European Centre for Medium Range Weather Forecasts

ECMWF NEWSLETTER

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Number 21 - June 1983

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METEOROLOGICAL

COMPUTING

GENERAL

COVER: The grid and land-sea mask of the new operational model (see article on p.8).

This Newsletter is edited and produced by User Support.

The next issue will appear in August 1983.

ECMWF PRODUCTS, EVEN ON THE HIGHEST MOUNTAIN IN THE WORLD

1. INTRODUCTION

On 30 July 1982, after preparation lasting two years, a Dutch group of climbers departed from Schipol Airport to China with the intention of climbing Mount Everest from the northside. A few weeks before, the leader of the group, Xander Verrijn-Stuart, asked the Royal Netherlands Meteorological Institute (KNMI) if it was possible to get some information about the weather during their stay on the mountain. After having made some inquiries, we found that the easiest way was to use the products of the European Centre and transmit the information by radio. Radio-Nederland (World Service) was willing to include the meteorological information on working days, at the end of their news, beamed at South-east Asia. So KNMI decided to give information on Monday, Wednesday and Friday, each bulletin repeated once on the next day. In consultation with the expedition leader, we decided to send them the height, temperature, wind speed and wind direction of the 300 mb level at the gridpoint nearest the Mount Everest, with verifying times H+18, H+30, H+42, H+54, H+66, H+84, H+108 and H+132. The difference in time between GMT and local time is about 8 hours, so forecasts verifying at 6 GMT verify at 14 LT, the time the climbers were usually active on the mountain. After H+84, there are only 12 hour intervals available. The starting date for the forecasts was planned to be 16 August, so there was little time to make arrangements with ECMWF regarding the products required, extract them at KNMI and develop the necessary computer programs. Thanks to the help of several people at ECMWF and KNMI, we were able to start with the forecasts on the date planned.

2. The forecast procedure

The data fields of the Himalayan area were plotted, including the values at a gridpoint near Mount Everest. A meteorologist had a quick look at the 500 and 300 mb charts and formulated a general description and outlook of the circulation pattern which, together with the gridpoint values, formed the weather forecast for the expedition. This forecast was sent by telex to Radio Nederland. There was one problem: nobody knew if the products could be useful in an area with such high mountains, so we told the members of the expedition to be very careful in making decisions based upon the forecasts. As compensation for our effort, they would try to make some observations of temperature and wind speed on the mountain. During the expedition, it was not possible to give us feedback.

3. The expedition

On 29 August, two members of the expedition were hit by an avalanche. One of them was very seriously injured and had to be transported to the base camp, thereafter to a Chinese hospital, where he recovered satisfactorily. Two weeks had been lost to the expedition, however. After this delay, the climb continued, but getting higher and higher up the mountain, movements were hindered by the strong winds, at temperatures of about -30^{o}C. Progress was very slow and the climbers were running out of time: the schedule for the return journey was fixed. On 10 October, the actual wind speed was still very high, the forecast for the next 5 days showed only very high wind speeds, so the expedition had to be abandoned. The highest level to be reached was about 7800 metres, there were still more than 1000 metres to go to the top. During these last weeks, the climbers looked in vain for a forecast of calm weather: the forecasts continued to give high wind speeds. By the end of October 1982, the members of the expedition were back in The Netherlands.

4. Verification results

During the expedition, some observations of temperature, wind speed and wind direction were made at a height of 5150 m (base camp). This camp was situated in an elongated valley, with 1200-1800 m mountain chains on either side. This means that the climate was strongly influenced by the surroundings and there appeared to be - as we had expected - little correlation between 500 mb gridpoint values and the observations. The observed wind speeds in the base camp are plotted in Fig. 3. More interesting was the weather above 7000 metres. According to the local population, the circulation above the mountains should be from the Northwest from the second half of September onwards, but the circulation stayed south-west, as forecast. During the time the members of the expedition stayed above 7000 metres, the wind speed was very high and qualitatively in good agreement with the predicted wind speed (the same for the temperature values). The general impression of the climbers was that the forecasts were very useful, especially as a basis for making decisions. With the initialised analyses of ECMWF we verified the forecasts at the gridpoint used. Some results are given in Figures 1, 2 (opposite) and 3 (overleaf) and in Tables 1 and 2. The figures confirm the subjective verification by the members of the expedition.

As far as the forecasts were concerned, we can conclude that the experiment was successful. Maybe some time in the future, we can help a new expedition to the "Qomolangma Feng".

	H+18	H+30	H+42	H+54	H+66	H+84	H+108	H+132
Z	10.9	16.8	16.3	24.4	19.1	16.1	19.6	26.3
T	1.4	1.2	1.4	1.3	1.6	1.4	1.5	1.6
FF	4.1	3.5	4.2	3.8	4.4	6.5	6.8	7.2

Table 1 Root Mean Square Error of 300mb height (Z), temperature (T) and windspeed (FF). Units respectively metres, degrees Celsius, metre/second. Number of cases: about 60.

	H+18	H+30	H+42	H+54	H+66	H+84	H+108	H+132
Z	-4.8	-11.6	-9.5	-19.6	-11.8	-3.4	-8.9	-11.4
T	1.3	0.9	1.2	1.0	1.2	0.6	0.7	0.7
FF	-1.0	-1.2	-2.0	-1.0	-1.8	-2.3	-3.5	-3.9

Table 2 Idem, Mean Error

- Kees Lemcke
Royal Netherlands
Meteorological
Institute (KNMI)

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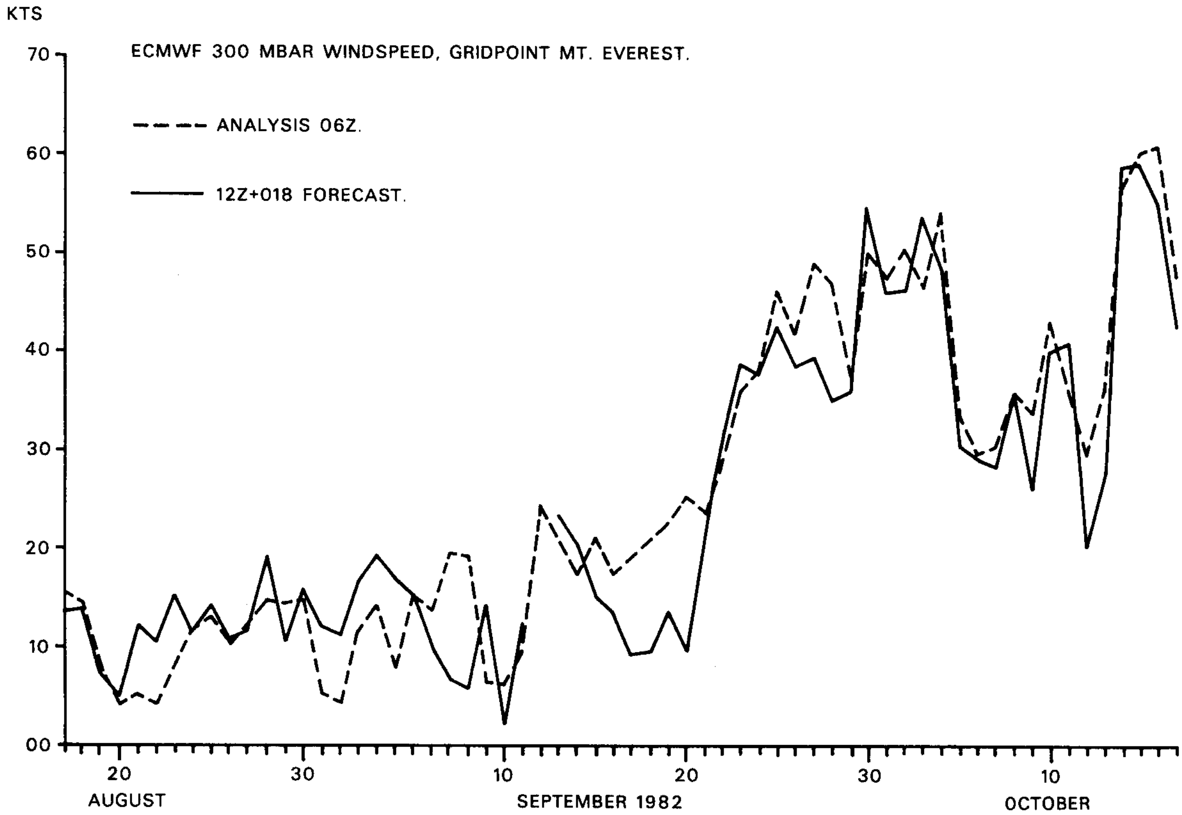
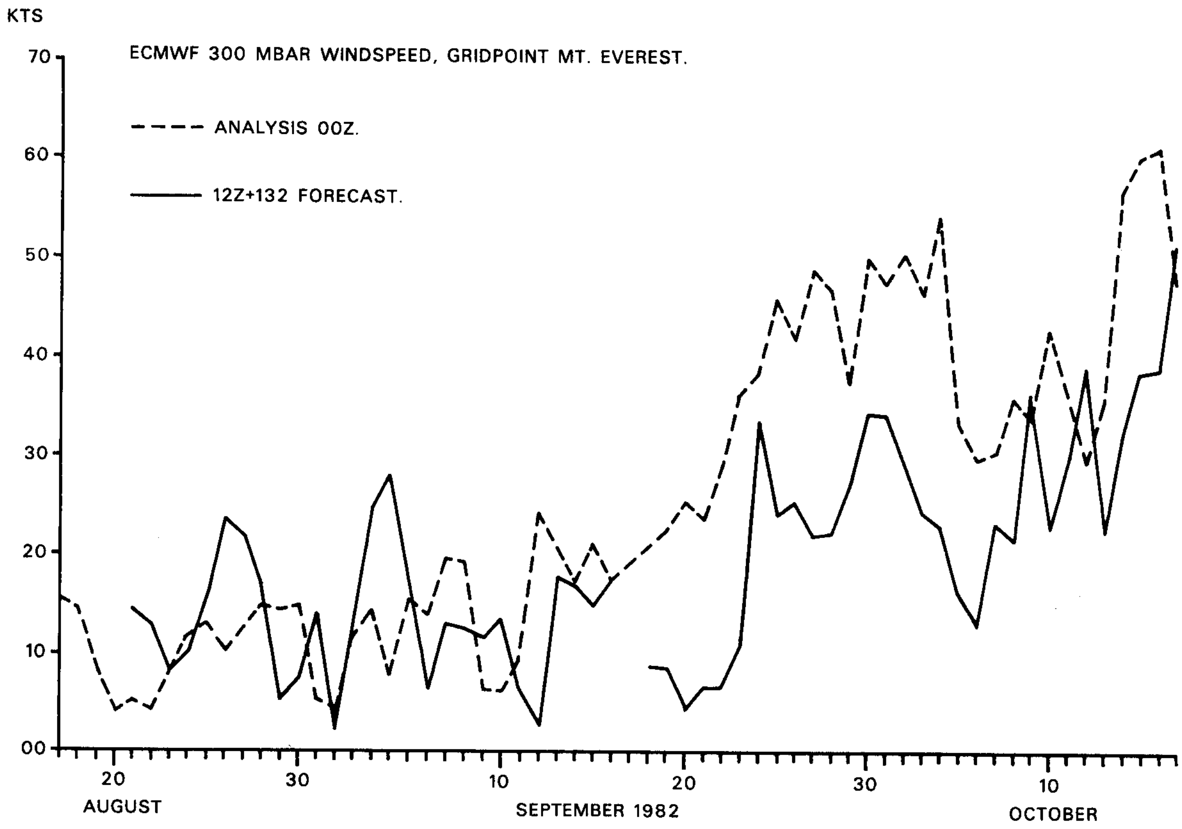

KTS
70
60
50
40
30
20
10
00
ECMWF 300 MBAR WINDSPEED, GRIDPOINT MT. EVEREST.
ANALYSIS 06Z.
12Z+018 FORECAST.
20
30
10
20
30
10
AUGUST
SEPTEMBER 1982
OCTOBER

Fig. 1


KTS
70
60
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ECMWF 300 MBAR WINDSPEED, GRIDPOINT MT. EVEREST.
ANALYSIS 00Z.
12Z+132 FORECAST.
20
30
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AUGUST
SEPTEMBER 1982
OCTOBER

Fig. 2

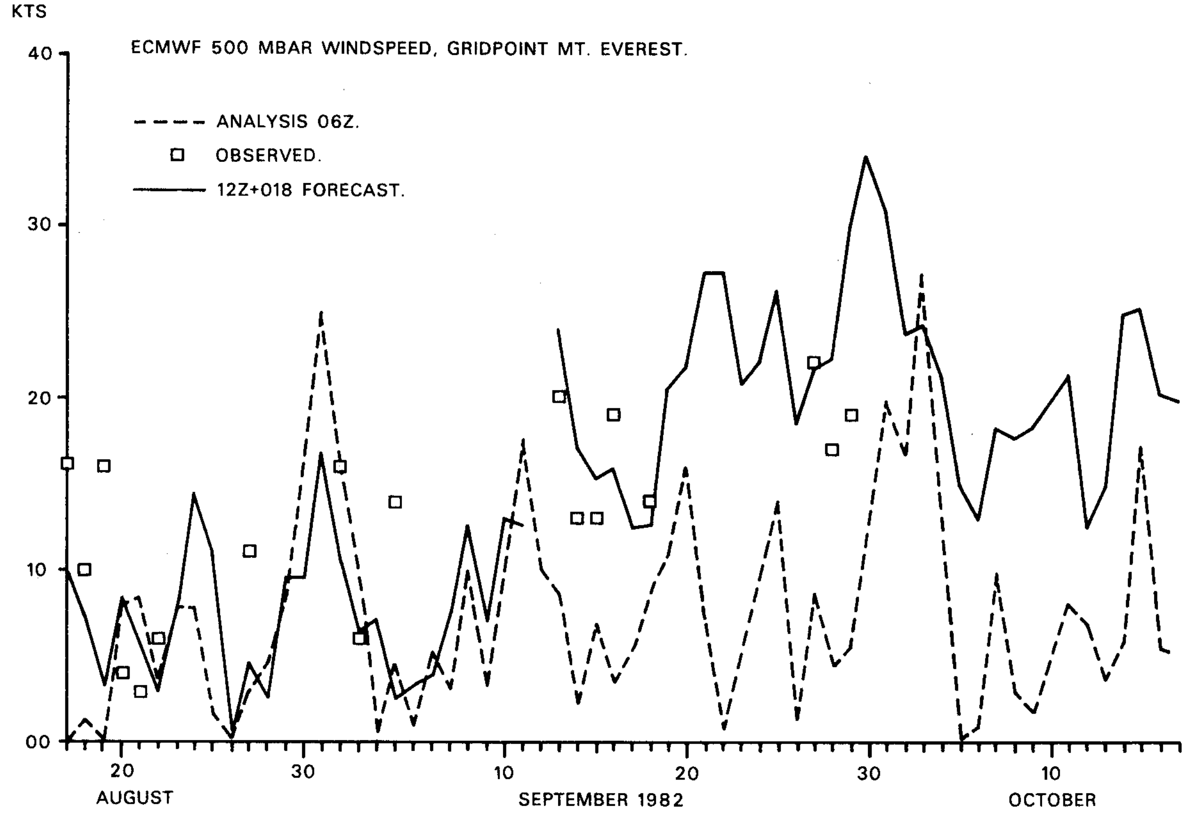

Fig. 3 Note the different vertical scale

FEEDBACK ON ECMWF OPERATIONAL FORECASTS

ECMWF forecasts from the new spectral model for New Zealand

1. Extract from a letter of 16 May 1983 from A.A. Neale, Chief Forecaster, New Zealand Meteorological Service:

> "Since you changed to a new operational spectral Model on 21 April, the only problem we have experienced was the non receipt of any material from the 12Z 1 May 1983 data base. This may well have been caused by a communication problem between your Centre and Australia. This is the first day in well over a year when nothing at all has been forthcoming. This was unfortunate, because between 4 and 5 May, there was a dramatic change of weather type in the New Zealand region - from relative light winds to unusually strong westerlies. It would have been interesting to know whether your model foretold this event at T+96."

2. Extract from the Centre's reply:

> "Concerning the change in weather type which occurred in the New Zealand region between 4 and 5 May, I enclose copies of charts (Figure 1 opposite) which show the analysis of 4 May (top) and 5 May (middle), together with the D+4 forecast from 1 May, valid on 5 May (bottom), for 1000mb. It is clear that the change from anticyclonic conditions to strong westerlies was well indicated in the forecast from 1 May."

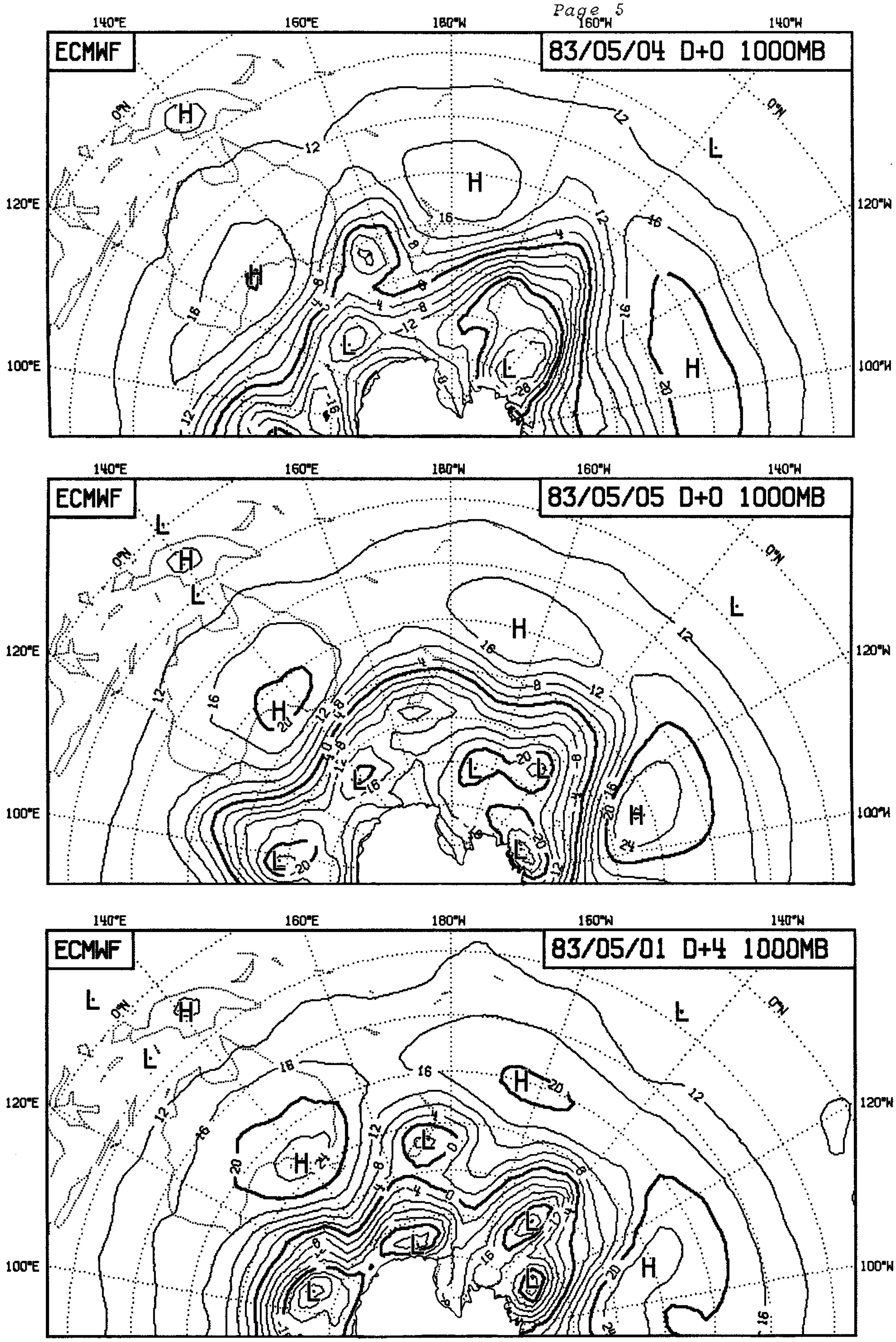
ECMWF
83/05/04 D+0 1000MB
ECMWF
83/05/05 D+0 1000MB
ECMWF
83/05/01 D+4 1000MB
140°E
160°E
180°W
160°W
140°W
120°E
100°E
120°W
100°W

Fig. 1

ECMWF forecasts for the Mediterranean, February - April 1983

1. Extract from a letter of 6 April 1983 from Dr. Michele Conte, Meteorological Contract Point, CNMCA, Italy:

"During March and at the beginning of April, some important and sometimes severe disturbances penetrated into the central Mediterranean producing spells of very bad weather over Italy, in particular in the recent Easter week.

All these disturbances were very well predicted by ECMWF meteorological products, even at D+6 and D+7. Also the D+6/D+10 mean maps were found to be very useful and indicative. An interesting feature of these disturbances was the movement (West to East) of the waves which was not too fast as in other cases of the past years. As a consequence, our post-processing system of forecast (which is known with the poetic name of "Afrodite") gave largely successful results, which were much appreciated."

2. Extract from a letter of 3 March 1983 from A. Kakouros, Meteorological Contact Point, and M. Refene, National Meteorological Service, Greece:

"We wish to point out three excellent ECMWF forecasts during February 1983, which helped the meteorologists on duty to improve the reliability of the forecasts in our Service.

1. During the dates 4, 5 and 6 February, a very deep trough influenced the meteorological conditions over the area of East Mediterranean Sea. It snowed in most areas of Greece, even in the southern flat areas, and there was much snow in Athens, which is very unusual phenomenon.

The development and movement of this trough as well as the significant falling of the temperature, were very well predicted since 30 January in the range of D+2 up to D+6 products of ECMWF.

2. During the second half of February, two other deep troughs influenced the meteorological conditions of Greece. The first occurred during 17 and 18 February and the second one during 23 and 24 February. In both cases, again it snowed very much even in flat areas and in Athens.

Between those two very bad weather conditions, there was a significant improvement of the weather in Greece by the influence of a ridge.

The ECMWF products in the range of D+2 up to D+6 predicted very well all the systems mentioned above. They enabled the meteorologists on duty to forecast the very bad weather conditions and make them known to the public five days before they prevailed over Greece.

The success of our forecasts in such significant weather situations increased the reliability of our service."

SMHI Evaluation of ECMWF and other forecasts in May 1983

On 21 April 1983, the new spectral model and the revised orographic representation (envelope orography) were introduced into operation (see ECMWF Newsletter No. 20, April 1983). Verification results from previous forecast experiments and from quasi-operational tests of the new model indicated that substantial improvements of the forecasts can be expected in the medium range, both at the surface and in the middle troposphere.

After the end of the first complete month of forecasting with the new model, the Centre received a telex from R. Joelsson at the Swedish Meteorological Service (SMHI) in Norrköping with their assessment of the ECMWF 500mb forecasts compared to those from NMC Washington and DWD Offenbach. The forecasts are valid on day 5. Note that the Centre's products are used with a time lag of 12 hours. The subjective evaluation (scale: 1=very poor, 3=useful, 5=very good) focusses on Scandinavia, while the objective verification is carried out for an area covering northern Europe, the North Sea, stretching to the south as far as northern Germany and reaching the British Isles in the west.

The text of the telex from SMHI is given below. The advantage of the ECMWF forecasts compared to NMC and DWD in the subjective evaluation is reflected in the objective scores. These results are indeed most encouraging.

Telex received from SMHI on 1 June 1983:

"I HAVE THE PLEASURE TO PRESENT SOME PRELIMINARY SCORES CONCERNING OUR ASSESSMENT OF NUMERICAL FORECASTS FOR 500MB DURING MAY 1983:

	ECMWF (132H)	USA (120H)	DW (120H)
SUBJECTIVE EVALUATION			
(SCALE 1 TO 5)	3.5	2.9	2.9
OBJECTIVE VERIFICATION			
ANOMALY CORR.	0.68	0.52	
RMS	72	102	
SI-SCORE	64	74	

I THINK THE SCORES FOR FORECASTS FROM ECMWF SPECTRAL MODEL ARE MOST ENCOURAGING."

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THE GRID OF THE NEW OPERATIONAL MODEL

The illustration on the front cover presents the grid and land-sea mask used in the new operational model. The sub-grid scale physical processes are computed at grid points. This grid, usually referred to as the Gaussian grid, allows an exact conversion from grid point values to spectral components. The model surface fields are represented on this Gaussian grid (192 x 96), which is regular in the longitudinal direction with a 1.875 degree interval (as in the old operational model, N48), but is slightly irregular in latitude, with no point at the pole. Table 1, column 1, shows the latitudinal discretisation. The departure from a regular grid is very small: column 2 represents the latitudinal position assuming a regular distribution between the Northernmost and Southernmost rows, and column 3 the difference between the two grids in kilometres.

Northern Hemisphere (Symmetric for Southern Hemisphere)

Gaussian	Regular	Difference in km	Gaussian	Regular	Difference in km
88.5722	88.5722	0.0000	43.8335	43.8199	-1.5058
86.7225	86.7075	-1.6721	41.9682	41.9552	-1.4434
84.8620	84.8428	-2.1298	40.1030	40.0908	-1.3807
82.9989	82.9781	-2.3131	38.2377	38.2259	-1.3178
81.1350	81.1135	-2.3923	36.3725	36.3612	-1.2546
79.2706	79.2488	-2.4211	34.5072	34.4965	-1.1912
77.4059	77.3841	-2.4218	32.6420	32.6319	-1.1277
75.5411	75.5194	-2.4052	30.7767	30.7672	-1.0640
73.6761	73.6548	-2.3772	28.9115	28.9025	-1.0001
71.8111	71.7901	-2.3413	27.0462	27.0378	-0.9361
69.9461	69.9254	-2.2997	25.1810	25.1731	-0.8720
68.0810	68.0607	-2.2538	23.3157	23.3085	-0.8078
66.2159	66.1960	-2.2047	21.4505	21.4438	-0.7434
64.3507	64.3314	-2.1531	19.5852	19.5791	-0.6791
62.4856	62.4667	-2.0994	17.7200	17.7144	-0.6140
60.6204	60.6020	-2.0441	15.8547	15.8498	-0.5501
58.7552	58.7373	-1.9875	13.9894	13.9851	-0.4855
56.8900	56.8727	-1.9298	12.1242	12.1204	-0.4208
55.0248	55.0080	-1.8711	10.2589	10.2557	-0.3562
53.1596	53.1433	-1.8116	8.3937	8.3910	-0.2914
51.2944	51.2786	-1.7514	6.5284	6.5264	-0.2267
49.4292	49.4139	-1.6907	4.6631	4.6617	-0.1619
47.5639	47.5493	-1.6295	2.7979	2.7970	-0.0972
45.6987	45.6846	-1.5678	0.9326	0.9323	-0.0324

Interval of the regular grid: 1.8647 in latitude (96 points)
1.875 in longitude (192 points)

Table 1

- Frédéric Delsol

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ECMWF WORKSHOP, 30 JUNE - 2 JULY 1982

Last year, a workshop on the "Intercomparison of large-scale models used for extended range forecasts" was held at the Centre. It was appropriate to hold such a workshop because the increasing availability of large computers has encouraged many groups to design their own models. This has led to a wide diversity of models which have been used to carry out extensive experimentation into both extended range forecasting and climate simulations.

The purpose of the workshop was threefold:

i. To obtain an intercomparison of the performance of different models used for extended range forecasting and general circulation simulations.

ii. To assess qualitatively their systematic errors.

iii. To discuss the nature of, and reasons for, these systematic errors.

The workshop was divided into two sessions. In the first, invited scientists (both from within the Centre and outside) presented papers on special topics. This was followed by the second session, in which the subjects listed below were discussed in working groups.

i. Similarities and differences between various model simulations and their respective systematic errors.

ii. Likely causes of the systematic errors and how they can be overcome by improving the models.

As a result of the discussion of i., it was noted that in some respects different models exhibit different systematic errors. Therefore, in order to make comparisons easier, it was recommended that the results of model studies should be presented in terms of difference maps (model minus observation or model A minus model B) or as deviations from zonal means. As well as considering statistics from long runs, it was thought valuable to examine the systematic evolution of the forecast flow from ensembles of forecasts. Also it was argued that high and low frequency fluctuations should be examined separately, and that the geographical variations of statistics should be studied along with the integrated values.

In addition to variances, it was suggested that there are other useful quantities which could be calculated in order to study the model's ability to simulate transient eddy activity. Also it was thought that it would be desirable to estimate the low frequency diabatic forcing using both observed and model data.

Since there are uncertainties about the "observed" conditions, it was argued that a comprehensive intercomparison of analyses, made in different centres from essentially the same input data, should be undertaken. The global (level III) FGGE data should be especially useful for such studies.

During the discussion of (ii), it became obvious that all the processes represented in sophisticated models are candidates for being causes of systematic errors. Despite this, it was possible to make various recommendations about how the causes of the systematic errors can be investigated.

The interactive nature of the many processes represented in models is so crucial that studies of particular synoptic systems or weather regimes should be undertaken for both the real atmosphere and models. It was also thought that the problem of the interaction between adiabatic and diabatic processes should be reassessed. The first stage should consist of experiments in which both the input to, and output from, the parameterisations are spatially smoothed.

Since clouds are at the centre of the feedback problem with radiation, experiments should be conducted with zonally averaged or fixed clouds; the effect of imposing different optical problems should then be investigated. The same kind of experiments should be carried out with fixed water vapour derived from observations.

Further details of the discussions and recommendations, along with the invited papers, can be found in the proceedings of the workshop which have recently been published by the Centre. Copies of the proceedings can be obtained by writing to the Librarian at ECMWF.

\- Bob Riddaway

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ECMWF 1983 SEMINAR

Numerical methods for weather prediction - 5-9 September 1983

The preliminary programme includes the following speakers and topics:

A. Arakawa	Finite difference techniques for the vertical discretisation
F. Mesinger	Finite difference techniques for the horizontal discretisation
B. Machenhauer	Spectral techniques
M. Jarraud	The comparative performance of spectral and finite difference models
A. Simmons	The design and performance of ECMWF's new operational model
M. Cullen	Solutions of some non-linear partial differential equations relevant to meteorology and implications for numerical methods
D. Burridge	A finite difference representation for the vertical discretisation in primitive equation models
H. Davies	Techniques for limited area modelling
L. Dell'Osso	A practical approach to the problems of limited area modelling
R. Bates	Analysis and implementation of the semi-Lagrangian technique
J. Steppeler	Flux corrected techniques for advection
R. Sadourny	Theta coordinate modelling. Turbulence theory and the representation of sub-gridscale dissipation
K. Morton	Recent developments in numerical methods for fluid dynamics problems

Invitations have been sent to the Member States asking them to nominate delegates for the seminar.

The papers produced by the invited speakers and presented at the seminar will be published by the Centre in due course.

\- Bob Riddaway

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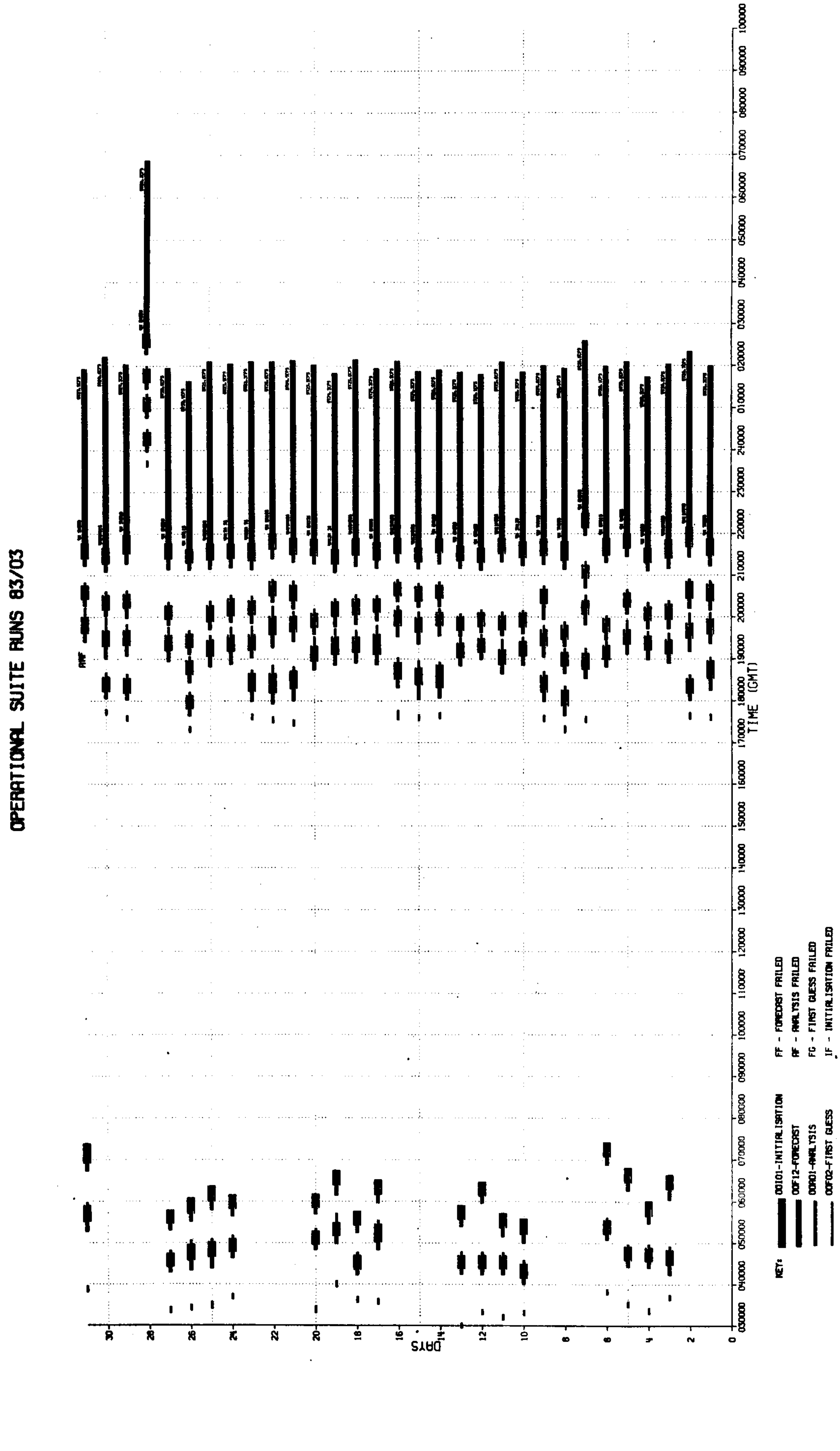
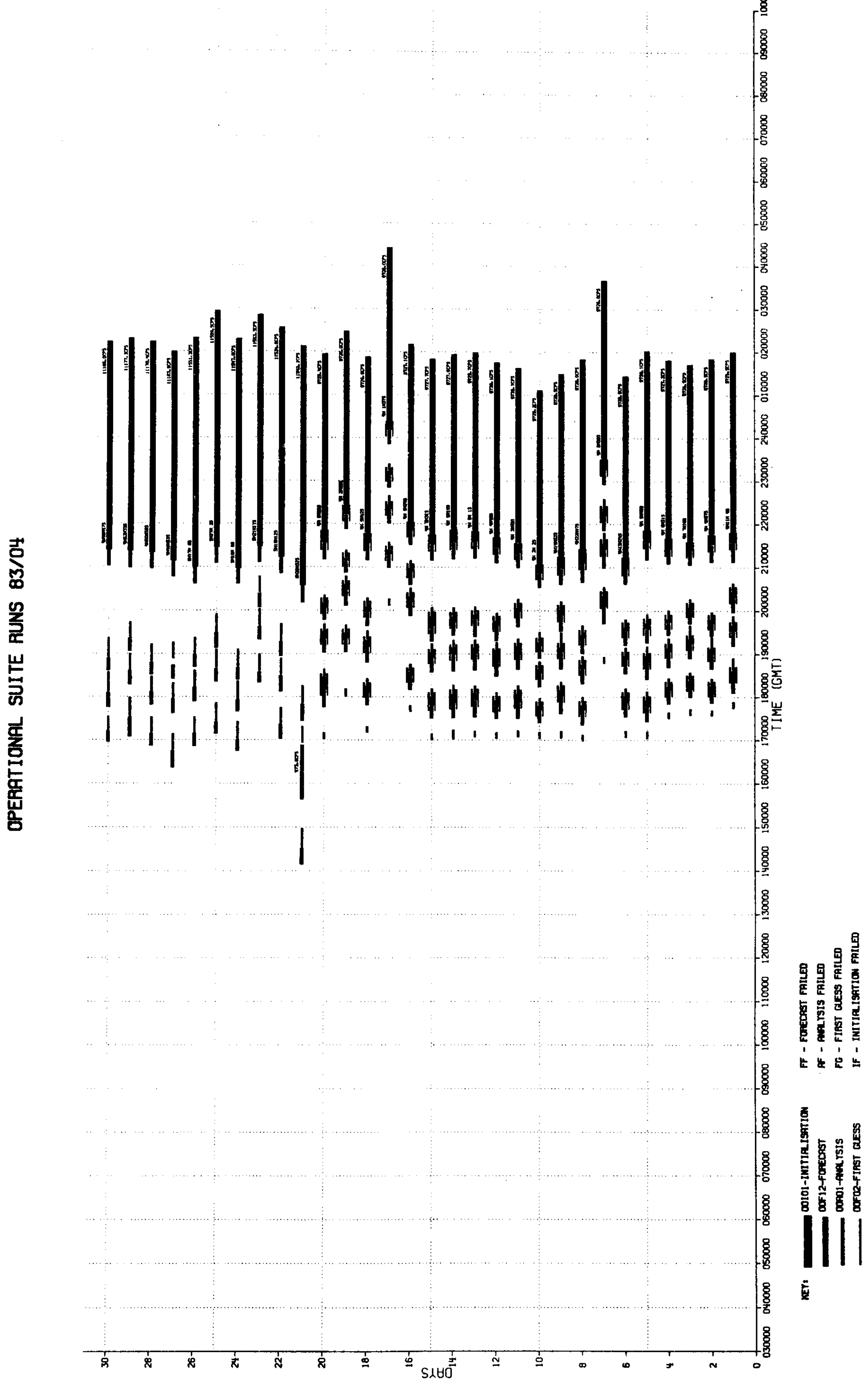


The delay on 28 March was due to air conditioning failure, followed by a subsequent Cray INSTALL.



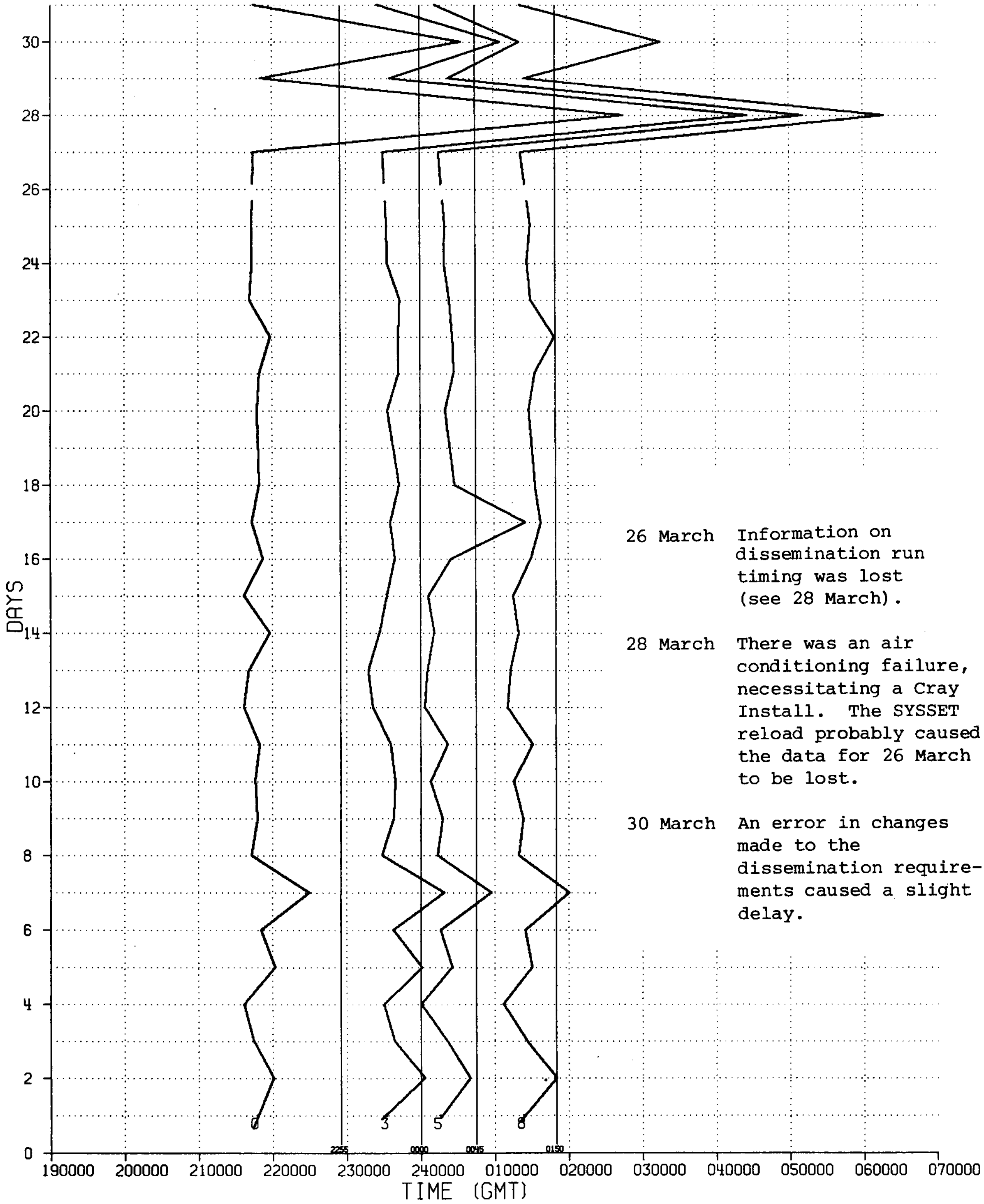
Cray hardware errors, and disc controller faults, were the causes for the delays on 7 and 17 April respectively.

DISSEMINATION RUNS

March 1983

The following diagrams for March and April 1983 (overleaf) show times at which dissemination products were produced during the operational forecasts.

The zig-zag lines show times by which analysis products (day 0) and forecast products (days 3, 5 and 8) were completed on the CYBER and routed to the NFEP telecommunications computer, but not the times at which products were routed onward to individual Member States. Also shown, as solid vertical reference lines, are corresponding clock times (GMT) by which products are expected to be available on ninety percent of occasions. The 'ninety percent' time for day 0 is 2255, for day 3 is 0000, and so on.



26 March	Information on dissemination run timing was lost (see 28 March).
28 March	There was an air conditioning failure, necessitating a Cray Install. The SYSSET reload probably caused the data for 26 March to be lost.
30 March	An error in changes made to the dissemination requirements caused a slight delay.

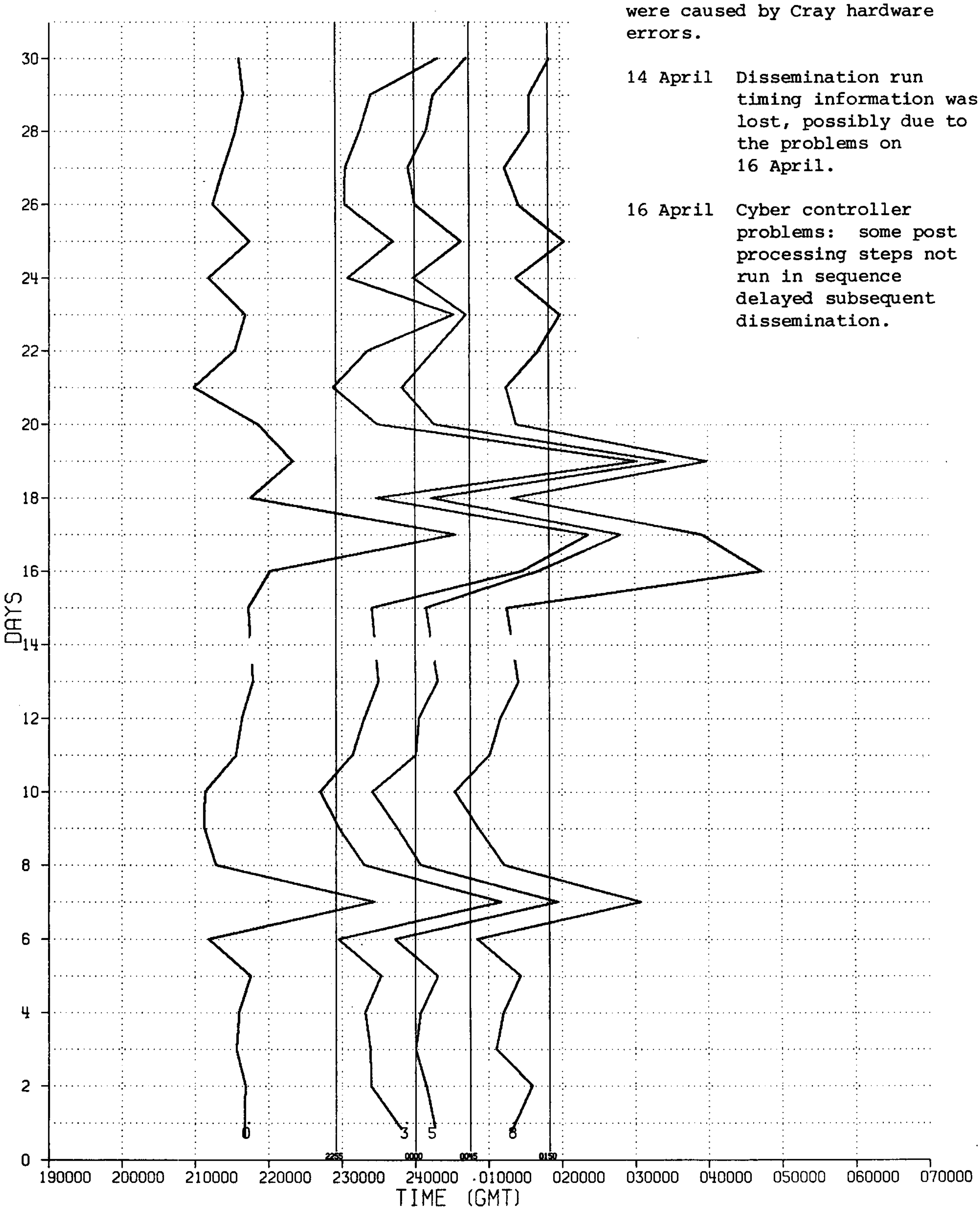
DISSEMINATION RUNS

April 1983

On 7, 17 and 19 April delays were caused by Cray hardware errors.

14 April Dissemination run timing information was lost, possibly due to the problems on 16 April.

16 April Cyber controller problems: some post processing steps not run in sequence delayed subsequent dissemination.



THE FIFTH SESSION OF THE TECHNICAL ADVISORY COMMITTEE

The fifth session of the Technical Advisory Committee was held at ECMWF Headquarters, Shinfield, on 21-22 March 1983, the first session to be held under the chairmanship of Mr. W.H. Wann (Ireland).

This meeting was an extraordinary session which did not cover the wide range of topics normally discussed by the Committee (this business will be dealt with in its sixth session on 14-16 September 1983) but dealt solely with those recommendations requiring urgent consideration, regarding the acquisition of new computer equipment on which the future development of the Centre's work depends.

In its consideration of these proposals, the Committee was greatly assisted by the advice and information supplied by the Technical Advisory Committee Subgroup on New Computing Facilities, which had been set up ad hoc at the Committee's fourth session (June 1982). The Subgroup met twice, in November 1982 and in February 1983, and was able to receive and review more detailed information and cover complex issues in greater depth than would have been possible within a full session. Some details of the Committee's decisions are given in the paragraphs below.

The Committee approved a proposal to replace the present Cray-1A with a Cray X-MP dual processor, incorporating a Solid State Storage Device (SSD) of 16 Mwords. This configuration will guarantee the increase in throughput required by the Centre to fulfil its operational and research requirements as laid down in the 4 Year Plan (1983-86).

The replacement of the Cyber 175 with a Cyber 855, one of CDC's range of new technology machines (to which the Centre's present Cyber 835 belongs) was also approved. This acquisition, as well as enabling the Centre to avoid the significantly increased maintenance costs now charged for the Cyber 175, will also give the benefit of having two fully compatible Cyber front-ends, both with micro-coded CPU's and with peripheral processors of equal speed. In contrast to the Cyber 175 with its out-dated architecture, the Cyber 855 has the potential to support future developments in peripheral equipment, allowing extension of these facilities, if necessary in the future.

Approval was also given to the acquisition of a Data Handling Sub-System comprising an IBM 4341 configuration with the Common File System (CFS) from Los Alamos National Laboratory, supplemented by meteorological applications software to be developed by the Centre, as the system software. Owing to the special situation caused by part of the software being acquired from a source other than the hardware manufacturer, the Centre took the precaution of undertaking a joint feasibility study. The study is intended to confirm that the total system will meet the Centre's requirements, and will be completed in the near future, prior to the signing of contracts.

A proposal for the acquisition of a Local Computer Interconnection Subsystem was also approved, thus completing the Committee's endorsement of all the Centre's proposals for the future development of its facilities.

Finally, a proposal from the United Kingdom to establish, on a temporary basis, a second medium-speed connection between the Centre and the United Kingdom Meteorological Office, for the provision of Remote Job Entry facilities was approved, the Committee noting the benefit to both the United Kingdom Meteorological Office and to the Centre itself in such an arrangement.

These recommendations were put before Council at its 17th session, on 20-21 April 1983, and were all approved. The contract for the acquisiton of the Cray X-MP was signed on 3 May, that for the Cyber 855 on 20 May, and machine room preparations for their installation have already commenced. Some technical information on the Cray X-MP and the Cyber 855 appears on p. 16 and p. 18 respectively.

- Daniel Söderman

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THE CRAY X-MP

Computers in the Cray X-MP series, announced by Cray Research Inc. in April 1982, might be considered as multiprocessor versions of the Cray-1A, as they have two CPUs which are software compatible with the CPU of the Cray-1A. The dual processors access a shared 2 or 4 million (64 bit) word memory. An Input/Output Subsystem (IOS) containing 2, 3 or 4 I/O processors (IOPs) is an integral part of the system, and can contain 1, 4 or 8 Mwords of buffer memory. A Solid State Storage Device (SSD) containing 64, 128 or 256 Mbytes of MOS semiconductor memory (8, 16 or 32 Mwords) is an optional addition.

The two CPUs of the X-MP are identical and the machine can degrade to single CPU running, if necessary. The CPUs differ from that of the Cray-1A in several minor aspects, but are software compatible. Each CPU has a clock cycle time of 9.5 nanoseconds, giving 105 MFLOPS per processor, this being 1.3 faster than the Cray-1A with a clock cycle time of 12.5 nanoseconds. Each processor has four instruction buffers, with a combined capacity of 512 16 bit instruction parcels, double the capacity of those on the Cray-1A.

The dual processor system allows either loosely coupled multiprogramming (1 job using each CPU) or single program multitasking (1 job using both CPUs). This latter facility will be supported by both COS and CFT, and common versions of the systems software will run on both the Cray-1A and the Cray X-MP.

Repackaging and sophisticated, reliable cooling systems have enabled the use of 4 Kbyte chips, so increasing the maximum possible central memory size. Four parallel memory access ports per processor (2 Read, 1 Write, 1 Input/Output) provide eight times the total usable bandwidth of the Cray-1A.

There are three clusters of inter-CPU communication registers to coordinate the running of the two CPUs. Each cluster has eight (24 bit) shared address registers, 8 (64 bit) shared scalar registers and 64 (1 bit) synchronisation registers.

Enhanced chaining features result in the X-MP providing good throughput on long vector processing. There are now no restrictions on chaining (the mechanism whereby the result of one vector operation can be used as the operand of another, without waiting until all the 64 elements of the result vector are ready), so chain slot time has now been eliminated.

The I/O Subsystem is an integral part of the X-MP system and acts as a data concentrator and distribution point. It relieves the mainframe from handling I/O interrupts and driving peripherals. It also handles the operator consoles and is used to deadstart the Cray X-MP. The buffer memory, of which the Centre's configuration will have 1 Mwords, may be used for residence of datasets in order to eliminate I/O to disk. The Centre will have a minimum IOS configuration, containing 2 I/O processors: an MIOP handling the front-end machines and controlling the other IOPs and a BIOP handling data transfers between buffer memory and central memory or disk, and between central memory and disk.

The Cray X-MP is so powerful that the I/O devices attached to it become a limiting factor; this has led to the development of the Solid State Storage Device. To the user and operating system, the SSD appears to be an extremely fast disk, but with a zero seek time as compared to the 50 milliseconds average for a DD-29 disk. Moreover, the SSDs have a transfer rate to the X-MP of up to 1250 million bytes/second (depending on the size of the model), compared to 4.5 million bytes/second for a DD-29 disk. The Centre will acquire an SSD of 16 Mwords, the maximum transfer rate of which is 625 million bytes/second. Figure 1 gives an overall configuration diagram.

Benchmark tests carried out in 1982 by ECMWF staff on the prototype X-MP indicate the following processing speed improvements, comparing a single X-MP processor with the Cray-1:

1. 1.3 for scalar code
2. up to 4 depending on the type and sequence of vector operations involved.
3. approximately 1.7 for the previous operational grid point model.

Throughput was subsequently measured using both processors. Two models were executed simultaneously, one in each processor. By using the SSD instead of real disks for the work datasets, a throughput improvement of 3.6 was achieved over the Cray-1.

The probable installation date is early November. After a 48 hour provisional acceptance test, there will be a 30 day final acceptance test, during which normal user batch work will be executed on the Cray X-MP. Production work will remain on the Cray-1. This will be followed by a 90 day production test when ALL work will be executed on the new computer. The Cray-1 will remain available to take over in case of problems.

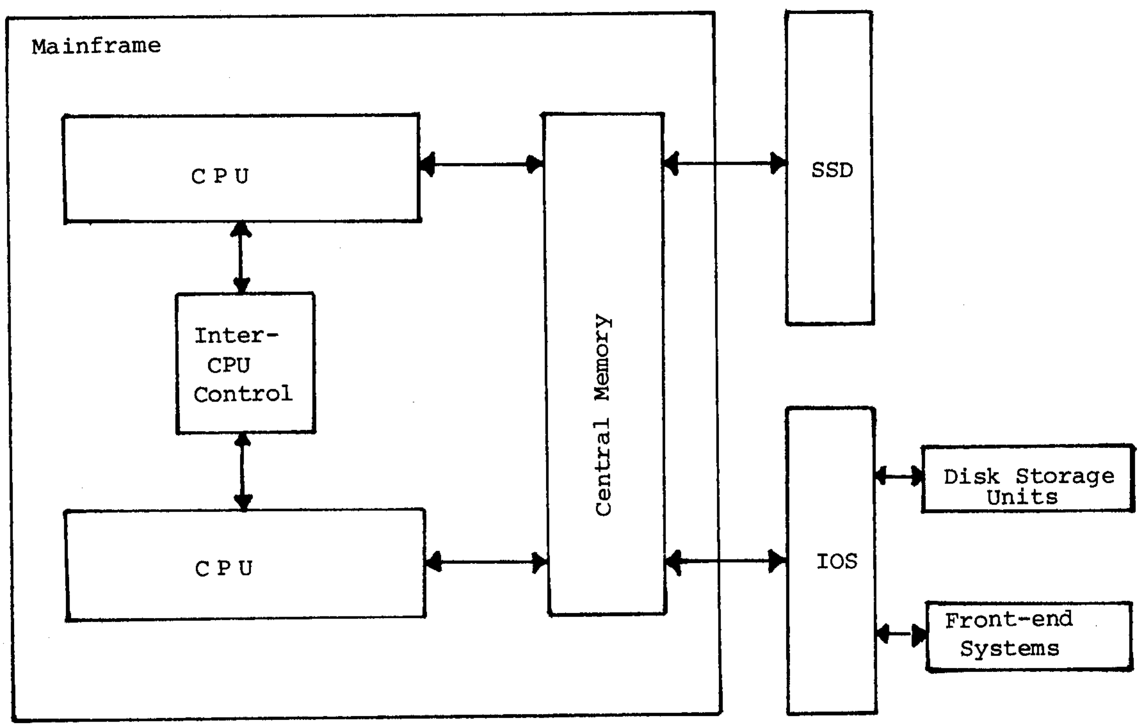

Fig. 1 CRAY X-MP Overall System Organisation

- David Dent

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THE CYBER 170-855 TO REPLACE THE CYBER 175

The Cyber 855 shortly to be installed at the Centre as a replacement for the Cyber 175 is one of a new range of machines, the Cyber 170-800 series, announced by Control Data in April last year. This range, to which the Cyber 835 also belongs, is based on an architecture completely different from that of the Cyber 175, the older technology of which is leading to significant increases in maintenance costs charged by the manufacturer.

The machines in this new series have micro-coded CPU's, up to 2 Mwords of central memory and the added feature of cache memory. The configuration the Centre is acquiring, which is the most closely equivalent to the Cyber 175, has 512K (60 bit) words central memory, 2K (60 bit) words cache memory and 20 peripheral processors. The speed of the peripheral processors is 250 nanoseconds (major cycle), twice that of the Cyber 175's peripheral processors. There are 24 I/O channels, each with a transfer rate of up to 48 Mbit/sec.

The general performance of this configuration has been shown, based on benchmarks performed by the Centre, to be very close to that of the Cyber 175. However, the speeds of the CPU's are rather difficult to compare, since the ratio between Cyber 175 CPU time and Cyber 855 CPU time varies considerably from job to job. This variation is caused by differences in execution times for the individual CPU instructions, the effect of cache memory and the extra central memory which allows the Cyber 855 operating system to perform certain peripheral processor functions faster in the CPU. Nevertheless, measured over any realistic mixture of jobs, the throughput on the Cyber 855 was found to be between 2% - 5% better than on the Cyber 175. From the user's point of view, the Cyber 855 is fully compatible with the Cyber 175, so no changes of user code will be needed.

As well as avoiding the sharply increasing maintenance costs, the Cyber 855 has the advantage of being fully compatible with the Cyber 835, both having micro-coded CPU's and peripheral processors of equivalent speed. The full compatibility of the two machines will greatly facilitate software maintenance, avoiding the present need for modifications to allow the Cybers 175 and 835 to run compatibly. The new machine will also be capable of supporting future developments in peripheral technology, thus allowing expansion in these facilities, if necessary in the future.

At present, delivery of the Cyber 855 is expected in July this year. While the new machine is being installed and tested, only one Cyber will be operational. Therefore, to ensure sufficient Cyber capacity during the installation, the Cyber 855 will at first replace the Cyber 835, running in parallel with the Cyber 175 for a period of up to 3 months. Once the new machine has stabilised, the exchange of machines will be completed by replacing the Cyber 175 with the Cyber 835. The net effect of this is that there will be 2 periods of at least 4 days each when only one Cyber will be operational. This is not expected to delay the forecasts, but turnaround for other Cyber work will be poorer than usual. The exact dates will be communicated as soon as they are known, and at least one week's notice will be given.

- Claus Hilberg

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STILL VALID NEWS SHEETS

Below is a list of News Sheets that still contain some valid information which has not been incorporated into the Bulletin set (up to News Sheet 146). All other News Sheets are redundant and can be thrown away.

No.	Still Valid Article
16	Checkpointing and program termination
19	CRAY UPDATE (temporary datasets used)
47	Libraries on the Cray-1
53	Writing 6250 bpi tapes (EEC parameter)
54	Things not to do to the Station
56	DISP
67	Attention Cyber BUFFER IN users
73	Minimum Cyber field length
89	Minimum field length for Cray jobs
93	Stranger tapes
118	Terminal timeout
120	Non-permanent ACQUIRE to the Cray
121	Cyber job class structure
122	Mixing FTN4 and FTN5 compiled routines
127	(25.1.82) IMSL Library
130	Cyber software: PACKS, SPACE
	Contouring package: addition of highs and lows
131	File storage on TEMP
132	(21.6.82) NOS/BE level 552, including SORT/MERGE5.
135	Local print file size limitations
136	Use of TEMP disk space
	Care of terminals in offices
140	PURGE policy change
141	AUTOLOGOUT - time limit increases
142	INTERCOM login default procedures
143	APOLLO - a new version of GEMINI
144	DISSPLA FTN5 version
145	48 hour forecast - new schedule
146	Replacement of Cyber 175 by Cyber 855 Cyber dayfile message switches

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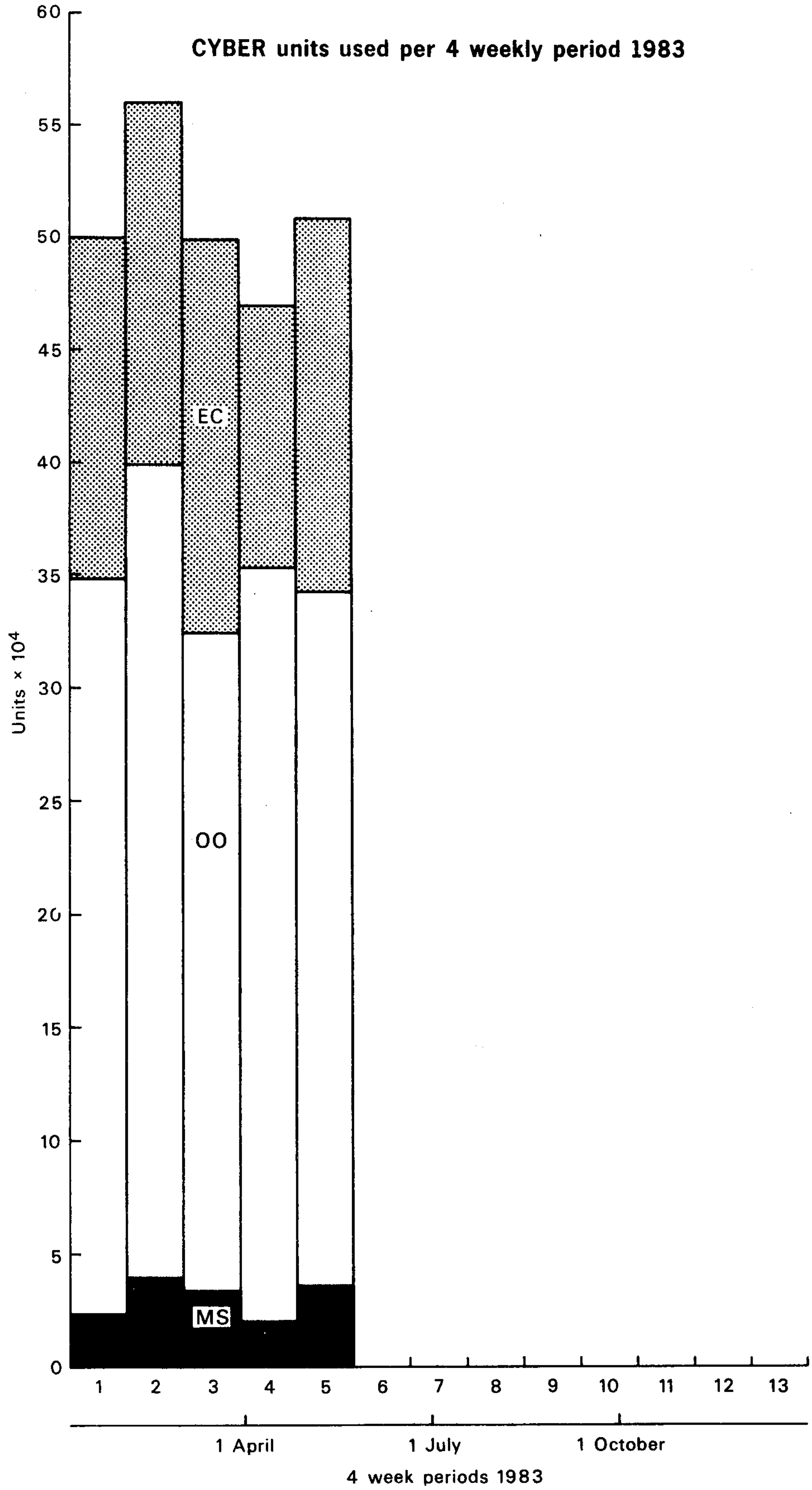
COMPUTER USAGE STATISTICS

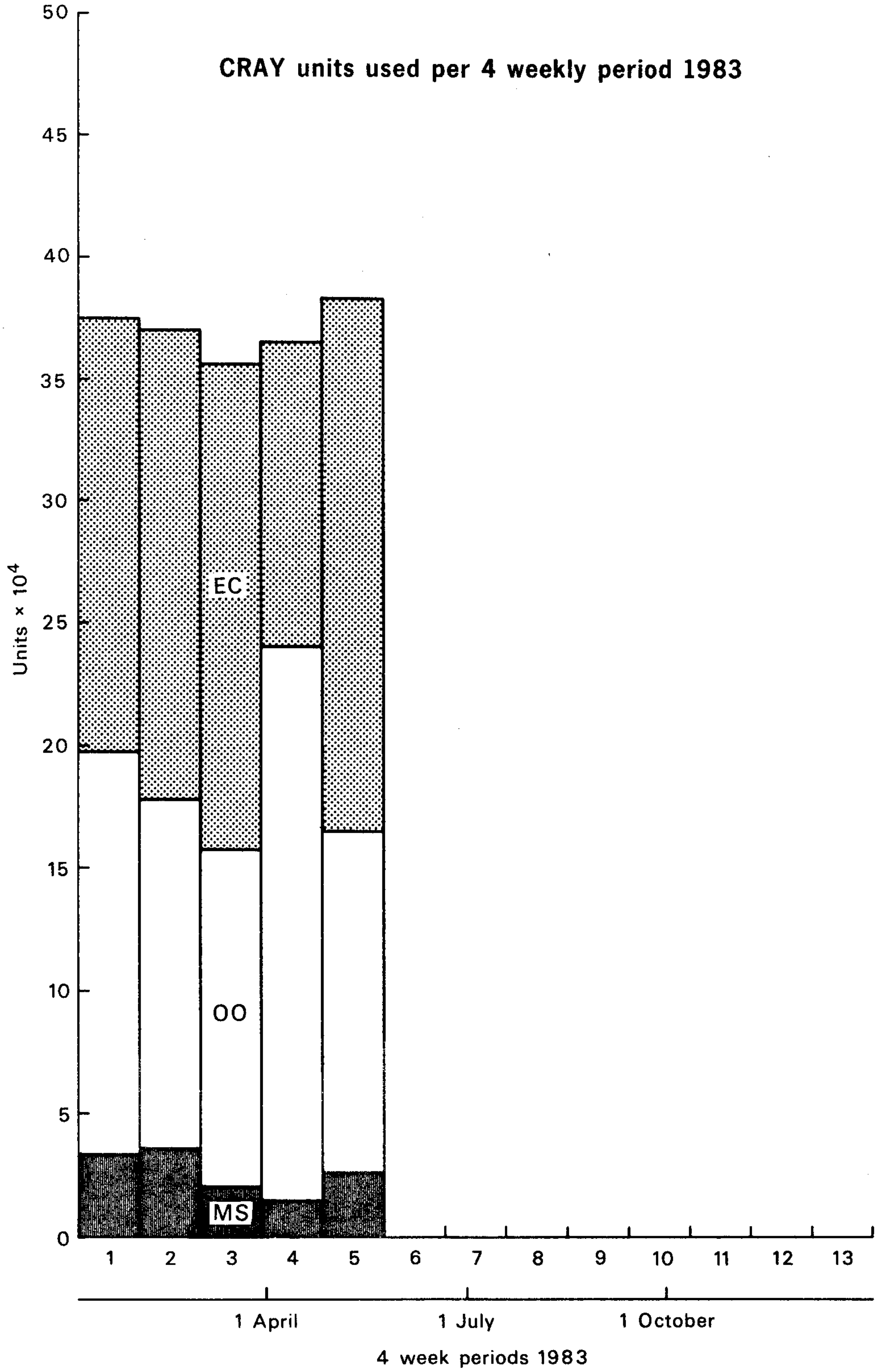


EC = Centre users

OO = operational suite running

MS = Member State users, including Special Projects

EC + OO + MS = total usage, less those jobs classed as systems overheads



ECMWF PUBLICATIONS

Technical Memorandum No. 73 A simple memory manager
ECMWF Forecast and Verification Charts to 20 March 1983

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CALENDAR OF EVENTS AT ECMWF

5 - 9 September 1983	ECMWF 1983 Seminar on Numerical Methods for Weather Prediction
12 - 14 September 1983	11th session of Scientific Advisory Committee
14 - 16 September 1983	6th session of Technical Advisory Committee
28 - 30 September 1983	30th session of Finance Committee
23 - 24 November 1983	18th session of Council

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INDEX OF STILL VALID NEWSLETTER ARTICLES

This is an index of the major articles published in the ECMWF Newsletter plus those in the original ECMWF Technical Newsletter series. As one goes back in time, some points in these articles may have been superseded. When in doubt, contact the author or User Support.

*T indicates the original Technical Newsletter series

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Communications & Graphics Section Head	-	Peter Gray	OB 227	448
COMPUTER OPERATIONS				
Console	-	Shift Leaders	CB Hall	334
Reception Counter) Tape Requests)	-	Jane Robinson	CB Hall	332
Terminal Queries	-	Norman Wiggins	035	209
Operations Section Head	-	Eric Walton	CB 023	351
Deputy Ops. Section Head	-	Graham Holt	CB 024	306
DOCUMENTATION	-	Pam Prior	OB 016	355
Libraries (ECMWF, NAG, CERN, etc.)	-	John Greenaway	OB 017	354
METEOROLOGICAL DIVISION				
Division Head	-	Frédéric Delsol	OB 008	343
Applications Section Head	-	Joël Martellet	OB 316	422
Operations Section Head	-	Austin Woods	OB 107	406
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	-	Veli Akyildiz	OB 104A	379
	-	Horst Böttger	OB 104A	378
	-	Rauno Nieminen	OB 104A	378
Meteorological Operations Room			CB Hall	328/443
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RESEARCH DEPARTMENT				
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Meteorological Education and Training	-	Robert Riddaway	OB 117	405
Operating Systems Section Head	-	Claus Hilberg	CB 133	323
Telecommunications Fault Reporting	-	Stuart Andell	CB 035	209
User Support Section Head	-	Andrew Lea	OB 003	348

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