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High alkalinity input into the Yellow Sea

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Western Pacific marginal seas

N inputs

Yellow River

Bohai Sea

Korea

East Sea

Yellow Sea

Japan

East China Sea

Changjiang River

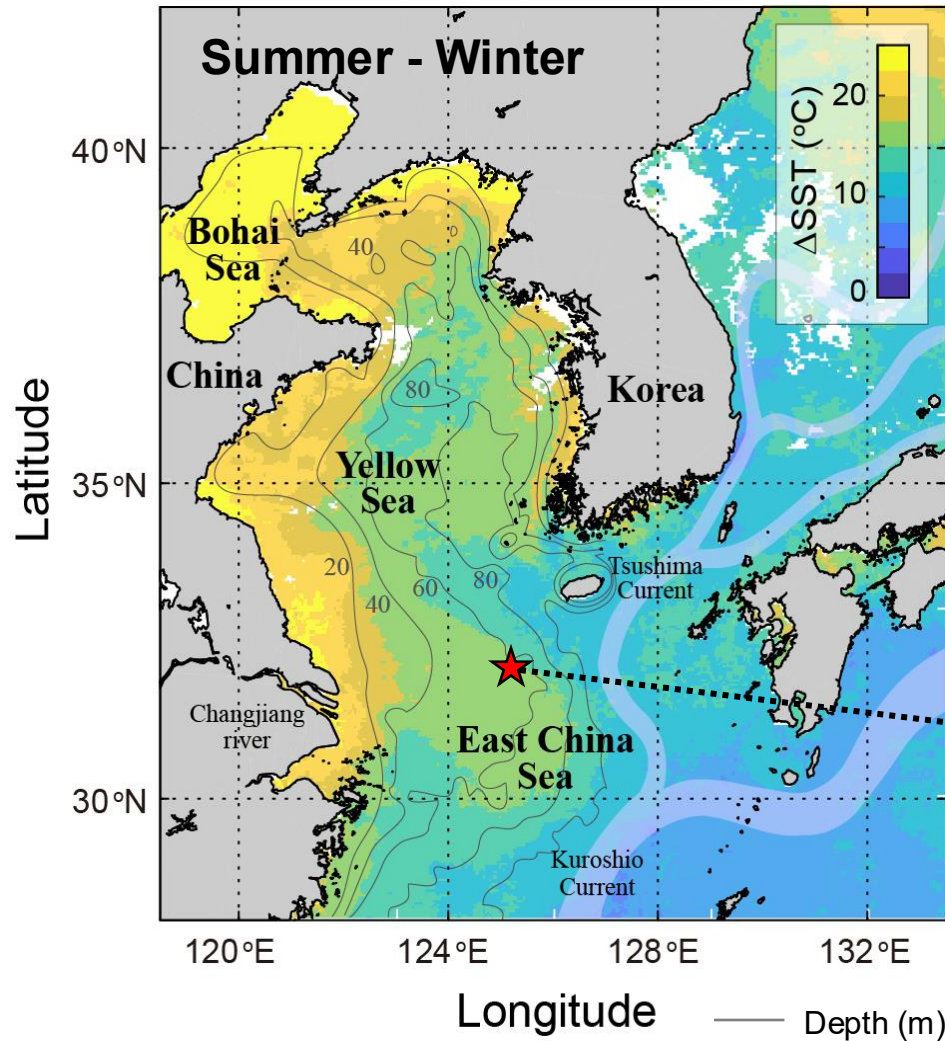
**Kuroshio
current**

Continental shelf

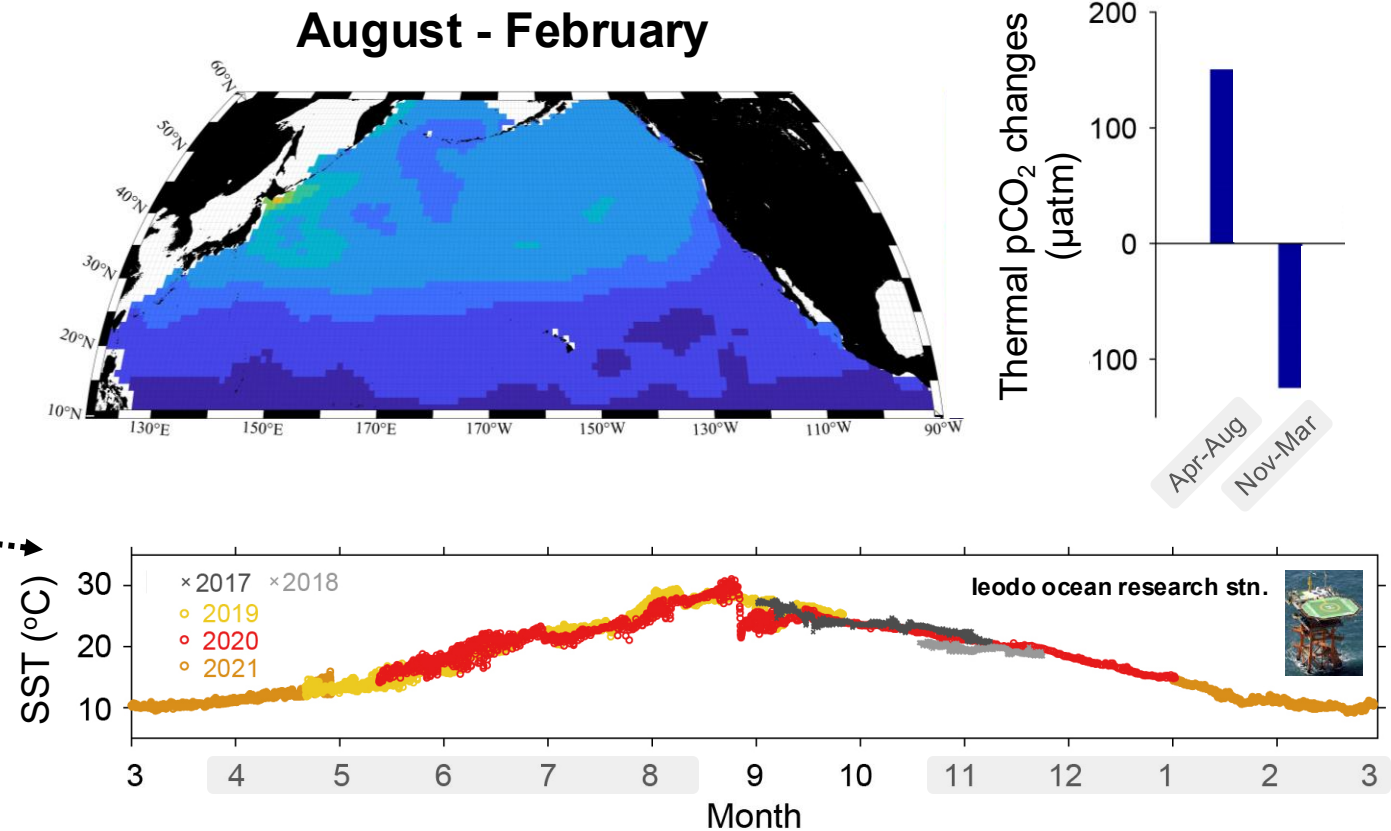
East Asian Monsoon

**Natural
+
Anthropogenic
Forcings**

1. Extreme seasonal temperature variations (Natural)

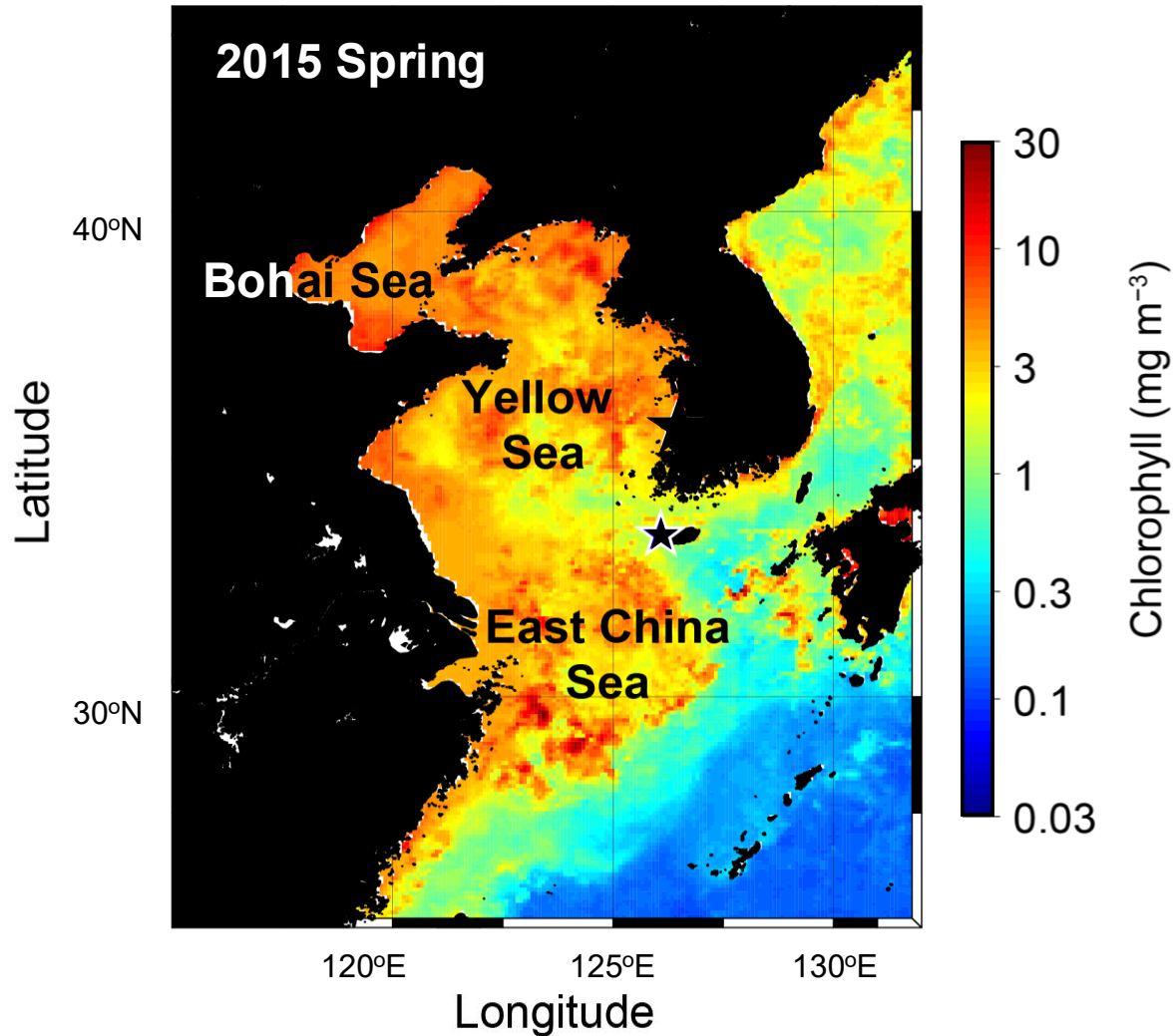


Extreme SST variations

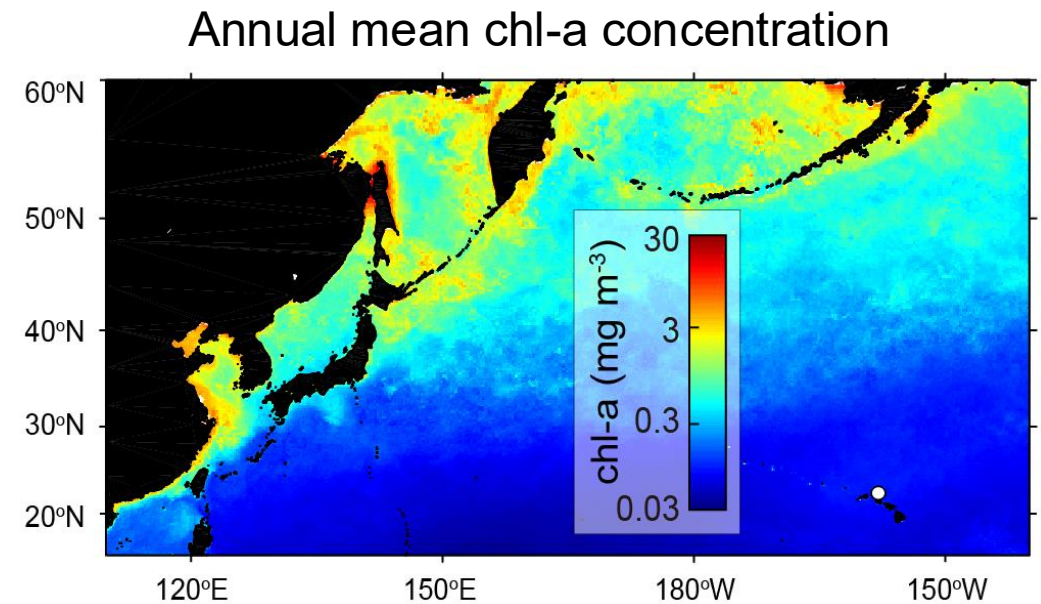


Lee et al. (Frontiers in Marine Science 2022)

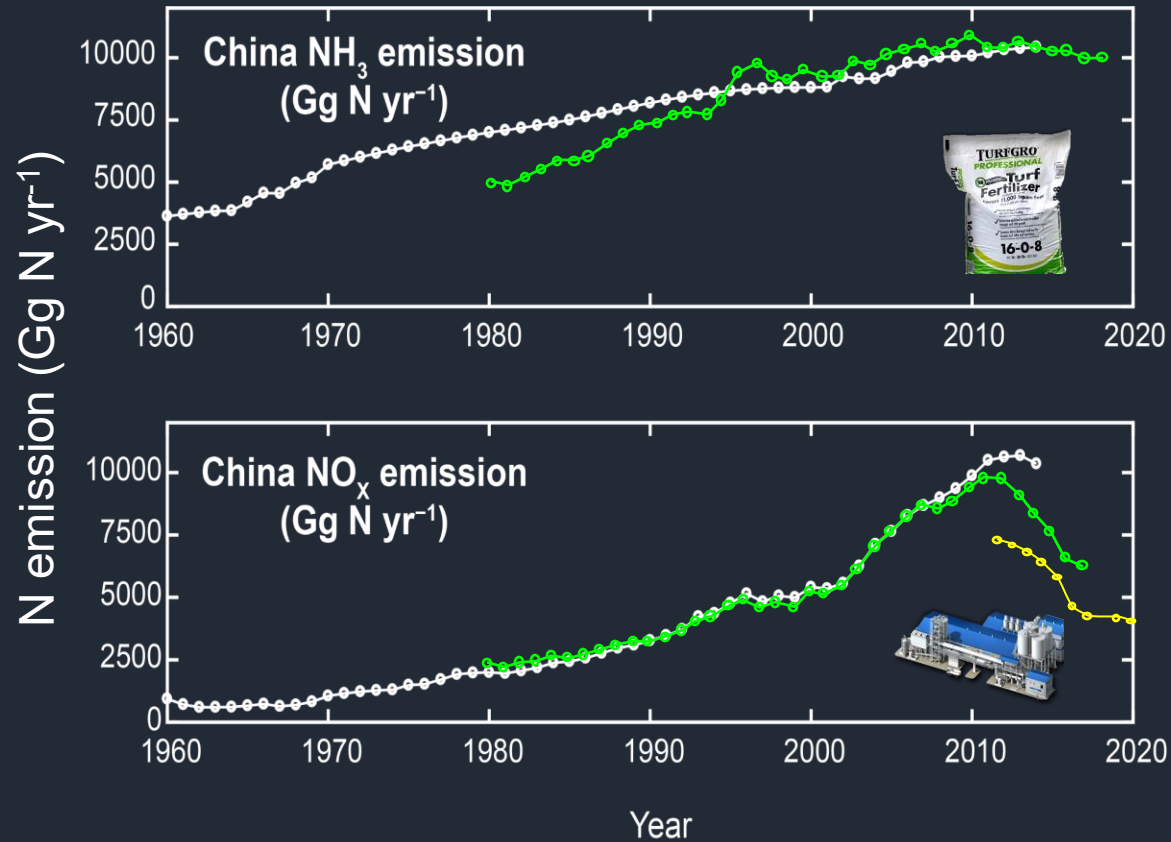
2. High biological productivity (Natural)



High biomass



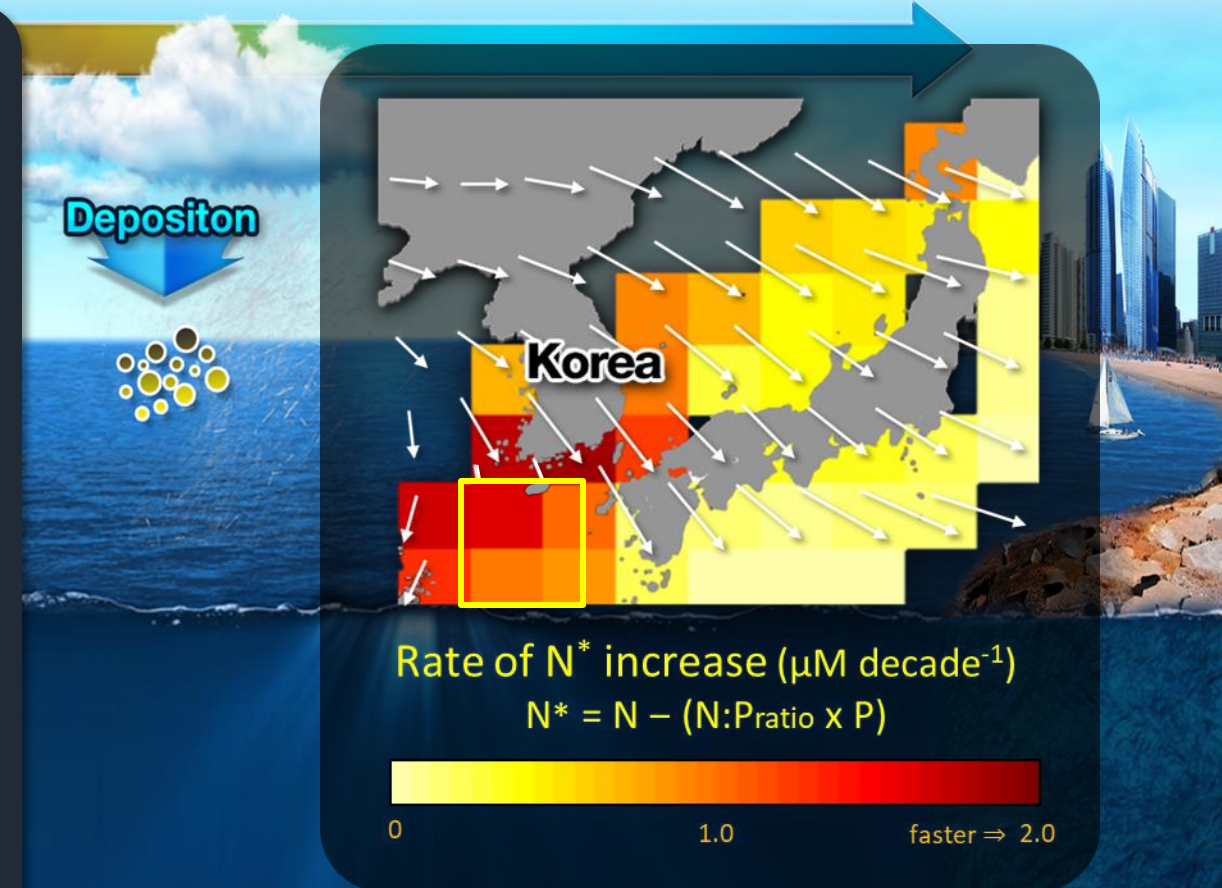
3. Increasing anthropogenic N release



Hoesly et al. (Geoscientific Model Development 2018)

Zheng et al. (Atmospheric Chemistry Physics 2018) · Liu et al. (Philosophical transactions A 2020)

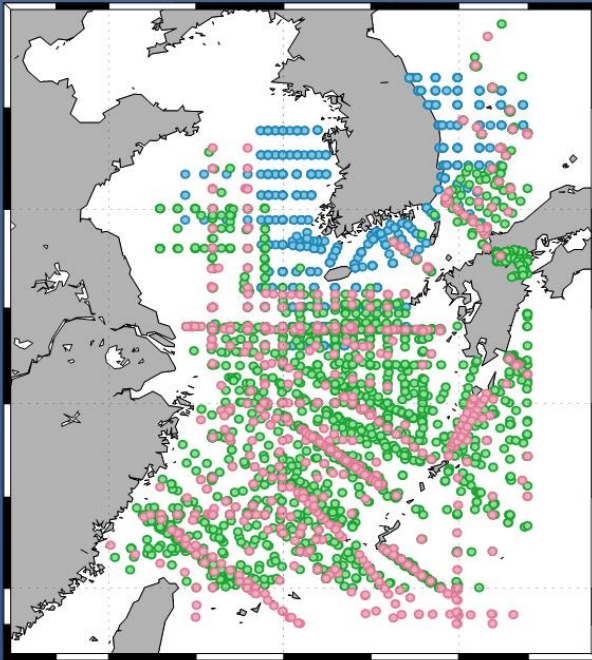
Emissions Database for Global Atmospheric Research · China Statistical Yearbook 2022



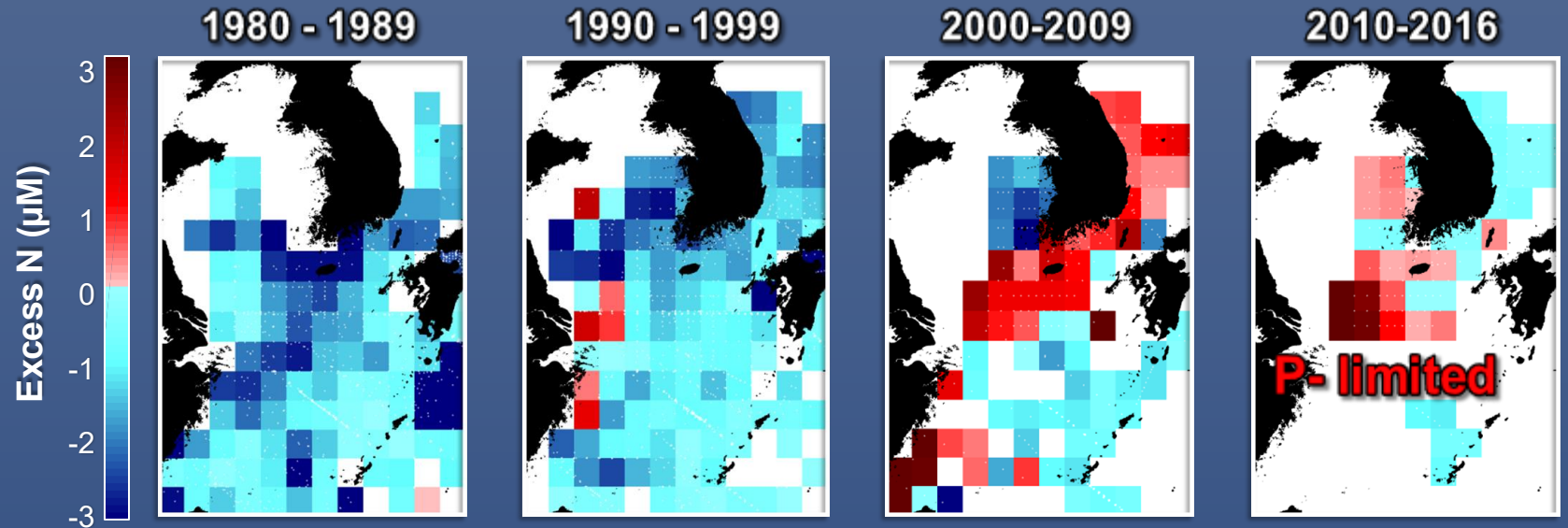
Kim et al. (Science 2011)

Shift from N-limited to P-limited

Data (N & P)



- KODC 106,300 data points
- JODC
- WOD



The area of P-limitation has increased over time!

Carbon data observed in the Yellow Sea

Data for Bohai Sea and Chinese-side Yellow Sea



provided by [prof. Wei-dong Zhai](#)

Institute of Marine Science and Technology
Shandong University, China

periods: 2012–2018

parameters: T, S, O₂, A_T, C_T

Carbon Observations in waters around Korea

by **POSTECH** and **National Institute of Fisheries Science**



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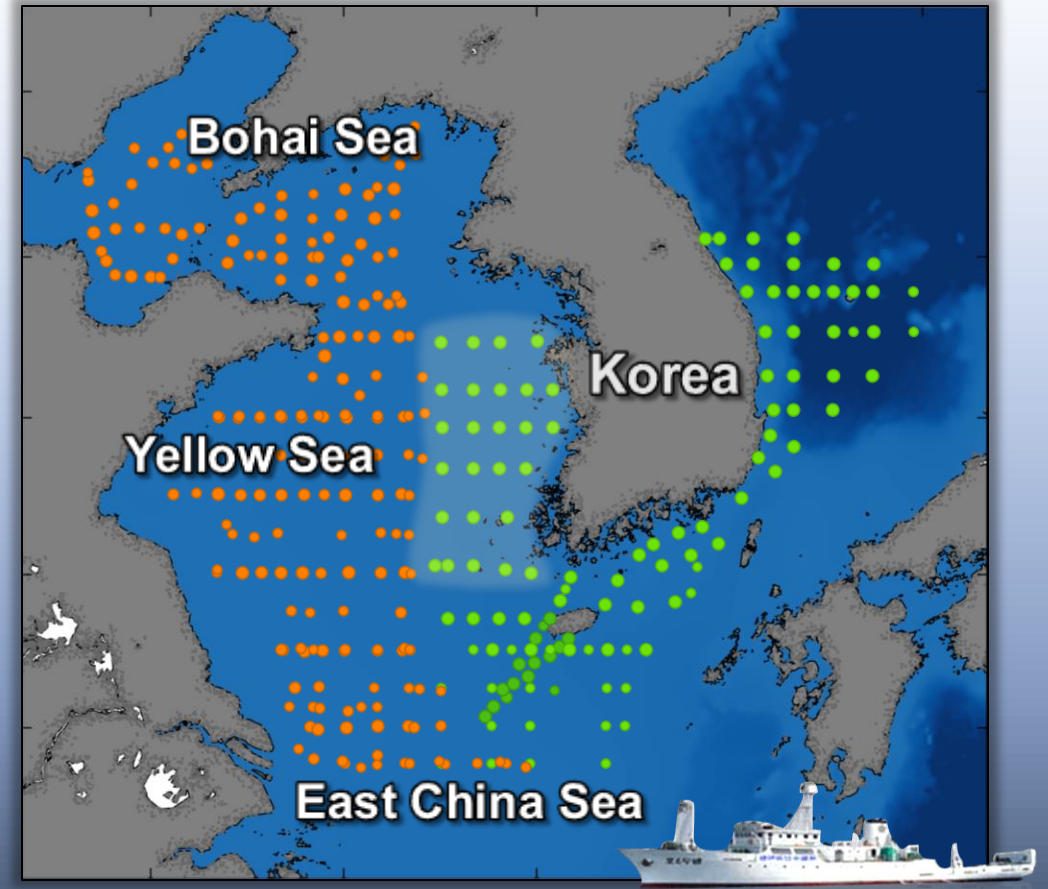


**National Institute of
Fisheries Science**

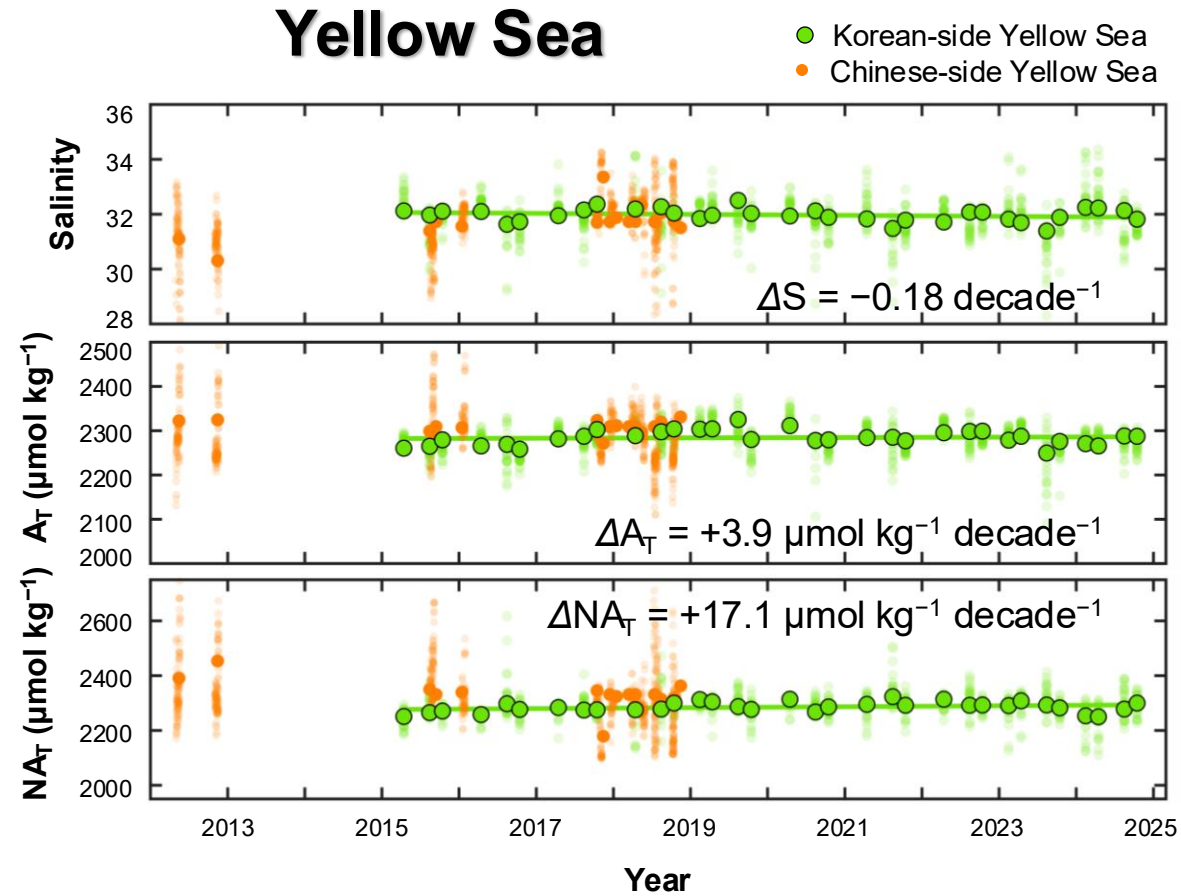
periods: 2015–Present

(Feb · Apr · Aug · Oct)

parameters: T, S, A_T, C_T



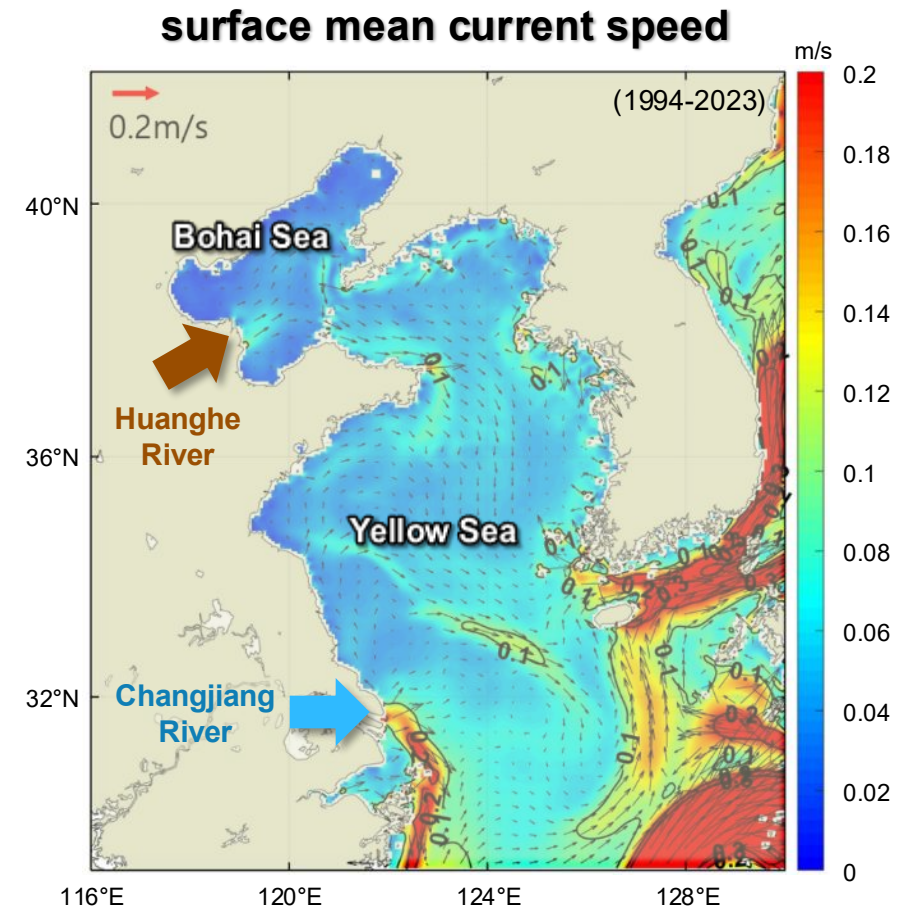
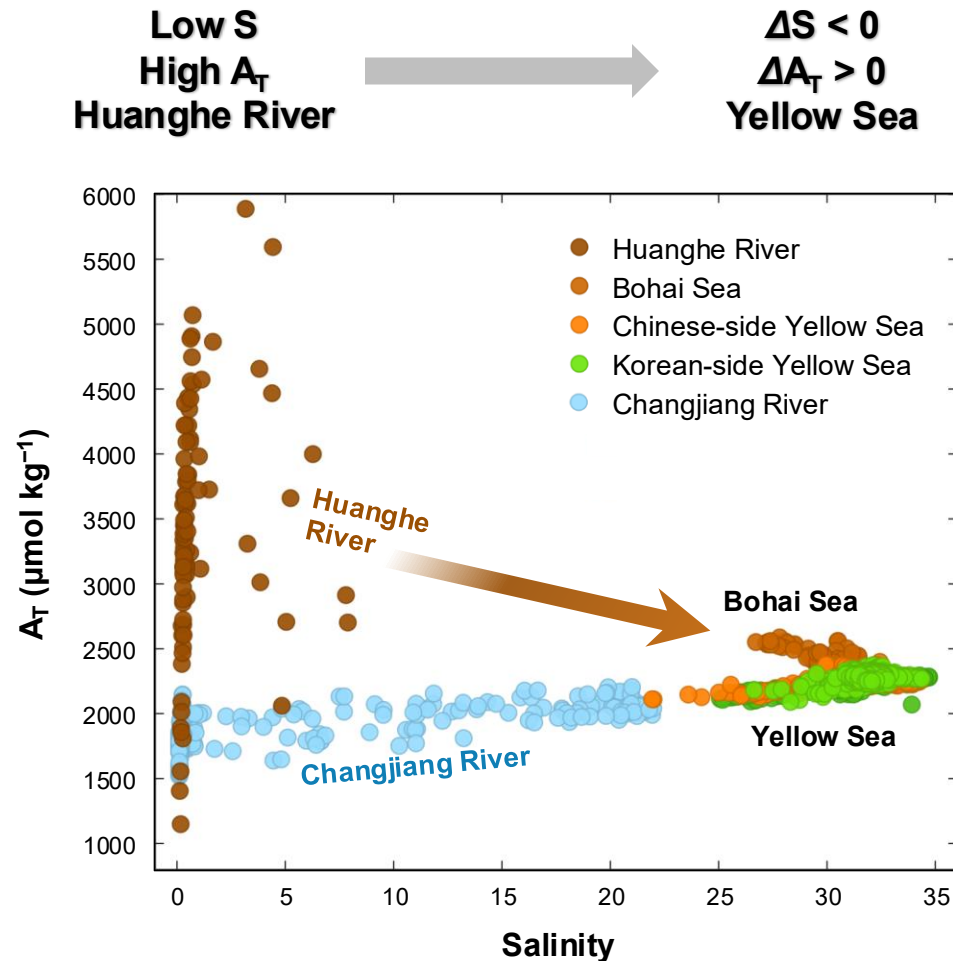
Decadal freshening and alkalinity increase in the Yellow Sea



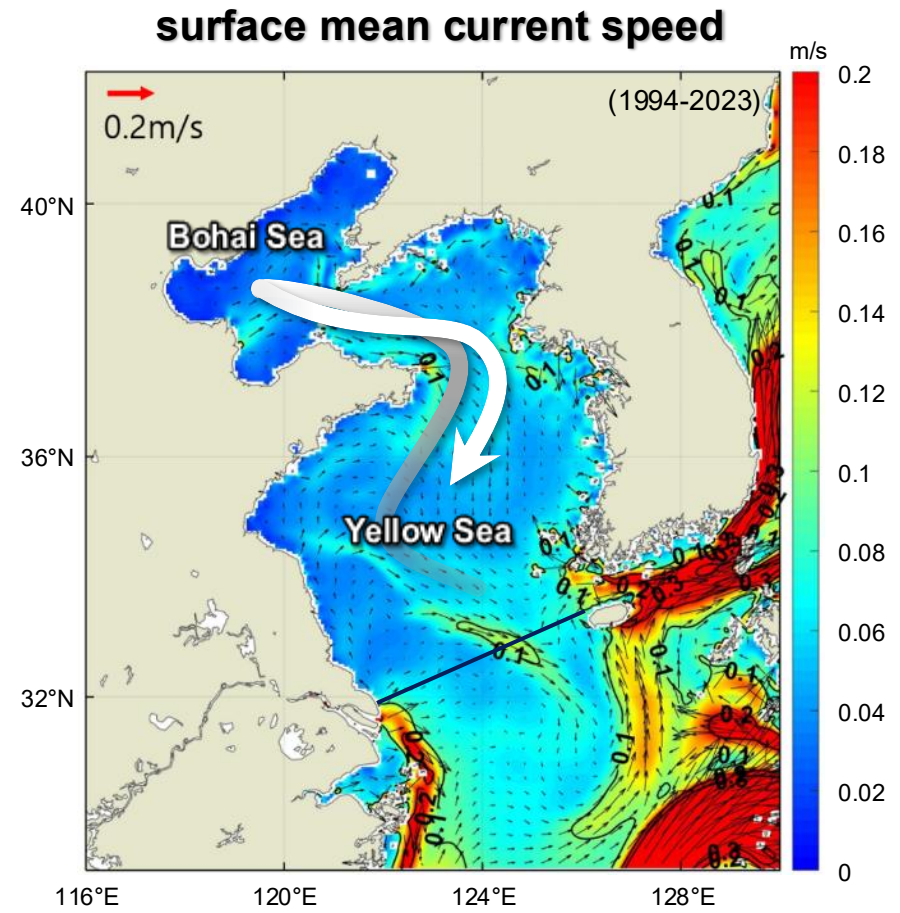
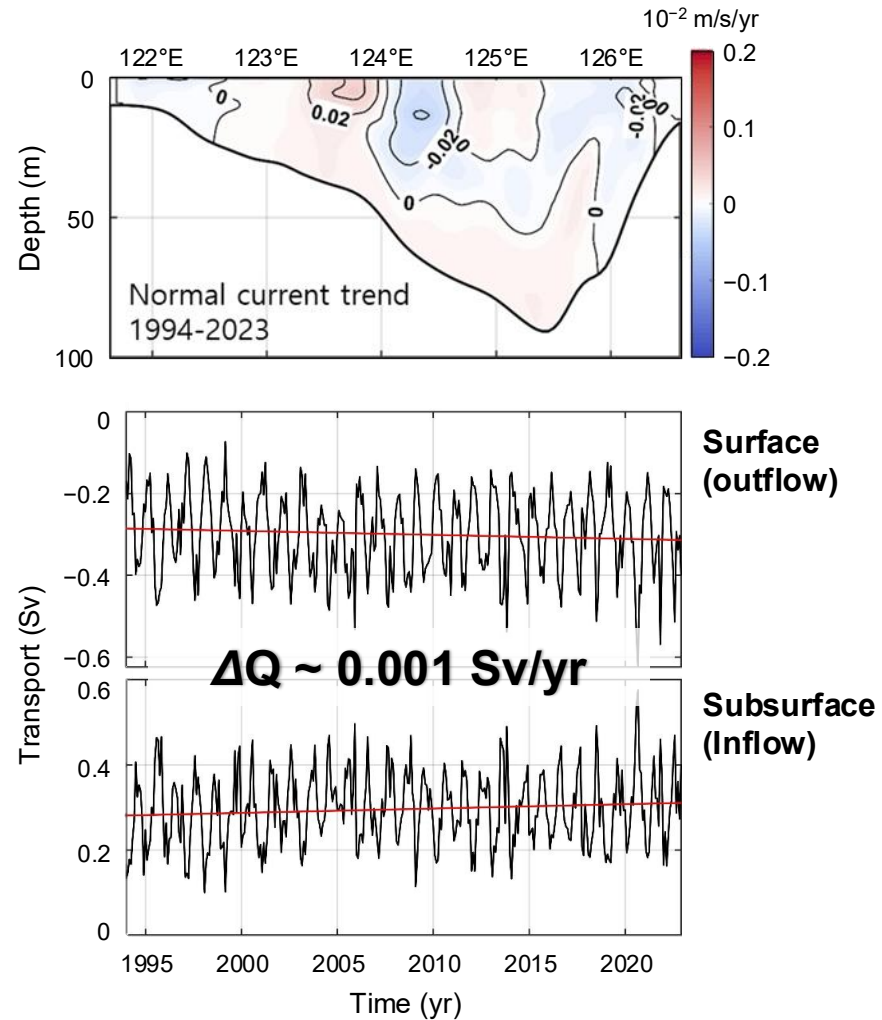
S ↓

A_T ↑

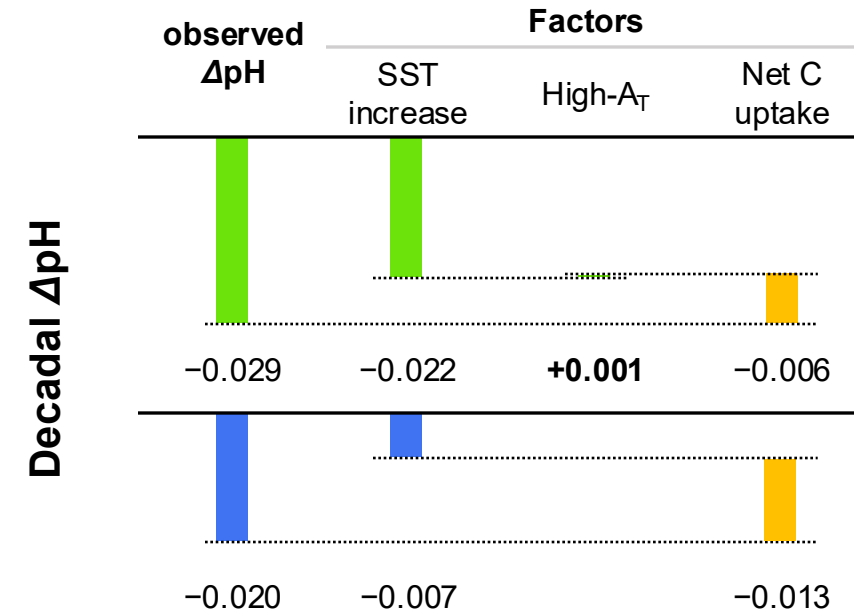
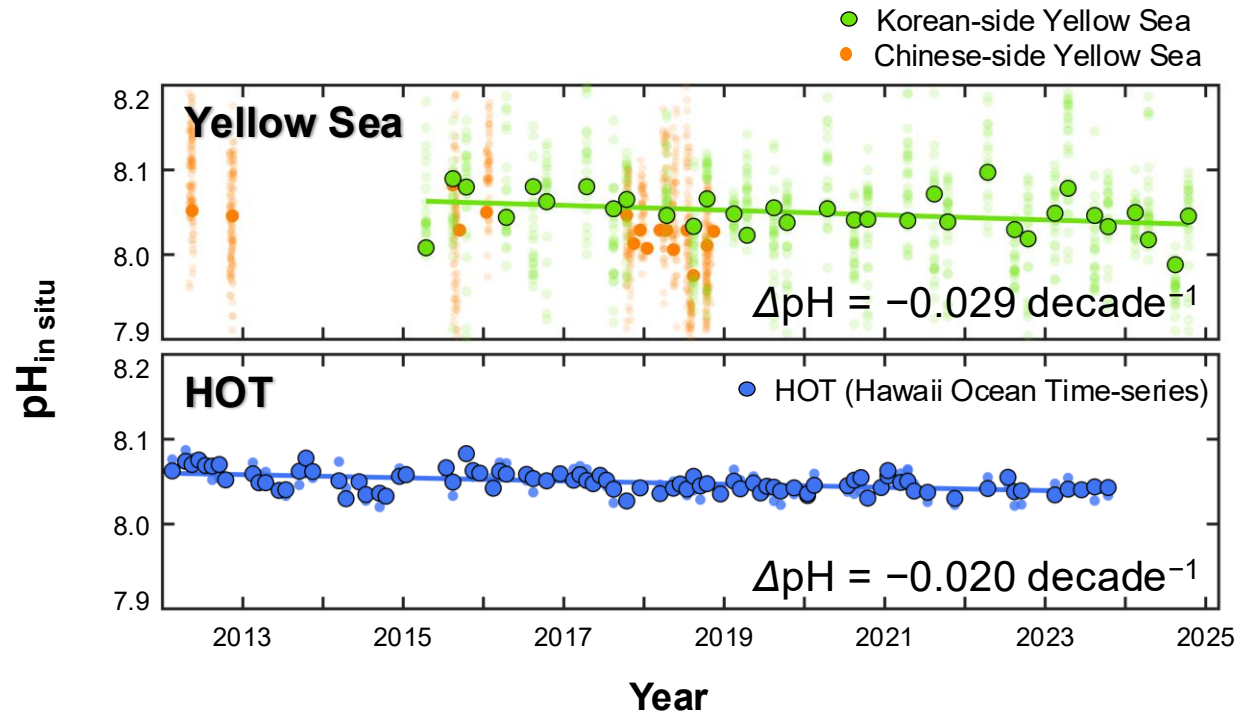
Evidence of freshwater-driven alkalinity in the Yellow Sea



Enhanced circulation in the Yellow Sea



Impact of freshwater-driven alkalinity on seawater pH



Freshwater-driven A_T increases have only a minor impact on pH changes in the Yellow Sea

Conclusions

