Predicting Future Tropical Cyclone Intensity Using a Convolutional Neural Network

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The prediction of tropical cyclone (TC) intensity change remains one of the greatest challenges for forecasters. The Statistical Hurricane Intensity Prediction Scheme (SHIPS) is one of the most accurate models used in operational centers. The current version of SHIPS uses predictors including climatology and persistence, environmental conditions, and infrared satellite information. One critical piece of information that is missing from SHIPS is the rainfall and structural features of TCs. In this study, I proposed a novel Hurricane Convolutional Neural Network (HCNN) model to predict future TC intensity by using satellite rainfall images and existing SHIPS predictors. I designed the HCNN model to detect specific TC structures such as circular eyewall and curved rainbands for potential TC intensity change. A 20-year (2000-2019) satellite rainfall dataset was obtained from the NASA Integrated Multi-satellite Retrievals for the Global Precipitation Measurement (GPM) mission (IMERG) product for TCs from the Atlantic basin. The HCNN model was tested for 3 different radii of the IMERG data from the TC center and 200-km was selected. The model was trained using satellite images for TCs from 2000-2017 and tested using TCs from 2018-2019. Relative to SHIPS, the HCNN model with satellite rainfall input significantly improved forecasts by up to 13%, 18%, and 9% for all TCs, major hurricanes, and intensifying TCs, respectively, at 6-24 hour forecast intervals. I further integrated my HCNN predictions of hurricane intensity into a web/mobile app to demonstrate the ability of real-time applications of my model.

Awards Won:
Third Award of $1,000
U.S. Agency for International Development: Second Award Working in Crisis and Conflict