The CEARAC Expert meeting on eutrophication assessment

Identification of eutrophic zones in the NOWPAP sea areas of China based on the Screening Procedure

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- Reviews of assessment methodology
- Assessment in the NOWPAP sea areas of China
- Major Problems in the assessment
- Suggestions

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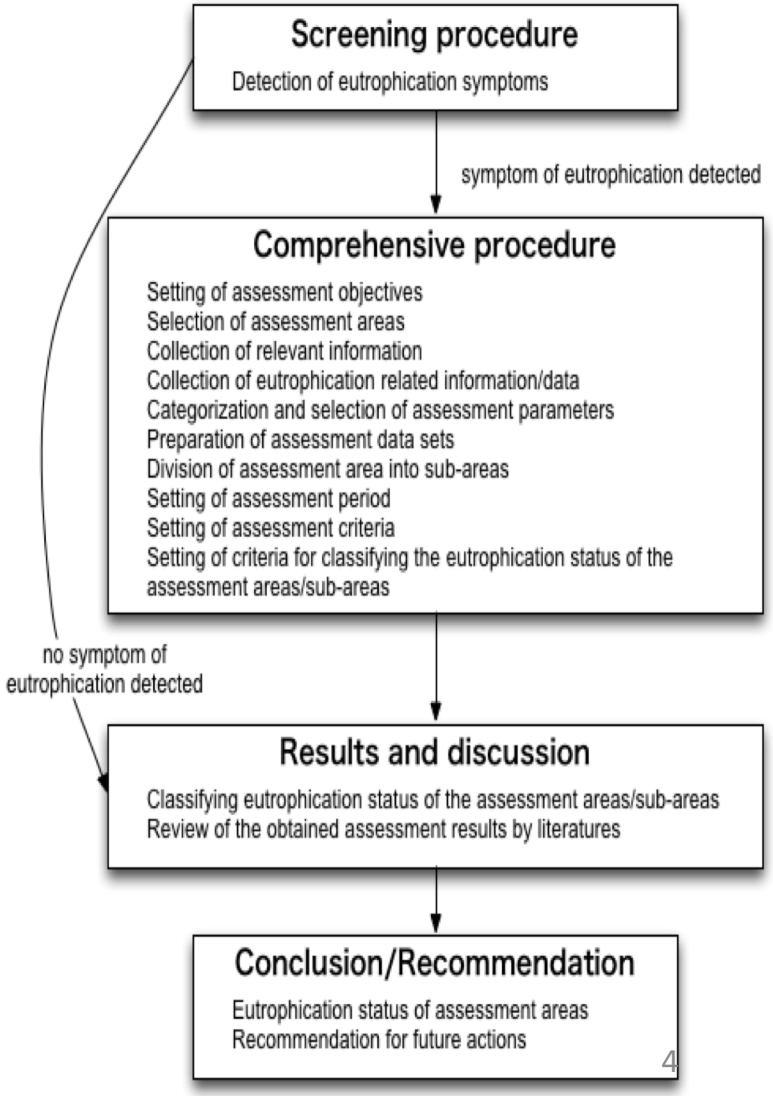
- **Reviews of assessment methodology**
- **Assessment in the NOWPAP sea areas of China**
- **Major Problems in the assessment**
- **Suggestions**

Assessment Method

Several methods based on PSR principle: NEEA/ASSETS (USA), OSPAR (EU)

The NOWPAP Common Procedure:

- **Screening Procedure**
- **Comprehensive Procedure**



According to CEARAC working scheme, we now focus on the identification of eutrophic zones through the Screening Procedure.

Screening procedure

According to the methodology of screening procedure, the three parameters will be detected for potential eutrophication assessment:

- COD/TOC
- HABs (red tide)/hypoxia
- *Chl.a*

When two of them show symptoms of eutrophication, the area will be detected as potential eutrophic zone.

Assessment criteria of eutrophication symptoms

- **COD/TOC: Annual mean trend analysis. Increasing trend (by Mann-Kendall) will be regarded as symptom of eutrophication;**
- **HABs/hypoxia: One or more events of HABs (Diatom and flagellate sp.) or hypoxia recorded in the last 3 years.**
- **Chl. *a*: Mean satellite Chl.*a* in the last 3 years exceeds 5 µg/L and an increasing/no trend of annual mean satellite Chl.*a*.**

Identification of eutrophic zones

	Eutrophic area	All parameters of COD, HABs/hypoxia events and chl.*a* indicate symptoms of eutrophication.
	Potential eutrophic area	More than two of above parameters indicate symptoms of eutrophication.
	Non eutrophic area	Only one or none of above parameter indicates symptoms of eutrophication.
	Improved area	COD or HABs/hypoxia events indicate the eutrophic status has improved.

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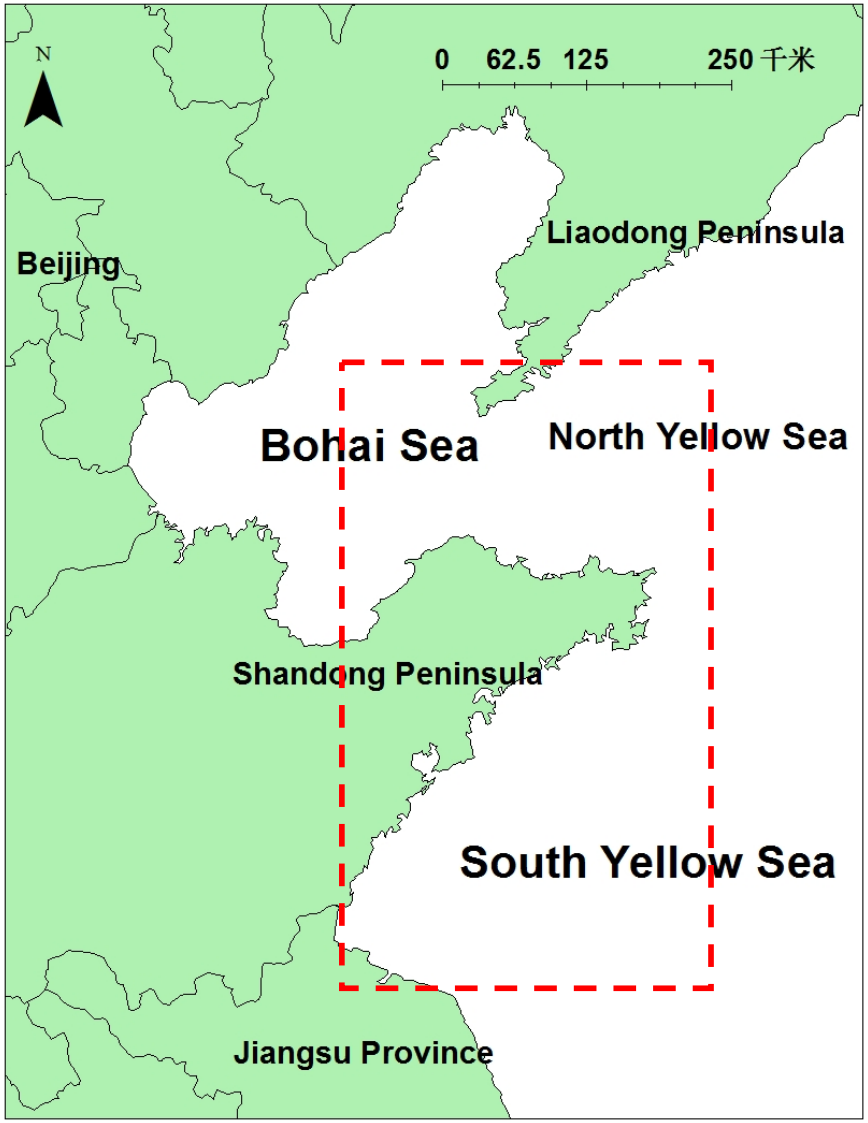
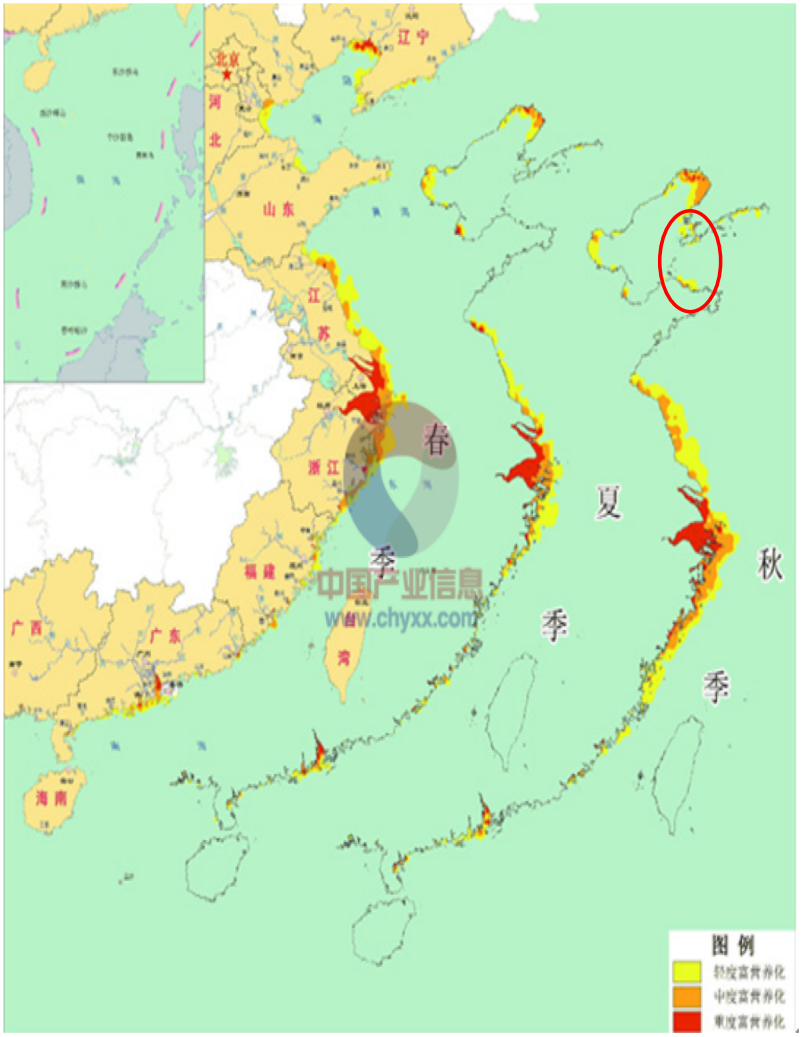
Assessment of NOWPAP area in China



- East coast of Liaodong Peninsula and North coast of Shandong Peninsula which belong to North Yellow Sea
- South coast of Shandong Peninsula and Jiangsu coast which belong to South Yellow Sea

Characteristics of this area



Eutrophic status by nutrient index method (SOA, 2014)

- Most density population area - more than 400 people/ km^2
- High pressure of nutrient input from land sources (Riverine and Sewage Treatment Plant), such like Jiaozhou Bay, Sishili Bay, etc. (Gao et al., 2011; Sun et al., 2011)
- Eutrophic zones have been addressed by governmental bulletin of marine environment (SOA, 2014)

The typical coastal areas for screening procedure

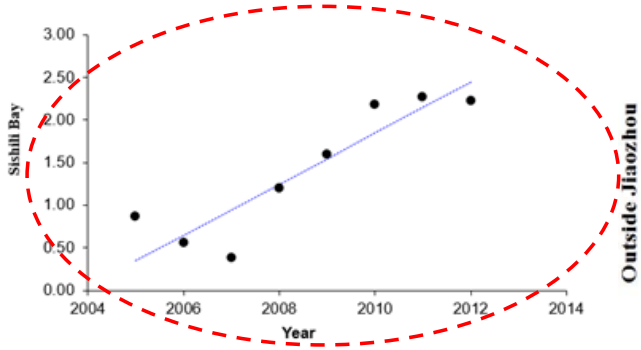
Region	Coastal areas
East coast of Liaodong Peninsula	Dalian Bay
North coast of Shandong Peninsula	Sishili Bay
South coast of Shandong Peninsula	Rushan coast
	Jiaozhou Bay
	Qingdao coast
	Haizhou Bay

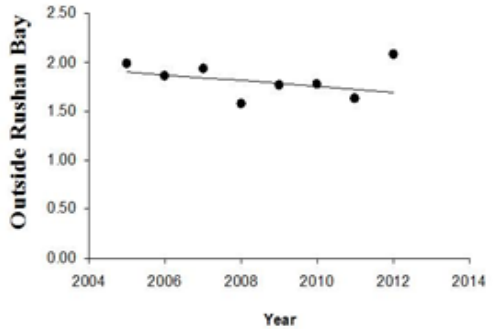
Collection of assessment data

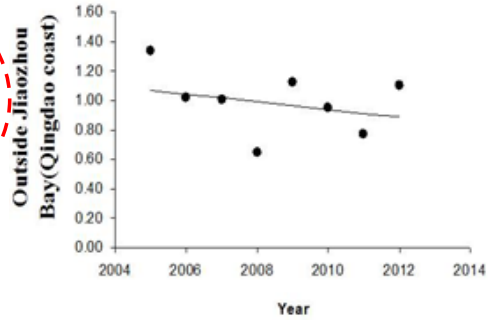
- 8 years of COD data (2005-2012, spring, summer and autumn data) was collected from the CNEMC (Environmental Monitoring Center of China)
- The occurrences of HAB events (2009-2014) were collected from published national/regional reports.
- The occurrences of hypoxia were collected from literatures.
- Chl *a* was from satellite analysis and provided by CEARAC.

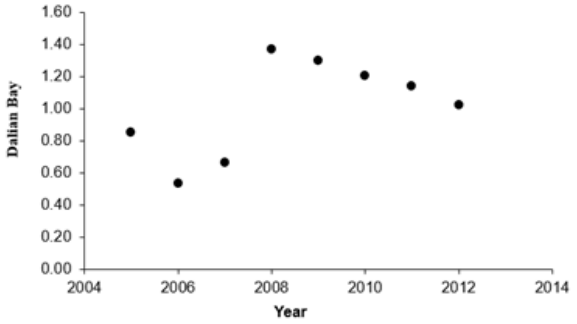
Assessment of parameters — COD

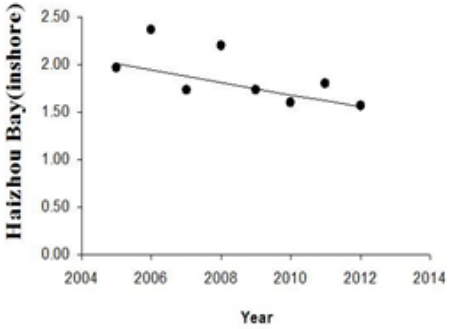
- Only one site, Sishili Bay, showed increasing trends in annual COD, with positive S statistics in Mann-Kendall test.
- Others showed no trends or decreasing trends in annual COD, with negative S statistics in Mann-Kendall test. No symptoms of eutrophication according to the criteria of COD

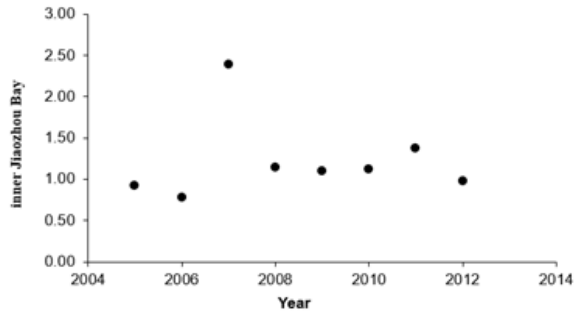


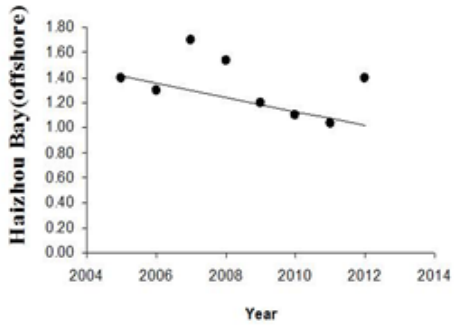




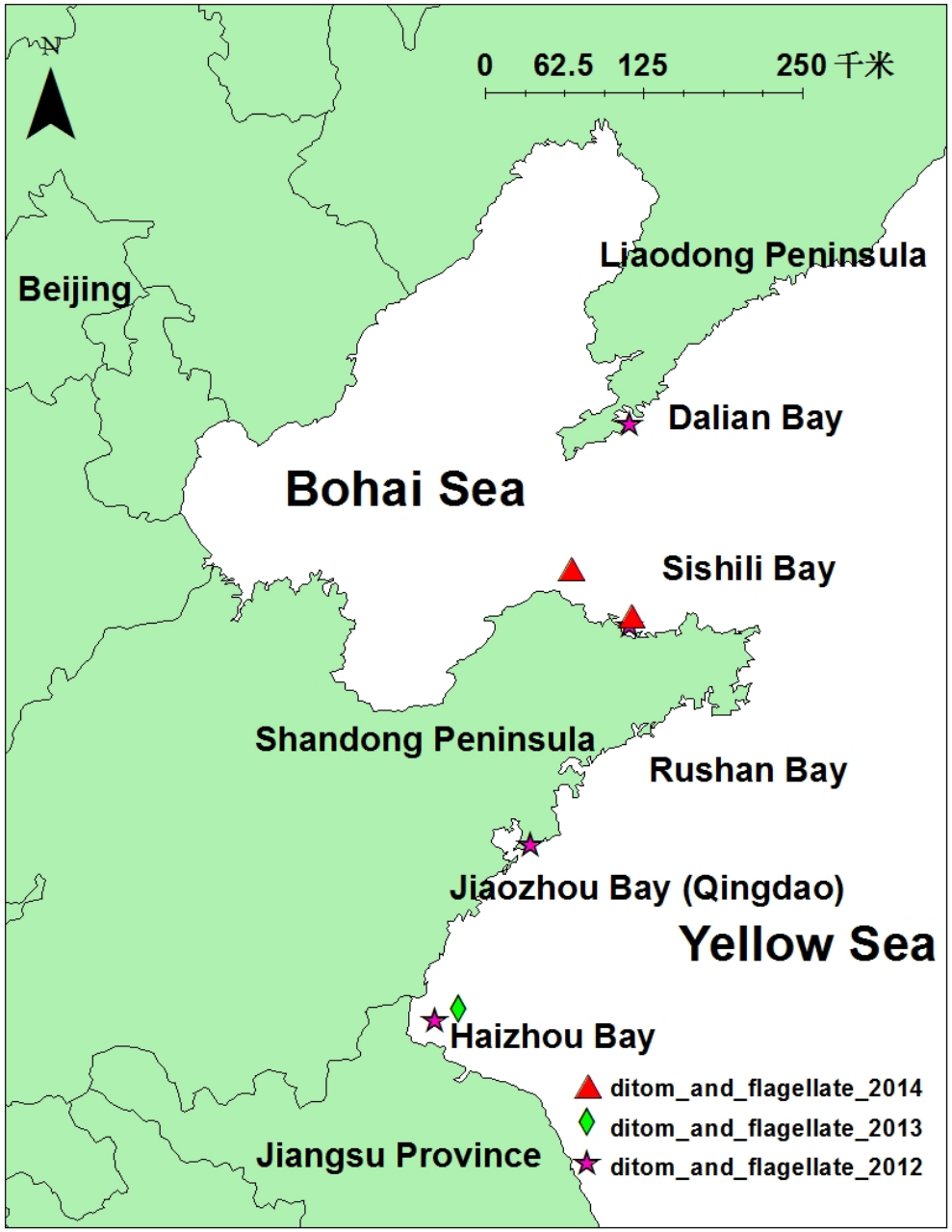






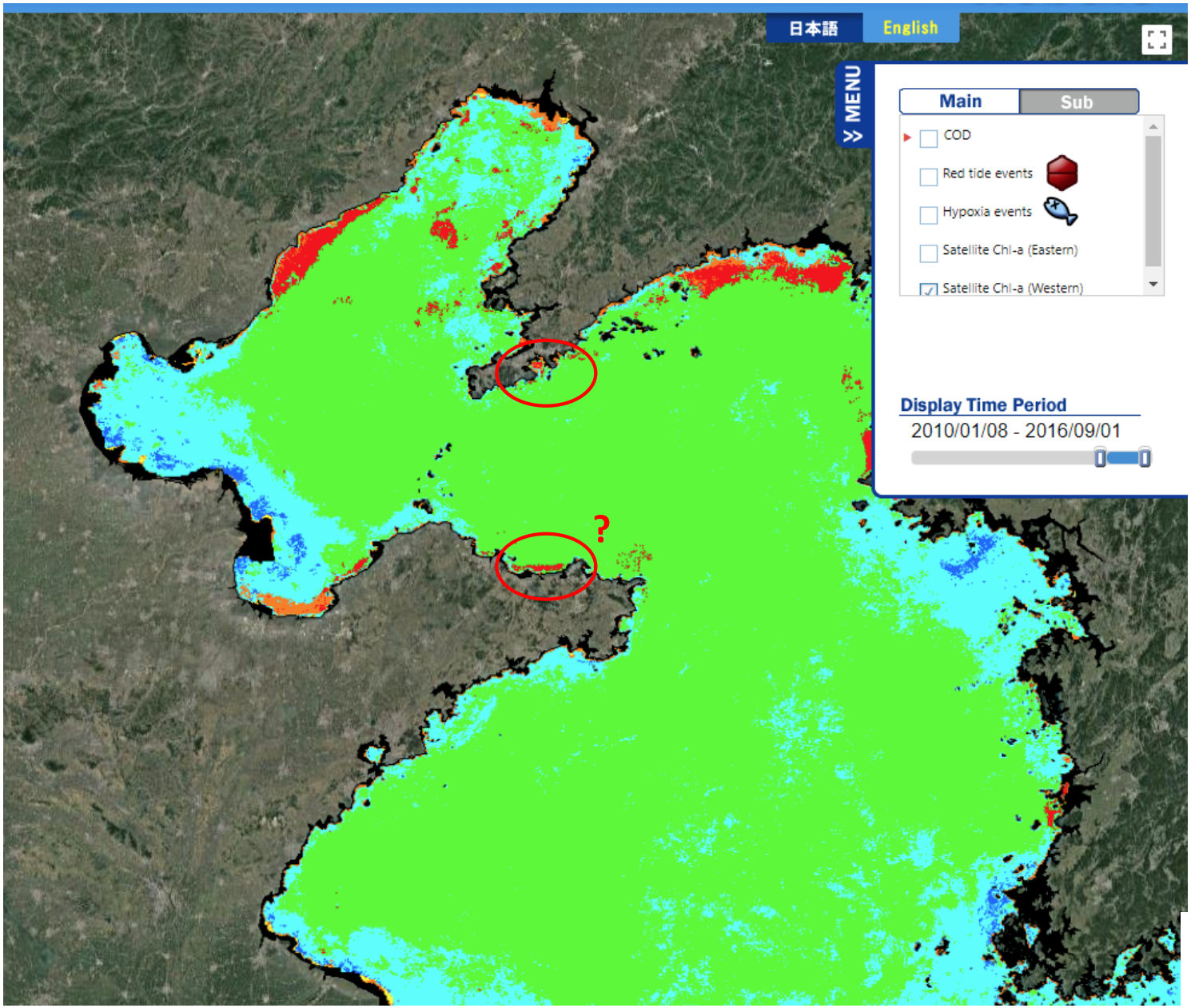


Assessment of parameters — HABs



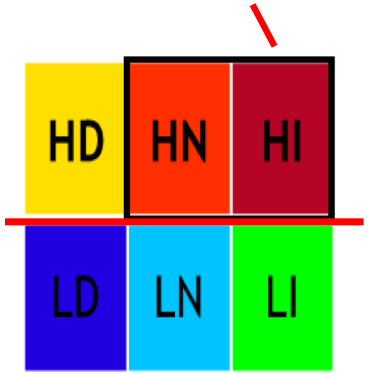
- Dalian Bay, Sishili Bay, Qingdao coast and Haizhou Bay were recorded one or more HAB events (diatom sp. and flagellate sp.) in the last 3 years (2013-2015) and regarded as areas with symptom of eutrophication according to the assessment criteria.

Assessment of parameters — Chl.*a*



- **A high and increasing trend of Chl-*a* detected in Dalian Bay by satellite.**

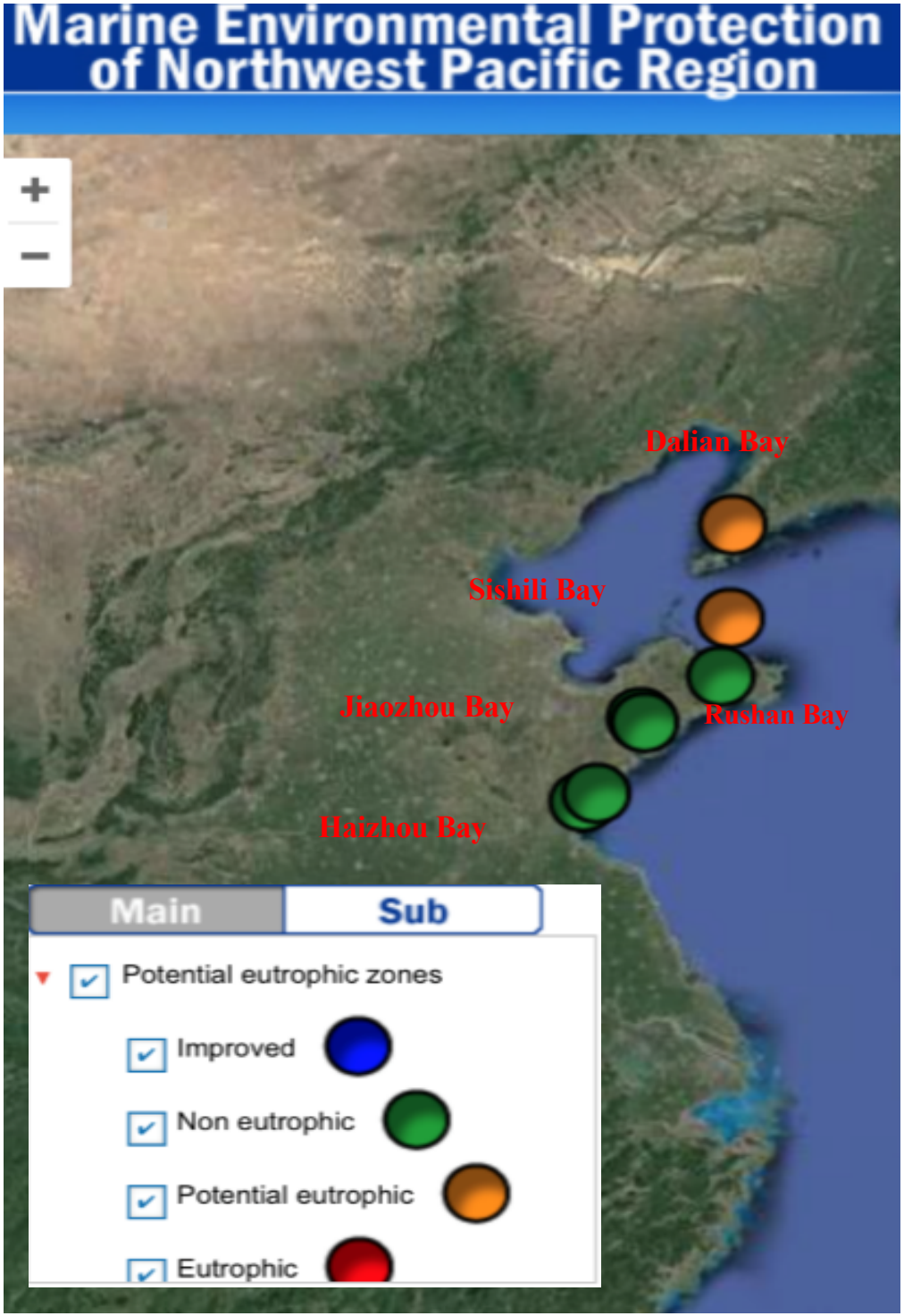
5 mg m^{-3} against three years mean (2013 to 2015)

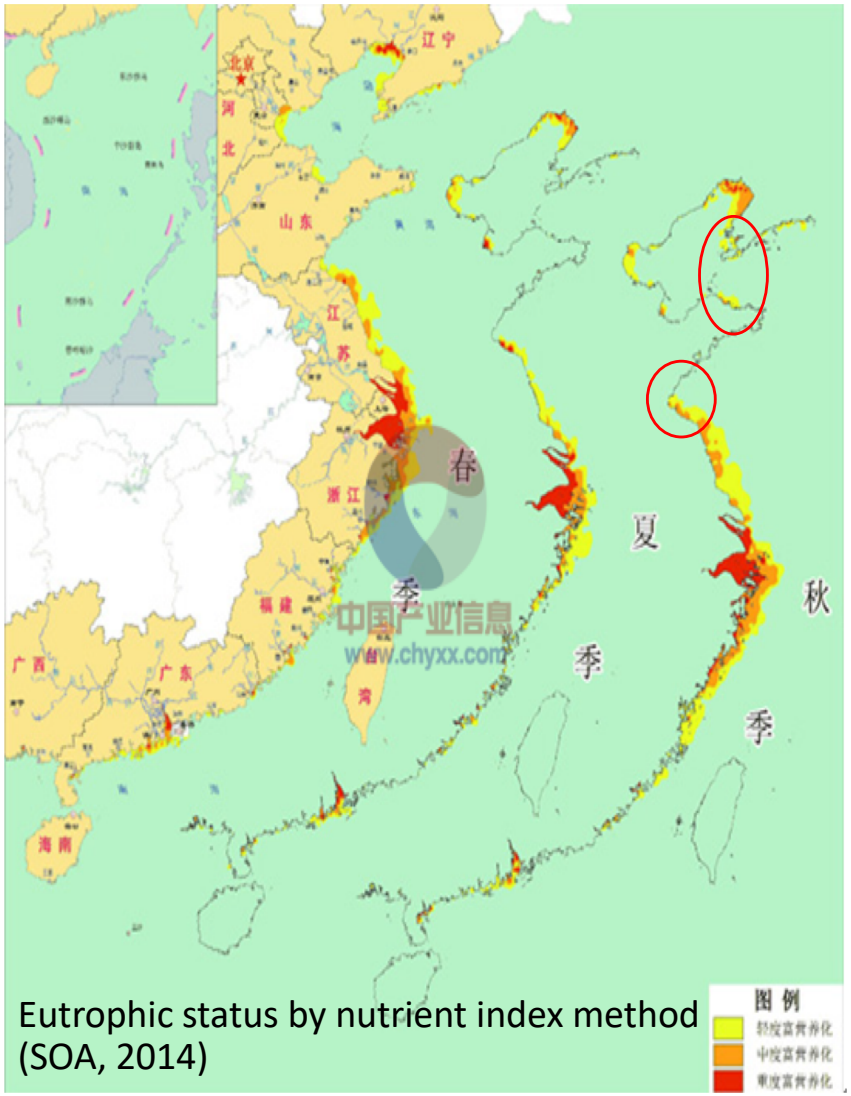


Pixel wise trend in annual maximum From 1998 to 2015

Assessment results

coast/bay	Assessment criteria and results						Final eutrophic status
	COD trend	Eutrophic symptom	HABs/hypoxia in last 3 years	Eutrophic symptom	Satellite Chla	Eutrophic symptom	
Dalian Bay	No trend	Not	8 red tide incidents	Yes	High and increasing	Yes	Potential eutrophic
Sishili Bay	Increasing	Yes	4 red tide incidents	Yes	Low and increasing	Not	Potential eutrophic
Rushan coast	No trend	Not	No incident	Not	Low and No trend	Not	Non eutrophic
Jiaozhou Bay	No trend	Not	No incident	Not	Low and No trend	Not	Non eutrophic
Qingdao coast	No trend	Not	2 red tide incidents	Yes	No data available	–	Non eutrophic
Haizhou Bay	No trend	Not	4 red tide incidents	Yes	High and decreasing	Not	Non eutrophic





Eutrophic status by nutrient index method (SOA, 2014)

Dalian Bay and Sishili Bay are identified as "potential eutrophic" bays which are consistent with the Government report (SOA, 2014), and others are no "eutrophic areas" identified.

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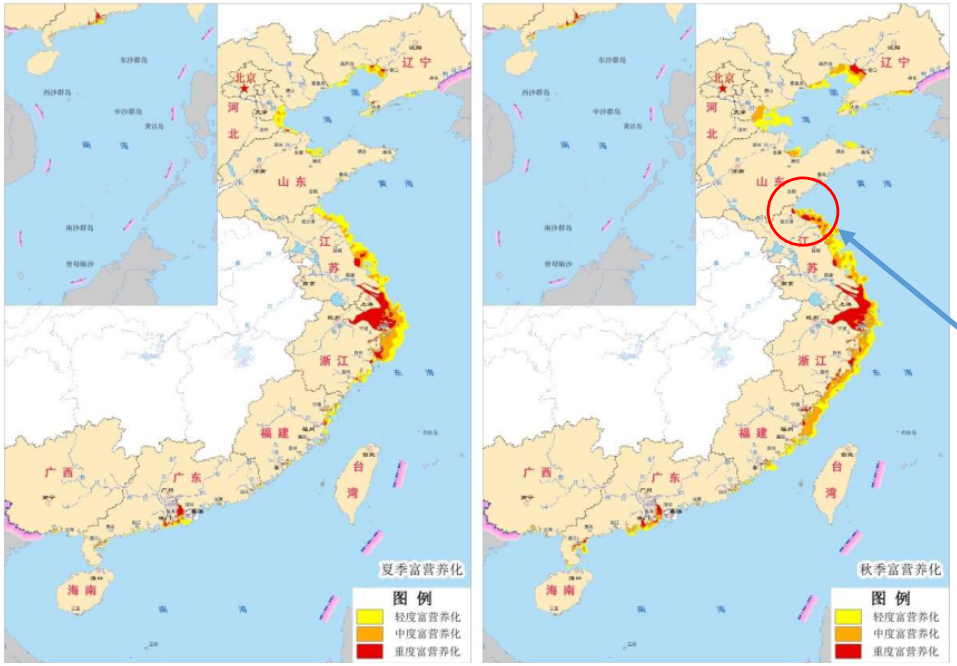
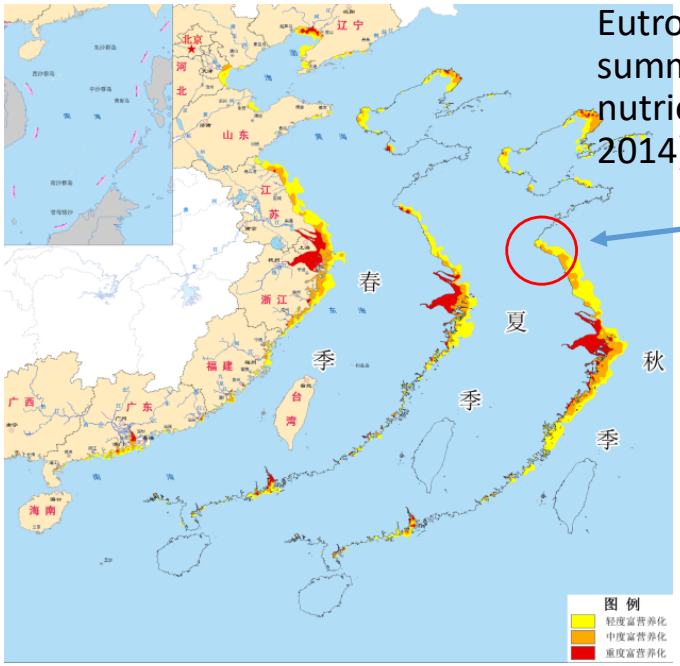
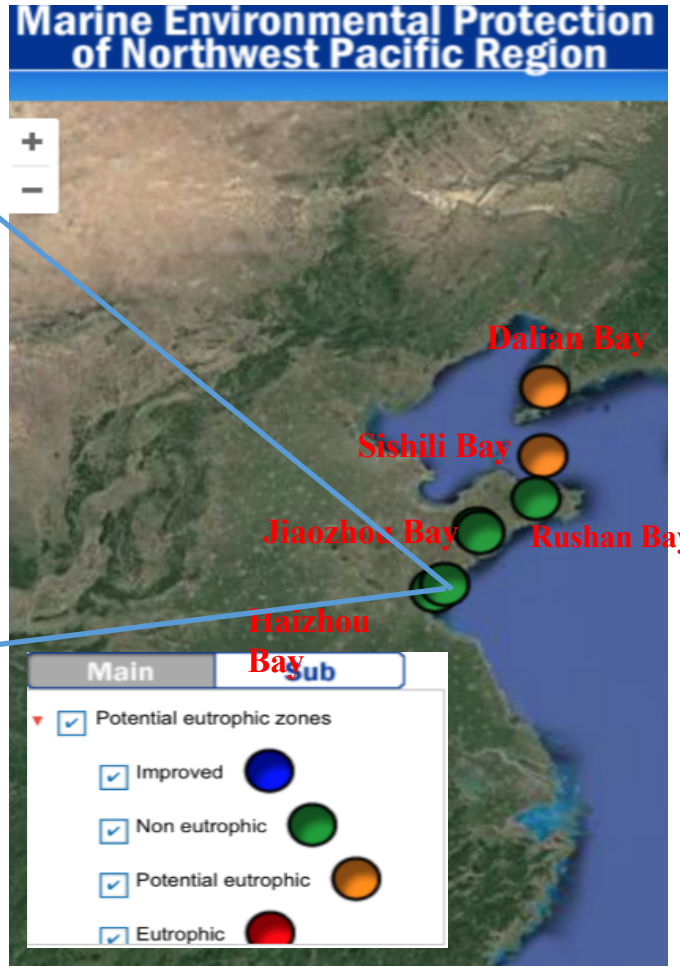
There is a difference between assessment and real status



Eutrophic status of spring, summer, autumn in 2014 by nutrient index method (SOA, 2014)



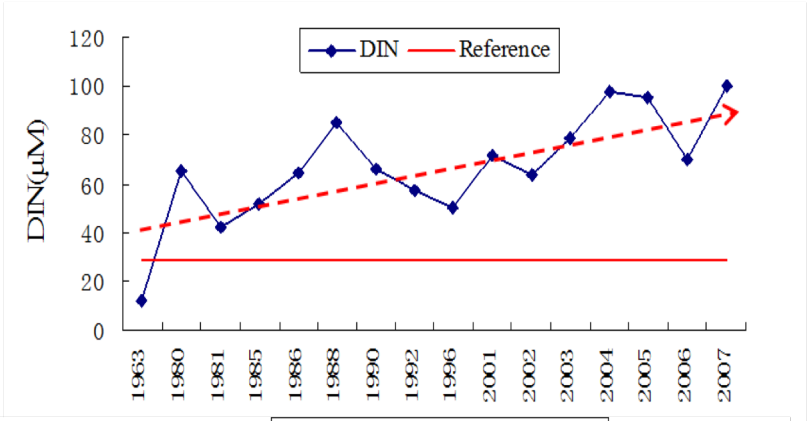
Eutrophic status of summer, autumn in 2015 by nutrient index method (SOA, 2015)

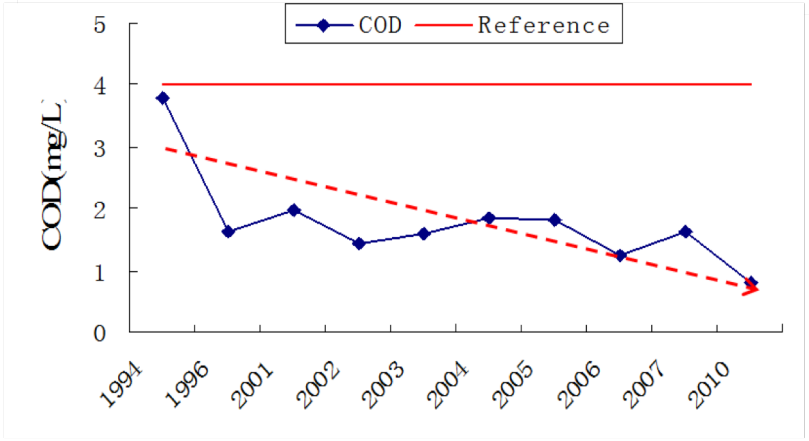


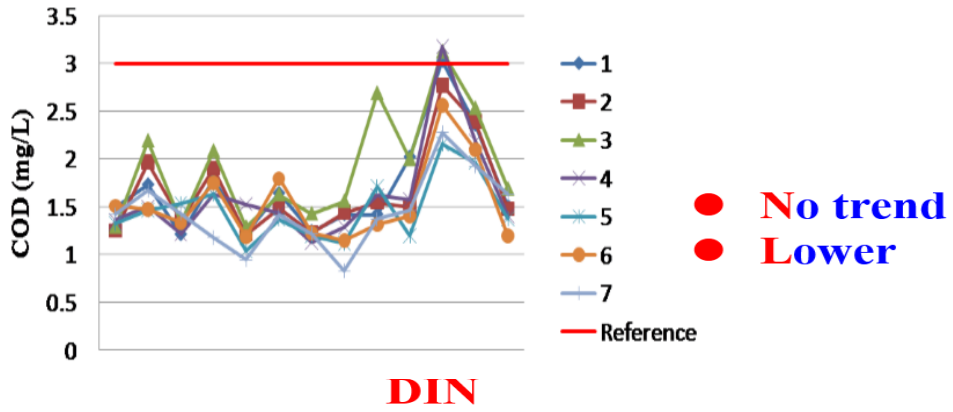
Assessment parameters in screening procedure

PSR Category		ASSETS	OSPAR	Screening Procedure
Pressure: nutrient enrichment		Nutrient inputs (DIN、DIP)	Nutrient inputs (DIN、DIP)	No nutrients COD, instead
Status (major)	Direct effects	Chl-*a*, Phytoplankton species etc	Chl-*a*, Phytoplankton species etc	Chl-*a*/COD
	Indirect effects	DO, HAB events; Submerged aquatic vegetation etc	DO; HAB events, Fish kills; Organic carbon/Organic matter etc	HAB events and DO
Response		√	√	neglected

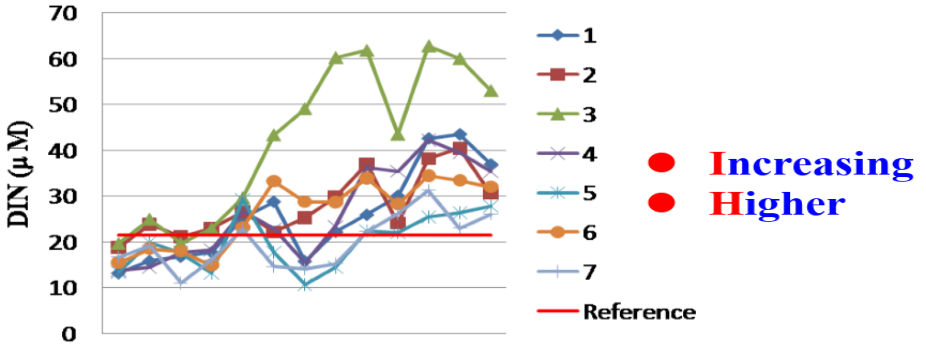
- **Assessment parameters don't include nutrients in screening procedure, instead, COD is one of the four major parameters.**
- **<u>Nutrients are "pressure" and "cause" of eutrophication, and cannot be neglected.</u>**
- **COD have no correlation with nutrients and cannot replace nutrients.**







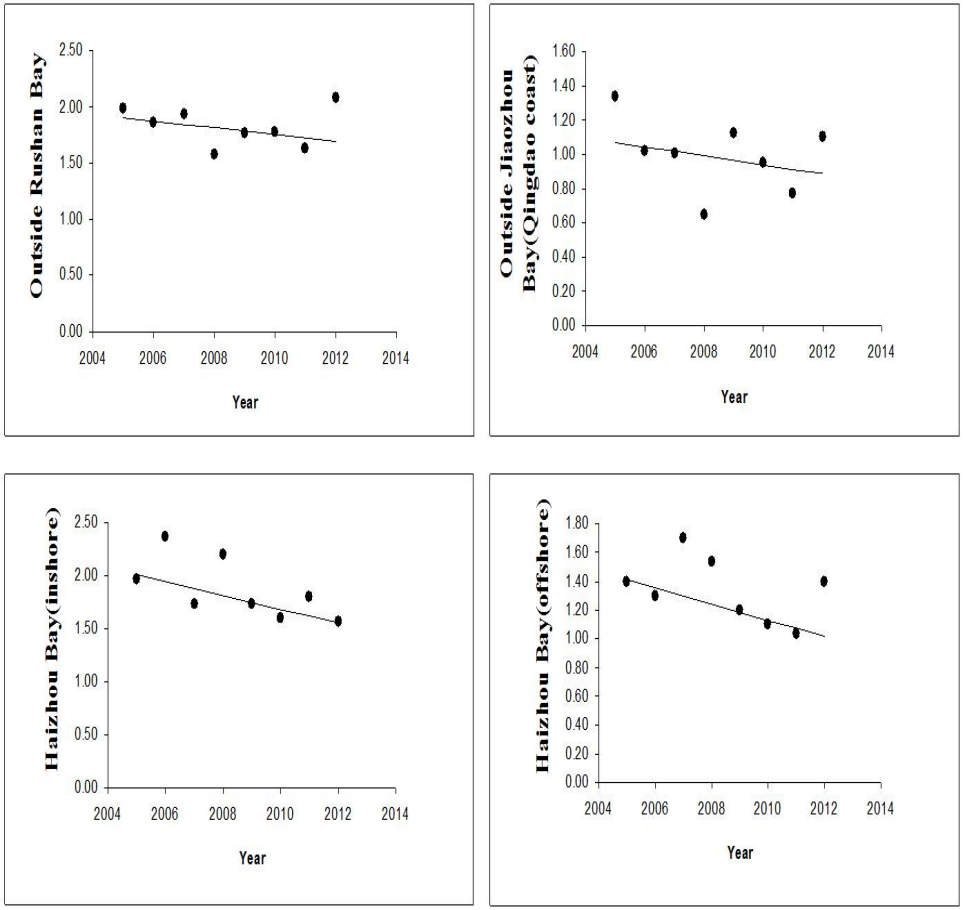
DIN



Criteria of parameters

Criteria of parameters should be considered besides trend analysis.

e.g. COD: Annual mean trend analysis. Increasing trend (by Mann-Kendall) will be regarded as symptom of eutrophication.



Both COD of Rushan and Qingdao coasts showed no trend and no symptom of eutrophication, however, the concentration in Rushan coast (2 mg/L) is one time higher than that of the Qingdao coast (1 mg/L). Apparently their degree of eutrophic status should not be the same.

Criteria of Hypoxia

- The criteria of hypoxia in this screening procedure should be specified. For example, the hypoxia refers to >0, but ≤2 mg/L in the ASSETS methodology in the USA.

- No specification of criteria of hypoxia may also impact the result of assessment, since all DO concentration lower than 5 mg/L could be regarded and called as low oxygen event in current literatures.

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- Nutrients should be included in screening procedure.
- Chl.*a* data from satellite should be corrected through field samples.
- Harmonized and universal reference or criteria of parameters should be recommended and specified in order to compare each other in different areas.
- A second assessment (comprehensive) should be implemented in the future.
- Targeted studying area should be further selected according to data available .


Thank You !