Toward operational satellite monitoring of chlorophyll-a concentrations in turbid inland waters

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Inland lakes are essential fresh water resources for human populations in terms of providing multiple ecosystem services, but are encountering serious eutrophication all over the world. Accurate monitoring of chlorophyll-a concentration (Chl-a) is essential for sustainable management of inland lakes. Satellite remote sensing provides the only feasible technique for monitoring Chl-a at large scale over long-term. Nevertheless, the conventional ocean-color satellite data are not applicable for small-size inland lakes due to the course spatial resolutions. In contrast, the Sentinel-2/MSI data provide a new opportunity for monitoring water quality of global lakes owning to its high spatial resolution and plentiful band configurations. However, the current land surface reflectance product of Sentinel-2/MSI data (i.e., the L2A product) cannot always guarantee high data quality for water monitoring applications. Consequently, we developed a novel quality assurance (QA) system to screen the atmospherically corrected water-leaving reflectance for Chl-a estimation. In the proposed QA system, a simulation dataset of water-leaving reflectance was first generated to include extensively wide ranges of water constituent concentrations. Then, satellite data were remained only if the similar spectral shape can be found from the simulation dataset. Finally, the Chl-a estimation models based on the three-band index were compared between the whole match-up datasets and the screened datasets. The validation results for Lakes Inbanuma, Teganuma and Kasumigaura of Japan demonstrated that the estimation accuracy was improved with the root-mean-square-errors (RMSE) decreased from 38.3 mg/m3 to 25.7 mg/m3, and R2 increased from 0.54 to 0.69, respectively. Moreover, reasonable spatial and temporal distribution patterns were also observed for the study lakes in 2018. The results indicate that the proposed QA system has the potential for operational monitoring of Chl-a in turbid inland lakes based on the Sentinel-2 images.

Keywords: inland lakes, remote sensing, chlorophyll-a

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