A Comparison of Impacts of Radiosonde and AMSU Radiance Observations In GSI-based Hybrid and 3DVar Data Assimilation Systems for NCEP GFS

Govindan Kutty[a] and Xuguang Wang[b]

[ab]*School of Meteorology and Centre for Analysis and Prediction of Storms, Norman, OK, USA*
Corresponding author address: xuguang.wang@ou.edu

The impact of observations can be dependent on many factors in a data assimilation (DA) system including data quality control, preprocessing, skill of the model and the DA algorithm. The present study focuses on exploring the difference of the impacts of observations assimilated by two different DA algorithms. A 3DVar-based ensemble-variational (3DEnsVar) hybrid data assimilation system was recently developed based on the Gridpoint Statistical Interpolation (GSI) data assimilation system and was implemented operationally for the GFS. One interesting question is if and how the impacts of observations differ when assimilated by the GSI 3DVar and 3DEnsVar. Experiments were conducted over a 6-week period during Northern Hemisphere winter season at a reduced resolution of T190L64 following the configuration of [1]. The control runs assimilated all operational conventional and satellite observations. The impacts of AMSU and Radiosonde observations were studied through data denial experiments. These platforms were selected based on the significance shown by these two data sets in the previous studies. The impacts of AMSU and Radiosonde assimilated by 3DEnsVar were compared with those assimilated by GSI 3DVar. For both the control and data denial experiments, the forecasts produced by the 3DEnsVar are more accurate than the GSI3DVar experiments. The AMSU and Radiosonde, showed positive impact assimilated by both DA schemes in general. In the GSI3DVar, the errors of global wind and temperature forecasts were increased more by denying Radiosonde than denying AMSU observations. In the 3DEnsVar,such impacts of the AMSU and Radiosonde are similar. For the humidity forecasts, the AMSU has larger impact than Radiosonde in both the GSI3DVar and the 3DEnsVar. For the GSI3DVar, the Radiosonde and AMSU observations show similar impact in both magnitude and spatial distribution in the Southern extra-tropics (SH). For the Northern extra-tropics (NH), Radiosonde shows larger and more extensive impact than AMSU. The largest difference of the degradation of the forecast between the 3DEnsVar and GSI3DVar was seen in the SH when Radiosonde was denied, where the forecast was degraded much less in the 3DEnsVar than in the GSI3DVar. The percentage degradation of the forecast skill after denying Radiosonde and AMSU observations is less in the 3DEnsVar than the GSI3DVar. The anomaly correlation of forecasts up to 5-day forecast lead time indicates that the impact of AMSU and Radiosonde observations increases with increasing forecast lead time in both DA systems. The AMSU radiance biases estimated by the GSI 3DVar and the 3DEnsVar show similar values.

References

[1] Wang, X., D. Parrish, D. Kleist and J. Whitaker, 2013: GSI 3DVar-based Ensemble-Variational Hybrid Data Assimilation for NCEP Global Forecast System: Single Resolution Experiments, Monthly Weather Review, accepted.