Assimilation of QuikSCAT / SeaWinds Ocean Surface Wind Data into the Global Data Assimilation System at JMA

Masami Tokuno and Yasuaki Ohhashi
Numerical Prediction Division, Japan Meteorological Agency
1-3-4 Otemachi, Chiyodaku, Tokyo 100-8122, Japan
e-mail: tokuno@met.kishou.go.jp, ya-ohashi@met.kishou.go.jp

The Japan Meteorological Agency (JMA) used the ERS-2 scatterometer winds and surface pressure retrieved from the ERS-2 winds together with auxiliary data for the global analysis in the optimum interpolation scheme (OI) from July 1998 to January 2001.

The QuikSCAT satellite, a successor of ERS-2, was launched being equipped with a new scatterometer SeaWinds in June 1999. A large contribution to numerical weather prediction (NWP) is expected, as the width of QuikSCAT observation is more than three times wider than that of ERS-2 scatterometer. Taking an advantage of QuikSCAT winds, an observation system experiment (OSE) for QuikSCAT winds in July 2000 was conducted with the same assimilation method as that used for ERS-2 data. Results showed that QuikSCAT winds after the ambiguity removal and quality control performed at JMA had almost the same accuracy as ship or buoy data.

JMA introduced a three-dimensional variational scheme (3D-VAR) instead of OI to the global data assimilation system in September 2001. Using QuikSCAT winds in July 2000, an impact study was performed with the JMA 3D-VAR using T106L40 version of the JMA global NWP model. The results showed a large improvement over the Southern Hemisphere and a small or a neutral improvement over the Tropics and the Northern Hemisphere.

To use QuikSCAT Winds operationally with the JMA 3D-VAR, impact studies using QuikSCAT winds in December 2001 and July 2002 are performed with the T213L40 version of the JMA global NWP model.

The impact of all elements to model's performance is neutral in December 2001. However, obvious improvement is indicated in Mean Error of altitude for 850 hPa and 500 hPa in tropical regions (20N – 20S). Figure 1 shows Mean Error of altitude for 850 hPa in four regions (global (GL), northern hemisphere (NH, 20N – 90N), tropical region (TR, 20N – 20S), southern hemisphere (SH, 20S – 90S)), for TEST and CNTL. Mean Error of altitude in 850 hPa in TEST is extremely improved after 3 forecast days and becomes almost zero at 9 forecast days in the tropical region.

In July 2002, impact of almost all elements to model's performance is neutral as the same as in December 2001. Small decrease of RMSE in the Northern Hemisphere is appeared in temperature and altitude in 850 hPa and temperature in 500 hPa. Obvious improvement is indicated in Mean Error of temperature for 500 hPa in the Southern Hemisphere shown in Figure 2.

Figure 3 shows Anomaly Correlation of altitude for 500 hPa in the Northern Hemisphere in July 2002. Anomaly Correlation in TEST is extremely improved after 6 forecast days.

Furthermore we performed the experiment for the impact of the typhoon track forecast in July 2002. Figure 4 shows the forecast track of typhoon 7 (HALONG). QuikSCAT wind data were assimilated in the global model 6 hourly and the result of the forecasted track of typhoon from the initial time 12 UTC July 10 2002 is shown in Figure 4. Each line shows the best track, TEST, CNTL, ROUTINE, respectively. The error of forecasted typhoon track in TEST decreases about 100 km to the best track. Thus QuikSCAT wind data is effective to improve the forecast of typhoon track. Additionally, we performed statistics of the error of typhoon track forecast in 36 cases during July 2002. The result shows that the error of typhoon track forecast in TEST is extremely decreased after forecast time 72 hours in comparison with the other cases.

Throughout the experiment, QuikSCAT data were recognized to have a good enough quality to be used for NWP. The evident positive impacts were not recognized over all regions, but small positive impact over the Northern Hemisphere in summer. In addition, the remarkable positive impacts were recognized for typhoon track forecast. As the result, JMA will start to use QuikSCAT wind data in NWP operationally in early FY2003.

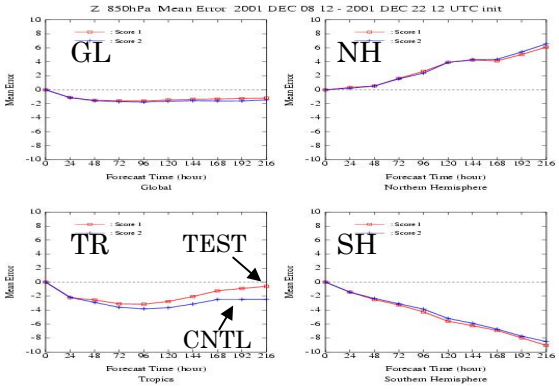

Figure 1 Mean Error of altitude for 850 hPa in December 2001.

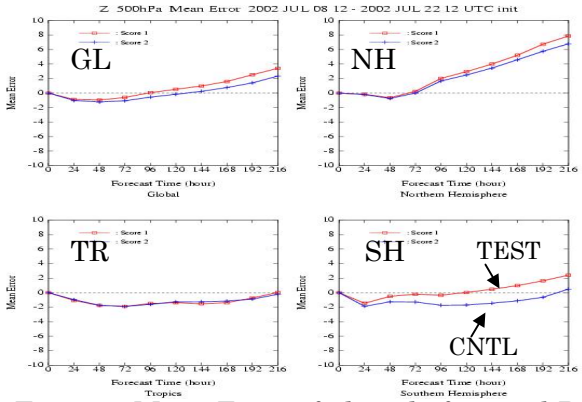

Figure 2 Mean Error of altitude for 500 hPa in July 2002.

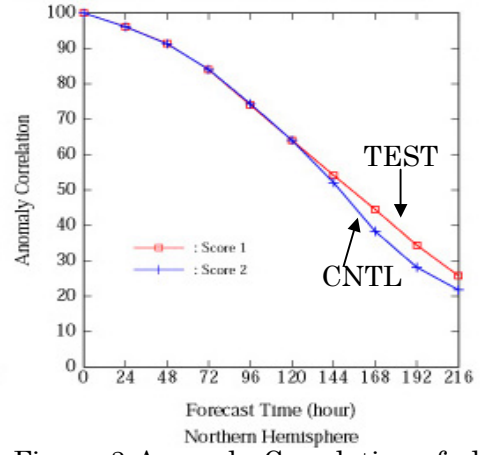

Figure 3 Anomaly Correlation of altitude for 500 hPa in northrern hemisphere in July 2002.

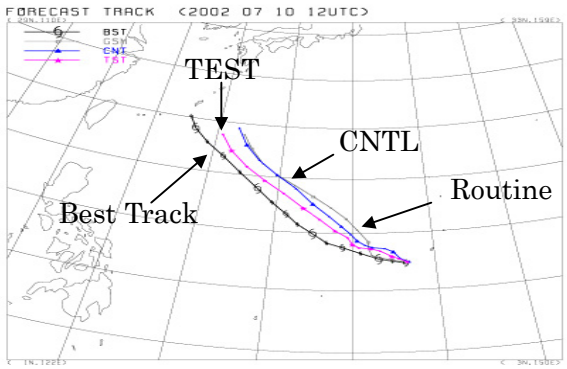

Figure 4 The results of forecast track of typhoon 7 (HALONG).