Assimilation of Multifunction Phased Array Radar data for the Prediction of Thunderstorms during the May 24th, 2011 Oklahoma Tornado Outbreak

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The NWRT (National Weather Radar Testbed) MPAR (Multifunction Phased Array Radar) has the ability to scan thunderstorms in high-temporal-resolution, and provides rapid volumetric updates about every 1 minute. The high-temporal-resolution radar data has very advantageous benefits in monitoring storm evolution and issuing storm warnings compared to current operational WSR-88D radar data [1][2][3]. Assimilation of such high-temporal-resolution radar data into an NWP model to improve the forecast of storms is an ongoing research topic and a very challenging problem. Yussouf and Stensrud [4] have demonstrated in their EnKF (Ensemble Kalman Filter) OSSEs (Observing System Simulation Experiments) that assimilating PAR (Phased Array Radar) observations every 1 minute for 15 minutes can produce better analyses and ensemble forecasts than assimilating WSR-88D radar data. Ge et al. [5] also showed in their variational OSSEs that for wind observations, 1-minute assimilation frequency produced better analysis than 5-minute or 10-minute frequency. However, it is still unknown in real case studies how the high-temporal-resolution MPAR data affects the data assimilation and the forecast of thunderstorms.

During the May 24th, 2011 Central Oklahoma Tornado outbreak, the MPAR scanned the storms in very high frequency. A three-dimensional variational data assimilation system (3DVAR) developed at the Center for Analysis and Prediction of Storms (CAPS) is used to assimilate this data into a storm scale non-hydrostatic NWP model—the Advanced Regional Prediction System (ARPS). Both reflectivity and radial velocity data will be assimilated. 3DVAR analyses will be produced every 1 minute and every 5 minutes using a cycling approach, where the ARPS model is used to integrate the 3DVAR analysis forward in time between data insertions. The initial model background state is provided by the NCEP NAM mesoscale forecast system to ensure that realistic environmental structures are given to the data assimilation system. The results from the 1-minute cycle and 5-minute cycle are compared to examine the impact of high-temporal-frequency data on storm-scale radar data assimilation and subsequent forecasts. It is expected that the high-temporal-resolution MPAR data can improve the data assimilation and the ensuing forecast.

References

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