UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

Pilot study report

Global Dialogue on Ocean Accounting
November 12-15 2019

ZHAO Peng
China

Global Ocean Accounts Partnership

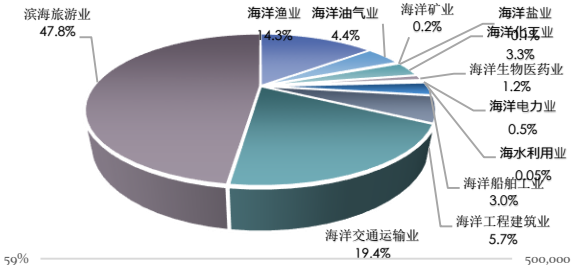
System of Environmental Economic Accounting

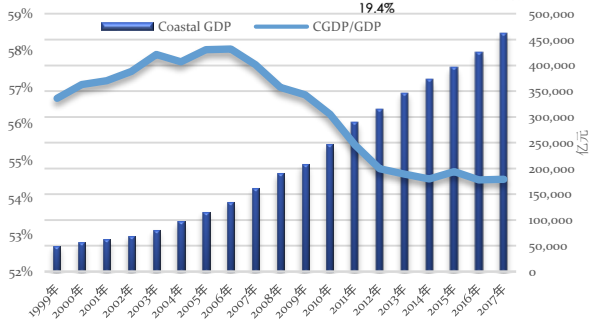
1. The policy context for the pilot

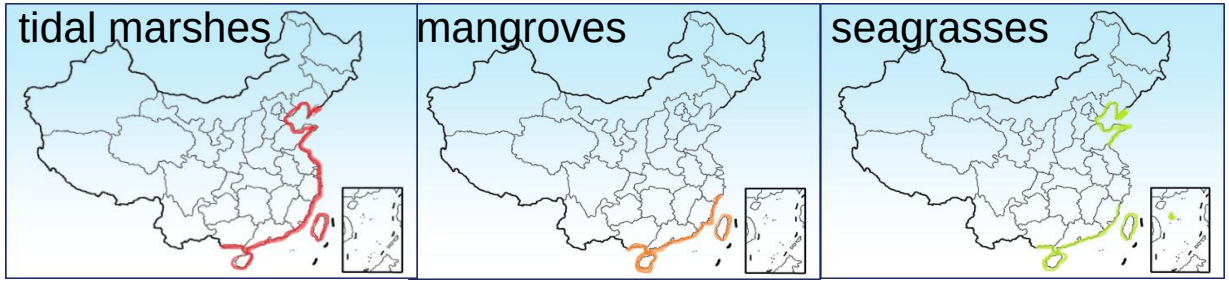
- Facts List of China's Oceans

  - Seas: Bohai Bay, Yellow Sea, East China Sea, South China Sea, the Sea to the east of Taiwan Island;
  - Mainland Coastline:18 000km,

    Island Coastline: 14 000km;
  - Typical Marine Ecosystems : tidal marshes, seagrasses, seaweeds, mangroves, coral reefs, oyster reefs; islands, estuaries, bays, rocky reefs, tidal flats;
  - Coastal Regions includes 10 provinces on the mainland, Taiwan and Hainan Islands, Hongkong and Macao SARs;
  - Oceanic GDP accounts for 9.4% of GDP.







- Concerns

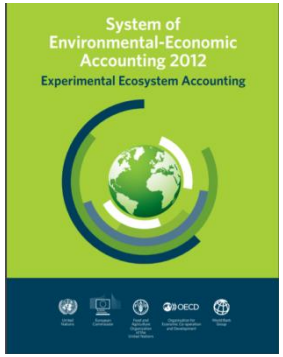
United Nations

China

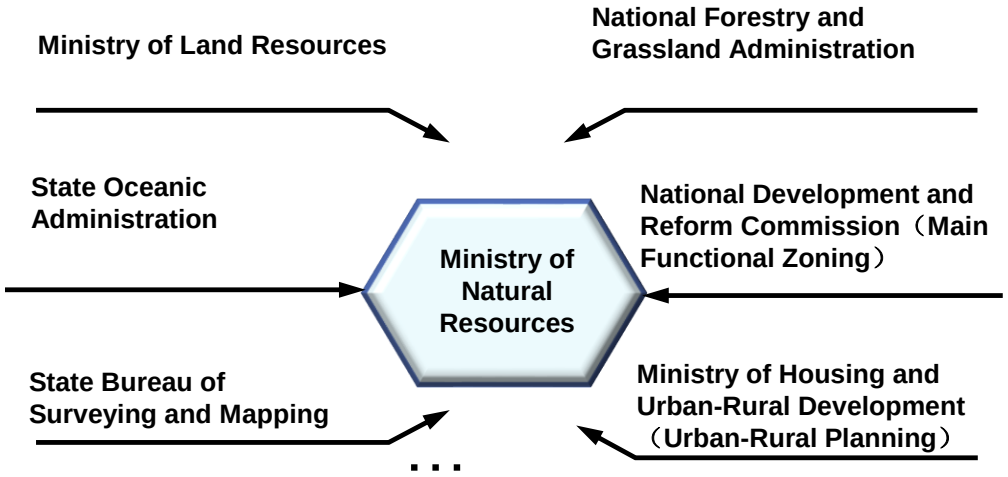
Sustainable Development Goals

Ecological Civilization

Central Framework



EEA



• Concerns

Legislations

No.	Laws and Regulations	Years
1	Law of the People's Republic of China on the Territorial Sea and the Contiguous Zone	1992
2	Law on the Exclusive Economic Zone and the Continental Shelf of the People's Republic of China	1998
3	Environmental Protection Law of the People's Republic of China	2014 *
4	Marine Environment Protection Law of the People's Republic of China	2017 *
5	Law of the People's Republic of China on Environmental Impact Assessment	2018 *
6	Island Protection Law of the People's Republic of China	2009
7	Law of the People's Republic of China on the Administration of Sea Areas	2001
8	Fisheries Law of the People's Republic of China	2013 *
9	Wild Animal Conservation Law of the People's Republic of China	2018 *
10	Mineral Resources Law of the People's Republic of China	2009 *
11	Law of the People's Republic of China on the Exploration and Development of Resources in Deep Seabed Areas	2016
12	Waterway Law of the People's Republic of China	2016
13	Law of the People's Republic of China on Ports	2018 *
14	Statistics Law of the People's Republic of China	2010 *
15	Regulations of the People's Republic of China on Nature Reserves	2017 *

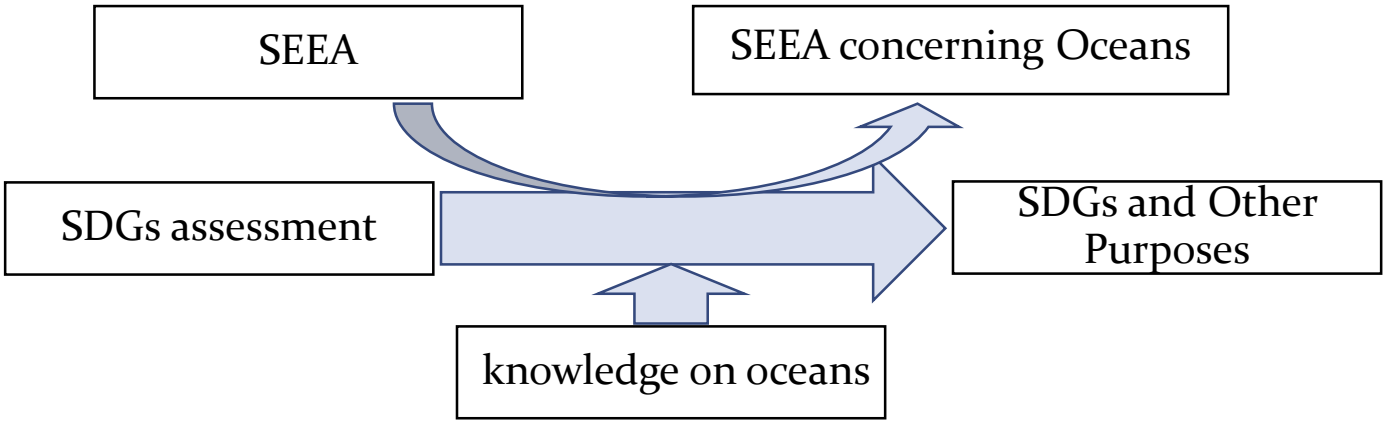
National Strategies

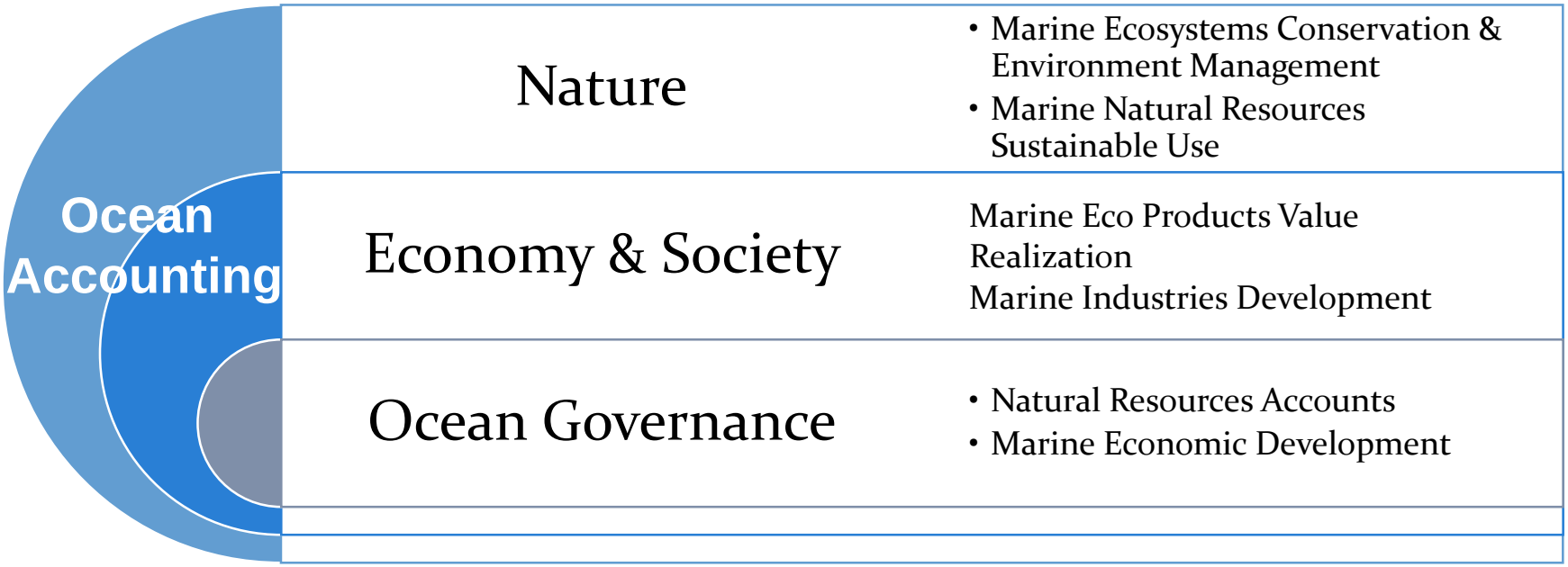
- Ecological civilization
- Building China into a maritime power

Policy Tools

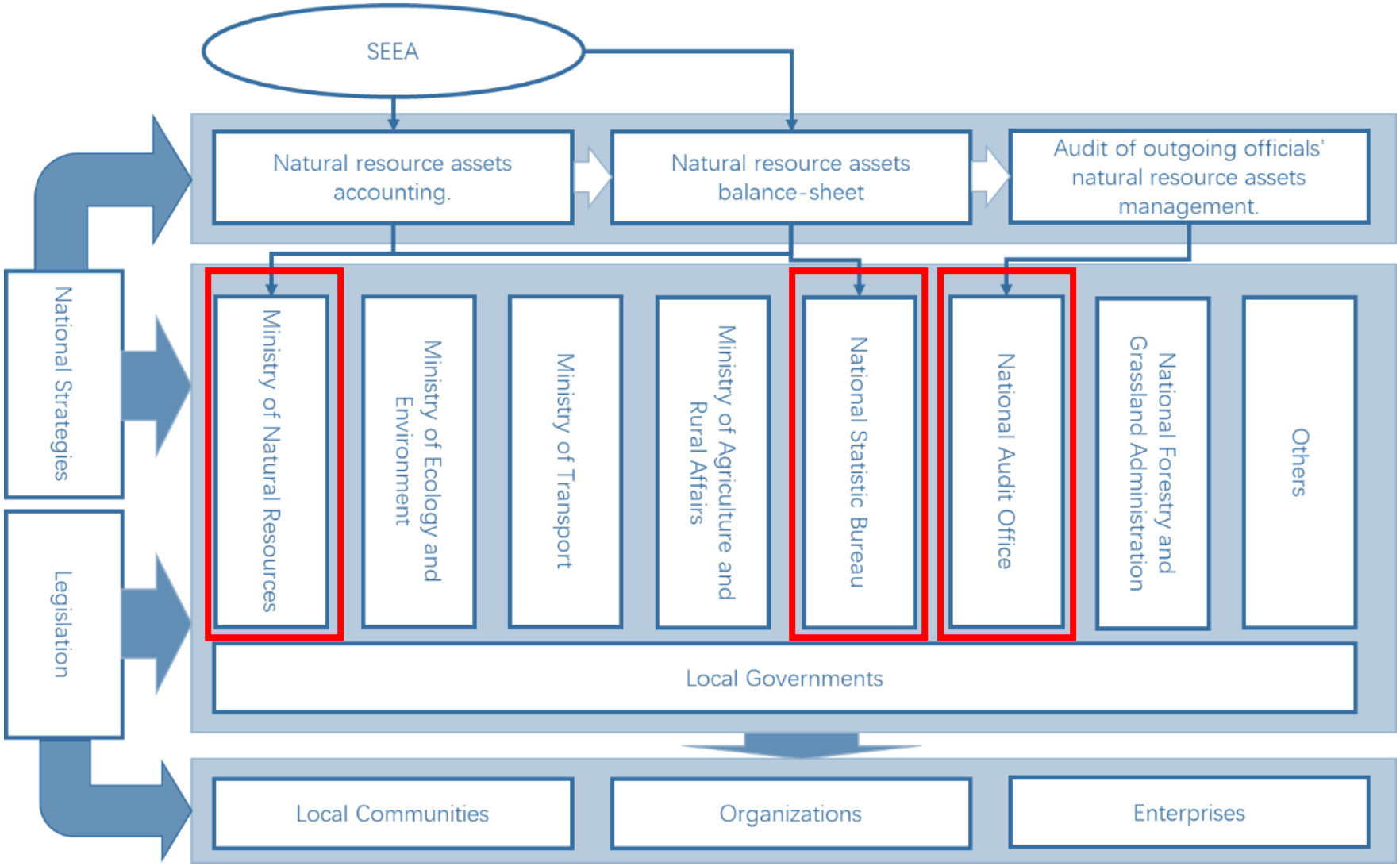
- Natural resource assets accounting
- Natural resource assets balance-sheet
- Audit of outgoing officials' natural resource assets management

- Concerns


SEEA
SEEA concerning Oceans
SDGs assessment
SDGs and Other Purposes
knowledge on oceans


Ocean Accounting
Nature
• Marine Ecosystems Conservation & Environment Management
• Marine Natural Resources Sustainable Use
Economy & Society
Marine Eco Products Value Realization
Marine Industries Development
Ocean Governance
• Natural Resources Accounts
• Marine Economic Development

- Stakeholders



2. Scoping the pilot

- Key data sources (and gaps)

	Sources	Space-time scales	Availability
Land	Satellite, Aircrafts, Social & Economical Data	Submeters, meters Yearly, 5 years	Easier to acquire
Ocean	Optic and Acoustic Survey & Field Research	Meters to kilometers Infrequent	Many data are classified

Open-access statistics data

China Marine Economic Statistical Bulletin

China Marine Statistical Yearbook

China Ocean Development Index

China Ocean Economic Development Index

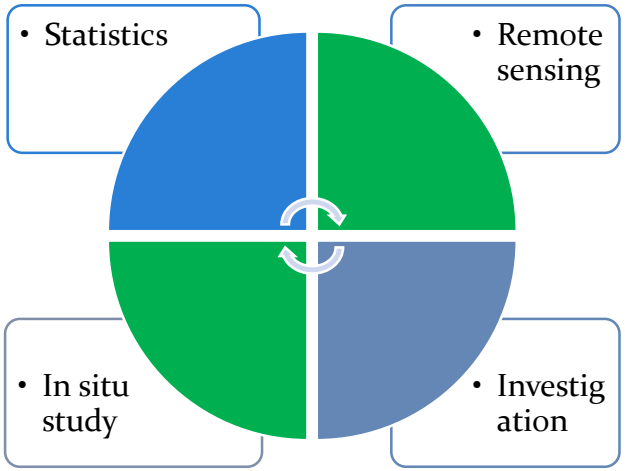
Marine Economic Climate Index Report

Report on China's marine Economy Development

Bulletin of marine ecological environment status

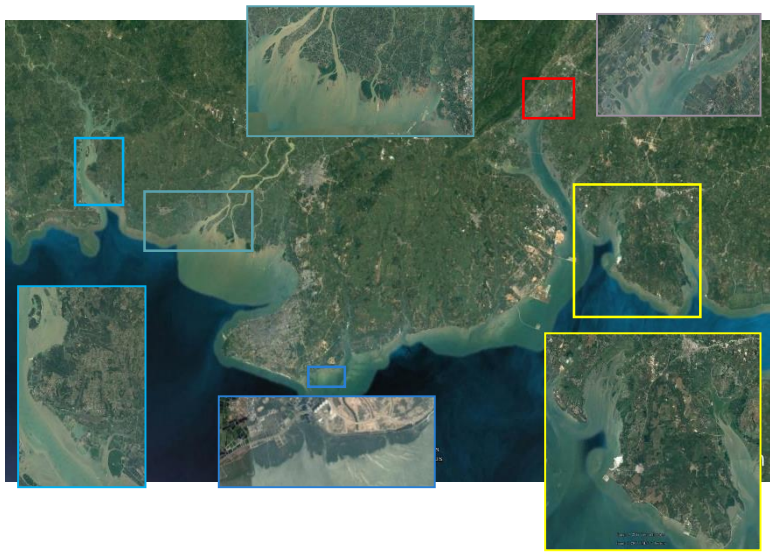
Statistical communique of national economic and social development

Fisheries statistical yearbook



- The choice of pilot focus
  - Site: Beihai, Guangxi
  - Content: mangroves Assets and Ecosystem Services
- The reason for choosing the pilot focus
  - Easy to start;
  - Local support;
  - Multiple Benefits;
  - Wider application.

Apr. 19, 2017, President Xi Jinping visited in Beihai Golden Bay Mangrove Reserve, and asked to study and conserve rare plants, and enhance the biodiversity of coastal wetland reserve.



3. Pilot design

- Main considerations for design of the pilot
  - Stakeholder requirements

    lucid waters and lush mountains are invaluable assets--Ecosystems
  - Data availability

    Open-published data, and *remote sensing* data
  - Existing work

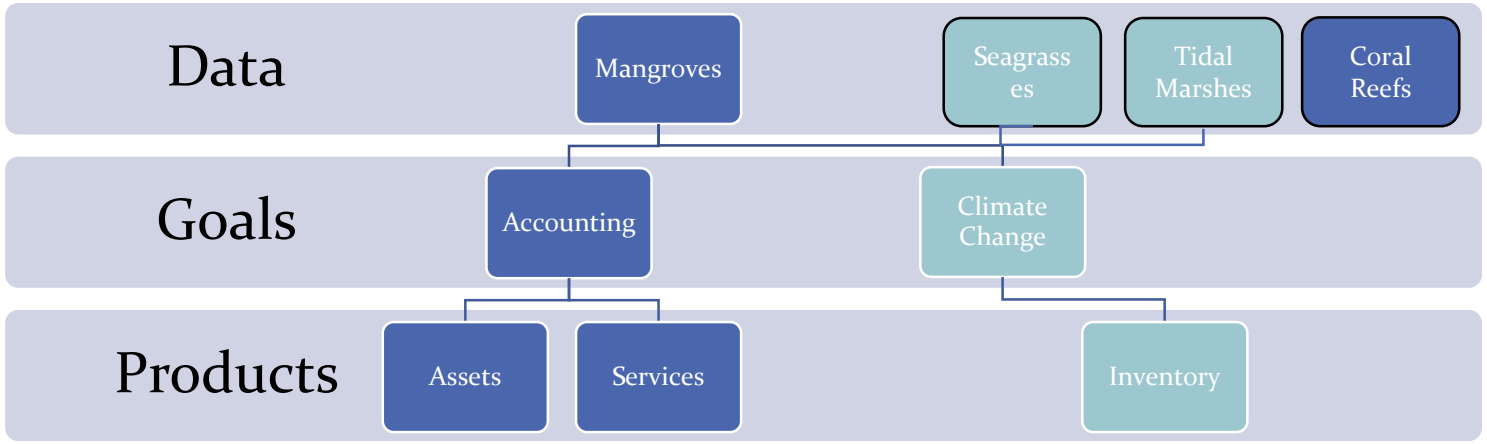
    Blue Carbon (Mangroves, Seagrasses, Tidal Marshes);

    Coastal Restoration;

    Coastal and Animal Remote Sensing.
  - Technical capacity: Sciences and technologies support Decsion-making
  - Time available: （6 months） *--local scale*

Using sciences and technologies to support coastal ecosystems accounting at local scale

- Pilot design
  - Research question: the status of assets and ecosystems of mangrove ecosystems in Beihai, and its implication
  - Data sources: open-published data, and remote sensing data
  - Analytical outputs: the assets and ecosystem categories of mangrove ecosystem, and its preliminary application in Beihai



4. Activities undertaken

• Establishment of working group

Advisers

- **Chen Shang** (First Institute of Oceanography, Ministry of Natural Resources)
- **Huang Qi** (Guangxi Shankong Mangrove National Nature Reserve)
- **Shi Jianbin** (Paulson Institute)
- **Ye Haiyuan** (Beihai Marine Industrial Zone)
- **Zhang Hongke** (Guangxi Hepu Dugong National Nature Reserve)
- **Zhang Qiufeng** (First Institute of Oceanography, Ministry of Natural Resources)
- **Zhu Chunquan** (IUCN Beijing Office)

Consultant

- **Zhao Peng** (Fourth Institute of Ocean Resources / National Marine Data & Information Service)

Group members

- **Li Feixue** (Nanjing University)
- **Jiang Hongyou** (The Fourth Institute of Ocean Resources of the Ministry of Natural Resources)
- **Zhang Yunlan** (Guangxi University of Finance and Economics/Guangxi Mangrove Research Center)
- **Zhu Zuhao** (The Fourth Institute of Oceanography, Ministry of Natural Resources)
- **Zuo Ping** (Nanjing University)

Invited contributors

- **Wang Qian** (National Marine Data & Information Service)
- **Xing Wenxiu** (First Institute of Oceanography, Ministry of Natural Resources)
- **Zhu Zuhao** (The Fourth Institute of Oceanography, Ministry of Natural Resources)
- **Jiang Hongyou** (The Fourth Institute of Ocean Resources of the Ministry of Natural Resources)
- **Li Feixue** (Nanjing University)
- **Li Li** (The Fourth Institute of Ocean Resources of the Ministry of Natural Resources)
- **Yang Yang** (The Fourth Institute of Oceanography, Ministry of Natural Resources)
- **Zhang Yunlan** (Guangxi University of Finance and Economics/Guangxi Mangrove Research Center)
- **Luo Huilin** (Tsinghua University)
- **Zhao Peng** (The Fourth Institute of Ocean Resources / National Marine Data & Information Service)
- **Yuan Xiutang** (National Marine Environmental Monitoring Center)
- **Guo Yue** (National Marine Data & Information Service)
- **Tan Lun** (National Marine Data & Information Service)

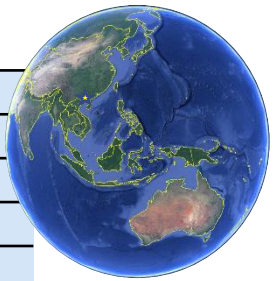
- Workshops and Consultation

Aug 2018, Bangkok
Asia and the Pacific Regional Expert Workshop on Ocean Accounts

May 2019, Beijing
First Workshop for the Pilot Study of ESCAP Ocean Accounting in China

Sep 2019, Beihai
Second Workshop for the Pilot Study of ESCAP Ocean Accounting in China

- Research
- (1) Linking Oceanic Assets to SEEA-2012



	SEEA-2012Environmental Assets	Oceanic Environmental Assets
1	**Mineral and energy resources**	**Marine minerals and energy resources**
1.1	Oil resources	Offshore oil resources
1.2	Natural gas resources	Marine natural gas resources
1.3	Coal and peat resources	Submarine coal mine
1.4	Non-metallic mineral resources	Marine non-metallic mineral resources
1.5	Metallic mineral resources	Marine metal mineral resources
2	**Land**	**Sea area**
3	**Soil resources**	**Sediment and seawater nutrients**
4	**Timber resources**	**Marine higher plants**
4.1	Cultivated timber resources	Cultivated marine higher plants
4.2	Natural timber resources	Natural marine higher plants
5	**Aquatic resources**	**Marine living resources**
5.1	Cultivated aquatic resources	Cultivate marine living resources
5.2	Natural aquatic resources	Natural marine living resources
6	**Other biological resources**	/
7	**Water resources**	**Marine freshwater resources**
7.1	Surface water	River Input
7.2	Groundwater	Rainfall
7.3	Soil water	Sea Ice
8		Other

• (2)Assets of Mangroves

No.	Assets
2	**Sea area**
2.1	Mangrove area
3	**Sediment and seawater nutrients**
3.1	Sediment
3.1.1	Carbon
3.2	Nutrients
3.2.1	Nitrogen
3.2.2	Phosphorus
	.....
4	**Marine higher plants**
4.1	Cultivated Mangrove Biomass
4.2	Natural Mangroves Biomass
5	**Marine living resources**
5.1	Cultivate marine biomass
5.1.1	Crab
	.....
5.2	Natural marine living resources
5.2.1	Crab
5.2.2	Fish
5.2.3	Bird
	.....
7	**Marine freshwater resources**
7.1	Input freshwater Flux
7.1.1	River Flux
7.1.2	Rain Flux
7.1.3	Underground Water Flux

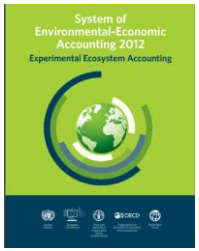
No.	Items	Annual Freshwater input
5	Marine freshwater resources	$W = W_r + W_f$
5.1	River Input	$W_r = \sum_{n=1}^{i} w_r$
5.2	Rainfall	$W_f = \sum_{n=1}^{12} w_f$

No.	Items	Raw Data(unit)	Depth (m)	Stock (t/ha)	Stock in Total
3.1	Sediment		/	/	/
3.1.1	carbon		1	Ss_c	$Ss_c \times S$
3.1.2	nitrogen			Ss_n	$Ss_c \times S$
3.1.3	phosphorus			Ss_p	$Ss_p \times S$
...	.....	.....	.....	.....	.....
3.2	Seawater		/	/	/
3.2.1	carbon		1	Sw_c	$Sw_c \times S$
3.2.2	nitrogen		1	Sw_n	$Sw_c \times S$
3.2.3	phosphorus		1	Sw_p	$Sw_p \times S$
...	.....	.....	.....	.....	.....

No.	Items	Area(S, ha)	Biomass (B, t/ha)	Biomass in Total (t)
4	Marine Higher Plants	$S = S_c + S_n$	$B = B_c + B_n$	$T = T_c + T_n$
4.1	Cultivated Mangrove	$S_c = \sum_{n=1}^{i} S_i$	$B_c = \sum_{n=1}^{i} B_i$	$T_c = \sum_{n=1}^{i} T_i$
4.1.1	Avicenna marina		$Wtop = 0.308D^{2.11}$	
4.1.2	Kandelia candel		$Wtop = 3.614D^{1.446}$	
4.1.3	Aegiceras corniculatum			
4.1.4	Sonneratia apetala			
...	.....	.....	.....	.....
4.2	Natural Mangroves	$S_n = \sum_{n=1}^{j} S_j$	$B_n = \sum_{n=1}^{j} B_j$	$T_n = \sum_{n=1}^{j} T_j$
4.2.1	Avicenna marina		$Wtop = 0.308D^{2.11}$	
4.2.2	Kandelia candel		$Wtop = 3.614D^{1.446}$	
4.2.3	Aegiceras corniculatum			
4.2.4	Bruguiera gymnorrhiza		$Wtop = 0.186D^{2.31}$	
4.2.5	Rhizophora stylosa		$Wtop = 0.128D^{2.60}$	
...	.....	.....	.....	.....

No.	Items	Area(S, ha)	Biomass (B, t/ha)	Biomass in Total (t)
5	Marine living resources	$S = S_c + S_n$	$B = B_c + B_n$	$T = T_c + T_n$
5.1	Cultivate marine living	$S_c = \sum_{i=1}^{n} S_i$	$B_c = \sum_{i=1}^{n} B_i$	$T_c = \sum_{i=1}^{n} T_i$
5.1.1	Shrimp			
5.1.1.1	Crab			
5.1.1.2	Shellfish			
5.1.2	Fish			
5.1.3	Worm			
...	.....	.....	.....	.....
5.2	Natural marine living	$S_n = \sum_{i=1}^{n} S_i$	$B_n = \sum_{i=1}^{n} B_i$	$T_n = \sum_{i=1}^{n} T_i$
5.2.1	Microalgae			
5.2.2	Shrimp			
5.2.3	Crab			
5.2.4	Shellfish			
5.2.5	Fish			
5.2.6	Worm			
5.2.7	Bird			
...	.....	.....	.....	.....

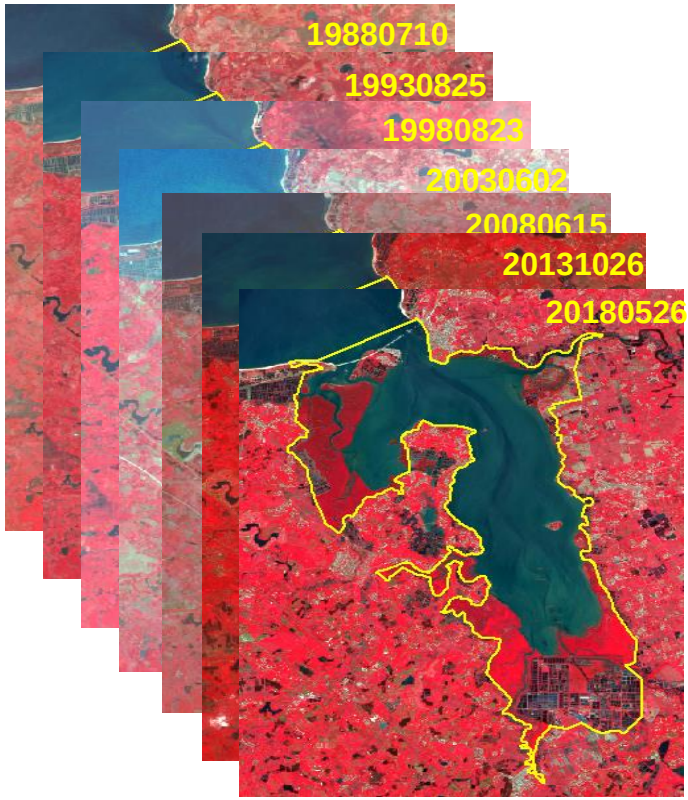
- (3) Linking Oceanic Ecosystem Services to SEEA-2012



Section	Division	Group
Provisioning	Materials	Captured edible plants and animals
		Plants and animals' fiber and structure
		Natural product
		Gene
	Energy	Bio-energy (Yes but not recommended)
	Other	
Regulating	biophysical environment	Bio regulation
		Pollutant filter and carbon sequestration
	Flow	Air regulation (disaster reduction)
		Water regulation(disaster reduction)
		Material regulation(erosion reduction)
	physicochemical environment	Atmosphere regulation (Oxygen production)
		Water cycle regulation
		Soil cycle regulation
	biotic environment	Life history, habitat and gene pool conservation
		Disease and pest control
Cultural	Physical or experiential use	tourism
		Knowledge and Sciences
	Intellectual representations	Spirit and Religion

- Data collection

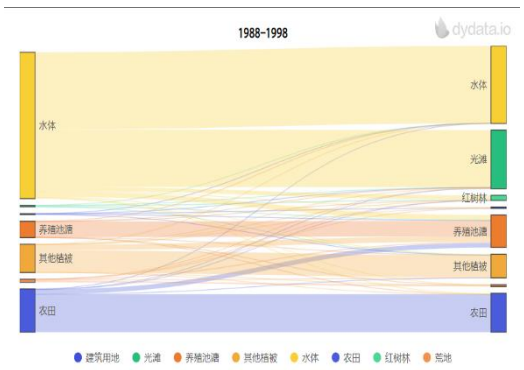
(1)mangrove areas mapping

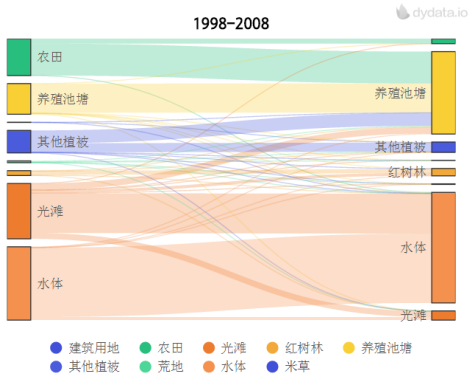


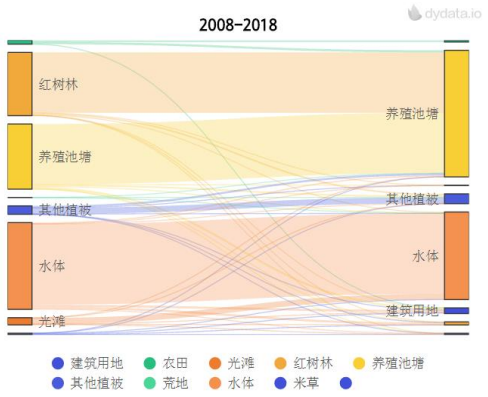
序号	时间	行列号	卫星	分辨率（单位：米）
1	19880919	124/045	Landsat5 TM	30
	19881129	125/045	Landsat5 TM	30
2	19980526	124/045	Landsat5 TM	30
	19980821	125/045	Landsat5 TM	30
3	20081028	124/045	Landsat5 TM	30
	20081120	125/045	Landsat5 TM	30
4	20181125	124/045	Landsat8 OLI	30
	20181031	125/045	Landsat8 OLI	30

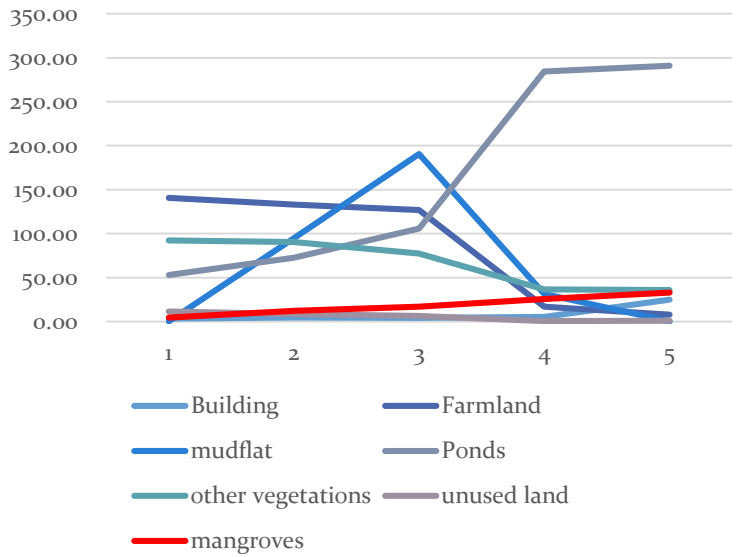
	Building	Farmland	mudflat	mangroves	Ponds	other vegetation	unused land	water	tidal marshes	total
1988年	3.31	140.62	0.00	4.68	52.96	92.36	11.48	476.37	0.00	781.77
1993年	4.37	133.13	94.62	12.14	72.58	90.35	8.67	367.28	0.00	783.16
1998年	4.19	126.82	190.38	16.81	105.58	77.46	6.21	252.43	0.00	779.88
2008年	5.42	17.03	31.61	25.46	284.46	36.70	0.43	380.88	0.00	782.00
2018年	24.87	7.67	0.00	32.79	290.96	35.71	0.85	384.25	6.45	783.55

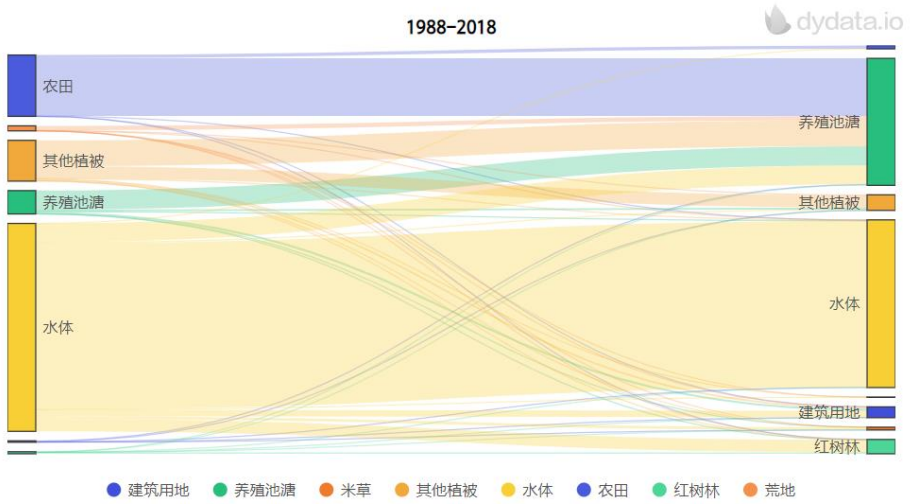
- Mangroves are increasing
- Invaded tidal marshes are increasing
- Ponds is increasing sharply


1988-1998
dydata.io
水体
光滩
红树林
养殖池塘
其他植被
农田
建筑用地 光滩 养殖池塘 其他植被 水体 农田 红树林 荒地


1998-2008
dydata.io
农田
养殖池塘
其他植被
光滩
水体
红树林
建筑用地 农田 光滩 红树林 养殖池塘
其他植被 荒地 水体 米草


2008-2018
dydata.io
红树林
养殖池塘
其他植被
水体
光滩
建筑用地
建筑用地 农田 光滩 红树林 养殖池塘
其他植被 荒地 水体 米草

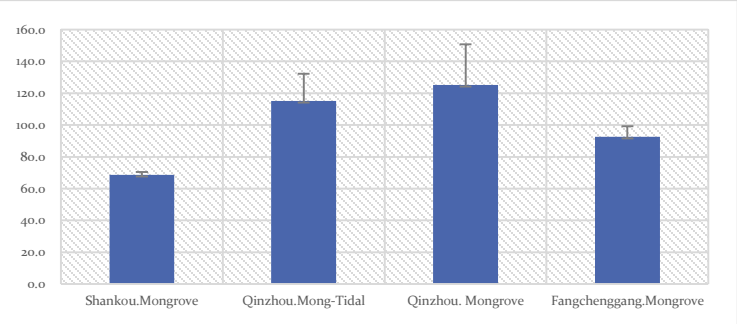

350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
1
2
3
4
5
Building
Farmland
mudflat
Ponds
other vegetations
unused land
mangroves

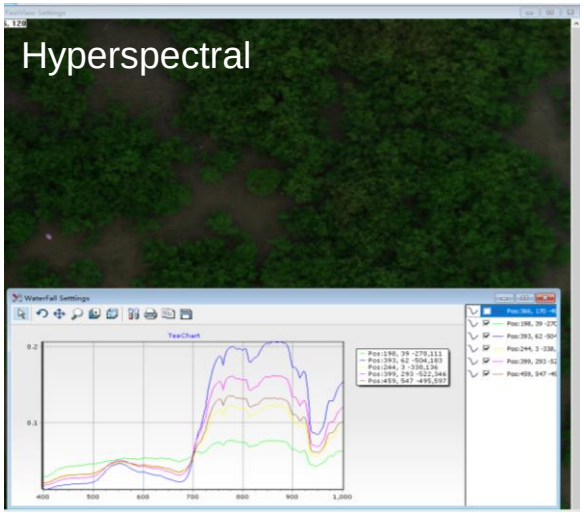

1988-2018
dydata.io
农田
其他植被
养殖池塘
水体
养殖池塘
其他植被
水体
建筑用地
红树林
建筑用地 养殖池塘 米草 其他植被 水体 农田 红树林 荒地

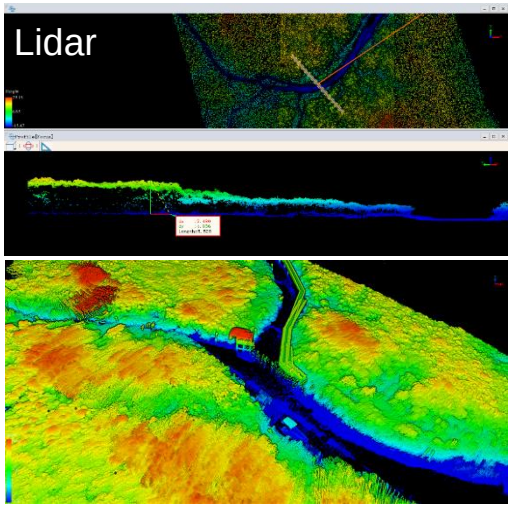
(2) In situ Study

- The average soil carbon stock of Beihai's mangroves is 100.4 t C/ha
- Total carbon stock of Beihai's mangroves is about 0.67 million t C.
- New technologies including hyperspectral and Lidar were applied in the investigation too.

Field Sampling







(3) Researches Review

(1) Sediment

b Nitrogen

The average total nitrogen (TN) of mangrove sediment in Beihai is 1.35%. (Fan et al. 2015)

c Phosphorous

The average total phosphorous (TP) of mangrove sediment in Beihai is 1.35%. (Fan et al. 2015)

（2）Seawater

a Carbon

The average TOC of mangrove seawater in Beihai is 2.33mg/L. (Fan et al. 2015)

b Nitrogen

The average total nitrogen (TN) of mangrove seawater in Beihai is 0.90mg/L. (Fan et al. 2015)

c Phosphorous

The average total phosphorous (TP) of mangrove seawater in Beihai is 0.067mg/L. (Fan et al. 2015)

5.3 Marine Higher Plant Assets

(1) Cultivated Mangrove

The area of cultivated mangrove in Beihai is 290 ha (2007), main species are *Avicenna marina, Kandelia candel, Aegiceras corniculatum, Sonneratia apetala*.

(2) Natural Mangrove

The area of natural mangrove in Beihai is about 3279 ha (2018), main species *are Avicenna marina, Kandelia candel, Aegiceras corniculatum, Bruguiera gymnorrhiza, Rhizophora stylosa*.

5.4 Marine Living Resource Assets

(1) Cultivated Living Resources

(2) Natural Living Resources

The average biomass of benthos in mangroves of Beihai is 116g/m2 year. In which, mollusk accounts for 57.6%, and crustaceans accounts for 37.6%.

5.5 Freshwater Resources

（1）River Input

The average runoff of Nanliu River in Beihai is 68.3×109 m3/yr.

（2）Rainfall

The average rainfall of Beihai is 1663.7mm/yr.

5. Research findings
Ocean Accounting Informs More than Accounting

Water Purification and Primary Production

National Green House Gases Inventory (Blue Carbon)

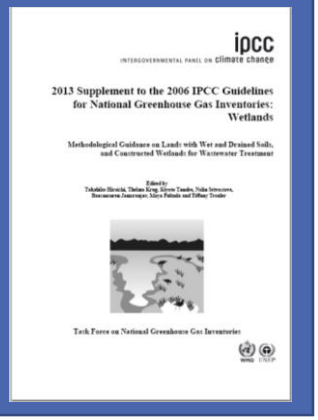
Eco products and Restoration

Biodiversity Conservation and Fishery Enhancement

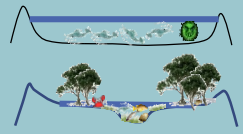
Key factor for Mangroves

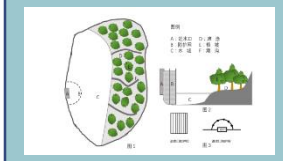
No.	Assets
2	**Sea area**
2.1	Mangrove area
3	**Sediment and seawater nutrients**
3.1	Sediment
3.1.1	Carbon
3.2	Seawater
3.2.1	Nitrogen
3.2.2	Phosphorus
	.....
4	**Marine higher plants**
4.1	Cultivated Mangrove Biomass
4.2	Natural Mangroves Biomass
5	**Marine living resources**
5.1	Cultivate marine biomass
5.1.1	Crab
	.....
5.2	Natural marine living resources
5.2.1	Crab
5.2.2	Fish
5.2.3	Bird
	.....
7	**Marine freshwater resources**
7.1	Input freshwater Flux
7.1.1	River Flux
7.1.2	Rain Flux
7.1.3	Underground Water Flux

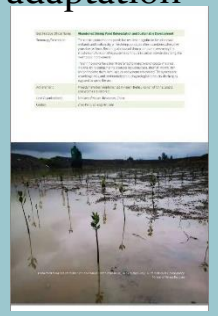
- Blue Carbon Inventory and investigation
- A part of ocean accounting
- Climate mitigation and adaptation



- Abandoned shrimp pond restoration
- Increase natural assets and enhance eco services
- Climate mitigation and adaptation



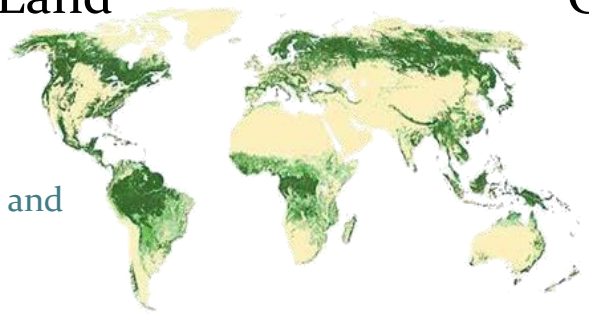




6. Main challenges and needs

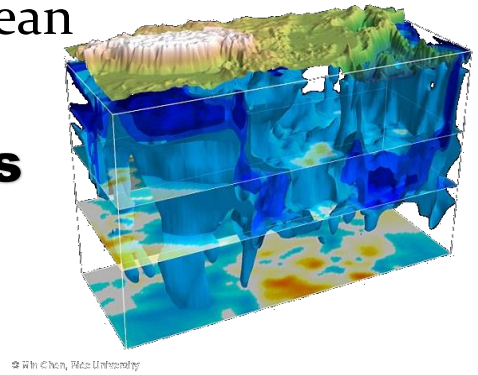
- Data
  - Dimensions variation
  - Fluidity
  - Data Availability
  - Economic Activities between the land and the ocean

Land



Ocean

Vs



- Institutional
  - Extend SEEA to the Oceans
  - Data scaling up and down, Data Acquisition Tech
- Technical capacity and linkage
  - Remote sensing
  - International Ocean Monitoring Systems
  - Modeling methods

- Guidance
  - 3-D data framework
  - Assets and ecosystem services framework under SEEA
  - Technique guideline
- International collaboration
  - UN systems
  - International and Regional Cooperation
  - National Initiatives e.g. Belt and Road Initiative, South to South Cooperation Fund
  - Hot Spot e.g. Climate Change, Biodiversity

7. Next steps for ocean accounts or policy

- Extending the pilot study to other coastal ecosystems
- Linking the Carbon-related assets accounting to National/Local Greenhouse Gas Inventories (Coastal wetlands)
- Establishing a experimental database framework for Oceanic SEEA.

Thank you!