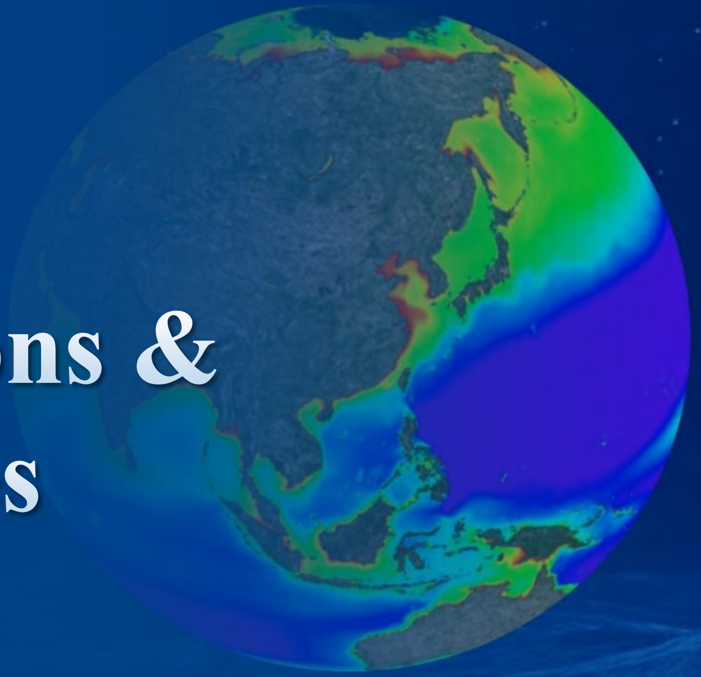
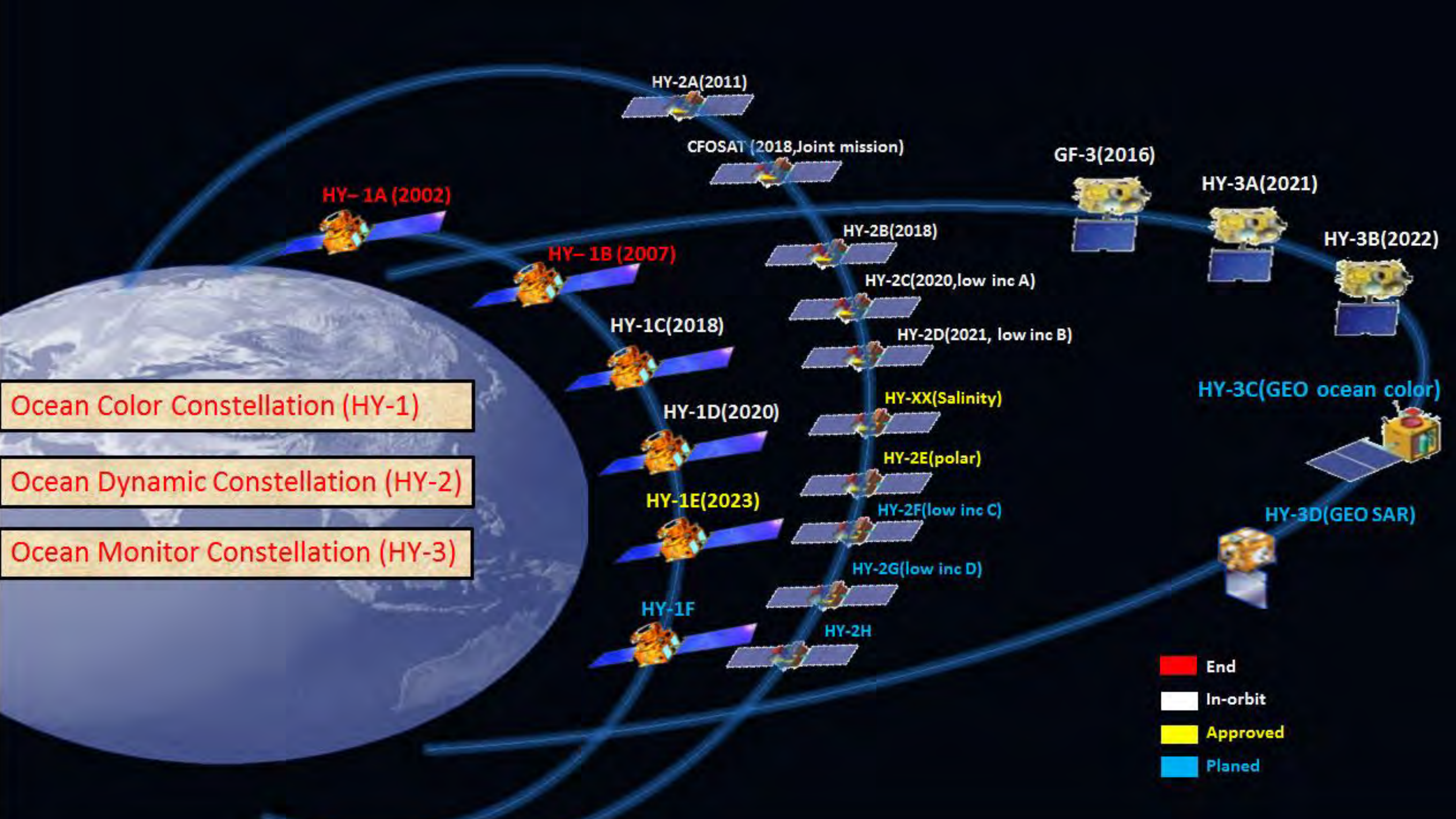
IOCS-2023

Progress in China's OC satellite missions & remote sensing application technologies



Xianqiang He

Second Institute of Oceanography, Ministry of Natural Resources, China

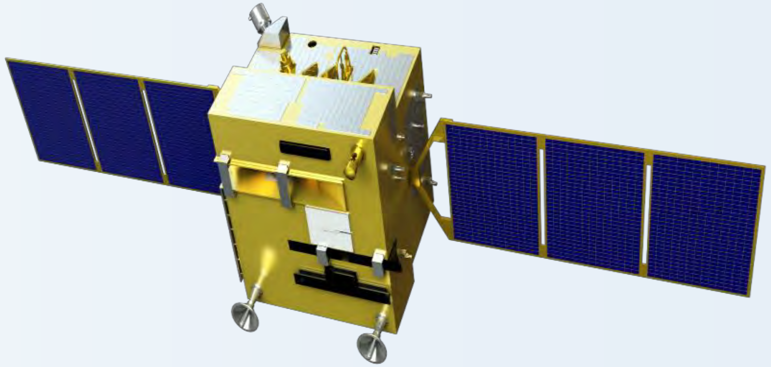

HY-2A(2011)
CFOSAT (2018,Joint mission)
GF-3(2016)
HY-3A(2021)
HY-3B(2022)
HY– 1A (2002)
HY– 1B (2007)
HY-2B(2018)
HY-2C(2020,low inc A)
HY-1C(2018)
HY-2D(2021, low inc B)
HY-3C(GEO ocean color)
HY-XX(Salinity)
HY-1D(2020)
HY-2E(polar)
HY-1E(2023)
HY-2F(low inc C)
HY-3D(GEO SAR)
HY-2G(low inc D)
HY-1F
HY-2H
Ocean Color Constellation (HY-1)
Ocean Dynamic Constellation (HY-2)
Ocean Monitor Constellation (HY-3)
End
In-orbit
Approved
Planed

■ HY-1C/HY-1D OC satellites

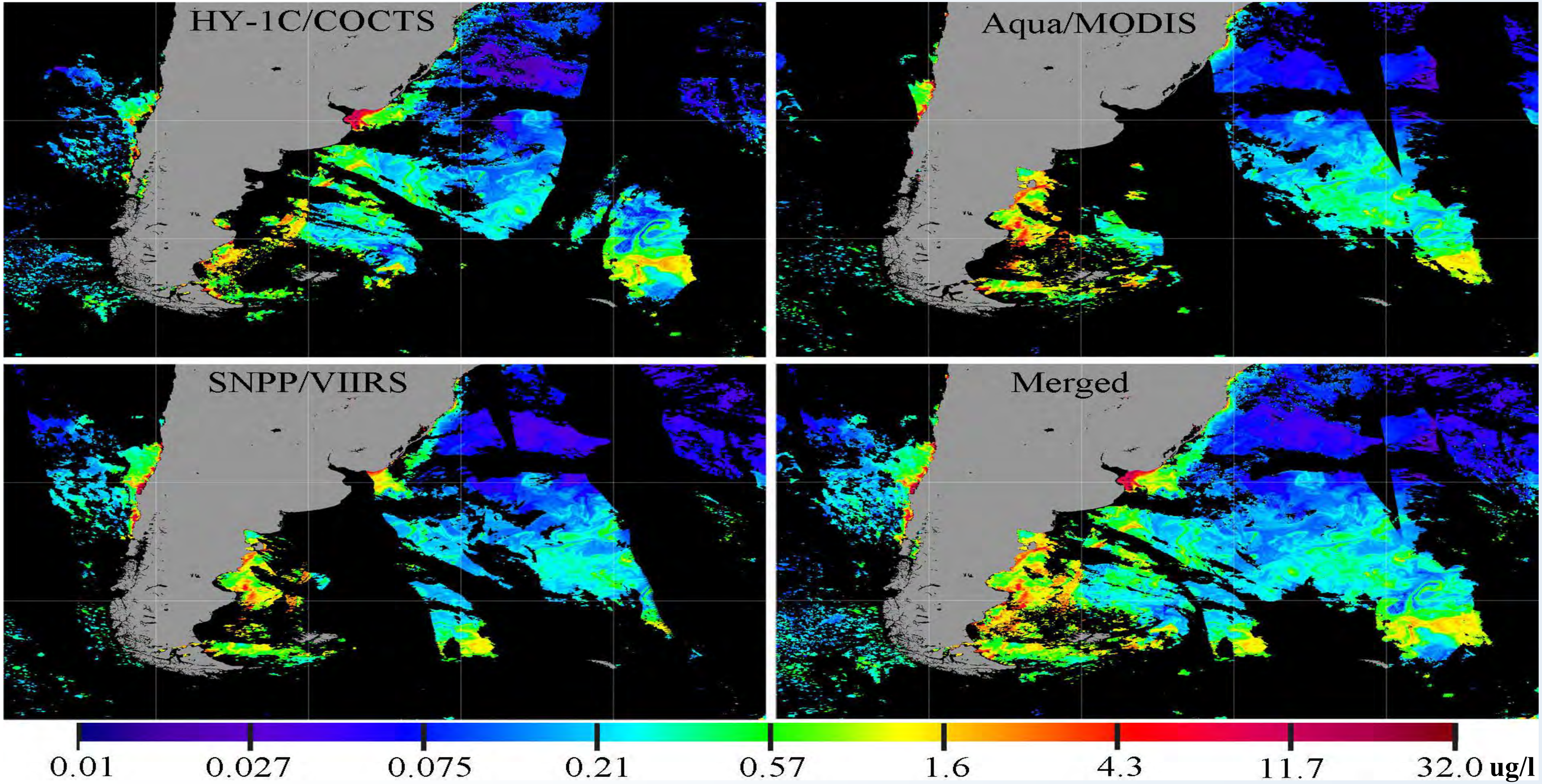
SatCO2

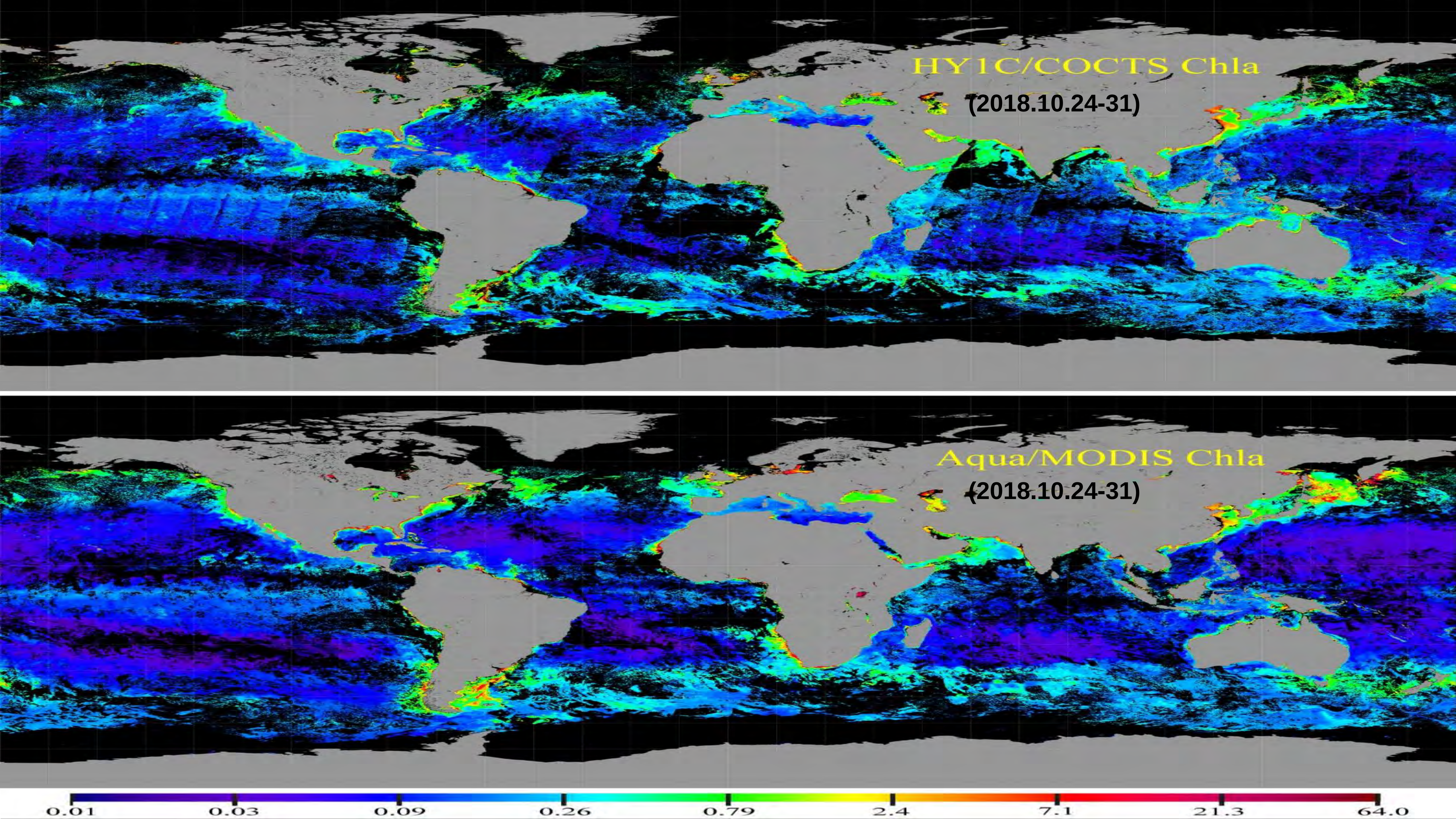
□ HY-1C/D missions (2018.9.7,2020.6.11)
□ Successor of HY-1A (2002-2004) and HY-1B (2007-2016).

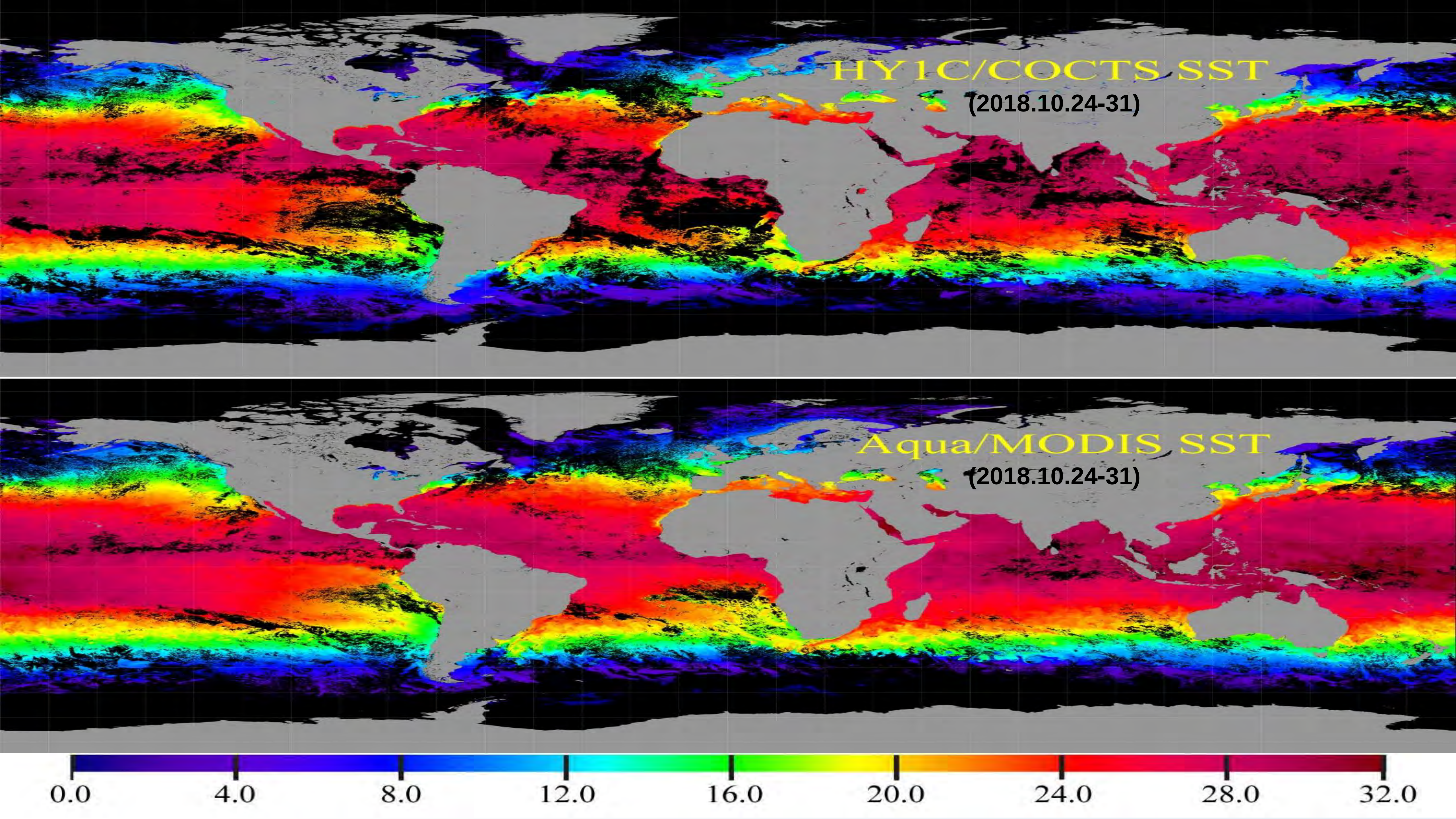
Sensor	Bands	Resolution	Swath	Revisiting period
COCTS (China Ocean Color and Temperature Scanner)	10 bands (8 VIS/NIR, 2 TIR)	1.1km	~3000km	Global daily
CZI (Coastal Zone Imager)	4 bands (3 VIS, 1 NIR)	50m	~1000km	3 days for one satellite, 1.5 days for two satellites
UVI (Ultra Violet Imager)	2 UV bands (355nm, 385nm)	550m	~3000km	Global daily

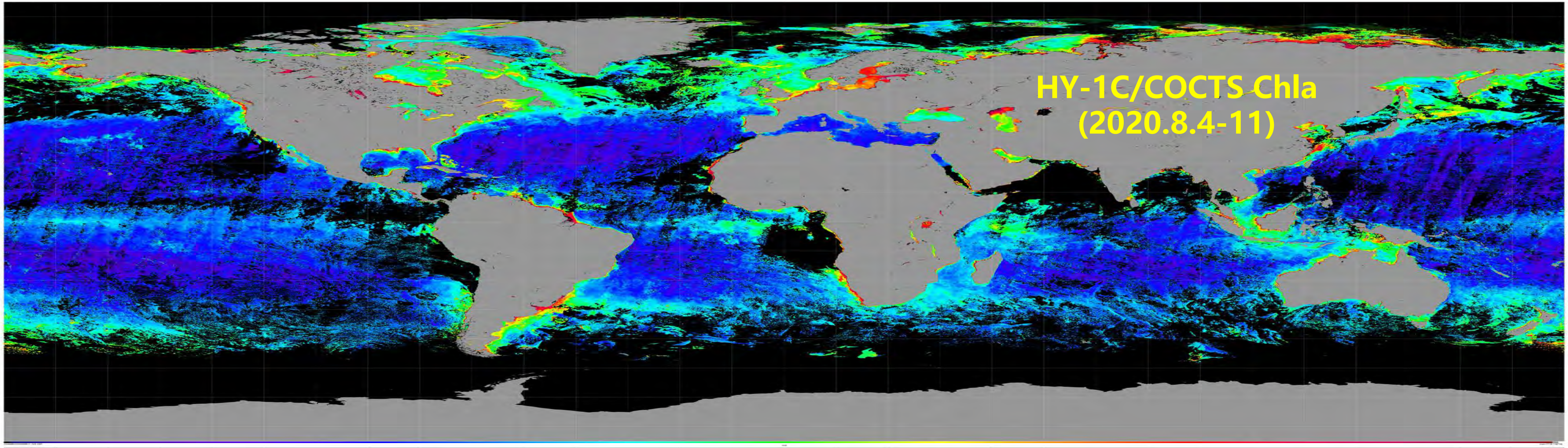


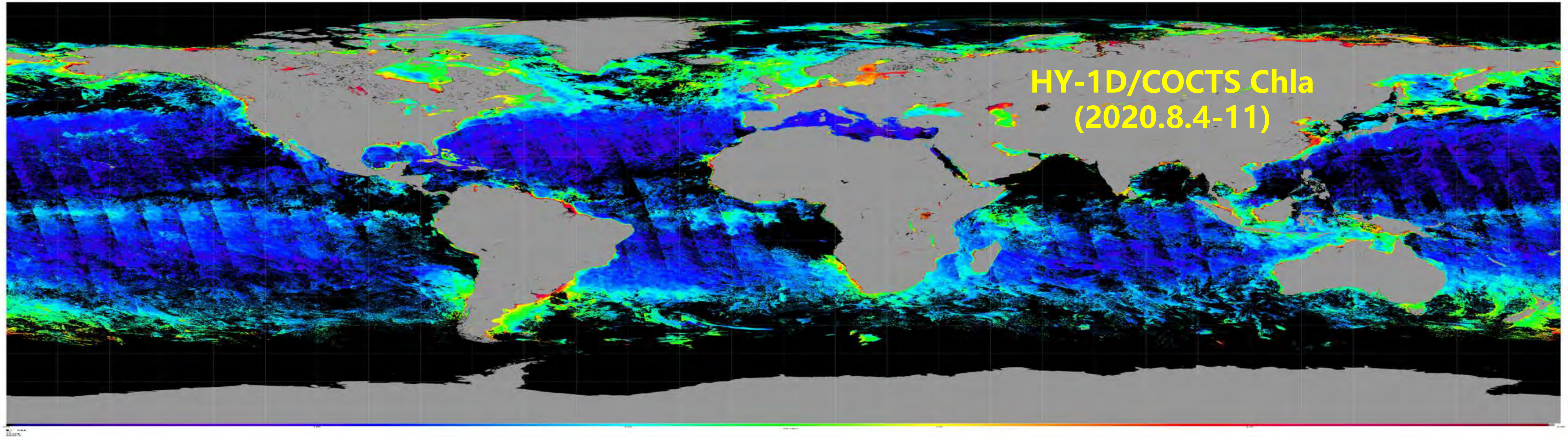
Daily Chla products (HY1C/COCTS, Aqua/MODIS, SNPP/VIIRS)
(2019.1.1)

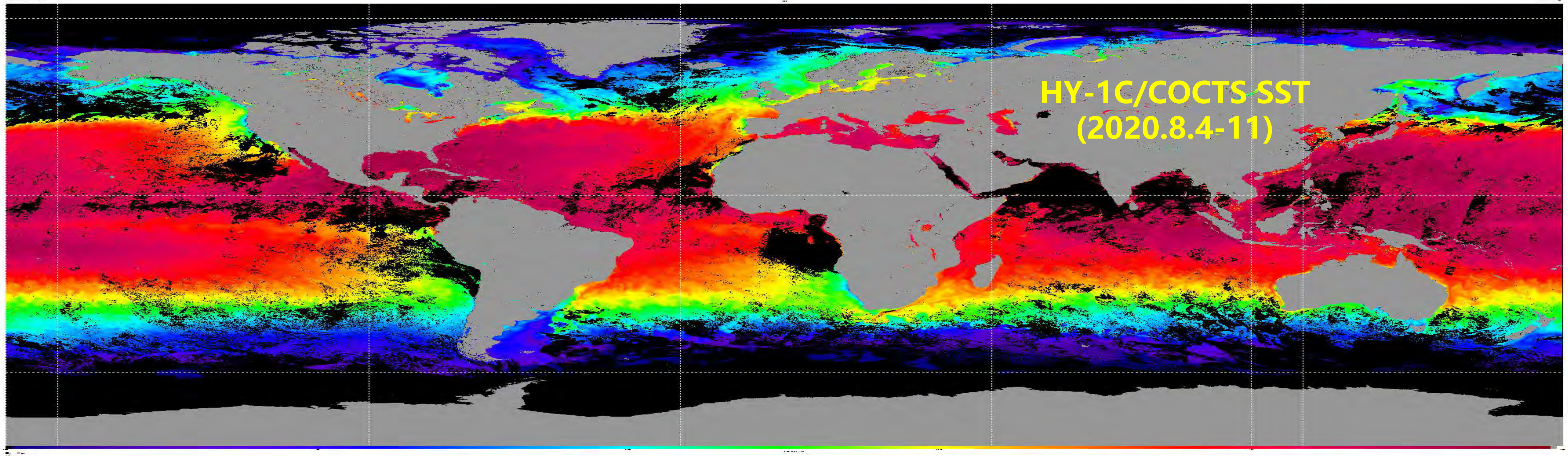


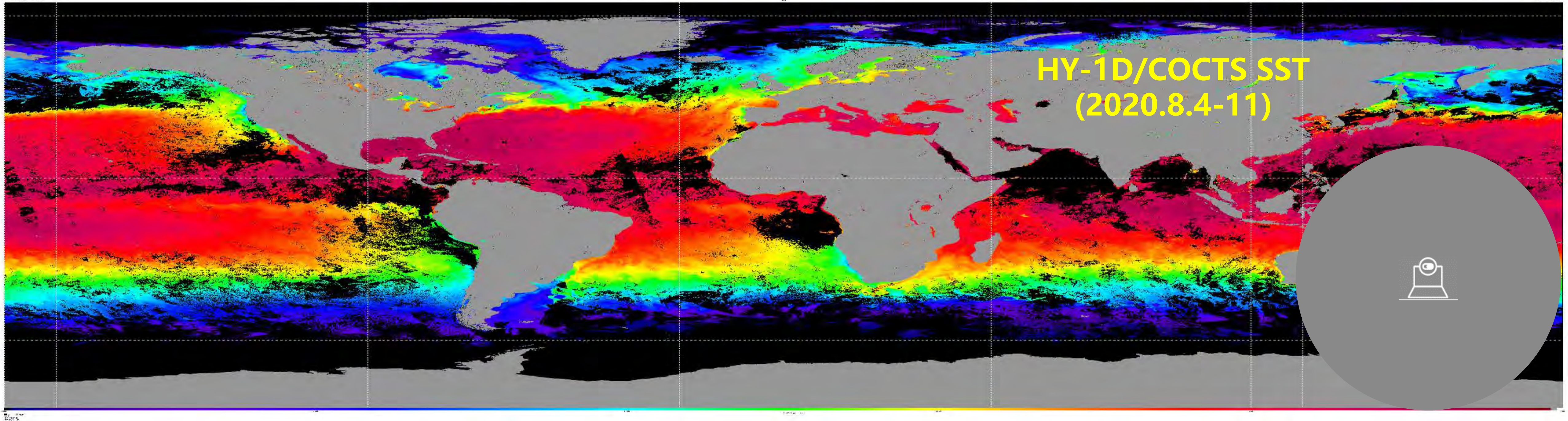

HY1C/COCTS Chla
(2018.10.24-31)
Aqua/MODIS Chla
(2018.10.24-31)
0.01
0.03
0.09
0.26
0.79
2.4
7.1
21.3
64.0


HY1C/COCTS SST
(2018.10.24-31)
Aqua/MODIS SST
(2018.10.24-31)
0.0
4.0
8.0
12.0
16.0
20.0
24.0
28.0
32.0

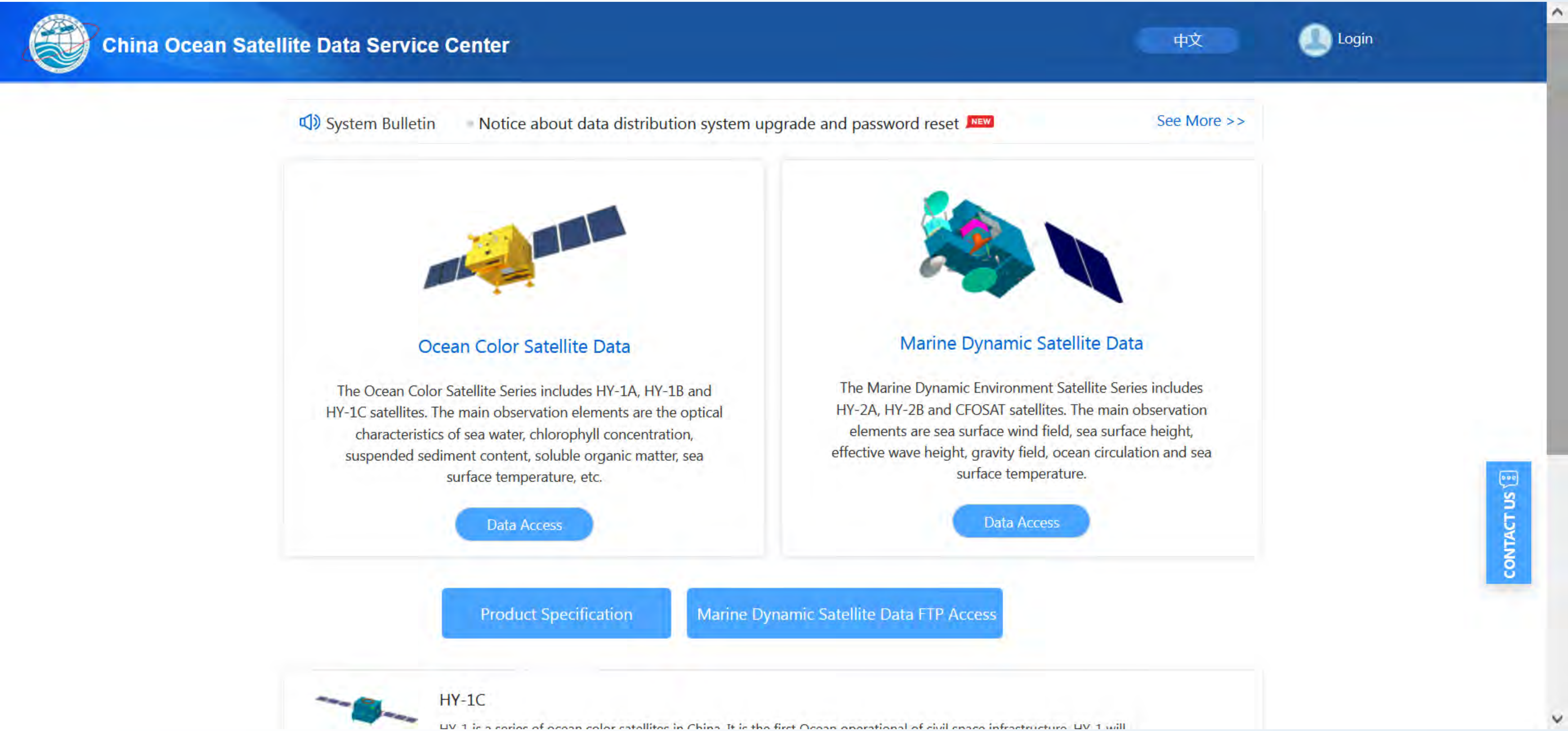

HY-1C/COCTS Chla
(2020.8.4-11)


HY-1D/COCTS Chla
(2020.8.4-11)


HY-1C/COCTS SST
(2020.8.4-11)

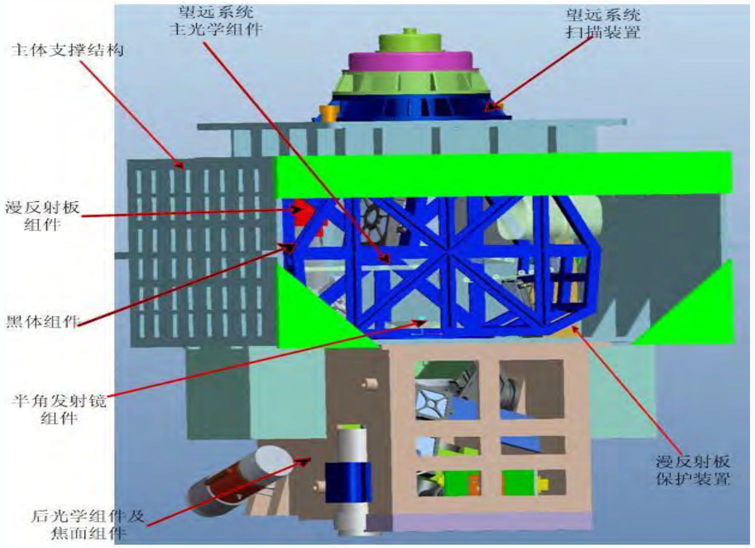

HY-1D/COCTS SST
(2020.8.4-11)

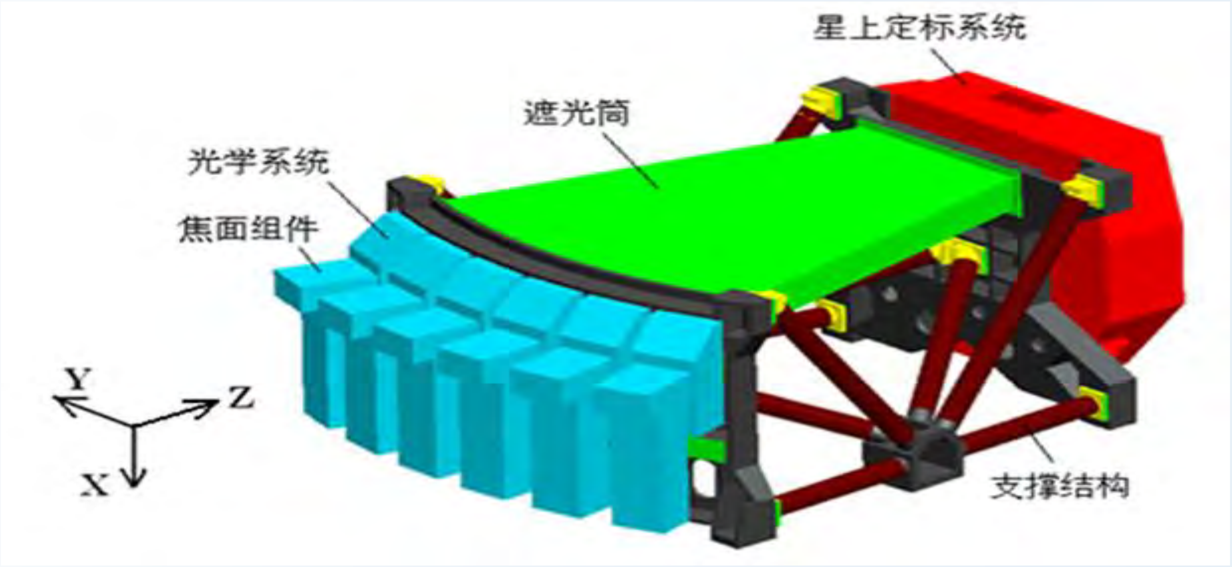
Free access to HY-1C/1D data (https://osdds.nsoas.org.cn/)



■ China new generation polar-orbit OC missions

- ◻ **HY-1E (2023, approved by Dec. 29, 2018; experiment) & HY-1F(planed, operational)**
- ◻ **Three major payloads:**
  - ✓ **New Ocean Color and Temperature Scanner (COCTS)**
  - ✓ **Programmable Moderate Resolution Imaging Spectroradiometer (PMRIS)**
  - ✓ **New Coastal Zone Imager (CZI)**





New Chinese ocean color and temperature scanner (COCTS)

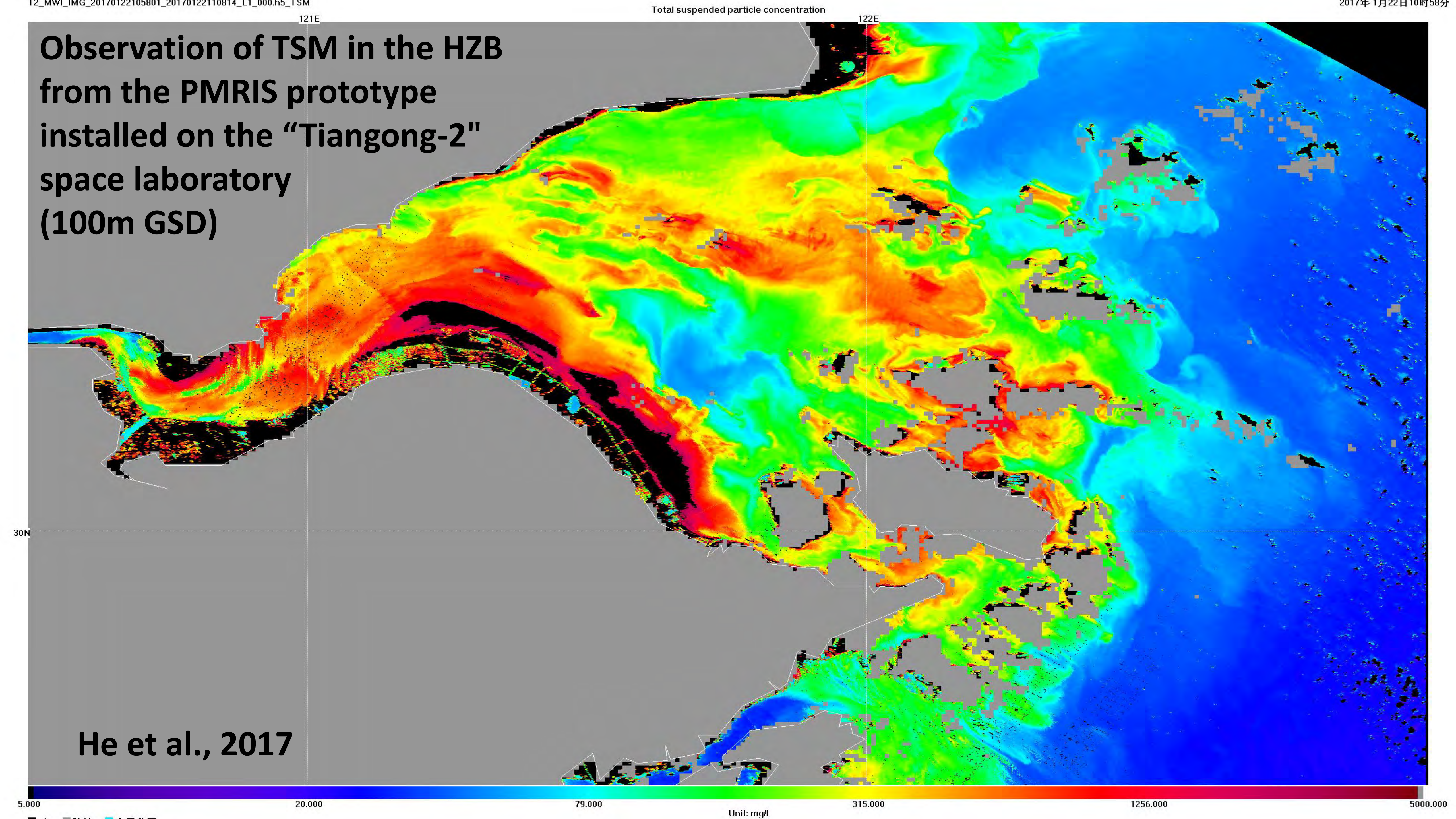
- Spatial resolution (GSD): 500m(@782km)
- Swath: ≥ 3000km (@782km)
- Polarization sensitivity: within ±20° field of view, B3-B10: ≤1%, B11-B15: ≤1.5%; within ±57° field of view, ≤ 3%
- Stray light coefficient: ≤ 1%
- Full optical path on-board calibration capability
- 24-hour operation

Band	Central wavelength (nm)	Band width (nm)	Typical radiance ($mW/cm^2 \mu msr$)	SNR
1	360	20	7.46	≥1000
2	385	20	7.22	≥1000
3	412	20	7.86	≥1000
4	443	20	7.02	≥1000
5	490	20	5.31	≥1000
6	520	20	4.58	≥1000
7	565	20	3.39	≥1000
8	620	15	2.0	≥1000
9	665	15	1.6	≥1000
10	681	15	1.45	≥1400
11	705	20	1.19	≥1000
12	744	20	0.45	≥400
13	865	40	0.15	≥600
14	1245	40	0.15	≥250
15	1640	80	0.088	≥180
16	3740	190	NEΔT≤0.15K 200-320K	
17	10800	1000	NEΔT≤0.15K 200-320K	
18	12000	1100	NEΔT≤0.15K 200-320K	

Programmable Moderate Resolution Imaging Spectroradiometer (PMRIS)

- Spatial resolution (GSD):
  - ✓ multiple channel mode: 100m (@782km)
  - ✓ high spectral mode: 200m (@782km)
- Swath: 950km (@782km)
- Output mode:
  - ✓ multiple channel mode: programmable output 15 bands in UV/VIS/NIR (0.375-0.92 μ m), 4 fixed SWIR bands;
  - ✓ high spectral mode: programmable output 90 spectral bands in UV/VIS/NIR, with minimum step of 2.5nm; 4 fixed SWIR bands;
- Full optical path on-board calibration capability.
- Domestic area observation, overseas area selective observation with maximum 20 minutes for each orbit

Band No.	Central wavelength (nm)	Band width (nm)	SNR	Typical radiance ($mW/cm^2 \mu msr$)
1	385	20	≥260	7.22
2	412	20	≥500	7.86
3	443	20	≥500	7.02
4	475	15	≥500	6.19
5	490	20	≥500	5.31
6	520	20	≥500	4.58
7	565	20	≥500	3.39
8	617	20	≥500	2.19
9	640	20	≥500	1.90
10	665	15	≥440	1.60
11	681	10	≥340	1.45
12	710	15	≥360	1.19
13	744	20	≥340	1.12
14	820	15	≥200	0.59
15	865	40	≥230	0.45
16	1020	40	≥400	0.2
17	1245	20	≥250	0.15
18	1640	40	≥180	0.088
19	2135	50	≥100	0.029



T2_MWI_IMG_20170122105801_20170122110814_L1_000.h5_TSM
Total suspended particle concentration
2017年 1月22日10时58分
121E
122E
30N
Observation of TSM in the HZB from the PMRIS prototype installed on the “Tiangong-2" space laboratory (100m GSD)
He et al., 2017
5.000
20.000
79.000
315.000
1256.000
5000.000
Unit: mg/l

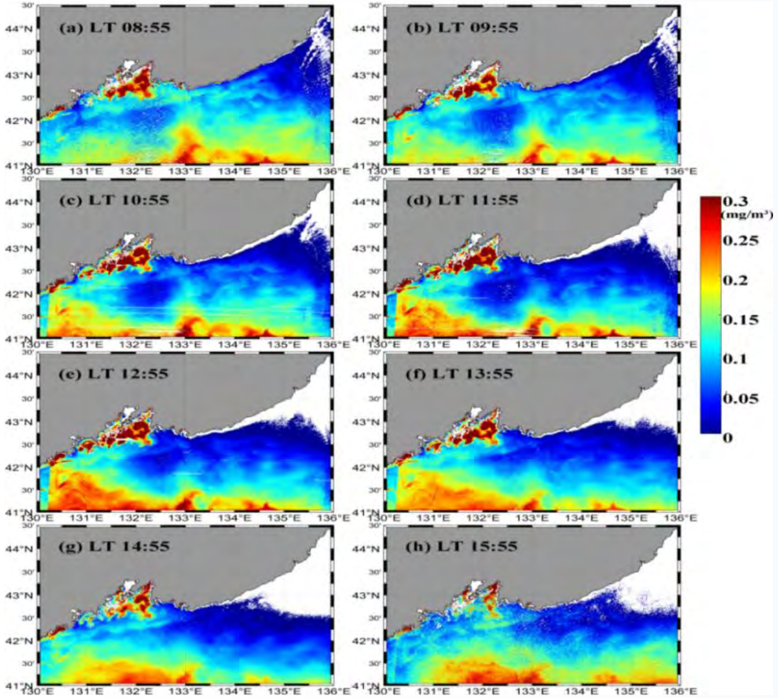
New Coastal Zone Imager (CZI)

- Spatial resolution (GSD):
  - ✓ Panchromatic: 5m (@782km)
  - ✓ Multispectral: 20m (@782km)
- Swath: 60km (@782km)
- Visual range under side sway condition: ≥ 1000km
- Domestic area observation, overseas area selective observation with maximum 20 minutes for each orbit

Band No.	Central wavelength (nm)	Band width (nm)	SNR	Typical radiance (mW/cm^{2}μmsr)	Saturation radiance (mW/cm^{2}μmsr)
1	425	50	≥300	6.95	28.95
2	485	70	≥300	6.1	32.08
3	555	70	≥300	4.6	28.96
4	605	40	≥300	3.4	26.32
5	660	60	≥300	2.63	24.36
6	725	40	≥200	2.1	18.69
7	830	120	≥200	1.55	16.43
8	950	180	≥200	1.43	9.94
P	625	350	≥200	6.72	25.34

■ AC technique for high solar zenith angles

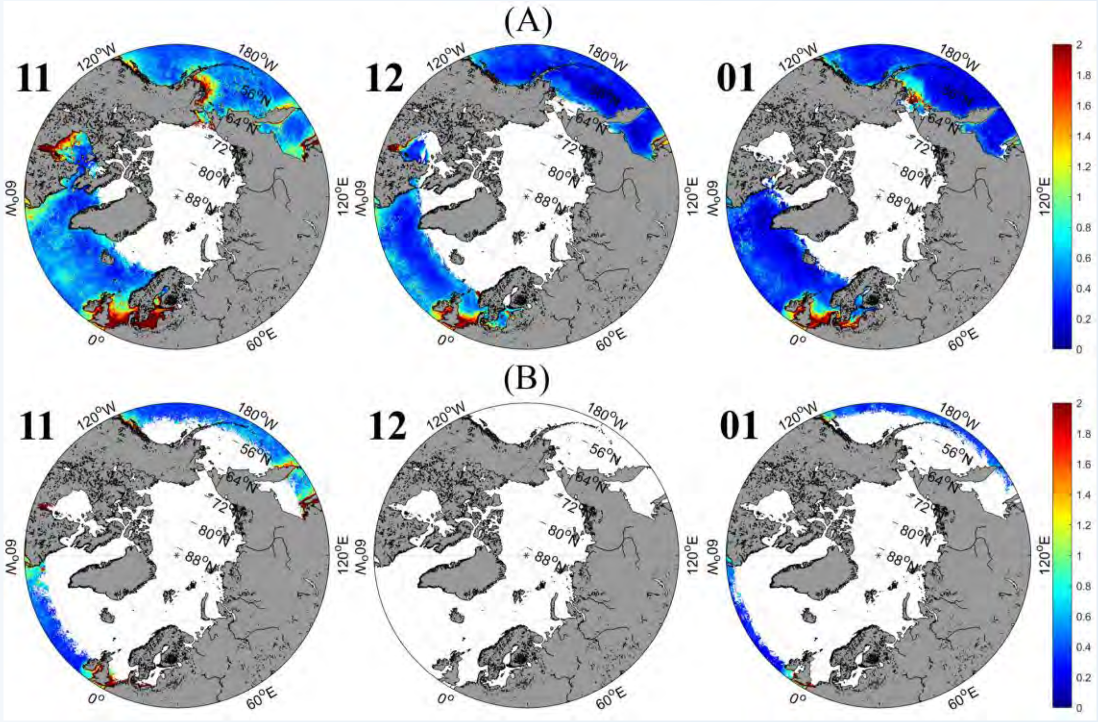
- Current AC algorithms can't process satellite data under high solar zenith angles (>70°), hindering the applications of Geo-OC observation at dawn and dusk, and the polar-orbit OC observation at high latitude oceans during winter
- A RT model for coupled atmosphere-ocean system with considering Earth curvature effect was established (PCOART-SA) (He et al., RSE, 2018)
- Based on PCOART-SA and marine learning method, AC algorithms for high solar zenith angles were developed for Geo-OC observation and polar-orbit OC observation



Li, He* et al., RSE, 2020

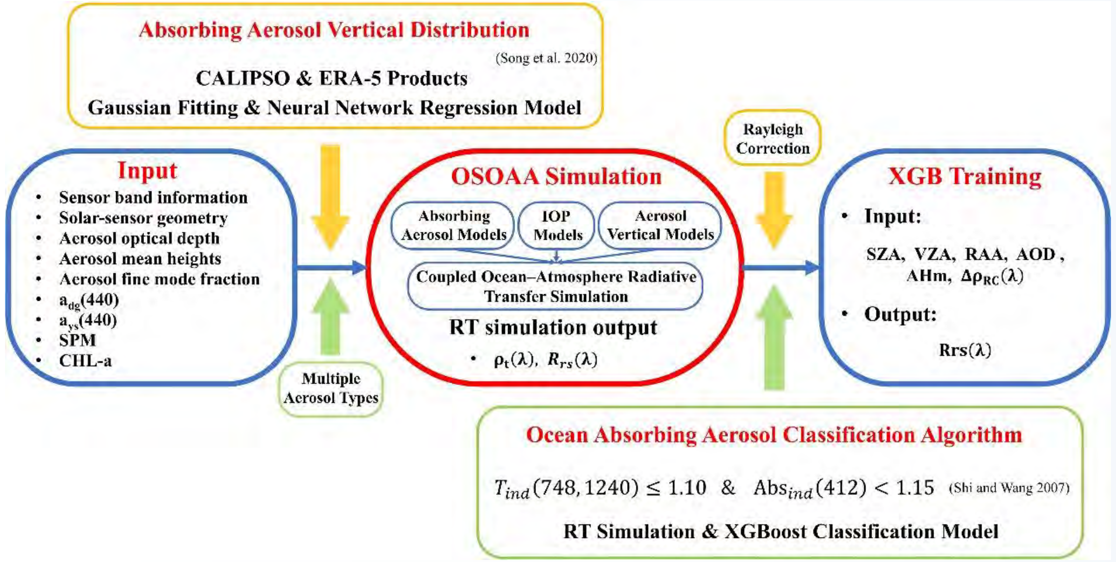
Chla (New AC)

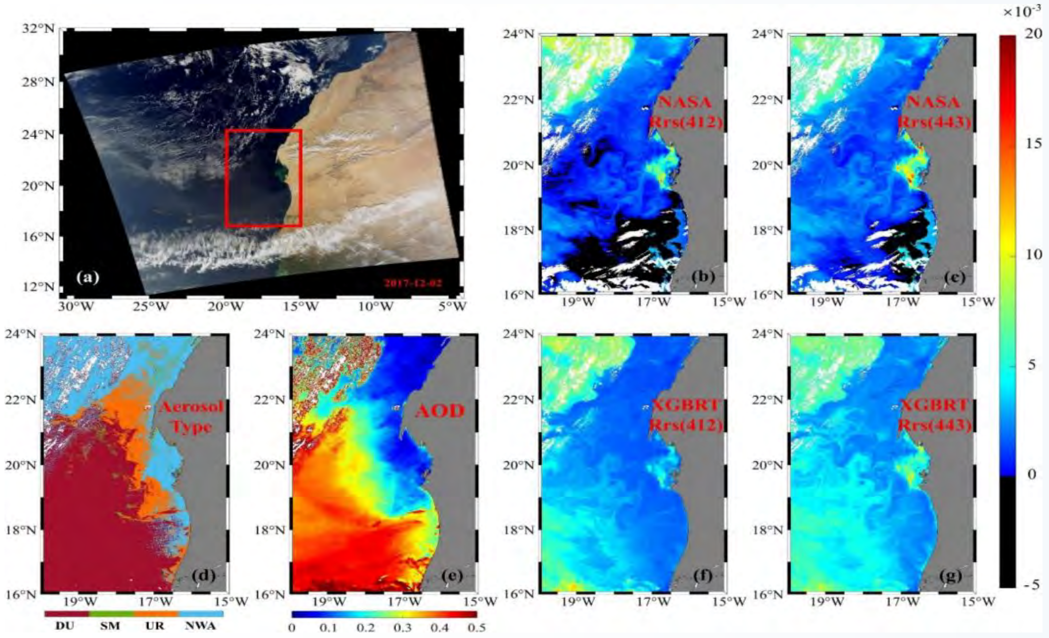
Cha (NASA)

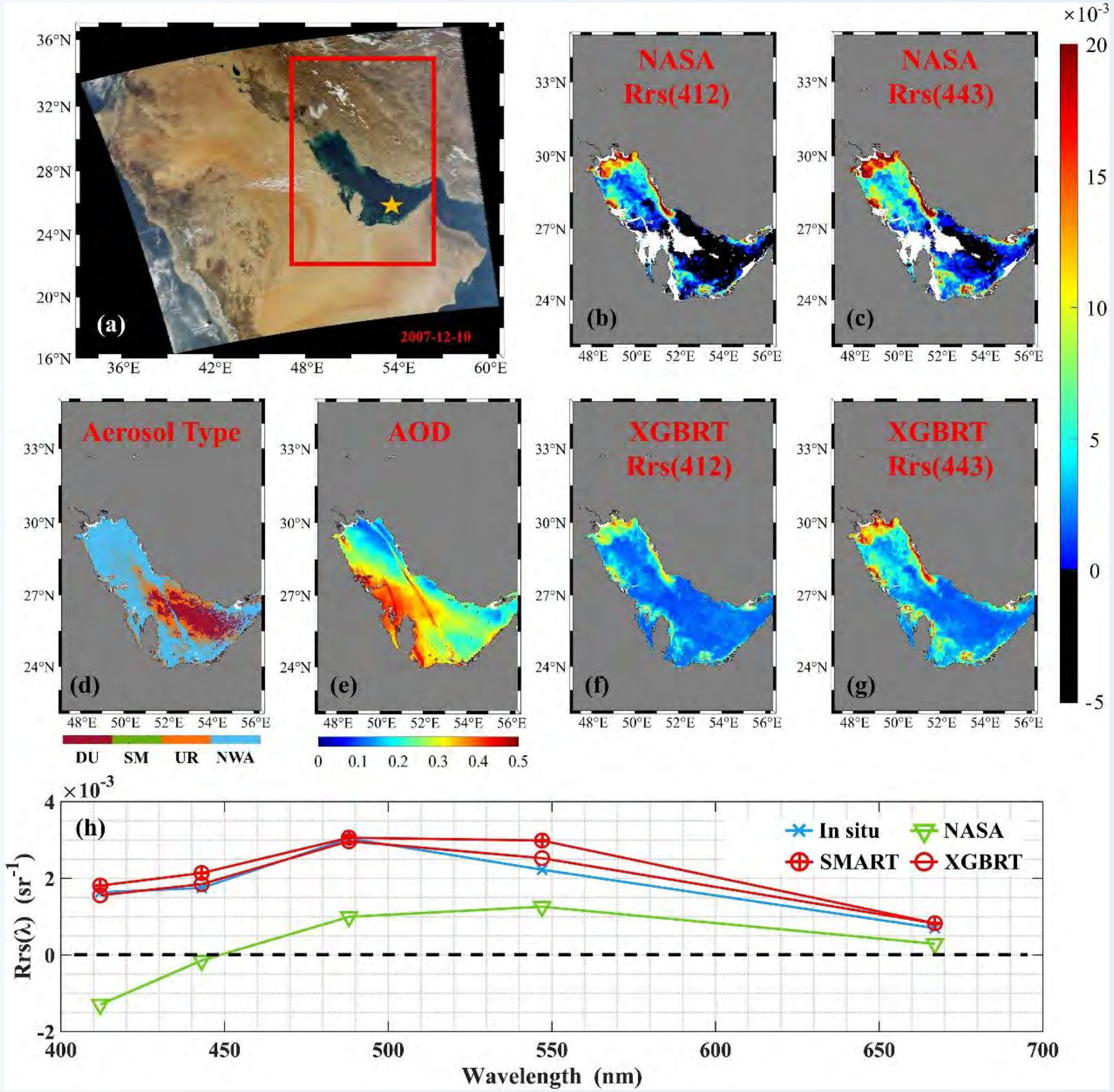


Li, He* et al., IEEE-TGRS, 2023

■ AC technique for absorbing aerosol



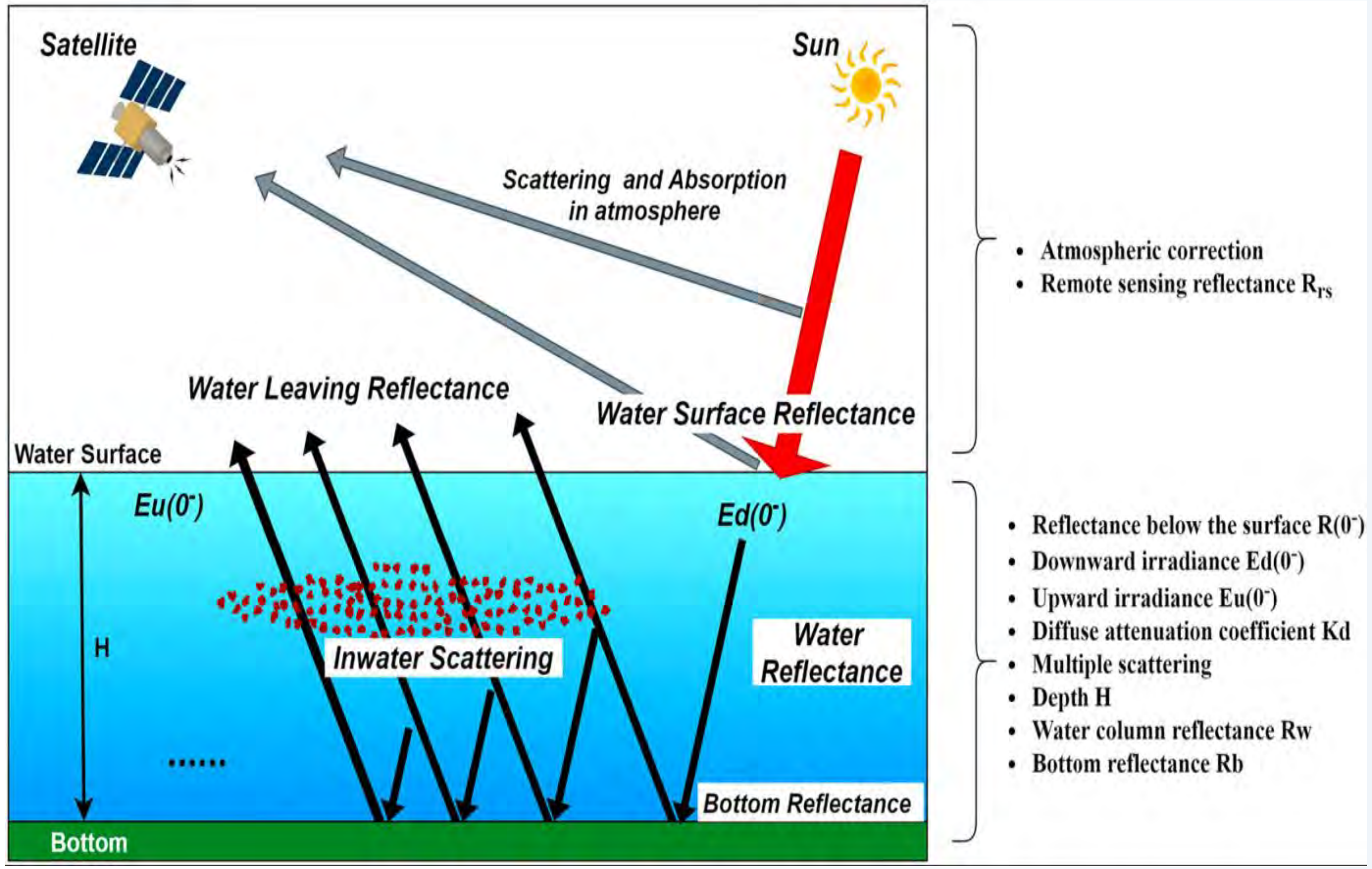


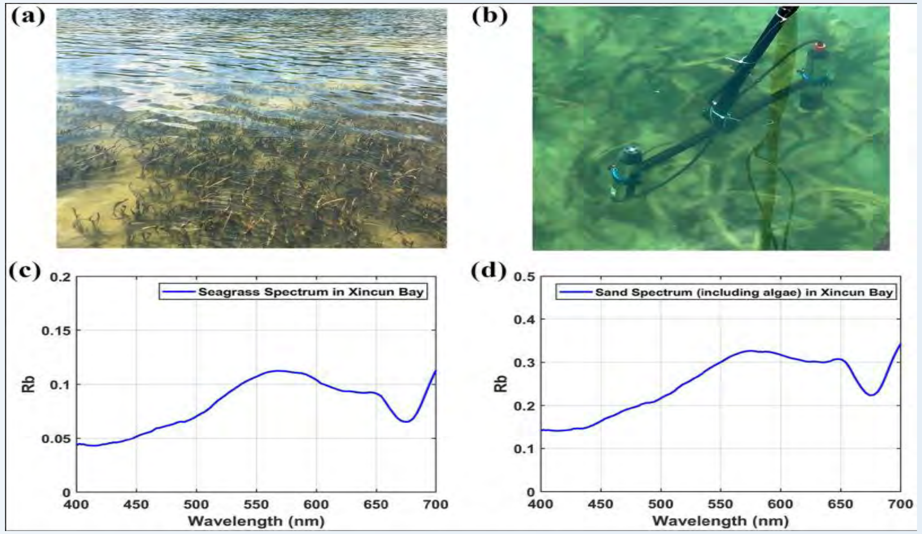


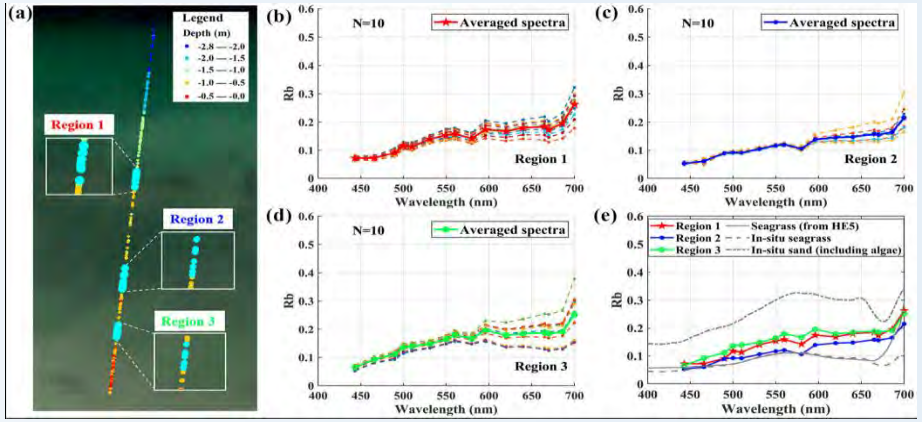
Song, He*, et al., RSE, 2023

■ Satellite retrieval of benthic reflectance

□ A novel semi-analytical algorithm was proposed for retrieval of benthic reflectance by combining lidar and passive high-resolution imagery (Wang, He* et al., RSE, 2022)







Chronic oiling in global oceans

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REPORT | OIL POLLUTION

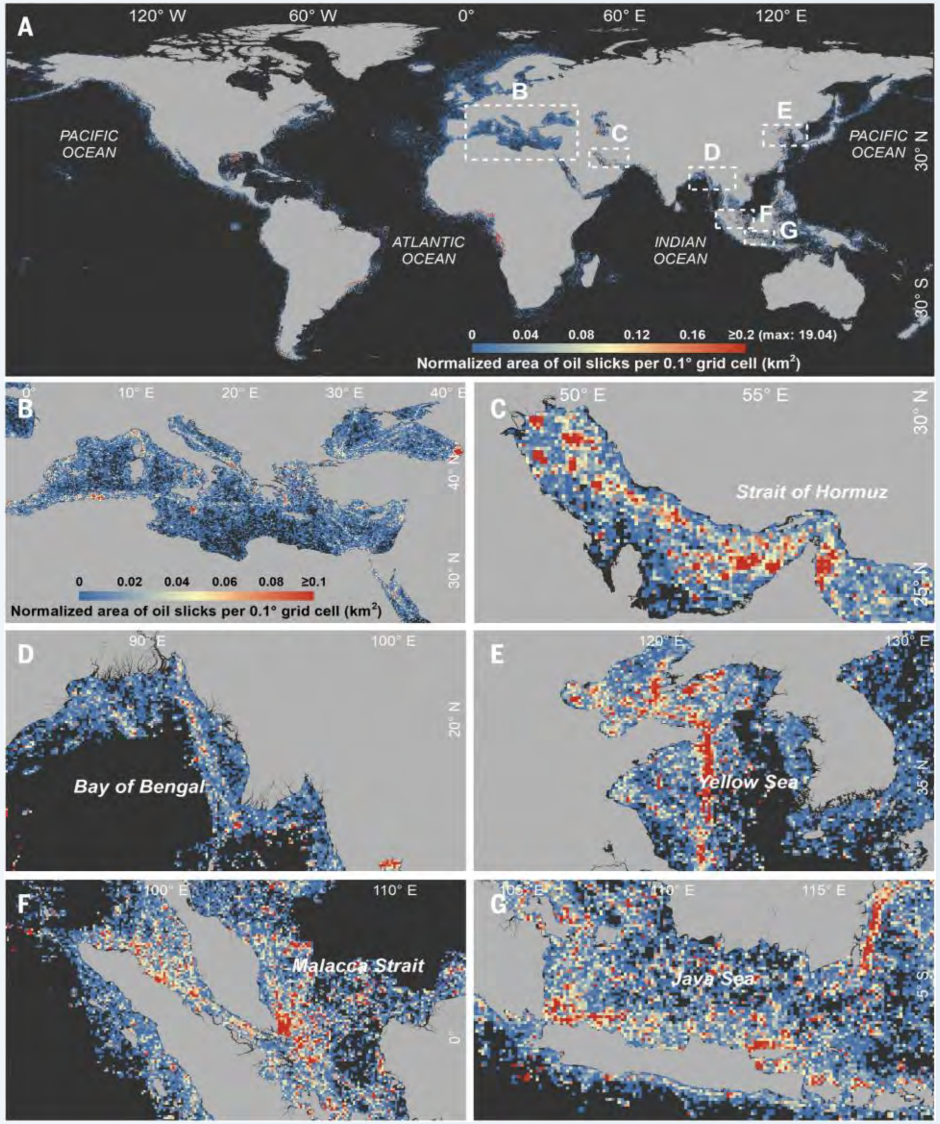
Chronic oiling in global oceans

YANZHU DONG, YONGXUE LIU, CHUANMIN HU, IAN R. MACDONALD, AND YINGCHENG LU Authors Info & Affiliations

SCIENCE • 16 Jun 2022 • Vol 376, Issue 6599 • pp. 1300-1304 • DOI: 10.1126/science.abm5940

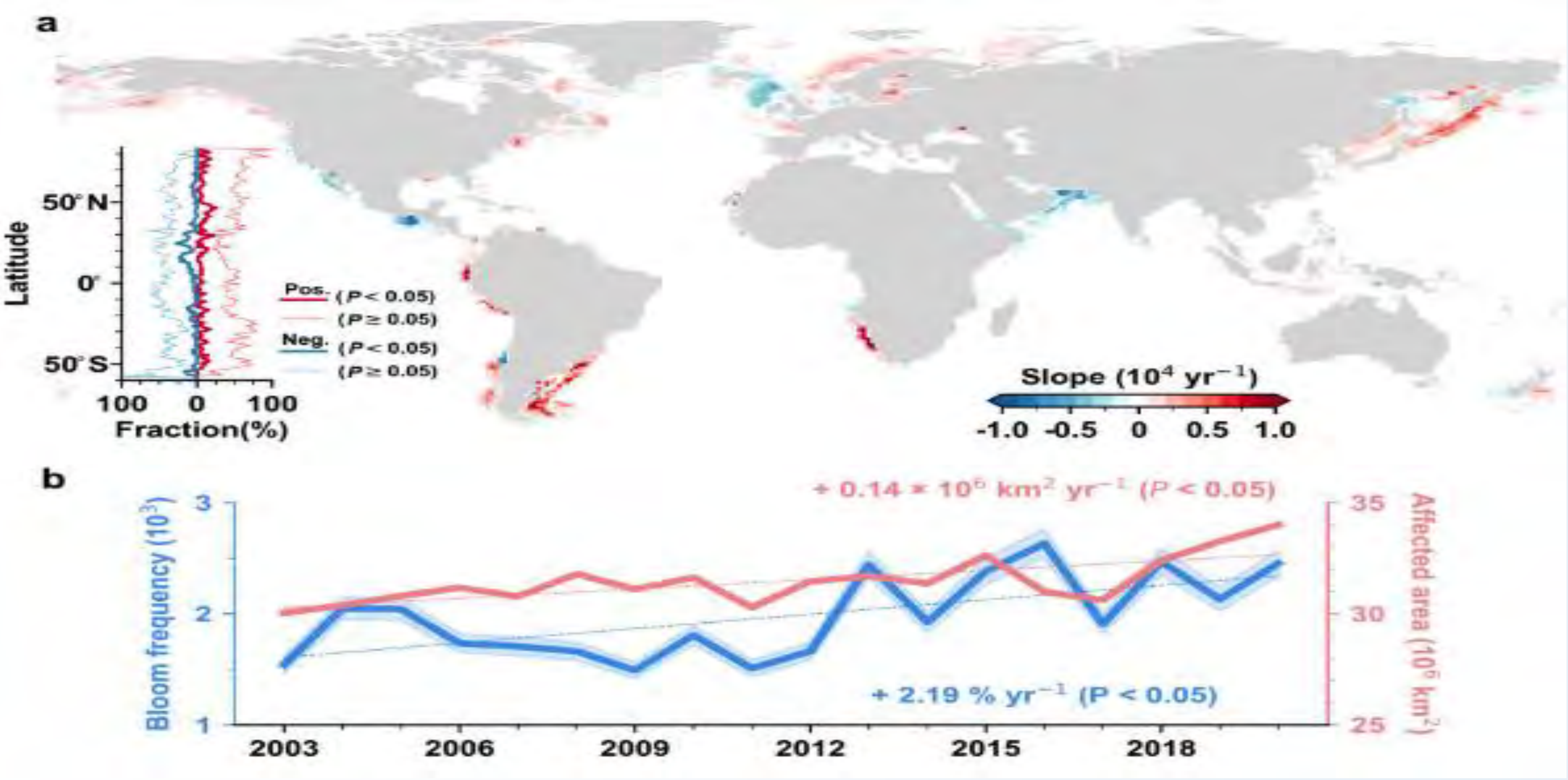
Slick findings

Ocean oil slicks may have natural or anthropogenic sources, but how many occur, how extensive they are, and in what proportions they happen are unclear. Dong *et al*. present a global oil slick map and a detailed inventory of static-and-persistent sources for the period between 2014 and 2019 (see the Perspective by Leifer). They observed a highly uneven distribution of slicks, with most of them located within 160 kilometers of coastlines and along shipping routes. Anthropogenic sources constitute the overwhelming majority of cases, and their numbers show that their contribution may have been significantly underestimated in the past. —HJS



Dong, Liu,…,Lu et al., Science, 2022

■ Coastal phytoplankton blooms



Dai,…,Feng* et al., Nature, 2023

■ SatCO2-V international training workshop

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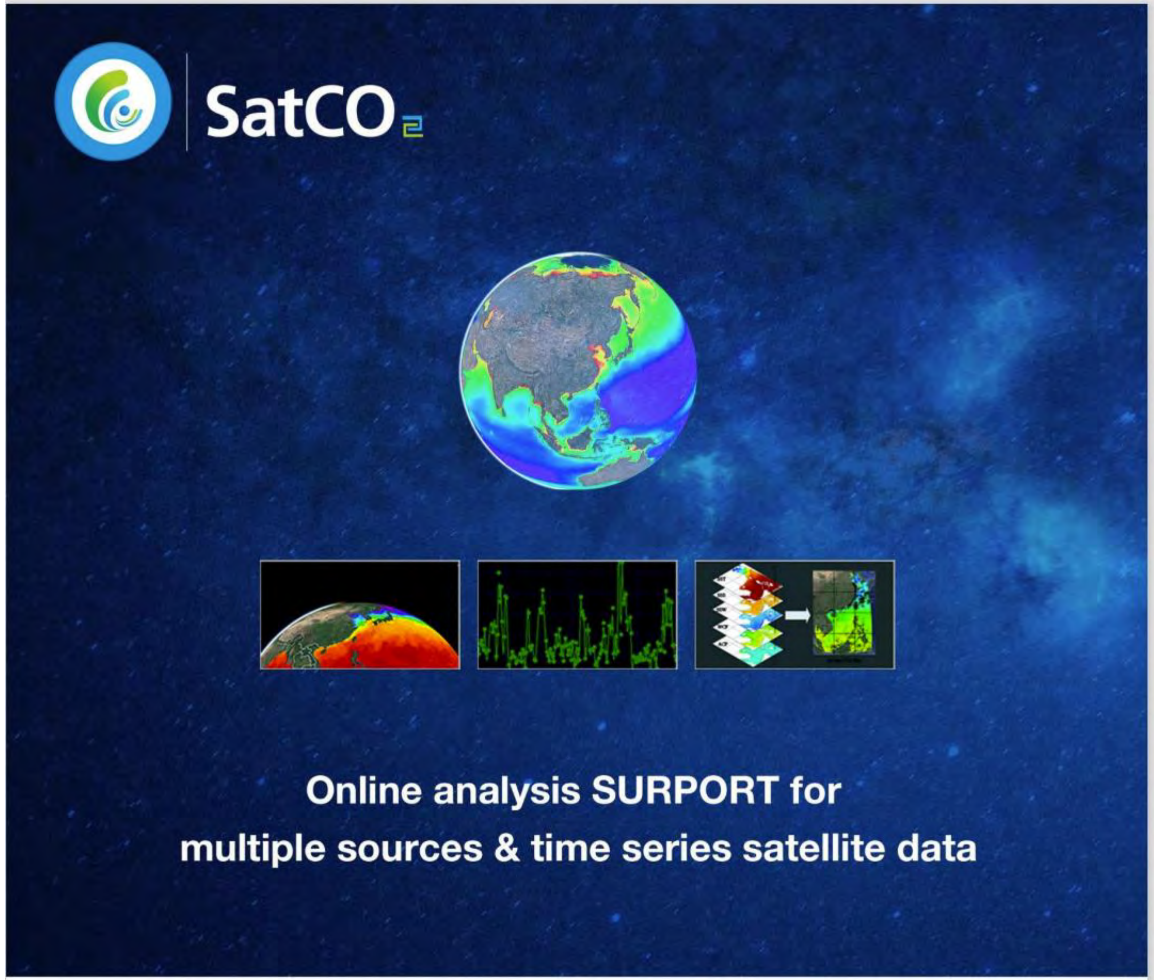

Marine Satellite Data Online Analysis Platform

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