Operational Implementation of a new semi-Lagrangian global NWP model at JMA

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1) Introduction

The global modeling group of NPD/JMA, and the Climate Research Department of MRI/JMA have been developing the JMA-MRI unified global model. The new global model will be used for climate research at MRI and the operational NWP at JMA. The new model adopts a semi-Lagrangian scheme and has been well optimized on various supercomputers such as Hitachi SR8000 and NEC SX-6 (Earth Simulator) (Katayama et al., 2004).

Data assimilation and forecast experiments with the new global model (TL319L40) have been conducted on the JMA operational NWP system. The forecast performance of the new model is as well as the JMA operational global NWP model (GSM-T213L40). The new global NWP model will be operational in the beginning of 2005.

2) Configuration of data assimilation and forecast experiments

(a) Dynamical core : Vertically conservative semi-Lagrangian scheme (Yoshimura and Matsumura 2003)
(b) Physical Processes : Same as the JMA operational global NWP model
(c) Resolution : TL319L40 (640x320x40 grids)
(d) Time steps : 900 sec (9 days forecast) and 450 sec (data assimilation cycle)
(e) Initialization : Vertical normal mode incremental initialization (Murakami and Matsumura 2004)
(f) Target period : January and August 2004

3) Results

(a) January 2004

Figure 1 shows the root mean square error (RMSE) of 500 hPa height field. RMSE is almost same as the control-run (operational model) in both the Northern Hemisphere and the Southern Hemisphere. Figure 2 shows the mean error (ME) of 500 hPa height field. ME of the new model in the Southern Hemisphere is smaller than the control-run.

(b) August 2004

RMSE is almost same as the control-run until 5 days forecast and slightly larger after 6 days forecast (Figure 3) in both the Northern Hemisphere and the Southern Hemisphere. ME is much smaller than the control-run in both the Northern Hemisphere and the Southern Hemisphere (Figure 4). Figure 5 shows the mean track error of Typhoon forecast for 9 Typhoons. The Typhoon track forecast with the new global model is better than the operational model.

(c) Computational time

The computational time for 9 days forecast with the new model is 30-50 % shorter than the current operational Eulerian model.

References

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Yoshimura, H., T. Matsumura, 2003: A Semi-Lagrangian Scheme Conservative in the Vertical Direction. Research Activities in Atmospheric and Ocean Modeling, CAS/JSC Working Group on Numerical Experimentation, 33, 0319-0320.

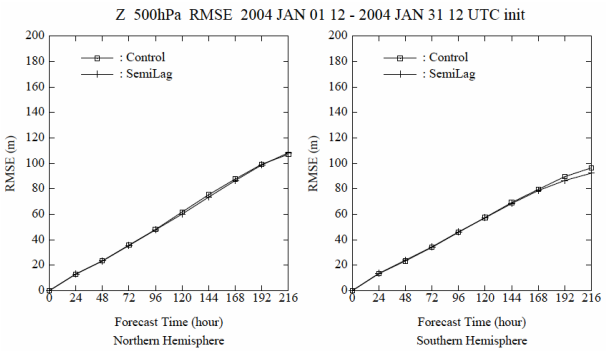

Fig.1 Result of the experiment in Jan 2004. Root mean square error of 500 hPa height. Northern hemisphere (left) and Southern hemisphere (right). Control-run (□) and new semi-Lagrangian model (+).

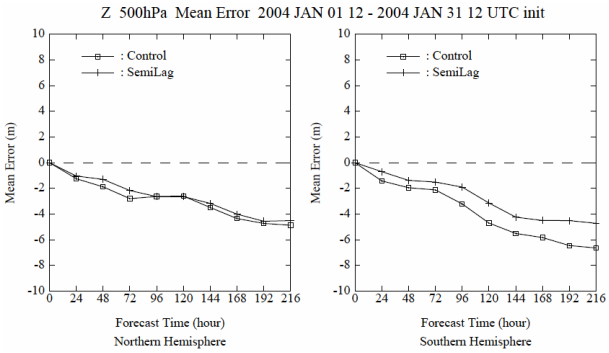

Fig.2 Result of the experiment in Jan 2004. Mean error of 500 hPa height.

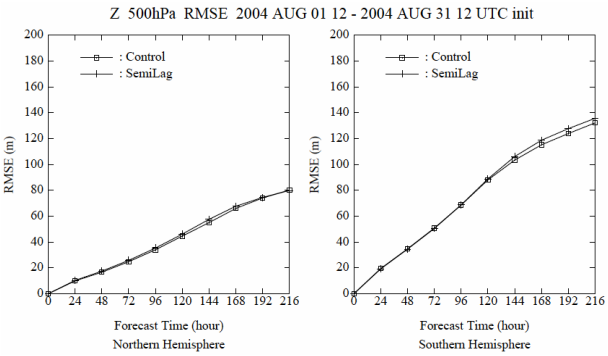

Fig.3 Same as Fig.1, but for Aug 2004.

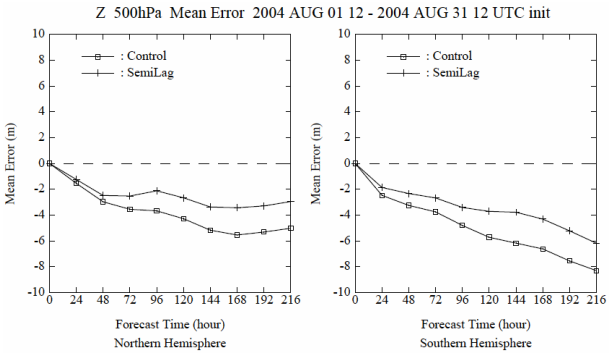

Fig.4 Same as Fig.2, but for Aug 2004.

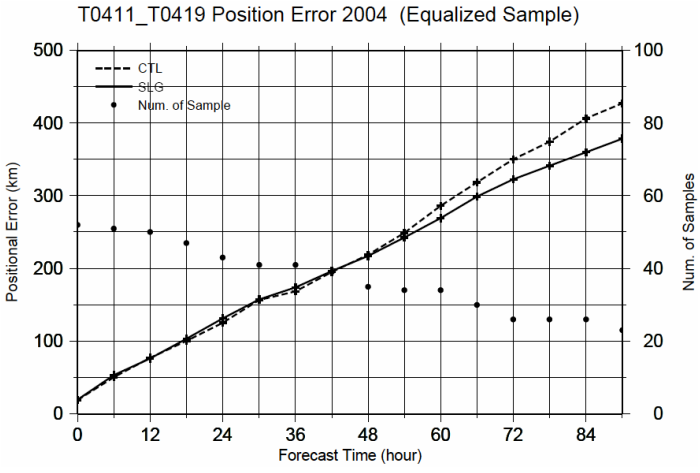

Fig.5 Mean Typhoon track error. Control-run (broken line) and new semi-Lagrangian model (solid line).