Operational use of Metop-A/ASCAT Winds in the JMA Global Data Assimilation System

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At the Japan Meteorological Agency (JMA), ocean surface vector winds derived from the Advanced SCATerometer (ASCAT) on board the Metop-A satellite have been assimilated in the operational global data assimilation (DA) system since 28 July 2009. ASCAT is an active C-band (5.3 GHz) scatterometer which has less sensitivity to rain than Ku-band (13.5 GHz) type (e.g., SeaWinds on board the QuikSCAT satellite, hereafter referred to as "QuikSCAT"). The six fan-beam antennas set on both sides of the spacecraft scan 550-km swaths separated by a gap of about 700-km. Wind data produced by the Royal Netherlands Meteorological Institute (KNMI) with a resolution of 50-km and 25-km cell spacing are used in this study. The increased data coverage using ASCAT wind vectors is expected to provide more valuable information to correct the initial field in one analysis.

Figure 1 shows two-dimensional histograms of JMA's first guess of ocean surface winds versus scatterometer winds derived from ASCAT and QuikSCAT. Both scatterometer winds closely match the Numerical Weather Prediction (NWP) winds, although high-speed ASCAT winds are underestimated.

In the preprocessing step of the DA, data thinning to approximately 100-km intervals and quality control are applied for the scatterometer winds. The former is to avoid using observations with errors that are highly correlated to each other. The latter is performed as follows: First, low-quality data are rejected by land/sea flag and KNMI quality control flag. Next, the most likely wind vector is selected in the ambiguity removal step using a median filter method initialized by nudging with JMA's first guess. Finally, data showing large departures of wind speed and direction from the first guess winds are screened.

To evaluate the impacts of ASCAT data on analysis and forecasting, observing system experiments in a low-resolution (TL319L60) global DA and forecast system were carried out. Figure 2 shows the improvement rate of the root mean square error against the initials for sea level pressure forecast in August 2008. All experiments with scatterometer data significantly improved forecast scores in the short-range forecast period over the Northern and Southern Hemispheres. The scores of the experiment assimilating both QuikSCAT and ASCAT were comparable with that using only one scatterometer, indicating that the use of at least one scatterometer (ASCAT) avoids the degradation of forecast scores even if QuikSCAT data become unavailable.

As ASCAT winds of which speed is lower than 15 m/s have good quality, they have been assimilated in operation since July 2009. However, the end of QuikSCAT nominal mission in November 2009 points to a need for assimilating ASCAT high wind speed data. A new usage of ASCAT employing a bias correction method for wind speed is currently under investigation.

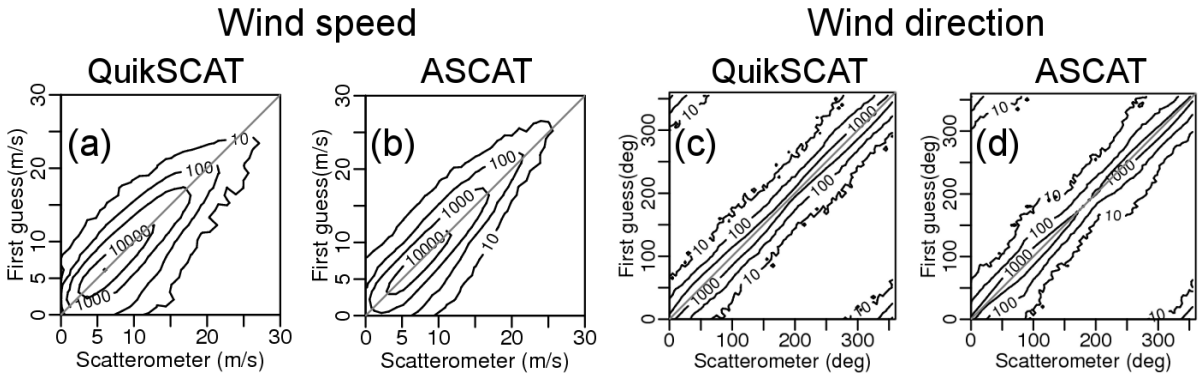

Figure 1: Two-dimensional histograms of JMA's first guess for sea surface winds versus scatterometer winds derived from ASCAT (b, d) and QuikSCAT (a, c) for 1 — 31 January 2009. Scatterometer winds after quality control and data thinning are used. The contour lines are on a logarithmic base-10 scale.

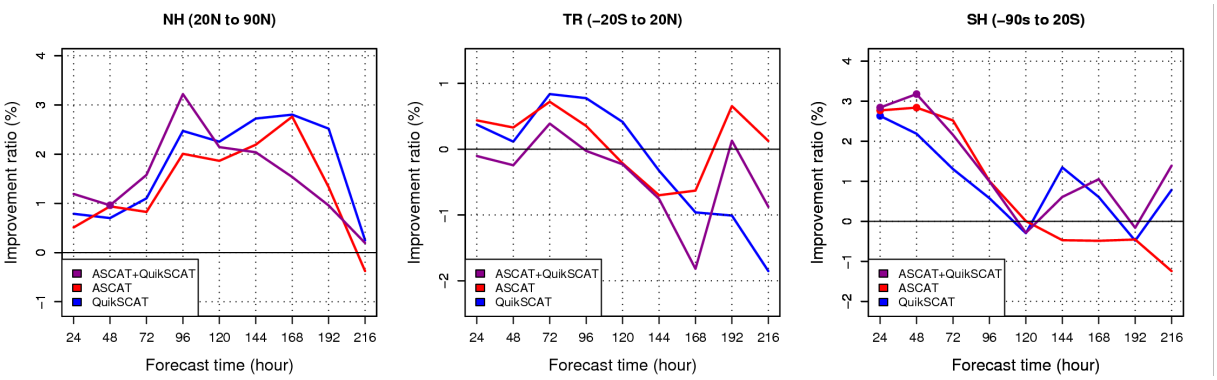

Figure 2: Improvement rate of the root mean square error (RMSE) against the initials for sea level pressure forecast, averaged over the Northern Hemisphere (left), the tropics (center) and, the Southern Hemisphere (right) for August 2008. The improvement rate is defined as (CNTL−TEST) / CNTL, where CNTL and TEST are the RMSEs of the experiments without and with scatterometer usage, respectively. The dots on the lines indicate statistical significance.