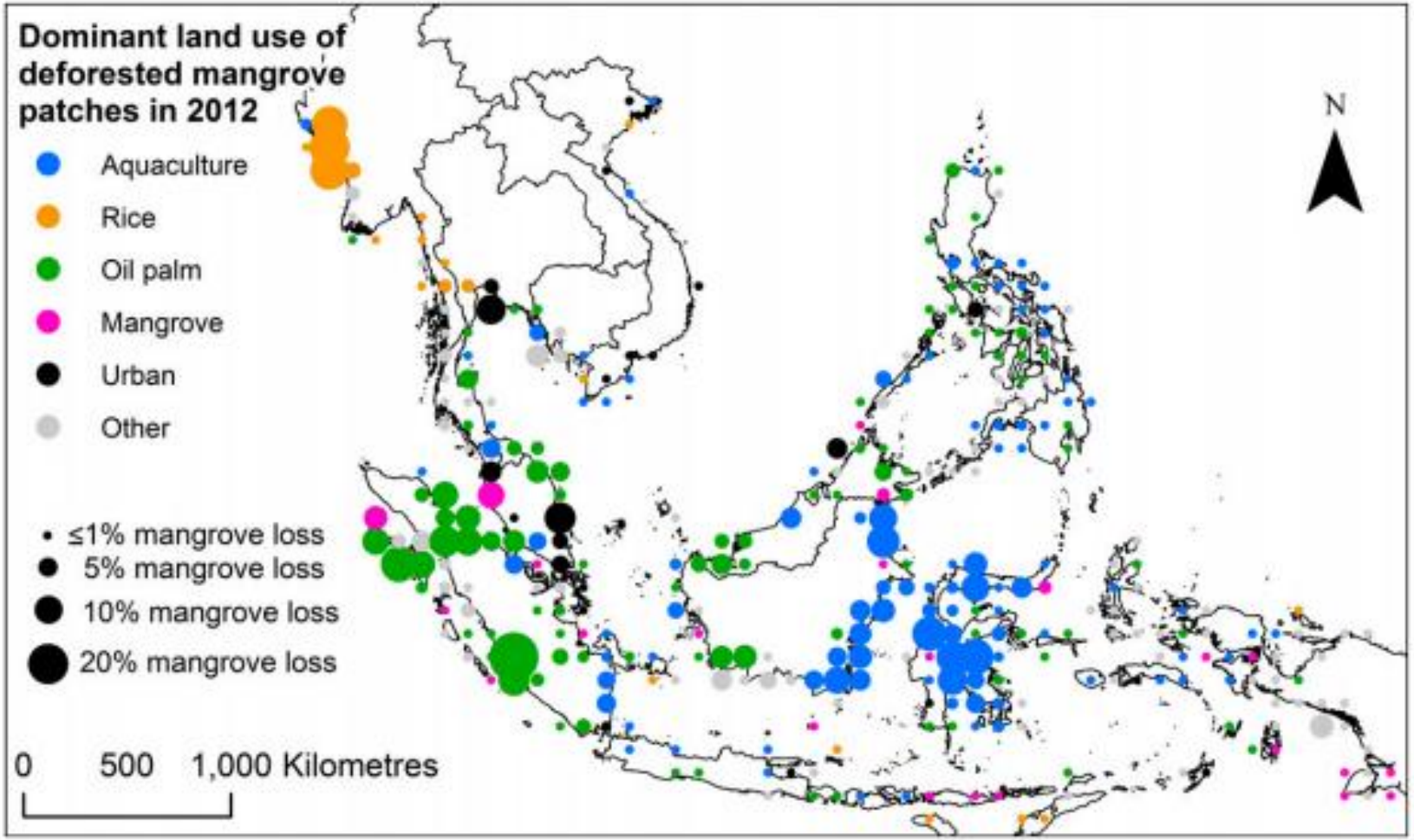


Fig. 2. Percentage mangrove deforestation between 2000 and 2012, and dominant land uses of deforested areas in 2012. Land uses are summarized as the converted land use with the greatest area within each 1 decimal degree grid square. Circles are located in the center of each grid square, and circle size represents the percentage of the mangrove area in 2000 that has been lost.

(Richards and Friess, 2016, PNAS)

Fallen mangrove trees caused by Typhoon Haiyan (2013)

Calauit Island, Busuanga (April 23, 2017)

How much intensified in mangrove gaps by future bigger typhoons?

⇩

Risk assessment/prediction of mangrove damages under super typhoon

What should we know as "BC"?

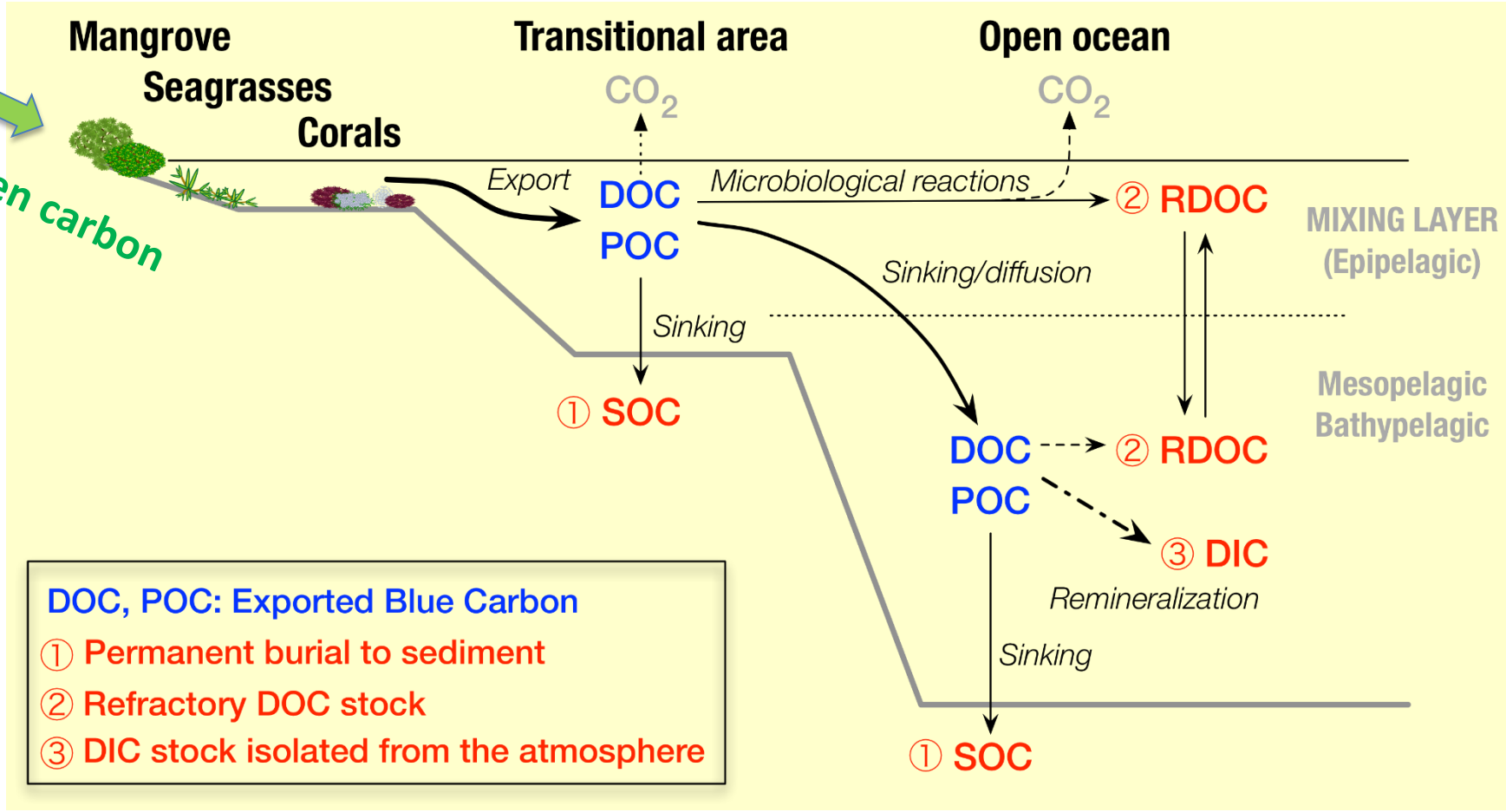
BC stock

BC stock change dynamics under changing environments

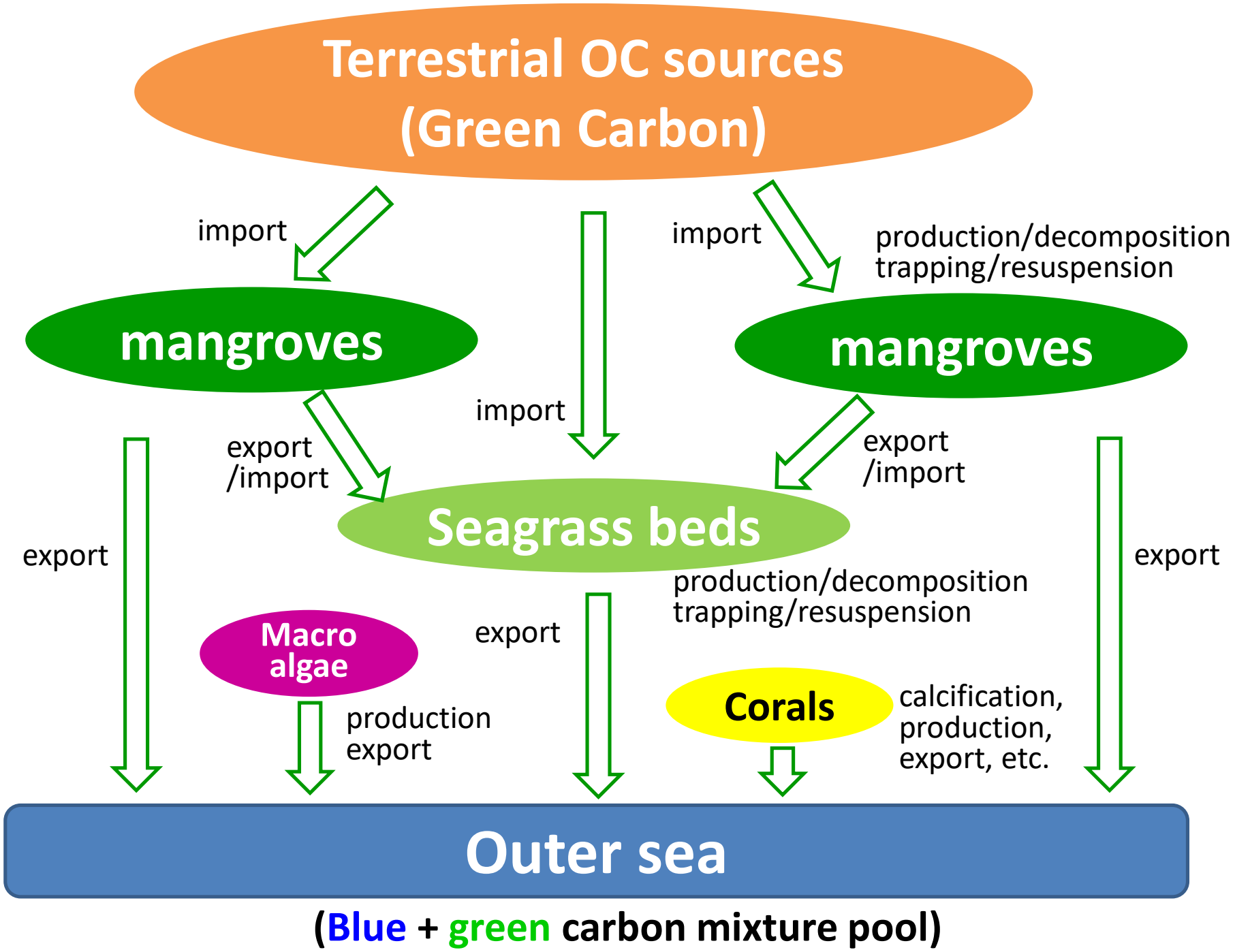
Example: Seagrasses around Panay Island have largely been lost by siltation caused by deforestation in the uplands, etc.

Major pathways of blue-carbon sequestration to the outer ocean

(Based on the figure by T. Miyajima)



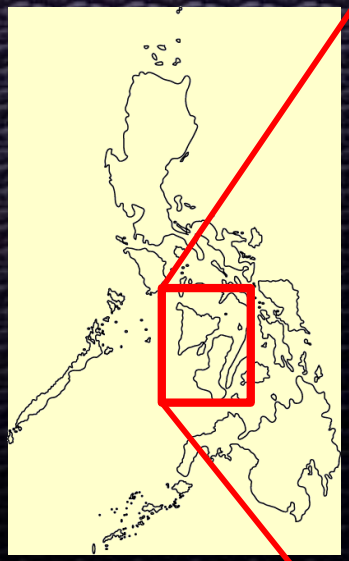
More extensive scope is needed for accurate understanding of blue carbon dynamics!

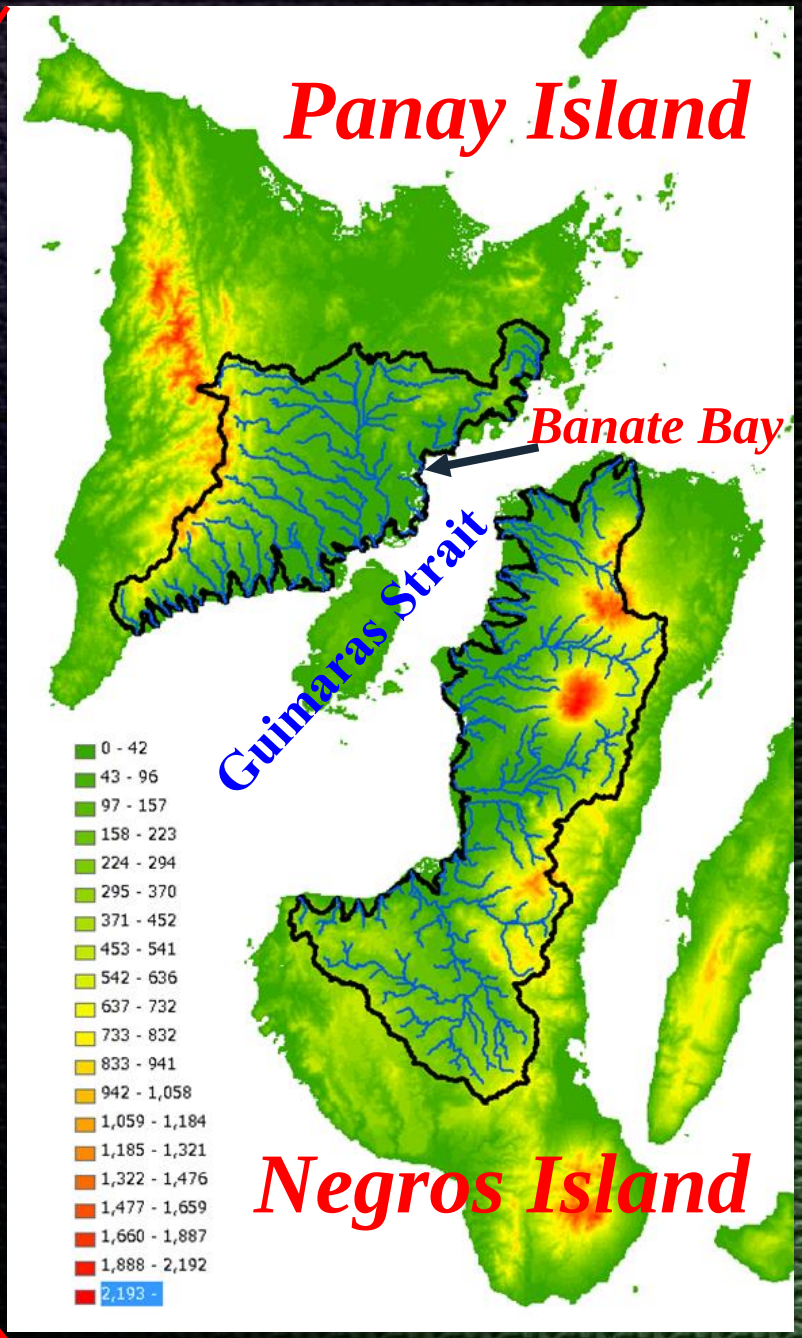

Terrestrial OC sources
(Green Carbon)
import
import
production/decomposition
trapping/resuspension
mangroves
mangroves
import
export
/import
export
/import
Seagrass beds
export
export
production/decomposition
trapping/resuspension
Macro
algae
export
Corals
calcification,
production,
export, etc.
production
export
Outer sea
(Blue + green carbon mixture pool)

"Green + Blue" Approach

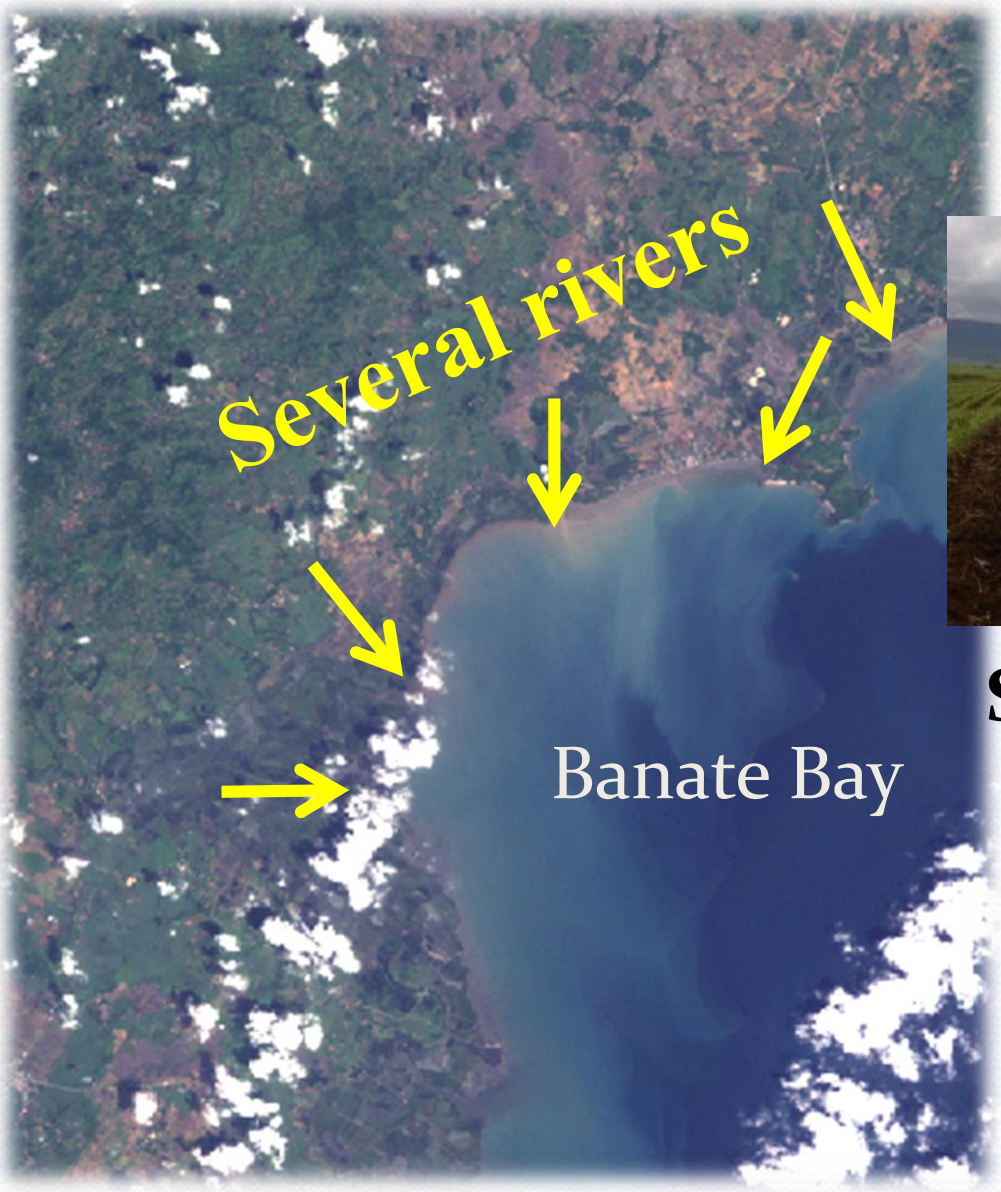
- **For properly understanding the BC ecosystem dynamics, especially its changes due to terrestrial impacts**
- **For implementing proper conservation and restoration policies/actions**

Philippines





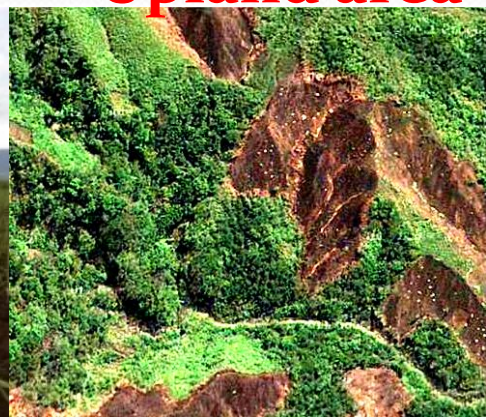
High Turbidity in Banate Bay & its Possible causes



Sources of sediments

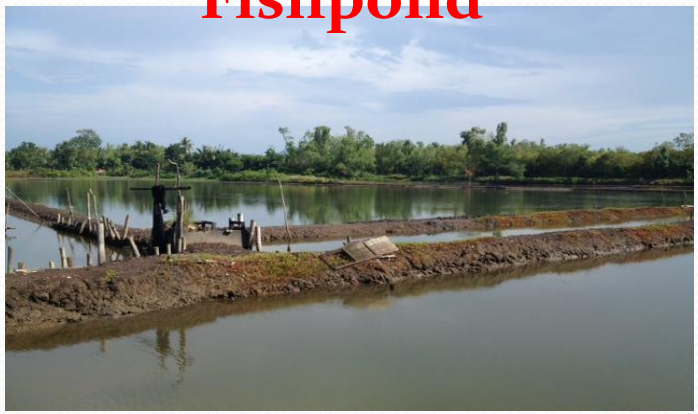
Farmland

Upland area

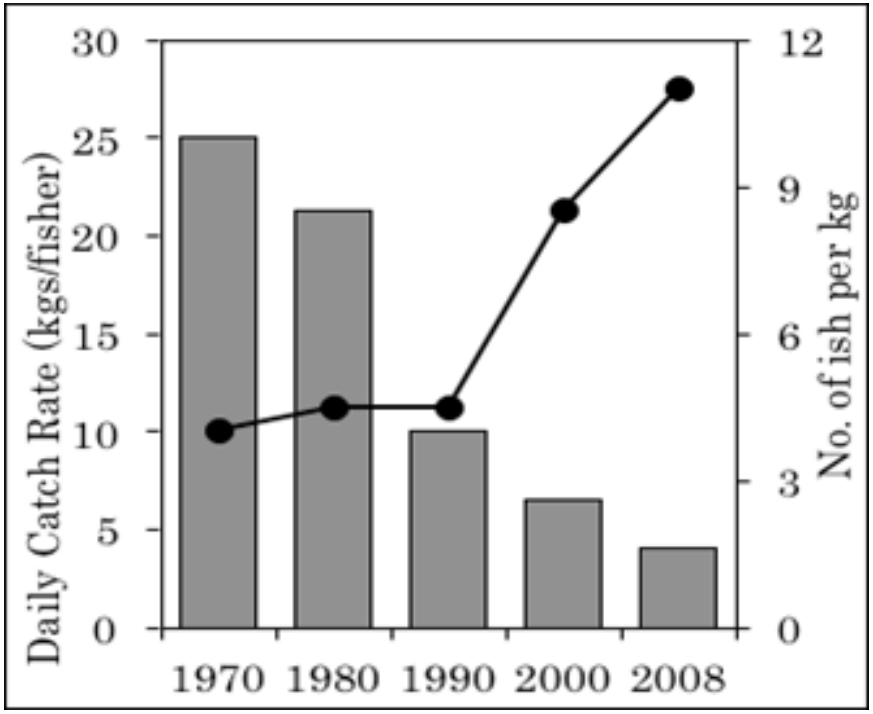


Source of organic matters

Fishpond



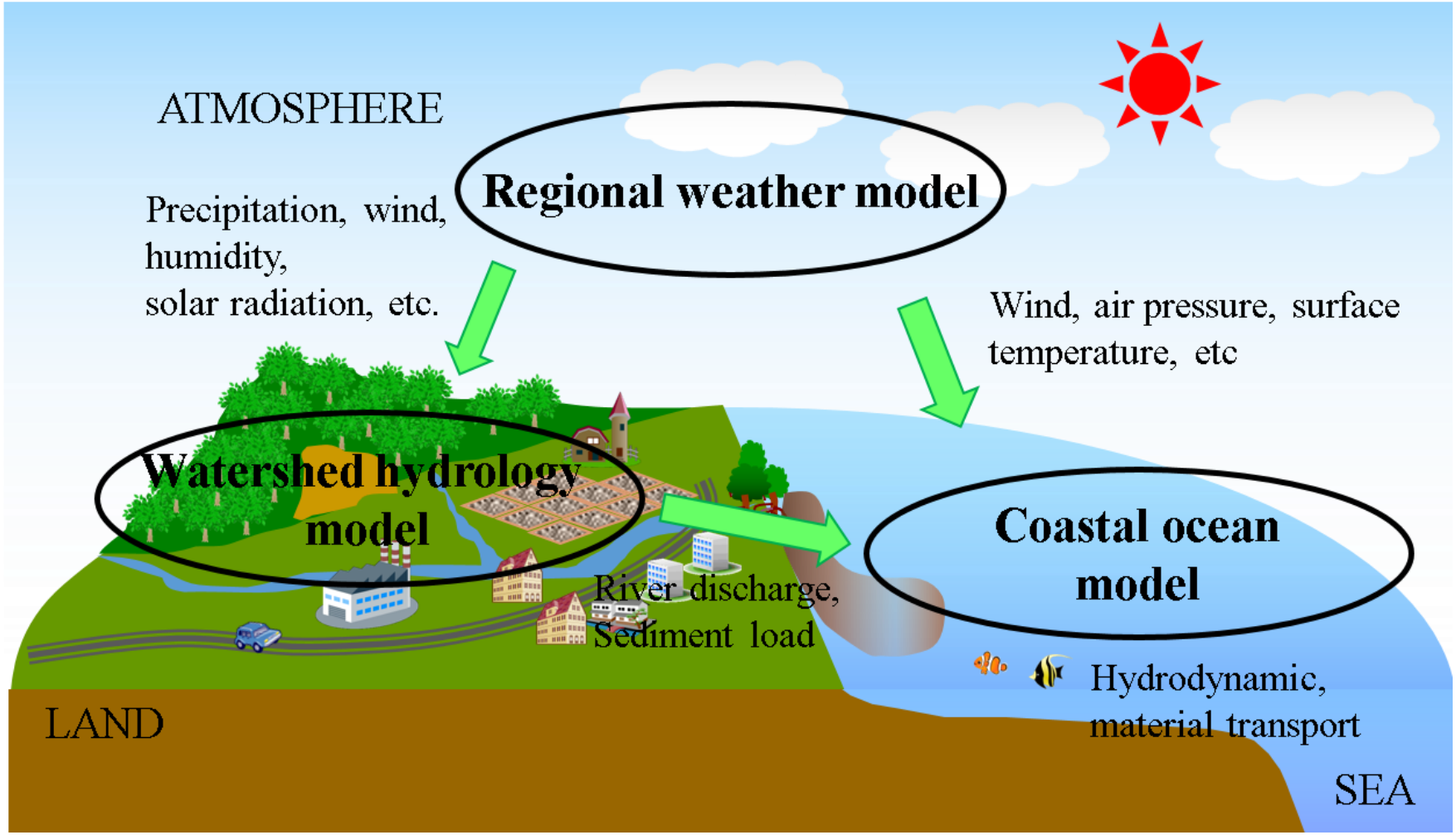
Fish catch decline



(BBBRMCI, 2008)

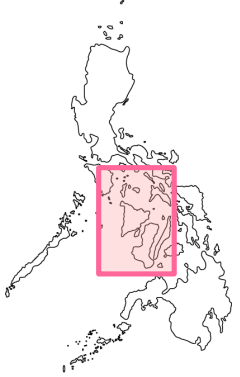
- Recent fish catch decline by 80% compared to that in 1970's.
- In contrast, number of fish per unit weight increased.

“Atmosphere-Land-Coastal-Ocean” coupling model

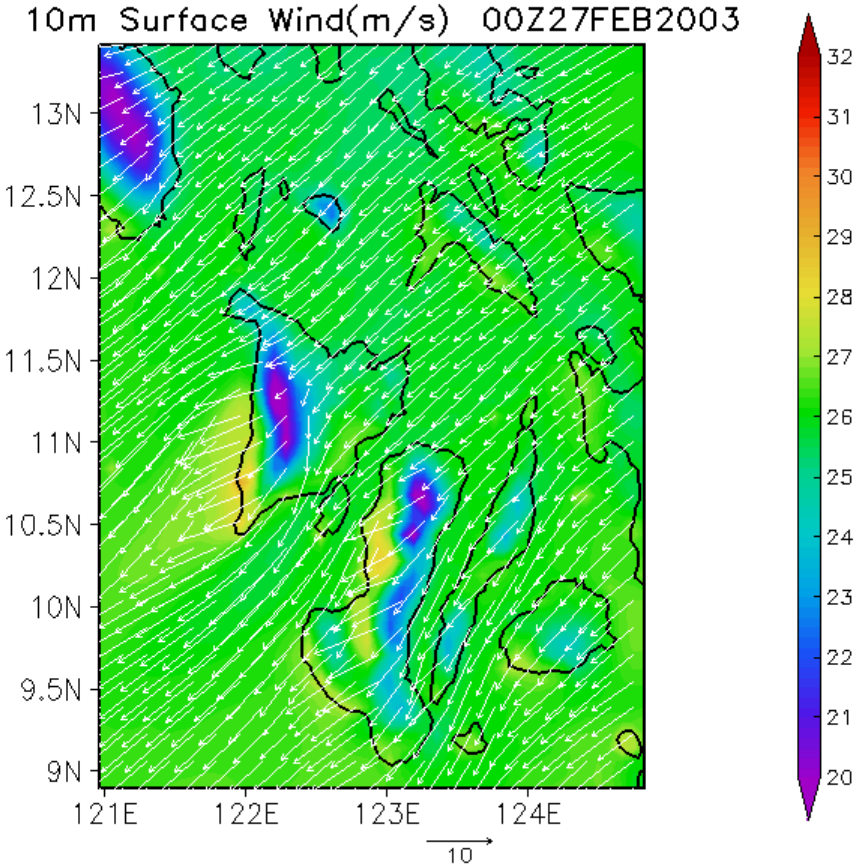


(Yamamoto and Nadaoka, 2018)

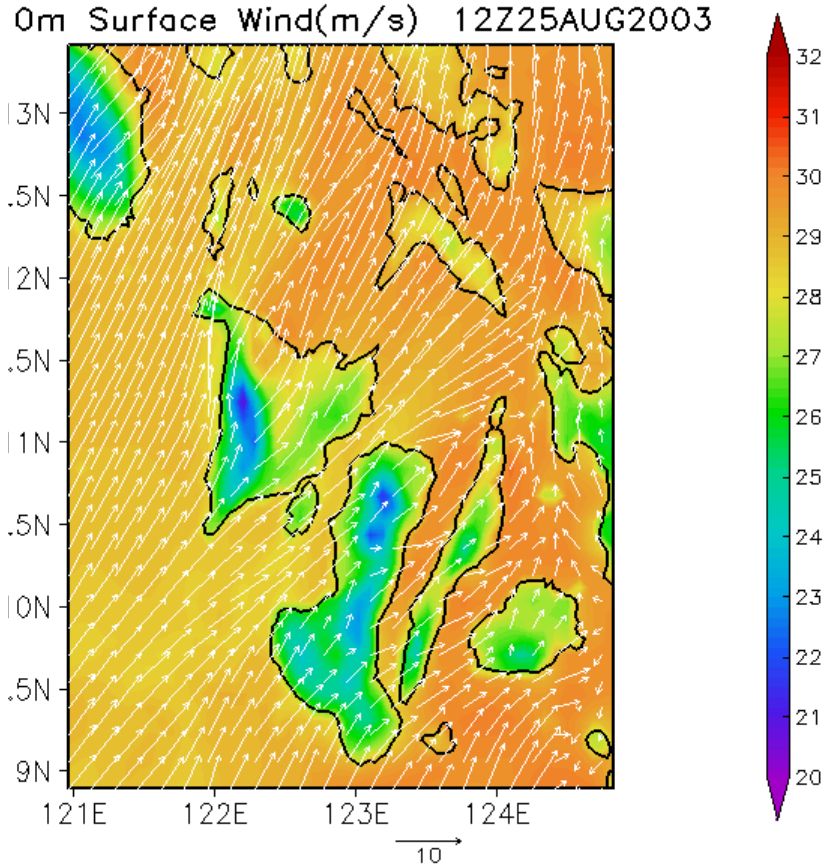
Atmospheric model outputs



10m surface wind & 2m surface air temperature

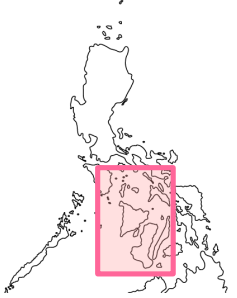


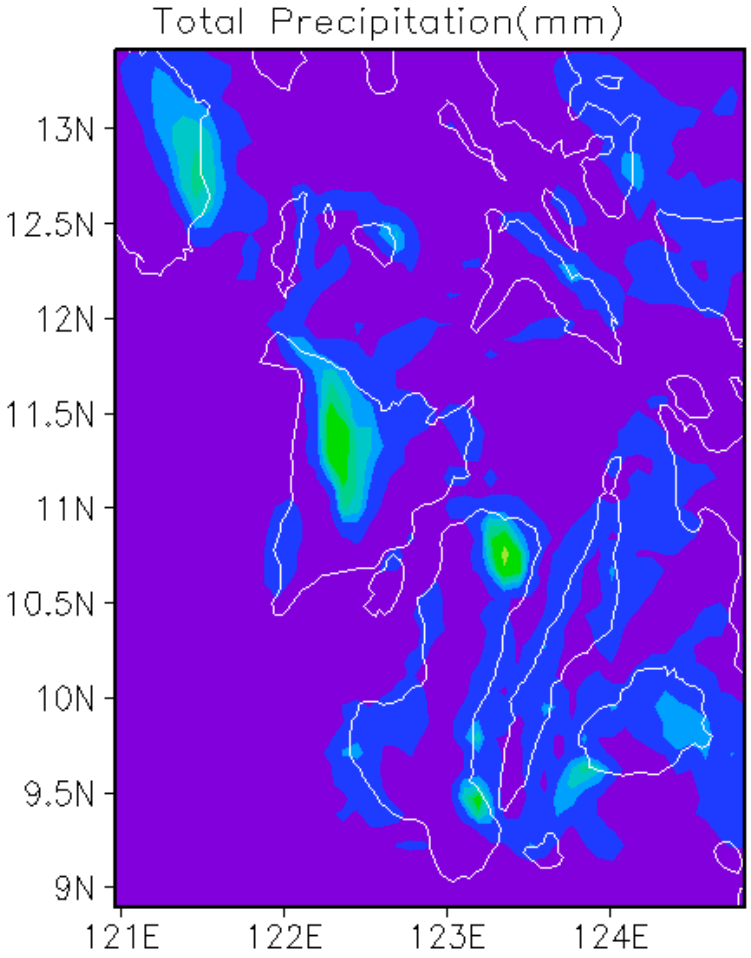
February 2003

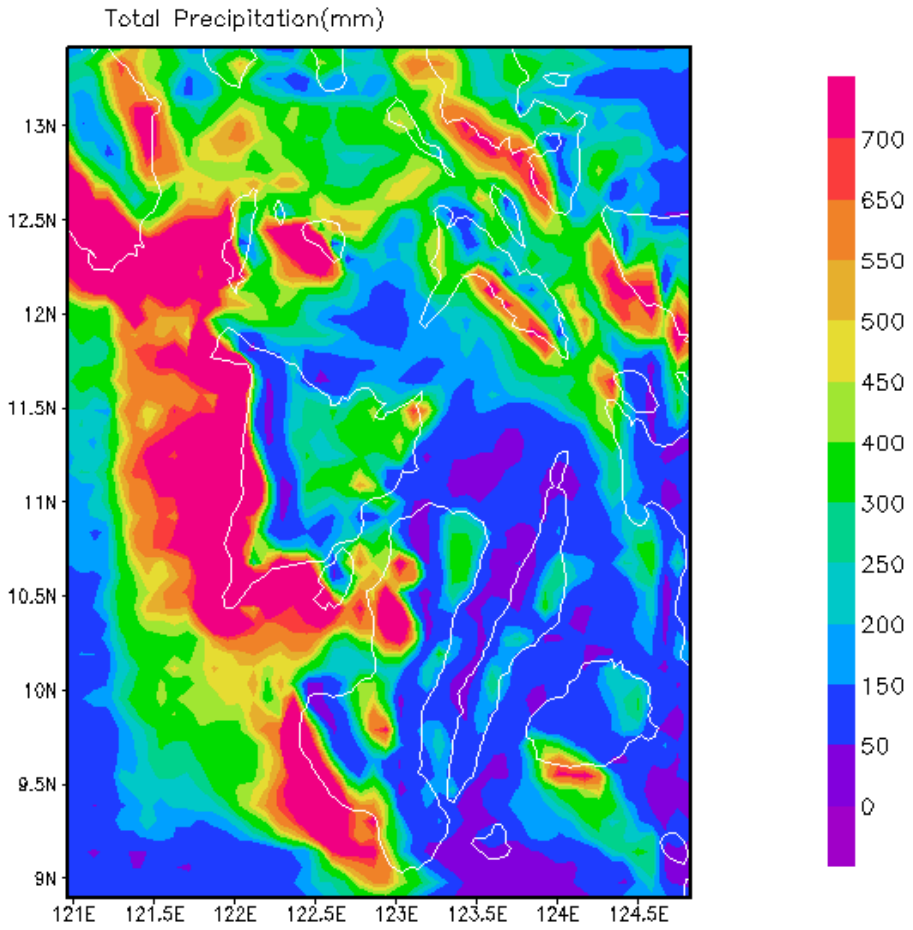


August 2003

Seasonal and spatial variation in atmospheric condition







Monthly rainfall (March 2003)

(September 2002)

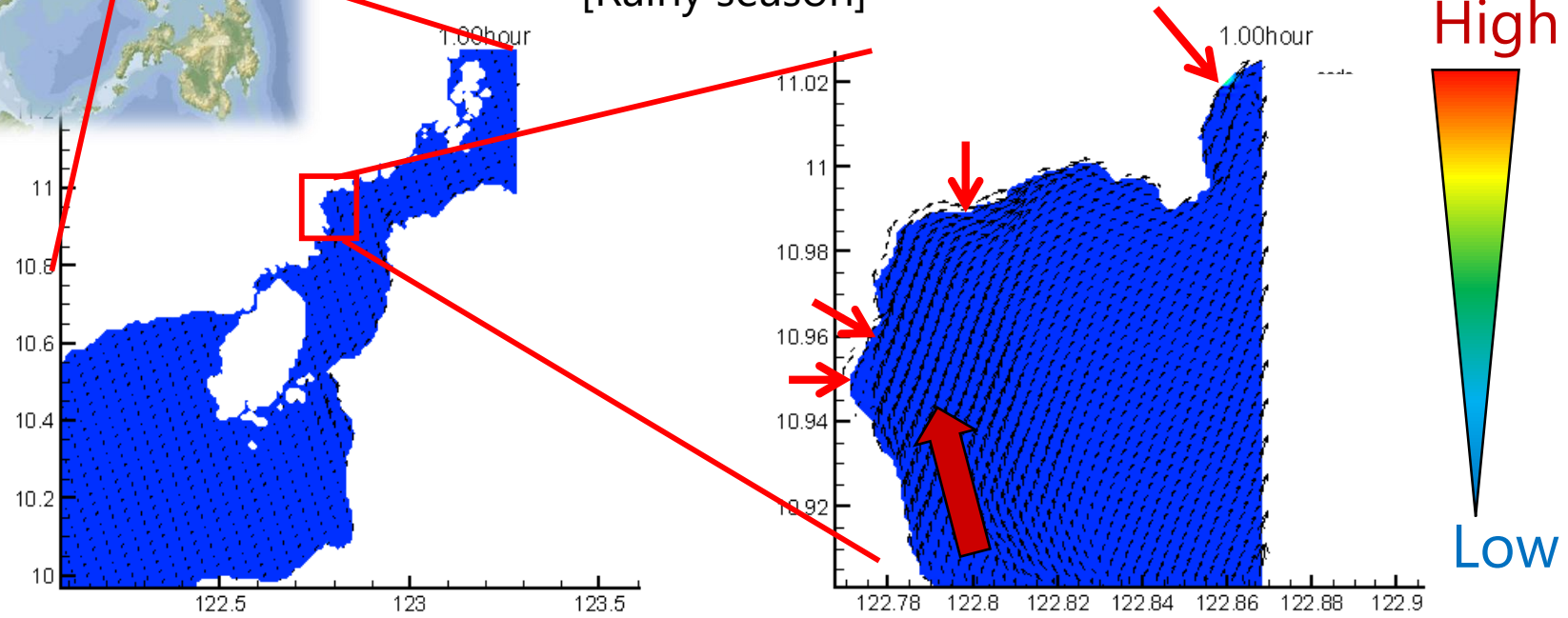
Dynamic atmospheric data affect hydrology in watersheds.

Sediment Transport simulation

Sediment transportation by current

Sediment is originated not only from the adjacent rivers, but also from outside the Bay.

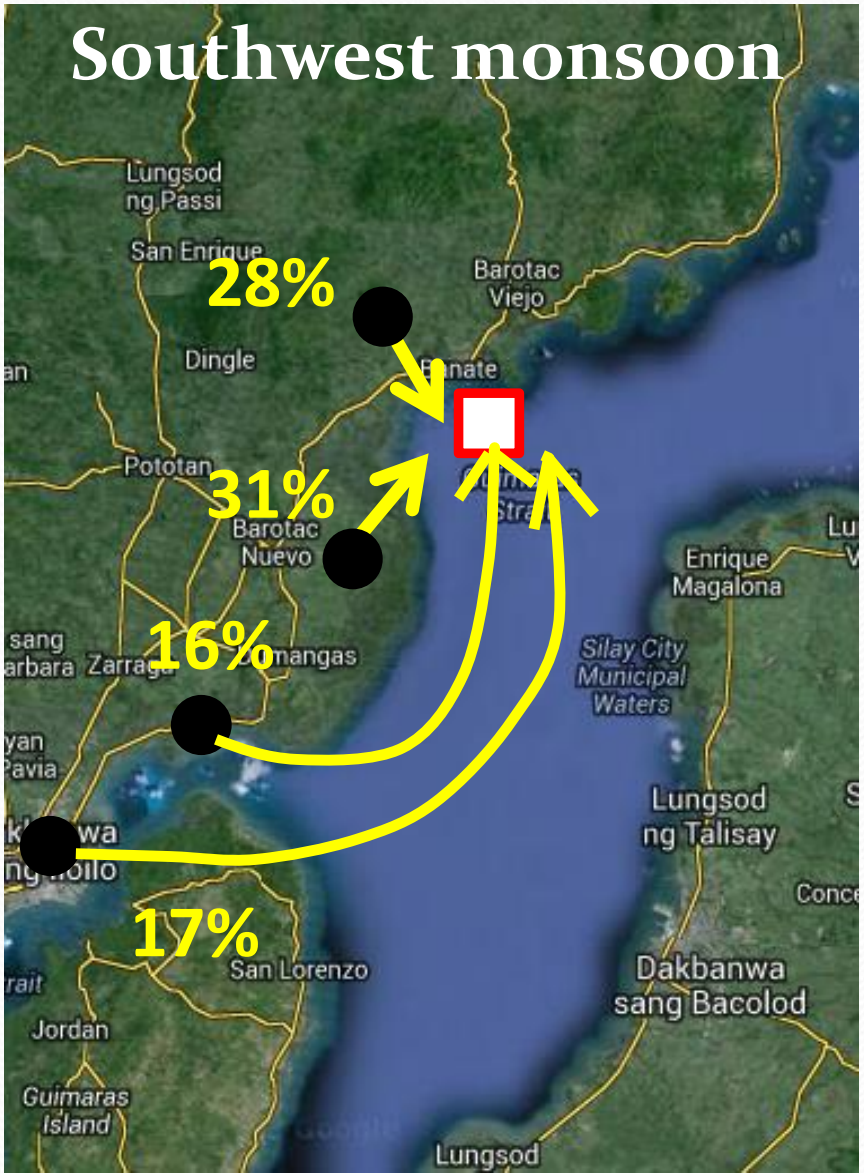
[Rainy season]

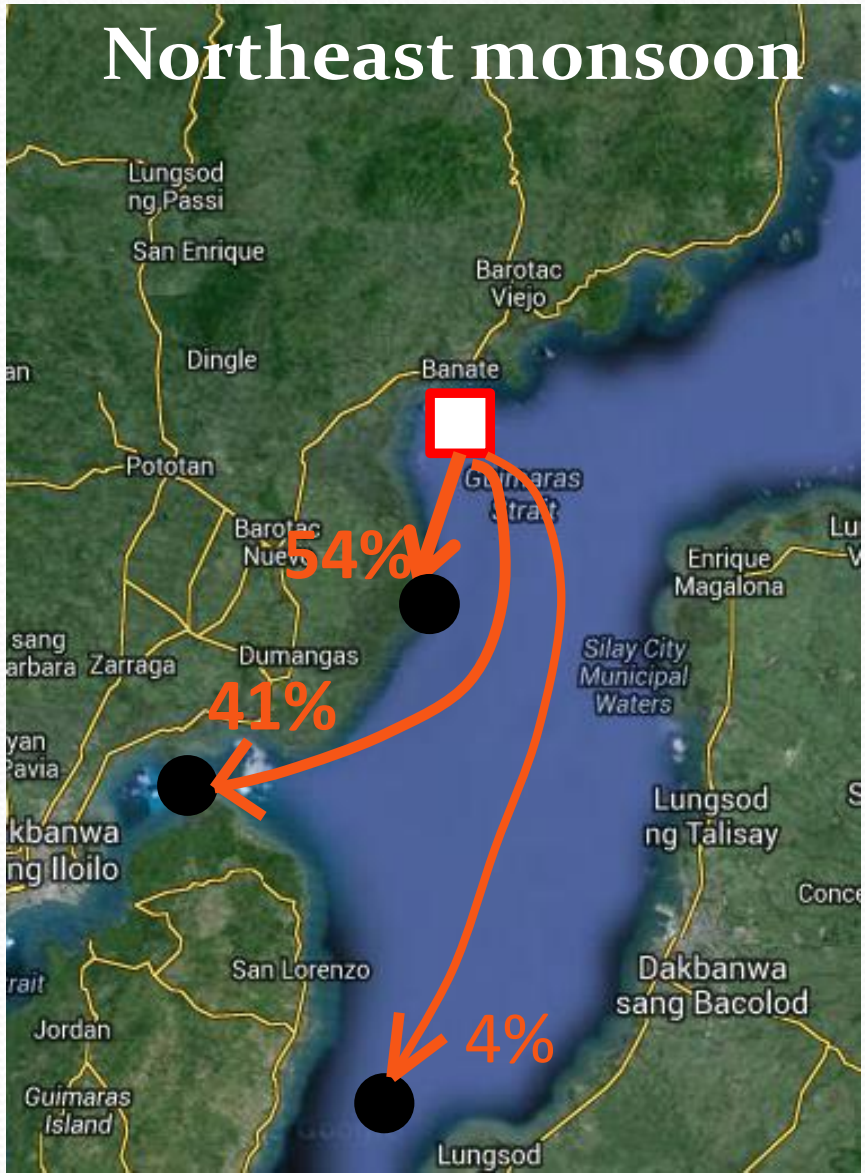


Sediment transport in Guimaras Strait and Banate Bay

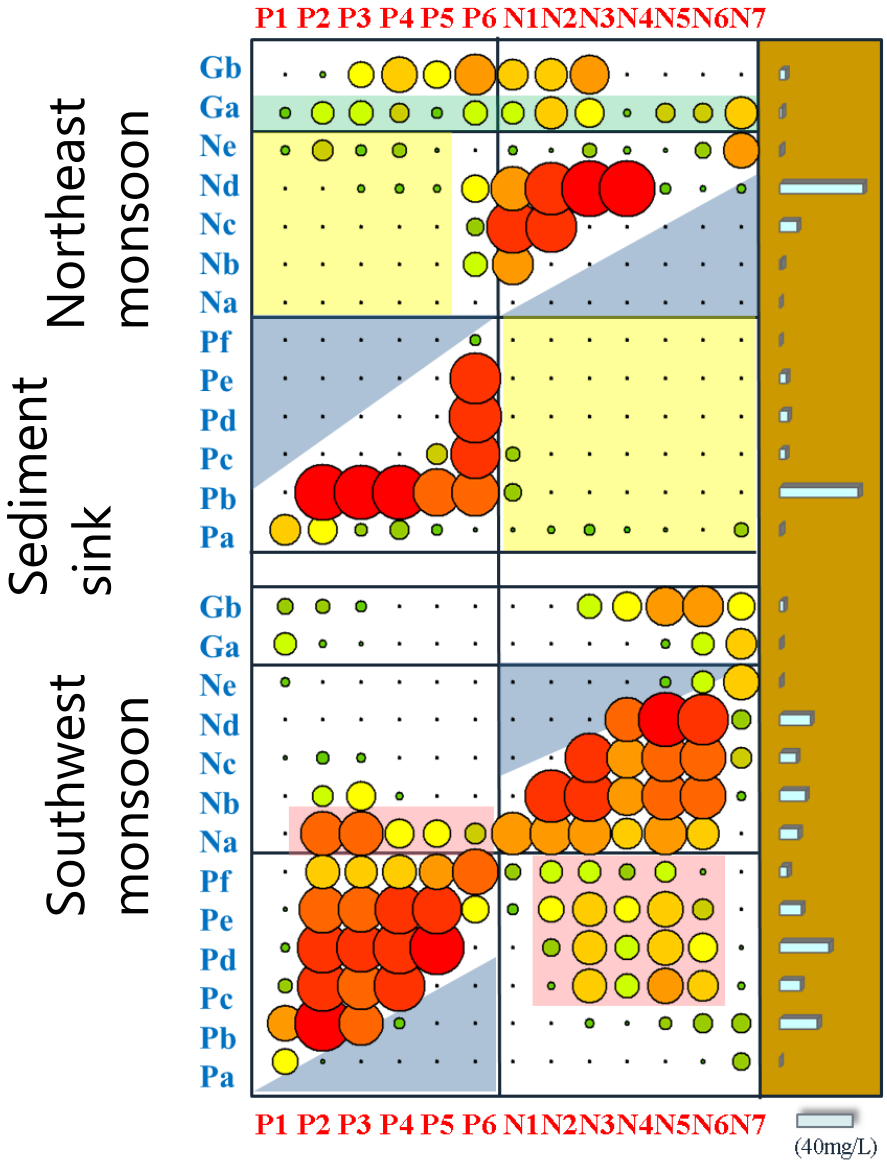
We need to take into account the environmental loads from the Strait-scale multiple watersheds!

Banate Bay as Source and Sink of Sediments

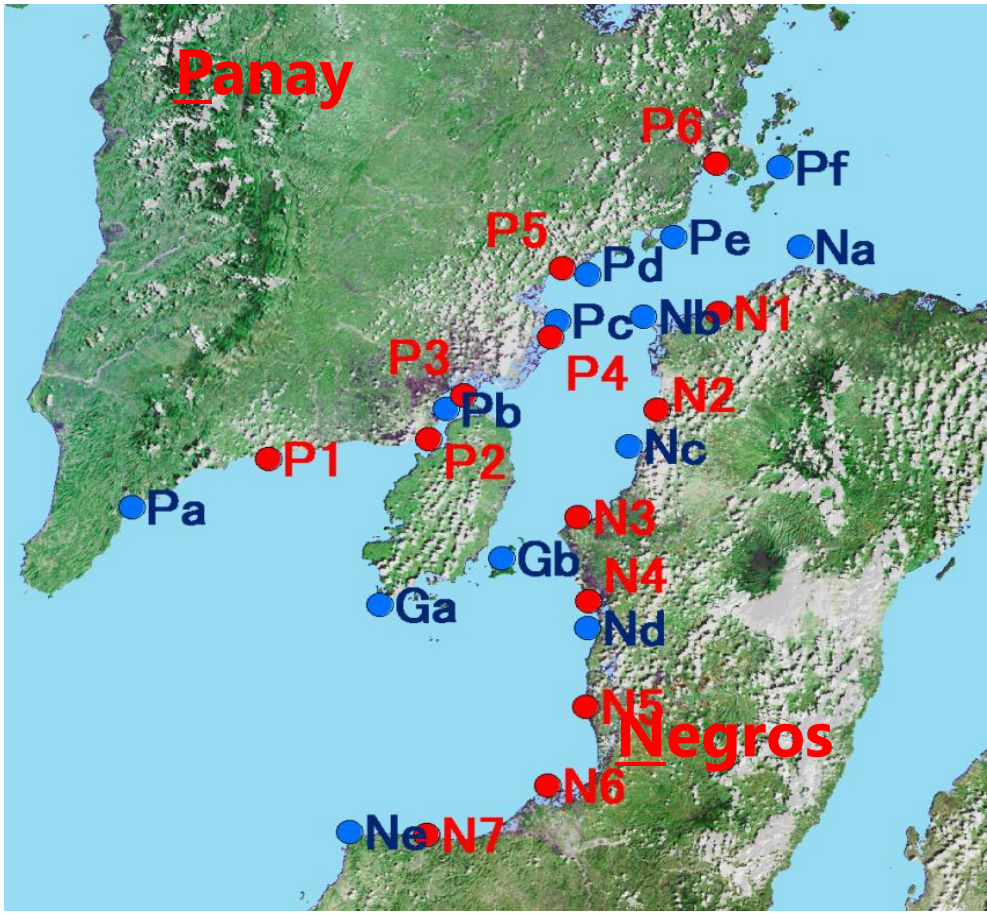




"Stress Connectivity Matrix"

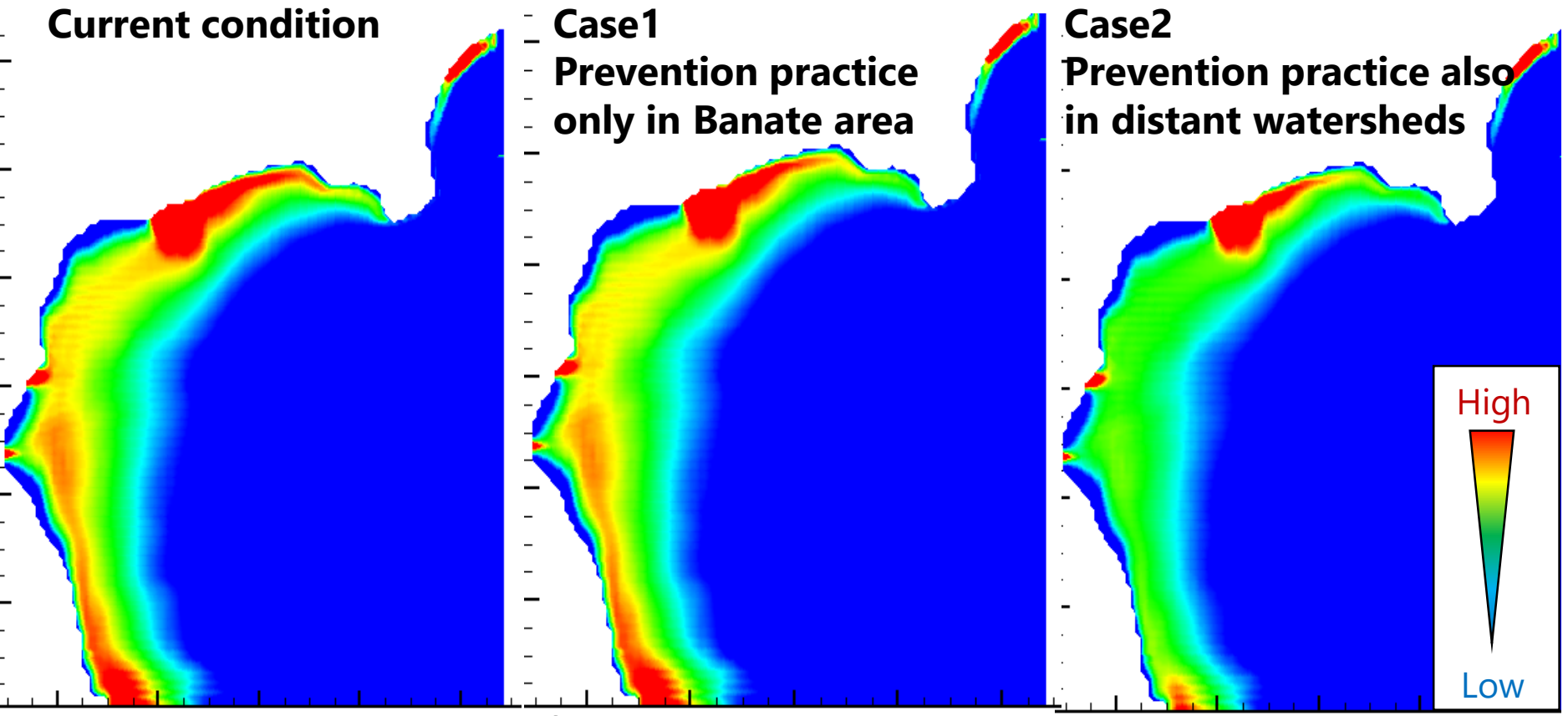


Sediment source (River mouth)



Useful for expressing complicated Strait-scale connectivity of stresses

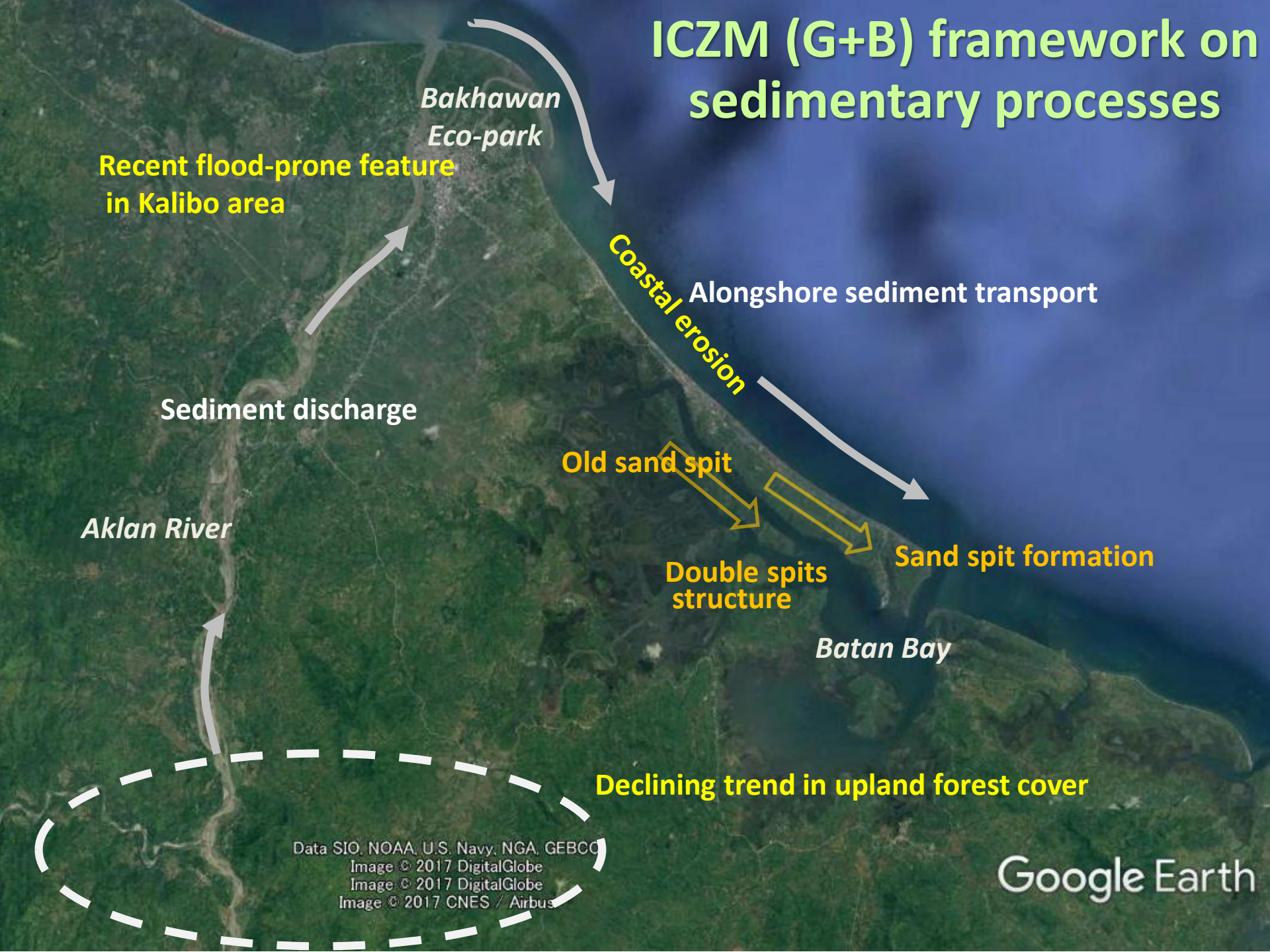
Enhanced Improvement by Introducing a Soil Erosion Prevention Practice in Strait-scale Integrated Watersheds



Average turbidity for one month during a rainy season

Need of implementing "inter-watershed" initiative for effectively reducing turbidity


Thank you!


ICZM (G+B) framework on sedimentary processes
Bakhawan Eco-park
Recent flood-prone feature in Kalibo area
Coastal erosion
Alongshore sediment transport
Sediment discharge
Old sand spit
Aklan River
Sand spit formation
Double spits structure
Batan Bay
Declining trend in upland forest cover
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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Google Earth


Bakwahan Eco-park
Sediment supply
Accretion area
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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