Progress of the Retrieval Algorithms for Ocean Color Measurements in China (WP2)

Tinglu Zhang

Ocean Remote Sensing Institute
Ocean University of China

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- **Algorithms for Oceanic constituents (CHL, SPM and CDOM);**

  Statistical algorithm;

  ANN-based algorithms;

  Genetic Algorithm (Global Optimization methods)

- **Algorithms for IOPs ;**

  Statistical Algorithm;

- **Algorithms for K_d(490).**

  Statistical algorithms

Retrieval Algorithms for Oceanic Constituents

Statistical Algorithms for CHL

He et al., 2000 (OUC) (Applied Optics)

Step1. Rrs→at

$$\ln[a_t(\lambda)] = a_0(\lambda) + a_1(\lambda)\ln[Rrs412/Rrs555] + a_2(\lambda)\ln[Rrs443/Rrs555] + a_3(\lambda)\ln[Rrs490/Rrs555] + a_4(\lambda)\ln[Rrs510/Rrs555] + a_5(\lambda)\ln[Rrs670/Rrs555] + a_6(\lambda)\ln[Rrs682/Rrs555]$$

Step 2. a_t →aph

$$a_t(\lambda) = a_{ph}(\lambda) + a_{dg}(\lambda) + a_w(\lambda)$$

Step 3. aph(440) →chl

$$a_{ph}(440) = 0.06[CHL]^{0.65}$$

Retrieval Algorithms for Oceanic Constituents

Statistical Algorithms for CHL

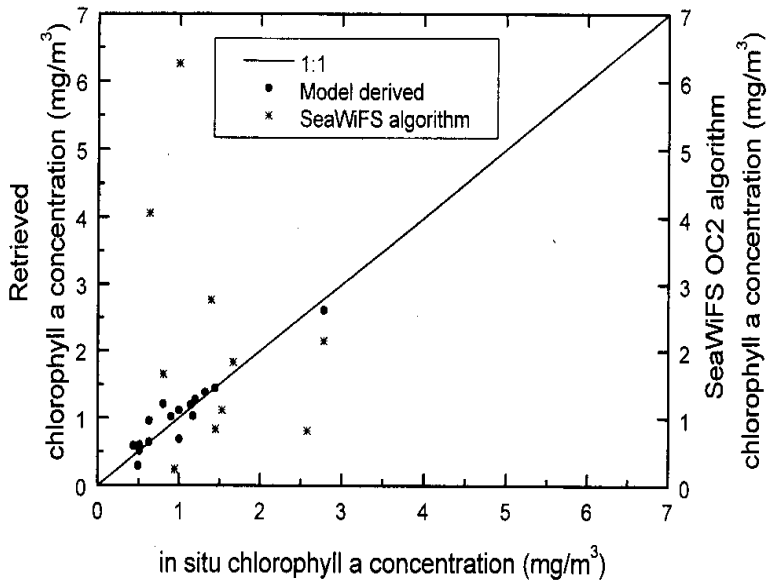


Fig. 8. Comparison of retrieved chlorophyll concentration values with *in situ* values. The solid curve represents the 1:1 ratio. The error is 18%. In comparison, the SeaWiFS OC2 algorithm retrieved chlorophyll concentration values with *in situ* values had an error of 147%.

He et al., 2000 (Applied Optics)

Summary

- Good performance in Case II waters;
- Local algorithms (the Eastern China Sea);
- More *in-situ* measurements to validate it;
- Application to satellite data to assess it.

Retrieval Algorithms for Oceanic Constituents

Statistical Algorithms for CHL, SPM and CDOM

Tang et al., 2004 (*National Satellite Ocean Application Service)*, Advance in Marine Science

Algorithm for CHL

$$Log_{10}C = a_0 + a_1 \log_{10} X + a_2 (\log_{10} X)^2 \qquad X = (Rrs443/Rrs555)(Rrs412/Rrs510)^{-1}$$

Algorithm for SPM

$$Log_{10}C = a_0 + a_1 (Rrs555 + Rrs670) + a_2 (Rrs490/Rrs555)$$

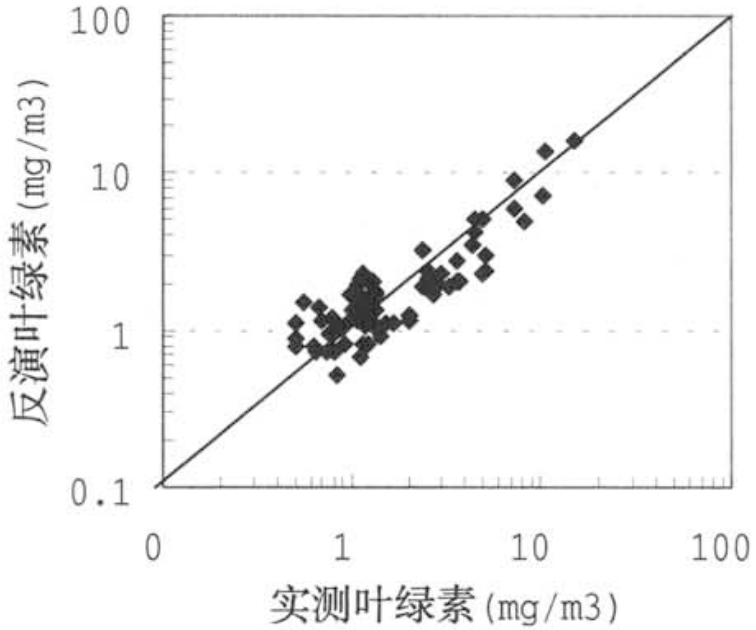
Algorithm for CDOM

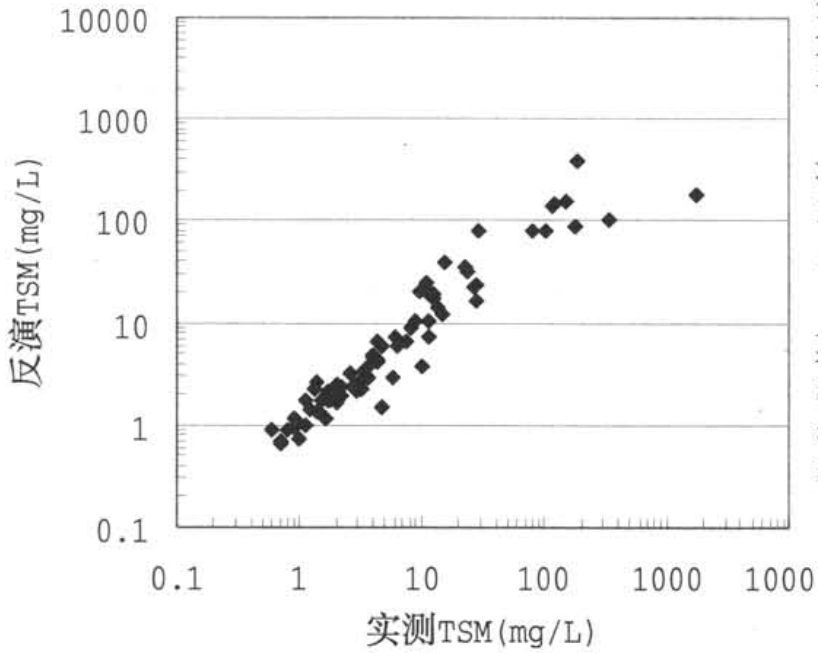
$$Log_{10}C = a_0 + a_1 \log_{10} X + a_2 (\log_{10} X)^2 + a_3 (\log_{10} X)^3 + a_4 (\log_{10} X)^4$$

$$X = (Rrs412/Rrs510)(Rrs555 + Rrs670)^{0.23}$$

Retrieval Algorithms for Oceanic Constituents

Statistical Algorithms for CHL, SPM and CDOM





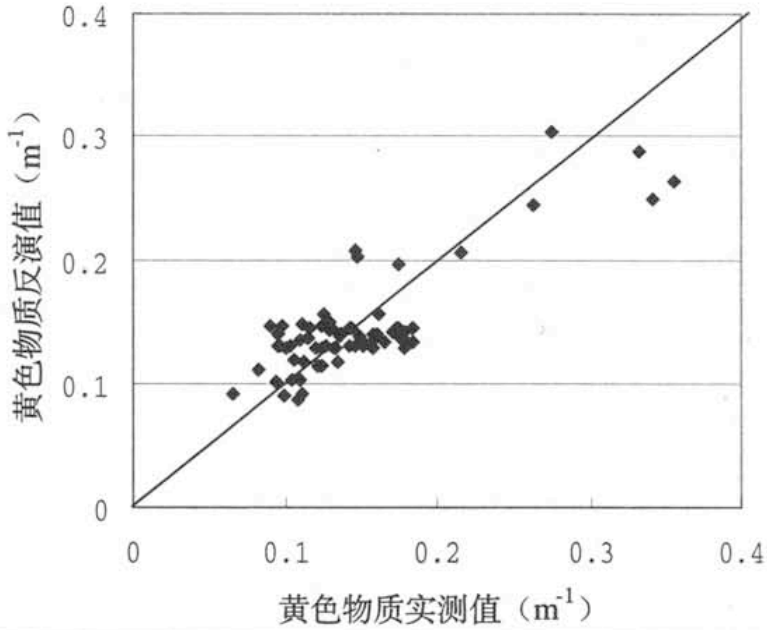
(N=77, R^2=0.74, error=36 %)

(N=83, R^2=0.92, error=30 %)

Tang et al., 2004 (Advance in Marine Science)

Retrieval Algorithms for Oceanic Constituents

Statistical Algorithms for CHL, SPM and CDOM



N=83, R^2=0.59, error=17%

Tang et al., 2004 (Advance in Marine Science)

Summary

- Good performance in Yellow Sea and Bohai Sea;
- Local algorithms;
- Used for COCTS(HY-1B) and MERSI (FY-3A);
- Synchronous data to assess it

Retrieval Algorithms for Oceanic Constituents

Genetic Algorithm for Oceanic Constituents

ZHAN et al., 2004 (Journal of Remote Sensing)

Gauss-Newton and Levenberg-Marquart methods used in Optimization scheme
Problem: Local search, and strongly depend on initial values

Genetic algorithm --Global Optimization methods

Summary

- The advantages demonstrated by simulation and in-situ data.
- Enough *in-situ* measurements to validate;
- Application to satellite data to assess it;
- Improvement of the computing efficiency.

Retrieval Algorithms for Oceanic Constituents

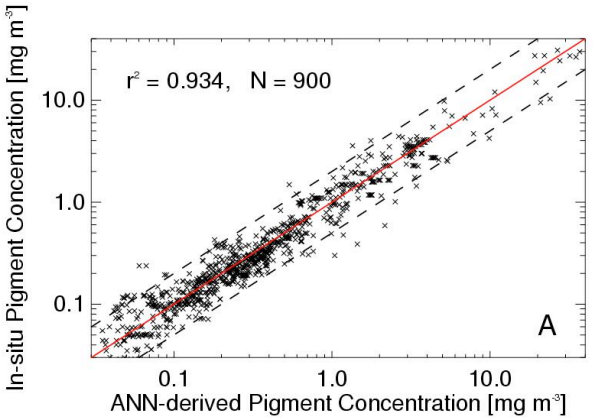
ANN-based Algorithm for CHL in Case I waters

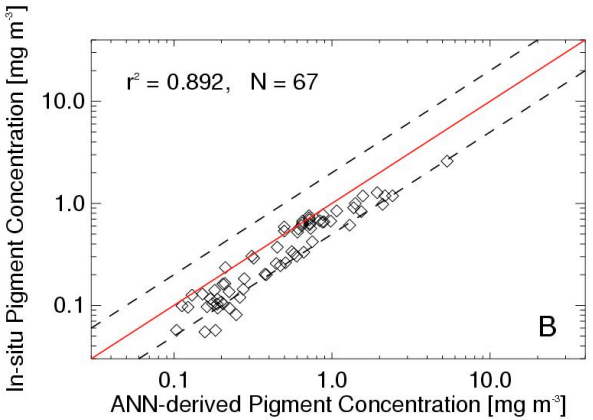
Zhang et al., 2003, JGR

ANN-based algorithm---synthetic data

3 layers MLPs (Multi-Layer-Perceptrons)

Rrs440/Rrs555, Rrs490/Rrs555, Rrs510/Rrs555





Summary

- Comparable to OC4 (operational algorithm for SeaWiFS and MODIS)
- Global algorithms;
- Application to satellite data to assess it

Retrieval Algorithms for Oceanic Constituents

ANN-based Algorithm for CHL, SPM and CDOM

Zhang, 2003

ANN-based algorithm---synthetic data
3 layers MLPs (Multi-Layer-Perceptrons)

Algorithm for CHL

Input: R412/R443, R490/R443, R510/R443, R619/R443,R705/R443

Algorithm for SPM

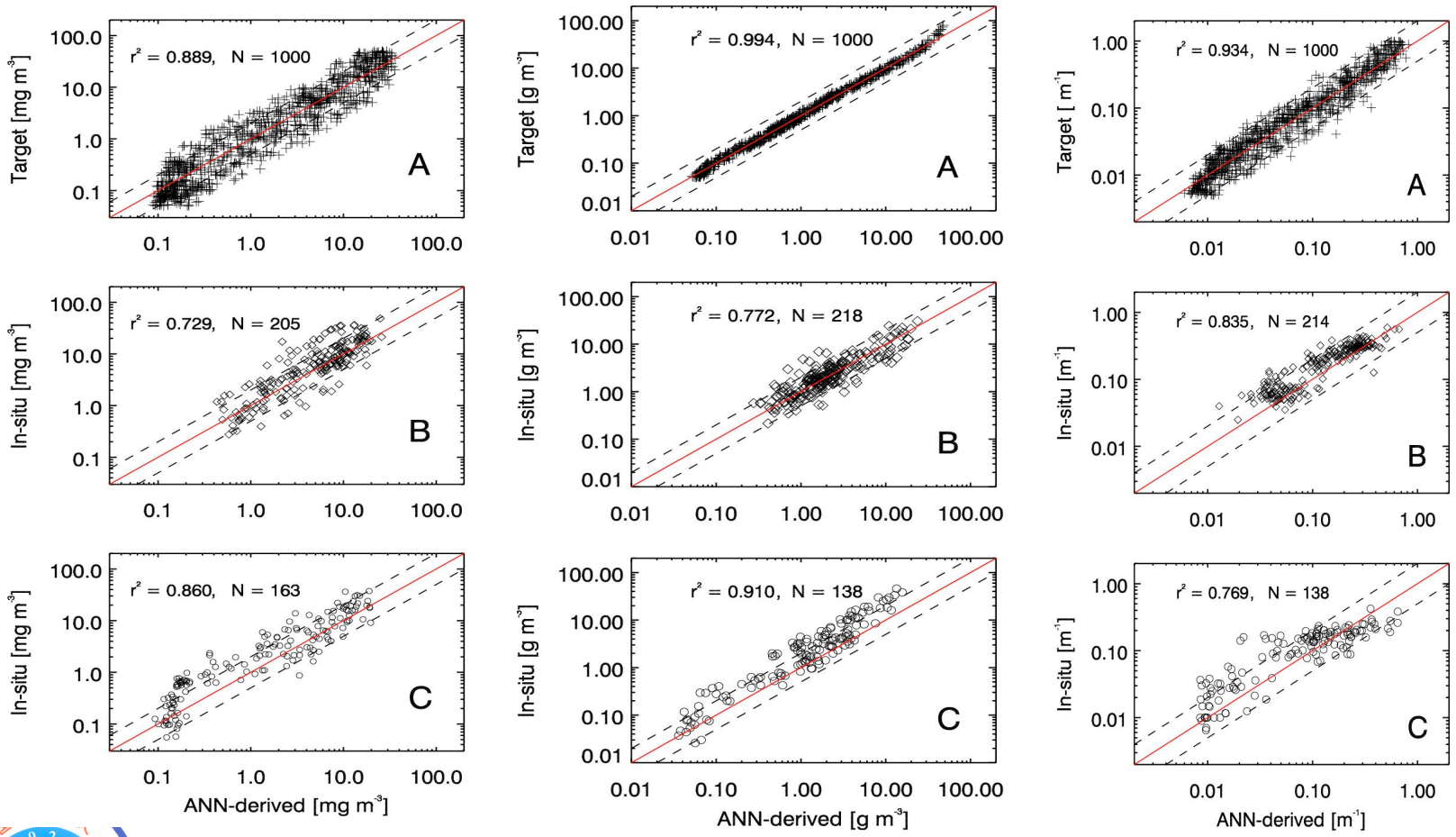
Input: R559, R665, R705

Algorithm for CDOM

Input: R411, R443, R665

Retrieval Algorithms for Oceanic Constituents

ANN-based Algorithm for CHL, SPM and CDOM



Retrieval Algorithms for Oceanic Constituents

ANN-based Algorithm for CHL, SPM and CDOM

Summary

- Good performance in European coastal waters ;
- Local algorithms;
- More *in-situ* measurements to validate;
- Application to satellite data to assess it

Retrieval Algorithms for IOPs

Statistical Algorithm for a_t in Case II waters

Wang et al., 2006 (*National Satellite Ocean Application Service)*,
Chinese Journal of Oceanology and Limnolog

$$\log_{10}(a_t(\lambda)) = A_0 + A_1 \log_{10}(\rho_{15}) + A_2(\log_{10}(\rho_{15}))^2 + B_1 \log_{10}(\rho_{35}) + B_2(\log_{10}(\rho_{35}))^2$$

$$\rho_{15} = Rrs412 / Rrs555,\ \rho_{35} = Rrs490 / Rrs555$$

a_t (λ) are for a_t412, a_t440, a_t488, a_t510, a_t532 and a_t555 respectively.

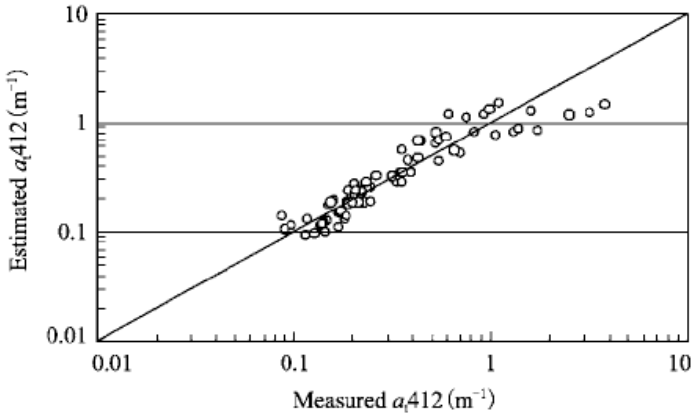


Fig.3 a_t412 algorithm for all turbidity waters for the Yellow Sea and the East China Sea

Retrieval Algorithms for IOPs

Statistical Algorithm for a_t in Case II waters

Wang et al., 2006

at	R^2	Error (Relative)
*a*t412	0.87	25.1
at440	0.85	23.7
at488	0.85	25.8
at510	0.82	24.1
at532	0.81	21.9
at555	0.75	22.0

Summary

- Good performance in Yellow Sea and Bohai Sea;
- Local algorithms;
- Enough independent *in-situ* measurements to validate;
- Application to satellite data to assess it

Retrieval Algorithms for $K_d(490)$

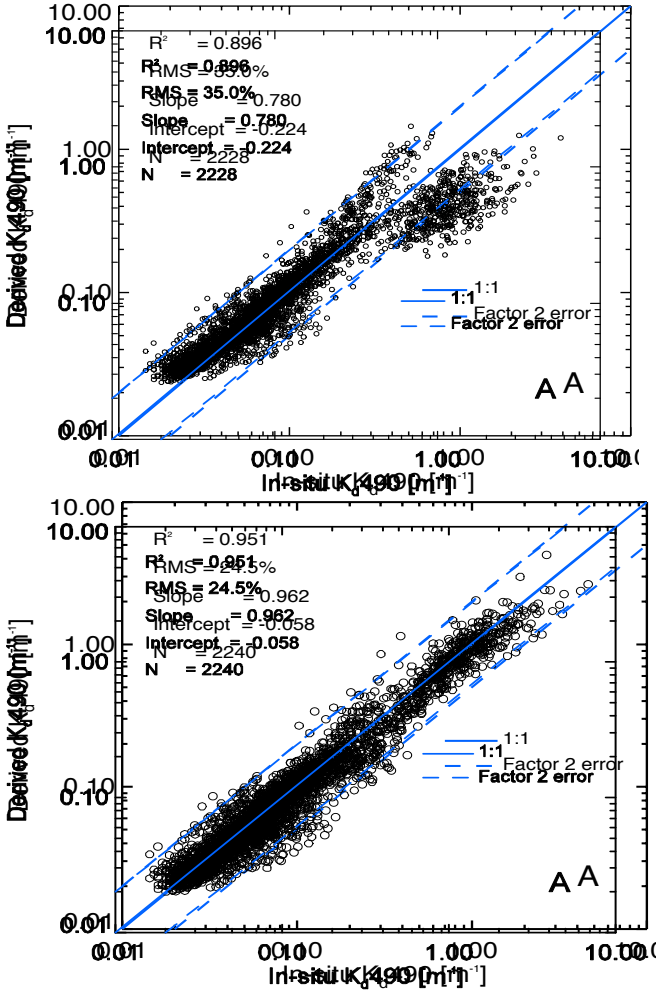
Statistical Algorithm for $K_d(490)$

Zhang and Fell, 2007
(Limnoloy and Oceanology: Methods)

$$K_d(490) = 10^{a_{j,0}+a_{j,1}x+a_{j,2}x^2+a_{j,3}x^3} + K_w(490)$$

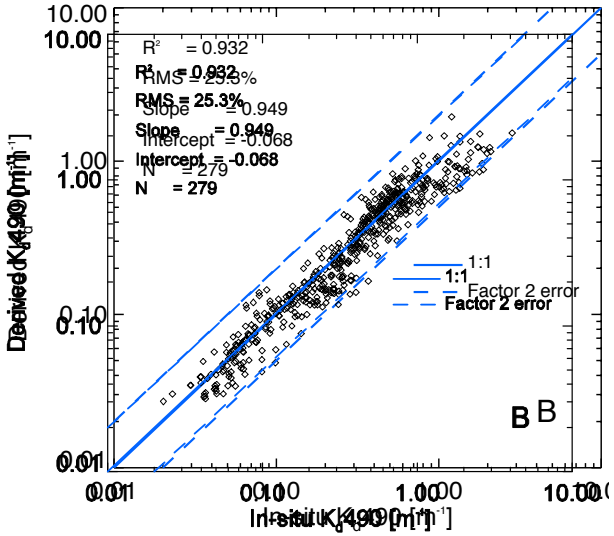
$$if\ \{R_{rs}(490)/R_{rs}(555) \geq 0.85\}:$$
$$use\ x = \log 10(R_{rs}(490)/R_{rs}(555))$$

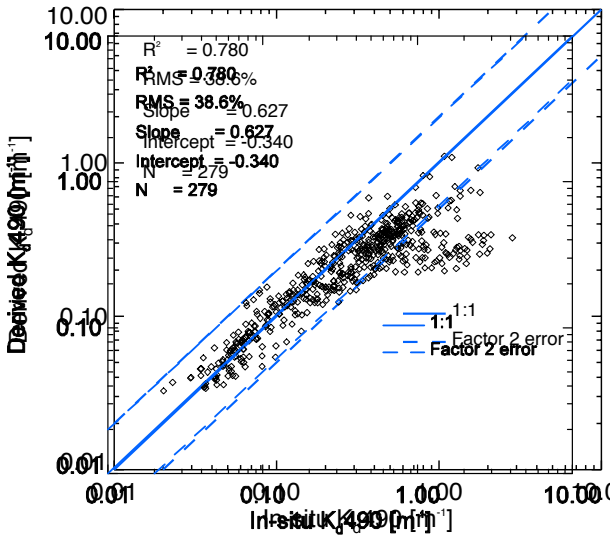
$$if\ \{R_{rs}(490)/R_{rs}(555) < 0.85\}:$$
$$use\ x = \log 10(R_{rs}(490)/R_{rs}(665))$$



Retrieval Algorithms for $K_d(490)$

Statistical Algorithm for $K_d(490)$





Summary

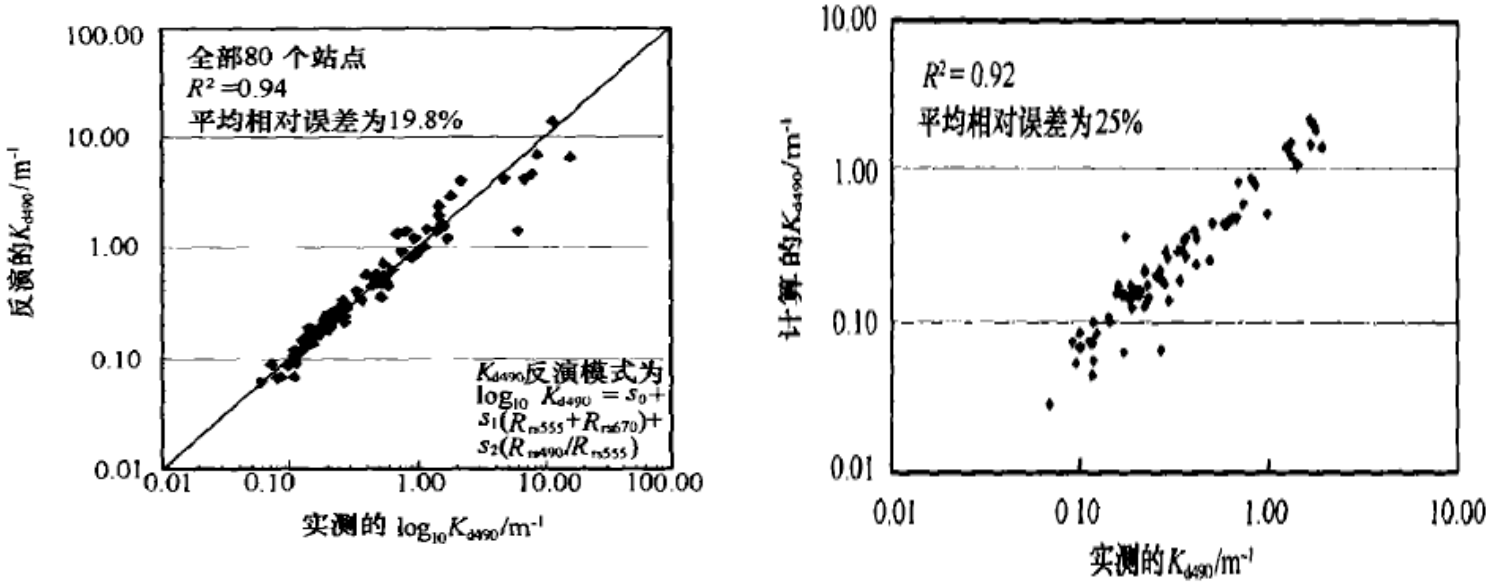
- Good performance in both Case I and Case II waters
- Global algorithms;
- Application to satellite data to assess it

Retrieval Algorithms for Kd(490)

Statistical Algorithm for Kd(490)

WANG Xiaomei, TANG Junwu, DING Jing, and et al., 2005 (ACTA OCEANOLOGICA SINICA)

$$Log_{10}K_d(490) = a_0 + a_1(Rrs555 + Rrs670) + a_2(Rrs490 / Rrs555)$$



Retrieval Algorithms for $K_d(490)$

Statistical Algorithm for $K_d(490)$

WANG Xiaomei, TANG Junwu, DING Jing, and et al., 2005 (ACTA OCEANOLOGICA SINICA)

Summary

- Good performance in Yellow Sea and Bohai Sea;
- Local algorithms;
- Used for COCTS(HY-1B);
- Synchronous data to assess it.

Thank You !

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