

**GIS** - Geographic Information System

**RS** - Remote Sensing

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# Topics Covered

## **GIS – Geographic Information System**

- Introduction to GIS
- Geospatial data
- Components of GIS
- Application of GIS

## **RS – Remote Sensing**

- Introduction to RS
- Information Extraction from Remote Sensing Imagery
- Types of RS
- Application of RS

# Geospatial Data

- Also called geographically referenced data
- Geospatial data are **data that describe both the locations and the characteristics of the spatial features such as roads, land parcels, and vegetation stands on the Earth's surface.**
- To describe a road, we refer to its location (i.e. where it is) and its characteristics (e.g.: length, name, speed, limit and direction)
- The location, also called geometry or shape, represents spatial data, whereas the characteristics are attribute data.

# Introduction to GIS

- A geographic information system (GIS) is a computer system designed to capture, store, manipulate, analyze, manage and present all types of spatial or geographical data.
- GIS applications are tools that allow users to create interactive queries (user created searches), analyze spatial information, edit data in maps and present the results of all these operations.

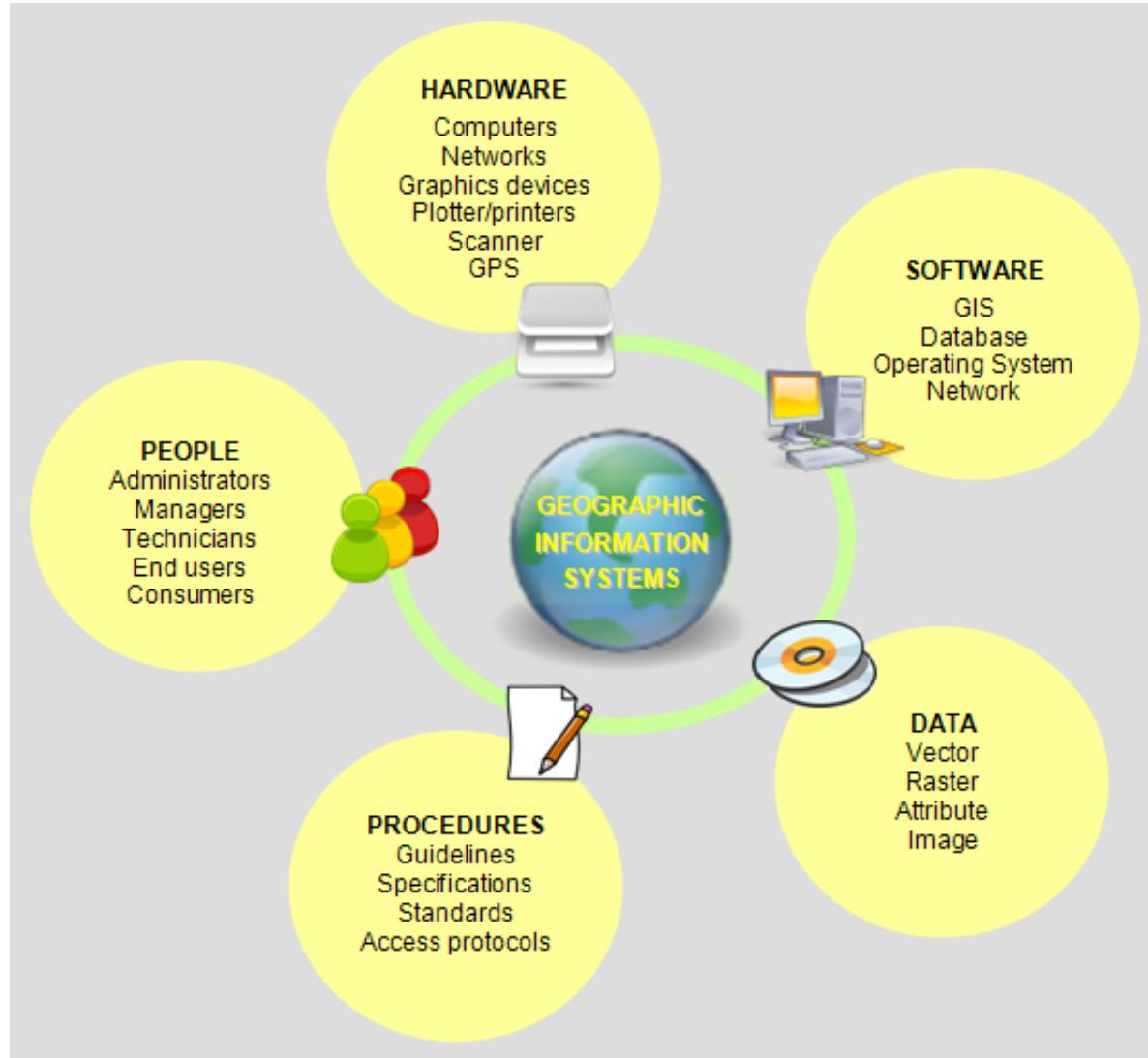
# GIS answers the following

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- **Location:** What is at...?
- **Condition:** Where is it?
- **Trends:** What has changed since...?
- **Patterns:** What spatial patterns exist?
- **Modeling:** What if...?

*Exploring data using GIS turns data into information into knowledge*

# Components of GIS



# Contd...

## **1. Computer System (Hardware)**

- The computer system includes the computer and the operating system to run GIS.
- Additional equipment may include monitors for display, digitizers and scanners for spatial data input, GPS receivers and mobile devices for fieldwork and printers and plotters for hard-copy data display.

# Contd...

## **2. Software**

- The GIS software includes the program and the user interface for driving the hardware. Common user interfaces in GIS are menus, graphical icons, command lines, and scripts.
- Software provides the functions and tools required to store, analyze and display the spatial data.
- This includes the GIS software, database and the drawing software.

# Contd...

### **3. Data**

- Data is the core of any GIS.
- Data consist of various kinds of inputs that the system takes to produce information.
- There are two types of data used in a GIS - spatial and tabular (also known as *attribute data*).
- The availability and accuracy of data will affect the results of any analysis.
- A GIS can integrate data from a number of different sources and store in a database management system.

# Contd...

## 4. People

- People refers to GIS professionals and users who define the purpose and objectives and provide the reason and justification for using GIS.
- GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.

Contd...

## **5. Infrastructure**

- The infrastructure refers to the necessary physical, organizational, administrative and cultural environments that support GIS operations.
- The infrastructure include requisite skills, data standards and general organizational patterns.

# Tools for a GIS

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- **Hardware**

- Computer
- Printer / Plotter
- Digitizer
- Scanner

- **Software**

- Desktop GIS
- CAD Software
- Internet Browser GIS
- Database software

- **Data**

- Spatially referenced data
- Non-spatial data
- Multimedia (Photos, Video, 3D Models)

- **World Wide Web**

- **GIS Personnel**

GEOGRAPHICAL DATA CAN BE REPRESENTED  
AS THREE DIFFERENT TYPES OF  
GEOMETRICAL OBJECTS IN A GIS

- ▶ 1 POINT OBJECTS (E.G. DRILL HOLES,  
SAMPLE POINTS, WELLS ETC)
- ▶ 2 LINES (ROADS, WATERCOURSES AND  
BORDERS)
- ▶ 3 POLYGONS (LAND USE, LAKES AND  
PROPERTIES)

# Applications

- ⌘ What is where?

- ─ Query and info. retrieval - e.g. MapQuest, Google Maps

- ⌘ What geographic patterns exist?

- ─ E.g. Geostatistics; e.g. prediction of ore grades from limited data

- ⌘ Where have temporal changes occurred?

- ─ E.g. LULC change, water table levels, morphologic studies

- ⌘ Where do certain conditions apply?

- ─ E.g. suitability analyses - "where is the best place for..."

- ⌘ "What if" forward modeling; what are spatial implications for certain actions?

- ─ E.g. mine reclamation

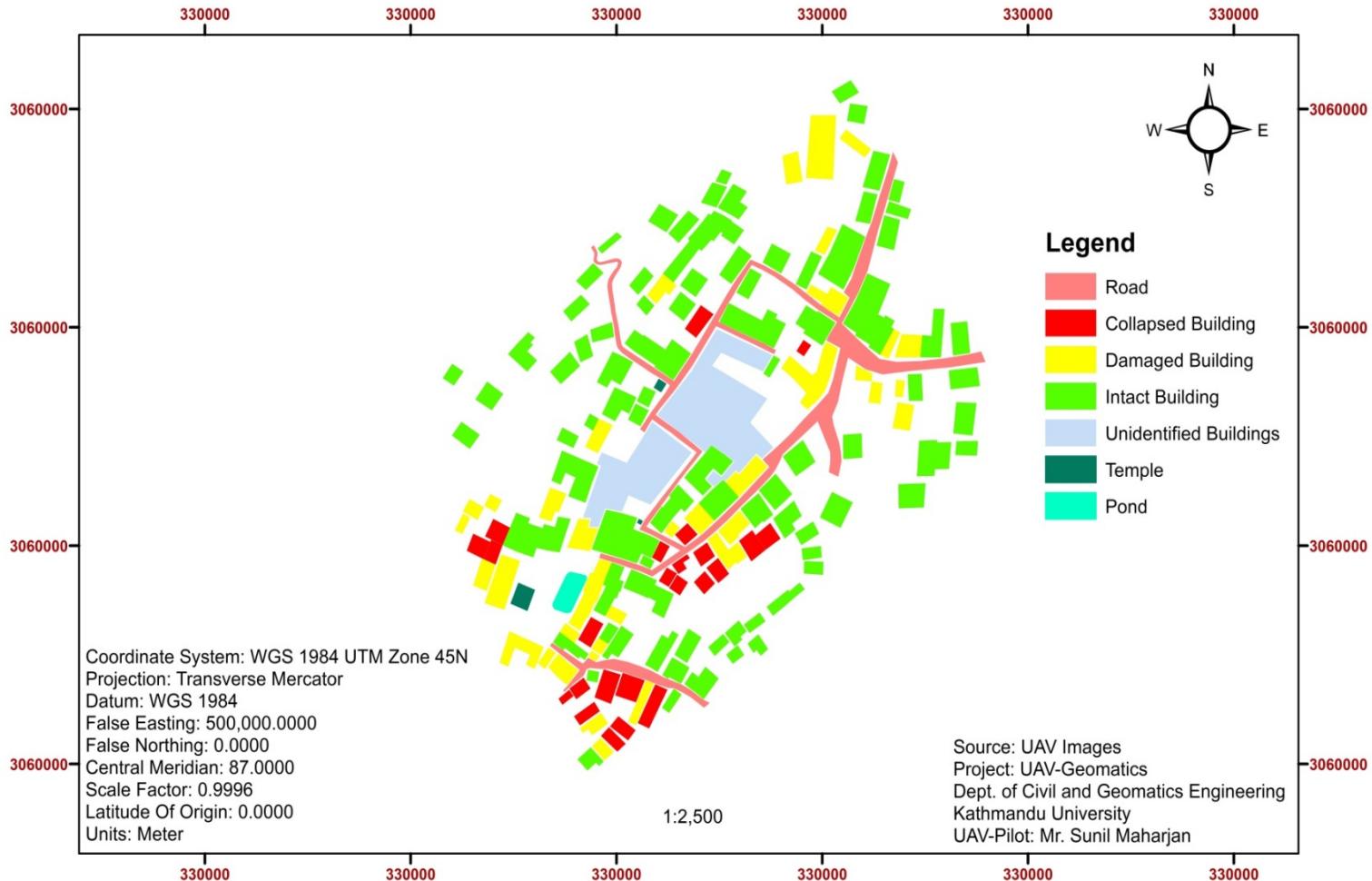


GIS may aid in disaster assessment and recovery. These satellite images from Banda Aceh, Indonesia, illustrate tsunami-caused damage to a shoreline community. Emergency response and longer term rebuilding efforts may be improved by spatial data collection and analysis(courtesy Digital Globe).



## Preliminary Earthquake Damage Assessment of Panga, Kirtipur

### May, 2015



Aqua

Tera

Aster

Landsat

MODIS

IKONOS

MERIS

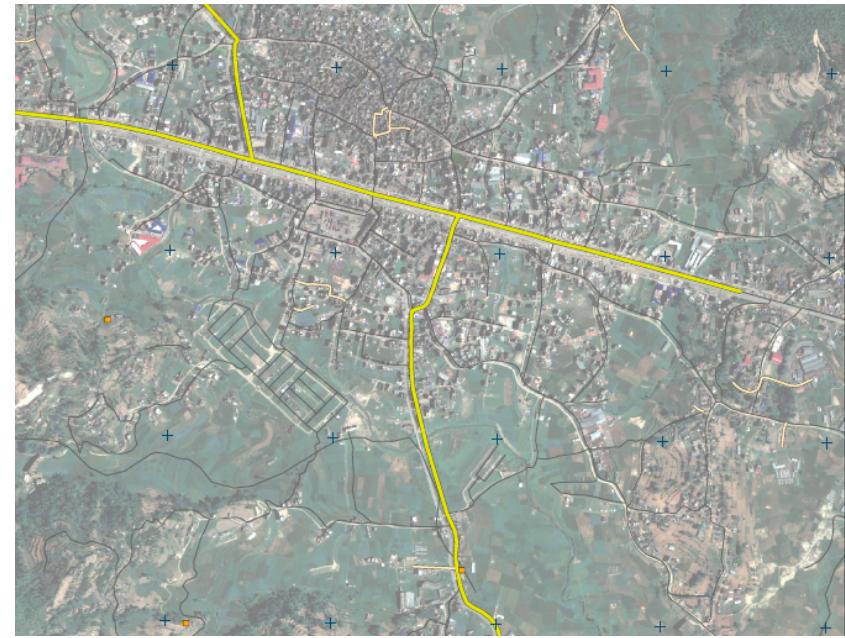
AVHRR

SPOT

HyMap

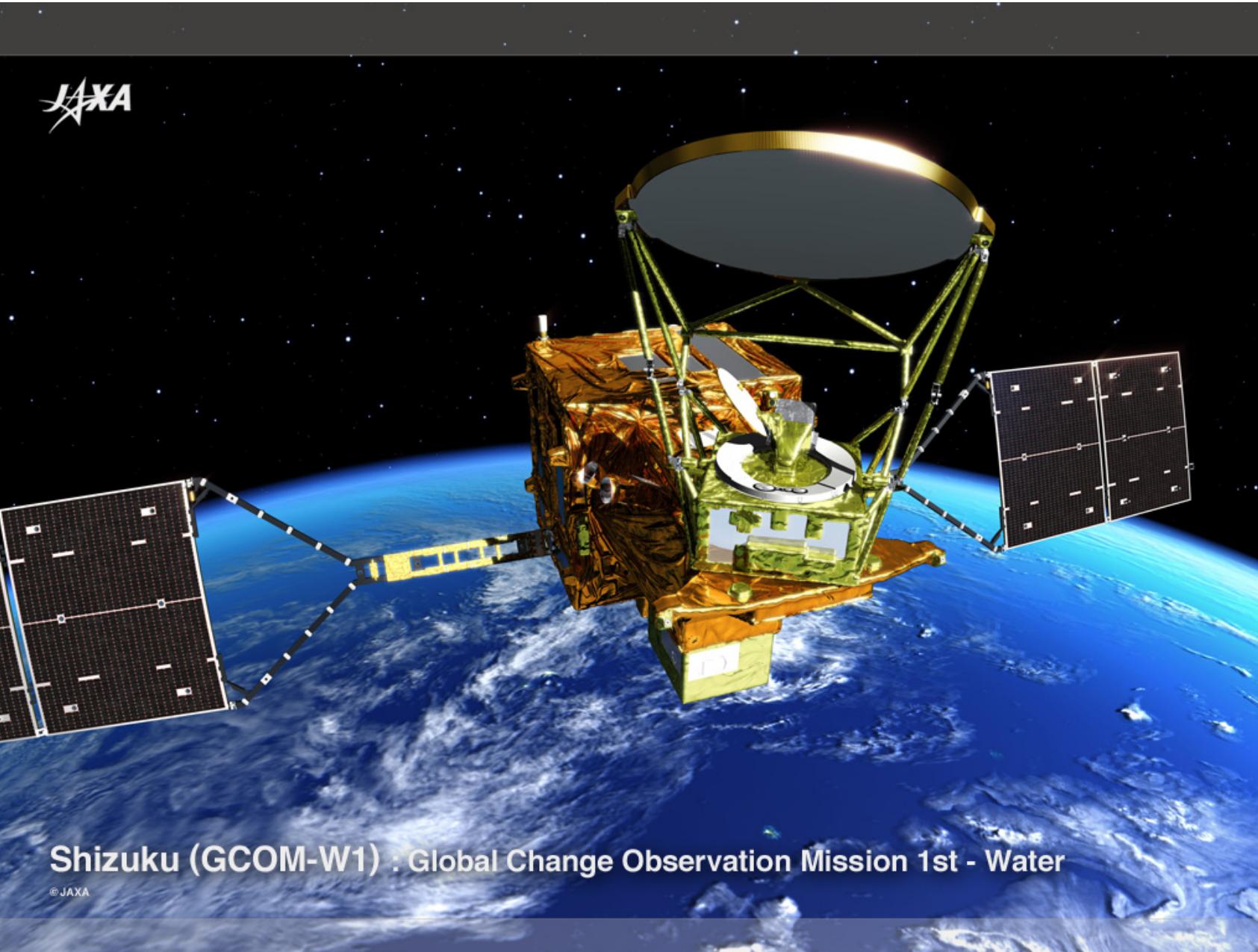
Quickbird

ALI



# RS – Remote Sensing





**Shizuku (GCOM-W1) : Global Change Observation Mission 1st - Water**

© JAXA

# Introduction

- ✓ Remote Sensing is an Art, science and technology of observing an object, scene or phenomenon by instrument-based techniques without physical contact.
- ✓ The process of use of electromagnetic radiation sensors to record images of the environment ,which can be interpreted to produce useful information.

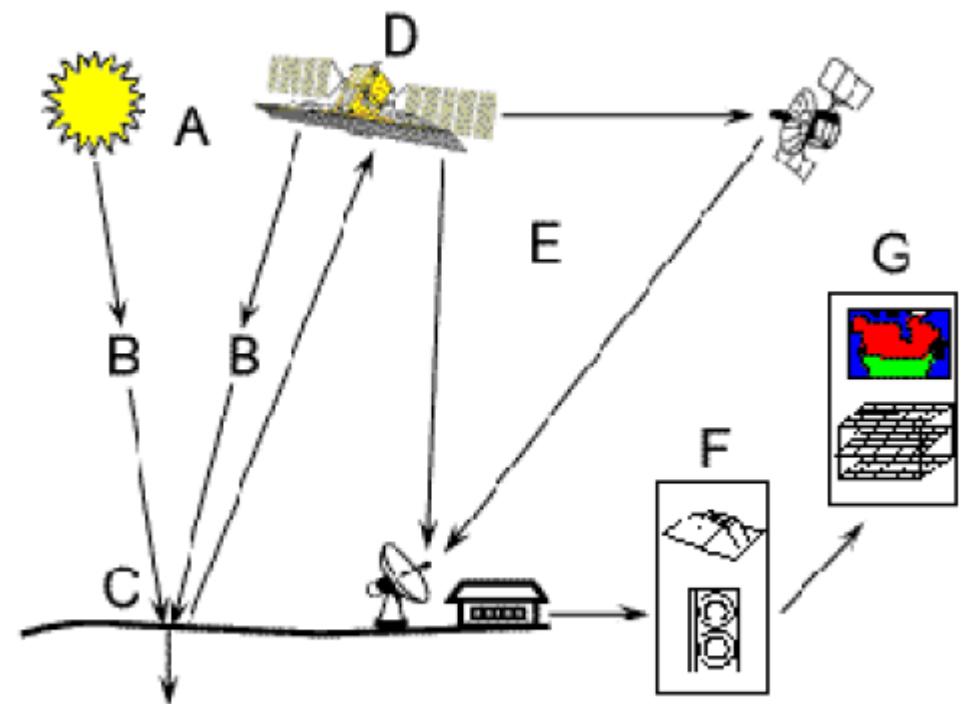
# Contd...

- In remote sensing, the sensors are not in direct contact with the objects or events being observed.
- The information needs a physical carrier to travel from the objects/events to the sensors through an intervening medium.
- The electromagnetic radiation is normally used as an information carrier in remote sensing.
- The output of a remote sensing system is usually an image representing the scene being observed.
- A further step of image analysis and interpretation is required in order to extract useful information from the image.

# Contd...

## Process Involved

- A – Energy Source or Illumination
- B – Radiation and the Atmosphere
- C – Interaction with the Target
- D – Recording of Energy by the Sensor
- E – Transmission, Reception and Processing
- F – Interpretation and Analysis
- G - Application



© CCRS / CCT

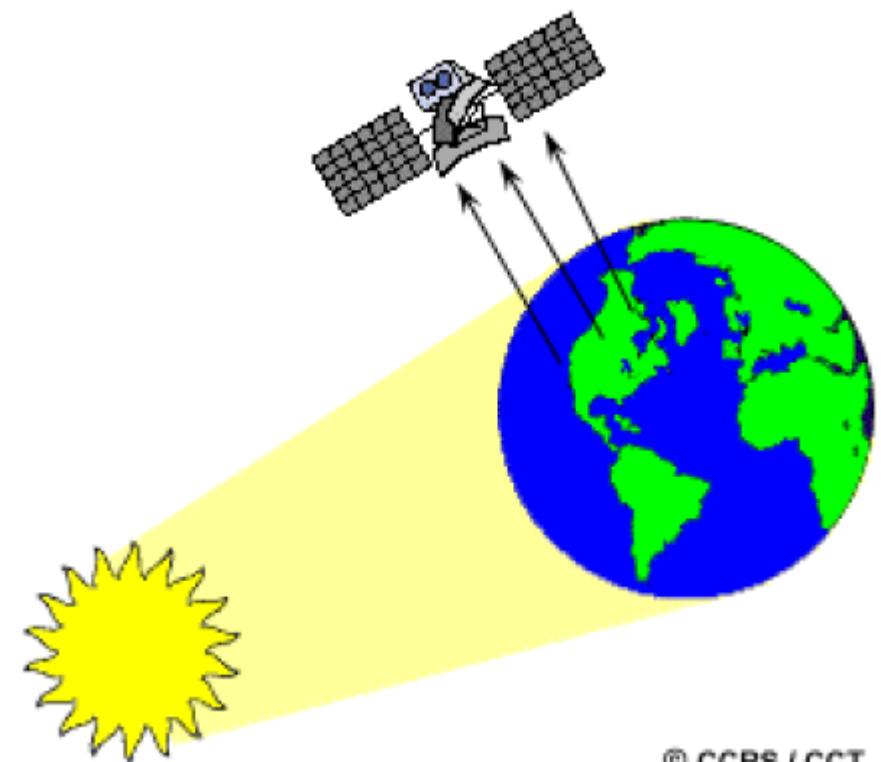
# Why remote sensing?

- For real time measurements
- High repeatability
- Global, inaccessible/secure areas
- Multi purpose
- Cost effective (can be)

# Types of RS

## 1. Passive Remote Sensing

- Remote sensing systems which measure energy that is naturally available
- Sun is the major source of energy
- Passive sensors can only be used to detect energy when the naturally occurring energy is available.
- Energy that is naturally emitted (such as thermal infrared) can be detected day or night, as long as the amount of energy is large enough to be recorded.

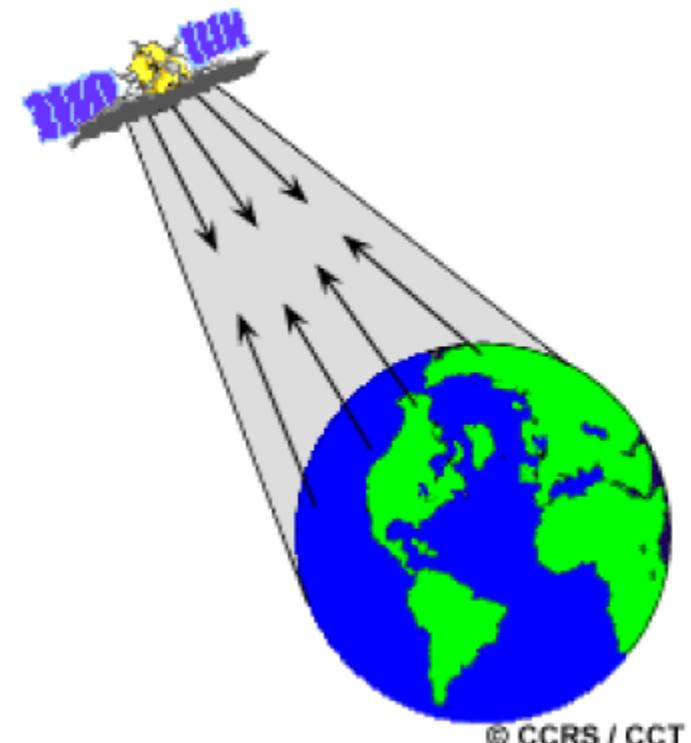


© CCRS / CCT

# Types of RS

## 2. Active Remote Sensing

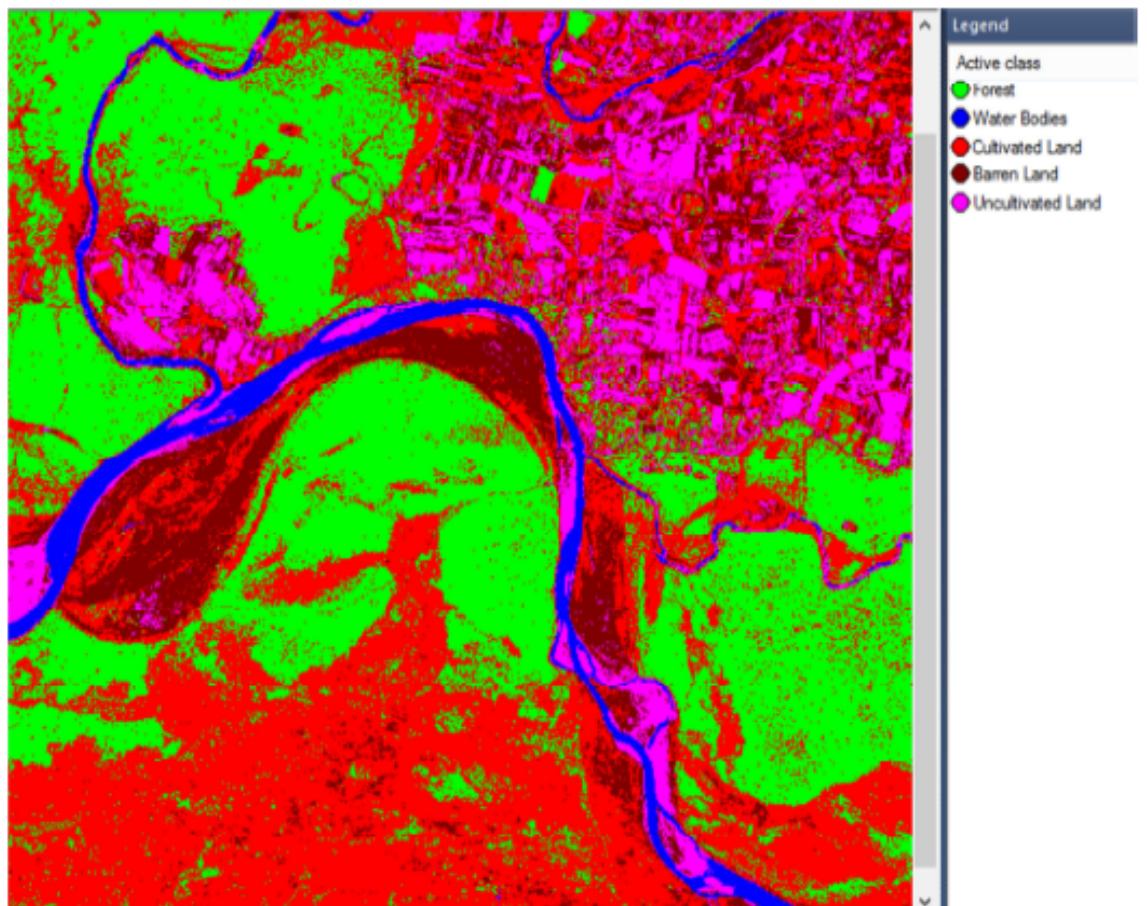
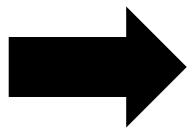
- Remote sensing systems where the energy is emitted to scan the objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target.



# Application of RS

- Environmental assessment and monitoring (Urban growth, hazardous waste)
- Global change detection and monitoring (atmospheric ozone depletion, deforestation, global warming)
- Agriculture (crop condition, yield prediction, soil erosion)
- Non-renewable resource exploration (minerals, oil, natural gas)
- Meteorology (atmosphere dynamics, weather prediction)
- Mapping (topography, land use, civil engineering)
- Military surveillance and reconnaissance (strategic policy, tactical assessment)

# Examples



# A sample remote sensing image



## **Data Source:**

- Landsat: [landsat.usgs.gov](http://landsat.usgs.gov) or [www.earthexplorer.usgs.gov](http://www.earthexplorer.usgs.gov)
- AVHRR: <http://nsidc.org/data/avhrr/>
- MODIS: <http://modis.gsfc.nasa.gov/>
- MODIS Level 1 data, geolocation, cloud mask, and Atmosphere products:  
<http://ladsweb.nascom.nasa.gov/>
- MODIS land products: <https://lpdaac.usgs.gov/>
- MODIS cryosphere products: <http://nsidc.org/daac/modis/index.html>
- MODIS ocean color and sea surface temperature products: <http://oceancolor.gsfc.nasa.gov/>



**THANK YOU**  
*for your attention!*