Numerical weather prediction model performance summary January to March 2004

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Introduction

This summary, covering the three-month period January to March 2004, continues the series reporting on the performances of numerical weather prediction (NWP) models used operationally in the Australian Bureau of Meteorology.

NWP models verified

The models considered in this performance summary are from the NMOC (National Meteorological and Oceanographic Centre) in Melbourne, ECMWF (European Centre for Medium-range Weather Forecasts), NCEP (National Centers for Environmental Prediction, USA), UKMO (Met Office, United Kingdom) and JMA (Japan Meteorological Agency).

Three local models, from NMOC, are considered, *viz*.: LAPS (Limited Area Prediction System) – run over the Australian region on a 0.375° latitude/longitude grid, with 29 vertical levels, and using one-dimensional variational retrievals (1DVAR) and multivariate statistical interpolation in the assimilation; TLAPS (Tropical Limited Area Prediction System) – run over an extended tropical domain on a 0.375° latitude/longitude grid, with 29 vertical levels, and multivariate statistical interpolation in the analysis; and GASP (Global ASsimilation and Prediction) – run over a global domain at the triangular spectral truncation resolution T239 in the horizontal, and 29 levels in the vertical, together with 1DVAR and multivariate statistical interpolation in the assimilation.

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The following four overseas global models are included in the comparisons (where the associated acronyms, used in the figures below, are shown in parentheses): ECMWF Assimilation and Spectral Model (ECSP) – run at the resolution: T511 and 60 levels, with a 4DVAR multivariate analysis procedure; NCEP Global Forecast System (USAVN) – run at T254 and 64 levels (for the forecast times processed below), with 3DVAR and a multivariate Spectral Statistical Interpolation analysis scheme; UK Meteorological Office Grid Point model (UKGC) – run on a 0.56° latitude/0.83° longitude grid and 38 levels, with a 3DVAR analysis scheme; and JMA Global Spectral Model (JMAGSM) – run at T213 and 40 levels, with a 3DVAR assimilation scheme.

Recent changes to the NWP models

The basic configuration features for the local and overseas models, as delineated above, remained unchanged during the period January to March 2004, staying the same as those specified in the previous summary (Stewart 2004).

Local models

During the January to March 2004 quarter, it is noted that the main development work in NMOC was that associated with preparatory conversion work for the move of operational systems to the new Central Computing Facility (CCF).

Overseas models

Notes on operational upgrades and changes to the overseas models can be found on their respective centre web sites:

- ECMWF: http://www.ecmwf.int/publications/newsletters
- JMA: http://www.jma.go.jp/JMA_HP/jma/jma-eng/jma-center/nwp/nwp-top.htm
- NCEP: http://wwwt.emc.ncep.noaa.gov/gmb/STATS/html/model_changes.html
- UKMO: http://www.metoffice.com/research/nwp/publications

In addition, annual summaries, covering the operational models from NMOC and the overseas centres, can be found on the WMO site: http://www.wmo.ch/web/www/DPS/Annual-Tech-Progress.

During the period, the ECMWF moved to a new version (*viz*. Cycle 28r1) of their model which included, among other things, improved use of the GOES BUFR winds. Also, NCEP made some changes to their parametrisation of airflow over mountains.

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 500 hPa geopotential height and mean sea-level pressure (MSLP) fields over the irregular Australian verification area (Miao 2003). It is noted that this particular verification grid has southerly points that are outside the TLAPS domain and, hence, the TLAPS scores are not strictly compatible with those from GASP and LAPS. The results for the 0000 and 1200 UTC base-times have been combined. The results are presented, at this stage, for forecast periods out to a maximum of 192 hours.

The NMOC limited area operational models are run several hours before GASP (for a given base date-time). This earlier data cut-off could affect their skill relative to GASP. Also, the US, UK and JMA models run with a short data cut-off time of about three hours, compared with seven hours for GASP and ten hours for ECMWF, which again makes the intercomparison not strictly compatible.

Review of performance – January to March 2004

Local models (GASP, TLAPS, LAPS)

The MSLP verification intercomparison, between the local models for the January to March quarter (Fig. 1(a)), shows that LAPS performed better than either GASP or TLAPS for the 48-hour period shown. The 500 hPa geopotential height S1 skill-scores (Fig. 1(b)) show that GASP performed better than the limited area models for forecast periods beyond 24 hours.

Fig. 1(a) MSLP S1 skill-score comparison, for different forecast periods, between LAPS, TLAPS and GASP (January to March 2004).

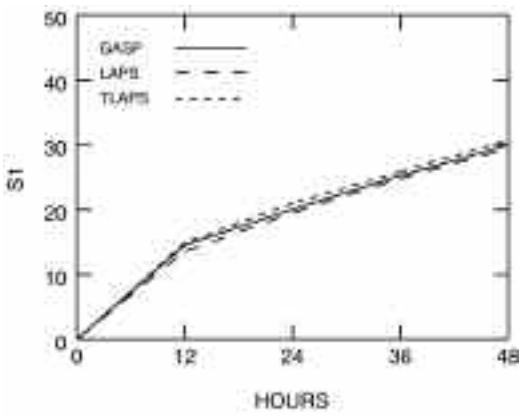
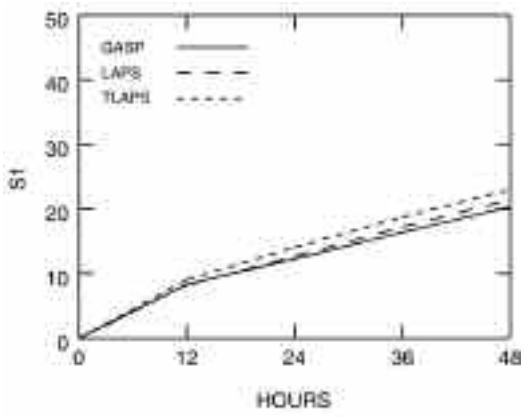


Fig. 1(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between LAPS, TLAPS and GASP (January to March 2004).



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

For the January to March quarter (Fig. 2), the ECMWF (ECSP) continues to perform better than the other global systems, at least when using S1 skill-scores for MSLP and 500 hPa geopotential height. Figure 3, which shows the anomaly correlation results for MSLP, again highlights the leading performance

Fig. 2(a) MSLP S1 skill-score comparison, for different forecast periods, between GASP, ECSP, USAVN, UKGC and JMAGSM (January to March 2004).

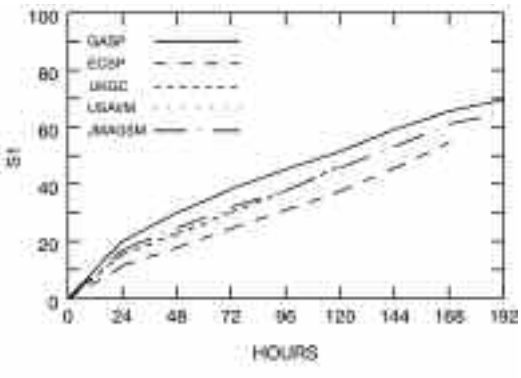


Fig. 2(b) 500 hPa geopotential height S1 skill-score comparison, for different forecast periods, between GASP, ECSP, USAVN, UKGC and JMAGSM (January to March 2004).

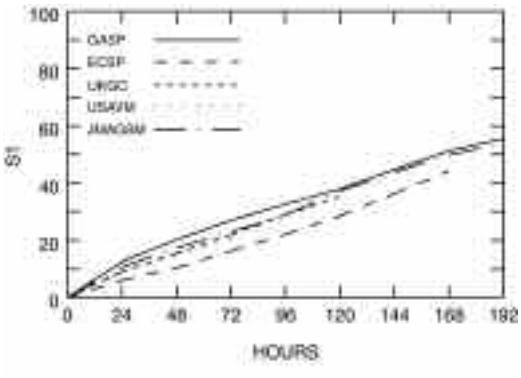
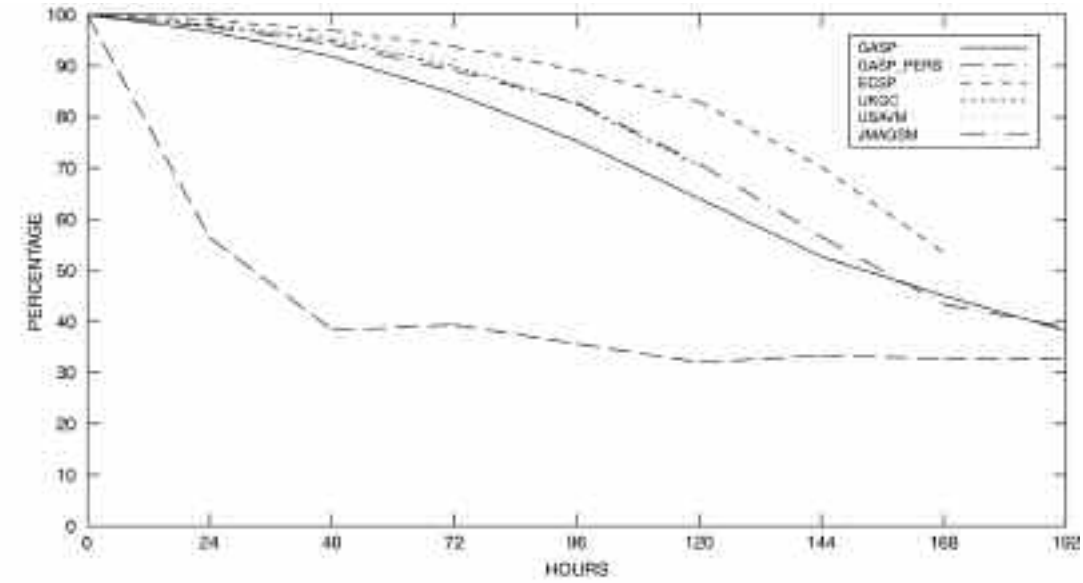


Fig. 3 Anomaly correlation of MSLP comparison, for different forecast periods, between GASP, ECSP, USAVM, UKGC and JMAGSM (January to March 2004).



of the ECMWF system with respect to the other global systems. (It is noted that 'PERS' refers to persistence in Fig. 3.) Assuming the commonly used cut-off of 60 per cent as the criterion for useful forecasts, it is seen that, of the models processed, the ECMWF consistently produced useful guidance out to at least six days, approximately one day more than the GASP and JMA systems. These observations on the relative performance of the global models are consistent with the previous summary (Stewart 2004).

References

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