OBSERVATION PROVISION BRANCH

REPORT ON ASDAR MONITORING RESULTS

JULY - SEPTEMBER 1994

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THE ASDAR CENTRE

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1). INTRODUCTION

ASDAR reports received into the Met. Office Synoptic Data Bank (SDB) have been monitored by the ASDAR Centre since the first ASDAR unit began flying on 29/11/90. The aim of the monitoring is to detect and identify any problems with the data or their transmission as soon as possible and to instigate fault correction procedures. These processes are vital to maintaining data quality and credibility.

Monitoring of the observations has covered data availability, receipt delays, reporting frequency and checks on the consistency and quality of the meteorological data. All irregularities have been reported to the ASDAR Technical Centre.

This report highlights outstanding problems with data availability, transmission and quality, and with fault correction procedures.

2). OPERATIONAL UNITS

Data from eleven ASDAR units were received in the SDB during the period, the same number as in the previous period. (A twelth, with identifier SV003ISZ, began transmitting data on 14th September but the reports contained no useful meteorological information and had invalid latitudes and longitudes, so were not stored in the SDB. The problem was caused by a incorrect parameters specified in the ASDAR software ; it will be corrected by the ASDAR maintainers. The airline technicians have meanwhile been instructed to switch off the unit until this fix is in place.)

The following table shows the carriers, types of aircraft, identifiers and the dates on which observations were first received for current operational units :-

AIRLINE	AIRCRAFT TYPE	IDENTIFIER	OPERATIONAL START DATE
British Airways	747	BA000NEZ@	12/ 6/92
British Airways	DC 10	BA001LLZ	29/11/90
British Airways	DC 10	BA008DJZ	19/12/91
British Airways	DC 10	BA009BMZ	11/ 2/92
British Airways	747	BA010PUZ	27/ 6/91
British Airways	747	BA025LFZ	15/ 4/94
British Airways	747	BA026LGZ	15/ 4/94
British Airways	747	BA027LJZ	15/ 4/94
British Airways	747	BA028LLZ	15/ 4/94
KLM	747	KL012UMZ=	23/ 4/92
Lufthansa	747	LH005VNZ	23/ 6/93

@ Unit identifier reported as BA000NDZ before 4/10/92
= Unit identifier reported as PH012UMZ before 11/5/93

3). LIST OF OUTSTANDING PROBLEMS

A list is given below of known faults and anomalies present during the latest three month period :-

- that were also present in the previous period (long term) and

- that became apparent in the latest 3-month period (new)

All have been reported to the ASDAR Technical Centre, who inform the relevent bodies where appropriate. For faults where a specific unit is not mentioned, the fault is present for more than one unit (usually several).

i) Long term problems

a) Occasional missing positional information eg latitude or missing meteorological information eg temperature.

b) Occasional erroneous data eg impossibly strong wind speeds.

Both (a) and (b) often occur when the aircraft is on the edge of the satellite "footprint".

c) Missing reports (occasionally whole flights missing). Lack of descent reports can be attributed to the aircraft being powered down after landing and before transmission time.

d) Spurious observations - reports received while aircraft are on the ground but flight level indicates aircraft is airborne ; usually such reports are from KL012UMZ. Software has been written to attempt to eliminate this fault.

e) Temperature biases - there are positive temperature differences for KL012UMZ relative to numerical forecast model fields of about 2.0 deg C at cruise levels. Until mid-August there were also positive temperature differences of about 1-2 deg C for BA009BMZ at all levels. Temperature differences taken over all the other units are about +0.4 deg C for all levels, which might be due to a model bias.

Fig 1 shows a time series plot of monthly mean differences at the cruise levels for KL012UMZ (=2UMZ), BA009BMZ (=9BMZ) and all other units combined. During August, a new temperature probe was fitted to BA009BMZ and this has significantly reduced the positive bias.

Unit KL012UMZ also has an anomalous negative temperature bias in the ascent/descent phases (see fig 2). The marked change in the bias for BA009BMZ is again evident, the bias now removed.

f) Varying cruise flight levels - cruise flight levels reported from KL012UMZ fluctuate more frequently than those from other ASDAR aircraft and regularly vary by 100 or 200 feet between observations. Although this feature is anomalous, it does not affect the validity of the ASDAR meteorological data. New software which will set the phase of flight to "level" for reports above 20000 feet irrespective of small deviations in flight level should eliminate this problem.

g) Receipt of reports from BA025LFZ, BA028LLZ and LV005VNZ is patchy, particularly from the last named, due to suspected problems with antennae. Steps are being made to refit replacement antennae to these aircraft (already occurred with BA028LLZ).

ii) <u>New problems</u>

Nil.

4). MONITORING RESULTS

i). Data Availability

ASDAR reports are received via Darmstadt (EESA), Washington (KWBC) and Tokyo (RJTD), depending on the location of the aircraft. Table 1 shows for each unit the number of reports received in the SDB, the number of days when no reports were received, the average number of reports received per day and an estimate of the number of complete ascents, complete descents and level flight stages that were not received.

The number of reports received is adjusted to remove duplicates (identical versions of the same report) but, due to inconsistencies in the reports received via Washington and Darmstadt, the totals are likely to include some duplicates.

Periods of more than 7 days when a particular unit did not report were :-

BA010PUZ : Jul 24th - Aug 30th (aircraft out of service, then clock not set correctly)

BA025LFZ : Sep 11th - Sep 20th (suspected antenna fault)

BA028LLZ : Jul 14th - Aug 25th (antenna fault, new antenna now fitted)

KL012UMZ : Jul 15th - Oct ?? (aircraft out of service)

LH005VNZ : Aug 16th - Sep 2nd, Sep 4th - October ?? (suspected antenna fault)

Over the 3 month period as a whole an average of 889 reports per day were received from all units combined, compared with 1218 in the previous three-month period. Fig 3 displays the average daily number of ASDAR reports received since the end of 1992.

Note that a further contributing factor to the reduction in number of observations besides the outages listed above is that for units BA000NEZ and BA010PUZ, installation of new software has reduced the frequency of reporting in level flight from below 5 minutes (excessive) to the standard 7 minutes ; the software change for BA010PUZ took place part-way through the period.

ii). Data Coverage

Most of the aircraft carrying ASDAR units during the period flew predominately between Europe and North America or within these regions. However the 4 units BA025LFZ, BA026LGZ, BA027LJZ and BA028LLZ also flew to Asia, Africa, Australasia and South America.

iii). Data Timeliness

Table 2 gives the frequencies of report receipt delays. Receipt delay is taken to be "time of receipt in SDB - time of report" and reports where the time is missing are ignored.

Speed of data receipt was good with 73% of reports being received within one hour of observation time and 99 % within two hours, over all reporting units.

iv). Frequency of Reporting

The expected frequency of ASDAR reports is one every 7 minutes during level flight and one every 10 hPa or 50 hPa during ascent and descent (with the higher frequency applying to the lower part of the atmosphere). Taking daily samples wherever possible, the average time between reports during level flight, and the average pressure difference (in hPa) between the first 10 reports on ascent and the first 10 reports below 3500 feet (approximately 890 hPa) on descent are shown in Table 3. Maximum and minimum values are also given. The pressure differences are obtained from height differences using the standard atmosphere relationship that 1 hPa

is approximately equivalent to 29 feet in the layer 1000-900 hPa.

From Table 3 it can be seen that all the reporting units achieved the "report every 7 minutes" target in level flight. All units also achieved the "report every 10 hPa" target in the near-ground phase of ascent. However, the mean frequency for near-ground descent was slightly poorer than the specified criterion for most of the units.

A software change for units BA000NEZ and BA010PUZ has by design now reduced their anomalously high frequency of reporting in level flight to closer to that of other units.

5). DATA QUALITY

Figures 4 to 12 show for individual units and the complete three month period the results of "O-B" (observation minus background i.e. a 6-hour forecast) and "O-A" (observation minus analysis) comparisons for all levels between 950 and 150 hPa. Profiles for KL012UMZ and LH005VNZ are not included due to their lack of observations. The UK 19-level global forecast model is the model used for the comparison. Results are given for temperature and for wind (u component, v component, speed, direction and rms vector) separately and show mean and standard deviation of the differences from the model fields at each level. Hand-written headings have been added to fig 4 to clarify the charts.

Although both "O-B" and "O-A" plots are shown, comparison with the background field is more meaningful as in data sparse areas the model analysis will tend to fit to an observation, regardless of its quality, provided it passes the quality control.

The profiles shown indicate general high quality of the reports.

6). SUMMARY

i) Overall timeliness and quality of the data from the existing operational units remain high.

ii) Availability of data was lower than the previous three month period principally because two of the aircraft were out of service for extended periods and antenna problems (or suspected problems) affected transmission of data from a further three aircraft (BA025LFZ, BA028LLZ and LH005VNZ).

iii) Temperatures from KL012UMZ (until the aircraft was taken out of service in mid-July) compared to model background temperatures continued to be somewhat anomalous but long-standing biases for BA009BMZ have been resolved by a change of temperature probe in mid-August.

iv) All units maintained the stipulated reporting frequencies for level flight and for near-ground phase of ascent. The frequency for near-ground phase of descent fell slightly short of stipulated frequencies for the majority of the units.

v) Spurious reports from the ground continued to be received from KL012UMZ until the aircraft was taken out of service early in the period.

7). AMDAR data from Dutch aircraft

AMDAR coded data from Dutch aircraft are also being monitored. These aircraft have call sign of the form KL1nnaa where nn are two digits and aa are two alphabetic characters. The data are in the same format as the ASDAR data and provide the same meteorological information but are not transmitted via satellite links. The monitoring has mainly taken the form of visual inspection of sequences of reports. Unfortunately, many reports are being assigned to the wrong day within the Met Office data-bank due to deficiencies with regard to the coding of the date for aircraft reports. The data-bank team are aware of this problem but any solution is likely to be long term and cannot be completely successful without a change in the format of the code.

Nineteen units reported during the 3 month period. Due to the fact that reports are often assigned to the wrong day, and that there are frequent gaps in the sequences of reports, it is difficult to monitor their quality or to produce meaningful statistics. However, visual checks of the reports suggest there are no obvious problems with the quality of data from any of the units.

TABLE 1 : SUMMARY OF DATA RECEIVED AND MISSING DATA : JULY - SEPTEMBER 1994

UNIT	NO. REPORTS RECEIVED	PERCENTAGE VIA KWBC	EESA	RJTD	"NO REPORT" DAYS	AVE NO. PER DAY*	<-NO. OF MISSING EVENTS% ASC	DES	LF>
BA000NEZ	11503	41	59	-	10	140	16	21	0
BA001LLZ	11266	52	48	-	5	129	29	42	0
BA008DJZ	12877	50	50	-	5	148	32	29	0
BA009BMZ	12906	49	51	-	5	148	38	48	0
BA010PUZ	7992	41	59	-	34	138	20	16	0
BA025LFZ	1022	19	81	-	56	28	25	10	3
BA026LGZ	7276	24	76	-	20	101	38	31	0
BA027LJZ	9378	28	72	-	5	108	31	58	0
BA028LLZ	4902	31	69	-	40	94	15	25	0
KL012UMZ	2182	40	60	-	78	156	6	11	0
LH005VNZ	474	14	86	-	73	25	9	16	1
TOTAL	81778								

NOTES

* Days with no reports are excluded for averaging purposes.

% Number of missing events does not include occasions where whole flights are missing

ASC : Complete ascent
DES : Complete descent
LF : Level flight

TABLE 2 : SUMMARY OF DELAY FREQUENCIES : JULY - SEPTEMBER 1994

UNIT	NUMBER OF REPORTS	PERCENTAGE FREQUENCIES OF DELAY (MINUTES)							MAXIMUM DELAY	MEAN DELAY
		0-30	31-60	61-120	121-180	181-360	361-720	>720		
BA000NEZ	11503	25.7	42.8	30.9	0.5	0.1	0.1	-	403	50
BA001LLZ	11266	18.8	43.9	36.6	0.4	0.2	-	-	307	53
BA008DJZ	12877	29.3	45.7	24.2	0.3	0.3	0.1	0.1	1404	47
BA009BMZ	12906	26.7	47.9	23.8	0.6	0.7	0.2	-	464	48
BA010PUZ	7992	32.0	47.9	19.4	0.2	0.6	-	-	317	43
BA025LFZ	1022	38.4	45.1	16.5	-	-	-	-	114	42
BA026LGZ	7276	34.0	43.3	22.3	0.1	0.2	0.1	0.0*	923	45
BA027LJZ	9378	32.9	41.8	25.0	0.3	-	-	-	171	46
BA028LLZ	4902	30.0	43.0	26.7	0.2	0.2	-	-	227	48
KL012UMZ	2182	35.7	50.3	12.5	-	1.5	-	-	334	41
LH005VNZ	474	49.7	37.6	12.7	-	-	-	-	88	33
TOTALS	81778	28.5	44.9	25.9	0.3	0.3	0.1	0.0*	1404	47

NOTE

* Percentage between 0 and 0.05.

TABLE 3 : SUMMARY OF REPORTING FREQUENCIES : JULY - SEPTEMBER 1994

	<-----LEVEL FLIGHT----->				<--ASCENT (1st 10 OBS)->				<DESCENT(10 OBS AFTER 890hPa)>			
UNIT	N.O.S.	MEAN	MIN	MAX	N.O.S.	MEAN	MIN	MAX	N.O.S.	MEAN	MIN	MAX
		<----MINUTES--->				<-----hPa------>				<------hPa----->		
BA000NEZ	52	7.0	6.5	7.0	59	9.4	8.8	12.3	54	10.0	8.0	10.7
BA001LLZ	69	7.0	6.5	7.0	47	9.5	8.8	11.1	55	10.0	7.7	11.9
BA008DJZ	49	7.0	6.5	7.0	48	9.5	8.8	10.0	46	9.9	8.8	10.7
BA009BMZ	71	6.3	3.9	7.0	47	9.9	9.2	12.3	49	10.1	7.7	11.9
BA010PUZ	37	5.7	3.3	7.0	31	9.6	8.8	10.0	33	10.0	8.8	10.7
BA025LFZ	3	6.7	6.1	7.0	6	9.6	8.8	10.0	22	10.3	8.8	11.9
BA026LGZ	56	7.0	7.0	7.0	38	9.1	8.0	12.3	37	10.2	8.8	11.9
BA027LJZ	70	7.0	5.3	7.0	51	9.1	8.0	10.3	37	10.2	8.8	11.1
BA028LLZ	31	7.0	6.5	7.0	22	9.3	8.0	10.0	18	10.3	8.8	11.9
KL012UMZ	0 *	-	-	-	7	10.0	10.0	10.0	5	10.2	10.0	10.7
LH005VNZ	2	7.0	7.0	7.0	9	9.2	8.8	9.6	0	-	-	-

KEY TO "REPORTING FREQUENCY" TABLE HEADINGS

N.O.S. : Number of samples.

NOTE

* KL012UMZ - cruise flight levels fluctuate frequently (see text)

Figure 1

Monthly mean ASDAR O-B temperatures (deg C)

150-350 hPa

Key : 9--9 9BMZ 2--2 2UMZ 0—0 OTHERS

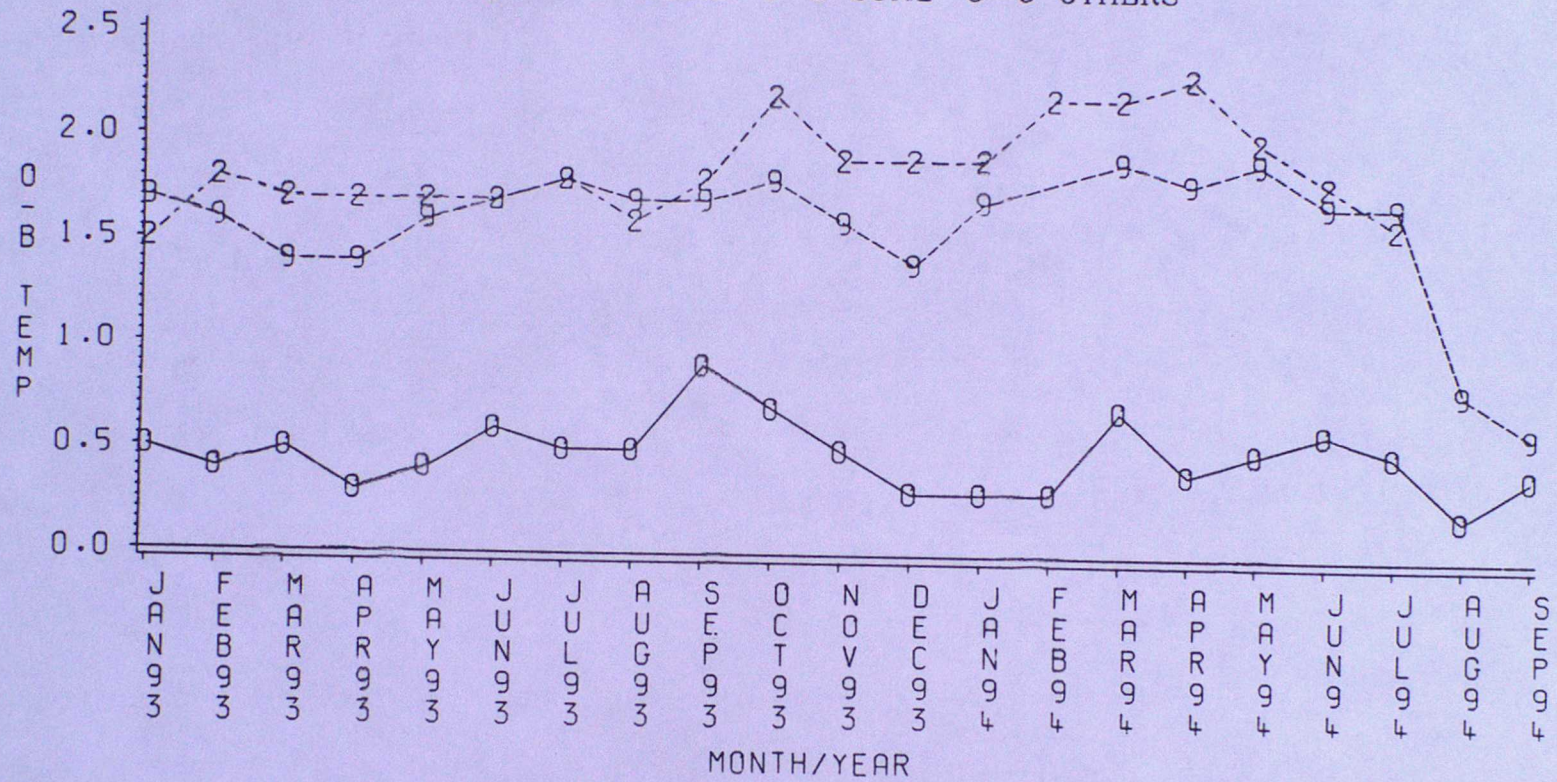


Figure 2

Monthly mean ASDAR O−B temperatures (deg C)

400−950 hPa

Key : 9−−9 9BMZ 2−-2 2UMZ 0−0 OTHERS

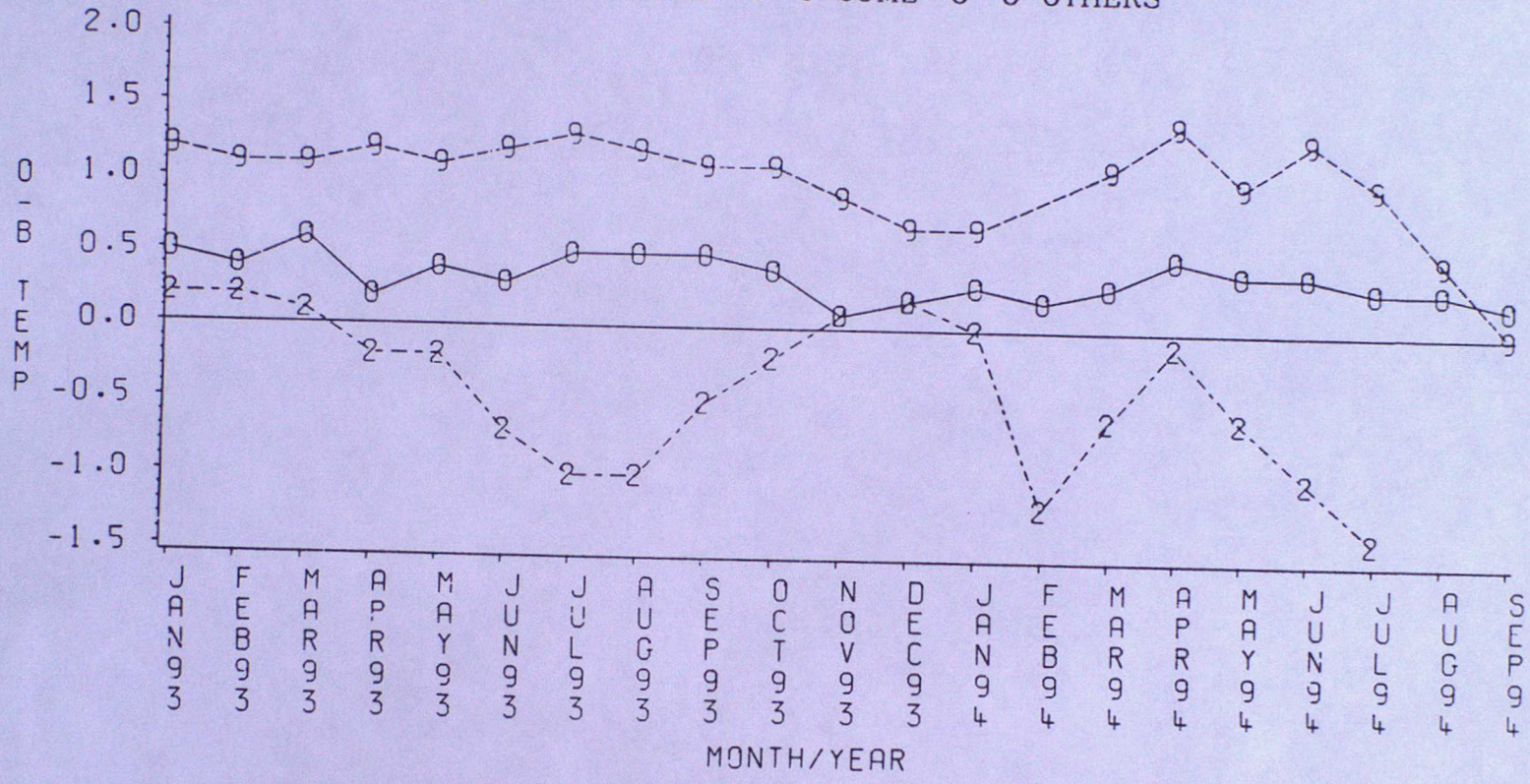
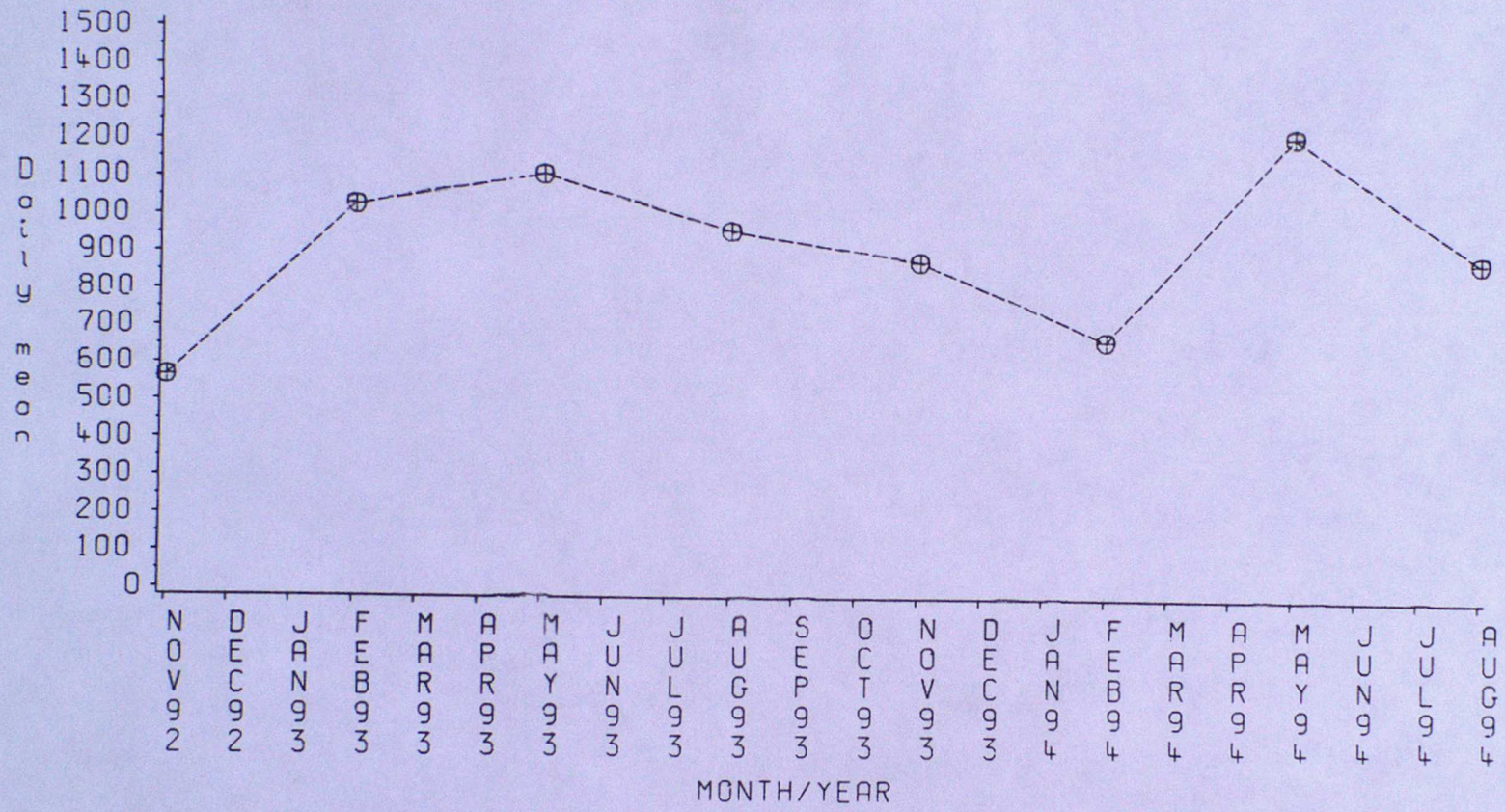


Figure 3

Average daily number of ASDAR reports

Values represent centred 3 month means



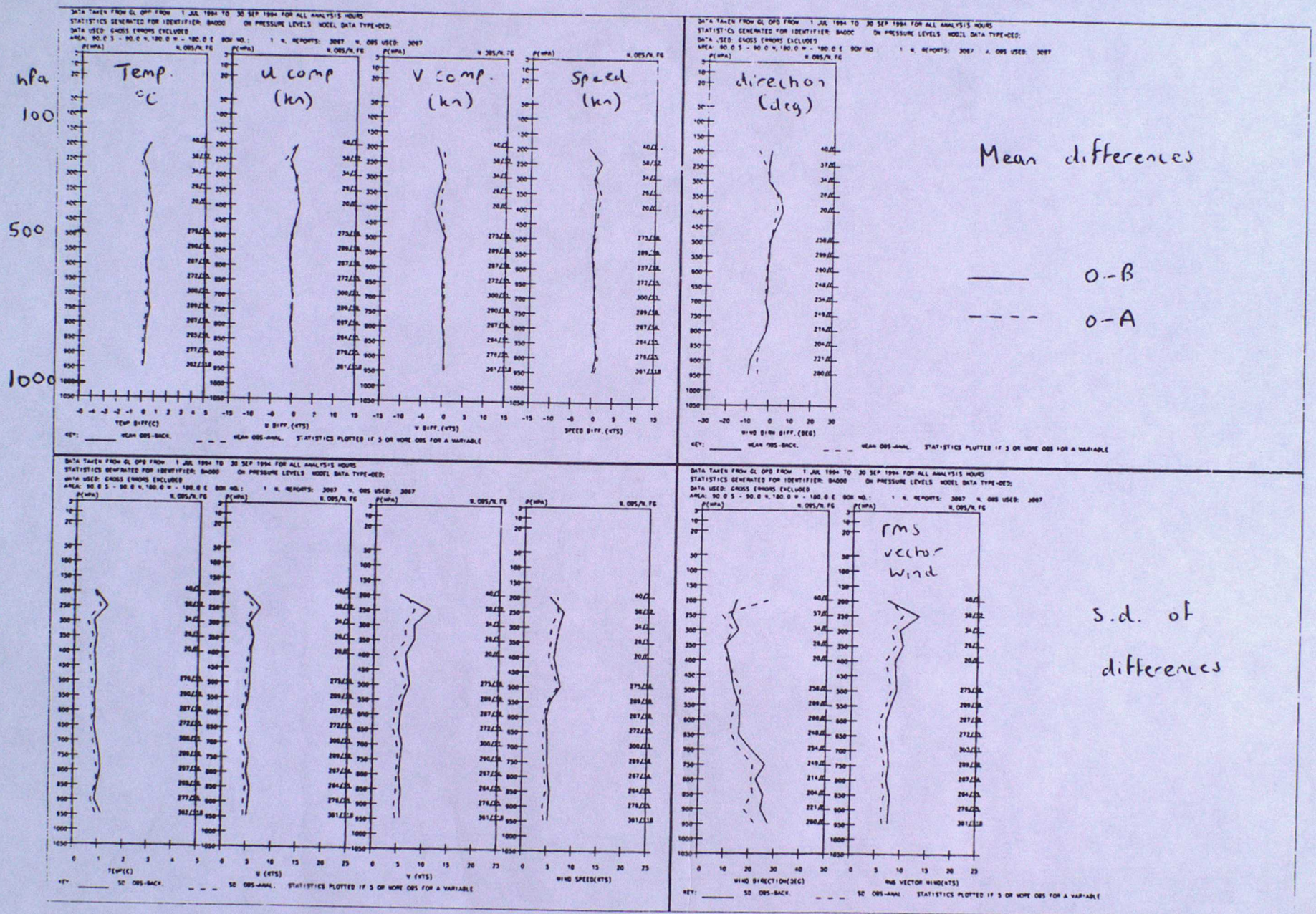
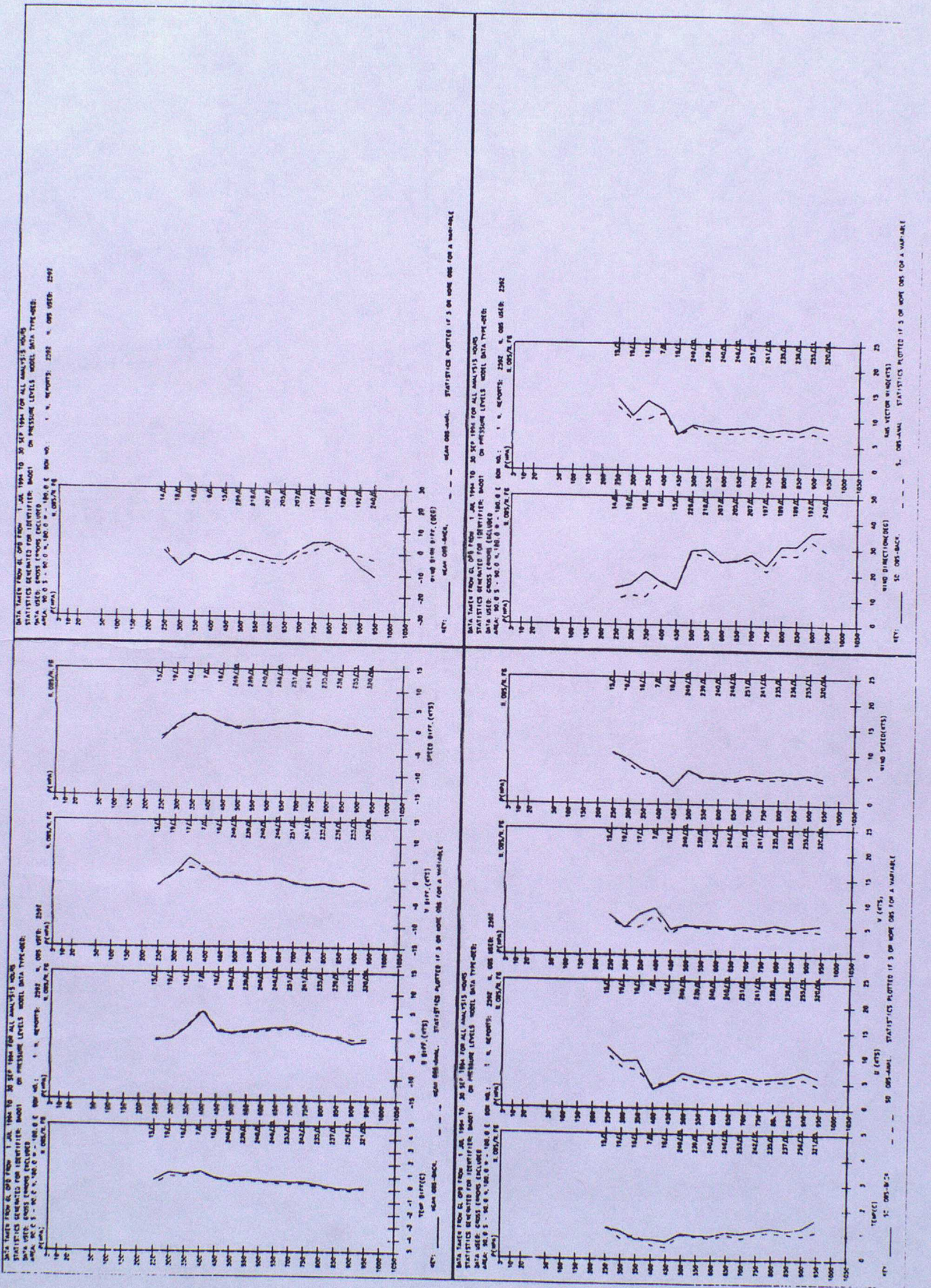


FIGURE 4 : BA000NEZ - MODEL COMPARISON RESULTS (950-150 hPa)

FIGURE 5 : BA001LLZ - MODEL COMPARISON RESULTS (950-150 hPa)



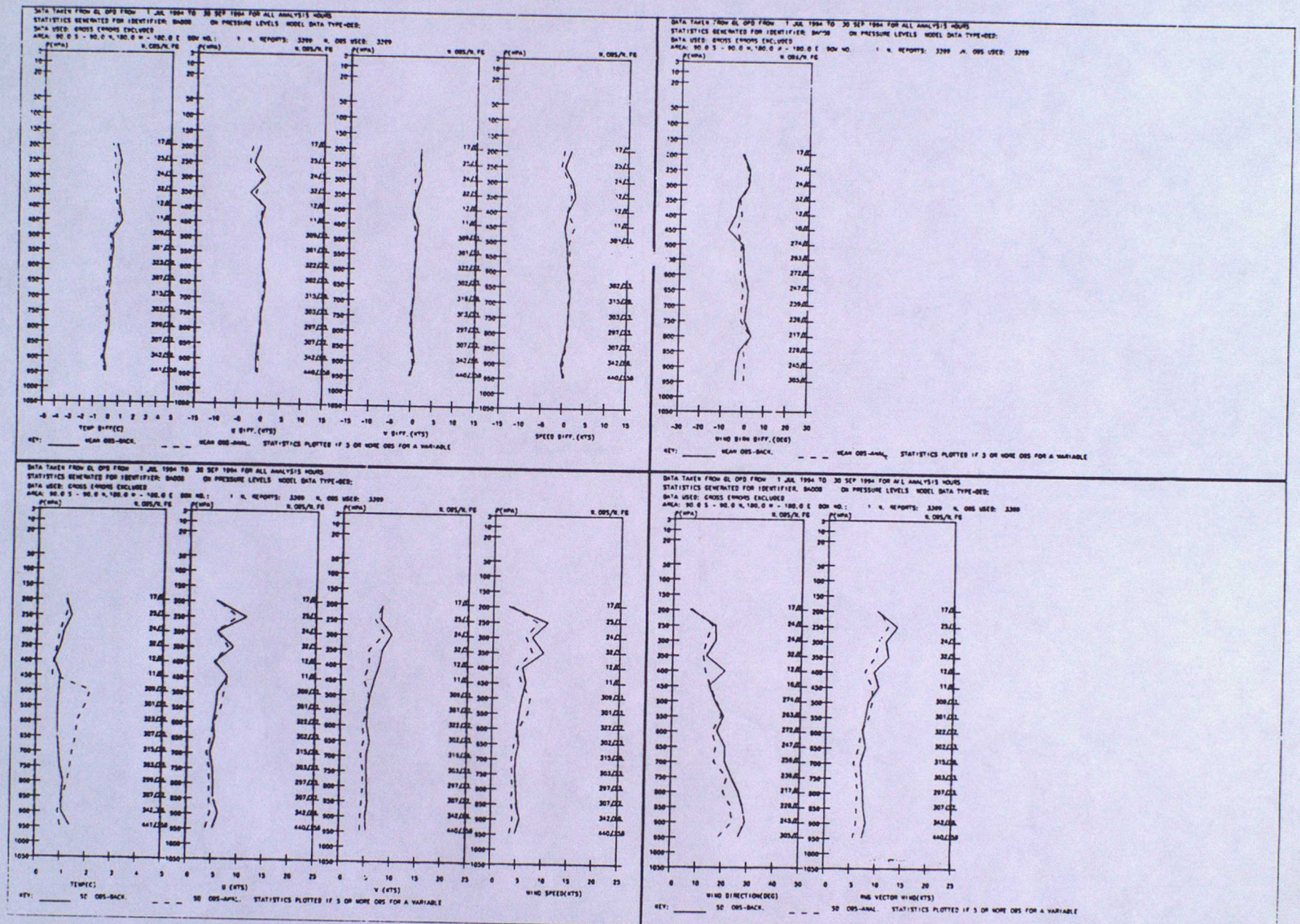


FIGURE 6 : BA008DJZ - MODEL COMPARISON RESULTS (950-150 hPa)

FIGURE 7 : BA009BMZ - MODEL COMPARISON RESULTS (950-150 hPa)

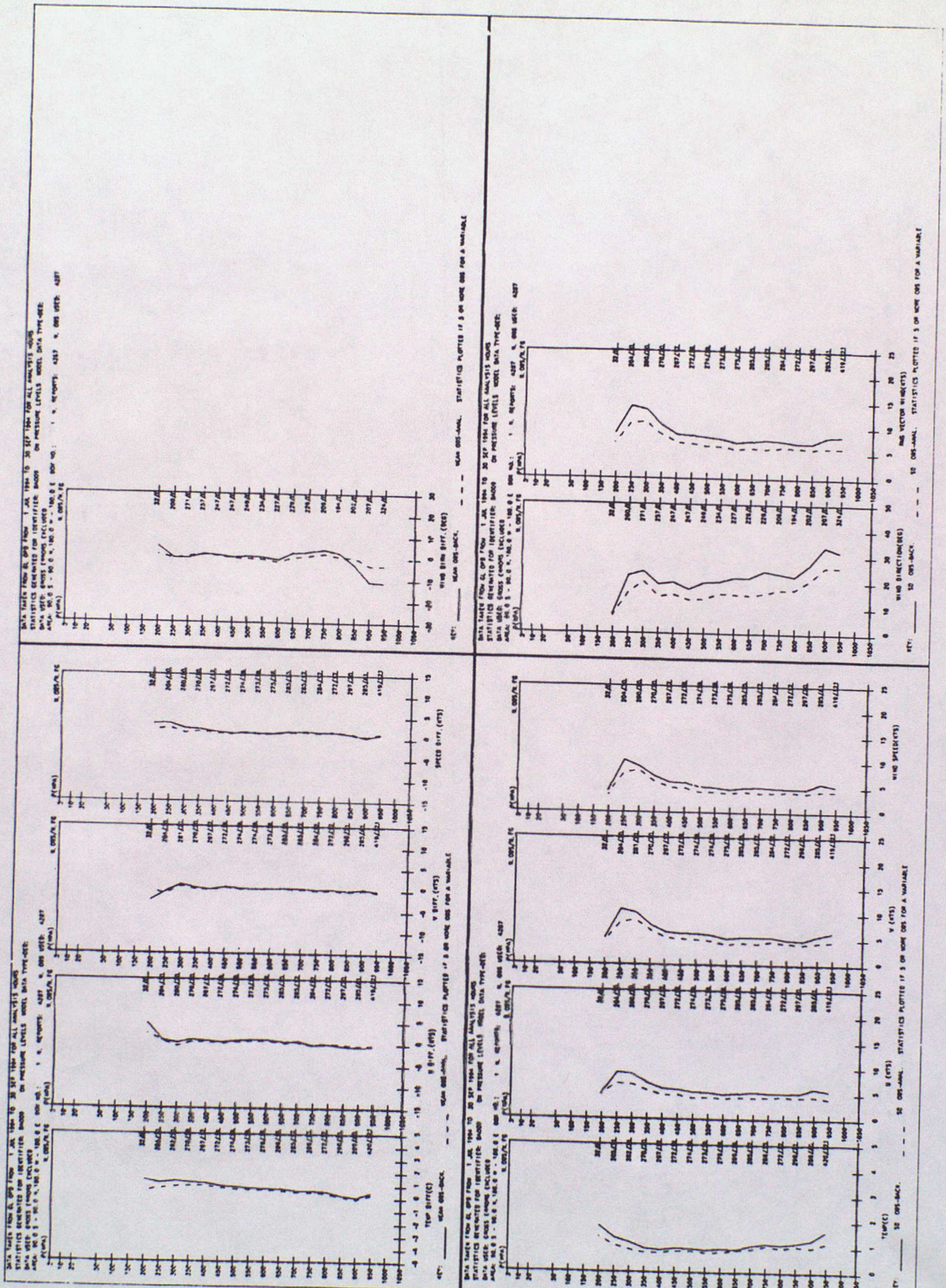


FIGURE 8 : BA010PUZ - MODEL COMPARISON RESULTS (950-150 hPa)

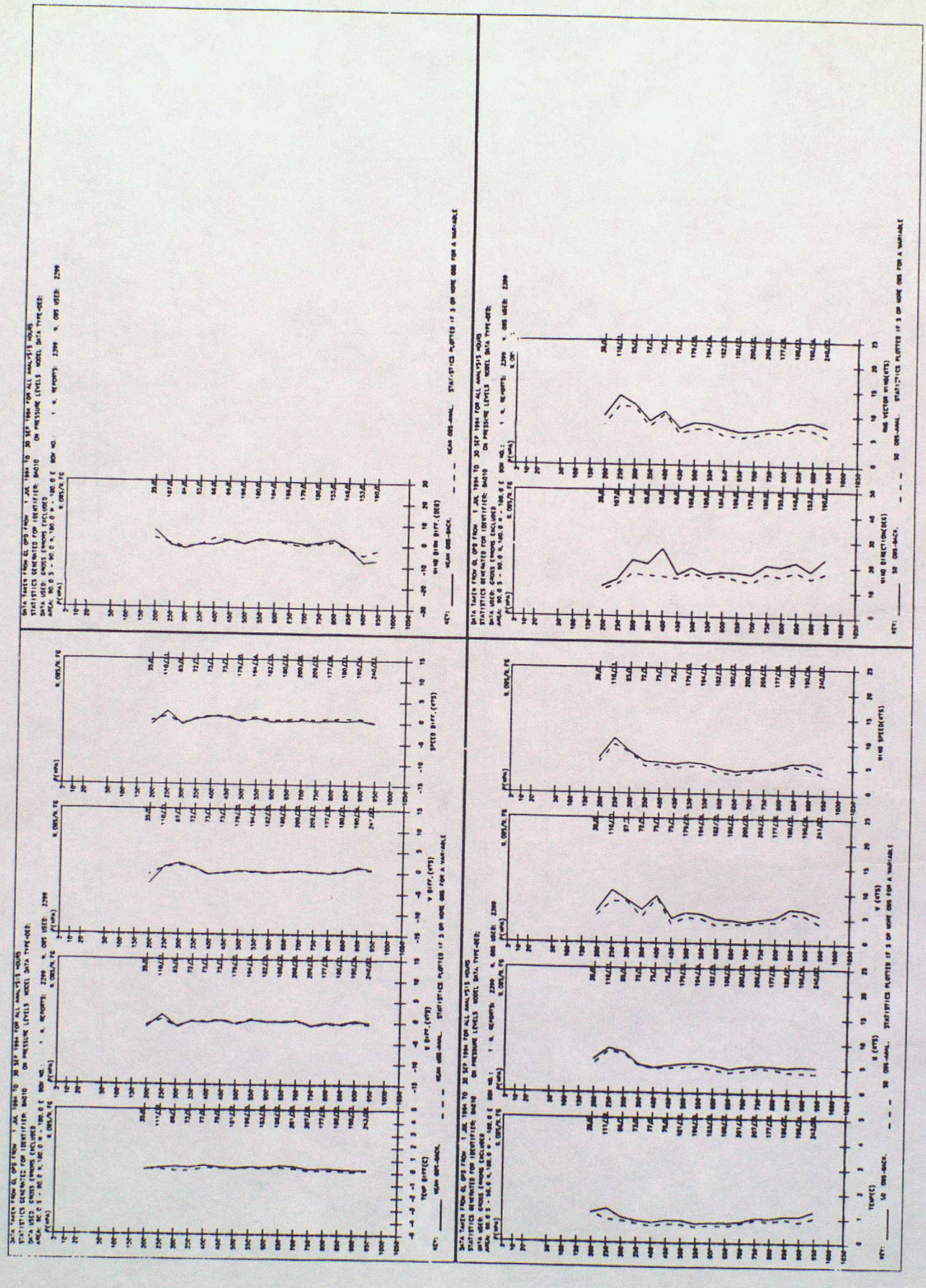


FIGURE 9 : BA025LFZ - MODEL COMPARISON RESULTS (950-150 hPa)

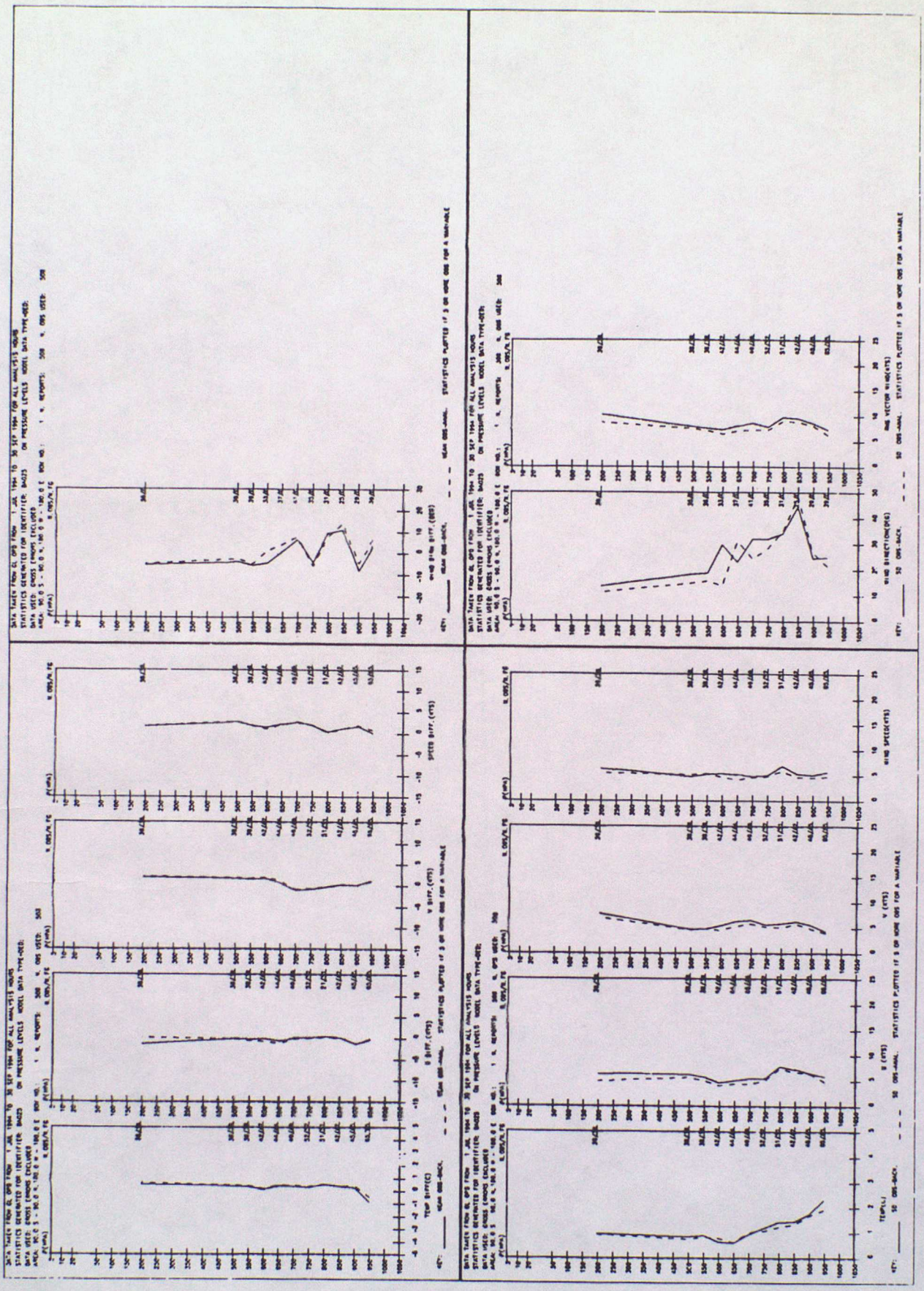
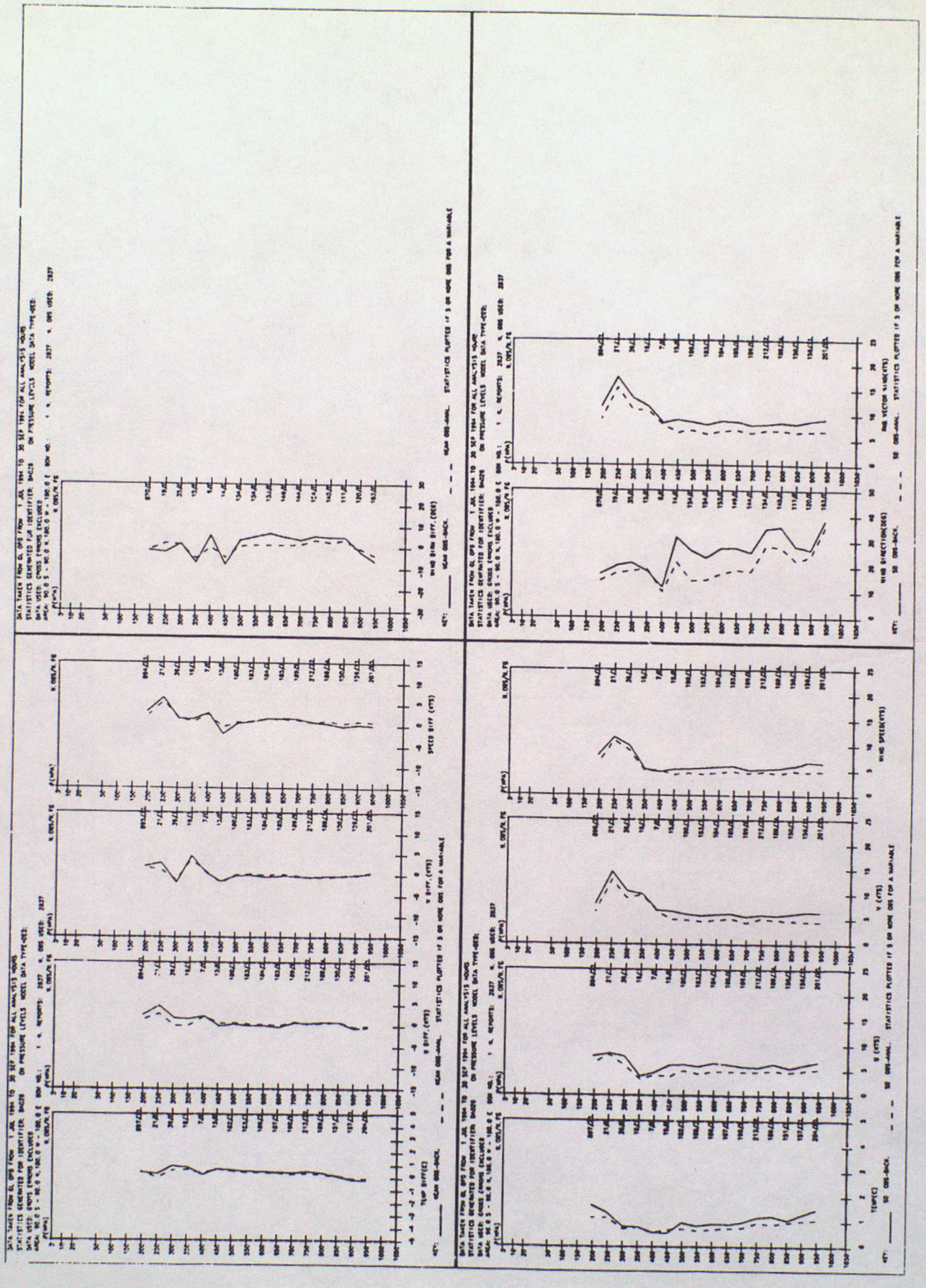


FIGURE 10 : BA026LGZ - MODEL COMPARISON RESULTS (950-150 hPa)



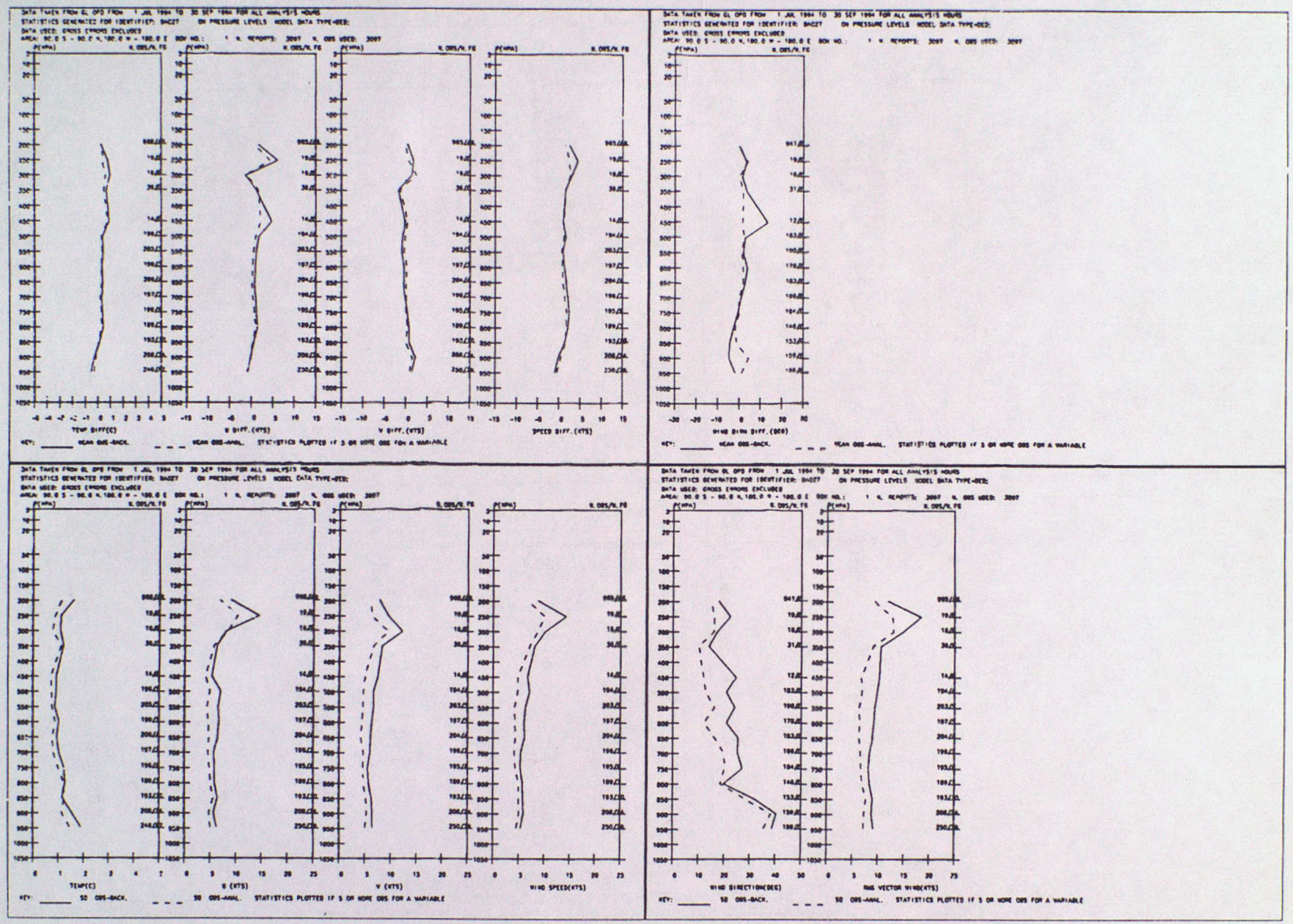


FIGURE 11 : BAQ27LJ2 - MODEL COMPARISON RESULTS (950-150 hPa)

FIGURE 12 : BA028LLZ - MODEL COMPARISON RESULTS (950-150 hPa)