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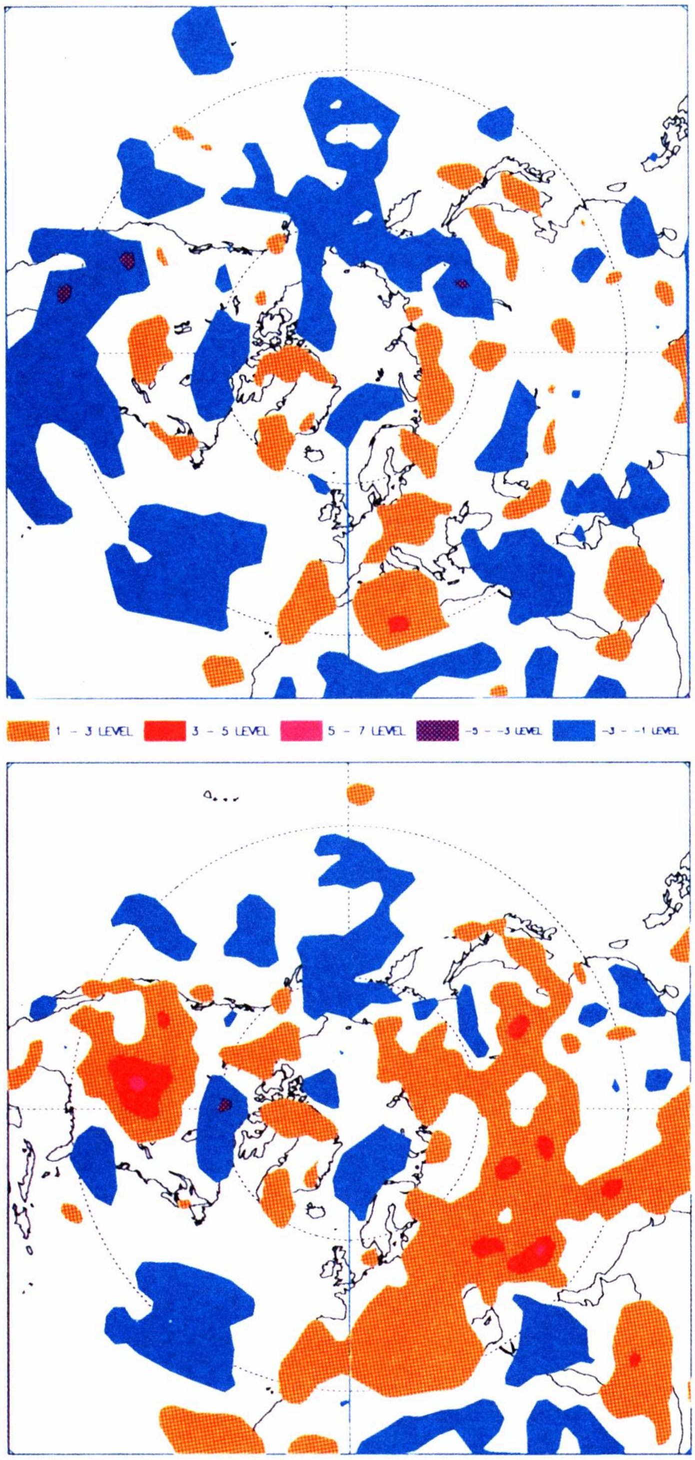

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European Centre for Medium-Range Weather Forecasts
Europäisches Zentrum für mittelfristige Wettervorhersage
Centre européen pour les prévisions météorologiques à moyen terme

IN THIS ISSUE

COVER: Temperature error of day 5 forecasts averaged from 4 July to 3 August 1993:
Top panel: New model, parallel run
Bottom panel: Operations

This Newsletter is edited and produced by User Support.

The next issue will appear in December 1993.

In the meteorological section, the modified formulation of surface and boundary layer processes referred to in "Recent changes to the operational system" is covered in the following article, which describes the steps taken to resolve the problems arising with the previous formulation. In the same section is the report on the expert meeting on the ensemble prediction system, held at the Centre in July 1993.

The UNIX service replacing NOS/VE is detailed in the computing section of this Newsletter, and users will also find information on the UNIX service for Member States which replaces NOS/VE as from 1 September 1993.

Our series of reprints of the articles on Fortran 90, by Jeanne Adams, continues with two articles dealing with vector subscripts and vector intrinsic functions respectively.

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CHANGES TO THE OPERATIONAL FORECASTING SYSTEM

Recent changes

On 4 August 1993, changes were made in the model's physics to improve the representation of surface and planetary boundary layer processes:

- introduction of entrainment at the top of the planetary boundary layer;
- increased entrainment in shallow clouds;
- modified roughness length and air-sea transfer coefficients;
- enhancements to the parametrisation of the soil processes (four layers with prognostic variables for soil moisture and temperature plus a skin layer temperature).

The meteorological impact of these changes, as seen from extensive experimentation and the first weeks of operational experience, are:

- an overall synoptic improvement of the predicted flow, particularly over Europe in summer;
- a significant reduction of the warm bias in continental boundary layer during daytime in summer;
- a large improvement of the humidity in the boundary layer, with a more realistic diurnal cycle.

The impact on the temperature in the daytime boundary layer will be noticeable with a typical reduction in the warm bias at 2m of 2-3 degrees. A beneficial impact should also be seen at 850 hPa, especially in mountainous regions.

However, an increase in the cold night-time bias has been noticed. Depending on the prevailing cloud cover, the 2m night temperatures may, in places, be too low by several degrees. This problem is related to the calculation of 2m temperature in very stable situations and is currently under investigation.

Planned changes

No meteorological changes are planned at present, but the new IFS code is expected to be implemented in the last quarter of 1993.

- Anders Persson

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A NEW SURFACE/BOUNDARY LAYER FORMULATION AT ECMWF

Introduction

This article describes the model changes introduced operationally on 4 August 1993 and results of forecast and data assimilation experiments with the new model version (Cycle 48). Many of these changes were introduced to cure problems that were identified by comparison with field data (see Betts et al., 1993 and Beljaars and Betts, 1992). The problems of the previous model version (Cycle 47) can be summarized as follows:

- the ground heat flux over land surfaces was too large by a factor of 2 to 3 and had a large phase error in the diurnal cycle;

- the diurnal cycle of the sensible and latent heat flux had a phase error of about 2 hours due to thermal inertia of the 7 cm surface soil layer in the model;

- the boundary layer depth was generally too small, indicating a lack of boundary layer entrainment;

- the boundary layer was too moist, even if the surface fluxes were correct. This was again due to lack of boundary layer entrainment;

- the evaporation from the surface was too large in wet conditions and too small in dry conditions;

- the soil moisture was excessively dominated by the climate layer;

- runoff tended to be a constant fraction of precipitation, resulting in relatively large runoff even when the soil was dry.

These model deficiencies inspired a set of changes in the boundary layer parametrization and in the land surface parametrization.

In addition, the parametrization of air-sea interaction has been modified. The principles of air-sea interaction have already been described by Miller et al. (1992), together with a description of the enhancement of evaporation at low wind speeds that was introduced in Summer 1990, with an empirical formula restricted to low wind speeds. The revised air-sea interaction is now part of the Monin-Obukhov formulation.

Model changes

Boundary layer above the surface layer

We have to distinguish two different regimes: (i) the stable and (ii) the unstable regime.

(i) The stable regime

Two different versions of the vertical diffusion scheme were used for the stable regime in Cycle 47 of the operational model. Below a generous estimate of the boundary layer height, the stability-dependent exchange coefficients were a function of the Richardson number (Louis, 1979, Louis et al., 1982). It was discovered that, when applied to the free atmosphere, the Richardson number formulation results in excessive mixing and is detrimental to the wind jet structures in the vicinity of the tropopause (revised in model version Cycle 29, January 1988). In Cycle 47 a Monin-Obukhov (MO) formulation (Beljaars and Holtslag, 1991) was used above the boundary layer height. An iterative procedure is used to calculate the Obukhov length given the Richardson number. The diffusion coefficients used by the model are much smaller in the free troposphere than below the boundary layer height.

The new model (Cycle 48) follows the same approach; the only difference is that the stability functions of the new MO formulation are slightly modified to get a better Richardson-dependence of the turbulent Prandtl number (ratio of turbulent diffusivities for momentum and heat) in the range of Ri from 0.2 to 1. Originally an attempt was made to use the MO scheme in the boundary layer as well (which makes the estimation of the boundary layer height obsolete), but this was abandoned because of a detrimental impact on the European objective scores from the reduced diffusivities in the stable case.

(ii) The unstable regime

The formulation of vertical diffusion in Cycle 47 (Louis, 1979, Louis et al., 1982) in the unstable regime is similar to the stable regime, with Richardson number dependent stability functions below the boundary layer height. The diffusion coefficients in the unstable regime are large leading to rapid dry adiabatic adjustment. This process is relatively insensitive to the formulation since mixed profiles of dry static energy are always produced, provided that the diffusion coefficients are sufficiently large.

It was shown with help of FIFE data that the lack of entrainment through the stable capping inversion results in mixed layers that are too shallow and too moist. An entrainment parametrization has been introduced in Cycle 48, by specifying the diffusion coefficient in the capping inversion such that the buoyancy flux in the entrainment layer becomes proportional to the surface buoyancy flux. The entrainment constant is 0.2. Since the heat flux becomes negative in the upper part of the mixed layer, the traditional local closure cannot be used any more (since the stable regime of the closure would be selected). A profile of diffusion coefficients is prescribed in the mixed layer as proposed by Troen and Mahrt (1986). Details of how this scheme performs in comparison with FIFE data are given by Beljaars and Betts (1992).

The surface layer

In Cycle 47, the transfer coefficients for heat, momentum and moisture were based on the Richardson number formulation, and a single roughness length was used for all the fluxes (Louis, 1979). Over sea there was a correction to the heat and moisture transfer, enhancing the transfer rates at low wind speeds.

In Cycle 48, the transfer coefficients which are used to parametrize the surface fluxes of momentum, heat and moisture consist of a neutral part determined by the logarithmic profile and separate roughness lengths for momentum and heat (the moisture roughness length is identical to that for heat), plus a stability correction. Over the ocean the roughness length for momentum has been modified at low wind speeds according to smooth surface scaling (see Miller et al. 1992). This concept has been applied for all wind speeds in the roughness lengths of heat and moisture. The high wind part of the heat and moisture transfer coefficients used is virtually independent of wind speed, in accordance with recent reviews of observational data (see de Cosmo, 1991, for a summary of the HEXOS experiment results).

The roughness lengths over land have been recomputed from vegetation, urbanisation and orographic distributions, where new empirical formulae have been used for the orographic contribution (see Mason, 1992). Where an orographic contribution applies to the roughness length for momentum, the neutral transfer coefficients for heat and moisture are kept constant. This results in orders of magnitude reduction of the roughness lengths for heat and moisture, when compared to the momentum values.

The stability corrections applied to the neutral transfer coefficients are now expressed as a function of the Obukhov length instead of the Richardson number. This allows for a consistent treatment of different roughness lengths for heat and momentum in combination with stability corrections.

The skin temperature

In order to have a faster response of the sensible and latent heat fluxes to the radiative forcing and to reduce the heat flux into the ground, the concept of a skin layer has been introduced. The skin layer has no heat capacity and adjusts its temperature instantaneously to the radiative forcing. The heat transfer to the underlying soil is parametrized with the help of an empirical conductivity, the value of which determines the amplitude of the diurnal cycle in the soil heat flux. The skin temperature is calculated implicitly as part of the vertical diffusion scheme in order to reduce time truncation errors. The skin layer together with the reduced roughness length for heat is responsible for a weaker coupling between surface and atmosphere and for a much reduced coupling between surface and soil. The surface temperature is allowed to increase during daytime without increasing the temperature at 2m and without increasing the soil heat flux. Likewise, during nighttime, the skin layer cools radiatively, leading to lower minimum surface temperature. Although this is realistic, two-metre temperatures are currently adversely affected, giving rise to negative biases (see section on parallel run). The problem lies in the post processing of two-metre temperatures and is under investigation.

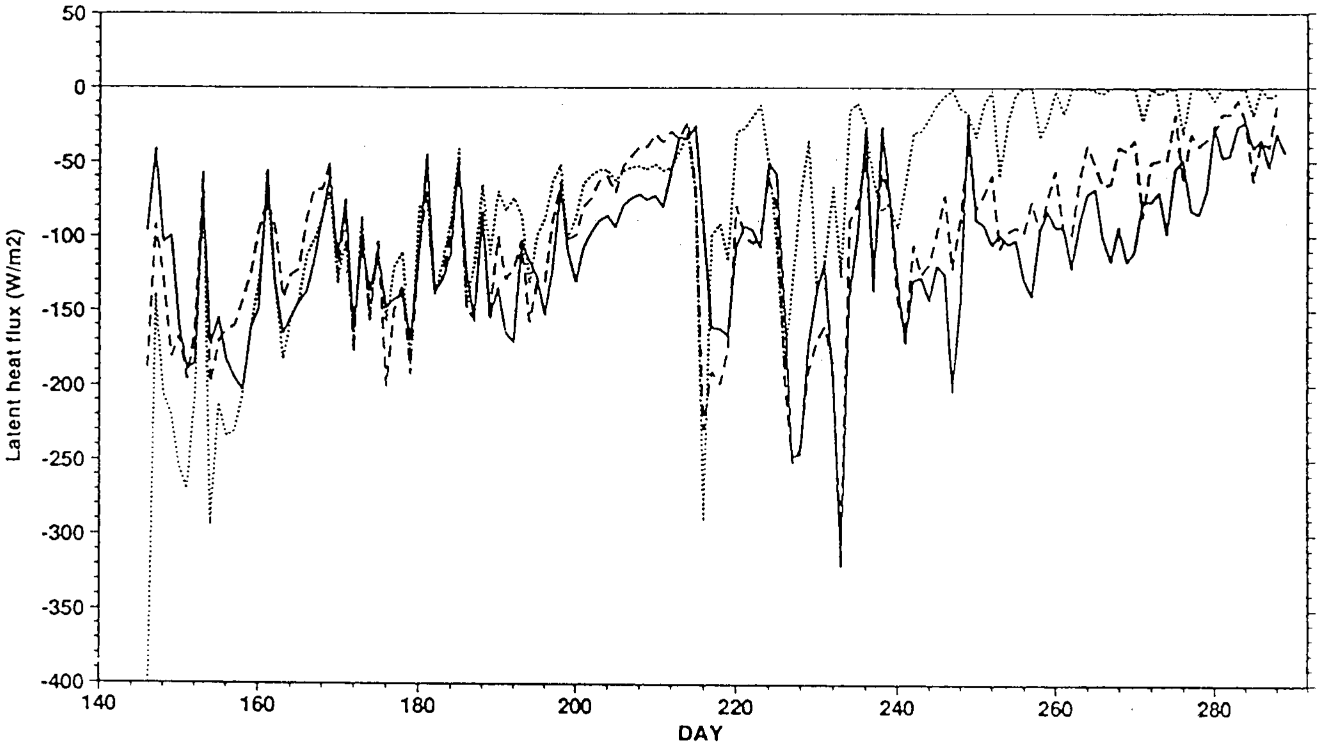

Fig. 1: Latent heat fluxes for FIFE; time in Julian days, from the end of May to mid-October.

Solid line: Observations
Dotted line: One-column simulation using the old operational scheme
Dashed line: One column simulation with the new scheme

Land hydrology

The Cycle 47 surface scheme was based on the heat and water budget of two active soil layers plus an additional surface layer underneath (Blondin, 1991, Viterbo and Illari, 1993). The fluxes of water and energy between the layers are based on constant diffusion coefficients. The climate values, kept constant during the forecasts, were used as lower boundary conditions and updated at the beginning of every month. The "Mintz and Serafini" climate (Mintz and Walker, 1993) is used for soil moisture, while for surface temperature the RAND climatology is used (Brankovic and van Maanen, 1985).

From comparisons with FIFE data it was concluded that the land hydrology in Cycle 47 was inaccurate and dominated excessively by the climate fields. This was confirmed by single column simulations where the model's atmospheric forcing is replaced by observational data (see Fig. 1, described below).

The new scheme has 4 prognostic layers, to represent the diurnal to the annual time scales. The diffusivities and conductivities of soil moisture are non-linear functions of the soil moisture. This allows precipitation to penetrate fairly quickly into the soil, and in dry conditions the upward diffusion of water becomes slower. The runoff in the new model is mainly due to gravitational drainage. Boundary conditions at the bottom are zero energy flux and free percolation. The new hydrology scheme has been extensively tested in one column mode with the help of long data sets (see Fig. 1 for FIFE). Results of these comparisons will be published elsewhere. The main conclusion is that the new scheme maintains evaporation in the drying season for a longer time and that it loses less water in runoff when the soil is dry. In general the new scheme tends less to extremes. It produces less evaporation in wet conditions and the soil dries out less quickly.

Clouds

The entrainment in shallow cumulus clouds has been increased and the relative humidity criterion for inversion clouds has been modified. The effect of increased entrainment in shallow convection is to have a more rapid mixing of the updrafts with surrounding air, resulting in less deep penetration.

Long runs

Two types of long integrations were carried out with the new version of the model at T63 resolution:

- a multi-year run (4.5 years) to examine the long term stability of the model;
- 120 day summer and winter runs.

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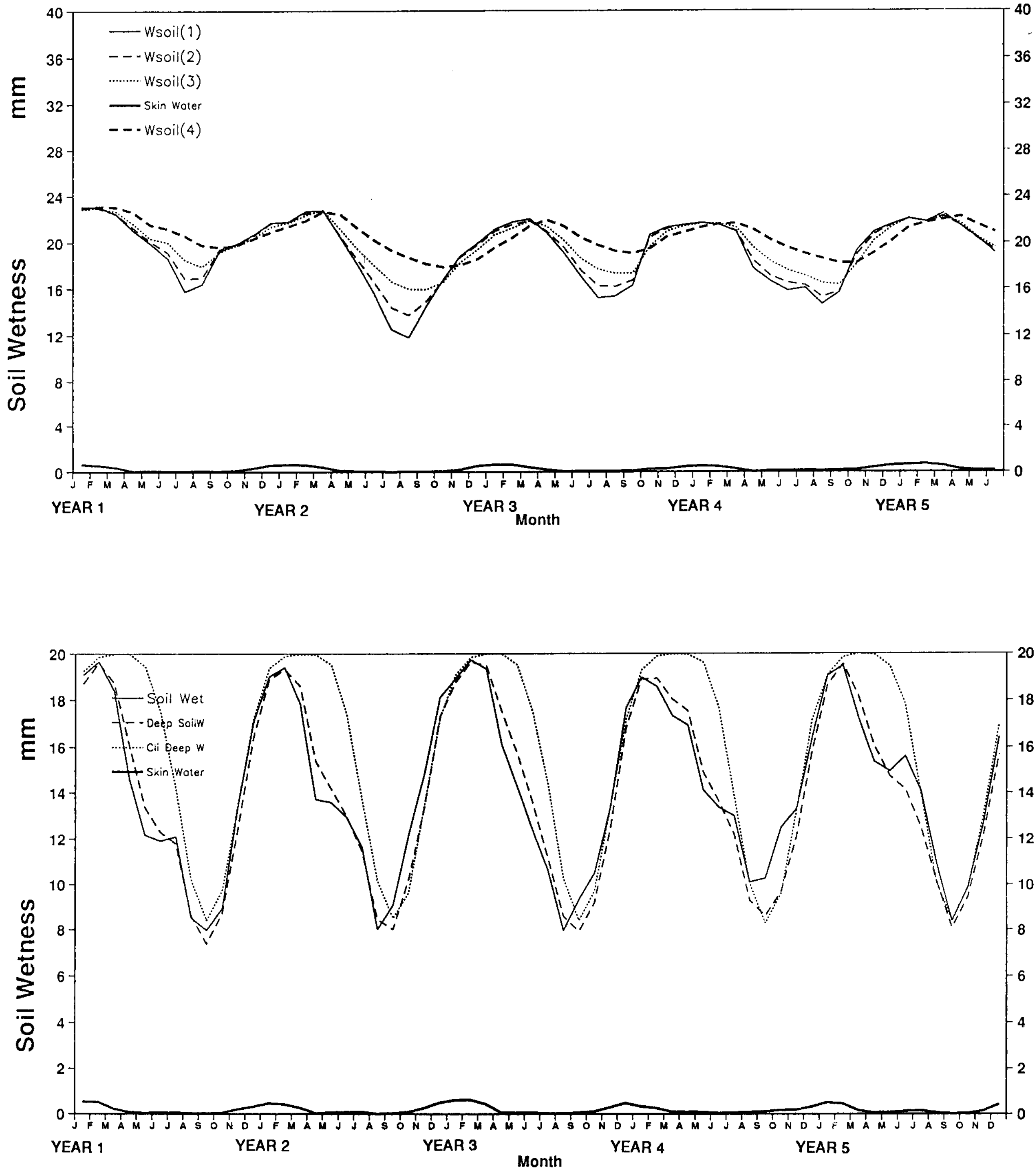


Fig. 2: Time series of monthly averages of soil wetness for Central Europe from multi-year runs with T63L31. The upper panel shows results for the NEW model, the lower panel for the control. The labels 1 to 4 in the upper panel correspond to increasingly deeper soil layers.

Multi-year integrations (T63L31)

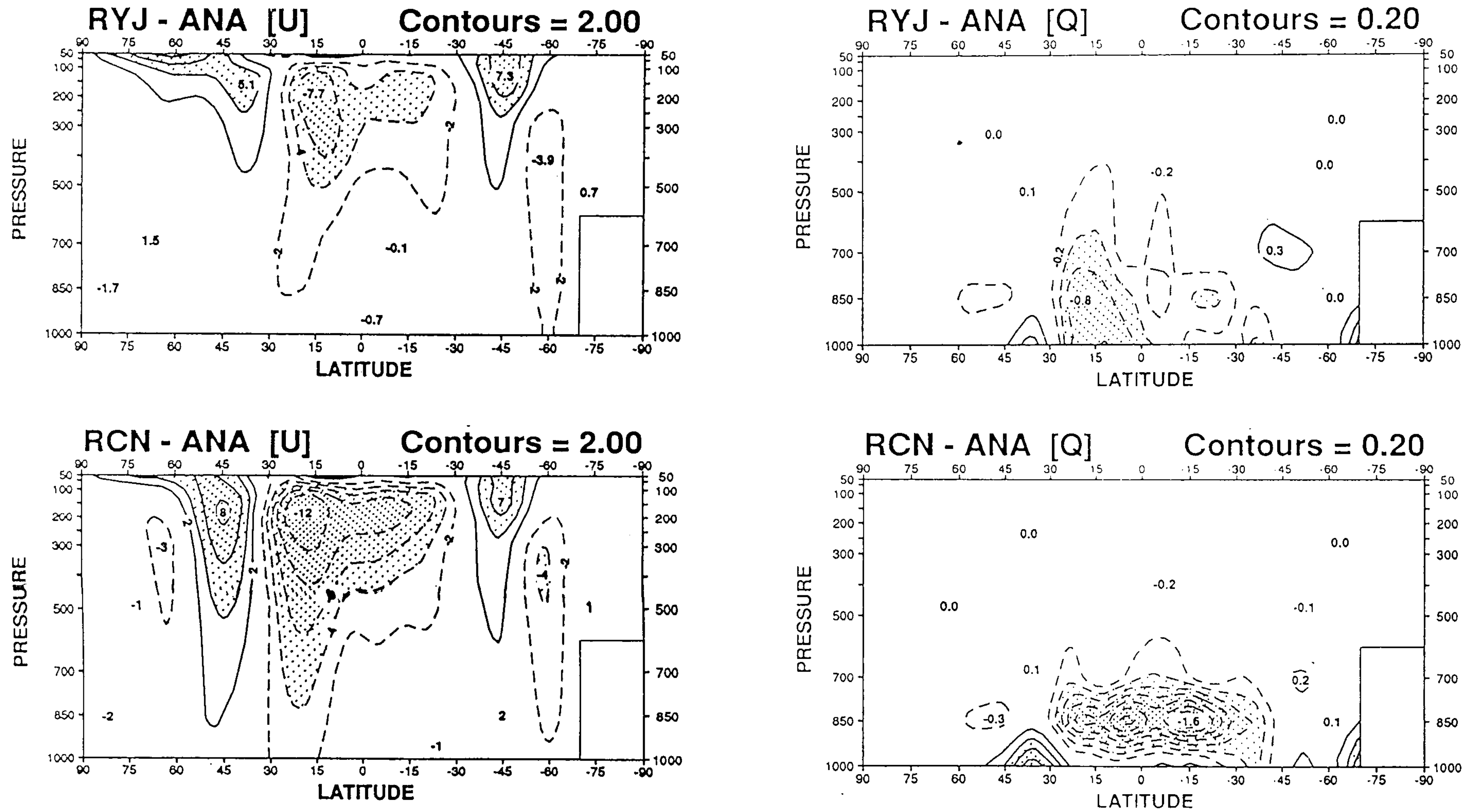
From the multi-year integration, monthly averaged surface fields were computed (for 12 UTC) and used to make time series for different areas. Fig. 2 shows the time series for soil wetness averaged over Central Europe for the control and the NEW model. The first impression is that the NEW annual cycle is physically more realistic in that we see a decreasing amplitude of the annual cycle with increasing depth, and that phase differences occur. The magnitude of soil moisture (in mm of water per 70 mm of soil) in the two model versions cannot be compared directly because it has to be interpreted in relation to the settings of field capacity and wilting point. (At field capacity the evaporation is not limited by soil moisture availability; at the wilting point, evaporation stops).

To understand the difference between control and NEW it should be realized that the soil moisture processes are quite different. In the control model, the top layer and the deep layer have roots (7+42 cm of soil); in NEW, layer 1, 2 and 3 have roots (7+21+72 cm of soil). The supply of water from the climate layer in the control run is therefore through diffusion when the difference in soil moisture between the climate layer and the deep layer is large. In NEW, the roots have direct access to water from a 1m deep soil layer; the supply from layer 4 is through diffusion, but this is relatively slow.

120 day runs (T63L19)

Summer and winter 120 day integrations were done to study the model climate. Soil moisture and soil temperature were initialized with monthly averages from the multi-year runs. The zonal mean wind and moisture errors for the NH-winter run are shown in Fig. 3. The errors are generally reduced in the tropics: the NEW model reduces the easterly errors, the Hadley circulation is enhanced (reduced V and W errors, not shown) and the cold bias is reduced (not shown). Also the moisture bias is reduced considerably in the tropics. With respect to this it is interesting to note that the negative bias at 850 hPa as well as the positive near-surface bias between 20 and 50 degrees north are reduced. This can mainly be attributed to changes in shallow convection and to the boundary layer entrainment. The shallow convection change makes the convection less deep but enhances the mixing across the inversion and therefore moistens the levels around 850 hPa (Fig. 4a). Over land, the entrainment dries the boundary layer from above, but it competes with more moistening at the surface due to the new surface hydrology. The net effect is to reduce the moistening by vertical diffusion over land (Fig. 4b).

The effects on the tropical circulation are very similar in the NH summer integration. It is worth noting that about half of the impact (enhanced Hadley circulation, reduced easterly errors and increased tropospheric temperatures) is due to the boundary layer and air-sea interaction changes; the other half comes from the shallow convection change.



a) zonal wind

b) specific humidity

Fig. 3: Zonal mean errors averaged from day 31 to day 119 for the NH winter integrations (from 1-11-91) with NEW model (upper panels) and control (lower panels): a) zonal wind and b) specific humidity.

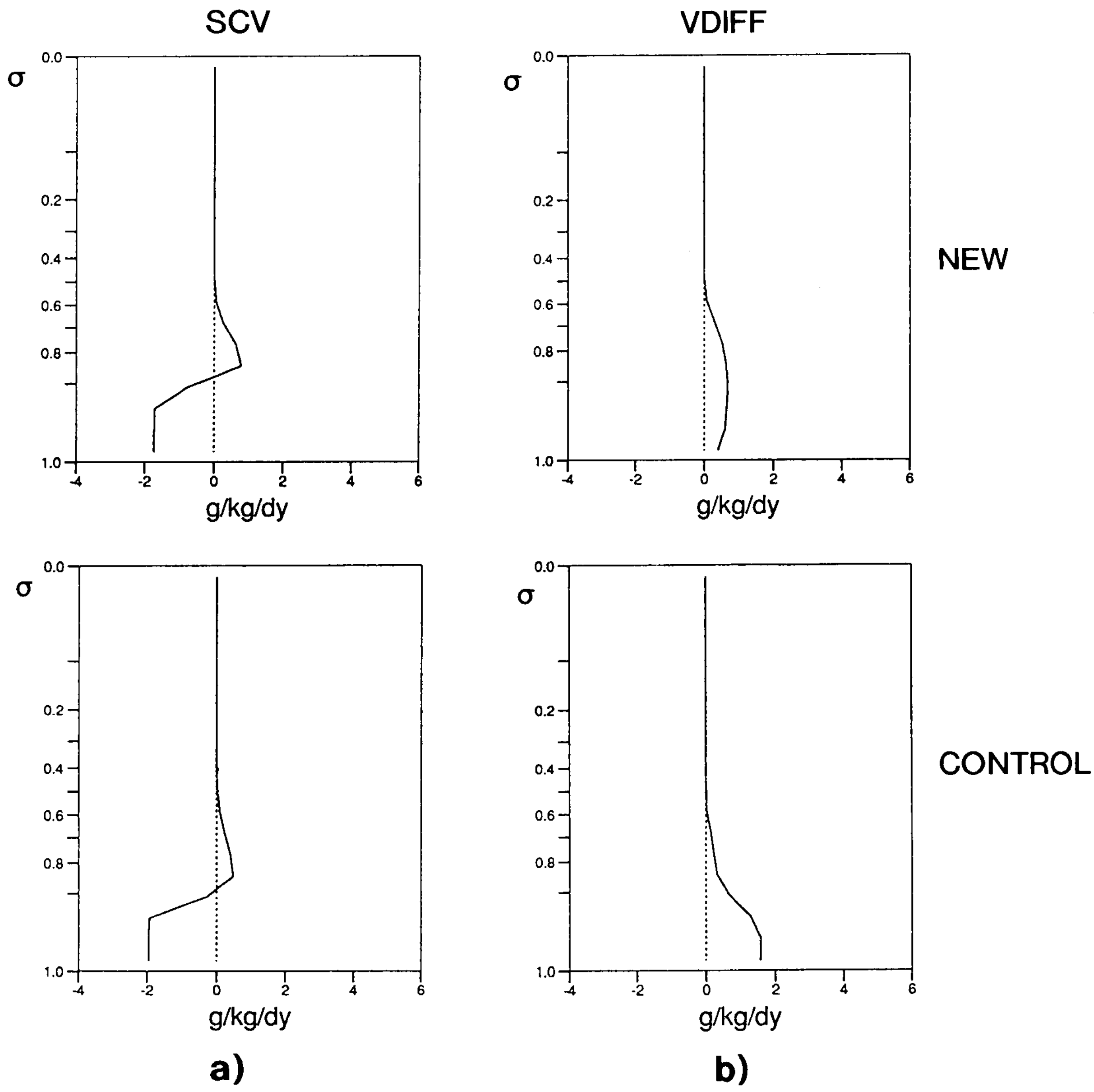


Fig. 4: **a) Moisture tendency from shallow convection averaged for all sea points.**
b) Vertical diffusion tendency averaged for all land points.
Mean results from a T63L19 NH summer from day 30 to day 119. Upper panels show results for the NEW model, lower panels for the control run. Units g/kg/day.

Forecast and assimilation experiments

A standard ensemble of 12 forecasts was run for the 15th of each month; later the ensemble was extended to 15 with 3 winter cases. Soil moisture and soil temperature were initialized from the monthly climate of the multi-year T63 runs. The mean impact on the scores is fairly small. Furthermore, the T213 tests confirm the earlier findings from the 120-day T63 runs: the Hadley circulation is enhanced and the systematic errors in boundary layer moisture content are reduced.

Ten days of data assimilation (with 10-day forecasts run from the last 5 days) were run for May 1993 with the NEW model. The fit to the data in this experiment is very similar to the operational suite, except for the relative humidity. The relative humidity in the NEW model boundary layer is much closer to the data. This is due to a better control of evaporation from the surface and to the introduction of boundary layer entrainment which tends to dry the boundary layer. The 500 and 1000 hPa European and Northern Hemispheric scores show a clear advantage of the NEW model over the Control run (not shown).

17 days of data assimilation and the corresponding forecasts covering the period of November 1992 were run at T106 with the NEW and Control model. The main signal is again from the boundary layer humidity. The impact of the changes on the mean scores is very small for this data assimilation experiment, although considerable day to day variability was found.

Parallel run

The NEW model was run in parallel (data assimilation and forecast) from 2 July 1993 until it entered into operation (4 August 1993). In this section we compare the Control and the NEW run.

The analysis fit to the data is very similar, except for the humidity, as before. The fit of boundary layer humidity to radiosonde data (not shown) is better over the Northern Hemisphere and worse over the Southern Hemisphere.

Comparison of near surface parameters with SYNOP data also shows an improved moisture structure in the boundary layer. The specific humidity is always closer to the data in the NEW model and the amplitude of the diurnal cycle is reduced (see Fig. 5 for Europe). In the NEW model the moistening from the surface is partially compensated by drying from the boundary layer top. Also the reduced coupling between the atmosphere and surface makes the specific humidity drop less with the reduction in surface temperature during the night. The beneficial effect of Cycle 48 on near surface specific humidity is most pronounced over Southern Europe (not shown).

The daytime two-metre temperature errors over Europe are reduced and they compare better with the SYNOP observations (Fig. 5). The night-time temperatures are also lower and in fact become too low. It should be realized, however, that the daytime near-surface temperatures are coupled

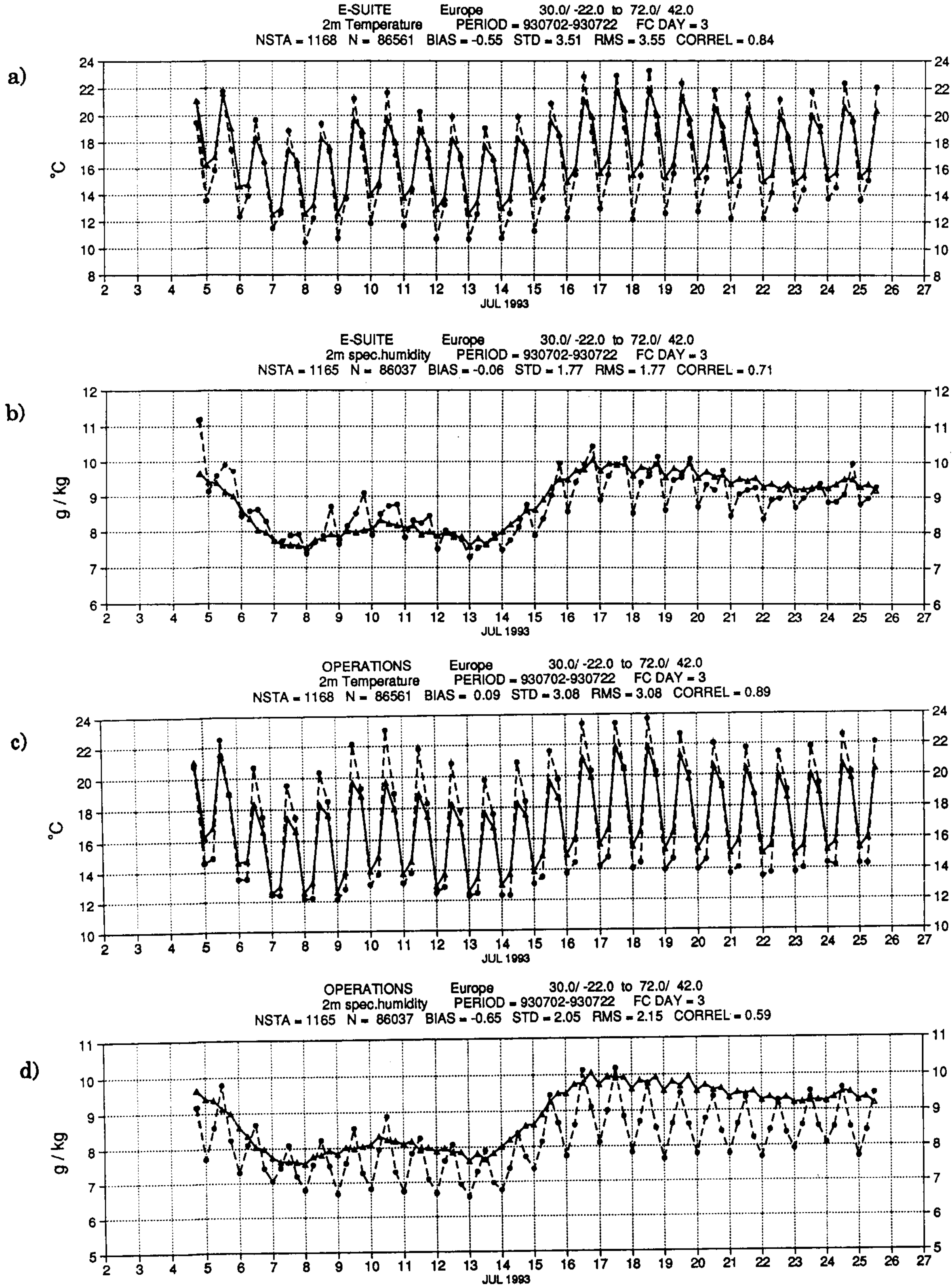


Fig. 5: Time series of temperature and specific humidity over Europe (54 to 72 hour forecasts, dashed lines) in comparison with SYNOP data (solid line):

a) Two-metre temperature, NEW model;
b) Two-metre specific humidity, NEW model;
c) Same as in a), for Control;
d) Same as in b) for Control.

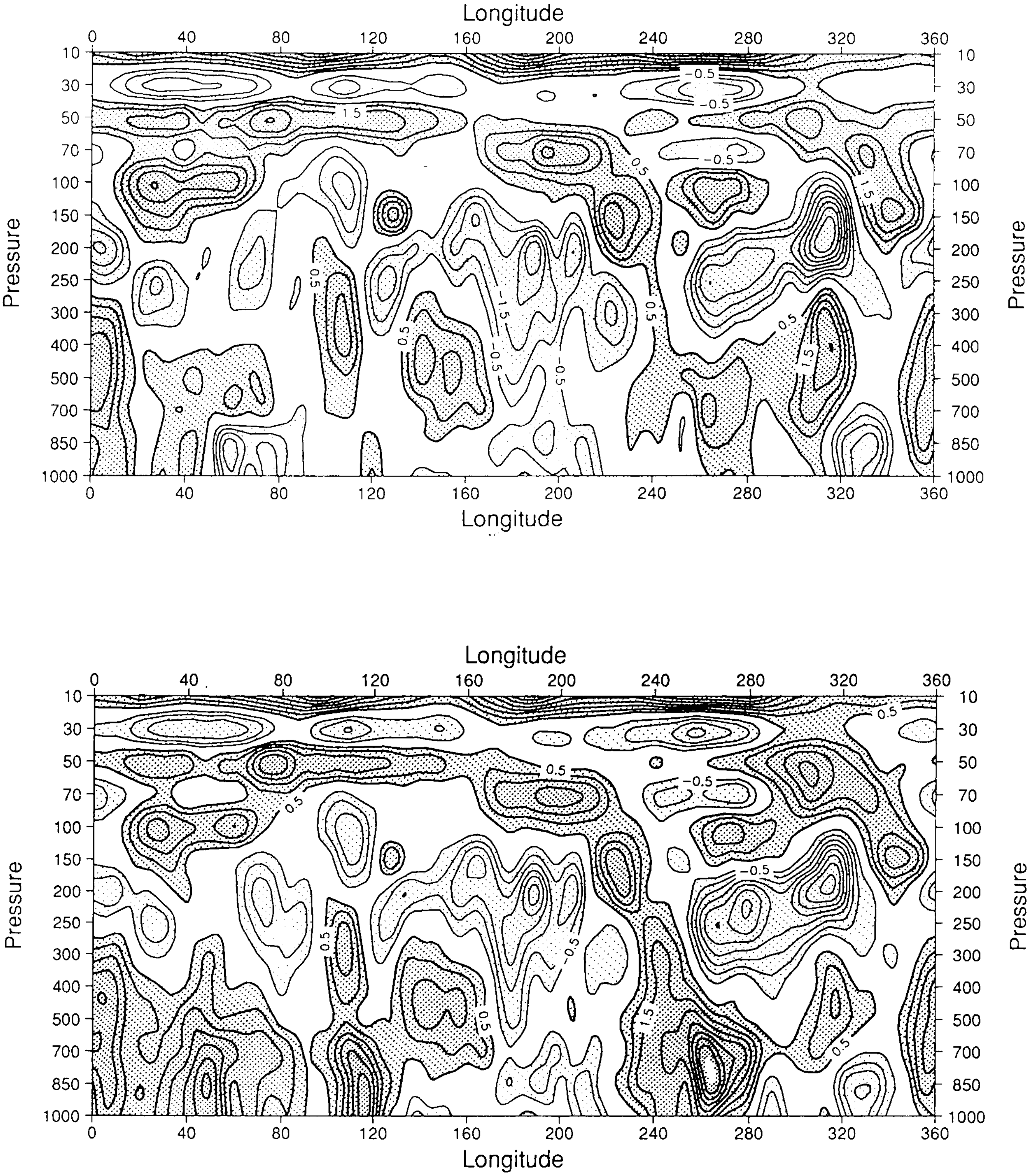


Fig. 6: **Cross section of temperature error at latitude band from 40° to 50° North for NEW (top panel) and Control (bottom panel).**

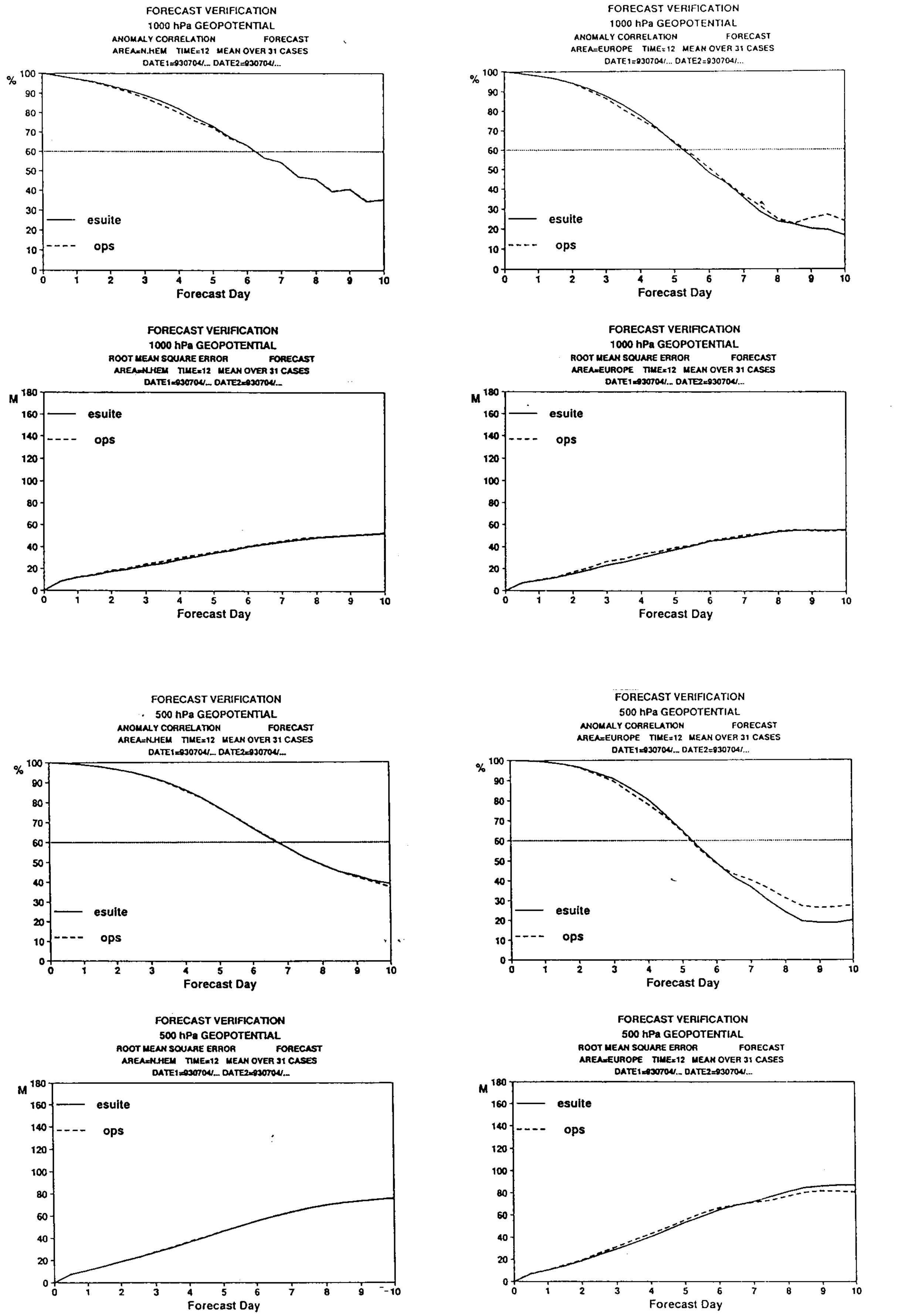


Fig 7: **Scores averaged over 31 forecasts from the parallel run with the NEW model in comparison with Control.**

to a deep atmospheric layer and that the night-time cooling is restricted to a very shallow boundary layer. The improved temperature structure of the atmosphere over continental areas is probably best illustrated by the 850 hPa temperature error map of the day 5 forecast with the control run and the NEW model, averaged over the entire parallel run, for a total of 31 forecasts (see front cover; night-time plot is not shown, but very similar). That these temperature errors exist over deep layers becomes clear from the cross section along the latitude band 40°-50°N (Fig. 6).

Averages of the scores for Europe and Northern Hemisphere are shown in Fig. 7. Both regions show an improvement in the day 3 to day 4 range which is considered to be quite robust (the scatter from individual forecasts is very small). It is believed to be related to the reduction of the continental temperature bias.

- Anton Beljaars, Pedro Viterbo

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EXPERT MEETING ON THE ENSEMBLE PREDICTION SYSTEM

6 - 7 JULY 1993

Introduction

A meeting on the experimental Ensemble Prediction System (EPS) was held at ECMWF on 6-7 July 1993. The purpose of the meeting was to review the experiment, present the evaluations carried out in the Member States and internally at ECMWF, and discuss the future development of the system, in particular the requirements for new products. Participants from 10 Member States were present.

During the first part of the meeting ECMWF reported on the status of the EPS and Member States had the opportunity to present their experience with the products. The last day of the meeting was devoted to discussions on future development of the EPS taking into account user requirements.

Current products

The EPS has been running experimentally since December 1992. Products are disseminated to the Member States three times a week on Sundays, Mondays and Tuesdays. Fig. 1 shows the familar form of the 3-plume graph disseminated by fax. On this colour version of the graph, individual members of the Ensemble Prediction are also plotted. Cluster fields of height and temperature in GRIB are made available through the ECMWF dissemination system. Individual fields from all the ensemble members are accessible through MARS.

Assessment of the performance

Objective scores have been computed for every member of the ensemble, for the unperturbed ("control") T63 forecast and for the operational T213 forecast. The distribution of the scores shows that in general the scores are highly correlated, i.e. during periods where the T213 and the control are relatively poor then the ensemble members also tend to score less. At day 7, about 45% of ensemble members are more skilful than the operational forecast (as measured by the anomaly correlation coefficient), and in most cases a high skill is obtained by at least one member of the ensemble.

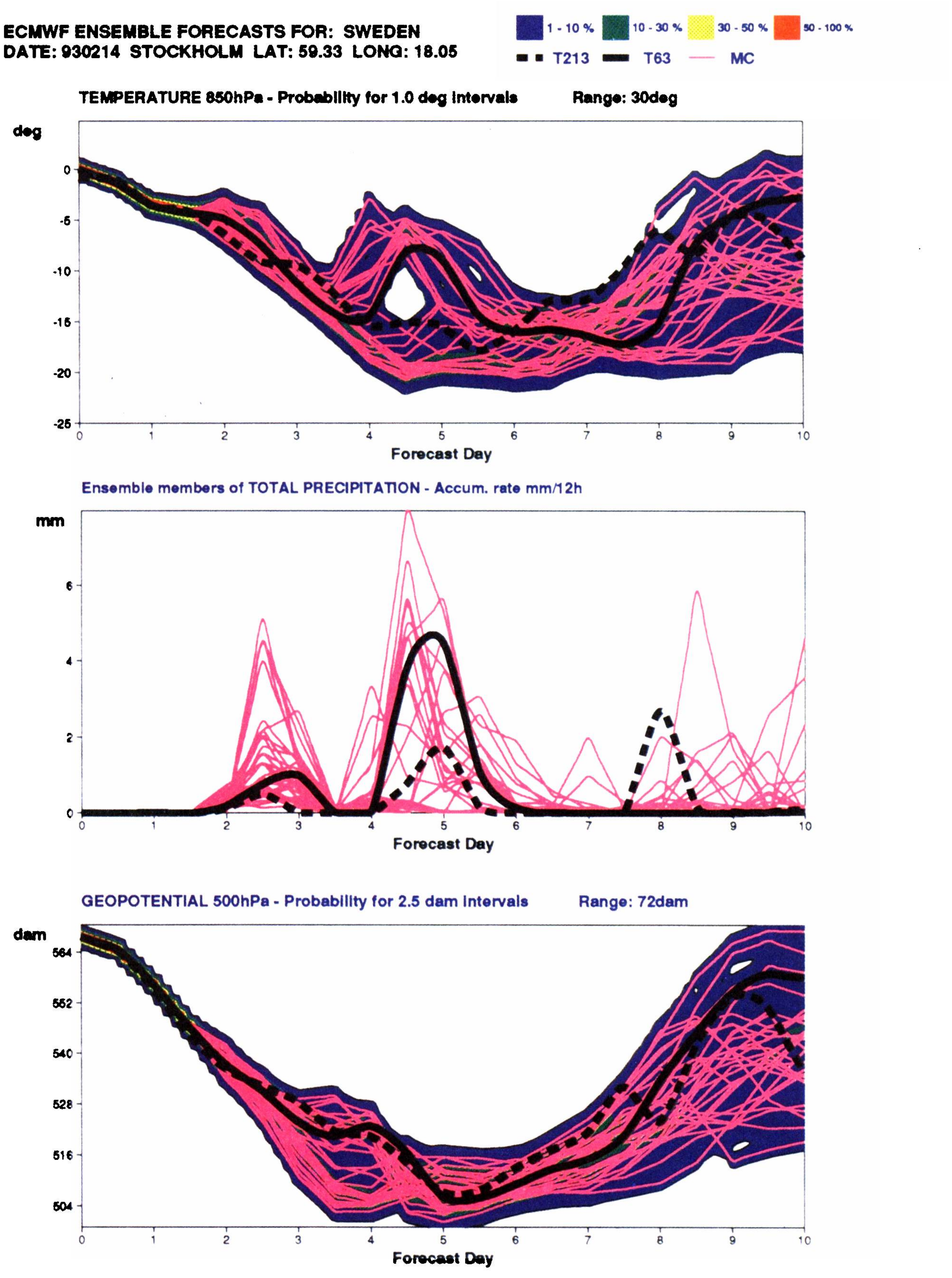

Fig. 1: The 3-plume graph disseminated to the Member States by fax. Individual members of the Ensemble Prediction are also plotted.

Statistics on the position of the initial perturbations confirm the sensitivity of the forecast to the analysis over the west Atlantic and west Pacific areas. North Africa seems also to be important, mainly in the area of the sub-tropical jet, which is known to have a relatively poor data coverage.

Correlations between spread and skill were studied using the forecast probability plumes at some European locations. For almost all cases studied, below average spread was associated with above average skill. As would be expected theoretically, above average spread was not always associated with below average skill.

The characteristics of the ensemble depend on the behaviour of the T63 model used to generate it. T63 is known to have several limitations compared to T213; in particular it has a tendency to be underactive in the medium range. This may have an adverse impact on the spread of the ensembles.

An evaluation of the experiment and an assessment of the possible use of the products by the forecasters was undertaken by ECMWF.

Considering essentially synoptic scale features, it was found that in the early medium range, day 3 and 4, the range of solutions covered by the ensembles is usually small and adds little to the T213 model, which gives the better guidance. For this period, the forecasting should remain essentially deterministic. For the 5 to 7 day period the spread of the ensemble members is often quite small. In particular when the T213 model varies greatly from one day to the next, the ensemble remains for each day broadly similar to the T213. Nine cases were studied in detail for the late medium range, day 8 to 10. In this range the spread of the ensemble is often much larger, offering a real range of solutions. The ensemble is expected to give useful probabilities of differing solutions.

Presentations by Member States

Most of the evaluations concentrated either on the clusters or on the plume diagrams. Evaluation of the individual ensemble members was only briefly discussed, although several participants indicated that the "stamp charts" are being looked at regularly. The views of the usefulness of this product were not uniform amongst the participants.

The overall response to the clusters was very positive in general terms, but actual use has been limited so far. The clusters are very often too smooth and too similar to each other. Objective assessment showed that the clustering itself is consistent; the problem seems to lie with the definition of the area and time interval used to compute the distance between the individual ensemble members prior to clustering.

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Rain more than 1mm cont.: 30

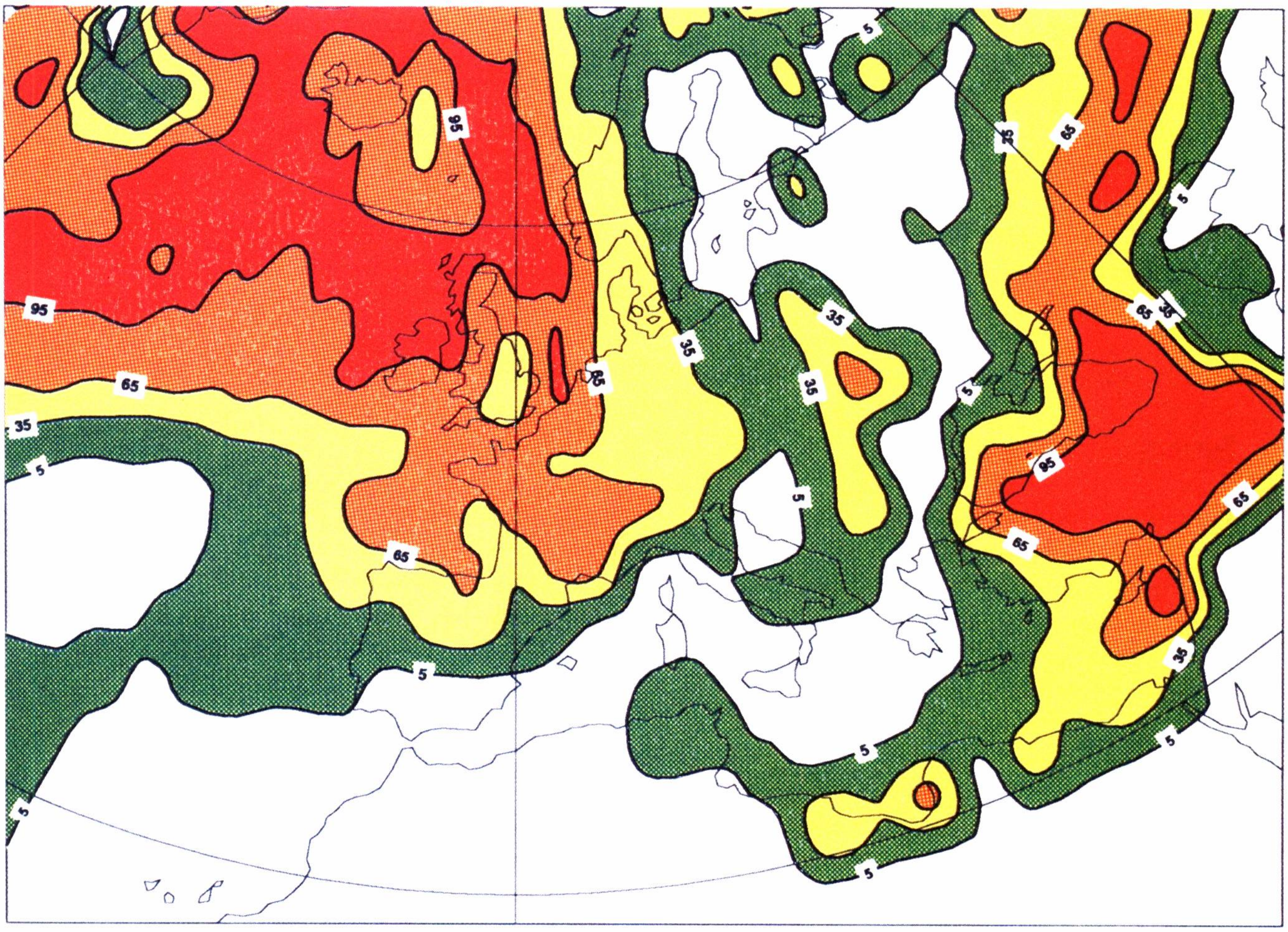

Fig. 2: Probability distribution of the event "Total Precipitation forecast exceeds 1mm/day" for day 4 to 5 starting from 24 January 1993.

Several Member States assessed individual plumes within their own countries and attempted to decide subjectively for what period the plumes gave some useful guidance. Typically the plumes were felt to be useful out to about 5 to 7 days. A more formal statistical approach was also used to evaluate the plumes, showing that the ensemble forecast was better than the T213 forecast for the late medium range (beyond day 7).

Many Member States have tried to use the spread of the plume as an indicator of the skill of the forecast. Results gave some indication that large forecast errors are more unlikely in the case of small spread.

Finally, large differences were noted between the T213 forecast and the T63 control.

Summary of the discussion

There is still an open question as to what the spread of the ensembles in an optimal ensemble prediction system should be. Several participants commented that the spread of the ensemble is usually too small in the present system, in that the elements of the ensemble are closer to each other than to the verifying analysis. Work will continue on this question,and on the ways of modifying the spread (by tuning the generation of the perturbations and/or using a model at higher horizontal or vertical resolution).

There was general agreement that the probability charts proposed as new products were potentially very interesting. The first products to be implemented should concern temperature anomaly and precipitation. As it would not be appropriate to use 2 metre temperature with a T63 solution, 850 hPa will be used instead. For precipitation forecasts, thresholds of 1 mm/24h and 50 mm/24h were mentioned (although a smaller value than 50 mm/24h will have to be used as long as the model resolution is T63). The resolution will also be a problem in certain areas.

One of the new products presented in the meeting appreciated by many participants, was the spatial probability values of temperature anomaly over Europe. Similarly precipitation probability maps can be produced for different threshold values. Fig. 2 gives the probability distribution of the event "Total precipitation forecast exceeds 1mm/day" for day 4 to 5 starting from 24 January 1993 and helps the forecaster to identify areas with high (red) and low (green) values of precipitation probability.

These new products are of particular value when thresholds correspond to weather extremes. For instance, Fig. 3 gives the probability distribution of the event "Temperature of 850 hPa warmer (colder) by 8°C than climatological value"; information which becomes of significant importance when, for example, weather conditions are close to heatwave (frost) at the surface.

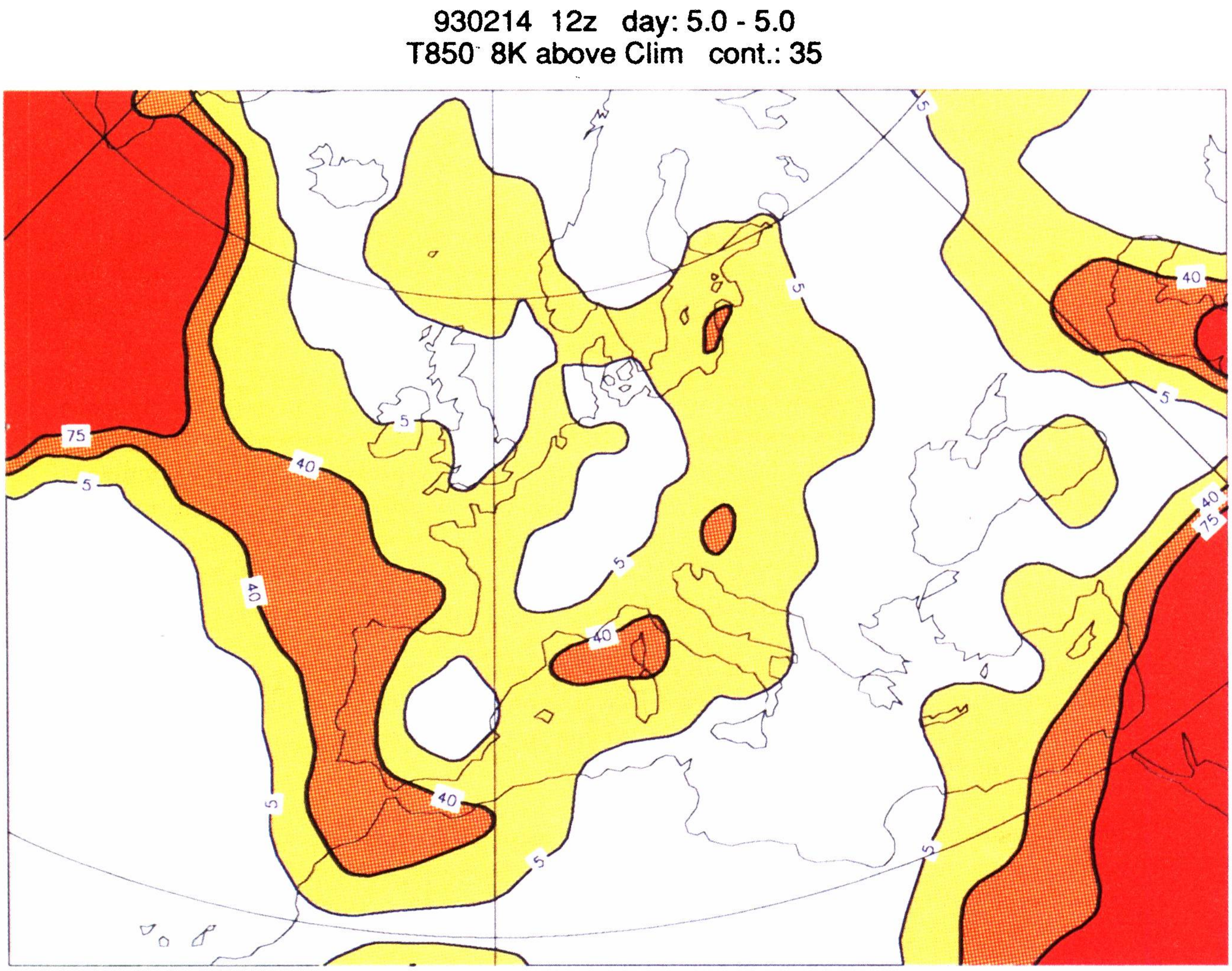

Fig. 3: Probability distribution of the event "Temperature of 850 hPa warmer by 8°C than climatological value".

Several participants supported the idea that the ultimate aim of the system should be to forecast the weather parameters (obviously, some post-processing will always be needed). The development of new products should continue to take this requirement into account as much as possible, given the limitations implied by the resolution of the model used for the ensemble.

Synoptic information on the flow pattern or the temperature distribution will also be required to allow the forecasters to put the point forecast products into a synoptic scale context. Individual forecasts from the ensemble may be inspected for this purpose but this will become unmanageable with increasing sample sizes.

Clustering is still seen as the answer to this problem; however, most participants reported that the present scheme is not adequate. According to the evaluations in Member States and to the internal monitoring of the experiment, the main deficiency currently is that the clusters are too similar to each other. This may be due to several reasons: the area on which the clustering is based (currently the whole of Europe), the time interval (day 5 to 7), or the clustering algorithm itself. It may be necessary to reduce the area, so that, for example, two clusterings would be run, one for northern Europe and one for southern Europe.

Several participants stressed that, even in the present experimental mode, the assessment of the ensemble prediction is hampered by the fact that it is only produced three times a week. Daily execution of the system is required, as soon as the available computer power and the other development projects at ECMWF permit.

The meeting ended with a general discussion on the nature of the forecasts which the Ensemble Prediction System should eventually provide. The choice is between deterministic and probabilistic forecasts. Initially, the work on predictability concentrated on the prediction of the skill of the numerical forecast in the late medium range. However, with the development of the EPS, it becomes clear that guidance of a more general and useful nature can be obtained, namely, information on likely alternative weather scenarios.

- Bernard Strauss, Thomas Petroliagis

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MIGRATION FROM NOS/VE AND PCs TO UNIX WORKSTATIONS

Background

As reported in the last edition of the ECMWF Newsletter, the Centre has been gradually moving from an environment based on IBM-compatible PCs together with the CYBER NOS/VE interactive service to a UNIX-based workstation environment. There are now approximately 100 workstations installed and being used at the Centre, together with a number of file and compute servers.

In order for users to be able to migrate from using NOS/VE and PCs, replacement facilities for the services provided on NOS/VE and PCs have been developed and made available during the last two years. Since users can still access the NOS/VE system from their workstation, they can gradually move their work from NOS/VE to the workstation environment within the time available. Replacement facilities for all the major NOS/VE services have been identified and are being implemented. The only exception is Source Code Maintenance, for which a Unix facility has been chosen, but due to the nature of the product, it is not immediately available to all users.

Services provided by NOS/VE and their replacement on UNIX systems

File Storage

One of the most important services provided by NOS/VE is file storage. Obviously, this service is also provided on the Unix workstations. The major difference is that the file space is distributed to each workstation using NFS. The workstations are all run in "dataless" mode, which means that the local disks on each machine are used to store the basic operating system, but all user "permanent" files are stored on a central server. Additional system software, utilities and applications are stored on other servers. These servers are fully backed up, so that they can be restored in the event of a disk crash.

All workstations do have some temporary local disk space, which can be used by the "owner" of the workstation for his or her own purposes. On the Sun workstations, this is limited to about 70 Mbytes; on the Silicon Graphics workstations about 200 Mbytes is available. However, this disk space is temporary and is not automatically backed up.

The file storage for permanent files (HOME directories) is provided by the CD4680 server, which has RAID disks, so that the loss of a single disk drive will not cause an interruption to the service. This filespace is also exported to the Cray, so that Cray programs can be stored in the user's workstation HOME directory and edited on the workstation. Similarly, the two major user filesystems on the Cray (/ec and /tmp) are exported and mounted on the workstations, so that they can be read and edited using a workstation.

Files can be transferred between the NOS/VE and Unix systems using FTP. This is perhaps most useful for ASCII files but other files can be transferred in binary mode. To augment the standard FTP facility, a NOS/VE procedure "SENDVF" has been developed, which will also transfer whole NOS/VE catalogs, including subcatalogs, reproducing the original tree structure on the Unix system.

Unix files may also be saved in and retrieved from Datatree, either directly using *ecfile,* which is identical to ecfile on the Cray, or using the X-Windows/MOTIF *Xcfs* interface, which provides a point and click interface to Datatree.

Text Editing

NOS/VE includes a Full Screen text editor called *edif,* which has been customized at the Centre to improve its utility. UNIX systems traditionally provide the *vi* editor, which has the advantage of being available on all Unix systems, but is comparatively unfriendly and has fewer features than ECMWF users are accustomed to.

In order to provide a more acceptable text editor, the *Iris Editor* (known as *ie*) has been installed for use on both the Sun and Silicon Graphics workstations. This is an X-Windows based editor, so it can only be used on a graphics workstation, X-Terminal or PC running an X-Windows emulation.

Source Code Management

The Centre has been using the NOS/VE Source Code Utility (SCU) for source code management and version control. This allows changes to source code to be identified and removed, if necessary. The major use of SCU has been for the development of the IFS model in co-operation with Météo France.

The identification of a suitable Unix based source code management tool proved to be a difficult task. Several candidates were considered, and eventually *ClearCase* was selected. It is a very powerful tool, designed from the outset and implemented for a Unix environment. In particular, its ability to provide "transparent" access to source code stored in a ClearCase database, so that existing Unix tools, in particular *make*, can be used without making any changes to scripts, is very attractive.

ClearCase will be available only on the Silicon Graphics systems. It can be accessed from any Sun system by logging on to a Silicon Graphics server, and it is also possible for Cray jobs to access source code stored within a ClearCase database. Initially, ClearCase will only be available for certain users, due to the nature of the administrative support required, and the need to gain some experience of actual use within the ECMWF environment. It will then be made available to all users in the autumn.

In addition, the standard Unix SCCS and RCS utilities are also available on all Unix systems. A "read-only" implementation of SCU, which can be used to extract source code decks from SCU Program Libraries, is available under EP/IX on the CD4680.

File Manager

NOS/VE has two full screen utilities which make it easier for users to access their files: Edit_Catalog *(edic)* and the File Manager *(entfm)*. The latter, in particular, has been customized for use within the ECMWF environment, for example providing the ability to submit a job to the Cray by simply selecting the file to be submitted and then pressing a Function key.

The replacement facilities on the workstations are icon-based file managers, which are platform-dependent.

(i) On the Silicon Graphics systems, a tool called *WorkSpace* is provided. This allows an application to be started by double clicking on the icon representing the application or by dragging the icon representing a file onto the icon representing the application, which is then started using that file. This allows simple customization of facilities. For example, to submit a job to the Cray, a user has only to select the icon representing his job and drag it on to the icon representing the QSUB command.

(ii) On the Sun systems, a tool called File Manager is provided, which also allows point and click access to files and applications, but cannot be so easily customized.

Both these facilities are graphically based, so they cannot be used from a character style terminal.

Cray Job Support

A major service provided by NOS/VE is Cray job submission, output return, job queue inspection and control of jobs submitted. This service is provided by the NOS/VE Cray Station software, which requires a special purpose hardware connection between the CYBER and the Cray.

On the workstations, this service is provided by RQS (Remote Queuing System), a Cray Research product, which provides a subset of the features of NQS, but does not allow jobs to execute on the workstations or servers. In particular, RQS provides facilities for job submission and the return of output files. It also provides facilities for inspection of the NQS queue status on the Cray. No special hardware is required, since RQS uses standard TCP/IP services over the FDDI connection between the Cray and the Unix workstations and servers.

Programming Environment

On NOS/VE, two programming environments are provided: a simple environment for compiling and debugging programs using a full screen interactive debugger and Professional Programmming Environment, which includes an interface to the SCU source code utility.

On the workstations, programming environments with interactive debug facilities are provided by

(i) CaseVision/WorkShop on Silicon Graphics systems, which supports Fortran, C and C++ programs and can be integrated with ClearCase.

(ii) CodeCenter on Sun systems, which supports only C programs, but provides an interpreter which can find certain bugs more easily than a normal breakpoint debugging system.

Screen Design Utility

NOS/VE provides a utility to assist in the implementation of programs using a full screen interface. This has been mainly used to construct the PREPEX and PREPAN utilities to allow Research Department users to submit model and analysis experiments to the Cray.

On the workstations, a tool called *X-Designer* is provided to assist in the construction of MOTIF-based GUI interfaces. This tool has been used for several projects within the Centre, notably *Xcfs*, the GUI interface to *ecfile*, and *Xcdp*, the interface to SMS. This tool is also being used to construct the PREPIFS utility, which will effectively replace PREPEX and PREPAN, and is also being used to develop METVIEW/ws.

Print Service

All the printers at the Centre can be accessed from any of the Unix workstations or servers, which is more flexible than the service provided by NOS/VE. There are 3 principal groups of printers currently available:

* the VAX postscript printers (black & white and colour);

* the Office printers driven via the NOVELL network (black & white only);

* the NOS/VE MOHAWK line printer and PostScript printers.

The method of connection of the printers is transparent to the workstation user. Many of the printers are PostScript printers. The print service will automatically convert an ASCII file to PostScript format, if necessary.

The MOHAWK high speed line printer will be moved onto one of the Unix servers, as there is still a requirement for producing large volume listings on continuous stationery.

Electronic Mail

Since the integration of the various Electronic Mail facilities at the Centre, users have been able to choose whether to access their email via the NOS/VE Mail tool, or on a PC using WordPerfect Office Mail, or on their Unix workstation. As described below, tools for accessing email on workstations are provided. Users currently still have the option to access email on NOS/VE but they are now encouraged to switch to the workstation tools as soon as possible.

ECFILE

Two interfaces to ecfile are available to allow workstation users to save and retrieve files. The *ecfile* command is almost identical to the same command on UNICOS, and can be used in interactive shells and also within shell scripts.

The *xcfs* utility is also provided. This is a MOTIF application program which provides an easy to use "point and click" access to ecfile.

Services provided by PCs and their replacement on UNIX systems

The Centre used to provide every scientific and technical user with an IBM compatible PC. These were networked using NOVELL and a small central fileserver provided permanent filespace for PC files. The services provided on the PCs were primarily terminal emulation to allow access to the Centre's mainframes via serial connections, word processing, electronic mail, spreadsheets etc.

Most users' PCs have been replaced by workstations, with PCs being retained by secretaries and by users in the Administration Department.

Word Processing

The Centre has standardized on WordPerfect for word processing. Version 5.1 of WordPerfect is available on the Sun systems both in a character mode, which is very similar to the standard PC version, and also a modern GUI version, which provides true WYSIWYG ("What You See Is What You Get") editing of documents. WordPerfect files are independent of the platform used and can be interchanged freely between Sun and PC versions.

Unfortunately, WordPerfect 5.1 is not available for the Silicon Graphics system. Therefore, a PC emulator called *SoftPC*, which can be used to run the standard PC version of WordPerfect 5.1, has been installed for use on the Silicon Graphics systems. SoftPC allows full and transparent access to the Unix files available on the workstation.

Terminal Emulation

One of the major advantages of Unix workstations and the X-Windows system in particular is being able to access several systems by creating a new window and logging on to the desired system. The Centre provides access to all its mainframes from any workstation and it is extremely simple and quick to work on several systems in parallel.

Electronic Mail

All Electronic Mail systems at the Centre are integrated, so that email can be passed between Centre users. Email can also be exchanged with external users, in particular those using Simple Mail Transport Protocol (SMTP). All email handling on the Unix systems is passed in SMTP format. A server is used to convert between X400 email and SMTP.

As mentioned earlier, easy to use tools to access Electronic Mail are provided on the workstations. Both Sun and Silicon Graphics workstations can use Z-Mail. It is also possible to use the Sun Deskset Mailtool running on a Sun system. In addition, the public domain ELM mail tool is available on all platforms.

Z-Mail, in particular, can be used in X-Windows/MOTIF mode, full screen mode or in line mode.

Other services

A number of other services are provided on the workstations. Some of these replace equivalent facilities on the PCs, others are new. It should be noted that, because software is installed onto servers, these facilities are in principle available to all workstation users, although for some products the Centre has only a limited number of licences.

(i) Calendar Manager - the SUN Deskset Calendar Manager is available and can be used from a Silicon Graphics workstation by running the program remotely on a Sun server.

(ii) Spreadsheet - the Wingz spreadsheet is available on the Sun systems. It, too, can be used from a Silicon Graphics workstation by running the program remotely on a Sun server.

(iii) Online Documentation - the standard Unix "man" pages are available. A powerful local help facility is available to give online access to locally produced documentation.

(iv) PostScript Previewer - a very useful facility is the ability to display PostScript documents on the workstation screen, rather than printing them. Since MAGICS produces PostScript and the Cray user filesystems are mounted on the workstations, it is possible to display Cray plots on the workstation screen.

(v) Empress Database - this is available on both the Sun and Silicon Graphics systems and is being used for several projects within the Centre.

(vi) MAGICS - this has been ported onto both the Sun and Silicon Graphics systems.

(vii) Meteorological Visualization and Manipulation - the Centre is developing METVIEW/ws, a general and unified system for the interactive visualization and manipulation of meteorological data.

(viii) Presentation Graphics - Island Presents, Chart and Table - this is an easy to use package for the production of overhead slides. It is currently only available on the Sun systems but it is anticipated that it should become available on the Silicon Graphics systems in due course. Silicon Graphics also provide a tool called ShowCase, which has more limited functionality.

(ix) Data Visualization - a Public Domain program called *xmgr* is available on Sun and Silicon Graphics systems for making quick graphs or histograms of various types of data. It is also possible to use Wingz and the Island Presents package for producing various type of graphs and histograms. In addition, the Silicon Graphics *EXPLORER* package is available and it is intended that the Centre will gain some experience in its use in due course.

Summary of services

NOS/VE and Unix services

Service	NOS/VE	Unix Replacement
File Service	NOS/VE file system	Standard Unix/NFS file system
Text Editor	edif	ie, vi
Source Code Management	SCU	ClearCase, SCCS, RCS
File Manager	entfm, edic	WorkSpace (SG) File Manager (Sun)
Cray Job Submission	NOS/VE-Cray Station	RQS
Programming Environment	PE, PPE	WorkShop, CodeCenter
Screen Design	Screen Design Utility	X-Designer
Electronic Mail	Mail/VE	Z-Mail

PC and Unix Services

Service	PC version	Unix Replacement
Word Processing	WordPerfect 5.1	Sun - WordPerfect (native) SG - SoftPC+WordPerfect
Terminal Emulation	PC-Connect, Relay Gold	xterm (part of X-Windows)
Electronic Mail	WordPerfect Office Mail	Z-Mail
SpreadSheet	Symphony	Wingz (currently Sun only)
Database	Symphony	Empress
Presentation Graphics	CorelDraw DrawPerfect	Island Presents (Sun) ShowCase (SG) CorelDraw (Sun)
Data Visualization	Stanford Graphics	xmgr, Explorer
Meteorological Visualization	MicroMagics	Metview/ws

Summary

The migration from NOS/VE and PCs to a Unix workstation and server based environment is proceeding as planned. All facilities required to complete the migration are considered to be available and users are being encouraged to move their work gradually to the workstation environment.

- Richard Fisker

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The following two articles are reprinted here by courtesy of SCD Computing News. The first appeared in the June 1992 issue, and the second in the September/October 1992 issue of that publication. Jeanne Adams chaired the International Programming Languages Committee of the ISO (International Standards Organisation) and chaired the ANSI Committee which developed Fortran 90. She also co-authored the book "The Fortran 90 Handbook: Complete ANSI/ISO Reference".

VECTOR SUBSCRIPTS FEATURED IN FORTRAN 90 AND CF77 5.0

The subscript triplet is used to select a portion of an array called an array section. This portion of a parent array is also an array. For example, if A is dimensioned A(20), then the section A(2:10:3) selects only elements A(2), A(5), and A(8). According to the subscript triplet, the elements are selected from a lower bound (2) to an upper bound (10) in increments of 3. The bounds can be positive, negative, or 0, and the stride can be positive or negative; this selects a regular pattern that is either increasing or decreasing with a fixed stride. An example of a decreasing subscript triplet is A(15:4:-3), which selects elements A(15), A(12), A(9) and A(6).

Occasionally a problem arises where the elements of an array that are needed for an array section are random or arbitrary. This portion of an array may be selected using vector subscripts. The feature is available both in Fortran 90 and in CF77 Version 5.0 on the Cray.

A vector subscript is a rank-1 array of integer expressions that evaluate to a vector of subscripts. Each subscript value must be within the bounds of the allowable subscripts for its dimension. The number of elements selected in the section by one element of a vector subscript is dependent on the other subscripts, if there are any. Vector subscripts, subscript triplets, or simple subscripts may be used in combination with one another to identify an array section, as shown in Example 1. (Program output is shown in Example 2.)

In Example 1, both X and Y are initialized to zero in a whole-array assignment statement with zero broadcast to the shape of X and Y.

Example 1. Sample program showing vector subscripts

```
      PROGRAM VECTOR
       IMPLICIT NONE
       INTEGER J(5), K(3)
       DATA J/4, 3, 10 , 5, 1/, K/2 ,5, 3/
       REAL Y(10), X(6,5,2)
C
       Y = 0.0
       Y(J) = 1.0
       PRINT "(A/ 10F4.0)", "VALUES OF Y", Y
C
       X = 0.0
       X(1:6:3, K, 2) = 1.0
       PRINT "(A)", "VALUES OF X"
       PRINT "(6F4.0)", X
      END
```

Example 2. Output of sample program

```
VALUES OF Y

1. 0. 1. 1. 1. 0. 0. 0. 0. 1.

VALUES OF X

0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0.
0. 0. 0. 0. 0. 0.

0. 0. 0. 0. 0. 0.
1. 0. 0. 1. 0. 0.
1. 0. 0. 1. 0. 0.
0. 0. 0. 0. 0. 0.
1. 0. 0. 1. 0. 0.
```

The vector subscript J defines an array section of the whole array Y. The values of J are defined in a DATA statement as 4, 3, 10, 5, and 1. The elements of Y that are selected by J are assigned the value 1.0 in the statement:

```
Y(J) = 1.0
```

The vector subscript J is used to identify the five elements of this array section.

A section of X is chosen by using X(1:6:3, K, 2) and assigning the value 1.0. The X array is three dimensional: the first subscript is a subscript triplet selecting 1 and 4 in the first dimension; K is a vector subscript that selects 2, 5, and 3 in the second dimension; a simple subscript of 2 is selected in the third dimension. The elements of this array section are:

```
X(1,2,2), X(4,2,2)
X(1,5,2), X(4,5,2)
X(1,3,2), X(4,3,2)
```

An integer value in a vector subscript may be repeated. For example, a vector subscript could be defined in a DATA statement as:

```
DATA M/5, 3, 3, 2/
```

In this case, element 3 of the parent array is selected twice.

Another interesting use of vector subscripts is to rearrange, or indeed, reverse, the elements of an array. Example 3 shows a sample program that reverses an array. The output for this program is as follows:

```
1  2  3  4  5
5  4  3  2  1
```

Example 3. Reversing an array

```
        PROGRAM REVERSE
          IMPLICIT NONE
          INTEGER SIZE
          PARAMETER (SIZE=5)
          INTEGER A(SIZE), VEC(SIZE), I
C
C                 INITIALIZE A AND VEC
C
          DO I = 1, SIZE
                A(I) = I
                VEC(I) = SIZE + 1 - I
          ENDDO
C
          WRITE(6, 100) A
 100      FORMAT(' ', 5I4)
C
C                 REVERSE THE ELEMENTS OF A
C
          A = A(VEC)
          WRITE(6, 100) A
        END
```

Syntax

The following is some formal syntax for array subscripts:

subscript	is	*scalar-integer-expression*
section-subscript	is	*subscript*
	or	*subscript-triplet*
	or	*vector-subscript*
subscript-triplet	is	*[subscript]:[subscript] [:stride]*
stride	is	*scalar-integer-expression*
vector-subscript	is	*rank-1-integer-array-expression*

- Jeanne Adams

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FORTRAN 90, CF77 5.0 MAKE USE OF VECTOR INTRINSIC FUNCTIONS

The term *intrinsic* in Fortran 90 is used to describe facilities that are always defined by the language and available to programmers - that is, procedures such as sine and cosine, data types such as REAL or INTEGER, and operators such as +, -, **, *, /, and //. These facilities are built into Fortran and are called intrinsic procedures, intrinsic data types, and intrinsic operators.

A vector intrinsic function is one that has an array argument and is built into Fortran. For example, in

```
DIMENSION TEMP(100), X(100)
X = SIN(TEMP)
```

the function SIN with an array argument returns 100 values of the sine of TEMP, which in the example are assigned to a corresponding element of X.

In version 6.0 of CF77, there will be a number of Fortran 90 array functions. The array construction functions are MERGE, PACK, SPREAD, and UNPACK. A RESHAPE function will allow the programmer to reshape a rank-1 array to any array of any specified shape, up to seven dimensions. The CSHIFT, EOSHIFT, and TRANSPOSE functions shift and transpose the elements of an array.

A vector function may return an array result, or it may return a scalar result "reduced" from an array (an array reduction function). The array reduction functions in Fortran 90 are ALL, ANY, COUNT, MAXVAL, MINVAL, PRODUCT, and SUM. These functions will also be in the next version of CF77, version 6.0. For example,

```
...
DIMENSION Y(10)
X = SUM(Y)
...
```

sums the 10 elements of Y and assigns the value to the scalar X.

Fortran 90 and version 5.0 of CF77 have whole-array assignment and whole-array expressions as well as array-section assignment and array-section expressions. In order to use the mathematical and conversion intrinsic functions in these expressions and assignment statements using whole arrays, array-valued results from intrinsic functions are needed. Cray CF77 has full vectorization of most of these functions.

Appendix B of the Cray Research publication *CF77 Compiling System, Vol. 1: Fortran Reference Manual (SR-3071 5.0)* contains tables that indicate which functions provide vector-valued results.

The simple case in Example 1 uses a DATA statement to establish values for X. Using a whole-array assignment statement, Y is set to 2.8 times X. The next assignment sums the vector values using SIN and COS intrinsics, and assigns the result to the vector Z.

Example 1. Vector intrinsic functions

Program

```
      PROGRAM FULLVECT
        REAL X(10), Y(10), Z(10), R(10)
        DATA X /2., 3.1, 4.5, 1.0, 1.0, 1.0, 7.23, 42., 1.0, 1.0/
        Y = 2.8 * X
        Z = SIN (X) + COS (Y)
        R = ALOG (Y) + .5
        PRINT "(A,10F6.1/)", "X", X, "Y", Y, "Z", Z, "R", R
      END
```

Output

```
X  2.0  3.1   4.5  1.0  1.0   1.0   7.2   42.0  1.0  1.0

Y  5.6  8.7  12.6  2.8  2.8   2.8  20.2  117.6  2.8  2.8

Z  1.7 -0.7   0.0 -0.1 -0.1  -0.1   1.0   -1.1 -0.1 -0.1

R  2.2  2.7   3.0  1.5  1.5   1.5   3.5    5.3  1.5  1.5
```

R is a vector that is assigned values for the expression ALOG(Y) + .5. The intrinsic ALOG has full vectorization, and .5 is broadcast to the number of elements declared for vectors Y and R.

In Example 2, the scalar A is set to 23, and its square root is calculated through traditional Fortran. MARIGOLDS is a vector of 10 values initialized in a DATA statement. BB is the vector of the square roots of the vector AA in a whole-array assignment statement using a vector square root. AA is assigned floating-point values in the assignment of MARIGOLDS, a type INTEGER rank-1 array.

TULIPS is assigned a value from the SIN of the FLOAT function of MARIGOLDS, plus the scalar 3.2, which is broadcast to ten elements - the number of elements in MARIGOLDS and TULIPS.

Example 2. Vector assignment and intrinsic functions

Program

```
      PROGRAM INTRIN
       IMPLICIT NONE
       REAL TEMPERATURE_NORTH (50,4), WEST (10,3)
       REAL TULIPS (10), A, B, AA(10), BB(10)
       INTEGER MARIGOLDS (10)
       DATA MARIGOLDS /2, 4, 6, 8, 10, 0, 0, 0, 0, 0/
       DATA A /23./
C
       B = SQRT (A)
      PRINT "(A, 2F5.1)", "SCALAR A AND B", A, B
C
       AA = MARIGOLDS
       BB = SQRT (AA)
      PRINT "(A,10F5.1)", "VECTOR AA", AA, "VECTOR BB", BB
C
       TULIPS = 3.2 + SIN (FLOAT (MARIGOLDS) )
      PRINT "(A, 10F5.1)","TULIPS", TULIPS
C
       TEMPERATURE_NORTH = 999.
       TEMPERATURE_NORTH (5:50:5, 2) = BB
       WEST (1:10,2:3) = TAN ( TEMPERATURE_NORTH (5:50:5,2:3) )
      PRINT "( A,/(10F7.3/) )" , "WEST", WEST
      END
```

Output

```
SCALAR A AND B 23.0  4.8

VECTOR AA  2.0  4.0  6.0  8.0 10.0  0.0  0.0  0.0  0.0  0.0

VECTOR BB  1.4  2.0  2.4  2.8  3.2  0.0  0.0  0.0  0.0  0.0

TULIPS     4.1  2.4  2.9  4.2  2.7  3.2  3.2  3.2  3.2  3.2

WEST
 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000

 6.334 -2.185 -0.829 -0.324  0.021  0.000  0.000  0.000  0.000  0.000

-0.026 -0.026 -0.026 -0.026 -0.026 -0.026 -0.026 -.0026 -0.026 -0.026
```

In the last assignment statement, an array section is used for both TEMPERATURE_NORTH and WEST. The section WEST (1:10, 2:3) is conformable with (has the same shape as) TEMPERATURE_NORTH (5:50:5,2:3). In the printout of the array WEST, the first row of the second dimension is not involved and happens to be zero. The second row of the second dimension is derived from TEMPERATURE_NORTH having been assigned values from BB. The third row is simply the TAN of the value 999. It was initialized as 999 before the assignment of BB to the second row of the second dimension.

Other intrinsics

The bit intrinsic functions of Fortran 90 are fully vectorized in Cray Fortran. The following intrinsic names take INTEGER arguments: IOR, IAND, NOT, IEOR, IBSET, IBCLR, BTEST, ISHFT, ISHFTC, MVBITS, and IBITS.

For example, the logical AND, IAND(1,3) with arguments 1 and 3 would be:

Argument		**Result of**
1	3	IAND(1,3)
1	1	1
0	1	0
0	0	0
0	0	0

The exclusive OR, IEOR(1,3), has the value 2. The inclusive OR, IOR(1.3) has the value 3.

On the CRAY, SHIFT, SHIFTL, and SHIFTR remain from earlier Fortrans and are offered as shifting functions that take REAL and INTEGER arguments. They also take Boolean constants and Cray pointers as arguments. (Note that REAL arguments may be used with AND, OR, NOT, and XOR as a Cray extension to the above Fortran 90 bit intrinsics, which are restricted to INTEGER type in the Fortran 90 standard.)

The date and time functions, as well as the system clock, are available; however, the names are different from the ones chosen for Fortran 90. There is a Fortran 90 DATE_AND_TIME intrinsic function with four optional arguments that provide for the Cray functions CLOCK, TIMEF, DATEF, and DATE. In Fortran 90 there is a system clock with three arguments that obtain data from the system clock. It is called SYSTEM_CLOCK, and some of its functionality is available with RTC (real-time clock) on the Cray.

The Fortran 90 random-number generation is available using the intrinsic subroutines RANDOM_NUMBER and RANDOM_SEED. The subroutine RANDOM_NUMBER returns one pseudo-random number (a scalar) or an array of these numbers (depending on whether the argument is scalar or an array) from the uniform distribution over the range of 0 to 1. For example, in the following code segment,

```
...
DIMENSION X(10)
CALL RANDOM_NUMBER(X)
...
```

the array X is returned with ten random numbers generated.

The same facility is provided on the CRAY Y-MP, but the names are different: use RANF, RANGET, and RANSET on the Cray to generate random numbers.

MATMUL and DOT_PRODUCT are available as external functions. These functions, which are intrinsic in Fortran 90, will be available in a subsequent release of CF77 as intrinsics.

- Jeanne Adams

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AN INTERACTIVE UNIX SERVICE FOR MEMBER STATES

Interactive services at ECMWF for Member States are currently provided on either the NOS/VE or the VAX/VMS systems. As the NOS/VE service terminates on 30 November 1993, a replacement is now being provided on one of the Centre's UNIX based systems. The replacement service will be available as of Wednesday, 1 September 1993.

This UNIX based service will initially be run on a Silicon Graphics Challenge system, which will be shared with members of the Operations Department of ECMWF. Depending on future usage, the Member State service may be moved to another server, dedicated solely to Member State users.

The service will be provided by the standard Silicon Graphics IRIX 5 operating system. This version is based on UNIX System V release 4, with some Berkeley extensions. In addition, job submission to the Cray will be provided by RQS.

The method of connection will be via a standard 'telnet' command, the service name (for TCP/IP linked sites) being *'ecserver.ecmwf.co.uk'*. For those sites linked by DECnet the service name may be different. Note that users should always use a service name rather than the IP address. If ECMWF decides at some stage to move the service to another server then the service name will be automatically remapped to the new server address.

As mentioned before, the service is based on standard UNIX. In addition, there will be some third party packages, in particular zmail (interactive mail interface), ClearCase (source code manager) and two packages available only with xterm interfaces namely ie (interactive text editor) and WorkShop (programming environment). Most of these packages incorporate their own on-line help. More general help on the various services are provided by the standard UNIX man pages, plus *'insight'* (an on-line system for Silicon Graphics manuals) and *'echelp'* (ECMWF's local documentation).

- 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 (up to News Sheet 300). All other News Sheets are redundant and can be thrown away.

No.	Still Valid Article
204	VAX disk space control
205(8/7)	Mispositioned cursor under NOS/VE full screen editor
207	FORMAL changes under NOS/VE
224	Job information cards
235	VAX public directory - how to create
253	Copying/archiving NOS/VE catalogs to ECFILE Copying complete UNICOS directories to ECFILE
254	UNICOS carriage control
260	Changes to PUBLIC directories for VAX users
261	Meteogram system on UNICOS
265	Lost UNICOS outputs submitted via RJE or VAX Microfiche changes
266	Reminders on how to import/export magnetic tapes
268	Changes to WMO FM 92 GRIB

<u>**No.**</u>	<u>**Still Valid Article**</u>
270	Changes to the Meteogram system
271	New ECFILE features on UNICOS
280	UNICOS on-line documentation: docview
281	File transfer via FTP (possible problems)
283	New features for Member State batch users (RQS 1.1)
284	UNICOS 7 features & differences
286	Improving the performance of "model" jobs on the Cray Y/MP8 at ECMWF (pre-allocating disk space)
294	Changes to the Meteogram system
296	Introduction of the new (TCP/IP) ECFILE on the Y/MP16-C90
297	Automount on the C90
298	New Member State job queues
300	Techniques to reduce memory requirements and improve I/O performance on the C90 Transfer of files and catalogs from NOS/VE to other systems

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ECMWF CALENDAR 1993

22 - 24 September	**Scientific Advisory Committee**, 21st session
4 - 6 October	**Technical Advisory Committee**, 18th session
11 - 13 October	**Finance Committee**, 51st session
14 - 15 October	**Policy Advisory Committee**, 1st session
15 - 17 November	**Workshop** - The role of the stratosphere in Numerical Weather Prediction
22 - 26 November	**Workshop** - Meteorological Operational Systems
1 - 2 December	**Council**, 39th session
24 - 28 December	**ECMWF HOLIDAY**

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ECMWF PUBLICATIONS

ECMWF Workshop Proceedings on Variational assimilation, with special emphasis on three-dimensional aspects. 9-12 November 1992

Forecast and verification charts to 30 June 1993

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INDEX OF STILL VALID NEWSLETTER ARTICLES

This is an index of the major articles published in the ECMWF 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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USEFUL NAMES AND 'PHONE NUMBERS WITHIN ECMWF

		Room*	Ext.**
DIRECTOR	- David Burridge	OB 202	2001
DEPUTY DIRECTOR and HEAD OF OPERATIONS DEPARTMENT	- Michel Jarraud	OB 010A	2003
ADVISORY: Available 9-12, 14-17 Monday to Friday			2801
Other methods of quick contact:	- Telefax (+44 734 869450) - VMS MAIL addressed to ADVISORY - Internet mail addressed to Advisory@ecmwf.co.uk		
REGISTRATION			
Project Identifiers	- Pam Prior	OB 225	2384
User Identifiers	- Tape Librarian	CB Hall	2315
COMPUTER OPERATIONS			
Console	- Shift Leaders	CB Hall	2803
Console fax number	- +44 734 499 840		
Reception Counter	- Tape Librarian	CB Hall	2315
Tape Requests	- Tape Librarian	CB Hall	2315
Terminal Queries	- Norman Wiggins	CB 026	2308
Telecoms Fault Reporting	- Michael O'Brien	CB 028	2306
ECMWF LIBRARY & DOCUMENTATION - DISTRIBUTION	- Els Kooij-Connally	Library	2751
LIBRARIES (ECLIB, NAG, etc.)	- John Greenaway	OB 226	2385
METEOROLOGICAL DIVISION			
Division Head	- Horst Böttger	OB 007	2060
Applications Section Head	- John Hennessy (acting)	OB 014	2400
Operations Section Head	- Bernard Strauss	OB 328	2420
Meteorological Analysts	- Andreas Lanzinger	OB 314	2425
	- Ray McGrath	OB 329	2424
	- Anders Persson	OB 315	2421
Meteorological Operations Room	-	CB Hall	2426

		Room*	Ext.**	Bleeper
COMPUTER DIVISION				
Division Head	- Geerd-R. Hoffmann	OB 009A	2050	150
Systems Software Sect.Head	- Claus Hilberg	OB 104A	2350	115
User Support Section Head	- Andrew Lea	OB 227	2380	138
User Support Staff	- Antoinette Alias	OB 224	2382	154
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	- Norbert Kreitz	OB 207	2381	156
	- Dominique Lucas	OB 206	2386	139
	- Pam Prior	OB 225	2384	158
Computer Operations				
Section Head	- Peter Gray	CB 023	2300	114
Security, Internal Networks and				
Workstation Section Head	- Walter Zwieflhofer	OB 140	2352	145
GRAPHICS GROUP				
Group Leader	- Jens Daabeck	CB 133	2375	159
RESEARCH DEPARTMENT				
Head of Research Department	- Anthony Hollingsworth	OB 119A	2005	
Computer Co-ordinator	- David Dent	OB 123	2702	

* 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.

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

Internet: The ECMWF address on Internet is **ecmwf.co.uk**
Individual staff addresses are firstname.lastname, e.g. the Director's address is David.Burridge@ecmwf.co.uk