Microphysics and cumulus parameterization sensitivity of the WRF Model to extreme rainfall in tropical Island - Evaluation of the 2016 May flood event of Sri Lanka

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This study uses the Advanced Research Weather Research and Forecasting model (WRF-ARW) 3.6.1 to improve the simulation of the features associated with an extreme rainfall and flood event over Sri Lanka on 14th to 20th May 2016. Several sensitivity experiments were conducted to examine the model performances with respect to different combinations of cloud microphysics schemes and cumulus parameterizations. The model domain consists of one domain with 3 km horizontal grid resolution and the National Centers for Environmental Prediction Climate Forecast System version 2 (NCEP-CFSv2) data at 0.5 degrees and 45 vertical levels were used as initial and lateral boundary conditions. Three different microphysical schemes (namely - Lin, WSM6, Morrison) and four cumulus parameterization scheme options (namely - Kain-Fritsch, Betts-Miller-Janjic, Grell-Freitas ensemble, Explicit Convection) were tested for their performance in simulating the event. Hourly rainfall and the accumulated rainfall of the event were compared with the observation data obtained from the Department of Meteorology, Sri Lanka, and the CMORPH (the climate prediction center morphing algorithm) data. All the parametrization combinations were able to simulate the extreme event initiation, development, and accumulated rainfall nearly well. In particular, the combination of Lin microphysics scheme with Yonsei University PBL scheme and Kain-Fritsch cumulus parameterization scheme provides the optimal combination of physical parameterization schemes in the simulation of this extreme rainfall and flood event over Sri Lanka. The study also emphasizes the need for a comprehensive, multi-observational platform observational campaign to improve the parameterizations of the cloud microphysics and cumulus convection for the numerical weather simulations over Sri Lanka. Moreover, suggesting WRF has a potential for operational use in numerical weather prediction in Sri Lanka and these parametrizations would serve as reference in future numerical weather forecasting or simulation in similar extreme events

Keywords: Model sensitivity, Atmospheric dynamics, Microphysics, Cumulus convection, WRF model

