An Artificial Intelligence Tool for Intensity Estimation of Global Tropical Cyclones

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Forecasting the intensity of tropical cyclones (TCs) is very important because it is directly associated with the potential damage from the storm. In order for forecasts to be accurate, there must first be accurate estimations of the current intensity of TCs. Currently, the operational method of TC intensity estimation is the Dvorak Technique. However, the Dvorak Technique is subjective, meaning that different forecasters can get different intensity estimates from the same image. In this study, a novel Convolutional Neural Network (CNN) model was developed to estimate the current TC intensity automatically by using satellite rainfall images. The CNN model was designed to identify circular arcs within the TC rainfall structure. The satellite rainfall data used in this study was obtained from the NASA Integrated Multi-satellitE Retrievals for the Global Precipitation Measurement (GPM) mission (IMERG) product for global TCs during 2000-2019. This study utilized a total of 37316 IMERG rainfall images of TCs for a total of 1349 TCs from global TC-prone basins. TC center locations and current intensities were obtained from the International Best Track Archive for Climate Stewardship. Multiple different CNN architectures were tested for accuracy to select the best model for estimating TC intensity. The final model was trained using TCs from 2000-2017 and tested using TCs from 2018-2019. Results showed that this model outperformed all previous TC intensity estimation algorithms including the Dvorak Technique. It had a large improvement on global TCs with a major-hurricane strength, therefore can be used to dramatically improve disaster response worldwide.