

EGU24-13617, updated on 20 May 2024

<https://doi.org/10.5194/egusphere-egu24-13617>

EGU General Assembly 2024

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Tropical cyclone intensity estimation using two geostationary satellite data and deep learning

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Tropical cyclones (TCs) are among the most severe and destructive natural events, and they have a major detrimental impact on both the economy and society. This study used Geo-KOMPSAT-2A (GK2A) satellite data to estimate TC intensity in the western North Pacific based on a convolutional neural network (CNN) model. Given that the GK2A data cover only the period since 2019, we applied transfer learning to the model using information learned from previous Communication, Ocean, and Meteorological Satellite (COMS) data, which cover a considerably longer period (2011–2019). Transfer learning is a powerful technique that can improve the performance of a model even if the target task is based on a small amount of data. Experiments with various transfer learning methods using the GK2A and COMS data showed that the frozen–fine-tuning method had the best performance due to the high similarity between the two datasets. The test results for 2021 showed that employing transfer learning led to a 20% reduction in the root mean square error (RMSE) compared to models using only GK2A data. For the operational model, which additionally used TC images and intensities from six hours earlier, transfer learning reduced the RMSE by 5.5%. Because continuous long-term data are not always available for TC intensity estimation based on geostationary satellite images, these results imply that transfer learning may constitute a new advance in this area.

Acknowledgement. This research was supported by Korea Institute of Marine Science & Technology Promotion (KIMST) funded by the Korea Coast Guard (RS-2023-00238652, Integrated Satellite-based Applications Development for Korea Coast Guard).