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Quarterly numerical weather prediction model performance summary—October to December 2011

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Introduction

This summary, covering the three-month period from October to December 2011, continues the series reporting on the performances of Numerical Weather Prediction (NWP) models used operationally in the Australian Bureau of Meteorology.

NWP models—October to December 2011

Local Models

The Bureau's tropical cyclone model ACCESS-TC was made operational on 11 November 2011. ACCESS-TC is the successor to the Bureau's old tropical cyclone model TCLAPS which was turned off in August 2010. For the details regarding ACCESS-TC, please refer to: http://www.bom.gov.au/australia/charts/bulletins/apob90.pdf

No changes have been reported for the Bureau's operational global model ACCESS-G and the limited area models ACCESS-R, ACCESS-T and ACCESS-A during this verification period.

Details on the configurations of the Bureau's models are described in an earlier summary (Wu and Bridge 2010). For more details about the ACCESS systems, please refer to: http://www.bom.gov.au/australia/charts/bulletins/apob83.pdf and http://www.bom.gov.au/nmoc/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 25 October 2011 JMAGSM increased the inner loop horizontal resolution from T159 (~80km) to TL319 (~60km).

On 15 Nov 2011 ECMWF introduced a new version of the NWP system called Cycle 37r3. The new cycle includes a collection of improvements to the forecast models and the data assimilation system. The cycle also contains hourly post-processing of model data to 90 hours in support of the BC (Boundary Conditions) Optional Programme. The main meteorological changes implemented in this cycle include modification of the entrainment/detrainment of convection; modification of the supersaturation and deposition rate for clouds; modification of the surface roughness; bias correction of aircraft temperature observations; cycling of stratospheric model error (for the weak-constraint 4D-Var); assimilation of accumulated rainfall from NEXRAD radar data from the United States; assimilation of ozone observations from infrared radiances; use of the latest version of the NWP-SAF (Satellite Application Facilities) radiative transfer model; and retuning of cloud detection for the advanced infrared sounder data.

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 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 ACCESS-T's southern domain boundary and, hence, the ACCESS-T scores are not strictly

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comparable with those from ACCESS-G/R. 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—October to December 2011

Figures 1 to 3 are the plots covering the verifying period from October to December 2011.

Local models (ACCESS-G, ACCESS-R, ACCESS-T)

The intercomparison of the S1 skill scores of the MSLP forecasts for the three local models covering the verifying period October to December 2011 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 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

Fig. 1(a) MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G, ACCESS-R and ACCESS-T (October to December 2011).

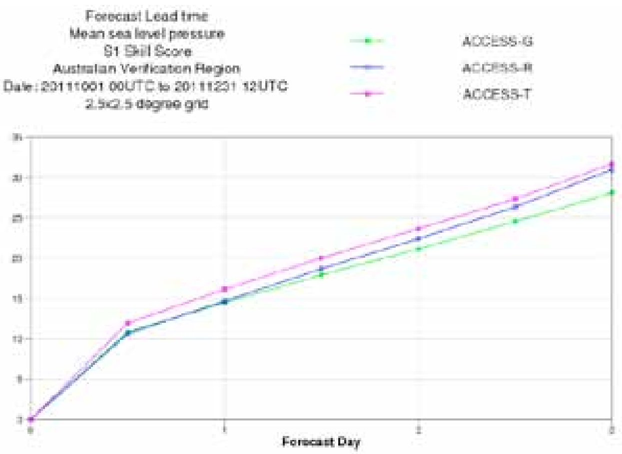


Fig. 1(b): 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G, ACCESS-R and ACCESS-T (October to December 2011).

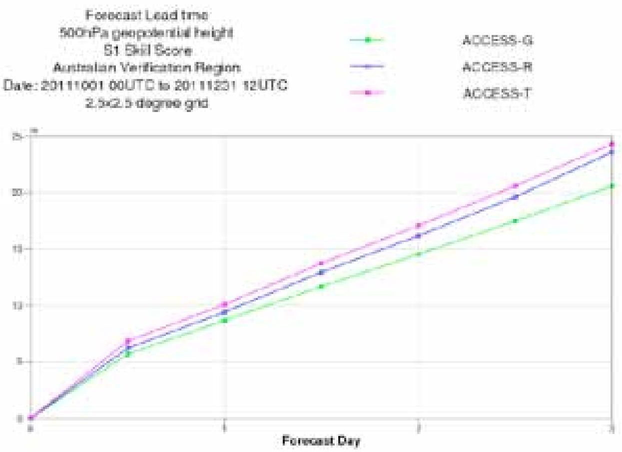


Fig. 2(a): MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN, and JMAGSM (October to December 2011).

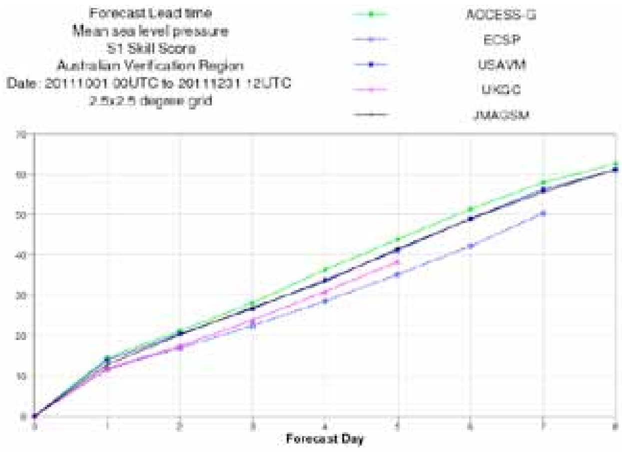
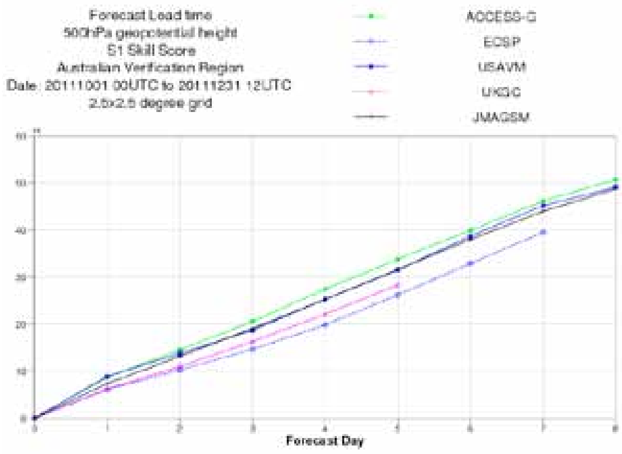


Fig. 2(b): 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (October to December 2011).



scales below which a verification method was not intended to measure if models that are run at different resolutions are to be objectively compared.

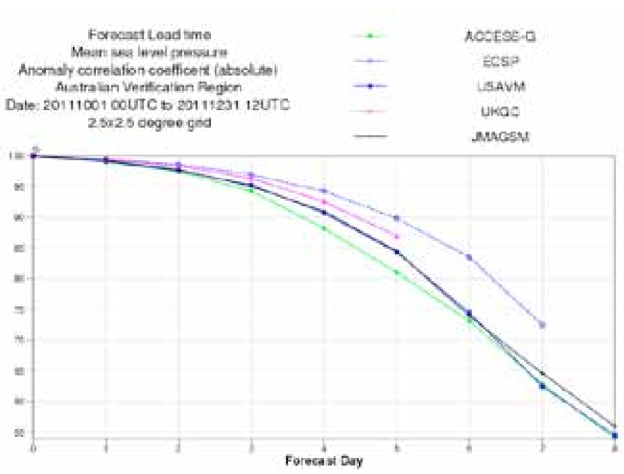
Global models (ACCESS-G, ECSP, UKGC, USAVN, JMAGSM)

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 October to December 2011 are presented in Figs 2(a) and 2(b). Anomaly correlations for the MSLP forecasts are shown in Fig. 3.

From this quarterly summary, the low resolution USAVN model at the 2.5° x 5.0° grid points has been replaced by the high-resolution model at 0.5°x0.5° grid points. With the same verification method as other models presented in this summary, the high-resolution US forecasts and analyses are regridded on the common 2.5° x 2.5° verification grid before the verification. It is then verified at the forecast hours up to 192 hours which is the same valid forecast period as ACCESS-G and JMAGSM.

Assuming the commonly used cut-off of 60 per cent as the criterion for useful forecasts (Murphy 1989), for the October to December 2011 quarter the anomaly correlation scores for the ACCESS-G, ECMWF, JMAGSM and USAVN show useful skill to beyond seven days. ACCESS-G has similar skill as JMAGSM and USAVN at the short term up to two days but becomes less skillful than those two models for the longer term up to six days, before becoming similarly skillful to USAVN again at day seven and day eight.

Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (October to December 2011).



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