Improvement of GK-2B GOCI-II sensor-based Land products to Enhance Usability

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1. Introduction

Geo-KOMPSAT-2B satellite, launched in February 2020, is a geostationary satellite at an altitude of 3600 km and is takeing images of the Korean Peninsula a total of eight times at hourly intervals. This satellite is equipped with a Geostationary Ocean Color Imager II(GOCI-II) ocean optical sensor, which provides improved spatial and spectral resolution compared to GOCI sensor(Choi et al., 2021). The National Ocean Satellite Center(NOSC) is currently servicing total twenty-six ocean/land/atmosphere products including four types of land products. In particular, time-series satellite images at hourly intervals in conjunction with the GOCI-I sensor, which has been provided since 2010, are very useful on land(Lee et al., 2022) . In the case of agriculture and forestry, time series NDVI data is very useful, and if NDVI in a time period is provided in the existing daily cycle, its usability is very high(Yeom & Kim et al., 2015). Additionally, in the event of a disaster, land information on an hourly basis is very useful for real-time response. However, the GOCI-II products currently in service are produced with an initial algorithm developed based on GOCI-I images before satellite launch, and require improvement of suit the GOCI-II sensor. In order to improve the usability of GOCI-II images in the field of land, the accuracy of land products must be improved, and auxiliary data for input into numerical models related to climate, ecology, and environment must be provided(Boussetta et al., 2015; Yeom & Kim et al., 2015). In this study, we estimate the accuracy of the current initial Land product algorithms and seek ways to improve the terrestrial output of the GOCI-II sensor to increase usability.

2. Materials and Methods

The GOCI-II sensor captures an area of 2,500*2,500km centered on 130°E, 36°N a total of 8 times at hourly intervals during the day. The spatial resolution is 250m, and a total of 13 spectral bands are provided.

Table 1: Specifications of GOCI-II sensor.

Items	Specifications
Launching date	Feburary 19, 2020
Orbit	35,786 km altitude, 128.2ºE
Spatial resolution	250m
Temporal resolution	1 hour(10 times/day, 23UTC~8UTC)
Band	13 bands(1 band for UV, 8 bands for visible, 3 bands for NIR, 1 band for broad bandwidth, 370-865nm)
Imaging area	2,500km X 2,500km (center coordinate 130°E, 36°N)

Source: https://kosc.kiost.ac.kr/

The current GOCI-II sensor provides land surface reflectance, albedo, vegetation index, and land cover, and provides them in various algorithms and periods as shown in the table below. In this study, to estimate the accuracy of the initial land product, 21 images were used by selecting a date with low cloud cover and comparable with other satellites among the 2023 annual data. As shown in the table below, MODIS Product (MCD19, MCD43) data was used to estimate accuracy. GOCI-II data were provided from the NOSC webpage (https://www.nosc.go.kr/), and MODIS data were provided from the USGS EarthDATA webpage (https://lpdaac.usgs.gov).

Table 2: Specifications of GOCI-II Land products.

Land Products	Layers	Period	Initial algorithm
Surface Reflectance (GK2B_GOCI2~SRL.nc)	12 bands SRL, flag, lat,lon	8 times	Minimum reflectance selection algorithm for 16 days
Broadband albedo (GK2B_GOCI2~LSAB.nc)	1 band blacksky, 1 band whitesky albedo, flag, lat,lon	1 day	Regression algorithm based on MCD43A3
Narrowband albedo (GK2B_GOCI2~LSAN.nc)	12 bands blacksky, 12 bands whitesky albedoflag, lat,lon	1 day	Semi-empirical BRDF model based on Roujean model
Vegetation Index (GK2B_GOCI2~VI.nc)	NDVI, EVI, flag, lat,lon	1 day	Using BRDF-corrected surface reflectance data
Land Cover (GK2B_GOCI2~LCC.nc)	Classified land, Unclassified land, In land water, No data, flag, lat,lon	1 year	PCA & Clustering method

Among the four land products, the land surface reflectance and albedo are resampled to fit the MODIS product, calculating the overlapping area among the areas excluding cloud areas, and then calculating the correlation coefficient and RMSE. The vegetation index was calculated after BRDF correction to land surface reflectance, and its accuracy was not estimated. In addition, the current land cover map algorithm had problems with automation, so a new land cover map was created. Atmospherically corrected land surface reflectance is used to estimate vegetation index or albedo, and is also very useful. Albedo can be input and utilized in a climate prediction model, and measures for this are defined through existing cases. In addition, in the case of the vegetation index, the types of additional data of overseas vegetation indices were investigated to improve usability. In addition, we sought ways to produce land cover that could be automated.

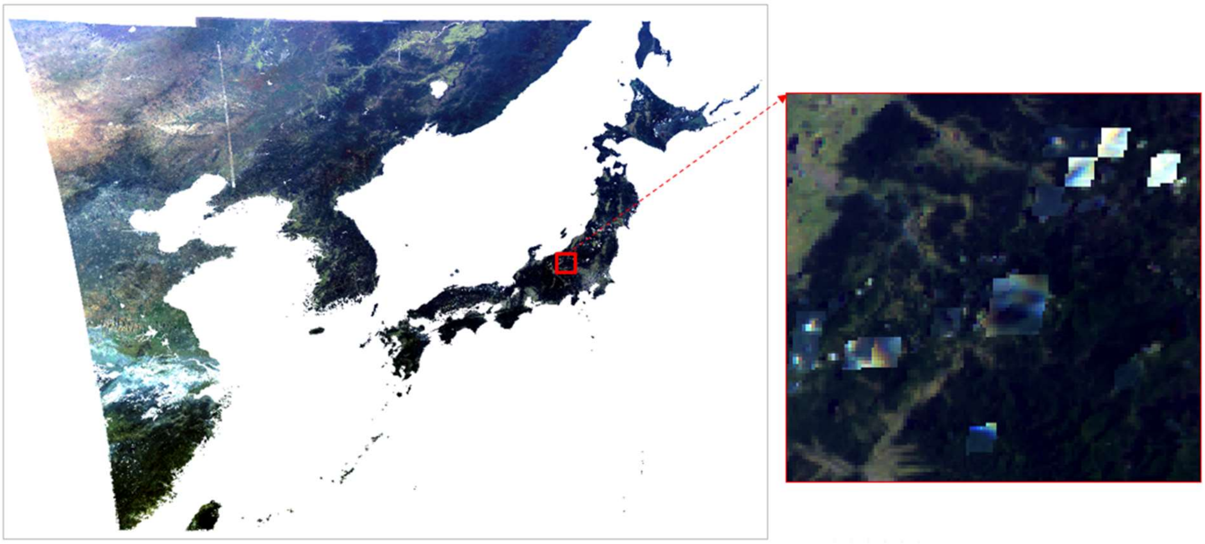

Figure 1: GOCI-II SRL natural color composite image obtained at 10:15 am KST on October 5, 2023.

3. Results and Discussion

In the case of land surface reflectance product, the green and red bands showed a correlation coefficient of more than 0.75 and an RMSE of less than 0.1. Relatively low accuracy was observed in the blue and NIR regions. In addition, it showed a similar pattern to the TOA reflectance, and as data from a 16-day cycle were used, a spatially uneven patch shape was seen. Accordingly, it is planned to be replaced with the 6SV LUT-based atmospheric correction algorithm, which is widely used for atmospheric correction of existing satellite optical images. In the case of broadband albedo, a very low correlation coefficient was shown due to the difference in the wavelength range of GOCI-II and MCD43. In comparison, the narrow-band albedo showed a correlation coefficient of more than 0.68 and an RMSE of less than 0.12 in the visible band. As with the reflectance data, the near-infrared region showed somewhat low accuracy. In the case of albedo data, it shows an RMSE of 15% based on MCD43 data, so rather than improving the algorithm, we plan to add auxiliary data to increase usability. In order to generate albedo data for input to the current climate prediction model, additional processing must be applied to the current GOCI-II albedo data. To achieve this, resampling must be performed to the required spatial resolution, and quality control and snow masking must be performed. Additionally, it is necessary to apply gap-filling techniques for the smoothing process through spatial filtering and interpolation of temporally missing data. In the case of the vegetation index, clouds, shadows, sensor angle information, and snow information are required for use, and quality level information is especially required. This is because the quality information of the vegetation index is required to allow users to selectively select pixels of desired quality when inputting them into future composite or vegetation-related models. For the land cover map, maximum likelihood and Random Forest classification techniques were applied to time series GOCI-II images, but showed very low classification accuracy. Accordingly, a hierarchical classification technique was applied to a total of six classification classes (bare soil, grassland, urban area, water, forest, and cropland) targeting the GOCI-II image on October 5, 2023, which had little influence of clouds. At this time, a standard land cover map showing a classification accuracy of 77% was produced by applying thresholds to the NDVI and red-edge bands. For this standard land cover map, we plan to update the land cover map by automatically detecting changes through comparison with GOCI-II satellite images and correcting only the changed areas.

Table 1: Example of a Table Caption.

Surface Reflectance Product			**Albedo Product**		
Wavelength (n)	Correlation	RMSE	Layer (n)	Correlation	RMSE
412nm (2,946,116)	0.573	0.252	Blacksky broadband (12,521,375)	0.267	0.078
443nm (2,945,522)	0.669	0.211	Whitesky broadband (12,516,029)	0.260	0.083
490nm (2,945,769)	0.720	0.167	Blacksky narrowband 555nm (12,681,359)	0.683	0.116
555nm (2,947,117)	0.713	0.126	Blacksky narrowband 660nm (12,680,351)	0.696	0.083

660nm (2,947,217)	0.727	0.103	Blacksky narrowband 865nm (12,682,903)	0.589	0.082
865nm (2,946,760)	0.516	0.210	Whitesky narrowband 555nm (12,681,680)	0.682	0.113
			Whitesky narrowband 660nm (12,680,211)	0.723	0.080
			Whitesky narrowband 865nm (12,682,907)	0.640	0.075

4. Conclusion and Recommendation

The current GOCI-II land surface reflectance showed an RMSE of less than 20%, but showed low correlation in the blue light and near-infrared bands. In comparison, albedo showed higher accuracy and was processed for climate model input to increase usability. is required. The vegetation index plans to provide quality grade information along with additional information for users. Lastly, in the case of land cover, it is necessary to develop automatic detection of change areas through comparison with the standard land cover map and the new GOCI-II image. It is expected that these improved processing techniques will improve the usability of GOCI-II land products, which provide high temporal resolution. Future research will present the quantitative accuracy of the improved algorithm.

Acknowledgements

This research was supported by Korea Institute of Marine Science & Technology Promotion(KIMST) funded by the Ministry of Oceans and Fisheries(RS-2022-KS221660).

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