Inversion of Ocean Transparency based on FengYun meteorological Satellite

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Background

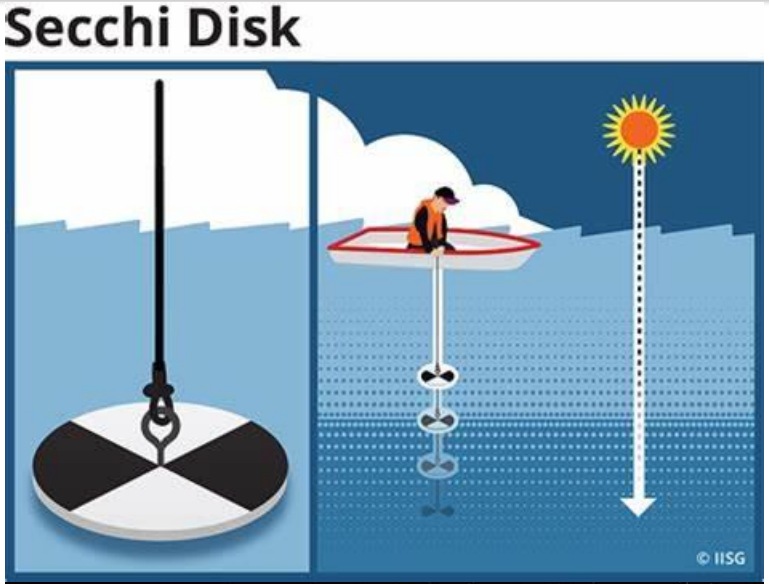
Ocean Transparency

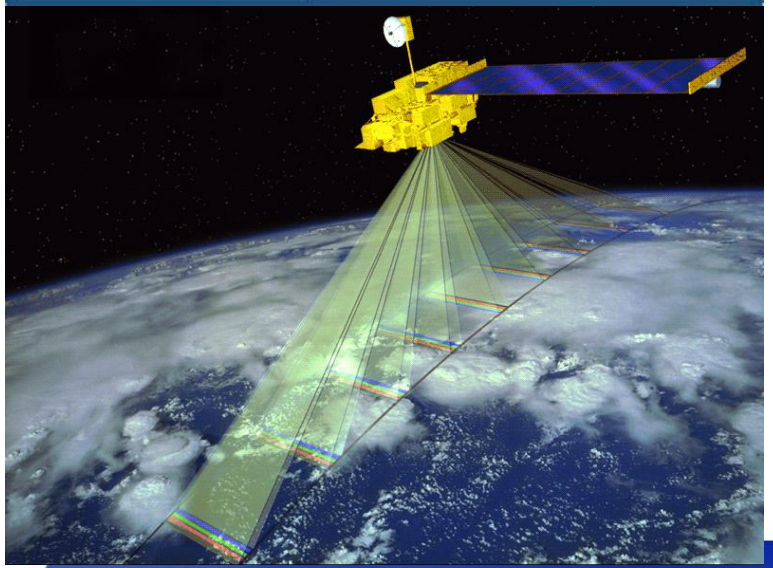
- ✓ directly indicate the turbidity and the inherent optical properties (IOPs) of the ocean;
- ✓ Important physical quantity for describing the optical properties of seawater;
- ✓ Great significance on monitoring of ocean water quality, navigation and underwater activities.

Background

Ocean Transparency Measurement

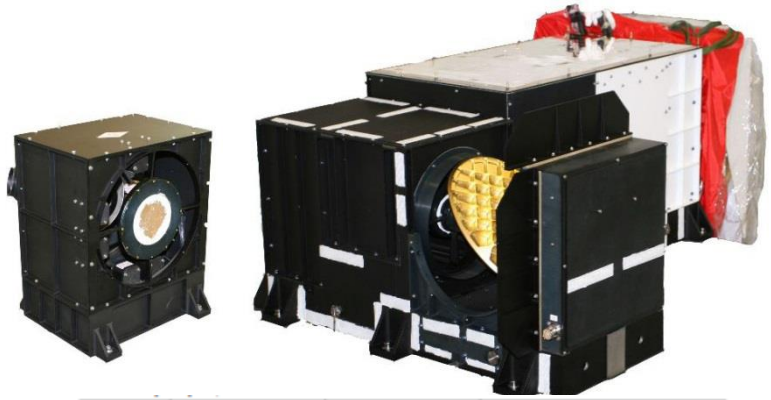
- ✓ Measured using Secchi disk (A white and black disk hold by a line that is lowered into the water until it disappears from the sight, and the maximum visible depth indicates the transparency level of the water called the Secchi Depth) ;
- ✓ Ocean color remote sensing (wide spatial coverage, high temporal and spatial resolution).





Data

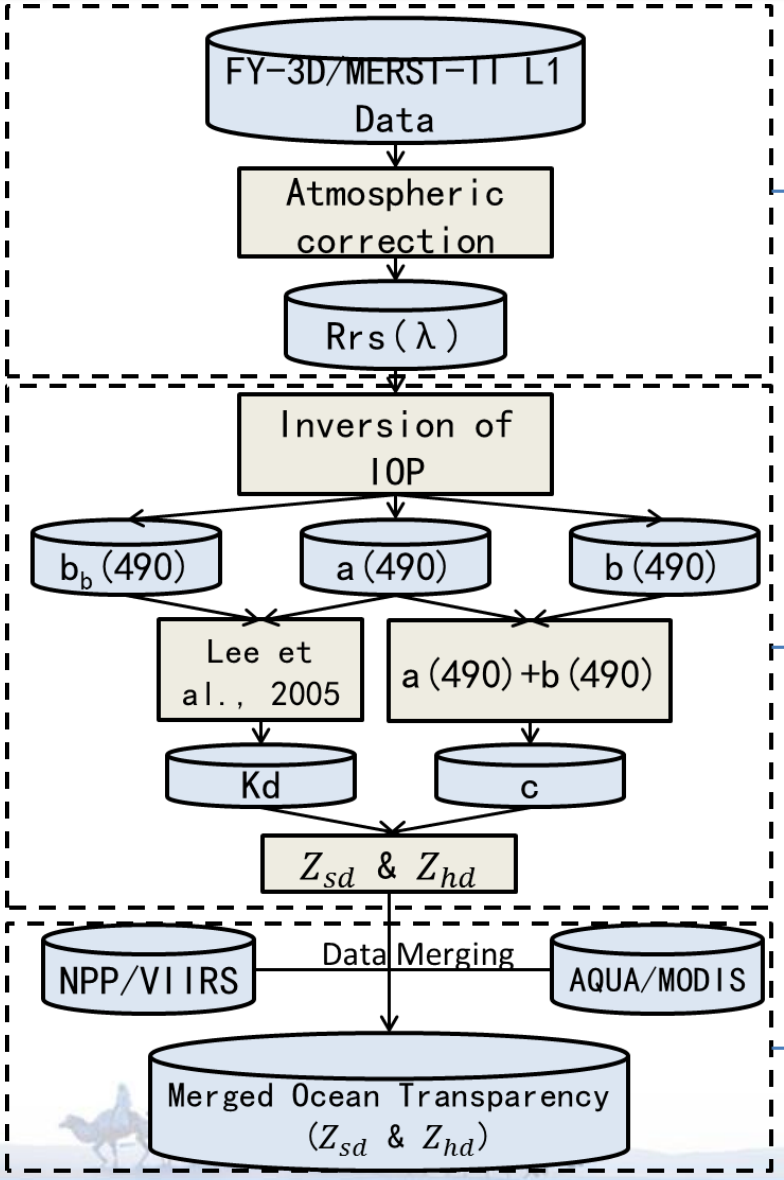
FY-3D/MERSI-II



- ✓ MERSI-II improves its calibration accuracy and sensitivity, which is recognized as one of the most advanced wide-swath imagers;
- ✓ MERSI-II data can be used to measure the global ocean with nearly no gap, and to provide information on the Ocean Transparency monitoring.

Channel	Central wavelength (μm)	Spatial resolution (m)	Primary application
1	0.470	250	Land, PBL, features
2	0.550	250	
3	0.650	250	
4	0.865	250	
5	1.380	1000	
6	1.640	1000	
7	2.130	1000	
8	0.412	1000	Ocean color, plankton,
9	0.443	1000	biology, earth chemistry
10	0.490	1000	
11	0.555	1000	
12	0.670	1000	
13	0.709	1000	
14	0.746	1000	
15	0.865	1000	
16	0.905	1000	Atmosphere, water vapor
17	0.936	1000	
18	0.940	1000	
19	1.030	1000	Cirrus
20	3.800	1000	Land, water, cloud
21	4.050	1000	
22	7.200	1000	Atmosphere, water vapor
23	8.550	1000	
24	10.800	250	Land, water, cloud
25	12.000	250	

Method



Step 1

FY-3D/MERSI L1 data atmospheric correction to calculate the remote sensing reflectance of the water surface in different wavelengths (Rrs(λ)).

Step 2

Inversion of IOP based on Rrs(λ) (QAA V6: Lee et al.,2015);

Calculate the Kd & c (Lee et al.,2005);

Estimate Z_{sd} (Vertical transparency) & Z_{hd} (Horizontal transparency).

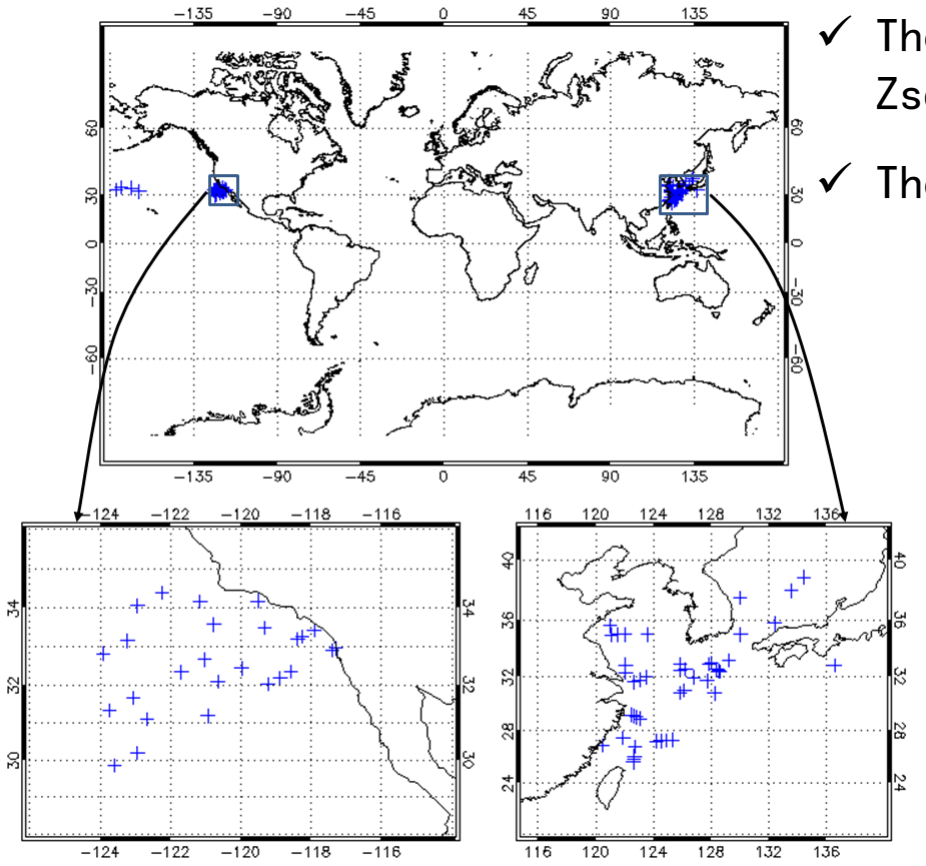
Step 3

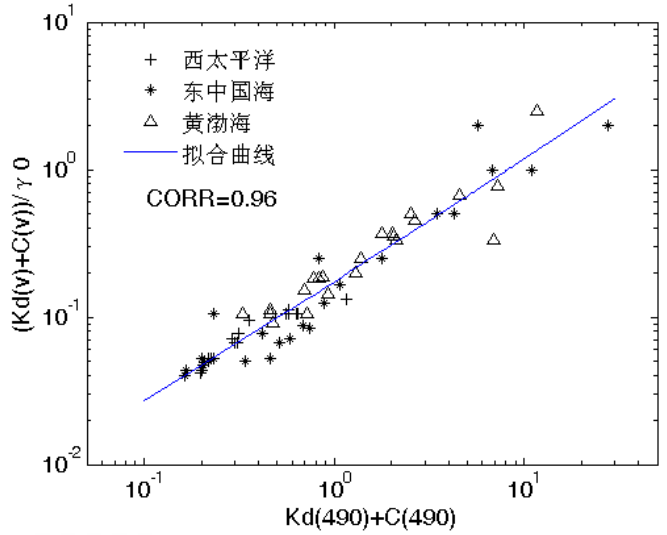
Merging data from multiple sensorsto improve the spatial coverage and reliability of the products.

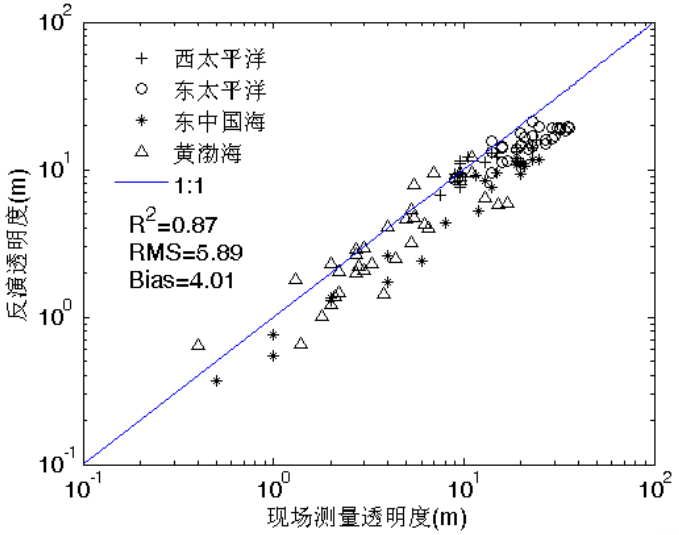
Method: Estimate Z_{sd}

$$Z_{SD} = \frac{\ln\left(\frac{C_0}{C_{\min}}\right)}{K_d(v)+c(v)} = \frac{\gamma_0}{K_d(v)+c(v)}$$

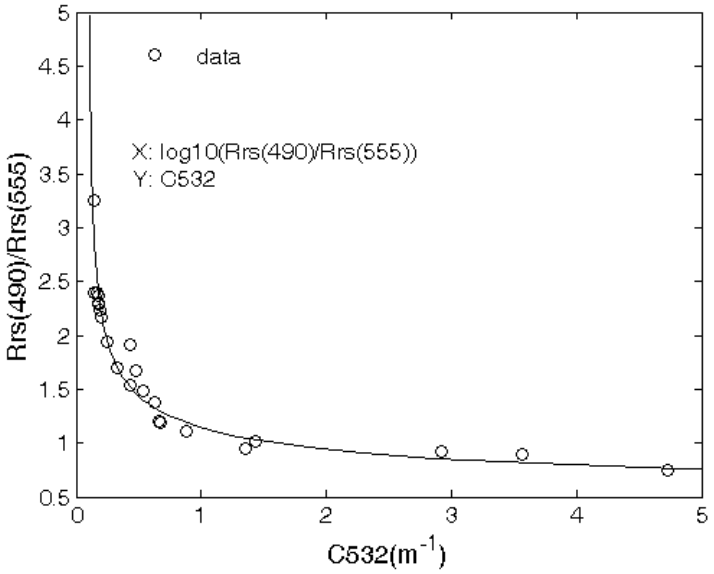
- ✓ Zsd can be expressed by the brightness attenuation function in the vertical direction;
- ✓ Also can be estimate by Kd(490)+C(490);
- ✓ The Zsd estimation method were established based on regression of Zsd and Kd(490)+C(490) from in-situ data (whit high correlation);
- ✓ The Zsd estimate results are close to the in-situ measured data.

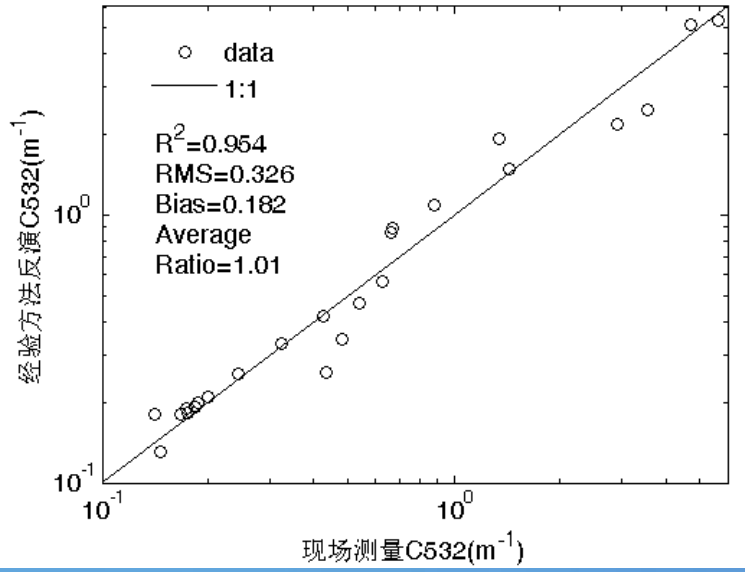






Method: Estimate Z_{hd}

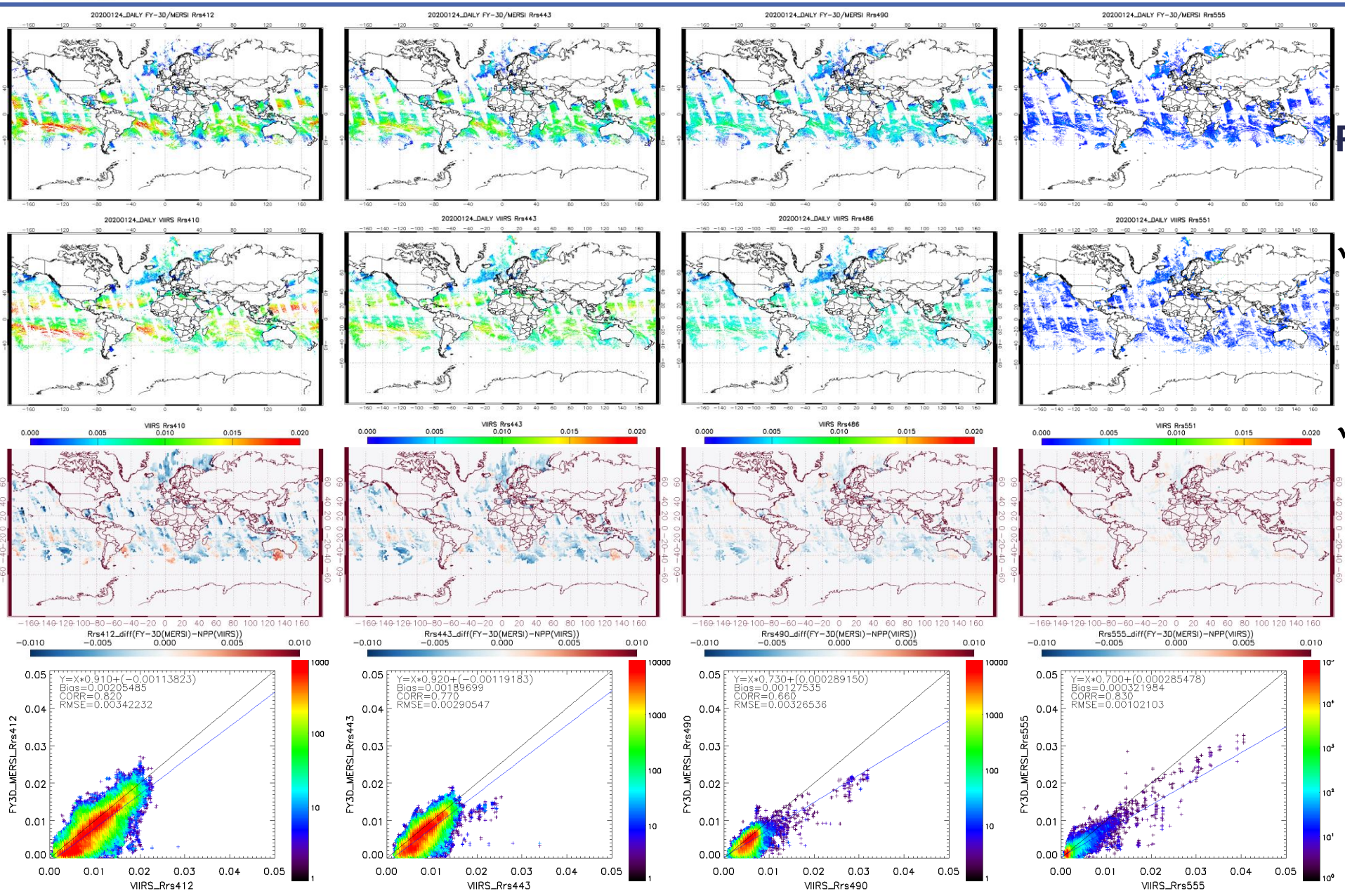




$$Z_{vd} = \frac{\ln(\frac{C_0}{C_{min}})}{c(v)}$$

- ✓ Zhd can be expressed by the brightness attenuation coefficient in the horizontal direction;
- ✓ Brightness attenuation coefficient can be estimate by C(532) (Zaneveld and Pegau., 2003);
- ✓ The C(532) estimation method were established based on regression of C(532) and Kd(490)+C(490) from in-situ data (whit high correlation);
- ✓ The C(532) estimate results are close to the in-situ measured data.

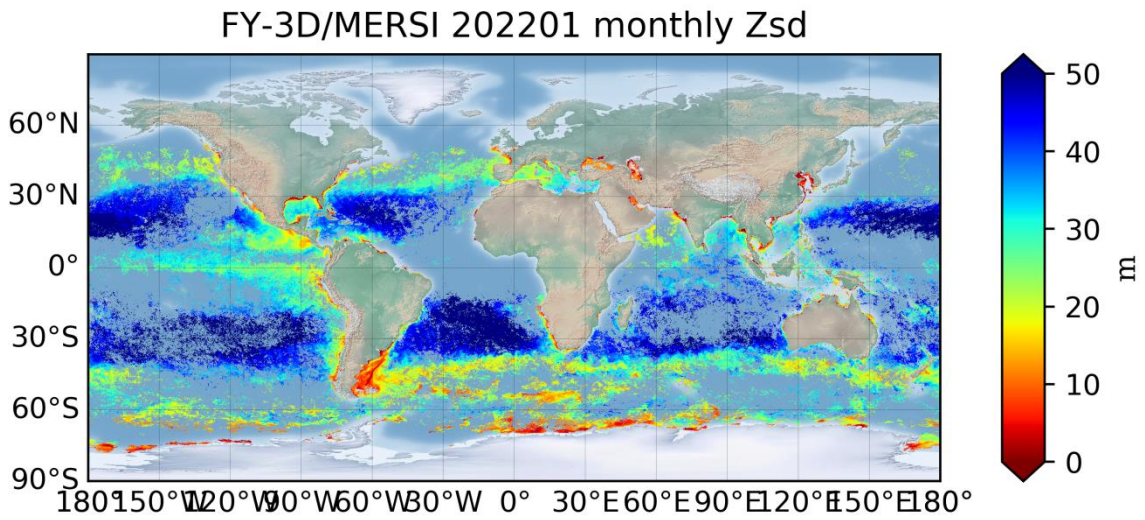
Result: Rrs(λ)

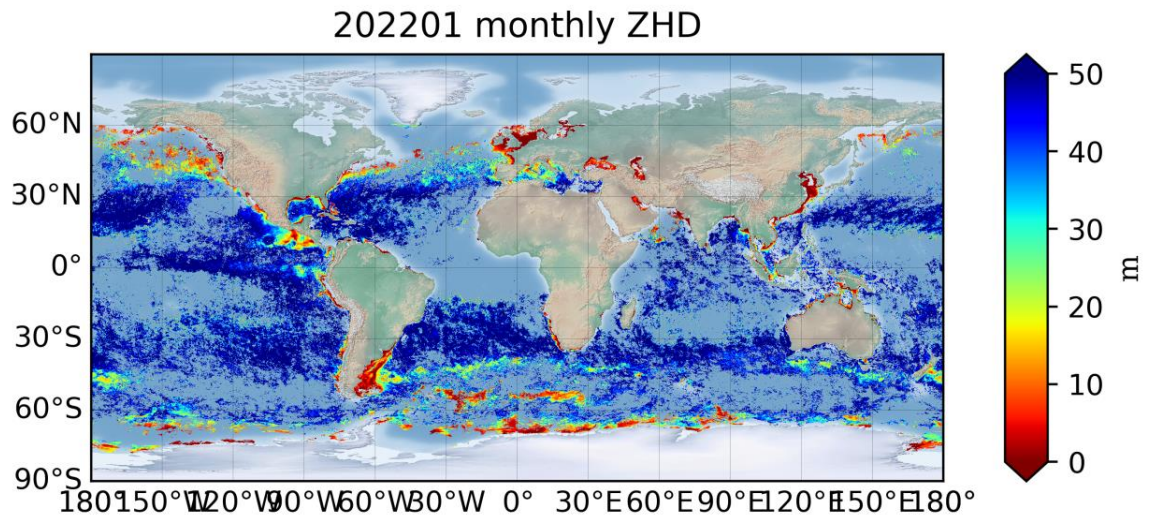


Rrs(λ) MERSI VS VIIRS

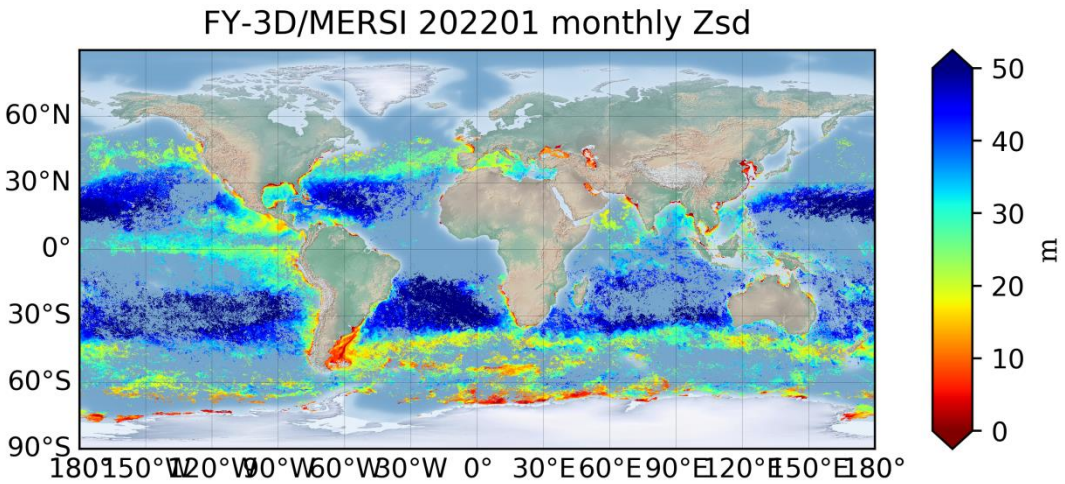
- ✓ The quality of MERSI-II data is comparable to VIIRS;
- ✓ MERSI-II can be used for ocean remote sensing applications .

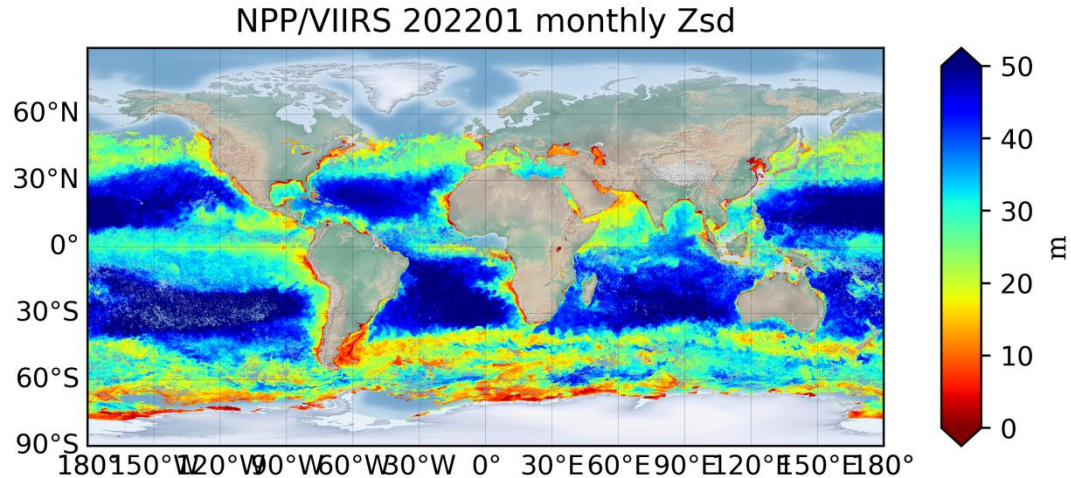
Result: Z_{sd} & Z_{hd}



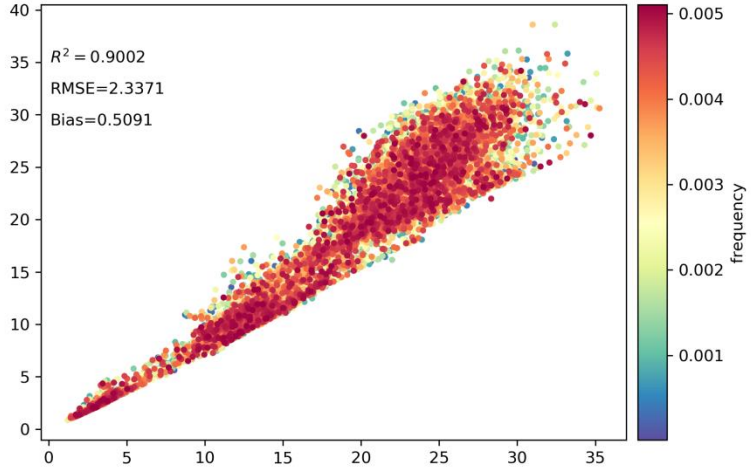


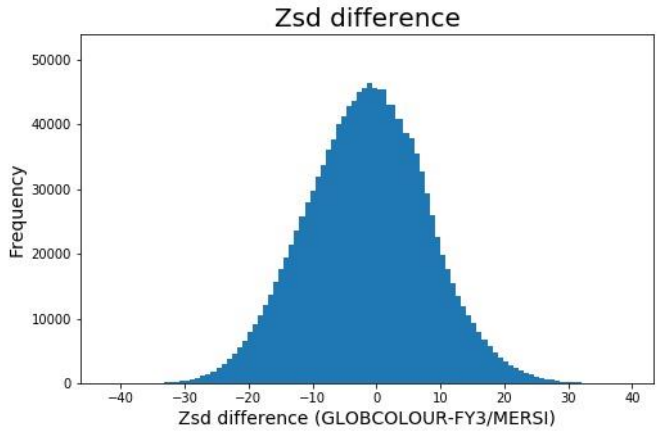
Result: Validation





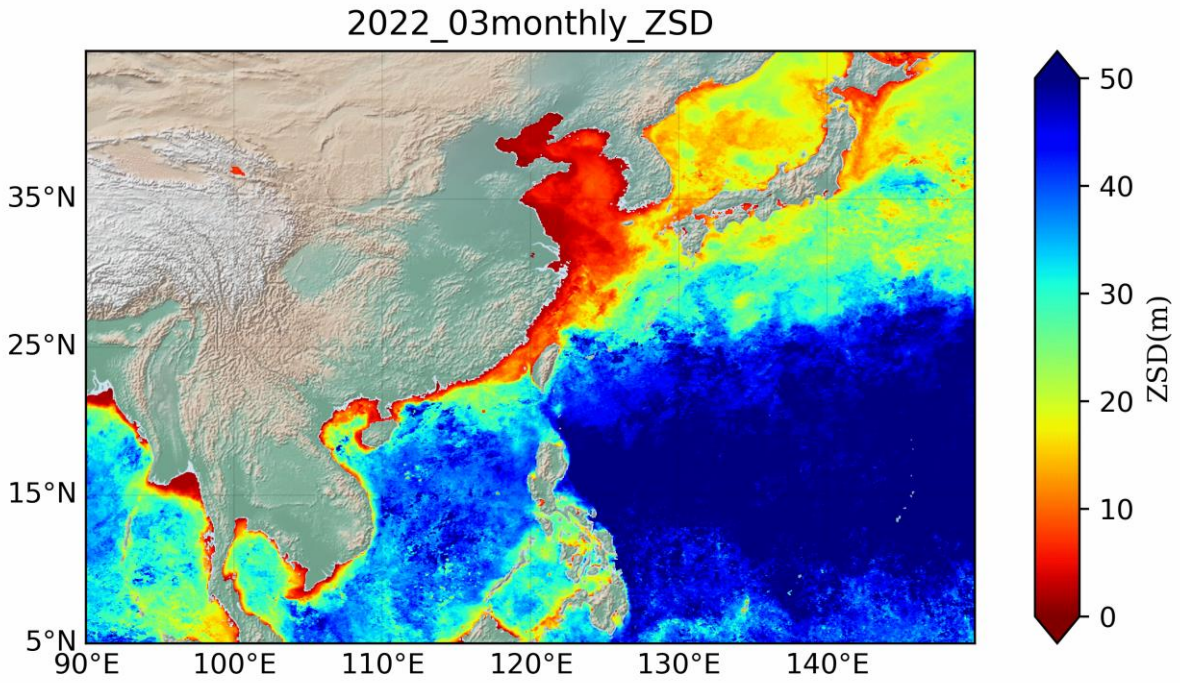
(GlobColour Zsd);

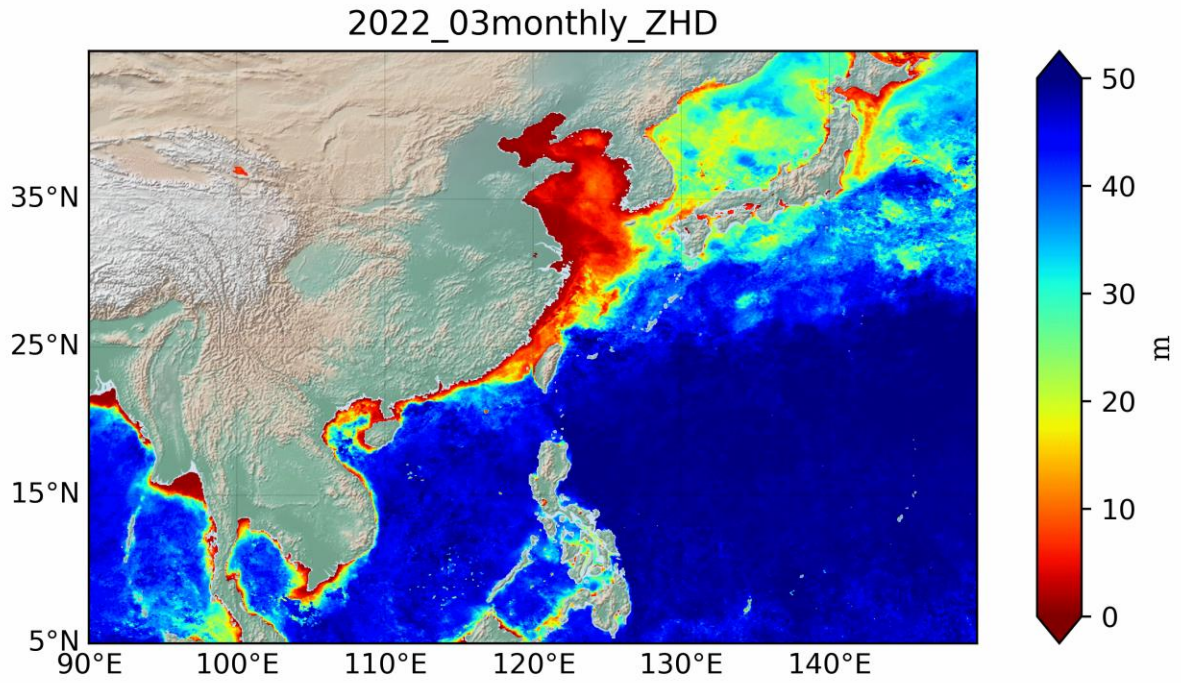




- ✓ The reliability of the results are tested by compared to NPP/VIIRS Zsd product (GlobColour Project);
- ✓ The results shows Zsd estimated by FY-3D/MERSI were closed to Zsd product estimated by NPP/VIIRS;
- ✓ It have high reliability.

Result: Data merging





- ✓ In order to improve the spatial coverage and reliability of the product, FY-3D/MERSI data were merged with NPP/VIIRS and AQUA/MODIS;
- ✓ Then the monthly merged Ocean Transparency (Zsd and Zhd) data were generated, and would be used in international remote sensing services.

Conclusion

- ✓ The Ocean Transparency (Zsd and Zhd) inversion method based on FY-3D/MERSI data are developed in this research;
- ✓ The Zsd estimated by FY-3D/MERSI were compared with NPP/VIIRS Zsd product (GlobColour Project),the results shows Zsd estimated by FY-3D/MERSI have high reliability;
- ✓ The Ocean Transparency estimated based on FY-3D/MERSI were merged with NPP/VIIRS and AQUA/MODIS data, and the spatial coverage and reliability of the product are improved;
- ✓ The merged Ocean Transparency product would be used in international remote sensing services.

Further works

- ✓ The FY-3D/MERSI data atmospheric correction method would be improved to make the data have better coverage and reliability in case-II water;
- ✓ The Ocean Transparency (Zsd and Zhd) estimation method need improved using more in-situ measured data in different sea and season.

Thank you for your attention ！

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For more information, please visit the following website ：
http://satellite.nsmc.org.cn