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Quarterly numerical weather prediction model performance summary - July to September 2006

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Introduction

This summary, covering the three-month period from July to September 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 July to September 2006

Local models

On 14 September 2006 the ozone and UV system, which makes use of Global Analysis and Prediction (GASP) output, was upgraded. The improvement included increased horizontal resolution of the ozone analysis and forecast systems from R53L33 to T79L33. More sophisticated mid-stratospheric ozone retrieval was also introduced.

There have been minor changes to the Bureau's limited area models, LAPS_PT375 and TXLAPS_PT375 during this verification period. However no significant upgrade has been reported.

Overseas models

Products from four global models run by overseas operational NWP centres are received by 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 Forecast (ECMWF) system, UKGC to the Unified Model from United Kingdom Meteorological Office (UKMO), USAVN to Global Forecasting System (GFS) from National Centers for Environmental Prediction (NCEP) and JMAGSM to the global assimilation and forecast model from the Japan Meteorological Agency (JMA).

On 12 September ECMWF reported changes to the ECSP model physics and its radiance assimilation. NCEP also announced changes to its operational model, USAVN, during this period. No new upgrades were announced either for JMAGSM or for UKGC. For further information on the improvements made to overseas NWP assimilation and forecast models refer to web reference 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 by 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, 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 July to September 2006

Local models (GASP, LAPS, TXLAPS)

The intercomparison of the S1 skill-scores of the MSLP forecasts for the local models is shown in Fig. 1(a). Figure 1(b) shows similar scores for 500 hPa geopotential height. The relative performance among the models follows the long-term trend, the coarser-resolution GASP generally 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 an earlier run 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 (July to September 2006).

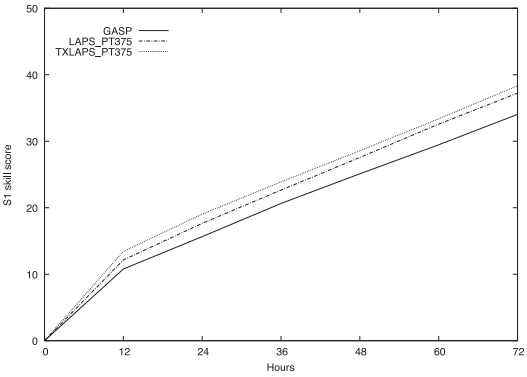


Fig. 1(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, LAPS_PT375, and TXLAPS_PT375 (July to September 2006).

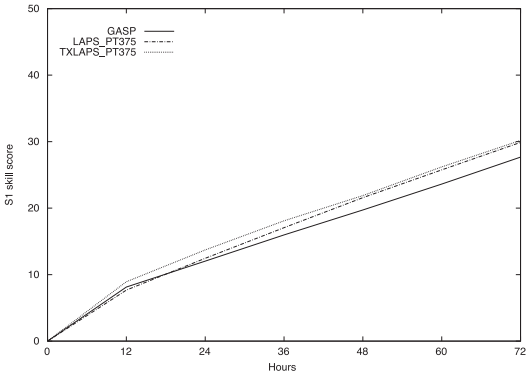


Fig. 2(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN, and JMAGSM (July to September 2006).

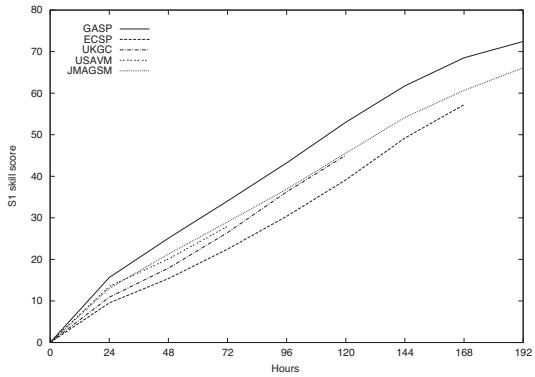


Fig. 2(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (July to September 2006).

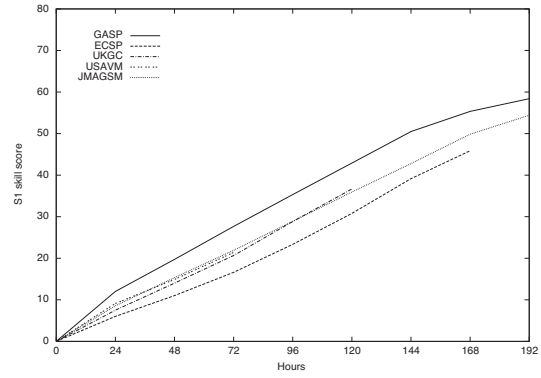
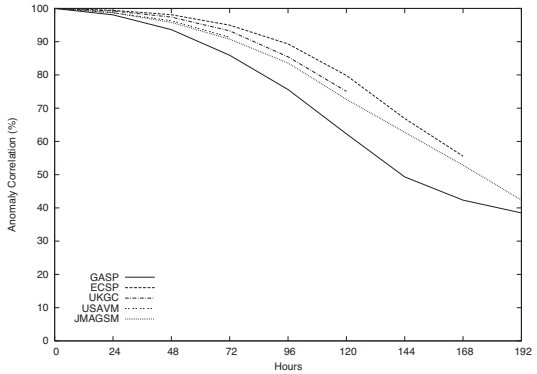


Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between GASP, ECSP, UKGC, USAVN and JMAGSM (July to September 2006).



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

The Bureau's operational global spectral model, GASP, and the four global models from overseas NWP centres are operationally used by forecasters. The outputs from these models are also postprocessed to produce various objective guidance products for users within 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 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 by longitude grid except USAVN which is verified on a 2.5° latitude by 5.0° longitude grid. However the coarser grid spacing for USAVN is not thought to have affected the intercomparison.

In this quarter, the performance of the global models' forecasts follow the trend established in the past. JMAGSM forecast model continues to show skill advantage over the USAVN model at shorter leadtimes. Also notable is the performance of the UKGC model which continues to show better skill over USAVN. The improvement of UKGC model is thought to have begun when UKMO implemented the 4DVAR data assimilation scheme in their model.

References

Lee, J. 2005. Quarterly numerical weather prediction model performance summary – July 2005 to September 2005. Aust. Met. Mag., 54, 253-261.

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

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

Web references

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

For UKMO: http://www.meto.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