Operational Use of ASCAT Coastal Wind Data in JMA's Mesoscale Data Assimilation System

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1. Introduction

Assimilation of data on ocean vector winds (OVWs) from the Advanced Scatterometer (ASCAT) onboard the EUMETSAT Metop satellites contributes to the improvement of low-level wind analysis fields in Japan Meteorological Agency (JMA) global and mesoscale numerical weather prediction (NWP) systems (Takahashi 2010, Moriya 2016). To further improve the forecast skill of mesoscale NWP by assimilating higher-resolution wind data, JMA changed the OVW product for mesoscale NWP analysis from ASCAT 25-km winds to ASCAT 12.5-km coastal winds (Verhoef et al. 2012) on March 26 2019. This report outlines the impacts of the assimilation on the NWP system.

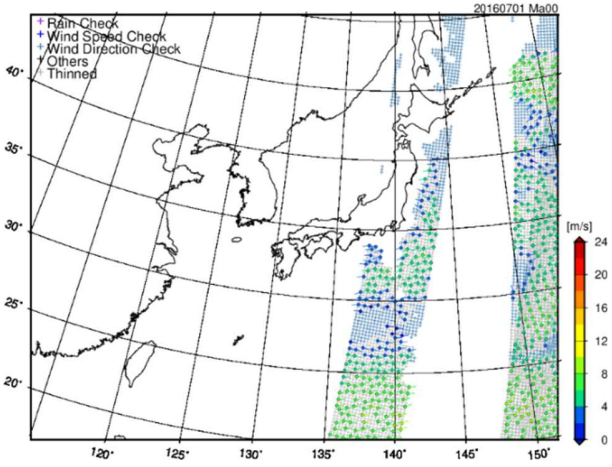
2. Utilization of coastal OVW data

The settings and parameters of quality control for coastal wind data are identical to those for 25-km OVWs. Spatial thinning of 0.5 degrees (approximately 50 km) was applied to both products, but a clear difference is seen in the spatial coverage of the OVWs used (Figure 1). As the target area of the JMA mesoscale NWP system includes many islands and coastal regions, the use of coastal wind data increases coverage on the sea surface around coastal regions.

3. Verification results

Two observing system experiments (OSEs) were performed over the periods from June 27 to August 30 2016 and from December 11 2016 to January 15 2017 to investigate the effects of ASCAT OVW data assimilation into the JMA mesoscale NWP system. One experiment (referred to here as CNTL) involved the use of OVWs from the ASCAT 25-km product, and the other (TEST) assimilated those of the ASCAT coastal product. CNTL had the same configuration as the JMA operational system, and TEST was identical to CNTL except for the ASCAT OVWs. Precipitation scores for three-hour cumulative precipitation forecasting against Radar/Raingauge-Analyzed Precipitation were improved in TEST. The bias score improved slightly for light rain, and the threat score increased. These improvements were confirmed by both summer and winter season experiments, and were remarkable for early forecast lead times. Typhoon position forecast skill was also improved, as shown in Figure 2. Figure 3 shows the example of Typhoon Mindulle in 2016. The speed of northward movement was

(a) 25-km products



(b) Coastal products

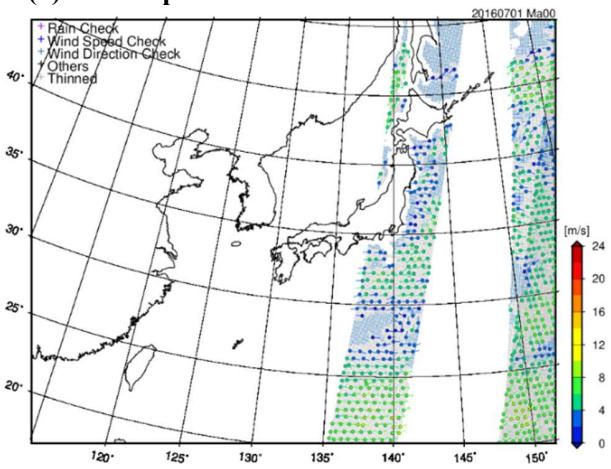


Figure 1. OVWs of (a) 25-km products and (b) coastal products in 00 UTC mesoscale analysis on July 1st 2016. Circles and crosses represent assimilated and rejected data, respectively. Colors represent wind speed for the circles and reasons for rejection (as indicated in the top left of the panels) for the crosses.

increased, and the predicted track was close to the best track from the Regional Specialized Meteorological Center (RSMC) Tokyo.

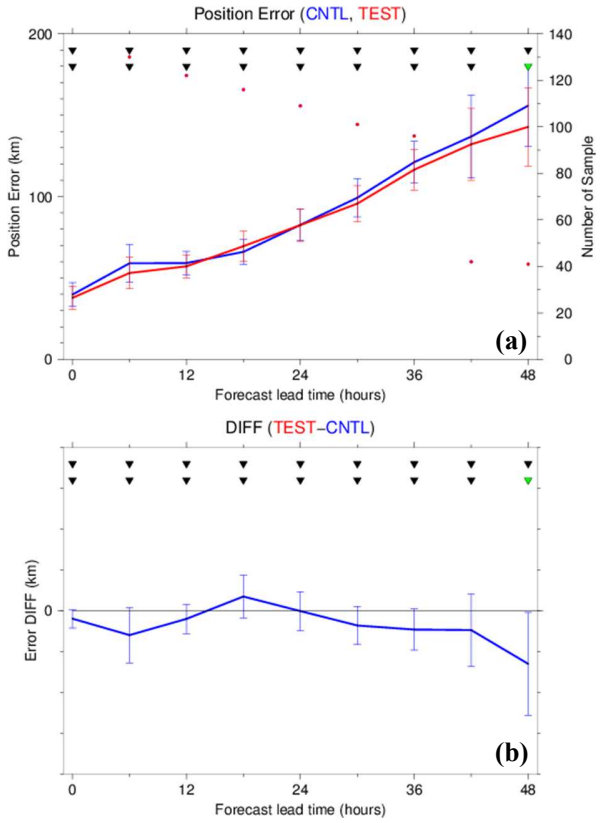


Figure 2. (a) Average typhoon track forecast errors for 8 typhoons in summer 2016. The red and blue lines represent positional errors in TEST and CNTL, respectively. Red dots indicate the number of cases included in the statistics. Forecasts were verified against best-track data from RSMC Tokyo. (b) Difference in typhoon position errors between TEST and CNTL. Negative values indicate error reductions, and error bars represent a 95% confidence interval. The triangles at the top indicate statistical significance differences, with green indicating significance.

4. Summary

The use of ASCAT coastal wind data increased the spatial coverage of OVWs on the sea surface around coastal regions, and OSEs showed improved precipitation scores and typhoon track prediction. Based on these results, JMA began assimilation of ASCAT coastal products into its mesoscale NWP system on March 26 2019.

References

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Takahashi, M., 2010: Operational use of Metop-A/ASCAT winds in the JMA global data assimilation system. *CAS/JSC WGNE Res. Activ. Atmos. Oceanic Modell.*, 40, 01.39-01.40

Verhoef, A., M. Portabella and A. Stoffelen, High-resolution ASCAT scatterometer winds near the coast, IEEE Transactions on Geoscience and Remote Sensing, 2012, 50, 7, 2481-2487

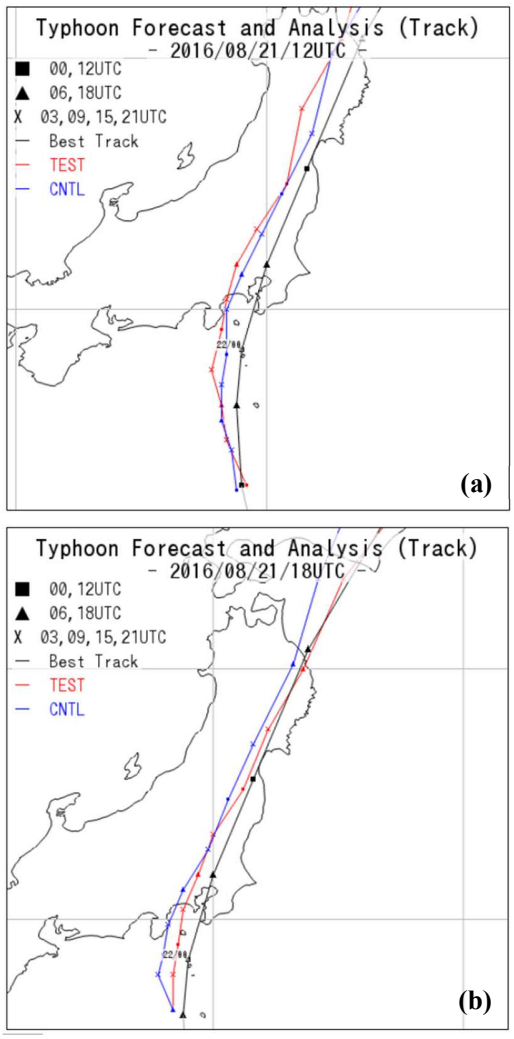

Figure 3. Track forecasts for Typhoon Mindulle at the initial times of (a) 12 UTC and (b) 18 UTC on August 21st 2016. The red and blue lines represent track predictions in TEST and CNTL, respectively, and the black lines show the best track from RSMC Tokyo.