Simulation of Tropical Cyclone Nargis Using WRF-ARW Model:sensitivity to Parameterization Schemes of Microphysics and Cumulus

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It has been realized that tropical cyclone is the most destructive meteorological phenomenon, as it ravages life and property, especially over the coastal belt due to storm surges and violent gusty winds at the time of landfall. The mortality associated with the tropical cyclones is considerably high in the coastal areas of the Bay of Bengal region mainly due to the socio-economic conditions in the boarding nations. In the recent years, fairly intense tropical cyclones developed in the Bay of Bengal and therefore this paper investigates movement and intensity of very severe tropical cyclone Nargis using WRF-ARW model. Nargis has been the deadliest tropical cyclone developed in the Bay of Bengal in the recent history. It was a category 4 of the Saffir-Simpson scale with maximum sustained wind about 210 km/h, by which more than 1,30,000 people died as it hit the low-lying areas of Irrawaddy delta of Myanmar around 1300 UTC on the 02 May 2008. WRF-ARW model, developed by the National Centre for Atmospheric Research (NCAR) of USA is utilized to simulate movement and intensity of Nargis with different microphysics and cumulus schemes. National Centre for Environment Prediction (NCEP) FNL analysis data is utilized as initial and lateral boundary conditions (LBCs) at six hourly intervals. Domain is selected at 20 km horizontal resolution with 27 vertical sigma levels. Three-day (72 hours) runs are made for simulating the event with all possible options.

Maximum sustained wind and central sea level pressure associated with the cyclone are calculated to investigate the intensity of the system. Some of the model derived parameters are compared with satellite derived parameters (http:// rammb.cira.colostate.edu/products/tc_realtime) to verify the model performance as in-situ data is sparse or not available over the vast oceanic area. RMSE of position error is also calculated to understand the accuracy of the model track. It reveals that WRF-Single moment 3-class microphysics scheme (simple ice and snow scheme) with Kain-Fritch cumulus parameterization scheme is the best combination for simulating Nargis cyclones as it gives low RMSE of position error of about 99 km. In addition, maximum sustained wind (153 km/h) and central sea level pressure (950 hPa) are also quite closer to the observations with this combination. In all these simulations, surface layer is treated with Monin-Obukhov and Carslon-Bolan viscous sub-layer option and boundary layer is treated with Yonsei University scheme. Noah 4-layer land surface model is utilized with the above combination.