

Development of a Numerical Weather Forecasting Model for Disaster Risk Reduction in Kandy

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Extreme rainfall events, which are frequent and widespread, pose significant hazards in Kandy, leading to potential flooding and landslide risks across various areas. Implementation of a numerical weather forecasting model for the Kandy region could mitigate these risks by enabling early disaster identification. Despite numerous studies on weather forecasting in Sri Lanka, there is a notable lack of research focusing on weather prediction in mountainous terrains like Kandy using numerical models such as the Weather Research and Forecasting (WRF) model. This study aims to fill this research gap by developing a 24-hour weather forecasting model for Kandy, with a particular focus on identifying the optimal microphysics parameterization scheme for the region. The input data for the WRF model was sourced from the National Centers for Environmental Prediction-National Center for Atmospheric Research (NCEP-NCAR) database. Four microphysics schemes which are WSM5, Ferrier, Lin et al., and WSM6 were evaluated against observed data from four rain gauge stations (Katugasthota, Kundasale, Kandy Kings Pavilion, and Madulkelle) at 0300 UTC, using WRF simulations for three rainfall events exceeding 50 mm/day. The optimal microphysics scheme was identified using statistical tests, including the frequency bias index (BIAS), root mean squared error (RMSE), mean absolute error (MAE), and Pearson correlation coefficient. The WRF model, run with the Ferrier microphysics scheme, was found to optimally simulate these rainfall events for the Kandy region, as evidenced by a low Total Model Performance (TMP) in two simulations. An evaluation of the Ferrier microphysics scheme for precipitation forecasting revealed overestimations between 25 mm to 60 mm at the Kandy Kings Pavilion and Kundasale stations, while underestimations between 8 mm to 40 mm were observed at the Madulkelle and Katugasthota stations. The developed model can be effectively used to forecast weather patterns and provide early warnings, thereby contributing to disaster risk reduction in the Kandy region.

Keywords: Extreme rainfall, Numerical Weather Forecasting, Weather Research and Forecasting, Kandy