# An overview and validation results of the GCOM-C/SGLI ocean color products for version 3

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## Introduction

The Ver.3 standard product of GCOM-C/SGLI was released on November 29, 2021. The ocean products have been upgraded for normalized water-leaving radiance(NWLR) and sea surface temperature(SST). In this poster, we introduce the outline of the upgrade of NWLR algorithm and its validation results, as well as the validation results of Chlorophyll-a concentration(CHLA), Colored Dissolved Organic Matter(CDOM), and Total Suspended Matter(TSM), which are the products with NWLR as input.

## Overview of NWLR for version 3

The following items have been updated from the Version 2 SGLI atmospheric correction.

(1) Change in calculation method of aerosol reflectance

The LCI(Linear Combination Index) methods is used to estimate the water-leaving reflectance at near infrared bands (NIR), improving the accuracy of aerosol reflectance estimation. Due to this improvement, the SWIR band atmospheric correction in Ver.2 is not used.

(2) Aerosol look-up table is updated

The base aerosol model has been changed to Yoshida et al.(2020), and the look-up table is updated.

(3) Change in transmittance evaluation

The transmittance is calculated using the calculation result of the radiation transmission simulation by the aerosol model.

(4) Correction for inter-band parallax effect in sunglint reflectance evaluation

When calculating the sunglint, a method for correcting reflectance by inter-band parallax was added in the atmospheric correction

(5) Aerosol model reselection for negative water-leaving reflectance

When the water-leaving reflectance becomes negative after atmospheric correction, the aerosol model is reselected so that it does not become negative.

Yoshida (2020), Algorithm Theoretical Basis Document of aerosol by nonpolarization for GCOM-C/SGLI, SGLI ATBD, https://suzaku.eorc.jaxa.jp/GCOM_C/data/ATBD/ver2/V2ATBD_A3AB_ARN P_Yoshida.pdf.

## Method of validation

- Period of validation : January 1, 2018 - July 31, 2021
- Validated the accuracies of estimated NWLR and IWPR data from the SGLI algorithm comparing with in-situ data: ship observation, buoy(MOBY and BOUSSOLE) and AERONET-OC (**Lakes are excluded**)
- In-situ values within ±3 hours of satellite observation time were used for validation.
- The SGLI data was compared with the average of 5x5 pixels centered on the field observation point when the following conditions were met (Bailey, 2006)
  1. 13 or more pixels which satisfies the following conditions: aerosol optical thickness < 0.5, solar zenith angle < 70 degrees, NWLR of all channels > 0, CLDAFFCTD flag isn't set.
  2. When the median value is 0.15 or less (0.05 or less for CDOM) for the coefficient of variation of pixels included within ±1.5 times the standard deviation of NWLR 380-565nm and AOT 865nm for each product for the validation points validated in 1.

Bailey, S.W., and Werdell, P.J. (2006). A multi-sensor approach for the onorbit validation of ocean color satellite data products. Rem. Sens. Environ. 102, 12-23.

## Results and Discussion

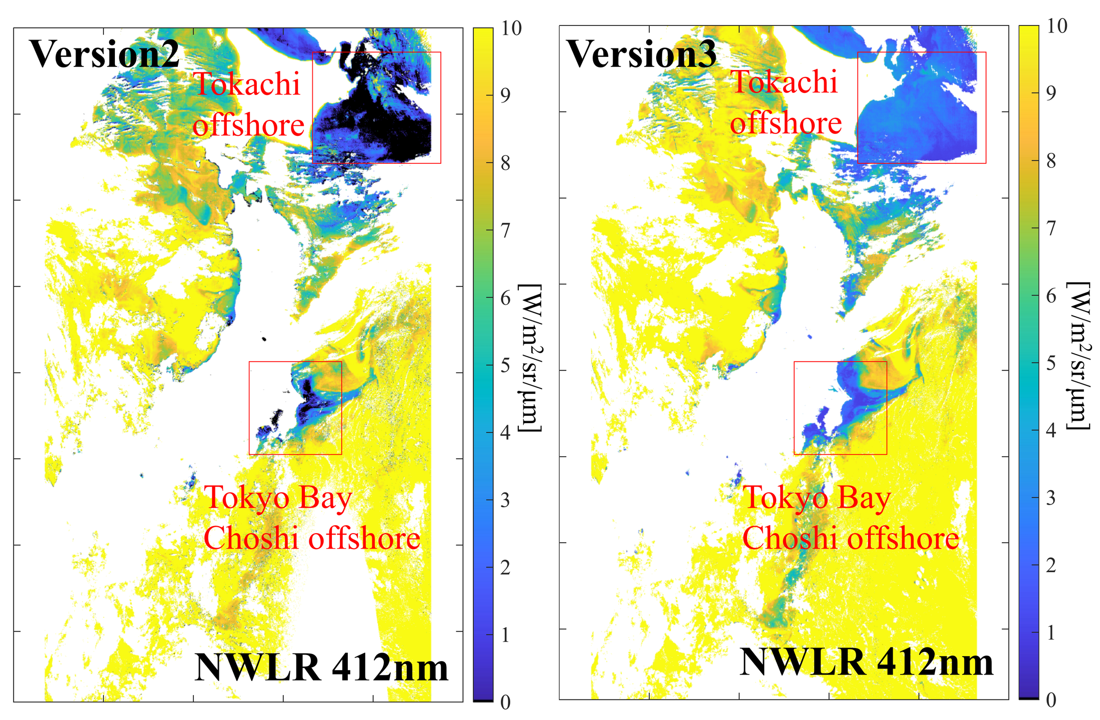
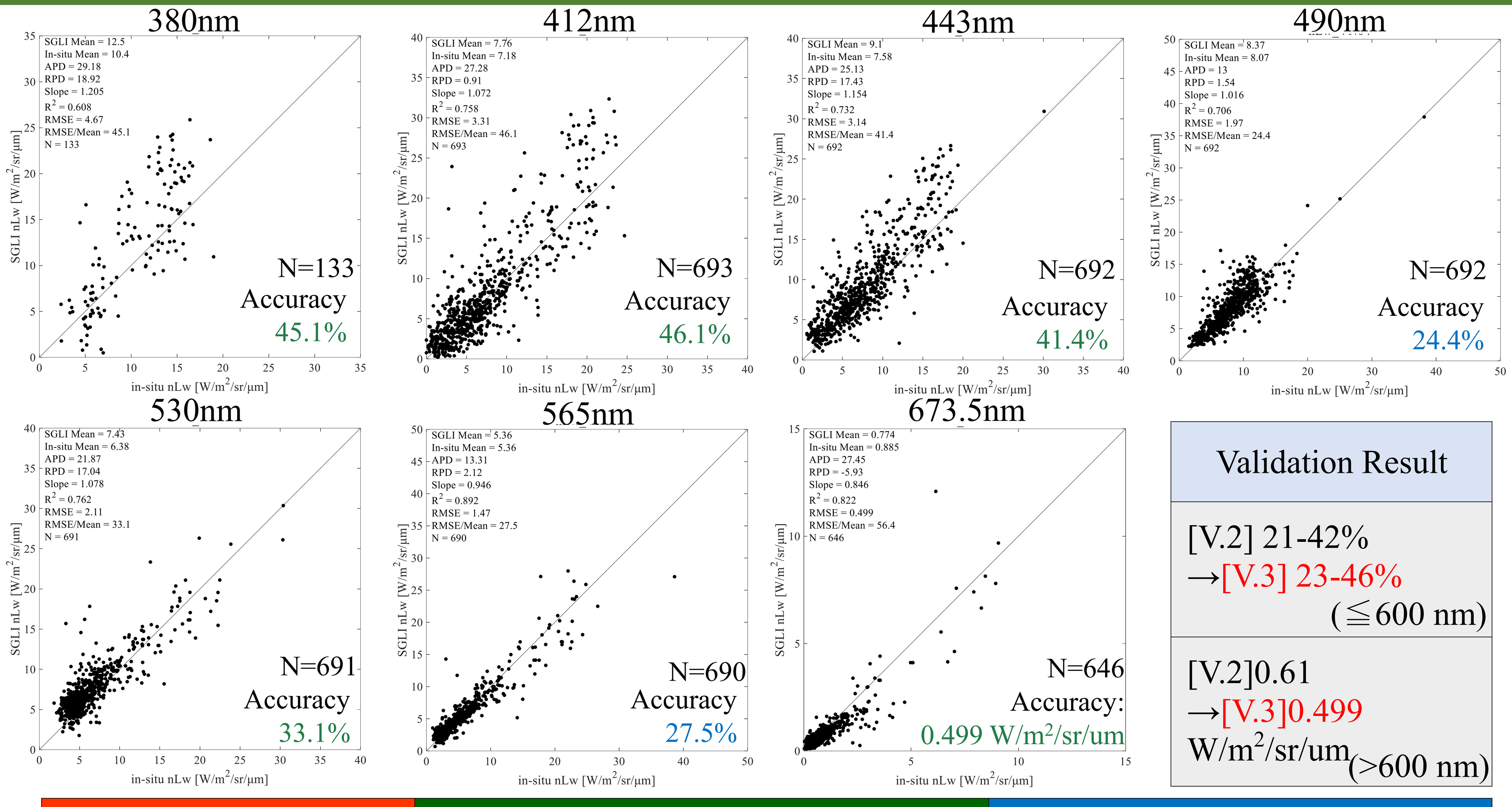



**Figure 1: NWLR (412nm) in the Japanese coastal area on August 20, 2021 (left: ver.2, right: ver.3)**

In Version 2, unrealistically negative values (black pixels in figure 1) due to atmospheric correction errors were generated in the regions where the influence of absorbent aerosols was strong (Tokyo Bay and Choshi offshore) and where the influence of CDOM absorption was large (Tokachi offshore). However, in version3, when NWLR is negative after atmospheric correction, an algorithm was introduced to reselect the aerosol model so that it does not become negative, which significantly improved the distribution of negative values.

Figure 2 shows the comparison and validation results between the SGLI estimates and field observations at each wavelength of the NWLR. The number of validation points increased compared to version 2 (ver.2: 117~616 points → ver.3: 133~693 points), mainly due to the increase in the number of valid pixels in the sunglint area and coastal area. The accuracy slightly decreased with the increase in the number of valid pixels in the region where accurate estimation is




| Validation Result |
|---|
| [V.2] 21-42% →[V.3] 23-46% (≦600 nm) |
| [V.2]0.61 →[V.3]0.499 $W/m^2/sr/um$ (>600 nm) |

| Release Accuracy | Standard Accuracy | Target Accuracy |
|---|---|---|
| 60%(443-565 nm) | 50% (≦600 nm) | 30% (≦600 nm) |
| N/A | 0.5W/m2/sr/um (>600 nm) | 0.25W/m2/sr/um (>600 nm) |

**Figure 2: NWLR validation results for version 3**

difficult, but the target accuracy was achieved at 490 nm and 565 nm, and the standard accuracy was achieved at other wavelengths.

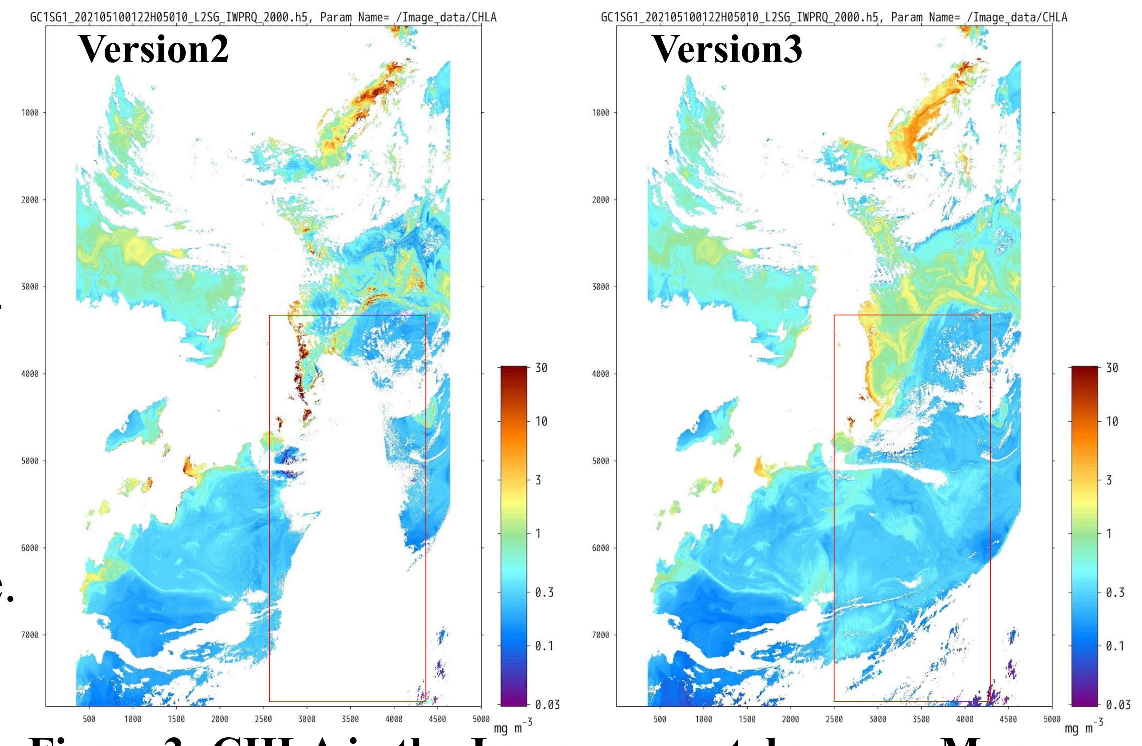



**Figure 3: CHLA in the Japanese coastal area on May 10, 2021 (left: ver.2, right: ver.3)**

Figure 3 shows the estimated Chl-a concentration in the Japanese coastal area on May 10, 2021. In ver.2, the red box in the figure 3 is a missing value due to sunglint, but in ver.3, the number of valid pixels has increased significantly, and the ratio of valid pixels to total pixels has increased by about 10%. This is mainly due to the correction of the overcorrection of the sunglint correction (the phenomenon that NWLR becomes negative).

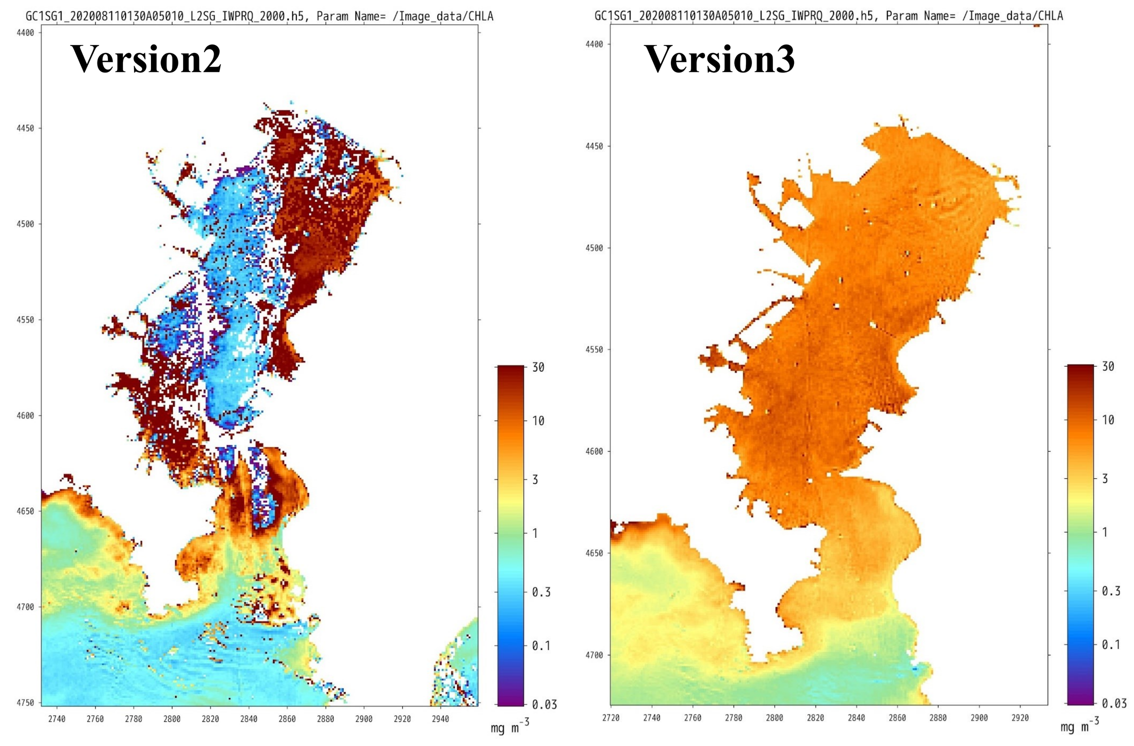
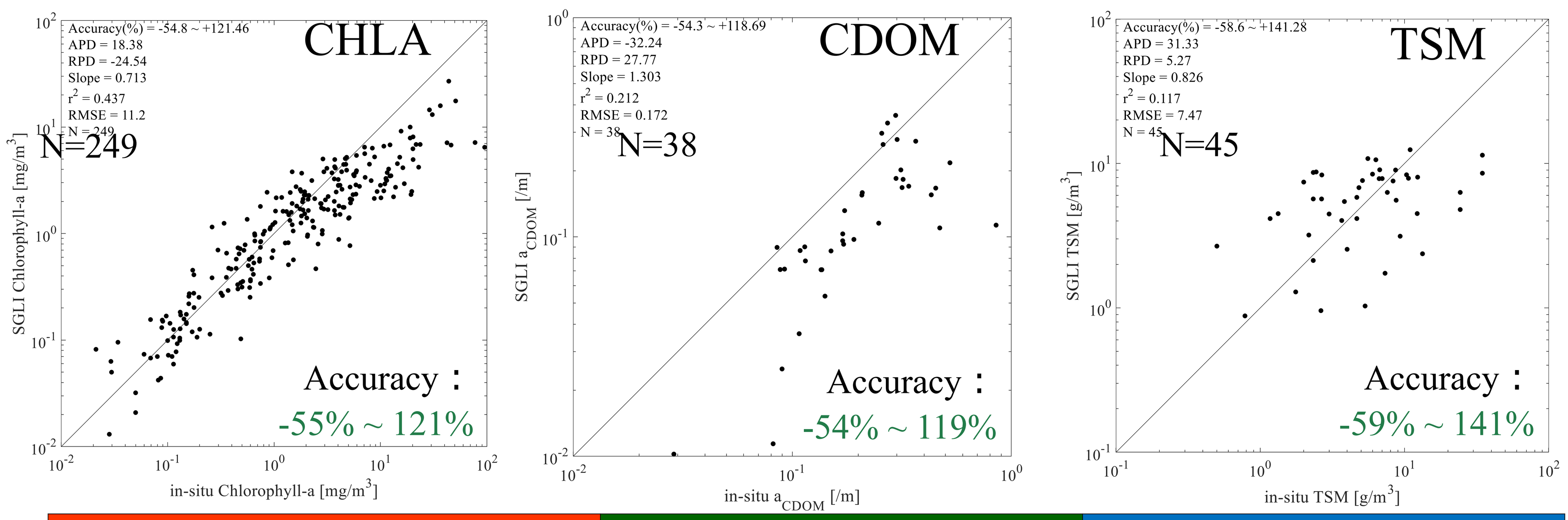



**Figure 4: CHLA in Tokyo Bay on August 11, 2020 (left: ver.2, right: ver.3)**

Figure 4 shows an estimated Chl-a concentration in Tokyo Bay on August 11, 2020. ver.2 showed sparse missing pixels and unrealistic extreme value fluctuations in the bay due to atmospheric correction errors. On the other hand, the estimation results of ver.3 showed no missing pixels in the bay and more reasonable estimation results.




| Release Accuracy | Standard Accuracy | Target Accuracy |
|---|---|---|
| -60%~+150%(offshore) | -60%~+150% | -50%~+100% |

**Figure 5: CHLA(left), CDOM(middle), TSM(right) validation results for version 3**

Figure 5 shows the results of the comparison between the SGLI estimates of CHLA, CDOM and TSM and the field observations. Standard accuracy was achieved for both CHLA and CDOM, and the number of valid points increased compared to version 2. The number of valid points increased and the estimation accuracy of TSM increased compared to version 2, as a result of the removal of outliers by comparison with simultaneously observed Chl-a concentrations and strict quality control of valid points in the high concentration range (>40 g/m3) where accurate field measurements are difficult.

## Conclusion

With this upgrade, the number of valid pixels for NWLR and CHLA, TSM, and CDOM with NWLR as input in the sunglint area and coastal area has been improved and the standard accuracy is achieved. In the future, it is required to develop more versatile algorithms to improve the underestimation of Chl-a concentrations above 100 mg/m3 and TSM concentrations above 40 g/m3.