Quarterly numerical weather prediction model performance summaries—October to December 2010 and January to March 2011

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Introduction
These summaries cover the two periods October to December 2010 and January to March 2011, and report on the performance of the Australian Bureau of Meteorology’s operational numerical weather prediction (NWP) models.

NWP models—October 2010 to March 2011
Local Models
No significant changes have been reported for the Bureau’s new global model, ACCESS-G, or the limited area models ACCESS-R, ACCESS-T and ACCESS-A during this verification period, apart from a new dewpoint parameterisation operationally implemented in ACCESS-R/ACCESS-T/ACCESS-A on 6 January 2011 to better handle the screen-level forecasts. Details on the configurations of the Bureau’s models are described in an earlier summary (Wu 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 9 November 2010 ECMWF introduced a new version of the NWP system called Cycle 36r4. The changes implemented in this system include a new cloud parameterization scheme with five prognostic variables on model levels: cloud fraction, cloud water, cloud ice, rain water content and snow water content. New surface analysis schemes were also introduced for snow and soil moisture.

On 1 November 2010 JMAGSM was upgraded by assimilating the Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) radio occultation data.

For further information on the improvements made to overseas NWP assimilation and forecast models refer to the 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 TXLAPS_PT375 and ACCESS-T’s southern domain boundary and, hence, the TXLAPS_PT375 and ACCESS-T scores are not strictly comparable with those from GASP, ACCESS-G/R 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.

All the 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 inter-comparison.

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Review of performance—October 2010 to March 2011

Figures 1 to 3 are the plots covering the verifying period from October to December 2010 and Fig. 4 to Fig. 6 are the plots from January to March 2011.

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

The intercomparisons of the S1 skill scores of the MSLP forecasts for the three local models covering the verifying period October to December 2010 and January to March 2011 are shown in Figs 1(a) and 4(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 Figs 1(b) and 4(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. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between ACCESS-G, GASP, ECSP, UKGC, USAVN and JMAGSM (October to December 2010).

Fig. 4(a) MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G, ACCESS-R and ACCESS-T (January to March 2011).

Fig. 4(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G, ACCESS-R and ACCESS-T (January to March 2011).

Fig. 5(a) MSLP S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN, and JMAGSM (January to March 2011).

Fig. 5(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (January to March 2011).

Fig. 6 Anomaly correlation of MSLP comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (January to March 2011).
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 2010 and January to March 2011 are presented in Figs 2(a), 2(b), 5(a) and 5(b). Anomaly correlations for the MSLP forecasts are shown in Figs 3 and 6.

Assuming the commonly used cut-off of 60 per cent as the criterion for useful forecasts (Murphy 1989), for the October to December 2010 quarter the anomaly correlation scores for the ACCESS-G, ECMWF and JMAGSM show useful skill to beyond seven days. ACCESS-G also shows useful skill beyond eight days. For the January to March 2011 quarter ECMWF shows useful skill to beyond seven days, ACCESS-G to seven days and JMAGSM to close to seven days. At short lead times, USAVN is marginally more skillful than ACCESS-G at three days for the October to December 2010 quarter and has similar skills as ACCESS-G at three days for the January to March 2011 quarter.

References

Web references
For ECMWF:
http://www.ecmwf.int/publications/newsletters
http://www.ecmwf.int/products/data/technical/model_id/index.html
For UKMO:
http://www.metoffice.gov.uk/research/nwp/publications/
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