European Centre for Medium Range Weather Forecasts

ECMWF NEWSLETTER

Shinfield Park, Reading, Berkshire RG2 9AX, England. Tel: U.K. (0734) 876000, Int. (44 734) 876000, Telex: 847908

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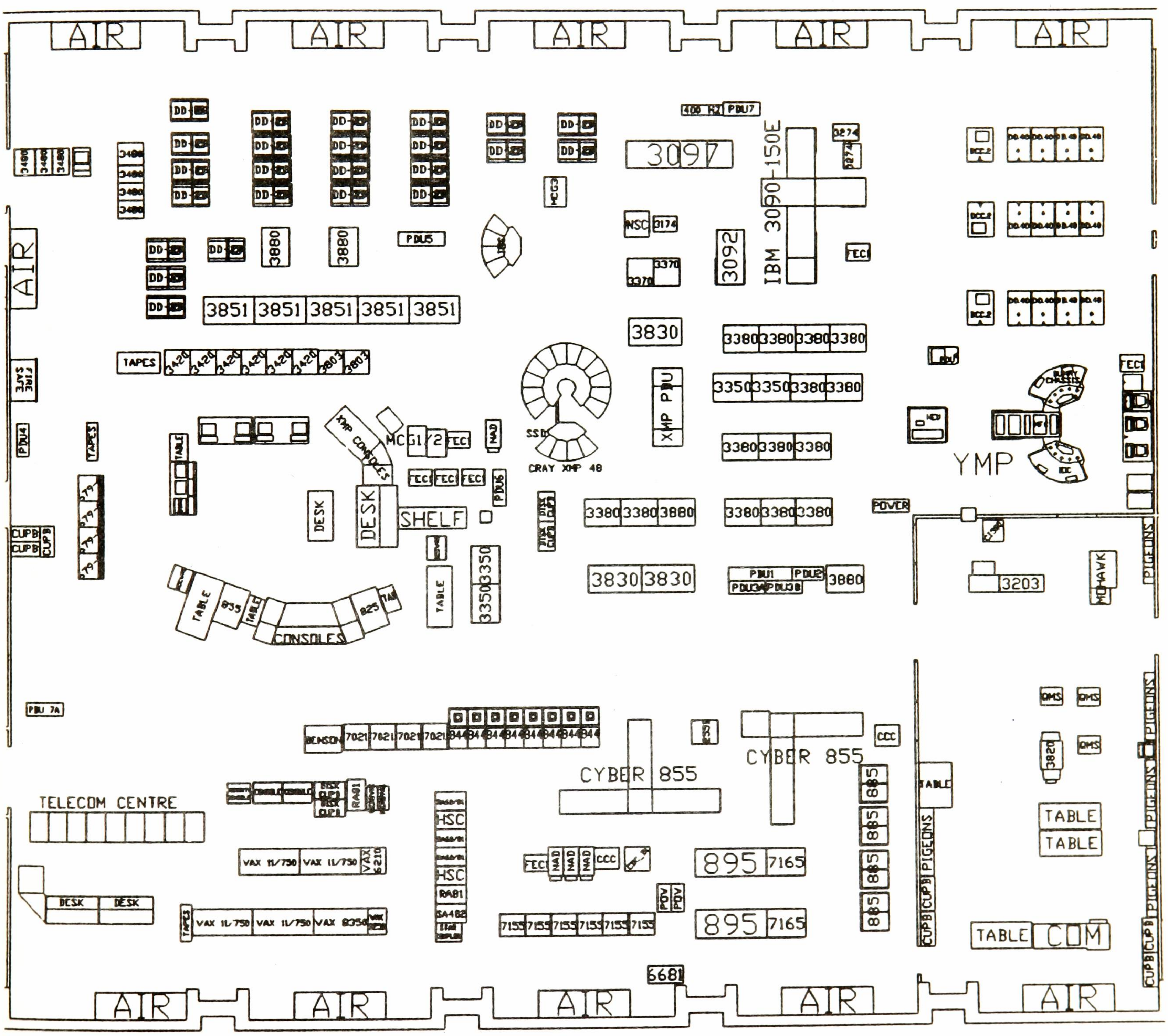

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COVER: Floor plan of the central area of the Computer Hall, showing the location of the CRAY Y-MP8/8-64

This Newsletter is edited and produced by User Support.

The next issue will appear in September 1990.

A number of changes to the forecasting system are described in this issue. An article on potential vorticity maps at ECMWF is followed by an article from users of the forecasts in Sweden, regarding prediction of a particularly severe storm which hit southern Sweden in January this year.

Details are given of the early stages of the installation of the CRAY Y-MP; next is an introductory article on the use of UNICOS on this new system. This subject will be developed further in subsequent issues of the Newsletter. A more general article on the use of passwords, which appeared originally in the CERN Newsletter, has been reprinted here, as it may be of interest to all users of the ECMWF computer system.

Information on the computer user training course to be held in September is also given in this issue.

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CHANGES TO THE OPERATIONAL FORECASTING SYSTEM

Recent changes

On 16 May 1990 the following changes were implemented in the forecast model:

(i) a reduction of the run-off of convective rain, increasing the amount of water available to wet the soil. The implied change of energy balance at the surface increases the latent heat flux at the expense of the sensible heat flux, giving a decrease in the surface and near-surface air temperature. This should significantly reduce the warm bias of the 2m temperature over continental areas during the day;

(ii) modifications to the treatment of snow covered surfaces:

- the thermal budget of the snow is modified to take into account the effect of shade from vegetation;
- the albedo of the snow is no longer only dependent on snow depth; the new formulation also takes into account masking by vegetation, the effects of temperature and the presence of ice dew.

The overall effect is to decrease the albedo of the snow covered areas;

(iii) a modification to the model pressure-gradient calculation and a change in the calculation of pressure level geopotential heights by the model post-processing and in the first-guess for the analysis;

(iv) modifications to the convection scheme, mainly to the treatment of cloud processes at detrainment levels for convective clouds, to prevent a spurious moistening at cloud tops which was noticeable over the subtropical oceans in connection with shallow convection.

On 28 March 1990, a new pre-processing system was introduced operationally on VAX.

On 21 March 1990, an error in the handling of the climate fields of deep-soil temperature and deep-soil wetness was corrected (these fields had been static since August 1989, instead of being updated at the beginning of every month).

Planned changes

A set of changes to the physics of the forecast model will be introduced, consisting of a revision to the prescription of the surface flux scheme, revision to the cloud cover, and update to the fields of surface albedo.

The first-guess checks of wind and humidity data will be enhanced.

A new procedure will be implemented for the quality control of satellite temperature profiles; a pre-selection will be performed before the data are passed to the analysis, making use of the high resolution cloud-cleared radiances received from NESDIS.

A change will be introduced in the analysis so that the departures of the observations will be calculated against a first-guess at 3, 6 or 9 hours range depending on the actual observation time.

- Bernard Strauss

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POTENTIAL VORTICITY MAPS AT ECMWF

In recent years, there have been a number of papers published which have used the concept of potential vorticity (PV) as a means of understanding and explaining certain atmospheric phenomenae. Most of these studies have focussed on behaviour in the stratosphere but a few have appealed to the use of PV in the diagnosis of tropospheric developments. Hoskins, McIntyre and Robertson (1985) give a comprehensive review on potential vorticity and its use as a diagnostic tool. They also give an extensive reference list of relevant publications up to that time. A shorter account which focusses rather more on the tropospheric rôle of PV appears in McIntyre's contributions to the ECMWF seminar proceedings for 1987.

The above publications were timely in drawing together the ideas and experiences in using the concept of PV. However, the theoretical developments have had little impact on operational practice and the use of PV maps in routine operational weather forecasting has not been marked as yet. The majority of NWP users continue to rely on the usual displays of height charts, supplemented by the use of wind charts and, if available, other diagnostics such as vorticity and vertical velocity.

PV, defined as $-g(f+\zeta_\theta)\partial\theta/\partial p$ on an isentropic surface, has two important properties. Firstly it is conserved in adiabatic, frictionless motion which means that it is possible to use PV as a tracer of the motion in such circumstances. Secondly there is an invertibility principle which means that under a suitable balance condition the PV distribution determines the wind, temperature and pressure fields.

In the atmosphere, diabatic effects introduce non-conservation of PV and this limits the time over which particles can be traced, particularly in the troposphere and lower stratosphere. Moreover, interpolation procedures and truncation in both modelling and post-processing may alter PV values, as does the introduction of data from observations during analyses. Nonetheless, it is often possible to follow distinct PV features for 4 to 5 days or longer, even when the feature itself is changing shape.

It is usual for a synoptician to appeal to quasigeostrophic theory to assess development and vertical motion from height and/or thickness/temperature charts. In particular, it is usual to infer the forcing for certain patterns in the fields. Similar concepts are used by applying the invertibility principle where we recognize how particular distributions of PV induce specific structures in the wind and temperature fields. In particular, high/low PV anomalies (ie. locally high/low PV values) induce cyclonic/anticyclonic circulation. Some simple examples of flows induced by idealized PV and potential temperature distributions were obtained by Thorpe (1985) and some are reproduced in Hoskins et al (1985) and McIntyre (1988) who also go on to discuss real cyclogenesis in terms of PV. Thus the fundamental idea is to recognize that PV (and potential temperature) controls the dynamical evolution of the atmosphere.

From our definition of PV earlier, we see that there are contributions from the absolute vorticity and static stability. Generally, tropospheric values of PV (in units of $10^{-6}m^2s^{-1}Kkg^{-1}$) are usually below 1 unit whereas in the lower stratosphere PV values increase to more than 2 units, mainly due to the increase in static stability.

Figure 1 shows a typical PV map on the 315K isentropic surface from ECMWF analyses for 00UTC 24 January 1990. The continuous contours show the PV at intervals of 1 unit with shading between 1 and 2 units. The arrows are the horizontal winds on the isentropic surface and the dashed lines show the pressure altitude of the surface at intervals of 50hPa. For comparison the corresponding 500hPa chart is shown in figure 4. Generally there is a correspondence between the troughs and ridges in the height charts and the undulations in the PV (which we also term troughs and ridges to reflect their height counterparts; i.e. trough/ridge in PV refers to HIGH/LOW PV.) However, there is more detail in the PV values in excess of 1 unit; the height chart appearing to give a smoother picture.

The 315K isentrope has been chosen to sample PV in the lower stratosphere near, or just above, the tropopause polewards of the polar-front jet. In winter in the northern hemisphere isentropes between 305K and 320K would give essentially the same picture. In summer isentropes below 315K tend to be too low to pick out the anomalies effectively. In practice 315K has been found to be a suitable level to use on most occasions. This choice of isentrope is such that in the region of the polar-front jet the isentrope slopes and then levels out in mid-troposphere equatorwards of the jet. An advantage of using PV rather than height or wind charts is that the polar-front in the region of the tropopause is an unbroken feature apart from those regions of either high or low PV cut-off from their source regions or reservoirs; the lower stratosphere on the poleward side of the jet for high PV, the troposphere on the equatorward side of the jet for low PV.

In figure 1 the plotted winds serve to give an idea of the instantaneous advection of PV but it should be remembered that as the PV field alters then so will the wind field. For suitably short periods (which in some circumstances may be as long as 24 hours) it is often useful to visualize the advection of the anomalies. The pressure levels show not only the altitude of the anomalies and the slope of the isentropes but also reveal the motion up and down the isentropes (upgliding and downgliding). From a synoptic point of view these motions may account for the largest contribution to the vertical motion in places.

Together with a chart of mean sea-level pressure and equivalent potential temperature θ_e at 850hPa (or alternatively wet-bulb potential temperature

θ_w), a PV map as described above enables one to build up a comprehensive picture of the structure of the extra-tropical atmosphere with just two charts. With these we can track the different air-masses, identify frontal zones and follow the main features in the upper-air which are responsible for the development of surface and upper-air features.

In the research department at ECMWF, programs have been developed to post-process model output on isentropic surfaces and from the resulting GRIB format datasets maps of PV can be produced using MAGICS. PV maps for each 12UTC analysis are regularly obtained and selected forecast case-studies have been carried out with the aim of increasing our experience in the use of PV maps as a practical diagnostic.

An example of their use is demonstrated by the case shown in the figures. The dates chosen relate to the development of the violent storm which caused considerable damage and loss of life in northern Europe on 25 and 26 January 1990. The forecast performance by the Centre's model is discussed later in the newsletter in the article by Joelsson and Åkesson.

Although there are features in the height charts that might lead us to expect development of the surface wave over the western Atlantic in figure 7, the reason for explosive cyclogenesis rather than more limited development is not so clear. From 00UTC 24 January 1990, the approximate pressure falls indicated by the ECMWF analyses in successive 12-hourly periods were 10hPa, 20hPa and 20hPa, the central pressure achieving a value below 960hPa by 12UTC 25 January 1990. In fact the depression was analysed by hand as 952hPa at 12UTC 25 January 1990 and soon after reached 949hPa, see McCallum (1990). McCallum(1990) also discusses the development in terms of the satellite imagery and height charts. He stated that the 500hPa chart showed characteristics typical of rapid cyclogenesis, in particular the slightly confluent nature of the trough at 12UTC 24 January 1990.

The PV perspective of the development is revealing. Where necessary PV maps at intermediate times have been used but they are not shown here for lack of space. Major troughs and ridges are easily followed from map to map but care is needed in following anomalies on the poleward side of the main PV gradient as these may alter shape, appear to merge with other anomalies and may also be advected over large distances. Figures 1 to 3 show PV on the 315K surface at 00UTC, 12UTC 24 January 1990 and 00UTC 25 January 1990. The corresponding 500hPa charts are shown in figures 4 to 6 and the PMSL charts in figures 7 to 9. Of particular note is the large PV anomaly in excess of 9 units just upstream of the surface depression at 00UTC 25 January 1990. Recall that the depression has already deepened by 30hPa during the previous 24 hours and deepens at least another 20hPa during the following 12 hours. At 12UTC 24 January 1990, the PV anomaly in question is a distinct area of high PV over the Labrador coast (the central value of PV in excess of 8 units) whilst the development at the surface is being controlled by the major PV trough approaching 40°W. The degree of development at the surface depends not only on the size of the anomaly but also upon the advection of the anomaly so that the stronger the advection of PV the larger the induced development.

At 00UTC 24 January 1990 the PV map (figure 1) shows the PV trough near Newfoundland, the developing wave being situated near 45°N 45°W where there is a strong thermal gradient, as indicated by the θ_e gradient at 850hPa in figure 7 (dashed lines). PV values in excess of 7 units are visible over an area centred over the Gulf of St Lawrence. However, a large part of the high PV is advected

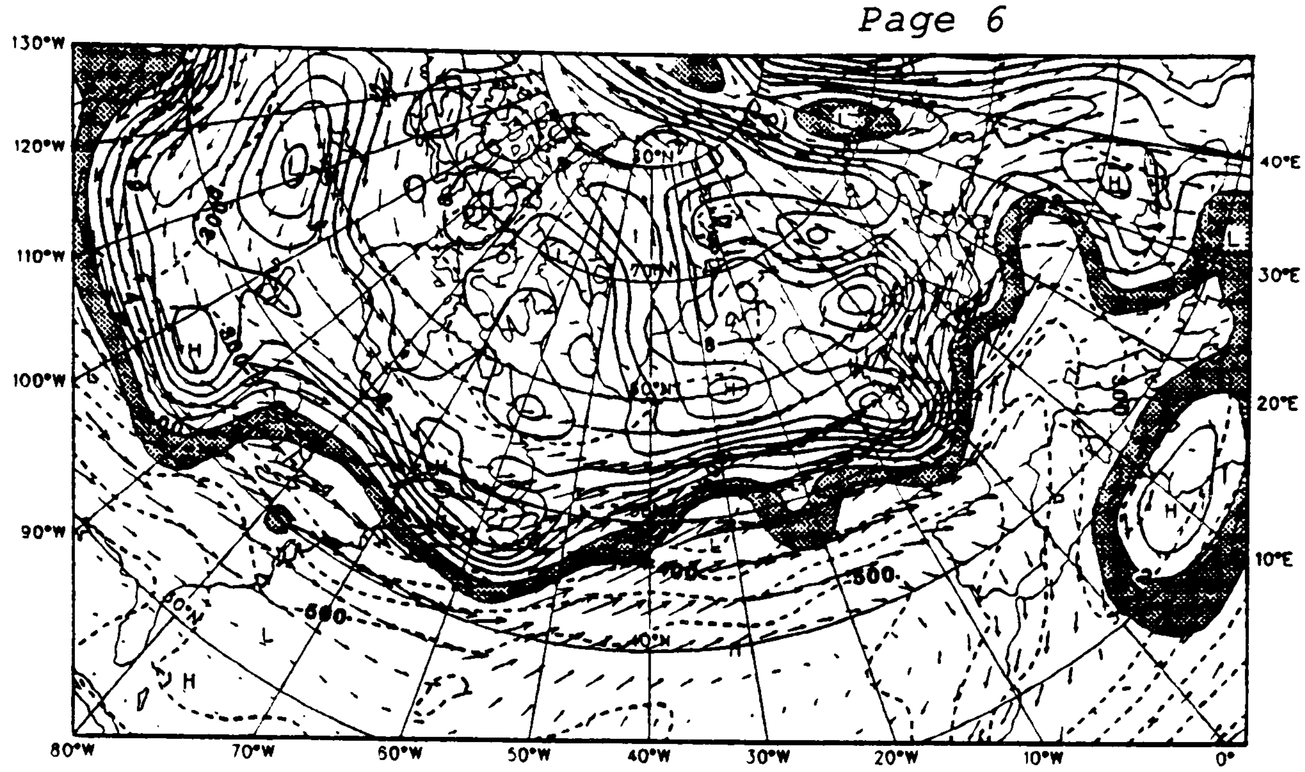

Fig. 1: ECMWF Analysis 315K Potential Vorticity, DT 0UTC 24 January 1990

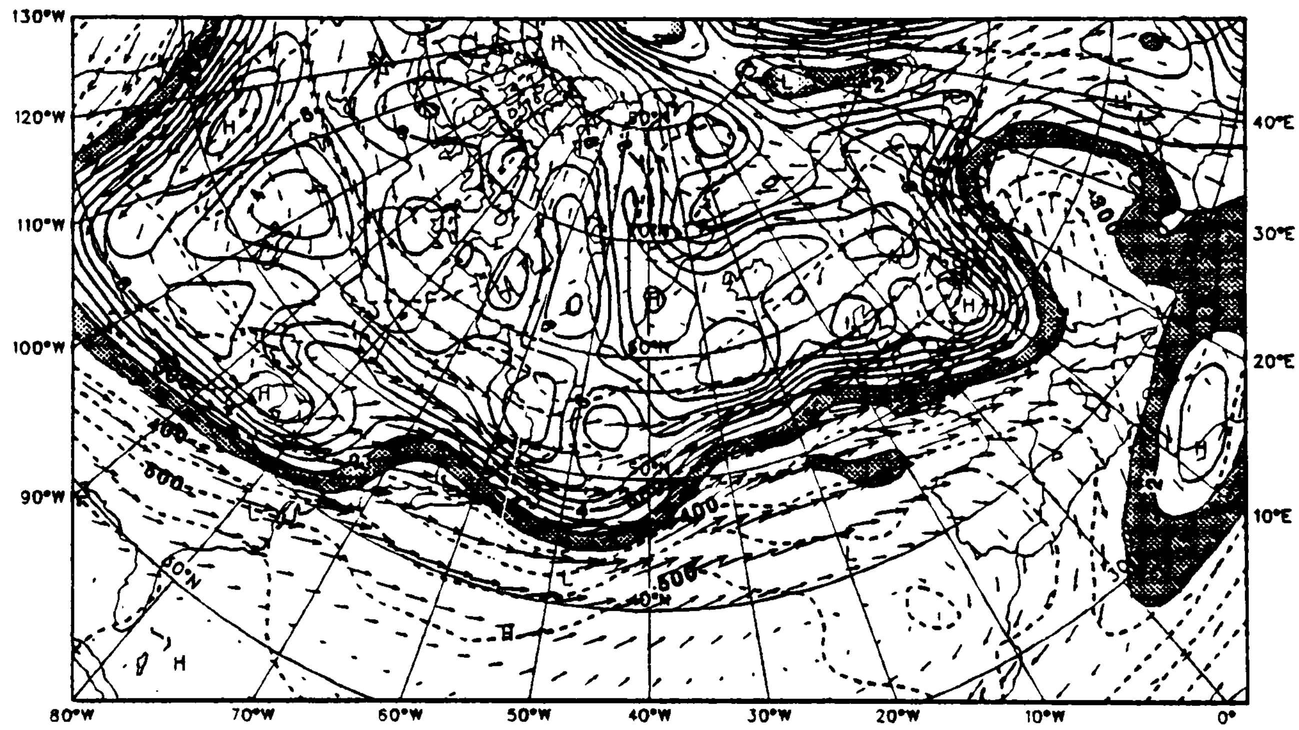

Fig. 2: ECMWF Analysis 315K Potential Vorticity, DT 12UTC 24 January 1990

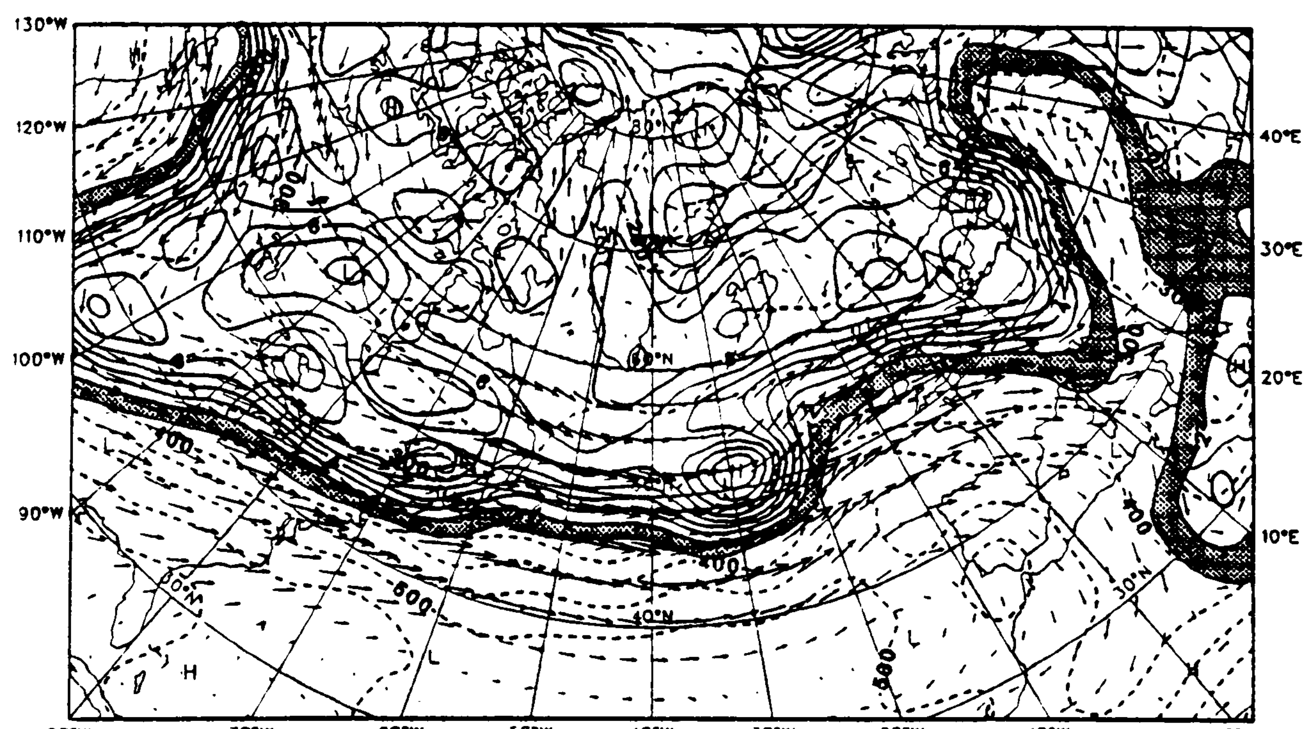

Fig. 3: ECMWF Analysis 315K Potential Vorticity, DT 00UTC 25 January 1990

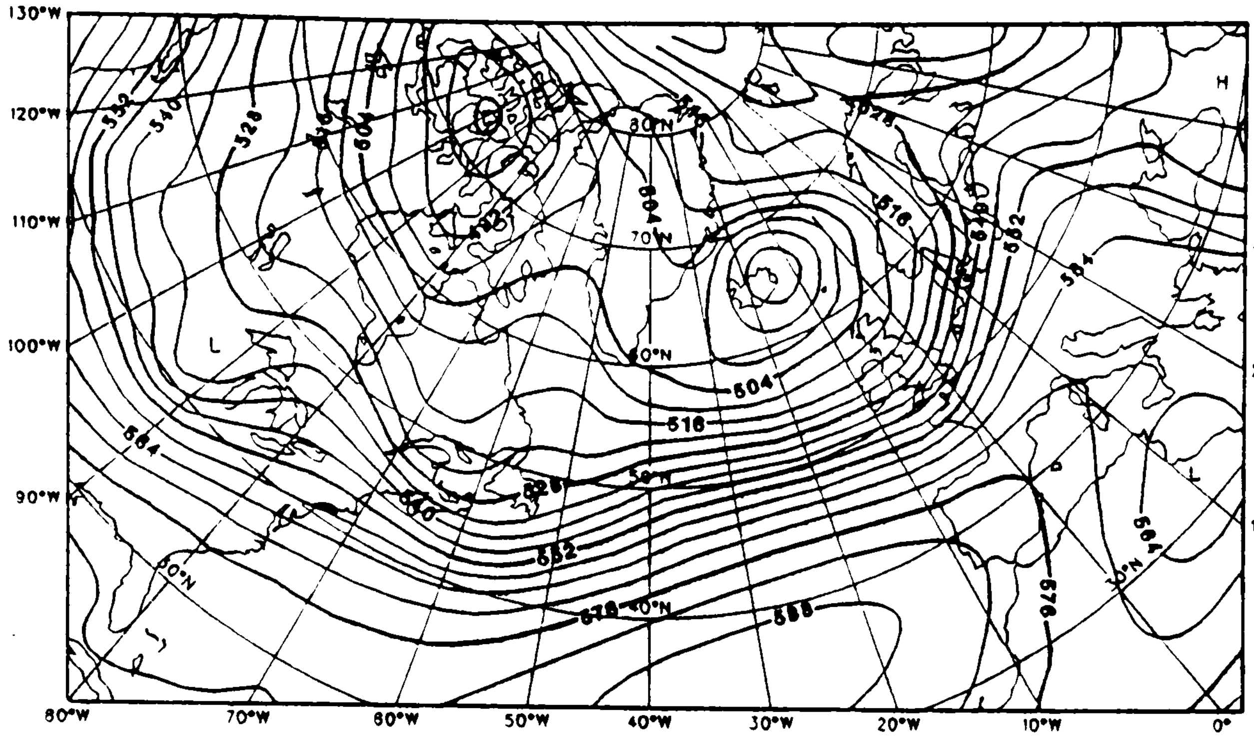

Fig. 4: ECMWF Analysis 500 hPa Height, DT 00UTC 24 January 1990

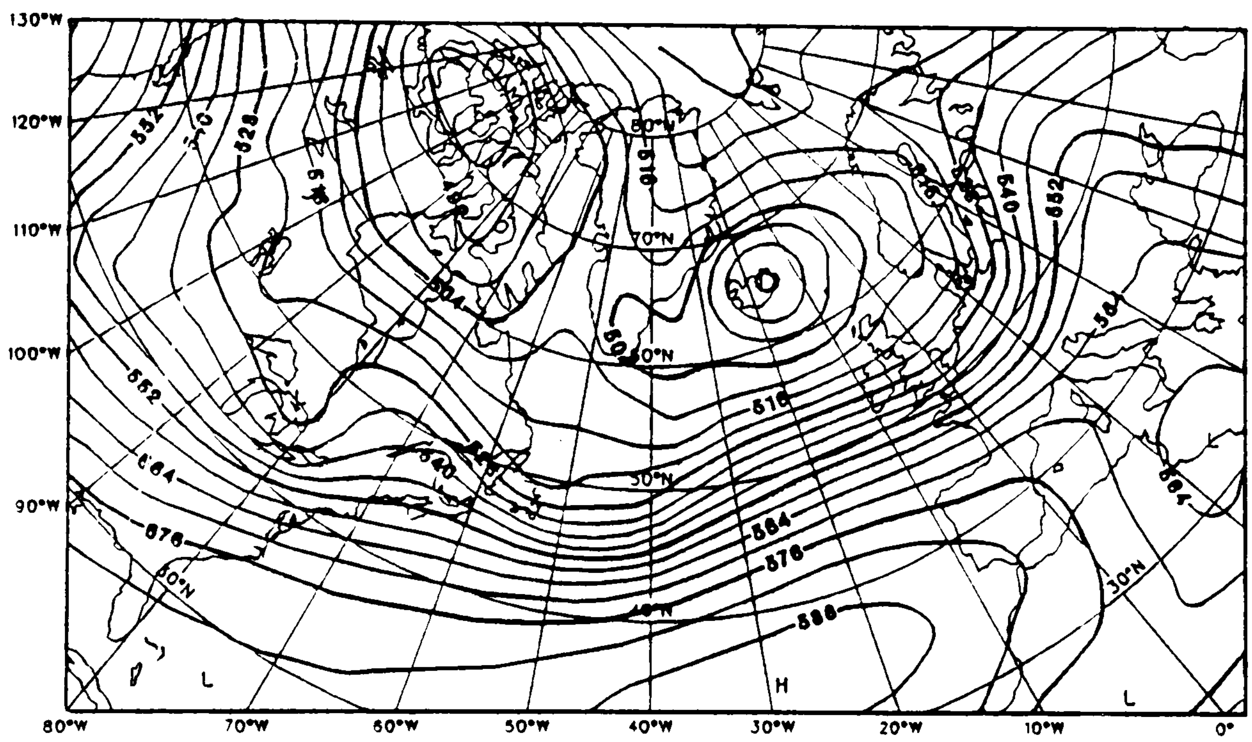

Fig. 5: ECMWF Analysis 500 hPa Height, DT 12UTC 24 January 1990

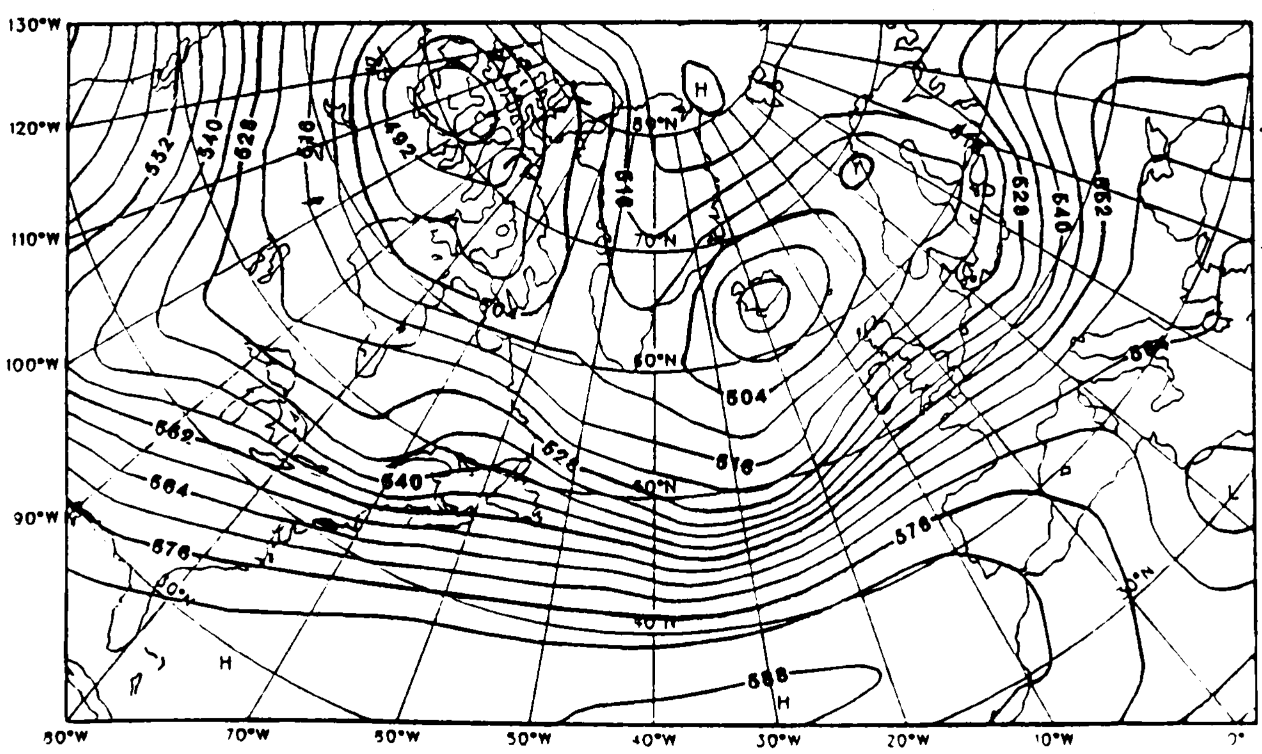

Fig. 6: ECMWF Analysis 500 hPa Height, DT 00UTC 25 January 1990

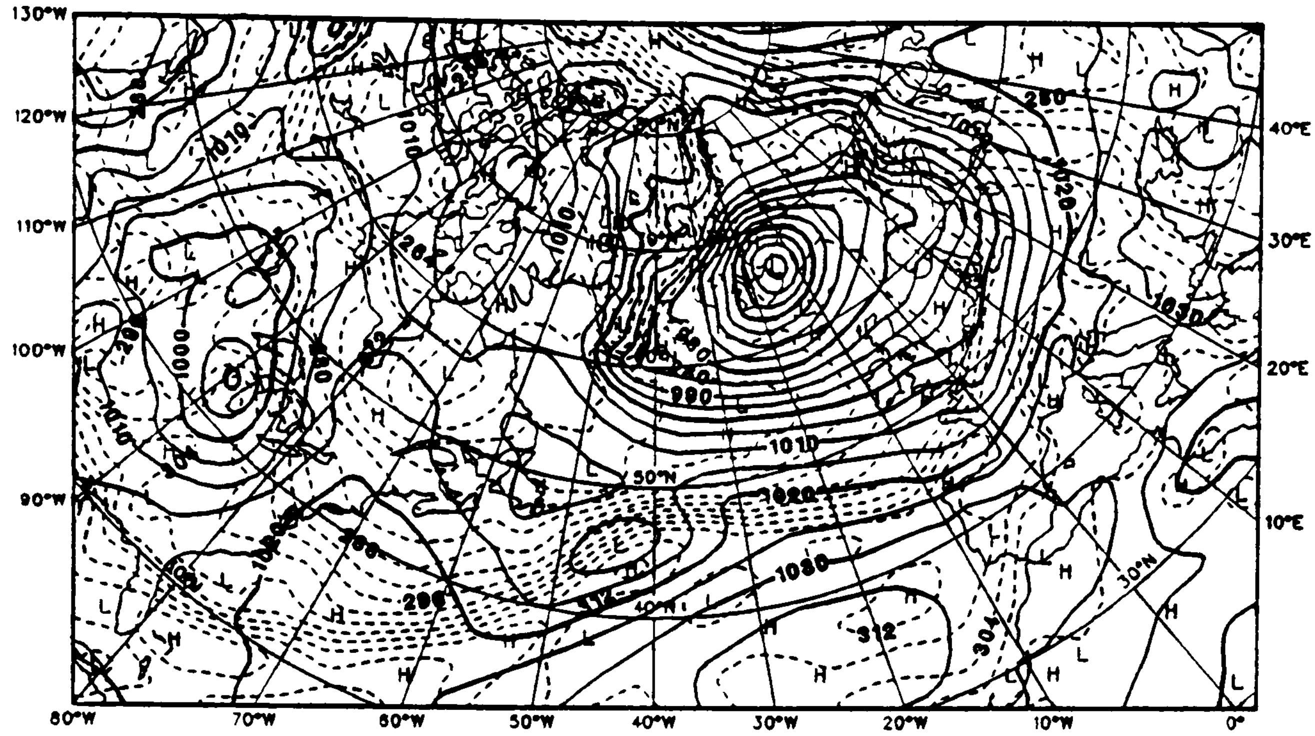

Fig. 7: ECMWF Analysis Pressure Msl 850 hPa Thetae, DT 00UTC 24 January 1990

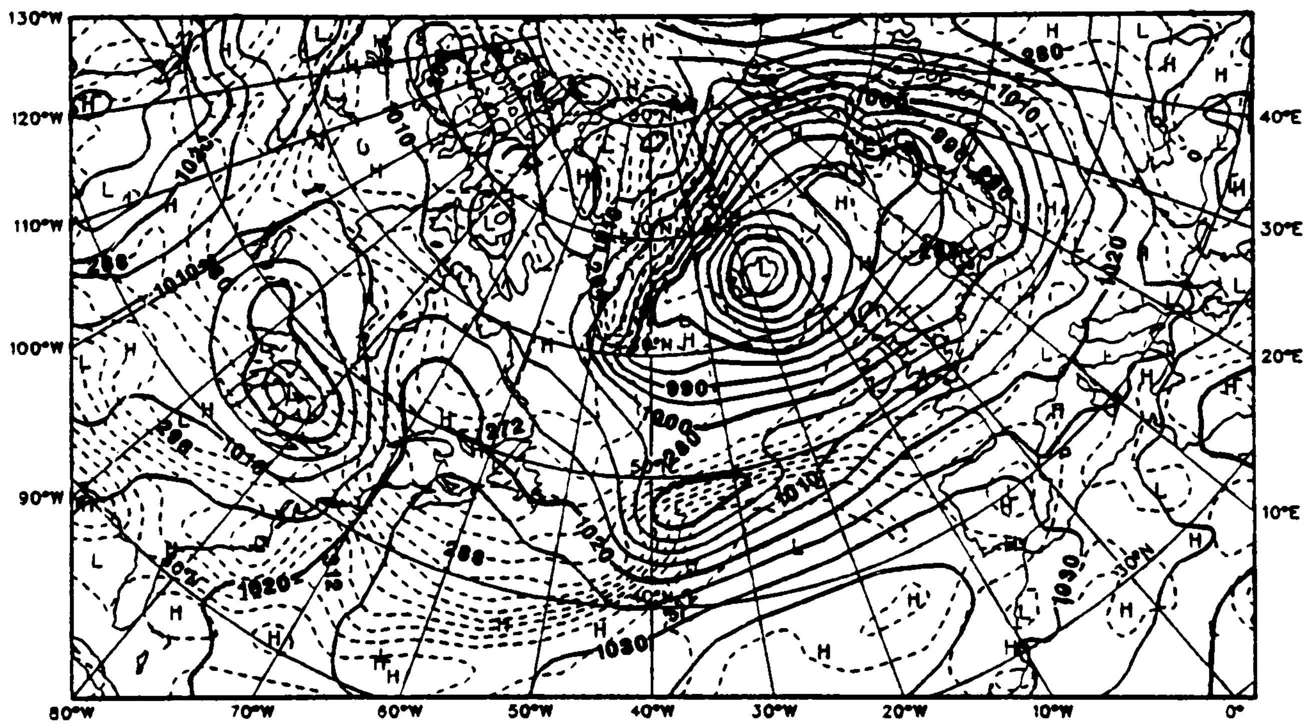

Fig. 8: ECMWF Analysis Pressure Msl 850 hPa Thetae, DT 12UTC 24 January 1990

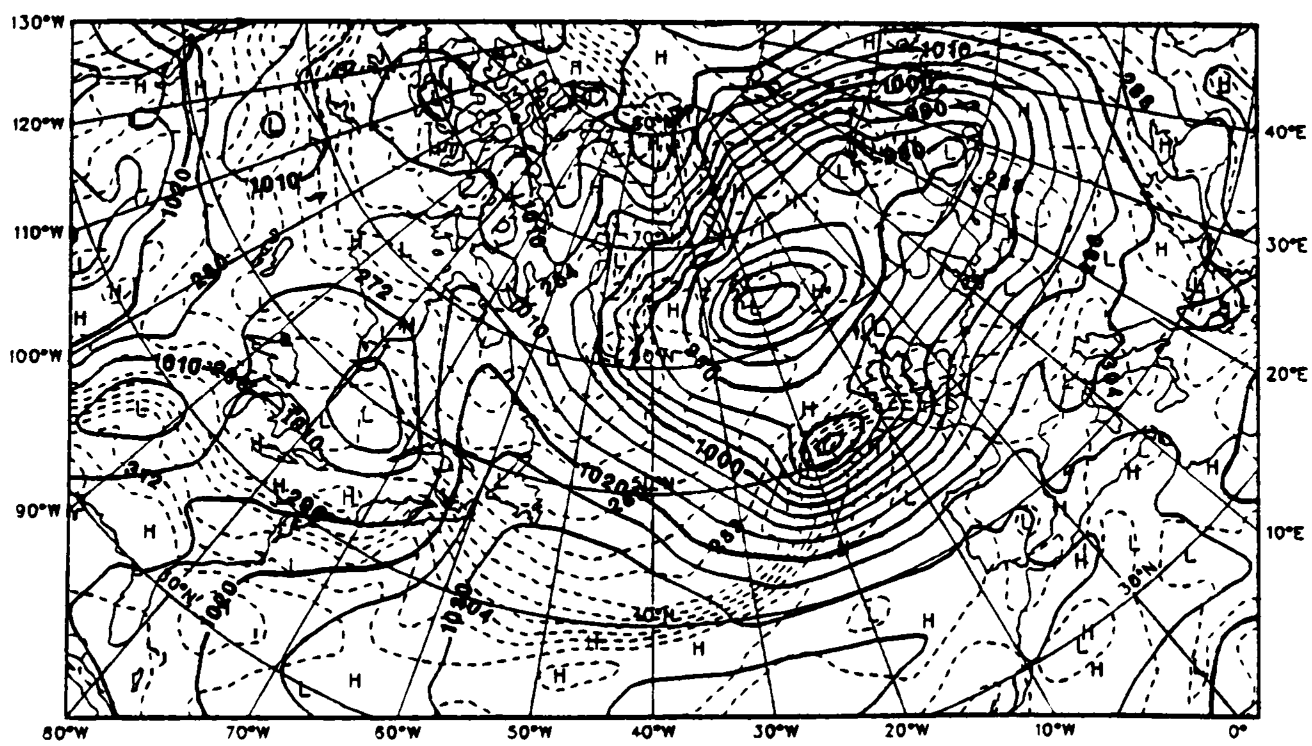

Fig. 9: ECMWF Analysis Pressure Msl 850 hPa Thetae, DT 00UTC 25 January 1990

away northeastwards (this is more apparent on the PV map for 6UTC, not shown) whilst more high PV is advected from the northwest. Here we are using the conservation principle so that high PV can only arise by being advected along the isentropes from a source region of high PV. However, if there are significant diabatic effects or changes introduced by the analysis, the conservation may appear tenuous. In this case we would expect diabatic effects to be small over Eastern Canada and the source regions of PV values of more than 7 units at 00UTC 24 January 1990 are over Quebec and over the Hudson Bay area. Note that in the latter region the PV values are not particularly anomalous compared with immediate surrounding values.

The PV sequence shown here is typical of explosive cyclogenesis events. However, even within the broad definition of explosive cyclogenesis there is a wide variation in the degree of development and resulting damage. In this case there are indeed signs of major development at 00UTC 24 January 1990 but the factors that distinguish it from other explosive cyclogenesis events over the North Atlantic are not revealed by the 500hPa chart for either 00UTC or 12UTC 24 January 1990. Whereas satellite imagery around 12UTC 24 January 1990 shows characteristics of explosive deepening (see McCallum (1990)), a depression which attained a central pressure of near 970hPa would have fitted the criterion for explosive development and resulted in very strong winds near and over the UK, without being exceptional. The feature of crucial importance with regards to the intense development continuing for about another 12 hours, and hence resulting in an exceptional storm crossing the UK, is the anomaly over Labrador at 12UTC 24 January 1990. There is little evidence of its presence in a 500hPa chart apart from the tightening of the flow (jet-streak) near Newfoundland. Signatures in the PV map such as that shown for 00UTC 25 January 1990 (figure 3) are important if forecasters are to be aware of continuing development of already major storms.

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McCallum, E. 1990. The Burns' day storm, 25 January 1990. Weather Vol. 45 p.166.

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Thorpe, A.J. 1985 Diagnosis of balanced vortex structure using potential vorticity. J.A.S. 42 p.397.

- Terry Davies

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GOOD PREDICTION OF A SEVERE STORM OVER SOUTHERN SWEDEN

On 26 January 1990 a violent storm crossed southern Sweden, with winds reaching hurricane force, mainly in coastal areas. The damage to trees caused by these winds brought down power lines and left a large part of southernmost Sweden without electricity. Damage and disruption to traffic was reported from many areas.

The performance of some of the ECMWF numerical guidance available to SMHI forecasters is described below, followed by examples of subjective forecast charts and text, and, finally, the predictability of the ECMWF forecasts is briefly discussed.

Good guidance

More than four days ahead the ECMWF operational forecasts correctly foresaw the weather development (Fig. 1).

Consistent and, in the main, accurate forecasts from day to day were noted.

All the consecutive forecasts gave a good indication of the intensity of the cyclone which crossed southern Sweden on 26 January.

It is unusual but also encouraging that numerical weather prediction was able to forecast such a small but intense low several days ahead. It is also satisfactory to note the high degree of consistency in the sequence of forecasts from ECMWF. The main reason for this is presumably a correct analysis for each forecast run, with sufficient and accurate observations over crucial areas for the assimilation scheme.

Subjective forecasts

The numerical guidance available to forecasters at SMHI in the days before the onset of the storm received optimum interpretation.

In the initial state (Fig. 2, 500 hPa) we see a strong widespread westerly air flow. The temperature contrast is large and there is a pronounced baroclinic situation.

The subjective forecast situation - including weather zones and temperature information - are visualised in Figs. 3 (+24h) and 4 (+36h).

Comparison with the verifying analysis (Figs. 5 and 6) shows the good quality of the forecasts. The position of the predicted low is a little too far to the east (+24h). The strong pressure gradient, however, is correctly depicted. The forecasts and storm warnings given to the public and SMHI customers therefore gave a correct picture of the severe weather to come, including the strong winds.

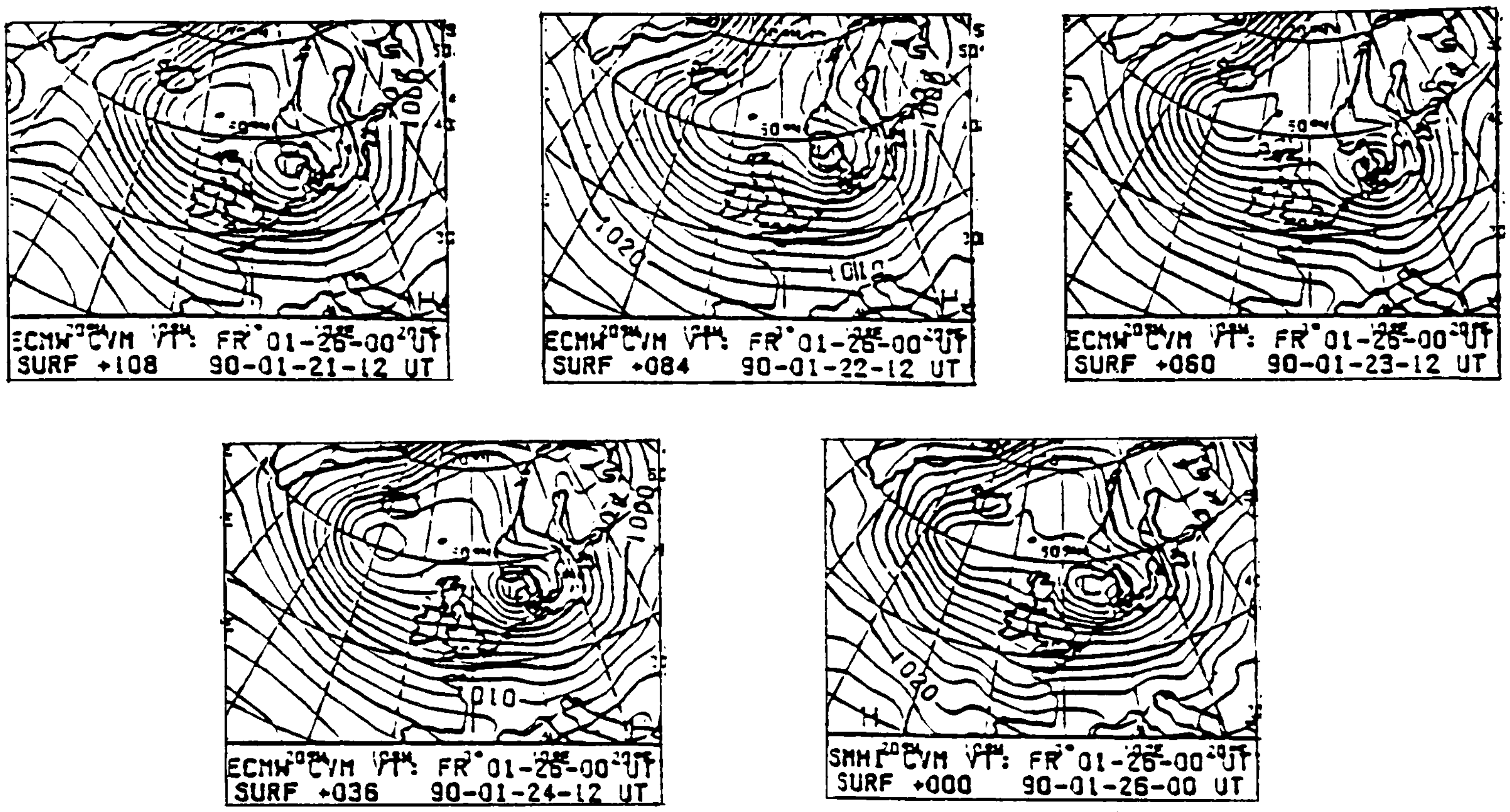

Fig. 1: ECMWF forecasts of surface pressure (+108h, +84h, +60h and +36h). All forecasts valid 21 January 1990, 00Z. Verification analysis in the lower right panel.

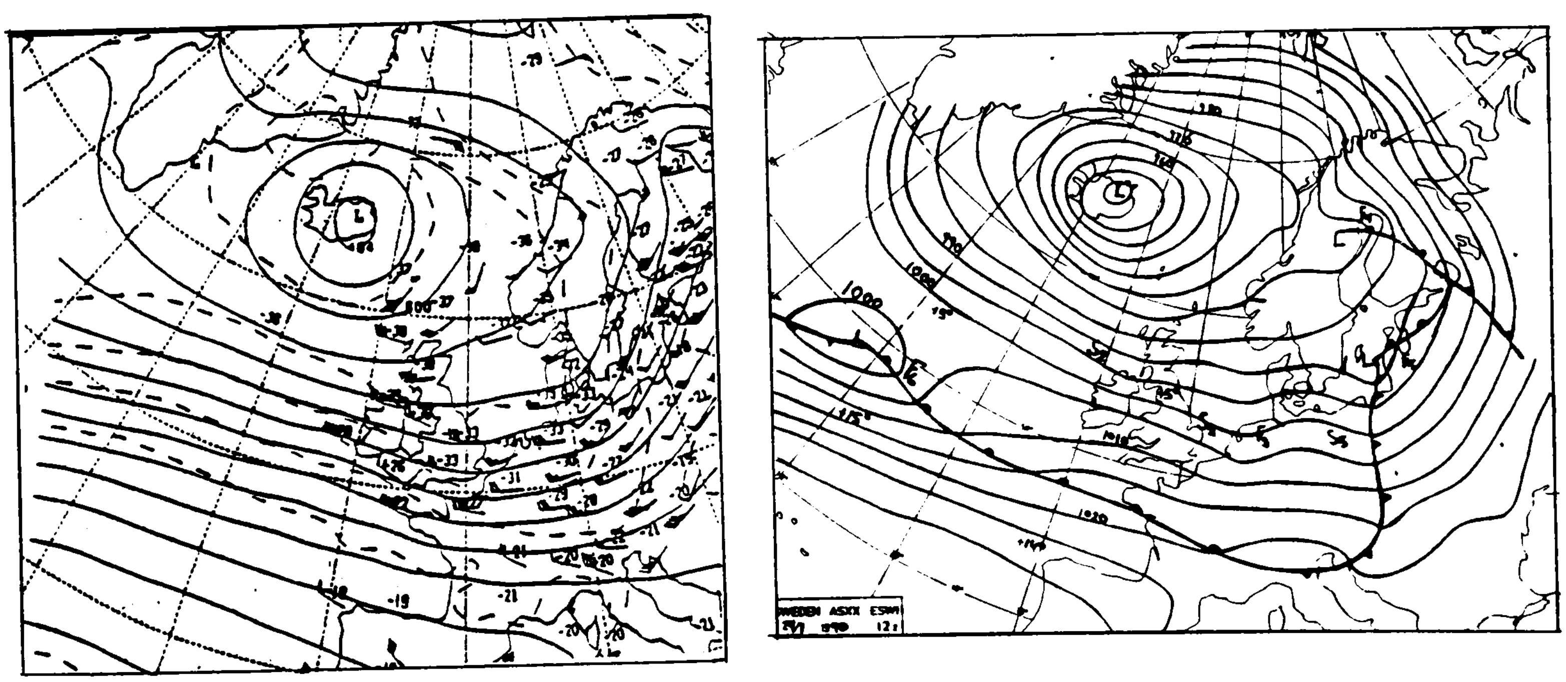

Fig. 2: 500 hPa with temperature and surface pressure with the frontal zone. Analysis from 24 January 1990, 12Z.

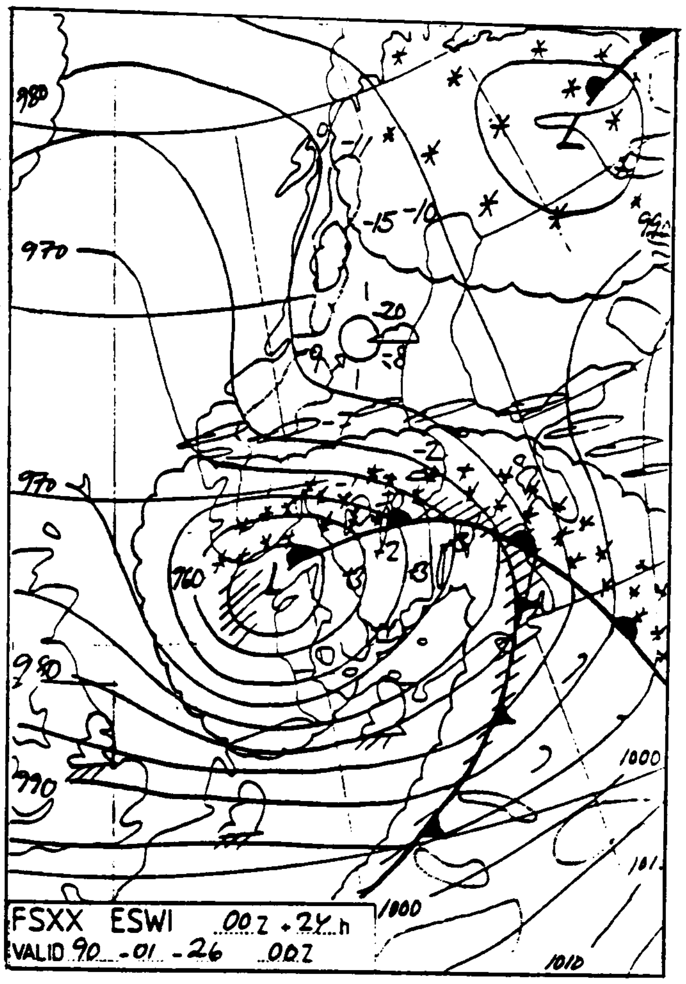

Fig. 3: Subjective +24h forecast.
VT 26 January 1990, 00Z

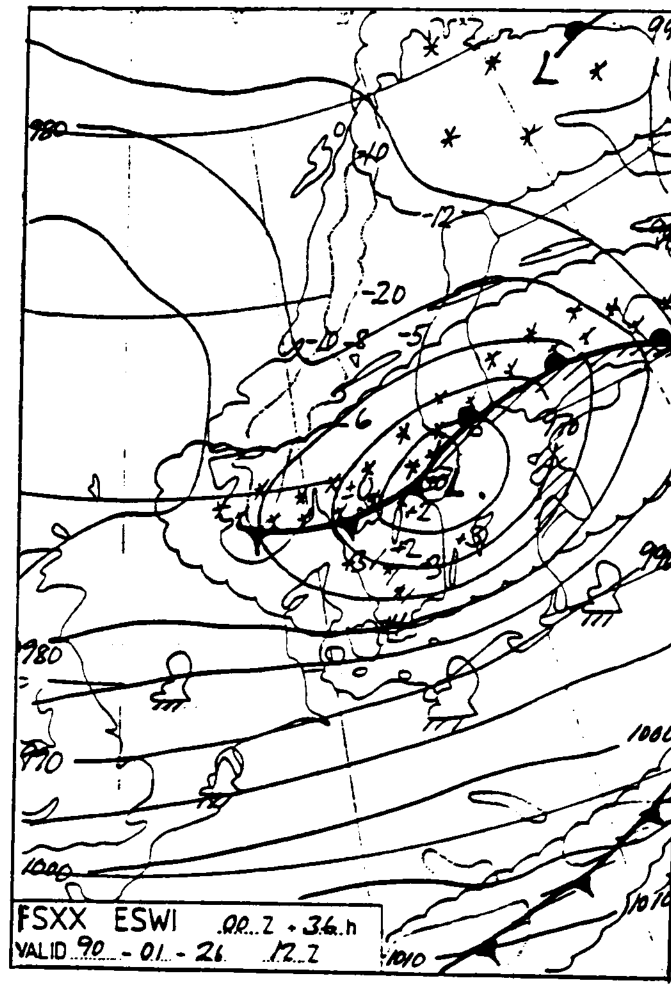

Fig. 4: Subjective +36h forecast.
VT 26 January 1990, 12Z

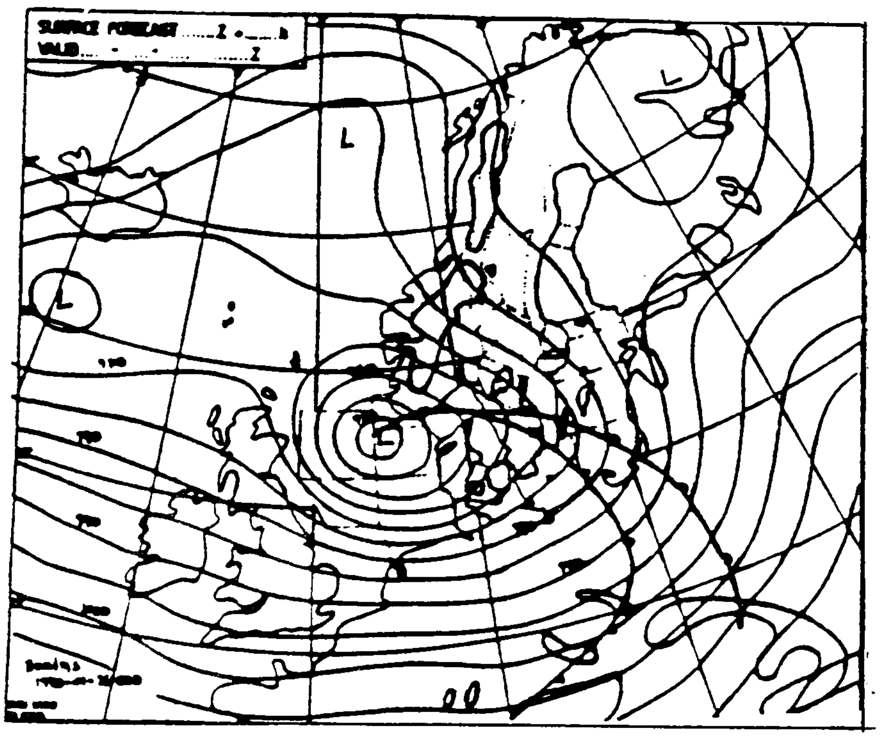

Fig. 5: Surface. Analysis
26 January 1990, 00Z

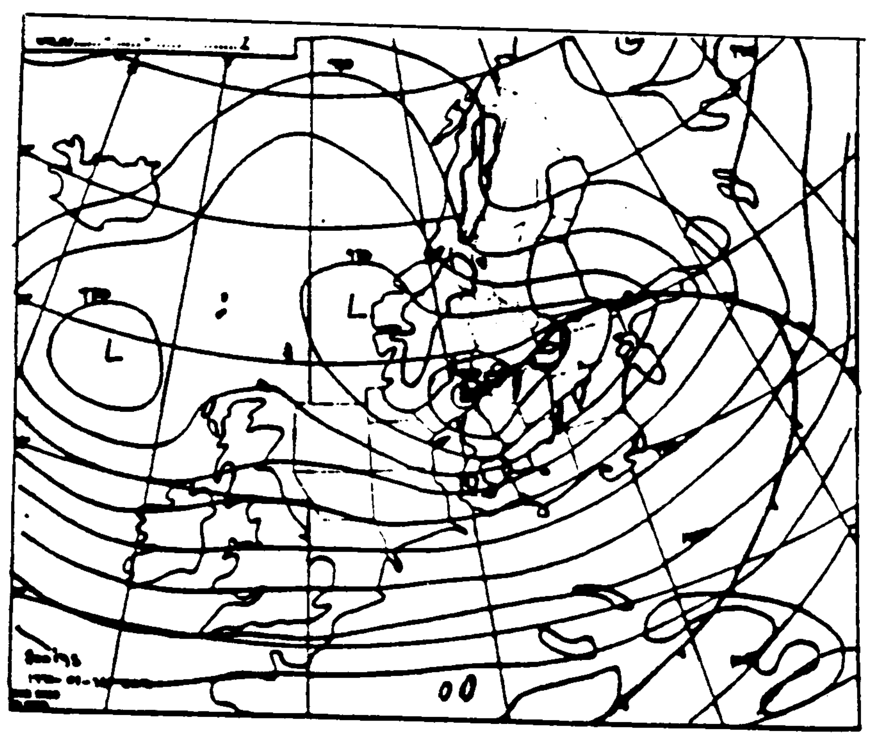

Fig. 6: Surface. Analysis
26 January 1990, 12Z

On the day before the storm hit parts of Sweden, the public radio forecasts read: "A severe storm will affect southernmost Sweden tomorrow, with violent storm force westerly winds and possible gusts reaching hurricane force". For southern and western Swedish waters the warning indicated westerly winds of 25-30 m/s (10 minutes average).

Predictability

The quality of the ECMWF operational forecasts has been good during the last 3 or 4 months. From November/December last year the predictability has increased strikingly. During the first 3 months of 1990 the 500 hPa forecasts have on average given useful information to day 7, and the surface forecasts to almost 6.5 days ahead.

The predictability for the first quarter this year is determined as a mean of subjective scores, where score 3 (in a scale of 1-5) has been defined as the limit of useful forecasts (predictability). The same result is obtained with anomaly correlation where 0.6 is the corresponding limit.

The large scale circulation - often characterised by an intense westerly jet - over northwestern Europe during the last winter, has been well predicted, and the large number of violent depressions, embedded in the basic zonal flow, have been dealt with well in many cases. The prediction of the devastating storm of 26 January 1990 is a good example of this.

Over the last year (May 1989 - March 1990) it has been found that the ECMWF model in general (and especially for D+3) outperformed the NMC and UKMO forecasts.

- Rune Joelsson, Ove Åkesson,
Swedish Meteorological & Hydrological Institute

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TIMETABLE FOR THE CRAY Y-MP INSTALLATION

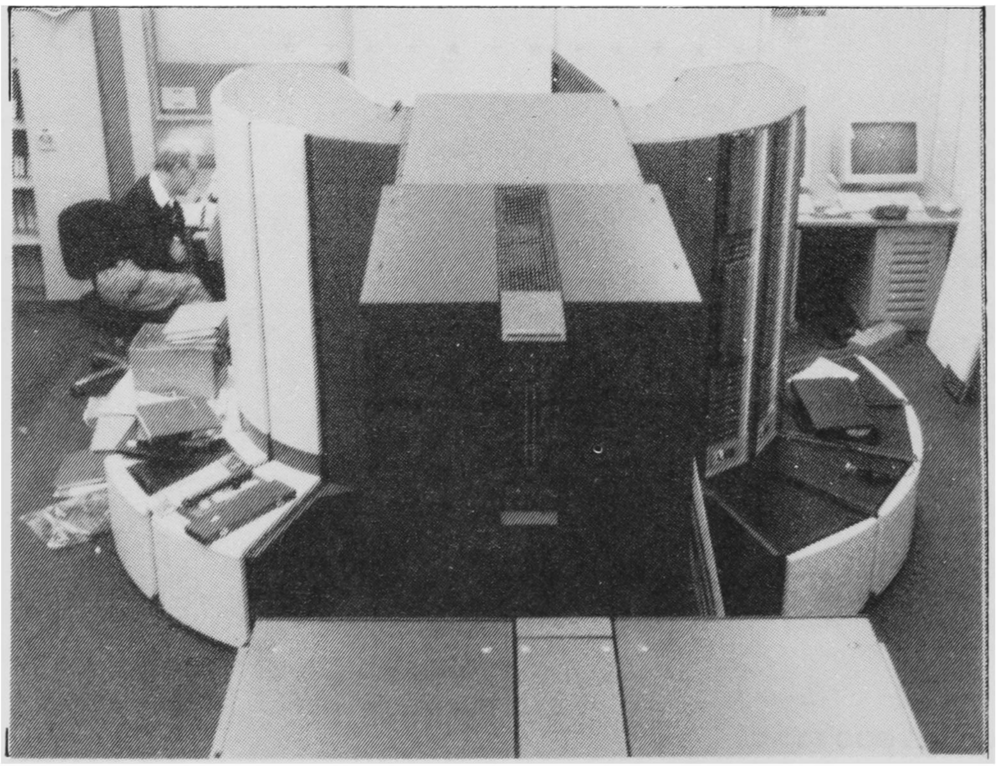
The general plan for the provision of high speed computing facilities at ECMWF for the next 5 years was outlined in the last ECMWF Newsletter (No. 49, page 10). The first stages of that plan are the installation of a Cray Y-MP8/8-64, a switch over of user work from the Cray COS to the Cray UNICOS operating system, and the removal of the existing Cray X-MP/48. Given below is the timetable envisaged for these first stages. As always users will be kept informed, by the customary channels, of the details of each particular stage.

Time table

6 June: The Cray Y-MP8/8-64 arrived at ECMWF. After installation and powering up, various hardware and software tests are being run by Cray staff.

1 July: The contractual date on which the one-day Provisional Acceptance trial should be run. This acceptance trial consists of repeated runs of ECMWF's benchmark test suite. After this trial has been successfully completed, a 30-day Final Acceptance trial will begin. This trial consists of running the machine in normal operational mode with as much user work as possible. Initially, a great deal of systems time will be used to enable key software (ECFILE, MARS, MAGICS, etc.) to be ported as quickly as possible, and to carry out the transfer of the operational suite. However, time should nevertheless be available for users to begin running their own programs.

31 December: Switch off and removal of the Cray X-MP. Formal accounting on the Cray Y-MP will begin.



The Cray YM-P8/8-64: installation in progress

Method of working

The envisaged method of working for most users is that UNICOS batch jobs will be prepared on one of the front-end systems (NOS/VE or VAX/VMS) and sent to UNICOS for execution, with the results coming back to the front-end system. Interactive access to UNICOS will also be available, maybe with with imposition of some CPU time and memory limitations. If it turns out that interactive work seriously affects the performance of the Y-MP, then some further restrictions may have to be imposed.

User training

About 30 members of staff have already attended UNICOS training courses to prepare for the transition before the arrival of the CRAY Y-MP itself. For the remaining Centre staff a 2-day training course will be given at Bracknell covering:

UNICOS filing system;

Fortran under UNICOS;

UNICOS batch system.

This course will be repeated four times in all, the dates currently planned being 25/26 June, 28/29 June, 9/10 July and 12/13 July.

The Centre's normal 2-week course for Member States will this year be held on 17-28 September at ECMWF. Details are published elsewhere in this Newsletter.

- Andrew Lea

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UNICOS - ITS USE AT ECMWF

1. Introduction

The Centre's new high-speed computing facility, the Cray Y-MP8/8-64, is being installed in June, with provisional acceptance expected about 1 July, and full acceptance about 1 month later.

Since this Cray uses a new operating system, UNICOS, it is necessary to convert all user work from COS to UNICOS. It will take some time to set up the system to provide a proper user service and solve any problems encountered, and it is not possible to say now when a full service will be available. Further details will be given in due course.

The Centre will be providing training courses for UNICOS. These will be held in June and July for ECMWF staff, and in September for Member States.

UNICOS is an enhanced version of UNIX. For most purposes, it is normal AT&T SYSTEM V UNIX. In comparison with COS, UNICOS provides considerably more power and flexibility; it also provides more facilities for networking, in particular support for the TCP/IP protocols. Most of the system is written in a high-level language (C), and it can be ported to other architectures fairly easily.

UNIX is rapidly becoming the standard operating system for systems ranging from workstations to supercomputers. This means that the same (or almost the same) user interface will be available on these systems, so that experience of using UNIX on a workstation will be immediately useful when using UNICOS on a Cray, and vice-versa. However, UNIX is not particularly user friendly, with its short non-mnemonic commands, frequently with many single letter options.

The enhancements in UNICOS are mostly transparent to normal users - they include I/O facilities appropriate for supercomputers, improved system administration etc. There are, however, enhancements which are visible to users, e.g.

- migration of programs from COS to UNICOS is simplified as CFT77 and SEGLDR are available on both systems;

- COS blocked data sets can be transferred to UNICOS and used by FORTRAN programs (the default data set structure on UNICOS for unformatted FORTRAN I/O is COS blocked);

- debugging of FORTRAN programs is simplified by using CDBX, which provides all the feature of DEBUG on COS, but can also be used interactively.

There is one very important difference between COS and UNICOS; in UNICOS upper and lower case are treated as quite distinct; the files "a" and "A" are separate files; many commands have option letters in both upper and lower case which have different effects. Note that all commands are in lower case.

There are many text books for a general introduction to UNIX. One that seems very satisfactory is *A Practical Guide to UNIX* by Mark G. Sobell (published by *The Benjamin/Cummings Publishing Company)*.

2. UNICOS at ECMWF

The aim of this article is to give a very simple introduction to use of UNICOS at ECMWF. However, since this is in an early stage, it is very likely that changes will occur as the service develops. The information presented here is of an introductory nature - further details will be published once the service is available.

The most important areas to be covered are

- File system use
- The Shell
- ECFILE
- access to the system (interactive and batch)
- Using UPDATE PLs under UNICOS
- Fortran Compiler
- Libraries, BLD and SEGLDR
- Example NQS (Batch) job.

3. File Systems

The YMP will have approximately 60 Gigabytes of online disk space, consisting of 3 DS-40 disk subsystems, each of which comprises 4 DD-40 disks. Out of the 60 Gigabytes, about 50 will be available to users, the remaining disk space being used for files required by the operating system, and also to swap jobs out of memory.

A major difference between COS and UNICOS is that the latter provides a tree structured directory system, similar to that provided by ECFILE, NOS/VE, MS-DOS, VMS etc. The starting point for all file paths is /, otherwise known as **root**.

Files can be referenced using the full file path, which always starts with /, or with a relative path name (i.e. starting with any character other than /), in which case the search for the file starts in the current working directory. The initial working directory will be the **HOME** directory.

Users will be able to create files under two root directories - under **/ec** and under **/tmp**. It is not possible to create files directly under /.

3.1 The /ec file system

The purpose of the **/ec** file system is to store small frequently-used files; in particular, files like **.profile** (the login prolog - this is executed once for every login, similar to the NOS/VE prolog file or the VMS login.com file), **.exrc** etc.

Under **/ec** a directory for every user name will be created. This will be the **HOME** directory for every user name. The user *abc* will be able to create the file */ec/abc/myprog*, to which he could also refer as *$HOME/myprog*, or if the current directory is the **HOME** directory, simply as *myprog*. The system **.profile** file (login profile executed before the user's **.profile**) will set **HOME** as the working directory.

Files created under **/ec** are **PERMANENT**; they will be backed up several times per day, and in the event of a disk crash, they will be restored. Because these files are backed up, the total file space will be very small. Each user will only be able to use at most 2 Megabytes within **/ec**. This quota will be enforced by the UNICOS system. Once the quota limit has been reached, it will not be possible to create more files under **/ec**.

3.2. <u>The /tmp file system</u>

All other user files should be stored under the **/tmp** file system. Again, every user name will have a directory created under **/tmp**. Thus the user abc could create the file */tmp/abc/my_large_file*.

This file system occupies more than 80% of the available disk space, initially approximately 46 Gigabytes. It is therefore not possible to back this up automatically. In order to ensure sufficient free disk space for the system to operate, files will be deleted regularly from **/tmp**. The policy will be to delete files starting with the least recently accessed files. Users are expected to save any files that they require in ECFILE (see below). However, directories will not be deleted; this makes it simpler to retrieve files into specific directories using ECFILE.

Because the **/tmp** system is not backed up, if a disk crash occurs, the whole of **/tmp** will be lost. It may be possible to arrange regular backups of the directories created under **/tmp**, in which case they will be restored should **/tmp** be lost. However, you are strongly recommended to write Shell Scripts (see below) to create any directories needed, by testing for their existence and recreating them if necessary.

This is basically the same policy that is used under COS on the X-MP/48, the main difference being that COS does not allow the creation of subdirectories.

In order to make it easier to create files that are automatically deleted when NQS jobs have finished, or after logging out, UNICOS provides a unique directory called **TMPDIR**, which is deleted (along with any files it contains) at the end of an NQS job or on logging out. **TMPDIR** is in fact a shell variable which will contain something like */tmp/jtmp.00303a* (interactive jobs) or */tmp/nqs.+++BFa* (NQS jobs). However, it is not necessary to know the actual contents of **TMPDIR**, merely that it creates a unique directory under **/tmp** which will be deleted automatically when the job is completed or on logging out.

Since **TMPDIR** is a Shell variable (see below), it must be prefixed with a $ so that its value is substituted within a file path - e.g. use $TMPDIR/myfile.

/tmp will also be used as "ldcache" for the SSD. This means that file accesses to **/tmp** will be buffered within the SSD; if data is written to a file, and immediately reread, it will be read from the SSD buffer, rather than from the file on disk. It will only be written out to disk, if the buffer on SSD is not accessed for some time.

This process is completely transparent to programs; the only visible aspect is the variation in elapsed times that can occur due to this buffering. It also means that in order to use SSD, files are simply written and read under **/tmp**; no special job control is required.

4. The Shell

The Shell is the command interface for UNICOS. It is not actually part of the operating system as such, but runs as a user process. It interprets commands, loading and executing programs as required and makes calls to the UNICOS Kernel as appropriate.

The Shell provides:

- a high-level language style of job control;
- the ability to execute files containing Shell scripts (similar to COS JCL procedures) to perform specific tasks;
- Shell variables, which contain useful information; e.g. the variable "PATH" is a list of directories to be searched for executable files when a command is issued;
- wild-card character substitution, allowing all files matching a pattern to be used within a command;
- built-in commands which are obeyed directly by the Shell (e.g. **cd**).

There are two main Shells available on UNICOS - the Bourne Shell, and the C-Shell. However, unless users are already familiar with the C-Shell, it is recommended that they use only the Bourne Shell. This will be the default shell set for all users.

In order to use the value of a Shell variable within a command, it must be preceded by $. This is one of several special characters for the Shell; others are *, ?, ", ' etc.

The Shells provide a very powerful and flexible user interface which, however, is not particularly user friendly. For full details of the Shell and writing Shell scripts, a UNIX text book should be consulted.

5. ECFILE

ECFILE will be available, with a similar user interface to the COS interface, but in UNIX style. The simplest use of ECFILE is as follows

ecfile save modpl	save the file *modpl* in CFS
ecfile get modpl	retrieve the file *modpl* from CFS.

A more complex example shows how to specify the filepath in CFS

ecfile -p /abc/progs/model get model.f

The above example retrieves the CFS file */abc/progs/model* saving it as model.*f* within the current working directory on UNICOS.

The sample NQS job in section 10 below also demonstrates use of ECFILE.

A FORTRAN callable library interface to ECFILE will also be provided. Full details for use of ECFILE under UNICOS will be given in an ECMWF bulletin.

6. Access to the system

For both interactive and batch access to the system, it is necessary to give a registered user name (normally referred to as the "User ID") and an associated password. Details of user IDs and initial passwords will be provided by the User Support Section. Passwords will expire after a period of time, and a new, different password will be required in order to continue using the system.

To submit batch jobs, it will also be necessary to quote a valid account code; this too will be provided by User Support.

Most users are expected to use UNICOS by submitting batch jobs, as with COS. It will be possible to submit NQS jobs from NOS/VE (via the NOS/VE Cray Station) and from the VAX (using a utility called RQS). NQS jobs can also be started from interactive sessions or existing NQS jobs using the UNICOS command **qsub**.

An NQS job is basically a Shell Script, which is preceded by a number of lines describing options requested by the submitter. These provide similar information to that provided by the JOB card of a COS batch job. The following is a simple script with a FORTRAN program compilation and execution:

```
# QSUB -eo        # combine standard output and standard error
# QSUB -a account # use account code "account"
#
cd $TMPDIR
#
cat >prog.f <<EOF
        program prog
        implicit integer (a-z)
        write (*, '(a)') ' Hello there'
        stop
        end
EOF
#
cft77 prog.f
segldr -o prog
./prog
```

The above script starts with two NQS directives (the lines starting # QSUB). This is followed by the command **cd $TMPDIR,** which means that files created will be deleted when the job is finished.

The program source is contained within a "Here" document, i.e. directly within the script. A "HERE" document is created using the **cat** command, which copies the lines following to the file **prog.f,** until the terminator **EOF** is encountered. The terminator may be any string of characters, and is specified by the **<<** prefix characters on the **cat** command. Note that the CFT77 compiler requires that the name of the file containing the Fortran source code end with "**.f**".

Next, the **cft77** command is used to compile the program; **segldr** is used to make an absolute binary, which is written to the file **prog**. Finally, the program is executed using the ./ command, which causes the shell to load the program **prog** from the current working directory (in this case **$TMPDIR**) and execute it. This is used because by default the current working directory is not searched for commands or executable programs - specifying **./<command>** causes only the current working directory to be searched.

7. Using UPDATE PLs under UNICOS

There are two versions of UPDATE available under UNICOS - **update** and **nupdate**. **update** is basically the same as UPDATE under COS. **nupdate** provides some additional facilities and is faster. However, there are currently difficulties with NORMAL mode updates using **nupdate**.

Both versions use the same structure for program libraries (PLs) as COS, so to use an existing PL stored in CFS, **ecfile** is used to retrieve the PL, and then **update** or **nupdate** is run.

Use of **nupdate,** being the more modern product, is advised unless NORMAL mode updates are required.

8. Fortran Compiler

The Fortran compiler will be CFT77, which has been available under COS for some time. It is accessed using the command **cft77,** e.g.

cft77 -l listing -e s prog.f

The file containing the Fortran source code must end with the suffix **.f**. The default memory allocation style on the Y-MP is **stack** (the default being **static** on the X-MP). In order to use static allocation, it is necessary to specify **-a static** on the **cft77** command.

9. Libraries, BLD and SEGLDR

As well as the default system libraries, which are the same as those available under COS, the following libraries will be provided

- eclib
- naglib
- magics
- disspla

To use these libraries, the **-l** option on the **segldr** command must be specified, e.g.,

segldr -l eclib magics

The eclib library will be a subset of the COS version; although it will not contain many of the COS dependent permanent file routines, such as ATTACH and CATALOG.

To make libraries or relocatable routines, the recommended utility is **bld,** which is the UNICOS version of the COS BUILD utility. Relocatable files produced by CFT77 (and any other compilers, e.g. C and PASCAL) have the suffix .o by convention.

The recommended loader is **segldr,** which has been available for several years under COS. If wished, the command **cf77** can be used - this uses CFT77 to compile the program and then invokes SEGLDR to make an absolute binary. This command can also be used for AUTOTASKING, which attempts to automatically identify parallel regions of code.

10. Example of an NQS job

The following example retrieves a program source file from ECFILE, compiles the program, retrieves a library from ECFILE, loads the program to make an absolute called "prog", retrieves the data required from ECFILE, executes the program and finally saves a results file back to ECFILE.

```
# QSUB -eo        # combine standard output and standard error
# QSUB -a account # use account code "account"
#
cd $TMPDIR
#
ecfile -p /abc/unicos/models/model1 get model1.f
#
cft77 model1.f
#
ecfile -p /abc/unicos/models/support_lib get support_lib
segldr -o prog -l eclib $TMPDIR/support_lib
#
ecfile -p /abc/unicos/model_data/start_ds get start_ds
FILENV=$TMPDIR/assign.$$
export FILENV
assign -a start_ds fort.20
assign -a results  fort.30
#
./prog
ecfile -p /abc/unicos/results/results1 save results
```

There are some points to note on the above example:

- In order to associate FORTRAN unit numbers with UNICOS file names, the **assign** command is used; the unit number is "nn" within the "fort.nn" name. In the above example, "start_ds" is associated with unit number 20, "results" with unit number 30.

- For this to work, a shell variable called "FILENV" must be created with a file name as a value - in the above example, the file name used is "assign.$$"; the variable must be made available to the script using the **export** command.

11. Summary

This article attempts to give a very simple introduction to using UNICOS at ECMWF on the YMP8/8-64. Further details of using the service will necessarily be published at a later stage.

- Richard Fisker

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ADVICE ON THE CHOICE AND USE OF PASSWORDS

This article appeared in the CERN Computer Newsletter of October-December 1989 and may be of interest to users of the ECMWF computer system also.

Recent experience has shown that when accounts on our computer systems are penetrated and used in an unauthorised way, this not only causes problems on these systems but can also then lead to attacks on any other systems reachable by networks. Determining what has happened, how to correct the situation and trying to identify the source of the attack, inevitably uses the time of experts in the systems involved, time that can be ill afforded.

The only mechanism available on most computer systems at CERN, to protect against gaining unauthorised access to accounts is the **password**. If this is to provide an effective protection, care must be taken, in the choice and method of use of passwords. For them to be effective, a compromise has to be reached between two conflicting factors:

- The password must be **easily remembered** by its 'owner'.
- It must be **difficult** for other people (or programs) to guess.

The aim of this note is to provide suggestions on how to choose passwords and use them correctly.

Choice of password

At the level of attacks that concern us at present, the attempts of individuals or programs to find passwords are usually limited to trying to guess passwords by working through a list of frequently chosen passwords, default passwords used when a system is shipped, passwords used by field service organisations, etc. With this in mind the recommendations on how to choose effective passwords start with a list of DON'Ts:

- Don't use the ID of the account.
- Don't use one of your names or any of those of your family.
- Don't use names or words related to your experiment or your profession.
- Don't use common words used in the field of computing, e.g. SYSTEM, FIELD, GUEST ....
- Don't use well known place names.
- Don't use common words from the French, German or English languages.

Two ways of choosing effective passwords can be recommended:

- Choose a word that is easy for you to remember but that will be very difficult for someone else to guess, e.g. words in less well known languages, local names or words that will not be known outside of a limited area.

- Choose a word that is easy for you to remember, but without necessarily being very obscure and then devise an algorithm (which is also easy for you to remember) that will substitute some of the characters of your word or pad it out to have, say eight, characters. Don't of course make the algorithm too obvious (like $ for d, 1 for l) or pad the word out with all of the same characters. Check the modified word isn't easier to guess than the original.

Use of passwords

Your efforts at choosing an effective password in a way that you can easily remember can be wasted if the password doesn't remain confidential. So:

- Don't tell other people the password, or if you must do so, keep your number to a strict minimum, in which case you are advised to change your password more frequently.

- Don't include your password in files (DCL, REXX EXECs etc.).

- Don't use the same password for several different accounts even if they are on different systems. Again you could develop an algorithm for yourself to derive different passwords for different accounts; **don't** make it as simple as appending the system name.

- Don't write down your password and then leave it where others can read it.

A few final suggestions:

- Try changing your passwords more frequently than the system forces you to, it is a good habit to get into.

- Forgetting your password or having it become invalid after you have been away for sometime, is annoying. You can always avoid this by keeping at home or locked in your desk, a copy of your password(s) that doesn't show explicitly to which systems and accounts they refer.

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EFFICIENCY IMPROVEMENTS FOR MARS USERS

As users are doubtless aware, requests for retrieval of large amounts of data from MARS can take a long time to execute. These requests can block the system so that small requests are in turn held up. Work is now underway to alleviate the problem internally. Users requesting large numbers of file retrievals can also help greatly by modifying their job running pattern.

Very recently an internal change has been made so that the scheduling of MARS data retrievals is now handled on the IBM rather than on the Cray. On the IBM information is available as to how many files a given request will need to access, and, based on this, a priority order is built up. The result is now that user jobs requiring only a few files take priority over those requesting many files. This has helped to let small jobs through more quickly. Also on the IBM the number of MARS retrievals allowed at any one time can be varied according to the time of day. Evaluation is now underway to determine the best mix of requests requiring large or small numbers of files for various periods in the day.

Currently when a request comes in for a file that is on tape, the data is first copied to disk and subsequently accessed from there. If a job contains many such requests, it repeatedly goes through the cycle of copying a tape file to disk, accessing the data (and perhaps doing an extraction), copying the next tape file to disk, accessing data, etc. etc. This is a very lengthy process. A modification is now being worked on whereby <u>all</u> the tape files requested will be copied to disk together. As the typical large request often involves many files held sequentially on tape, this change should improve efficiency.

Users who submit several jobs accessing similar MARS data are asked to submit such jobs sequentially rather than to put them all in as a batch. If submitted as a batch, it often happens that two jobs go into execution together, each requiring files from the same tape. Then the jobs compete for access to the tape, interfering severely with each other. Thus, to avoid this, users are asked to submit such jobs one at a time, waiting for the one currently executing to finish before submitting the next.

Users requiring data for many dates and/or time steps will oblige MARS to access very many files, even though the amount of data eventually recovered may be rather small. Users should realise that such a request is in fact a large one as far as MARS is concerned. Again, the request to run such jobs sequentially applies to these users also.

With all the above-mentioned changes, it is hoped that significant improvements in efficiency can be made, to the benefit of all.

- Andrew Lea

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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 or republished in this Newsletter series (up to News Sheet 243). All other News Sheets are redundant and can be thrown away. (Please note that termination of the NOS/BE operating system service has resulted in many News Sheets recently becoming obsolete.)

No.	Still Valid Article
89	Minimum field length for Cray jobs
135	Local print file size limitations
158	Reduction in maximum print size for AB and AC
187	Maximum memory size for Cray jobs
194	Preventive maintenance schedules
201	New Cray job classes
204	VAX disk space control
205(8/7)	Mispositioned cursor under NOS/VE full screen editor
207	FORMAL changes under NOS/VE
	Job submission from within a Cray job, using LAUNCH
208	Restriction of Cray JCL statement length
212	MFICHE command from NOS/VE
214	NAG Fortran Library Mark 12
	News Sheets on-line
215	MARS - data retrievals and model changes
219	MARS-Retrieval of most recent fields extraction utility
223	Corrections to ECFILE bulletins B8.3/1 and B8.3/2
	Aborting programs under VAX VMS
224	CRAY deferred class
	Job information cards
226	CRAY Class X
227	Extension of NOS/VE SUBCJ.
229	ECFILE audit facility
230	Access to AB printer via NOS/VE CDCNET
	Replot facility for DISPLOT
231	METGRAM under NOS/VE
232	NOS/VE passwords - how to change
235	VAX public directory - how to create
236	Alternative VAX graphics service for in house users
241	SENDTM - Cray file transfer to Member States
242	MARS - various changes

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COMPUTER USER TRAINING COURSE

The Centre will offer a computer user training course for Member State personnel and ECMWF staff from 17-28 September 1990. Full information and a request for nominations has been sent to all Member States, nominations from ECMWF staff will shortly be invited via Section Heads.

The course will cover four broad areas across the two weeks:

1. How to run a Cray job

   - overview of ECMWF computer system
   - Cray service, including job submission, debugging, and libraries
   - file storage, including UNICOS files, ECFILE, stranger tapes, and moving files between systems
   - front-end interactive service
   - remote user service.

2. MARS

   - archive and data services
   - formats
   - user interface
   - data retrieval.

3. MAGICS

   - overview and concepts
   - plot layout, mapping and coastlines
   - data input
   - contouring
   - specialist plotting (wind fields, observations, etc.)
   - specification groups
   - linear contouring, axis plotting
   - MicroMAGICS

4. Cray in more depth

   - hardware in detail
   - filing system and file structure
   - I/O efficiency
   - vectorising
   - procedures (shell scripts), libraries.

Throughout the course, each day will be divided approximately equally between lectures and practical sessions.

- Andrew Lea

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ECMWF CALENDAR

4-15 June	Meteorological Training Course Met 3: Use and interpretation of ECMWF products
27 August	*ECMWF holiday*
10-14 September	Seminar: Tropical-extratropical interactions
17-28 September	Computer user training course
1-3 October	Scientific Advisory Committee - 18th session
3-5 October	Technical Advisory Committee - 15th session
9-11 October	Finance Committee - 45th session
12-15 November	Workshop: Clouds and the hydrological cycle
26-30 November	Workshop: Use of parallel processors in meteorology
3-4 December	Council - 33rd session
24-26 December	*ECMWF holiday*

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ECMWF PUBLICATIONS

TECHNICAL MEMORANDUM NO. 165	Description of the radiation scheme in the ECMWF model
TECHNICAL MEMORANDUM NO. 166	Report on meeting on ECMWF Wide Area Network security, 1 December 1989
TECHNICAL MEMORANDUM NO. 167	The decrease of the systematic error and the increased predictability of the long waves in the ECMWF model
WORKSHOP PROCEEDINGS	ECMWF/EUMETSAT: Workshop on the use of satellite data in operational numerical weather prediction: 1989-1993. 9-12 May 1989, 2 volumes
FORECAST REPORT	Latest issue No. 49, Dec. 1989 - Feb. 1989

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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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* T indicates the original Technical Newsletter series

USEFUL NAMES AND 'PHONE NUMBERS WITHIN ECMWF

			Room*	Ext.**
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Head of Operations Department	-	Michel Jarraud	OB 010A	2003
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Other methods of quick contact:	-	Telex (No. 847908) (Bleeper 139)		
	-	Telefax (No. 869450)		
	-	VMS MAIL adressed to ADVISORY		
REGISTRATION				
Project Identifiers	-	Pam Prior	OB 225	2384
User Identifiers	-	Tape Librarian	CB Hall	2315
COMPUTER OPERATIONS				
Console	-	Shift Leaders	CB Hall	3333
Reception Counter) Tape Requests)	-	Tape Librarian	CB Hall	2315
Terminal Queries	-	Norman Wiggins	CB 028	2308
Telecoms Fault Reporting	-	Michael O'Brien	CB 035	2306
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Distribution	-	Els Kooij-Connally	Library	2751
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	-	Alan Radford	OB 002	2421
	-	Alex Rubli	OB 003	2425
Meteorological Operations Room	-		CB Hall	2426/2427
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Systems Software Section Head	-	Claus Hilberg	CB 133	2350
User Support Section Head	-	Andrew Lea	OB 227	2380
Computer Operations Section Head	-	Peter Gray	CB 023	2300
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Group Leader	-	Jens Daabeck	OB 016	2375
RESEARCH DEPARTMENT				
Head of Research Department	-	David Burridge	OB 119A	2005
Computer Co-ordinator	-	David Dent	OB 123	2702

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* CB - Computer Block OB - Office Block

** The ECMWF telephone number is READING (0734) 499000, international +44 734 499000, or direct dial to (0734) 499 + last three digits of individual extension number, e.g. the Director's direct number is (0734) 499001.

EARN/Bitnet: The ECMWF address on the EARN/Bitnet network is UKECMWF. Individual staff addresses are the first 8 characters of their surname, e.g. the Director's address is BENGTSSO@UKECMWF

DEC MAIL: Contact scientific and technical staff via VMS MAIL, addressed to surname