Open Source GIS in India: Present Scenario

T. V. Ramachandra @ CiSTUP. CST and CES, IISc, 16th Nov 2009

Centre for *Infrastructure*, Sustainable Transportation and Urban Planning [C*i*STUP]
Indian Institute of Science, Bangalore, OSGEO (India), KSCST, IISc Campus

Open Source GIS @ IISc
Recap of our Journey

- Discussion at CES R No 215, during June and Oct 2000 (Prasad and TVR)

- Date: Thu, 26 Jul 2001 05:30:56 +0100 (BST), Narendra Prasad" narendra_prasad@yahoo.com
- Subject: Re: From SN Prasad

My dear Ramachandra,
I am happy to inform you that the GRASS proposal was approved by MOEnF on 24 .They have agreed to Rs 2 lacs only. You have to somehow adjust the inst. charges. Detailed MOU will be sent to you soon.

- Prasad—

2002 --→

Date: Mon, 14 Jan 2002 04:32:35 +0000 (GMT)

- From: "[iso-8859-1] Narendra Prasad" <narendra_prasad@yahoo.com>
- To: Dr. T.V. Ramachandra cestvr@ces.iisc.ernet.in

My dear Ramachandra,

Thanks for the progress report. I am really sorry that you have so far not received the funds. I will find out from Coimbatore the reason and will get back to you. Pl continue the project as planned as approvals are already there for payments. There has been a major bungling as usual from the MOEn F on release of funds and I suspect that is the reason you got no response. Did you sign the MOU?. Pl Inform

- Thanks - Prasad--- "

- Dr. T.V. Ramachandra" <cestvr@ces.iisc.ernet.in> wrote: >

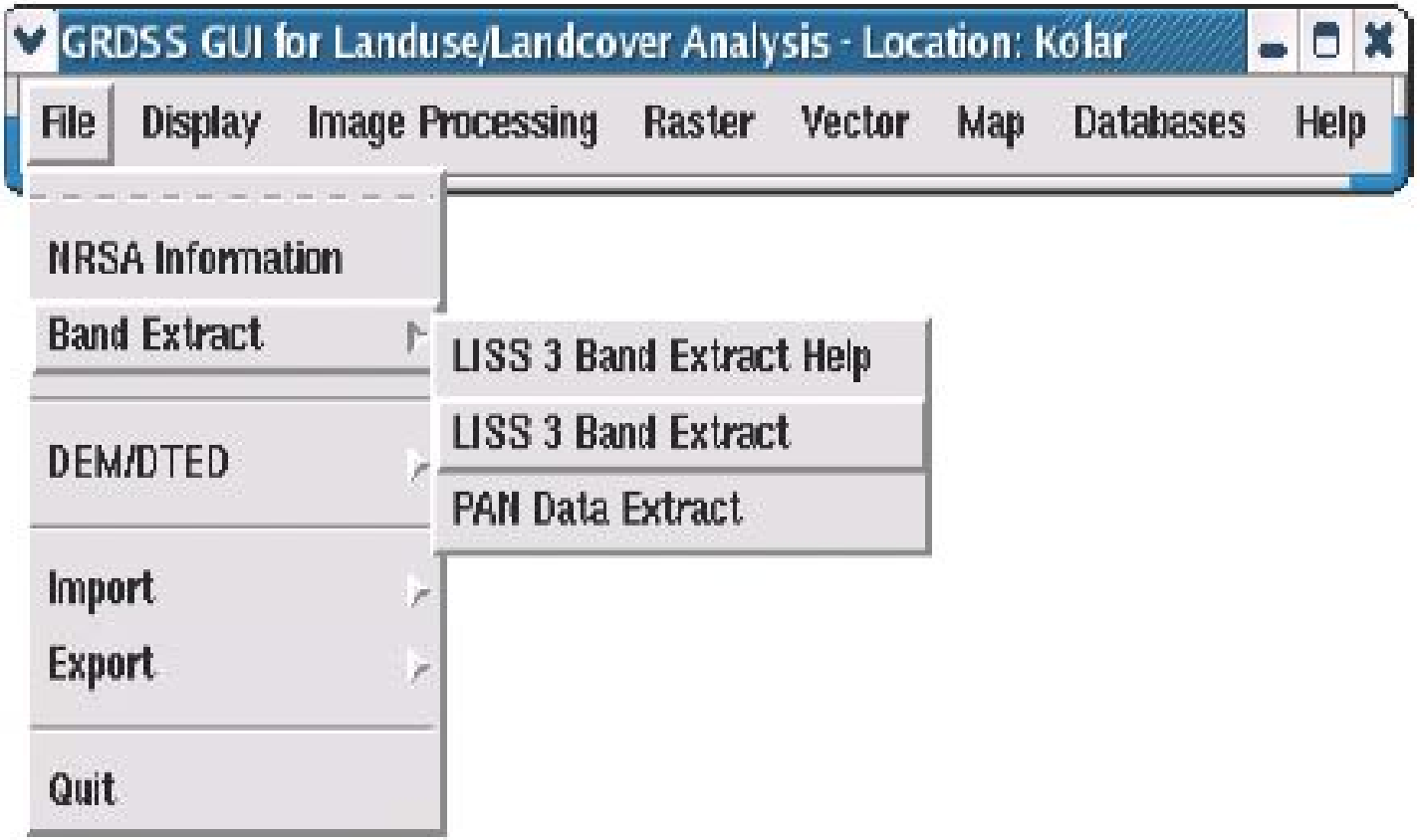
- Dear Dr. Prasad

This is just to keep you updated. Report is attached detailing the progress of work. I have also attached the training report. I have not heard from Dr.Vijayan so far. Please advice.

with best regards

tvr

GRDSS – ß version



2002 – Training

- Date: Fri, 30 Aug 2002 06:20:37 +0100 (BST)
- From: "[iso-8859-1] Narendra Prasad" narendra_prasad@yahoo.com
- Subject: Re: Mr.Viashnav's visit to Dehradun
-
- My dear Ramachandra,

If Mr Vaishnav can visit any time in the second week. The GRASS loaded in the laptop cannot be accessed as the user name as well as the password are refused!.I hope vaishnav can reload the linux as well as the GRASS

Prasad---
"Dr. T.V. Ramachandra" <cestvr@ces.iisc.ernet.in> wrote: > Dear Dr.Prasad

-

Mr.Vaishnav has made significant progress in the project and has included PostGRE sql. As per our earlier discussion, he plans to visit Dehradun in IInd week of September. Please confirm - the dates as per your convenience.

with best regards

tvr

Dec 2003 – GRASS mirror site @ IISc

- Date: Thu, 11 Dec 2003 05:22:37 +0000 (GMT), From: "[iso-8859-1] Narendra Prasad" narendra_prasad@yahoo.com
- My dear Ramachandra ,
- It was very nice that GRASS mirror site is at CES.Congratulations. I have some suggestions .I am planning to be in CES on 15 for this purpose only. Your mail came in the right time for me!!.I will reach –if my morning flight from Delhi comes at right time-CES by 10.30 or so and will be there till afternoon. If you have any good BE/ME student in water resources to work for wetlands project(mainly hydrology aspects) and also willing to do Ph.D, pl let me know. The project is for three years and is on the UP wetlands.

Congratulations once again and with best wishes - Prasad

"Dr. T.V. Ramachandra" cestvr@ces.iisc.ernet.in wrote: >
Dear Dr.Prasad

INDIAN SITE for GRASS is set up at CES http://wgbis.ces.iisc.ernet.in/grass/

We plan to place the GUI developed at CES at this site . You may also see the front page

http://wgbis.ces.iisc.ernet.in/grass/Welcome.html

GRASS GIS - The World Leading Free Software GIS - Windows Internet Explorer

http://wgbis.ces.iisc.ernet.in/grass/index.php

File Edit View Favorites Tools Help

Favorites | GRASS GIS - The World Leading Free Software GIS | Page | Safety | Tools

Welcome to GRASS GIS

You are at an official GRASS site (other mirror sites)
This site is updated daily: 14 Nov 2009

Search

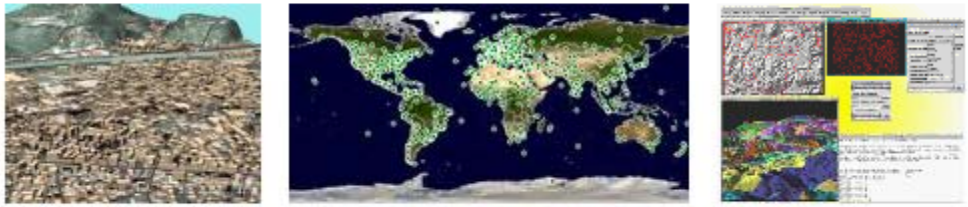
Advanced search

Home | Intro | Docs | Download | Community | Applications | Development

- About GRASS
- Screenshots
- Download
- Wiki - help site | FAQ
- Mirror sites
- Mailing lists | IRC
- Translating
- Newsletter
- Get involved!
- GRASS in the Press
- Bug/Feature trackers

Donate

Celebrating 25 years!



GRASS User map (without pop-up)

Geographic Resources Analysis Support System

Commonly referred to as GRASS, this is free Geographic Information System (GIS) software used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualizatio GRASS is currently used in academic and commercial settings around the world, as well as by many government agencies and environmental consulting companies. GRASS is an official project of the Open Source Geospatial Foundation.

Module of the day:

v.univar.sh Calculates univariate statistics on selected table

2004, 2005 .....Knowledge sharing..

1. Ramachandra T.V., Uttam Kumar, Vaishnav B and Prasad S.N., 2004. Geographic Resources Decision Support System – an open source GIS, Geospatial Today, 3(3): 52-59
2. Ramachandra T.V. and Uttam Kumar, 2004. Geographic resources decision support system for land use land cover dynamics analysis, FOSS/GRASS 2004 Conference, 12-14 sept 2004, Bangkok, Thailand.
3. T. V. Ramachandra, S. N. Prasad, Uttam Kumar and Vaishnav B (2005). GRASS Applications in Land use/Land cover assessments. Paper presented at Workshop on Free and Open Source Software, Geological Survey of India, Southern Region, 17-18 May, Hyderabad, pp2-4.

Date: Wed, 19 Jan 2005 06:40:10 +0000 (GMT)
From: Narendra Prasad <narendra_prasad@yahoo.com>
Subject: Re: Thanks for the Geospptial&Lake2002

My dear Ramachandra,
Many thanks for the Geospatial Today featuring GRDSS. It is well written and hopefully we will get people to use it.

- **Regards – Prasad**

http://wgbis.ces.iisc.ernet.in/grass/welcome.html

Geographic Resources Analysis Support System

Welcome to Open Source GIS in India

GRASS Mirror

GRASS GUI (Under Construction)

Access Statistics

GRASS Team

GRASS Contact

Suggestion

Centre for Ecolgical Sciences,
Indian Institute of Science,
Bangalore 560012,
Karnataka, India
Email: grass@ces.iisc.ernet.in

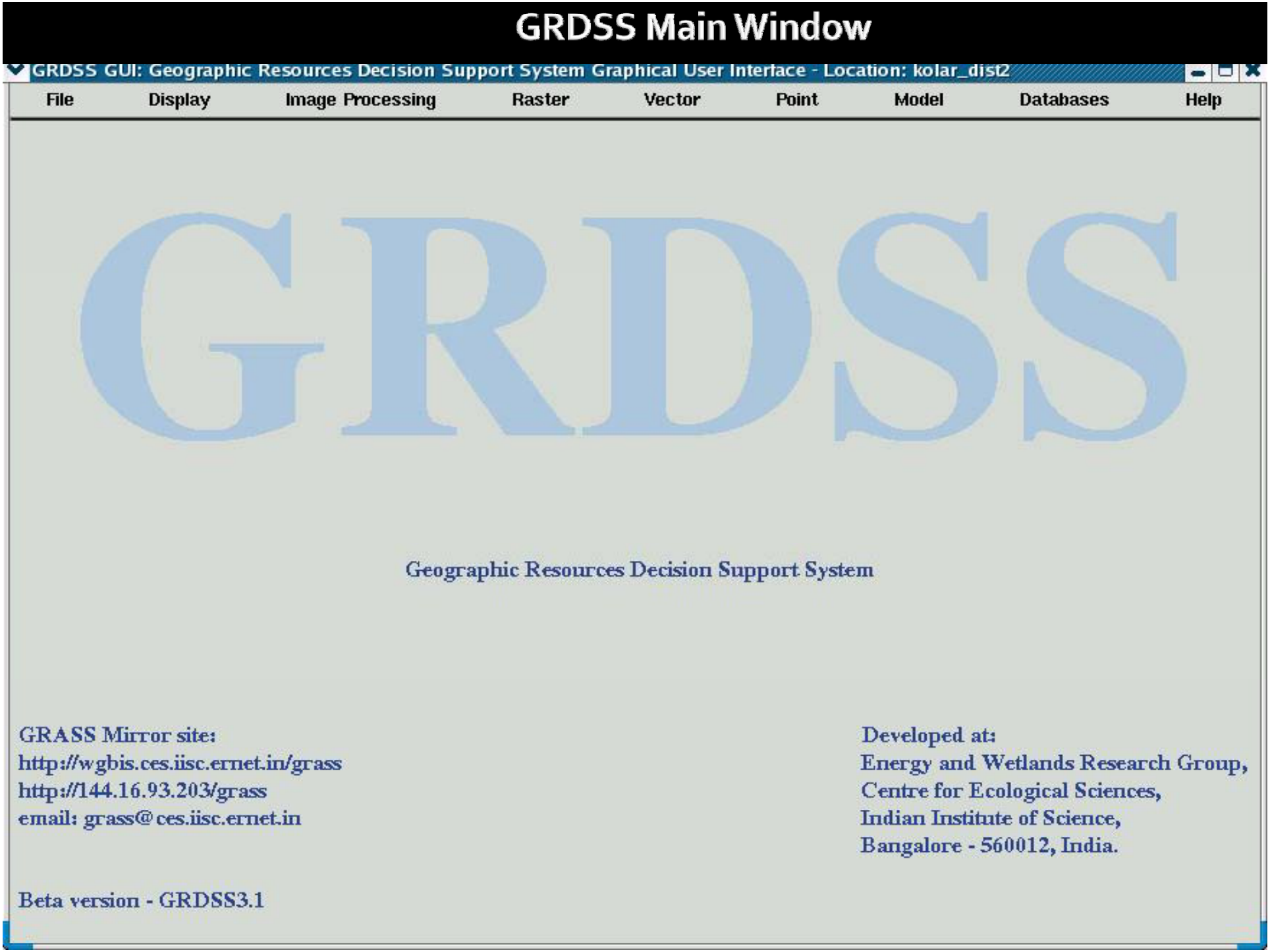
http://wgbis.ces.iisc.ernet.in/grass

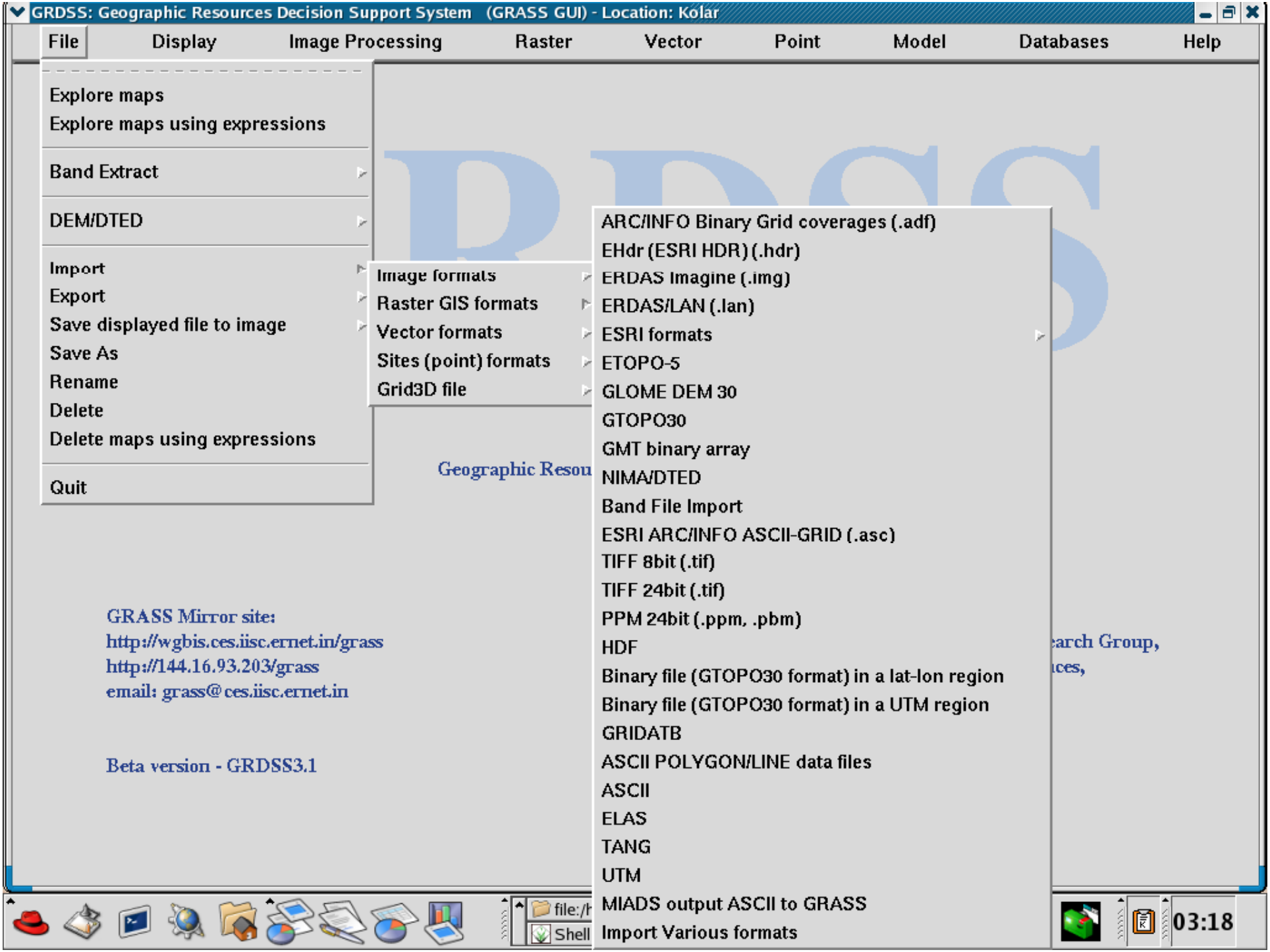
http://144.16.93.203/grass

Visitor No (Since 24 Dec 2003): 4,301

Email GRASS Sahyadri ENVIS Energy CES IISc Email

GRDSS Main Window




GRDSS: Geographic Resources Decision Support System (GRASS GUI) - Location: Kolar
File
Display
Image Processing
Raster
Vector
Point
Model
Databases
Help
Explore maps
Explore maps using expressions
Band Extract
DEM/DTED
Import
Export
Save displayed file to image
Save As
Rename
Delete
Delete maps using expressions
Quit
Image formats
Raster GIS formats
Vector formats
Sites (point) formats
Grid3D file
ARC/INFO Binary Grid coverages (.adf)
EHdr (ESRI HDR) (.hdr)
ERDAS Imagine (.img)
ERDAS/LAN (.lan)
ESRI formats
ETOPO-5
GLOME DEM 30
GTOPO30
GMT binary array
NIMA/DTED
Band File Import
ESRI ARC/INFO ASCII-GRID (.asc)
TIFF 8bit (.tif)
TIFF 24bit (.tif)
PPM 24bit (.ppm, .pbm)
HDF
Binary file (GTOPO30 format) in a lat-lon region
Binary file (GTOPO30 format) in a UTM region
GRIDATB
ASCII POLYGON/LINE data files
ASCII
ELAS
TANG
UTM
MIADS output ASCII to GRASS
Import Various formats
Geographic Resou
GRASS Mirror site:
http://wgbis.ces.iisc.ernet.in/grass
http://144.16.93.203/grass
email: grass@ces.iisc.ernet.in
Beta version - GRDSS3.1
03:18

2006 – Uttam, MS joins IISc for Ph.D

- Date: sat, 7 jan 2006 07:09:51 +0000 (gmt)
- From: narendra prasad <narendra_prasad@yahoo.com>
- Subject: re: happy new year
-
- My dear Ramachandra,
- It is nice to know that uttam has rejoined you. The GSI has been waiting for the GRDSS to be available. Is there something that you can do? I would like one of Our pc's exclusively for GRASS and therefore require The whole set up(linux and grdss). I can send santosh from Hyderabad to ces for the required hands on Experience for installing grass and linux at Hyderabad. He has some basic experience on linux. Meanwhile can you pl arrange to provide link to our Wetland website www.wetlandsofindia.org from your ENVIS Website?

Best regards

Narendra prasad

PATENT /REGISTRATION - 2006

Type	Title of the work	Registration Number
Copy Left	Geographic Resources Decision Support System	SW2658/2006 Ramachandra T V, Uttam Kumar Prasad S N, Vaishnav B

STUDENTS (2002- 2009) with FOSS-

Urban sprawl pattern recognition using remote sensing	Aswathnarayana Kamal G. B.E. (computers) 2002	M.V.J. College of Engg
Urban Sprawl Pattern Recognition	Karthik S. Raj MCA, 2002	PES College of Engg, Mandya
Land use analysis using GRASS (Geographic Resources Analysis Support System), 2003	Uttam Kumar BE (Information Science) 2003	Department of Computer Science and Engineering, SJM Institute of Technology, Chitradurga.
Landscape characterization using GIS and remote sensing	Shilpa, S. B.E. (Information Science), 2004.	Information Science and Engineering, The National ,
Evaluation of Algorithms for land cover analysis using Hyperspectral data,	Uttam Kumar, 2005-06	IIRS, DEhradun and ITC Netherland
Geo-visulaisation for local resource planning – a free open source approach	Jaisen N.D. M Sc (2008)	School of Environmental Sciences M G University, Kerala
Image Fusion Techniques in Remote Sensing-Digital Image Processing	Bharath H Aithal BE (2009)	UVCE, Bangalore University

Publications -2004 to 2009

1. Ramachandra T V, 2009. Mapping of Fuelwood trees using Geoinformatics, *Renewable and Sustainable Energy Reviews*, *In Press, Uncorrected Proof*, *Available online 4 November 2009* [doi:10.1016/j.rser.2009.10.007]
2. Ramachandra T V and Uttam Kumar, 2009. Land surface temperature with land cover dynamics: multi-resolution, spatio-temporal data analysis of Greater Bangalore, International Journal of Geoinformatics, 5 (3):43-53
3. Ramachandra T. V., and Uttam Kumar, (2009). Geoinformatics for Urbanisation and Urban Sprawl pattern analysis. Chapter 19, In: Geoinformatics for Natural Resource Management (Eds. Joshi et al.). Nova Science Publishers, NY. Pp- 235-272
4. Uttam Kumar, Mukhopadhyay C and Ramachandra T V., 2009. Spatial data mining and modelling for visualisation of rapid urbanisation, SCIT Journal, 9(2): 1-9
5. Uttam Kumar, Chiranjit Mukhopadhyay, and T. V. Ramachandra, 2009. Pixel based fusion using IKONOS imagery, International Journal of Recent Trends in Engineering (Computer Science), 1(1): 178-182
6. Bharath H Aithal, Uttam Kumar, Ramachandra T V, 2009. Fusion of multi resolution remote sensing data for urban sprawl analysis, COSMAR 2009, Orgnised by MS, IISc.
7. Ramachandra T.V and Uttam Kumar, 2008. Wetlands of Greater Bangalore, India: Automatic Delineation through Pattern Classifiers, *The Greendisk Environmental Journal*. Issue 26 (International Electronic Jour. URL: (http://egj.lib.uidaho.edu/index.php/egj/article/view/3171).

Publications –

8. Uttam Kumar and Ramachandra T.V. 2008. Endmembers discrimination in MODIS using spectral angle mapper and maximum likelihood algorithms, International Journal of Applied Remote Sensing, 2(1): 2-14
9. Ramachandra, T. V. and Kumar Uttam, 2008. Decision Support System for Land Use Planning. The Icfai University Journal of Environmental Sciences, II (3): 7-19, Available at SSRN: http://ssrn.com/abstract=1187983
10. Ramachandra T.V., 2007. Geospatial Mapping of Bioenergy Potential in Karnataka, India. Journal of Energy & Environment (JEE), 6(1): 28-44.
11. Ajay Narendra and Ramachandra T.V., 2008. Remote detection and distinction of ants using nest-site specific LISS-derived Normalised Difference Vegetation Index, Asian Myrmecology Volume 2, 51 – 62
12. Ramachandra T.V., 2007. Vegetation Status in Uttara Kannada District, Mapana – Journal of Sciences, 6(1):1-26
13. Ramachandra T.V., 2007. Spatial Analysis and Characterisation of Lentic Ecosystems: A Case Study of Varthur Lake, Bangalore, International Journal of Ecology and Environment, 9(8):39-56
14. Ramachandra T.V. and Uttam Kumar, 2006. Relevance of Hyperspectral Data for Sustainable Management of Natural Resources, GIS and Development 10(4):30-36 (India)
15. Ramachandra T.V. and Uttam Kumar, 2004. Watershed Management using GRDSS, GIS and Development 8(8):20-26 (India)
16. Ramachandra T.V., Uttam Kumar, Vaishnav B and Prasad S.N., 2004. Geographic Resources Decision Support System – an open source GIS, Geospatial Today, 3(3): 52-59

OSGEO – 2006, Osgeo_discuss] OSGeo India Chapter Officers

From "Venkatesh Raghavan" <raghavan@media.osaka-cu.ac.jp>
Date: Wed, August 30, 2006 2:13 pm

- Dear All,
-
- Having had the chance to meet and discuss with most of the initial India OSGeo Chapter Members in early August, 2006, I take the liberty to propose the following members to take up the role of officers of India OSGeo Chapter.
-
- a) Co-Cordinator, India OSGeo Chapter (any volunteers or suggestion. We need somebody who can spend time keeping the wiki and India OSGeo Chapter Website updated)
- b) OSGeo Software Development Chairs (Prototyping, Localization, Proof of Concepts etc.)
- (Jitendra Shah, VJTI and T.V. Ramachandra, IISc. Hope both of you can agree to this)
- c) Regional Events Chairs (V. Ravi Kumar, GSI, Maneesh Prasad, GIS-Development. Hope both of you can agree to this)
- d) Education and Training (K.K. Surendran and N.J. Pawar. Hope both of you can agree to this)
-
- Your comments and suggestions are welcome. Look forward for some inputs from Autodesk India too. Autodesk USA and Autodesk Asia-Pacific have been greatly supporting OSGeo since its inception.
-
- Kind regards
-
- Venkatesh

Venki Visits IISc - Early August 2006

Dear Prof. Venkatesh Ragahavan

Thank you for your mail and the inclusion in OSGeo. My research group is involved actively in the development OS GIS. GRASS mirror in India is located at http://wgbis.ces.iisc.ernet.in/grass/welcome.html GRDSS developed by us is at http://wgbis.ces.iisc.ernet.in/grdss/index.php

Currently we are involved in1. working on mapping urban sprawl, understading of sprawl dynamics; this involves geospatial simulations
Developing algorithms for hyperspectral image processing. Optimal spectral and spatial resolutions for land use planning.

I suggest you to include my colleague Mr.Uttam Kumar uttam@ces.iisc.ernet.in), who had also attended the workshop organised by you. with best regards TVR

Geographic Resources DecisionSupport System

tvr@ces.iisc.ernet.in;
uttam @ces.iisc.ernet.in

E-mail: cestvr@ces.iisc.ernet.in
grass@ces.iisc.ernet.in

URL: **http://ces.iisc.ernet.in/energy/welcome.html**
Indian GRASS mirror site: **http://wgbis.ces.iisc.ernet.in/grass**

GRDSS Works with

- Linux Operating system
- PostgreSQL (Database Management System)
- TCL/TK
- C compiler

- At least 64 MB RAM for better performance is desired and around 200 MB space for compiling binaries and source code.

Why GRDSS was required ?

- GRASS is a freeware under the GNU General Public License (GPL).
- GRASS consists of more than 350 programs (in C) and tools to render maps and images on monitor and manipulate raster, vector, and sites data; process multi spectral image data; and create, manage, and store spatial data.
- Works in command line arguments.

Geographic Resources Analysis Support System - GRDSS

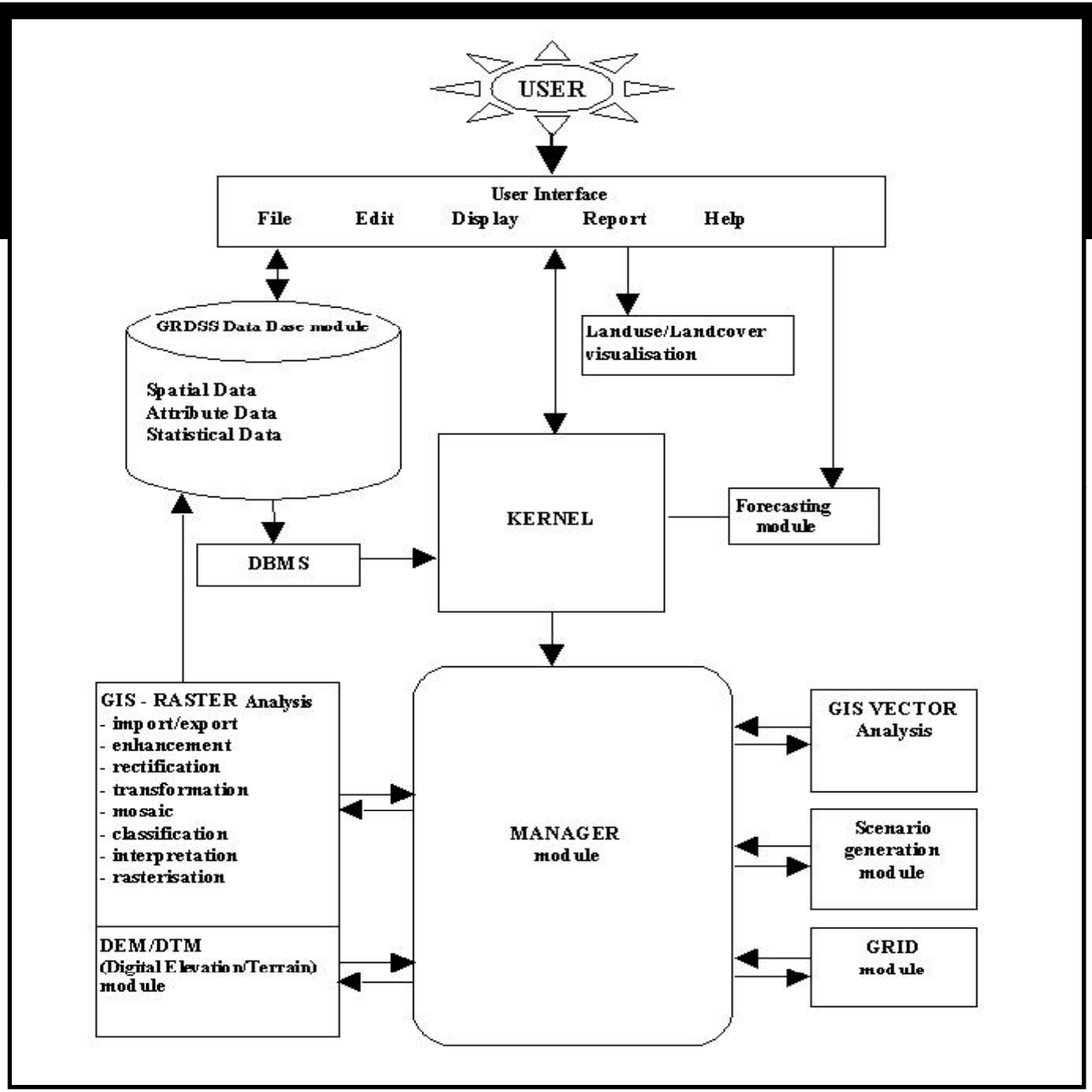
- GRDSS is a freeware under the GNU General Public License (GPL).
- GRDSS consists of more than 350 programs (in C) and tools to
  - render maps and images on monitor
  - manipulate raster, vector, and sites data
  - create, manage, and store spatial data

- GRDSS works through it's ...
- **LOCATION/MAPSET concept.**

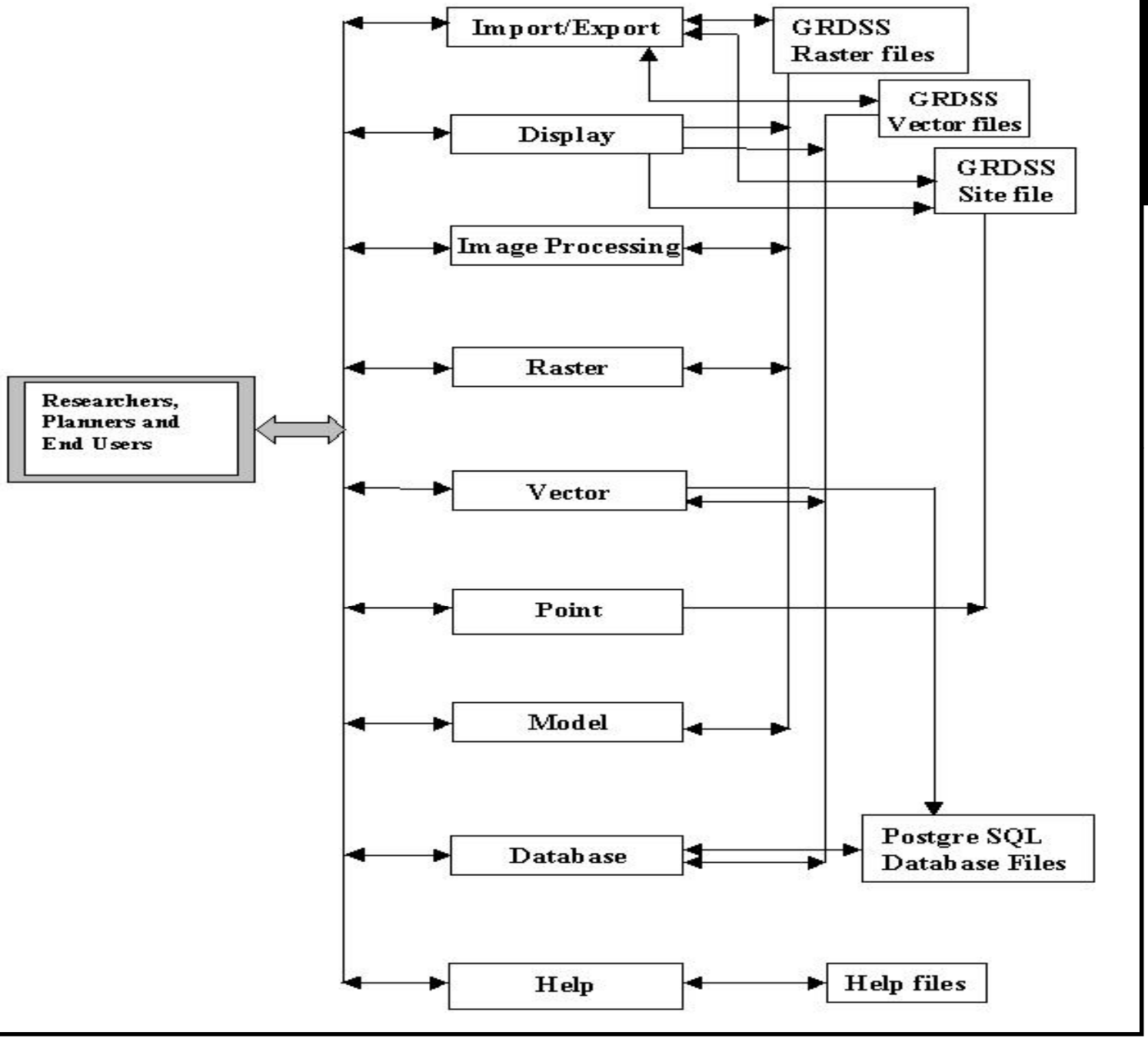
- ✓ A **"LOCATION"** is some geographic extent that contains data sets in the same coordinate system.
- ✓ **"MAPSET"** can organize GIS maps thematically or geographically or by project or whatever. Technically they are subdirectories under any location.

Functional Aspects of GRDSS

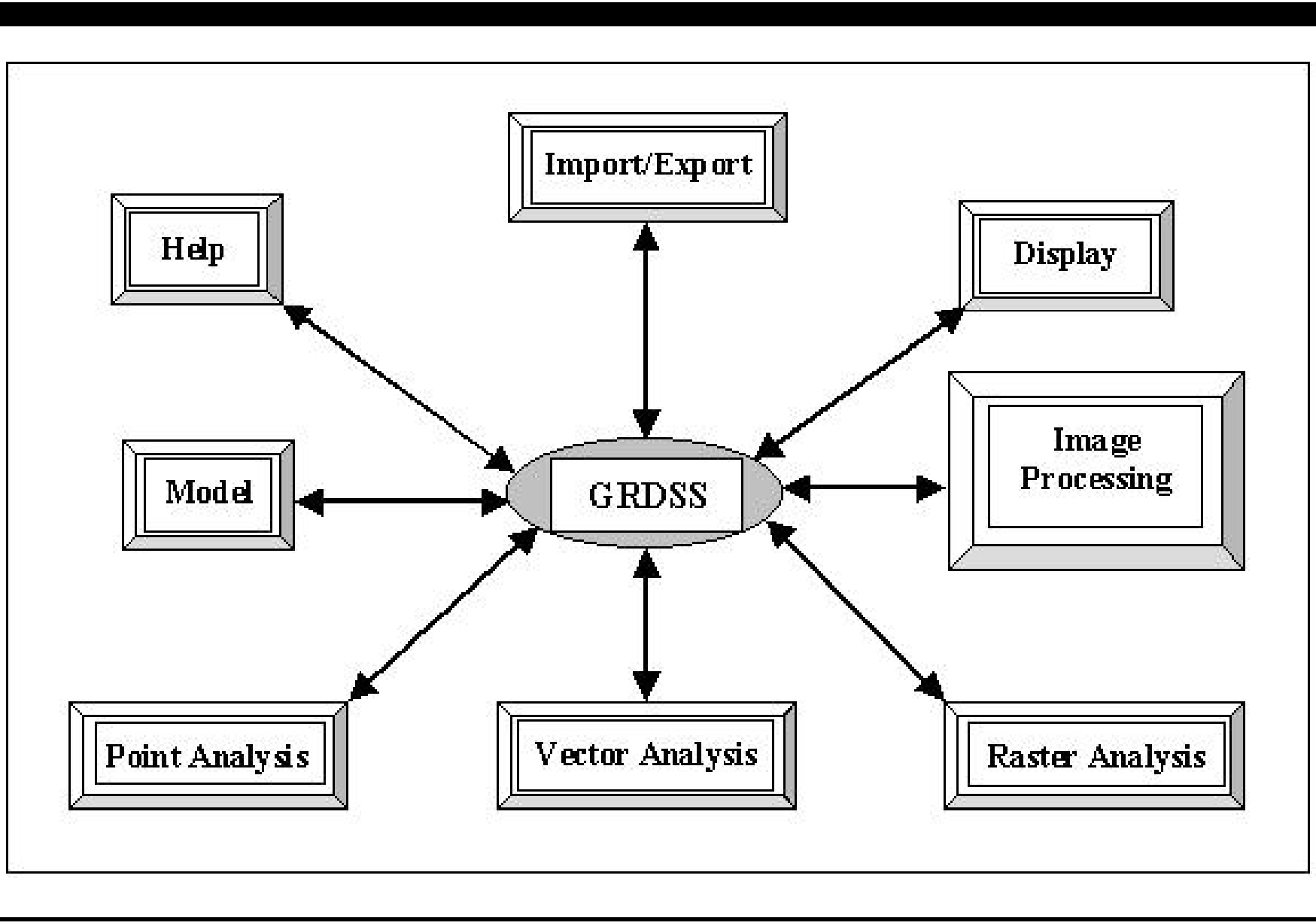
- data management
- image processing
- graphics production
- spatial modelling
- visualization of many types of data
- help policy makers and planners to take effective decision



GRDSS design and conceptual diagram.



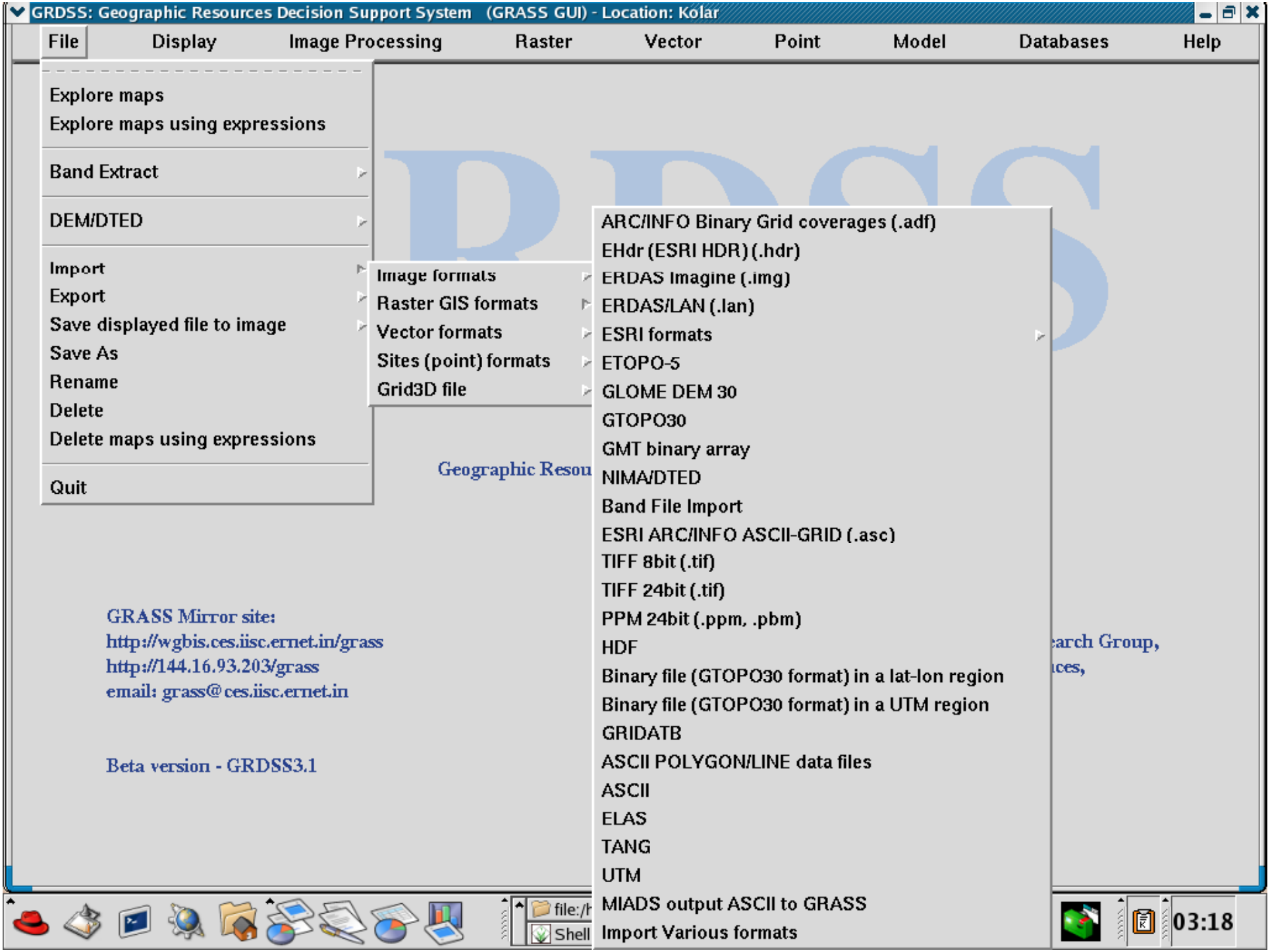
GRDSS data flow diagram.

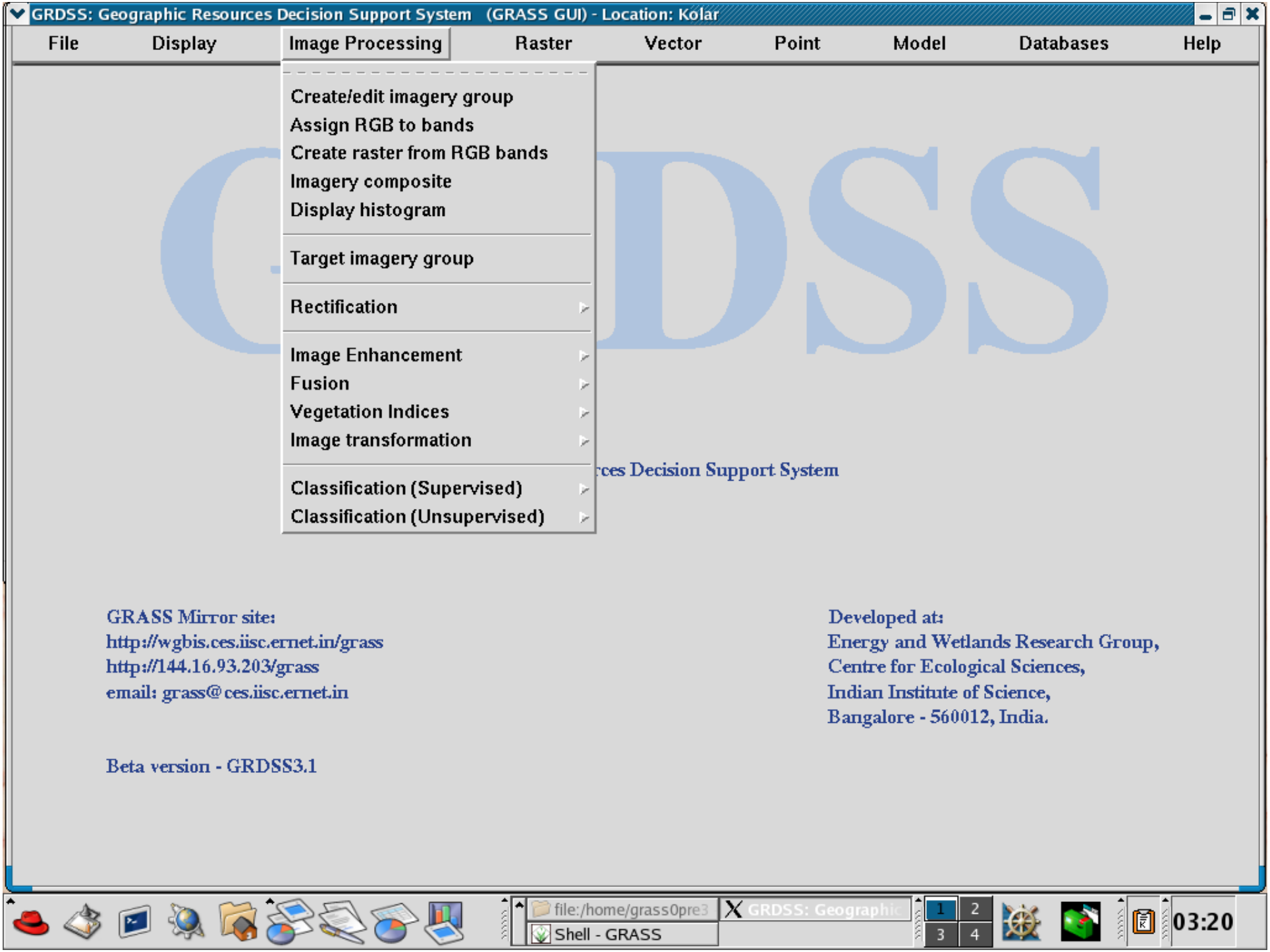


GRDSS hierarchical menu.

Geographic Resources Decision Support System

- GRDSS is a user friendly GUI (Graphical User Interface) in Tcl/Tk based on GRASS, developed in Linux.
- Extraction module of LISS-3 bands from IRS (Indian Remote Sensing Satellites) in BIL (Band Interleaved by lines) format.
- GUI more aesthetically appealing.
- GRASS commands (functions) now categorized and arranged in hierarchical order in the GUI.
- GUI developed keeping in view the novice users, less experienced in working with GRASS commands.

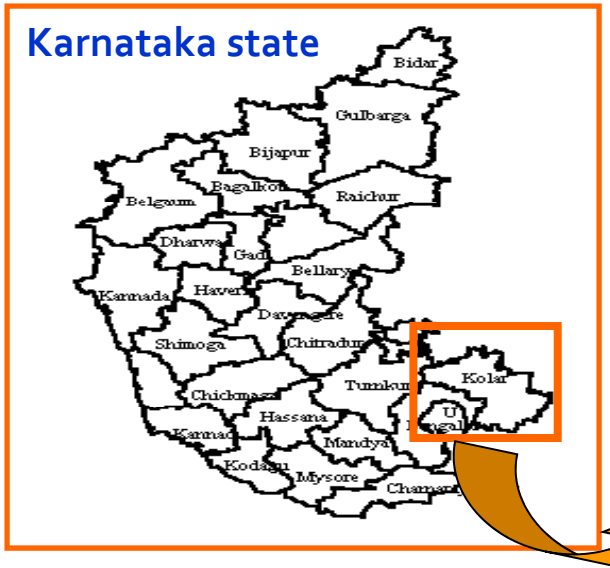

GRDSS: Geographic Resources Decision Support System (GRASS GUI) - Location: Kolar
File
Display
Image Processing
Raster
Vector
Point
Model
Databases
Help
Explore maps
Explore maps using expressions
Band Extract
DEM/DTED
Import
Export
Save displayed file to image
Save As
Rename
Delete
Delete maps using expressions
Quit
Image formats
Raster GIS formats
Vector formats
Sites (point) formats
Grid3D file
ARC/INFO Binary Grid coverages (.adf)
EHdr (ESRI HDR) (.hdr)
ERDAS Imagine (.img)
ERDAS/LAN (.lan)
ESRI formats
ETOPO-5
GLOME DEM 30
GTOPO30
GMT binary array
NIMA/DTED
Band File Import
ESRI ARC/INFO ASCII-GRID (.asc)
TIFF 8bit (.tif)
TIFF 24bit (.tif)
PPM 24bit (.ppm, .pbm)
HDF
Binary file (GTOPO30 format) in a lat-lon region
Binary file (GTOPO30 format) in a UTM region
GRIDATB
ASCII POLYGON/LINE data files
ASCII
ELAS
TANG
UTM
MIADS output ASCII to GRASS
Import Various formats
Geographic Resou
GRASS Mirror site:
http://wgbis.ces.iisc.ernet.in/grass
http://144.16.93.203/grass
email: grass@ces.iisc.ernet.in
Beta version - GRDSS3.1
03:18

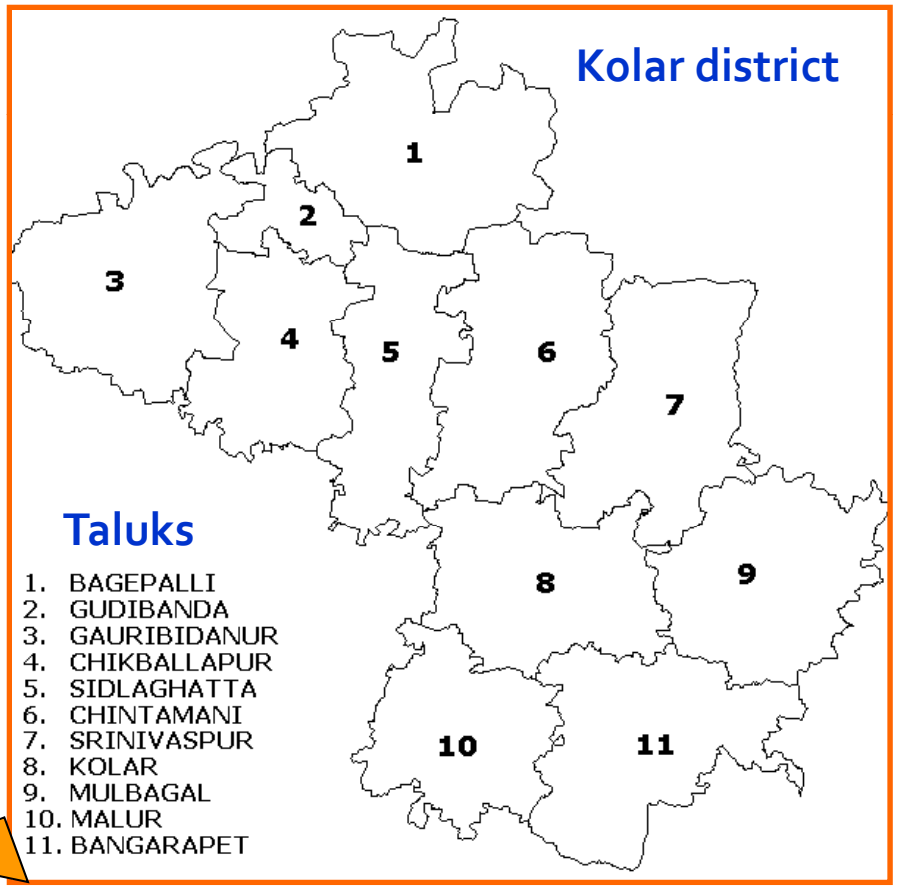

GRDSS: Geographic Resources Decision Support System (GRASS GUI) - Location: Kolar
File
Display
Image Processing
Raster
Vector
Point
Model
Databases
Help
Create/edit imagery group
Assign RGB to bands
Create raster from RGB bands
Imagery composite
Display histogram
Target imagery group
Rectification
Image Enhancement
Fusion
Vegetation Indices
Image transformation
Classification (Supervised)
Classification (Unsupervised)
GRDSS
rces Decision Support System
GRASS Mirror site:
http://wgbis.ces.iisc.ernet.in/grass
http://144.16.93.203/grass
email: grass@ces.iisc.ernet.in
Developed at:
Energy and Wetlands Research Group,
Centre for Ecological Sciences,
Indian Institute of Science,
Bangalore - 560012, India.
Beta version - GRDSS3.1
file:/home/grass0pre3
GRDSS: Geographic
Shell - GRASS
1
2
3
4
03:20

Study area : Kolar district, India.

Location : 77°21' to 78°35' E
12°46' to 13°58' N

Area : 8238.47 sq. km.

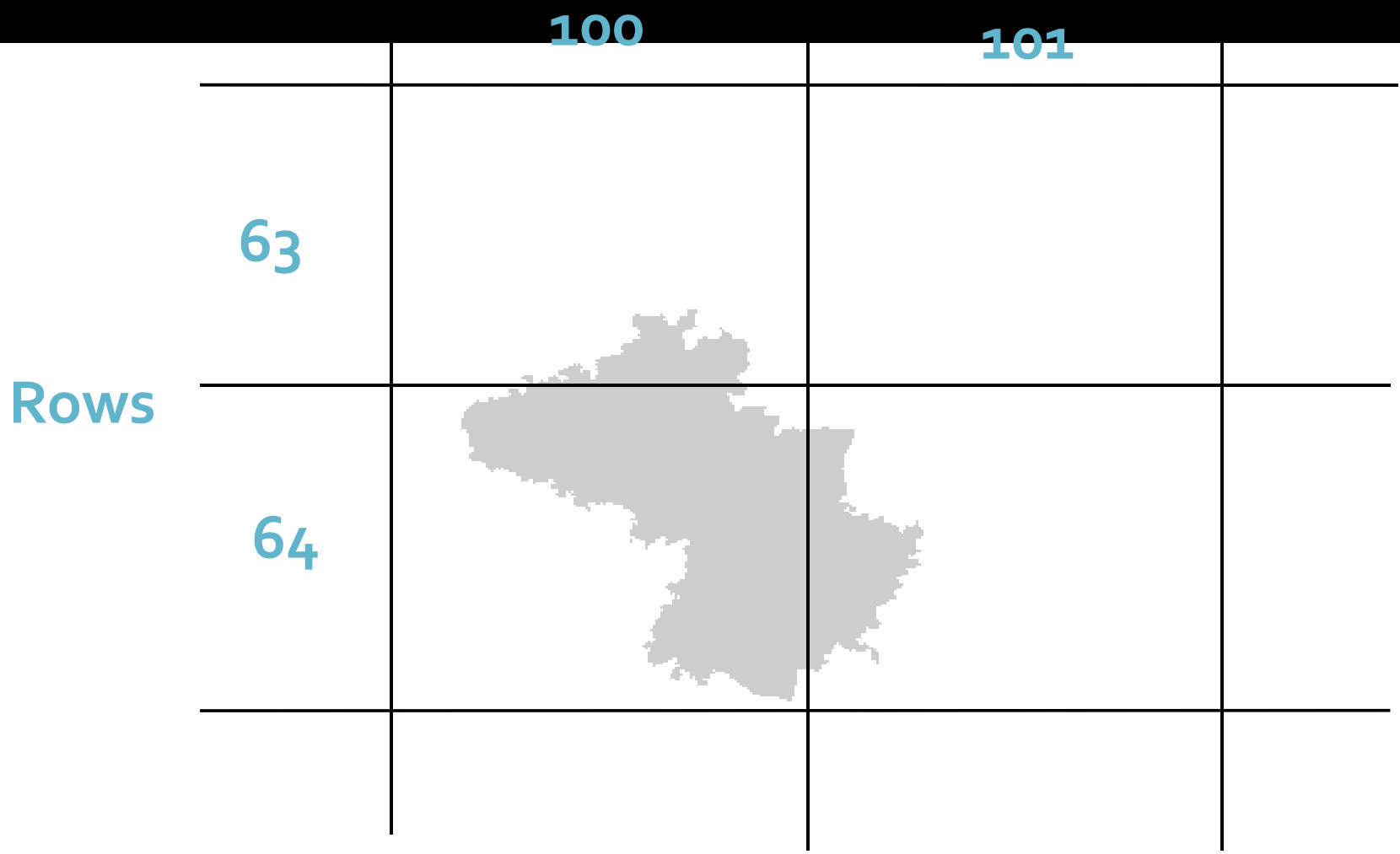




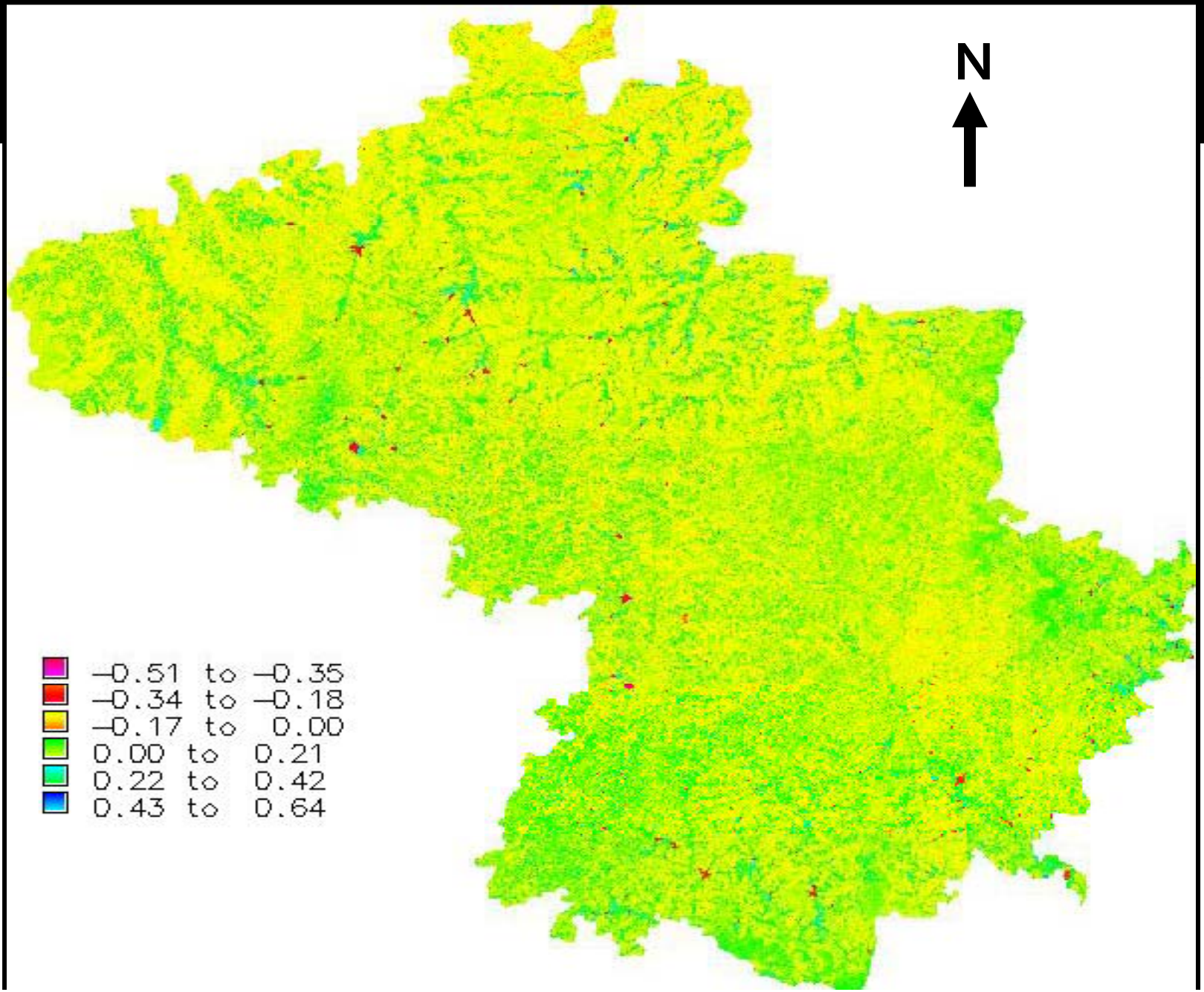
Taluks

1. BAGEPALLI
2. GUDIBANDA
3. GAURIBIDANUR
4. CHIKBALLAPUR
5. SIDLAGHATTA
6. CHINTAMANI
7. SRINIVASPUR
8. KOLAR
9. MULBAGAL
10. MALUR
11. BANGARAPET

IRS 1C and 1D PATH AND ROWS for Kolar District



LAND COVER ANALYSIS

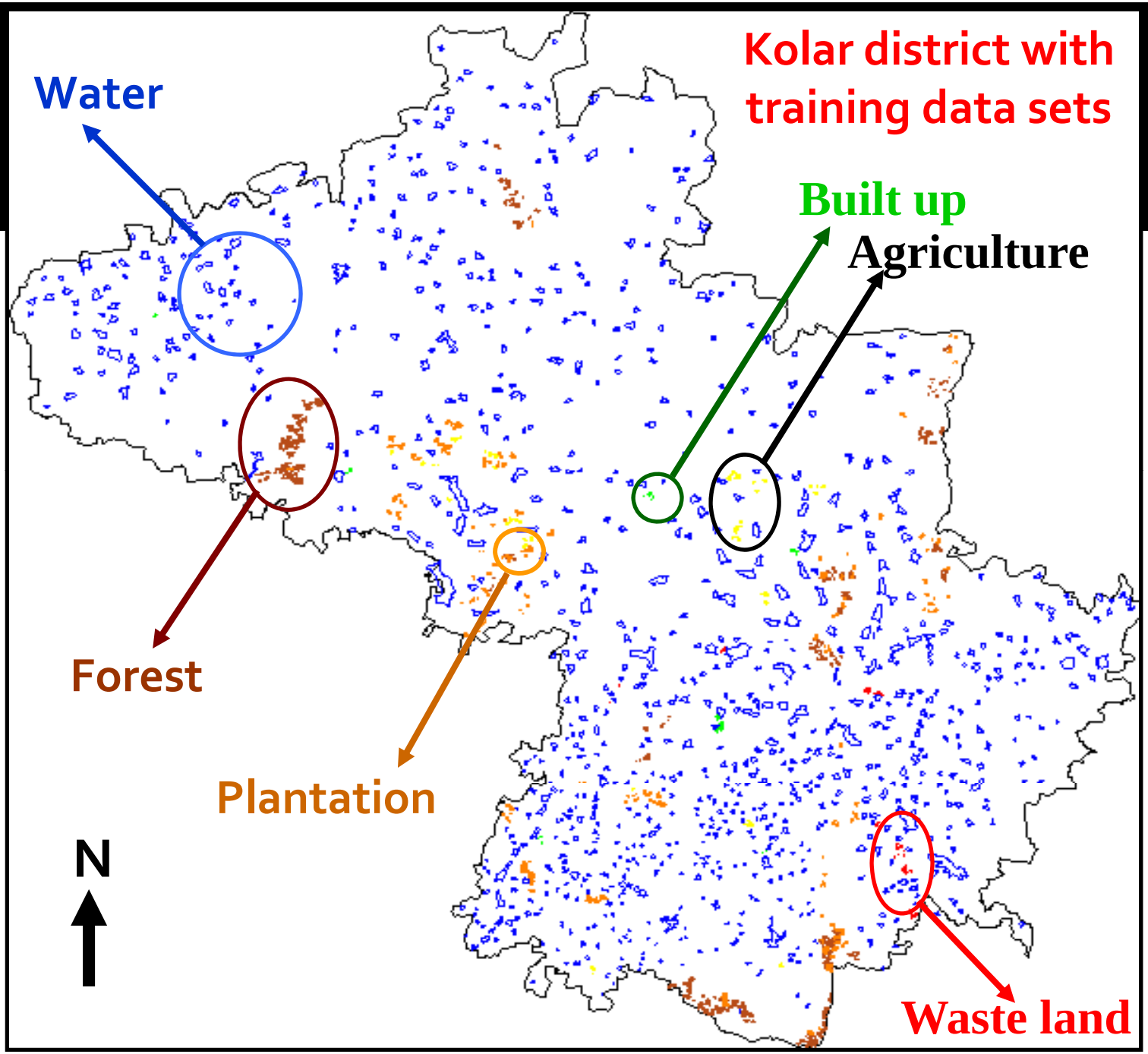


Vegetation Indices with area under vegetation and non-vegetation

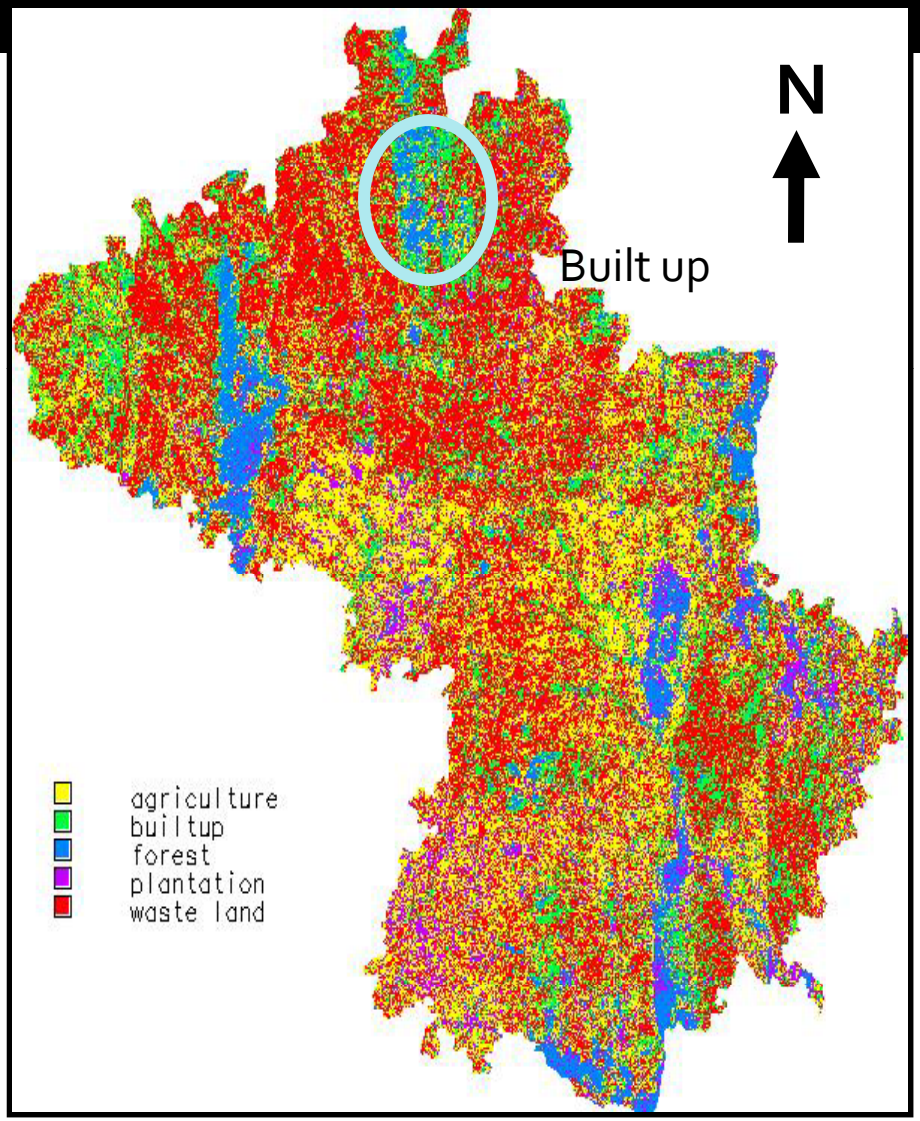
Vegetation Indices	Cutoff point	Area in hectares (ha)		Area in percentage (%)	
		Non-vegetation	Vegetation	Non-vegetation	Vegetation
RATIO	1	444659	379184	53.98	46.03
NDVI	0	418783	401654	54.05	45.96
RVI	1	82824.8	68955.7	54.56	45.43
NRVI	0.99	401647	369692	52.08	47.93
TVI	0.71	444099	379183.2	53.94	46.06
CTVI	0.707	418203	379183.2	52.46	47.55
TTVI	0.73	364415.1	305628	54.39	45.61
PVI	26.00	446960	376808	54.26	45.74
PVI1	7.00	453558	369512	55.10	44.89
PVI2	104	435853	387416	52.95	47.05
PVI3	3850	448812	375025	54.47	45.53
DVI	45	452326	371438	54.91	45.09
AVI	1	468967	354879	56.92	43.08
SAVI	0.02	72405.7	55919.4	56.42	43.58
TSAVI1	0.0199	409483	390422	51.19	48.81
TSAVI2	0.024	453360	370482	55.03	44.97
MSAVI1	0.17	451548	372294	54.81	45.19
MSAVI2	0	444626	355103	55.60	44.41
WDVI	42.01	450160	373627	54.65	45.35

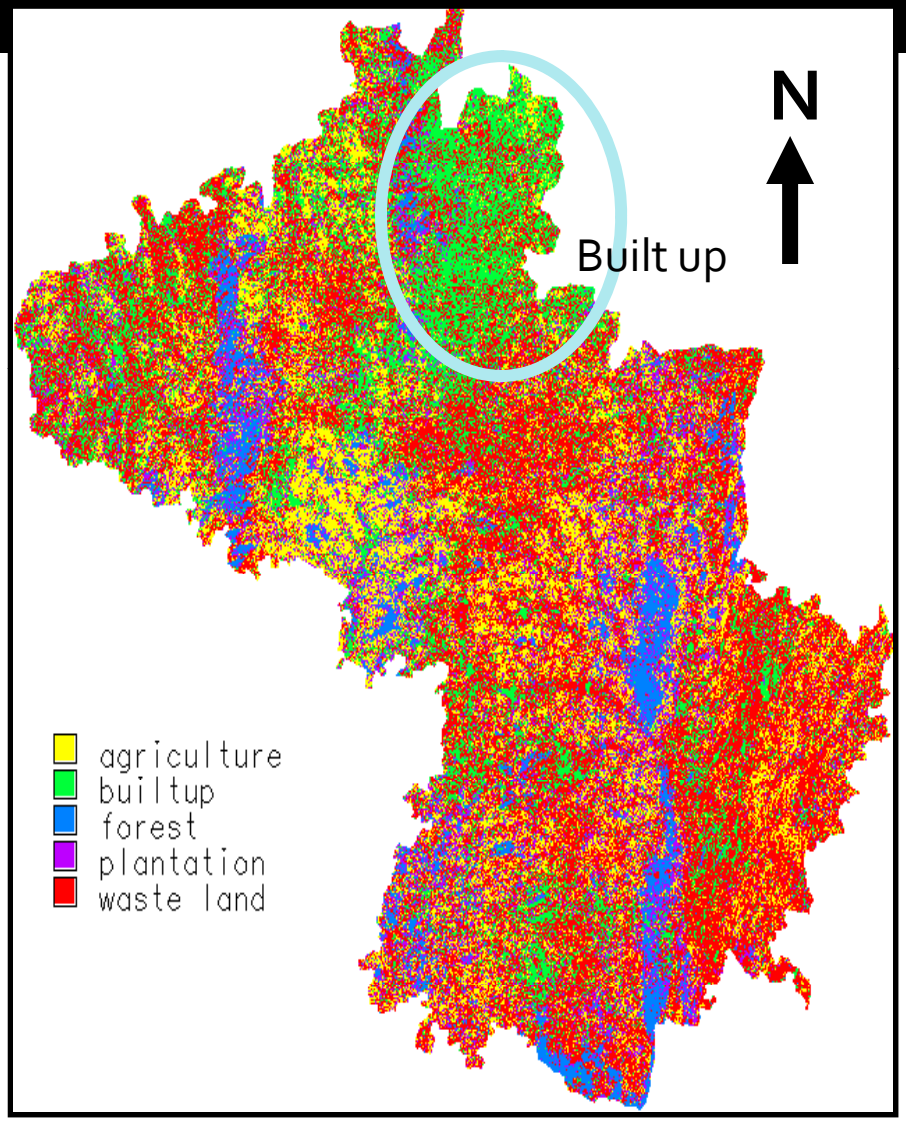
Landuse Analyses

- Fusion of LISS3 imagery with spatial resolution – 23.5 meters and PAN with spatial resolution - 5.8 meters data using RGB (Red, Green, Blue) to HIS (Hue, Intensity, Saturation) and HIS to RGB conversion technique.
- Generation of FCC (False Color Composite) and identification of training sites on FCC.
- Collection of attribute information from field corresponding to the chosen training sites using GPS.
- Classification of remote sensing data (1998 and 2002): Land use analyses (both district wise and taluk wise) with overall accuracy of 78.08%.
- Change detection analysis using different techniques (Image differencing, Image ratioing, etc.).
- Detection, visualisation and assessment of change analysis.
- Statistical analysis and report generation .


Kolar district with
training data sets
Water
Built up
Agriculture
Forest
Plantation
N
Waste land

Landuse classification of Kolar district



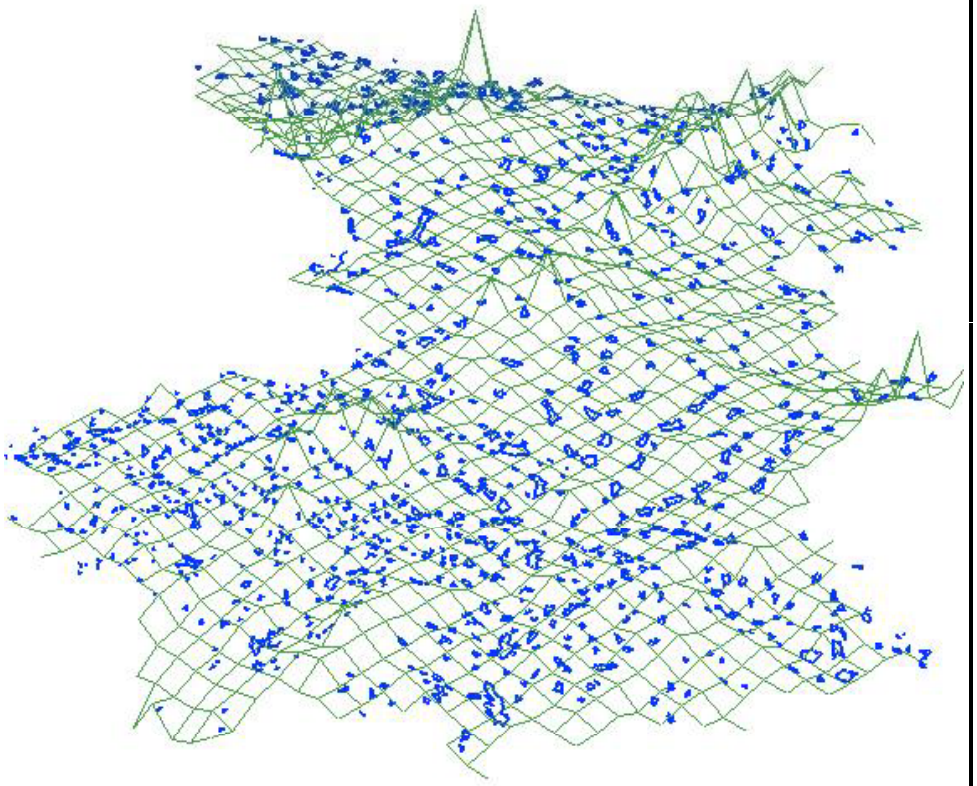


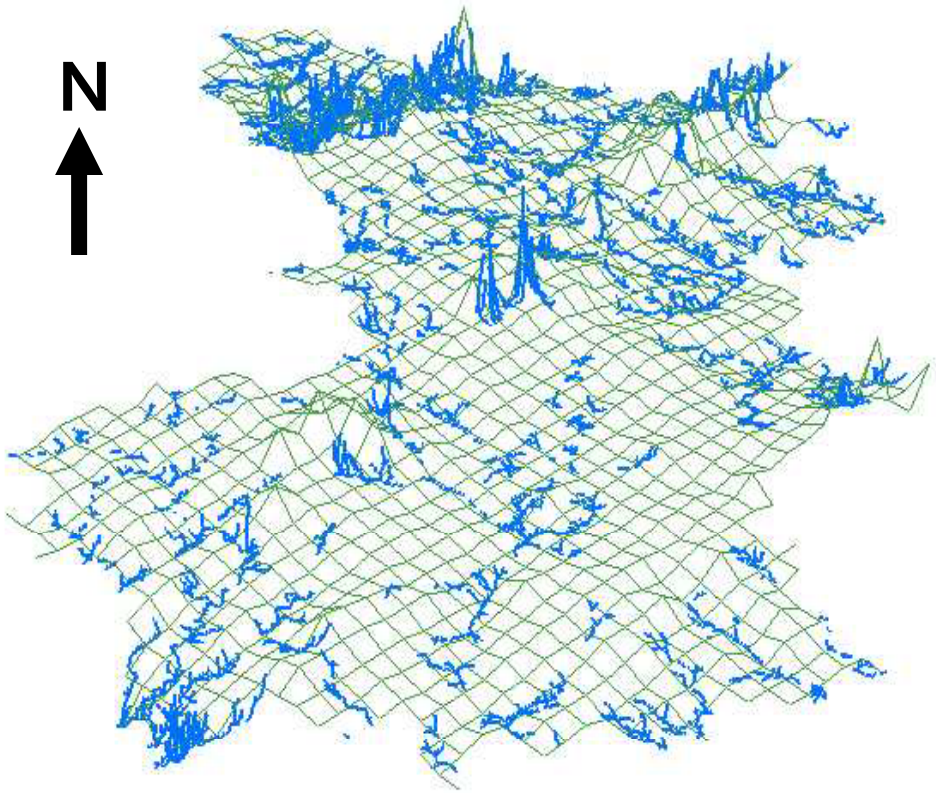
Landuse details of Kolar district

	1998		2002	
Categories	Area (in ha)	Area (%)	Area (in ha)	Area (%)
Agriculture	233519	28.34	165711.42	20.13
Built up	131468	15.96	154668.68	18.79
Forest	68300	8.29	58979.35	7.17
Plantation	70276	8.53	103110.13	12.53
Waste land	320284	38.43	340570.16	41.38

Categories	1998	2002
Non vegetation	54.39	60.17
Vegetation	45.61	39.83

3-d View of Kolar with overlaid water bodies and drainage network.

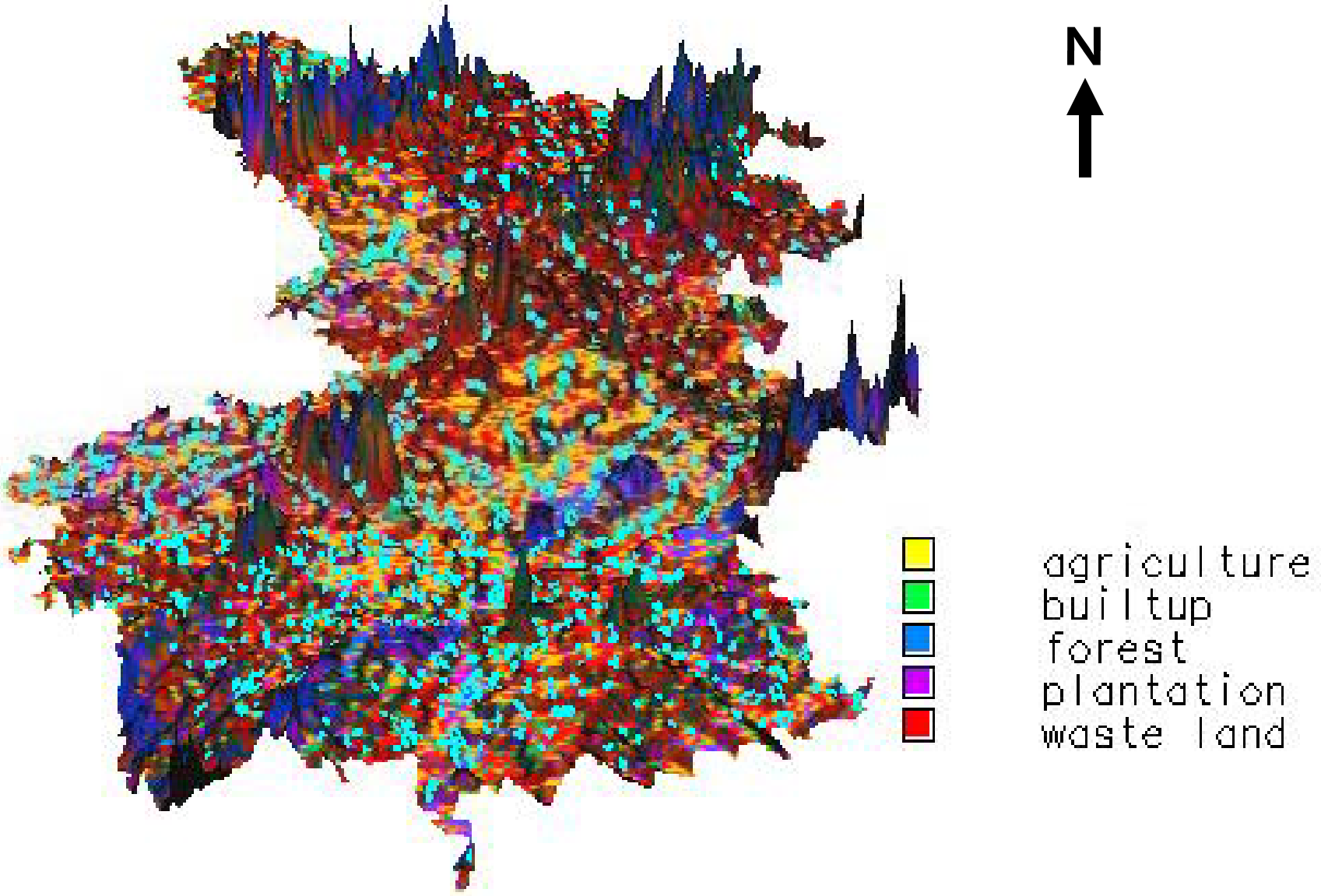


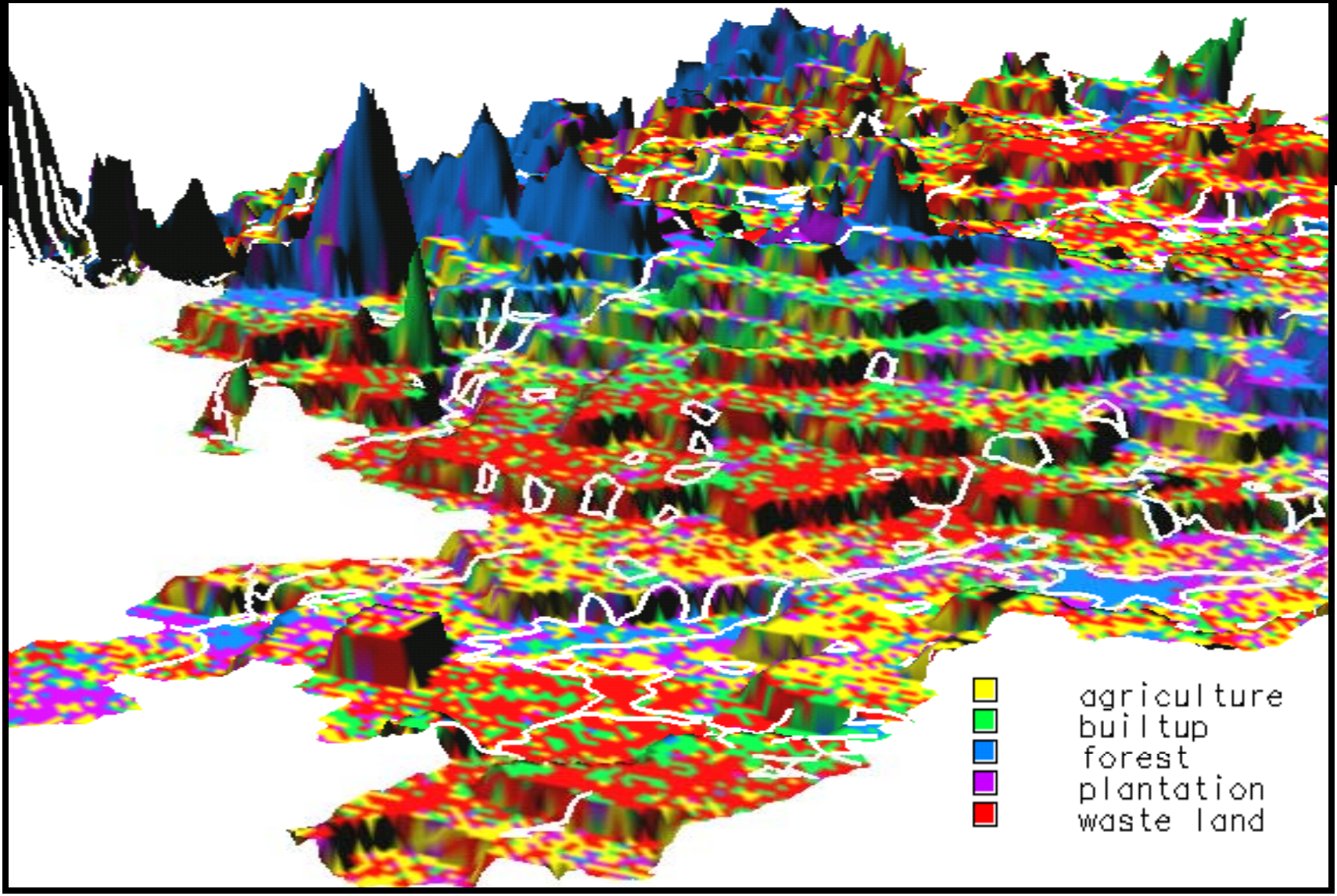


Water bodies

Drainage Network

3-d View of Kolar with land use map overlaid.



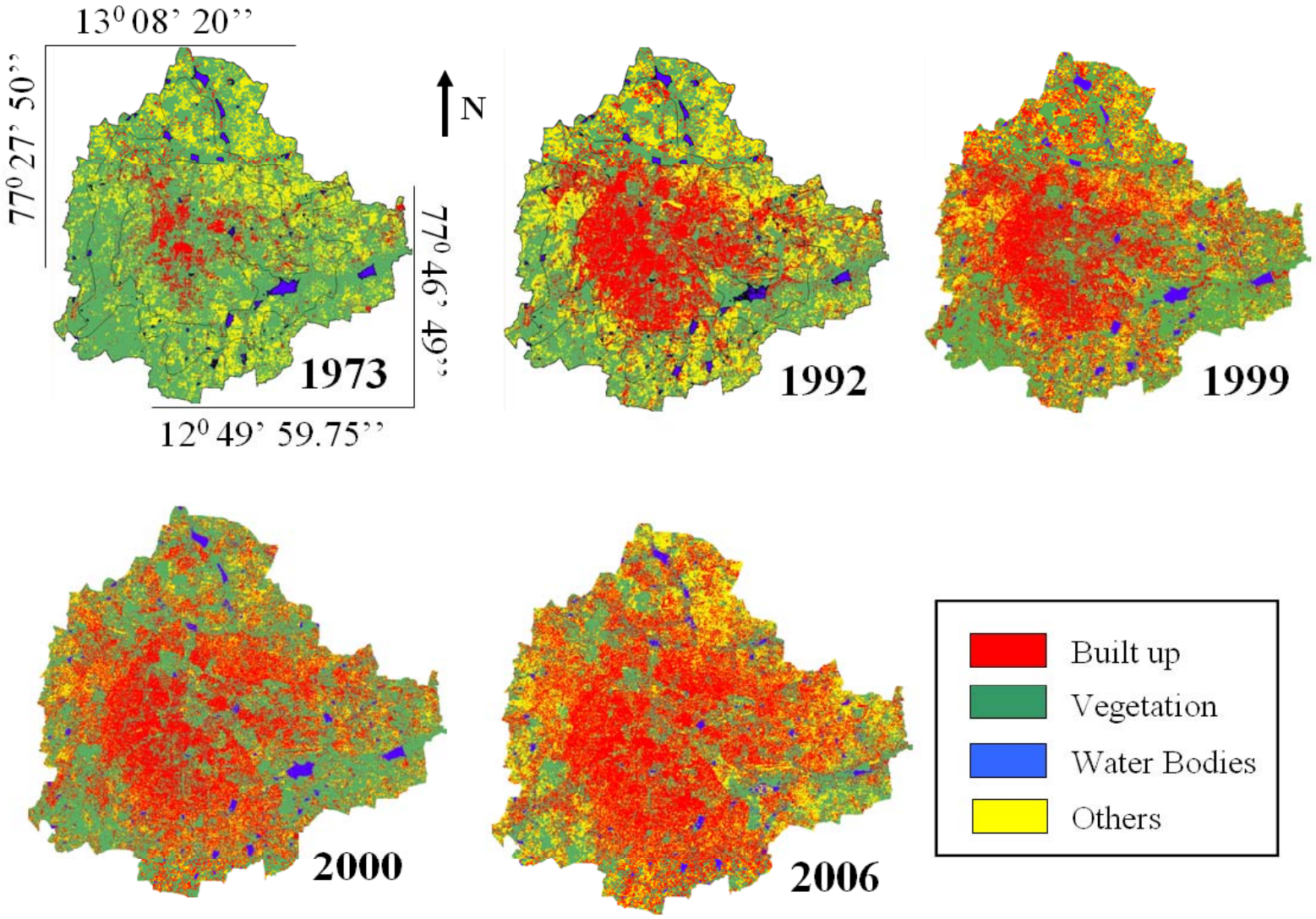


A watershed catchment from the Bangarpet taluk in Kolar district.

Bangalore – Urbanisation and Urban Sprawl

Urbanisation pattern - Data

- Survey of India (SOI) toposheets of 1:50000 and 1:250000.
- Field data were collected with a handheld GPS.
- Landsat MSS of 1973
- Landsat TM of 1992
- Landsat ETM+ of 2000
- IRS LISS-III of 1999 and 2006
- MODIS (Moderate Resolution Imaging Spectroradiometer) Surface Reflectance 7 bands product of 2000 and 2007
- MODIS Land Surface Temperature/Emissivity 8-Day L3 Global and Daily L3 Global (V004 and V005 products)
- SRTM (Shuttle Radar Topography Mission) elevation data of 90 m resolution
- Google Earth data (http://earth.google.com) served in pre and post classification process and validation of the results.


13⁰ 08' 20''
77⁰ 27' 50''
77⁰ 46' 49''
12⁰ 49' 59.75''
N
1973
1992
1999
2000
2006
Built up
Vegetation
Water Bodies
Others

Concentrated activities leading to intense urbanisation

Rapid urbanisation leading to sprawl

Urban Sprawl?
Outgrowth of cities either along the periphery or along the highway.

Increase in the spatial extent of the city.

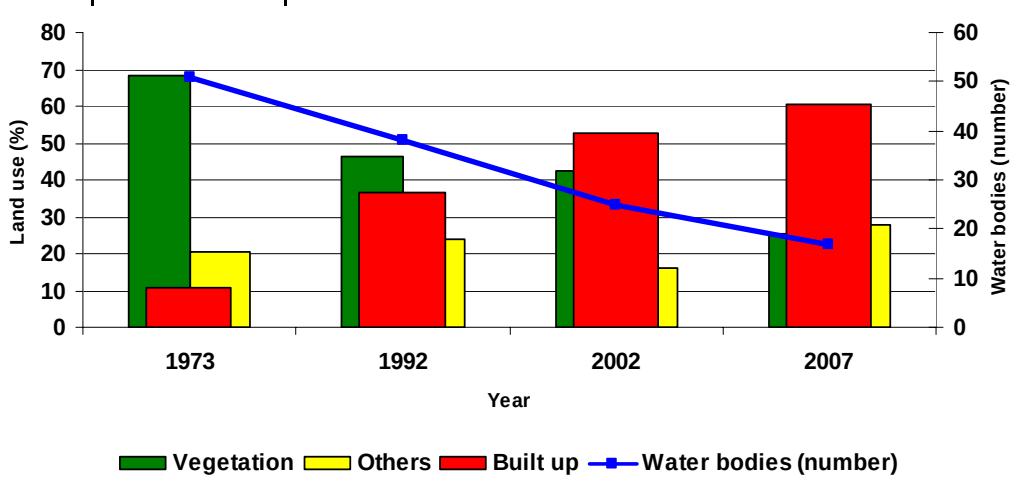
* lack of basic amenities (water, electricity, sewage, solid waste management, etc.)

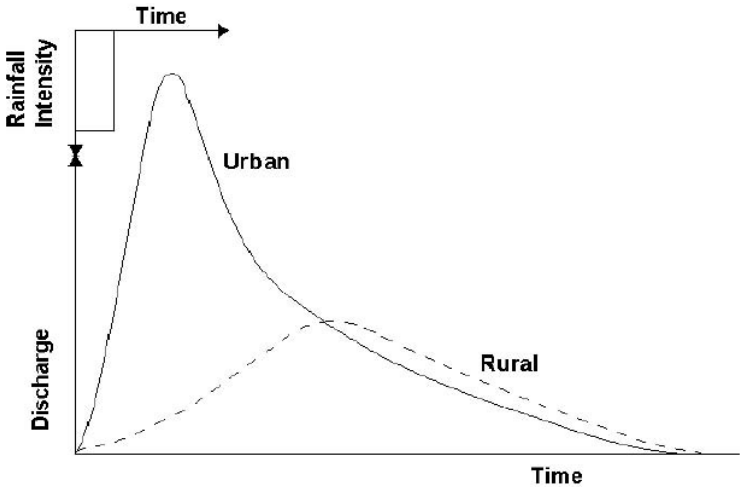
Built forms / built-up areas as a direct measure of sprawl – the proportional change

IMPLICATIONS

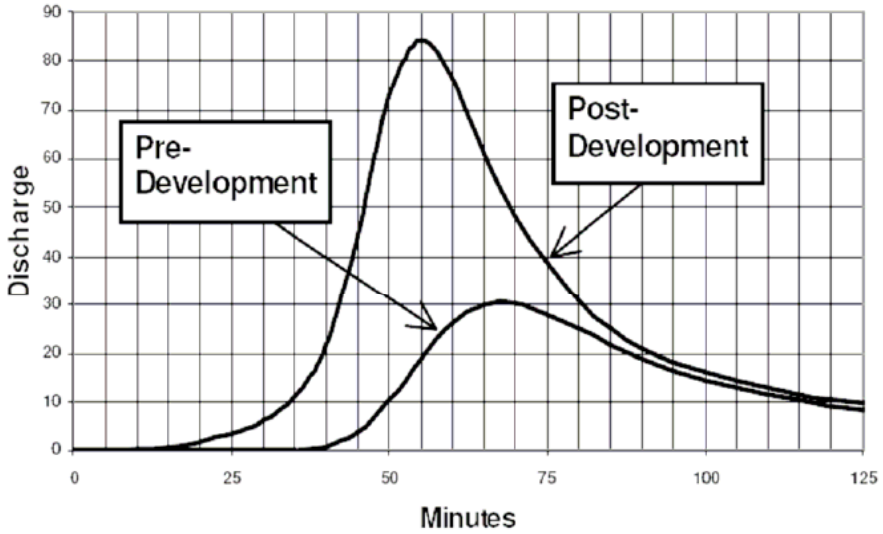
- Loss of waterbodies
- Lack of appropriate infrastructure (social and economic)
- Changes in local climate
- Increased population
- Traffic bottlenecks
- Enhanced pollution levels
  - Lack of Governance

Class → Year ↓		Built up	Vegetation	Water Bodies	Others
1973	**Ha**	5448	46639	2324	13903
	%	**7.97**	**68.27**	**3.40**	**20.35**
1992	**Ha**	18650	31579	1790	16303
	%	**27.30**	**46.22**	**2.60**	**23.86**
1999	**Ha**	23532	31421	1574	11794
	%	**34.44**	**45.99**	**2.30**	**17.26**
2000	**Ha**	24163	31272	1542	11346
	%	**35.37**	**45.77**	**2.26**	**16.61**
2002	**Ha**	26992	28959	1218	11153
	%	**39.51**	**42.39**	**1.80**	**16.32**
2006	**Ha**	29535	19696	1073	18017
	%	**43.23**	**28.83**	**1.57**	**26.37**
2007	**Ha**	30876	17298	1005	19143
	%	**45.19**	**25.32**	**1.**	



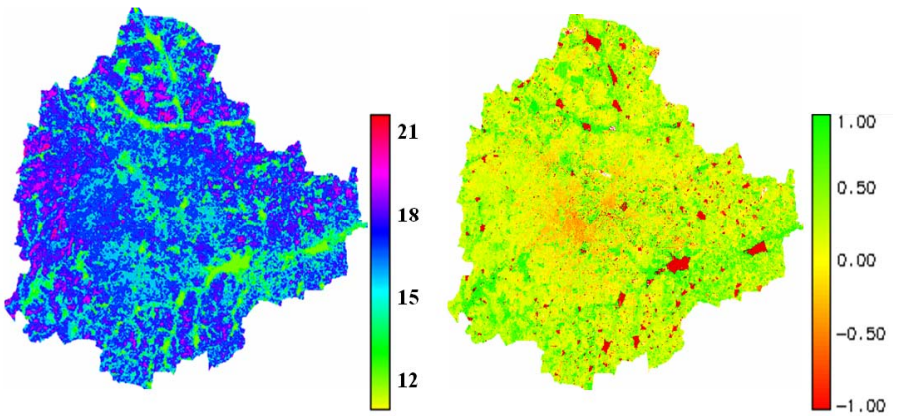


Flood Hydrographs for Urbanized and Natural Drainage Basins

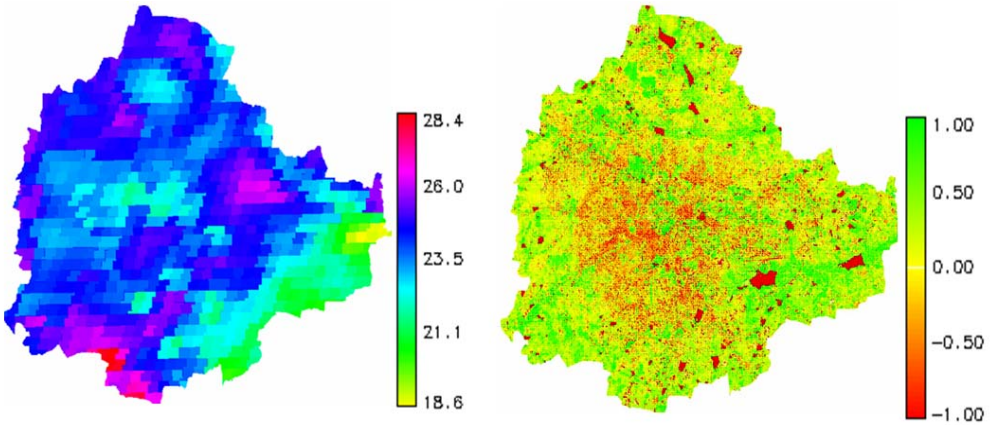


Runoff Hydrograph under Pre-and Post-Development conditions

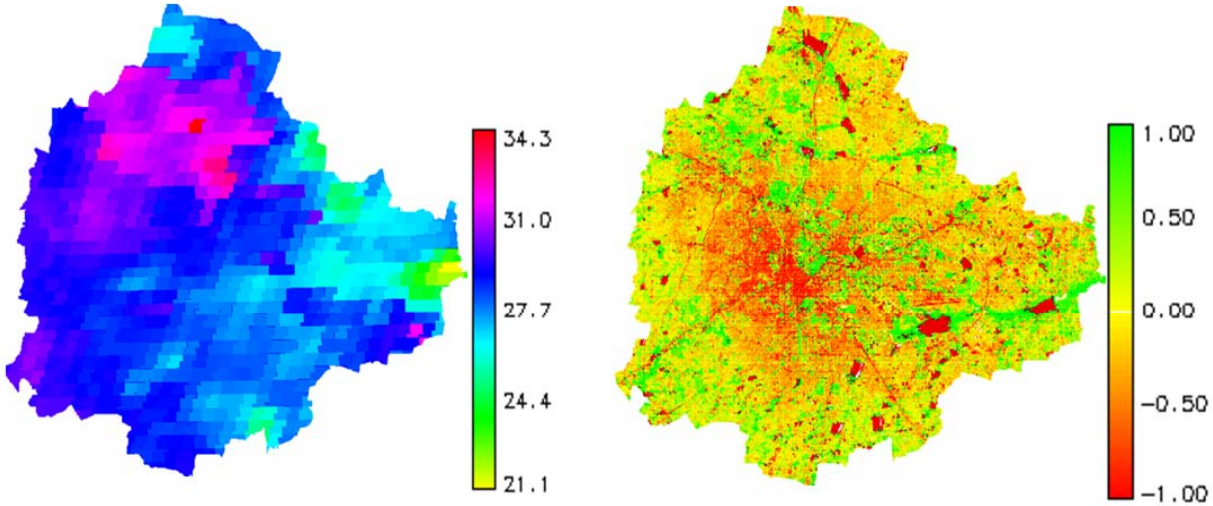
LST and NDVI



Landsat TM of 1992



MODIS LST and ETM+ NDVI of 2000



MODIS (2007) and IRS LISS-III (2006)

Land use	1992 (TM)		2000 (MODIS)		2007 (MODIS)	
	LST ± SD	**NDVI ±SD**	**LST ± SD**	**NDVI ±SD**	**LST ± SD**	**NDVI ±SD**
Builtup	19.03 ±1.47	-0.162 ±0.096	26.57 ±1.25	-0.614 ±0.359	31.24 ±2.21	-0.607 ±0.261
Vegetation	15.51 ±1.05	0.467 ±0.201	22.21 ±1.49	0.626 ±0.27	25.79 ±0.44	0.348 ±0.42
Water bodies	12.82 ±0.62	-0.954 ±0.055	21.27 ±1.03	-0.881 ±0.045	24.20 ±0.27	-0. 81 ±0.27
Open ground	17.66 ±2.46	-0.106 ±0.281	24.73 ±1.56	-0.016 ±0.283	28.85 ±1.54	-0.097 ±0.18

Land use	**1992**	**2000**	**2007**
Built up	-0.7188	-0.7745	-0.7900
Vegetation	-0.8720	-0.6211	-0.6071
Open ground	-0.6817	-0.5837	-0.6004
Water bodies	-0.4152	-0.4182	-0.4999

•Urban areas that include commerci
exhibited the highest temperature followed by open ground.

•The lowest temperature was observed in water bodies across all years and vegetation.

IMPLICATIONS

- Loss of waterbodies
- Frequent flooding – loss of life and property
- Decline in ground water table
- Changes in local climate
- Traffic bottlenecks
- Enhanced pollution levels
- Increased population, aggressive behaviour
  - Lack of Governance
  - Dead city 2005 (Garden city in 70's, Garbage city in 2000)

Conservation & Management

- Environment Education (school and colleges)
- Capacity Building (Training Programmes, workshops and Symposiums – Lake series: Lake 2008)
- Create new lakes (urban environment)
- Database of wetlands,
- Spatial Decision Support Systems
- Advocacy and Sensitize Decision makers/planners

Centenary Pond - Waterbody @ IISc 2008

Create an Ecosystem
Mini Forest In front of CES at IISc (1988)

Western Ghats Liana near CES (1989)
(A unique spot in Bangalore)

-Temperature always 2.5 degrees lower than Malleswaram
-Groundwater table is 15' (compared to 140' earlier)

SYMPOSIUM ORGANISING COMMITTEE (SOC)	
T.V. Ramachandra	CES & CST, Indian Institute of Science
N.V. Joshi	CES, Indian Institute of Science
M.D. Subashchandran	CES, Indian Institute of Science
C. Rajasekara Murthy	Environment Canada, Canada
Krishna Alluri	Commonwealth of Learning, Canada
H.N. Chanakya	CST, Indian Institute of Science
K.V. Gururaja	CES, Indian Institute of Science
H.S. Sudhira	CES and CST, Indian Institute of Science
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D. S. Umesh	Lake Development Authority, Bangalore
M. A. Khan	K.K. High School, Varthur
Snehalatha V. Kumar	Vidyaniketan Public School, Ullal, Bangalore

Queries regarding the Programme/Exhibition, should be addressed to

Dr. T.V. Ramachandra, Convener, Lake 2008
Energy & Wetlands Research Group
Centre for Ecological Sciences, Indian Institute of Science
Bangalore 560 012, India
Tel: 91-080- 22933099 / 22932786 / 2293 2506 / 23600985 (Extn: 215/232)
Fax: 91-080- 23601428 / 23600683/ 23600085 [CES-TVR]
E mail: lake2008@ces.iisc.ernet.in, cestvr@ces.iisc.ernet.in, energy@ces.iisc.ernet.in
Web: **http://ces.iisc.ernet.in/energy, http://ces.iisc.ernet.in/biodiversity**

Lake 2008 Call for Papers

Lake2008: Conservation and Management of River and Lake Ecosystems

22nd-24th December 2008

Venue: Satish Dhawan Auditorium, Indian Institute of Science, Bangalore

ORGANISED BY

- Energy & Wetlands Research Group, Centre for Ecological Sciences (CES), Indian Institute of Science (IISc), Bangalore
- Centre for Sustainable Technologies (CST), Indian Institute of Science
- Commonwealth of Learning (COL), Canada
- Society of Wetland Scientists, Asia Chapter
- Karnataka State Council for Science and Technology (KSCST), Bangalore
- Karnataka Environment Research Foundation [KERF], Bangalore
- K.K. High School, Varthur, Bangalore
- Vidyaniketan Public School, Ullal, Bangalore 560 056

DATES TO REMEMBER

Submission of Abstract and Registration Form	**18th October 2008**
Acceptance of Abstract	**6th November 2008**
Receipt of Full Length Papers	**16th November 2008**
Notification of Acceptance of Papers (on web)	**4th December 2008**
Conference	**22-24th December 2008**

wetland.psd

File Edit Image Help

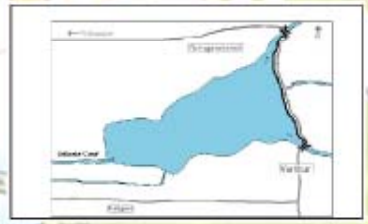
WETLAND MAPPING AND WATER QUALITY ANALYSIS

Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore – 560 012 in association with Bangalore Rural Schools

Varthur is a part of an ancient system of interconnected tanks and canals that receive virtually all the surface runoff, wastewater, and sewage from the Bangalore South taluk. With a surface area of 1.8 km2 it is the main irrigation source for agriculture and supports a wide variety of plants and animals. Rapid development and population expansion leading to heavy pollution loading has exceeded the lake's ability to assimilate contaminants. School students evaluated its ecological status to guide restoration efforts.

The study comprised:

* Survey of the depth, surface area, width, etc of the lake;
* Water quality survey



Map of Varthur Lake & surroundings

Methods

Water Quality

* Water samples collected from 10 to 30 cm below the surface during morning hours.
* Laboratory analysis: pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), coliform bacteria, dissolved oxygen (DO), nitrate and phosphate.

Mapping

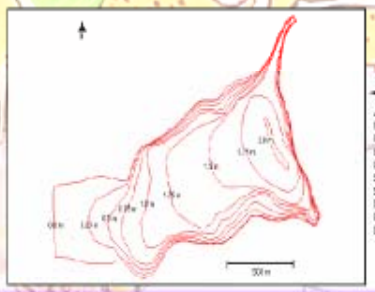
* Depth was measured at randomly distributed points around the lake. Their location recorded using a Geographic Positioning System.
* 31 depth samples were measured with a weighted line and measuring tape.
* 48 samples were taken from a boat using a graduated aluminum pole with a flat disc attached to the bottom.
* Created a contour map at 0.25 meter contour interval.

Water Quality

Parameters	Site1	Site2	Site3
Dissolved Oxygen (mg/l)	2	3	2.9
pH	7.61	7.55	7.68
Ammonia (mg/l)	>3.0	n/a	n/a
Nitrate (mg/l)	nil	1.074	1.4
Phosphorus (mg/l)	n/a	>1.0	15.54
Biological Oxygen Demand (mg/l)	n/a	n/a	74.2
Chemical Oxygen Demand (mg/l)	n/a	n/a	82.2
Coliform bacteria	Positive	Positive	Positive

Mapping

* The shoreline of Varthur Lake does not appear to have changed considerably between the early 1970's and present day, unlike many other tanks in the district that have decreased drastically in size due to encroachment



Parameter	Values from Contour and SOI Map
Area	1 478 000 Sq.m
Maximum observed depth	1.85 m
Maximum estimated depth	2.0 m
Mean depth	1.05 m
Relative depth	0.15%
Shoreline	6 560 m
Shoreline development	1.52
Maximum length	1 810 m
Maximum width	1 040 m
Mean width	117 m

Conclusion

* Varthur Lake, like many tanks in the Bangalore area, is suffering from rapid sedimentation that poses a threat to the ecology and very existence of the lake.
* Dissolved oxygen (DO) levels in Varthur Lake were extremely low.
* The pH of the water was found to be slightly alkaline (approximately 7.5 to 8.0) for all water samples.
* The BOD of water samples was extremely high and nearly equivalent to COD.
* Bacterial culturing confirmed the presence of the bacteria E. coli in the lake.
* Phosphorus concentrations of the samples were very high, averaging 15.1 mg/l.

Associated Schools: K K High School, Varthur and St. Josephs High School, White field, Bangalore Rural District

Background: Award winning poster by Ashwini N, Deepa N and Azeeza Kulsum [K K High School]

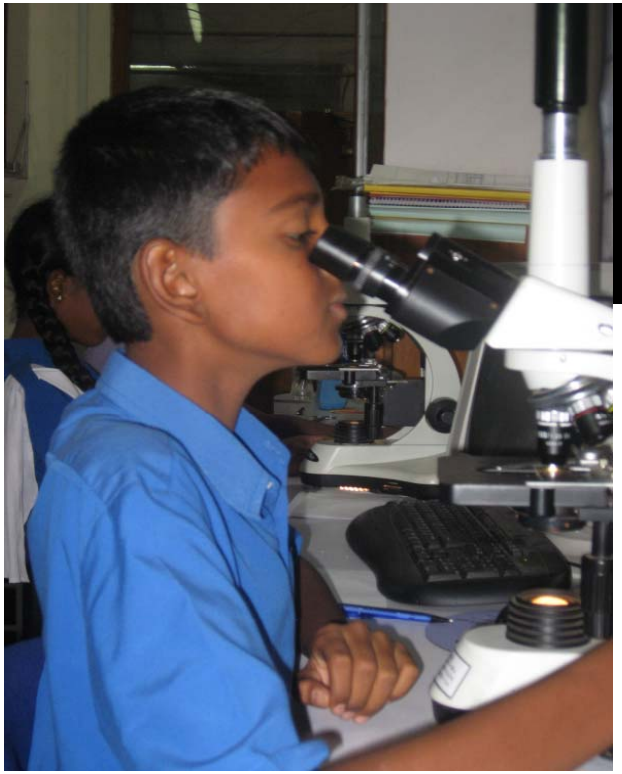
Slide 41 of 50 Default Design English (U.S.)

Diatom Collection at Varthur Lake with School Children

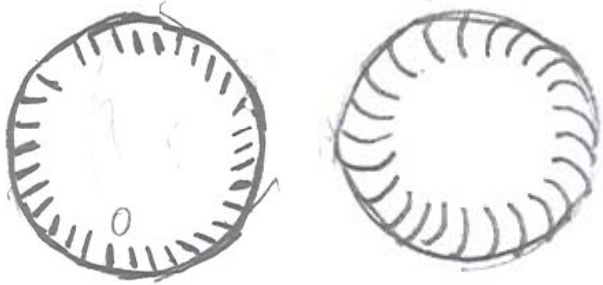
(Karthick interacting with school kids)

Diatom Collection at Varthur & Siddapura Lake with School Children

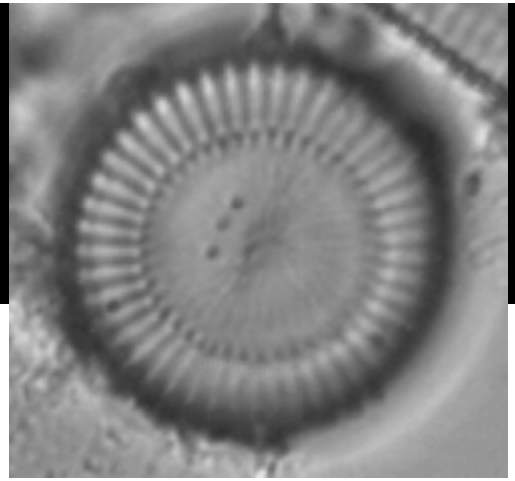
School kids at IISc

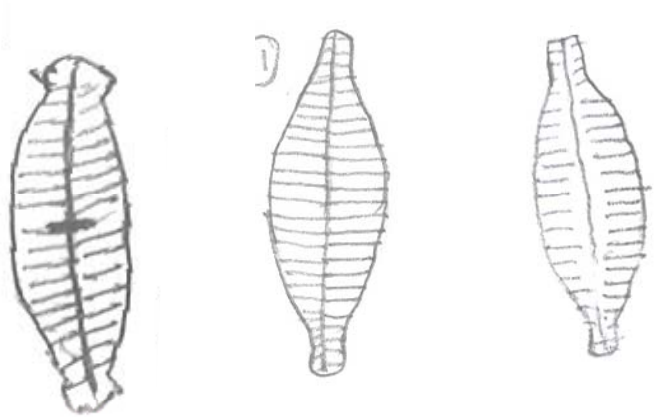


KIDS



RESEARCHER





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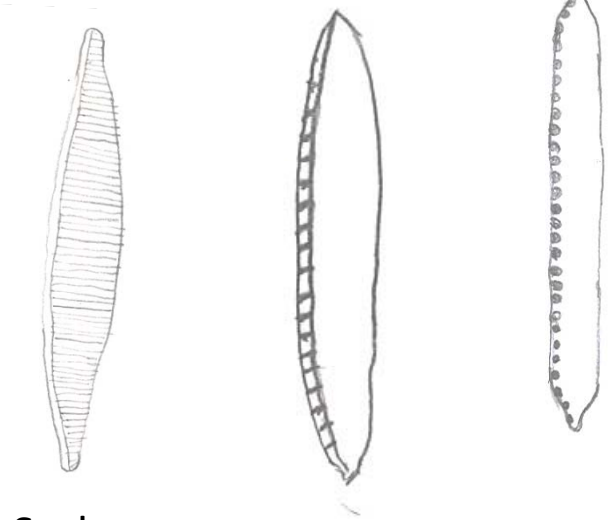

Not to Scale

Want to be OIL Baron – Read this!

- Ramachandra T.V., Durga Madhab Mahapathra, Karthick B and Gordon (2009). Milking diatoms for sustainable energy:bio chemical engineering versus gasoline-secreting diatom solar panel. (invite) Ind.Eng.Chem.Res.48(19),Complex materials II Special issue (October) in press.

GRASS http://wgbis.ces.iisc.ernet.in/grass	QGIS http://www.qgis.org/	Open JUMP http://openjump.org/
http://www.php.net/	http://www.tcl.tk/	http://qt.nokia.com/
Apache HTTP SERVER PROJECT http://www.apache.org/	MAPSERVER http://mapserver.org/	JabRef http://jabref.sourceforge.net/
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Dr. T. V. Ramachandra,
Urban Ecology, Environment & Policy Research
Centre for Infrastructure, Sustainable Transportation and Urban Planning [CiSTUP],
Indian Institute of Science, Bangalore 560 012
Email: cestvr@ces.iisc.ernet.in, grass@ces.iisc.ernet.in
Tel : 91-80-23600985/22932506/22933099
Fax : 91-80-23601428/23600085/23600683

Thank you all