Request for
VIIRS Ocean Color EDR Provisional Maturity

Menghua Wang
VIIRS Ocean Color EDR Team

Inputs & contributions from the VIIRS Ocean Color Team

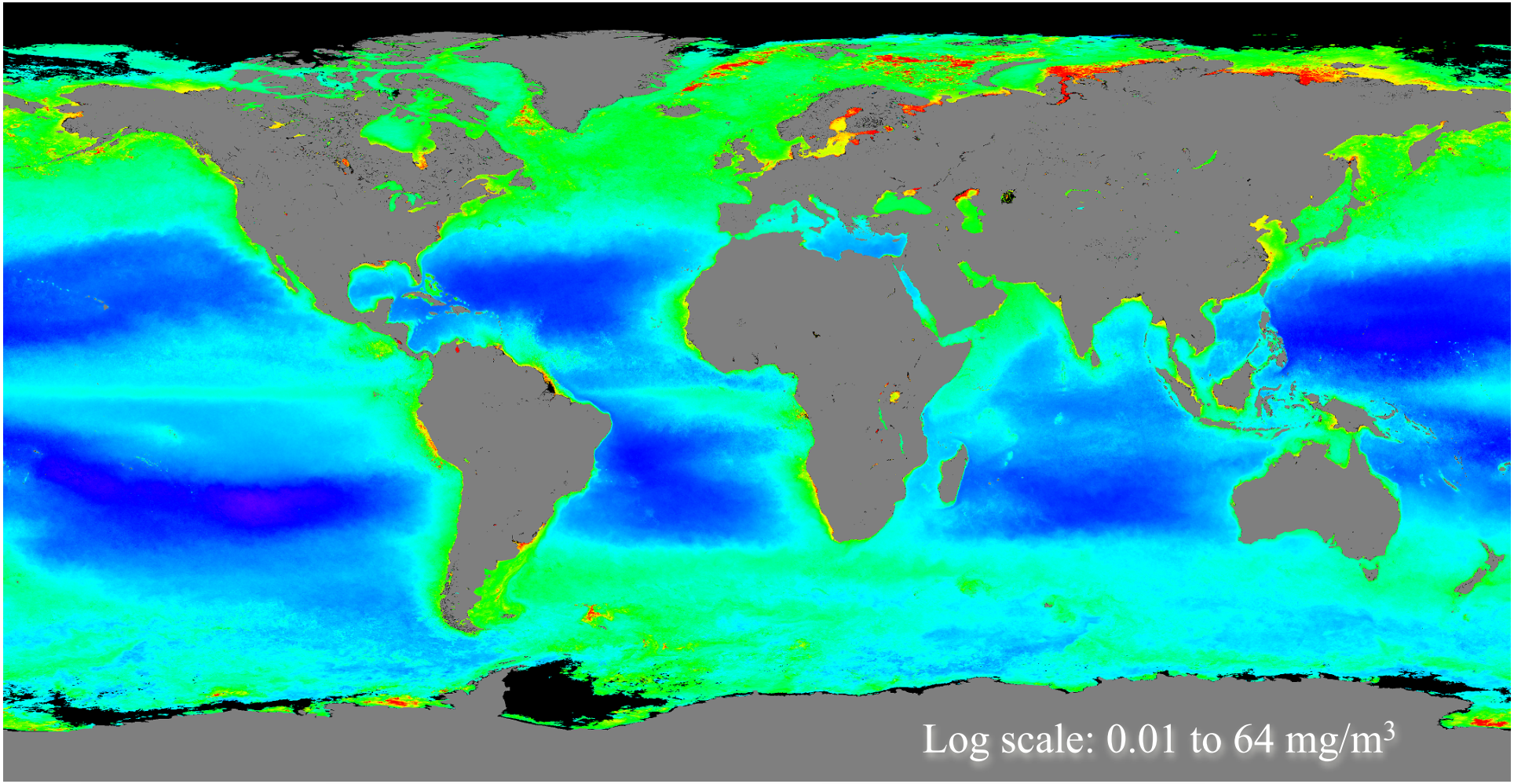
Team Members' Roles & Responsibilities

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	Leads – 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

(Feb. 2012 to Sep. 2013)



Generated from VIIRS IDPS Ocean Color EDR

Summary of VIIRS OCC EDR Algorithms

- **Inputs**: VIIRS M1-M7 bands SDR data, terrain-corrected geo-location file, SST EDR data (not used for current OC3V chlorophyll-a algorithm), cloud mask Intermediate Product (IP), on-board calibrator IP, 7 ancillary data files, 7 lookup tables, and 1 configurable parameter file.
- **Outputs**: Chlorophyll-a (Chl-a) concentration, normalized water-leaving radiance (nLw's) at bands M1-M5, Inherent Optical Properties (IOP-a and IOP-s) at VIIRS bands M1-M5, and quality flags. Primary outputs are chlorophyll-a and normalized water-leaving radiances.
- There are three sets of algorithms in the IDPS OCC-EDR data processing:
  - The Gordon & Wang (1994) atmospheric correction algorithm: including corrections for ozone, Rayleigh (molecules) and aerosols, ocean surface reflection, sun glint, whitecap, and sensor polarization effects.
  - chlorophyll-a algorithm: currently with OC3V algorithm (heritage algorithm), with option to switch between the OC3V and Carder chlorophyll-a algorithms.
  - IOP algorithm: Carder IOP algorithm.

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

EDR Provisional Maturity Definition

- Product quality may not be optimal
  - Product accuracy is determined for a broader (but still limited) set of conditions.
  - No requirement to demonstrate compliance with specifications.
- Incremental product improvements still occurring
  - DR history and future planned efforts will be shown.
- General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
- Users are urged to consult the EDR product status document prior to use of the data in publications
- Ready for operational evaluation

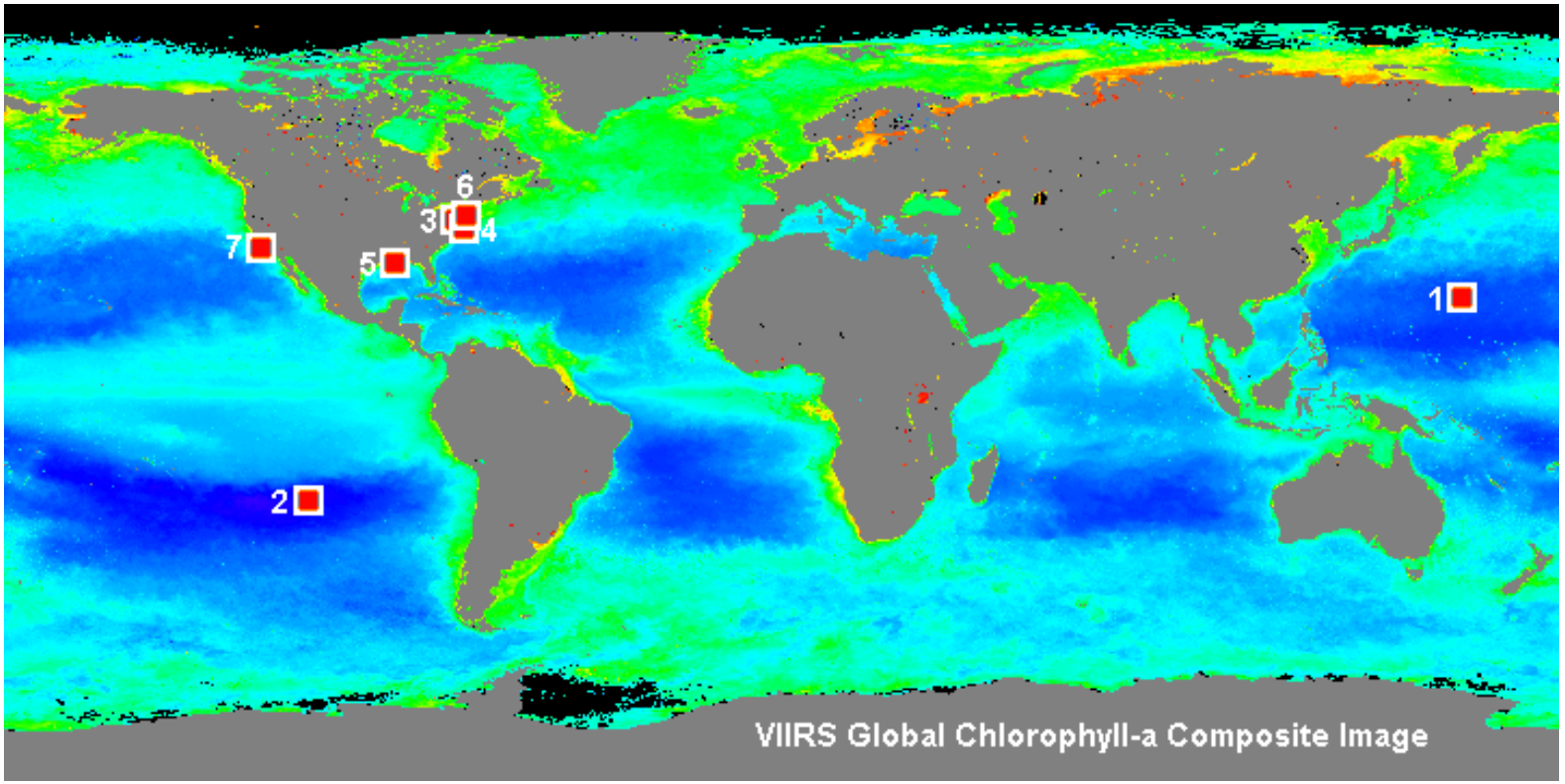
History of Algorithm Changes/Updates

- Changed chlorophyll-a algorithm from Carder algorithm to OC3V algorithm (heritage algorithm) with updated coefficients (DR4247, implemented in Mx5.1).
- Retrieval and output of Chl-a and IOPs when M5 remote-sensing reflectance is negative (DR4814, implemented in Mx6.3).
- Processing Chl-a and IOPs for pixels with negative normalized water-leaving radiance nLw (or remote-sensing reflectance Rrs) at some of the VIIRS ocean color bands (M1-M5) (DR4869, implemented in Mx6.6).
- Retrieval and output of OCC over coastal and inland waters (DR4877, implemented in Mx6.6).
- Changed Ocean Color HRI from sensor-zenith angle of 53^{o} to 60^{o} for more data coverage (DR4898, implemented in Mx6.6).
- Updated OCC operational software to enable ocean color data processing up to solar-zenith angles of 80^{o} instead of 70^{o} (note: the high solar-zenith angle is still at 70^{o}) (DR4940, implemented in Mx7).
- Updated the vicarious gain coefficients (in operation since June 17, 2013).
- Fixed some flag related bugs.
- Fixed bugs in sun glint correction code (to be implemented).

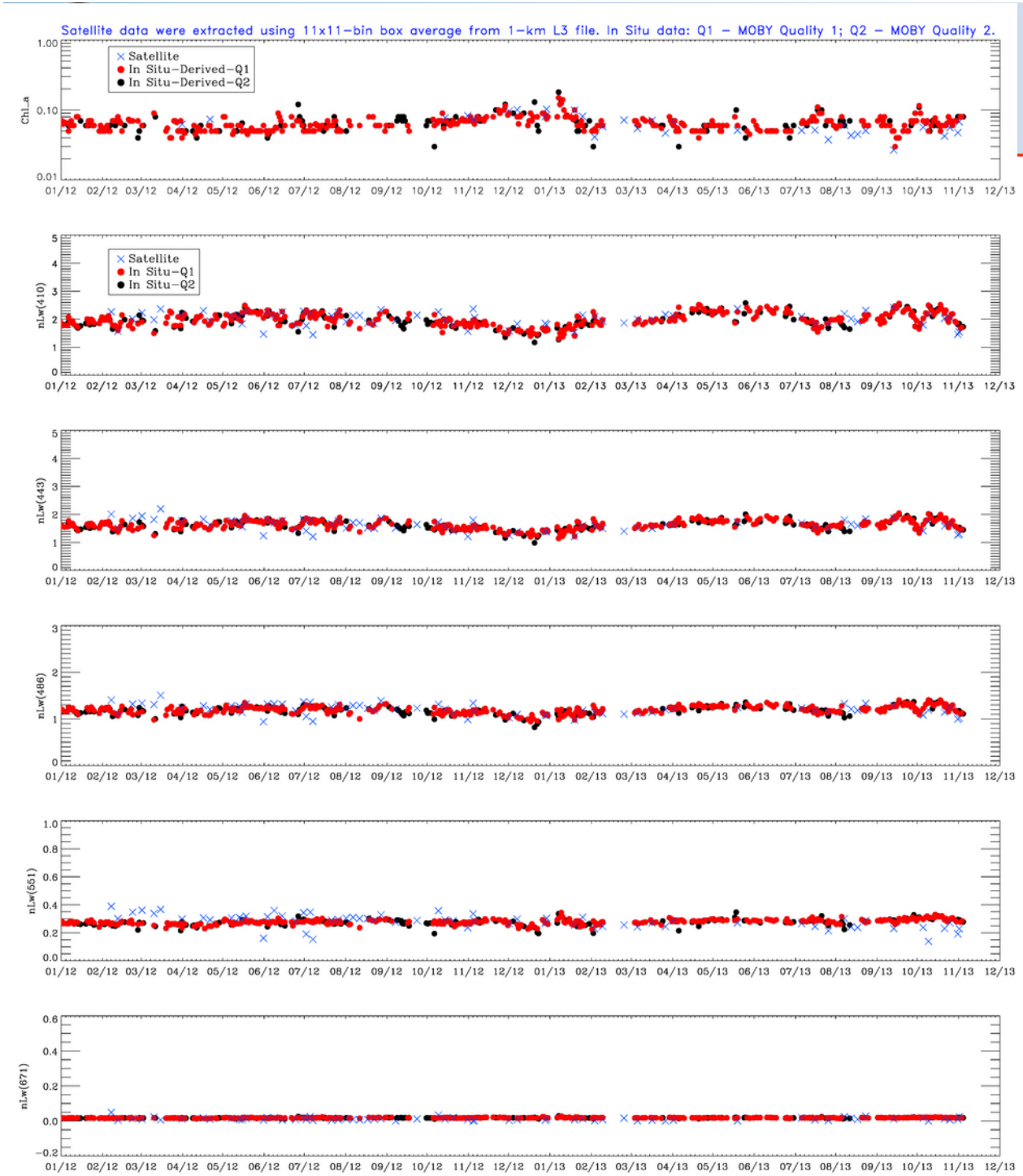
Provisional Maturity Evaluation

- Compared VIIRS OCC EDR data at MOBY site with MOBY in situ data since February 6, 2012.
- Some extensive validation results from AERONET-OC in situ measurements.
- Validation results from various ocean regions using in situ data.
- Monitoring VIIRS OC EDR data at the South Pacific Gyre.
- Compared VIIRS OC EDR data with JPSS Algorithm Development Libraries (ADL) results.
- Compared VIIRS OC EDR data with those from NRL-APS data processing.
- Extensively compared VIIRS OC EDR data with those from NOAA ocean color science processing (NOAA-MSL12). VIIRS RDR data were re-processed to SDR using ADL with updated daily F-LUTs, and then NOAA-MSL12 was used to process from SDR to ocean color Level-2 data (EDR).
- Extensively compared VIIRS OC EDR data with those form MODIS-Aqua in various regions, and global deep waters and oligotrophic waters.

VIIRS Ocean Color EDR Monitoring Sites

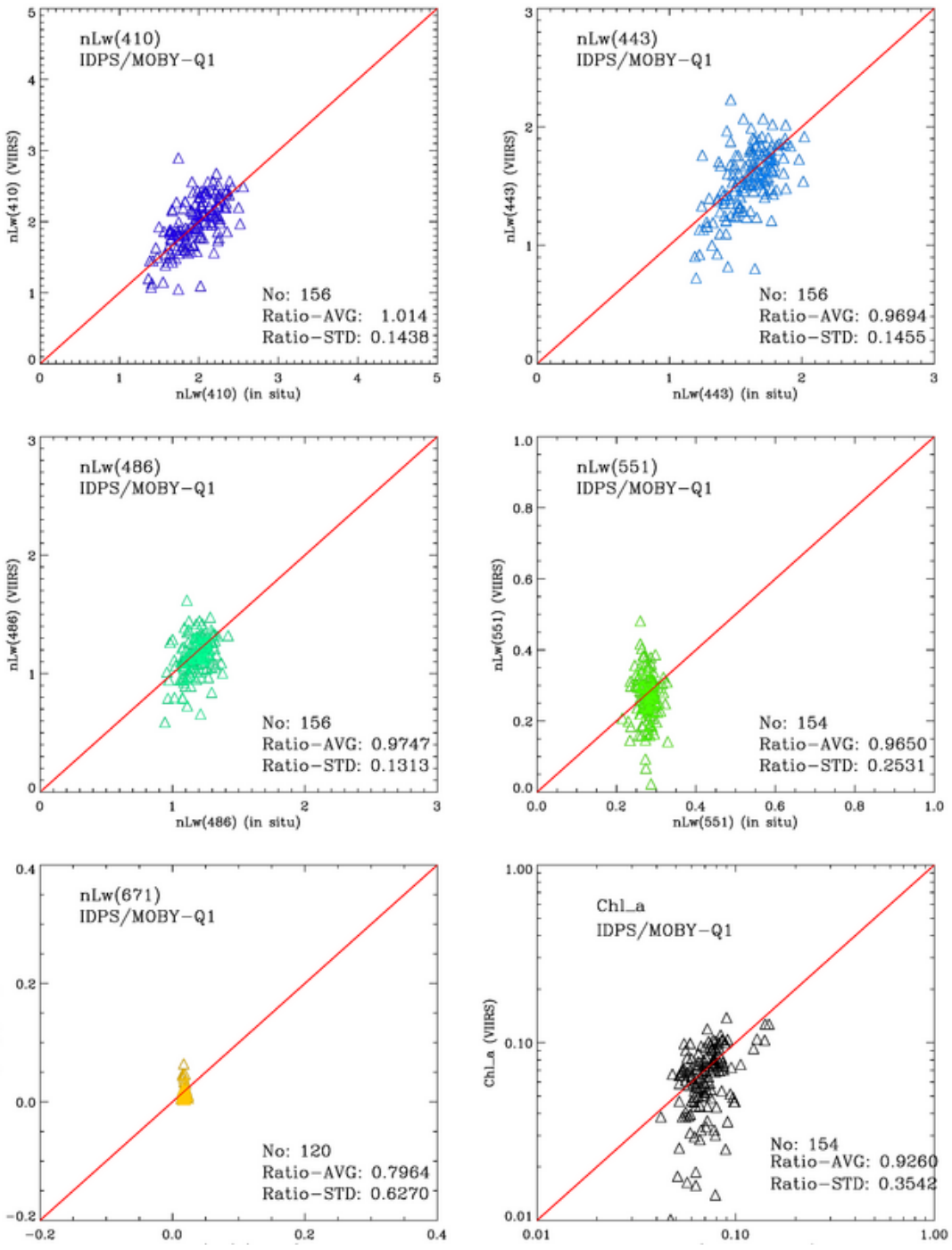


1. MOBY Site; 2. South Pacific Gyre; 3. Chesapeake Bay; 4. US East Coast; 5. AERONET-OC CSI Site; 6. AERONET-OC LISCO Site; 7. AERONET-OC USC Site.



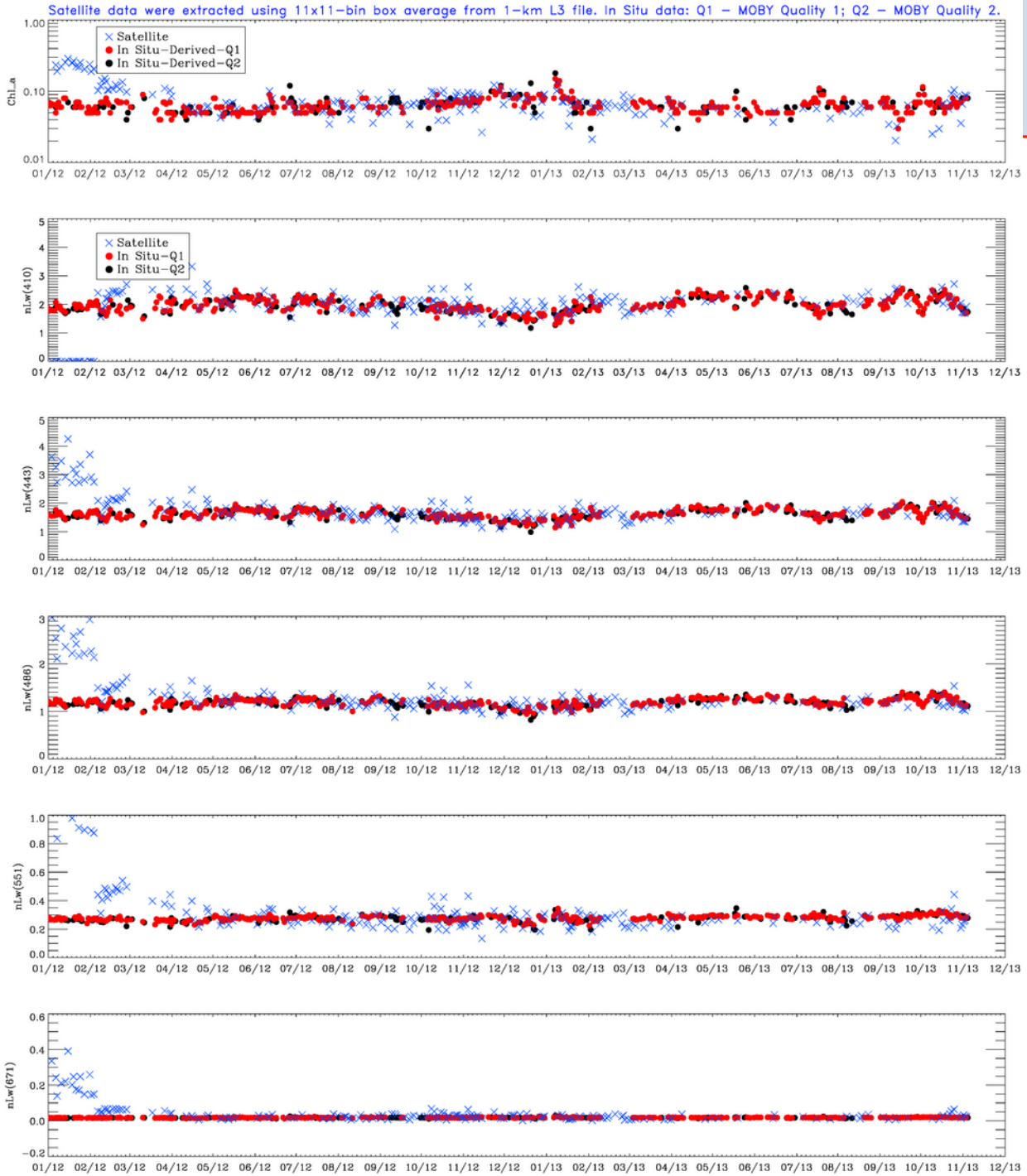
Comparison of
VIIRS IDPS OC EDR with
MOBY in situ data since
February 6, 2012.

Note:
Vicarious calibration gains
applied since June 17, 2013.



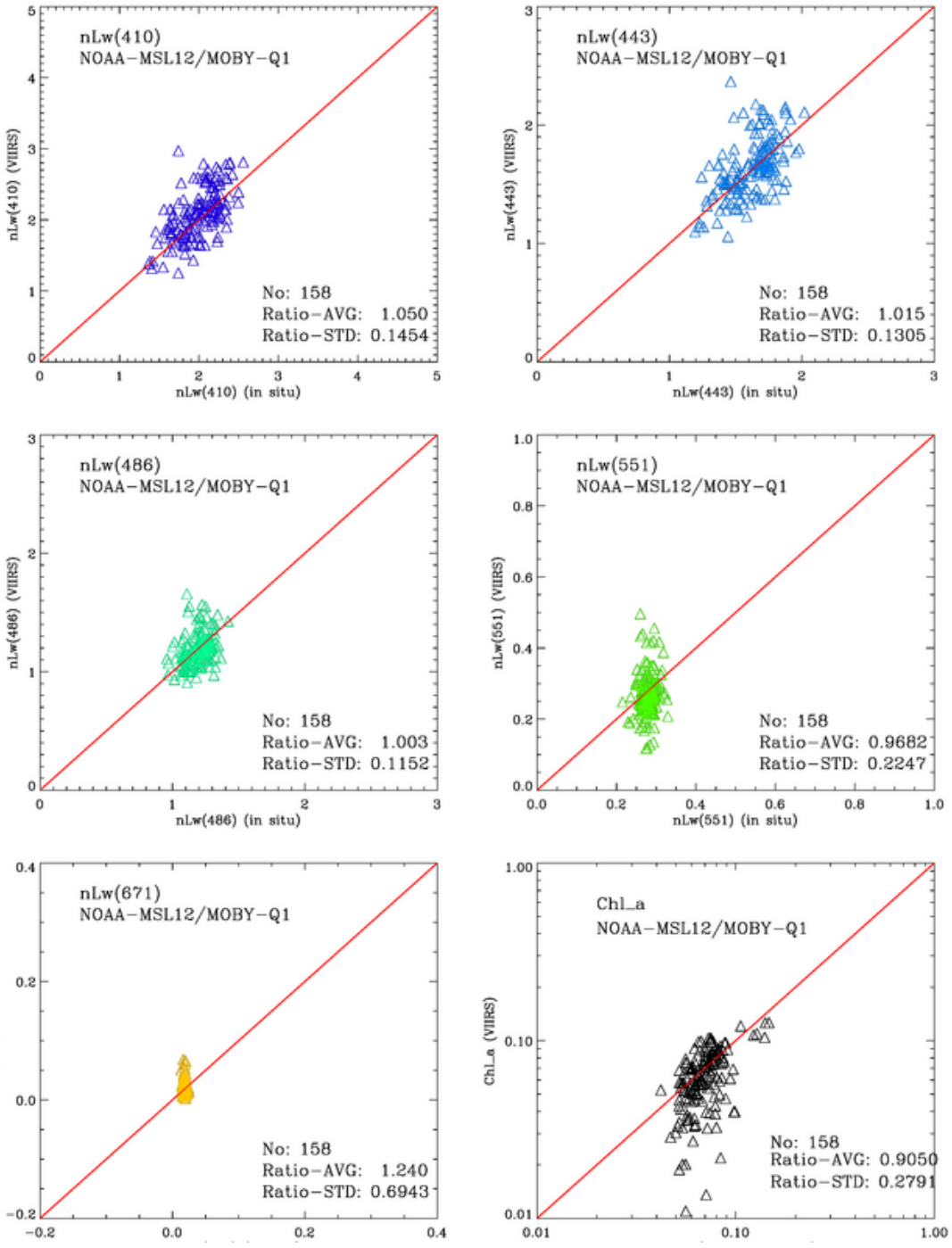
Scatter plots of VIIRS IDPS OC EDR data match-up with MOBY in situ data (Quality-1) since February 6, 2012.

Note:
Vicarious calibration gains applied since June 17, 2013.



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

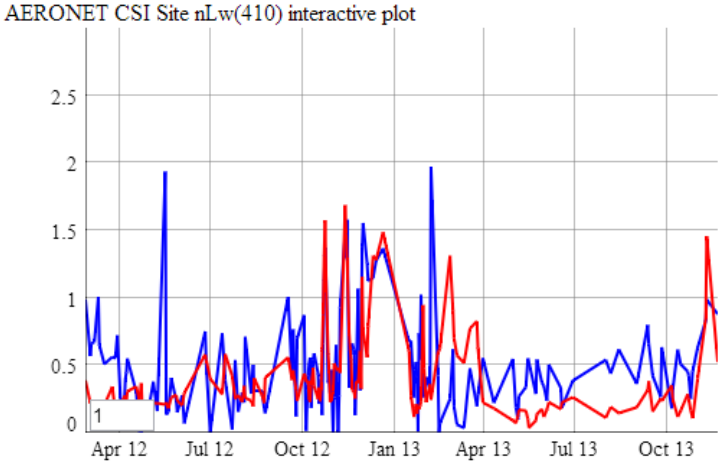
Note:
Vicarious calibration gains applied since May 2012.

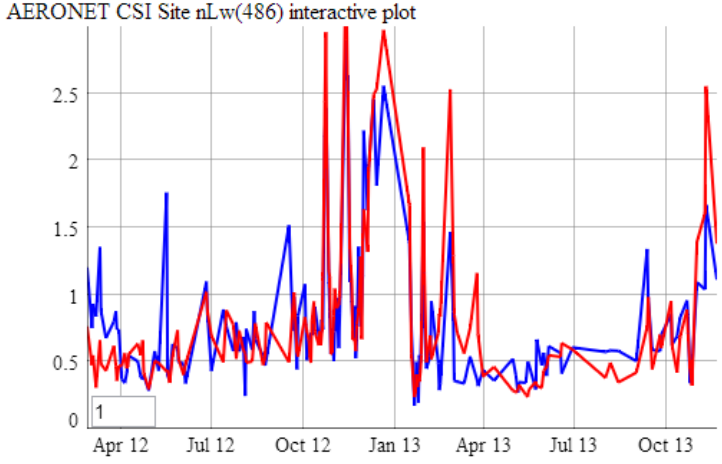


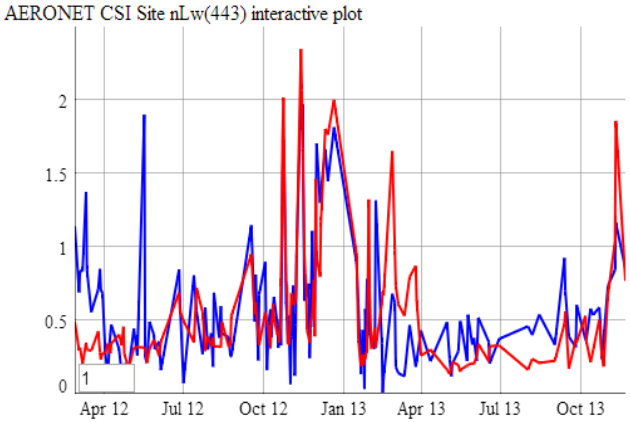
Scatter plots of NOAA-MSL12 Level-2 data match-up with MOBY in situ data (Quality-1).

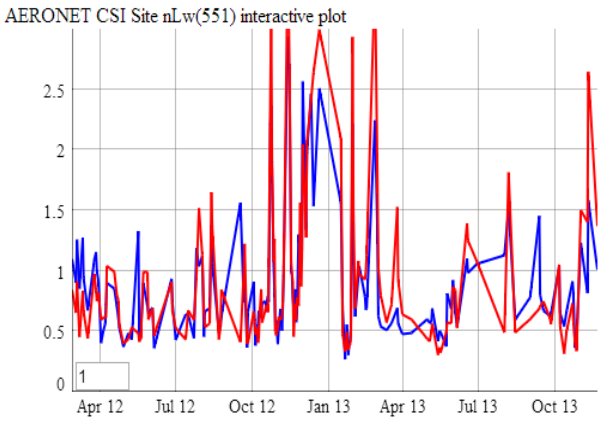
Note:
Vicarious calibration gains applied since May 2012. Thus, they are used as verification.

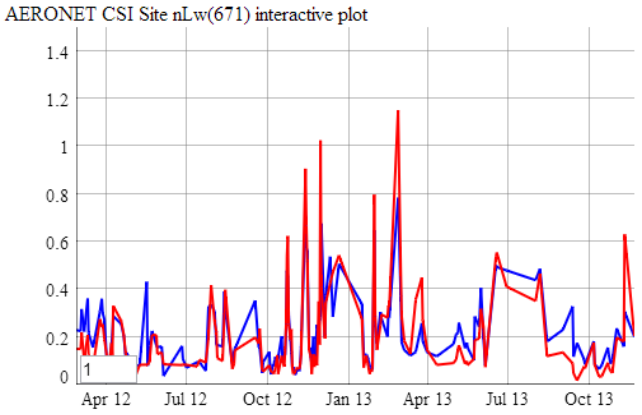
AERONET-CSI nL_w Time Series





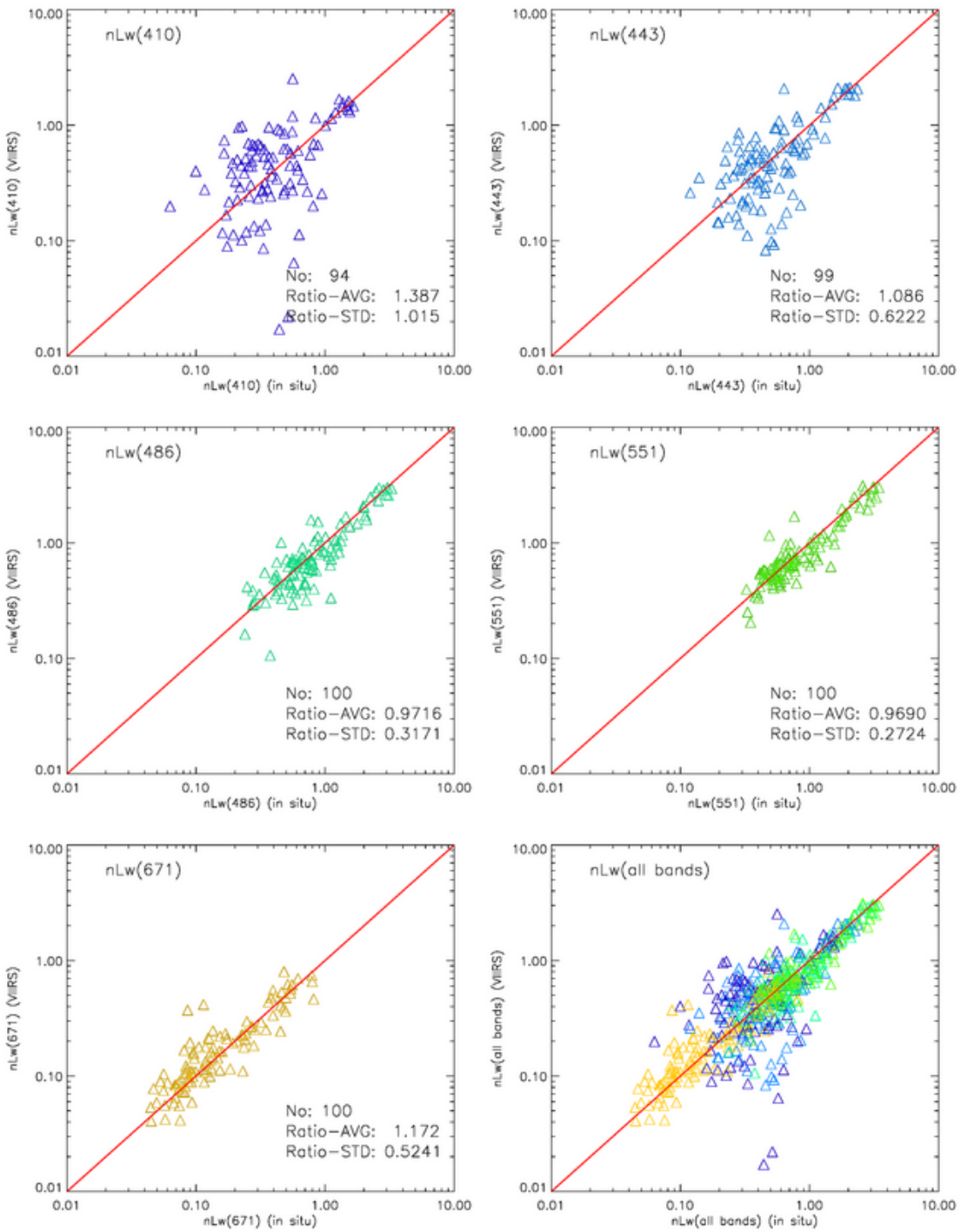






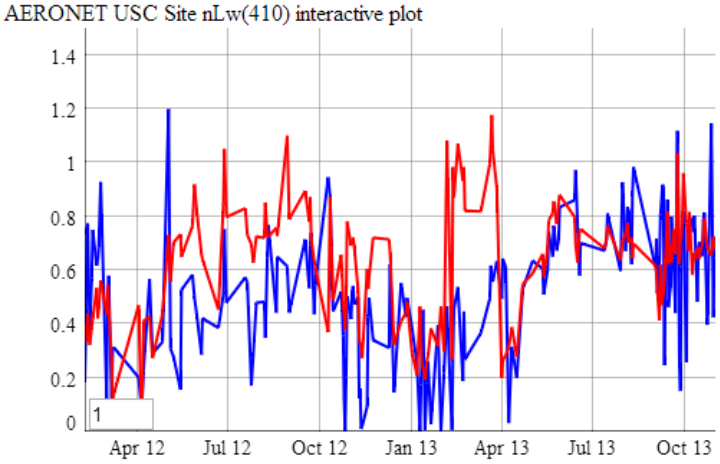
In Situ

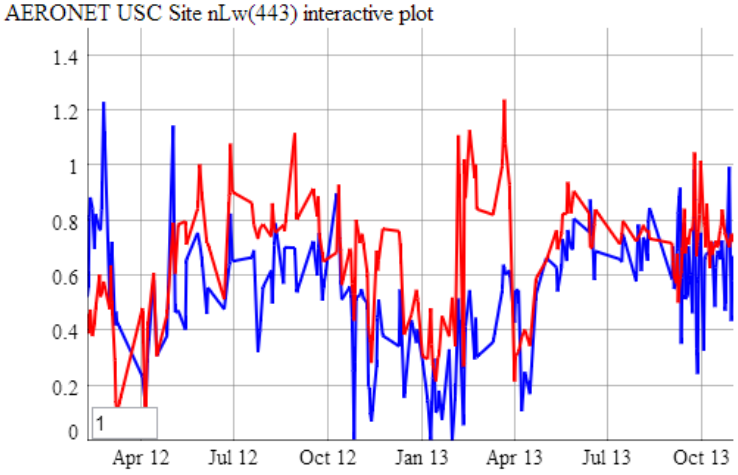
VIIRS (NOAA-MSL12)

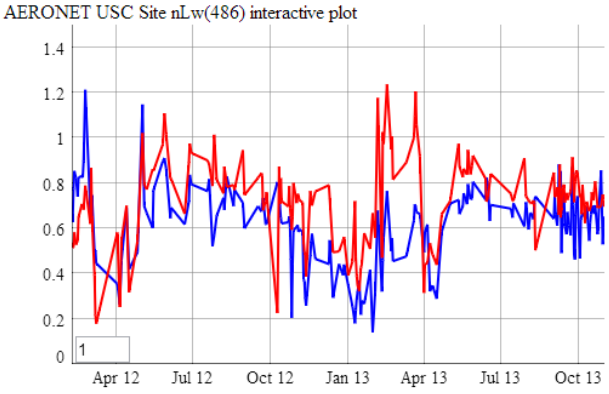


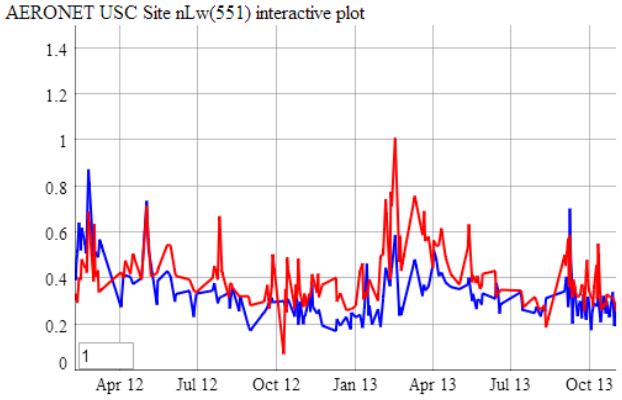
AERONET-CSI nL_w scatter plot

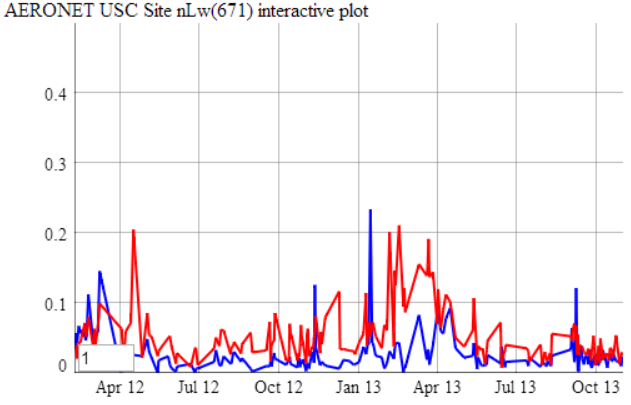
AERONET-USC nL_w Time Series





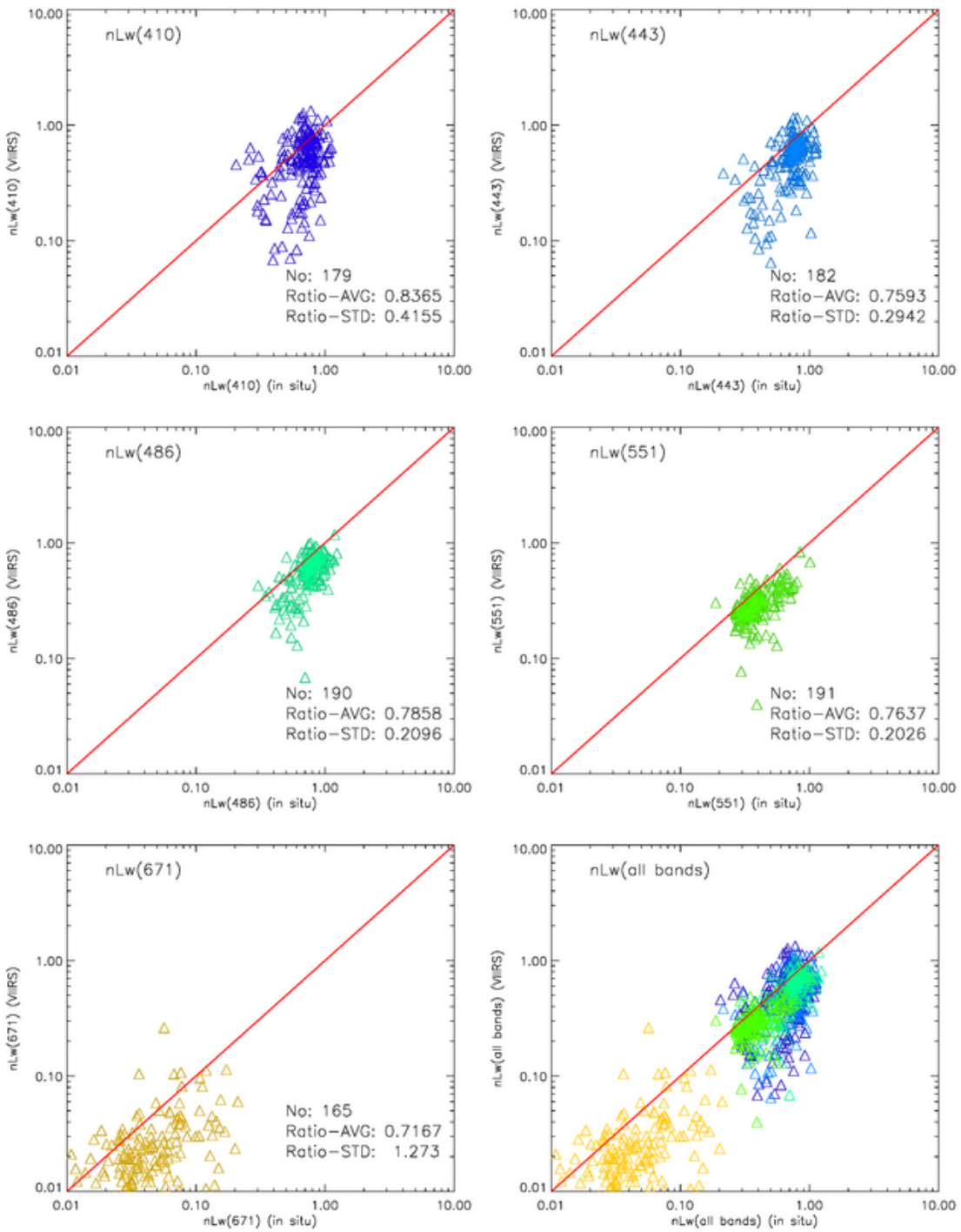






In Situ

VIIRS (NOAA-MSL12)



AERONET-USC nL_w scatter plot

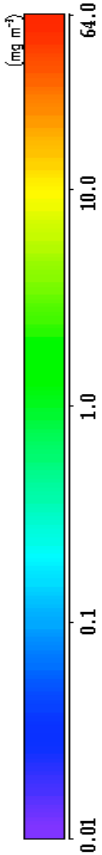
VIIRS vs. MODIS-Aqua Global Images

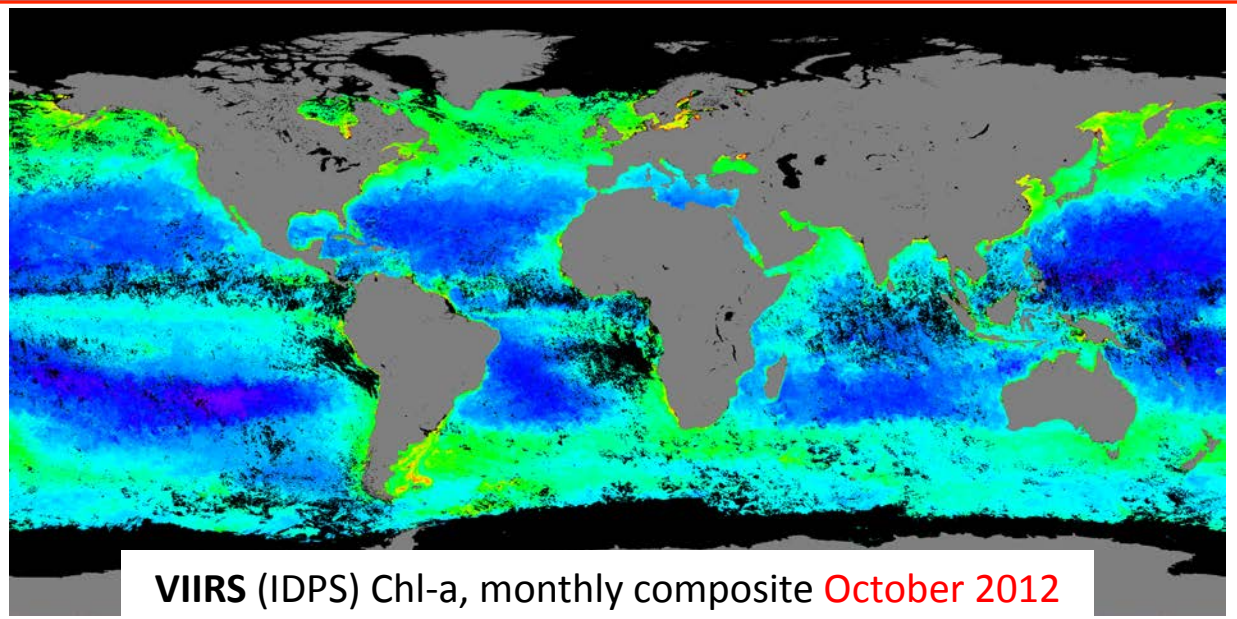
- VIIRS OC EDR team has been routinely downloading MODIS-Aqua ocean color products from NASA/OBPG ocean color website since VIIRS launch.
- MODIS-Aqua ocean color data are converted to appropriate units for comparisons.
- Daily, 8-day, and monthly global MODIS-Aqua ocean color data have been produced and compared with those from VIIRS ocean color products.
- Example global ocean color data comparisons from VIIRS (IDPS) and MODIS-Aqua are provided in the following slides.
- The monthly global images show that VIIRS and MODIS-Aqua were consistent in 2012, but discrepancy started to appear since early 2013.
- It is determined now that the Chl-a differences between VIIRS and MODIS-Aqua are due to VIIRS SDR calibration issues.

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

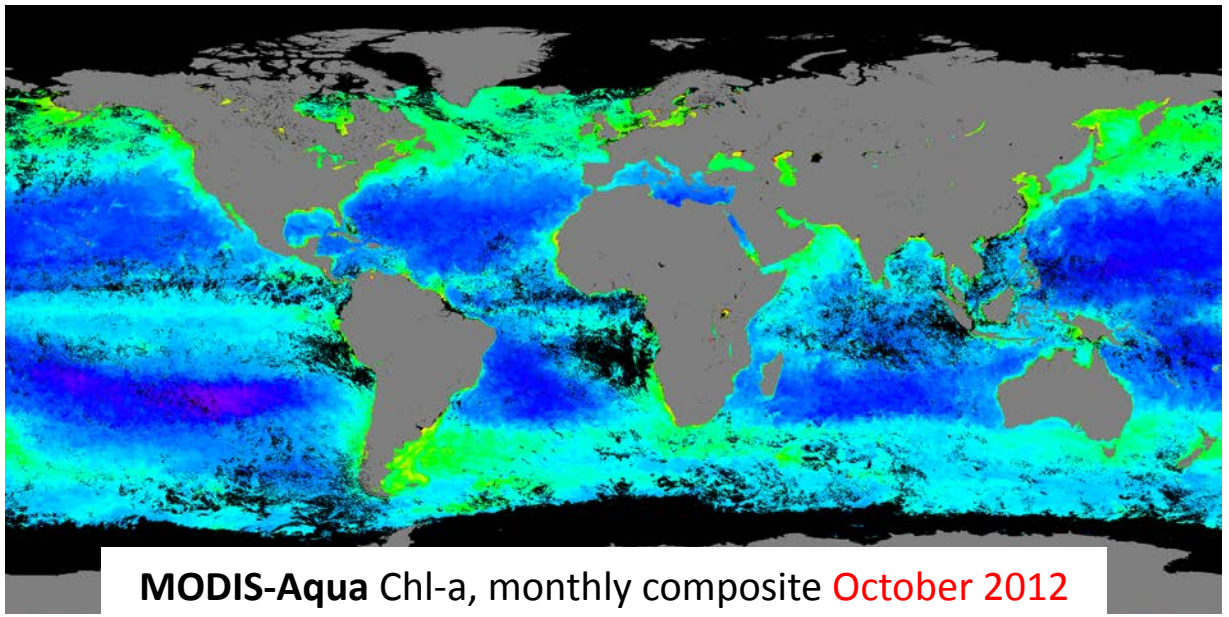
Chlorophyll-a

Log scale:
0.01 to 64 mg/m3





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



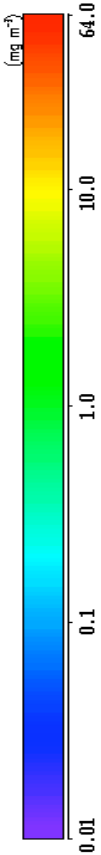
MODIS-Aqua Chl-a, monthly composite October 2012

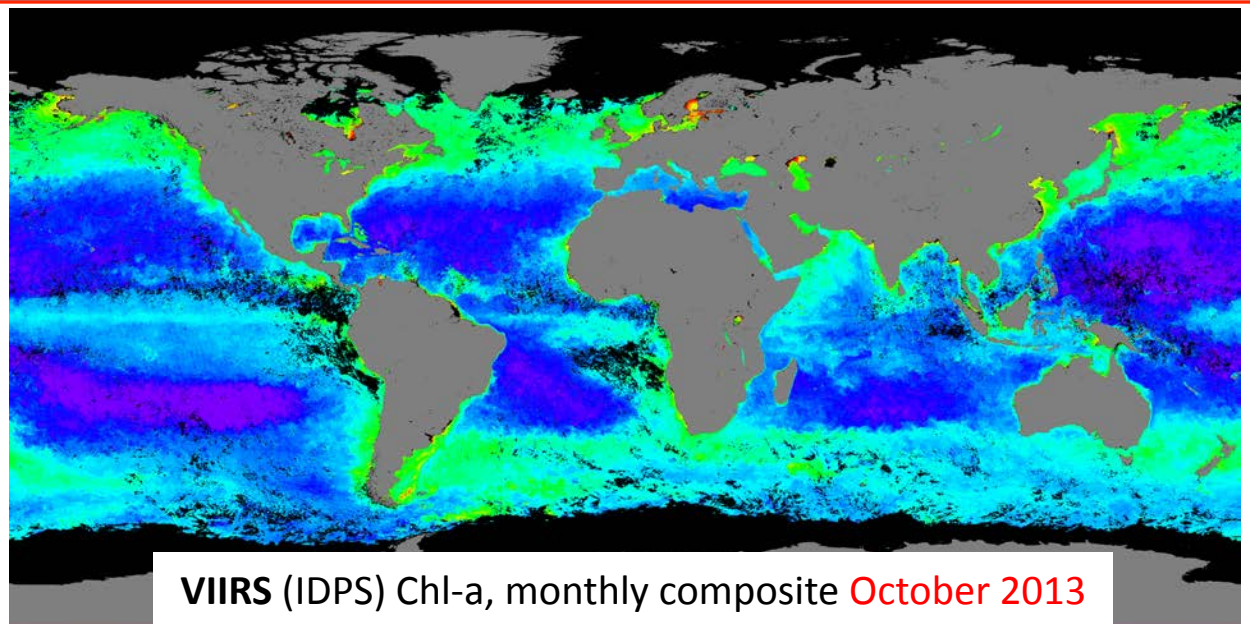
MODIS-Aqua data were obtained from NASA/OBPG ocean color website.

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

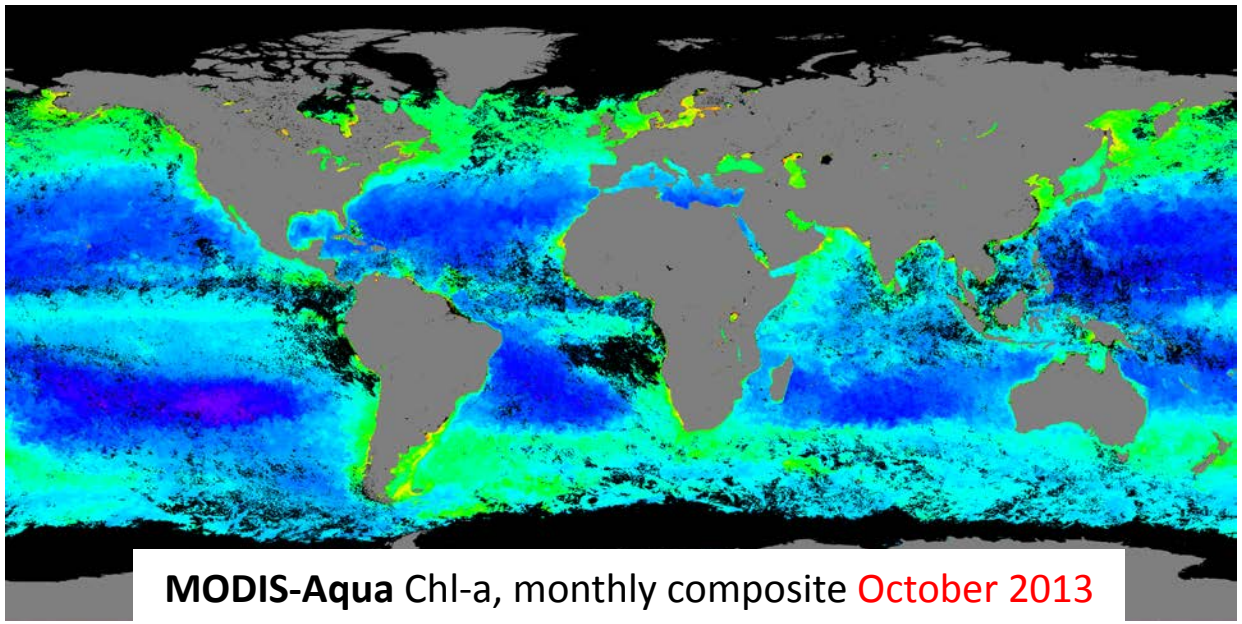
Chlorophyll-a

Log scale:
0.01 to 64 mg/m3





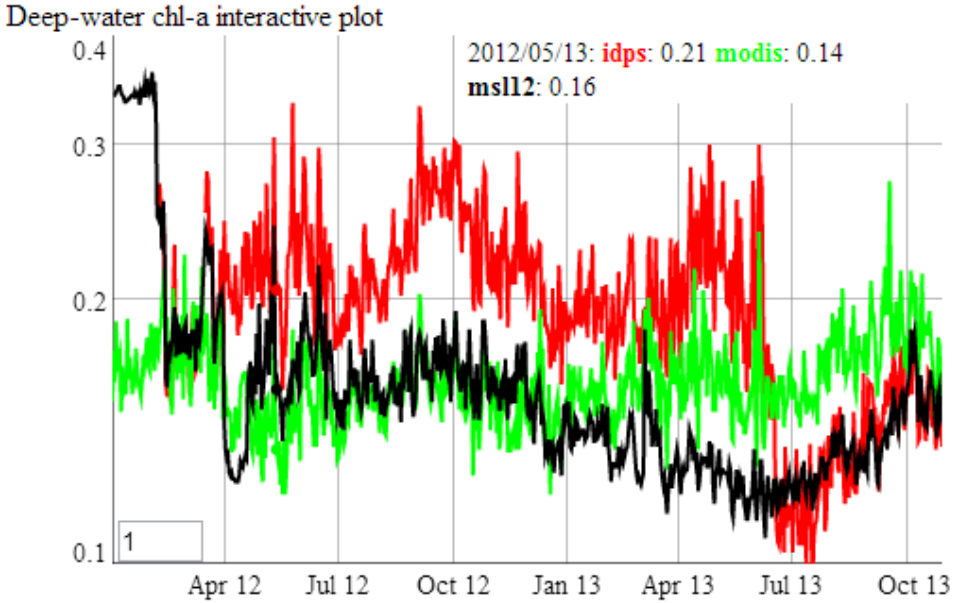
VIIRS (IDPS) Chl-a, monthly composite October 2013



MODIS-Aqua Chl-a, monthly composite October 2013

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

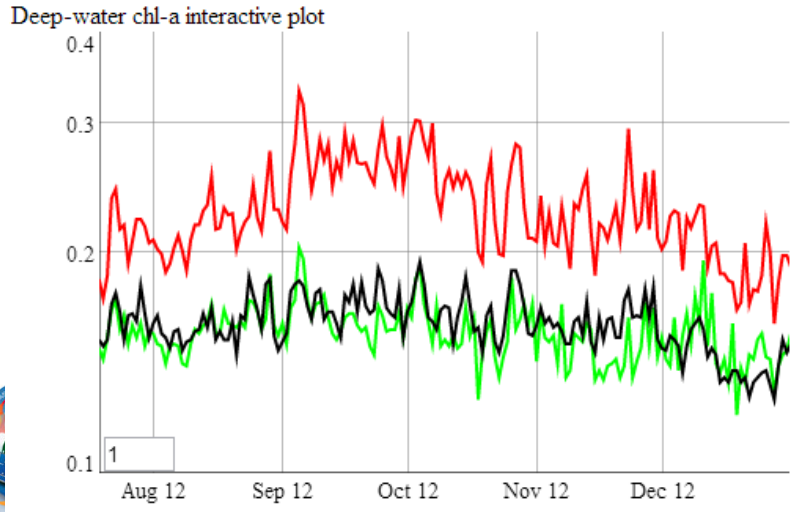
VIIRS vs. MODIS Quantitative Comparisons

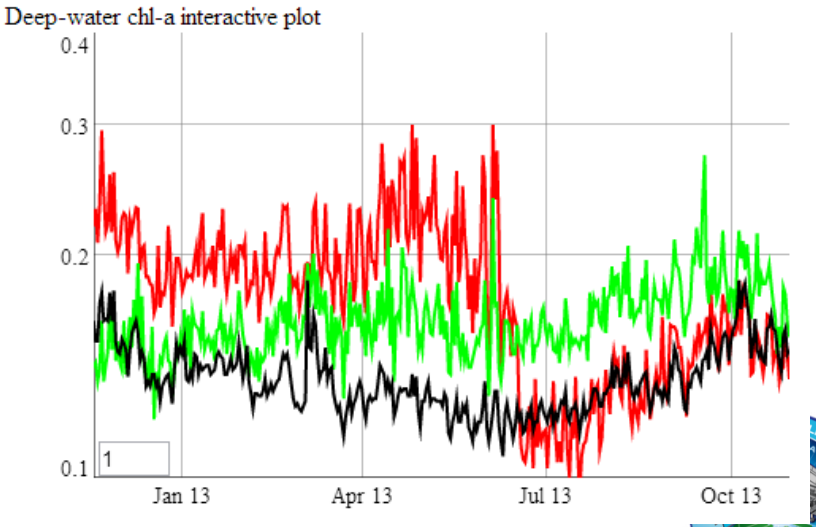


Comparison of VIIRS IDPS OC EDR with MODIS-Aqua and NOAA-MSL12 results in **global deep-water** open oceans.

Vicarious gain applied in IDPS data since June 2013.

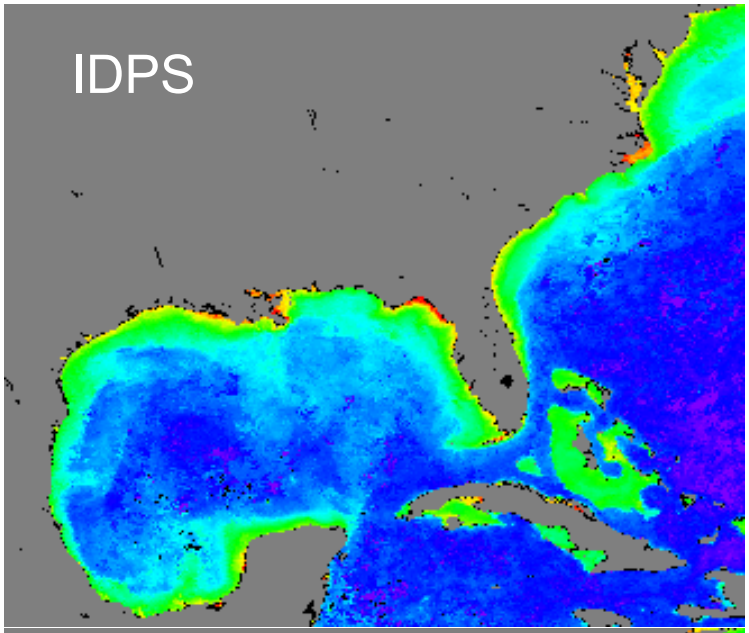
MODIS-Aqua data were obtained from NASA/OBPG ocean color website.

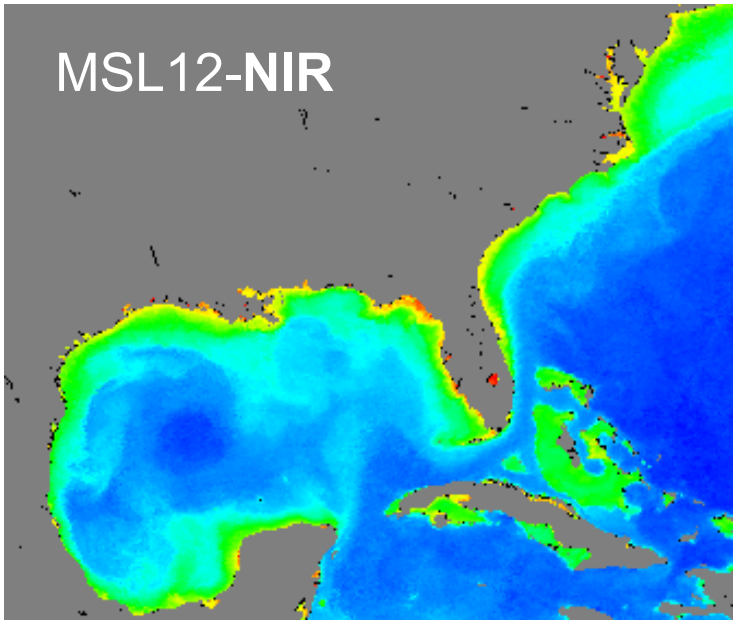


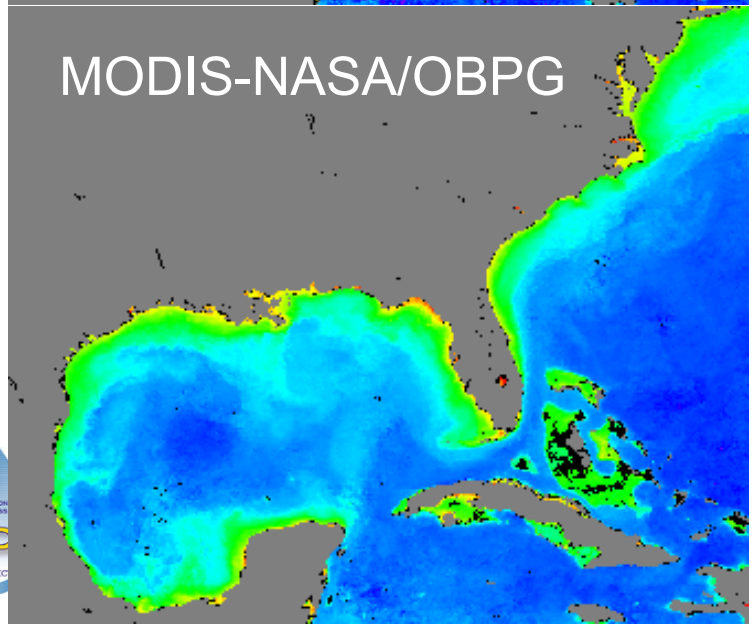


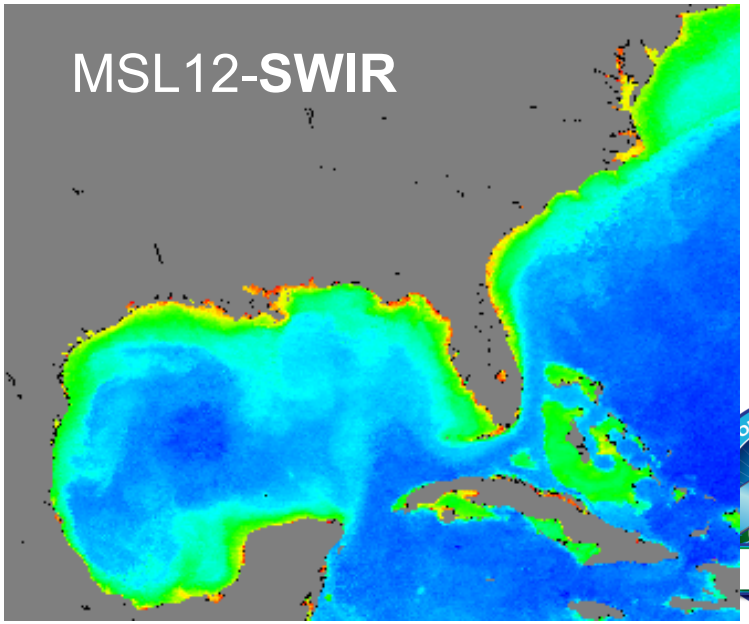
NOAA-MSL12 MODIS-Aqua IDPS

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

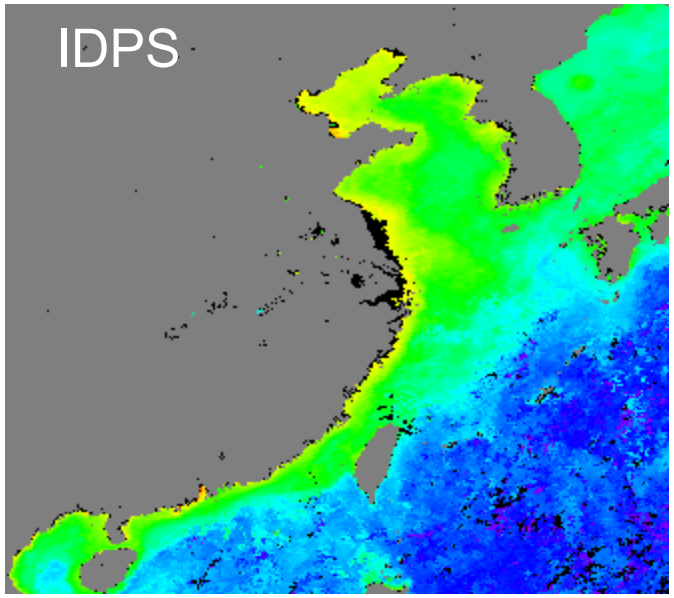


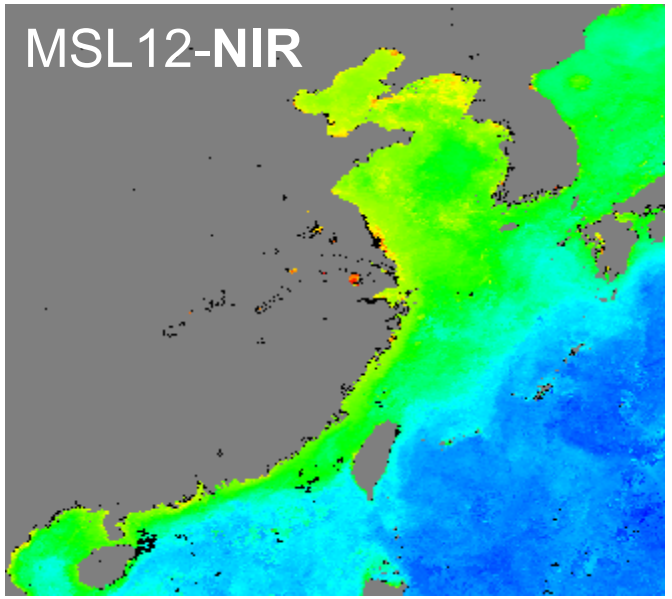


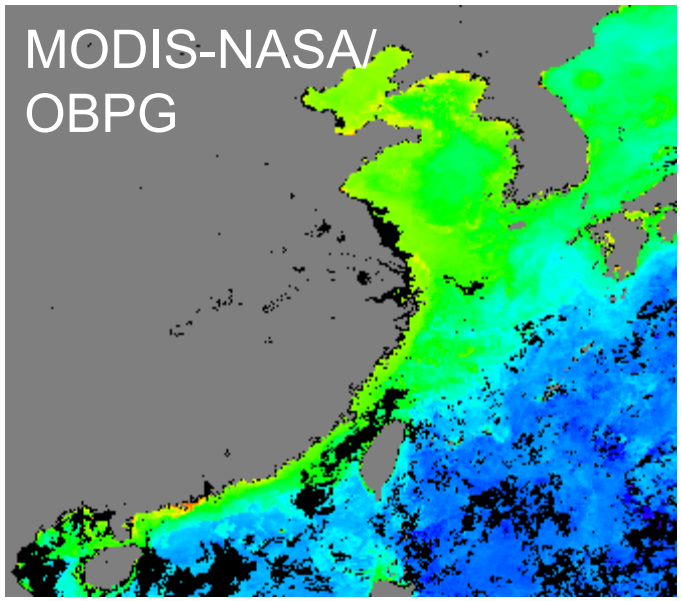


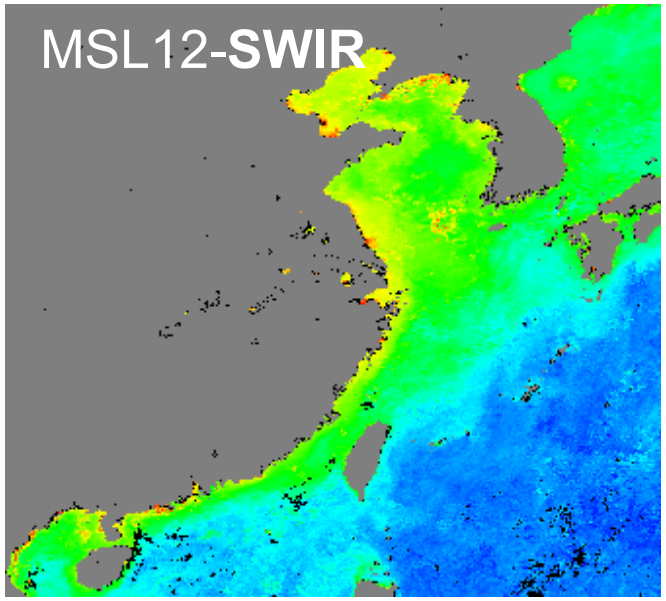


Performance in Coastal and Inland Waters (2)
(China East Coast—October 2013 Monthly)









VIIRS OC Team Cal-Val Activities

VIIRS OC Cal-Val Team Members

- NOAA STAR
- Univ. Southern Mississippi/NRL
- NIST
- Univ. of Southern California
- Oregon State Univ.
- City University of New York
- University of Massachusetts Boston
- University of South Florida
- Northrop Grumman Corporation
- MOBY team

The VIIRS OC Team has:

- Built OC near-real-time data monitoring and evaluation capability
- Obtaining in situ data in various ocean regions for VIIRS OC validation
- Improving VIIRS OC data processing system
- Provide feedback to VIIRS SDR team for SDR improvement
- VIIRS data have supported NOAA field operations

VIIRS OC Related Publications (2013)

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

Hlaing, S., T. Harmel, A. Gilerson, R. Foster, A. Weidemann, R. Arnone, M. Wang, and S. Ahmed, "Evaluation of the VIIRS ocean color monitoring performance in coastal regions," *Remote Sens. Environ.*, **139**, 398–414, 2013. http://dx.doi.org/10.1016/j.rse.2013.08.013

Jiang, L. and M. Wang, "Identification of pixels with stray light and cloud shadow contaminations in the satellite ocean color data processing," *Appl. Opt.*, **52**, 6757–6770, 2013. http://dx.doi.org/10.1364/AO.52.006757

Arnone, R., S. Ladner, G. Fargion, P. Martinolich, R. Vandermeulen, J. Bowers, and A. Lawson, "Monitoring bio-optical processes using NPP-VIIRS and MODIS-Aqua ocean color products," *Proc. SPIE* 8724, Ocean Sensing and Monitoring V, 87240Q (June 3, 2013), http://dx.doi.org/10.1117/12.2018180.

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Vandermeulen, R., R. Arnone, S. Ladner, and P. Martinolich "Improved monitoring of bio-optical processes in coastal and inland waters using high spatial resolution channels on SNPP-VIIRS sensor," *Proc. SPIE* 8724*, Ocean Sensing and Monitoring V*, 87240L (June 3, 2013), http://dx.doi.org/10.1117/12.2018108.

There are many presentations/talks related to VIIRS ocean color EDR in various meetings, conferences, workshops etc.

Considerations/Known Issues

- There was no vicarious calibration applied in the operational IDPS OCC EDR processing before June 2013 (vicarious gain applied since June 17, 2013).
- No Chl-a retrievals in case of negative remote-sensing reflectance in M1-M4 (fixed in Mx6.6).
- No retrievals in coastal and inland waters (fixed in Mx6.6).
- Sun glint masking/correction algorithm needs to be modified/improved (DR submitted/ working).
- IDPS OCC EDR quality flags need significant modifications/improvements.
- There are some limited IOP products evaluations and these products are considered as experimental products. It may require a different IOP algorithm.
- There are atmospheric correction problems in coastal turbid and inland waters due to the algorithm issue. The required algorithm for correction of the near-infrared (NIR) water-leaving radiance contributions has not been implemented in the IDPS OC EDR data processing.
- Issue with different detector-to-detector characteristics/performance (striping) (the issue related to SDR).
- **Known upstream SDR issues**:
  - Sensor degradation (suggested to update F-LUTs daily, resolved and implemented in Mx6.2).
  - Duel gain switch issue (resolved and implemented in Mx6.3).
  - No calibration updates during the shutdown (one month).
  - There are some important discrepancies between VIIRS and MODIS-Aqua Chl-a since early 2013 in global oligotrophic waters as shown in the next slide, due to VIIRS SDR calibration issue.
  - Some other SDR issues, e.g., c0 and c2, solar and lunar Cal differences, etc.

SDR Calibration Issues (1)
VIIRS Calibration Problem in 2013

MODIS-Aqua global oligotrophic water chl-a from 2002 to 2013 (green) overplotted with VIIRS data from 2012 to 2013 (red)

MODIS-Aqua

VIIRS (NOAA-MSL12)

- VIIRS and MODIS-Aqua match each other quite well in 2012.
- They have noticeable difference in 2013 (biased low from VIIRS).
- Since MODIS-Aqua has a reasonable Chl-a annual repeatability, It is confirmed that VIIRS SDR has calibration issues, in particular, for the M4 (551 nm) band (**biased low**).

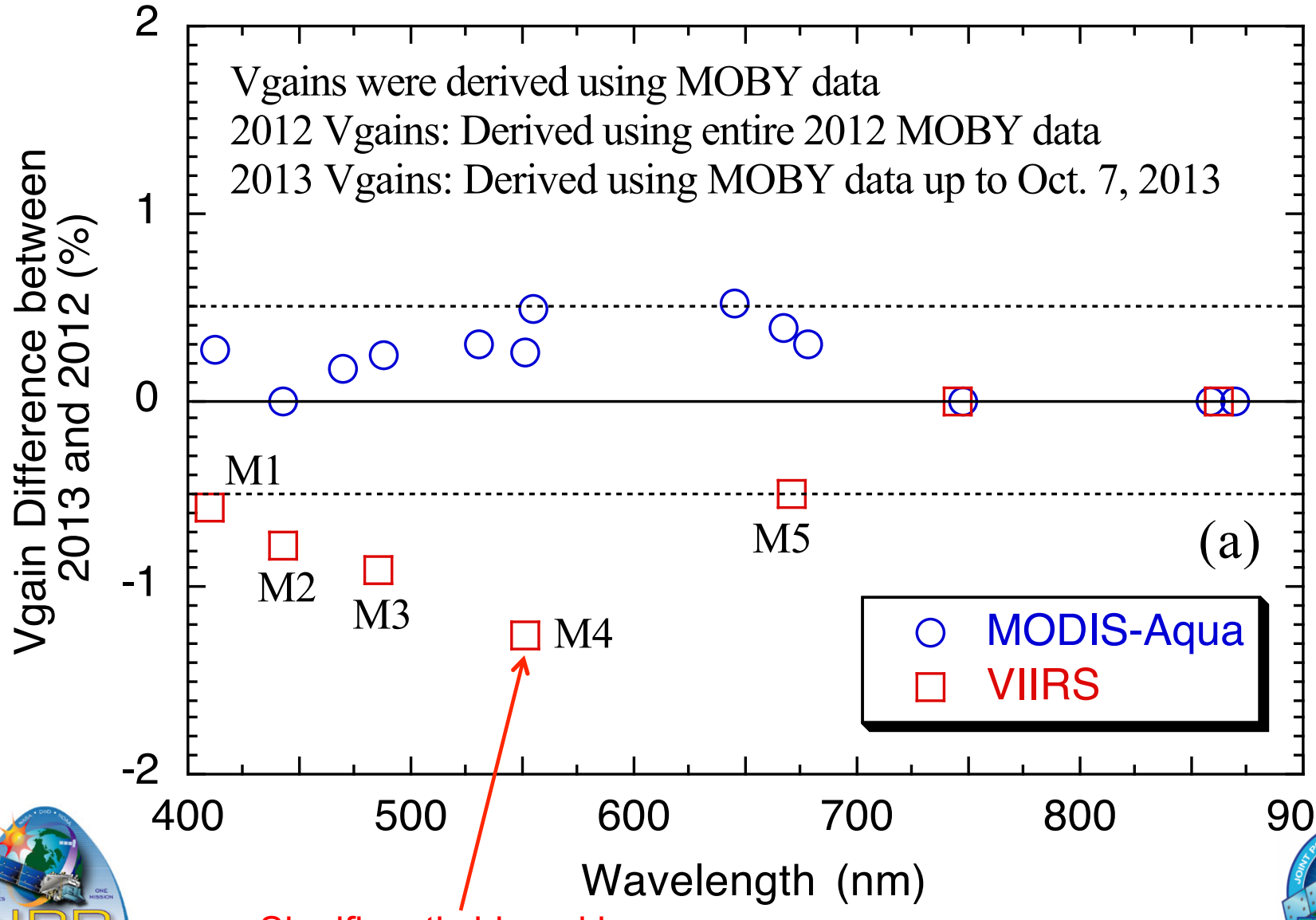
Identifying SDR Calibration Issue

- Using MOBY data, we derived the vicarious gains separately in 2012 and 2013 for both VIIRS and MODIS-Aqua. This method can identify which sensor calibration is in error.
- In an ideal case, e.g., if SDR calibration done perfectly, the derived vicarious gains for both 2012 and 2013 should be the same. In reality, however, they should be close. **Requirement is ~0.1%**.
- MODIS-Aqua **Collection-6** L1B data and VIIRS SDR derived using the **most updated F-LUTs** in the entire mission over MOBY site were used.
- NOAA-MSL12 was used for ocean color data processing for both VIIRS and MODIS-Aqua (the same data processing used for both sensors).
- Results show that VIIRS 2013 calibration for M1-M5 are biased low compared with those in 2012, in particular, band **M4** is biased low significantly, leading to biased low Chl-a values in 2013.

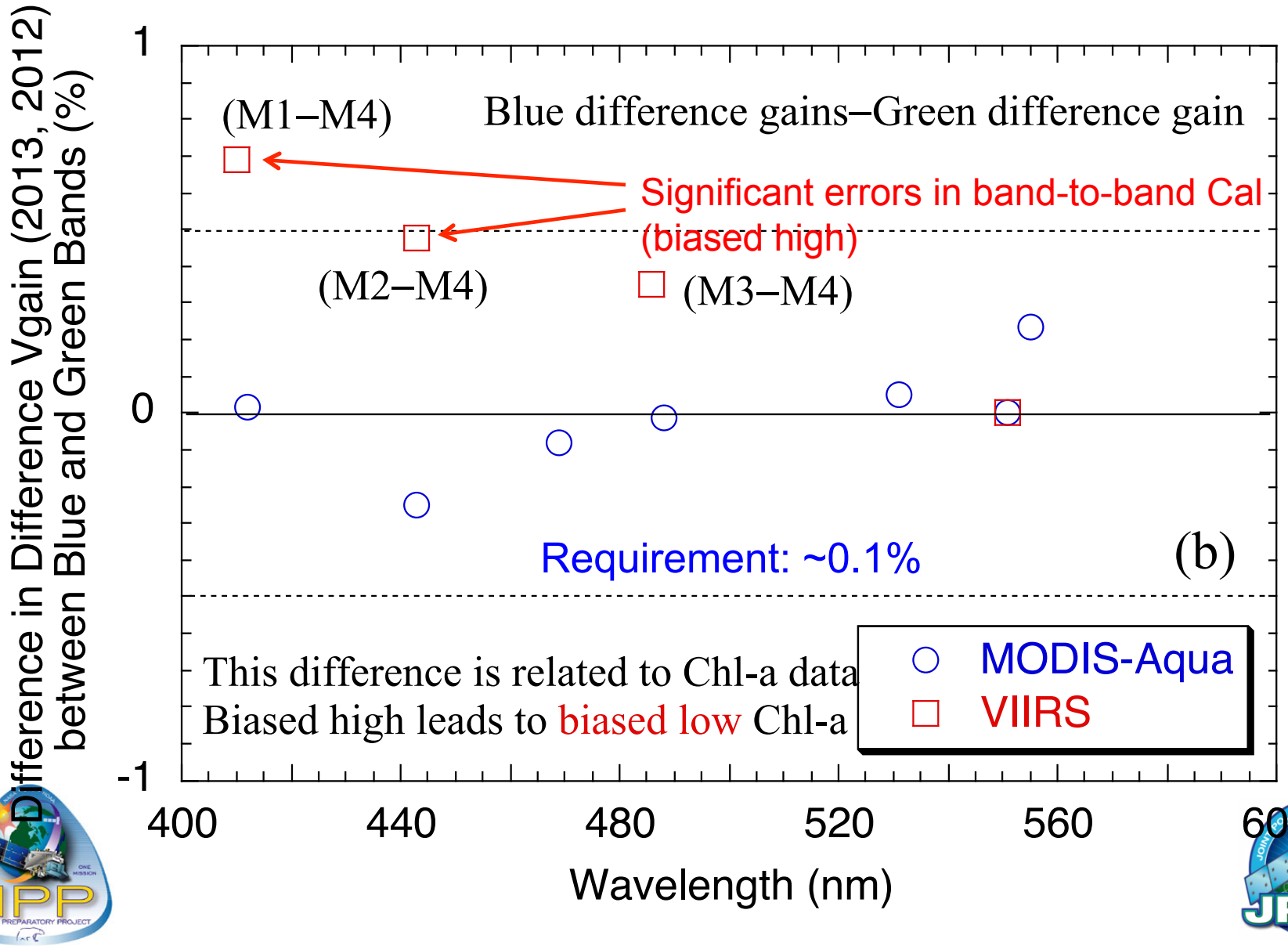
➢ Specifically, comparing with Cal in 2012, VIIRS M1-M5 calibrations are biased low by about -0.6%, -0.8%, -0.9%, -1.3%, and -0.5%, respectively.

➢ On the other hand, MODIS-Aqua 412, 443, 486, 551, and 667 nm Cal differences are 0.3%, -0.0%, 0.2%, 0.3%, and 0.4%, respectively.

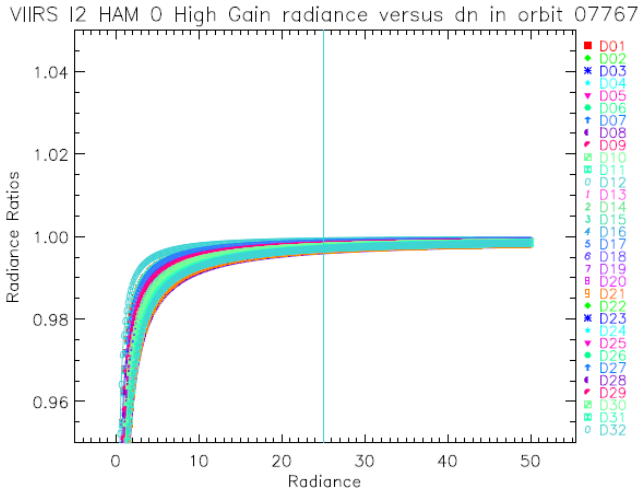
Results confirmed VIIRS Cal issue in 2013

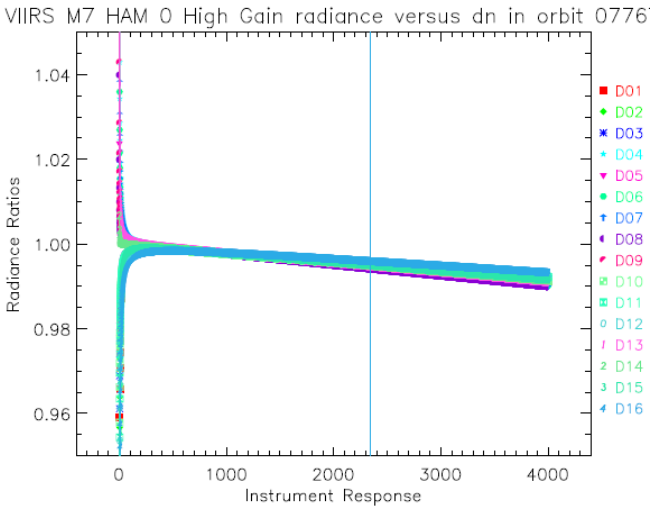


Results confirmed VIIRS Cal issue in 2013



SDR Calibration Issues (2)
Impact of the non-zero C_0 and C_2



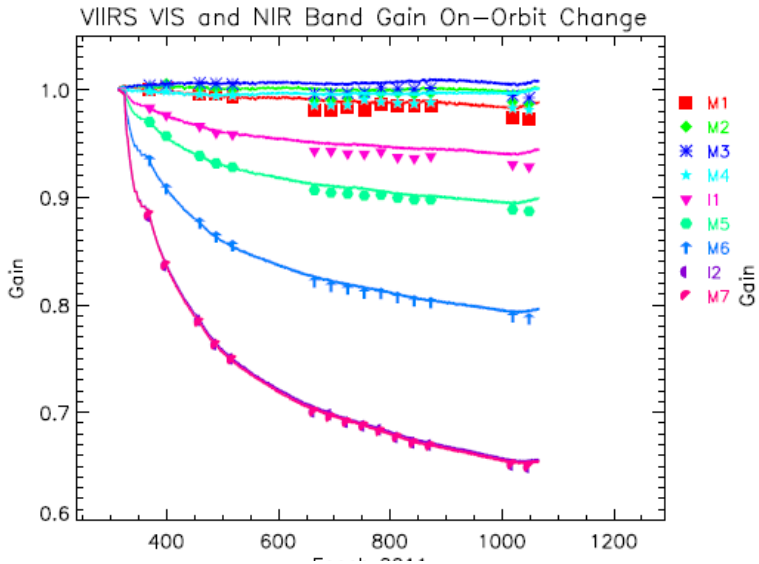


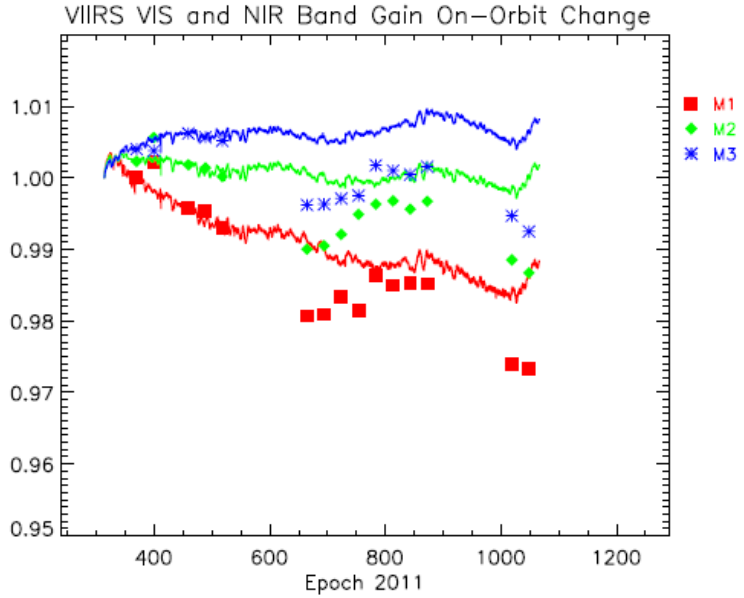
- F factors are calculated with prelaunch C_0 and C_2 and without them (force them to be zero), respectively.
- Radiance are calculated with non-zero and zero C_0 and C_2 using the corresponding F factors, respectively.
- The curves and symbols are the ratios of the two sets of radiance.

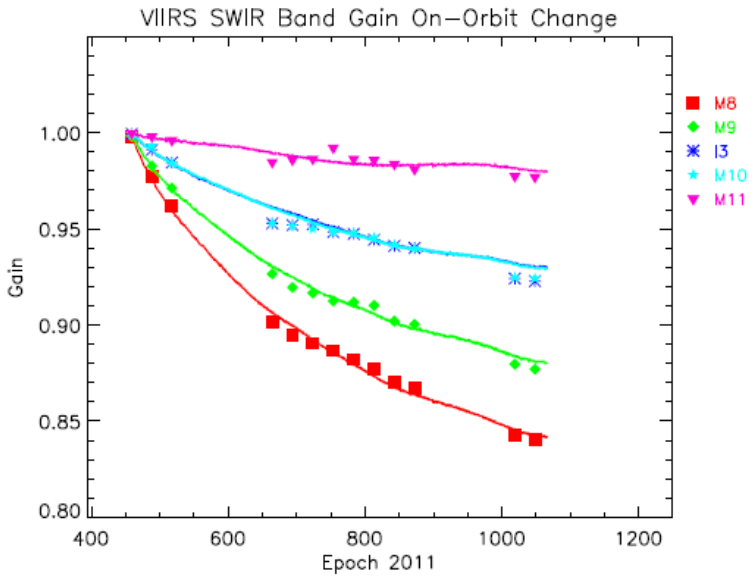
- Prelaunch C_0 has large impact on I2 at low radiance. It may induce striping in the ocean surface images and large radiometric uncertainty, especially for dark ocean.
- Prelaunch C_0 has much less impact on M7 at low radiance, while C_2 may have noticeable impact around typical radiance.

C_0 has been set to zero for I2 and M7, how about other M bands?

SDR Calibration Issues (3)
SD and Lunar F Factors Comparison



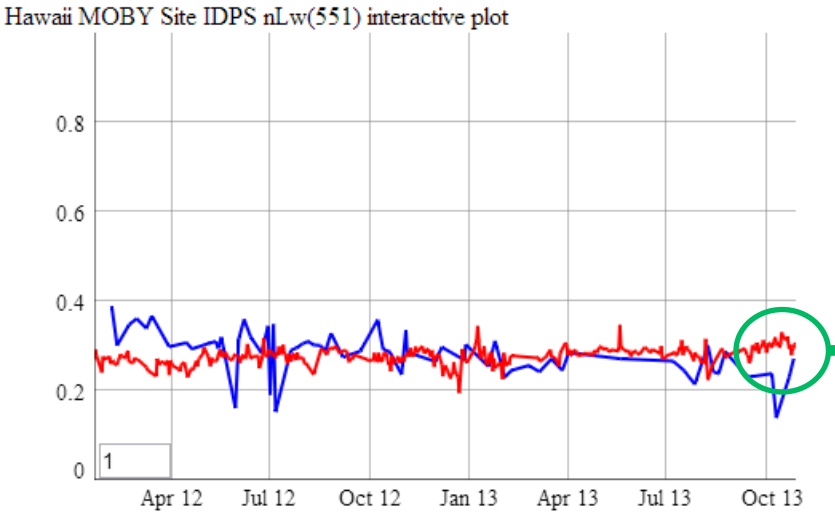


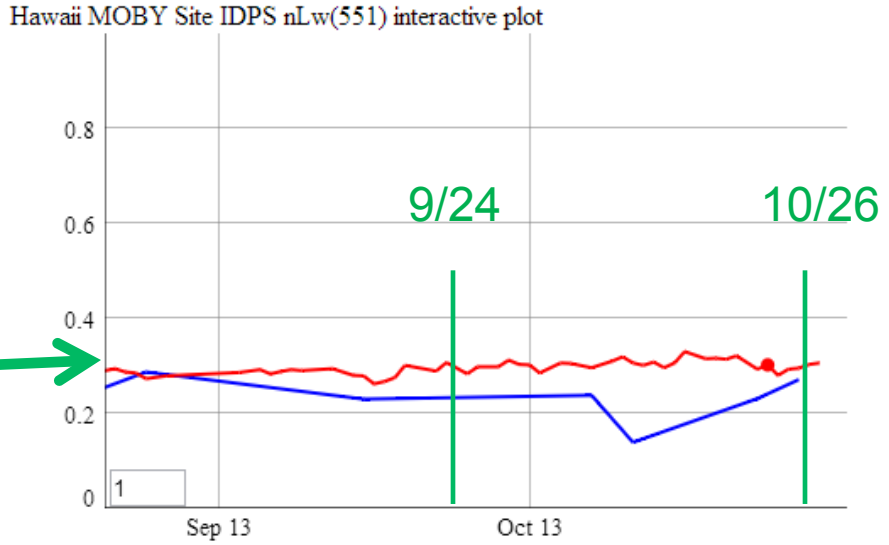


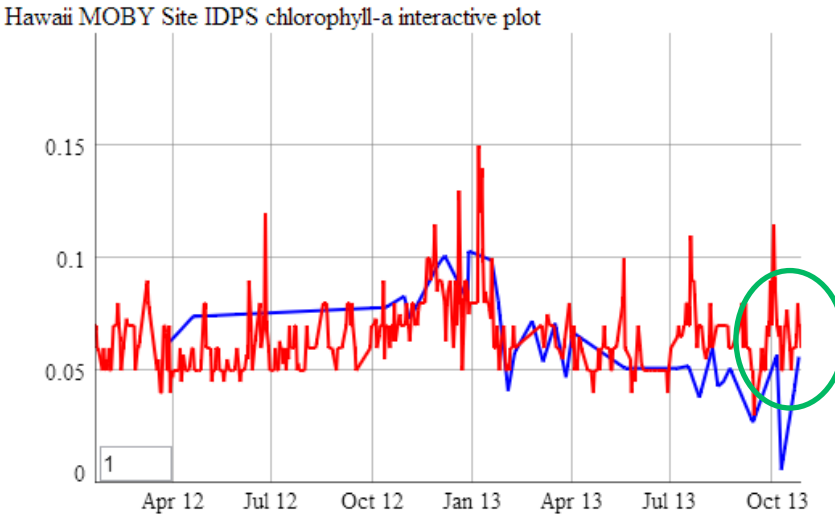
- Symbols are lunar F Factors
- Curves are SD F factors
- Disagreement between SD and lunar calibration in autumn-winter time period every year for short-wavelength bands

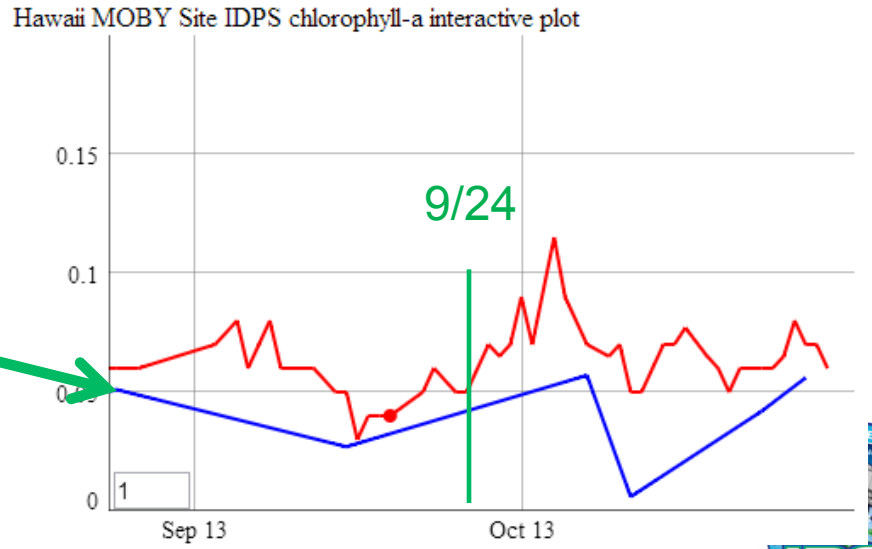
SDR Calibration Issues (4)

Impact of the Shutdown









satellite

In situ

Users of VIIRS OCC EDR Products

- NOAA National Ocean Service (e.g., Rick Stumpf, Varis Ransi)
- NOAA National Fisheries Service (e.g., Cara Wilson, Mike Ford, Jeffrey Polovina, John Lamkin)
  - Roffer's Ocean Fishing Forecasting Service (ROFFS), Inc
- NOAA Air Resource Laboratory (e.g., Daniel Tong, Pius Lee)
- NOAA CoastWatch/OceanWatch (Kent Hughes)
- Other US Agencies (e.g., Navy)
- Academia (e.g., CUNY, OSU, UMB, USF, etc.)
- Ocean Community.

Some Users Feedbacks

Feedbacks, comments, and plans from some NOAA users:

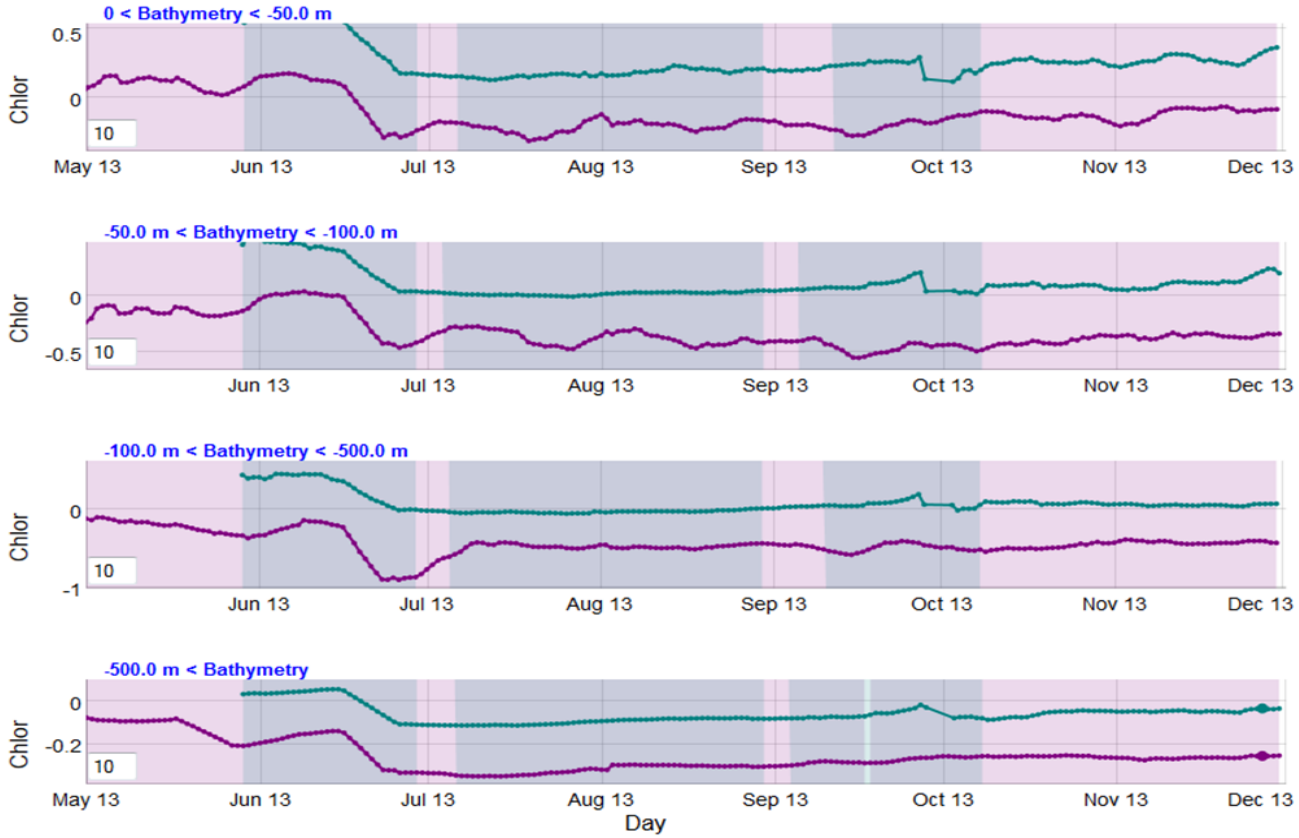
1. CoastWatch/OceanWatch (including inputs from various NOAA users).
2. NOAA Fishery (in support of NOAA project in Gulf of Mexico in near-real-time).
3. OSPO plan for using VIIRS data.

User Response – OceanWatch
(Kent Hughes)

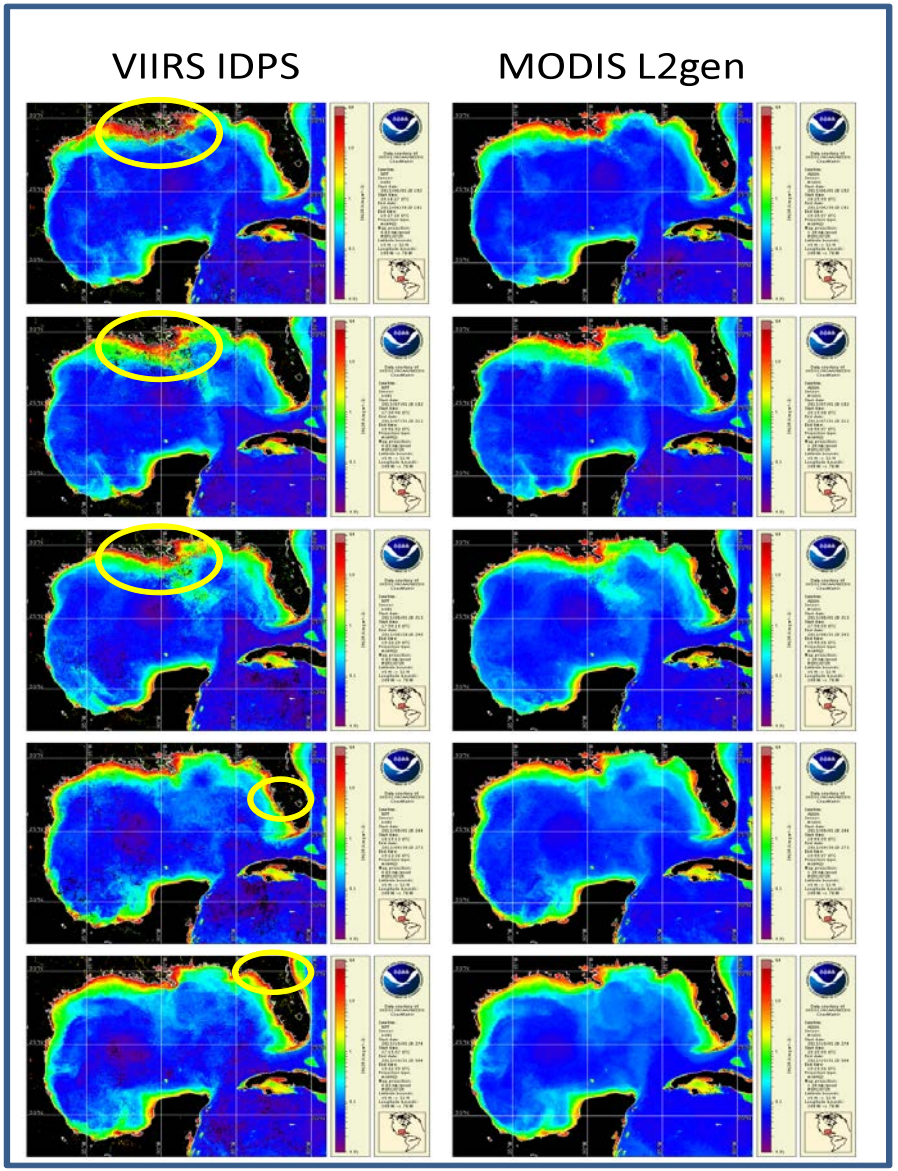
- **Who:** NOAA CoastWatch-OceanWatch with operational users (NOS NCCOS for HAB forecasts and warnings, NWS/EMC for NWP models, and NMFS/NCBO for ecological modeling).
- **Evaluation Response/comments**:
  - significant coastal issues remain including significantly out-of-range values and missing pixels vs. MODIS climatologies
  - significant coastal AND global offsets persist with respect to both MODIS chlorophyll *a* climatologies AND comparable NASA VIIRS generated chlorophyll
- **Recommendation:** Without resolution of the known significant coastal and global issues, there will be minimal NOAA utilization of NOAA's present VIIRS IDPS EDR ocean color products. We strongly recommend that NOAA **rapidly** devise, demonstrate and deploy an operational product generation system yielding comparable science quality products or risk certain NOAA user defections.

User Response - OceanWatch

Median chlorophyll relative difference for VIIRS IDPS EDR versus NASA VIIRS Science Quality (green) and VIIRS IDPS EDR versus MODIS Climatology (purple) (May 2013 to Dec 2013). Global, 10-day average plots are arranged from coastal (top) to open-ocean (bottom) by stratifying the chlorophyll into bathymetric zones 0-50m, 50-100m, 100-500m, and >500m depth. The dip in the time series in June 2013 is a result of implementing the ocean color vicarious calibration in the IDPS data processing.



User Response - OceanWatch



NOAA's VIIRS IDPS vs MODIS l2gen showing missing pixels. Monthly composites (June – November 2013) **c**omparison of Gulf of Mexico (Mississippi River delta and Florida panhandle) showing missing pixels in areas covered by NOAA's operational HAB forecasts and warnings.

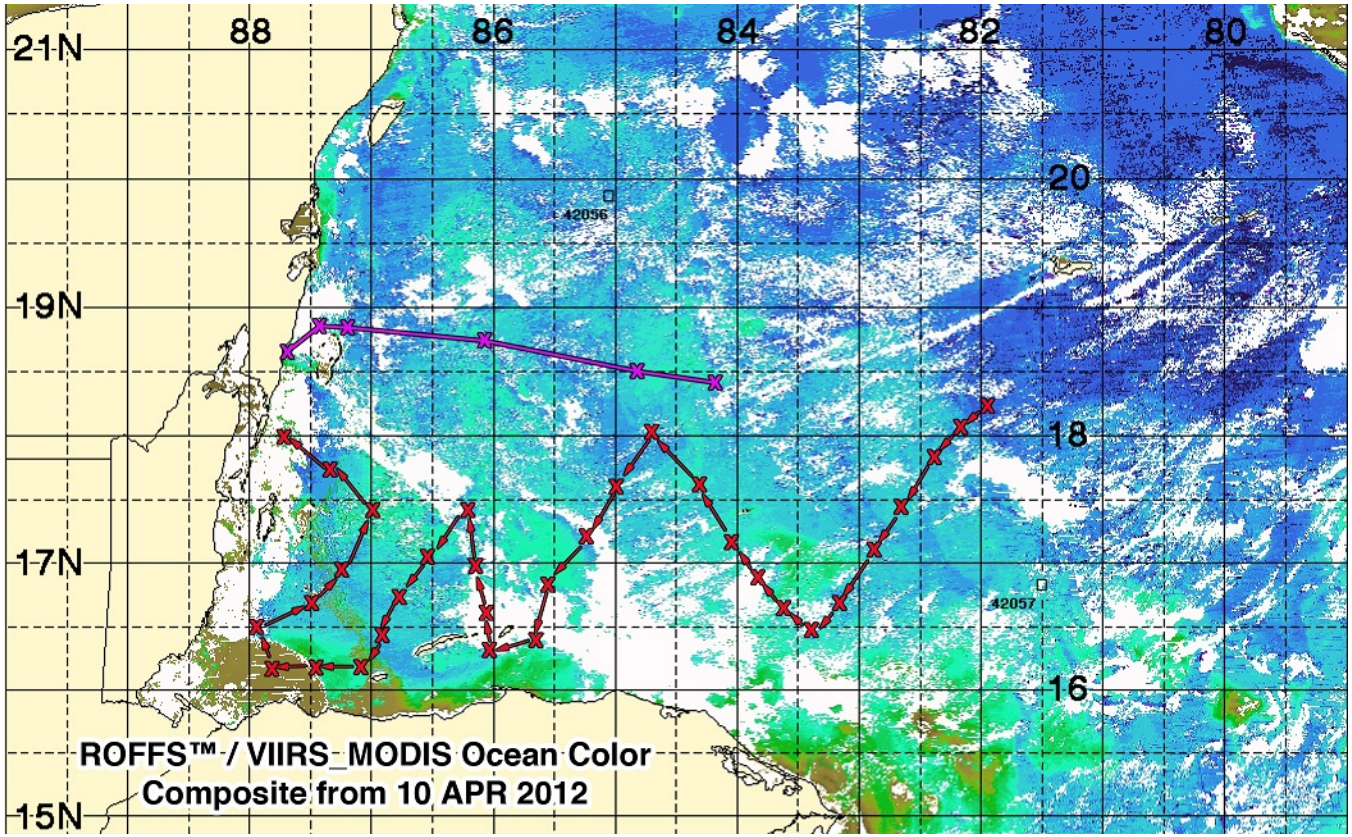
Near-real-time Imagery Support for NOAA Fishery Project (ROFFS, Inc)

- NRT VIIRS chlorophyll-a image support for ROFFS, Inc in their summer cruise for both 2012 and 2013 with about half day delay.
- Areas of interest include Gulf of Mexico, Caribbean Sea and Bahamas.
- "We applaud your efforts to getting us the VIIRS data on a daily basis. This data is operationally very valuable... we have seen excellent matchups up with the VIIRS and MODIS chlorophyll features. "

  -- ROFFS, Inc

…continue

- Composite of MODIS-Aqua and VIIRS-SNPP from April 10, 2012 that ROFFS used to direct the NOAA research vessel Gordon Gunther to different sampling stations.



OSPO Response
(Banghua Yan)

- Here is our plan to use VIIRS ocean color products before they go to our Okeanos operational system:
  1. Feb. 2014: Start to process the VIIRS ocean color products in limited coastal regions from IDPS in Okeanos PTS.
  2. May 2014: Provide preliminary assessment of the products in limited coastal regions with regard to quality of VIIRS ocean color products (both daily and bimonthly means).
  3. Summer 2014: Process global VIIRS ocean color products and also provide assessment of the product.

Conclusions

- VIIRS ocean color products have been improved after the implementation of some important DRs since beta maturity status, and one DR is still pending to be implemented.
- In general, VIIRS OC normalize water-leaving radiance spectra show reasonable agreements with in situ measurements at MOBY, AERONET-OC sites, and various other ocean regions.
- In global deep waters and oligotrophic waters, the VIIRS ocean color products generated from NOAA-MSL12 were consistent with MODIS-Aqua in 2012, but discrepancy started to become noticeable for IDPS and MSL12 Chl-a data since early 2013. We confirmed that this is a VIIRS calibration problem in 2013.
- There are still some issues in VIIRS IDPS OC EDR products (e.g., the atmospheric correction algorithms in turbid coastal waters) and quality flags, and solutions are to be evaluated and recommended.
- Although the OC EDR product quality is still not optimal, incremental product improvements have been made, and are occurring. Based on the definition and the evidence shown in the presentation, VIIRS OC EDR has met the provisional stage, and is ready for operational evaluation.
- However, it is urgent for us to understand and resolve the VIIRS SDR Cal issue to provide consistent Chl-a product over global ocean.

Future Plans

- Continue Cal/Val activities for VIIRS OC EDR.
- Evaluate and improve data quality flags.
- Evaluate and improve the IOPs in OCC EDR.
- Long-term validation NPP OC products monitoring.
- OC EDR validation cruises (e.g., GOM, East coast, west coast)
- Algorithms refinements and improvements, e.g., sun glint masking and correction, sea ice masking, etc.
- Algorithms improvements for coastal turbid and inland waters.
- Evaluate the discrepancy between VIIRS and MODIS-Aqua in the global deep waters and oligotrophic waters in 2013, and help to resolve the VIIRS calibration issue.
- Reprocess from RDR to SDR, and from SDR to OC EDR since the beginning of VIIRS mission.

NPP Ocean Color In Situ Cal-Val 2014

Ocean Color Cruises and Insitu Data

PI	Region	Timing
C. Davis/R. Letelier (OSU)	Hawai Time Series , Oregon Coast	Quarterly,
R. Arnone, S. Ladner (USM, NRL)	N. Gulf of Mexico, East coast US, Yellow Sea	Fall 2013 , Spring 2014
ZhongPing Lee (UMB)	Lake Michigan and Green Bay	Sept 2012, Spring 2014
Alex Gilerson, Sam Ahmed (CUNY)	LISCO-Long Island NY, Chesapeake	Spring , summer 2014
M. Ondrusek (NOAA)	Chesapeake Bay, Gulf of Mexico Hawaii	Summer 2013 , Spring 2014
C. Hu	Tampa, Gulf of Mexico	Fall 2012 , Spring 2013
Jones, Burt (USC)	West Coast Southern Cal.	Summer 2014
AERONET -Seaprism -		
Bob Arnone/Gibson	Gulf of Mexico	deployed
Jones, Burt	UCS, West Coast	deployed
Ahmed, S	Long Island Sound	deployed
G. Zibordi	Adriatic Sea (Venice), Abu_Al_Bukhoosh; Gustav_Dalen_Tower; Helsinki_Lighthouse', Gloria	Data at AERONET-OC
MOORING - MOBY		
K. Voss	Hawaii	deployed

Some Backup Slides

Thank You!

Some Sample Results from the **OC Team PIs** shown in following slides

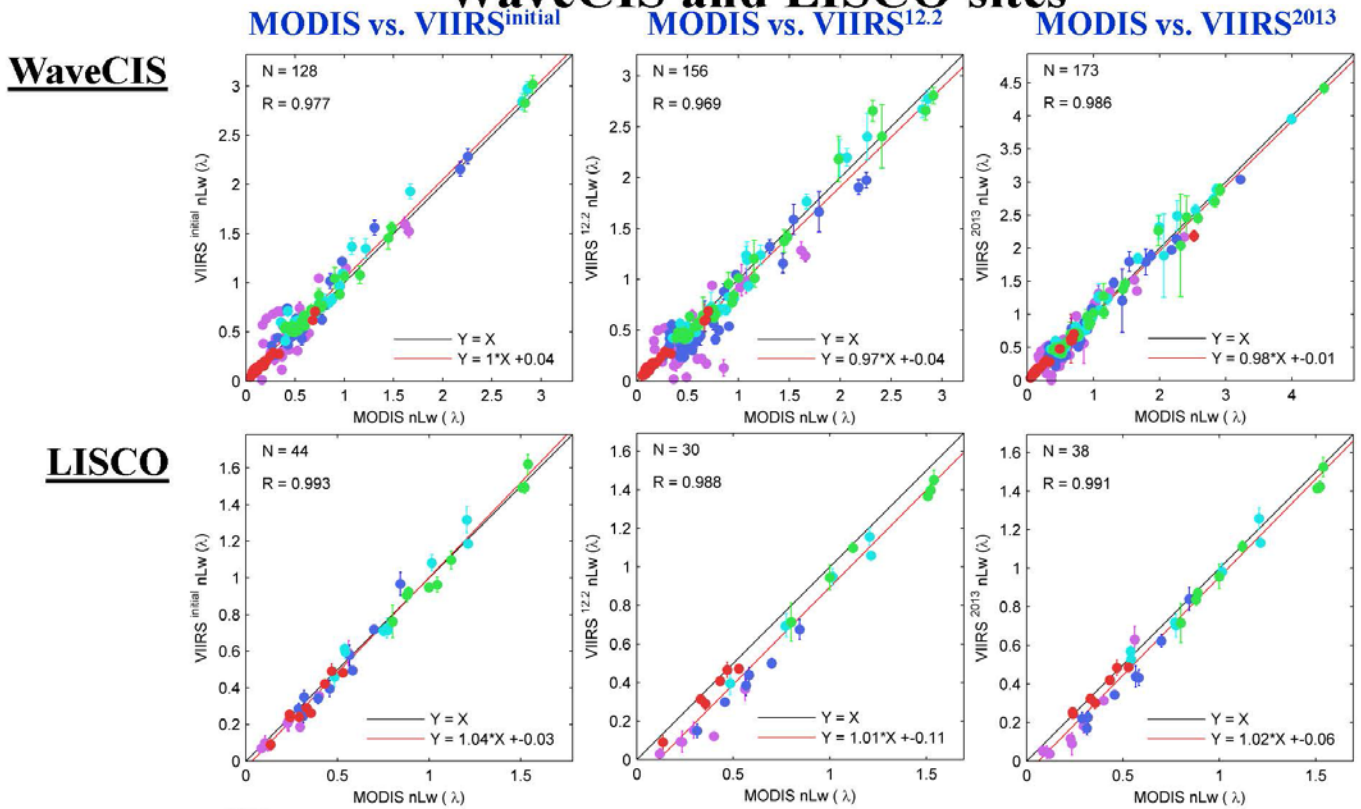
VIIRS Cal-Val Team Activities (CUNY)

VIIRS Cal-Val Team Activities around Long Island, New York

WQM deployment on the buoy near LISCO tower

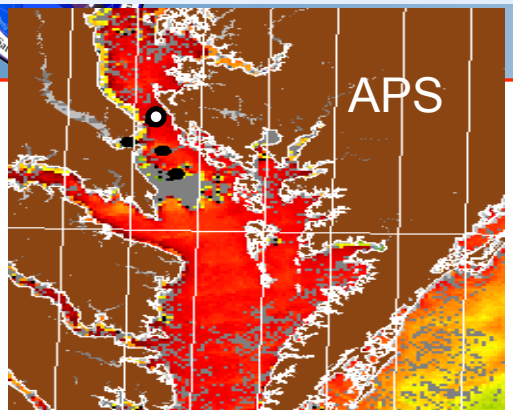
VIIRS Cal-Val Team Activities (CUNY)

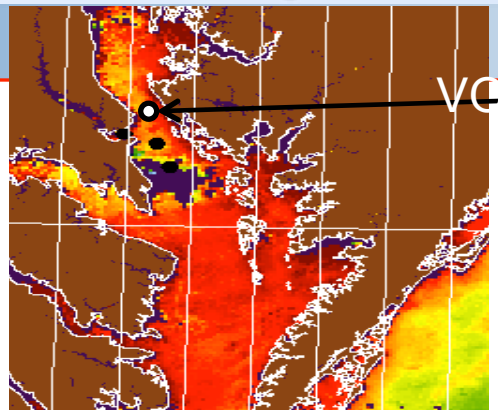
nLw(λ) Matchup between VIIRS and MODIS for WaveCIS and LISCO sites

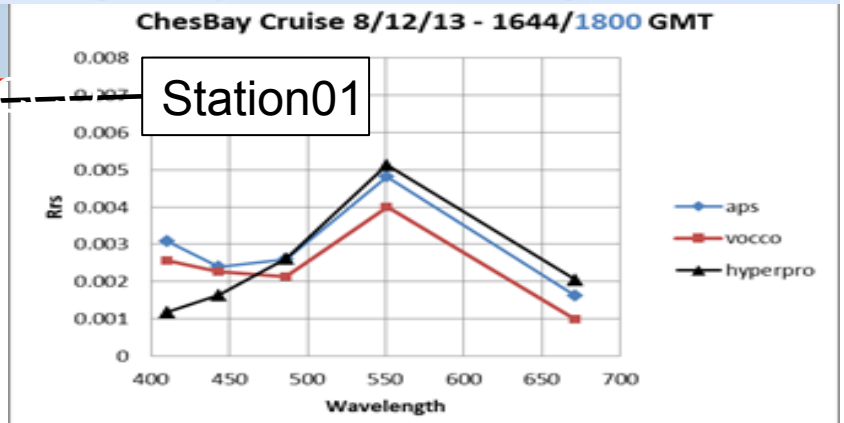


- With VIIRS^{2013}, correlation at the 413 nm is greatly. Bias between the *nLw* data at 413 nm retrieved by two sensors almost vanishes with *PD* value equal to 0.73%.
- Similarly, overall spectral average *PD* value obtained for comparison between MODIS and VIIRS^{2013} is also lowest with its value equal to -1.01% compared to 12.2% obtained with VIIRS^{initial} and -6.2 % with VIIRS$^{12.2}$.
- VIIRS^{2013} is most consistent with MODIS for WaveCIS whereas VIIRS^{initial} is for LISCO.

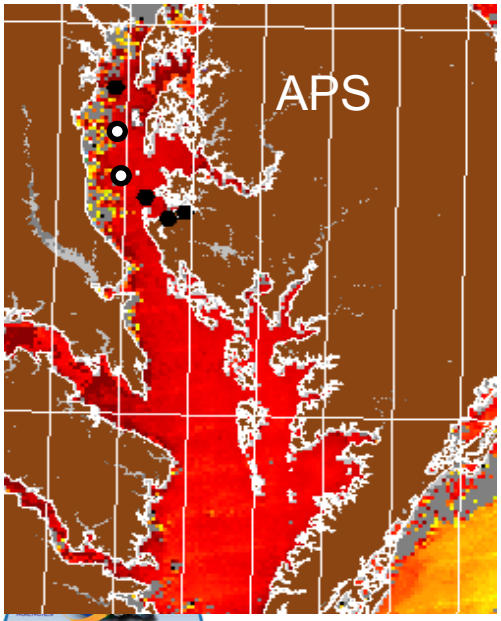
Chesapeake Bay Matchups (USM/NRL)

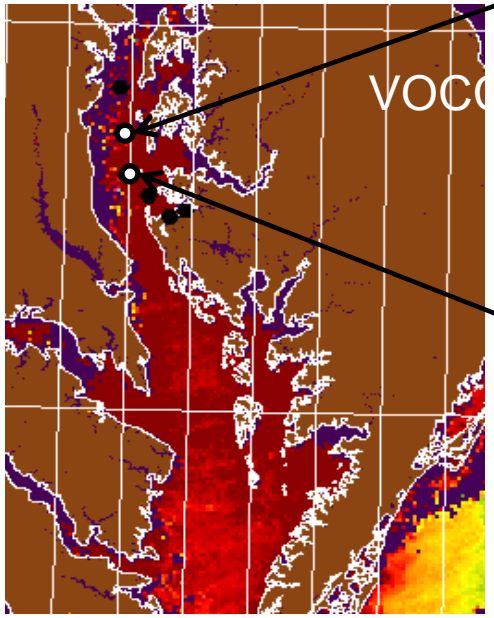


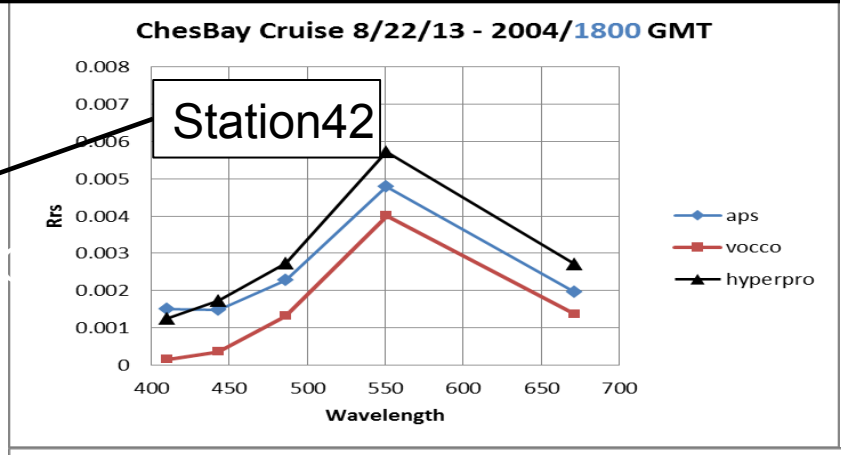


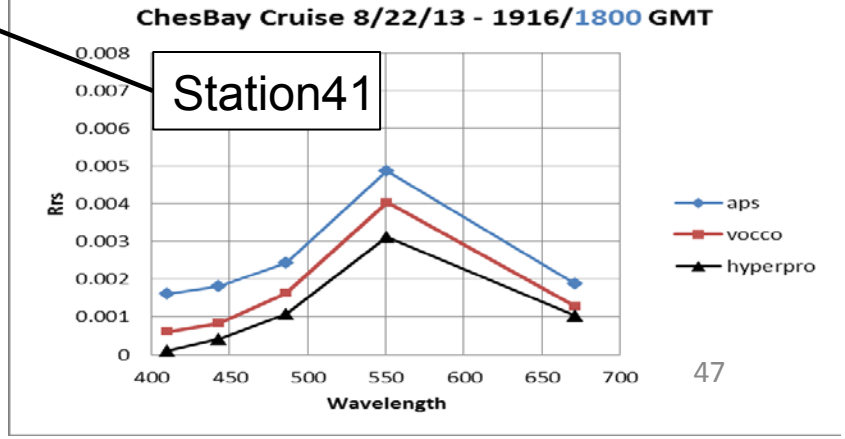


Matchups getting better in coastal regions for both APS and VOCCO



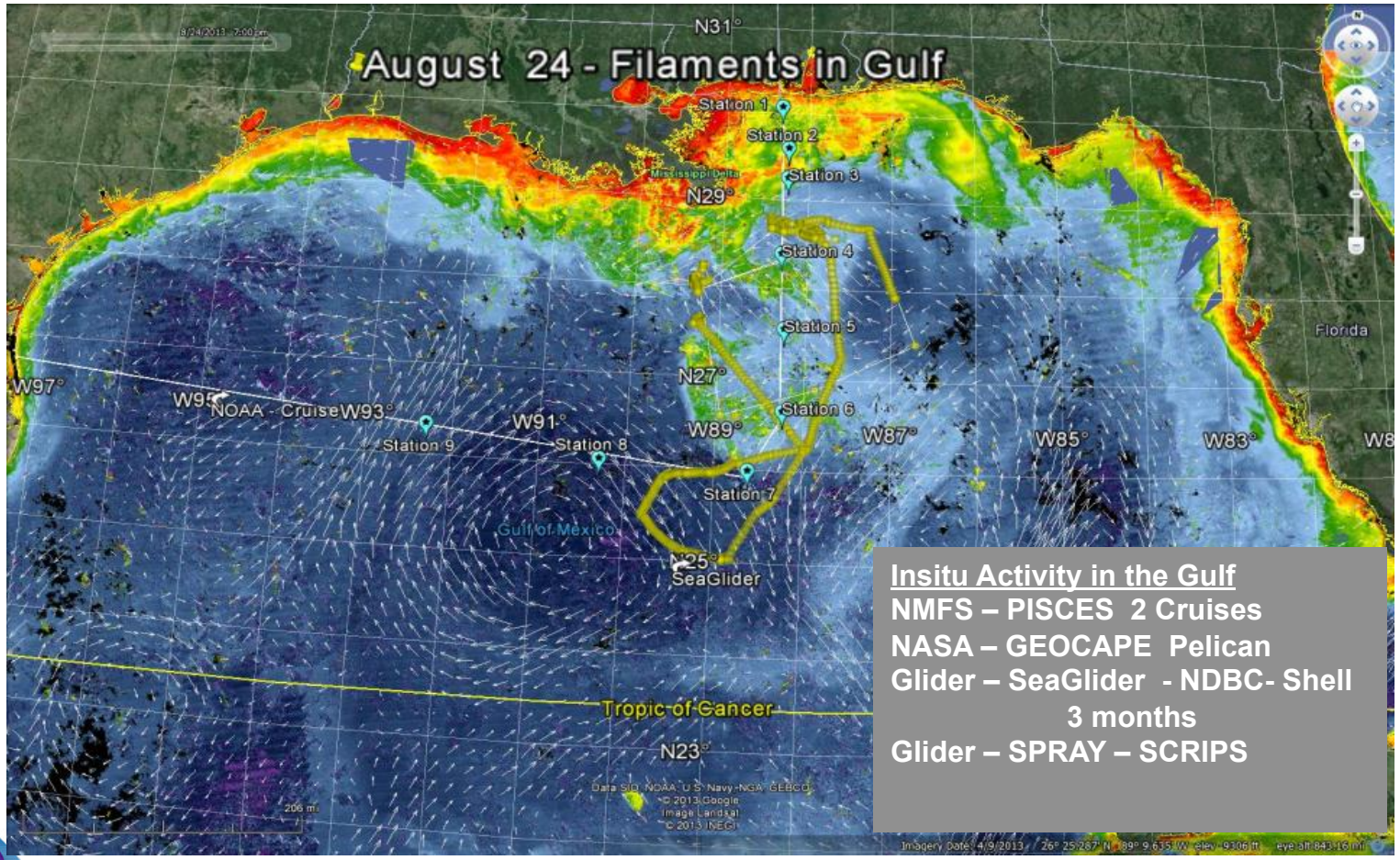






VIIRS Cal-Val Team Activities (USM/NRL)

Cal Val Activities in the Gulf of Mexico

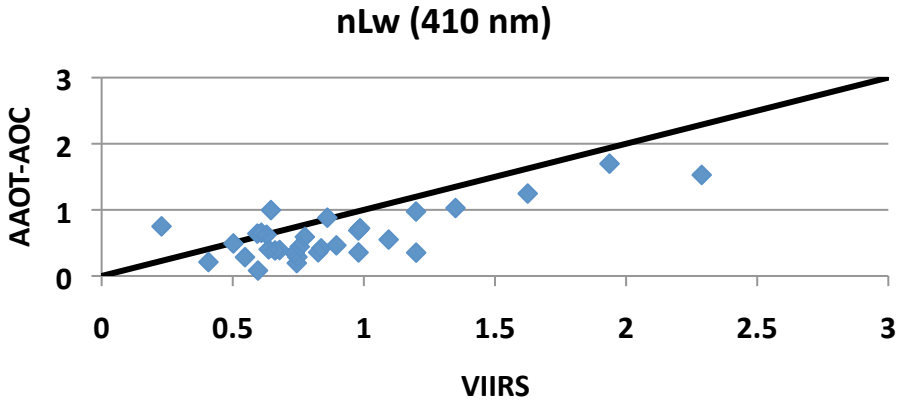


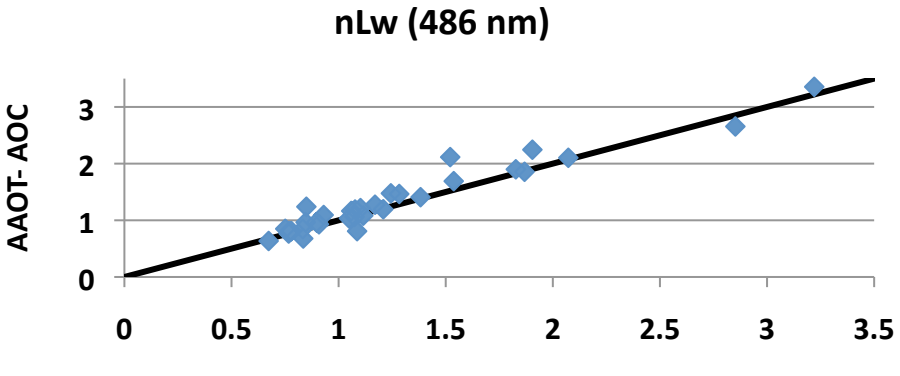
Insitu Activity in the Gulf

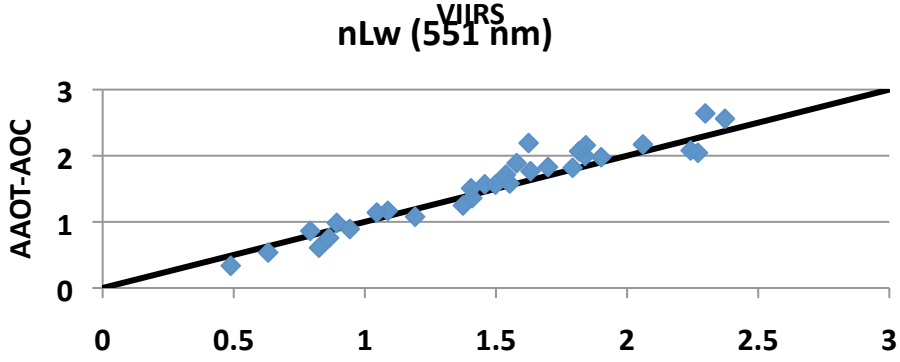
NMFS – PISCES 2 Cruises
NASA – GEOCAPE Pelican
Glider – SeaGlider - NDBC- Shell 3 months
Glider – SPRAY – SCRIPS

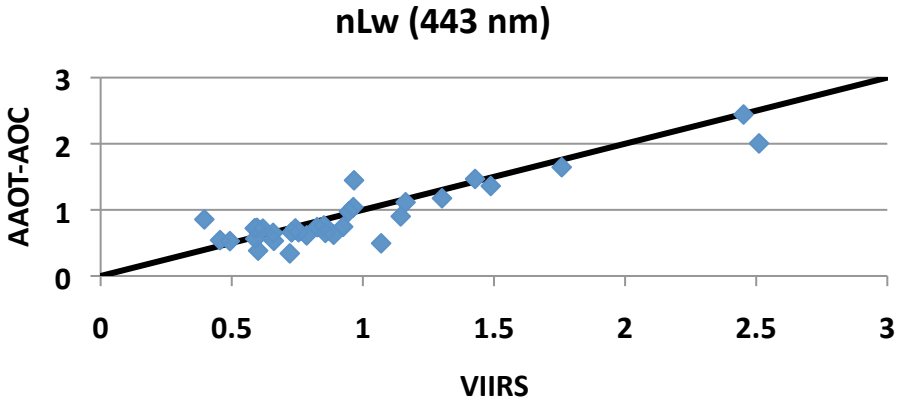
VIIRS Cal-Val Team Activities (USM/NRL)

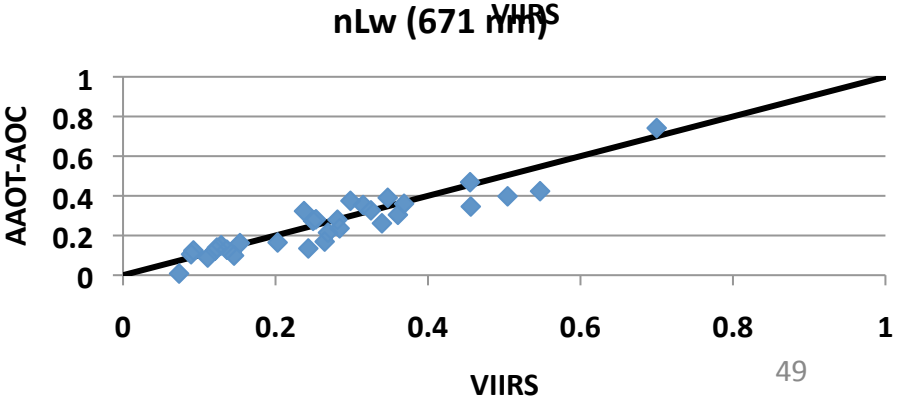
Spectral response Matchup in GOM AAOT: APS VIIRS vs SeaPrism nLw, screened 2013





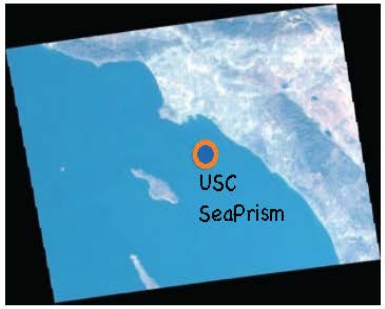


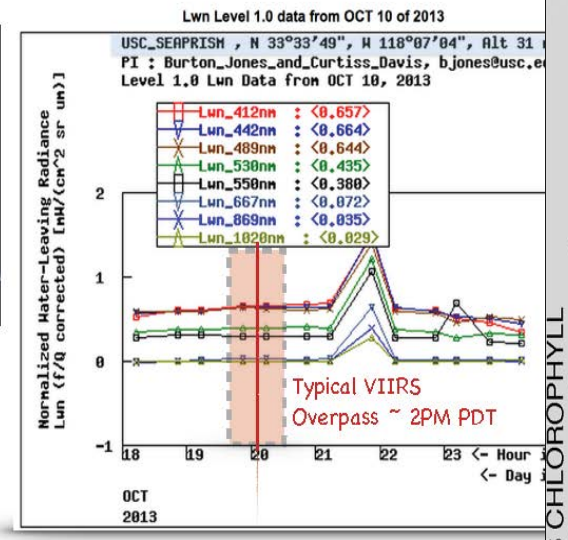




VIIRS Cal-Val Team Activities (OSU)

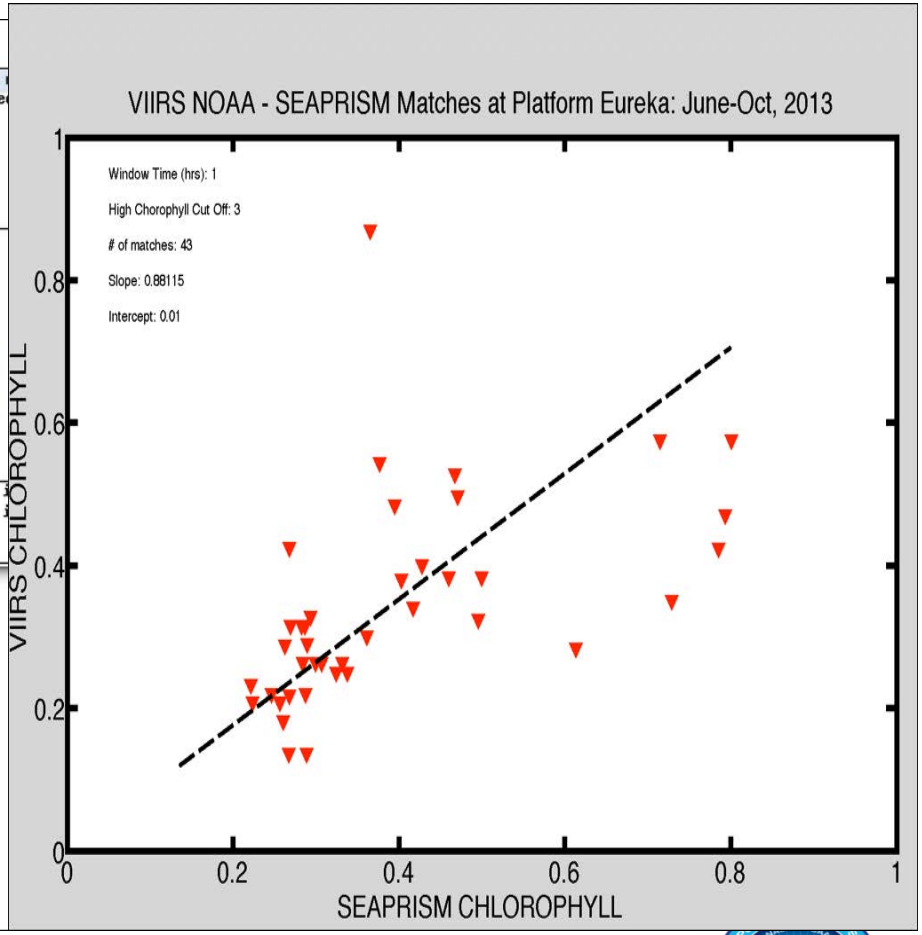
SeaPrism Matchup in West Coast





Outline

- Example Spectra — Sunny Days
- Time Series & Regressions of Chlorophyll-a
- Time Series & Regressions of Normalized Water Leaving Radiance

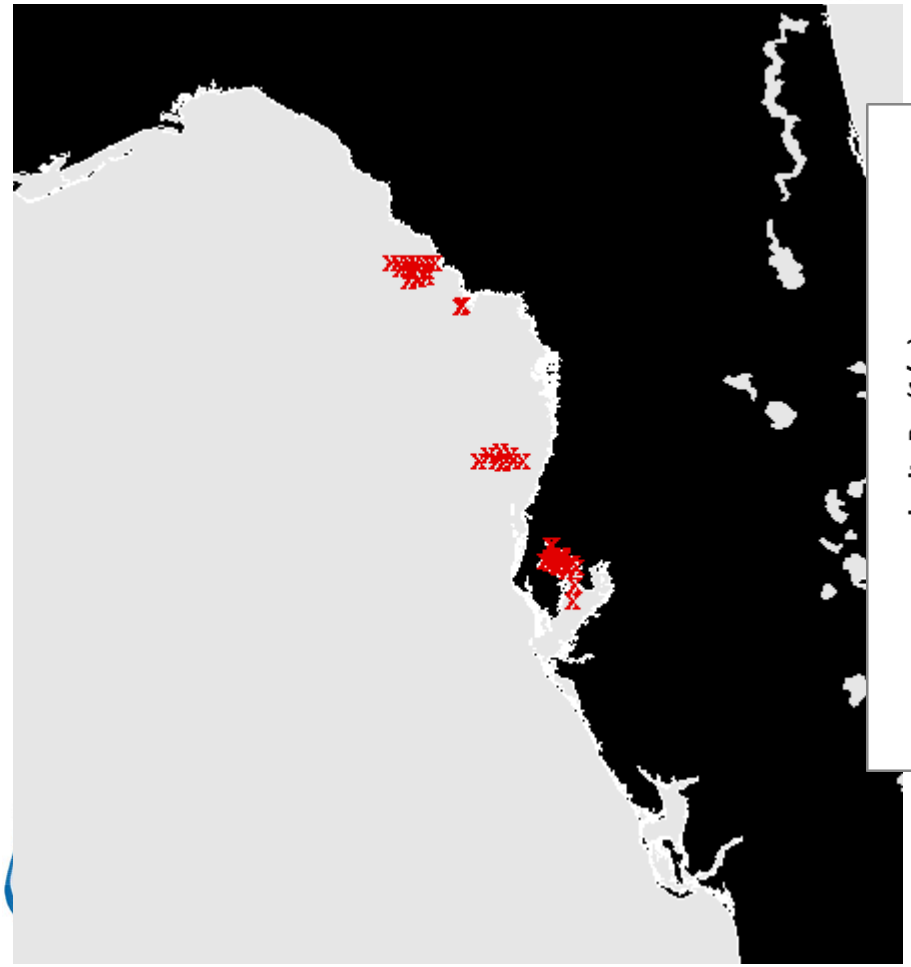


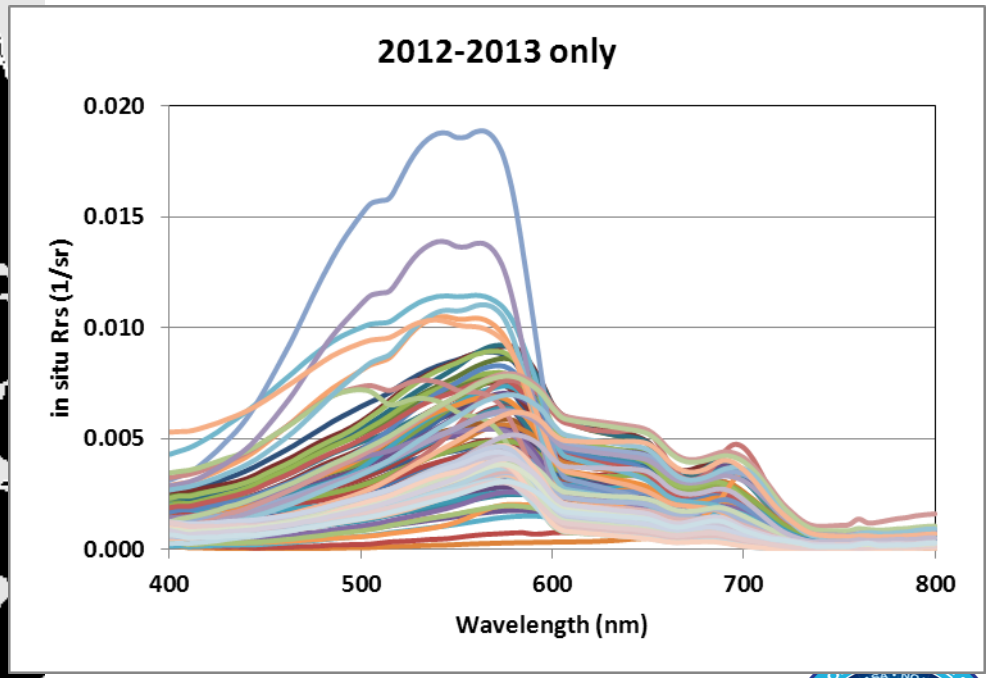
Data Sources

Field measurements – USF Optical Oceanography Lab

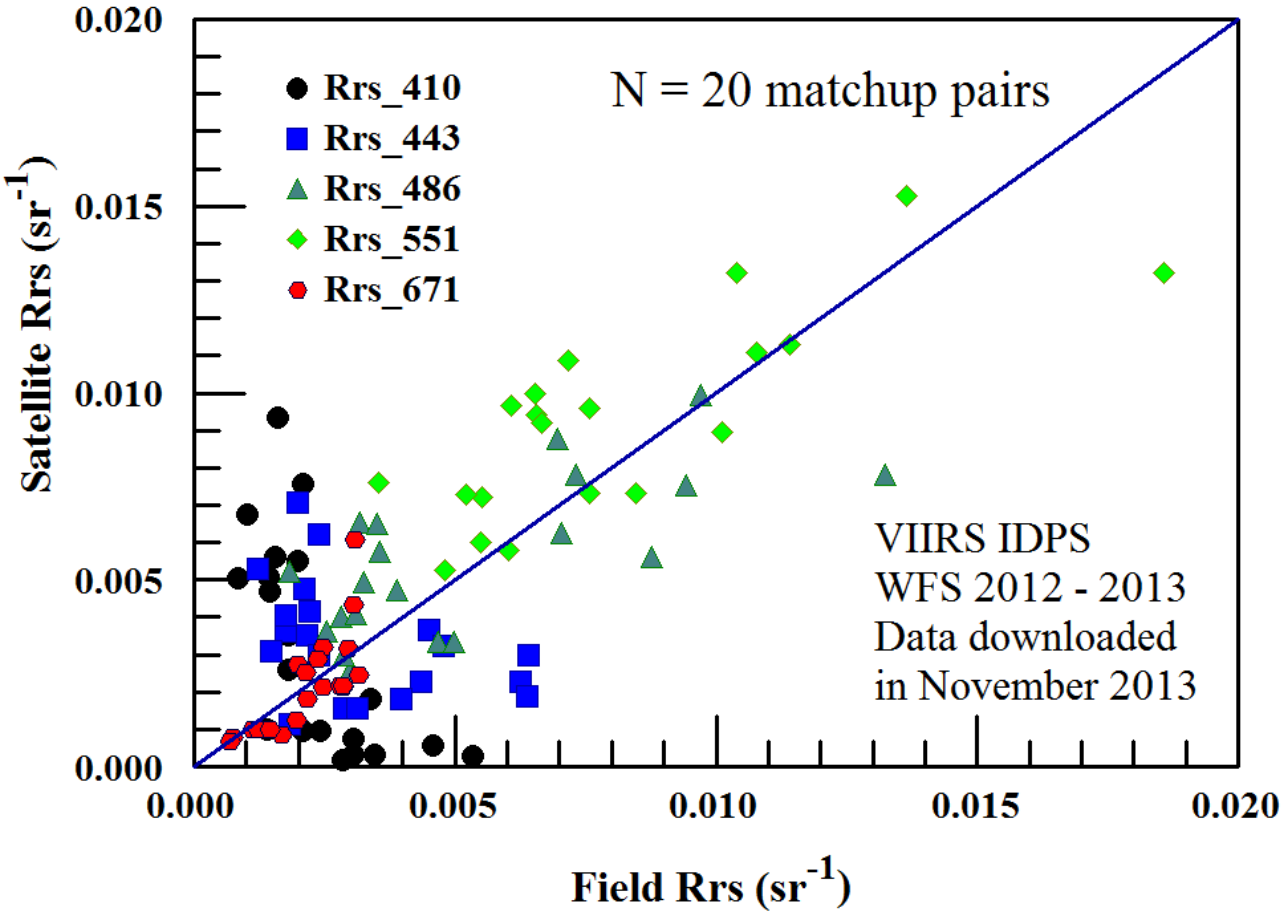
Typical measurements: water samples, above-water Rrs, in-water IOPs, with occasional light profiling

N = 80





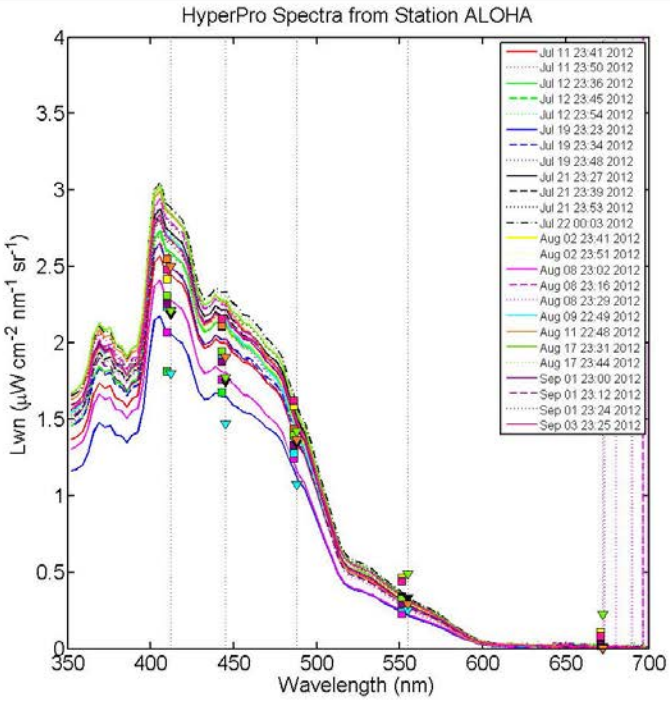
VIIRS IDPS Products



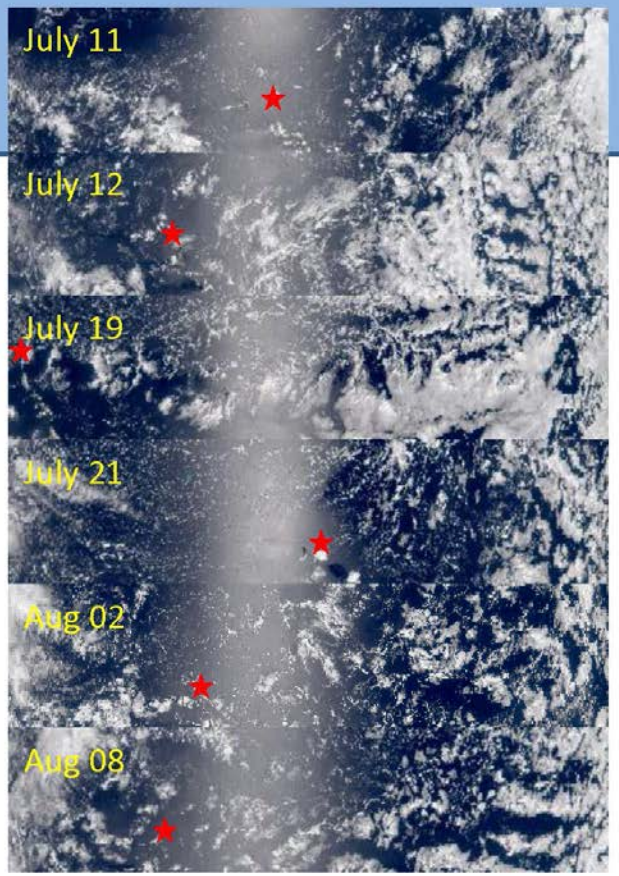
VIIRS Cal-Val Team Activities (OSU)

Cal Val Activities at Station Aloha around Hawaii

HyperPro – VIIRS matchups at Station ALOHA



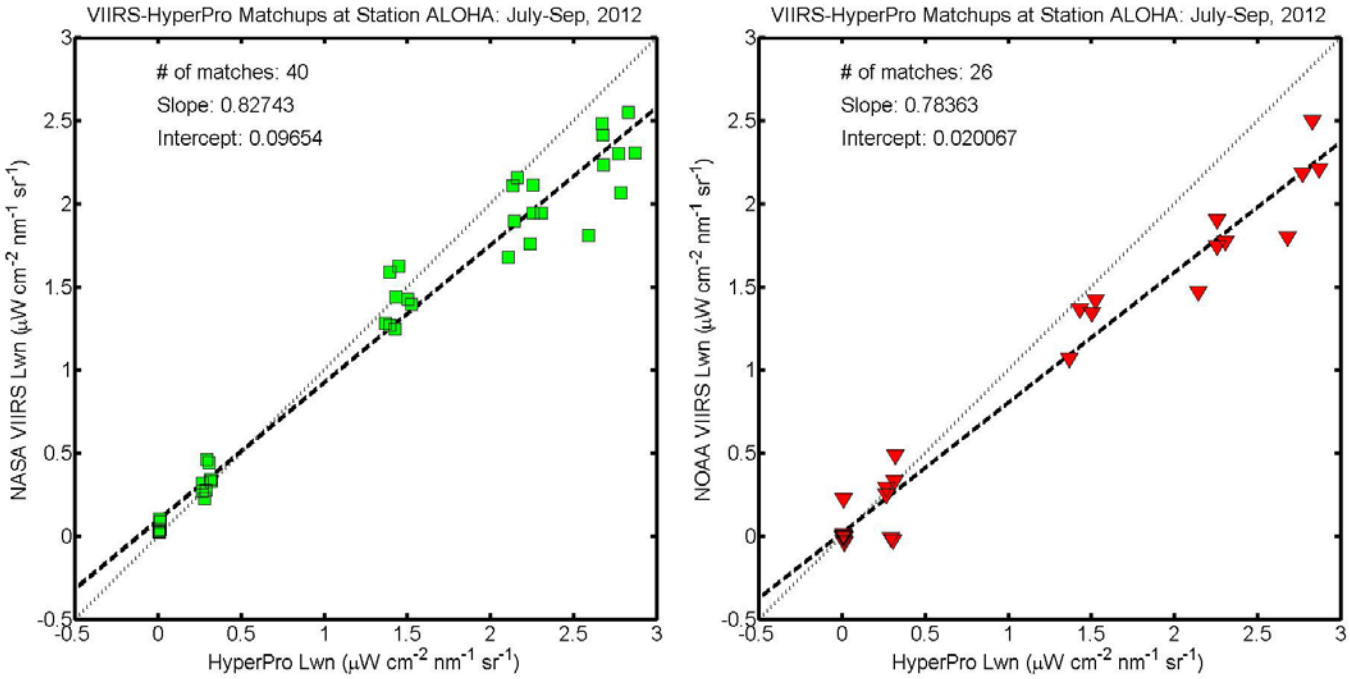
Normalized water-leaving radiance at Station ALOHA as measured on clear-sun days with a HyperPro *in situ* (lines) and from VIIRS (triangles processed by NOAA, squares processed by NASA). The HyperPro and VIIRS measurements were made within an hour of each other.



Some example VIIRS scenes with HyperPro matchups. The location of Station ALOHA is marked with a red star. Note the frequent issue with clouds and sunglint in this region. The VIIRS data from July 11 were not used.

VIIRS Cal-Val Team Activities (OSU)

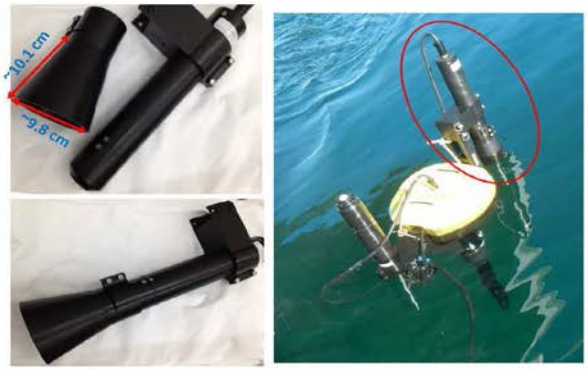
HyperPro – VIIRS matchups at Station ALOHA



Comparison of VIIRS satellite data with *in situ* HyperPro optics data for clear-sun days at Station ALOHA from July to September 2012. Data from all visible VIIRS wavelengths are shown (412, 445, 488, 555, and 672 nm). Two versions of VIIRS data are examined: NASA OBPG (left panel) and NOAA CLASS (right panel). The best fit line is shown as a thick dashed line. The one-to-one line is the thin dotted line.

VIIRS Cal-Val Team Activities (UMB)

Measuring R_{rs} with Skylight-blocked approach (SBA)

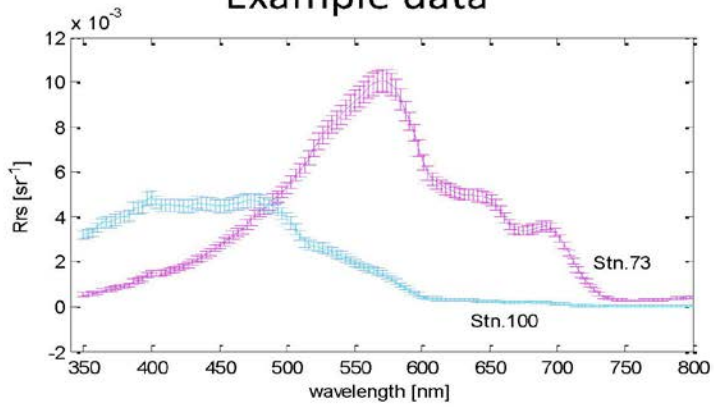


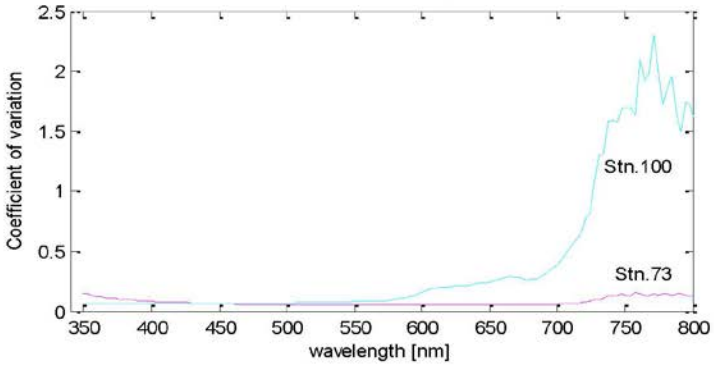
Environment conditions

Station 73: clear sky,
1.5-m waves,
10 m deep

Station 100:
variable sky,
3-m waves,
100 m deep

Example data

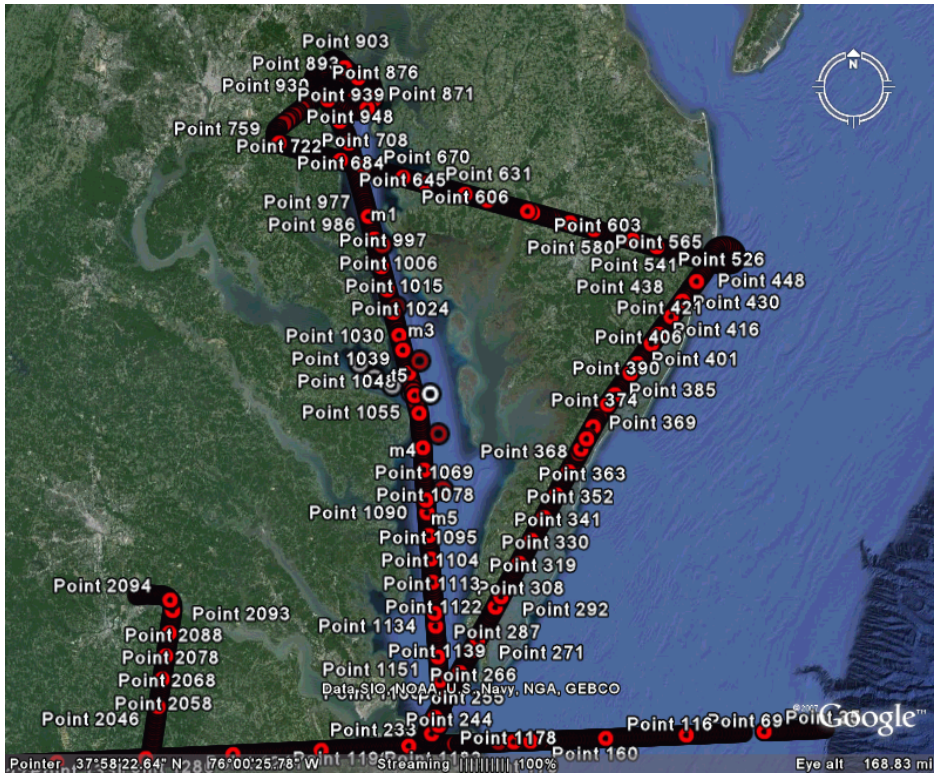




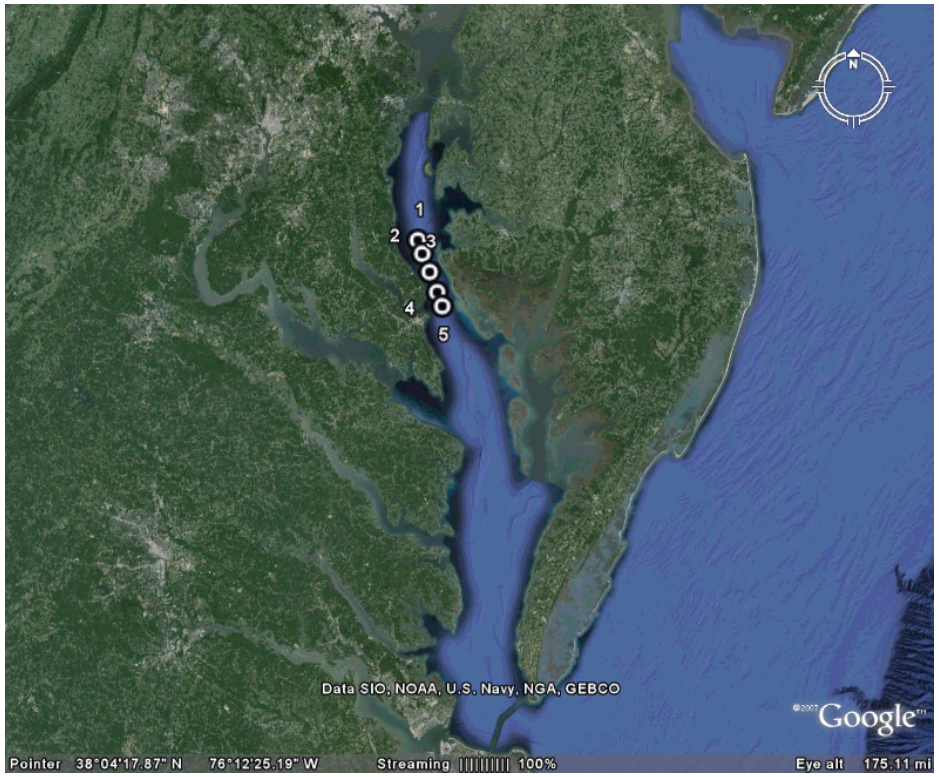
VIIRS Cal-Val Team Activities (NOAA/STAR)

Sept. 25, 2013 *Multiple Altimeter Beam Experimental Lidar* (*MABEL*) Flyover Validations Locations

MABEL Track

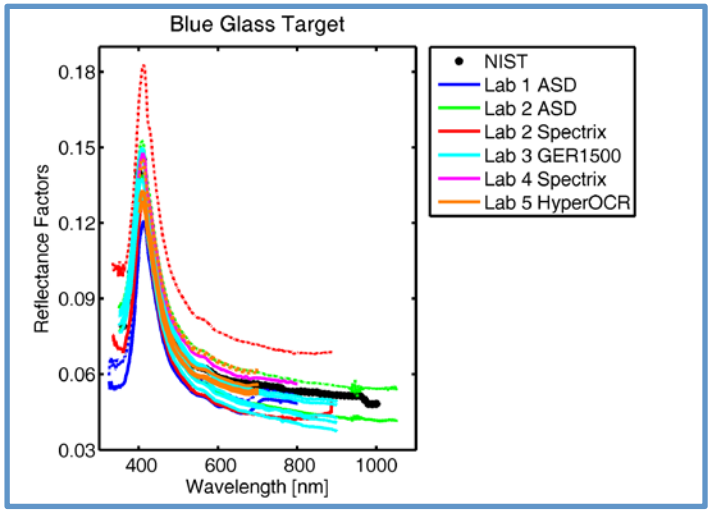


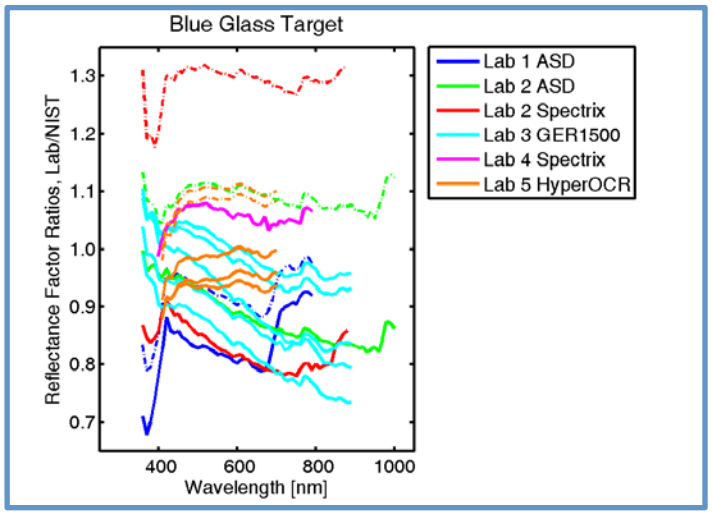
Validation Stations

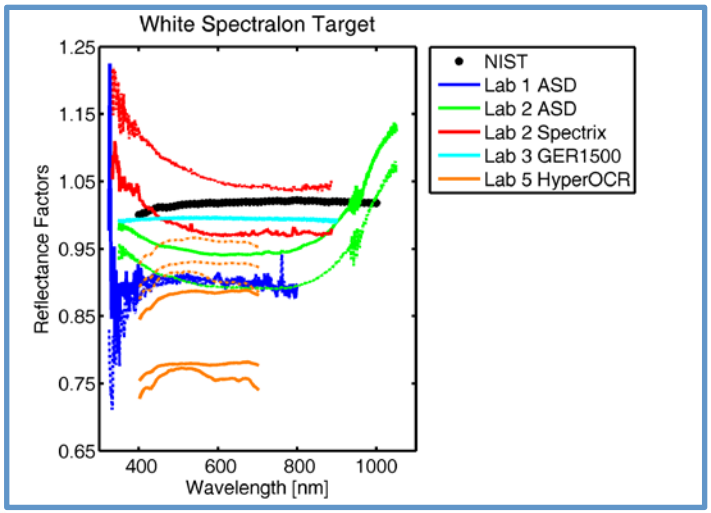


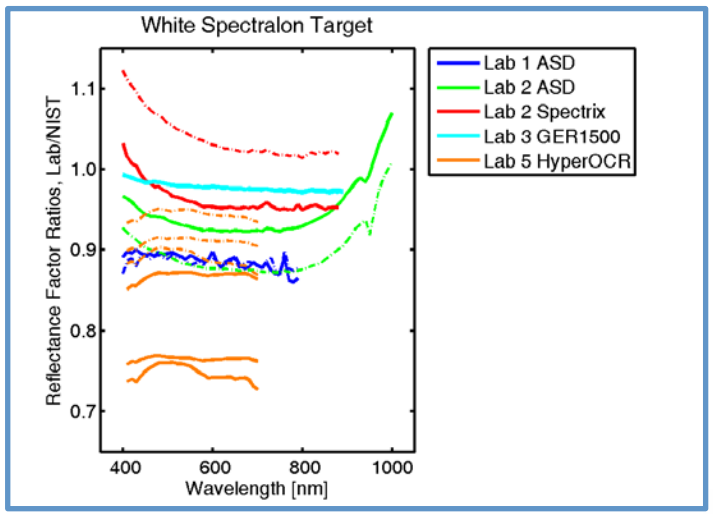
Drop in KLu

VIIRS Cal-Val Team Activities (NIST)





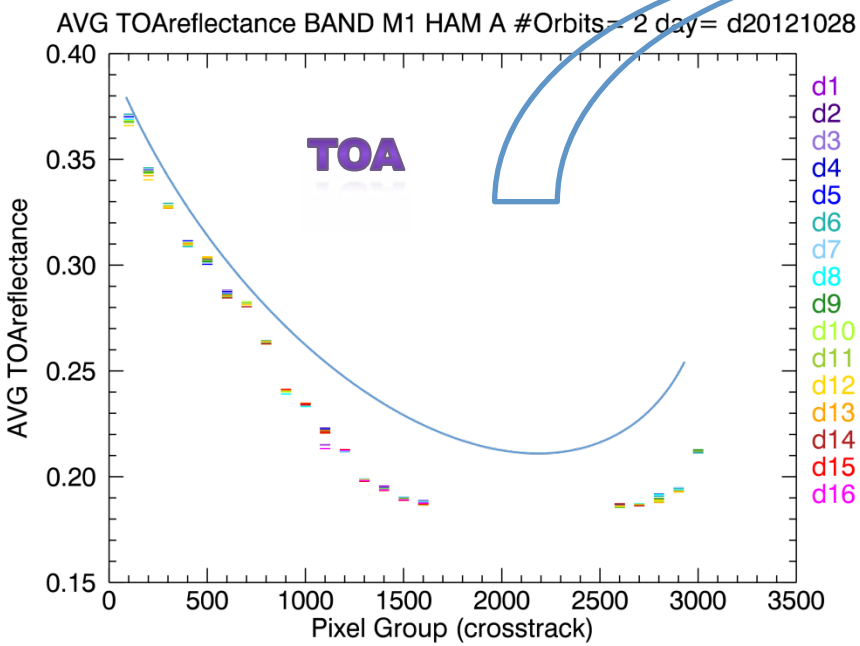


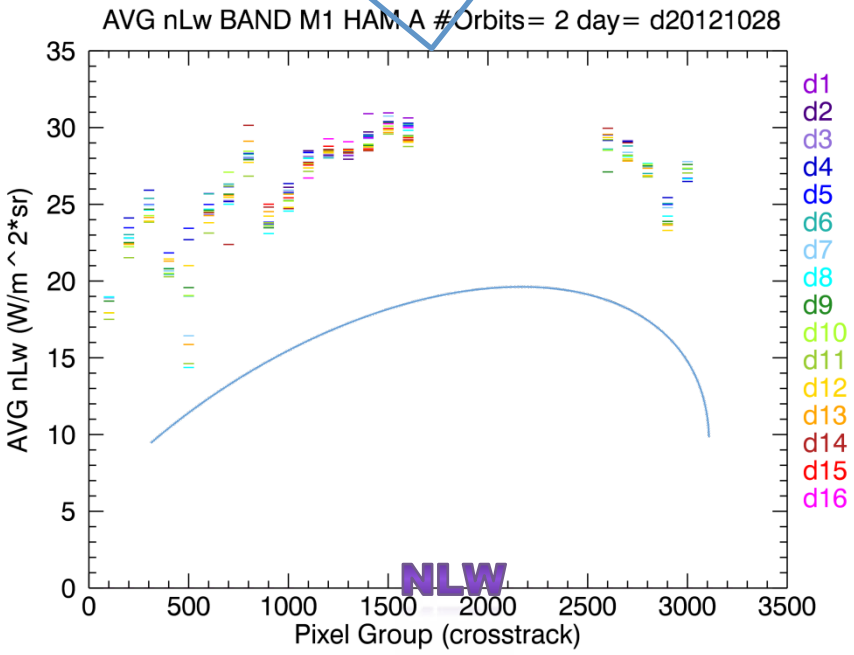


VIIRS Cal-Val Team Activities (NGAS)

M1 nLw retrievals mirror the TOA for Sample 1 in 2012

Detectors are averaged together by band and discrete scan intervals to investigate the trends that are upstream from the OC EDR.

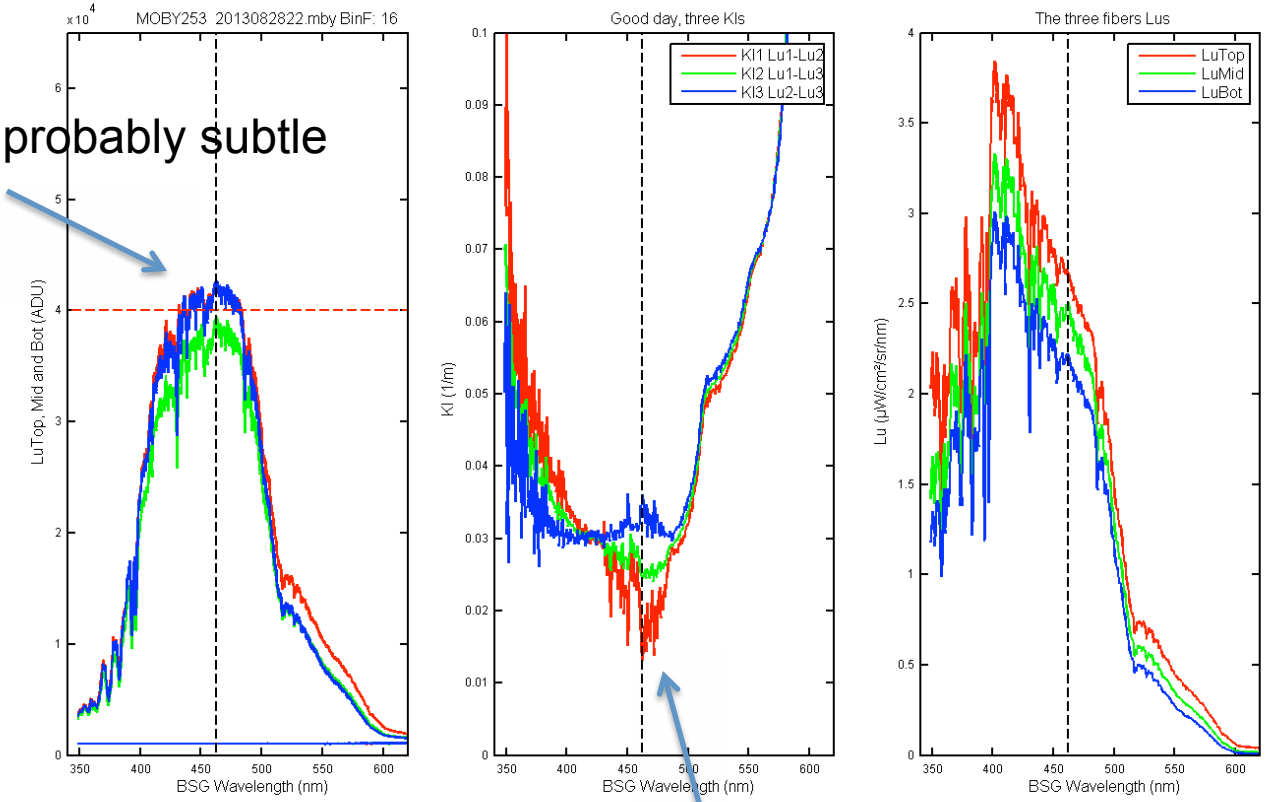




VIIRS Cal-Val Team Activities (MOBY)

Raw signal on left, mid arm (green) lower than 40K, not saturated. Other two arms are saturated. This causes KLu to drop significantly when calculated between top and mid arm, and increase when calculated between mid and bottom arm

Saturation probably subtle



Drop in KLu