中国海水富营养化业务化监测

Marine Eutrophication operational monitoring in China

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NMEMC, SOA, CHINA

www.nmemc.org.cn

Contents

Introduction

Who we are

National Marine Environmental Monitoring Centre (NMEMC) as well as the Institute of Marine Environmental Protection of State Oceanic Administration(SOA) of China was established in 1959.

As the national operation center directly under the SOA, Undertakes the tasks of organizing for marine environmental monitoring and sea use monitoring and surveillance in China.

Introduction

What we do

1. Developing annual program of national marine environmental monitoring
2. Developing monitoring technology and making it operational
3. Establishing the assessment criteria for marine environmental quality, making quality control and assurance
4. Managing national marine environment monitoring data and processing information products
5. Implementing technical training, technique instructing and supporting on monitoring skills for national monitoring system, etc.

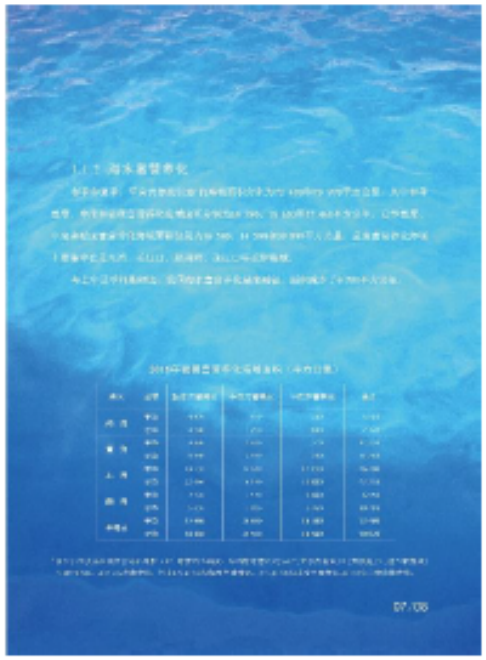
Introduction

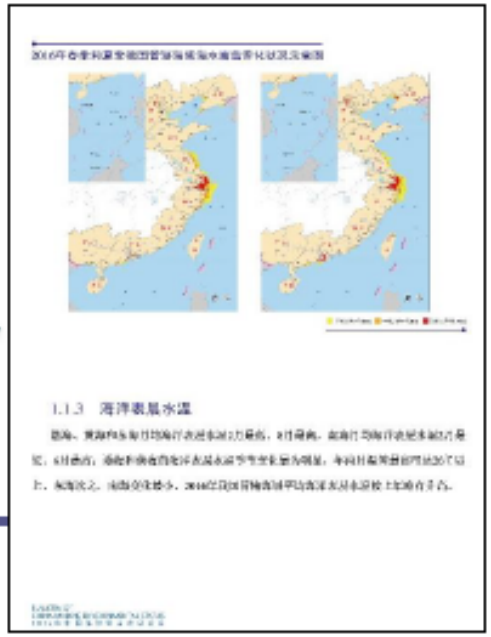
What we do

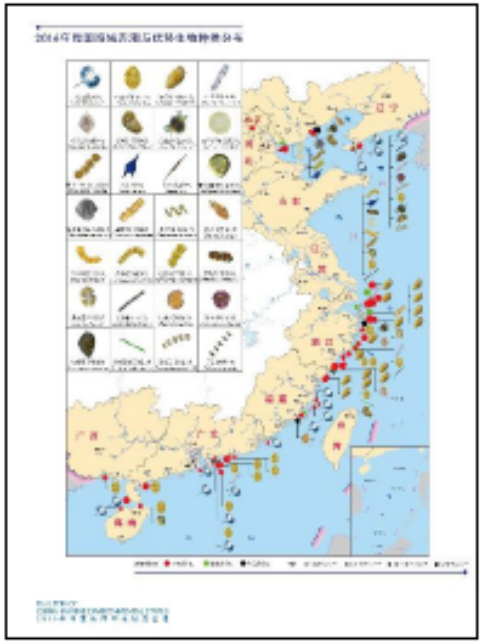
Provide annual Bulletin of Marine Environmental Status of China.

Since 2000-2016, ……

Eutrophication Assessment (2011-2016)







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Operational monitoring system in China

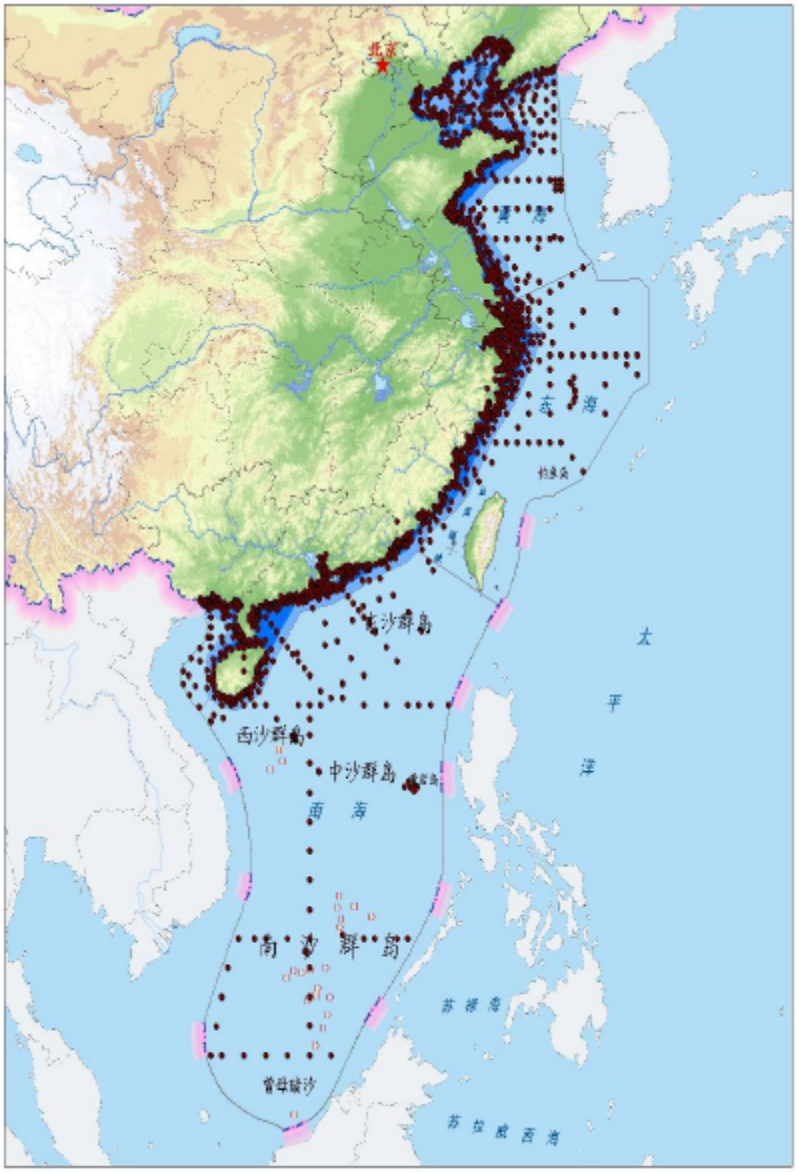
- Since 2011, Eutrophication assessment as an official operational work has been implemented.
- 2010, “Coastal Eutrophication Status assessment guide” has passed the expert review by SOA.
- 2015, “Technical regulation for evaluation of seawater quality condition” （Trial version）has been defined and implemented. And the evaluation software was developed and applied.
- .

Software copyright certificate

Operational monitoring system in China

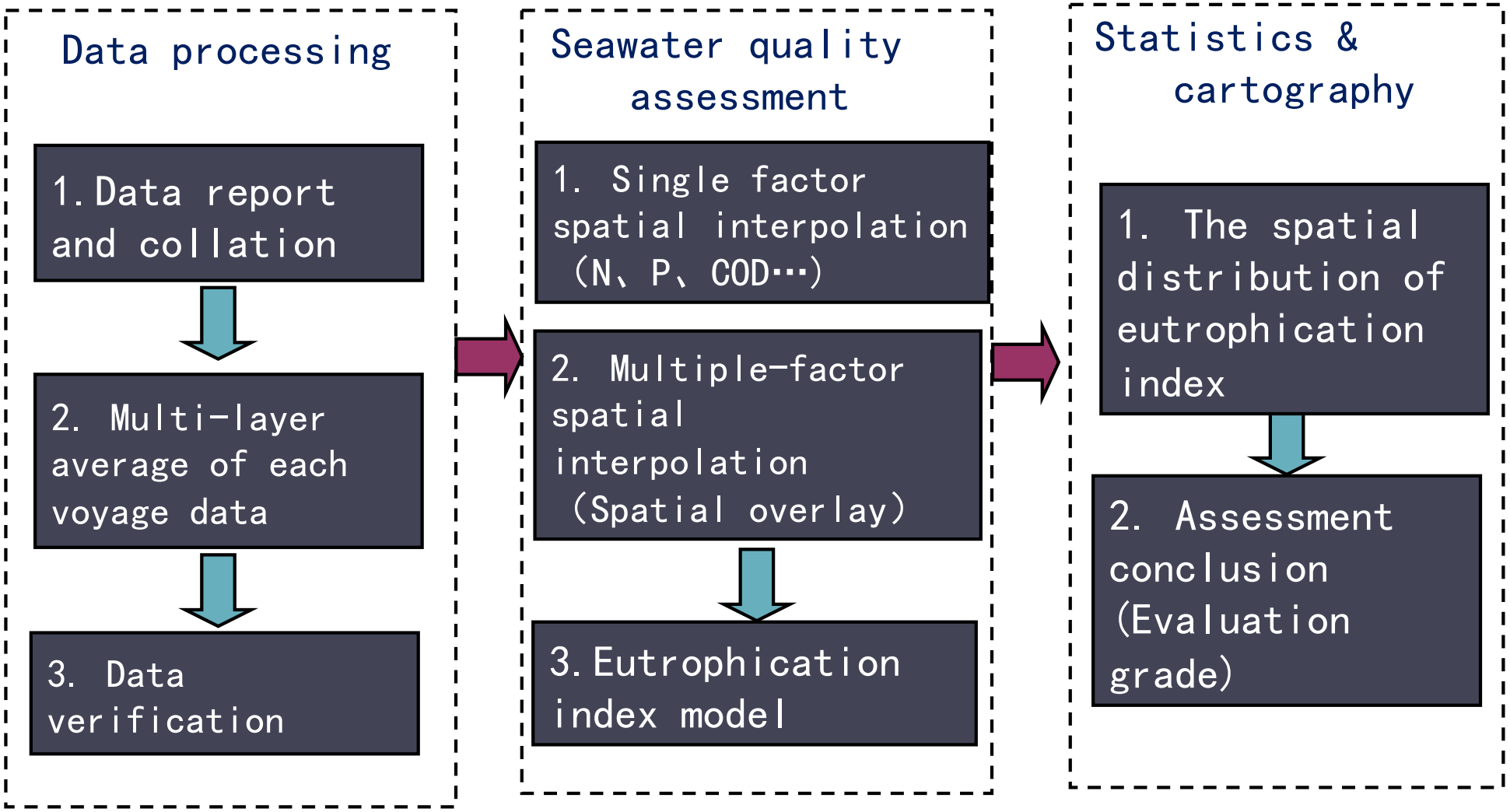
- Monitoring Spatial scope
  ---nearshore
  ---offshore

- Trend sample stations (1941)

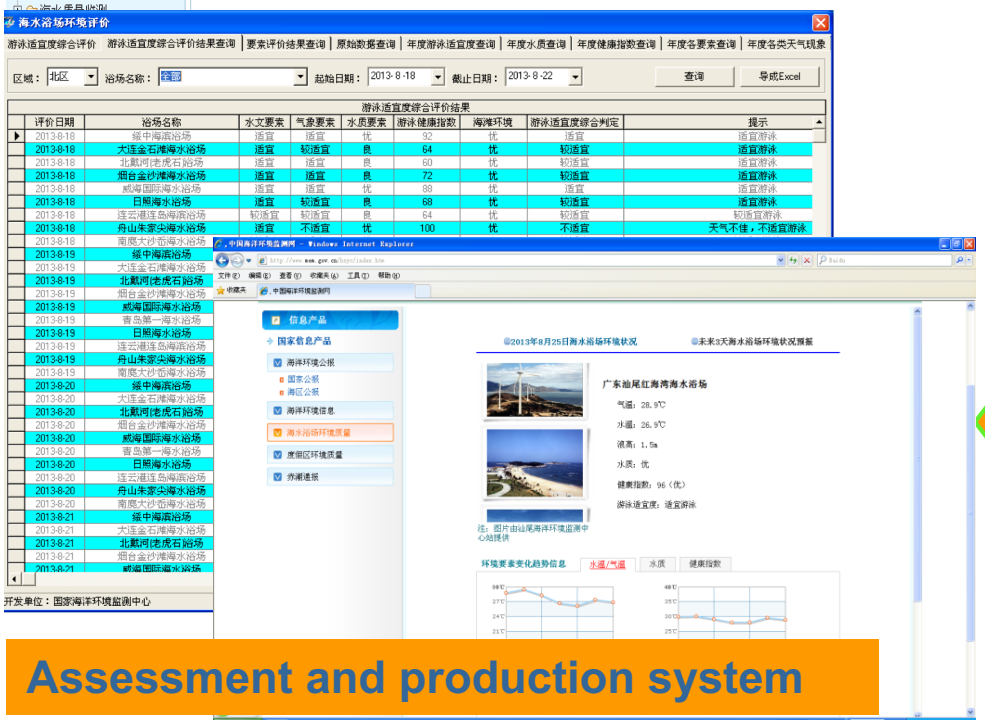


Operational monitoring system in China

Eutrophication Assessment process

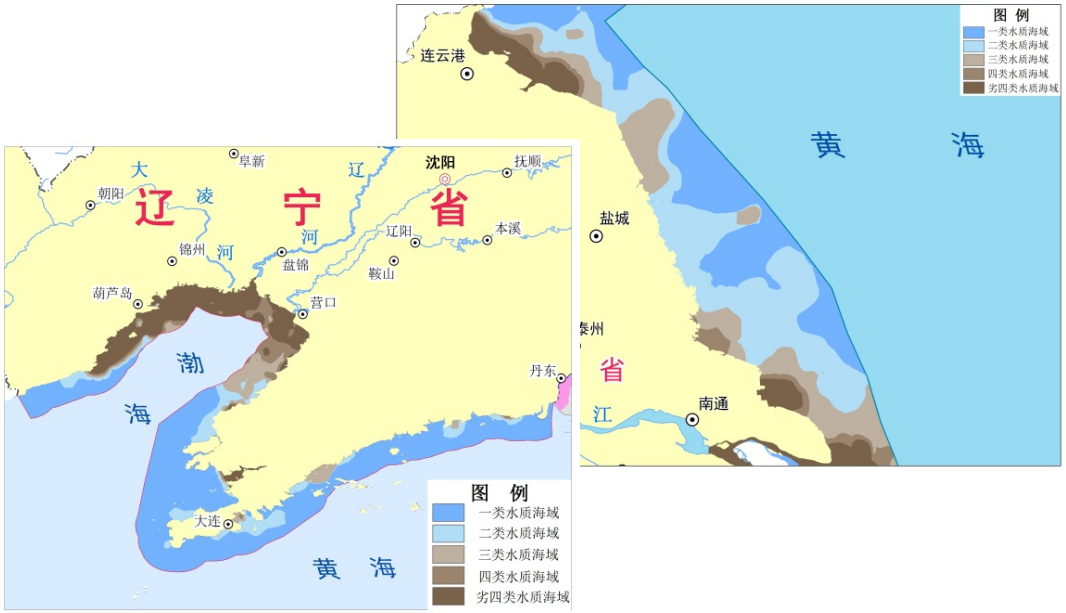


Eutrophication Automatic Assessment Process



Operational monitoring system in China

- Some coastal provinces also follow the Technical regulation. Such as… …



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1. Introduction
2. Operational monitoring system
3. Assessment method
4. Status and trends
5. Problems and suggestions

Assessment method

Single index method

- Physical parameter method: Water color, transparency, illumination, radiation quantity, etc
- Chemical parameter method: DO、CO_2、N、P、COD , etc
- Biological parameter method: Chla、*H'*（Diversity index）、AGP（Algae growth potential） , etc

Assessment method

Comprehensive index method

- Nutrient quality index：

  NQI=COD/CODs+TN/TNs+TP/TPs+Chla/Chlas

- Ratio method：

  $COD \times DIN \times DIP/4500 \times 10^6$ (Okaichi Woori、邹景忠等)

- Dissolved oxygen saturation method：

  $D=((Xs)^2+(Xb)^2)^{1/2}$ (Justic etc.)

- Normal distribution method：

  The data of N and P are normalized so that the data becomes normal distribution, and μ and σ are determined （Ignatiades L.et al.1992）

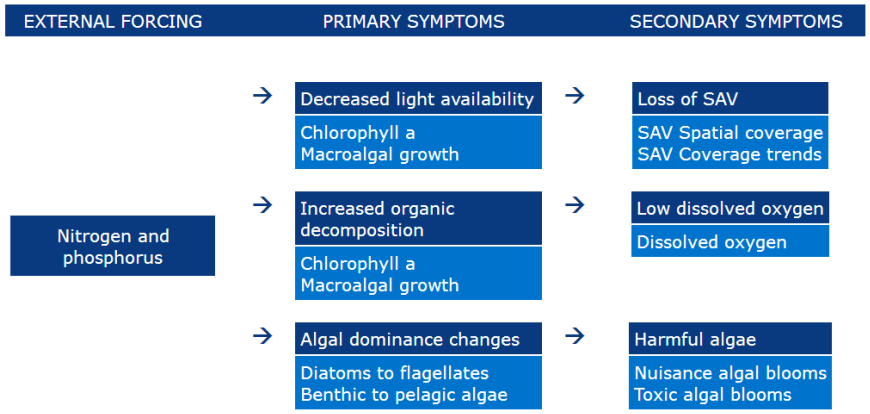
- Fuzzy evaluation method based on fuzzy theory (彭云辉 等，1991)

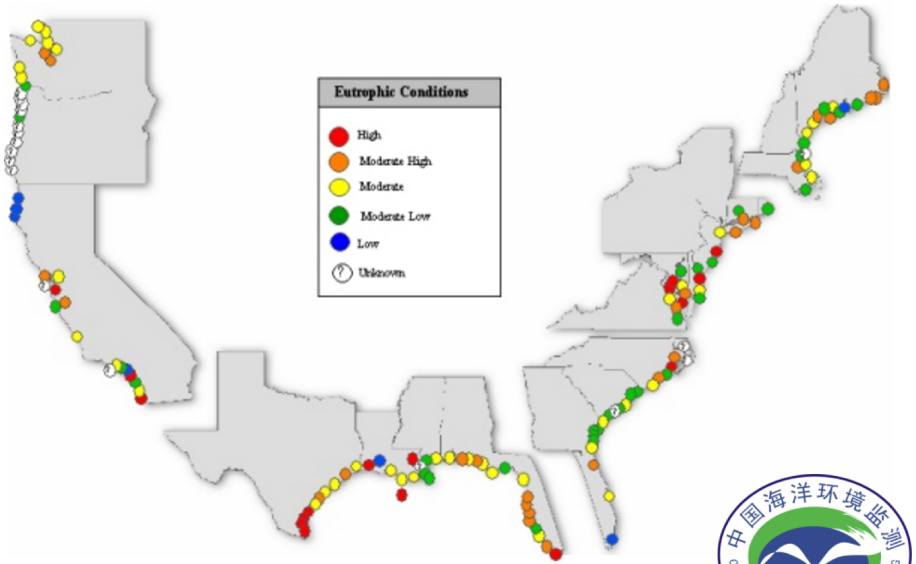
Assessment method

Based on Pressure-state-response

Assessment of Estuarine Trophic Status，ASSETS

National Estuarine Eutrophication Assessment，NEEA





Assessment method

Definition

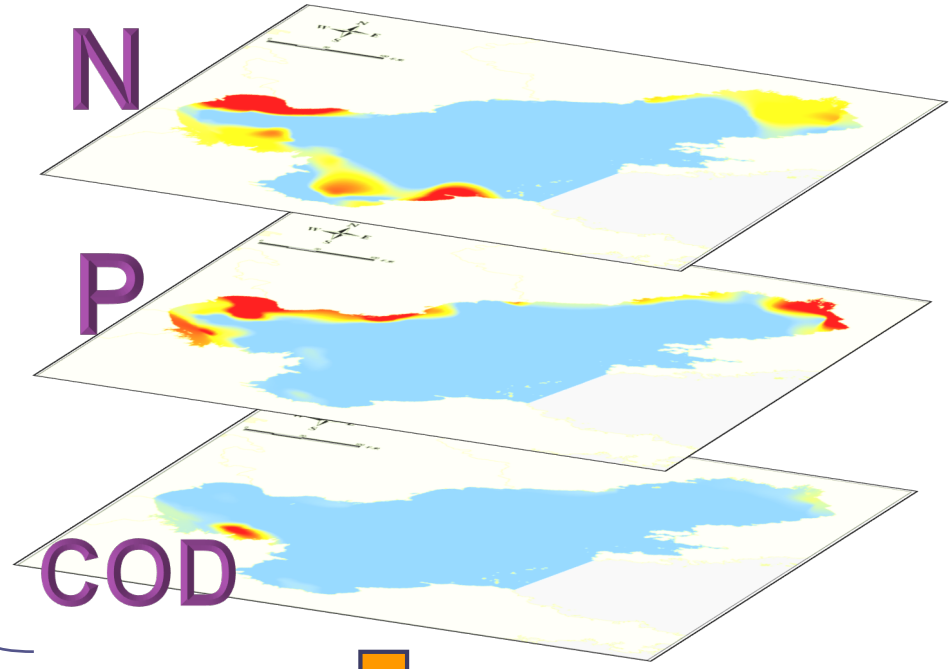
- **The concentration of nitrogen and phosphate in seawater exceeds the normal level.——** "Technical specification for evaluation of seawater quality condition"（Trial version）

- The increase of organic matter supply rate in ecosystem（Nixon,1995）
- The process of changing the nutritional status of specific water by increasing the supply of inorganic nutrients（Jorgensen & Richardson,1996）
- "Due to the enrichment of nutrient in water, algae or other higher plants accelerate appreciation, the balance of organisms in water and water quality cause unnecessary interference, especially refers to the human activities lead to the adverse impact of the nutrient enrichment"（OSPAR Convention & Nitrate Directive,1991 & Urban Water-Water Treatment Directive,EU）

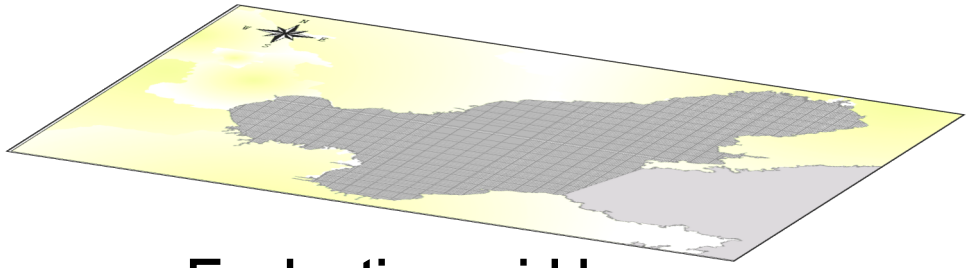
1 Nixon S W. Coastal marine eutrophication: a definition, social causes, and future concerns [J]. Ophelia, 1995, 41:199-219.
2 Jorgensen B B, Richardson K. Eutrophication in coastal marine ecosystem [M]. Coastal and estuarine studies 52. Washington, D.C.: American geophysical union, 1996.
3 Anonymous. Council Directive of 21 May 1991 concerning urban waste water treatment (91/271/EEC) [J]. Official Journal, 1991a, L 135.
4 Anonymous. Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources [J]. Official Journal, 1991, L 375.

Assessment method

Interpolation

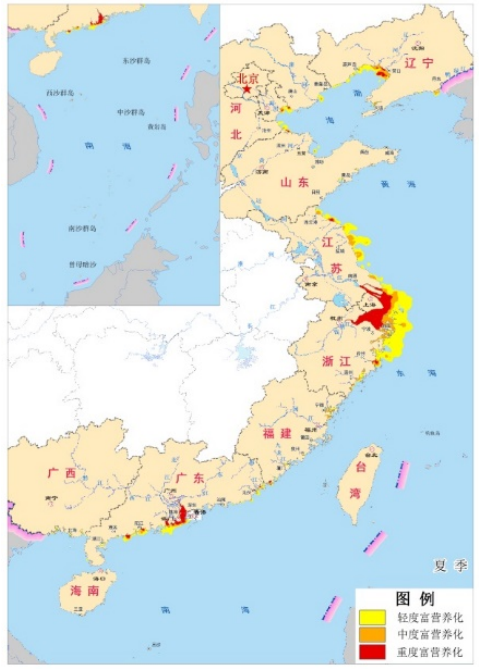


Overlay maps to the space grid



Evaluation grid layer

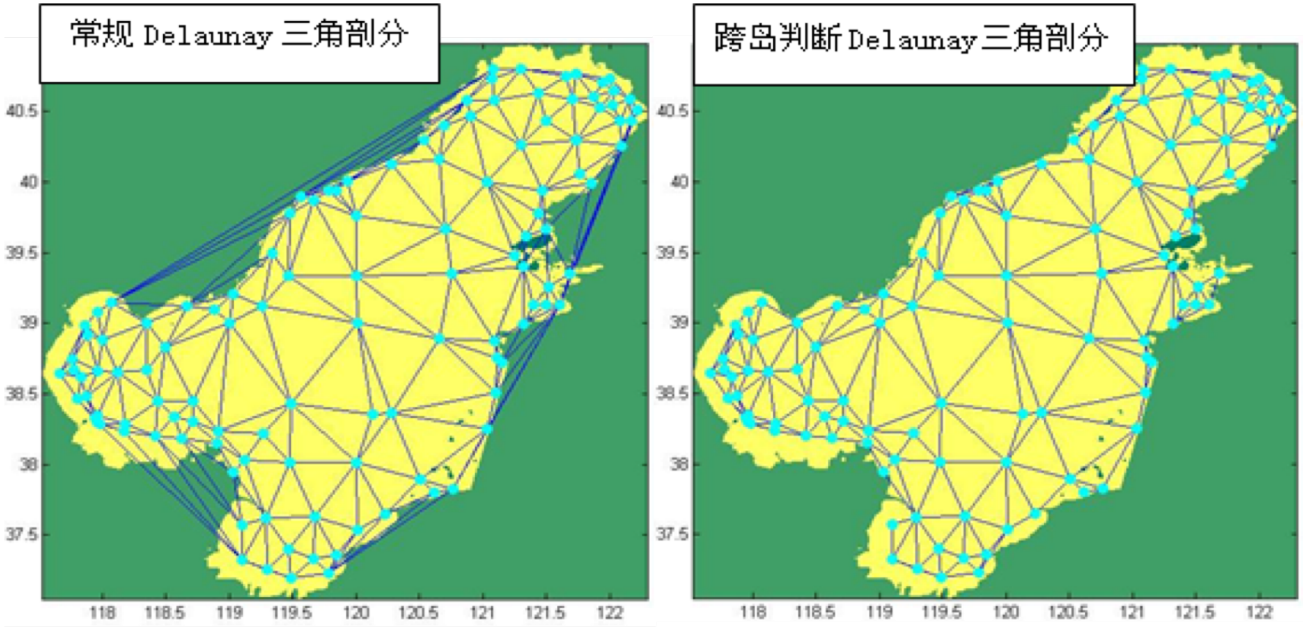
Eutrophication index method

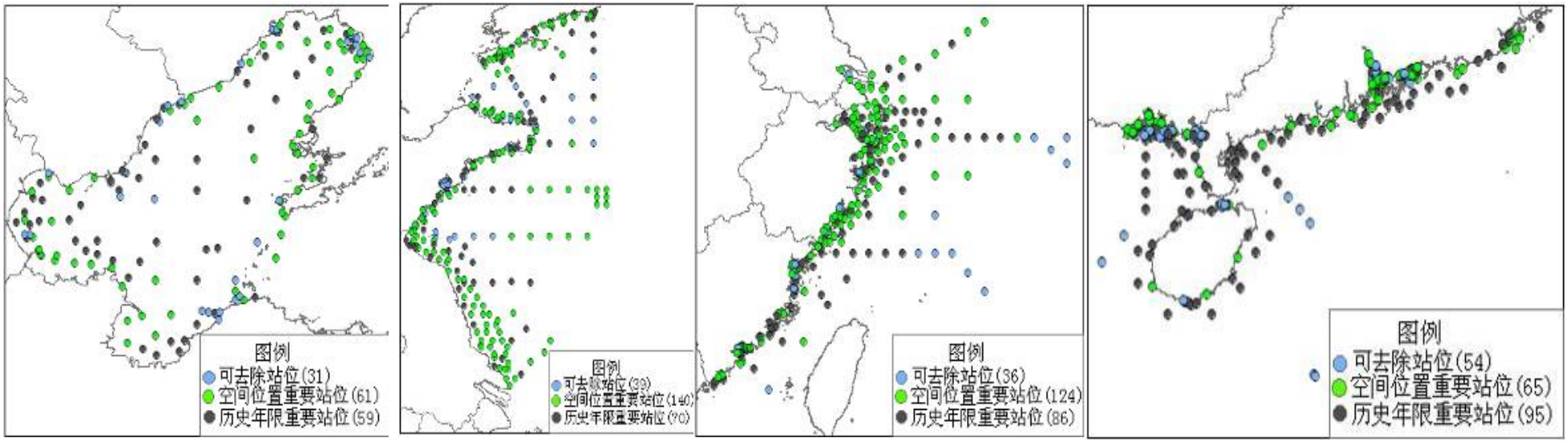


Evaluation Results

Assessment method

Delaunay Triangulation





Assessment method

Seawater spatial Interpolation model

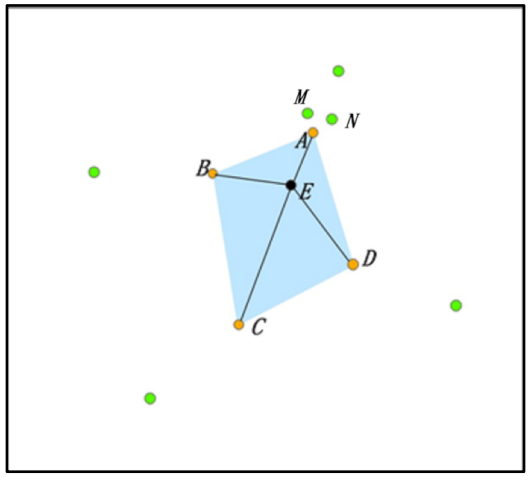
Assessment software

Why use IDW interpolation algorithm?

- Fast speed, calculation time is short
- The interpolation is smooth and will not exceed the maximum and minimum values
- Overall practicability

Spatial interpolation based on IDW model:
The interpolation method is used to assign values to the grid of the evaluation region

$$Z(E)=\sum_{i=1}^{n} Z(X_i)\lambda_i \quad \cdots (1) \qquad \lambda_i=\frac{1}{d_i^4}\Big/\sum_{i=1}^{n}\frac{1}{d_i^4} \quad \cdots (2)$$



Seawater Eutrophication Assessment

Eutrophication Index

The comprehensive index method was used in the operational assessment of seawater eutrophication:

$$E=(C_{COD}\times C_{DIN}\times C_{DIP}\times 10^6)/4500$$

E —— Eutrophication index;

C_{COD} —— Chemical oxygen demand concentration, Unit:*mg/L*;

C_{DIN} —— Inorganic nitrogen concentration, include the concentration of Nitrite nitrogen (NO_2-N), Nitrate nitrogen (NO_3-N) and Ammonia nitrogen (NH_4-N), Unit:*mg/L*;

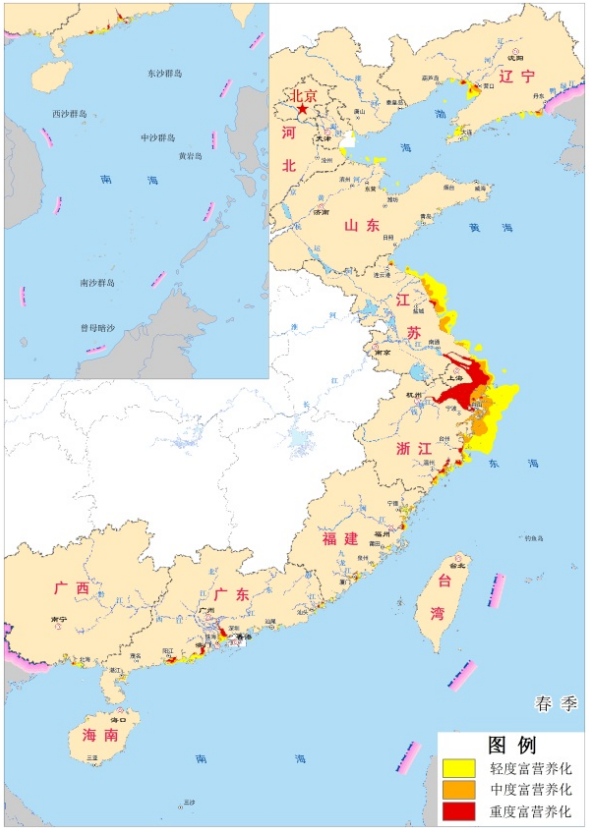
C_{DIP} —— Active phosphate concentration, Unit:*mg/L*

- The decision principle of eutrophication level fellows the table.

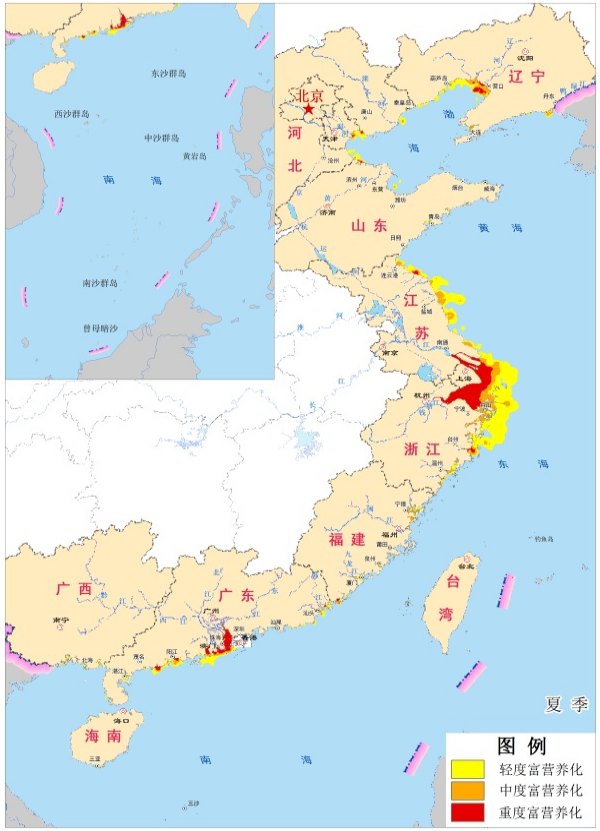
Eutrophication Level	Decision Principle
Slightly	$1<E\leq 3$
Medium	$3<E\leq 9$
Heavily	$E>9$

Contents

Status

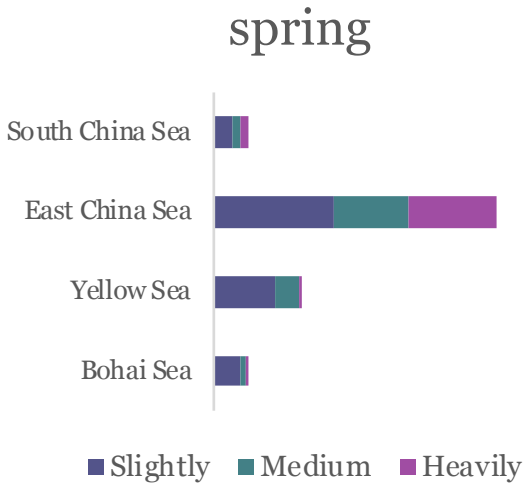


Spring（71 560km^2）

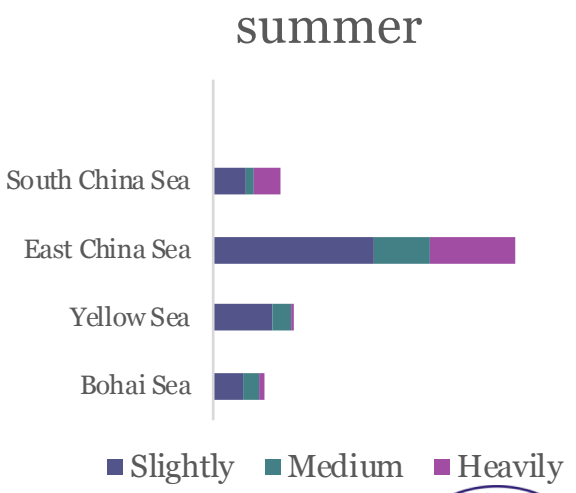


Summer（70 340km^2）

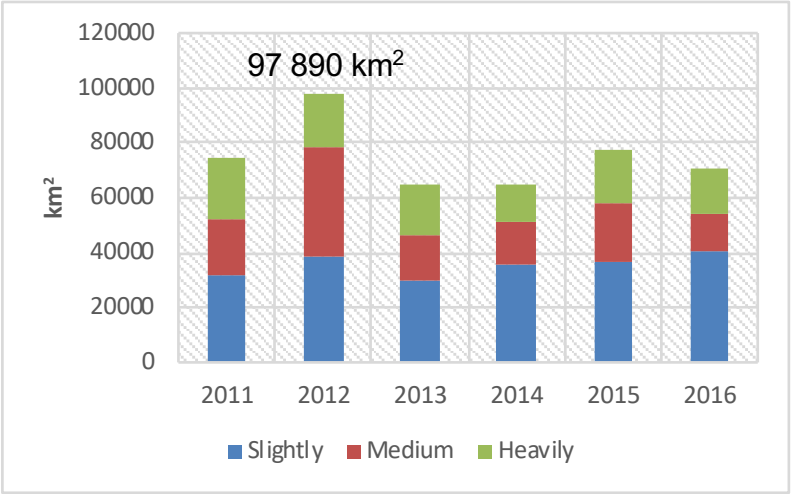
2016



2016



Trends


120000
100000
80000
60000
40000
20000
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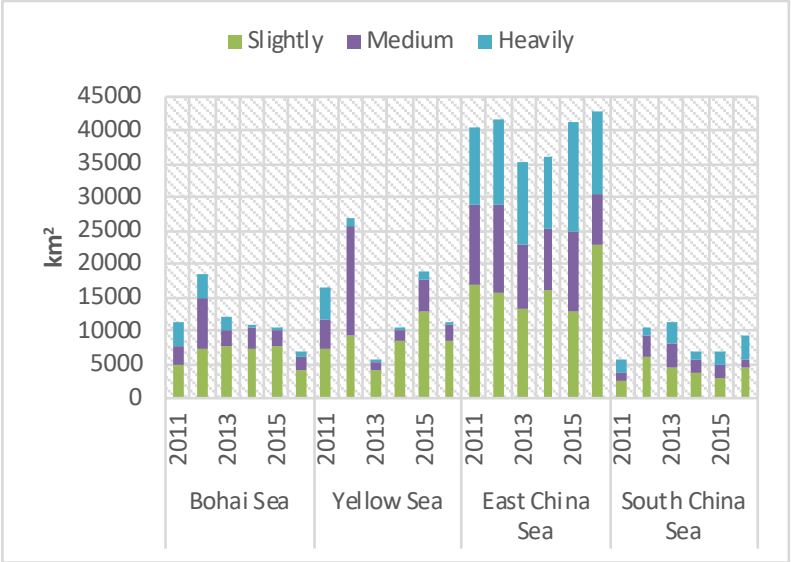
km²
97 890 km²
2011
2012
2013
2014
2015
2016
Slightly
Medium
Heavily


Slightly
Medium
Heavily
45000
40000
35000
30000
25000
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10000
5000
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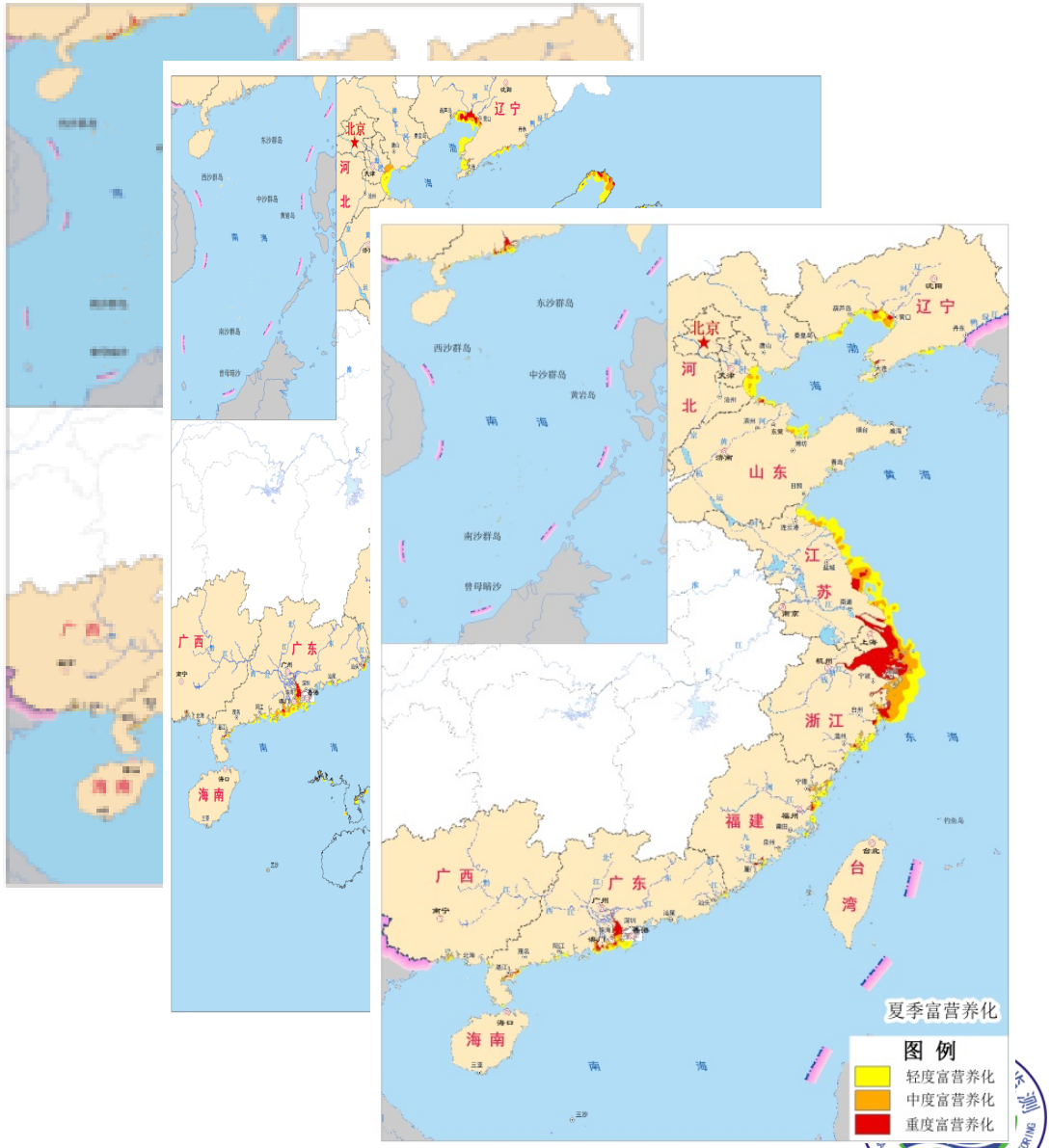
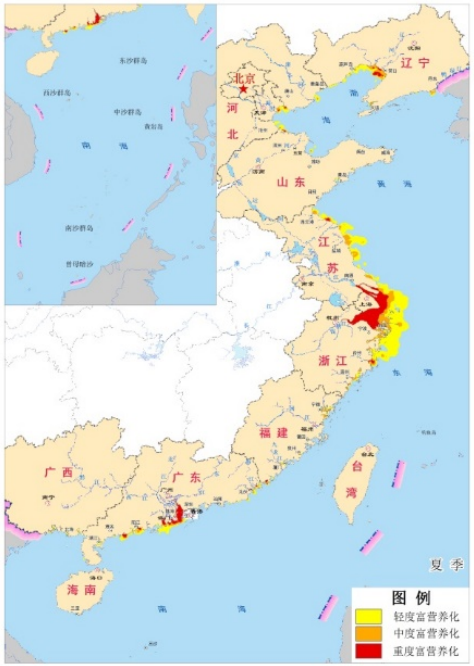
km²
2011
2013
2015
Bohai Sea
Yellow Sea
East China Sea
South China Sea


辽宁
北京
河北
山东
江苏
浙江
福建
台湾
广西
广东
海南
夏季富营养化
图 例
轻度富营养化
中度富营养化
重度富营养化

2015

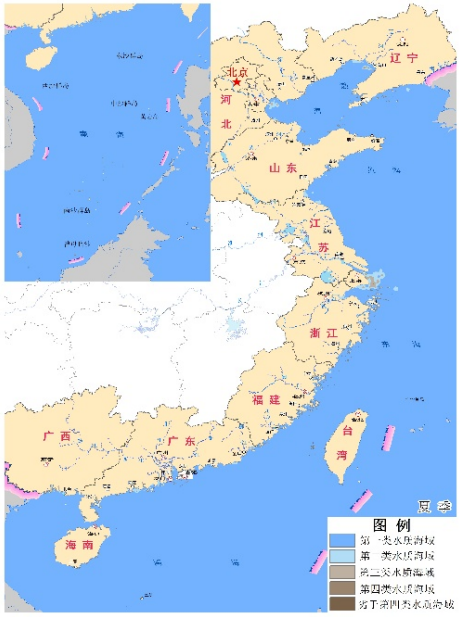
Correlation



Eutrophication

N

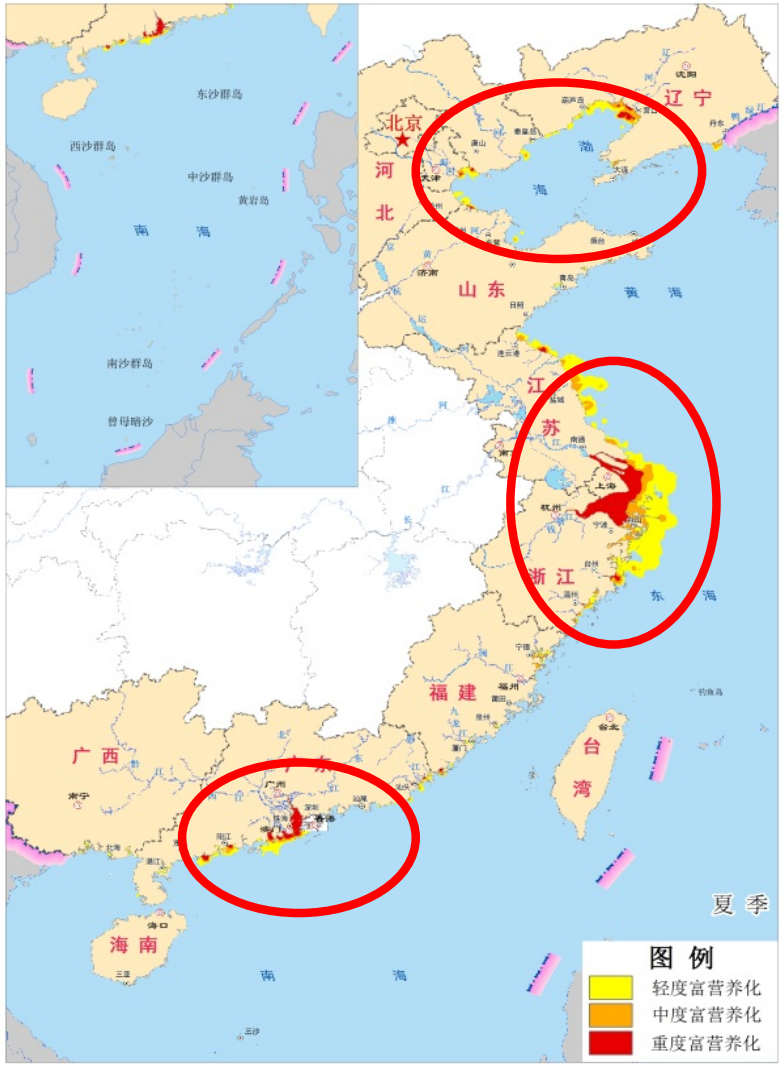
P



COD

2016

Correlation



EUTROPHICATION

HAB

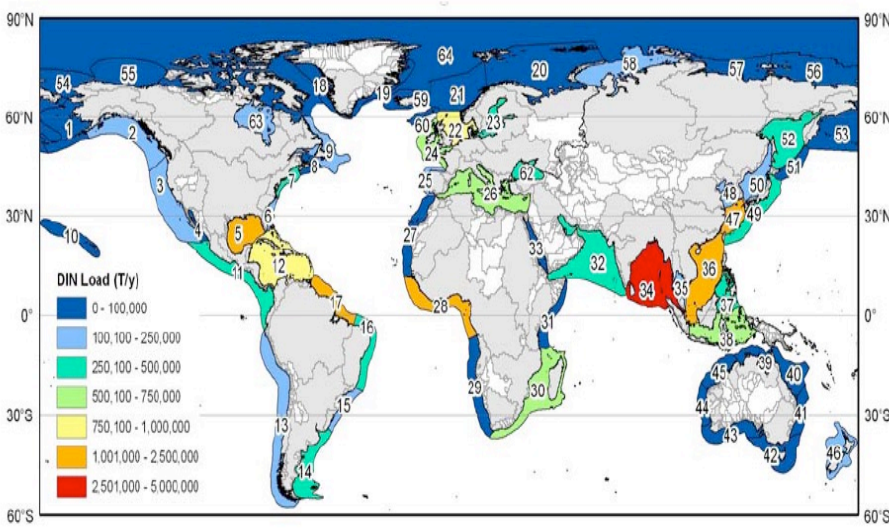
Contents

Problems and suggestions

Advantages	Disadvantages
• Multiyear continuous monitoring • Seasonal monitoring per year • Assessment method is simple ,Less monitoring indicators, Easy to popularize	• Based on seawater function, not enough to consider the health of offshore ecosystem • The standard of eutrophication grade not enough to consider the difference of ecological environment

Suggestions

- Nutrient structure and its changes should be considered
- Assessing the comprehensive impact of eutrophication based on pressure-state-response model
- Establish eutrophication level scientifically
- Keeping up with the international advanced assessment method.
- New technologies will be applied, such as satellite inversion of chlorophyll data….

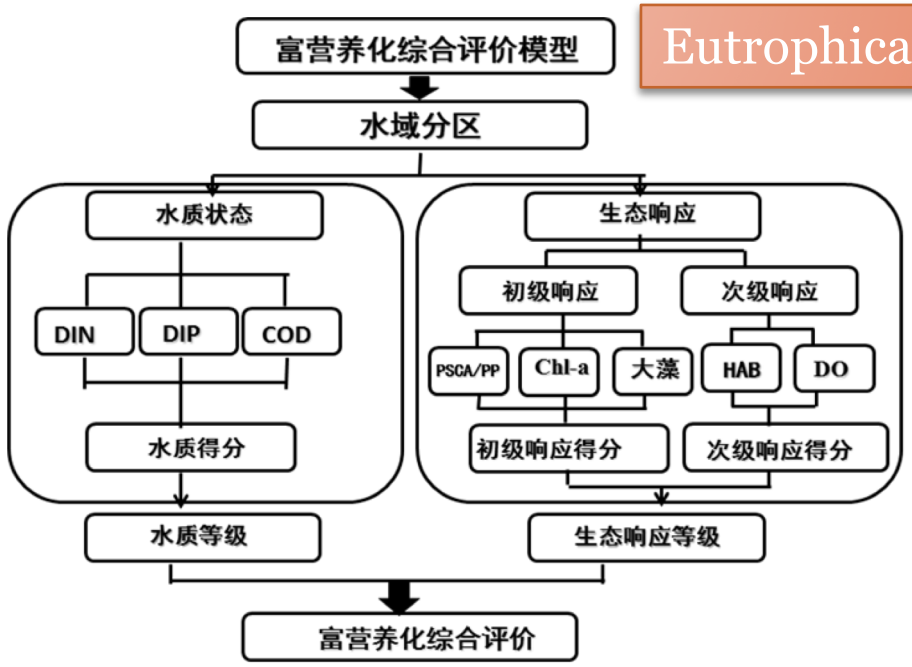


Suggestions

"Guideline for assessing status and trends of marine environmental quality "

Part 1:Sea water quality assessment （Unpublished）

Water quality
- ✓ N
- ✓ P
- ✓ COD



Eutrophication Assessment model

Ecological response
- ✓ primary productivity responses
- ✓ secondary responses(HAB,DO)

Suggested by Dr.Zhiming Yu&Dr.Zaixing Wu (Institute of Oceanology Chinese Academy of Sciences)