McIDAS-X

Man computer Interactive Data Access System for Unix

Learning Guide

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Space Science and Engineering Center
University of Wisconsin-Madison
1225 West Dayton Street
Madison, WI 53706
Telephone (608) 262-2455
TWX (608) 263-6738

Preface

The Learning Guide introduces you to McIDAS-X and teaches you the basic tools and concepts needed to use the system. The Learning Guide assumes you know meteorology; however, you do not need to know McIDAS or Unix.

The manual consists of nine lessons that build upon one another:

- Getting Started
- Loop Control System
- Satellite Imagery
- Graphics and the Cursor
- String Tables
- MD Files
- Grids and Grid Files
- Weather Analysis
- Enhancements

You will learn most effectively completing them in order.

The cover image shows a detailed weather analysis of the "Storm of the Century" from 13 March 1993. The satellite image is a Meteosat-3 infrared image taken at 18 UTC. A series of MC commands combined the infrared image and a basemap image, separating the land, cloud, and ocean pixels. The land, cloud, and ocean images were then stretched to different brightness values using the command IMGPRO. These images were then combined using IMGPRO to create an image where land, cloud, and ocean pixels have different brightness values. Lastly, the image was color enhanced using command EU.

The dark green to tan to brown progression of colors shows land regions stretching from colder to warmer infrared temperatures. The dark blue to light blue regions depict decreasing ocean temperatures. The light blue to white regions show decreasing infrared temperatures in cloudy regions. Surface pressure contours (solid light blue contours) and surface temperature contours (dashed red contours) are overlaid on the image. Also included are weather symbols showing the current weather conditions reported. All labels were added using command XFONTS.

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Getting Started

The Man computer Interactive Data Access System (McIDAS) is a powerful data ingest, management, and analysis system used for meteorological research and operational weather forecasting. The McIDAS database contains both real-time weather satellite data and conventional weather data which you can access and analyze. For example, with McIDAS you can:

- view a time sequence of real-time satellite images
- track cloud motions
- color enhance displayed images
- overlay surface and upper air contoured analyses on satellite imagery
- calculate derived parameters
- display a thermodynamic diagram

This Learning Guide introduces you to McIDAS-X and teaches the basic tools and concepts needed to use the system. The lessons build upon one another; you will learn most effectively completing them in order. Lesson 1 describes how to:

- start and exit McIDAS-X
- log on to the workstation
- use online helps
- raise windows
- display frames
- display opposite frames
- add frames
- stop commands
- connect to the mainframe

The following commands are used in this lesson.

Command	Function
A	advances one frame
B	backs up one frame
EXIT	shuts down a McIDAS-X session
H	toggles between the host mode and local mode
F	displays the workstation's state
HELP	lists online documentation
KILL	stops a command
LOGON	logs you on to the McIDAS system
MAKFRM	creates additional frames
O	switches to the opposite frame
SF	displays a frame
?	lists McIDAS-X commands currently running
/	stops a McIDAS-X command

Basic Concepts

Three-button Mouse

You can use either a two or three-button mouse with McIDAS-X; however, a two button mouse is required. In all cases, when you are instructed to use the right button, use the rightmost button of your mouse. When instructed to use the left button, use the left button on a 2-button mouse or the middle button on a 3-button mouse.

McIDAS-X Windows

A McIDAS-X session generates three windows:

- command window
- image window
- text window

Windows can be *active* and *raised*. Active windows normally receive all keyboard input. To make a window *active*, move the pointer onto the title bar and click the left mouse button. By activating a window, you also *raise* it. Raising a window brings it the top of any overlapping windows.

All windows have a title bar that contains the following information:

McIDAS *window type : user@workstation* **[T=***Num***]**

Window type describes the window as either the command, image or text window; user@workstation displays your McIDAS logon name and the workstation running your McIDAS session; and [T=Num] is the McIDAS session number you are running.

Command Window

Use the command window to enter McIDAS-X commands and to view the status of McIDAS-X. This window must be active to run McIDAS-X commands. A status line appears in the upper portion of the command window as shown below. It contains information about the current looping status, loop bounds, frame number, host connection, image status, text file status, date, and time.

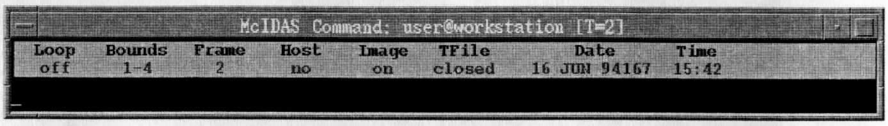
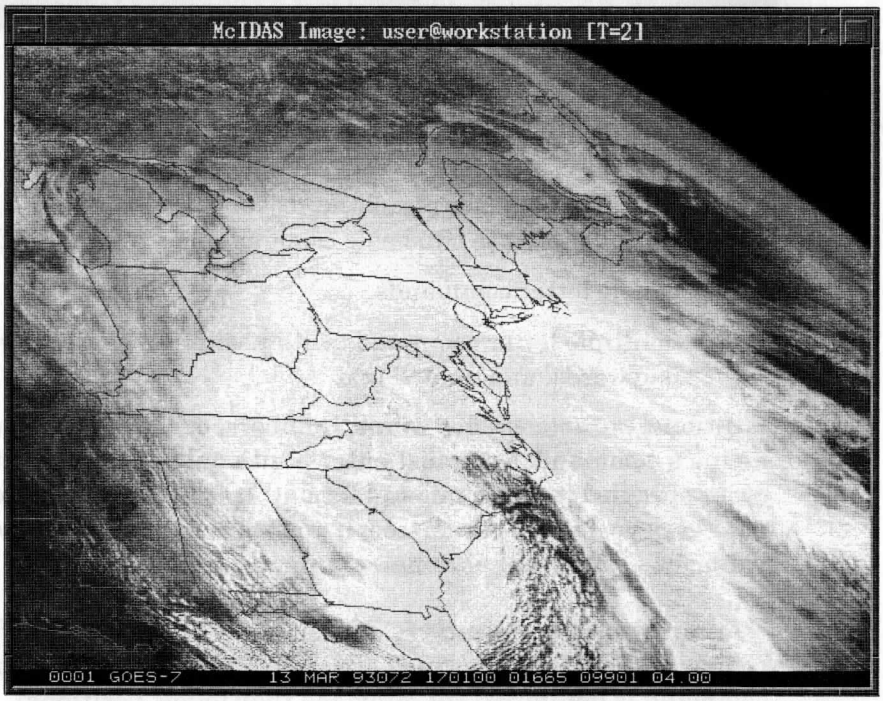


Image Window

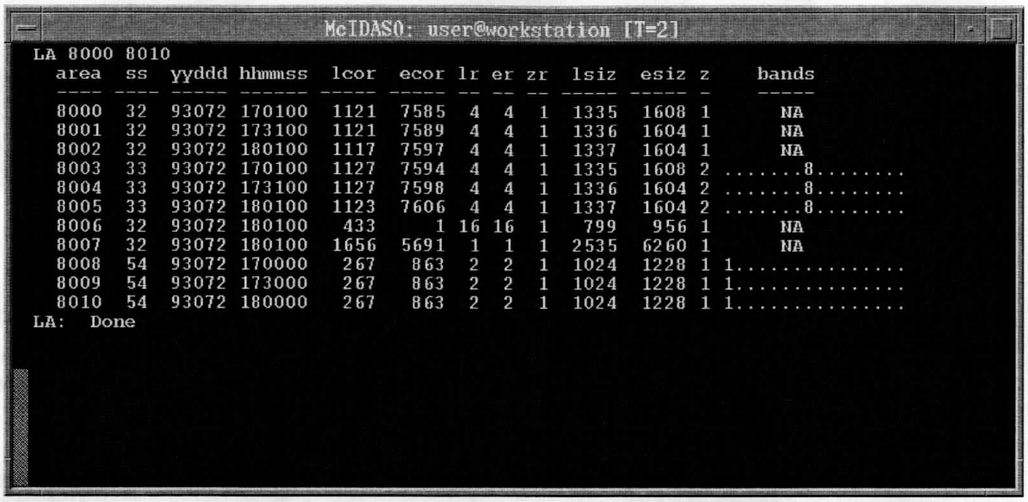
The image window shows frames that display McIDAS-X images and graphics. An image is a pictorial representation of area data, for example, a satellite image. A frame can display an image, graphic, or both, like the one shown below.



Text Window

You can create up to ten text windows to display McIDAS-X text, such as helps for McIDAS commands, data information, and a history of executed commands. The example below shows the text output for the LA command. You can scroll in a text window by moving the cursor to the vertical scroll bar and pressing the right and/or middle mouse button.

The text window number is displayed after McIDAS in the title bar. The example below shows text window 0.



```
McIDAS0: user@workstation [T=2]
LA 8000 8010
  area  ss  yyddd hhmmss  lcor   ecor lr er zr  lsiz  esiz z     bands
  ---- ---- ----- ------ -----  ----- -- -- -- ----- ----- -     -----
  8000  32  93072 170100  1121   7585  4  4  1  1335  1608 1       NA
  8001  32  93072 173100  1121   7589  4  4  1  1336  1604 1       NA
  8002  32  93072 180100  1117   7597  4  4  1  1337  1604 1       NA
  8003  33  93072 170100  1127   7594  4  4  1  1335  1608 2 .......8........
  8004  33  93072 173100  1127   7598  4  4  1  1336  1604 2 .......8........
  8005  33  93072 180100  1123   7606  4  4  1  1337  1604 2 .......8........
  8006  32  93072 180100   433      1 16 16  1   799   956 1       NA
  8007  32  93072 180100  1656   5691  1  1  1  2535  6260 1       NA
  8008  54  93072 170000   267    863  2  2  1  1024  1228 1 1...............
  8009  54  93072 173000   267    863  2  2  1  1024  1228 1 1...............
  8010  54  93072 180000   267    863  2  2  1  1024  1228 1 1...............
LA:  Done
```

Commands

McIDAS applications are command-driven which make the system very flexible. There are two basic command formats in McIDAS-X:

- single letter commands
- multiple letter commands with positional parameters, keywords, and quoted text

Positional *parameters* are words, numbers, or letters that further define a command. You must enter positional parameters in the exact order specified in the command format. It is not always necessary to use every positional parameter. If you want to specify the default value for a positional parameter, enter an X in its place.

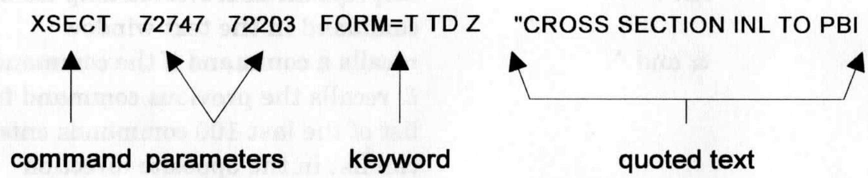
You can also add *keywords* to the command to further clarify a command function. Keywords are optional and their order in the command is not important, provided they follow positional parameters and precede quoted text.

Most keywords are command specific; however, the four global keywords below can be used with any McIDAS-X command.

- DEV=
- FONT=
- TWIN=
- VIRT=

The DEV= keyword specifies the destination device of text output generated by a command. The FONT= keyword specifies the font for drawing text on the image window. The TWIN= keyword specifies the destination text window to route the command output to. The VIRT= keyword specifies a virtual graphics number to write the graphics output to. See the McIDAS-X Users Guide for more information.

The maximum command length is 160 characters. A sample command line is shown below.



To run single letter commands, simultaneously press the Alt key and the letter key, or type the letter and press Enter. Below is an example of the format for single letter commands in the Learning Guide.

Press: **Alt A**

To run multiple letter commands, type the command and press Enter. This Learning Guide assumes you will always press Enter after typing the command. Below is an example of the command format in the Learning Guide.

Type: **CW 1 3**

This means you should type **CW 1 3** and then press Enter. Commands will not run if a space precedes the first character of the command name. However, you can have multiple spaces between parameters and keywords.

A command line can contain several commands. To concatenate commands, type a semicolon between the commands. For example:

Type: **DF 10 3; LS 1-3**

When multiple commands are entered on the command line, each command is run in the order it is listed. The first command must finish before the next command can begin.

Several keys are available for editing the command line. Listed below are command line editing keys and their functions.

Key	Function
Home	moves the cursor to the beginning of the line
End	moves the cursor to the end of the line
Insert	toggles to the insert typing mode
Delete	deletes the character over the cursor
Backspace	deletes the character to the left of the cursor
Right/Left arrows	moves the cursor one character to the right or left
Tab, Shift Tab	moves the cursor one parameter to the right or left
Enter	runs the command
Esc	erases the command from the command window and places the cursor at the front of the line
Alt ?	displays an abbreviated help for the current command in the text window
& and ^	recalls a command if the command line is empty; & recalls the previous command from a circular list of the last 100 commands entered; ^ scans the call list in the opposite direction

Note: The Home, End, right/left arrows, Ins and Del keys on the numeric keypad do not work in McIDAS-X.

Command Helps

The online helps provide an abbreviated description of the McIDAS-X commands. For a complete description of each command, see the McIDAS-X Users Guide.

McIDAS-MVS

If your workstation connects to a mainframe running McIDAS-MVS, you can send commands from the workstation to the mainframe. This is useful for accessing real-time data. The mainframe can have up to 15 workers; each runs one command line entry. The command entry can be multiple concatenated commands. A workstation can only use four workers at a time. So, for example, if you quickly entered these five commands: CUR 5, DF 101 1, EG, LA 100 120, MDU SET 1001, one of the first four commands must be completed before the fifth command can be assigned a worker. Command SS lists the commands in use and the workers they occupy.

Starting and Exiting McIDAS-X

Before you begin this lesson, McIDAS-X and the X Window System must be installed on your workstation and configured according to the specifications in the McIDAS-X Users Guide.

1. **Start McIDAS-X by entering the following in lowercase from the Unix prompt.**

   Type: mcidas

2. **Exit McIDAS-X by typing EXIT in the McIDAS command line. In step 3, you will restart McIDAS and change the display.**

   Type: EXIT

3. **Start McIDAS-X again, but this time change the display by adding *flags* at the Unix prompt to change the font, number of text windows, foreground and background colors, number of graphics levels, and number of frames.**

   Type: mcidas -lv 128 8 -tx 2 -fn r14 -bg gray30 -fg white -fr 4 8

   Your McIDAS-X session is displayed with:

   - **128 image levels and 8 graphics levels**
   - **2 text windows that use Roman 14 font**
   - **4 frames with a maximum of 8 frames, each 480 lines by 640 elements**
   - **gray background color and white foreground in text windows**

For more information on the flags, see the McIDAS-X Users Guide, or type mcidas -h from the Unix prompt.

Logging on to the Workstation

You can start McIDAS-X without logging on to the workstation, as you did at the beginning of this lesson; however, some system and data files (e.g. grid files and string tables) you create or edit won't have your initials or project number saved with them. The LOGON command with the I (initialization) parameter modifies the McIDAS-X session by:

- clearing the string table
- setting the image frame loop bounds from one through one-half the total number of frames
- setting the MD file number to 1
- setting the default dwell rate to nine units for the first frame and six units for the remaining frames
- setting the graphics line width to one pixel
- initializing the graphics color levels
- displaying a red, 31 by 31 pixel, cross hair cursor
- setting the enhancement table to 0 255 0 255 0 255 0 255

1. Log on to the workstation. Type your initials and project number. The I parameter initializes the workstation; the WS parameter logs you on to the workstation only, and not the mainframe. The WS appears as dashes on the command line when entered.

   Type: **LOGON** *initials project* **I WS**

   The message "LOGON to McIDAS-X completed" is displayed in the active text window.

Using Online Helps

Online helps list the syntax of each command including the parameters, keywords, and remarks. To access the online help, type HELP in the McIDAS-X command window followed by the command for which you'd like more information. You can find additional command information in the McIDAS-X Users Guide.

1. **Find the help for the EG command.**

   Type: **HELP EG**

   The help text appears in the active text window as shown below.

```
EG -- Erases graphics frames
EG bframe eframe
EG I bframe eframe
Parameters:
bframe | beginning frame to erase (def=current)
eframe | ending frame to erase (def=bframe)
       | erases image and graphics
Remarks
  If the pseudo-independent graphics option (-ig yes)is
  selected when McIDAS is started, a copy of the image
  displayed is saved in memory and referred to as the
  "back plane." When an EG command is run, graphics are
  erased from the display by restoring the images saved
  in the back plane. This gives the impression of separate
  image and graphics.
```

Raising Windows

Raising a window brings it to the front of any overlapping windows so you can view the entire window. To raise a text window, press the corresponding number on the numeric keypad. To raise the image window, press the plus (+) key.

The instructions in this exercise are for IBM RISC System/6000 and HP Apollo 9000 workstations. If you have an SGI Personal Iris workstation, press the Shift key plus the appropriate number. If you have a SUN SPARCstation, press the Altgraph key plus the appropriate number.

1. Raise text window 1, named McIDAS1, by pressing the number 1 on the numeric keypad.

   Press: **1**

2. Raise text window 0, named McIDAS0, by pressing 0 on the numeric keypad.

   Press: **0**

3. Raise the image window.

   Press: **+**

Displaying Frames

The image window may contain several frames. By default, the image window contains four empty frames. In this exercise, you will display four satellite images in four frames and step through the frames.

1. Display four images in the four frames using the DF command. The DF command displays satellite images and is discussed further in Lesson 3.

   Type: **DF 8000 1 EC DCA X 2**
   Type: **DF 8003 3 EC DCA X 2**

2. Show frame 3 using the SF command.

   Type: **SF 3**

3. Advance through the frames.

   Press: **Alt A**

   Because A is a single letter command, you don't need to press Enter. Command A advances the frames one by one.

4. Back up through the displayed frames.

   Press: **Alt B**

Displaying Opposite Frames

Each frame has an opposite frame that is half the total number of frames away. For example, on a session with ten frames, frames 1 and 6 are opposite, frames 2 and 7 are opposite, etc. The single letter command O toggles between a frame and its opposite, which is useful for comparing images.

In this exercise, you will use the four images set up in the previous task to toggle between the images and their opposites.

1. List the current and opposite loops.

   Type: **LS**

   The current loop is frames 1 through 4 and the opposite loop sequence is frames 3, 4, 1, 2.

2. Display frame 2 using the SF command.

   Type: **SF 2**

3. Show the opposite frame, frame 4.

   Press: **Alt O**

4. Backup one frame to frame 3.

   Press: **Alt B**

5. Show the opposite frame, frame 1.

   Press: **Alt O**

Adding Frames

You can create additional frames after McIDAS has been started using the MAKFRM command. New frames are added to the end of the current frame list. The default size of the new frame is the same as that of the frame currently displayed. You cannot exceed the maximum number of frames defined when you started the McIDAS-X session. A maximum of eight frames was defined when you started this session.

1. Add two new frames the same size as the current frame (480 x 640) to your McIDAS-X session.

   Type: **MAKFRM 2**

   Two frames are added to the session, giving you six frames.

2. Check the number of frames for this session.

   Press: **Alt F**

   Status information for your workstation is displayed as shown below. The number of available frames is six.

```
   Video Status for Your Terminal
Number of Available                  6
Current                              1 (Opp = 3 )
Loop Bounds                          1 to 4
Visible (K toggle)                   Yes
Looping (L toggle)                   No
Cursor parameters:  Size =  31 / 31          Type  = Xhair
        Center position = 152 / 555          Color = RED
Image frames 1 - 6  with imbedded graphics are 480 BY 640
```

Stopping Commands

Every command being run has a Process Identification (PID) number associated with it. To stop a command on the workstation, you must find the PID for the command by checking the command status with the question mark (?) command and then using the KILL or slash (/) command. In this exercise, you will enter a command and then stop it.

1. Enter the following command.

   Type: **ZLM**

2. Find the PID for the ZLM command by checking the command status.

   Press: **?**

   McIDAS-X lists command status information. An example is shown below.

```
statcmd
UID      PID    PPID  C  STIME     TTY    TIME   COMMAND
tester   17308     1  0  07:56:28  ttyq3  0:00   sked.mx 2 4 uc
tester   17328     1  1  08:03:32  ttyq3  0:00   statcmd.mx 2 4 uc
tester   17312     1  0  07:56:28  ttyq3  0:00   import.mx 2 4 uc
tester   17310     1  0  07:56:28  ttyq3  0:00   tcpip.mx  2  4 uc
tester   17326     1  0  08:03:31  ttyq3  0:00   zlm.mx  2  4  uc
```

3. Find the PID for the ZLM command. Type KILL followed by the appropriate PID number and press Enter. For example, to stop PID 17326:

   Type: **KILL 17326**

   or

   Type: **/17326**

   Be sure not to accidentally stop the commands SKED, TCPIP, IMPORT or COMM. This halts communications and the command scheduler. If you stop these programs, you must restart McIDAS-X.

Connecting to the Mainframe

If you have access to a mainframe computer running McIDAS-MVS, you can run in two McIDAS modes: local and host. When you started McIDAS-X at the beginning of this lesson, you started a local session of McIDAS on your workstation.

Host mode refers to accessing a mainframe computer running McIDAS-MVS. A user operating in the host mode is sending commands to the mainframe running McIDAS-MVS, for execution. You can alternate between host and local mode using Alt H. For example, you might toggle to host mode to copy real-time satellite data onto the workstation.

If you have access to McIDAS-MVS, follow the steps below. If not, you can go to Lesson 2.

In this exercise, you will log on to McIDAS-MVS and then toggle between the host and local modes.

1. Log on to the mainframe. Enter your initials and the appropriate project number and password. The password will appear as dashes on the command line. The X is a placeholder for the positional parameters. If you are unable to connect to the mainframe, see your system administrator or operator.

   Type: **LOGON** *initials project* **X** *password*

   You are now logged on to McIDAS-MVS and McIDAS-X. Notice that there is a period in the first position in the command window. Also note that Host in the command window status line now reads *yes*.

2. Enter the mainframe command SS to check the McIDAS-MVS system status.

   Type: **SS**

   Information about commands being run on McIDAS-MVS is listed.

3. **Return to local mode.**

   Press: Alt H

   The period in the command window disappears and the Host indicator changes to *no*. You are still connected to the mainframe, but you have switched from host mode to local mode.

4. **Enter the McIDAS-X question mark (?) command to check the workstation status.**

   Type: ?

5. **Log off the mainframe.**

   Type: LOGOFF

6. **End your McIDAS-X session.**

   Type: EXIT

   All McIDAS-X windows are closed and the Unix prompt should be displayed.

2. Loop Control System

Lesson 2
Loop Control System

Lesson 2

Loop Control System

The loop control system is a group of McIDAS-X commands for viewing frames in a sequence. The order of frames in a loop can be sequential or random. For example, when frames are loaded with a chronological series of satellite images, you can loop them to follow cloud motions. This lesson describes how to:

- create a loop
- change the dwell rate
- change the loop sequence

The following commands are used in this lesson.

Command	Function
A	advances one frame
B	backs up one frame
DR	defines the dwell rate
F	displays the workstation's state
L	turns looping on and off
LS	defines a looping sequence
O	displays the opposite frame

Basic Concepts

You can define a random or sequential loop, and set the display time (dwell rate) for each frame in the loop.

Loop Bounds and Sequences

A loop has beginning and ending frames called loop bounds. When you start McIDAS-X, the loop bounds are set from frames one through the total number of frames. If you log on to McIDAS-X and initialize the workstation, the loop bounds are one through one-half the total number of frames. You will use command LS to set loop sequences which can be sequential or random.

When defining loop bounds, you also create opposite loop bounds. For example, a workstation with ten frames and a loop set for frames one through five, will set an opposite loop from frames six through ten. This is useful for comparing visible and IR images.

Dwell Rate

The dwell rate is the amount of time each frame is displayed during automatic looping. The default dwell rate is nine units for the first frame and six units for the remaining frames. One unit is approximately 1/15 of a second; the fastest dwell rate is 1/15 of a second (1 unit), though some workstations will not be able to sustain that rate.

Creating a Loop

In this exercise, you will start a McIDAS-X session with six frames, display six images with the DF command and loop the frames using Alt L. Then, you will switch to the opposite loop with the Alt O command.

1. Start McIDAS-X from the Unix prompt and specify six frames for this exercise.

   Type: **mcidas -fr 6**

2. Log on to the workstation.

   Type: **LOGON** ***initials project*** **I WS**

3. Check the loop bounds.

   Press: **Alt F**

   The default loop bounds are 1 through 3 as shown below. Notice that Bounds in the status line is *1-3*.

```
   Video Status for Your Terminal
Number of Available                   6
Current                               1 (Opp =  4)
Loop Bounds                           1 to 3
Visible (K toggle)                    Yes
Looping (L toggle)                    No
Cursor Parameters:   Size=  31 / 31     Type=Xhair
         Center position= 100 / 100     Color=RED
Image frames 1 - 6  with embedded graphics are 480 X 640
```

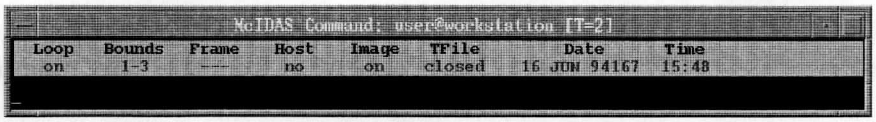
4. Display six images using the following DF command. DF is discussed further in Lesson 3.

   Type: **DF 8000 1 EC DCA X 6**

5. Loop frames 1 through 3.

   Press: **Alt L**

   Notice that the status line indicates Loop is *on* and Frame has dashes (---).



6. Toggle to the opposite loop.

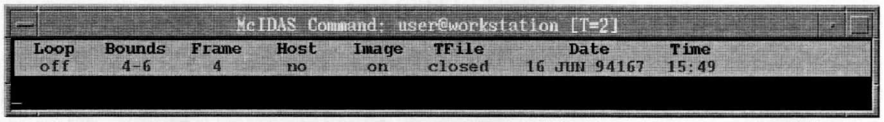
   Press: **Alt O**

   The loop displays frames 4 through 6 and Bounds in the status line changes to *4-6*.

7. Stop the loop.

   Press: **Alt L**

   The loop display returns to the first frame in the current loop sequence, in this case, frame 4. Notice that Frame has the value 4 and Loop is *off* on the status line.



8. Toggle to the primary loop.

   Press: **Alt O**

9. Use the single letter commands A and B to manually step through the current loop. Alt A advances through the frames; Alt B moves backwards through the frames.

   Press: **Alt A**
   Press: **Alt B**

Changing the Dwell Rate

In this exercise, you will use the DR command to change the dwell rate which is the amount of time each frame is displayed during automatic looping. Each frame can have a dwell rate assigned by DR.

1. Check the dwell rates.

   Type: **DR**

   The default dwell rate is nine units for the first frame and six units for the remaining frames.

2. Start the loop.

   Press: **Alt L**

3. Change the dwell rate to two units.

   Type: **DR 2**

   The images continue looping, but at a faster rate. Each frame in the loop is displayed for two units.

4. Change the dwell rate to 20 units.

   Type: **DR 20**

   Each frame in the loop bounds is displayed for 20 units.

5. Set the dwell rate to a variety of values.

   Type: **DR 2 10 20**

   The first frame is set to two units, the second frame to 10 units, and the third frame to 20 units.

6. **Stop the loop.**

   Press: Alt L

7. **Change the dwell rate to its initialized value.**

   Type: DR INI

   The dwell rate should be nine units for the first frame and six units for the remaining frames.

Changing the Loop Sequence

In this exercise, you will change the loop sequence with the LS command.

1. Change the loop sequence to be from frames 1 through 6.

   Type: **LS 1-6**

   Notice that Bounds on the status line changes to *1-6* and frame 1 is displayed.

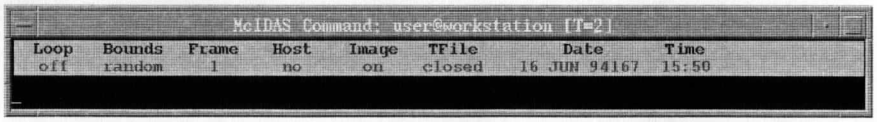
2. Start and stop the loop.

   Press: **Alt L**

3. Define a loop with random sequencing.

   Type: **LS 1 3 2**

   The primary loop is frames 1, 3, and 2, and the opposite loop is frames 4, 6, and 5. Notice that Bounds in the status line changes to *random*.



4. Set the opposite loop to display a random sequence.

   Type: **LS O 6 5 4**

5. Check the current loop settings.

   Type: **LS**

   The primary loop is frames 1, 3, and 2, and the opposite loop is frames 6, 5, and 4. The dwell rate for both loops is nine units for the first frame and six units for the remaining frames.

6. Loop the primary sequence, the loop set in step 3.

   Press: **Alt L**

   Notice the frames loop from frame 1 to 3 to 2.

7. Toggle to the opposite loop sequence.

   Press: **Alt O**

8. Toggle back to the primary loop sequence.

   Press: **Alt O**

9. Stop looping.

   Press: **Alt L**

10. Exit McIDAS-X.

    Type: **EXIT**

For more information on the commands of the Loop Control System, see the McIDAS-X Users Guide.

3. Satellite Imagery

Lesson 3
Satellite Imagery

Lesson 3

Satellite Imagery

McIDAS-MVS receives real-time weather satellite data that you can easily access and analyze using McIDAS-X. This lesson describes how to:

- **display satellite data**
- **use coordinate systems**
- **list area data**
- **change the image resolution**
- **copy and display areas**
- **delete areas**

The following commands are used in this lesson.

Command	Function
AA	copies and displays areas
C	lists a frame directory
D	lists the area data at the cursor center
DF	displays an area on a frame
E	lists the earth coordinates at the cursor center
LA	lists area directories
OD	lists the area data inside the cursor
QA	deletes areas

Basic Concepts

McIDAS-MVS receives satellite images from geostationary and polar orbiting satellites. Geostationary satellites remain above a fixed location on the earth's surface, approximately 22,500 km above the equator. Because the satellites rotate with the earth, they always view the same portion of the globe. GOES-7 observes North America, South America, and the eastern Pacific Ocean. METEOSAT-3 monitors North and South America, and the western Atlantic Ocean. METEOSAT-4 and METEOSAT-5 monitor Europe, Africa, western Asia, and the eastern Atlantic Ocean. GMS monitors eastern Asia, Australia, the western Pacific Ocean and the eastern Indian Ocean.

Polar orbiting satellites orbit at much lower elevations (800-900 km). Their path is 2,400 km wide centered at the orbit path. With each orbit, the satellites observe a new path. Currently, McIDAS ingests two POES satellites, NOAA-11 and NOAA-12.

Satellite Data Storage

Satellite data is stored in locations on disk called *areas*. You can copy, change, display, and delete areas. Areas contain both data and area directories. Area data can be displayed on McIDAS-X frames. The area directory contains descriptive information, such as the sensor source, image date, picture start time, and image coordinates. An area directory is shown below and each field defined.

area	ss	yyddd	hhmmss	lcor	ecor	lr	er	zr	lsiz	esiz	z	bands
8000	32	93072	170100	1121	7585	4	4	1	1335	1608	1	NA

Field	Definition
AREA	location where the areas are stored. Typical ranges are 1 to 9999 for McIDAS-X, and 1 to 32000 for McIDAS-MVS.
SS	sensor source number. SSEC assigns a number to each sensor type, such as a satellite or radar. The number distinguishes data collected from different sensors with coincident days and time. In the example, 32 designates a GOES-7 visible sensor source. See the McIDAS-X Users Guide for a list of currently assigned SS codes.

Field	Definition
YYDDD	date of the sensor reading. The first two digits refer to the year and the next three digits correspond to the day in the Julian date, where January 1 is day 001, January 2 is day 002, etc. The date 93072 in the example is 13 March 1993.
HHMMSS	image start time in hours, minutes, and seconds UTC. In the example, 170100 refers to 11:01 AM Central Standard Time (CST).
LCOR and ECOR	image coordinates for the upper-left corner of the area
LR and ER	sampling factor for the line and elements. You'll learn more about sampling later in this chapter.
ZR	number of bands. You'll learn more about bands later in this chapter.
LSIZ and ESIZ	image sector's size. You'll learn more about them later in this chapter.
Z	number of bytes per pixel
BANDS	wavelength used to scan the earth. For example, GOES-7 uses band 8 for infrared and NA for visible imagery.

Area Naming Conventions

Areas use the naming convention AREA*nnnn* where *nnnn* is the four-digit area number. For example, AREA0013 is the name of the file that contains area 13. Most McIDAS commands use only the area number. However, you must use the AREA prefix with the DMAP command or when using Unix commands to copy, move, or delete areas.

Image Sectors

Complete images are often too large to display on a frame. You can subsect the original area into another area or onto a frame with increased, decreased, or the original resolution. This is useful when copying mainframe areas to your workstation. These subsections of the original area are called *image sectors*. An image sector can be created four ways:

- sampling every *n*th line and element to decrease the resolution
- averaging *n* number of pixels down and to the right to decrease the resolution
- reproducing every pixel once to retain the original resolution
- duplicating every pixel *n* number of times to magnify the resolution

The sampling and/or averaging rates are saved as LR and ER. These additional descriptors enable the system to compute the image coordinate of the J^{th} element in the I^{th} line in an image sector by means of the following calculations:

LINE = LCOR + (I-1) * LR
ELEMENT = ECOR + (J-1) * ER

The number of lines and elements extracted from the original image (LSIZ, ESIZ) determines the size of the image sector.

SSEC's Real-time Area Data

SSEC's McIDAS-MVS has 32,000 areas; areas 1 to 1999 are reserved for the system operators. The table below lists the satellite data that SSEC receives and its location on the mainframe.

Satellite data type	Area number
GOES Prime 112° W	
1 km VIS	101-104
4 km VIS	105-108
4 km IR	109-112
8 km MSI	121-128
8 km Dwell Sounding	131-136
GMS	
10 km VIS	18101-18114
10 km IR	18121-18144

Satellite data type	Area number
METEOSAT 0° W	
2.5 km VIS	200
5 km VIS	201-204
5 km IR	205-212
5 km H_2O	213-218
2.5 km VIS	221-222
5 km IR	223-224
5 km H_2O	225-226
METEOSAT 75° W	
5 km VIS	301-304
5 km IR	305-312
5 km H_2O	313-318
POES NOAA-11	
HRPT	715-719
GAC	810-829
TIP	740-759
POES NOAA-12	
HRPT	710-714
GAC	770-789
TIP	720-739

You can copy areas from the mainframe to your workstation using the McIDAS-MVS SENAA command. See Chapter 4 in the McIDAS-MVS Users Guide for more information about the SENAA command; also see the McIDAS-X Users Guide for information about the bands for satellite areas.

SSEC's History Data

SSEC has history data for the following satellites.

Satellite	Years
GOES-W	20 November 1978 to present
GOES-E	18 February 1979 to 18 January 1989
METEOSAT-3	1 January 1993 to present

Other Digital Imagery

Although geostationary satellites, polar orbiting satellites, and radar images are usually displayed, you can digitize any data and display it on McIDAS. For example, cell proteins have been digitized for biochemistry studies and human photographs have been digitized to aid in forensic work.

Coordinate Systems

McIDAS references image data in four different, but interconnected coordinate systems:

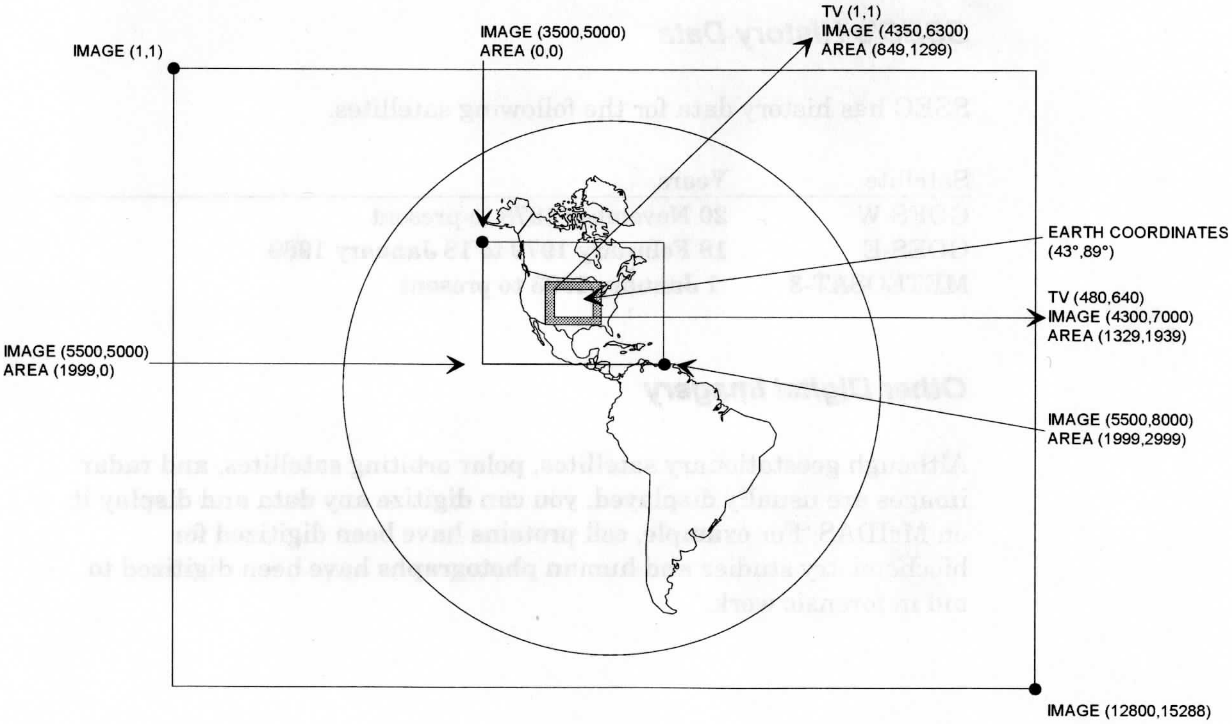
- Image
- Area
- Earth
- TV

Image Coordinates

The image coordinate system forms the basis for the other McIDAS coordinate systems. A full image is a sequence of lines and elements arranged from top to bottom. The top line and leftmost element have image coordinates (1,1). Therefore, each pixel has a unique pair of line and element values that are its image coordinates. The figure below represents a full image, image sector, and displayed area. The upper-left image coordinates of the full image are (1,1) and the upper-left coordinates of the image sector are (3000,5000).

Area Coordinates

Area coordinates are based on the size of the area only. Like image coordinates, area coordinates are referenced as lines and elements. The first pixel has area coordinates (0,0) as shown in the image sector below. The bottom-right pixel has area coordinates (LSIZ -1, ESIZ-1) where LSIZ and ESIZ are the number of lines and elements in the area.



Earth Coordinates

If the displayed image is navigated, the image coordinates can be converted to earth coordinates (latitude and longitude). Earth coordinates are specified in degrees, minutes, and seconds in the form DDD:MM:SS. Southern latitudes, and longitude east of Greenwich, are negative. Latitudes run from -90:00:00 to +90:00:00 and longitudes run from -180:00:00 to +180:00:00.

TV Coordinates

The pixels on the McIDAS-X frames are arranged by raster lines and pictel elements. The raster lines run horizontally across the frame and the pictel elements run vertically across the frame. The pixel in the upper-left corner of the frame is numbered (1,1) which means (raster line 1, pictel element 1). The total number of raster lines and pictel elements on the frame is determined by the frame size. The lower-right corner of the default-sized frame is (480,640) in TV coordinates.

Area Navigation

Navigation, as applied to satellite imagery, means the conversion between the satellite image coordinates (line and element) and earth coordinates (latitude and longitude). This is usually done when the data is ingested.

If a displayed image sector is navigated, McIDAS can convert the image coordinates of a specified pixel to earth coordinates. The E command lists the earth, TV and image coordinates at the cursor center.

Area Resolution

Area resolution is measured in kilometers. The highest available resolution depends on the satellite and sensor source, as the table below shows.

Satellite	Visible image	Infrared
GOES	1 km	4 km
METEOSAT	2.5 km	5 km
GMS	1.25 km	5 km
POES	1 km	1 km

For example, a single GOES infrared pixel represents a 4 km by 4 km square on the earth's surface. In contrast, a single POES infrared pixel represents a 1 km by 1 km square on the earth's surface.

Area resolution is calculated by multiplying the line and element resolution factors (LR and ER) by the highest resolution available for a satellite. For example, if LR and ER for an area are l, the resolution of the visible data will be 1 km for GOES, 2.5 km for METEOSAT, 1.25 km for GMS and 1 km for POES data. If LR and ER are 8, the resolution of the visible data will be 8 km for GOES, 20 km for METEOSAT, 10 km for GMS and 8 km for POES.

You can display imagery at a resolution other than that stored in the area. Specifying a positive magnification factor in McIDAS-X commands (e.g. DF, REFRESH) enlarges or *blows up* the data by replicating pixel values; a negative magnification factor produces a *blow down* by sampling pixel values. For example, if you choose a magnification factor of 16, the value of each pixel in the area is duplicated 256 times (in a 16 x 16 box of pixels) when displayed on the frame. If you choose a magnification factor of -4, the value of every fourth element along every fourth line is displayed as one pixel on the image frame.

Displaying Satellite Data

Before displaying satellite data, you must know the area number where it is stored. Both the DMAP and LA commands list the areas on your workstation. DMAP lists the area numbers; LA lists the area directories. Once located, you can display the images using the DF command.

When you display an image on a frame, McIDAS-X creates a frame directory for the image which lists the frame number, sensor source, date, image time, band number, image coordinates, magnification factors, and area number. The C command lists the frame directory.

You can display images one at a time or in a sequence. If the areas on disk are chronologically ordered, an entire set of images can be sequentially loaded using one DF command with a repeat factor.

In this exercise, you will select two areas and display them on frames, list the frame directory for one frame, and display a sequence of images using the DF command with a repeat factor.

1. Start a McIDAS-X session with six frames.

   Type: **mcidas -fr 6**

2. Log on and initialize the workstation.

   Type: **LOGON** *initials project* **I WS**

3. List the area directories for areas 8000 to 8009.

   Type: **LA 8000 8009**

4. **List the areas between 8000 and 8009 on your workstation.**

   Type: DMAP AREA800

   The DMAP command locates all the areas you can access in this range with McIDAS-X.

```
DMAP  AREA800
NAME      SIZE   DATE                         PATH
----      ----   ----                         ----
AREA8000  14     TUE APR 26 10:25:02 1994     /u/mcguest/mcidas/data
AREA8001  14     TUE APR 26 10:25:02 1994     /u/mcguest/mcidas/data
AREA8002  14     TUE APR 26 10:25:02 1994     /u/mcguest/mcidas/data
AREA8003  14     TUE APR 26 10:25:02 1994     /u/mcguest/mcidas/data
AREA8004  14     TUE APR 26 10:25:03 1994     /u/mcguest/mcidas/data
AREA8005  14     TUE APR 26 10:25:03 1994     /u/mcguest/mcidas/data
AREA8006  14     TUE APR 26 10:25:03 1994     /u/mcguest/mcidas/data
AREA8007  14     TUE APR 26 10:25:03 1994     /u/mcguest/mcidas/data
AREA8009  14     TUE APR 26 10:25:03 1994     /u/mcguest/mcidas/data
```

5. **List the area directories between 8000 and 8009 that contain images taken at 170100 UTC on day 93072.**

   Type: LA 8000 8009 DAY=93072 TIME=17:01:00

   Areas 8000 and 8003 are listed. Area 8000 is a GOES visible 4 km image; area 8003 is a GOES infrared 4 km image.

```
LA 8000  9009  DAY=93072  TIME=17:01:00
area ss  yyddd  hhmmss  lcor  ecor  lr  er  zr  lsiz  esiz  z bands
---- --  -----  ------  ----  ----  --  --  --  ----  ----  - -----
8000 32  93072  170100  1121  7585  4   4   1   1335  1608  1 NA
8003 33  93072  170100  1127  7594  4   4   1   1335  1608  2 ..8..
```

6. Display the GOES visible image 8000 on frame 1.

   Type: **DF 8000 1**

   Notice that the bottom of the image has an annotation line which lists the frame number, satellite type, sensor source, Gregorian date, Julian date, UTC time, upper-left corner image line and element, and resolution. For a GOES visible image, the sensor source is blank.

7. Display the infrared area 8003 on frame 4 and show frame 4.

   Type: **DF 8003 4**
   Press: **Alt O**

   Notice that Alt O is an easy way to compare visible and infrared images displayed on opposite frames.

8. List the frame directory for the current image on frame 4.

   Press: **Alt C**

   Information about the frame number, sensor source, date, time, band, image coordinates, line and element magnification and area numbers is displayed for the image. Notice that the annotation line and the frame directory have much of the same information.

FRM	SS	YYDDD	HHMMSS	BAND	LINE	ELEM	LMAGN	EMAGN	AREA
4	33	93072	170100	8	1127	7594	1/4	1/4	8003

9. Display three areas that are in sequence using one DF command.

   Type: **DF 8008 4 X X X X 3**

   The repeat factor is three; therefore, this entry displays three areas in sequence, 8008, 8009, and 8010, on frames 4, 5, and 6.

10. **Step through the frames to view the images.**

Press: **Alt A**
Press: **Alt B**

11. **Erase the contents of frames 4 through 6 to prepare for the next exercise.**

Type: **EG 4 6**

Using Coordinate Systems

In this exercise, you will display the same area using different coordinate types. The coordinate system and location where the specified coordinates are positioned on the frame define the coordinate type. The four coordinate systems are:

- A (area)
- E (earth)
- I (image)
- T (TV)

The three locations are:

- C (center)
- D (lower-right corner)
- U (upper-left corner)

The coordinate type defines the location of the image; for example, IU 1121 4657 positions the (I) image coordinates (1121, 4657) in the (U) upper-left corner.

The first exercise shows that the same image can be displayed using different coordinate types.

1. Switch to the primary loop.

   Press: **Alt O**

2. Display area 8006 on frame 1 so the element having image coordinates (1121, 4657) appears at the upper-left corner of the frame.

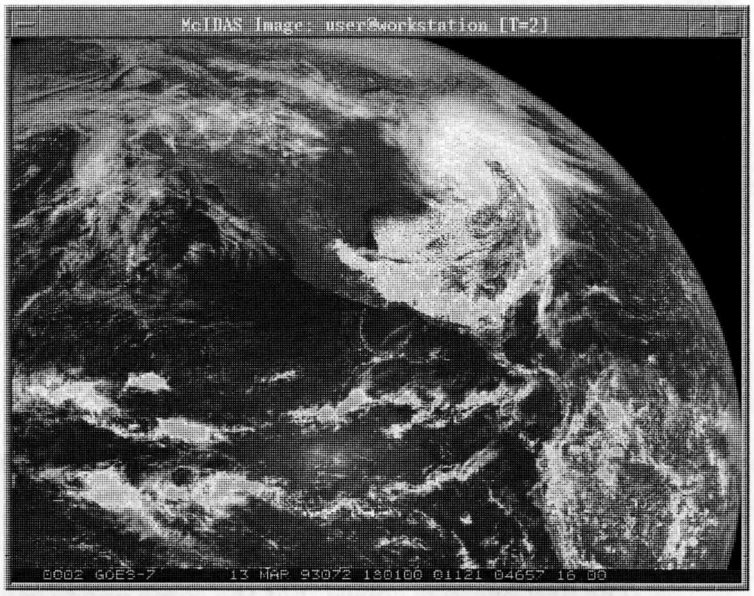
   Type: **DF 8006 1 IU 1121 4657**

   The IU parameter places the specified image coordinates in the upper-left corner.

3. Display area 8006 on frame 2 so that Puerto Escondido, Mexico, is at the center of the frame.

   Type: **DF 8006 2 EC PXM; SF 2**

   The EC parameter places the earth coordinates for Puerto Escondido in the center of the frame, as shown below.



4. Display area 8006 on frame 3 so that the element with the area coordinates (522, 930) appears in the lower-right corner of the frame.

   Type: **DF 8006 3 AD 522 930; SF 3**

   The AD parameter places the specified area coordinates in the lower-right corner.

5. Start and then stop the loop.

   Press: **Alt L**

   All the images are the same, except they are displayed using different coordinate types.

6. Position the cursor in the center of frame 2 and find the earth coordinates of Puerto Escondido. The PC command is discussed in more detail in Lesson 4.

   Type: **SF 2; PC C**
   Press: **Alt E**

   Command E lists the latitude and longitude of a pixel on a navigated frame in the format DD:MM:SS. It also lists the TV coordinates and image coordinates of the pixel.

Frame	Latitude	Longitude	Tvline	Tvelem	Line	Elem
2	15:48:27	97:07:46	240	320	4945	9761

Next, you will display the same image three times, but change the location of the displayed image using different coordinate types.

1. Erase frames 1 through 3 and show frame 1.

   Type: **EG 1 3; SF 1**

2. Display area 8014 on frame 1 so that the earth coordinates 30° latitude and 89° longitude are centered in the frame. Then position the cursor at the center of the frame and verify that the earth coordinates are 30° latitude and 89° longitude.

   Type: **DF 8014 1 EC 30 89**
   Type: **PC C**
   Press: **Alt E**

   Notice that the center of the frame has a latitude of 29:57:12 and a longitude of 89:02:17.

3. Display area 8014 on frame 2 so that the image coordinates (1999, 2503) are centered in the frame and show frame 2. Then position the cursor in the center of the frame.

   Type: **DF 8014 2 IC 1999 2503; SF 2**
   Type: **PC C**
   Press: **Alt E**

   Notice that the image coordinates (1999, 2503) are in the center of the frame.

4. Display area 8014 on frame 3 so that the area coordinates (0,0) appear in the upper-left corner of the frame and show frame 3.

   Type: **DF 8014 3 AU 0 0; SF 3**

5. Change the dwell rate and then start and stop the loop. Notice how the image position changes.

   Type: **DR 10**
   Press: **Alt L**

Next, you will display a sequence of GOES visible and infrared images using the same earth coordinates to compare them. Display the GOES visible images on the primary loop and the GOES infrared images on the opposite loop.

1. Display the GOES visible image area 8000 on frame 1, centering the image on earth coordinates 35° N and 75° W. Use the SF= keyword to automatically display the frame.

   Type: **DF 8000 1 EC 35 75 SF=Y**

2. Display the next two GOES visible images on frames 2 and 3, centering the images on coordinates 35° N and 75° W.

   Type: **DF 8001 2 EC 35 75; DF 8002 3 EC 35 75**

3. Display the three GOES infrared images, which begin in area 8003, on frames opposite the GOES visible images. The repeat factor (3) loads all three images with one DF command.

   Type: **DF 8003 OPP EC 35 75 X 3**

   You are using the same coordinates, 35° N and 75° W, to load the images. The X represents no change in image resolution. The repeat factor 3 displays three areas in sequence, 8003, 8004, and 8005, on frames 4, 5, and 6.

4. Change the dwell rate and loop the images.

   Type: **DR 5**
   Press: **Alt L**

   You should see the loop of the GOES visible images on frames 1 through 3.

5. Toggle to the opposite loop to compare the images. Then stop the loop.

   Press: **Alt O**
   Press: **Alt L**

   You should see the loop of the GOES infrared images on frames 4 through 6.

6. Practice comparing the images with the loop control system commands Alt A, Alt B, Alt L, and Alt O that you learned in Lesson 2.

Listing Area Data

In this exercise, you will list area data by positioning the cursor on the image and entering the D and OD commands.

The D command lists data from the area represented on the image at the cursor center. It lists the area number, area coordinates, image coordinates, raw, brightness, and when present, temperature and radiance values.

The OD command lists the data from the area inside the cursor. By specifying different parameters, you can list raw, brightness, and when present, temperature and radiance values.

1. Change your cursor to a smaller size with the CUR command, which is explained in more detail in Lesson 4.

   Type: **CUR 5 5**

2. Show the GOES infrared image on frame 4 and position the cursor in the center of the frame.

   Type: **SF 4; PC C**

3. List the area values for the element at the cursor center.

   Press: **Alt D**

   The area number, area coordinates, image coordinates, raw, and brightness values are listed. Because this is an infrared image, the temperature and brightness values are also listed.

```
AREA    AREA             IMAGE       RAW     RAD        TEMP     BRIT
     LINE/ELEMENT  LINE/ELEMENT               **          K
8003 239/319       2083/8870   10624  69.758   267.6     125
   **milliwatts/meter**2/steradian/cm
```

4. List the brightness values for the area inside the cursor.

   Type: **OD L B**

   The L parameter lists the data and the B parameter lists brightness values. Notice that the data value at the cursor center is the same value listed with Alt D.

5. Show the GOES visible image on frame 1 and list the values inside the cursor.

   Type: **SF 1**
   Press: **Alt D**

   Only raw and brightness values are listed when using visible data; whereas, temperature, radiance, raw and brightness values were listed for the infrared image in step 3.

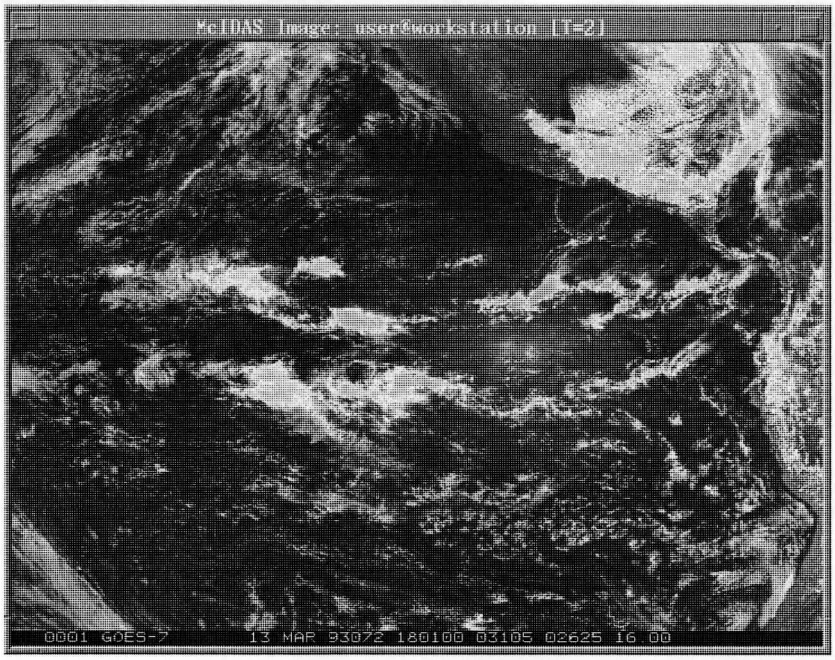
Changing the Image Resolution

In this exercise, you will magnify the resolution of displayed images using the DF command. Then, you will use the OD command to list data values inside the cursor.

Many other commands, for example AA, have parameters to change the resolution. Refer to your McIDAS-X Users Guide for more information.

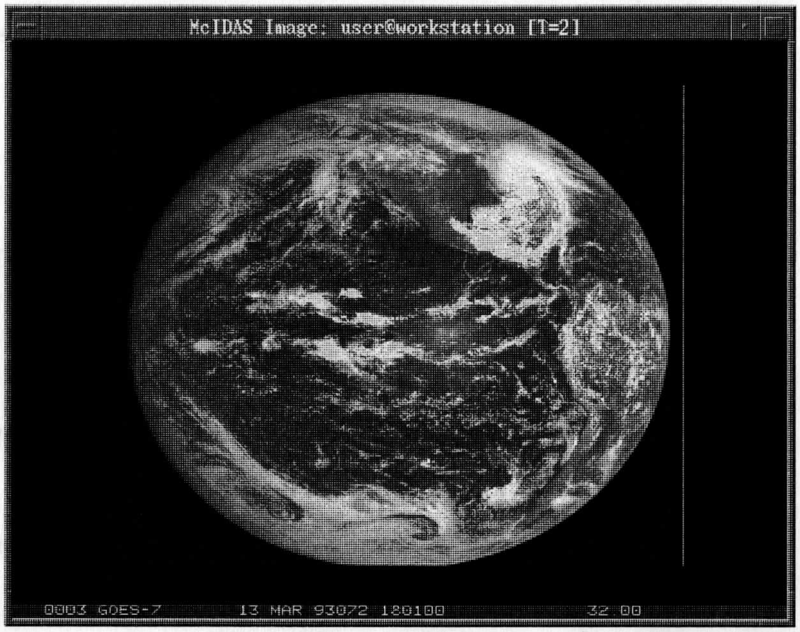
1. Display area 8006 in its original resolution (16 km) on frame 1. Center the image on earth coordinates 0° and 112°.

   Type: **DF 8006 1 EC 0 112**



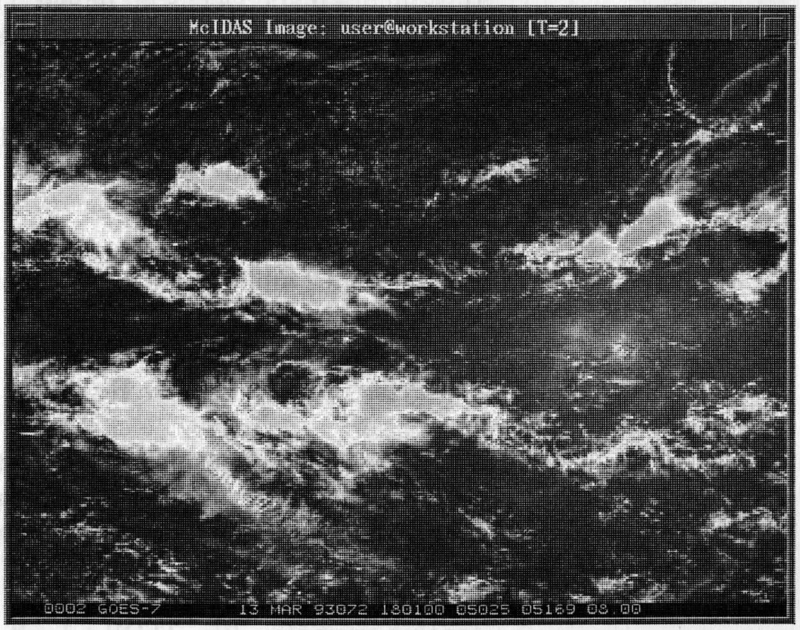
2. Decrease (blow down) the image resolution of area 8006 by a factor of 2 and display it on frame 3.

   Type: **DF 8006 3 EC 0 112 -2**



3. Magnify (blow up) the image resolution of area 8006 by a factor of 2 and display it on frame 2.

   Type: **DF 8006 2 EC 0 112 2**



4. **Loop the frames.**

   Press: **Alt L**

5. **Change the loop sequence to view the images in the order of increasing resolution.**

   Type: **LS 3 1 2**

6. **Show frame 1 and list the data and brightness values inside the cursor.**

   Type: **SF 1; OD L B**

   Notice you have 5 lines and 5 elements of data.

7. **Show frame 3 and list the data and brightness values inside the cursor.**

   Type: **SF 3; OD L B**

   Notice that you have 9 lines and 9 elements of data. Because the image was blown down by a factor of 2, every second line and element was sampled. Therefore, the number of lines and elements read from the area is twice the amount displayed as an image. The following equation determines the number of lines and elements in the cursor area for a blow down:

   (*cursor size* -1) * *blow down factor* + 1
   for this example: (5 - 1) * 2 + 1 = 9

8. **Show frame 2 and list the data and brightness values inside the cursor.**

   Type: **SF 2; OD L B**

   There are 3 lines by 3 elements of data listed. The following equation determines the number of lines and elements in the cursor area for a blow up:

   (*cursor size* -1) / *blow up factor* + 1
   for this example: [(5 - 1) / 2] + 1 = 3

Copying and Displaying Areas

In this exercise, you will copy and display areas with the AA command.

1. Show frame 4, copy area 8000 to area 5000 on your workstation and display the area on frame 4. The ASIZE=ALL keyword copies the entire area 8000 to area 5000.

   Type: **SF 4; AA 8000 5000 4 ASIZE=ALL**

2. List areas 8000 and 5000.

   Type: **LA 8000; LA 5000**

   Notice that areas 8000 and 5000 now contain the same information and the lsiz and esiz are the same.

```
LA 8000; LA 5000
area  ss  yyddd  hhmmss lcor  ecor lr er zr  lsiz  esiz  z  bands
----  --  -----  ------ ----  ---  -- -- --  ----  ----  -  -----
8000  32  93072  170100 1121  7585 4  4   1  1335  1608  1   NA

LA: DONE
area  ss  yyddd  hhmmss lcor  ecor lr er zr  lsiz  esiz  z  bands
----  --  -----  ------ ----  ---  -- -- --  ----  ----  -  -----
5000  32  93072  170100 1121  7585 4  4   1  1335  1608  1   NA
```

3. Show frame 5, copy area 8003 to area 5001, and display the image on frame 5 centered on Boston.

   Type: **SF 5; AA 8003 5001 5 EC BOS**

4. List areas 8003 and 5001.

   Type: **LA 8003; LA 5001**

   Notice that LSIZ is 480 and ESIZ is 640 on area 5001. In area 8003, the LSIZ is 1335 and ESIZ is 1608. If the ASIZE=ALL keyword is not specified, a 480 by 640 image sector is copied to the new area.

```
LA 8003; LA 5001
area ss  yyddd hhmmss lcor ecor  lr er zr  lsiz  esiz  z  bands
---- --  ----- ------ ---- ----  -- -- --  ----  ----  -  -----
8003 33  93072 170100 1127 7594   4  4  1  1335  1608  2  ...8..

LA: DONE
area ss  yyddd hhmmss lcor ecor  lr er zr  lsiz  esiz  z  bands
---- --  ----- ------ ---- ----- -- -- --  ----  ----  -  -----
5001 33  93072 170100 1407 10134  4  4  1  480   640   2  ...8..
```

5. Show frame 6, copy area 8002 to area 5002, display the image centered on Mobile, Alabama, on frame 6, and increase the resolution by a factor of 2.

   Type: **SF 6; AA 8002 5002 6 EC MOB 2**

   The image is displayed on frame 6 with a resolution of 2 km.

6. List areas 8002 and 5002 to compare image resolutions. Note that the ER (element resolution) and LR (line resolution) values are different.

   Type: **LA 8002; LA 5002**

   The original area (8002) had a resolution of 4 km and the new area (5002) has a resolution of 2 km. This is a blow up.

Deleting Areas

In this exercise, you will delete several areas using the QA command.

1. List areas 5000 through 5002, then delete them.

   Type: **LA 5000 5002**
   Type: **QA 5000 5002**

2. List area directories 5000 through 5002 on your workstation.

   Type: **LA 5000 5002**

   Areas 5000 through 5002 are not listed in the directory. Once you delete an area, you can no longer access data values such as temperature, even if the image is still displayed. The image is only a representation of the data.

3. Exit McIDAS-X.

   Type: **EXIT**

4. Graphics and the Cursor

Lesson 4
Graphics and the Cursor

Lesson 4

Graphics and the Cursor

Graphics are line drawings such as maps, isolines, diagrams, or text displayed on a frame. You can change the graphics color, line width, dash length, dash gap length, and dash gap color.

The cursor is a visible marker on a frame that can be moved with the mouse. You can use the cursor to point to specific locations and then determine the coordinates. You can change the color, shape, and size of the cursor.

This lesson describes how to:

- define graphics parameters
- generate graphics
- erase graphics
- save and restore graphics and frames
- change the cursor shape, color, and size
- contour data with the cursor
- locate specific positions using the cursor
- find distances between points

The following commands are used in this lesson.

Command	Function
CCODE	lists country codes
COTV	contours the area data within the cursor
CUR	defines cursor size, shape and color
CW	fills or erases graphics inside the cursor
DIST	finds the distance on a navigated frame
DMAP	lists information about LW files
E	lists earth, image and TV coordinates
EG	erases the contents of a frame
GD	defines graphics display parameters
GU	graphics utility
K	turns an image on and off
LVF	lists virtual frame files
MAP	draws maps

Command	Function
MSL	lists information from the international master weather station list
PC	positions the cursor at a specific location
RVF	restores virtual frame files
SHOWVG	displays virtual graphics
SVF	saves frames to a virtual frame file
SVGIF	saves a McIDAS frame to the GIF format
ZA	displays an annotation at the cursor
ZLM	permits freehand drawing using the mouse

Basic Concepts

Graphics

Graphics are lines and text that can be drawn on frames. Examples of graphics include:

- a map of coastal borders overlaying a satellite image
- a plot of surface temperatures over the eastern United States
- a label to identify a satellite image
- a contour of satellite brightness data

A frame can have several different graphics. For example, you can have a map and a temperature contour over a satellite image. By default, McIDAS-X graphics are embedded in the displayed image. When graphics are erased, the entire contents of a frame are also erased. To use independent graphics, which erase graphics without erasing the image, specify the **-ig y** flag when starting a McIDAS-X session from the Unix prompt.

Graphics Parameters

You can modify graphics colors using the GU command. Line width, dash and gap lengths, and the color of gaps in dashed lines can also be changed using the GD command.

Multiple colors are particularly useful for creating graphics displays with several overlays. The graphics commands assign colors through the use of *levels*. Each level is assigned one color. For example, level 1 is magenta. The assigned colors are not fixed and you can assign different colors to the levels.

When the color of a level changes, all the graphics already drawn in that level are changed on the current frame.

By default, McIDAS-X has 34 predefined colors and 16 graphics color levels. Therefore, only 16 colors can be used at one time. However, you can change the number of graphics color levels and the color assigned to each.

To change the total number of graphics color levels, specify a number with the *graphics* parameter in the **-lv** flag when starting the McIDAS-X session from the Unix prompt.

The following table shows the 16 default color levels.

Level	Color	Level	Color
0	Black	8	Navy
1	Magenta	9	Gold
2	Cyan	10	Pink
3	Yellow	11	Aquamarine
4	Green	12	Orchid
5	Red	13	Gray
6	Blue	14	Sky
7	White	15	Beige

Most McIDAS-X graphics commands are displayed with a default color level, but you can usually specify a different color level using a parameter or keyword.

Although McIDAS-X has 34 predefined graphics colors, you can create custom colors using the GU command and specify the intensities for each of the primary colors. The intensities range from 0 to 255; 0 is the darkest shade of the color and 255 is the brightest. The 34 predefined colors and their intensities of red, blue, and green are listed below. You can save new colors to a file called a graphics table which you can restore to an individual frame or a range of frames.

Color	Blue	Green	Red
Aquamarine	147	219	112
Avocado	35	131	67
Beige	127	171	255
Black	0	0	0
Blue	255	0	0
Brown	35	35	127
Coral	80	127	255
Cyan	255	255	0
Firebrick	35	35	142
Gold	0	187	255

Color	Blue	Green	Red
Goldenrod	112	219	219
Green	0	255	0
Gray	127	127	127
Khaki	95	159	159
Lemon	67	255	227
Magenta	255	0	255
Maroon	105	35	142
Navy	115	0	0
Orange	0	127	255
Orchid	219	112	219
Pink	127	127	255
Plum	234	173	234
Purple	127	0	127
Salmon	66	66	111
Red	0	0	255
Sienna	35	107	142
Sky	255	163	0
Tan	112	147	219
Thistle	216	191	216
Turquoise	234	234	173
Violet	203	127	255
Wheat	191	216	216
White	255	255	255
Yellow	0	255	255

Drawing Maps

You can draw maps on frames containing nothing, an image, and/or a graphic. To draw a map over a satellite image, the satellite image must be navigated; all real-time satellite images are navigated. When history satellite images are restored on McIDAS-MVS, their navigation is also restored.

Virtual Graphics and Virtual Frame Files

Graphics can be saved in three formats:

- virtual graphics files
- virtual frame files
- graphics interchange format (GIF)

Virtual graphics files contain only graphics. Virtual graphics are saved when they are created with the VIRT keyword. VIRT is a global keyword you can use with any graphics command.

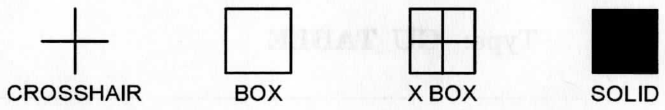
The VIRT keyword assigns a number to the virtual graphics file for identification when restoring it with the SHOWVG command. For example, VIRT=1 writes the virtual graphic to LW file VIRT0001. Each workstation can have up to 9999 virtual graphics.

Virtual frame files save the entire contents of the frame, unlike virtual graphics files which save only the graphics. The RVF command restores the image, graphic, frame directory, navigation, image enhancement and graphics table that were present when the frame was saved with the SVF command. Virtual frames can only be restored to frames that are the same size as the original, and only if the current McIDAS-X session has the same number of graphics and image levels as was present when the frames were saved.

The GIF format saves only the pixel brightness values. The GIF format is useful for displaying McIDAS-X images on Unix workstation terminal windows.

Cursor

There are four cursor shapes:



To change the cursor size, shape, and color, use the CUR command. The size is designated by height and width and should be defined in odd numbers. If you enter even numbers, they are rounded up to odd numbers. For example, if you specify a 20 by 20 pixel cursor, the cursor will be 21 by 21 pixels. The maximum size for a cursor in McIDAS-X is display dependent; the default is 31 by 31 pixels.

Use the PC command to place the cursor at specific positions, and the E command to list the coordinates at the cursor center.

Defining Graphics Parameters

In this exercise, you will use the GU (Graphics Utility) command to list the colors currently assigned to the graphics color levels, change the color assigned to a level, create new colors, save the color assignments to a graphics table, and restore a graphics table.

1. **Start a McIDAS-X session with the independent graphics option.**

   Type: **mcidas -ig y**

2. **Log on and initialize the workstation.**

   Type: **LOGON** *initials project* **I WS**

3. **List the colors assigned to the graphics levels in the default graphics table.**

   Type: **GU TABLE**

```
GU TABLE
LEVEL    COLOR        BLUE     GREEN      RED
-----    -----        ----     -----      ---
0        Black        0        0          0
1        Magenta      255      0          255
2        Cyan         255      255        0
3        Yellow       0        255        255
4        Green        0        255        0
5        Red          0        0          255
6        Blue         255      0          0
7        White        255      255        255
8        Navy         115      0          0
9        Gold         0        187        255
10       Pink         127      127        255
11       Aquamarine   147      219        112
12       Orchid       219      112        219
13       Gray         127      127        127
14       Sky          255      163        0
15       Beige        127      171        255
```

4. **Generate a map of the United States with latitude and longitude lines on frame 1, then generate a map of the Midwest with latitude and longitude lines on frame 2. The next exercise discusses generating graphics in more detail.**

   Type: **MAP USA 1 LALO 5 GRA=1; MAP MID 1 LALO 5 GRA=2**

5. **List the predefined colors on your workstation.**

   Type: **GU COLORS**

```
GU COLORS
COLORS
-------
AQUAMARINE   BLACK       BLUE      NAVY    CORAL
CYAN         FIREBRICK   BROWN     GOLD    GOLDENROD
GREEN        GRAY        GREY      KHAKI   MAGENTA
MAROON       ORANGE      ORCHID    PINK    PLUM
RED          SALMON      SIENNA    TAN     THISTLE
TURQUOISE    VIOLET      WHEAT     WHITE   YELLOW
BEIGE        LEMON       PURPLE    SKY     AVOCADO
```

6. **Assign the color avocado to graphics color level 1, thistle to graphics color level 2, and goldenrod to graphics color level 5.**

   Type: **GU MAKE 1 AVOCADO; GU MAKE 2 THISTLE; GU MAKE 5 GOLDENROD**

   Notice the graphics colors displayed in frame 1 changed when you assigned the new colors.

7. **Show frame 2.**

   Type: **SF 2**

   Notice that the colors on frame 2 did not change. Each frame has its own graphics table; graphics color level changes affect only that frame. However, if you specify a range of frames, the changes affect the graphics tables for those frames.

8. **Show frame 1 and list the colors in the graphics table.**

   Type: SF 1; GU TAB

   Notice that color levels 1, 2, and 5 have changed.

9. **Create a new color by specifying red, blue, and green intensities. Assign the new color to graphics color level 1.**

   Type: GU MAKE 1 35 107 200

10. **List the graphics table to verify that graphics color level 1 has new intensities.**

    Type: GU TABLE

    Since you defined the color intensities, the name is blank in the table.

11. **Save the graphics table to a file called NEW and list the graphics tables on your workstation to verify that it was saved.**

    Type: GU SAVE NEW; GU LIST

    Notice that all graphic tables have a .GRX extension.

12. **Restore the graphics table named GRAPHIC and list the graphics color levels in the table. GRAPHIC contains the default graphics color levels.**

    Type: GU REST GRAPHIC; GU TABLE

13. **Restore the graphics table NEW to frames 1 and 2 and list its graphics color levels.**

    Type: GU REST NEW 1 2; GU TABLE

14. Verify that both frames have the new graphics table restored.

    Press: **Alt A**
    Press: **Alt B**

15. Restore the default graphics table, erase the frames, then change the line width to 3 pixels.

    Type: **GU REST GRAPHIC 1 2 ; EG 1 4; GD 3**

16. Display area 8000 on frame 1 centered on Raleigh-Durham, North Carolina, decrease the resolution by a factor of 2, and draw a map on the satellite image. The graphics lines will appear thicker, making the map easier to see.

    Type: **DF 8000 1 EC RDU -2; MAP H**

17. Change the line width back to the default, 1 pixel.

    Type: **GD 1**

Generating Graphics

In the following two exercises, you will generate maps and create freehand drawings.

Generating Maps

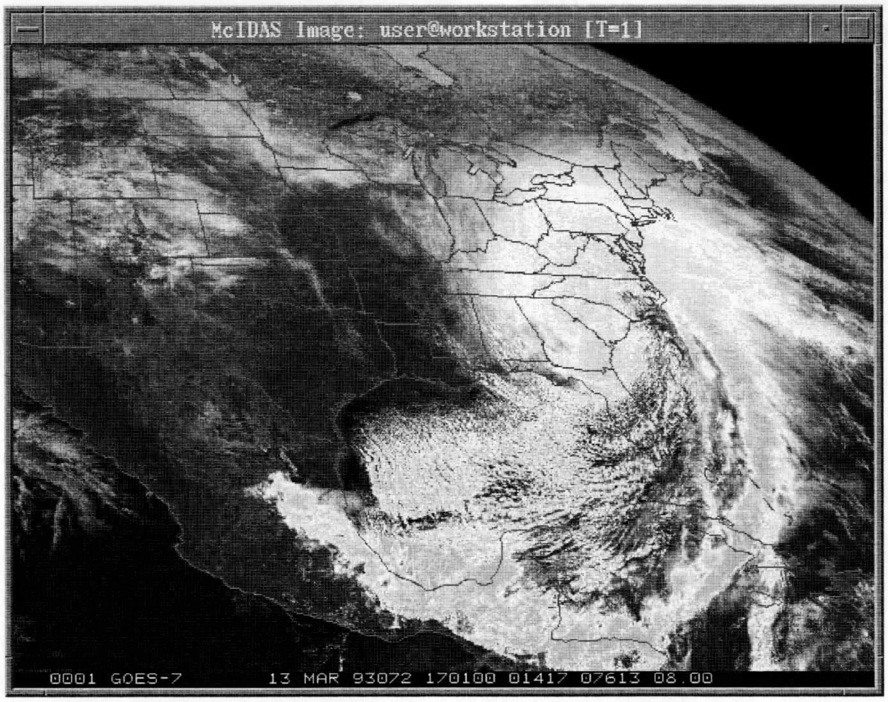
1. Display area 8000 on frame 1 centered at Baton Rouge, Louisiana, and decrease the resolution by a factor of 2.

   Type: **DF 8000 1 EC BTR -2 SF=Y**

2. Generate a medium resolution map on the image.

   Type: **MAP H**

   The H parameter indicates a medium resolution map of North America conforming to the displayed image, as shown below.



3. **Display area 8001 on frame 2 centered at Baton Rouge, and generate a coastal outline map in graphics color level 5, red.**

   Type: **DF 8001 2 EC BTR -2 SF=Y; MAP L 5**

   The L parameter specifies a low resolution map conforming to the satellite image.

4. **Turn off the satellite image so the map is easier to see.**

   Press: **Alt K**

5. **Turn the satellite image back on.**

   Press: **Alt K**

6. **Show frame 3 and generate a Mercator map of the USA independent of any satellite image.**

   Type: **SF 3; MAP USA**

7. **Display area 8004 on frame 4 and generate a map with political boundaries, coastal boundaries, and latitude and longitude lines.**

   Type: **DF 8004 4 EC BTR -2 SF=Y; MAP X 5 LALO NAME=OUTLHPOL; MAP L 3**

   Notice that the political boundaries are in graphics color level 5 and the coastal boundaries are in graphics color level 3.

Adding Text and Freehand Drawings

In this exercise, you will write text to a frame with the ZA command and create freehand drawings with the ZLM command.

1. Show frame 1 and erase its graphics.

   Type: **SF 1; EG 1**

   Because you started your McIDAS session with the independent graphics option, EG erases only the graphics and not the image.

2. Position the cursor at TV line 30 and element 100.

   Type: **PC T 30 100**

3. Add the following annotation to the frame describing the image.

   Type: **ZA 5 10 "GOES VISIBLE FOR 13 MARCH 1993 AT 17:01 UTC**

   The phrase GOES VISIBLE FOR 13 MARCH 1993 AT 17:01 UTC is written on frame 1. The first parameter (5) indicates the graphics color level; the second parameter (10) indicates the height of the letters in pixels.

4. Show frame 2 and erase both the image and the graphics.

   Type: **SF 2; EG I 2**

5. Activate the freehand drawing command ZLM.

   Type: **ZLM DRAW**

6. **Press and hold the middle mouse button and draw something on the screen by moving the mouse.**

7. **End the draw option by pressing the right and middle mouse buttons simultaneously, or:**

   Press: **Alt Q**

Erasing Graphics

In this exercise, you will erase the graphics inside the cursor with the CW command and then erase all the graphics inside the current frame with the EG command.

1. Show frame 1.

   Type: **SF 1**

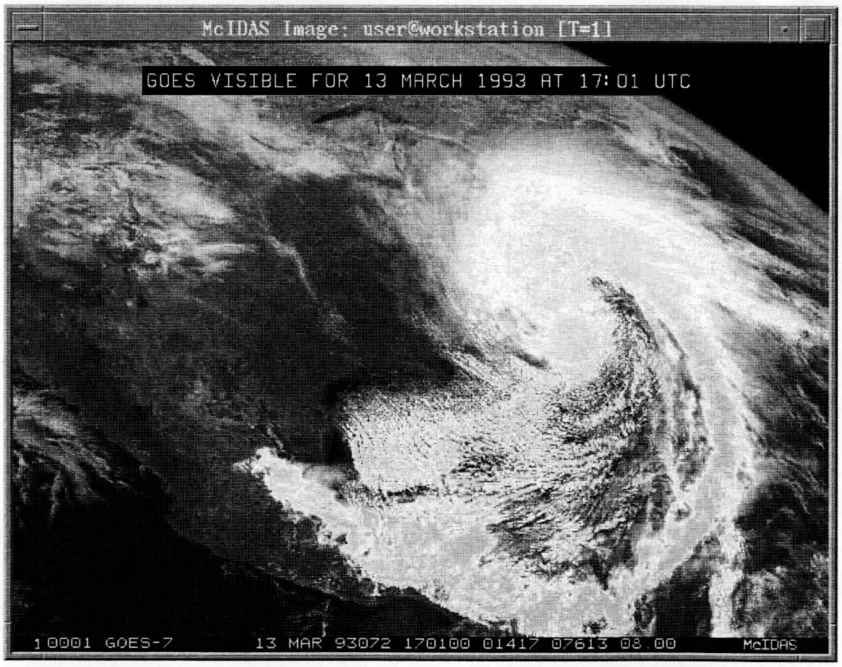
2. Place the cursor at TV line 30 and element 320.

   Type: **PC T 30 320**

3. Erase the graphics inside a 25 by 440 cursor. Use Xs for the graphics color level and frame number parameters.

   Type: **CW X X 25 440**

   The graphics and image inside the 25 by 440 cursor are restored to the background color, usually black (color level 0).



4. Position the cursor at TV line 25 and element 105, and add the annotation again. The black background makes it easier to read.

   Type: **PC T 25 105; ZA 5 10 "GOES VISIBLE FOR 13 MARCH 1993 AT 17:01 UTC**

5. Erase the graphics in frames 1 through 4.

   Type: **EG 1 4**

   The graphics are cleared, leaving the frames either empty or with a satellite image.

Saving and Restoring Graphics and Frames

In this exercise, you will save and restore virtual graphics files, virtual frame files, and GIF files.

Virtual Graphics Files

In these five steps, you will generate a map over a satellite image and save the map as a virtual graphics file with keyword VIRT. Then you'll erase the image and graphics, locate the saved virtual graphics file, and restore it with the SHOWVG command.

1. Show frame 1.

   Type: **SF 1**

2. Generate a map over the image and save it as a virtual graphic assigned to file 10. You must assign the graphic to a virtual file when you run the graphics command.

   Type: **MAP H VIRT=10**

   The output is written to virtual graphics file VIRT0010 and the frame.

3. List virtual graphic 10 on your workstation to verify it was saved.

   Type: **DMAP VIRT0010**

```
DMAP VIRT0010
NAME        SIZE   DATE                          PATH
----        ----   ----                          ----
VIRT0010    48640  Thu Jun 2 10:02:35 1994      /u2/user/mcidas/data
```

4. Erase the image and graphics.

   Type: **EG I**

5. Restore virtual graphic 10 to frame 1.

   Type: **SHOWVG 10 1**

   Notice only the graphic was saved and not the satellite image.

Virtual Frame Files

In the next five steps, you will use the SVF command to save a satellite image and map. Then you'll list the virtual frame files on your workstation using the LVF command, and restore a virtual frame file using the RVF command.

1. Display area 8000 centered on Washington, DC, draw a map, and set the loop bounds from 1 to 4.

   Type: **DF 8000 1 EC DCA; MAP H; LS 1-4**

2. Save the satellite image and map as a virtual frame file named SATMAP.

   Type: **SVF 1 X SATMAP**

   Be sure the message "Frames saved in SATMAP.PIX 1" is displayed in the text window before continuing.

3. List the virtual frame files on your workstation.

   Type: **LVF**

   A list of virtual frame files and corresponding information for each is displayed in the text window as shown below. Notice that virtual frame files are saved with the extension .PIX.

```
LVF
NAME         SIZE    DATE                      PATH
----         ----    ----                      ----
SATMAP.PIX   618664  Thu Jun 2 10:02 1994      /u2/user/mcidas/data
```

4. **List information about the number of frames, frame size, graphics, and image levels for the virtual frame file SATMAP. The frame size and graphic and image levels in the virtual frame file must be the same as the frame where it is being restored.**

   Type: **LVF SATMAP FORM=ALL**

```
LVF SATMAP FORM=ALL
FILE NAME  #FRAMES  HEIGHT X WIDTH  #GRAPHICS LEVELS #IMAGE LEVELS
---------  -------  --------------  ---------------- --------------
SATMAP.PIX   1      480     640        16              128
```

5. **Show frame 2 and restore the virtual frame file you saved as SATMAP.**

   Type: **SF 2; RVF 2 X SATMAP**
   Press: **Alt A**
   Press: **Alt B**

   The image and graphics are displayed in frame 2. Notice that the frame's annotation line is saved with the image and may not match the frame number where the virtual frame file is restored. When you advance through the frames, use the status line to determine which frame is displayed.

GIF Files

In the following steps, you will show frame 1 and then save it as a GIF file.

1. **Show frame 1.**

   Type: **SF 1**

2. **Save frame 1 in GIF format.**

   Type: **SVGIF 1 PICTURE**

3. **Use the xloadimage command at the Unix prompt to display the GIF file on a workstation terminal window.**

Changing the Cursor Shape, Color, and Size

In this exercise, you will use the CUR command to change the cursor size, shape, and color.

1. Define the cursor size as 31 by 63 pixels, the color as blue, and the type as xbox. Move the cursor onto the image window.

   Type: **CUR 31 63 XBOX BLUE**

2. Define the cursor as a 25 by 25 pixel solid cursor in a custom color.

   Type: **CUR 25 25 SOLID 63 128 255**

3. Change the cursor to its default setting.

   Type: **CUR**

Contouring Data with the Cursor

In this exercise, you will contour the temperatures and brightness levels of an image.

1. Display area 8005 on frame 1 centered on 36° N and 104° W. Magnify the resolution by a factor of 4.

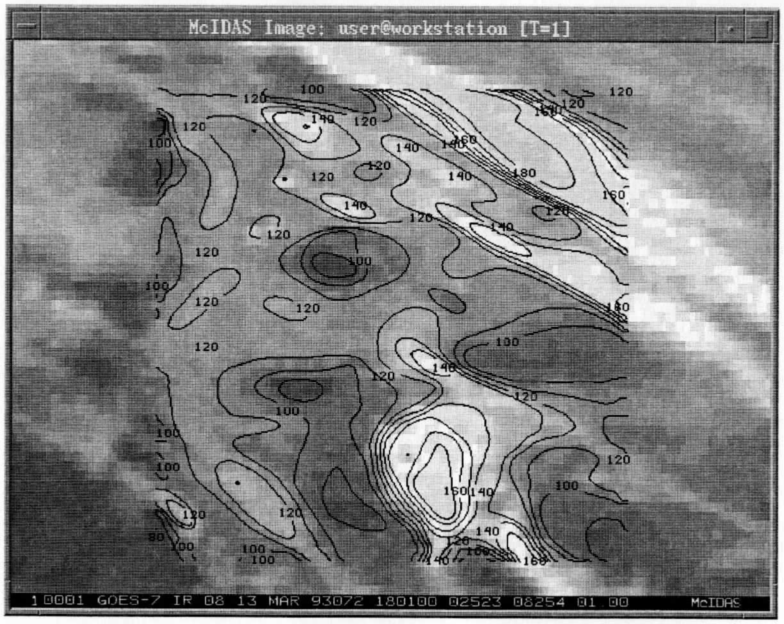
   Type: **DF 8005 1 EC 36 104 4**

2. Position the cursor in the center of the frame.

   Type: **PC C**

3. Contour the brightness levels using a contour interval of 10 inside a 401 by 401 pixel cursor.

   Type: **COTV 10 BRIT 401 401**



4. Display area 8005 on frame 2 centered on 36° N and 104° W. Magnify the resolution by a factor of 4.

   Type: **DF 8005 2 EC 36 104 4 SF=Y**

5. Contour the temperature inside a 401 by 401 pixel cursor. Specify a contour interval of 5 degrees Kelvin.

   Type: **COTV 5 TEMP 401 401**

Locating Specific Positions Using the Cursor

In this exercise, you will use the MSL command to find the station ID for Charleston, West Virginia, position the cursor at that location using the PC command, and display its earth coordinates using Alt E. Then you'll do the same procedure for Montreal, Canada.

1. **Display area 8010 on frame 2 centered over Bangor, Maine. Add a medium resolution map.**

   Type: **DF 8010 2 EC BGR; MAP H**

2. **List the stations in West Virginia.**

   Type: **MSL ST=WV**

   The stations in West Virginia are listed, including their station number, station ID, station name, data types, state and country, earth coordinates, and elevation, as shown below.

```
MSL ST=WV
IDN     ID   STATION NAME          DATA TYPES  ST CO  LAT      LON     ELEV
724120  BKW  BECKLEY MEMORIAL        W     LD  WV US 37:47N  081:07W 766
724125  BLF  BLUEFIELD/MERCER CO     W     L   WV US 37:18N  081:12W 871
724127  LWB  LEWISBURG/GREENBRIE     W     L   WV US 37:52N  800:24W 702
724140  CRW  CHARLESTON/KANAWHA    M W     LD  WV US 38:22N  081:36W 299
724170  EKN  ELKINS/RANDOLPH FLD     W     L   WV US 38:53N  079:51W 609
724175  CKB  CLARKSBURG/BENEDUM      W     L   WV US 39:18N  080:14W 367
724176  MGW  MORGANTOWN/HART FLD     W     L   WV US 39:39N  079:55W 380
724177  MRB  MARTINSBURG RGNL        W     L   WV US 39:24N  077:59W 170
724250  HTS  HUNTINGTON/TRI STAT M W RP L   WV US 38:22N  082:33W 255
724273  PKB  PARKERSBURG/WILSON     OW     L   WV US 39:21N  081:26W 262
724275  HLG  WHEELING/OHIO CO.       W     L   WV US 40:11N  080:39W 365
```

3. **Position the cursor over Charleston.**

   Type: **PC L CRW**

   The PC command places the cursor over the designated location (L indicates location) on the displayed frame.

4. **Display the coordinates at the cursor position.**

   Press: **Alt E**

   Notice that the latitude and longitude are the same as those listed in the MSL command.

Frame	Latitude	Longitude	Tvline	Tvelem	Line	Elem
2	38:22:45	81:35:38	341	94	821	2255

5. **Find the country code for Canada, as you will need it for the keyword CO in step 6.**

   Type: **CCODE CANADA**

6. **Find the station code for Montreal.**

   Type: **MSL CO=CN "MONTREAL**

   The text window lists three stations in Montreal, as shown below. Use the station code for Montreal /Dorval.

```
MSL CO=CN "MONTREAL
IDN     ID   STATION NAME         DATA TYPES  ST  CO    LAT      LON     ELEV
716270  YUL  MONTREAL/DORVAL        IM  W PALD  QB  CN  45:28N  073:45W    36
716278  YMX  MONTREAL/MIRABEL        W  AL      QB  CN  45:41N  074:02W    82
717363  WGJ  MONTREAL RIV RADAR   D             ON  CN  47:14N  084:3 W   559
```

7. **Position the cursor at Montreal.**

   Type: **PC L YUL**

8. **Display the coordinates at the cursor position.**

   Press: **Alt E**

Finding Distances Between Points

In this exercise, you will use the cursor and DIST command to find the distance between points on a navigated frame.

1. Position the cursor at Raleigh-Durham, North Carolina.

   Type: **PC L RDU**

2. Enter the DIST command.

   Type: **DIST**

3. Position the cursor at Bangor, Maine.

   Type: **PC L BGR**

4. Press the middle mouse button.

   A distance of 1301 kilometers is marked on the frame and also listed in the text window with the latitude and longitude measurements.

5. Position the cursor at New York City and press the middle mouse button. Raleigh-Durham is still the starting point.

   Type: **PC L NYC**

   The distance from Raleigh-Durham to New York City (687 km) is calculated.

6. Press the right mouse button to reset the starting point.

7. Position the cursor at Cincinnati, Ohio, and press the middle mouse button.

   Type: **PC L LUK**

   The distance from New York City to Cincinnati (896 km) is calculated.

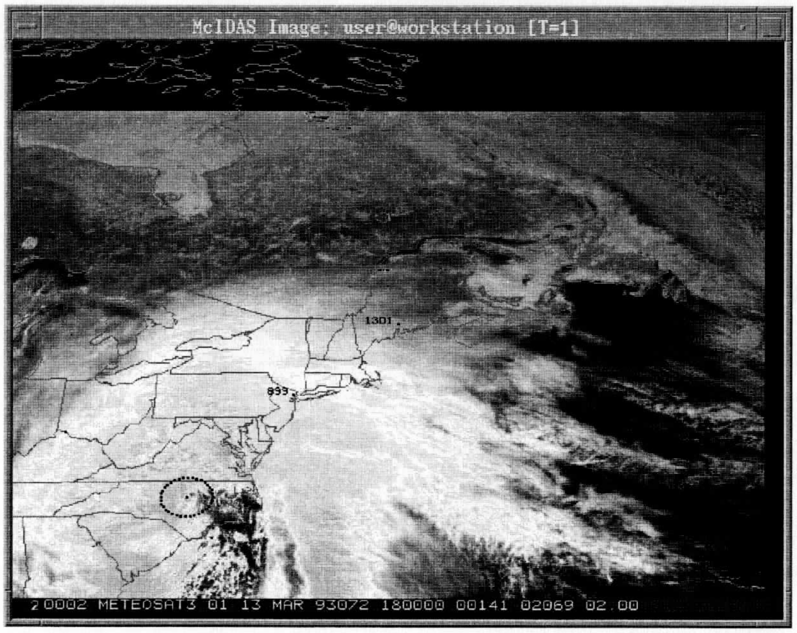
8. End the DIST command by pressing the middle and right mouse buttons, or:

   Press: **Alt Q**

9. Position the cursor at Raleigh-Durham and draw a circle encompassing the area within 100 km of the point.

   Type: **PC L RDU; DIST CIR X X 100**

   This is useful for quickly determining the approximate distance between a weather system and a particular location, as shown below.



10. Exit McIDAS-X.

    Type: **EXIT**

5. String Tables

Lesson 5
String Tables

Lesson 5

String Tables

Strings are often used as shorthand for typing commonly used commands, parts of commands, or non-executable text, and for initializing your workstation during logon. For example, if you often load satellite images centered around latitude 35:30:15 and longitude 98:25:40, you could assign the string name LATLON to the string 35:30:15 98:25:40. Then whenever you would normally enter the latitude and longitude coordinates, you could now use the string LATLON. For example, instead of typing DF *area frame* EC 35:30:15 98:25:40, you could type DF *area frame* EC #LATLON.

This lesson describes how to:

- **create and use strings**
- **save strings**
- **delete strings and string tables**
- **create and delete global strings**
- **increment values in a string**

The following commands are used in this lesson.

Command	Function
REPEAT	repeats a McIDAS-X command while incrementing command values
TD	deletes strings from the string table
TE	enters a string in the string table
TL	lists the strings in the string table
TU	saves, deletes, lists, and restores string tables

Basic Concepts

Creating Strings

Strings are created by assigning a string name to a character string with the TE command. A character string consists of alphanumeric and printable characters. When creating strings, keep in mind the following guidelines:

- String names can be up to 12 alphabetic characters and must be uppercase.
- Only the first character of a string name can be a numeral or special character unless defining a function key.
- Strings H and Y contain the current time and date and cannot be redefined or deleted.
- X cannot be used as a string name because McIDAS-X interprets
it as a placeholder for default values in a command.
- String names beginning with a question mark (?) are global strings and cannot be deleted the same way as other strings.
- An expanded string definition can't be more than 160 characters.
- Any executable string must be uppercase.

Using Strings

To run a string containing a command, you must type a pound key (#) followed by the string name. For example, to run the string DISPIMAGE, which contains the command DF 101 4 EC 35 98, you would type #DISPIMAGE on the command line. To use a string containing part of a command, type the command and substitute *#stringname* at the appropriate position. For example, to use the string LATLON which contains the text 43:35:15 98:25:40, you could run the command DF 101 1 EC #LATLON.

Strings can be nested allowing one string to use another string. For example, the string DISPIMAGE ="DF 101 1 EC #LATLON" has a nested string (LATLON). In the string table, #LATLON is expanded and DISPIMAGE is listed as DF 101 1 EC 35:30:15 98:25:40. The nested string must be defined before it is used in another string.

If the string contains a value that will change, an additional pound sign allows the string to be expanded when it is run. For example, if LATLON will change, type a pound sign before LATLON so the string DISPIMAGE becomes DF 101 1 EC ##LATLON.

When the string DISPIMAGE is entered in the string table, it will appear as "DF 101 1 EC #LATLON. When DISPIMAGE is run, the current value of LATLON is inserted.

You can also assign strings to a single letter, or a number (0 to 9). To run these strings, press the Ctrl key and the appropriate letter or number. Strings can also be assigned to the function keys (F Keys) with an Alt, Shift, or Ctrl key combination. This is useful if you enter certain commands often.

Non-executable strings can be used to add remarks and comments in your string table. Non-executable strings are strings that have numerals or special characters after the first character.

Using Global Strings

A string name whose first character is a question mark (?) is called a global string. Global strings are useful for defining strings you don't want accidentally deleted. They are not saved in user defined string tables, but remain in the string table until you delete them.

Deleting Strings

The TD command deletes individual strings, strings with a common prefix, or all the strings in the string table. When you delete all the strings in the string table, two system strings (H and Y) and global strings remain. Global strings are stored in the string table and will remain unless you delete them using TD ALL GLOB.

Some McIDAS-X commands write global strings to the string table. If you have problems using the string table, clear out your string table with the TD ALL GLOB command.

Saving and Restoring String Tables

Each McIDAS-X session has its own string table which stores strings until they are saved into a user defined string table with the TU SAVE command. Saved with each user defined string table are the project number and the initials of the user who created it. A string table can contain up to 256 strings; a workstation can store up to 512 string tables. When a user defined string table is restored with the TU REST command, a copy of the strings from the user defined string table is written into the string table. When a string table is saved, any existing table with the same name and user initials is overwritten.

To restore a user defined string table within a McIDAS-X session, specify its name and user initials with the TU REST command. You cannot delete another user's string tables. When a string table is restored, the default table is overwritten and unsaved strings are lost (except global strings).

Determining the Current String Table

The strings contained in the string table depend on how the McIDAS-X session was started. If a McIDAS-X session was started:

- without logging on to the the workstation, the string table is the one used in the previous session.
- with the **LOGON** *initials project* **X WS** command, the string table is the one used in the previous session.
- with the **LOGON** *initials project* **I WS** command, the string table is cleared and any unsaved strings are removed from the string table except global strings.
- with **LOGON** *initials project string password,* the string table that matches *string* is restored and all strings that start with the table name are automatically run.
- with **LOGON** *initials project . password,* a string table matching the user initials is restored, and all strings that start with the table name are automatically run.

Incrementing String Values

The REPEAT command increments variables in a command by running it multiple times until a specific value is reached. For example, you can use the REPEAT command with a string containing the DF command to display areas in multiple frames with one command.

Copying McIDAS-MVS String Tables

You can copy string tables from the mainframe to your workstation using the McIDAS-MVS SENST command. See Chapter 3 in the McIDAS-MVS Users Guide for more information about the SENST command.

Creating and Using Strings

In this exercise, you will create several strings and run them.

1. Start a McIDAS-X session.

   Type: **mcidas**

2. Log on and initialize the workstation.

   Type: **LOGON** *initials project* **I WS**

3. List the strings in the string table.

   Type: **TL**

   The string table contains the H and Y system strings, which contain the current date and time, as shown in the example below. When you logged on with the I option, the string table was cleared.

```
TL
H  :=13:03:47
Y  :=94123
```

4. Position the cursor in the center of the frame and run the Y string with the ZA command to print the date on frame 1.

   Type: **PC C; ZA "#Y**

   Notice that the string is expanded in the text window; the current Julian date (*yyddd*) replaces #Y.

5. Define a string called NOTE that stores a comment.

   Type: **TE NOTE "MAP OF THE WORLD**

6. Define a string called WORLDMAP that contains the command MAP WORL 3 BOX=NO.

   Type: **TE WORLDMAP "MAP WORL 3 BOX=NO**

7. List the strings in the string table and erase frame 1.

   Type: **TL; EG 1**

   The string table now contains four strings: H, NOTE, WORLDMAP, and Y, as shown below.

```
TL
H          :=13:05:54
NOTE       :=MAP OF THE WORLD
WORLDMAP   :=MAP WORL 3 BOX=NO
Y          :=94123
```

8. Display a map by running the string called WORLDMAP.

   Type: **#WORLDMAP**

   A map of the world is drawn on the frame.

9. Position the cursor at TV line 15 and element 260.

   Type: **PC T 15 260**

10. Use the string NOTE with the ZA command to print text on the screen.

    Type: **ZA "#NOTE**

    The text MAP OF THE WORLD is printed on the screen.

11. Erase frame 1.

    Type: **EG 1**

12. Define a string named T to print the current time. Remember that the ZA command requires a double quote before text to be printed.

    Type: **TE T "ZA "#H**

    Notice the expanded string in the text window. The system time when the string was created (HH:MM:SS) replaces the #H, as shown below.

```
TE T "ZA "#H
T   :=ZA "13:08:39
```

13. Run the string called T. Move the cursor and run the command several times. Because the string name is a single letter, you can press Ctrl and the letter to run the string.

    Press: **Ctrl T**

    The time is drawn on the screen. Notice that it is the same each time the string is run.

14. Define the string CT so that the time updates to the current time each time the string is run. The double pound signs indicate that the value of string H should not be replaced until string CT is executed.

    Type: **TE CT "ZA "##H**

    Notice the expanded string in the text window as shown below.

```
TE  CT  "ZA " ##H
CT := ZA "#H
```

15. **List the strings in the string table and notice the difference between T and CT.**

Type: TL

The #H string is expanded in the T string and not in the CT string.

```
TL
CT          :=ZA "#H
H           :=13:10:32
NOTE        :=MAP OF THE WORLD
T           :=ZA "13:08:39
WORLDMAP    :=MAP WORL 3 BOX=NO
Y           :=94123
```

16. **Move the cursor and run the string called CT. Move the cursor and run the command several times.**

Type: #CT

The time is drawn on the screen; it is updated each time the string is run.

Saving Strings

In this exercise, you will save the strings from the previous exercises to the user defined string table LEARN.

1. List the strings in the string table.

   Type: **TL**

   You should have 4 user defined strings (CT, NOTE, T, WORLDMAP) and 2 system strings (H,Y) as shown below.

```
TL
CT          :=ZA "#H
H           :=13:38:49
NOTE        :=MAP OF THE WORLD
T           :=ZA "13:08:39
WORLDMAP    :=MAP WORL 1 BOX=NO
Y           :=94123
```

2. Save the strings you created in a string table named LEARN.

   Type: **TU SAVE LEARN**

   A copy of each string is saved in the user defined string table LEARN. The strings also remain in the string table until you delete them or restore another user defined string table.

3. List all the user defined string tables on your workstation.

   Type: **TU LIST**

   You should see a string table named LEARN with your initials associated with it.

```
TU LIST
#     NUM   SAVE NAME  INIT  PROJ  SAVED  RESTORE  USER TERM
---   ---   ---------  ----  ----  -----  -------  ---- ----
 1     2      LEARN    SSS   4583  94123
```

4. **Delete all the strings in the string table.**

   Type: **TD ALL**

   When you saved the strings into the user defined string table LEARN, a copy of each string was stored in LEARN and a copy remained in the string table. When you deleted the strings, they were removed from the string table, but not from the user defined string table LEARN.

5. **List the stings in the string table.**

   Type: **TL**

   Only the H and Y system strings remain.

6. **Restore the string table LEARN.**

   Type: **TU REST LEARN**

   A copy of the strings in LEARN are placed in the string table.

7. **List the strings in the string table.**

   Type: **TL**

   The strings you saved in the user defined string table LEARN were restored to the string table.

Deleting Strings and String Tables

In this exercise, you will list strings in the string table, delete them, then delete the entire string table.

1. List the strings in the string table that begin with the letter N.

   Type: **TL N**

   The string NOTE is listed.

2. Delete the string called NOTE.

   Type: **TD NOTE**

3. List the strings in the string table to see that NOTE was deleted.

   Type: **TL**

4. Delete all the strings that begin with the letter T.

   Type: **TD PREFIX T**

5. List the strings in the string table again.

   Type: **TL**

   Your string table should contain 4 strings: 2 system strings, H and Y, and the user defined strings WORLDMAP and CT.

6. Delete all the strings in the string table, then list the strings to verify they were deleted.

   Type: **TD ALL; TL**

7. **List the string tables on your workstation.**

   Type: **TU LIST**

8. **Restore the user defined string table LEARN.**

   Type: **TU REST LEARN**

9. **List the strings. You will see the strings from the user defined string table LEARN have been restored, as shown below.**

   Type: **TL**

```
TL
CT         :=ZA "#H
H          :=13:46:24
WORLDMAP   :=MAP WORL 1 BOX=NO
T          :=ZA "13:08:39
Y          :=94123
```

10. **Delete the string table called LEARN.**

    Type: **TU DEL LEARN**

11. **Verify that the user defined string table LEARN was deleted, and see that the strings in the string table remain.**

    Type: **TU LIST; TL**

Creating and Deleting Global Strings

A string name whose first character is a question mark (?) is a global string. In this exercise, you will define, use, and delete global strings.

1. Define a global string to change the cursor size, shape, and color.

   Type: **TE ?CURSOR "CUR 15 15 BOX BLUE**

2. List all the strings in the string table.

   Type: **TL OUT**

   The OUT parameter lists all strings, including global strings.

```
TL OUT
?CURSOR   :=CUR 15 15 BOX BLUE
CT        :=ZA "#H
H         :=13:46:24
NOTE      :=MAP OF THE WORLD
WORLDMAP  :=MAP WORL 1 BOX=NO
T         :=ZA "13:08:39
Y         :=94123
```

3. Run the global string that you defined.

   Type: **#?CURSOR**

   The cursor changes to a blue box, 15 by 15 pixels.

4. Delete the strings from the current string table.

   Type: **TD ALL**

5. List the strings in the string table.

   Type: **TL**

   Notice that only H and Y are listed. To list the global strings, you must specify the ? or OUT parameter with the TL command.

6. List all the strings in the string table.

   Type: **TL OUT**

   Notice that the TD ALL command did not delete the global string ?CURSOR.

```
TL
?CURSOR    :=CUR 15 15 BOX BLUE
H          :=13:46:2
Y          :=94123
```

7. Delete the global string CURSOR from the string table.

   Type: **TD ?CURSOR**

   You must type the question mark (?) prefix to delete a global string or you can type TD ALL GLOB.

8. List all the strings in the string table to verify that the global string was deleted. Only the H and Y strings should remain.

   Type: **TL OUT**

Incrementing Values in a String

In this exercise, you will define a simple string that displays three images in three consecutive frames, use the REPEAT command to define values for the string, and run the string.

1. Create a string called DISPLAY that displays images on frames.

   Type: **TE DISPLAY " DF !1 !2**

   The exclamation point (!) indicates the value will be defined and incremented when you use the REPEAT command. In this example, the area number (!1) and the frame number (!2) will increment.

2. Repeat the DISPLAY string 3 times, starting at area 8000 and frame 1, and increase each value by 1 until area 8002 is displayed in frame 3.

   Type: **REPEAT DISPLAY 8000 TO 8002 BY 1 1 BY 1**

3. Set the loop bounds to frames 1 through 3 and loop the frames. Stop looping.

   Type: **LS 1-3**
   Press: **Alt L**

4. Exit McIDAS-X.

   Type: **EXIT**

6. MD Files

Lesson 6
MD Files

Lesson 6

MD Files

McIDAS-MVS receives real-time meteorological data that can be easily accessed and analyzed using McIDAS-X. MD (Meteorological Data) files contain information such as surface hourly weather data, radiosonde observations, ship and buoy observations, NMC forecast guidance (FOUS) and surface synoptic data.

MD files can be used for creating plots, generating isentropic surfaces and stability parameters, and displaying soundings and cross sections. This lesson describes the basic MD file commands. In later chapters, you will use MD files to generate contours and plots.

This lesson describes how to:

- list MD file directories and data records
- search MD files for specific observations
- copy and delete MD files
- add comments to an MD file directory

The following commands are used in this lesson.

Command	Function
DMAP	lists information about files
LSCHE	lists an MD file schema
MDL	lists MD file data
MDU	MD file utility

Basic Concepts

MD files normally contain observational data for a specific time period, for example, a day or an entire year. MD files store the data in individual records for a specific location at a specific time. Each MD file contains individual records. A record contains observational data for a latitude and longitude at a specific time. For example, one record may include measurements of temperature, dew point, wind speed, wind direction, and sea level pressure at 15 UTC for Houston, TX. A single MD file may contain thousands of records.

MD files use the naming convention MDXX*nnnn* where *nnnn* is a four-digit file number. For example, MDXX0013 is the name for MD file 13. Most McIDAS commands use only the MD file number. However, you must use the MDXX prefix with the DMAP command or when using Unix commands to copy, move, or delete MD files.

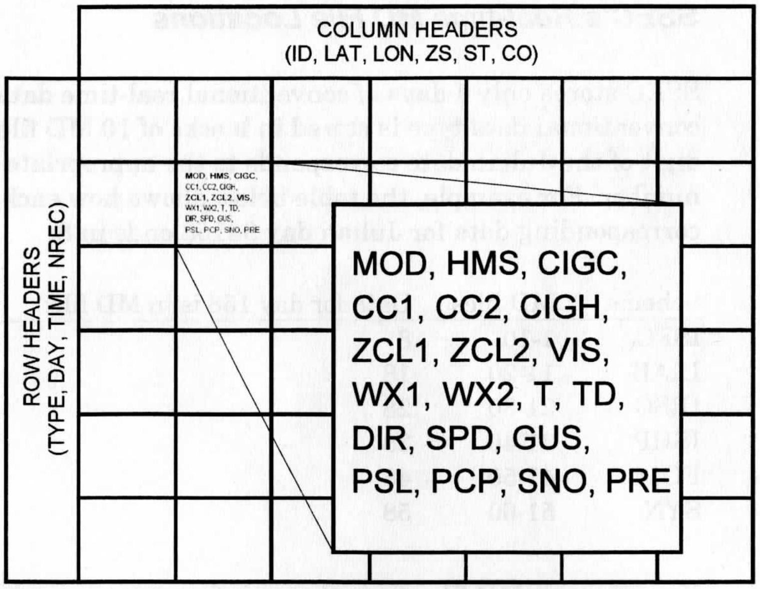
MD File Schemas

McIDAS-X stores MD files according to unique templates called *schemas*. SSEC's McIDAS-MVS receives real-time data for these six schemas:

- ISFC (international surface hourly observations)
- IRAB (international RAOB (radiosonde) mandatory levels)
- IRSG (international RAOB (radiosonde) significant levels)
- ISHP (ship and buoy observations)
- FO14 (FOUS 14, model output statistics)
- SYN (international surface synoptics)

MD files in the ISFC, IRAB, FO14, and SYN schemas are arranged in a table of rows and columns as shown in the ISFC example on the opposite page. Time and day information common to all records in the row appears in the row header. Similarly, a column header designates common information according to location. Therefore, all the records along a particular row represent the same time and all the records down a particular column are reports from the same station.

MD files in the IRSG and ISHP schemas have row headers, but not column headers because the reporting location changes.



The individual data values within the MD file are stored according to the *keys* of the schema. Examples of keys within the ISFC schema are temperature, dew point, and cloud cover. Keys are used for searching and plotting the MD file data. For each key, the schema provides:

- **a scaling factor, for example 2, meaning temperatures are stored in Kelvin $* 10^2$**
- **the units in which the values are stored, for example Kelvin**

Note the difference between *keys* and *keywords*. Keywords are entered as part of a command to clarify the command function. Keys label data stored within an MD file data record.

SSEC's Real-time MD File Locations

SSEC stores only 4 days of conventional real-time data. Each conventional data type is stored in blocks of 10 MD files. The last digit of the Julian date corresponds to the appropriate MD file number. For example, the table below shows how each MD file with corresponding data for Julian day 94158 ends in 8.

Schema	MD files	Data for day 158 is in MD file:
ISFC	1-10	8
IRAB	11-20	18
IRSG	21-30	28
ISHP	31-40	38
FO14	41-50	48
SYN	51-60	58

You can copy MD files from the mainframe to your workstation using the McIDAS-MVS SENMD2 command. See the McIDAS-MVS Users Guide for more information about the SENMD2 command and data storage and file allocation.

SSEC's History Data

SSEC has history data for the following schemas and years.

Schema	Years
ISFC	1976 to present
IRAB/IRSG	1977 to present
ISHP	1985 to present
SYN	1991 to present

Listing MD File Directories and Data Records

In this exercise, you will list an MD file directory and information about its schema, and examine individual records in the MD file.

1. **Start a McIDAS-X session from the Unix prompt.**

   Type: **mcidas**

2. **Log on and initialize the workstation.**

   Type: **LOGON** ***initials project*** **I WS**

3. **List the file directories for MD files 8000 through 8004.**

   Type: **MDU LIST 8000 8004**

   The MD file number, date the MD file was created, schema type, project number, number of rows and columns, MD data date, and description for each MD file are listed.

```
MDU LIST 8000 8004
MD#    CREATED SCHM PROJ  NR    NC   ID       DESCRIPTION
-----  ------- ---- ---- ---- ---- -------   ------------
8000   93216   ISFC 4587  72  3500 93072     SURFACE HOURLY OBSERVATIONS
8001   93216   IRAB 4587   8  1500 93072     INTL.RADIOSONDE OBS (UPPER AIR)
8002   93216   IRSG 4587  16  8000 93072     INTL.RADIOSONDE OBS--SIG LEVELS
8003   93216   ISHP 4587  24  3000 93072     SHIP/BUOY OBSERVATIONS
8004   93216   SYN  4587   8  6000 93072     SURFACE SYNOPTICS
```

4. **List all the MD files stored on your workstation.**

   Type: **DMAP MDXX**

5. **List the structure and keys in the ISFC schema.**

   Type: LSCHE ISFC

   The keys, units, and scale factors for the ISFC schema are displayed as shown below. If the schema type does not exist, register the schema with the SCHE command. See the *Introduction* and the SCHE command in the McIDAS-X Users Guide for more information.

```
LSCHE ISFC

NAME: ISFC  VERSION:  5  DATE:   90289  TEXTID: "SURFACE HOURLY OBSERVATIONS
----    -------
      DEFAULT NUMBER OF ROWS:  72                               INTEGER ID:0
              COLS:             3500               MISSING DATA VALUE: -2139062
      REPEAT GROUP:  NUMBER OF REPITITIONS:     1
                     STARTING POSITION         11
                                   SIZE        20

NUMBER OF KEYS IN ROW HEADER:       4
                     COL HEADER     6                STARTING AT POSITION  5
                     DATA RECORD   20                STARTING AT POSITION 11
                                   --
                                   30 TOTAL

      KEY   SCALE   UNIT    KEY   SCALE    UNIT   KEY   SCALE    UNIT
      ---   -----   ----    ---   -----    ----   ---   -----    ----
      TYPE    0             DAY     0      SYD    TIME    0      HMS
      NREC    0             ID      0      CHAR   LAT     4      DEG
      LON     4     DEG     ZS      0      M      ST      0      CHAR
      CO      0     CHAR    MOD     0             HHS     0      HMS
      CIGC    0             CC1     0             CC2     0
      CIGH   -2     FT      ZCL1   -2      FT     ZCL2   -2      FT
      VIS     1     MI      WX1     0      CHAR   WX2     0      CHAR
      T       2     K       TD      2      K      DIR     0      DEG
      SPD     1     MPS     GUS     1      MPS    PSL     2      MB
      PCP     2     IN      SNO     0      IN     PRE     2      MB
```

6. **Set a pointer to MD file 8000 to make it the current MD file.**

   Type: MDU SET 8000

   All subsequent commands will affect MD file 8000, unless you change the pointer or specify a different MD file number in the command.

7. **List the keys in MD file 8000.**

Type: MDL KEYS=LIST

Also listed are row and column headers, and the data keys for MD file 8000. Each key lists units and a description.

```
 MDL KEYS=LIST
 NAME     UNIT    DESCRIPTION              NAME    UNIT    DESCRIPTION
 ----     ----    -----------              ----    ----    ---------------
ROW:
  TYPE            TYPE OF DATA             DAY     SYD     YEAR AND JULIAN DAY
  TIME    HMS     TIME                     NREC            #OF RECORDS IN ROW
COLUMN:
  ID      CHAR    STATION IDENTIFIER       LAT     DEG     LATITUDE
  LON     DEG     LONGITUDE                ZS      M       SURFACE ELEVATION
  ST      CHAR    STATE ID                 CO      CHAR    COUNTRY ID
DATA:
  MOD             MODIFICATION FLAG        HMS     HMS     ACTUAL TIME OF OBS
  CIGC            CLD COVER OF CEILING     CC1             CLOUD COVER 1ST-CLOU
  CC2             CLOUD COVER 2ND CLOU     CIGH    FT      CEILING HEIGHT
  ZCL1    FT      HEIGHT OF 1ST NON-CE     ZCL2    FT      HEIGHT OF 2ND NON-CE
  VIS     MI      VISIBLILITY              WX1     CHAR    WEATHER-1ST 4 CHAR
  WX2     CHAR    WEATHER -2ND 4 CHAR      T       K       TEMPERATURE
  TD      K       DEW POINT TEMP           DIR     DEG     WIND DIRECTION
  SPD     MPS     WIND SPEED               GUS     MPS     WIND GUSTS
  PSL     MB      SEA LEVEL PRESSURE       PCP     IN      3-HRLY PRECIP TOTAL
  SNO     IN      CUMULATIVE SNOW DEPT     PRE     MB      PRESSURE
```

8. **List the first record in MD file 8000.**

Type: MDL

MDL without any parameters lists the first reported observation in the current MD file as shown below. Be careful that you do not type an MDL ALL without keywords; all the records in the MD file will be listed.

```
MDL
--RECORD AT (ROW,COL) = (    1,     2)
|TYPE = 0              |DAY   =    93072 SYD   |TIME  = 0HMS
|NREC = 1924           |ID    =    OAR         |LAT   = 36.6833 DEG
|LON  = 121.7666 DEG   |ZS    =    41 M        |ST    = CA
|CO   = US             |MOD   =    0           |HMS   = 235500 HMS
|CIGC = 2              |CC1   =    2           |CIGH  = 15000. FT
|ZCL1 = 20000. FT      |VIS   =    25.0 MI     |WX1   =
|WX2  =                |T     =    289.27 K    |TD    = 284.83 K
|DIR  = 270 DEG        |SPD   =    6.2 MPS     |PSL   = 1019.31 MB
```

Searching MD Files

In this exercise, you will search an MD file for information according to time, date and location, and save the search conditions in a string table so you can use them automatically.

1. List the temperature (T) and dew point (TD), in degrees Fahrenheit, for Cape Hatteras, North Carolina, at 0 UTC using MD file 8000.

   Type: **MDL 8000 KEYS=T TD ID=HAT UNIT=F F TIME=0**

   The temperature is 46° and the dew point is 42°.

2. List the three-letter station identifier (ID), temperature (T), and dew point (TD) of the first reported observation for North Carolina at 15 UTC. You don't need to retype the MD file number since the pointer is set to MD file 8000. The X in the UNITS keyword is a placeholder for the station identifier key which does not have units. Display the temperature and dew point in Fahrenheit.

   Type: **MDL KEYS=ID T TD ST=NC TIME=15 UNIT=X F F**

   The station in Wilmington, North Carolina, reporting a temperature of 60° and a dew point temperature of 58° at 15 UTC is listed.

3. List all the occurrences of station ID, temperature, and dew point in North Carolina at 15 UTC. Use the UNIT keyword to display the temperature and dew point in Fahrenheit.

   Type: **MDL ALL KEYS=ID T TD UNIT=X F F ST=NC TIME=15**

   The ALL parameter lists all reporting stations in the MD file that match the criteria. Without the ALL parameter only the first match is listed.

4. List all occurrences of station ID, time (TIME), precipitation (PCP), and wind gusts (GUS) in North Carolina from18 to 20 UTC. Add the INI and SAVE parameters to initialize the current string table and save the search conditions as strings. List the data in units of inches and miles per hour.

   Type: **MDL ALL INI SAVE KEYS=ID TIME PCP GUS ST=NC TIME=18 20 UNIT=X X IN MPH**

5. List the current string table MO entries.

   Type: **TL MO**

   The search condition keys appear in string MOCON, and the search condition values appear s6

   in strings MOCVL and MOCVU. The output keys and units appear in strings MOKEY and MOUNI respectively. You do not need to enter them again in future MDL commands unless you want to change them.

6. List all the stations in North Carolina from 18 to 20 UTC.

   Type: **MDL ALL KEYS=SNO**

   The station IDs, time, precipitation, amounts of snow, and wind gusts are listed. The time, state, station ID, precipitation and wind gusts come from the string table and the amount of snow was added.

7. Delete the strings with the MO prefix to clear the search conditions from the string table.

   Type: **TD PREFIX MO**

Copying and Deleting MD Files

In this exercise, you will copy MD file data from one file to another on the workstation and delete an MD file.

1. **Copy the contents of MD file 8002 on your workstation to MD file 4000.**

   Type: **MDU COPY 8002 4000**

2. **List the MD file headers to verify that the MD file was copied.**

   Type: **MDU LIST 8002; MDU LIST 4000**

3. **Delete MD file 4000.**

   Type: **MDU DEL 4000**

Adding Comments to the MD File Directory

In the following exercise, you will add a comment to an existing MD file. Comments are helpful for describing the information in the MD files.

1. Copy the contents of MD file 8003 to MD file 4000.

   Type: **MDU COPY 8003 4000**

2. List the MD file directory for MD file 4000.

   Type: **MDU LIST 4000**

3. Change the comment in the MD file directory describing the data in MD file 4000.

   Type: **MDU DIR 4000 "CASE STUDY**

4. List the MD directory again to verify that the comment was added.

   Type: **MDU LIST 4000**

   The comment CASE STUDY is displayed under the header DESCRIPTION.

5. Delete MD file 4000.

   Type: **MDU DEL 4000**

6. Exit McIDAS-X.

   Type: **EXIT**

7. Grids and Grid Files

Lesson 7
Grids and Grid Files

Lesson 7

Grids and Grid Files

A McIDAS-X grid is a lattice of regularly spaced data points. Grids can be generated from numerical models or observational data. When you contour observational data, it is interpolated and stored as a grid. Grids are stored in grid files.

This lesson describes how to:

- **list grids and grid files**
- **copy grids and grid files**
- **delete grids and grid files**
- **create grids and grid files**

The following commands are used in this lesson.

Command	Function
DMAP	lists information about files
IGG	grid utility
IGU	grid file utility

Basic Concepts

Grids

A grid is a lattice of regularly spaced data points superimposed on a projection of the earth. Grids can store numerical model data and serve as an interface between observational data stored in MD files and analyzed data displayed as contours on a frame. To contour observational data, compute derived parameters, and display manually digitized radar (MDR) data, etc., the data must first be interpolated from the observing locations to a uniform latitude, longitude lattice. McIDAS stores this geographic lattice as a grid.

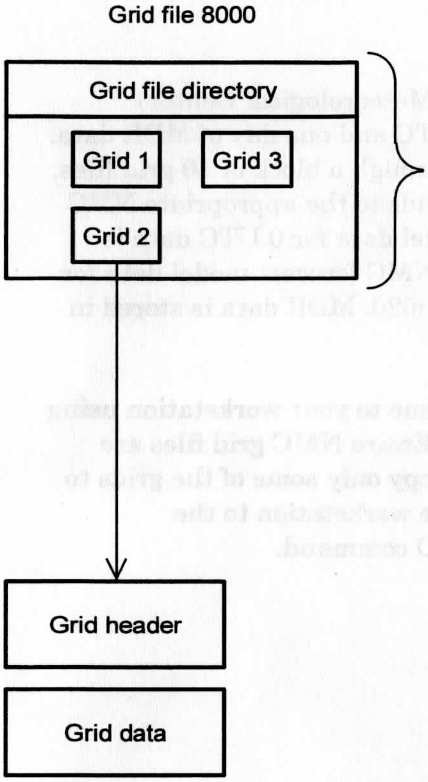
Grid Files

Grids are stored in grid files. When McIDAS-X is started, a pointer is set to grid file 1. All grids created during that workstation session are stored in grid file 1 unless you use the IGU SET command to direct grids to another grid file. You can also use the GRIDF keyword to specify a grid file number in some commands.

Grid files are stored as LW files and use the naming convention GR*nnnnnn* where *nnnnnn* is the six-digit file number. If the file number is less than six digits, I and D replace the first two digits and zeros precede the number. For example, GR111111 is the name for grid file 111111, GRI90112 is the name for grid file 90112, and GRID0013 is the name for grid file 13. Most McIDAS commands use only the grid file number. However, you must use the GRID prefix with the DMAP command or when using Unix commands to copy, move, or delete grid files.

Grid File Format

A grid file contains a grid file directory, a grid header for each grid, and the grid data as shown below. A sample grid directory and two types of grid header information are also shown below.




```
IGU  LIST  8000  8002
GRIDFILE   PROJ    CREATED    MAXGRD    IDENT

8000       2360    93070      159        12Z 93070 NMC NGM TRAINING GRID
8001       2360    93071      159        00Z 93071 NMC NGM TRAINING GRID
8002       2360    93071      159        12Z 93071 NMC NGM TRAINING GRID
```

```
IGG LIST 2
Grid file: 8000 **12Z 93070 NMC NGM TRAINING GRID**
# YYDDD HHMMSS GNAME LEVEL    SRC  VT  NR  NC  LLNW   ROWINC COLINC
-- ----- ------ ---- -------- ---  --- --  --  ---    ------ ------
 2 93070 120000  T    1000 MB NGM   0  33  36 60/140  1.2500 2.5000
```

```
GEDIT 8000 2 FORM=DIR
GRID HEADER LISTING:
Grid File =     8000 Grid =      2
Max Words =     1188 Cols =     36  Rows =
Date      =    93070 Time = 120000  Valid Time = 0
Variable Name  =    T      Scale =   2  Units = K
Vertical Level =       1000 MB
Grid Type =      Pseudo - Mercator (more general)
Maximum Latitude = 60.000       Longitude = 140.0000
```

Manipulating Grids and Grid Files

The IGG command manipulates grids in a grid file. IGG lists, deletes, moves, and performs mathematical operations on grids. These operations include adding or subtracting two grids, filling a grid with a constant value, or redefining all values within a grid that are less than a specified number to be a new number (e.g. all values less than zero are set to zero). If you have u and v component grids, you can create a vorticity or divergence grid, or use the component grids to advect a parameter in another grid.

The GEDIT command provides information about grids. You can use it to list information about the grid header and statistics on the grid data, or list and edit grid data points.

The IGU command manipulates grid files. With this command you can make, list, copy, delete, or set a pointer to a grid file.

See the McIDAS-X Users Guide for more information about these commands.

SSEC's Real-time Grid Data

SSEC stores one day of NMC (National Meteorological Center) forecast model data for 0 UTC and 12 UTC and one day of MDR data. The NMC forecast model data rotates through a block of 10 grid files. The last digit of the Julian day corresponds to the appropriate NMC grid file number. The NMC forecast model data for 0 UTC data is stored in grid files 16001 to 16010. The NMC forecast model data for 12 UTC is stored in grid files 16011 to 16020. MDR data is stored in grid file 15999.

You can copy grid files from the mainframe to your workstation using the McIDAS-MVS SENGRD command. Entire NMC grid files are very large; therefore, you may want to copy only some of the grids to your workstation. To send grids from the workstation to the mainframe, use the McIDAS-X SENGRD command.

Listing Grids and Grid Files

In this exercise, you will list the grid files on your workstation, change the current grid file, and list the grids in that grid file.

1. **Start McIDAS-X with six frames.**

   Type: **mcidas -fr 6**

2. **Log on to the workstation.**

   Type: **LOGON** ***initials project*** **I WS**

3. **List the grid files between 8000 and 8099 on your workstation.**

   Type: **DMAP GRID80***

   The DMAP command locates all the grid files you can access with McIDAS-X.

4. **List the grid file directory for grid files 8000 to 8004.**

   Type: **IGU LIST 8000 8004**

   Each grid file has a corresponding project number, date the grid file was created, maximum number of grids the grid file can store, and a file description, as shown below.

```
IGU LIST 8000 8004
GRIDFILE   PROJ   CREATED   MAXGRD  IDENT
--------   ----   -------   ------  -------------
8000       2360   93070       159   12Z 93070 NMC NGM TRAINING GRID
8001       2360   93071       159   00Z 93071 NMC NGM TRAINING GRID
8002       2360   93071       159   12Z 93071 NMC NGM TRAINING GRID
8003       2360   93072       159   00Z 93072 NMC NGM TRAINING GRID
8004       2360   93072       159   12Z 93072 NMC NGM TRAINING GRID
```

5. Set the pointer to grid file 8000 to make it the current grid file.

   Type: **IGU SET 8000**

   Subsequent grid commands are automatically performed on grid file 8000. The previous and current grid file numbers are displayed in the text window. The previous grid file was 1 and the current grid file is 8000. To determine the grid file number the pointer is set to, enter the command IGU SET.

6. List the first ten grids in grid file 8000.

   Type: **IGG LIST 1 10**

   The first ten grids are listed as shown below. The text window lists the grid file number, grid file description, grid number, Julian date of the data, time of the data, parameter type, pressure level, source type, valid time, number of rows and columns in the grid, northwest corner latitude and longitude, and row and column increments in degrees latitude and longitude.

```
IGG LIST 1 10
 Grid file: 8000 **12Z 93070 NMC NGM TRAINING GRID**
  # YYDDD HHMMSS  GNAME  LEVEL     SRC    VT   NR  NC    LLNW    ROWINC   COLINC
 -- ----- ------  -----  -----     ---    --   --  --    ---     ------   ------
  1 93070 120000  Z       1000 MB  ROI     0   33  36  60/140  1.2500   2.5000
  2 93070 120000  T       1000 MB  NGM     0   33  36  60/140  1.2500   2.5000
  3 93070 120000  U       1000 MB  ROI     0   33  36  60/140  1.2500   2.5000
  4 93070 120000  V       1000 MB  ROI     0   33  36  60/140  1.2500   2.5000
  5 93070 120000  Z        850 MB  ROI     0   33  36  60/140  1.2500   2.5000
  6 93070 120000  T        850 MB  ROI     0   33  36  60/140  1.2500   2.5000
  7 93070 120000  U        850 MB  ROI     0   33  36  60/140  1.2500   2.5000
  8 93070 120000  V        850 MB  ROI     0   33  36  60/140  1.2500   2.5000
  9 93070 120000  Z        700 MB  ROI     0   33  36  60/140  1.2500   2.5000
 10 93070 120000  T        700 MB  ROI     0   33  36  60/140  1.2500   2.5000
```

Copying Grids and Grid Files

Next, you will copy grids and grid files.

1. Copy grid file 8000 to grid file 5000.

   Type: **IGU COPY 8000 5000**

2. Set the pointer to grid file 5000.

   Type: **IGU SET 5000**

3. List grids 115 through 130 in grid file 5000.

   Type: **IGG LIST 115 130**

   Note that grids 115 though 120 are used; therefore the first available grid is 121 in grid file 5000.

4. Copy grids 1 through 10 from grid file 8001 to grid file 5000 starting at grid 121.

   Type: **IGG GET 8001 1 10 5000 121**

5. **Verify the grids were copied into grid file 5000; grids 121 through 130 are now being used.**

   Type: IGG LIST 115 130

   Notice that grids 115 to 120 have the Julian date 93070, and grids 121 to 130 have the Julian date 93071.

IGG LIST 115 130

Grid file: 5000 **12Z 93070 NMC NGM TRAINING GRID**

#	YYDDD	HHMMSS	NAME	LEVEL	SRC	VT	NR	NC	LLNW	ROWINC	COLINC
115	93070	120000	LI	SFC	NGM	36	33	36	60/140	1.2500	2.5000
116	93070	120000	LI	SFC	NGM	48	33	36	60/140	1.2500	2.5000
117	93070	120000	RH	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
118	93070	120000	RH	850 MB	NGM	6	33	36	60/140	1.2500	2.5000
119	93070	120000	RH	850 MB	NGM	12	33	36	60/140	1.2500	2.5000
120	93070	120000	RH	850 MB	NGM	24	33	36	60/140	1.2500	2.5000
121	93071	0	Z	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
122	93071	0	T	1000 MB	NGM	0	33	36	60/140	1.2500	2.5000
123	93071	0	U	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
124	93071	0	V	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
125	93071	0	Z	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
126	93071	0	T	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
127	93071	0	U	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
128	93071	0	V	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
129	93071	0	Z	700 MB	ROI	0	33	36	60/140	1.2500	2.5000
130	93071	0	T	700 MB	ROI	0	33	36	60/140	1.2500	2.5000

6. **List grids 1 to 10 from grid file 8001. Note that they are the same as grids 121 to 130 in the example above.**

   Type: IGG LIST 1 10 GRIDF=8001

IGG LIST 1 10

Grid file: 8001 **00Z 93071 NMC NGM TRAINING GRID**

#	YYDDD	HHMMSS	NAME	LEVEL	SRC	VT	NR	NC	LLNW	ROWINC	COLINC
1	93071	0	Z	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
2	93071	0	T	1000 MB	NGM	0	33	36	60/140	1.2500	2.5000
3	93071	0	U	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
4	93071	0	V	1000 MB	ROI	0	33	36	60/140	1.2500	2.5000
5	93071	0	Z	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
6	93071	0	T	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
7	93071	0	U	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
8	93071	0	V	850 MB	ROI	0	33	36	60/140	1.2500	2.5000
9	93071	0	Z	700 MB	ROI	0	33	36	60/140	1.2500	2.5000
10	93071	0	T	700 MB	ROI	0	33	36	60/140	1.2500	2.5000

7. **Change the description in the grid file header to LEARNING HOW TO COPY GRIDS.**

   Type: **IGU DIR 5000 "LEARNING HOW TO COPY GRIDS**

8. **List grid file 5000 to see the new description.**

   Type: **IGU LIST 5000**

```
IGU LIST 5000
GRIDFILE    PROJ    CREATED    MAXGRD  IDENT
--------    ----    -------    ------  ------------
5000        XXXX    YYDDD       159    LEARNING HOW TO COPY GRIDS
```

Deleting Grids and Grid Files

In this exercise, you will use the IGG command to delete grids and the IGU command to delete grid files. Verify that the current grid file contains the grids you want to delete so you don't accidentally delete grids from the wrong grid file.

1. List grids 121 to 130 in grid file 5000.

   Type: **IGG LIST 121 130**

2. Delete grids 121 through 130 from grid file 5000.

   Type: **IGG DEL 121 130**

3. List the grids in grid file 5000.

   Type: **IGG LIST**

   Grid file 5000 currently stores 120 grids.

4. Delete grid file 5000.

   Type: **IGU DEL 5000**

5. Verify that grid file 5000 was deleted.

   Type: **IGU LIST 5000**

Creating Grids and Grid Files

In this exercise, you will create a new grid file, copy and contour grids, create advection and divergence grids, and list the grids and grid files. Chapter 8, *Weather Analysis,* discusses grid contouring in more detail.

1. Generate a grid file numbered 5000 with a maximum of 100 grids, and the description ADVECTION AND DIVERGENCE GRIDS.

   Type: **IGU MAKE 5000 100 "ADVECTION AND DIVERGENCE GRIDS**

   If you don't specify a maximum number of grids, the grid file is created with space for 159 grids.

2. List grid file 5000.

   Type: **IGU LIST 5000**

3. Copy grids 21 through 24 from grid file 8000 to grid file 5000 starting at grid 1.

   Type: **IGG GET 8000 21 24 5000 1**

   The 1 at the end of the command is optional. If you do not specify a number, the grids are copied to the first available grid in grid file 5000.

4. List grid file 5000 to verify the grids were copied.

   Type: **IGG LIST**

   Grid file 5000 should contain 4 grids.

5. **Create a temperature advection grid using the winds in grids 3 and 4 to advect the temperatures in grid 2. The new grid is filed into grid 5, which is the first available grid.**

   Type: IGG MAKE 3 ADV 2

   Commands that use the u and v wind components assume the next grid is the v grid unless the keyword V specifies a different number.

6. **Verify that grid 5 was created.**

   Type: IGG LIST

   Note the parameter type for grid 5 is TADV as shown below.

```
IGG LIST
 Grid file: 5000 **ADVECTION AND DIVERGENCE GRIDS**
  # YYDDD HHMMSS  NAME  LEVEL     SRC   VT   NR  NC  LLNW    ROWINC   COLINC
 -- ----- ------- ----  --------  ---   ---  --  --  ---     ------   ------
  1 93070 120000  Z     1000 MB   NGM   12   33  36 60/140  1.2500   2.5000
  2 93070 120000  T     1000 MB   NGM   12   33  36 60/140  1.2500   2.5000
  3 93070 120000  U     1000 MB   NGM   12   33  36 60/140  1.2500   2.5000
  4 93070 120000  V     1000 MB   NGM   12   33  36 60/140  1.2500   2.5000
  5 93070 120000  TADV  1000 MB   NGM   12   33  36 60/140  1.2500   2.5000
```

7. **Show frame 4, and display area 8000 centered on Washington, DC. Add a high resolution map.**

   Type: SF 4; DF 8000 4 EC DCA; MAP H

8. **Contour the temperature advection grid 5 over the image using a contour interval of 5 degrees per day. Make negative values (cold advection) dashed.**

   Type: IGTV 5 5 SAT DASH=NEG

9. **Create a divergence grid from grid 3 and write the resulting grid to grid 6.**

   Type: IGG MAKE 3 DVG

10. List the contents of grid file 5000 to verify that grid 6, a divergence grid, was added.

    Type: **IGG LIST**

    Note the parameter type for grid 6 is DVG.

11. Contour the divergence grid over the satellite image with a contour interval of 5 and graphics color level 3. Make the convergence areas dashed and display the contour on frame 4.

    Type: **IGTV 6 5 SAT COLOR=3 DASH=NEG**

12. Delete grid file 5000.

    Type: **IGU DEL 5000**

13. Exit McIDAS-X.

    Type: **EXIT**

8. Weather Analysis

Lesson 8
Weather Analysis

Lesson 8

Weather Analysis

An important function of McIDAS-X is the access and analysis of conventional meteorological data stored in MD files and grids. For example, you can:

- plot and contour surface observations, upper air observations, and FOUS data
- create skew T thermodynamic diagrams, vertical cross sections, and meteorograms

This lesson describes how to:

- list surface and upper air data
- plot and contour MD surface and upper air data
- create meteorological diagrams
- plot and contour MD file data with the MDX command
- use the MDX command

The following commands are used in this lesson.

Command	Function
MDX	plots or grids data from MD files or grids
MG	plots a 24-hour surface meteorogram
MSL	lists information from the international master weather station list
SC	grids and contours data from a surface MD file
SKEWT	plots a sounding on a skew T thermodynamic diagram
SL	lists data from a surface MD file
SP	plots data from a surface MD file
UC	grids and contours data from an upper air MD file
UL	lists data from an upper air MD file
UP	plots data from an upper air MD file
XSECT	displays a vertical cross section of upper air data

Basic Concepts

Listing Data

You can see raw MD file data without having to plot it by entering the MDL, SL and UL commands. The MDL command, which lists MD file data, was discussed in Lesson 6 *MD Files.*

To list data for a specific station, you must know the correct station ID. The MSL command lists all stations that match a given match string, state, country, latitude range, longitude range, or data type. The output lists the station ID, station name, data types, country, latitude, longitude and elevation for each station.

The SL command lists surface data availability by giving the number of reports per hour, or listing the actual surface data in American or metric units. Data can be listed for one or more stations or for a time range. SL provides many keywords which can be used as search conditions to further define the output. For example, you can list all the stations in the United States which reported heavy thunderstorms between 12 UTC and 18 UTC on day 93172.

The UL command lists upper air data availability (i.e. the number of stations reporting for each observation time) or the sounding data for a particular station. If you use the LIST option, both mandatory and significant level data are listed with a set of calculated stability indices. For missing upper air data, a value is linearly interpolated using neighboring data points. If you want just the original mandatory level, significant temperature levels and significant wind levels without interpolation, specify the OPT=3 keyword.

Plotting Data

You can plot MD file data over an image or graphics map using the SP and UP commands. The SP command plots surface hourly weather observations such as sea level pressure, cloud cover, precipitation, and wind speed. The UP command plots upper air data, such as height, wind speed, temperature, and the mixing ratio at a specific pressure level. Data can be plotted individually or in a station model. To plot data from any other MD file types, such as pilot reports, FOUS data, or ship observations, use the MDX command which is discussed later in this lesson.

Contouring Data

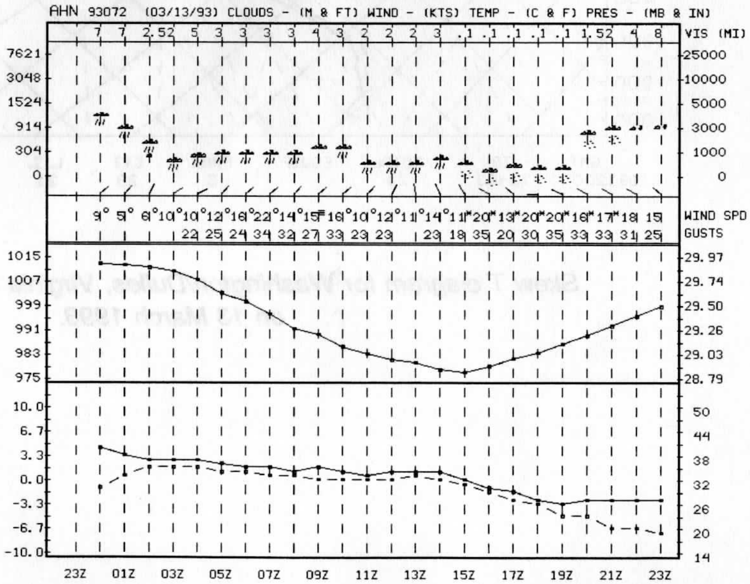
You can draw contours of MD file data over an image or graphics map using the SC and UC commands. These commands use the Barnes scheme to objectively analyze data from an MD file and store the data in one or more uniform grids. Then, the commands use the grid or grids to draw contours or streamlines on the frame. SC is used with surface MD files; UC is used with upper air files. To contour data from any other MD file schema, you must use the MDX command.

Some parameters such as wind barbs (WIN) and station IDs (ID or IDN) can only be plotted. Other parameters such as streamlines and derived parameters (for example, divergence, vorticity, temperature advection), can only be contoured because gridded values are required for those calculations.

To redraw a set of contours, use the IGTV command so the grids do not have to be recreated each time. IGTV can recontour grids with a different contour interval, units, and label sizes.

Creating Meteorological Diagrams

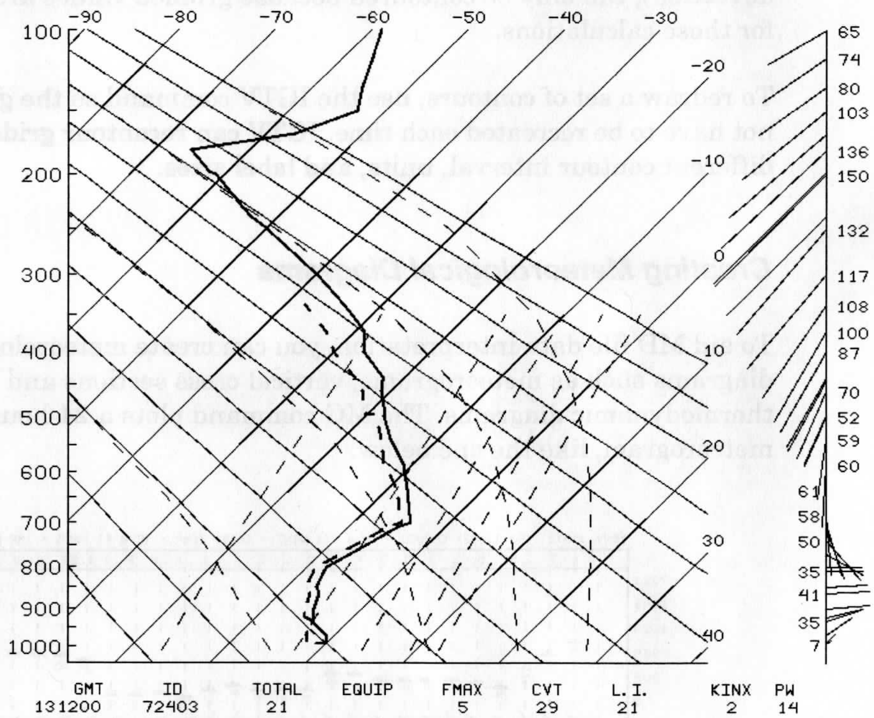
To aid MD file data interpretation, you can create meteorological diagrams such as meteorograms, vertical cross sections and skew T thermodynamic diagrams. The MG command plots a 24-hour surface meteorogram, like the one below.



Surface meteorogram for Athens, Georgia, starting at 23 UTC on 12 March 1993 and ending at 23 UTC on 13 March 1993.

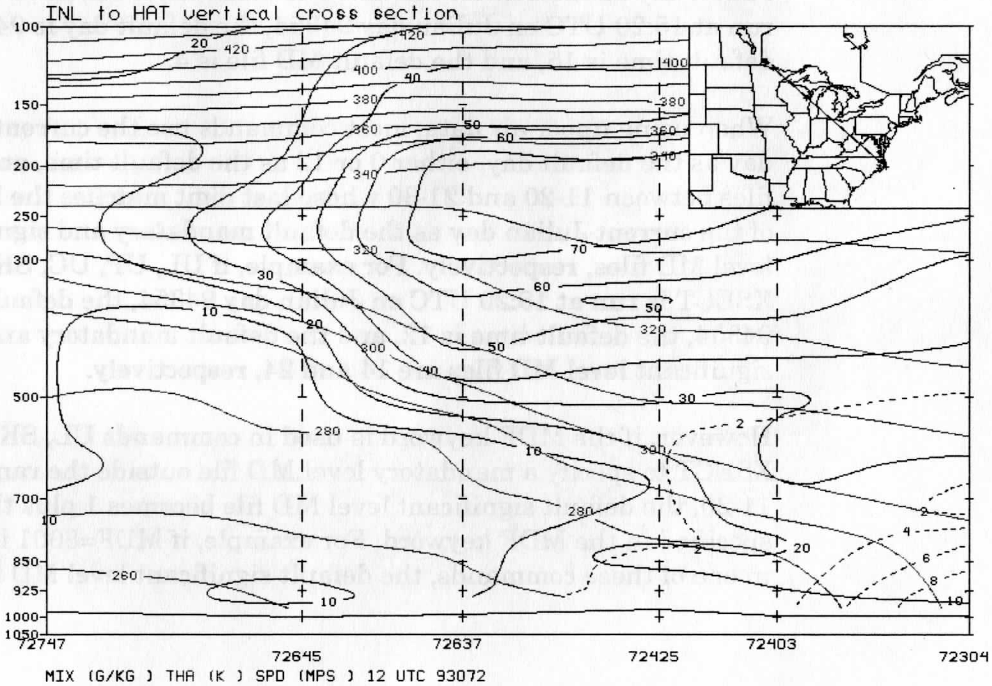
The meteorogram plots temperature, dew point, altimeter setting, wind speed and direction, visibility, current weather and cloud cover for the specified station over the past 24 hours. Before drawing a plot, the MG command automatically erases the contents of the frame and initializes the graphics colors.

The SKEWT command plots a skew T thermodynamic diagram from upper air data. A set of stability indices is also calculated and plotted. The stability parameters include: total totals, equilibrium pressure, forecast maximum temperature, convective temperature, lifted index, K-index and precipitable water. You can overlay a second sounding on the same diagram for comparison purposes. Below is an example of a skew T diagram.



Skew T diagram for Washington/Dulles, Virginia (72403) at 12 UTC on 13 March 1993.

The XSECT command displays a vertical cross section of upper air data. The cross section displays mandatory and significant level information for all reporting stations within a 500 km corridor between the beginning and ending stations. Keyword FORM plots multiple parameters. Valid parameters include derived parameters and some MD file schema keys. Other keywords allow for latitude and longitude specifications, a map inlay of the cross section coverage, top and bottom pressure levels, and a paneling feature for multiple cross sections on one frame. Below is an example of a vertical cross section.



Vertical cross section at 12 UTC on 13 March 1993.
The cross section extends from International Falls, Minnesota (72747) to Cape Hatteras, North Carolina (72304).

Using Command Defaults

Many commands that list, plot, contour or create a meteorological diagram using surface or upper air MD file data have defaults for the day, time and MD file. Each command also has parameters and/or keywords to override the default values.

When using surface data, most commands use the current Julian day as the default day, the current hour as the default time, and the MD file between 1 and 10 which matches the last digit of the current Julian day as the default MD file. For example, if SL, SP, SC or MG is run at 15:20 UTC on Julian day 94354, the default day is 94354, the default time is 15, and the default MD file is 4.

When using upper air data, most commands use the current Julian day as the default day, either 0 or 12 as the default time, and the MD files between 11-20 and 21-30 whose last digit matches the last digit of the current Julian day as the default mandatory and significant level MD files, respectively. For example, if UL, UP, UC, SKEWT or XSECT is run at 15:20 UTC on Julian day 94354, the default day is 94354, the default time is 12, and the default mandatory and significant level MD files are 14 and 24, respectively.

However, if the MDF keyword is used in commands UL, SKEWT or XSECT to specify a mandatory level MD file outside the range of 11-20, the default significant level MD file becomes 1 plus the number specified in the MDF keyword. For example, if MDF=8001 is specified in one of these commands, the default significant level MD file is 8002.

Using the MDX Command

The MDX command is a general plotting and gridding command. MDX can plot or grid and contour data from MD files of any schema type. The SP and SC commands only work with ISFC or SVCA schemas and the UP and UC only work with IRAB or RAOB schemas. MDX also has many keywords that let you perform more advanced functions such as:

- changing the parameter units
- specifying where to plot the data relative to the station location
- combining data from several MD files on a single plot or contour analysis
- changing gridded analysis smoothing factors

MDX has only one positional parameter, *parm,* to use with MD file data. In most cases, *parm* specifies the data parameter to plot or grid and contour. The remaining information such as map, projection, graphics color level and units, is specified using keywords. Keyword SORT specifies which data in the MD file to plot or contour. Any key in the MD file can be used with keyword SORT. For example, if plotting IRAB schema MD file data, SORT=DAY 93702 TIME 12 P 500 plots only 500 mb data for 12 UTC on day 93072. Notice there are no equal signs, only spaces, between the sorting parameters. In addition to limiting the data search and plot or contour analysis, keyword SORT determines the information that appears on the graphics label below the plot or contour analysis and fills the grid directory's day, time, and level information.

MDX uses a set of strings to store the default values, keywords, and keyword values each time the MDX command is run. By default, the MDX strings use the dollar sign ($) prefix to keep them separate from user defined strings; however, you can specify any character as a string prefix, except the pound sign (#) or numbers. Before starting a new MDX command, these strings should be initialized using MDX CLE; otherwise, the MDX command entry may not work or may give unexpected results. MDX CLE creates the necessary strings, clears out old values and enters the default values. The MDX LIST command outputs a table of the keywords contained in the strings with their current values.

You can combine data from several MD files to calculate and plot or contour new values. For example, to calculate streamlines from an MD file containing cloud drift winds and another containing radiosonde winds, use two MDX commands, each having a plus sign (+) as the second parameter and the keyword PREFIX to assign the values to two sets of strings. Then, use a third MDX command with the PREFIX keyword to draw the combined streamlines.

In addition to plotting or gridding and contouring data from MD files, MDX can plot grid point values from any grid. The first positional parameter, *grid,* specifies the grid number and keyword SOU=GRID indicates that the data source is a grid. For example, the command MDX 5 SOU=GRID MAP=USA UNIT=F plots the gridded temperature data found in grid 5 on a USA map in degrees Fahrenheit.

Listing Data

In this exercise, you will use the MSL command to search and list station information from the international master weather station list, and use the SL and UL commands to list surface and upper air data.

1. Start a McIDAS-X session with six frames.

   Type: **mcidas -fr 6**

2. Log on and initialize the workstation.

   Type: **LOGON** *initials project* **I WS**

3. List the station information for O'Hare Airport in Chicago (ORD).

   Type: **MSL ORD**

4. Find all stations containing the string LONDON in their station name.

   Type: **MSL "LONDON**

5. List all the radar stations in Wisconsin.

   Type: **MSL ST=WI TYPE=RADAR**

6. Clear the strings in the string table.

   Type: **TD ALL**

7. List MD files 8000 to 8010.

   Type: **MDU LIST 8000 8010**

   MD files 8000 to 8004 contain surface hourly, mandatory level RAOB, significant level RAOB, ship/buoy, and synoptic reports for day 93072, respectively.

8. Assign values to the SVCA and DAY strings in the current string table.

   Type: **SL SET MDF=8000 DAY=93072**

   All subsequent SL commands will access MD file 8000 by default unless you enter SL RESET to reset the defaults to MD files 1 through 10 and the current day.

9. List the surface hourly data for LaGuardia International Airport from 12 UTC to 14 UTC on day 93072. Because you assigned values in the string table, you do not need to specify the MD file or date. Use the A parameter to specify American units.

   Type: **SL A LGA 12 14**

10. Determine if there were any wind gusts from 20 to 25 meters per second between 12 UTC and 23 UTC in Cape Hatteras, North Carolina. Use the M parameter to specify metric units.

    Type: **SL M HAT 12 23 GUS=20 25**

11. List all the US stations that reported thunder between 12 and 13 UTC.

    Type: **SL 12 13 WX=T CO=US**

12. List the availability of upper air data in MD file 8001 for day 93072.

    Type: **UL AVA MDF=8001 DAY=93072**

13. List the mandatory level data from day 93072 at 12 UTC for station 72645, Green Bay, Wisconsin.

    Type: **UL MAND 72645 12 MDF=8001 DAY=93072**

14. List all the RAOB station in Georgia.

    Type: **MSL ST=GA TYPE=RAOB**

15. List the mandatory and significant level data from day 93072 at 0 UTC for station 72311, Athens, Georgia.

    Type: **UL LIST 72311 0 MDF=8001 DAY=93072**

    In this example, the significant level data is extracted from MD file 8002 because the default significant level MD file number is 1 plus the mandatory level MD file number specified with keyword MDF.

Plotting and Contouring Data

In this exercise, you will display several images and draw plots and contours of surface and upper air data.

1. Clear the string table and erase frames 1 through 6.

   Type: **TD ALL; EG 1 6**

2. Display areas 8009 and 8010 on frames 1 and 2 centered on Charlotte, North Carolina, with the resolution magnified by a factor of 2. Then, display frame 1 and add a map in graphics color level 2.

   Type: **DF 8009 1 EC CLT 2 2;**
   SF 1; MAP H 2

3. Plot the 850 mb heights on the satellite image displayed on frame 1 using data from MD file 8001 on day 93072 at 12 UTC. Draw the plot in graphics color level 4.

   Type: **UP Z 850 SAT 12 MDF=8001**
   DAY=93072 COLOR=4

4. Draw contours over the plot on frame 1 using the same data. Draw the contours in graphics color level 5, with a contour interval of 30.

   Type: **UC Z 850 SAT 12 MDF=8001**
   DAY=93072 COLOR=5 CINT=30

5. Show frame 2 and add a map in graphics color level 2.

   Type: **SF 2; MAP H 2**

6. Plot the snow depth at 18 UTC on day 93072 on the satellite image using data from MD file 8000. Draw the plot in graphics color level 5.

   Type: **SP SNO SAT 18 MDF=8000 DAY=93072**
   COLOR=5

7. Contour the snow depth over the plot using the same data and conditions as in step 6. Draw the contours in graphics color level 6 and define a contour level of 2 inches.

   Type: **SC SNO SAT 18 MDF=8000 DAY=93072 COLOR=6 CINT=2**

8. Display area 8005 on frame 3, centered at 30 ° latitude and 85° longitude with the resolution decreased by a factor of 2. Use the SF=YES keyword to show frame 3 and add a map in graphics color level 8.

   Type: **DF 8005 3 EC 30 85 -2 SF=YES; MAP H 8**

9. Plot 500 mb wind flags at 12 UTC on day 93072 on the satellite image using data from MD file 8001. Draw the plot in graphics color level 9.

   Type: **UP WIN 500 SAT 12 MDF=8001 DAY=93072 COLOR=9**

10. Define a string containing the keywords MDF=8000 DAY=93072. The following steps use the same MD file and day.

    Type: **TE SFC "MDF=8000 DAY=93072**

11. Display area 8007 on frame 4, centered at 37 ° latitude and 83° longitude with the resolution decreased by a factor of 2. Use the SF=YES keyword to show frame 4, and add a map in graphics color level 2.

    Type: **DF 8007 4 EC 37 38 -2 SF=YES; MAP H 2**

12. Plot the surface weather symbols on the satellite image at 18 UTC on day 93072 using data from MD file 8000. Draw the plot in graphics color level 8.

    Type: **SP WXS SAT 18 #SFC COLOR=8**

13. **Contour the surface temperatures at 18 UTC on day 93072 using data from MD file 8000. Draw the contours in graphics color level 5.**

    Type: **SC T SAT 18 #SFC COLOR=5**

14. **Show frame 5 and plot the winds over South Carolina at 15 UTC on day 93072. Use data from MD file 8000 and draw the plot in graphics color level 4.**

    Type: **SF 5; SP WIN SC 15 #SFC COLOR=4**

15. **Draw the streamlines in graphics color level 14, using the same data in step 14.**

    Type: **SC STR SC 15 #SFC COLOR=14**

Creating Meteorological Diagrams

In this exercise, you will create three types of meteorological diagrams: a meteorogram, a skew T diagram and a vertical cross section.

1. Erase frames 1 through 6.

   Type: **EG 1 6**

2. Show frame 2 and plot a 24-hour surface meteorogram for Macon, Georgia, ending at 23 UTC day 93072 using data from MD file 8000.

   Type: **SF 2; MG MCN 23 93072 MDF=8000**

3. Show frame 3 and plot a meteorogram for Jackson, Kentucky, ending at 12 UTC day 93072.

   Type: **SF 3; MG JKL 12 93072 MDF=8000**

   Since MD file 8000 only stores data for day 93072, there is no data plotted for 12 UTC to 23 UTC on day 93071 (the left half of the diagram). If data for day 93071 was present in MD file 7999, it would be plotted for both days since MG assumes the previous day's data resides in the previous MD file.

4. Show frame 4 and plot a skew T diagram for station 72425, Huntington, West Virginia, at 12 UTC using MD file 8001.

   Type: **SF 4; SKEWT 72425 12 MDF=8001 DAY=93072**

5. Overlay a skew T diagram for Cape Hatteras, North Carolina, at 12 UTC on day 93072. Use the OLAY=YES keyword to overlay the existing sounding with the new sounding in graphics color level 2.

   Type: **SKEWT 72304 12 DAY=93072 MDF=8001 OLAY=YES 2**

6. Show frame 5 and display a vertical cross section of theta, wind, and mixing ratio values from International Falls, Minnesota (72747) to West Palm Beach, Florida (72203) using upper air data from MD file 8001 at 0 UTC on day 93072. The MAP=YES keyword displays a map in the upper-right corner showing the cross section location and stations selected.

Type: **SF 5; XSECT 72747 72203 MAP=YES MDF=8001 TIME=0 DAY=93072 FORM=THA WIN MIX**

Using the MDX Command

In this exercise, you will use the MDX command to plot and contour individual parameters and combine data from separate MD files into a single plot. Some of the plots and contours generated by the MDX examples below can be more easily done with the SP, SC, UP, and UC commands; however, MDX is more flexible and provides many advanced features. These examples provide only a sampling of tasks that MDX can perform. See the McIDAS-X Users Guide for a complete description of MDX and additional examples.

Plotting MD File and Grid Data

1. Initialize MDX by clearing the string table of previous MDX strings and by creating new command parameters and values. Also erase the contents of frames 1 through 6.

   Type: **MDX CLE; EG 1 6**

   This entry creates and initializes a set of strings used by command MDX. The strings all have the dollar sign ($) prefix, and contain the default command parameters and values.

2. List the string values created in step 1.

   Type: **MDX LIST**

   A set of strings with the dollar sign ($) prefix is listed. These strings must exist before any operations are performed with MDX. Each time an MDX command is run, the parameter and keyword values are added to the string table.

3. **Show frame 1 and plot temperatures in degrees Fahrenheit at 16 UTC for day 93072 on a map of North Carolina using data from MD file 8000.**

   Type: **SF 1; MDX T MAP=NC MDF=8000 UNIT=F SORT=TIME 16 DAY 93072 TYPE 0**

   Keyword SORT limits the output data to a specific time, 16 UTC, and data type 0, hourly data only. Specifying DAY 93072 was not required since MD file 8000 stores only one day's data. However, you may want to regularly include DAY in your MDX command entries so the information appears on the graphics label below the plot or contour analysis.

4. **List the MDX keywords and their values.**

   Type: **MDX LIST**

   Notice that new values are assigned to several of the keywords. Values relevant to the current parameter T are filled in at the bottom of the table, for example, UNIT, COLOR and SORT.

5. **Plot wind flags in graphics color level 7 over the plot created in step 3. Since all the other parameters are saved in strings, only enter the additional parameters you want to plot. The string values are saved until an MDX CLE is done.**

   Type: **MDX WIN COLOR=7**

6. **Display area 8007 on frame 2, centered on Charlotte, North Carolina. Reduce the resolution by a factor of 2 and add a map in graphics color level 8.**

   Type: **DF 8007 2 EC CLT -2 SF=YES; MAP H 8**

7. Clear the MDX strings and plot the pressure at 18 UTC on day 93072 using data from MD file 8000, graphics color level 5, and a label height of 6 pixels.

   Type: **MDX CLE; MDX PRE SORT=DAY 93072 TIME 18 LSIZE=6 COLOR=5 PRO=SAT MDF=8000**

   Notice that keyword PRO=SAT, not MAP=SAT, is used to plot the data on the image. When PRO=SAT is specified, MDX plots or contours according to the navigation in the frame directory, regardless if the navigation is from an image or a map.

8. List grids 46, 47, and 48 in grid file 8002.

   Type: **IGG LIST 46 48 GRIDF=8002**

9. Show frame 3, clear the MDX strings and plot wind flags on a map of Georgia using data from grid file 8002. Derive the wind flags from grids 47 and 48. Grids 47 and 48 are the 850 mb u and v component 24-hour forecast grids from the 12 UTC NGM run on day 93071.

   Type: **SF 3; MDX CLE; MDX PLT 47 48 SOU=GRID MAP=GA GRIDF=8002 LSIZE=16**

   The LSIZE=16 keyword makes the wind flags twice as big as the default size of 8.

10. Plot the 850 mb temperatures using the same grid file, model run, and forecast time.

    Type: **MDX 46 UNIT=C COLOR=7 LSIZE=10**

    Keywords SOU=GRID, GRIDF=8002 and MAP=GA were not needed in the command because the MDX strings created in step 9, included this information. Keywords UNIT=C, COLOR=7, and LSIZE=10 were chosen to override the corresponding values created in the string table during step 9.

Contouring MD File Data

In this exercise, you will use MDX to draw several contours over the plots just created. But first, you will create a grid file in which to store the resulting values.

1. Create grid file 5010 and make it the current grid file.

   Type: **IGU MAKE 5010; IGU SET 5010**

2. Show frame 1, clear the MDX strings, and draw dew point contours for 16 UTC on day 93072 in dashed lines over the plot in frame 1. Use the OUT=CON keyword to specify a contour output and the GCOLOR keyword to specify the graphics color level. Specify a negative graphics color level to create dashed contour lines.

   Type: **SF 1; MDX CLE; MDX TD OUT=CON GCOLOR= -5 UNIT=F SORT=TIME 16 DAY 93072 MAP=NC CINT=5 MDF=8000**

   MDX has two color keywords; COLOR is used for plots and GCOLOR is used for contours. The resulting grid is filed into the current grid file, 5010, and the contours are drawn on frame 1.

3. Show frame 2, clear the MDX strings, and draw pressure contours for 18 UTC on day 93072 over the pressure plot in frame 2. Draw the contours using data from MD file 8000 in color level 6 with a label height of 6 pixels.

   Type: **SF 2; MDX CLE; MDX PRE SORT=DAY 93072 TIME 18 OUT=CON CINT=2 LSIZE=6 GCOLOR=6 PRO=SAT MDF=8000 LAT=30 45 LON=72 92 INC=1.0**

   Keywords LAT and LON determine the bounds of the resultant grid, and the INC keyword determines its increment in degrees latitude and longitude. In this example, the bounds cover the approximate bounds of the satellite image displayed on frame 2, and the increment is set to 1 degree.

4. Draw the pressure contours again, but decrease the grid increment to 0.5° to see more detail. Draw the contours in graphics color level 3.

   Type: **MDX PRE INC=0.5 GCOLOR=3**

5. Show frame 3, clear the MDX strings, and contour absolute vorticity at 850 mb over the plotted wind flags. Use data from MD file 8001 and store the resulting values in grid file 5010. Draw the contours in graphics color level 2 using a contour interval of 2.

   Type: **SF 3; MDX CLE; MDX ABV SORT=TIME 12 DAY 93072 P 850 OUT=CON CINT=2 MDF=8001 MAP=GA GCOLOR=-2**

   When viewing the data on this frame, remember that the plotted data is from the 24-hour forecast of the 12 UTC NGM run on day 93071, while the contoured data is from the actual upper air observations at 12 UTC on day 93072.

Combining MD Files

Next you will use MDX to plot two parameters in one frame. Since MDX will only plot one parameter at a time, you must use the plus (+) option to store the parameters in the string table before plotting them. The (+) option will also be used to combine data from two MD file schemas (ISFC and ISHP) to produce a temperature plot along the East Coast. Because two MD files are used, you must clear the string table and initialize two sets of strings.

1. Display area 8007 on frame 5 centered on Huntsville, Alabama. Decrease the resolution by a factor of 2 and add a map in graphics color level 5.

   Type: **DF 8007 5 EC HSV -2 SF=YES; MAP H 5**

2. **Clear the MDX strings and define them to plot the temperature and dew point, in degrees Fahrenheit, from MD file 8000 at 18 UTC on day 93072 on the satellite image. Use the keyword PLACE to position the temperature over the dew point.**

   Type: **MDX CLE; MDX T TD + MDF=8000 SORT=TIME 18 DAY 93072 PRO=SAT PLACE= 41 50 UNIT=F F COLOR=3 4**

3. **Plot the values saved in the MDX strings.**

   Type: **MDX PLT**

4. **Erase frame 6, clear the string table and initialize MDX strings beginning with a dollar sign ($) and an exclamation mark (!). Since the dollar sign is the default string prefix, you only need to use keyword PREFIX in the second MDX CLE command.**

   Type: **EG 6; MDX CLE; MDX CLE PREFIX=!**

5. **Show frame 6 and define keywords for the dollar sign ($) strings. Specify keywords that plot temperatures for 18 UTC on day 93072 on a map centered over South Carolina. MD file 8000 contains surface observations.**

   Type: **SF 6; MDX T + SORT=TIME 18 DAY 93072 MAP=SC OUT=PLO MDF=8000 UNIT=F**

   The plus sign indicates the strings are defined, but will not be plotted.

6. **Define keywords for the exclamation mark (!) strings. Specify keywords that plot temperatures for 18 UTC on day 93072 on a map centered over South Carolina. MD file 8003 contains ship and buoy observations.**

   Type: **MDX T + SORT=TIME 18 DAY 93072 MAP=SC OUT=PLO MDF=8003 UNIT=F PREFIX=!**

7. Combine the surface, ship, and buoy temperatures and plot the data.

   Type: **MDX T PREFIX=$:!**

   The colon (:) is the concatenation operator. Contour analyses in coastal regions are often more accurate when surface, ship and buoy data are concatenated. To contour instead of plot the data in this example, change the OUT=PLO keyword to OUT=CON in steps 5 and 6. Then run the command in step 7.

   Other operators are available for adding, subtracting, multiplying, and dividing data from one or more MD files. However, these require the MD files be the same schema type. Only concatenation allows the MD files to be different types.

8. Exit McIDAS-X.

   Type: **EXIT**

9. Enhancements

Lesson 9
Enhancements

Lesson 9

Enhancements

Enhancements are used to improve image contrast and produce colored imagery. This allows you to emphasize the image features you are analyzing. For example, you can enhance thunderstorm cloud tops, low clouds, or fog.

This lesson describes how to:

- create color enhancements
- change grayscale contrast

The following commands are used in this lesson.

Command	Function
EB	black and white contrast stretching
EU	enhancement utility
SU	image data stretching utility

Basic Concepts

There are two types of enhancements: color enhancements and grayscale enhancements. A color enhancement changes grayshades to colors and a grayscale enhancement changes a grayshade value to a different grayshade value.

Color Enhancements

A color enhancement is a table of colors that corresponds to brightness values. Color enhancements are useful for tracking cloud features. For example, to track the tops of thunderstorms overshooting the tropopause, you can color all brightness values between 180 and 250 red.

Color enhancements are created with the EU MAKE command. You can create a color enhancement by assigning a color to a brightness value or brightness range. For example, you could create an enhancement table where the color green corresponds to the brightness range of 50 to 79, the color blue corresponds to the brightness range of 80 to 99, and the color red corresponds to brightness value 100.

In addition, you can create a color enhancement by specifying color intensities. The values within the brightness range are interpolated within the color intensity range. For example, if the brightness range 0 to 71 is assigned to a blue color intensity of 203 to 255, a green color intensity of 173 to 200, and a red color intensity of 3 to 100, as shown below, the pixels with a low brightness value (near 0) will have corresponding low red, green, and blue intensities, and the pixels with high brightness values (near 71) will have corresponding high red, green, and blue intensities.

```
BRIGHTNESS     BLUE      GREEN      RED
MIN  MAX     MIN  MAX  MIN  MAX  MIN  MAX
---  ----    ---  ---  ---- ---  ---  ----
0     71     203  255  173  200   3   100
```

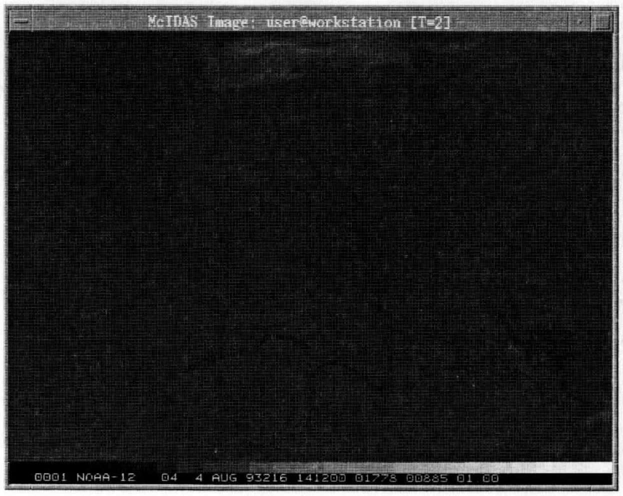
Once you create an enhancement table, you can save it using EU SAVE and then restore it using the command EU REST. You can apply the same or different enhancement tables to each frame on the workstation.

Grayscale Enhancements

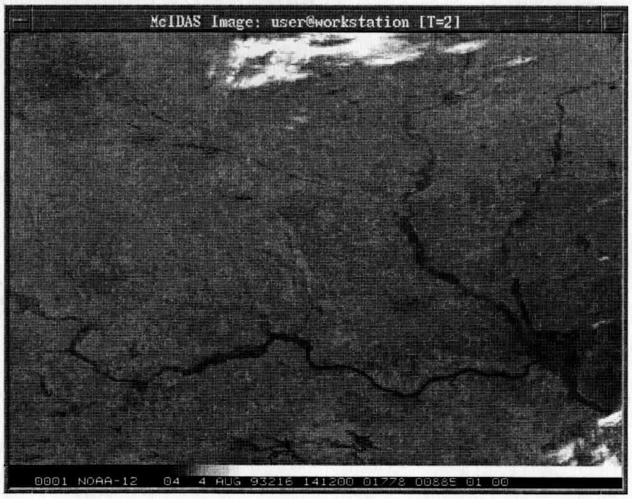
Normally, a pixel's digital value, stored in an area, correlates to a brightness value. Each brightness value appears as a different shade of gray when the image is displayed. When a grayscale enhancement is applied, the correlation between the digital values and the displayed grayshades changes. You can change the grayscale contrast of an image two ways: using image contrast stretching or using image data stretching.

Image Contrast Stretching

Image contrast stretching changes the grayscale of the displayed image; it does not change the area data values. You can change the grayscale contrast of an image using the EB command. You can run the EB command two ways: using the command line and using the mouse. Using the command line, you specify the lower and upper brightness values to be enhanced. All pixels with brightness values below the lower input values and above the upper input value will remain unchanged. The brightness values between the range are linearly interpolated. Using the mouse controlled version, you move the mouse to increase or decrease the brightness of the image. You can save grayscale enhancements and apply them to other images using the EU SAVE and EU REST commands. The example below shows the original contrast of an image and the contrast of an image after image contrast stretching.



Original image



Contrast stretched image

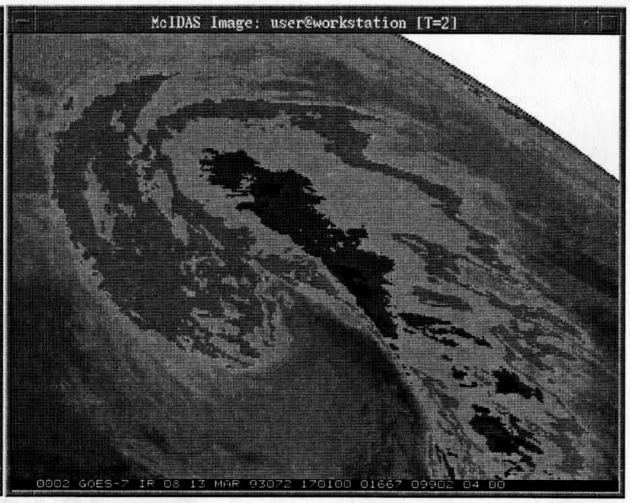
Image Data Stretching

Image data stretching changes the grayscale of an image by stretching area data values to brightness values. To stretch the image data values, you must create a table that defines the values to stretch, as shown below.

```
SU  TABLE  MB
BREAKPOINTS  STORED  IN TABLE:  MB.ST
 INPUT          OUTPUT
 -----          ------
 162.8           250
 192.3           250
 192.4           250
 209.3            10
 209.4            10
 213.3            10
 213.4            75
 219.3            75
 219.4           156
 230.3           156
 230.4           117
 241.3           117
 241.4           167
 279.8           103
 279.9           102
 301.9             0
 302               0
 330               0
CALIBRATION TYPE :  AAA
CALIBRATION UNITS: TEMP
BAND NUMBER:          -1
INTERPOLATION TYPE: LIN
```

The SU command defines tables to stretch raw, radiance, temperature, albedo or brightness values (depending on the calibration type) to a user-defined brightness value. Stretch tables are used with the DF command to emphasize weather features in an image. The example below shows an image before and after an MB data stretch table was applied.

Original image



Data stretched image

Creating Color Enhancements

In this exercise, you will use the EU command to assign colors to brightness values. You will create a simple enhancement that assigns brightness values to colors and another enhancement that assigns various brightness ranges to color ranges.

1. Start a McIDAS-X session with six frames.

   Type: **mcidas -fr 6**

2. Log on and initialize the workstation.

   Type: **LOGON** *initials project* **I WS**

3. Set the loop sequence to frames 1 through 6.

   Type: **LS 1-6**

4. Display area 8003 on frame 1 centered on New Orleans. Decrease the image resolution by a factor of 2 and add a high resolution map.

   Type: **DF 8003 1 EC NEW -2; MAP H**

5. Assign the color red to the brightness range 180 to 220 to color enhance the cloud tops.

   Type: **EU MAKE 180 220 RED**

6. List the enhancement table. The brightness values between 180 and 220 are assigned to a red intensity range of 255 to 255.

   Type: **EU TABLE**

```
EU   TABLE
BRIGHTNESS       BLUE        GREEN       RED
MIN   MAX       MIN   MAX   MIN   MAX  MIN   MAX
---   ----      ---   ---   ----  ---  ---   ----
180   220        0     0     0     0   255   255
```

7. Assign the brightness range 180 to 220 to the range of colors between yellow and red.

   Type: **EU MAKE 180 220 YELLOW RED**

   The brightness value 180 is yellow, the brightness value 220 is red, and the values between are displayed as various shades between the two colors.

8. List the enhancement table.

   Type: **EU TABLE**

   The enhancement table is listed as shown below. The blue, green, and red intensity values of 0, 255, and 255 create the color yellow and are assigned to brightness value 180. The blue, green, and red intensity values of 0, 0,and 255 create the color red and are assigned to brightness value 220.

```
EU   TABLE
BRIGHTNESS       BLUE        GREEN       RED
MIN   MAX       MIN   MAX   MIN   MAX  MIN   MAX
---   ----      ---   ---   ----  ---  ---   ----
180   220        0     0     0     0   255   255
```

9. **Save the enhancements in the file STORM.**

   Type: EU SAVE STORM

10. **Restore the default enhancement to the frame.**

    Type: EU REST

11. **Restore the enhancement STORM to the frame.**

    Type: EU REST STORM

12. **List the enhancement tables in your account on the workstation.**

    Type: EU LIST

    The file STORM.ET is listed.

13. **Delete the enhancement STORM.**

    Type: EU DEL STORM

14. **Restore the default enhancement to frames 1 through 6.**

    Type: EU REST 1 6

Changing Grayscale Contrast

In this section, you will use two methods to change the grayscale contrast. First, you will create image contrast stretching and then you will create and apply image data stretching.

Creating Image Contrast Stretching

In this exercise, you will use the EB command to change the grayscale contrast of an image. First, you will use the mouse to move the cursor over the image and stretch the grayscale contrast. Then, you will input the values manually.

1. Display area 8016 on frame 1 centered on Kirksville, Missouri, and add a gray scale bar.

   Type: **DF 8016 1 EC IRK GRAY=YES**

2. Initiate mouse-controlled grayscale stretching.

   Type: **EB**

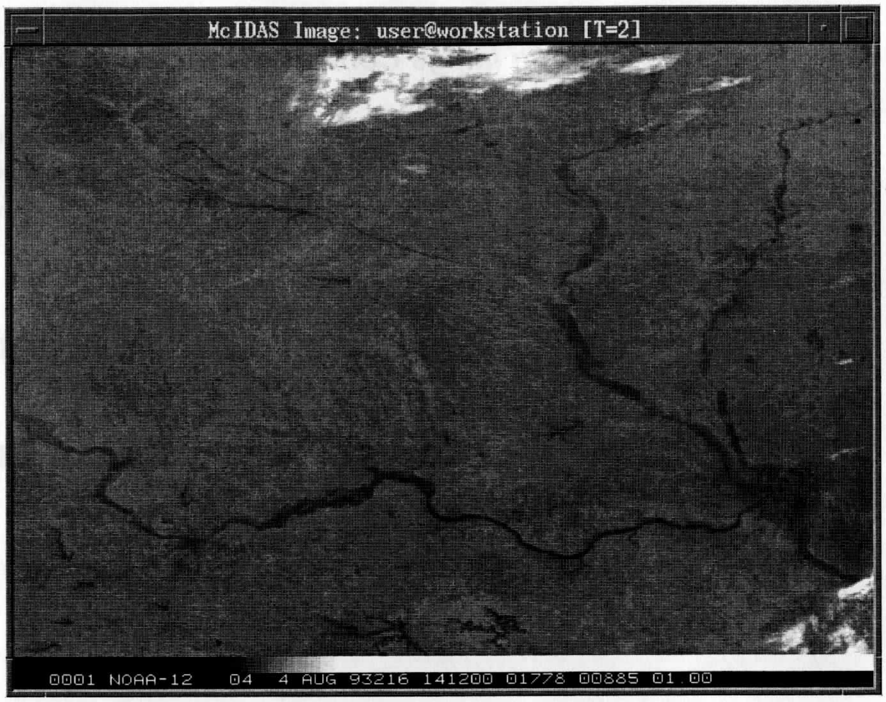
3. Move the cursor to the image window.

4. Move the mouse to the right to brighten the image. The range of pixels with a brightness value near 255 (white) increases, as shown in the gray scale bar at the bottom of the frame.

5. Move the cursor towards the top of the frame to decrease the image brightness. The range of pixels with a brightness value near 0 (black) increases, as shown in the gray scale bar at the bottom of the frame.

6. Position the cursor at TV coordinates (364,393) using the PC command. The image contrast should be similar to the example below.

   Type: **PC T 364 393**



7. Press the right mouse button to end the enhancement.

8. Save the grayscale enhancement as GRAY.

   Type: **EU SAVE GRAY**

9. List the brightness value at the cursor center.

   Press: **Alt D**

   The brightness value should be 75 and the corresponding temperature 292.7° K.

10. Restore the original grayscale of the image.

    Type: **EU REST**

11. List the brightness value at the cursor center.

    Press: **Alt D**

    Note the values are the same as those in step 9. Image contrast stretching does not list modified values, but lists the values stored in the area.

Now, you will manually input the brightness values with the EB command.

1. Position the cursor at TV coordinates (342,243) and find the brightness value.

   Type: **PC T 342 243**
   Press: **D**

   The brightness value is 70.

2. Position the cursor at TV coordinates (35,282) and find the brightness value.

   Type: **PC T 35 282**
   Press: **D**

   The brightness value is 97.

3. Rescale the brightness values 70 to 97 to go from 0 to 255. Brightness value 70 will become 0 and value 97 will become 255. All values in-between will be linearly stretched between 0 and 255.

   Type: **EB 70 97 0 255**

   Since most of the brightness values are between 70 and 97, creating an enhancement for this range makes the image features more prominent. Note that all brightness values outside the range 70 to 97 remain unchanged.

4. **Save the enhancement as GRAY2.**

   Type: **EU SAVE GRAY2**

5. **Restore the default enhancement table to the frame.**

   Type: **EU REST**

6. **List the enhancement tables that start with GRAY in your account on the workstation.**

   Type: **EU LIST GRAY**

```
EU LIST
NAME        SIZE    DATE                          PATH
----        -----   ----                          ----
GRAY.ET     3268    Thu Aug 11 07:33:39 1994      /home/tester/mcidas/data
GRAY2.ET    3268    Thu Aug 11 07:33:35 1994      /home/tester/mcidas/data
```

7. **Delete the saved enhancement tables.**

   Type: **EU DEL GRAY; EU DEL GRAY2**

Creating and Applying Image Data Stretching

Next, you will define stretch tables to stretch brightness and temperature values stored in an area. Then you will apply the stretch tables to images and compare the stretched values to the original values.

1. Display area 8000 on frame 1 centered at New Orleans. Decrease the resolution by a factor of 2 and add a high resolution map.

   Type: **DF 8000 1 EC NEW -2; MAP H**

2. Position the cursor at the center of the frame and list the brightness value.

   Type: **PC C**
   Press: **D**

   The brightness value at the center is 82.

3. Next, initialize a stretch table named LEARN to stretch brightness values. The VISR parameter specifies the data type as GOES 1-byte data.

   Type: **SU INI LEARN VISR BRIT**

4. Define the brightness ranges to stretch. Assign the brightness value 0 to 255 and the value 255 to 0 to make light areas dark and dark areas light.

   Type: **SU MAKE LEARN 0 255 255 0**

5. **List the breakpoints in the stretch table.**

   Type: SU TABLE LEARN

   The table lists the brightness values and the correponding stretched values as shown below.

```
SU  TABLE  LEARN
BREAKPOINTS  STORED IN TABLE:  LEARN.ST
INPUT     OUTPUT
-----      ------
  0        255
 255        0
CALIBRATION TYPE   :  VISR
CALIBRATION UNITS  :  BRIT
BAND  NUMBER       :  -1
INTERPOLATION TYPE:   LIN
```

6. **Display area 8000 on frame 2 centered at New Orleans. Decrease the resolution by a factor of 2, add a high resolution map, and apply the stretch table LEARN.**

   Type: DF 8000 2 EC NEW -2 SU=LEARN SF=YES; MAP H

7. **Set the loop bounds from 1 to 2 and compare the images.**

   Type: LS 1-2
   Press: Alt A
   Alt B

8. **Show frame 2 and list the area values at the cursor's center.**

   Type: **SF 2;PC C;D**

   Notice that there is a MODB/LEARN data type listed in the output of the D command, as shown below. This lists the value of the stretched data.

```
PC C;D
Area      Area             Image
          Line/Element     Line/Element      Raw    MODB/LEARN
8000       565/680          3381/10305        82        173
```

   Since the values in the table are reversed (0 is now 255 and 255 is now 0), you can calculate the stretched value of a pixel by subtracting the pixel's original brightness value from the maximum value. For example, to calculate the stretched value of the center pixel, subtract the original brightness value (82) from the maximum brightness value (255); the stretched value of the center pixel is 173.

9. **List the stretch tables on the workstation.**

   Type: **SU LIST**

Next, you will create a multiple breakpoint stretch table to enhance clouds in a GOES infrared image and create an approximate MB stretch curve.

1. **Display a GOES IR image.**

   Type: **DF 8003 1 EC DCA SF=YES**

2. **Initialize a stretch table named MB to stretch temperature values to a brightness range. The AAA parameter specifies 2-byte GOES data.**

   Type: **SU INI MB AAA TEMP**

3. **Assign the temperature values between 330 °K and 302°K to the brightness value 0 in the MB stretch table.**

   Type: SU MAKE MB 330 302 0 0

4. **Assign the temperature values between 301.9° K and 279.9° K to the brightness range 0 to 102 in the MB stretch table.**

   Type: SU MAKE MB 301.9 279.9 0 102

5. **Assign the temperature values between 279.8° K and 241.4° K to the brightness range 102 to 167 in the MB stretch table.**

   Type: SU MAKE MB 279.8 241.4 102 167

6. **Assign the temperature values between 241.3° K and 230.4° K to the brightness value 117 in the MB stretch table.**

   Type: SU MAKE MB 241.3 230.4 117 117

7. **Assign the temperature values between 230.3° K and 219.4° K to the brightness value 156 in the MB stretch table.**

   Type: SU MAKE MB 230.3 219.4 156 156

8. **Assign the temperature values between 219.3° K and 213.4° K to the brightness value 75.**

   Type: SU MAKE MB 219.3 213.4 75 75

9. **Assign the temperature values between 213.9° K and 209.4° K to the brightness value 10.**

   Type: SU MAKE MB 213.9 209.4 10 10

10. **Assign the temperature values between 209.3° K and 192.4° K to the brightness range 10 to 250.**

    Type: **SU MAKE MB 209.3 192.4 10 250**

11. **Assign the temperature values between 192.3° K and 162.8° K to the brightness value 250.**

    Type: **SU MAKE MB 192.3 162.8 250 250**

12. **Verify that the stretch table contains the correct breakpoints.**

    Type: **SU TABLE MB**

    The table MB is listed as shown below.

```
SU  TABLE  MB
BREAKPOINTS  STORED  IN TABLE:  MB.ST
INPUT           OUTPUT
-----           ------
162.8            250
192.3            250
192.4            250
209.3            10
209.4            10
213.3            10
213.4            75
219.3            75
219.4            156
230.3            156
230.4            117
241.3            117
241.4            167
279.8            103
279.9            102
301.9            0
302              0
330              0
CALIBRATION TYPE :    AAA
CALIBRATION UNITS:   TEMP
BAND NUMBER:          -1
INTERPOLATION TYPE:  LIN
```

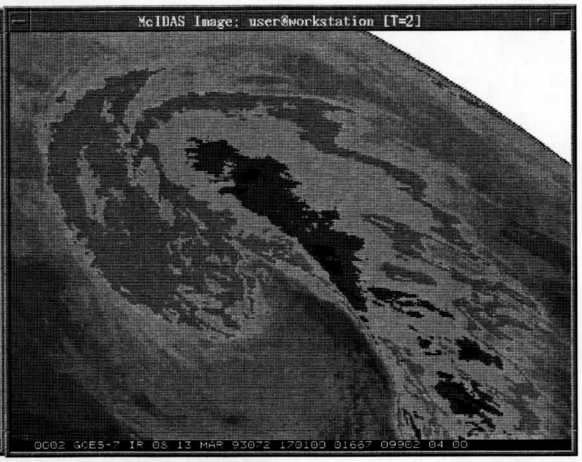
13. **Display area 8003 on frame 2 centered on Washington, DC, and apply the stretch table MB. Set the loop bounds from 1 to 2.**

    Type: **DF 8003 2 EC DCA SU=MB SF=YES; LS 1- 2**

14. **Compare the two images, one without a stretch table applied and the one with, as shown below.**

    Press: **Alt B**
    Alt A

Original image



Data stretched image

15. **List the stretch tables on your workstation.**

    Type: **SU LIST**

```
SU LIST
NAME        SIZE   DATE                            PATH
----        -----  ----                            ----
LEARN.ET    1604   Thu Aug 11 07:33:39 1994        /home/tester/mcidas/data
MB.ET       1604   Thu Aug 11 07:33:35 1994        /home/tester/mcidas/data
```

16. **Exit McIDAS-X.**

    Type: **EXIT**

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Learning Guide Dataset Installation

The McIDAS-X Learning Guide dataset contains the following files from a 1993 spring snow storm over the East Coast of the United States:

- twelve AREA files (numbers 8000-8010, 8014 and 8016)
- five MD files (numbers 8000-8004)
- five GRID files (8000-8004)

Installing the Learning Guide dataset requires about 123 MB of disk space: 93 MB for the dataset and 30 MB for the compressed tar file.

Follow the steps below to install the dataset via tape or ftp in the **mcidas** account. Then, follow the instructions for linking the dataset to the account of each user of the McIDAS-X Learning Guide.

To remove the dataset, complete the section *Removing the Dataset*.

Installing the Dataset via Tape

1. Login to the workstation as: **`mcidas`**

2. Insert the tape and enter the following command.

   Type: **`tar xvf /dev/`***your-tape-device-name*

3. Build and install the dataset.

   Type: **`sh ./lgdata1.0.sh make`**
   `sh ./lgdata1.0.sh install`

   This completes the installation of the dataset. Next, complete the section *Linking the Dataset to Users' Accounts* on the next page.

Installing the Dataset via ftp

1. Login to the workstation as: **`mcidas`**

2. Ftp to: **`ftp.ssec.wisc.edu`**

3. Login as: **`anonymous`**

4. Change to the **`/pub/mcidas/learning.guide.data`** directory.

5. In binary mode, obtain the file: **`lgdata1.0.tar.Z`**

6. In ASCII mode, obtain the files: **`lgdata1.0.sh`**
   `lgdata1.0.sp`
   `lgdata1.0.README`

7. Quit the ftp session.

8. Build and install the dataset.

   Type: **`sh ./lgdata1.0.sh make`**
   `sh ./lgdata1.0.sh install`

   This completes the installation of the dataset. Next, complete the section *Linking the Dataset to Users' Accounts* on the next page.

Linking the Dataset to Users' Accounts

Link the dataset from the **~mcidas/data** directory to the **$HOME/mcidas/data** directory of each user of the McIDAS-X Learning Guide. Choose the appropriate option below.

- If the AREA, MD and GRID file numbers do not conflict with any user data, have the user login and enter the command below from the **$HOME** directory.

  Type: **lglink**

- If the user has and must keep AREA, MD or GRID files that conflict with the Learning Guide dataset, have the user enter the McIDAS-X commands below.

  Type:
  ```
  REDIRECT ADD AREA80* "/home/mcidas/data
  REDIRECT ADD MDXX80* "/home/mcidas/data
  REDIRECT ADD GRID80* "/home/mcidas/data
  ```

Removing the Dataset

To remove the dataset, use the commands below.

Type:
```
sh ./lgdata1.0.sh uninstall
sh ./lgdata1.0.sh unmake
```