Predictive Modeling of Tropical Cyclone Rapid Intensification by Analyzing Convective Patterns with Convolutional Neural Networks, Year Four

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Rapid Intensification (RI), a 30+ kt increase in a storm's 1-minute maximum sustained winds, is a potentially catastrophic event occurring within tropical cyclones. The leading current RI model has an accuracy rate of 82% and analyzes large-scale environmental trends, such as surrounding sea surface temperatures, but undersamples inner-core convective patterns within storms. Accuracy could therefore potentially be improved by analyzing convective patterns. A Convolutional Neural Network (CNN) is a machine learning program specializing in image analysis. CNNs work by taking local convolutions from images, running it through several layers of neurons, where convolutions are compared, until an output pattern can be determined. By using a CNN to analyze GOES GridSat satellite images, filtered using infrared radiation to detect cloud top temperatures, convective patterns could emerge. To achieve this, a CNN was built in Python using package Tensorflow, and run on storm images classified as RI or not RI. This model was tuned to focus on four different "crops" of data at different radii around a storm's center. The storm's eyewall crop saw a 10th-epoch mean validation accuracy of 77.8%. This indicates that the model was 77.8% accurate at detecting rapid intensification in storms - only 4.2% lower than the SHIPS RI model. In addition, validation accuracy increased as the crop became more focused on a storm's eyewall. By integrating more datasets, potentially those containing similar variables to those studied in SHIPS RI, accuracy could be increased.

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