European Centre for Medium Range Weather Forecasts

ECMWF NEWSLETTER

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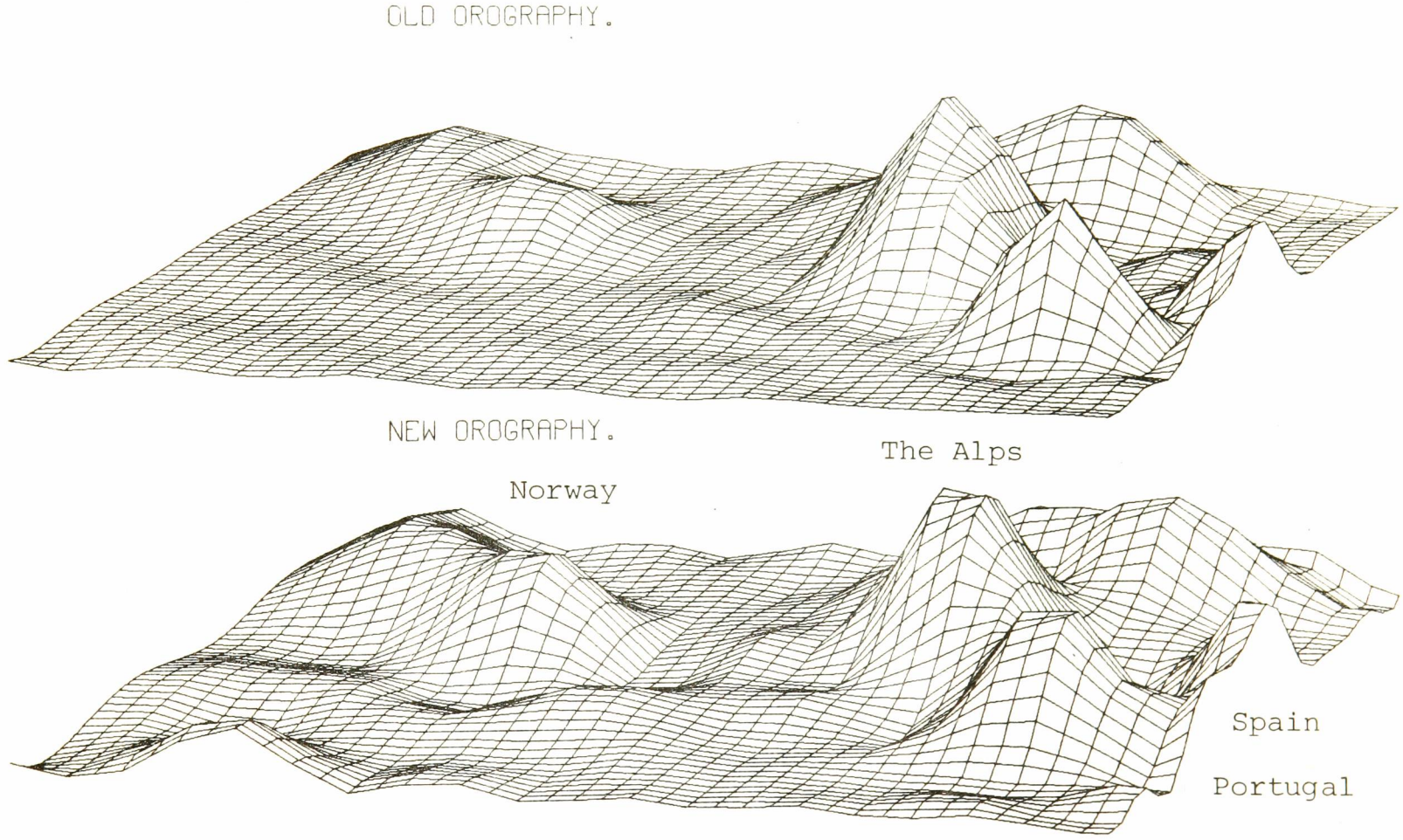

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IN THIS ISSUE

COVER: 3-dimensional representation of the old orography and new orography revised over Europe and between South America and Antarctica (see article on p. 3)

This Newsletter is edited and produced by User Support.

The next issue will appear in June 1984.

DEVELOPMENT OF A NEW FORECASTING SYSTEM

The commitment in the Centre's 4-year plan is to introduce a revised operational forecasting system on the Cray X-MP in 1985. The implementation of the revised system will involve 3 stages, as described below:

Stage I — the introduction of a higher resolution model;

Stage II — the introduction of analysis/data-assimilation code;

Stage III — the introduction of alternative parameterisation, improved 'resolution' in the analysis, and optimisation to both the model and data assimilation. A change in adiabatic formulation, to include finite elements in the vertical, may also take place at this time.

Stage I - Higher resolution

The enhanced computational power provided by the Cray X-MP allows us to plan for a significant increase in the resolution of the operational forecast model for 1985. The resolution that can be accommodated within present operational timings will depend on the performance of the X-MP at higher resolution, the extent to which the model can be optimised, and the parameterisation schemes which will be adopted. Precise figures cannot be given at present, but the following gives an indication of combinations of horizontal and vertical resolution which may be feasible:

Horizontal	Vertical
T106	L16
T99	L18
T95	L20
T89	L22
T84	L24

(T106 - a spectral representation with truncation [triangular] at total wavenumber 106; L16 - 16 levels in the vertical.)

There seems little doubt from past work that benefits will arise from increases in horizontal resolution, not only through a direct improvement in the accuracy with which smaller atmospheric scales can be represented but also through improved orographic forcing and more realistic local forecast products. Although there is uncertainty as to the choice of orography at higher resolution, the strategy will be to use as high a horizontal resolution as is practical in view of the choice of vertical resolution and physical parameterisations.

Much experimentation to date has shown less sensitivity of forecast quality to the representation in the vertical than to that in the horizontal. Studies of the impact of stratospheric resolution on the Centre's forecasts, taken together with the difficulties in data analysis and computational stability found for strong stratospheric flow, suggest that in the framework of producing an operational model for 1985, it would be appropriate not to consider raising the top model level above its present location at 25 mb. It also seems advisable not to place emphasis on increased boundary layer resolution at the present time, in view of the choice still to be made between the two competing boundary-

layer formulations for the 1985 model. Thus the choice of vertical resolution for the first high-resolution X-MP model will be made on the basis of experiments performed using enhanced resolution in the free troposphere and in the vicinity of the tropopause.

Stage II - New Analysis System

The horizontal resolution of the present analysis system is determined primarily by the structure functions and by the data selection algorithms. Theoretical studies have shown that a statistical interpolation scheme can extract information, where observations are available, on a significantly higher resolution than the present operational scheme. The vertical resolution suffers from extensive interpolation of both data and fields. The aim is to have, by mid 1985, a compact analysis which uses data at their reported spatial position, has a data dependent resolution and produces analysis increments directly at the model levels.

Stage III - New parameterisation schemes and other revisions

The alternative parameterisation will be based on developments arising from on-going research, the likely changes being:

- use of an evolution equation for turbulent kinetic energy as a basis for the computation of subgrid vertical turbulent transports;
- replacement of the Kuo convection scheme, possibilities include the Arakawa-Schubert scheme or the Miller-Moncrieff (Imperial College) scheme;
- use of a new cloud cover representation for radiative flux computations (including boundary layer, large-scale and sub-grid convective clouds);
- sub-grid orography.

Whereas the envelope orography appears to be an improvement for the large scale dynamics of the model and will be used for the high resolution tests, it has obvious shortcomings in its ability to represent surface and near surface fields (snow cover is one example) which may, in turn, affect the overall model behaviour. An alternative method based on a more physical use of the statistical properties of sub-grid orography is being developed as a research project. If it proves successful, it will be incorporated in the 1985 model.

In addition to the parameterisation changes, a change to a finite-element representation of the vertical is possible for the adiabatic model at Stage III. This will depend on the success of the programme of testing and further development.

Lorenz has estimated that, with no change in one-day forecast errors, model improvements alone could, in principle, lead to a two to four day improvement in the predictive skill of the ECMWF model; however, by halving the one day forecast errors, a further two days could be added to the range of useful predictability. Lorenz's work and other similar studies carried out at ECMWF are an encouraging indication that the research and development programme outlined above will lead to significant improvements in ECMWF's medium range forecasts.

This plan is the result of many discussions, involving all sections of the research department, which have taken place during the last year.

- Dave Burridge

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MODIFICATION TO THE OROGRAPHY IN THE ECMWF OPERATIONAL MODEL INTRODUCED ON 1 FEBRUARY 1984

The current envelope orography was introduced into the operational forecasting system in April 1983. It is based on a mean orography to which $\sqrt{2}$ times the subgrid variance is added. If such an orography were to be used unmodified, unrealistic heights of coastal gridpoints, both over land and sea would cause a large number of data rejections, mainly SYNOPs but also TEMPs, along the coasts of the continents.

In an attempt to alleviate the problem, it was decided to reduce the height of sea points to zero after the initial spectral fit, then to perform a new spectral fit followed by another reduction over the sea and to reiterate this procedure nine more times. It achieved the aim of lowering the height of coastal points and, as a consequence, the number of coastal data rejections.

However, it soon became obvious that such a procedure also had some drawbacks. The reduction of the height of coastal and sea points contributed to the wiping out of most islands (Iceland, New Zealand, the Indonesian islands...) and peninsulae (e.g. near Antarctica). It also slightly shifted mountains like the Alps away from the coast and substantially modified the shape of orography near Greenland and Spain. There has also been growing evidence that some local problems observed during the parallel running in April and subsequently in operational mode are partly associated with these deficiencies, such as mean errors in the forecast of geopotential near Cape Horn or errors in the precipitation forecasts over Europe.

In order to remedy these effects, a modified envelope orography was introduced operationally on 1 February 1984. It is based on the same concept, i.e. a $\sqrt{2}$ multiple of the subgrid variance is added to the mean orography, but for the land points only, thus avoiding excessive rising of coastal points and of oceanic regions with numerous islands. One single spectral grid is applied afterwards. Fig. 1 shows details of the old and Fig. 2 of the new orography for the European area. Fig. 3 gives a 3-dimensional representation of the two orographies.

It is worth noting in particular the more realistic shape of Spain, Iceland and the better position of the Alps. Significant differences are also found in the Southern Hemisphere.

Extensive tests, in particular for cases in late spring and summer this year, revealed benefits resulting from the use of this modified envelope orography. As its introduction represents only a modest change to the operational forecasting system, no major changes in the large scale forecasts could be expected. However, a small overall improvement has been observed at least in the useful part of the forecast, i.e. the first five to seven days. A larger positive impact has been found on the precipitation forecasts. This is quite significant over Europe.

It should be noted though, that in some areas of Europe, the revised orography will have a major impact on the surface temperature of this model. To minimise the effect on users, values will be adjusted before dissemination, so as to be appropriate to a mean orography.

- Horst Böttger
  Michel Jarraud

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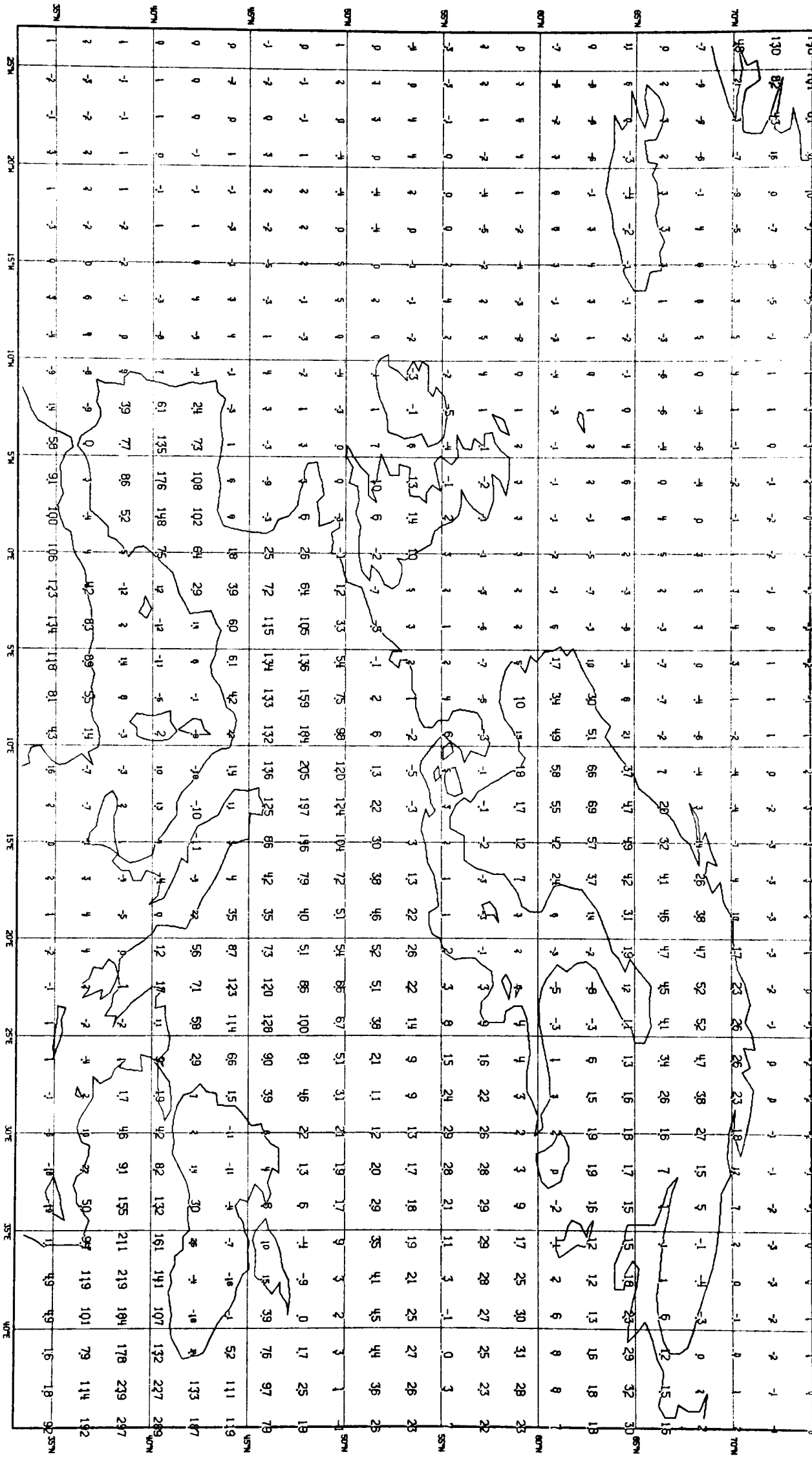

Fig. 1 Heights of the former model orography for the European area on the Gaussian grid, units in 10 metres, small digits indicate sea points

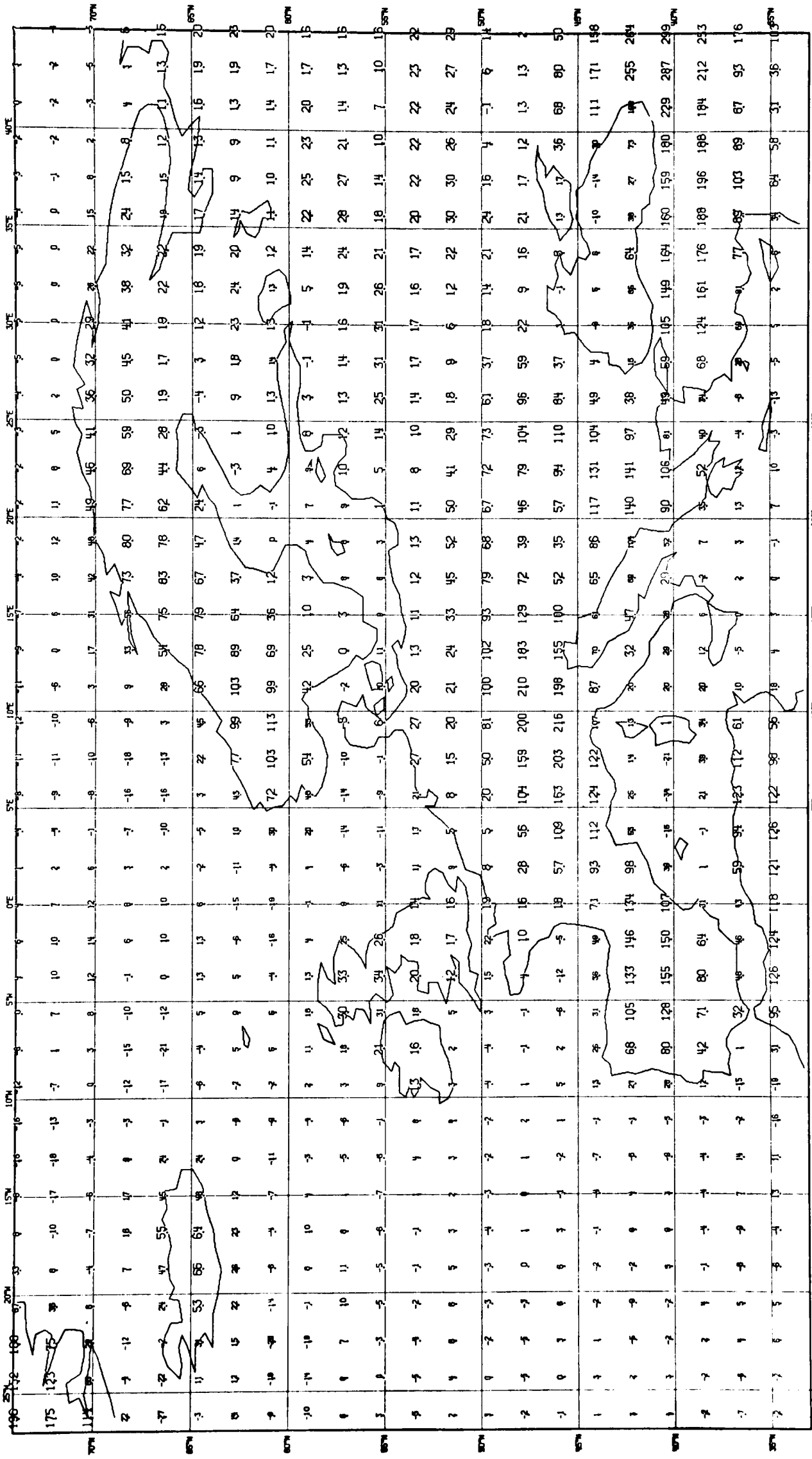

Fig. 2 Heights of the new operational orography on the Gaussian grid, units in 10 metres, small digits indicate sea points.

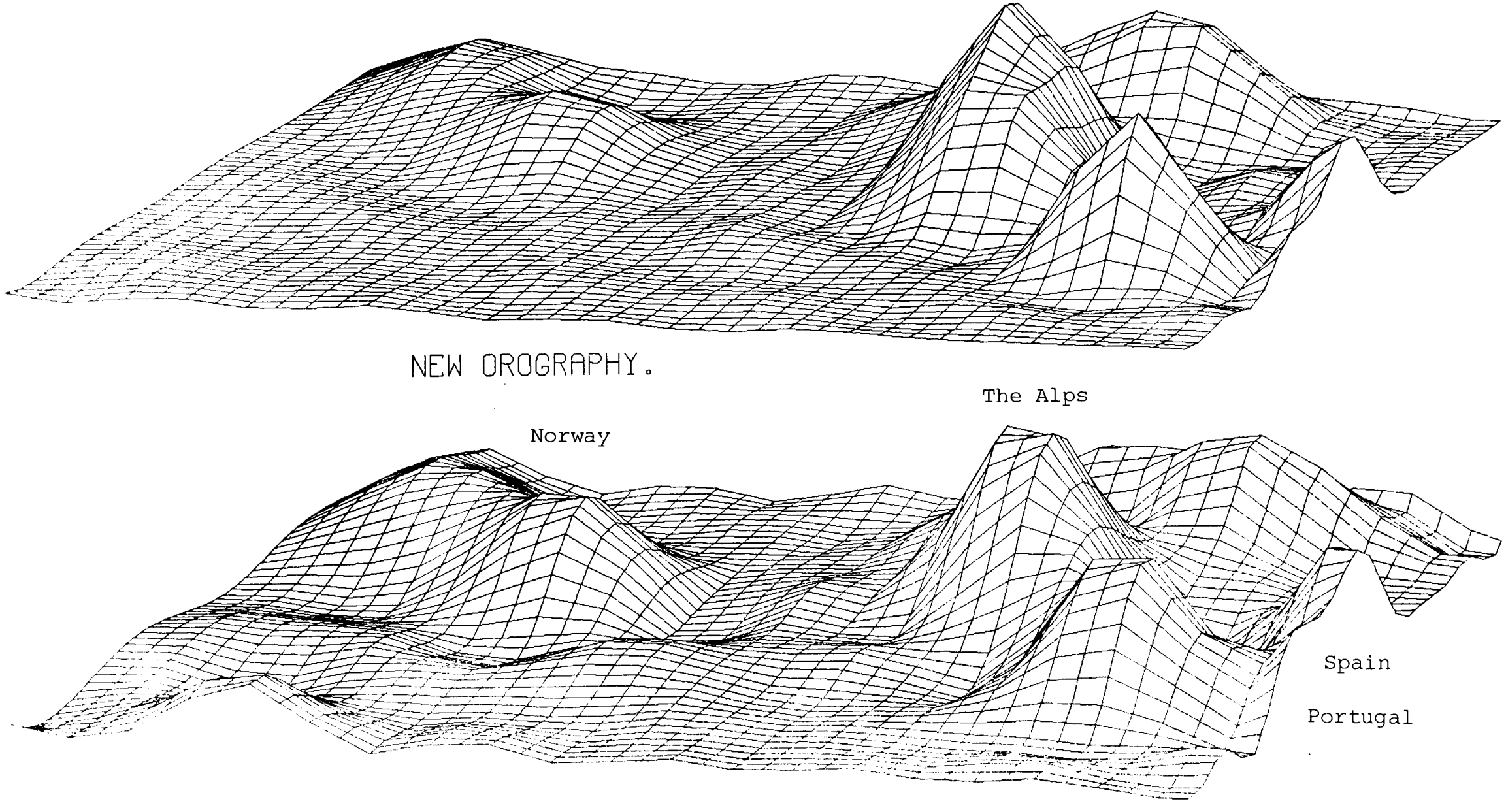

Fig. 3 3-dimensional representation of the old (top) and new (bottom) model orography for Europe.

OPERATIONS DEPARTMENT PLANS FOR 1984

Plans for 1984 in the Operations Department include projects which will have a significant effect on the range and quality of the facilities which the Centre will be able to provide in the future. Moreover, it is hoped that the results of the meteorological projects will be of benefit to the meteorological community worldwide. These projects will take up a substantial proportion of the department's manpower and are above and beyond the routine effort required to ensure the smooth and efficient operation of an ever-increasing range of facilities, and support the implementation of the many changes in the forecasting system planned by the Research Department during the course of the year (see article on p. 1).

Meteorological data

As a centre with a responsibility to carry out global analyses of the highest quality, it is essential that ECMWF obtains the maximum coverage of observational meteorological data, in time for the data cut-off and containing as few errors as possible in the coding and meteorological content of the incoming messages. The reception at ECMWF and the quality of the conventional data, such as SYNOP, TEMP, PILOTs, will be monitored throughout the year. Statistics concerning three important aspects of the World Weather Watch system, i.e. the availability of the data, time of arrival and the quality of selected parameters will be accumulated and scrutinised on a monthly basis. Both the availability and the quality of data, e.g. for the radiosondes (TEMP) will be represented by a very limited number of values highlighting the results, both country by country and/or station by station. This information will allow the most appropriate action to be taken, either internally at the Centre or by approaching the WMO, the countries or the observing sites directly.

With the support of consultants, the joint WMO/ECMWF project creating global datasets of upper air analysis and surface observations for the years 1980 to 1982 will be finalised in 1984. The upper air gridpoint fields (analysis at 12Z) will include the six parameters, height, temperature, u- and v-wind, vertical velocity and relative humidity at seven standard pressure levels in the troposphere up to 100mb. The analyses will be complemented by synoptic observations for the four main synoptic hours as received via GTS at ECMWF. These datasets will form a unique source of information for meteorological research and development work. The Centre will provide the service of copying and extracting subsets of data on request. In order to ensure that these WMO/ECMWF datasets are based on the most comprehensive global data coverage, the Centre will, in 1984, monitor the data traffic on the GTS and shortcomings will be traced and brought to the attention of the telecommunication centres involved.

Graphics

At the beginning of 1984, a new Graphics Project was launched within the Operations Department. The work will be concentrated on the design and implementation of the Meteorological Applications Graphics Integrated Colour (MAGIC) System. The new facilities will be released in several stages. For

1984, the following phases can be envisaged: Phase 1 (end of March) will contain the contouring part only and will be available as a subroutine package on the Cray. The contouring interface will, at this stage, only contain facilities needed for making the contours on plots and support colour. Phase 1 will only be useful for users having written DISSPLA programs who want to add/replace the contouring facilities. In phase 2 (end of June) the MAGIC System will be extended with mapping, text blocks, layout/overlaying enhancements in order to create complete plots. After this, in phase 3 (end of September) additional contouring facilities will be released, including shading between levels.

The CUECHART/TELLAGRAF service will be made generally available at the end of the second quarter. It will allow users to create presentation slides in colour based on a number of standard chart styles (CUECHART) or creating new layouts (TELLAGRAF).

Data highway, data handling

Now that the majority of the additional computer equipment planned in 1983 has been delivered and installed at the Centre, the main emphasis will be on integrating the individual items into the overall final system and developing the facilities and expertise needed to exploit their special features to the full.

Some of the data highway (LCN) equipment has arrived at the Centre. It is planned that the Cybers will be the first host machines connected to the LCN and this should take place early in the year. Connection of the IBM will occur within a similar timescale, although this will be with provisional software which lacks some facilities. Final software for the IBM connection is expected in the summer, when a CFS software upgrade also will be implemented. The implementation of the Cray connection is planned next, and will be realised via a Cyber front end gateway, using a Cyber 815. The VAX will be the last system to be connected.

At the beginning of the year, the main priority for the Common File System (CFS) project will be the enhancement of CFS to support magnetic tape storage. Work on interfacing CFS to the Remote Host Facility (RHF) on the IBM system has begun, and it is expected that an implementation without error handling facilities will be available at first, to allow further developments to proceed, with a reliable interface complete later in the year.

The development of the Meteorological Archival and Retrieval System (MARS) will continue, with the first part of the year taken up with completion of the detailed design work. Development and testing of the first phase should be completed in time to allow a limited user service as soon as the CFS/RHF interface is available in July. It is planned to provide the GETDATA facilities under MARS at this stage. Phase 2 of MARS will handle data in field format but operational availability will depend upon the implementation of the important enhancements to CFS described above.

Telecommunications

In addition to these intensive development projects, following the Council's decision at its November 1983 session, that the ECMWF telecommunication system should be replaced in 1985, work is in progress to specify the requirements for a new telecommunications system. This will be a major task, entailing the estimation of traffic volumes into the next decade, taking into account likely future changes, both in the ECMWF forecasting system and in the Member States. These investigations will lead to the preparation of an Invitation to Tender and the final selection of equipment in time to allow the installation of the new system in autumn 1985. Throughout this procedure, the Centre will be liaising closely with the Member States, principally via the Technical Advisory Committee Sub-group established for this purpose.

Once again, the Operations Department has been set a challenging range of targets for the coming year. None of the projects described above is a minor undertaking and it will require dedicated effort by every member of staff to reach the goal by the end of the year.

- Daniel Söderman

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ECMWF DATA ASSIMILATION - SCIENTIFIC DOCUMENTATION

The main objective of the data assimilation scheme developed at ECMWF is to provide initial states for the Centre's operational forecast model. The assimilation scheme has also been used to produce analyses from the observations made during FGGE for use by the scientific community. The scheme produces global analyses in numerical form using all appropriate types of available observations. It is designed to run efficiently with minimal human intervention, on a large, fast, vector processing computer.

Scientific documentation of the data assimilation scheme has recently been produced (Meteorological Bulletin M1.5/1). It describes the analysis of mass, wind, humidity and surface fields, interpolation methods and normal mode initialisation.

A copy of the documentation should be available in the Library of your National Meteorological Service and further copies are available from the Centre.

- Peter Lönnberg
  Dave Shaw

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THE METEOROLOGICAL TRAINING COURSE - 30 APRIL-22 JUNE 1984

The objective of the training course is to assist Member States in advanced training in the field of numerical weather forecasting. Students attending the course should have a good meteorological background, and some practical experience of numerical weather prediction is an advantage.

The course is divided into four modules:

M1: Dynamical meteorology and numerical methods (30 April-11 May)

M2: Numerical weather prediction - analysis, initialisation and adiabatic formulation (14-24 May)

M3: Numerical weather prediction - diabatic processes and the inclusion of orography (29 May-8 June)

M4: Use and interpretation of ECMWF products (11-22 June)

Modules M1, M2 and M3 will be of most interest to scientists who develop numerical models for operational forecasting or research. Module M4 is quite different from the others. It is directed towards those staff in the Meteorological Services who are (or will be) using ECMWF products, either directly as forecasting staff, or in development work aimed at maximising the benefits to users of the Centre's products.

Students can attend any combination of the four modules. However, those attending only M2 are expected to have a good knowledge of the topics covered in M1. Attendance at the other models is not a requirement for participation in M4.

In each module, there will be lectures, exercises and problem or laboratory sessions; in some modules, there will also be some computing, though no computing experience will be assumed. Participants are encouraged to take an interest in the work of ECMWF and to discuss their own work and interests with the staff of the Centre. All the lectures will be given in English and a comprehensive set of lecture notes will be provided. Many of the lecture notes for the first three modules should already be available in the Library of your National Meteorological Service.

A booklet describing the course has been sent to Meteorological Services and many universities and institutions. If you do not have access to one of these, a copy can be obtained from me.

- Bob Riddaway

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BI-DIRECTIONAL MEMORY ON CRAY X-MP

Introduction

The Cray X-MP hardware enables four data paths to be used to each addressable word of memory. In practice, one path is reserved for I/O, two paths are reserved for READ operations (memory to register) and one path for WRITE operations (register to memory). READ instructions always issue immediately. WRITE instructions may be subject to delay. In consequence, where a READ is dependent on the completion of a WRITE operation, it may be necessary to enforce a "completion of memory requests" (or CMR) to ensure that the data is not read before the completion of the WRITE.

Some simple rules have been formulated by Steve Chen of Cray Research, and are used within the CFT FORTRAN compiler to ensure safety. These rules are reproduced below.

It should be noted that, because CFT does not conduct a GLOBAL assessment of the code it compiles, safety is NOT guaranteed across subroutine boundaries. In particular:

```
SUBROUTINE EG(PA,PB,PC,KLEN)
DIMENSION PA(KLEN), PB(KLEN), PC(KLEN)
---
```

will be compiled as though arrays PA, PB and PC do NOT intersect. If a CALL is made to EG which implies intersection, such as

```
CALL EG(A,A,A,KLEN)
```

then the programmer must guard against possible bi-directional hazards. This is an analogous situation to that which exists with respect to vectorisation, as code of the type illustrated can also lead to CFT not detecting vector hazards.

Safe Sequences

The following sequences are safe under the given conditions. In each case, the vector READ issues before the vector WRITE, guaranteeing that the read elements remain ahead of those being written back, or there is no intersection or dependence.

a.
```
A(I) = B(I) + C(I) + etc.
D(I) = E(I) + F(I) + etc.
                     (no intersection)
```

b.
```
A(I) = B(I+1) + etc.
B(I) = A(I+1) + etc.
       for I=1,3,5,.....2n+1
                     (no intersection)
```

c.
```
A(I) = A(J+C) +
       for I=1, 1+d1, 1+2d1,....
           J=1, 1+d2, 1+2d2,....

       if C > 0
          d1=d2     (intersection, read before write)
```

```
d.  B(I) = A(I+C)
    A(I) = .....

           if C > 0        (intersection, read before write)
```

Unsafe Squences

```
a.  A(I) = ....
    B(I) = A(I-C)

           C > 0
```

is unsafe because the READ of A(I-C) can issue ahead of the write of A(I). CFT will insert a CMR here.

```
b.  DO ...   I =
    DO ...   J =
    A(J,I) = A(J,I-C) + ...

           C = 1
```

is unsafe because the READ of A(J,I-C) for the next pass of the inner loop may issue before the write to A(J,I) on the current pass.

```
c.  B(I) = A(I) + ...
    A(I) = B(I) + ...
    B(I) = ......
```

is unsafe with respect to the second statement because the READ OF B(I) can issue ahead of the write.

CFT Strategy

Currently, CFT will insert CMR before any construct which does not satisfy the "SAFE" conditions described above. The product development team are endeavouring to discover modifications to these algorithms which would allow CFT to insert fewer CMR commands, but will not do so until completely satisfied that each extension is safe. For example, work is being carried out to test "SAFE" condition c. for the relaxed condition $d_1 \geq d_2$.

It was suggested to Cray that they consider the provision of a pre-processor to scan FORTRAN code to detect possible hazards associated with subroutine calls.

CAL Strategy

The above algorithms should assist CAL programmers to understand when to insert CMR commands. It should be noted that CMR causes ALL instruction chains to complete, and can be an expensive overhead. Another strategy is to identify the chain which needs to be broken and use a dummy scalar operation on an appropriate vector element.

- Rex Gibson

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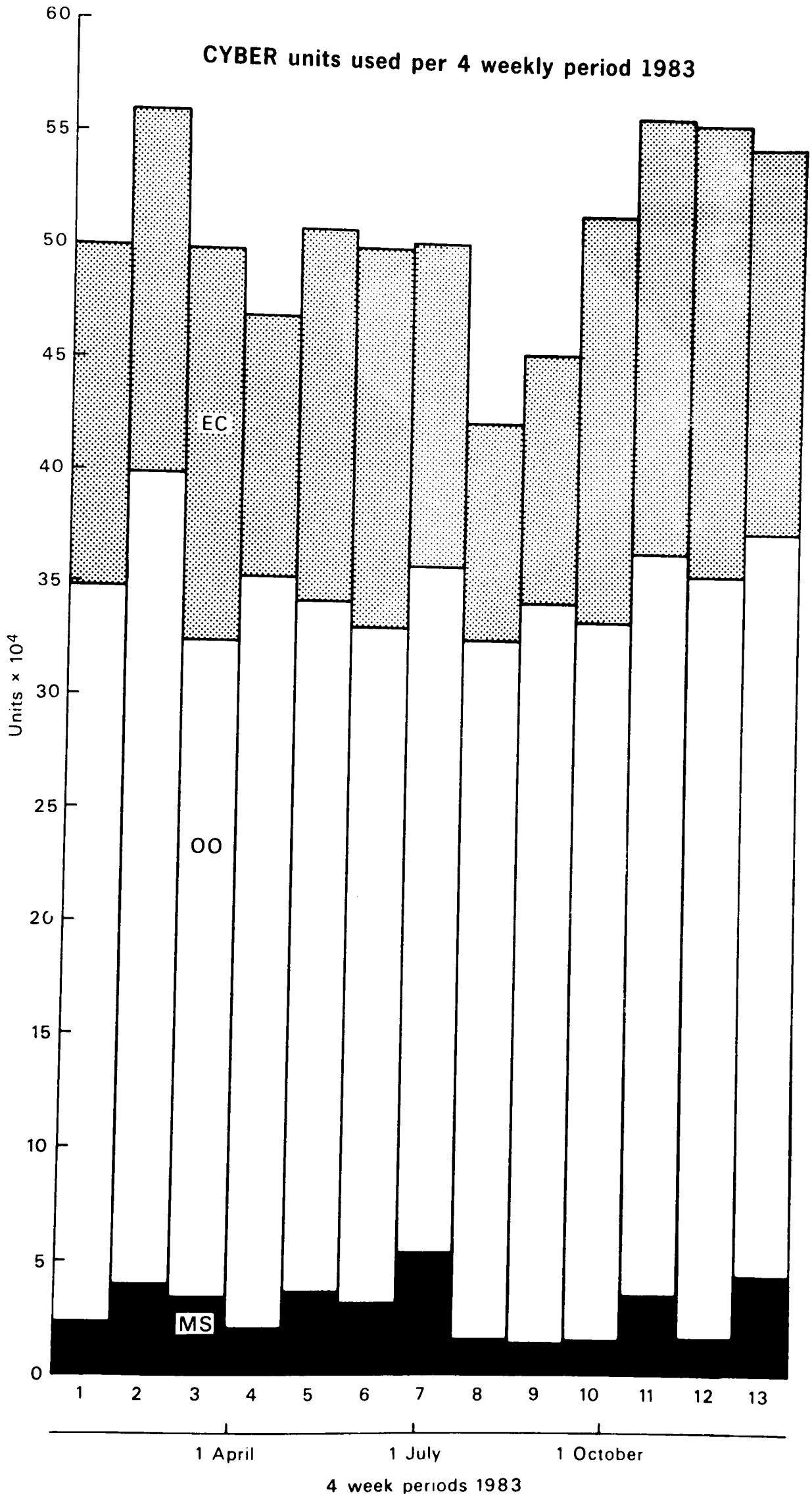
COMPUTER USAGE STATISTICS 1984

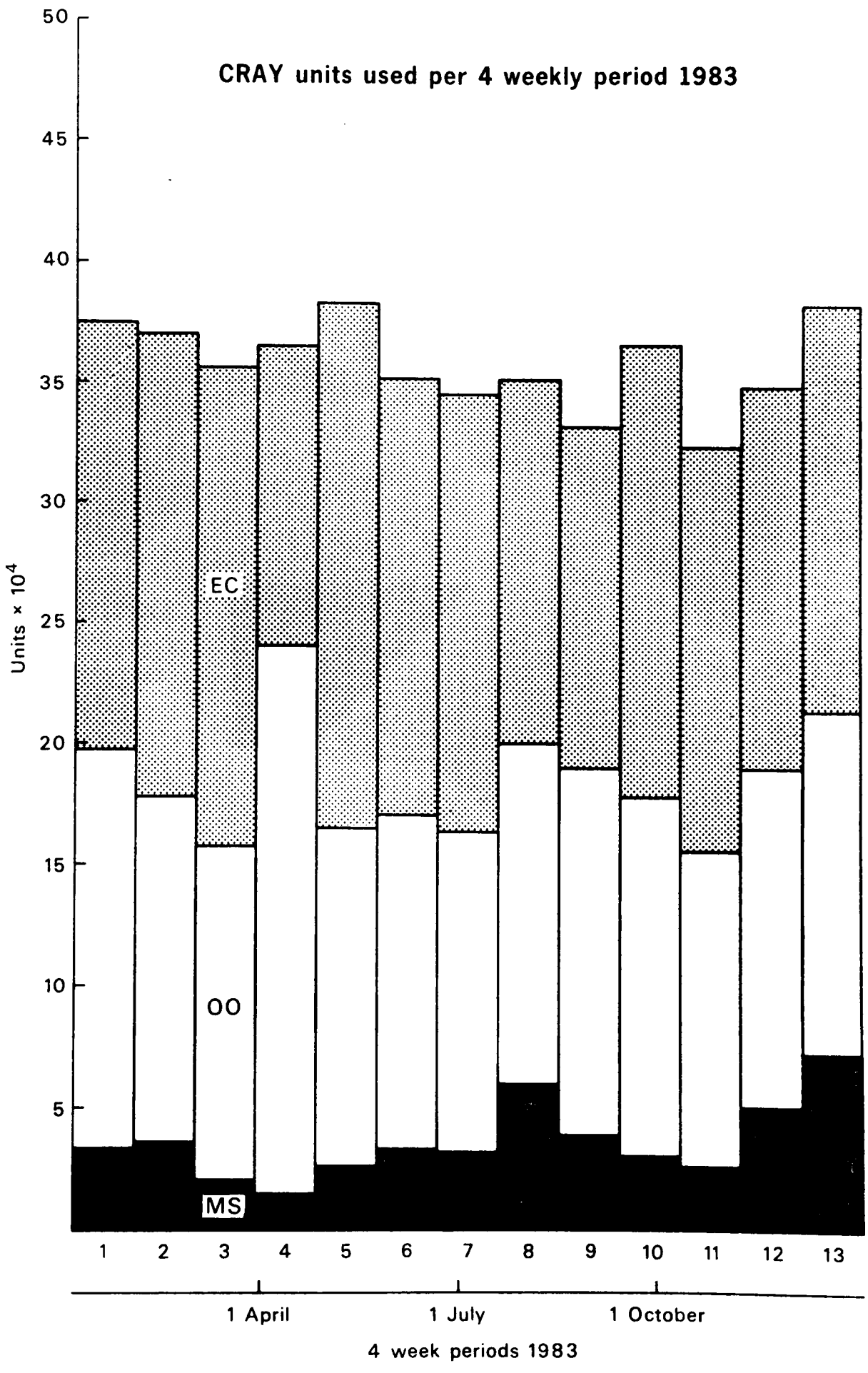


EC = Centre users

OO = operational suite running

MS = Member State users, including Special Projects

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



A SIMPLE WAY TO SUBMIT JOBS TO THE CRAY X-MP

A new parameter has been added to the 'SUB' procedure in order to submit jobs to the Cray X-MP easily. The new parameter's list is as follows:

```
SUB,LFN,.........,ROUTE=CRX
```

The 'ROUTE=CRX' overrides the 'STCRA' specification on the job card and sends the job(s) in lfn over to the Cray X-MP. This new parameter does not substitute ST=CRX. Depending on whether the job card is provided or not, two different cases are possible:

A. If the job card and account do not exist in lfn:

```
SUB,LFN,....,ST=CRX
```

has to be used.

B. If the job card and account are specified:

```
SUB,LFN,....,ROUTE=CRX
```

overrides the STCRA specification and submits the job(s) to the Cray X-MP.

This feature is useful to those users who want to submit their job to the Cray X-MP without needing to change a previously specified job card.

- Sergio Bernardi

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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 158). All other News Sheets are redundant and can be thrown away. The following News Sheets can be discarded since this list was last published: 142, 155, 157

No.	Still Valid Article
16	Checkpointing and program termination
19	CRAY UPDATE (temporary datasets used)
47	Libraries on the Cray-1
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	Contouring package: addition of highs and lows
135	Local print file size limitations
136	Care of terminals in offices
140	PURGE policy change
141	AUTOLOGOUT - time limit increases
144	DISSPLA FTN5 version
146	Replacement of Cyber 175 by Cyber 855
	Cyber dayfile message switches
147	(20.7.83) NOS/BE level 577
152	Job information card
153	Introduction of the Cray X-MP
154	Cray X-MP
156	Reduced visibility of Cray jobs
158	DISSPLA unit numbers on the Cray.
	Change of behaviour of EDIT features SAVE, SAVEX.
	Reduction in maximum print size for AB and AC

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NEW ARRANGEMENTS FOR VISITING THE CENTRE

On 16 December 1983, security arrangements at ECMWF headquarters changed slightly. Now, all proposed visits to ECMWF must be notified to the Director in writing in advance. The Director will reply to requests to visit by return and will ensure that the necessary arrangements are made.

The information required concerning each proposed visitor is:

- name and affiliation;
- proposed business at the Centre;
- dates of proposed visit, including approximate arrival time if arriving outside working hours (working hours are 0830 - 1700 Monday to Thursday, 0830 - 1630 Friday);
- car registration (if coming by car);
- nationality;
- if usage of the ECMWF computer system will be made during the visit, then please also notify the computer project and user identifier that you wish to use.

Visitors attending committee meetings, seminars, workshops and training courses will receive automatic permission to visit, once the Centre has accepted their nomination to attend the relevant function.

- Pam Prior

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TABLE OF TAC REPRESENTATIVES, MEMBER STATE COMPUTING REPRESENTATIVES AND METEOROLOGICAL CONTACT POINTS

Member State	TAC Representative	Member State Computing Representative	Meteorological Contact Point
Belgium	Dr. W. Struylaert	Dr. W. Struylaert	Mr. E. De Dyker
Denmark	Mrs. A.M. Jørgensen	Mr. P. Henning	Mr. H. Voldborg
Germany	Dr. R. Lamp	Dr. R. Lamp	Mr. G. Stielow
Spain	Mr. B. Orfila	Mr. M. Hortal	Mr. R. Font Blasco
France	Mr. M. Trochu	Mr. J.P. Bourdette	Mr. M. Trochu
Greece	Mr. G. Barbounakis/ Mr. D. Katsimardos	Mr. I. Iakovou	Mr. A. Kakouros
Ireland	Mr. W.H. Wann	Mr. D. Murphy	Mr. P.M.P. MacHugh
Italy	T. Col. G. de Florio	T. Col. G. de Florio	Dr. M. Conte
Yugoslavia	Mr. M. Jovasevic	Mr. M. Gavrilov	Mr. S. Nickovic
Netherlands	Dr. A.P.M. Baede	Mr. T. van Dijk	Mr. W.M. Reinten
Austria	Dr. G. Wihl	Dr. G. Wihl	Dr. H. Gmoser
Portugal	Mr. S. Cristina	Mr. M.J. Rodrigues de Almeida	Mrs. M.I. S.A. Barros Ferreira
Switzerland	Mr. M. Haug	Mr. G. Siegwart	Mr. M. Schönbächler
Finland	Mr. P. Nurminen	Mr. T. Hopeakoski	Mr. P. Kukkonen
Sweden	Dr. L. Moen	Mr. S. Orrhagen	Mr. G. Salomonsson
Turkey	Mr. M. Cemil Özgül (Major Gen. Rt.)	Mr. M. Cemil Özgül (Major Gen. Rt.)	Mr. M. Cemil Özgül (Major Gen. Rt.)
United Kingdom	Mr. D.H. Johnson	Dr. A. Dickinson	Mr. C. Flood

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ECMWF PUBLICATIONS

Technical Memorandum No. 81	Economic benefits of weather forecasts in some Member States of ECMWF.
Technical Memorandum No. 82	A method of correcting tidal biases in the data assimilation system.
Technical Memorandum No. 83	A comparison of NMC and CAC sea surface temperature analysis.
Technical Memorandum No. 84	Evaluation of the gridpoint model and the new spectral model for the period 1 April to 20 April 1983.
ECMWF Forecast and Verification Charts	to 30 November 1983
Seminar/Workshop 1982	Interpretation of Numerical Weather Prediction products.
Meteorological Bulletin M1.5/1	Research Manual 1 - ECMWF Data Assimilation Scientific Documentation.

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CALENDAR OF EVENTS AT ECMWF

5-6 March 1983	31st session of Finance Committee
30 April - 22 June 1984	ECMWF meteorological training courses
3-4 May 1984	19th session of Council
3-7 September 1984	Annual ECMWF seminar: "Data assimilation systems and observing system experiments, with particular emphasis on FGGE."
12-14 September 1984	12th session of Scientific Advisory Committee
18-20 September 1984	7th session of Technical Advisory Committee
21-22 November 1984	20th 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.

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Computer Division Head	- Geerd Hoffmann	OB 009A	340/342
Communications & Graphics Section Head	- Peter Gray	OB 101	369
COMPUTER OPERATIONS			
Console	- Shift Leaders	CB Hall	334
Reception Counter) Tape Requests)	- Jane Robinson	CB Hall	332
Terminal Queries	- Norman Wiggins	CB 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	- Rex Gibson	OB 227	448
Operations Section Head (Acting)	- Horst Böttger	OB 004	347
Meteorological Analysts	- Veli Akyildiz	OB 005	346
	- Herbert Pümpel	OB 006	345
Meteorological Operations Room		CB Hall	328/443
REGISTRATION			
Section & Project Identifiers	- Pam Prior	OB 016	355
Intercom	- Jane Robinson	CB Hall	332
Operating Systems Section Head	- Claus Hilberg	CB 133	323
Telecommunications Fault Reporting	- Stuart Andell	CB 035	209
User Support Section Head	- Andrew Lea	OB 018	353
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* CB - Computer Block
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