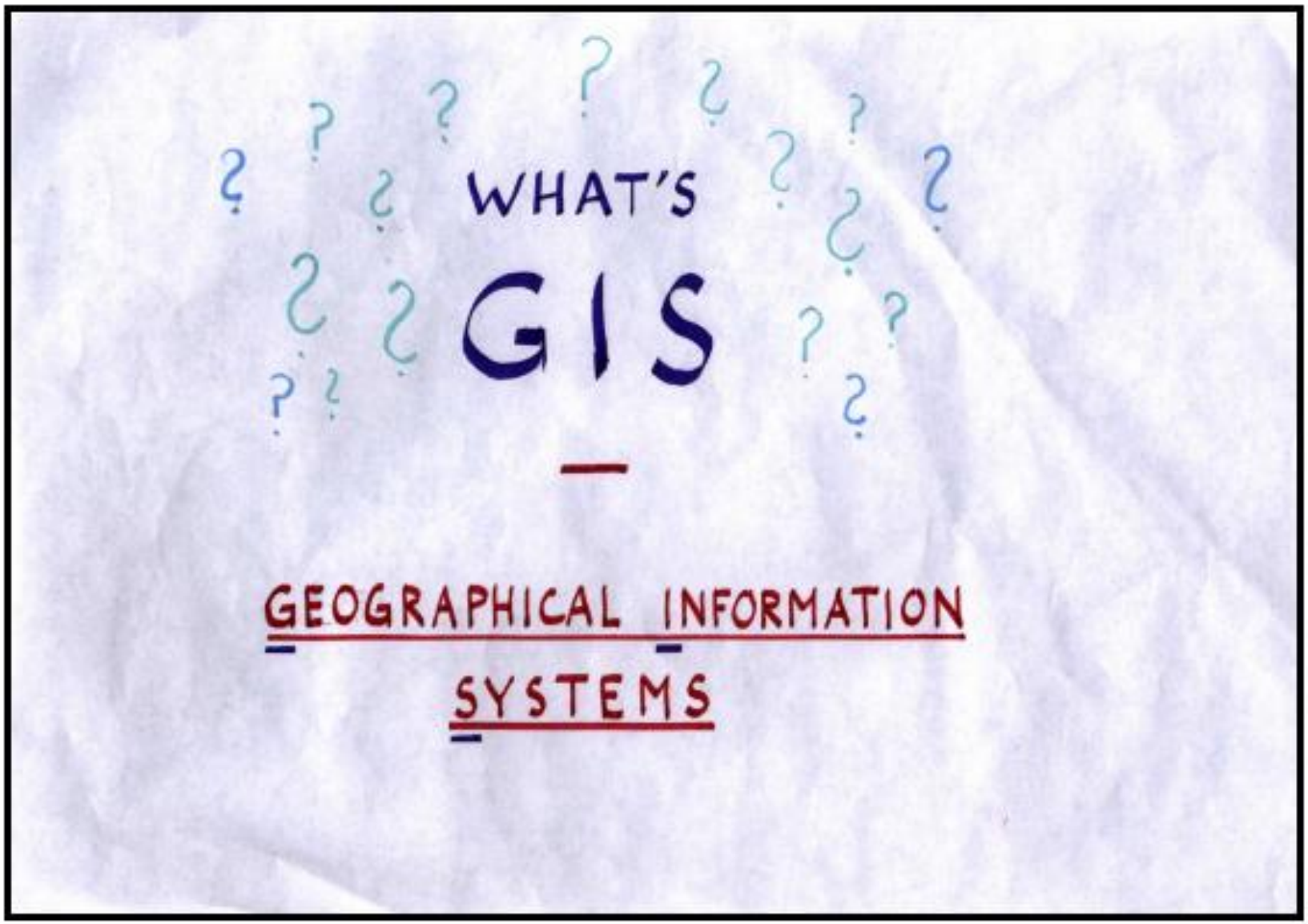
ELEMENTS OF ENGINEERING (ENGG111)

GIS AND REMOTE SENSING

Presented by:
Er. Sudin Adhikari
BE in Geomatics Engineering
sudinadhi2662@gmail.com


WHAT'S
GIS
—
GEOGRAPHICAL INFORMATION
SYSTEMS

What is a GIS?

At the most basic level, a GIS is a computer system capable of storing and manipulating spatial data

What is GIS?

- Geographic Information System
- A GIS is a tool for making and using spatial information. Although there are many formal definitions of GIS, for practical purposes we define GIS as: a computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information.

GIS answers the following

- **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

- A GIS is comprised of hardware, software, data, humans, and a set of organizational protocols.
- These components must be well integrated for effective use of GIS, and the development and integration of these components is an iterative, ongoing process.
- The selection and purchase of hardware and software is often the easiest and quickest step in the development of a GIS.
- Data collection and organization, personnel development, and the establishment of protocols for GIS use are often more difficult and time-consuming endeavours.

Tools for a GIS

- 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)

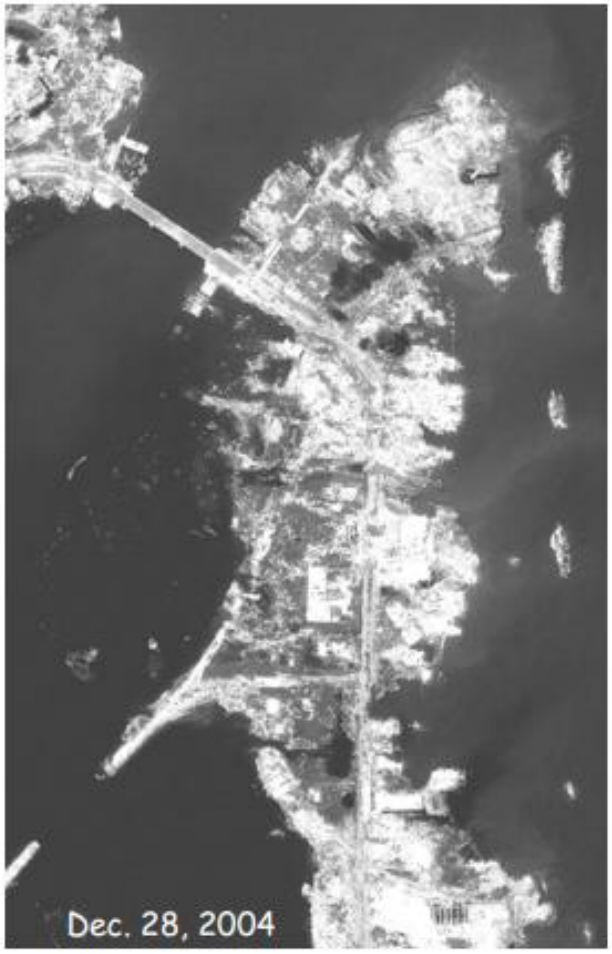
3. POLYGONS (LAND USE, LAKES AND PROPERTIES)

Applications

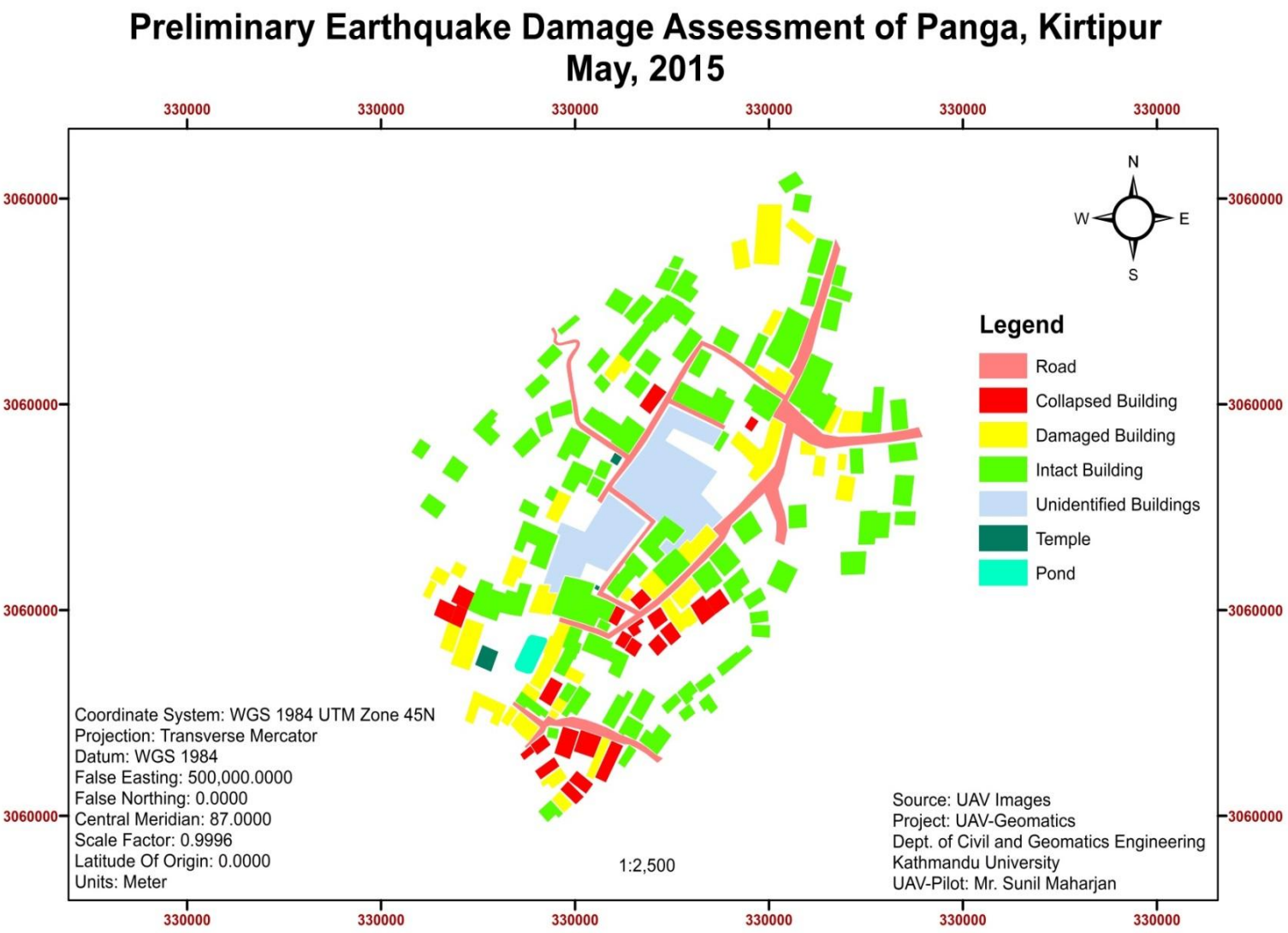
- What is where?
  - Query and info. retrieval – e.g. MapQuest, Google Maps
- What geographic patterns exist?
  - E.g. Geostatistics; e.g. prediction of ore grades from limited data
- Where have temporal changes occurred?
  - E.g. LULC change, water table levels, morphologic studies
- Where do certain 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

The Five M's

- Mapping
  - Accuracy, Reproducibility, Portability, Customization
- Measuring
  - Automation, Accuracy
- Modeling
  - Scaling, Verifiability, Analytical Tools
- Monitoring
  - Automation, Flexibility
- Management
  - Storage, Updating, Data Integrity, Security



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
330000
3060000
N
W
E
S
Legend
Road
Collapsed Building
Damaged Building
Intact Building
Unidentified Buildings
Temple
Pond
Coordinate System: WGS 1984 UTM Zone 45N
Projection: Transverse Mercator
Datum: WGS 1984
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: 87.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
1:2,500
Source: UAV Images
Project: UAV-Geomatics
Dept. of Civil and Geomatics Engineering
Kathmandu University
UAV-Pilot: Mr. Sunil Maharjan

Questions you need to know?

- Define GIS
- List five application of GIS
- Name the components of GIS
- How can be following features represented in GIS

  - Mountains
  - Houses
  - Forest
  - Rainfall

Remote Sensing

DEFINITION

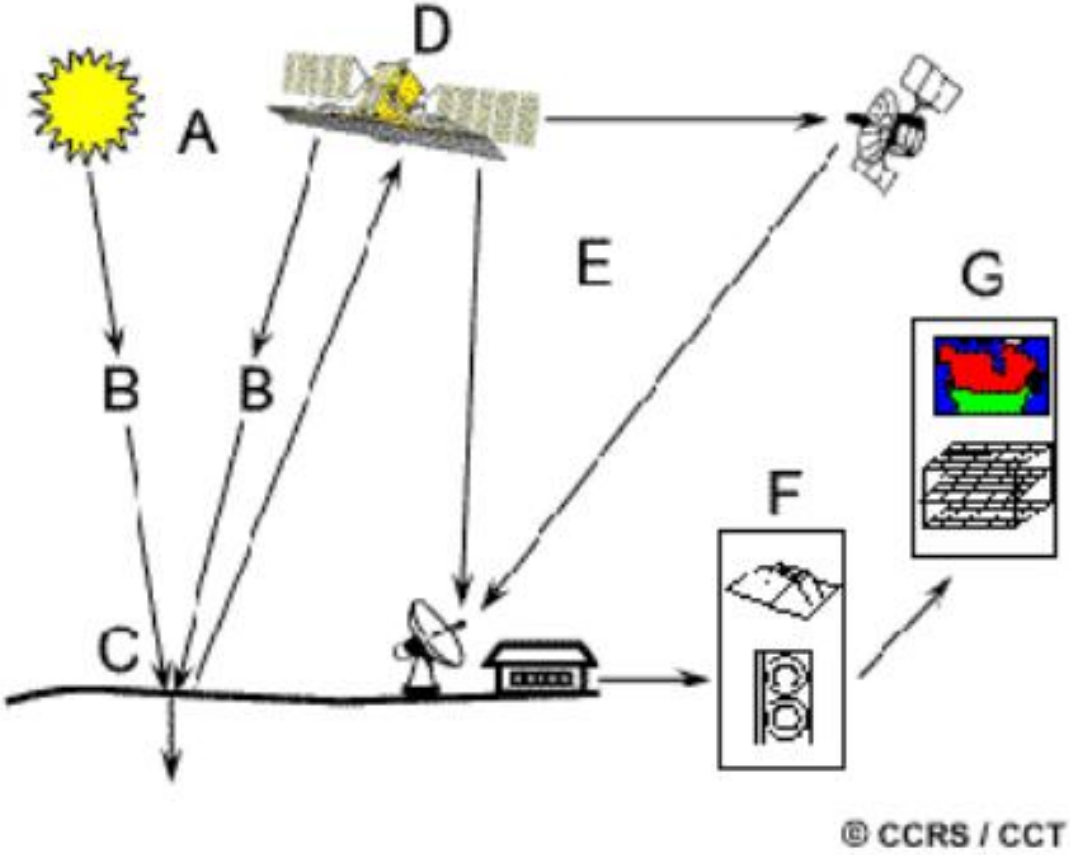
- ✓ Remote Sensing is an Art, science and technology of observing an object, scene or phenomenon by instrument-based techniques without physical contact.
- ✓ The process of use of electromagnetic radiation sensors to record images of the environment ,which can be interpreted to produce useful information.

Contd…

- ✓ Remote sensing is the science (and to some extent, art) of acquiring information about the Earth's surface without actually being in contact with it. This is done by sensing and recording reflected or emitted energy and processing, analyzing, and applying that information.

"Knowing Without going"

Remote Sensing Process



Why remote sensing?

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

Types of remote sensing

- Active remote sensing
- Passive remote sensing

Passive and active Remote Sensing

Remote sensing systems which measure energy that is naturally available are called **passive sensors.** Passive sensors can only be used to detect energy when the naturally occurring energy is available. For all reflected energy, this can only take place during the time when the sun is illuminating the Earth. There is no reflected energy available from the sun at night.

Passive and active Remote Sensing

Active sensors, on the other hand, provide their own energy source for illumination. The sensor emits radiation which is directed toward the target to be investigated. The radiation reflected from that target is detected and measured by the sensor.

Active sensors can be used for examining wavelengths that are not sufficiently provided by sun such as microwave.

A camera provides an excellent example of both active and passive sensors.

Passive and active Remote Sensing

Passive Sensors

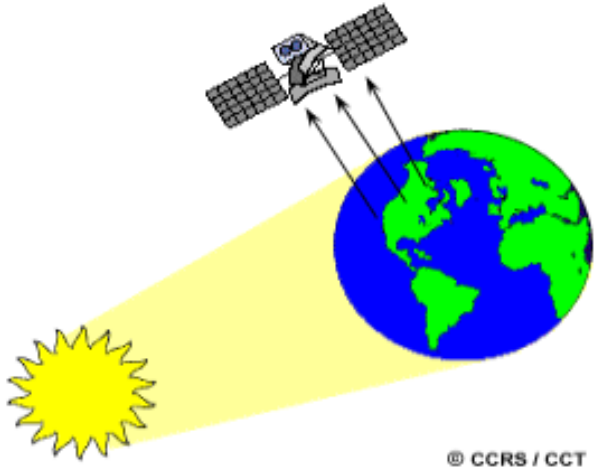
- Passive sensors measure energy that is naturally available.
- Require sunlight/ emission from ground objects.
- Normally shorter wavelengths are used.
- Limited control on the way that a target is illuminated.
- Most often the natural source of EM energy is sun, sometimes earth.
- Clouds ,dust, smoke, and other particals in the atmosphere can block reflected energy from target to sensor.
- Measurements are less controlled because of varying illumination condition.

Passive and active Remote Sensing

Active Sensors

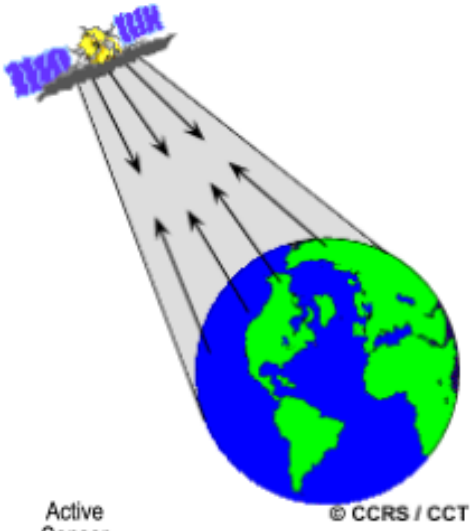
- Active sensors provide their own energy source for illumination.
- Can obtain measurements anytime, regardless of the time of day or season.
- Normally longer wavelengths are used.
- Examine wavelengths that are not sufficiently provided by the sun (microwaves).
- Better control the way that a target is illuminated.
- Measurements are more controlled because they don't depend on varying illumination condition.
- Less effect of dust, smoke and other particles in atmosphere because of longer wavelength.

Passive and active Remote Sensing



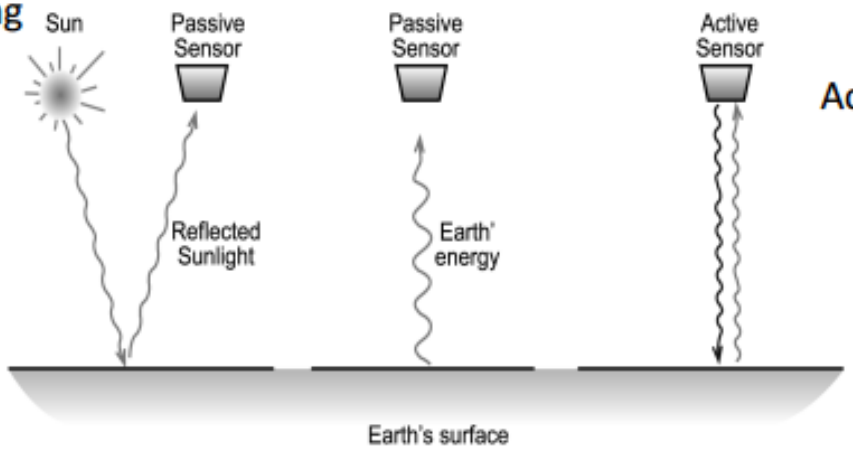
© CCRS / CCT

Passive Remote Sensing



© CCRS / CCT

Active Remote Sensing



Application of remote sensing

- Agriculture - Crop monitoring, Forecasting and Estimation
- Disaster monitoring and mitigation
- Surveying and urban planning
- Glacier monitoring
- Hydrological modelling and flood simulation
- Water resource management
- Environmental monitoring
- Mineral exploration
- Telecommunication

Data Sources

- Landsat
- MODIS
- AVHRR


THANK YOU
for your attention!