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YSLME
SCIENCE
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15-19 July 2019
Qingdao, PR China

Coastal acidification and deoxygenation/hypoxia: the other eutrophication problems

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UNOPS

YSLME
UNDP/GEF Yellow Sea Large Marine Ecosystem

Contents:

- Background
- Long-term changes of environmental parameters in the YS: Observations on deoxygenation and acidification
- Conceptual view and implications
- Concluding remarks

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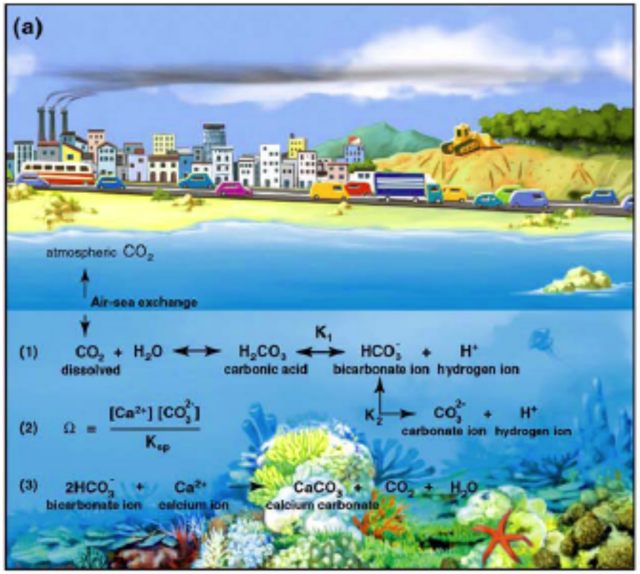
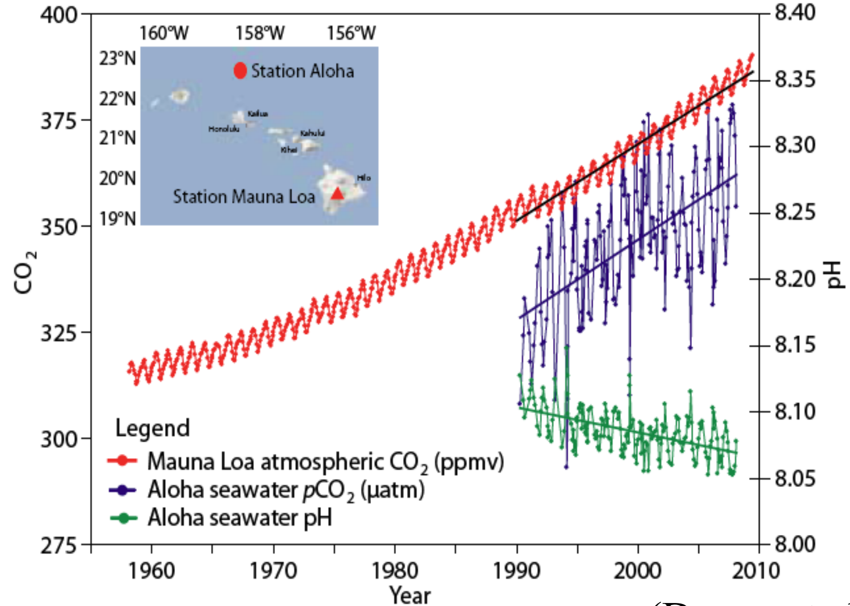
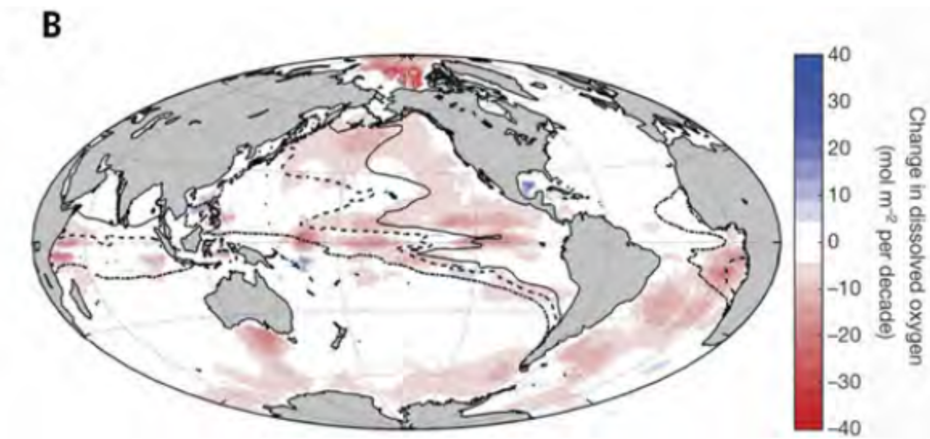
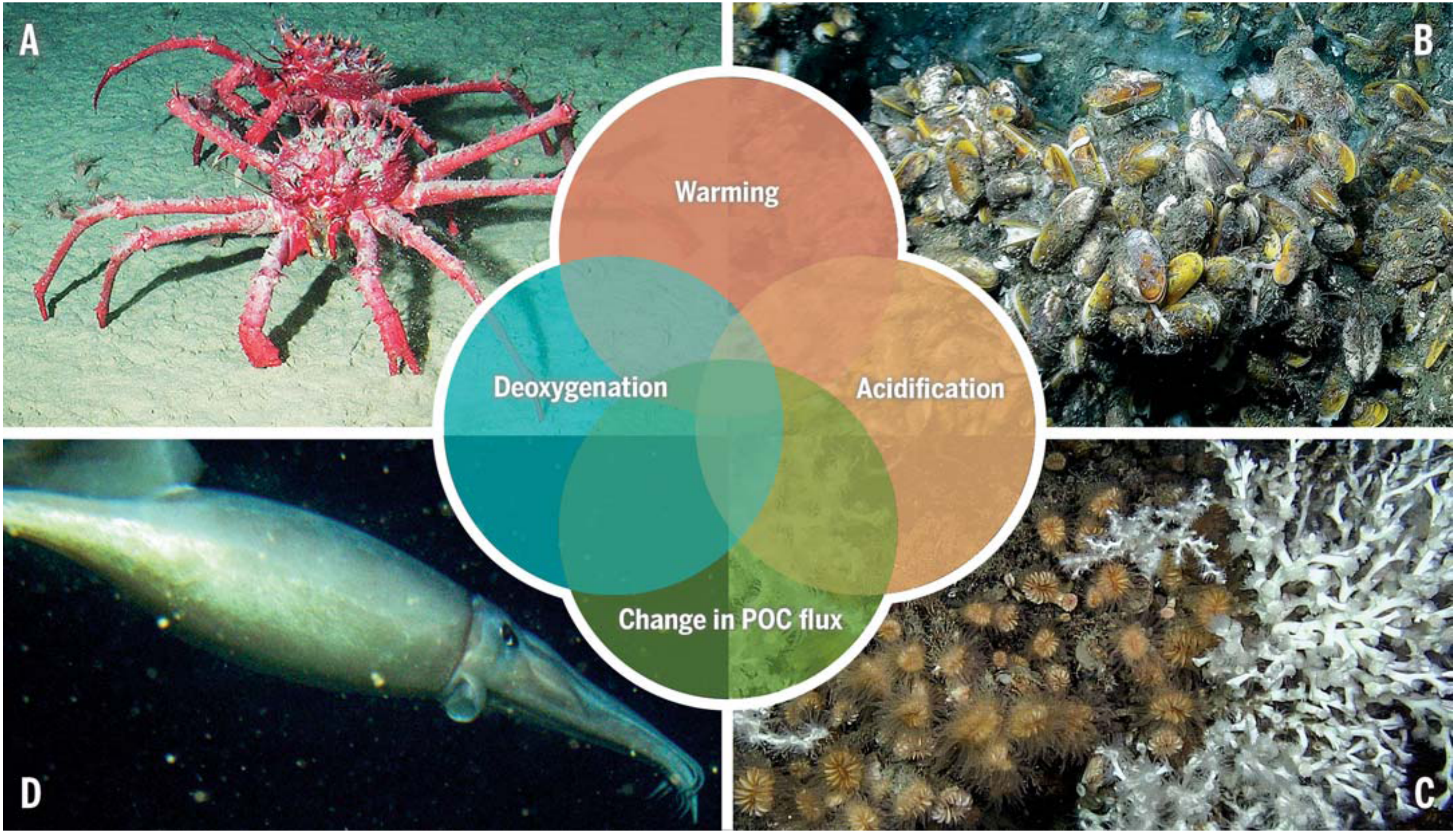




(Doney et al. 2009)

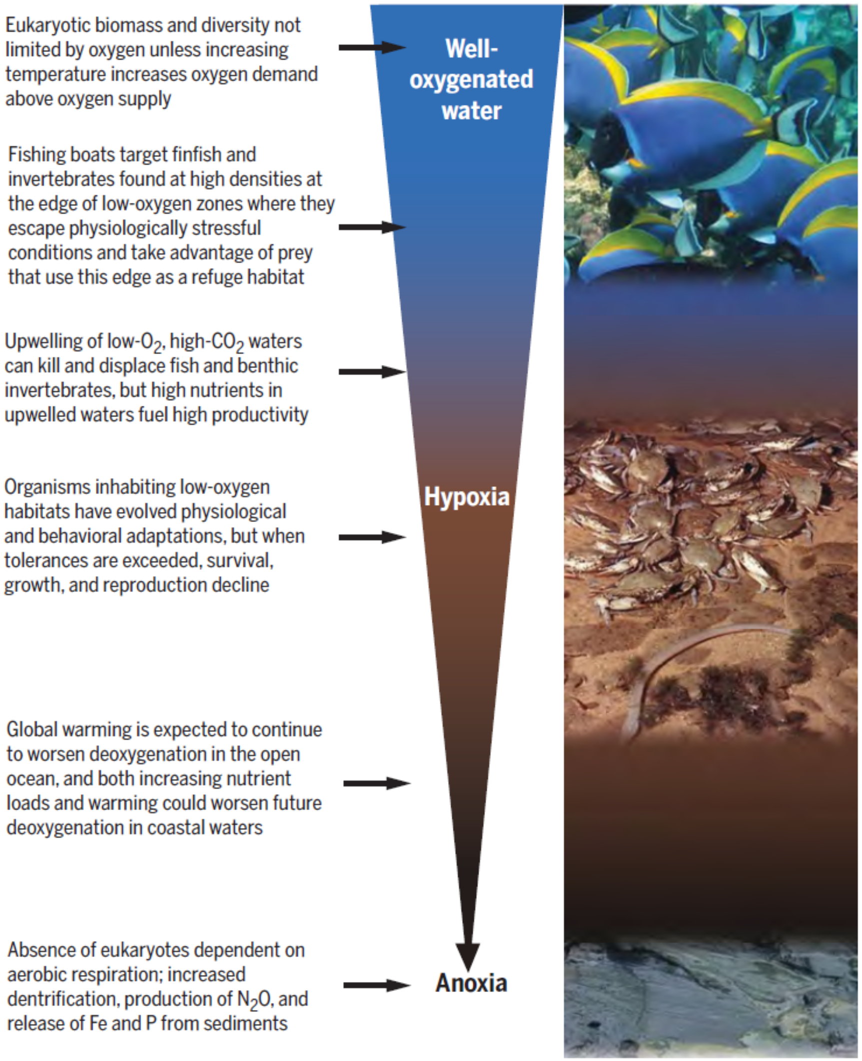


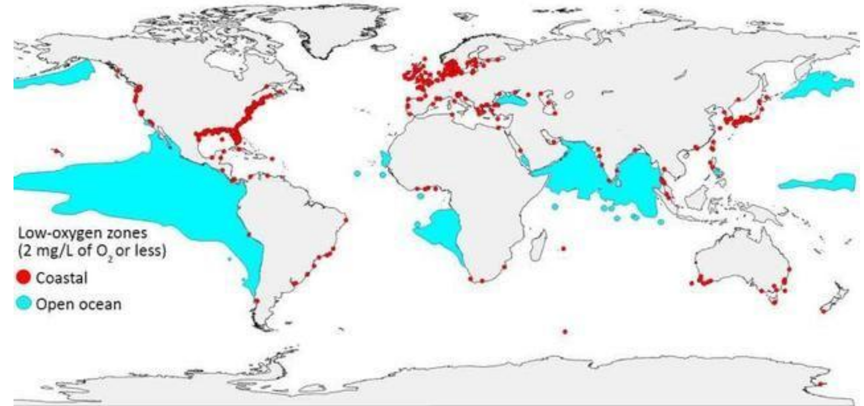
(Breitburg et al. 2018)



(Levin and Le Bris, 2015)

Impacts of deoxygenation on ecosystems





(Breitburg et al. 2018)

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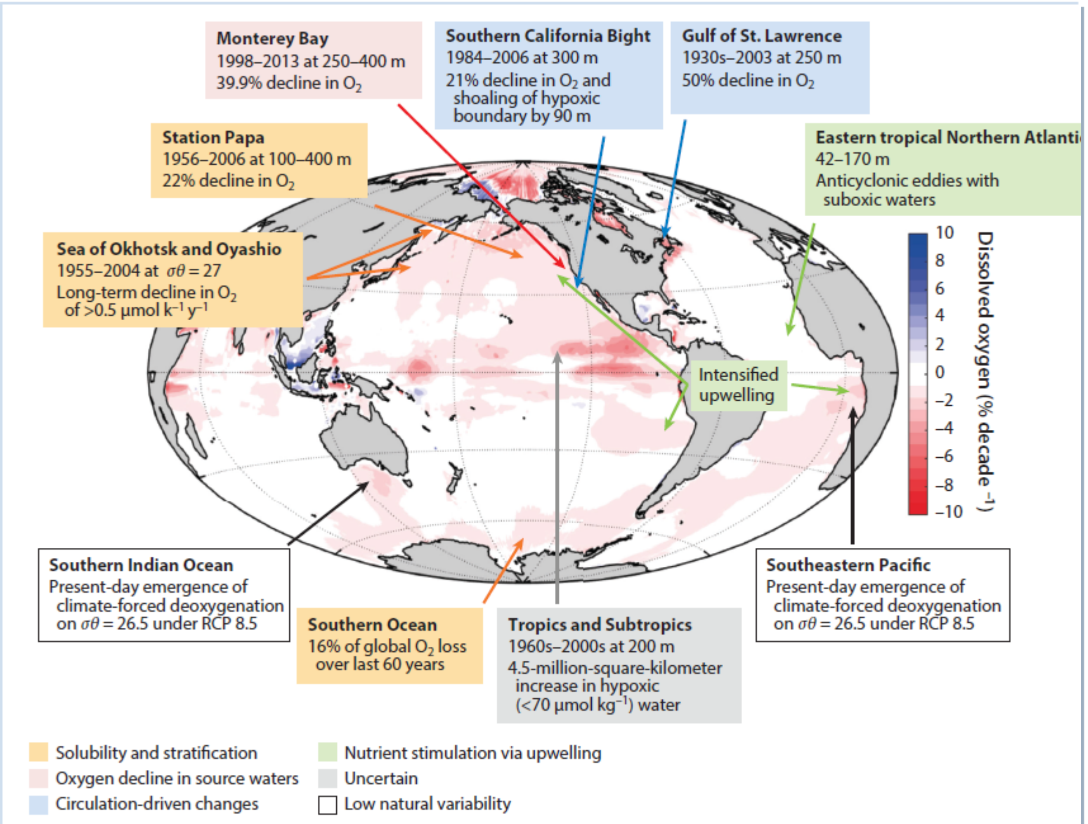
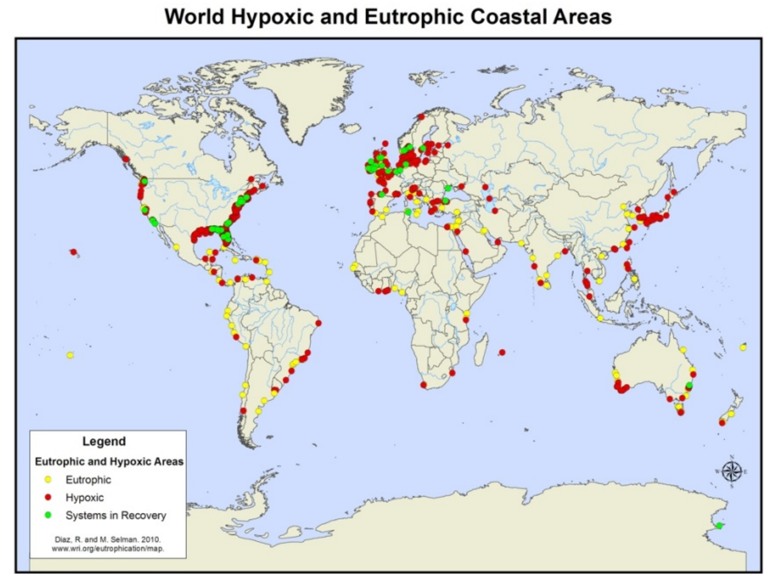
Hotspots of deoxygenation





(Breitburg et al. 2018)

Deoxygenation and hypoxia in coastal waters and open ocean has been a global environment issue.

- ✓ OMZ is expanding.
- ✓ More and more hypoxic zones in the coastal area.

LETTERS
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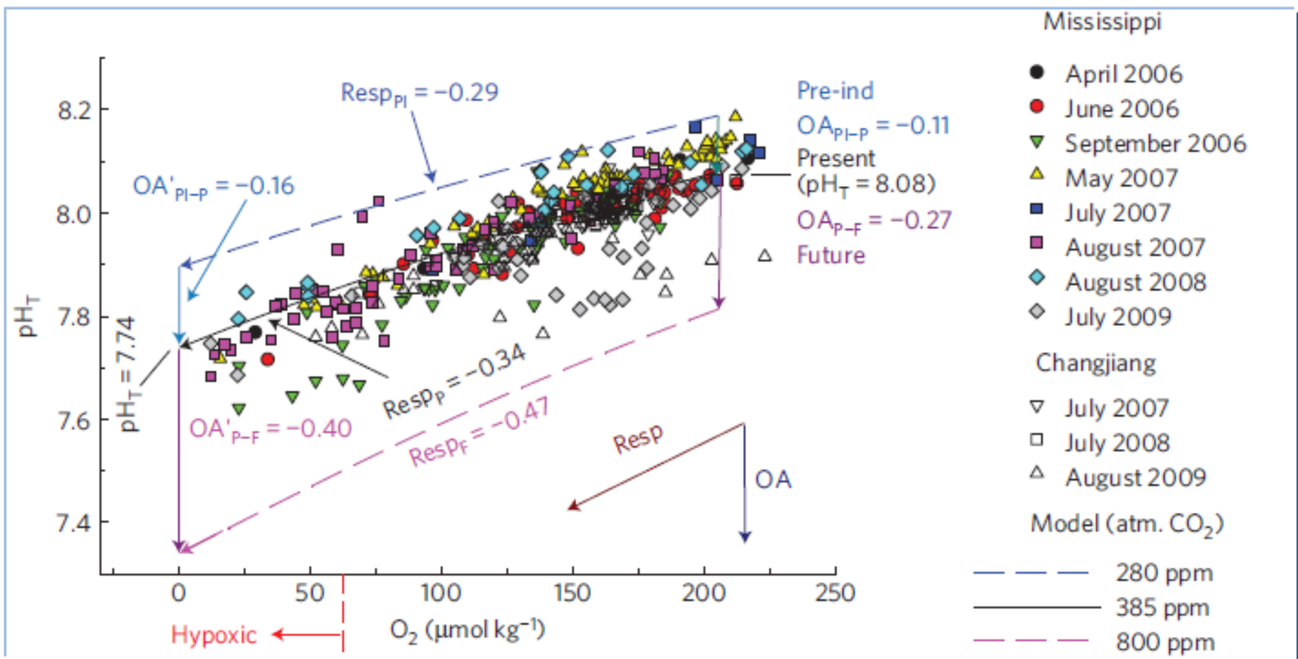
nature geoscience

Acidification of subsurface coastal waters enhanced by eutrophication

Wei-Jun Cai[1]*, Xinping Hu[1], Wei-Jen Huang[1], Michael C. Murrell[2], John C. Lehrter[2], Steven E. Lohrenz[3], Wen-Chen Chou[4], Weidong Zhai[5], James T. Hollibaugh[1], Yongchen Wang[1], Pingsan Zhao[1], Xianghui Guo[1,5], Kjell Gundersen[6], Minhan Dai[5] and Gwo-Ching Gong[4,7]



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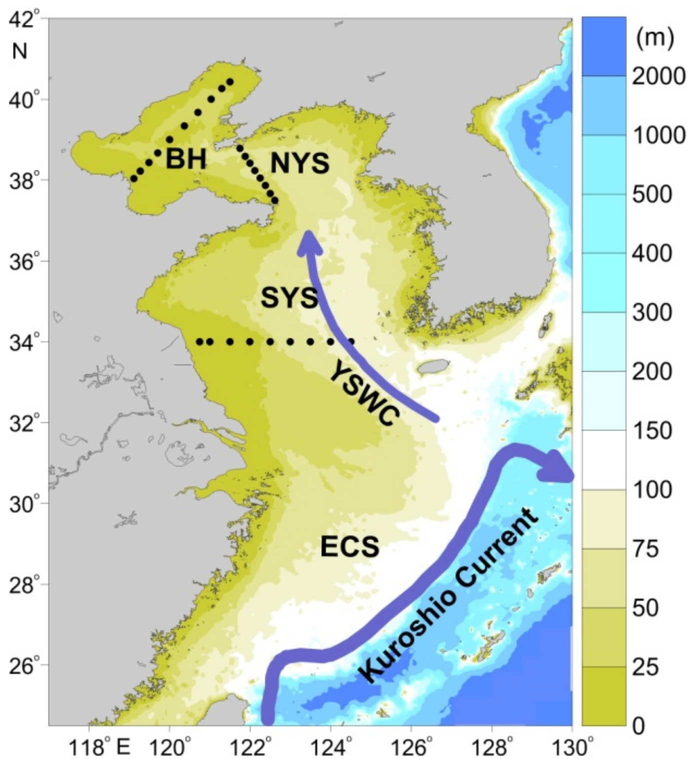
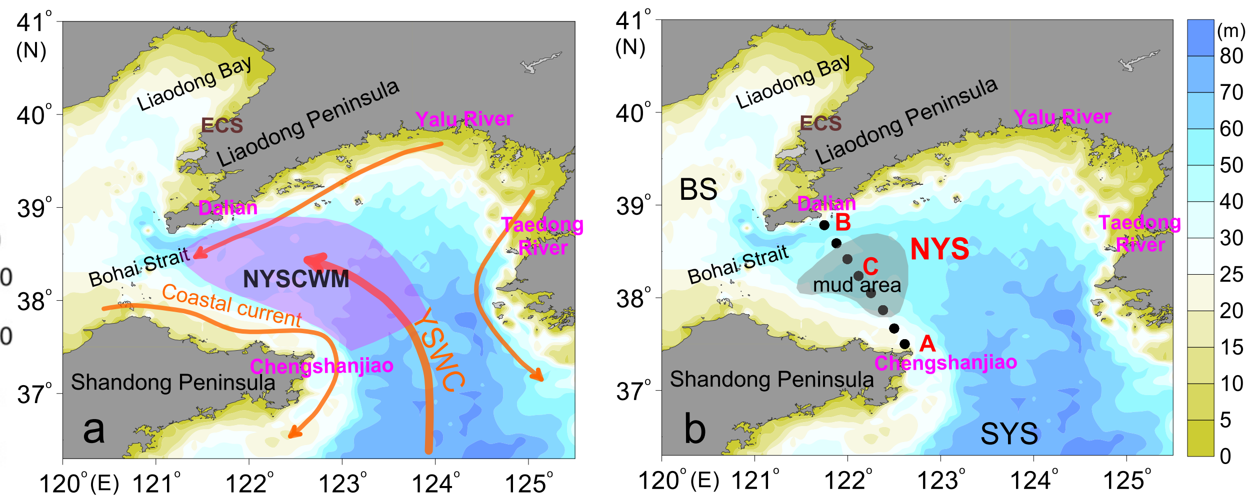
Study area





Data:

1) Long-term data along the section (1976-2006) of Chengshanjiao-Dalian in the NYS:

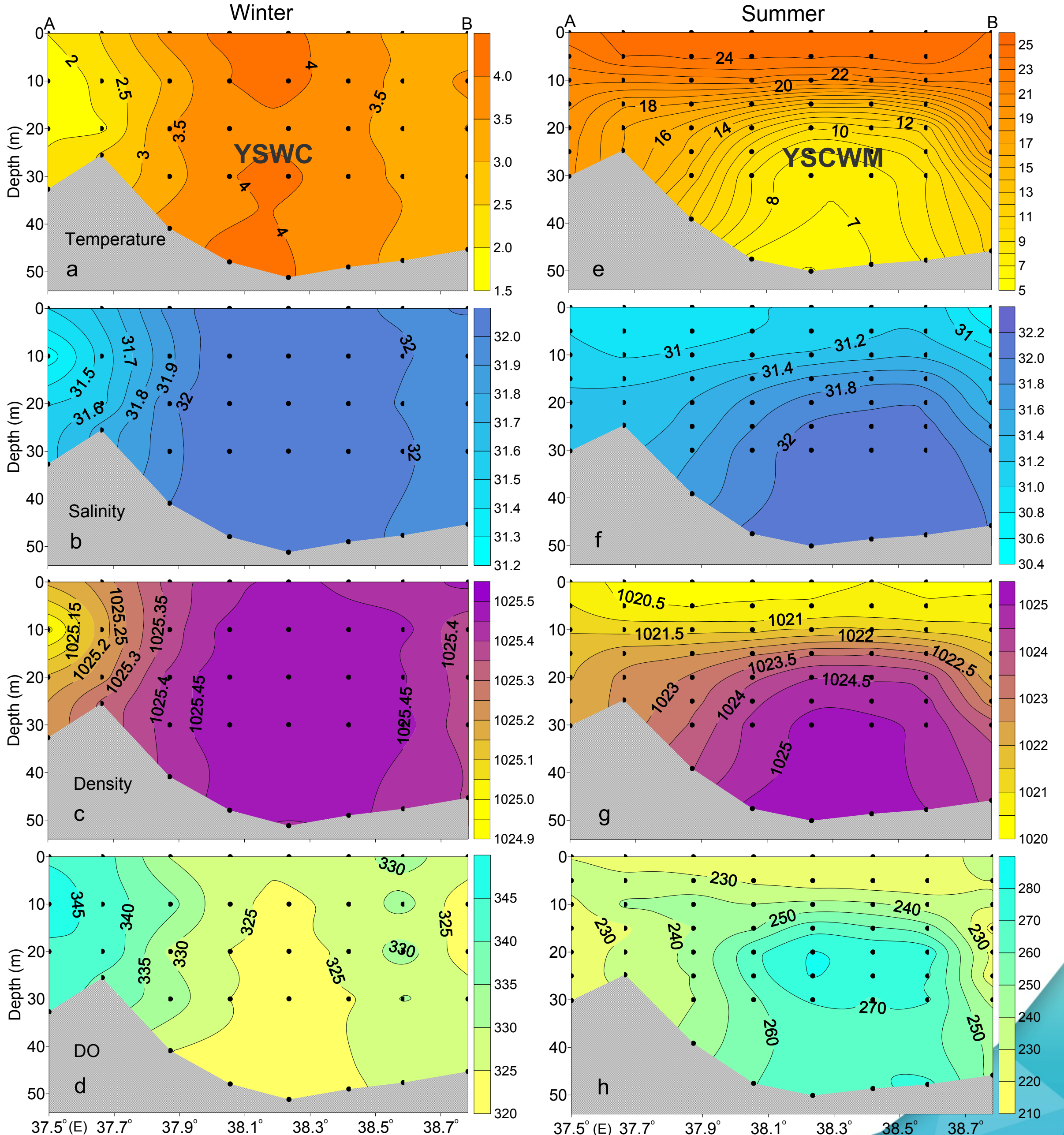
temperature, salinity, DO, Nutrient, O_2%, AOU

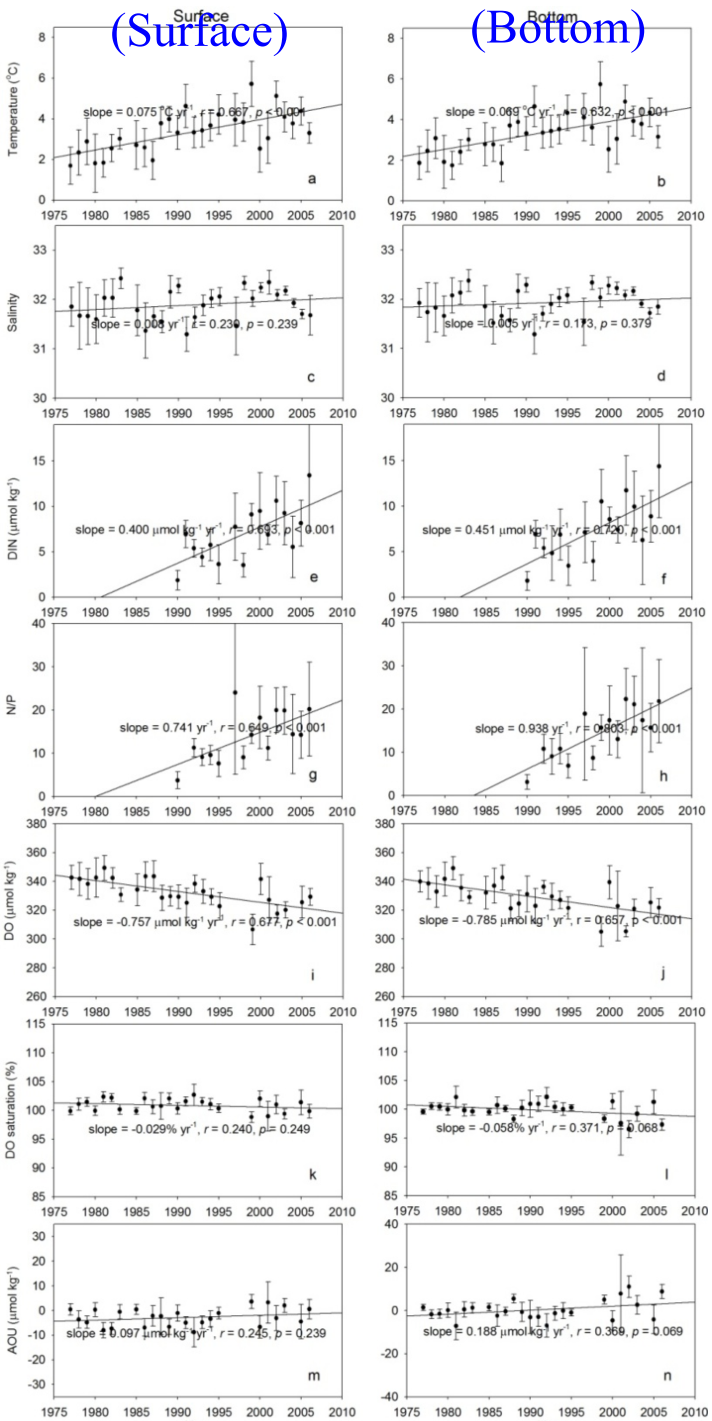
2) Sea surface Chl-a derived from multiple-satellite products of SeaWiFS and MODIS

Climatologic vertical distributions:

Vertical mixing winter

Stratified summer

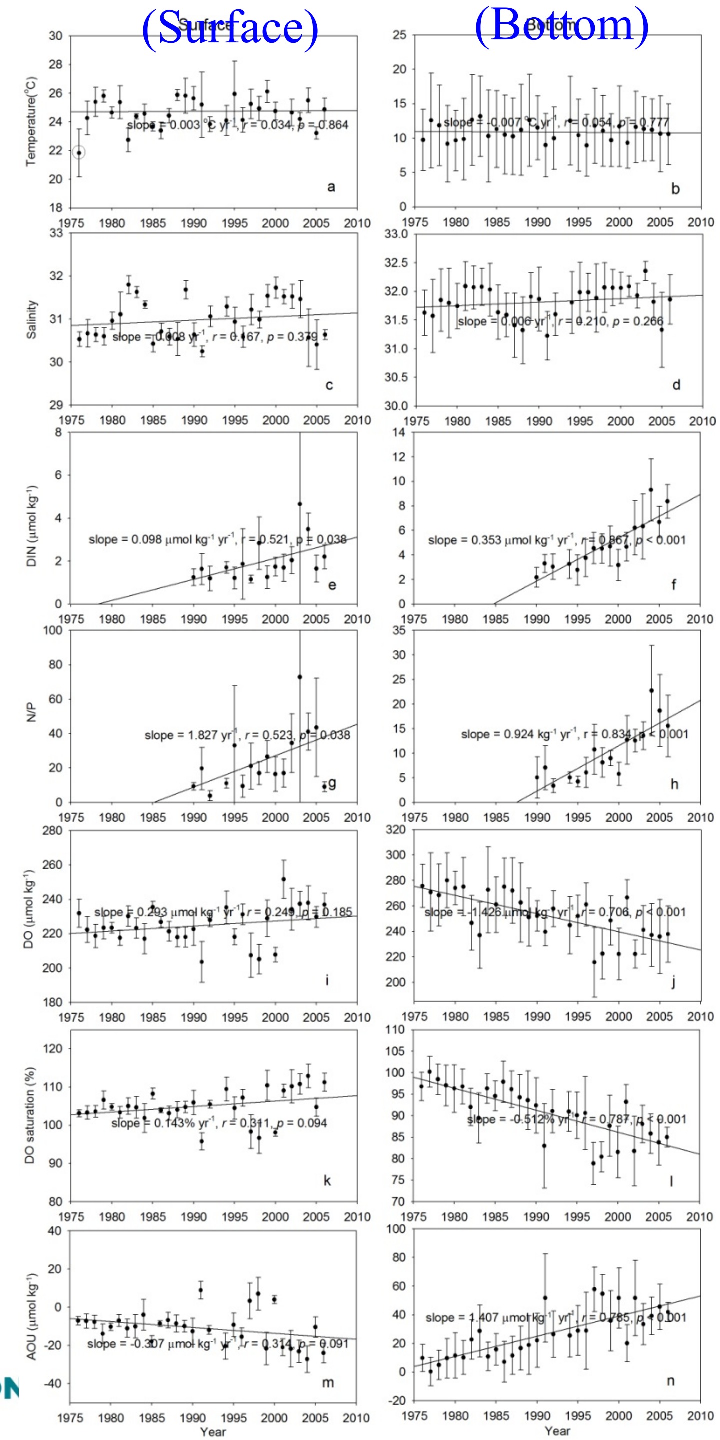




Winter

- Temperature: increased
- Salinity: almost no changes
- DIN and N/P: increased
- DO: decreased

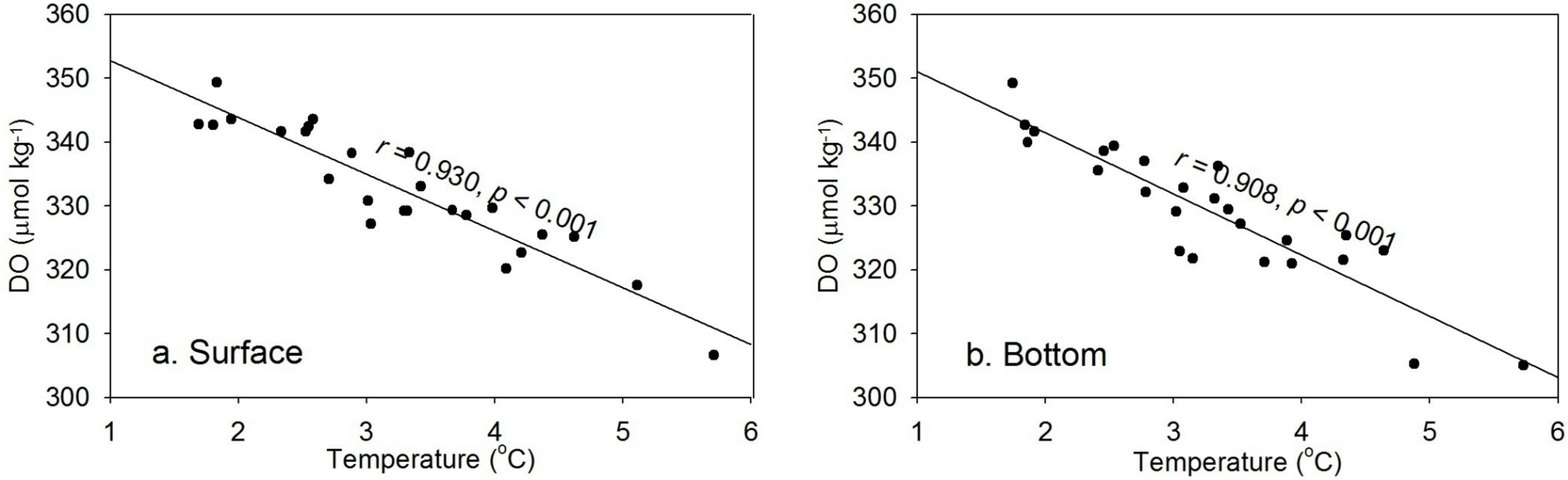
  (~0.76 and ~0.78 μmol kg^{-1} yr^{-1} in surface and bottom, respectively)
- DO saturation and AOU: almost no changes



Summer

- Temperature and salinity: almost no changes
- DIN and N/P: increased
- DO: decreased in bottom (~1.43 $\mu mol\ kg^{-1}\ yr^{-1}$)
- DO saturation: decrease in bottom
- AOU: increased in bottom

Winter deoxygenation

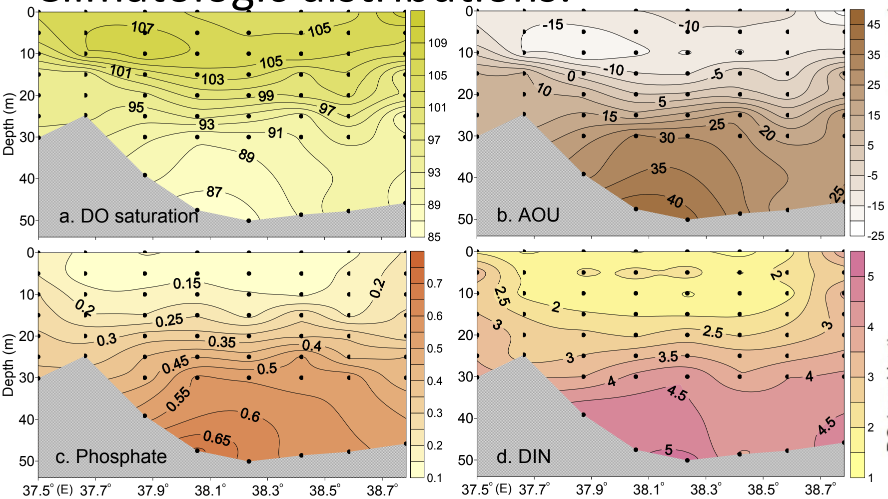


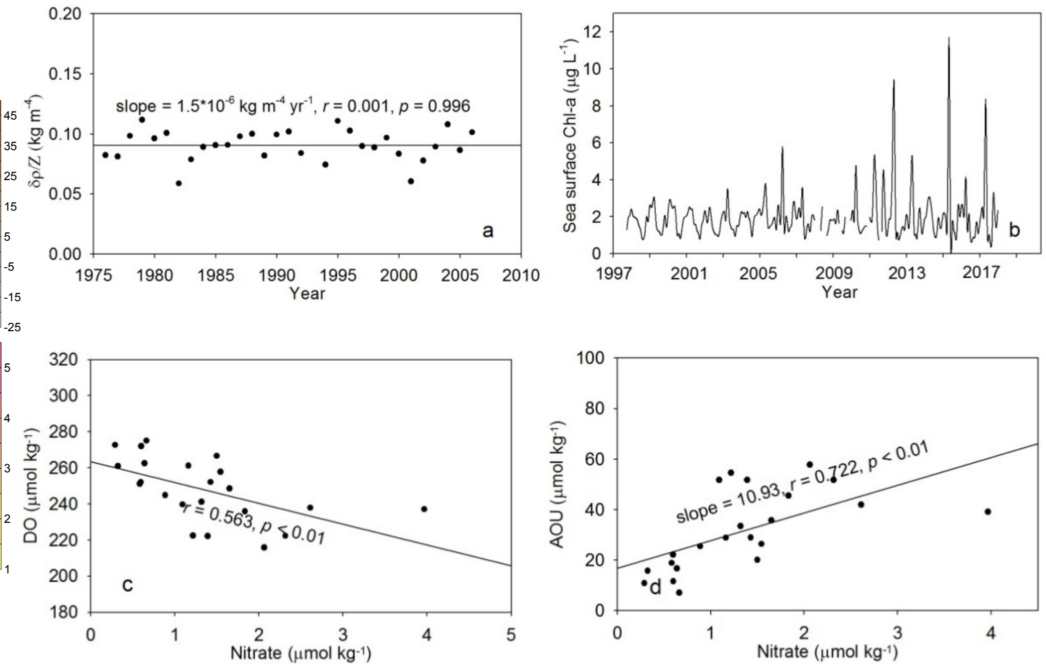
Relations between the annual average DO content and temperature

- In winter, when the water column is vertical homogeneous, DO at near-saturation indicates that physical mixing overwhelmed biological activities, and a linear correlation between DO content and seawater temperature suggests that warming is the most plausible driver of deoxygenation in this region in winter.

Summer deoxygenation

Climatologic distributions:





- In the stratified summer, increased nutrient availability and consequently enhanced productivity are reasonable for the drawdown of DO in the bottom layer, and the stoichiometric pattern between DO depletion and N also suggests a cascading linkage between the eutrophic conditions and bottom deoxygenation.

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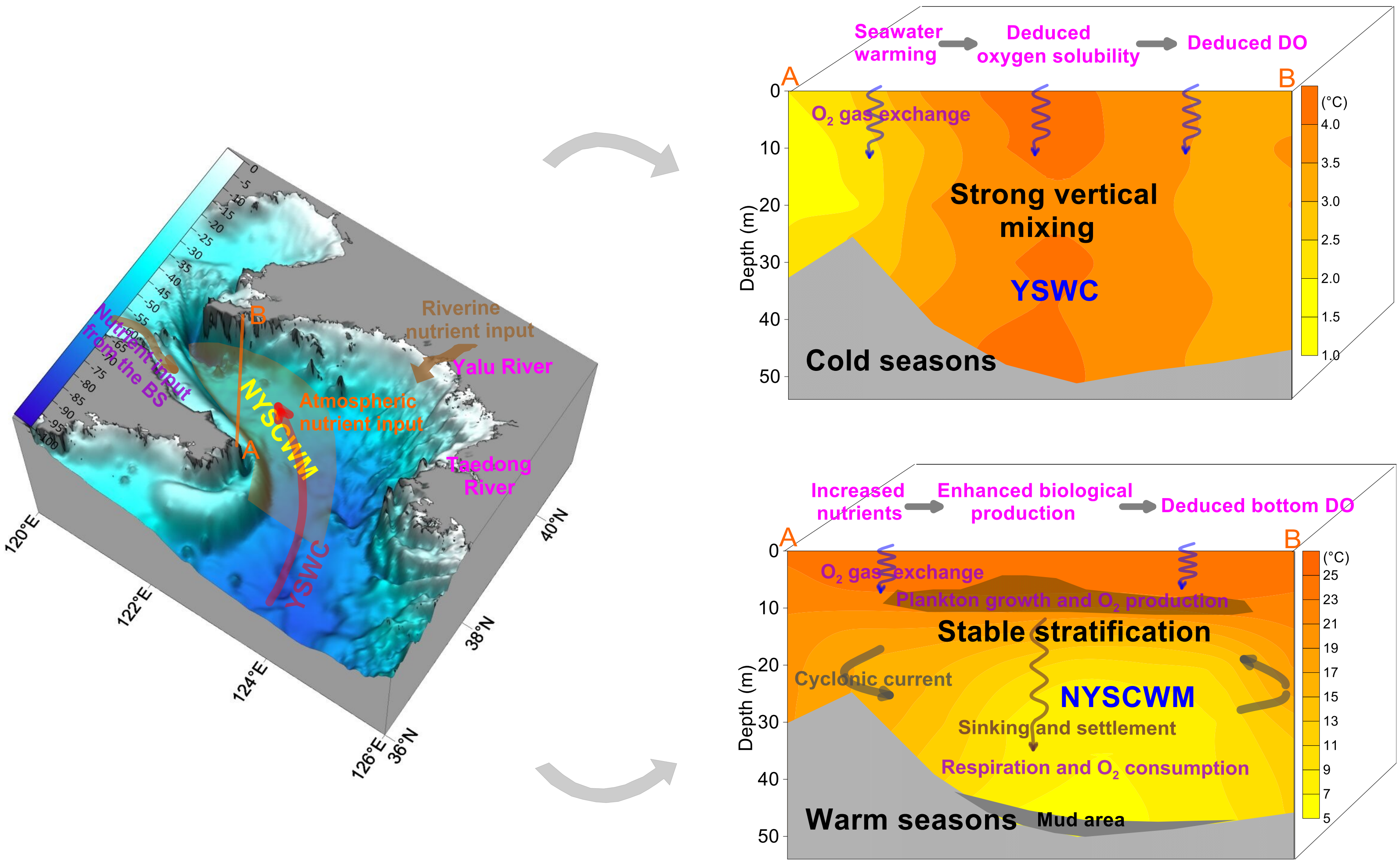
Conceptual view of deoxygenation



Showing the different mechanisms of DO declining in seasonality

(Wei et al, under review)

Concluding remarks

- Shows the drawdown of DO in winter and in the bottom layer in summer (~0.76 and ~0.78 μmol kg^{-1} yr^{-1} in surface and bottom in winter, respectively; ~1.43 μmol kg^{-1} yr^{-1} in summer), which is companied with seawater warming (especially in winter) and enhanced nutrients.
- In winter, seawater warming is the most plausible driver of deoxygenation in the NYS.
- In the stratified summer, increased nutrient availability and consequently enhanced productivity are reasonable for the drawdown of DO in the bottom layer.

谢谢大家！

Thank you

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