Quality and impact of Indian Doppler weather radar wind profiles: A diagnostic study

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Abstract - In the tropics, efficient weather forecasts require high quality vertical profiles of winds to overcome improper coupling of mass and wind fields and balance relationships in the region. The India Meteorological Department (IMD) operates the network of Doppler Weather Radar (DWR) in microwave frequencies (S-band or C-band) at various locations in India. The National Centre for Medium Range Weather Forecasting (NCMRWF) receives the volume velocity processing (VVP) wind profiles from all DWRs through the Global Telecommunication System (GTS) network in near real time. The radar VVP wind is a mean horizontal wind derived at different heights from radial velocities suitable for numerical weather prediction (NWP) applications. Three numerical experiments, CNTL (without VVP winds), 3DVAR and HYBRID with the assimilation of VVP winds by using 3-dimensional variational (3dvar) and hybrid data assimilation systems were conducted using the NCMRWF Global Forecast System (NGFS) model. This study had two objectives: 1) quality assessment of VVP winds and 2) investigation of the impact of VVP wind profiles on NGFS model forecast. The quality of VVP wind profiles was assessed against the NGFS model background and radiosonde wind profiles. The absolute value of zonal and meridional wind observation minus background (Oī B) increased with the pressure for all DWRs. All radars exhibited the accepted (rejected) ratio as a decreasing (increasing) function of pressure. The resemblance of the zonal and meridional Oī B statistics for 3DVAR and HYBRID experiments is apparently remarkable. The accepted VVP winds and radiosonde winds in both experiments (3DVAR and HYBRID) were consistent. The correlation coefficient (R) was higher at Patna (Patiala) for zonal (meridional) winds in the 3DVAR experiment and at Patna (Jaipur) in the HYBRID experiment. At Chennai, the R value was lower in both the experiments for both wind components. However, because of the assimilation of VVP winds by using 3dvar, the root-mean-square error (RMSE) of zonal and meridional winds improved by approximately 2%-3% up to the day 5 forecast in the analysis performed below 700 hPa. Further improvement in RMSE approximately 5% was observed in both the wind components because of the hybrid data assimilation. The zonal and meridional wind RMSE in the HYBRID (3DVAR) experiment improved by å5 (3)% compared with the 3DVAR (CNTL) experiment.