NIR and SWIR-Based On-Orbit Vicarious Calibrations for VIIRS Ocean Color Data Processing

Wei Shi and Menghua Wang

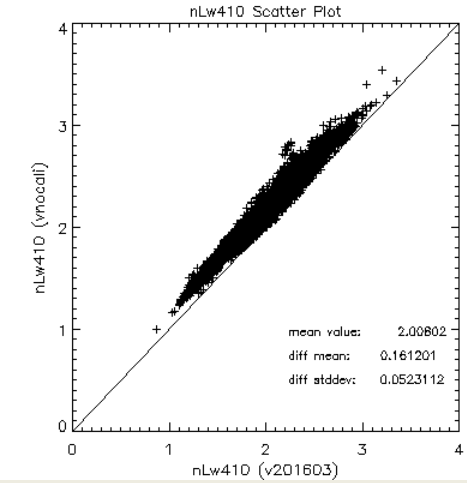
NOAA/NESDIS
Center for Satellite Applications and Research
5830 University Research Ct.
College Park, MD 20740, USA

2016 STAR JPSS Science Meeting
August 10, 2016

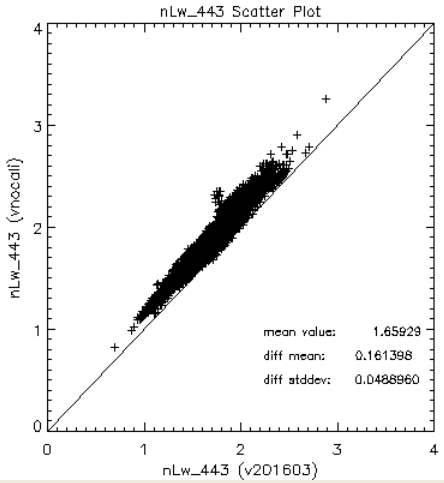
Comparison of VIIRS Ocean Color Products

(w/o vicarious calibration vs. Ref. V201603)

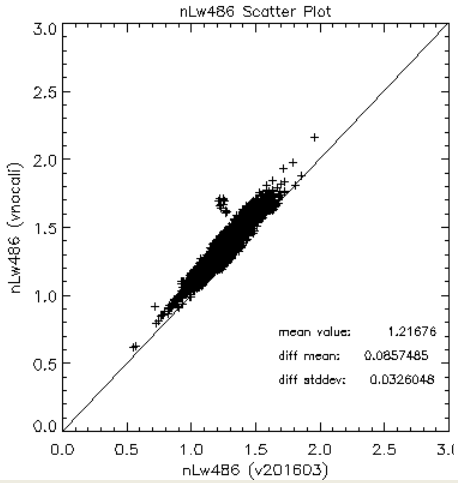
$nL_w(410)$



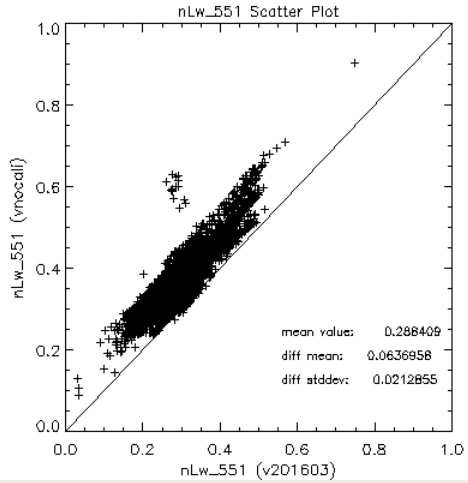
$nL_w(443)$



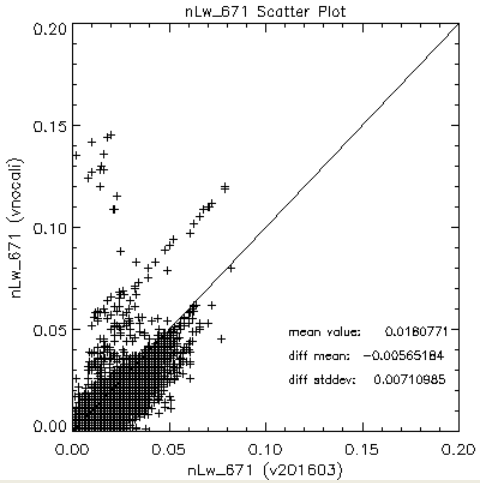
$nL_w(486)$



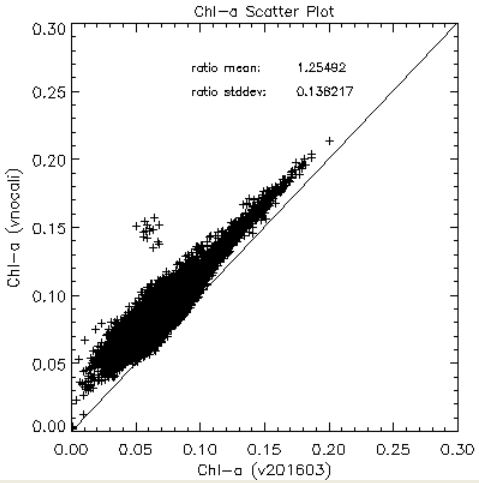
$nL_w(551)$



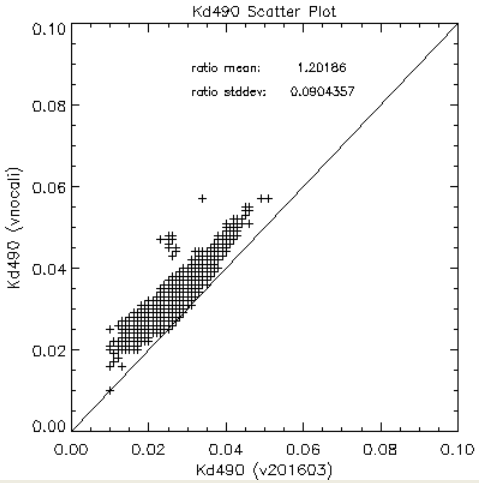
$nL_w(671)$



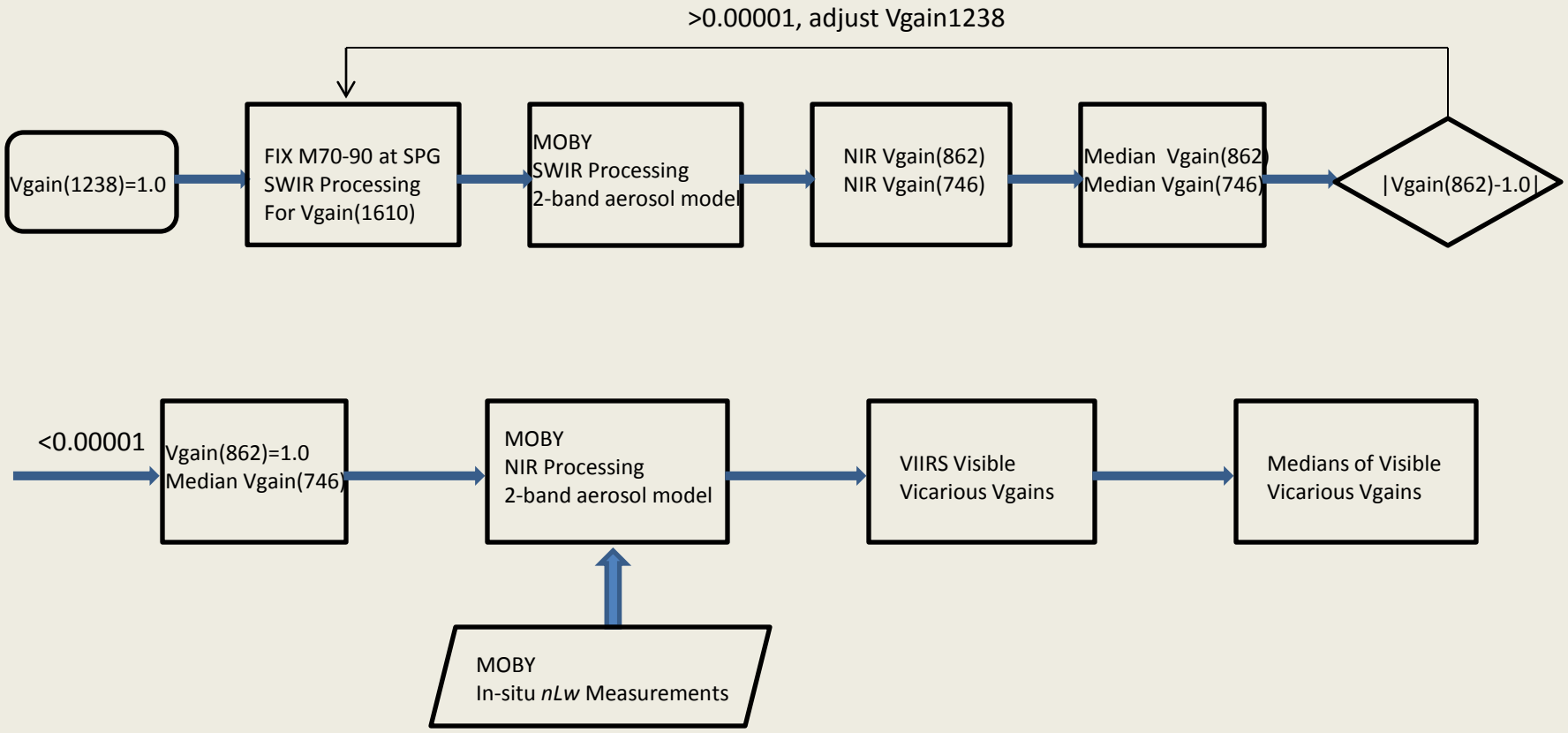
Chl-a



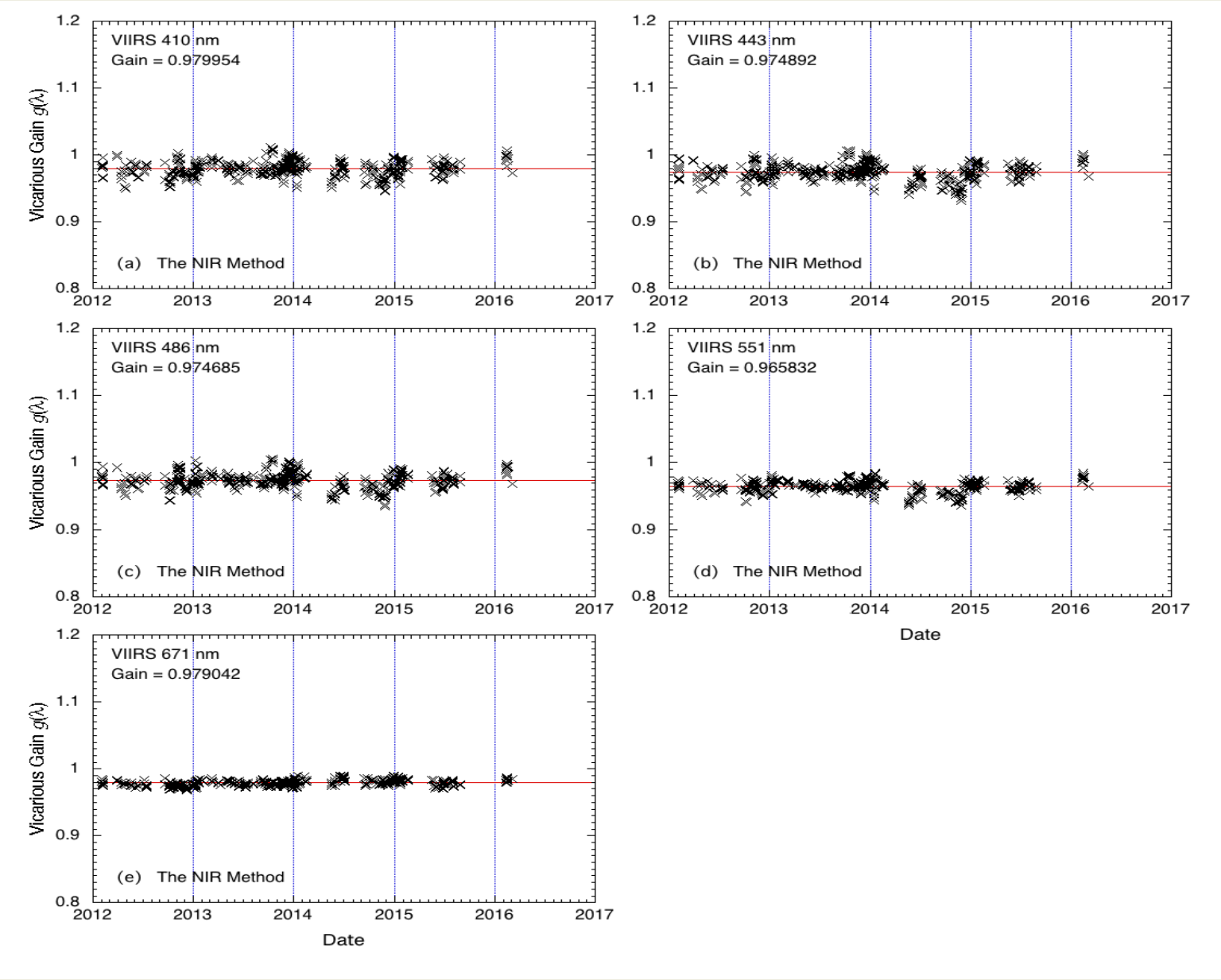
$K_d(490)$



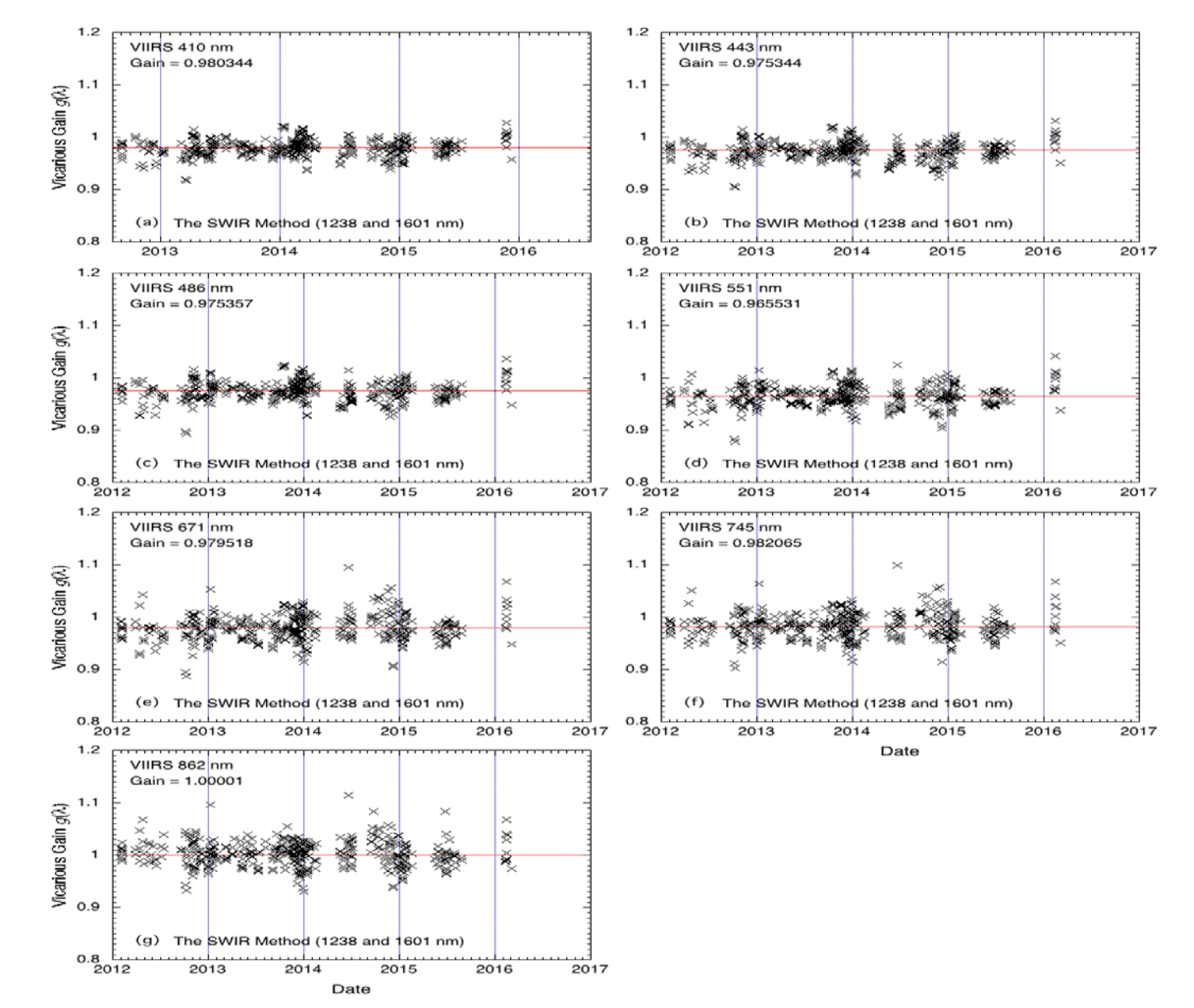
Vicarious Calibration Flow Chart



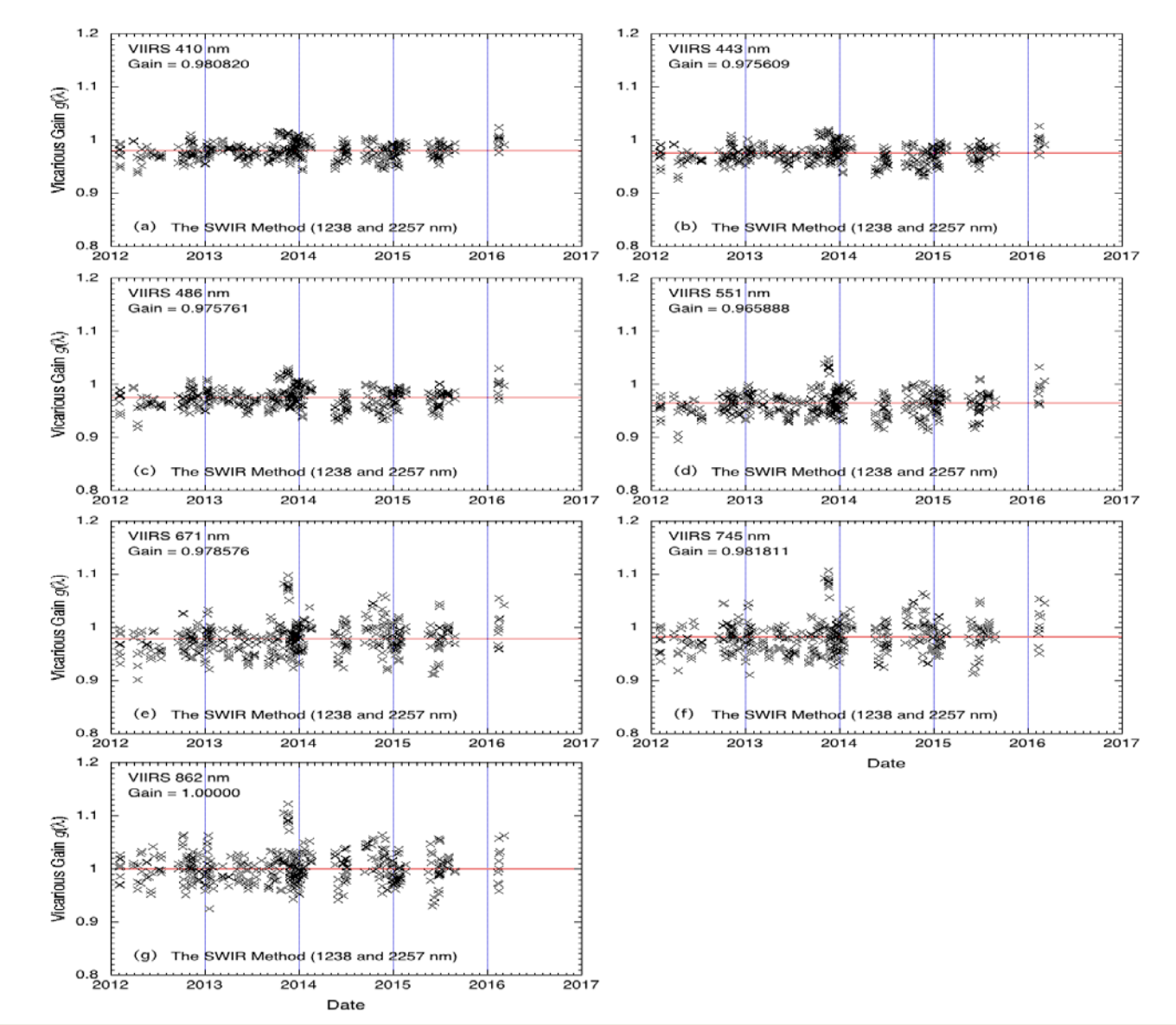
The NIR-Derived (M6, M7) Vicarious Calibration Gains $g^{(NIR)}(\lambda)$



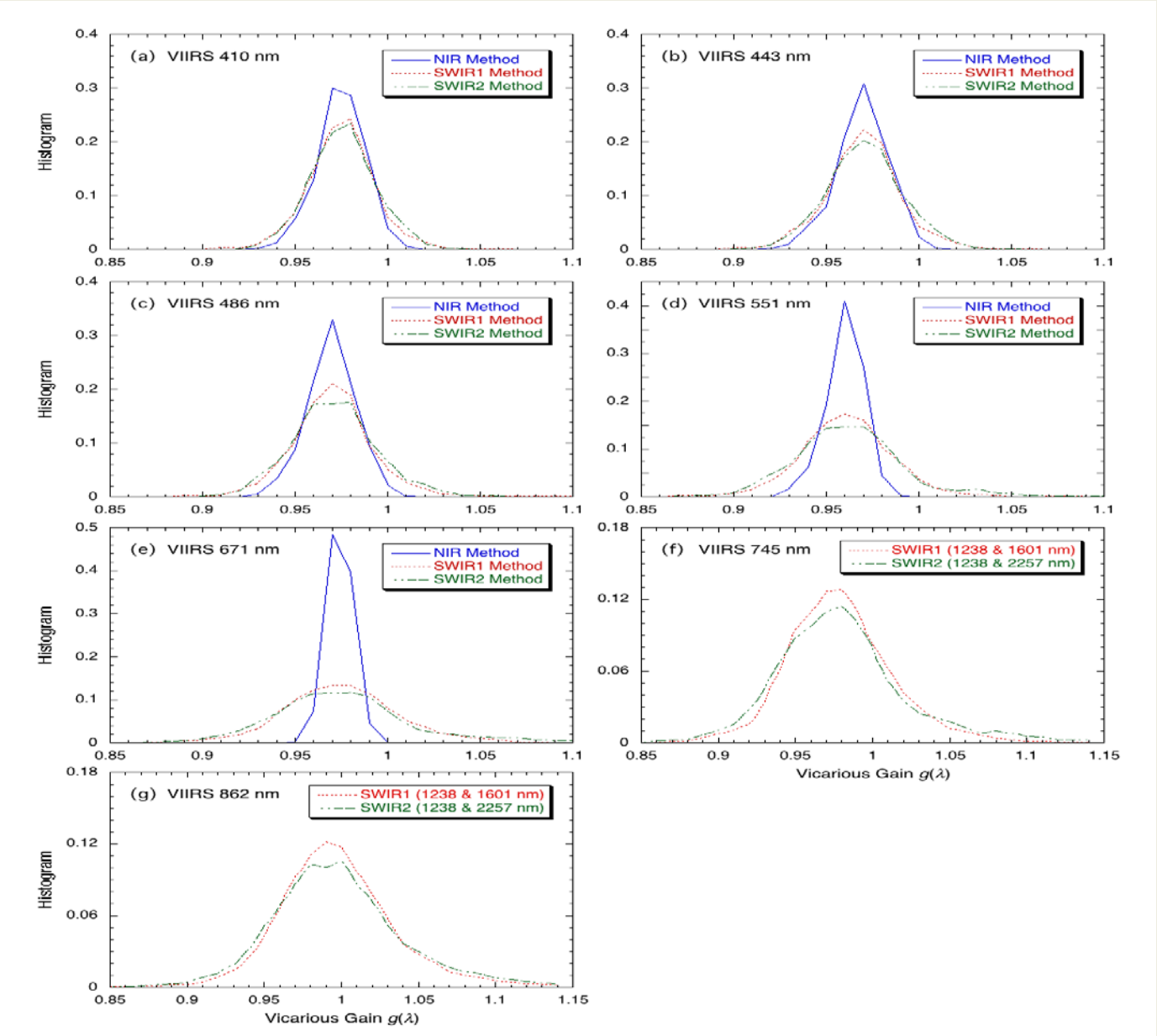
The SWIR1-Derived (M8, M10) Vicarious Calibration Gains $g^{(SWIR1)}(\lambda)$



The SWIR2-derived (M8, M11) Vicarious Calibration Gains $g^{(SWIR2)}(\lambda)$



Histograms of the NIR-, SWIR1-, and SWIR2- Derived Vicarious Gains



VIIRS-SNPP NIR- and SWIR-based Vicarious Gains (May 2016)

VIIRS Spectral Band (nm)	**VIIRS SWIR- and NIR-Based Vicarious Calibration Gains**							
	NIR-derived $g^{(NIR}(\lambda)$ and STD		SWIR1-derived $g^{(SWIR1)}(\lambda)$		SWIR2-derived $g^{(SWIR2)}(\lambda)$		Diff1 (%) (SWIR1 vs. NIR)	Diff2 (%) (SWIR2 vs. NIR)
410 (M1)	0.979954	0.0129	0.980344	0.0190	0.980820	0.0181	0.040	0.088
443 (M2)	0.974892	0.0142	0.975344	0.0219	0.975609	0.0212	0.046	0.074
486 (M3)	0.974685	0.0131	0.975357	0.0246	0.975761	0.0240	0.069	0.110
551 (M4)	0.965832	0.0100	0.965531	0.0299	0.965888	0.0314	-0.031	0.006
671 (M5)	0.979042	0.0064	0.979518	0.0356	0.978576	0.0445	0.049	-0.048
745 (M6)	0.982065	—	0.982065	0.0379	0.981811	0.0476	0.000	-0.026
862 (M7)	1.00000	—	1.00001	0.0423	1.00000	0.0490	0.001	0.000
1238 (M8)	—	—	1.01812	—	1.01812	—	—	—
1601 (M10)	—	—	0.994676	—	—	—	—	—
2257 (M11)	—	—	—	—	1.20252	—	—	—

Gain differences from the NIR- and SWIR-based approaches are within ~0.05%!

Unified NIR- and SWIR-based Vicarious Gains (May 2016)

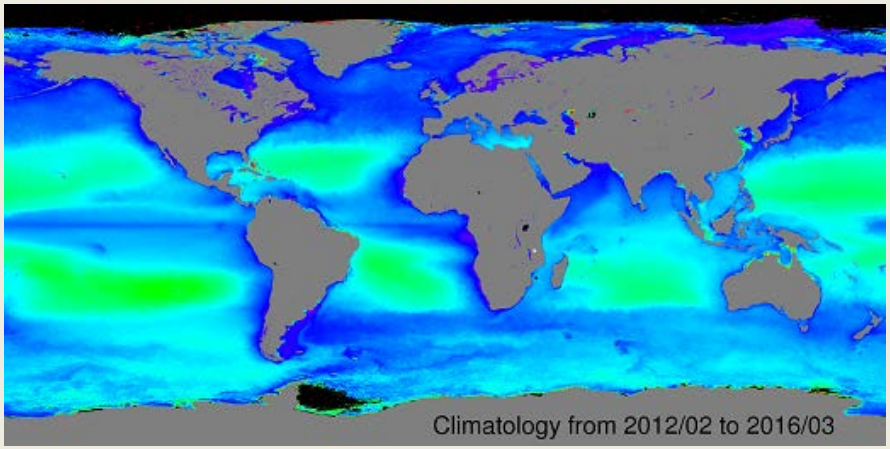
VIIRS Spectral Band (nm)	VIIRS Unified Vicarious Gains for the MSL12
410 (M1)	0.979954
443 (M2)	0.974892
486 (M3)	0.974685
551 (M4)	0.965832
671 (M5)	0.979042
745 (M6)	0.982065
862 (M7)	1.00000
1238 (M8)	1.01812
1601 (M10)	0.994676
2257 (M11)	1.20252

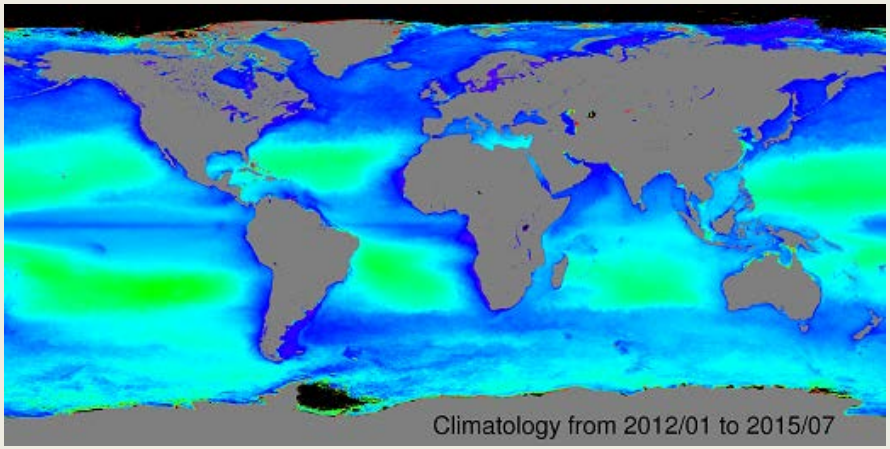
Comparison of Climatology of VIIRS NIR- and SWIR-based Ocean Color Products

VIIRS NIR Ocean Color Product

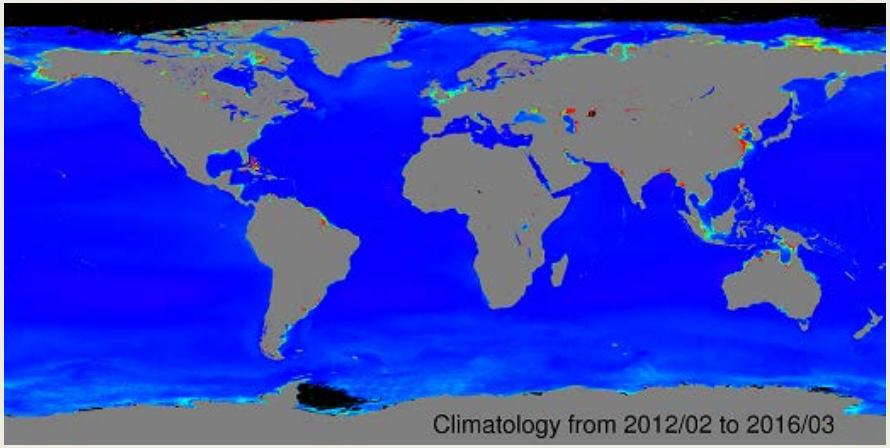
VIIRS SWIR Ocean Color Product

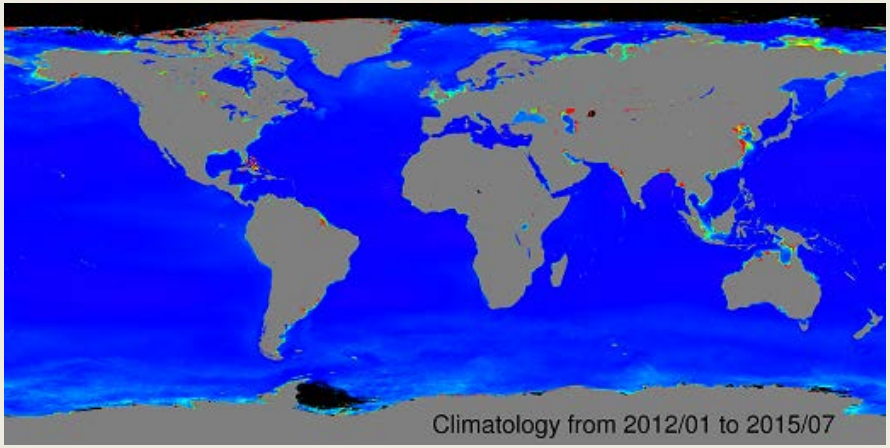
$nL_w(443)$





$nL_w(551)$



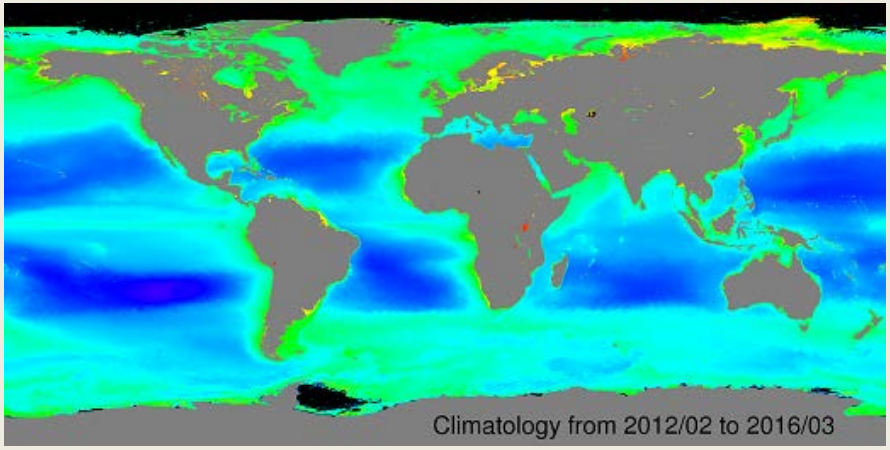


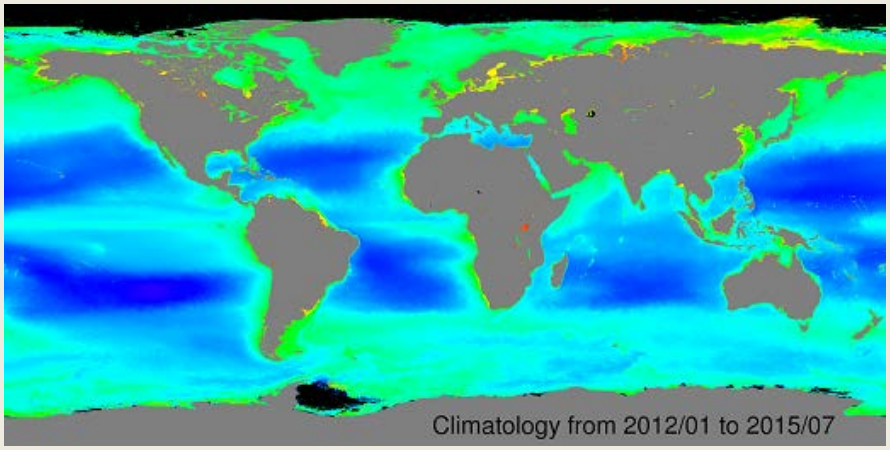
Comparison of Climatology of VIIRS NIR- and SWIR-based Ocean Color Products

VIIRS NIR Ocean Color Products

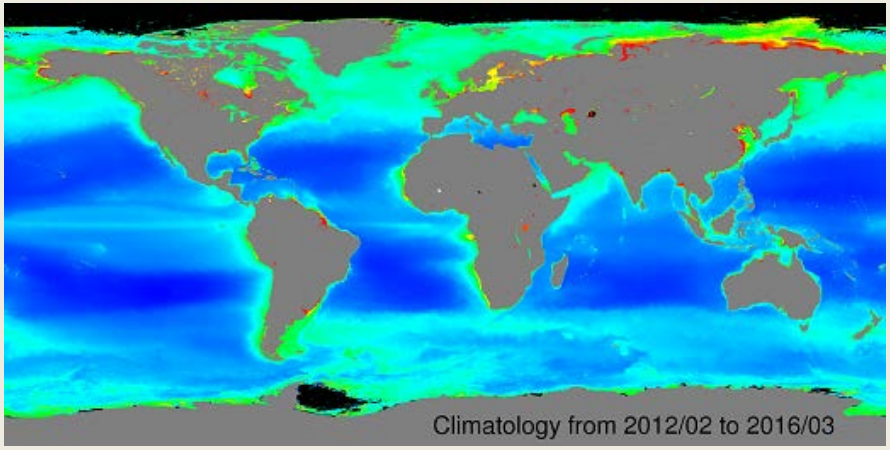
VIIRS SWIR Ocean Color Product

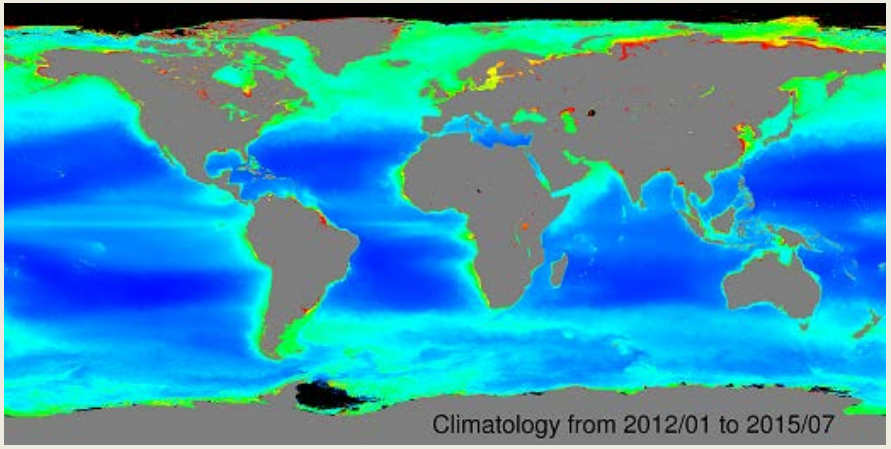
Chl-a





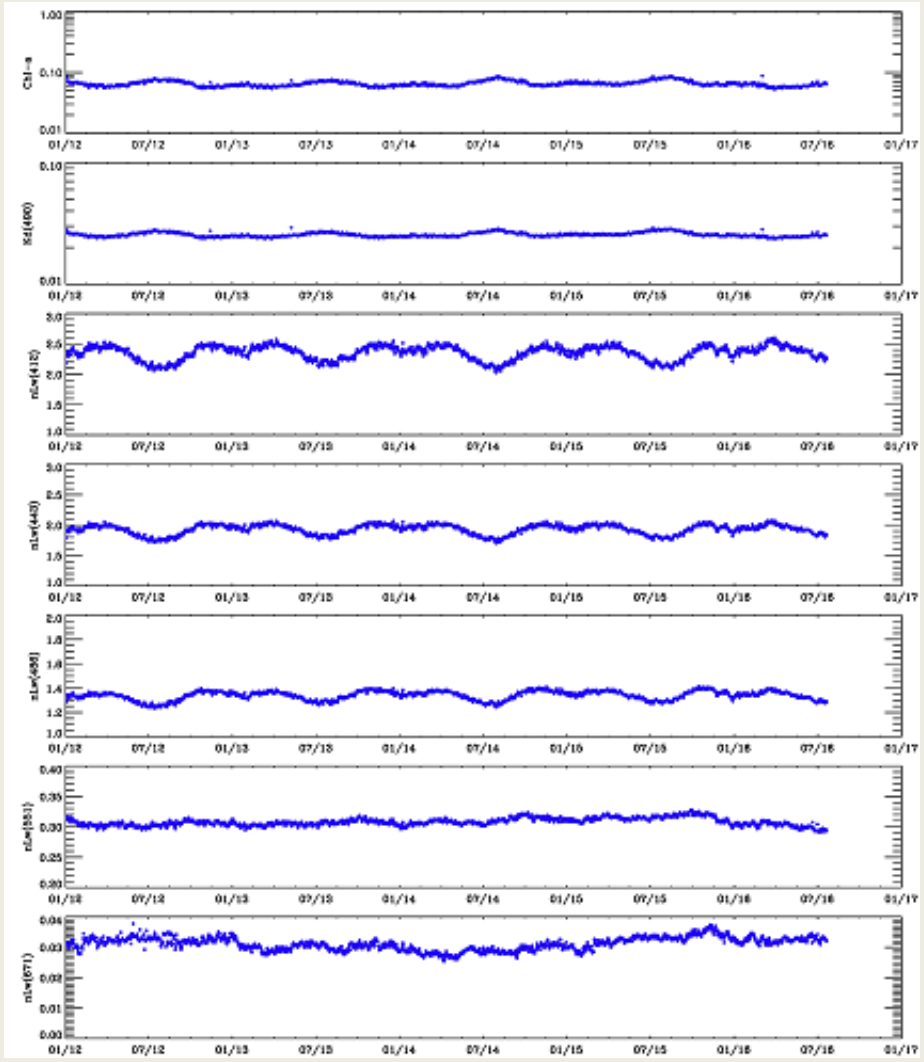
K_d(490)



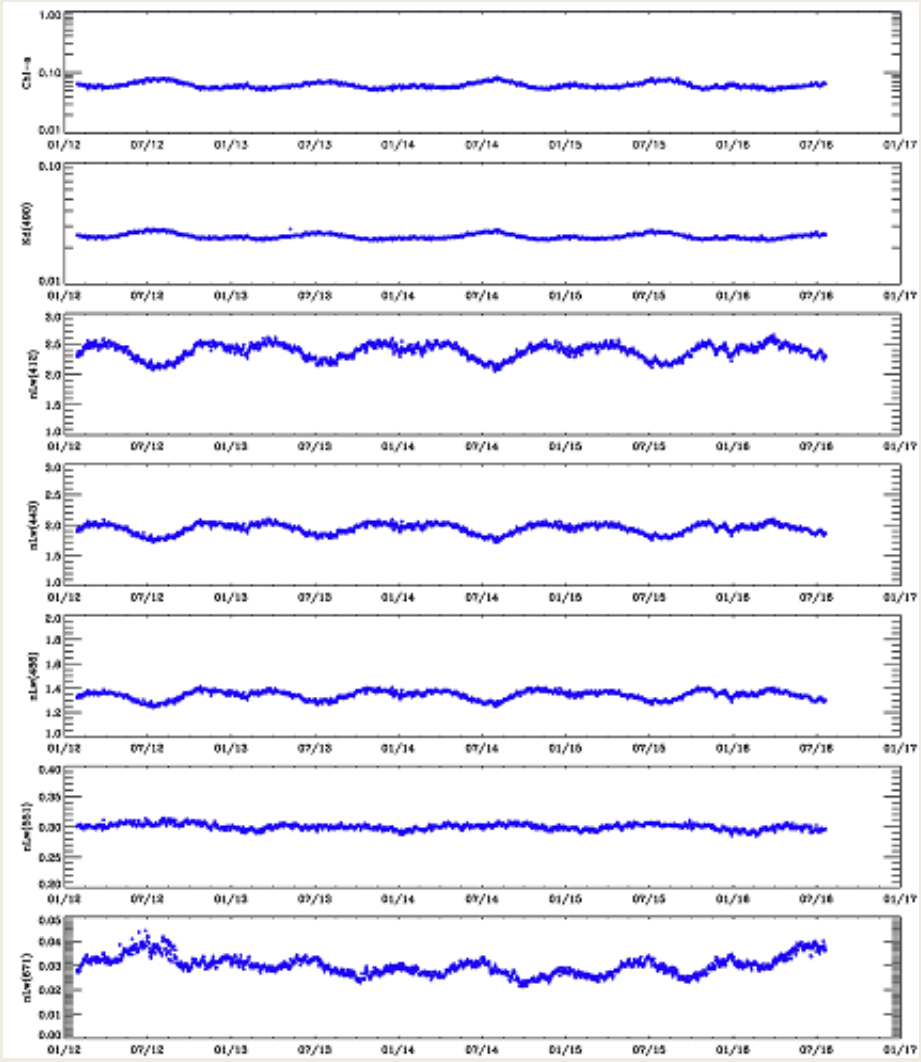


Comparison of VIIRS NIR- and SWIR-based Ocean Color Products in Global Oligotrophic Water

VIIRS NIR Ocean Color Products

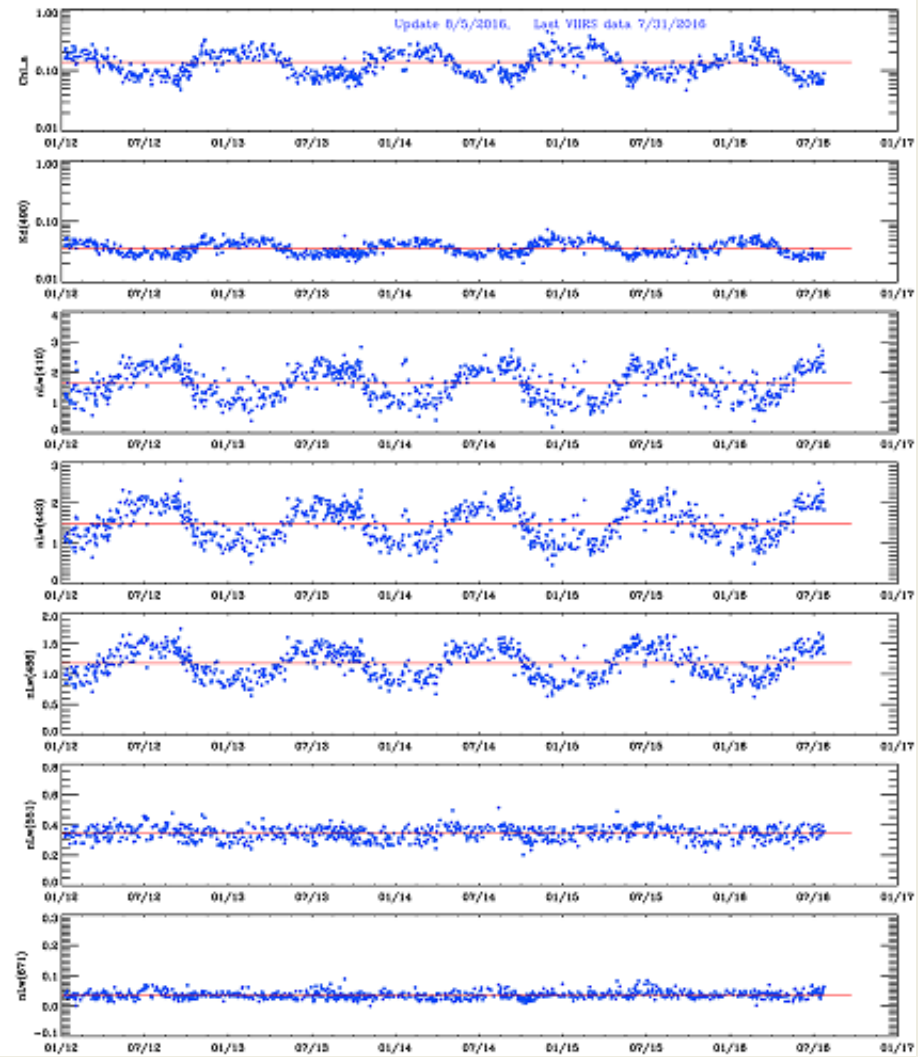


VIIRS SWIR1 Ocean Color Products

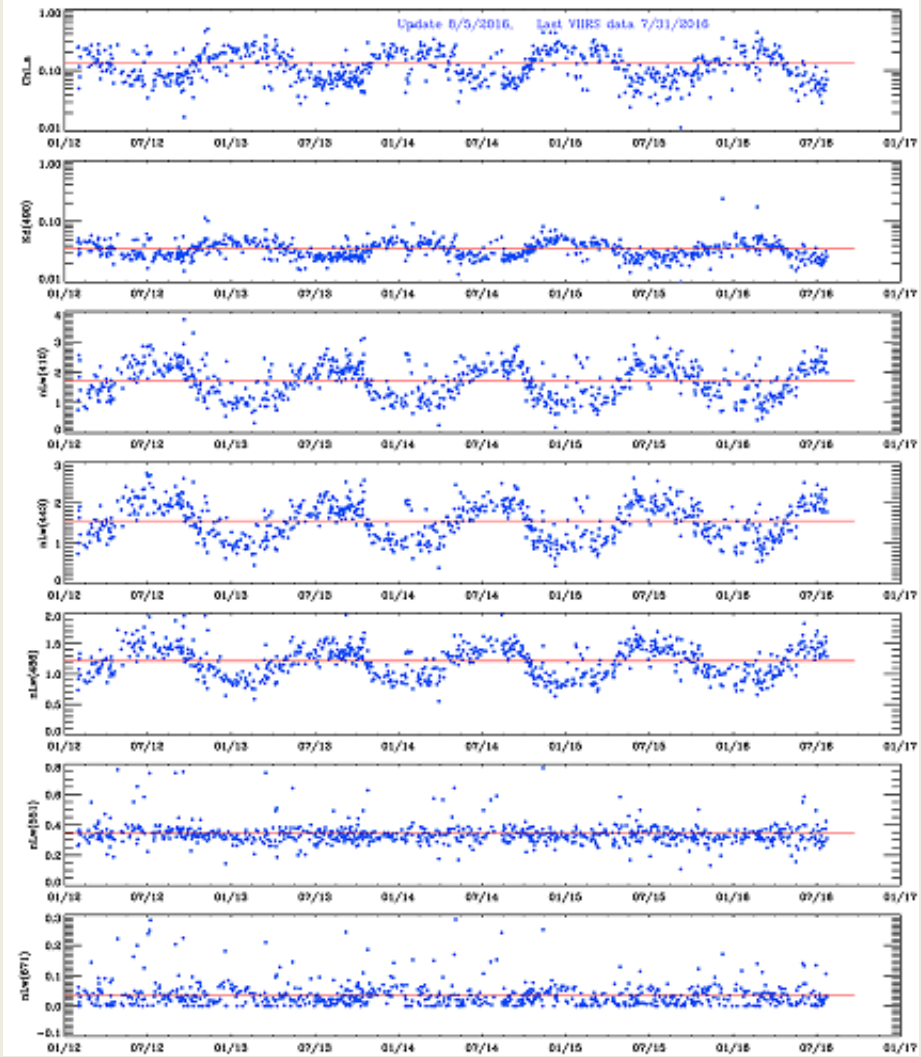


Comparison of VIIRS NIR- and SWIR-based Ocean Color Products in the US East Coast

VIIRS NIR Ocean Color Product



VIIRS SWIR Ocean Color Product



Summary

- Vicarious calibrations with high accurate in situ observations (e.g., MOBY) are indispensible for satellite ocean color data processing.
- We developed a strategy to vicariously calibrate VIIRS-SNPP observations for both the NIR- and SWIR-based ocean color data processing, including the NIR-SWIR combined approach.
- Vicarious calibration gains for VIIRS spectral bands are derived using the in-situ normalized water-leaving radiance $nL_w(\lambda)$ spectra from the MOBY in the waters off Hawaii.
- The NIR-based vicarious calibration gains are consistent with those from the two SWIR-based approaches, with discrepancies mostly within ~0.05% from three data processing methods.
- A unified vicarious gain set for VIIRS bands M1–M8 and M10–M11, has been implemented in the VIIRS ocean color data processing for routine ocean color production.
- Using the unified vicarious gain set, VIIRS mission-long ocean color data have been successfully reprocessed using the NIR, SWIR, and NIR-SWIR approaches in May 2016. The science quality data streams have been going forward since then.