EGU24-857, updated on 21 Jul 2024
https://doi.org/10.5194/egusphere-egu24-857
EGU General Assembly 2024

Improving extreme rainfall forecasting for a flood prone region: A hybrid modelling approach

Athira Krishnankutty Nair[1] and Sarmistha Singh[2]
[1]Department of Civil Engineering, Indian Institute of Technology Palakkad, Kerala, India
[2]Department of Civil Engineering and ESSENCE, Indian Institute of Technology Palakkad, Kerala, India

Numerical weather prediction models are utilized to forecast extreme rainfall events at fine resolutions; however, these models possess inherent errors due to the parameterization and discretization of differential equations, which diminishes simulation accuracy. Recent advancements in machine learning methods indicate their potential capability to significantly enhance forecast results. In this study, multiple extreme rainfall events for the Pamba river basin during the Indian Summer Monsoon Period spanning 2-4 days were forecasted using the WRF model. Pamba, one of the flood-prone basins in southern states of India (Kerala), experiences severe flood events annually. While numerous studies have been conducted to simulate the Kerala flood of 2018, those demonstrating the application of high-resolution rainfall data for the Pamba river basin remain unexplored. Therefore, in this study, we simulated multiple storm events during the period from 2015 to 2018 using the WRF model at a high resolution (1 km * 1 km) and a temporal resolution of a one-hour interval. The WRF-simulated rainfall dataset was further post-processed using various machine learning algorithms, including Random Forest, Support Vector Machine, and extreme gradient boost (XGBoost), to reduce bias in the hourly forecast of extreme rainfall events. Several cross-validation training and testing procedures were carried out using various algorithms, and the forecasted and predicted results were compared with ERA5 hourly data of 10*10 km resolution. Results indicated that XGBoost, with hyperparameter tunings, substantially reduced the Root Mean Square Error (RMSE); it was able to reduce the RMSE by up to 50% across the river basin. This hybrid model will provide a more accurate forecast of hourly extreme rainfall during the Indian Summer Monsoon Period for Pamba river basin, with high resolution essential for flood forecasting and warning.