Inversion of Ocean Transparency based on FengYun meteorological Satellite

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Outline

- Background
- Data
- Method
- Result
- Conclusion
- Further works
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.
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).
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.
Method

**Step 1**
FY-3D/MERSI L1 data atmospheric correction to calculate the remote sensing reflectance of the water surface in different wavelengths ($R_{rs}(\lambda)$).

**Step 2**
Inversion of IOP based on $R_{rs}(\lambda)$ (QAA V6: Lee et al., 2015):
- Calculate the $K_d$ & $c$ (Lee et al., 2005):
- Estimate $Z_{sd}$ (Vertical transparency) & $Z_{hd}$ (Horizontal transparency).

**Step 3**
Merging data from multiple sensors to improve the spatial coverage and reliability of the products.
Method: Estimate $Z_{sd}$

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

✔ Zsd can be expressed by the brightness attenuation function in the vertical direction;

✔ Also can be estimate by $K_d(490) + C(490)$;

✔ The $Z_{sd}$ estimation method were established based on regression of $Z_{sd}$ and $K_d(490) + C(490)$ from in-situ data (with high correlation);

✔ The $Z_{sd}$ estimate results are close to the in-situ measured data.
Method: Estimate $Z_{hd}$

- $Z_{hd}$ 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 (with high correlation);
- The $C(532)$ estimate results are close to the in-situ measured data.

\[
Z_{vd} = \ln\left(\frac{C_0}{C_{min}}\right) \frac{c(v)}{c(v)}
\]
Result: $\text{Rrs}(\lambda)$

- 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

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.
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