II WORKSHOP REPORT

1. INTRODUCTION

A joint workshop was held by ECMWF and CPTEC Brazil (Centre for Weather Prediction and Climate Studies) 30 November - 2 December 1988. There was a total of 14 presentations on the following topics: MicroMAGICS, future directions in MAGICS and MicroMAGICS, animation and workstations.

MicroMAGICS

MicroMAGICS is a graphical system for meteorological applications on microcomputers. It is adapted from the ECMWF MAGICS/GKS software system and includes a user-friendly interface and an animation module. MicroMAGICS is being developed by CPTEC, a unit of Brazil's Institute for Space Research (INPE), under guidance from ECMWF. The first release of MicroMAGICS is scheduled to be made to ECMWF and its Member States in 1989. A prototype of the MicroMAGICS product was demonstrated at the workshop on graphics in meteorology.

Future directions in MAGICS and MicroMAGICS

Many standard types of meteorological maps can now be produced with MAGICS and most of them will be available in MicroMAGICS. This discussion centred around enhancements proposed by Member States and those originating from within ECMWF. Recommendations are listed under the discussion of this topic.

Animation

For the purpose of more detailed analysis and study of model output, the production of animation sequences is the most efficient solution, since this medium allows the flexible combination of various parameters in colour and adds the important dimension of time. The analysis of the vast amounts of data resulting from the model would be beyond human capacity without the aid of such visualisation techniques. In the discussion on this topic it was stated that 2D computer animation of meteorological parameters is considered useful. 3D animation is still in its infancy. It needs further research to find ways of using it, but should be pursued. Flexibility in user interfaces to animation software is considered important (i.e. user control of the selection of meteorological parameters, geographical area etc.). Interactive intervention with a weather forecast model was considered useful as a research tool at the present time.

Workstations

Recently, many new and powerful workstations have been announced. Workstations, which now span a wide range in performance and cost, have become suitable tools on which to implement resource demanding visualisation techniques and systems. In the discussion, it was concluded that workstations have a definite role in the meteorological community but the requirements of different organisations vary considerably. For pioneers, high-powered workstations will lead the way in the development of new techniques which can then be scaled down for use on lower cost systems.

There were a total of 53 participants made up of representatives from 14 Member States, WMO, Brazil, Canada, Israel, USA and six computer and workstation vendors.

2. DISCUSSIONS

2.1 Future directions in MAGICS and MicroMAGICS

MAGICS

The discussions centred around recommended enhancements received from Member States and from within ECMWF. Specific MAGICS problems were not discussed.

Shading, masking, blanking

Land/sea orography shading is considered very important, especially for presentation applications. It was suggested that all shading be based on the GKS polygon fill attribute using GKS shading patterns.

The land/sea masking of surface parameters, e.g. the clipping of contours at coastlines was not given high importance. If implemented it should be a course clipping based on grid points.

The blanking of text and legend texts was considered important, but too time consuming (in both CPU time and development time) to implement. If done at all, it should be limited to raster devices using rectangular polygon blanking.

The availability of thick contours, high/low markers and labels was considered to be a GKS question and not a MAGICS concern.

Projection/mapping

The plotting of fields, already projected to polar stereographic with true map scale, was considered important as some models run in polar stereographic. However, MAGICS calculates the contours in the cylindrical grid and then projects them to polar stereographic.

A rotated lat/long grid is essentially a translation from the actual grid to a new lat/long grid where the equator runs through the centre of the area of interest. This was considered important when areas of high latitude are the primary areas of interest and, in particular, for limited area models.

Transverse Mercator projections were considered important, but no agreement could be obtained as to which one. Every meteorologist has his own favourite. There are in fact WMO recommendations on this subject.

Observation plotting

BUFR, which is now a full WMO/CBS standard, should be implemented in MAGICS during 1989, or as soon as possible after it becomes available. The majority of participants believed that they could make use of BUFR quickly. In response to a question, it was confirmed that MAGICS would continue to handle all existing observation types.

Plotting of METAR observations will be available when BUFR is incorporated into MAGICS. In the meantime, METARs can be plotted by presenting the METAR as a surface observation. It was requested that the internal observation plotting interface be documented so that Member States can plug in their own packages.

Many participants requested that observations should be rotated as a function of the longitude.

The problem of over-plotting of observations is non-trivial, especially in relation to coastal stations and preferred station lists. In general, it was agreed that this was required, but was of low priority.

New Features

The plotting of thermodynamic diagrams was difficult to discuss as there are so many different types.

The X/Y axis plotting for use with cross-sections has already been implemented. The plotting of X/Y graphs can be done completely within MAGICS or by incorporating a third party package. There was not, however, much interest in X/Y graphs, other than for trajectory plotting.

The plotting of grid point markers was of minor interest only, but is nevertheless simple to do.

The plotting of random digits/letters/markers also generated little interest.

Imaging and array cell shading was considered important but, for efficiency reasons, should not be implemented using the GKS cell array. Perhaps a "standard" GDP should be established within the meteorological community that can be used efficiently for imagery.

Other Topics

There was great interest in the production of internal documentation of the contouring interface so that other packages might be substituted.

There was also some interest in support of segmentation within CGM.

The documentation of font interfaces is chiefly a GKS question.

It is quite easy to substitute alternative coastlines as they are held in ASCII files external to MAGICS. Documentation can be provided.

Chart identification to be embedded in user items in metafile.

Description of ECMWF (CGM) metafile.

MicroMAGICS

In the limited time, and without a previously prepared list of topics, the discussion was somewhat unstructured.

A non-English version was suggested.

All data acquisition will be in GRIB and BUFR format.

Individual terminal keystrokes should be recorded for possible use later.

The problems of how GRIB/BUFR are actually ported to the PC needs to be solved.

Transfer only metafiles to PC.

It was asked if MicroMAGICS would be available under UNIX as well as MS-DOS. The answer was probably not, but a UNIX version will be developed for a SUN workstation.

2.2 Animation

1. Objectives

The objectives of the working group were to discuss current and future trends in computer graphics animation, with particular emphasis on animation of meteorological parameters.

a) Method of display:

- 2D
- 2D layers
- 3D

b) User interaction:

- preset selection
- manipulation and display
- interactive model visualisation

c) Application:

- routine operation
- research experiment
- case studies and presentation

2. Background

The analysis of the vast amount of data produced by numerical models is almost impossible to achieve using the old convention of 2-dimensional maps on hard copy. During the last few years, the advent of mini-supercomputers and powerful workstations has brought the production of computer graphics animation within the reach of most national meteorological organisations. It has become obvious that the most efficient way to depict the results of numerical models is by the production of animated sequences, since this medium allows the flexible combination of various parameters in colour and adds the important dimension of time. There are already many animation techniques developed by various organisations around the world, some of which have been demonstrated at this workshop. There is now a need to look at the future of animation in meteorology, with the benefit of hindsight and taking the availability of hardware into account.

3. Discussion

3.1 Method of display

There was a general consensus of opinion here that 2D animation was of tremendous value and would always be a very good tool for both operational and research people. There were some people who thought that 3D animation is not needed at all, because of the difficulty in knowing the geographical location and in making measurements. Others felt that it would play a useful role in such things as simulating the approach of a weather front, and plotting of trajectories. It was generally agreed that, at the moment, 3D animation was a research tool rather than an operational one. It was also suggested that 3D was a relatively new concept and, as such, people were not familiar with it and did not know how to handle it. There was a feeling that 3D animation was still very new and that the possibilities of exploiting it have not yet been fully or properly investigated. People should try to think about what is possible using 3D animation in the future.

3.2 User interaction

3.2.1 Preset selection

It was generally agreed that preset selection was not sufficient to enable forecasters to make full use of animation systems to analyse data from numerical models. Preset selection may, in fact, be useful to 'local' forecasters who might like to examine a fixed list of maps or situations every day. There was general agreement that more flexibility was required in the user interaction and that preset selection could be part of this flexibility.

3.2.2 Interactive model visualisation

The use of animation to examine fields etc. from the model in real time was discussed. The main use of this would be that the forecaster could intervene in the model if the forecast was developing wrongly. It was generally felt that this was not of any great value in an operational environment and could, in fact, be dangerous, but it could benefit researchers.

4. CONCLUSIONS

a) 2D computer animation of meteorological parameters has a definite future.

b) 3D animation is still in its infancy and needs further research to find ways to use it. It should not be ruled out entirely.

c) More flexibility and options required in user interface to animation packages, but a preset selection could be part of the flexibility.

d) Interactive Model Visualisation should be used as a research tool and not as an operational one.

2.3 Workstations

1. Objectives

Weather forecasting models produce large amounts of data which can only be analysed using graphical techniques. The presentation of meteorological products on workstations is an area which is not yet fully exploited.

2. Background

Video techniques in general take too long to be of value to the operational forecaster. Workstations provide the means to provide real time analysis of forecast models.

The developments in the workstation area, with falling prices and improved performance, brings them within the reach of the budgets of more meteorological institutions. The range of computers termed "workstations" now starts with PCs, but ends with supercomputers with attached display devices.

3. Discussion

The discussion centred around five topics. The role of the workstation in a meteorological environment, their size, location and questions of their connectivity and cost benefit.

There was a wide range of views concerning workstations.

Some participants felt they had only a small part to play as the operational forecaster does not have the time to explore the diversity of information available to him. The appropriate important features of a forecast need to be pre-selected and presented. Ordinary colour maps (or even black and white) can adequately fill this need. It was even felt that workstations could distance a forecaster from his work as traditional methods demanded a much higher degree of interaction with the data (e.g. drawing contours by hand). However, well designed workstation systems with a high degree of operator interaction could counter this argument.

Other participants felt that the workstation has a real role to play, but the techniques to use have not yet been identified. What is required is inspiration similar to that which saw the leap from black and white maps to colour video techniques.

The size of workstations varies a great deal and only the very low end of the market is within the reach of the majority of meteorological organisations. This reflects the fact that only a small minority can even afford to use computers.

The location of workstations (i.e. close to or distant from their data source) is an issue closely related to today's dynamic network capabilities. Vendors should ensure that their workstations can be connected to all major computers by use of standards such as TCP/IP. Today's networks do not, however, provide the required bandwidth for meteorological use, where transfer rates in the order of 100 MB/s are required. Only vendor specific networks can provide this performance at present. This data rate can be reduced by down loading the images during the forecast run. This gives more time for the data to be transferred , but demands massive storage capabilities on the workstation.

For the majority of institutions it was considered that a PC could satisfy initial requirements, with the GTS as the source of data.

The cost benefit of workstation is difficult to assess as the short term costs outstrip the short term gains. In the long term, dedicated workstations will off-load work from general purpose central computers, will give faster access to data, and will permit more informative visualisation techniques such as the overlaying of imagery and contours. This can only lead to an improvement in the quality of operational forecasting.

4. CONCLUSION

Workstations have a definite role in the meteorological community, but the requirements of different institutions vary considerably. For pioneers, high powered workstations will lead the way in the development of new techniques which can then be scaled down for use on lower cost systems.