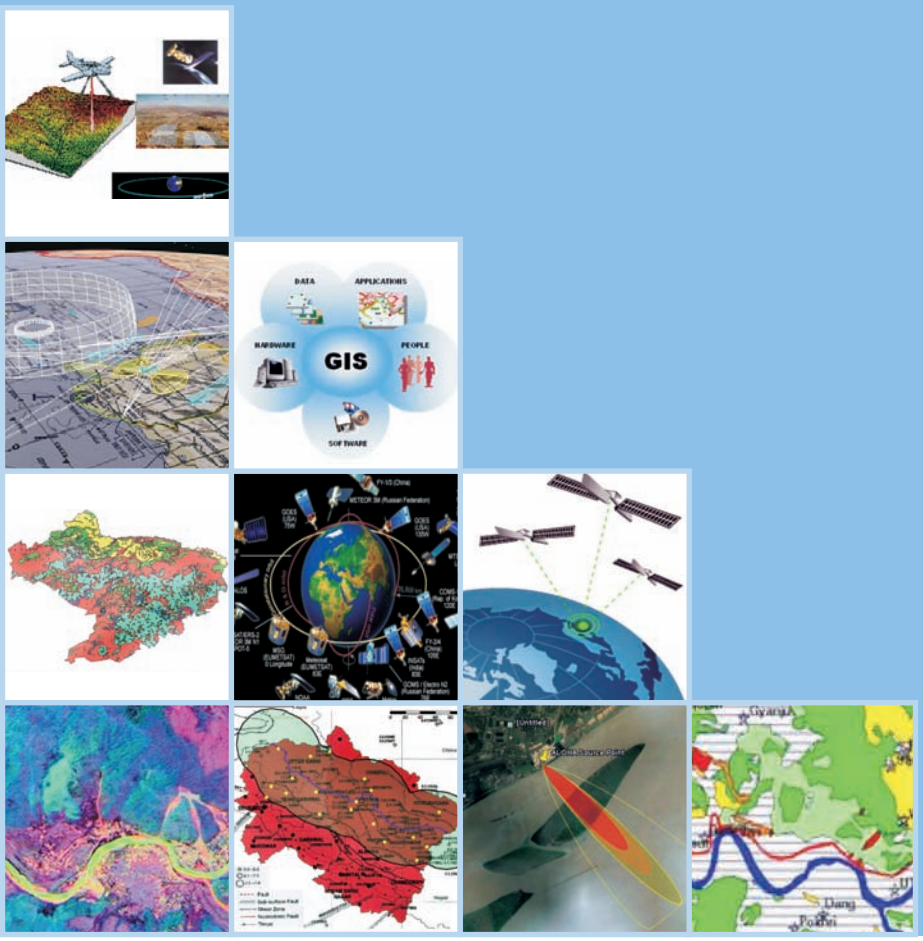
सत्यमेव जयते

Training Module

Geoinformatics

Applications in Disaster Management



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NATIONAL INSTITUTE OF DISASTER MANAGEMENT
MINISTRY OF HOME AFFAIRS, GOVERNMENT OF INDIA

TRAINING MODULE

Geoinformatics Applications in Disaster Management

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Training Module
Geoinformatics Applications in Disaster Management

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P.S. Roy
Director

MESSAGE

Geoinformatics applications in Disaster Risk Management and is an emerging field in last two decades. Geoinformatics, which includes Remote Sensing, Geographic Information System, Global Positioning Systems, and Internet Mapping Services, provides the most powerful technology for all phases of disaster management i.e. hazard mapping, monitoring, risk assessment, emergency response and reconstruction. Planning for disaster management would need to consider the spatial and temporal aspects of the location.

India is having a huge space imaging capability, and one of the countries were the technology has been put into operational applications during last two decade for natural hazard mapping and monitoring. During the last decade Indian Space Research Organization initiated several programmes and projects for mapping and monitoring the landscapes, hazards and disasters. Key amongst are Disaster Management Support Programme (an umbrella programme to cover various initiatives related to Disaster Risk Management and Emergency Response), National Agricultural Drought Assessment and Monitoring System (NADAMS, now under DMS), INFRASS for forest fire monitoring, Bhuvan, Bhoosampada (land use, Land-cover), desertification and land degradation status mapping of India, National Wasteland Mapping, Wetland delineation and mapping and so on.

Disaster Risk Management and Emergency Response), National Agricultural Drought Assessment and Monitoring System (NADAMS, now under DMS),

INFRASS for forest fire monitoring, Bhuvan, Bhoosampada (land use, Land-cover), desertification and land degradation status mapping of India, National Wasteland Mapping , Wetland delineation and mapping and so on.

Despite the tremendous potential of Geoinformatics applications in disaster management the technology is yet to be uses optimally by the decision makers. Ironically Geoinformatics is yet limited in our country as a research subject, where tremendous advancements were made. Training and capacity building of disaster managers in effectively utilizing Geoinformatics is an important area were focus is needed, besides the huge investments in achieving technological milestones.

By the introduction of training programs for various target groups on the role of Geoinformatics applications in disaster management since the year 2005, National Institute of Disaster Management is playing a significant role in capacity building of administrators, disaster managers and also the technical professions. It is my pleasure to write this message for the training module developed by National Institute of Disaster Management by significant contributions from experts on this subject. I am sure this module will be extremely useful for the trainers for developing and implementing training courses and also for enhancing knowledge and skills on the uses of geoinformatics applications in disaster management.

P.S. Roy
Director, IIRS

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Dr. SATENDRA, IFS
Executive Director

Foreword

With the launch of U N International Decade of Disaster Risk Reduction in 1990s and following Hyogo Framework for Action in 2005, countries started paying greater attention to Disaster Risk Management over the previous relief centric approach. Actions for achieving Disaster Risk (DRM) Management require the government to be prepared with 'information readiness' to address issues related to all stages of DRM such as assessment, planning. Mitigation, preparedness, response and recovery. The space-based and geospatial information provides insight related to the hazards, vulnerability and risk and thus, assists in taking decisions and planning appropriate measures to avoid impact of potential disasters.

Report of the High Power Committee on Disaster Management (HPC, 2000) in India and the recent National Disaster Management Guidelines on National Disaster Management Information and Communication System released by National Disaster Management Authority in 2012 lays special emphasis on the use of GIS based Decision Support Systems. Department of Space, under its Disaster Management Support Programme, initiated the development of a National Database for Emergency Management, Decision Support Centre has been set up at National Remote Sensing Centre (NRSC) for providing necessary support to the Disaster Managers. Besides, Geospatial data and information required for DRM purpose is often available with various agencies. The main challenges in employing space-based and geospatial information in disaster management are: inadequate awareness about the sources of data, access to

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such information and services offered by the technology solution providers, issues related to data sharing and integration; and generating willingness of the disaster management agencies to use geoinformatics tools and spatial data for decision making.

National Institute of Disaster Management (NIDM) has been mandated under the Disaster Management Act for capacity building including training, research, documentation and policy advocacy on all aspects of disaster management. The Institute offers a wide range of courses specific to hazards like Earthquake, Floods, Landslide, Chemical (Industrial) disasters and interdisciplinary areas like health and Psychosocial Care, Gender Issues, Geoinformatics Applications, Early Warning Systems, Ecosystem Approach Climate Change Adaptation, and so on. NIDM started offering 3-5 days Training Course on Application of Geoinformatics in Disaster Management since May 2005. In this context, a training module on Geoinformatics Applications in Disaster Management has been developed by the institute for use by various institutions dealing with Geoinformatics Applications in Disaster Management like Remote Sensing Applications Centres, technical professionals of state and district level disaster management authorities and, the nodal ministries and institutions in the country at various levels. I hope the initiative of the institute shall be of significant contribution towards acheiving the goal of capacity development in the use of geoinformatics in disaster management.

Dr. Satendra, IFS
Executive Director, NIDM

Preface

Geoinformation data and tools like Remote Sensing (RS), Geographic Information Systems (GIS) and Global Positioning Systems (GPS) have increasingly been used world over in pre, during and post disaster phases for generating updated maps, integrating information, visualizing scenarios and identifying and planning effective solutions. As part of capacity-building and training activities on disaster management, NIDM has been implementing various training programmes at national and state levels for technical working group members, disaster managers and community representatives. Training programmme on Geoinformatics in Disaster Management has been offered by the institute since 2005.

This training module on Geoinformatics Applications in Disaster Management has been prepared for developing the capacity of technical professionals and disaster managers to optimally use Space Technology, Remote Sensing & GPS, GIS coupled with internet mapping services to manage disasters in various phases. Based on needs assessment and feedback from the national, state and district level technical professionals and Disaster Managers the document is presented as a series of modules and units containing introduction to Geoinformatics as well as applications in various phases of disaster management, i.e. pre, during and post disaster phases.

Module 1 describes the basics of disaster management, vulnerability profile of India and the overview of the institutional and legal framework for disaster management in India. Module 2 gives an on Introduction to Geoinformatics, i.e. Remote Sensing, GIS and GPS. Module 3 is on the applications of Geoinformatics in Disaster Management with case studies whereas Module 4 is intended to give and introduction to various global and national initiatives on Geoinformatics applications with due focus on the Disaster Management Support Programme of ISRO and the Key Global Initiatives like International Space Charter, SENTINEL Asia, UNSPIDER, SERVIR etc.

In the application sections, Module 5 introduces tools and methods for undertaking hazard mapping, Monitoring, Vulnerability Analysis and Risk Assessment. Examples/ case studies on drought, landslides, cyclone, chemical hazards etc are included in this module. Annexure 2 part II can be referred for hands-on Practice. Module 6 offers guidance for developing, implementing and utilizing Decision support systems for DM Planning and Emergency Response.

Module 7 introduces data requirement and methods for damage assessment with a case study of flood inundation mapping and damage assessment.

The module has two annexes. Annexure 1 contains formats for pre-training entry level assessment, sample schedule and evaluation/ feedback forms. Annexure –II is elaborate and self explanatory hands on exercise manual which can be used with the introductory module, hazard mapping, monitoring and risk assessment module as well as the damage assessment module. Practical manual developed using widely used proprietary software like ArcGIS, ERDAS and ENVI as well as in open source products like Quantum GIS , ALOHA, Marplot, Google Earth.

Though designed and tested for technical experts representing State Remote Sensing application centers, Research & Development organizations, the module can also can be used by other training facilitators, non technical professionals and self-learners as well. However, it is strongly recommended that training participants and self-learners already have some basic knowledge of Geoinformatics. The training programme suggested in the schedule is tested at NIDM and ATIs. However the programme may be designed to be flexible so that the base information can be tailored to participants' needs. This flexible training strategy is highly recommended over a step-by-step prescribed approach.

Each module also contains Learning Units with suggested training methods and exercises (in Annexure II) based on that module's content. The exercises expose the participants to new concepts skills and current practices. The training activities include interactive lectures, review sessions, guided hands on exercises, group exercises and presentations. The training can be facilitated by faculty members of NIDM, ATIs, Faculty members of Universities and so on. However, to be most effective delivery of the course, facilitators should have some background in both geoinformatics and disaster management so they are able to answer the technical questions which may arise from the participants. Training coordinator and facilitators are requested to follow the training strategy to ensure that they capture the key aspects of the module. We hope the information presented in this module would enable participants to acquire knowledge and basic skills of effectively utilizing geoinformatics in managing disasters.

Sreeja S. Nair
Author

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The module has been developed in consultation with many experts at national at international level and revised in response to the feedbacks from the participants of the NIDM Training courses since 2005. The author acknowledges the significant contributions from National Remote Sensing Agency and Indian Institute of Remote Sensing, Department of Space in developing the module. Inputs received from organizations at national and state level including State Remote Sensing Application Centres, DMCs of Administrative Training Institutes, Vellore Institute of Technology, ITC-Netherlands and ESRI India is deeply acknowledged. Comments from the reviewers on the draft of the module remarkably from Dr. P.S. Roy, Director Indian Institute of Remote Sensing, Shri V. Bhaumurthy, Head of the Decision support Centre at NRSC and Dr. S.K. Srivastava, Head Geoinformatics Department of Indian Institute of Remote Sensing were extremely useful in improving the contents and design of the module and the practical manual. Author is grateful to all whose support has made the effort turn into a successful publication particularly Dr. K. Radhakrishnan, Chairman Indian Space Research Organisation Dr. V.S. Hegde, Former Director, DMS Programme, ISRO, and Shri. P.G. Dhar Chakrabarti, Former Executive Director of NIDM. Inputs suggestions and encouragement from the following experts and faculty members of NIDM during different stages of developing and reviewing the module and the manual have been very significant.

- Dr. P.S. Roy, Director, Indian Institute of Remoter Sensing (IIRS) Dehradun (Reviewer)
- Mr. V. Bhanumurthy, Group Director, Disaster Management Group, National Remote Sensing Centre, Department of Space, Hyderabad. (Reviewer)
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- Mr. Jothiganesh Shanmugasundaram, Decision Support Tool Development Specialist, Regional Integrated Multi-Hazard Early Warning Systems (RIMES), Bangkok, Thailand (Reviewer)
- Mr. P.G. Dhar Chakrabarti, Former Executive Director, NIDM.
- Dr. Satendra, Executive Director, NIDM.
- Dr. V.K. Sehgal, Senior Scientist, Division of Agriculture Physics, Indian Agricultural Research Institute
- Prof. Chandan Ghosh, Head Geohazards and IT, NIDM
- Dr. Anil Kumar Gupta, Associate Professor, PPCCI, NIDM

- Mr. Sanjay Singh Gahlout, Deputy Director General, National Informatics Centre, New Delhi
- Dr. Sanjay Srivastava, UN-ESCAP, Bangkok, Thailand.
- Dr. Shirish Ravan, Coordinator, UNSPIDER- China, UNOOSA.

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- Mr. Hemant Kumar, Computer Programmer, NIDM

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List of Acronyms

AHP	Analytical Hierarchical Process
ALOHA	Areal Locations of Hazardous Atmospheres
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
ATI	Administrative Training Institute
AVHRR	Advanced Very High Resolution Radiometer
CAMEO	Computer Aided Management of Emergency Operations
CII	Confederation of Indian Industry
CRATER	Coastal Risk Analysis of Tsunamis and Environmental Remediation.
DIP	Digital Image Processing
DMIS	Disaster Management Information System
DMP	Disaster Management Plan
DOS	Department of Space
DRM	Disaster Risk Management
DSC	Decision Support Centre
DSS	Decision Support Systems
EMR	Electro Magnetic Radiation
ENVI	ENvironment for Visualising Images
FCC	False Color Composite
FICCI	Federation of Indian Chambers of Commerce and Industry
FMIS	Flood Management Information System
GMES	Global Monitoring for Environment and Security
GEPR	GIS based Emergency Planning and Response
GIS	Geographical Information System
GNSS	Global Navigation Satellite Systems
GPS	Global Positioning Systems
GRASS	Geographic Resources Analysis Support System
GSI	Geological Survey of India
HFA	Hyogo Framework for Action
HPC	High Power Committee
ICIMOD	International Centre for Integrated Mountain Development
BMTPC	Building Materials & Technology Promotion Council
ILWIS	Integrated Land and Water Information System
INFRASS	Indian Forest Fire Response and Assessment System

KML	Keyhole Markup Language
MARPLOT	Mapping Applications for Response, Planning & Local Operational Tasks
MHA	Ministry of Home Affairs
OGC	Open Geospatial Consortium.
NADAMS	National Agricultural Drought Assessment and Monitoring System.
NDMA	National Disaster Management Authority
NDVI	Normalized Difference Vegetation Index
NIC	National Informatics Centre
NOAA	National Oceanic and Aeronautic Administration
NRSC	National Remote Sensing Centre
QGIS	Quantum GIS
RADIUS	Risk Assessment Tools for Diagnosis of Urban areas against Seismic Disasters
RIMES	Regional Integrated Multi-Hazard Early Warning System.
MAH	Major Accident Hazard
RS	Remote Sensing
RSAC	Regional Space Application Centre
SAFER	Service and Applications For Emergency Response
SBI	Space Based Information
SDRN	State Disaster Resource Network
SPOT	Système Pour l'Observation de la Terre
STRM	Shuttle Radar Topography Mission
UN	United Nations
UNSPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
VCI	Vegetation condition Index
VPN	Virtual Private Network

Contents

Annexure

1.0 Salient features of the Module

Name :	Training Module on Geoinformatics Applications in Disaster Management
Total Number of modules : 7	
Target Group :	Technical Professionals, Subject Specialists (Geologist, Environment, Agricultural Specialist, Watershed Professional and so on) Trainers and Administrators working on Disaster Management.
Duration :	3 days to 2 weeks depending upon the target groups and their training needs.
Infrastructure Requirements	
•	Geoinformatics lab with high end computers (it is advisable to have PCs with RAM of 2 GB or more with more than 50 GB unused disk space)
•	GIS and Image Processing Software e.g. Arc GIS, ENVI, ERDAS and ILWIS, Quantum GIS. Application specific softwares like HEC-RAS, HAZUS, ALOHA, MARPLOT, Health Mapper etc also may be required for hazard specific programmes.
•	Number of trainers required is minimum 4-5 for each course. A technical assistant for handling GIS and Remote Sensing Lab is also needed.
•	Sitting arrangement is Class Room Type
•	Training materials include data in desired format, hand-outs and Practical Manuals
•	High speed internet connectivity

2.0 INTRODUCTION TO THE MODULE

2.1 CONTEXT

There is an increasing trend in disasters both in frequency as well as damage caused in terms of human casualties, economic and environmental. In many states of our country, basic information for disaster reduction (technical studies, geographical data, etc) usually exists, but is not readily available to local authorities and other stakeholders. The information is hardly available in a form that facilitates sound decision-making. With the use of GIS and remote sensing the possible effects of natural phenomena like floods, drought, earthquakes, landslides, volcanic eruptions and forest fires on buildings, population, infrastructure etc. can be modelled and made visible in a spatial and interactive manner. If this is done in a proper way, GIS and remote sensing can be used as a powerful tool for analysis of hazard, vulnerability and risk, resulting in the development of different scenarios and concrete measures for disaster prevention. Simple, low-cost GIS systems allow local authorities to properly plan the areas under their jurisdiction, and to incorporate the local knowledge and ensure community participation, combined with modeling results from experts. To achieve this, professionals needs to be trained in the application of GIS and remote sensing for disaster management.

2.2 TITLE OF THE MODULE

Training Module on Geoinformatics Applications in Disaster Management

2.3 AIM

To raise awareness amongst the participants and develop skills for effectively utilising the Geoinformation tools like Geographic Information Systems, Image Processing, Global Positioning Systems and Space Based Information(SBI) in Disaster Management.

2.4 LEARNING OBJECTIVES

The main objectives are following

- To enable the participants to understand the basic concepts of Natural Disaster Management and institutional mechanism for Geoinformation data and services particular to DM in India.
- To sensitize participants about the potential role of Remote Sensing and GIS for holistic disaster risk reduction and management, i.e., in various phases of disaster management, data sources and national Initiatives (Mainly DOS and MHA).
- To impart knowledge on application of RS, GPS and GIS for

mapping / monitoring, analysis of hazard, vulnerability & risk assessment, early warning and damage assessment.

- To improve the skills of participants in implementing functionalities of Remote Sensing & GIS software for disaster management through hands on training and demonstrations.

2.5 COURSE CONTENT

- Disaster Management Definitions and Concepts
- Introduction to Geoinformatics
- Applications of Geoinformation in Disaster Management
- Principles of Remote Sensing
- Introduction to Global Positioning System
- GIS Components and Functions
- Drought Forecasting, Early Warning and Monitoring
- Landslide Hazard Mapping, Vulnerability and Risk Assessment
- Storm Surge Hazard Mapping, Vulnerability Mapping and Risk Assessment
- Tsunami Vulnerability Mapping and Risk Assessment
- Flood Inundation Mapping and Preliminary Damage Assessment GIS for Disaster Management Planning
- Off site Emergency Management Planning for Chemical (Industrial) disasters
- Creating Internet Based map Services for data sharing

It is not practically feasible to complete all the modules in 5 days time. Similarly, Geoinformatics is a tool to facilitate decision making and hence its applications and the training needs also highly depends upon the requirement of the participants. For example an administrator likes to know about the data availability and how the tool can be used for decision making. But a district informatics officer or a GIS professional working with Remote Sensing Application Centre is interested in generating various data sets for decision making. Similarly officials from Agriculture, Water Resources, Environment, Disaster Management and Industries have different training needs. So it is advisable to have a suitable combination of 4 to 5 modules for each 3 day, 5 day and 2 weeks training programme after assessing the training needs.

2.6 TARGET GROUP & COURSE DURATION

(a) Administrators and disaster managers: 3 days awareness generation programme. Prior experience of Geoinformation technology is not required to for undergoing this programme.

(b) Technical Professionals from Ministries and Nodal Departments:

3 days to 2 weeks thematic programme for technical professionals from research & academic Institutions including State Remote Sensing Application Centers, technical professionals from ministries and nodal departments like agriculture, water resources, Forestry, environment, urban development, disaster management, Geological Survey of India etc , Industries and private sector like FICCI, CII etc. Prior experience of handling spatial data and use of RS and GIS software is preferable for this programme.

(c) Professionals involved in GIS database development for Disaster Management: 5 days programme (technical skill development) for officials of National Informatics Centre, Emergency Operation Centres and other professionals supporting the decision makers and disaster managers at State and District level. Prior expertise in Information technology preferably GIS and GPS is required for this programme.

2.7 COURSE DURATION

- 3 days awareness generation course
- 5 days course on Geo-informatics applications in DM.
- 3 days - 2 weeks (Thematic Programme)

2.8 MODE OF TRAINING

- Lecture & question answer session
- Power Point Presentations
- Video Conferencing, Space NET Class (depends on the availability of the facility)
- Group discussion and Experience Sharing
- Demonstrations
- Hands on Exercise
- Field Visit (NIC's GIS Unit, GIS Facilities at Remote Sensing Application Centres, Science and Technology Councils and Emergency Operation Centres)

2.9 TRAINING MATERIALS AND EQUIPMENT

- Computers (2 GB RAM) and Windows XP Preferably)
- GIS and Image Processing Software (ArcGIS, ENVI, ERDAS, Quantum GIS)
- Handheld GPS
- LCD Projector
- Screen
- Mike and Speakers
- Flip Chart
- Folder, CD, Pen

2.10 PERFORMANCE AIDS

- **Practical Manual**: This practical manual should be elaborate and self explanatory with all the steps and screen shots.
- **Lecture Notes:** Disaster

Management, GIS, GPS and Remote Sensing.

- **Handouts of Presentations**: Should be clear enough to read and space for adding notes to be provided.
- **Readings :** Case studies and published papers, articles, white papers etc on the applications of Geoinformatics

3.0 HOW TO USE THE MODULE

- This module is meant for use by Course Coordinators and the trainers identified by him / her. Although the module is self explanatory the trainers are advised to undergo the training organized by NIDM prior to using it for delivering such training programmes.
- Before starting the training programme they must thoroughly familiarise themselves with the module.
- The module is having the following details
  - Title of the modules and Learning units : This identifies the topics of the session. Each session should begin with a brief outline of the topic.
  - Duration: This shows the duration of each of the learning unit. The resource persons should be told to complete the session within the allotted time. Any deviation will upset the training schedule.
  - Learning Objective : This describes what the participants will be able to gain in terms of knowledge, skill or attitude by the end of each session. The facilitator / trainer may explain the objectives before commencing each session.
  - Content: The contents to be covered in each session are given. The resource persons should go through these and ensure that all items are covered in the session.
  - Methodology : Methodology to be adopted for each session is given. However, the resources persons can choose own methods to make the session more interactive and participatory.
- Guidelines to course director / facilitator: These are instructions to resource persons for handling the sessions effectively.
  - The course director/ coordinator / facilitator of programme should adequately equip him/herself by reading the relevant literature on the subject and preferably by attending similar training programmes.
  - Course director should make sure that the profile (i.e., computer proficiency) of the participants is relatively uniform. Since Geoinformatics is a technical programme and it involves lot

of hands-on exercise. Mixed (technical and non technical) group is not very successful since the needs of different target groups are extremely different.

- Though it may be necessary to bring in out side experts as guest faculty, it is essential that the available faculty members from the Institute are involved as far possible for providing continuity to the training and to support and facilitate the learning process.
- The reading material provided is for the Course Director/ Resource persons as well as the participants. The resource persons should also read it before starting the programme so that he/she gains a thorough knowledge in the subject area. It is desirable that the reading materials are supplied to them well in advance or at least on day one of the course.
- Selected list of Web links on Geoinformatics and Disaster Management is provided and the course directors/ resource persons are advised to update their knowledge on recent developments in the field by using the same.
- The suggested timings of the programme are from 9.30 am to 5.30 pm with 60 minutes for each lecture session followed by 120 minutes exercise. This is required for adequate coverage of all sessions in a day. It is better to make the programme a residential one. This will enable the participants to spend the evening hours in studying cases, go through the reading material, and exchange their views and so on.
- Each session has to be participatory and experiential. The participants may be encouraged to ask questions, seek clarifications, share their personal experience and express their views freely.
- The reading material provides national/ state specific case studies on the Role of Geoinformation in Disaster Management. However, the resource persons should present district and state level data relating to the respective state on various topics and discuss the same. This way the participants will gain more insight into the issues closer to home.
- Case studies depicting the local situation may be prepared in advance for use in the hands on sessions. Course director can suggest

participants to bring own data sets. This will help them in understanding the data needs, source, updating and applications.

- Though the modules and exercises were tested at NIDM, it may be necessary to make some changes suitable to the local context. Feedback from participants is very important and useful for making the necessary modifications. This may be done as part of the evaluation session on the last day.
- The course has to be sufficiently flexible, in terms of time allotted to each session and content, to accommodate the requirements of the participants.
- Since the module attempts to cover a number of topics with hands on exercises, there is no separate time slot for participants to use the library at NIDM or ATIs. However the library facilities, including borrowing of books, should be provided to them after training sessions.

DESIGN BRIEF

DAY 1

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
1. Disaster Management Concepts and Institutional Framework	LU 1.1-Disaster Management Concepts and Institutional Framework	All participants and courses	1 hour
2. Introduction to Geo-informatics	LU 2.1 Remote Sensing LU 2.2 - Global Positioning System LU 2.3 -Geographic Information Systems and Geospatial data management LU 2.4 - Introduction to data sources and software	All target Groups	1 hour
	LU 2.1 -Principles of Remote Sensing • Remote Sensing Systems • Platforms and Sensors • Interaction of EMR with the objects • Resolution and Scale	All target Groups	1 hour
Exercise 4	• Downloading imageries from existing sources like SPOT, Landsat, UNOSAT, NOAA AVHRR etc • Georeferencing a satellite image Integrating with RS imageries and other spatial non spatial data in GIS	All target Groups	2 hours

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
DAY 2			
	LU 2.2 -Geographic Information Systems • Components and Functions • Capturing data • Displaying • Querying and examining data • Working with spatial data formats • Working with tables and attribute data • Editing data (spatial) • Analysis using extensions (Spatial Analyst, Network analyst etc) • Generating outputs	District Informatics Officers, State RSAC officials, ATI Faculty, technical professionals from concerned departments (except administrators)	1 hours
Exercise 1 Exercise 2 Exercise 3	• Digitization of hazard maps • preparation of multi hazard map • identifying the various districts/ blocks and town in hazard prone areas and vulnerable population	District Informatics Officers, State RSAC officials, ATI Faculty, technical professionals from concerned departments (except administrators)	2 hours
	LU 2.3 -Introduction to Global Positioning System • GPS Segments • How GPS works • Advantages of GPS • Accuracy • Applications in DM	District Informatics Officers, State RSAC officials, ATI Faculty, technical professionals from concerned departments	1 hour

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
Field Exercise	• Collecting way points , paths GPS data to Map • Representing on Google Map	District Informatics Officers, State RSAC officials, ATI Faculty, technical professionals from concerned departments	2 hour
3.Geo-informatics Applications in Disaster Risk Reduction & Management	LU 3.1 Geo-information in DM Cycle • Prevention & Mitigation • Hazard Mapping • Risk Assessment • Modeling • Preparedness and Early Warning • Response and Relief • Damage assessment • Rehabilitation and Recovery Planning LU 3.2 Case Studies and advances in the field LU 3.3 Advantages Issues and Challenges	All target Groups	1 hour 30 Minutes

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
4. Global and National Initiatives	LU 4.1 Overview of Disaster Management Support Programme (with Special Focus on DSC Products and Services)Initiatives by ISRO/DOS Various projects and programmes for Disaster Management National Database for Emergency Management Community Centric Geo-information approach and case studies International Charter for Disaster Management EDUSAT, Telemedicine etc. Constitution of NDSS at NRSA, Concepts, Scope, applications and current status. Services of DSC, Role & Responsibilities of NDSS during any disasters Some best cases of the services of DSS (Bihar Flood, Tsunami 2004, NADAMS, Perachu Lake Burst, Kosi Floods etc) 4.2 Key Regional and International Initiatives Existing international space-based initiatives for disaster management International Charter and Major disasters UN-SPIDER SERVIR Himalaya/SENTINEL Asia GMES/SAFER Geo/Crowd Source Opportunities and gaps for using existing initiatives. Opportunities for better collaboration.	All target groups (Mandatory for Administrators and Disaster Managers)	1 hour 30 Minutes

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
5. HAZARD MAPPING, MONITORING, VULNERABILTY AND RISK ASSESSMENT			
5 (A) Remote Sensing Applications in Agricultural Drought Monitoring and Forecasting	LU - 5 (A)1: Drought definition and types LU – 5 (A) 2: Agricultural Drought Monitoring Potential of Space Technology in Agricultural drought Monitoring Spectral signatures of crops Crop condition monitoring Vegetation Indices (NDVI & VCI) NADAMS Methodology Advantages and Limitations	State Remote Sensing Application Centres ATI Faculty, Technical professionals (involved in Agricultural Drought) (Not for participants from NIC, GSI and those involved in Response)	1 hour
Exercise-5 Practical Session of module 5 A	Drought Assessment and monitoring using SPOT vegetation data Downloading SPOT vegetation data Spatial Subset, Generating NDVI NDVI Enhancement and Analysis and NDVI Change Detection Image Classification, Spatial Statistics Identifying district wise status (Normal/ Watch, Alert)		2 hours

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
5 (B) Landslide Hazard Maping	LU – 5 B.1 : Introduction to Landslide Hazards, Hazard Mapping Concepts LU – 5 B.1 : Methodology for regional scale hazard mapping Landslide Inventory Mapping Data Requirements Analytical Hierarchical Process Advantages and limitations	Geological Survey of India, State Remote Sensing Application Centres, ATI Faculty, Technical professionals (involved in Landslide Hazard Mapping and Vulnerability Analysis)	1 hour
Exercise 6 Practical Session of 5 (B)	Preparation of regional scale Land slide hazard zonation map Downloading SRTM – preparing slope map Creating Various Thematic layers Converting feature to Raster Weightage Computation Editing Tabular data Landslide Susceptibility Mapping Validation with Inventory map Buffer Zones and Identifying vulnerable areas, infrastructure and population	-do-	2 hours

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
DAY 4			
5(C) Remote Sensing and GIS for Flood Hazard Mapping	Hazard Mapping Concepts Data Requirements Issues and Challenges	State Remote Sensing Application Centres ATI Faculty, Technical professionals (involved in Flood Hazard Mapping and Vulnerability Analysis)	1 hour
	Hazard Mapping Creating various thematic layers Weightage Computation Susceptibility Map Validation with past disaster data Buffer Zones and Identifying vulnerable areas, infrastructure and population	-do-	2 hours
5 (D) Storm Surge Hazard Mapping, Vulnerability and Risk Assessment	Impact of Cyclones Storm Surge Hazard Maps Data requirements Methodology Issues and Challenges		1 hour
Exercise 7 Practical Session of 5(D)	Prepare a storm surge hazard map for each return period Generating DEM Surge Model based on Historical Records		3 hours

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
5 (E) Coastal Vulnerability Analysis – Tsunami	Introduction to Multi- criteria Vulnerability Analysis Built Environment Vulnerability Population Vulnerability Socio-economic Vulnerability Environment Vulnerability Risk Assessment Limitations	State Remote Sensing Centers, ATI Faculty and Technical Institutions	1 hour
Exercise of Practical Session of 5(E) (Source:ADPC Toolkit)	Built Environment Vulnerability Population Vulnerability Socio-economic Vulnerability Environment Vulnerability Risk Assessment	-do-	2 hours
5 (F) Chemical (Industrial) Hazard Mapping & Risk Assessment	Industrial Hazards Data Requirements Tools CAMEO, ALOHA, MARPLOT Limitations	Factories, labour department, Industries & technical professionals involved in Chemical Risk Assessment, preparation of offsite plans and also for Land-use mapping for Industrial areas	1 hour
Exercise 8 Practical Session of 5(F)	Identifying MAH Locations (one MAH unit) Mapping based on Google imageries and free LANDSAT data Type of Hazard, Resources available Modeling Scenarios using CAMEO, ALOHA, MARPLOT	-do-	2 hours

Module	Learning Units (LU) & Contents	Target Group / Course	Duration
6. Disaster Management Planning and Emergency Response	Web-GIS based DM Plan and Emergency response tool for Delhi GIS based contingency plan upto community level for Satyabadi block , Puri District WebGIS based DM plans for Surat Gujrat and SDRN GIS based emergency preparedness and response tool for MAH units developed by NIC (for Chemical Disasters)	Administrators and disaster Managers	
7. Flood Inundation mapping & Damage Assessment	Applications of Remote Sensing data and GIS in Flood inundation mapping and damage assessment Case studies demonstrating data requirements, advantages and limitations.	Remote sensing Application centre technical professional & disaster manager	
Exervise 9 Exercise 10	Data preprocessing Classification of pre disaster and post disaster images Change detection Identify the affected area Assess the damage using the space-based information ,GIS data and ground truth .		

Module 1

Disaster Management Concepts and Institutional framework

Description

This module is intended to introduce the basic concepts, definitions and terminologies used in disaster management. i.e. Hazard Vulnerability, Risk and Disaster Management Cycle. Besides this will cover a brief introduction to the institutional and legal framework for disaster management in India including the DM Act, 2005. The session will orient the participants towards the training programme. This is relevant because participants are mainly from technical background and not having understanding about the basic DM Concepts and institutional framework for disaster management in the country.

Learning Objectives

Towards the end of this module participants will be able to

- Define the various terminologies used in Disaster Management
- Distinguish between terms e.g. hazard and disaster, vulnerabilty and and risk etc.
- Enumerate various disasters
- Classify based on origin and scale
- Describe various phases of Disaster Management Cycle
- Explain the existing Institutional Mechanism
- Describe the salient features of DM Act 2005

Learning Units

Methodology

- Film on Disaster Management
- Power Point Presentation
- Question Discussion & Answer

Duration

1 hour

Teaching and Performance Aids

- Lecture Note on DM Concepts – Chapter 1 of the reading material
- Copy of DM Act
- Handout of Presentation
- Flip chart
- White Board

Contents

- Definitions and Terminologies : Hazard, Vulnerability, Risk and Disaster
- Phases of Disaster Management Cycle
- Vulnerability of India
- Legal and Institutional Framework

Instruction for the Trainer

The trainer should be knowing about the profile of the participants

and should make a presentation suitable for participants from technical background having very little or no knowledge on Disaster Management. Presentation should be made in such a manner to grab attention from participants of Geo-informatics background. Less text and more pictures and photographs is advisable for the group. Before the illustrative presentation a 10 minute movie on disaster management would be shown to the participants from Remote Sensing centres Instruction shall be given to the participants to observe the film carefully and note down the observations and comment on how they are gomj to apply Geoinformation in Disaster Management.

Module 2

Introduction to Geoinformatics

Learning Unit 1 : Remote Sensing

Description

This unit is intended to introduce the basic principles and terminologies used in Remote Sensing. Introduction to the various remote sensing data and their importance in Disaster Management also will be included in this unit.

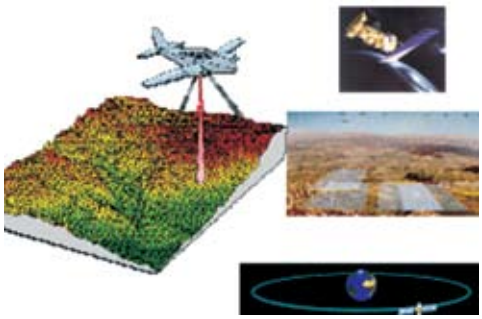
Learning Objectives

Towards the end of this module participants will be able to

- Define Remote Sensing
- Describe about the remote sensing systems
- Explain the detail about the electromagnetic spectrum and physics of RS
- Distinguish between Active and Passive Remote Sensing
- Explain about the interaction of objects and EM Radiation and spectral reflectance curve
- Define remote sensing Platforms and Sensors
- Describe about the various types of resolution

Methodology

- Power Point Presentation
- Question - Answer
- Demo



Duration

1 hour Lecture+Demo & 2 hours for Hands on Training.

Teaching and Performance Aids

- Lecture Note Remote Sensing – (Chapter 2 of the reading material)
- Handout of Presentation

Contents

- Definition of Remote Sensing
- Advantages of Satellite Remote Sensing
- Remote Sensing Systems, Source, Target, Sensor and Analyzer
- Remote Sensing Platforms and Sensors
- Electromagnetic Spectrum
- Interaction of objects with EMR and Spectral Reflectance Curve
- Active and Passive Remote Sensing
- Scale and Resolution, Spectral, Spatial, Temporal and Radiometric

- Remote Sensing data and applications

Practical Exercise on ERDAS Imagine. ENVI or ILWIS to be made as a part of the Session to introduce image processing for technical professionals (only)

Refer to Exercise 4 of the practical manual for the same.

Instruction for the Trainer

The trainer should know about the profile of the participants and should make the presentation suitable for participants. For Disaster Managers and IT professionals the emphasis can be given on the Remote Sensing concepts. If the group is dominated by participants from Remote Sensing Centres then the focus should be on applications and not on the basics. Most of the time the group is having both kind of participants and it is a challenge for the trainer to address the needs of the mixed group.

Learning Unit 2.2 Global Positioning Systems

Description

In this unit the participants will be introduced to the concepts and functions of Global Positioning System (GPS) and Global Navigation Satellite Systems (GNSS) and applications in Disaster management.

Learning Objectives

Towards the end of this module participants will be able to

- Define GPS
- Enumerate the advantages of GPS
- Describe about the various Segments of GPS
- Explain how a GPS system works?
- Explain about the existing GNSS?
- Specify the different types of errors in GPS Systems?
- Explain about Differential GPS and advantages over the handheld GPS Systems
- Use a basic handheld GPS
- Capture data in GPS and integrate in GIS using Map source and connecting to Google Earth.
- Examples of GPS applications in Disaster Management.

Methodology

- Lecture and Power Point Presentation
- Demo on GPS
- Field Survey to collect data
- Hands on Exercise to integrate data in GIS

Duration

- Total – 3 Hours, 1 hour (lecture +
- Demo+2 hour practical on GPS data collection and integrate to GIS

Teaching and Performance Aids

- Lecture Note Global Positioning Systems – (Chapter 3 of the reading material)
- Handout of Presentation
- Handheld GPS instrument with a brief field note (instruction)

Contents

- What is GPS?
- Components/ segments of GPS , Space Segment, Control Segment and user Segment
- Why GPS? What are the advantages?
- How does a GPS Work? Triangulation and Timing

- Errors in GPS
- Applications (in brief)
- GPS data and integration with Google earth

Instruction for the Trainer

The trainer should give more emphasis on demonstration of the GPS instrument and data collection and integration in GIS. It is also important to explain about the limitations and advantages of using the GPS and the tips to collect the data of maximum possible accuracy using a given instrument. Do not get much into the details of datum, projection etc which is beyond the scope of the course.

Learning Unit 2.3 : Geographic Information Systems

Description

This session will introduce the definition, components and functions of Geographic Information Systems (GIS).

Learning Objectives

Towards the end of this module participants will be able to

- Define Geographic Information Systems
- Enumerate the advantages of GIS over the conventional tools and techniques
- Describe about the various components of GIS
- Explain the functions of GIS
- Use GIS Software (Arc GIS or Quantum GIS) to perform the basic GIS functions and generate a desired out put.
    - Georeference a map
    - Create new layers for mapping
    - Edit maps and tabular data
    - Join spatial data with tables
    - Perform query and analysis
    - Prepare of thematic maps
    - Generate outputs as maps, tables, Charts and Reports.

Methodology

Lecture and Power Point Presentation

Demo on GIS Software (ArcGIS/ Quantum GIS)

Hands on Exercise

Duration

1 hour (lecture + Demo) + 2 hour practical on GPS data collection and integrate to GIS

Teaching and Performance Aids

- Lecture Note (Components and Functions of Geographic Information Systems)
- Handout of Presentation
- Practical Manual, Exercise-2
- GIS Software, Scanned Map, administrative boundary map and Census data

Contents

- What is GIS?
- Components of GIS
    - Hardware
    - Software
    - Data
    - Personal
    - Procedures

- Data types
  - Non Spatial – Attribute data
  - Spatial
    - Raster data
    - Vector data i.e. Point, Polygon, Polyline
- GIS Functions
  - Data generation
  - Storage
  - Manipulation and updating
  - Query and Analysis
  - Displaying data
  - Generating output

Practical Exercise on ArcGIS or Quantum GIS to develop skills on performing the GIS functionality. Exercise on Earthquake hazard mapping of Uttarakhand State (Refer to Practical Manual) Exercise 1,2&3).

Instruction for the Trainer

The trainer should give more emphasis on demonstration of the GIS Functions and data integration and analysis in GIS. The exercise should be designed and conducted in such a way that all the basic functions to be introduced after performing the hands on exercise. Since it is important to learn the basic functions, make sure that participant already acquired basic skills of performing GIS functions. Please keep in mind that this exercise is not earthquake hazard mapping exercise.

Learning Unit 2.4 Introduction to data Sources and Software

Description

This session is aimed at introducting to various sources of spatial and non spatial data sets and open source and proprietary (commercial) softwares available.

Learning Objectives

Towards the end of this module participants will be able to

- Download and process Different datasets i.e. SPOT Vegetation, NOVA AVHRR, SRTM, ASTER, LANDSAT TM etc
- Download and install open source GIS/RS software like GRASS, ILWIS, DIVA, QGIS, ARCGIS etc
- Use Google Earth and Bhuwan

Teaching and Performance Aids

1. Lecture Notes
2. Handout of Presentation
3. Computer with internet connectivity

Instruction for the Trainer

This is a self testing module for the participants and trainer should only facilitate the process. There is no dedicated time slot for doing this exercise and participants should test this module any time on day one or day two of the course.

Module 3

Applications of Geoinformatics in Disaster Risk Reduction and Management: Scope, Examples and Advancements

Description

This session will give an overall description of the applications of geoinfomatics tools and techniques and spatial data for the various phases of disaster management cycle with examples and case studies.

Learning Objectives

Towards the end of this module participants will be able to

- Describe the role of Geoinformatics in various phases of Disaster Management Cycle, i.e., Pre, during and Post disaster Phase for natural and manmade hazards
- Enumerate the advantages of using Geoinformatics in DM
- Mention about the Gaps and Implementation issues

Methodology

- Lecture and Power Point Presentation
- Demonstration of case studies e.g. DMIS, FMIS etc.

Duration

1 hour (lecture + Demo)

Teaching and Performance Aids

1. Lecture Note on Geoinformatics applications in Disaster Management
2. Handout of Presentation

Contents

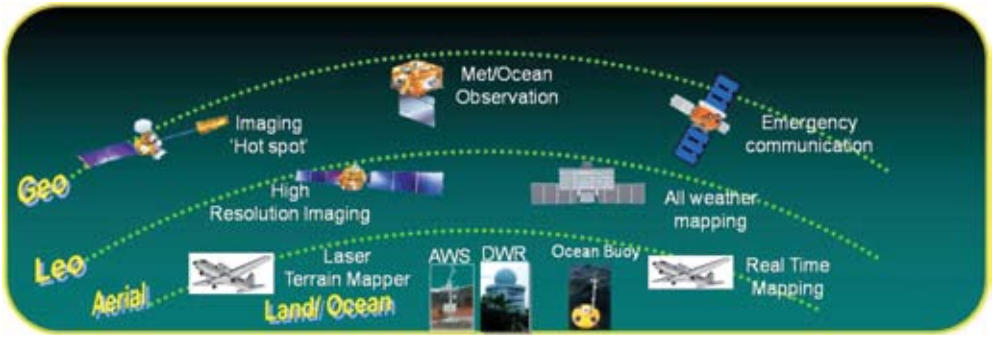
- Application of Geoinformatics in Disaster Management cycle
  - a. Hazard, Vulnerability and Resource Mapping
  - b. Catastrophic Risk Models
  - c. Preparedness, Contingency Planning
  - d. Early Warning, Decision Support System
  - e. Evacuation Planning
  - f. Search and Rescue
  - g. Relief Distribution
  - h. Damage Assessment
  - i. Recovery Planning
- Case Studies
  - a. Agricultural drought monitoring
  - b. Seismic Risk Assessment
  - c. Chemical/ Plume Dispersion Models
  - d. DM Plans in GIS / what it means?
  - e. Emergency Management.
  - f. Damage Assessment, etc.
- Advances
  - a. Data sets
  - b. Technology including web GIS
  - c. Open source GIS
- Gaps and Implementation Challenges
  - d. Software/ hardware
  - e. Data
  - f. Models and limitations
  - g. Examples and lessons learned from DMIS systems of India

Instruction for the Trainer

The trainer should give details about the Geoinformatics applications in various phases of Disaster Management Cycle with examples. It is important to present Indian/ state specific case studies with examples of both successful and failed systems to make a better understanding of the practical issues and implementation challenges. Case studies from other countries should be shown only if relevant Indian examples not available. Too much emphasis on case studies from develolped world can create disinterest amongst participants.

GLOBAL AND NATIONAL INITIATIVES

Learning Unit 4.1: Overview of the Disaster Management Support Programme



Description

This unit is intended to give an overview of the Disaster Management Support Programme of Department of Space, Government of India with special emphasis on the Decision Support Centre (DSC) set up at National Remote Sensing Centre, Hyderabad.

Learning Objectives

Towards the end of this module participants will be able to

- Mention about the scope of the Disaster Management Support Programme
- Know about the deliverable i.e. products and services by NRSC DSC for various natural disasters
- how to access them for management of disasters effectively and timely.

Methodology

Lecture and Power Point Presentation. Videoconferencing with DSC if the programme is at NIDM

Duration

1 hour

Teaching and Performance Aids

1 Brochure on the DSC Products and Services

2 Handout of Presentation

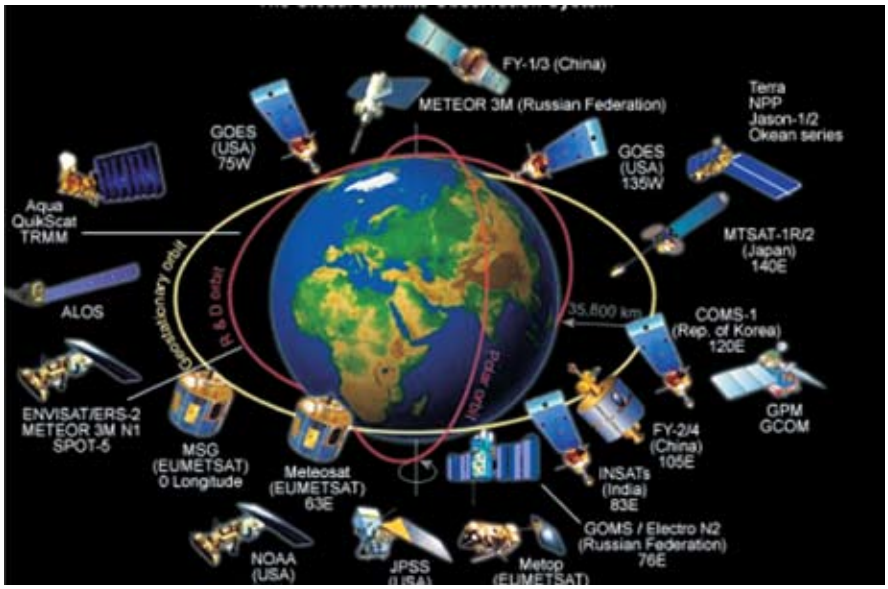
Contents

- About the DMS Programme
- Indian Space Programme, Earth Observation and Imaging Capabilities
- Remote Sensing and Communication satellites and systems for weather and climate monitoring
- Products and Services
  a. Agricultural drought monitoring - NADAMS
  b. Flood Hazard Mapping
  c. Earthquake Precursor Studies
  d. Landslide Hazard Mapping
  e. Flood Inundation mapping/ damage assessment
  f. Cyclone and Storm Surge Models, damage assessment
  g. GLOFs and LLOFs monitoring
  h. Forest Fire (INFRASS) etc
- Data dissemination services VPN, VRC, Telemedicine etc
- Training and capacity building : EDUSAT
- International cooperation i.e, Charter, SPIDER, Sentinel Asia etc

Instruction for the Trainer

The trainer (from Department of Space/ NRSC) should give details about the products and services provided under the disaster management support programme and the accessibility to them so that the users can effectively make use of them for Disaster Management.

Learning Unit 4.2 : Key International and Regional Initiatives



Description

Aim of this unit is to introduce the key global and regional level initiatives on space based information and Geoinformatics in Disaster Management, particularly during emergencies. Disasters occur in all the countries and not only in the countries with space observation capabilities. Even in a country with its own space-based resources could not cope with disasters with existing capabilities. For example, India is country with very high space observation capabilities, however depends on Canadian RADARSAT data for flood season. More and more initiatives are coming up in recent times to share the geospatial data online to support the disaster management and emergency response functionaries.

Learning Objectives

Towards the end of this module participants will be able to understand

- Why Space-Based Cooperation for Disaster Management?
- The gaps between Earth observation capacity (quantitative) and requirement for disaster management community (qualitative).
- List the key international initiatives like International Charter, Sentinel Asia, etc.
- Know about the deliverable i.e. products and services offered to Disaster Management Community under this programmes.

- How to / what is the procedure access the data for management of disasters effectively and timely.
- Recent examples of Global – Regional support through International Charter, Sentinel Asia, SERVIR Himalaya like Fukushima disaster, Japan, Pakistan Flood etc.

Methodology

Lecture and Power Point Presentation.

Videoconferencing with DSC if the programme is at NIDM

Duration

1 hour

Teaching and Performance Aids

Lecture note on various international initiatives /Handout of Presentation/ brochures

Contents

- International Charter Space and Major Disasters
- Service and Applications For Emergency Response (SAFER)

- GMES Emergency Response Service
- Sentinel Asia
- Regional Visualization and Monitoring System (SERVIR)- SERVIR Africa, SERVIR Latin America, SERVIR Himalaya
- Group on Earth Observation
- United Nations Platform for Space Based Information for Disaster Management and Emergency Response (UNSPIDER)
- Crowd Source
- Relief web etc
- Scope / Spatial and temporal coverage/ accessibility

Instruction for the Trainer

Expert from International Charter Programme, ISRO, regional organizations like ICIMOD or UNSPIDER experts should deliver this session. Recent examples on how the international community supported during disasters to be included. Besides the resource person should highlight the scope of these services and how to get access to products and services for Disaster Management and Emergency Response.

Module 5

HAZARD MAPPING, MONITORING, VULNERABILTY AND RISK ASSESSMENT

Salient Features

Objective of the Module 5 is intended to develop skills on applications of Spatial and non Spatial data and Geo-informatics tools for Hazard and Vulnerability Mapping, Monitoring and Risk Assessment.

This module includes various natural hazards like drought, landslides, floods, Landslides and Industrial (chemical) hazards.

There are 5 units in this module (5(A)-5 (F)) with to address the interests of various target groups. Each of this module can be used as add on module to ongoing hazard specific programmes and also for the Hazard Vulnerability and Risk Assessment programme.

Module 1 to 4 are for all the participants irrespective of the target group.

Module 5 and Exercise 5 to 8 are for skill development training targeting technical professionals and not for awareness generation programmes.

Sufficient time (4 Hours minimum) shall be allocated to cover the basics if this module is used in other courses. One or two of the exercise from this module shall be included in every five days training programme depending upon the target group.

5 (A) Remote Sensing Applications in Agricultural Drought Monitoring and Forecasting

Learning Unit 5 (A) 1: Drought definition and types

In this unit the participant will be given a brief introduction to drought definition and types before introducing to the applications of Remote Sensing and GIS in drought monitoring. The objective to understand different type of drought and how space based data can be used for agricultural drought monitoring. The trainer should make it as a part of the session on drought monitoring before the participants do hands on exercise.

Learning Unit 5 (A) 2: Agricultural Drought Monitoring

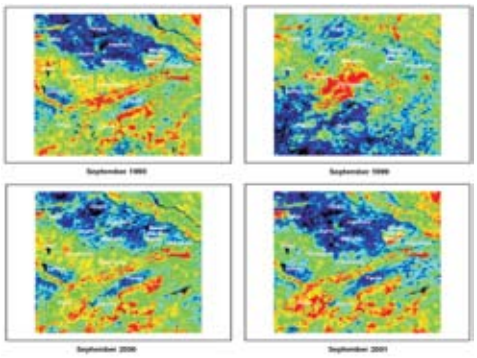
Description

This unit will be an introduction to the concept of Agricultural Drought Monitoring using remote sensing data.

Learning Objectives

Towards the end of this module participants will be able to

- Describe the concept of agricultural drought monitoring and Normalised Difference Vegetation Index (NDVI)
- Download and process vegetation data from various sources
- Develop a NDVI map/ database showing the vegetation condition
- Calculate the percentage deviation from normal and classify the areas based on the vegetation condition as normal/ watch and alert.



Methodology

- Lecture and Power Point Presentation on concepts
- Demo
- Guided Hands on Practice

Duration

3 hours including 45 minutes lecture/ presentation

Teaching and Performance Aids

- Handouts and Lecture notes on the concepts of Agricultural drought monitoring
- Training Manual demonstrating the steps. Exercise on Drought Monitoring in the training manual.

- Data: Freely downloadable SPOT vegetation data of 1 km spatial resolution for the hands on exercise.

Contents

- Introduction to drought and drought monitoring
- About NDVI
- Downloading data from SPOT website
- How to open data in ENVI software (or ERDAS)
- Spatial Subset
- Creating NDVI
- Representing NDVI as pseudo-colors
- Selecting multi-date data for a normal and drought year
- Creating NDVI difference images (drought year – normal year)
- Classify based on the NDVI difference values
- Overlaying vector data and Generating Region of Interest
- Spatial Statistics
- Calculating the percentage variation from normal for each region of interest i.e. at district, block or mandal level
- Classifying the vegetation condition of the districts/ blocks are normal, watch and alert based on the deviation from normal.

Instruction for the Trainer

The concept of Agricultural drought monitoring and advantages and limitation should be explained clearly to the participants before doing the exercise. ENVI software is been used for doing this exercise since the software is having advanced functions for ***data processing and spatial statistics*** and is very ***user friedly***. Other open source and commercial software like ERDAS Imagine, Geomedia, PRIMEWIN and ILWIS also having functionalities for generating NDVI. The same concept and methodology can be applied for other datasets and softwares also.

Note: This exercise is only for participants having experience in remote sensing preferable for Scientists of Remote Sensing Applications Centers or similar R&D Scientific Institutions. This exercise is not to be given for emergency managers like Fire, Police department officials or administrators.

5(B) - Landslide Hazard Mapping

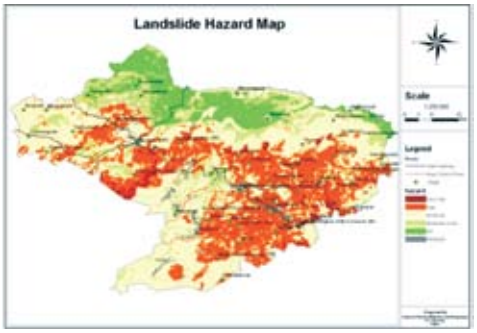
Description

This module will give a detailed description of the data sets and methodology used for regional scale Landslide Hazard mapping and comparison with the land slide inventory map generated using the field data. The exercise for this module is based on the methodology and data used in the preparation of Landslide Vulnerability Atlas, Developed by BMTPC & centre for Disaster Management Anna University Vulnerability Atlas, Developed by BMTPC & Centre for Disaster Management, Anna University.

Learning Objectives

Towards the end of this module participants will be able to

- Identify the various data sets to be used for Landslide Hazard Mapping
- Download data from existing sources
- Use spatial analysis extension
- Use Analytical Hierarchical Process for hazard mapping
- Generate a landslide inventory map using historical data
- Comparing the regional scale hazard map generated with the LS inventory map
- Identify the vulnerable villages, settlements and routes.



Methodology

- Power Point Presentation
- Demo on the software
- Guided Hands on Practice

Duration

3 hours including 45 minutes Lecture and demonstration.

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Contents

- Data requirements for Regional scale landslide hazard mapping
- Method to prepare a regional level landslide hazard map. (BMTPC)
- Preparation of the landslide location map based on the latitude and longitude of the historical landslides.
- preparation of various thematic

layers in the land slide hazard mapping

- Basics of weightage computation and Analytical Hierarchical Process (AHP).
- Generating the regional level landslide hazard Zonation map based on the Slope, Landuse, Rainfall and Geology layers.
- Identifying the villages in hazard prone areas.

Instruction for the Trainer

The concept of Analytical Hierarchical Process (AHP) with advantages and limitation should be explained clearly to the participants. ***ARCGIS software*** and Spatial Analysis extension is been used for doing this exercise since the software is having advanced functions for and is ***user friendly***. Other open source and commercial soft wares like Quantum GIS and ILWIS also can be used. The same concept and methodology can be applied for other datasets and softwares also.

Note: This exercise is only for participants from Geological Survey of India, Remote Sensing Applications Centers or similar R&D Scientific Institutions. This exercise is not to be given for emergency managers like Fire, Police department officials, administrators and other departments like industries, agriculture etc.

5 (C) Flood Hazard Mapping

Description

This module will give a detailed description the data sets and methodologies used for Flood frequency hazard mapping. The exercise for this module is based on the methodology and data used by NRSC.

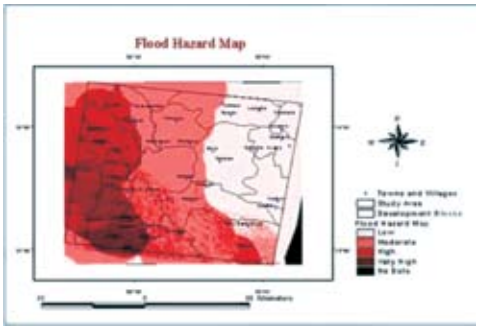
Learning Objectives

Towards the end of this module participants will be able to

- Identify the various data sets to be used for flood frequency mapping and Hazard Mapping
- Download data from various sources
- Use Analytical Hierarchical Process for hazard mapping (similar to Landslides) , integrating land- use land cover, Geomorphology, Rainfall, DEM etc.
- Generate a frequency map using historical data
- Identify the elements at risk i.e. the vulnerable villages, settlements and routes.

Methodology

- Power Point Presentation
- Demo on the software
- Guided Hands on Practice



Duration

3 hours including 45 minutes Lecture and demonstration.

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Contents

- Data requirements
- Method to prepare a flood hazard map.
- Preparation of the frequency map based on historical data
- Preparation of various thematic layers
- Basics of weightage computation and AHP.
- Generating the hazard frequency and intensity map.

Instruction for the Trainer

The concept of Analytical Hierarchical Process (AHP) with advantages and limitation should be explained clearly

to the participants. ***ARCGIS software*** and spatial Analysis extension is been used for doing this exercise since the software is having advanced functions for and is ***user friendly***. Other open source and commercial softwares like Quantum GIS and ILWIS also can be used. The same concept and methodology can be applied for other datasets and softwares also. Advanced hydrologic models like HEC RAS, MYKE 21 etc also can be used for specialized courses. Such product shall be used only for participants having considerable good level of domain expertise and also well versed with GIS.

Note: This exercise is only for participants from Remote Sensing Applications Centers or similar R&D Scientific Institutions. This exercise is not to be given for emergency managers like Fire, Police department officials, administrators etc.

5(D) Storm Surge Hazard Mapping and Vulnerability Analysis

Description

The modules cover the data requirements and methods to prepare a storm surge hazard map for each return period for cyclone for a particular location and vulnerability assessment based on the population density. Other indicators also can be used similarly if available.

Exercise is covered in two parts. Part 1 will be on the surge mapping and Part 2 on the vulnerability mapping.

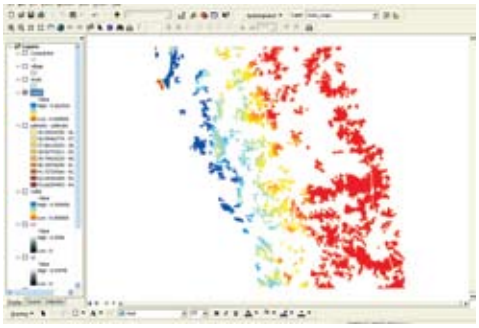
Learning Objectives

Towards the end of this module participants will be able to

- Identify the various data sets to be used for Storm Surge Mapping
- Download data from various sources
- Prepare DEM using the height data
- Create Distance layers for calculations, Calculate decay coefficient, surge height calculation for different zones.
- Prepare storm surge vulnerability map and flood risk map.

Methodology

- Power Point Presentation
- Demo on the software (Arc GIS)
- Guided Hands on Practice



Duration

3 hours

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Contents

- Data requirements and preprocessing steps
- Creation of Digital Elevation Model and Distance Layer
- Calculation of surge decay coefficient
- Surge Depths calculation
- Population vulnerability analysis (coastal flooding due to surge)

Instruction for the Trainer

ARCGIS software and spatial Analysis extension is been used for doing this exercise since the software is having advanced functions for raster

calculations, generation of DEMs etc ad is ***user friendly***. Other open source and commercial softwares like Quantum GIS and ILWIS also can be used. This exercise is only for participants having considerably good level of domain expertise and also well versed with GIS. Vulnerability analysis can be done including more indicators like build area map, land-use, Geomorphology etc to make the exercise more useful and applicable to real situations.

Note: This exercise is only for participants from Remote Sensing Applications Centers or similar R&D Scientific Institutions. This exercise is not to be given for emergency managers like Fire, Police department officials, administrators etc.

5 (E) Coastal Risk Analysis for Tsunami

Description

The module gives a detailed description of the module gives a detailed description about the multi criteria risk assessment tool developed by Asian Disaster Preparedness Centre. Multi-criteria analysis includes, Built Environment, Population, Socio-economic factors, Environmental factors and Risk Assessment method including the limitations of the tool. The exercise included in the module is based on the Coastal Risk Analysis for Tsunami and Environmental Remediation (***CRATER) Tool Kit*** developed by ADPC, Bangkok. The exercise is not included as a part of the training manual since the kit is available online.

Learning Objectives

Towards the end of this module participants will be able to

- Understand the concept of coastal risk assessment
- Perform vulnerability map using built environment vulnerability, population density, socio economic and environmental vulnerability.
- Hazard Mapping (Maximum height of water column reached in each point of the study area during the tsunami 2004)
- Risk Assessment

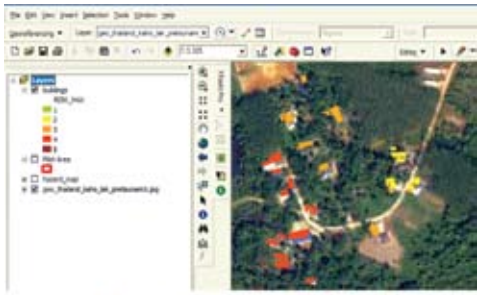


Figure 28. A detail of the buildings risk map of the pilot area

Methodology

- Power Point Presentation (brief intro to the tool)
- Demo on the software (Arc GIS)
- Guided Hands on Practice

Duration

3 hours including 45 minutes Lecture and demonstration.

Teaching and Performance Aids

- Risk Assessment and Evaluation Tool Box developed by ADPC.

Ref : http://www.adpc.net/

Contents

- Introduction to the tool developed by ADPC and Tsunami vulnerability and risk analysis.
- Vulnerability level for different factors
  - o Creating a “built environment” vulnerability map
  - o Creating a “population” vulnerability map

- o Creating a "socio-economic aspects" vulnerability map
- o Creating an "environment" vulnerability map
- Hazard Mapping
- Risk Level

Instruction for the Trainer

ARCGIS software software is used by ADPC for developing the tool kit. Other open source and commercial softwares like Quantum GIS and ILWIS also can be used. This exercise is only for participants having considerably good level of domain expertise and also well versed with GIS. Vulnerability analysis can be done including more indicators (if data is available) to make the exercise more useful and applicable to real situations.

Note: This exercise is only for participants from Remote Sensing Applications Centers or similar R&D Scientific Institutions. This exercise is not to be given for emergency managers like Fire, Police department officials, administrators etc.

5 (F) Chemical (Industrial) Hazard Mapping and Risk Assessment

Description

This module will give an introduction to Chemical Risk Assessment with an over view of various tools used for Modeling Scenarios for different hazardous chemicals and atmospheric conditions. EPA – NOAA developed CAMEO suits, i.e. CAMEO Chemicals, ALOHA and MARPLOT. http://www.epa.gov/oem/content/cameo/index.htm

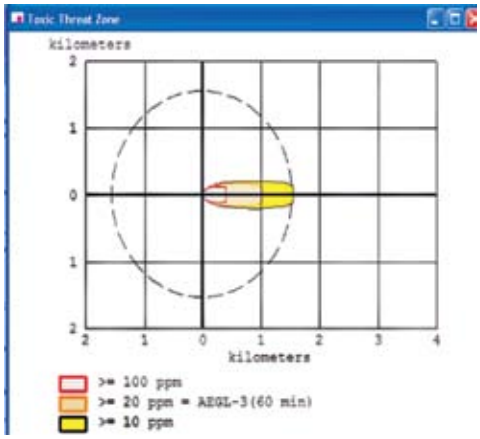
Learning Objectives

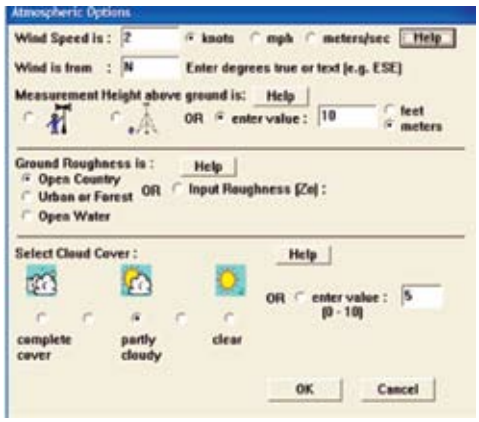
Towards the end of this module participants will be able to

- Identify the various data sets to be used
- Acquire data from various sources
- Generate Scenarios/ foot prints using ALOHA
- Represent the scenarios in Marplot
- Validate the modeled scenario with a past incident if available
- Represent the scenario on google earth.

Methodology

- Power Point Presentation
- Demo on the software (EPA CAMEO MARPLOT, ALOHA and CAMEO Chemicals)
- Guided Hands on Practice





Duration

3 hours including 1 hour presentation of Chemcial Risk Assessment and software demonstration.

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Module 5

Contents

- Data requirements and preprocessing steps
- Creation of layers for analysis
- Hazard Identifications – See the CAMEO Chemical list showing the Chemical Response Data Sheets and Reactivity Prediction Tool
- Generating Scenario using Areal Locations of Hazardous Atmospheres (ALOHA)
- Representing the scenarios in MARPLOT (Mapping Applications for Response, Planning, and Local Operational Tasks)
- Converting the map document to KML file for viewing in GOOGLE earth.

Instruction for the Trainer

The trainer should use open source GIS softwares i.e Quantum GIS for creating and modifying spatial and non spatial data. Analysis can be done using EPA-NOAA developed CAMEO System (open source) The CAMEO system integrates a chemical database and a method to manage the data, an air dispersion model, and a mapping capability. All modules work interactively to share and display critical information in a timely fashion. The CAMEO system is available in Macintosh and Windows formats

Note: The module will be extremely useful for administrators and disaster managers who are involved in developing offsite plans and chemical disaster response. This exercise will help emergency planners with a tool to enter local information and develop incident scenarios to better prepare for chemical emergencies. This exercise for participants from Factories department, labour department, Industries and technical professionals involved in Chemical Risk Assessment, preparation of offsite plans and also for Landuse mapping for Industrial areas. This exercise is not to be given for participants from Remote Sensing Centres, GSI and professionals from agriculture, water resources etc.

Module 6

Disaster Management Planning and Emergency Response-Case Studies

Description

The modules will demonstrate examples of development and implantation of Geoinformatics based Disaster management plans and emergency response.

Case studies on Decision Support Systems, DM plans, contingency and Emergency Response Plans developed in India with requirement of data, software, applications and implementation challenges shall be explained in this module.

Learning Objectives

Towards the end of this module participants will be able to

- Enlist the uses of decision support system and GIS based plans
- Identify the various data sets to be used and availability
- Acquire data from various sources and processing them
- Prepare relevant datasets for analysis.
- Creating Scenarios
- Come up with appropriate solutions to manage the scenario with exiting resources.

Methodology

- Power Point Presentation
- Demo

Duration

- 1 hour

Teaching and Performance Aids

- Handouts
- Lecture notes

Contents

- **Web GIS for Developing District Disaster Management Plan**
  - o Developing Spatial and Non-Spatial database for Risk and Capacity Analysis for Delhi Region.
  - o Developing Preparedness and contingency plans.
  - o Evacuation Plans and Emergency response.
  - o Developing Internet Mapping Services in WebGIS Platform and advantages.
- **Community Contingency Plans in GIS**
  - o Developing Spatial and Non-Spatial database

- Collecting data for community level analysis
- Integrate with DM plans to the spatial data.

Instruction for the Trainer

The trainer should show demonstration of the applications developed besides the power point presentations so that participants can appreciate the advantages of decision support systems. Case studies of implemented tools like Flood Management Information System, GIS based Emergency Preparedness and Response (GEPR) etc. also can be demonstrated to generate interest amongst the participants. Presentation of case studies relevant to the local context will be extremely helpful in generating interest.

Note: The module will be extremely useful for administrators and disaster managers who are involved in developing disaster Management Plans, offsite plans and disaster response. This exercise will help emergency planners with a tool to enter local information and develop scenarios to better prepare and respond to emergencies.

Module 7 Flood Inundation Mapping and Preliminary Damage Assessment

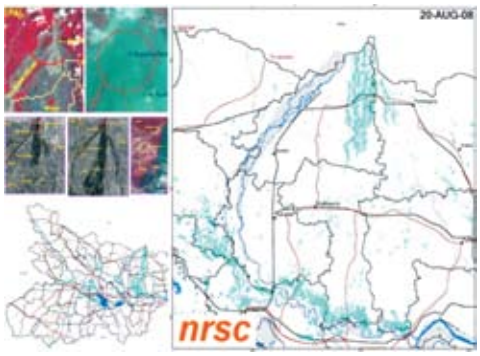
Description

This module will demonstrate the applications of space based information i.e. the pre-disaster and post disaster satellite imageries coupled with data on administrative boundary, land use map, census data to perform inundation mapping and preliminary assessment of damages. The exercise included in this module is developed using the RADARSAT image of 'Pre flood' time and 'Peak Flood' time for Naogaon district of Assam provided by National Remote Sensing Agency.

Learning Objectives

Towards the end of this module participants will be able to

- Identify the data required/ suitable for doing inundation mapping
- Classifying images and change detection
- Identify the inundated areas
- Preliminary assessment of damage by overlaying the affected areas map on the exiting spatial data (location villages, buildings, roads, railway lines agriculture etc)
- Integrate the data with non spatial datasets i.e. census and other data sets collected from field.



Methodology

- Power Point Presentation
- Demo on the software (ENVI and ARCGIS)
- Guided Hands on Practice

Duration

3 hours

Teaching and Performance Aids

- Handouts and Lecture notes
- Training Manual demonstrating the steps

Contents

- Preprocessing of data (RADARSAT)
- Image Enhancement (e.g. Pseudo coloring using ENVI Map)
- Image Classification using Hierarchical Decision Rule Classification
- Preparation of pre-flood and peak

flood classified maps showing flood inundated areas, permanent water bodies and drainage and dry land.

- Change detection using (bath-math in ENVI software and Raster Calculation in Arc GIS)
- Converting Classified layers to vector map
- Overlaying the inundation map on the other layers
- Assessing the preliminary damages

Instruction for the Trainer

The trainer should give an demonstration using Softwares (ENVI/ERDAS/ ARCGIS). Although this exercise is developed for flood scenario the same method can be applied for other disasters also. The tutor should keep in mind that the spatial/ spectral and temporal resolution of the data depends on the type of disaster. e.g. for assessing earthquake damages very high resolution data is required for Flood season microwave data of moderate resolution is required(for cloud free imageries) and for drought high temporal and spectral resolution with low to moderate spatial resolution to be used.

Note: The module will be extremely useful for the technical professionals working with State Remote Sensing Application Centres who are supporting the administrators and disaster managers by providing processed space based information for emergency response. This will also help the users who are involved in disaster response and damage assessment to appreciate the potential of space based information in assessing near real time scenario and damage assessment.

6.0 GROUP EXERCISE

Description

Objective of the module is to assess the leanings and skills acquired during the 4½ days of training. This session shall be dedicated to the presentation of the applications, analysis and outputs developed by the participants. This will help the participants in using the skills developed during the training in the working environment. This will also help in understanding the further training needs.

Tasks for the course coordinator/ trainer

1. Inform in advance regarding the course schedule and group work module to the participants.
2. Request the participants to bring sample data for doing the group exercise which can be implemented at their workplace. E.g. data for hazard mapping, risk assessment, damage assessment etc.
3. Brief about the group exercise/ topics and data sources to the participants.
4. Divide participants into 4 groups (5 each) and assign a task on day 1.
5. Gentle reminder to the participants to check the progress.
6. Presentation Session on day 5 before the valedictory

Tasks for Participants

1. Finalize theme for group exercise- Hazard mapping, risk assessment, damage assessment or any other theme (day 1)
2. Identify a group lead. Assign task to each member. i.e. digitizing/ modifying a map, downloading satellite imagery, census data, generating a scenario etc (day 1 and 2)
3. Collection, compilation and collation of data available amongst the team members and other sources (day 2 and 3)
4. Data processing and generating a sample exercise (Day 4)
5. Presenting (ppt stration demo)- Day 5

7.0 Feedback and Valedictory

Context and Description of the Session

Participant's feedback on the programme – design, contents, learning and resources, are important for the continuous improvement of the course and its delivery. Besides, it also generates many innovative ideas and options for diversifying the courses for effective and objective-oriented delivery of training. Feedback of the course faculty/coordinators on the course participants and overall conduct of the course will also be important at the end. A pre-developed feedback format shall be given to the participants for their entries before the valedictory session, which shall be later analyzed and be used in developing summary course-report.

Valedictory session is important and shall be chaired by the host institute's Director or a Senior academic faculty on related subject. Alternatively the course Director/DM Faculty Head shall preside the session. A brief course report including the sessions field work practical etc shall be presented during the valedictory by the course coordinator following by few brief feedback rounds from the participants and messages of long-term interaction and continuous learning on the subject. Valedictory session shall aim at generating the feeling that the training objectives shall be fulfilled by putting in-use of the lessons discussed in the course, and by initiating a process of improving the delivering on routine basis towards effective risk management and response. A formal vote of thanks shall be given at the end to express gratitude towards the participant's organizations, host institution, collaborators, resource persons, associates, team and all others whose contribution was important in making the course a success.

Objectives

- To review and understand the suitability of course design and contents for future courses
- To review and enlist the possible improvements/changes and diversifications in the course design and deliveries
- To assess possible cooperation, network and future strategies of applying the course lessons in line functions and practice.

Duration

30 minutes

Contents

- Course feedback and lessons
- Course brief-report
- Roadmap for implementing the skills
- Broad guidelines and future strategies

ANNEXURES

Annexure I - Formats

Format I : Pre-training Assessment

1. Define the following terms
   a) Geographic Information Systems
   b) Remote Sensing
   c) Global Positioning Systems
2. What are components of GIS?
3. What functions of GIS can peform?
4. Define Remote Sensing?
5. What are the segments of GPS?
6. What do you mean by Resolution? types of resolution?
7. What is meant by Scale of a map?
8. What are different type of data sets used in GIS?
9. What is meant by spatial data? Describe the two data models?
10. What is vector data? Three types of vector data sets with examples?
11. Mention two Indian satellites used for Earth observation?
12. What is meant by spatial resolution with respect to satellite data?
13. Define the following in your own words
    i. Hazard
    ii. Disaster
    iii. Risk
    iv. Vulnerability
    v. Disaster Management Cycle
14. Are you using spatial data/ maps for Disaster Management planning decision making? If yes, How?
15. Are you using digital maps? If yes what kind of digital maps you are using?
16. Are you familiar with Bhuvan/Google earth and Maps of India? What is the difference between the two?
17. Are you using Geo-informatics Softwares ? (GIS or Image Processing)? Name the product you are using? (e.g. ARCGIS, ENVI, ERDAS, MAPINFO or any other)
18. Do you have prior experience is using GIS for Hazard Mapping, Modelling, Risk Assessment, damage assessment, emergency management or any other related applications? If yes please give brief details

19. Do you find the tools and spatial data useful? What are advantages of using the space based data and GIS as compared to conventional tools.
20. What are the challenges/ difficulties you faced which became a limiting factor for using Geoinformatics for disaster Management?

Note: this is a general Pre training questionnaire for the five days technical professionals training programme. Course coordinator shall include subject specific questions for the thematic programmes and more simple application centric and questions for the administrator focused programme if required.

Subject/ theme related questions can be included for specialized programmes

Example What is Drought? What is meant by agricultural drought?

Questions on general awareness questions on Disaster Management.

Define disaster? Are you involved in DM activities? Describe DM activities undertaken by you?

Format II : SAMPLE SCHEDULE

Hrs	Monday	Tuesday	Wednesday	Thursday	Friday
9:30	Registration	Recapitulation – 1st day	Recapitulation – 2nd day	Recapitulation – 3rd day	Recapitulation – 4th day
10:00-11:00	Inaugural Address Introduction to Course participants & Participants expectation from this course Pre training Assessment	Principles of Remote Sensing and Digital Image processing and applications in DM	Role of Geo-information in Disaster Management: Scope, Examples & Advancements	Geoinformatics for Drought Early Warning & Monitoring	GIS based Spatial Decision Support Systems for Floods and Drought
11:30	Tea Break				
11:45-13:00	Disaster Management Concepts & Institutional Framework for DM	Demonstration and hands on Exercise on ERDAS Imagine: Subsetting, Georeferencing, Enhancement, Fusion, classification	Preparation of Multi hazard map for Uttarakhand State Hands on Exercise	Hands on Exercise on Analyzing Multi Date Data for Drought Early Warning And Monitoring using ENVI	Geoinformatics for Chemical Disaster Management CAMEO, ALOHA and MARPLOT
13.00	Lunch Break				

cont...

Format II : SAMPLE SCHEDULE

Hrs	Monday	Tuesday	Wednesday	Thursday	Friday
14:00-15:30	GIS Components and Functions and Demo on ArcGIS 9.0/ Q GIS	Global Positioning System- Principles and Applications Demo on GPS Instrument Field visit and GPS data collection using GARMIN GPS	Application of Geo-informatics in Landslide Hazard Zonation and Susceptibility Mapping Hands on Exercise	Overview of DMS Programme and Decision Support Center – NRSC, Scope, Services, Status and Road Map	Exercise Presentation
15:30	Tea break				
15:45-17:00	Hands on Exercise on Arc GIS or Quantum GIS (open source) Functionalities	Field visit and GPS data collection using GARMIN GPS	Storm Surge Hazard Mapping, Vulnerability and Risk Assessment Hands on Exercise	Mapping Flood Inundation of Nagaon District of using RADARSAT data.	Evaluation Valedictory Session (at 15:00 PM)
17:00-17:15	Summary of 1st day's program	Summary of 2nd day's program	Summary of 3rd day's program	Summary of 4th day's program	

Format III: EVALUATION / FEEDBACK FORM

Name of the training programme :

Date and Venue:

Name of the Participant:

Organization:

Thank you in advance for giving your assessment. Just **encircle** the option that expresses you truly.

1. I think the structure and organization of the course fulfill the objectives of the training Workshop.

   Very well Well Moderate Average Unstructured

2. I feel this training would be useful to me immediately in my job.

   Very much Quite Moderately Limited use Not at all

3. I believe this will help me in my future job related Disaster Management

   Strongly Agree Agree Can not say Disagree Strongly disagree

4. Practical orientation of the Workshop / training course

   Very high High Uncertain Limited Very less

5. I feel this inspires me to take up assignments related to disaster management

   Very strongly Strongly Can not say Low Do not feel at all

6. I have benefited from interaction with fellow participants in the course

   Very much To a large extent Not sure Little extent
   Not at all

7. I found the course materials supplied to us to be

   Very relevant Relevant Can not say Little relevance
   no relevance

8. Your overall impression of the training Workshop

   Excellent Very Good Good Fair Poor

9. As per the objectives of the training, any element that is left out of the Workshop in your view.

10. Which portion of the training you found least helpful

11. Any specific observation/ comments you wish to make.

12. Any suggestion regarding the training methods.

13. Any suggestion regarding topic and speakers.
14. Any particular faculty you have in mind, give the subject and session of that faculty
15. Your comments on administrative/logistic arrangements (Just encircle the option that expresses you truly):

Sl. No.	Item	Comments				
a.	Reception & Registration	Excellent	Very Good	Good	Satisfactory	Poor
b.	Drinking water arrangements in the Lecture hall	Adequate		Inadequate		
c.	Lunch and Tea during the Programme	Excellent	Very Good	Good	Satisfactory	Poor

16. Evaluation of the Practical Exercises (keep separate table for each Exercise) give rating 1 to 5 (1 – Excellent and 5 poor). Please tick in appropriate box Exercise No.

Sl. No	Parameters					
		1	2	3	4	5
1.	Briefing about the Exercise					
2.	Facilitation during the Exercise					
3.	Supply of Material/ Data					
4.	Overall Utility of the exercise					

17. Evaluation of the Group Exercise

    1 to 5 (1 – Excellent and 5 poor)// Please tick in appropriate box

Sl. No	Parameters					
		1	2	3	4	5
1.	Briefing about the Exercise					
2.	Facilitation during the Exercise					
3.	Supply of Material/ Data					
4.	Overall Utility of the exercise					

18. Field Visit

give rating 1 to 5 (1 – Excellent and 5 poor).Please tick in appropriate box

Sl. No	Parameters					
		EX	VG	G	A	P
1.	Briefing about the field visit					
2.	Administrative and logistic arrangement					
3.	Supply of Material					
4.	Presentations and guidance during the visit					
5.	Overall Utility of the field visit					

19. Participant's evaluation about the resource persons

give rating 1to 5 (1 – Excellent and 5 poor). Please tick in appropriate box

DATE/TIME	Session	Resource Person					
			Excellent	V. Good	Good	Average	Poor
DAY 1, Monday							
10 00 – 11 30							
11 45 – 13 00							
14 00 – 15 30							
15 45 – 17 15							
DAY 2, Tuesday							
10 00 – 11 30							
11 45 – 13 00							
14 00 – 15 30							
15 45 – 17 15							
DAY 3, Wednesday							
10 00 – 11 30							
11 45 – 13 00							
14 00 – 15 30							
15 45 – 17 15							
DAY 4, Thursday							
10 00 – 11 30							
11 45 – 13 00							
14 00 – 15 30							
15 45 – 17 15							
DAY 5, Friday							
10 00 – 11 30							
11 45 – 13 00							
14 00 – 15 30							

20. Any other comments/ suggestions to improve the training programme.

Annexure II

Practical Manual

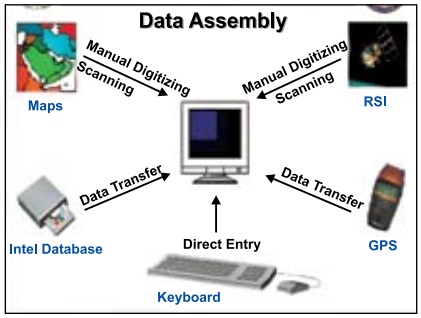
Part 1

Geoinformatics Basics

INTRODUCING GIS FUNCTIONS

1. DATA CAPTURE

Data can be assembled in GIS by scanning and converting it into compatible raster formats, satellite imageries, GPS or thought manual digitization process.



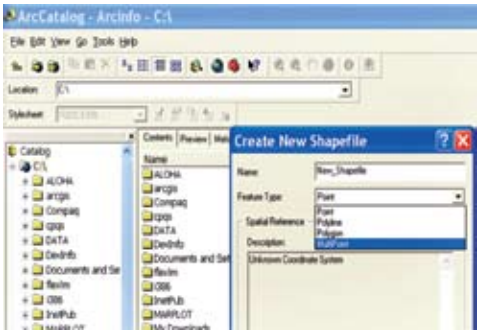
How to Create New Vector layers?

New vector layers can be created in Arc Catalog.

Step-1

Open Arc Catalog

Start/ Programs/ Arc GIS/ Arc Catalog or can directly access catalogue from Arc Map Window.



Step-2

Go to file/new/shape file

Select Point, Polyline or Polygon depends upon the feature.

E.g. Hospitals, Fire stations etc captures as Points.

Rivers, lakes, land-use etc as polygons and streams, railway line etc as polylines.

2. DISPLAYING DATA

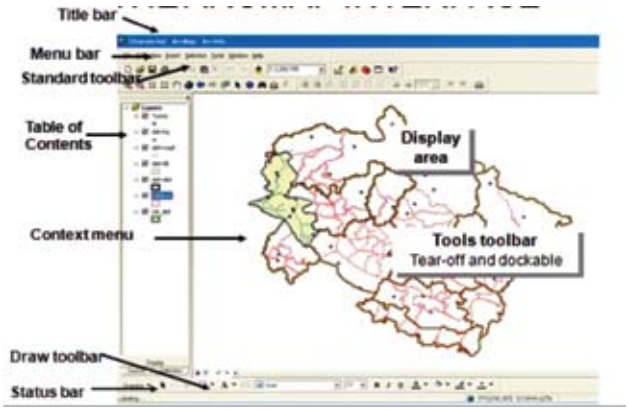
Displaying data: visualizing the geographic features using a variety of symbology.

1. The Arc Map interface and tools
2. Data View and Layout View
3. Layers, data frames, and map elements
4. Layer properties for symbols and labels

A. THE ARCMAP INTERFACE

- Title bar displays the map name
- Table of contents shows the list of layers (Thematic) and legend.
- The display area is where the map features draw.

- Status bar displays the co-ordinates as well as description of selected buttons and menu items.



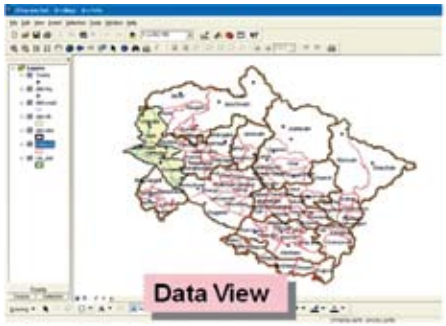
B. DATA VIEW AND LAYOUT VIEW

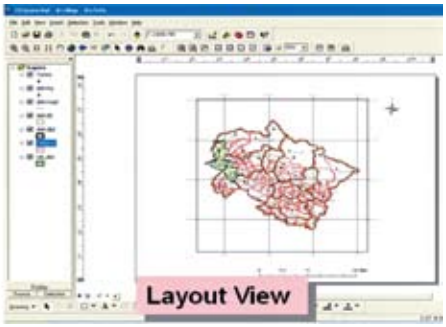
Data View

- For display, queries, editing, and analysis

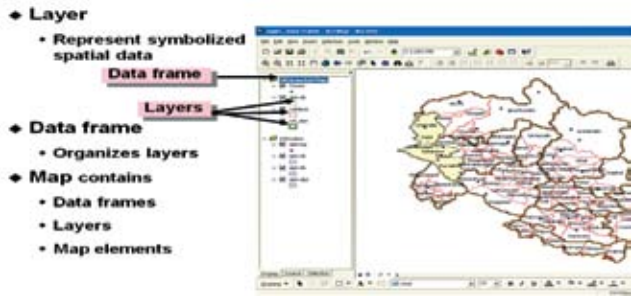
Layout View

- For creating map layouts





C. LAYERS, DATA FRAMES AND MAPS



Layers store the path to data source as well as the display properties

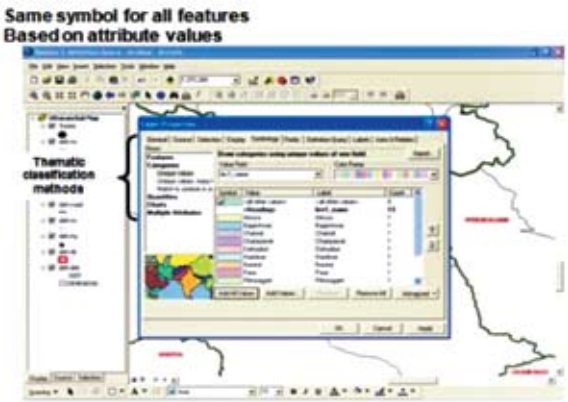
A Data frame is a container for layers. When you create a new empty map, a default data frame named Layers is automatically added to the top of the Table of contents. If you want to change the layer name double click on layer and change it. Name of each layer also can be manipulated similarly. **A map is the** document that stores the data frames, layers and map elements such as texts and graphics.

D. MOVING AROUND THE MAP

- Zoom in
- Zoom out
- Fixed Zoom in
- Fixed Zoom out
- Pan the display
- Full extents
- Back or forward one display
- Zoom to a layer
- Zoom to selected features

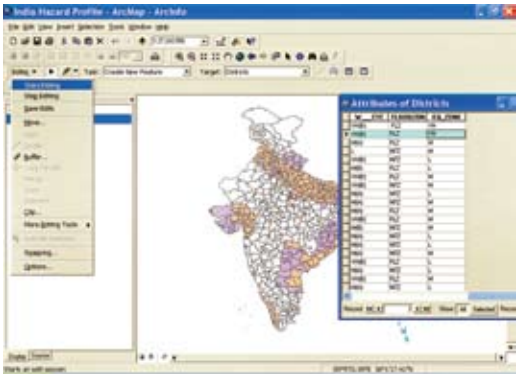
E. LAYER PROPERTY SYMBOLS AND LABELS

Right click on the layer go to properties/ symbology/ value field



3. MANIPULATION & TRANSFORMATION OF SPATIAL DATA (EDITING OF ATTRIBUTE DATA AS WELL AS MAPS)

Editing maps



Steps

View/Editor

Go to Editor /Start Editing

After adding new features or doing modifications stop editing and save.

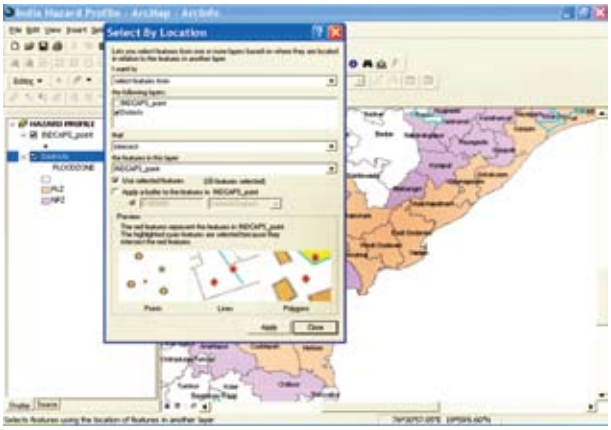
For editing the **table or Attribute data.**

Steps:Select the feature

Go to layer (e.g. Districts)/open attribute table/show selected/edit (by double click)

4. QUERY DATA

Identifying specific features



Attribute Selection

Selection/select by attributes or location/select the field/apply

To view the selected features

Zoom to selected features

To view the attribute data of the selected features right click on the layer/ open the attribute table/ show selected

Select by location

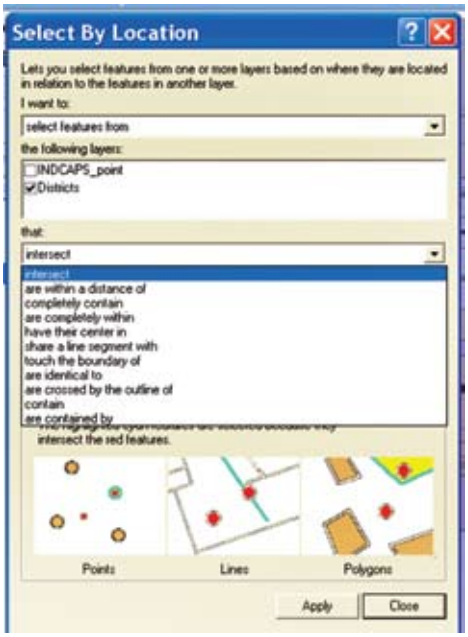
To find features based on their geographic, or spatial relation ship to other features.

Location Selection methods

E.g. for finding the number of houses in a flood affected area. Overlay a map of settlements over the area affected Flood. And find the settelements are completely with the flood affected area.

Go to Selection→Select by location-

It is also possible to select from selected features and with in the bufferzone as well.



5. GENERATING OUTPUT

Output can be generated in the form of printed out puts, image files, Xls files and reports. provisions for adding grids, north arrow. Scale bar text, inset map etc are also available in ARCGIS. Such outputs are generated in the layout view.

Exercise 2

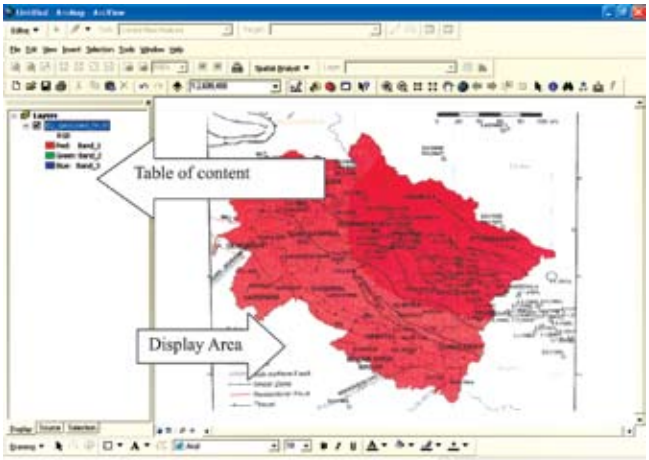
PREPARATION OF EARTHQUAKE HAZARD MAP FOR UTTARAKHAND STATE

This exercise will show you, how to prepare an Earthquake hazard map for the Uttarakhand state based on BMTPC Atlas. During this exercise you will learn the basics i.e how to prepare different type of layers i.e. Point, line and polygon, various thematic layers, editing of table and maps etc. The overall objective of this exercise is to familiarize you with the basic GIS Functions like creating layers, overlaying layers, editing tables and maps, preparing thematic maps, performing queries and generating output and not about the hazard zonation mapping procedure.

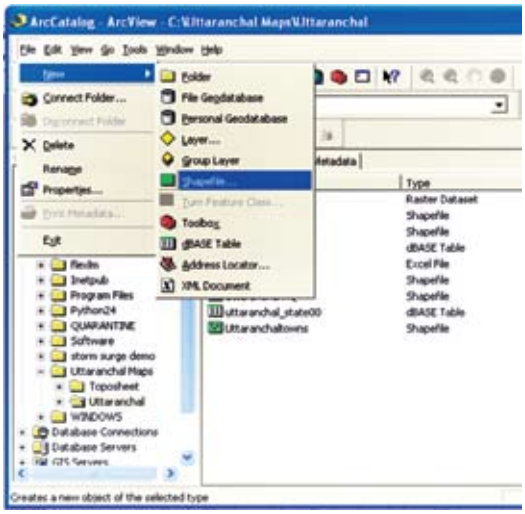
STEP 1: START ARCMAP AND ADD REQUIRED DATA

First, Launch the Arc Map Application.

- If you have a shortcut for ArcMap on your desktop, double-click it to start ArcMap. Otherwise, click start > programs > ARCGIS > ArcMap.
- If you see the ArcMap startup dialog, confirm or click a new empty map: then click OK.
- In the table of contents, right-click the Layers data frame, then click Add Data. Otherwise, click Add Data icon in standard tool bar.
- In the add data dialog, navigate to "C:\ Uttarakhand Maps\ Uttarakhand"
- Add EQ Geocoded tif. (Scanned and georeferenced Earthquake hazard map of Uttrakhand State)



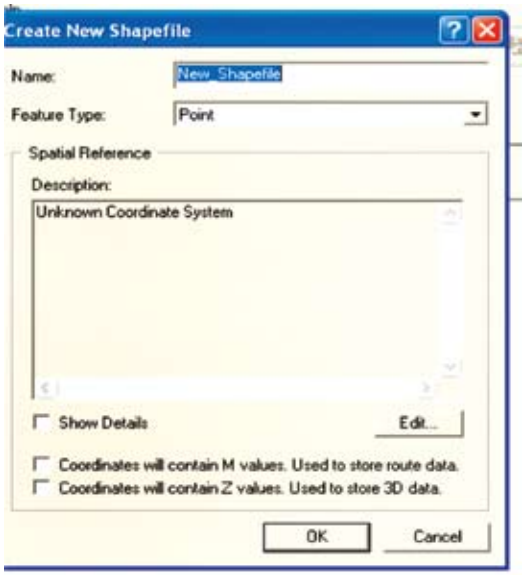
STEP 2: CREATING LAYERS FOR PREPERATION OF HAZARD MAP.



If you examine the BMTPC hazard map you can find information about the Hazard Zone, Epicenters of past earthquakes, geological structures, State & district boundary and location of towns. For the preparation of a vector map it is essential to create various layers and overlay the layers on the Raster. For creating layers go to Arc catalogue and create a new Shape file.

a) Create a layer for capturing epicenters of past earthquakes.

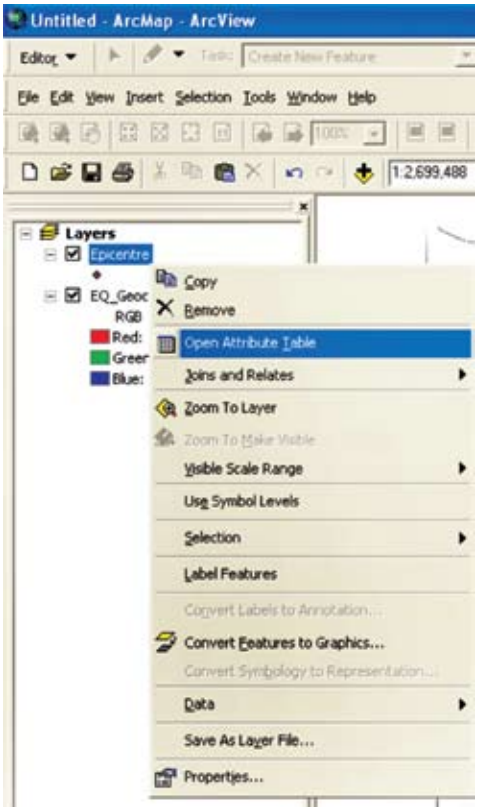
Go to file, new shape file as given above. Name the new shape file as Epicentre and select feature type as point.



For giving a spatial reference go to Edit, Spatial reference properties, import select EQ Geocoded tif and add. Now you are imported the projections to the new map from an already geo-referenced map. A layer for capturing epicenter data is been created. Now go to Arc map and add the new layer using add data given in the standard tool bar.

In the table of contents, right-click Epicentre; then click Open the attribute table.

The attribute table of epicenter will appear. By default the attribute table is having three field viz. feature id shape and an id. You need to create new fields for capturing information about the location (i.e. Lat and Long), Magnitude, year etc. For creating new fields go to **options, add field.**



For capturing data go to editor and start editing. Once you start capturing data each record represents an individual earthquake event. For saving the data go to editor stop editing and save edits. Now your epicenter layer is ready.

- Close the attribute table.

b) Create a layer for capturing geological structures.

Go to file, new shape file as given above. Name the new shape file as Structures and select feature type as polyline.

For giving a spatial reference go to Edit, Spatial reference properties, import select EQ Geocoded tif and add. Now you are imported the projections to the new map from an already geo-referenced map. A layer for capturing structures is been created. Now go to Arc map and add the structures using add data given in the standard tool bar similar to epicenter data.

Open the attribute table and add desired field similar to epicenter map.

c) Create a layer for hazard mapping.

Go to file, new shape file as given above. Name the new shape file as Structures and select feature type as polygon.

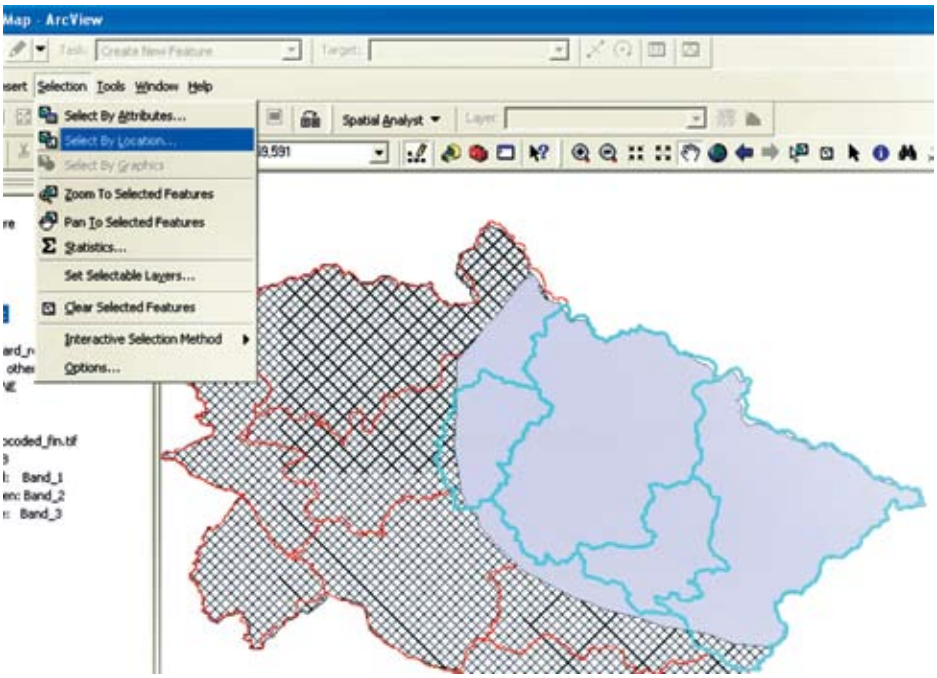
For giving a spatial reference go to Edit, Spatial reference properties, import select EQ Geocoded tif and add. Now you are imported the projections to the

new map from an already geo-referenced map. A layer for hazard map is been created. Now go to Arc map and add the structures using add data given in the standard tool bar.

STEP 3: OVERLAYING DISTRICT BOUNDARY MAP AND TOWNS AND IDENTIFY DISTRICTS AND TOWNS IN ZONE IV AND V

In this step you will learn how to overlay existing maps are find the districts and towns falling under Zone IV and Zone V.

- In Main menu, add using the add button menu add the EQ hazard Zone map. Open district boundary map, Block boundary map and town to the hazard map. Or else select from selected features.
- Go to Selection, select by attributes and select ZONE IV and Zone V and save them as separate maps.
- Go to selection select by location and identify the districts completely and partially in Zone 4 and Zone 5.

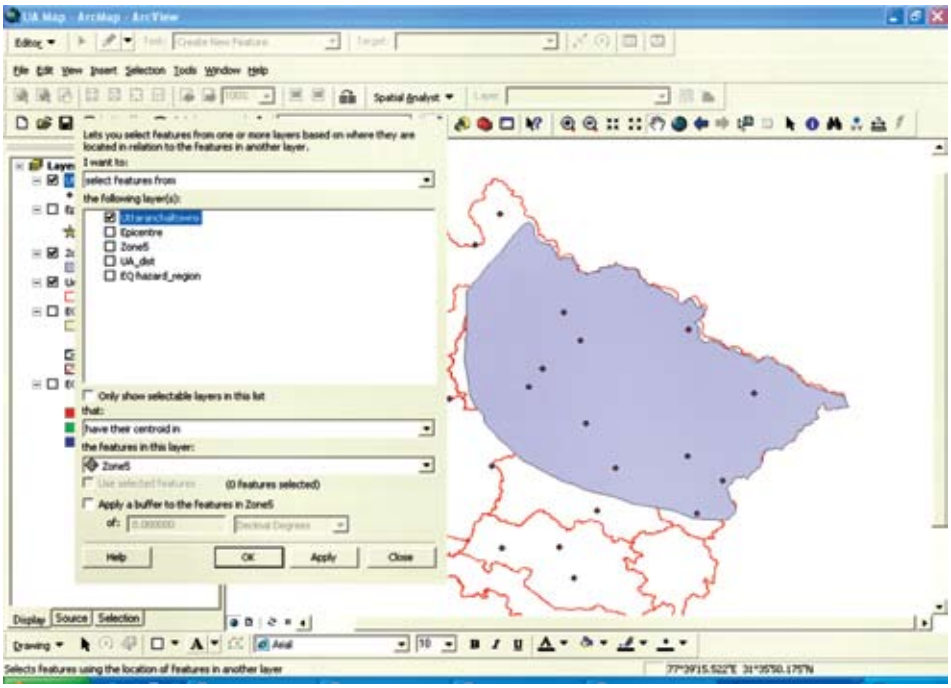


- You can find that 4 districts are almost completely in Zone 5
- 8 Districts in Zone 4.

Selected Attributes of UA_dist

FID	Shape	Popu_den	lev1_cod	lev1_name	lev1_lev0
2	Polygon	108	IND005008	Bageshwar	0
3	Polygon	48	IND005002	Chamoli	0
8	Polygon	65	IND005007	Pithoragarh	0
9	Polygon	120	IND005003	Rudraprayag	0

Similarly you can find the number of towns in Zone V.



Selected Attributes of Uttaranchaltowns

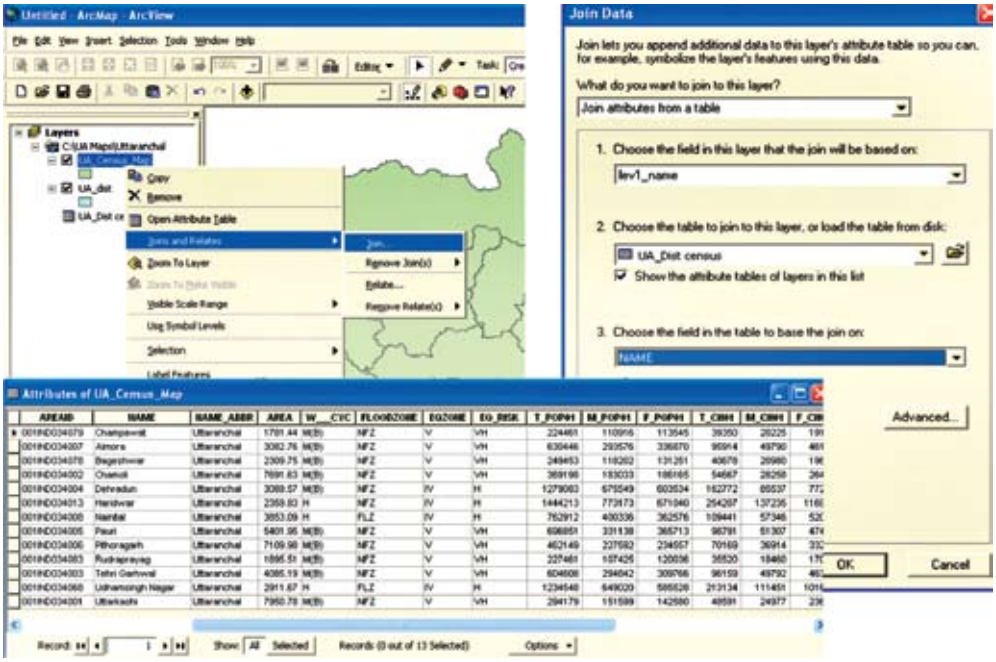
FID	Shape *	PLACE_NAME	COUNTRY	LATITUDE	LONGITUDE
10	Point	Joshimath	India	30° 33' 44" N	79° 33' 37" E
11	Point	Langsu	India	30° 18' 7" N	79° 16' 25" E
12	Point	Kandai	India	30° 5' 50" N	79° 35' 34" E
13	Point	Bageshwar	India	29° 50' 43" N	79° 45' 15" E
14	Point	Nachani	India	29° 54' 37" N	80° 9' 27" E
15	Point	Topidunga	India	30° 37' 43" N	80° 9' 50" E
16	Point	Dakar	India	30° 15' 59" N	80° 31' 31" E
17	Point	Tham	India	29° 46' 31" N	80° 21' 0" E
18	Point	Pithoragarh	India	29° 35' 18" N	80° 12' 35" E
35	Point	Chamoli			
36	Point				

Similar steps can be repeated for identifying the towns in Zone 4.

STEP 4: JOINING AND LINKING OF CENSUS DATA WITH MAPS

In this step you will learn how to Join the census data with the maps.

- Go to editor and start editing, Select UA Dist Map
- Using add data add UA Dist Census.dbf file
- Right Click on UA Dist Map, go to Join and Relates, select join (make sure that the table is editable)
- Select Join Attributes from a table, choose field as lev1_name, Choose the table to join as census data, and choose the field in the table to base the join as Name. (Joining is based on common field in both the tables)
- After joining stop editing, go to data - export (name the export out put as UA census map.



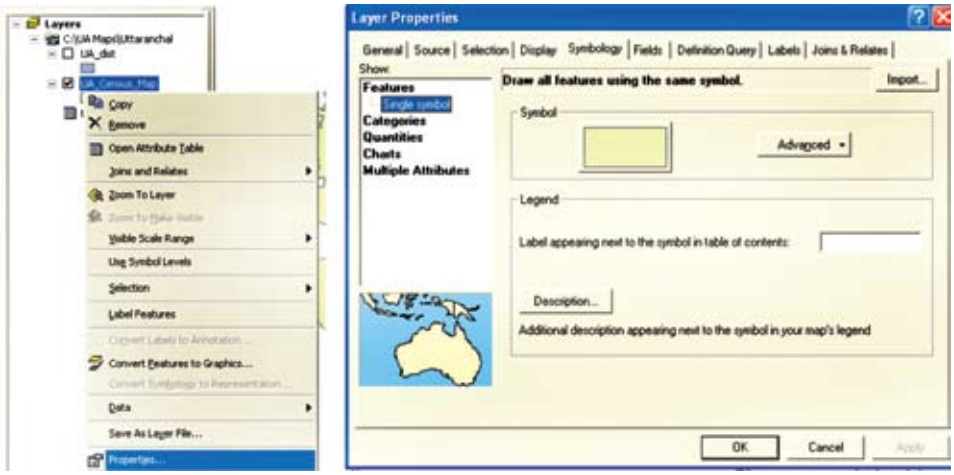
TEST - 1

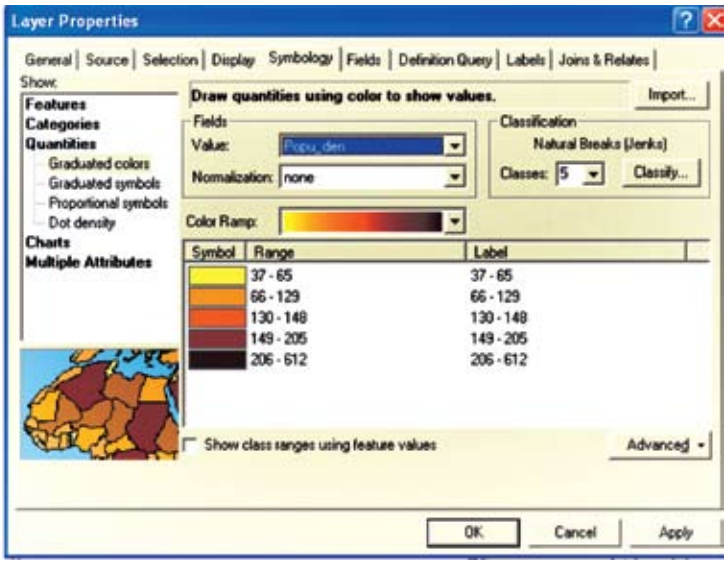
1. Identify the number of multi-hazard prone districts
2. Identify the number of Districts in EQ Zone V and IV
3. Identify the towns in Zone 4 and 5 and Sort the multi-hazard prone districts based on the population.

STEP 5: PREPARATION OF THEMATIC MAPS BASED ON VARIOUS CENSUS DATA AND HAZARD PROFILE

In this step you will learn how to prepare thematic maps.

- Go to properties, select Symbology
- Right click and view the property table of UA Census map.
- Quantities for range values (e.g population density etc.)
- Right click and view the property table of UA Census map. Select Graduated colors, select value as popu_density and prepare thematic map. You can select suitable number of classes and change the class names as well.





INTRODUCTION TO QUANTUM GIS

Contents

Exercise 3

I. ABOUT Q-GIS

QGIS is a desktop GIS application with most of the functionality you expect from a GIS package. It is an open source GIS software. The software cab be downloaded free of cost from OsGeo website or from www.qgis.org. Quantum GIS (QGIS) is a user friendly Open Source Geographic Information System (GIS) that runs on Linux, Unix, Mac OSX, and Windows. QGIS supports vector, raster, and database formats. QGIS is licensed under the GNU Public License, for downloading QGIS visit www.9gis.org

Let's get started!!!

a. The Q GIS Layout

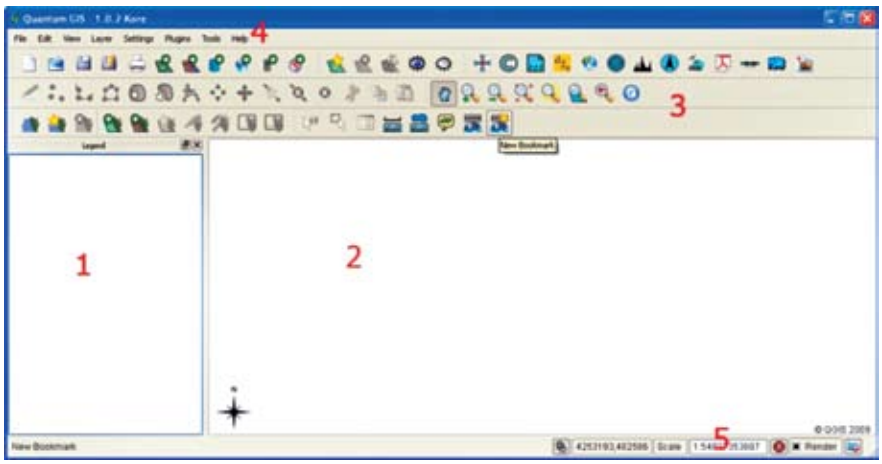
b. Navigation Hints

c. Reading data sources

   a. vector
   b. raster
   c. web-based
   d. Style the layers
   e. Edit the data in a layer
   f. Creating new layers
   g. Do some spatial analysis
   h. Make a map to print

I. THE Q-GIS LAYOUT

Go ahead and fire up QGIS – you should see an application that looks like most other GIS applications you have used (except for the red numbers I added for discussion).



- Area 1 - This is the Table of Contents (legend) where you add layers and work with them, such as grouping them, setting symbology, and such.
- Area 2 - This is the main map area where the layers show up and all your visualization is done.
- Area 3 - These are your button bars. Like most modern windows apps you can drag your button bars around and move them between layers. I think most of the icons convey what they do but if you are uncertain then just hover over the button and you will get a short description.
- Area 4 - Menu bar with most of the functionality in the buttons up here as well as some more - don't forget the all important HELP. QGIS has good documentation so use it.
- Area 5 - This is your status/coords/etc. area. Sometimes QGIS can be slow to render large data files and so you might want to turn off rendering when dealing with large files until you want to see the file. The application waits until all the data is rendered before returning control to the user interface.

Some quick navigation hints i.e. for moving around the map

This is the navigation button bar and I think most of the buttons are self explanatory except the last buttons.

- The first one from left is for moving the map i.e. PAN
- Second one is for Zoom in - enlarging.
- Third one for Zooming out – reducing the size.
- Forth one for Zooming to the full
- Fifth one is for zooming to a selected feature
- Sixth one for Zooming to a selected layer
- Seventh and eight for zoom to previous extents (last and next)
- Last one for refreshing the map without affecting the zoom.

II. Reading data using QGIS

You will notice in the top button bar there is a row of icons that all have plusses in the top left corner – these buttons allow you to add data as a layer to the map.

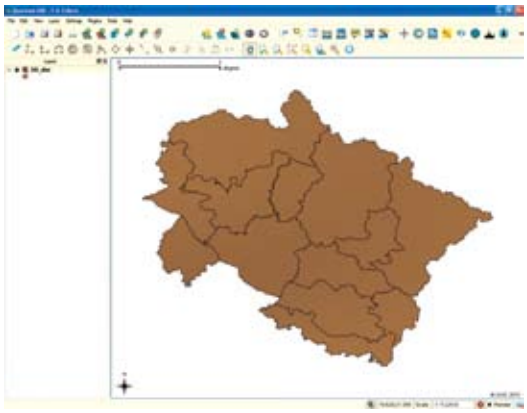
From left to right these buttons are for:

- Adding vector data
- Adding raster data
- Adding Postgis Data
- Adding a WMS data source
- Adding data from a GPS
- Adding a WFS data source

As you can see QGIS accepts data in many different formats. Let's start by adding vector data from a shape file.

a) Reading Vector Data

- Click the "Add vector data" button and navigate to the data location i.e. Uttarakhand data . In this folder you will see several shape files.
- Please select the UA_dist. shp file.

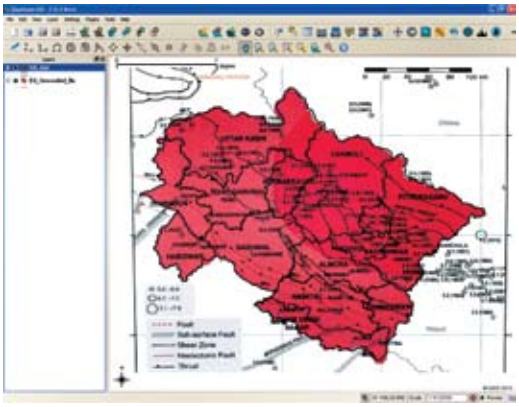


When the file loads you should see a screen that looks something like this: You are looking at the outline map of Uttarakhand.

b) Reading Raster Data

Since QGIS uses *GDAL* under the hood, you have access to a wide variety of raster formats to load. For today we are going to load a GeoTIFF.

- Please zoom to the red box in the center to set us up for the next step.
- Now click the add raster button.
- Please select the **`EQ_Geocoded_fin.tif`** file in the data directory.



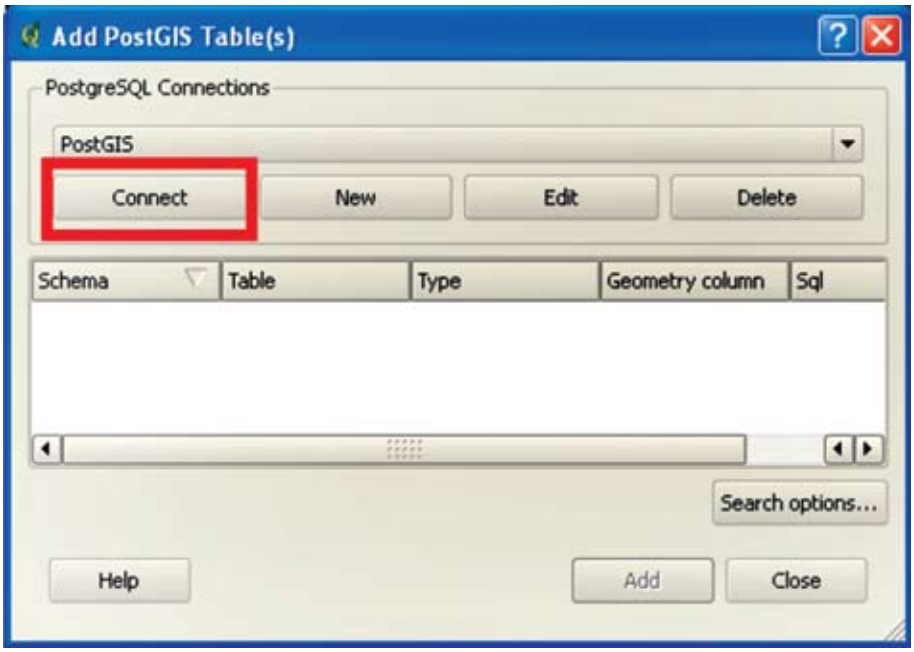
After the GeoTIFF file loads, you should see the image above our building footprints.

- Drag the EQ_Geocoded_fin.tif layer below the UA_dist layer.

Reading PostGIS Data

We have all that nice data in PostGIS, let's bring it into QGIS!

- Click on the next icon over – the "Add PostGIS Data" Button
- You will be greeted with this dialog:



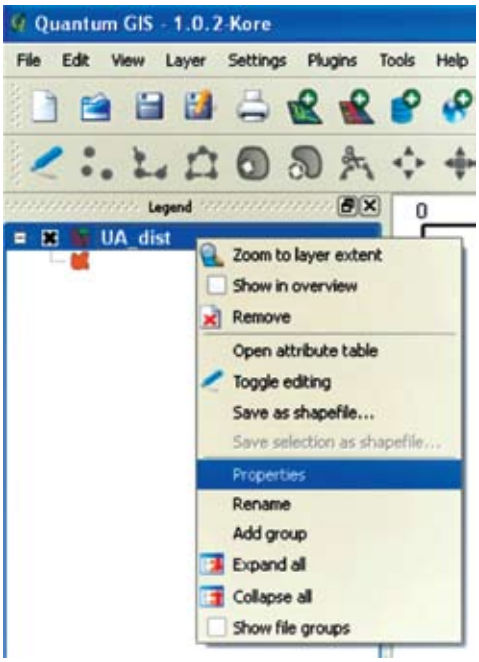
Since we already created a PostGIS connection for QGIS back when we loaded data into PostGIS, it is there waiting for us. Just click the *Connect* button and you should see a listing of the layers you loaded in the data loading exercise.

- Select the Streets coverage and then click the Add button.

You should now see a map that contains the street centerlines overlaid on the roads.

III. Styling Layers

To change the colour of Districts. To start with it, right-click on the streets and select "Properties".

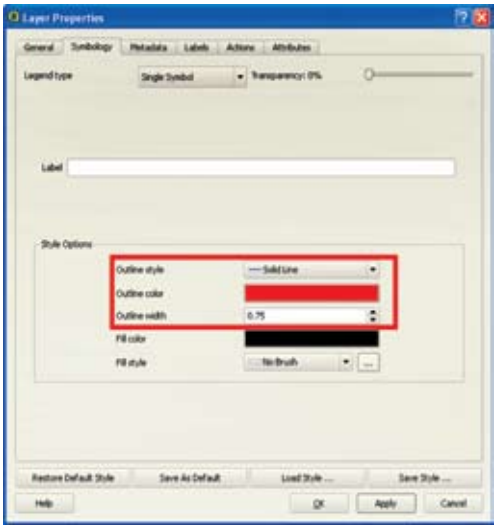


Then click on the tab that says Symbology.

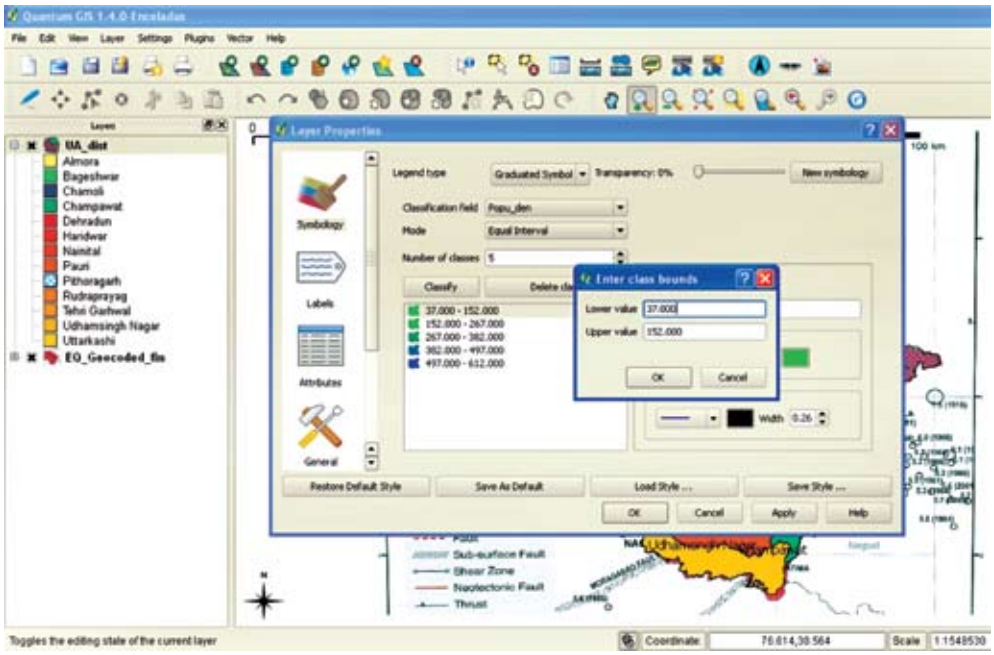
- "Outline color" controls the color of the line: **choose red**.
- "Outline width" controls the width of the line: **change it to 0.75**

After you are done you can click *OK* or *Apply* and the line color for the districts should change to red. If you clicked *Apply* then please click *OK* to make the dialog go away.

Once again, right-click on the layer for building footprints and choose the symbology tab again.



- This time choose "Legend type" to and **change it to "Graduated Color"**. This will cause the menu to switch to a whole new set of options.
- Change the **"Classification" field to "Popu_den"**.
- Leave the **"Mode" as "Equal Interval"**.
- Set **"Number of classes" to 5**.

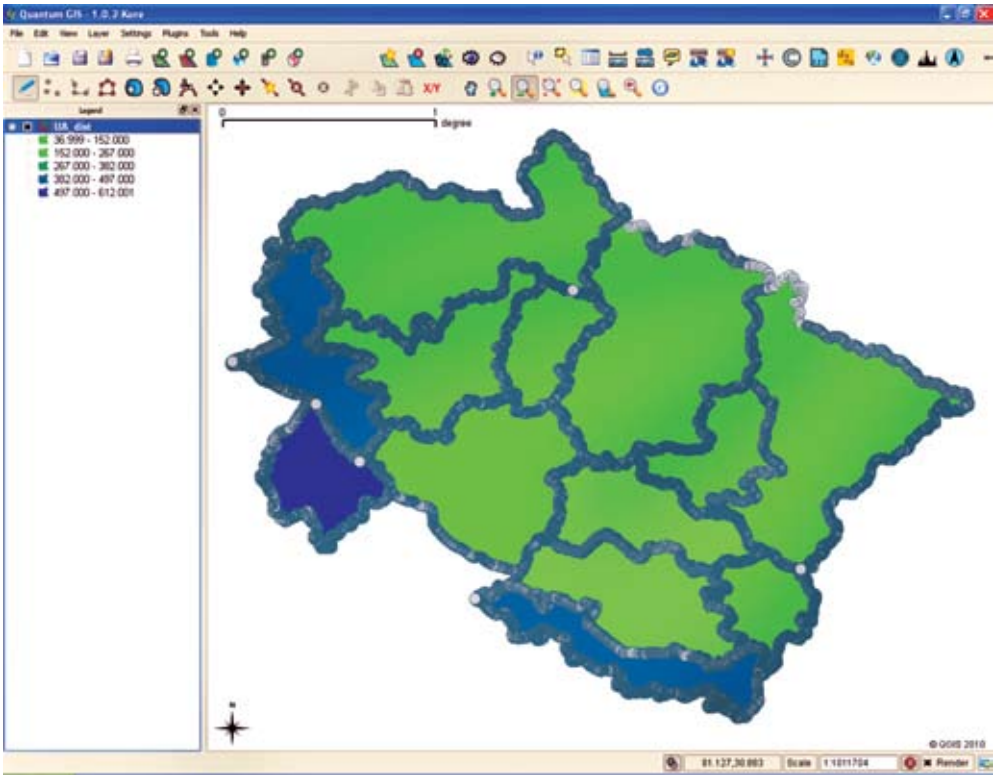


After you are done with those changes press the *Classify* button. Under the hood, QGIS takes the values for all the polygons in the layer and breaks it into 5 equal classes and uses a color range to separate values. The reason almost everything in view is green is because most of the districts have population density between 36.999 to 152.000. The ranges can be changed to achieve desired results.

IV. Editing MAP

- Add the UA_dist.shp file
- Right-click on the layer and choose "Toggle Editing".
- Click on the editing button which looks like a pencil.

After doing this the editing toolbar becomes enabled and you should see light grey/blueish circles on the all the nodes for the district layer.



Moving Existing Features

The first thing we will do is move existing vertices. Activate the move vertices tool:

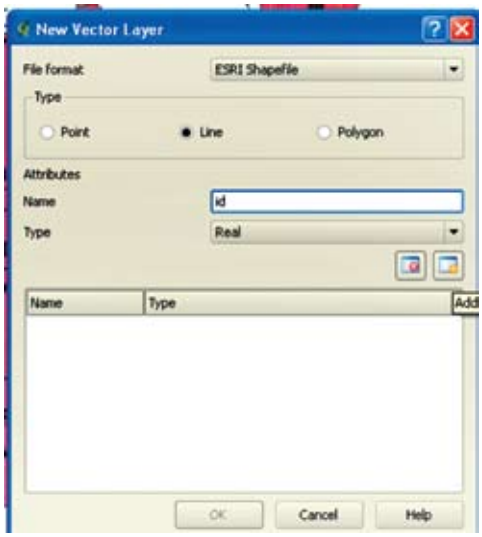
Your mouse will change to crosshairs.

- Please click on a vertex of your choice and drag it away from it's current location.
- Once you have messed up the boundary to your liking please untoggle the editing button.
- When you are prompted to save, please select the save option.

V. Creating New Layer

In this section we will learn how to create a new layer. Load the EQ_Geocoaded_fin.tiff and Uttarakhandtowns.shp.

Click the below shown icon.



Select type field to Line

Enter id into name field

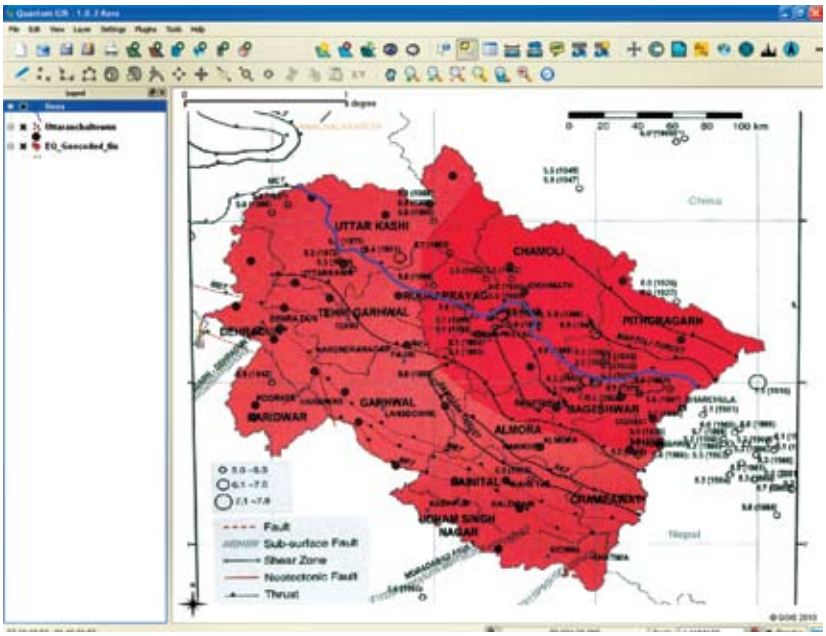
click on Add attribute button

click OK

Save it and give your preferred name.

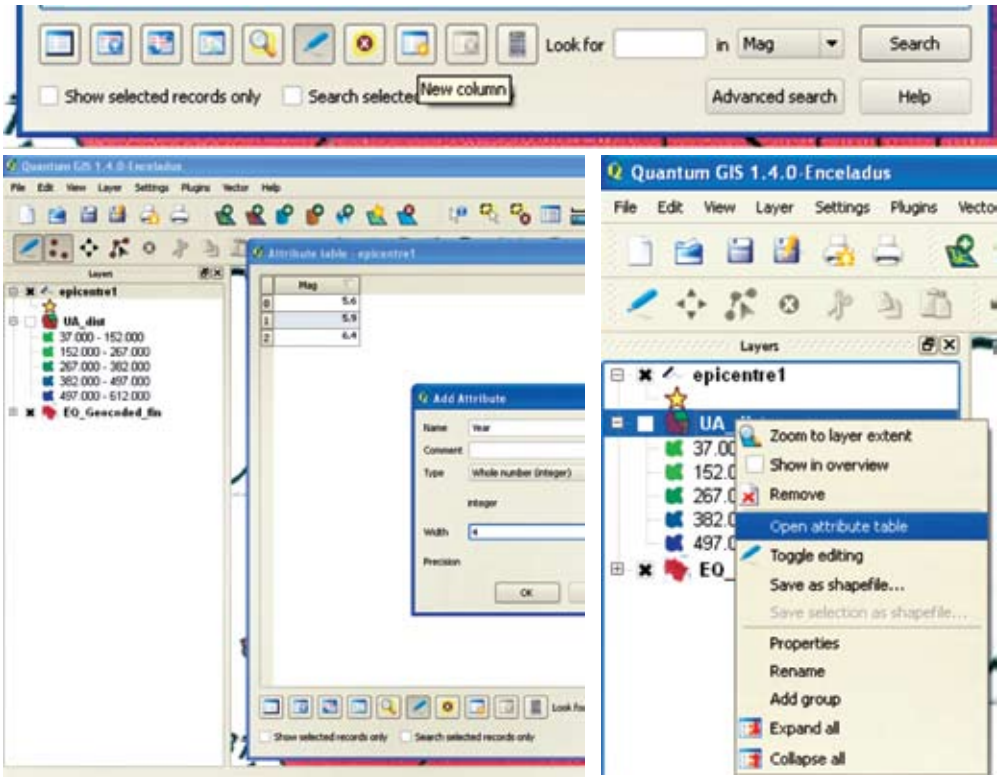
Now we need to use the Capture Line tool to create the new line. Please activate the Capture Line tool.

Start by left-clicking on any of the black lines that are seen on the background image. When you are ready finish the line just right-click. When you do this a dialog box will pop up to allow you to fill in the attribute information for the line.There you have it – you have created a line.



Exercise 3

If you have to create a layer for capturing epicenter then select point in the place of line. You can add new fields i.e. columns to an already generated layer. To generate a new field right click on the layer, go to attribute table and create a new column



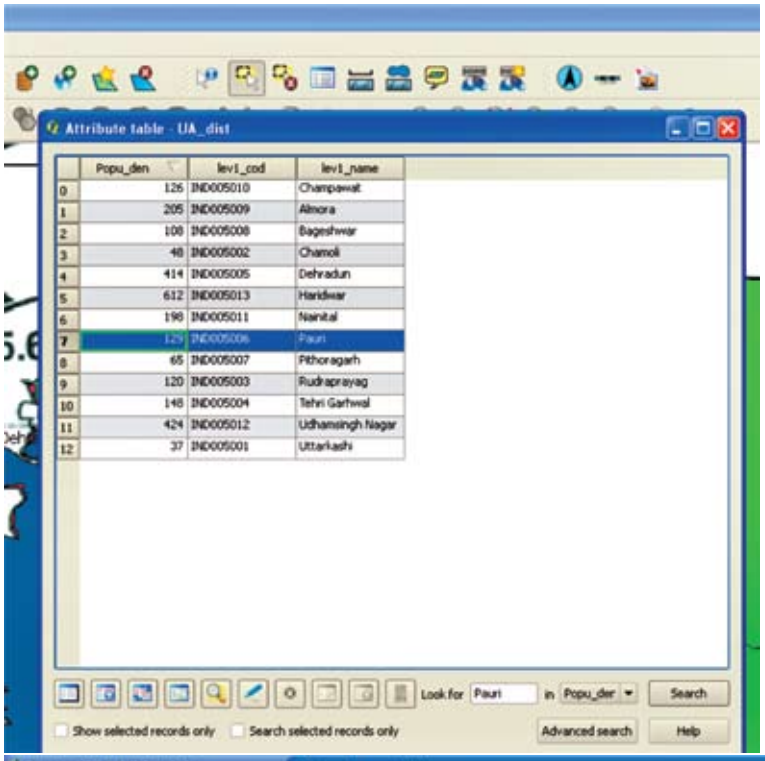
VI. GIS Analysis in QGIS

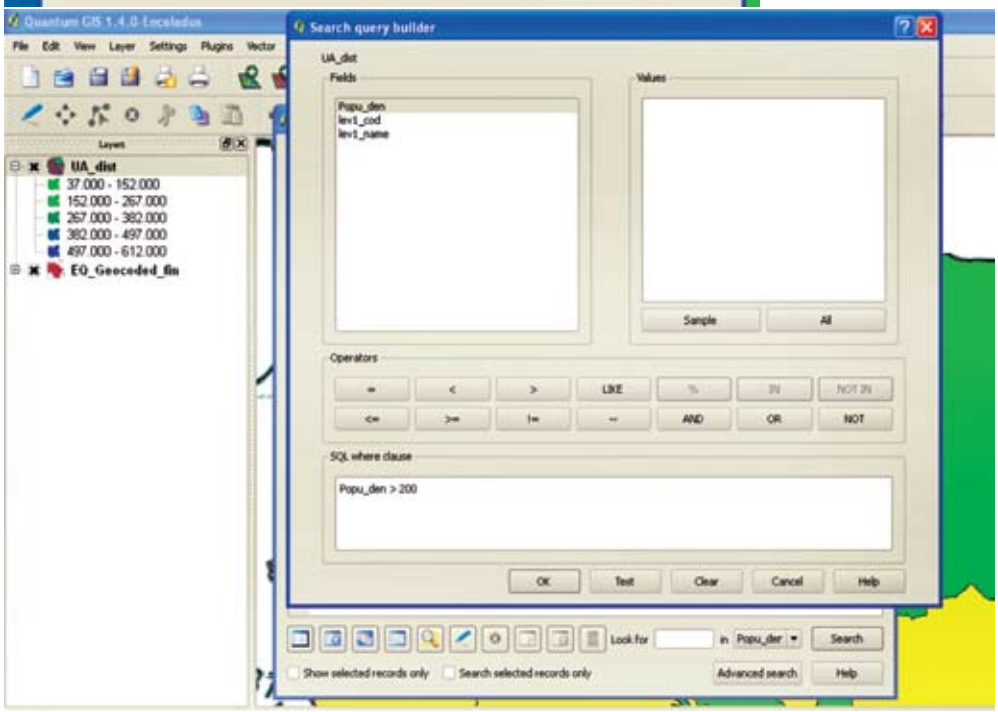
Query

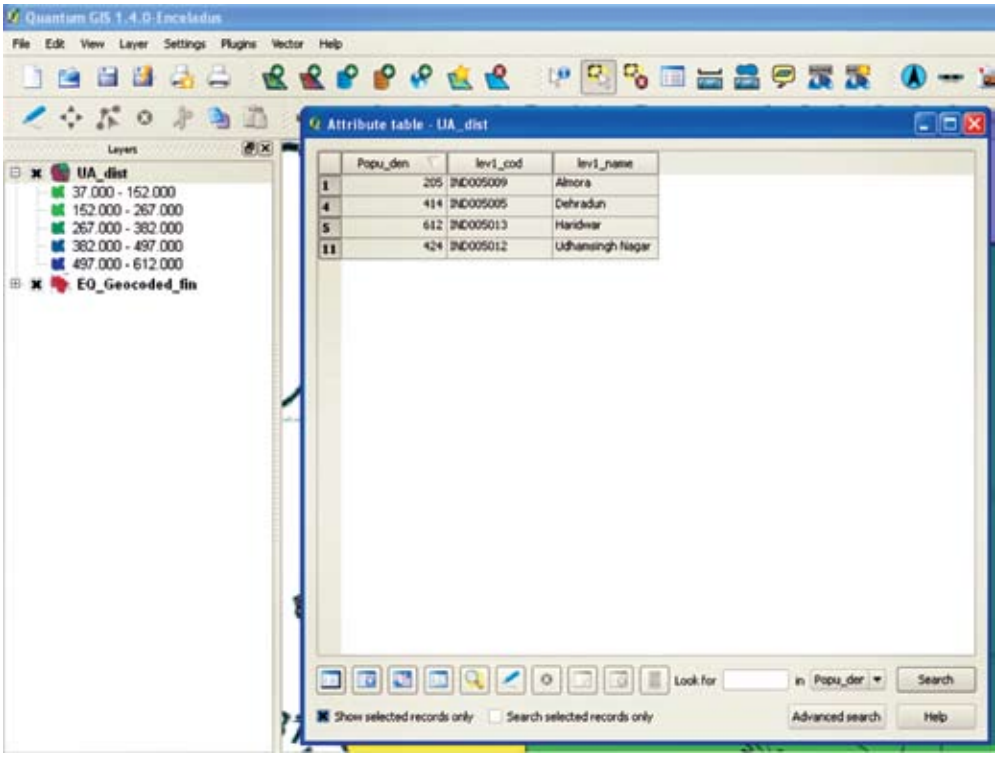
Query can be performed based on the attributes and also based on the location. To perform an attribute based query right click on the layer, open the attribute table go to search for doing simple query and advanced search for expression based query.

Simple Query

Type the word/ field you are looking for and click search


Attribute table - UA_dist
Popu_den
lev1_cod
lev1_name
0 126 IND005010 Champawat
1 205 IND005009 Almora
2 108 IND005008 Bageshwar
3 48 IND005002 Chamoli
4 414 IND005005 Dehradun
5 612 IND005013 Haridwar
6 198 IND005011 Nainital
7 129 IND005006 Pauri
8 65 IND005007 Pithoragarh
9 120 IND005003 Rudraprayag
10 148 IND005004 Tehri Garhwal
11 424 IND005012 Udhamsingh Nagar
12 37 IND005001 Uttarkashi
Look for Pauri in Popu_den
Search
Show selected records only
Search selected records only
Advanced search
Help


Quantum GIS 1.4.0 Enceladus
File Edit View Layer Settings Plugins Vector
Layers
UA_dist
37.000 - 152.000
152.000 - 267.000
267.000 - 382.000
382.000 - 497.000
497.000 - 612.000
EQ_Geocoded_fin
Search query builder
UA_dist
Fields
Popu_den
lev1_cod
lev1_name
Values
Sample
All
Operators
=
<
>
LIKE
%
IN
NOT IN
<=
>=
!=
--
AND
OR
NOT
SQL where clause
Popu_den > 200
OK
Test
Clear
Cancel
Help
Look for
in Popu_den
Search
Show selected records only
Search selected records only
Advanced search
Help



Buffering and other GIS Tools

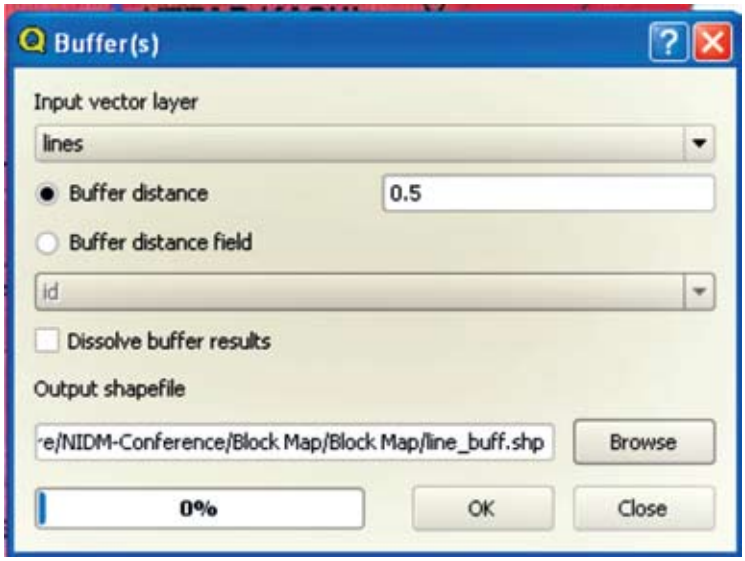
We shall now try creating buffer around the line that you have just digitized.

Go to the "Tools" menu to look at the f Tools menu.

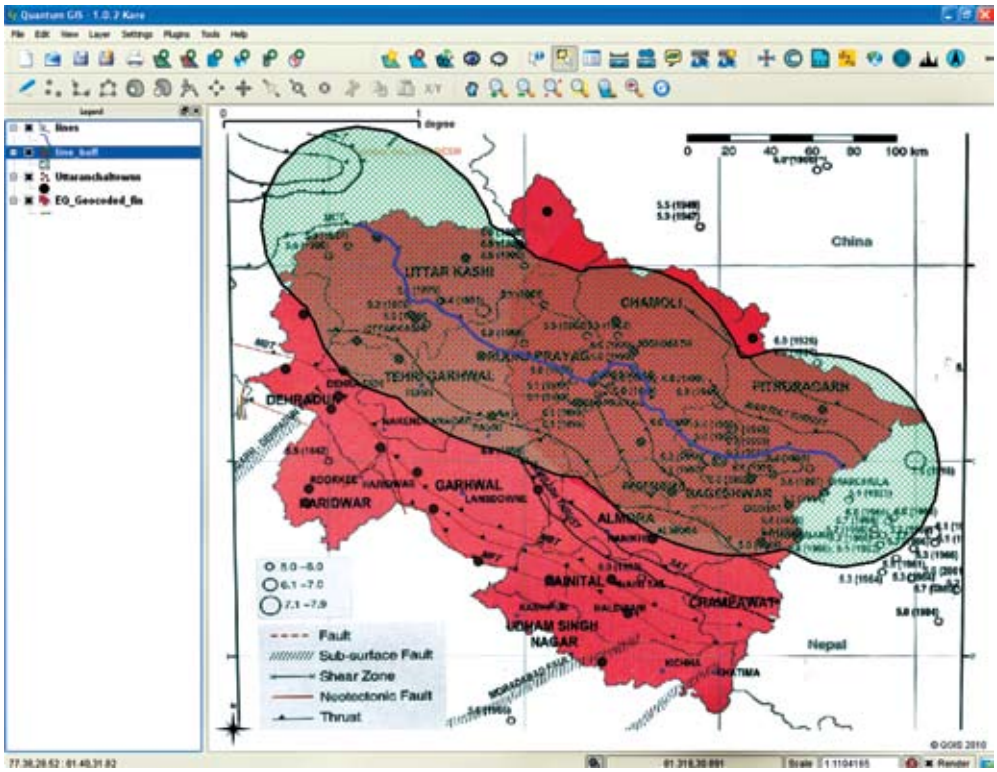
It allows for Vector GIS analysis with only the QGIS and Python libraries so no other plugins or libariers are needed. It contains 95% of the analysis most people would ever need to do (scientifically measured of course). Some of the functionality in the tool would cost the upgrade to advanced GIS software costing thousands of dollars by certain commercial vendors.

Under the "Tools" menu please go to "Geoprocessing" tools and then select "Buffer".

- Input vector layer is lines
- Buffer distance is 0.5
- Output is line_buff.shp



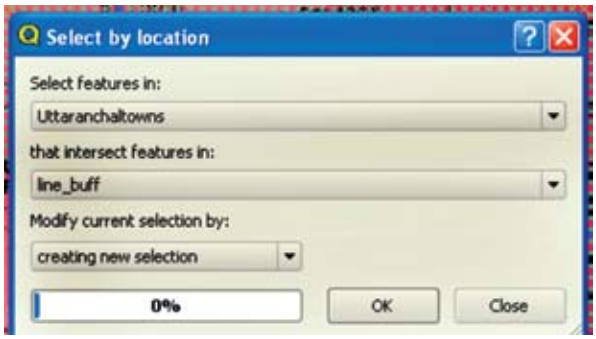
Go ahead and click *OK* and then *Yes* when it asks if you want to add it to the table of contents. Then click *Close* on the buffer dialog when it is complete.



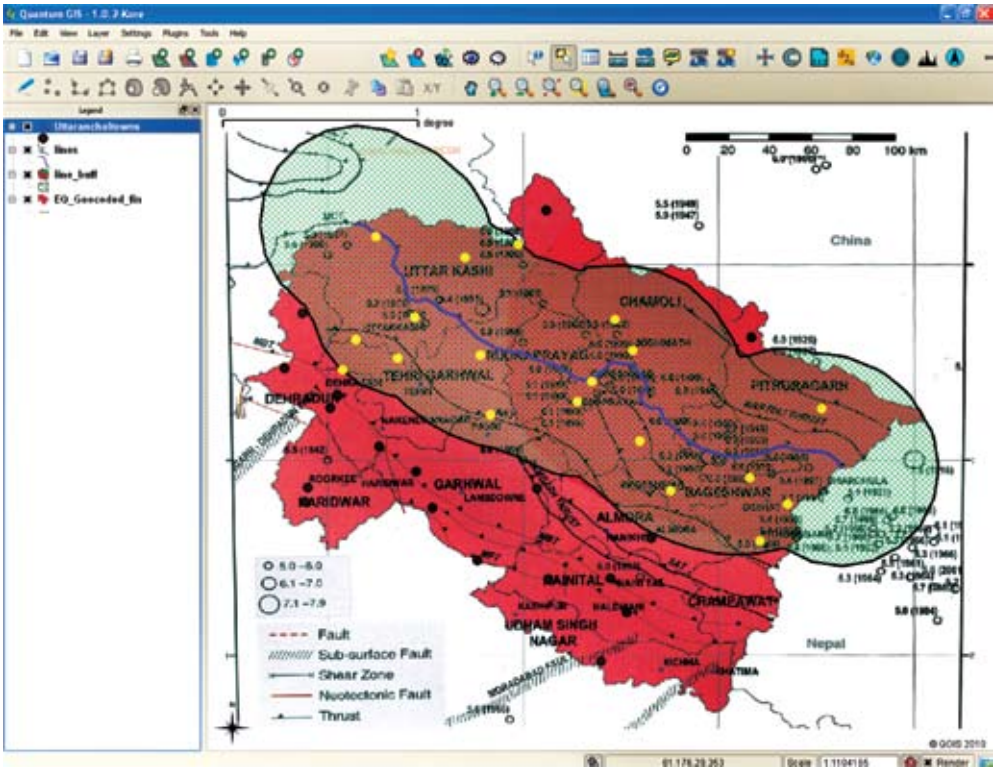
Exercise 3

Now it is time to select the towns layer using our buffer polygon.

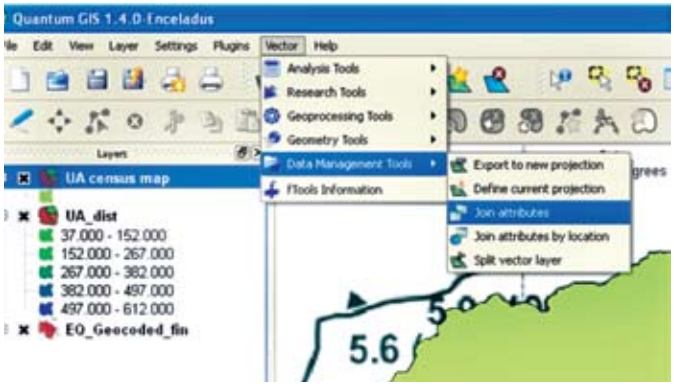
Go to the "Tools" menu again and choose "Research Tools" and then "Select by Location".



We want to select features in **Uttarakhand towns** layer that intersect **lines_buff**. Since we do not want a shapefile yet we do no fill in that box. This operation will just select features and let us work with them. After you click *OK* you will notice that many towns in the map view turn yellow.

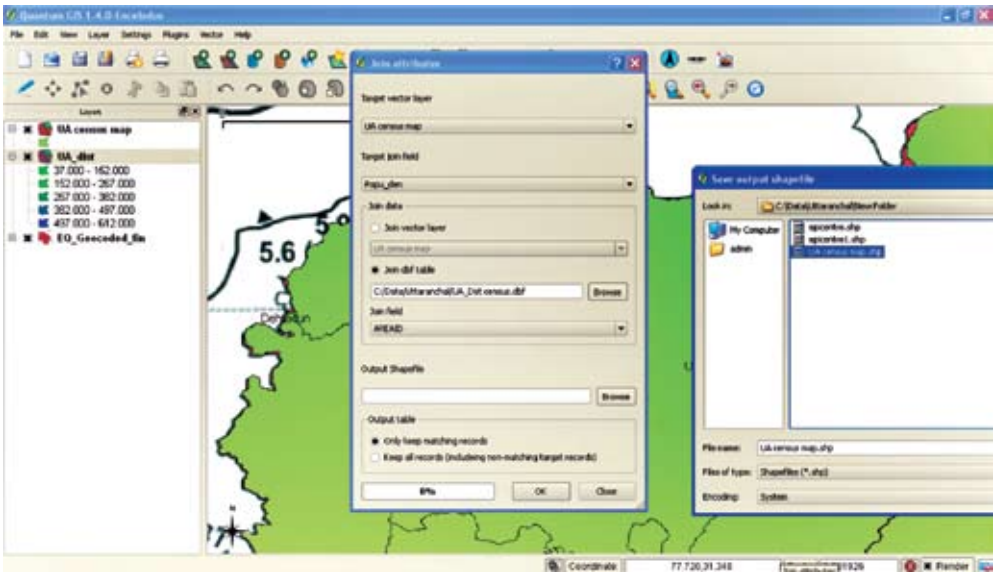


VII. Joining database to Map



It is possible using Q GIS to connect a database in dbf format to a map. It is also possible to join two maps.

The condition for performing such joining is that there should be a common field in both the attribute tables. E.g. there a common field district name in both the UA_Dist and UA Census dbf file. Lev_01 name in UA_Dist and Name in Census data dbf are the matching field based on which the join can be performed.

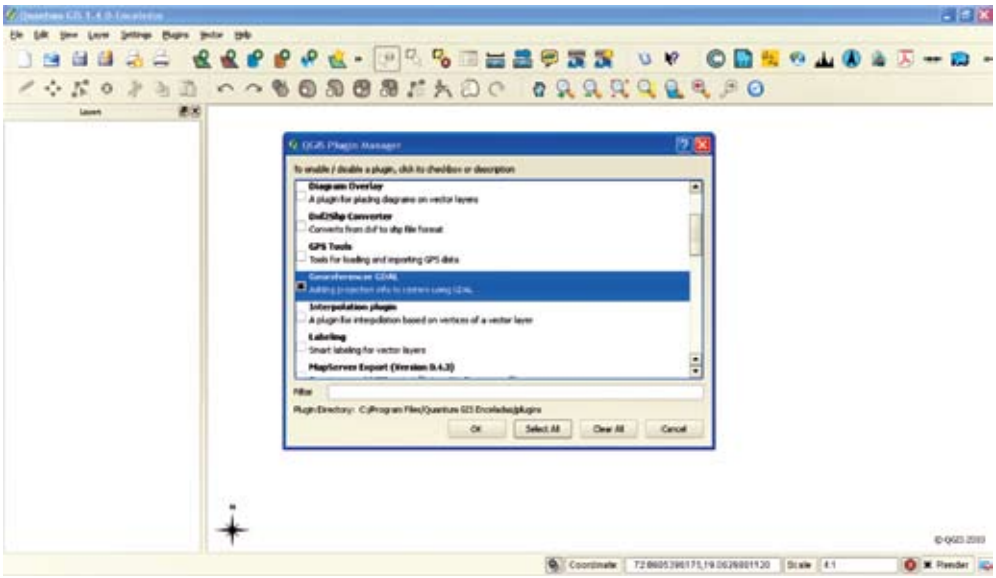


Now you can right click on the attribute table of the new vector layer and see the joined output.

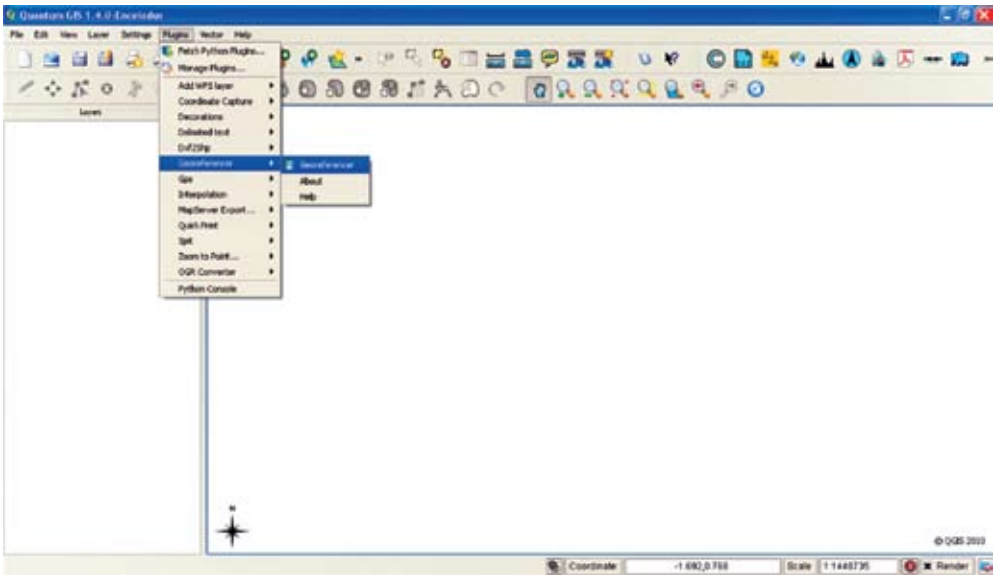
VIII. Exercise 1: Georeferencing raster data

Open QGIS and follow the steps below

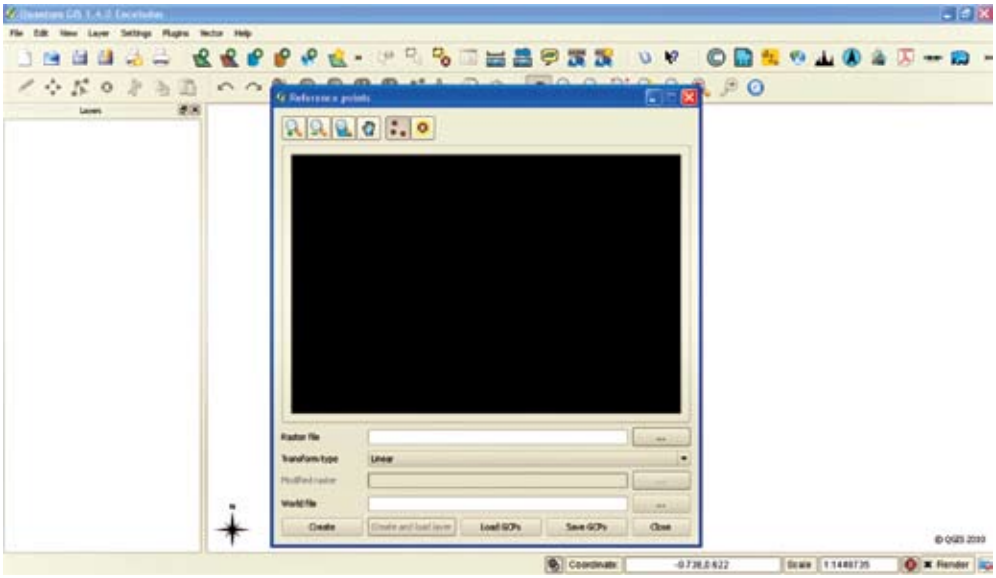
Step 1: From Plugins>>Manage Plugins…>>check the Georeferencer GDAL



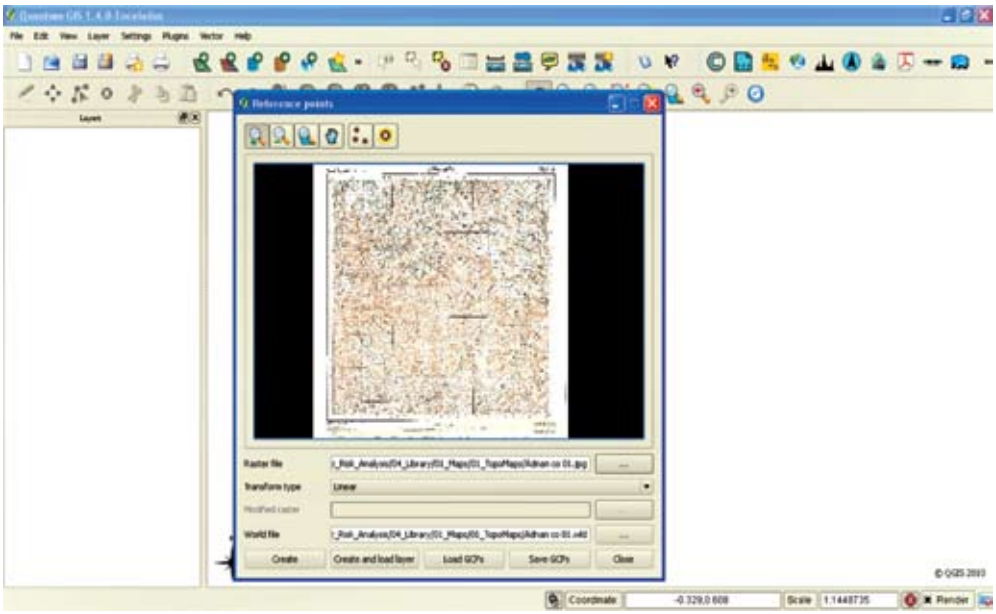
Step 2: Plugins>>Georeferncer>>Georeferencer



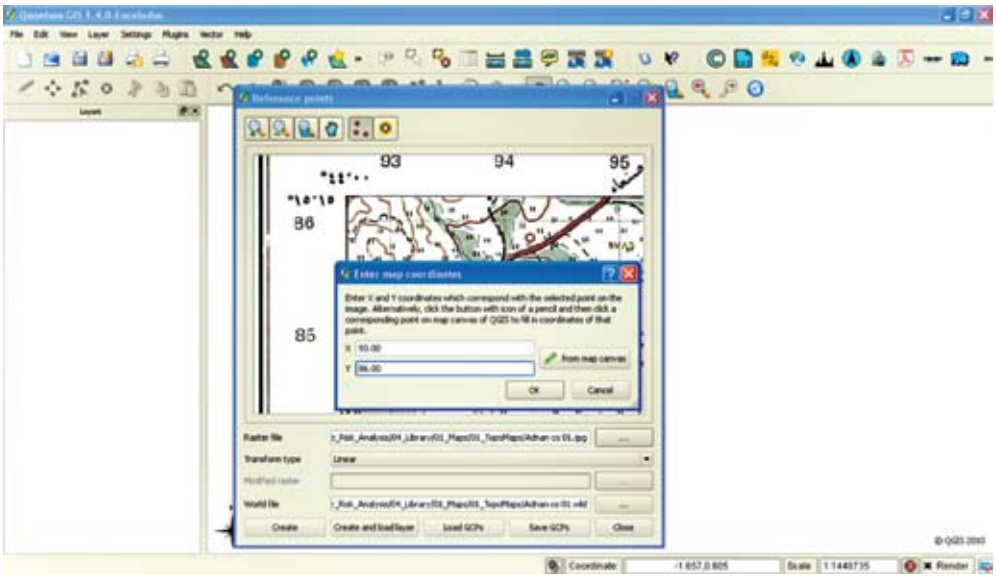
Step 2 Reference points window open>>open the open raster (toposheet) through raster file browser



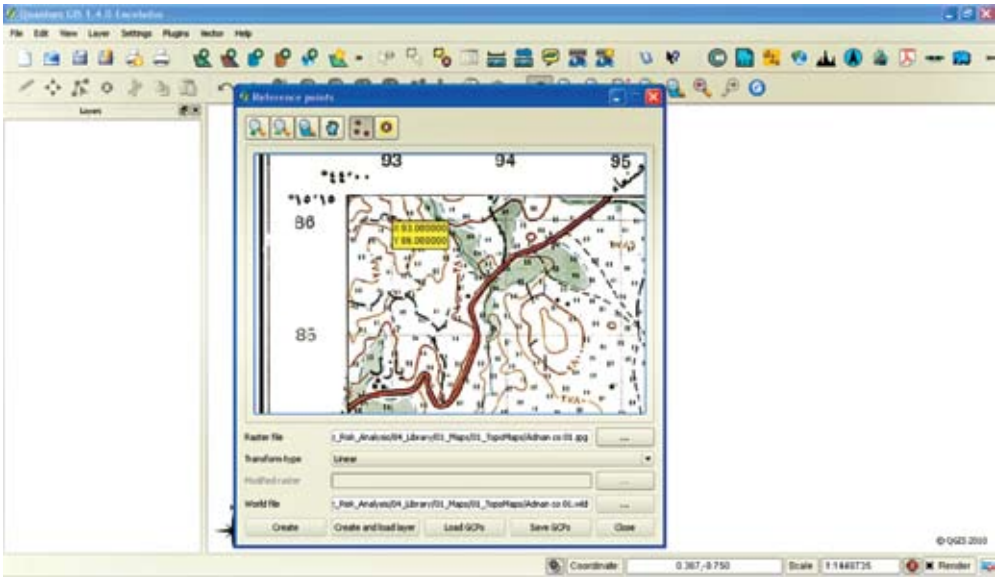
Step 3: Raster file open (toposheet)>>



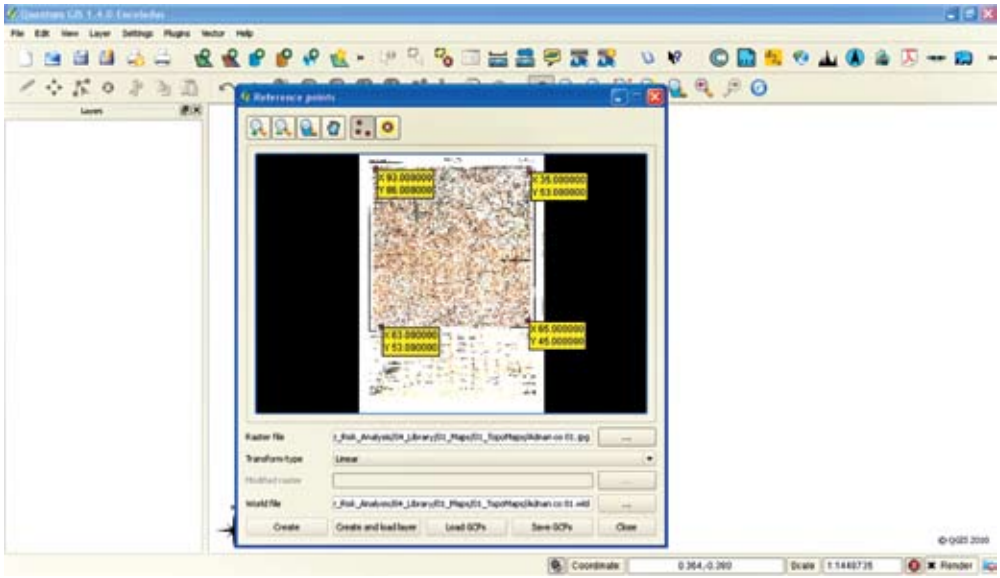
Step 4: Use Zoom tool and zoom to corner or the toposheet or where you intend to pitch the coordinates on raster>>click the point on the raster>>Enter map coordinates window appear>>enter the X and Y>> click OK button



Step 5: Similarly>> enter the coordinates for all four corners of the raster or more



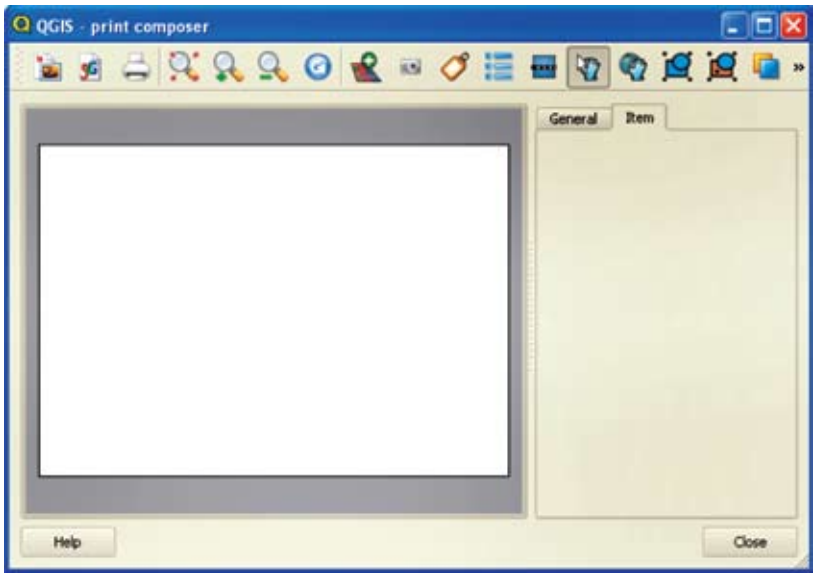
Step 6:



Save GCPs , Save and close the window

IX. Printing Maps

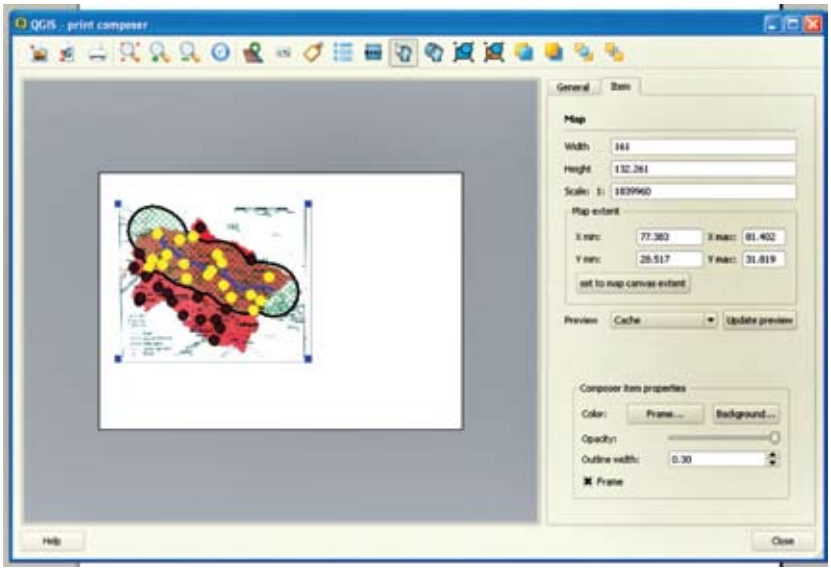
QGIS has a map composer to help you put together a map for printing. You can find it under the “File” menu and with the printer button. Once you choose either option, the print composer window appears.



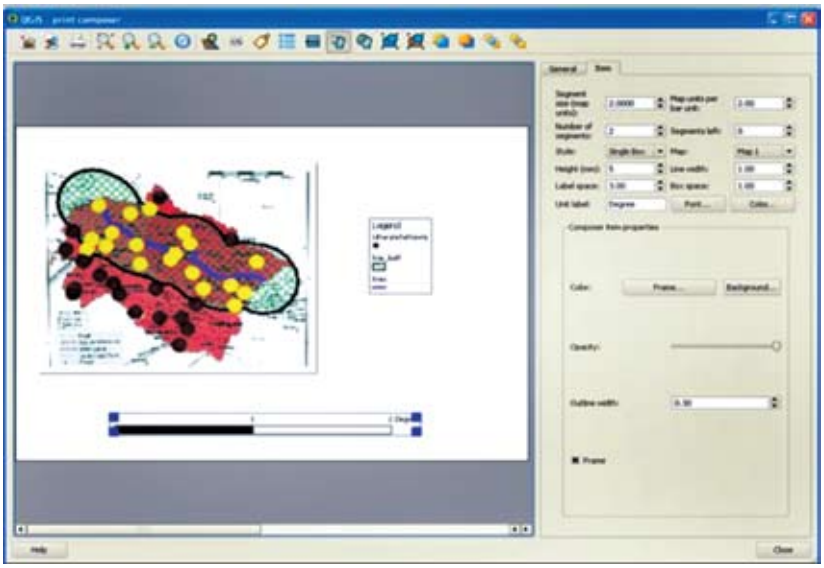
Exercise 3

We can add a map, a north arrow, a legend, and a scale bar.

- Add a map by click on the Map icon with the plus symbol.
- Then drag a box across the canvas to show the size and shape of the map image you want on your page.
- Go to the item tab and change the preview to cache and then click update preview.



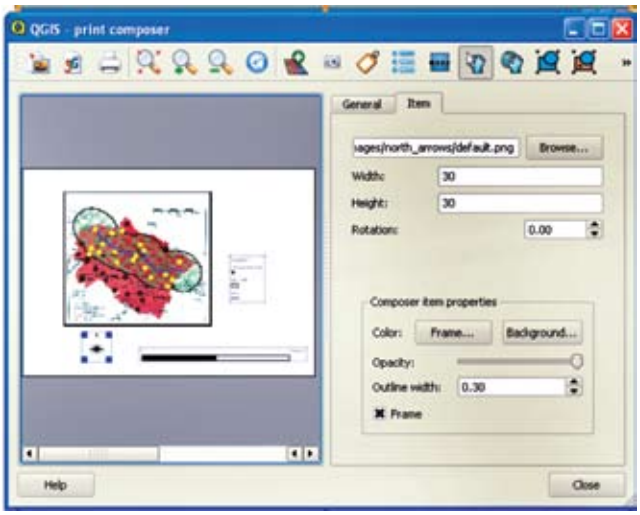
Go ahead and add a vector legend to the right side of the map.



Now add a scale bar. Remember, the scale bar is going to use map units. I set mine to 2 degrees, used the line style, and added units feet to the map.

Adding a north arrow is like adding any other graphic to your composer canvas. The QGIS north arrow is located at: C:\ Program Files\Quantum GIS\images\north_arrows

Click the add image button and then navigate to that location and add the north arrow.



To see what your image would have printed like, please click on the “export to image” button.

Save the image somewhere on your disk you will remember and then open it in your favorite image viewing application.

And with this, we conclude our shallow tour of QGIS.....

Exercise 4

INTRODUCTION TO ERDAS IMAGINE AND IMAGE PROCESSING

CONTENTS

I. INTRODUCTION TO ERDAS IMAGINE

Start - Programme – ERDAS IMAGINE

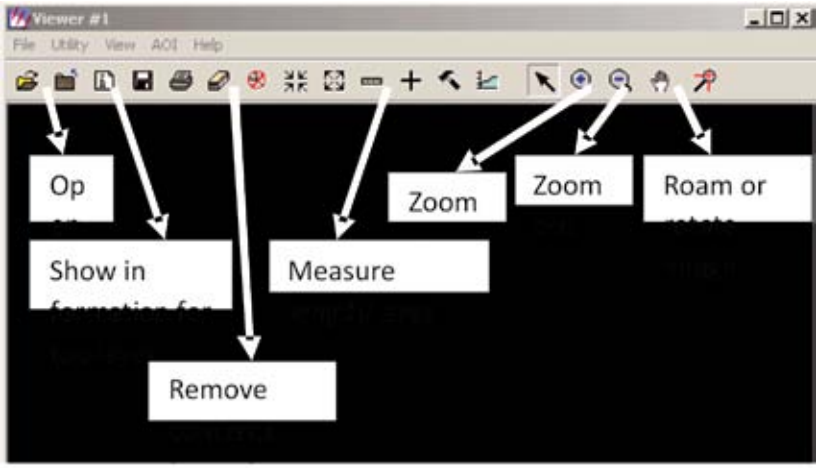
STEP: 1

Click Open Layer (on the top left corner of the viewer)

(Location: C – Data –select tiff and open Subset 06 image)

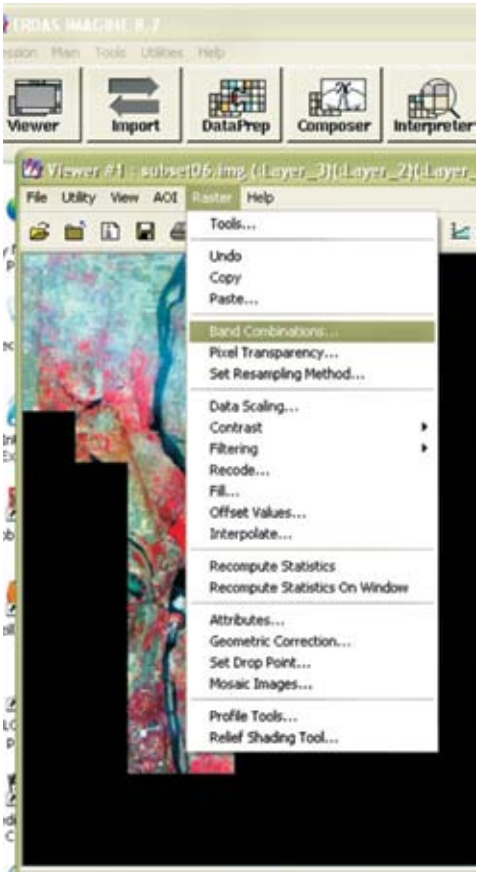
STEP: 2

- Try interactive zoom in
- Roam/ rotate Image (Pan)
- Try interactive zoom out
- Measure length/ area (Try to find out the resolution of image)
- Start/ update Inquire Cursor
- Show information for top raster layer



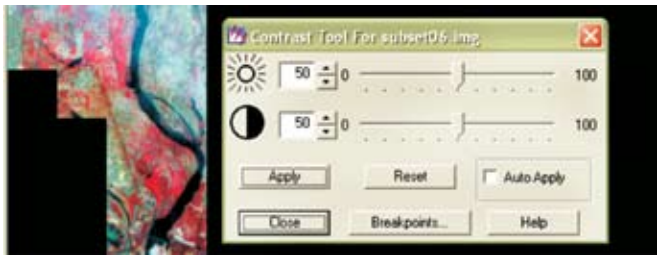
STEP: 3

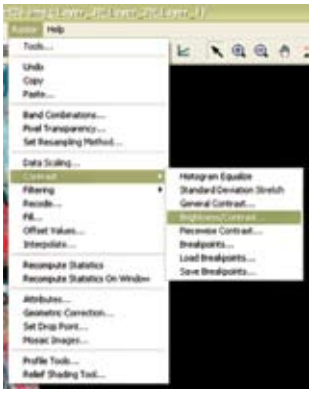
Raster – Band Combination (Observe by changing different band combination)



STEP: 4

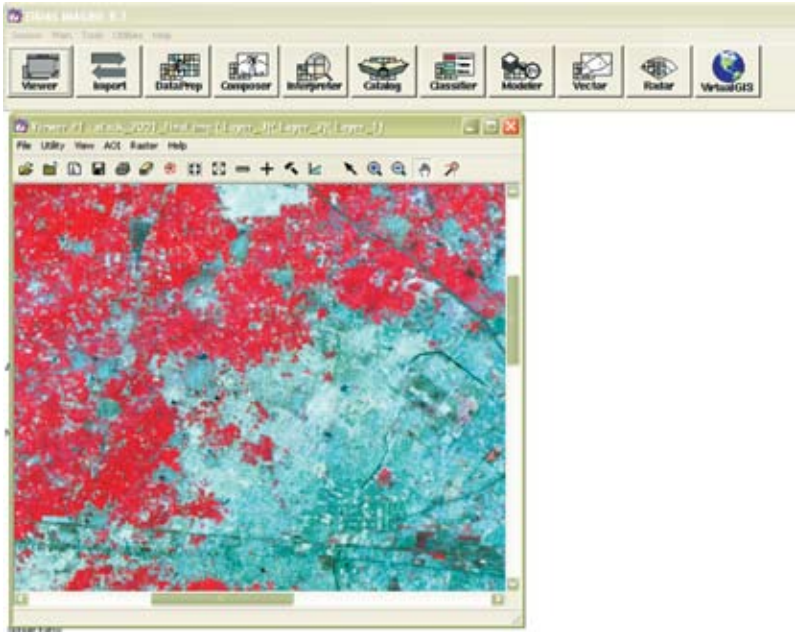
Raster – Contrast – Brightness/contrast (Examine the image by increasing and decreasing the brightness and contrast of the image).





2. SUBSET IMAGE

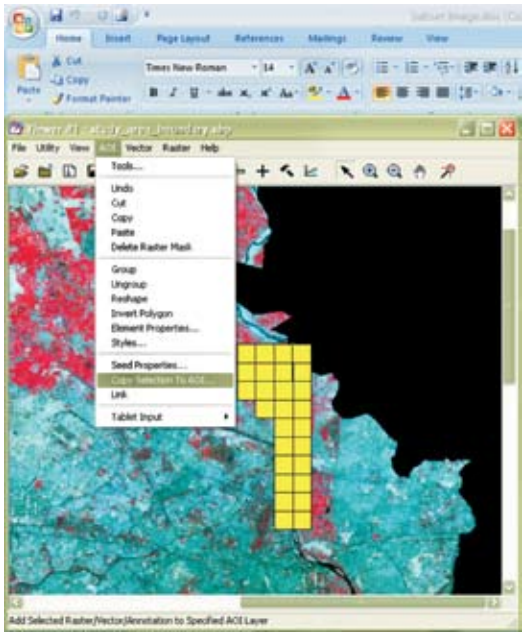
Start - Programme - Leica Geosystems GIS Mapping - ERDAS IMAGINE -



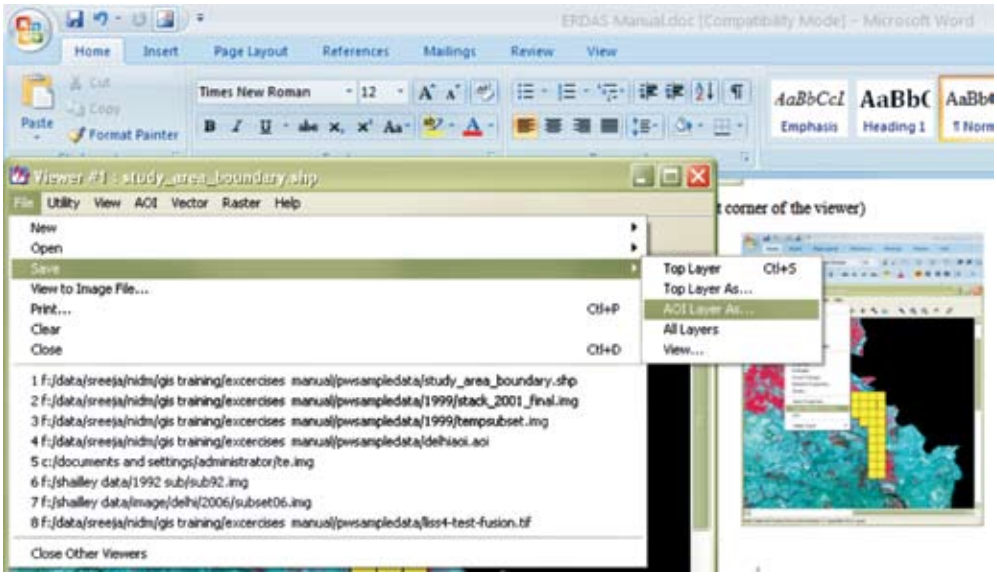
Click Open Layer (on the top left corner of the viewer)

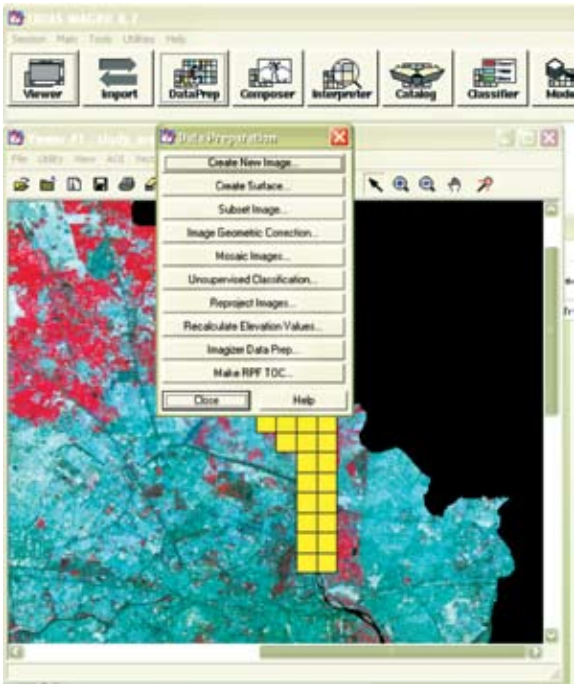
(Location: C – Data-ERDAS Exercise-1999-stack 2001 final image)

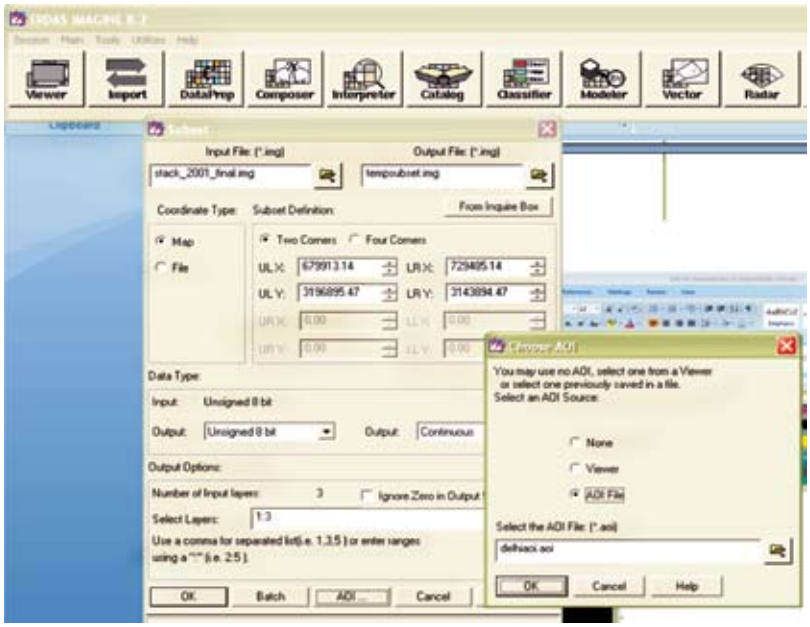
Open Vector File

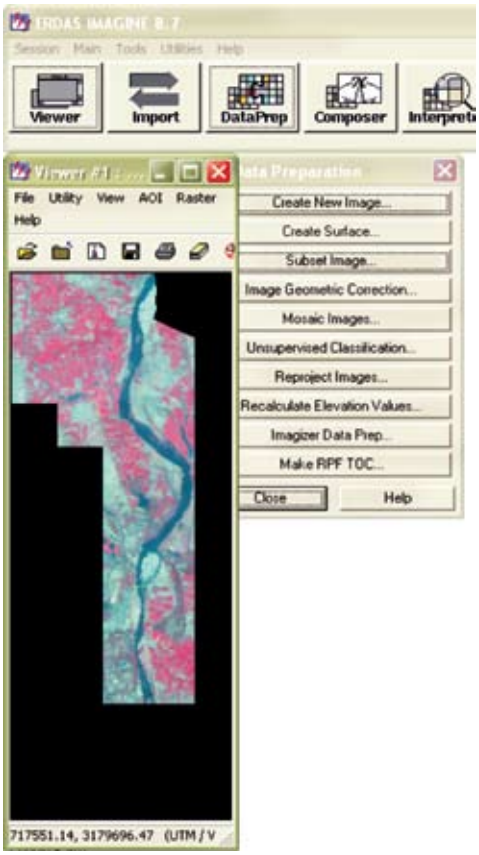


Exercise 4


ERDAS Manual.doc [Compatibility Mode] - Microsoft Word
Home
Insert
Page Layout
References
Mailings
Review
View
Paste
Cut
Copy
Format Painter
Times New Roman
12
Emphasis
Heading 1
Viewer #1 : study_area_boundary.shp
File
Utility
View
AOI
Vector
Raster
Help
New
Open
Save
View to Image File...
Print...
Ctl+P
Clear
Close
Ctl+D
Top Layer
Ctl+S
Top Layer As...
AOI Layer As...
All Layers
View...
1 f:/data/sreeja/nidm/gis training/excercises manual/pwsampledata/study_area_boundary.shp
2 f:/data/sreeja/nidm/gis training/excercises manual/pwsampledata/1999/stack_2001_final.img
3 f:/data/sreeja/nidm/gis training/excercises manual/pwsampledata/1999/tempsubset.img
4 f:/data/sreeja/nidm/gis training/excercises manual/pwsampledata/delhiaoi.aoi
5 c:/documents and settings/administrator/te.img
6 f:/shailey data/1992 sub/sub92.img
7 f:/shailey data/image/delhi/2006/subset06.img
8 f:/data/sreeja/nidm/gis training/excercises manual/pwsampledata/liss4-test-fusion.tif
Close Other Viewers
corner of the viewer)


Viewer
Import
DataPrep
Composer
Interpreter
Catalog
Classifier
Data Preparation
Create New Image...
Create Surface...
Subset Image...
Image Geometric Correction...
Mosaic Images...
Unsupervised Classification...
Reproject Images...
Recalculate Elevation Values...
Imagine Data Prep...
Make RPF TOC...
Close
Help


Viewer
Import
DataPrep
Composer
Interpreter
Catalog
Classifier
Modeler
Vector
Radar
Input File: (*.img)
Output File: (*.img)
stack_2001_final.img
tempsubset.img
Coordinate Type:
Subset Definition:
From Inquire Box
Map
File
Two Corners
Four Corners
Data Type:
Input:
Unsigned 8 bit
Output:
Output Options:
Select Layers:
OK
Batch
AOI...
Cancel
Viewer AOI
You may use no AOI, select one from a Viewer or select one previously saved in a file.
Select an AOI Source:
None
Viewer
AOI File
Select the AOI File: (*.aoi)
Help


Viewer
Import
DataPrep
Composer
File
Utility
View
AOI
Raster
Help
Create New Image...
Create Surface...
Subset Image...
Image Geometric Correction...
Mosaic Images...
Unsupervised Classification...
Reproject Images...
Recalculate Elevation Values...
Imagizer Data Prep...
Make RPF TOC...
Close
Help
717551.14, 3179696.47 (UTM / V

3. RESOLUTION MERGE

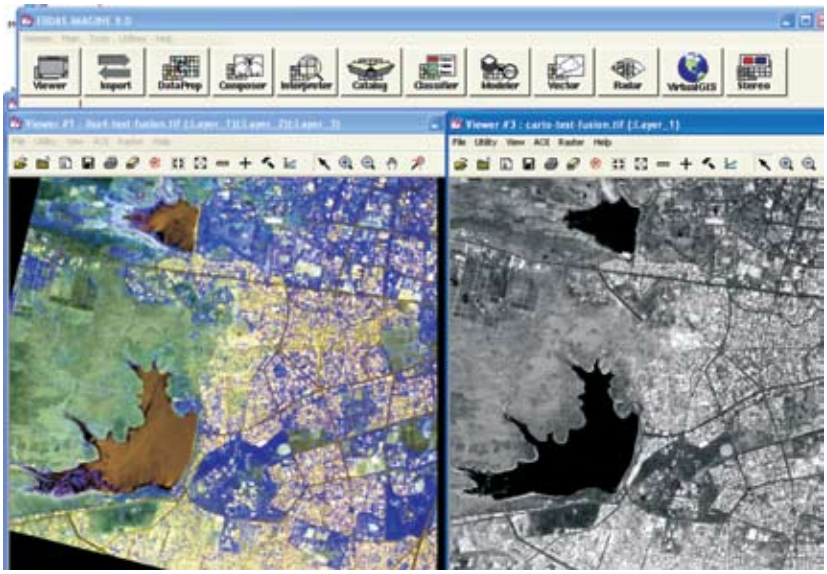
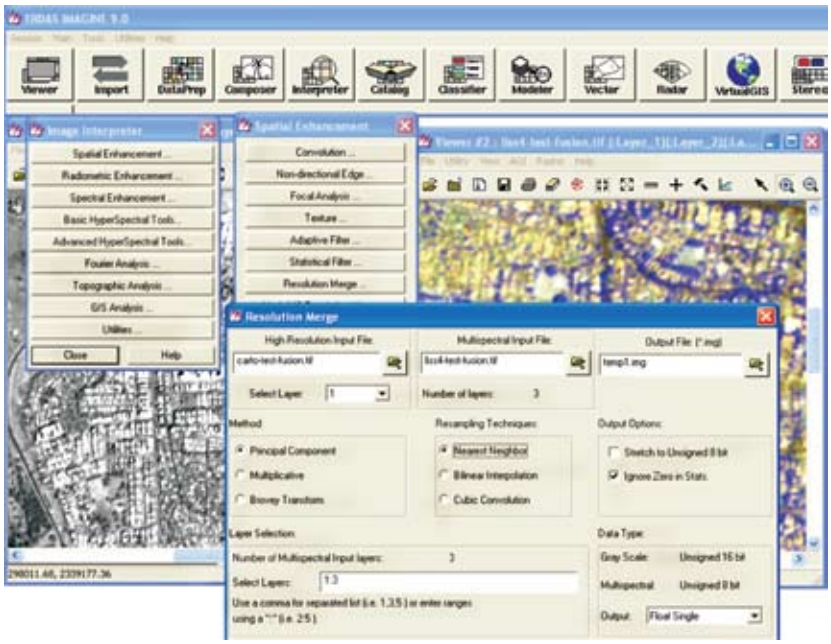


Image Interpreter – Spatial Enhancement - Resolution Merge



Select Cartosat in High Resolution input file and LISS in Multispectral Image image and out put as temp or LISS_Carto Fusion image. In the fused image one can get the advantage of high spatial and spectral resolution.

4. CLASSIFICATION OF IMAGE

The intent of the classification process is to categorize all pixels in a digital image into one of several land cover classes, or "themes". This categorized data may then be used to produce thematic maps of the land cover present in an image. Normally, multispectral data are used to perform the classification and, indeed, the spectral pattern present within the data for each pixel is used as the numerical basis for categorization. The objective of image classification is to identify and portray, as a unique gray level (or color), the features occurring in an image in terms of the object or type of land cover these features actually represent on the ground.

Two main classification methods are **Supervised Classification and Unsupervised Classification.**

Supervised Classification

With supervised classification, we identify examples of the Information classes (i.e., land cover type) of interest in the image. These are called *"training sites"*. The image processing software system is then used to develop a statistical characterization of the reflectance for each information class. This stage is often called "signature analysis" and may involve developing a characterization as simple as the mean or the rage of reflectance on each bands, or as complex as detailed analyses of the mean, variances and covariance over all bands. Once a statistical characterization has been achieved for each information class, the image is then classified by examining the reflectance for each pixel and making a decision about which of the signatures it resembles most.

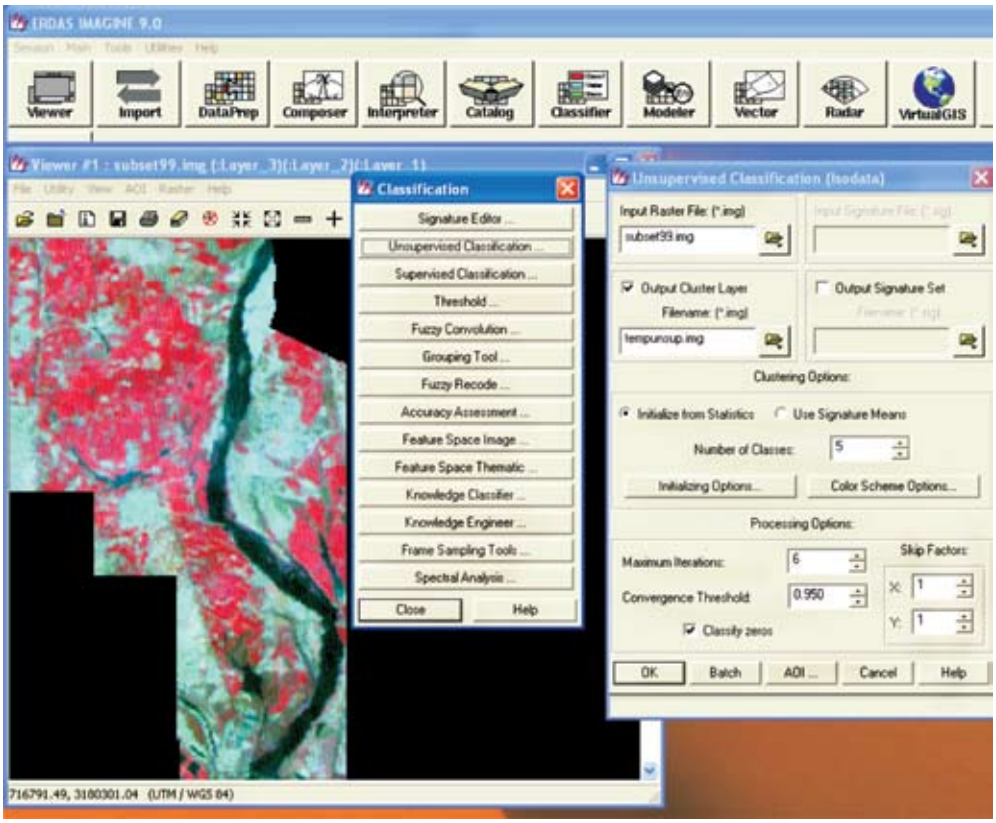
Unsupervised Classification

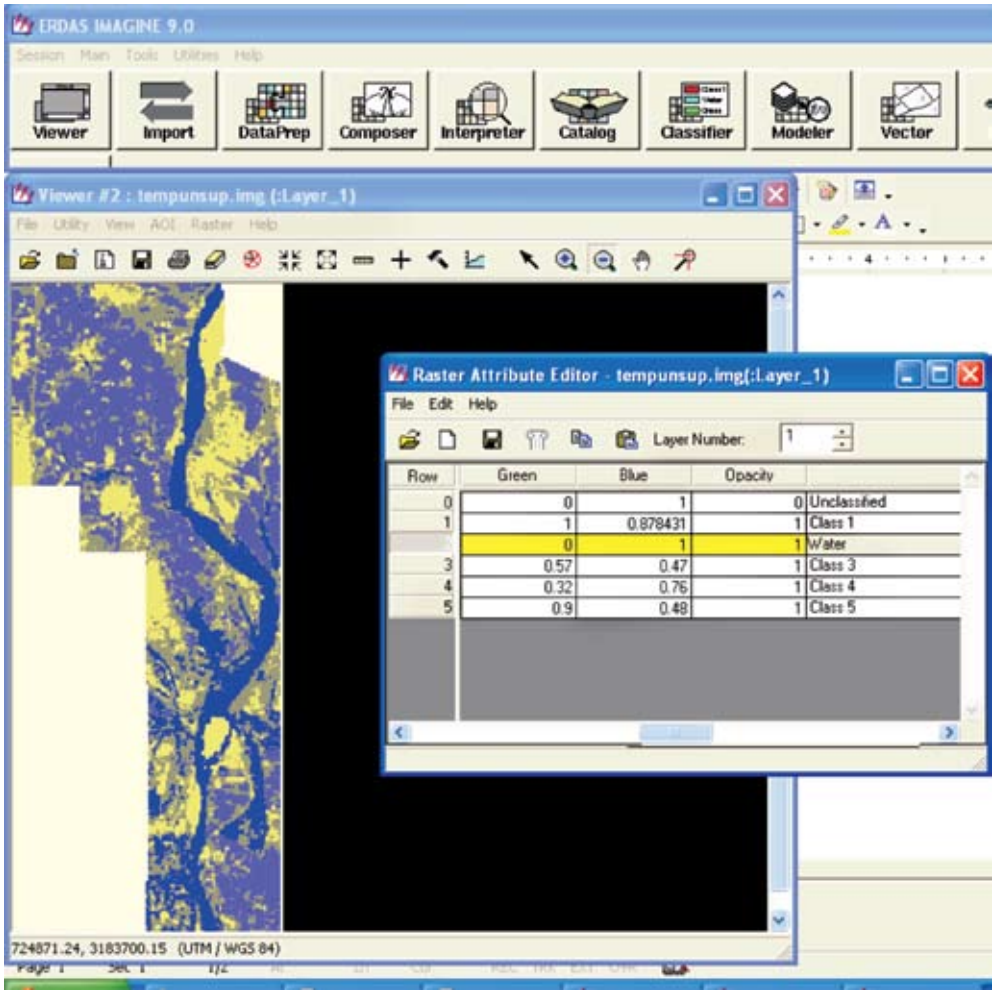
Unsupervised classification is a method which examines a large number of unknown pixels and divides into a number of classed based on natural groupings present in the image values. Unlike supervised classification, unsupervised classification does not require analyst-specified training data. The basic premise is that values within a given cover type should be close together in the measurement space (i.e. have similar gray levels), whereas data in different classes should be comparatively well separated (i.e. have very different gray levels).The classes that result from unsupervised classification are spectral classes which based on natural groupings of the image values, the identity of the spectral class will not be initially known, must compare classified data to some from of reference data (such as larger scale imagery, maps, or site visits) to determine the identity and informational values of the spectral classes.

Thus, in the supervised approach, to define useful information categories and then examine their spectral separability; in the unsupervised approach the computer determines spectrally separable class, and then define their information value.

UNSUPERVISED CLASSIFICATION

Classifier- Unsupervised-Input Raster- Output Raster





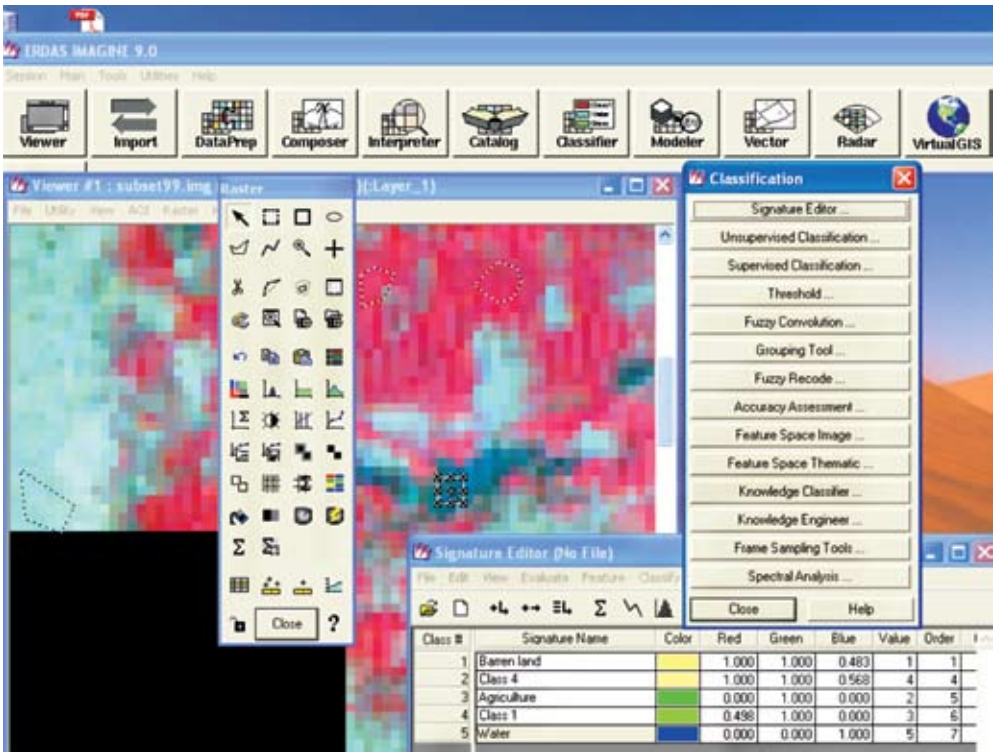
Go to Attribute Editor and check the areas under each land use land cover type in the study area.

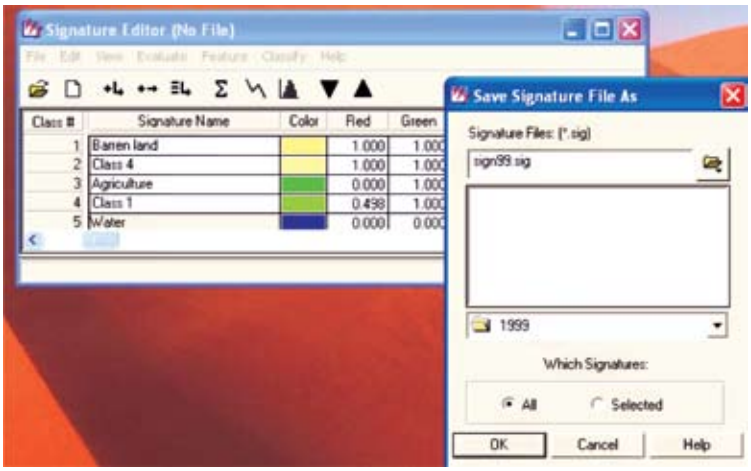
Raster option – deselect clear display – select background transparent – ok.

Utility – swipe (try blend and flicker also) – swipe the original image to get the clarification.

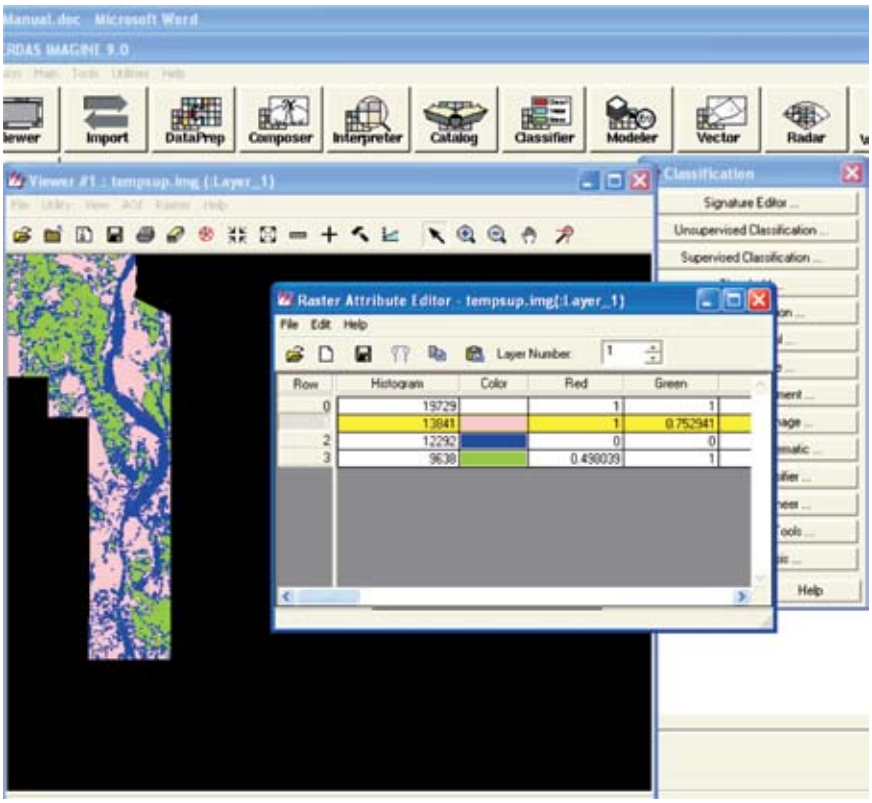
SUPERVISED CLASSIFICATION

Classifier- Signature Editor

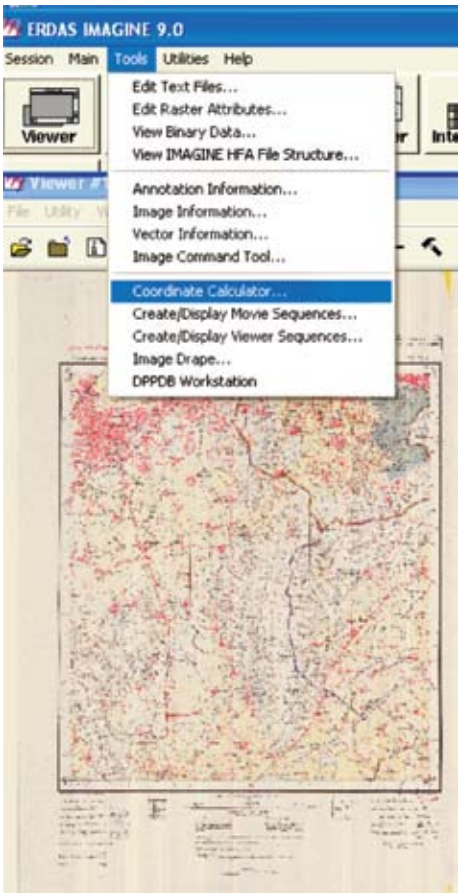


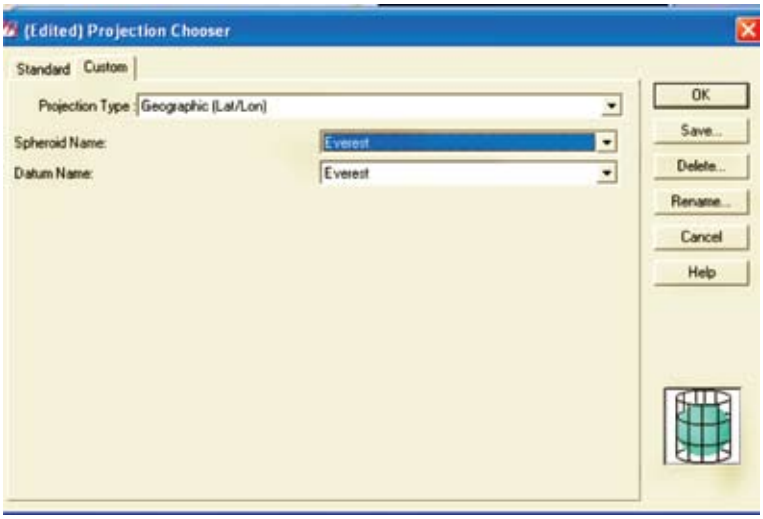



Supervised Classification
Input Raster File: (*.img)
subset99.img
Input Signature File: (*.sig)
delhi.sig
Classified File: (*.img)
tempsup.img
Distance File
Filename: (*.img)
Attribute Options...
Fuzzy Classification
Best Classes Per Pixel
Decision Rules:
Non-parametric Rule:
None
Overlap Rule:
Parametric Rule
Unclassified Rule:
Parametric Rule
Parametric Rule:
Maximum Likelihood
Classify zeros
Use Probabilities
OK
Batch
AOI ...
Cancel
Help


Import
DataPrep
Composer
Interpreter
Catalog
Classifier
Modeler
Vector
Radar
Viewer #1 : tempsup.img (:Layer_1)
Classification
Signature Editor ...
Unsupervised Classification ...
Supervised Classification ...
Raster Attribute Editor - tempsup.img(:Layer_1)
File Edit Help
Layer Number
Row
Histogram
Color
Red
Green
Help

5. GEOREFERENCING





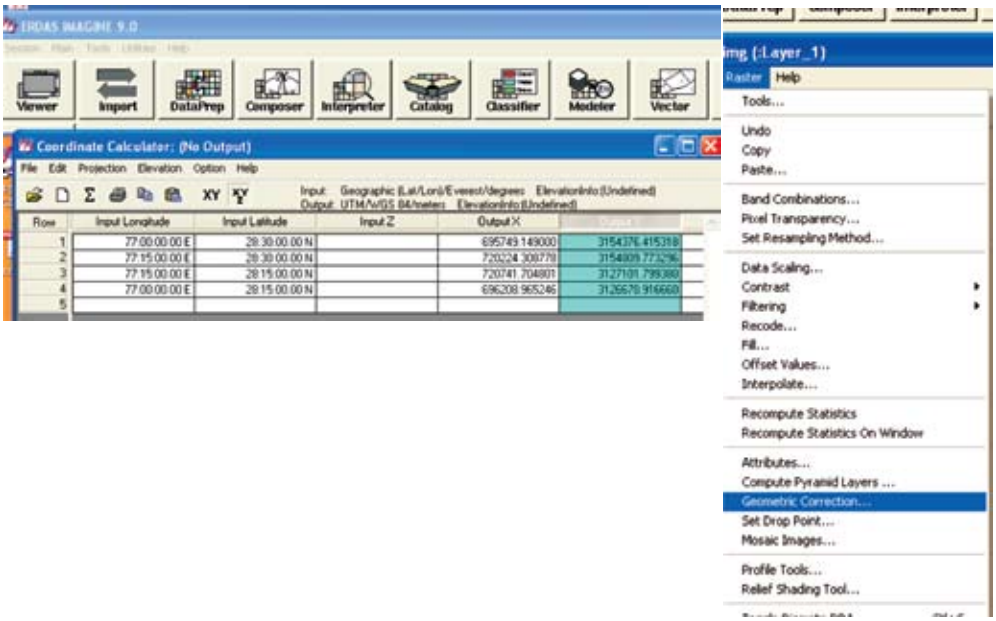
Tools – Coordinate Calculator

Set Input projection – Custom – Geographic (Long/Lat)-Spheroid- Everest – datum –Everest

Set output projection – Custom –UTM-WGS 84 – Datum WGS 84- Zone 43

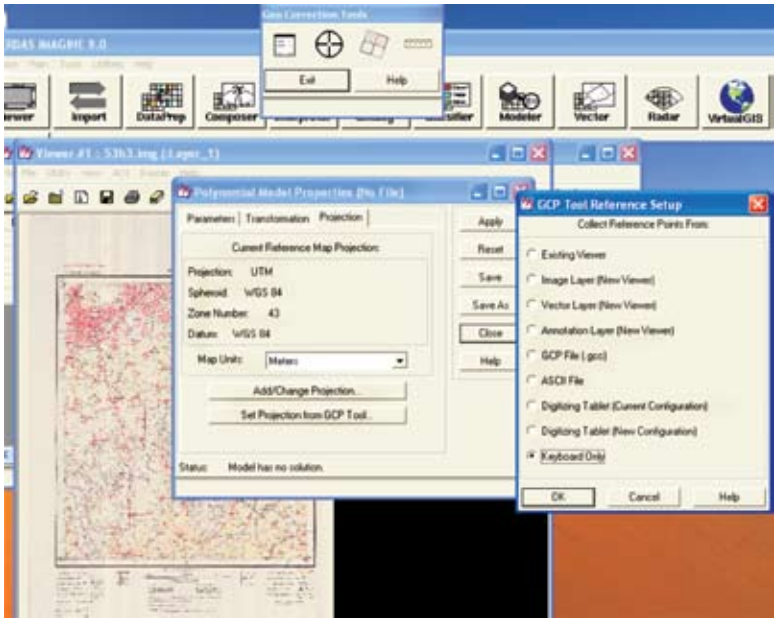
Input Latitude and longitude in X and Y coordinates (convert to degree decimals.. e.g 27 degree 15 minutes as 27.25.

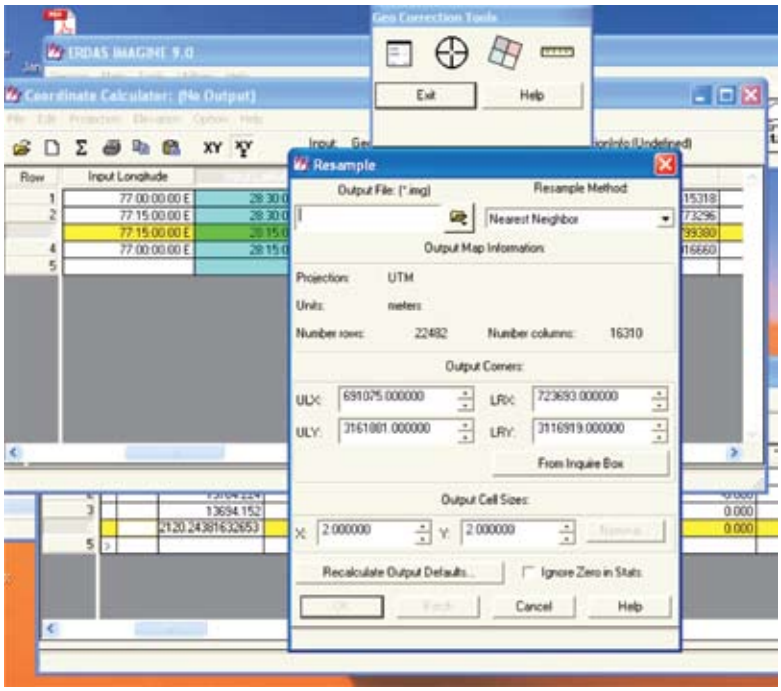
Set Projection to GCP tools – keyboard only – ok – ok.



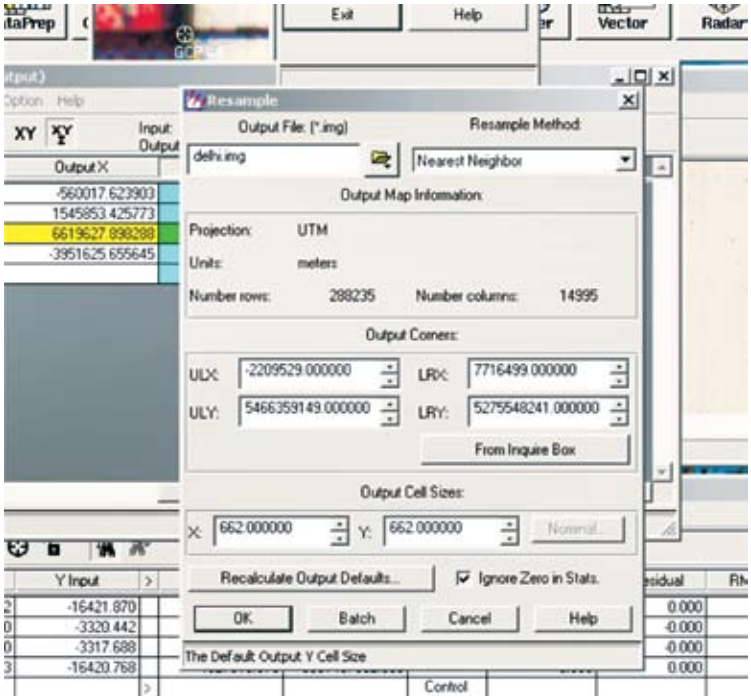
Exercise 4

In the main window go with geo correction tools to the bottom left coordinate and click. From coordinate calculator table select X and Y output and paste in X and Y ref. Like wise top left, top right and bottom right coordinates are to be pasted.





In geocorrection tools click on Display resembling image dialog.



Output file (give location) – ignore Zero in stats – ok. (Rest keep default).

Exercise 4

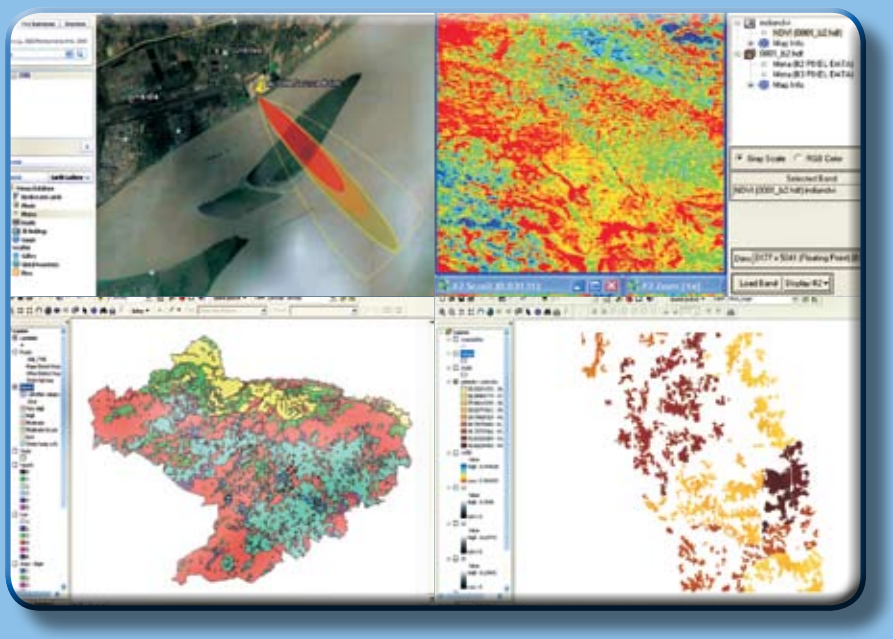
Test 1

1. Down-load a landsat imagery form www. landsat .org
2. Subset the Area of Interest
3. Classify the imagery (supervised and unsupervised)
4. Computer the Area under each class (Spatial statistics)

Test 2

1. Georeference a scanned toposheet
2. Download time series imageries from any existing source and do change detection.

Part 2



Hazard Mapping, Monitoring, Vulnerability and Risk Assessment

ANALYZING MULTI DATE DATA FOR DROUGHT EARLY WARNING AND MONITORING

Description: The aim of the exercise is to monitor crop conditions for early warning and assessment of agricultural drought using multi-date satellite imageries. This exercise will increase the skills of the participants in using ENVI software for performing various tasks like sub-setting image, image enhancement, generating NDVI, creating NDVI difference images and spatial statistics.

Data Used: SPOT VGT derived 10-day NDVI images for June to Sept 2001 (Normal Year) and 2002 (Drought Year)

http ://free.vgt.vito.be/

Start working with ENVI.

(A) DATE PREPERATION - OPENING & LOADING SPOT VGT BANDS, SUBSETTING INDIA FROM ASIA AND COMPUTATION OF NDVI

Working Directory: C:\DATA\SVGT\BANDS

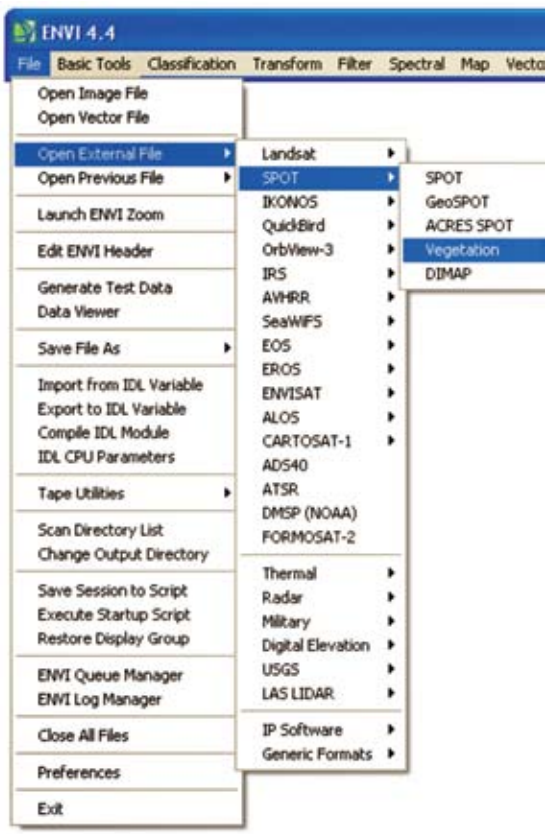
Data Available: JUNE1, 2002

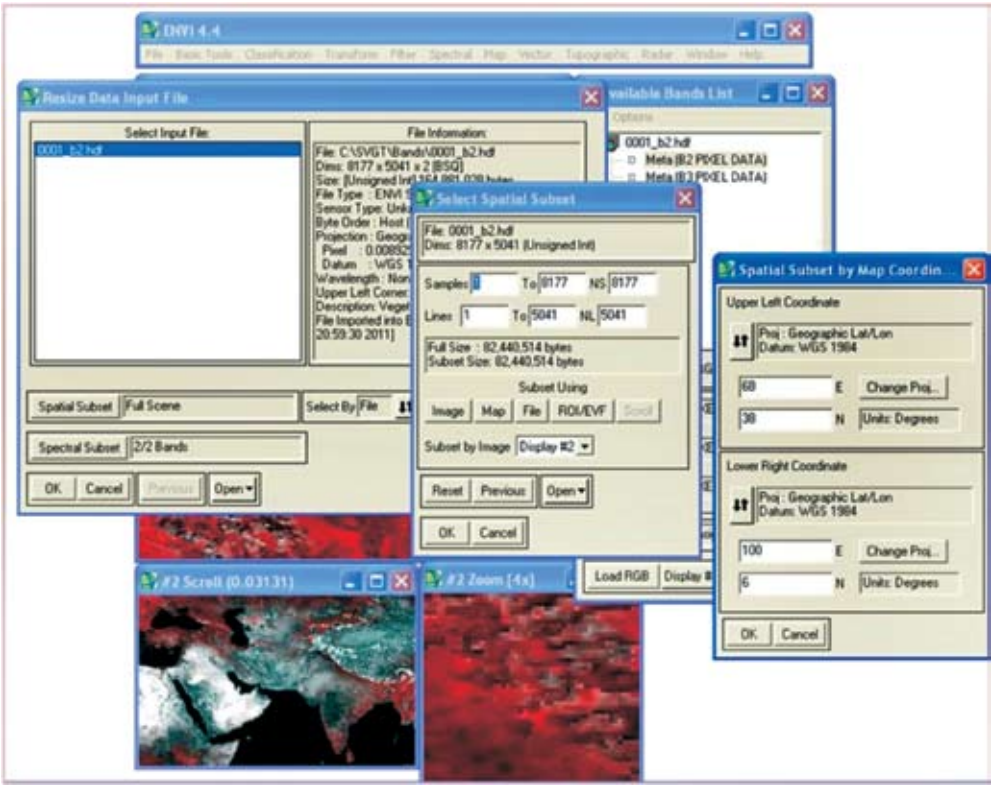
Red Band (File name: 0001_b2.hdf) NIR Band
(Filename: 0001_b3.hdf Ancillary info
(Filename: 0001_log.txt)

STEPS

1. Opening the Image
   - Main MENU → File → Open External File → SPOT → Vegetation
   - Select File from Working Directory & OPEN [0001_b2.hdf]
   - Will see AVAILABLE BAND LIST
   - Select BUTTON RGB Color
   - Select in R → Infra red band (b3)
   - Select in G → Red band (b2)
   - Select in B → Red Band (b2)
   - Press BUTTON Load RGB

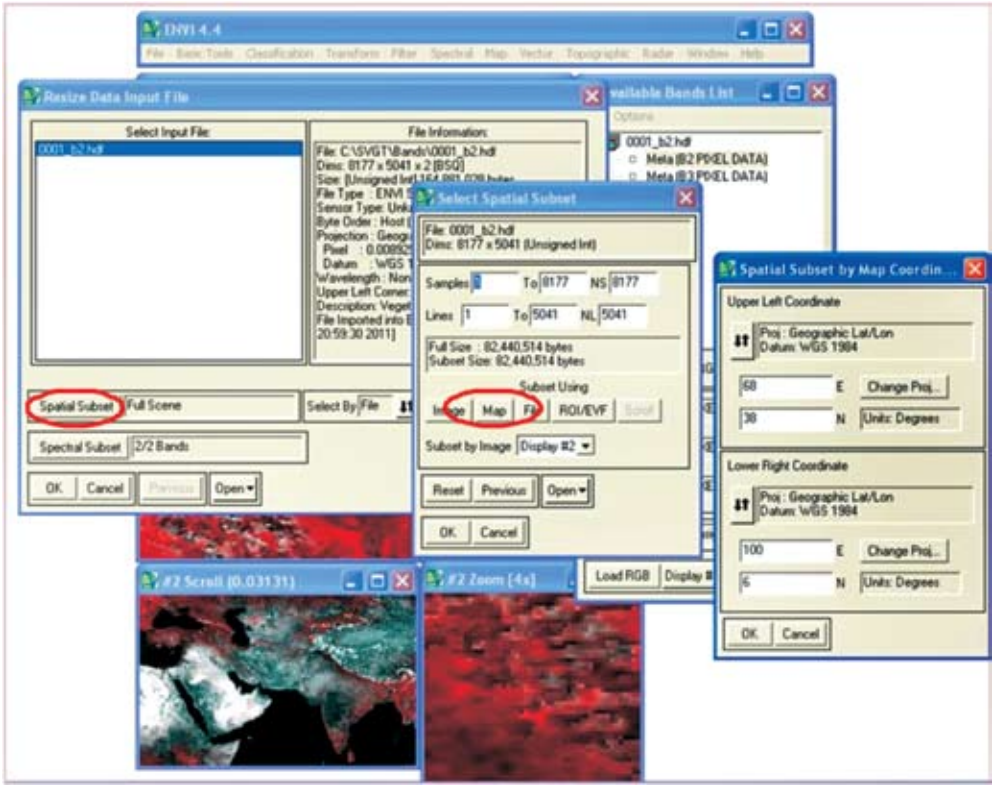
Image is now displayed as False Color Composite (FCC) in 3 windows: Image window, Scroll Window, Zoom Window





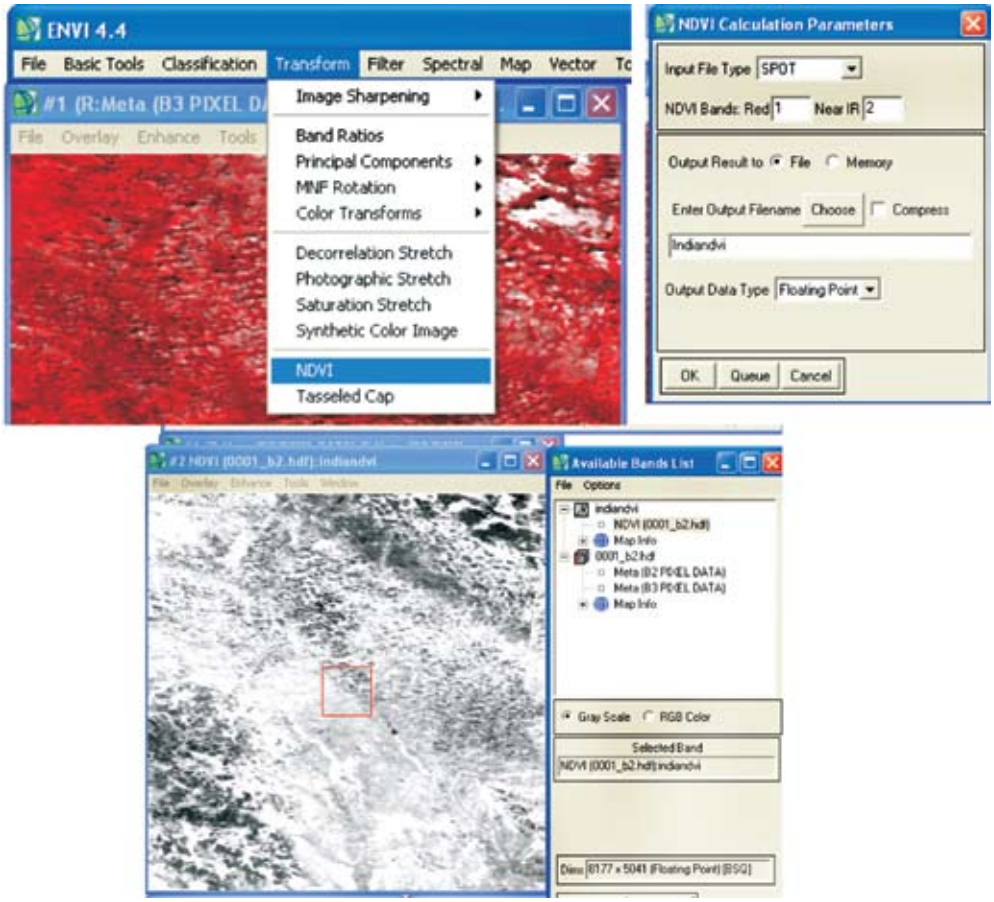
2. Try to **PAN Image** by moving Square on SCROLL Window
3. **SUBSETTING: Extract INDIA from ASIA**
   - Main MENU → Basic Tools → Resize Data
   - Select file [0001_b2.hdf]
   - Select SPATIAL SUBSET
   - Select MAP
   - Enter Upper left Coordinates: 68.0 E & 38.0 N
   - Enter Lower left Coordinates: 100.0 E & 6.0 N
   - Press OK
   - Press CHOOSE and select working directory

- Give new file name [India june1.img]
- Press OK
- In Available Band List you will a new file [India junel.img]
- Display this image as RGB



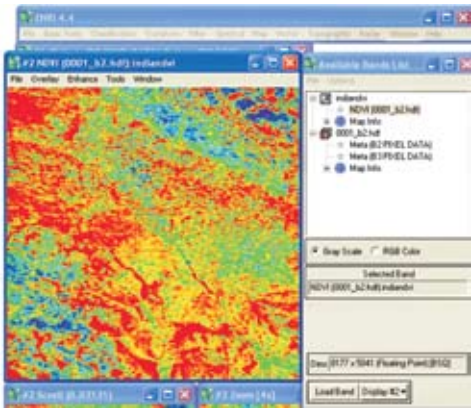
5. Compute NDVI

- Go to Main Menu → Transform → NDVI
- Select Image file[India_june1.img] & Press OK
- Select Input File type : SPOT
- Enter NDVI Bands: Red = 1 Near IR=2
- Give Output file name: Ind_ndvi_ june1.img
- Output Data Type = Floating Point
- Press OK
- In Available Band List will see a new file [Ind_ndvi junel.img]



6. Pesudo Coloring NDVI

- Display this image as Grey Scale
- Go to Image Window Menu → Tools → Cursor Location / Value
- Move cursor in image window to see values of NDVI
- Go to Image Window Menu → Tools → Color Mapping →ENVI Color Table → Select RAINBOW
- Low NDVI are in Black/Blue whereas High NDVI is in Red
- Close Display
- Close all files in Available Band List



(B) CROP MONITORING & DROUGHT ASSESSMENT Working Directory: C:\DATA\SVGT\NDVI

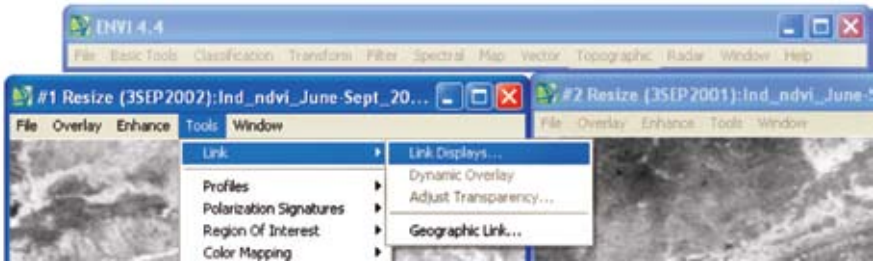
Data Available:

JUNE1 - SEPT3, 2001 (Filename: Ind_ndvi_June-Sept2001.img] JUNE1 - SEPT3, 2002 (Filename: Ind_ndvi_June-Sept2002.img]

District Boundary Vector (Filename: MP_Dist.evf)

STEPS

1. Extract (Subset) Madhya Pradesh Area from both year NDVI Images (please refer to pervious page to see the steps)
   a. Upper left Coord: 74.0E & 27.0 N
   b. Lower right Coord: 84.15E & 21.0N
2. Load 2AUG NDVI Band of 2001 & 2002 in two displays
3. Right Click in Image Window → Link Displays



4. Load Pseudo Color table RAINBOW on both displays
5. Load MP_Dist Vector on both displays
   a. Go to Main Menu → File → Open Vector File → Select file [MP_Dist.evf]
   b. See Layer:MP_Dist.evf in Available Vector List
   c. Select Layer:MP_Dist.evf → Load Selected → Display#1
   d. Select Layer:MP_Dist.evf → Load Selected → Display#2
6. Visual comparison be made on State of NDVI in two years
7. **COMPARING NDVI PROFILE of selected locations**
   a. On display window right click → Link Display → Dynamic Overlay OFF → OK
   b. Go to Display1 Menu → Tools → Profile → Z profile [2001]
   c. Go toDisplay2 Menu → Tools → Profile → Z profile [2002]
   d. Compare the NDVI profile of two years at different locations

8. NDVI Differencing

a. Go to MAIN MENU → BASIC TOOLS → BAND MATH → Enter FLOAT(B1)-FLOAT(B2) → Press OK → Select B1 as 3 Sept 2002 and B2 as 3 Sept 2001

b. Give Output file name [NDVI_Difference] & Press OK

9. **Load Difference Image in New Display Window**

10. Go to Image Window Menu → TOOLS → COLOR MAPPING → DENSITY SLICING → Select NDVI_Difference Image → Press OK → Press APPLY

a. The NDVI Difference image is shown in Different Colors

b. Check for Negative ranges and Positive Ranges

c. You can define your own density slice by giving all negative values RED Color and all positive values GREEN Color

11. Positive Values mean: 2001 Vegetation is poorer than 2002

12. Negative Value mean: 2002 Vegetation is poorer than in 2001 and is current season drought

13. Date Wise NDVI Differencing

a. Go to MAIN MENU → BASIC TOOLS → BAND MATH → Select FLOAT(B1)-FLOAT(B2) → Press OK → Select B1 → Map Variable to Input file → Select MP_ndvi_2001.img file → Select B2 → Map Variable to Input file → Select MP_ndvi_2002.img file

b. Give Output file name [MP_NDVI_Difference.img] & Press OK

c. In Available Band List this new file with 12 bands becomes available.

d. Load 3July NDVI diff in Display 1, 3Aug NDVI diff in Display 2 and 3Sept NDVI Diff in Display 3. Density Slice all 3 displays into Negative (RED Color) and Positive (GREEN Color).

e. Link all the three displays

f. Do visual analysis how drought conditions varying for different dates

14. These NDVI Difference values are averaged over an administrative boundary and aggregated over growing season

a. NDVI Difference is > 10% but <25% of normal: Watch

b. NDVI Difference is > 25% of normal: Alert

15. Aggregating NDVI in a district

a. Display any one date NDVI of MP_NDVI_2002 image

b. Go to Available Vector List → Select Layer: mp_dist → Load Selected → Display 1 (NDVI display)

c. On 1 Vector Parameters Go to File → Export Active Layer to ROIs → Select Convert each record of an EVF layer to a new ROI → Select DISTRICT in Attribute column to use for name

d. Go to Image Display 1 → Overlay → Region of Interest → ROIs are loaded over NDVI image all in white color

e. Go to →1 ROI Tool Window → Right Click on COLOR → Assign Default colors → Now ROIs are loaded in different color for each district

f. Expand ROI Name by dragging margin to see district names of ROIs

g. Select a ROIs representing a District

h. On → ROI Tools → Stats - will show ROI Statistics

i. Select Basic Stats given in lower part, right click to copy and paste in EXCEL worksheet

j. Aggregate the MEAN NDVI over all bands in EXCEL. Now display NDVI of MP_NDVI_2001.img in DISPLAY 1

Overlay ROIs on this image and calculate stats m. Similarly copy 2001 stats in Excel. Aggragte MEAN NDVI for 2001 and 2002.

Use the formula

a. Drougth Index = $\frac{\sum NDVI2002 - \sum NDVI2001}{\sum NDVI2001} \times 100$

b. Decide Watch / Alert for this district for drought

c. Calculate index for other districts

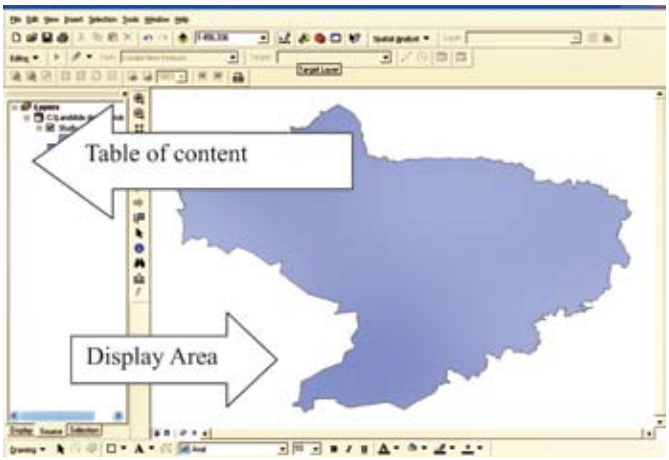
LANDSLIDE HAZARD ZONATION

This exercise will show you, how to prepare a regional level landslide hazard map for the Nilgiri District. During this exercise you will learn to prepare the landslide location map using on the latitude and longitude of the historical landslides. This exercise will give idea about the preparation of various thematic layers in the land slide hazard mapping, basics in weightage computation, generate the regional level landslide hazard Zonation map, based on the Slope, Landuse, Rainfall and geology which only gives the fair idea in the landslide susceptibility.

STEP 1: START ARCMAP AND ADD REQUIRED DATA FOR THE ANALYSIS

First, Launch the Arc Map Application.

- If you have a shortcut for ArcMap on your desktop, double-click it to start ArcMap. Otherwise, click start > programs > ArcGis > ArcMap.
- If you see the ArcMap startup dialog, confirm or click a new empty map: then click OK.
- In the table of contents, right-click the Layers data frame, then click Add Data. Otherwise, click Add Data icon in standard tool bar.
- In the add data dialog, navigate to “C:\Landslide demo” folder and open the geodatabase landslide.mdb
- Press ctrl key and click ‘Study’ and ‘Ls’ to select it.
- Click Add.

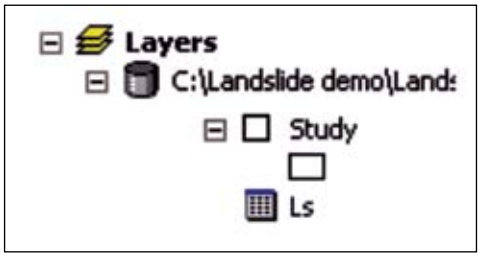


The selected layers are added as a layer in the table of contents and displayed in the display area as show in the above figure.

- In the table of contents, right-click Ls; then click Open.

The attribute table of landslide location appears. Each record represents an individual landslide event in the study area. The attribute table of the LS contains the Latitude and longitude of each Landslide.

- Close the attribute table.
- You can switch off or on the layer visibilities. Try to switch off the layer visibility of study and switch on the layer visibility by check or unchecking the small box near the layer name in the table of content.
- In Main menu, click File; then click save.
- Save as dialog box appears select "c:\Landslide demo" in the save in field and enter the file name as Demo.mxd.
- Press save button.

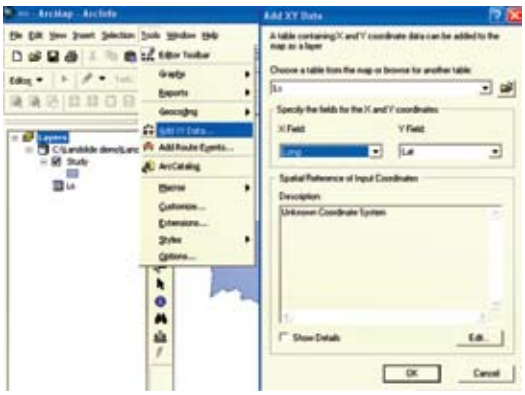


Now your map document stored in the path "c:\Landslide demo" as Demo.mxd file.

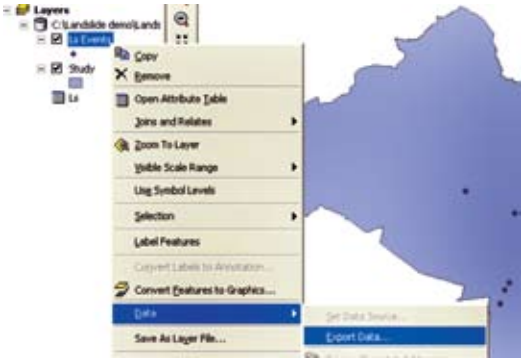
STEP 2: CREATING LANDSLIDE LOCATIONS LAYER

In this step you will learn to create the landslide location layer based on the latitude and longitude of the event

- In Main menu, click Tools; then click Add XY Data. Add xy Dialog box appears.

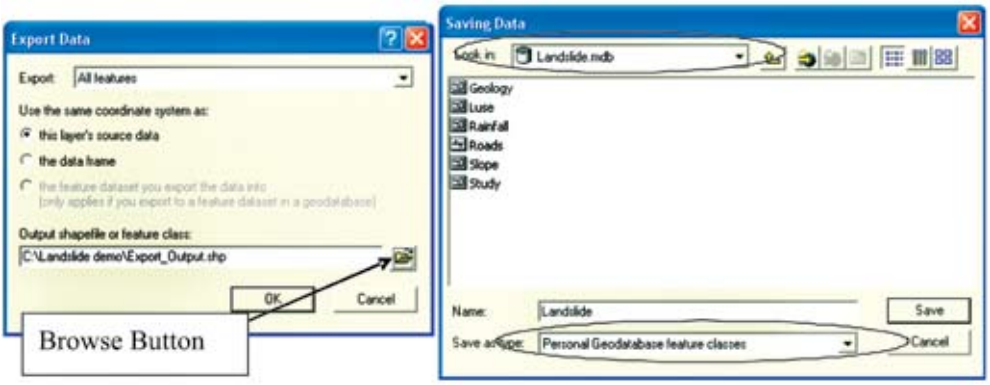


- In Add XY data dialog box select the table LS, X Field as long and Y Field as Lat
- Press OK.
- ArcMap creates the new event layer as 'Ls Events' in the table of content and displayed in the display area

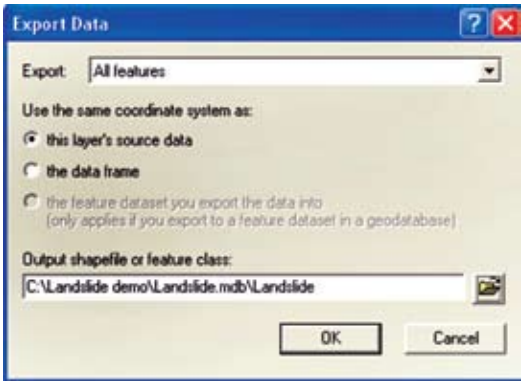


•Right click on 'Ls Events'; click data and then click Export Data

•Export data dialog box appears, click Browse button



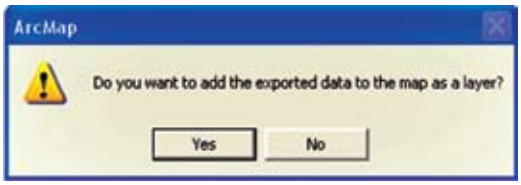
- Saving data dialog box appears, Select save as type as 'Personal Geodatabase Feature classes' and browse to 'C:\landslide demo\Landslide.mdb' and Enter name as Landslide
- Click save



•Export data dialog appears as shown above click Ok

•ArcMap exports the data and ask your confirmation to add it as one layer, press Yes to add the layer

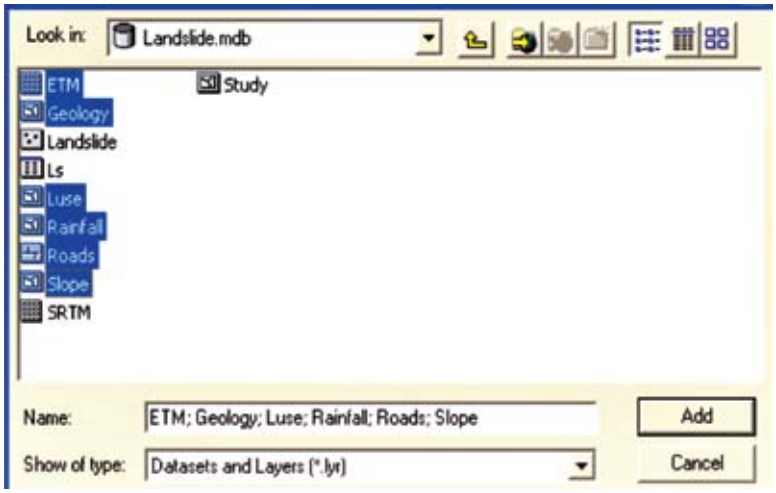
- In table of content, right click the 'Ls Events' layer; then click ✕ Remove .



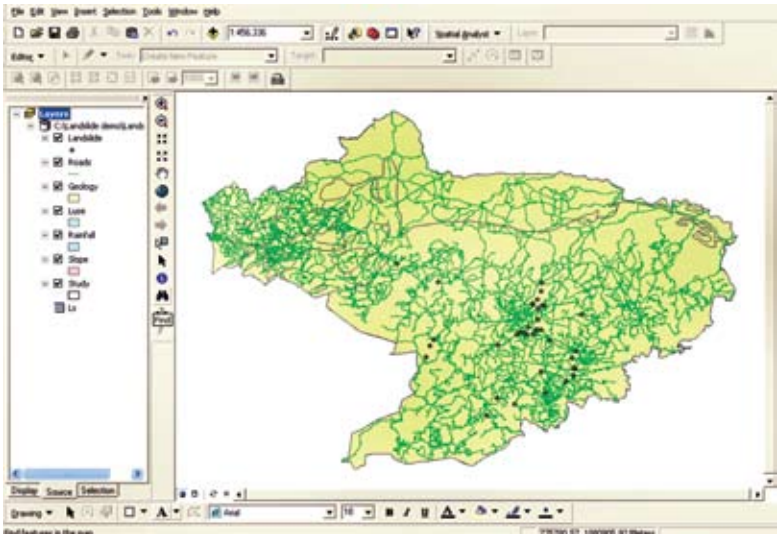
STEP 3: ADD REQUIRED DATA FOR THE ANALYSIS

Now you will add the required data for the analysis

- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar.
- In the add data dialog, navigate to "C:\Landslide demo" folder.
- Press ctrl key and click 'Geology', 'Luse', 'Rainfall' 'Roads' and 'slope' to select it.



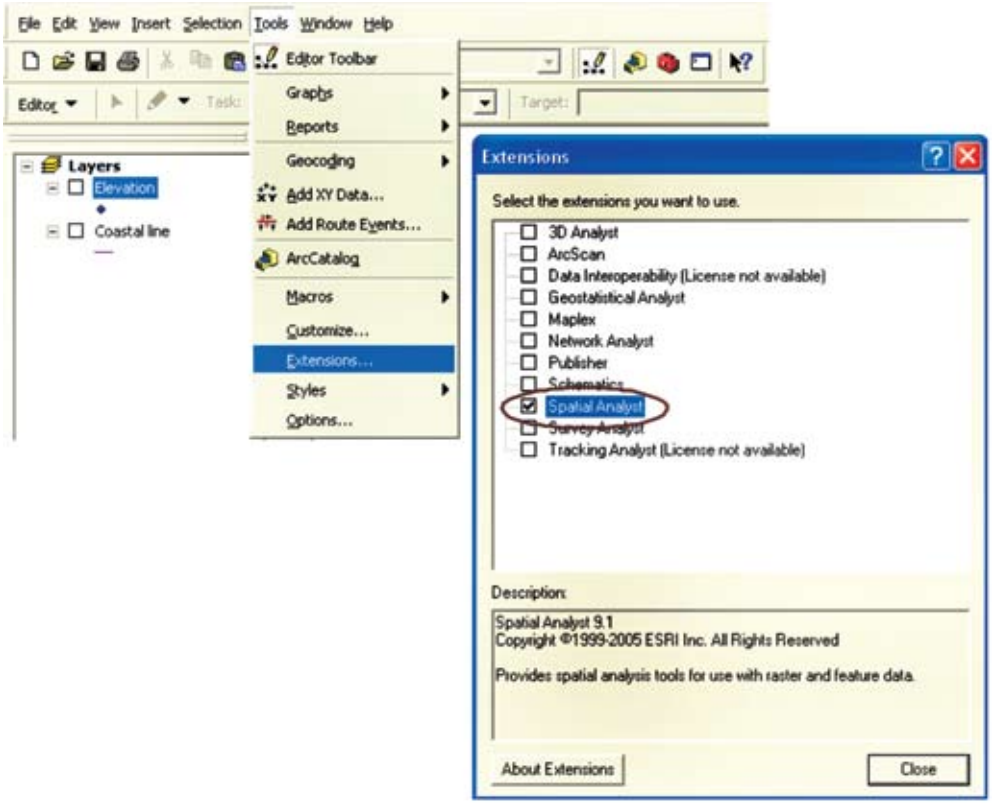
- Click Add.
- Selected layer are added to the ArcMap as shown below.



STEP 3: CONVERTING VECTOR LAYERS INTO RASTER LAYER

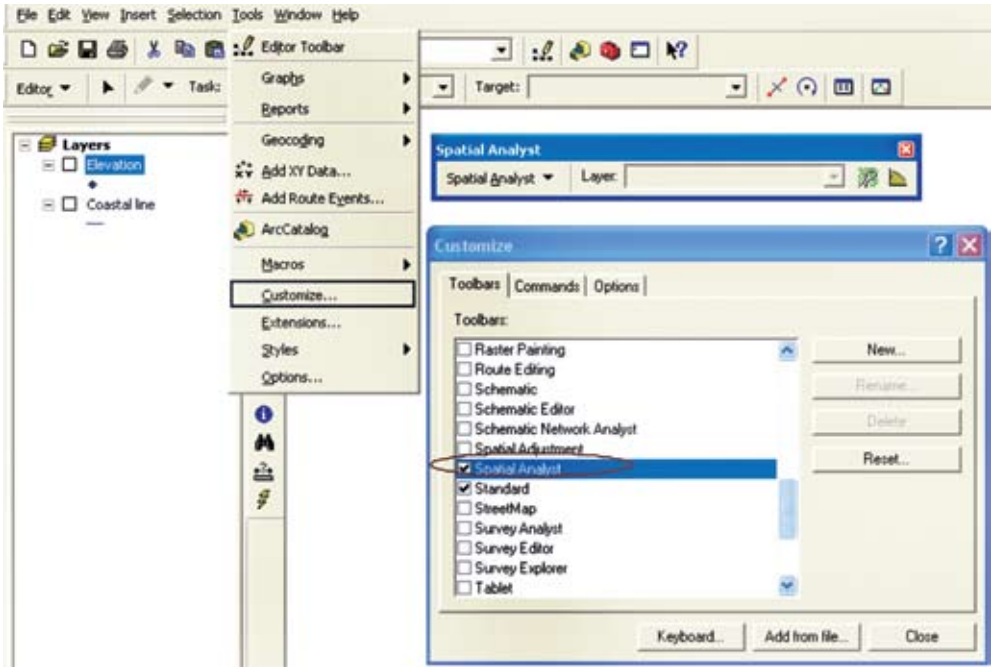
In this step you are going to convert the vector layer to raster map

- In the Main menu, click Tools; then click Extensions.
- In extension dialog box, select the box next to Spatial Analyst.
- Close the extension dialog box.



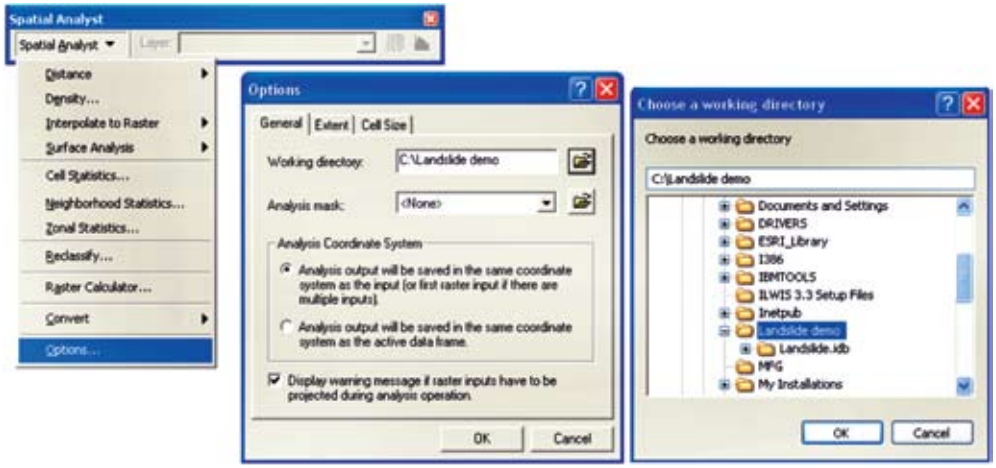
In this step you will enable the spatial analyst tool bar.

- In the Main menu, click Tools; then click Customize.
- In Customize dialog box, In Tool bar tab, select the box next to Spatial Analyst.
- Close the Customize dialog box.



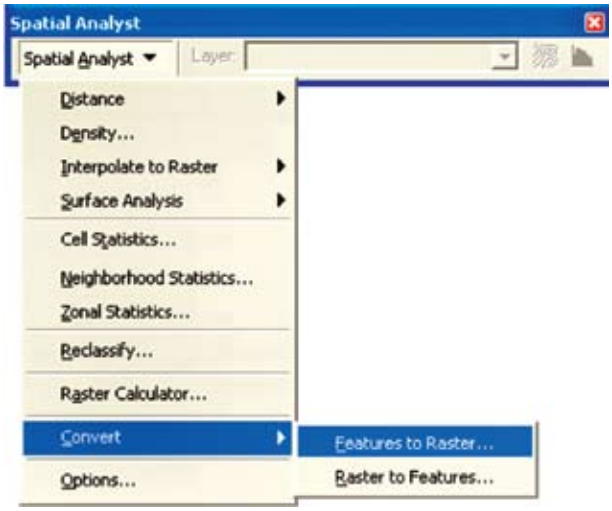
Now you will see the spatial Analyst tool bar on your ArcMap Application window.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Option. In Options Dialog box select the working directory "C:\Landslide Demo".

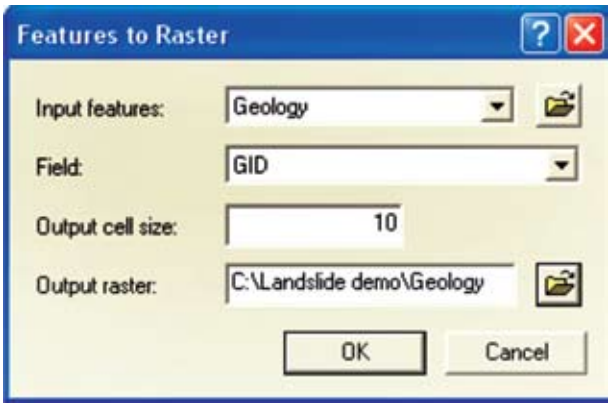


- Click Ok

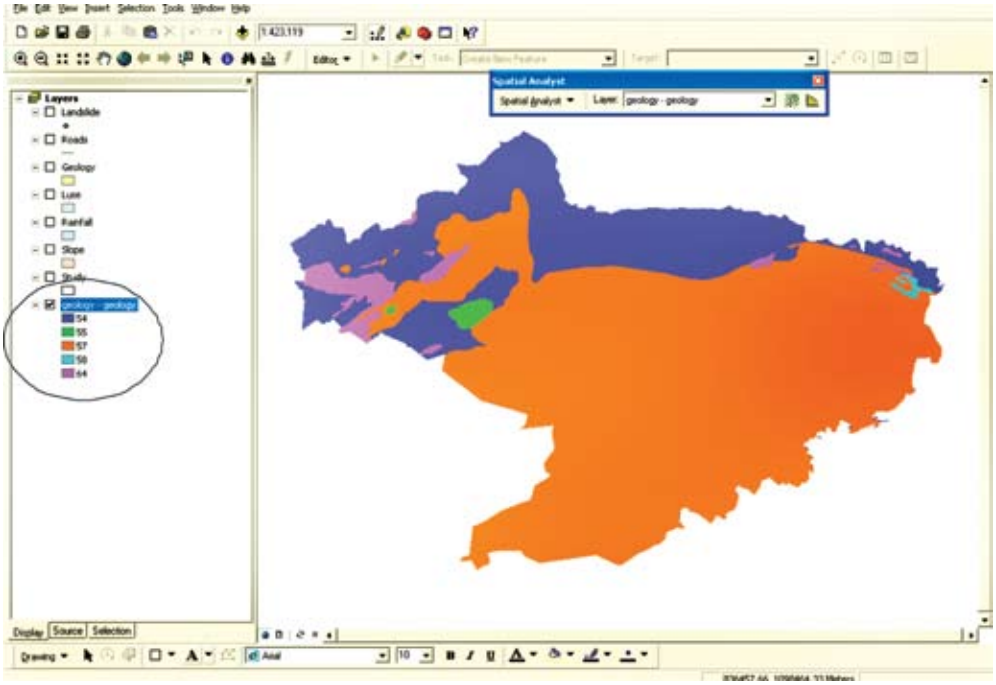
- In spatial analyst tool Bar click Spatial Analyst drop down, Click Convert and then click feature to raster



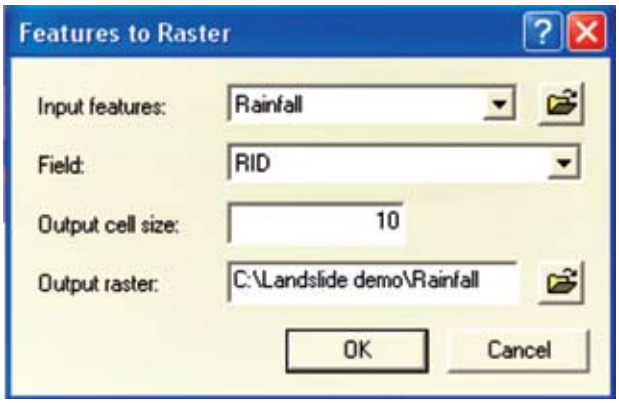
- In feature to raster dialog enter input feature as 'geology', Field as 'GID', Output cell size as 10 and Output raster as 'C:\Landslide demo\Geology' as shown below and press ok to convert the layer



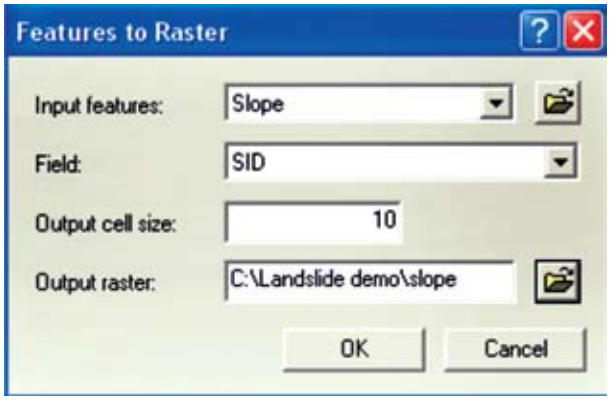
ArcMap Creates the new raster layer in 'C:\landslide demo' based on the GID value in the Geology layer with cell size of 10 and raster layer is add to ArcMap as 'geology – geology' as given below.



- To convert Rainfall vector layer into rainfall raster layer, click Spatial Analyst drop down, Click Convert and then click feature to raster
- In feature to raster dialog enter input feature as 'Rainfall', Field as 'RID', Output cell size as 10 and Output raster as 'C:\Landslide demo\Rainfall' as shown below and press ok to convert



- To convert slope vector layer into slope raster layer, click Spatial Analyst drop down, Click Convert and then click feature to raster
- In feature to raster dialog enter input feature as 'slope', Field as 'SID', Output cell size as 10 and Output raster as 'C:\Landslide demo\slope' as shown below and press ok to convert



- Press Ctrl Key & click Geology, rainfall, slope and Luse then right clicking over the layer name in the table of content; then click Remove .
- Remove vector layers used for creating raster layers for weightage classification
- Converting landuse vector layer to raster layer requires more time. so converted raster Luse layer is already available in your demo folder add it to the ArcMap by right-clicking the Layers data frame Otherwise by clicking Add Data icon in standard tool bar.

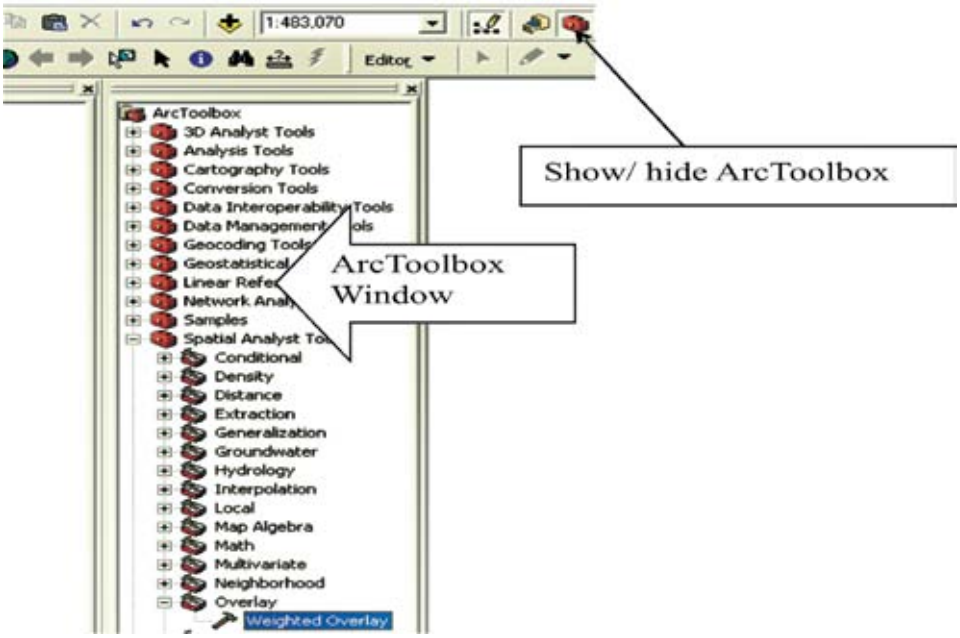
STEP 4: RANK AND WEIGHTAGE CALCULATION

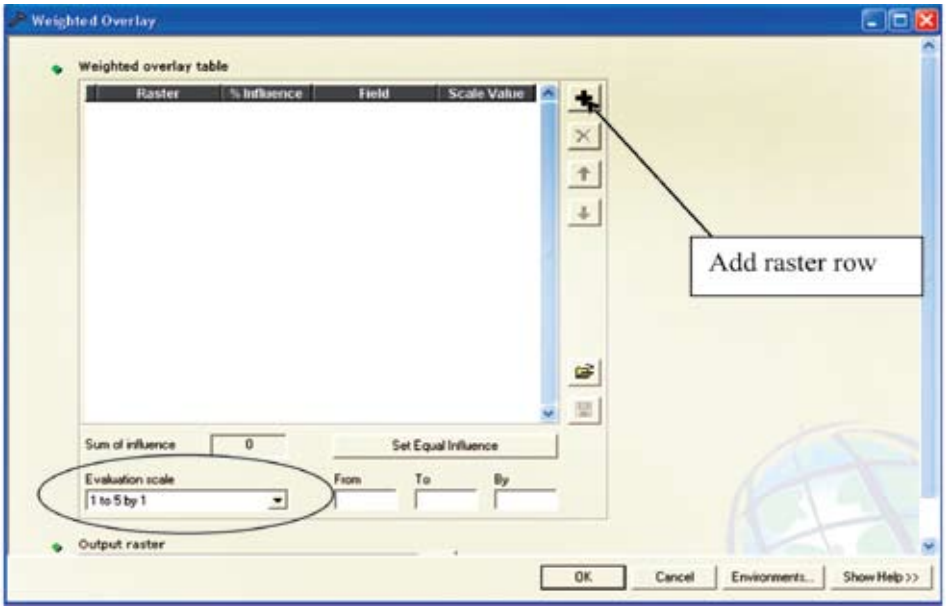
In this step you will be using the following table to perform the overlay analysis, by overlaying all the layers and finally to prepare the landslide hazard zonation map.

Table: Weightages based on Expert Knowledge and BMTPC guidelines

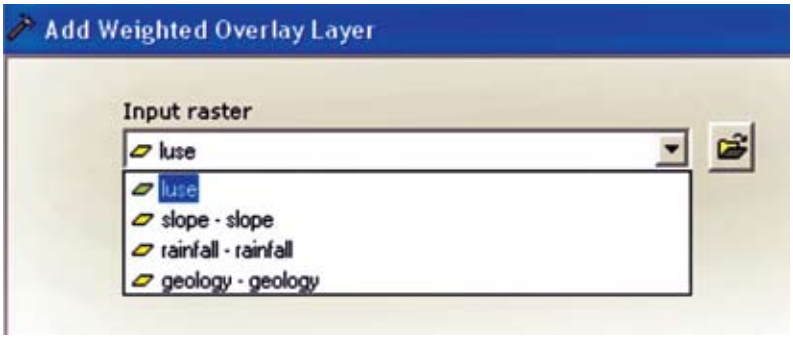
Layer	% percentage	Class Id	Class description	Rank in 5 point Scale
Slope	40	1	>60º	5
		2	30-60º	4
		3	15-30º	3
		4	8-15º	2
		5	0-8º	1
Landuse	36	1	Forest	1
		2	Scrub and Grass	5
		3	Arable	4
		4	Unproductive land	0
		5	Builtup land	0
		6	Water Body	0
Rainfall	12	10	1000-1200	4
		11	1200-1400	4
		12	1400-1600	4
		13	1600-2000	5
		14	2000-2400	5
		15	2400-2800	5
Geology	12	54	Fissile hornblende biotite gneiss	2
		55	Hornblende-biotite gneiss	3
		55	Garnetiferous quartofeldspathic gneiss	3
		57	Metagabbro, Pyroxenite, Pyroxene granulite	4
		57	Charnockite	4
		58	Felsite	3
		64	Ultramafic rocks (Mylonite)	2
		64	Fuchsite quartzite, schistose quartzite, sillimani	2

- click button in standard bar in the ArcMap to show the ArcToolbox window if you already having the arctoolbox window move to next step
- In ArcToolbox, Click Spatial Analyst Tools, overlay and then weighted overlay.





- Weighted overlay tool appears as shown above. Change the evaluation scale into '1 to 5 by 1'
- Click add raster row button, input raster select slope - slope and click ok
- Similarly add 'luse' 'rainfall – rainfall' and 'geology – geology' raster layers into the weighted overlay tool.

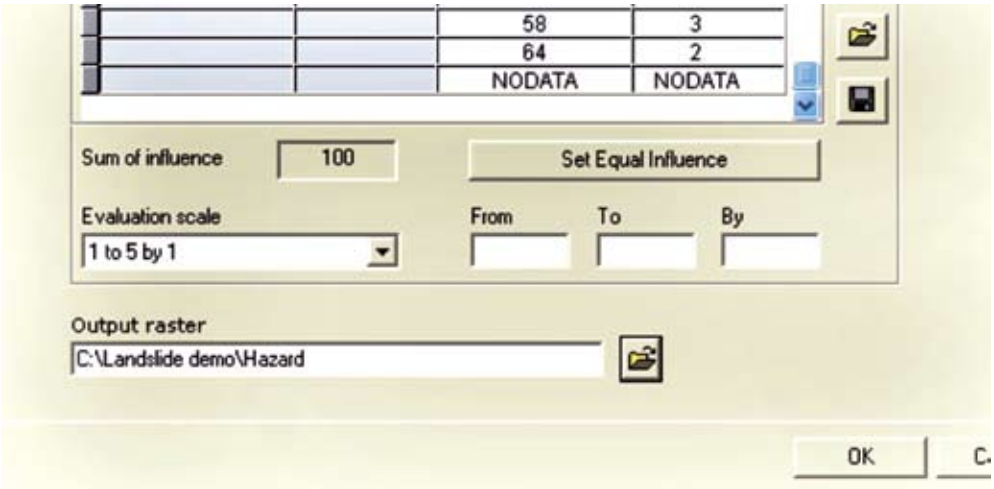


- In the º of influence enter the influence value in the table 1.
- Using above table 1 assign the scale value for each class value (class id) in the layer. Edit (Change Influence Values based on BMTPC Criteria)

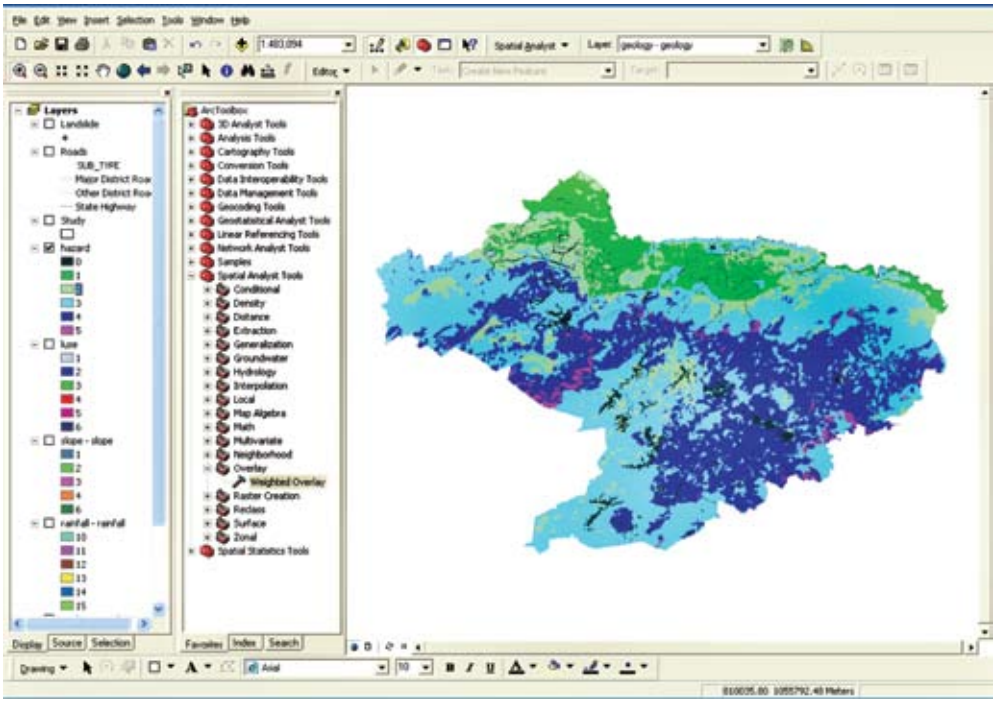
Raster	% Influence	Field	Scale Value
slope - slope	40	Value	
		1	5
		2	4
		3	3
		4	2
		6	1
		NODATA	NODATA
luse	36	Value	
		1	1
		2	5
		3	4
		4	4
		5	Restricted
		6	Restricted
		NODATA	NODATA

Raster	% Influence	Field	Scale Value
		5	Restricted
		6	Restricted
		NODATA	NODATA
rainfall - rainfall	12	Value	
		10	4
		11	4
		12	4
		13	5
		14	5
		15	5
		NODATA	NODATA
geology - geology	12	Value	
		54	2
		55	3
		57	4
		58	3
		64	2
		NODATA	NODATA

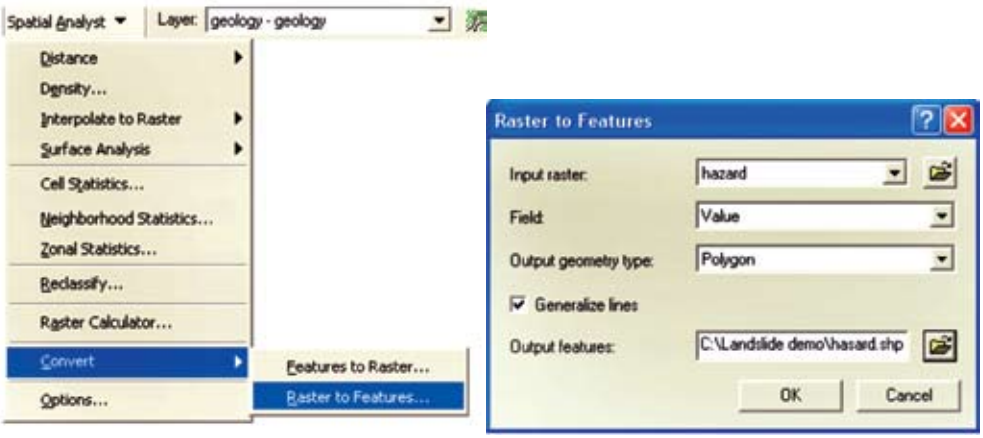
- After entering all scale values enter the output raster as 'C:\Landslide demo\Hazard'.



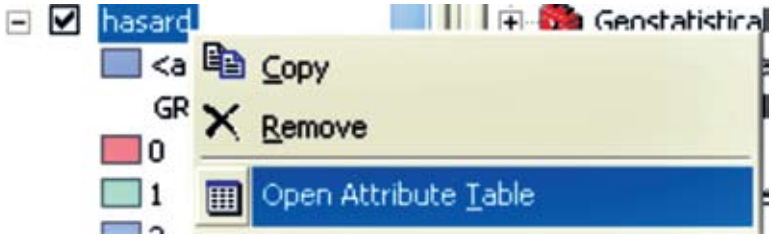
- Click ok. Wait until ArcMap completes the process. ArcMap will display the result as shown below
- Switch off visibility of all the layer except hazard layer by unselecting the small box near the layers.



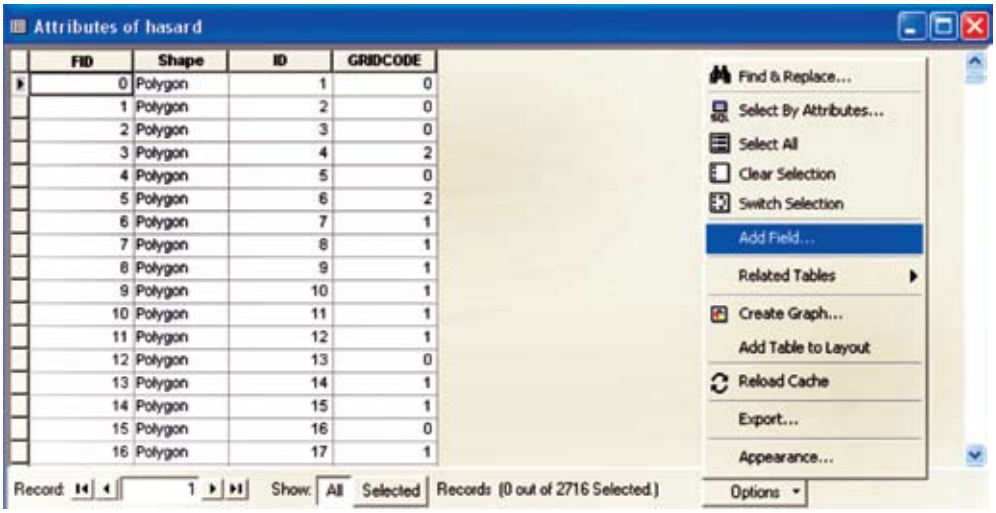
- In spatial analyst tool Bar click Spatial Analyst drop down, Click Convert and then click raster to feature



- In raster to features dialog box, select Input raster as hazard, Field as value, Output geometry type as polygon and output features as 'c:\Landslide demo\hazard.shp'
- Click Ok ArcMap creates new layer hazard.
- Rightclick on hazard layer and click open attribute table



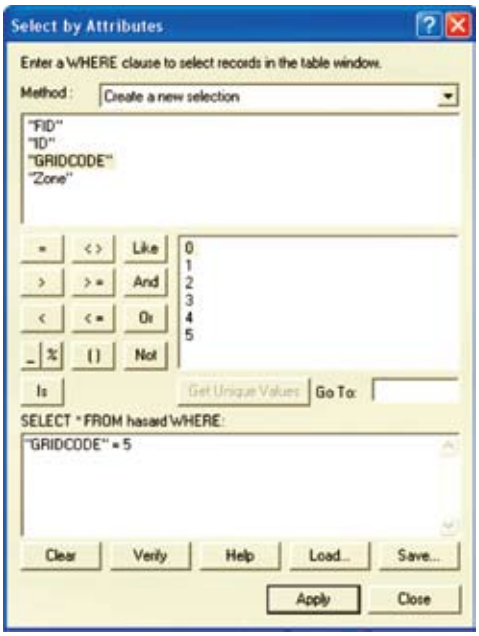
- In 'attributes of hazard' window click option button then click Add Field.



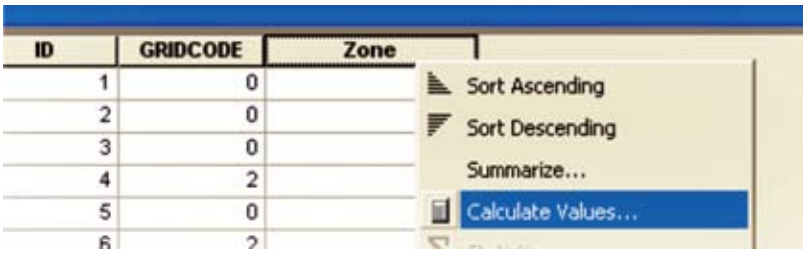
- in add field dialog box enter name as zone, select type as text and field length as 15 then click ok to create new field

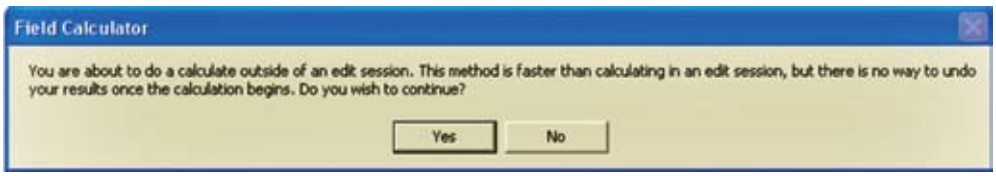
- click option button and click 

.
- In the select by attribute window enter '"gridcode" = 5' as shown below and press apply. ArcMap selects all the features in hazard layer when we enter the above command.

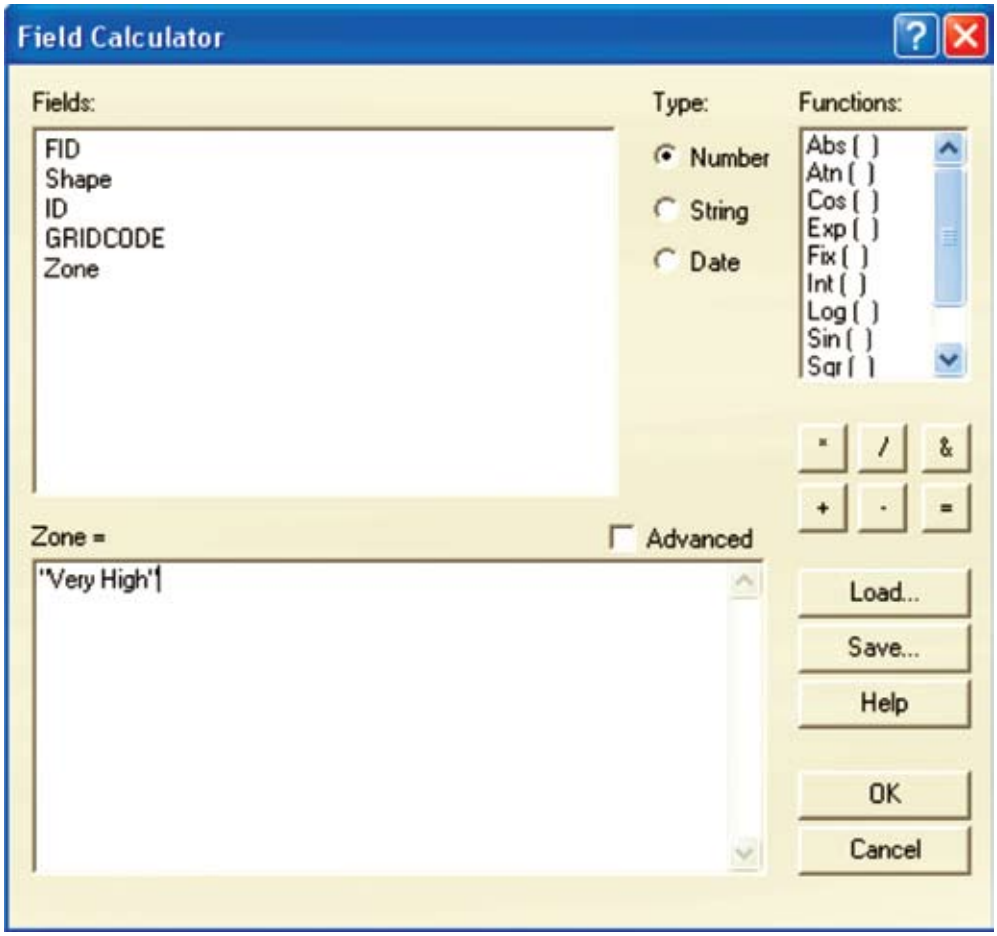


- in the attribute of hazard window right click over the zone field and click calculate value

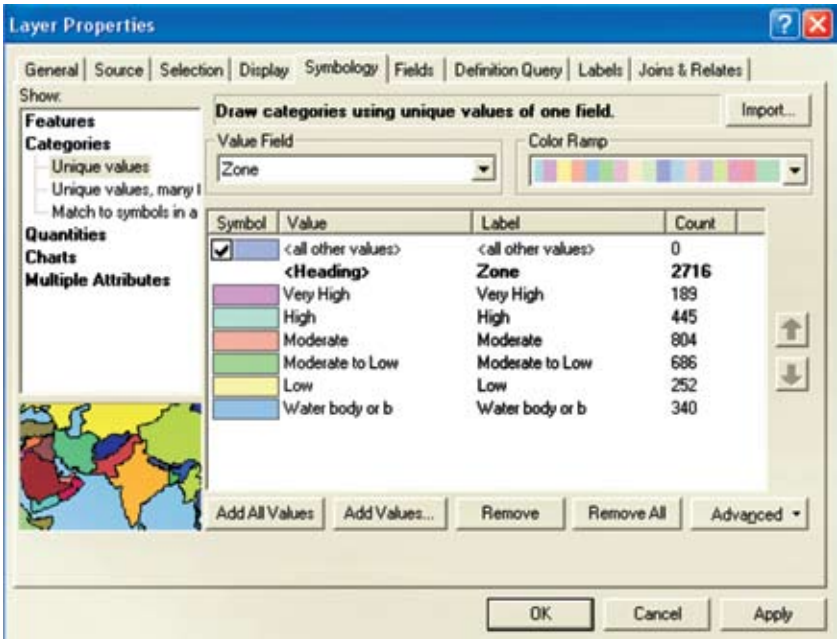




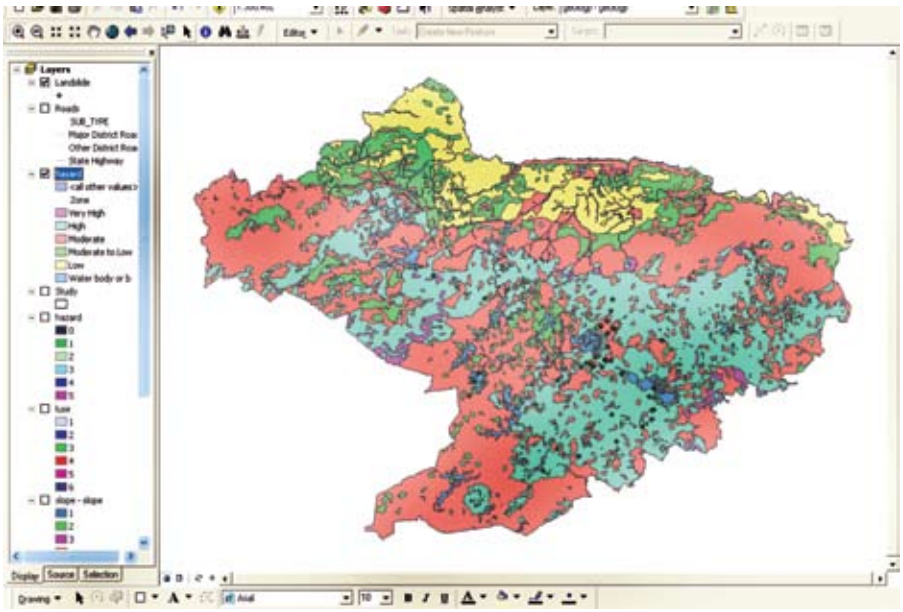
- Field calculator message will come. confirm the message by pressing yes
- In field calculator dialog box enter text “Very High”. then press ok



- using select by attribute dialog box select gridcode = 4 and calculate the zone field value has “High” has done in previous steps
- similarly for gridcode = 3 zone value is “Moderate” ,for gridcode = 2 Zone value is “Moderate to Low”, for gridcode = 1 zone values is “Low” and for gridcode = 0 and zone value is “Water body or builtup land”
- After entering all the values close the attribute table.
- Right click on the hazard layer and click properties and in properties window click Symbology tab



In symbology tab, Click categories, unique values and select value field as Zone and click Add all values rearrange the order using the arrow on the right and side of the tab. by clicking over the color you can change the color. Select your colors and click Ok to close the layer properties window. You can see the final landslide hazard map of the Nilgiri district as shown below



I. STORM SURGE HAZARD MAPPING

This exercise will show you, how to prepare a storm surge hazard map for each return period of cyclone event. During this exercise you will make a map of the flood water depth during the cyclone in the Chittagong/Banskhali area. For this two models will be used:

1. A surge model based on historical records of cyclone flooding in Bangladesh; and
2. The Digital Elevation Model (DEM) of the area.

STEP 1: START ARC MAP

First, Launch the ArcMap Application.

- If you have a shortcut for ArcMap on your desktop, double-click it to start ArcMap. Otherwise, click start > programs > ArcGis > ArcMap.
- If you see the ArcMap startup dialog, confirm or click a new empty map: then click OK.

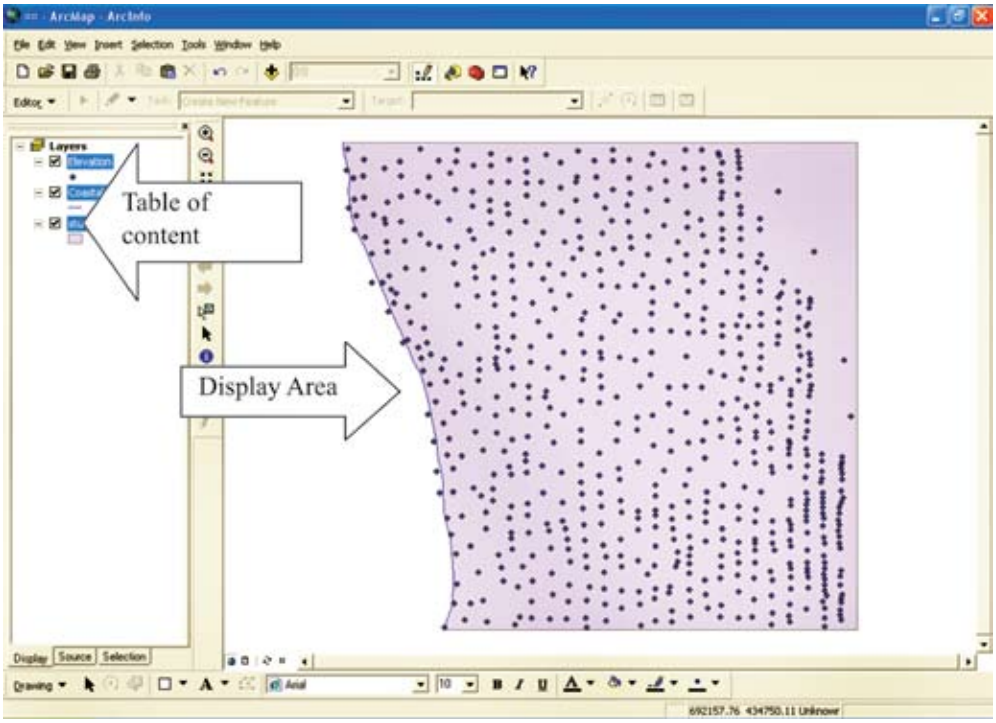
You are now looking at the interface of the ArcMap application. ArcMap allows you to view maps in Data View or Layout View. Data view lets you examine, query, edit, symbolize and otherwise prepare your data for map output. Layout view provides tools for creating a presentation-quality map.

Whenever you work in ArcMap, you are working with a map document. This document can contain various data frames, which in turn are populated by spatial datasets. A map document has an .mxd file extension.

STEP 2: ADD REQUIRED DATA FOR THE ANALYSIS

Now you will add the required data for the analysis

- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar.
- In the add data dialog, navigate to “C:\storm surge demo” folder.
- Press ctrl key and click ‘coastal line’, ‘Study’ and ‘elevation layers’ to select it.
- Click Add.



The selected layers are added as a layer in the table of contents and displayed in the display area as show in the above figure.

- In the table of contents, right-click elevation; then click Open Attribute Table.

The attribute table associated with the elevation layer appears. Each record represents an individual feature in the elevation layer. The attribute table of the elevation layer contains the elevation of each feature above the Mean Sea Level (MSL).

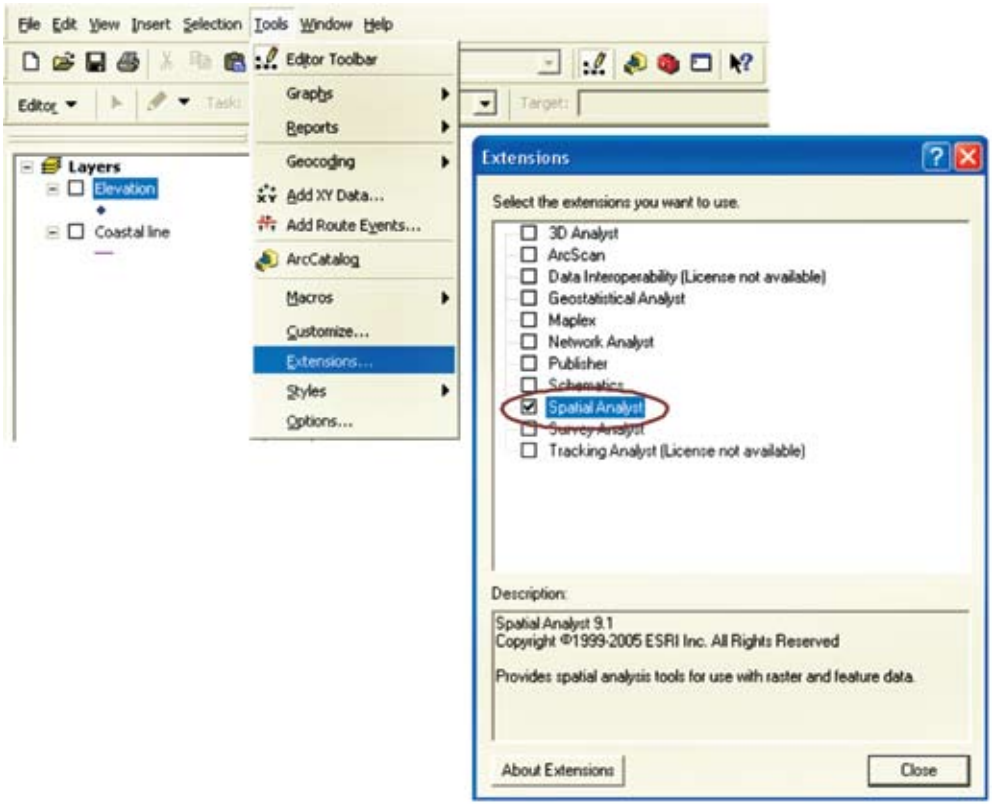
- Close the attribute table.
- In Main menu, click File; then click save.
- Save as dialog box appears select “c:\storm surge demo” in the save in field and enter the file name as Demo.mxd.
- Press save button.

Now your map document stored in the path “c:\storm surge demo” as Demo. mxd file.

STEP 3: ENABLING EXTENSIONS

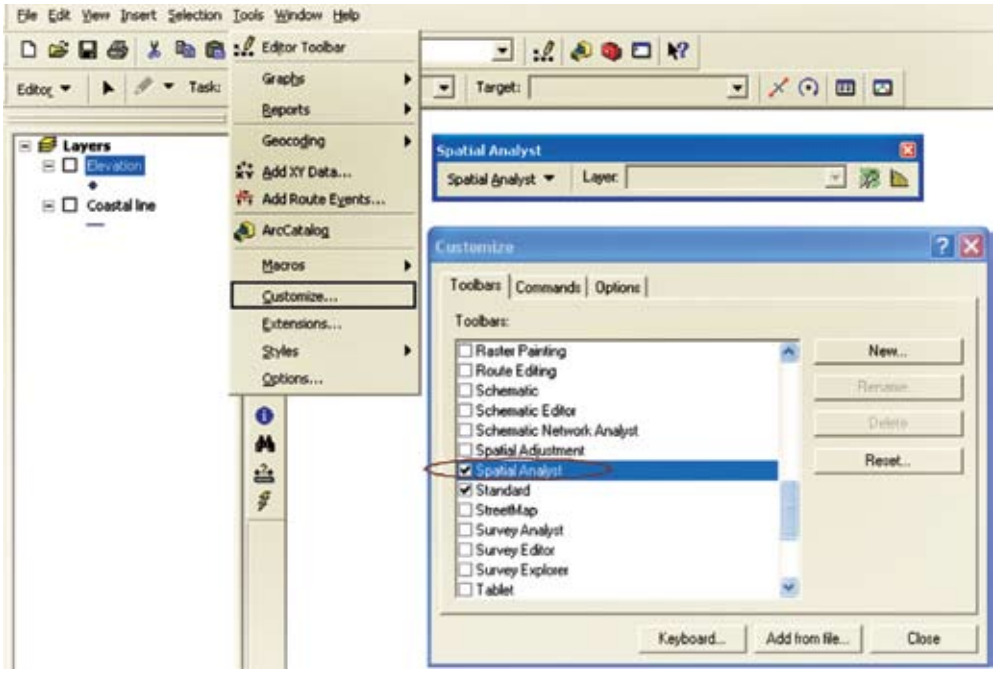
In this step you will enable the extension required for the analysis

- In the Main menu, click Tools; then click Extensions.
- In extension dialog box, select the box next to Spatial Analyst.
- Close the extension dialog box.



In this step you will enable the spatial analyst tool bar.

- In the Main menu, click Tools; then click Customize.
- In Customize dialog box, In Tool bar tab, select the box next to Spatial Analyst.
- Close the Customize dialog box.



Now you will see the spatial Analyst tool bar on your ArcMap Application window.

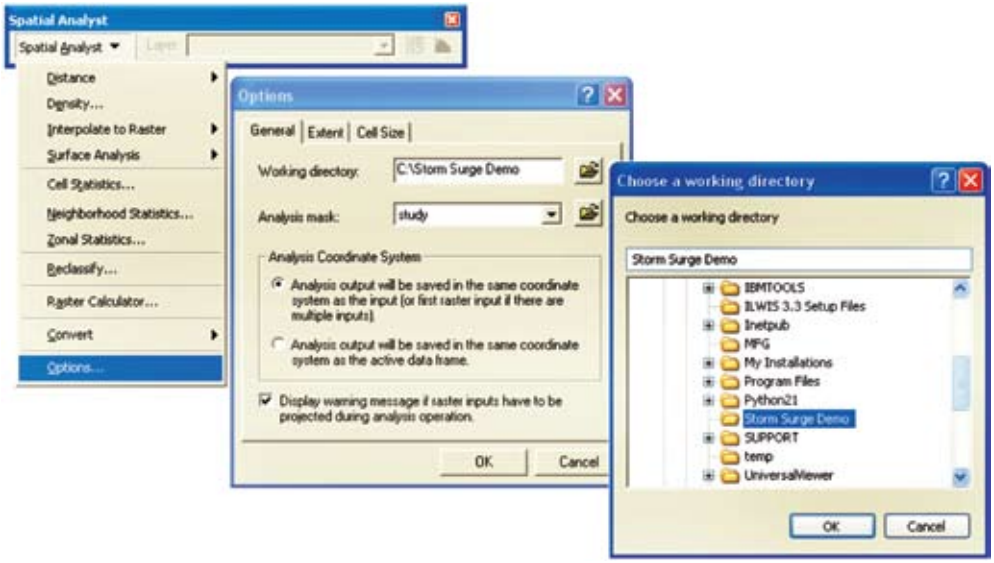
STEP 4: CREATION OF DIGITAL ELEVATION MODEL

In this step you will create the Digital Elevation Model (DEM) by Spline method using the elevation data.

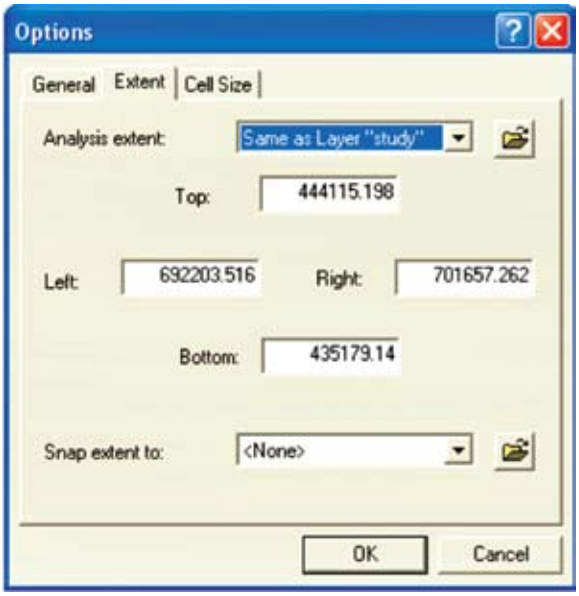
The Spline method is an interpolation method that estimates values using a mathematical function that minimizes overall surface curvature, resulting in a smooth surface that passes exactly through the input points.

Conceptually, the sample points are extruded to the height of their magnitude; Spline bends a sheet of rubber that passes through the input points while minimizing the total curvature of the surface. It fits a mathematical function to a specified number of nearest input points while passing through the sample points. This method is best for generating gently varying surfaces such as elevation, water table heights, or pollution concentrations.

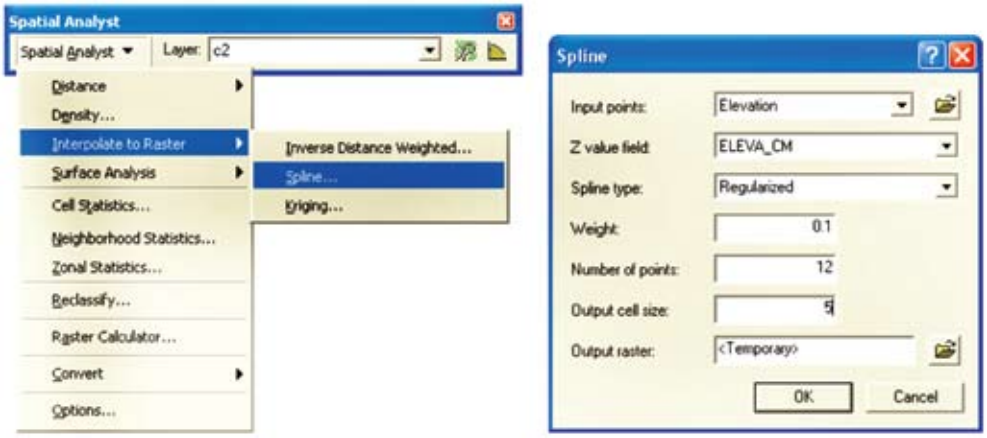
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Option
- In Options Dialog box select the working directory “C:\Storm Surge Demo” and Analysis Mask As ‘study’;



- Click Extent tab and select analysis extent as 'Same as Layer "study"' press ok to close the Options dialog box



- In Spatial analyst tool bar, Click Interpolate to Raster; then click Spline.
- In Spline Dialog box, Select Elevation as input points, ELEVA_CM as Z value field, Weight as 0.1, Number of points as 12, Output cell size as 5 and Output raster as <Temporary> as shown in the figure.



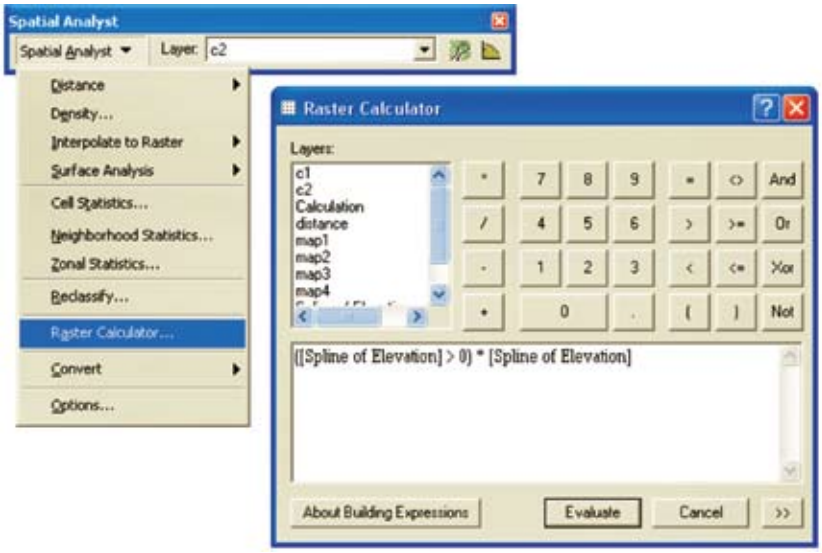
- Press Ok and wait for few minutes.

ArcMap generates "Spline of Elevation" layer using the elevation details specified in the elevation layer by Spline method. Generated map is added on the table of content as one layer and it displayed on the display area in the arc map.

- Click the identify features button on the Tools toolbar.
- Position the pointer over the displayed DEM area; then click it.

The Identify results dialog appears and pixel value is displayed. The pixel value is the elevation value of the point you clicked, similarly check the elevation of other points in the DEM layer. You can notice that the elevation value near the coast is smaller and the value increases towards the land. As you will see, some pixels have negative values which make no sense for further calculations you exclude the negative values by following steps.

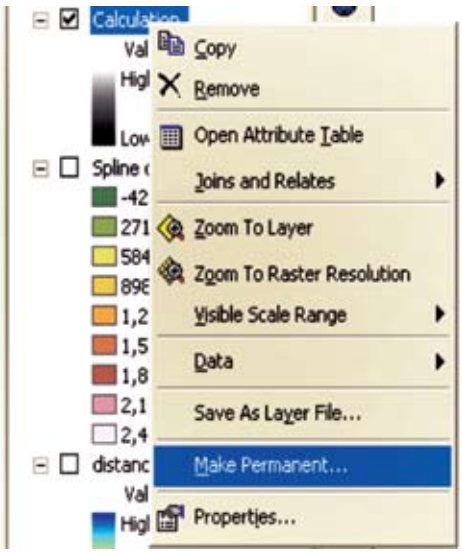
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([Spline of Elevation] > 0) * [Spline of Elevation]



Arc map creates new layer with name calculation.

- In table of content, right click the calculation layer; then click Make permanent.

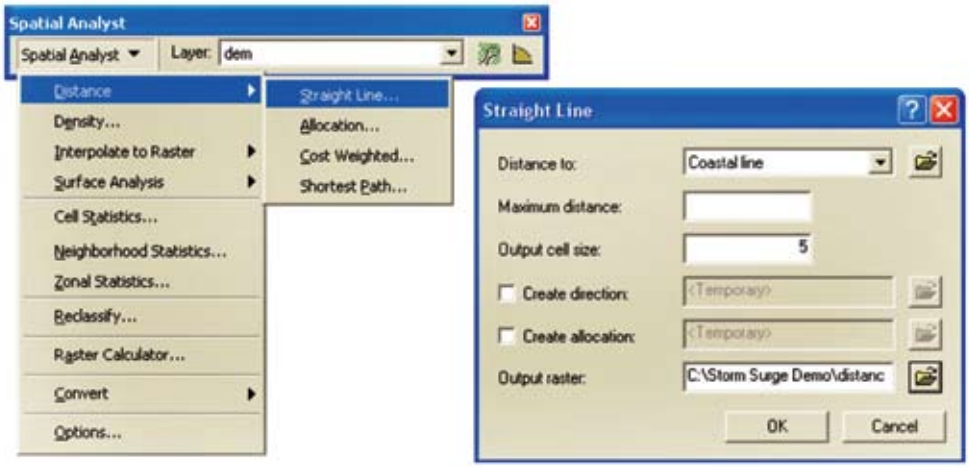
- In make calculation permanent dialog box enter the layer name as dem and press save.
- In table of content, right click the calculation layer; then click Remove .
- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar and add the DEM layer.
- Now you learned how to prepare the digital elevation model of an area using the elevation data.
- Click 'Yes'



STEP 5: CREATION OF DISTANCE LAYER

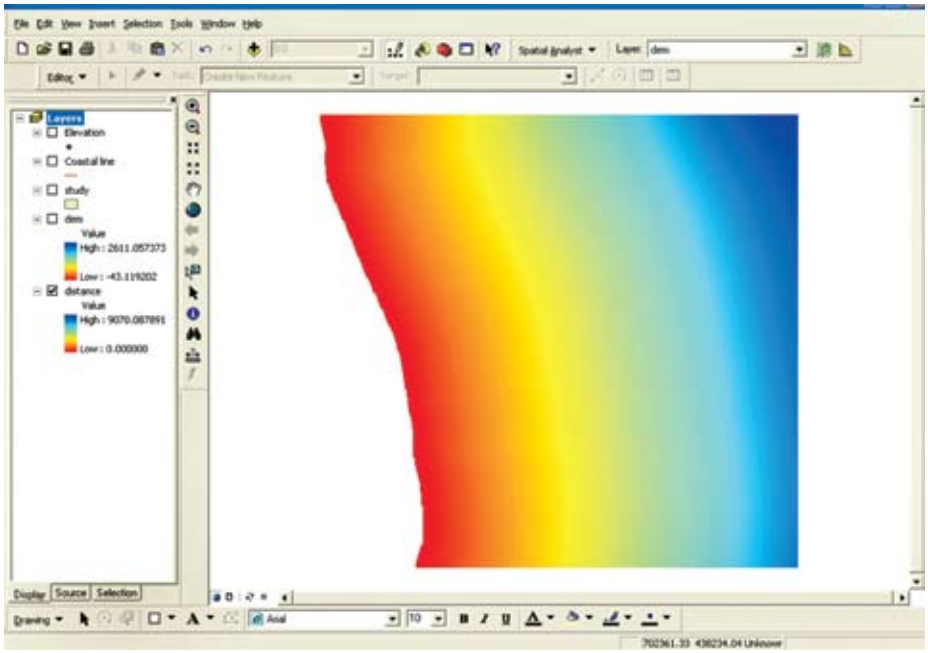
In this step you will create the distance raster layer. In which each pixel value represents the horizontal distance between coastal line and the corresponding pixel.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Distance; then click Straight Line
- In Straight Line dialog box, select distance to field with coastal line; enter out put cell size as 5 and output raster as "C:\Storm Surge Demo\ distance".



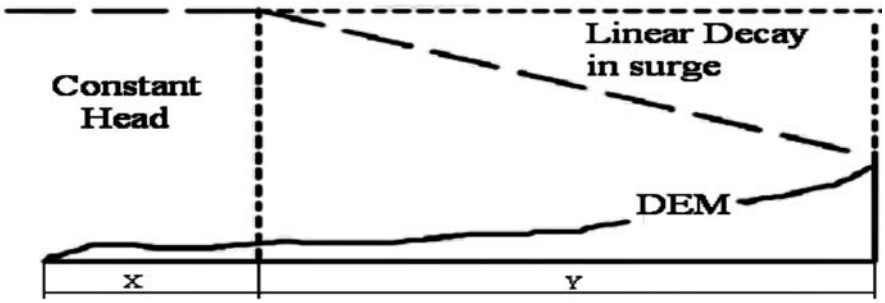
- Press ok and wait for few minutes.

ArcMap generates the Distance layer and display it as shown below. Using identify tool you check the pixels values in the distance layer each pixel gives the horizontal distance between the coastal line and the pixel you clicked. You can notice that the distance value near the coast is smaller and the value increases towards the land. Now you learned how to prepare the distance raster layer.



STEP 6: CALCULATION OF SURGE DECAY COEFFICIENT (SDC)

Before starting the calculations for the surge model, you have to find out how the surge depth decreases inland. This is the so-called Surge Decay Coefficient (SDC), which will be different for each surge height. The SDC is a function of the friction caused by surface forms (morphology, embankments and elevated roads) and land cover (houses, rice fields, homestead gardens with trees, etc.). The contribution to the friction of all the terrain elements to the SDC is not fully understood and is still being investigated. However, from historical records we know that in areas with low or no dikes along the coast the surge depth will be more or less constant; after this it will decrease until a certain distance inland.



Linear Flood-Decay model

The *Surge Decay Coefficient* (SDC) is calculated as follows:

$$\mathbf{SDC}_{RP} = \frac{\text{Surge Height} - \text{Average elevation at the end of surge}}{\text{Total surge inundation} - \text{Width of constant surge}}$$

Where,

RP is the return period of the cyclone event.

The data from the total limit to inundation from the coastline for different storm surge heights have been taken from the Multi-purpose Cyclone Shelter project (MCSP, 1993) in Bangladesh. Some of these data for the whole coast of Bangladesh are presented in the following table. (4200 as the midline)

Flood height (meters)	Area under constant surge depth (distance from coast in meters)	Total inundated area (distance from coast in meters)
3.7	415	2000
4.1	520	2900
4.7	580	3900
5.1	670	4200
5.6	760	4400
6.0	880	4700
6.5	1000	5000

From the literature (Khan, 1995) there is information on he following return periods of the cyclone events along the whole Bangladeshi coast as shown in table below.

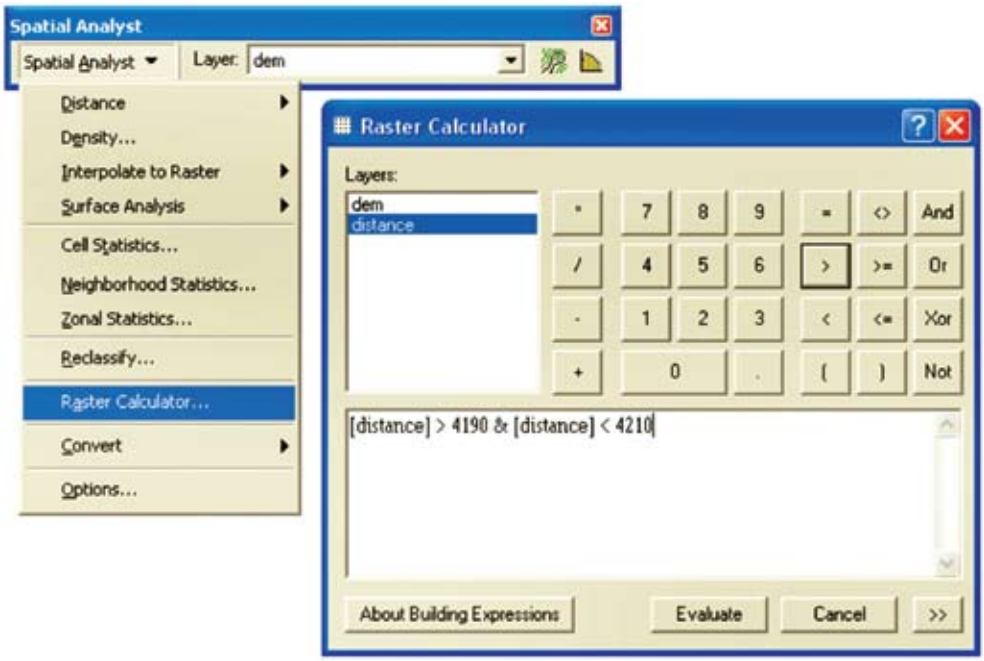
Return period	Probability in 100 yr.	Chittagong (m)
5 years	0.2	3.7
10 years	0.1	4.1
20 years	0.05	4.7
50 years	0.02	5.1

For 50 Years return period of the cyclone event in the Chittagong area the expected storm surge height is 5.1 M (510 Cm). For 5.1 M storm surge width of constant surge is 670 and total inundation width is 4200. Now you know all the

values required to compute the SDC value except average elevation at the end of the surge which can be calculated by the following steps

Create the 20m strip zone map near the 4200 M from the coastal line

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression [distance] > 4190 & [distance] < 4210 as show in the figure.

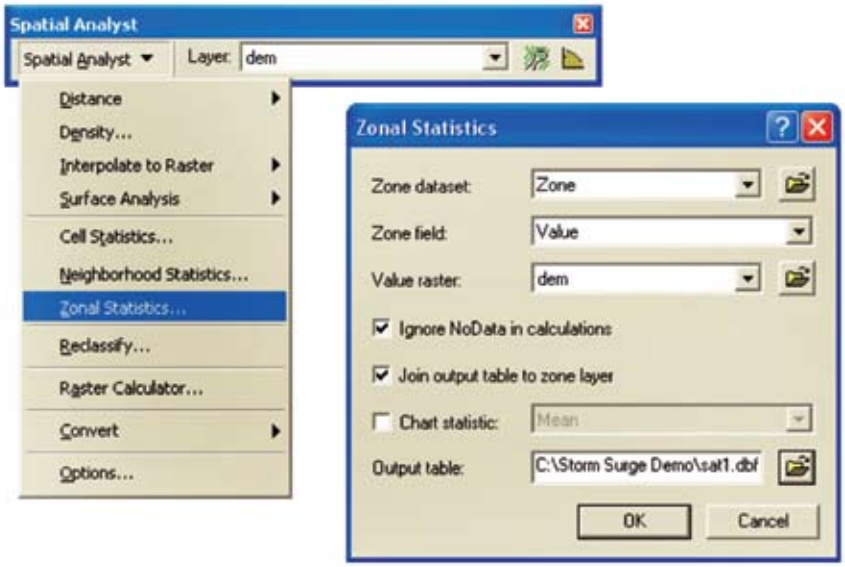


- Click evaluate button and wait.

Arc map creates new layer as calculation which have 0 and 1 pixels only. Pixels having value 1 are in the region of 4190M to 4210M from the coast line.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as Zone and press Ok.
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Zonal statistics.
- In raster Zonal statistics dialog box, enter Zone dataset as Zone, zone field as value, value raster as dem, check ignore nodata in calculation, check

join output table to zone layer, output table as “c:\storm surge demo\sat1.dbf”, as show in the figure below.

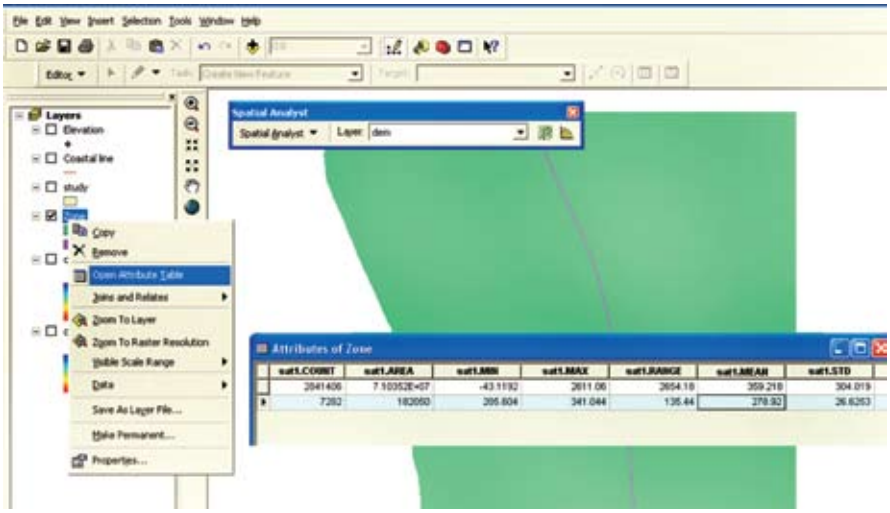


- Press Ok

ArcMap create stat1.dbf and relate the database with the zone layer.

- In the table of contents, right-click Zone; then click Open Attribute Table.

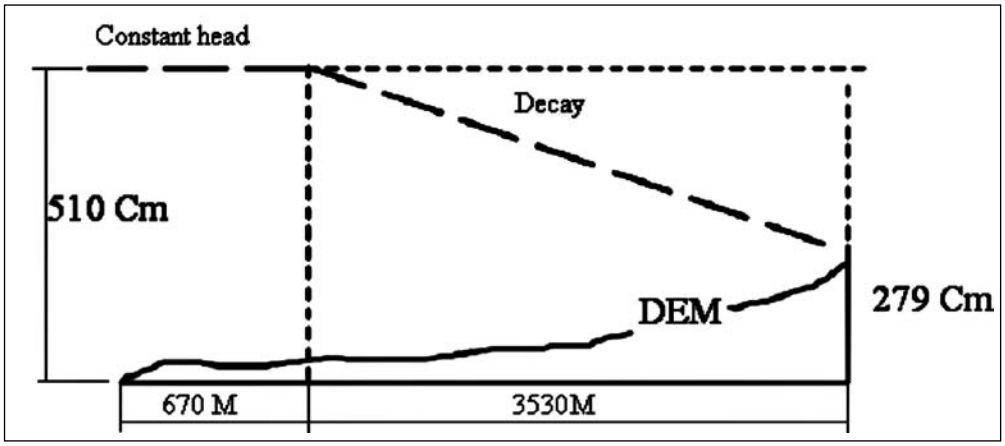
Arc map shows the table related to the layer as shown below. From that table you can get the mean value of the value one pixel as 278.92 say 279 Cm.



Storm surge details for 50 year return period

- Height of storm surge 510 cm
- Average elevation at the end of surge 279 cm
- Width of constant surge 670 M
- Total surge Inundation 4200 M

$$\mathbf{SDC}_{RP} = \frac{\text{Surge Height} - \text{Average elevation at the end of surge}}{\text{Total surge inundation} - \text{Width of constant surge}}$$



$$\mathbf{SDC}_{50} = \frac{510 - 279}{4200 - 670} = 0.065 \text{ cm / m}$$

For 50 year return period of the cyclone event the storm surge coefficient is calculated and the value is 0.065 cm/m. Similarly you can compute the SDC value for the other return period of cyclone event. Now you learned how to compute the SDC value. From next steps you will learn how to compute the expected storm surge depth for the 50 year return period of the cyclone event.

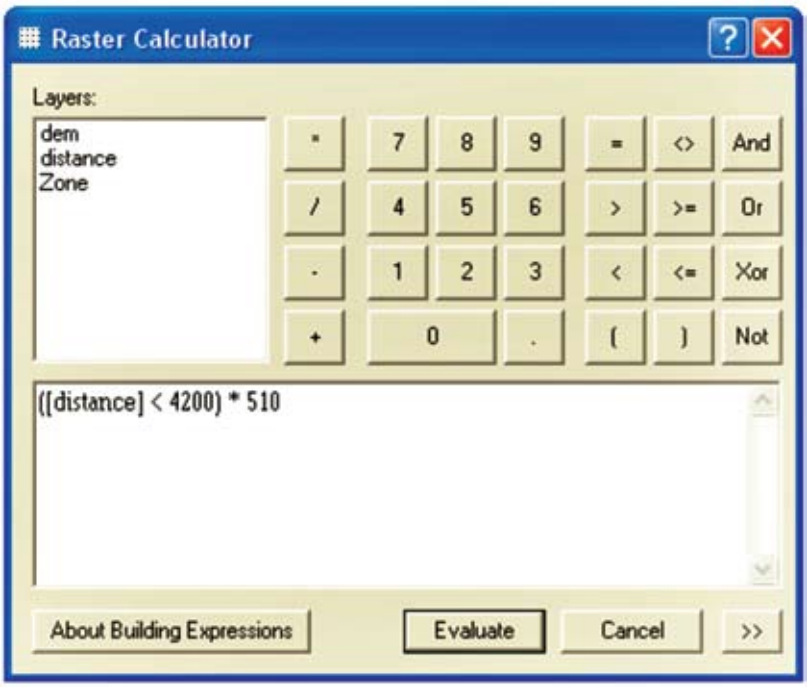
STEP 7 SURGE DEPTHS CALCULATION

Now you are going to calculate the expected storm surge depth for the 50 year return period of the cyclone event in order to achieve this you have to prepare the following layers.

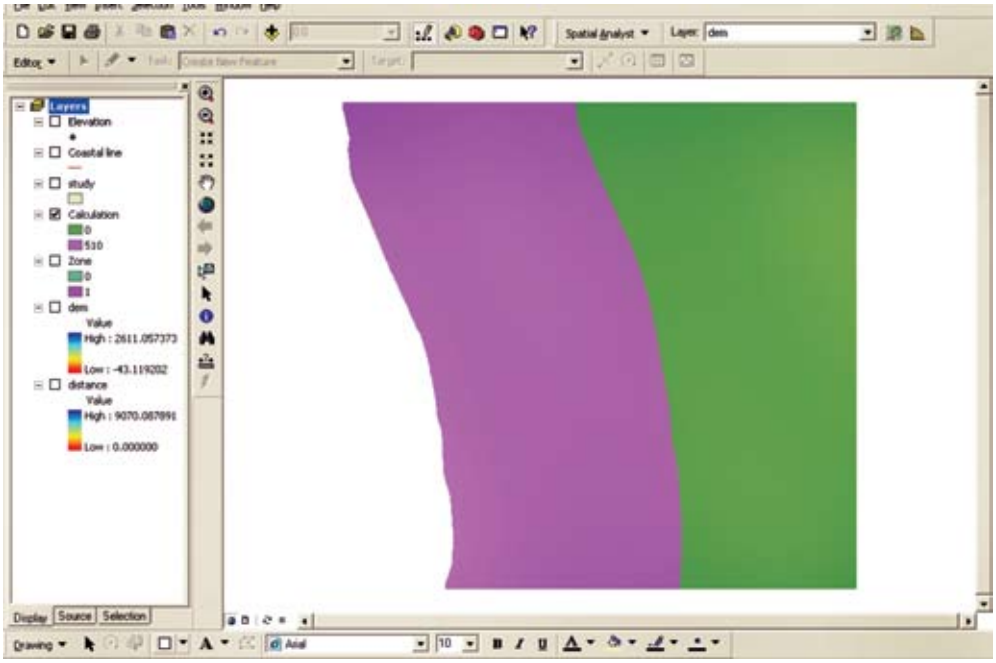
- Map 1 – constant flood height of 510Cm until 4200m inland (no decay).
- Map 2 – Decay starting at 670m inland and giving linear decreasing values until 4200 m inland based on the distance and SDC value.
- Map 3 – map 2 subtracted from the map 1.
- Map 4 – DEM subtracted from the map3
- Map 5 – Removal of all negative values from Map 4.

Map 5 is the final storm surge hazard map. Map1 is created by the following steps

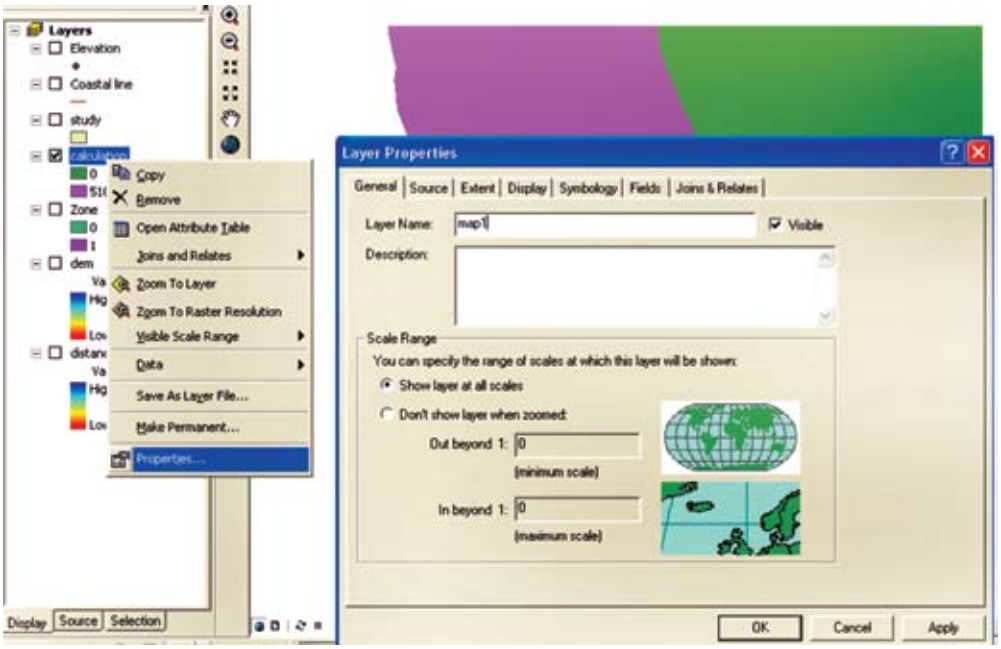
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([distance] < 4200) * 510 as show in the figure.



Arc map creates new layer as calculation which have the value of 510 up to 4200M from the coastal line and displayed as shown below.



- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as Map1 and press Ok.



Exercise 7

Now map 1 is created. Now follow the steps to create map2

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([distance] > 670) * (([distance] - 670) * 0.065).

Arc map creates new layer as calculation which have the zero value upto 670 M from the coast and the value increases gradually based on the distance and SDC value.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as Map 2 and press Ok.

Now you are going to subtract the map2 with map1 to find out the surge depth which is the map3.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression [Map1] - [map2].

Arc map creates new layer as calculation which have the contant value that is 510 upto 670 M from the coast and the value decrease gradually based on the distance and SDC value.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as Map 3 and press Ok.

Now you are going to subtract the surge depth with DEM to find out the actual depth of storm surge.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression [map3] - [dem].

Arc map creates new layer as calculation which have the contant value that is 510 upto 670 M from the coast and the value decrease gradually based on the distance and SDC value.

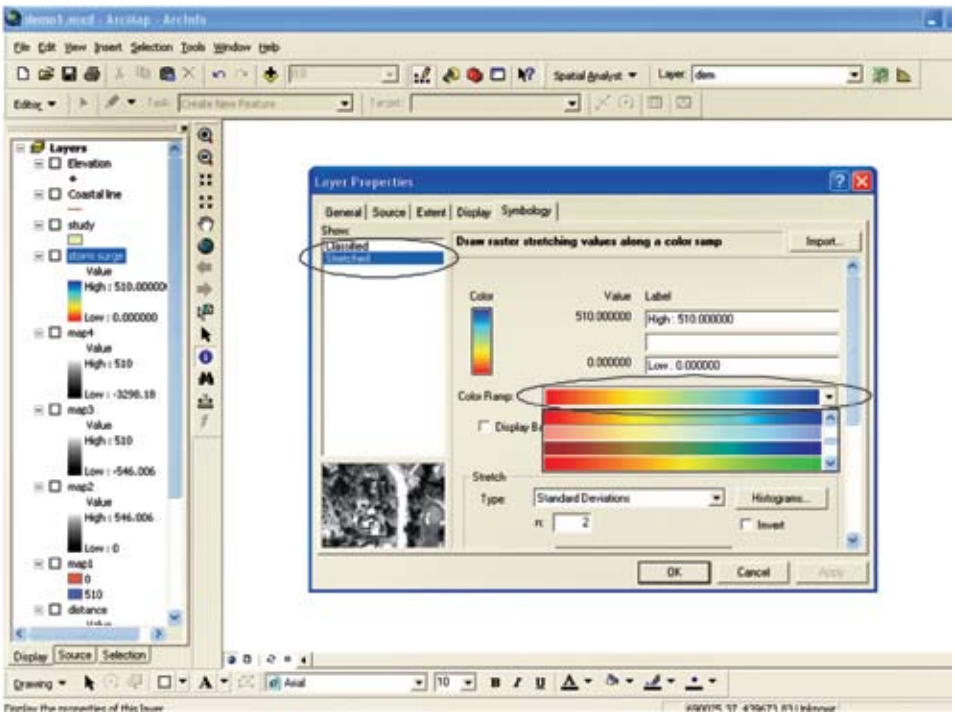
- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as Map4 and press Ok.

In map 4 you have negative values which are meaningless in order to remove that follow the steps.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([map4] > 0) * [map4].

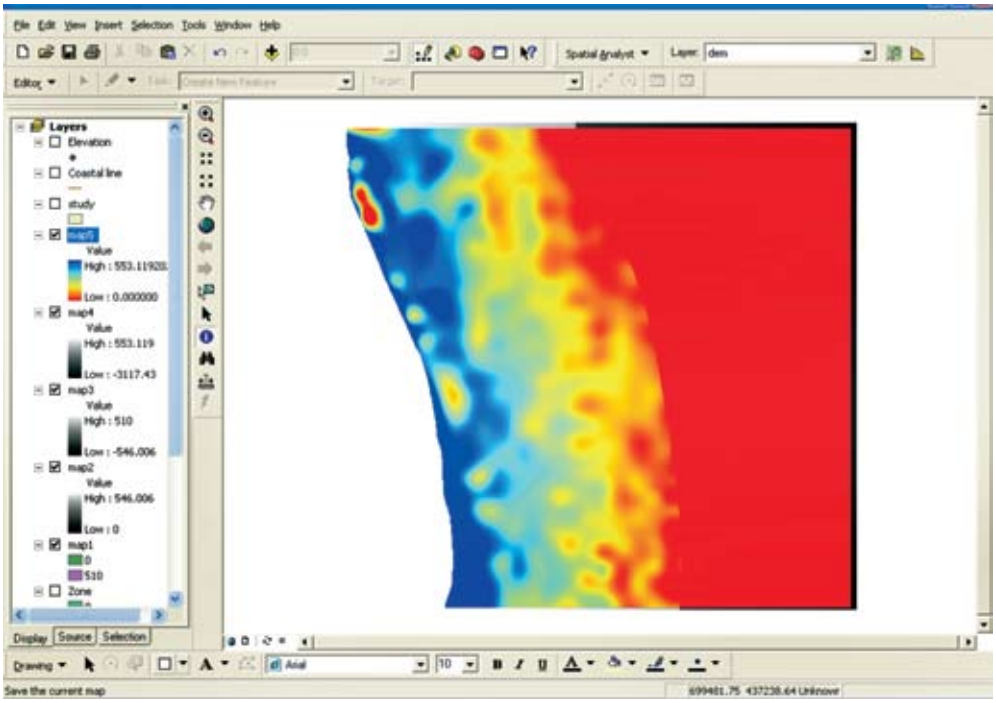
Arc map creates new layer as calculation which have the contant value that is 510 upto 670M from the coast and the value decrease gradually based on the distance and SDC value.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as storm surge.
- In layer properties dialog box select symbology tab, In Show tab select stretched option and select your color ram as shown below.

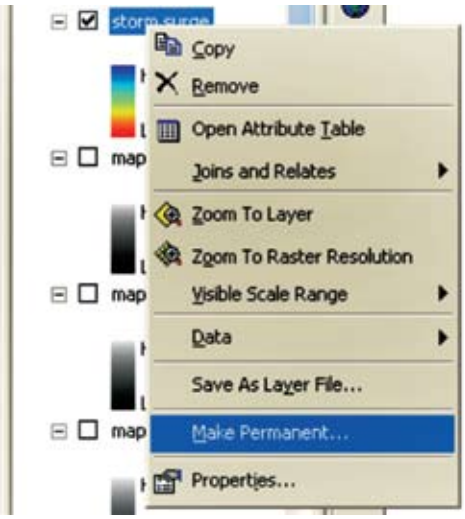


- Press ok.

Storm surge layer is displayed in the ArcMap as given below.



- In table of content, right click the storm surge layer; then click Make permanent.



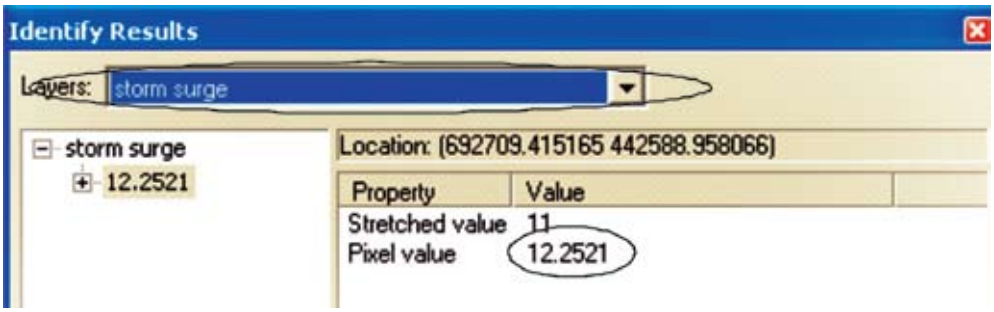
- In make calculation permanent dialog box browse to the storm surge demo folder and enter the layer name as “storm surge” and press save.
- In Main menu, click File; then click save.

Now you prepared the storm surge hazard map for 50 years return period of cyclone event. Now you have the expected flood water depth during the cyclone in the Chittagong/Banskhali area.

Now you have the expected flood water depth during the cyclone in the Chittagong/Banskhali area for 50 years return period. In imp layer you have the important locations in our study area. You add the imp layer into ArcMap and find out expected flood depth in each point. Follow the step and fill in the table given below below

- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar and imp layer into ArcMap.
- In table of content, right click the imp layer; then click label features.

- Click the identify features button on the Tools toolbar.
- Position the pointer exactly over the imp point; then click it.
- The Identify results dialog appears select layer as “storm surge”, then again click on the imp point and note the pixel value which is nothing the expected storm surge height on that location.



- Continue the same procedure and find out the expected storm surge height in each point in the imp layer and fill in the table given below.

Important places	Expected Storm Surge (in m)
Chamball	
Baharchar-01	
Baharchar-02	
Baharchar-03	
Saral	
Katharia-01	
Katharia-02	
Kalipur	

STORM SURGE VULNERABILITY AND RISK MAPPING

This exercise contains two parts; first part of this exercise will show you how to prepare storm surge vulnerability map of the inhabitants of the Chittagong/ Banskhali area using 1991 cyclone event data. In second part of this exercise will show you how to prepare the storm surge flood risk map.

STEP 1: VULNERABILITY ANALYSIS OF THE POPULATION

The vulnerability of the people to flooding is the degree of loss to the total population, or particular categories, resulting from flooding with a certain depth. It has to be expressed on a scale from 0 to 1.

Unfortunately we do not have sufficient good data on the vulnerability for the people to certain surge flood depth values. From the April 1991 cyclone in the Chittagong area we know that the casualty figures in several of the villages near the coast were as high as 70 percent of the population. In a belt at some distance from the coast, but still in the hazard zone, the casualty rate was in the range of 30-35 percent. In the whole coastal belt, including the areas at the foot of the hills outside the hazard zone, deaths were probably up to 20-30 percent of the existing population. The causality rates for the different population categories were as follows: Children: 50%, Women: 25%. Elderly: 15% and Men: 10% (Source: Cyclone 91 - An environmental and perceptional study. 1991, Bangladesh Center for Advanced Studies).

Although several warnings were given before the impact of the April 1991 cyclone, only about 16 percent of the population moved to saver places, such as a cyclone shelter or the foothills. The primary reason for staying home was fear of burglary. The small farmers risked their lives, because they were poor and did not want to take risk of becoming even poorer.

Based on the above figures we assume the following for our calculations of the vulnerability to surge flooding of the people living in the area:

A. "Near the coast" (= 1000m) the vulnerability is 0.7. By using storm surge hazard map we can calculate the average flood depth at 1000 from the coast: 371cm;

B. "At some distance from the coast" (we assume in our case = 2000m) the vulnerability is 0.3 and the average flood depth 193cm;

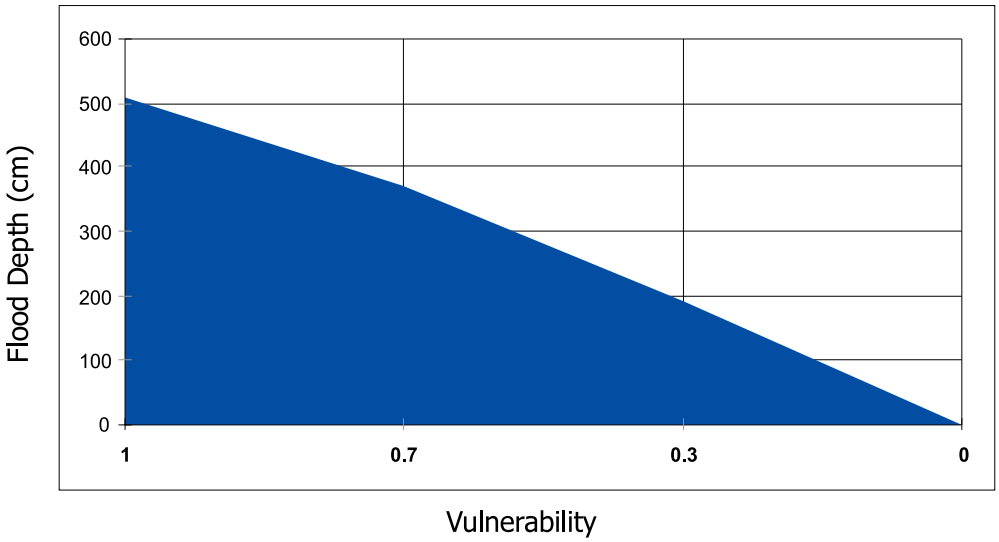
C. About 16% of the total population moved to saver places prior to the disaster.

D. The vulnerability function increases linear with flood depth;

Based on the above-described assumptions the relationship between the flood depth and vulnerability is described in the table below. The Vulnerability Coefficients (Vc) gives the increase in vulnerability per cm growth of the flood depth and is also an indication of the steepness of the line in the graph.

$$\text{Vulnerability Coefficient} = \frac{\text{Vulnerability}}{\text{Flood Depth (cm)}}$$

Flood Depth (cm)	Vulnerability	Vulnerability Coefficient
510	1	0.00196
371	0.7	0.00188
193	0.3	0.00155
0	0	0.0



The Vulnerability Coefficients (Vc) gives the increase in vulnerability per cm growth of the flood depth and is also an indication of the steepness of the line in the graph.

$$\text{Vulnerability Coefficient} = \frac{\text{Vulnerability}}{\text{Flood Depth (cm)}}$$

By multiplying the Vc with the flood depth values of the hazard map you will get the final vulnerability maps.

STEP 2: START ARC MAP

First, Launch the Arc Map Application.

- If you have a shortcut for ArcMap on your desktop, double-click it to start ArcMap. Otherwise, click start > programs > ArcGis > ArcMap.
- If you see the ArcMap startup dialog, confirm or click a new empty map: then click OK.

STEP 3: ADD REQUIRED DATA FOR THE ANALYSIS

Now you will add the required data for the analysis

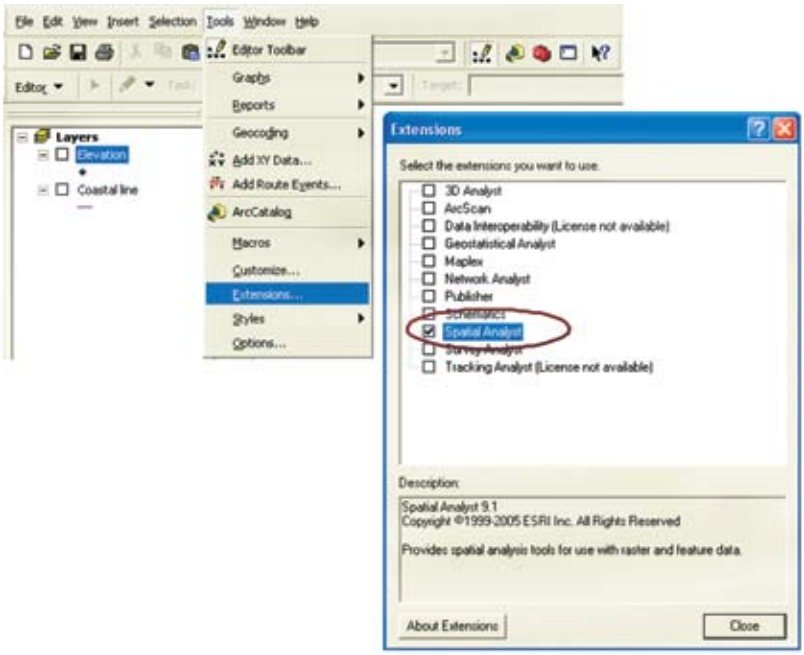
- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar.
- In the add data dialog, navigate to "C:\storm surge demo" folder.
- Press ctrl key and click 'coastal line', 'village', 'Study' and 'storm_ surge' to select it.
- Click Add.
- In Main menu, click File; then click save.
- Save as dialog box appears select "c:\storm surge demo" in the save in field and enter the file name as Vdemo.mxd.
- Press save button.

Now your map document stored in the path "c:\storm surge demo" as Vdemo. mxd file.

STEP 4: ENABLING EXTENSIONS

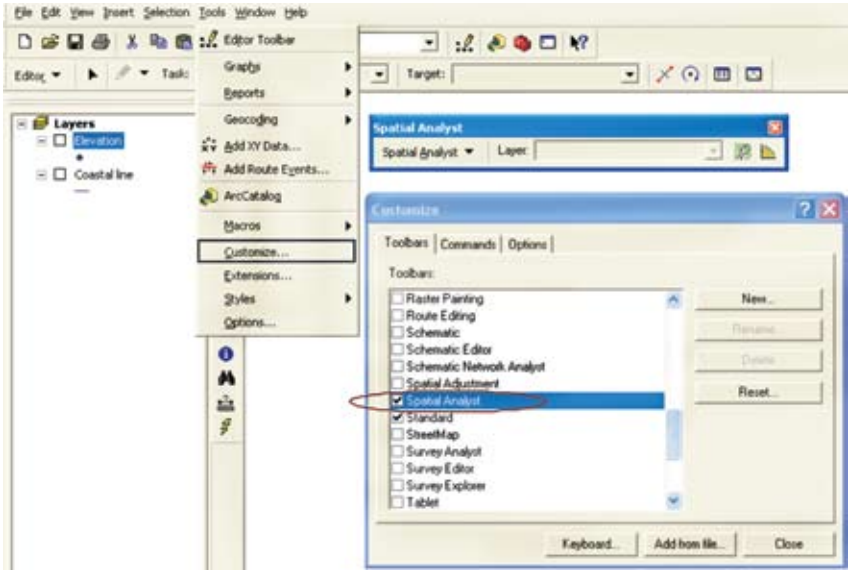
In this step you will enable the extension required for the analysis

- In the Main menu, click Tools; then click Extensions.
- In extension dialog box, select the box next to Spatial Analyst.
- Close the extension dialog box.



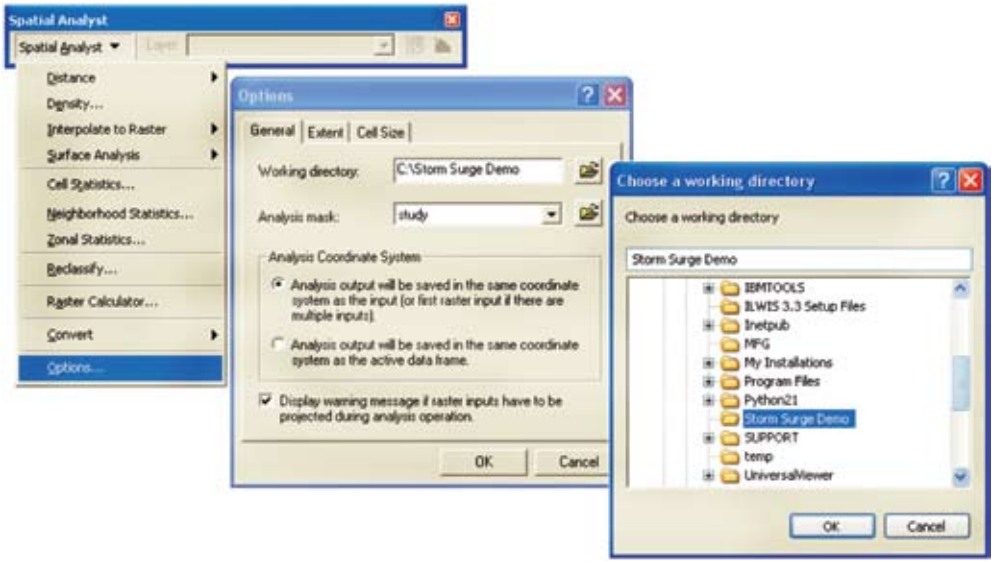
In this step you will enable the spatial analyst tool bar.

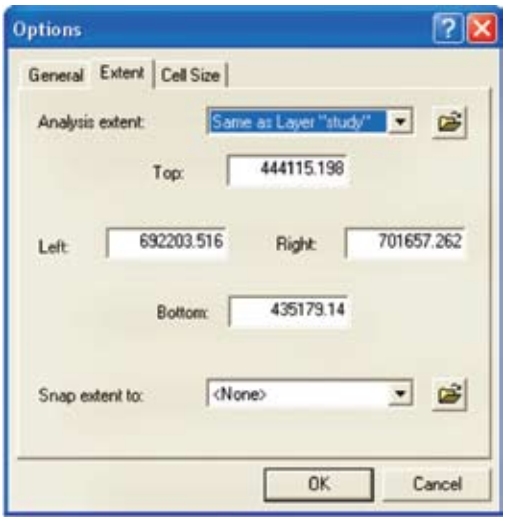
- In the Main menu, click Tools; then click Customize.
- In Customize dialog box, In Tool bar tab, select the box next to Spatial Analyst.
- Close the Customize dialog box.



Now you will see the spatial Analyst tool bar on your ArcMap Application window.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Option
- In Options Dialog box select the working directory "C:\Storm Surge Demo" and Analysis Mask As 'study';





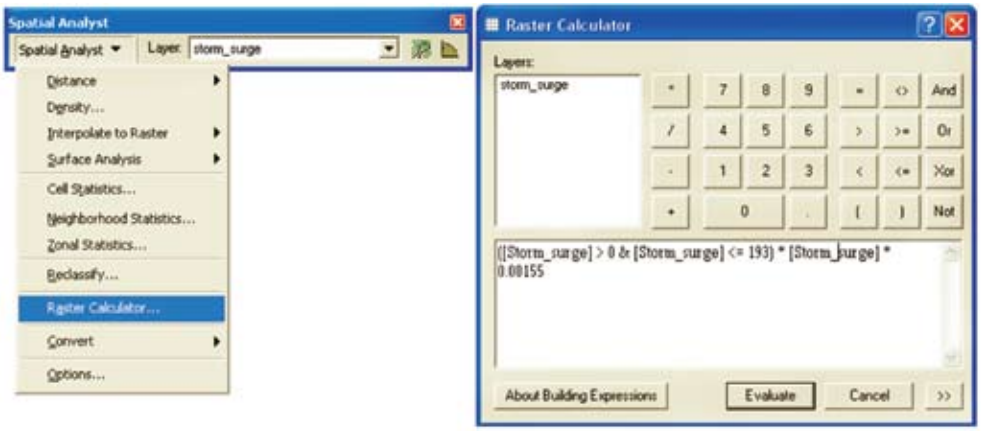
Click extent tab and select analysis extend as 'Same as Layer "study"', then press ok to close the Options dialog box.

STEP 5: VULNERABILITY CALCULATION

In this step you will learn how to prepare the vulnerability map for the estimated storm surge height. By multiplying the Vulnerability coefficient with the flood depth values of the hazard map you will get the final vulnerability maps.

In these steps you will compute the vulnerability value for the flood heights less then 193cm

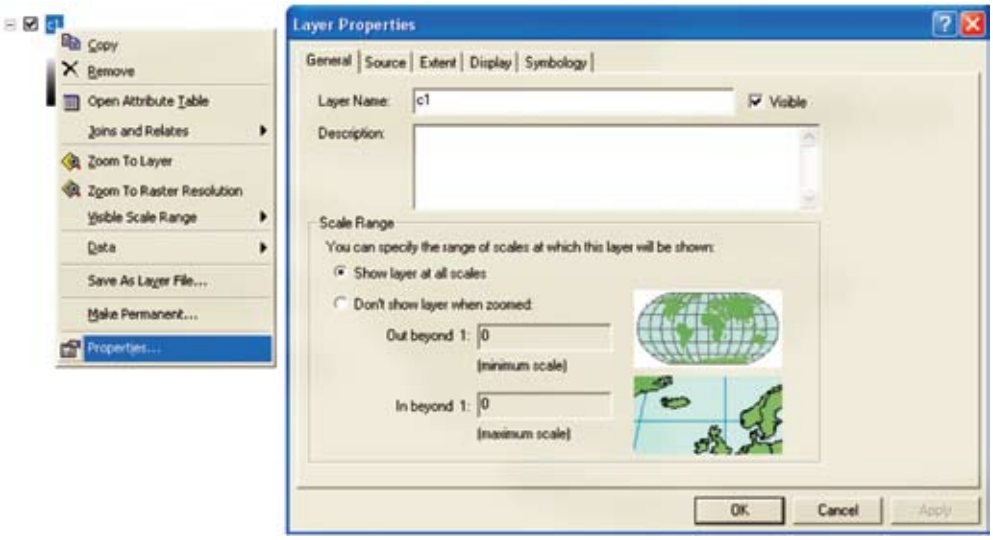
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([Storm surge] > 0 & [Storm surge] <= 193) * [Storm surge] * 0.00155 as show in the figure.



- Click evaluate button and wait.

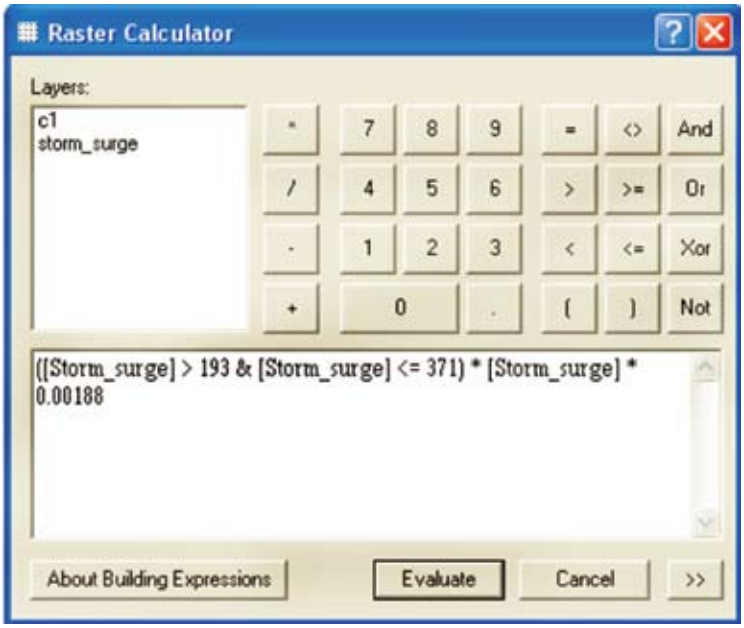
Arc map creates new layer as calculation which having vulnerability values for the surge height less then 193 cm.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as 'c1' and press Ok.



In these steps you will compute the vulnerability value for the flood heights between 193cm to 371cm.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([Storm surge] > 193 & [Storm surge] <= 371) * [Storm surge] * 0.00188 as done before.



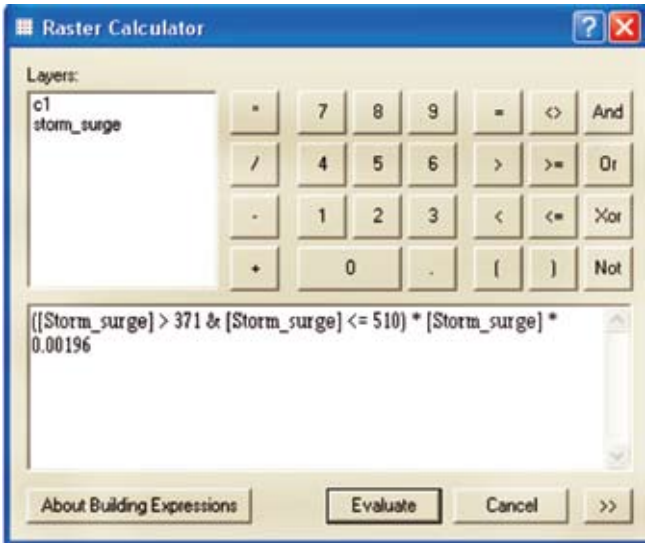
- Click evaluate button and wait.

Arc map creates new layer as calculation which having vulnerability values for the surge height between 193cm to 371cm.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as 'c2' and press Ok.

In these steps you will compute the vulnerability value for the flood heights greater then 371cm

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression ([Storm surge] > 371& [Storm surge] <= 570) * [Storm surge] * 0.00196 as done before.



- Click evaluate button and wait.

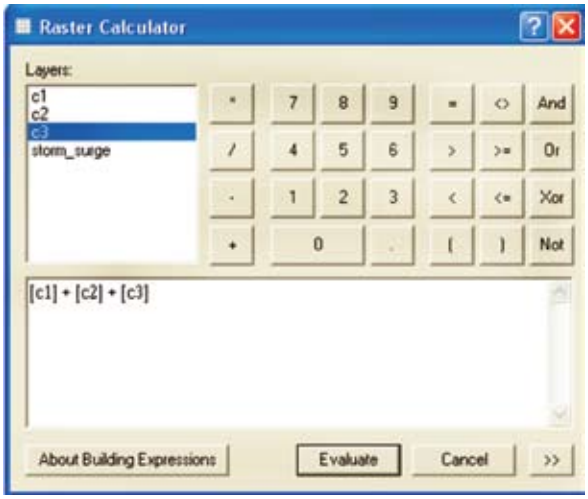
Arc map creates new layer as calculation which having vulnerability values for the surge height greater then 371cm.

- In table of content, right click the calculation layer; then click properties.
- In Layer properties dialog box select general tab, enter the layer name as 'c3' and press Ok.

In these steps you will compute the vulnerability value for the entire study area by summing C1, C2 and C3.

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;

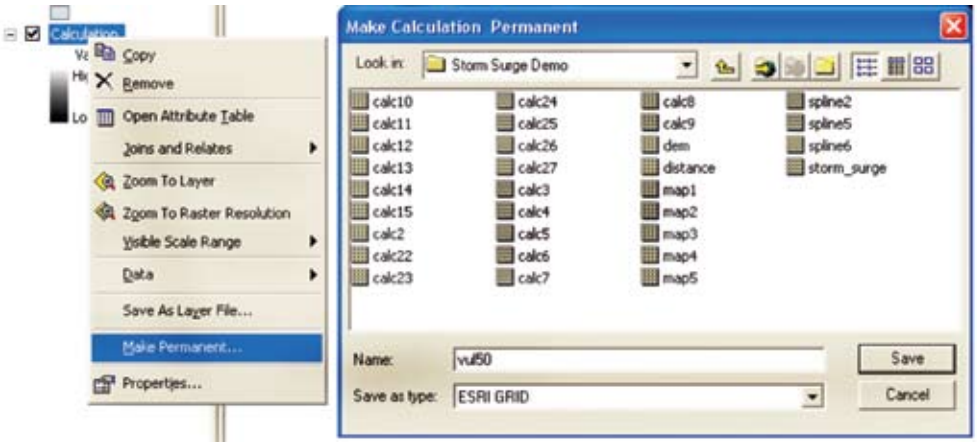
- In raster calculator dialog box, enter expression [c1] + [c2] + [c3] as given below.



- Click evaluate button and wait.

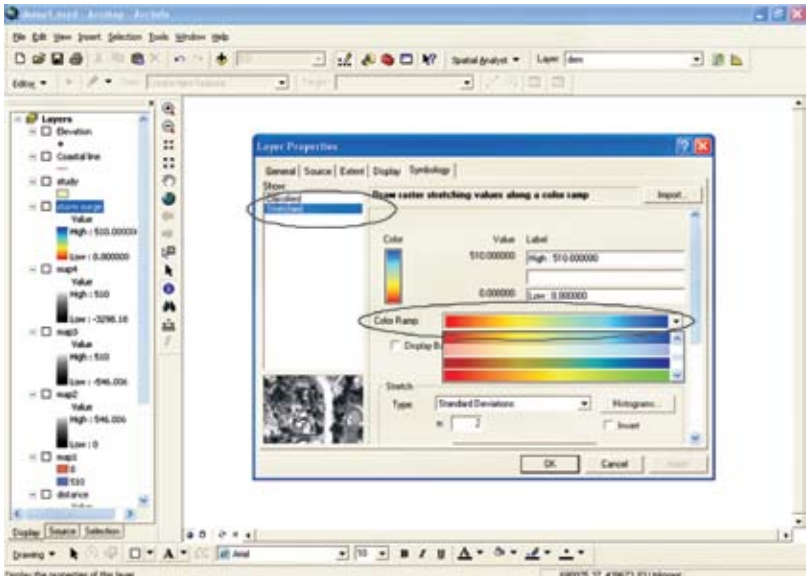
Arc map creates new layer as calculation which is the final vulnerability map of the study area.

- In table of content, right click the calculation layer; then click make permanent.



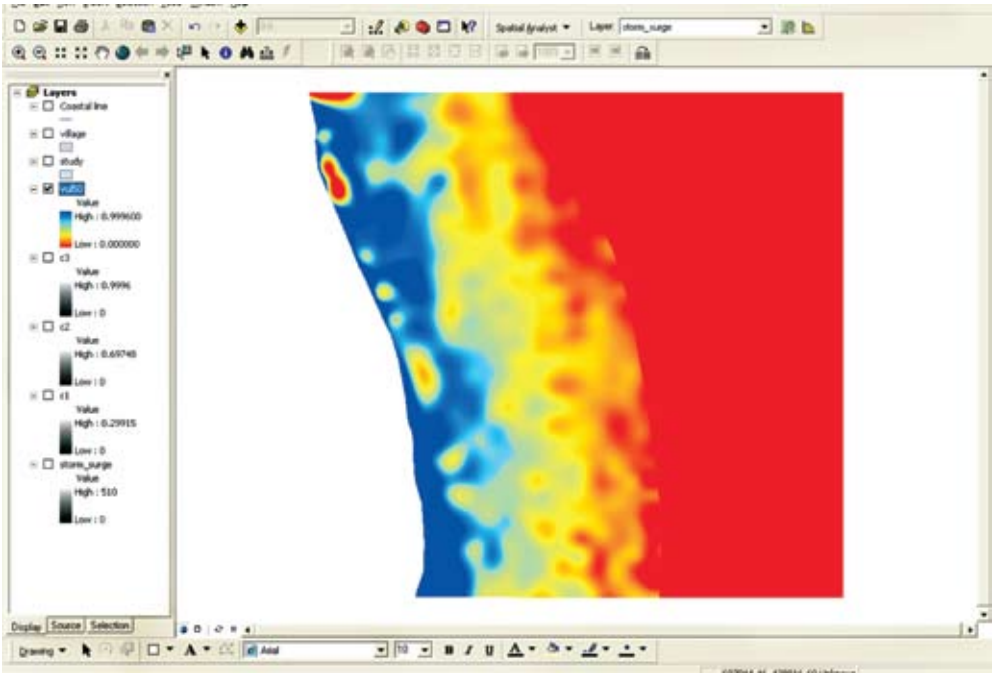
- In make calculation permanent dialog box, enter name as 'Vul50' and press save.
- In table of content, right click the calculation layer; then click Remove .
- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar and add vul50 layer.

- In table of content, right click the vul50 layer; then click properties.
- In layer properties dialog box select symbology tab, In Show tab select stretched option and select your color ram as shown below.



- Press ok.

vulnerability layer is displayed in the ArcMap as given below.

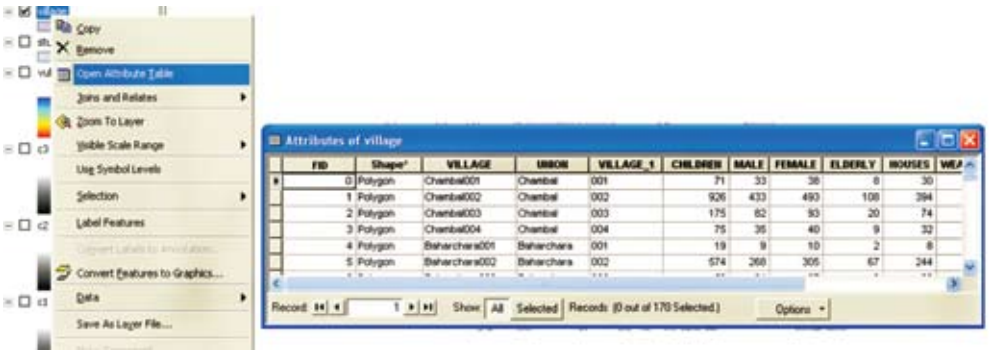


STEP 6: PREPARATION OF POPULATION DENSITY MAP

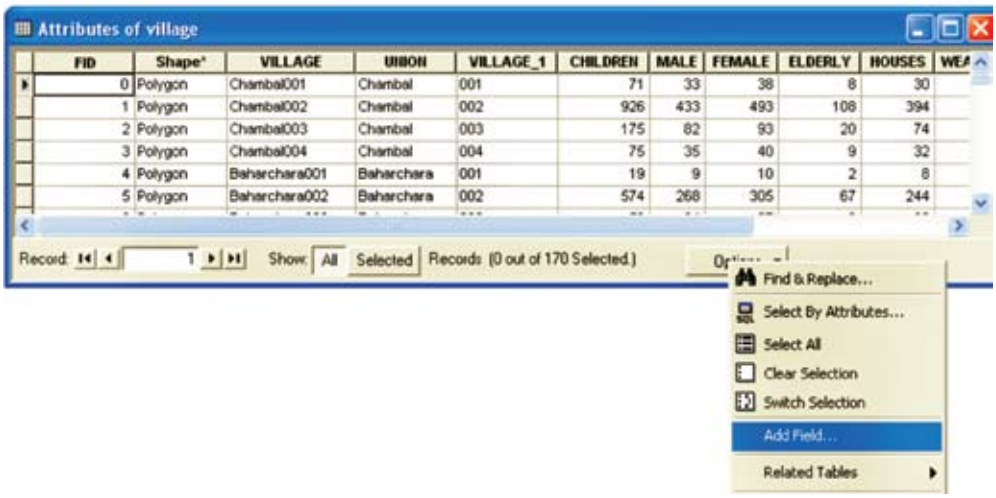
Now you are going to prepare the population density map using the village layer and population data

- In the table of contents, right-click Village layer; then click Open Attribute Table.

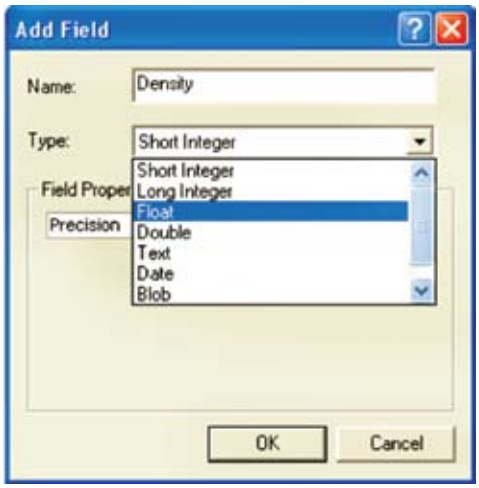
Arc map shows the table related to the layer as shown below.



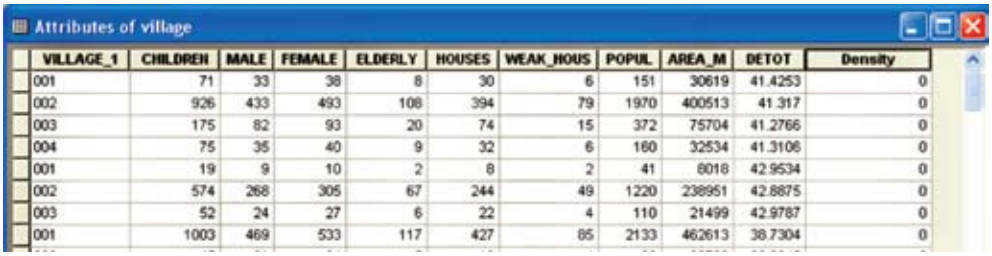
- In attributes of village window click option, then Add Field



Add field dialog appears in that ether name as Density and type as Float and click ok



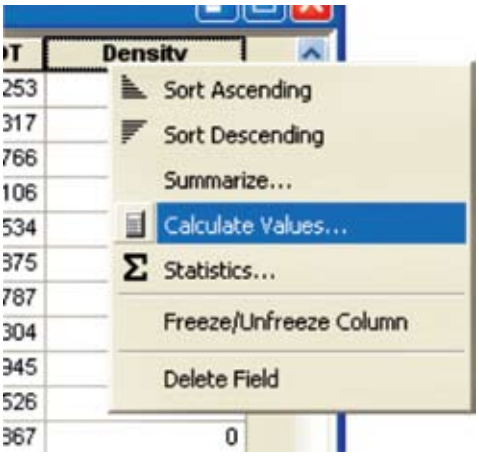
Arc map creates new field with name Density with zero values as shown below



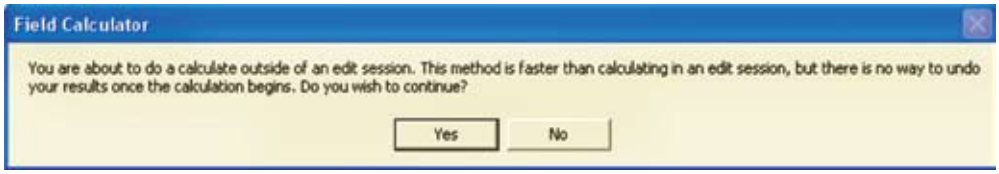
Attributes of village

VILLAGE_1	CHILDREN	MALE	FEMALE	ELDERLY	HOUSES	WEAK_HOUS	POPUL	AREA_M	DETOT	Density
001	71	33	38	8	30	6	151	30619	41.4253	0
002	926	433	493	108	394	79	1970	400513	41.317	0
003	175	82	93	20	74	15	372	75704	41.2766	0
004	75	35	40	9	32	6	160	32534	41.3106	0
001	19	9	10	2	8	2	41	8018	42.9534	0
002	574	268	305	67	244	49	1220	238951	42.8875	0
003	52	24	27	6	22	4	110	21499	42.9787	0
001	1003	469	533	117	427	85	2133	462613	38.7304	0

- Right click on the density field, then click calculate Values

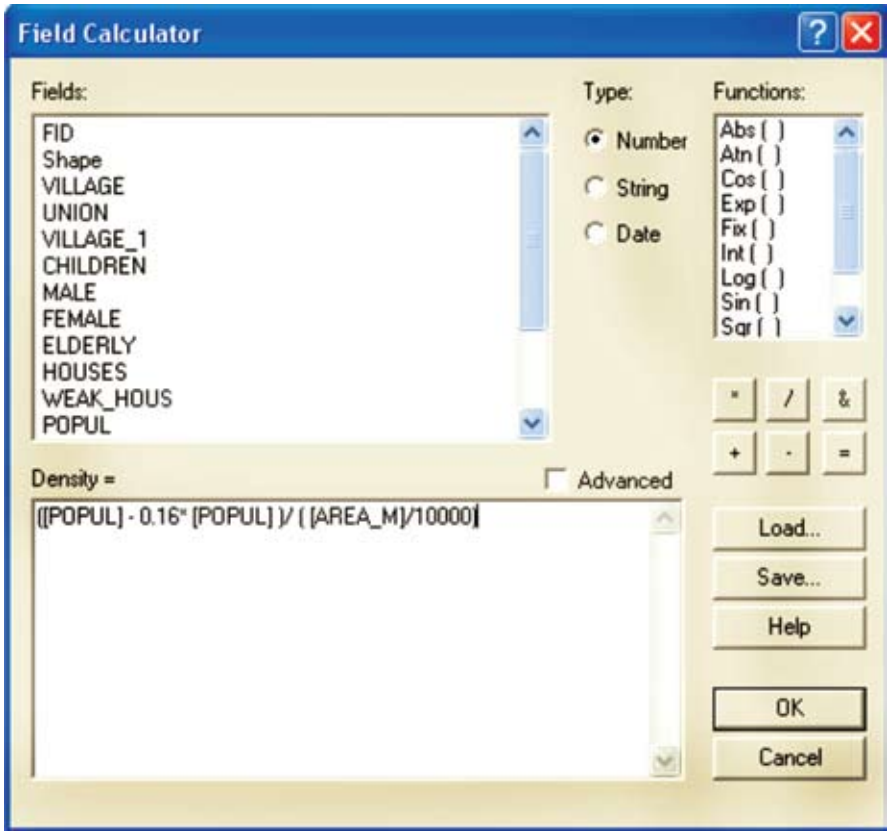


- field calculator message will come confirm by pressing yes



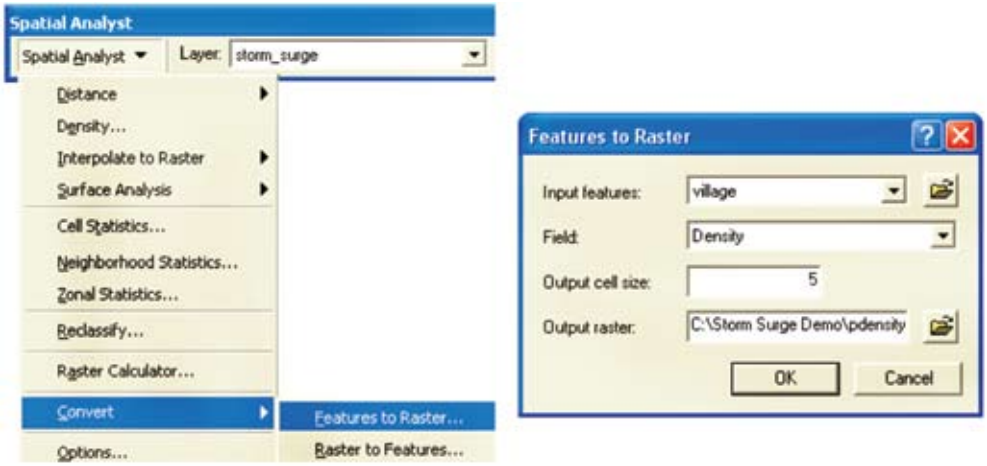
- Field calculator appears, enter the expression ([POPUL] - 0.16* [POPUL])/ ([AREA_M]/10000)

(16 % of the population has moved to safer places so deduct from the total)

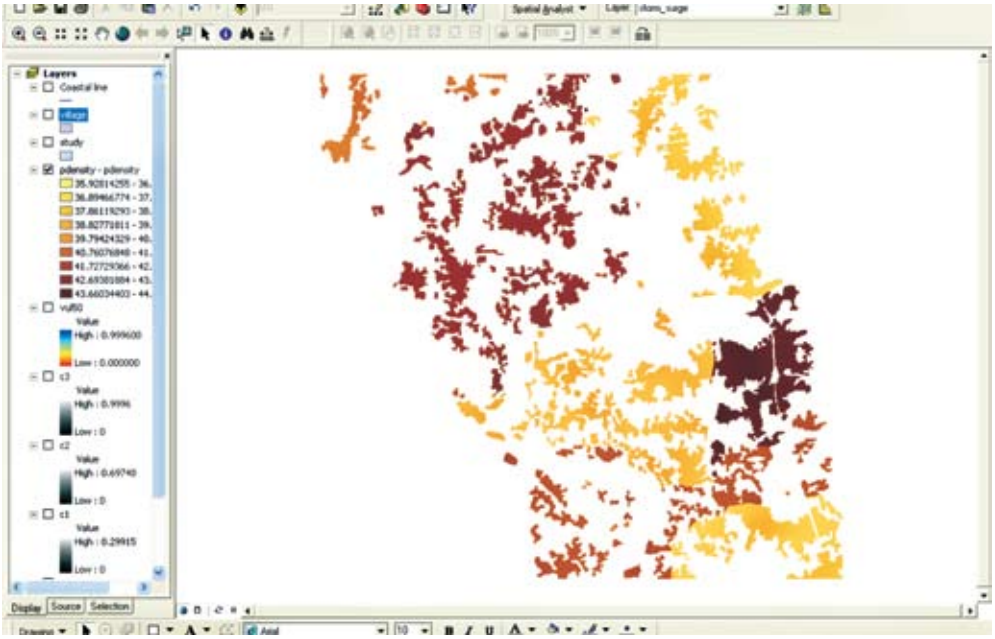


Covert the layer into raster by following steps

- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click convert; then select feature to raster.
- in feature to raster dialogue box select input feature as Village, Field as Density, Cell Size as 5 and output raster as “c:\storm surge demo\pdensity”; then press ok.

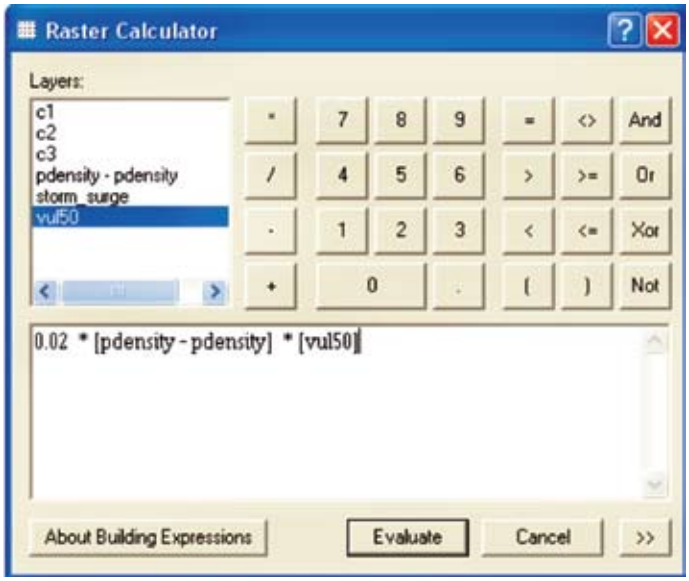


Arcmap generate the layer and display as shown below



STEP 7: PREPARATION OF RISK MAP

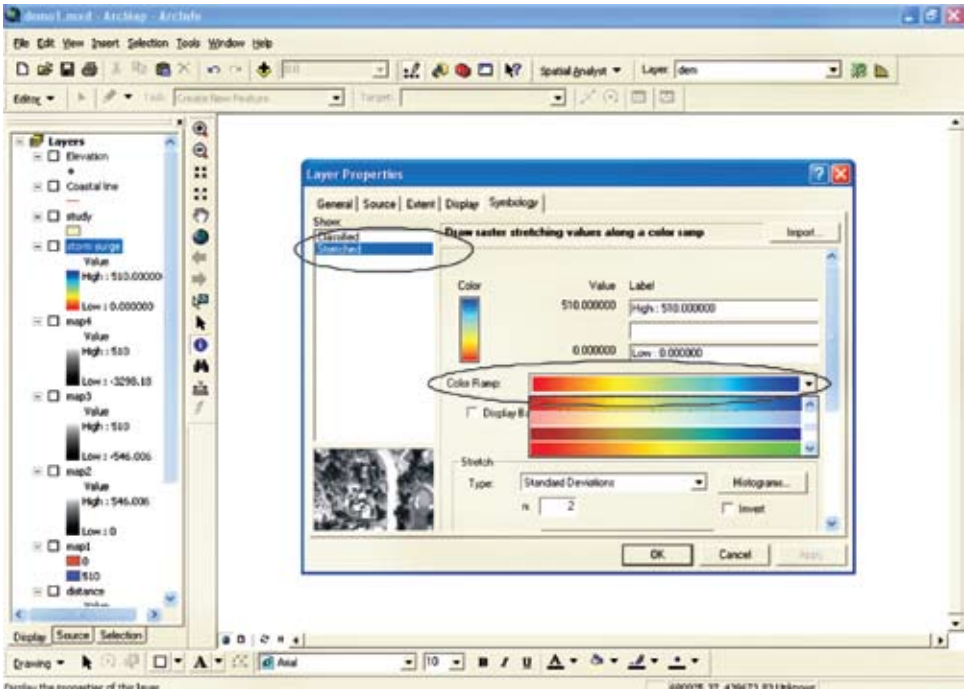
- In Spatial Analysis tool bar, click Spatial Analyst drop down; then click Raster calculator;
- In raster calculator dialog box, enter expression 0.02 * [pdensity – pdensity] * [vul05] as given below. (20% of the population)



- Click evaluate button and wait.

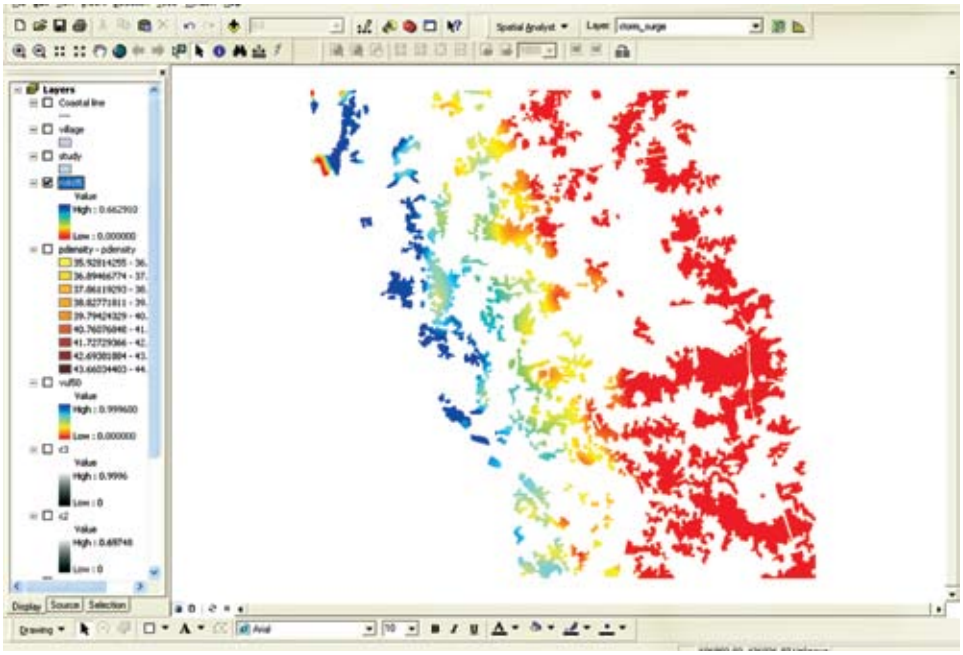
Arc map creates new layer as calculation which is the final risk map of the study area.

- In table of content, right click the calculation layer; then click make permanent.
- In make calculation permanent dialog box, enter name as 'risk05' and press save.
- In table of content, right click the calculation layer; then click Remove .
- In the table of contents, right-click the Layers data frame, the click the Add Data. Otherwise, click Add Data icon in standard tool bar and add risk05 layer.
- In table of content, right click the risk05 layer; then click properties.
- In layer properties dialog box select symbology tab, In Show tab select stretched option and select your color ram as shown below.



➢ Press ok.

Risk layer is displayed in the ArcMap as given below.



CHEMICAL RISK ASSESSMENT

Objective of the exercise to introduce the CAMEO, ALOHA and MARPLOT (CAMEO Pakage) and its applications in Chemical Risk Assessment and emergency response.

WHAT IS CAMEO- Computer Aided Management of Emergency Operations

- CAMEO® is a system of software applications used widely to plan for and respond to chemical emergencies.
- It is one of the tools developed by EPA's Office of Emergency Management (OEM) and the National Oceanic and Atmospheric Administration Office of Response and Restoration (NOAA)
  - To assist front-line chemical emergency planners and responders.
  - To access, store, and evaluate information critical for developing emergency plans.
  - CAMEO supports regulatory compliance by helping users meet the chemical inventory reporting requirements of the Emergency Planning and Community Right-to-Know Act.
  - Integrates a chemical database and a method to manage the data, an air dispersion model, and a mapping capability. All modules work interactively to share and display critical information in a timely fashion.

- ☐ CAMEO also can be used with a separate software application called Land View to display EPA environmental databases and demographic/ economic information to support analysis of environmental justice issues.

CAMEO Data Management Modules: Keep track of information to assist in emergency response and planning.

- CAMEO Chemicals: Search the CAMEO chemical database to find response recommendations (including firefighting and spill response) and physical properties (such as hazard alerts and vapor pressure) on thousands of chemicals. Use the reactivity prediction tool to predict what hazards could occur if chemicals in your collection mixed together.
- ALOHA: Estimate threat zones for hazardous chemical releases (toxic gas clouds, fires, and explosions). A threat zone is an area where a hazard (such as toxicity, flammability, thermal radiation, or damaging overpressure) has exceeded a user-specified Level of Concern (LOC).
- MARPLOT: Display ALOHA threat zones and other objects on a map. Map objects may include CAMEO Facilities and Special Locations (for example, hospitals and schools where there are populations of special concern).

ALOHA

ALOHA uses two different models, depending on the type of pollutant:

Gaussian plume model for light gases and a heavy gas model due to Spicer and Havens (1989). It assumes a flat terrain, no chemical reaction, no fire, stationary emission conditions (a time varying source is modelled as a sequence of constant releases).

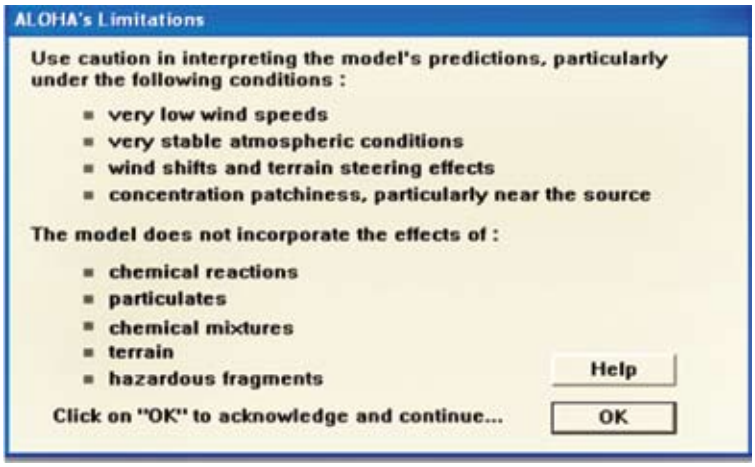
Generating Scenario

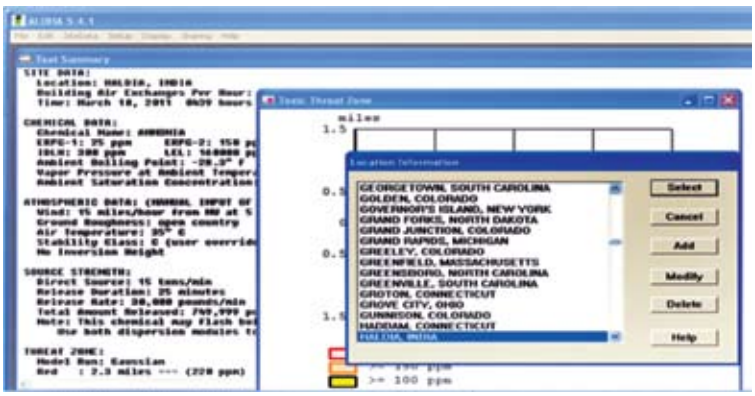
Using ALOHA, MARPLOT & Google Earth In Risk City, a rupture in the Ammonia storage tank of Sanjana Cryogenic Limited has led to a release of considerable amount of the toxic gas in the atmosphere. Approximately, 150 MT of the gas has been released in 25 minutes from a pipeline valve failure on the tank surface at a height of 15m from the ground. The incident occurred on a clear day, with outside temperature at 35 C and wind was blowing in a North-West direction at a speed of 6m/sec.

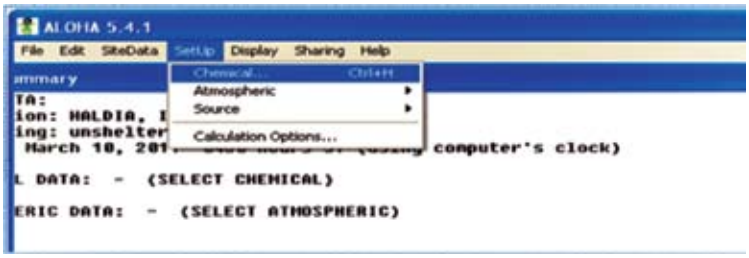
Steps: Go to Desktop and click on the ALOHA shortcut menu.

- ➢ ALOHA will initiate the application with an initial confirmation box.
- ➢ Click on the menu bar, select Setup Chemical.
- ➢ Select the Ammonia from the existing list.

- On menu bar select Setup Atmospheric
- User Input. Here you can enter the required atmospheric parameters. Please leave any field unmodified, Please override stability class to C
- On menu bar select Setup - *Source Direct.*
- Enter required parameters in this window. Select continuous release and enter values of 15 T of release for 25 mins (which equals 150 T).
- ALOHA will generate the hazard footprint (in graphical form) and the endpoint distance in the.







Exercise 8

Location: HALDIA, INDIA

Building: unsheltered single storied

Time: March 10, 2011 0430 hours ST (using computer's clock)

CHEMICAL DATA:

Chemical Name: AMMONIA Molecular Weight: 17.03 g/mol

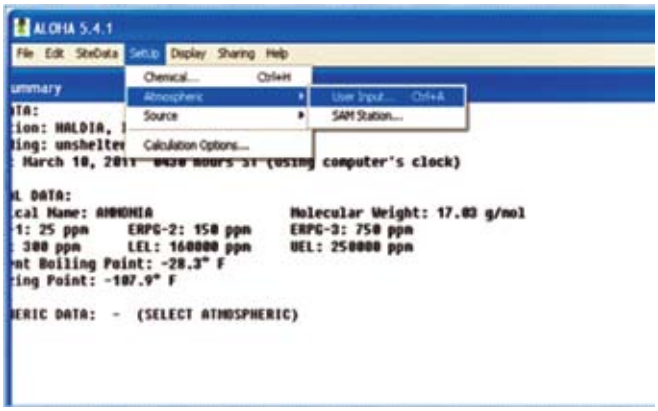
ERPG-1: 25 ppm ERPG-2: 150 ppm ERPG-3: 750 ppm

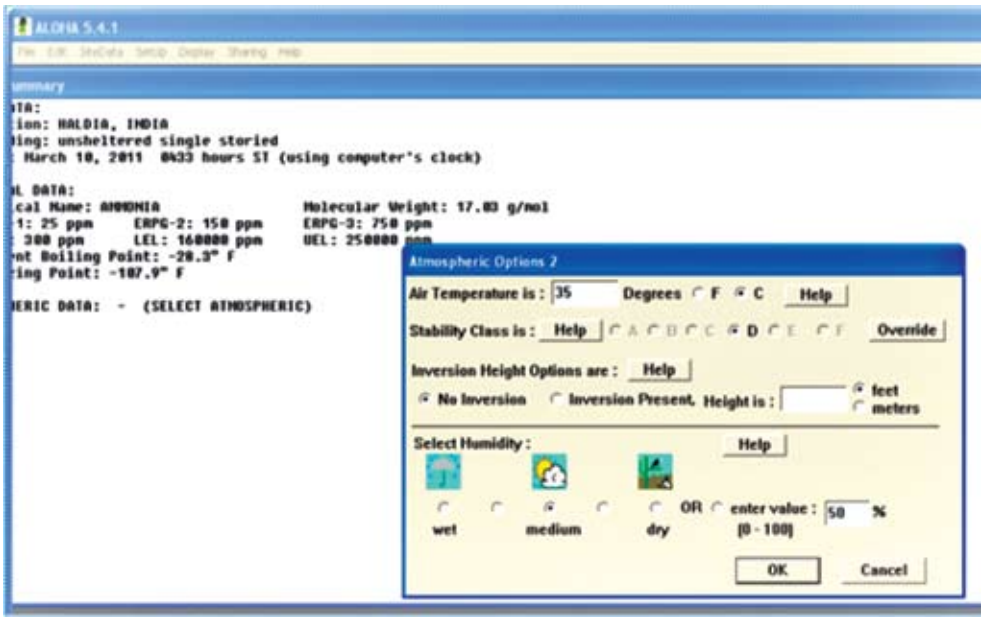
IDLH: 300 ppm LEL: 160000 ppm UEL: 250000 ppm

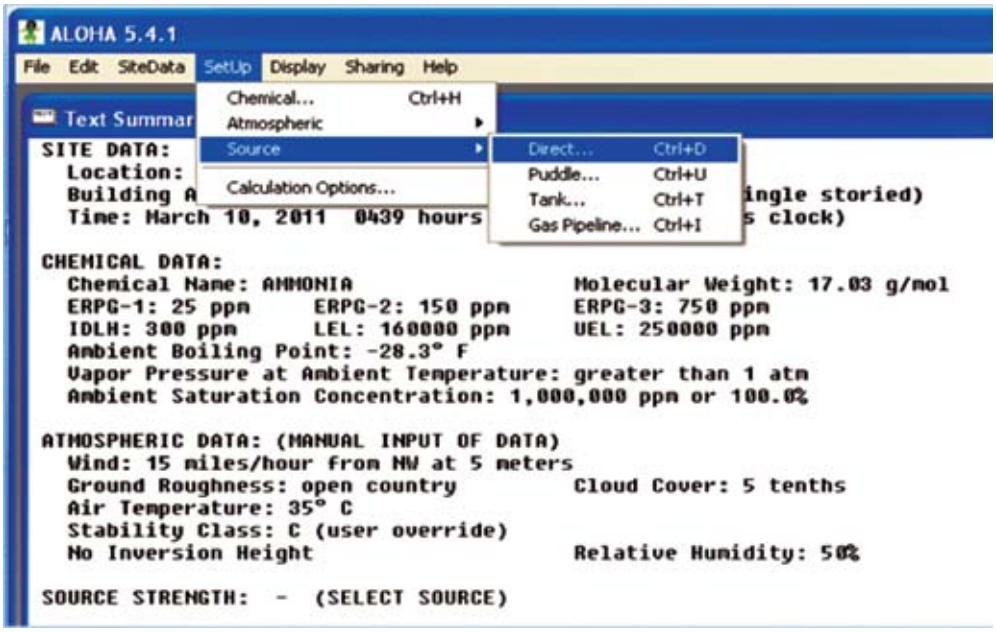
Ambient Boiling Point: -28.3° F

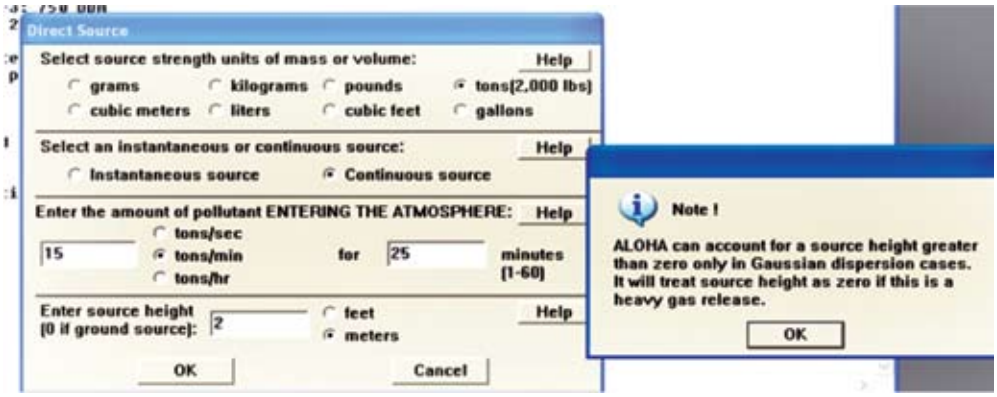
Freezing Point: -107.9° F

ATMOSPHERIC DATA: - (SELECT ATMOSPHERIC)

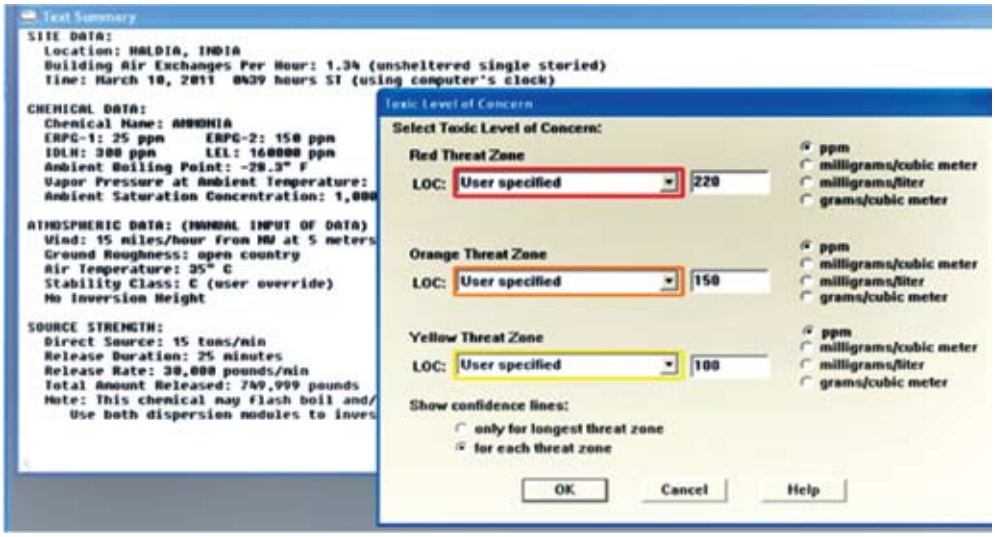


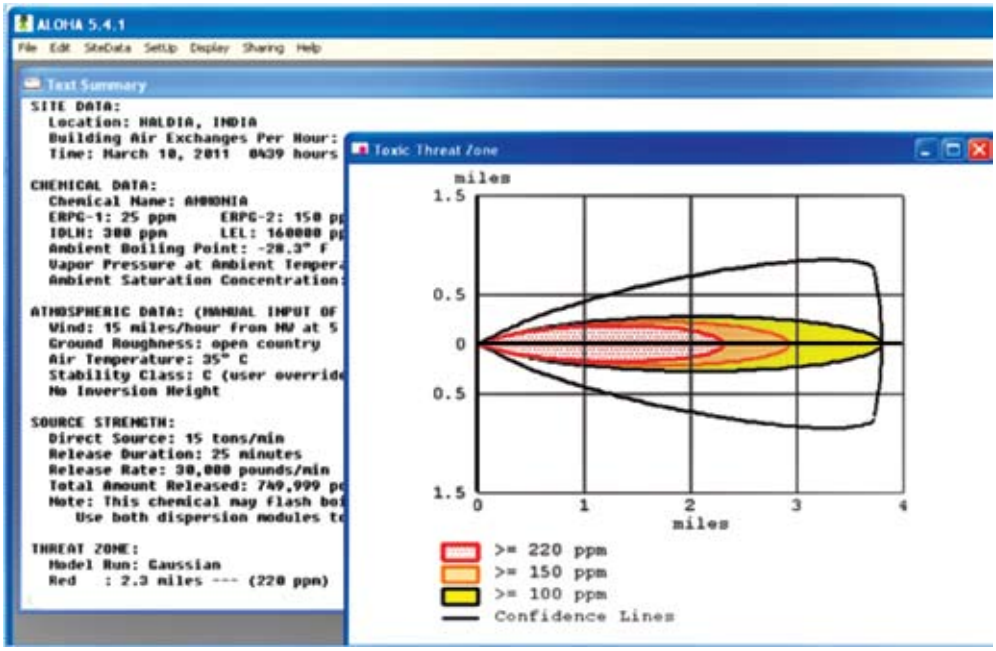




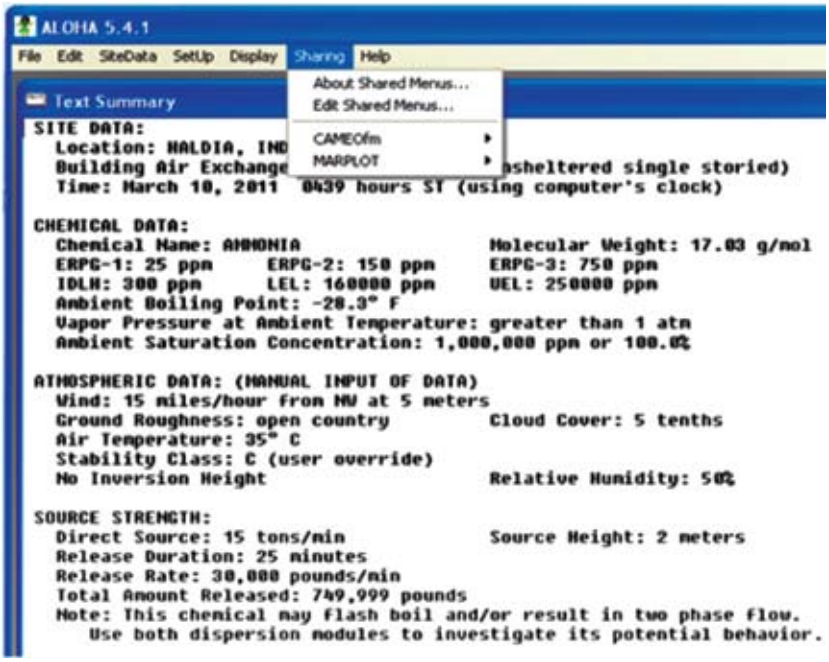


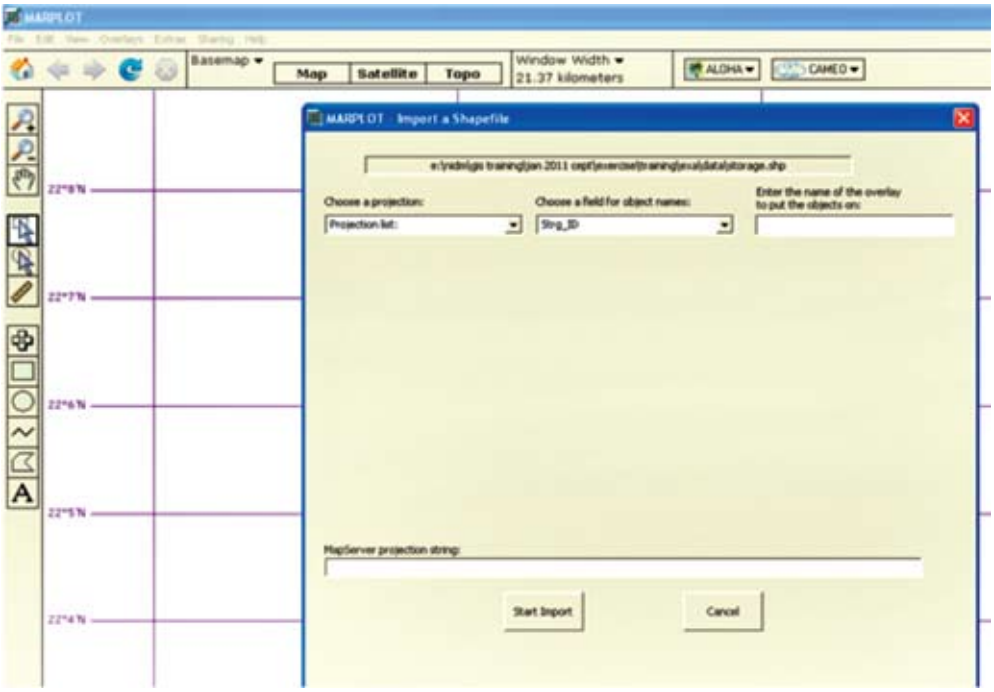
- On menu bar select Display Threat Zone From the next window select toxic release and add toxic levels of concern as follows. Red 220 ppm, Orange 150 ppm and Yellow 100 ppm.



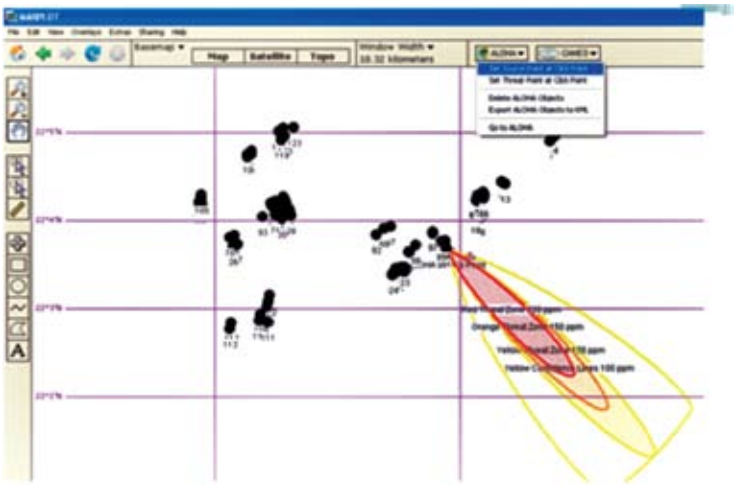


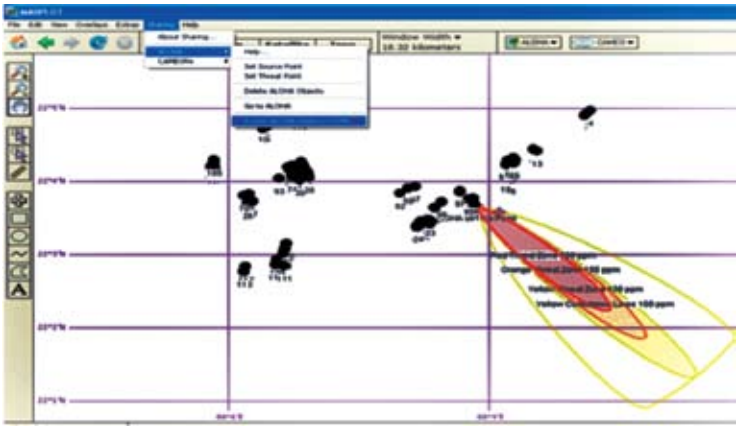
Go to Sharing > MARPLOT > Go to Map in MARPLOT, go to File > Import as overlay object and select storage.shp from ***Exercise*** data folder. The storage layer should show up on the map window. Zoom to the required level to identify ***Storage 91*** and click on the pointer and then in point at "**Click Point**"

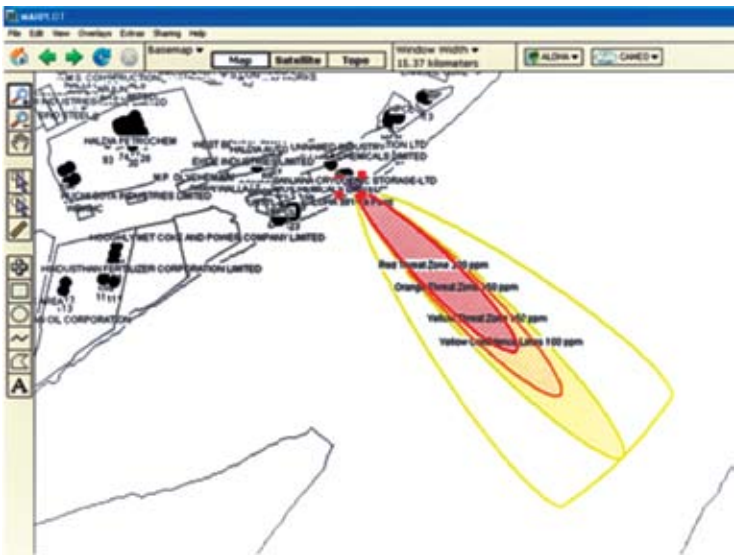

ALOHA 5.4.1
File Edit SiteData SetUp Display Sharing Help
About Shared Menus...
Edit Shared Menus...
CAMEOfm
MARPLOT
Text Summary
SITE DATA:
Location: HALDIA, IND
Building Air Exchange
asheltered single storied)
Time: March 10, 2011 0439 hours ST (using computer's clock)
CHEMICAL DATA:
Chemical Name: AMMONIA
Molecular Weight: 17.03 g/mol
ERPG-1: 25 ppm
ERPG-2: 150 ppm
ERPG-3: 750 ppm
IDLH: 300 ppm
LEL: 160000 ppm
UEL: 250000 ppm
Ambient Boiling Point: -28.3° F
Vapor Pressure at Ambient Temperature: greater than 1 atm
Ambient Saturation Concentration: 1,000,000 ppm or 100.0%
ATMOSPHERIC DATA: (MANUAL INPUT OF DATA)
Wind: 15 miles/hour from NW at 5 meters
Ground Roughness: open country
Cloud Cover: 5 tenths
Air Temperature: 35° C
Stability Class: C (user override)
No Inversion Height
Relative Humidity: 50%
SOURCE STRENGTH:
Direct Source: 15 tons/min
Source Height: 2 meters
Release Duration: 25 minutes
Release Rate: 30,000 pounds/min
Total Amount Released: 749,999 pounds
Note: This chemical may flash boil and/or result in two phase flow.
Use both dispersion modules to investigate its potential behavior.


MARPLOT
Basemap
Map
Satellite
Topo
Window Width
21.37 kilometers
ALOHA
CAMEO
MARPLOT - Import a Shapefile
Choose a projection:
Choose a field for object names:
Enter the name of the overlay to put the objects on:
Projection list:
Strg_ID
MapServer projection string:
Start Import
Cancel

Exercise 8

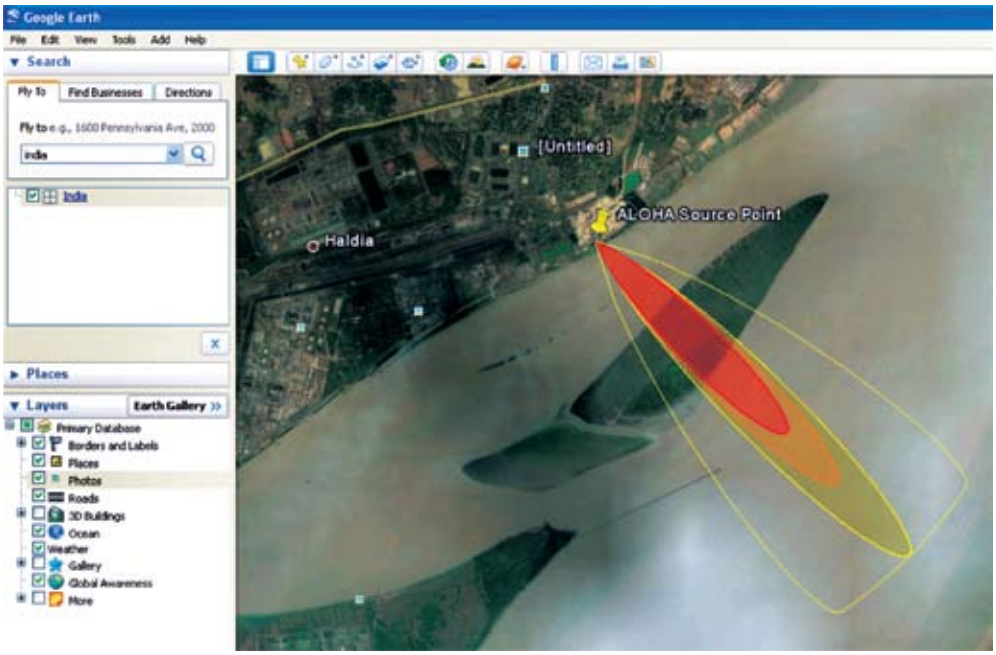




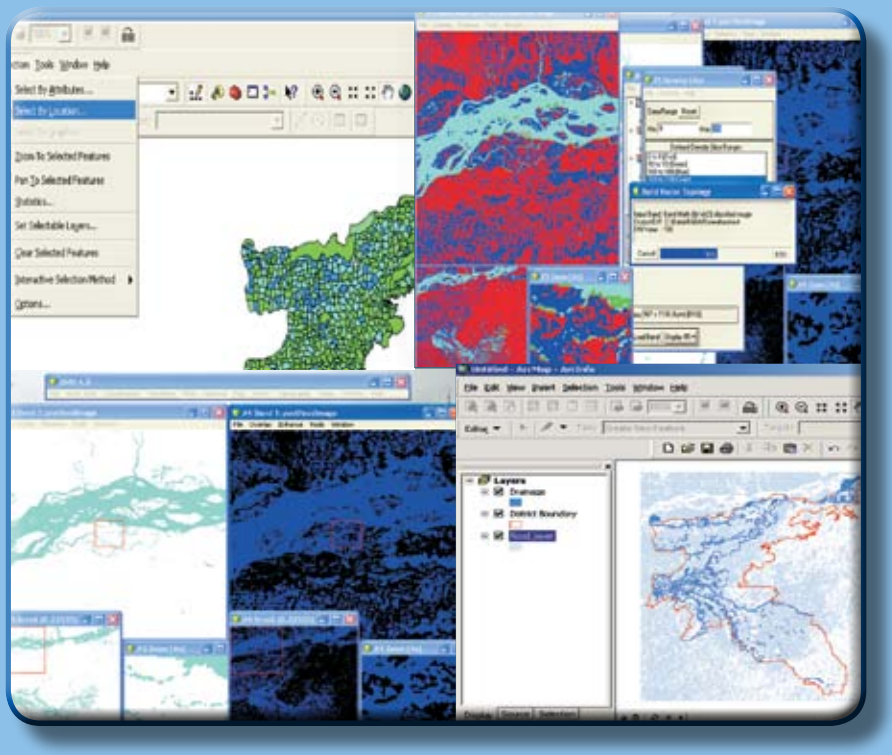


Now click again on

The KML file in the desired location. Open Google Earth, go to File > Open and load the saved KML file. You will go to the desired location of the footprint



Part 3



Damage Assessment

Exercise 9

FLOOD INUNDATION MAPPING

Aim: Mapping Flood Inundation using Radarsat Data

Data Used: Microwave RADARSAT Data of pre flood (2-June) and Post Flood (13-July) of Nagaon District of Assam

(A) Flood Inundation Mapping

Working Directory: C:\DATA\RADAR

Data Available:

Pre flood (File name: 02juneradar_100m.img)

Post flood (Filename: 13julyradar_100m.img)

District boundary Vector (Filename: district_polygon.evf)

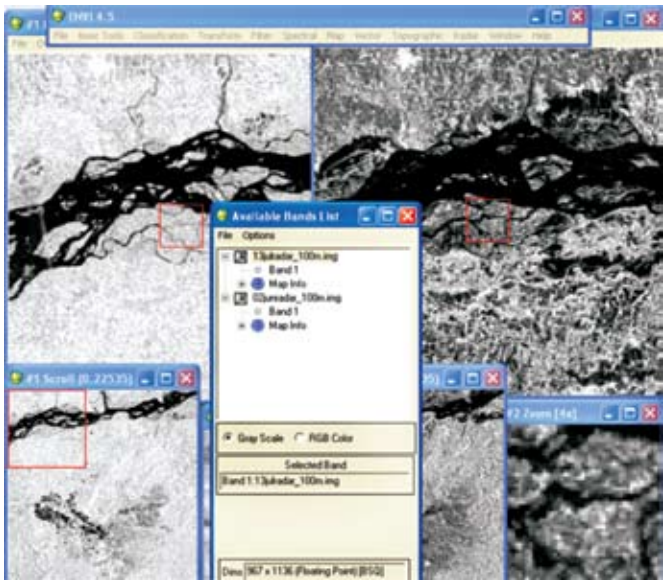
Taluk Boundary Vector (Filename: taluk_poygon.evf)

Village Boundary Vector (Filename: vil_polygon.evf)

STEPS

1. Opening the Images

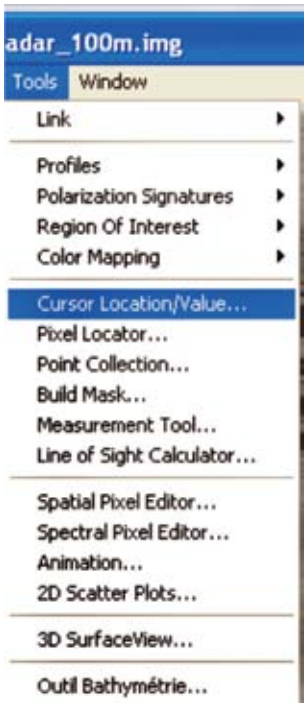
- Open pre flood and post images: Main Menu → File → Open image file
- Display Pre Flood image in Display #1 and Post Flood Image in Display#2
- Open District Boundary Vector file
- Overlay District Vector on Display#1 and Display#2
- Change Contrast of Images by Enhancement : Go to Display Window Menu → Enhance → Square root/ Gaussian/Linear
- The inundation due to water appears in dark



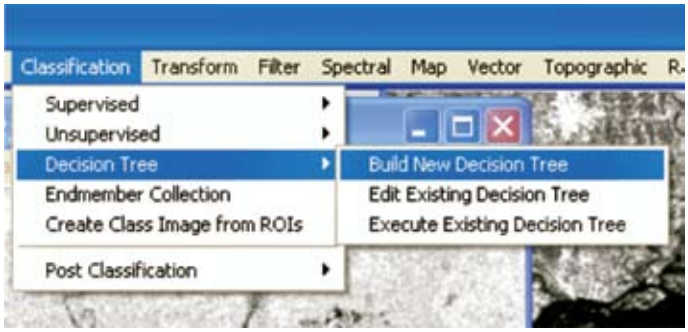
tones.

- Link the Display#1 and Display#2
- Visually analyze the change in inundation between two dates
- Try applying different Color Tables to improve visualization

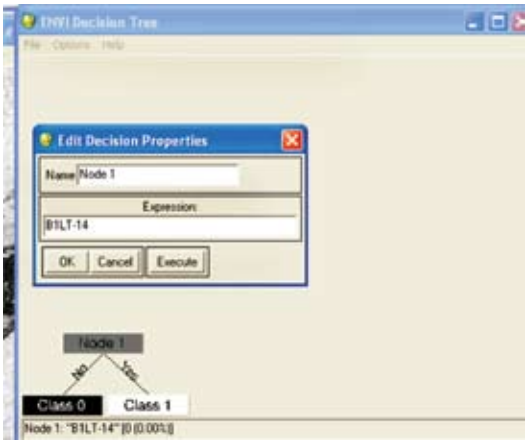
2. Mapping Inundation by using Hierarchical Decision Rule Classification

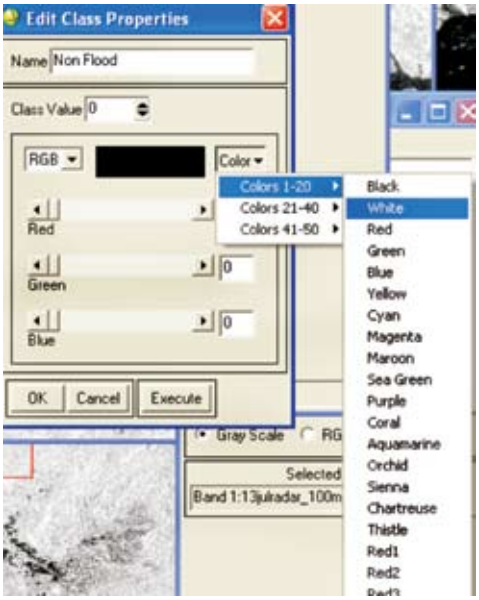


- Load pre flood image in Display#1
- Go to Display Window Menu → Tools → Cursor Location / Value
- Click at different pixels in image and see the DN value in Cursor Location / Value
- Decide on DN value (say VAL1) below which is water and above is non-water
- Go to Main Menu → Classification → Decision Tree → Build New Decision Tree → ENVI Decision Tree window will open

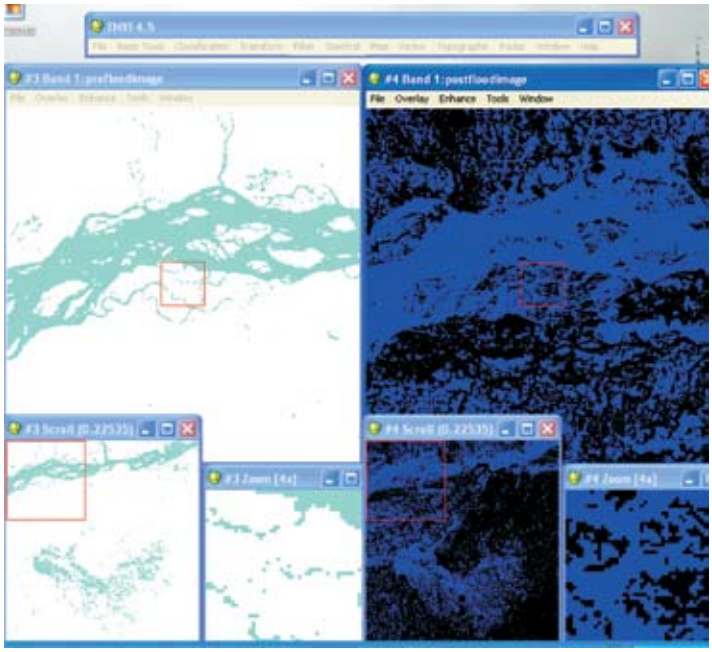


- Click on Node 1 → In Expression Enter formula: B1 LT VAL1 → OK (select value as -14)
- Variable / File Pairings Window Opens Up → Click on B1 → Select Band1 of Pre Flood Image → OK
- Click on Class 1 → Enter Name: Pre Flood Water; Class Value: 10; Color Cyan → OK
- Click on Class 0 → Enter Name: Non Flood; Class Value: 0; Color White → OK



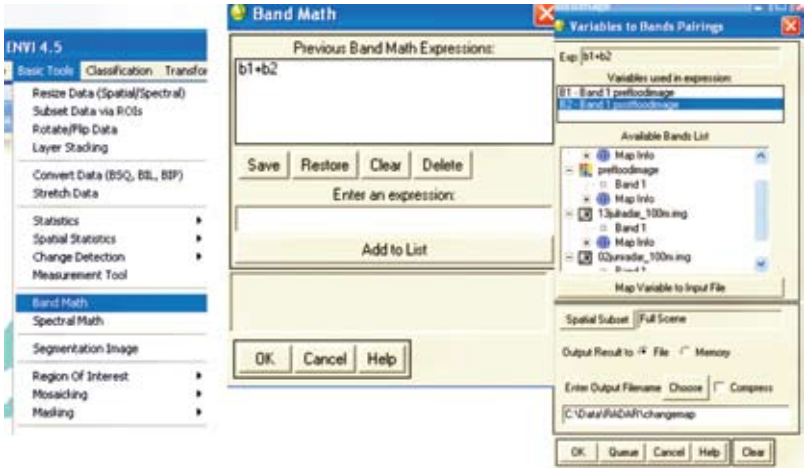


- Goto Options → Execute → Choose Output file name [Pre_Flood.img] → A classified image gets loaded in new Diplay Window
- Check if the Classification is Correct, otherwise keep Changing the Val1 in Expression and Execute to see different results.
- Goto Envi Decision Tree Window → File → Save Tree → Choose File name → OK
- Repeat all above steps for Post Flood Image and generate a classified file [Post_Flood.img] where Post Flood Water Class Value is 100 and No Water Class Value is 0
- Create ROI from District_polygon Vector and calculate Stats under the ROI for Pre_flood classified image and Post_flood Classified image. Hint look for Values under PERCENT corresponding to DN=10 for pre flood and DN=100 for post flood.
- Similarly stats could be generated for taluks and villages

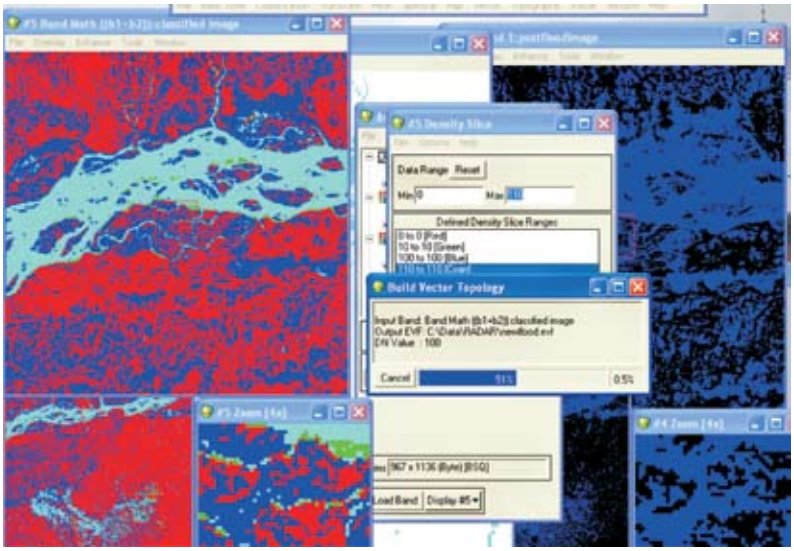


3. Change Detection in Flood

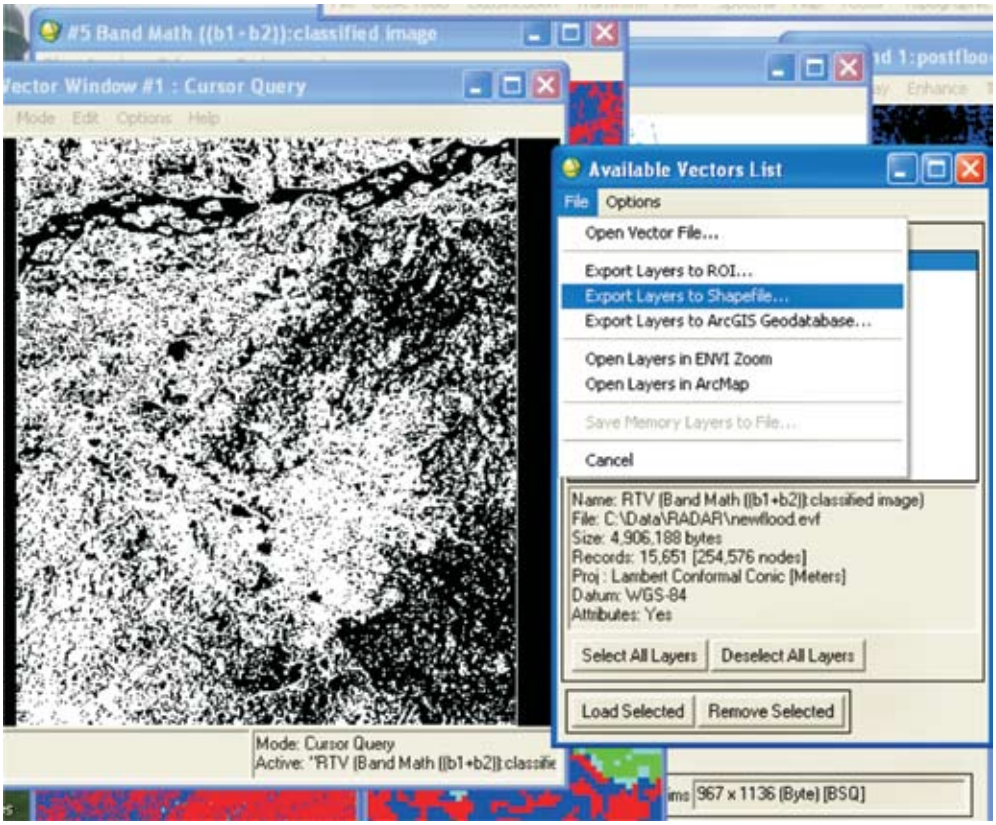
- Go to Main Menu → Basic Tools → Band Math → Enter Expression [B1+B2] → OK → Assign B1 to Pre_Flood classified → Assign B2 to Post_Flood classified -- > Choose Output File Name



- In output file DN=10 corresponds to Water logging, DN=100 corresponds to New Flooding, DN=110 corresponds to Water Logging still continuing
- Use Density Slice to assign different colors to different classes
- Goto Main Menu → Classification → Post Classification → Classification to Vector → Select Output of Band Math → DN=100 → Choose a file name to save vector [New_Flood.evf] → This vector is Shown in Available Vector List



- Go to Window Available Vector List → Select New_Flood.evf →Go to File → Export Layer to Shapefile → Give output file name [New_Flood_shape.shp] → OK
- The [New_Flood_shape.shp] file can now be opened in ArcGIS for further analysis



Pre flood lower value for water body is selected as 14 and post flood 80.

Pre flood 0 = No water, Pre flood 10 = Water

Post flood 0 = No water, Post flood 100 = Water

Pre	Post	Category
0	0	No water
0	**100**	**newly Flooded area (Area of Interest)**
10	0	Water Drained out
10	100	Permanent Water body

Preliminary Flood Damage Assessment

Objective: To assess the flood damage based on the flood Inundation map prepared using the pre-flood and post flood imageries and existing administrative boundary maps and Census data. Please make note that it is not a complete damage assessment. Objective of the exercise is to demonstrate the potential of space based information in preliminary damage assessment.

Working Directory C: // Damage Assessment/ NRSA Data and C: //Data/Damage Assessment

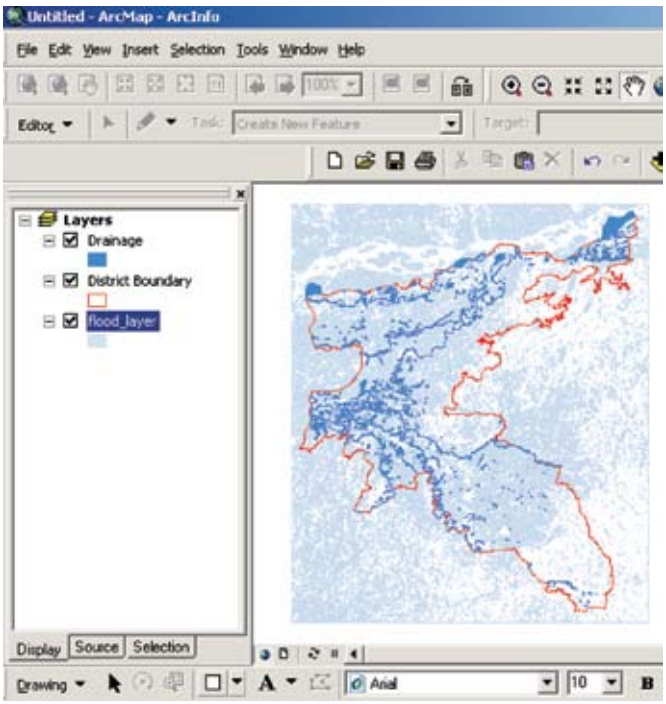
DATA SETS USED

Administrative boundary maps, road network, railways, land use map, Flood layer derived using the pre-flood and post flood satellite imageries (Exercise I).

Exercise

1. **Start Arc Map add the required data for analysis.**

Step 1. Add the flood layer (DN Number 100 exported as shape file from evf file generated in ENVI)



2. **Identify all the flood affected blocks/ taluka based on visual interpretation and GIS based Analysis. Identify the number of talukas affected**

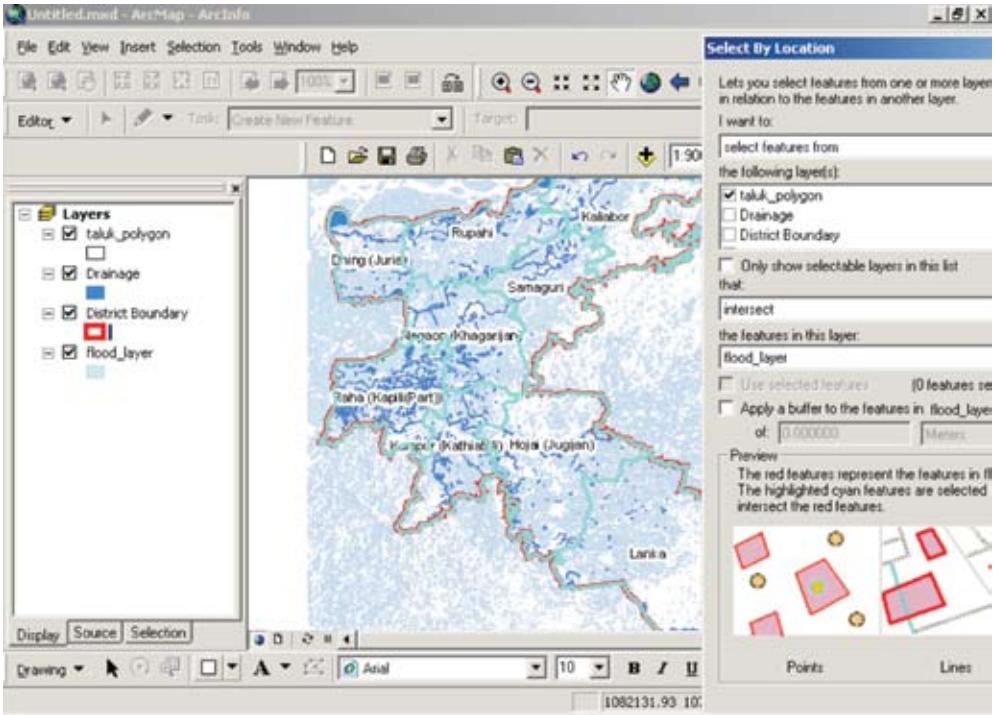
Step1: Go to main menu tool bar and add flood layer , district boundary and taluk boundary layers.

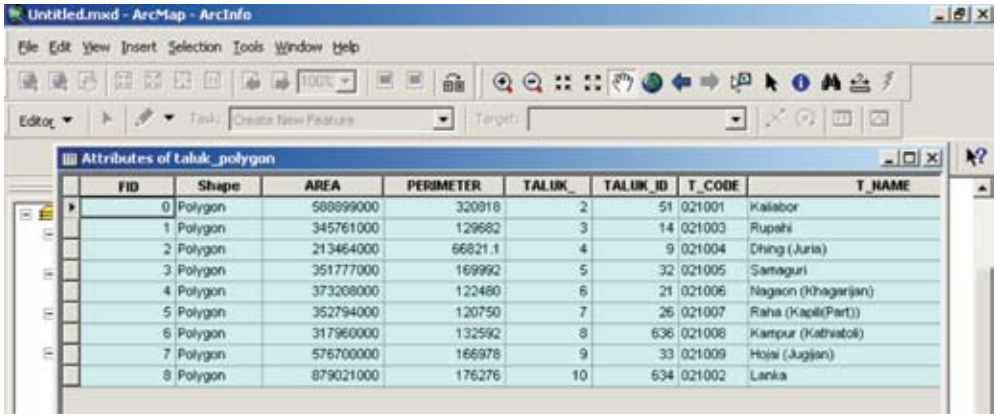
Step 2: Go to layer properties → symbology and make both district layer and taluka layer as transparent (Red and black outline colors to distinguish them and thicker line for district boundary).

Step 3: Go to Selection, select by location

For identifying the taluks affected by floods go to selection / select by location/ select features from taluk polygon that intersect with features in the layer new flooding.

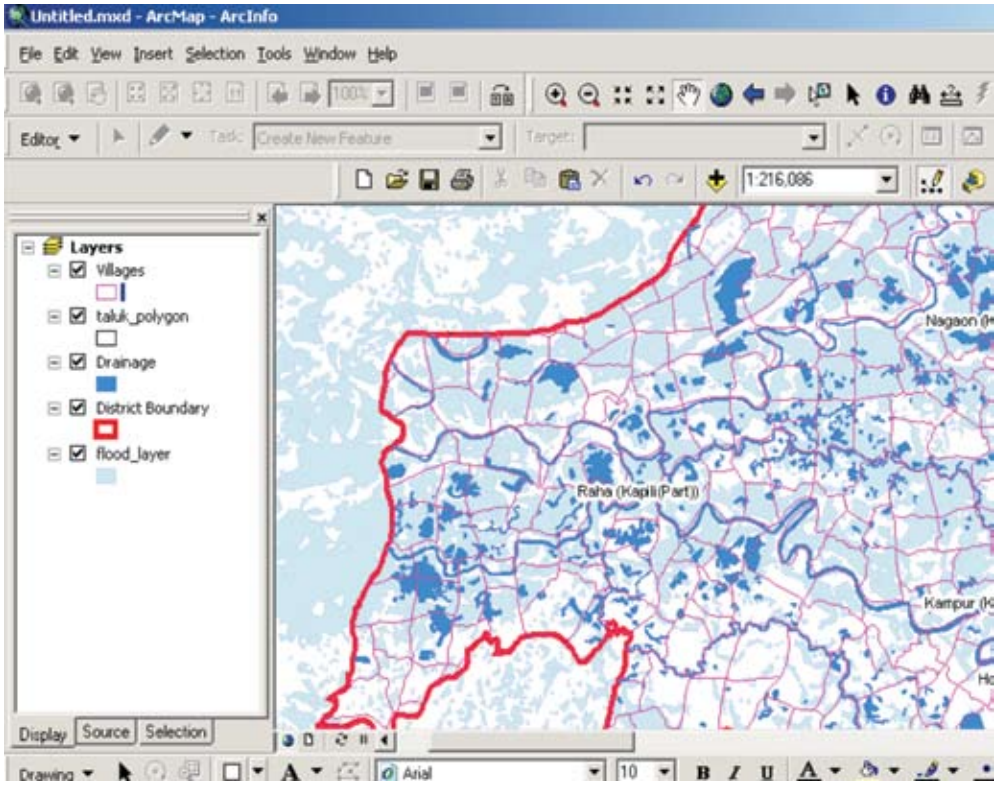
Open the attribute table and see the result. All the 8 taluks in the district are affected by flood.





FID	Shape	AREA	PERIMETER	TALUK_	TALUK_ID	T_CODE	T_NAME
0	Polygon	588899000	320918	2	51	021001	Kaliabor
1	Polygon	345761000	129682	3	14	021003	Rupahi
2	Polygon	213464000	66821.1	4	9	021004	Dhing (Juria)
3	Polygon	351777000	169992	5	32	021005	Samaguri
4	Polygon	373208000	122480	6	21	021006	Nagaon (Khagarijan)
5	Polygon	352794000	120750	7	26	021007	Raha (Kapili(Part))
6	Polygon	317960000	132592	8	636	021008	Kampur (Kathiatoli)
7	Polygon	576700000	166978	9	33	021009	Hojai (Jugijan)
8	Polygon	879021000	176276	10	634	021002	Lanka

3. **Identify the number of villages affected and the total population affected based on the population of the affected villages**



4. **Pick one Taluk, and identify the number of villages affected in that taluka**

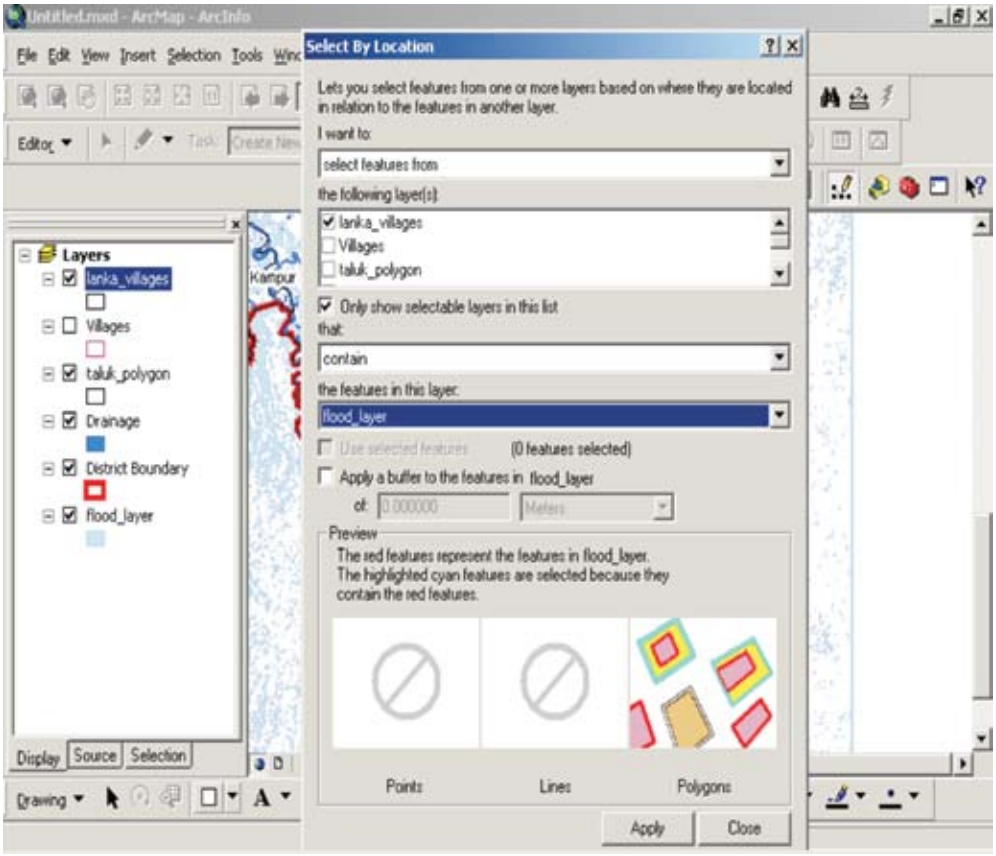
Step 1: Select on partly affected taluk say lanka from select by attribute function or from the attribute table.

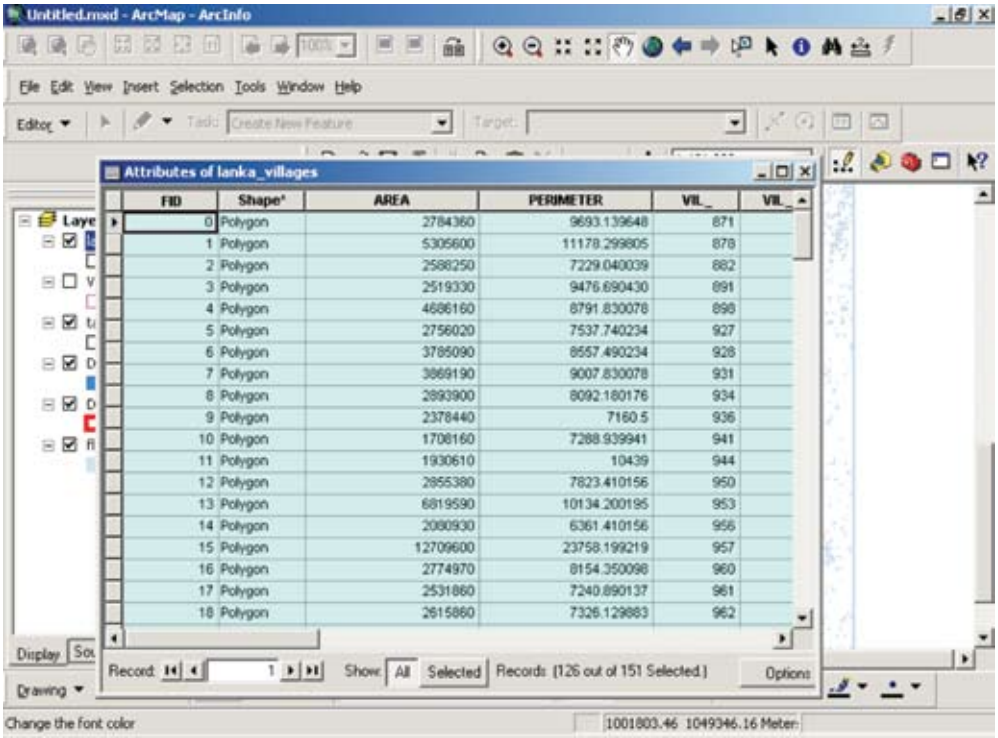
Step 2: Select the villages with in the lanka taluk based on select by location. Save as lanka villages

Step 3: Go to Selection, select by location

For identifying the villages affected by floods go to selection / select by location/ select features from lanka villages polygon that contained with features in the layer flood layer. Similarly you can identify other affected elements based on select by location and interactive selection methods.

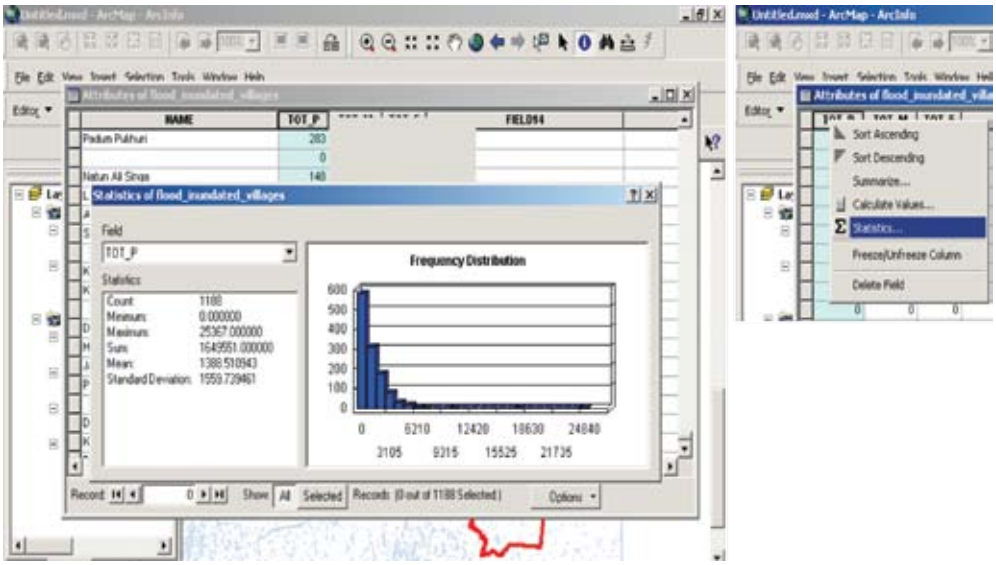
Step 4: Result (Attribute table) indicates that 126 out of 151 villages are fully or partly affected by floods. To get a list of villages completely affected go for the option completely with in instead of contain



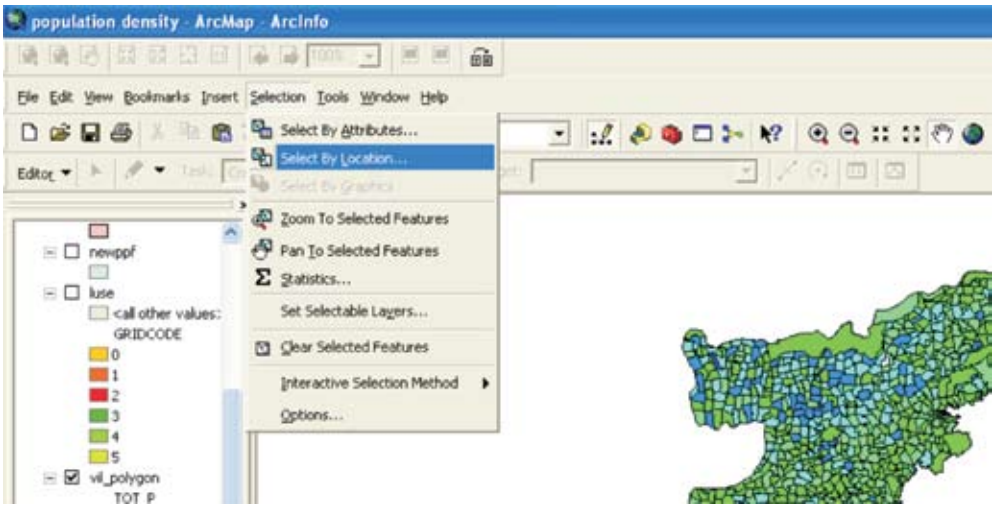


FID	Shape*	AREA	PERIMETER	VIL_	VIL_
0	Polygon	2784360	9693.139648	871	
1	Polygon	5305600	11178.299805	878	
2	Polygon	2588250	7229.040039	882	
3	Polygon	2519330	9476.690430	891	
4	Polygon	4686160	8791.830078	898	
5	Polygon	2756020	7537.740234	927	
6	Polygon	3785090	8557.490234	928	
7	Polygon	3869190	9007.830078	931	
8	Polygon	2893900	8092.180176	934	
9	Polygon	2378440	7160.5	936	
10	Polygon	1708160	7288.939941	941	
11	Polygon	1930610	10439	944	
12	Polygon	2855380	7823.410156	950	
13	Polygon	6819590	10134.200195	953	
14	Polygon	2080930	6361.410156	956	
15	Polygon	12709600	23758.199219	957	
16	Polygon	2774970	8154.350098	960	
17	Polygon	2531860	7240.890137	961	
18	Polygon	2815860	7326.129883	962	

Step 5: To calculate the total population of the affected villages right click on the total population field and select statistics



STEP 6: Overlay land use map and select the forest area, agriculture area settlement area affected similar to villages affected.



TEST

1. Number of settlements affected?
2. Forest area affected? Agriculture affected? (based on LUSE map and census data)
3. Roads Railways affected or not? If yes identify the stretches in one taluka.
4. Save the list of taluks affected as database file and generate a report, based on the analysis.
5. Save the list of villages affected in each taluka similar to Lanka villages and calculate the total population affected.
6. Prepare a final map with affected population at village level for each taluk and also the total population affected in each taluka.
7. Identify the limitations of this method.

Glossary

Analytical Hierarchy Process (AHP) – AHP is a multiple criteria decision making tools especially in the problems with spatial nature (in GIS) .

Arcs - Lines that begin and end with a node. Intersections of arcs are always connected with a node. Arcs also make up part of a polygon. An example of data that would use this form would be roads.

Area - A description of the dimension or content of a polygon.

Coordinate System - A fixed reference framework superimposed onto the surface of an area to designate the position of a point within it by using x and y coordinates. The State Plane Coordinate System and the system of latitude and longitude used on the Earth's surface are common examples.

Coverage - A file format used in Arc/INFO software developed by ESRI that contain a set of points, arcs, or polygons (or features) that hold tabular data and a spatial location.

Data - A collection of facts, concepts or instructions in a formalized manner suitable for communication or processing by human or automatic means.

DEM - A digital elevation model is a digital model or 3D representation of a terrain's surface .

Digital Data - In a most generalized way, a digital image is an array of numbers depicting spatial distribution of a certain field parameters (such as reflectivity of EM radiation, emissivity, temperature or some geophysical or topographical elevation.

Digital Image Processing - Digital Image Processing is a collection of techniques for the manipulation of digital images by computers. Three steps of DIP are Pre-processing, Display and enhancement and Information extraction

Digital Number – Value depicting the average radiance of relatively small area within a scene

Disaster - A catastrophe, mishap, calamity in any area, arising from natural or man made causes, which results in substantial loss of life or human suffering, damage destruction of, property, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area. (DM Act, 2005)

Disaster Management - Disaster management means a continuous and integrated process of planning, organising, coordinating and implementing

measures which are necessary or expedient for prevention of danger or threat of any disaster, mitigation or reduction of risk of any disaster or its severity or consequences; capacity building; preparedness to deal with any disaster, prompt response to any threatening disaster situation or disaster, assessing the severity or magnitude of effects of any disaster, evacuation, rescue and relief, rehabilitation and reconstruction. Disaster Management comprises all forms of activities including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of disasters in the pre-disaster phase and post disaster stage (Response, Relief , Recovery, Reconstruction).

Feature - A spatial element which represent a real-world entity by having specific characteristics. Often used synonymously with the term object. A generalized description of a point, line or polygon.

Field - A location in a data record in which a unit of information is stored. For example, in a database of addresses, one field would be 'city'.

Geocoding - The process by which the geographic coordinates of a location are determined by its address, postal code, or other explicitly non-geographic descriptor.

Geographic Information System (GIS) -GIS is a system of hardware, software, data and personnel to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.

Geoinformatics - Geoinformatics is the science and technologies which develops and uses information science and computer infrastructure to address the problems of geography, geosciences, related branches of engineering etc. Geoinformatics combines geospatial analysis and modeling, development of geospatial databases, information systems design, human-computer interaction and networking technologies. Geoinformatics is a broader term cover Remote Sesnsing, GIS, GPS & Internet Mapping Services.

Global Positioning System (GPS)- Global Positioning System – A network of satellites continuously transmit coded information, which makes it possible with help of an instrument (hand held or vehicles) to precisely identify locations on earth by measuring distance from the satellites.

Hazard- Potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation

Image Classification – Image Classification is the process of sorting all the pixels in an image into a finite number of individual classes. The classification

process is based on Patterns of their DN, usually in multichannel data (Spectral Classification), Spatial relationship with neighbouring pixels and relationships between the data acquired on different dates.

Image Resolution - Resolution can be defined as "the ability of an imaging system to record fine details in a distinguishable manner". A working knowledge of resolution is essential for understanding both practical and conceptual details of remote sensing. Along with the actual positioning of spectral bands, they are of paramount importance in determining the suitability of remotely sensed data for a given applications.

Legend - The description of the symbology representing features on a map.

Map - A graphic representation of geographically distributed phenomena. The information displayed may be in the form of symbols or signs.

Node - Beginning, connecting and ending points of an arc. An example of data that would be represented by this form would be manholes or inlets in a storm water system.

Normalized Difference Vegetation Index (NDVI) – NDVI depicts vegetation vigour, density and biomass. It varies in a range of -1 to +1. Among the all the vegetation indices that are available, it is a universally acceptable index for operational drought assessment because of its simplicity in calculation, easy to interpret and its ability to partially compensate for the effects of atmosphere, illumination geometry (http://dsc.nrsc.gov.in). NDVI= (NIR-Red) / (NIR+Red) . Where, near Infra Red and Red are the reflected radiations in these two spectral bands.

Pixel - Digital image consists of discrete picture elements called pixels.

Point - A single "dot" location. A point is also called a "label point". A label point is the element that holds information in the polygon. An example of data that would be stored in the system using this form would be fire hydrants, or a set of individual address locations.

Polygon - An arc that closes on itself to make a circle or a closed shape. An example of a set of data that would be stored in the GIS in this format would be parks or lakes.

Query - A way of selecting features based on a set of common characteristics. For example, the act of selecting all the buildings that have an area greater than 2000 sq. ft. out of a database.

Radiometric Resolution - Radiometric Resolution or radiometric sensitivity refers to the number of digital levels used to express the data collected by the sensor. It is commonly expressed as the number of bits (binary digits) needs to store the maximum level. For example Landsat TM data are quantised to 256 levels (equivalent to 8 bits). Here also there is a tradeoff between radiometric resolution and signal to noise. There is no point in having a step size less than the noise level in the data. A low-quality instrument with a high noise level would necessarily, therefore, have a lower radiometric resolution compared with a high-quality, high signal-to-noise-ratio instrument. Also higher radiometric resolution may conflict with data storage and transmission rates.

Remote Sensing - Remote Sensing is the Science and Art of obtaining information about phenomena through the analysis of data acquired by a device that is not in direct contact with the object, phenomena or area under investigation.

Raster data - In its simplest form, a raster consists of a matrix of cells (or pixels) organized into rows and columns (or a grid), as shown in the graphic below, where each cell contains a value representing information, such as temperature. Rasters are digital aerial photographs, imagery from satellites, digital pictures, or even scanned maps.

Risk - The probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interaction between natural or human-induced hazards and vulnerable conditions

Scale - The ratio or fraction between the distance on a map, chart or photograph and the corresponding distance in the real world.

Shapefile - A set of files that contain a set of points, arcs, or polygons (or features) that hold tabular data and a spatial location. This file format can be used in wide range of GIS and Image processing softwares. A set of files that contain a set of points, arcs, or polygons (or features) that hold tabular data and a spatial location.

Spatial Resolution- Spatial Resolution of an imaging system is defines through various criteria, the geometric properties of the imaging system, the ability to distinguish between point targets, the ability to measure the periodicity of repetitive targets ability to measure the spectral properties of small targets.

Spectral Resolution – Spectral Resolution refers to the width of the spectral bands. As different material on the earth surface exhibit different spectral reflectances and emissivities. These spectral characteristics define the spectral

position and spectral sensitivity in order to distinguish materials. There is a tradeoff between spectral resolution and signal to noise. The use of well -chosen and sufficiently numerous spectral bands is a necessity, therefore, if different targets are to be successfully identified on remotely sensed images.

Table - A means of organizing data in rows and columns in which each row represents an individual entity, record, or feature and each column represents a single field or attribute value.

Temporal resolution - Temporal resolution refers to the frequency with which images of a given geographic location can be acquired. Satellites not only offer the best chances of frequent data coverage but also of regular coverage. The temporal resolution is determined by orbital characteristics and swath width, the width of the imaged area.

Vulnerability - The conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

Vector – Spatial data represented in the form of point, line and polygons.

Bibliography

Adam, R., & Gangopadhyay, N. (1997). *Database Issue in Geographic Information Systems*. London: Kluwer Academic Publishers

ADPC (n.d.). *Coastal Risk Analysis of Tsunami And Environmental Remediation*. Accessed on 10 September 2007 from www.adpc.net .

Anderson, J.R., Hardy, E.E., Roach, J.T., & Witmer, R.E. (1976). A landuse and land cover classification for use with Remote Sensor data. *Geological Survey professional paper 964.* U S Department of interior, Washington, DC: US Government Printing Office.

Barrett, E.C. & Brown (1991). *Remote Sensing for Hazard Monitoring and Disater Assessment: Marine and Costal Applications In The Mediterranean Region*. Philadelphia: Gordon and Breach Scence Punlishers.

Bhanumurthy,V., & Hari Prasad, V. (2004). Remote Sensing and GIS in Flood Management. In Vijay P. Singh, Nayan Sharma; C Ojha;. P. Shekhar *"The Brahmaputra Basin Water Resources"* pp 560—578. Springer Verlag.

BMTPC (1997). *Vulnerability Atlas of India* (Ist Edn). New Delhi : BMTPC.

BMTPC (2003). *Landslide Hazard Zonation Atlas of India*. New Delhi : BMTPC.

BMTPC (2006). *Vulnerability Atlas of India (2nd Edn)* . New Delhi : BMTPC.

Burrough, P.A. (1976). *Principles of Geographic Information System for Land Assessment,*. Oxford: Clarandon Press.

Campbell, J.B., & Wynne, R.H. (2011). *Introduction to Remote Sensing,* Fifth Edition. New York: Guilford Press.

Cutter, S., Boruff, L., Bryan, J., & Shirley, W.L. (2003). Social Vulnerability to Environmental Hazards", *Social Science Quarterly, 84* (2), 242-261.

Dracup, J.A., (1980). On the definition of droughts, *Water Resources Research.* 116, 291-302.

Dwyer, A., Zoppou, C., Nielsen, O., Day,S. & Roberts,S. (2004). Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. *GeoCat No. 61168, Geoscience Australia.*

EMI (2002). Earthquake and Megacities Initiative. Accesses from http://www-megacities.physik.uni-karlsruhe.de/.

FEMA (2012). Hazus-MH Overview Flyer February 2012 . Accesses from http://www.fema.gov/hazus/.

Fotheringham, A., & Wegener, M. (2000). *Spatial Models and GIS: New Potential and New Models.* London:Taylor & Francis.

Graciela, M., Lorenz, H., & Radu, G., (2005). Remote Sensing of Landslides: An Analysis of The Potential Contribution to Geo-spatial systems for Hazard Assessment in Mountainous Environments. *Remote Sensing of Environment, 98* (2-3), 284-303.

Granger, K., Jones, T., & Scott, G. (1999). *Community Risk in Cairns: a Multi-Hazard Risk Assessment, Technical Report.* Commonwealth Government of Australia Canberra: Geoscience, Australia.

GSI (1982). *The Nilgiri Landslides.* Geological Survey of India - Publication no: 57.

GSI (2000). *Seismotectonic Atlas of India and its Environs*. Kolkata : Geological Survey of India.

GSI(2005). *Landslides : Inventory of Northwest Himalaya* . Special Vol No- 71. Lucknow: Geological Survey of India.

Guyot, G., & Rotterdam, P.T. (1997). *Physical Measurements and Signature in Remote Sensing.* Brokefield: A A Balkema.

Herbst, P.H., Bredenkamp, D.B., & Barker, H.M.G. (1966). A Technique for the Evaluation of Drought from Rainfall Data. *Journal of Hydrology, 4,* 264-272.

Jampoler, S. M., & Haack, B. N. (1990). *The use of SPOT Data to Map Urbanization and Analyze Change*: Kathmandu, Nepal. In Technical Papers: 1990 ACSM-ASPRS Annual Convention, 4, 208-17.

Jensen,J.R.(1996). *Introductory Digital Image Processing: A Remote Sensing Perspective*, 2nd edition. New Jersey, USA: Prentice Hall.

John, R. J. (2006). *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd Edition). USA: Prentice Hall.

Kennedy, M. (2006*). Introducing Geographic Information Systems*. New Jersey, USA : John Wiley & Sons Inc.

Kennedy, M.(2010). *Global Positions System and GIS*. New York, USA:CRC Press.

Kogan., F. N. (2000). *Contribution of Remote Sensing to Drought Early Warning*. NOAA, NESDIS.

Komecny, G. (2003). *Geoinformation : Remote Sensing ,Photogrammetry and GIS*. New Delhi: Taylor and Francis.

Lillesand, J.M, Kiefer, R.W. & Chipman (2007). *Remote Sensing and Image Interpretation*, 6th Edition. USA: John Wiley & Sons.

Longley, P. A.(2005). *Geographic Information System and Science* . U.K: John Wiley & Sons Inc.

Lovett, A. (2004). *GIS for Environmental Decision Making*. New Delhi:CRC Press.

Mansourian, A., Rajabifard, A., Valadan Zoej, M.J., & Williamson, I. (2006). Using SDI and web-based system to facilitate disaster management. *Computers & Geosciences*, *32* (3), 303-315.

Marcal, A. (2006). *Global Development in Environment: Earth Observation form Space*. Netherlands: Mill Press.

Mehrotra, A. & Suri, R.K.(1995). *Remote Sensing for Environment and Forest Management.* New Delhi : Indus Publishing Co.

National Drought Mitigation Center (2005). What is Drought ? Accessed from http://www.drought.unl.edu/whatis/concept.htm.

Nayak, Z. (2003). *Remote Sensing and GIS technologies for monitoring and prediction of Disasters.* New Delhi : Springer.

Neteler, M (2004). *Open Source GIS: A Grass GIS Approach* . New Delhi:Kluwer Acasemic Publishers.

Nieuwenhuis, G.J., & Vaughan, A. (1999). *Operational Remote Sensing for Sustain Development.* Brookfield: A A Balkema.

NRSA (2001). *Landslide Hazard Zonation Mapping in the Himalayas of Uttaranchal and Himachal Pradesh*. Hyderabad: National Remote Sensing Agency Department of Space.

Oasterom, P. (2005). *GeoInformation for Disaster Management.* New York: Springer.

OYO Group (2000). *Risk Assessment Tools for Diagnosis of Urban Areas Against Seismic Disasters.* Website: http://www.geohaz.org/projects/radius.html.

Palmer, W.C. (1965). Meteorological Drought..US Weather Bureau Research Paper No.45.

Ramasamy, S.M. (2006). *Remote Sensing in Geology* . Jaipur : Rawat Publication.

Ramasamy, S.M (2005). *Remote Sensing in Geomorphology.* New Delhi : New India Publishing Agency.

Rashind, S.M & Khan, M.M.A.(1993). *Dictionary of Remote Sensing*. New Delhi: Manak Publisher.

Reddy, A.M. (2006). *Remote Sensing and Geographical Information Systems* Hydrabad: BSB Publication.

Roy, P.S., Bhanumurthy, V., Murthy, C.S, & Chand, T.K. (2008). Space for Disaster Management: Lessons and Perspectives. *Journal of South Asia Disaster Studies* 1(1), 157-177.

Saaty, T.L. (1980). *The Analytic Hierarchy Process*. New York: McGraw-Hill.

Sabins, F.F. (1996). *Remote Sensing: Principles and Interpretation* .New York: W H Freeman and Co.

Schowengerdt, R. A. (1997). *Remote Sensing: Model and Methods for Image Processing* . London: Academic Press.

Sharkov, E.A. (1998). *Remote Sensing of Tropical Regions*. New York: John Wiley & Sons.

Singh, R.B. (2000). *Disaster Management*. Jaipur: Rawat Publications.

Smakhtin., V. U., & D.A.Hughes (2004). *Review, Automated Estimation and Analyses of Drought Indices in South Asia.* W. P. 83. Colombo, Sri Lanka, International Water Management Institute.

Solimini, D (1995). *Microwave Radiomertey and Remote Sensing of the Environment* Netherlands :VSP.

Star, J.L., Estes, J.E., & McGwire, K.C. (Eds). (1996). *Integration of Geographic Information Systems and Remote Sensing.* New York: Cambridge University Press.

Wolf, P.R. (1983). *Elements of Photogrammetry*. New York: McGraw-hill Inc.

Method

Question Answer and Discussion.

Resource persons

Director/Head of Host Institute, Course Director & Coordinator/ Faculty, Senior officials of concerned departments.

Trainer's note

Course coordinator/director shall coordinate the session with positive attitude and must be ready to accept criticism and valuable suggestions from the participants for improving the course contents and delivery. Coordinator shall extend thanks to all including dignitaries, team of faculty and all associates personally while closing the valedictory session. Make the participants to feel that the training is the beginning of a long term association.

About the Author

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Sreeja S. Nair, Assistant Professor at National Institute of Disaster Management since 2007. She is a disaster management professional having more 12 years of experience . Her areas of training and research at NIDM include Geoinformatics Applications in Disaster Management, Environmental Law, Disaster Data and Information Management, Ecosystem Approach to Disaster Risk Reduction, Chemical Disaster Management, Drought Vulnerability Analysis etc. Before joining NIDM she has been working with Disaster Risk Management Project, United Nations Development Programme (2003-2007), Phelps Dodge Exploration Limited, Risk Management Software India Private Limited and with the Editorial board of GIS@ Development. She is a life member of several esteemed professional bodies like Indian Geomatics Society, Indian Society of Remote Sensing, Society of Earth Scientists India and Member Secretary of the Hazard related statistics set up under the National Disaster Statistics Committee of the Central Statistical organization. She published twelve papers in peer reviewed national and international journals, authored three training modules, two books (Edited Volumes) Titled "Ecosystem Approach to Disaster Risk Reduction" and "Environmental Knowledge for Disaster Risk Reduction", edited two proceeding volumes" Chemical Disaster Management" and "Risk to Resilience: Strategic Tools for Disaster Risk Management". Besides she is a member of the Editorial Team of NIDM Journal Disaster and Development and International Journal of Earth Sciences and Engineering.

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