TECHNICAL MEMORANDUM

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Comparison of ECMWF forecasts starting from 00Z data with operational forecasts from the preceding 12Z data

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ABSTRACT

ECMWF operational forecasts use a data cutoff time of close to nine hours and are based on 12Z analyses. The arrival of 00Z GTS data at ECMWF between 0230Z and 0330Z has been monitored for the period 14 to 20 January 1981. Inspection of data coverage charts showing data received in the ECMWF data base at 0230Z, 0300Z and 0330Z shows that while many important data, including Southern Hemisphere and Pacific data (important for the ECMWF global analysis scheme) are received between 0230Z and 0300Z, there is a significantly reduced data inflow between 0300Z and 0330Z. However, many TEMP C and D (high level) reports are not received until after 0330Z.

A series of test forecasts, five in May 1980 and ten in February-April 1981, have been carried out. These forecasts were run to 7½ days, starting from 00Z analyses and with (about) an 03Z data cutoff time. They have been compared, both subjectively and objectively, with the operational forecasts starting from 12Z analyses from the preceding and subsequent days. Data coverage used in the test and operational forecasts was monitored. In one of the test forecasts (that from 00Z 13 May 1980) data coverage was much reduced compared to that of the operational forecasts. In all cases, the short range (to D+2½ of the tests) forecasts were better than the corresponding operational (to D+3) forecasts made from full data coverage, but from analyses of 12 hours earlier.

Comparison of the test and operational forecasts in the medium range, i.e. 3½ to 6½ days of the tests shows that in general the 00Z test forecasts had succeeded in predicting many of the synoptic changes which had occurred between the two operational forecasts. In so far as a 4 to 6-day forecast is normally better than a 5 to 7-day forecast from the preceding day, the 00Z test forecast, even with the reduced data coverage, was in general better than that from 12Z preceding with fuller data cover. However, the test forecast from 00Z 13 May 1980 (with only small data amounts) was a notably poorer forecast than either of the two operational forecasts. Further, the forecast from 00Z 13 February 1981, which was chosen as a test on the basis that the 6-day forecast from 12Z 13 February 1981 was poorer than the 7-day forecast for 24 hours earlier, also showed many of the changes, which resulted in a deterioration from the excellent 7-day forecast preceding the test. Overall, however, the tests indicate that on the average an improvement would be gained in the forecasts if they were to be started from 00Z analysis with a 3-hour data cutoff time.

1. 00Z DATA COVERAGE IN THE ECMWF REPORTS DATA BASE AT 0230Z, 0300Z AND 0330Z

On the nights of 14 to 20 January 1980, data coverage charts, showing the coverage of 2101-0300Z data at that time in the ECMWF Reports Data Base, were produced at about 0230Z, 0300Z and 0330Z. These charts were carefully examined and compared. Table 1 a to g shows in detail the results of this comparison. It is evident that while there was reception of many important 2101-0300Z data between 0230 and 0300, the data inflow was considerably reduced between 0300 and 0330, as most of the data had been received by 0300Z. This was especially true for the TEMP data and also for data from distant and data-sparse regions, including the Pacific and the Southern Hemisphere.

Figure 1, as an example, shows in graphical form the reception of TEMP A,B,C and D report, PILOT A, B, C and D reports and SYNOP reports for the period 2101 18 January 1981 to 0300 19 January 1981 in the data base during the early hours of 19 January, and also the number of these reports received at 2100 on 20 January (when virtually all the reports had been received). Although the number of SYNOP reports only increased from 2,700 to 2,900 and there was only a marginal increase in PILOT and (to a lesser extent), TEMP A and B reports after 0300, there was a notable inflow of (high level) TEMP C and D reports between 0300 and 0545. Figure 2 shows the TEMP coverage received at 0234, 0302 and 0333. Note the increase in TEMP coverage between 0234 and 0302, especially from the Pacific, Asia and Central America.

It appears, therefore, that while 0230 would be too early a time for a data cutoff for the Centre's global analysis scheme, many of the necessary data have been received by 0300. A series of forecast experiments were carried out, which used (about) 0300 as a data cutoff time.

Date	Time	Time	Time
a.14.1.81	0238	0313	0335
SYNOP	most received	extra ships SW Pacific - Australia, isolated elsewhere	no significant change
TEMP		extra A&B West Pacific, Canada. extra C&D China extra reports India, Africa.	isolated extra reports - many C&D still not received
PILOT	most received	isolated extra	isolated extra
AIREP	most received	isolated extra	isolated extra
SATEM	2 orbits received	increase to 3 orbits	increase to 4 orbits
SATOB	both GOES received	no change	no change - Japan still missing
SEA	most received	no change	no change
b.15.1.81	0232	0302	0339
SYNOP	most received	isolated extra ships	no change
TEMP		many extra (A&B, total reports, C&D) received	isolated extra received, many C&D still not received.
PILOT	most received, except Pacific	Pacific received.	no change, a few still not received.
AIREP		slight increase	no change, many still not received.
SATEM	1 orbit received	no change	no change
SATOB	none received	no change	no change
SEA	most received	no change	no change
c.16.1.81	0234	0305	0337
SYNOP	most received	no significant change	some N. African received.
TEMP		Pacific A or B received S. Asia A or B received China B or C received many Antarctic received.	no change
PILOT	some received	no change	no change
AIREP	some received	significant increase	no change
SATEM	1½orbits received	no change	increase to 2½orbits
SATOB	GOES received	no change	no change
SEA	most received	no change	no change

Table 1 continued

d.17.1.81	0234	0302	0412
SYNOP	most received	extra ships SW Pacific isolated elsewhere.	isolated extra received
TEMP		many extra received, including Australia, West Pacific, Asia, N. America.	some extra received including some Southern Hemisphere.
PILOT	most received	isolated extra received, including South Africa.	isolated extra received.
AIREP	most received	some extra received.	isolated extra received.
SATEM	½ orbit received.	no change	increase to 1½ orbits.
SATOB		no change	no change
SEA	most received	no change	no change

e.18.1.81	0236	0305	0349
SYNOP	most received	isolated extra	isolated extra
TEMP		many extra received, including Pacific, Australia, Asia, North America.	some extra, including OWS"L" Asia, Africa, Pacific.
PILOT	most received	isolated extra	no change
AIREP		scattered extra	some extra
SATEM	3 orbits received.	no change	increase to 4 orbits.
SATOB	only N. Hemi-sphere.	S. Hemisphere GOES received received.	no change
SEA	most received	no change	3 extra reports.

f.19.1.81	0234	0302	0333
SYNOP	most received	isolated extra	isolated extra
TEMP		many extra Pacific Asia, Central America	scattered extra including some S. Hemisphere.
PILOT		isolated S. Hemisphere extra	isolated S. Hemisphere extra
AIREP		isolated extra	isolated extra
SATEM	3½orbits received.	no change	increase to 5 orbits
SATOB	GOES received	no change	no change
SEA		few extra, including central Pacific.	no change

Table 1 continued

g.20.1.81	0246	0306	0342
SYNOP	most received	isolated extra	some extra Pacific ships.
TEMP		many extra Asia, Pacific etc.	scattered extra, including Asia, Antarctic and elsewhere.
PILOT	most received	isolated extra	no change
AIREP		isolated extra	isolated extra
SATEM	2 orbits received	no change	no change
SATOB	most received	no change	no change
SEA		isolated extra Pacific	isolated extra

TABLE 1: 2101-0300Z data received in the ECMWF data-base. The centre column indicates the increase in data coverage from (about) 0230Z (left column) to 0300Z. The right column indicates the further increase in coverage to 0330Z. SEA includes DRIBU, BATHY and TESAC reports.

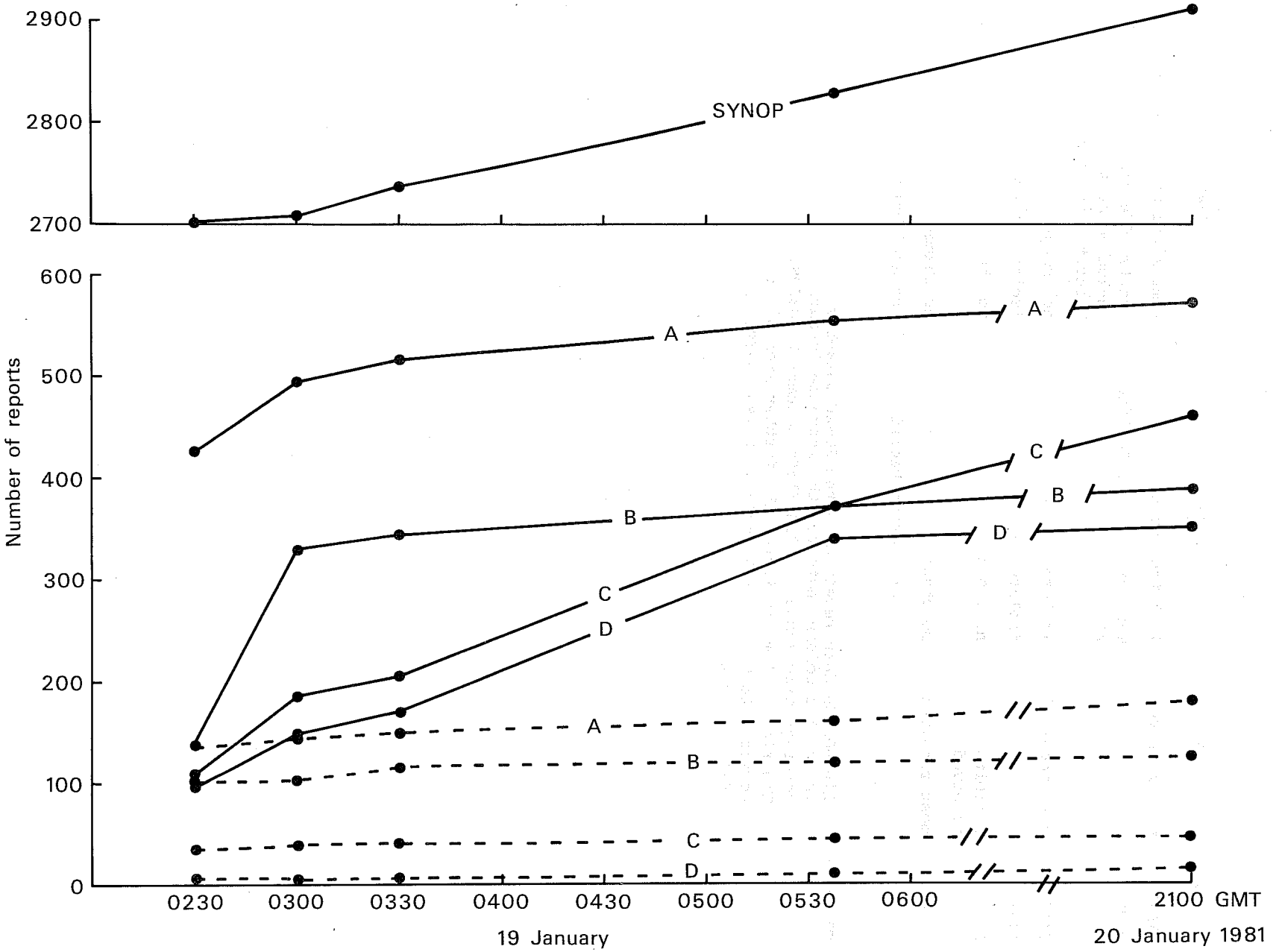

Fig. 1 Number of SYNOP (top), TEMP A,B,C and D (solid lines) and Pilot A,B,C and D (dashed lines) for the period 2101 GMT 18 January to 0300 GMT 19 January received in the ECMWF data-base between 0230 GMT 19 January and 2100 GMT 20 January 1981.

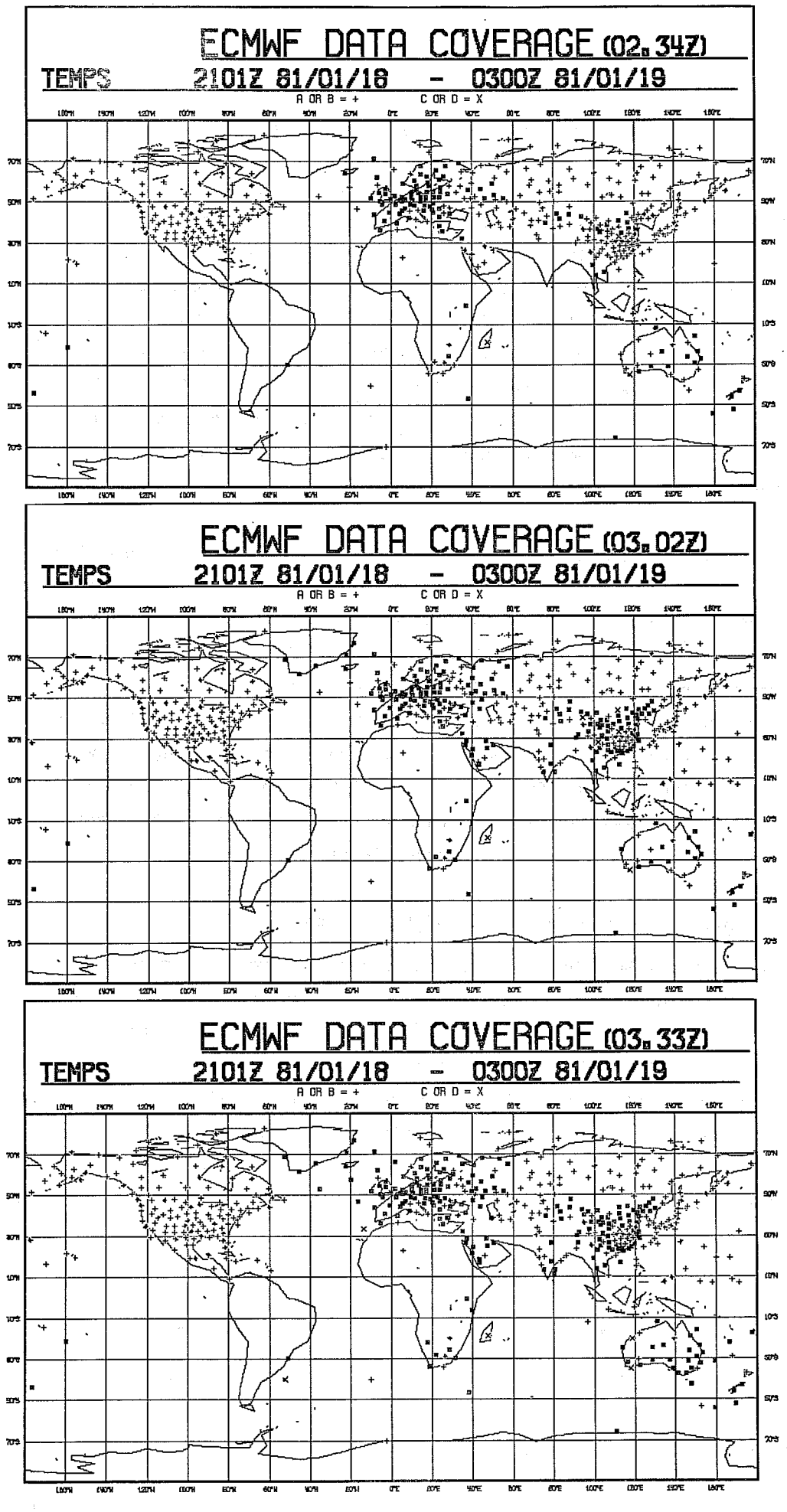

Fig. 2 ECMWF coverage of 00Z TEMP A or B (+), C or D (X) or complete reports(■) in the ECMWF Reports Data Base at 0234Z (top), 0302Z (centre) and at 0333Z (bottom) on 19 January 1981.

2. THE FORECAST EXPERIMENTS - DATA, EVALUATION, RESULTS

2.1 Data and data cut-off times

A series of 15 experiments has been carried out, 5 in May 1980 and 10 in February-April 1981. During May 1980, real-time data acquisition had not yet been implemented, and the data used in the first five tests had a data cutoff time of 0245Z. The last 10 tests had a data cutoff time as close as possible to 0300Z, but for operational reasons, this time was delayed on three occasions, until 0318 (13.2.81), until 0317 (25.2.81) and until 0330 (11.3.81). Table 2 lists the data cutoff times and total number of 2101-0300 reports (all data types) available for the 00Z analysis.

Note that the number of reports received for the test forecast from 00Z 13 May 1980 was substantially reduced compared to the other tests. Figure 3 shows the TEMP (top) and SYNOP (bottom) coverage used in this test. Figure 4 by contrast shows the distribution of TEMP reports received with an 0245Z cutoff on 22 May 1980 (top) compared with the reports received with an 1800Z cutoff (bottom). It can be seen that while some, especially southern hemisphere, reports were not received in time for the test of 22 May, the majority of TEMP reports had been received and this was true for most of the tests. The case of the 13 May is discussed later.

2.2 Synoptic situation and choice of test cases

During May 1980, the flow over the Atlantic-European region had a large meridional component and the tests were, in general, of blocking situations. The 1981 series of tests were made during a mixed weather regime and included a test of a blocking situation (from 13.2.81) of predominantly zonal flow (from 24.3.81) and of change of flow from predominantly meridional to predominantly zonal (from 14.3.81).

The test forecasts were chosen with several criteria in mind, including

- data coverage
- synoptic situation
- evolution of the operational forecasts, to include especially cases where there were significant changes between two operational forecasts in the medium range of the forecasts, i.e. in the period D+4 to D+7.

The test forecasts were run to 7½ days, the operational forecasts had been run to 10 days.

Date of 00Z analysis	Data cutoff time	Number of 2101-0300 reports available
7.5.1980	0245	5622
13.5.1980	0245	2311
15.5.1980	0245	4598
20.5.1980	0245	5716
22.5.1980	0245	5849
13.2.1981	0318	4400
25.2.1981	0317	5166
11.3.1981	0330	4956
14.3.1981	0303	5415
24.3.1981	0304	5286
31.3.1981	0302	5509
10.4.1981	0301	4972
13.4.1981	0305	4944
16.4.1981	0304	5338
22.4.1981	0323	5750

TABLE 2. Data cutoff times and total number of 2101-0300Z reports received for the fifteen forecast experiments.

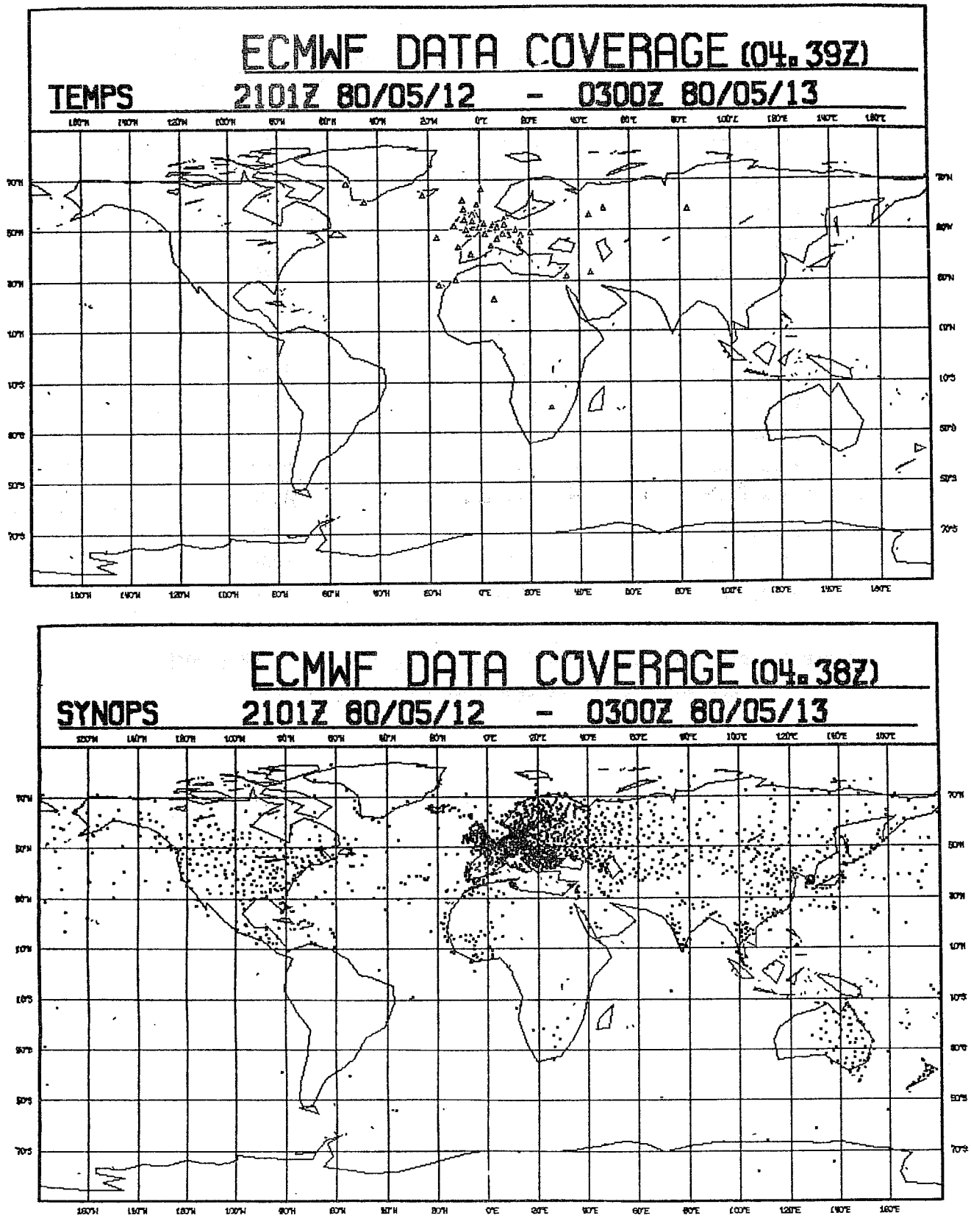

Figure 3. TEMP (top) and SYNOP (bottom) data coverage used in the test from 00Z 13 May 1980

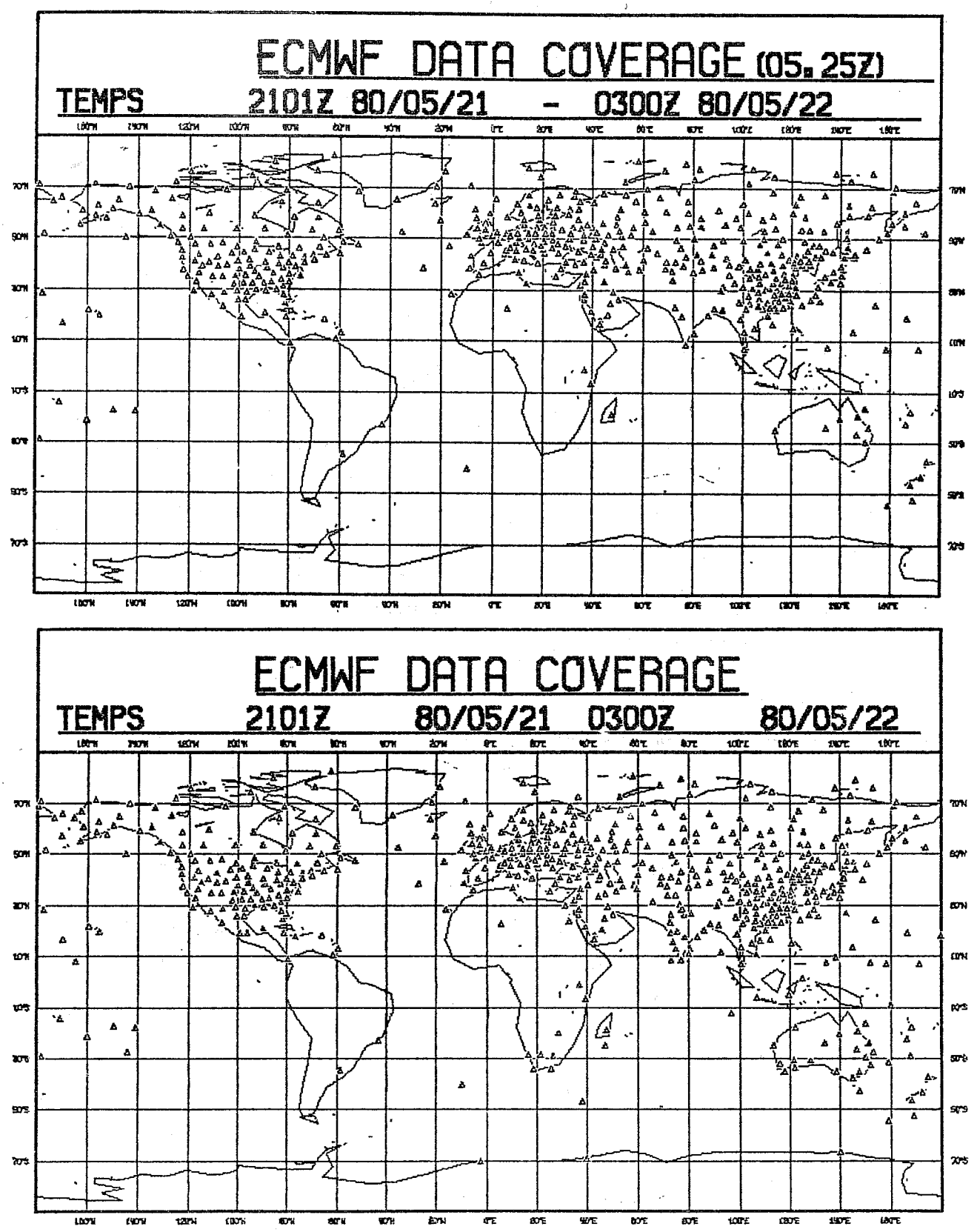

Figure 4. 00Z TEMP coverage for test from 00Z 22 May 1980 (top) compared with total number of 00Z TEMP reports received by 18Z 22 May 1980 (bottom)

2.3 Evaluation of the results

2.3.1 Synoptic evaluation

The synoptic evaluation was concentrated on the Atlantic-European area, although evaluation was also made over the rest of the Northern Hemisphere and, to a lesser extent, of the Southern Hemisphere.

The 00Z test forecasts were compared with the 12Z operational forecasts preceding and following the test, and with the verifying analyses. The evaluation was mainly in the time-scale D+3 to D+7 (i.e. D+2½ to D+6½ of the test forecasts). The evaluation especially concentrated on significant synoptic events affecting the European area, which in general were the events which led to the choice of these particular forecasts as test cases. The experiments were carefully examined to see if they had succeeded in predicting the changes which had occurred between the two 12Z operational forecasts. They were also scored on a 5-point scale (-2, -1, 0, +1, +2) as to whether they were better than (positive score) the same as (0 score) or worse then (negative score) the 12Z operational forecast preceding the 00Z test.

2.3.2 Objective verification

Objective scores were computed for the forecasts. For the ten 1981 tests these scores include standard deviation of forecast errors and anomaly correlations for the northern hemisphere and the S1 skill score for the European area. Not all these scores were available for the 1980 tests. The scores for the 1980 tests include standard deviation of forecast errors and tendency correlations (for the northern hemisphere) and standard deviation of forecast errors (for the European area). Objective scores are not available for the test runs of 20 and 22 May 1980.

2.3.3 Results

Table 3 summarises the results of both the synoptic evaluation and the objective verification of the tests. Tables 4 to 6 give in detail the 500mb objective scores for each of the ten 1981 experiments including hemispheric standard deviation of forecast error (Table 4), hemispheric anomaly correlation coefficients (Table 5) and European area S1 skill scores (Table 6). Table 7 gives the hemispheric standard deviations of forecast error, hemispheric tendency correlations and European area standard deviations of forecast error for three of the five 1980 tests. Objective scores for the remaining two 1980 tests are not available.

Tables 4 to 7 show that in all cases, the short-range (to D+2½ of the tests) forecasts were better than the corresponding short range (to D+3) forecasts made from full data coverage but from analyses of 12 hours earlier.

Table 3 shows that seven of the test forecasts predicted the changes which had occurred in the medium range between the two 12Z operational forecasts, four did not while the remaining four were not significantly more like either of the two operational forecasts from the synoptic point of view. The forecast from 00Z 13 May 1980 was notably poorer than that from 12Z 12 May (see also next section), but in this case, the data coverage was substantially reduced below the normal. Subjectively for the European area, two experiments were much better than the preceding 12Z operational forecasts, four were better, seven were of similar quality, one was worse and one (that of 13 May 1980) was much worse.

For the objective scores, over the hemisphere 2 of the forecasts were much better, 5 were better, 4 were of similar quality, 2 were worse. For the European area, 3 of the forecasts were much better, 5 were better, 1 was of similar quality and 4 were worse.

Figure 5 shows the mean standard deviation of forecast error and anomaly correlation scores for the northern hemisphere and the skill score for the European area for the ten 1981 experiments. Inspection of this figure shows the curves to be displaced by about 12 hours in the 00Z test forecasts. This indicates that the benefit of using later data overwhelmingly compensates for the penalty incurred by the lack of complete stratospheric and southern hemispheric data in the final data analysis and initialization cycle.

These experiments are not random, but were selected on the basis of, amongst other criteria, synoptic situations which in most cases included significant changes during the forecasts. While we cannot therefore conclude that a similar gain would result from a random series of tests, it is clear that there is on the average a substantial benefit to be gained by the use of later data.

Date of Test	Synoptic Evaluation (European area, D+3½ to D+6½)			Objective Verification (D+3½ to D+6½)	
	Test forecast more like 12Z operational forecast—		Test forecast compared with preceding 12Z operational forecast	Test forecast compared with preceding 12Z operational forecast	
	Preceding Test	Following Test		Northern Hemisphere	Europe
7.5.80	✓		0	+1	+1
13.5.80	-	-	-2	-1	-1
15.5.80		✓	0	0	+1
20.5.80		✓	0	N/A	N/A
22.5.80		✓	+1	N/A	N/A
13.2.81		✓	-1	0	-1
25.2.81	-	-	+1	+1	+1
11.3.81		✓	+2	-1	+2
14.3.81	✓		+1	+1	+1
24.3.81	-	-	0	0	-1
31.3.81		✓	+2	+2	+2
10.4.81	✓		0	+1	+1
13.4.81	✓		0	0	-1
16.4.81	-	-	+1	+2	0
22.4.81		✓	0	+1	+2

TABLE 3. Summary of Synoptic evaluation (left) and objective verification (right) of the 00Z test forecasts compared with the 12Z operational forecasts. D+3½ to D+6½ of the test forecasts are compared with D+4 to D+7 of the operational forecasts. The scale used in comparison is from -2(test much worse) to +2 (test much better).

NH SDE		DATE OF VALIDITY OF FORECAST (12Z)						
		13	14	15	16	17	18	19
12.2.81	12Z	25	46	58	69	73	71	82
13.2.81	00Z	17	37	52	69	80	89	106
13.2.81	12Z	-	26	40	58	69	77	85
		25	26	27	28	01	02	03
24.2.81	12Z	20	34	49	63	89	112	121
25.2.81	00Z	15	30	48	61	78	102	115
25.2.81	12Z	-	22	35	48	63	80	88
		11	12	13	14	15	16	17
10.3.81	12Z	21	38	46	60	76	90	111
11.3.81	00Z	12	29	38	61	89	105	127
11.3.81	12Z	-	21	32	53	72	84	109
		14	15	16	17	18	19	20
13.3.81	12Z	22	39	57	84	118	139	149
14.3.81	00Z	14	29	48	71	94	114	126
14.3.81	12Z	-	23	43	65	80	98	101
		24	25	26	27	28	29	30
23.3.81	12Z	20	32	51	73	89	101	-
24.3.81	00Z	15	26	46	70	95	109	N/A
24.3.81	12Z	-	20	37	56	72	84	-
		31	01	02	03	04	05	06
30.3.81	12Z	21	39	64	84	91	98	104
31.3.81	00Z	12	26	45	60	69	76	82
31.3.81	12Z	-	22	40	56	67	71	73
		10	11	12	13	14	15	16
9.4.81	12Z	23	39	57	73	84	99	122
10.4.81	00Z	16	31	48	65	78	89	99
10.4.81	12Z	-	22	37	53	68	75	86
		13	14	15	16	17	18	19
12.4.81	12Z	19	35	49	59	67	88	101
13.4.81	00Z	14	28	44	56	68	88	102
13.4.81	12Z	-	20	34	43	53	77	101

Table 4 continued.

		16	17	18	19	20	21	22
15.4.81	12Z	21	33	56	75	84	94	96
16.4.81	00Z	16	28	48	61	65	74	73
16.4.81	12Z	-	19	37	53	66	83	85
		22	23	24	25	26	27	28
21.4.81	12Z	16	29	39	53	73	95	113
22.4.81	00Z	15	29	39	48	62	79	93
22.4.81	12Z	-	19	32	51	61	76	93

TABLE 4: Northern hemisphere (18N to 78N) standard deviation of forecast error scores at 500mb for the ten 1981 experimental forecasts and for the operational forecasts preceding and following the tests. Scores in vertical columns are the scores of forecasts verifying at the same time. Scores are underlined when the experimental forecast improves on the preceding operational forecast (D+3½ to D+6½ only).

NH ANOM CORREL.		DATE OF VALIDITY OF FORECAST (12Z)						
		13	14	15	16	17	18	19
12.2.81	12Z	98	93	87	82	79	80	75
13.2.81	00Z	99	98	95	90	83	78	72
13.2.81	12Z	-	98	94	88	82	78	72
		25	26	27	28	01	02	03
24.2.81	12Z	99	96	91	84	63	42	35
25.2.81	00Z	99	97	92	85	71	50	41
25.2.81	12Z	-	99	96	91	81	69	63
		11	12	13	14	15	16	17
10.3.81	12Z	98	93	91	85	75	65	51
11.3.81	00Z	99	96	93	84	67	54	34
11.3.81	12Z	-	98	95	88	79	71	54
		14	15	16	17	18	19	20
13.3.81	12Z	98	94	87	74	52	34	24
14.3.81	00Z	99	96	90	82	70	55	45
14.3.81	12Z	-	98	92	84	77	61	57
		24	25	26	27	28	29	30
23.3.81	12Z	98	95	87	71	58	44	-
24.3.81	00Z	99	97	89	73	53	37	N/A
24.3.81	12Z	-	98	93	82	71	60	-
		31	01	02	03	04	05	06
30.3.81	12Z	98	92	76	58	50	43	36
31.3.81	00Z	99	96	88	78	72	65	57
31.3.81	12Z	-	97	90	82	77	73	70
		10	11	12	13	14	15	16
9.4.81	12Z	97	91	80	68	63	54	30
10.4.81	00Z	99	94	86	73	66	62	50
10.4.81	12Z	-	97	91	82	73	73	64
		13	14	15	16	17	18	19
12.4.81	12Z	98	94	90	84	78	64	47
13.4.81	00Z	99	95	91	87	79	63	44
13.4.81	12Z	-	98	95	91	86	72	47

Table 5 continued

		16	17	18	19	20	21	22
15.4.81	12Z	98	95	85	71	63	51	50
16.4.81	00Z	99	96	89	80	77	70	72
16.4.81	12Z	-	98	94	86	77	66	68
		22	23	24	25	26	27	28
21.4.81	12Z	99	96	92	83	67	45	24
22.4.81	00Z	99	96	92	86	76	58	43
22.4.81	12Z	-	98	94	84	77	62	41

TABLE 5: As Table 4, but northern hemisphere anomaly correlations.

EUROPEAN S1 Score

		DATE OF VALIDITY OF FORECAST (12Z)						
		13	14	15	16	17	18	19
12.2.81	12Z	19	37	49	63	67	70	71
13.2.81	00Z	15	37	50	61	73	91	92
13.2.81	12Z	-	30	42	61	71	65	77
		25	26	27	28	01	02	03
24.2.81	12Z	26	48	59	58	75	78	77
25.2.81	00Z	15	36	45	52	67	65	69
25.2.81	12Z	-	27	37	43	53	56	72
		11	12	13	14	15	16	17
10.3.81	12Z	19	33	46	64	72	71	74
11.3.81	00Z	12	26	41	57	61	66	55
11.3.81	12Z	-	20	39	60	57	60	73
		14	15	16	17	18	19	20
13.3.81	12Z	29	47	55	63	71	83	95
14.3.81	00Z	22	43	52	56	53	64	82
14.3.81	12Z	-	31	50	67	72	75	79
		24	25	26	27	28	29	30
23.3.81	12Z	20	25	44	61	66	67	-
24.3.81	00Z	15	25	48	61	69	76	N/A
24.3.81	12Z	-	23	43	56	72	82	-
		31	01	02	03	04	05	06
30.3.81	12Z	25	50	83	93	99	84	82
31.3.81	00Z	13	35	56	60	66	71	60
31.3.81	12Z	-	26	46	57	72	69	65
		10	11	12	13	14	15	16
9.4.81	12Z	23	42	41	69	76	65	83
10.4.81	00Z	16	30	33	62	71	62	84
10.4.81	12Z	-	21	33	63	70	61	63
		13	14	15	16	17	18	19
12.4.81	12Z	24	29	36	56	67	80	74
13.4.81	00Z	16	26	41	60	82	87	81
13.4.81	12Z	-	16	39	55	77	91	98

Table 6 continued

		16	17	18	19	20	21	22
15.4.81	12Z	24	45	45	52	61	78	81
16.4.81	00Z	17	45	45	58	64	72	67
16.4.81	12Z	-	27	33	49	64	77	74
		22	23	24	25	26	27	28
21.4.81	12Z	26	46	60	68	76	85	83
22.4.81	00Z	17	34	43	49	51	62	69
22.4.81	12Z	-	21	38	46	49	61	70

TABLE 6: As Table 4, but European area (36-72N, 12W-42E) S1 skill scores.

NH SDE

		7	8	9	10	11	12	13
6.5.80	12Z	24	41	55	74	84	89	96
7.5.80	00Z	17	35	49	65	74	86	96
		13	14	15	16	17	18	19
12.5.80	12Z	22	39	48	62	64	71	89
13.5.80	00Z	19	35	46	66	79	85	100
		15	16	17	18	19	20	21
14.5.80	12Z	22	39	48	62	64	71	89
15.5.80	00Z	17	32	43	52	67	78	121
20.5.80	N/A							
22.5.80	N/A							

EUROPEAN SDE

		7	8	9	10	11	12	13
6.5.80	12Z	22	31	68	106	113	126	126
7.5.80	00Z	11	19	47	72	82	107	115
		13	14	15	16	17	18	19
12.5.80	12Z	24	40	52	52	50	52	65
13.5.80	00Z	17	33	55	63	63	69	77
		15	16	17	18	19	20	21
14.5.80	12Z	15	25	45	47	55	69	97
15.5.80	00Z	14	28	42	42	46	55	89
20.5.80	N/A							
22.5.80	N/A							

NH TEND CORREL

		7	8	9	10	11	12	13
6.5.80	12Z	.90	.85	.81	.74	.72	.70	.67
7.5.80	00Z	.95	.89	.85	.79	.76	.71	.67
		13	14	15	16	17	18	19
12.5.80	12Z	.91	.89	.89	.84	.81	.75	.66
13.5.80	00Z	.94	.90	.90	.82	.72	.63	.57
		15	16	17	18	19	20	21
14.5.80	12Z	.95	.93	.92	.88	.83	.80	.57
15.5.80	00Z	.97	.95	.94	.91	.85	.79	.55
20.5.80	N/A							
22.5.80	N/A							

Table 7: Northern Hemisphere (top) and European area (centre) standard deviation of forecast errors, and Northern Hemisphere tendency correlation (bottom) for three of the five 1980 experiments.

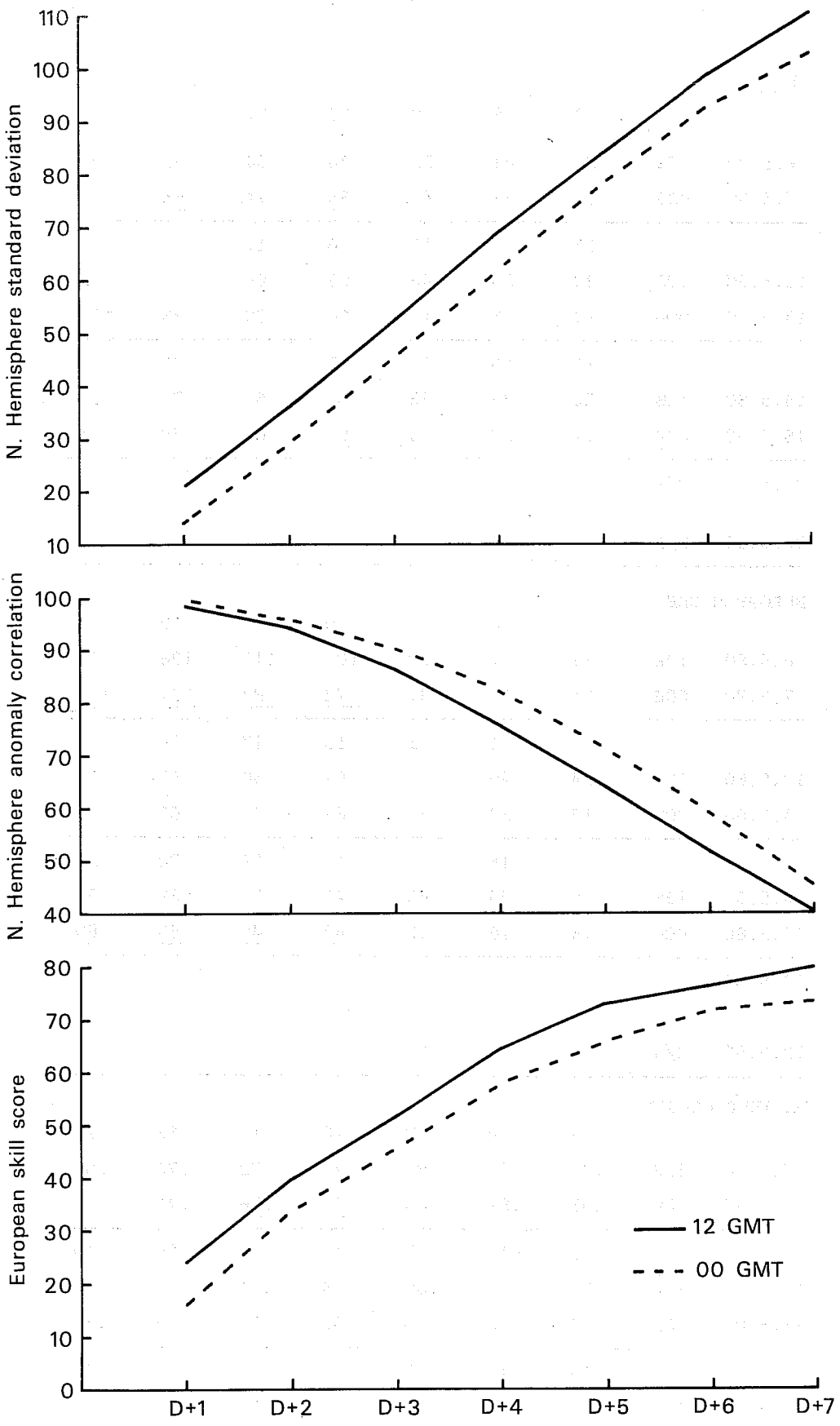

Fig. 5 Average northern hemisphere standard deviation of forecast error (top), anomaly correlation (centre) and European area skill scores (bottom) for the ten 1981 00 GMT tests and for the 12 GMT operational forecasts preceding the test. The forecast day indicated on the abscissa applies to the 12 GMT operational forecast, the scores for the 00 GMT tests being for $\frac{1}{2}$ day earlier in the forecasts.

2.3.4 Examples and discussion

Test from 00Z 13 February 1981.

This date was chosen as a test because the operational forecast from 12Z 12 February 1981 was an excellent forecast to D+7 and later, while the operational forecast following, from 12Z 13 February 1981 was not quite as good (Tables 4 to 6). Figure 6 shows the D+7 and D+6 operational forecasts, the D+6½ test forecast and the verifying analysis. The excellence of the D+7 operational forecast is obvious. Note the block over Europe, the northerly position of the jet and the cutoff low near 40W. The D+6 operational forecast was rather less successful in the prediction of details of the flow and since the test forecast included some of the features of both operational forecasts, the addition of the 00Z analysis in this case meant that the 00Z forecast was not as good as the preceding 12Z forecast.

Test from 00Z 11 March 1981

Figure 7 shows the D+7 and D+6 operational forecasts, the D+6½ test forecast and the verifying analysis. At this time, the operational forecasts were near the 60% score in the hemispheric anomaly correlations (Table 5) and although the hemispheric scores indicate a lower performance for the test forecast, the score for the European area (Table 6) shows a substantial improvement in the score. Inspection of Figure 7 shows that the test forecast for Europe was a notable improvement synoptically on the preceding operational forecast. Compare the flow over Scandinavia, over western and central Europe and over southern Europe and the Mediterranean.

Test from 00Z 31 March 1981

Figure 8 shows the D+5 and D+4 operational forecasts, the D+4½ test forecast and the verifying analysis. Most of the substantial change that is evident between the two operational forecasts had been captured by the 00Z test resulting also in a distinct improvement in the objective scores (Tables 4 to 6). The treatment of the trough near OE has been improved, although the intensity of the cutoff low in the eastern Atlantic clearly still was not deepended sufficiently by the experimental forecast.

Test from 00Z 13 May 1980

It has been noted that this test was run with very sparse data (Fig. 3) and that this was one of the worst forecasts made in the series of tests (Table 3). Figure 9 shows the hemispheric D+5 and D+4 operational forecasts from before and after the test, the D+4½ test forecast and the analysis verifying these forecasts. It is apparent that the test forecast seriously changed the evolution of the high centred in the North Sea. No other test forecasts have been made with such sparse data coverage. Further tests would be necessary to fully investigate this problem. Changes which have been made to the operational data assimilation since the test ensure that there would be no impact on the model fields by the analysis scheme in areas of no data.

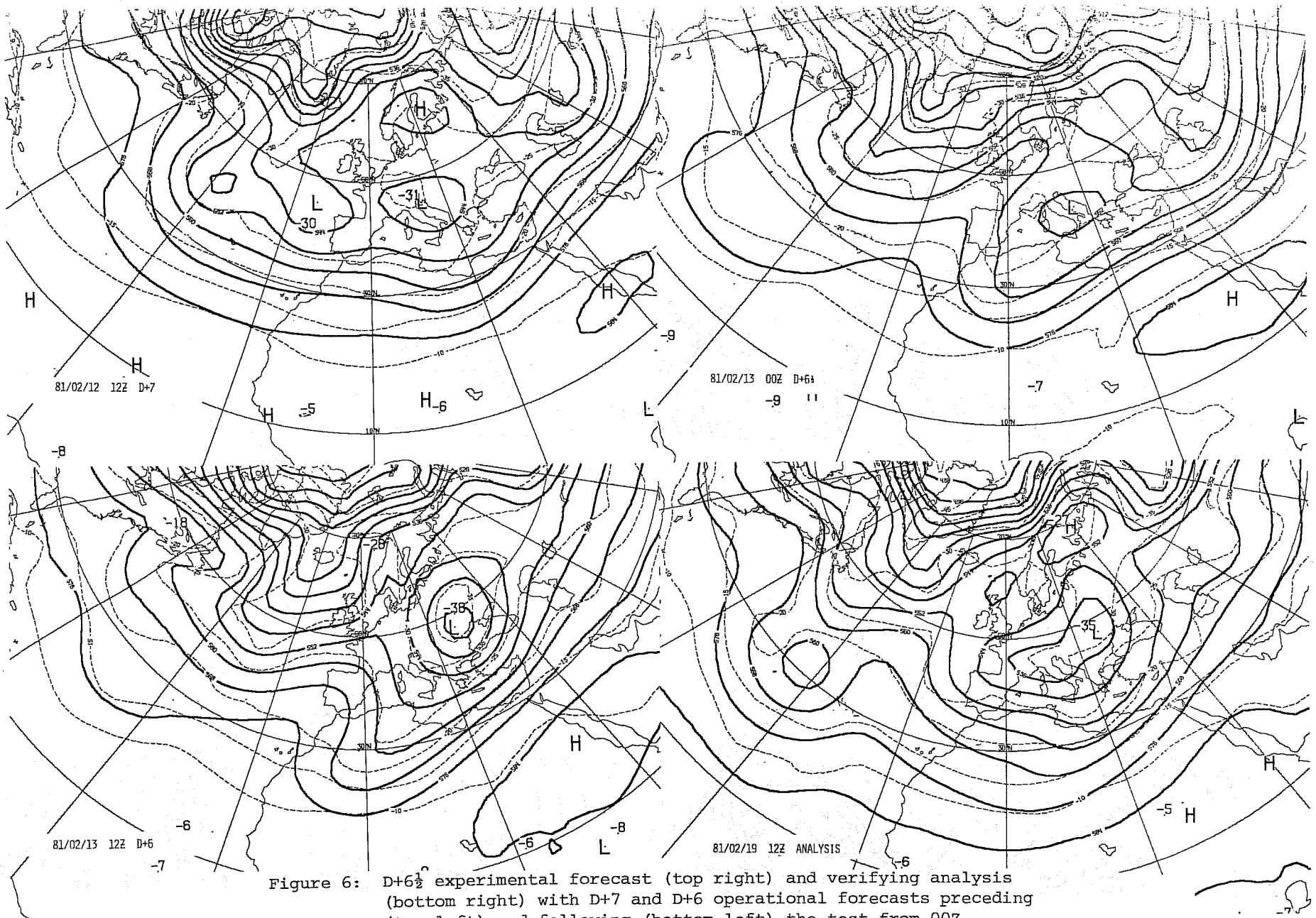

Figure 6: D+6½ experimental forecast (top right) and verifying analysis (bottom right) with D+7 and D+6 operational forecasts preceding (top left) and following (bottom left) the test from 00Z 13 February 1981.

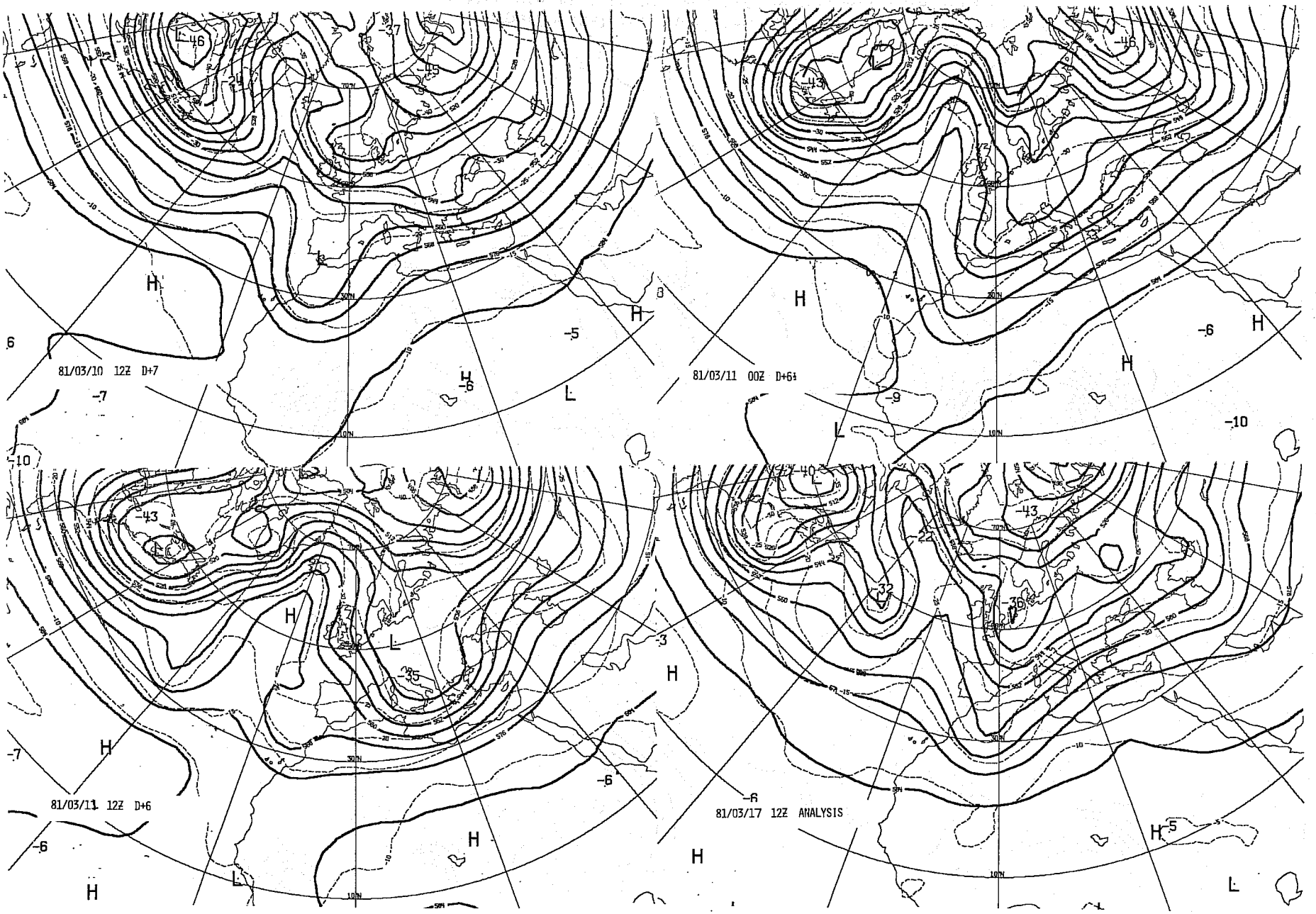

Figure 7: As Figure 6, but for the test from 00Z 11 March 1981

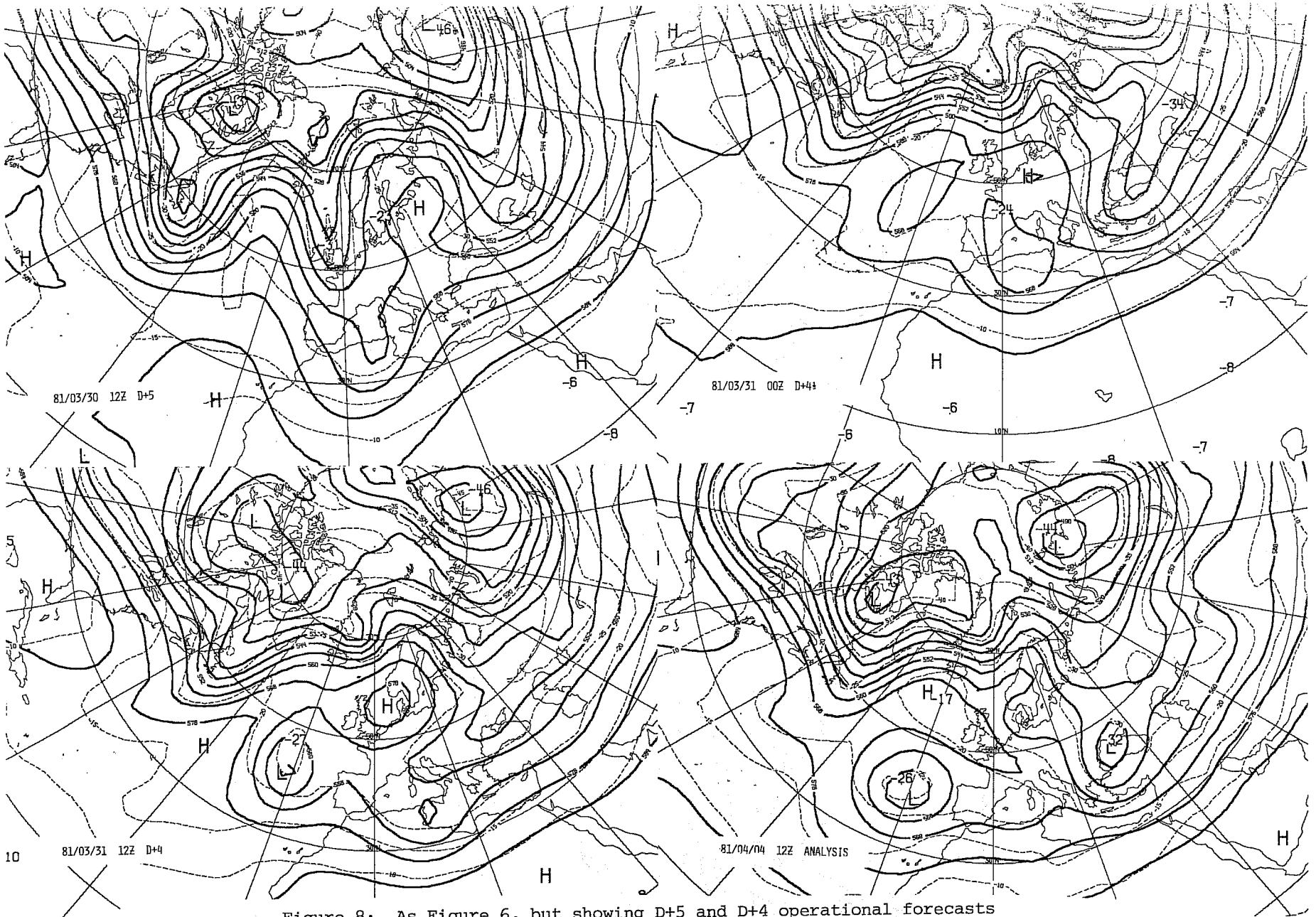

Figure 8: As Figure 6, but showing D+5 and D+4 operational forecasts and the D+4½ test forecast from 00Z 31 March 1981

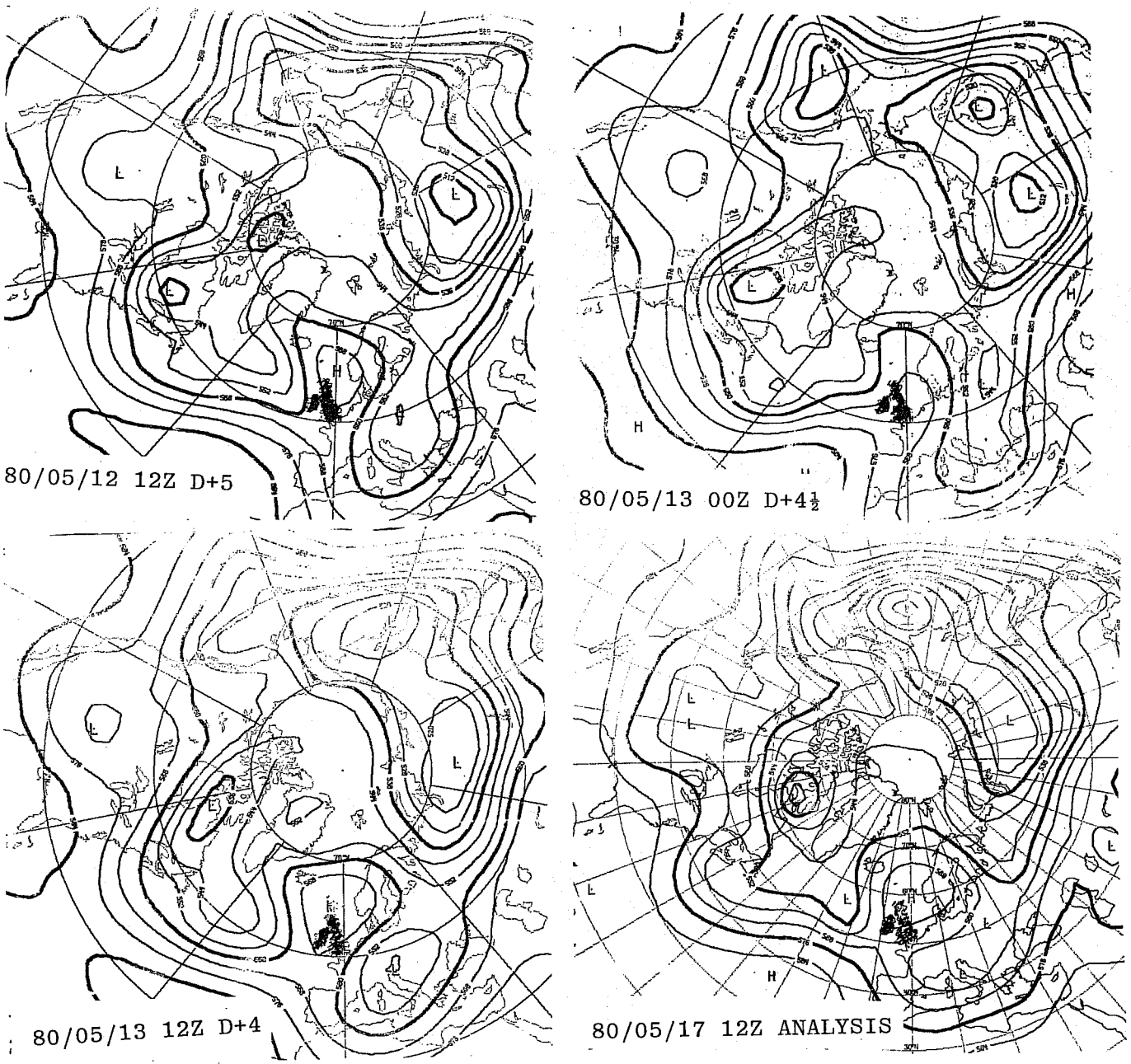

Figure 9: As Figure 8, but for the test from 13 May 1980.

3. SUMMARY AND CONCLUSIONS

Reception of operational GTS reports with times between 2101 and 0300Z in the ECMWF Reports Data Base during the time period 0230Z to 0330Z has been monitored. While many important data are received between 0230 and 0300Z, data inflow is considerably reduced between 0300 and 0330Z.

Fifteen experimental forecasts, starting from 00Z analyses, with a 3-hour (0300Z) data cutoff time, were run and subjectively and objectively compared with the preceding and following 12Z operational forecasts. To D+2½ of the test forecasts, all tests showed an improvement compared with the preceding operational forecasts (to D+3). In the range D+3½ to D+6½ of the test forecasts, there is on average an improvement to be gained by starting from the 00Z analyses. Objective scores from the European area indicate that 3 of the forecasts were much better, 5 were better, one was of similar quality and 4 were worse.

On the average of the ten 1981 experiments, there was a gain of close to 12 hours in the northern hemispheric and European area scores, indicating that the benefit of using later data overwhelmingly compensates for the penalty incurred by the lack of complete stratospheric and southern hemispheric data in the final data analysis and initialization cycle.