OPERATIONAL USE OF WORKSTATION APPLICATIONS AT THE CANADIAN METEOROLOGICAL CENTRE

Richard Hogue, Garry Toth
Canadian Meteorological Centre
Dorval, Canada

1. INTRODUCTION

The Canadian Meteorological Centre (CMC) is one of the first meteorological Centres to implement UNIX workstation technology in an operational environment. In December 1992, UNIX became the sole operating system in use at CMC on both front end and back end computers. Over the years, a variety of workstation applications have been developed and extensively tested. As a result, they are well tailored to the daily work of the operational meteorologists. For historical reasons, these applications were specifically developed for CMC's operational environment. The focus of the work of the operational meteorologists at CMC is in the assessment of NWP operational and parallel products (short to long term outputs), the quality control of the incoming data and the analysis and monitoring of the wide range of operational and parallel runs. The meteorologists also produce a series of subjective analyses and prognoses and respond to environmental emergencies.

In recent years, a series of workstation applications have been developed within the regional weather centers to meet their specific operational needs which are different from those of CMC. Consequently, instead of a single national application, a variety of workstation applications have been developed across the country (FPA, Metworks, WADS, RAPID, etc...). The following focuses on the applications developed and used operationally at CMC.

2. WORKSTATION APPLICATIONS

2.1 **Historical perspective**

Software development of CMC's applications has always been based on the use of XWINDOWS and MOTIF with the code being written in C and FORTRAN. More recently, the use of 'Tcl/TK' (Tool Command Language (TCL) and Tool Kit (TK)) is becoming more and more popular. Although modularity, expandability and efficiency have always been of prime importance in the development of applications, the most important goals have been the user friendliness of the application and its response time. This last point ensures a dynamic feedback between developers and the operational meteorologists,

especially in the context of limited staff resources. Instead of developing a large single application which would answer all needs, the evolution has been to develop a set of applications to meet the specific needs of the meteorologists in an efficient way. Additionally, all applications are fully bilingual (English and French).

2.2 Data management

Instead of a commercial database management system, an 'in-house' database format was developed to store station point data: BURP (Binary Universal Report Protocol) format. Also, an 'in-house' format was developed nearly 15 years ago to store gridded data information: Standard Files format. It is a GRIB-like format which is well suited for quick input/output operations. These formats are discussed in Mailhot (1993) along with the database structure.

2.3 Current operational applications

The development of observation and grid point plotting applications has reached a certain maturity now after numerous interactions between developers and operational meteorologists during the last decade. A full set of capabilities are available to the meteorologist (animation of fields, cross sections, zooming, scrolling, superimposition of various types of grids, operations on fields, etc...). Moreover, in order to keep 'button clicking' to a minimum, application macros are being used extensively. More recently, task-oriented automatic window set-up has become an essential part of the operational environment. This capability allows the meteorologist to store a pre-defined series of window set-ups which automatically load applications and carousels of images. The 'automatic window set-up' can be easily modified and customized by the meteorologist. This mechanism has made the use of the applications significantly more user-friendly and efficient. Here is a short description of the main operational applications in use at CMC:

- XFLOWCHART: application which is used to control and monitor the 2000 jobs that are run daily in operations which execute 1.5 million lines of FORTRAN code each day. Xflowchart was developed to provide the meteorologists with a single point of interaction with the operational runs. It's primary function is to display at a glance, the current status of the operational jobs. Most of Xflowchart runs in a fully automatic mode, indicating normal system conditions as well as a wide range of alarm mechanisms to alert the operational meteorologist if problems arise. Additional functions include monitoring of outgoing bulletins and charts, ability to re-transmit any products as necessary, specific run control functions and other items such as printer controls, all in a very user-

friendly interface. The current operational procedures at CMC would be impossible to carry out without this tool.

- XDISPLAY: displays and animates raster files. Permits construction of carrousels of images and of customized window set-ups.
- MAX: plots point observations and gridded data. Permits superimposition of all grid types and can be macro driven. Full range of cross-sectional capabilities.
- XREC: displays and animates gridded data. It is a quick visualization tool for direct model and analysis outputs. It was developed by Recherche en Prévision Numérique (RPN).
- DATAMON: displays real-time information on observations available by type and geographical region.
- EDIGRAF: drawing tool to produce subjective prognosis charts. Enables superimposition of satellite imagery with gridded forecast data.
- XRDBURP: displays graphically or in text format observation types.
- XTEPHI: displays observed and forecast tephigrams and hodographs at upper air sites.
- XRARC: manages the CMC archival system. Permits the submission of an archival request in a fully automatic mode.

In the operational setting, it is a high priority that these applications run in a very responsive fashion. Our experience has shown that it is important not to explicitly merge these applications together. This might be seen as a disadvantage initially, but this flexible approach has proven to be quite efficient overall.

3. TOOLS AND OPERATIONAL-DEVELOPMENT-RESEARCH INTERACTION

The availability of efficient and useful workstation applications has certainly played a key role in our ability to interact with the development and research personnel (RPN) on location in the CMC building. Once or twice weekly, a formal briefing is presented by the operational meteorologists to all interested parties (Operations, Development and Research Branches). Comments on recent model performance and/or performance of parallel runs are presented at these briefings. Sometimes, comments from meteorologists in the seventeen Canadian regional forecast centers concerning the performance of our models over their specific areas are presented to the audience or serve as the basis for the cases presented in these briefings. These presentations use extensively the numerous capabilities of the workstation applications in order to clearly and effectively present the meteorological information.

The fact that the main applications are available to all personnel in the building on powerful workstations permits efficient feedback and exchange between groups. Typically, a meteorological problem noted by the operational staff is quickly passed on to staff at Development Branch who, in turn, engages research personnel on-site. This then leads to discussions and possibly to a series of tests and/or parallel runs. The whole process permits rapid implementation of improvements to the NWP model and analysis systems. Our experience has been that the efficiency of this important process is highly dependent on the high level of efficiency, usefulness and user-friendliness of the workstation applications that have been developed at CMC.

4. 3D APPLICATIONS AND FUTURE DEVELOPMENTS

Our experience in the Development Branch has been that 3D visualization can be an extraordinary tool for specific tasks (e.g. in research to visualize results, in presentations to show animated sequences of weather events, etc...). However, volume rendering is not an easy task and can require quite a bit of work in the preparation of the 3D images (defining angle of view, choosing the iso-surfaces, etc...). This is why the use of 3D visualization in operations is rather limited for now. However, it seems quite promising in the context of intercomparison of model outputs when evaluating parallel runs. For instance, the difference between two geopotential forecast fields or fields of analysis increments generate structures which are well suited to 3D visualization. The production of these fields into 3D images can be more easily automated and introduced in the operational environment than more complex fields such as cloud patterns. These images may then be used along with 2D fields to efficiently diagnose problems over specific areas. We plan to test and implement the use of VIS5D in this context later this year.

Future developments in the area of workstation applications at CMC will focus on the improvement of the automatic window set-up capabilities of the different applications. There are now plans to merge some of these applications. Again, short response time and user friendliness will continue to be a fundamental criterion for the operational applications.

5. REFERENCE

Mailhot R., G. Toth, J. Garcia, and S. Fillion, 1993: The UNIX integrated environment at the Canadian Meteorological Center. Workshop Proceedings, Fourth Workshop on Meteorological Operational Systems, 22-26 November 1993, ECMWF, 142-149.

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