ORSG
OCEAN REMOTE SENSING GROUP

HY-1B/COCTS vicarious calibration

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China ocean color (HY-1) satellite missions

- HY-1A Satellite (May 2002- Apr. 2004)
- HY-1B Satellite (Apr. 2007)
- HY-1C/1D Satellite constellation (Approved)

Chinese ocean color and temperature scanner (COCTS)

Sensor	HY-1A/COCTS	HY-1B/COCTS
Spatial resolution	1.1km	1.1km
Scan coverage	1400km	3000km
Digitization	10bit/pixel	10bit/pixel

Band	Wavelength (μm)	Referred radiance (mW/cm²μmsr)	SNR	Saturated radiance (mW/cm²μmsr)
1	0.402 ~ 0.422	9.10	349	13.94
2	0.433 ~ 0.453	8.41	472	14.49
3	0.480 ~ 0.500	6.56	467	14.59
4	0.510 ~ 0.530	5.46	448	13.86
5	0.555 ~ 0.575	4.57	417	13.89
6	0.660 ~ 0.680	2.46	309	11.95
7	0.740 ~ 0.760	1.61	200	5.0/9.72
8	0.845 ~ 0.885	1.09	327	3.5/6.93
9	10.30 ~ 11.40	0.2K(300K, NEΔT)		200-320K
10	11.40 ~ 12.50	0.2K(300K, NEΔT)		200-320K

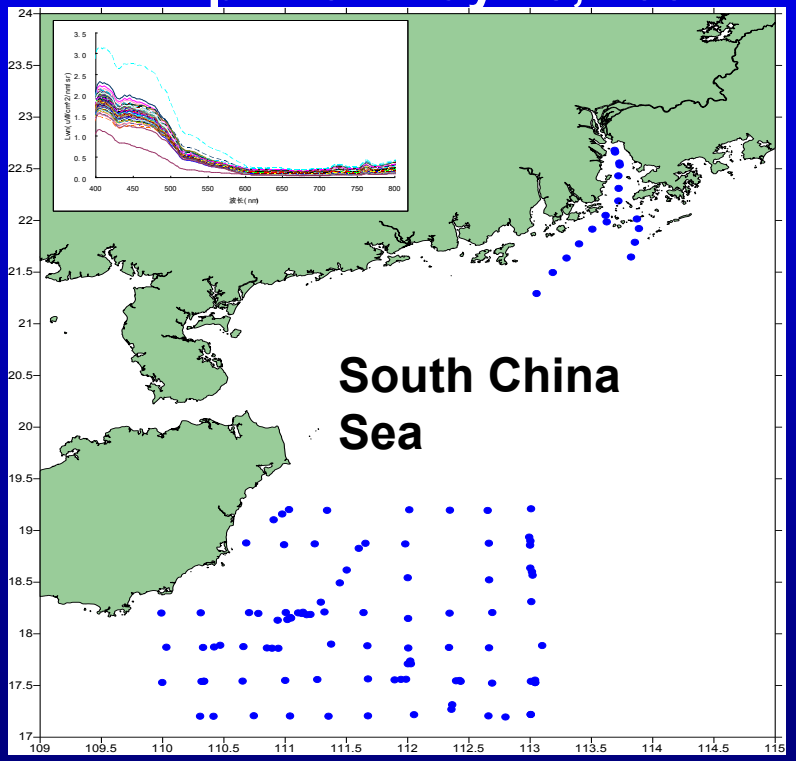
Main challenge

- No on-orbit calibration device for VIS/NIR. Difficult to track the degrade of the response.
- No pre-launch polarization sensitivity measurement with whole optic path.

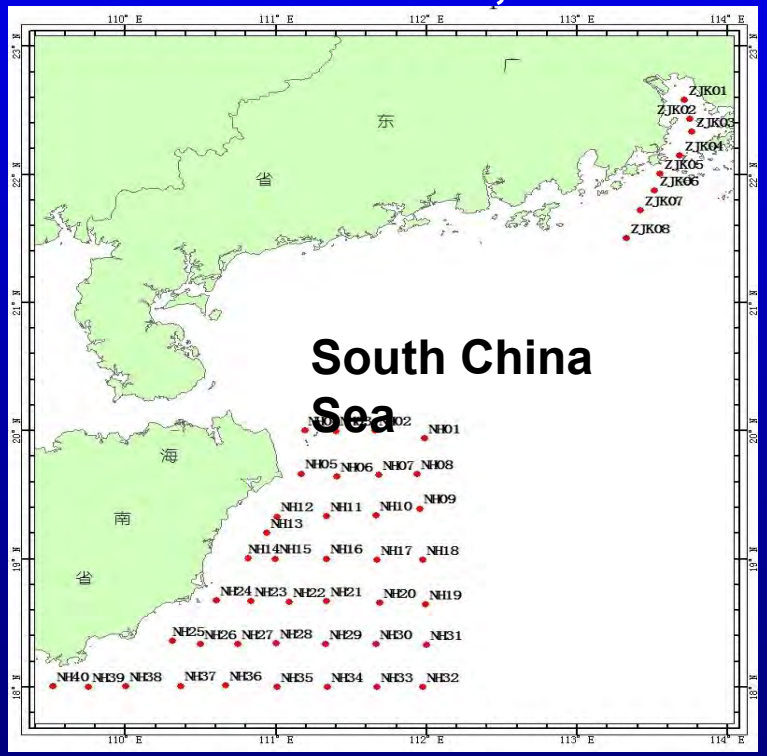
HY-1B/COCTS calibration

- Calibration based on in-situ measurement
- Difficult to carry out frequency, and not suitable for the monitoring of the long-term changes of response.

Apr. 20 - May 15, 2007

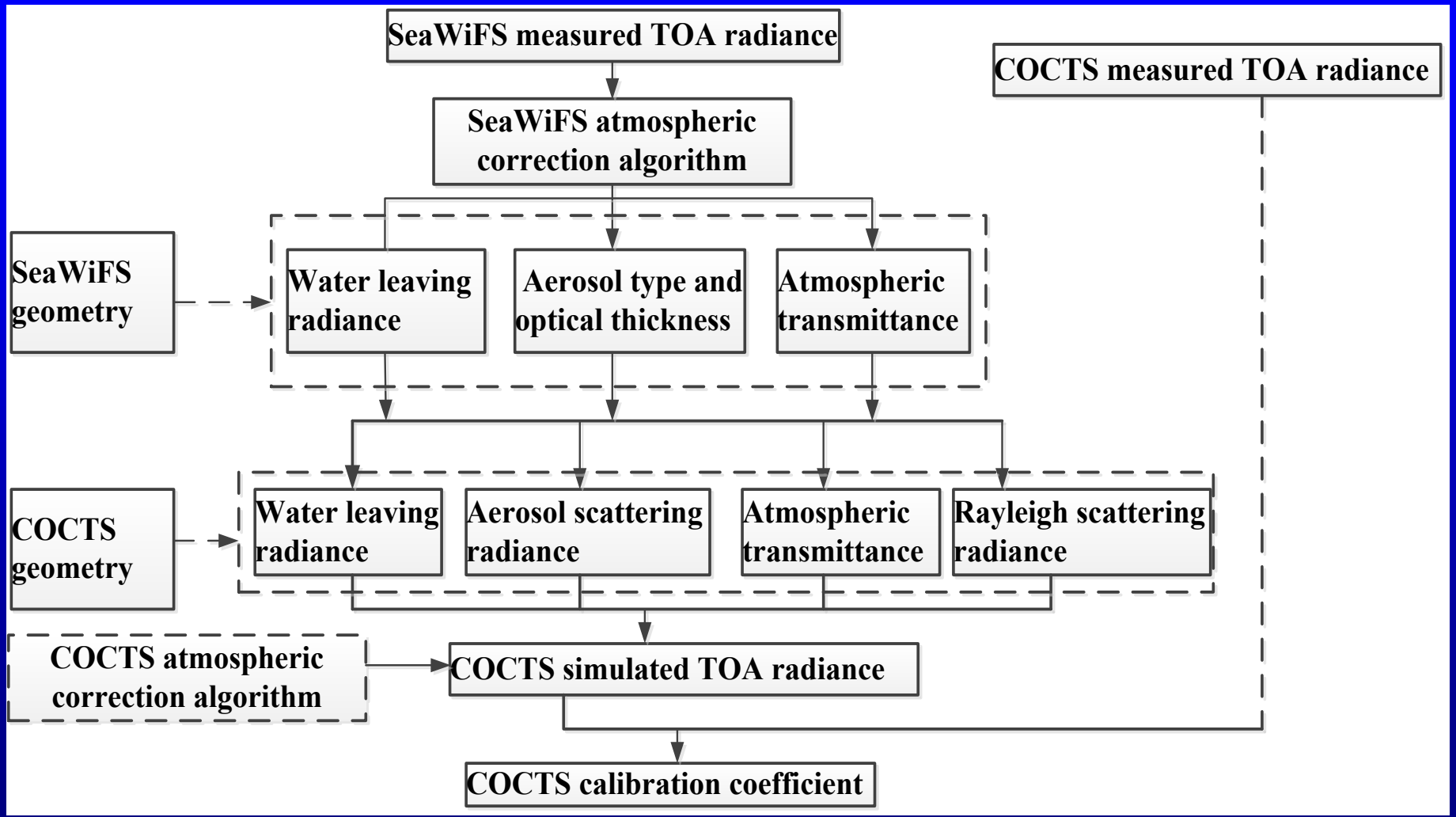


Feb.16 - Mar. 2, 2009



Courtesy of Dr. Qingjun Song from NSOAS,China

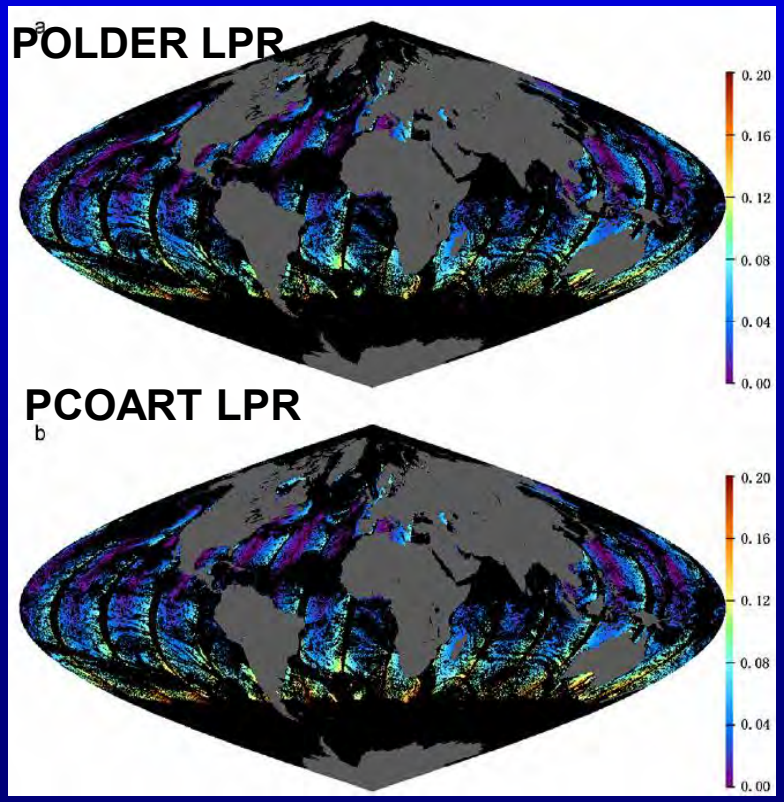
Cross-calibration based on SeaWiFS

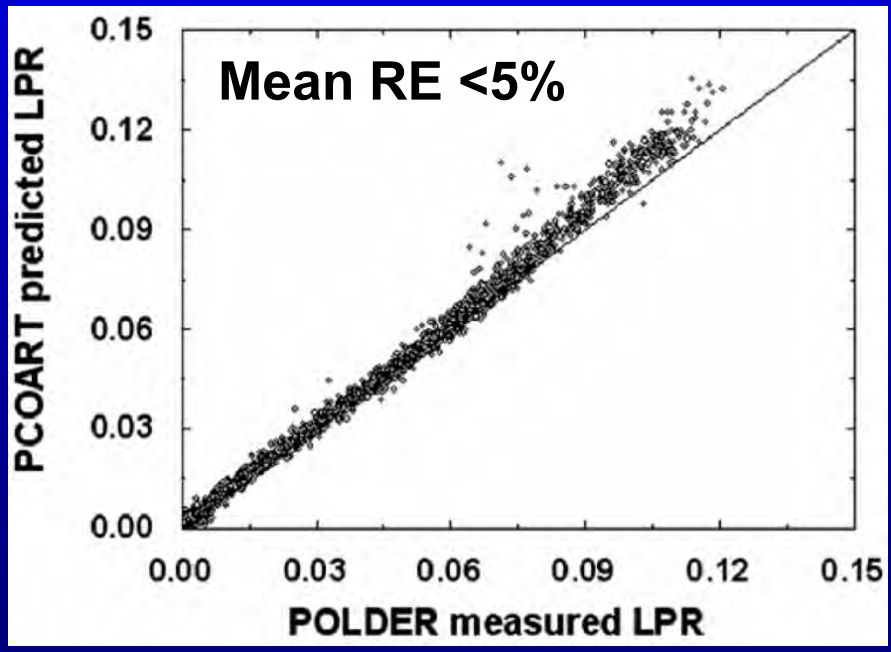


Pan, He & Zhu, 2004

Atmospheric correction algorithm of HY-1B/COCTS

- Similar as AC algorithm of SeaWiFS/MODIS (Gordon&Wang, 1994).
- A VRT model of coupled ocean-atmosphere system (PCOART) was developed for generation of look-up tables of Rayleigh scattering, aerosol scattering, and atmospheric diffusing transmittance.





He et al., JQSRT,2010

Aerosol scattering LUT

- Gordon&Wang(1994), SeaWiFS/MODIS/…

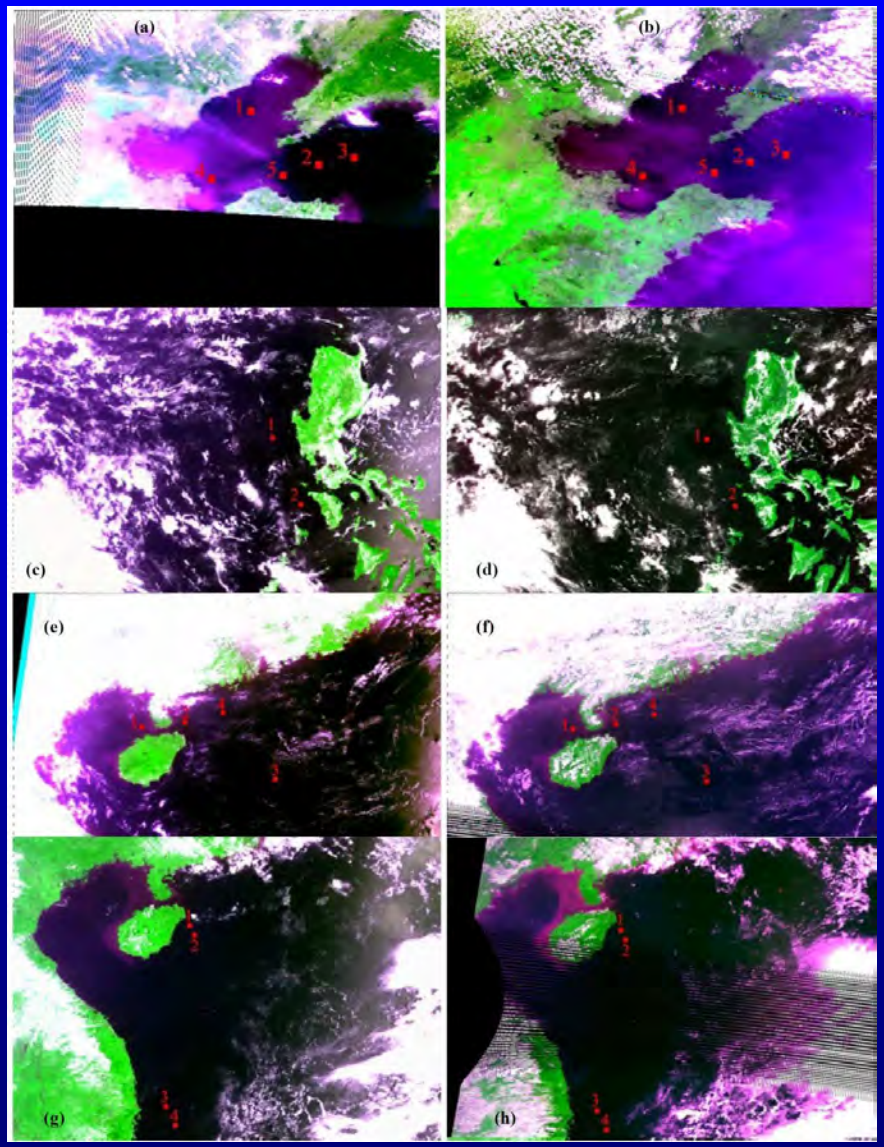
$$\ln\left(L_{ma}\right) = a + b\ln\left(L_{as}\right) + c\left[\ln\left(L_{as}\right)\right]^2$$

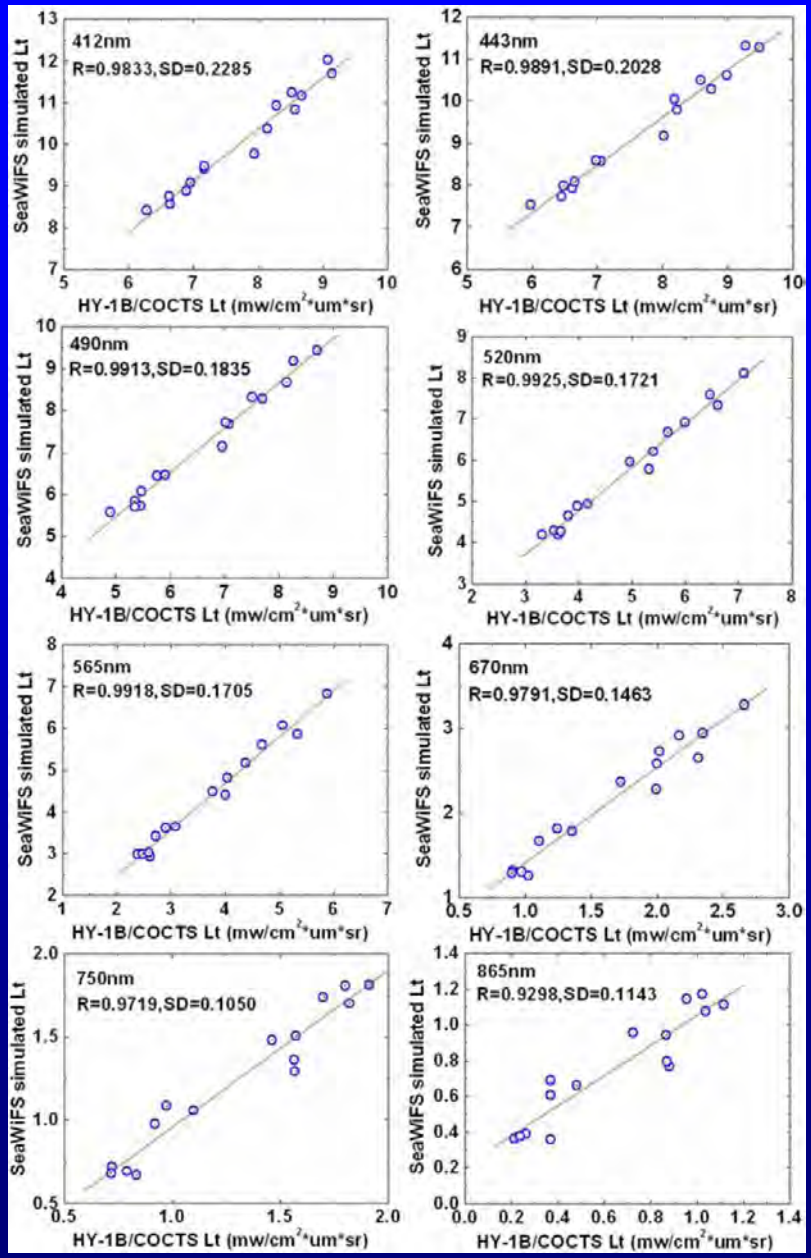
- Antoine (1999), MERIS, vector RT model

$$\frac{L_{path}}{L_r} = \frac{L_r + L_{ma}}{L_r} = a + b\tau_a + c{\tau_a}^2$$

- 20 aerosol models were adopted (O98,M98,M90,M80,M70, M50,C98,C90,C80,C70,C50,T98,T90,T80,T70,T50,U98,U90 ,U70,U50).

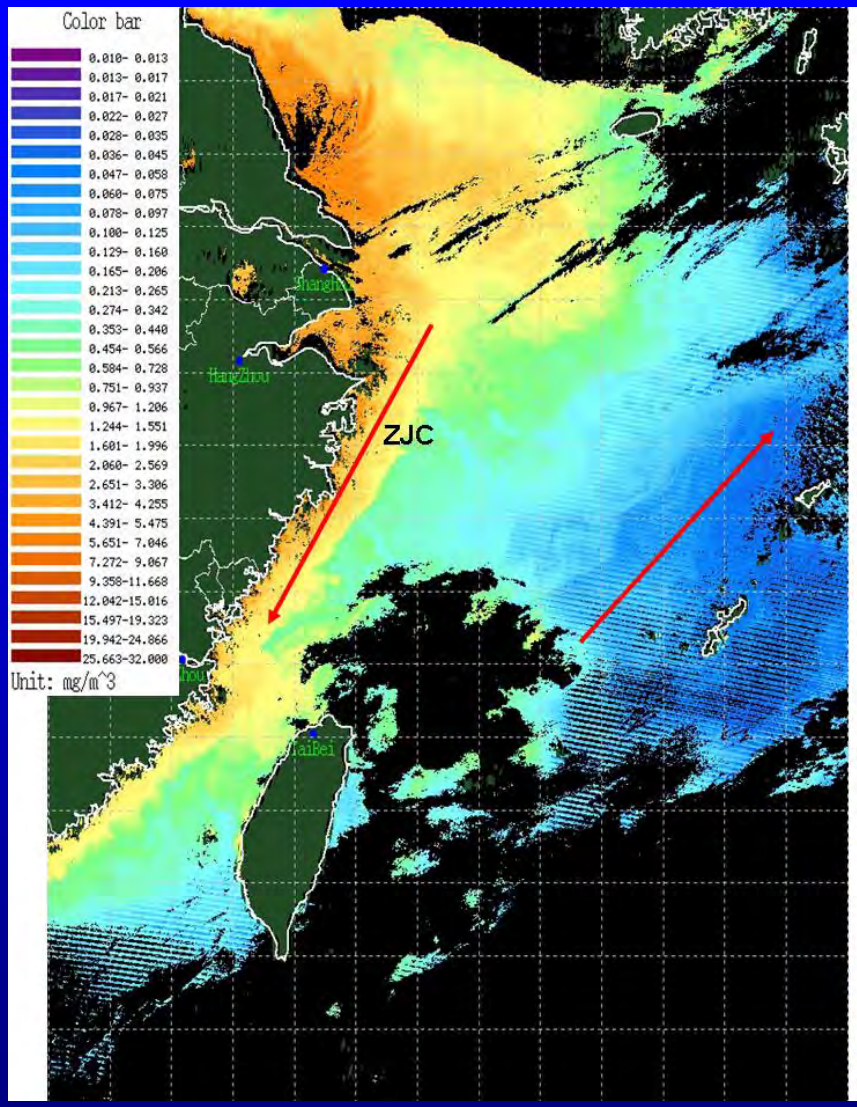
Cross-calibration of HY-1B/COCTS based on SeaWiFS

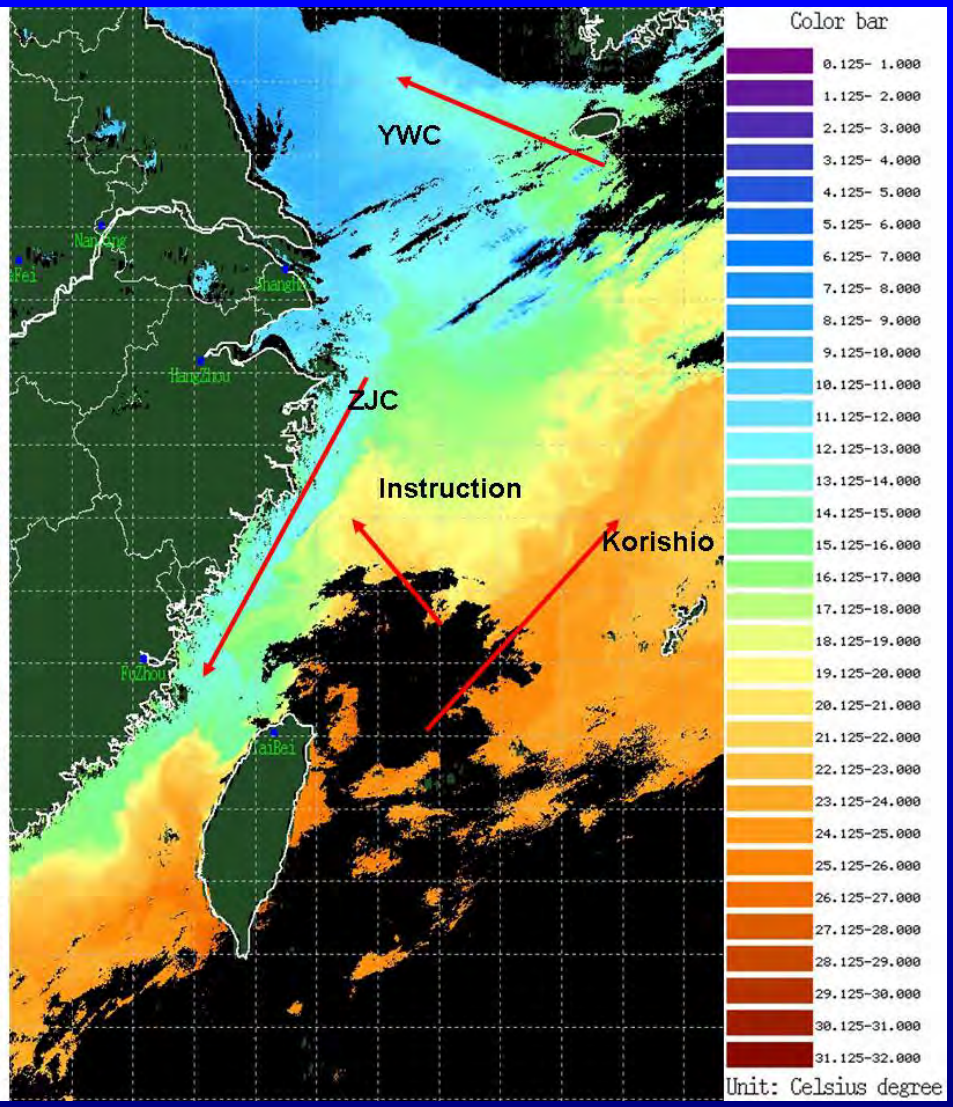




Chl_a

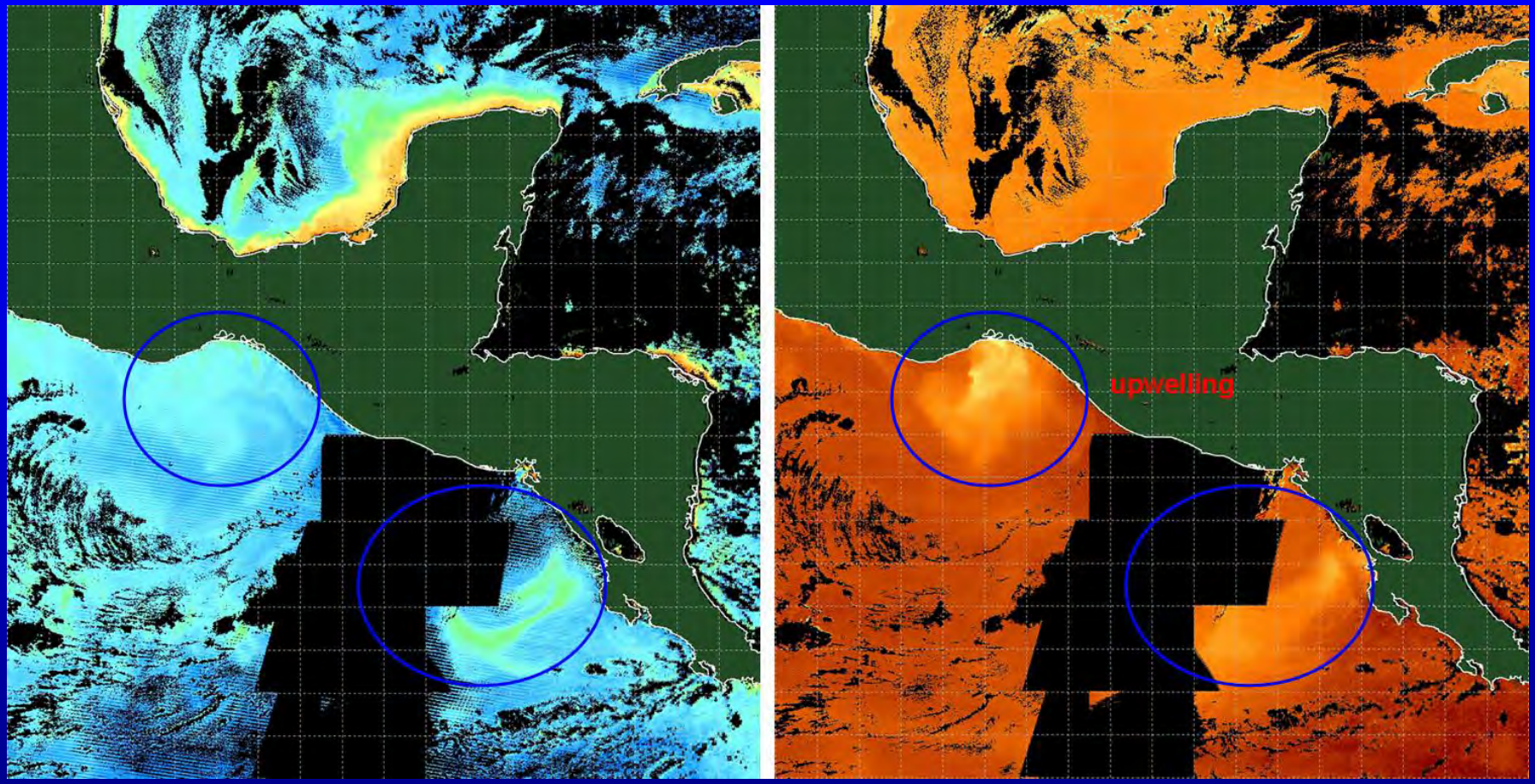
SST





2008-3-2 02:19 GMT

Chl_a *SST*



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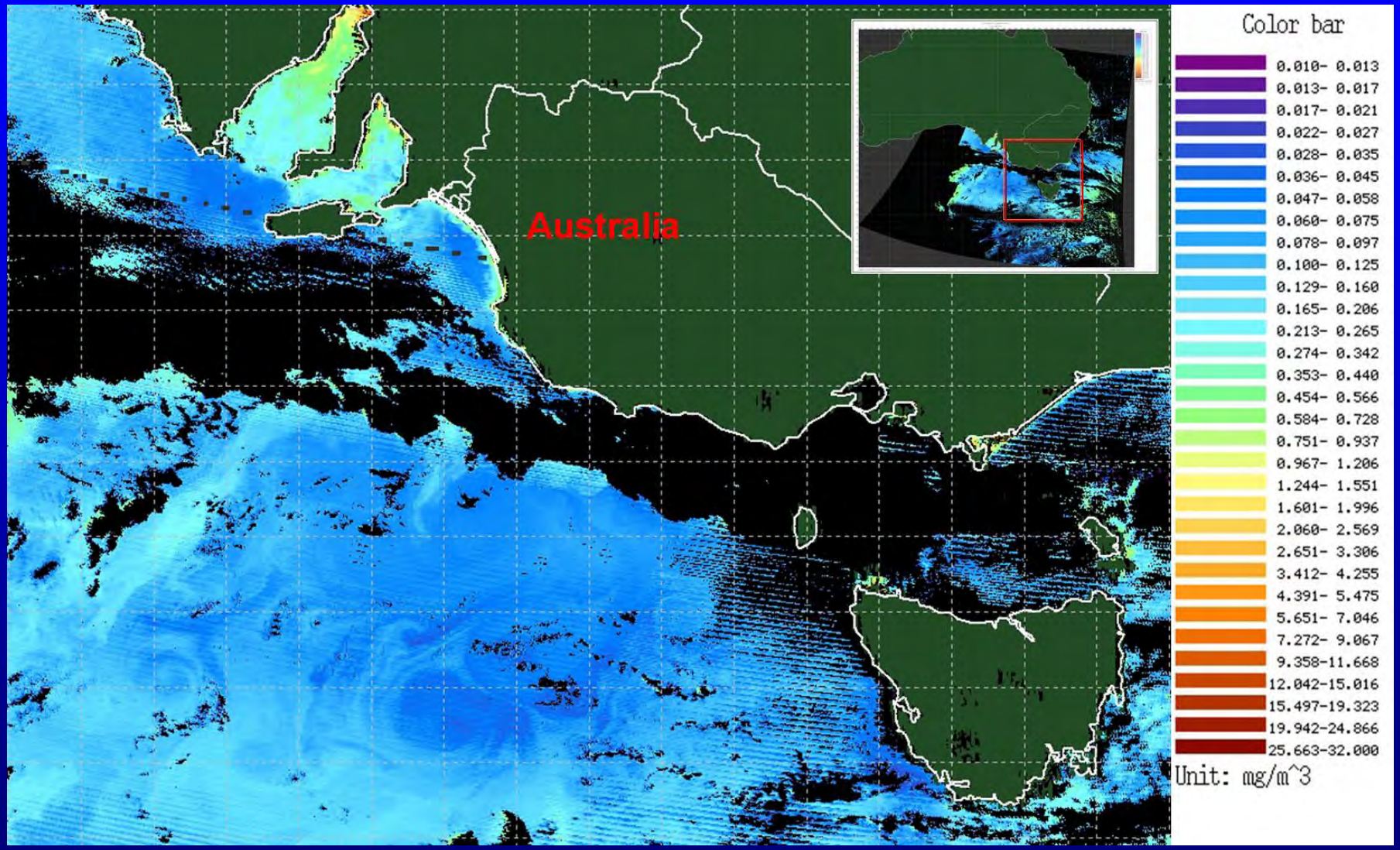
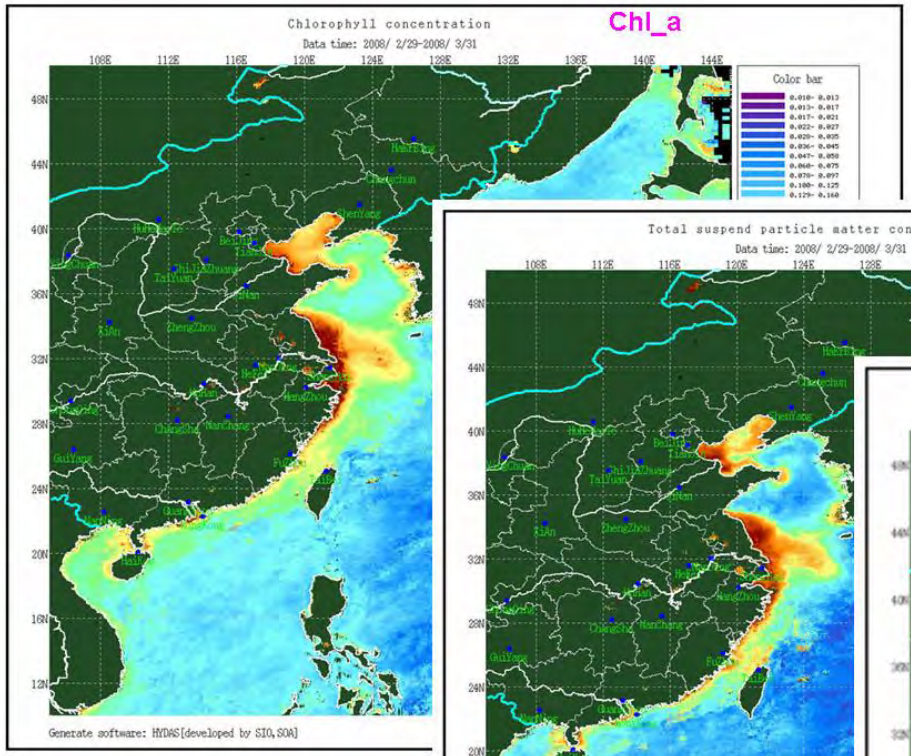
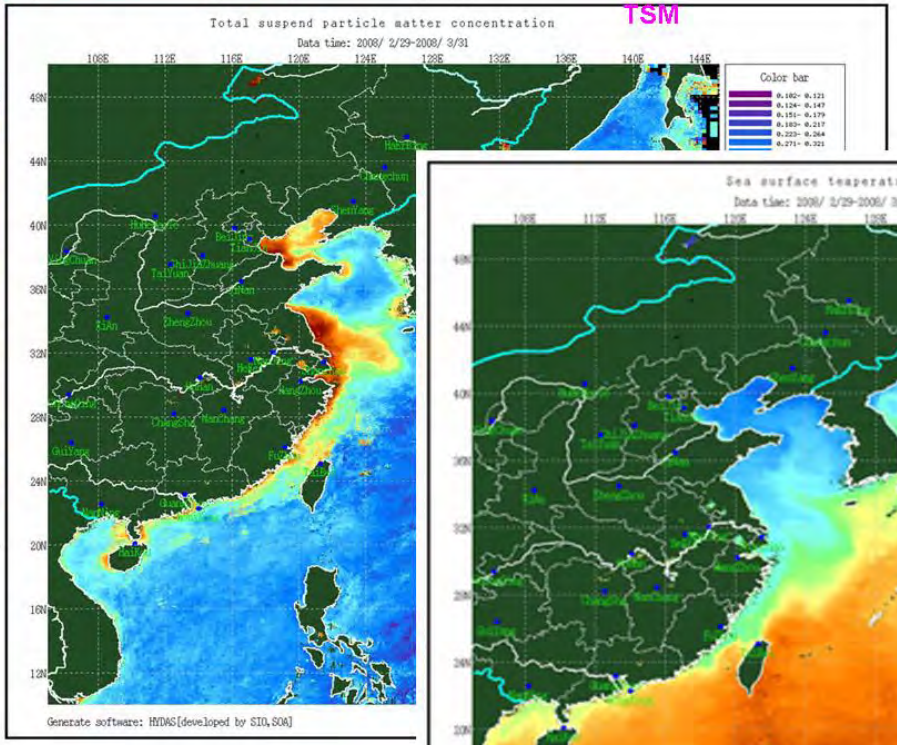
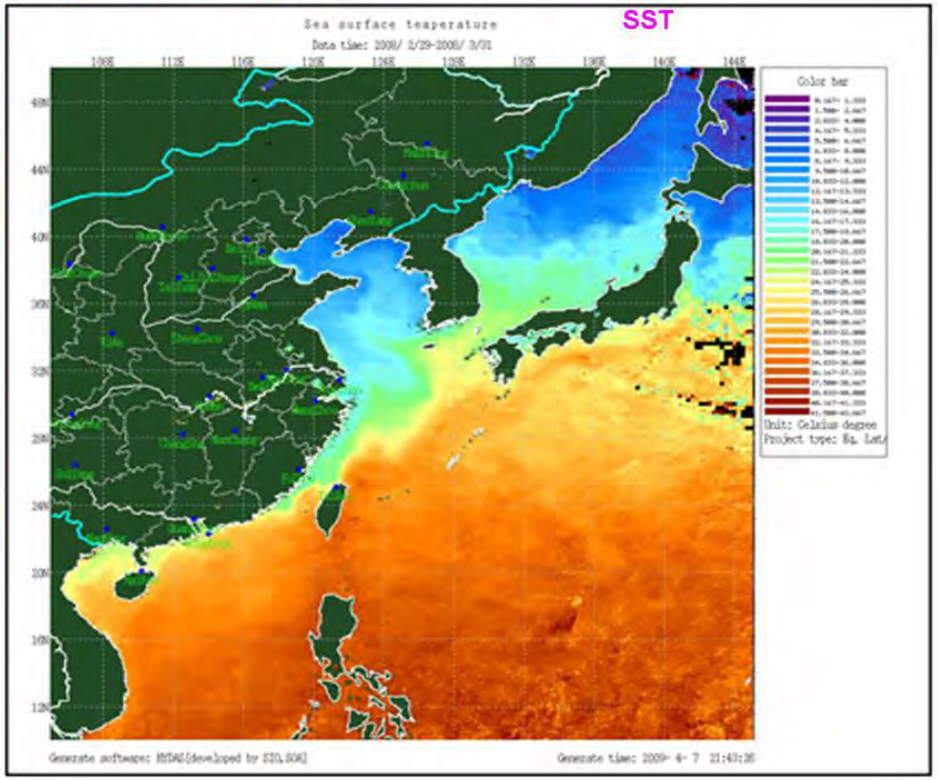
Chlorophyll concentration
2009-1-26 00:30 GMT



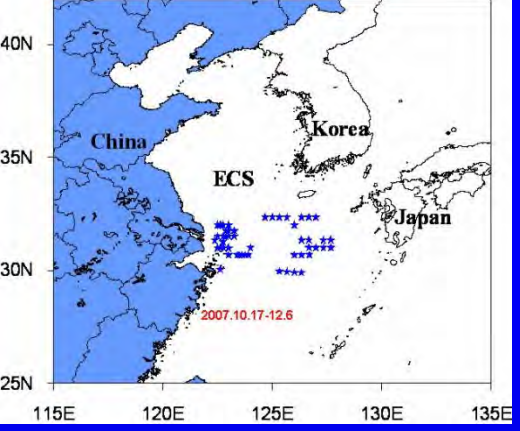
Monthly products



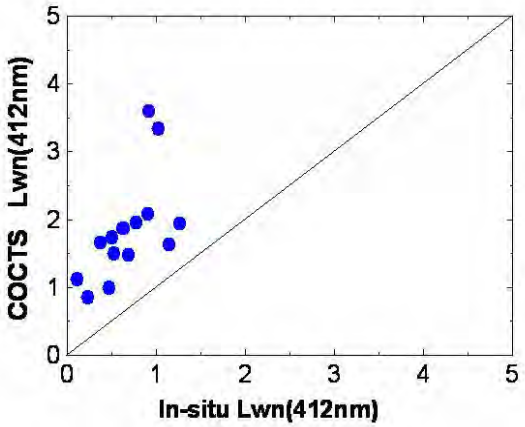


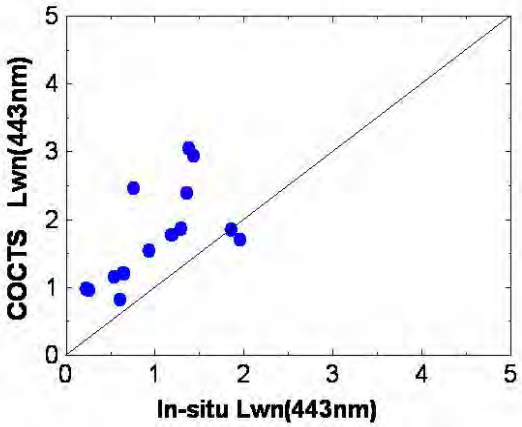


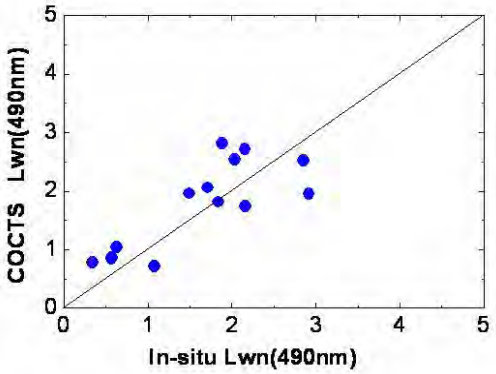
Mar. 2008

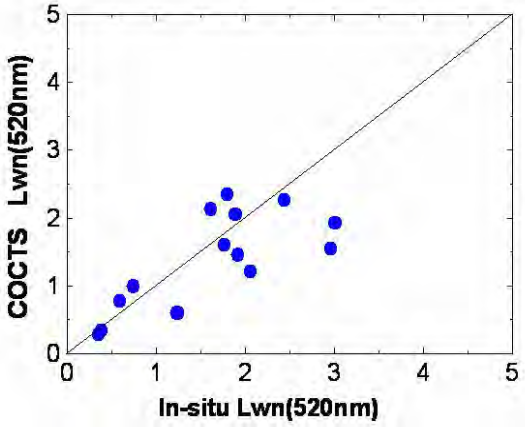


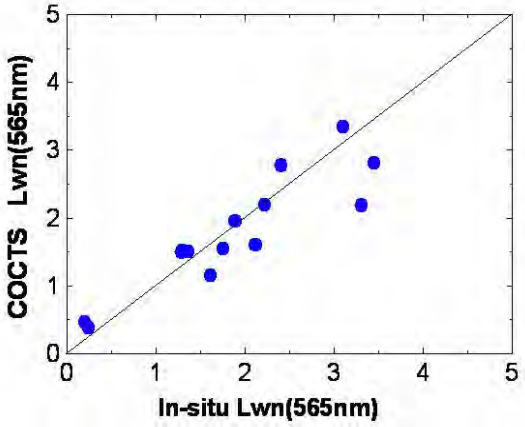
Validation of Lwn retrieved by HY-1B/COCTS

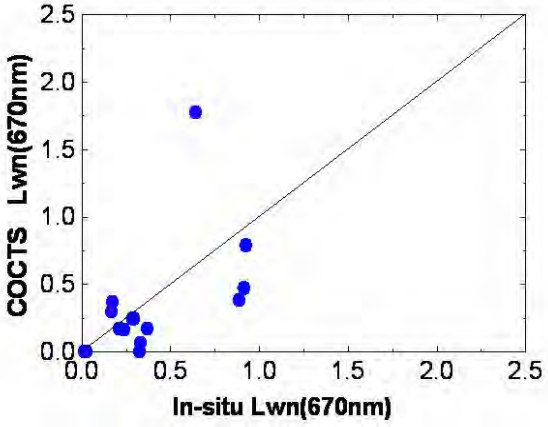




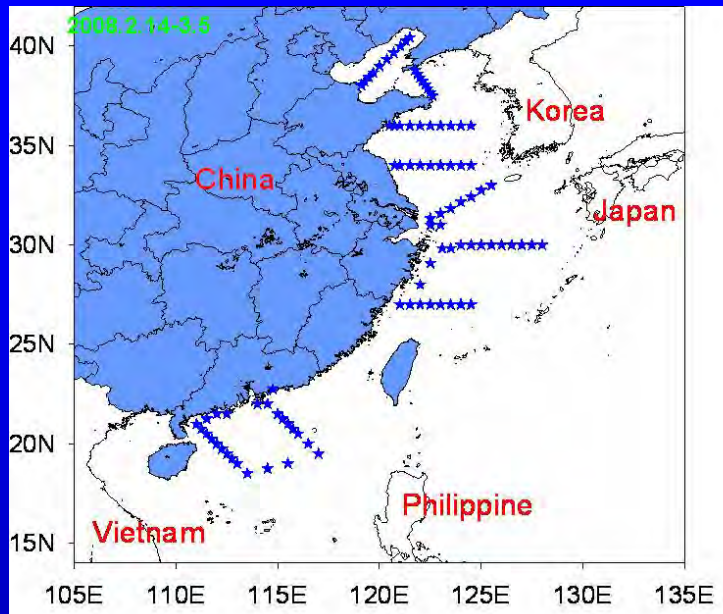


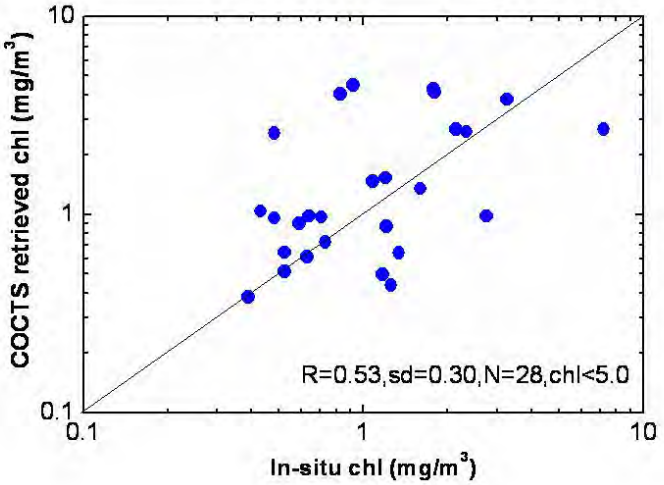


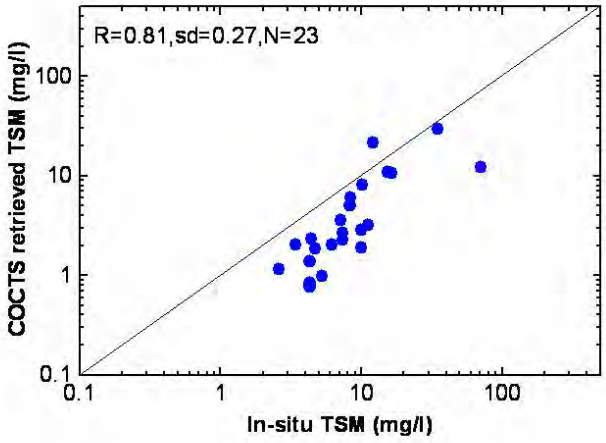


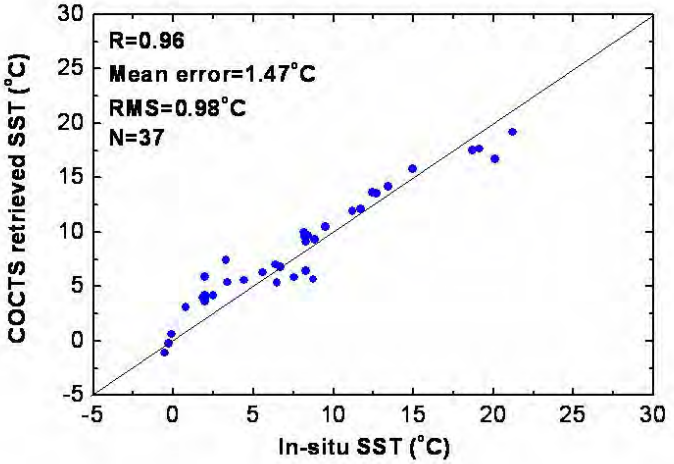


Validation of oceanic parameters retrieved by HY-1B/COCTS







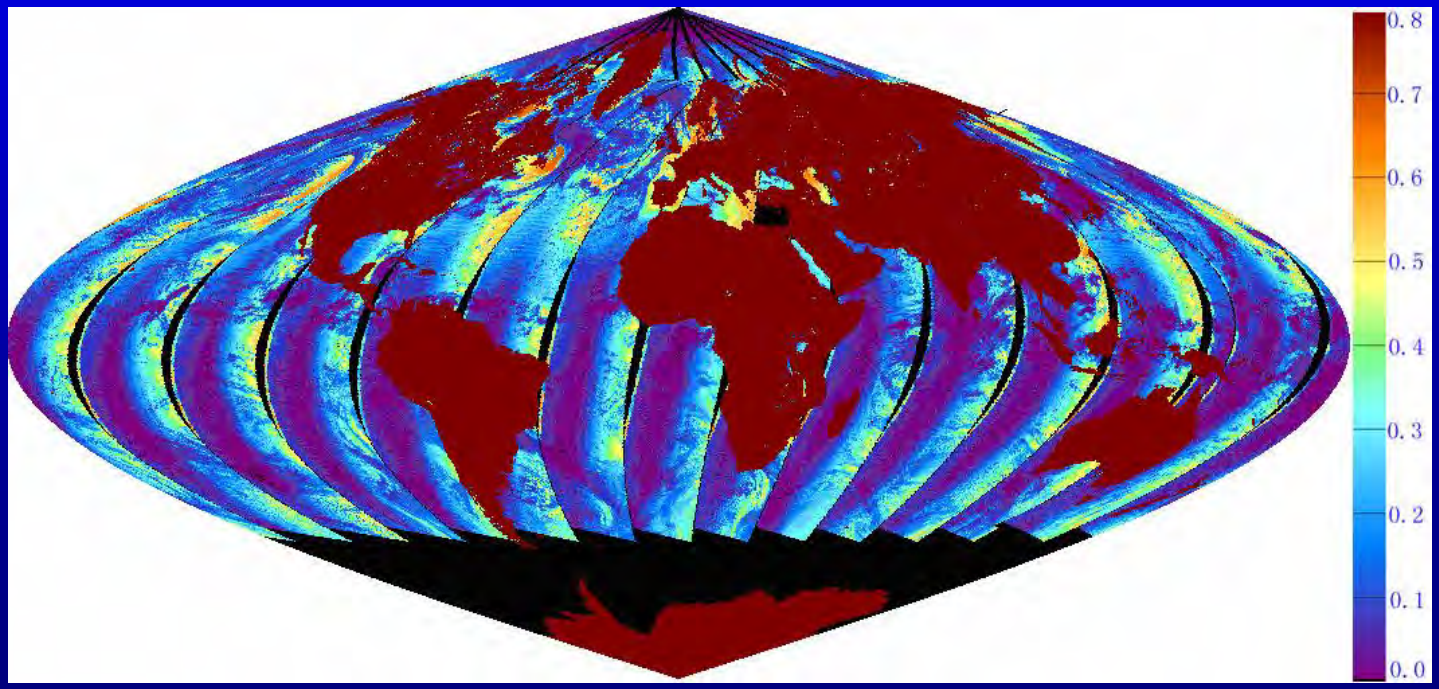


Main challenge

- No on-orbit calibration device for VIS/NIR. Difficult to track the degrade of the response.
- No pre-launch polarization sensitivity measurement with whole optic path.

Polarization sensitivity of HY-1B/COCTS

- Design goal: <5% (within ±20°) , larger than the requirement (<2.5%).
- Polarization can induce 3% error of sensor measured radiance (0.05×0.7×0.9=0.032 ）,which can induce 30% error of Lwn.



Linear polarization degree at TOA observed by POLDER (2003-7-10)

On-orbit estimation of polarization sensitivity

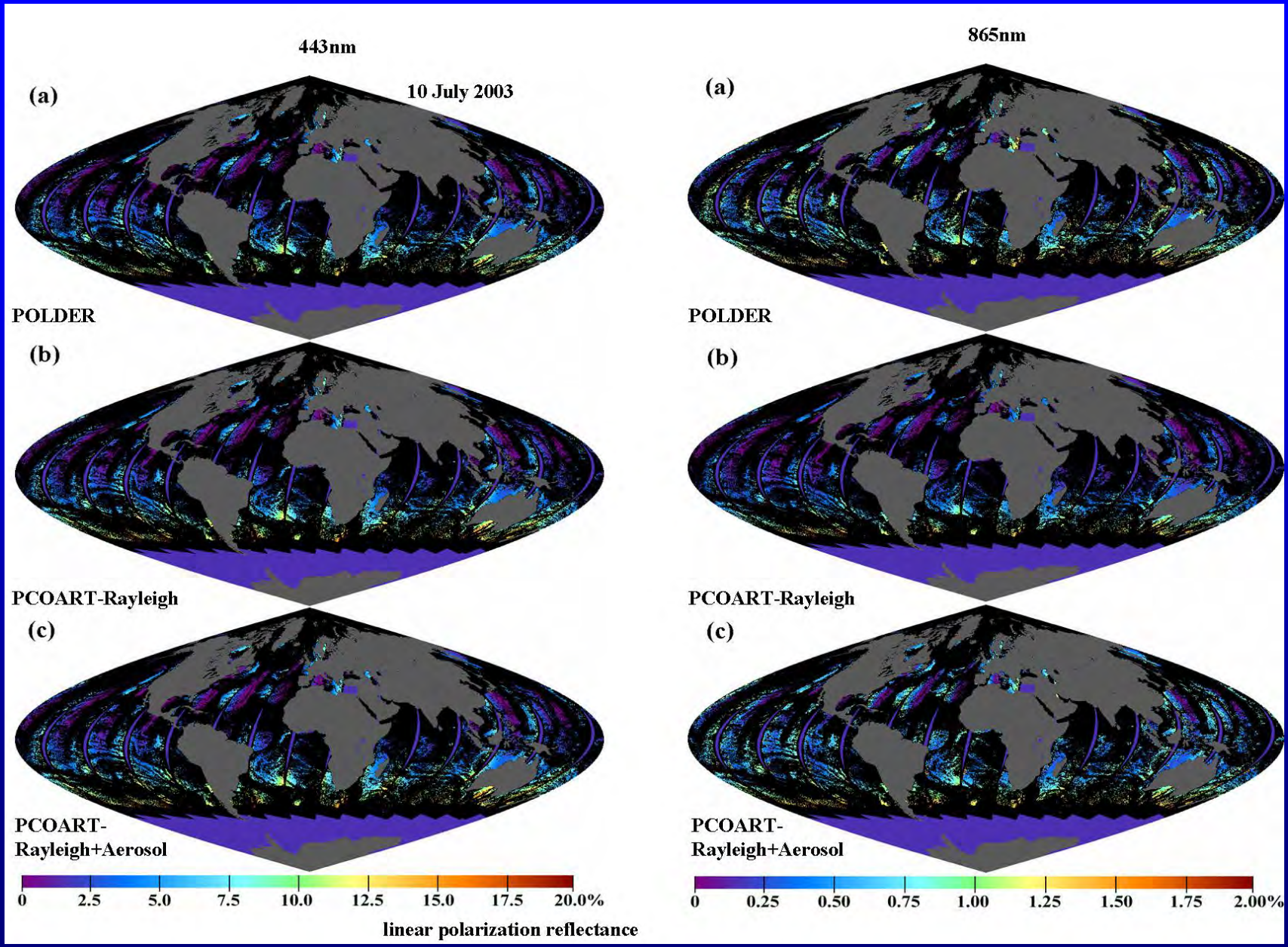
$$I_t(scene) = I_m(scene)\left(1 - \frac{Q_t(scene)}{I_m(scene)} m_{12} - \frac{U_t(scene)}{I_m(scene)} m_{13}\right)$$

$I_t(scene)$ **Exact radiance estimated by cross-calibration using SeaWiFS**

$I_m(scene)$ **Sensor measured radiance**

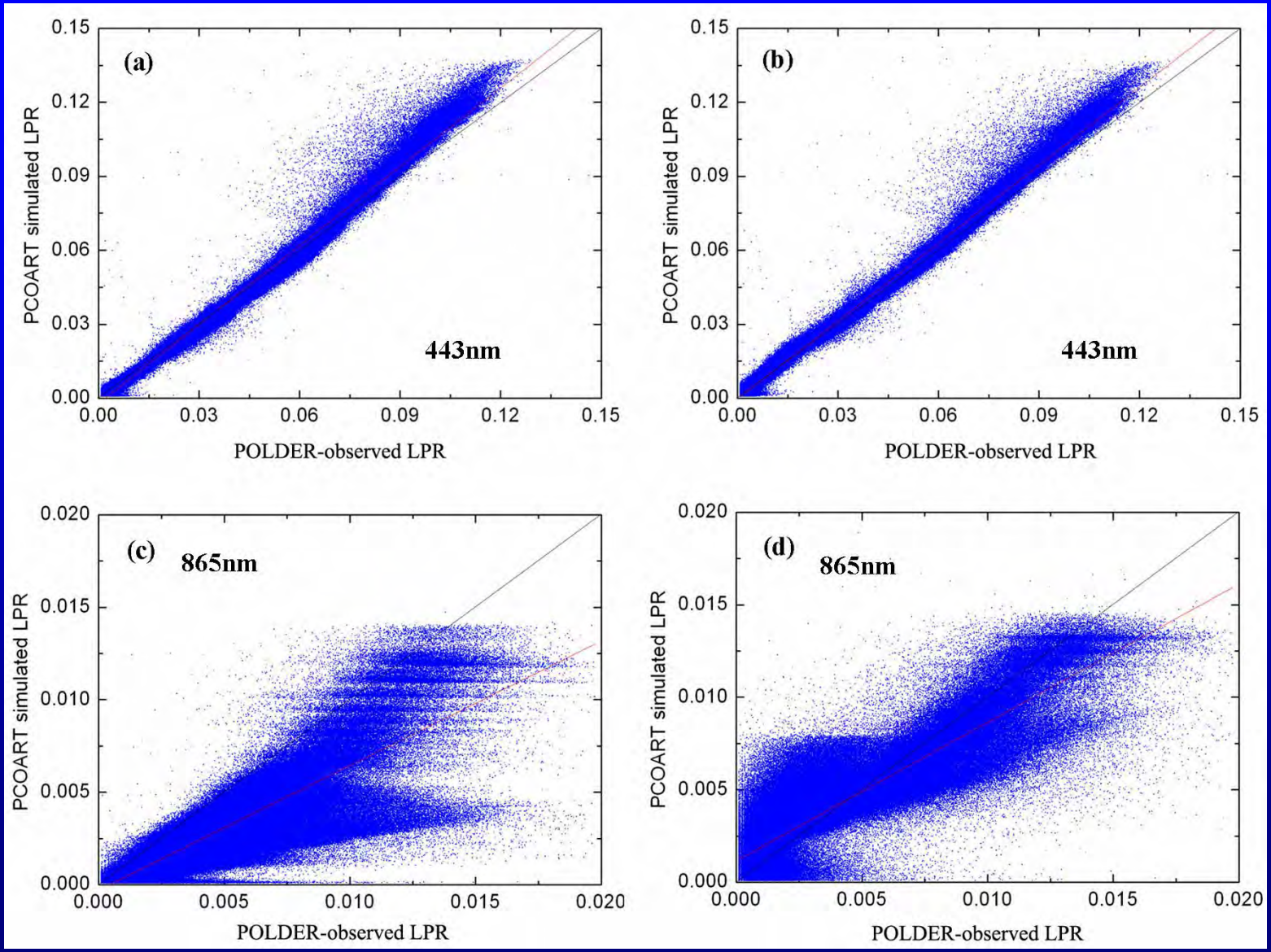
$Q_t(scene), U_t(scene)$ **Simulated by vector RT model (PCOART), including aerosol**

Linear polarization components simulated by VRT

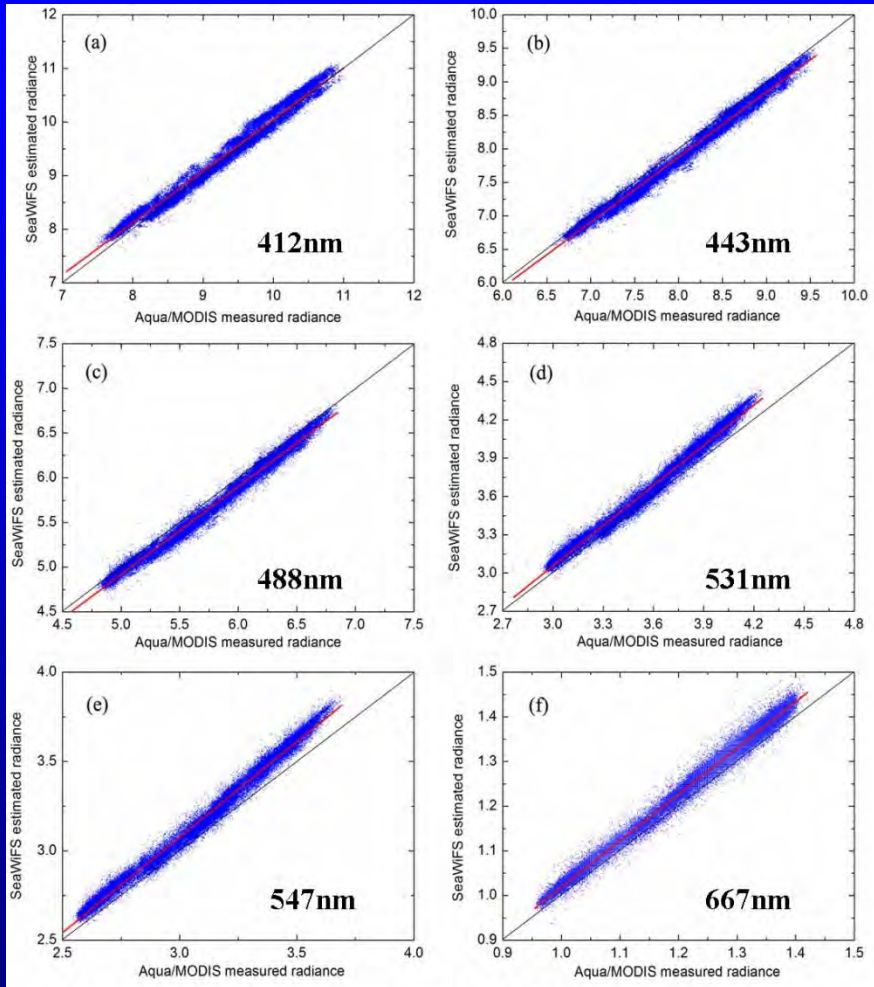


Without aerosol

With aerosol

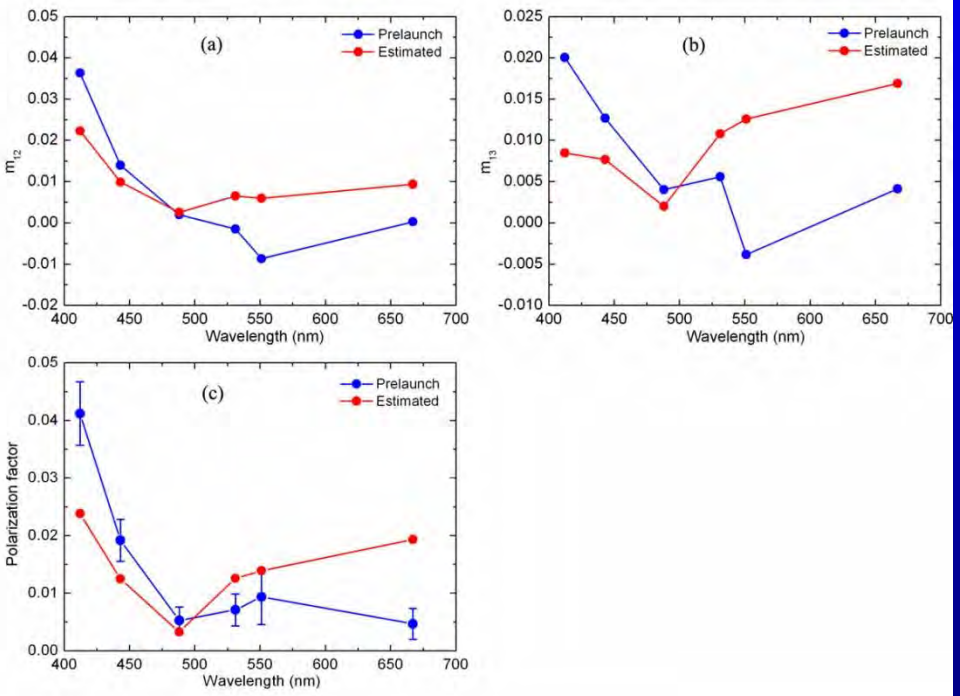


Method test- apply to Aqua/MODIS

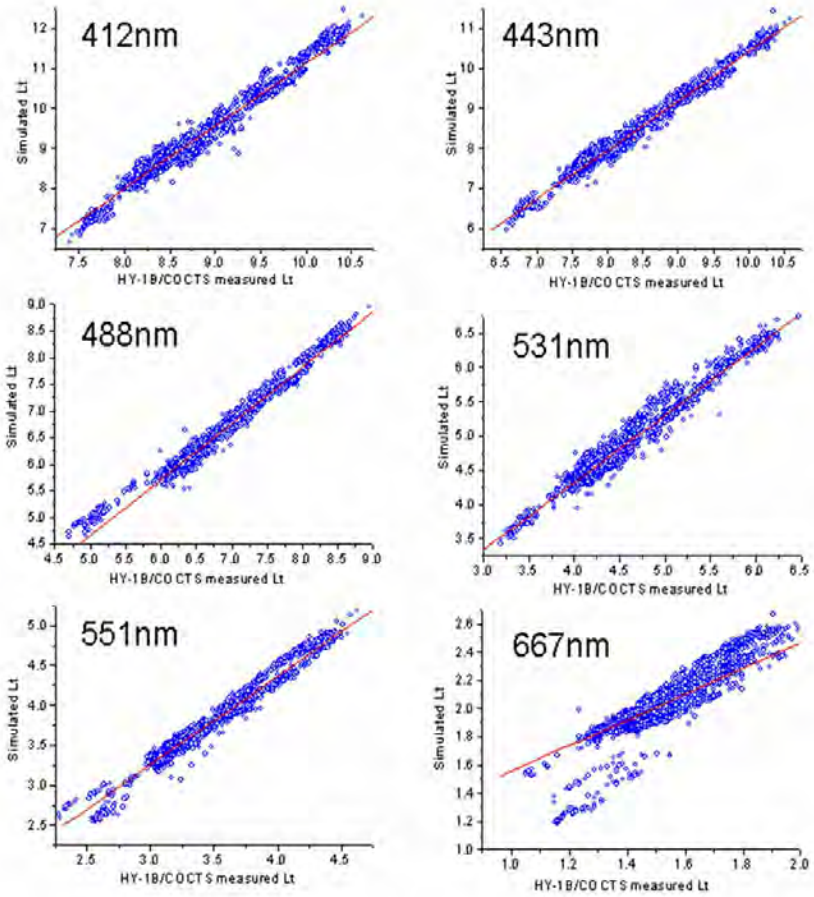


Cross-calibration by SeaWiFS

Comparison of estimated and prelaunch polarization responses

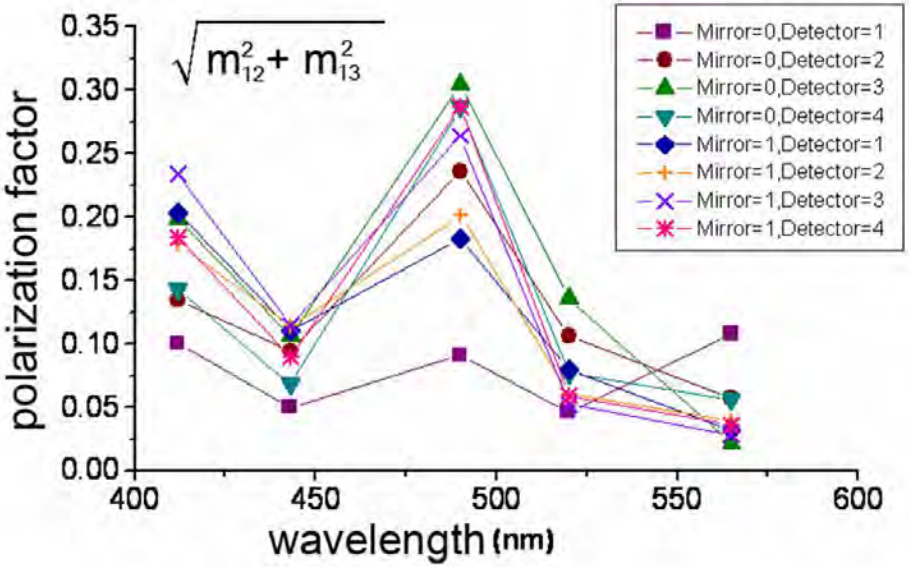


Method applying to HY-1B/COCTS

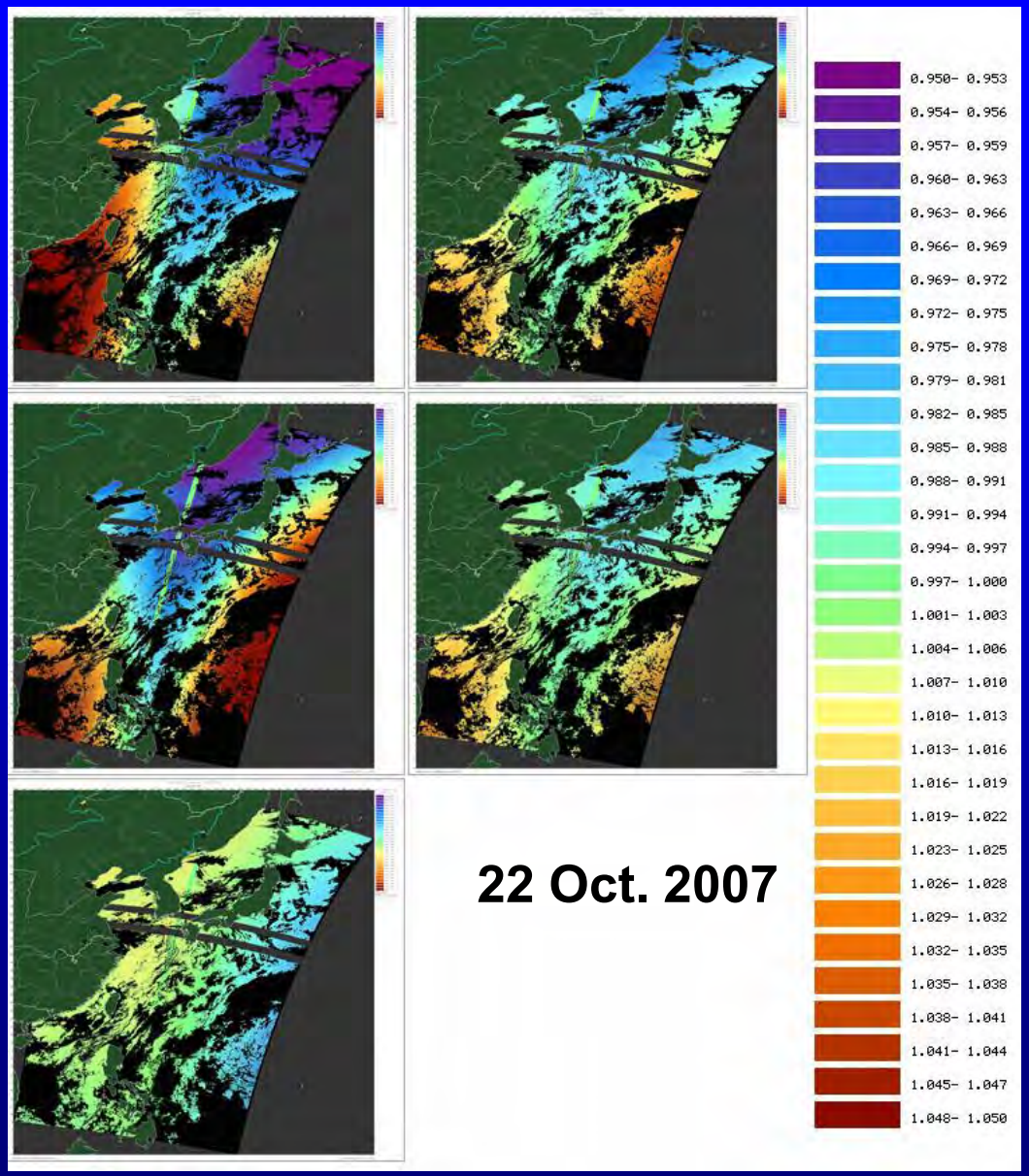


Cross-calibration by SeaWiFS (Mirror 0, detector 1)

Estimated polarization factor

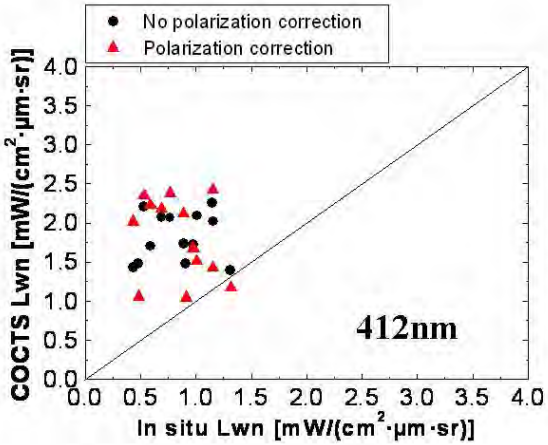


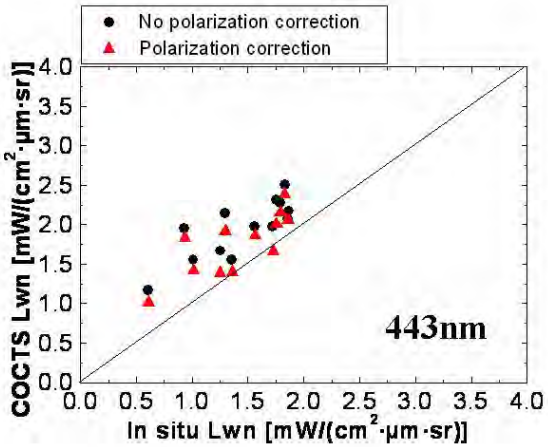
Polarization sensitivity correction

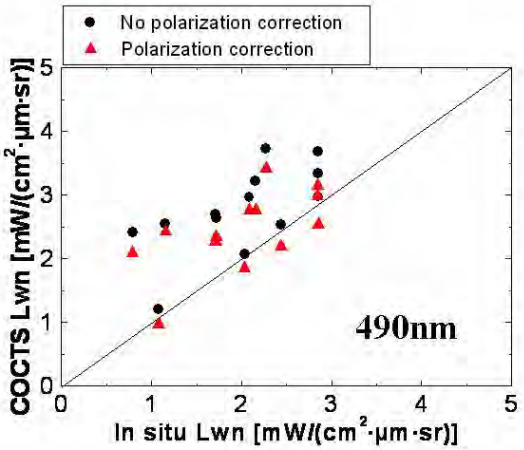


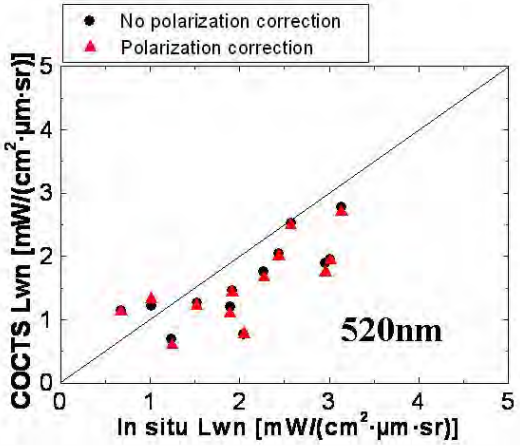
- Large correction at edges, with maximum up to 5%;
- 412nm and 490nm has relative large correction.

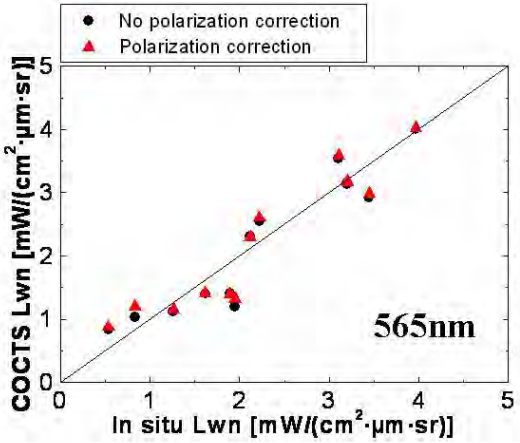
Polarization correction improving Lwn retrieval











Summary

- HY-1B/COCTS has no onboard calibration device and no pre-launch measurement of polarization sensitivity, make it challenge for calibration.
- Cross-calibration has been carried out for HY-1B/COCTS based on SeaWiFS. Analysis of long-term change of sensitivity and data reprocess will be done using the Aqua/MODIS in the future.
- Polarization sensitivity can be estimated preliminarily based on on-orbit data.

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OCEAN REMOTE SENSING GROUP

Thanks for your attention !