International Ocean Colour Science Meeting 2025

NOAA Ocean Color Research and Applications

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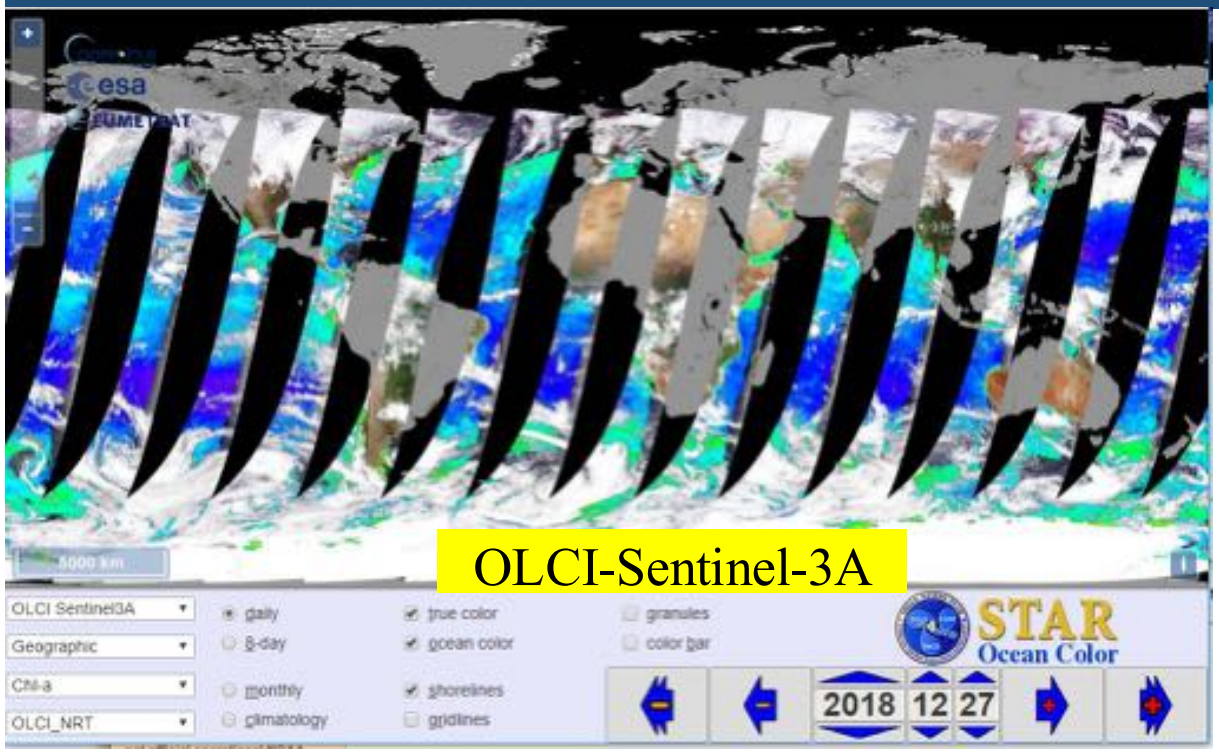
JPSS Status Update

- NOAA's Joint Polar Satellite System (JPSS) provides global observations that serve as the backbone of both short- and long-term forecasts, including those that help us predict and prepare for severe weather events.
- Three VIIRS sensors on the SNPP (2011-present), NOAA-20 (2017-present), and NOAA-21 (2022-present) satellites are in operation. They are working normal and well.
- JPSS-4, to be renamed NOAA-22 in orbit, will be the next JPSS satellite to launch, with a launch date around September 2027.
- JPSS-3 is the last one in the JPSS series (after JPSS-4), which will be launched after about another 5 years.

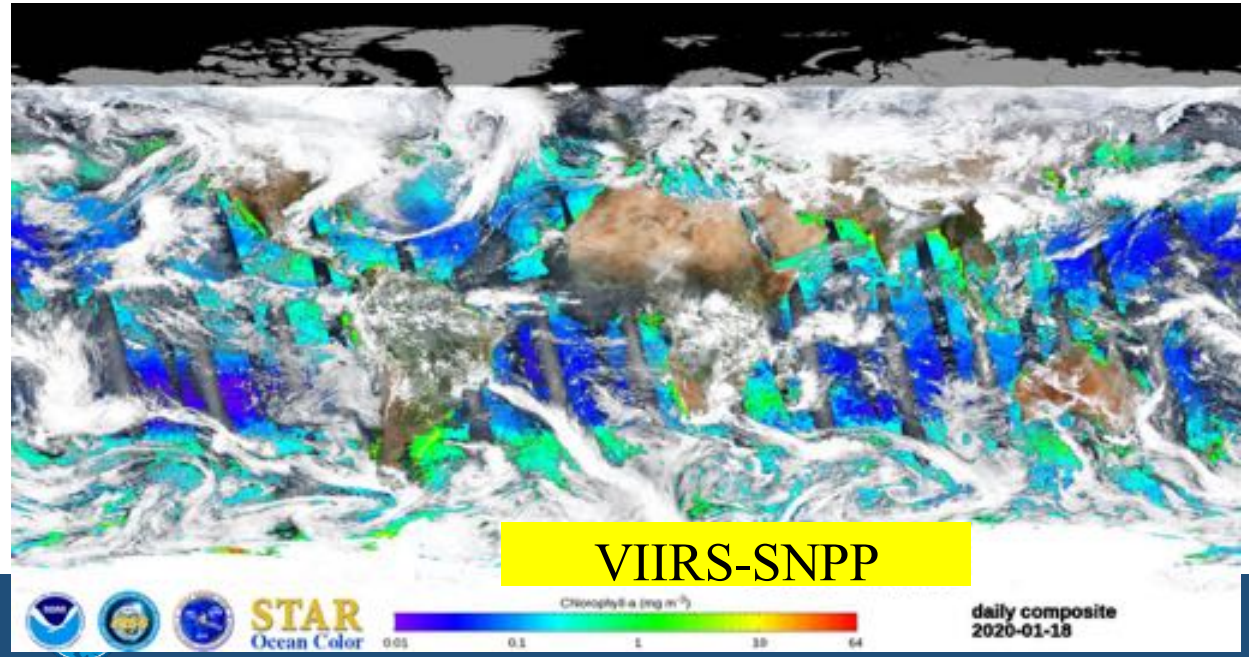
https://www.nesdis.noaa.gov/our-satellites/currently-flying/joint-polar-satellite-system

NOAA OCView and CoastWatch

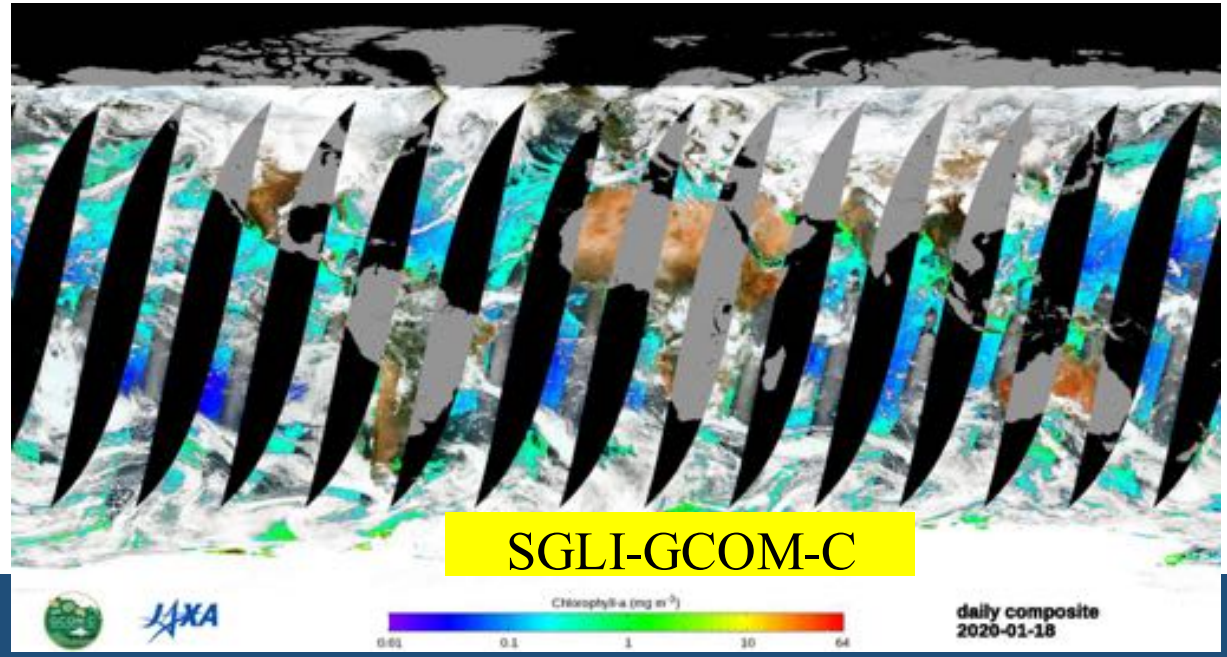
- **NOAA OCView** (https://www.star.nesdis.noaa.gov/socd/mecb/color/)
  - Routine global near-real-time VIIRS, OLCI, and SGLI true color & ocean color imageries, with also false color from VIIRS-SNPP.
  - Routine Cal/Val results and performance monitoring for VIIRS, OLCI, SGLI, etc., including routine satellite vs. in situ comparison results from **MOBY** and **AERONET-OC** measurements.
  - Routine statistical satellite vs. in situ comparison results.
- **NOAA CoastWatch** (https://coastwatch.noaa.gov/cwn/)
  - Produces routine L3 for Mediterranean for EUMETSAT operational use
  - Hosts several satellite ocean color and true color imageries/data
  - Satellite data distributions
  - **MOBY** in situ data distributions



OLCI-Sentinel-3A



VIIRS-SNPP

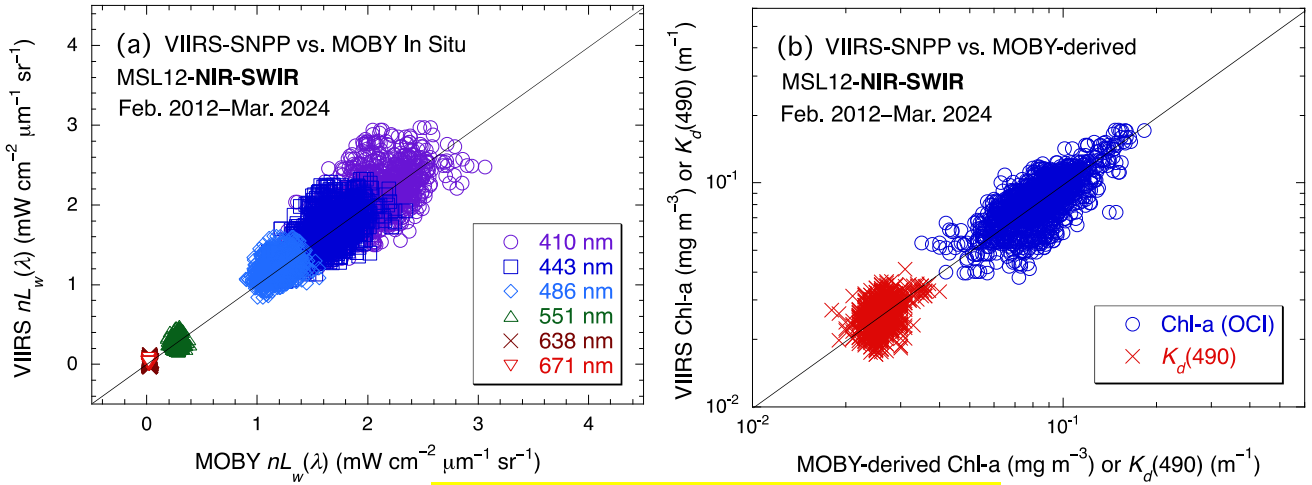


SGLI-GCOM-C

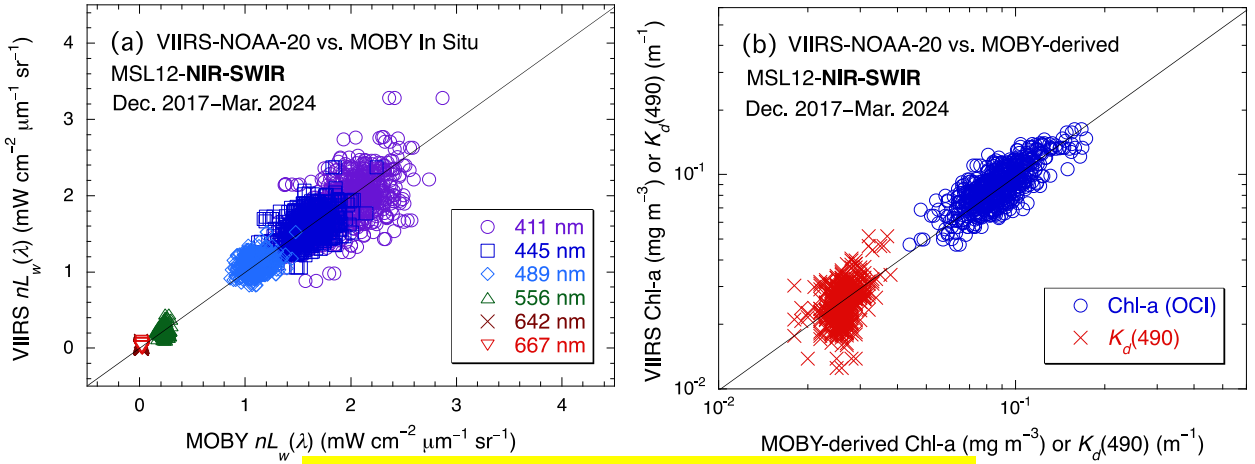
New System Vicarious Calibration Gain Sets for Three VIIRS Sensors

VIIRS-NOAA-21 Spectral Band (nm)	$g^{(SVC)}(\lambda)$ and Differences Between SWIR- and NIR-Based SVC Gains			
	Unified SVC $g^{(SVC)}(\lambda)$	Diff12 (%) (SWIR12 vs. NIR)	Diff13 (%) (SWIR13 vs. NIR)	Diff23 (%) (SWIR23 vs. NIR)
411 (M1				31
445 (M2				46
488 (M3				20
555 (M4				38
641 (I1)				48
671 (M5				43
747 (M6				23
868 (M7				50
1241 (M8				22
1613 (M1				
2252 (M11)	0.8434	—	—	—

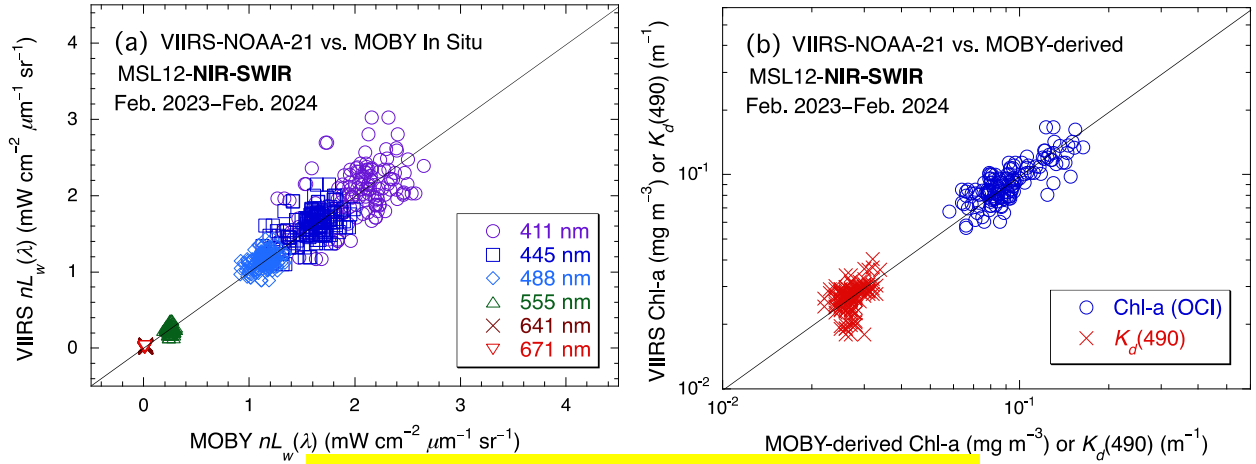
Band	SNPP	NOAA-20	NOAA-21
M6	0.9765	1.0052	1.0051
M7	1.0000	1.0000	1.0000
M8	1.0050	1.0435	0.8982
M10	0.9960	1.0235	0.8779
M11	1.0230	1.0330	0.8434



VIIRS-SNPP (2012-2024)



VIIRS-NOAA-20 (2017-2024)



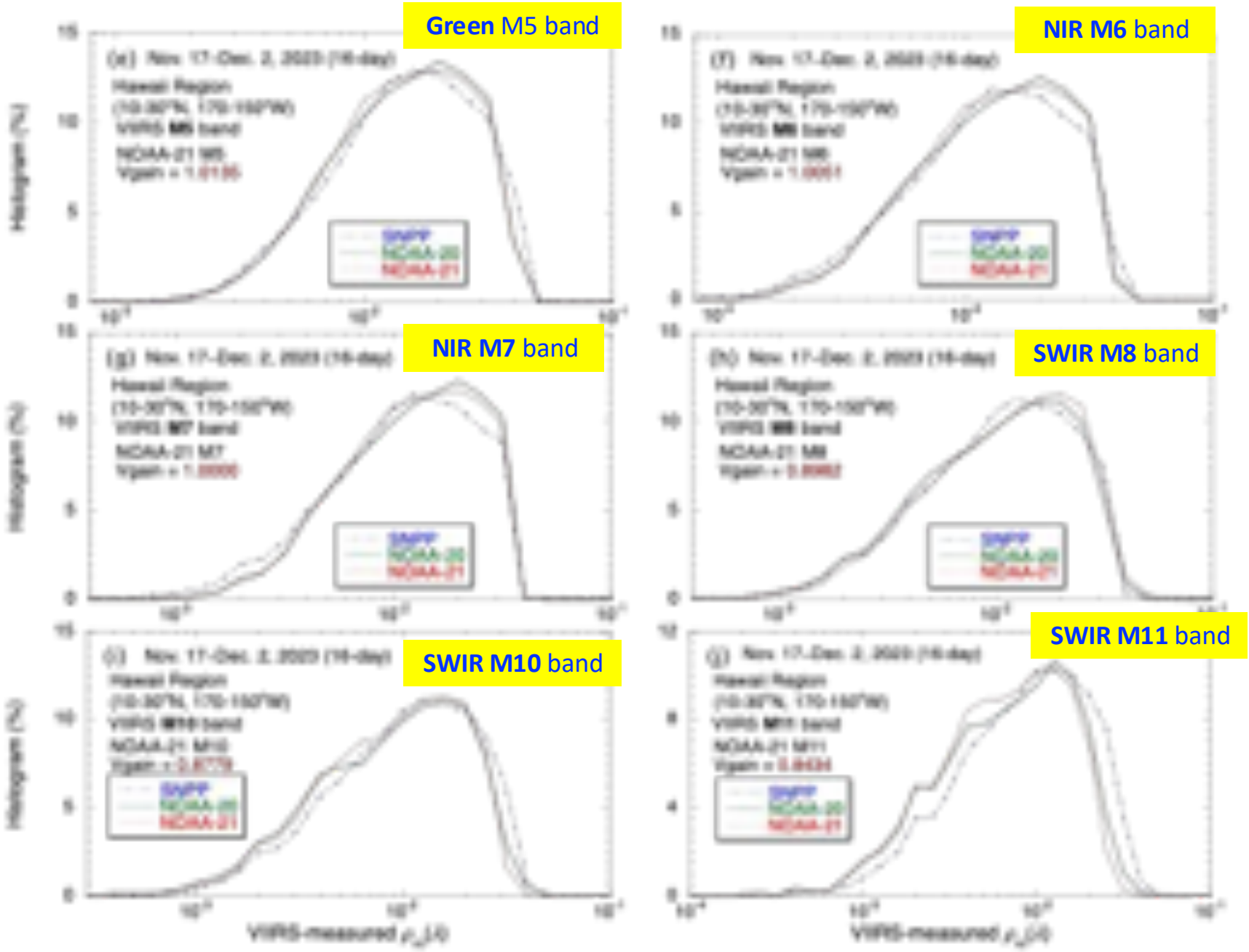
VIIRS-NOAA-21 (2023-2024)

Wang, M. and L. Jiang, "On-orbit system vicarious calibrations for three VIIRS sensors using the NIR-SWIR ocean color data processing approach," *IEEE Trans. Geosci. Remote Sens.*, **63**, 4203416, 2025. https://doi.org/10.1109/tgrs.2025.3542331

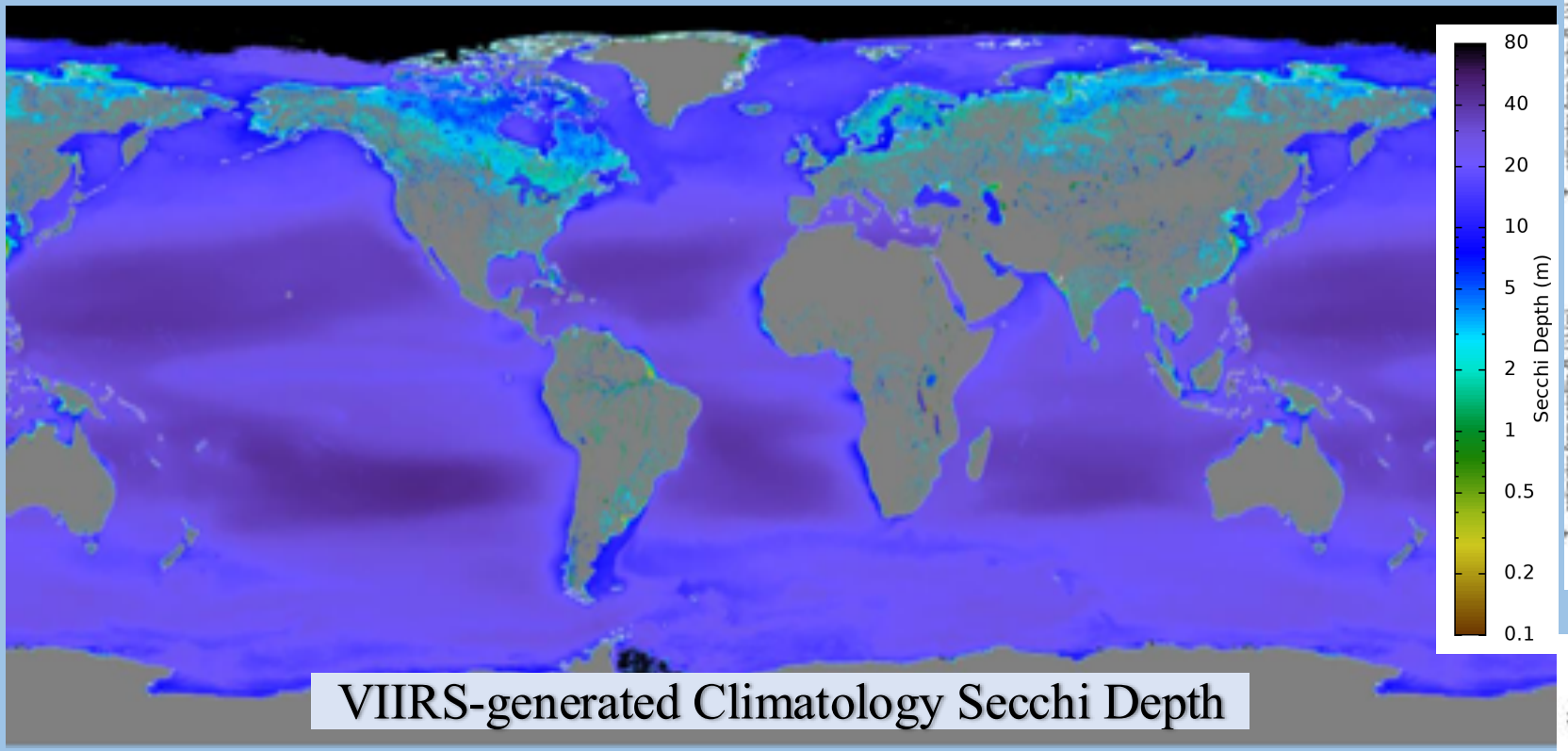
VIIRS-measured Rayleigh-corrected reflectance (16-day) over MOBY site (Nov. 17-Dec. 2, 2023)

SVC gains are applied for three VIIRS sensors

Results show that the SVC gains are reasonable!

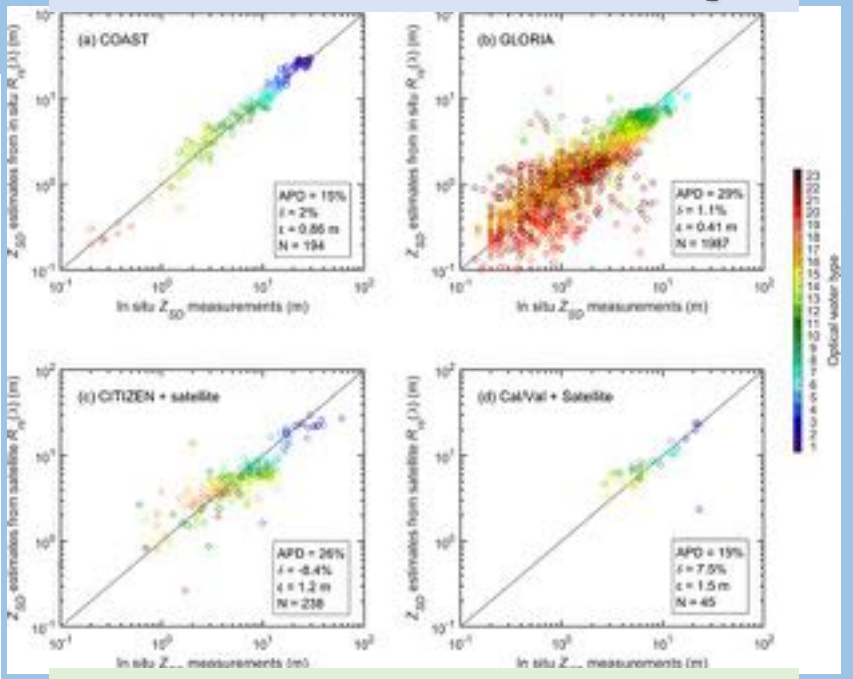


Global Water Transparency Product

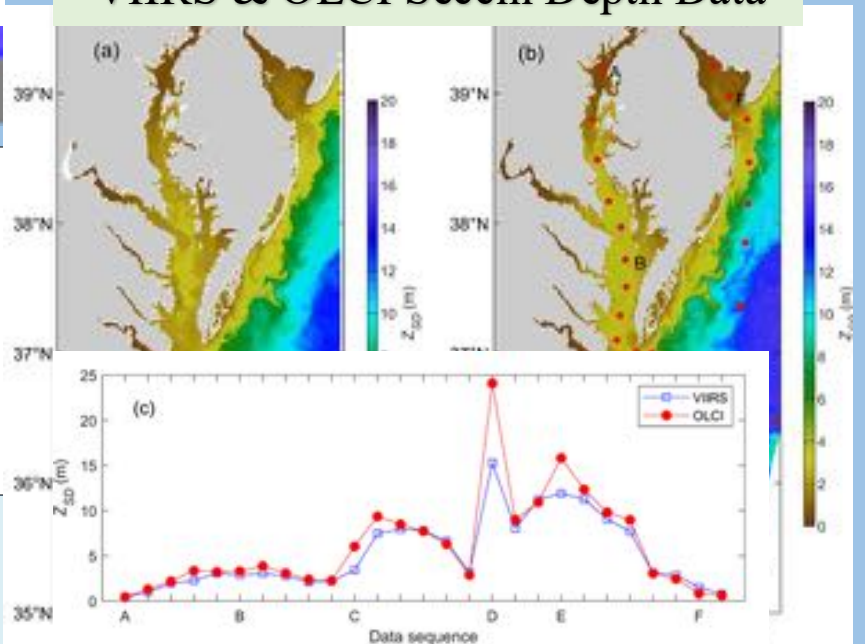


VIIRS-generated Climatology Secchi Depth

Validation Results for Secchi Depth



VIIRS & OLCI Secchi Depth Data

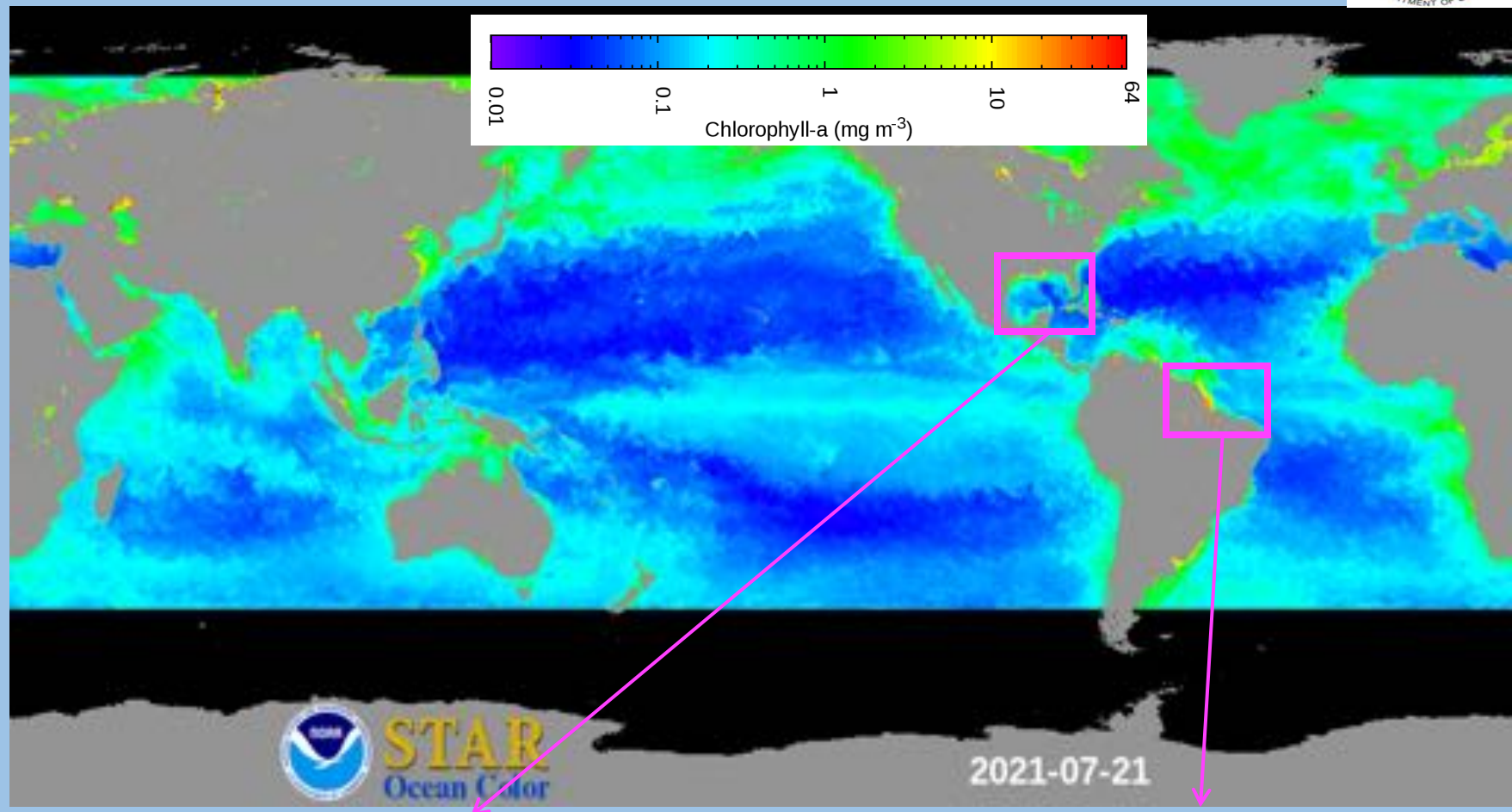


- New satellite-derived Secchi depth (Z_{SD}) products are created for global waters and have been routinely produced from VIIRS and OLCI.
- The hybrid approach only used satellite remote sensing reflectance as input.
- The derived Z_{SD} data are reliable across different global water classes (open oceans, coastal regions, and inland waters).
- Secchi depth can be easily understood by the user community and can be easily measured by citizen scientists.

Wei, J., M. Wang, L. Jiang, Z. Lee, R. Kirby, K. Mikelsons, and G. Lin, "Satellite observations of water transparency from VIIRS in global aquatic ecosystems," *Remote Sens. Environ.*, **330**, 114981, 2025. https://doi.org/10.1016/j.rse.2025.114981

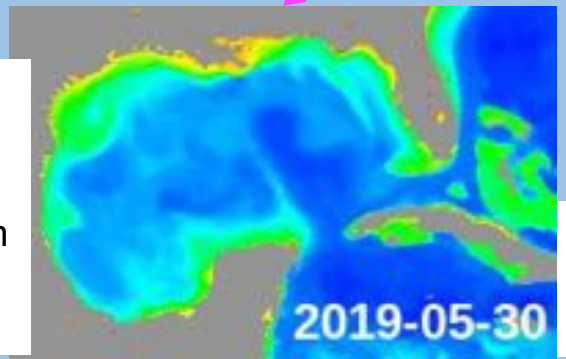
Global *Daily* Gap-free Ocean Color Data for User Community

- We are generating improved global gap-free ocean color data for user community for various research and applications
  - **DINEOF method:** the Data Interpolating Empirical Orthogonal Function.
  - **Three-sensor** (VIIRS-SNPP, VIIRS-NOAA-20, and VIIRS-NOAA-21) global daily data are merged to produce improved data coverage (**9-km**).
  - **Five-sensor** (VIIRS-SNPP/NOAA-20/NOAA-21, and OLCI-S3A/3B) global daily data are merged to produce improved data coverage (**2-km** and **9-km**).
  - **Gap-free products:** Chl-a, $K_d(490)$, SPM, and Secchi Depth (Z_{SD}).

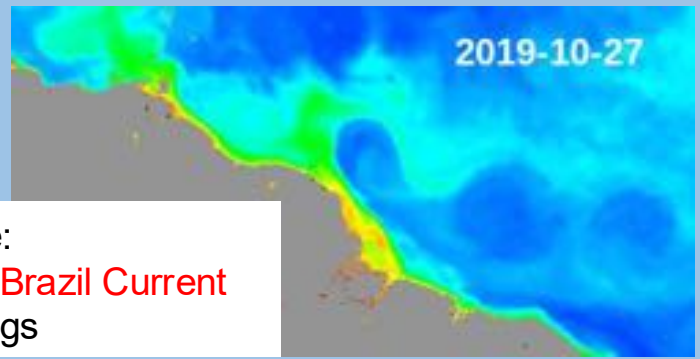


Meso-scale ocean features in the gap-free Chl-a data (two examples shown in the right)

In the movie:
- Formation of Loop Current Eddy (LCE): a LCE shedding from the Loop Current around 7/10/2019

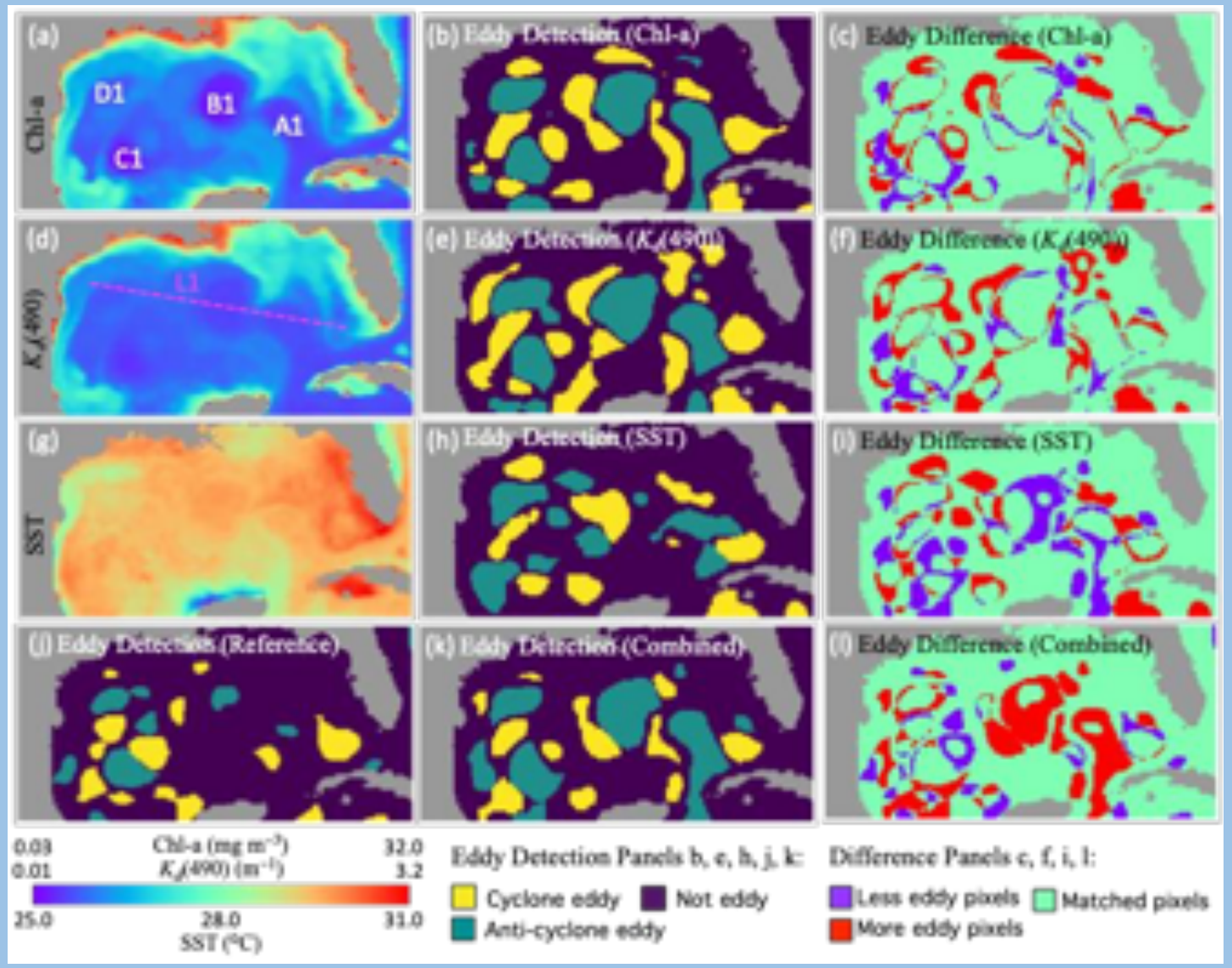


In the movie:
- Northern Brazil Current (NBC) rings



Applications: Eddy Detection from Ocean Color and SST Measurements Using the AI Method

- A new deep convolution neural network (CNN) has been developed for mesoscale ocean eddy detection using images derived from multiple satellite sources.
- A fusion of three parameters, Chl-a, K_d(490), and SST, are integrated into the neural network.
- It is necessary to use **daily** gap-free Chl-a, K_d(490), and SST data for a new CNN model development and applications.
- The three-parameter neural network model performs significantly better than all single-parameter models, and better than the sea surface height (SSH) model.
- The three-parameter (Chl-a, K_d(490), and SST) model can detect all eddies with accurate locations and shapes, as Chl-a, K_d(490), and SST data provide complementary and more complete information about the eddy features.
- The AI/ML is a powerful tool to build the solid relationships among ocean physical, optical, biological, and biogeochemical properties (more so over regional scales).

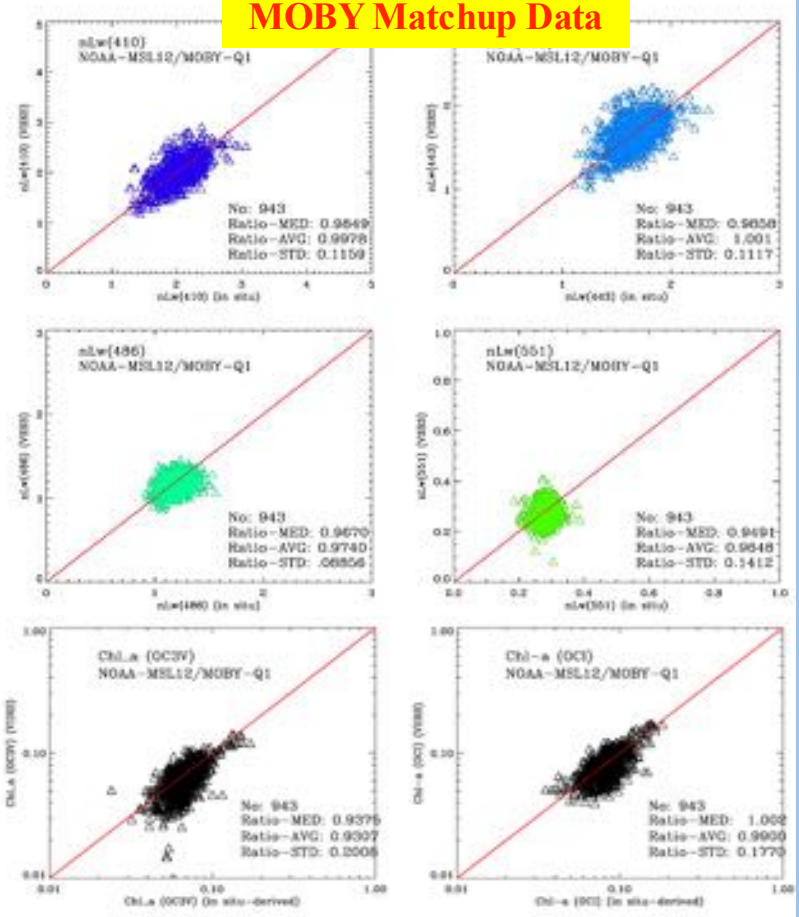


Liu, X. and M. Wang, "Detection of ocean eddies from satellite ocean color and SST measurements using a deep learning approach," *Int. J. Appl. Earth Obs. Geoinf.*, 144, 104929, 2025. https://doi.org/10.1016/j.jag.2025.104929

NOAA Ocean Color Cal/Val Activities

- Completed **ten** dedicated annual Cal/Val cruises (2014-2025)
- Completed the 2025 dedicated Cal/Val cruise (Sep. 23-Oct. 6) over the US west coastal region.
- Participating various in situ measurement opportunities.
- Support and routine **MOBY** in situ measurements.
- Routine monitoring of VIIRS, OLCI, SGLI, etc., ocean color data performance using in situ measurements.

MOBY Matchup Data



Feb-Mar 2023 Cruise

May 2024 Cruise

May 2018 Cruise

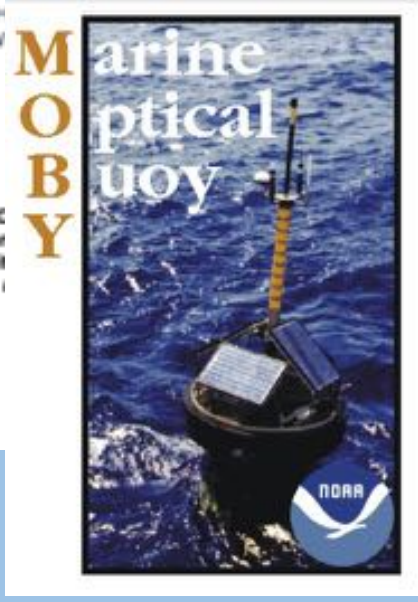
NOAA NESDIS

NOAA TECHNICAL REPORT NESDIS 163

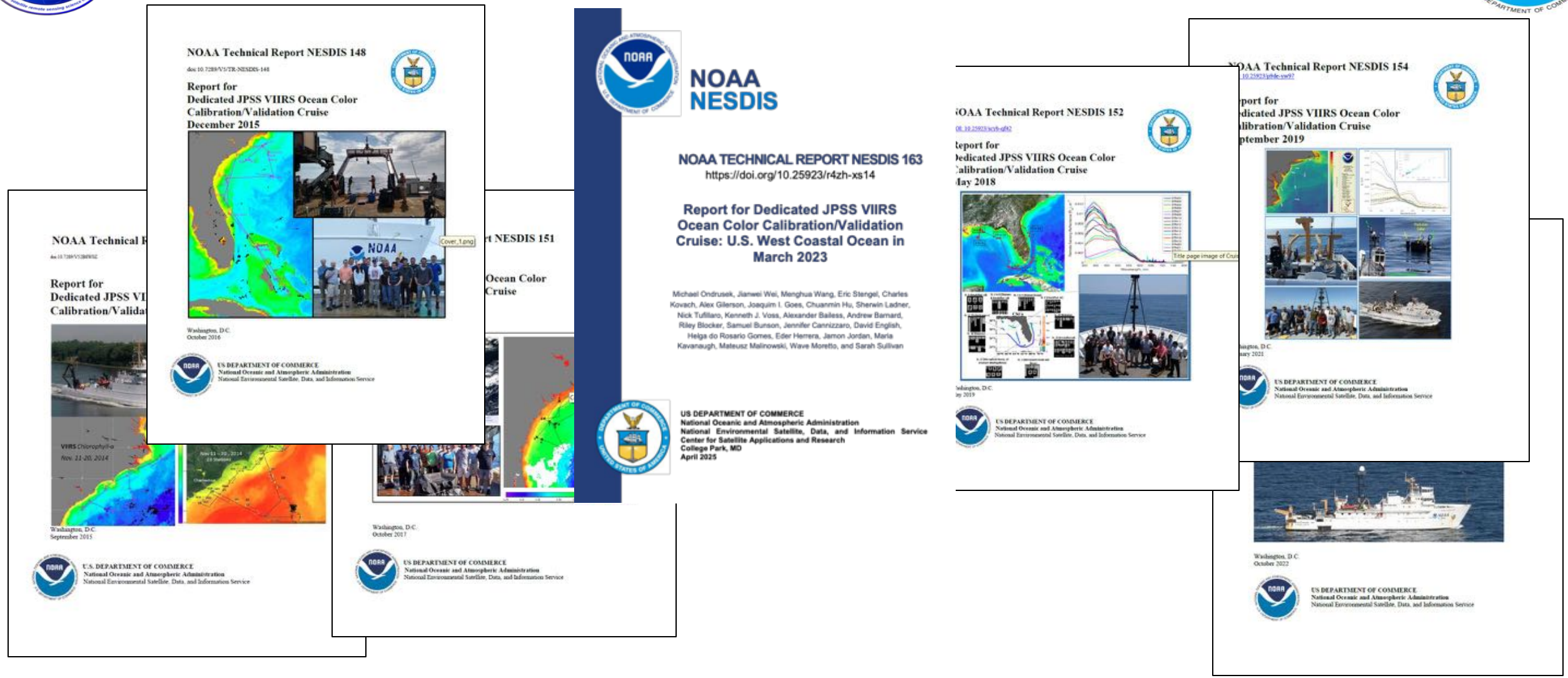
https://doi.org/10.25923/r4zh-xs14

Report for Dedicated JPSS VIIRS Ocean Color Calibration/Validation Cruise: U.S. West Coastal Ocean in March 2023

Michael Ondrusek, Jianwei Wei, Menghua Wang, Eric Stengel, Charles Kovach, Alex Gilerson, Joaquim I. Goes, Chuanmin Hu, Sherwin Ladner, Nick Tufillaro, Kenneth J. Voss, Alexander Bailess, Andrew Barnard, Riley Blocker, Samuel Bunson, Jennifer Cannizzaro, David English, Helga do Rosario Gomes, Eder H
Kavanaugh, Mateusz Malinowski, W



Reports of the NOAA Dedicated Ocean Color Cal/Val Cruises



- Ondrusek, M., J. Wei, M. Wang, E. Stengel, C. Kovach, A. Gilerson, J. I. Goes, C. Hu, S. Ladner, N. Tufillaro, K. J. Voss, A. Bailess, A. Barnard, R. Blocker, S. Bunson, J. Cannizzaro, D. English, H. do Rosario Gomes, E. Herrera, J. Jordan, M. Kavanaugh, M. Malinowski, W. Moretto, and S. Sullivan, "Report for Dedicated JPSS VIIRS Ocean Color Calibration/Validation Cruise: U.S. West Coastal Ocean in March 2023," U.S. Dept. of Commerce, NOAA Technical Memorandum NESDIS-163, 60 p., Silver Spring, Maryland, April 2025. https://doi.org/10.25923/r4zh-xs14

OCView--VIIRS, OLCI, SGLI Images and Cal/Val:
https://www.star.nesdis.noaa.gov/sod/mecb/color/

https://coastwatch.noaa.gov/cwn/index.html

CoastWatch HelpDesk: CoastWatch.Info@NOAA.gov

Online public user forum: https://vlab.ncep.noaa.gov/web/coastwatch

Thank You!