VIIRS Ocean Color Team Activities

Menghua Wang &

NOAA Ocean Color Team

NOAA/NESDIS Center for Satellite Applications and Research (STAR)
E/RA3, 5830 University Research Ct.
College Park, MD 20740, USA

STAR JPSS 2016 Annual Science Team Meeting
NCWCP, College Park, Maryland, August 8-12, 2016

Website for VIIRS ocean color images and Cal/Val:
http://www.star.nesdis.noaa.gov/sod/mecb/color/

Website for VIIRS ocean color data:
http://coastwatch.noaa.gov/cwn/cw_products_ocLOM.html

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VIIRS Ocean Color EDR & Cal/Val Teams Members

EDR	Name	Organization	Funding Agency	Task
Lead	**Menghua Wang (OC EDR & Cal/Val Lead),** L. Jiang, X. Liu, W. Shi, S. Son, L. Tan, X. Wang, J. Sun, K. Mikelsons, M. Chu, V. Lance, **M. Ondrusek,** E. Stengel	NOAA/NESDIS/ STAR	JPSS/NJO	Leads – Ocean Color EDR Team & Cal/Val Team OC products, algorithms, SDR, EDR, Cal/Val, vicarious cal., refinements, data processing, reprocessing, algorithm improvements, software updates, data validations and analyses
Ocean Color	**Robert Arnone** Sherwin Ladner, Ryan Vandermeulen Adam Lawson, Paul Martinolich, Jen Bowers	U. Southern MS NRL QinetiQ Corp. SDSU	JPSS/NJO	Look Up Tables – SDR-EDR impacts, vicarious calibration Satellite matchup tool (SAVANT) – Golden Regions Cruise participation and support WAVE_CIS (AERONET-OC site) operation
	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, Matthew Ragan	USC	JPSS/NJO	Eureka (AERONET Site)
	Alex Gilerson, **Sam Ahmed**	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	UMB	JPSS/NJO	Ocean color IOP data validation and evaluation Ocean color optics matchup

Working with: NOAA **CoastWatch**, VIIRS **SDR team**, DPA/DPE (R. Williamson, Neal Baker), Raytheon, NOAA OC Working Group, NOAA various line-office reps, NOAA NCEI, NOAA OCPOP, NASA, etc.

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

VIIRS Spectral Bands for Ocean Color

VIIRS (Visible Infrared Imaging Radiometer Suite) on
Suomi National Polar-orbiting Partnership **(SNPP)**
VIIRS-**SNPP**, Oct. 28, **2011**, VIIRS-Joint Polar Satellite System (**JPSS**) **J1**, **2017**, VIIR-**J2**,
2021, and J3 & J4 (up to ~2038)

VIIRS†		MODIS		SeaWiFS
Ocean Bands (nm)	Other Bands (nm)	Ocean Bands (nm)	Other Bands (nm)	Ocean Band (nm)
410 (M1)	638 (I1)	412	645	412
443 (M2)	862 (I2)	443	859	443
486 (M3)	1600 (I3)	488	469	490
—		531	555	510
551 (M4)	*SWIR Bands*	551	*SWIR Bands*	555
671 (M5)	1238 (M8)	667	1240	670
745 (M6)	1601 (M10)	748	1640	765
862 (M7)	2257 (M11)	869	2130	865

†VIIRS-SNPP nominal center wavelength

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

Nominal Center Wavelength for VIIRS

SNPP & JPSS-1

VIIRS Nominal Center Wavelength (nm)		
Band	**SNPP**	**JPSS-1**
M1	410	411
M2	443	445
M3	486	489
M4	551	556
M5	671	667
M6	745	746
M7	862	868
I1	642	638
I2	862	867

Summary of VIIRS Ocean Color EDR Products

- **Inputs**:
  - VIIRS M1-M7 and the **SWIR** M8, M10, and M11 bands SDR data
  - Terrain-corrected geo-location file
  - Ancillary meteorology and ozone data
- **Operational (Standard) Products** (8):
  - Normalized water-leaving radiance (nL_w's) at VIIRS visible bands M1-M5
  - Chlorophyll-a (Chl-a) concentration
  - Diffuse attenuation coefficient for the downwelling spectral irradiance at the wavelength of 490 nm, $K_d(490)$
  - Diffuse attenuation coefficient of the downwelling photosynthetically available radiation (PAR), $K_d(\mathrm{PAR})$
  - Level-2 quality flags
- **Experimental Products:**
  - Inherent Optical Properties (IOP-a, IOP-a_{ph}, IOP-a_{dg}, IOP-b_b, IOP-b_{bp}) at VIIRS M2 or other visible bands (M1-M5) from the Quasi-Analytical Algorithm (QAA) (*Lee et al.*, 2002)
  - Photosynthetically Available Radiation (PAR) (*R. Frouin*)
  - Chl-a from ocean color index (OCI) method (*Hu et al.*, 2012; *Wang and Son*, 2016)
  - Others from users requests

➢ Data quality of ocean color EDR are extremely sensitive to the SDR quality. It requires **~0.1%** data accuracy (degradation, band-to-band accuracy…)!

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

➢ NOAA-MSL12 Ocean Color Data Processing

- ✓ NOAA-MSL12 is based on SeaDAS version 4.6.
- ✓ Some significant improvements: (1) the SWIR-based ocean color data processing for coastal and inland waters, (2) improved Rayleigh and aerosol LUTs, (3) algorithms for detecting absorbing aerosols and turbid waters, (4) ice detection algorithm, (5) improved straylight and cloud shadow algorithm, (5) improved NIR water reflectance correction algorithm, (6) new destriping algorithm, and others.

➢ MSL12 for VIIRS Ocean Color Data Processing

- ✓ Routine ocean color data processing (daily, 8-day, monthly) since VIIRS launch.
- ✓ Routine global VIIRS ocean color data productions for the two data streams: Near-Real-Time (NRT) and Science Quality ocean color data processing.
- ✓ Coastal turbid and inland waters from other approaches, e.g., the **SWIR approach**, results in the US east coastal, China's east coastal, Lake Taihu, Lake Okeechobee, Aral Sea, etc.

MSL12 Ocean Color Algorithms, Improvements, and Updates

- **Algorithms used in the ocean color EDR data processing:**
  - Atmospheric corrections:
    - Gordon & Wang (1994) (and Wang et al. (2005)) for open ocean using the NIR bands
    - Wang (2007) and Wang and Shi (2007) using the SWIR bands
    - The NIR reflectance correction algorithm using **BMW** (Jiang and Wang, 2014) for costal/inland waters
  - Operational chlorophyll-a: OC3V algorithm
  - K_d(490) algorithm: Wang et al. (2009) algorithm
  - K_d(PAR) algorithm: Son and Wang (2015)
  - Destriping algorithm: Mikelsons et al. (2014)
  - Stray light/Cloud shadowing effects: Jiang and Wang (2013)
- **Updates**
  - Polarization correction algorithm (errors are corrected)
- **Experimental Products**
  - IOPs: Quasi-Analytical Algorithm (QAA) (Lee et al., 2002)
  - PAR: Frouin et al. (2003)
  - Chlorophyll-a data from the OCI method: Hu et al. (2012) and implemented in VIIRS using Wang and Son (2016)

End-to-End Ocean Color Data Processing

- NOAA Ocean Color Team has been developing/building the capability for the **End-to-End** satellite ocean color data processing including:
  - Level-0 (or Raw Data Records (RDR)) to Level-1B (or Sensor Data Records (SDR)).
  - Level-1B (SDR) to ocean color Level-2 (Environmental Data Records (EDR).
  - Level-2 to global Level-3 (routine daily, 8-day, monthly, and climatology data/images).
  - Validation of satellite ocean color products (in situ data and data analysis capability).
- Support of in situ data collections for VIIRS Cal/Val activities, e.g., MOBY, AERONET-OC sites, **NOAA dedicated cruises** (2014, 2015, 2016, ….,)

➢ **On-orbit instrument calibration (solar and lunar) for ocean color data processing:**

- J. Sun and M. Wang, "Visible Infrared Imaging Radiometer Suite solar diffuser calibration and its challenges using solar diffuser stability monitor," *Appl. Opt.*, **53**, 8571-8584, 2014.
- J. Sun and M. Wang, "On-orbit characterization of the VIIRS solar diffuser and solar diffuser screen," *Appl. Opt.*, **54**, 236-252, 2015.
- J. Sun and M. Wang, "On-orbit calibration of Visible Infrared Imaging Radiometer Suite reflective solar bands and its challengers using a solar diffuser," *Appl. Opt.*, **54**, 7210-7223, 2015.
- J. Sun and M. Wang, "Radiometric calibration of the VIIRS reflective solar bands with robust characterizations and hybrid calibration coefficients," *Appl. Opt.*, **54**, 9331–9342, 2015.

➢ **On-orbit vicarious calibration using MOBY in situ data:**

- Developed the NIR- and SWIR-based vicarious calibration approach with a unified gain set for OC data processing.
- M. Wang, W. Shi, L. Jiang, and K. Voss, "The NIR- and SWIR-based on-orbit vicarious calibrations for satellite ocean color sensors," *Opt. Express* (Submitted).

➢ **RDR (Level-0) to SDR (Level-1B) data processing** (efficient RDR to SDR processing)**:**

- Sun, J., M. Wang, L. Tan, and L. Jiang, "An efficient approach for VIIRS RDR to SDR data processing," *IEEE Geosci. Remote Sens. Lett.*, **11**, 2037–2041, 2014.

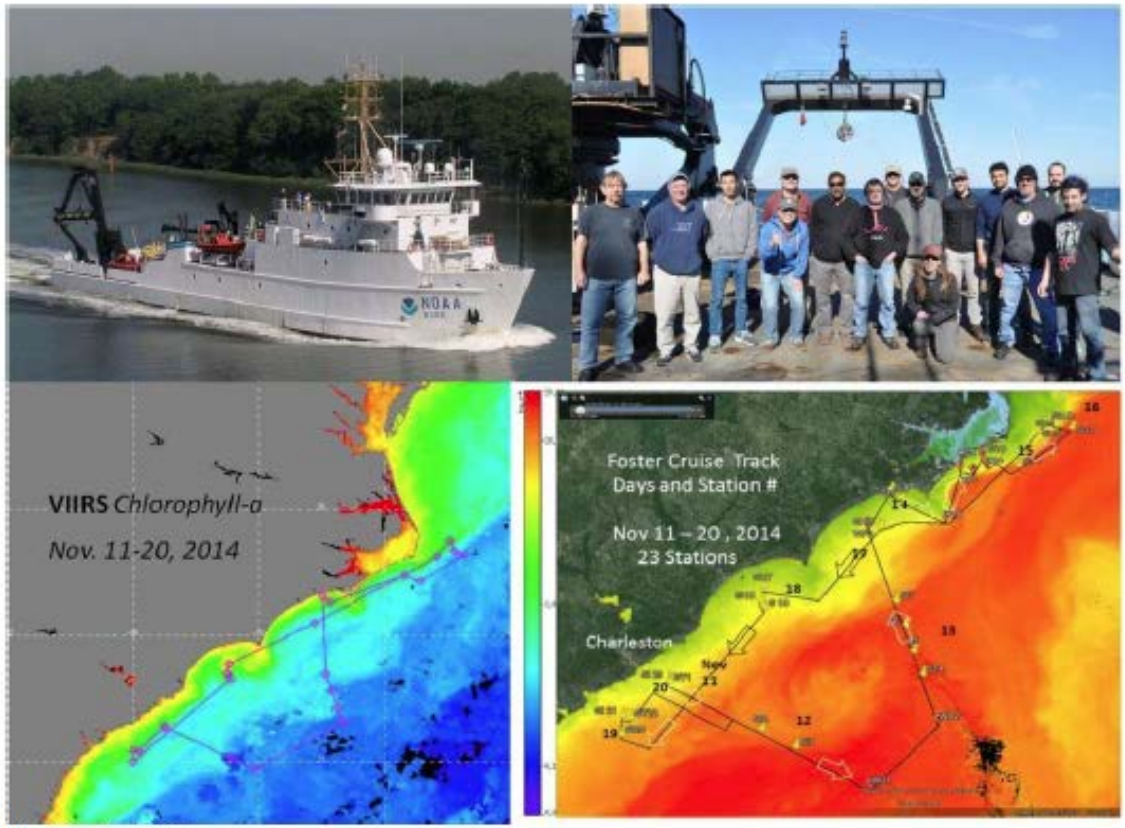
- **O**cean **C**olor **D**ata **A**nalysis and **P**rocessing **S**ystem (**OCDAPS**)—IDL-based VIIRS ocean color data visualization and processing package
  - Wang, X., X. Liu, L. Jiang, M. Wang, and J. Sun, "VIIRS ocean color data visualization and processing with IDL-based NOAA-SeaDAS", *Proc. SPIE 9261*, 8 Nov. 2014.

Report for the 2014 NOAA dedicated Cal/Val cruise has been published!

NOAA Technical Report NESDIS 146

DOI: 10.7289/V52B8W0Z

Report for
Dedicated JPSS VIIRS Ocean Color
Calibration/Validation Cruise



Washington, D.C.
September 2015

Dedicated VIIRS Cal/Val Cruises

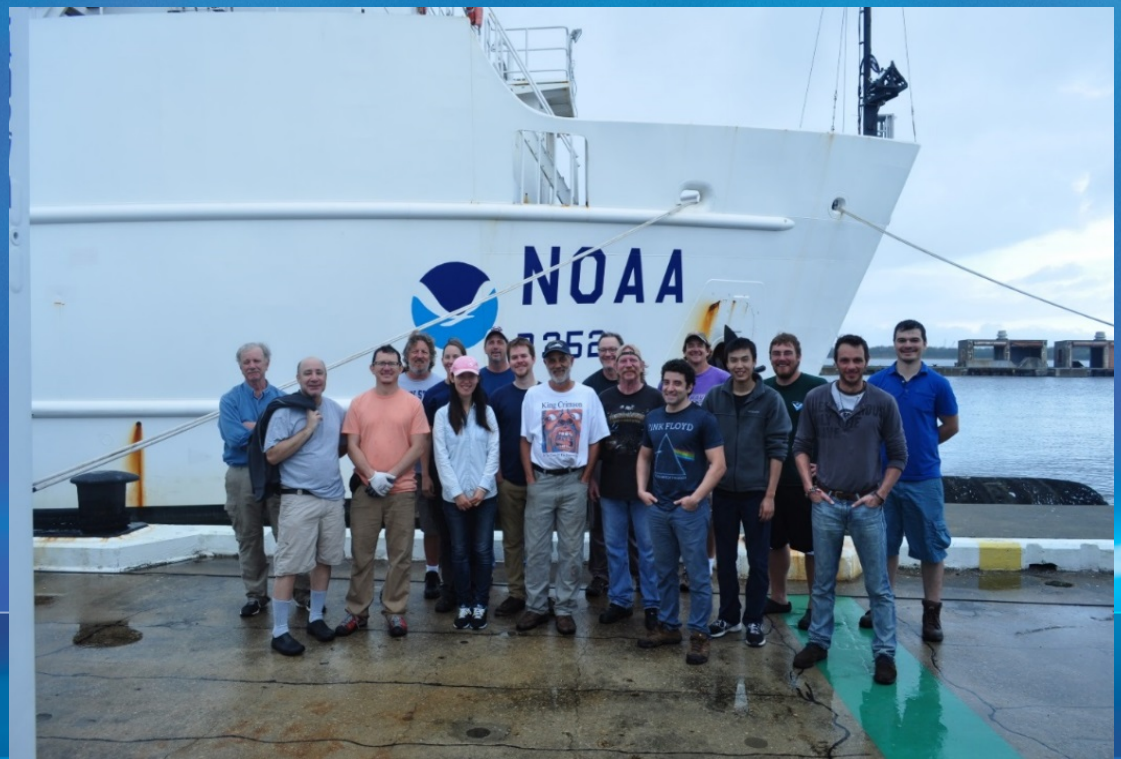
http://dx.doi.org/10.7289/V52B8W0Z

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Dedicated VIIRS Cal/Val Cruise
NOAA Ship Nancy Foster
2-14 December 2015

Validation Measurements

- **Water-Leaving Radiance** - HyperPro, MicroPro, C-OPS, GER, SBA, TRIOS, HyperSAS, ASD
- **Aerosol Optical Depth** - Microtops
- **Chlorophyll** - HPLC, Fluorometric, (in situ and extracted)
- **Absorption** - ACS, AC9, Spectrophotometric
- **Backscatter** - BB9, BB7, BB3, ECO Puck
- **Bi-directional radiance distribution** - NURADS
- **Phytoplankton Physiology -** FRRF, FIRe, Alf-a
- **Carbon** - POC and DOC water analysis; plus CDOM
- **Total Suspended Matter** - Gravimetric



International, Interagency and Academic Collaborations:

US Agencies

- **NOAA**/NESDIS/STAR (NOAA)
- Naval Research Laboratory, Stennis Space Center (**NRL**)
- NASA/Goddard Space Flight Center (**NASA**)
- National Institute of Standards and Technology (**NIST**)

Universities

- City University of New York, Long Island; CREST
- Lamont-Doherty Earth Observatory, Columbia University
- University of Massachusetts, Boston
- University of Miami
- University of South Florida
- University of Southern Mississippi
- Oregon State University

Two Data Streams for VIIRS Ocean Color EDR

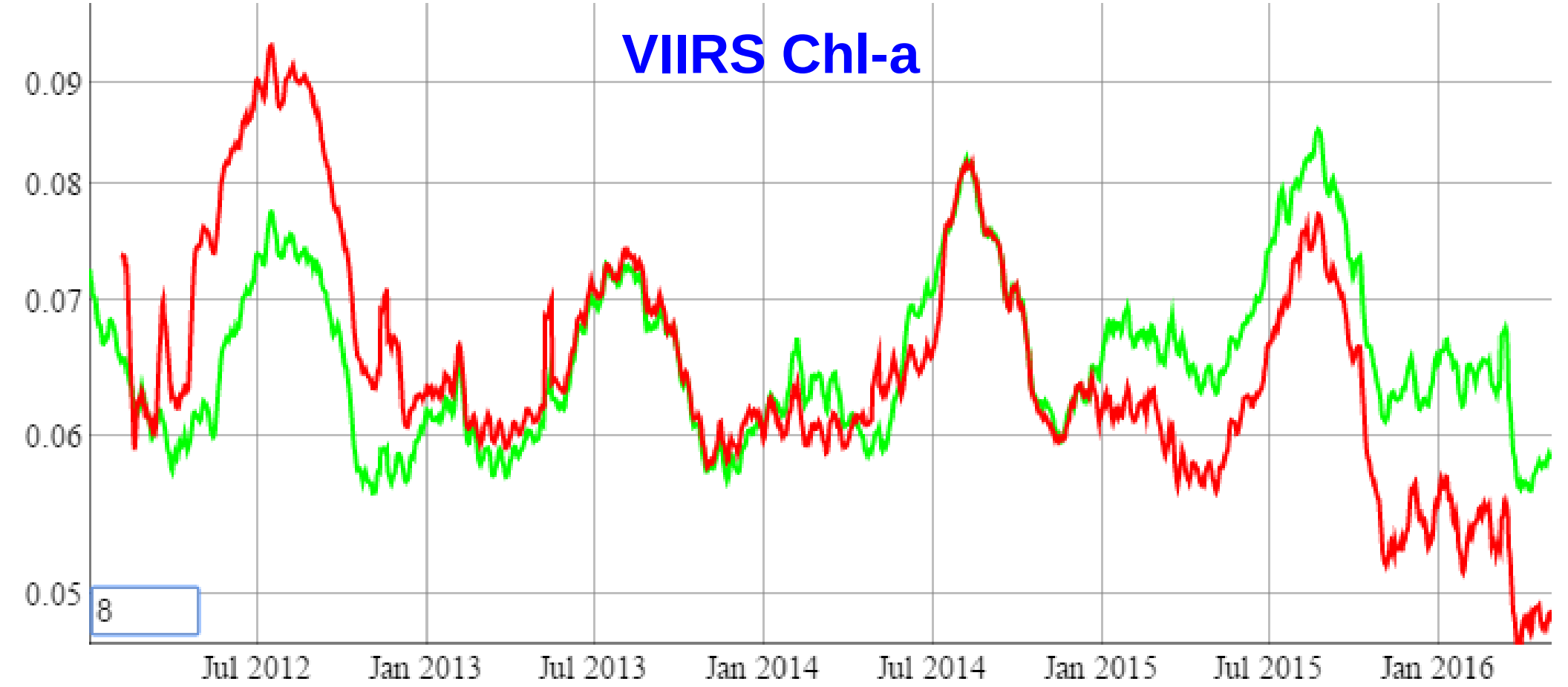
To meet requirements from **All** users (operational, research, modeling, etc.), we proposed and have been routinely producing VIIRS global ocean color products in **two data streams**:

- **Near-Real-Time (NRT) Ocean Color Data Processing (12-24 hours):**
  - Quick turn around with ~12-24 hours latency (operational)
  - Using standard IDPS operational SDR data
  - Ancillary data using the Global Forecast System (GFS) model
  - Data may not be completed due to various issues (SDR missing, computer, etc.)
  - Data will be processed in NOAA CoastWatch and OSPO
- **Science Quality Ocean Color Data Processing (One-two weeks delay):**
  - About one-two weeks delay
  - Reprocessed mission-long ocean color data and continue-forward data stream
  - Using improved SDR (based on IDPS SDR data) (science quality SDR)
  - Science quality (assimilated) NCEP ancillary data
  - Complete global coverage
  - May expand to more experimental products & test with improved algorithms
  - Ocean color EDR will be reprocessed (mission-long) about every two-three years (or as needed, e.g., short-term data reprocessing, error fixing, etc.)
  - Data will be processed in NOAA/STAR and transferred to CoastWatch for distributions

VIIRS Mission-long Ocean Color Data Reprocessing

- ✓ We have successfully reprocessed VIIRS mission-long ocean color data products for the Near-Real-Time data stream in summer 2015 and the Science Quality data stream just recently (May 2016). Both data streams have been going forward routinely.
- ✓ For the Science Quality data stream, VIIRS mission-long SDR has been reprocessed using significantly improved on-orbit calibration (both solar and lunar approaches).
- ✓ Both VIIRS ocean color data are available through CoastWatch. In particular, the ocean color Science Quality data stream is now distributed through **CoastWatch** (will also be distributed in NCEI) at: **http://coastwatch.noaa.gov/cwn/cw_products_ocLOM.html**.
- ➢ The reprocessed VIIRS mission-long Science Quality ocean color data have been significantly improved, providing accurate and consistent ocean color data for science research and applications. **It shows the importance of the lunar data for calibration, particularly in recent years (and forwarding)**.
- ➢ In particular, significant improved VIIRS ocean color data over global **high altitude lakes**, which is a very significant progress for remote sensing of inland water quality.
- ➢ VIIRS chlorophyll-a, $K_d(490)$, $nL_w(443)$ and $nL_w(551)$ data from global oligotrophic waters for two data streams: Near-real-time data stream with IDPS SDR and the recently reprocessed Science Quality data stream with the new OC-SDR. The same **MSL12** ocean color data processing system has been used for both data streams. We also show some global images and quantitative comparisons with MOBY in situ data.

Global Oligotrophic Waters

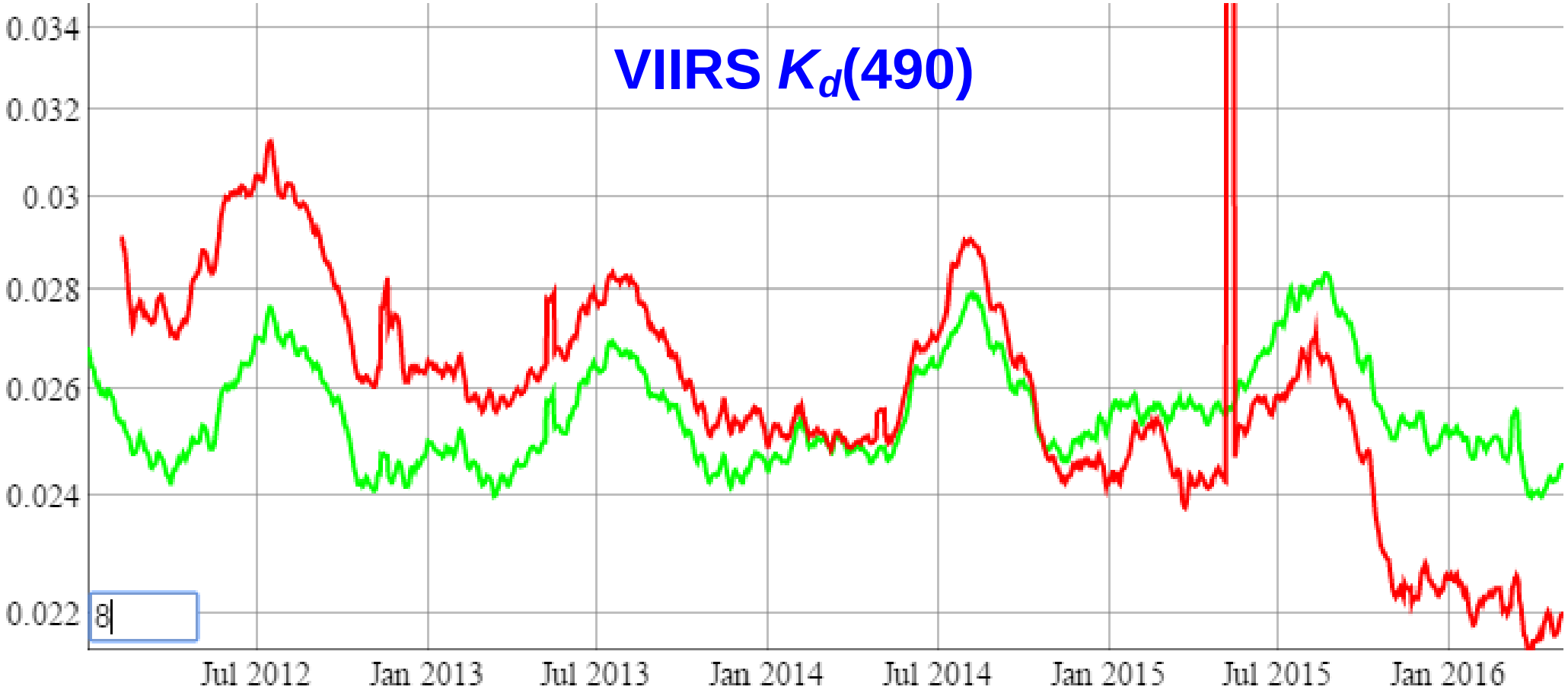


Red: VIIRS **IDPS-SDR**
Near-real-time data

Green: VIIRS **OC-SDR**
Science quality data

Both data are reprocessed using the same MSL12!

Global Oligotrophic Waters



Red: VIIRS **IDPS-SDR**
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Science quality data

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Global Oligotrophic Waters

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Science quality data

Both data are reprocessed using the same MSL12!

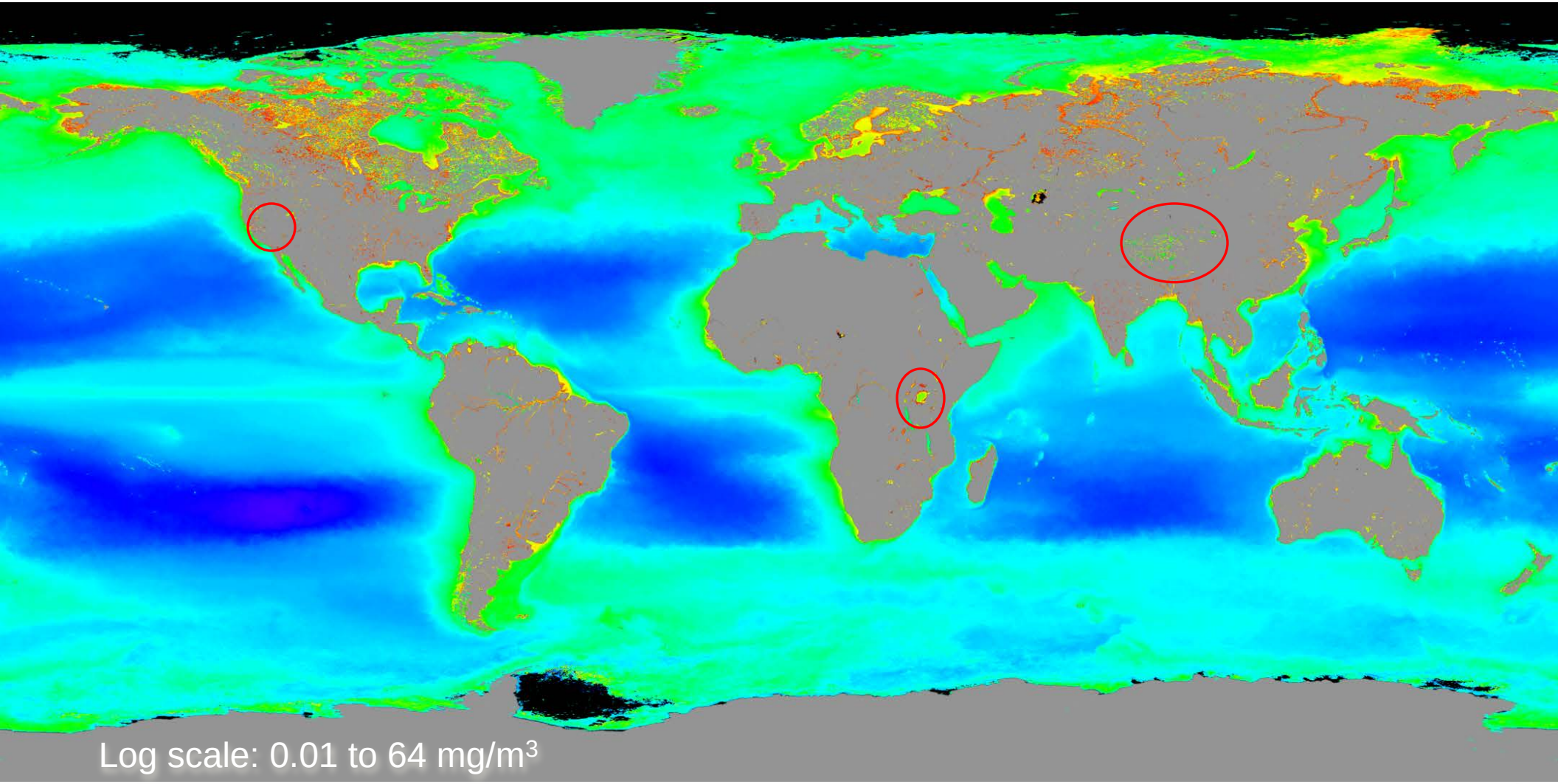
Global Oligotrophic Waters

Red: VIIRS **IDPS-SDR**
Near-real-time data

Green: VIIRS **OC-SDR**
Science quality data

Both data are reprocessed using the same MSL12!

VIIRS Climatology Chlorophyll-a Image
(February 2012 to January 2016)

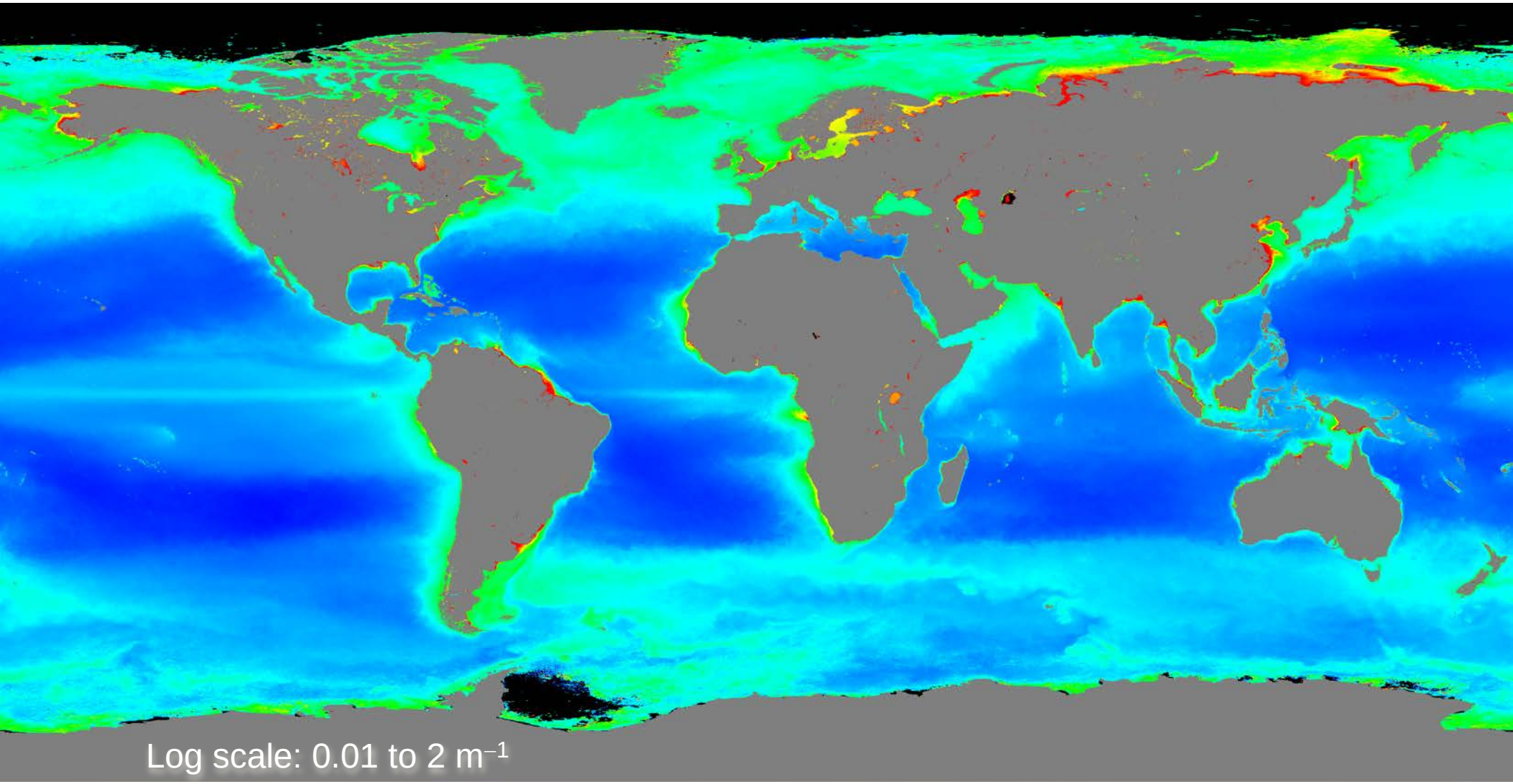


Generated using MSL12 for VIIRS mission-long ocean color data reprocessing

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

VIIRS Climatology $K_d(490)$ Image (OLD)

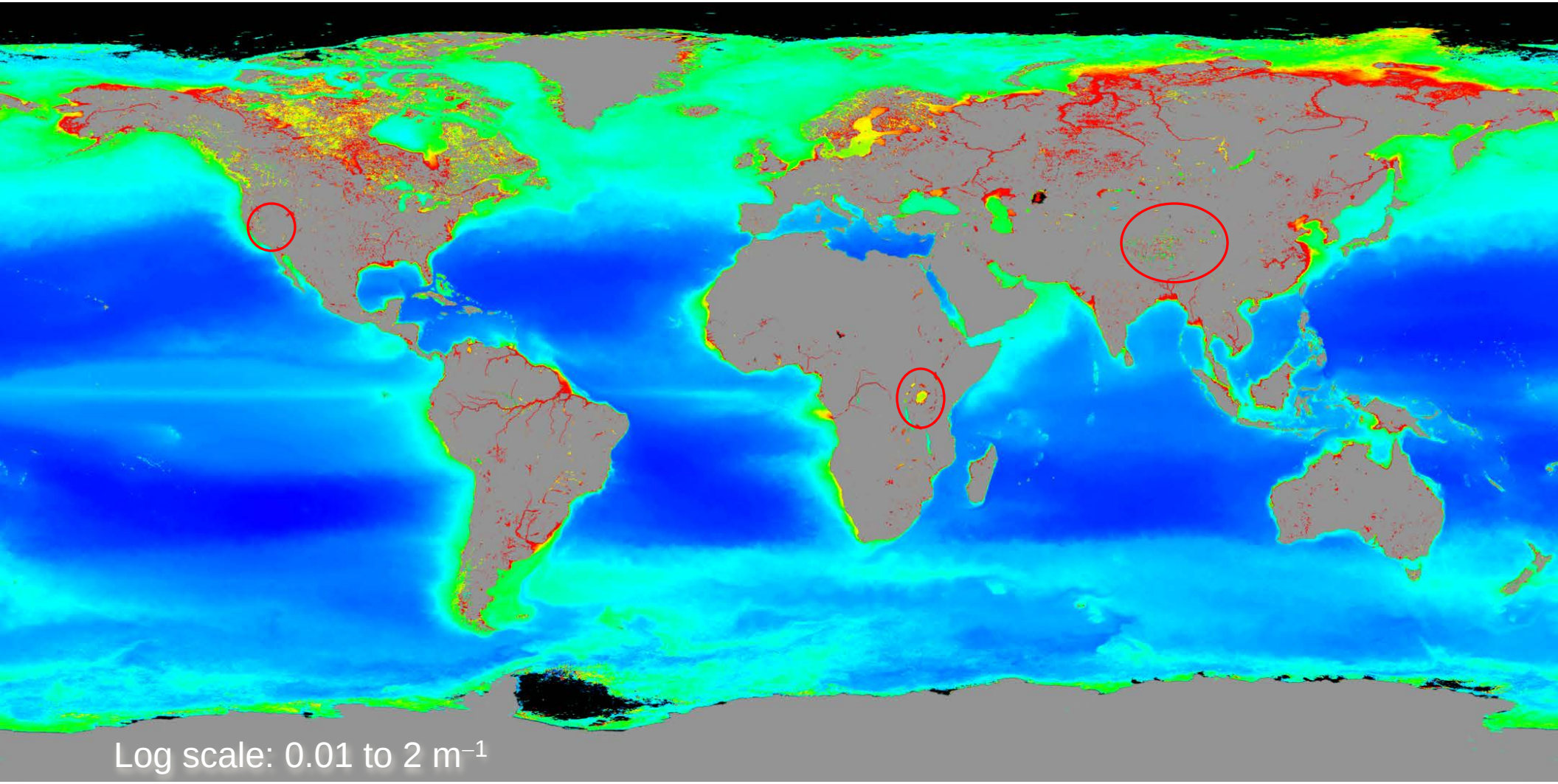
(March 2012 to February 2015)



Generated using MSL12 for VIIRS ocean color data processing

Wang, M., S. Son, and L. W. Harding Jr., "Retrieval of diffuse attenuation coefficient in the Chesapeake Bay and turbid ocean regions for satellite ocean color applications," *J. Geophys. Res.*, **114**, C10011, 2009. http://dx.doi.org/10.1002/2009JC005286

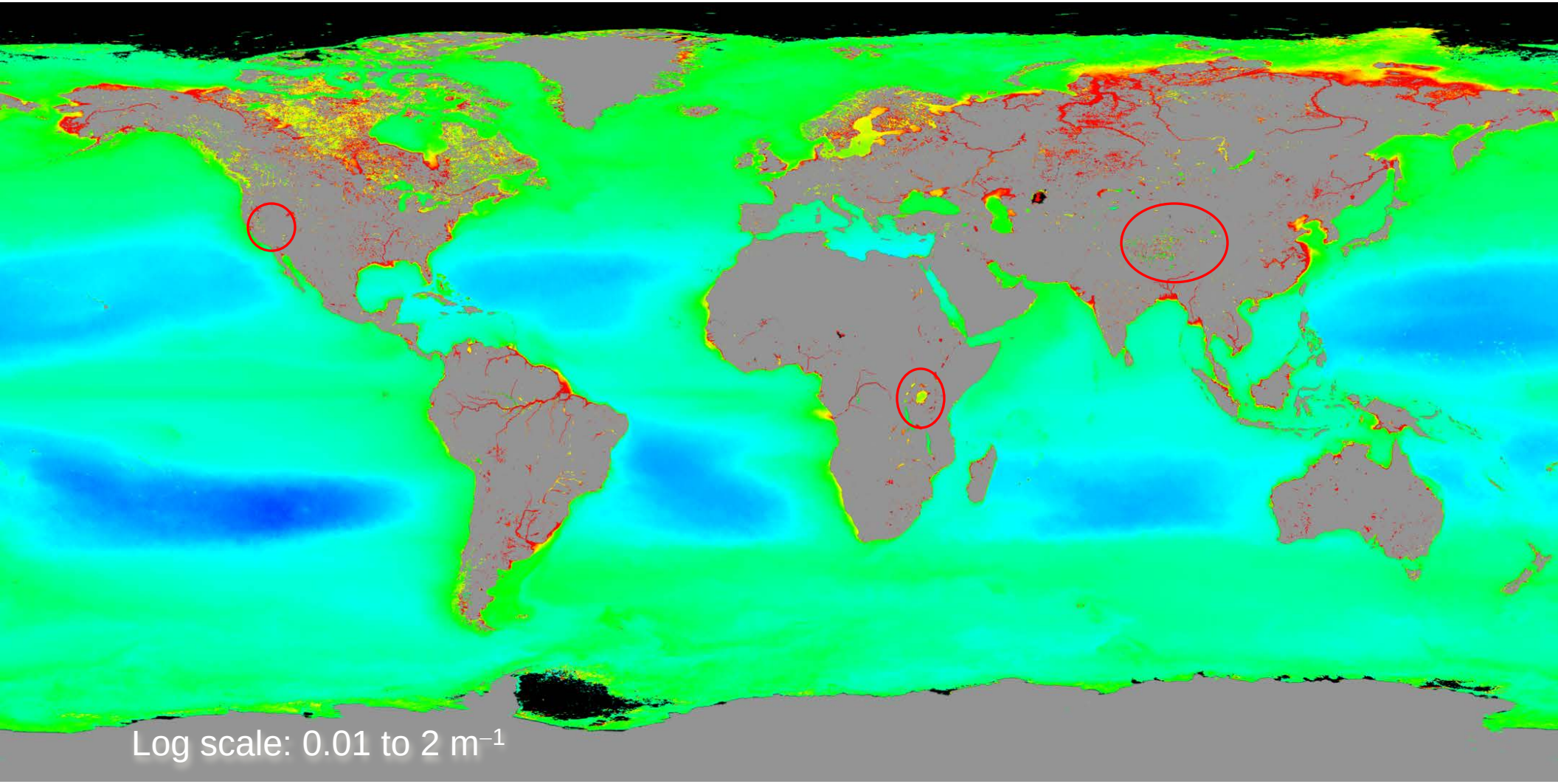
VIIRS Climatology $K_d(490)$ Image
(February 2012 to January 2016)



Generated using MSL12 for VIIRS mission-long ocean color data reprocessing

Wang, M., S. Son, and L. W. Harding Jr., "Retrieval of diffuse attenuation coefficient in the Chesapeake Bay and turbid ocean regions for satellite ocean color applications," *J. Geophys. Res.*, **114**, C10011, 2009. http://dx.doi.org/10.1002/2009JC005286

VIIRS Climatology K_d(PAR) Image
(February 2012 to January 2016)



Generated using MSL12 for VIIRS mission-long ocean color data reprocessing

Son, S. and M. Wang, "Diffuse attenuation coefficient of the photosynthetically available radiation Kd(PAR) for global open ocean and coastal waters," *Remote Sens. Environ.*, **159**, 250–258, 2015. http://dx.doi.org/10.1016/j.rse.2014.12.011

Matchup of

VIIRS-MSL12

&

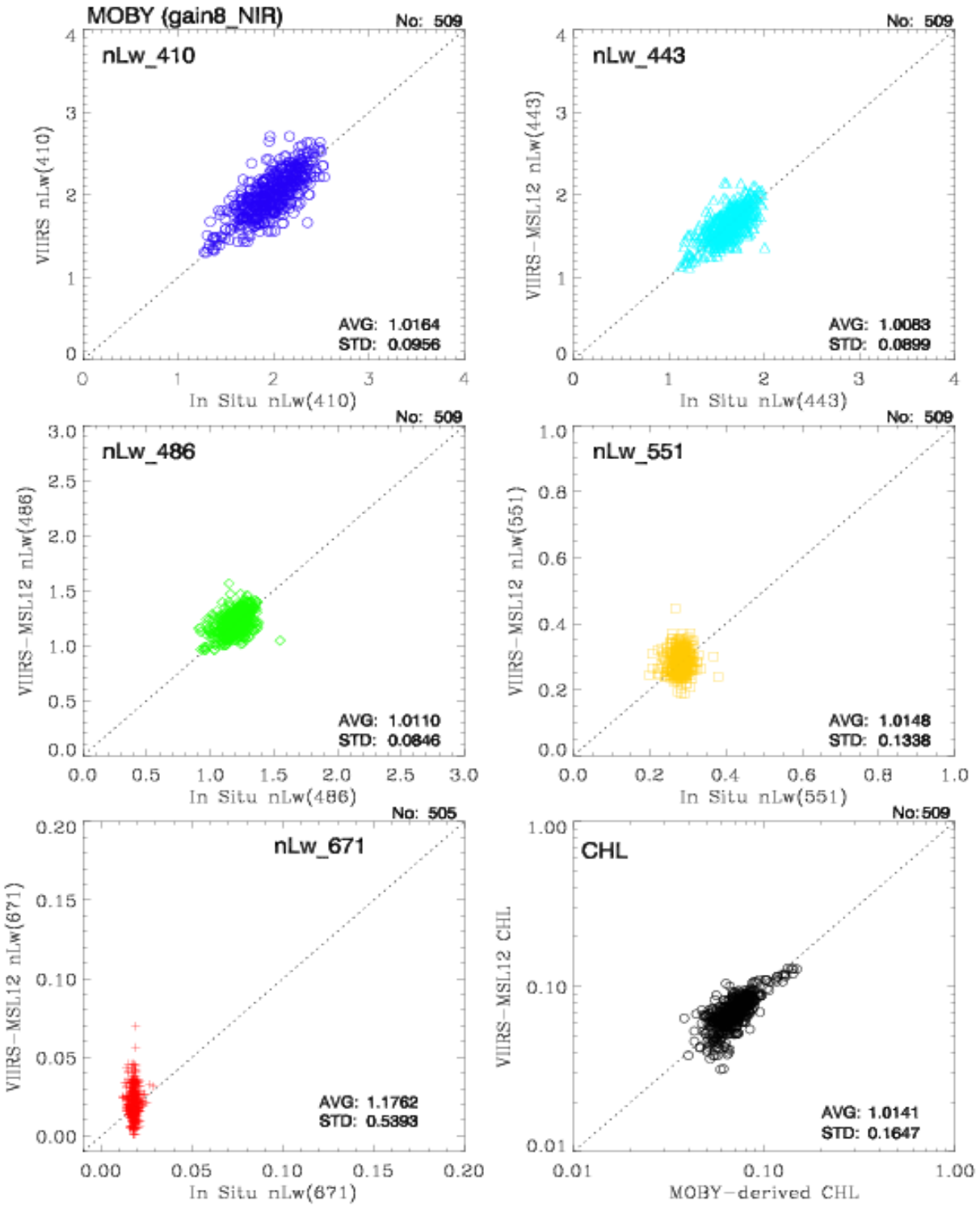
MOBY In Situ

(2016-05-05)

Science Quality Data

MOBY

Marine Optical Buoy (MOBY) --- In situ hyperspectral radiometric data measured at water off the island of Lanai in Hawaii.



Statistics of VIIRS Data vs. In Situ (MOBY)

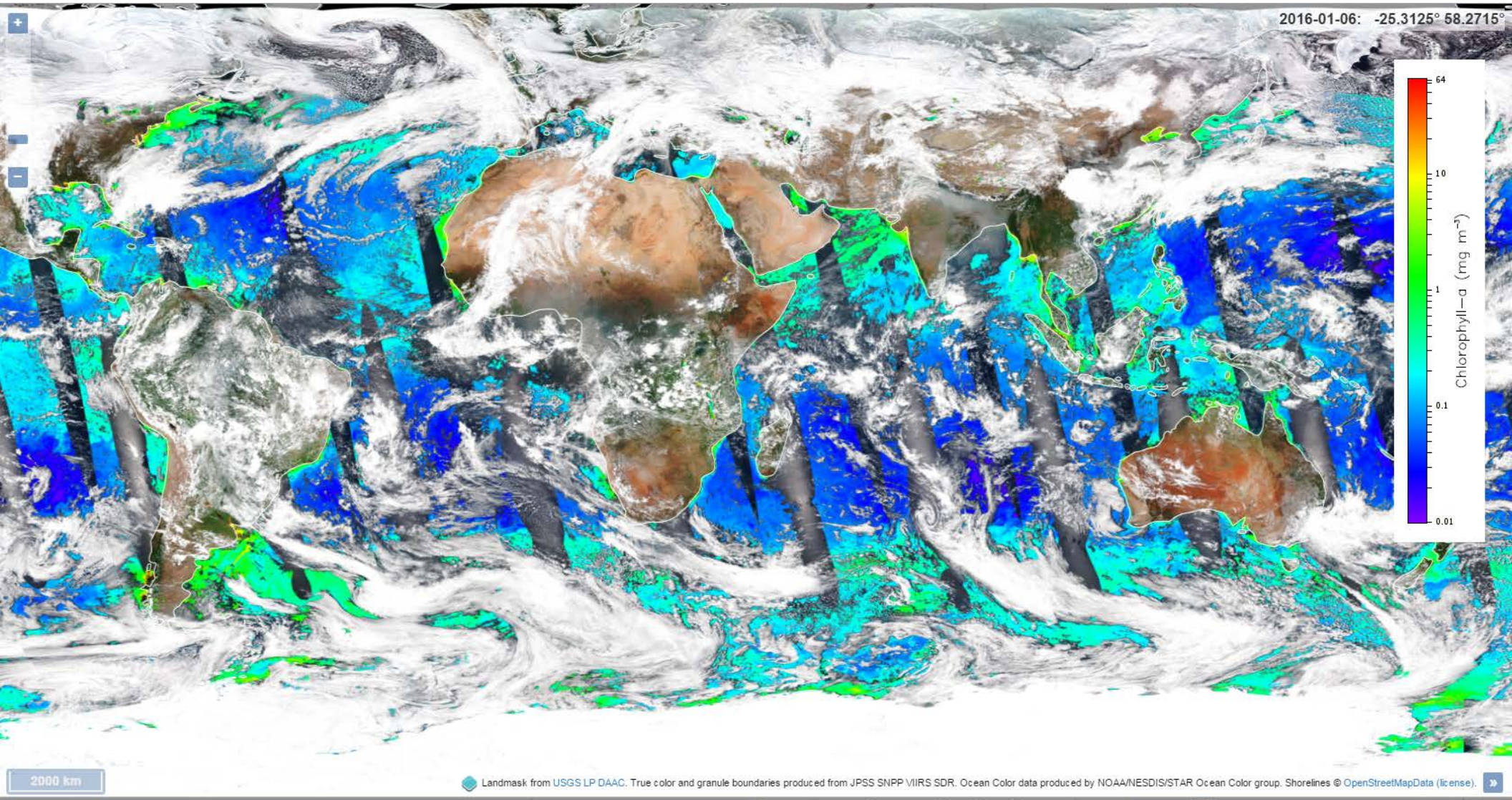
(2012-01-01 to 2016-04-27)

	IDPS-SDR MSL12 (ver. 1.10) (Near-Real-Time Data)				OC-SDR MSL12 (ver. 1.10) (Science Quality Data)			
	AVG	**MED**	**STD**	**No**	**AVG**	**MED**	**STD**	**No**
$nL_w(410)$	**1.0083**	1.0065	0.0961	463	**1.0164**	1.0157	0.0956	509
$nL_w(443)$	**1.0191**	1.0005	0.1733	475	**1.0083**	1.0062	0.0899	509
$nL_w(486)$	**1.0258**	0.9991	0.1861	475	**1.0110**	1.0103	0.0846	509
$nL_w(551)$	**1.0604**	0.9809	0.4910	475	**1.0148**	1.0004	0.1338	509
$nL_w(671)$	**1.3366**	1.0059	2.1345	487	**1.1762**	1.1053	0.5393	505
Chl-a	**1.0508**	0.9764	0.4254	468	**1.0141**	1.0041	0.1647	509
$K_d(490)$	**1.0135**	0.9826	0.2437	471	**0.9842**	0.9760	0.1007	505

MOBY

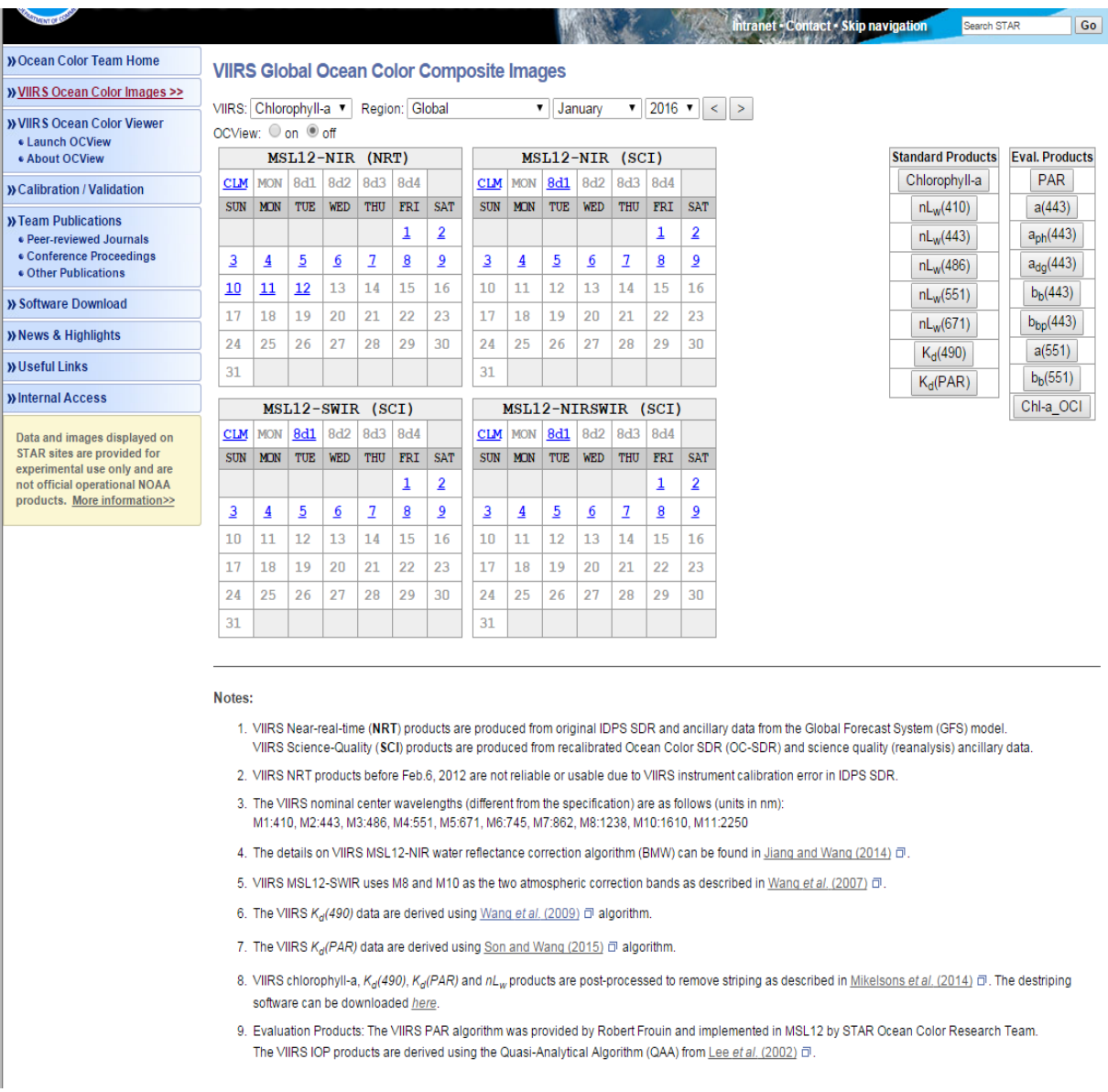
NIR Gain 8 = [0.979954, 0.974892, 0.974685, 0.965832, 0.979042, 0.982065, 1.00000, 1.01812, 0.994676, 1.20252]

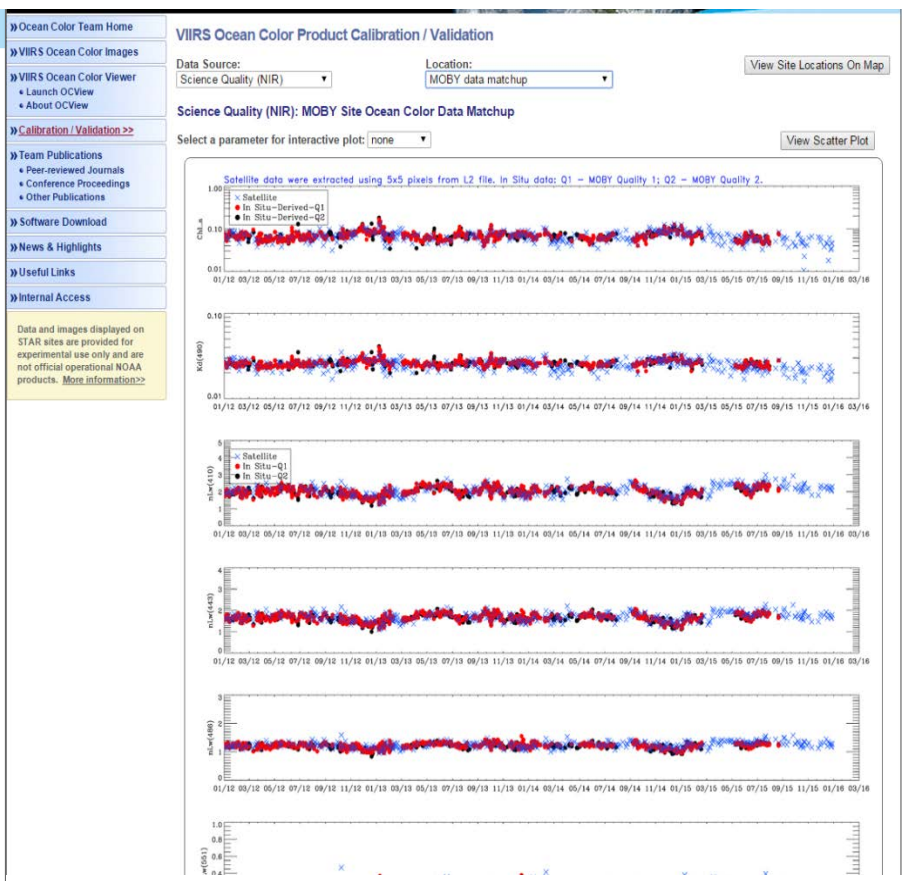
OCView: Seamless Global Coverage



Website: http://www.star.nesdis.noaa.gov/sod/mecb/color/

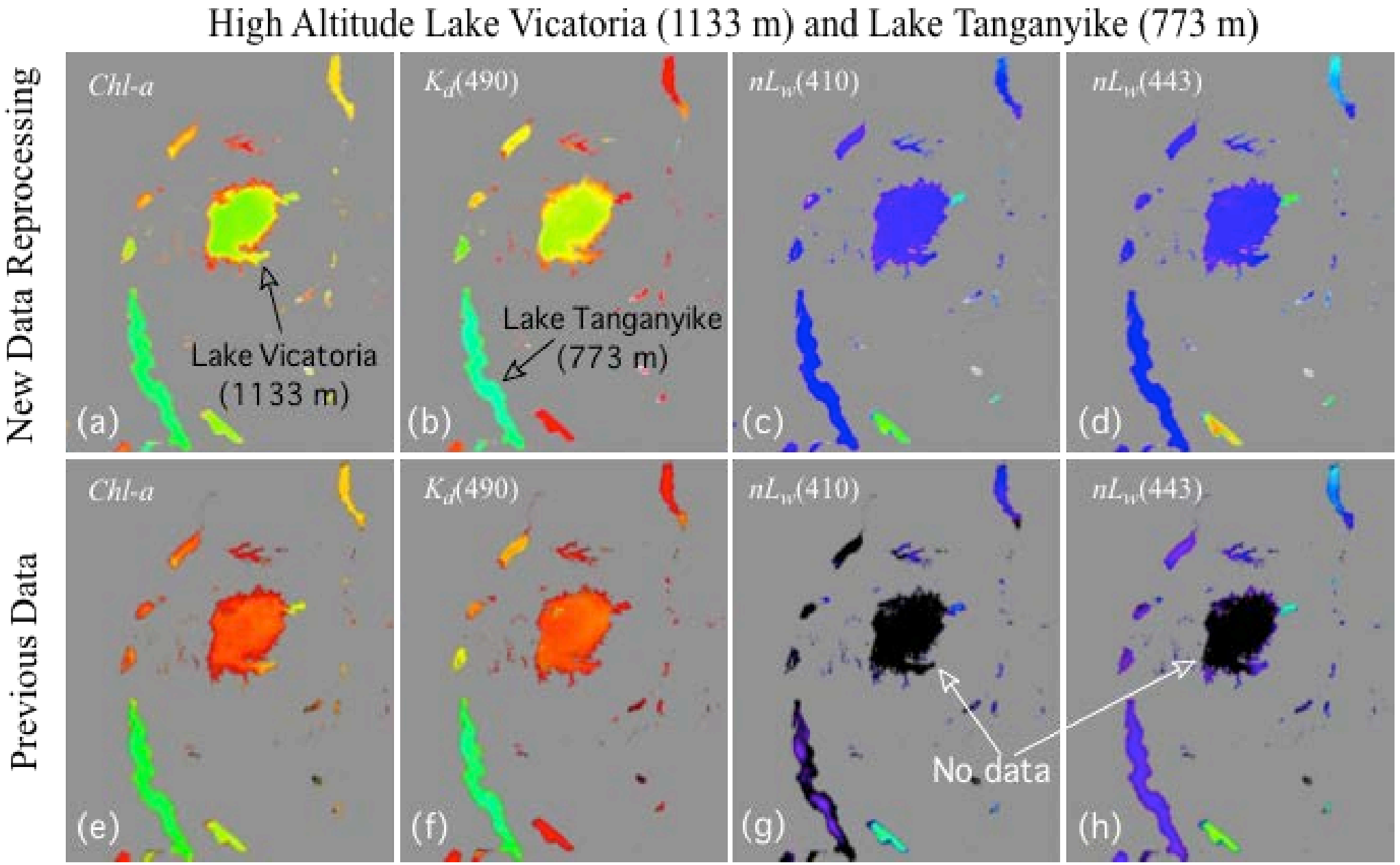
Composite Images & Cal/Val





Routinely producing VIIRS global ocean color products (**daily**, **8-day**, **monthly**, **climatology**) using the **MSL12** with the **NIR**, **SWIR**, and **NIR-SWIR** atmospheric correction algorithms.

Significantly Improved Water Property Data Over High Altitude Lakes (1)

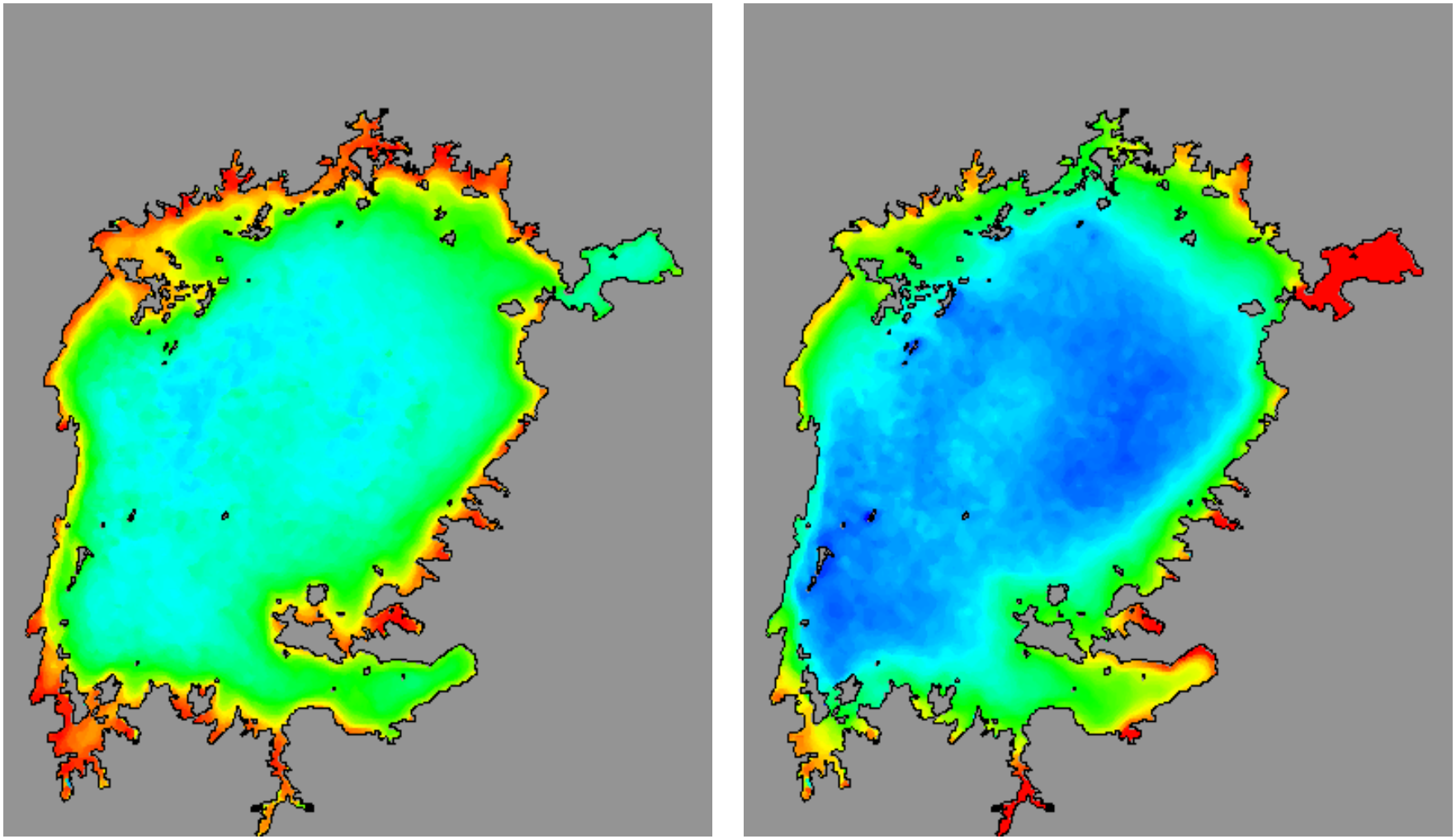


VIIRS mission-long ocean color data have been successfully reprocessed using improved MSL12. VIIRS ocean color data over open oceans and coastal/inland waters have been significantly improved, in particular, over high altitude lakes. This is a significant progress for remote sensing of inland water quality.

Lake Victoria---Fresh water (South Africa, Area: 68,800 km^2, Ave. depth: 40 m)

VIIRS Climatology Images (Jan. 2012–May 2016)

VIIRS *Chl-a* | **VIIRS K_d(490)**



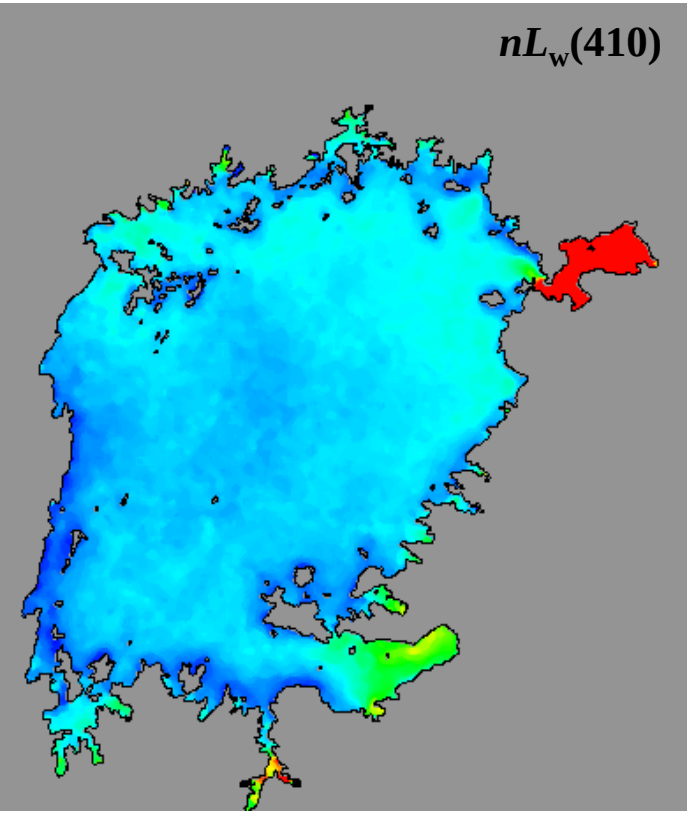
Color scales: Chl-a (1~64.0 mg m^{-3}) & K_d(490) (0.3~2.0 m^{-1}) in log-scale

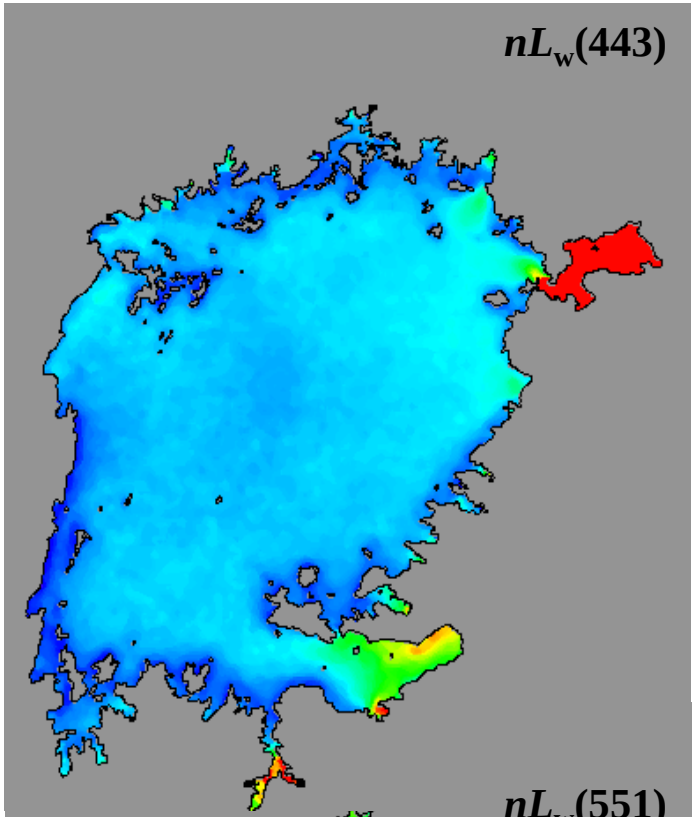
5 × 5 Median Filter

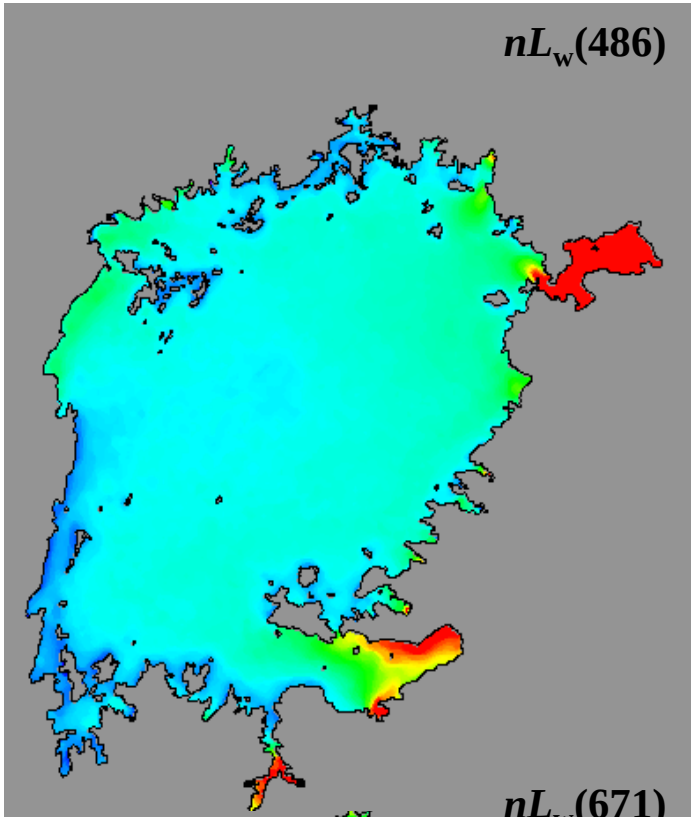
Lake Victoria

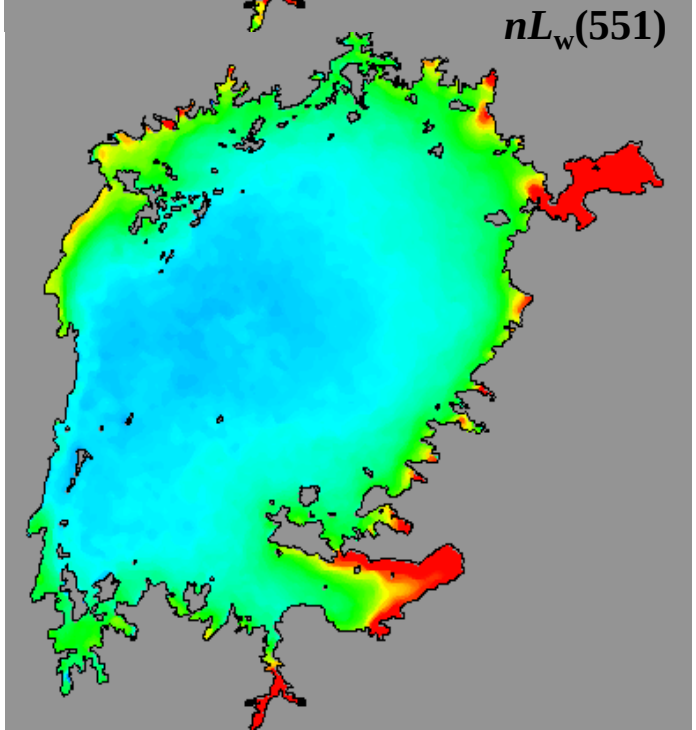
VIIRS Climatology Images (Jan. 2012–May 2016)

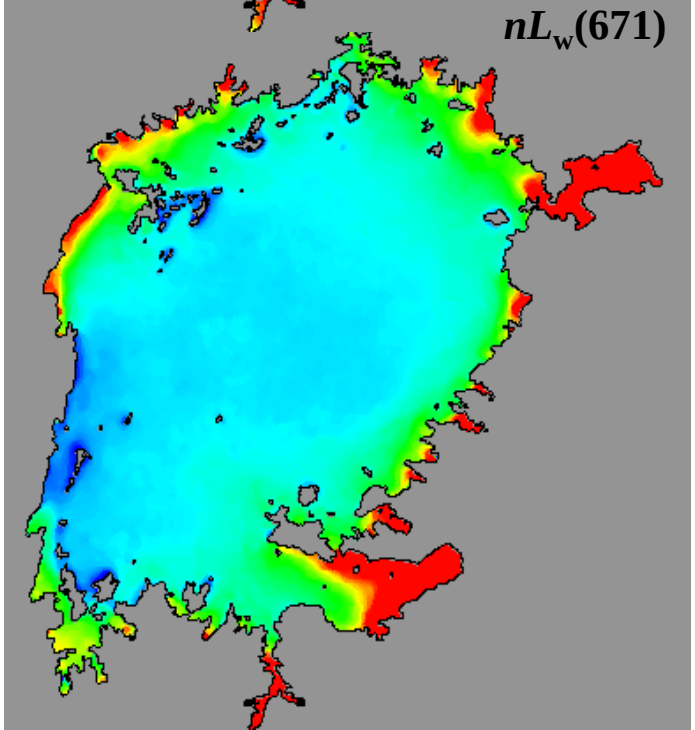
Lake Victoria











Color scales (linear-scale):

$nL_w(410)$: 0 ~ 1.0

$nL_w(443)$: 0 ~ 1.2

$nL_w(486)$: 0 ~ 1.5

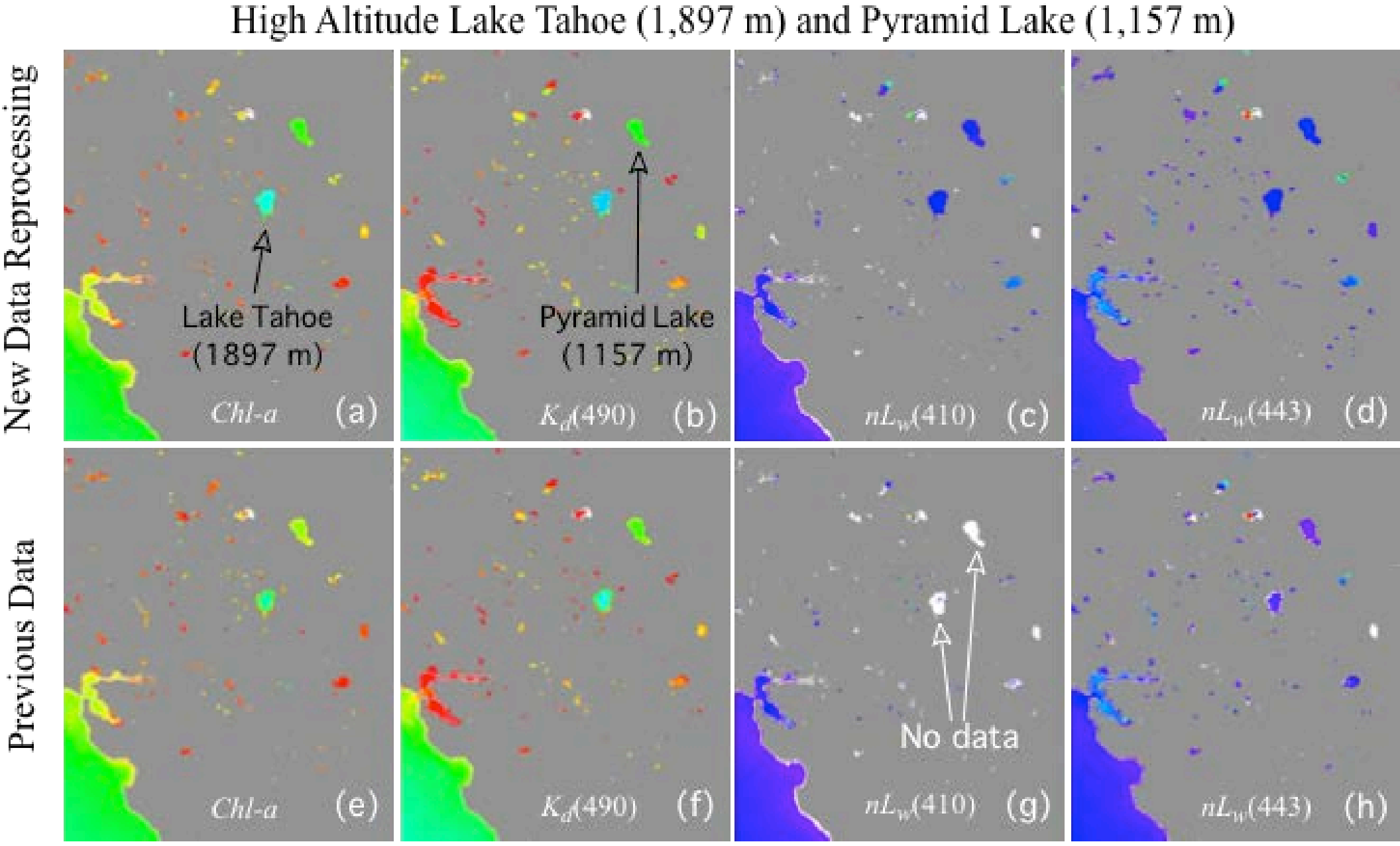
$nL_w(551)$: 0 ~ 2.0

$nL_w(671)$: 0 ~ 0.5

Unit: mW cm^{-2} ⌈ m^{-1} sr^{-1}

5 × 5 Median Filter

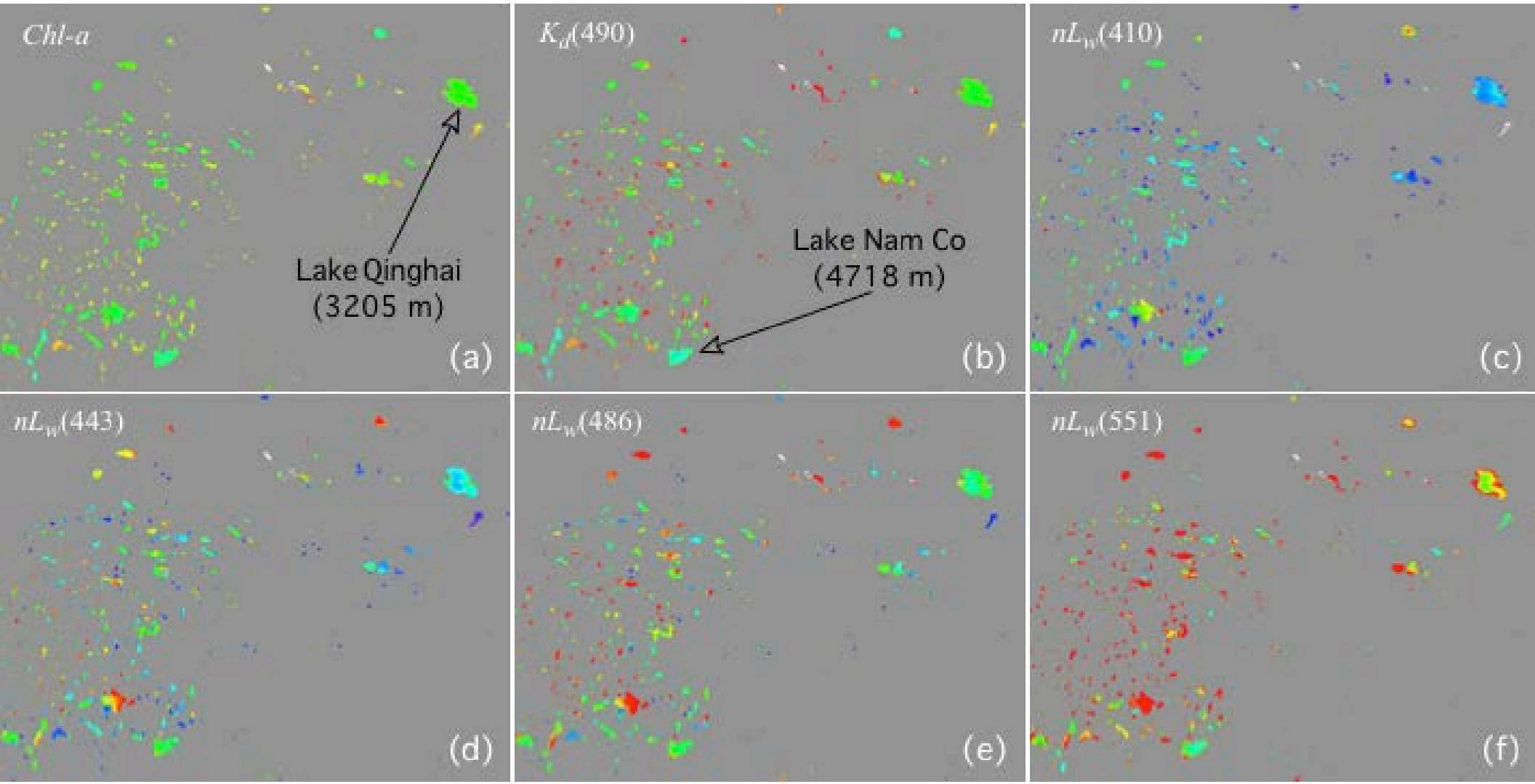
Significantly Improved Water Property Data Over High Altitude Lakes (2)



Lake Tahoe---Fresh water (California/Nevada, Area: 490 km^2, Ave. depth: 300 m)
Pyramid Lake---1/6 salinity (Nevada, Area: 490 km^2, Max. depth: 109 m)

Significantly Improved Water Property Data Over High Altitude Lakes (3)

High Altitude Lake Qinghai (3,205 m) and Lake Nam Co (4,718 m)



Lake Qinghai---Saline lake (Qinghai, China, Area: 4489 km^2, Ave. depth: 21 m)
Lake Nam Co---Saline lake (Tibetan, China, Area: 1920 km^2, Ave. depth: 33 m)

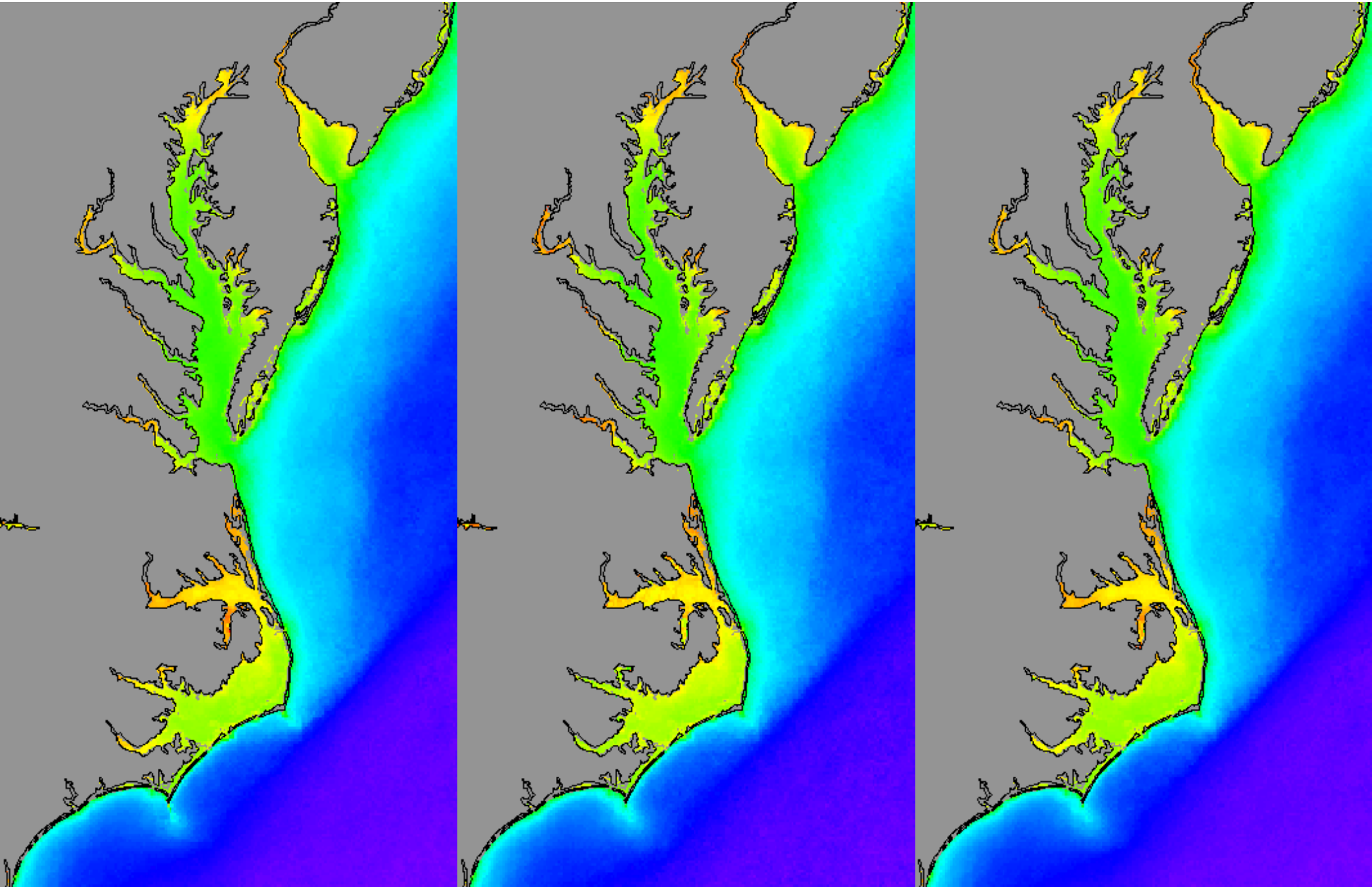
Wang, M., "Rayleigh radiance computations for satellite remote sensing: Accounting for the effect of sensor spectral response function," *Opt. Express*, **24**, 12414–12429, 2016. http://dx.doi.org/10.1364/OE.24.012414.

VIIRS (OC-SDR) Climatology Images (2012–2015)

$K_d(490)$ (0.03−8.0 m^{-1} in log scale)

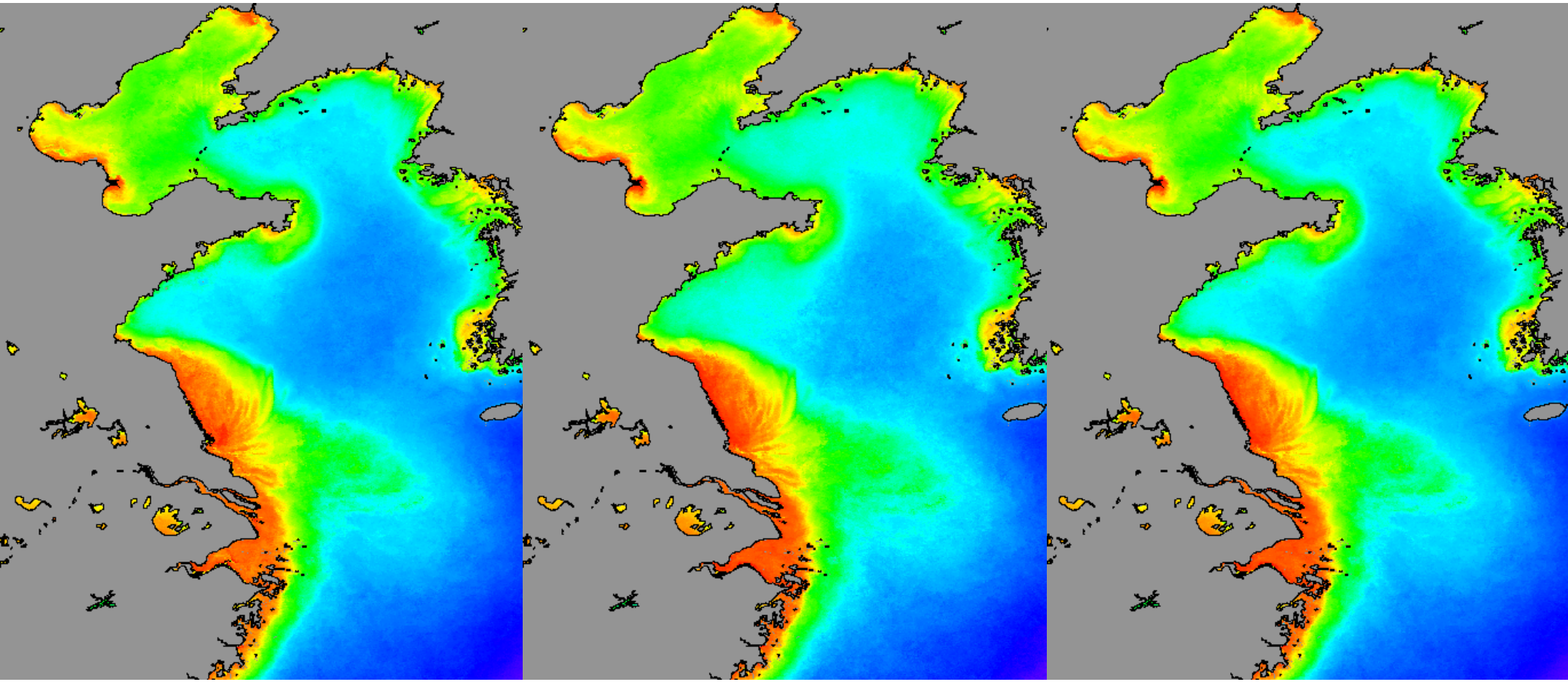
US East Coast

NIR | **SWIR** | **NIR-SWIR**



VIIRS (OC-SDR) Climatology Images (2012–2015)

NIR | SWIR | NIR-SWIR

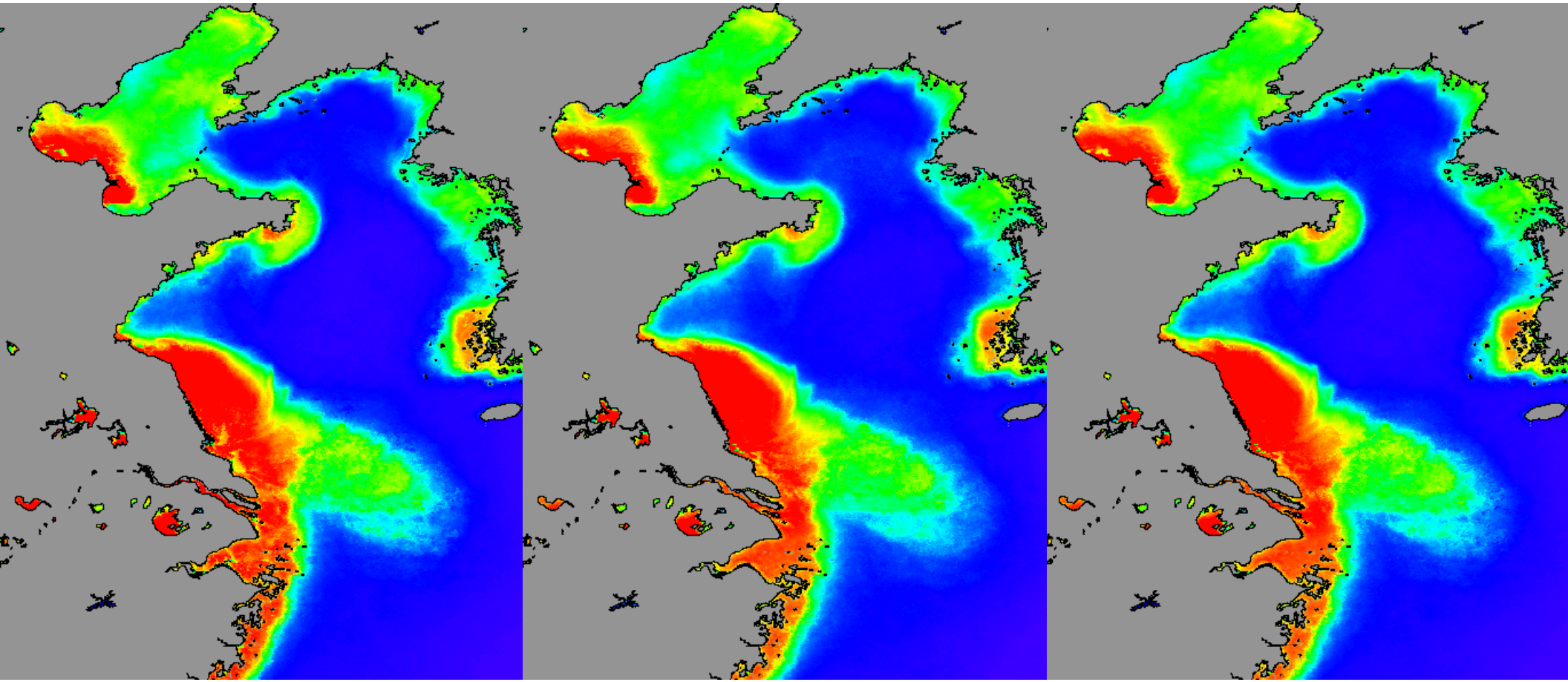


$K_d(490)$ (0.03~8.0 m^{-1} in log scale)

China East Coast

VIIRS (OC-SDR) Climatology Images (2012–2015)

NIR | SWIR | NIR-SWIR



$nL_w(551)$ (0.0~5.0 mW/cm^2 μm sr in linear scale)

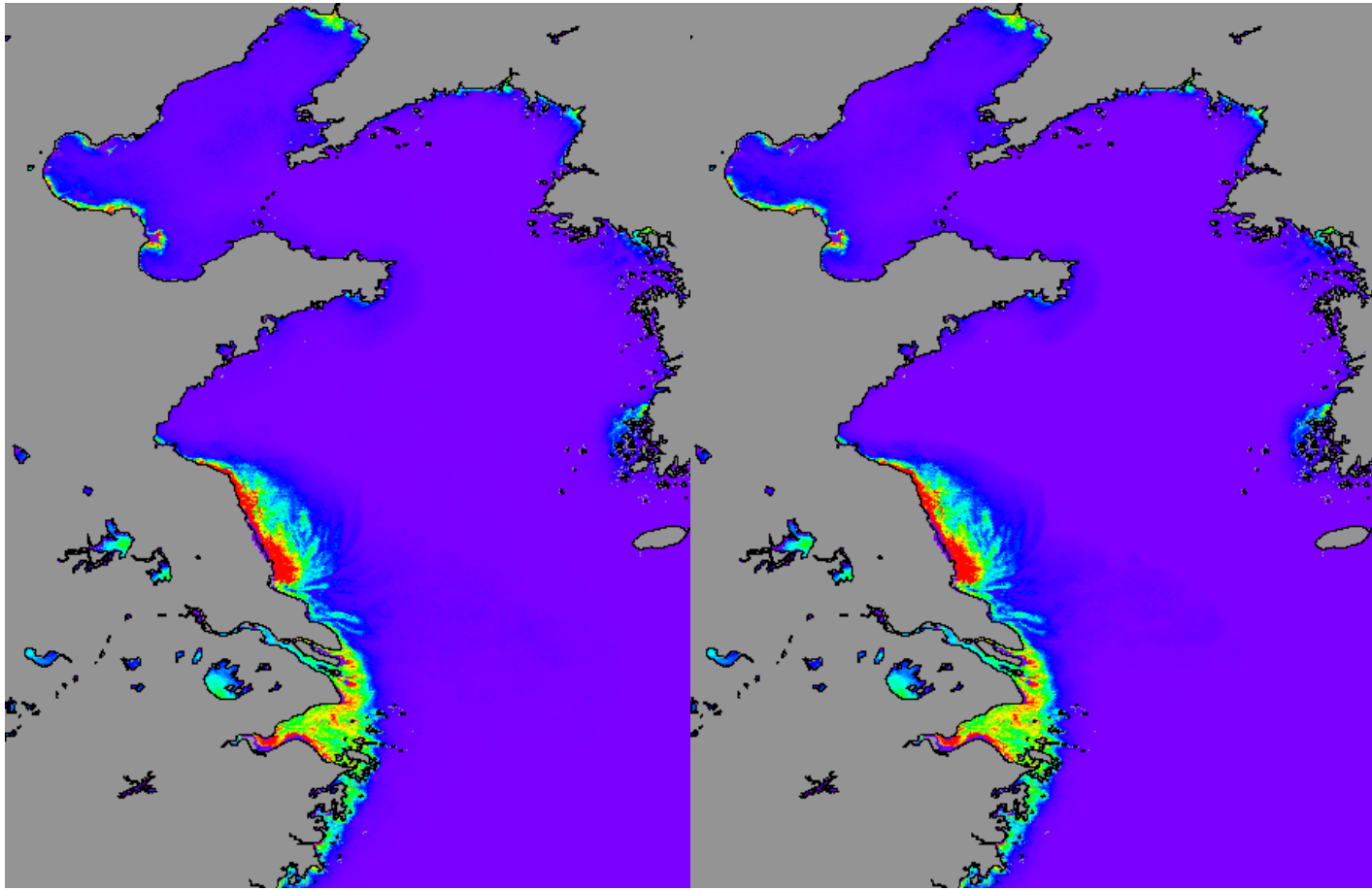
China East Coast

VIIRS (OC-SDR) Climatology Images (2012–2015)

The **NIR** normalized water-leaving radiance contribution in highly turbid coastal regions.

China East Coast

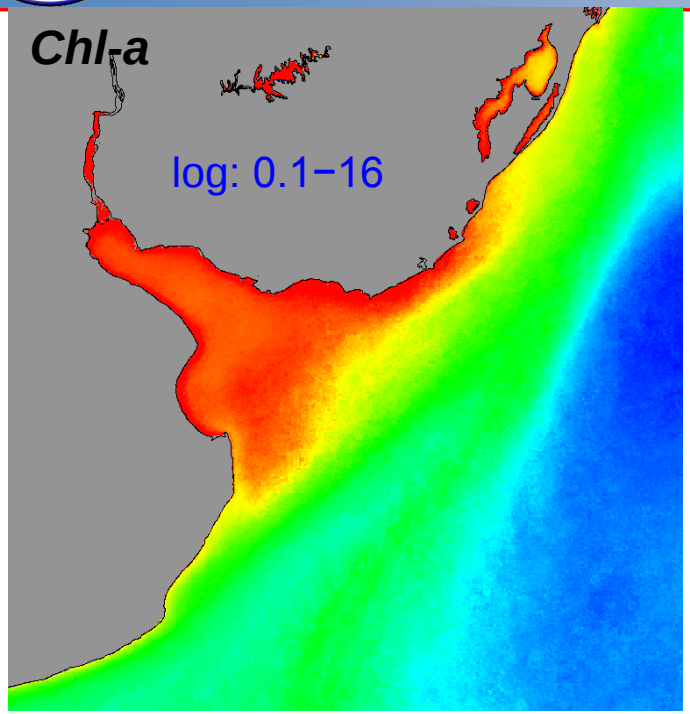
SWIR **NIR-SWIR**

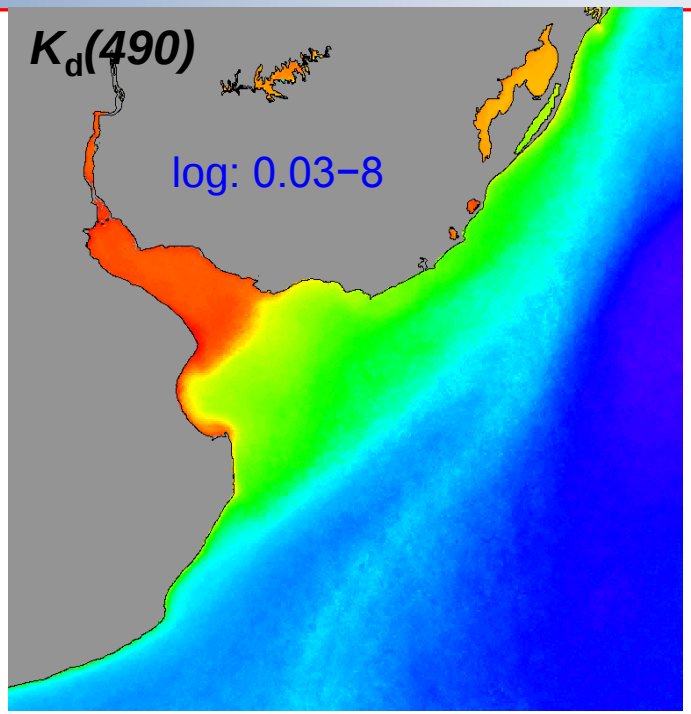


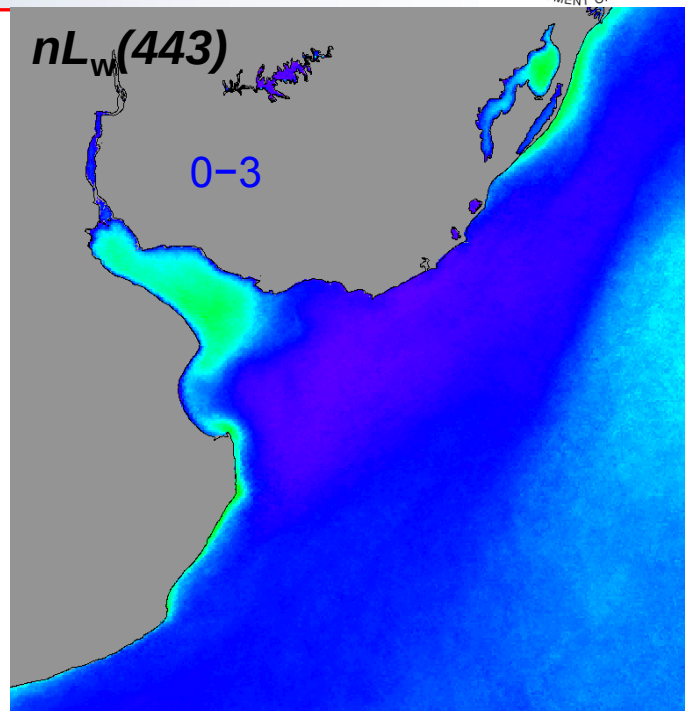
***nL*$_w$(862)** (0.0~**2**.0 mW/cm^2 μm sr in linear scale)

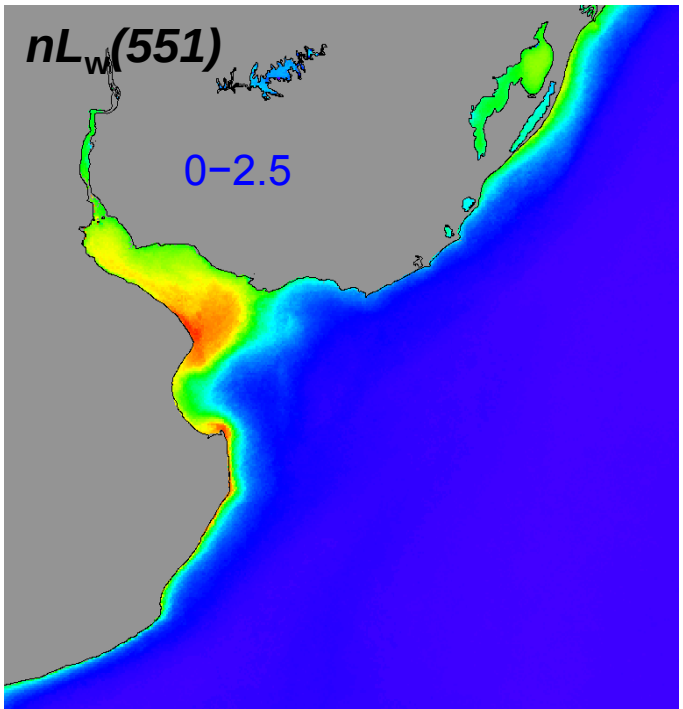
VIIRS Climatology (2012-2015) using the NIR-SWIR Approach

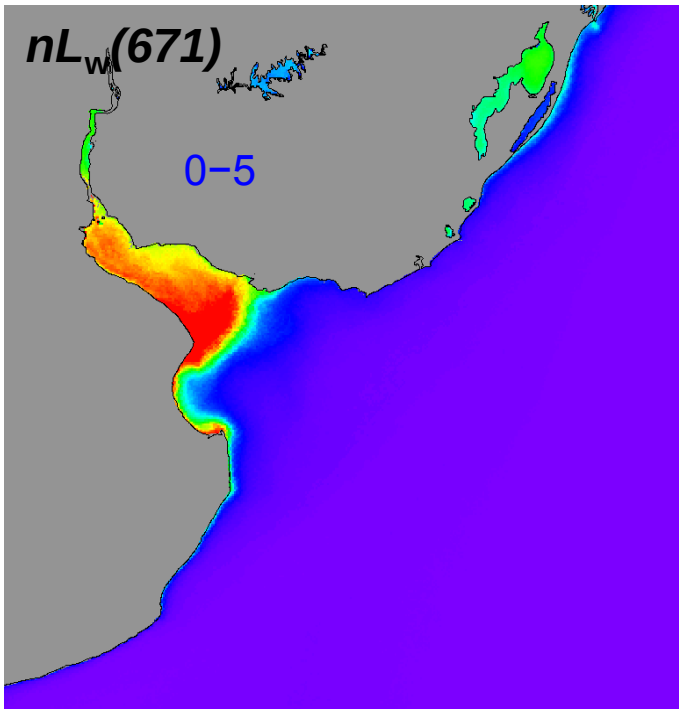
La Plata

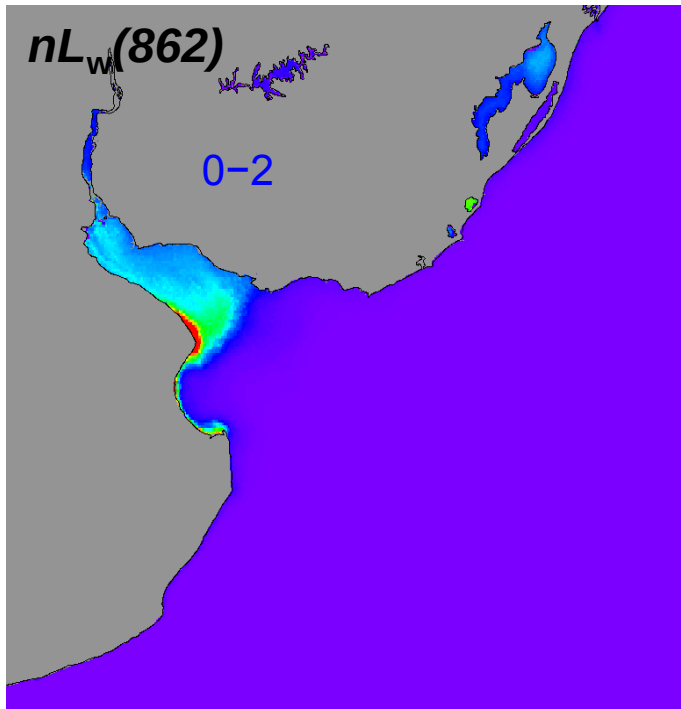












Conclusions

- We have completed VIIRS mission-long science quality ocean color data **reprocessing** (including **SDR** and **EDR**), and the data stream is now going forward. **Two data streams have been routinely produced: near-real-time and science quality ocean color data.**
- We have developed VIIRS instrument calibration capability, and with new calibration LUTs, VIIRS ocean color products are significantly improved.
- VIIRS ocean color products have been significantly improved (**over global high altitude lakes**) after the implementation of some important updates, new algorithms, and with vicarious calibrations using MOBY data.
- In general, VIIRS **normalize water-leaving radiance** spectra show reasonable agreements with in situ measurements at MOBY, AERONET-OC sites, and various other ocean regions.
- The new NIR ocean reflectance correction algorithm (**BMW**) improves ocean color data over coastal and inland waters.
- VIIRS global ocean color products have been routinely produced using the **NIR**, **SWIR**, and **NIR-SWIR** atmospheric correction algorithms, providing necessary satellite data for various applications in coastal and inland waters, as well as for further improving data quality.
- Our evaluation results show that **VIIRS-SNPP is now capable of providing high quality global ocean color products in support of science research and operational applications**.
- Have been/will be working on **VIIRS-JPSS-1**, **OLCI-Sentinel-3**, **GOCI**, **SGLI-GCOM-C**.

VIIRS Images and Cal/Val:
http://www.star.nesdis.noaa.gov/sod/mecb/color/
VIIRS Ocean Color Data:
http://coastwatch.noaa.gov/cwn/cw_products_ocLOM.html