Impact of Data Assimilation on Simulation of Thunderstorm Events over Bangladesh using WRF 3DVARDA Technique

Nazlee Ferdousi, Sujit K. Debsarma and Md. Majajul Alam Sarker
SAARC Meteorological Research Centre (SMRC)
E-4/C, Agargaon, Dhaka-1207, Bangladesh
Email: nferdousi@yahoo.com

Abstract

The purpose of this paper is to demonstrate the effect of data assimilation by using Weather Research and Forecasting (WRF) Model in the simulation of thunderstorm events over Bangladesh and its neighborhood. The thunderstorms or Nor'westers which are locally known as "Kalbaishakhis" are mainly the well known short lived severe weather phenomena that cause a lot of damage to properties and loss of human lives in and around Bangladesh almost every year during the pre-monsoon season (March – May). Two moderate thunderstorm events along with squalls lashed over Ishurdi, Dhaka and Chittagong regions of Bangladesh and Shillong of India on 26 April 2010 and Satkhira Rajshahi, Khepupara, Patuakhali, Dhaka and Chittagong regions of Bangladesh and Alipore, Dumdum, Haldia, Bankura, Gaya and Jamshedpur regions of India on 26 May 2010. WRF Model with horizontal resolution of 9 km and 27 vertical eta levels is run for a period of 24 hours using NCEP-FNL data starting from 0000 UTC of 26 April 2010 and 0000 UTC of 26 May 2010 as initial and boundary conditions for those two cases. YSU (Yonsei University) Planetary Boundary Layer (PBL) parameterization scheme for boundary layer option, Rapid Radiative Transfer Model (RRTM) for long wave and Dudhia for short wave radiation scheme have been utilized to run the model. Noah Land Surface Model (LSM) and Kain-Fritsch (KF) cloud scheme are also considered in the Model. An effort is made to simulate those cases by assimilating SYNOP and Upper Air data of Bangladesh and neighbourhood using WRF 3DVAR Data Assimilation (3DVARDA) technique in WRF Model. The simulated rainfalls (convective and non-convective) are compared with TRMM 3B42RT product and rainfall data of Bangladesh Meteorological Department (BMD) for validation process. The model outputs are also compared with satellite and RADAR imageries for validation and utilized in explaining the development mechanism of the thunderstorms. The WRF Model products like dBZ, rainfall intensity, wind flow pattern, vertical wind shear and vertical wind velocity show improvement after DA over CTRL run in both the cases which are quite encouraging.

Keywords: WRF Model, CTRL, 3DVARDA, Parameterization, RRTM, SYNOP, Planetary Boundary Layer (PBL), Noah Land Surface Model (LSM), Kain Fritsch (KF).