

Quarterly numerical weather prediction model performance summary - April to June 2006

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Introduction

This summary, covering the three-month period from April to June 2006, continues the series reporting on the performances of numerical weather prediction (NWP) models used operationally in the Australian Bureau of Meteorology.

Verified NWP models and their upgrades during the April to June 2006 period

Local models

On 19 April 2006 an upgrade to the Tropical eXtended Area Prediction System TXLAPS_PT375 was made. The number of vertical sigma levels of the model was increased from 29 to 51. Several sigma levels were added to the top of the model atmosphere so that the model lid was raised from approximately 50 to 10 hPa. Additional sigma levels were added at various heights of the model atmosphere, where large vertical gradients of meteorological fields are commonly found. These include the top of the planetary boundary layer and the tropopause. Other configurations of the analysis and model components remained essentially unchanged. The Bureau's other limited area model that is verified in this article, Limited Area Prediction System (LAPS_PT375) underwent a similar upgrade on 3 May 2006; the vertical levels of the model also increased to 51 levels with the placement of the levels exactly matching that of TXLAPS_PT375. No significant upgrade to the Bureau's global model, Global Analysis and Prediction (GASP) has been reported during this verification period.

Overseas models

Products from four global models run by overseas operational NWP centres are received in the National Meteorological and Oceanographic Centre

(NMOC) and are verified in this article. For this article, ECSP refers to the European Centre for Medium range Weather Forecasts (ECMWF) system, UKGC to the Unified Model from the UK Met Office, USAVN to the Global Forecast System (GFS) from the National Centers for Environmental Prediction (NCEP) and JMAGSM to the global assimilation and forecast model from the Japan Meteorological Agency (JMA).

Except JMAGSM, which announced an upgrade to its assimilation of satellite radiance, no significant improvements were reported from other overseas operational NWP centres. For minor improvements made to other overseas NWP models refer to web references given below. Details on the configurations of the assimilation and forecast models are contained in an earlier summary (Lee 2005).

Verification method

A description of the S1 skill-score, as applied in NMOC, can be found in an earlier article (Skinner 1995). All results have been calculated within NMOC Melbourne, where each of the models was verified against its own analyses. 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 domain and, hence, the TXLAPS_PT375 scores are not strictly compatible 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 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 – April to June 2006

Local models (GASP, LAPS, TXLAPS)

The intercomparison of the S1 skill-scores of the MSLP forecasts for the three local models is shown in Fig. 1(a). Figure 1(b) shows similar scores for 500 hPa geopotential height. The relative performance among the three models follows the long-term trend, the coarser-resolution GASP outperforming the finer-resolution limited area models. This result is partly due to longer data cut-off of the GASP assimilation. It's also due to the disadvantage suffered by the limited area models which obtain their initial first guess and boundary conditions from earlier runs

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 the '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 which are run at different resolutions are to be objectively compared.

Fig. 1(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, LAPS_PT375, and TXLAPS_PT375 (April to June 2006).

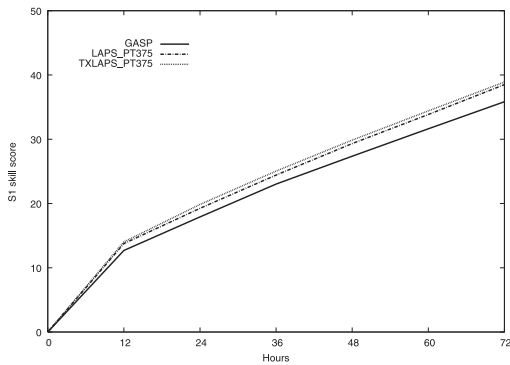


Fig. 1(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, LAPS_PT375, and TXLAPS_PT375 (April to June 2006).

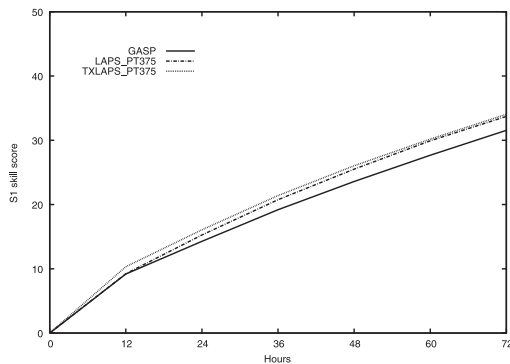


Fig. 2(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN, and JMAGSM (April to June 2006).

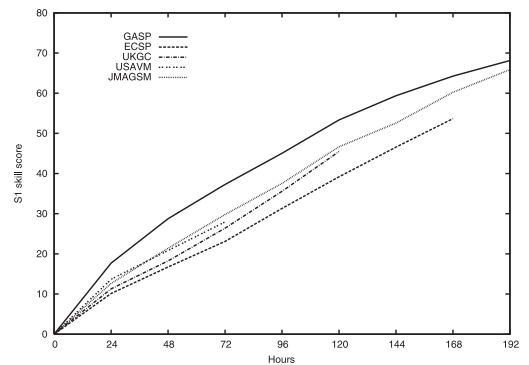
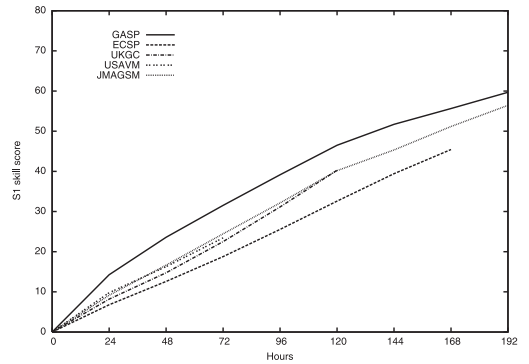


Fig. 2(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (April to June 2006).



Global models (GASP, ECSP, UKGC, USAVN, JMAGSM)

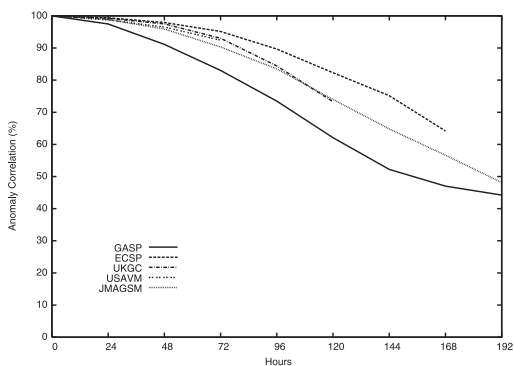
The Bureau's own operational global spectral model, GASP, and the four global models from overseas NWP centres are operationally used by forecasters. The outputs from the models are also postprocessed to produce various objective guidance products for users within and outside the Bureau. Hence their forecast performance is of great interest to the forecasters and other users. The S1 skill-scores for MSLP and 500 hPa geopotential height forecasts 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 and longitude grid except USAVN, which is verified on a 2.5° latitude by 5.0° longitude grid. However this use of coarser grid spacing for USAVN is not thought to have affected the intercomparison.

In this quarter, the forecast performance of the global models follow the trend established in the past. JMAGSM forecast model continues to show a skill advantage over the USAVN model at shorter lead-times. UKGC has maintained a small but discernible relative skill over USAVN. This is a continuation of past trend which appears to have begun when UKMO implemented the 4DVAR data assimilation scheme in the UKGC model.

References

- Lee, J. 2005. Quarterly numerical weather prediction model performance summary – July 2005 to September 2005. *Aust. Met. Mag.*, 54, 253-61.
- Miao, Y. 2003. Numerical prediction model performance summary July to September 2002. *Aust. Met. Mag.*, 52, 73-5.
- Skinner, W. 1995. Numerical prediction model performance summary April to June 1995. *Aust. Met. Mag.*, 44, 309-12.

Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (April to June 2006).



Web reference:

For ECMWF:

<http://www.ecmwf.int/publications/newsletters>

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

For UKMO:

http://www.metu.gov.uk/research/nwp/publications/nwp_gazette/index.html

For NCEP:

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

For JMA:

<http://ddb.kishou.go.jp>