PROJECT REPORT

ON

REMOTE SENSING APPLICATIONS IN LAND USE/COVER STUDIES IN HARIDWAR DISTRICT

MAY 18 – JULY 17, 2017

BY:

PRAGYA NIGAM

DEPARTMENT OF ENVIRONMENTAL ENGINEERING, GAUTAM BUDDHA UNIVERSITY, GREATER NOIDA

AT

NATIONAL INSTITUTE OF HYDROLOGY

ROORKEE 247667

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Literally words are unable to express my heartfelt sentiments to my parents without which I would never been to accomplish my academic pursuit.

Pragya Nigam

PRAGYA NIGAM

TO WHOM IT MAY CONCERN

This is to certify that Ms. PRAGYA NIGAM, a student of M.Tech. (Environmental Engineering), Gautam Buddha University, Greater Noida, has done summer training in the field of Remote sensing and GIS, in the National Institute of Hydrology, Roorkee from 18th May 2017 to 17th July 2017. During the training, she learned basics of remote sensing and GIS. She has used ERDAS IMAGINE 9.2 and ARCGIS 9.3 software packages for Image Processing and GIS analysis. She carried out a project work on "Remote sensing applications in Land use/cover studies in Haridwar district". She was quite regular, sincere, and hard working during the training work.

I wish her all success in her future career.

SKJain

(Dr. Sanjay. K . Jain)

Scientist G

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CHAPTER 1

REMOTE SENSING

1.1 INTRODUCTION

Remote sensing, encompassing the study of satellite data, is a powerful technique for exploration, mapping and management of the earth resources. It is understood to imply the acquisition of information about and object by scientific devices called sensors without being any physical contact between the object and the sensing device.

The basic principle involved in remote sensing is each object, depending upon its physical characteristics, reflects, emits and absorbs varying intensities of radiation at different EM wavelength ranges. Using information from one or more wavelength ranges, it is possible to discriminate between different types of ground objects (e.g. water, dry soil, wet soil, vegetation, rocks etc.) and map their distribution on the ground. One of the important remote sensing technique use is aerial photography. Aerial photography has essential remained to the visible part of the electromagnet spectrum where it is only a very fraction of the electromagnetic spectrum. Remote sensing techniques have extended the scope of utilisation of the electromagnetic spectrum to almost its entire range.

The electromagnetic radiation (EM) is the source of all signals collected by most remote sensing instruments. The source of this energy varies depending on the sensor characteristics. Most systems rely on the sun to generate all the EM energy needed to image their own energy, called active sensors, transmits that energy in a certain direction and records the portion reflected back to features within the single path.

Electromagnetic energy can be generated by chances in the energy levels of electrons, acceleration of charges, decay of radioactive substances, and the thermal motion of atoms and molecules. Nuclear reactions within the sun produce a full spectrum of EM radiation which is transmitted through space without major changes in its character until it.

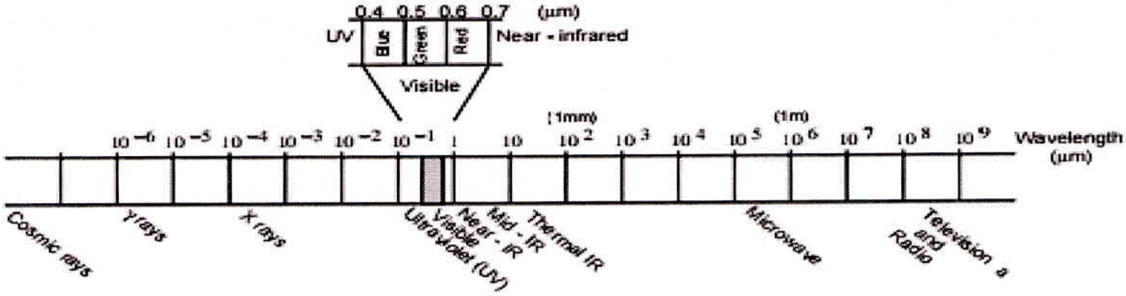


FIG:1 ELECTROMAGNETIC SPECTRUM

1.2 REFLECTANCE CHARACTERSTICS OF DIFFERENT OBJECTS:

Reflectance is the percentage of energy reflected to the total energy incident on a body. It is the ratio between radiation off the surface (outgoing) to the total radiation incident on the surface (incoming). We see an object green because only green energy is reflected in the visible spectrum. Thus, blue coloured objects throw blue only or red coloured objects throw red only which is perceived by the eye. 'Blue', 'Green'. And 'Red' are the three fundamental colours. Pure black or pure white are not a colour at all. Other colours such as magenta, violet, yellow, cyan etc. are the mixing of three basic colours RBG in different proportions.

Advantages of remote sensing

- Broader perspective
- Larger area
- Birds eye view
- "see" beyond visible EM energy
- Accessibility

1.3 IMAGE INTERPRETATION

The main objective of image interpretation i.e. to extract information about features displayed in an image. It is defined as the act of examination images for the purpose of identifying objects and finding their significance. The extraction of information depends on image analyst's experience, power of observation, imagination and patience. It also depends on his understanding of the basic principles of an image.

1.4 VISUAL INTERPRETATION

It is the traditional method for extracting information on various natural resources. Tone/colour , texture, shadow, shape, size, pattern, site, height, and their association are some of the basic image characteristics on which visual interpretations are:

(a) It is difficult to get consistent result from different interpreters

(b) Human eyes can detect the difference only about 16-20 grey levels in the black and white photograph, while more than hundred colours can be distinguished in a colour photograph. Therefore, colour images are preferred over black and white for visual image interpretation.

(c) When multi-spectral data is obtained, the task is to identify the optimal three bands to generate the colour composite. False Colour Composite (FCC) using green, red, and NIR are the most preferred combination for visual interpretation. However the range of gray values recorded on the film is limited. Thus nowadays we go for digital image processing.

1.5 DIGITAL IMAGE PROCESSING

Any pictorial image can also be represented in digital form, so that the patterns of image brightness forms an array of numeric values which can be conveniently added, subtracted, multiplied, divided, and in general subjected to statistical manipulation that are difficult or impossible, if the image is available in pictorial form. Digital analysis encompasses a broad set of operations by which remotely sensed data are subjected to operations that yield information or enhanced data. It must be remembered that digital analyst is not totally free from human interactions. It requires significant inputs from the analyst while making decisions, thus providing information at faster rate, with high quality output, when compared with manual interpretations.

Image processing systems require various input/output devices, central processing unit (CPU), data storage devices and system consoles for man-machine interaction. Adequate image display facilities are important in the processing of an image.

The image processing software required in remote sensing applications can be broadly, grouped such as a Data input routines, Pre-processing routines, Image display routines, Image enhancement and filtering routines, classification routines, Image output routines.

An idealized sequence for digital analysis can broken up into four specific groups.

(a) Pre-processing,

(b) Enhancement,

(c) Analysis and Classification, and

(d) Data Presentation

Pre-processing

Pre-processing operations prepare satellite data for subsequent analysis, usually by attempts to correct pr compensate for systematic errors. The pre-processing operations display the data as a means of inspecting characteristics and quality, present histograms, scatter grams or statistical summaries that permit the operator to assess image quality and thereby determine subsequent pre-processing steps (if any) that may be necessary. In condition, they compensate for radiometric and geometric errors.

Enhancement

Image enhancement is the modification of an image to alter its impact on the viewer. Therefore, enhancement operations are normally performed on image data prior to visual interpretation efforts. The increase the apparent contrast between the features in the scene and thus improve its interpretability.

Most of the individual scenes consequently make use of only a small portion of the full dynamic range. To produce an image with the optimum contrast, it is important to utilize the full brightness range of the display medium. If the display device, then this process is referred to as linear stretch.

Analysis & Classification

One of the most often used methods of information extraction is multispectral classification. The process of multispectral classification may be performed using either of the two methods: supervised or unsupervised method.

In a supervised classification, the identity and location of some of the land cover types, such as urban, agriculture, wetland, and forest, are known a priori through a combination of field work, analysis of aerial photography, maps, and personal experience, the analyst attempts to locate specific sites in the remotely sensed data that represent homogeneous examples of these known land-cover types. These areas commonly referred to as training sites because the spectral characteristics of these known areas are use to “train” the classification algorithm for land cover mapping of the remainder of the image. Every pixel both within and outside these training sites is then evaluated and assigned to the class of which it has the highest likelihood of being a member.

In the unsupervised classification, the identities of land cover types to be specified as classes within a scene are generally not known a prior because either the ground truth data are not available or surface features within the scene are not well defined. The computer is required to group (cluster) pixel data into different spectral classes, according to some statistically determined criteria, and it is then the responsible of the analyst to label these clusters into various classes.

Advantages of digital image processing:

- Cost-effective for large geographic areas
- Cost-effective for repetitive interpretations
- Cost-effective for standard image formats
- Consistent results
- Simultaneous interpretations of several channels
- Complex interpretation algorithms possible
- Speed may be an advantage
- Explore alternatives
- Compatible with other digital data

Disadvantage of digital processing:

- Expensive for small areas
- Expensive for one-time interpretations
- Start-up costs may be high

- Requires elaborate, single purpose equipment
- Accuracy may be difficult to evaluate
- Requires standard image formats
- Data may be expensive, or not available
- Pre-processing may be required

1.6 REMOTE SENSING SATELLITE PROGRAMS

LANDSAT Program: Till date, Landsat programme has provided the most extensively used remote sensing date, the world over. Its chief plank has been in delivering unrestricted global data of good geometric accuracy. Under the Landsat programme till data six satellites (Landsat – 1,2,3,4,5 & 6) have been launched (Landsat-6 having failed). These satellites have been placed in placed in near-polar, near-circular, sun-synchronous orbit. In this configuration, as the satellite orbits in the north-south plane, the Earth below spins around its axis, from west to east. Thus, different parts of the global are 'seen' by the satellite during different north-south passes. The remote sensing data are acquired in the descending node, i.e. as the satellite moves from the north pole to south pole. The L-1,2,3 at an altitude of 705km with a repeat cycle of 16 days.

The Landsat have carried on-board two main sensors, Multispectral Scanning System (MSS) and Thematic Mapper (TM), both being OM-line scanners and producing ground scenes of nominally 185*185 km size. The MSS sensor has been a regular payload of the Landsat and has made this programme a tremendous success. The TM is an advanced multispectral scanner used in Landsat 4 &5 missions. Tm operates in seven wavelength bands, out of which six are in the solar reflection region and one in thermal-IR region.

SPOT Programme: The French satellite system SPOT is a typical second generation earth resources satellite. These satellites have been places in near-polar sun-synchronous 830km high orbit with a repeat cycle of 26 days. The sensor here is called HRV (High Resolution Visible) which is a CCD-line scanner. The HRV's acquire data in two interesting modes: (a) panchromatic mode in a swath of 60 km with ground resolution of 10*10 m and (b) multispectral mode, in three channels (green, red and infrared) with a ground resolution of 20*20 m in swath width of 60km. Further, the HRV's can be titled to acquire data in off-nadir viewing mode, for more frequent repetitive coverage, and for stereoscopy.

1.7 INDIAN SPACE PROGREMME

Remote sensing is an important part of the Indian Space Programme and the Department of Space (DOS), Government of India is the realization of the National Natural Resources Management System (NNRMS), The National Resources Information System (NRIS) and the Integrated Mission for Sustainable Development (IMSD) and they together exploit space technology for application in the areas of communication, broadcasting, meteorology, disaster warning search and rescue operations and remote sensing.

Space Mission Objectives:

- Continues space based remote sensing services to user community.
- For operating systems for data reception, recording, processing generation of data products.
- Develop new areas of user applications to take full advantages of enhanced capabilities of new versions of IRS series like – IRS -1C/1D.

Remote Sensing Satellite Missions:

Under the Indian Remote Sensing Satellite (IRS) programme, the Indian Space Research Organisation (ISRO) has launched a series of land observation satellites, named as:

- **Bhaskara 1 and 2**

Experimental Remote Sensing Satellite launched on June 1979 and November 1981 respectively.

- **IRS – 1A and IRS – 1B**

These were their operational first generation remote sensing satellites.

✓ Launched on March 1988 and August 1991,
✓ Altitude of 904 km,
✓ Placed in near – polar, sun-synchronous orbit,
✓ Ground Resolution of 72.5 and 36.25 respt.
✓ Repetitive Time of 22 days,
✓ Life of 3 years, (IRS – 1B still working) and
✓ Sensors with two linear Scanning Sensors (LISS-I and LISS-I) for providing data in four spectral bands: Visible, Infra red (IR) and Near Infra Red (NIR).

IRS- P2

The satellite was launched in October 1994, on the indigenously developed Polar Satellite Launch Vehicle (PSLV – D2). It carried a modified LISS camera.

IRS-1C and IRS-1D

These were the first of the second generation, operational, multi-sensor satellite missions with better resolution.

✓ Launched on 1995 and 29 September 1997 from Sriharikota, ...
✓ Altitude of 817 km and 780km
✓ Placed in near-polar, sun-synchronous orbit, whereas there have been some problems with the orbit of IRS-1D,
✓ Resolution of 5.2- 5.8 and 188 respectively.,
✓ Life of 3 years,

✓ Sensors with Panchromatic (PAN) and LISS-III cameras.

IRS-P3

Launched on April 1996 on PSLV- D3, had two imaging sensing sensors and one non-imaging sensors i.e., with a resolution of 188mt swath 810km.

Other IRS Satellite Missions

Keeping in view the rapid developments taking place in space technology and increasing application of remote sensing and GIS techniques Indian Space Research Organisation has planned a number of future satellite IRS launched

- RISAT-1
- NISAR

CHAPTER 2

GEOGRAPHIC INFORMATION SYSTEMS (GIS)

2.1 GENERAL

Computers have been used in the field of hydrology and water resources for many years as means of organising information in order to solve management problems. At the same time the use of Geographical Information System (GIS) became widespread during the last decade. This technology has altered traditional way of modelling in hydrology and water resources management and continues to do so.

The term Geographic Information System may be explained as follows:

'Geographic' stands for spatial data. These are the data which are associated with a specific place or places on Earth's surface, sometimes called as 'geo-referenced'. 'Information' may be viewed as data added knowledge.

'System' refers to the integration of users and machine (hardware and software) able to input, manipulate and present data.

Therefore, we can say that GIS is a purpose computer based technology for handling geographical data in digital form. It is designed to capture, store, manipulate and perform analyses of spatial distributed data. The latter contain both geometry data (coordinates and topographical information) and attribute data (i.e., information describing the properties of geometrical objects).

2.2 MAIN FUNCTIONS OF GIS:

All GIS operations can, in principle, be done manually, but many tasks are so time consuming that they can be manually performed only for very small research areas. By using computers and their graphics facilities and GIS software, the laborious tasks can be performed with ease. The early concepts of map handling by a computer had a serious drawback in that they could not handle the tabular or attribute data in conjunction with spatial features. This lead to the development of additional methods and techniques where the spatial and attribute data both could be handled and integrated so that the outputs are more meaningful for planners and decision-makers. The upcoming of this technology has enhanced our capability not only of map handling but also map manipulation and analysis. therefore, using a GIS:

(a) Users can interrogate geographical features displayed on a computer may and retrieve associated attribute information for display or further analysis.

(b) Maps can be constructed by querying or analysis attribute data.

(c) New sets of information can be generated by performing spatial operations (such as polygon overlay) on the integrated database.

(d) Different items of attribute data can be associated with one another through a shared location code.

Before any spatial analysis or modelling operations can be carried out in GIS, it is necessary to input the requisite data. Data input is the procedure of encoding data into computer-readable form and writing the data to the GIS are of two types- spatial data and associated non-spatial attribute data. The spatial data represent geographic location of features. Points, lines and areas are used to represent geographic features like a street, a lake or a forest land. These data will normally be obtained from one or more of the following sources:

- Existing maps
- Aerial photographs
- Satellite imageries
- Existing digital data
- Other GIS data bases

Database provides facilities to perform several operations commonly required in manipulation of attribute data. These operations include:

- Retrieving data from the existing datasets
- Updating, editing and/or transforming the existing datasets
- Inserting new data into existing datasets
- Adding new datasets to the database
- Deleting data from existing datasets
- Deleting data from existing datasets
- Removing datasets from the database

2.3 COMPONENTS OF SPATIAL DATA

Spatial data have three major components: geographic position, attributes or properties and time dynamics.

Position: position refers to the fact that each feature has a location that must be specified in a unique way. The location can be absolute or relative. Absolute location is defined using a coordinate system like CARTESIAN (X,Y) or global geographic (latitude/longitude), easting and northings, row and column position describing a position on a grid etc. Relative location is given with reference to some other objects, e.g. as topologic position, which is described through a relationship to other objects, such as "adjacent to" or "intersects with".

Attributes: Attributes are often termed as non spatial data since they do not in themselves represent location information. An attribute is a characteristic of an entity.

Time: is important and critical since the geographic information is referenced to a point in time or to a period of time. Knowing the time where geographic data were collected is of utmost importance for using these data appropriately, e.g. an area may be covered by forest one year and have been clear out the next.

2.4 BASIC TYPES OF SPATIAL DATA:

There are four elementary types of geometric entities designed to encode spatial data: Point, lines, polygons and continuous surface (area).

Point Data: Points are the simplest type of spatial data. Points can be of two kinds: observations relating to discretely distributed phenomena such as oil and water wells and observations relating to continuous distributions such a weather station reporting precipitation measurements of soil temperature.

Line data: Line entities are linear features made of many points or straight line segments made defined of two or more pairs of coordinates. The line entities can be static (structural type) or dynamic (flow). An arc, chain, or a string is a set of x-y coordinate pairs describing a continuous complex line.

Polygon or area data: Polygons constitute the most common data type used in GIS. They are bounded regions determined by natural phenomena such a land forms of many segments. The boundaries may be defined by natural phenomena such a land forms or by man-made features such as forest stand or land use units.

Continuous surface: Examples of continuous surface are elevation (as part of topographic data). Rainfall, temperature, etc. Most of the GIS systems handle these, essential three dimensional data as topographic data, usually as Digital Elevation Model (DEM).

2.5 SPATIAL DATA STRUCTURE

In the computer there are three types of spatial data representation which are commonly used: the raster model and vector model. The vector model represents an object by means of points, lines and polygons. Lines are created by connecting points with straight lines, areas are defined by a set of lines. The position of each object is defined by its placement in a map space, with respect to coordinate reference system. The spatial entities in the vector model correspond more or less to the spatial entities in the real world which they represent.

The raster model consists of a rectangular array of pictures elements or pixels which are in one to one correspondence with small rectangular areas on the original picture material which they represent. The area that each pixel represents defines the spatial resolution.

In the raster structure a valve for the parameter of interest like land use class, soil type etc. is given to pixel in an array. Operations on raster files involve the retrieval and processing of the data in all pixels.

A geographical information system (GIS) is a collection of hardware, software, geographic data and personnel designed to create, store, edit, manipulate, analyze and display geographically referenced information.

CHAPTER 3

IMAGE PROCESSING SOFTWARE USED

As a part of this project work, the hands on training on the two image processing software have been used. This software, a case study, which is available in the software, has been carried out.

3.1 EARTH RESOURCES DATA ANALYSIS (ERDAS)

ERDAS software is available in a variety of optional modules that can be used independently or combined to meet the application requirements. ERDAS programs within each module are accessible through a series of menus. The ERDAS system is raster based which means that all data is stored in the form of two dimensional arrays of integer numbers which are referenced to a common geographic coordinate system.

The new version of ERDAS is now available with the name as IMAGINE, ERDAS IMAGINE is a geoprocessing product featuring the image viewer, image processing, spatial and statistical modelling, attribute handling and the map composer. To make the capabilities easy to learn Imagine is built around a point and click user interface with pull-down menus, scroll bars and icons. The image viewer provides multiple windows with virtual lookup tables interactive colour assignment tools. An unlimited number of multiple windows can geographically liked, enabling users to roam and zoom across different views of the same area. In the visualization tools, the roaming and zooming etc. can be performed easily. Annotation, vector graphics, attributes handling and pointer driven query is also included in the viewer. ERDAS IMAGINE performs spatial and statistical modelling and advance image processing functions on multiple data layers with a powerful new version of the GIS modeller. The map composer creates cartographic quality soft copy and hard copy products with sophisticated annotation.

In image processing the functions such as Image enhancement, Rectification, classification etc. have been included. Image enhancement performs image enhancement, principal components and convolution filtering. In the rectification module, the imagery can be rectified to over 30 map projections, image to image, image to map or map to image referencing can be performed. The classification and view and manipulation statistics in up to four signature files.

3.2 Arc GIS software

ArcGIS is a geographic information system (GIS) for working with maps and geographic information. It is used for creating and using maps, compiling geographic data, analyzing mapped information, sharing and discovering geographic information, using maps and geographic information in a range of applications, and managing geographic information in a database.

ArcGIS includes the following Windows desktop software:

- ArcReader, which allows one to view and query maps created with the other ArcGIS products;
- ArcGIS for Desktop, which is licensed under three functionality levels.
- ArcGIS for Desktop Basic (formerly known as ArcView), which allows one to view spatial data, create layered maps, and perform basic spatial_analysis;
- ArcGIS for Desktop Standard (formerly known as ArcEditor), which in addition to the functionality of ArcView, includes more advanced tools for manipulation of shapefiles and geodatabases;
- ArcGIS for Desktop Advanced (formerly known as ArcInfo), which includes capabilities for data manipulation, editing, and analysis.

ArcGIS Desktop includes two main applications: ArcCatalog and ArcMap.

- **ArcCatalog** - used to organize and manage GIS data. It also allows you to preview datasets and view and manage metadata.
- **ArcMap** - used to view, edit, and analyze spatial data and create maps.
- **ArcScene** - ArcScene provides the interface for viewing multiple layers of 3D data, visualizing 3D data on a 2D surface data, creating 3D surfaces and analyzing 3D surfaces.
- **ArcToolbox** is a component of ArcCatalog, ArcMap and ArcScene. It contains tools for geoprocessing, data conversion, and defining map projections etc.

CHAPTER 4

REMOTE SENSING APPLICATION IN LANDUSE/LANDCOVER

4.1 GENERAL

Land use and land cover is a important component in understanding the interactions of the human activities with environment and thus it is necessary to be able to simulate changes. The study has been done through remote sensing approach using SOI map of Haridwar district. The aim of this study is to detect land use/cover changes between 1998 to 2014 using satellite images of Landsat (ETM^{+}, TM, MSS) and digital SOI topographic map have been used. The aim of this study is to produce a land use/land cover map of Haridwar district at two epochs in order to detect the changes that have taken place particularly in the built- up land and forest areas. Landuse changes have been detected by imagine processing method in ERDAS imagine 9.2 and ARCGIS 9.3. Finally to predict the changes in urban habitants and land use/cover changes occurred. Monitoring of land use/cover changes which would help to plan development activities such as a major schemes and their land requirements.

4.2 THE STUDY AREA AND THE DATA USED

Haridwar district, covering an area of about 2360 sq.km. is in the western part of Uttarakhand state of India. Its latitude and longitude is The height from the sea level is 249.7 mts. The district came into existence on 28th Dec. 1988. Prior to its inclusion in the newly created state of Uttarakhand, this district was a part of Saharanpur Divisional Commissionary. The district is ringed by Saharanpur in the west, Dehradun in the north and east, Pauri Garhwal in the east, Muzzaffar Nagar and Bijnor in the south. The district is administratively subdivided into three tehsils i.e. Haridwar, Roorkee and Laksar and six development blocks i.e. Bhagwanpur, Roorkee, Narsan, Bahadrabad, Laksar and Khanpur. Haridwar is one of the first towns where Ganga emerges from the mountains to touch the planes. As per the 2001 census, the population of the district is 14,44,213. Figure 1: Map of Haridwar District The Land use/cover Map was generated by using satellite image of 1972, 1980, 1992, 2002 and 2011, through ERDAS IMAGINE (version 9.2), which is powerful image processing software. The determination of digital land cover classification is to have a meaningful information class value, which can evaluate the landscape in accurate. Land Cover refers to the cover including vegetation, urban infrastructure, water, barren land, etc. Land cover is a fundamental variable that impacts on and links many parts of the human and physical environments. Land cover is highly affected by human induced activities rather than natural events.

4.3 METHEDOLOGY

All exercises has been done on ERDAS Imagine. In the Image Processing exercise, image rectification, extracting study area from supervised classification of landsat imageries for obtaining land use/cover map for the study area is done.

4.4 GEOREFERENCING

Georeferencing is the process of assigning real-world coordinates to pixel of the raster image. Many times these coordinates are obtained by doing field surveys – collecting coordinates with GPS device for few easily identifiable features in the image or map. In some cases, where we looking to digitize scanned maps, we can obtain the coordinates from the marking points on the map image itself. Using these sample coordinates or GCPs (Ground Control Points), the image is warped and made to fit within the chosen coordinate system.

4.4 NEED OF GEOREFERENCING

Georeferencing is crucial to making aerial and satellite imagery, usually raster images, useful for mapping.

Very essential information may be contained in data or images that were produced at a different point of time. It may be desired either to combine or compare this data with that currently available.

Different maps may use different projection systems.

The purpose of georeferencing is to turn non spatial imagery, such as historical air photos or maps, into spatial raster data for use in variety of circumstances. Specialized air photos can be use for GIS land cover analysis.

4.6 METHODS OF GEOREFERENCING

There are various GIS tools available that can transform Image data to some geographic control framework, like the commercial ArcMap, PCI Geomantic, TNT mips or ERDAS Imagine. One can georeference a set of points, lines, polygons, Images, or 3D structures. For instance, a GPS device will record latitude and longitude coordinates for a given point of interest, effectively georeferencing this point.

To georeference an Image, one first needs to establish control points, Input the known geographic coordinates of these control points, choose the coordinate system and other projection parameters and the minimize residuals.

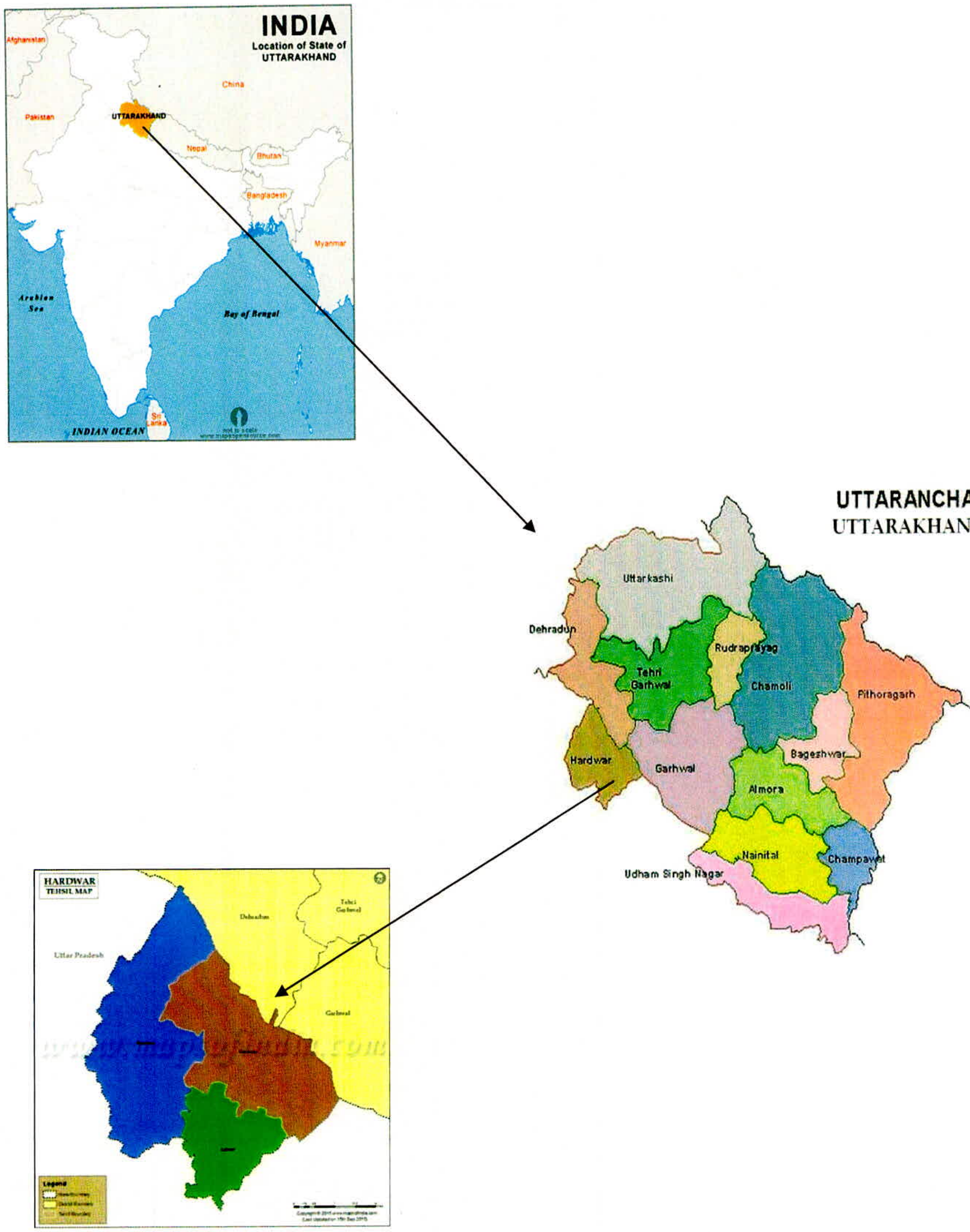


FIG: 2 LOCATION MAP OF HARIDWAR ISTRICT

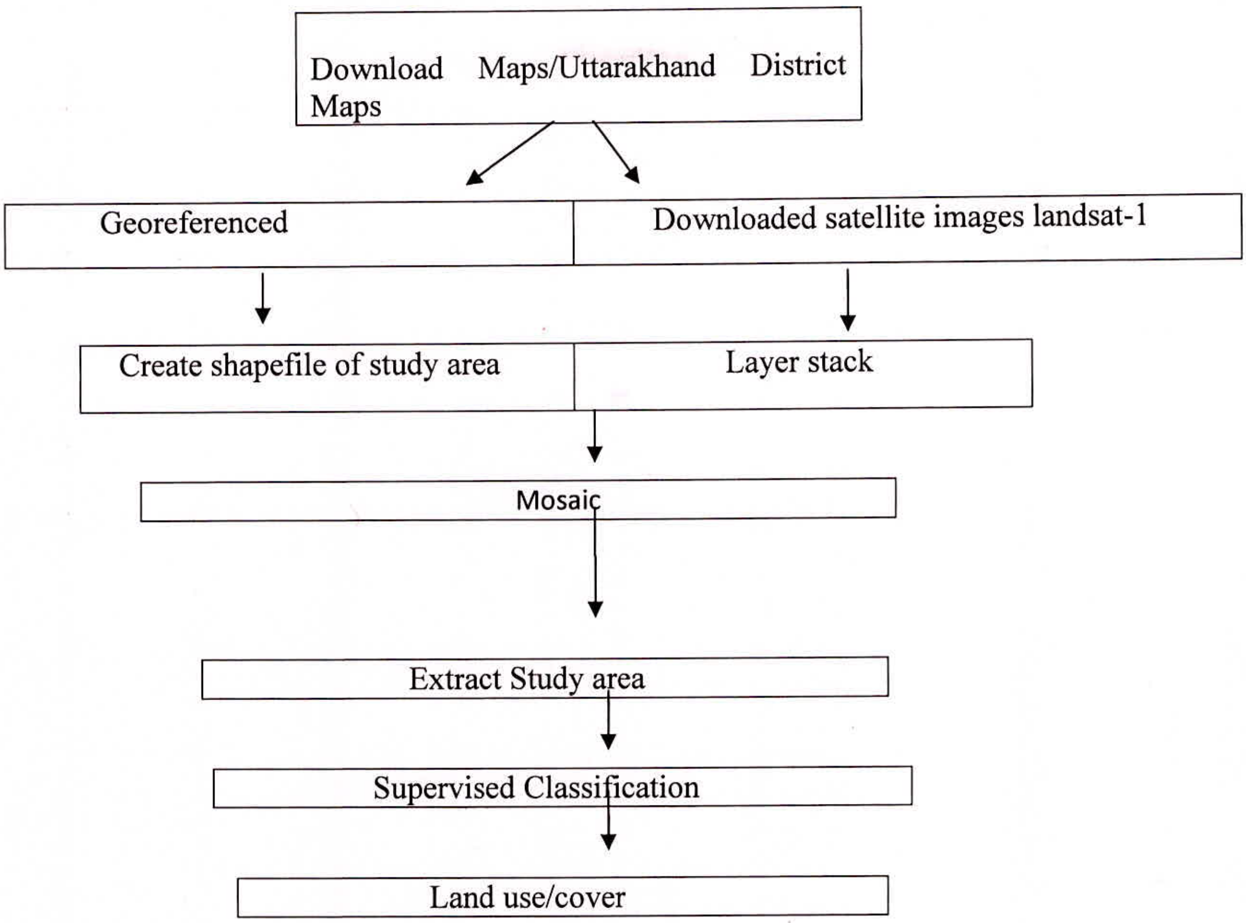


FIG: 3 METHEDOLOGY FLOW CHART

4.7 GEOREFERENCING OF SCANNED MAP OF UTTARAKHAND

In this, Uttarakhand map is downloaded and scanned for gepreferencing with its latitude and longitude is 78^{0}E to 81^{0}E and 31^{0}N to 29^{0}N as shown in figure4. Which is further georeferenced along its lat-long by locating points on its four corners one by one by in ERDAS software.

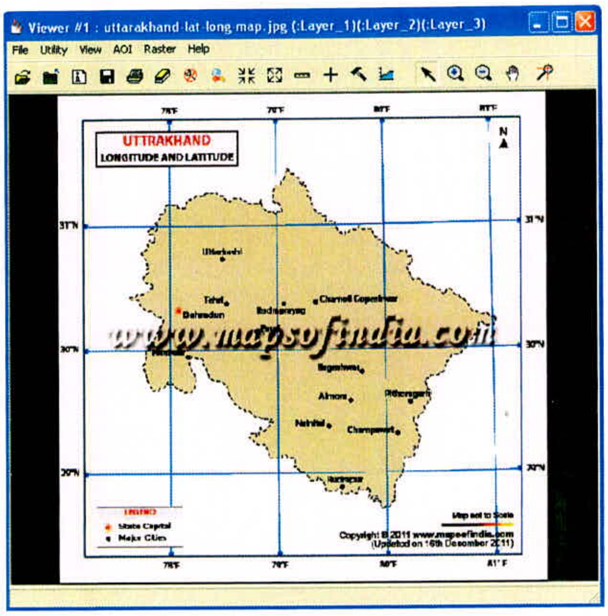


FIG:4 Downloaded Uttarakhand Scanned Map

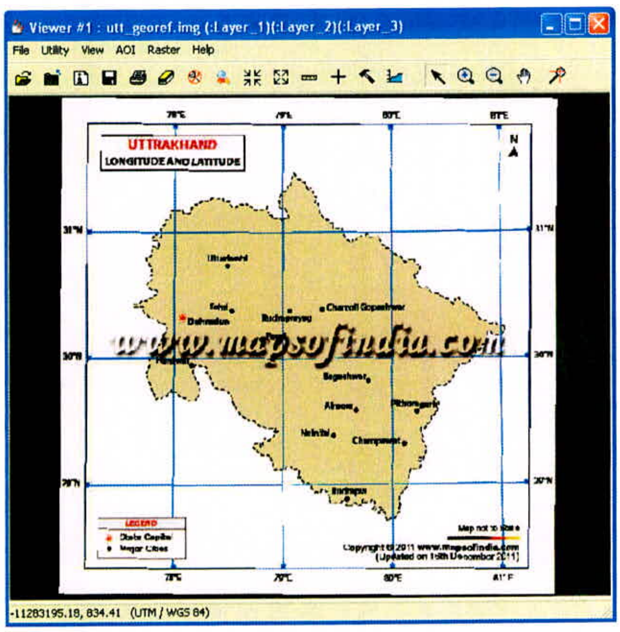


FIG: 8 Georeferenced Map

Swip method used in ERDAS imagine, which allows to see all layers in the viewer by swiping the top layers out of the way.

4.9 METHOD

In this method the lat-long map which is georeferenced is kept as reference and same time another image in another viewer is set as input to overlap each other by raster process to swipe those two maps.

In this we will see how to load image and vector data and how to use the swipe tool, including multilayer functionality and automation shown in figure 9 and figure 10

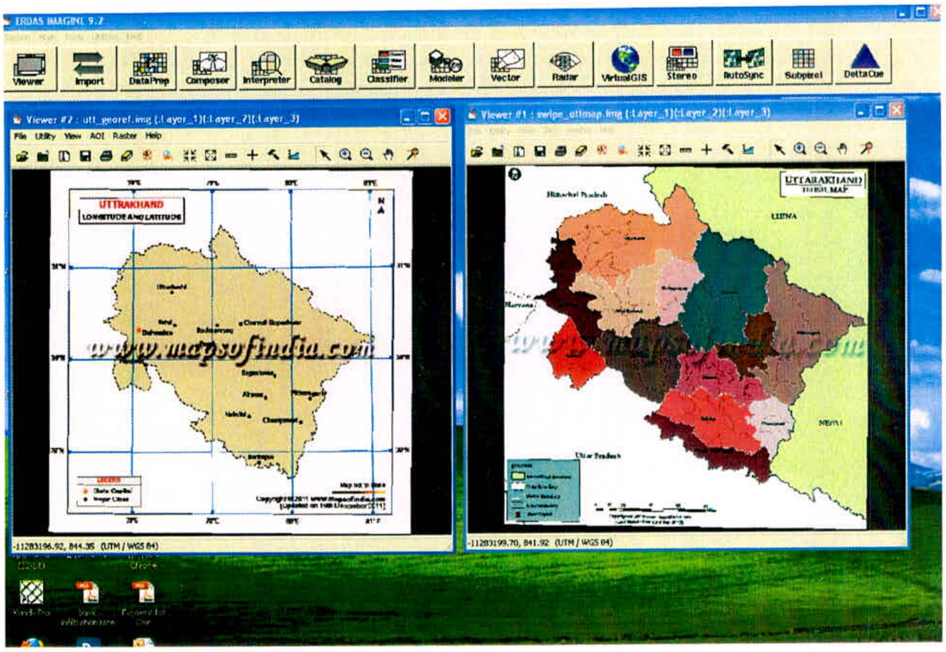


FIG: 9 Georeferenced Map and Input map

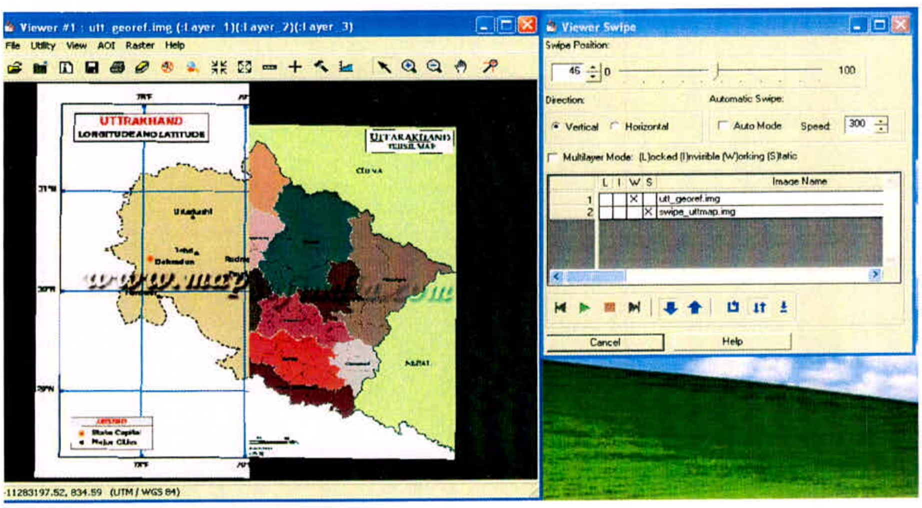


FIG:10 Swiped Map

SHAPE FILE

The shapefile format is a popular geospatial vector data format for geographic information system (GIS) software. It is developed and regulated by Esri as a (mostly) open specification for data interoperability among ESRI and other GIS software products the shapefile format can spatially describe vector features: points, lines, polygons, representing, for example water, rivers, lakes. Each item usually has attributes thats describe it, such as name and temperature.

A shapefile is a simple, nontopological format for storing the geometric location and attribute information of geographic features. Geographic features in a shapefile can be represented by points, lines, or polygons(areas).

NEED OF SHAPEFILE

When we add a shapefile, Map Viewer converts it to a format that web clients can quickly read and display. To help further improve the performance of the display, we can choose to generalized the features in our shapefile. Generalizing reduces the size of the shapefile by simplifying the features and is often appropriate for data at small scales. Here we have taken Uttarakhand Map to eliminate the area on which study is carried out further. For this this method of creating shapefile of Haridwar district is done in ArcGIS wich is shown in figure 11.

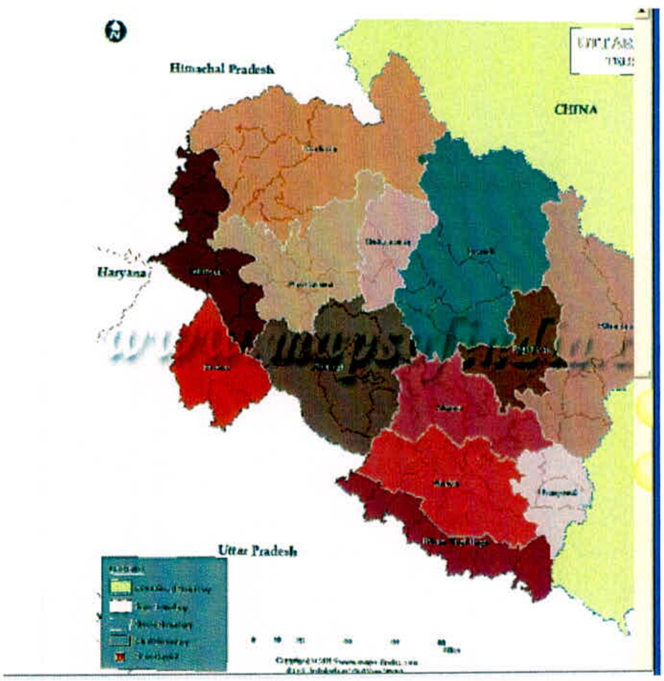


FIG:11 Uttarakhand Map

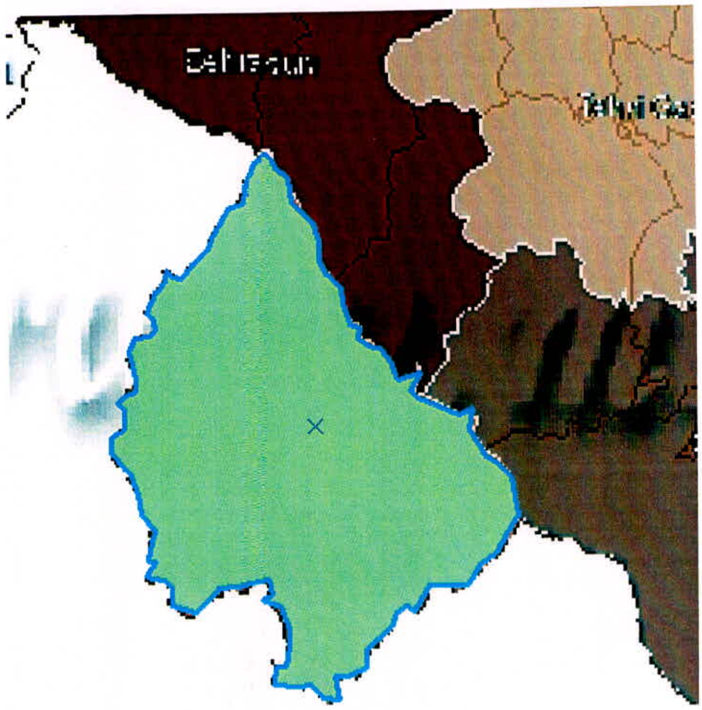


FIG: 12 Shows the Hridwar district area eliminated from uttarakhand map.

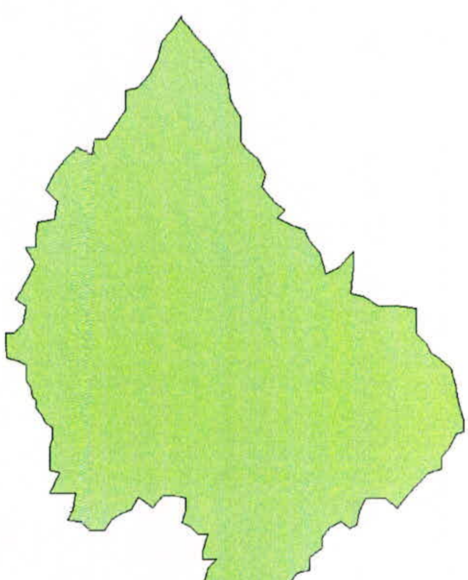


FIG: 13 Shapefile of haridwar district

DOWNLOADED IMAGES FOR LAYER STACKING

For layer stacking the images are firstly downloaded from Earth Explorer. For downloading firstly we register on USGS is United States Geological Survey (USGS, formerly simply Geological Survey) and then focusing on the study area.

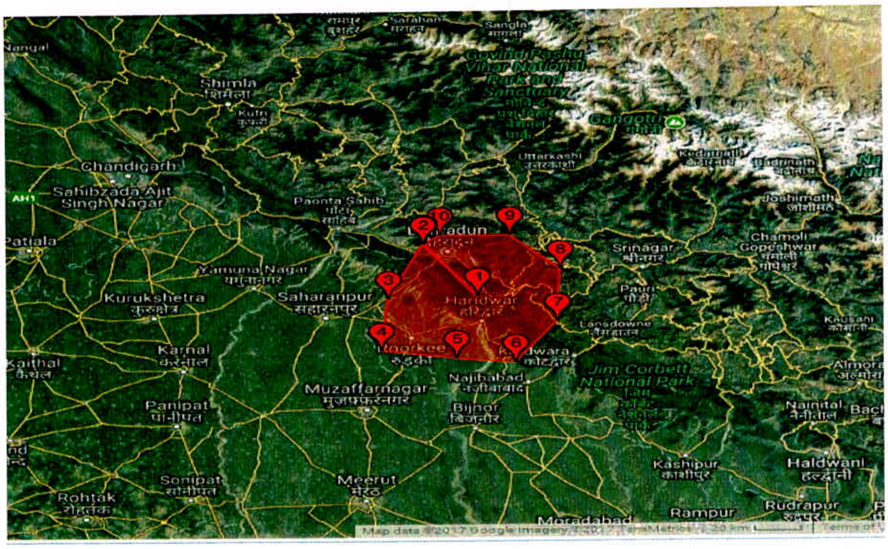


FIG:14 Shown haridwar district are from Google Earth

LAYER STACK

A layerstack is often used to combine separate image bands into single multispectral image file. Layer stacking is also used to combine image derivatives with spectral bands for further analysis i.e., layer stack an image with spectral bands for input to an image classification.

ASSUMPTIONS

Two or more images to be stacked (ERDAS Imagine format).

To create a layer stack Utilities of the Image Analysis extension in ERDAS Imagine is used.

There are two types of stacks: a new image stack and a virtual stack:

For the new image stack, we do have to resample all bands at the same resolution. This will markedly increase the size of the data. This is done from image interpreter > utilities > image stack.

With virtual stack (vsk file), we don't have that constraint. A vsk is a Erdas format and it is in fact a simple text file with the list of all files (with full path). It can be created with the "report" command.

We can also use a hybrid approach where you create image stacks for each pixel size.

The layer stack function is useful for placing layers one on top of the other. It is especially useful for satellite data are being released in full-scene, one-layer-per-image files. Also, Landsat 7files often come in one-band-per-image files, and this procedure will work as well, but keep in mind that Landsat 7 band 6 (thermal) typically has 60-meter resolution, and the panchromatic band typically has15-meter resolution, while the other bands have 30-meter resolution. If the panchromatic band isstacked into the output file, bands 1 through 7 will be resampled to 15-meter pixel size, some spectral definition will be lost, and the file size more than quadrupled. For Landsat 7 data, layer stack bands 1through 5 and band 7. Keep the panchromatic band and band 6 as separate files.

The process for layer stacking is downloaded images from google earth showing different layers of the area. These landsat images are of 1998 2001.

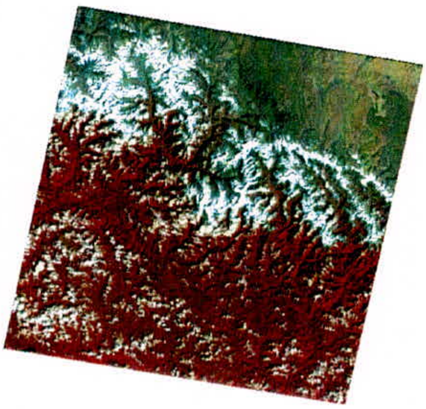
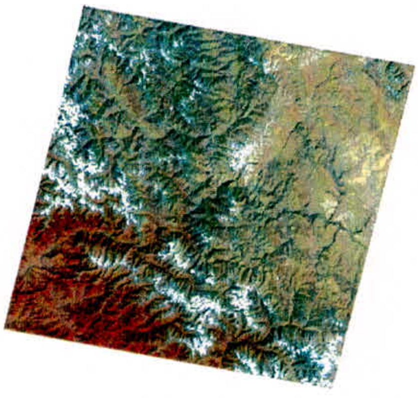


FIG:15



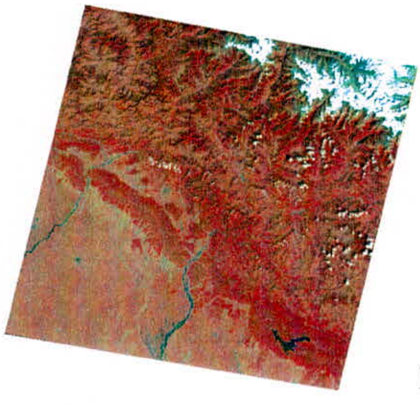


FIG:17

FIG:16

IMAGE MOSAICING

"Mosaic" originates from an old Italian word "mosaic" which means a picture or pattern produced by arranging together pieces of stones, tiles, glass, etc. Mosaic is the process of assembling a series of images and joining them together to form a continuous seamless photographic representation of the image surface.

Many a time, it may not possible to capture the complete image of a large document in a single exposure as most image capturing media work with documents of definite size. In such cases, the document has to be scanned part by part producing split images. Thus document image analysis and processing require Mosaicing of the split images to obtain a complete final image of the document. Hence, document image mosaicing is the process of merging split images that are obtained by scanned different parts of single large document image with some sort of overlapping region (OR) to produce a single and complete image of document.

Registration and mosaicing of image has been in practice since long before the age of digital computers.

For mosaicing the images firstly, Landsat image is downloaded from USGS (United States Geological survey). For downloading registration is made first and then internet browser is navigate to USGS website.

The **United States Geological Survey** (**USGS**, formerly simply **Geological Survey**) is a scientific agency of the United States government. The scientists of the USGS study the landscape of the United States, its natural resources, and the natural hazards that threaten

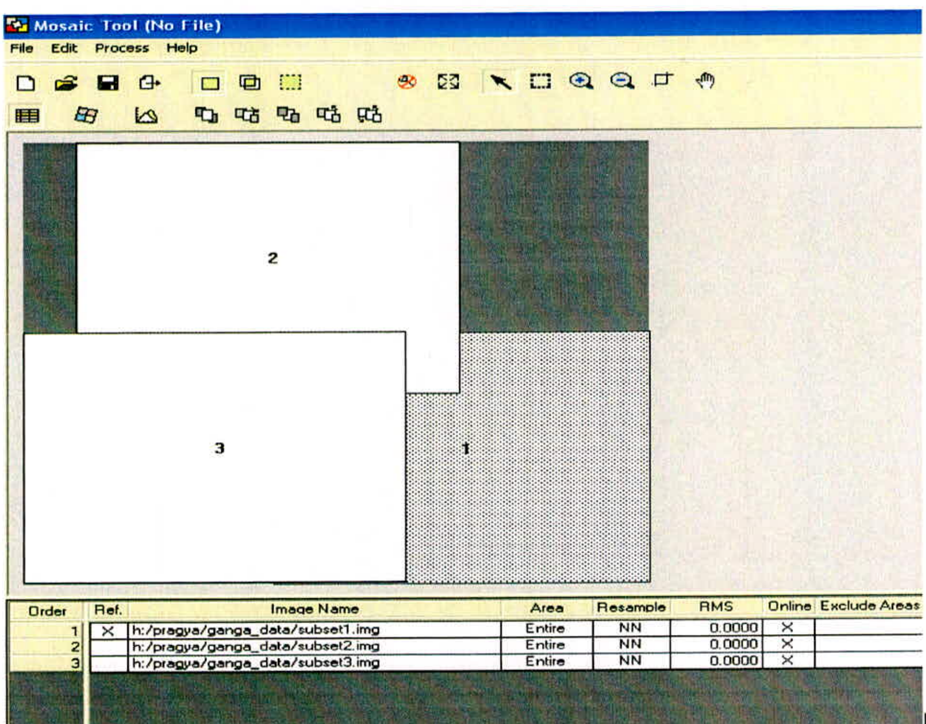


FIG:18

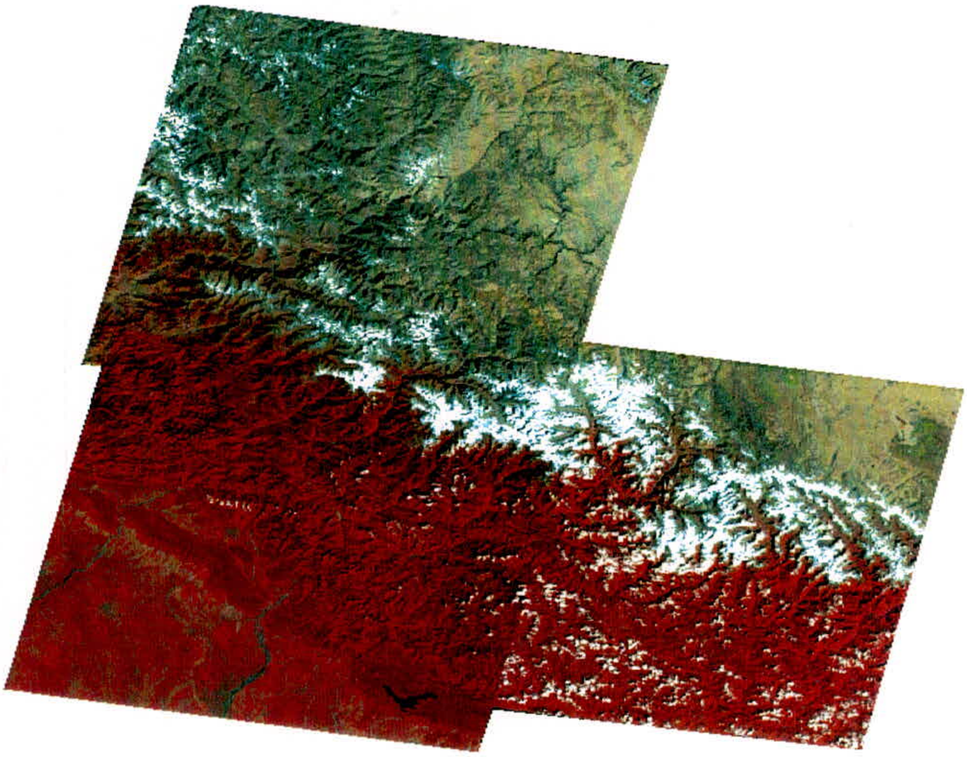


FIG:19 Showing three landsat images layer stacked

KML FILE FORMAT

KML is a file format used to display geographic data in an Earth browser such as Google Earth. KML uses a tag-based structure with nested elements and attributes and is based on the KML standard. All tags are case-sensitive and must appear exactly as they are listed in the KML reference. The Reference indicates which tags are optional. Within a given element, tags must appear in the order shown in the Reference.

If we are new to KML, explore this document and the accompanying samples files to begin learning about the basic structure of a KML file and the most commonly used tags. The first section describes features that can be created with the Google Earth user interface.These features include placemarks, descriptions, ground overlays, paths, and polygons. The second section describes features that require authoring KML with a text editor. When a text file is saved with a *.kml* or *.kmz* extension, Earth browsers know how to display it.

In fig 20, the Haridwar district area is selected out by inserting the shapefile of Haridwar district in the Google Earth to show the land use/cover area of Haridwar district.

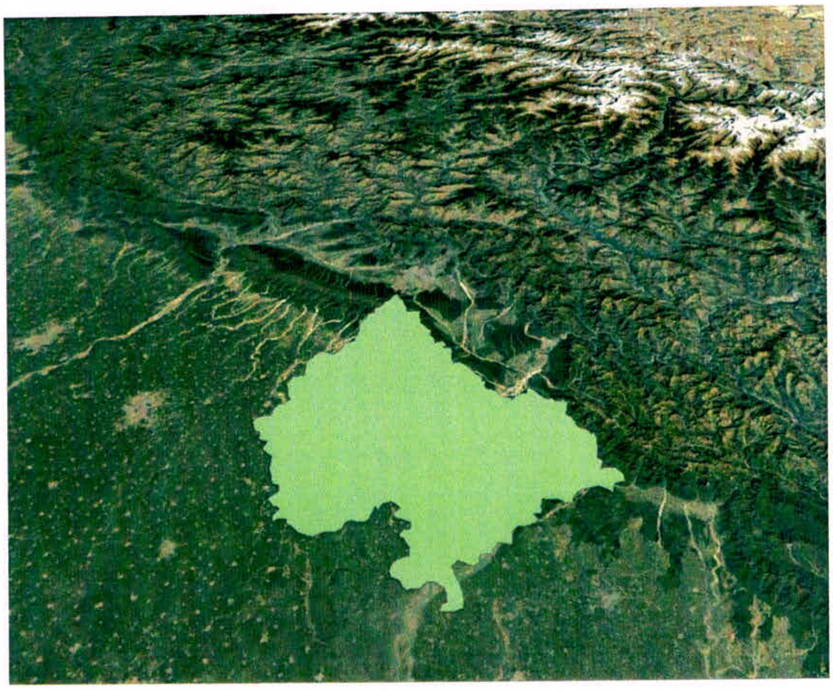


FIG: 20

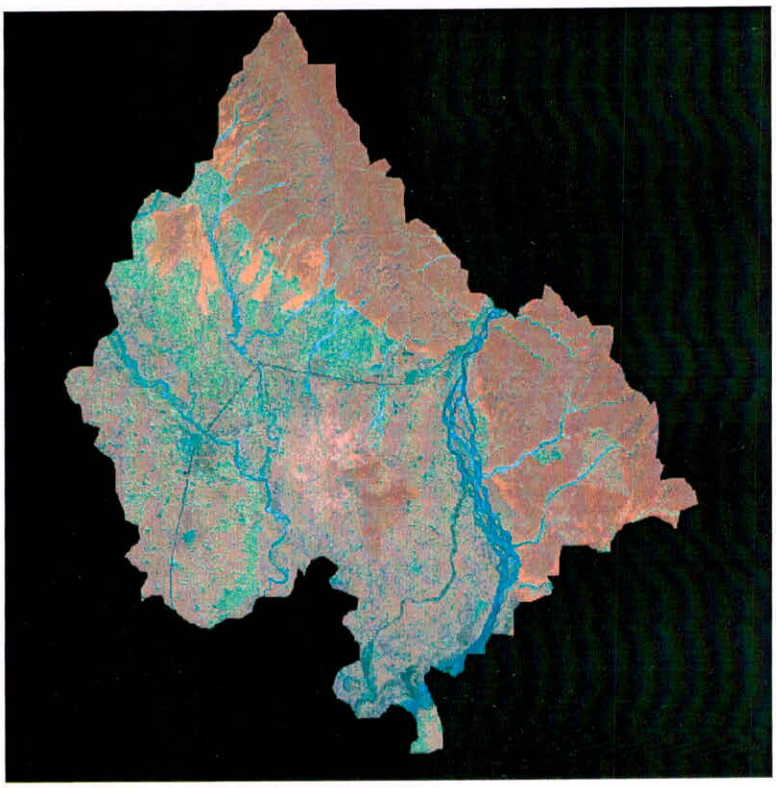


FIG: 21 Showing land use/cover area of Haridwar District

CLASSIFICATION

Classification is regarded as a fundamental process in remote sensing used to relate pixel values to land cover or sometimes land use classes that are present at the corresponding location on the Earth's surface. Conventionally, pixel class assignment is determined by the spectral properties (signatures) of a given class or theme. Each spectral feature, for example red, near-infrared or shortwave infrared reflectance, is taken as an explanatory or independent variable.

Classifiers assign labels to pixels based on partitioning of feature space values using either unsupervised or training-based supervised methods.

Thus supervised method is explained.

SUPERVISED CLASSIFICATION:

In supervised classification methods, training data of accurately labeled examples are taken as the dependent variable and associated to a set of independent variables. For land cover mapping using earth observation imagery, training data may be gathered on the basis of image interpretation, ground measurements or any other trusted source of information. In general, collecting training data requires considerable time and effort. Supervised classification approaches are dependent on the experience of the remote sensing analyst in collecting training data and on the quality of the imagery. Supervised classification is the analyst, based on the prior information on the spectral characteristics of these classes, 'trains' the computer to generate boundaries in the feature space within which each class should lie. Then the each pixel lying within a class boundary is assigned to that class. In this the essential requirements is a set or training patterns whose class membership is known.

SUPERVISE CLASSIFICATION PROCEDURE

Typical supervised classification involves three steps:

1. The training stage, wherein the multi-spectral parameters are extracted for various classes from the training sites identified in the image,
2. The classification stage, wherein each pixel is assigned to a class to which it most probably belongs, and
3. The output stage- the presentation of the data is in the form of maps, tables, graphs, etc.

DATA CHART

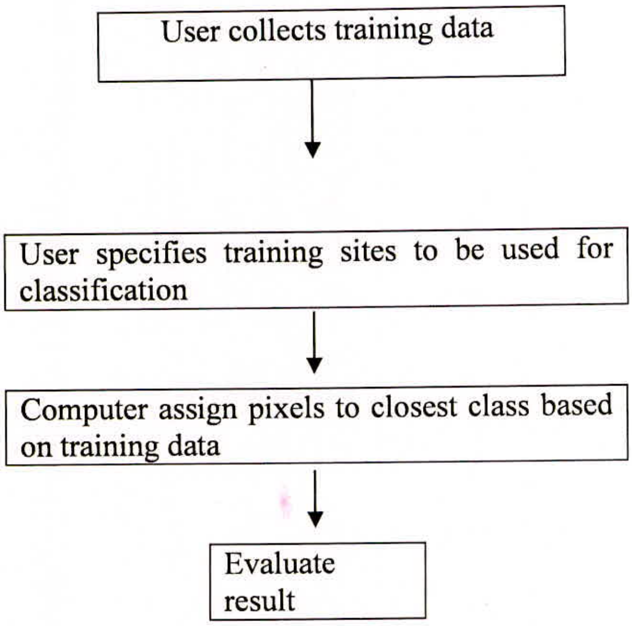


FIG: 23

Erdas Imagine 9.2 software is used for preparing Landuse/ cover map. For this, supervised classification of an IRS LISS-III image will be carried out to classify the image in to classes, namely forest, urban, fallow, barren etc.

SIGNATURE

Signatures define a training sample rule. Signature has to be defined before carrying out the classification. Each signature corresponds to a class and is used with a decision rule to assign the pixel in the image file.

Signatures are of two types: parametric-based on the statistical data and Non-parametric not based on statistical data but on discrete objects in a feature space image.

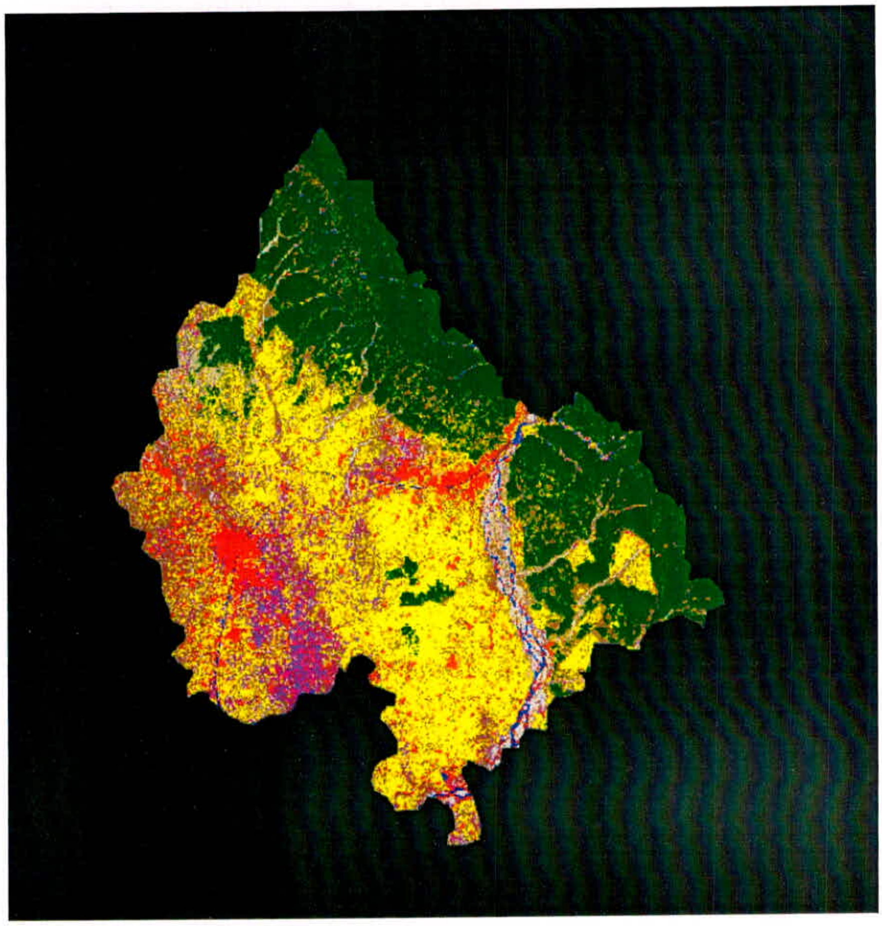


Fig:25

CONCLUSIONS

During the training period, I learned two software viz. ERDAS and ArcGIS. After that a case study for land use/cover classification of Haridwar district has been carried out. The base of the study area was prepared and then classification using satellite data have been made. The satellite data was classified using supervised classification techniques. In this supervised classification technique, training sets were prepared. In this technique, signature has to be defined before carrying out of the classification. Signature defines a training sample of cluster. Each signature corresponds and is used with a decision rule to assign the pixels in the image file. The whole image was classified on the basis of signature file. In supervised classification we rely on our own pattern recognisation, skills and previous knowledge of the data. The outcome of the study is classified map of the study area.

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