Mangroves: A Potential Coastal Defense for Shanghai in the Future

Dr. XingXing Cai

- School of Life Sciences
- Fudan University, Shanghai, China
- xxcai@fudan.edu.cn

- 29 August 2023

CONTENT

- Coastal wetland ecosystem restoration: A necessity for Shanghai
- Mangrove Plantation as a potential Nature-based Solution
- Current Progress and future prospects

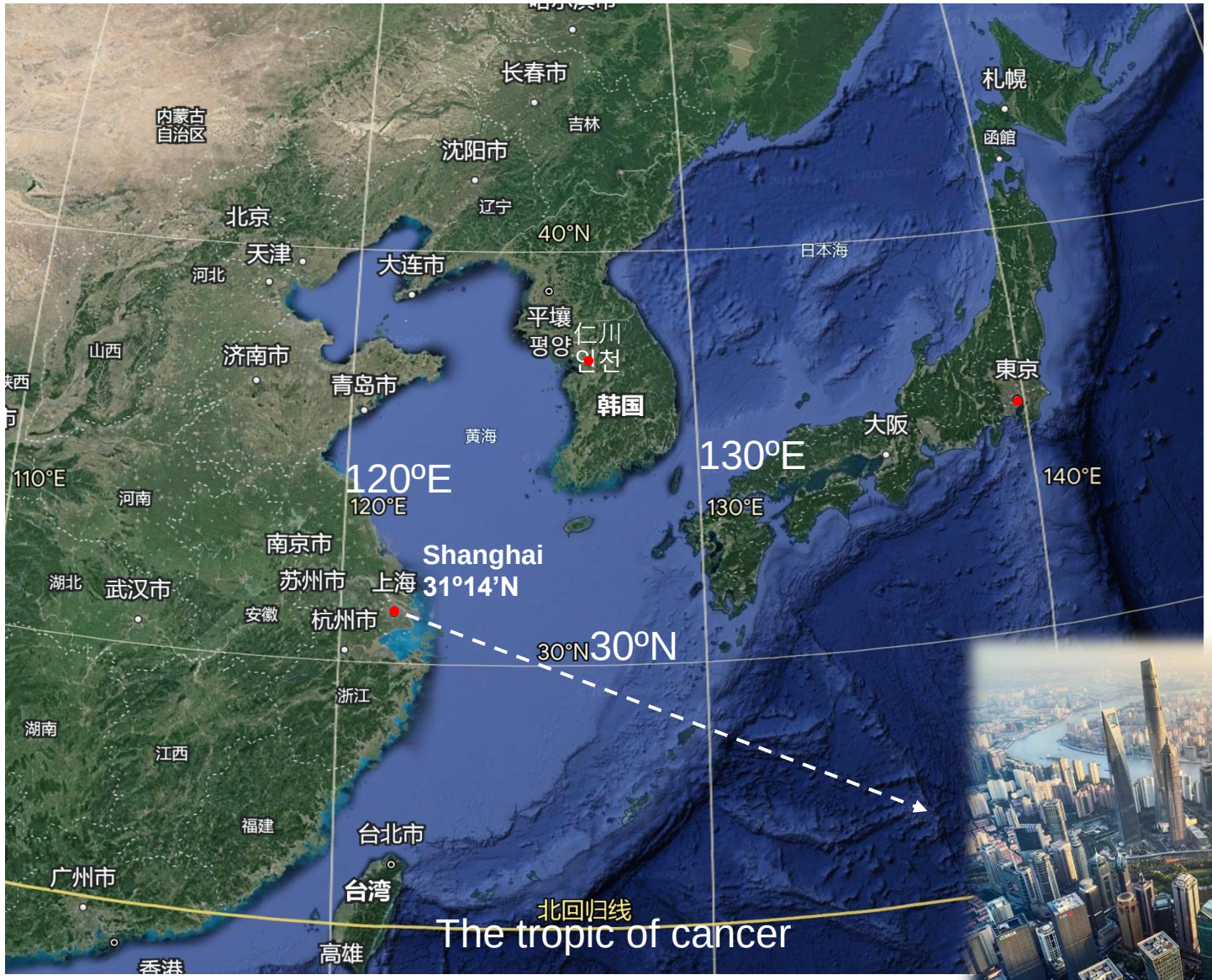
Coastal wetland ecosystems help achieve SDGs

Coastal wetland ecosystems which offer **numerous ecological services**, frequently rank among the most densely populated areas and are facing escalating human impacts.

- raw materials and food
- coastal safeguarding
- Erosion control
- Biodiversity conservation
- Water purification
- Carbon sequestration
- Tourism, recreation, education and research

…

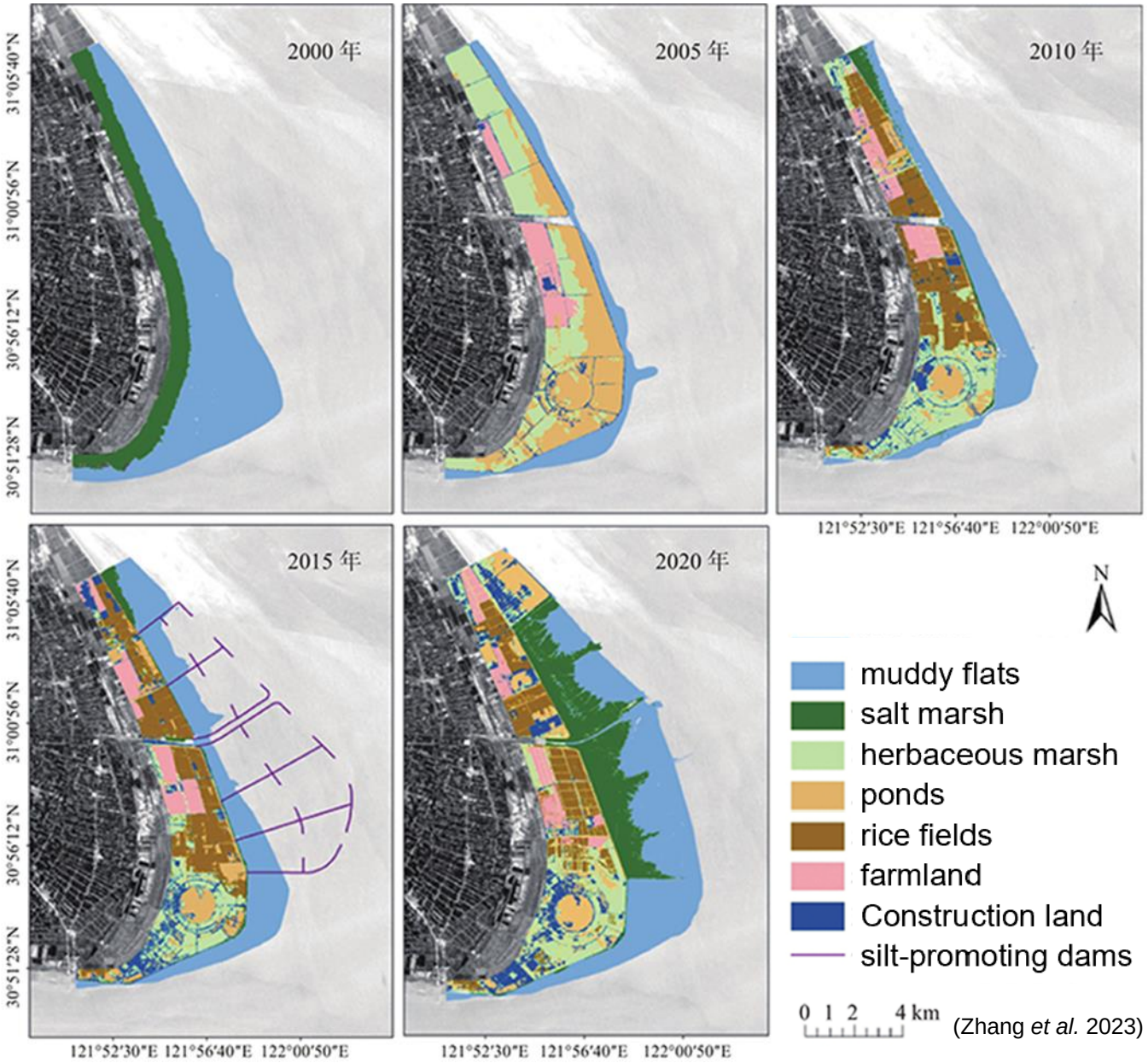
Coastal wetlands loss and degradation in Shanghai, China



Shanghai(31°14'N,121°29'E), is a coastal modern megacity with high population concentration**, located at the Yangtze River Estuary**

- With more than **25 × 10^4 ha coastal wetlands**
- Controlled by **East Asian subtropical** monsoon climate
- **facing threats** from reclamation, exotic species invasion, coastal erosion and climate change

Factors threaten Shanghai's coastal wetland ecosystems



(Zhang *et al.* 2023)

Reclamations not only directly modify wetland morphology and hydrology

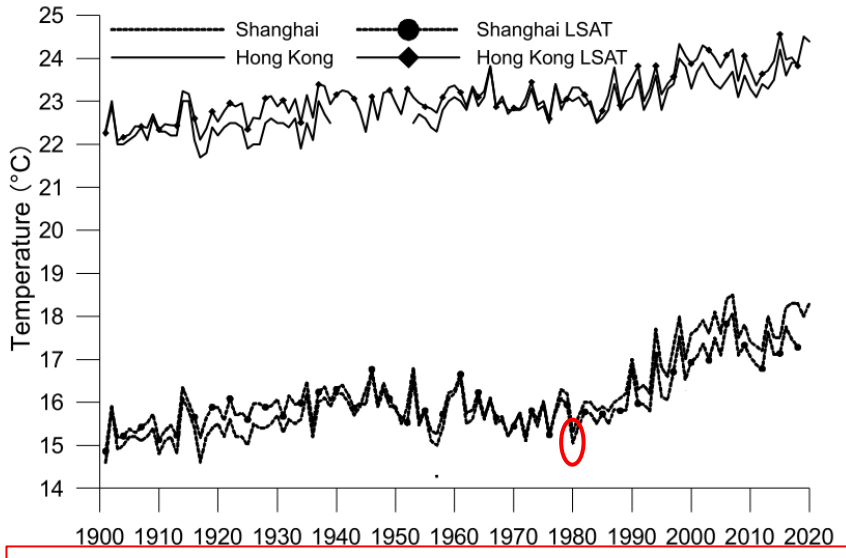
→ but also cause **severe water and soil pollution**

→ lead to **biodiversity and habitat losses**

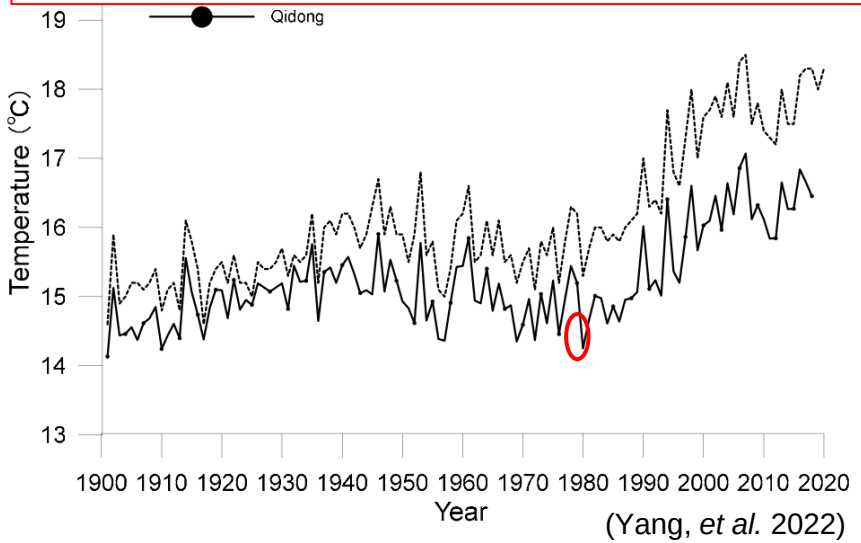
→ **impair wetland ecosystems functioning and ecosystem services**

Meanwhile, **the expansion of *S. alterniflora*** is the main factor that threatens the remaining tidal wetlands quality in the near future.

Increasing vulnerable to disasters induced by climate change

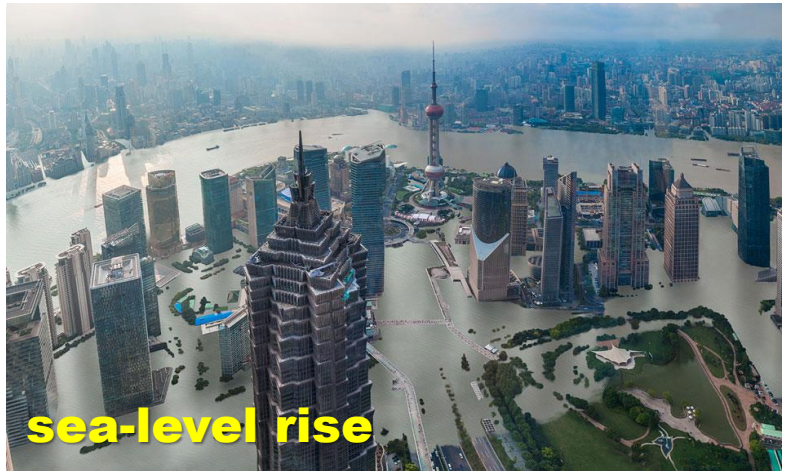


The average mean temperature increased rapidly since 1980

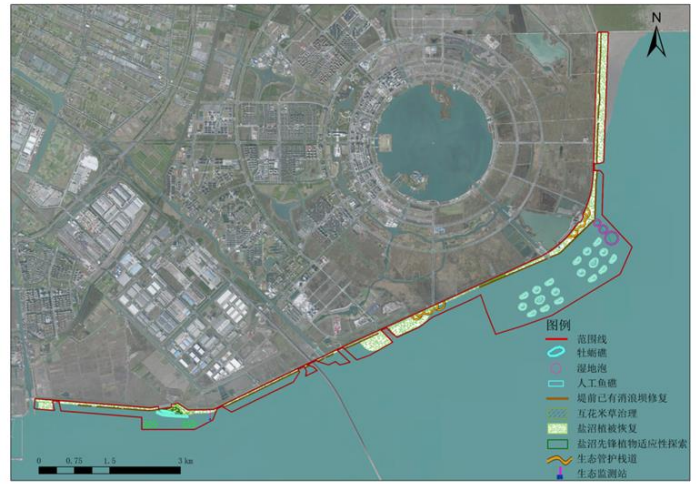


(Yang, *et al.* 2022)

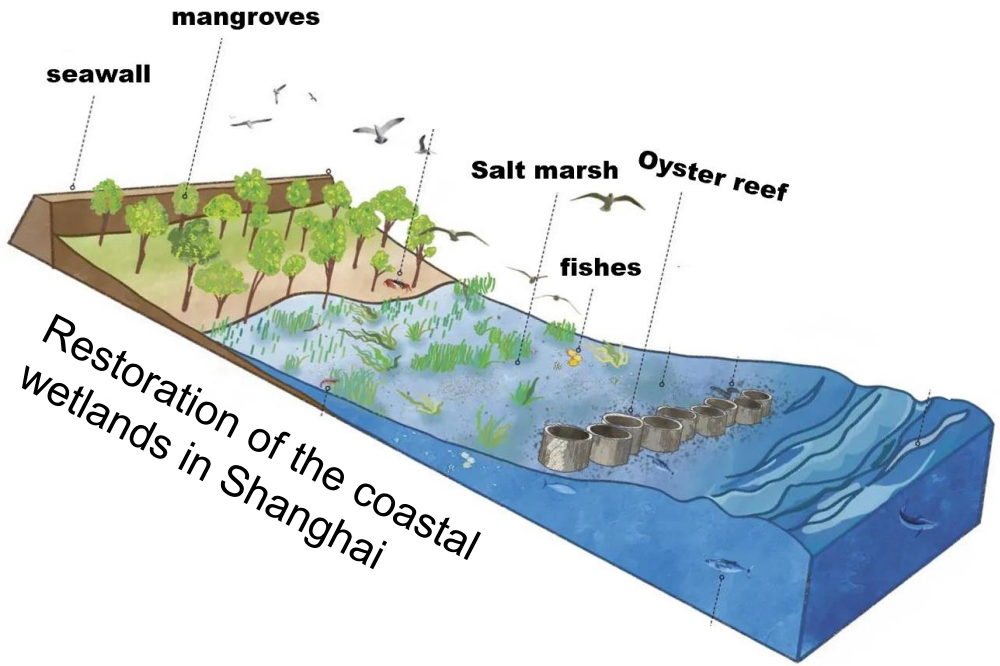
To ensure Shanghai's sustainable development, a comprehensive plan for conserving and restoring coastal wetlands is crucial.



Planting mangroves may be a possible NbS to restore degraded coastal wetlands in Shanghai

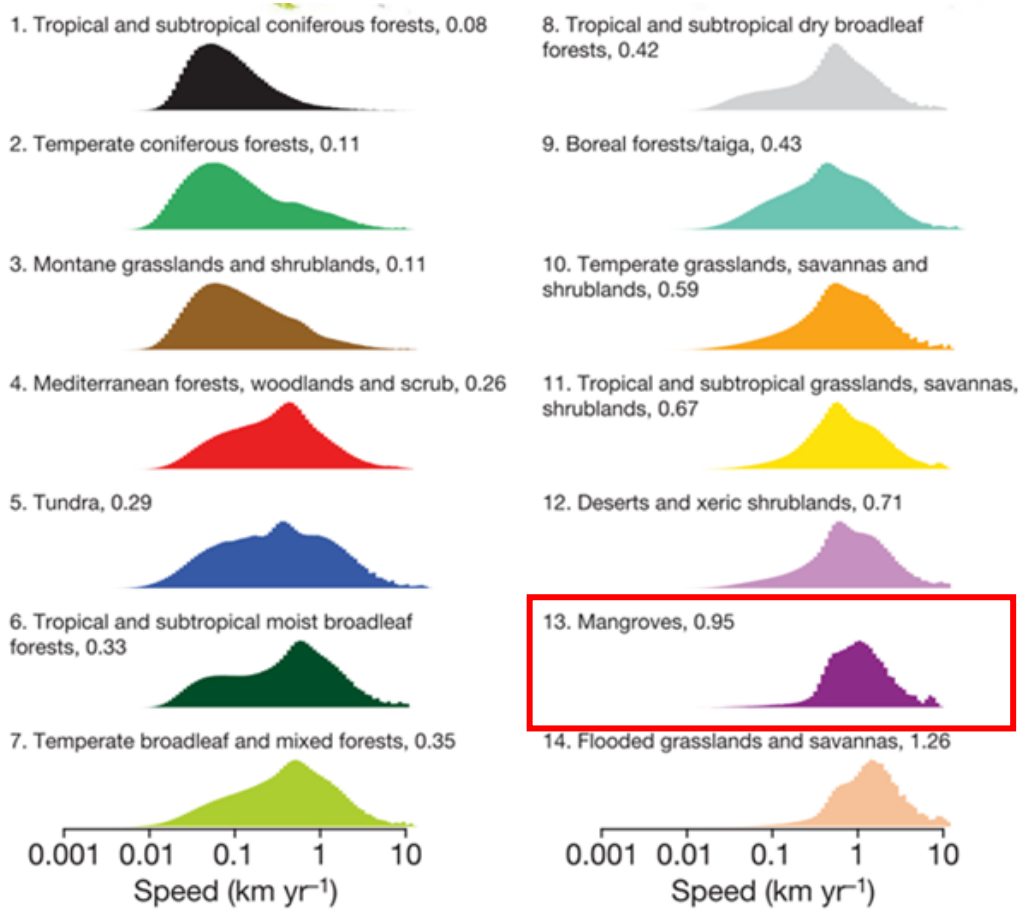


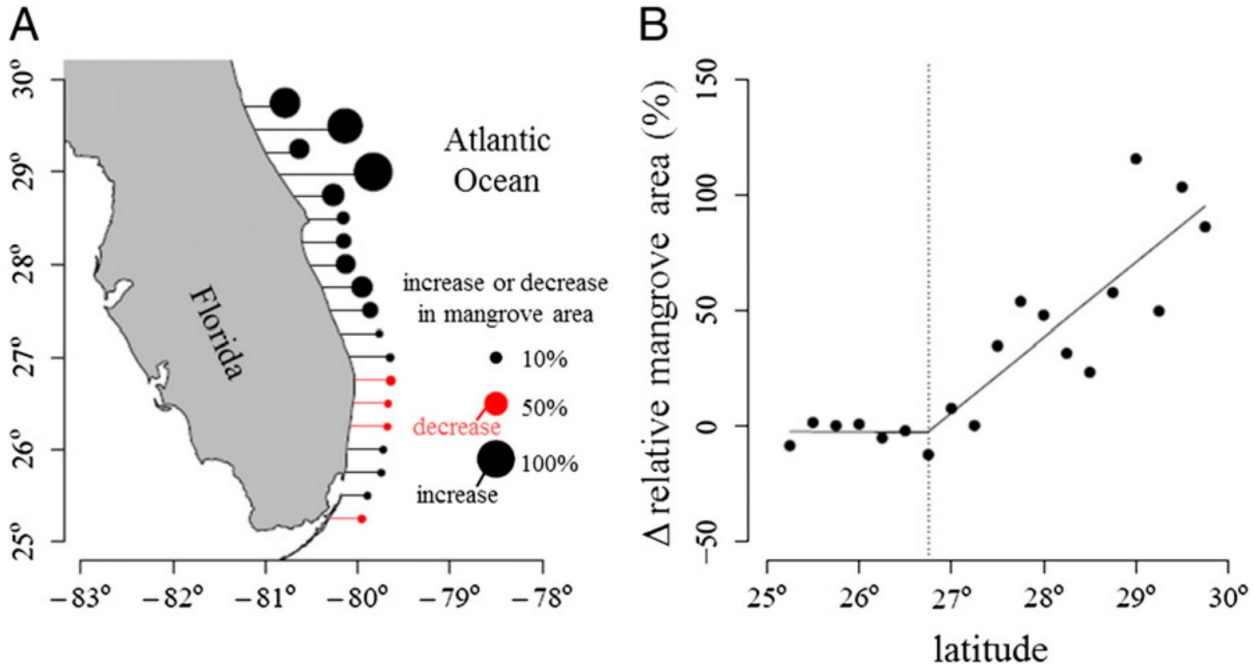
Mangroves, woody plant communities thriving in the coastal intertidal zones and river estuaries of the tropics and subtropics, constitute a unique form of forest adapted to the transitional zone between land and ocean**, likely delimited in latitudinal range by varying sensitivity to cold.**



Mangrove ecosystems provide outstanding ecological ,economic and social values

Opportunities : the ranges of plants are moving in response to recent changes in climate



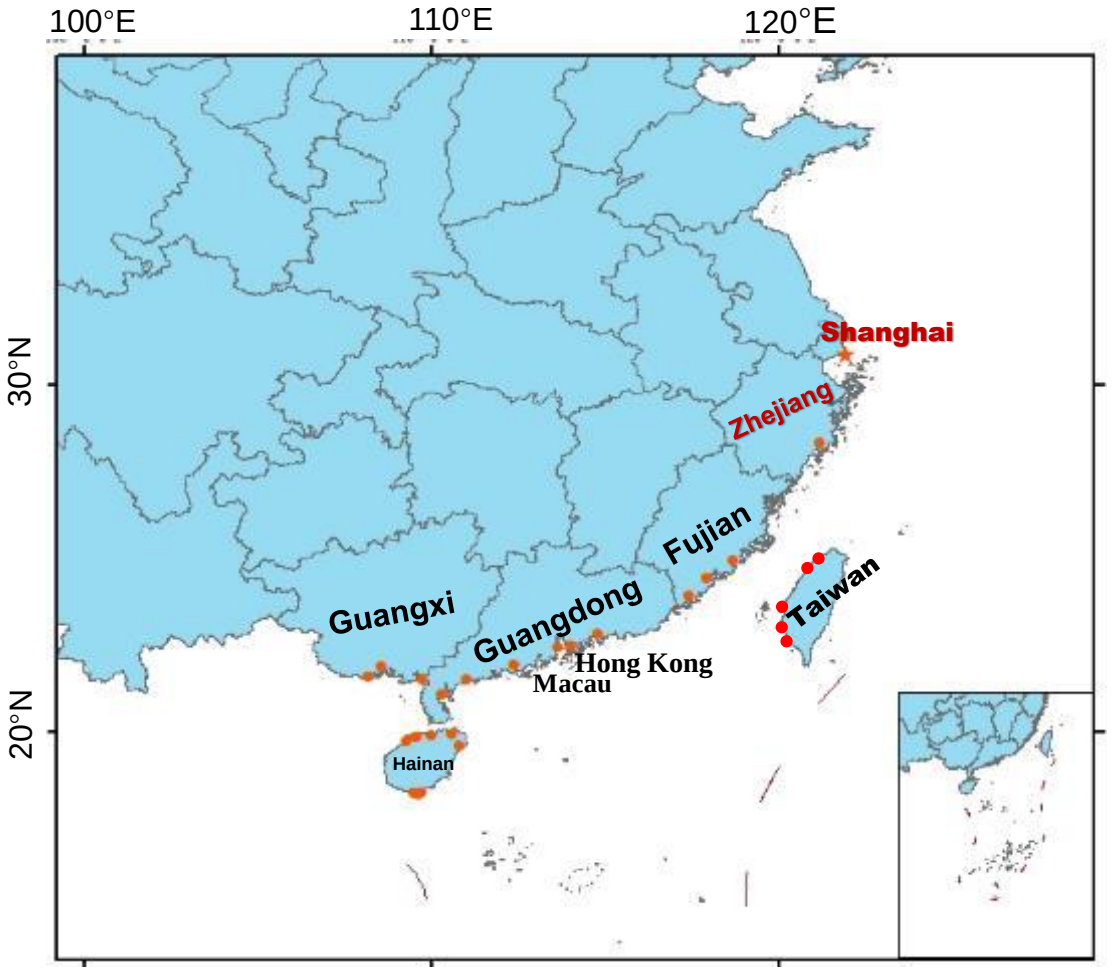


Mangroves **northward expansion** in Florida: due to **a reduction in the frequency of "extreme" cold events(−4°C)** (Cavanaugh *et al.* 2014)

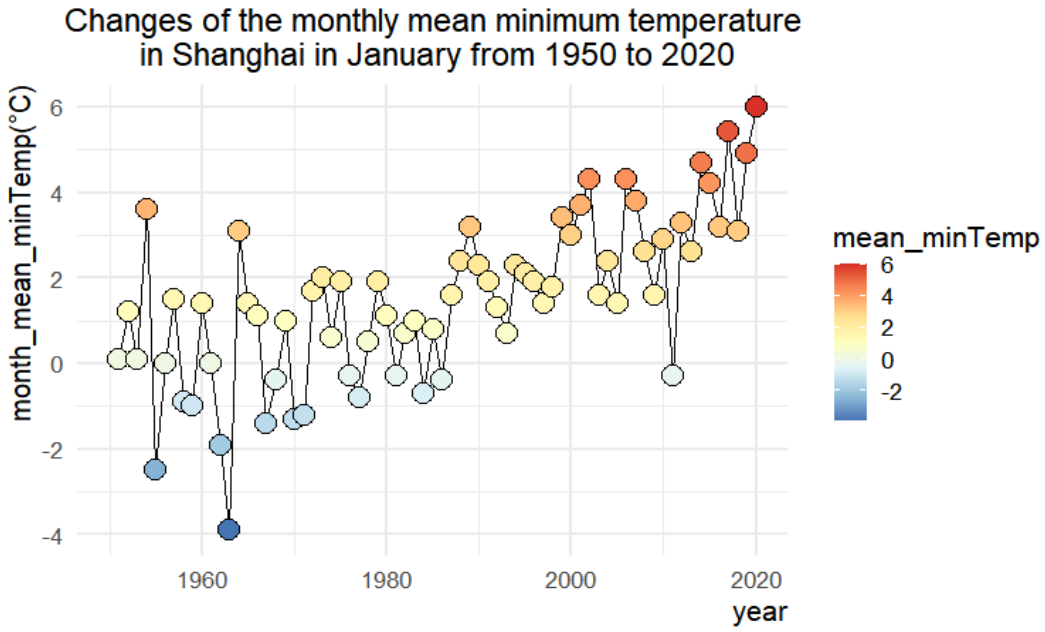
Mangroves need a relative velocity at 0.95km yr-1 so as to keep pace with climate change (Loarie *et al.* 2009)

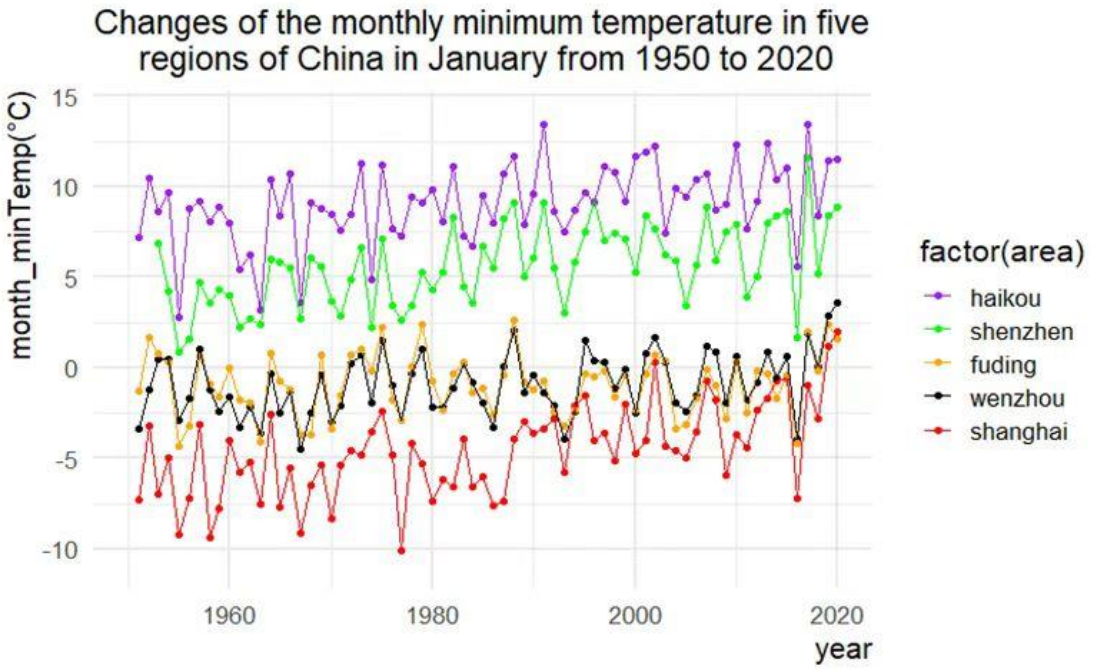
Artificial mangroves have been established in Zhejiang, China

Mangroves in China are **naturally** distributed in 8 provinces and regions except **Zhejiang** province, where mangroves are **introduced**.



Monthly mean minimum temperature in January in Shanghai is warming (1950~2020)





years	1951~1960	1961~1970	1971~1980	1981~1990	1991~2000	2001~2010	2011~2020
annual average temperature(℃)	15.67	15.67	15.65	16.01	16.94	17.78	17.80
Minimum average temperature in January(℃)	0.35	-0.23	0.74	1.06	1.98	2.86	3.71

Screening cold tolerant mangrove plant species in the past decade

2011-13

10 mangrove plant species were **introduced** altogether from Fujian(natural) and Zhejiang(artificial introduced)province to Shanghai

2013-16

2 mangrove plants （*Kandelia obovata* & *Aegiceras corniculatum* ） **survived and reproduced** in plastic greenhouse successfully

2016-17

Relocation of planting areas, most of the previously surviving mangroves **destroyed**

2018

3.33 hectares **seedling nursery** was established, *Kandelia obovate* was **reintroduced** from Fujian and Zhejiang province

2021

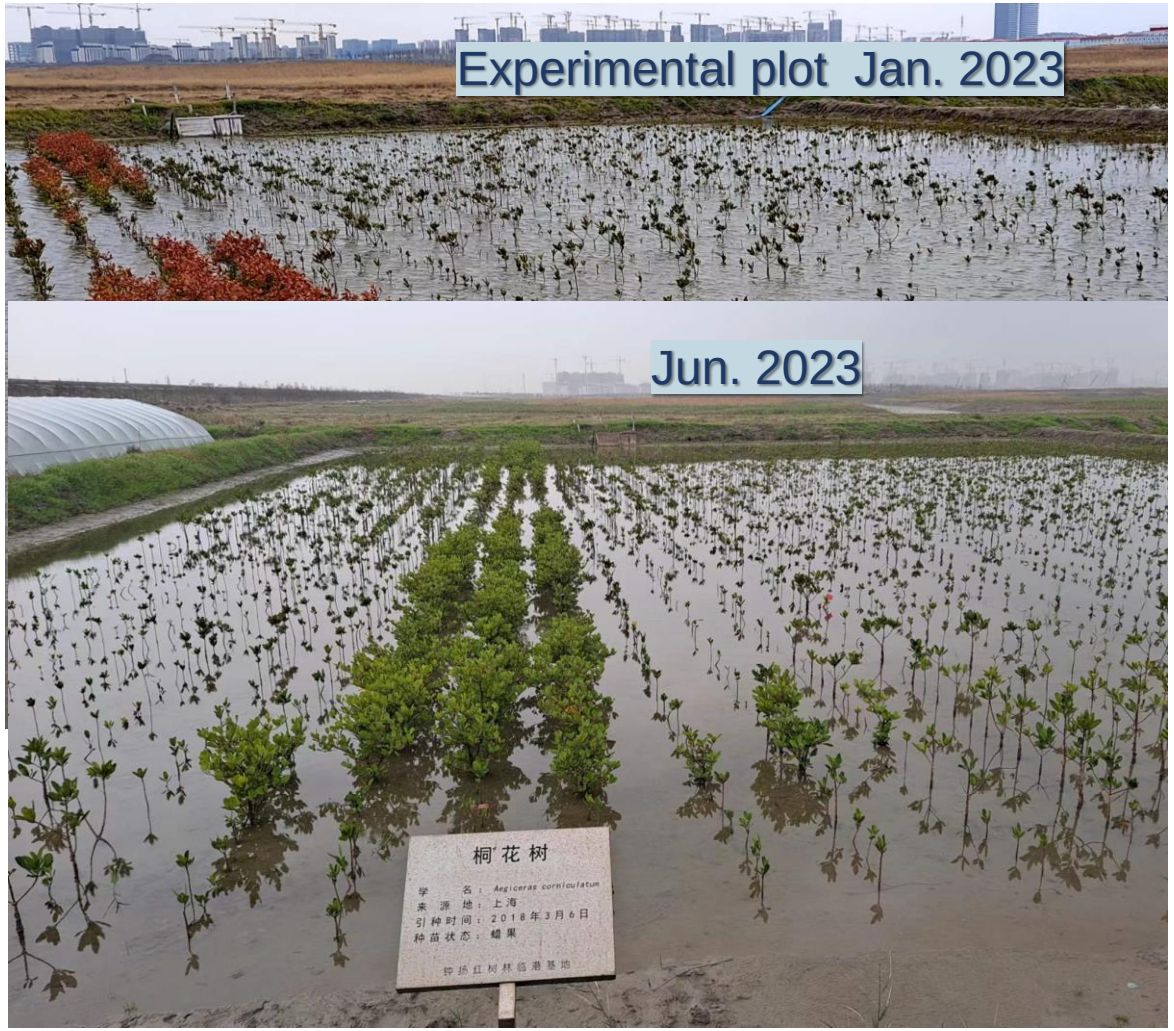
keeping warm by flooding, *Kandelia obovata* & *Aegiceras corniculatum* survived overwinter(-6℃) in the field without plastic greenhouse

2023

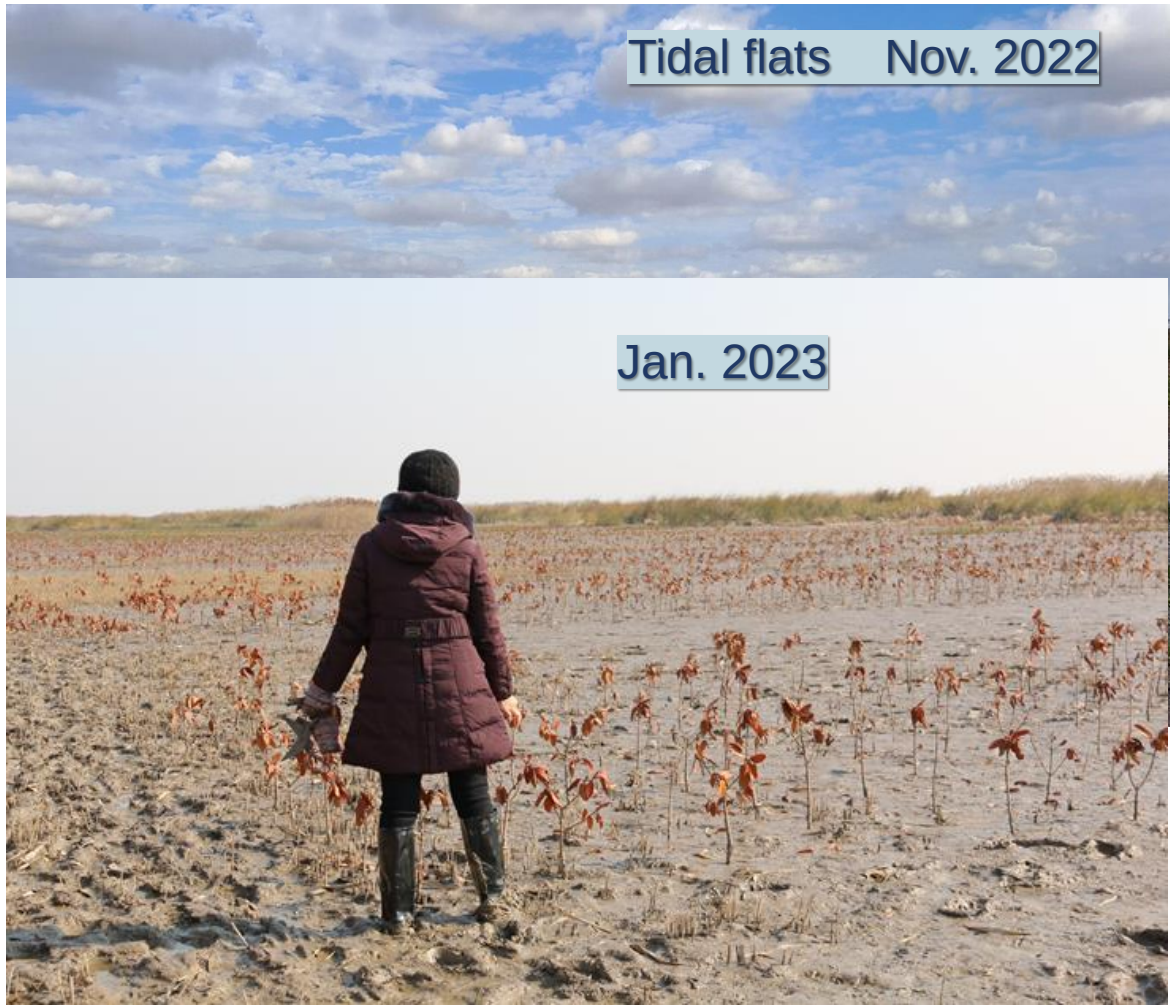
Antifreeze insulation is ineffective in helping mangroves survive winter below -6℃, artificial introduced mangrove seedlings have better cold tolerance than natural seedlings.

Scientific research:
northward migration of mangroves has a long way to go

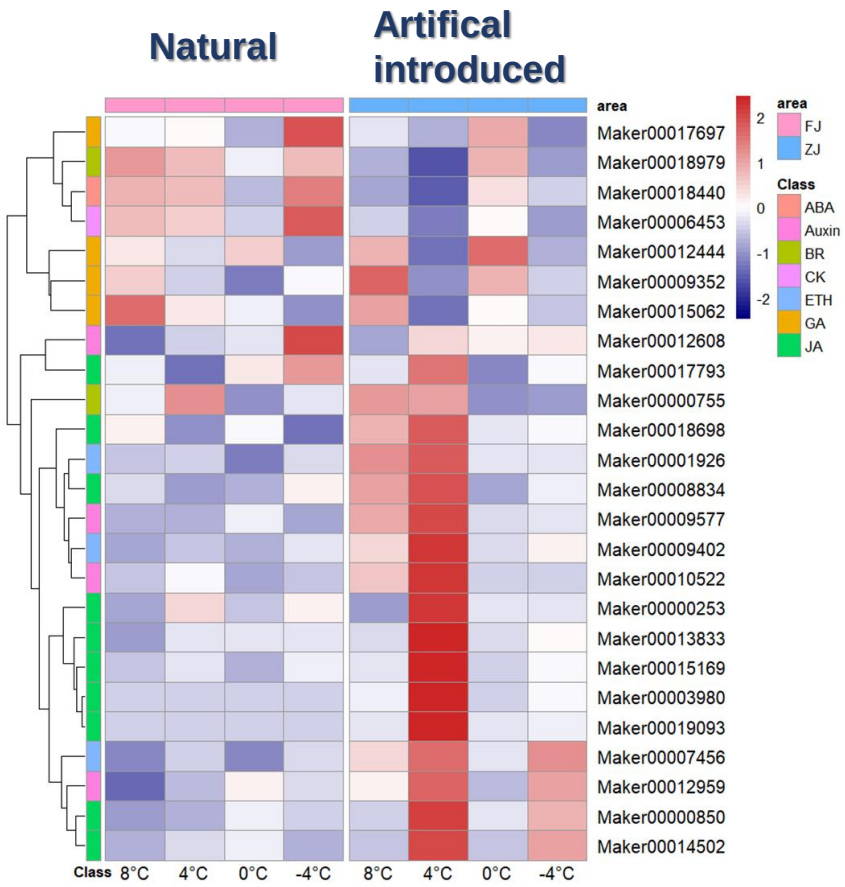
The mangroves planted in our experimental plots have survived the winter(-8℃) safely by flooding



The mangroves planted on salt marsh outdoors haven't survived the winter (-8℃) even with the protection of antifreeze



Ongoing scientific research:
revealing the molecular mechanism of cold-tolerance & conducting cold tolerance training on the propagules of *Kandelia obovata*



Under cold stress, natural and artificial introduced *Kandelia obovata* exhibited different hormone responses

Public science education and hands-on activities

Dr. Yang Zhong

Fudan team and collaborators

Thanks to the Shanghai Municipal Science and Technology Commission Fund,
as well as to the public welfare funds donated by Gangcheng Group Company and Morgan Stanley Securities

xxcai@fudan.edu.cn, +86 (21) 31246710