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A BRIEF INTRODUCTION TO THE METEOROLOGIST WEATHER PROCESSOR

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Introduction

In August, 1991, the staff of the Auburn, Washington, CWSU received training on the newly installed Meteorologist Weather Processor (MWP). After approximately two months familiarization with MWP, and ensuring that it was stable enough to replace existing weather communication and display systems, the CWSU staff began using it exclusively as their analysis and briefing tool.

Prior to the acceptance of MWP, CWSU technology was little better than that of a typical pre-AFOS Weather Service Forecast Office. Satellite images and most graphics were in printed form. A Zenith RTA, installed in 1989, was capable of receiving and displaying a limited number of AFOS graphics. Alphanumeric data were collected, displayed, and disseminated on the Leased Service A/B System originally intended for Flight Service Stations.

MWP System Overview

MWP is the culmination of a joint FAA/NWS effort to provide the CWSUs with a near state-of-the-art meteorological workstation using off the shelf hardware. The result is a workstation with high resolution color display monitors, mouse driven menus, color and dot matrix printers, and a processor with approximately 2 gigabyte disk storage capacity. MWP gives the meteorologist substantial capacity to analyze, edit, and disseminate graphic and alphanumeric weather products.

The MWP system uses a nationwide communications network based at a central hub in Melbourne, Florida. This hub provides all data except radar to each of the 22 Air Route Traffic Control Centers (ARTCC) across the country and to the Air Traffic Control System Command Center (ATCSCC) in Washington, D. C. Radar data are collected locally via dedicated telephone lines.

Figure 1 shows how data flow through the MWP system. The hub receives AFOS graphic and alphanumeric data from the National Weather Service Family of Services. Satellite data are received at the hub directly from the Geostationary Orbiting Environmental Satellite (GOES). All data received are ingested into the hub computer and forwarded, via satellite link, to a processor located at each ARTCC and the ATCSCC. Radar data are received by the processor via dedicated radar channels. After processing, the received data are available to the Meteorologist Workstation (MWS).

Accessing Data and Creating Products with MWP

Selection of operations and products is accomplished almost exclusively through the use of mouse driven menus. Figure 2 is a reproduction of the main menu (Fig. 2a) and the analysis menu (Fig. 2b). The main menu appears upon logging on to MWP. The analysis menu, selected from the main menu, allows the user access to operations and products. All menu choices below "PRIORITY COMMANDS" are used to gain access to sub-menus. In nearly every case a sub-menu must be accessed before final choices can be made for display.

MWP allows a user to manipulate data in almost unlimited fashion. Any number of graphic fields can be individually overlaid on a wide range of map backgrounds, images, or other graphic fields. This can be done either manually, or automatically through the use of command strings which accomplish these tasks within the Automatic Product Generator (APG) (see Fig. 1). APG command strings can be initiated upon receipt of an AFOS graphic, through a scheduler, or at the command of the user. Figure 3 shows an example of an automated product with several overlays that was created with no manual intervention.

Manual product creation begins by combining one or more graphic and image products, zooming or centering, applying maps or airways boundaries, or selecting IR enhancement curves. These functions can be expedited through the use of APG command strings. Most of our manually created products require the use of the graphic editor, which is generally time consuming (partially due to the present menu design). Graphic editing is used primarily to draw lines, shade areas, apply text, and add symbols. With these techniques, we are able to highlight and discuss weather phenomena pertinent to aviation. Figure 4 is an example of a product which combines several of the aforementioned techniques. Products created in this way, once stored, may be sent to briefing terminals (Fig. 1) located in the main control room within easy access of air traffic personnel.

A hybrid products menu (located above "PRIORITY COMMANDS" on the analysis menu in Fig. 2b) provides the user quick access to files of related products. These have been processed by the APG to create finished graphic products that are ready for display and analysis. In addition to the files that appear in our reproduction of the analysis menu (Fig. 2), we also have hybrid products under the following headings: RADAR, PSEUDO, SKEW-T, STATION_PLOTS, and PIVA.

MWP as an Analysis Tool

Satellite Data

MWP's enormous capacity to display and process satellite data is perhaps its single greatest strength. Every half hour MWP receives visible, infrared, and water vapor images. All satellite images can be displayed in satellite projection (as satellite images are normally viewed on SWIS or MicroSWIS) or in Polar Stereographic North projection, which is the projection most AFOS graphics use.

MWP is very flexible in its ability to animate satellite data, though the process is a little time consuming. Loops are either created by selecting individual photos from directories of like images, or by selecting "SELECT LAST 6" from the animation directory menu.

Since the MWP workstation comes with two monitors, different animations can be viewed at the same time. It should be noted that all graphics and images can be animated.

Another benefit of the high resolution monitors and a satellite communications link is the unsurpassed quality of satellite images. With its higher resolution, the clarity of detail on a visible image is outstanding, and the quality of the image holds up well when enlarged. As with all graphical products in MWP, satellite images can be zoomed from any point on the screen with no limit to the amount of enlargement. Of course, there is little value in displaying a single pixel, and the user soon learns the practical limit to this function.

While standard enhancement curves from the National Environmental Satellite Data and Information Service (NESDIS) are included in MWP software, MWP allows the user unlimited ability to create enhancement curves in gray shades, in color, or in a combination of the two. Once created, enhancement curves are stored and available for immediate application.

Radar Data

MWP allows the user immediate access to a maximum of nine FAA and NWS radars within or near the boundary of the ARTCC zone. An additional dial-up port is available to access other radars. Any individual radar may be called up for a quick look or displayed in a continuous scan mode, updating every two minutes.

The most useful radar display feature, however, is the radar mosaic. All routinely available radars can be displayed simultaneously, resulting in much greater continuity of features depicted by two or more radars. Figure 5 is an example of our radar mosaic.

Radar data, both individual and mosaic, can be easily animated, adding dramatically to the user's ability to distinguish precipitation from ground clutter. Ground clutter seemingly disappears as an echo passes from within one radar's coverage to the next.

Other Analysis Functions

Range finding and interrogation are functions that apply to virtually any image or graphic product involving a geographical area. The range finder will determine and display the distance (NM) and direction (16 point compass) from a selected point to any other point. The interrogation feature will provide a decoded surface observation of the closest station to the map point selected.

Other interactive functions that we have used to a lesser degree include image panning and interactive soundings (Stuve and Skew-T). The interactive sounding functions will re-compute stability indices immediately as the user modifies the temperature or dew-point profile. The panning feature allows fast and efficient scanning of zoomed images.

AFOS Graphics

AFOS graphics can be displayed on MWP in much the same manner as on AFOS but there are some differences. MWP displays graphics on high resolution color monitors, with colors selected by the user, and several map projections are available.

Gridded Binary Data

One of the more powerful capabilities of MWP is its ability to access and manipulate gridded model data (called gridded binary data, or GRIB). GRIB data are available for both the Nested Grid Model (NGM) and the Global Spectral Model (GSM). Most fields are available in six-hour increments through 36 hours, and for 48 hours. GSM GRIB data are available through 60 hours.

Isopleth analyses for both the NGM and GSM can be created using MWP's isopleth program. This program can also grid and contour raw observational data (both surface and upper air) using Barnes analysis techniques.

Isopleths can be created for the following fields:

- Sea Level Pressure
- 3 Hour Surface Pressure Change
- Altimeter Setting
- Temperature
- Dew-Point Temperature
- Wind Speed
- Wind Direction
- Dew-Point Depression
- Relative Vorticity
- Divergence
- Moisture Convergence
- Temperature Advection
- Equivalent Potential Temperature
- Relative Humidity
- Mixing Ratio
- Lifted Index
- K Index
- Showalter Index
- Thickness (1000-500 mb)
- Thickness (1000-850 mb)
- Thickness (850-500 mb)
- Freezing Level
- Potential Temperature
- Omega Wind Component
- Precipitation

Cross Sections

MWP has an easy-to-use program that allows the meteorologist to display and overlay data derived from upper-air soundings in a cross section defined by a series of upper-air stations. Cross sections can be produced for temperature, dew-point depression, wind speed, potential temperature, equivalent potential temperature, and relative humidity.

Streamlines

MWP can produce streamlines for any mandatory level using either raw upper-air data or GRIB data.

Selectable Plot Products

This is yet another very powerful MWP tool. Plotted surface and upper-air data can be displayed in seemingly endless ways. Of course, data can be plotted using standard surface and upper-air plot formats, but MWP is not limited to this. The user can create the plot model that best depicts the desired data, and display specific fields anywhere around the station circle. An alert mode can be initiated that will change the color of a specific field within a surface plot whenever a predetermined threshold has been reached.

Comments

After making do with outdated technology for more than a decade, the CWSUs have been given a weather processor with near state-of-the-art potential. MWP represents a commitment by the FAA to provide meteorologists with powerful automation and imagery capabilities, with the expectations of a commensurate improvement in weather support. In a more basic sense, the planned integration of the CWSU into the future air traffic system accelerated the development of CWSU technology, with MWP being the first step.

The development of MWP was so rapid that field testing was minimal. This resulted in a number of operational problems, the two most significant being the menu configuration and alphanumeric functions. The mouse driven menu system, which has the potential to be an excellent way to retrieve data and initiate processes, was poorly designed and is cumbersome to use. Alphanumeric retrieval and word processing have been found to be totally inadequate, seldom used, and, thus, not discussed here.

MWP allows the meteorologist to more effectively monitor aviation weather trends, and to supply air traffic personnel with continuously updated weather images, graphics, and, to a lesser degree, alphanumeric products. High quality imagery and animation greatly enhances the CWSU's ability to identify developing weather hazards and produce timely advisories. With continued involvement by the CWSU staff, and the completion of needed enhancements by the contractor, MWP can come close to maximizing the use of available technology for providing weather support to the ARTCC.

While the use of MWP Briefing Terminals to supply ARTCC controllers with continuous weather data is a step forward, it introduces the FAA to the extremely complex problem of how this information is to be used. There are limits to the frequency that some products can be updated and sent to Briefing Terminals, and it is feared that the misinterpretation of data could result in liability problems. Because of this, many controllers have developed the policy of ignoring the Briefing Terminals. This kind of information avoidance is inappropriate, and it is essential that a comprehensive plan for continued system refinement, training, and the development of operating procedures be in place so that the CWSU can provide the best possible service to its users.

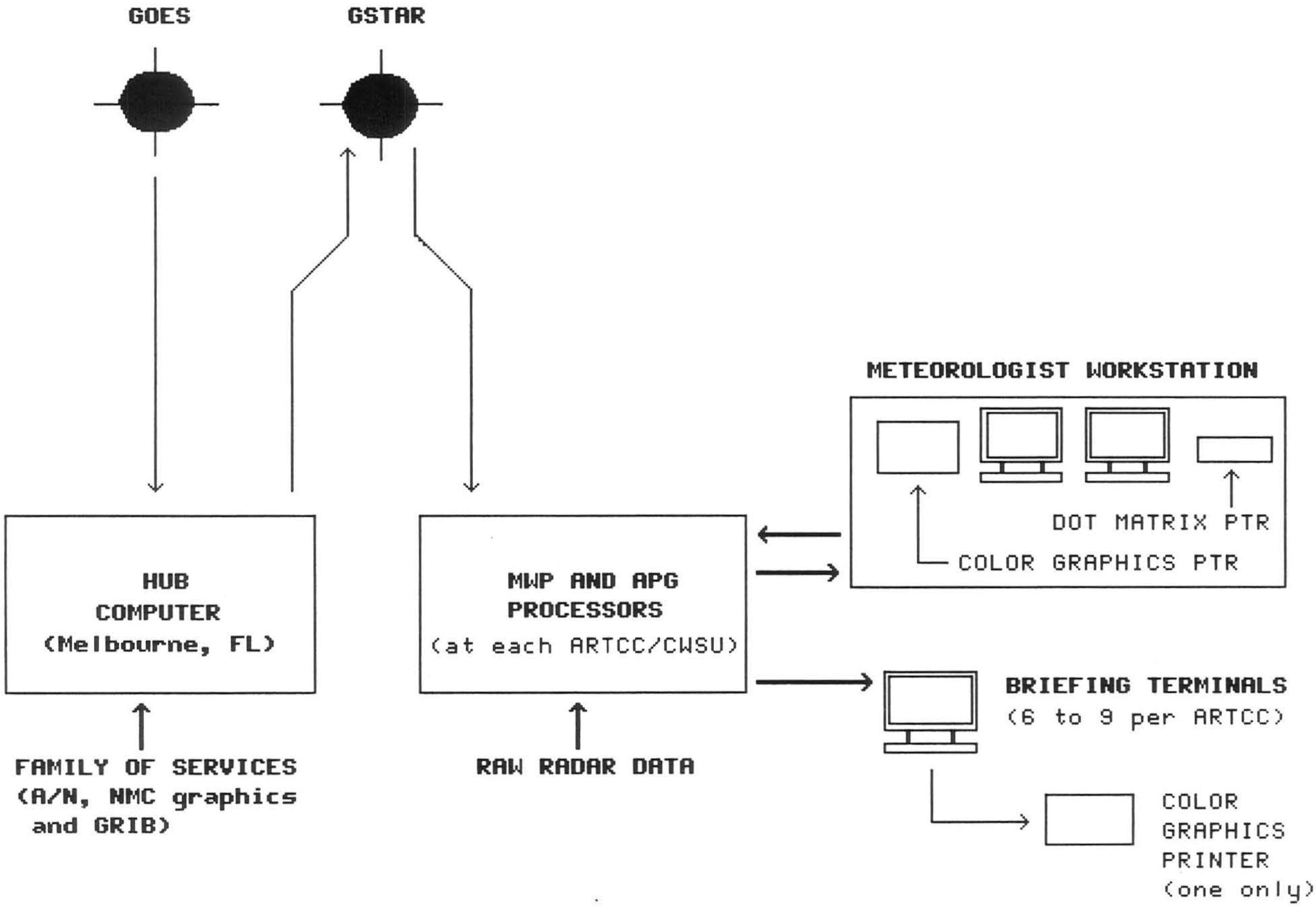

FIGURE 1. MWP DATA FLOW

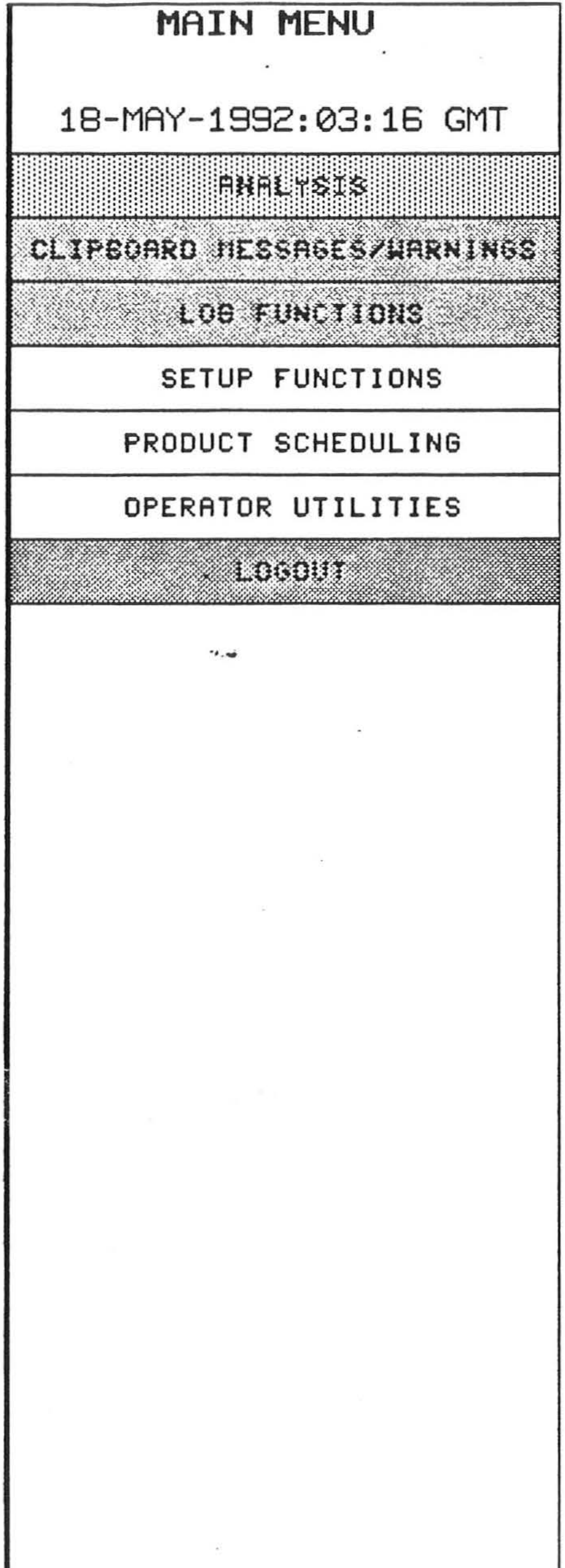

FIGURE 2A.
MWP Main Menu

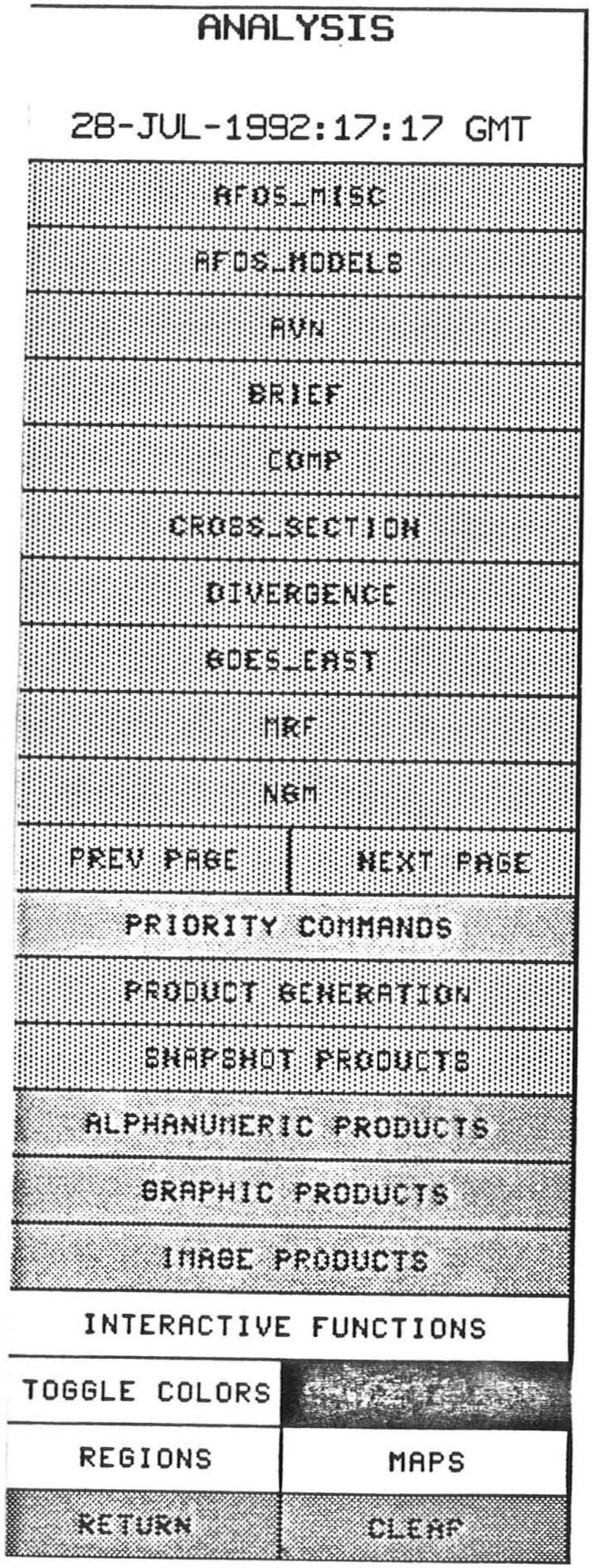

FIGURE 2B.
MWP Analysis Menu

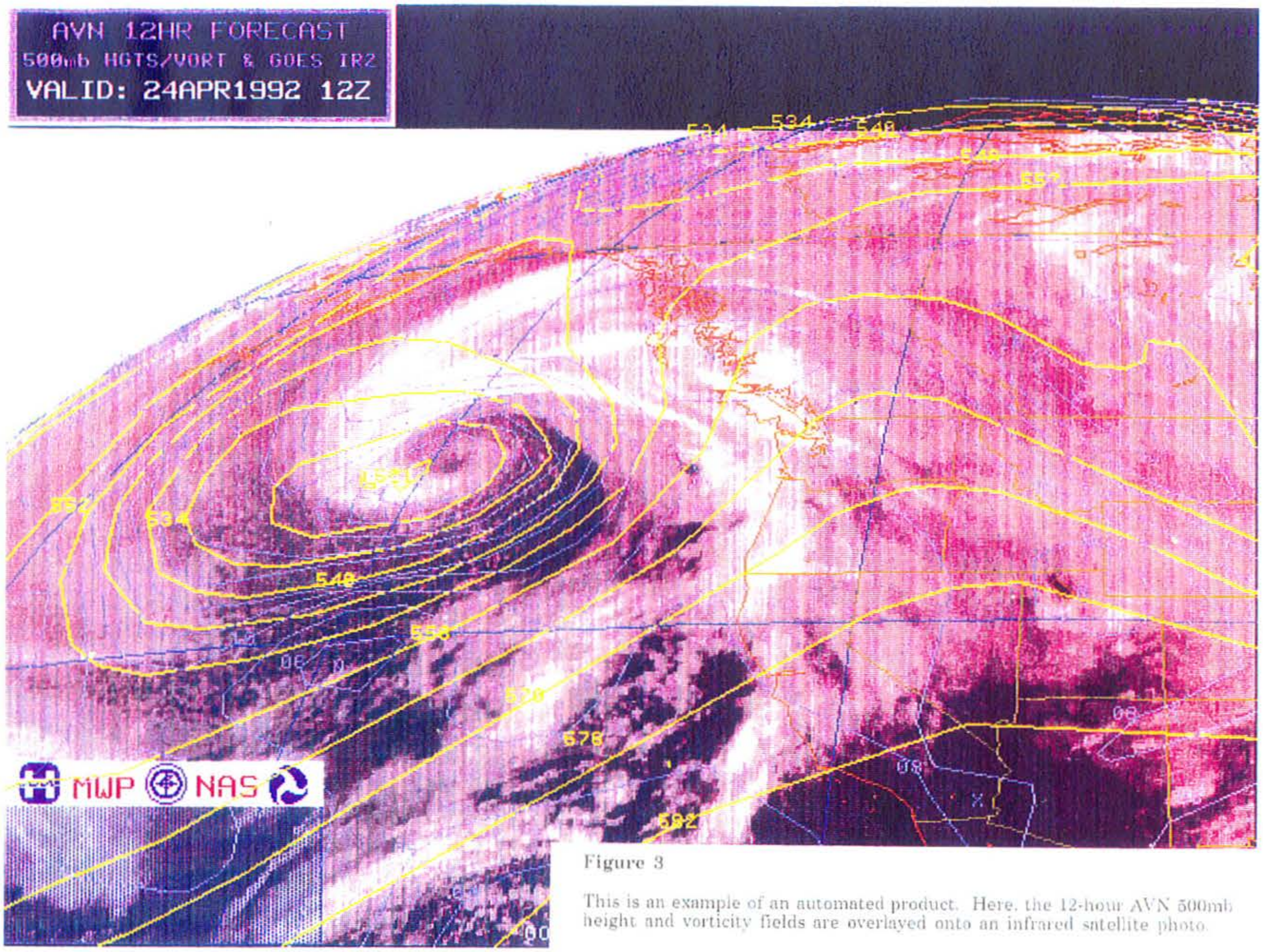

Figure 3

This is an example of an automated product. Here, the 12-hour AVN 500mb height and vorticity fields are overlayed onto an infrared satellite photo.

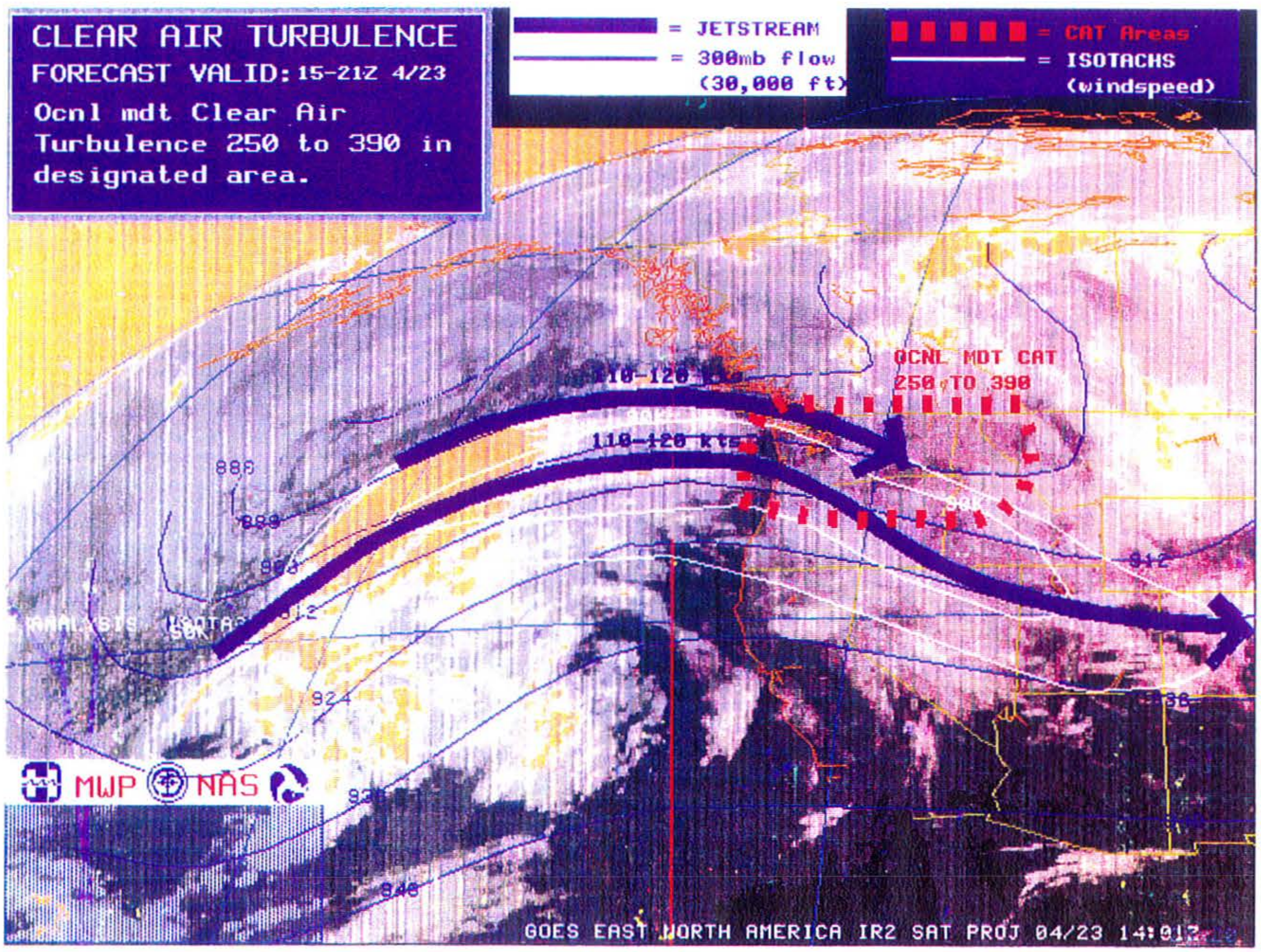

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Figure 4.

Here, graphic editing has been applied to an automated product. The automated portion consists of a color enhanced, infrared satellite photo, 300mb height and isotach fields, along with several labels. Graphic editing was used to depict the jetstream, show the area affected by clear air turbulence, and to apply text relating to turbulence.

Figure 5.

This is an example of a radar mosaic graphic available for immediate selection from the hybrid menu. This print has been done in reverse video. The image seen on MWP has a black background with white labels for VORs.