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Quarterly numerical weather prediction model performance summary – April to June 2013

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Introduction

This summary, covering the three-month period from April to June 2013, continues the series reporting on the performances of numerical weather prediction (NWP) models used operationally in the Australian Bureau of Meteorology.

NWP models – April to June 2013

Local models

The Bureau's regional model ACCESS-R was operationally upgraded on 17 April 2013. The major changes in this upgrade include an improvement to the model grid spacing from 0.375° to 0.11° which is approximately 12 km; an increase in the number of model atmospheric levels from 50 to 70; an increase in remote sensing observation assimilation and the use of updated software. For further information regarding the ACCESS-R upgrade, please refer to www.bom.gov.au/australia/charts/bulletins/apob98.pdf

The Bureau's area model ACCESS-A was turned off on 8 May 2013, as the upgraded ACCESS-R combines the much higher spatial resolution of ACCESS-A over the larger domain of the old ACCESS-R and also incorporates upgraded model components.

The configurations of the operational ACCESS systems are summarised in Table 1. For more details about the ACCESS systems, please refer to:

- www.bom.gov.au/australia/charts/bulletins/apob83.pdf
- www.bom.gov.au/australia/charts/bulletins/apob90.pdf
- www.bom.gov.au/australia/charts/bulletins/apob93.pdf
- 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 25 June 2013 ECMWF introduced a new version of the NWP system called Cycle 38r2. The new cycle includes higher vertical resolution in the high resolution forecast and data assimilation system at 0000 and 1200 UTC runs and higher vertical resolution in the boundary conditions optional programme at 0600 and 1800 UTC runs. The number of model levels increases from 91 levels to 137 levels. The model top remains unchanged at 0.01 hPa.

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 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.

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Review of performance – April to June 2013

Figures 1 to 3 are the plots covering the verifying period from April to June 2013.

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 April to June 2013 are shown in Fig. 1(a). The S1 skill-scores are averaged over the three-month period for various forecast periods ranging from zero to 72 hours. S1 skill score comparisons of the 500 hPa geopotential height forecasts are 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 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, ACCESS-R and ACCESS-T (April to June 2013).

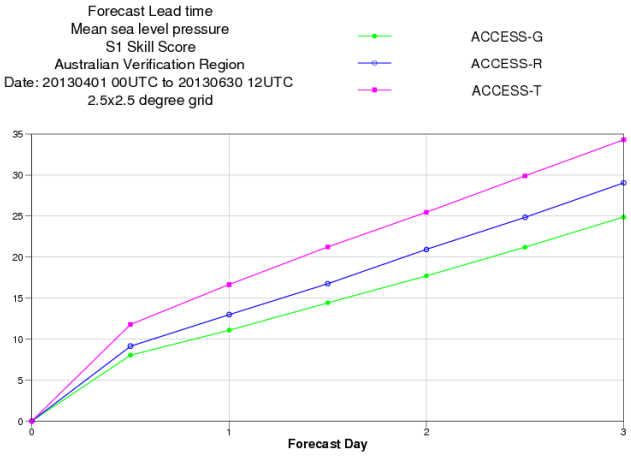


Fig. 1. (b) 500 hPa geopotential height S1 skill score comparison, for different forecast periods, between ACCESS-G, ACCESS-R and ACCESS-T (April to June 2013).

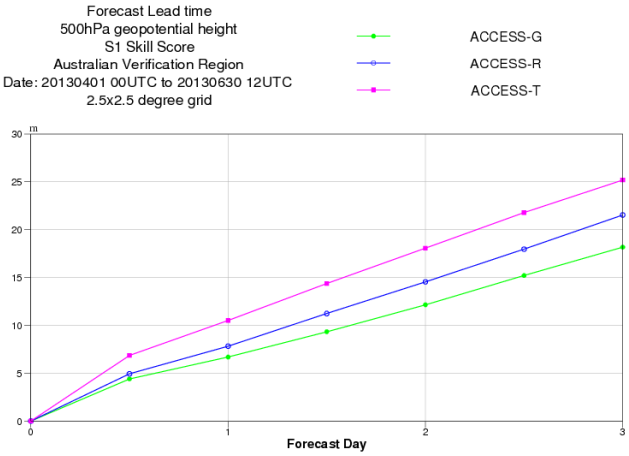


Fig. 2. (a) MSLP S1 skill score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN, and JMAGSM (April to June 2013).

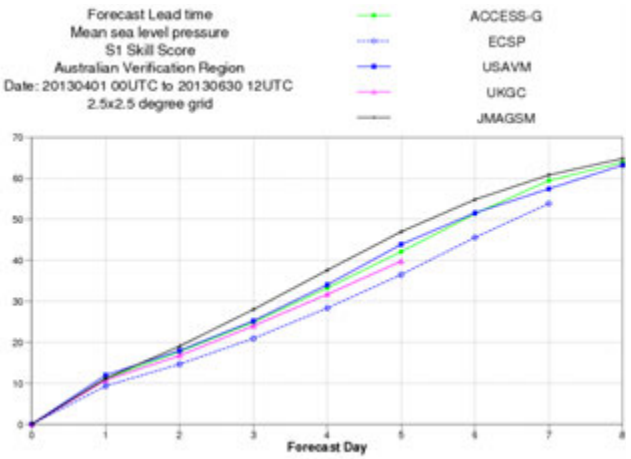


Fig. 2. (b) 500 hPa geopotential height S1 skill score comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (April to June 2013).

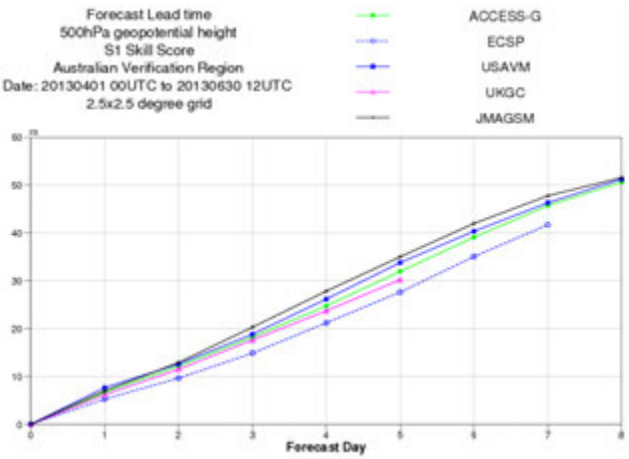
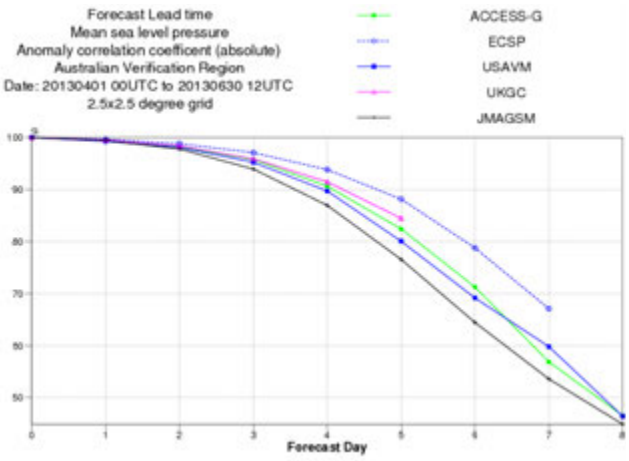


Table 1. Configurations of the operational ACCESS systems.

NWP system	*Domain*	*Type*	*Resolution*	*Domain limits S–N, W–E (lat. × long.)*	*Duration (hours)*	*Runs (UTC)*
ACCESS-G	Global	Assim + Forc	N320 0.375° × 0.5625° (~40km)	90.00°S to 90.00°N, 0.00°E to 359.44°E (481 × 640)	+240 +78	00, 12 06, 18
ACCESS-R	Regional	Assim + Forc	0.11° (~12 km)	65.00°S to 16.95°N, 65.00°E to 184.57°E (746 × 1088)	+72	00, 06, 12, 18
ACCESS-T	Tropical	Assim + Forc	0.375° (~37.5 km)	45.00°S to 55.875°N, 60.00°E to 217.125°E (270 × 420)	+72	00, 12
ACCESS-C	Brisbane	Forc	0.05° (~5 km)	31.00°S to 22.05°S, 148.00°E to 155.95°E (180 × 160)	+36	+36
	Perth	Forc	0.05° (~5 km)	37.00°S to 28.05°S, 112.00°E to 119.95°E (180 × 160)		
	Adelaide	Forc	0.05° (~5 km)	39.50°S to 30.55°S, 132.00°E to 141.95°E (180 × 200)		
	VICTAS	Forc	0.05° (~5 km)	46.00°S to 34.05°S, 139.00°E to 150.95°E (240 × 240)		
	Sydney	Forc	0.05° (~5 km)	38.00°S to 30.05°S, 147.00°E to 154.95°E (160 × 160)		
ACCESS-TC	Tropical Cyclone	Assim + Forc	0.11° (~12 km)	Relocatable within the ACCESS-T domain: (300 × 300)	+72	00, 12

Fig. 3. Anomaly correlation of MSLP comparison, for different forecast periods, between ACCESS-G, ECSP, UKGC, USAVN and JMAGSM (April to June 2013).



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 April to June 2013 are presented in Figs 2(a) and 2(b). Anomaly correlations for the MSLP forecasts are shown in Fig. 3.

Assuming the commonly used cut-off of 60 per cent as the criterion for useful forecasts (Murphy and Epstein 1989), for the April to June 2013 period the anomaly correlation scores for the ACCESS-G, ECMWF, JMAGSM and USAVN show useful skill to beyond six days. All the verified models have similar skills for the first two forecast days. ACCESS-G consistently performs better than JMAGSM from day three to day eight and is more skillful than USAVN for the longer term up to six days, but is less skillful than ECSP in the longer term.

References

Wu, X. 2012. Quarterly numerical weather prediction model performance summary – January to March 2012. *Aust. Met. Oceanogr. J., 62,* 111–3.

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

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

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

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

Web reference:

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