Quarterly numerical weather prediction model performance summary – January to March 2008

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Introduction

This summary, covering the three-month period from January to March 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 January to March 2008 period

Local models

The Bureau's tropical region Extended Limited Area Prediction System (TXLAPS_PT375) was upgraded from a 51 to a 61 vertical-level version in the Darwin RSMC on 4 March 2008. This upgrade enables the use of higher quality global and direct readout (i.e. locally received and processed) ATOVS satellite radiance data from more satellite instruments during data assimilation, along with enhanced surface grid fields and physics.

Overseas models

Products from four global models run by overseas operational forecast centres are received in NMOC and are verified 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.

JMA revised the calculation procedure of the convective triggering scheme on 10 January, which corrected an excessive limitation on the cumulus mass flux.

On 11 March ECMWF introduced the modified Cycle 32r3 which integrated its Monthly Forecasting System with the medium-range Ensemble Prediction System (EPS). The main changes in this revision include the use of persisted SST anomalies in all atmospheric forecasts and daily ocean-coupling of days 10 to 15 of the 0000 UTC EPS forecast. Additionally, the monthly forecast is run once per week from 0000 UTC on a Thursday as an extension of the 15-day EPS forecast from this base time. The modified Extreme Forecast Index (EFI) products use the new unified re-forecasts and the new GRIB description for all Monthly Forecast products is analogous to the current medium-range EPS data. The changes will mainly affect the monthly forecasts, but some changes will also have an impact on the medium range, both the EPS and the deterministic forecasts.

For further information on the improvements made to overseas NWP assimilation and forecast models refer to web references given below. Details on 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 its own analysis. From the large number of

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objective verification results routinely produced, the statistics presented here cover only the mean sea level pressure (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 – January to March 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 January to March 2008 is shown in Fig. 1(a). The S1 skill scores are averaged over the three-month period for various forecast periods ranging from 0 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 models. This result is partly due to the longer 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 produced 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'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

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

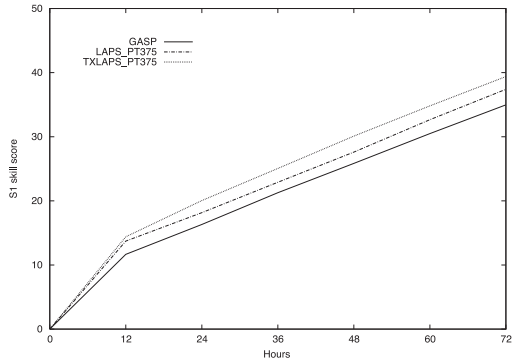
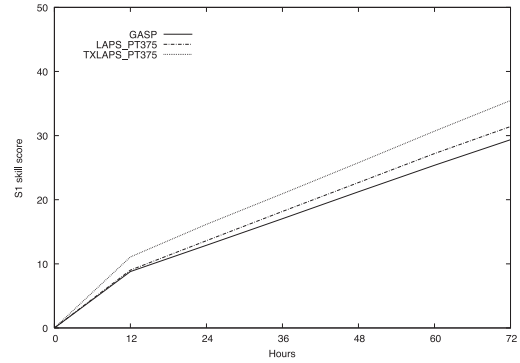


Fig. 1(b) 500 hPa geopotential height S1 skill score comparison, for different forecast periods, between GASP, LAPS_PT375, and TXLAPS_PT375 (January to March 2008).



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 January to March 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,

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

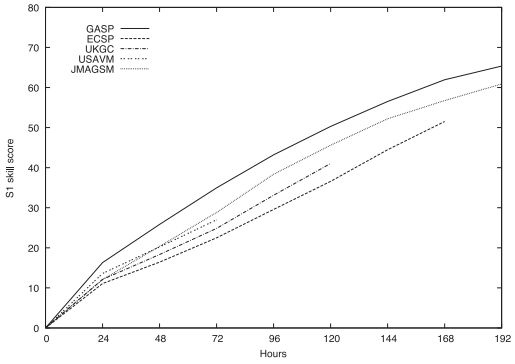


Fig. 2(b) 500 hPa geopotential height S1 skill score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (January to March 2008).

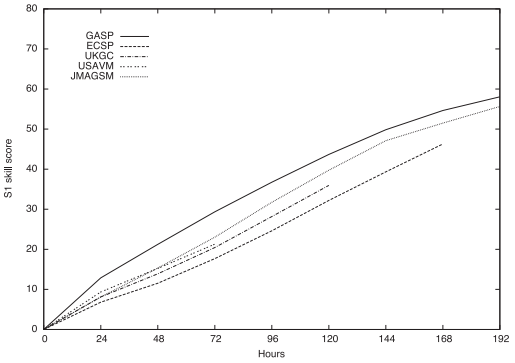
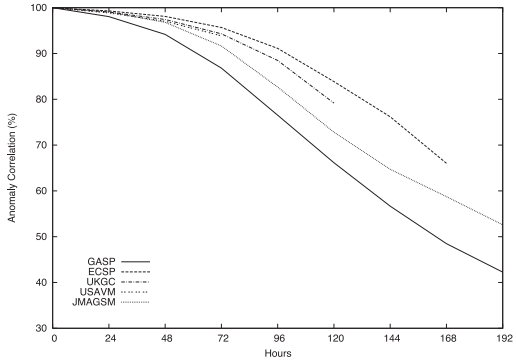


Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (January to March 2008).



JMA also shows useful skill to around seven days and GASP between five and six days. The UKGC is marginally better than JMA and USAVM at the shorter lead times but much better than JMA in the longer term up to five days.

Acknowledgments

The helpful comments from Terence Skinner are appreciated.

References

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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 and 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