Impact of Parameterization of Physical Processes on Simulation Severe thunderstorms over Gangetic West Bengal using triple nested WRF model

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Thunderstorm is a severe weather phenomenon accompanied by heavy rainfall, thunder, lightening, hail, and squall line. Single cell thunderstorms are towering cumulus or cumulonimbus clouds of convective origin with high vertical extent. Though short lived, the severe thunderstorms can cause loss of lives and huge damage to properties. Hence, it is important to provide reasonably accurate prediction of these storms. In the present study, attempted is made to investigate the performance of different planetary boundary layer (PBL), cumulus convection and cloud microphysics parameterization schemes towards simulation of severe thunderstorm over Gangetic West Bengal. For this purpose, triple nested mesoscale model WRF with 2 km resolution inner most domain is used to simulate two severe thunderstorms that affected Kharagpur region of Gangetic West Bengal. Sensitivity experiments are conducted with two planetary boundary layer (YSU and Mellor-Yamada-Janjic), two cumulus convection (Grell- Devenyi ensemble and Simplified Arakawa Schubert) and two cloud microphysics (WSM6 and Ferrier) parameterization schemes (with explicit representation in the inner most domain). Several important model simulated fields; viz., surface pressure, horizontal wind, temperature and precipitation are verified towards predicting these convective events over the region and also at Kharagpur. The model simulated fields at Kharagpur are compared with the micrometeorological tower observations. The surface fluxes obtained from model simulation is also compared with estimated fluxes to evaluate the PBL parameterization schemes. The results indicate that the combination of Ferrier (cloud microphysics)-Simplified Arakawa Schubert (Cumulus convection for outer two domains)-Mellor Yamada Janjic (PBL) provides the better result than the other combination of schemes. The peak intense period of the storm is better simulated with explicit cloud microphysics at 2 Km resolution. The timing of the

storm could not be well simulated by any of the schemes and duration of the events is also not well captured by many of the schemes. In model simulations, the error in time of occurrence of the storms is in the range of an hour or more.

Keywords: thunderstorm, cumulus convection, planetary boundary layer, cloud microphysics.

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