GRASS Usage for Virtual Planetary Exploration

Installation: Kurt Schwehr
Documenation: Daniel Delgado and Kurt Schwehr

Style Guide

This document uses 12 point Times New Roman Font.

`GRASS output uses a Courier 9 point font`

`User input is a Courier 9 point font that is bold and italicized`

GRASS or UNIX command line input uses a Geneva 9 point font that is bold and italicized

1.1 What is GRASS?

GRASS stands for Geographic Resources Analysis Support System, and is a widely used software package allowing one to manipulate geographical information. Software like GRASS is known as a Geographical Information System (GIS). GRASS is released free of charge by the US. Army Corp. of Engineers (The FTP site for obtaining it is in Section 1.4: Resources)

The internet posts a monthly NetNews article in net.answers called the 'GIS FAQ' that answers Frequently Asked Questions about GIS systems. Two definitions cited are:

A GIS is ...

> An information system that is designed to work with data referenced by spatial or geographic coordinates. In other words, a GIS is both a database system with specific capabilities for spatially-referenced data, as well as a set of operations for working [analysis] with the data. (Star and Estes, 1990)
>
> ... simultaneously the telescope, the microscope, the computer, and the Xerox machine of regional analysis and synthesis of spatial data (Abler, 1988).

A typical use for GRASS would be the creation of a map suitable for urban development. The map might be required to show vegetation, all areas that are currently range land, plus any slopes equal to or less then 15 degrees. For this application, the GRASS database would contain several types of data; such as Digital Elevation Models (DEMs) with x,y,z information, raster pictures (perhaps from LandSat photos), road locations, and vegetation densities.

With GRASS you can display these types of data easily and in relation to each other (only several display commands are needed). You can overlay the raster pictures on the DEM data, and include road and vegetation information. You can then zoom in on areas of interest, and using the database functions of GRASS, do queries for additional information.

The VPE GRASS installation contains a sample database (spearfish, located in Montana), that can be used to create a map of this type. A tutorial (Section1.5.1 Stanford Workshop Grass Tutorial) is included that shows the procedures for this process.

1.2 Usage for the VPE Laboratory

GRASS comes with tools used to import 'raw' raster scan pictures, DEMs, and categorical data. These tools allow for the building of new databases. GRASS can then be used to create a planetary database, such as of Mars and Earth.

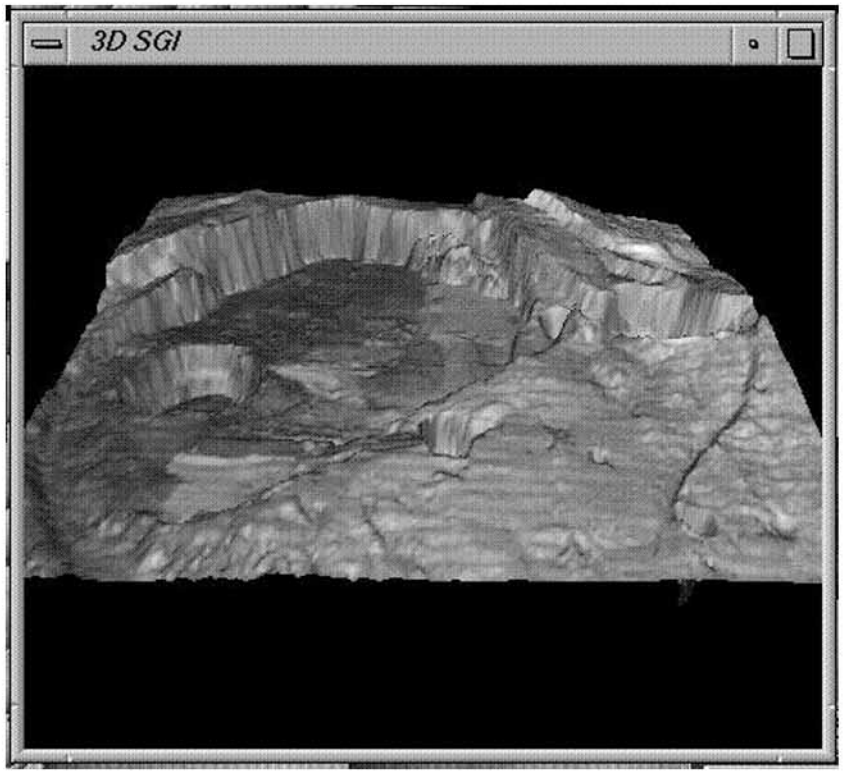
In Section 1.3: Tutorial, you will be shown the steps needed to obtain data on Mars from a CD-ROM, and, using this data, create a GRASS database. You will also be shown the process of registration using data from Mt. Kilauea, a volcano in Hawaii (also from a CD-ROM.)

Registration is the process of combining spatial information that corresponds to each other on different datasets.:

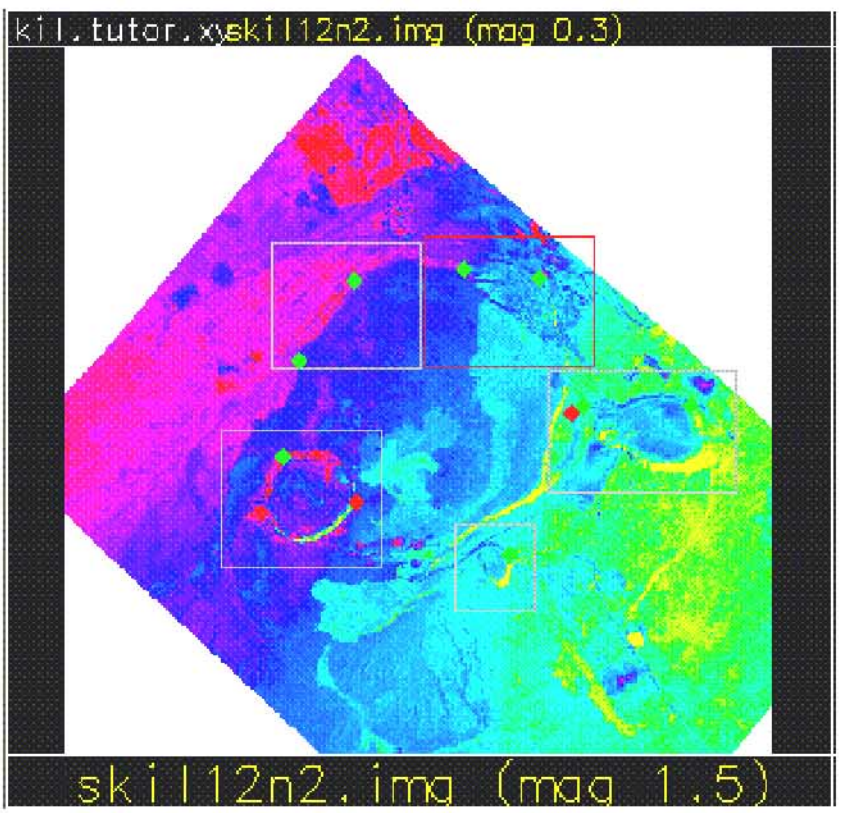
> In many image processing applications it is necessary to form a pixel-by-pixel comparison of two images of the same object field obtained from different sensors, or of two images of an object field taken from the same sensor at different times. To form this comparison it is necessary spatially to register the images and thereby correct for relative translational shifts magnification differences and rotational shifts, as well as geometrical and intensity distortions of each image (W. Pratt, Digital Image Processing, 1978)

Registration is a key advantage of using GRASS.

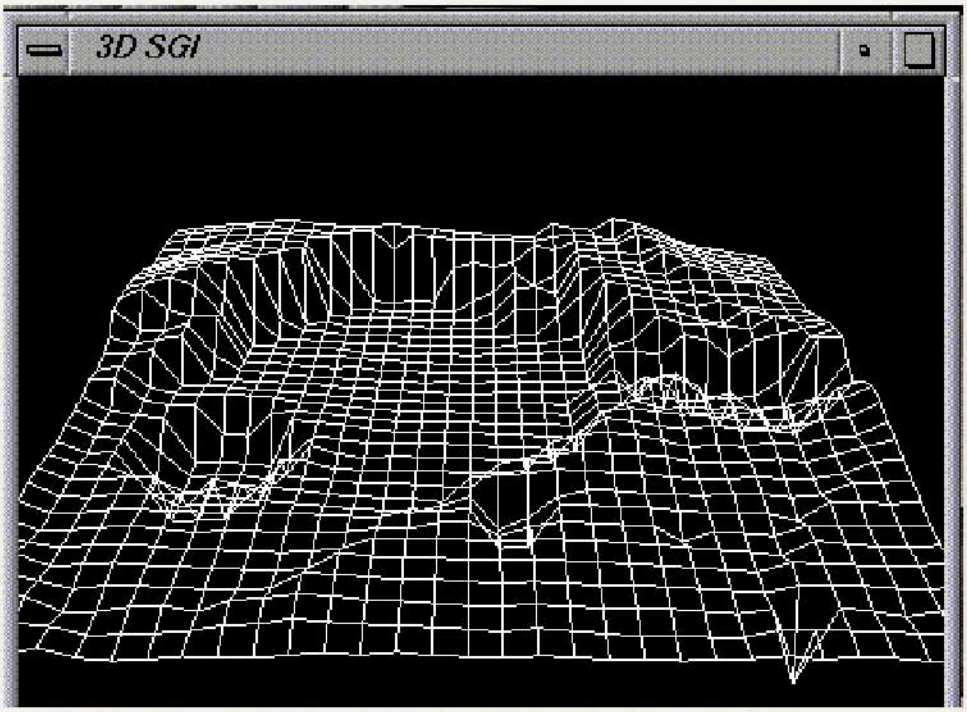
GRASS is ideal for the displaying and processing (e.g. sizing) of raster images (Figure 1: kildem1.gif).



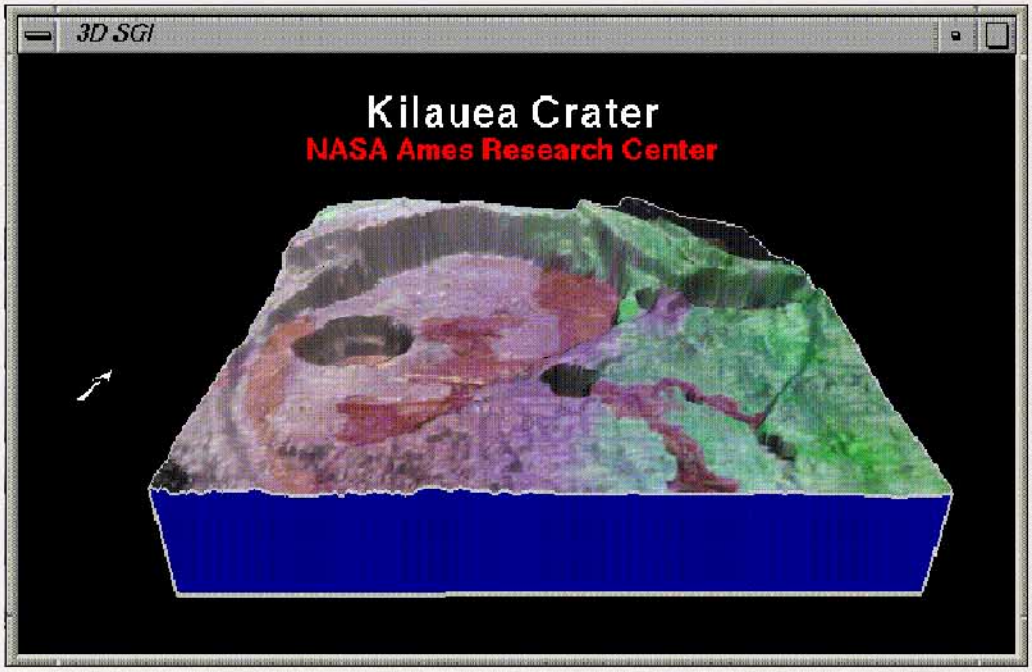
It also allows for the overlaying of images into one congruent orientation (Figure 2: imgtps4s.gif):



Using an elevation map of the site (such as DEM data - Figure 3: sg3d1.gif), one can create a 3d map representation that corresponds to the raster image.



The resulting visualization can be sequence together into an animated series using the grass SG3D program (Figure 4: sg3fin.gif):



After having created a database of interest, one can do manipulations that correspond to typical GRASS usage. If you are interested in the geology of the terrain, you might want to obtain a Mapset that has coloration indicative of the terrain type, as well as a classification of the elevations of a certain steepness. This usage correspond with the workshop example mentioned previously (and supplied in Section 1.5.1 : Stanford Workshop Grass Tutorial).

1.3 Tutorial

This section is a tutorial for the following:

Before starting, you will first need an account on a machine with network accessibility to GRASS. Langrenus, Niestene, and Pirenne have GRASS access (all 3 have visible binary executables). Pirenne in addition has documentation (see Resources: Documentation.) The System Administrator is Amy Wu (4x3238). After obtaining permission from Mike McGreevy (Principle Investigator of the VPE laboratory), one can contact her for an account.

Space on Langrenus is limited, so accessing the GRASS system from another machine is advised (please see Section 1.5.3: Installation Size) for the size of the GRASS installation. The VPE facilities have several SGI machines available (Pirenne and Niestene.)

The tutorial assumes that access is from the SGI machine called Pirenne. If you are not familiar with the SGI windowing environment, you should learn the SGI operating systems before attempting this tutorial. Alternatively, NASA has a site license for MACx, which lets you use GRASS on a Mac connected to the Local Applenet (Currently, this option is being developed - so we do not yet have complete instructions for this method.) This access is noticibly slower than from a SGI machine.

1.3.1 Logging on to the computer

At a SGI console, log on using your Login and Password. Please take notice of the message telling you of the Schedule. Make sure you are not interfering with any on-going experiment or demonstration.

Make grass accessible to your account by typing:

set path=($path ~schwehr/grass ~schwehr/bin)

You may want to include this in your ".tcshrc" or your ".csrhrc"

1.3.2 Starting up GRASS

Start up grass by typing:

grass4.1

You will see a pre-filled form:

```
GRASS      4.1

LOCATION: This is the name of an available geographic location.
MAPSET:   Every GRASS session runs under the name of a MAPSET.
```

```
Associated with each MAPSET is a rectangular COORDINATE REGION and a list
of any new maps created.

DATABASE: This is the UNIX directory containing the geographic databases The REGION
defaults to the entire area of the chosen LOCATION.

You may change it later with the command: g.region

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
LOCATION:    spearfish_____(enter list for a list of locations)

MAPSET:      schwehr_______(or mapsets within a location)

DATABASE:    /home/schwehr/grass/data_____________________________
   AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
```

If you are accessing Pirenne via a remote login or telnet, you must set up a graphics window accessible to GRASS on your console;
i.e.

setenv DISPLAY mymachine.arc.nasa.gov:0

Otherwise, one can use a display on the Pirenne console:

GRASS 4.1 > *setenv DISPLAY pirenne@arc.nasa.gov:0*

To see what DISPLAY is set at use the UNIX command "printenv". Note that one can use the UNIX commands at the GRASS prompt. GRASS is a variation of a cshell with access from the command line. This gives you the ability to create GRASS scripts just as one is able to create shell scripts.

1.3.3 Creating a GRASS Database for use with the Mars data

Enter Grass and change the initial form as follows:

Change the Location to 'mars.tutor.xy':

Change the Mapset to your last name. In this tutorial, the name will be 'schwehr,' however you will see your name in the output because this step changes the name.

Continue by typing in the <ESC>. If the location already exists, you will enter GRASS, otherwise your next screen will be:

```
LOCATION <mars.tutor.xy> - doesn't exist
Available locations:
----------------------
den.utm.z12                    mars.in.xy
denver.aea                     spearfish
----------------------
Would you like to create location <mars.tutor.xy> ? (y/n) y

To create a new LOCATION, you will need the following information:
1. The coordinate system for the database
                        x,y (for imagery and other unreferenced data)
                        UTM
                        State Plane
                        Latitude-Longitude
                        other projection
```

```
2. The zone for the database
                (except for x,y and Latitude-Longitude databases)
3. The coordinates of the area to become the default region
   and the grid resolution of this region
4. A short, one-line description or title for the location

Do you have all this information for location <mars.tutor.xy> ? (y/n) y

Please specify the coordinate system for location <mars.tutor.xy>
          0 x,y
          1 UTM
          2 State Plane
          3 Latitude-Longitude
   99 Other
RETURN to cancel
>  0
x,y coordinate system? (y/n) [y]

Please enter a one line description for location <mars.tutor.targ>
>  Mars Database for the grass      4.1 tutorial

=======================================================
Mars Database for the grass 4.1 tutorial
=======================================================
ok? (y/n) [y]


                          DEFINE THE DEFAULT REGION

                        ====== DEFAULT REGION =======
                        | NORTH EDGE:2000_______     |
                  WEST EDGE|                         |EAST EDGE
                0_________|                         |2000_______
                        | SOUTH EDGE:0_________      |
                        ============================

        PROJECTION: 0 (x,y)                          ZONE: 0

                        GRID RESOLUTION
                           East-West:     1_________
                          North-South:    1_________

      AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                        (OR <Ctrl-C> TO CANCEL)

   projection:    0 (x,y)
   zone:                0
   north:            2000
   south:               0
   east:             2000
   west:                0
   e-w res:                1
   n-s res:                1

   total rows:          2000
   total cols:          2000
   total cells:    4,000,000

Do you accept this region? (y/n) [y] > y
```

```
LOCATION <mars.tutor.xy> created!
Hit RETURN -->

GRASS     4.1

LOCATION: This is the name of an available geographic location.
MAPSET:   Every GRASS session runs under the name of a MAPSET.

Associated with each MAPSET is a rectangular COORDINATE REGION and a list
of any new maps created.

DATABASE: This is the unix directory containing the geographic databases The REGION
defaults to the entire area of the chosen LOCATION.

You may change it later with the command: g.region

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
LOCATION:   mars.tutor.xy__(enter list for a list of locations)

MAPSET:     schwehr_____(or mapsets within a location)

DATABASE:   /home/schwehr/grass/data_____________________
   AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE


Welcome to GRASS 4.1 (Spring 1993) Update package 4
Geographical Resources Analysis Support Systems (GRASS) is a Trademark of U.S. Army
Construction Engineering Research Laboratories (USACERL)
New releases of GRASS are coordinated and produced by the Office of GRASS Integration
(OGI) located at USACERL, and incorporate software contributions from numerous sources

This version running thru the C Shell (/bin/csh)
Help is available with the command: g.help

When ready to quit enter:            exit

Mapset <schwehr> in Location <mars.tutor.xy> GRASS 4.1 > exit
Mapset <schwehr> in Location <mars.tutor.xy> GRASS 4.1 >
GRASS SESSION WRAPUP
You have just finished working on mapset: <schwehr>
There are no RASTER maps in this mapset
There are no VECTOR maps in this mapset
There are no SITES maps in this mapset
Shall the mapset <schwehr> be saved? y/n [y]

   GOOD BYE from GRASS
```

1.3.4 Accessing Mars Data from the CD-ROM

The VPE facilities has an assortment of planetary data on CD-ROM; including Mars. The CD-ROM needed for this tutorial is:

MARS: GLOBAL TOPOGRAPHY; VOLUME7
Mission To Mars: Digital Topographic Map, prepared by USGS fo NASA 1993

This tutorial assumes that the CD-ROM is loaded on the computer which is running GRASS. Please ask the System Adminitrator to place the CD-ROM on the machine. Once accessible, go to the LOCATION directory:

GRASS 4.1 > *cd ~schwehr/grass/data/mars.tutor.xy Mapset >*

If you do a listing you should see your name as the directory for your mapset:

GRASS 4.1 > ls

```
PERMANENT
 schwehr
```

Go to the Mapset directory. Here we will create a subdirectory called 'cell' where we will place the CD-ROM data of interest. For this example we will use the dataset called: tg15n067. The nomenclature is that of the Mars CD-ROM system where each image file has a unique name constructed according to the type of image file, resolution and its central latitude and longitude (See Section 1.5.4: Appendix: VOLINFO.TXT).

GRASS 4.1 > *cd schwehr*
GRASS 4.1 > *mkdir cell*
GRASS 4.1 > *cd cell*
GRASS 4.1 > *cp /CDROM/tng15nxxx/tg15n067.img*

The data comes with an ascii header file that must be removed in order to make it GRASS accessible. See Section 1.5.4 Appendix: VOLINFO.TXT) for a description of all the records of the header. You can see the header by using a unix listing command like 'more' or 'head :'

GRASS 4.1 > *more tg15n067.img*

```
CCSD3ZF0000100000001NJPL3IF0PDS200000001 = SFDU_LABEL

/*          FILE FORMAT AND LENGTH */
RECORD_TYPE       = FIXED_LENGTH
RECORD_BYTES      = 1912
FILE_RECORDS      = 962
LABEL_RECORDS     = 2

/*          POINTERS TO START RECORDS OF OBJECTS IN FILE */
^IMAGE                = 3

/*          IMAGE DESCRIPTION */
DATA_SET_ID       = "VO1/VO2-M-VIS-5-DTM-V1.0"
SPACECRAFT_NAME   = {VIKING_ORBITER_1, VIKING_ORBITER_2}
TARGET_NAME       = MARS
IMAGE_ID   = TG15N067
INSTRUMENT_NAME   = {VISUAL_IMAGING_SUBSYSTEM_CAMERA_A,
VISUAL_IMAGING_SUBSYSTEM_CAMERA_B} NOTE = "DIGITAL TERRAIN MODEL, 1/64-DEGREE PER
PIXEL"

/*          DESCRIPTION OF OBJECTS CONTAINED IN FILE */
OBJECT     = IMAGE
LINES      = 960
LINE_SAMPLES      = 956
SAMPLE_TYPE       = VAX_INTEGER
SAMPLE_BITS       = 16
CHECKSUM   = 128838457
MINIMUM    = 2497
MAXIMUM    = 4749

/*        ELEVATION (METERS) = 2*DN - 6000, NULL DN VALUES = 0 */
```

```
    MISSING    = 0
    SCALING_FACTOR    = 2
    OFFSET     = -6000
END_OBJECT   = IMAGE
```

To strip the header use the split.pds.image command (Section 1.5.2: C Code Written During Installation):

GRASS 4.1 > split.pds.image

```
File to read from:tg15n067.img
Img Output file:tg15n067
Text Output file:tg15n067.lbl
Text Header Size:3824 3824
characters written 1835520 characters written
```

In addition to stripping the header, the binary file bye order must be swapped. The Mars DTM files from the USGS Viking CD-ROM lists the data type as 16 bit Vax_integers. IBM and Vaxes have a different byte order than MIPs (SGI) machines in that integers are longer than one byte. The symtom of the wrong byte order is to have unusual and rapidly varying values in small areas on the image. Use the swap.bytes command to change the file for the SGI machine. This program reads in each pair of bytes, swaps them, and writes them out to a different file (Appendix: C-Code):

GRASS 4.1 > swap.bytes

```
Swap bytes for a 16bit image file.
File to read from:tg15n067 Img
Output file:tg15n067.swap
917760 characters written
```

If you do a listing you should see the following files:

GRASS 4.1 > ls -l

```
total 10771       -rw-r--r-- 1 schwehr vpe 1835520 Aug 17 13:42
tg15n067          -rw-r--r-- 1 schwehr vpe 1839344 Aug 17 13:38
tg15n067.img      -rw-r--r-- 1 schwehr vpe 3824    Aug 17 13:42
tg15n067.lbl      -rw-r--r-- 1 schwehr vpe 1835520 Aug 17 13:44
tg15n067.swap
```

For convenience, one can rename the file:

GRASS 4.1 > *mv tg15n067.swap tg15n067*

1.3.5 Creating the GRASS header Support Files

GRASS needs some support files called header files. The utility used is 'r.support'.

GRASS 4.1 >>*r.support*

```
Enter name of raster file for which you will create/modify support files
Enter 'list' for a list of existing raster files
Enter 'list -f' for a list with titles
Hit RETURN to cancel request >
```

GRASS treats any file in a /<location>/<mapset>/cell/ directory as a binary raster image.

```
list <list>

-------------------------------------------
 raster files available in mapset schwehr:
tg15n067
tg15n067.img
tg15n067.lbl
-------------------------------------------

Enter name of raster file for which you will create/modify support files
Enter 'list' for a list of existing raster files
Enter 'list -f' for a list with titles
Hit RETURN to cancel request
> tg15n067
<tg15n067>
```

Since we are creating the header file, GRASS will indicate this and then allow us to create it. The input values are obtained from the header file of the raw data:

```
LINES      = 960
LINE_SAMPLES      = 956
SAMPLE_TYPE       = VAX_INTEGER
SAMPLE_BITS       = 16
```

One obtains the number of bytes per cell by dividing the SAMPLE_BITS by 8 (resulting in 2). The values are used as follows:

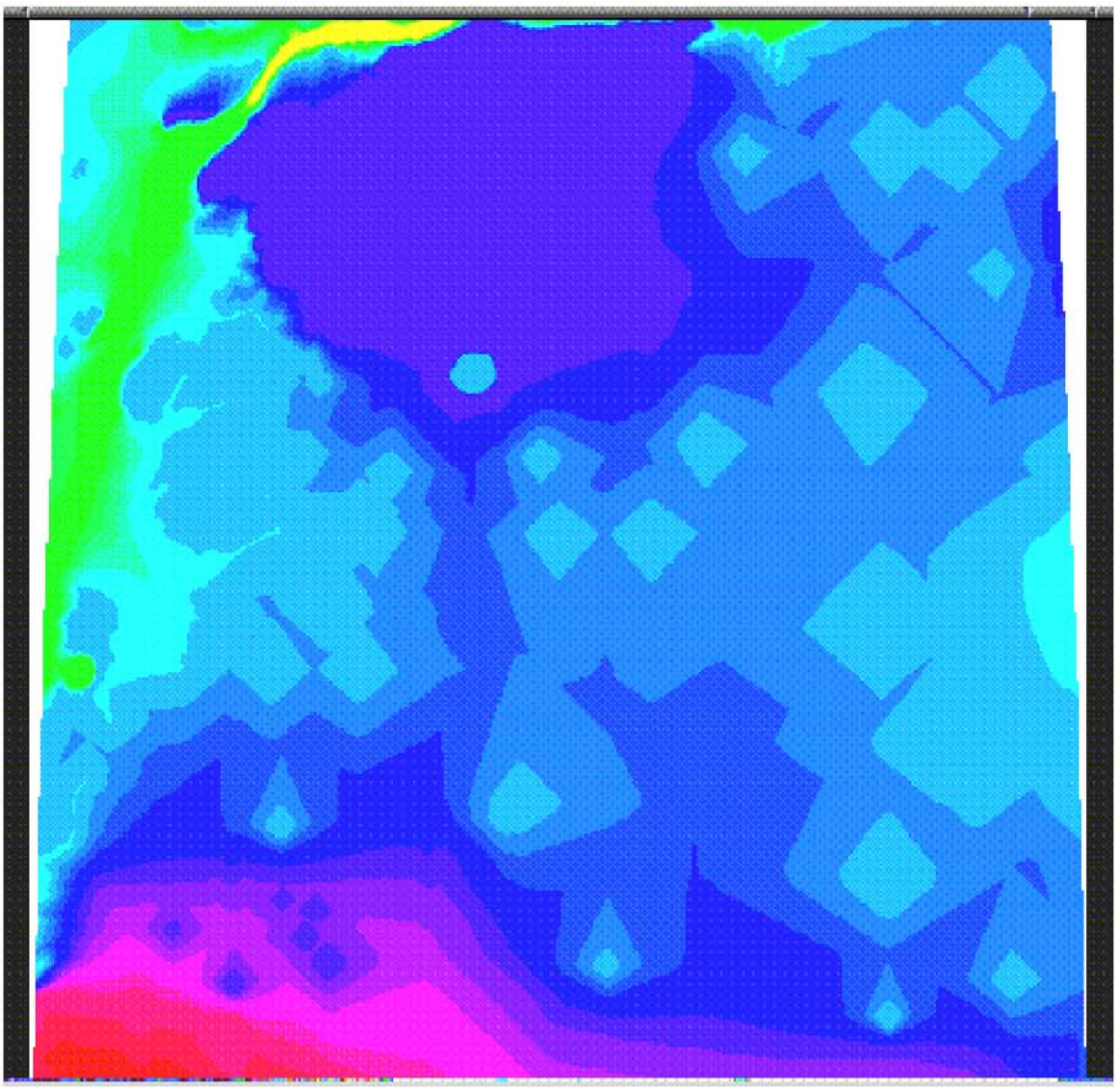
```
WARNING: Can't open header file for [tg15n067 in schwehr]
Edit the header for [tg15n067]? (y/n) [y] y
Edit header for [tg15n067] cellhd
compression: 0 3.0 compression not indicated
pre 3.0 compression not indicated
hit RETURN to continue -->

Please enter the following information for [tg15n067]

960__      Number of rows
956__      Number of cols
2____      Number of bytes per cell

rows * cols * bytes per cell must be same as file size (1835520)
If you need help figuring them out, just hit ESC
AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE (OR <Ctrl-C> TO CANCEL)
```

If you input the incorrect information, GRASS will attempt to assist you. For example suppose that you entered 957 instead of 956. Your ouput will show

```
The product of the rows(960), cols(957) and bytes per cell(2) does not equal the file
size (1835520)

The following combinations will produce the correct file size

2 bytes per cell
1 * 917760        2 * 458880     3 * 305920
4 * 229440        5 * 183552     6 * 152960
8 * 114720        10 * 91776     12 * 76480
15 * 61184        16 * 57360     20 * 45888
24 * 38240        30 * 30592     32 * 28680
```

```
40 * 22944        48 * 19120    60 * 15296
64 * 14340        80 * 11472    96 * 9560
120 * 7648        128 * 7170    160 * 5736
192 * 4780        239 * 3840    240 * 3824
256 * 3585        320 * 2868    384 * 2390
478 * 1920        480 * 1912    640 * 1434
717 * 1280        768 * 1195    956 * 960
hit RETURN to continue -->
```

Figure 5: tg15n067.first.gif.



1.3.6 Registration using Kilauea Data

The tutorial in the Appendix contains examples of registration (Section 1.5.1: Stanford Workshop Grass Tutorial). This example uses sample data from a CD-ROM containing data of the Kilauea Volcano in Hawaii.

Registration is a multi-step proccess, involving creating a Group (a collection of images) and a Target Database, followed by the selection of control points; i.e. points that are congruent on the different images, and finally the registration of the images together using the control points..

This example is a fairly detailed one that shows how to register one raster image (kildem) to a set of three (skil12n2.img, skil12n4.img, skil12n7.img). In the process, we will modify the kildem image by creating a grey scale for it. We will then create a group for the kildem data (kildem.grp), target it, and rectify it. Following this, the set of three images will also be grouped and targeted (producing image.grp), followed by the rectification to the first image.

Througout the process, note that the 'i.point' procedure is used to obtain the reference points used to register the images together. Note also that one has to 'group' the kildem image, even though it is a group of one. GRASS considers this neccessary so as to allow one to target the image to it (since GRASS targets a 'group').

1.3.6.1 Specifiying the Location and Mapset

First, one must specify a Location and a Mapset:

```
GRASS     4.1
LOCATION: This is the name of an available geographic location.
MAPSET:   Every GRASS session runs under the name of a MAPSET.  Associated with each
MAPSET is a rectangular COORDINATE REGION and a list of any new maps created.
DATABASE: This is the unix directory containing the geographic databases The REGION
defaults to the entire area of the chosen LOCATION.

You may change it later with the command: g.region
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
LOCATION:   kil.tutor.targ_(enter list for a list of locations)
MAPSET:     schwehr_____(or mapsets within a location)
DATABASE:   /home/schwehr/grass/data_____________________________
                    AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                                (OR <Ctrl-C> TO CANCEL)
```

Please input 'kil.tutor.targ' as the Location and your name as the Mapset:

```
LOCATION <kil.tutor.targ> - doesn't exist
Available locations:
----------------------
den.utm.z12       kil.sample.xy       kill.dan.xy   spearfish.tar.Z
denver.aea.2      kil.sample.xy.tar   mars.in.xy    text.files
denver.in.1       kil.tutor.xy        mars.tutor.xy
denver.ll         spearfish
----------------------
Would you like to create location <kil.tutor.targ> ? (y/n) y
```

```
To create a new LOCATION, you will need the following information:
1. The coordinate system for the database
                        x,y (for imagery and other unreferenced data)
                        UTM
                        State Plane
                        Latitude-Longitude
                        other projection
2. The zone for the database
                    (except for x,y and Latitude-Longitude databases)
3. The coordinates of the area to become the default region
   and the grid resolution of this region
4. A short, one-line description or title for the location

Do you have all this information for location <kil.tutor.targ> ? (y/n) y

Please specify the coordinate system for location <kil.tutor.targ>
          0 x,y
          1 UTM
          2 State Plane
          3 Latitude-Longitude
   99 Other
RETURN to cancel
>  0
x,y coordinate system? (y/n) [y]

Please enter a one line description for location <kil.tutor.targ>

>  Tutorial location for Kilauea - target for registering files - xy coords

=======================================================
Tutorial location for Kilauea - target for registering files - xy coords
=======================================================
ok? (y/n) [y]

                              DEFINE THE DEFAULT REGION

                            ====== DEFAULT REGION ========
                           | NORTH EDGE:400_______        |
                 WEST EDGE|                              |EAST EDGE
                0_________|                              |400_______
                           | SOUTH EDGE:0_________        |
                            ============================

       PROJECTION: 0 (x,y)                          ZONE: 0

                          GRID RESOLUTION
                             East-West:     1_________
                          North-South:      1_________

      AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                          (OR <Ctrl-C> TO CANCEL)

   projection:   0 (x,y)
   zone:          0
   north:       400
   south:       0
   east:        400
   west:        0
```

```
    e-w res:      1
    n-s res:             1
    total rows:                400
    total cols:                400
    total cells:           160,000
Do you accept this region? (y/n) [y] >
LOCATION <kil.tutor.targ> created!
```

After specifiying the Location and Mapset, be sure to save it when exiting:

```
When ready to quit enter:              exit
```

GRASS 4.1 > exit

```
GRASS SESSION WRAPUP
You have just finished working on mapset: <schwehr>
There are no RASTER maps in this mapset
There are no VECTOR maps in this mapset
There are no SITES maps in this mapset

Shall the mapset <schwehr> be saved? y/n [y]
```

Enter GRASS again and specify the Location kil.tutor.targ and your Mapset ('schwehr' in this tutorial). By using a 'g' command (i.e. general, one can list the raster files available):

GRASS 4.1 > g.list rast

```
 ----------------------------------------------
raster files available in mapset PERMANENT:
kildem    skil12n2.img  skil12n4.img  skil12n7.img
----------------------------------------------
```

1.3.6.2 Customizing the Database Environment and Selecting the Graphic Output Device

One can now customize the database environment and select the graphics output device. Use of the 'g.gisenv ' command displays the specified variable as part of the prompt if desired:

GRASS 4.1 > g.gisenv

```
GISDBASE=/home/schwehr/grass/data LOCATION_NAME=kil.tutor.targ MAPSET=schwehr
```

GRASS 4.1 > setenv DISPLAY console:0
GRASS 4.1 > d.mon start=iris

Graphics driver [iris] started

GRASS 4.1 > d.frame -e

1.3.6.3 Obtaining a Grey Scale

Obtain a grey scale with the following commands:

GRASS 4.1 > g.region rast=kildem
GRASS 4.1 > d.rast kildem
GRASS 4.1 > i.grey.scale

```
which layer needs a grey scale?
```

```
Enter 'list' for a list of existing raster files Enter 'list -f' for a list with
titles
Hit RETURN to cancel request
> list
<list>

-------------------------------------------
raster files available in mapset PERMANENT:
kildem    skil12n2.img skil12n4.img skil12n7.img
-------------------------------------------

which layer needs a grey scale?
Enter 'list' for a list of existing raster files
Enter 'list -f' for a list with titles
Hit RETURN to cancel request
> kildem
<kildem>
Reading kildem ...
[kildem in PERMANENT] now has a grey scale color table
which layer needs a grey scale?
Enter 'list' for a list of existing raster files
Enter 'list -f' for a list with titles
Hit RETURN to cancel request
>
```

Display the output:

GRASS 4.1 > d.rast kildem

The grey scale file is an ascii text that is can be edited using any text editor such as vi or emacs. The format is of an altitude, followed by the grey scale range to code for that altitude level:

GRASS 4.1 > cd ~schwehr/grass/data/kil.tutor.targ/schwehr/colr2/PERMANENT
GRASS 4.1 > cat kildem

```
% 1 6363
0:0
1:0 15:0
16:1 28:1
29:2 37:2
38:3 47:3
48:4 53:4
54:5 62:5
63:6 69:6
   ...
   etc ...
```

To get familiar with the data, one can use the d.what.rast command. This will let you use your mouse to select a point and obtain information on that point: Using this, one can select different altitudes ranges and modify the grey scale.

GRASS 4.1 > d.what.rast

```
Buttons
 Left:  what's here
 Right: quit
221.5(E) 935.5(N)
kildem in PERMANENT (4496)
```

```
212.5(E) 762.5(N)
kildem in PERMANENT (3618)
469.5(E) 691.5(N)
kildem in PERMANENT (3547)
558.5(E) 629.5(N)
kildem in PERMANENT (3250)
724.5(E) 598.5(N)
kildem in PERMANENT (2505)
Buttons
 Left:  what's here
 Right: quit

GRASS 4.1 > ls -l
total 9
-rw-r--r--   1 schwehr  vpe         4292 Aug 18 17:07 kildem
```

Using this technique, the grey scale can be changed to what one desires (after using the 'd.what.rast' command to obtain the values one wants). For this example the kildem grey scale was changed to the following:

GRASS 4.1 > more kildem

```
% 1 6363
0:0 2505:255
2506:255:255:255 3250:0:255:0
3251:0:255:0 3547:255:0:0
3548:255:0:0 3618:0:255:0
3619:0:255:0 4045:255:0:255
4046:255:0:255 4496:255:0:0
```

This is not the best color scale. Try your own, and you will probably get better results.

One can use the 'zoom' command to change the current region:

GRASS 4.1 > d.rast kildem
GRASS 4.1 > d.zoom

```
Buttons:
Left:   Establish a corner
Middle: Check coordinates
Right:  Accept region
north: 889  south: 888  east: 512  west: 511
north: 889  south: 654  east: 512  west: 265
This region now saved as current region.
Note: run 'd.erase' for the new region to affect the graphics.
```

See Figure 1: kildem1.gif for a sample of the display output.

Since the display is using an iris monitor, it needs to be cleared using the d.frame -e command.

> *GRASS 4.1* > d.frame -e
> *GRASS 4.1* > d.rast kildem

1.3.6.4 Grouping the first Raster Image

Grass can be used on multiples of images. This is facilitated by the use of a 'group'; i.e. sets of images that are coprocessed. Creating a group is required for this registration:

> GRASS 4.1 > i.group

```
This program edits imagery groups. You may add data layers to, or remove data layers
from an imagery group. You may also create new groups
Please enter the group to be created/modified
GROUP:    kildem.grp_____________   (list will show available groups)
                                AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                          (OR <Ctrl-C> TO CANCEL)

kildem.grp - does not exist, do you wish to create a new group? (y/n) [n] y

LOCATION: kil.tutor.targ      GROUP: kildem.grp   MAPSET: schwehr
Please mark an 'x' by the files to be added in group [kildem.grp]
MAPSET: PERMANENT
_x kildem
__ skil12n2.img
__ skil12n4.img
__ skil12n7.img

                AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                      (OR <Ctrl-C> TO CANCEL)

Group [kildem.grp] references the following raster file

-----------------------
kildem in PERMANENT
-----------------------
Look ok? (y/n) y
Group [kildem.grp] created!
LOCATION: kil.tutor.targ            GROUP: kildem.grp            MAPSET: schwehr
          1.    Select a different group
          2.    Edit group title
          3.    Include new raster files in the group
                or remove raster files from the group
          4.    Assign colors to the group
          5.    Create a new subgroup within the group
   RETURN exit
```

1.3.6.5 Targeting the First Image

After creating the group, one must target it to the database one wants to use:

GRASS 4.1 > i.target

```
This program targets an imagery group to a GRASS database
Enter group that needs a target
Enter 'list' for a list of existing imagery groups Enter 'list -f' for a verbose
listing
Hit RETURN to cancel request
> list

<list>
Available groups
--------------------------------
kildem.grp
--------------------------------
```

```
hit RETURN to continue -->

Enter group that needs a target
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> kildem.grp

<kildem.grp>
Please select the target LOCATION and MAPSET for group <kildem.grp>
CURRENT LOCATION: kil.tutor.targ
CURRENT MAPSET:   schwehr
TARGET LOCATION:  ____________________
TARGET MAPSET:    ____________________
(enter list for a list of locations or mapsets within a location)

 AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                          (OR <Ctrl-C> TO CANCEL)
```

Fill this form with 'kil.tutor.targ' as the Location and your name as the Mapset.

1.3.6.6 Using 'i.points' on the First Image

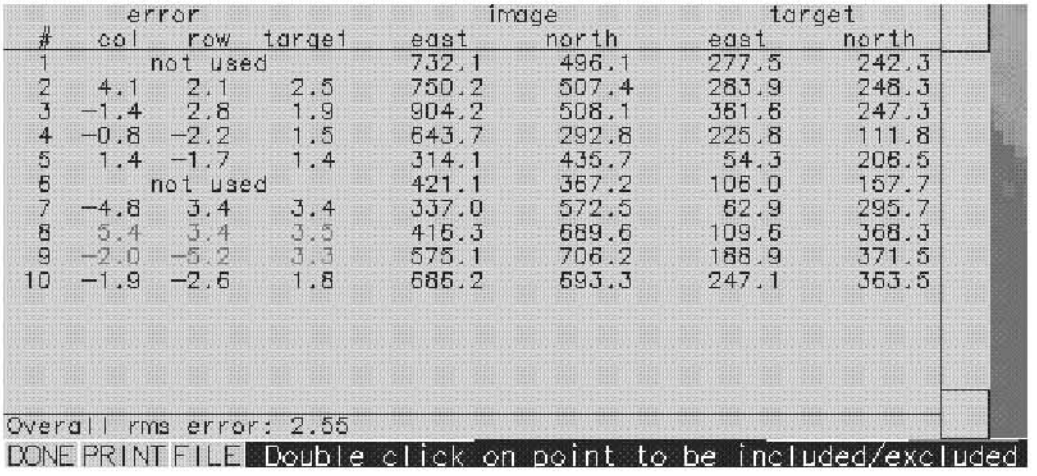
Finally, one can begin the registration process. 'i.points' will let you locate the points that you will use as markers. It uses a mouse menuing system to let you pick the map points that you believe you have coordinate information on.

You can then do an analysis that shows the list of control points and the positioning error. Iteratively, one can do the point selection and analysis to reduce the error (Figure 6: img.pts.3.sml.gif):

GRASS 4.1 > i.points

```
Enter imagery group to be registered
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> list

<list>
Available groups
---------------------------------
kildem.grp
---------------------------------
hit RETURN to continue -->
Enter imagery group to be registered
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> kildem.grp
```

Figure 6: img.pts.3.sml.gif:



#	error col	error row	error target	image east	image north	target east	target north
1	not used			732.1	496.1	277.5	242.3
2	4.1	2.1	2.5	750.2	507.4	283.9	248.3
3	-1.4	2.8	1.9	904.2	508.1	361.6	247.3
4	-0.8	-2.2	1.5	643.7	292.8	225.8	111.8
5	1.4	-1.7	1.4	314.1	435.7	54.3	206.5
6	not used			421.1	367.2	106.0	157.7
7	-4.8	3.4	3.4	337.0	572.5	62.9	295.7
8	5.4	3.4	3.5	416.3	689.6	109.6	368.3
9	-2.0	-5.2	3.3	575.1	706.2	188.9	371.5
10	-1.9	-2.6	1.8	686.2	693.3	247.1	363.5

Overall rms error: 2.55

DONE PRINT FILE Double click on point to be included/excluded

1.3.6.7 Rectifying The First Image

***GRASS 4.1* > i.rectify**

```
Enter the group containing files to be rectified Enter 'list' for a list of existing
imagery groups Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> list
<list>

Available groups
---------------------------------
kildem.grp
---------------------------------
hit RETURN to continue -->

Enter the group containing files to be rectified Enter 'list' for a list of existing
imagery groups Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> kildem.grp

<kildem.grp>

Please select the file(s) you wish to rectify by naming an output file
kildem@schwehr . . . . . kildem_____

(enter list by  name to get a list of existing raster files)
AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                    (OR <Ctrl-C> TO CANCEL)

Please select one of the following options
 1. Use the current region in the target location
```

```
 2. Determine the smallest region which covers the image
> 1
```

You will receive mail when i.rectify is complete. The contents of the rectification notice will look similar to the following:

GRASS 4.1 > mail

```
From schwehr  Thu Aug 18 17:42:25 1994
Received: by langrenus.arc.nasa.gov (920330.SGI/911001.SGI)
for schwehr id AA21585; Thu, 18 Aug 94 17:42:25 -0700 Date: Thu, 18 Aug 94 17:42:25 -
0700
From: schwehr (Kurt Schwehr)
Message-Id: <9408190042.AA21585@langrenus.arc.nasa.gov> Subject: i.rectify
Apparently-To: schwehr
**********************************************
Rectify [kildem@PERMANENT] (LOCATION kil.tutor.targ)
into  [kildem in schwehr] (LOCATION kil.tutor.tar)
complete
----------------------------------------------
 400 rows, 400 cols (160000 cells) completed in 0:06
   1600000.0 cells per minute
? d
```

1.3.6.8 Grouping the Three Other Images

After receiving notification one can continue:

***GRASS 4.1* > i.group**

```
LOCATION: kil.tutor.targ.group       MAPSET: schwehr
This program edits imagery groups. You may add data layers to, or remove data layers
from an imagery group. You may also create new groups

Please enter the group to be created/modified

GROUP:    images.grp_____________   (list will show available groups)

AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                (OR <Ctrl-C> TO CANCEL)

images.grp - does not exist, do you wish to create a new group? (y/n) [n] y
LOCATION: kil.tutor.targ      GROUP: images.grp   MAPSET: schwehr
Please mark an 'x' by the files to be added in group [images.grp]

MAPSET: PERMANENT
__ kildem
_x  skil12n2.img
_x  skil12n4.img
_x  skil12n7.img

AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
          (OR <Ctrl-C> TO CANCEL)
```

These images can be grouped together since they have already been registered to each other. Thus the same transform will be used on all three to rectify them together to match the kildem in kil.tutor.targ

```
Group [images.grp] references the following raster files
```

```
----------------------
   skil12n2.img in PERMANENT
   skil12n4.img in PERMANENT
   skil12n7.img in PERMANENT
----------------------
Look ok? (y/n) y

Group [images.grp] created!
LOCATION: kil.tutor.targ          GROUP: images.grp          MAPSET: schwehr
   1.    Select a different group
   2.    Edit group title
   3.    Include new raster files in the group
         or remove raster files from the group
   4.    Assign colors to the group
   5.    Create a new subgroup within the group
   RETURN exit
>
```

1.3.6.9 Targeting The Three Images

***GRASS 4.1* > i.target**

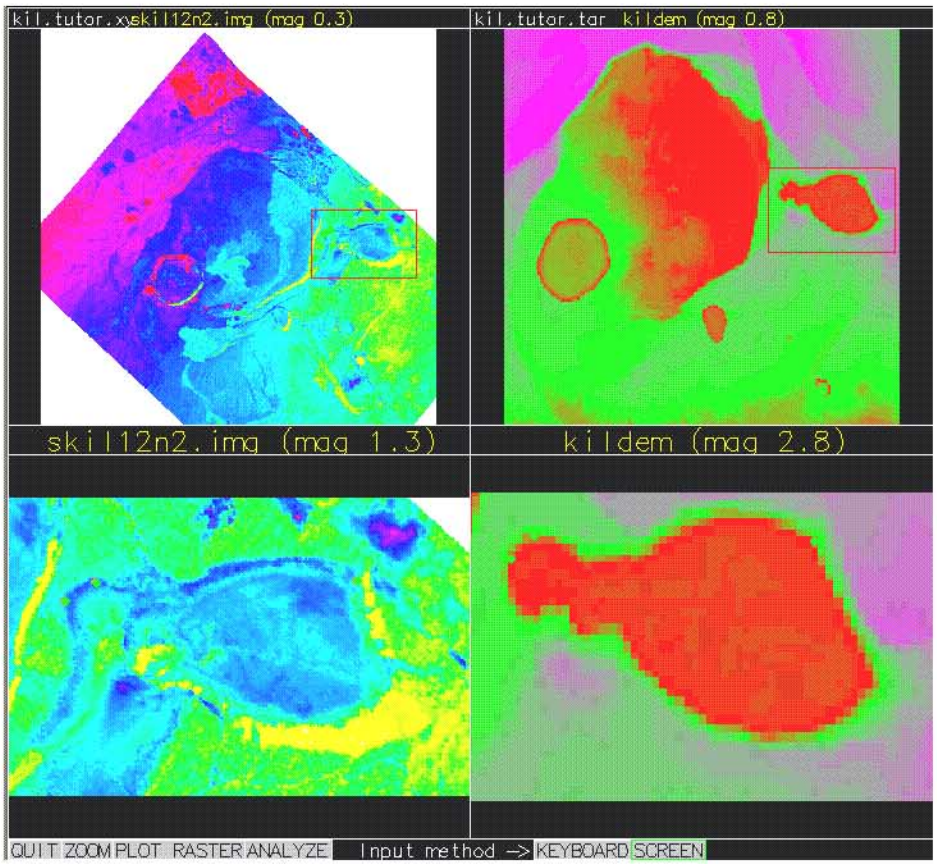
```
This program targets an imagery group to a GRASS database
Enter group that needs a target

Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> list

<list>
Available groups
---------------------------------
images.grp  kildem.grp
---------------------------------
hit RETURN to continue -->
Enter group that needs a target
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> images.grp

<images.grp>
Please select the target LOCATION and MAPSET for group <images.grp>
CURRENT LOCATION: kil.tutor.targ
CURRENT MAPSET:   schwehr
TARGET LOCATION:  _____________________
TARGET MAPSET:    _____________________

(enter list for a list of locations or mapsets within a location)
AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
          (OR <Ctrl-C> TO CANCEL)

group [images.grp] targeted for location [kil.tutor.tar], mapset [schwehr]
Mapset <schwehr> in Location <kil.tutor.targ>
```

1.3.6.10 Using Points on the Three Images group to prepare to Register with the First

***GRASS 4.1* > i.points**

```
Enter imagery group to be registered
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> list

<list>
Available groups
--------------------------------
images.grp  kildem.grp
--------------------------------
hit RETURN to continue -->

Enter imagery group to be registered
Enter 'list' for a list of existing imagery groups
Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> images.grp
```

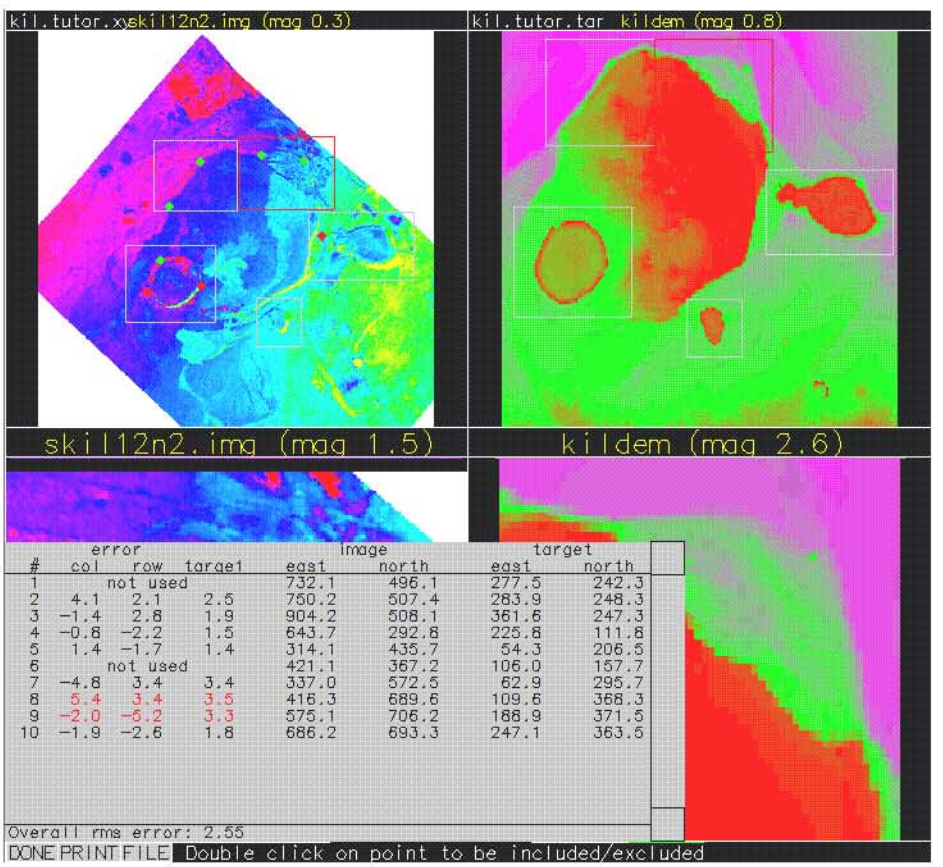
Use plot raster to bring up the image hidden on the right (Figure 7: imp.pts.1.gif):



The i.point command uses the mouse to select the registration points. The following are some sample mouse point selections (yours may be very different):

```
|Point 1 marked on image at
|   East:732.07
|   North:      496.06|
|Point located at
|   East:277.49
|   North:      242.29
|Point 2 marked on image at
|   East:750.19
|   North:      507.36

    ....

|Point 9 marked on image at
|   East:575.12
|   North:      706.23
|Point located at
|   East:188.86
|   North:      371.47
|Point 10 marked on image at
|   East:686.16
|   North:      693.27
|Point located at
|   East:247.08
|   North:      363.47
```

See above (Figure7: imp.pts.1.gif). As well as Figure 8: img.pts.2.gif:



1.3.6.11 Rectifying the First Image Group to the Three Image Group

***GRASS 4.1* > i.rectify**

```
Enter the group containing files to be rectified Enter 'list' for a list of existing
imagery groups Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> list

<list>
Available groups
 ---------------------------------
images.grp  kildem.grp
 ---------------------------------
hit RETURN to continue -->
Enter the group containing files to be rectified Enter 'list' for a list of existing
imagery groups Enter 'list -f' for a verbose listing
Hit RETURN to cancel request
> images.grp

<images.grp>
Please select the file(s) you wish to rectify by naming an output file
skil12n2.img@PERMANENT . . . . . skil12n2_____
skil12n4.img@PERMANENT . . . . . skil12n4_____
skil12n7.img@PERMANENT . . . . . skil12n7_____
(enter list by any name to get a list of existing raster files)

AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
                 (OR <Ctrl-C> TO CANCEL)

Please select one of the following options
 1. Use the current region in the target location
 2. Determine the smallest region which covers the image
> 1
You will receive mail when i.rectify is complete
```

***GRASS 4.1* > mail**

```
From schwehr  Thu Aug 18 18:03:32 1994
Received: by langrenus.arc.nasa.gov (920330.SGI/911001.SGI)
   for schwehr id AA21649; Thu, 18 Aug 94 18:03:32 -0700 Date: Thu, 18 Aug 94
18:03:32 -0700
From: schwehr (Kurt Schwehr)
Message-Id: <9408190103.AA21649@langrenus.arc.nasa.gov> Subject: i.rectify
Apparently-To: schwehr
**********************************************
Rectify [skil12n2.img@PERMANENT] (LOCATION kil.tutor.xy)
into  [skil12n2 in schwehr] (LOCATION kil.tutor.tar)
complete ------------------------------------------------
400 rows, 400 cols (160000 cells) completed in 0:06
 1600000.0 cells per minute
**********************************************
Rectify [skil12n4.img@PERMANENT] (LOCATION kil.tutor.xy)
 into  [skil12n4 in schwehr] (LOCATION kil.tutor.tar)
 complete ------------------------------------------------
400 rows, 400 cols (160000 cells) completed in 0:06
 1600000.0 cells per minute
**********************************************
```

```
Rectify [skil12n7.img@PERMANENT] (LOCATION kil.tutor.xy)
 into  [skil12n7 in schwehr] (LOCATION kil.tutor.tar)
 complete ------------------------------------------
400 rows, 400 cols (160000 cells) completed in 0:05
 1920000.0 cells per minute
? d
```

1.3.7 Visualization of the Kilueau Mapset

After the registration process, it is possible to explore your mapset with the use of several of the GRASS commands and the SG3d program.

langrenus 7% **grass4.1**

```
GRASS 4.1

LOCATION: This is the name of an available geographic location.  -spearfish is the
sample data base for which all tutorials are written.

MAPSET:   Every GRASS session runs under the name of a MAPSET.  Associated with each
MAPSET is a rectangular COORDINATE REGION and a list
of any new maps created.

DATABASE: This is the unix directory containing the geographic databases The REGION
defaults to the entire area of the chosen LOCATION.

You may change it later with the command: g.region
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

LOCATION: kil.tutor.xy__(enter list for a list of locations)
MAPSET:   schwehr_____(or mapsets within a location)
DATABASE: /home/schwehr/grass/data_____________________________
AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
          (OR <Ctrl-C> TO CANCEL)

list
_____
Available locations:
----------------------
den.utm.z12       kil.tutor.tar       mars.tutor.xy denver.aea.2
kil.tutor.xy      spearfish           denver.in.1
denver.ll         kill.dan.xy         kil.sample.xy.tar.Z
mars.in.xy
----------------------
Hit RETURN -->

GRASS 4.1

LOCATION: This is the name of an available geographic location.  -spearfishis the
sample data base for which all tutorials are written.

MAPSET:   Every GRASS session runs under the name of a MAPSET.  Associated with each
MAPSET is a rectangular COORDINATE REGION and a list
of any new maps created.

DATABASE: This is the unix directory containing the geographic databases The REGION
defaults to the entire area of the chosen LOCATION.
```

```
You may change it later with the command: g.region
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
LOCATION: kil.tutor.xy_____(enter list for a list of locations)
MAPSET:   schwehr_______(or mapsets within a location)
DATABASE: /home/schwehr/grass/data_____________________________

AFTER COMPLETING ALL ANSWERS, HIT <ESC> TO CONTINUE
          (OR <Ctrl-C> TO CANCEL)


Welcome to GRASS 4.1 (Spring 1993) Update package 4
Geographical Resources Analysis Support Systems (GRASS) is a Trademark of U.S. Army
Construction Engineering Research Laboratories (USACERL)
New releases of GRASS are coordinated and produced by the Office of GRASS Integration
(OGI) located at USACERL, and incorporate software contributions from numerous sources
This version running thru the C Shell (/bin/csh)
Help is available with the command: g.help
When ready to quit enter:                exit
```

GRASS 4.1 > g.list rast

```
-------------------------------------------
raster files available in mapset schwehr: kildem    skil12n2  skil12n4  skil12n7
-------------------------------------------
```

If the Iris window is already running type:

GRASS 4.1 > d.mon unlock=iris
GRASS 4.1 > d.mon sel=iris

Otherwise type:

GRASS 4.1 > d.mon start=iris

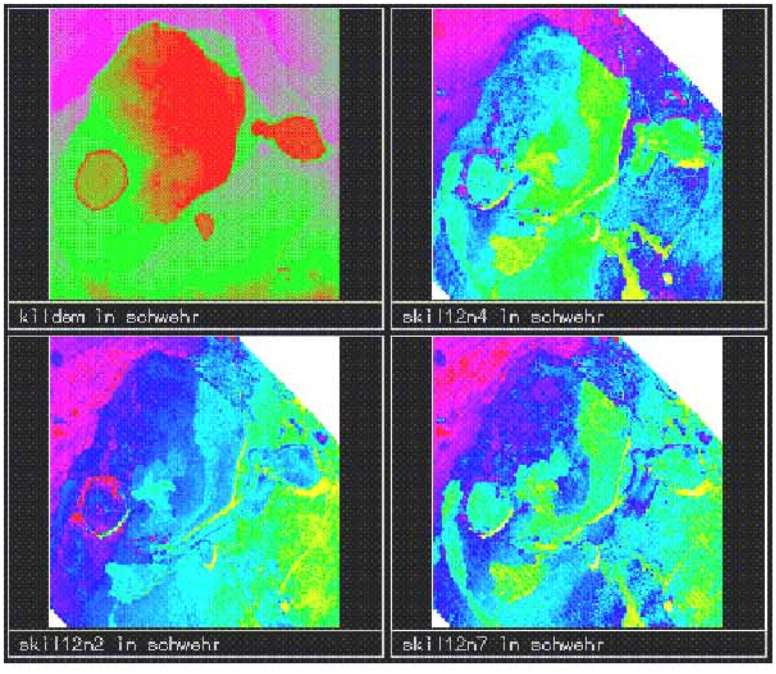
Continue with :

GRASS 4.1 >
GRASS 4.1 > d.frame -e
GRASS 4.1 > slide.show.sh mapset=schwehr
GRASS 4.1 > slide.show.sh help

```
Unrecognized option: help
Options: across=#maps_across down=#_maps_down Defaults:
   across =   4
   down   =   3
```

GRASS 4.1 > slide.show.sh across=2 down=2 mapset=schwehr

Figure 9: slide.show.gif:



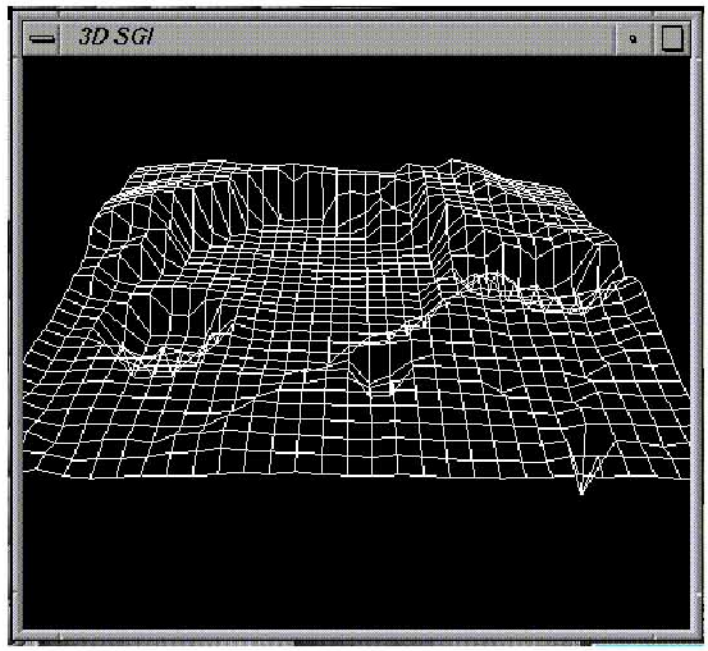
GRASS 4.1 > setenv DISPLAY willinck:0
GRASS 4.1 > SG3d

```
OPTION:   Raster file for Elevation
          key: elevation
required: YES

Enter the name of an existing Raster file Enter 'list' for a list of existing Raster
files
Hit RETURN to cancel request
> list

<list>
-------------------------------------------
Raster files available in mapset schwehr: kildem    skil12n2  skil12n4  skil12n7
-------------------------------------------

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files Hit RETURN to cancel request
> kildem
<kildem>
OPTION:   Raster file(s) for Color (1 or 3 files) key: color
required: YES
multiple: YES

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to cancel request
> skil12n2
<skil12n2>
```

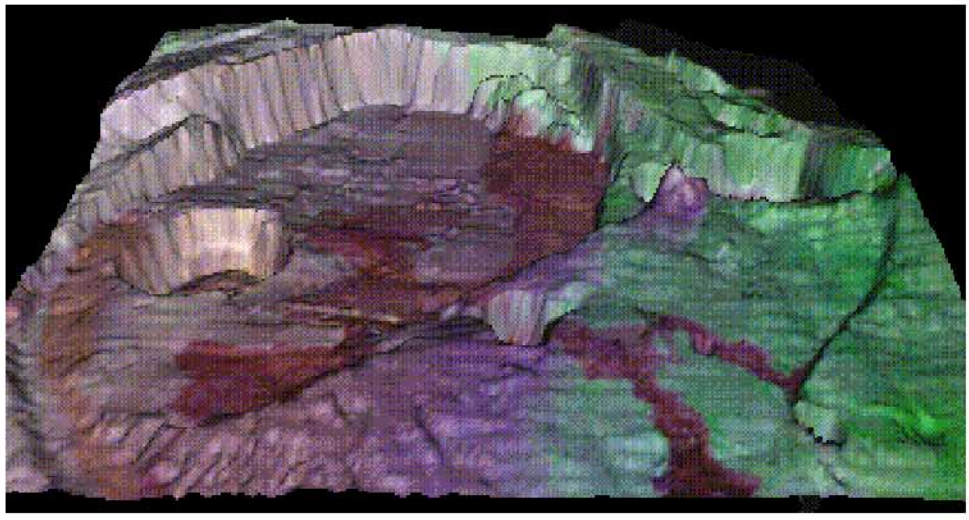
```
Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to accept the default
>
<>
OPTION:   Vector overlay file
          key: vector
required: NO

Enter the name of an existing Vector file
Enter 'list' for a list of existing Vector files
Hit RETURN to cancel request
>
<>

OPTION:   3D viewing parameters
          key: 3dview
required: NO
Enter the name of an existing 3dview file
Enter 'list' for a list of existing 3dview files
Hit RETURN to cancel request
>
<>
OPTION:   Sites overlay file
          key: sites
required: NO

Enter the name of an existing Sites file
Enter 'list' for a list of existing Sites files
Hit RETURN to cancel request
>
<>
OPTION:   Raster file for site category color key: scolor
required: NO

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to cancel request
>
OPTION:   Automatically run script file
          key: script
required: NO
enter option >
FLAG: Set the following flag?
Enable writing to script files?(y/n) [n]
FLAG: Set the following flag?
   Use site category as Z value?(y/n) [n] Initial load of data:  Loading data:  Done.
elevation range: 3165.000000 to 4097.000000 Done.
recalculating normals...100
```

GRASS 4.1 > SG3d

First you will see a wire frame representation of the topography as in Figure3: sg3d.1.gif:



Click on the draw button to see a rendered version that looks like figure10: sg3d.2.gif:



To finish, click on the 'quit' button to exit back to GRASS.

Now we'll merge together three image bands. The first will be red, the second green, and the third green. This will give the impression of 'color' from the images.

```
OPTION:   Raster file for Elevation
   key: elevation
required: YES
Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to cancel request
> list

<list>
-------------------------------------------
Raster files available in mapset schwehr: kildem    skil12n2  skil12n4  skil12n7
-------------------------------------------

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to cancel request
> kildem
<kildem>
OPTION:   Raster file(s) for Color (1 or 3 files) key: color
required: YES
multiple: YES
Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
 Hit RETURN to cancel request
> skil12n2
<skil12n2>

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to accept the default
> skil12n4
<skil12n4>

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to accept the default
> skil12n7
<skil12n7>

Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to accept the default
>
<>
OPTION:   Vector overlay file
   key: vector
required: NO
Enter the name of an existing Vector file
Enter 'list' for a list of existing Vector files
Hit RETURN to cancel request
>
<>
OPTION:   3D viewing parameters
          key: 3dview
required: NO
```

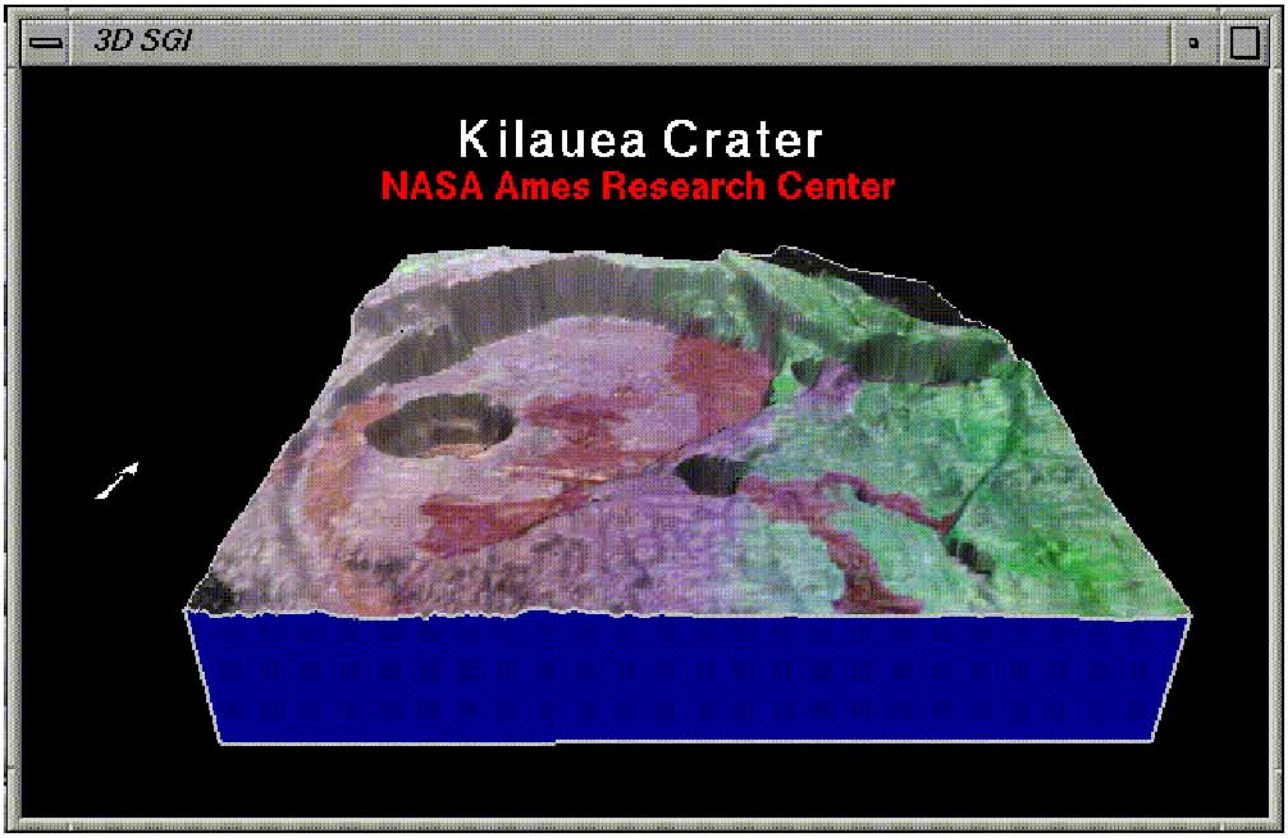
```
Enter the name of an existing 3dview file
Enter 'list' for a list of existing 3dview files
Hit RETURN to cancel request
>
<>
OPTION:    Sites overlay file
           key: sites
required: NO
Enter the name of an existing Sites file
Enter 'list' for a list of existing Sites files
Hit RETURN to cancel request
>

OPTION:    Raster file for site category color key: scolor
required: NO
Enter the name of an existing Raster file
Enter 'list' for a list of existing Raster files
Hit RETURN to cancel request
>
<>
OPTION:    Automatically run script file
           key: script
required: NO
enter option >
FLAG: Set the following flag?
Enable writing to script files?(y/n) [n]
FLAG: Set the following flag?
   Use site category as Z value?(y/n) [n] Initial load of data:  Loading data:  Done.
elevation range: 3165.000000 to 4097.000000 Done.

See 12: ssg3d.3.gif:
recalculating normals...100
recalculating normals...100 200 300 recalculating normals...100
recalculating normals...100 200 300 recalculating normals...100
LEFT MOUSE BUTTON to mark center of scale ESCAPE key to cancel
<scale set>
LEFT MOUSE BUTTON to mark center of scale ESCAPE key to cancel
<scale set>
LEFT MOUSE BUTTON to mark first letter of label ESCAPE key to cancel
<label set>
LEFT MOUSE BUTTON to mark first letter of label
ESCAPE key to cancel
<label set>
LEFT MOUSE BUTTON to mark first letter of label ESCAPE key to cancel
<label set>
LEFT MOUSE BUTTON to mark first letter of label ESCAPE key to cancel
<label set>
LEFT MOUSE BUTTON to mark first letter of label ESCAPE key to cancel
<label set>
```

GRASS 4.1 > exit

```
GRASS 4.1 >

GRASS SESSION WRAPUP
You have just finished working on mapset: <schwehr>
The following RASTER maps belong to it:
 kildem    skil12n2  skil12n4  skil12n7
There are no VECTOR maps in this mapset
```

```
There are no SITES maps in this mapset
Shall the mapset <schwehr> be saved? y/n [y]
Do you wish to selectively remove data files? y/n [n]
GOOD BYE from GRASS
langrenus 8% exit
langrenus 9% logout
```

The output: Figure 4: sg3d.final.gif:



1.4 Resources

This section has additional resources that one might find helpful.

1.4.1 Software

The GIS source code with installation instructions is available from the FTP site:

moon.cecer.army.mil

Grass programs are available from:

ftp://pasture.ecn.purdue.edu/pub/mccauley

1.4.2 Databases

A document that catalogs free database systems is available from:

idiom.berkeley.ca.us.

This is also posted on various newsgroups as explained in the following grassu-list announcement (information on the mailing list is provided in Section 1.4.7: GRASS Mailing List):

```
Date: Fri, 5 Aug 1994 21:35:07 -0500
>From: James Darrell McCauley <mccauley@ecn.purdue.edu>
To: grassu-list@max.cecer.army.mil
Subject: FYI: free database systems

>         Catalog of Free Database Systems
>
> This document attemts to catalog databases that are
> available without payment and with source.
>
> The latest version of the document can be ftp'ed: get
> pub/free-databases from idiom.berkeley.ca.us.
>
> I will post this document about once a month to comp.databases,
> comp.databases.object, comp.answers, and news.answers.  I will
> also post it to other groups somewhat randomly.
```

In addition here are some FTP sites with geospatial data:

```
FTP sites:

IP Number Host Name     Description
-------------------------------------------------------------------------------
130.11.48.107    ridgisd.er.usgs.gov USGS GILS (/pub/gils.txt)
130.11.48.2      isdres.er.usgs.gov  USGS FGDC, SDTS, NSDI (gdc.documents)
130.11.51.171    dis2qvarsa.er.usgs.gov     USGS Land use/cover data
130.11.51.187    waisqvarsa.er.usgs.gov     USGS WAIS source
```

```
130.11.52.55      resdgs1.er.usgs.gov USGS GIS Lab FTP site
130.11.52.92      nmdpow9.er.usgs.gov USGS NMD Tech Inst Docs (/public)
130.11.54.41      eomg.er.usgs.gov    USGS Office of Energy & Marine Geology
130.11.54.6       ncrds.er.usgs.gov   USGS Natl Coal Rescources Data System
130.118.120.28    garlock.wr.usgs.gov USGS Seismology & Tectonophysics
130.118.120.30    alum.wr.usgs.gov    USGS Fault Mapping Data
130.118.24.14     walrus.wr.usgs.gov  USGS Pacific Marine Geology
131.247.143.100   wayback.er.usgs.gov USGS Coastal Center
136.177.40.102    sedproc.cr.usgs.gov USGS Branch of Sedimentary Process
152.61.192.70     edcftp.cr.usgs.gov  USGS EDC FTP site
192.70.225.78     spectrum.xerox.com  Xerox Selected USGS data (DLG, DEM, GNIS
136.177.20.9      neis.cr.usgs.gov    USGS Global Seismology & Geomagnetism
128.111.105.65    ncgia.ucsb.edu            NCGIA reports newsletter, bib, ...
128.128.40.24     charon.er.usgs.gov  USGS COGS files, OzGIS & pointer data
136.177.48.5      greenwood.cr.usgs.gov     USGS Digitial data, Open file reports
129.229.20.254    moon.cecer.army.mil GRASS (/grass)
131.118.70.11     midget.towson.edu   IDRISI (/pub/gis)
148.129.129.10    info.census.gov           US Bureau of Census
130.11.51.209     srv1rvares.er.usgs.gov    USGS Stream Flow Data (/hcdn92)
```

1.4.3 Tutorials

A tutorial in WordPerfect format and Postcript is available at:

ftp://ftp.nps.gov/tutorial.gis/

This document contains a tutorial on various aspects of GRASS (Section 1.3). This document, with the tutorial, is available on Pirenne:

~delgado/tutor/all

In addition, the appendix includes a tutorial originally included with a Stanford workshop on GRASS usage. This document is available on Pirenne :

~delgado/tutor/stanford

There are several WWW homepages where you can get information:

http://baldrick.cecer.army.mil/grass/GRASS.main.html

http://www-leland.stanford.edu/~truk/grass/grass.index.html

1.4.4 Newsgroups

If you want a overview of GIS system, there is a Net News article posted monthly in net.answers called the GIS FAQ that answers Frequently Asked Questions (i.e. a FAQ using internet termininology) about GIS systems.

There is also a newsgroup devoted to GIs systems that frequently mentions GRASS:

comp.infowsystems.gis

1.4.5 Programming notes

Capture files were used frequently in the writing of this document: This included a recording of the typing needed to interactively accomplished a desired result.

These files, as well as graphic snapshots of various screens and display outputs are availble from Pirenne in the directory:

~schwehr/tutor/

This directory contains subdirectories with the capture and graphics snapshots needed for a particular procedure e.g.:

Registration

~schwehr/tutor/register.try1.log

~schwehr/tutor/register.gifs/*.gif

1.4.6 GIS Mailing Lists

```
Internet lists:

List Name Host Name           Send Message To List
--------------------------------------------------------------------------------
GIS-L           listserv@ubvm.cc.buffalo.edu     GIS-L@ubvm.cc.buffalo.edu
MAPS-L          listserv@uga.bitnet        MAPS-L@uga.cc.uga.edu
GOVDOC-L  listserv@psuvm.psu.edu           GOVDOC-L@psuvm.psu.edu
COASTGIS  listserv@irlearn.ucd.edu.ie
TGIS-L          listserv@ubvm.cc.buffalo.edu
UIGIS-L         listserv@ubvm.cc.buffalo.edu
GEOGRAPH  listserv@finhutc.hut.fi
IMAGRS-L  listserv@csearn.earn
INGRAFX         listserv@psuvm.psu.edu
BIONET          biosci@net.bio.net
ECOLOG-L  listserv@umdd.umd.edu
CONSBIO         listserv@uwavm.u.washington.edu
AQUA-L          listserv@vm.uoguelph.ca
MARINE-L  listserv@vm.uoguelph.ca
BEN       ben@cue.bc.ca              (botany/ecology news letter)
CP        listserv@opus.hpl.hp.com
NSDI-L          listproc@grouse.umesve.maine.edu NSDI-L@grouse.umesve.maine.edu
```

1.4.7 GRASS Mailing list

```
Date: Thu, 1 Sep 1994 06:01:02 -0500
To: grassp-list@max.cecer.army.mil
Subject: Intro to the GRASShopper lists [posted once a month]
```

About the OGI GRASS Mailing Lists
Office of Grass Integration

[This document is sent out to the GRASS Programmers' Electronic Mailing List once a month as a reminder and introduction to the list manager software.]

November 25, 1991

The Office of GRASS Integration has set up a service that will be of interest especially to those GRASS users who have access to electronic mail. We have set up two e-mail lists to foster communication between GRASS Users and GRASS Programmers. The lists work on the principle of "mail exploding" -- a user mails a note to one address, and the computer at that address "explodes" the letter, re-mailing it to everyone who subscribes to the list. Replies to the original letter generally go to the list as well (if there is general interest in the answer), but can be directed solely to the original author if desired. Both lists are also automatically preserved in an archive, and users may at any time request a file containing an archive of list messages.

These lists exist to foster communication between parties interested in the GRASS software; many CERL employees will participate in the lists, but on an infrequent and informal basis. The list will be maintained and stored on CERL computers; however, CERL will not officially monitor the content, intent, or accuracy of any messages that pass through the list. The point-of-contact for the list is:

grass-lists-owner@moon.cecer.army.mil

The list for GRASS users and friends is called "grassu" (short for "GRASS users"), while the list for programmers and system-level users is called "grassp" (short for "GRASS programmers"). Topics for discussion on the |grassu-list| may include questions about various GRASS applications, sources of (or reviews of) third-party support, and various and sundry other experiences with GRASS. |Grassp-list| topics will include discussion of the algorithms and intricacies of current GRASS programs, programming hints and ideas for new GRASS applications, and other prorgrammer-oriented issues. Note that the grassp-list is |not| the best (nor even an appropriate) place to report suspected bugs in GRASS code; the current <bug.report.sh> program and correspondance with OGI are the preferred problem-report procedures.

Accessing the mailing lists

Each mailing list has two addresses. The first is the destination of messages that should be "exploded" out to all subscribers. This address takes the form of

grassu-list@moon.cecer.army.mil

for the user's list, and

grassp-list@moon.cecer.army.mil

for the programmer's lists.{1}

{footnote1:These, and all other e-mail addresses in this article, are provided in an "Internet-standard" format; different host computers might require different specifications of the address. The system administrator at each site should be able to help if the addresses here do not work as specified.}

The other important address for each list is the destination of commands to the list-management software (such as subscribe, unsubscribe, etc.). They should be sent to

grassu-request@moon.cecer.army.mil
or
grassp-request@moon.cecer.army.mil

as appropriate. Multiple commands may be included in messages. Commands may be located in the subject line or in the body of the letter, but there should be only one command per line. Upper- or lower-case letters may be used for commands, and they may be abbreviated to simply the first three letters if desired. All commands are acknowledged with return e-mail.

Commands that the server will accept are:

HELp

This command mails back a copy of the list's help file from the archive directory.

PINg

This command "pings" the mailing list, causing a simple "I'm alive" response to be returned. This is a good way to check the list's address, to check if the list is reachable from your machine, and to check if the list is up and running. This command is meant to be an alternative to mailing a message to the everyone on the list asking "Is the list working" and so forth.

SUBscribe [name]

This command adds [name] to the mailing list. The subscriber's e-mail address is taken from the "From:" line of the subscription letter, and this address is what is added to the list. The [name] parameter is is used to specify the user's real name.

UNSubscribe

This command removes the user's subscription from the list. It relies on the "From:" field of the request letter. If this address does not match any name in the list, the software will notify the sender and the CERL list-maintainer, who will resolve the problem by hand.

WHO [address]

If no [address] option is given, this command returns a sorted list of list subscribers. If [address] is supplied, the software searches for a user with that address and returns that user's name.

DIRectory

This command returns the mailing list's archive directory. The primary purpose of this is to see which list-archive files are

available. The list software will mail back a list of available files.

GET [file]

This command returns the named [file] from the list's archive directory. Case and spelling are important; the name must |exactly| match a file shown by the "DIR" command. A message acknowledging the request will be mailed to the user.

If the file is short, the user will simply receive a copy of it in mail. For example, the command "GET LOG" (capitalization of "LOG" is important) will cause the list-server to mail back a copy of the most recent messages to the list (which are always stored in the file named "LOG").

If the file is very long, the list server software will <uuencode> the file and split it into several mail-sized chunks. ("Uuencode" and "uudecode" are common UNIX programs to encode files for e-mail transport. The local computer must have the <uudecode> program in order to decode these files. The acknowledgement note will inform the user how many chunks to expect, and each chunk will have a subject line that specifies "filename: part X of Y".

Examples of List Usage

To "ping" the list (i.e. check that it is functioning and reachable from your computer):

Send a mail message to:

grassu-request@moon.cecer.army.mil

In the subject or the message body, type "PING" or "ping" or "pin" (without the quotes; case is unimportant and only the first three letters of commands are significant). The list server will reply with a brief "I'm here" message. To ping the programmer's list, substitute "grassp" for "grassu" in the address above.

To subscribe to one of the lists:

Send a mail message to either

grassu-request@moon.cecer.army.mil
or
grassp-request@moon.cecer.army.mil

with "subscribe [yourname]" in the subject or body. Replace [yourname] with your real name. The list will add the e-mail address that it finds in the "From:" field of your letter.

Summary

These two lists are provided by OGI as a service for the GRASS community; we hope that they will prove to be useful resources. We encourage you to try several commands to experiment with the lists. If there are any questions, feel free to send mail to

grass-lists-owner@moon.cecer.army.mil

```
or contact the OGI by phone or mail.
```

1.4.8 Useful Information obtained from the Mailing List Archive:

During the VPE GRASS installation, the programmer (Kurt Schwehr) made use of the GRASS mailing list to obtain good information on a variety of topics:

1.4.8.1 Compiling Grass on IRIX 5:

Compiled versions of GRASS can be found at the location:

file://ftp.regis.berkeley.edu/pub/grass/grass-src.tar.Z and

file://ftp.regis.berkeley.edu/pub/grass/grass-axp-binaries.tar.Z

Notes on compiling it:

```
Date: Thu, 11 Aug 1994 13:51:12 -0500
>From: Bill Brown <brown@diego.cecer.army.mil>
To: grassu-list@max.cecer.army.mil
Subject: Re: IRIX 5 GRASS


Kurt,

I compiled GRASS for IRIX 5.2 a few weeks ago.  Here's my compilation
notes:

------------------------------------------------------------------------
A few compile problems:

To fix the i.points, i.ortho.photo, i.vpoints problem:
make the function "screen" in the files "mark.c" a non-static function.
(Just delete the keyword "static" where the function is defined)
These files need to get this fix:
src/imagery/i.points/mark.c
src.alpha/imagery/i.ortho.photo/photo.2image/mark.c
src.alpha/imagery/i.ortho.photo/photo.2target/mark.c
src.alpha/imagery/i.vpoints/mark.c

To compile xgrass, I needed to use these XCFLAGS:
```

```
XCFLAGS              = -D_NO_PROTO -DXM_1_1_BC -Umips
```

To compile v.digit, I needed to remove this dependancy from the Gmakefile:
menus.o: menus.i

Everything else compiled OK.

xdigit did not work correctly when run. To fix I added this test in the function init_graphics() in the file src/xgrass/xdigit/draw.c : (~line 76)

```
    if(XtIsRealized(canvas)){
   /* ...body of function... */
    }
```

This is the head file I used:

```
CC                   = cc
ARCH                 = sgi5

GISBASE              = /GRASS.bin/4.1/sgi5
UNIX_BIN             = /usr/local/bin

DEFAULT_DATABASE     = /data/foghorn/4.0
DEFAULT_LOCATION     = spearfish

COMPILE_FLAGS        = -O -cckr
LDFLAGS              = -s

XCFLAGS              = -D_NO_PROTO -DXM_1_1_BC -Umips
XLDFLAGS             = -lPW
XINCPATH             =
XMINCPATH            =
XLIBPATH             =
XTLIBPATH            = -L/usr/lib
XMLIBPATH            = -L/usr/lib
XLIB                 = -lX11
XTLIB                = -lXt
XMLIB                = -lXm
XEXTRALIBS           = -lPW

TERMLIB              = -ltermlib
CURSES               = -lcurses $(TERMLIB)
MATHLIB              = -lm

#                    LIBRULE = ar ruv $@ $?
#                    LIBRULE = ar ruv $@ $?; ranlib $@
#                    LIBRULE = ar ruv $@ $?; ar ts $@
#                    LIBRULE = ar rc $@ `lorder $(OBJ) | tsort`
LIBRULE              = ar ruv $@ $?

USE_TERMIO           = -DUSE_TERMIO
USE_MTIO             = -DUSE_MTIO
USE_FTIME            =
DIGITFLAGS           = -DUSE_SETREUID -DUSE_SETEUID -DUSE_SETPRIORITY
VECTLIBFLAGS         =
GETHOSTNAME          = -DGETHOSTNAME_OK
```

```
XDRLIB = -lsun
```

1.4.8.2 Mars Data

```
From: Bill Brown <brown@diego.cecer.army.mil>

> Also, is there a way to let grass georeference stuff on mars
> or will I have to stick to keeping the data in xy?

I guess it depends somewhat on what it looks like now, but I had
some Mars data in a lat-long location & it seemed to work OK.
(see http://www.cecer.army.mil/grass/viz/global.html)
```

1.4.8.3 Searching through the grassu-list archives

```
Newsgroups: info.grass.user
>From: ront@picea.CNR.ColoState.EDU (Ronald Thomas)
Subject: Re: Grassu archives searching?
Date: Fri, 12 Aug 1994 13:09:12 GMT
Apparently-To: grassu-list@max.cecer.army.mil

>is there any way to search ?through the grassu-list archives at
>the max.cecer.army.mil site?
>Many problems haunting a grass novice were probably grilled there
>zillions of times.
>Cheerio, Ania

Don't know about searching achives on the "moon"; best bet is to retrieve
the achives and search at your own site.  Your comments about some
questions being asked (& answered) over & over are right on.

Here is a script I use to query a copy of the archives that I keep:
---------------------------------------
#!/bin/sh
#This script "grassu94" searches for a 'keyword' in the following
# file:  grassu.92.gz.  If it finds whatever you requested, the
# script then prints that line or lines out on the terminal.  If it doesn't
# find what you asked for, the script will tell you that it can't be found.
# usage: grassu94 'keyword'
if test $# -gt 0
then
  arg="$*"
  gzcat $HOME/mail/grassu.94.gz | grep -i -n "$arg" | more
  es=$?
  if test $es = '0'
  then
    exit 0
  else
    echo "$*" not found in grassu.94 file.
    exit 1
  fi
else
  echo You have not entered anything to look up.
  exit 2
fi
-----------------------
The following script file can be used to delete a LOT of extraneous header
lines that unfortunately come with the archives -- I estimate this reduces
the size of the achives by 30%.  Of course, UNIX compress of GNU gzip
should be used to keep the 'cleaned' file as small as possible, but that's
```

```
a personal decision.

----------------------
#clean
#usage: clean 'file'
ex $1 << EOF
:g/^Re/d
:g/^       id/d
:g/^  (/d
:g/^Se/d
:g/^Appar/d
:g/^X/d
:g/^In-Reply/d
:g/^Status:/d
:g/^Errors-To/d
:g/^Pre/d
:g/^From lists/d
:g/^Message/d
:g/^To:/d
:g/^From grass/d
:g/^Content/d
:g/^Organization/d
:g/^Received/d
:wq
EOF
```

1.4.8.4 Histograms

```
Date: Sun, 21 Aug 1994 02:32:29 -0500
>From: James Darrell McCauley <mccauley@ecn.purdue.edu>
Subject: histograms

>for a rast-based image on GRASS monitor, after running a GRASS d.histogram
>command, colored pie-scale histogram with category values are shown, as
>general process of GRASS. My question is .....
>Anyway, anyone help me to printout histogram graphics ?

an alternative for histograms may be to use g.gnuplot:

GRASS 4.1 > r.stats -c sample > sample.dat
GRASS 4.1 > g.gnuplot

gnuplot> set term postscript
gnuplot> set out 'sample.ps'
gnuplot> plot [1:] 'sample.dat' w i
gnuplot> quit
```

GRASS 4.1 > lp sample.ps

1.4.8.5 Color display in GRASS explained

```
Date: Mon, 22 Aug 1994 14:29:55 -0500
>From: Bill Brown <brown@diego.cecer.army.mil>
To: grassu-list@max.cecer.army.mil
Subject: Re: GRASS colors


> From: kilee@CC.UManitoba.CA
> Date: Mon, 22 Aug 94 13:02:28 CDT
```

> To: grassu-list@max.cecer.army.mil
>
> Q: In GRASS, just 0-255 integer rast-based color coding image is possible,

Using GRASS color files, you can specify values from 0-255 for EACH
of the three (red,green,blue) color components, yielding something
like 16 million possible colors. Of course, the problem comes in
trying to display your map. There are severe limitations with the
GRASS X-driver and with 256 color 8-bit monitors. But even with
24-bit displays, the GRASS X-driver still limits you to something
like 216 colors. (I understand that the tcl/tk viewer will let you
use all your available color depth). But for now, if you have a
display device capable of more colors, you could use r.out.ppm to
convert the GRASS raster file into a 24-bit ppm image, then output
that.

And just a reminder that if you're running on an SGI with 24-bit
graphics, don't overlook the IRIS monitor driver, which will give
you 3840 colors.

1.4.8.6 Running GRASS programs without starting grass

Date: Tue, 23 Aug 1994 13:11:41 +0100
To: grassu-list@max.cecer.army.mil
Subject: Re: problems in interface

>Does anyone knows how to excute GRASS command or scripts
>in external?

I wrote the following script a couple of years ago to see how this
could be done (we didn't need to in the end). I'm sure that it could
be a lot prettier but at least it's a starting point ! To find out what
the variables need to be set to on your system, it's easiest to start
grass and type "printenv |more" (assuming you use csh).

The files:

```
----------<<  grassrc_test  >>----------
GISDBASE: /data/grass
LOCATION_NAME: tyne
MAPSET: phil

----------<<  exec_grass  >>----------
#!/usr/bin/csh

set path= (/user/grass/sun4/bin /user/grass/sun4/scripts /user/grass/sun4/garden/bin
/user/grass/sun4/alpha/bin /usr/local/bin /usr/bin /usr/ucb /etc /usr/etc /usr/lib)
setenv GISBASE /user/grass/sun4
setenv GISDBASE /data/grass
setenv GISRC grassrc_test
setenv LOCATION /data/grass/tyne/phil
setenv LOCATION_NAME tyne
setenv MAPSET phil

g.list rast
```

1.4.8.7 Sample usage of r.mapcalc

>From: Firma Nieuwland <nieuwlnd@sci.kun.nl>

```
Date: Thu, 25 Aug 1994 09:09:37 +0200
To: grassu-list@max.cecer.army.mil
Subject: Re:  thresholding in GRASS

Try:

rmapcalc   output=if(input > 110 && input < 140 , a + bx , if (input>160 && input <
200, c + dx,0)
-Olga van de Veer
```

1.4.8.8 Autocad DXF files

```
Date: Fri, 26 Aug 1994 10:21:20 -0400 (EDT)
>From: preston@malibu.dst.battelle.org (Evan Preston)
Subject: DXF Files??
To: grassu-list@max.cecer.army.mil

We are working on a project that is using GRASS as well as a package called
World Toolkit (for 3D/animation).  An ideal way to display map data in this
package is by importing DXF polygons and texturing them.  So...we are looking
for anyone who may have some DXF files they would like to share (preferably
maps of the Korean Penninsula, but we'll take anything reasonable in order
to test out this concept).

Please post response or email me directly.
Evan

Evan B. Preston                          # Battelle                    #
phone:     614.424.3983                  # National Security Division   #
fax:       614.424.3776                  # 505 King Ave.                #
internet:  preston@malibu.dst.battelle.org # Columbus, Ohio  43201       #
```

1.4.8.9 Databases and GRASS

```
Date: Tue, 6 Sep 94 07:29:39 MDT
>From: susan@its.nbs.gov (Susan Stitt)
To: nsegura@halcon.dpi.udec.cl (Nelson Segura Nunez)
Subject: Data Bases and GRASS

Nelson,

Another item you may wish to be aware of is the pending availability
of L.A.S.'s version of GRASS in TCL-TK.  They have claimed that they
have created a version with an implementation of a database capability
built into the GRASS software.  This software is described below by
Gilles Clement who is president of LAS.

>Date: Fri, 8 Jul 1994 09:54:54 -0400
>From: gc@copernic.lasinc.qc.ca (Gilles Clement)
>To: grassu-list@max.cecer.army.mil
>Subject: [ANNOUNCE] tcltkgrass
>>
>A lot of people are asking about the status of tcltkgrass.  Initially, we
>thought we could have a release for mid-May.  Unfortunately, financing for the
>project was slightly delayed and we decided to redesign the software almost
>completely.  This is why we haven't been able to release any new version so
>far.  We've been working on this project for several months now and we believe
>our final beta version will be available in September 1994.
```

>
>
>This new version is entirely redesigned using object-oriented development
>technique and will have a lot of very cool new features such as: an enhanced
>bugfree superviewer, a WYSIWYG postscript output for the superviewer, a
>completely rebuilded GUI for every GRASS function, a visual interactive
>programming environment for GRASS, a new set of converters for vector, raster
>and databases, an imbedded RDBMS and georelational link capability and a
>simplification of the installation procedure.
>

>As promised, the UNIX version of tcltkgrass will be contributed to the public
>domain but the long awaited MSWindows version will be a commercial product.
>Presently, 8 sites have shown interest in acting as alpha and beta testers for
>the new version but we would like to extend that to approximately 20
>organisations.
>
>Anybody can have the opportunity to be one of the 20 alpha test sites, provided
>that their organisation is active in either development, applications or
>education of GRASS and is using either a PC with MS-Windows or a SUN
>SparcStation running SUN OS 4.0.x or a DEC DecStation running Ultrix 4.x. The
>alpha version will be available at the end of July.
>
>
>Of course, the sites using PC's will be provided with a free alpha and beta
>version.
>
>For those interested, please contact Valerie DesRoches:
>vader@copernic.lasinc.qc.ca
>
>
>L.A.S. inc.
>
>Gilles Clement, president
>
>p.s.: list of organisations interested in acting as alpha and beta testers:
>
>Organisation Scientific authority E-mail
>PNFI (Forestry Canada) Tom Moore tmoore@pnfi.forestry.ca
>DREV (National Defense) Dominic Roy droy@jupiter.drev.dnd.ca
>CAST (Un. of Arkansas) Jim Farley jim@cast.uark.edu
>USACERL (US Army) Kurt Buehler kurt@zorro.cecer.army.mil
>HQ (Qubec Hydro) Guy Moisan moisang@envir.hydro.qc.ca
>and a few private companies we can't name... :-)

1.4.8.10 New r.in.hdf Command

Date: Thu, 8 Sep 1994 14:33:36 -0500
>From: Bill Brown <brown@diego.cecer.army.mil>
To: grassu-list@max.cecer.army.mil
Subject: new r.in.hdf

I just put an updated version of r.in.hdf on moon in grass/incoming .

This latest version adds features to correctly import NASA AVHRR
data & other HDF format data that uses the HDF calibration feature.

It also allows you to list the contents of the HDF file, and select

```
random datasets from the file for importing to GRASS. (With the old
version, you had to either import only the first dataset or all datasets.)

This version also writes some of the HDF annotation & label info to
the GRASS history file.

Bill B.
```

1.5 Appendix

1.5.1 Stanford Workshop GRASS Tutorial

1.5.2 C Code Written During Installation

1.5.3 Installation Size

1.5.4 VOLINFO.TXT Mars CDROM