VIIRS Ocean Color Breakout Highlights

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NOAA/NESDIS Center for Satellite Applications and Research (STAR)

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

Acknowledgements: This work has been supported by JPSS/VIIRS funding. We thank MOBY team for in situ optics data, VIIRS Cal/Val PIs and their collaborators in support of VIIRS Cal/Val activities.

VIIRS Ocean Color Breakout Highlights

22 Presentations; several posters (Wed. session)
About 50+ attendees throughout the day

STAR Ocean Color team covered overview;
• OC improved sensor calibration;
• Vicarious calibration with MOBY data;
• Implementing OCI chlorophyll algorithm (experimental);
•OCView monitoring tool;
•DINEOF gap-filling technique

OSPO – OC into production at OKEANOS

VIIRS Cal/Val team (external members):
•VIIRS dedicated cruise results;
•AERONET-OC results;
•apparent and inherent optical properties;
•using VIIRS overlap data for temporal changes;
•NIST traceability

Users, New Applications
•Using ocean color for water-quality monitoring of coral reefs
•Using ocean color for in models: biogeochemical and heating, hydrodynamics
•Harmful algae algorithm
•Science of BRDF effect

Prominent Themes/Discussions

•Improvements of Science Quality data

•Satellite data discovery, version naming, citing, DOI, archiving

•Data distribution, CoastWatch, NCEI

•Plans for J-1 (compare, contrast with SNPP – plans for data productions)

•Bringing IOP products into standard product suite, i.e. a_{ph}; desire for products vs. rigorous validation

•Interest in Sentinel 3 (and other sensors) data

•Usefulness of 745 nm band ; Developing algorithms to exploit 450 nm band

•Potential biases in gap-filled data (using only cloud free pixels)

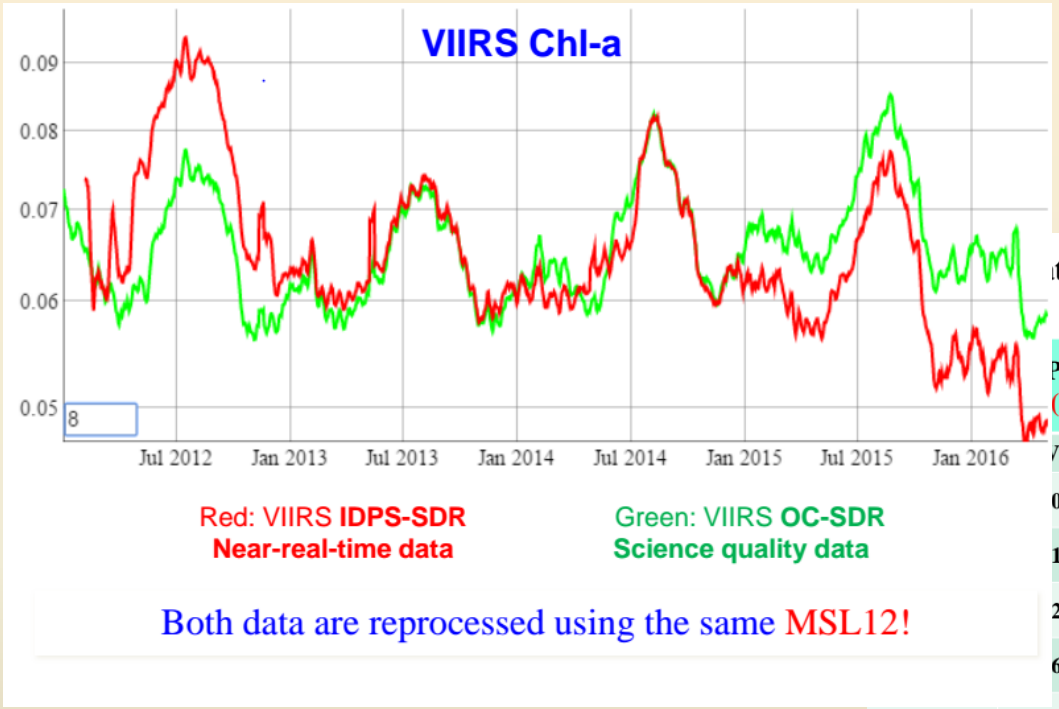
•Ocean color in models – pros and cons NPZD, encoda, Hycom, GODAS, etc.

•Work to be done on coastal retrievals

•Overall, much progress in VIIRS OC over the 5 years since launch

Cal/Val Team Discussions (Thur. session)
• In situ data analysis and discussion
• Measurement protocol discussion
• Lessons learned from past two VIIRS Cal/Val cruises
• Preparing for the upcoming cruise in Oct. 2016
• In situ data archive (format, etc.)
• Documentation (preparing for papers)

Data improvement through OC reprocessing



tistics of VIIRS Data vs. In Situ (MOBY)

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

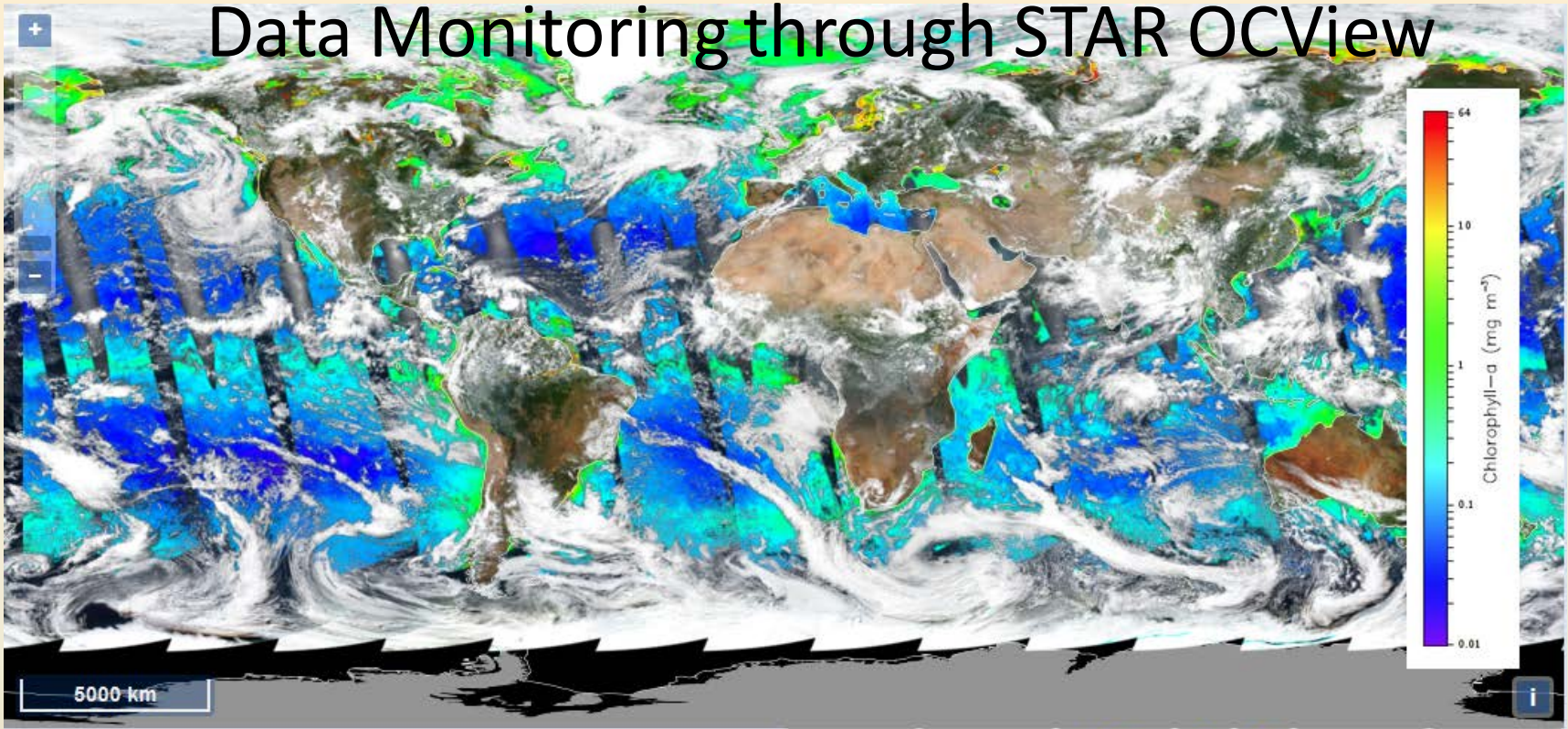
	PS-SDR MSL12 (ver. 1.10) (Near-Real-Time Data)				OC-SDR MSL12 (ver. 1.10) (Science Quality Data)			
	VG	MED	STD	No	AVG	MED	STD	No
	083	1.0065	0.0961	463	**1.0164**	1.0157	0.0956	509
	191	1.0005	0.1733	475	**1.0083**	1.0062	0.0899	509
	258	0.9991	0.1861	475	**1.0110**	1.0103	0.0846	509
	604	0.9809	0.4910	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]

STAR JPSS Oceans

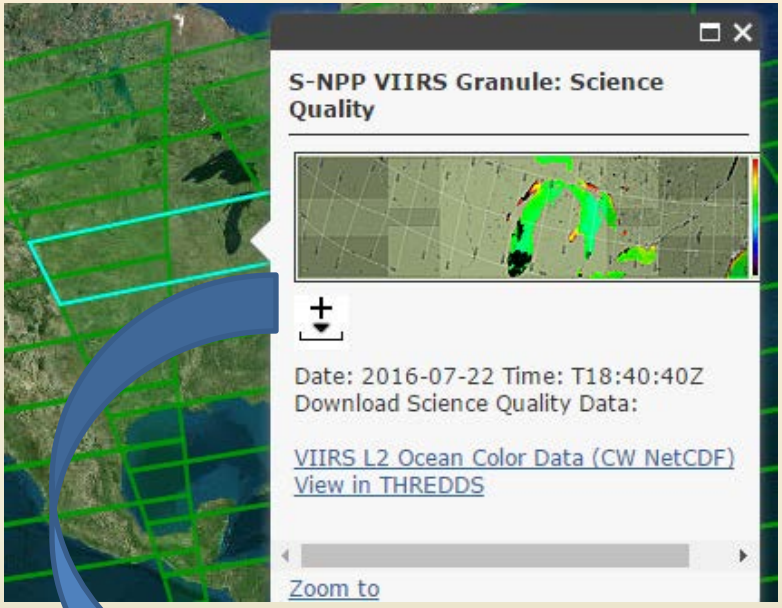
Data Monitoring through STAR OCView

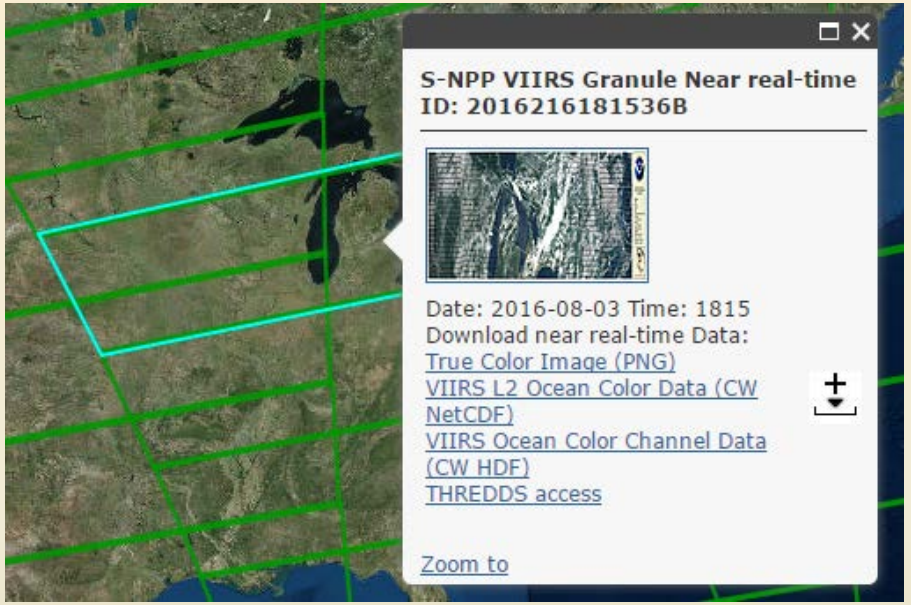


http://www.star.nesdis.noaa.gov/sod/mecb/color/

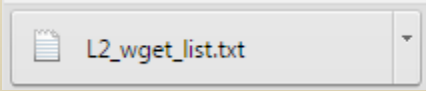
STAR JPSS Oceans

Data Distribution through NOAA CoastWatch/OceanWatch



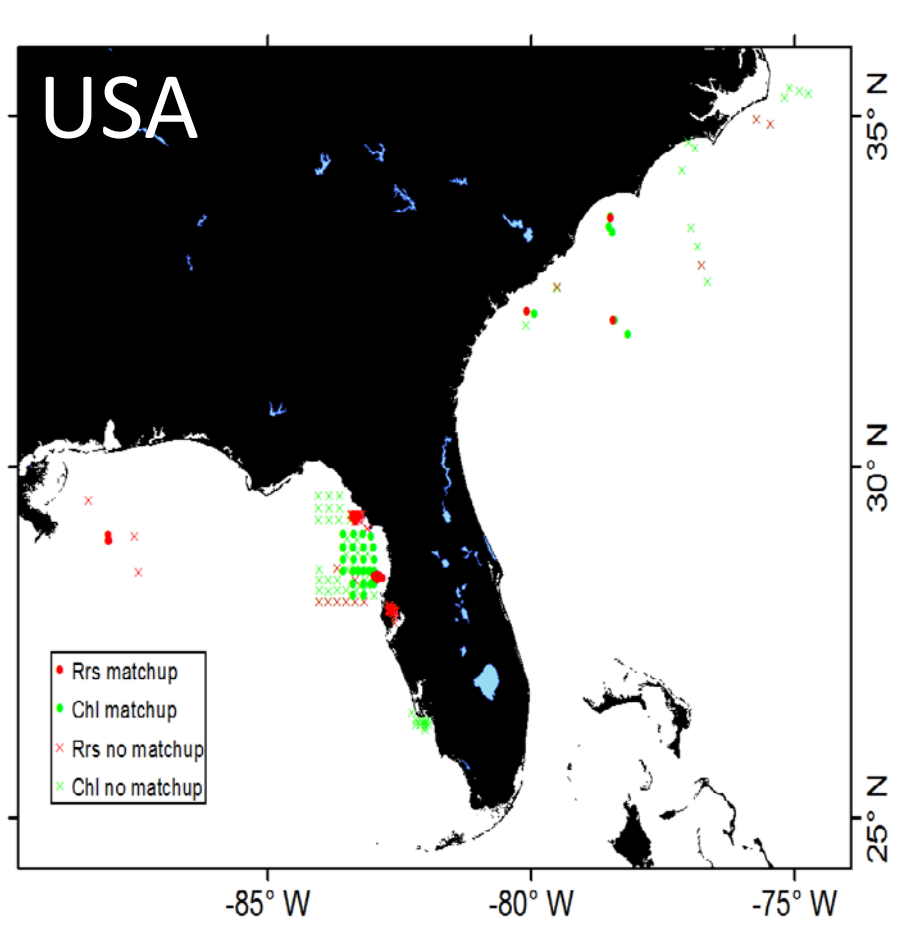


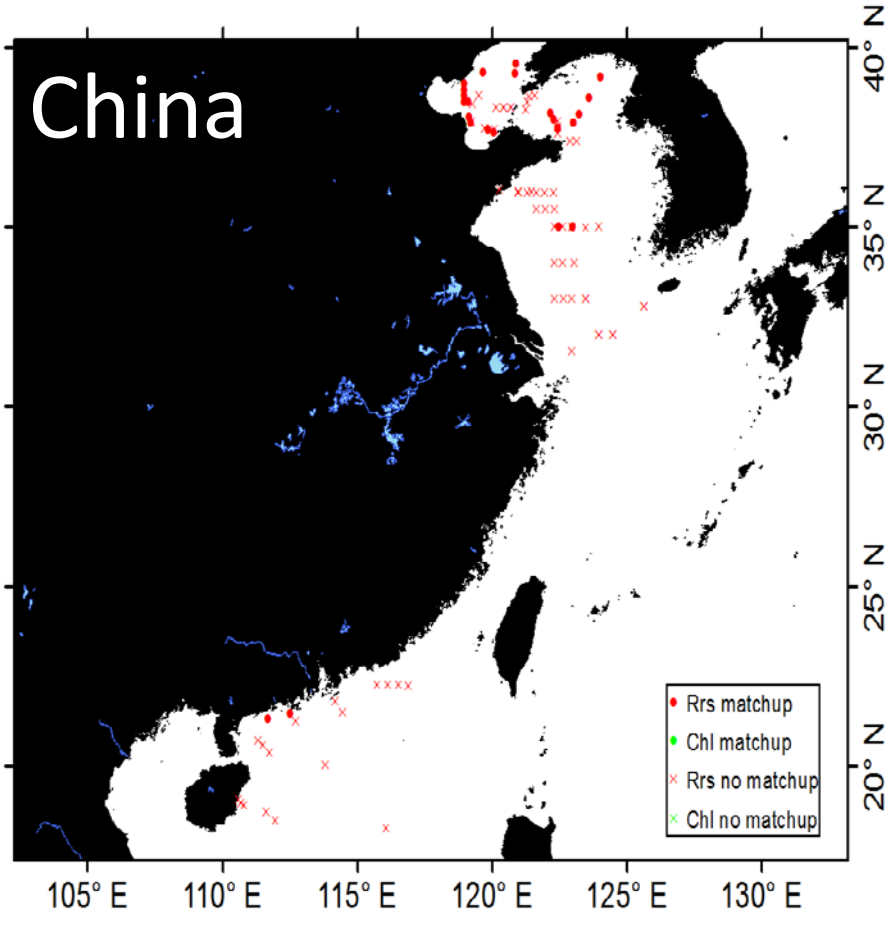
For batch download



New Validation (MSL12 processing)

VIIRS data downloaded from NOAA/NESDIS ftp site in July 2016
Field data collected between 2012 and 2015 from different cruises



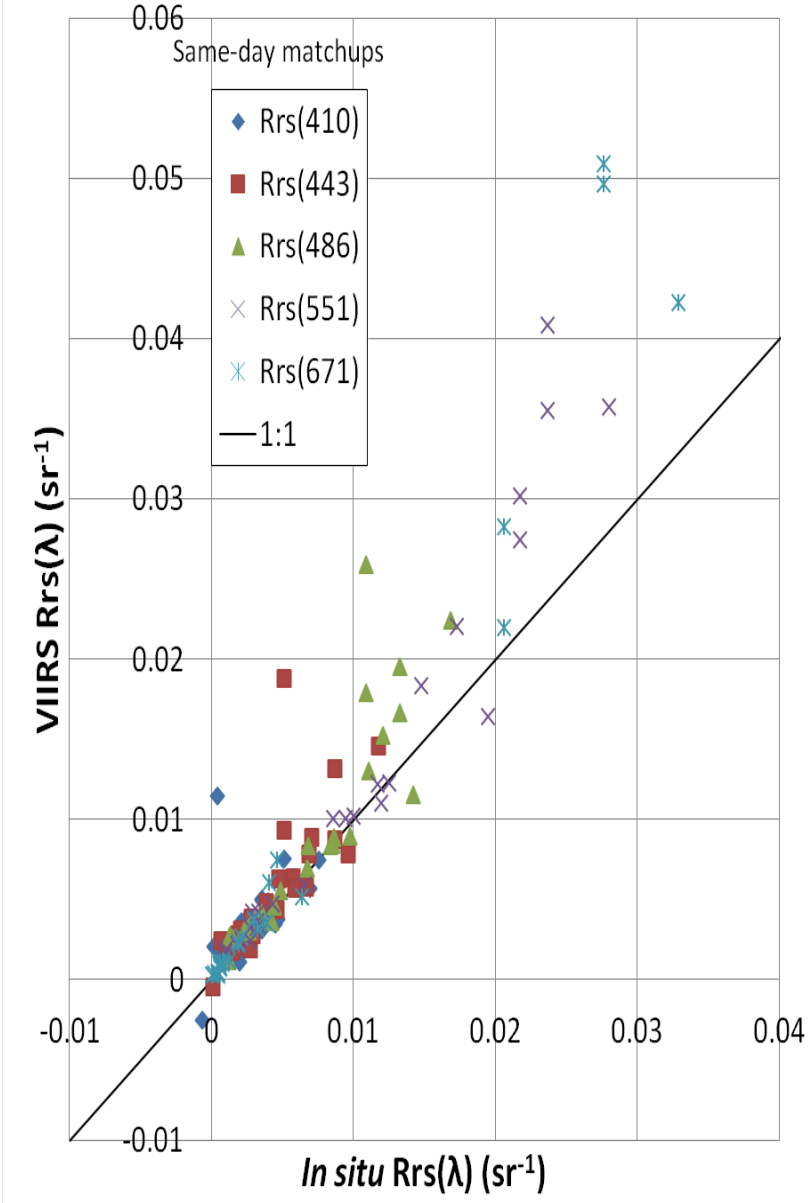


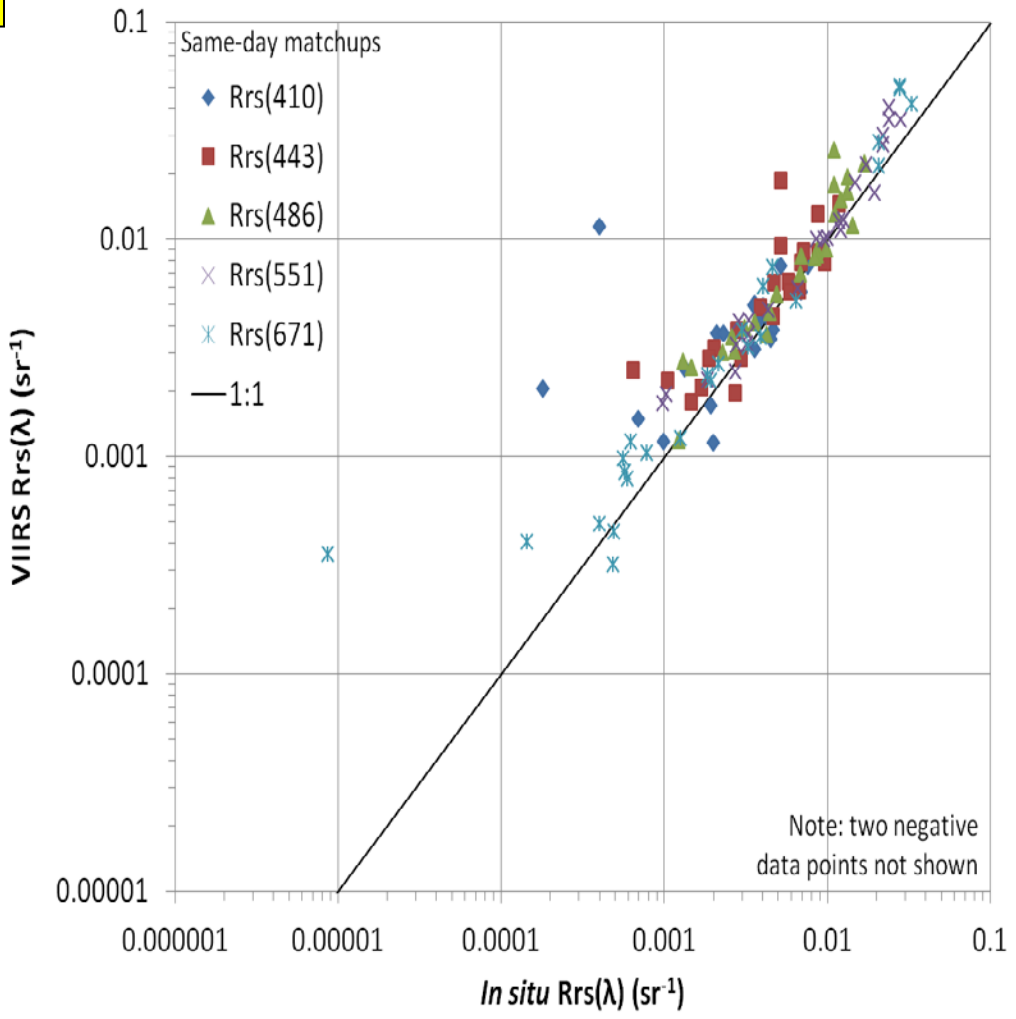
Hu et al. (USF)

NOAA VIIRS

Hu et al. (USF)

China only





	UPD (%)	MAD (sr^{-1})	N
Rrs(410)	35.6	0.00144	22
Rrs(443)	19.1	0.00171	25
Rrs(486)	23.8	0.00224	25
Rrs(551)	21.7	0.00293	25
Rrs(671)	38.5	0.00301	25

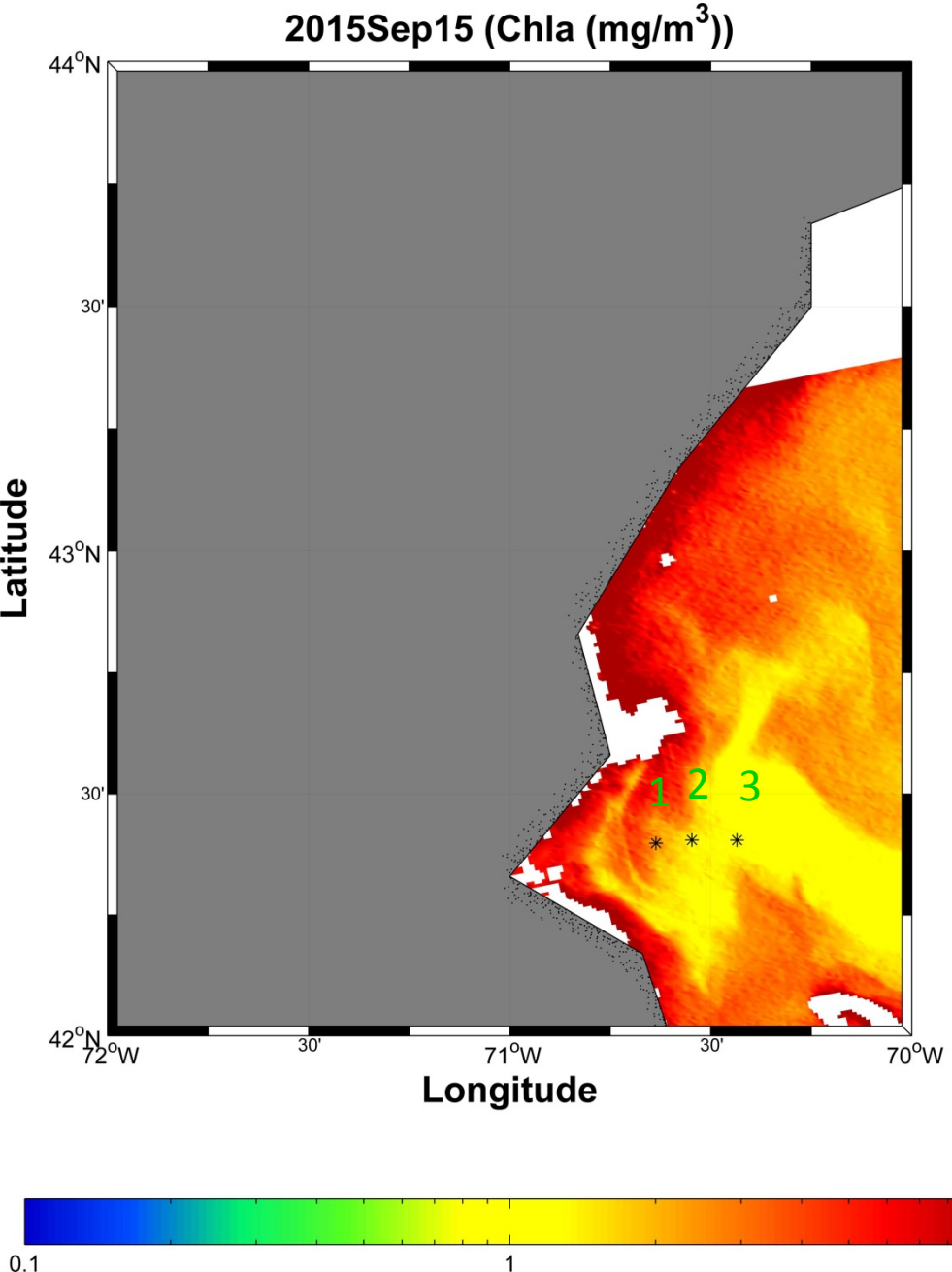
Hu et al. (USF)

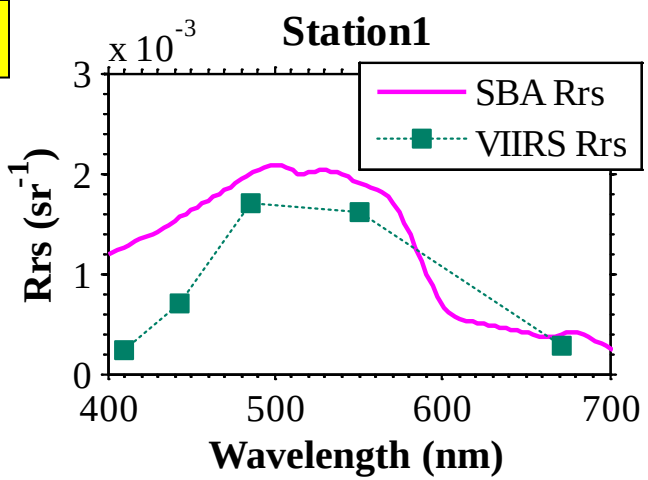
Conclusions from validation results

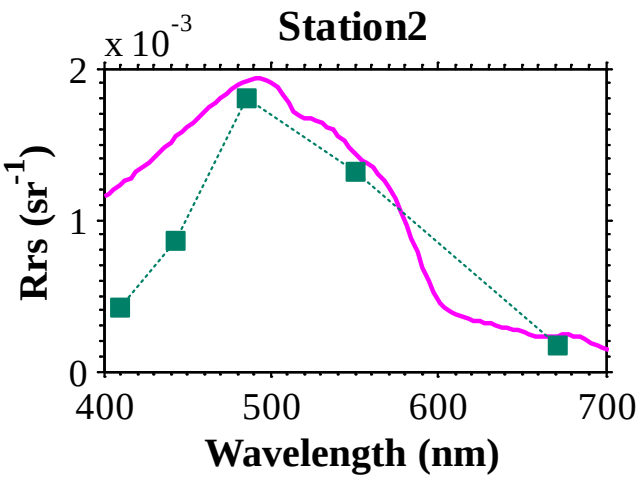
- MSL12 Rrs performance generally satisfactory in coastal waters (comparable to published MODIS results)
- Bio-optical inversion algorithms still need improvements
- MSL12 Rrs slightly better than L2gen Rrs for the same pixels
- MSL12 shows more retrievals than L2gen

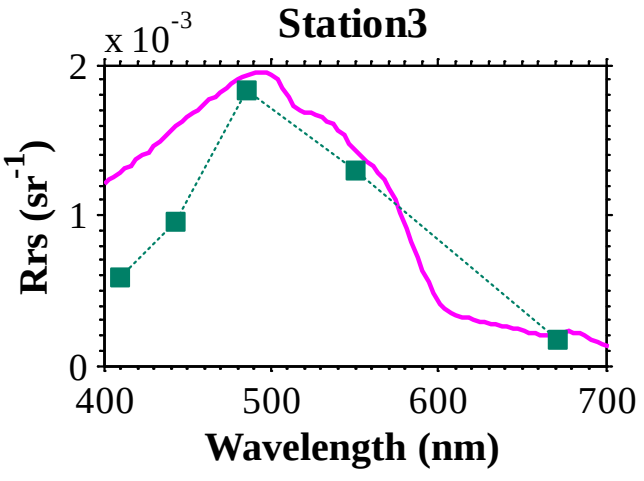
MassBay, September 15, 2015

Lee et al. (UMB)









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**.

JPSS SST Report Back

Sasha Ignatov, Paul DiGiacomo

NOAA Center for Satellite Applications and Research (STAR)

Three Major Themes

- VIIRS **L2/L3 Data Producers**-8: STAR(5), NAVO(2), U. Miami(1)
  - NOAA ACSPO product continues history of solid performance
  - Reduced-size ACSPO L3U widely used & improved
  - New ACSPO error characterization improves SST performance
  - U. Miami and NAVO continue improving their VIIRS SST products
- ACSPO **Holdings/Archives**-2: STAR(1), NCEI/Silver Spring(1)
  - ACSPO L2P/L3U Products are fully archived at PO.DAAC and NCEI
  - STAR is exploring supplemental product access via CoastWatch
- ACSPO **Users**-10: UKMO(1), ABoM(2), JMA(1), NOAA CRW(1) and Geo-Polar Blend(1), JPL(1), NCEI(1), NOS(1)
  - Sustained 2 major users: CMC and NOAA Geo-Polar-Blended
  - 2 new users: **Met Office (OSTIA)** and NOAA CRW
  - 5 emerging users: ABoM, JMA, JPL, NOS, NCE/Asheville

Improvements to UKMO OSTIA L4 SST Analysis from: (1) Assimilating VIIRS; (2) Replacing Ref to VIIRS

Region (CMEMS definitions)	RMS diff to Argo Floats (K)		
	Control	+VIIRS+AMSR2	+VIIRS_Ref
	Operational before 15 Mar 2016	Operational after 15 Mar 2016 – pr	Operational after 20 Sep 2016
Global	**0.50**	**0.44**	**0.40**
North Atlantic	0.59	0.53	0.42
Tropical Atlantic	0.30	0.28	0.24
South Atlantic	0.56	0.50	0.44
North Pacific	0.50	0.45	0.45
Tropical Pacific	0.33	0.29	0.22
South Pacific	0.39	0.36	0.30
Indian Ocean	0.34	0.30	0.28
Southern Ocean	0.52	0.47	0.42

Assimilating VIIRS and using it as REF significantly improves its relative ranking compared to other L4 analyse

Comparison to other SST analyses

Assimilating VIIRS (and REMSS AMSR2) substantially improves the accuracy of the OSTIA analysis compared to other L4 SST analyses.

The effect of using VIIRS as a reference dataset for OSTIA instead of MetOp-A AVHRR continues this improvement.

Analysis Name	Global RMS Diff to independent Argo (K)
OSTIA +VIIRS, AMSR2, and VIIRS bias correction	0.40
CMC	0.42
GMPE Median	0.43
OSTIA +VIIRS, AMSR2	0.44
NRL FNMOC	0.48
NAVO K10_SST	0.52
UKMO OSTIA (original)	0.53
RSS mw	0.53
ABoM GAMSSA	0.54
JMA MGDSST	0.57
NCEI Reynolds	0.59
NCEP RTG	0.69
RSS mw_ir	0.82

Statistics for 9 December 2015 to 11 January 2016, from the GMPE (GHRSST Multi-Product Ensemble) system