Quarterly Numerical Weather Prediction Model Performance Summary – January to March 2015

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(Manuscript received June 2015; accepted December 2015)

Introduction

This summary, covering the three-month period from January to March 2015, continues the series reporting on the performances of NWP (Numerical Weather Prediction) models used operationally in the Australian Bureau of Meteorology.

NWP models – January to March 2015

Local Models

No changes have been reported for the Bureau's ACCESS systems during this verification period.

Details on the configurations of the Bureau's models are described in an earlier summary (Wu 2014). For more details about the ACCESS systems, please refer to http://www.bom.gov.au/australia/charts/bulletins/apob83.pdf, http://www.bom.gov.au/australia/charts/bulletins/apob90.pdf, http://www.bom.gov.au/australia/charts/bulletins/apob93.pdf, http://www.bom.gov.au/australia/charts/bulletins/apob99.pdf and http://www.bom.gov.au/nwp/doc/access/NWPData.shtml.

Overseas Models

The following four operational global models which are run by overseas forecast centres 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 National Centers for Environmental Prediction (NCEP) and Japan Meteorological Agency Global Spectral Model (JMAGSM) to the global assimilation and forecast model from JMA.

On 14 January 2015 NCEP operationally upgraded the global forecast and analysis system. This is a major upgrade and main changes include change in method from Elerian dynamics to Semi-Lagrangian dynamics; increase in model horizontal resolution from T574 (~27km) to T1534 (~13km); use of high resolution daily real time global SST (Sea Surface Temperature) instead of weekly optimal interpolation SST and use of daily sea ice analysis; conversion of GFS GSI (Geographic Information Systems to vertical structure; increase in GSI ensemble horizontal resolution from T254 to T574 and use of enhance radiance bias correction scheme.

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 forecast models are described in an earlier summary (Wu 2014).

Verification method

A description of the S1 skill-score, as applied in the Bureau, can be found in the paper by Skinner (1995). All results have been calculated within the Bureau, where each of the models was verified against its own analysis. From the large number

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of 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 the results for the 00 and 12 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 2015

Fig. 1 to Fig. 3 are the plots covering the verifying period from January to March 2015.

Local models (ACCESS-G and ACCESS-R)

The intercomparisons of the S1 skill scores of the MSLP forecasts for the two local models covering the verifying period January to March 2015 are shown in Figure 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 comparisons of the 500 hPa geopotential height forecasts are shown in Figure 1(b). In general, the coarser-resolution global model outperforms the finer-resolution limited area models. This result is partly due to the later data cut-off of the assimilation for the global models. 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 the global model 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 the global models 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.

Fig. 1(a) MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G and ACCESS-R (January to March 2015).

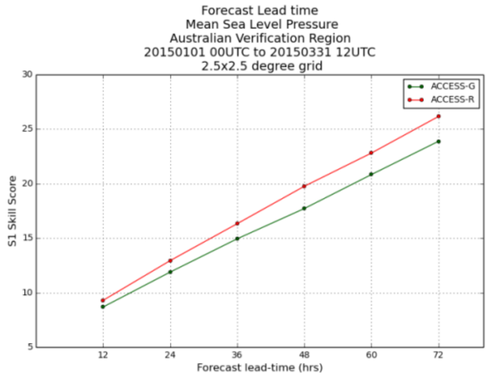
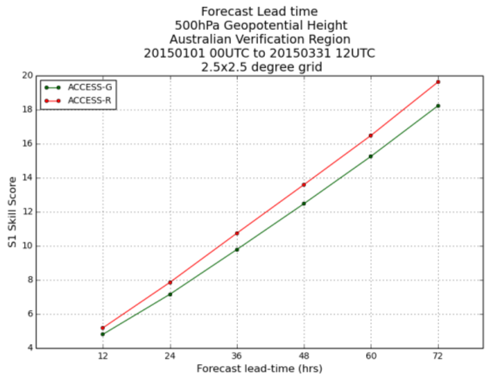


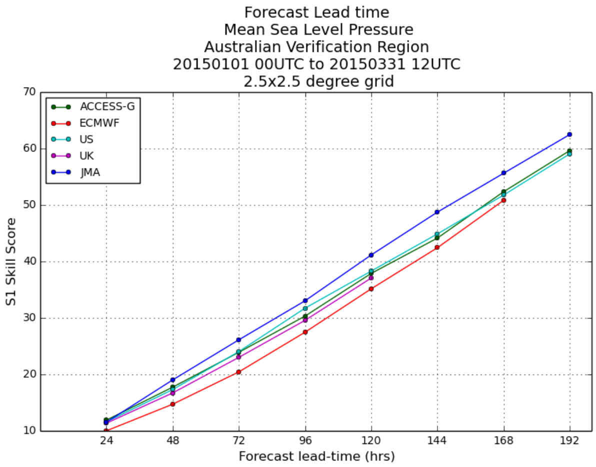
Figure 1(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G and ACCESS-R (January to March 2015).

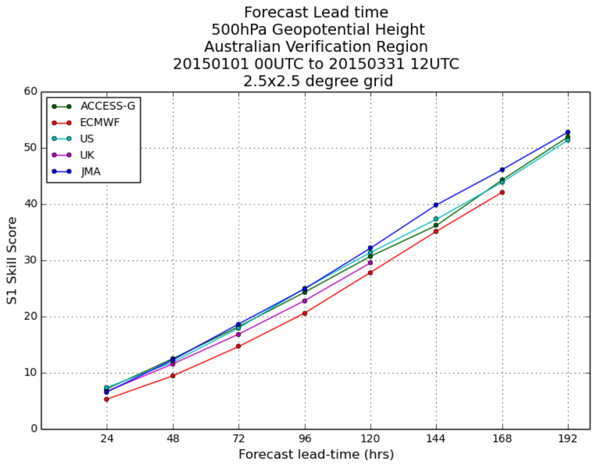


Global models (ACCESS-G, ECSP, UKGC, USAVN, JMAGSM)

The Bureau's new operational global spectral model ACCESS-G and the four global models from overseas NWP centres are operationally used by forecasters. The outputs from the models are also postprocessed to produce various objective guidance products used 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 2015 are presented in Figure 2. Anomaly correlations for the MSLP forecasts are shown in Figure 3.

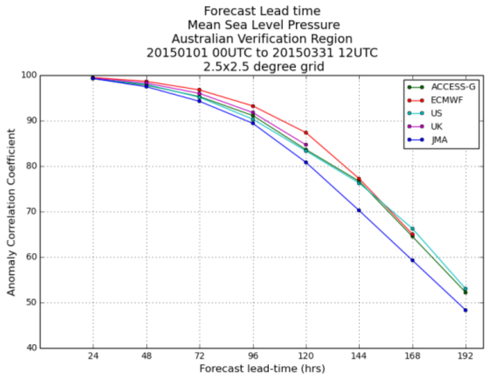
Figure 2 (left) MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN, and JMAGSM (January to March 2015), (right) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (January to March 2015).





Assuming the commonly used cut-off of 60% as the criterion for useful forecasts (Murphy and Epstein 1989), for the January to March 2015 period the anomaly correlation scores for ACCESS-G, ECMWF, JMAGSM and USAVN show useful skill to beyond six days. All the models have very similar skill at day one, then ACCESS-G has similar skill as USAVN at day two, day three, day five and day six, but performs slightly better than USAVN at day four. ECMWF and UKGC perform consistently better than other models from day two to day five. For the longer term ECMWF performs worse than USAVN at day seven which is very rare, although slightly better than ACCESS-G. JMAGSM has worst skill for all forecast hours from day two during this verification period.

Figure 3 Anomaly correlation of MSLP comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (January to March 2015).



References

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Miao, Y. 2003. Numerical prediction model performance summary July to September 2002. *Aust. Met. Mag*., *52*, 73-75.

Murphy, A. and Epstein E. S. 1989. Skill Scores and Correlation Coefficients in Model Verification. *Mon. Wea. Rev.*, 117, 572-581.

Skinner, W. 1995. Numerical prediction model performance summary April to June 1995. *Aust. Met. Mag*., *44*, 309-312.

Web reference:

For ECMWF:

http://www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model

For UKMO:

http://www.metoffice.gov.uk/research/modelling-systems/unified-model

For NCEP:

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

For JMA:

http://www.wis-jma.go.jp/ddb/latest_modelupgrade.txt

For ACCESS:

http://www.bom.gov.au/australia/charts/bulletins/apob83.pdf

http://www.bom.gov.au/australia/charts/bulletins/apob90.pdf

http://www.bom.gov.au/australia/charts/bulletins/apob93.pdf

http://www.bom.gov.au/australia/charts/bulletins/apob98.pdf

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