Relevance of Background Error Statistics for Variational Radar Assimilation System

*THIRUVENGADAM PADMANABHAN[1], INDU J[1,2], SUBIMAL GHOSH[1,2]

1. Department of Civil Engineering, Indian Institute of Technology Bombay, Mumbai 400076, India., 2. Interdisciplinary Centre for Climate Studies, Indian Institute of Technology Bombay, Mumbai 400076, India.

Skillful prediction of extreme convective weather events remains a challenge in regional Numerical Weather Prediction (NWP) models. Reduced forecast skill in regional NWP models is often attributed to improper representation of convective storm structure in the initial condition. Assimilation of high-resolution Doppler Weather Radar (DWR) observations through variational systems provide critical information about the pattern and evolution of convective systems in the initial conditions. However, the quality of variational radar assimilation hinges on the Background Error statistics (BES) which is a statistical measure of the error in model forecasts. The BES is generally modeled using control variables through either the National Meteorological Centre (NMC) or the ensemble method. Hence the choice of control variable and modeling method have a significant influence on the skill of analysis from the variational systems [Thiruvengadam et al., 2019]. In this study, we investigate the control variable (CV) properties of both NMC and ensemble-based BES and their impact on the skill of the three-dimensional variational radar assimilation system. Results demonstrate that the use of zonal and meridional momentum CV in both the NMC and ensemble method improves the moisture and dynamics forecast state variables when compared to the use of stream function and velocity potential CV. Best precipitation forecast results are obtained when ensemble-based BES modeled using zonal and meridional momentum CV are used for assimilating DWR observations.

Reference:

Thiruvengadam, P., J. Indu, and S. Ghosh (2019), Assimilation of Doppler Weather Radar data with a regional WRF-3DVAR system: Impact of control variables on forecasts of a heavy rainfall case, Adv. Water Resour., 126, doi:10.1016/j.advwatres.2019.02.004.

Keywords: Doppler Weather Radar, Data Assimilation, Background Error statistics

