Analysis and Prediction Operations Bulletin No. 66

6-hourly Running Of Operational MESO_LAPS_PT125

11 July 2007

Introduction

On Wednesday 11 July 2007 the operational Australian region mesoscale prognosis system MESO_LAPS_PT125 will commence to be run four times per day with the introduction of additional model forecasts from basetimes 06Z (UTC) and 18Z to supplement the existing 00Z and 12Z based standard forecasts.

Previous studies within BMRC have shown that more frequent running of the model can be beneficial in the following ways:

- capturing the "change of heart" of LAPS in significant weather events, i.e. cases where 12-hour interval model runs differ significantly,
- providing forecasters with 6-hour longer lead in situations of changed model conditions e.g., situations relevant to frontal timing, rainfall events, and severe convection.
- providing more timely and better first guess fields for the upcoming mesoscale surface analysis system (MSAS) which will be used as an input to the GFE project via gridded-OCF.

Additional 06Z/18Z MESO_LAPS_PT125 model forecasts have been tested in trial mode in NMOC since June 2006. Verification results presented in this bulletin indicate a useful incremental improvement in forecast skill for these 06Z/18Z forecasts compared to the prior 00/12Z model runs.

System Description

The original configuration of MESO_LAPS_PT125 has been described in the NMOC Analysis and Prediction Operations Bulletin No. 49 (APOB 49) of November 1999 with a subsequent upgrade to use the Bulk Explicit Microphysics (BEM) rainfall scheme in June 2003 (c.f. APOB 58 for a description of the BEM implementation in LAPS_PT375). The present model configuration, including the horizontal and vertical resolutions, is essentially the same as that described in those reports – a brief configuration summary is given in table 1 below.

MESO_LAPS_PT125 does not perform its own observational data analysis but rather gets its initial and boundary conditions from the latest LAPS_PT375 analysis and forecast. For a recent description of the standard LAPS_PT375 "3-cycle" assimilation and prediction scheme, refer to APOB 64 of May 2006. In brief, three separate analysis-forecast cycles are used, each cycle 6 hours apart from others. At the end of the third cycle the model is time-integrated fully to produce a +72 hour forecast. The whole sequence begins again after 12 hours. In the standard LAPS_PT375 system, the second cycle (cycle-2) 06Z/18Z assimilation steps are not run until 4:45 hours after the nominal base time (this cut-off period is reduced to 3:45 hours during the summer daylight saving period) to allow as much observational data to arrive in the Bureau as possible – overseas QUIKSCAT and TOVS satellite data, in particular, can take several hours to trickle into the Bureau.

In order to permit timely running of the new 06/18Z MESO_LAPS_PT125 model forecasts, special "early data cut-off" 2-cycle assimilation and prediction runs of the LAPS_PT375 system are now performed 1:45 hours (45 minutes during daylight saving) after the nominal 06Z/18Z analysis basetimes. After the second cycle, a +72 hr forecast is then run to provide boundary conditions for the 06Z/18Z MESO_LAPS_PT125 model run. These early LAPS_PT375 data assimilation and forecast runs are independent of the standard 3-cycle assimilation runs used for the 00Z & 12Z model forecasts - the output files are saved in different subdirectories and the standard LAPS_PT375 cycle-1 and 2 assimilation steps are rerun again from scratch several hours later to make use of all available observational data. A simplified schematic of the interdependencies of the MESO_LAPS_PT125, LAPS_PT375 and GASP model runs is shown in Figure 1 below.

One point to note is that the standard 00Z (or 12Z) LAPS_PT375 assimilation and forecast system actually uses initial and boundary conditions provided by the previous 12Z (or 00Z) GASP forecast. However, the early 06Z (or 18Z) LAPS_PT375 runs are able to use initial and boundary conditions supplied by the recently completed latest 00Z (or 12Z) GASP forecasts. The improvement in these boundary conditions will flow through into the LAPS_PT375 boundary conditions that are then supplied to the 06Z (or 18Z) UTC MESO_LAPS_PT125 forecasts.

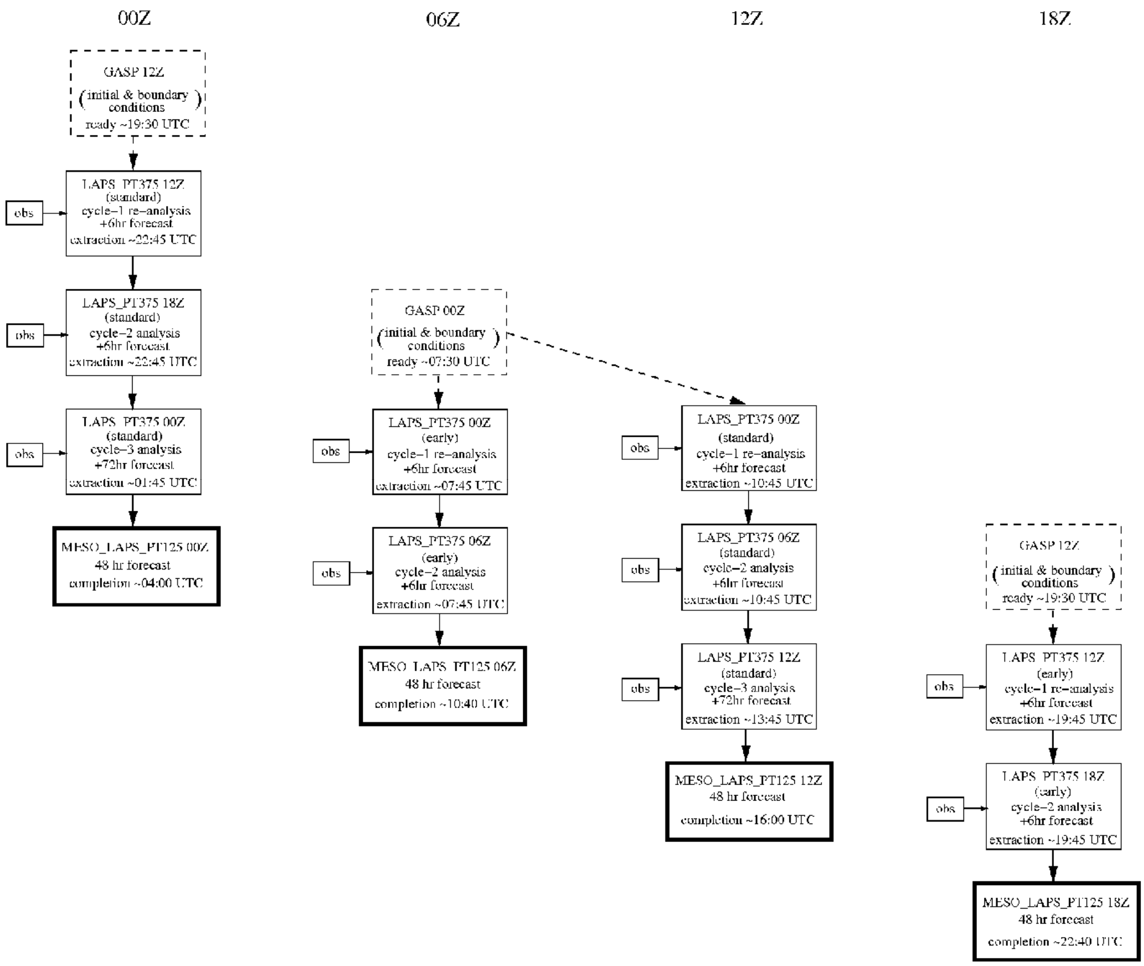

Figure 1: Schematic diagram showing the nesting of each 6-hourly MESO_LAPS_PT125 forecast inside the initial and boundary conditions provided by LAPS_PT375. Note the use of special "early data cut-off" LAPS_PT375 analyses to allow for timely running of the new 06Z & 18Z MESO_LAPS_PT125 forecasts. Data extraction and model completion times shown are those used for non-daylight saving period – during daylight saving period the relevant times are 1 hour earlier.

Table 1: Operational configuration of MESO_LAPS_PT125

Domain: Australian Region	55.0°S to 4.875°N, 95.0°E to 169.875°E
Horizontal resolution (analysis and prognosis)	0.125^0 (480x600 latitude-longitude grid)
Vertical resolution (analysis and prognosis)	29 sigma levels, top level at ~50 hPa
Initial Condition:	interpolated from LAPS_PT375 analysis
Nesting:	lateral boundary conditions derived from +0 to +48 hour LAPS_PT375
Topography:	derived from a 30" resolution dataset via climate program
Soil Moisture:	Pescod daily soil moisture data over Australia, climatology elsewhere
Sea Surface Temperature:	global weekly 1° SST dataset
Timestep:	dynamics 10 seconds; physics 240 seconds
Output:	+48 hour forecast from 00Z, 06Z, 12Z, 18Z daily
NEC SX-6 supercomputer resources:	number of processors: 7, memory: 7.2 GB elapsed time: 4920 secs = 82 min (real), 28630 sec = 8 hr (virtual)

Model Performance

NMOC conducted a parallel trial of the 6-hourly MESO_LAPS_PT125 system from June 2006 to April 2007 prior to operational implementation. Objective verification results are discussed in detail below. Subjective assessment of model forecast charts compared to corresponding analyses, such as shown for a typical case in figure 2 below suggested, not surprisingly, that on average each subsequent model forecast generally tended to show incrementally reduced errors compared to previous forecasts for a specific validity date/time.

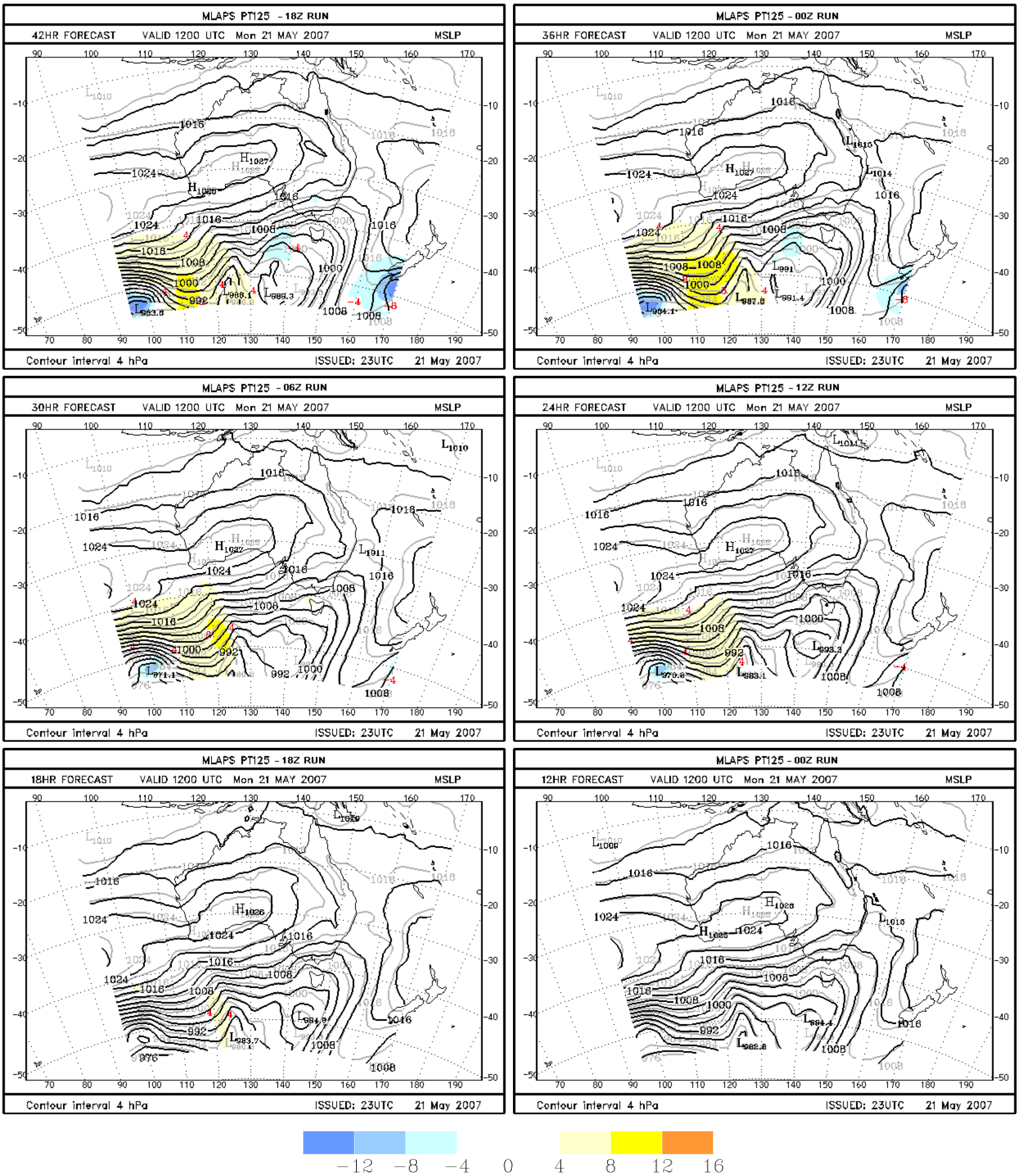

Figure 2: Model forecast MSLP field (black contours), overlayed on verifying analysis (gray contours) and error difference field (forecast – analysis, colour filled contours) for six successive MESO_LAPS_PT125 model forecasts, all valid for 12 UTC 21 May 2007. Note general reduction in forecast error with reduced forecast period.

Objective Assessment

1. S1 Skill Score, Root Mean Square error and Bias for MSLP and HGHT, U

To quantify the broad-scale model forecast performance, S1 skill score, root mean square (RMS) errors and bias were computed on the standard Australian verification grid for each model forecast over the assessment period, verified against the model's own initial conditions which are derived from the corresponding 6-hourly LAPS_PT375 analyses.

Figure 3 below shows mean S1 Skill Score for the MSLP and geopotential height (HGHT) fields for each model base time (00, 06, 12, 18 Z) averaged over the Australian verification region for all forecasts during the assessment period. The results are plotted as a function of forecast period and, by overlaying the results for all base times on the same graph, it can be seen that the general performance characteristics for each basetime is broadly similar.

There is however a slight alternating "ripple" pattern evident in the time evolution of the scores. On investigation, it was found that the 06Z/18Z MSLP analyses tend to have a slight positive pressure bias compared to the 00Z/12Z analyses (refer also to the section discussing the observational statistics comparison with observational data below). This bias has been attributed by modellers in BMRC to LAPS "not managing the diurnal/semi-diurnal tidal modes well and this becomes highlighted here because the 06Z/18Z LAPS analyses have only seen a prior 6 hours of assimilation relative to the GASP insert whereas the 00Z/12Z analyses have seen a full 12 hour assimilation window" (Bill Bourke, private communication).

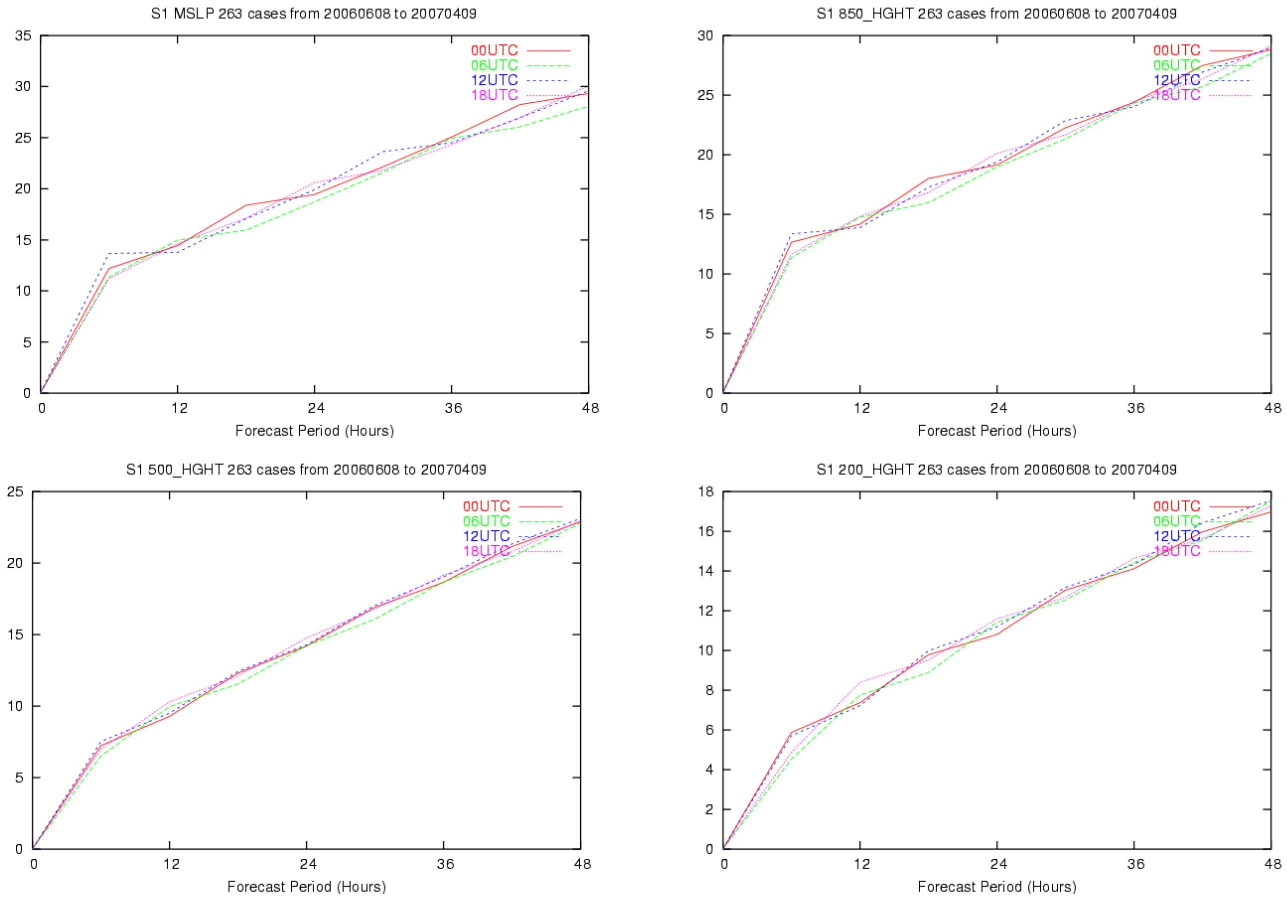

Figure 3: Comparison of MESO_LAPS_PT125 model S1 Skill Scores for MSLP and geopotential height (HGHT) at various levels as a function of forecast period for forecasts from the different model basetimes 00, 06, 12, 18 Z.

Tables 2 to 5 below present the mean S1 skill score, root mean square (RMS) error for the test MESO_LAPS_PT125 forecasts averaged for the period 8 June 2006 to 9 April 2007 over the Australian verification region. The results are grouped for all forecasts valid at a particular verifying time. It can be seen from these tables that generally, for a given validity time a more recent forecast is more accurate than an older forecast. The few anomalous results that don't fit in with this general observation (mainly evident in the bias statistics) are most likely due to the pressure biases found in the 06Z & 18Z verifying analyses relative to the 00Z & 12Z analyses.

Table 2 Mean S1 Skill Score, Bias and RMS Error for MSLP,HGHT and U for all forecasts valid at 00 UTC

Region: Standard Australian verification grid

Total Period: 8 June 2006 to 9 April 2007

Verifying Analyses: MESO_LAPS_PT125 initial condition (interpolated from LAPS_PT375 analysis)

Units: S1 skill scores are non-dimensional. Units for bias and RMS: MSLP (hPa), HGHT (m) and U (ms^{-1})

Verification Statistic	Field	Forecast period (run basetime)							
		+6hr(18Z)	+12hr(12Z)	+18hr(06Z)	+24hr(00Z)	+30hr(18Z)	+36hr(12Z)	+42hr(06Z)	+48hr(00Z)
S1	MSLP	11.3	13.8	16.0	19.5	21.9	24.6	26.2	29.3
	850 HGHT	11.6	13.9	16.0	19.1	21.7	24.0	25.8	28.8
	500 HGHT	7.0	9.5	11.5	14.2	16.8	19.0	20.4	22.9
	200 HGHT	4.9	7.2	8.9	10.8	12.7	14.3	15.5	17.0
	850 U	21.6	28.3	31.8	36.0	39.3	41.8	44.0	47.0
	500 U	19.8	27.2	31.2	35.4	39.7	42.8	45.2	48.0
	250 U	18.5	25.0	28.6	32.6	36.3	39.2	41.0	42.7
RMS	MSLP	0.90	0.99	1.28	1.51	1.75	1.99	2.16	2.51
	850 HGHT	7.14	7.79	10.21	11.80	13.92	15.50	16.88	19.34
	500 HGHT	6.31	10.01	12.45	16.12	18.58	21.95	23.76	27.55
	200 HGHT	7.68	11.96	14.85	19.30	23.20	26.82	29.58	33.92
	850 U	1.36	1.86	2.13	2.52	2.77	3.02	3.16	3.50
	500 U	1.64	2.37	2.80	3.31	3.77	4.15	4.42	4.87
	250 U	2.31	3.19	3.71	4.30	4.83	5.31	5.62	5.97
bias	MSLP	-0.55	-0.28	-0.55	-0.26	-0.45	-0.24	-0.39	-0.17
	850 HGHT	-4.45	-2.78	-5.26	-3.27	-5.00	-3.27	-4.39	-2.83
	500 HGHT	-1.72	-3.95	-5.32	-6.18	-6.22	-7.14	-7.63	-7.36
	200 HGHT	1.99	0.64	1.93	1.26	3.98	2.22	3.31	2.54
	850 U	0.03	0.10	-0.03	0.05	0.05	0.14	0.11	0.18
	500 U	-0.05	0.02	-0.06	-0.10	-0.07	-0.01	-0.01	0.05
	250 U	-0.32	-0.17	0.04	-0.04	-0.12	-0.19	-0.18	-0.21

Table 3 Mean S1 Skill Score, Bias and RMS Error for MSLP, HGHT and U for all forecasts valid at 06 UTC

Region: Standard Australian verification grid

Total Period: 8 June 2006 to 9 April 2007

Verifying Analyses: MESO_LAPS_PT125 initial condition (interpolated from LAPS_PT375 analysis)

Verification Statistic	Field	Forecast period (run basetime)							
		+6hr(00Z)	+12hr(18Z)	+18hr(12Z)	+24hr(06Z)	+30hr(00Z)	+36hr(18Z)	+42hr(12Z)	+48hr(06Z)
S1	MSLP	12.2	14.6	17.0	18.7	22.1	24.3	26.9	28.1
	850 HGHT	12.7	14.8	17.3	19.0	22.2	24.5	26.9	28.5
	500 HGHT	7.2	10.3	12.4	14.2	16.9	19.1	21.3	22.8
	200 HGHT	5.9	8.4	10.0	11.4	13.0	14.6	16.4	17.5
	850 U	24.3	30.3	34.0	36.0	39.7	42.3	44.5	46.4
	500 U	21.9	29.7	33.4	36.0	39.8	43.4	46.5	48.4
	200 U	20.9	27.5	30.7	33.0	36.2	39.2	42.2	43.8
RMS	MSLP	1.05	1.03	1.35	1.40	1.83	1.96	2.30	2.36
	850 HGHT	8.21	7.77	10.13	10.69	13.82	14.99	17.46	18.29
	500 HGHT	6.64	9.70	12.80	14.83	18.75	20.99	24.39	26.05
	200 HGHT	10.04	14.60	17.40	20.26	24.21	27.72	31.54	34.18
	850 U	1.53	1.96	2.24	2.41	2.78	2.98	3.22	3.37
	500 U	1.86	2.58	3.02	3.31	3.79	4.18	4.58	4.80
	200 U	2.63	3.57	4.04	4.40	4.92	5.39	5.91	6.17
bias	MSLP	0.66	0.26	0.52	0.27	0.48	0.34	0.53	0.40
	850 HGHT	5.05	1.35	3.12	0.97	2.43	1.15	2.66	1.72
	500 HGHT	0.20	-1.03	-3.02	-3.97	-4.92	-4.69	-5.58	-5.78
	200 HGHT	2.17	4.91	2.72	4.34	2.97	5.51	3.23	4.63
	850 U	-0.06	-0.08	0.13	0.05	0.10	0.12	0.20	0.15
	500 U	-0.06	-0.17	-0.24	-0.22	-0.18	-0.14	-0.14	-0.10
	200 U	-0.20	-0.31	-0.30	-0.27	-0.38	-0.49	-0.54	-0.52

Table 4 Mean S1 Skill Score, Bias and RMS Error for MSLP, HGHT and U for all forecasts valid at 12 UTC
Region: Standard Australian verification grid
Total Period: 8 June 2006 to 9 April 2007
Verifying Analyses: MESO_LAPS_PT125 initial condition (interpolated from LAPS_PT375 analysis)
Units: S1 skill scores are non-dimensional. Units for bias and RMS: MSLP (hPa), HGHT (m) and U (ms^{-1})

Verification Statistic	Field	Forecast period (run basetime)							
		+6hr(06Z)	+12hr(00Z)	+18hr(18Z)	+24hr(12Z)	+30hr(06Z)	+36hr(00Z)	+42hr(18Z)	+48hr(12Z)
S1	MSLP	11.3	14.4	17.1	19.9	21.6	25.0	27.0	29.6
	850 HGHT	11.3	14.2	16.8	19.4	21.3	24.4	26.4	29.0
	500 HGHT	6.5	9.3	12.1	14.3	16.1	18.7	20.8	23.1
	200 HGHT	4.5	7.4	9.5	11.2	12.5	14.1	15.6	17.5
	850 U	19.7	28.3	32.7	35.7	37.9	41.7	44.1	46.5
	500 U	17.0	26.3	32.7	36.0	38.8	42.6	45.8	48.5
	200 U	16.1	24.7	30.3	33.2	35.7	38.6	41.0	43.7
RMS	MSLP	0.88	1.00	1.28	1.50	1.70	2.04	2.22	2.50
	850 HGHT	7.28	7.94	10.62	11.82	13.59	16.00	17.54	19.36
	500 HGHT	6.50	10.01	12.77	16.03	18.26	22.31	24.37	27.89
	200 HGHT	7.03	12.10	16.05	19.56	22.41	26.83	29.93	34.49
	850 U	1.23	1.88	2.22	2.49	2.66	3.02	3.23	3.49
	500 U	1.39	2.28	2.89	3.29	3.61	4.13	4.49	4.84
	200 U	1.98	3.16	3.98	4.41	4.81	5.31	5.73	6.20
bias	MSLP	-0.52	-0.17	-0.45	-0.20	-0.43	-0.24	-0.34	-0.14
	850 HGHT	-4.93	-2.70	-5.40	-3.46	-5.22	-3.97	-5.01	-3.35
	500 HGHT	-2.96	-4.67	-5.33	-6.80	-7.61	-8.27	-8.00	-8.51
	200 HGHT	-1.09	-0.85	2.09	-0.06	1.21	-0.44	2.02	-0.12
	850 U	-0.10	-0.18	-0.22	-0.03	-0.06	0.02	0.01	0.11
	500 U	-0.03	-0.06	-0.11	-0.13	-0.09	-0.07	-0.06	-0.02
	200 U	-0.13	-0.17	-0.12	-0.22	-0.25	-0.33	-0.39	-0.39

Table 5 Mean S1 Skill Score, Bias and RMS Error for MSLP, HGHT and U for all forecasts valid at 18 UTC
Region: Standard Australian verification grid
Total Period: 8 June 2006 to 9 April 2007
Verifying Analyses: MESO_LAPS_PT125 initial condition (interpolated from LAPS_PT375 analysis)
Units: S1 skill scores are non-dimensional. Units for bias and RMS: MSLP (hPa), HGHT (m) and U (ms^{-1})

Verification Statistic	Field	Forecast period (run basetime)							
		+6hr(12Z)	+12hr(06Z)	+18hr(00Z)	+24hr(18Z)	+30hr(12Z)	+36hr(06Z)	+42hr(00Z)	+48hr(18Z)
S1	MSLP	13.7	15.0	18.4	20.6	23.6	24.9	28.2	30.1
	850 HGHT	13.4	14.8	18.0	20.1	22.8	24.4	27.5	29.1
	500 HGHT	7.5	10.0	12.3	14.8	17.0	18.7	21.2	22.9
	200 HGHT	5.7	7.7	9.8	11.6	13.2	14.4	16.0	17.3
	850 U	23.6	28.7	33.3	36.3	39.2	41.1	44.1	46.0
	500 U	21.8	27.3	32.0	36.2	39.3	41.6	45.0	47.7
	200 U	20.6	25.3	29.8	33.7	36.6	38.8	41.2	43.2
RMS	MSLP	1.09	1.04	1.47	1.56	1.95	2.01	2.44	2.54
	850 HGHT	8.06	7.56	10.62	11.50	14.27	14.90	18.13	18.95
	500 HGHT	7.15	9.68	12.62	15.08	18.41	20.43	24.49	26.37
	200 HGHT	9.21	12.64	16.91	20.92	24.05	27.08	31.20	34.41
	850 U	1.52	1.90	2.31	2.54	2.81	2.95	3.28	3.45
	500 U	1.87	2.41	2.92	3.35	3.70	3.99	4.47	4.79
	200 U	2.57	3.22	3.88	4.46	4.92	5.25	5.70	6.04
bias	MSLP	0.56	0.28	0.60	0.38	0.62	0.45	0.63	0.56
	850 HGHT	4.07	1.42	3.41	1.25	3.28	2.02	3.30	2.51
	500 HGHT	-0.07	-0.98	-2.31	-2.53	-3.56	-4.12	-4.25	-3.86
	200 HGHT	0.95	2.51	2.33	5.62	3.83	4.88	3.63	6.42
	850 U	0.02	0.04	0.06	0.02	0.11	0.09	0.15	0.14
	500 U	-0.04	-0.01	-0.12	-0.09	-0.03	-0.02	0.07	0.08
	200 U	0.08	0.13	0.15	0.10	0.05	0.09	0.01	-0.01

2. Observational statistics comparison for RAWIN, QUIKSCAT, SONDE, SYNOP

Observational statistics ("obstats") verification compares model forecasts against actual in-situ observational data rather than against model analyses which can have their own biases. An obstats verification of the MESO_LAPS_PT125 parallel trial forecasts for the month of July 2006 against RAWIN, QUIKSCAT, SONDE & SYNOP observations was kindly performed by Mohar Chattopadhyay of the BMRC Data Assimilation Group.

For this verification the +6hr forecasts from the 18Z MESO_LAPS_PT125 model run were compared against the corresponding 00Z observational data to generate average root mean square error (RMSE) and bias obstats results. Similar obstats were computed from the +12hr forecasts from the previous 12Z model runs and the two sets of results plotted together as shown in figure 4 below. Likewise, the obstats for the +18hr forecasts from the 06Z model runs are compared with the +24hr forecast obstats from the earlier 00Z run in figure 5.

The results can be summarized as follows:

- RAWIN winds and SONDE temperatures: The 06Z (18Z) based model forecasts are generally more accurate than the prior 00Z (12Z) based forecasts between 1000 to 300 hPa.
- QUIKSCAT 10m winds: The 06Z (18Z) based model forecasts are generally more accurate than the prior 00Z (12Z) based forecasts, particularly between 10° S to 35° S latitude.
- SYNOP MSLP: 06Z (18Z) based model forecasts actually perform slightly worse than the prior 00Z (12Z) based forecasts. This is due to a stronger positive pressure bias in these forecasts relative to the observations.

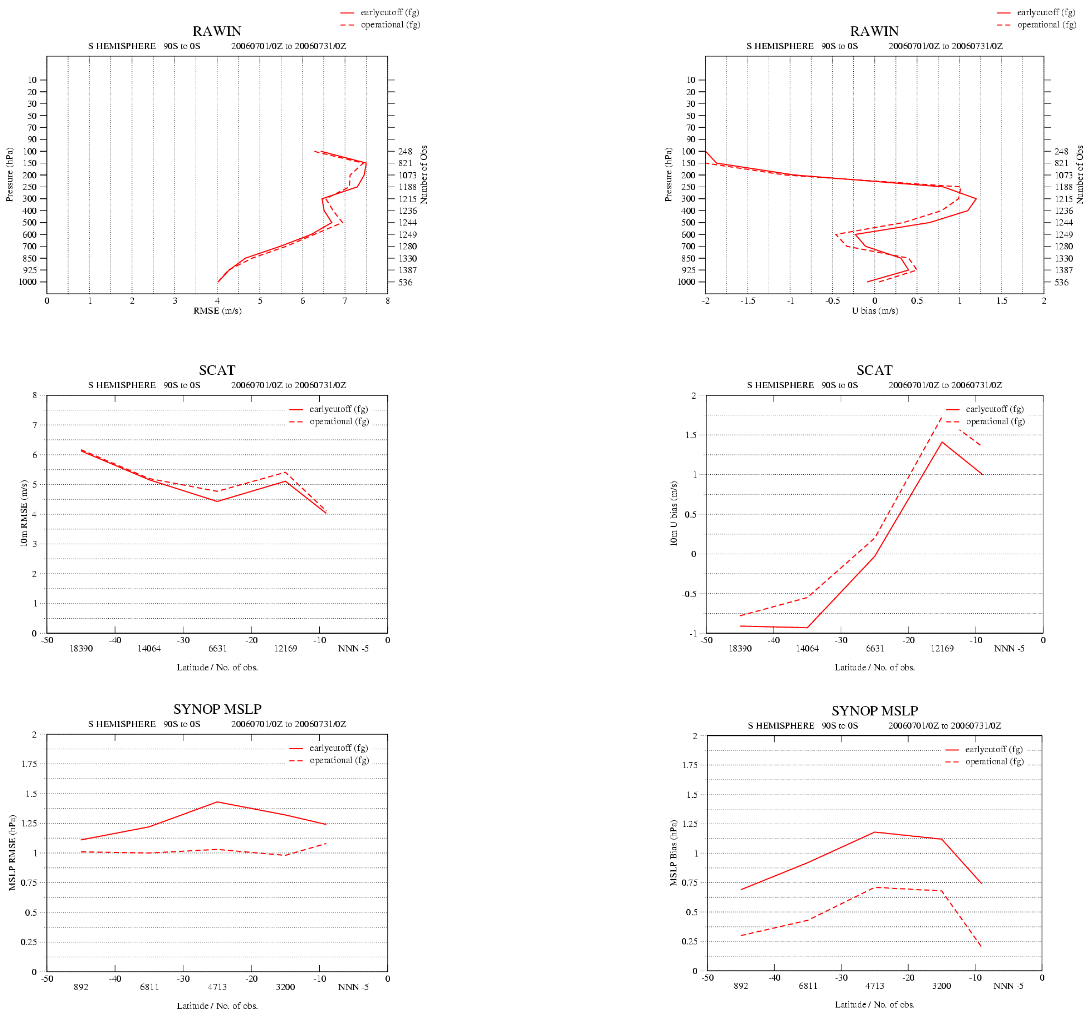

Figure 4: Root mean square error and bias obstats for +6hr forecasts from 18Z MESO_LAPS_PT125 model runs (here labelled "earlycutoff") versus +12hr forecasts from the 12Z model runs (labelled "operational"), both valid at 00Z, averaged over all forecasts for July 2006.

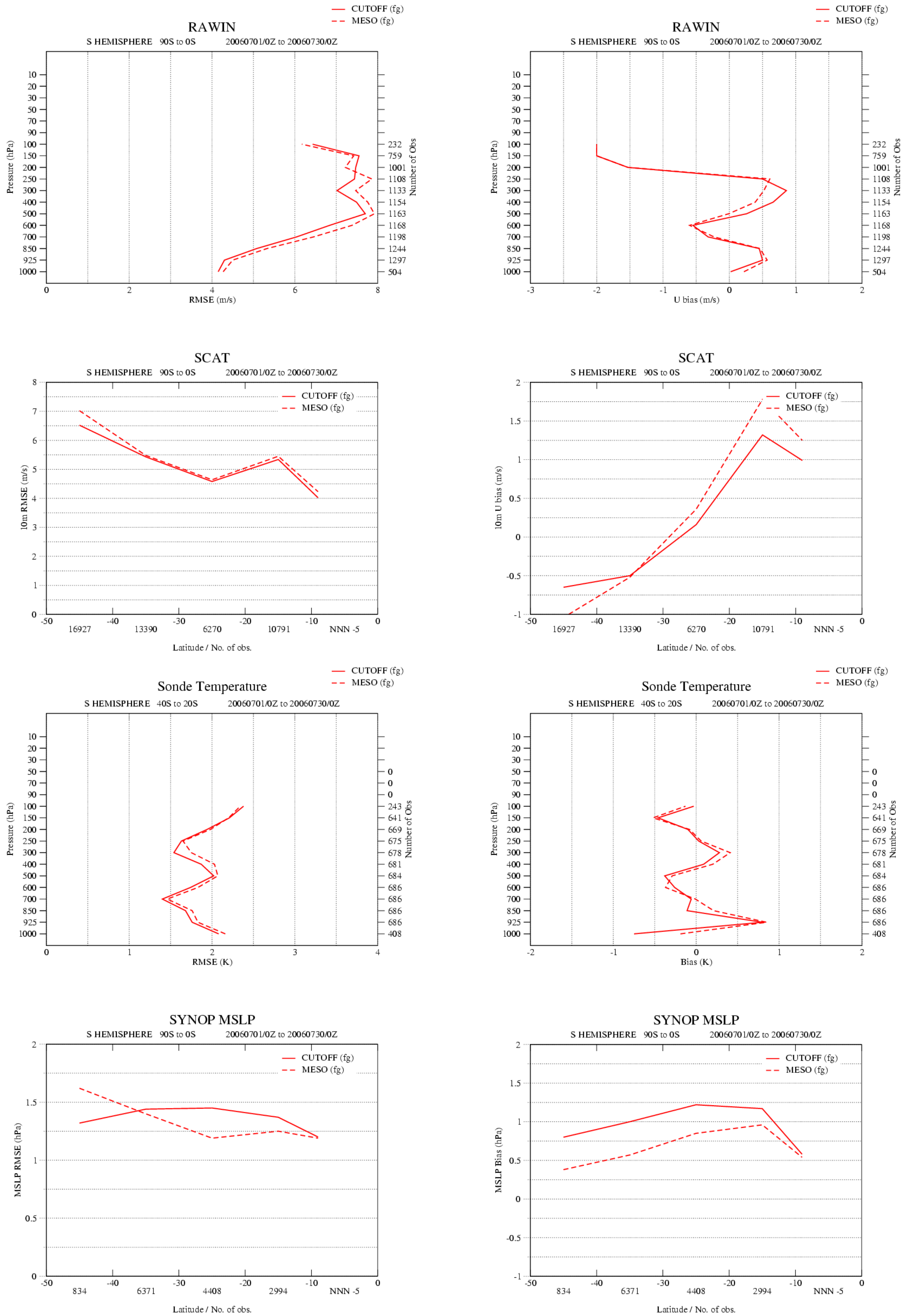

Figure 5: Root mean square error and bias obstats for +18hr forecasts from 06Z MESO_LAPS_PT125 model runs (here labelled "CUTOFF") vs +24hr forecasts from the 00Z model runs (labelled "MESO"), both valid at 00Z, averaged over all forecasts for July 2006.

3. Rainfall verification

The following rainfall verifications were performed using the RAINVAL statistical verification package, which verifies daily quantitative precipitation forecasts for NWP models against daily rainfall analyses. RAINVAL was developed by Beth Ebert and John McBride of BMRC (McBride & Ebert, 2000). A variety of statistical scores are available from this system for judging aspects of rainfall forecast performance. Further details, including a glossary that explains the strengths and weaknesses of the various statistical scores presented here, can be found at http://www.bom.gov.au/bmrc/mdev/expt/rainval/rainval_gui/rainval_gui.shtml.

Table 6 below shows RAINVAL statistics for the MESO_LAPS_PT125 model forecasts averaged over all Australian gridpoints for the period from 1 July 2006 to 24 April 2007. Since the verifying observations are available only for the period 9am to 9am, the model forecasts periods covering approximately this time vary depending on the model basetime, e.g. for the 00Z model run we verify the 00-24 hr rainfall forecast, whereas for the 18Z model run we must verify the 06-30hr forecast etc.

The results are generally consistent with what one might expect - the shorter the prog period the more skillful the forecast is, with the 00Z "00-24 hr" prog best and the 00Z "24-48 hr" prog worst (although the 18Z "06-30 hr" scores are quite similar to the previous 12Z "12_36 hr" scores, with the Equitable Threat Score slightly better but RMS and Mean Absolute Error slightly worse).

Table 6: Average RAINVAL statistics for all available days (263) and all gridpoints during the period 1 July 2006 to 24 April 2007. Verification done on a 0.25° grid, number of gridpoints = 9835.

		Forecast period (run basetime)				
	Observed	**00-24 hr** (00Z)	**06-30 hr** (18Z)	**12-36 hr** (12Z)	**18-42 hr** (06Z)	**24-48 hr** (00Z)
Rain Area ($km^2 * 10^3$)	958	997	1025	1029	1019	1017
Average Intensity (mm/d)	9.2	11.3	11.7	10.5	10.4	10.4
Rain Volume (km^3)	8.8	11.3	12.0	10.8	10.6	10.6
Max Intensity (mm/d)	55.7	142.4	141.5	117.6	114.0	108.1
Mean Abs Error (mm/d)	-	1.82	1.93	1.82	1.82	1.88
RMS Error (mm/d)	-	5.74	5.97	5.40	5.42	5.53
Correlation Coefficient	-	0.46	0.44	0.44	0.43	0.40
Bias Score	-	1.04	1.07	1.07	1.06	1.06
Probability of Detection	-	0.65	0.64	0.64	0.63	0.62
False Alarm Ratio	-	0.38	0.40	0.40	0.41	0.42
Critical Success Index	-	0.46	0.45	0.45	0.44	0.43
Hanssen & Kuipers Score	-	0.57	0.56	0.56	0.55	0.53
Equitable Threat Score	-	0.39	0.38	0.37	0.36	0.35

Future Developments

- A final 61-level upgrade of LAPS_PT375 model is planned to be implemented later this year. This model configuration has been developed, tested and verified within BMRC over the past year and promises a performance improvement. It will incorporate the following features:
    - new LAPS d2p5 model. This provides MPI capability for faster multi-node running on the supercomputer and also includes a new single level output file with more fields than the current slvfld file, plus bug fixes and improved stability features in the upper levels allowing for 61 sigma levels to be used
    - 61 sigma levels will permit the assimilation of locally received and processed ("direct readout") ATOVS radiances as well as radiances received from the UK Met Office which are processed by the same package (AAPP) as the local ones. The use of direct readout data will greatly increase the amount of ATOVS data available to the "short data cut-off" data assimilation steps which should improve the analysis and model forecast accuracy.
    - new climate program with improved coast-line matching and monthly climatologies for some fields
    - use of daily 1/12th deg SST data
    - use of post-processed GASP nesting data at higher resolution
    - multi-node running of LAPS analysis for faster turnaround
    - use of significant level data in analysis.

- Longer term planning for regional NWP modelling in the Bureau is dominated by a move towards systems based on the Australian Community Climate Earth System Simulator (ACCESS), a joint initiative led by the Bureau of Meteorology and CSIRO in cooperation with the university community of Australia. The initial version of ACCESS will be based largely around the UK Met Office Unified Model assimilation and prediction code.

References

McBride, J. and Ebert, E. "Verification of Quantitative Precipitation Forecasts from Operational Numerical Weather Prediction Models over Australia", Weather and Forecasting, Vol 15, 103-121, Feb 2000.