Bharathidasan University

Tiruchirappalli – 620 023, Tamil Nadu

6 Yr. Int. **M.Tech. Geological Technology and Geoinformatics**

Course Code : **MTISC0206G**

INTRODUCTION TO GEOTECHNOLOGY

Unit-5 Geoinformatics

ISS, NASA track @ Spot the Station
https://spotthestation.nasa.gov/signup.cfm

Dr. K.Palanivel
Professor, Department of Remote Sensing

Course Objectives

- To know the content and familiarize the courses of this entire programme
- To study the basics and concepts of major disciplines in Geological Technology
- To understand the importance of Geoinformatics and its applications
- To learn the application of Geological Technology and Geoinformatics in natural resources mapping
- To learn the application of Geoinformatics in natural disaster mitigation.

MTISC-0206G - INTRODUCTION TO GEOTECHNOLOGY ---- 3 credits

1. Earth System Processes: 6hrs

Earth Sciences: Definition, Branches of Earth Sciences, Scope and importance of Earth Sciences

Earth System Processes: Origin, interior & age of the Earth – Plate tectonics – Formation of Continents & Oceans – Mountain building activities – origin of rivers – Physiography of the Earth.

2. Lithology, Structure, Geomorphology: 12hrs

Lithology: Rock forming minerals – Igneous, Sedimentary & Metamorphic Rocks – Stratigraphy.

Structure: Folds, faults, geotectonics and their significance.

Geomorphology: Various Geomorphic Processes – Regional Geomorphology of India – Geological Ecosystems.

3. Natural Resources and Disasters: 12hrs

Natural Resources: Mineral Provinces of India and exploration strategies – Hydrocarbon provinces of India and exploration strategies–Water Resources and exploration strategies. Soil, Forest & Biomass and Marine resources.

Natural Disasters: Geodynamic Processes and Natural Disasters (Seismicities – Landslides – Floods – Tsunami – Other Natural Disasters).

4. Remote Sensing Based Mapping: 12hrs

Aerial Remote Sensing – Satellite Remote Sensing Principles – Digital Image Processing concepts – GPS based mobile mapping principles – Image interpretation principles for Geotechnology.

5. Geoinformatics: 6hrs

Definition & Concepts – Input Sources (Satellite, Aerial & Ground based) - Computer based Geospatial data base generation – data modeling on Natural Resources, Eco Systems & Natural Disasters – Information Systems.

Course Outcomes

After the successful completion of this course, the students are able to:

- Create subject interest amongst the students joined in this programme and gain knowledge on variety of sub disciplines that they can choose for their future.
- Understand the scope and importance of the Geological Technology and Geoinformatics subjects.
- Provide a brief exposure to the course works of entire 6 year programme.
- Brief exposure to the advanced and computerized tools in Geoinformatics and their applications to Geology, Natural Resources and Natural Disasters.
- Understand the concepts of mapping using Remote Sensing Satellites, Aerial Photography and Digital Image Processing.
- Know the concepts of Geospatial / Geoinformatics Technology based database generation, modeling and information systems.

Introduction to Geotechnology

Unit – 5 Remote Sensing Based Mapping

5. Geoinformatics: Definition & Concepts – Input Sources (Satellite, Aerial & Ground based) - Computer based Geospatial data base generation – data modeling on Natural Resources, Eco Systems & Natural Disasters – Information Systems. 6hrs.

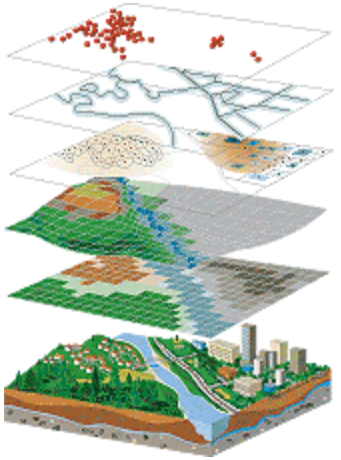
- **Geoinformatics** is an IT assisted appropriate technology to address the problems of geosciences and related branches of other sciences and engineering.

- Geoinformatics combines
  - geospatial analysis and modeling
  - development of geospatial databases
  - information systems design
  - human-computer interaction and
  - both wired and wireless networking technologies.

Geoinformatics Technology includes:

- Aerial and Satellite Remote Sensing **(ARS & SRS)**
- Digital Image Processing **(DIP)**
- Digital Photogrammetry **(DP)**
- Global Navigation Satellite System **(GNSS)**
- Geospatial / Geographic Information System **(GIS)**
- Query Based Information Retrieval System **(QUBIS)**
- Spatial Decision Support System **(SDSS)**

GIS

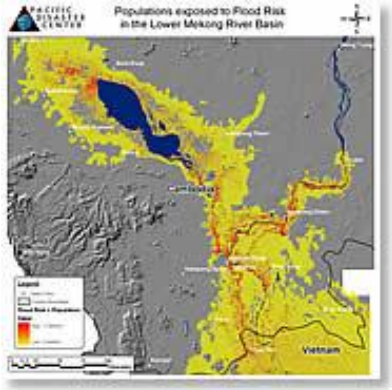


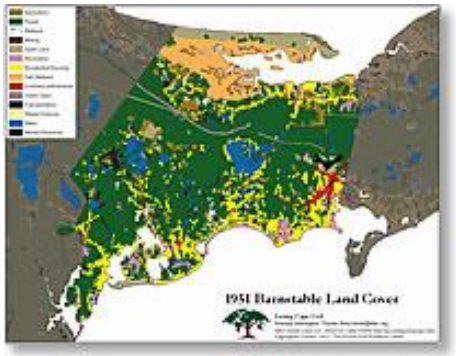
Capability based definition:

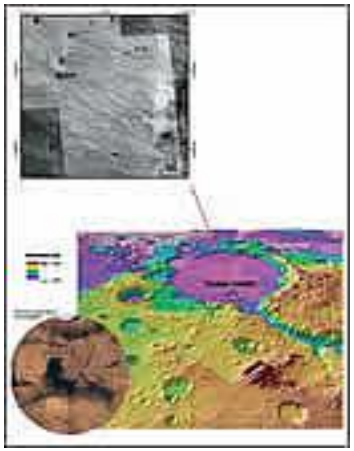
- **Geographic information system (GIS)**, is a computerised/digital system for capturing, editing, manipulating, systematically storing, analyzing, integrating, modeling, visualizing, sharing, retrieving, and representing/displaying huge quantity of both ***spatial*** and associated ***attribute data*** with customization and automation capabilities.

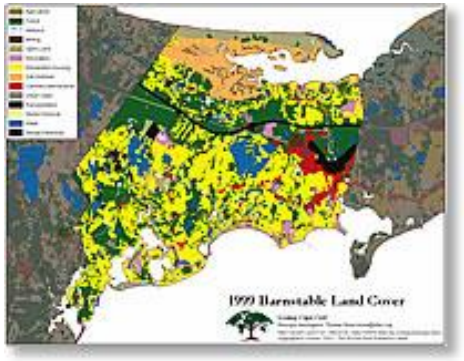
What can be done with GIS?

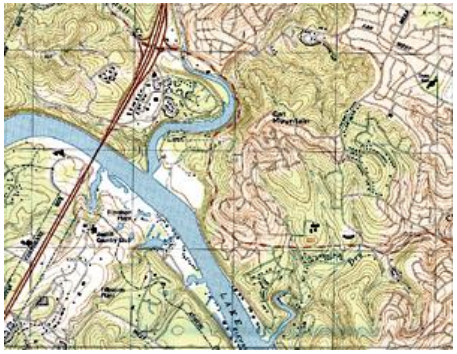
- Map where the things are
- Map quantities & qualities
- Map densities
- Find what's inside & nearby
- Find what & how changes are
- Develop Models & plans
- Automate processes …

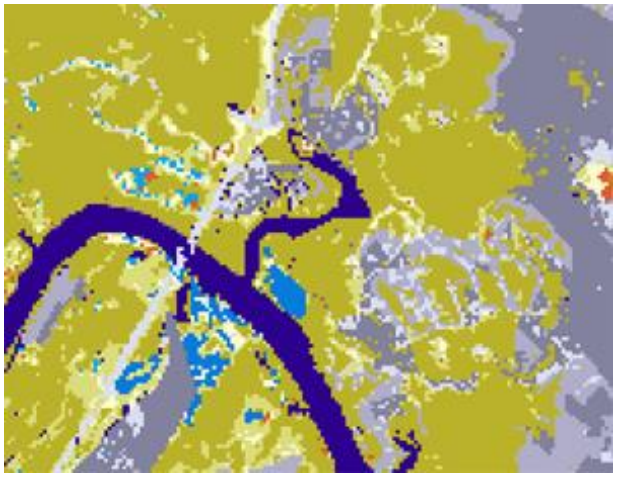


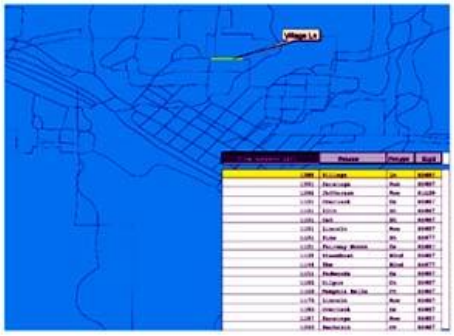


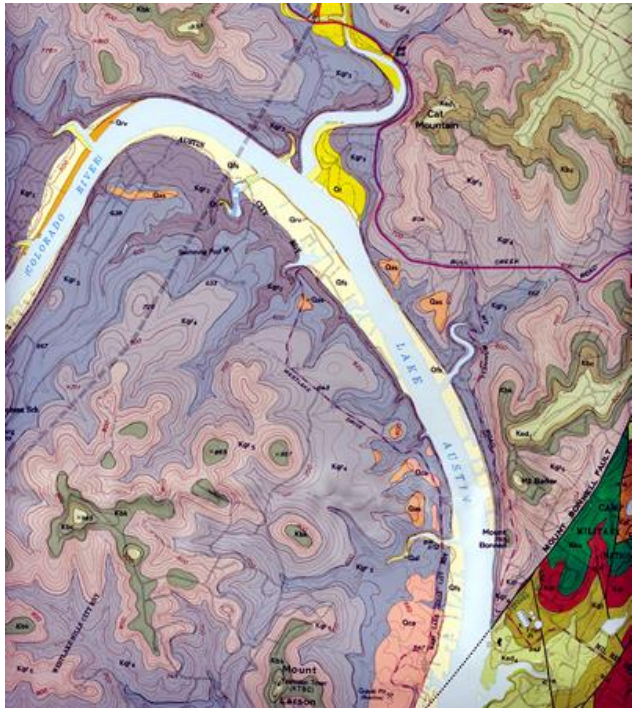


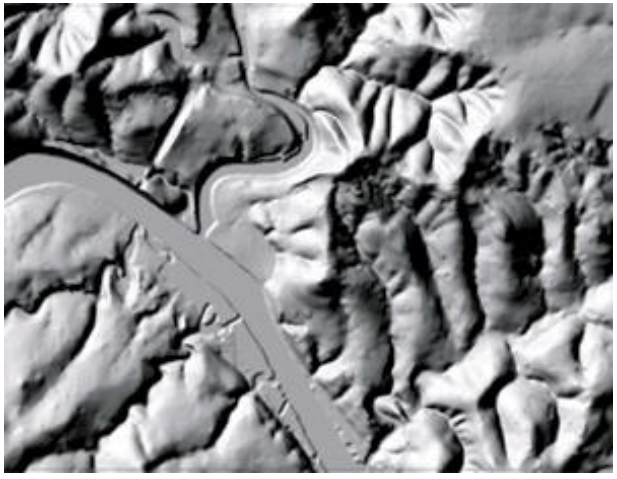


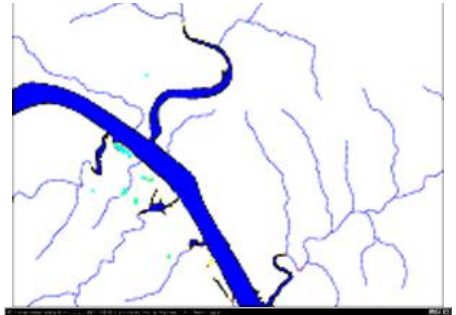


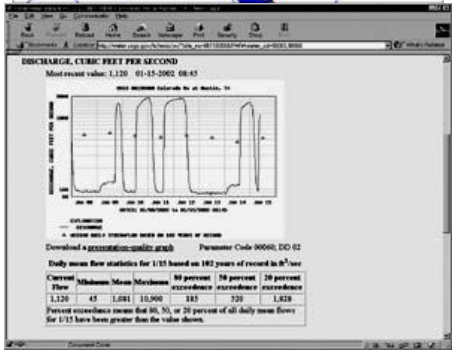


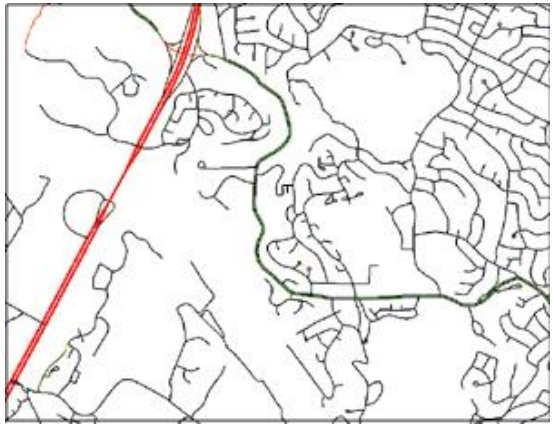

Village Ln


Cat Mountain
COLORADO RIVER
LAKE AUSTIN
Mount Larson






DISCHARGE, CUBIC FEET PER SECOND
Most recent value: 1,120 01-15-2002 08:45
Download a presentation-quality graph
Parameter Code 00060, DD 02
Daily mean flow statistics for 1/15 based on 102 years of record in ft³/sec
Current Flow
Minimum
Mean
Maximum
90 percent exceedance
50 percent exceedance
20 percent exceedance
1,120
45
1,081
10,900
185
320
1,820
Percent exceedance means that 90, 50, or 20 percent of all daily mean flows for 1/15 have been greater than the value shown.



Applications

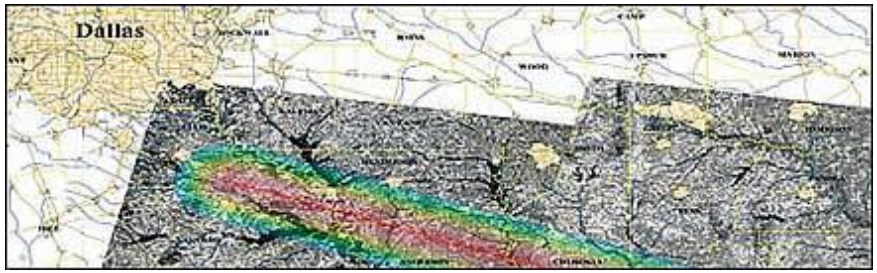
Many fields benefit from geoinformatics, including the development of

- in-car navigation systems,
- automatic vehicle location systems,
- transportation planning and engineering,
- environmental modeling and analysis,
- urban planning,
- telecommunications,
- agriculture,
- farming,
- public health, and so many other endless types of users.

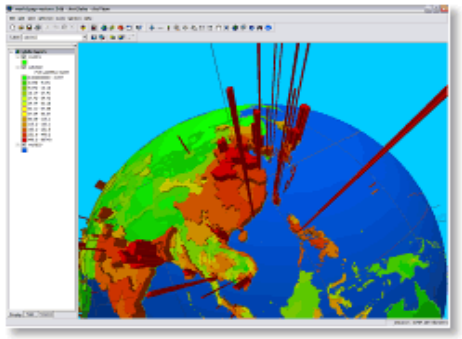
GIS

GIS can be viewed in three ways:

- **The Database:** GIS is a unique kind of spatial database of the world (geodatabase).
- It is a “Spatially Referenced Information System for all Resources”.



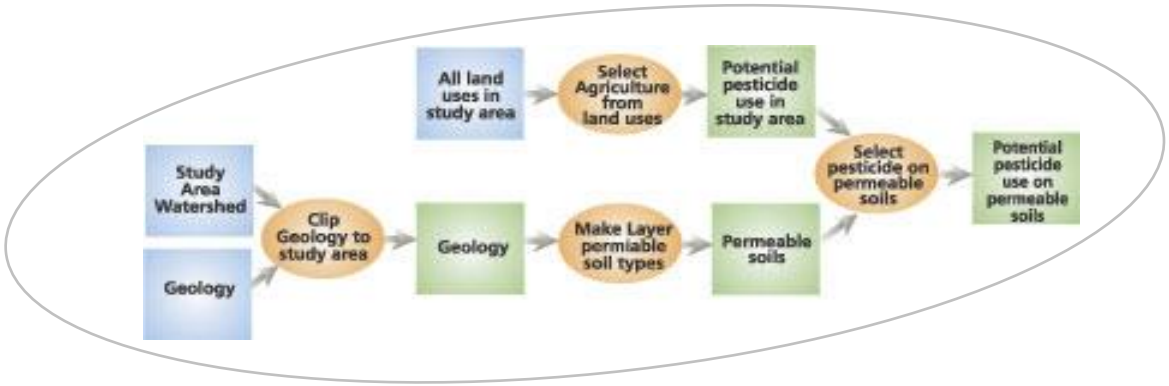
- **The Map :** GIS is a set of intelligent maps and show features and feature relationships on the earth's surface. Maps of the underlying spatial information can be constructed and used as "windows into the database" to support queries, analysis, and editing of the information.



- **The Model :** GIS is a set of information transformation tools that derive new spatial datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.

Hydrocarbon Exploration

Precious Metal targeting

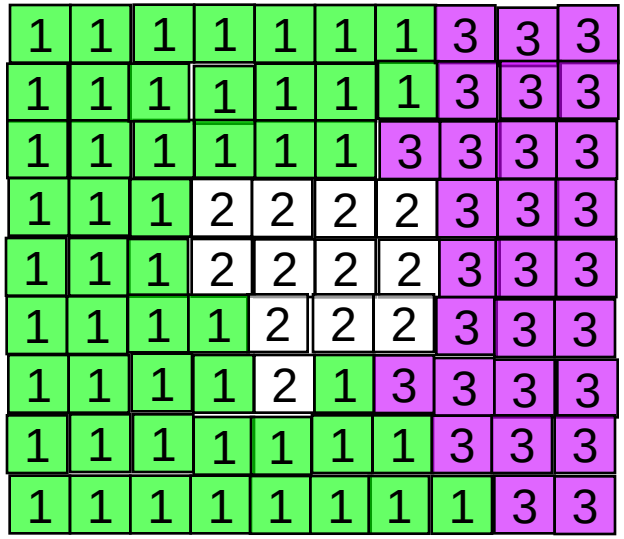


Tsunami forewarning

Soil erosion functions

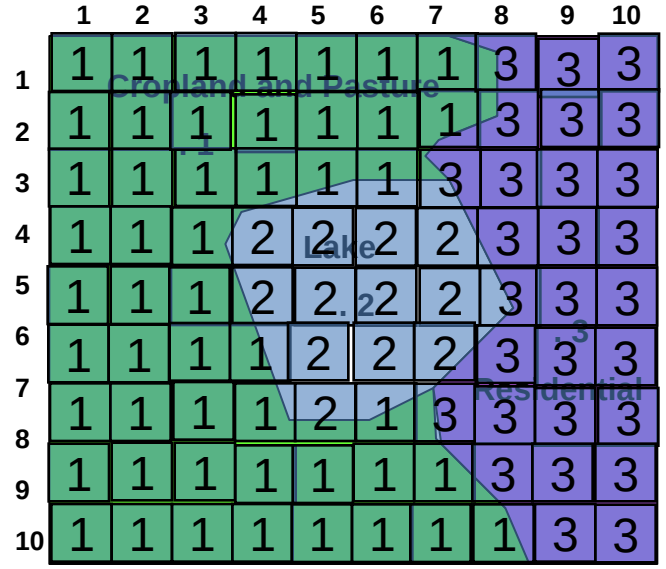
Landslide Hazard zonation

GIS Data Representation



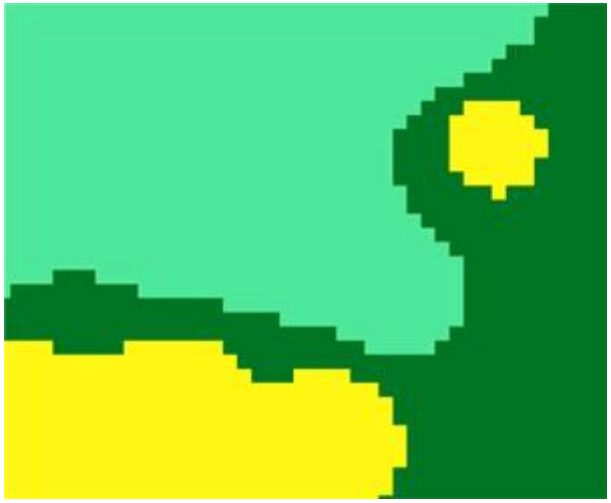
Rasterization

Vector

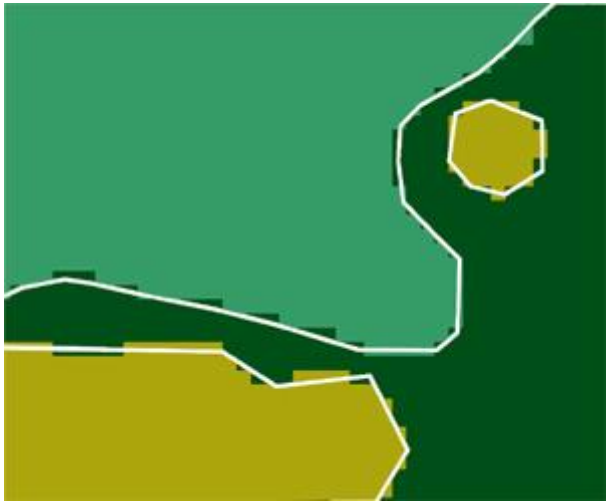


Consist arrays of cells in a grid pattern

Raster (Pixel size = 5mm x 5mm)



Vectorization



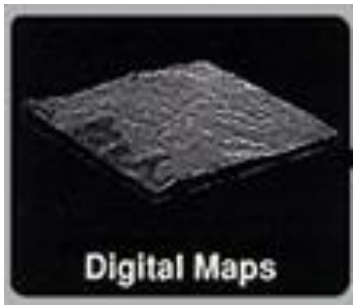
Consist vector elements – points, lines & polygons

Data Sources & capture

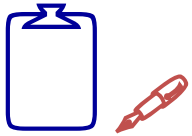
Field surveys

Collecting latitude and longitude coordinates with a Global Positioning System (GPS) receiver.

Remote sensing data



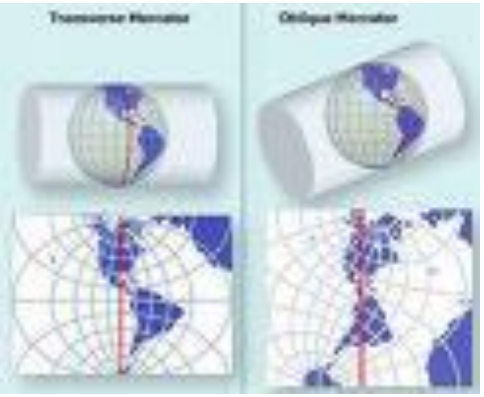
Scanning paper maps to produce digital data files for input into a GIS.

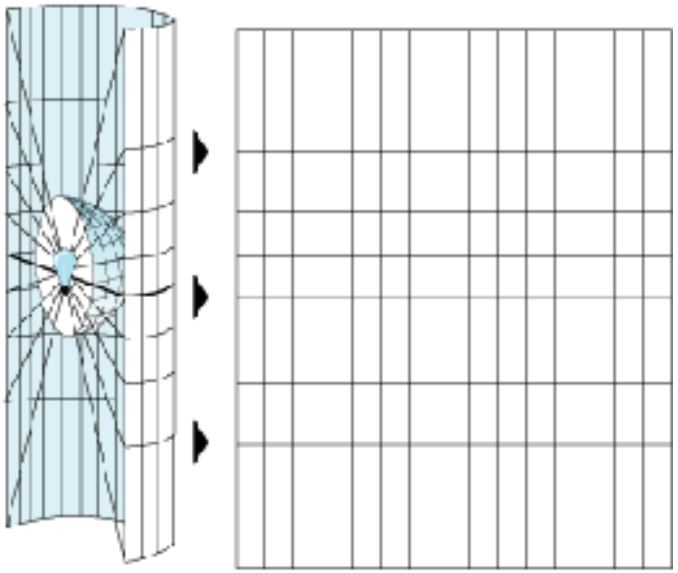


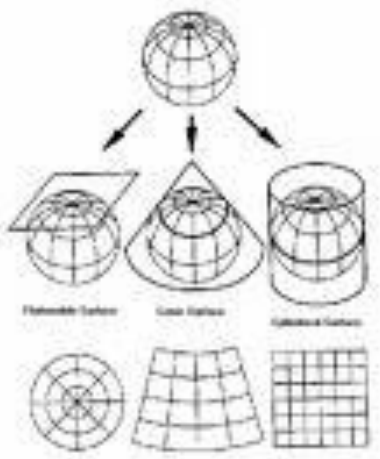
Collateral or Secondary data collection

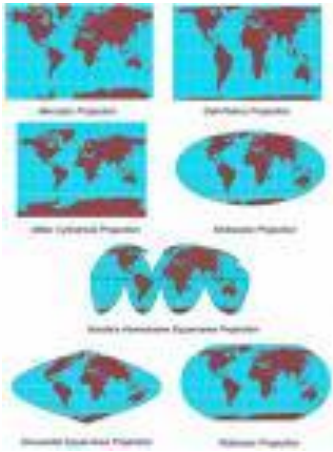
Literatures & References

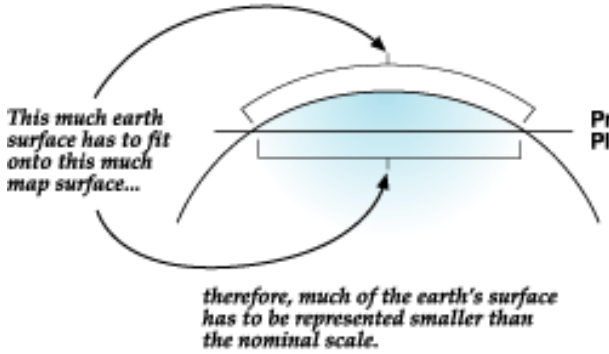
Projection and registration

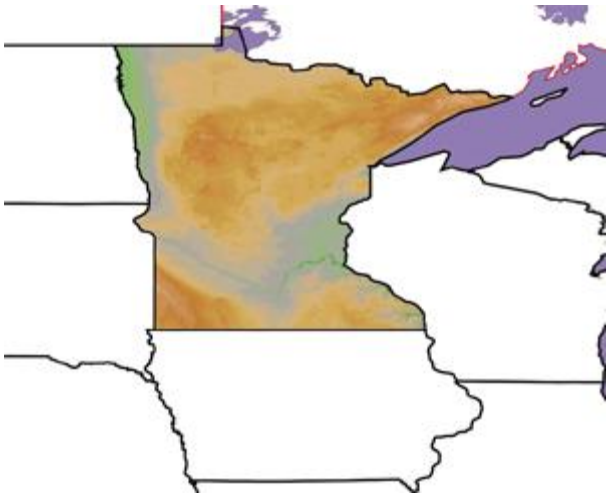


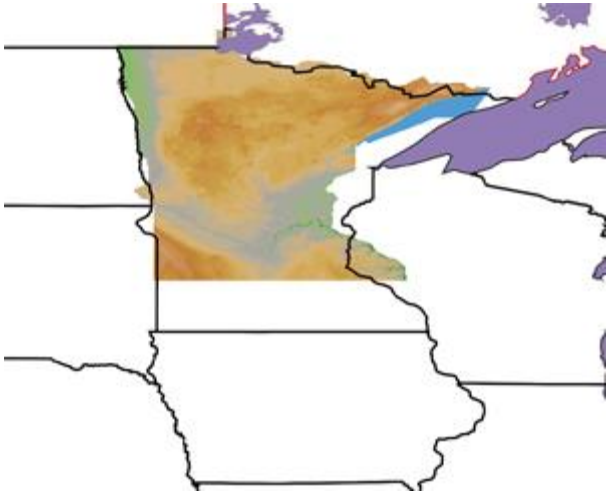






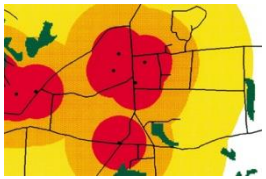


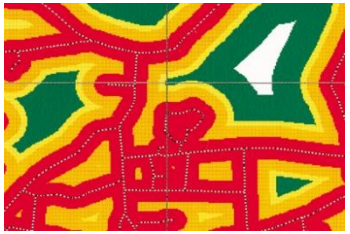


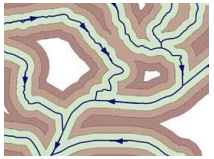


GIS Data Analysis & integration

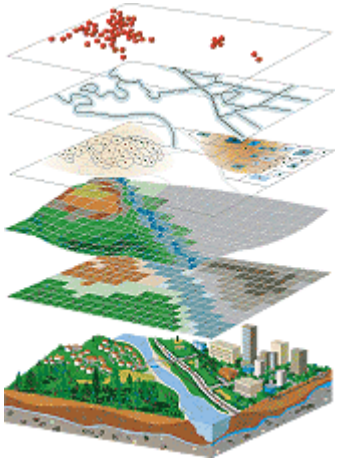
- Performing overlays
- Creating buffers
- Calculating statistics
- Merging datasets

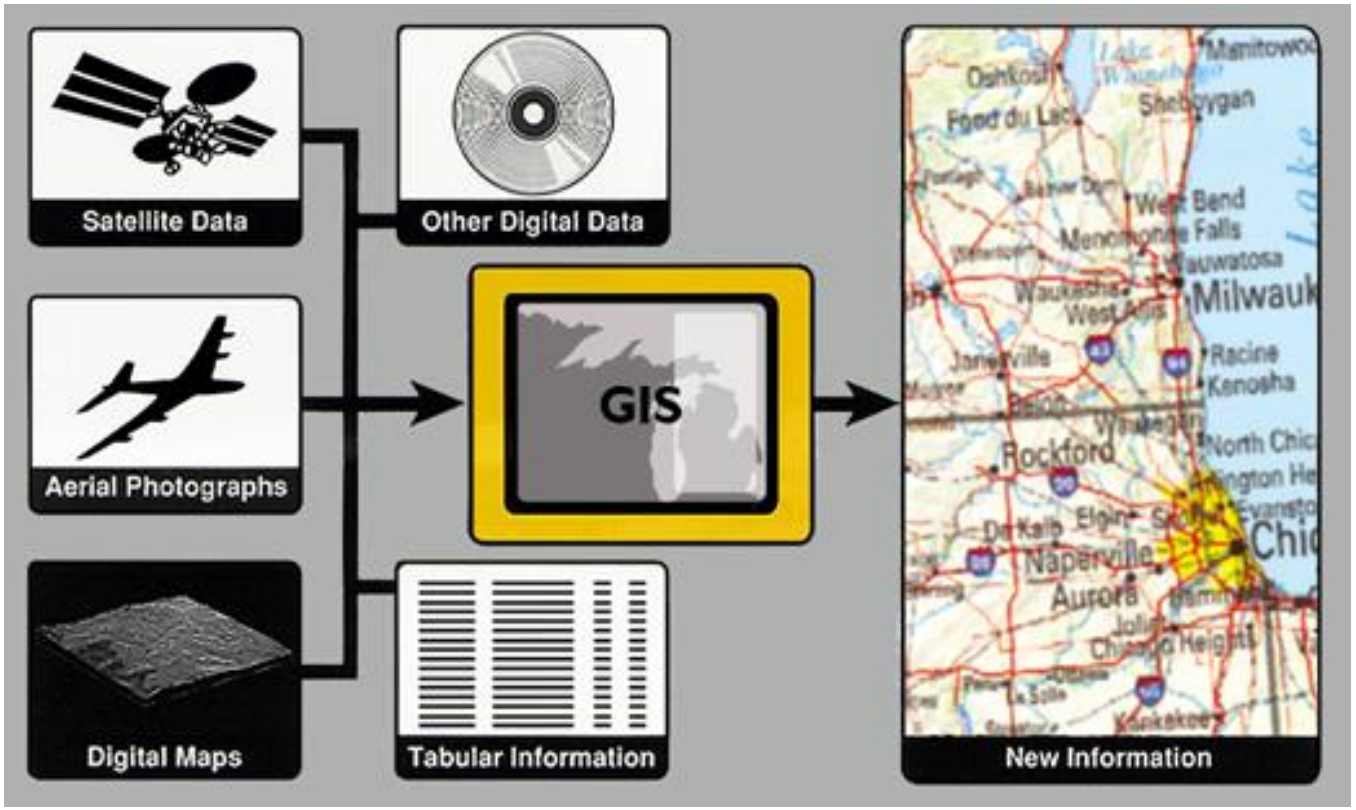


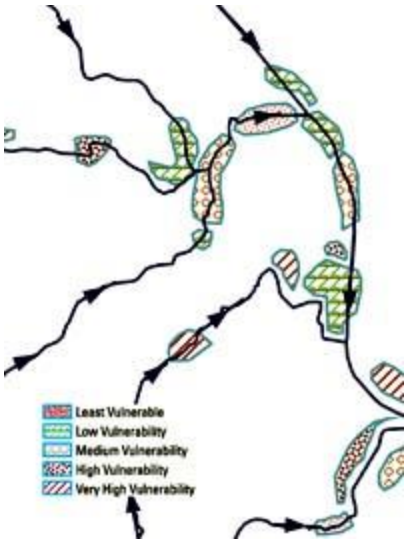




Data integration is the linking of information in different forms through a GIS

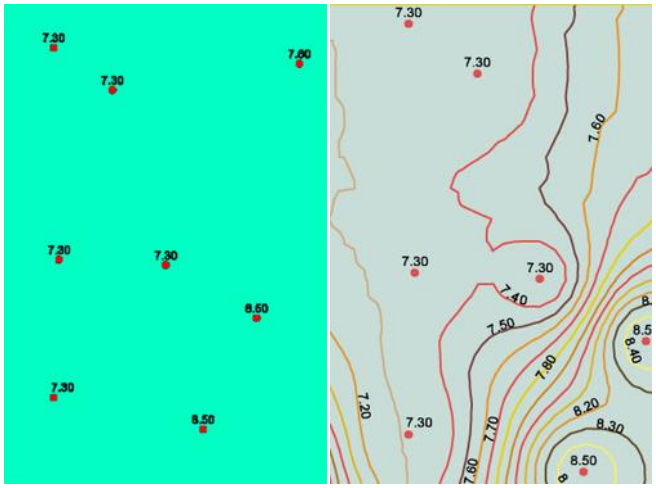


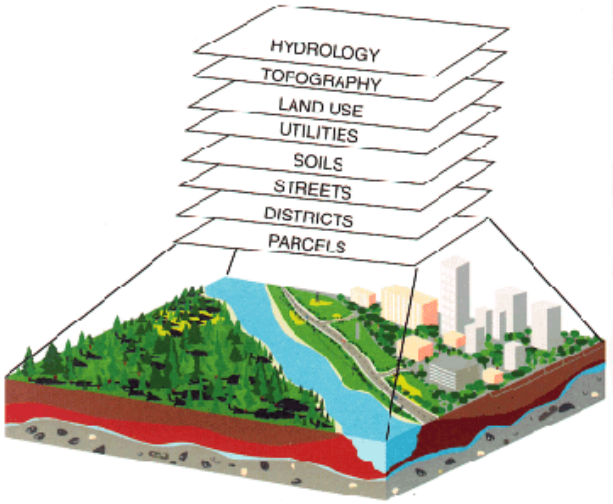


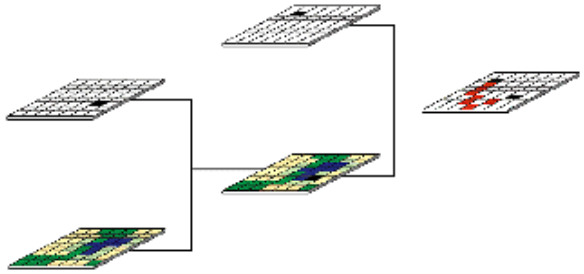


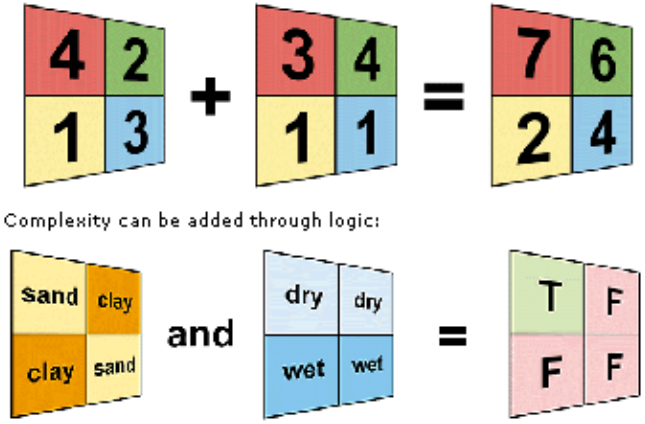
Data modeling

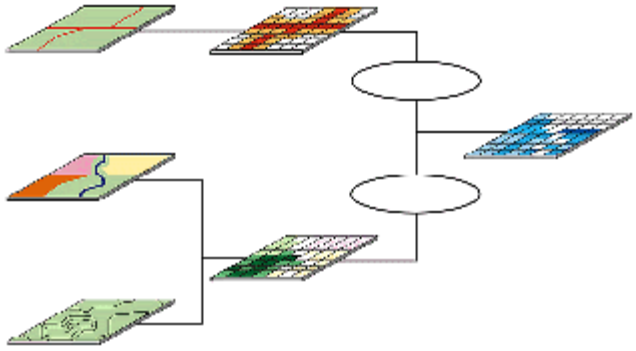
A model is a representation of reality.
Due to the inherent complexity of the world and the interactions in it, models are created as a simplified, manageable view of reality.
Models help to understand, describe, or predict how things work in the real world.











Binary model

Process model

Index model

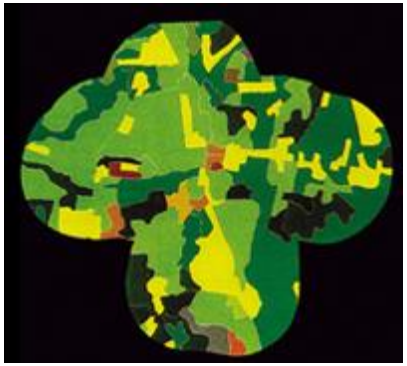
Regression model

…

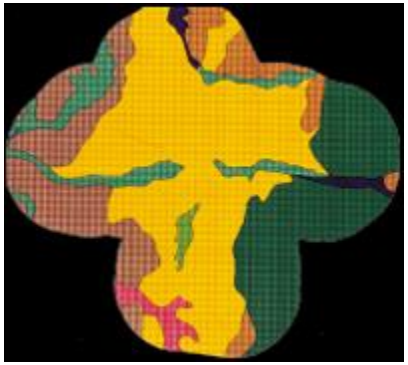
…

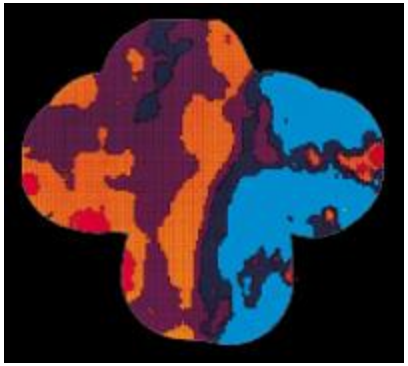
For example, Identification of Potential groundwater well sites

Land use and land cover data for the area bounded by a half-mile buffer zone around the water company service area.



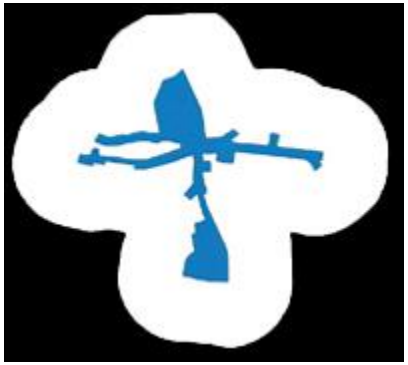
Map of surficial geology of the water service area

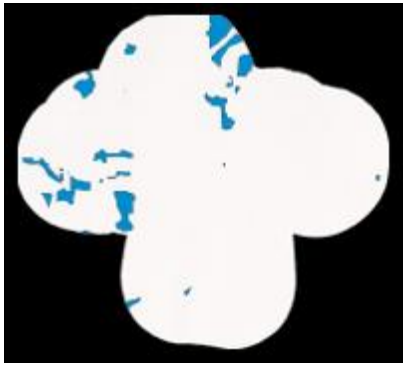




A bedrock elevation subtracted from water level elevation by a GIS to show the thickness of water-saturated sediment

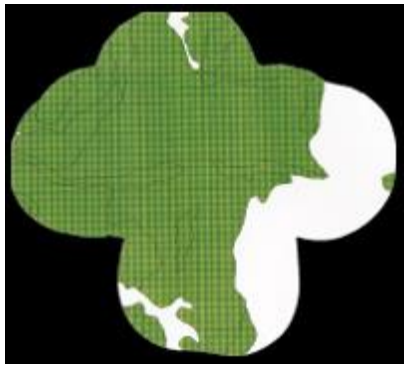
A half-mile buffer zone drawn around the service area



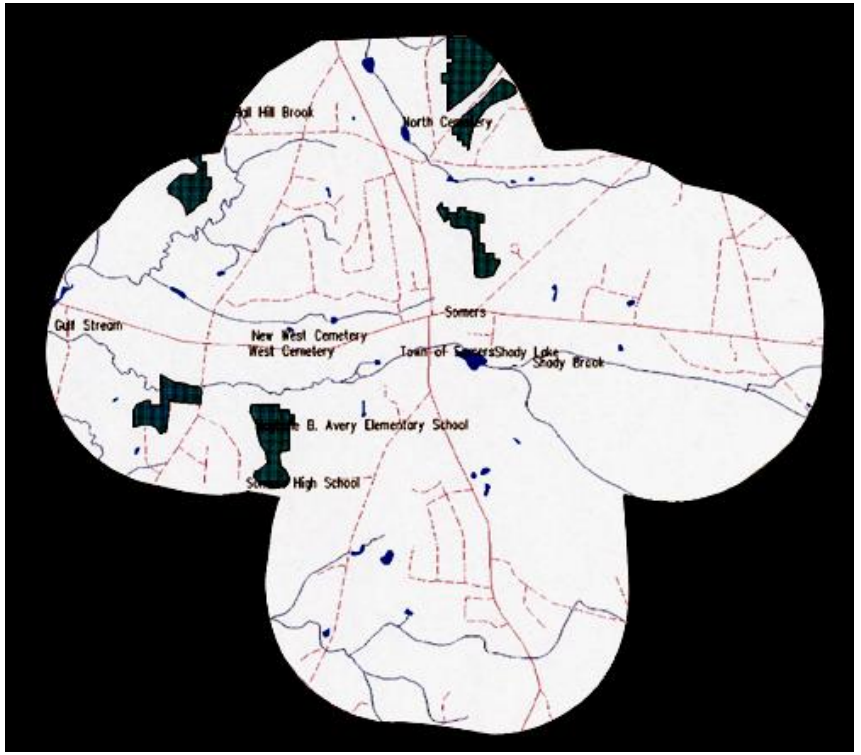


Potential sites with saturated thickness of sediments greater than 40 feet.

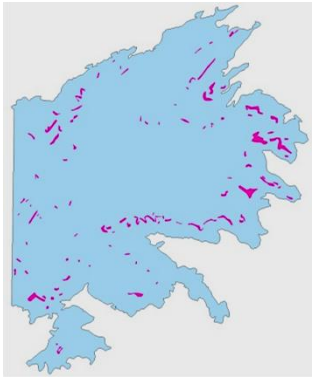
Selection areas of sand and gravel from the map of surficial geology



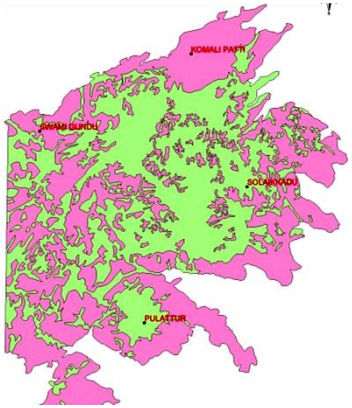
Buffer zones of 500 meters are drawn around the point sources of pollution.



LANDSLIDE HAZARD ZONATION AND INDUCING PARAMETER IDENTIFICATION

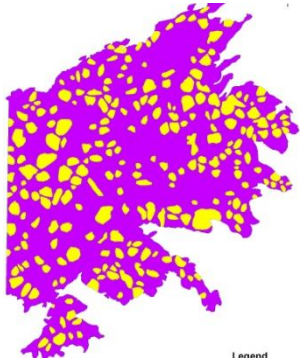


Mapping of Escarpments

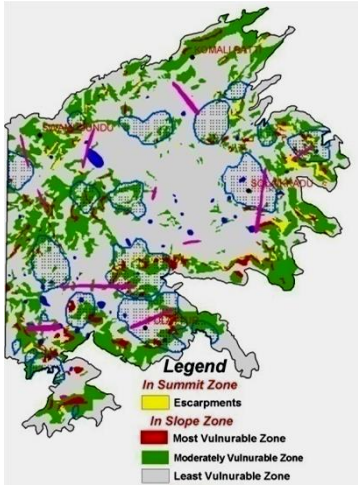


Identification of Active slope areas

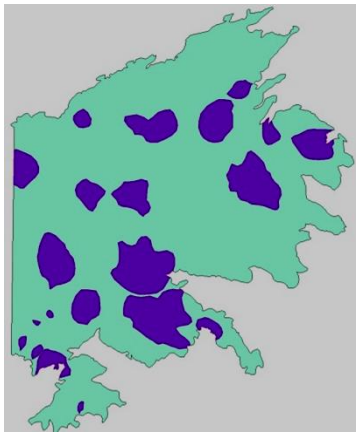
Interpretation of dip & obsequent slopes



Map out dissected slopes

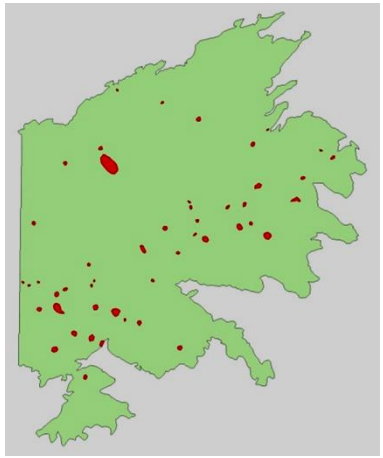


Landslide Hazard Zones

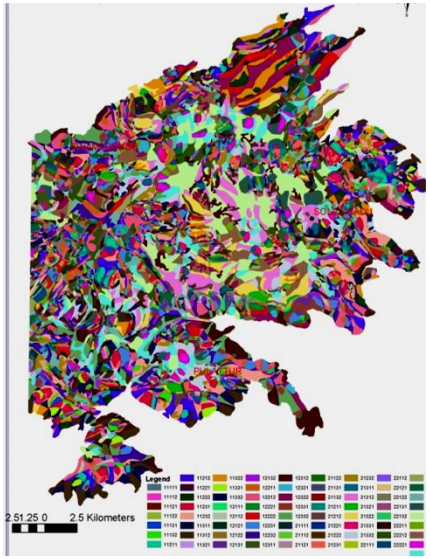


Zones of dendritic drainages

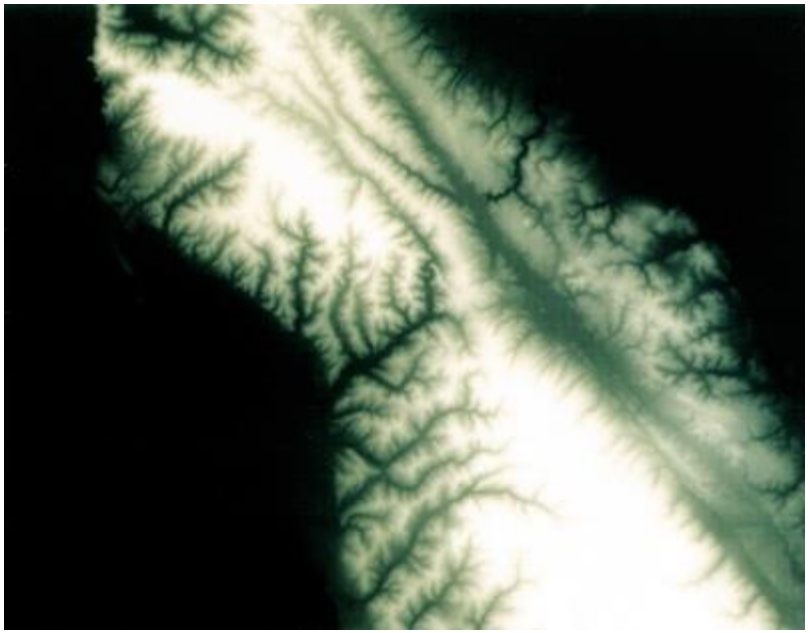
Filter out Convex & plain slopes



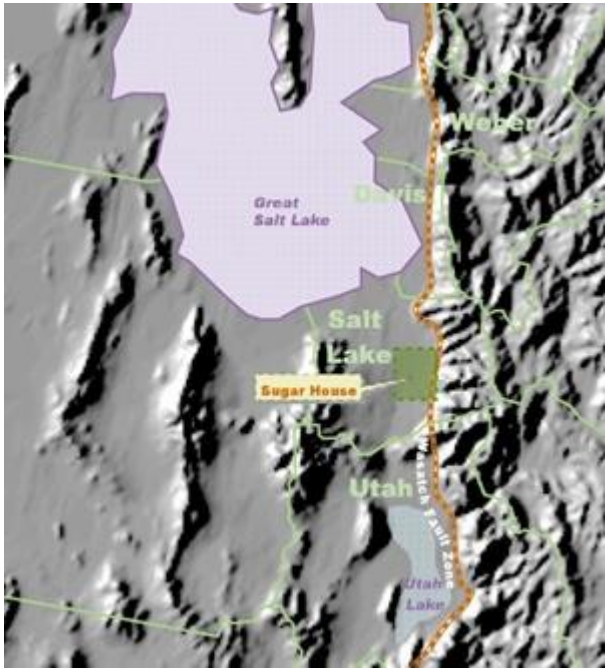
Buffer out sensitive toes



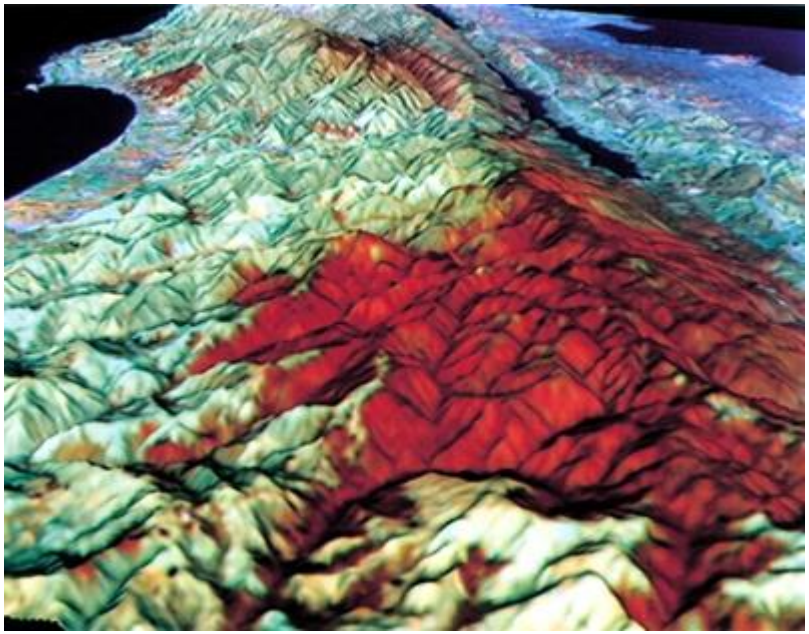
Landslide inducing parameters



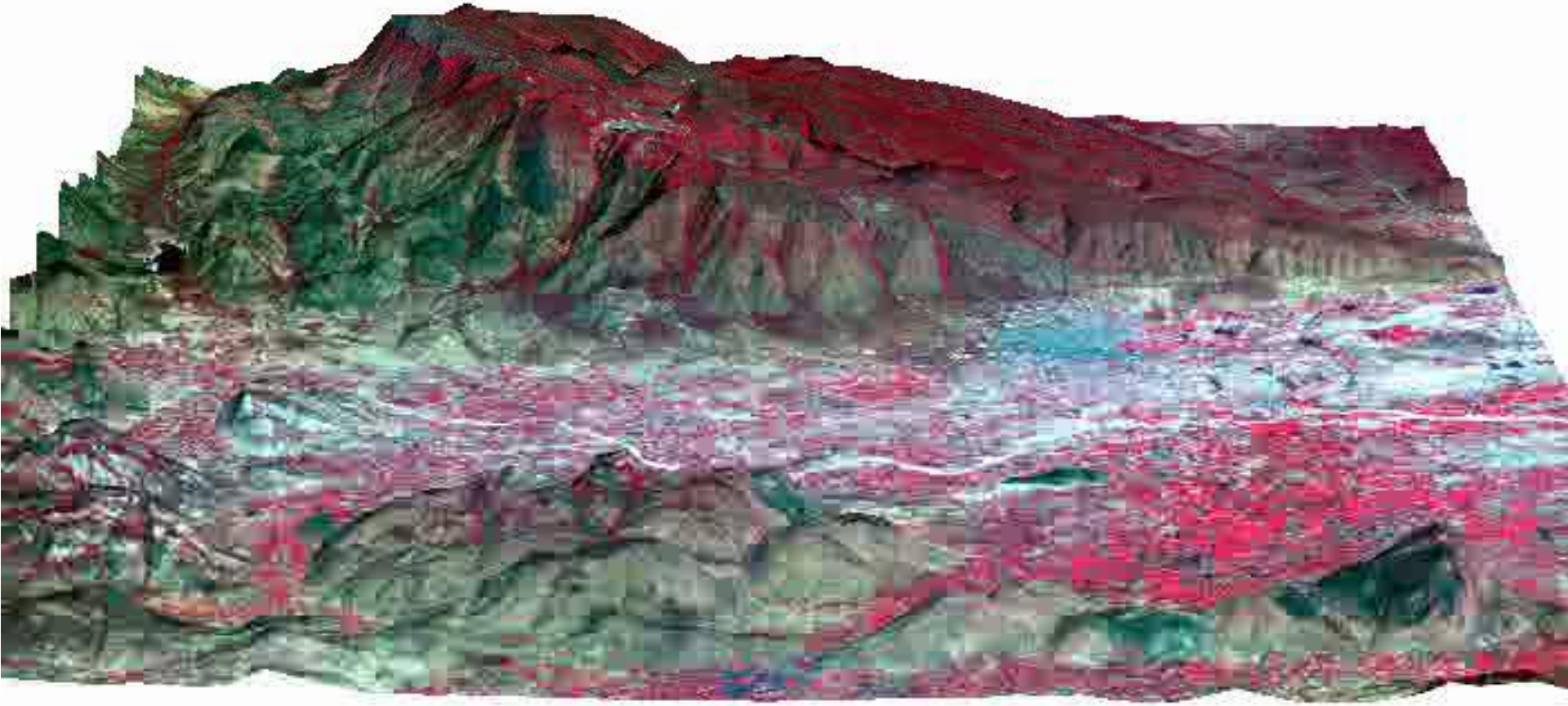
DEM – Digital Elevation Model – for 3D visualization of terrain and its parameters



SHADED RELIEF MAP



Satellite FCC image wrapped over DEM



3D Fly-through Model

INFORMATION SYSTEMS

QUERY BASED INFORMATION RETRIEVAL SYSTEM &

SPATIAL DECISION SUPPORT SYSTEM

Hence,

- Geoinformatics is a recent and fast emerging integrated digital technology, involving powerful S/Ws and H/Ws for quick and accurate generation of valuable information for planning, decision making, implementation and monitoring of earth related activities.

GIS can provide Query Based Information Retreival System (QUBIS) and Spatial Decision Support System (SDSS) for various developmental planning

- ➔ User defined, query based, spatial data retrieval / map display
- ➔ Display of non spatial data by linking spatial data
- ➔ Data listing, map wrapping
- ➔ Programming for automated mapping, spatial database generation, spatial / tabular analysis, spatial modeling and suggestion of remedial measures / providing action plan map, etc.

STN SDSS - Centre For Remote Sensing , Bharathidasan University

Environmental Resources | Agri Resources | Animal Resources | Infrastructural Resources | Industrial Resources | Data Updation | Help | Exit

1:4364710

Problem Selection | Statistics

- Natural Disasters Secto
  - Problems
    - Seismicity
    - Floods
      - Severity in Grade
        - VERY LOW
        - LOW
        - MODERATE
        - HIGH
        - VERY HIGH
        - Over all Sever
      - Level of S&T Inter
      - Agency invloved
    - Landslides
    - Tsunamis
    - Cyclones (last 25 ye
    - Coastal Erosion
    - Drought

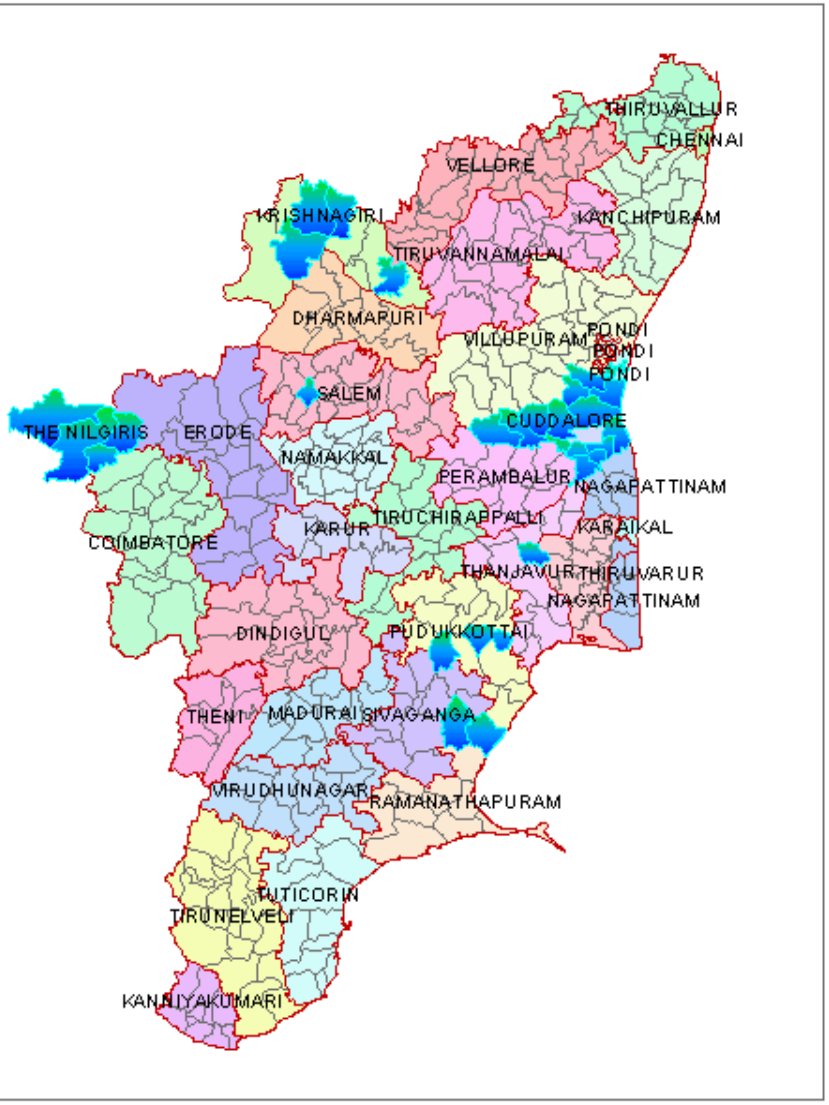
Blockwise Retrieval for

- (•) Entire State
- ( ) Districtwise

NATURAL DISASTERS SECTOR

Floods

Severity in Grades - MODERATE



30 0 30 60 km

N W E S

Severity in Grades

- MODERATE
- TN_DISTRICT

Centre For Remote Sensing, Bharathidasan University
Tiruchirappalli

75°51'48.35"E 14°34'24.69"N

NRDMS - Query Based Information System

Thematic Maps | Natural Resources | Water Conservation | Soil Conservation | Development Sector | Human Resources | Data Updation | Exit

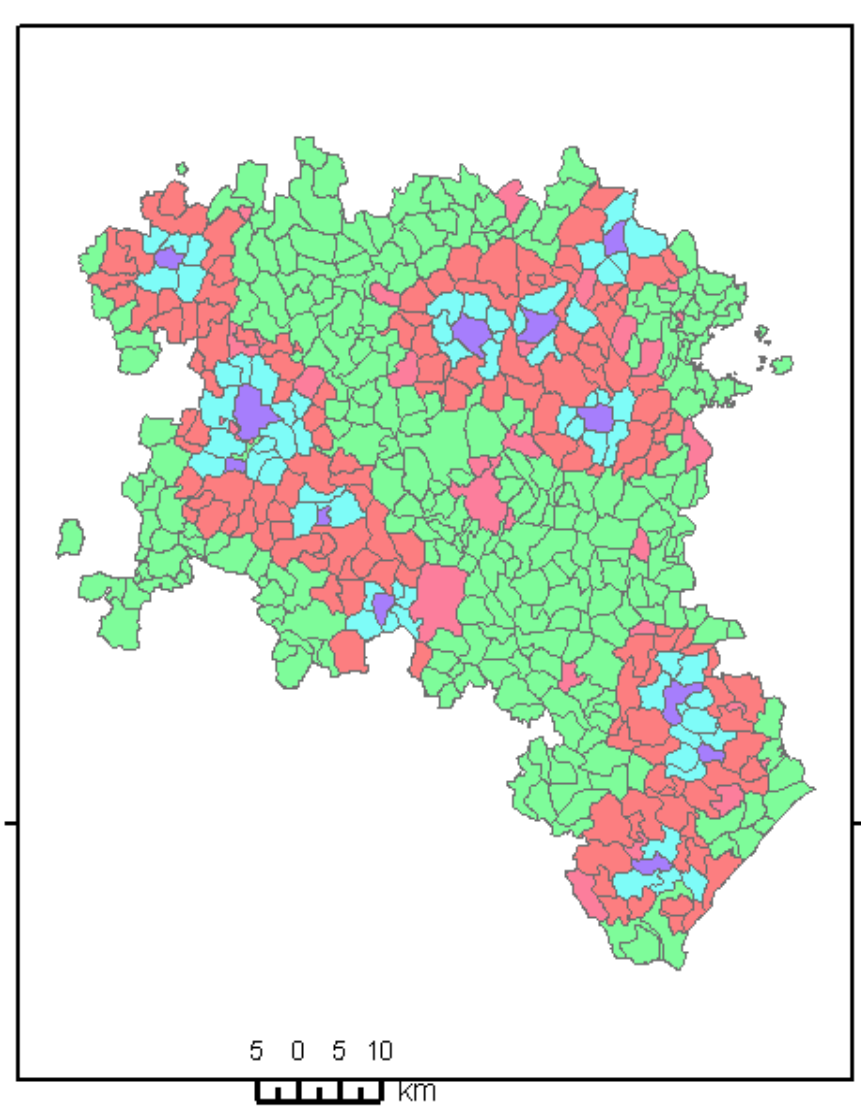
Map Selection | View

ital Availability - Block Prima
ailable
< 2
2 - 4
> 4
Overall Availability
available
< 3 km
3 - 6 km
> 6 km
Overall Availability and Reachability
rs

Districtwise | Blockwise
Talukwise | Villagewise
Mini Watershedwise
Featurewise

78.31, 10.34 Decimal Degrees

Health Sector - Hospital Availability - Block Primary Health CentreUnavailable - Overall Availability and Reachability



Legend

- < 3 km
- > 6 km
- 3 - 6 km
- 0

NRDMS - SDSS