



Free Open Source Software for Geoinformatics (FOSS4G)

A Practical Example – System for Automated Geoscientific Analyses (SAGA)

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Give a Basic Introduction to Free and Open Source Software (FOSS)

Give an Overview on FOSS for Geoinformatics (FOSS4G)

Talk on SAGA and Introduce the Basic Concepts of Software

A Basic Introduction to Free and Open Source Software (FOSS)



GNU



“Free software is a matter of the user’s freedom to run, copy, distribute, study, change and improve the software. More precisely, it means that the programs’s users have the four essential freedoms:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this”.

-from the Free Software Definition
<http://www.gnu.org/philosophy/free-sw.html>



The Open Source Geospatial Foundation (OSGeo) was created to support the collaborative development of open source geospatial software, and promote its widespread use.

- The FOSS4G was first coined in early 2004 as an acronym for Free and Open Source Software for Geoinformatics by a research group working on I18N of GRASS and MapServer
- The name of an event hosted today by the Open Source Geospatial Foundation
- Open source geospatial software refers to GIS, GPS, spatial data management and related developer tools and end user applications delivered with an open source license.
- The name FOSS4G is not registered as a trademark



FOSS4G 2013 will be in Nottingham

FOSS4G Explosion

Desktop Applications

ade4 in R



ANN: A Library for
Approximate Nearest Neighbor Searching

Statistical Computing

Geospatial Libraries and Database



Web Mapping

Introduction to Basic Concepts of SAGA

SAGA – Basic Information – What is SAGA

SAGA is the abbreviation for System for Automated Geoscientific Analyses

SAGA is a Geographical Information System (GIS) desktop software

SAGA supports the implementation of new functions with a very effective Application Programming Interface (API)

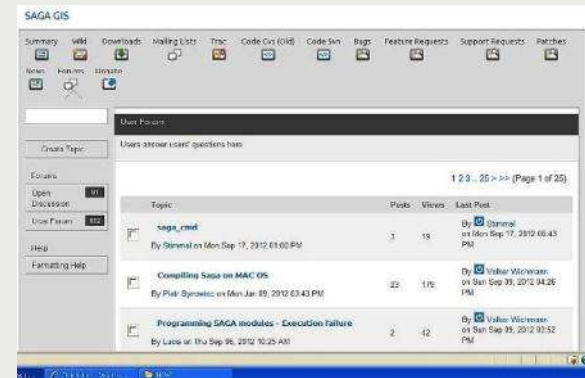
SAGA is a comprehensive, growing set of geoscientific methods for geodata processing and analysis

SAGA is programmed in the object-oriented C++ language

SAGA is a Free Open Source Software (FOSS)

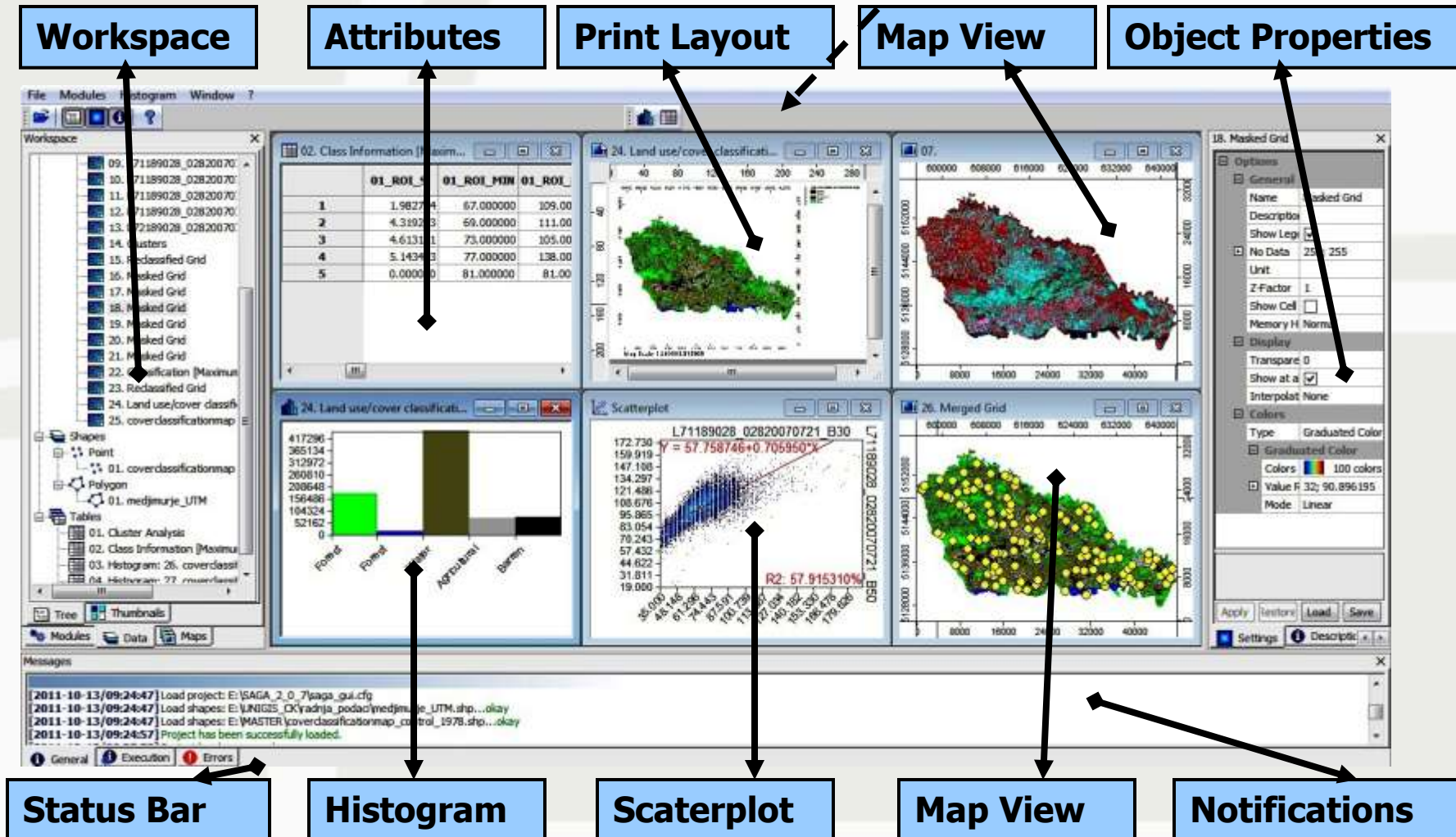
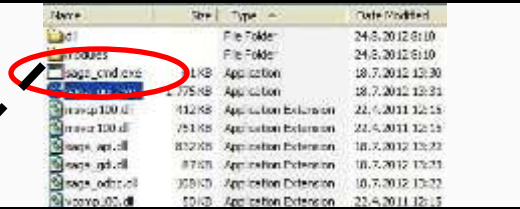
SAGA runs under Windows, Linux and FreeBSD operating systems

SAGA functions are organized as modules and can be accessed via GUI or various scripting environments

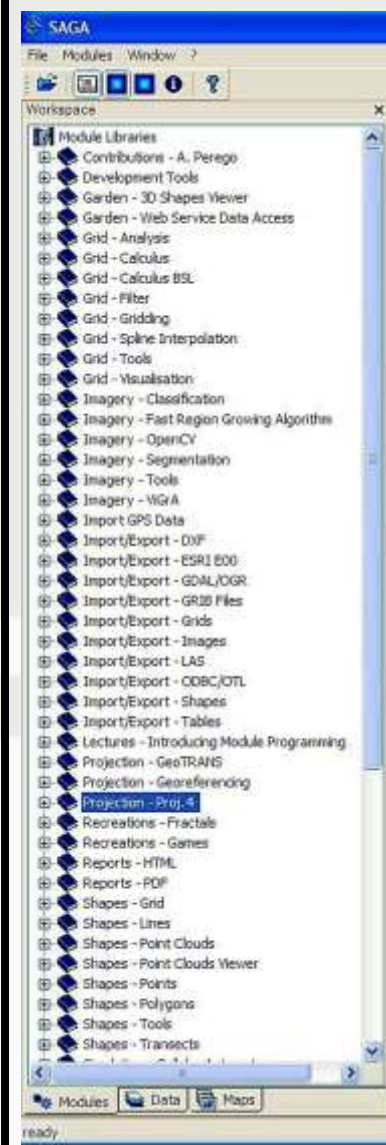


SAGA – Basic Information – Graphical User Interface


SAGA is a so-called portable software, there is no installation routines. Just download, unzip files and start "saga_gui.exe".




SAGA – Basic Information – Graphical User Interface



Modules

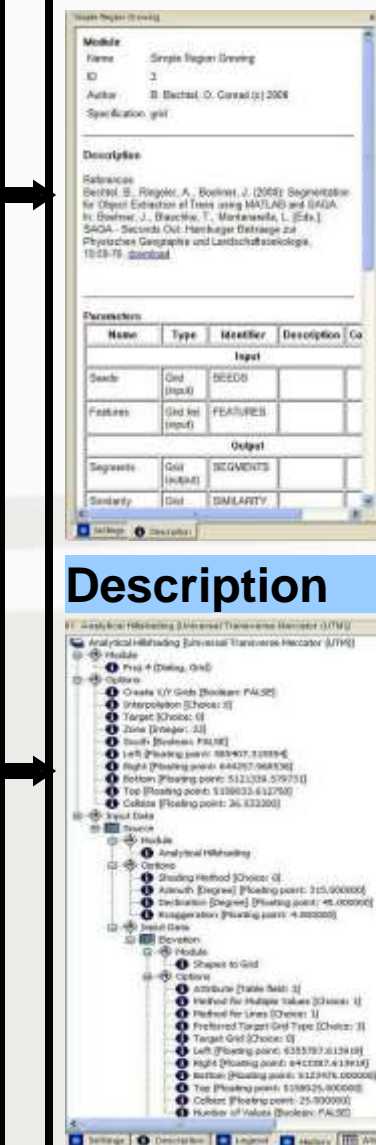


Data

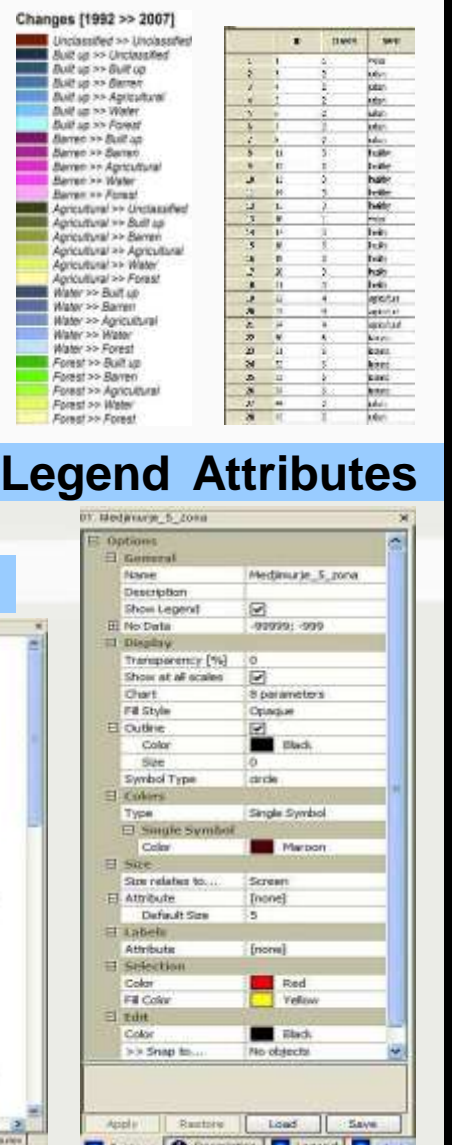


Maps

Notifications, Messages




Tree



Thumbnails

Description

Legend Attributes



Settings

History

A comprehensive and growing set of free modules and libraries, some of them represents the state of the art in their field of analysis

Saga v1.2 2005 – 34 libraries and 119 modules (as FOSS)

Saga v2.0.0, 2007 – 42 libraries and 234 modules

Saga v2.0.3, 2008 – 48 libraries and 300 modules

Saga v2.0.4 2009 – 49 libraries and 330 modules

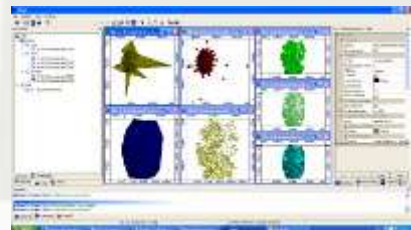
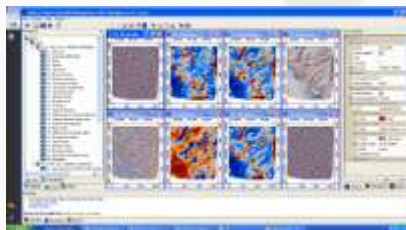
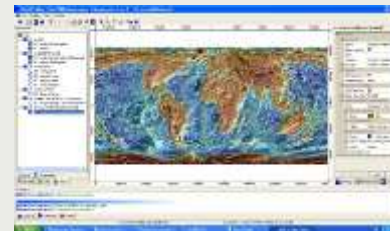
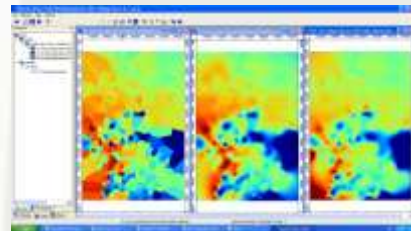
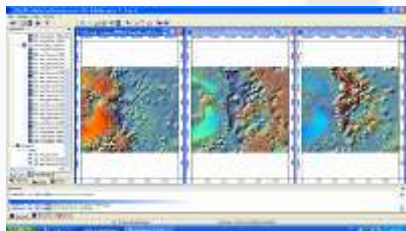
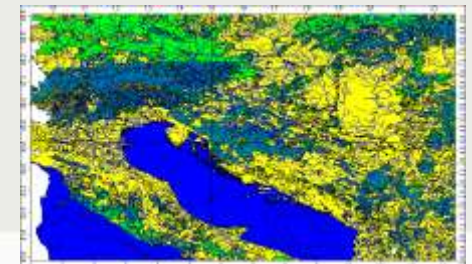
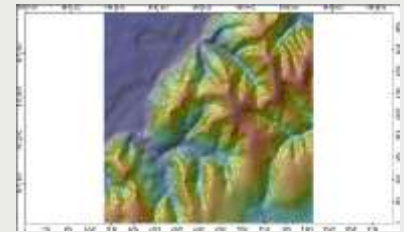
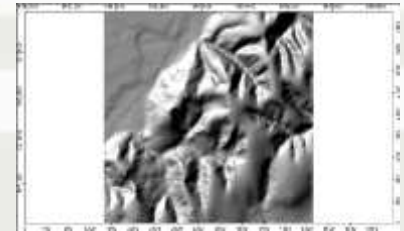
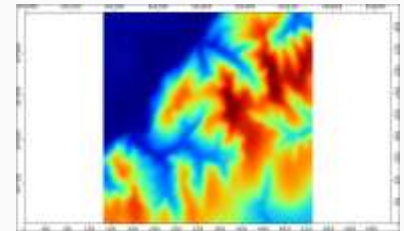
Saga v2.0.5, 2010 – 56 libraries and 401 modules

Saga v2.0.7, 2011 – 63 libraries and 447 modules

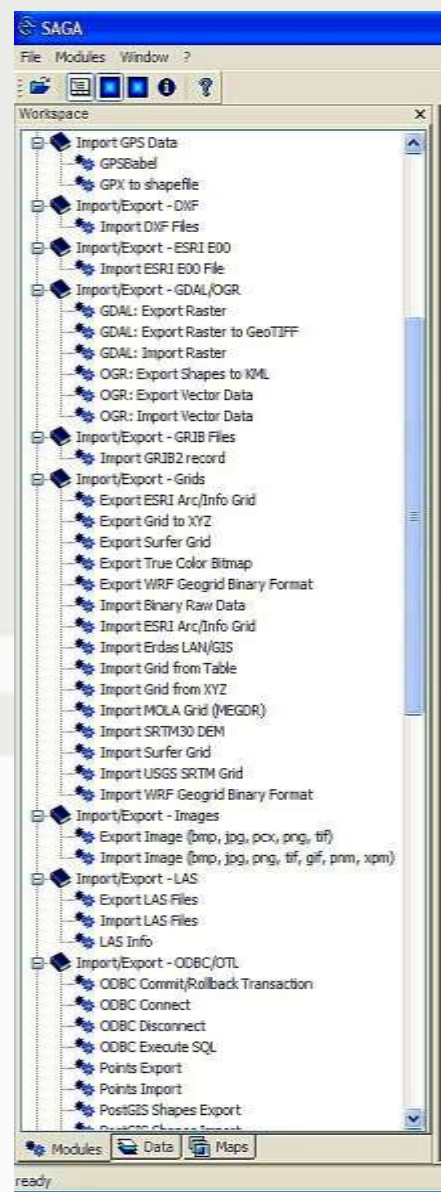
Saga v2.0.8, 2012 – 64 libraries and 469 modules

Saga v2.1 2012 – 65 libraries and 516 modules (beta)

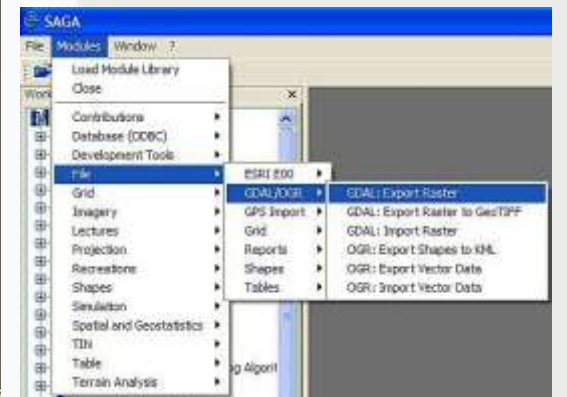
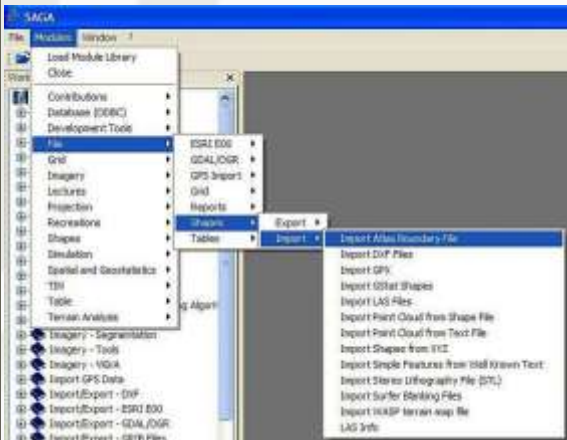
SAGA was created and developed by group of scientists from the Göttingen University and scilands GmbH Göttingen.



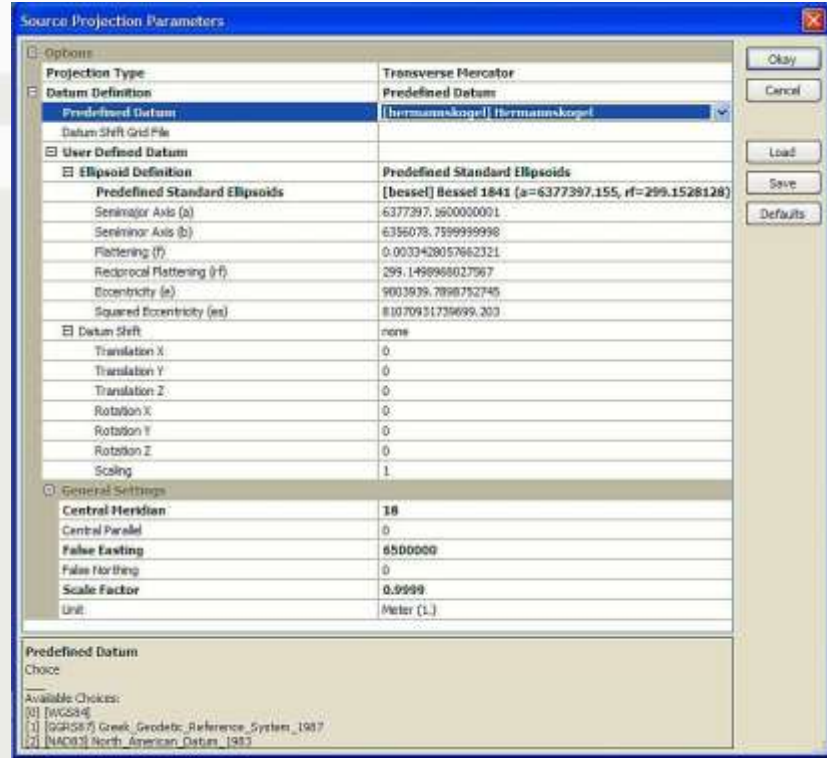
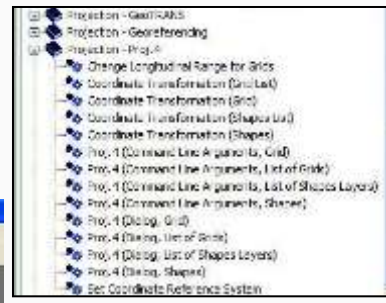
SAGA – GDAL and PROJ.4 Libraries



A library for reading and writing a variety of geospatial raster and vector formats



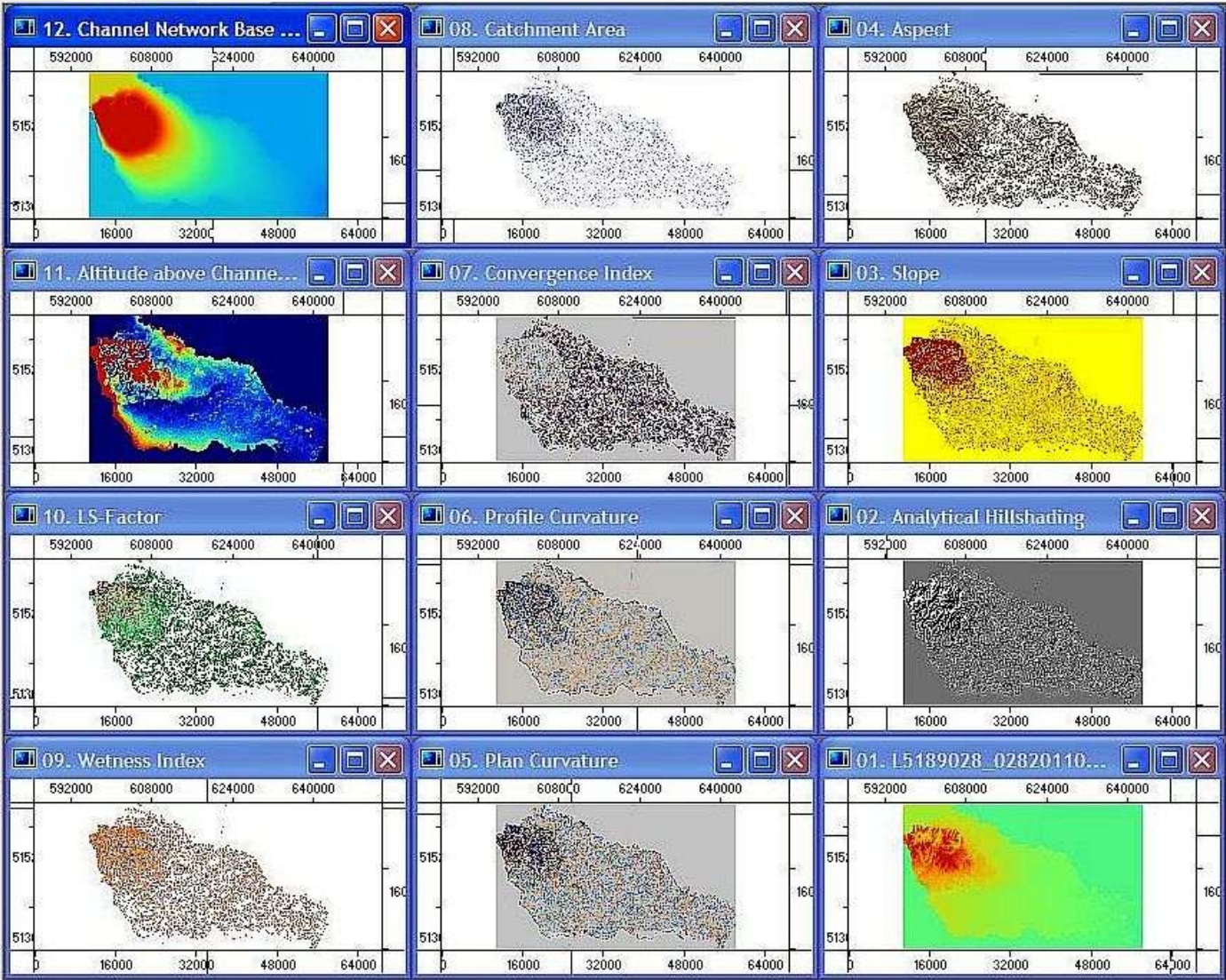
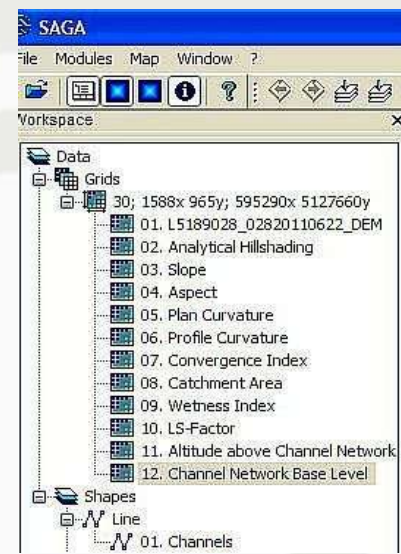
Cartographic Projections Library



SAGA (Automated) – Basic Terrain Analysis

- Terrain Analysis - Channels
- Terrain Analysis - Compound Analyses
 - Basic Terrain Analysis
- Terrain Analysis - Hydrology
- Terrain Analysis - Lighting, Visibility
- Terrain Analysis - Morphometry
- Terrain Analysis - Preprocessing
- Terrain Analysis - Profiles

A selection of basic parameters and objects to be derived from a Digital Terrain Model using standard settings



SAGA – Pan Sharpening

- Imagery - Tools
 - Colour Normalized Brovey Sharpening
 - Colour Normalized Spectral Sharpening
 - Enhanced Vegetation Index
 - IHS Sharpening**
 - Principle Components Based Image Sharpening
 - Tasseled Cap Transformation
 - Vegetation Index (Distance Based)
 - Vegetation Index (Slope Based)

IHS Sharpening

Grids

Grid system

>> Red

>> Green

>> Blue

High Resolution Grid System

>> Panchromatic Channel

<< Red

<< Green

<< Blue

Options

Resampling

Panchromatic Channel Merging

30; 1338x 965y; 595290x 512760y
06. L72189028_02820070721_B70
04. L71189028_02820070721_B40
02. L71189028_02820070721_B20
15; 3179x 1931y; 595260x 5127645y
01. L72189028_02820070721_B80
[create]
[create]
[create]

nearest neighbour

nearest neighbour

bilinear

cubic convolution

Okay

Cancel

Load

Save

Defaults

Module

Name

IHS Sharpening

ID

4

Author

O.Conrad (c) 2011

Specification

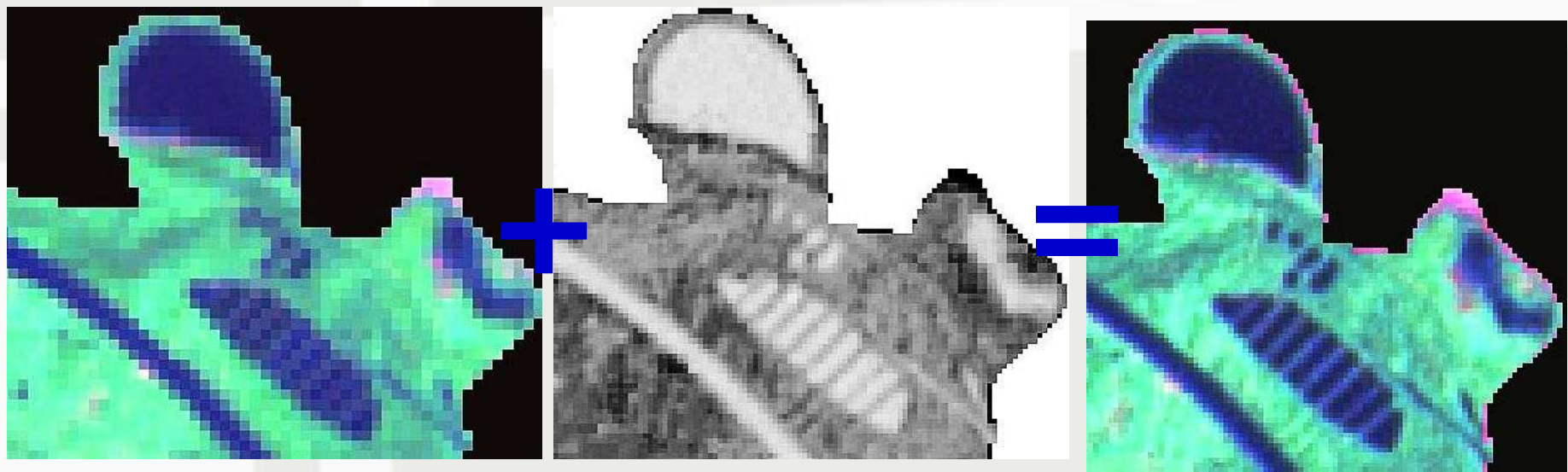
grid

Description

Intensity, hue, saturation (IHS) sharpening.

References:

Haydn, R., Dalke, G. W., Henkel, J., Bare, J. E. (1982): Application of the IHS color transform to the processing of multisensor data and image enhancement. Proceedings of the International Symposium on Remote Sensing of Arid and Semi-Arid Lands, Cairo, Egypt (Environmental Research Institute, Ann Arbor, Mich., 1982), pp. 599-616.

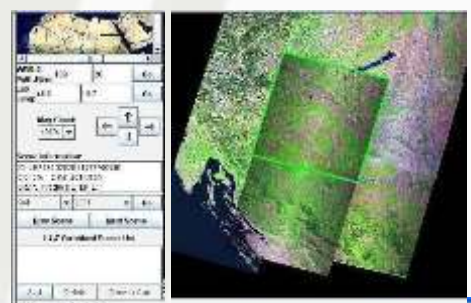


SAGA – Grids, Landsat, SRTM

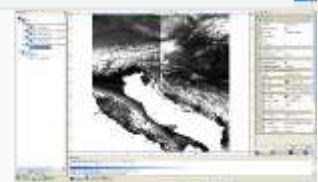
- Terrain Analysis - Compound Analyses
 - Basic Terrain Analysis
- Terrain Analysis - Hydrology
 - Analytical Hillshading
 - Potential Incoming Solar Radiation
 - Sky View Factor
 - Topographic Correction
 - Topographic Openness
 - Visibility (single point) [Interactive]

- Grid - Visualisation
 - Color Blending
 - Color Palette Rotation
 - Color Triangle Composite
 - Create 3D Image
 - Fit Color Palette to Grid Values
 - Histogram Surface
 - RGB Composite

- Grid - Tools
 - Aggregate
 - Change Cell Values [Interactive]
 - Change Grid Values - Flood Fill [Inter]
 - Close Gaps
 - Close Gaps with Spline
 - Close Gaps with Stepwise Resampling
 - Close One Cell Gaps
 - Combine Grids
 - Convert Data Storage Type
 - Create Constant Grid
 - Create Grid System
 - Crop to Data
 - Cutting [Interactive]
 - Grid Buffer
 - Grid Masking
 - Grid Orientation
 - Grid Proximity Buffer
 - Grid Shrink/Expand
 - Grid Value Request [Interactive]
 - Grids from classified grid and table
 - Invert Data/No-Data
 - Mosaicking
 - Patching
 - Proximity Grid
 - Reclassify Grid Values
 - Resampling
 - Sort Grid
 - Threshold Buffer
 - Tiling



Landsat Satellite Imagery Shuttle Radar Topography Mission Free Available Data Sets



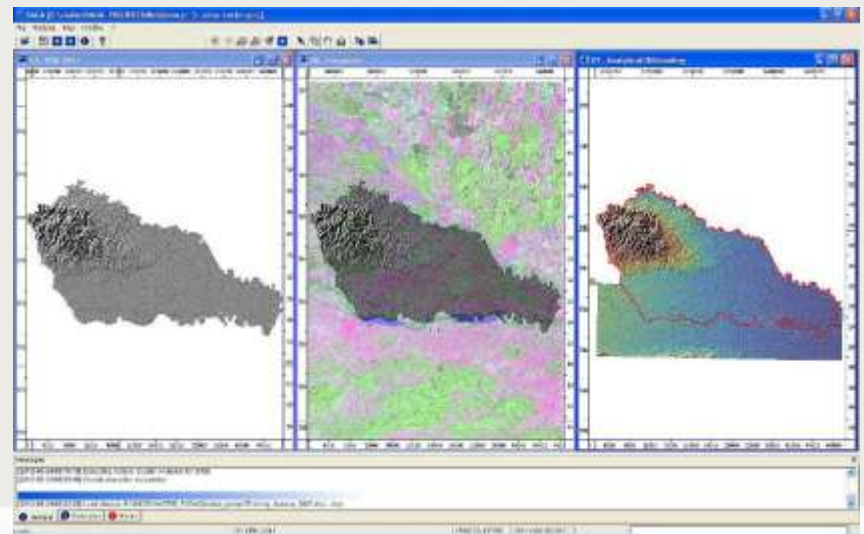
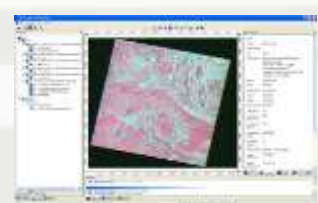
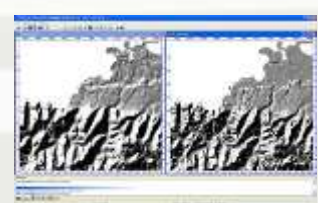
RGB 3,2,1



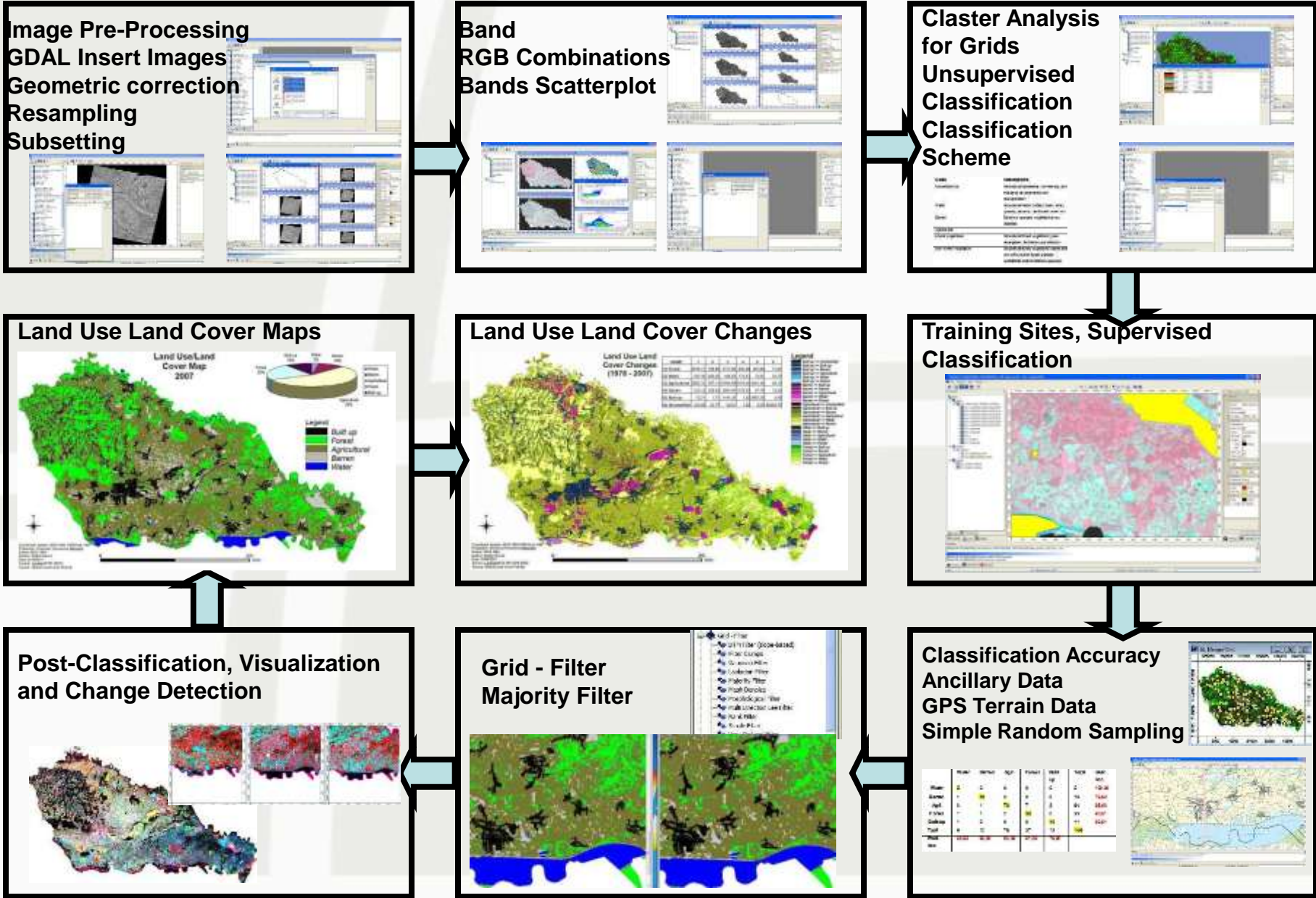
RGB 4,3,2



RGB 7,4,2



SAGA – Unsupervised and Supervised Classification, Change Detection



SAGA – Modules and Functions

Geostatistics Analysis

- Spatial and Geostatistics - Grids
 - Directional Statistics for Single Grid
 - Fast Representativeness
 - Global Moran's I for Grids
 - Inverse Principle Components Rotation
 - Multi-Band Variation
 - Principle Components Analysis
 - Radius of Variance (Grid)
 - Representativeness (Grid)
 - Residual Analysis (Grid)
 - Statistics for Grids
 - Zonal Grid Statistics
- Spatial and Geostatistics - Kriging
 - Ordinary Kriging
 - Ordinary Kriging (Global)
 - Ordinary Kriging (VF)
 - Ordinary Kriging (VF, Global)
 - Universal Kriging
 - Universal Kriging (Global)
 - Universal Kriging (VF)
 - Universal Kriging (VF, Global)
 - Variogram (Dialog))
- Spatial and Geostatistics - Points
 - Minimum Distance Analysis
 - Spatial Point Pattern Analysis
 - Variogram
 - Variogram Cloud
 - Variogram Surface
- Spatial and Geostatistics - Regression
 - Geographically Weighted Multiple Regression
 - Geographically Weighted Multiple Regression (Point)
 - Geographically Weighted Multiple Regression (Point)
 - Geographically Weighted Regression
 - Geographically Weighted Regression (Points/Grid)
 - Multiple Regression Analysis (Grid/Grids)
 - Multiple Regression Analysis (Points/Grids)
 - Polynomial Regression
 - Regression Analysis (Points/Grid)

Terrain Analysis

- Terrain Analysis - Morphometry
 - Convergence Index
 - Convergence Index (Search Radius)
 - Curvature Classification
 - Digital Anisotropic Hedging
 - Downslope Distance Gradient
 - Efficiency for Flow Heights
 - Hypsometry
 - Land Surface Temperature
 - Mass Balance Index
 - Morphometric Protection Index
 - Multiresolution Index of Valley Bottom Flatness (MIVISF)
 - Road Surface Area
 - Relative Height and Slope Positions
 - Slope, Aspect, Curvature
 - Surface Specific Points
 - TPI Based Landform Classification
 - Terrain Rugosity Index (TRI)
 - Terrain Surface Classification
 - Terrain Surface Convexity
 - Terrain Surface Texture
 - Topographic Position Index (TPI)
 - Vector Rugosity Measure (VRM)
 - Wind Effect (Windward / Leeward Index)
- Terrain Analysis - Processing
 - Burn Stream Network into DEM
 - Fill Sinks (Panchang/Danielson, 2003)
 - Fill Sinks (Yang & Li)
 - Fill Sinks 3D (Yang & Li)
 - Flat Detection
 - Sink Drainage Route Detection
 - Sink Removal
- Terrain Analysis - Profiles
 - Cross Profiles
 - Flow Path Profile (Interactive)
 - Profile (Interactive)
 - Profile from points
 - Profile from Lines
 - Depth Profile (Interactive)
- Terrain Analysis - Channels
 - Channel Network
 - Channel Network and Drainage Basin
 - Overland Flow Distance to Channel Network
 - Wetted Order
 - Vertical Distance to Channel Network
 - Watershed Basins
 - Watershed Basins (Extended)
- Terrain Analysis - Compound Analysis
 - Basic Terrain Analysis
- Terrain Analysis - Hydrology
 - Catchment Area (Flow Tracing)
 - Catchment Area (Plus-Plus Method)
 - Catchment Area (Parallel)
 - Catchment Area (Recursive)
 - Cell Balance
 - Downslope Area (Interactive)
 - Flow Depth (Interactive)
 - Flow Path Length
 - Flow Severity (Interactive)
 - Flow Width and Specific Catchment Area
 - Isobars Constant Speed (Interactive)
 - Isobars Variable Speed (Interactive)
 - Li Factor
 - Lake Flood
 - Lake Flood (Interactive)
 - Melton Rugosity Number
 - Grass Potential Index
 - Slope Length
 - Stream Power Index
 - Isobars Constant Speed (Interactive)
 - Isobars Variable Speed (Interactive)
 - Li Factor
 - Lake Flood
 - Lake Flood (Interactive)
 - Melton Rugosity Number
 - Grass Potential Index
 - Slope Length
 - Stream Power Index
 - Topographic Wetness Index (TWI)
 - Upslope Area
 - Upslope Area (Interactive)
- Terrain Analysis - Lighting, Visibility
 - Analytical Hillshading
 - Potential Incoming Solar Radiation
 - Sky View Factor
 - Topographic Correction
 - Topographic Openness
 - Visibility: Monte Carlo Simulation

Grid Analysis, Filters, Calculs...

- Grid - Analysis
 - Accumulated Cost (Anisotropic)
 - Accumulated Cost (Isotropic)
 - Aggregation Index
 - Analytical Hierarchy Process
 - Change Vector Analysis
 - Covered Distance
 - Cross-Classification and Tabulation
 - Fracturation (Alternative)
 - Fracturation (Standard)
 - Fracturation: Classes from Density and Connectivity
 - Layer of extreme value
 - Least Cost Path (Interactive)
 - Least Cost Path
 - Ordered Weighted Averaging (OWA)
 - Pattern Analysis
 - Soil Texture Classification
- Grid - Calculs
 - Function
 - Fuzzy
 - Fuzzy Intersection (AND)
 - Fuzzy Union (OR)
 - Geometric Points
 - Gradient Vector from Cartesian to Polar Coordinates
 - Gradient Vector from Polar to Cartesian Coordinates
 - Grid Calculator
 - Grid Difference
 - Grid Division
 - Grid Normalization
 - Grid Standardization
 - Grid Value
 - Grids Product
 - Grids Sum
 - Matrix Conversion
 - Polynomial Trend from Grids
 - Random Field
 - Random Terrain Generation
- Grid - Calculs 3D
 - 3D
 - 3D from File
- Grid - Filter
 - DTM Filter (slope-based)
 - Filter Clumps
 - Gaussian Filter
 - Laplacian Filter
 - Majority Filter
 - Median Denoise
 - Morphological Filter
 - Multi Direction Low Filter
 - Rank Filter
 - Single Filter
 - User Defined Filter
- Grid - Gridding
 - Inverse Distance Weighted
 - Kernel Density Estimation
 - Modified Quadratic Shepard
 - Natural Neighbour
 - Nearest Neighbour
 - Shapes to Grid
 - Triangulation
- Grid - Spline Interpolation
 - B-Spline Approximation
 - Cubic Spline Approximation
 - Multilevel B-Spline Interpolation
 - Multilevel B-Spline Interpolation (from Grid)
 - Thin Plate Spline (Global)
 - Thin Plate Spline (Local)
 - Thin Plate Spline (TIN)
- Grid - Tools
 - Grid - Visualization
 - Color Blending
 - Color Palette Rotation
 - Color Triangle Composite
 - Create 3D Image
 - Fit Color Palette to Grid Values
 - Histogram Surface
 - RGB Composite

Imagery Classification, Tools...

- Grid - Visualisation
- Imagery - Classification
 - Change Detection
 - Cluster Analysis for Grids
 - Decision Tree
 - Supervised Classification
 - Supervised Classification for Polygons
- Imagery - Fast Region Growing Algorithm
 - Fast Region Growing Algorithm
- Imagery - OpenCV
 - OpenCV - Basic Morphological Operations
 - OpenCV - Fourier Transformation
 - OpenCV - Single Value Decomposition
- Imagery - Segmentation
 - Grid Skeletonization
 - Seed Generation
 - Simple Region Growing
 - Watershed Segmentation
- Imagery - Tools
 - Colour Normalized Brovey Sharpening
 - Colour Normalized Spectral Sharpening
 - Enhanced Vegetation Index
 - IHS Sharpening
 - Principle Components Based Image Sharpening
 - Tasseled Cap Transformation
 - Vegetation Index (Distance Based)
 - Vegetation Index (Slope Based)
- Imagery - ViGrA
 - ViGrA - Basic Morphological Operations
 - ViGrA - Distance
 - ViGrA - Edge Detection
 - ViGrA - Fourier Filter
 - ViGrA - Fourier Transform
 - ViGrA - Fourier Transform (Real)
 - ViGrA - Fourier Transform Inverse
 - ViGrA - Smoothing
 - ViGrA - Watershed Segmentation

Sources, Documentations, Examples

Conrad, O. (2006): SAGA - Program Structure and Current State of Implementation. in: Böhner, J., McCloy, K.R. & Strobl, J. [Hrsg.]: SAGA - Analysis and Modelling Applications. Göttinger Geographische Abhandlungen, Bd.115, S.39-5., Available at: <http://www.saga-gis.org/en/about/references.html>

Cimmery, V. (2007-2010): An introduction to the graphical user interface of SAGA, Volume 1., and "How To" information on many SAGA modules, functions, and GIS applications, Volume 2, Available at: <http://www.saga-gis.org/en/about/references.html>

Victor Olaya, A Gentle Introduction to SAGA GIS., Available at: <http://volaya.es/pdf/SagaManual.pdf>

Murray Brown, Very impressive and useful series of exercises which includes the basic tools for making maps of marine and coastal areas with SAGA, Available at: <http://marinedataliteracy.org>

<http://www.saga-gis.org>

<http://sourceforge.net/projects/saga-gis>

<http://www.opengeospatial.org/>

<http://www.osgeo.org/>

<http://live.osgeo.org/en/index.html>

<http://www.cgiar-csi.org/>

<http://glcf.umiaccs.umd.edu/>

<http://glovis.usgs.gov/>

Over the last decade there has been an explosion in the numbers of users and developers of FOSS for Geoinformatics.

FOSS4G is increasingly gaining in importance, and has become a kind of alternative to the proprietary (closed) software.

SAGA is fast growing “child” of the FOSS4G family.

SAGA offers a comprehensive set of free geoscientific modules and libraries, some of them represents the state of the art in their field of analysis, and such functions are difficult to find in other FOSS programs.

Try FOSS4G (any), use them, make changes to the software, share your new knowledge with OSS community, solve your GIS tasks, make money with FOSS.

Thank you for your attention!

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<http://www.zlatkohorvat.com>