Aust. Met. Mag. 57 (2008) 269-271

Quarterly numerical weather prediction model performance summary April to June 2008

Xiaoxi Wu
National Meteorological and Oceanographic Centre, Bureau of Meteorology, Australia

(Manuscript received September 2008)

Introduction

This summary, covering the three-month period from April to June 2008, continues the series reporting on the performance of numerical weather prediction (NWP) models used operationally in the Australian Bureau of Meteorology.

Verified NWP models and their upgrades during the April to June 2008 period

Local models

The Bureau's Tropical eXtended region Limited Area Prediction System (TXLAPS_PT375) was updated on 27 May 2008 with the inclusion of the Asia Pacific – Regional ATOVS Re-transmission Scheme (APRARS) data. The parallel trials run during the April and May period have indicated a small positive impact on mean sea-level pressure (MSLP) and tropospheric temperature forecast skill. Operational robustness has also been improved through having the additional data and the locally processed data in the event of a failure of the link to the UK Meteorological Office.

The Tropical Cyclone Limited Area Prediction System (TCLAPS) was upgraded on 11 June 2008. The changes include an east-west extension from 70°E-163°W to 60°E-143°W; a high-resolution domain size increase from 27 x 27 to 30 x 30 degrees; a horizontal grid spacing reduction from 0.15 to 0.10 degrees; an increase in the number of vertical levels from 29 to 51; an increase in the height of the model top from 50 hPa to 10 hPa; addition of extra levels in most mid to higher sigma levels; replacement of the large-scale environment by use of TXLAPS and the new climate program ensures consistent matching between the model's topography and the coastline, as represented by the land-sea mask.

Overseas models

Products from four global models run by overseas operational forecast centres are received in the National Meteorological and Oceanographic Centre (NMOC) and their verifications are shown in this article. The European Centre Spectral Prognosis (ECSP) refers to the European Centre for Medium-range Weather Forecasts (ECMWF) system, UKGC to the Unified Model from the UK Met Office, United States Aviation Model (USAVN) to the Global Forecast System (GFS) from the National Centers for Environmental Prediction (NCEP) and Japan Meteorological Agency Global Spectral Model (JMAGSM) to the global assimilation and forecast model from JMA.

During the April-June period no significant upgrades to the overseas models were announced. On 5 August 2008, JMA reported the reduced gaussian grids in GSM and the reduced number of grid-points in the calculation of non-linear terms.

For further information on the improvements made to overseas NWP assimilation and forecast models refer to the web references given below. Details of the configurations of the assimilation and forecast models are described in an earlier summary (Lee 2005).

Verification method

A description of the S1 skill score, as applied in NMOC, can be found in the paper by Skinner (1995). All results have been calculated within NMOC Melbourne, where each of the models was verified against

Corresponding author address: Xiaoxi Wu, National Meteorological and Oceanographic Centre, Bureau of Meteorology, GPO Box 1289, Melbourne, Vic. 3001, Australia.
Email: x.wu@bom.gov.au

its own analysis. From the large number of objective verification results routinely produced, the statistics presented here cover only the MSLP and 500 hPa geopotential height fields over the irregular Australian verification area (Miao 2003). It is noted that this particular verification grid has southerly points that are outside the TXLAPS_PT375 domain and, hence, the TXLAPS_PT375 scores are not strictly comparable with those from GASP and LAPS_PT375. Also the results for the 0000 and 1200 UTC base times have been combined. For the locally run, limited-area models, the verified forecast periods go out to a maximum of 72 hours and for the global models to a maximum of 192 hours.

Review of performance – April to June 2008

Local models (GASP, LAPS, TXLAPS)

The intercomparison of the S1 skill scores of the MSLP forecasts for the three local models covering the period April to June 2008 is shown in Figure 1(a). The S1 skill-scores are averaged over the three-month period for various forecast periods ranging from 0 hour to 72 hours. S1 skill-score comparison of the 500 hPa geopotential height forecasts is shown in Fig. 1(b). In general, the coarser-resolution GASP generally outperforms the finer-resolution limited area

Fig. 1(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, LAPS_PT375 and TXLAPS_PT375 (April to June 2008).

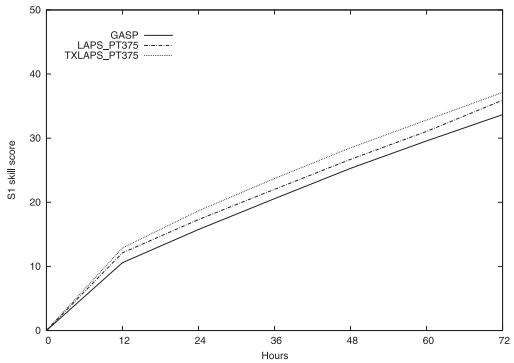


Fig. 1(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, LAPS_PT375 and TXLAPS_PT375 (April to June 2008).

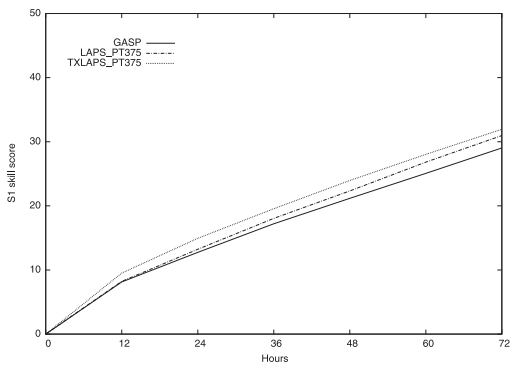


Fig. 2(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (April to June 2008).

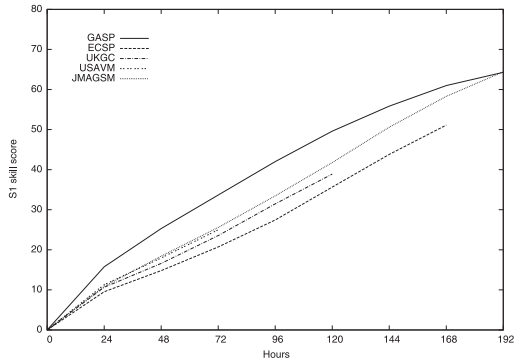
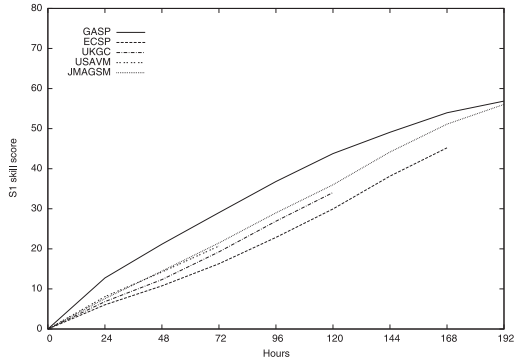


Fig. 2(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (April to June 2008).



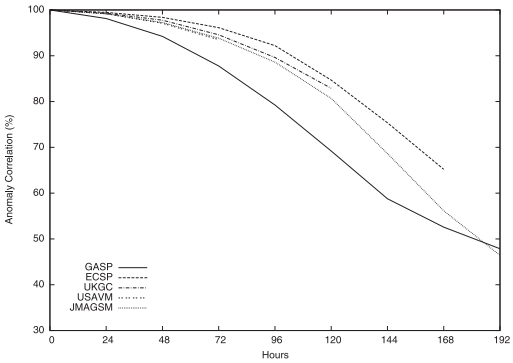
models. This result is partly due to the later data cut-off of the GASP assimilation. It is also due to the disadvantage suffered by the limited area models which obtain their initial first guess and boundary conditions from the earlier run of GASP forecasts. Forecasts from earlier runs tend to be poorer than forecasts from later runs. One other contributing factor for the better-than-expected scores for GASP is the verification method used here, which disadvantages finer resolution models through 'double penalty' scoring. For example, a location error of a deep low pressure system from a more realistic high-resolution forecast is counted once for misplacing the low where the verifying analysis does not have it and twice for not placing it where the verifying analysis does. Care needs to be taken to filter out scales below which a verification method was not intended to measure if models that are run at different resolutions are to be objectively compared.

Global models (GASP, ECSP, UKGC, USAVN, JMAGSM)

The Bureau of Meteorology's operational global spectral model, GASP, and the four global models from overseas NWP centres are used operationally by forecasters. The outputs from the models are also postprocessed to produce various objective guidance products used by users in and outside of the Bureau. Hence their forecast performance is of great interest to the forecasters and other users. The S1 skill scores for MSLP and 500 hPa geopotential height forecasts for the period April to June are presented in Figs 2(a) and 2(b). Anomaly correlations for the MSLP forecasts are shown in Fig. 3. All the global models are verified using a common 2.5 latitude/longitude grid except USAVN which is verified on a 2.5 latitude/5.0 longitude grid. However this use of coarser grid spacing for USAVN is not thought to have affected the intercomparison.

Assuming the commonly used cut-off of 60 per cent as the criterion for useful forecasts (Murphy and Epstein 1989), the anomaly correlation scores for the ECMWF show useful skill to beyond seven days, JMA also shows useful skill to around seven days and GASP around six days. The UKGC is marginally better than JMA and USAVN at the shorter lead times but clearly better than JMA in the longer term up to five days. It is interesting to note from Fig. 3 that both GASP and JMA MSLP forecasts at 192 hours exhibit similar skill, but below the 60 per cent threshold.

Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (April to June 2008).



Acknowledgments

Thanks are extended to Joan Fernon and Noel Davidson who provided the upgrade information for the local tropical models. The helpful comments from Terence Skinner are appreciated.

References

Lee, J. 2005. Quarterly numerical weather prediction model performance summary – July to September 2005. *Aust. Met. Mag., 54*, 253-61.

Miao, Y. 2003. Numerical prediction model performance summary July to September 2002. *Aust. Met. Mag., 52*, 73-5.

Murphy, A. and Epstein, E.S. 1989. Skill Scores and Correlation Coefficients in Model Verification. *Mon. Weath. Rev., 117*, 572-81.

Skinner, W. 1995. Numerical prediction model performance summary April to June 1995. *Aust. Met. Mag., 44*, 309-12.

Web reference

For ECMWF:

http://www.ecmwf.int/publications/newsletters

http://www.ecmwf.int/products/data/technical/model_id/index.html

For UKMO:

http://www.meto.gov.uk/research/nwp/publications

For NCEP:

http://www.emc.ncep.noaa.gov/gmb/STATS/html/model_changes.html

For JMA:

http://ddb.kishou.go.jp