In this issue

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European Centre for Medium-Range Weather Forecasts

Shinfield Park, Reading, RG2 9AX, UK

Fax: (0118) 986 9450

Telephone: National 0118 949 9000

International....................+44 118 949 9000

Cover

An example of polygon shading in MAGICS (see article on page 8).

The figure shows the zonal mean cloud cover in a north-south cross-section for each month 1992 to 1995 as predicted by the operational T213L31 forecast system for day 5. The marked increase in the cloud cover since April 1995 is related to the introduction of the new prognostic cloud scheme (see ECMWF Newsletter Number 70 pp 2-8).

Editorial

Major changes are under way in the operational analysis. The present OI based analysis scheme was replaced by one based on variational methods (so-called 3D-Var) January 1996. The article on page 2 describes the changes.

Over the years the Centre's meteorological graphics package (MAGICS) has been improved and extended. A description of the latest version will be found on page 8.

At the end of each year the Head of Computer Division gives a talk to all staff outlining the activities of the Division over the past year, and the plans for the immediate future. A summary of that talk is given on page 14.

Two of the recent computer service changes, upgrading the external network (ECnet) and the introduction of a Call desk, are explained in more detail in the subsequent two articles.

Finally those interested in attending any of the Centre's computer training courses should see page 18.

Changes to the operational forecasting system

Recent changes

On 28 November 1995, a revised form of the continuity equation was implemented in the forecast model, resulting in a reduction of noise in all lower tropospheric fields previously experienced near mountains. In particular, the fields of mean sea level pressure, geopotential height and temperature are smoother, and the near surface wind is better represented.

On 30 January 1996 ECMWF introduced a 3-dimensional variational (3D-Var) analysis scheme. 3D-Var is a new code for the analysis of model-level values of temperature, vorticity, divergence and specific humidity, and surface pressure. Minor changes to the forecast model were implemented at the same time.

On average, forecasts from 3D-Var for the Northern Hemisphere are of similar quality as forecasts from the previous Optimum Interpolation system, while forecasts for the Southern hemisphere tend to exhibit higher skill. In addition, 3D-Var gives generally better temperature verification results, especially at low levels and in the stratosphere, and better wind scores at 200 hPa and above.

The analysis and prediction of tropical cyclones appear to have improved with 3D-Var.

See the article on page 2 for more details.

Bernard Strauss

3D-Var - the new operational analysis scheme

Introduction

A new analysis scheme, based on variational methods, became operational at the end of January, 1996. It replaces the current OI (Optimum Interpolation) scheme, which has been operational at ECMWF for more than 15 years, in fact from the beginning of operational forecasting in 1979. The development of the variational scheme started in 1987, in parallel with continued development of OI. The new scheme gives similar forecast accuracy and comparable analysis quality to the OI in the Northern Hemisphere, and it gives an improvement in the Southern Hemisphere.

New features

One of the advantages of the new scheme is that it is more flexible in its use of observations, and more easily adapted to new types of observations. In addition to the data currently used by OI, the first operational implementation of 3D-Var will use scatterometer wind data and TOVS radiance data. The TOVS data are used in OI in the form of retrieved thicknesses and precipitable water content data.

The addition of scatterometer data has improved the analysis of the low-level wind fields over sea - a tropical cyclone case will be presented below. The better use of TOVS radiance data is one likely reason for the good Southern Hemispheric results.

Another advantage of the new scheme is that the level of noise (gravity waves) is controlled within the analysis itself. 3D-Var thereby combines three tasks: retrieval of TOVS data, analysis and initialisation in one step, rather than in three separate job steps. This should lead to a more optimal combination of the information in the different types of data.

3D-Var is a completely new program code for the upper-air analysis (temperature, vorticity divergence and specific humidity on model levels, and surface pressure). The analysis is performed directly in terms of the forecast model's spectral representation, on model levels. Observation processing, quality control, background error computation and surface analysis remain from the old system, but will soon be replaced by new modules.

The specification of background errors and observation errors are somewhat different, and more realistic in 3D-Var, compared to the operational scheme. There are therefore visible differences between analysis increments produced by 3D-Var compared to OI. Wind increments are smaller due to tuning of background errors and broader vertical correlations; temperature increments are smaller, particularly near the surface, and they have a larger vertical scale in the free atmosphere. The stratospheric increments are more large scale and much smoother in 3D-Var.

The implementation of 3D-Var is an important step towards 4D-Var, the four-dimensional variational scheme. The fourth dimension in 4D-Var is time, indicating that the development in time of the atmosphere and of forecast errors will be better accounted for by the use of observations distributed in time over several (up to 24) hours, and by the use of the forecast model itself as a constraint. 4D-Var and 3D-Var share the same program codes. The testing of 4D-Var will intensify on the more powerful Fujitsu super-computer that will be available during 1996.

Summary of forecast impact

The new analysis scheme has undergone a very comprehensive programme of testing and assessment of its impact, during the last two years, first at T106 resolution and then during the last year at full operational T213 resolution. 3D-Var has been run in parallel with OI for a total of 149 days:

	From	To	No. of days
1	941206	950117	43
2	950405	950421	17
3	950422	950514	23
4	950824	951028	66
Total			**149**

3D-Var has significantly different characteristics to OI. Many important aspects of the analyses will change, when 3D-Var replaces OI. The parallel tests have shown that there can be sizable differences between the two analyses, especially in the more data sparse oceanic areas. Although the differences on occasion have been large, it has often been difficult or impossible to assess which of the two analyses is more correct. There are few independent data to use for verification.

For individual days, there may also be large differences in the forecast performance in forecasts run from 3D-Var and from OI, respectively. Over short periods one system or the other may produce better forecasts. However, on average over larger samples (50 cases or more), the forecast quality of the two schemes comes out to be very similar. It is equal in the European area (Figure 1a) as well as in the Northern Hemisphere as a whole (Figure 1b); whereas 3D-Var performs clearly better than OI in the Southern Hemisphere, as we can see in Figure 1c. The diagrams show an objective measure of forecast accuracy as a function of forecast time (0 to 10 days), averaged over the last T213 parallel run (i.e. 66 cases). 3D-Var is shown as a full line and OI is dashed.

The large variability from day to day comes across well in scatter plots of the type shown in Figure 2. Here, 3D-Var forecast performance (x-axis) is plotted against OI (y-axis), each circle representing one 5-day forecast - so there are 66 circles in all. The cross represents the mean. The points near, or on, the diagonal represent cases with equal 3D-Var and OI forecast quality. Points above the diagonal indicate cases in which 3D-Var

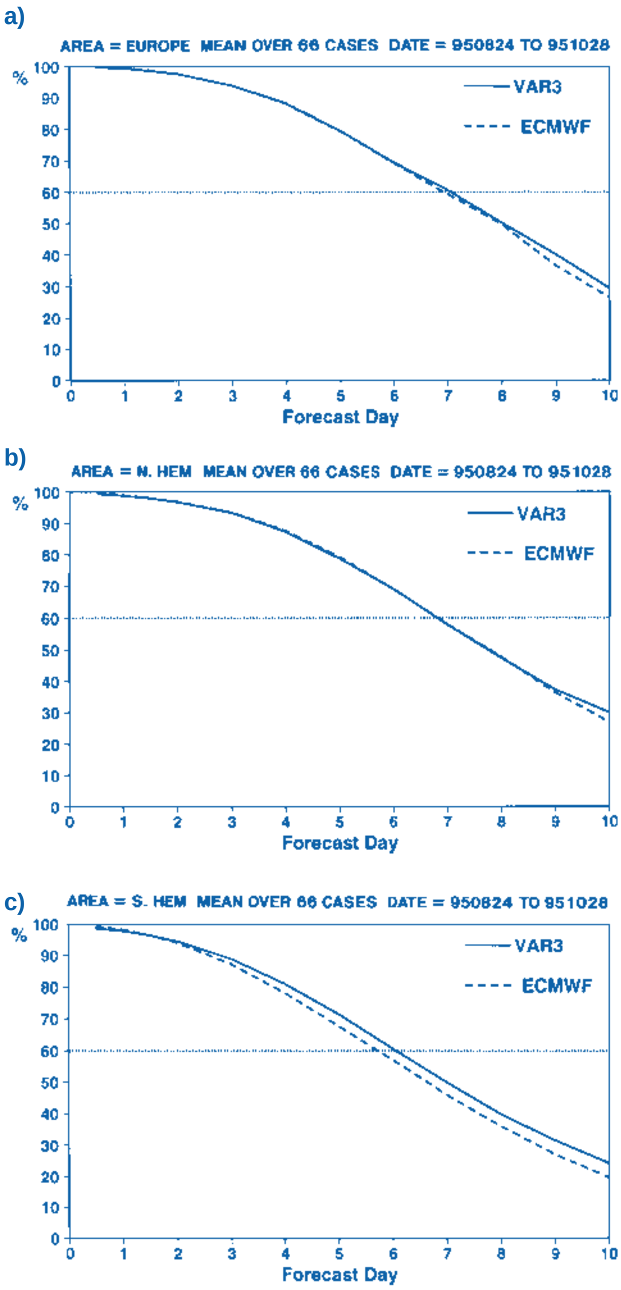


Fig. 1: Average forecast scores (anomaly correlation) for 500 hPa height for the fourth experiment period (950824-951028), 66 cases. The full line, labelled VAR3, shows 3D-Var and the dashed line, labelled ECMWF, shows the forecast performance of the operational (OI) scheme. Panel a) shows Europe, b) shows Northern Hemisphere and Panel c) shows Southern Hemisphere extra tropics.

has outperformed OI, and vice versa for points below the diagonal. We see that in Europe, the North Atlantic and the Northern Hemisphere as a whole (panels a, b, c), there is a large number of cases in which one scheme °is better than the other, with an approximately equal number of cases on both sides of the diagonal. In the Southern Hemisphere (panel d) we see a significant shift in the cloud of points in favour of 3D-Var.

Although the medium-range Northern Hemisphere forecast scores are neutral compared with operational ones, there is a very small degradation of the short range (1 day) geopotential scores from 3D-Var. This is not noticeable on any charts (1-2 m height) but is systematic in scores. It is likely to be related to different large scale analysis and no initialisation of the full field in 3D-Var. This absence of initialisation is believed to be beneficial for the tropics. The prediction of tropical cyclones is noticeably improved with 3D-Var. Temperature scores are generally better from 3D-Var, especially at low levels and in the stratosphere. Wind scores are better at 200 hPa and above.

Main characteristics of the variational scheme

At ECMWF, global analyses are produced every six hours, using data within the six-hour time window surrounding each analysis time. Approximately 40,000 to 80,000 observations are used in each analysis.

The variational formulation allows the analysis problem to be solved globally but not exactly. An approximate solution is found through a number of iterations of a minimisation algorithm. The scheme minimises a cost-function which measures the global misfit of the current model state to the observations and to the background. The background is a six-hour forecast valid at the analysis time, and based on the previous analysis. For each iteration the minimisation requires the calculation of the cost-function and its gradient with respect to the model variables. Given the value of the cost-function and its gradient, the minimisation algorithm finds an updated model state, with a smaller cost-function. The process is iterated until convergence, or until the predefined maximum number of iterations has been reached. We currently allow a maximum of 70 iterations in 3D-Var. Figure 3 shows an example of the gradual decrease of the cost function during minimisation. The very slow decrease after iteration number 30 indicates that the minimisation could be interrupted earlier with little loss of accuracy.

The cost-function consists of just one number (a scalar) but the gradient has the same dimension as the model - in the order of 106. The most efficient way to calculate the gradient is through the application of the adjoint technique. The cost of calculating the gradient with the adjoint technique is typically only two to four times the cost of calculating the cost-function.

The operational OI scheme cannot use all observations in one go. It would be too expensive. Instead the globe is subdivided into so-called "analysis boxes" with dimensions of around 2000 km. OI solves the analysis problem exactly within each box, but since partly different sets of data are used for the analysis of each box some discontinuity between neighbouring boxes is unavoidable. The variational scheme on the other hand is applied globally. All observations are used in one go, so data selection is not an issue. This will produce less small-scale "noise" in the analyses.

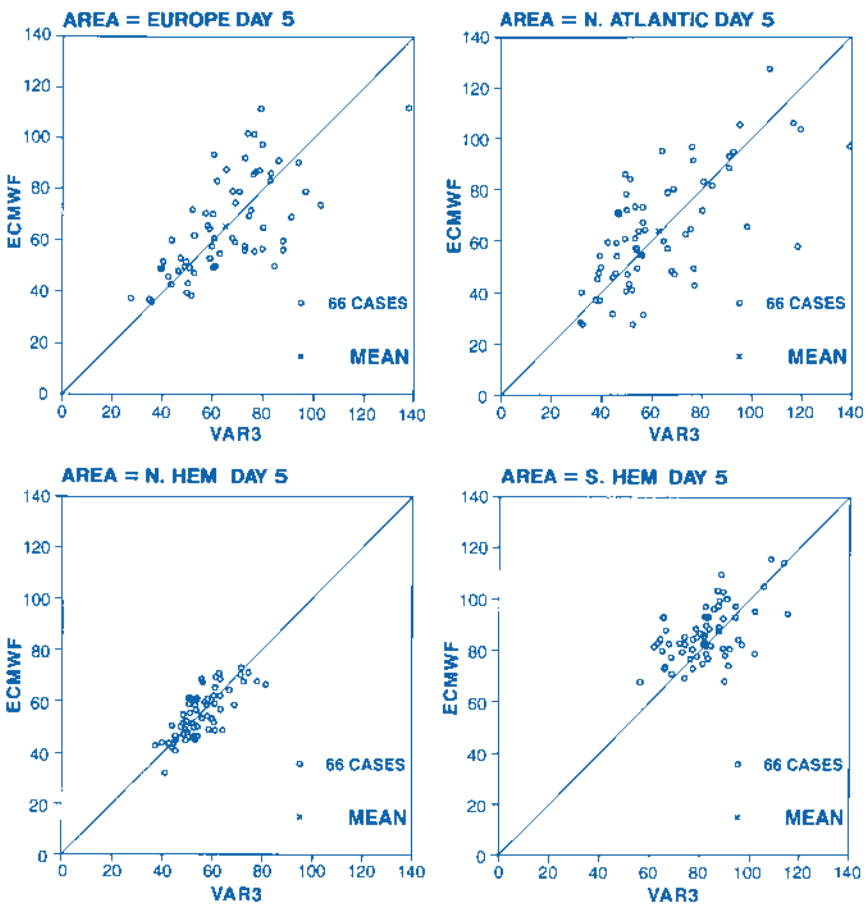


Fig. 2: Scatter-diagram of the 66 individual forecasts in the fourth experiment period (950824-951028). Each case is represented by a circle and the mean is indicated by a cross. VAR3 indicates 3D-Var, and ECMWF indicates the operational (OI) scheme. The measure of forecast skill is here root-mean-square of 500 hPa height forecast error. Panel a) is Europe, b) is North Atlantic, c) is Northern Hemisphere and d) is Southern Hemisphere.

Another important feature of 3D-Var is that observations can be treated multi-variately. By this we mean that one observation can influence the analysis of more than one analysis variable. Radiosonde height observations, for example are a function of both temperature and humidity through the virtual temperature effects of the hydrostatic integration. Thus, in 3D-Var, upper-air height data influence the analysis of both temperature (mainly) and humidity (to a lesser extent). Similar multi-variate effects are more important for the use of some TOVS channels, which depend strongly on both temperature and humidity. Another example is observations of relative humidity.

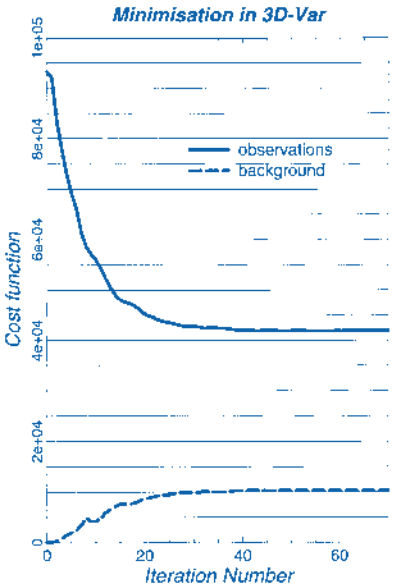
Examples of analysis impact

Figure 4 shows root-mean-square of the difference between 3D-Var and operational analyses of 500 hPa height, for a 18-day period in October 1995. We see that the two analyses generally are very close over the Northern Hemisphere continents (less than 2.5 m), and that larger differences (up to 7.5 m r.m.s.) occur over the Atlantic and Pacific oceans. The largest differences are, as expected, in the Southern Hemisphere mid-latitudes (in excess of 15 m) and over the Antarctic, where the analysis is most uncertain, due to relatively sparse data-coverage.

Figure 5 shows an example of an analysis of a tropical cyclone - in this case tropical cyclone Karen, on the 31 of August, 1995. Panel a) shows the observed scatterometer winds for an orbit which passes directly over the cyclone position (indicated by a large dot, at 20 North, 52 West). Panel b) shows the background (six-hour forecast) valid at the same time, and panel c) shows the 3D-Var analysis. The OI analysis in not shown, but is similar to the background field in this case, because few conventional data exist in this area, and OI does not use scatterometer wind data. This is a very striking example of favourable impact of additional data used in 3D-Var. Statistically, over the whole experiment period we see a significant improvement of the definition of the analysed wind field in and around tropical cyclones, and a small improvement of the day-1 and day-2 forecasts.

Summary

The three-dimensional variational analysis scheme replaced the operational optimum interpolation scheme at the end of January, 1996. This will lead to important changes in many aspects of the ECMWF analyses, but not significantly alter the forecast performance in the



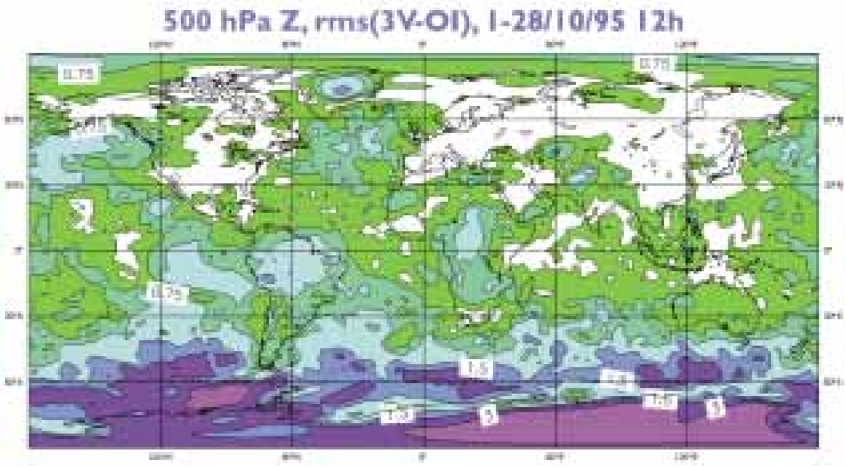


Fig. 3: (left) Evolution of the cost-function during the course of minimisation.

Fig. 4: (above) Root mean square of the 500 hPa height difference between 3D-Var and OI analyses for a 28-day period at the end of the fourth experiment, 951001-951028. The contours are 2.5, 5, 7.5, 10, 15, 20 and 30 metres.

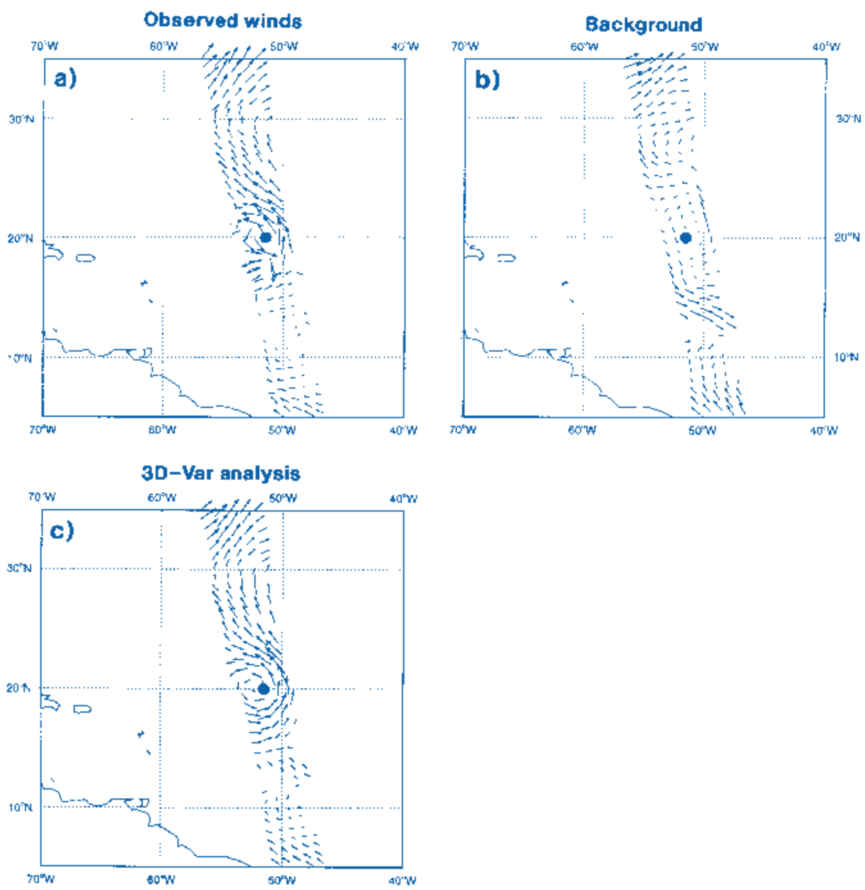


Fig. 5: Tropical cyclone Karen, on the 31 August 1995, 00 UT. Panel a) shows the observed scatterometer winds (ERS-1), b) shows the background winds interpolated to the locations of the scatterometer data and c) shows the 3D-Var analysis, also interpolated to the scatterometer data points.

Northern Hemisphere mid-latitudes, and Europe in particular. The results from extensive experimentation indicate that we should expect an improvement in the forecast performance in the Southern Hemisphere.

Implementation of 3D-Var provides the basis for future more general improvements in data assimilation and medium range forecasting.

E. Andersson, P. Courtier, C. Gaffard, J. Haseler, F. Rabier, P. Undén and D. Vasiljevic.

Summary of ECMWF Technical Memorandum No. 213

Treatment of the Coriolis terms in semi-Lagrangian spectral models

Clive Temperton

In September 1991, a new high-resolution (T213, 31-level) spectral model became operational at ECMWF. A considerable gain in the computational efficiency of the model was required to produce operational forecasts at this resolution with the available computer resources, and to this end the new model used a three-time-level semi-Lagrangian semi-implicit integration scheme as pioneered by *Robert* (1981, 1982). The formulation of this model and details of its performance are described in a recent paper by *Ritchie et al.* (1995).

In March 1994, a new version of the model was implemented operationally. While the scientific details of the forecast model itself remained essentially the same, the new code included many additional features required for three- and four-dimensional variational data assimilation (*Thépaut and Courtier*, 1991; *Andersson et al.*, 1994) and for determining optimal unstable perturbations for ensemble prediction (*Buizza et al.*, 1993). This new code was developed jointly by ECMWF (where it is known as the Integrated Forecast System, IFS) and Météo France (where it is known as ARPEGE). In the present context, one aspect of note is the operational use of this model by Météo-France in rotated and stretched mode *(Courtier and Geleyn*, 1988*)*.

The model is currently being adapted to make use of a two-time-level semi-Lagrangian scheme, both to take advantage of greater computational efficiency *(Staniforth and Côté, 1991)* and in the hope of reducing storage requirements when the model is used for four-dimensional data assimilation. Since the Coriolis terms can then no longer be treated in a simple explicit manner as in Ritchie et al. (1995), it is necessary to seek an alternative treatment. There are at least two possibilities, both of which can be evaluated within the framework of the well-established three-time-level scheme. These investigations formed the subject of a recent ECMWF Technical Memorandum *(C. Temperton, 1994)*.

The conclusions from these investigations were that: including the Coriolis terms in the semi-implicit scheme is stable and accurate, but results in a difficult problem to be solved in spectral space when the model is used with a rotated coordinate system. An alternative scheme proposed by *Rochas* (1990), in which the coriolis terms are incorporated in the semi-Lagrangian advection, is also stable and accurate provided that the spherical geometry of the problem is handled accurately. This alternative scheme has the additional advantage that the problem to be solved in spectral space has just the same simple form in a rotated coordinate system as in the corresponding unrotated case.

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Summary of ECMWF Technical Memorandum No. 215

The parametrization of surface fluxes in large scale models under free convection

Anton Beljaars

ECMWF Technical Memorandum No. 215 (TM-215) describes a comparison of the air-surface transfer law that is used in the operational ECMWF model with published data.

Recently, two papers appeared that address the parametrization of surface fluxes over land in free convection conditions. The paper by *Sykes et al.* (1993) discusses the scaling behaviour of bulk transfer laws in the surface layer over land and uses large eddy simulation (LES) to find the relevant constants. *Stull* (1994) proposes a new scaling law and derives constants from the BLX83 experiment. Finally, the *Bradley et al.* (1991) data is used for low wind speed conditions over the ocean.

Free convection parametrization over the ocean is rather crucial to the atmospheric circulation as it determines the atmosphere-ocean coupling in the warm pool area (*Miller et al.*, 1992) and therefore also determines to a certain extent the capability of atmospheric models to respond to anomalies in the sea surface temperature (*Palmer et al.*, 1992). Over land the problem has received less attention. Data on free convection over rough surfaces is relatively rare as it involves the radiative surface temperature as part of the bulk transfer law.

Although the scaling laws proposed by *Sykes et al.* (1993) and *Stull* (1994) are perfectly reasonable for free convection and provide a good fit to the data, it is less clear how they fit into the standard transfer laws that are widely used in atmospheric models. In TM-215 it is shown that the standard Monin Obukhov scaling works equally well for free convection provided that the free convection velocity scale is included in the near surface wind as used in the transfer law. This makes the implementation of free convection in large scale models rather straightforward.

Sykes et al. (1993) develop their scaling from the idea that free convection is a special case of forced convection, where the surface wind is forced by the large scale eddies in the outer part of the boundary layer. This idea is well accepted now and was used in a number of studies for rough as well as smooth surfaces. However, *Sykes et al.* (1993) develop a special kind of surface layer scaling, which suggests that free convection needs special attention in parametrization schemes. The logarithmic profile is used to relate the free convection velocity to the friction velocity and an internal boundary layer concept is used to estimate the height of the surface layer. TM-215 shows that an estimate of the surface layer depth is not needed if stability corrections are applied to the logarithmic profile. The reason is that for strong instability (large ratio of height and Obukhov length), the profiles become uniform (or well mixed), so the choice of the height where it is used in a transfer law becomes irrelevant. The implication is that normal Monin-Obukhov similarity can be used in the surface layer without modification for free convection (apart from the use of the free convection velocity in the surface wind).

Stull (1994) proposes a free convection bulk transfer law on the basis of similarity arguments and suggests an empirical interpolation with the forced convection situation. He does not include the surface roughness length as a relevant scaling parameter, which may limit his results to a small range of surface characteristics.

In TM-215 it is shown that free convection can be parametrized as a special case of forced convection. The near surface wind forcing is produced by the large eddies in the mixed layer. Asymptotic transfer laws are derived for smooth and rough surfaces. The resulting transfer laws for free convection are in reasonable agreement with data from tank experiments (e.g. smooth surface data by *Deardorff and Willis*, 1985) and with results from large eddy simulation for rough surfaces (*Sykes et al.*, 1993).

Atmospheric data for free convection data are virtually nonexistent; most data will have a non-negligible large scale wind component. It is therefore necessary to use an interpolation between free and forced convection. Such a formulation is proposed and compared with BLX83 data (*Stull*, 1994). It is concluded that the formulation works very well, but it is difficult to decide on the exact from of the interpolation on the basis of this data set.

The proposed formulation has a few advantages over the free convection formulations proposed by *Sykes et al.* (1993) and *Stull* (1994):

- The formulation is extremely simple to implement in an atmospheric model as it only involves an adjustment of the surface wind forcing in the traditional transfer laws.
- The same formulation works for a wide range of surface conditions (for smooth as well as rough surfaces).
- Particular surface conditions that affect high wind speeds (e.g. differences in roughness lengths for momentum and heat or in homogeneous terrain effects) are automatically taken care of in free convection, once they are dealt with at high wind speed.

TM-215 discusses the effect of dry convective motion on the air surface interaction. The dry convective boundary layer (mixed layer) is relatively well documented. It is not clear however, how the near surface wind forcing should be handled in the transition regime from free to forced convection. Large eddy simulation seems an attractive tool to study this problem. It is even less clear how the air-surface interaction is influenced by other types of motion that are sub-grid to large scale models. We can think of shallow clouds, organised convection, precipitating convection and meso-scale activity, all enhancing the averaged near surface wind but not resolved by large scale models.

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MAGICS - The ECMWF graphics package

Introduction

The Meteorological Applications Graphics Integrated Colour System (MAGICS), developed at the European Centre for Medium-Range Weather Forecasts (ECMWF) is a software system that permits the plotting of contours, satellite images, wind fields, observations, symbols, streamlines, isotachs, axes, graphs, text and legends.

Development started in 1984 with the first release for Centre users in 1985. It has since been used by several Member States. It is also being used as a basis for the meteorological workstation systems Metview[1] and Synergie[2].

MAGICS was designed to conform to and use new meteorological and graphics standards, e.g. GRIB[3], BUFR[4], GKS[5]. It makes use of modern contouring method (CONICON[6]) and enables users to take advantage of colour graphics and device independence.

Data to be plotted may be presented in various formats, i.e. GRIB code, BUFR code or in matrices.

The format of the graphical output from MAGICS depends on the GKS workstations (drivers) supported by the GKS implementation. MAGICS interfaces to a GKS level 2B implementation.

MAGICS Features

MAGICS contains the following features:

- Flexible user interface with a comprehensive list of simple English language parameters;
- Extensive use of colour;
- Matrix, GRIB and BUFR code data input;
- Selection of geographical area and direct projection of data;
- Polar stereographic, cylindrical, Mercator and space-view projections;
- High quality contouring based on CONICON and lower quality linear contouring;
- Satellite image plotting in all four projections;
- Shading between contour lines and also in graph and coastline plotting;
- Wind fields directly projected, as arrows, WMO flags, streamlines or isotachs;
- Full observation plotting;
- Symbol plotting;
- Axis and graph plotting;
- Legend plotting;
- Storage of program context (specification groups).

MAGICS subroutines and parameters

MAGICS consists of a small set of FORTRAN callable subroutines which are divided into five different categories, one for each of initialization, parameter setting, enquiry, action and pseudo action. Action routines are the only ones that produce plotted output and the parameters associated with each action routine should be set, if required, before the action routine is called.

Parameters in MAGICS are the attributes to be assigned to the various items that make up plotted output, such as line-style, colour and size of plot. They control all plotted output. The parameters may be set by calling MAGICS parameter setting routines, where the use of a keyword (a MAGICS parameter) as an argument defines the action to be taken.

A typical MAGICS program, as in the simple example below, consists of a series of parameter setting, action and pseudo action routines.

```
CALL POPEN                                      open the MAGICS package
CALL PSETC('CONTOUR_LINE_COLOUR','RED')         parameter setting
CALL PSET2R('INPUT_FIELD',FARRAY,320,160)       data field in FARRAY
CALL PCOAST                                     default map is global cylindrical
CALL PCONT                                      plot contours of FARRAY
CALL PCLOSE                                     close MAGICS
```

Plot layout

To make the positioning of users' plots simple, MAGICS has introduced the concepts of subpage, page and super page.

A super page corresponds to the plotting area to be used on a plotting device. With the plot layout facilities, pages can be positioned either automatically or by the user within the super page. Similarly, one or more subpages can be plotted inside a page.

Mapping

Mapping is the placing or projecting of coastlines, grids and data onto the user's subpage. Four types of projections are catered for in MAGICS, cylindrical, polar stereographic, Mercator and spaceview (satellite). It is not necessary for users to extract the required area

[1] See ECMWF Newsletter number 68
[2] Developed by Meteo France
[3] WMO standard
[4] WMO standard
[5] ISO standard
[6] Developed by the University of Bath, UK.

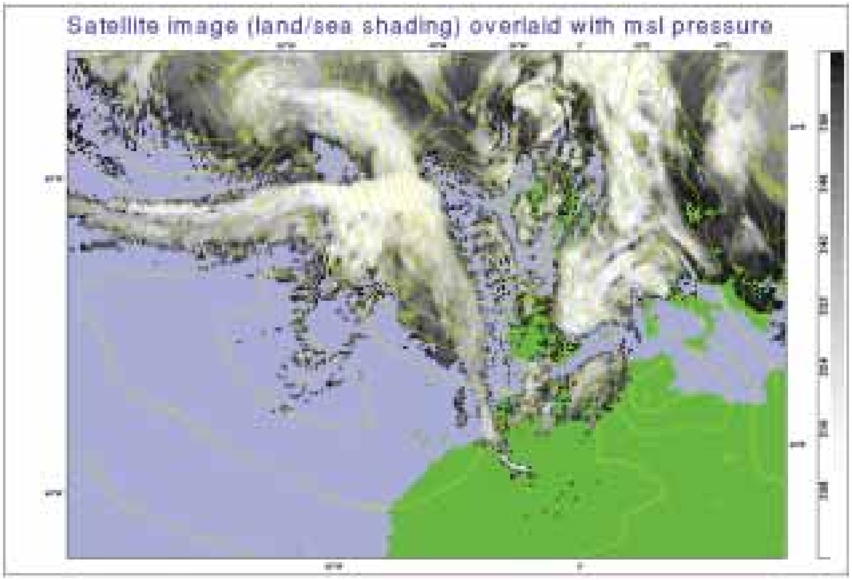

Fig. 1 Meteosat infrared satellite image 10th January 1996 0600 UTC overlaid with contours of MSL pressure, ECMWF analysis 10th January 1996 0600 UTC.

before passing data as MAGICS can perform this function and the conversion to the various projections, if required. It is possible to shade both the land and sea areas and Figure 1 shows an example of this.

Data input

Data to be plotted can be presented in a number of ways, depending on its type: contour fields, wind fields, observations, satellite images, axis and graph data etc.

A contour field can be presented as either a two-dimensional array of grid point values or in GRIB code format. GRIB code can be presented as either an external file or as a one-dimensional data array. Matrix data can be regularly spaced or on a gaussian grid.

A wind field can be presented as either a pair of two-dimensional arrays of grid point values or in GRIB code format. The pair of two-dimensional arrays can contain either U or V velocity components, or speed and direction components, of the wind. GRIB code can be presented as either an external file or as a pair of one-dimensional data arrays.

Observations must be presented as an external file. Data for observation plotting must be in WMO BUFR code.

Satellite images may be presented as a two-dimensional array of points or in GRIB code.

Axis and graph data must be presented in one dimensional arrays.

GRIB data

Facilities exist in MAGICS for automatic processing and plotting of GRIB coded data. In particular MAGICS can decode the GRIB data, convert from spectral to grid point, scale the fields and set up the MAGICS data input parameters. The pseudo action routine PGRIB handles all these functions. MAGICS can plot data in either GRIB edition 0 or 1, various gaussian grids and bit-map fields. MAGICS can cope with the extended GRIB code for satellite image data, GRIB data on stretched/rotated grids and GRIB data in polar stereographic projection. A special feature allows the plotting of wave direction and heights as wind arrows.

Contouring

MAGICS contouring is based on CONICON, which is designed to draw the contours of continuously differentiable fields.

For the user interface, emphasis has been placed on simplicity, making it easy for the user to define the contour levels required and the attributes to draw them with. Users have full control over plotting of labels, highs and lows as well as the thickness and colour of contour lines.

There is a faster but coarser method of contouring available in MAGICS, based on a linear interpolation. MAGICS shading facilities enable the user to shade between contour levels. Another feature of MAGICS contouring allows users to plot the grid point values on their exact location, either on their own or overlaid on contour lines.

MAGICS allows for the plotting of 'split' level contouring, where contours above a certain level can be plotted with different characteristics to those contours below the specified level.

Satellite image plotting

MAGICS provides facilities for plotting satellite images with optional overlaid fields, observations and coastlines. Each pixel in an image will be plotted in the tile format, i.e. each pixel is represented by a small rectangle filled with a colour (note that grey scale definitions are special cases of colour definitions). Input image data must be in the spaceview projection. If necessary, MAGICS will automatically reproject the image from spaceview to the required projection.

Image data can be passed to MAGICS in the extended GRIB representation or can be passed as a matrix.

The colour distribution of the plotted image is controlled by the use of a colour table. The user may specify a colour table or can use the MAGICS default one.

Figure 1 shows an example of satellite image plotting.

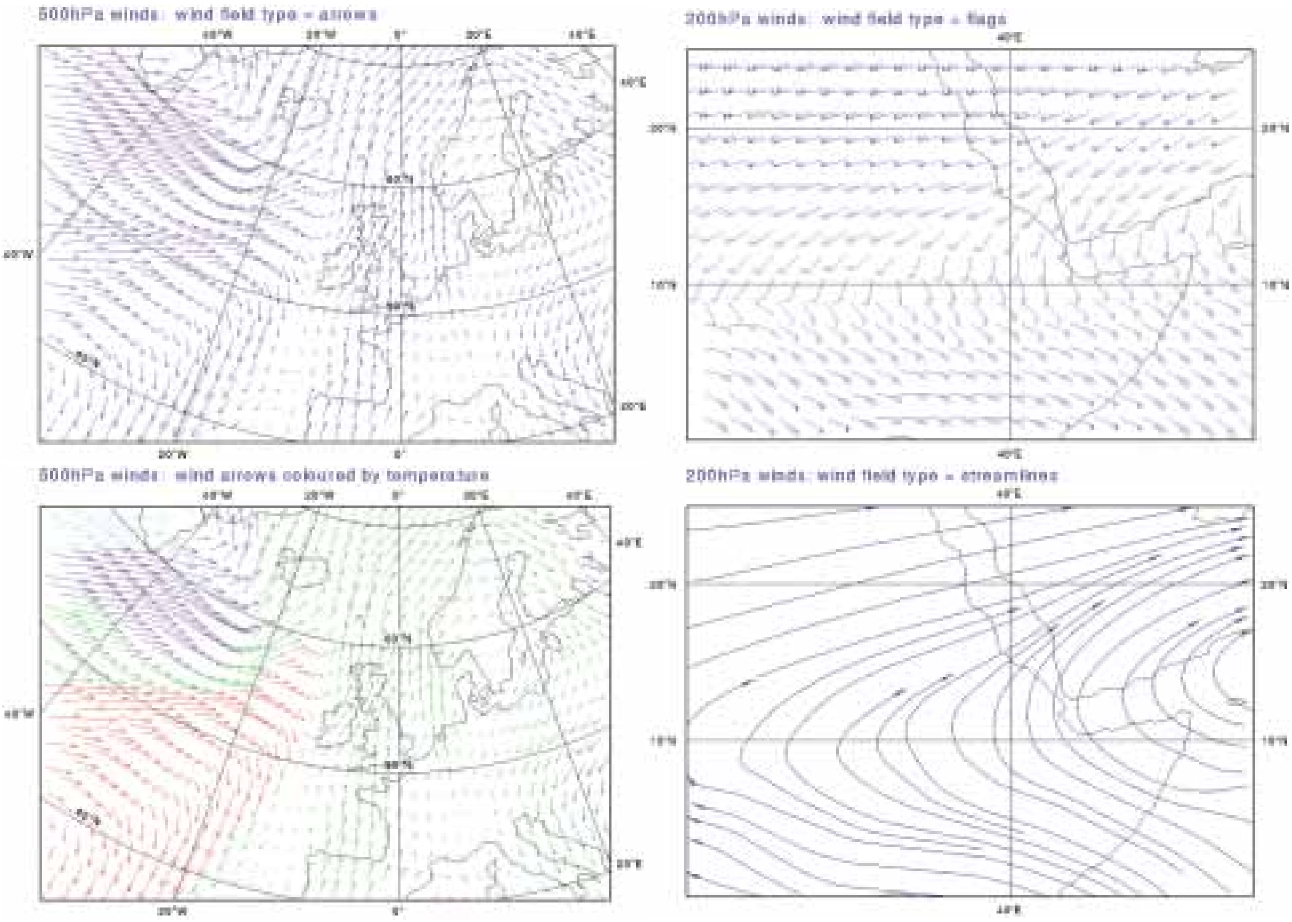

Fig. 2 Examples of wind representations in MAGICS

Wind field plotting

Wind fields may be presented to MAGICS as U and V velocity components, as speed and direction components or as GRIB code data. They may be plotted in one of four ways:

- wind arrows: where the wind is represented by a vector whose length is proportional to the speed of the wind;
- WMO standard wind flags: where a wind flag is represented by barbs and solid pennants;
- streamlines: A streamline is a line whose tangent at any point is parallel to the instantaneous velocity at that point;
- isotachs: which are contour lines of equal wind speed.

Wind related parameters, which are generated from differential properties of the wind field, may be plotted using normal contouring facilities, e.g. Divergence, Vorticity, Stream Functions and Velocity Potential. The use of colour enables the plotting of coloured wind arrows where the colour of the arrow can represent the relevant temperature, humidity, etc.

Figure 2 shows examples of coloured winds, streamlines, wind flags and wind arrows.

Observation plotting

Observation plotting allows for the plotting of all observation types, including the plotting of wave and swell heights. A special feature of observation plotting is the facility to plot information from the ECMWF Analysis Feedback, i.e. rejected data, data used or not used by the analysis and departure values. WMO standard plotting formats are adhered to as closely as possible. Figure 3 shows an example of Analysis Feedback observation plotting.

The user has full control over the type, number and size of the observations to be plotted. It is possible to plot only the positions of observations. The amount of meteorological information plotted may also be controlled by the user.

Axis plotting

MAGICS axis facilities allow users to plot vertical and horizontal axes. These facilities include axis labelling, axis title plotting and subdivision of axes with ticks. MAGICS AXIS parameters give the user control over all aspects of axis plotting, e.g. position, orientation, colour, thickness, etc. Axes may be regular, logarithmic or user-defined and may be subdivided with tick marks. Further subdivision between ticks, i.e. minor ticks, is also possible.Ticks may be labelled either on the tick mark or between ticks. Grid lines, may be plotted. MAGICS axis facilities can be used for plotting cross-sections or for graph plotting.

A special feature in Axis plotting is the automatic DATE/TIME axis facility. If the user specifies the start and end date, MAGICS will generate the axis with the correct

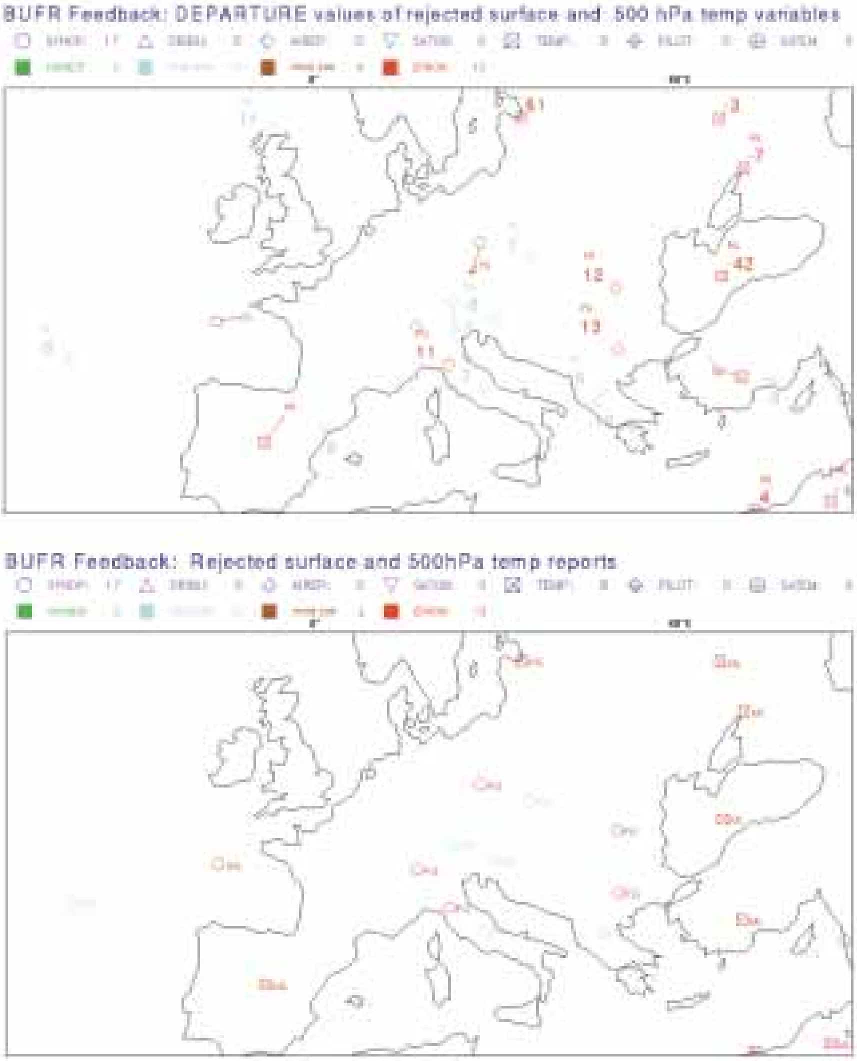

Fig. 3: Plots of Feedback information from ECMWF Analysis associated with observations over Europe

hour, day, month and year. Figure 4 shows and example of date/time axis plotting.

Graph plotting

Graph plotting in MAGICS is the plotting of line charts (curves), bar charts and area charts within a set of axes. An area chart is where the area between two curves is shaded. The user has full control over line style, colour and thickness of graphs and, if required, a legend describing the graph can be plotted. Bar charts and area charts can use all the MAGICS shading facilities.

Figure 4 shows examples of curve and bar chart plotting.

Symbols can be plotted on the curves and a specified area around curves can be blanked. Curves can be drawn straight or rounded, where a smoothing algorithm is applied to the curve. There are options for dealing with missing data.

MAGICS can automatically generate the axes for GRAPH plotting by analysing the input data. Another feature is the facility for drawing curves on maps.

Symbol plotting

Symbol plotting in MAGICS is the plotting of different types of symbols at selected locations. A symbol in this context is a number, a text string, a WMO wind flag or a MAGICS marker. The position of a symbol may be defined by its geographical location (latitude/longitude), by its position in centimetres from the bottom left hand corner of the subpage or by its X/Y position on a graph . There are facilities in symbol plotting that allow the user to control the height and colour of each symbol and, if required, a legend describing the symbols may be plotted. Figure 5 shows examples of symbol plotting.

Text facilities

MAGICS allows users to plot a block of text anywhere within the user's page. A text block consists of a number of text lines, up to a maximum of ten lines, and may be positioned automatically by MAGICS or specifically by the user.

Facilities exist for plotting integer, real and character values, the necessary type conversion being done by MAGICS. It is possible to plot the values of any MAGICS parameters in a text line.

Users have full control, via MAGICS parameters, over all aspects of text plotting, such as colour and style, as well as the height of text lines and the spacing between lines.

Instruction strings enable the plotting of complicated text strings and give even more user control of colour, height etc. Using Instruction strings, the user has control over each individual text character and may also plot symbols, e.g. the degree sign.

Legend plotting

MAGICS legend facilities enable users to annotate their plots. Legends can be produced automatically for contouring, wind plotting, satellite imaging, graphs and symbols. For contouring, attributes like style, colour and thickness are associated with a text, describing the relevant contour interval used in the plot. Shading legend entries consist of a sample of each shading pattern used in the plot.

For wind plotting, the shape and length of arrows are associated with a text which can describe the wind speed. Also, wind arrow colours may be associated with a text to describe the significance of the colours. Wind flags, plotted each time in the legend with a full barb, are associated with a text which describes the wind strength.

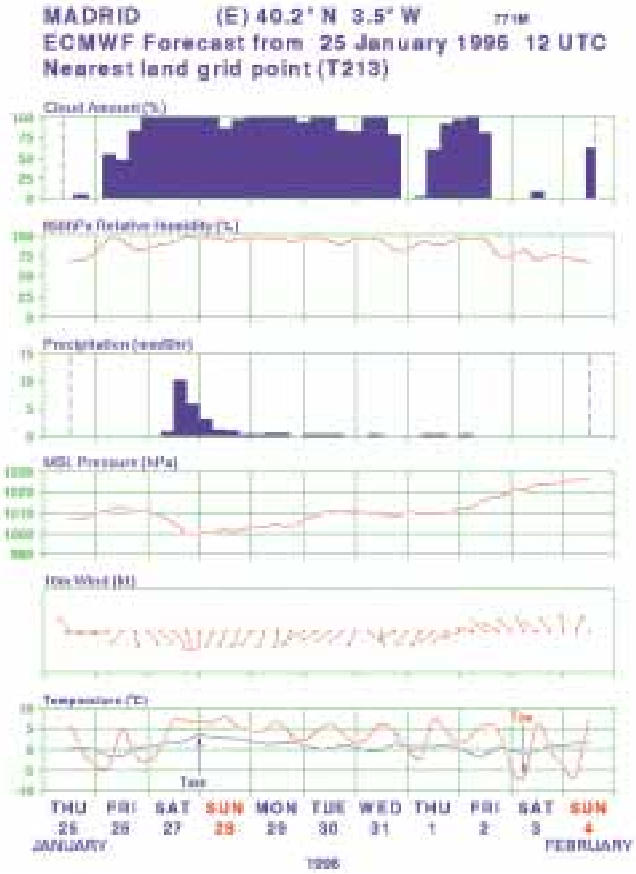

Fig. 4 Meteogram plotted entirely with MAGICS facilities

There are special legends for image plotting and in observation plotting of analysis feedback data.

The legend entries are plotted into an area known as the legend box, each legend entry consisting of three distinct parts: symbol, automatic text and user text. The user has full control over the positioning of the legend box, the number of legend entries and the way entries are plotted within the box.

There are examples of MAGICS legend facilities in Figures 3 and 5 and on the front cover.

MAGICS shading

MAGICS shading allows users to shade areas in contouring, graph plotting, coastline drawing etc. with varying intensities, patterns and colours. MAGICS parameters exist to control all the features and options in shading and their default values should ensure that, for most plots, a reasonable shaded plot can be achieved without having to set most of the shading parameters.

There are three different shading techniques used in MAGICS; polygon shading, tile (cell) shading and marker shading. Polygon shading is where the area between contours is formed into a closed polygon and filled. There are three different methods of shading available with polygon shading; dot, hatch and solid. Tile shading, which is a lower quality shading than polygon shading, shades each cell according to the value of the field at that cell. Marker shading consists of plotting a marker at each of the grid points in the field. The type of marker and also the height and colour of each marker is determined by the value at the grid point. Figures 6, 7 and the front cover give examples of the various shading methods and techniques.

Shading enables more information to be plotted on a map without causing confusion. It is useful for highlighting specific details, e.g. negative temperatures, rainfall above 20 millimetres etc. Shading can make a map more easily understood, particularly when used with MAGICS legend facilities.

Specification groups

A MAGICS specification group consists of a set of MAGICS parameter values, where each group may consist of one or more parameter values.

Users may request MAGICS to save, retrieve or delete specification groups in memory. It is also possible to save and retrieve specification groups in a user file. If required, the user may alter this file by using normal text editors. MAGICS can read specification groups from a user file, which has been created by MAGICS or by the user.

Specification groups are useful when writing MAGICS application programs that produce, for example, a predetermined sequence of plots. Users can predefine and save specific groups of MAGICS parameters that are used for each picture in the sequence. They simplify programming and make programs more readable.

Further development

MAGICS is a mature but still expanding graphics package. Future enhancements will be made in response to user's requirements and also to support the devlopment of Metview.

Paddy O'Sullivan

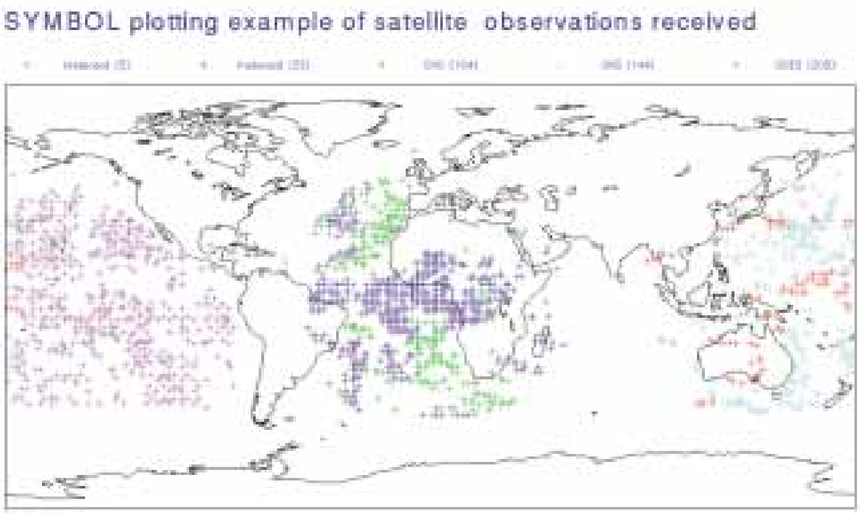

Fig. 5: Symbol plotting of wind observations from geostationary satellites.

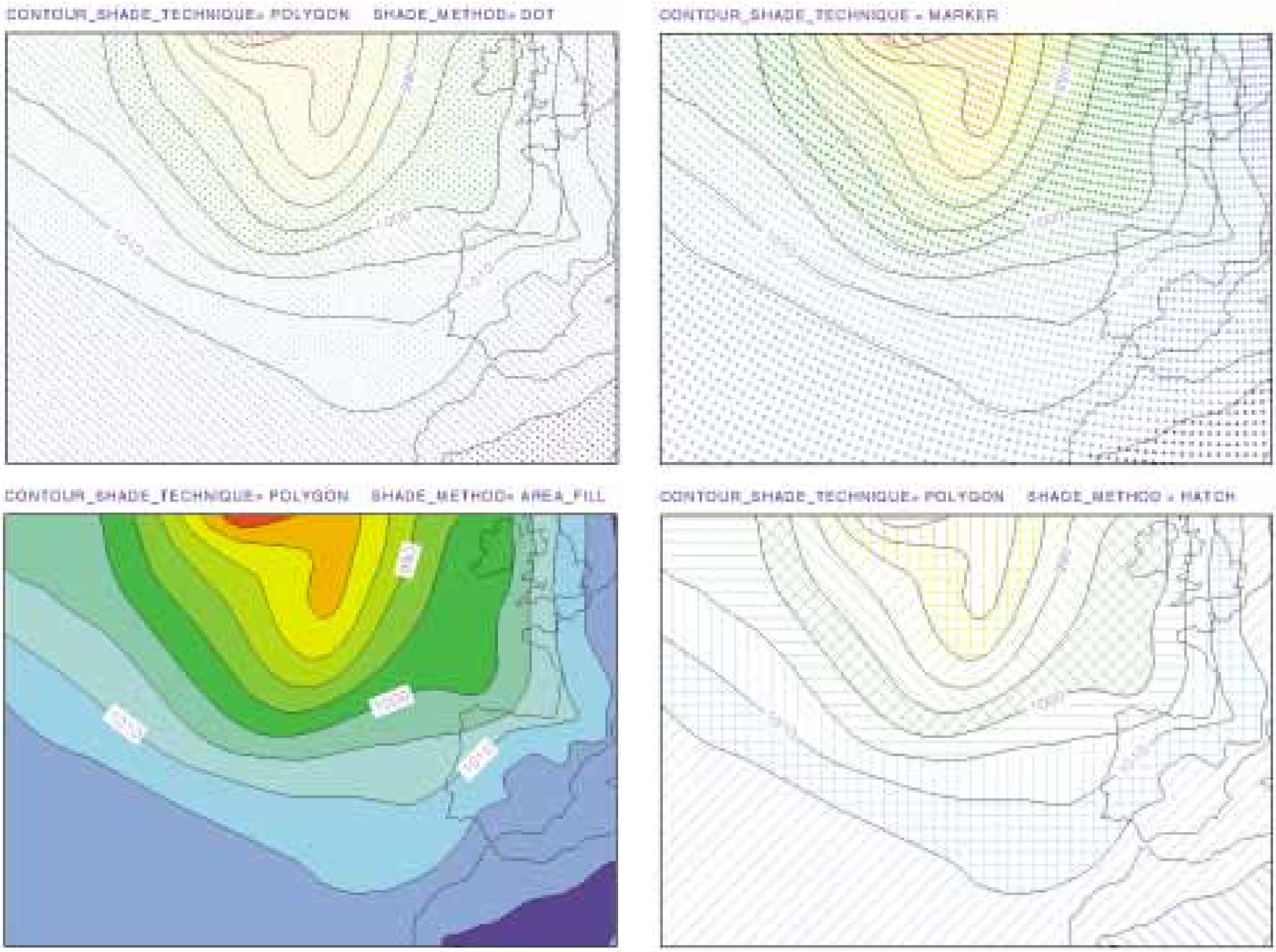

Fig. 6: Examples of MAGICS shading techniques and methods

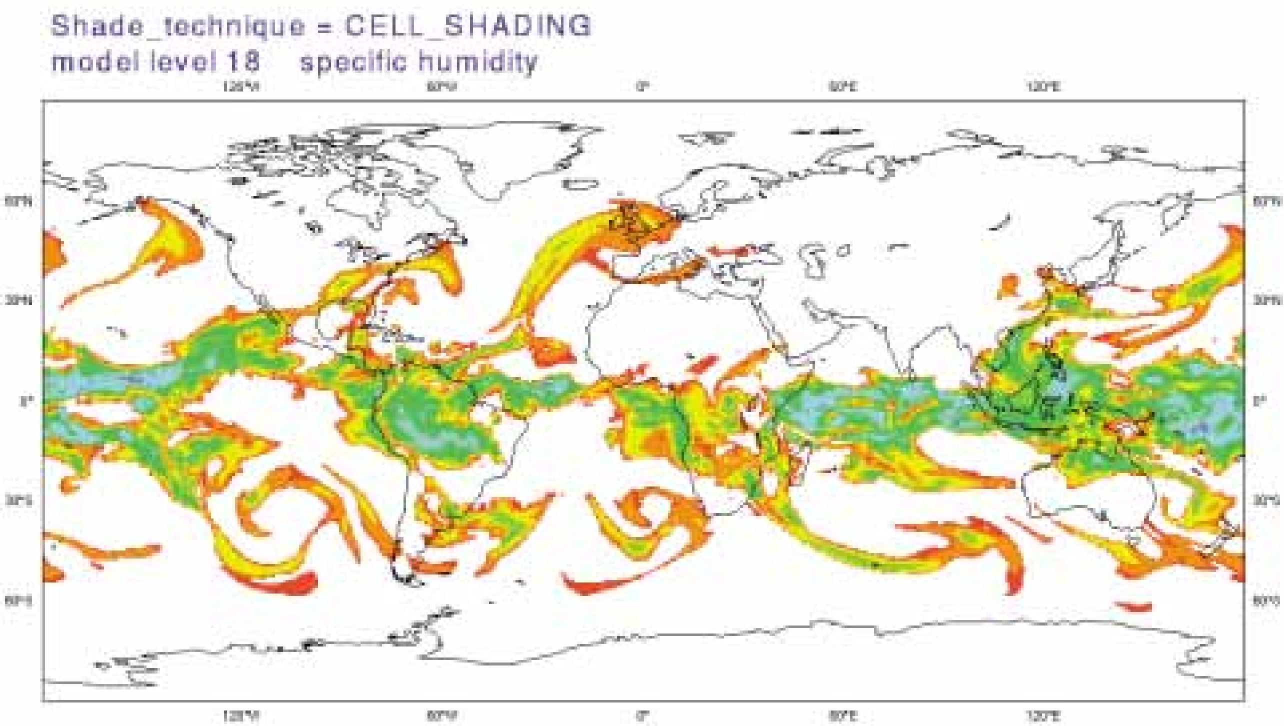

Fig. 7: Example of MAGICS shading using the CELL_SHADING technique

ECMWF computer system: status and plans

(This article is based on a recent talk given by Geerd-R. Hoffmann to ECMWF staff)

Although the past 12 months have not seen a great change in the user services, a great deal of effort has gone into preparing for major changes to come in 1996. In particular, Fujitsu has now been selected as a successor for the Cray service, and the first phase of the new IBM RS6000 based data handling system is being implemented.

Thus the computer configuration has barely changed through the year, the only additions being the IBM RS6000 systems which are the first part of the new data handling system (see Fig. 1).

Based on the measure of the number of hours the main forecast has been delayed due to major causes, 1995 was not as good as 1994 but it was still a very good year (< 20 hours in total delay up to 4 December).

Following the sudden death of Peter Gray there will be a change at Section Head Level on 1 January 1996. Claus Hilberg will become Head of Computer Operations Section, while Neil Storer becomes the acting Head of Systems Section. The only other staff change to report is that Dominique Lucas takes a staff position in User Support (previously he was a consultant attached to the same section).

Cray services

The availability of the Cray C90 continues to be plagued by periodic bouts of unreliability, each followed by a couple of months of trouble free behaviour. Thus over the year the availability has averaged 98%, but with swings between 96.5 and 99%. On the other hand, the user CPU utilisation is now over 93%, with system overheads down below 5%. This is a superb achievement, showing how well the system is balanced for the load it has to run. Finally, it is good to be able to report that turnaround times are still very acceptable.

The Cray T3D is running very stably with a good reliability record (availability well over 99%). On average it is 75% loaded, with a constant backlog of work.

Data handling

The IBM 9000, running the current production service, is little changed over the year. It is very reliable, with a slowly increasing load. However, there is still spare capacity there for when the Fujitsu users start to access it.

The data volume has reached 38 Tbytes, held in 7.4 million files, the rate of increase being linear over the past 12 months. The daily average for the volume of data moved is now around 300 Gbytes, with a peak of 500 Gbytes in one day. It is envisaged this will rise to more than 1 Tbyte when the Fujitsu service is underway.

Workstations and servers

All remaining SUN systems in user offices have been replaced with SGI Indigo or Indy systems. Thus we now have only one supplier of user workstations. As for the servers

- *Munin has been upgraded to 4 CPUs, as the original 2 CPU system was reaching saturation;*
- *RAID disks will shortly be added (to be shared between Hugin and Munin) to improve the resilience of ClearCase access;*
- *a Hewlett Packard based high availability server complex is being installed at this time. It will shortly take over the applications running on the three SUN servers, which will then be phased out;*
- *the user home file system will be moved from Odin to the HP server complex, and Odin will then be shut down;*
- *overall reliability of the servers continues to be very good.*

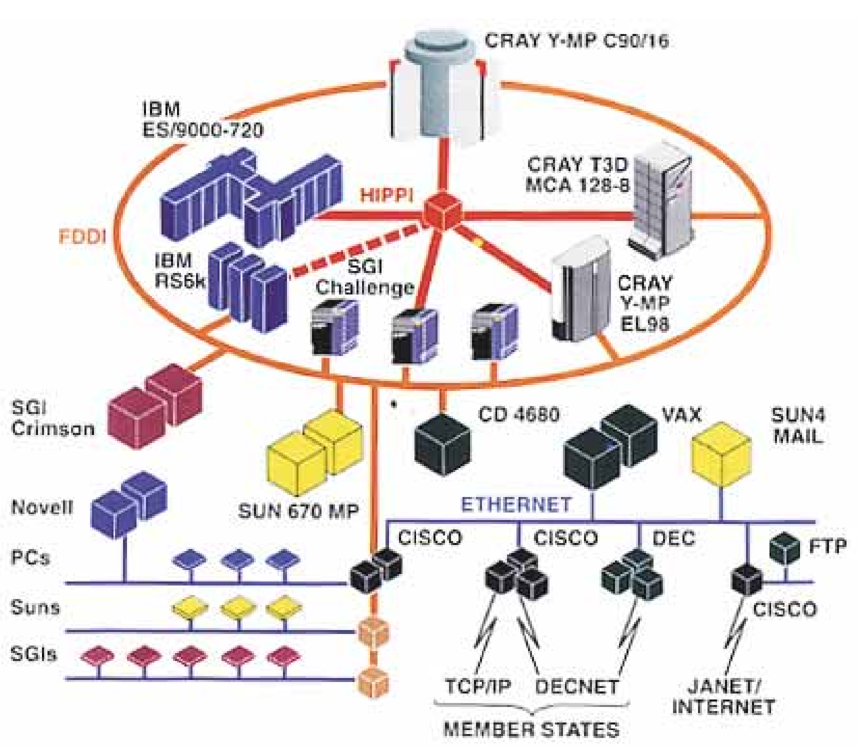

Fig. 1: ECMWF computer configuration - 1995

Networks

Despite its complexity, the internal local area network (LAN) has run well, with few large scale problems. A second NetStar Giga Router will be purchased shortly to improve the resilience of the HIPPI network, thus removing a potential single point of failure.

All Member State links are now 64 Kbps or higher, the following changes having been made this year

- Turkey upgraded to 64 Kbps;
- France upgraded to 128 Kbps;
- UK Met Office, and the JANET (Internet) links both upgraded to 2 Mbps;
- the TCP/IP protocol is available to all Member States, although some still use DECnet for all or part of their work;
- links to two Co-operating Member States have been established (64 Kbps to Iceland, 9.6 Kbps to Hungary).

Data dissemination continues to dominate the network usage, running at over 800 Mbytes per day now. Also electronic traffic routeing (traffic from one Member State to another through ECMWF) has increased with six Member States now participating.

MPP projects

The RAPS benchmark project continues to run well. This particular project turned out to be very valuable when the Centre went out to tender for the C90 replacement. This was because all potential vendors had been working for some time with the IFS based benchmark, and could thus bid aggressively in response to the Invitation To Tender.

The PPPE project (evaluating MPP based tools) will cease by mid 1996 when funding by the EU terminates.

Early in 1996 a new project will start, which will evaluate a set of HPF (High Performance Fortran) extensions. This will be done in conjunction with the University of Vienna, one of the prime developers of the HPF concept.

Plans for 1996

As stated at the beginning, the two big tasks for 1996 will be the replacement of the Cray service by Fujitsu, and the introduction of phase 1 of the new data handling system. Other activities in 1996 will include:

- *begin phase 2 of the new data handling system;*
- *select a new workstation/server supplier;*
- *upgrade the telephone PABX and install voice messaging;*
- *participate in trials of a high-speed pan European research network.*

In this last item, four Member States (Austria, France, Germany, UK) and ECMWF will conduct experiments over 34 Mbps links that are being installed under an EU initiative, TEN-34, which is organised by DANTE. This could provide Member State users with much higher speed interactive access to the Centre's equipment, something that would help them to more fully use their share of the Centre's increased computer resources.

Fujitsu

Finally, some details of the Fujitsu service that will be brought in production in 1996. The basic timetable is:

March	*Installation of the preliminary system: a Fujitsu VPP 300 with 16 processors (peak rate 1.6 Gflops/s per processor), 2 Gbytes memory per processor, and 200 Gbytes disk space*
April	*Acceptance trials of the VPP 300*
May	*User access available. Migration training given*
June	*Installation of the secondary system: a Fujitsu VPP 300-C with 46 processors (peak rate 2.2 Gflops/s per processor), 2 Gbytes memory per processor, and 1120 Gbytes disk space*
July	*Acceptance trials of the VPP 300-C*
September	*Transfer of the production service from the Cray C90 and Cray T3D to the Fujitsu VPP 300-C*
October	*Preliminary system reduced to 4 processors. Cray systems decommissioned and removed.*

It should be emphasised that the Fujitsu systems are distributed memory systems, albeit each processor has 2 Gbytes of main memory the same as the entire Cray C90 now has shared between 16 processors. Thus programs which run on more than one processor must use message passing to transfer data between processors.

Users should note that the VPP operating system, known as UXP/V is based on UNIX V release 4, hence migration of codes should not be as difficult as the move from Cray COS to Unicos.

Conclusions

The year 1996 will be a very busy one for all of Computer Division, and many users, as work is migrated to the new systems. At the end of it all, the capacity available should be at least five times that available today.

Andrew Lea

ECMWF's ECnet - an update

ECnet, ECMWF's Wide Area Network, has seen some dramatic changes during recent years. Following the trend started by some Member States in the early 1990's to use the industry standard TCP/IP network protocol suite, the need for faster data communication lines became evident. The TCP/IP network protocols gave Member States a lot more features compared to the old protocols (NTC, DECnet). The NTC protocols had been developed by ECMWF in the late 1970's - early 1980's. Later, in the late 1980's, some Member States with DEC computers began to use DECnet protocols. However, Member States users were not able to fully utilise ECMWF's computing resources because of the poor user interface the NTC and DECnet protocols provided.

With the arrival of the UNICOS operating system (CRAY's version of UNIX), TCP/IP started its life at ECMWF. Being the standard networking protocol for UNIX systems and following its successful use in the global Internet, it has become the industry standard networking protocol. UNIX also introduced a new and different way of computing/working for most users, as interactive sessions on host computers have become the norm, TCP/IP providing the network infrastructure to allow this.

Thus a pilot project was started with Météo-France in 1991 to get experience of using TCP/IP over a wide area link. It was soon realised that the standard line speeds to Member States at that time (9.6 kbps) would not be adequate and so a 64 kbps line was used. The experience with the new TCP/IP based communications link was very positive. French users were able to communicate much easier with the ECMWF computers. They had direct access to the CRAY system via interactive telnet sessions, they were able to transfer files directly, and they were able to keep contact with ECMWF users via e-mail. Remote job submission and dissemination of ECMWF products were easily adapted to use the TCP/IP protocol stack (i.e. ftp). Another very important issue was the reliability of the connection. Not only did 64 kbps digital circuits improve the reliability compared to analog ones, but the use of TCP/IP had a very positive impact on the high availability of the link. The old NTC software did have its moments of instability!

After the successful pilot period other Member States soon followed. It thus became clear that the new way of connecting to ECMWF was popular.

In parallel to the changes in networking technology, development of ECMWF's numerical model had progressed. This resulted in more products being available for Member States. Thus the 9.6 kbps lines, which had been the standard communication speed, were no longer sufficient to cope with the increased requirements of product dissemination and Member State interactive users. Therefore it was proposed to ECMWF's Council at its 39th session (December 1993) to upgrade the standard Member State line speed to 64 kbps as of 1 April 1995. Council approved this proposal and thus work began to upgrade all remaining connections to 64 kbps, using TCP/IP or DECnet (if a Member State was already using this) as the network protocol. By the end of 1994 the last NTC Member State finally moved over to TCP/IP, which meant that the NTC software could be terminated. In the summer of 1995 the last 64 kbps connection was installed. This completed the project to upgrade the standard communication speed for ECMWF Member States to 64 kbps.

Subsequently, France has upgraded its 64 kbps line to 128 kbps, and the UK has upgraded to 2 Mbps. Also in 1994, ECnet grew not just in communication speed but also in numbers. Two associate Member States established a data communications link with ECMWF. Iceland connected at 64 kbps and Hungary at 9.6 kbps, both using TCP/IP protocols. Table 1 summarises the current status of all ECnet connections.

Table 1: ECnet connections

Country	Speed	Protocol(s) used
Austria	64 kbps	TCP/IP
Belgium	64 kbps	TCP/IP
Denmark	64 kbps	TCP/IP + DECnet
Finland	64 kbps	TCP/IP + DECnet
France	128 kbps	TCP/IP
Germany	64 kbps	TCP/IP + DECnet
Greece	64 kbps	TCP/IP
Hungary	9.6 kbps	TCP/IP
Iceland	64 kbps	DECnet
Italy	64 kbps	TCP/IP + DECnet
Ireland	64 kbps	TCP/IP
Netherlands	64 kbps	TCP/IP
Norway	64 kbps	TCP/IP + DECnet
Portugal	64 kbps	DECnet
Spain	64 kbps	TCP/IP
Sweden	64 kbps	TCP/IP + DECnet
Switzerland	64 kbps	TCP/IP
Turkey	64 kbps	DECnet
United Kingdom	2 Mbps	TCP/IP + DECnet

Tony Bakker

The Calldesk

Historical background

From the start of the production service, Computer Operations Section (COS) has had a requirement for an incident and problem reporting system. This is in addition to the need to produce statistics on various aspects of the services: mainframe availability, CPU performance,..

Originally these logs, reports and charts were paper based and quite straight forward. But as the Centre's computing and networks configuration became increasingly intricate, the complexity of incidents and problems increased too, as did the difficulty to describe and categorize these incidents. The problem of getting the information to all concerned also had to be addressed as did the need to follow up such problems and their aftermath, to trace the solutions, and to design clear operators procedures with the aim of preventing a reoccurrence or producing a fast(er) problem resolution.

So COS set up a Calldesk together with an on-line incident database (Empress 4GL-based: Repgen) to address these increased needs in daily operations.

The Calldesk

The Calldesk was set up in March 1994, with the initial aim of providing staff and visitors to ECMWF with a principal contact point to report problems, big or small, affecting the various computer services. Recently the service has been extended to Member State users.

Though originally designed for COS specific problems, the Calldesk also acts as a "relay" for analyst or User Support calls when they are busy or unavailable: for instance minor problems reported while analysts are fixing a major problem, or User Support are in a meeting, etc..

The Calldesk aims to ensure that the incidents are logged and followed up, liaising with the relevant analysts until the problem is understood and/or solved, and provide the operators with the findings and/or suggested remedial course of action.

The Calldesk service is provided primarily by Maria Manuel Costa Nunes and Hélène Garçon both experienced in computer operations. Outside office hours and/or when all telephone lines busy backup is provided by the Console Operators.

The Calldesk is reached by calling x2303 within ECMWF or +44 1734 499303 from outside.

Helping users with incidents

It is not always easy for a user (whether on site or remote) to diagnose whether a problem is local to them or more general: they just experience a disruption to their working environment.

Here the Calldesk can inform the user of known system unavailability or disruption - this can save the user time investigating what is going wrong. In cases of doubt, a few basic questions can help as a "pre-diagnostic": the incident then can be linked to a package, a workstation, the office block network, the general network, a server, a Member State link,.... Each of these may require intervention by a different support analyst.

The Calldesk can also inform analysts of incident trends which, if not serious in isolation, may point to a more severe problem when a number of users report them. Thus when users report to the Call Desk such trends are easier to spot than when users report to different individual analysts, who may be unaware that someone else is already investigating the problem at the same time.

Having logged the calls, the Call Desk liaises with a given analyst or group of analysts who usually contact the users for a more detailed description of symptoms and progress of the solution.

Relatively small problems which users may be reluctant to report to analysts, but nevertheless affect their working environment in some ways, do get attention: intermittently flickering screen, noisy drive, printing setup problems, etc.

Providing this "Call point" is also useful to follow up the progress with other support:

- *reporting faulty equipment to vendors, checking the reception of replacement parts, providing contact between engineers and analysts,..*
- *liaison between Administration and COS regarding office moves planning, building work requiring Computer specialists intervention (eg electrical work..), etc..*

Incident database REPGEN (REPort GENerator)

An SQL database has been setup to provide a more up-to-date approach to incidents and problems logging, as well as data gathering and production of COS statistics.

The "Empress" system is used to administer and access this database, providing:

- *an interactive interface to specialized users and analysts (EMPSQL)*
- *a tailored menu design facility (EMP4GL) for the operators and Calldesk to interface with the database*
- *script writing facilities (MX/MR programming interface) allowing flexibility in the provision of statistics extraction, as well as batch or deferred/set-timed housekeeping operations.*

The incident part of the database and its menu driven application is known within COS as Repgen.

Repgen is used by both operators and the Calldesk to enter any reported or observed incident, as well as operational occurrences such as scheduled system sessions, etc.. As such between 5000 and 6000 entries are made each year.

It is used to mail automatically to analysts copies of incidents reports or Problem Reports that require their expertise or are worth being brought to their attention.

The electronic mail reply option can be used by the analysts to explain their findings and recommendations for future reference. These replies are then embedded in the incident report, and can easily be referred to using Repgen. Access to clearly described past incidents helps overcome similar problems faster - for instance the possibility of including displays of problem situations offers a clear advantage compared with the old handwritten summaries.

A number of "pre-set" statistics that are regularly required can easily and rapidly be produced by Repgen option: e.g. the number of incidents recorded for a given category.

Other more specific statistics can quickly be provided too, either from SQL or using a quick report writer (Snow Report Writer) which interfaces with the Empress database.

User registration and passwords

In collaboration with User Support the Calldesk now offers a central point for user registration on the different systems. The Calldesk can also reset passwords on request and will soon be able to register Ecgate1 and SecureID users.

The ability to perform these administration tasks via a single office means that the procedure is carried out faster. Complex cases and requirements are referred to User Support.

Summary

A Calldesk has been set up in the Computer Operations Section to act as a central point for all service related matters. As well as providing a mechanism to progress fault repairs etc., it enables statistics to be collected on all faults or service problems. An incident database (REPGEN) holds details of all incidents and problems that have been logged.

The service has proved very successful, both for the users and for the staff of the Computer Operations Section. Faults/problems are no longer occasionally "lost". Statistics are now available on the type and frequency of incidents allowing remedial action to be taken to reduce the more frequent ones.

Hélène Garçon

Computer user training courses

The Centre is offering in 1996 computer user training courses that cover the following topics:

Migration to Fujitsu
MARS and GRAPHICS
Using an MPP system.

Each of the above courses lasts one week, and consists partly of lectures and partly of practicals. Students may attend any or all of the courses.

Prospective students should note that they will be expected to have experience of a computer system elsewhere, to be familiar with ANSI 77 Fortran, to know basic UNIX commands, and to be able to use the vi editor.

Nominations to attend will be requested in March via the Member State Meteorological Services.

Migration to Fujitsu

COM 1: 13-17 May 1996 (possible repeat 3-7 June 1996)

This module is to help users migrating from Cray to Fujitsu systems. The contents will cover:

- System and hardware overview
- Batch job submission differences (e.g. new queues)
- FORTRAN differences
  compiler options;
  Cray specific features (e.g. pointers, buffer in/out etc.);
  any conversion tools available;
  debugging tools available; libraries available;
  vectorising differences
- Data conversion
  unblocking; IEEE format;
  conversion utilities available
- More advanced features
  I/O techniques;
  Fujitsu vectorising and optimisation options;
  memory handling (e.g. avoiding bank conflicts);
  PARMACS to MPI conversion
- Other new features
  SecurID controlled access;
  eqsub, eccopy;
  new data handling system user interface;
  new MARS (e.g. binary read routines);
  moving MAGICS jobs to a workstation server

MARS and Graphics

COM 2: (10-14 June 1996)

This module is aimed at new users. The following topics will be covered:

- NQS and Fortran job submission (overview)
- MARS (Meteorological Archival and Retrieval System)
  overview;
  description of data available;
  practical examples
- Graphics
  overview
  MAGICS
  METVIEW.

Using an MPP System

COM 3: (17-21 June 1996)

The aim is to introduce the Fujitsu as an MPP system, and show how to use it via extensions to Fortran.

- The course contents cover:
  Overview of parallel programming
  Architecture
  Message passing
  Running a program on the Fujitsu VPP 300
  Tools for optimisation and debugging.

Andrew Lea

ECMWF Annual Seminar - Data Assimilation 2-6 September 1996

For 1996, it is planned to hold a one week seminar on Data Assimilation. The seminar will be held at ECMWF from 2 to 6 September.

Data Assimilation is a major focus of the Centre's research and operational activity. Substantial theoretical and experimental progress in recent years has led to major developments in Variational Assimilation, and the formulation of plans for future developments in Simplified Kalman Filtering. Besides their significance for the data assimilation process *per se*, these developments have impact on other aspects of numerical weather prediction such as: extraction of information from the time history of in-situ and satellite observations; exploitation of tracer information; computational requirements, in terms of processing power and architecture; formulation of physical parametrizations; predictability studies and ensemble prediction. The seminar will give a pedagogical overview of current developments in the area.

Posters providing further information on the programme and application forms will be distributed around May 1996.

Els Kooij-Connally

Member State computer resource allocation 1996

Table 1: Allocation of Cray resources and data storage (including a 10% reserved allocation for Special Projects)

Member State	Cray C90 (kunits)	Cray T3D (kunits)	Data (Gbytes)	Member State	Cray C90 (kunits)	Cray T3D (kunits)	Data (Gbytes)
Belgium	258	25	53	Norway	203	19	41
Denmark	216	21	44	Austria	237	23	49
Germany	1144	110	235	Portugal	175	17	36
Spain	450	43	92	Switzerland	286	28	59
France	892	86	183	Finland	217	21	44
Greece	179	17	37	Sweden	282	27	58
Ireland	161	15	33	Turkey	204	20	42
Italy	832	80	171	United Kingdom	771	74	158
Yugoslavia*	195	19	40	Special projects	780	10	160
Netherlands	318	30	65	**Total**	**7800**	**685**	**1600**

* In accordance with UN Security Council Resolution 757 (1992) of 30 May 1992, the Council instructed the Director to suspend the telecommunications connection to Belgrade with immediate effect. This took place on 5 June 1992. As a consequence no operational products are disseminated to Belgrade and access to the Centre's computer system is not available to Belgrade.

Special Project allocations 1996

Member State		Institution	Project title	1996 resources Cray C90 Kunits	Cray T3D Kunits	CFS Gbytes
Continuation Projects						
Austria	1	Institut für Meteorologie und Geophysik, Vienna (Hantel)	Diabatic heating of the global atmosphere	0.5		1
France	2	CNET/CETP (Eymard)	Determination of ocean surface heat fluxes using satellite data and the ECMWF model	0.8		1.3
	3	Météo France, Toulouse (Tarrieu)	AVISO. Study of surface winds and surface fluxes at the interface ocean/atmosphere	5		1
	4	LMD, Palaiseau (Duvel)	Validation of spatial and temporal variabilities of the ECMWF model	3		1.5
	5	L.A.M.P., Aubière (Cautenet)	Chemistry, cloud & radiation interactions in a meteorological model	2		1.5
Germany	6	Institute for Geophysics and Meteorology (Speth)	Interpretation and calculation of energy budgets	2		4
	7	MPI, Hamburg (Roeckner)	Modelling the earth's radiation budget and evaluation against ERBE data	55		8
	8	MPI, Hamburg (Bengtsson)	Numerical experimentation with a coupled ocean/atmosphere model	85		15
	9	MPI, Hamburg (Bengtsson)	Simulation and validation of the hydrological cycle	80		10
	10	MPI, Hamburg (Hasselmann)	Extraction of two-dimensional wave spectra from ERS-1 SAR wave mode image spectra	3	2	1.5
	11	University of Munich (Wirth/Egger)	The behaviour of cutoff cyclones in ECMWF analysis: impact of diabatic processes on their development and decay	1.5		1
	12	FU, Berlin (Fischer/Thoss)	Comparison of the ECMWF cloud scheme with multi-spectral satellite data in the Baltic Sea	1.5		3.5
	13	Joh. Gutenberg Univ, Mainz (Zimmermann)	Computation of correlation dimensions from observed data	3		0.5

Special Project allocations 1996

Member State		Institution	Project title	1996 resources Cray C90 *Kunits*	Cray T3D *Kunits*	CFS *Gbytes*
Italy	**14**	Istituto per lo Studio della Dinamica delle Grandi Masse, Venezia (Cavaleri)	Testing and applications of a third generation wave model in the Mediterranean Sea	3	1	1.4
	15	Univ Bologna (Rizzi)	TOVS lB radiances and model simulations	20		10
Netherlands	**16**	KNMI, De Bilt (Siegmund)	Stratosphere-troposphere exchange	2		3.5
	17	KNMI (van Velthoven)	Chemistry and transport studies with a 3D off-line tracer model	25.2		7.5
	18	KNMI (Komen)	North Sea wave climate	15		3
	19	KNMI (Kelder/ L.P. Riishøjgaard)	Validation and assimilation of satellite ozone observations	10		1.5
Norway	**20**	Geophysical Institute, Univ. of Bergen (Grønås/Kvamstø)	Cloud parametrization in general circulation models	2		0.2
Sweden	**21**	SMHI, Norrköping (Källén)	The HIRLAM 3 project	75		1.5
	22	Uppsala University (Andrén)	Evaluation and development of PBL parametrization schemes suitable for GCM's and long range forecasts	30		5
	23	SMHI (Funkquist)	HIROMB (High resolution operational model for the Baltic Sea)	10		3.5
UK	**24**	Univ Reading (Hoskins)	Routine back trajectories	10		1.5
New projects						
Denmark	**25**	DMI (Christensen)	Regionalization of climate simulations	40		12
	26	DMI (Kaas)	Nordic Climate Modelling Project (NOCLIMP)	20		12
	27	Univ Copenhagen (Wiin-Nielsen)	Calculation of cascade processes from analysed data	20	-	0.5
Germany	**28**	GKSS (Rockel)	Energy and water cycle components in regional forecasts, remote sensing and field experiments	1		0.1
Netherlands	**29**	KNMI (Drijfhout)	Agulhas	10		1
	30	Univ Utrecht (v Gijzen)	MPR Ocean Project	10		3.5
	31	KNMI (Komen)	Validation of re-analysed A/S fluxes	20		3.5
	32	KNMI (v Meijgaard)	Simulation of the Antarctic climate	20		1.5
	33	KNMI (Siebesma)	Large Eddy Simulation (LES) of boundary layer clouds	4		3.5
	34	KNMI (Opsteegh)	Short term, regional probabilistic forecasting using IFS	40		1
Norway	**35**	Univ Oslo (Isaksen)	Ozone as a climate gas	6.5		4
	36	Univ Oslo (Iversen)	Climatic impacts of anthropogenic aerosols	2		1.5
	37	DNMI (Røed)	The role of mesoscale features in the heat transport in the Nordic seas	20		3.5
UK	**38**	Univ Oxford (Sutton)	Tropical seasonal cycle in the coupled atmosphere-ocean system	44		8
			Total	**702**	**3**	**144**
			Reserve *(to be allocated by ECMWF)*	78	7	16
			Overall total	**780**	**10**	**160**