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Numerical prediction model performance summary October to December 1995

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Introduction

This summary continues the series comparing the performances of numerical weather prediction (NWP) models for a three-monthly period.

Models and methods

Explanations of the National Meteorological Centre (NMC), Melbourne, NWP models and global models from other operational centres, together with Australian verification methods, can be found in a previous article (Skinner 1995). The three models considered from NMC Melbourne are: RASP (Regional Assimilation and Prognosis), TAPS (Tropical Analysis and Prediction System) and GASP (Global Assimilation and Prediction). Overseas global models included in the comparisons are: ECSP (European Centre for Medium Range Weather Forecasts (ECMWF) Spectral Assimilation), USAVM (National Centers for Environmental Prediction (NCEP), Washington, Spectral model for aviation) and UKGC (UK Meteorological Office Grid PE model).

All verification entities have been calculated within NMC Melbourne, and models were verified against their own analyses. Quoted results apply to the irregular Australian verification area only.

RASP and TAPS models were run several hours earlier than GASP and this premature data cutoff, particularly for satellite information, adversely affected their measured skill against GASP.

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Notes on NWP systems

GASP

A new version of Melbourne's Global Assimilation and Prediction System (GASP) was implemented from the 0000 UTC run on 12 December 1995. The new system has essentially the same horizontal and vertical resolution as the system it replaced, but includes several revised features.

The main changes are:

- replacement of the Kuo moist convection scheme with the Tiedkte mass flux scheme aimed at improving GASP's convection and reducing its tendency to overdevelop tropical lows;
- new moisture analysis;
- improvements in the radiative transfer calculations;
- conversion from rhomboidal R53 to triangular T79 truncation; and
- use of different grids for the analysis and prediction components including the option of thinned grids at high latitudes.

US

The following major changes to the US global NWP system were implemented on 25 October 1995:

- direct use of cloud-cleared radiances in the analysis system, rather than a prior retrieval to a profile of temperature and moisture;
- inclusion of near-surface winds from ERS-1 scatterometer data in the analysis;
- a change in the divergence increment constraint in the analysis, to reduce a small error in the amplitude of the semidiurnal atmospheric tide in the tropics;
- changes in the Arakawa-Schubert type of parametrisation of deep moist convection to control the too widespread coverage of small amounts of precipitation and occasional 'bull's eyes' of intense precipitation; and
- revised planetary boundary-layer scheme (Pan et al. 1995).

UK

A change to the horizontal diffusion scheme was made in the global model on 20 June 1995. The change effectively switches off the diffusion over steep terrain where the model levels are strongly sloping. In this situation, the diffusion, which had been intended to operate along model levels, was in fact mixing significantly between model levels. Benefits of the change were seen to be:

- reduction of model noise at high latitudes, especially near Greenland and Antarctica;
- improved upper-level winds, especially near 200 hPa and 250 hPa, with the largest effect downstream of the Himalayas and Andes;
- more realistic rainfall over high terrain including the Andes and New Guinea; and
- reduction of systematic errors, such as a reduction in the strength of the Hadley cell.

There has been a slight degradation of height forecasts in the tropics, caused by a small increase in the MSLP bias (UK Met. Office 1995).

Fig. 1(a) Comparison for RASP/TAPS/GASP from October to December 1995. S1 skill scores at MSLP for combined base-times 0000 UTC/1200 UTC and intervals +12, +24, +36, +48 h over the irregular Australian verification grid.

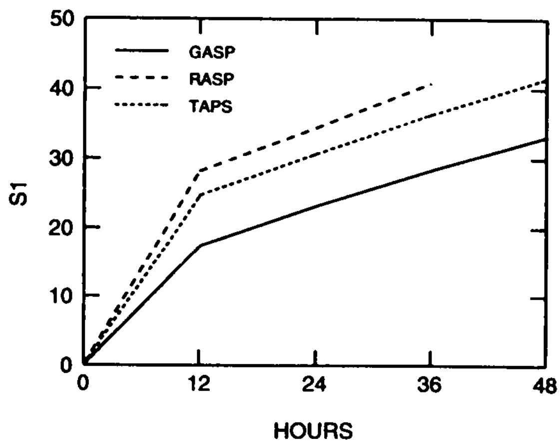


Fig. 1(b) Comparison for RASP/TAPS/GASP from October to December 1995. Rms errors at MSLP for combined base-times 0000 UTC/1200 UTC and intervals +12, +24, +36, +48 h over the irregular Australian verification grid.

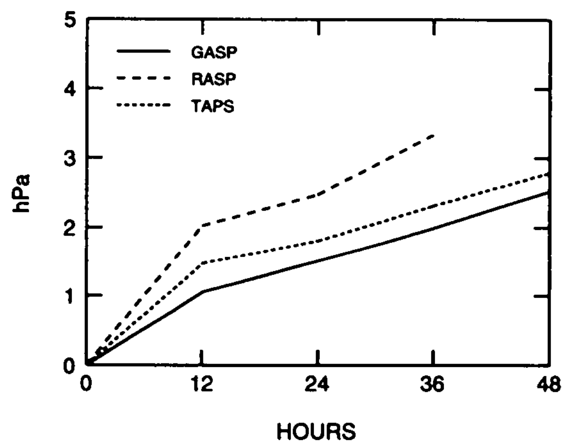


Fig. 1(c) Comparison for RASP/TAPS/GASP from October to December 1995. S1 skill scores at 500 hPa for combined base-times 0000 UTC/1200 UTC and intervals +12, +24, +36, +48 h over the irregular Australian verification grid.

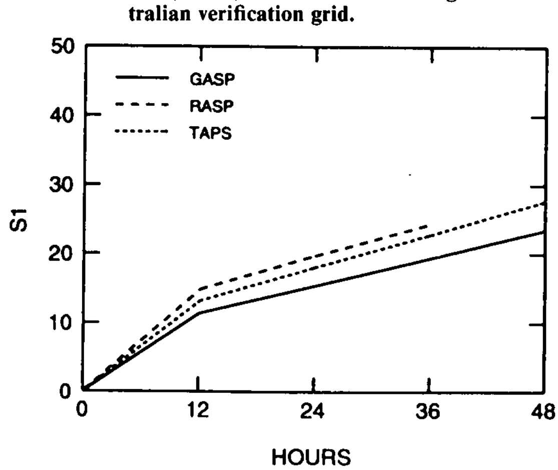
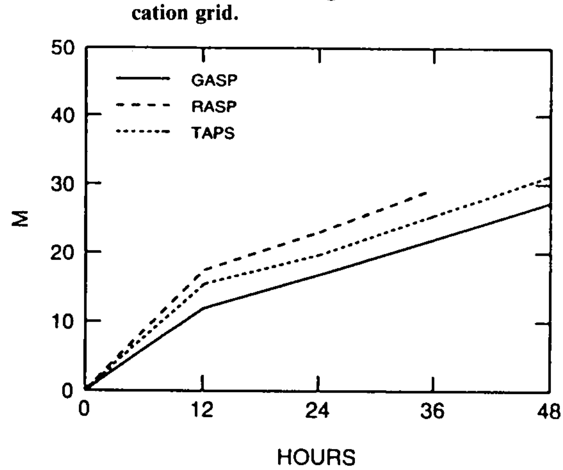


Fig. 1(d) Comaprison for RASP/TAPS/GASP from October to December 1995. Rms errors at 500 hPa for combined base-times 0000 UTC/1200 UTC and intervals +12, +24, +36, +48 h over the irregular Australian verification grid.



October to December 1995 intercomparisons

Local models: (RASP, TAPS, GASP)

In the three months to December, GASP at MSLP was a better prediction than RASP by at least 24 hours and better by about 20 hours than TAPS (Fig. 1(a)). GASP's superiority at 500 hPa was less marked, with a maximum improvement of GASP over RASP of about 16 hours, i.e. GASP +48 h had the same skill score as RASP interpolated to +32 h (Fig. 1(c)). Compared with the preceding three months, RASP showed a decrease in skill while TAPS and GASP remained much the same. In October, when strong pressure gradients at high latitudes were typical, GASP outperformed RASP by more than usual (Fig. 3(a)).

The TAPS grid does not cover the southernmost part of the verification grid and so direct comparisons in this case are inconclusive.

oot mean square (rms) errors showed GASP to outscore RASP by similar margins but the

Fig. 2(a) **Comparison for GASP/EC/US/UK from October to December 1995. S1 skill scores at MSLP for combined base-times 0000 UTC/1200 UTC and intervals +24 h to +168 h over the irregular Australian verification grid.**

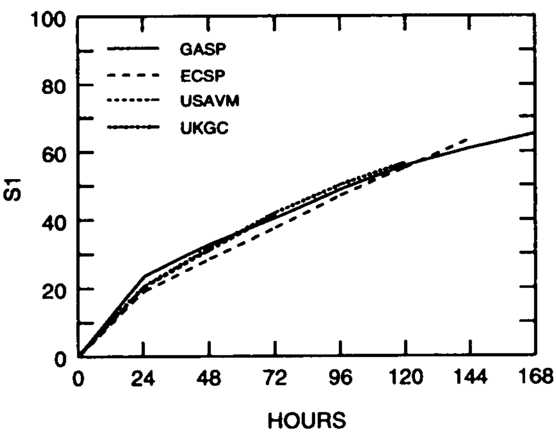


Fig. 2(b) **Comparison for GASP/EC/US/UK from October to December 1995. Rms errors at MSLP for combined base-times 0000 UTC/1200 UTC and intervals +24 h to +168 h over the irregular Australian verification grid.**

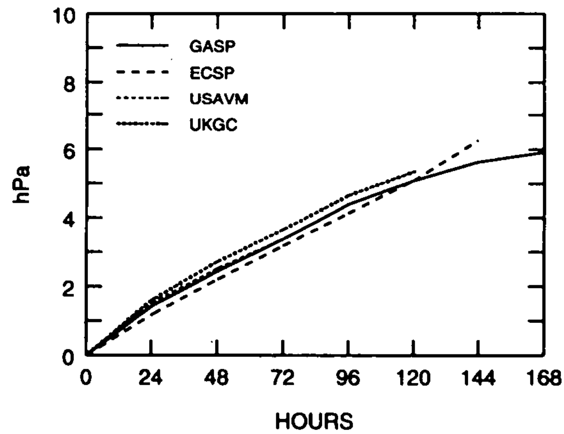
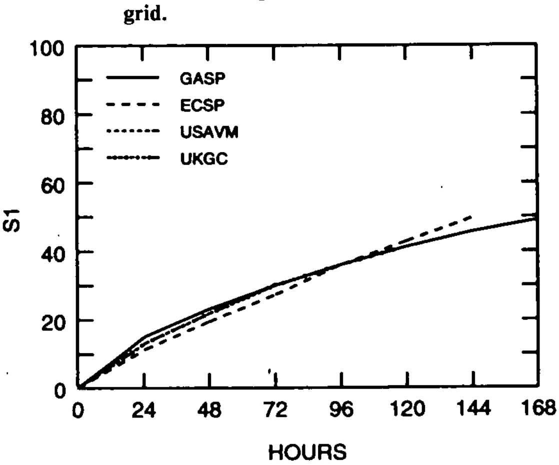


Fig. 2(c) **Comparison for GASP/EC/US/UK from October to December 1995. S1 skill scores at 500hPa for combined base-times 0000 UTC/1200 UTC and intervals +24 h to +168 h over the irregular Australian verification grid.**



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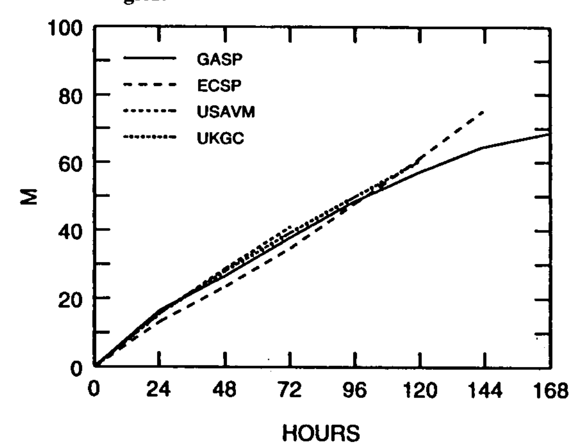


improvement over TAPS was less than for skill scores (Fig. 1(b), 1(d)).

All models showed higher skill scores at 500 hPa in December than in October and November (Fig. 3(b)) as several trough and low pressure systems had been poorly forecast. The model changes to GASP are most likely to influence convection and hence should show greatest improvements in tropical areas. Some improvement in the handling of tropical low development and subsequent movement is anticipated.

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

Skill scores showed an improvement of GASP relative to the other models. At MSLP (Fig. 2(a)) GASP scored better than UKGC and USAVM for intervals greater than +48 h and better than ECSP after +120 h. At 500 hPa the ECMWF clearly showed the best performance to +96 h (Fig. 2(c)). The relativity of the skills between models at +72 h at MSLP (Fig. 3(c)) and 500 hPa (Fig. 3(d)) showed a clear improvement for GASP in December. This is more likely to be due to the synoptic situation for the period rather than the model changes to GASP.

An upper-level trough over southeast Australia on 11 December was over-predicted by ECSP and USAVM, who forecast significant surface lows, and was under-predicted by GASP and UKGC. This appears to agree with previous model behaviour.

The new USAVM model produced smaller rms errors than previously and was better than the UKGC model over the period. GASP was slightly better than either, but the ECSP model continued to be the best for intervals less than +120 h at MSLP and +96 h at 500 hPa (Fig. 2(b), 2(d)).

Fig. 3(a) Monthly S1 skill scores at MSLP for RASP/TAPS/GASP from October to December 1995 for base-time 1200 UTC and interval +24 h over the irregular Australian verification grid.

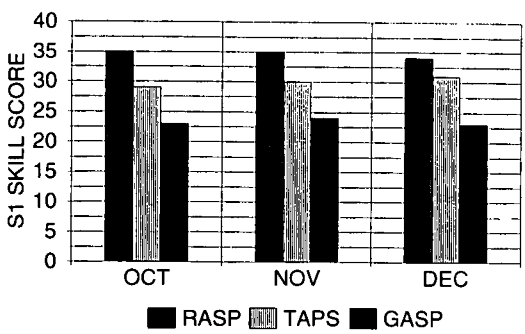


Fig. 3(b) Monthly S1 skill scores at 500 hPa for RASP/TAPS/GASP from October to December 1995 for base-time 1200 UTC and interval +24 h over the irregular Australian verification grid.

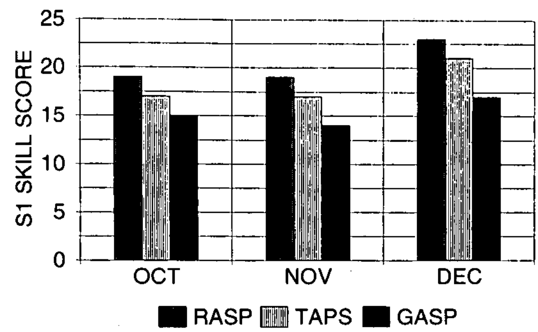


Fig. 3(c) Monthly S1 skill scores at MSLP for GASP/EC/UK/US from October to December 1995 for base-time 1200 UTC and interval +72 h over the irregular Australian verification grid.

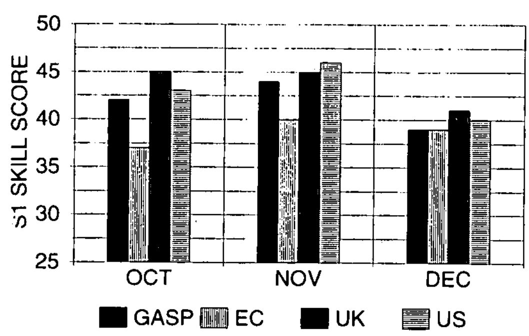
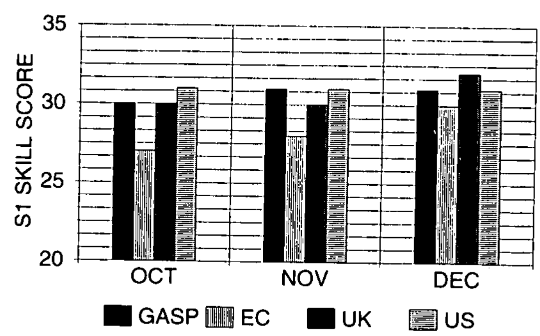


Fig. 3(d) Monthly S1 skill scores at 500hPa for GASP/EC/UK/US from October to December 1995 for base-time 1200 UTC and interval +72 h over the irregular Australian verification grid.



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