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Assessing the Severe Eutrophication Status and Spatial Trend in the Coastal Waters of Zhejiang Province (China)

浙江大學海洋學院
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Oct.30, PICES 2018 Annual Meeting, Yokohama

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01 Background

Marine pollution

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- Increasing anthropogenic activities (Shipping, Agriculture, Heavy industry…)
- Nutrient loading (Nitrogen, Phosphorous)
- Declining water quality, Harmful algal blooms, Hypoxia…

01 Background

Sea water quality of China

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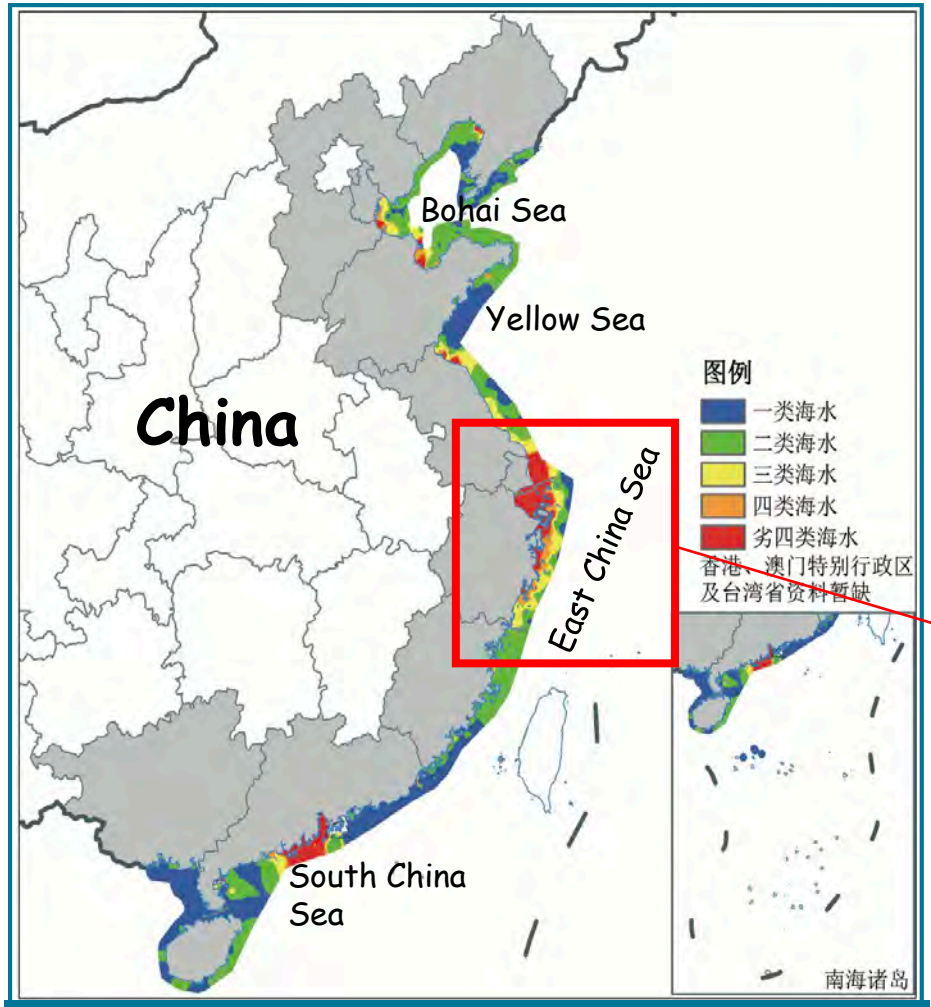
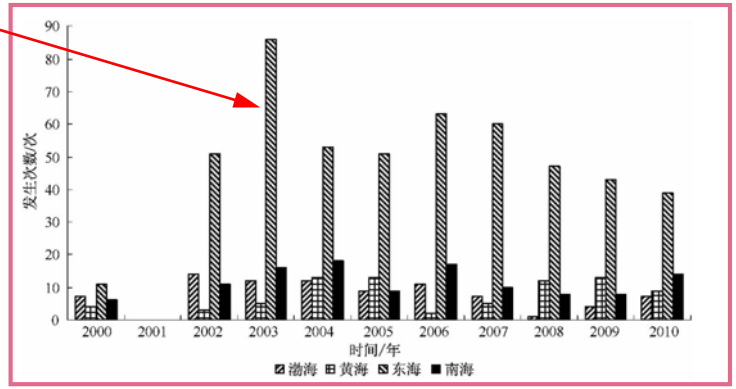


Bulletin of ecological environmental quality in China's coastal waters,2017

Effective seawater quality mapping and assessment based on Geostatistical methods

Frequency of harmful algae blooms in each sea region of China, 2000-2010



02 Study Area

Zhejiang coastal waters

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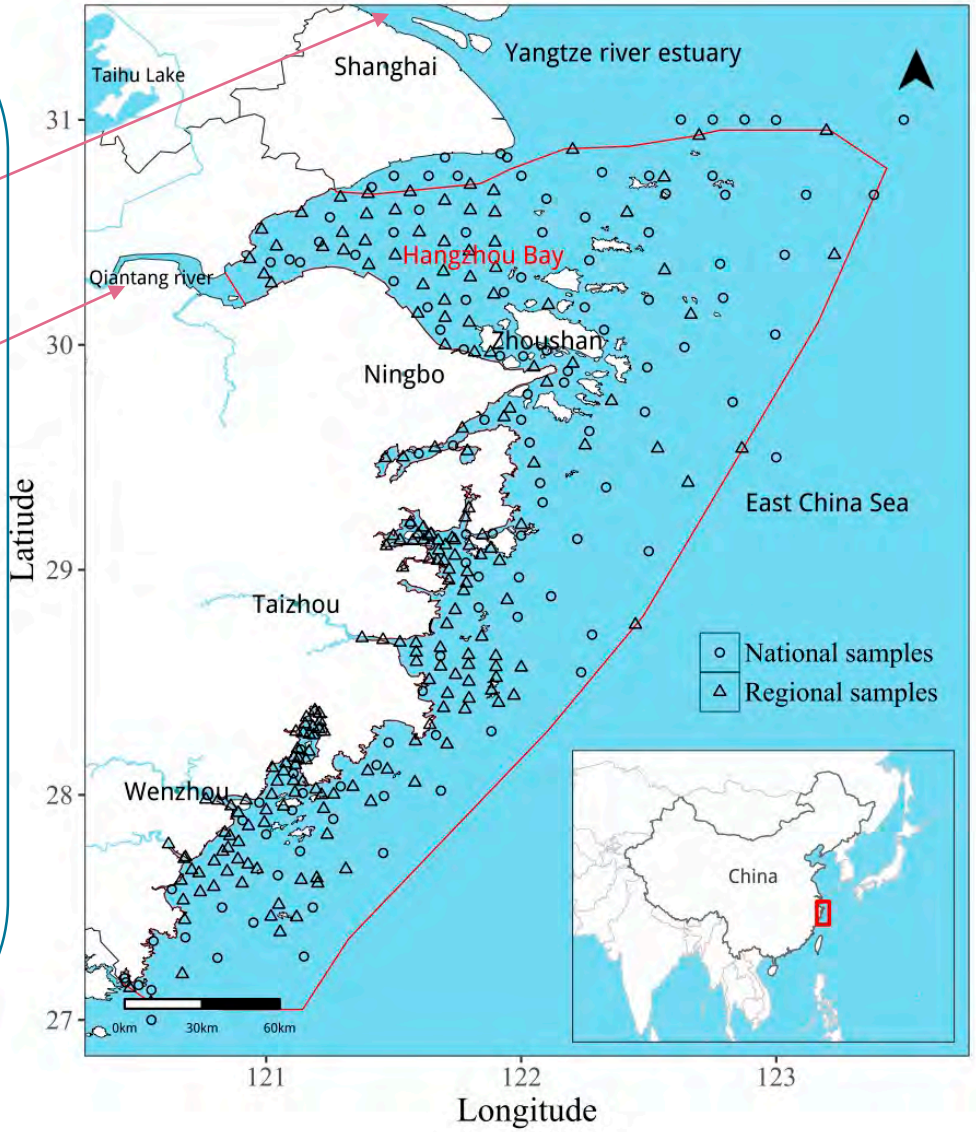
- 44.4 thousand km^2
- Along East China Sea
- Large amounts of anthropogenic nutrients flow into sea water from Yangtze River and Qiangtang River
- A total of 321 samples were collected during August 2015 with monitoring attributes such as pH, chemical oxygen demand (COD), dissolved inorganic nitrogen (DIN, the sum value of NO_2-N, NO_3-N, NH_3-N) and dissolved inorganic phosphorous (DIP)



03 Methods

Bayesian Maximum Entropy

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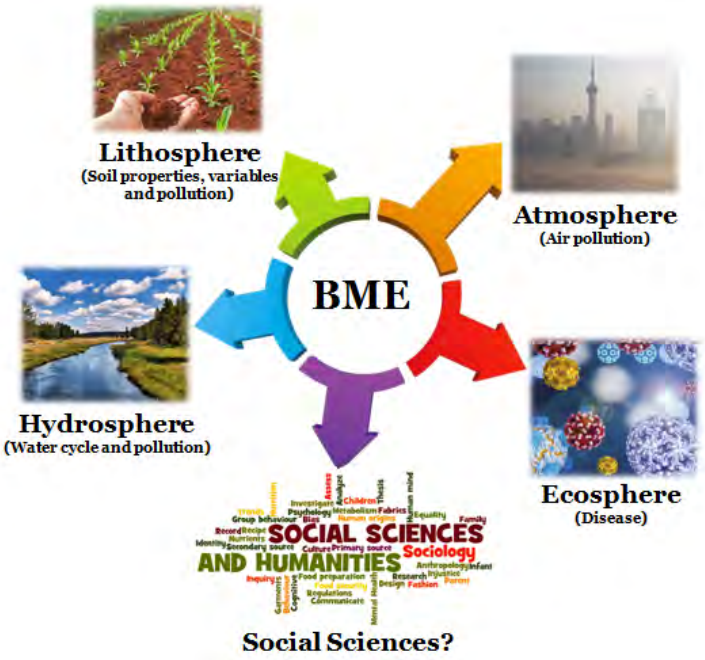
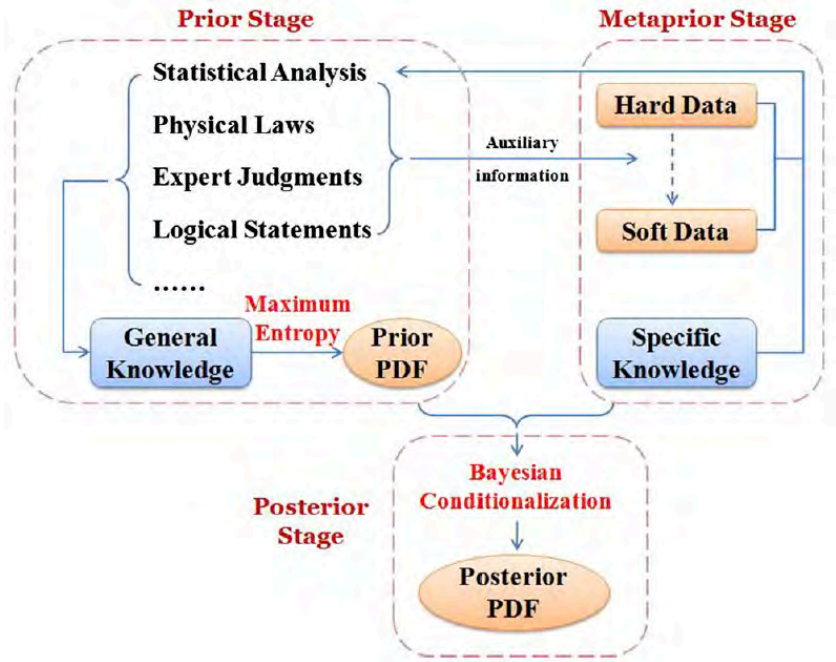
- Integrate informative content from different sources
- Independent of the data distribution (e.g., nonlinear interpolators, non-Gaussian distributions)
- Improved Space/Space-Time prediction accuracy (*vs* Kriging, IDW)





He, J., & Kolovos, A. (2017). Bayesian maximum entropy approach and its applications: a review. *Stochastic Environmental Research & Risk Assessment*(6), 1-19.

03 Methods

Stochastic Site Indictor

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Extent of eutrophication
Space-time distribution pattern
Quantitatively characterization
Identification of eutrophication risk & critical region

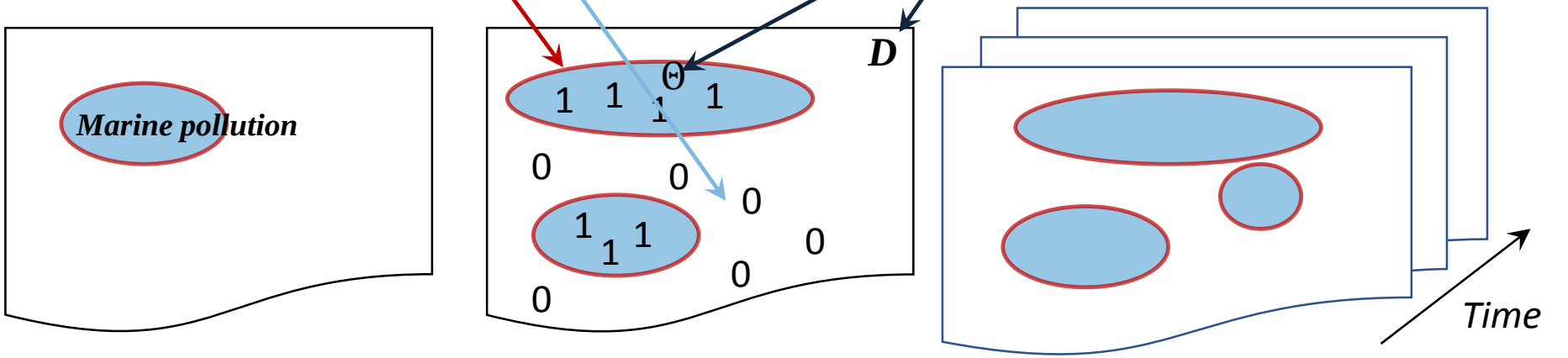
The binary marine pollution (e.g., eutrophication) characteristic

Conditional MEP (CMEP)

$$P_{mp}^{\Theta}(\zeta) = \overline{MP(\boldsymbol{s})|MP(\boldsymbol{s}) \geq \zeta}$$

Polluted indicator dispersion (PID)

$$\Psi_{mp} = \frac{\overline{L_{mp}^{D}(\zeta)}}{\overline{MP}}$$



04 Results

Water quality maps

The COD, DIN, and DIP concentration maps generated by the IDW, OK, and BME methods

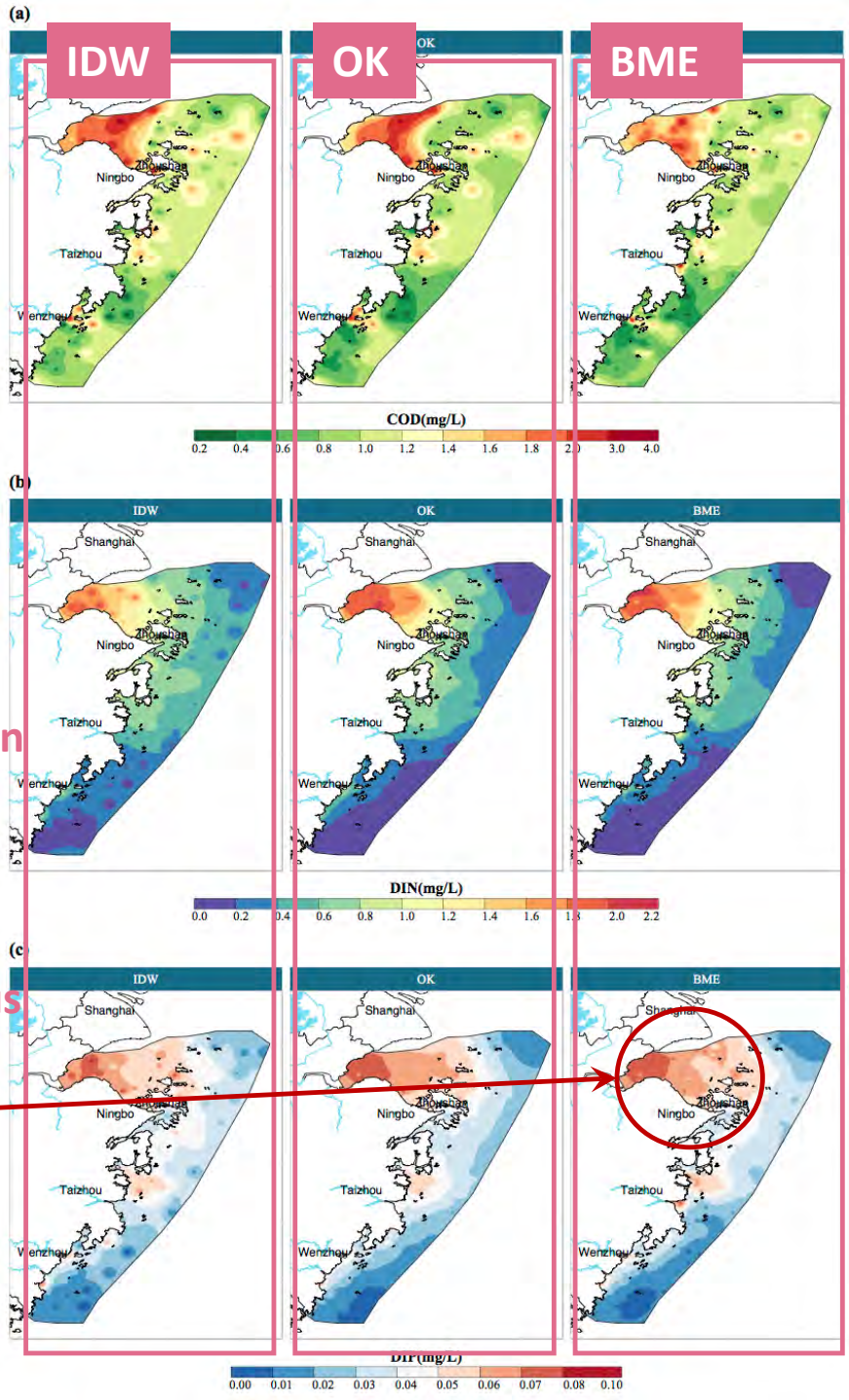
- BME has the best cross-validation performance.

Nitrogen

- Spatial maps show a global decreasing trend from the coastal estuary to the open sea.

Phosphorous

- Extremely high values were found in Hangzhou Bay ~~where there are much~~ human disturbances and pollutant accumulations from the upstream freshwater.



04 Results

Characterization & Assessment

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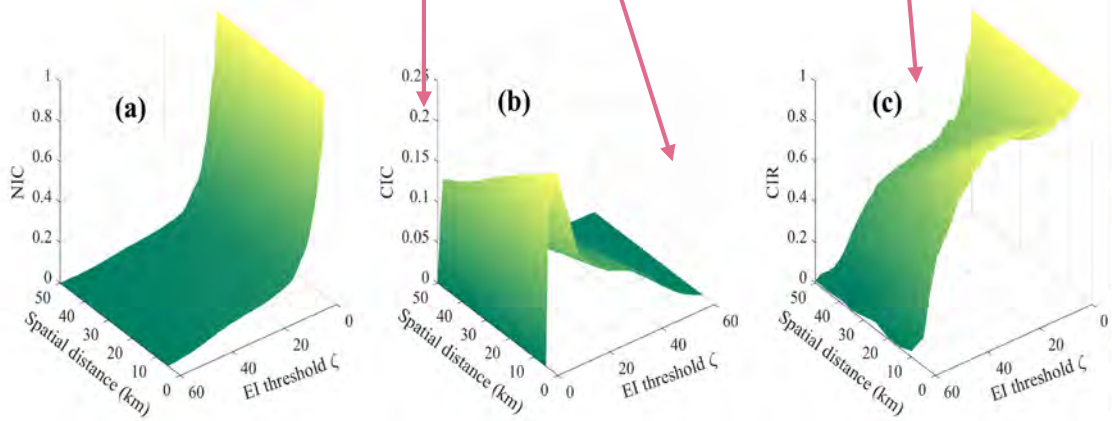
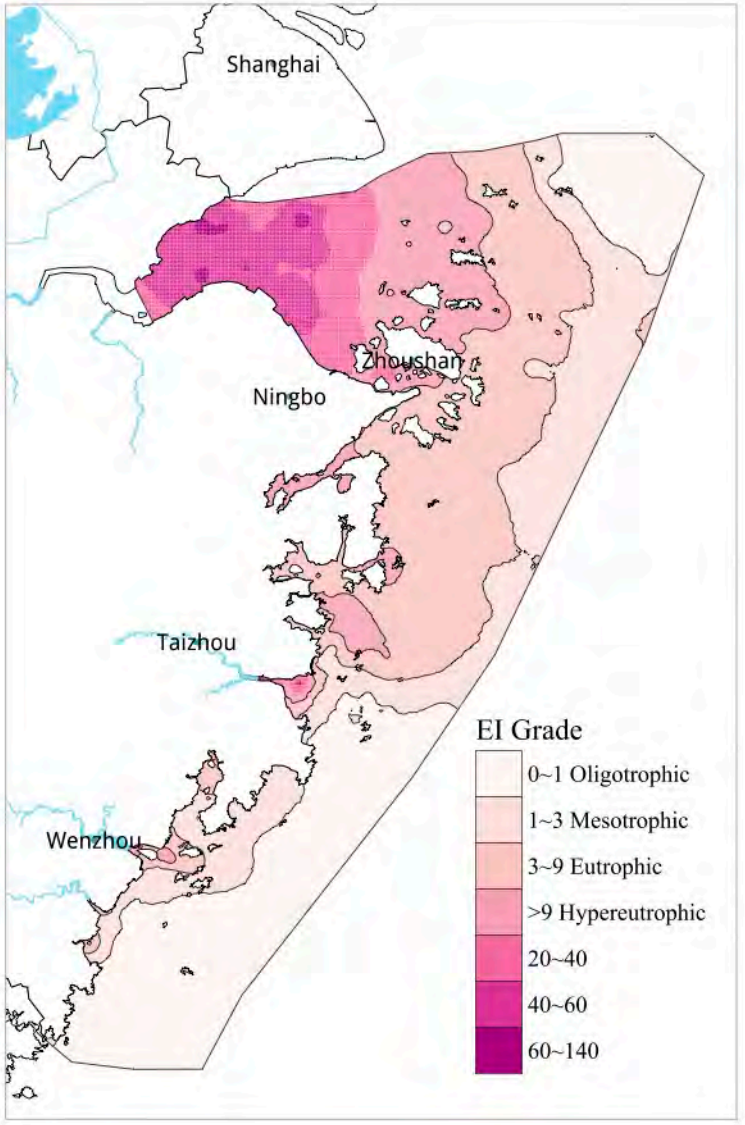
By calculating the RAEC differences for the thresholds 1, 3,and 9 of the Eutrophication index classification standards, it is found that in 25.95% of the Zhejiang coastal waters the quality grade is oligotrophic, in 19.18% mesotrophic, in 20.53 eutrophic, and in 34.34% hypereutrophic.

At distances smaller than a critical distance 15 km, the eutrophication locations are concentrated in the coastal waters of the Zhejiang province rather than being dispersed





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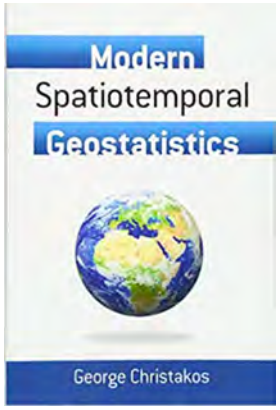
Main Reference

LIMNOLOGY AND OCEANOGRAPHY ASLO Association for the Sciences of Limnology and Oceanography

Jiang, Q., He, J., Wu, J., Hu, X., **Ye, G., & Christakos, G**. (2018). Assessing the severe eutrophication status and spatial trend in the coastal waters of zhejiang province (china). *Limnology & Oceanography*.



Our team works on Space-Time data analysis.
Academic exchange and cooperation are welcomed.
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Christakos, G. 2000. Modern spatiotemporal geostatistics. Oxford Univ. Press.
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Thanks

FOR YOUR ATTENTION

Oct. 25 ~ Nov. 4, PICES 2018 Annual Meeting, Yokohama, Japan

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