Cross validation of *TEMPEST-D CubeSat observations using ground polarimetric radar observations and* numerical weather model predictions *over precipitating storms*

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The Temporal Experiment for Storms and Tropical Systems (TEMPEST) is a 6U CubeSat mission to measure the temporal evolution of clouds, convective systems and the surrounding water vapor environment using global observations with temporal resolution of several minutes. The TEMPEST constellation mission consists of eight identical 6U CubeSats deployed in the same orbital plane with 3-4 minute spacing. The necessary technology for the success of the TEMPEST constellation mission has been demonstrated during the TEMPEST-D (“D” for demonstration) satellite mission launched in May 2018 and deployed into orbit in July 2018. The TEMPEST-D CubeSat radiometers measure at five millimeter-wave frequencies (87, 164, 174, 178 and 181 GHz) with the capability to provide temporal observations of convection and vertical profiles of the surrounding water vapor.

This paper focuses on cross-validation of the TEMPEST-D observations and simulated observations over convective events in the U.S. southern Great Plains that were also observed by ground-based polarimetric radar. The Weather Research and Forecasting (WRF) model is used to simulate the convective storms, and the ground-based polarimetric radars’ reflectivity and radial velocity data are assimilated into WRF to improve the space-time specificity of the model simulations. Assimilation of the radar data ensures the spatial and temporal specificity of the actual event. The results showed that assimilation of radar observations enhances the WRF simulation. The spatial and temporal specificity of the WRF-simulated storm is closer to the one observed from ground radars than to the a-priori information.

Radiance observations are estimated as brightness temperatures (TBs) at the TEMPEST-D frequencies using the Community Radiative Transfer Model (CRTM) with WRF (with radar data assimilation) simulated vertical profiles of the atmosphere. As part of this study, the temporal variability of TEMPEST observations is simulated before cross-validation of the TEMPEST-D observations. The results showed that the high-frequency channels are more sensitive to frozen hydrometeors, and the rate of change of TBs is large when transitioning from non-precipitating to precipitating hydrometeors. Detailed cross-validation results will be presented at the conference.