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Severe weather case studies using the Space and Time Multiscale Analysis System (STMAS)

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The Space and Time Multiscale Analysis System (STMAS) has been developed at NOAA/Earth System Research Laboratory/Global Systems Division, which uses multigrid variational technique to assimilate various observation data and can provide a multiscale and inhomogeneous analysis. The latest STMAS includes radar reflectivity analysis. This study focuses on severe weather events, including two mesoscale weather cases (hurricane Katrina 2005 in the Atlantic Basin and typhoon Morakot 2009 in the Pacific Basin) and a small-scale tornado event (Windsor tornado 2008 in Colorado, USA). The Advanced Research Weather Research and Forecasting (WRF-ARW) model is selected to run high-resolution forecasts from 5 km to less than 1 km. Hurricane intensity, track, and rainfall bands are analyzed for two hurricane cases. For the tornado case, in addition to wind, humidity, and temperature fields, horizontal and vertical distribution of forecasted radar reflectivity fields are compared with composite observed radar reflectivity. The case studies also compare the hot-start run with the STMAS initialization and the cold-start run using the background models as the initial condition. The moisture field at the STMAS initialization through the cloud analysis in the Local Analysis and Prediction System (LAPS) greatly reduces the spin-up time in the model integration and improves the forecasts for developing a dynamic system (such as vortex). The impact of the cycling run (using the high-resolution WRF forecasts as the background model) on the forecasts is also discussed.