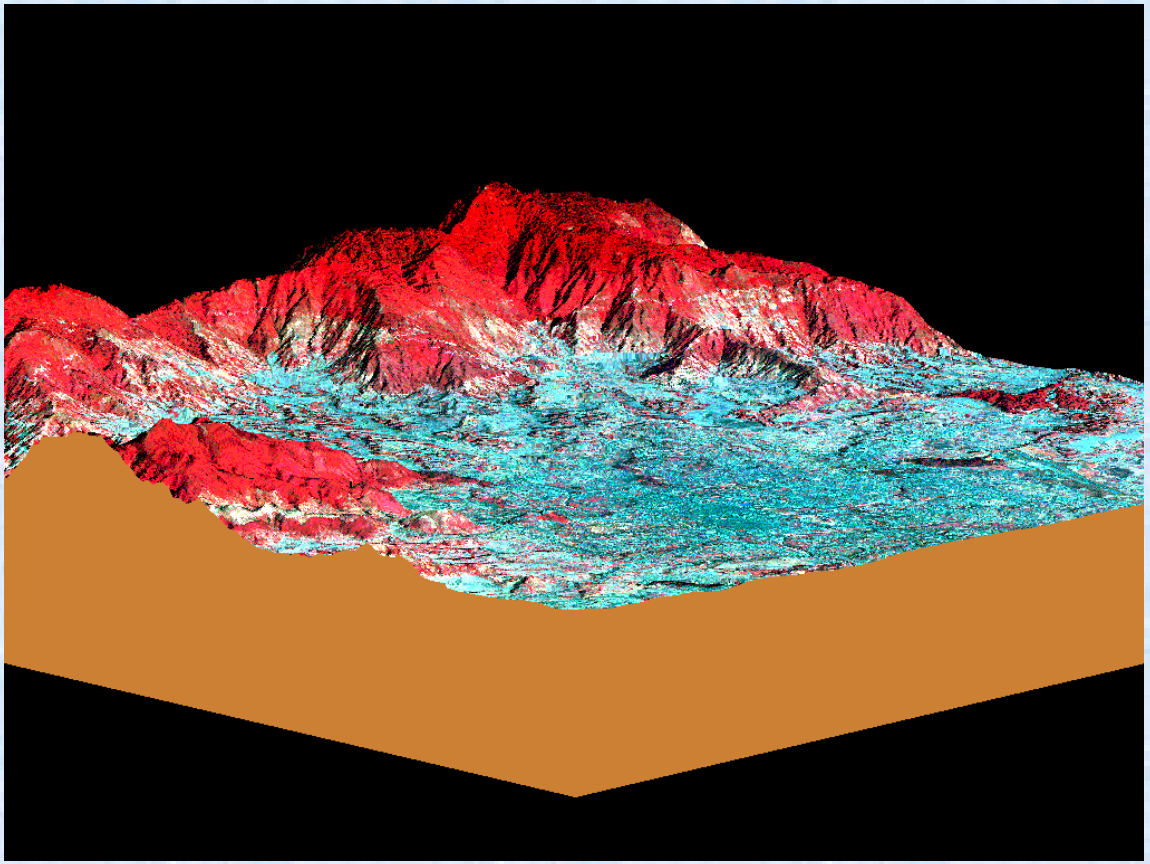
# Remote Sensing

is the science and art of acquiring information (spectral, spatial, temporal) about material objects, area, or phenomenon through the analysis of data acquired by a device from measurements made at a distance, without coming into physical contact with the objects, area, or phenomena under investigation.

# Remote Sensing



# The Major Components Of Remote-sensing Technology

1. **ENERGY SOURCE** (PASSIVE SYSTEM: sun, irradiance from earth's materials; ACTIVE SYSTEM: irradiance from artificially-generated energy sources such as radar)

2. **PLATFORMS** (Vehicle to carry the sensor) (truck, aircraft, space shuttle, satellite, etc.)

3. **SENSORS** (Device to detect electro-magnetic radiation) (camera, scanner, etc)

4. **DETECTORS** (To convert electro-magnetic radiation into recorded signals) (film, silicon detectors, etc)

5. **PROCESSING** (Handling signal data) ( photographic, digital, etc)

6. **INSTITUTIONALISATION** (Organization for execution at all stages of remote-sensing technology: international and national organizations, centers, universities, etc

# TYPES OF REMOTE SENSING
# ON THE BASIS OF ENERGY SOURCE

# Passive Remote Sensing

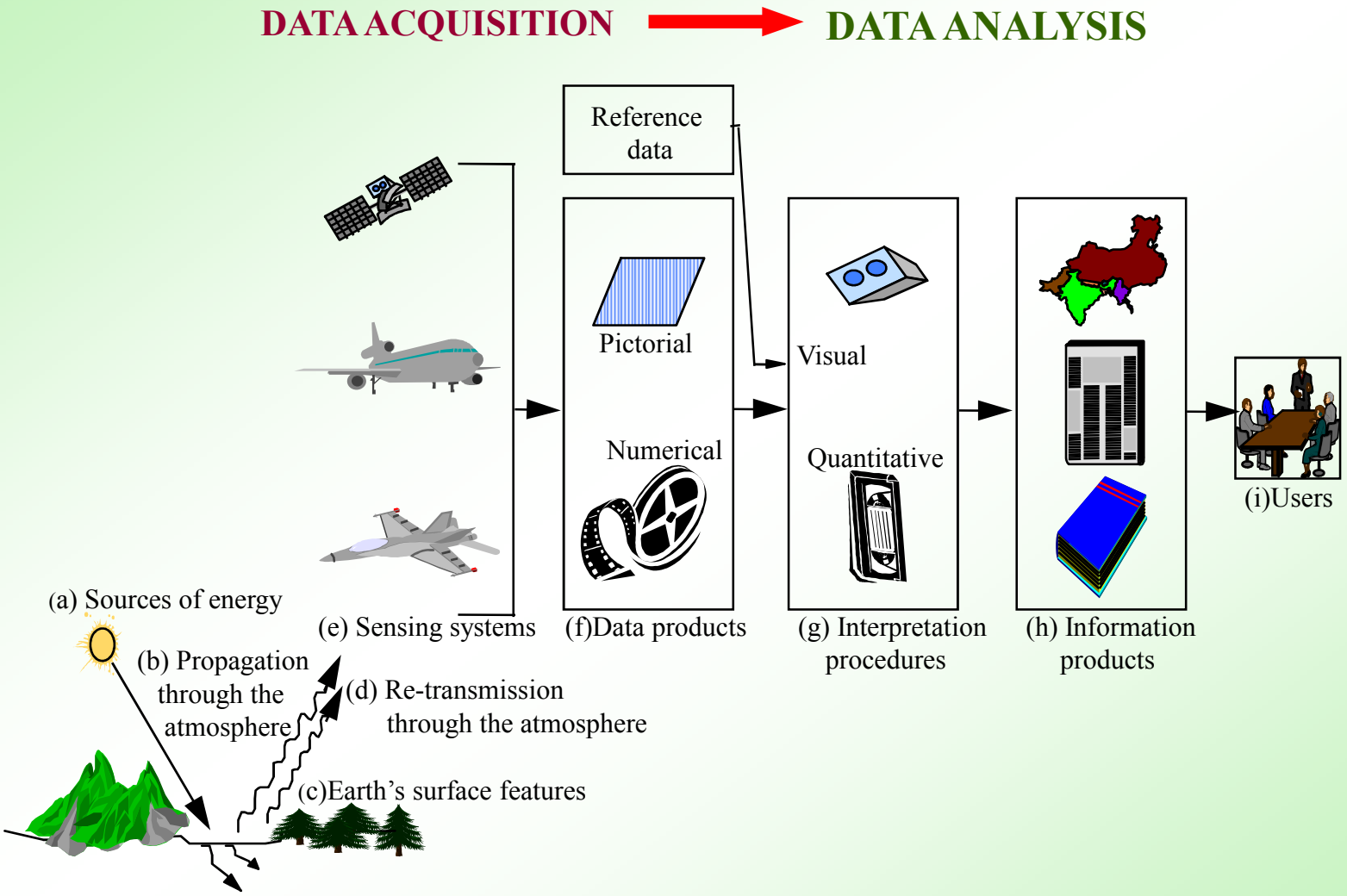
**makes use of sensors that detect the reflected or emitted electro-magnetic radiation from natural sources.**

# Active Remote Sensing

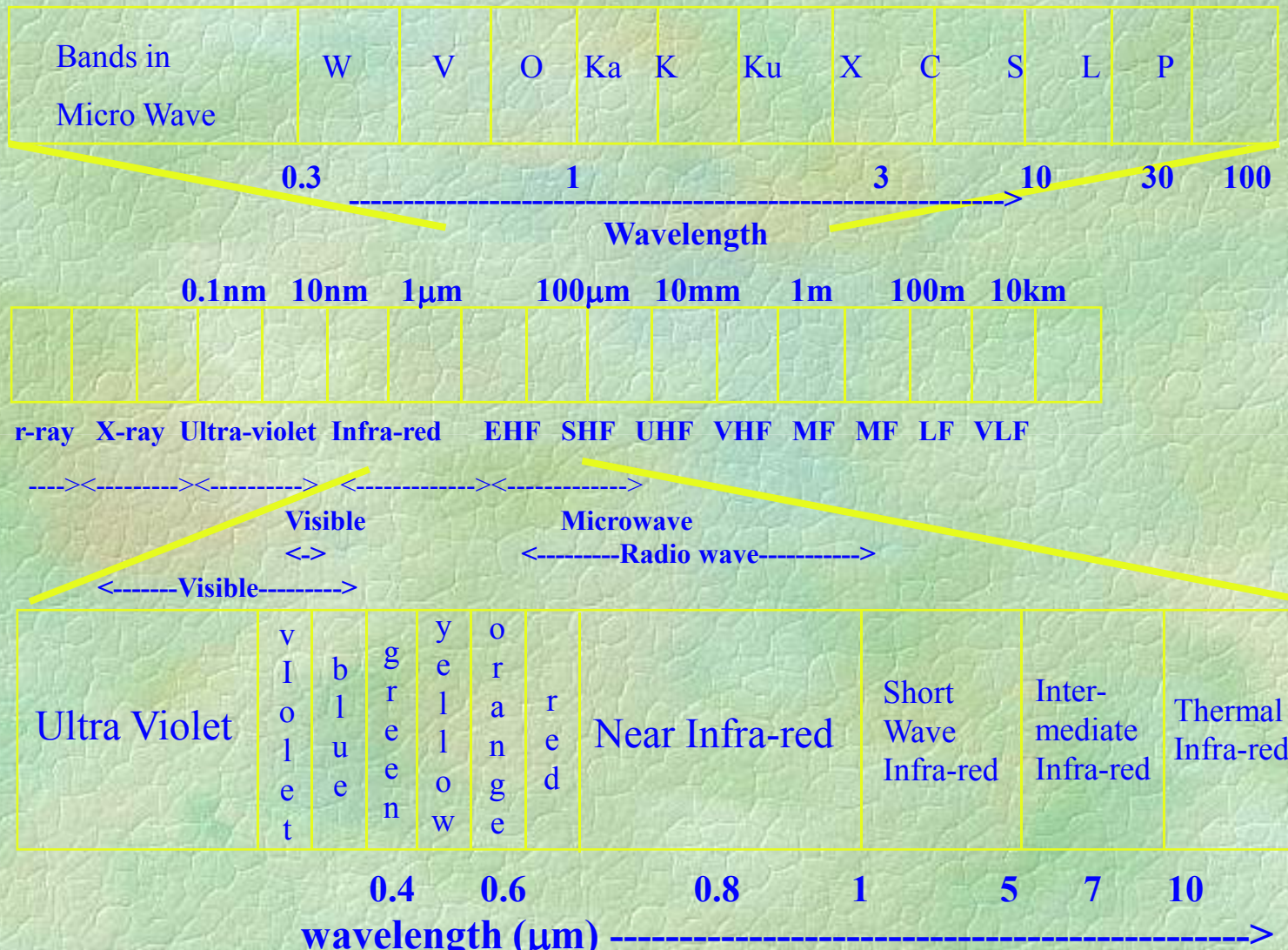
**makes use of sensors that detect reflected responses from objects that are irradiated from artificially-generated energy sources, such as radar.**

# MECHANISM OF REMOTE SENSING

# Electro-magnetic remote sensing of the earth's resources



# Figure 1: The Bands Used in Remote Sensing



# Classification of Electro-Magnetic Radiation (EMR)

| Class | Wavelength | Frequency |
|---|---|---|
| Ultraviolet | 100 A - 0.4 µm | 750 - 3,000 THz |
| Visible | 0.4 - 0.7 µm | 430 - 750 THz |
| (Infrared) | 0.7 - 1.3 µm | 230 - 430 THz |
| Near Infrared | 1.3 - 3µm | 100 - 230 THz |
| Intermediate Infrared | 3 - 8µm | 38 - 100 THz |
| Thermal Infrared | 8 - 14µm | 22 - 38 Thz |
| Far Infrared | 14 µm - 1 mm | 0. 3 - 22 THz |
| (Radio wave) Sub-millimeter | 0.1 - 1mm | 0.3 - 3 THz |
| (Radio wave) Microwave : | | |
| Millimeter (EHF) | 1 - 10 mm | 30 - 300 GHz |
| Centimeter (SHF) | 1 - 10 cm | 3 - 30 GHz |
| Decimeter (UHF) | 0.1 -1 m | 0.3 - 3 THz |
| (Radio wave) | | |
| Very Short-Wave (VHF) | 1 -10 m | 30 -300 MHZ |
| Short-Wave (HF) | 10 - 100 m | 3 - 30 MHz |
| Medium Wave (MF) | 0.1 -1 km | 0.3 - 3 MHz |
| Long-wave (LF) | 1 - 10 km | 30 - 300 kHz |
| Very Long-wave (VLF) | 10 -100 km | 3 - 30 kHz |

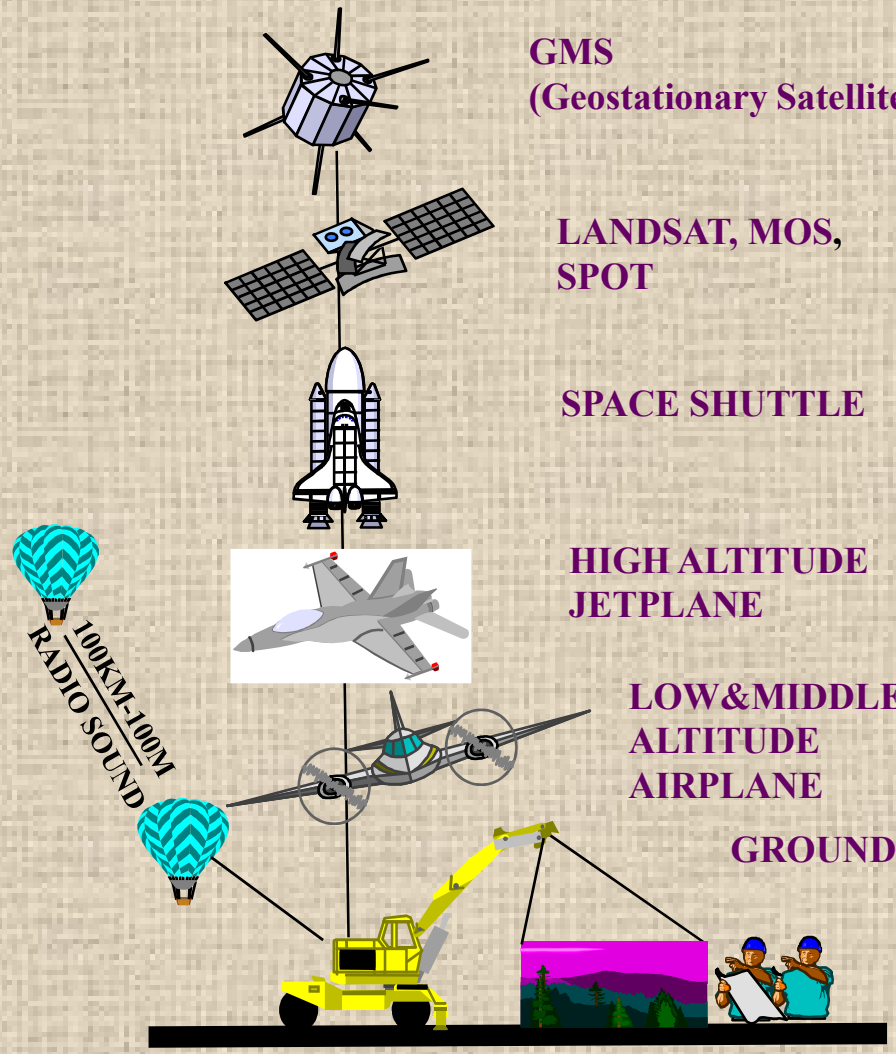
| Region | Wavelength | Remarks |
|---|---|---|
| Gamma Ray | <0.03 nm | Incoming radiation is completely absc atmosphere and is not available for remot |
| X-ray | 0.03 to 3.0 nm | Completely absorbed by the atmospher remote sensing. |
| Ultraviolet | 0.03 to 0.4 µm | In-coming wavelengths less than 0.3 absorbed by ozone in the upper atmosphe |
| Photographic UV band | 0.3 to 0.4 µm | Transmitted through the atmosphere. Det photo-detectors, but atmospheric scatterin |
| Visible | 0.4 to 0.7 µm | Imaged with film and photo-detectors. I energy peak of earth at 0.5µm. |
| Infrared | 0.7 to 100 µm | Interaction with matter varies with wav transmission windows are separated by al |
| Reflected IR band | 0.7 to 3.0 µm | Reflected solar radiation that contains r thermal properties of materials. The band detectable with film and is called the *photo* |
| Thermal IR band | 3 to 5 µm<br>8 to 14µm | Principal atmospheric windows in the th at these wavelengths are acquired b scanners and special videocon systems, bu |
| Microwave | 0.1 to 30cm | Longer wavelengths can penetrate clo Images may be acquired in the active or p |
| Radar | 0.1 to 30 cm | Active form of microwave remote sensir acquired at various wavelength bands. |
| Radio | >30 cm | Longest wavelength portion of the electr Some classified radar with very long wave region. |

# Platforms

**The vehicles or carriers for remote sensors are called the platforms. Typical examples of platforms are satellites and aircraft, but they can also include radio-controlled aeroplanes, balloons, kites for low altitude remote sensing, as well as ladder trucks or ground investigations. The key factor for the selection of a platform is the altitude that determines the ground resolution and which is also dependent on the instantaneous field of view (IFOV) of the sensor on board the platform.**

# Remote-Sensing Platforms

| Orbit Elevation | Platforms |
|---|---|
| 36,000 km | GMS (Geostationary Satellite) |
| 1,000km | LANDSAT, MOS, SPOT |
| 500km | SPACE SHUTTLE |
| 240 - 350 km | HIGH ALTITUDE JETPLANE |
| 10,000 - 12,000m | LOW&MIDDLE ALTITUDE AIRPLANE |
| 1,200 - 3,500m | GROUND TRUTH |



# Platform Types And Observation Objects

| Platform | Altitude | Observation |
|---|---|---|
| geostationary satellite | 36,000km | fixed point observation |
| circular orbit satellite (earth observation) | 500km - 1,000km | regular observation |
| space shuttle | 240km - 350km | irregular observation space experiment |
| radio - sound | 100m - 100km | various investigations (meteorological, etc) |
| high altitude jet-plane | 10km -12km | reconnaissance<br>wide area investigations |
| low or middle altitude plane | 500m - 8,000m | various aero investigation surveys |
| helicopter | 100m- 2,000m | various aero investigation surveys |
| radio-controlled plane | below 500m | various aero investigation surveys |
| hang-plane | 50 - 500m | various aero investigation surveys |
| hang-balloon | 800m - | various investigations |
| cable | 10 - 40m | archaeological investigations |
| crane car | 5 - 50m | close range surveys |
| ground measurement car | 0 - 30m | ground truth |

# The Generation of Satellite Images : a combination of satellite orbit, earth rotation and sensor design

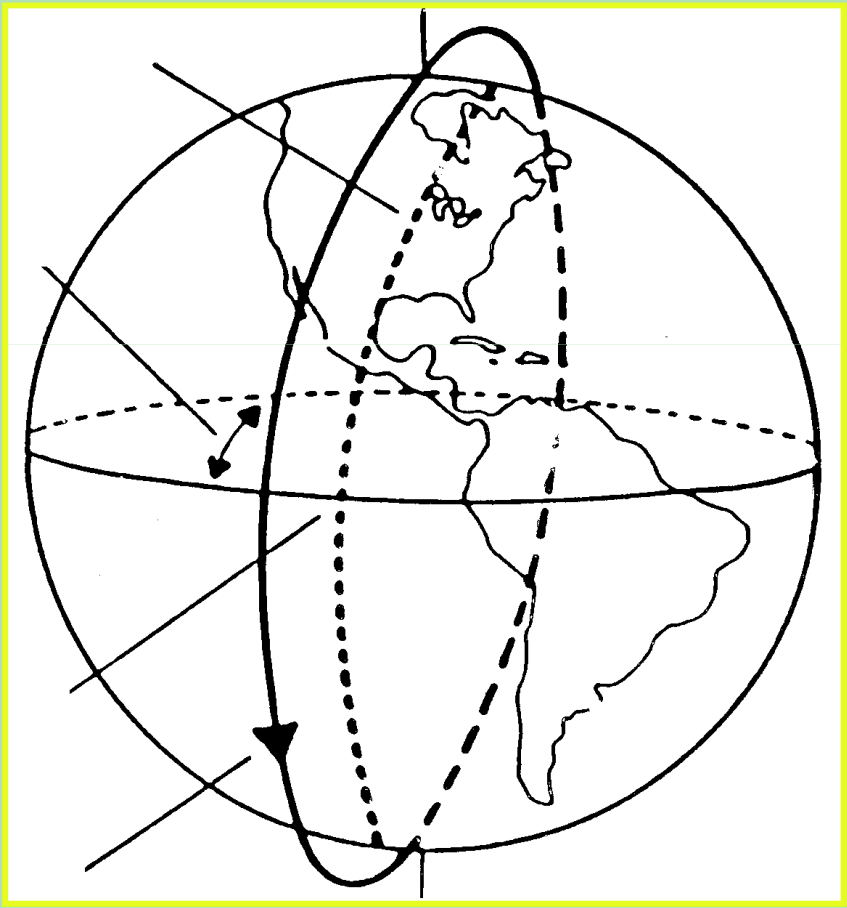
## Landsat 4/5 Orbit

GROUND TRACK

INCLINATION = 98.2$^{O}$

TIME OF DAY = 9:45AM (Local)

DIRECTION OF TRAVEL

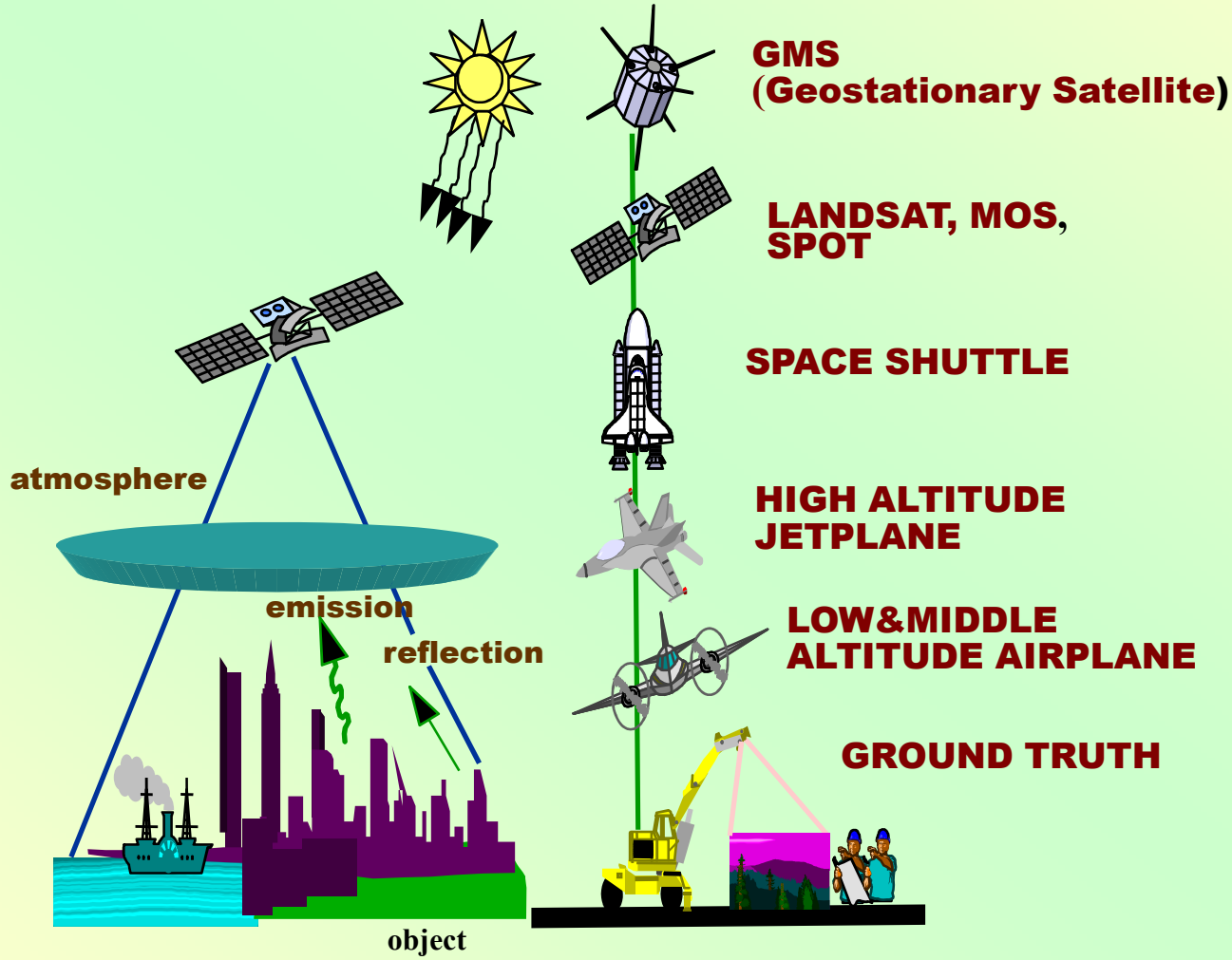


ALTITUDE = 705 KM (Nominal)

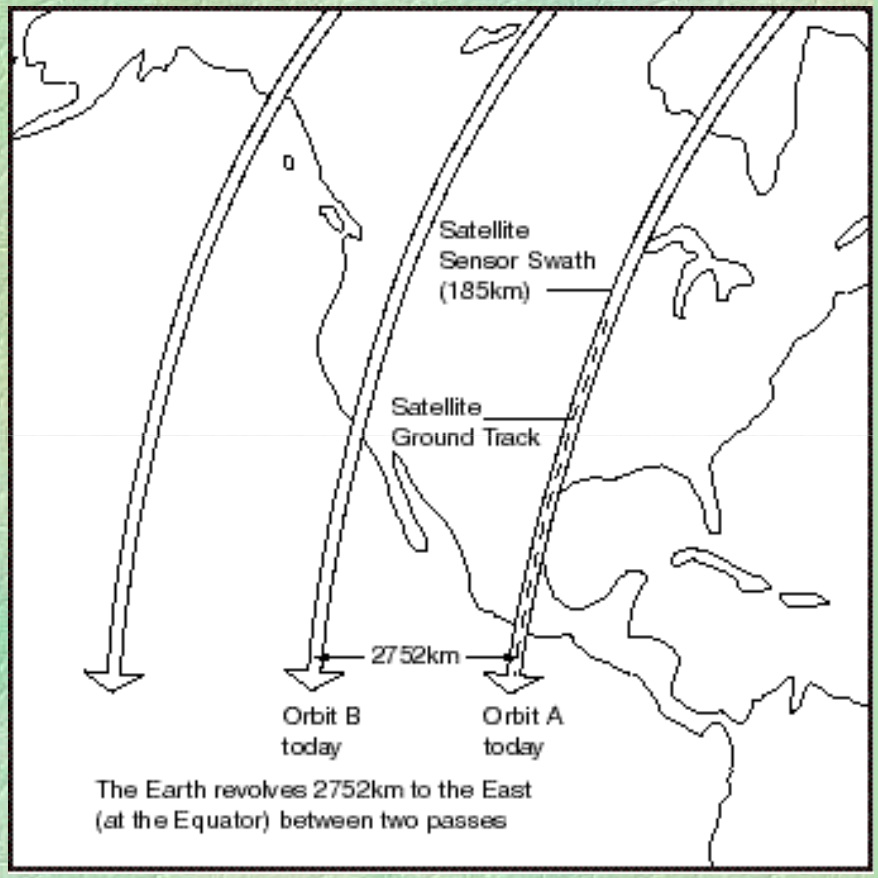
ORBIT PERIOD = 98.9 MINUTES

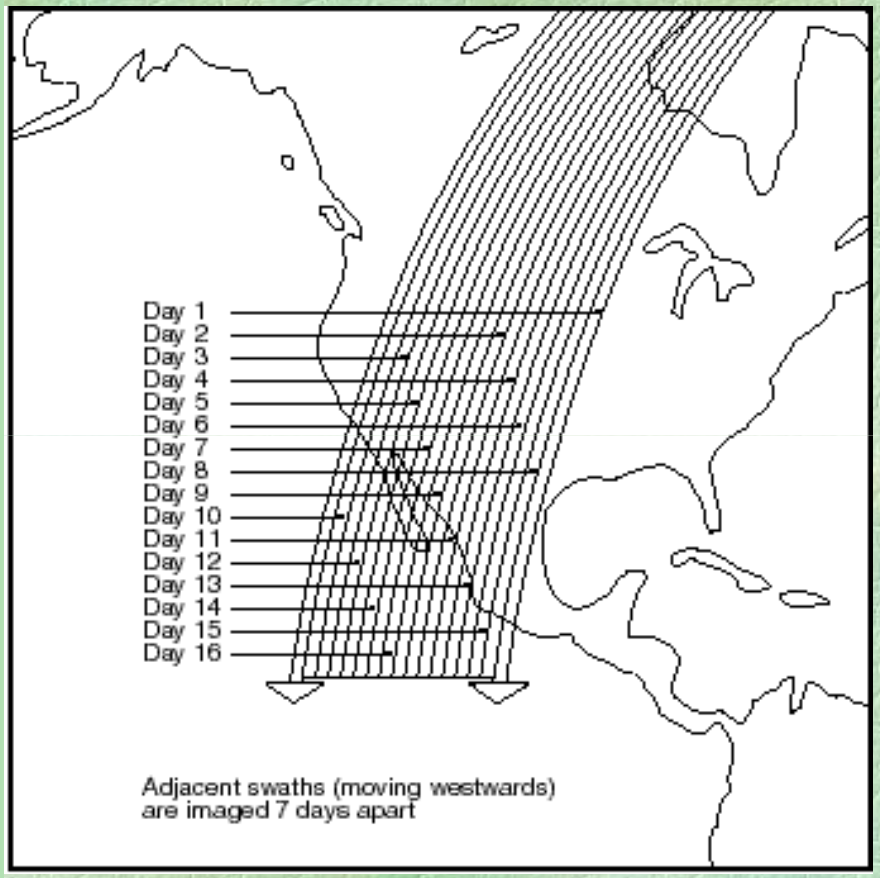
# Remote Sensing

## Platforms with Sensor on board



# Landsat 4/5 Swathing Pattern



## APPLICATION OF GIS/RS

## In Pakistan

- **LAND-USE PLANNING AND MANAGEMENT**
  - **Property Registration & Development**
  - **Use of parcels during different years** (For diff crops)
  - **Owner changes & keeping up to date record**
  - **Developmental plans like Peshawar Master plans**
  - **Urban Planning and management**

**Survey of Pakistan, SUPARCO, Peshawar Development Authority, Capital Development Authority, Planning Environment & Development AJK)**

# APPLICATION OF GIS/RS

- OIL & MINERAL EXPLORATION
  (O.G.D.C, Oil companies, GSP)

- management of water resources ( WAPDA)

- management of water resources ( WAPDA)

- natural hazard mapping (NESPAK)

natural hazard mapping ( NESPAK)

# APPLICATION OF GIS/RS

## ❑ NATURAL RESOURCES MANAGEMENT

- ❖ Forestry and Wildlife Management
- ❖ Changes between different years
- ❖ Causes of deforestation and recent most activities
- ❖ Propose steps to reclaim forest area
- ❖ Migration of birds from one region to another, their routes, causes and impact on the landuse

**(FOREST MANAGEMENT CENTRE, PAKISTAN FOREST INSTITUTE, AKRSP, WWF, ICIMOD Nepal)**

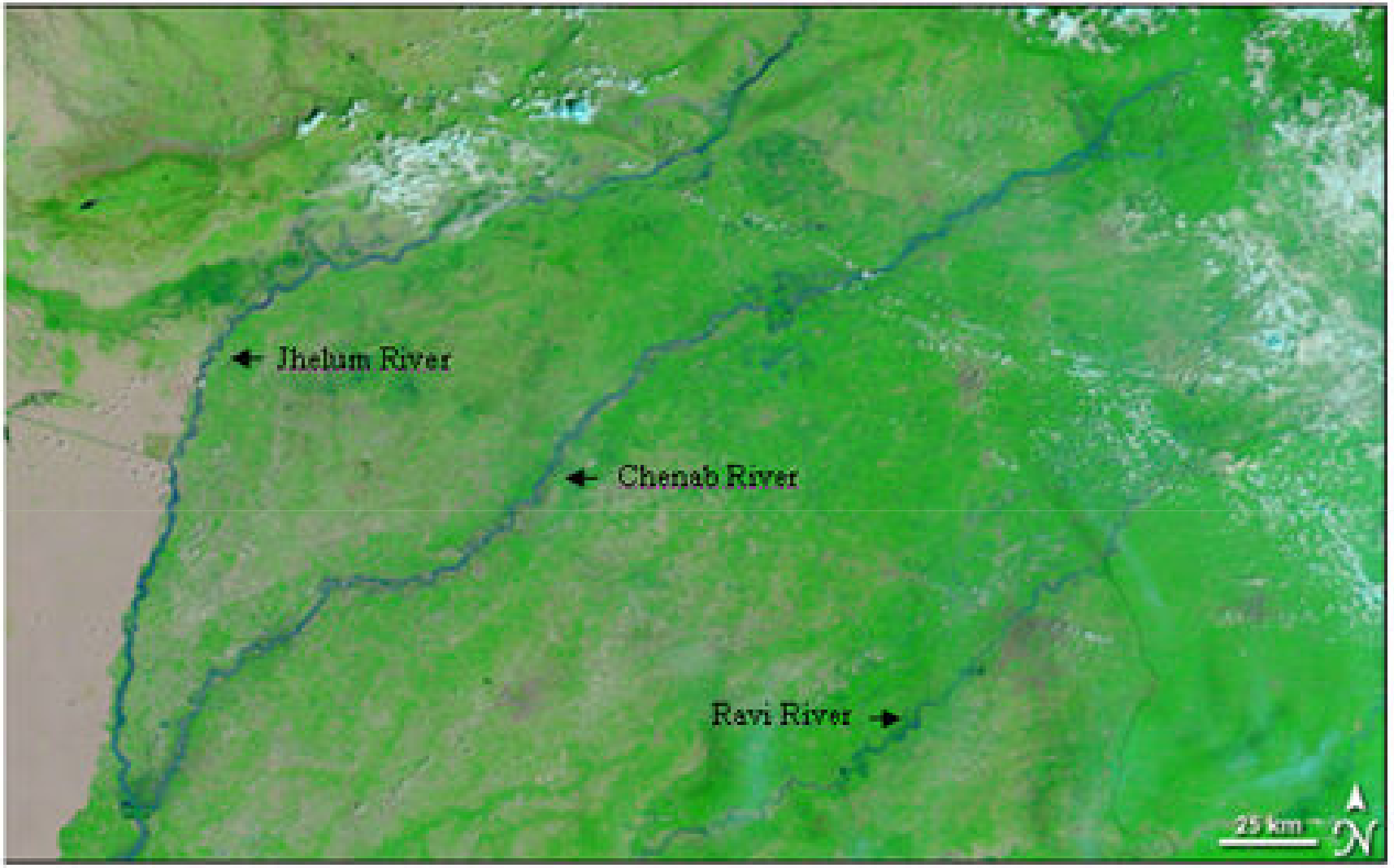
# APPLICATION OF GIS/RS

## ❑ SOCIO-ECONOMIC SURVEY & MAPPING

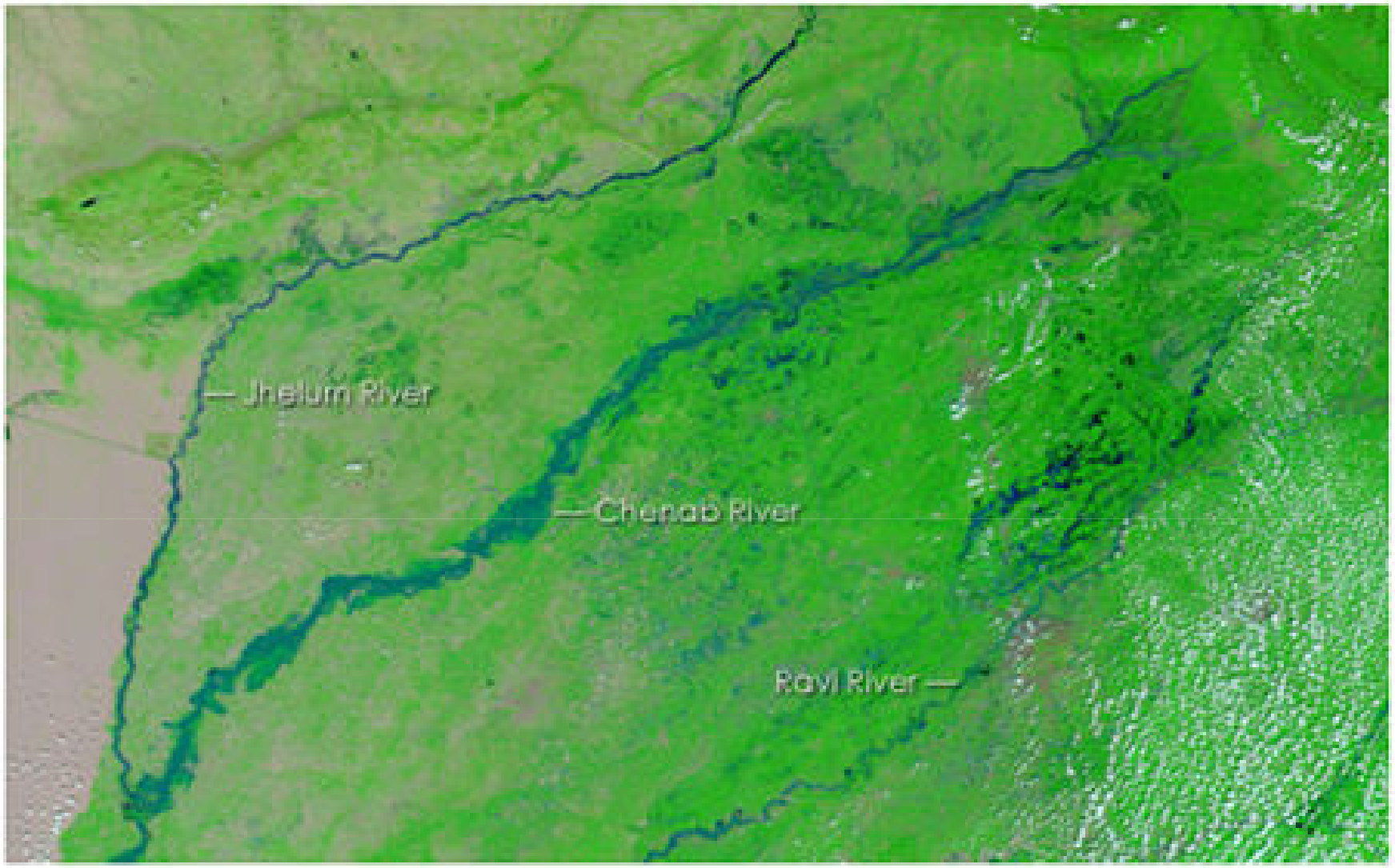
- **(S.O.P & Primary education project in NWFP, Baluchistan, Sind, N.As & A.K.)**

# APPLICATION OF GIS/RS

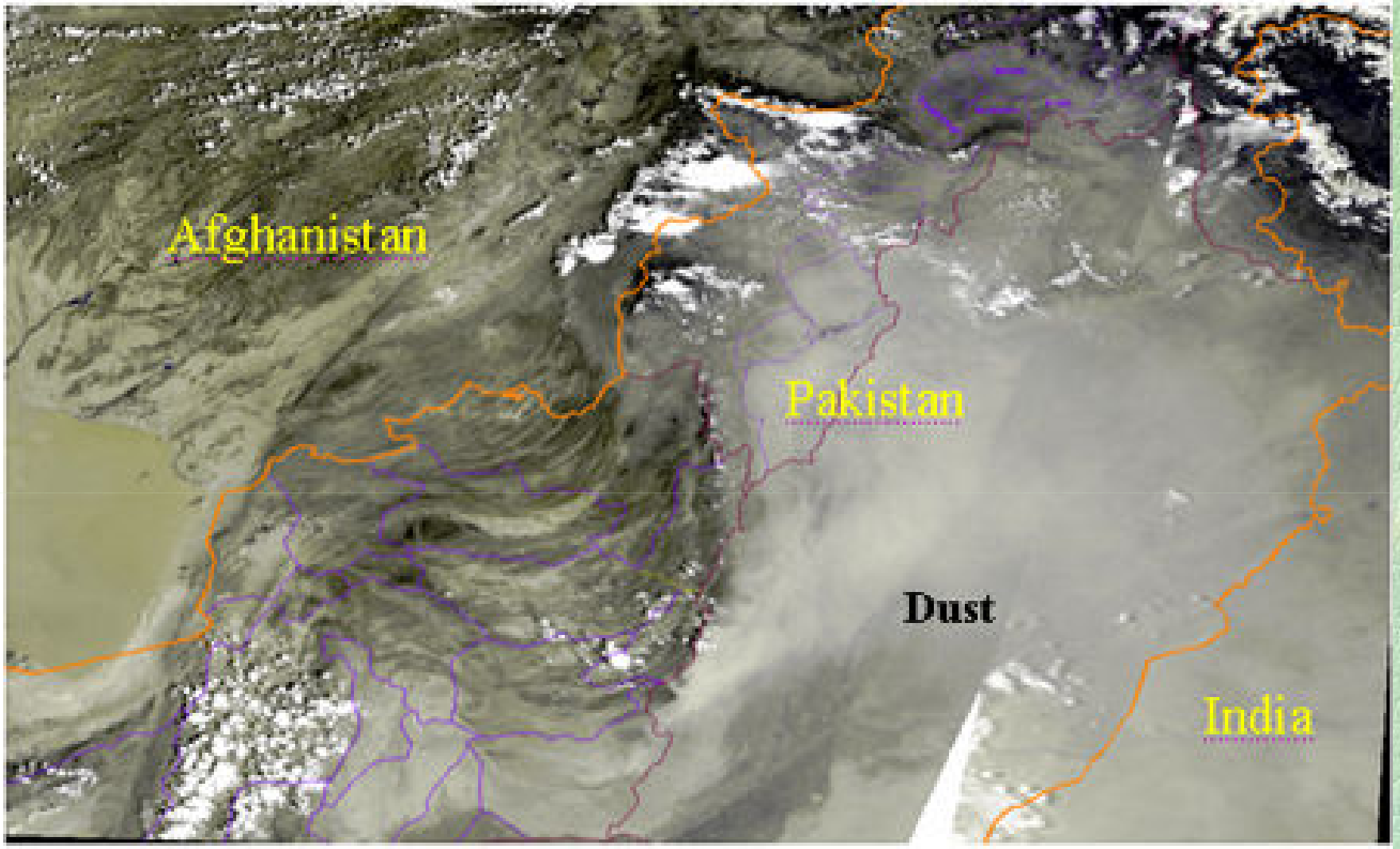
- **Educational Institution** **NCE In Geology, University of Peshawar, GIS Centre Punjab University and Brunal College for distance learning Islamabad/Rawalpindi, Environmental Sciences and Geography Departments in University of Peshawar.**




Pre-Flooded Image, August 25, 2006

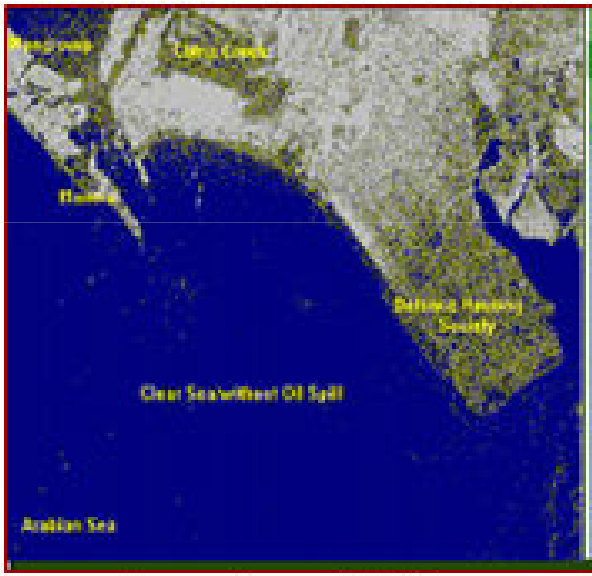


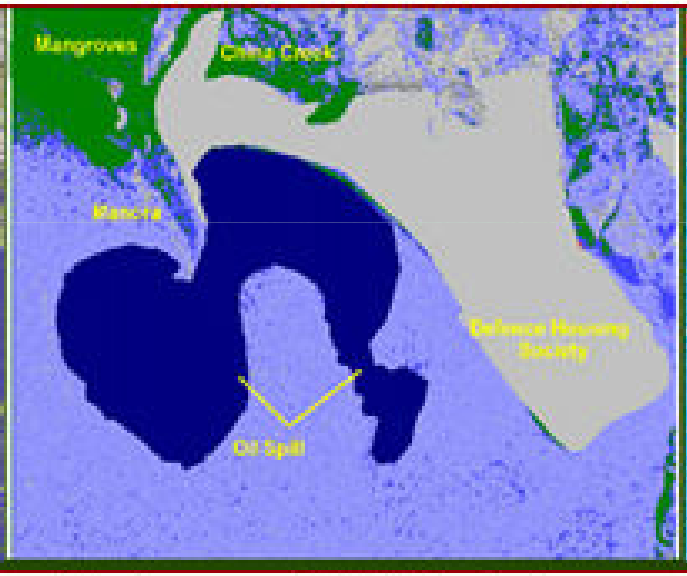

Post Flooded Image September 5, 2006

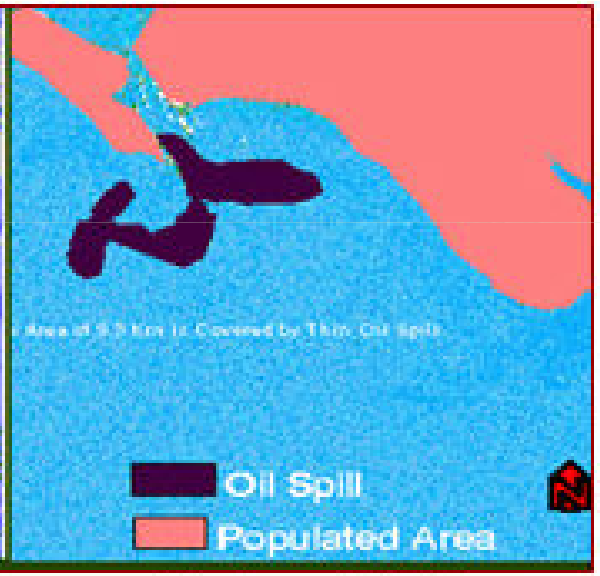



MODIS image showing Dust Storm sweeping thru Pakistan on 22 May 2006

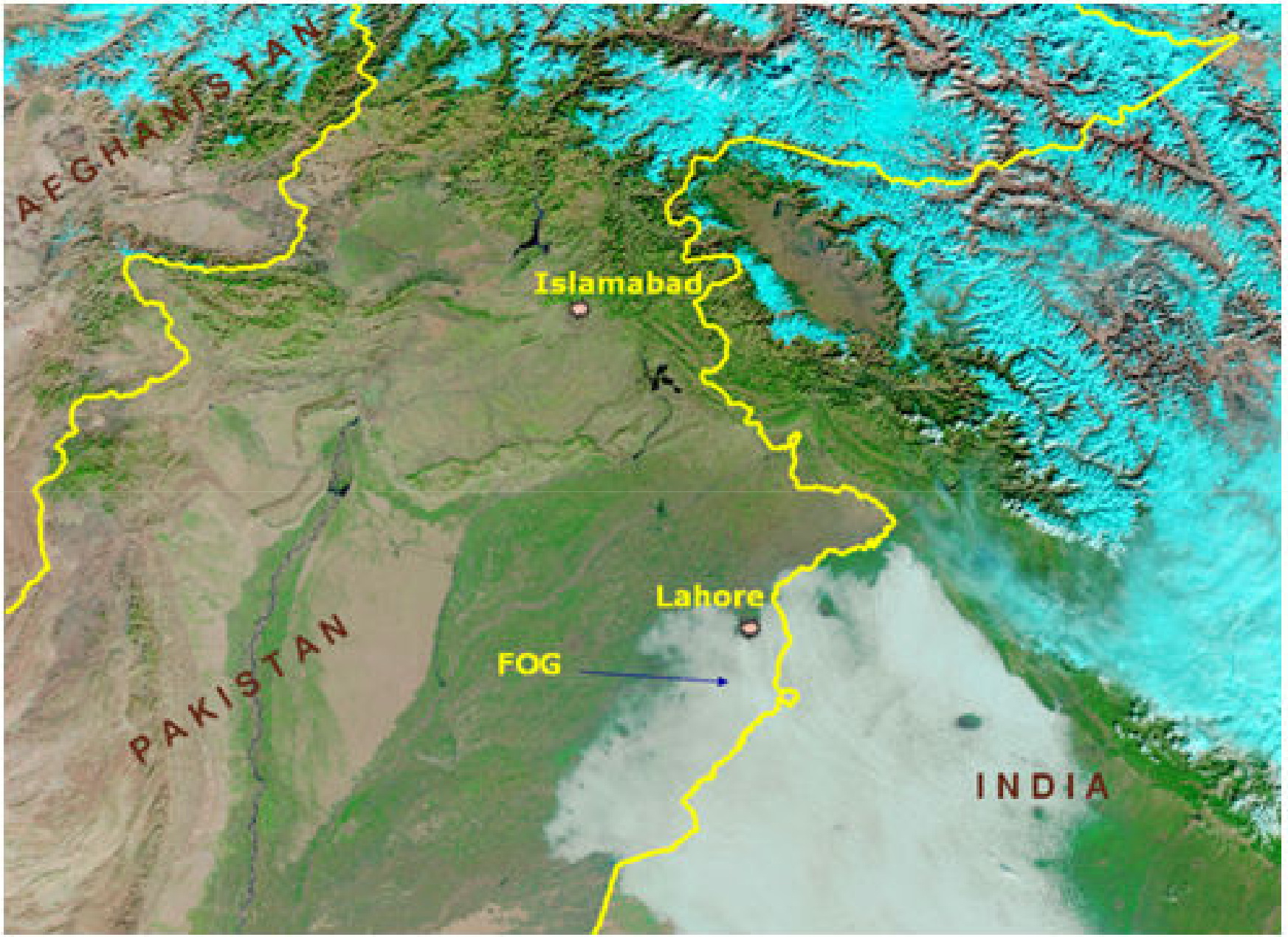
**Oil Spill at Karachi Coast On 14 August 2003 an oil tanker carrying 67,000 tons of crude oil, faced an accident and released about 30,000 tons of crude oil near the Karachi coast. The images given below are show the gradual dispersion of the oil spill.**




| | | |
|---|---|---|
| October 2001: Clear Sea without oil spill | 19 August 2003: 5 days after accident, oil spill spread around 36 sq km | 12 Dec 2003: image shows reduced Level of oil spill ~ 9 sq km |




MODIS Image showing fog on 4 January 2006