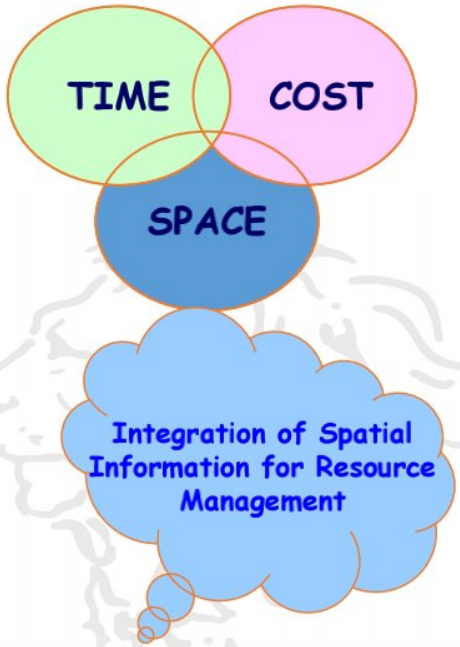
What is Remote Sensing?

- Remote sensing means sensing of the earth's surface from space by making use of the properties of electromagnetic wave emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resource management, land use and the protection of the environment.

Why Remote Sensing ?



- Increasing population & diminishing resources; reduction of forest land
- Green revolution : 55-127 MT; Crop yield: 1.7 tones/ha (Lowest in World)
- Concept of National Natural Resource Management (NNRMS)

Remote Sensing is the science and art of acquiring information (spectral, spatial, temporal) about material objects, area, or phenomenon, without coming into physical contact with the objects, or area, or phenomenon under investigation.

or

Remote Sensing is the science of deriving information about an object from measurement made at a distance from the object, and without the sensors actually coming in contact with it.

or

Remote sensing is a multidisciplinary activity, which deals with the inventory, monitoring and assessment of natural resources through the analysis of data obtained from remote platforms.

History of RS India

Department of Space (Established)-1972
First Indian satellite- Arabhatt (April, 1975)
Bhaskar (I) & (II) (June,7,1979 and Nov. 20, 1981)
Data reception station (Established) – NRSA now NRSC Hyderabad

AIM

- Productive utilization of waste land was possible option to meet the demand of increasing population.
- Bring more land under production.
- Quick assessment of different natural resources.

" At this juncture RS becomes an essential tool for NRM "

The synoptic view availability at regular interval was welcomed in the decision support or decision making system. As the resolution becomes better, more details can be captured by RS techniques.

After initial success in launching communication and meteorological satellite, the ISRO launched an ambitious program to design and develop operational remotes sensing satellite basically for management of the natural resources of the country.

Indian Remote Sensing (IRS)- Activities

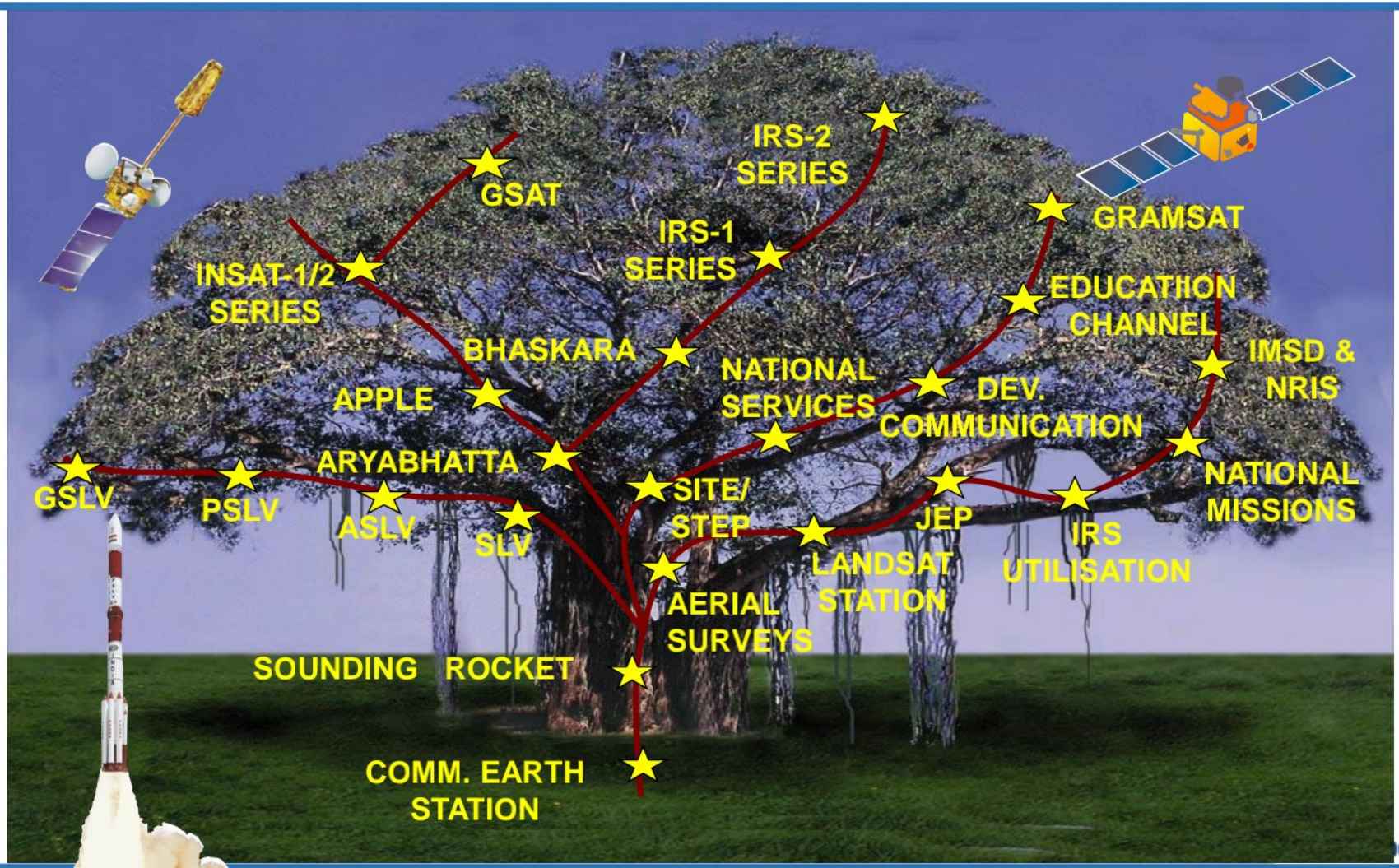
IRS-1 A (Mar 88) (72.5m x 72.5 m)

IRS-1 B and IRS-P2 (Aug 91 & 94) (36.5m x 36.5 m)

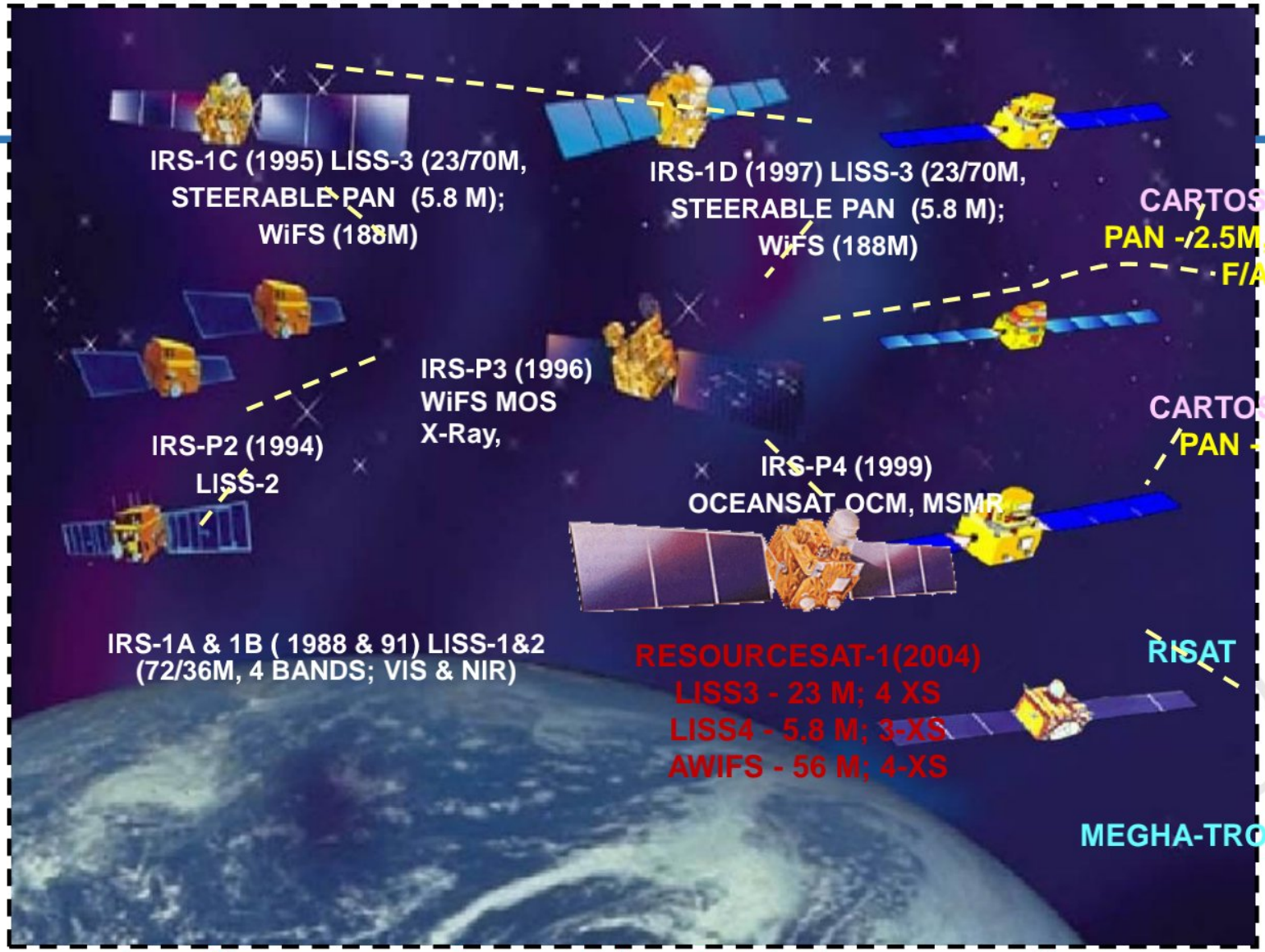
IRS-1 C/1D (Dec 95) (23.5m x 23.5 m)

- Even before launch of IRS satellite user community with help of DOS and outside were using Landsat (USA), Jan 1975 and SPOT (France) *(Jan 1986).*
- LANDSAT : Landsat Program is a series of Earth-observing satellite missions jointly managed by NASA and the U.S. Geological Survey. Since 1972, Landsat satellites have collected information about Earth from space. This science, known as remote sensing, has matured with the Landsat Program.
- SPOT : *System Probeteir d'observation de la Terra*

The Evolution

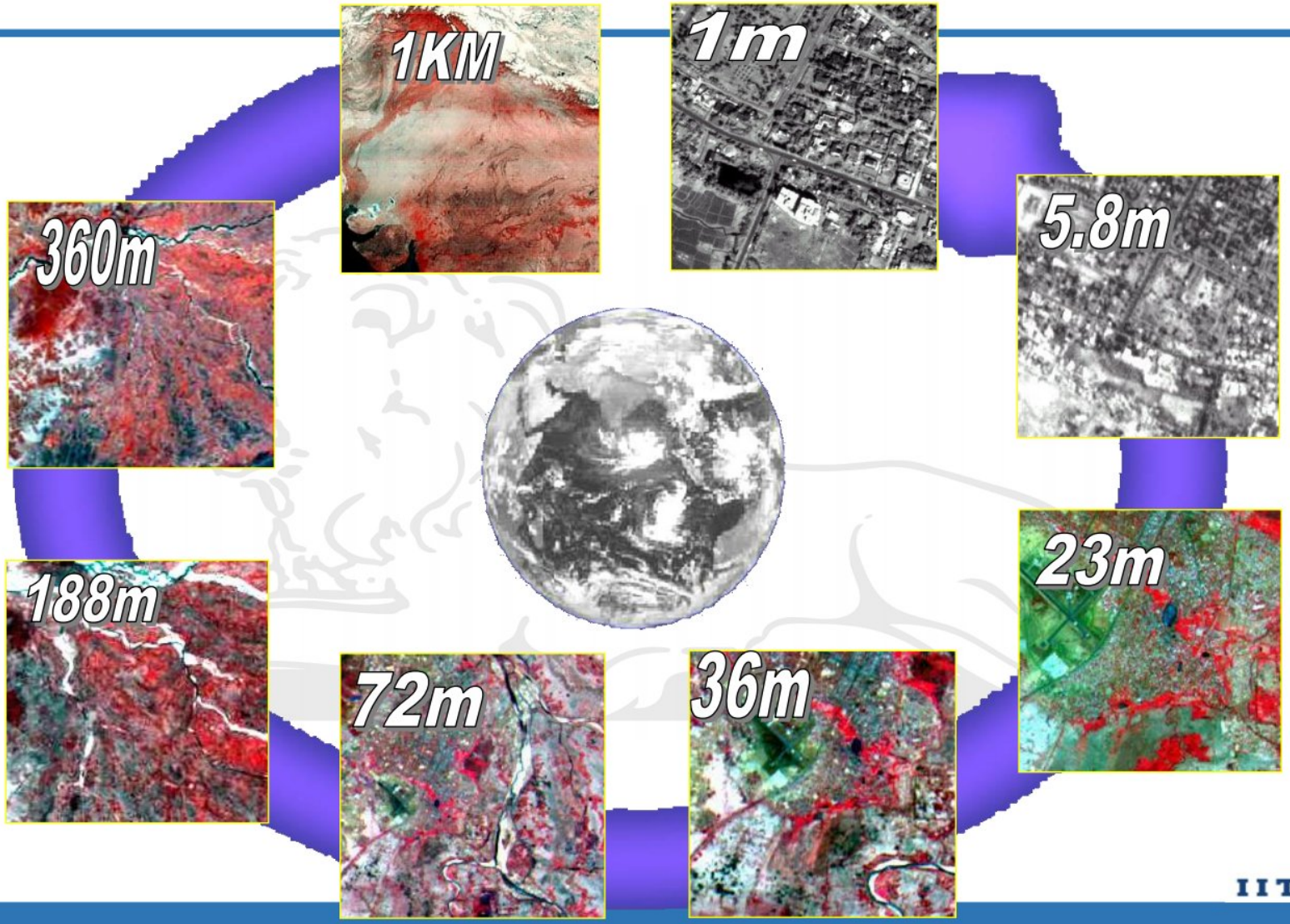


INDIAN REMOTE SENSING SATELLITES – PRESENT & FUTURE

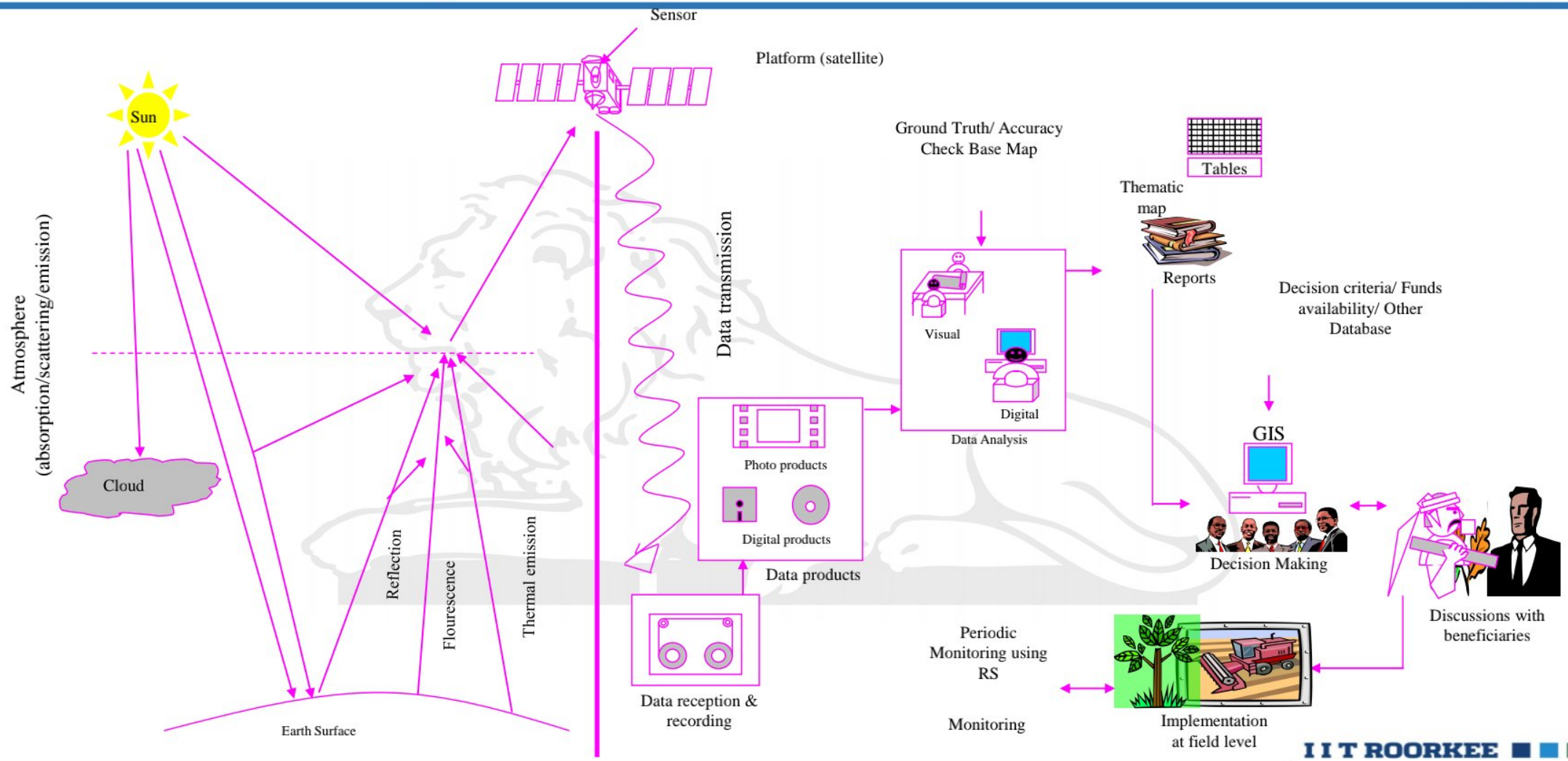


https://www.isro.gov.in/spacecraft/list-of-earth-observation-satellites

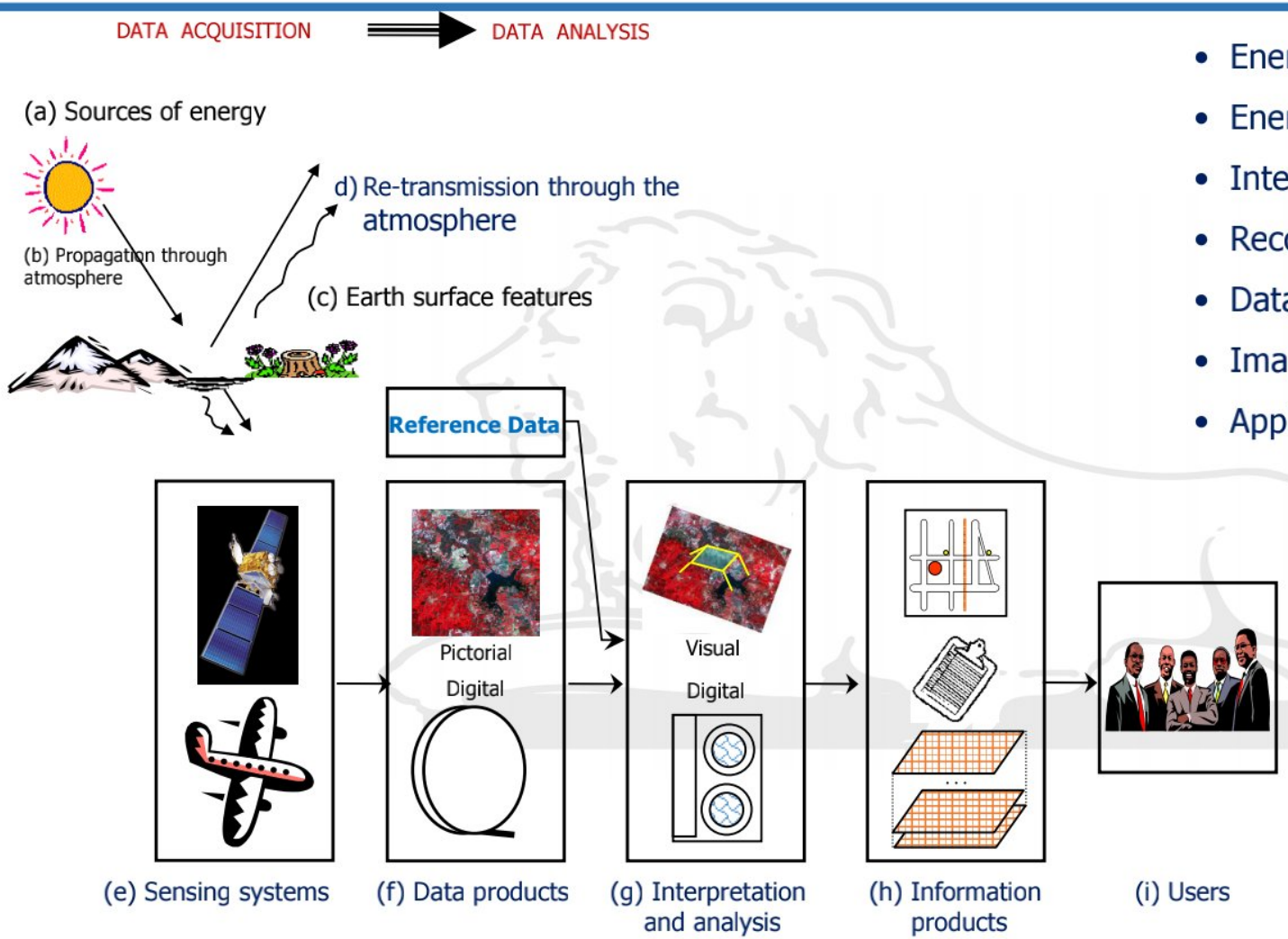
INDIAN Imaging CAPABILITY



Schematics Showing Remote Sensing System For Resource Management From Source To End Use



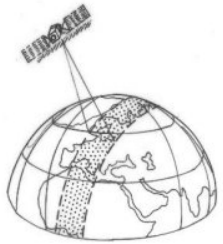
Electromagnetic Remote Sensing of Earth Resources



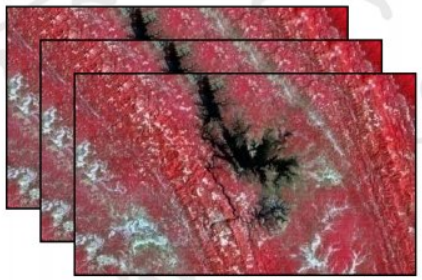
- Energy Source
- Energy Interaction with the atmosphere
- Interaction
- Recording of Energy by Sensor
- Data Transmission and Processing
- Image Processing and Analysis
- Applications

Advantages of Remote Sensing

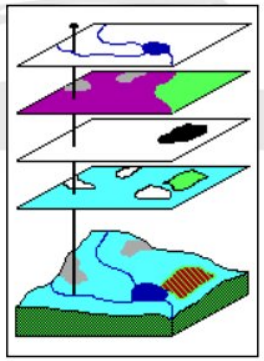
- Ø Synoptic view



- Ø Temporal



- Ø Multi-disciplinary applications



Satellite Data Quality Parameters

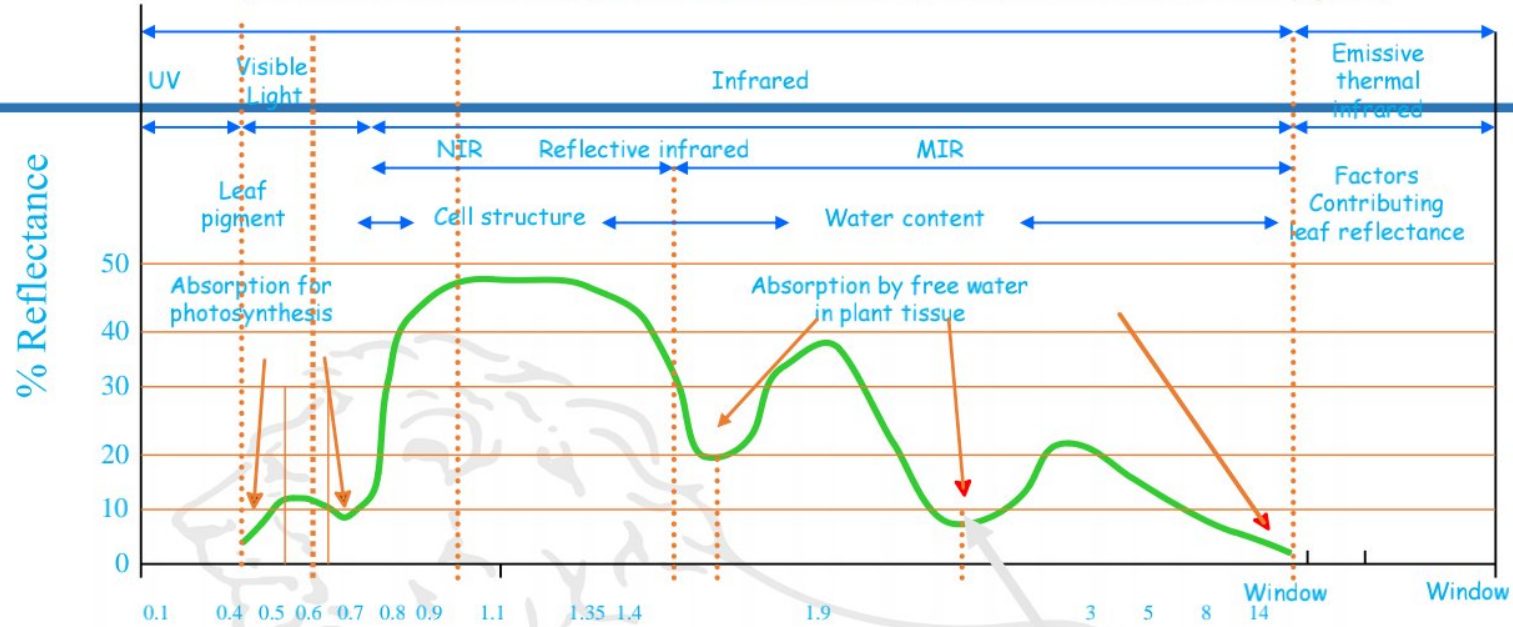
Spatial Resolution : A measure of the smallest angular or linear separation between two objects that can be resolved by the sensor.

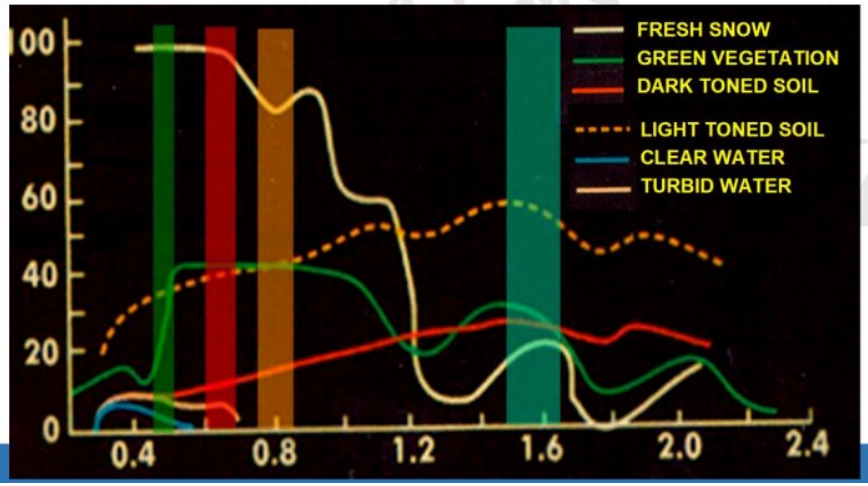
Spectral Resolution : The number and dimension of specific wavelength intervals in the electromagnetic spectrum to which a sensor is sensitive.

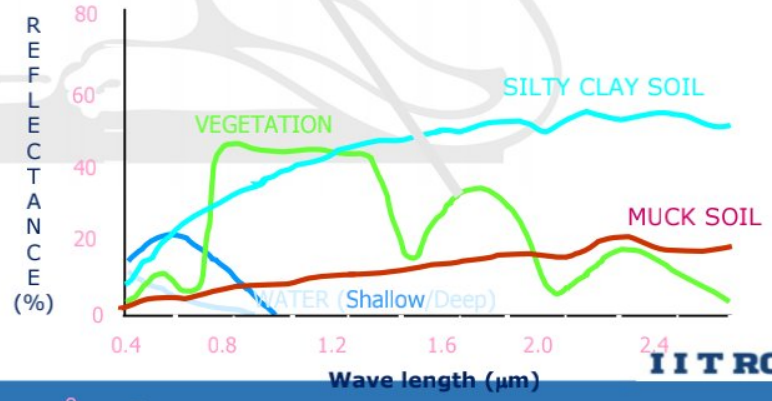
Temporal Resolution : It refers to how often a sensor records imagery of a particular area.

Radiometric Resolution: The sensitivity of a detector to differences in signal strength and it records the radiant flux reflected or emitted from the terrain or target of interest. (it is just discriminable signal levels; consequently, it can be a significant element in the identification of scene objects).

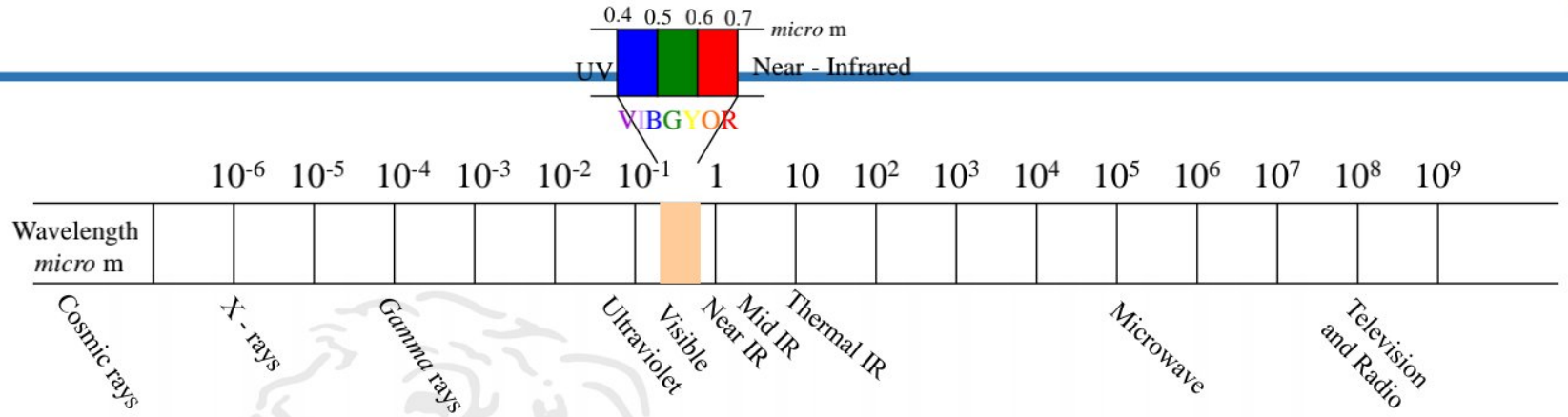
Reflectance Characteristics Of Earth's Cover Types







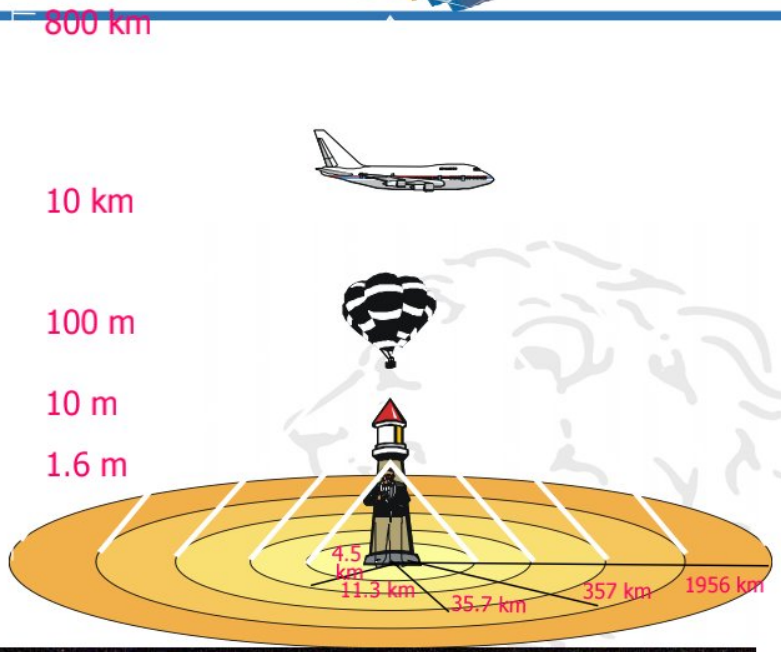
Electromagnetic Spectrum

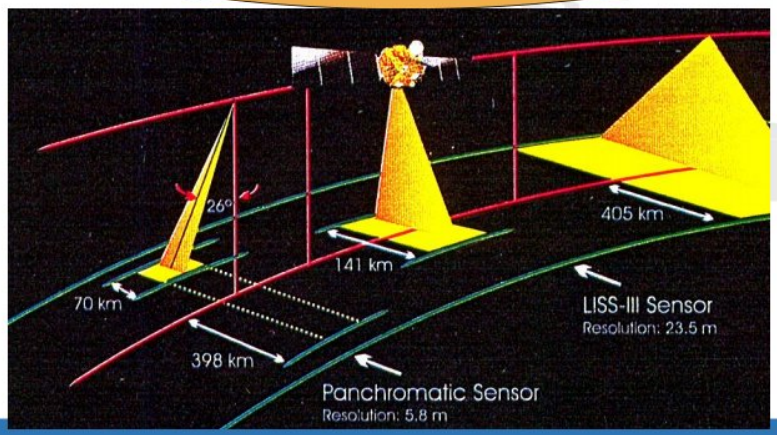


Bands refers to spectral channels in the electromagnetic spectrum.

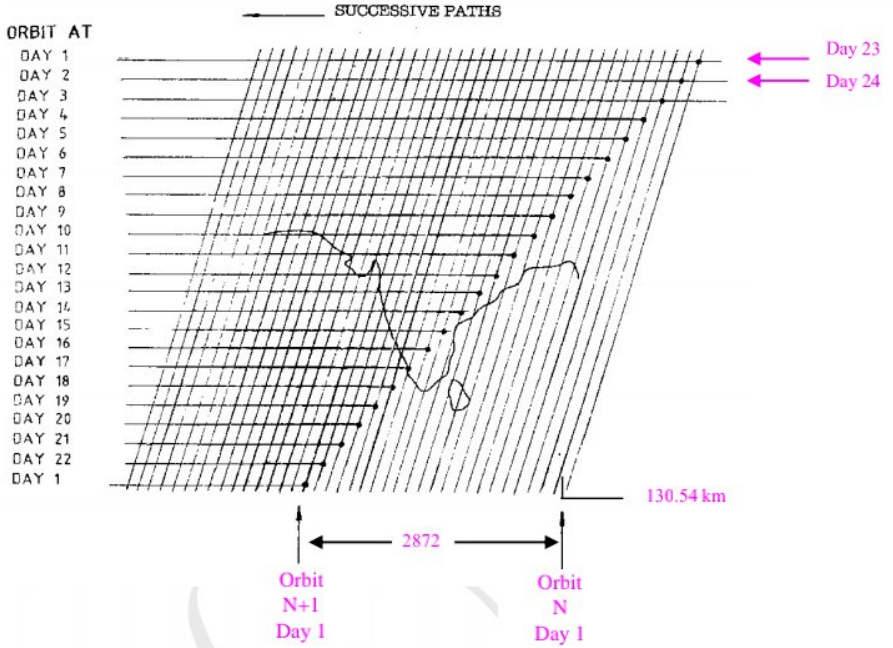
Band	Wavelength (*micro* m)	Nominal Spectral Location	Principal Application
1	0.45 - 0.52	Blue	Coastal water mapping, soil / vegetation,
2	0.52 - 0.62	Green	Vegetation discrimination, CF.
3	0.62- 0.69	Red	Chlorophyll absorption region, CF.
4	0.76 - 0.90	Near IR	Vegetation, water body, soil moisture
5	1.55 - 2.35	Mid IR	Moisture content, Snow and Cloud, Mineral and rock discrimination, vegetation moisture content
6	10.4 - 12.5	Thermal IR	Vegetation, Soil moisture discrimination
7	1 cm – 1m	Microwave	Soil moisture

Synoptic Coverage





Sunsynchronous Orbit



IRS-1A/B Swathing Pattern. Everyday the subsatellite track shifts westward. One coverage cycle takes 22 days. On 23rd day, the satellite retraces, the day-1 subsatellite track and begins the second cycle.

* THE SUNSYNCHRONOUS ORBIT PARAMETERS CHOSEN DEPENDING ON SWATH TO GENERATE COMPLETE COVERAGE DURING A COVERAGE CYCLE.

* AFTER A COVERAGE CYCLE THE SATELLITE RETRACES THE `DAY-1' TRACK AND THE SECOND CYCLE STARTS.

SPACE TECHNOLOGY

AND ITS APPLICATIONS

NATIONAL SPACE SYSTEMS

COMMUNICATION

INSAT SERIES OF SATELLITES

METEOROLOGY,
RADIO/TV BROADCAST,
DISASTER WARNING

REMOTE SENSING

IRS SERIES OF SATELLITES

NATURAL RESOURCES SURVEY,
MONITORING
AND MANAGEMENT

GEOGRAPHIC INFORMATION SYSTEM (GIS)

- **GIS** can be defined as a computerized system that deals with spatial data in terms of their collection, storage, management, retrieval, conversion, analysis, modeling, & display/output. It evolved as means of assembling & analyzing diverse spatial data.
- A GIS is a collection of computer hardware and software, data and skilled personnel for managing and analyzing geographic data.

Principles

A GIS can be described as a computer mapping & data storage system, in which data is represented in **points, lines, polygons or pixels**. Rather than just a 'dumb map', in which colours & symbols represent geographical features, the user can interact to varying levels with a GIS.

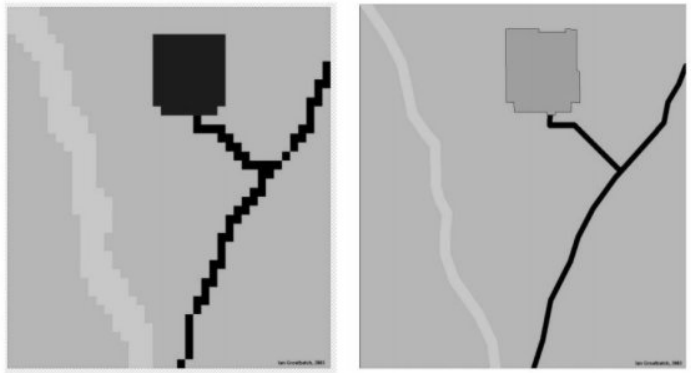
Fields where can be used

- **NATURAL RESOURCE MANAGEMENT**
  - Forest & Wildlife
  - Hydrological
  - Minerals
- **AGRICULTURAL MANAGEMENT**
  - Field Records
  - Crop monitoring
  - Animal Management
  - Climate Change / Human Impact
- **COMMERCIAL**
  - Market Area Analysis
  - Site Selection
  - Routing
- **URBAN & REGIONAL MANAGEMENT**
  - Land Use Planning/Environmental Impact
  - Public Works
  - Emergency Response

Data Structures

Raster data structure

In a raster data structure, map is divided into an array of square pixels – each of which has a value. For example, 1 may be road, 2 pasture, 3 water, etc.



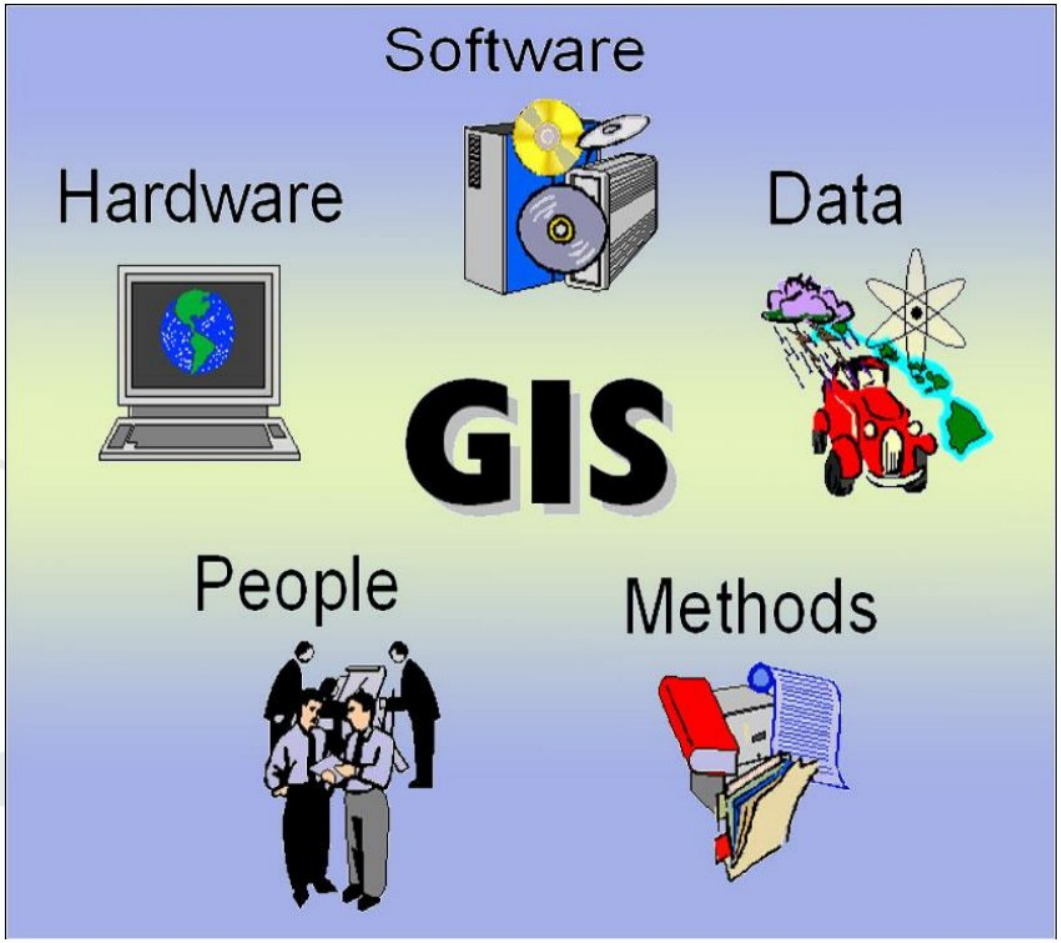
Raster Data Structure Vector Data Structure

Vector data structure

The other (and most common) form of GIS data structure is the vector data structure or object approach. Geographical objects are constructed of point, lines and polygons. In the view above the house is a polygon, constructed of lines that change direction at points.

Components of GIS

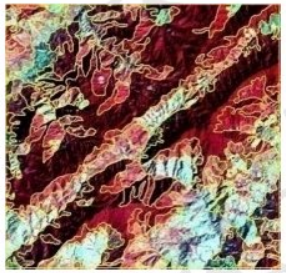
- **Hardware**: These are the devices that the user interacts directly in carrying out GIS operations, such as the computer, digitizer, plotter, etc.
- **Software**: It normally runs locally in the user's machine, also supports user to carry out multiple spatial analysis and management.
- **Data**: It is quite critical to GIS, contains either an explicit geographic reference, such as a latitude and longitude coordinate, or an implicit reference such as an address, postal code, census tract name, etc.
- **People:** It is most active components dealing with the design, programming, operation and management of GIS.
- **Method (Procedure):** It is more related to the management aspect of GIS, is referred to lines of reporting, control points, and other mechanism for ensuring the high quality of GIS.

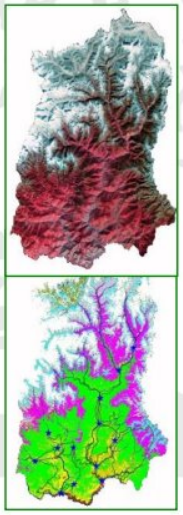


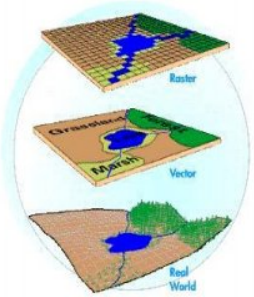
FUNCTIONS	MAJOR TASKS	LIMITATIONS
▪ Data collection ▪ Capture data ▪ Data storing, processing & analysis ▪ Store data ▪ Query data ▪ Analyze data ▪ Output production ▪ Display data ▪ Produce output	• *Input*: Digitalization from paper map, scanning and vector processing, image classification. • *Manipulation*: Before all the information are integrated, they must be transformed into same scale of resolution. • *Management*: The spatial and attribute database management. • *Query and viewing*: Once the data base is prepared, user can do any query on the data through GIS, e.g., where is the soil having land type MHL and clay-textured soils. • *Analysis*: GIS has many powerful tools to generate "what-if" scenario. For example, "Does drought exists in an area? How intensive is it? What is the extent and what will be the crop yield loss?" • *Visualization and printing*: Preparation of maps, legends, symbology, and other related elements, and providing facility to print from printers.	▪ Huge and high quality and reliable database is required for displaying quarries ▪ High speed computers and costly software ▪ Skilled technical personnel

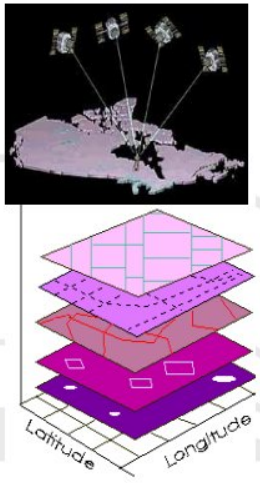
Trends In Technology

Aerial Photography	Satellite Remote Sensing Image Interpretation	Satellite Remote Sensing & Digital Image Processing	Satellite Remote Sensing & Geographic Information System (GIS)	Satellite Remote Sensing GIS & Global Positioning System	Satellite Remote Sensing GIS, Global Position System, Web communication & Virtual World
1960-1975	1975-1985	1985-1992	1990-1995	1995-2001	2001 - Beyond







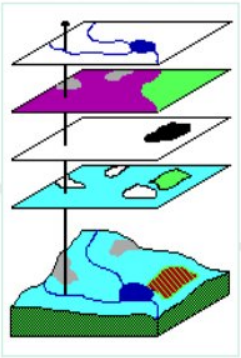


Trends In Application

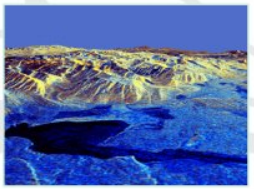
Topographic Mapping	Thematic Mapping	Widening of Thematic Disciplines	Integration of Thematic Information	Spatial Modelling	Decision Support System

- Geomorphology
- Geosciences
- Forestry
- Soils
- Water Resources

- Oceanography
- Marine Science
- Agriculture
- Fisheries
- Biodiversity
- Drinking Water



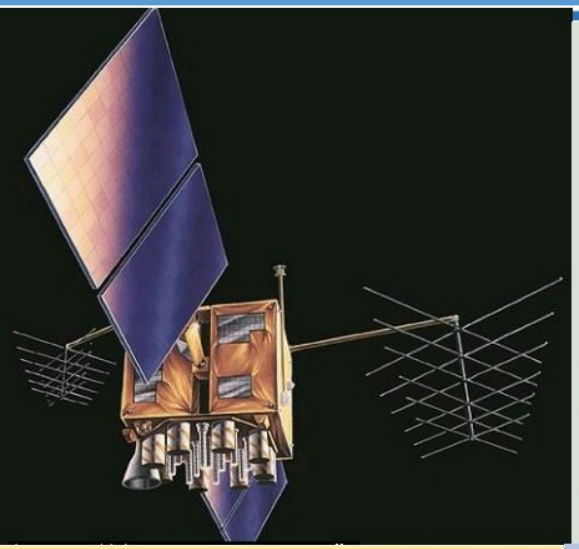
- Biodiversity Prioritisation Modeling
- Landslide Hazard Zonation Modeling



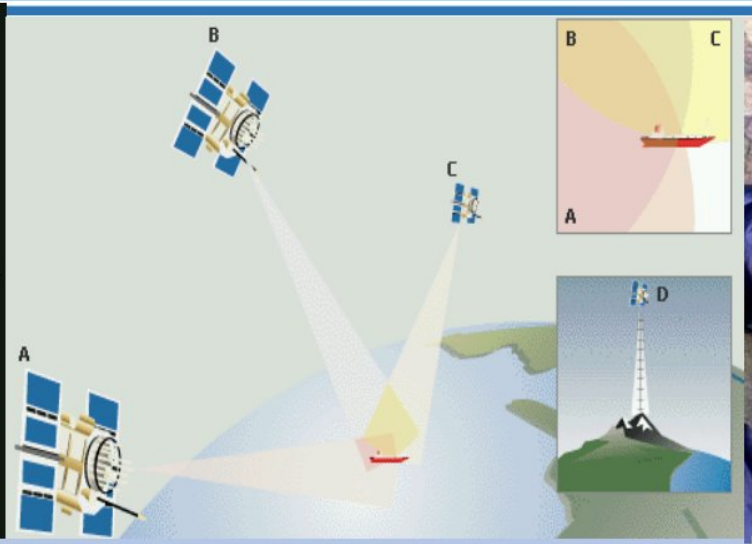
- Infrastructure Management
- Natural Resource Management
- Strategic Planning
- Land Management and Reform

.....-1975	1970-1980	1977-2001	1980-1995	1990-	Future trends

Global Positioning System (GPS)



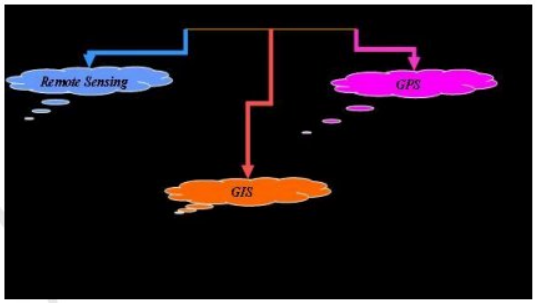
Total of 24 U.S. GPS satellites orbit overhead and provide accurate positioning and navigation information for both military & civilian use. Solar cells power each satellite and its atomic clocks. Antennas on a satellite continuously transmit timing information from the clocks. The signals can be picked up processed by a GPS receiver to determine exact location and altitude.



GPS satellites orbit high above the surface of Earth at precise locations. They allow a user with a GPS receiver to determine latitude, longitude, and altitude. The receiver measures the time it takes for signals sent from the different satellites (A, B, and C) to reach the receiver. From this data, the receiver triangulates an exact position. At any given time there are multiple satellites within the range of any location on Earth. Three satellites are needed to determine latitude and longitude, while a fourth satellite (D) is necessary to determine altitude.

GPS receivers use the signals from orbiting GPS satellites to determine location. The liquid crystal display of a basic GPS receiver shows latitude, longitude, and altitude. Advanced receivers display maps showing the user's location.

GEOINFORMATICS



LULC Change detection

- In this study, remote sensing and GIS techniques were used to extract spatial information of the Tons basin using satellite data of different spatial and temporal resolutions.
- Image classification was carried out to identify the features occurring in an image, which are actually present on the ground.
- Image processing satellite data and analysis of interpreted maps were carried out using ArcGIS 10.2.4 version software packages.
- Agricultural land is the dominant class in the basin followed by forest land which is second dominant class.