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Estimating Algae Concentration Based on Deep Learning from Satellite Observation in Korea

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Abstract : Over the last few tens of years, the coastal regions of Korea have experienced red tide algal blooms, which are harmful and toxic to both humans and marine organisms due to their potential threat. It was accelerated owing to eutrophication by human activities, certain oceanic processes, and climate change. Previous studies have tried to monitoring and predicting the algae concentration of the ocean with the bio-optical algorithms applied to color images of the satellite. However, the accurate estimation of algal blooms remains problems to challenges because of the complexity of coastal waters. Therefore, this study suggests a new method to identify the concentration of red tide algal bloom from images of geostationary ocean color imager (GOCI) which are representing the water environment of the sea in Korea. The method employed GOCI images, which took the water leaving radiances centered at 443nm, 490nm and 660nm respectively, as well as observed weather data (i.e., humidity, temperature and atmospheric pressure) for the database to apply optical characteristics of algae and train deep learning algorithm. Convolution neural network (CNN) was used to extract the significant features from the images. And then artificial neural network (ANN) was used to estimate the concentration of algae from the extracted features. For training of the deep learning model, backpropagation learning strategy is developed. The established methods were tested and compared with the performances of GOCI data processing system (GDPS), which is based on standard image processing algorithms and optical algorithms. The model had better performance to estimate algae concentration than the GDPS which is impossible to estimate greater than 5mg/m^3. Thus, deep learning model trained successfully to assess algae concentration in spite of the complexity of water environment. Furthermore, the results of this system and methodology can be used to improve the performances of remote sensing. Acknowledgement: This work was supported by the 'Climate Technology Development and Application' research project (#K07731) through a grant provided by GIST in 2017.

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