Simulation of Monsoon Depressions Using WRF-VAR with Different Background Error Statistics

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The study is undertaken during the pilot phase of South Asian Regional Reanalysis (SARR). The SARR project is being implemented at National Centre for Medium Range Weather Forecasting (NCMRWF) as a part of Memorandum of Understanding between the Ministry of Earth Sciences (MoES) and National Oceanic and Atmospheric Administration (NOAA) on Technical Cooperation in Earth Observations and Earth Sciences. Main purpose of the SARR is to advance understanding, modeling and prediction of monsoon hydroclimate variability and change. The South Asian region is highly sensitive to the consequences of climate change. It is known to be the most disaster prone region in the world supporting a huge population of more than 1.3 billion. The detailed objectives and relevance of the SARR project can be found in the http://www.ncmrwf.gov.in/SARR/.

In the variational data assimilation system, background error statistics (BE) spreads the influence of the observation in space and filter analysis increments through dynamic balance or statistical relationship. In this study regional domain specific BE statistics has been generated for the WRF-Var assimilation system. A comparative study is undertaken between the computed BE statistics data along with global BE data available in the WRF-Var system, both the BEs have been used in the assimilation cycles and forecast runs for simulating the meteorological features associated with the monsoon depressions (MDs). For this purpose, three numerical experiments (i) use of coarse resolution NCEP reanalysis data without assimilation, (ii) global BE used in the assimilation cycle and (iii) computed domain-specific BE for the Indian region are conducted to asses the relative improvement in the simulation of MDs due to the various BEs over the region. The results show that the use of regional BE in the assimilation cycle has a positive impact on the prediction of the location, propagation and development of rain bands associated with the MDs. The model simulated mean-sea-level pressure, winds, amount and intensity of rainfall and the track of the MDs are significantly improved in the assimilation experiments. From the statistical skill scores, it is concluded that the domain-specific BE enhanced the performance of the WRF-Var over the Indian region. For all the cases, the track errors are significantly reduced when region specific BEs are used. The results indicate that the use of domain-dependent BE in the WRF-Var analysis system can provide improved initial conditions and forecast than the use of global BE statistics.

Key Words: Background error statistics, variational data assimilation, Indian monsoon and monsoon depression

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