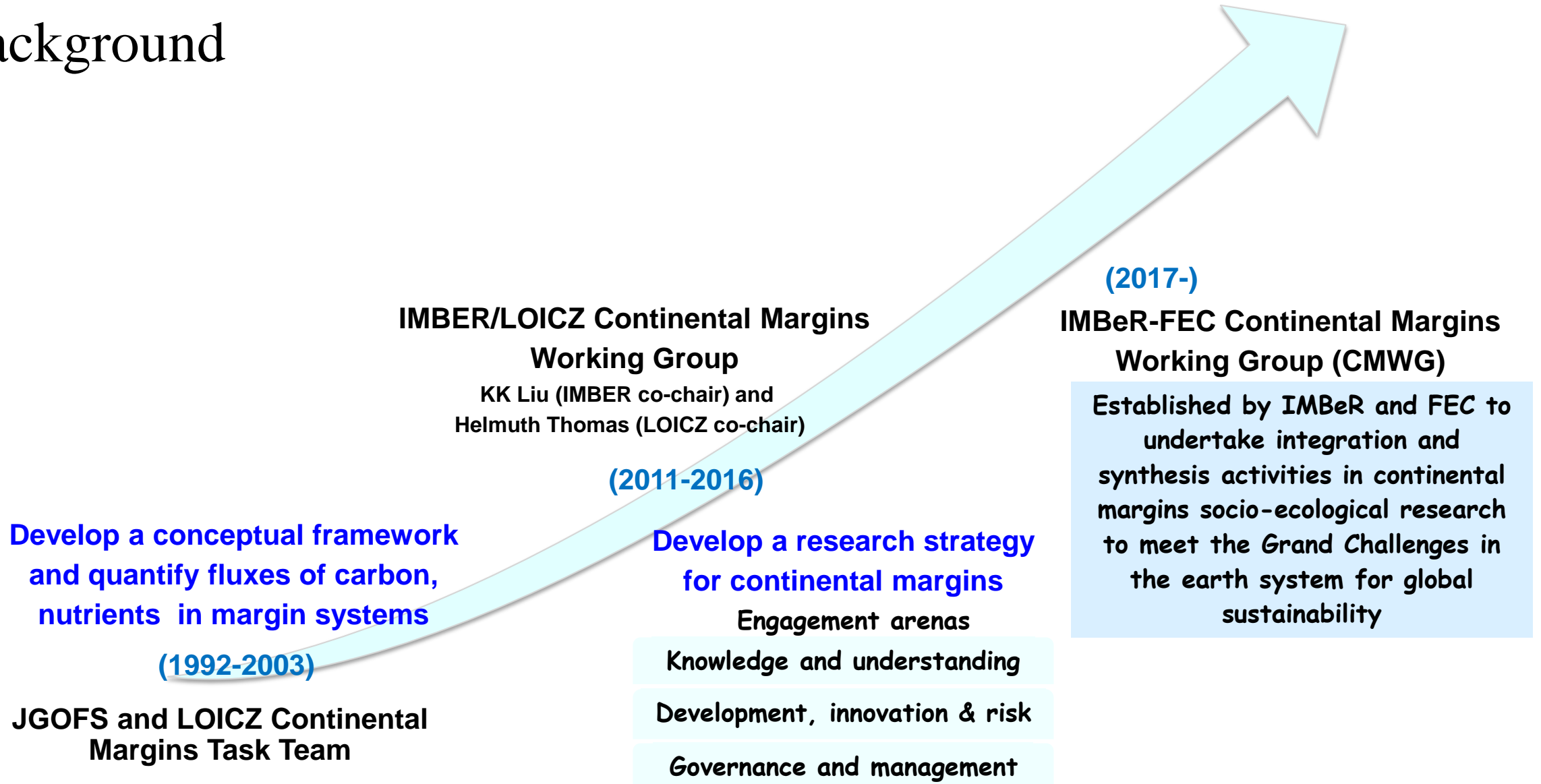


Continental Margins Working Group (CMWG)

Su Mei LIU

Ocean University of China
Qingdao National Laboratory for Marine Science and Technology

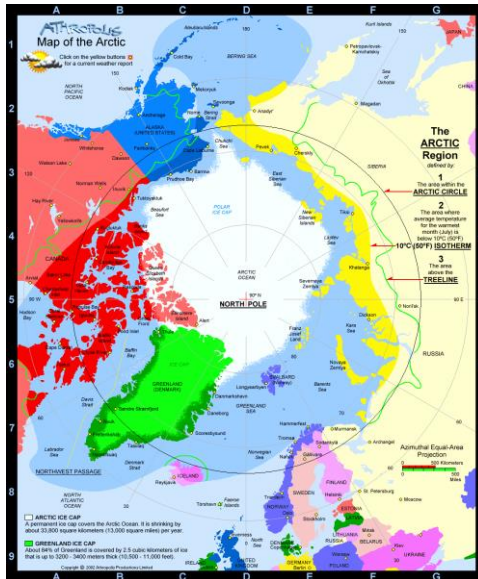
Background



Background

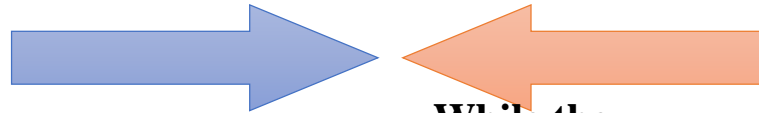
Two case studies that would provide a strong contrast in continental margins

Arctic



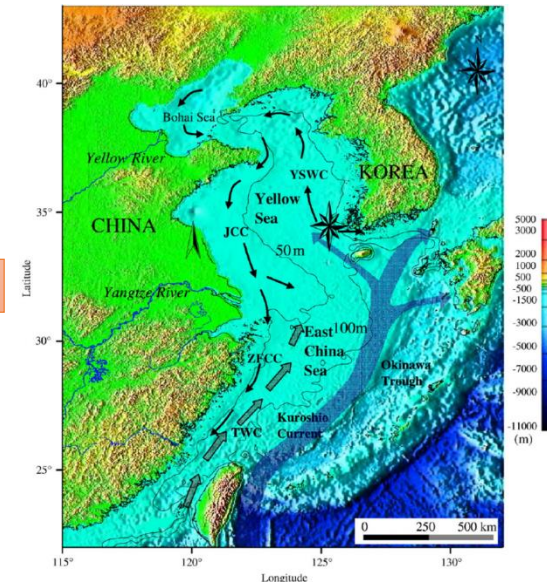
The Arctic case study in March – April 2017

The Arctic shelves are strongly impacted by global warming with projected declines in productivity and CO₂ uptake capacities.



While the Chinese marginal seas are severely disturbed by human activities.

Chinese marginal seas



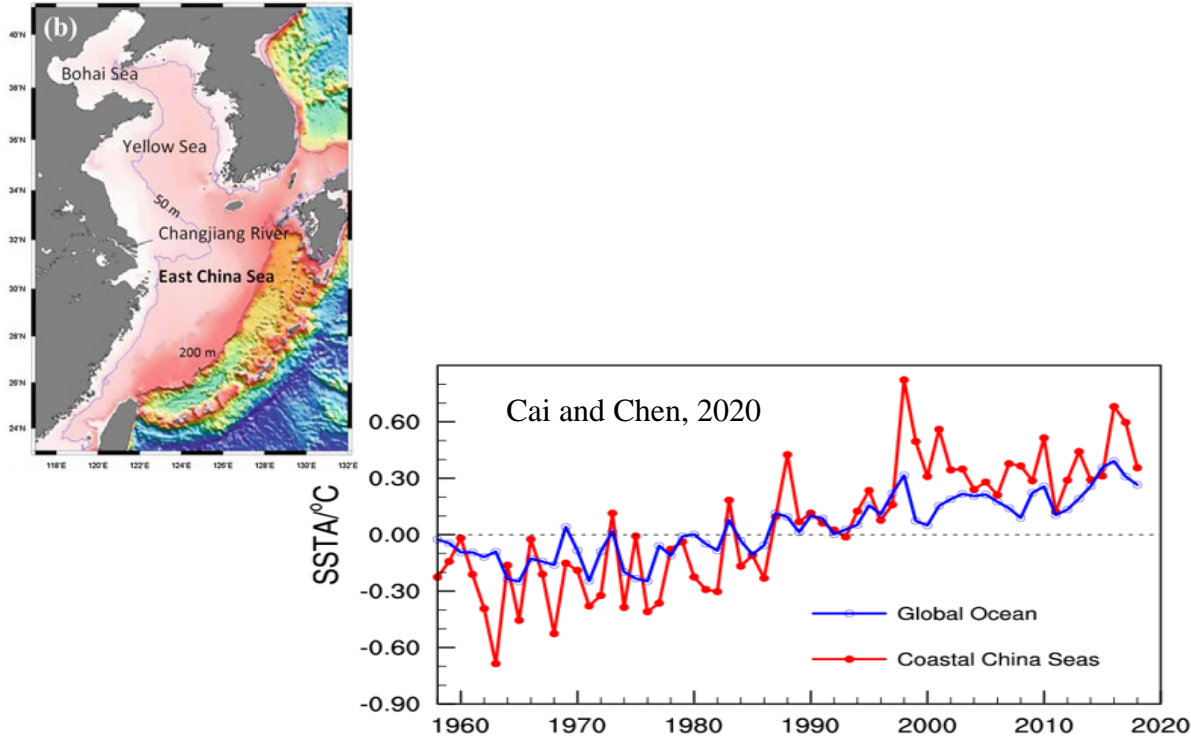
The East Asian continental margin case study during the Third Xiamen Symposium on Marine Environmental Sciences (XMAS – III) on 9-11 Jan 2017

To plan a trans-disciplinary research project to address key challenges on Arctic continental shelves arising from rapid climate change and Chinese marginal seas arising from extensive human activities

The Arctic case study was halted!



Chinese marginal seas case study



Current Status (1958-2018) :

- Chinese marginal seas: increased 0.98 ± 0.19 °C
- Global Ocean: increased 0.54 ± 0.04 °C

- The Chinese marginal seas are warming rapidly
- Coastal provinces and megacities host 43% of national population and contribute more than 60% of the national GDP
- Are experiencing eutrophication, pollution, and changing freshwater input, massive and intensive aquaculture, over-fishing, excess sea reclamation, course shifts, land use change, exploitation of renewable and non-renewable sources, and climate change; which may have disproportionately large impacts, and restrict the sustainability of the ecosystems



Chinese marginal seas case study

The goals

- **to assess health of the ecosystems**
- **to develop sound scientific management options to ensure the sustainable uses of the Chinese Marginal Seas**
- **to meet the current and future societal demands expressed by the UN Sustainable Development Goals**
- **to provide a set of scientific themes for different countries facing similar challenges across the different climate from tropics to the cold temperate regions**



Tasks

- The ecosystem and physicochemical environment change in the last 60 years (*Su Mei Liu*)
- Impacts of mariculture on eco-environment and options for sustainable sea food supply (*Zeng-Jie Jiang*)
- China's Blue Carbon Ecosystems in the context of global change: evolvement, conservation and management (*Qinhua Fang*)
- Integrated spatial planning for food-secure and carbon neutral blue economy (*Hui Liu*)
- Sustainable pollution prevention strategies in coastal zones (*Jian-Hui Tang, Xin-dong Ma*)
- Scientific measures to ensure sustainable development of marginal seas (*Jia-Yu Bai*)

These tasks are closely related to GC 1, GC 3, and IC 3.

Derivatives:

Papers, Books, Scientific reports, Projects,
Suggestions and services to administrators, policy makers and stakeholders



Main activities

Chinese Marginal Seas Case Study only:

- **14-15 November 2022, Chinese Marginal Seas Case Study 2022 Annual Meeting, Online**
- **27 May 2020, CMWG Chinese Marginal Seas Case Study Workshop, online**
- **13 November 2019, IMBeR-FEC Continental Margins Working Group Workshop, Qingdao**

- **22-25 November 2021, IMBeR West Pacific Symposium – Changing West Pacific Ocean: Science and Sustainability. Session 4: Ecological-Social interactions in the Coastal seas. Online. Co-moderators: Sumei Liu and Suvaluck Satumanatpan.**

- **15-21 June 2019, IMBeR OSM, Ecological-Social interactions in marginal seas. Brest, France.**
- **20-21 September 2018, Continental Margins Working Group Workshop, Shanghai**



What is CMWG's plan for the remaining two + years?

Overview of the Chinese marginal seas, including why the tasks are selected.



Progress of one task (The ecosystem and physicochemical environment change in the last 60 years, SM Liu) as an example

Earth System Changes in Marginal Seas/Oceanologia 65 (2023) 278–296



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ORIGINAL RESEARCH ARTICLE

Biogeochemistry-ecosystem-social interactions on the Chinese continental margins

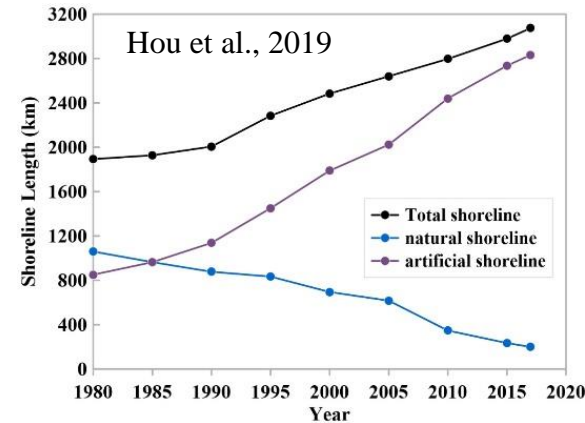
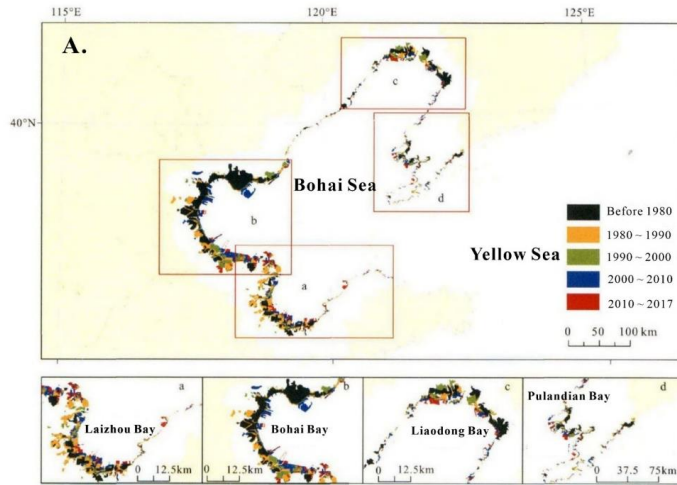
Su Mei Liu^{a,b,*}, Wen Liang^a, Xinyu Guo^c, Nian Wu^{a,b}, Wuchang Zhang^{b,d}, Xiujuan Shan^e, Hua-De Zhao^f, Juying Wang^f, Jin Huang^a

As a continental margin, the Bohai has been studied extensively, resulting in abundant hydrology and biogeochemistry data. This paper reflects the themes and discussions of the Continental Margins Working Group which was established jointly by Integrated Marine Biosphere Research (IMBeR at <https://imber.info/science/regional-programmes-working-groups/cmwg>) and Future Earth Coasts. The objective of this paper is to outline spatial and temporal variations of the hydrological and biogeochemical variables of the Bohai, their multi-drivers and pressures, and the ensuing feedback to ecosystems and to society. This study is vital to understand how ecosystems and society interact in the Bohai so that the information here can be extrapolated globally to predict and alleviate the stresses on similar continental margins that are experi-

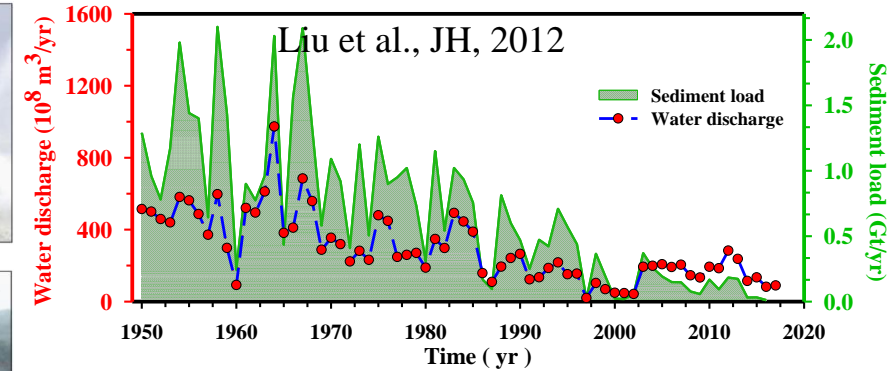
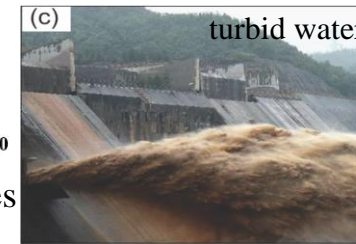
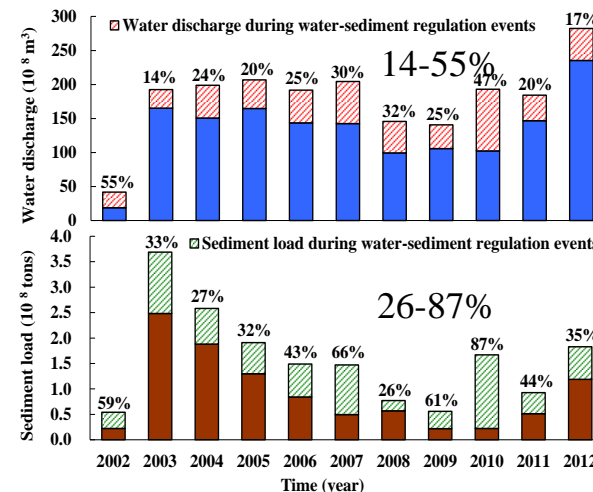
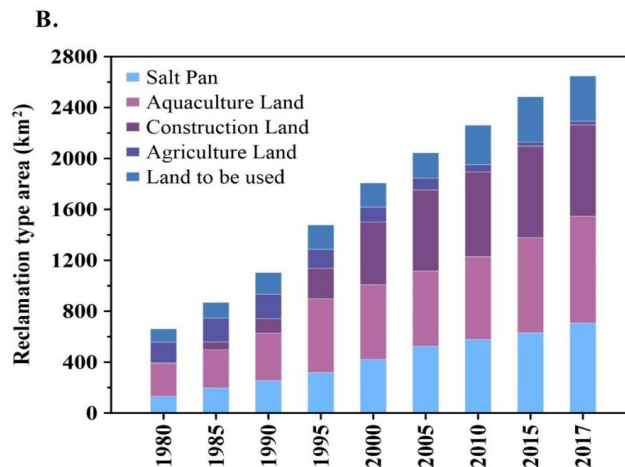


Drivers and pressures --Coastline changes

Impact of reclamation and rapid coastline changes on the Bohai ecosystem

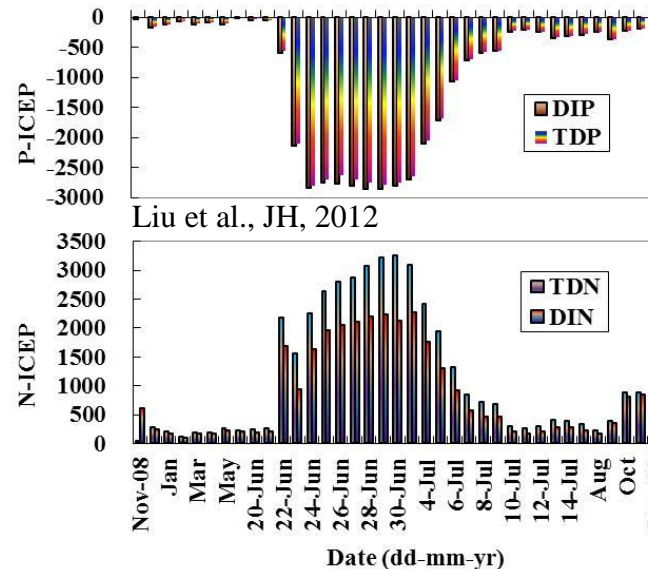
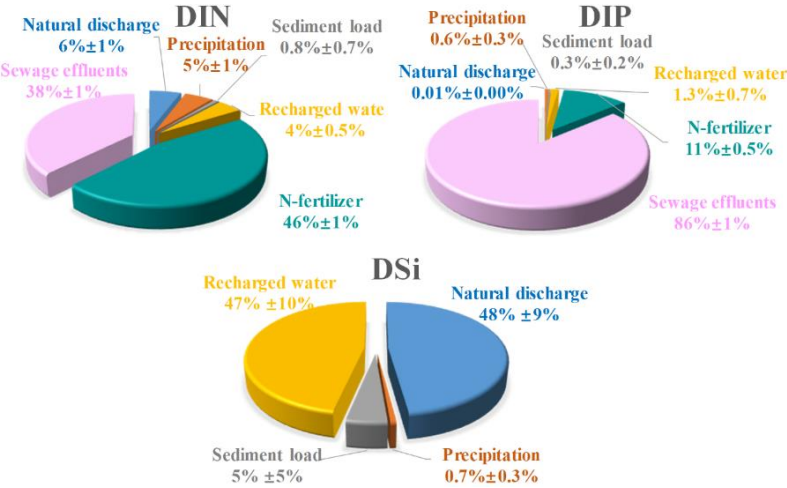
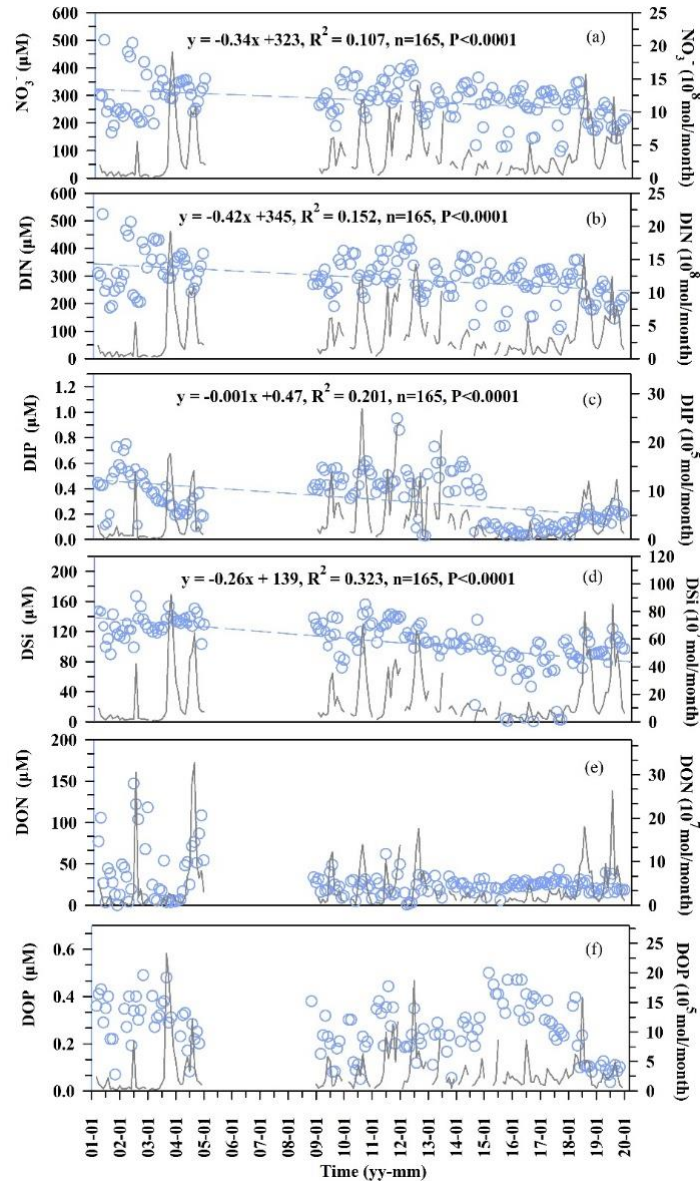


Changes in the length and properties of the shoreline in the Bohai Rim

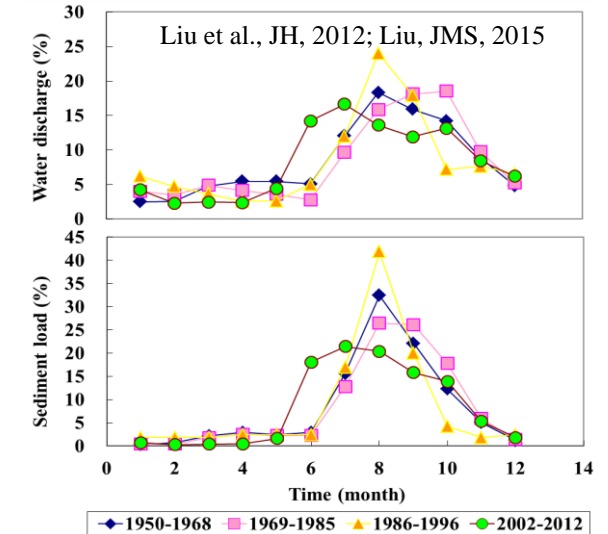


- The Bohai has recently experienced rapid coastline changes due to developments of the Huanghe delta and large-scale reclamation
- An increase in total shoreline length and artificial shoreline length but a decrease in natural shoreline length
- Rapid and sustained reduction of intertidal wetlands, loss and/or fragmentation of essential fish habitats
- In 2018, the State Council of China issued strictly controlling reclamation
- Riverine sediment transport related to agriculture and erosion, and “Grain-for-Green” program have been issued to protect the coastline

Drivers and pressures --Nutrient inputs to the Bohai



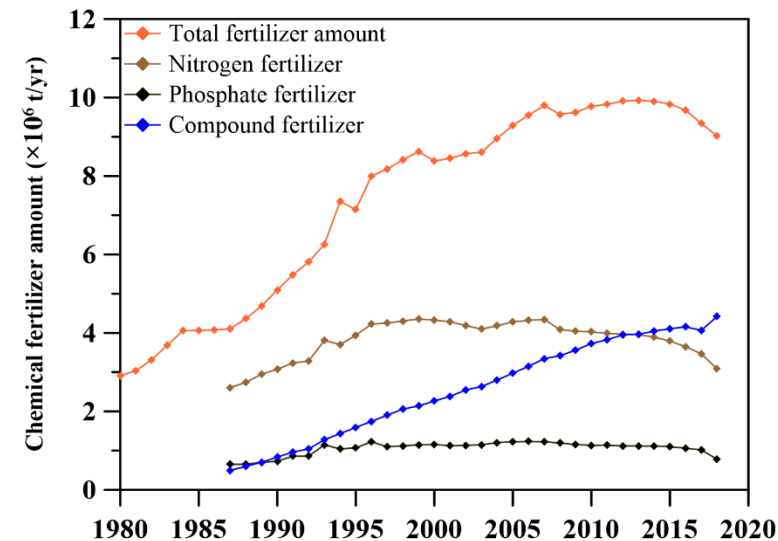
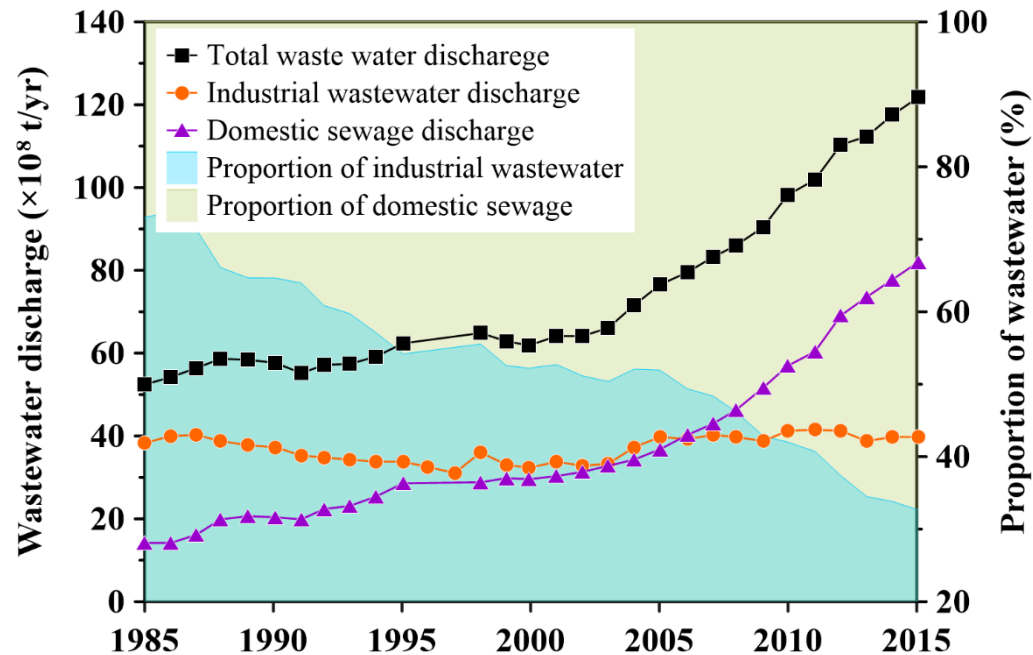
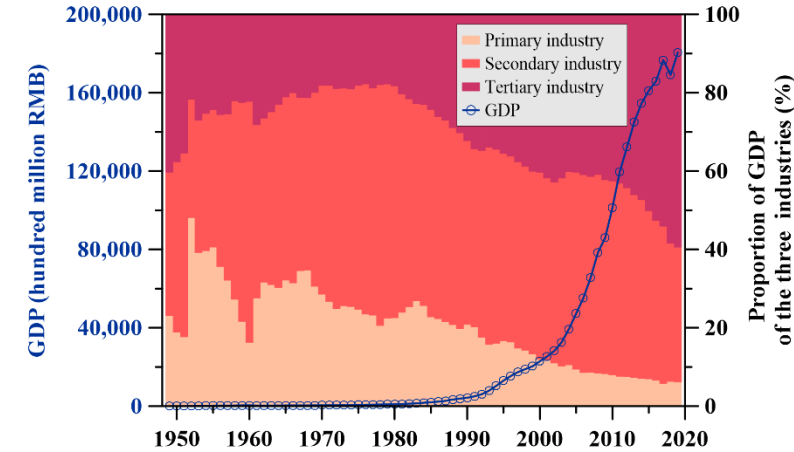
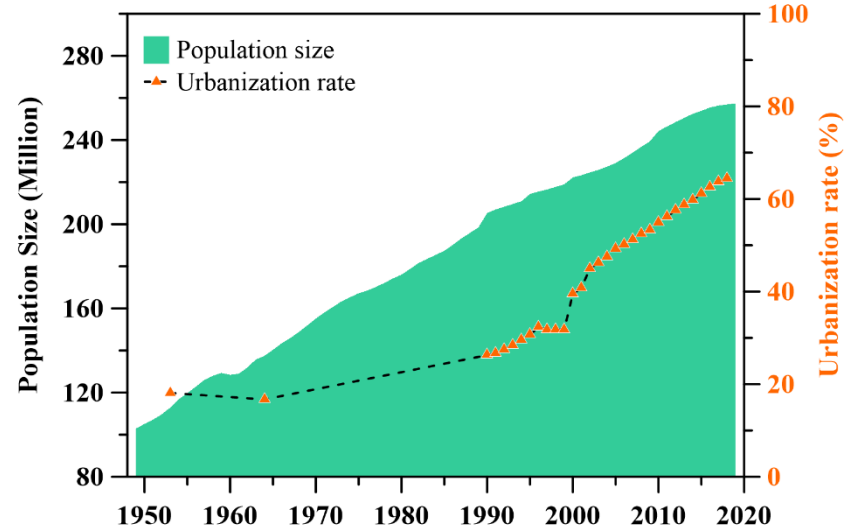
Daily variations of P- and N-ICEP in the Huanghe



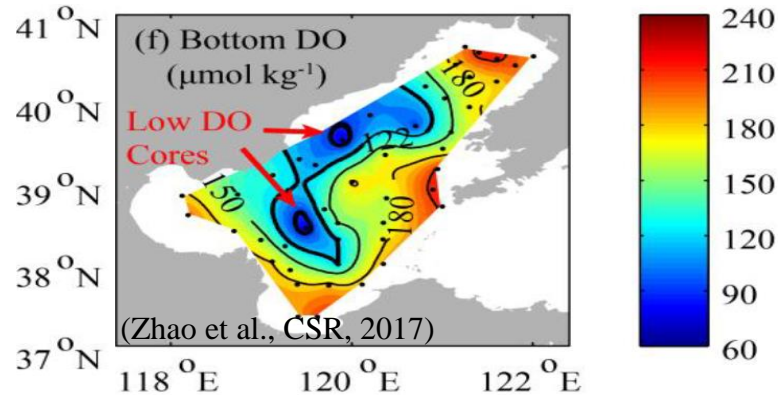
- The water-sediment regulation event cannot only increase nutrient inputs to the coastal ecosystem but can also further result in nutrient imbalance
- High monthly average water discharge and sediment load advanced to as early as 2 months earlier than before the event
- The surface Chl-a exhibited two peaks in spring and autumn until 2002, but has exhibited only one peak in spring-summer since 2002
- Water-sediment regulation along the Huanghe is not sustainable



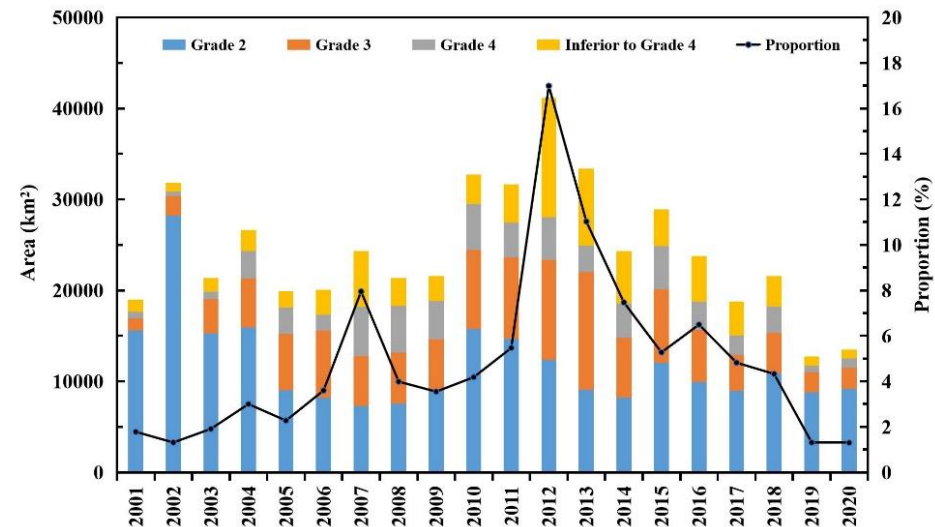
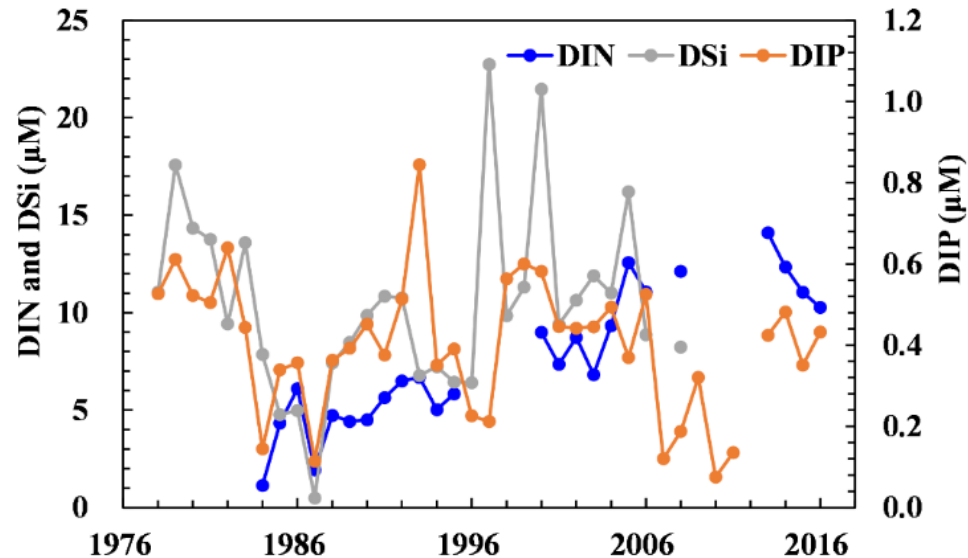
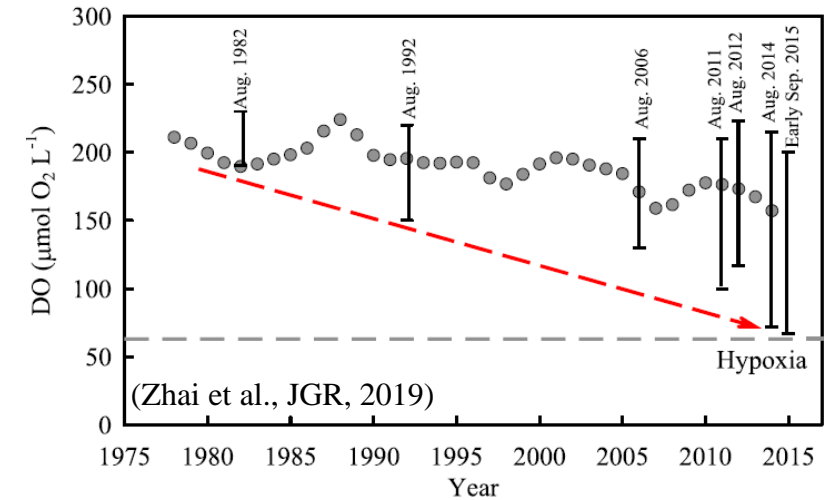
Drivers and pressures --Direct anthropogenic activities



Status of environmental change in the Bohai



Seasonal bottom oxygen-deficient water in the Bohai. There is a decreasing trend in summertime bottom water DO in the Bohai since the early 1980s

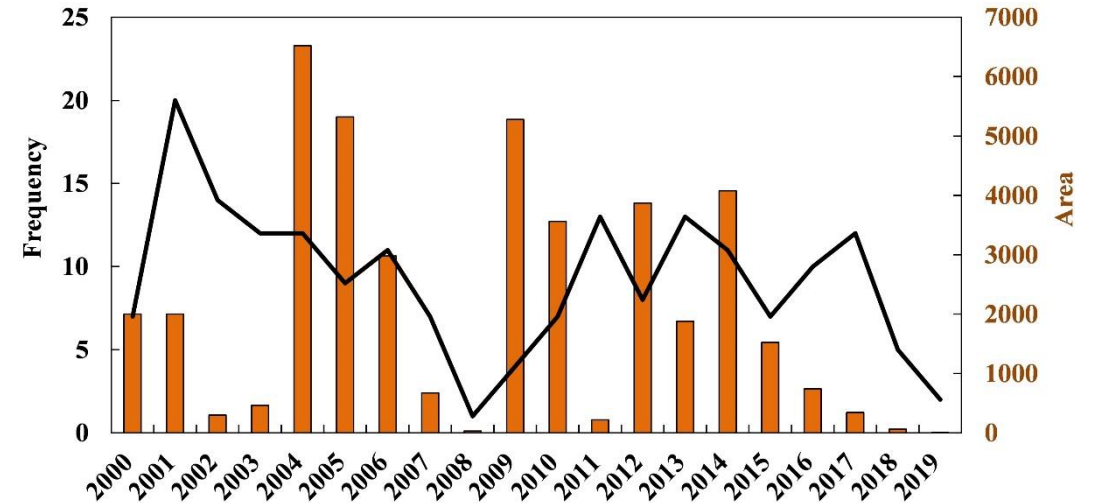
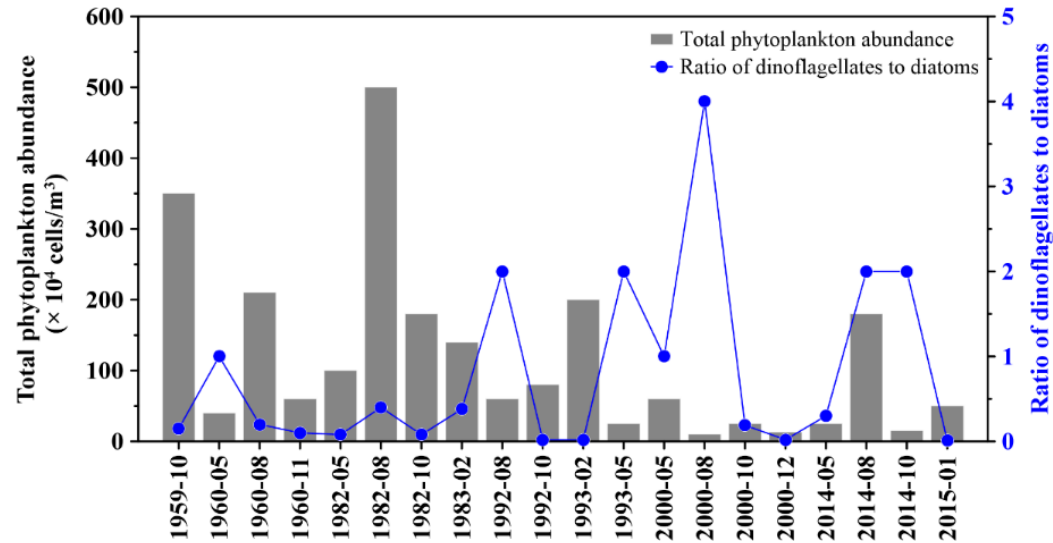


Area of varying sea water quality and the proportion of inferior to grade 4 sea water quality in the Bohai

Until 2012, marine ecosystem quality deteriorated because of eutrophication, pollution, and land use change due to intensified and low resource use efficiency during ocean exploitation. Since then, the marine ecological environment has improved, related to intensified pollution control and ecological restoration



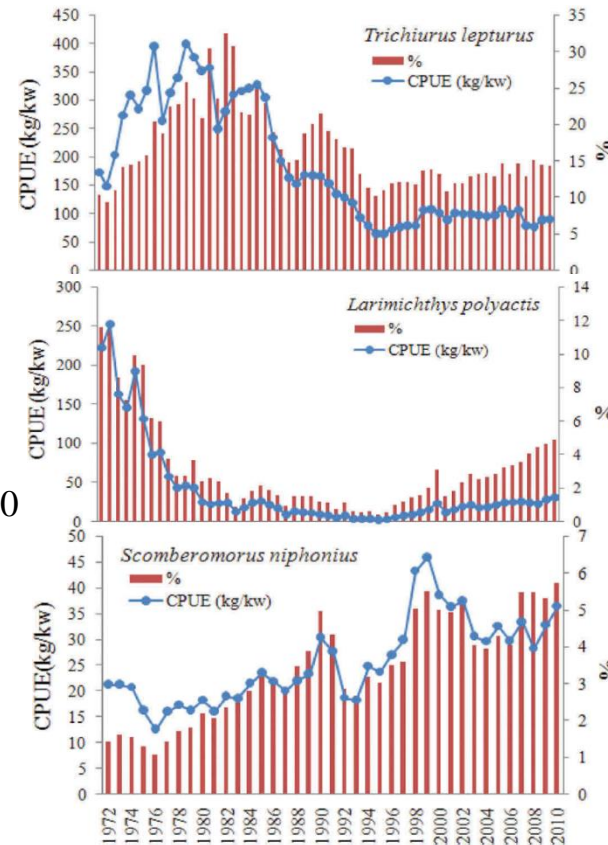
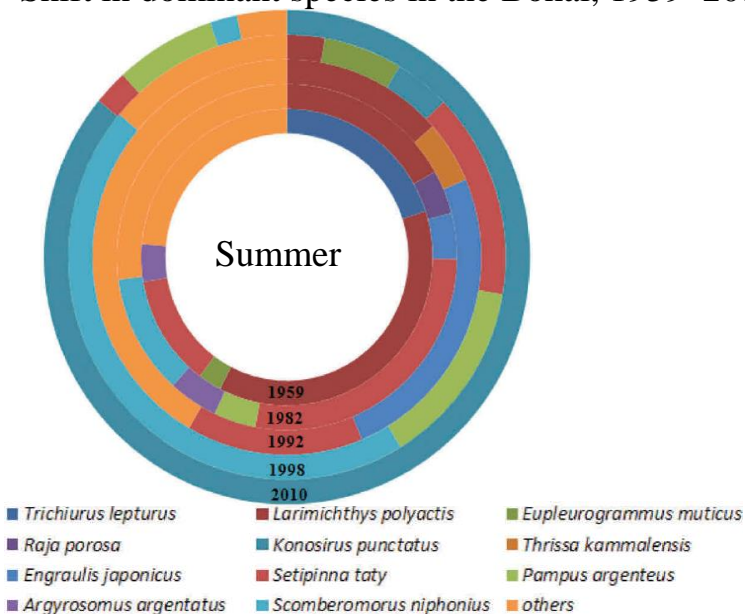
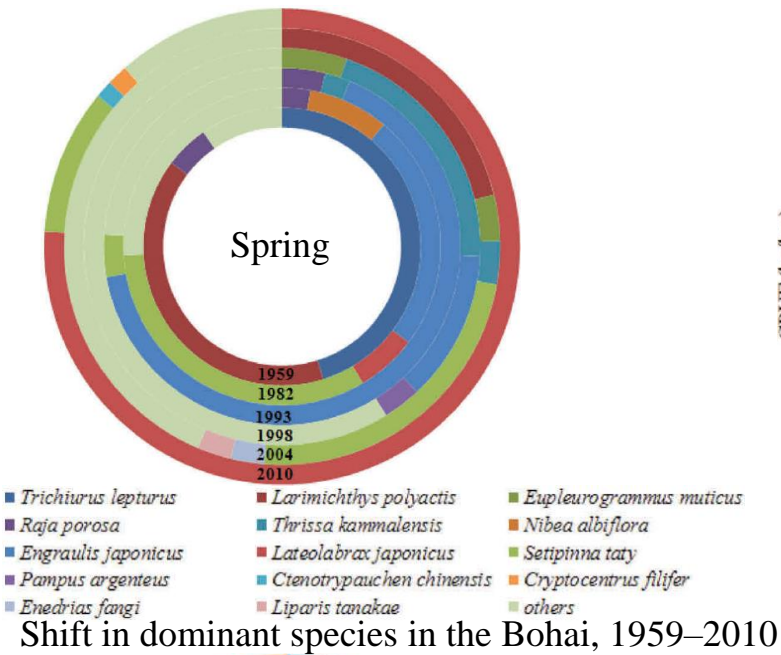
Status of environmental change in the Bohai



- A phytoplankton succession was observed from diatoms dominated communities in the last century to communities co-dominated by diatoms and dinoflagellates in this century
- The frequency and spatial extent of HAB outbreaks had increased significantly since 2000 although these have decreased in recent years



Rapid shifts of the dominant fish species in the Bohai

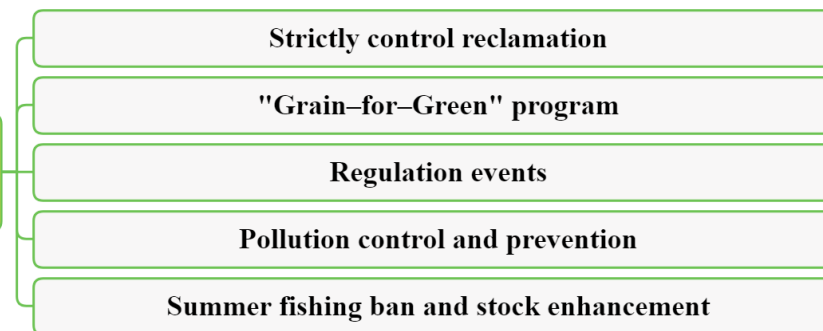
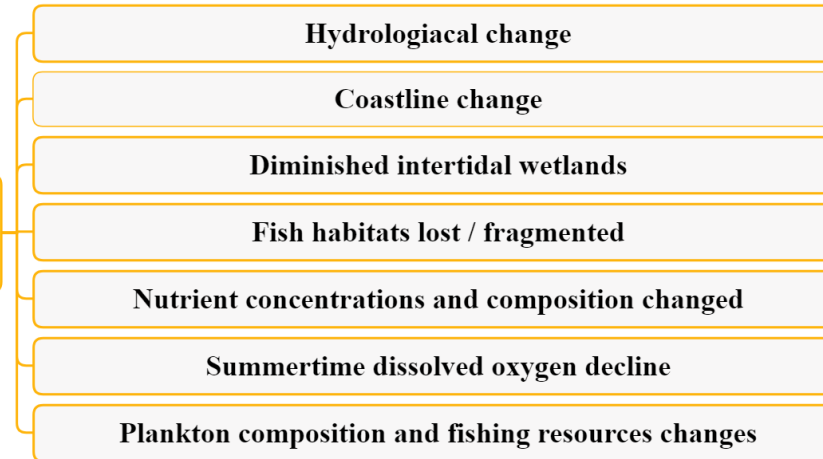
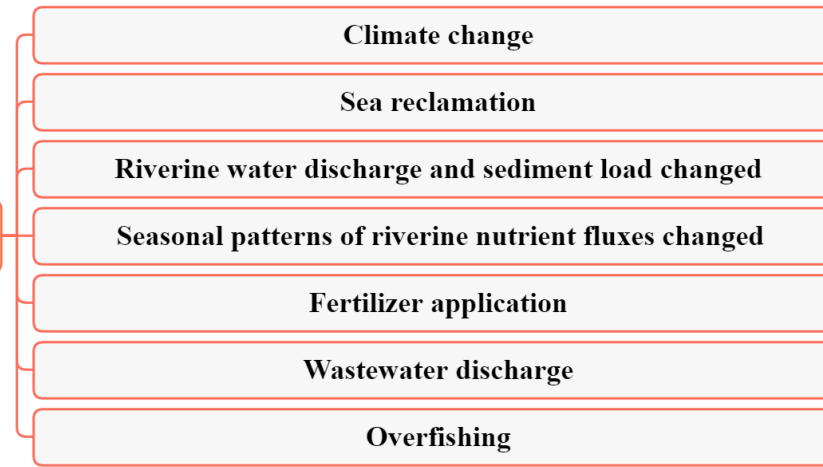
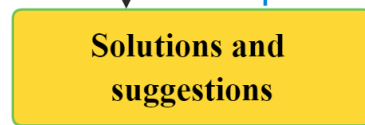
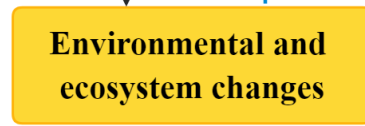
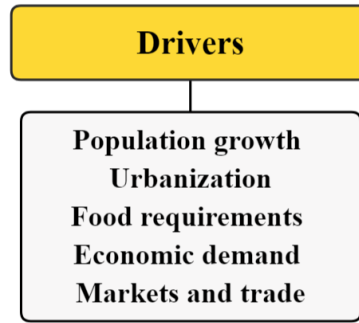


The CPUEs of the main commercial fish species and their percent contributions to the total catch

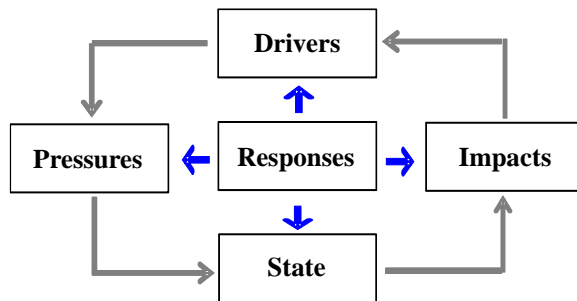
Jin, 2020; Shan et al., MCF, 2016

- The dominant species of large-size and high economic value have been replaced by the small-size, low-trophic-level species since the 1950s
- The biomass of fishery resources had a decreasing trend
- Main factors: top-down effect (increasing fishing pressure) and bottom-up effect (substantial environmental variations)
- Banned fishing periods
- Stock enhancement should be vital besides environmental improvement





The interlinkage of the drivers and pressures on the environmental state variables and social responses as well



The DPSIR model



Contributions from:

Initiators of tasks:

**Yongming Luo, Zengjie Jiang, Jiayu Bai, Xindong Ma, Guangshui NA,
Chen Tu, Su Mei Liu...**

IMBeR SSC member and IPO-Shanghai:

Ying Wu, Gi Hoon Hong, Fang Zuo, Kai Qin, Nian Wu



Thank you !



Grand challenge I

Understanding and quantifying the state and variability of marine ecosystems

Grand challenge II

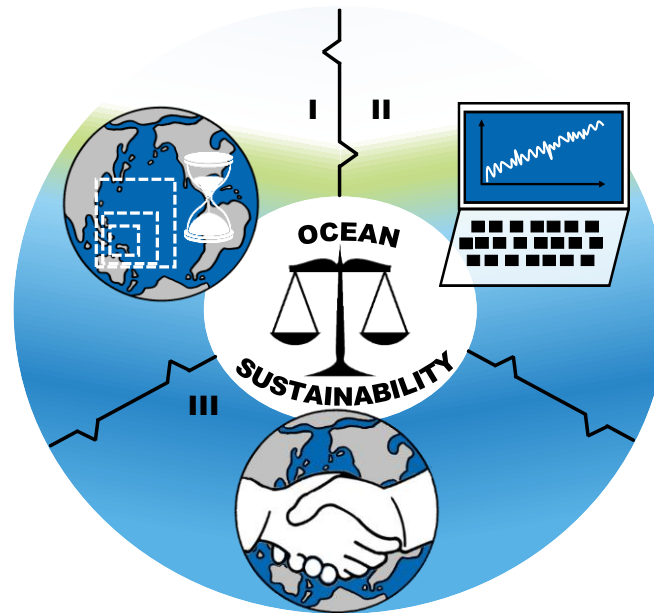
Improving scenarios, predictions, and projections of future ocean-human systems at multiple scales

Innovation challenge 5
Interventions to change the course of climate impacts



Innovation challenge 4

Advancing and improving the use of social science data for ocean management, decision making, and policy development



Innovation challenge 3

Advancing understanding of ecological feedbacks in the Earth System

Innovation challenge 6

Sustainable management of Blue Carbon ecosystems

Grand challenge III

Improving and achieving sustainable ocean governance

Key issues

Highlight priority issues for marginal seas

Knowledge & understanding

- Status and change?
- Current human activities and projected activities? How are humans responding to ecosystem changes?
- What are critical knowledge gaps?

Development, Innovation, and Risk

- Pressing needs?
- Trends and projected uses of resources?
- Risk from increased human use?

Governance and Management

- Stakeholders and current governance structures?
- What are the knowledge gaps that make some features of governance ineffective? What aspects of governance are strong and which are weak, with respect to sustainability?
- How can science more effectively inform policy toward governance and management?