TECHNICAL MEMORANDUM

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Experimental forecasts from 00Z data with a 3 hour cutoff compared with operational ECMWF forecasts

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1. ABSTRACT

Examination of arrival of operational data at ECMWF has shown that many 00Z observations have been received by 0300Z (Woods, 1981). A series of experimental forecasts have been run, five in May 1980 and ten in the period February to April 1981, and the results of these experiments have already been reported (Woods, loc.cit.). On the average of the ten 1981 experiments there was a gain of close to 12 hours in the objective scores, when comparing the experimental forecasts with the operational forecasts run from 12 hours earlier, but with more complete data coverage. However, these test forecasts had been chosen with several criteria in mind, including expecially cases where there had been significant meteorological changes between two operational forecasts.

A further series of thirteen experimental forecasts has now been carried out for the period January to April 1982. These experimental forecasts were run from 00Z data with a 3-hour data cutoff time from 00Z each Saturday from 23 January to 17 April (with a single exception when a test forecast failed and an experimental run was made from the following Tuesday). These forecasts were made from analyses which included different synoptic situations, e.g. blocking situations, etc. The results of these experiments are similar to those of the earlier tests. Combining the results of the ten 1981 experiments and the thirteen 1982 experiments, a gain of 9.6 hours $\pm$ 1 hour is obtained from the Northern Hemispheric standard deviation scores, a gain of 11.2 hours $\pm$ 3 hours is obtained for the European area scores. The gain for the Southern Hemisphere is only 6 hours $\pm$ 1.5 hours presumably because of reduced data coverage for this area as compared with the Northern Hemisphere associated with the early data cutoff time.

2. THE FORECAST EXPERIMENTS - DATA, EVALUATION, RESULTS

2.1 Data

For the purposes of these tests, preprocessing of observational data, including quality control and insertion of the data into the Reports Data Base (RDB), was carried out at 0130, 0200, 0230 and 0300Z. For the 18Z analyses, extraction of data from the RDB was carried out at 0200Z, giving an effective data cutoff time of 7½ hours from analysis time for these data. For the 00Z analyses, data were extracted from the RDB at 0315Z, i.e. data which had been received at ECMWF up to 0300Z were included in these analyses. Table 1 shows the total number of observations which were used in the 18Z and 00Z analyses for each of the tests.

Date	18Z	00Z
820122/23	7355	4897
820129/30	5744	3190
820205/06	8550	6062
820212/13	8086	5992
820219/20	8192	780
820226/27	6658	5617
820305/06	7001	316
820312/13	6530	5567
820319/20	8638	6148
820329/30	6649	5940
820402/03	7007	5183
820409/10	6787	6498
820416/17	6699	6347

TABLE 1 : Total number of observations used in the 18Z and 00Z analyses for each of the 13 test forecasts.

Although only small amounts of 00Z data were used in two of the test experiments (and this is unlikely to occur in an operational environment, as opposed to the experimental environment in which the tests were carried out), the results of these two tests have been included in the overall results given here; it can be seen from Table 1 that these tests had the benefit of much data for the 18Z analyses.

2.2 Forecast Data

In an earlier series of experiments carried out in 1980 and 1981, test forecast dates were chosed with several criteria in mind, including synoptic situation and the evolution of the operational forecasts, to include especially cases where there had been significant changes between two operational forecasts in the medium range of the forecasts, i.e. in the period D+4 to D+7. In this 1982 series, it was decided to run the test forecasts from 00Z each Saturday, starting with the 23 January 1982. In the event, one test forecast, that of 27 March 1982, failed and was replaced with one from the following Tuesday 30 March. The series included 13 test forecasts in total, finishing with that from 17 April 1982.

The starting analyses over the Atlantic-European sector included predominantly zonal situations (e.g. 6 and 13 February) and predominantly meridional situations with blocking (e.g. 20 February and 20 March). ECMWF Reference Charts can be consulted for indications of the flow pattern in the initial analyses for each of the individual tests.

The test forecasts were run to 7½ forecast days.

2.3 Evaluation of the Results

2.3.1 Synoptic evaluation

The synoptic evaluation was concentrated on the Atlantic-European area. 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 concentrated on the medium ranges of the forecast period. The experiments were examined to see if they had succeeded in predicting the changes which had occurred between the two 12Z operational forecasts. Results were not significantly different to those reported on in the 1981 series of experiments; examples of specific forecasts are given in section 2.3.5 below.

2.3.2 Objective verification

Objective scores were computed for all the forecasts for several areas. The scores included standard deviation of geopotential height, anomaly correlation and the S1 skill score, for areas including the Northern Hemisphere (18^{o}N to 78^{o}N), the Southern Hemisphere (18^{o}S to 78^{o}S), and Europe (36^{o}N to 72^{o}N, 12^{o}W to 42^{o}E).

2.3.3 Results

For the thirteen 1982 experimental forecasts, mean results of objective scores for the Northern Hemisphere, Europe and the Southern Hemisphere are given in Table 2. In this table, scores in the vertical columns are for forecasts verifying at the same time. Thus, for example, in the column labelled "D+1½" the top line shows the mean score for the 2-day operational forecasts preceding the tests, the middle line has the area score for the 1½ day test forecast, the bottom line the mean score for the 1 day operational forecasts following the tests. It can be seen that values of the test scores, as expected, lie between the two operational scores. For the limited area European scores, the D+5½ and D+6½ scores are slighly anomalous; there were of course large variations in the values of these limited area scores for the individual forecasts. For example, the individual D+6½ standard deviation scores over Europe ranged from 55 to 136m, the S1 scores from 52 to 97, the corresponding numbers for the Northern Hemisphere standard deviation scores are 82 to 128m.

Area	Objective Score		D+½	D+1½	D+2½	D+3½	D+4½	D+5½	D+6½
Northern Hemisphere (18-78°N, 0-360°E)	Standard Deviation	Operational 12Z	20.5	35.3	50.3	66.0	80.0	93.5	102.9
		Test 00Z	15.4	29.8	44.9	58.7	73.8	87.5	99.7
		Operational 12Z	-	20.4	35.1	49.9	65.0	78.2	89.7
	Anomaly Correlation	Operational 12Z	98.0	93.9	88.0	79.5	69.5	58.7	50.2
		Test 00Z	98.8	95.6	90.5	83.9	74.2	63.3	53.5
		Operational 12Z	-	98.0	93.9	87.6	79.3	70.1	61.5
Europe (36-72°N, 12°W-42°E)	Standard Deviation	Operational 12Z	19.8	31.7	48.6	71.5	82.3	96.4	99.5
		Test 00Z	13.1	25.3	44.2	64.5	78.0	90.2	101.2
		Operational 12Z	-	17.9	34.9	57.8	75.2	89.9	102.7
	S1 Skill Score	Operational 12Z	21.5	32.5	42.3	55.6	61.1	64.0	67.2
		Test 00Z	14.8	28.3	39.0	52.8	58.8	62.2	67.6
		Operational 12Z	-	20.9	32.8	48.9	58.0	62.9	67.9
Southern Hemisphere (18-78°S, 0-360°E)	Standard Deviation	Operational 12Z	32.6	47.5	60.5	71.1	81.9	91.5	98.0
		Test 00Z	26.2	42.8	56.0	67.4	79.2	88.9	95.9
		Operational 12Z	-	29.6	45.6	55.9	70.1	81.6	91.7

TABLE 2: Northern Hemisphere, European and Southern Hemisphere mean scores for the thirteen 1982 00Z test forecasts (middle lines for each score) with those for the operational forecasts preceding the tests (top lines) and following the tests (bottom lines). The scores are all valid for 12Z; in the column labelled 'D+1½' for example, the top score is for D+2 operational forecasts, the middle score for D+1½ test forecasts, the bottom score for D+1 operational forecasts, i.e. in the vertical columns the scores are for forecasts verifying at the same time.

Figure 1 shows average scores plotted for the 1982 test forecasts, Figure 2 the equivalent scores for the 1981 tests. The two figures are similar, i.e. the results from the 1982 random tests are not appreciably different from those of the 1981 selected forecasts. In the following section, therefore, the scores for the ten 1981 tests are combined with those for the thirteen 1982 tests.

2.3.4 Results for 1981 and 1982 tests combined

Table 3 shows the standard deviation of forecast error scores averaged over all twenty three tests for the Northern Hemisphere, Europe and the Southern Hemisphere. Figures 3, 4 and 5 show these scores plotted. It can be seen from the figures that the test forecast scores lay, as expected, between the two operational forecast scores. In the mean for D+1½ to D+6½, the gain in these scores is 9.6 hours $\pm$ 1 hour for the Northern Hemisphere and 11.2 hours $\pm$ 3 hours for the European area scores. For the Southern Hemisphere, the gain is only 6 hours $\pm$ 1.5 hours, which presumably is related to reduced data coverage for this area, associated with the early data cutoff time, as compared to the Northern Hemisphere.

2.3.5 Examples and discussion

Examples of results from four of the 1981 tests are included in the report of the earlier study (Woods, loc.cit.). Here, we include examples of four of the 1982 tests.

The test from 00Z 23 January 1982. This was the first test of the 1982 series. Figure 6 shows the D+4½ test forecast and the verifying analysis valid for 12Z 27 January. The D+5 and D+4 operational forecasts are shown for comparison. Note how the test forecast has captured many of the changes between the two operational forecasts.

The test from 00Z 13 February 1982. An example of a blocking forecast. Figure 7 shows an improvement in the forecasting of the anticyclone centred near the Greenwich meridian.

The test from 00Z 20 February 1982. A test with only little 00Z data. As is to be expected, the test forecast is very similar to the preceding operational forecast, see Figure 8.

The test from 00Z 16 April 1982. This was the final test of the 1982 series. Slight differences between the test forecast and the preceding operational forecast include a weakening in the anticyclone affecting north-west Europe and a southward shift in the trough near the south coast of France (Figure 9).

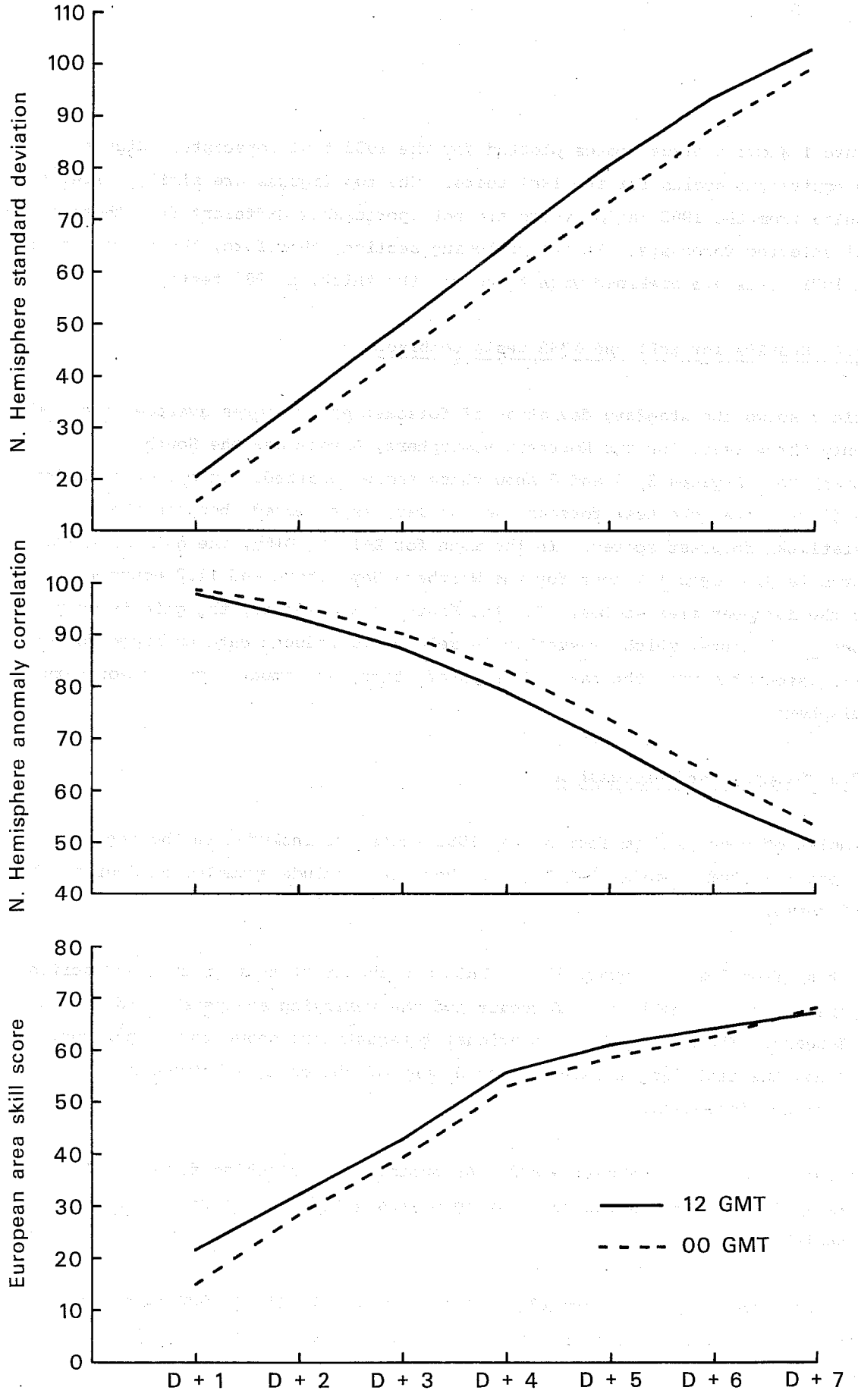

Fig. 1 Average northern hemisphere standard deviation of forecast error (top); anomaly correlation (centre) and European area skill scores (bottom) for the thirteen 1982 00 GMT tests and for the 12 GMT operational forecasts preceding the test. The forecast day indicated on the abscissa applies to the 12 GMT operational forecast, the scores for the 00 GMT tests being for $\frac{1}{2}$ day earlier in the forecasts.

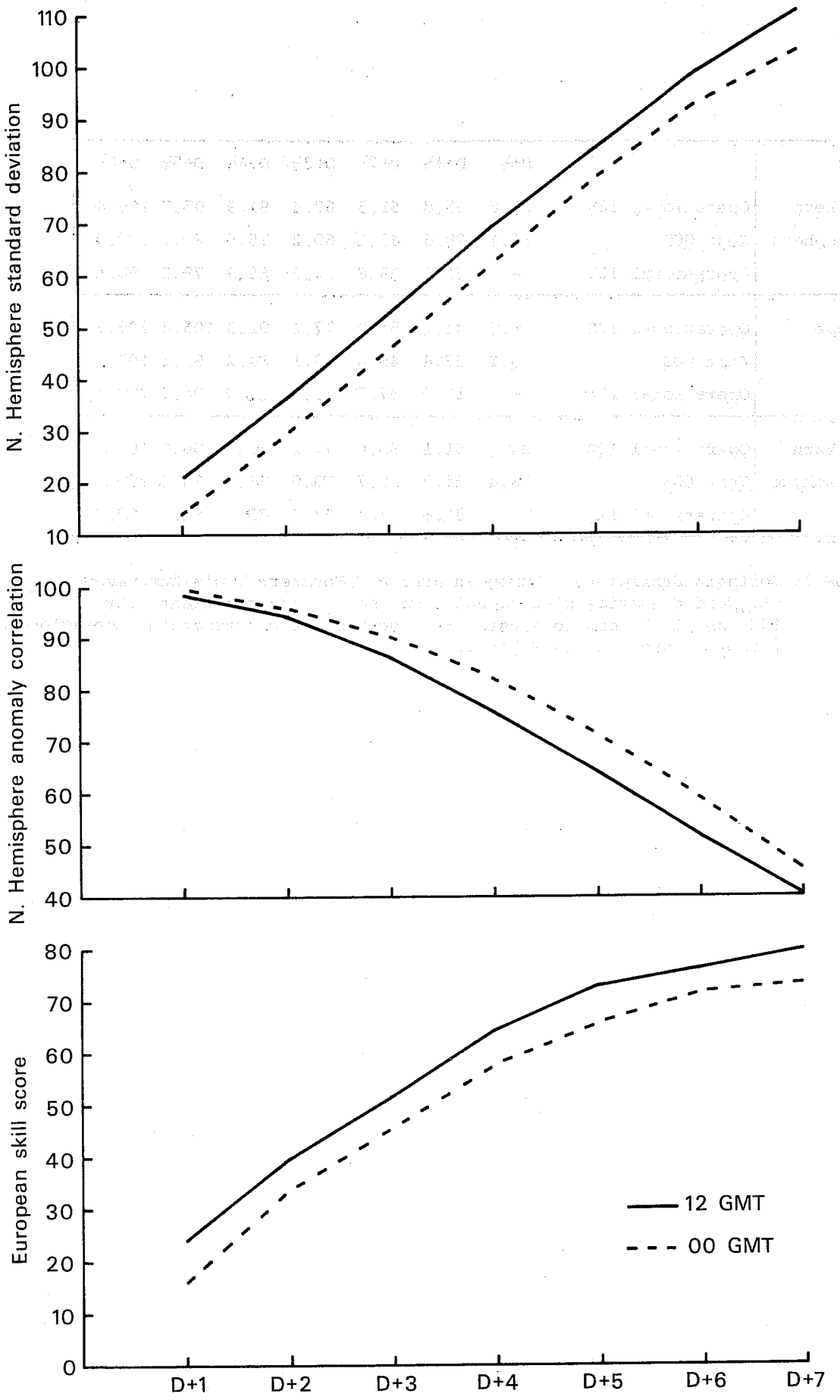

Fig. 2 As Fig. 1 but for the ten 1981 00 GMT tests.

Area		D+½	D+1½	D+2½	D+3½	D+4½	D+5½	D+6½
Northern Hemisphere	Operational 12Z	20.6	35.8	51.3	67.4	81.9	95.7	106.4
	Test 00Z	15.1	29.6	45.2	60.2	75.5	89.7	100.9
	Operational 12Z	-	21.8	35.8	51.5	65.9	79.2	90.4
Europe	Operational 12Z	20.2	34.1	51.8	77.1	91.3	105.4	109.9
	Test 00Z	13.1	27.4	45.8	73.1	84.2	99.1	107.7
	Operational 12Z	-	19.2	37.7	61.8	80.4	94.2	104.9
Southern Hemisphere	Operational 12Z	34.4	51.1	65.0	77.1	87.7	96.9	104.1
	Test 00Z	26.4	44.3	59.7	73.0	84.3	94.5	102.2
	Operational 12Z	-	31.6	47.2	58.9	73.4	84.3	92.9

TABLE 3: Northern Hemisphere, European area and Southern Hemisphere mean standard deviation of forecast error scores for the twenty three 1981 and 1982 test forecasts, with scores for corresponding operational forecasts shown as in Table 2.

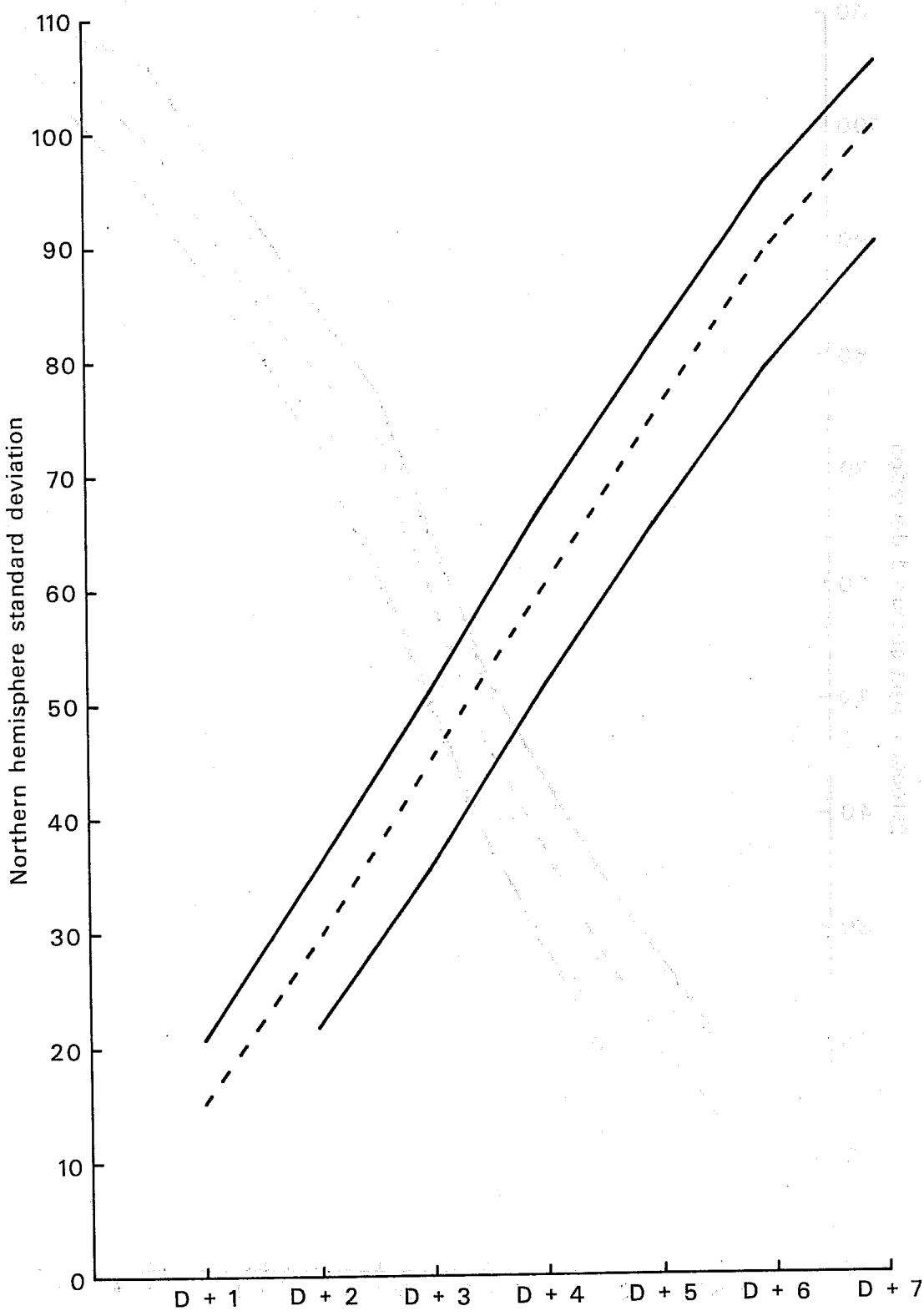

Fig. 3 Northern hemisphere standard deviation of forecast error scores averaged over 23 experiments, ten from 1981 and thirteen from 1982.

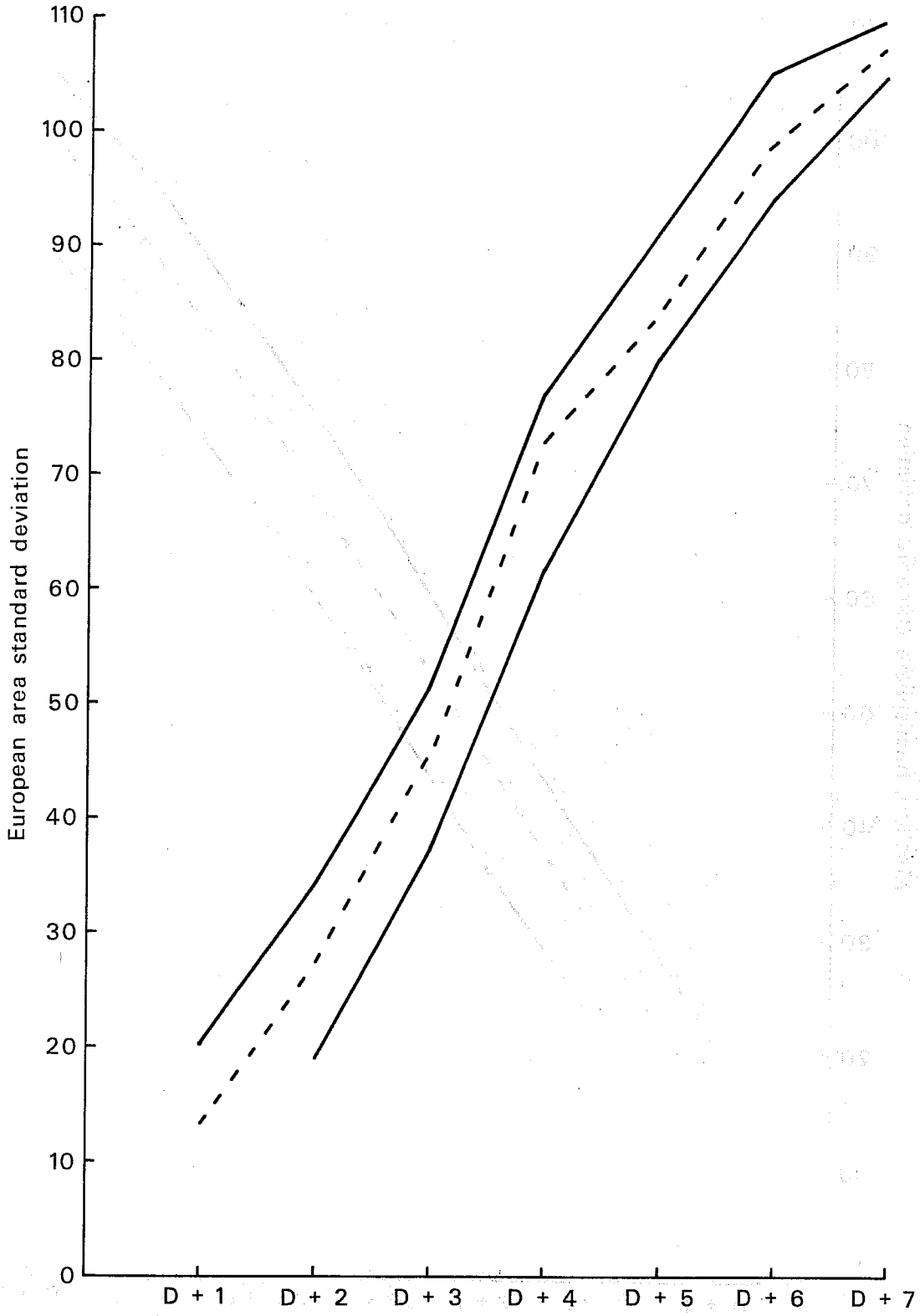

Fig. 4 As Fig. 3 but for the European area.

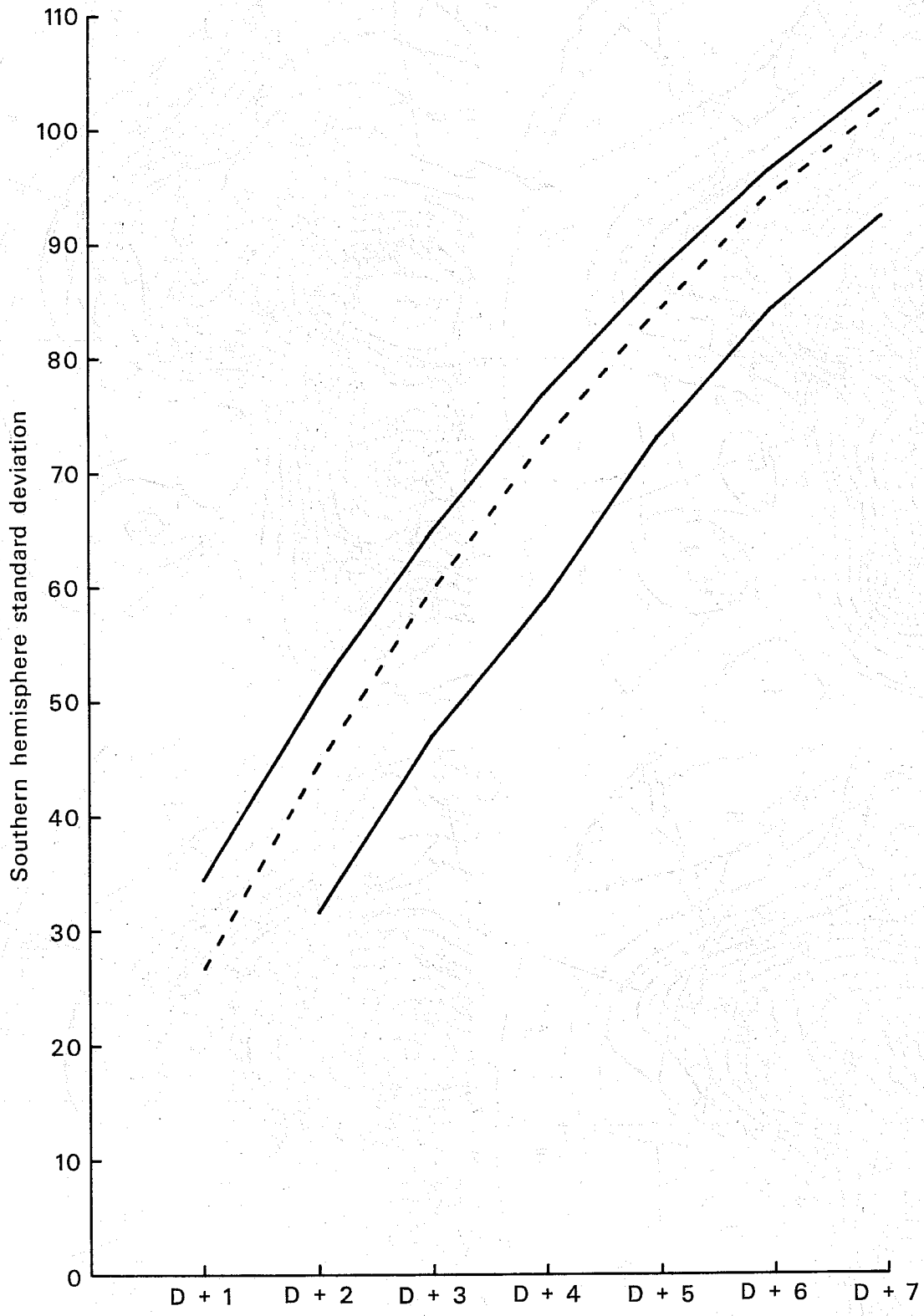

Fig. 5 As Fig. 3 but for the southern hemisphere.

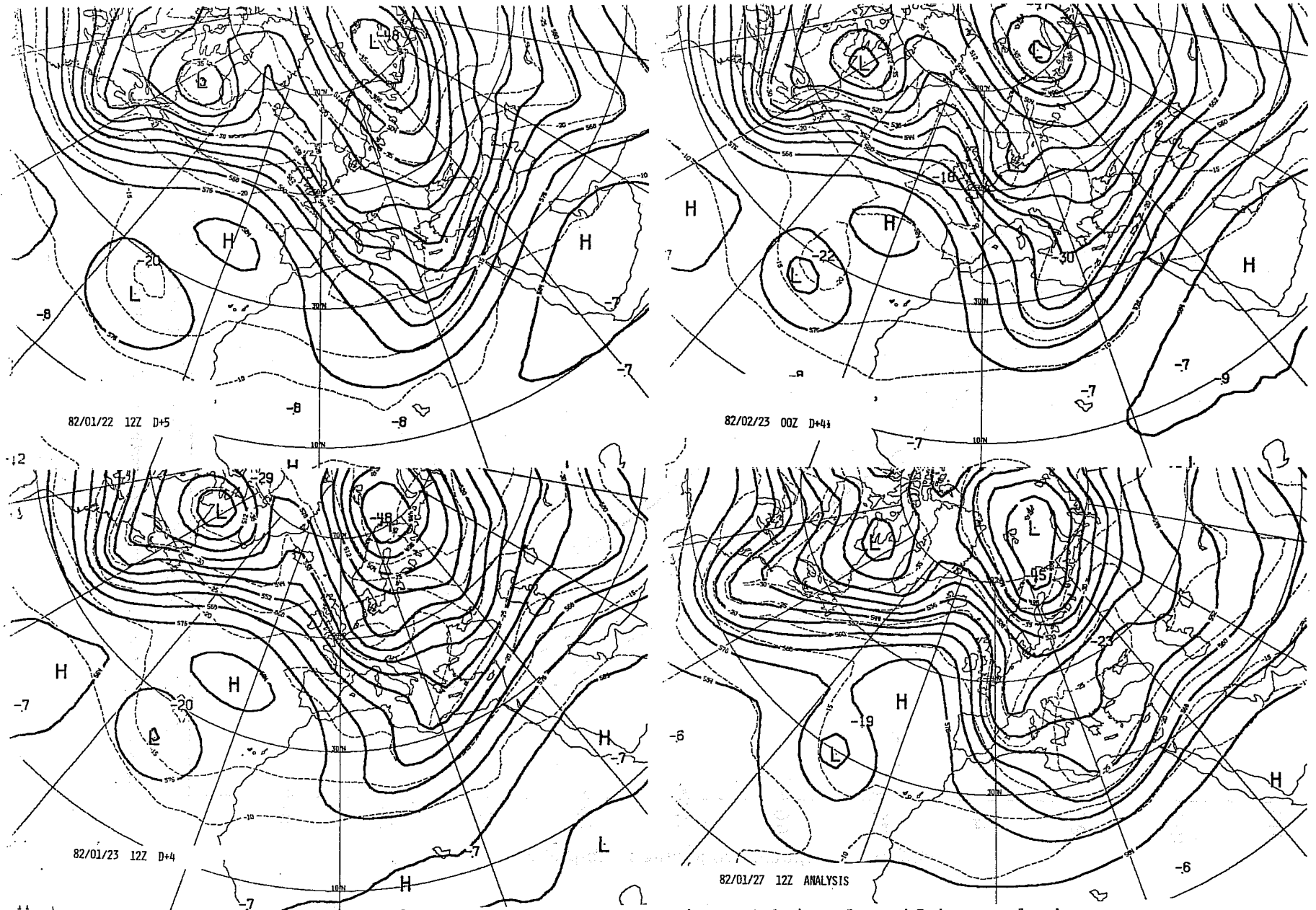

Fig. 6 D+4½ experimental forecast (top right) and verifying analysis (bottom right) with D+5 and D+4 operational forecasts preceding (top left) and following (bottom left) the test from 00Z 23 January 1982.

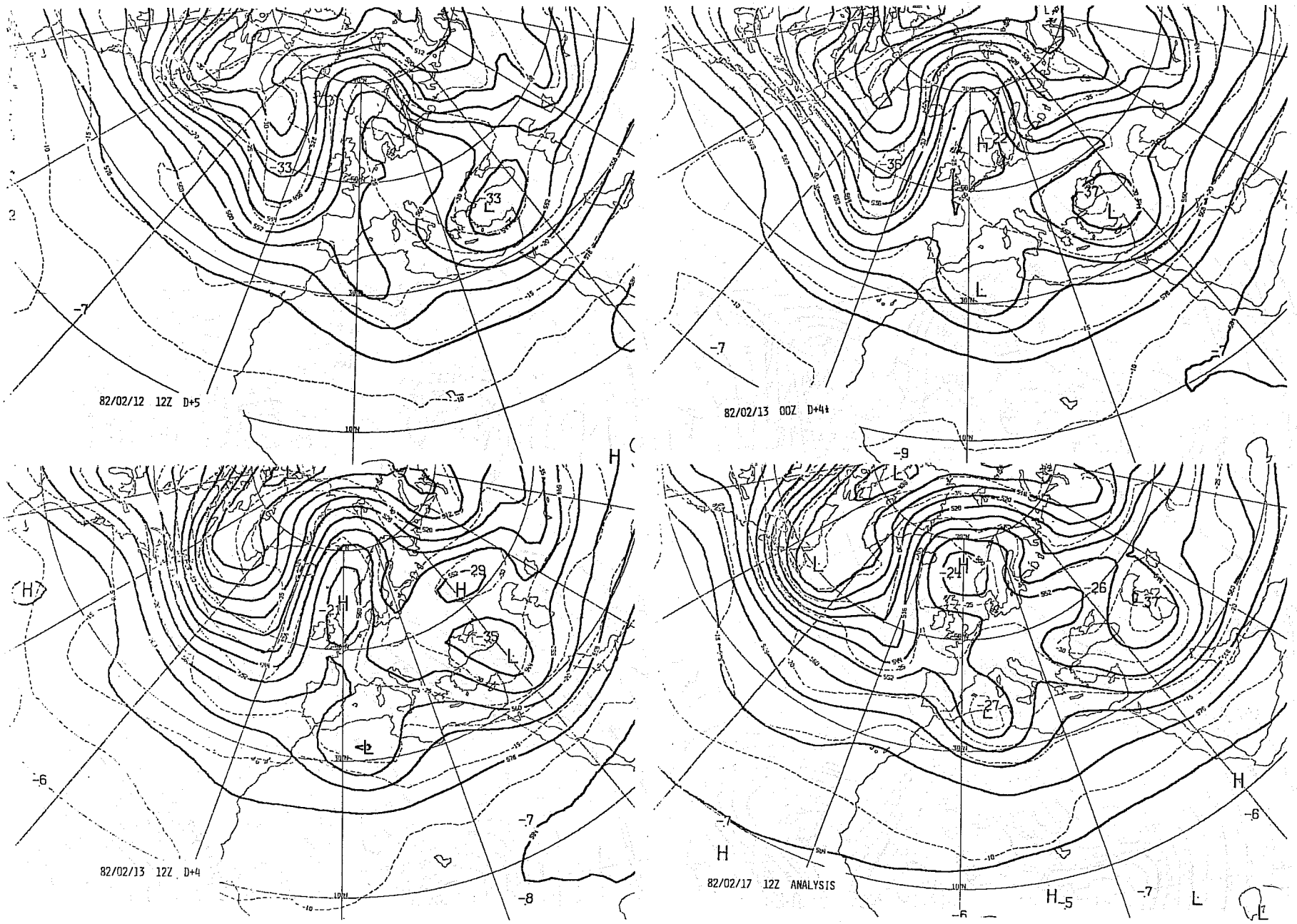

Fig. 7 As Fig. 6, but for the test from 00Z, 13 February 1982.

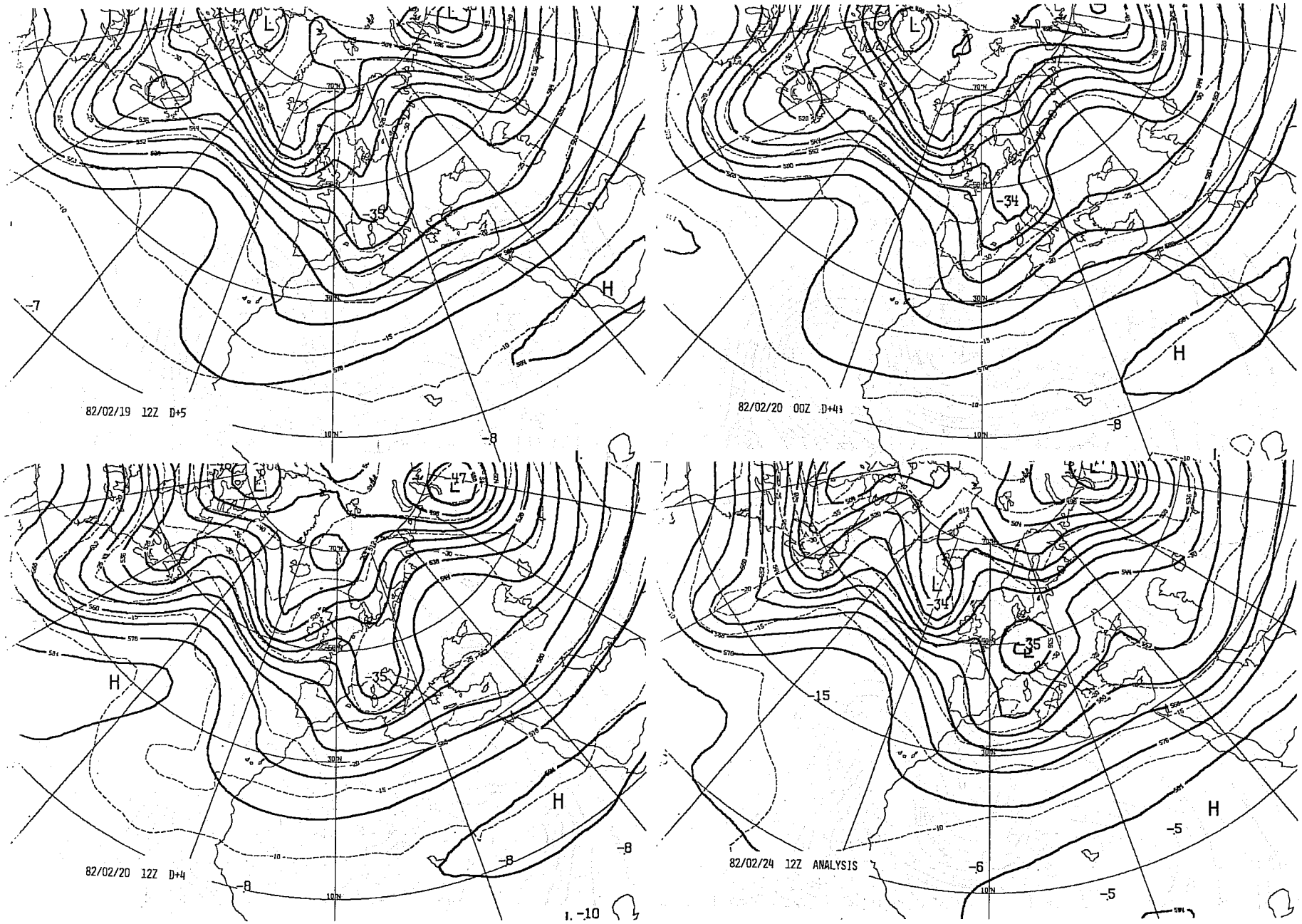

Fig. 8 As Fig. 6, but for the test from 00Z, 20 February 1982.

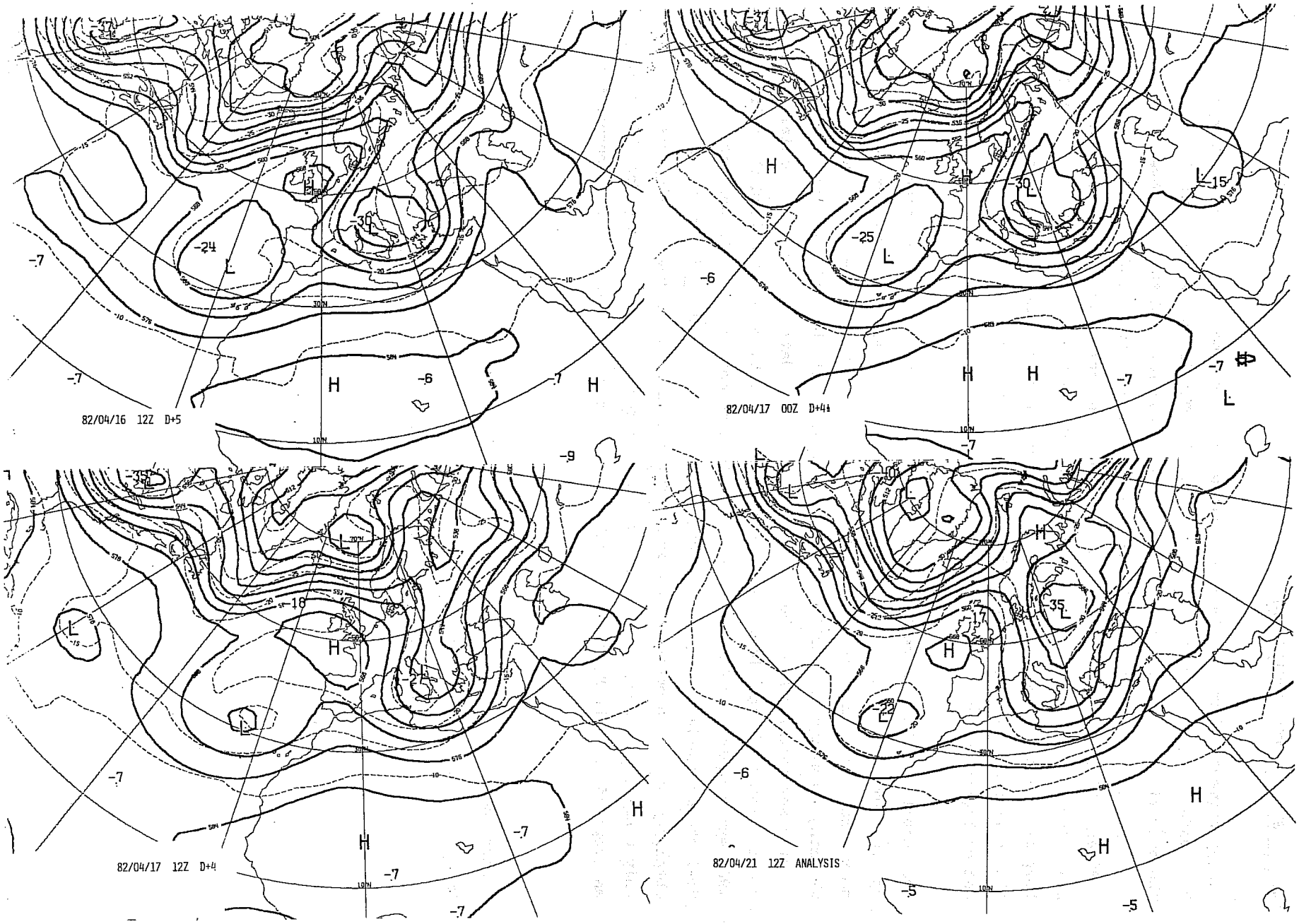

Fig. 9 As Fig. 6, but for the test from 00Z, 17 April 1982.

3. SUMMARY AND CONCLUSIONS

Ten experimental forecasts from 00Z data with a three-hour data cutoff time have been made in the period January to April 1982. The forecasts were compared with the operational ECMWF forecasts which preceded and followed them; the overall results were also compared with those of earlier experimental forecasts run in 1980 and 1981. The earlier forecasts had been selected with several criteria in mind, including synoptic situation and especially selecting cases where there had been significant meteorological changes between two operational forecasts. The 1982 series were run from 00Z each Saturday without pre-selection of the meteorological situation.

The results of the 1982 tests were similar to those of the earlier tests in which an improvement of close to 12 hours in the Northern Hemispheric and European area scores had been seen, 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 initialisation cycle. Combining the objective scores of the ten 1981 experiments and the thirteen 1982 experiments, a gain of 9.6 hours $\pm$ 1 hour is obtained for the Northern Hemispheric standard deviation scores, a gain of 11.2 hours $\pm$ 3.6 hours is obtained for the European area scores. The gain for the Southern Hemisphere is only 6 hours $\pm$ 1.5 hours, presumably because of reduced data coverage for this area as compared with the Northern Hemisphere associated with the early data cutoff time.

Reference:

Woods, A. 1981. Comparison of ECMWF forecasts starting from 00Z data with operational forecasts from the preceding 12Z data. ECMWF Technical Memorandum No. 30.