Models for Predicting Maximum Potential Intensity of Tropical Cyclones

Iftekhar Chowdhury, Gemechis Djira

Abstract

Tropical cyclones (TCs) are considered as extreme weather events, which has a low-pressure center, namely an eye, strong winds, and a spiral arrangement of thunderstorms that produces heavy rain, storm surges, and can cause severe destruction in coastal areas worldwide. Therefore, reliable forecasts of the maximum potential intensity (MPI) of TCs are critical to estimate the damages to properties, lives, and risk assessment. In this study, we explore and propose various regression models, to predict the potential intensity of TCs in the North Atlantic at 12, 24, 36, 48, 60, and 72-hour forecasting lead time. In addition, a popular machine learning method, the Gradient Boosted Regression Tree (GBRT) algorithms is also used to further predict the TCs intensity changes in every 12-h over its entire lifespan (up to 72-hour) and the model is optimized by the Bayesian Optimization algorithm. The MPI is determined by using maximum wind speed (VMAX) measured in knots associated with a TC. The model utilizes the data of 160 TCs (n = 8,011) over North Atlantic Basin obtained from the extended best track database from 2000 to 2021. We used data from 2000-2016 for model calibration and data from 2017-2021 for model validation. The results indicate that radius of maximum wind (RMAX), minimum central pressure (MCP), and latitude are the significant predictors that captures MPI of observed TCs. Some other implications of the results are also discussed.