Development and Implementation of Atmospheric Correction Algorithm for SGLI/GCOM-C Ocean Color Products

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SGLI/GCOM-C Data for Research, Applications, and NOAA Operational Users

- NOAA is very interested in **ALL** SGLI/GCOM-C data, including Level-1A (or Level-0), Level-1B, Level-2, and Level-3 data, as well as on-orbit calibration data.
- In particular, we would like to have near-real-time (quick turn-around) high-spatial resolution (250 m) data for NOAA operational users in all US coastal regions (and other coastal and inland waters).
- We will work with the SGLI/GCOM-C team to get high-quality ocean color products.

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SGLI Spectral Bands for Ocean Color

SGLI on GCOM-C

has ocean spectral bands similar to **VIIRS** and **MODIS**

VIIRS		MODIS		SGLI/GCOM-C	
Ocean Bands (nm)	Other Bands (nm)	Ocean Bands (nm)	Other Bands (nm)	Ocean Band (nm)	Ocean Band (nm)
410 (M1)	635 (I1)	412	645	412	380
443 (M2)	865 (I2)	443	859	443	
486 (M3)	1610 (I3)	488	469	490	
—		531	555	530	
551 (M4)	*SWIR Bands*	551	*SWIR Bands*	565	*SWIR Bands*
671 (M5)	1238 (M8)	667, 678	1240	673.5	1050
745 (M6)	1610 (M9)	748	1640	763	1630
862 (M7)	2250 (M11)	869	2130	868.5	2210

Spatial resolution for **VIIRS** M-band: 750 m, I-band: 375 m

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Proposed Works for SGLI/GCOM-C

(*Leverage JPSS-Supported VIIRS Ocean Color EDR Works*)

- Participating in Various SGLI/GCOM-C Related Activities
  - ✓ SGLI sensor performance (pre- and post-launch), sensor spectral response function, etc.
  - ✓ Related SGLI Ocean color data processing
  - ✓ SGLI/GCOM-C data format (Level-0, Level-1, Level-2, etc.)
- Implementation of Atmospheric Correction Algorithm for SGLI
  - ✓ Implementation of SGLI ocean color data processing in NOAA-MSL12
  - ✓ All LUTs will be generated specific for the SGLI
  - ✓ The same data processing can be used for SGLI, MODIS, VIIRS, GOCI, etc.
- Refinement of the Atmospheric Correction Algorithm
  - ✓ Coastal and inland ocean color data processing, e.g., using the shortwave (SWIR) approach
  - ✓ Improving other components: sun glint, large solar/sensor zenith angles, Earth curvature, polarization effects, etc.
- SGLI Ocean Color Data Analysis and Evaluation
  - ✓ Comparisons with in situ data from global ocean
  - ✓ Comparisons with satellite data, e.g., MODIS-Aqua, VIIRS
- Generation of $K_d(490)$ Data
  - ✓ Open ocean $K_d(490)$ data from heritage SeaWiFS/MODIS model
  - ✓ Coastal turbid waters from other approaches, e.g., *Wang et al.* (2009)

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Multi-Sensor Level-1 to Level-2 (MSL12) Ocean Color Data Processing

- Multi-Sensor Level-1 to Level-2 (MSL12)
  - ✓ MSL12 was developed during NASA SMIBIOS project (1997-2003) for a consistent multi-sensor ocean color data processing (*Wang and Franz*, 2000).
  - ✓ It has been used for producing ocean color products from various satellite ocean color sensors, e.g., SeaWiFS, MOS, OCTS, POLDER, MODIS, etc.
- NOAA-MSL12 Ocean Color Data Processing
  - ✓ NOAA-MSL12 is based on SeaDAS version 4.6.
  - ✓ Some significant improvements: (1) the SWIR-based data processing, (2) Rayleigh and aerosol LUTs, (3) algorithms for detecting absorbing aerosols and turbid waters, (4) ice detection algorithm, (5) improved straylight and cloud shadow algorithm, and others.
- NOAA-MSL12 for SGLI Ocean Color Data Processing
  - ✓ Open ocean $K_d(490)$ data from heritage SeaWiFS/MODIS model
  - ✓ Coastal turbid and inland waters from other approaches, e.g., **SWIR approach**, results in the US east coastal, China's east coastal, Lake Taihu, Lake Okeechobee, Aral Sea, etc.
  - ✓ Capability for multi-sensor ocean color data processing, e.g., MODIS-Aqua, VIIRS, GOCI, and will also add **SGLI/GCOM-C** and OLCI/Stentinel-3 data processing capability.

Some Examples of Analysis Results from VIIRS Ocean Color Products

(Leverage support from JPSS Ocean Color EDR & Cal/Val activities)

Similar approach can be used for GCOM-C/SGLI ocean color products

NOAA operational VIIRS ocean color data can be obtained from CLASS (www.class.ngdc.noaa.gov)

Wang, M., X. Liu, L. Tan, L. Jiang, S. Son, W. Shi, K. Rausch, and K. Voss, "Impacts of VIIRS SDR performance on ocean color products," *J. Geophys. Res. Atmos.*, **118**, 10,347–10,360, 2013. http://dx.doi.org/10.1002/jgrd.50793

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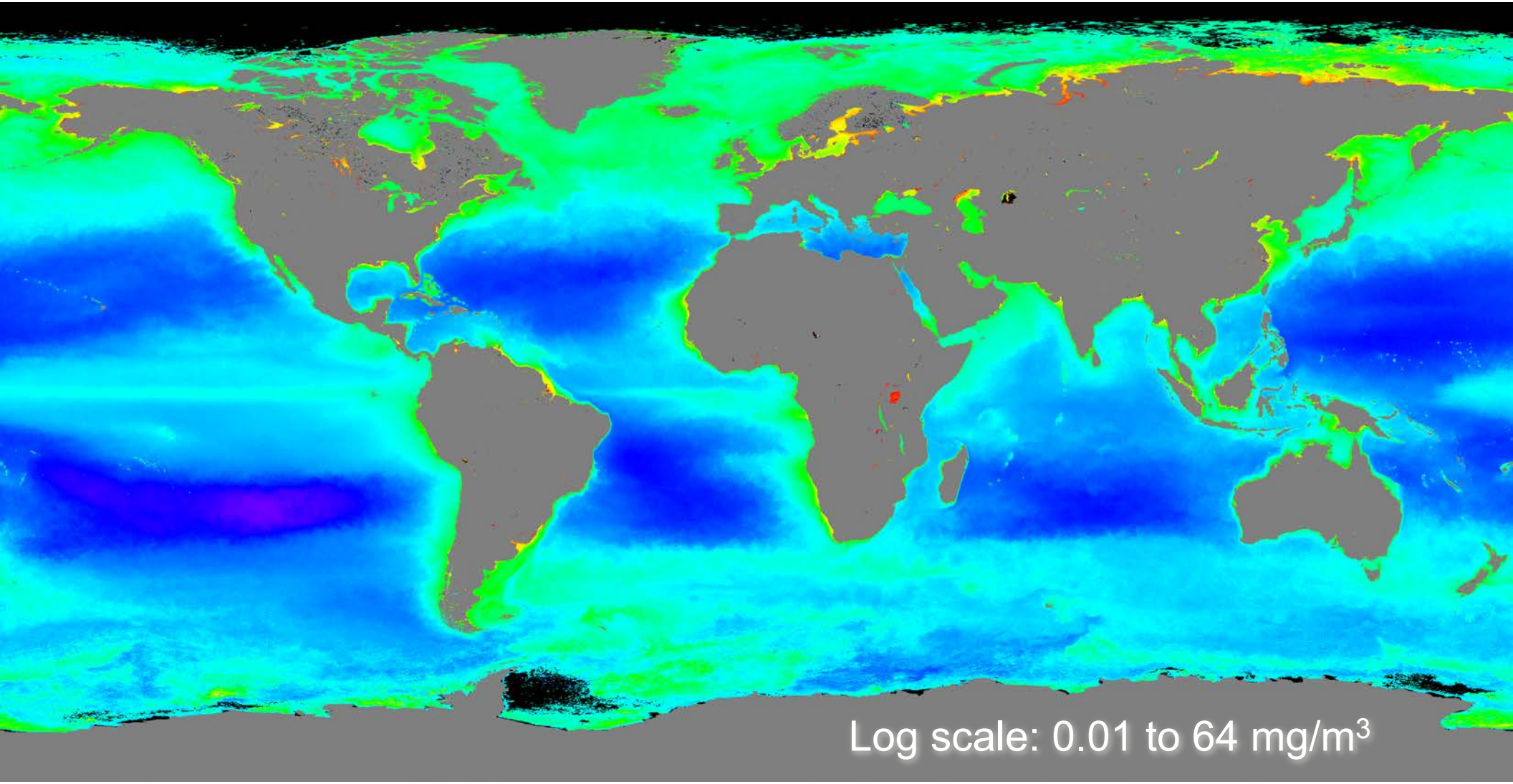
Team Members' Roles & Responsibilities

EDR	Name	Organization	Funding Agency	Task
Lead	**Menghua Wang (EDR Lead), , L. Jiang, X. Liu, W. Shi, S. Son, L. Tan, X. Wang, P. Naik, J. Sun, M. Ondrusek, E. Stengel**	NOAA/NESDIS/ STAR	JPSS/NJO	Leads – Ocean Color EDR Team OC products, algorithms, SDR, EDR, Cal/Val, vicarious cal., refinements, data processing DR- Software updates
Ocean Color	**Robert Arnone Sherwin Ladner, Ryan Vandermeulen Adam Lawson, Paul Martinolich, Jen Bowers, Giulietta Fargion**	U. Southern MS NRL QinetiQ Corp. SDSU	JPSS/NJO	Coordination Look Up Tables – SDR-EDR impacts, vicarious calibration Satellite matchup tool (SAVANT) – Golden Regions cruise participation . WAVE_CIS (AERONET site)
	Carol Johnson	NIST	JPSS/NJO	Traceability, AERONET Uncertainty
	Curt Davis, Nicholas Tufillaro	OSU	JPSS/NJO	Ocean color validation, Cruise data matchup West Coast
	Burt Jones	OSC	JPSS/NJO	Eureka (AERONET Site)
	Sam Ahmed, Alex Gilerson, Soe Hlaing	CUNY	JPSS/NJO	LISCO (AERONET site) Cruise data and matchup
	Chuanmin Hu	USF	JPSS/NJO	NOAA data continuity
	Ken Voss & MOBY team	RSMAS –Miami	JPSS/NJO	Marine Optical Buoy (MOBY)
	ZhongPing Lee, Jianwei Wei, Nima Pahlevan	UMB	JPSS/NJO	Ocean color IOP data validation and evaluation Ocean color optics matchup
	Patty Pratt, J. Ip	NGAS	JPSS/NJO	Detector tool Matchup and DR and IDPS updates

Working with: VIIRS **SDR team**, DPA/DPE (e.g., R. Williamson, Neal Baker), Raytheon (e.g., Marine Hollingshead), NOAA OC Working Group, NOAA various line-office reps, NASA OC Working Group (K. Turpie, B. Franz , et al.), NOAA OCPOP, etc.

Collaborators: D. Antoine (BOUSSOLE), B. Holben (NASA-GSFC), G. Zibordi (JRC-Italy), and others

VIIRS Climatology Chlorophyll-a Image
(April 2012 to December 2013)



Generated using NOAA-MSL12 for VIIRS ocean color data processing

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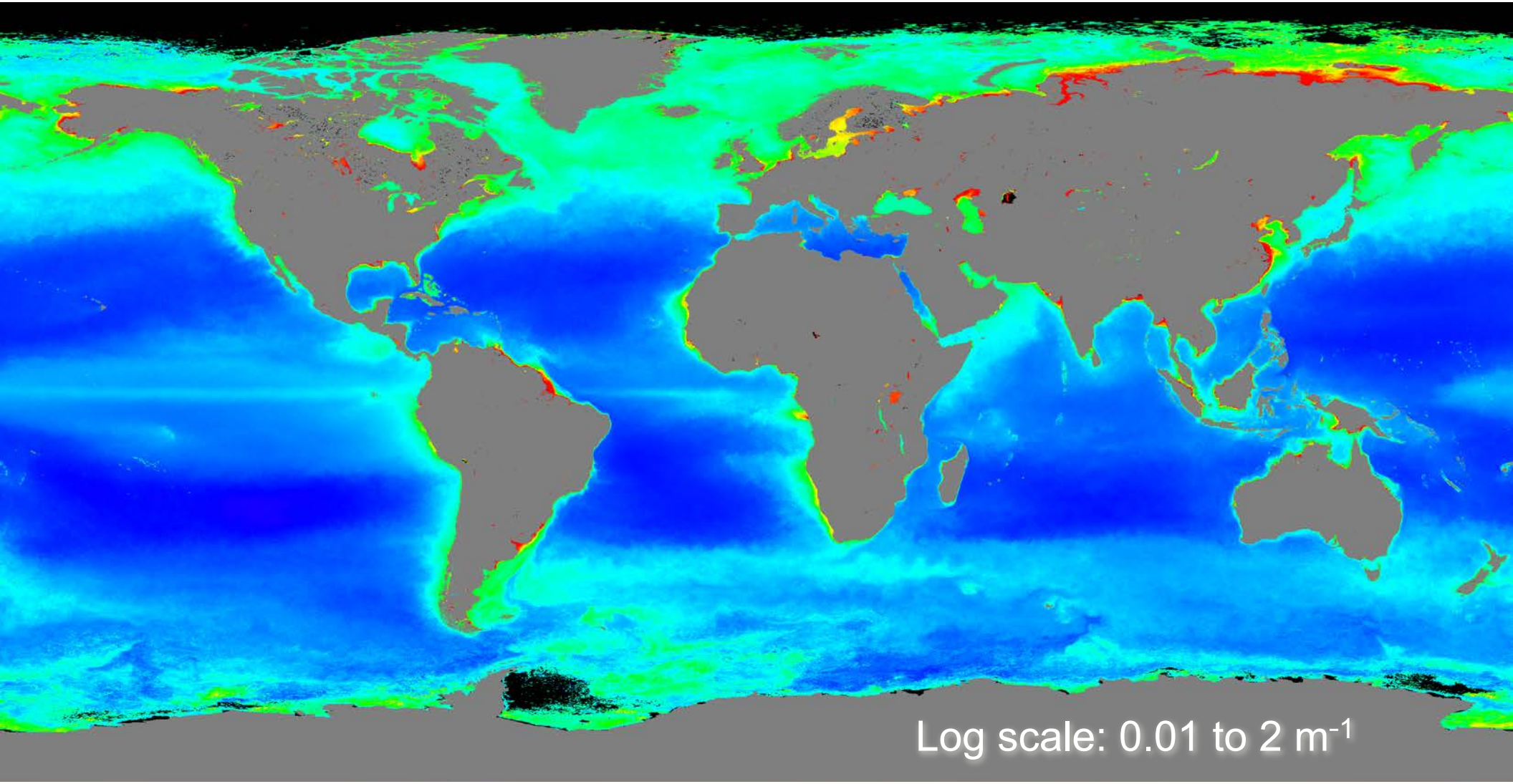
VIIRS Climatology K_d(490) Image
(April 2012 to December 2013)



Generated using NOAA-MSL12 for VIIRS ocean color data processing

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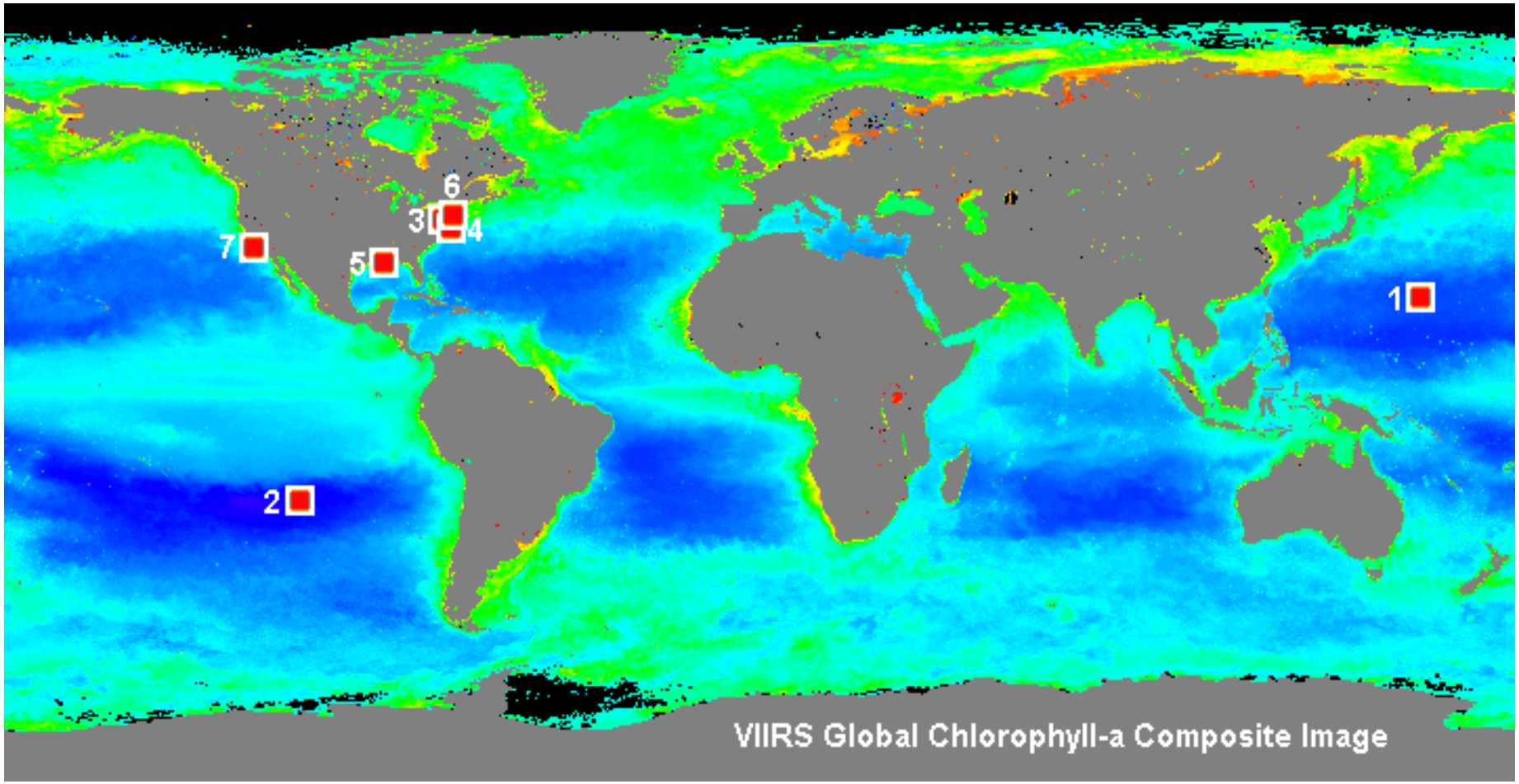
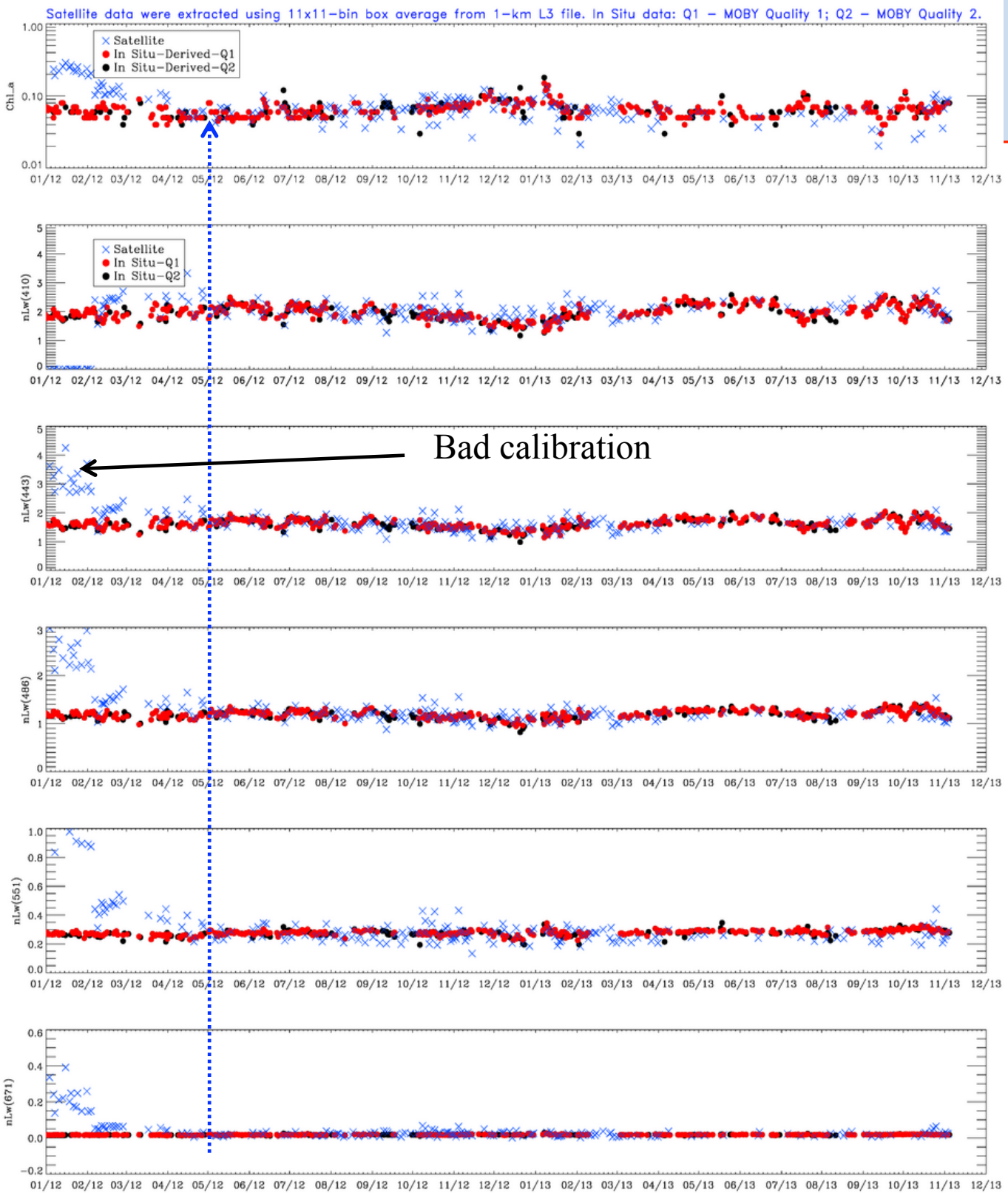
VIIRS Ocean Color EDR Monitoring Sites



1. MOBY Site; 2. South Pacific Gyre; 3. Chesapeake Bay; 4. US East Coast; 5. AERONET-OC CSI Site; 6. AERONET-OC LISCO Site; 7. AERONET-OC USC Site.



Comparison of VIIRS **NOAA-MSL12** results with MOBY in situ data.

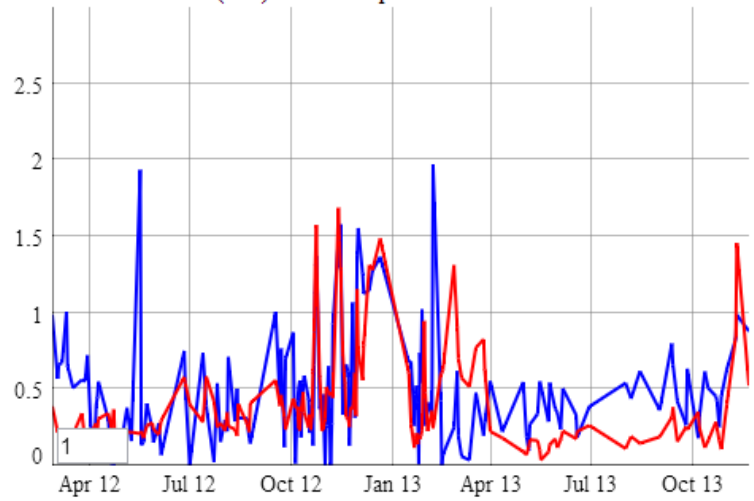
Note:
Vicarious calibration gains applied since **May 2012**.

Gains derived using MOBY data.

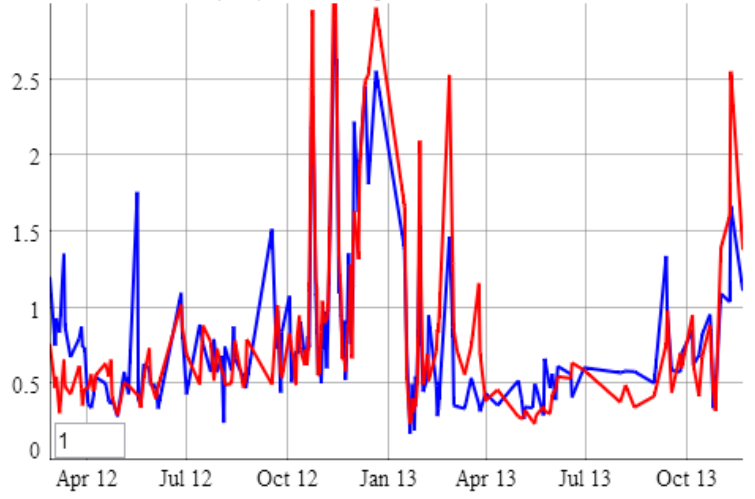
VIIRS ocean color products reached **Beta** status in January 2013, and just reached **Provisional** status in January 2014.

AERONET-CSI nL_w Time Series

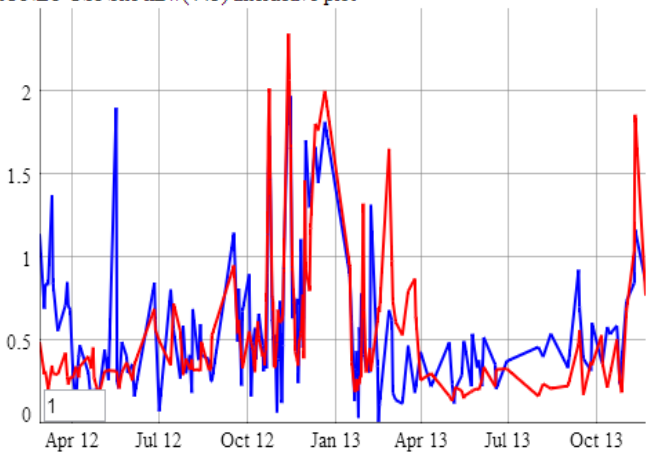
AERONET CSI Site nLw(410) interactive plot



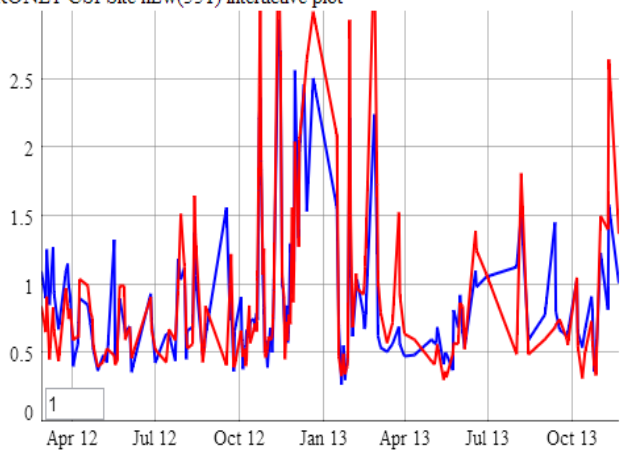
AERONET CSI Site nLw(486) interactive plot



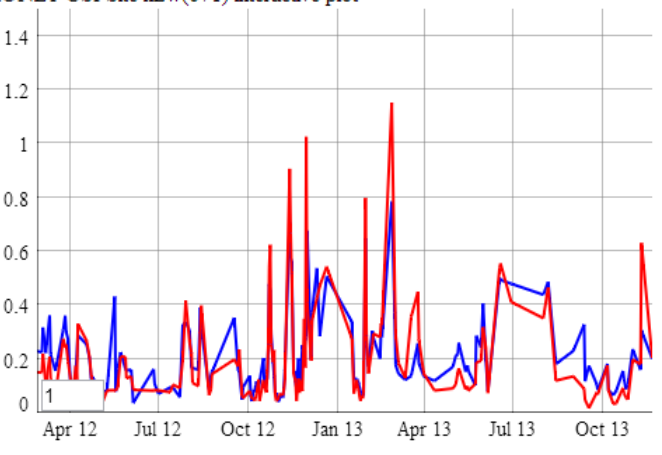
AERONET CSI Site nLw(443) interactive plot



AERONET CSI Site nLw(551) interactive plot

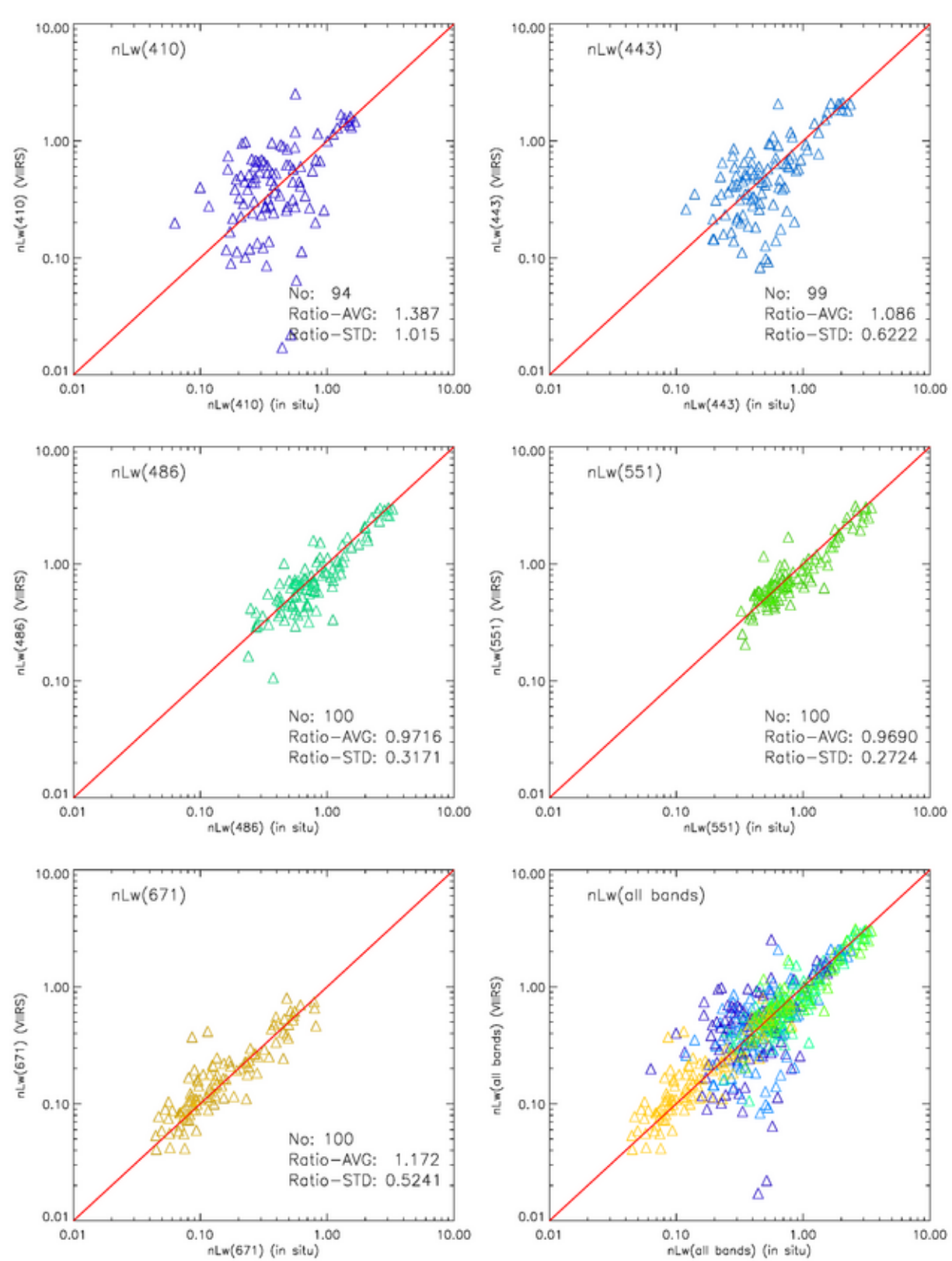


AERONET CSI Site nLw(671) interactive plot



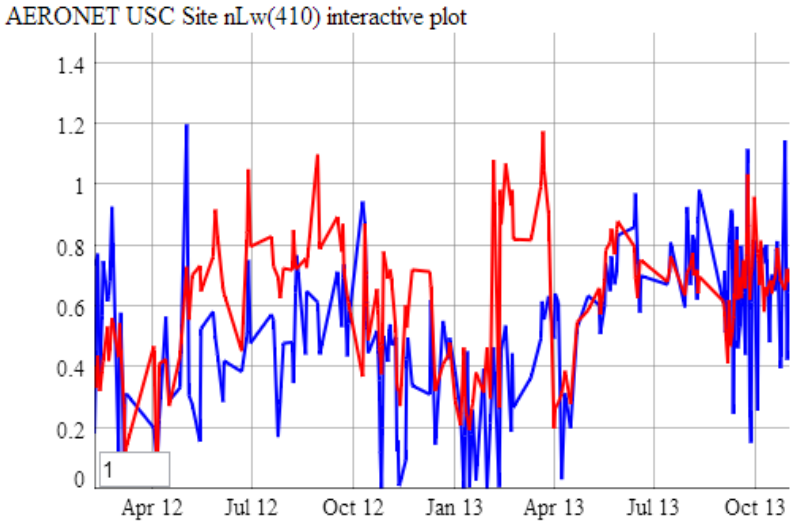
In Situ

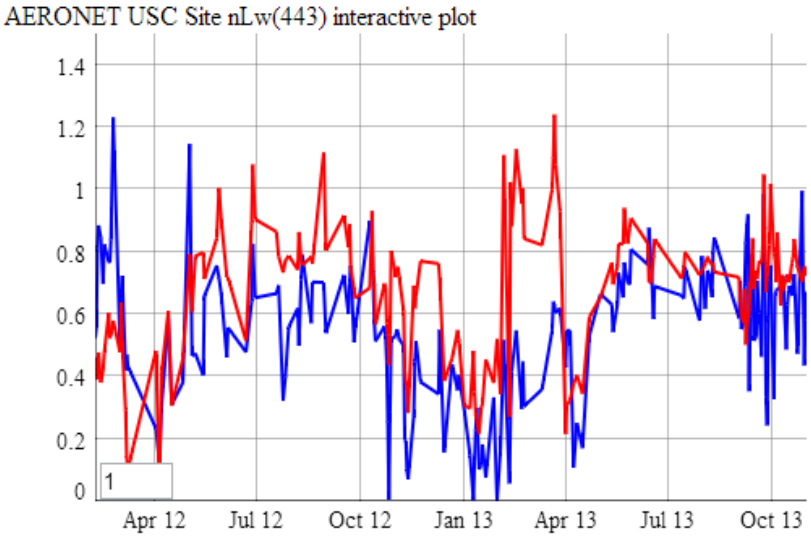
VIIRS (NOAA-MSL12)

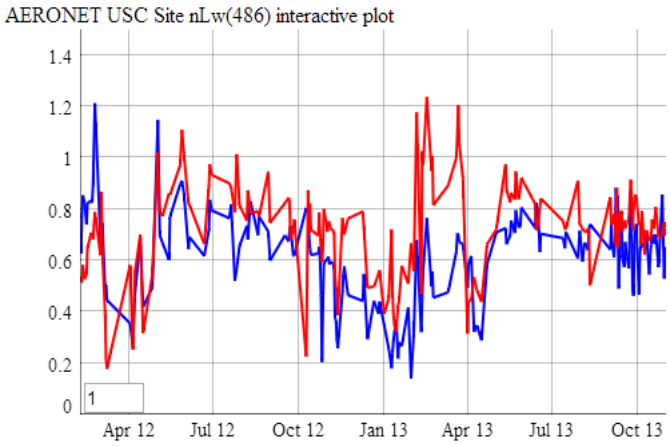


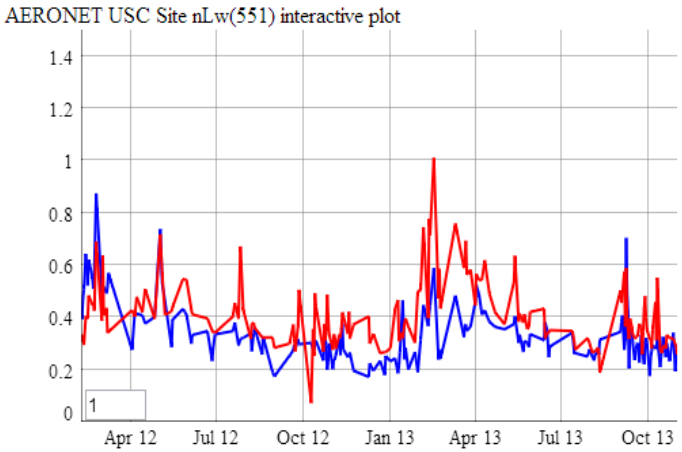
AERONET-CSI nL_w scatter plot

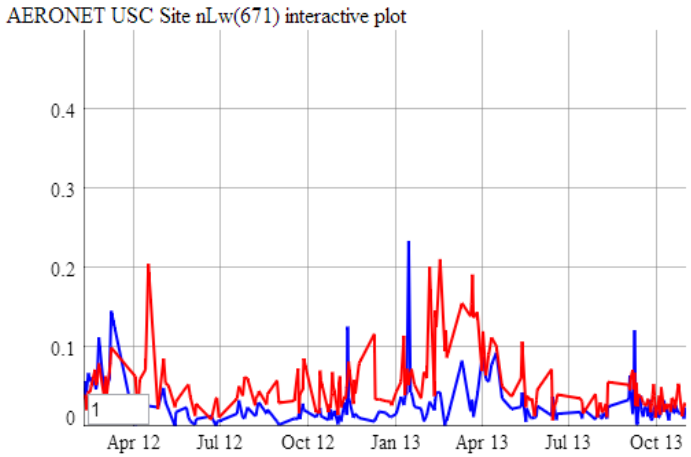
AERONET-USC nL_w Time Series





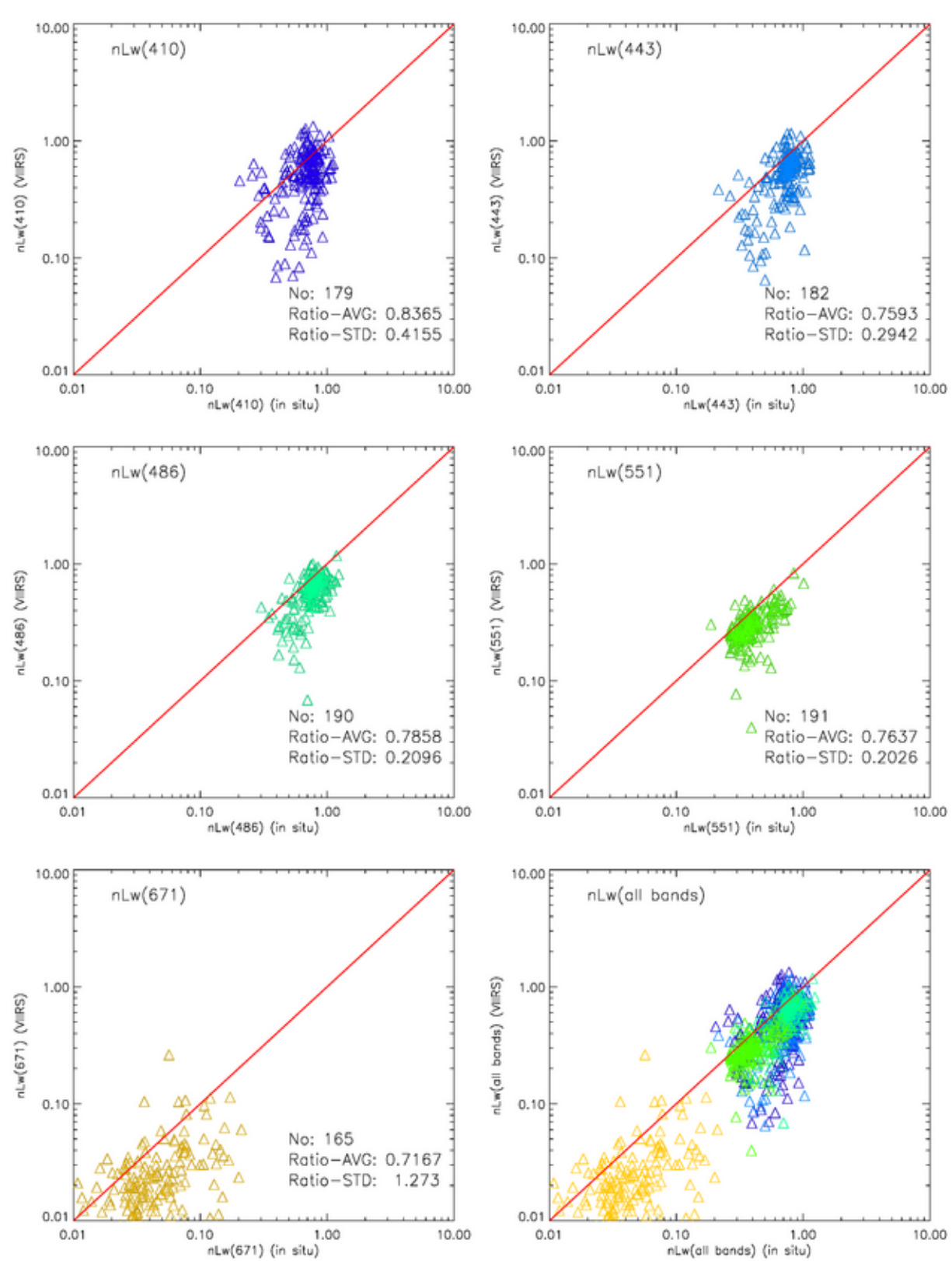






In Situ

VIIRS (NOAA-MSL12)

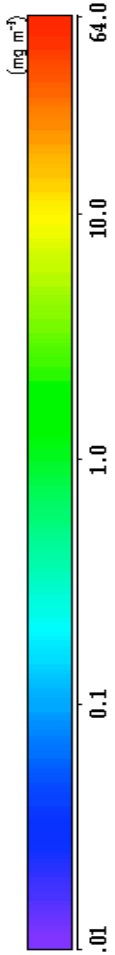


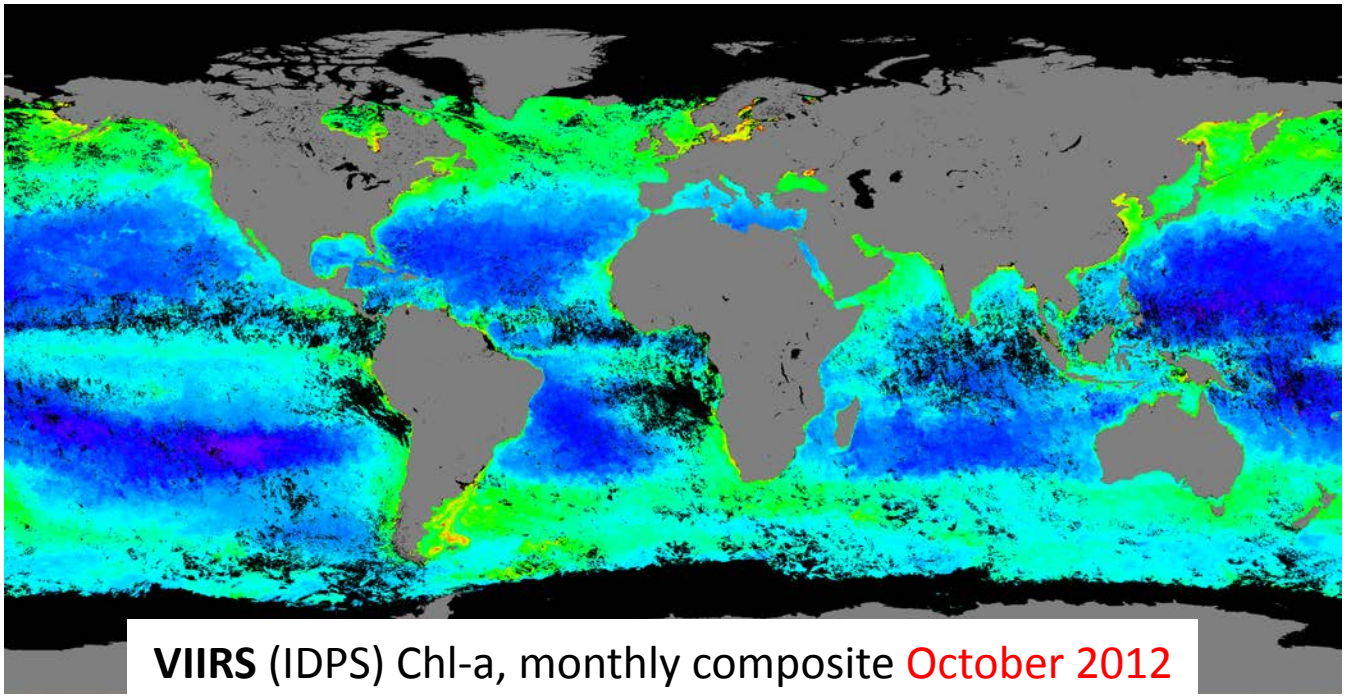
AERONET-USC
nL_w scatter plot

VIIRS (IDPS) vs. MODIS-Aqua (Monthly)

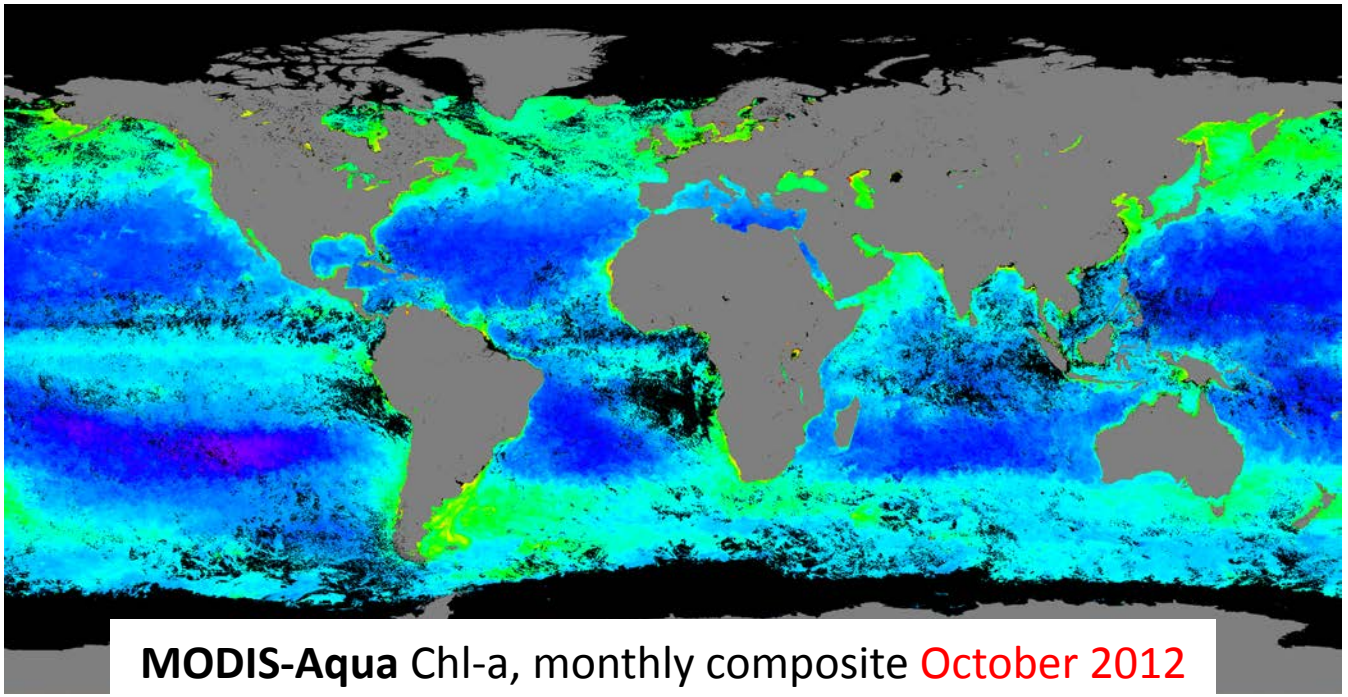
Chlorophyll-a

Log scale:
0.01 to 64 mg/m3





VIIRS (IDPS) Chl-a, monthly composite October 2012

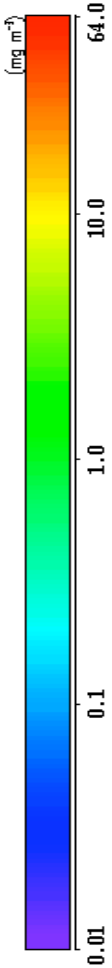


MODIS-Aqua Chl-a, monthly composite October 2012

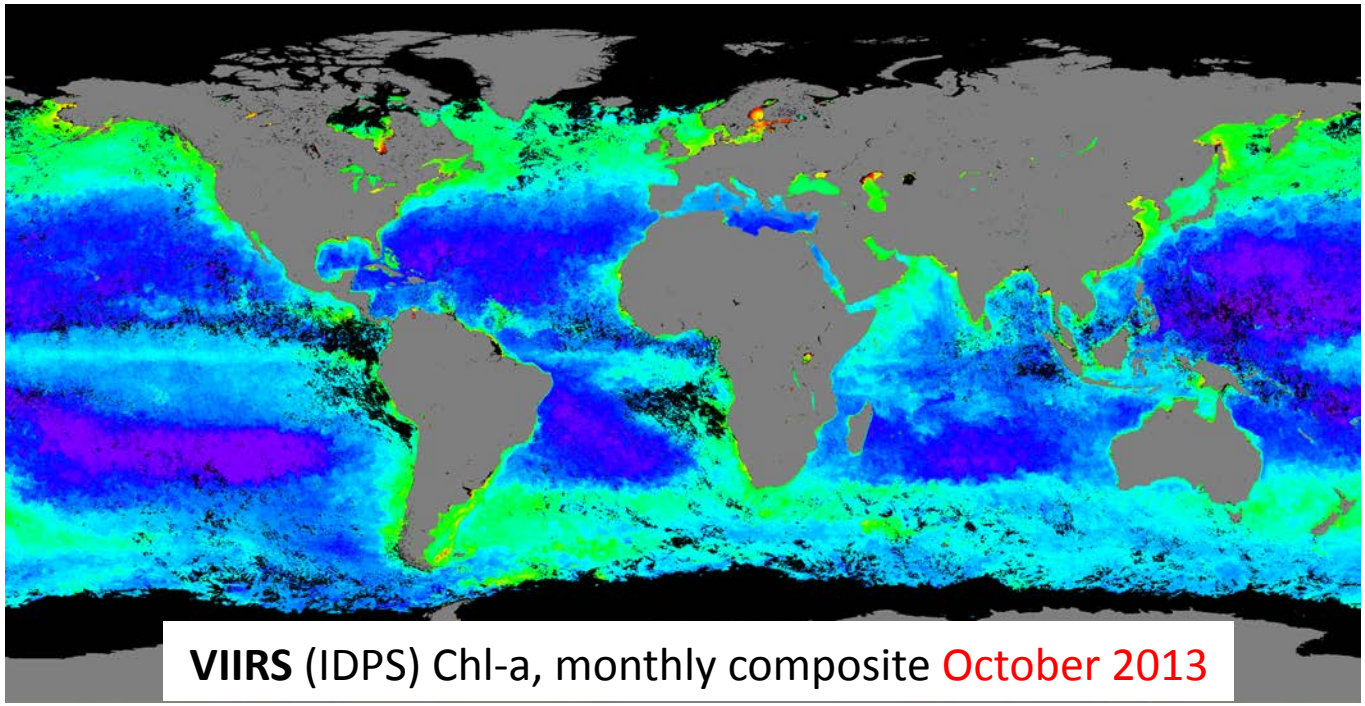
MODIS-Aqua data were obtained from NASA/ OBPG ocean color website.

VIIRS (IDPS) vs. MODIS-Aqua (Monthly)

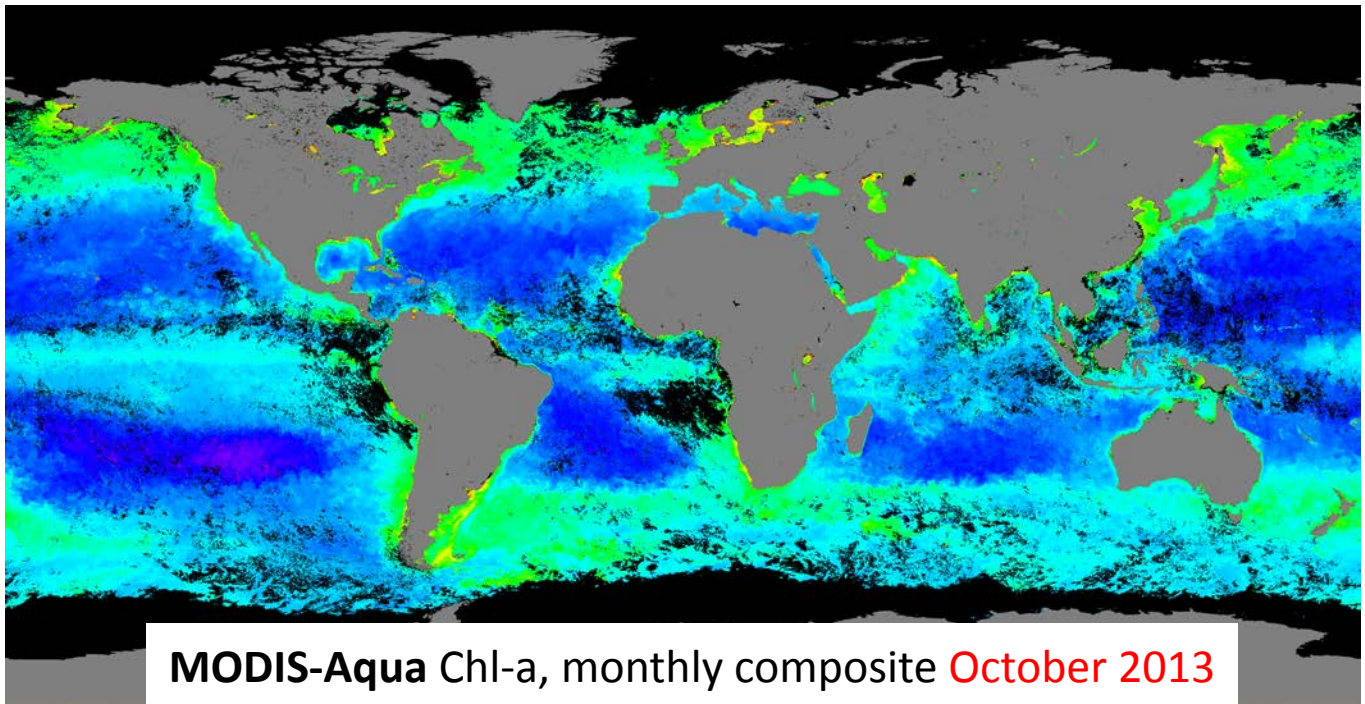
Chlorophyll-a



Log scale:
0.01 to 64 mg/m3



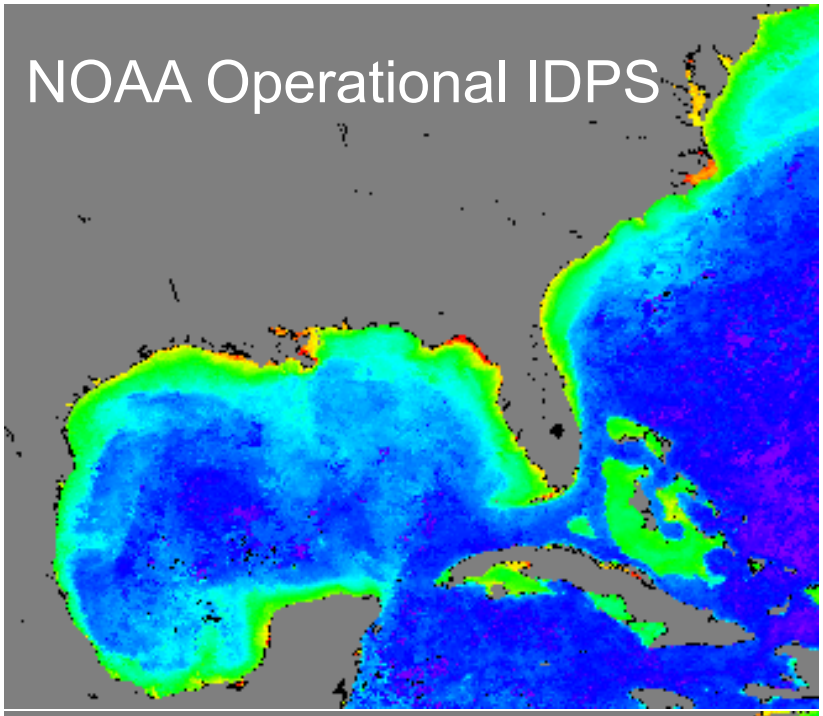
VIIRS (IDPS) Chl-a, monthly composite October 2013

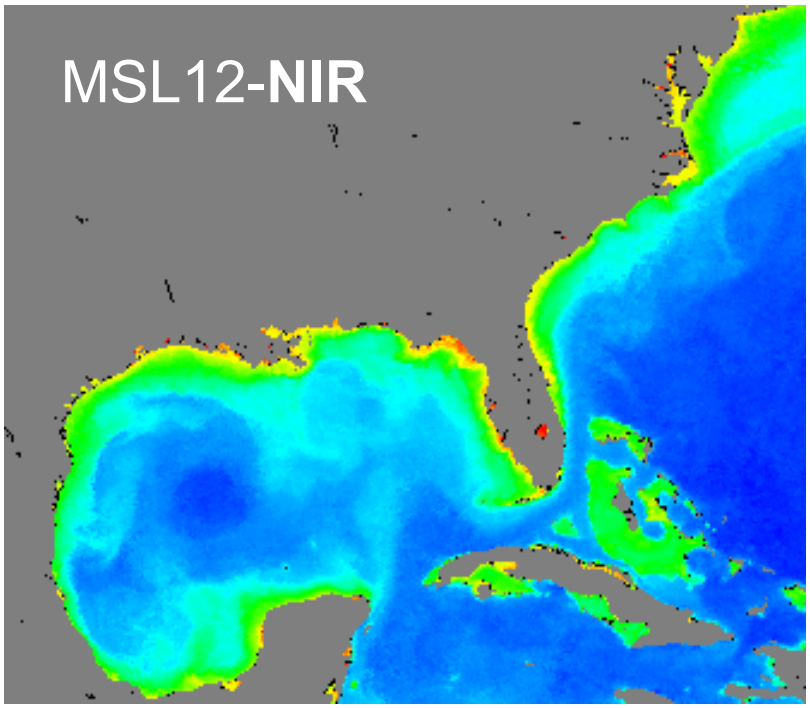


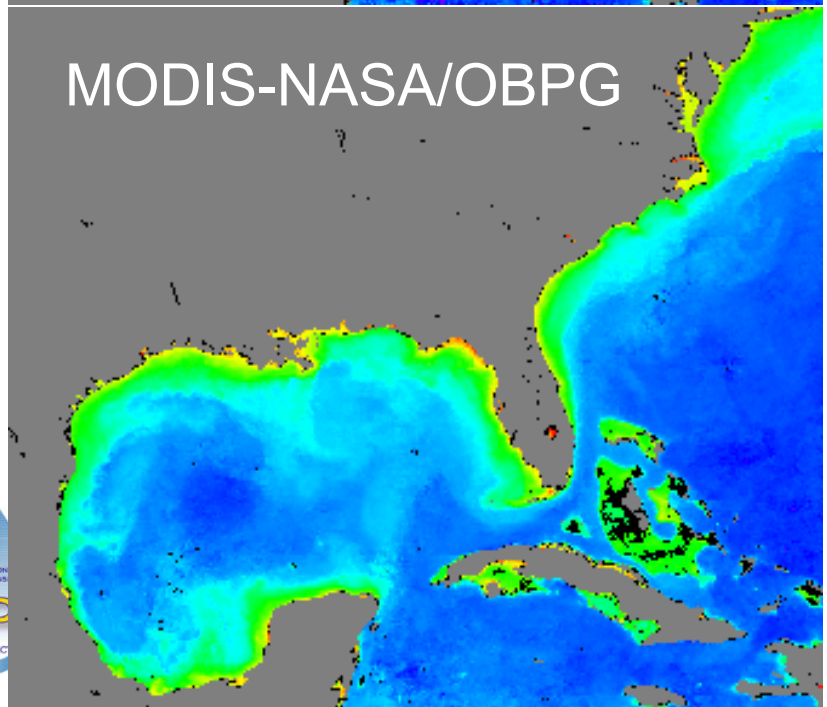
MODIS-Aqua Chl-a, monthly composite October 2013

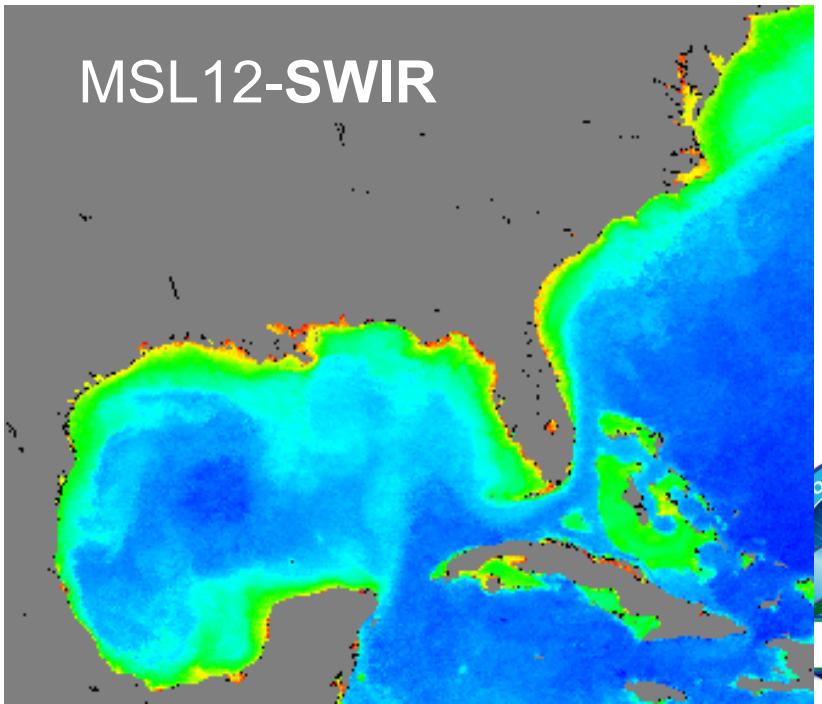
MODIS-Aqua data were obtained from NASA/ OBPG ocean color website.

Performance in Coastal and Inland Waters (1)
(US East Coast—October 2013 Monthly)

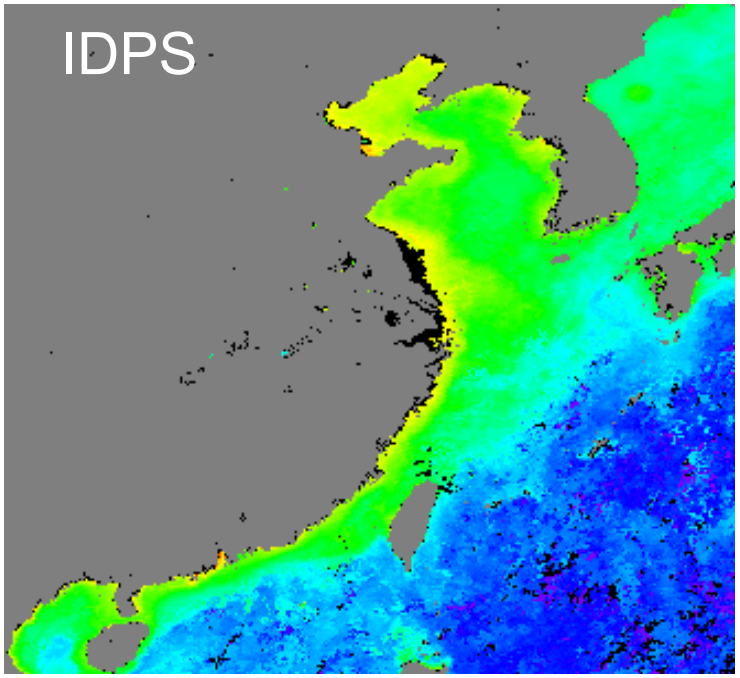


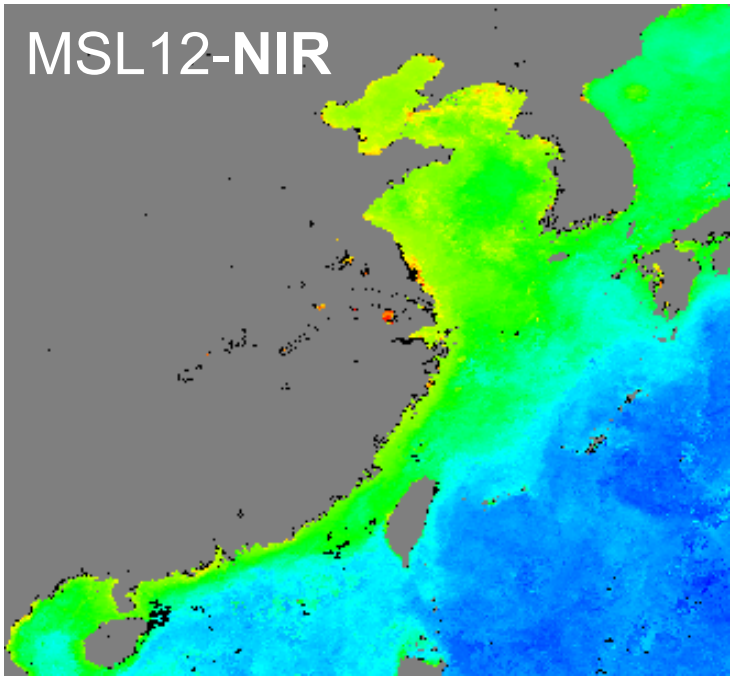


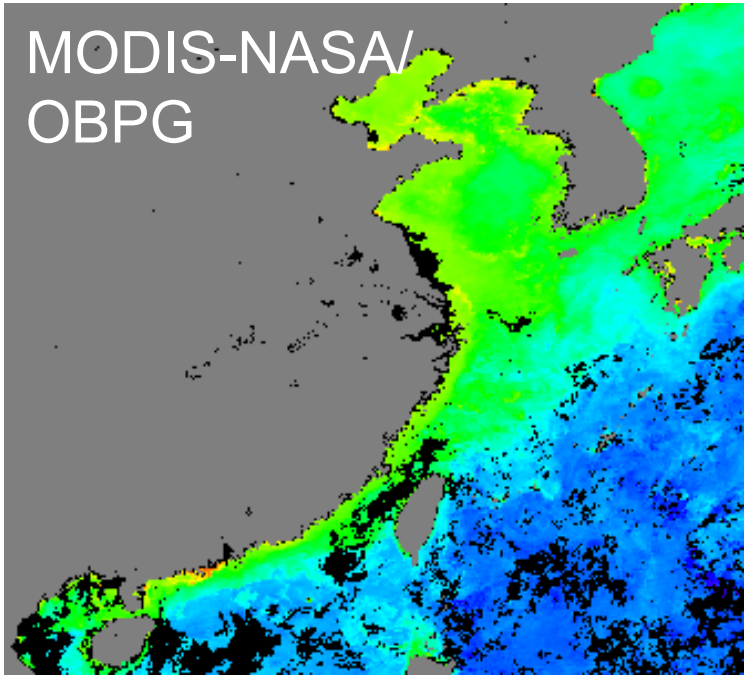


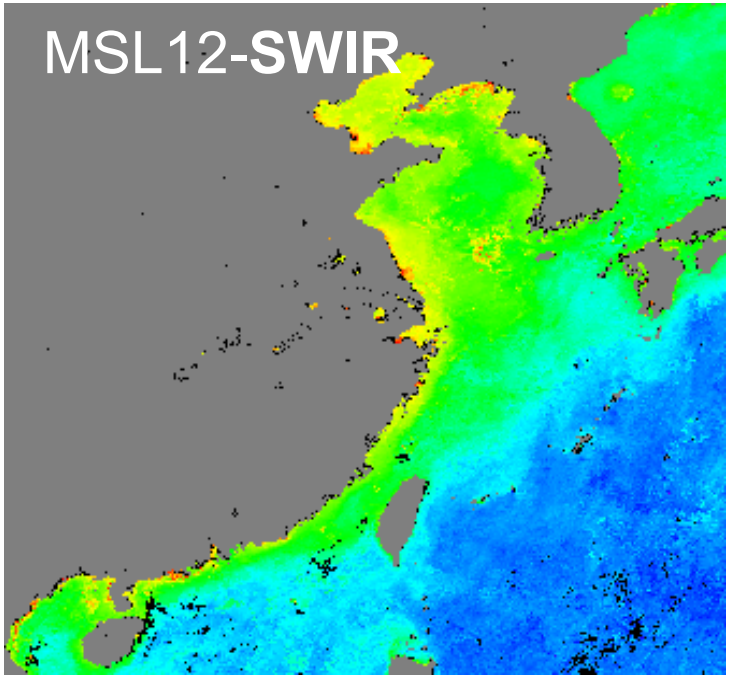


Performance in Coastal and Inland Waters (2)
(China East Coast—October 2013 Monthly)









Thank You!