

SENSITIVITY ANALYSIS OF LAND ATMOSPHERE INTERACTION USING DIFFERENT PARAMETERIZATION SCHEMES OF THE WRF MODEL TO SIMULATE HEAVY RAINFALL EVENTS OVER THE MAHI RIVER BASIN, INDIA

Aditya Sharma^{*1,2}, Rajarshi Dasgupta²

¹ Department of Atmospheric Science, School of Earth Sciences, Central University of Rajasthan, Ajmer, India-305801

² School of Public Policy, Indian Institute of Technology, Delhi, India

Presenter: Aditya Sharma; adityacuraj@gmail.com

ABSTRACT

A reliability-centered evaluation of intense precipitation occurrences offers insights into devising effective strategies and forecasts for mitigating flood risks. Contemporary challenges include accurately modeling such events, which are influenced by various synoptic conditions and modeling techniques. This research utilized the regional mesoscale Weather Research and Forecasting (WRF) model to assess the effectiveness of different parameterization schemes in simulating rainfall events over the Mahi River basin from August 22nd to 26th, 2020, with the peak rainfall observed on August 23rd, 2020. A high-resolution triple-nested (27, 9, and 3 km) WRF model was configured, with initial boundary condition data obtained from NCEP/NCAR FNL at a resolution of $1^{\circ} \times 1^{\circ}$ (six-hourly). Model performance was evaluated against gridded rainfall data from ECMWF Reanalysis v5 (ERA5) and the India Meteorological Department (IMD) at a spatial resolution of $0.25^{\circ} \times 0.25^{\circ}$. Additionally, GPM-IMERG data were utilized to compute skill scores (bias, threat score, probability of detection, and accuracy) at 24-hourly and 3-hourly scales to validate model output. Eight sensitivity tests were conducted to determine the optimal combinations of microphysics (WSM6 and Goddard), cumulus (Kain and BMJ), and planetary boundary layer (YSU and ACM2) parameterization schemes for simulating rainfall events. The Kain-Goddard-YSU and Kain-Goddard-ACM2 schemes exhibited superior performance in replicating the observed heavy precipitation. Moisture analysis utilized relative humidity, while cloud characteristics were assessed using reflectivity and brightness temperature. Model assessments indicated that the Kain-Goddard scheme outperformed others in reproducing heavy precipitation, particularly exceeding a threshold of 60 mm/day over the Mahi basin. The study findings demonstrate that employing specific combinations of parameterization schemes can effectively simulate convective organization and synoptic features associated with heavy rainfall events in the Mahi basin. This information holds significance for understanding future precipitation trends and devising sustainable water management strategies to aid decision-makers and water managers in operational planning..