Geographic Resources Analysis and Support System
GRASS 4.2 Fact Sheet

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1. What is GRASS?

Baylor University is pleased to announce it is the new home for the public domain Geographic Information System (GIS) GRASS (Geographic Resource Analysis Support System). GRASS is a GIS with raster, vector, image processing, and graphics production functionality that operates in the UNIX environment through a shell, and can also work under X-Windows. GRASS has been under continuous development since 1982 and has involved a large number of federal US agencies, universities, and private companies. The core components of GRASS and the management of the integration efforts into GRASS releases were accomplished by the U.S. Army - Construction Engineering Research Laboratory (USA-CERL) in Champaign, Illinois. USA-CERL completed its last release of GRASS as version 4.1 in 1992, and provided five updates and patches to this release through 1995. A new version, GRASS 4.2, has now been released by the GRASS Research Group at Baylor University. Through coordination with USA-CERL and other GRASS development sites, the GRASS Research Group will continue to update GRASS with powerful new capabilities in future releases.

GRASS contains over 85 raster data manipulation modules, more than 40 vector data manipulation modules, over 50 modules to render images on the monitor or paper, nearly 30 multi-spectral image processing modules, 6 point data management programs, and 16 general data management. GRASS also has tools for interfacing with digitizers, scanners, and the RIM, Informix, Postgres, and Oracle databases.

2. GRASS - an open GIS

GRASS' strengths lies in several areas: 1) The simple user interface makes it an ideal platform for those learning a GIS for the first time, but it is powerful enough for expert users. An X/Motif based program called XGRASS lends a "point-and-click" interface to GRASS, where interactive windows take the place of some command line options. 2) Users wishing to write their own code can do so by examining existing source code, along with the GRASS Programmer's Manual and documented GIS libraries. This allows personal customization of the program and more sophisticated functionality to be fully integrated within GRASS.

Since GRASS is an open system, it is ideally suited for developing new software. Users can modify existing modules, create new modules, and link to other third-party software packages in GRASS. Compiling new tools in GRASS is made simple by its own set of libraries and the 'gmake' command. The only external software needed is a standard ANSI 'C' compiler and a Fortran 77 compiler for a few modules. For help in developing new modules, a programmers guide is available that describes all of the essential functions and tools needed for software development.

3. GRASS System Requirements

GRASS can be supplied in binary version or as source code to be compiled on a wide variety of host machines including SUN, Silicon Graphics, and IBM PC. Because the source code is in the 'C' programming language, it lends itself to portability across many different flavors of UNIX and operating systems including DEC Alpha OSF/1, HP UX, Linux, SCO UNIX, SGI Irix, and SUN Solaris.

In addition to the traditional UNIX versions, GRASS has also been ported to the Windows 95 and Windows NT operating systems putting the power of the GRASS GIS into the traditional PC users hands. The functionality of MS-Windows-based drawing tools is also incorporated to aid in display and generation of output maps.

Platforms on which GRASS has been tested by the GRASS Research Group:

- Linux 2.x
- SUN Solaris 2.4.x, 2.5x, 2.6x
- HP UX 9.x, 10.x
- SGI Irix 5.x
- SUN OS 4.x
- Microsoft Windows95/NT

Space requirements:

- Minimum requirements
  - 8 megabytes RAM
  - 140 megabytes hard disk space for source code
  - 120 megabytes hard disk space for compiled binaries (Linux: 40 megabytes)
  - 'C' compiler, either native or "gcc"

- Optimum requirements
  - 32 megabytes of RAM or more
  - 140 megabytes free hard disk space for source code
  - 160 megabytes free hard disk space for compiled binaries
  - 'C' compiler, either native or "gcc"
  - Motif or free Motif-clone for compiling X-GRASS
  - 100 megabytes to several gigabytes hard disk space for data

4. GRASS Documentation

A complete set of GRASS documentation is available at no cost from the GRASS Research Group website. The text includes a multi-volume User's Manual containing descriptions of all GRASS commands in the current release, a Programmer's Guide for users who wish to develop their own applications, and Installation Guide to help new users through the installation and setup process. All documentation is available in Adobe Portable Document Format (PDF), which easily allows users to view the manuals on-line or print a hard copy. The complete User's Manual is also available on-line in HTML language for interactive use.

5. Capabilities of GRASS

GRASS 4.2 is an integrated set of tools for raster, vector, image, and point data analysis. For example, GRASS 4.2 has suites of tools for complete image processing and satellite data analysis and raster-based hydrologic models, among others. Using these tools, water resource managers can use satellite rainfall data with topographic maps to develop rainfall/runoff relationships for a watershed. Environmental managers could use the sites analysis capabilities in conjunction with raster and vector data to monitor and model population demographics and trends. Quite simply, the uses of GRASS are up to the expertise and imagination of the user.

<u>Data analysis and modeling</u>

- watershed analysis and modeling
- terrain analysis
- erosion modeling
- population demographics
- business geographics
- environmental analysis
- agricultural analysis
- data development
- land use planning
- land management
- spatial visualization
- satellite image classification
- air photo interpretation
- digitizing
- map production
- statistical analysis

Raster analysis

- Cell and profile data query
- Colortable modifications
- Buffering of line structures
- Correlation / covariance analysis
- Expert system analysis
- Flow analysis
- Interpolation for missing values
- Neighborhood matrix analysis
- Raster overlay with or without weight
- Automatic rasterline and area to vector conversion
- Conversion to vector and point data format
- Reclassification of cell labels
- Resampling (resolution)
- Rescaling of cell values
- Statistical cell analysis
- Surface generation from vector lines
- Surface analysis
- Watershed generation and analysis

Vector analysis

- Contour generation from raster surface
- Conversion to raster and point data format
- Digitizing with board or on screen (scanned raster image) with mouse
- Reclassification of vector labels
- Superpositioning of vector layers

Point data analysis

- Delaunay triangulation
- Surface interpolation from spot heights
- Thiessen polygons
- Topographic analysis (curvature, slope, aspect)

Image processing

- Canonial component analysis (CCA)
- Color composite generation
- Edge detection
- Frequency filtering (Fourier, convolution matrices)
- Fourier and inverse fourier transformation
- Histogram stretching
- IHS transformation to RGB
- Image rectification (affine and polynomial transformations on raster and vector targets)
- Ortho photo rectification
- Principal component analysis (PCA)
- Radiometric corrections (Fourier)
- Resampling
- RGB to IHS transformation
- Texture oriented classification (sequential maximum a-posteriori classification)
- Shape detection
- Supervised classification (training areas, maximum likelihood)
- Unsupervised classification (minimum distance clustering, maximum likelihood)

Screen displays

- 3D surfaces
- Color assignments
- Graphical user interface
- Histogram presentation
- Raster maps
- Vector maps
- Point data maps
- Zoom / Unzoom function

DTM Analysis

- Cost / path analysis
- Slope / aspect analysis
- Contour generation
- Surface generation from spot heights or contours

Map creation

- PPM-image maps
- Postscript maps
- Gif image production
- MPEG-type animation

Extra modules

- Erosion modeling (AGNPS, ANSWERS)
- Landscape structure analysis
- Solution transport
- Watershed and flood analysis (SWAT)
- Wildfire prediction

6. GRASS Data File Formats

One of the main functions of any GIS is integrating and formatting external data. Many data formats can be imported into GRASS, or they can be converted by other programs such as "xv" or "netpbm-tools" before importing. GRASS can also export data to many of these formats for use in other programs.

Data formats recognized by GRASS:

Raster

- PPM
- TIFF
- TGA
- USGS DEM
- DMA DTED
- PPM/3
- GIF
- SUN-Raster
- ASCII

Image

- ERDAS
- NHAP
- BIL
- SPOT
- LANDSAT MSS
- LANDSAT TM
- BSQ
- standard Raster formats

Vector

- ARC/INFO
- DLG
- IDRISI
- TIGER
- ASCII
- DXF
- MOSS

Sites

- ASCII

7. Projections and coordinate systems supported by GRASS

GRASS 4.2 allows different options for coordinate systems and projections. GRASS offers predefined projections, as well as the possibility to define a new geodetic projection.

The supported ellipsoids in GRASS are:
airy, australian, bessel, clark66, clark80, everest, grs67, grs80, hayford, hough, iau76, international, krassovsky, merit, mercury, modified airy, modified everest, modified merc, new international, SEasia, sphere, walbeck, wgs66, wgs72, and wgs84.

Projection can be defined in the following coordinate systems:
Latitude-Longitude, UTM, State Plane, Albers equal area, Lambert conformal conic, Mercator, and transverse Mercator (for Gauss-Krueger).