Description of the McIdas System

by

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THE MCIDAS SYSTEM

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Most of us are all too familiar with this type of presentation of weather information. For decades the facsimile charts prepared and distributed by large weather centres have been the backbone of synoptic information for field forecasters. The flexibility and timeliness of this information is definitely limited. Even with advanced instrumentation, when we are presenting satellite imagery to the forecasters, the product is often times less than usable. Technology is in the process of changing all this. The system I am going to describe here today provides not only very rapid access to an abundance of conventional weather data, but also presents plots and analyses of derived parameters not readily available before in real-time. It also has the capability of showing high resolution satellite imagery, of accurately determining earth coordinates on that imagery, of looping through sequential images to show the weather in motion, and probably most important, of combining the conventional or traditional weather information with the satellite data for presentation to the user.

The system is called McIDAS, which is an acronym for the Man-computer Interactive Data Access System. It began during 1973 in the Space Science and Engineering Center at the University of Wisconsin in Madison, with one satellite receiving dish on the roof, one small mini-computer for processing the data and one user terminal. The system has now grown to three dishes and eight computers in the network interconnected with high-speed data links. Terminals to this system are in Madison, Milwaukee, Kansas City, and Huntsville. Stand alone systems are located in Washington, Massachusetts, Florida and California.

Primary on-line storage for all the data is on digital disk. Current capacity is about 2 gigabytes. Permanent archiving of several data bases is done on either standard nine-track magnetic tape or on modified videocassettes. To be viewed by the user, the image data must be transferred under the control of the McIDAS computers to the

local terminal storage. Here it is placed either on a modified digital disk, into solid state memory or onto the analog disks such as the one shown. Each terminal is equipped with several local frames of storage. This terminal storage serves only to refresh the television monitor- the digital data required for quantitative evaluations remains on the host McIDAS computer.

Before any practical use can be made of the satellite data, a process called navigation is necessary because the satellite is constantly changing position. This predictive process requires about an hour of time by a person once a day at a McIDAS terminal to establish the required parameters for all of the next day's images. (Presently NESS staff perform this function on the VIRGS/McIDAS system in Washington and the navigation parameters are then transmitted with the IR documentation for each image). With the navigation established, the user may relate to the data seen on the television monitor in terms of geography or latitude-longitude coordinates. The navigation also provides the high degree of accuracy required for applications such as the determination of cloud-drift winds which need precise alignment of consecutive images.

The other major sources of data for the McIDAS systems are the more traditional forms of surface and upper-air observations. These are received at the McIDAS system over a medium speed digital broadcast service from the Weather Message Switching Center in Kansas City, Missouri. This circuit was established primarily to support the aviation industry and provides hourly surface data from more than 1000 stations in North America, surface synoptic and rawinsonde reports for much of the world, and a multitude of other related data. Data from this circuit is also made available in hard copy in the weather communications room of the Department of Meteorology. Here also a hard-copy terminal to the McIDAS system is provided and various forms of plots and analyses of data are available for student use. The terminal is also used in conjunction with the synoptic laboratory classroom where the videographics and satellite imagery can be displayed on a color television set.

The usual McIDAS terminal consists of a control and communications microcomputer, refresh memory, a color television monitor, a standard alpha-numeric CRT keyboard, and a pair of joysticks. Weather information may be displayed on the standard alpha-numeric CRT, such as the single observation shown for Madison. Most hourly reports are available to the user for processing by 15 minutes past

the hour. Here the computer was asked to list several consecutive hours of weather information for a single station. Radiosonde and surface hourly data are available on line for four days. In another type of data listing, the computer was instructed to list all the stations in the United States that were reporting light snow showers for a particular hour. Low resolution plots of observed and derived parameters, temporal changes, or grid point values can also be presented on the alpha-numeric CRT. For more complex presentations, the color television monitor is employed. Here, for example, is a rawinsonde observation plotted on a thermodynamic diagram. In the early McIDAS terminal hardware designs, the refresh memory for the graphics was separate from that for satellite imagery. In later terminals, using digital refresh for imagery, the graphics are simply a partition of the refresh memory space. In either case, three modes of display are possible: graphics, imagery, or graphics overlaying imagery.

Analyses ranging from observed parameters through spatial and temporal derivatives are available and the system allows great flexibility in manipulating the grids used for the displays. Here are the surface streamlines, and here we superimposed the isotachs on top of the streamlines. Here is another set of streamlines and now superimposed is the temperature advection field. Three colors are usually available from the graphics display. Although we could use three different colors for isopleths and dash some of the lines, two analyses really turn out to be about the practical limit for any single display. New terminals will permit up to seven colours with a selective fading of intensity .

Other forms of data presentation are also available. Here, for example, is the thermal part of a cross section analysis. To view several analyses at once, four panel plots are also available. The user may also change the colors of the lines and background maps presented, as shown here.

A slightly different form of four panel display is this picture of 500 mb height field presented here in three dimensional surface diagrams.

By far the largest use of the color monitors is to show satellite imagery. Within the system, it is also possible to display the observational data on top of the satellite imagery and then to analyze these data. If you take a close look in western

Pennsylvania, you will notice a bulls-eye in the analysis. Referring back to the original temperature plot, you will see a 65^{o} reading at Pittsburgh. Our experience has shown that data problems very often will show up in the analysis more readily than they do with simply the data plots or single-station continuity checks. As with the conventional data, if one is interested only in a particular region of the country, the satellite image may be blown up right over that region. For example, we have zoomed in on the area over the western Great Lakes states and on top of the satellite imagery have plotted the surface wind barbs and the indications of weather. Similar types of displays for upper air data are available on the system. For example, here are the height contours at 300 mb.

Of the myriad of other functions available from McIDAS is one of the oldest, and I think probably the original, reasons the system was created - to derive cloud drift winds from sequential GOES images. More recently the computer system has been employed to prototype the ground processing system for the VAS satellites. This slide also illustrates an important aspect of the McIDAS system, the ability to transform grey levels in the original image data to pseudo-colors on the display. The user has complete control over the transformation, by defining the luminescence, hue, and saturation.

Other applications of McIDAS include studying the atmospheric dynamics of Jupiter and Saturn from the Voyager satellite data. Here Titan is shown. It is important to realize that the navigation and wind-getting processes are really universal, as illustrated by these latitude-longitude lines which have been drawn on Titan. Here some colour studies were being one, this is a chromaticity diagram, and finally, this color enhancement of an image from the microwave channel on the NOAA-5 satellite.

I thought it good to end with this line to bring us back to reality, because this is the way things are. Technology certainly is offering a great promise and we will need to learn how to be employ these new tools to enhance our understanding and amplify our abilities in the years to come.